

 **Micro-livestock: Little-known Small Animals with a Promising Economic Future (BOSTID, 1991, 435 p.)**



Part III : Rabbits



(introduction...)



14 Domestic Rabbit

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Part III : Rabbits

Contrary to popular opinion, the domestic rabbit is a substantial part of the world's meat supply. Annual production of rabbit meat is estimated to be one million metric tons, and the total number of rabbits is approximately 708 million.' However, rabbits are now intensively raised for food only in temperate, mostly industrialized, nations. France, Italy, and Spain, for example, have long consumed rabbit meat; West German production was 20,000 tons each year; Hungary raises rabbits in large numbers (two of its commercial rabbitries have more than 10,000 does each); and the United States raises almost 8.5 million rabbits each year for consumption in homes and restaurants.2

In most developing countries, on the other hand, rabbits are not well known - at least compared with other livestock. But they have great promise there, and in recent years there has been a dramatic increase in interest. For those developing countries where information is available, rabbit meat production almost doubled between 1966 and 1980. For instance, several African countries - among them Ghana, Kenya, Malawi, Mauritius, Mozambique, Nigeria, Sudan, Tanzania, Togo, and Zambia - now have national rabbit-raising programs. A number of Asian countries - such as the Philippines, Indonesia, India, and Vietnam - are also encouraging rabbit farming. And some Latin American countries - Mexico, Costa Rica, and El Salvador, for instance - are actively promoting rabbits for subsistence farmers.

Ghana is also extensively promoting rabbit farming. Although able to produce all the cereals its population needs, it cannot produce enough meat to satisfy demand. In response, the government organized "Operation Feed Yourself." The National Rabbit Project was created

Hares

The common hare (*Lepus europus*) has not been domesticated, but it is nevertheless a major cash crop of several countries. In Argentina, for example, there is a booming, million-dollar enterprise that exports hundreds of thousands of carcasses, mainly to Germany where they are sold as game meat. For Argentine campesinos, many of whom have few sources of livelihood, trapping hares provides a vital income. In New Zealand, too, hare has become an export item.

A closely related species (*Lepus capensis*) is native to Africa, and perhaps could

be "ranching in the same fashion.

Rainforest Rabbit

The forest rabbit, or tapeti (*Sylvilagus brasiliensis*), is commonly eaten in its native habitat, which extends from southern Mexico to southern Brazil. It occurs in various hot and humid areas of Central and South America and probably within the Amazon Basin itself. Thus, this creature seems a possible candidate for a "tropical rabbit" that can be raised under sweltering conditions, perhaps even in rainforest regions. Although it seems to be heat resistant, it has an especially fine fur.

Little is now known about the tapeti. It is rather secretive and its natural history and even its range are still uncertain. However, its populations appear stable and it is not threatened with extinction. It produces litters of 1 - 5 young after a 44-day gestation, and may bear 4 litters a year. This may seem a lot, but compared with other wild rabbits, the litter size is small and the gestation period long. under this program to provide farmers with breeding stock and practical information on rearing rabbits. (To qualify for the purchase of new breeding stock, would-be rabbit raisers are required to take an intensive three-day course in rabbit husbandry, which is provided at no charge.) With both official and popular support, the rabbit's potential for Ghana has been enhanced through media campaigns complete with radio jingles (examples: "Get the bunny money!" "Grow rabbits - grow children." "Get into the rabbit habit!"), television spots, and large posters. Already, rabbit breeding is included in school curricula and rabbit meat is available in school lunches.

Other countries have mounted similar campaigns. In Mexico, for instance, teachers raise rabbits in rural schools as a way of training students; scores of government officials have taken to breeding rabbits in their homes; and several army units are raising rabbits as mess-hall substitutes for costly beef, pork, and chicken. In Nigeria, farmers can now acquire rabbits from 18 government rabbit-breeding centers, which distribute thousands of animals each year. In Costa Rica, the government has similarly established a series of breeding, distribution, and rabbit-farming training centers. And in El Salvador, the technology of rabbit production is being transferred to farmers via the army.

Although rabbits are ideal microlivestock in a general sense, rabbit rearing has many problems and limitations. Poor management is a common difficulty. Unlike the traditional method of keeping scavenger animals, rabbits have to be contained and cannot be left to find their own food. Raising rabbits requires more skills, more time, and much more effort than raising barnyard chickens or other familiar scavengers.

For all that, rabbits produce more food than scavenging animals; they are less likely to damage crops because they are kept confined; they live exclusively on forage, which tends to grow vigorously in tropical zones; and they generally produce a more valuable product. The rabbit's potential is far from exploited, and rabbit farming will have to increase enormously before its promise for the small farms of the world is realized.

There is, however, an increasing concern over a recent outbreak of an exceptionally virulent viral rabbit disease - hemorrhagic tracheopneumonitis, which attacks the lungs and lung tissue, killing 48 hours after the onset of symptoms.

The virus, which has ravaged the animals in parts of Asia and Europe, was identified in China five years ago in Angora rabbits imported from Germany. It spread to Korea in 1986, and in early 1988 moved through southern and eastern Europe and spread as far as Egypt. It has also been identified in Mexico. Vaccination may become a future prerequisite of rabbit rearing in many countries.

FAST FOOD

The order Lagomorpha includes more than 60 small quickmaturing, and rapidly reproducing species. It seems illogical to think that only one is useful as microlivestock. In principle, any rabbit, hare, or pike could be raised in captivity. All are clean, fast growing and rapid breeding. They are opportunistic feeders and can digest fibrous vegetation. Their meat tastes better than chicken and does not carry the stigma of rodent. The animals are small inoffensive, efficient at foraging, and generally tolerant of difficult environments. In theory, at least, they could be raised on vegetation not used by people or by many domesticated livestock. Species worthy of exploratory research include the following.

14 Domestic Rabbit

**FIGURE**

The domestic rabbit (*Oryctolagus cuniculus*)¹ is suited to small-scale production and backyard farming. It is easily maintained, requires scant space, makes minimal demands on the family budget, and thrives on plant materials that are usually disdained by humans. It utilizes forage efficiently. even coarse vegetation that is high in fiber, and under ideal conditions it can grow so rapidly that its rate is only slightly lower than that of broiler chickens.²

The rabbit's capacity for reproduction is legendary. In theory, a single male and four females can produce as many as 3,000 offspring a year, representing some 1,450 kg of meat - as much as an average sized cow.³ The meat is pink, delicately flavored, and is usually considered a premium product that provides variety in the diet. It has more protein and less fat and calories per gram than beef, pork, lamb, or chicken.

Some breeds are raised for their wool. The long-haired Angora, for instance, yields a luxury fiber that makes a soft, lustrous fabric. It sells at high prices and makes

these animals very valuable.

Rabbit pelts also bring cash. They are used in fur coats and other luxury garments. In addition, rabbit feet and tails are used in good luck charms and many curios.

AREA OF POTENTIAL USE

Worldwide.

APPEARANCE AND SIZE

Rabbits are well known for their long ears, fluffy tails, and long hind legs. Many commercial breeds are white, although colored types are sometimes chosen because of special qualities in their meat or pelts.

There are many breeds and much genetic diversity within and between breeds. (Almost 160 varieties are recognized by the American Rabbit Breeders Association.) However, in both North America and Europe, the New Zealand White has traditionally displaced most other breeds for commercial meat production. This medium-weight breed bears large litters, is a good milk producer, and has good mothering ability. It reproduces best under intensive farming and, among purebreds, yields the most meat. A full-grown New Zealand White weighs 4-5 kg, giving about 2 kg of meat at 8-10 weeks of age. Large breeds include the Flemish Giant or the Checkered Giant, which weigh more than 6 kg at maturity.

Hybrids are rapidly replacing purebreds in Europe for commercial production. Specific crosses of breeds have been shown experimentally to be more productive overall compared with purebred New Zealand Whites.

Different meat breeds are preferred in various countries. For example, in Ghana the most popular are Flemish Giants, New Zealand Whites, Yellow Silvers, and Checkered Giants; in Tanzania and Nigeria, New Zealand Whites and Dutch are preferred; in China, Chinchillas and Japanese Large Whites are the most widely consumed. Some smaller breeds - for instance, the Polish - are also valuable for husbandry.

Some Third World strains have already evolved. They show high tolerance to local conditions (for example, the Baladi - the main strain of the Sudan and the Near East - and the Criollo of Mexico). The Baladi has a small body and relatively low production, but it is hardy and tolerates harsh conditions.

Specialized breeds have been developed for wool, fur, and laboratory research. The Angora wool breed has already been mentioned. The Rex breed produces a high-quality pelt used in furs.

DISTRIBUTION

The wild ancestor of the domestic rabbit was originally restricted to Spain and Portugal. Today, its descendants are found worldwide.

STATUS

Plentiful.

HABITAT AND ENVIRONMENT

Domestic rabbits are best suited to temperate climates, but they do well in

tropical and subtropical conditions if hutches are constructed and sited to take advantage of shade and cooling breezes. Ventilation is important (but care must be taken to avoid direct exposure to cold drafts). Prolonged exposure to temperatures higher than 30°C reduces both fertility and growth. Apparently, all breeds tolerate heat equally well. However, heat is shed through the ears, and the longer the ear, the more heat a rabbit will tolerate. Lop-eared varieties withstand heat poorly.

BIOLOGY

Rabbits eat fibrous vegetation. In addition to normal feces, they produce special droppings called cecotropes. Softer and smaller than the regular fecal pellets, they are excreted in clusters and are swallowed as soon as they are eliminated. Cecotropes are rich in bacterial protein, and this double digestion (coprophagy) enables the animals to utilize the fermentation products formed in the cecum. This process is rather like that of ruminants, and rabbits are sometimes called pseudoruminants.

Breeding begins at 4-6 months of age and may continue up to age 4, occasionally to age 6. Gestation takes 28-32 days. Females can conceive within 24 hours after giving birth and can produce a second litter merely 4 weeks later. With good feed and early rebreeding, 9 or more litters a year are possible. (Such a rate is only achievable under exceptional management, however.) Litter size depends on breed and body weight. Small breeds average 4 young per litter; large breeds 8-10. Births occur at any time of the year, but production slackens when the weather is exceptionally cold or hot, when feed is scarce, or when days are short. Extremes of heat or cold can also affect the survival of the young.

Rabbits raised under subsistence conditions are likely to produce 4 or 5 litters a year, with an average of 5-8 young per litter' depending on management and feed quality.5 Annual production of about 20 weaned offspring per female per year under tropical and subtropical conditions is common. The young remain in the nest until they are 2-3 weeks old. Their eyes open at approximately 10 days of age. About 4 months are required to produce a 2-kg market rabbit under subsistence conditions.

BEHAVIOR

Rabbits that receive human handling are very gentle and can be trained to live inside people's houses and even use a "litter box."

USES

Rabbits are multipurpose animals yielding the following products:

- Meat. Delicious hot or cold, fancy or plain, it can be breaded and fried, broiled, baked, or barbecued.**
- Wool. The fineness of rabbit hair is an asset in the production of wool, which is the plucked or shaved hair of the long-haired Angora breed. It is usually mixed with fine Merino sheep wool to give more substance and to improve its wearing quality. An average Angora rabbit produces about 850 g of wool each year. (Some specimens produce as much as 1,000 g.)**
- Fur. The fur is dense.**

- **Leather or vellum.** Rabbit hide has the tension and strength required for tiny drive-belts in tape recorders and other delicate machines.
- **Fertilizer.** Rabbit manure often contains high proportions of nitrogen, phosphorus, and potash, and it comes in convenient drypellet form.
- **Tourist charms.** In many societies, rabbits are connected with good luck. Feet and tails are used for car decorations, key chains, charms, and mementos that appeal to tourists.

Rabbits are also used in biochemical and physiological research.

HUSBANDRY

Rabbits can be housed in hutches ranging from sophisticated commercial cages to simple packing crates with a few ventilation holes and rough troughs for food and water. In all cases, watertight roofing is essential. A floor space of only 0.25 m² is sufficient for one rabbit, but about 1 m² is recommended for a female and her young.

Starting small-scale rabbit production is generally inexpensive. An almost infinite variety of backyard feeding and drinking equipment can be made from various scrap items, such as old bottles. The main criteria are that cleaning should be easy and spillage minimized.

In practice, diets can be based largely on herbage: grass, leaves, legumes, crop residues, and kitchen scraps. However, the diet must be wholesome, and caged rabbits fed on forage usually need some grain or agricultural by-products (rice

bran, for instance) as a dietary supplement. Supplementation is particularly important for newborns and lactating females, whose diet must contain about 16 percent protein and at least 18 percent fiber. When "noncommercial" feeds are used, salt must be added to prevent salt deficiency.

Because of higher protein content, legumes (for instance, alfalfa, cowpea, vetch, or pea) are better than grass. Alfalfa is particularly valuable, and in the Sudan and Mozambique it is already grown extensively for feeding rabbits. On diets consisting of alfalfa and rye grass, weaned New Zealand Whites have demonstrated growth rates of 38-39 g per day in animals weighing up to 2 kg.

ADVANTAGES

Rabbits, as mentioned, can utilize almost any type of edible vegetation. Also, despite their diminutive size, they can collectively produce as much meat per unit of forage as large livestock, or even more (see page 183).6

There is much genetic diversity. Differences in growth rate, fertility, maternal ability, milk production, disease resistance, heat resistance, and other features have been noted. This is useful, since a wide genetic base enhances the likelihood of success of selection programs.

Rabbits are easy to handle and can be raised under primitive conditions. They require little financial investment and their husbandry is easily accomplished in the home by women and children.

The animal's rapid reproduction is a big advantage.

LIMITATIONS

Tropical conditions produce special problems. There, rabbits must be protected from heat and rain. Stress brought on by high temperatures, high humidity, and wet conditions can lead to respiratory disorders and even sudden death.

Most diseases are caused by poor management. Dirty or wet cages lead to diarrhea, sores, mites, and ringworm, all of which can cause serious losses. Enteritis (diarrhea) often kills 20 percent or more of all rabbits before they attain market age and weight. A major disease problem in most countries is coccidiosis, which is particularly harmful to young rabbits. Again, damp and unsanitary conditions increase the susceptibility; better management can control it.

In some countries - notably Australia and New Zealand - escaping rabbits have become a serious menace and have destroyed crops and grazing lands. Because of this threat, it is illegal to import rabbits into some countries.

At present, many people are unaccustomed to eating rabbit. Indeed, where commercial ventures have been established in areas with an otherwise plentiful meat supply, there have been financial failures. However, where rabbit meat is familiar, there is usually great demand for it. Also, in poorer areas where animal protein is in short supply, the tasty pink meat is widely appreciated.

HOW RABBITS WERE DOMESTICATED

For 30 or 40 million years the wild species *Oryctolagus Cuniculus* lived only in the area that today is Spain. Caves there contain Stone Age drawings of it. Phoenician traders landing on the Iberian Peninsula in about 1100 B.C. found huge numbers of

these wild rabbits. The little animals were unknown to them and they mistook them for the hyraxes they had seen in Africa. (Although small and rabbitlike, the hyrax is actually related to elephants.) Since the Semitic name for hyrax was shaphan ("one who hides"), the Phoenicians named the peninsula I-shepan-im, from which the Latin name Hispania developed. Thus, "Spain" actually means "island of hyraxes," even though these African animals have never occurred there.

Given the rabbit's reproductive powers and adaptability it is surprising that it hadn't spread beyond Spain, but dense forests covered most of Europe after the last Ice Age. The rabbit, which is suited to open country, only spread rapidly after man had cleared most of the trees. Even then, the natural spread was slowed by the Pyrenees mountains blocking the way into the rest of Europe.

Ancient Romans became acquainted with rabbits after they invaded Spain, and they eagerly added wild rabbit meat to their banquets. The meat was so popular that around 1 A.D. Roman voyagers released a pair of rabbits onto the Balearic Islands. In time, these produced so many offspring that the islanders had to appeal to the Roman emperor for help. They even asked to be moved to another country if the emperor could not get rid of the plague of rabbits!

Eventually, Romans in Italy, France, and other parts of the European mainland began raising rabbits for meat. They kept them in special cages called leporaria. Their rabbits were probably not truly domesticated; instead they were netted in the wild and caged for fattening before being prepared for the table. The Romans had little incentive to domesticate an animal that could be so easily captured.

The rabbit was the last farm animal to be domesticated. It seems likely that this

did not begin until the Christian era when monks in French monasteries began taming rabbits. In those days, rabbit embryos and newborn young were considered delicacies, called "laurices." In 600 A.D. the Pope declared that laurices were "not meatp," and permitted them to be eaten during fasts and in monasteries of strict discipline where meat was forbidden. Within a few years, the animal was domesticated,

RESEARCH AND CONSERVATION NEEDS

Government-sponsored rabbit-research stations and programs are found in France, Germany, Italy, Spain, the United States, and the United Kingdom.

Rabbit husbandry is well known, but much basic research is needed; for example, specific nutrient requirements, breed comparisons, disease control, reproductive management, and efficient housing and equipment. There is a particular need to reduce the labor required for feeding, breeding, caging, and cleaning.

With the increasing number of rabbit programs in Africa, Asia, and Latin America, there is a need to share information and ideas among the various countries. The exchange of experiences with rabbit breeding, health and nutrition, and the practical experiences and field studies could be of great value.

Further research in rabbit nutrition is necessary to identify nutrient requirements more precisely. Moreover, links between nutrition and disease should be clarified.

Further research into the cause and prevention of enteritis is needed. (At present, this condition is prevented by maintaining a fiber level in the diet of at least 18 percent and keeping the energy level relatively low.)

Legume shrubs could be an answer to the feed problems in the dry season. Deep-rooted shrubby legumes, such as gliricidia or leucaena, remain green well into the dry season and have high protein contents. Rabbits find the leaves of leucaena palatable (see companion report Leucaena: Promising Forage and Tree Crop for the Tropics. National Academy Press. Washington, D.C. 1984), and they are fairly resistant to mimosine (a sometimes toxic amino acid found in leucaena foliage). More research on this promising approach is needed.

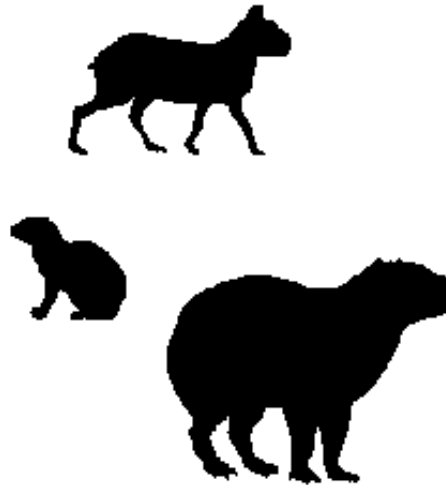
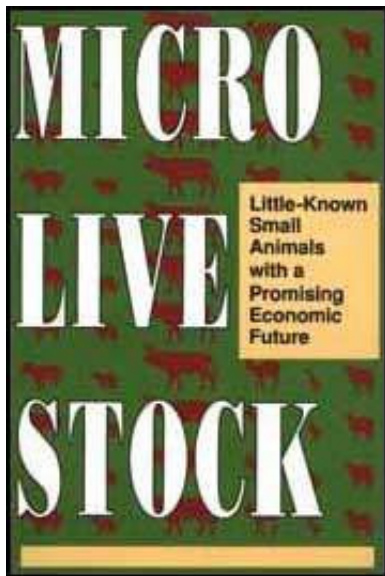
As noted earlier (page 181), a killer virus has recently appeared. Studies into its epidemiology and control are most important.

Outsiders who hope to improve conditions in underdeveloped areas, sometimes . . . introduce new food avoidances to the communities they came to help [if outsiders] show repugnance toward consuming goats, . . . rats, . . . crows, insects, intestines and blood, then the people they are educating may likewise give up those . . . foods and lose valuable proteins.

**Calvin W. Schwabe
Unmentionable Cuisine**

You can count on the fingers of one hand the domestic animals that produce virtually all of mankind's meat and milk - a selection made more than 10,000 years ago by our Neolithic ancestors. Yet the earth teems with thousands of species of animals; why limit ourselves to cattle, pigs, goats, and sheep? Given the world's shortages of energy and water and arable land, why not try to domesticate wild animals? The effort would save many species from extinction, provide the world with more food, and introduce gentle farming to fragile environments.











N.D. Vietmeyer

**FIGURE**

 **Micro-livestock: Little-known Small Animals with a Promising Economic Future (BOSTID, 1991, 435 p.)**



Part IV : Rodents

-  **(introduction...)**
-  **15 Agouti**
-  **16 Capybara**
-  **17 Coypu**
-  **18 Giant Rat**
-  **19 Grasscutter**
-  **20 Guinea Pig**
-  **21 Hutia**
-  **22 Mara**
-  **23 Paca**

**24 Vizcacha****25 Other Rodents****Micro-livestock: Little-known Small Animals with a Promising Economic Future (BOSTID, 1991, 435 p.)****Part IV : Rodents**

Rodents are the world's most widespread, adaptable, and prolific group of mammals. They reproduce well, grow fast, learn quickly, and adapt to a wide variety of local conditions. Many convert vegetation into meat efficiently, digesting some fiber, even though their stomach, like man's, is a simple one.

It seems probable, therefore, that some species would make suitable microlivestock - a notion supported by the previous domestication of the guinea pig, laboratory rat and mouse, gerbil, and hamster. Indeed, "ranching" rodents might be an effective way to increase food supplies in remote areas. It could also be a mechanism to ensure the survival of rare rodents whose natural habitats are being rapidly destroyed.

RODENTS AS FOOD

Rodents are already common foods in many countries and are valued items of commerce. It has been estimated that 42 of 383 cultures eat rodents.! But the fact that they are a major meat source is almost unrecognized. This is due in part to cultural misunderstanding. Rodents suitable for human food or other products do not live in filth, like common rats. They are clean and vegetarian. Like rabbits, they

eat grass and grains.

In some regions of the world, cooked rodent meat is regarded as the epitome of dining. In many countries, local rodent species are the most eagerly sought meats. City markets in different parts of Latin America carry guinea pig, pace, capybara, and vizcacha. Markets in Asia may carry rice rats, cloud rats, and bandicoot rats. Those of rural Africa are filled with "bushmeats" - usually including grasscutters, giant rats, and several other rodent species. These are often preferred to the meat of domestic stock and fetch higher prices than beef. And the amounts of rodent bushmeat available are not minor. In one year, for example, hunters in Botswana have brought to market 3.3 million kg of meat of the rodent called springhare (see page 278).

Fondness for rodent meat is not restricted to the tropics. In the United States, squirrel was once a much sought treat. Fat, nut-fed grey squirrels went into Brunswick stew, which has been called the most famous dish to emerge from the campfires and cabins of Colonial America. Thomas Jefferson liked it. Today, squirrel is the country's number two game animal (after deer), and many are still eaten.

Ancient Romans kept fat dormice in captivity, serving them as a delicacy. "The fat dormice are fattened up in barrel-like pots like those in country houses," wrote Varro (116-27 BC). "One feeds these animals large amounts of acorns, chestnuts, or other nuts."2 This small rodent remains a prized food in Europe and still appears on tables in certain areas. The meat is regarded as a delicacy because it tastes of almonds and other nuts. Often it is roasted, broiled, and cooked with its cracklings.

Rodents have seldom been included in livestock programs or economic development plans. Yet human appetite has actually caused the extinction of a number of species. Caribbean Indians ate several endemic rodents (one of which was as big as a bear), and may have caused several species to become extinct just before the time of Columbus. Others may soon follow the same dismal route, including the beautiful cloud rat of the Philippines, the hare-like mare of Argentina, the vizcacha of southern South America, and the gentle hutias of the Caribbean.

The guinea pig is described in a later chapter, but as it is the epitome of a rodent microlivestock species, some historical background is given here. It was domesticated for food use at least 7,000 years ago, probably in what is now the central highlands of Peru and Bolivia. With only llama and deer available, the prehistoric Andean peoples had few readily available sources of meat. They adopted wild cavies, and found that these rangeland rodents (which are more closely related to porcupines than to rats or mice) were gentle, manageable, and easy to rear. By the time the Spaniards arrived in the 1500s, the "cuy" (pronounced "coo-ee," like the faint cry it makes) was a major food from Argentina to the Caribbean.

This impressed the conquistadores, who introduced cuys into Europe, where they also became a delicacy.³ Within a century, these easily transported animals began to appear on tables in many parts of the Spanish empire. Guinea pigs are now reared in campesino huts in the mountains of central Mexico, in the Philippines, and in several African nations, along with other areas of the world.

Elsewhere, guinea pigs came to be used only as house pets and laboratory

animals. Although during World War II Mussolini's government urged Italians to keep them to supplement their meager meat rations, their use as food was largely ignored in most parts of the world.

DOMESTICATION

The idea of domesticating rodents may seem radical, but domestication projects are already under way with capybara in Venezuela (see page 206), paca in Panama (see next page and page 262), giant rat in Nigeria (see page 224), and the grasscutter in Ghana (see page 232). Rodent husbandry is not complicated and the animals' environmental requirements seem relatively simple and easy to satisfy. Moreover, rodents are not usually fastidious feeders, and being essentially vegetarian will readily accept a wide variety of commonly available foodstuffs.

LIMITATIONS

As with most animals with which man is in close contact, rodents can transmit human diseases.⁴ With care, however, managed rodents need not be any more dangerous to care for or to eat than pigs or horses - both of which are worldwide food resources.

DOMESTICATING RODENTS

To domesticate the paca (see page 262) would seem to be impossible. These large rodents of Central and South America are nocturnal and fiercely territorial; they have low fecundity and take 10 months to reach weaning, and they have tender skin that is easily damaged. Most researchers have written them off as candidates for domestication. But at least two have undertaken to beat the odds. We present

the findings of one of them here to show that, using modern techniques, even species that normally fight each other to the death on sight are potential farm animals.

Through years of studying paces in Panama, Smithsonian biologist Nicholas Smythe has found that with care and planning the aggressive behavior can be so radically altered that the animals become calm. Indeed, some become almost loving. Newborns, Smythe found, undergo "imprinting" and when he places them with docile adults or with humans, the fierce territoriality never develops. He nurses newborns on "surrogate" mothers that have been imprinted on people. The youngsters then welcome human company and, if fumed out of the cage, return there voluntarily. "It's difficult to imagine a more manageable animal," Smythe said. "Technically speaking they are behaviorally indistinguishable from traditional domestic animals."

As of this writing, Smythe has three generations totalling about 50 individuals, and has several "families" of gentle paces living together in harmony. He has observed that they lose their nocturnal habit and, although they live mainly on fruits in the wild, they readily eat leafy vegetables and other foods in captivity. His captive specimens have recently begun to breed. The offspring remain docile, but they have so far averaged only a little more than two young per female per year.

"If we can just double the reproduction rate, then raising paces can compete economically with raising cattle," Smythe explained. "The potential for a bigger brood is all in the animal's anatomy, and if successful, paces in the wet tropics could produce as much protein as cattle."*

Pacas need the shade and protection of the forest. Thus, pace raising might provide an alternative to cutting down rainforests for cattle raising. Instead of toppling trees and planting pastures, people could farm paces in the forest, and perhaps make as much or more money at the same time. In tropical America, the ready acceptance of pace meat is a near guarantee that all they produce will be snapped up at premium prices. In the past, many territorial and aggressive species have been dismissed as being impossible to domesticate or manage. But Smythe has demonstrated that with imprinting and other methods of behavior modification, these need be dismissed no longer.

Indeed, the pace may already be becoming a new domesticated species. In the first stage of his experiments, Smythe had to train his captive-born paces to be social and nonaggressive. Subsequent generations, however, need no training adopt the new behavior patterns of the parents, and do not revert to aggressive asocial behavior. By the third generation, they have become as accepting of, and indifferent to, people as cattle or sheep.

15 Agouti



FIGURE

Among the best known of all animals of the American tropics, agoutis (*Dasyprocta* species)' are prolific rabbit- or hare-sized rodents that are probably easily farmed. They are valued for food and are hunted throughout most of their range. Indeed, agouti meat, once common in Latin markets, is now difficult to find because of indiscriminate killing. Agouti hunting is already prohibited in Brazil; restaurants in Belem, for example, once offered a variety of "cotta" (agouti) dishes at prices equivalent to those of choice filet mignon, but since the early 1970s they have been banned from serving it. Other countries will probably have to institute similar bans.

Agoutis are active, long-legged, and high-strung. They flee in panic at the slightest alarm. They do not climb but they do burrow occasionally, being essentially specialized ground-dwellers that live in tropical forest regions.

There have been no organized scientific attempts to raise these swift, shy animals in captivity, but Latin Americans sometimes keep them as "domestics," especially

in parks and large gardens. (Agoutis are well known, for instance at the Goeldi Museum in Belem, Brazil.) These animals seem to tame easily, and could perhaps be mass produced on a large scale like rabbits or guinea pigs. They make affectionate pets, sometimes refusing to return to the wild. A research project on captive breeding of two local agouti species (*Dasyprocta mexicana* and *D. punctata*) for food is already under way in Tuxtla Gutierrez, Mexico.

AREA OF POTENTIAL USE

Most of lowland, tropical Latin America and the Caribbean.

APPEARANCE AND SIZE

Agoutis are delicately built, graceful, nimble, and beautifully proportioned. They have slender bodies, short ears, and look somewhat like a rabbit that has been "jacked up" in back. Generally, adults are 40-60 cm long and weigh 2-5 kg. Some are even bigger.

They run well and are good jumpers. From a standing start an agouti reportedly can leap as high as 2 m or as far as 6 m; however, as long as they are well fed, there is little problem keeping them behind a wall only 1 m high.² Reportedly, they sometimes climb easy-sloping trees to collect green fruits, but researchers studying Central American agoutis report that they are strictly terrestrial.³ They swim well.

The body hair is thick, coarse, and glossy: pale orange to black on the back, and white to yellow on the belly. Some species have faint stripes, and some have a rump that contrasts with the rest of the back. The short tail is partially concealed

under the long body hair.

DISTRIBUTION

Agoutis occur over a vast area from southern Mexico to Paraguay, including many islands in the Caribbean.⁴

STATUS

Because they occasionally damage sugarcane plantings and because the meat is particularly tasty, people hunt agoutis relentlessly, especially near cities and towns. Now, in the 1990s, they are becoming rare because of excessive hunting and habitat destruction. Many Latin Americans have never heard of them. In Mexico, for instance, there are few places where agoutis survive, and *Dasyprocta mexicana* may become extinct if habitat destruction and overhunting continue in its restricted range. In Costa Rica and Panama, agoutis occur only where there is little or no hunting or human interference.

HABITAT AND ENVIRONMENT

From sea level to elevations of at least 2,500 m, the adaptable agouti lives in many habitats: moist lowland forests, dry upland forests, thick brush, and savannas. However, although they thrive in secondary growth areas, they are mainly forest dwellers. Nonetheless, they often enter fields to forage, and young animals occasionally are seen in open areas such as grassy stream banks and cultivated fields.

BIOLOGY

Agoutis shelter in hollows among boulders, in riverbanks, or under tree roots. They also hide in heavy brush and sometimes in holes dug out by other species.

These herbivores eat seeds, fruit, stalks, leaves, roots, and other succulent plant parts, as well as occasional insects and fungi.

They seem to mate twice each year. The estrous cycle is variable, but is only about 34 days long. The young are born after a gestation period of 3.5-4 months. Usually, there are twins; however, single births and triplets have been recorded. Newborns are fully developed and are able to run around within hours. They start feeding on solids within a few days. Puberty occurs at about 9 months of age. Life expectancy is 10 years or more.

BEHAVIOR

In the wild, agoutis are shy and retiring. Every sense seems constantly triggered for instantaneous action and sometimes they become hysterical. If danger threatens, they usually "freeze," but when discovered they stamp their feet as an alarm signal and dash away, nimbly dodging obstacles.

Despite excessive timidity, they can be violent among themselves.

In undisturbed forests, agoutis are diurnal and are often seen. But around villages they become nocturnal, as a means of self-preservation.

For the most part, these rodents live in loosely formed pairs, with previous litters living around their territory as "satellites." There is some "bigamy," some "philandering," and some "divorce."5.

Despite their long claws, they display much finger dexterity. To eat, they usually sit erect, crouching on their haunches and holding the food in their forepaws. If it has a skin' they carefully peel it before starting their meal. They save some nonperishable foods (nuts, for instance) by digging holes in scattered locations, dropping each one in a separate location, stamping it down, and covering it over. This behavior helps disperse the seeds of many species of trees so that agoutis benefit tropical forests and reforestation.



The native range of the agoutis. Within this area, 11 species are found, but the best known and most widespread is *Dasyprocta punctata*.

figure

USES

As noted, agoutis are popular game animals. They are often hunted with dogs that even follow them into the burrows. Agouti meat is tasty, although it is usually said to fall short of the meat of the paca (see page 262) because it is leaner and

gamier.

HUSBANDRY

Agoutis adapt well to captivity. With appropriate care they can be bred without difficulty. The nervousness that is pronounced in nature is quickly lost in captivity. The young become tame pets. They can be fed on foods such as leafy vegetables, fruit, potatoes, and bread scraps. Although many wild specimens have become nocturnal, captives readily readapt to daylight.

Being entirely terrestrial, agoutis require no trees, but they do need space. Given enough area, they get on well (with each other and with different species), and they breed freely. To avoid fighting, it seems necessary to separate females from males at puberty. Probably removing progeny from breeding pens at weaning could also help avoid most of the interpersonal aggression. In large areas with plenty of cover (banana plants, for instance), groups can be kept, but breeding may be disappointing. Husbandry may be most appropriate in large enclosures (50-100 agoutis) with some animals then removed to small cages 0.5-1 m² for selective feeding.

ACOUCHIES

Close relatives, the green and red acouchies (*Myoprocta acouchy* and *Myoprocta exilis*) also deserve study. These are smaller animals with longer tails, bearing a little plume of white hairs. Although even more delicate and hypersensitive than agoutis, they can be kept in captivity and breed well. They then become less nervous and are easily handled. Acouchies. show remarkable intelligence and even

some affection for those they trust. They frequent rainforests, but are rare or even absent in disturbed areas. Adults weigh up to 1.5 kg.

The general biology (diet, reproduction, activity rhythm), is almost the same as that of the agouti, but they live in smaller home ranges (0.6-1.2 hectares versus 2.5 hectares for the agouti) and travel singly, although belonging to a well-established family unit. Adult males tolerate the juvenile males. They occur only in Colombia, the Guianas, Ecuador, Peru, and Brazil.

Farming methods would probably be the same as for the agoutis, but acouchies always need plant cover.

ADVANTAGES

Agoutis are appropriately sized: a dressed carcass can weigh 1-3 kg. The meat is good, and large commercial undertakings in urban centers could profit from the ready market that already exists.

The animals are prolific: females can produce up to two litters a year, each litter averaging two offspring. In protected areas, populations may grow fast.

These forest dwellers might provide a source of meat and income without destroying the forests in favor of cattle pastures. Also, they thrive in disturbed areas as long as there is some cover.

LIMITATIONS

Experiments in Brazil show that agoutis are highly susceptible to foot-and-mouth

disease.

The animals might become pests: they eat the roots, leaves, and fruit of agricultural crops and occasionally damage sugarcane and banana plants. However, current experience suggests that if they escape captivity they are quickly caught by hunters and do not reach pest levels.

Live agoutis have strong-smelling anal glands that may be offensive to breeders or could contaminate the meat if the animals are carelessly handled.

Where the rainforest is destroyed, the agouti population is destroyed. The animals were once well known throughout Latin America, but not anymore. In some areas, therefore, wild breeding stock may not be locally available. Moreover, people may have become sufficiently unfamiliar with them that their value may no longer be appreciated.

In captivity, they can be the prey of large birds such as eagles.

RESEARCH AND CONSERVATION NEEDS

The taxonomy of agouti species needs clarification.

Husbandry experiments are required, including studies on topics such as:

- Nutrition;**
- Growth rate;**

- **Shelters and enclosures;**
- **Reproduction; and**
- **Techniques for catching, moving, marketing, and managing the animals.**

One area where agoutis might profitably be raised is in enclosures in palm plantations. Palms such as the babassu provide food, shade, and shelter, while fallen and rotten logs offer secure retreats from predators. This deserves investigation.⁸

Instead of clearing vast areas of rainforest for cattle pasture, as is being done in much of Latin America, people might well "farm" agouties in the forests. Few of the settlers flooding into such regions can afford, let alone raise, beef. Small-scale agouti farming offers a promising and inexpensive alternative that would be gentle on the fragile land.

16 Capybara



FIGURE

The capybara (*Hydrochoerus hydrochaeris*), the world's largest rodent, can be as big as a sheep and weigh as much as a small person. Its natural habitat is the environs of South America's rivers, marshlands, and swamps, where it feeds on the grasses and reeds that grow near water.¹

Because of its size, tasty meat, valuable leather, and rapid reproduction, the capybara is a candidate for both ranching and intensive husbandry throughout the hot and humid lowland tropical regions of Latin America. It seems easy to handle. It is commonly raised in zoos or occasionally as a pet, and has, in at least one instance, been proven successful in large commercial herds.

In floodplain ecosystems, capybaras complement cattle because they prefer to graze swamp grasses rather than the dryland grasses on which cattle feed. They have simple stomachs, but are one of the more efficient herbivores. Although they are "selective feeders" that eat lush waterside grasses "preserved in quality" by the water, they also graze pasture, usually selecting new growth that is often too short and scattered for cattle, with their large muzzles, to eat.

AREA OF POTENTIAL USE

The floodplains of the South American subtropics and tropics where the animal is indigenous.

APPEARANCE AND SIZE

Although they have blunt, horselike heads, capybaras look like gigantic guinea pigs. They are ponderous, barrel shaped, and have a tail too small to be seen from a distance. Their skin is tough and covered by sparse, bristlelike hairs: the color

above is reddish brown to gray; beneath, it is yellowish brown.

The front legs are shorter than the back. Slightly webbed toes - four on the front feet and three on the back - make them good swimmers. They dive with ease and can stay underwater for up to five minutes. They also move nimbly on land.

The capybara is extremely large for a rodent. In size and color, it looks much like a pig. Often more than 100 cm long and 50 cm high at the shoulder, it can exceed 50 kg liveweight. Indeed, specimens weighing up to 90 kg have been reported.

DISTRIBUTION

Before livestock were introduced, the capybara grazed widely over riverine regions throughout South and Central America. Today, it is found in the flooded grasslands from Panama to Paraguay. Mainly, it occurs in the watersheds of the Orinoco, Amazon, Paraguay, and Parana rivers. High population densities exist in the Pantanal of western Brazil and on the Llanos floodplains of Venezuela and Colombia.

STATUS

There are few precise population counts, but capybaras can occur in large numbers.² However, in many areas they appear to be on the verge of extinction, being deliberately eradicated by farmers who think they compete with cattle and transmit diseases. Also, in some areas illegal hunting goes on year-round and great numbers are killed. The animals are particularly vulnerable during the dry season, when they concentrate around the diminished river channels and water holes.

HABITAT AND ENVIRONMENT

As noted, most capybaras live in swampy or grassy areas bordering rivers. However, some are found in other habitats, ranging from open plains to tropical rainforests. But even here they stay near ponds, lakes, streams, and swamps, and never venture much more than 500 m from water.



The capybara's native range

BIOLOGY

The capybara, like all rodents, is a simple-stomached animal, but it is a true herbivore. Its digestive system is especially adapted for fibrous materials. The large cecum - the site of enzymatic digestion- serves a function like that of the rumen of sheep, cattle, and goats. It has a digestive capacity similar to that of a sheep's rumen.

Like rabbits and all the rodents, capybaras are coprophagous. That is, during the

morning hours when they are resting, soft feces from the cecum are passed a second time through the digestive system.

Contributing to the animal's digestive ability is its efficient mastication. It chews its forage seemingly incessantly, reducing it to extremely small particles before it is swallowed.

Under natural conditions, the females annually bear 1 or 2 litters, each averaging from 4 to 6 offspring. Birth weight is between 1 and 2 kg, depending on litter size and sex. Both males and females reach sexual maturity when they reach a liveweight of 30 kg or more- usually between the first and second year of life.

BEHAVIOR

Capybaras are intelligent, shy, inoffensive, and harmless. In undisturbed ecosystems, they are gregarious and live in family groups of up to 30. The young follow the mother about for many months after birth.

Unlike most rodents, they do not construct dens, but the groups have specific resting areas.

The animals are both diurnal and nocturnal and, like many herbivores, they graze at daybreak and dusk, and perhaps also at midnight. They spend the morning resting in weeds on riverbanks, and at noon they cool off by bathing for an hour or so before grazing. They may feed belly deep in water.

Capybaras wallow in mud, allowing it to dry on their skin before bathing again. Mange can develop in captivity when they cannot take a mud bath.

When startled, a capybara barks loudly and dashes away, but after running 200 m or so it tires, slows down, and may lapse into hyperthermia. At that point a hunter can easily catch it. However, if the animal reaches water, it usually eludes the pursuer because it swims so well - especially underwater.

USES

Capybara meat is white and has qualities and properties (such as high emulsification) that might allow it to compete with pork and other meats in the food industry. Spanish-style sausages, Italian-style mortadellas, frankfurters, and German-style smoked chops have been produced experimentally.⁴ However, at present, the meat is mainly consumed only in the dried and salted form. It is particularly popular in Venezuela, where more than 400 tons are sold every year, especially during Easter festivities.⁵

The capybara's hide is one of the best for glove making. This luxury product, known in international commerce as carpincho leather, fetches high prices on European markets because it is more heat resistant than most leathers and because it stretches in only one direction. This one way grain allows gloves to stretch sideways without lengthening and looking sloppy.

HUSBANDRY

The capybara appears suitable for raising as a livestock animal. Amerindians traditionally collected capybara orphans during the hunting season and raised them until needed for food. Capybara breeding was reported in Brazil as early as 1565.

Modern attempts have been made towards domestication. Researchers at the Institute of Animal Production in Venezuela, for instance, started a breeding program in the 1970s using 20 females and 5 males. Since that time they have continuously kept capybaras in confinement. Through selection and management, they have improved the reproduction of captive animals. The current aim is to get 16 offspring per mother per year. Newborns are weaned after 5 weeks and the mother is returned to the breeding pen.⁶ In Colombia, similar work is in progress, and guidelines for raising capybaras on breeding farms have been published.⁷ In Brazil, research has been carried out to study capybara nutrition, genetics, management, reproduction, and social behavior in total confinement.⁸

ADVANTAGES

Throughout South America, the price of beef has increased greatly within the last few years, thereby providing a new incentive for capybara husbandry. It has also forced many campesinos to eat more wildlife, which adds another incentive for producing capybara meat on farms and thereby perhaps helping to relieve pressure on the wild stocks.

When tame, the animals are amenable to handling without physical restraint. They are so tractable that in Surinam a blind man once used one as a guide animal.

Capybaras can be raised on a variety of readily available vegetation: leaves, roots, fruits, and vegetables. They thrive in coarse grasses, if given opportunity to select nutritious parts. Their large incisors allow them to bite off short grasses that many herbivores cannot use. For instance, they eat "capybara grass" (*Paspalum fasciculatum*) that is abundant on river edges in Venezuela and is normally too

short for cattle to graze. This makes for low-cost feeding and utilization of a resource that is otherwise unused.

Capybaras are at home in hot, humid environments and are fully adapted to life on the tropical floodplains and seasonally flooded savannas. They thrive in extreme climates where cattle struggle, such as in the parts of the lower Paraguayan Chaco where summer temperatures reach 45°C.⁹ An ecological benefit to raising capybaras is that there is no need to alter habitats by introducing exotic forage plants.

They reproduce quickly. Age at first conception for females is about 1.5 years, and the time between parturitions is generally shorter than that of goats or sheep in the tropics. Young capybaras grow so fast that in 18 months they can reach a liveweight of more than 40 kg. In their natural conditions, they are more disease resistant than cattle. The annual productivity is said to exceed that of cattle in many parts of its range.

This species is already so widely eaten in South America that the meat from farmed animals should be readily acceptable.

LIMITATIONS

Capybaras occasionally raid fields and can harm sugarcane, rice, bananas, sweet potatoes, cassava, corn, and other crops. In many parts of Brazil, they are considered agricultural pests and are shot.

Confining these animals in high density may create serious problems. Infectious diseases and parasite outbreaks seem to be worse than those that occur with

conventional livestock. Aggression might prove a limitation to capybara husbandry: it is almost impossible to cage two adult males together or to introduce new animals to an existing group.

The animals may transmit disease to people and livestock. They can harbor foot-and-mouth disease and are known to be susceptible to brucellosis. They also carry a form of trypanosome, Trypanosoma evansi.

Compared with cattle, capybara use only a small proportion of the total plant biomass. They are largely selective feeders, and for satisfactory performance must have sufficient area to select the plants they need. If placed in a paddock of only coarse grass, most will eventually die. Like goats and gazelles, capybara probably select a diet that is at least 15 percent richer in crude protein than a typical cattle diet.'^o

High mortality has never been observed in Venezuela, but keeping the animals alive on a farm in some areas may not be easy. In one trial, more than half (55 percent) of the capybara died of disease, and a few of septicemia (the result of wounds incurred during fights), but most apparently of trypanosomiasis. Other losses were caused by speeding vehicles (29 percent), poaching (6 percent), and predation, mainly by jaguars (12 percent)."

RESEARCH AND CONSERVATION NEEDS

It is important for researchers to undertake the following:

- Gather specimens from different regions for comparative evaluation.**

- **Assess experiences of zoos and farms.**
- **Undertake nutritional trials.**
- **Initiate captive breeding trials - measurements of growth rates, space requirements, feed needs.**
- **Characterize the animal's productivity.**
- **Study the capybara's basic physiology and production potentials.**
- **Investigate biological factors, such as reproductive physiology, and social behavior (both in the wild and under controlled conditions).**
- **Determine the factors influencing capybara reproduction, growth, and development.**
- **Determine the animal's adaptability and economic merit in various farming systems.**
- **Study the influence of environment on reproduction rate.**
- **Determine their complementarity with water buffalo or other ruminants that normally use swampy habitats.**
- **Determine relative causes of mortality (such as diseases specific to capybaras) and predation (especially of the young) by spectacled caiman, crested caracayas, black vultures, and others.**

17 Coypu



FIGURE

The coypu' (Myocastor coypus) is an aquatic rodent native to South America. It has been called the "South American beaver," but its size is actually closer to that of a small dog or an agouti. It seems suited to be a microlivestock species because, compared with most rodents' it has a large body size and a relatively high reproduction rate. Moreover, it is easy to manage, and there is much literature on how to raise it in captivity.²

Fur is the main item of commercial value. In the late 19th century, it was in such high demand that the animal was nearly exterminated. However, in 1922 Argentineans began raising coypu in captivity and this practice spread through

South America and to other regions. In many European countries and in various locations in the United States some specimens escaped or were released, and coypu have become established in the waterways.

Coypu meat is tasty and is consumed in many regions of South America as well as in parts of Europe. Because of the absence of musk glands, the meat is free of the "gamy" flavor found in squirrels and rabbits. It is moist, fine "rained, medium light in color, and firm. It is one of the mildest and tenderest of wild meats.

AREA OF POTENTIAL USE

This animal has been widely distributed, but its area of safest use is within its natural range in South America.

APPEARANCE AND SIZE

The coypu is adapted to a semiaquatic existence and has webbed feet, valvular nostrils that can be closed to keep water out, and underfur that remains dry even under water. Its long, powerful claws on the forefeet are used for grooming, excavating burrows, and digging up and holding food. The tail is slender; the extremely large incisor teeth are orange-red.

An adult is 40-65 cm long and weighs 7-10 kg. Some occasionally weigh up to 17 kg. Males are larger than females. The pelage is thick, with coarse guard hairs overlying the underfur. The soft dense underfur (the commercially valuable pelt called "nutria") is about 2 cm long on the belly, and 2-5 cm long and less dense on the back. The color is yellowish to reddish brown on the back and pale yellow on the belly.

DISTRIBUTION

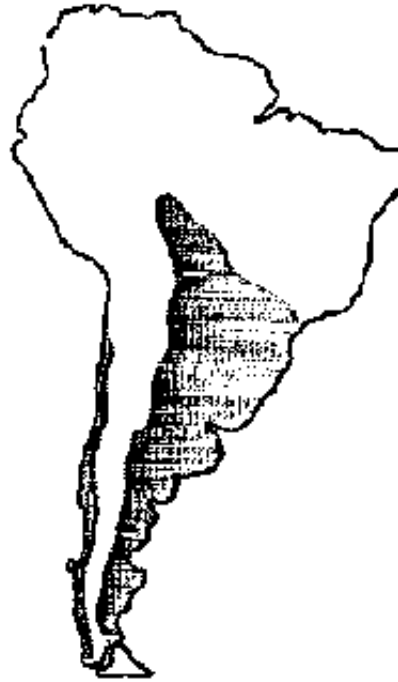
The coypu is distributed through southern Brazil, Paraguay, Uruguay, Bolivia, Argentina, and Chile. It has been widely introduced in North America, Europe, northern Asia, and eastern Africa. As a result of escapes and releases from fur farms, the animals are now feral in Europe, North America, northern Asia, Japan, and East Africa. In the United States, they are abundant in Louisiana, Oregon, Florida, and the Chesapeake Bay region.

STATUS

In various countries, the animal's status ranges from that of a rarity to that of a pest. Wild coypu are protected by law in Argentina because of overhunting, but there are about 100 producers of farmed coypu.³ Elsewhere the animals are destroyed en masse to reduce the threat of damage to irrigation ditches, dams, and agricultural crops. In England a decade-long program has eradicated them.

HABITAT AND ENVIRONMENT

Coypu mainly inhabit the banks of fresh or brackish waterways.⁴ They live in temperate zones and are highly sensitive to freezing conditions. Also, their heat tolerance is poor; lowland tropical regions may be too hot for them.



The coypu's native distribution. This is the only region safe for raising this extremely adaptable and potentially pestiferous animal.

figure

BIOLOGY

The coypu feeds mainly at night. The diet consists chiefly of plants, particularly water plants and reeds. Large amounts of fibrous vegetation is decomposed in the cecum, where bacteria break down cellulose particles. Mussels, snails, and other small organisms are also often eaten.

The animals burrow into soft soil or construct nests out of vegetation above ground.

Coypu are relatively fast breeding. Females first give birth at ages ranging from 6

to 15 months. From then on, they produce 2 or 3 litters a year. They are able to mate and give birth at any time of the year, although more young are born during certain seasons. The gestation period is between 128 and 140 days. There are 5 or 6 (sometimes up to 12) young in each litter. Newborns are well developed, able to see, and fully covered with hair at birth.

The female's four or five pairs of mammae are located on the side of the body, an adaptation that permits the young to nurse while floating with their mothers in the water. In captivity, young are nursed for two months, but can survive if weaned at five days. The mean body weight at birth is about 225 g, but growth is rapid during the first five months.

Coypu have a potential life span of more than six years. However, they seldom survive more than three years, and in the wild probably no animals are older than five years.

BEHAVIOR

These are passive creatures, usually entirely lacking in aggression. They are shy and fearful; the slightest disturbance will send them scurrying to the shelter of water, a burrow, or other hiding place. With their large incisors they can bite viciously, but in captivity they tame down, even to where they can be carried around by hand. Compared with domestic animals, they are very sanitary in their feeding and living habits.

In hot climates they are nocturnal, in cooler climates crepuscular, and in cold weather they become diurnal. Captive animals become conditioned to diurnal

activity if fed during daylight hours. Most of the active period is spent feeding, grooming, and swimming. Grooming is done by scratching and "nibbling" the fur, and an oily secretion from glands located near the mouth and anus lubricates the pelage. Secretions from the anal glands are also employed for marking out territory.

Excellent swimmers, coypu spend most of their time in the water. They can remain submerged for five minutes or more. On land, they lumber about with awkward, clumsy movements; however, when the need arises they can run fast and jump short distances.

Although they usually live together in pairs, coypu will form large colonies. They tend to remain in one area throughout their lives: their daily "cruising range" has been measured at less than 45 m.⁵ However, drought or freezing weather can induce mass migrations.

The burrows, which are dug in sloping banks, are usually short with no branching tunnels and generally end in a simple chamber.

USES

In South America, the coypu has a long history of use. Nutria fur was in such high demand and the animal was hunted so avidly at the beginning of the last century that it became rare and had to be protected by government decree. As a result, populations increased dramatically. Nowadays, coypu are protected in many areas, but widespread poaching has reduced their numbers and range.

Many thousands are killed each year just for the guard hairs, which are used in

making felt.

Coypu are used in marsh management to reduce infestations of aquatic weeds and to keep waterways open.

HUSBANDRY

In most areas where it is found, the coypu is trapped by commercial hunters. However, as noted, several countries have coypu farms. In Germany, the animals have been raised on diets consisting chiefly of potatoes supplemented with oats, clover, corn, hay, green forage, legumes, turnips, or cabbage. Elsewhere, feeds generally include such materials as hay, corn, crushed oats, greens, root vegetables, apples, bread, and rabbit feed.

To confine coypu, a wall of stone or concrete or a fence of stout wire netting is necessary. It must be set 1 m deep into the ground and rise 1-1.5 m above ground. Water must be available.

Where selected strains of animals are kept, it is usual to house each female in separate small compartments, complete with pools and shelter boxes. Each is then paired with a male, which is removed after mating to leave the female to rear her brood in seclusion.

ADVANTAGES

The fur is particularly valuable because the female's nipples are so high that the soft belly fur is unbroken.

This herbivore is much cheaper to feed than the furbearing carnivores such as mink. Furs of coypu raised in captivity fetch a price about three times greater than furs from wild animals.⁶

LIMITATIONS

Wherever the coypu has escaped it has damaged embankments and stream banks. The burrows sometimes weaken dikes that protect low lying areas from flooding. In northern Europe and eastern England, for example, it is considered a serious pest. In rice paddies, coypu could become particularly devastating. They can also damage crops and natural plant communities.

Coypu can carry viruses that result in toxoplasmosis, papillomatosis, rabies, and equine encephalomyelitis; bacteria that cause salmonellosis, paratyphoid, and leptospirosis; protozoans that produce sarcosporidiosis and coccidiosis; and rickettsia. Common diseases of captive specimens are bacterial pneumonia, hepatitis-nephritis, Strongyloides infection, and neoplasms.

European winters often cause the coypu's tail (which is hairless) to freeze, but the animal hardly seems to notice. A more dangerous situation arises when lakes, streams, or rivers freeze over; beneath the ice, coypu cannot find their way as easily as beavers, and often drown.

RESEARCH AND CONSERVATION NEEDS

Little research needs to be done. There is massive literature on farming coypu. Nonetheless, the animal's behavior is little studied, and there are few reliable published observations on its social organization.

18 Giant Rat

The giant rat, also known as the pouched rat, is one of Africa's largest rodents. Two species have been distinguished: *Cricetomys gambianus*, which lives chiefly in savannas and around the edges of forests and human settlements; and *Cricetomys emini*, which occurs mainly in rainforests. Both are highly prized as food

These animals are solitary, but they are easy to handle, have a gentle nature, and make good pets. Researchers at the University of Ibadan in Nigeria have been developing techniques for managing them in captivity. Breeding stocks were established in 1973, and since then so many generations have been bred that this small population is considered domesticated. Commercial-scale giant rat farming is now being established in southern Nigeria.

This is a promising development because giant rats are a common "bushmeat" throughout much of Africa. Since these herbivores are well known there, and are acceptable as food, they may have as much or more potential as meat animals than the introduced rabbits that are getting considerable attention (see page 178).

AREA OF POTENTIAL USE

The intertropical zone of Africa from the southern Sahara to the northern Transvaal.

APPEARANCE AND SIZE

This species is among the most striking of all African rodents.

Because of its large size, it often causes amazement - even alarm - when seen for the first time. The body measures as much as 40 cm, and, on average, weighs about 1-1.5 kg. The record for a hand-reared specimen is 1.6 kg

Apart from its size, the best known species (*Cricetomys gambianus*) is noted for the dark hair around its eyes, a nose that is sharply divided into dark upper and pale lower regions, and a tail that has a dark (proximal) section and pale (distal) section. The overall body color is a dusky gray.

The lesser known species (*Cricetomys emini*) has short, thin, and relatively sleek fur. Its upper parts are pale brown; the belly is white.

DISTRIBUTION

Giant rats are commonly found from Senegal to Sudan, and as far south as the northern region of South Africa. The main species is mostly found in moist savannas, patches of forests, and rainforests. However, it can also be found in all West African vegetation zones from the semiarid Sahel to the coast. It also exists at high altitudes- up to about 2,000 m in West Africa and 3,000 m in eastern Africa.

The rainforest species occurs in the great equatorial forest belts of Zaire and neighboring Central African countries.

STATUS

These animals are probably not threatened with extinction. However, they have been exterminated in some areas (such as in parts of eastern Zaire) where the

human population is dense, the land fully cultivated, and the wildlife overhunted. Although common, they are not as well known as one might suppose from their bulk and from the fact that they are sometimes found around, and even inside, houses.

HABITAT AND ENVIRONMENT

Giant rats occur largely in lightly wooded dryland regions or in forested humid regions. They cannot tolerate high temperatures or truly arid conditions. They often live in farm areas and in gardens. Their burrows are commonly found inside deserted termite mounds and at the base of trees. Some have also been found in the middle of cassava fields.



The giant rat's distribution

BIOLOGY

These are herbivores with a tendency to omnivory. They prefer fruits, but also subsist on tubers, grains, vegetables, leaves, legume pods, and wastes (such as banana peels). However, they are not grasseaters. Giant rats also kill and eat mice, insects (caterpillars, cockroaches, and locusts, for example), and probably many other small animals.³ They are particularly fond of mollusks (such as snails).

Reproduction is prolific and year-round. The female attains puberty at 20-23 weeks and the gestation period is about 20-42 days. The young are weaned at 21-26 days of age but stay with their mother until 2-3 months of age. So far, the record for the most litters has been 5 in 9 months. It thus seems possible that a female can reproduce 6 times a year. Litter size ranges between 1 and 5, but 4 is most common. Thus, in 1 year a single female could produce 24 or more young.

BEHAVIOR

These strictly nocturnal animals usually lead solitary lives and forage alone. Mostly, they occupy a burrow by themselves, except when the

young are being raised. The burrows can be complex. Below the entrances are vertical shafts leading to a system of galleries and chambers for storing food, depositing droppings, sleeping, or breeding. The home range is individual and limited (1-6 hectares). In the wild, one male "supervises" the home ranges of several females.

In captivity, the animals are often seen sitting up and ramming large amounts of food into their spacious cheek pouches. With full cheeks, they return to their

burrows and disgorge the food into a "larder." Food (chiefly hard nuts) is stored there.

They swim and climb well.

USES

A study carried out in Nigeria showed that the giant rat produces about the same amount of meat as the domestic rabbit.⁴ The meat's nutritional value compares favorably with that of domestic livestock, and African villagers know how to preserve it by smoking or by salting.

The giant rat has recently attracted attention as a potential laboratory animal.

HUSBANDRY

Farmers in Nigeria have traditionally trapped the juveniles and fattened them for slaughter. They usually keep the animals in wire cages and feed them daily with food gathered in the wild as well as with scraps from the household.

As noted, the program at the University of Ibadan indicates that the giant rat can be domesticated. Already, specimens are being bred and reared in an intensive program. They adapt to captivity after about a month. They are subsequently transferred into breeding cages, which are wooden boxes with a rectangular wire-mesh "playroom." Each cage holds a breeding pair or a nursing female with its young. Experimental feeding cages have also been designed.⁵

Food-preference trials show that palm fruits and root crops (especially sweet

potato) are preferred to grains and vegetables. Nutritional studies show that the animals can tolerate up to 7 percent crude fiber in their rations. Although largely vegetarian, they eagerly consume dry and canned dog food.

ADVANTAGES

These animals have several advantages:

- They are well known and much sought after for food.**
- They have adapted to life in lowland tropics.**
- They are able to live on locally available plant materials, including vegetable waste.**
- They reproduce rapidly.**
- They are more tolerant of captivity than the grasscutter (see next chapter). This is largely because omnivorous feeding makes them easier to feed than the grasscutter and other strict herbivores.**

LIMITATIONS

This species could easily become a pest. It is recommended for rearing only in areas where it already exists. The crops it damages include cacao, root crops, peanuts, maize, sorghum, vegetables, and stored grains and foods. There is also the possibility that this rodent may transmit diseases to humans.

A project at the University of Kinshasa in Zaire reports problems in getting giant rats to reproduce in captivity. When two specimens were paired they sometimes fought so viciously that copulation was impossible.⁶ Special management may be required, such as housing animals in adjacent cages before actually introducing them to each other. Moreover, selection for docility may also be necessary.

The ratlike appearance is not attractive, and a few African tribes have taboos against consuming the meat of these animals.

RESEARCH AND CONSERVATION NEEDS

Throughout Africa south of the Sahara, giant rat domestication deserves experimentation and trials. Success would open up the potential for supplemental meat supplies in rural and urban areas where meat is now scarce. Tests are needed to determine the factors that favor breeding: temperature, aeration, light, privacy, and size and form of cages. Moreover, diets that are cheap and easy to make from local feedstuffs must be identified.

Further research on the domestication of the giant rat might include:

- Identifying husbandry techniques that are applicable at low cost in rural areas;**
- Studying food digestibility and setting up various diets;**
- Illuminating social behavior: pairing of animals, the best moment for pairing, duration of pairing, age of partners;**
- Outlining the basics of husbandry (for instance, capital costs, food conversion**

ratios, growth rates) and making simple and cheap cages;

- **Studying biology (anatomy, physiology, birth records, growth rate); and**
- **Testing the practical likelihood that this rodent may transmit diseases to people and other animals.**

The giant rat has an interesting commensal relationship with Hemimerus, an insect that feeds on secretions in the skin. It seems to cause no irritation or damage, and may even benefit the host by helping to keep the skin clean. Caging these animals results in the general loss of the insect, but attempts should be made to maintain them and to determine their role and life cycle.⁷

The potential of this species as a laboratory animal in nutritional, clinical, and pharmacological research also deserves exploration.

19 Grasscutter



FIGURE

The grasscutter (*Thryonomys swinderianus* and *Thryonomys gregorianus*) is found in many forests and savannas of Africa. Its meat, said to resemble suckling pig, often sells for more per kilogram than chicken, beef, pork, or lamb. It is the preferred, and perhaps most expensive meat in West Africa. Indeed, in Ivory

Coast it sells for about \$9 per kg. With prices like that, grasscutter is a culinary luxury that only the wealthy can afford.

If domestication of this wild species were successful in providing meat at a price similar to that of poultry (the second most popular meat), markets would be unlimited.² However, as production costs are high, long-term research will be

required before grasscutter production can be profitable to the small farmer. This research should now be undertaken.

In an effort to capitalize on the markets for this delicacy, agricultural extension services of Cameroon, Ghana, Ivory Coast, Nigeria, Togo, and particularly Benin are already encouraging farmers to rear grasscutters as backyard livestock. They furnish breeding stock and information, and maintain central offices for records. In addition, a bilateral cooperation project in Benin has started experimental work on improved breeding methods combined with the study of animal responses under domestication.³

In future, this vegetarian animal might become the African equivalent of South America's guinea pig, playing an important role in reducing Africa's chronic protein shortage.

AREA OF POTENTIAL USE

Humid and subhumid Africa south of the Sahara.

APPEARANCE AND SIZE

Grasscutters are robust animals with short tails, small ears, and stocky bodies. Taxonomically, they are more closely related to porcupines than to common rats or mice.

Although many varieties have been described, there are probably only two species. The larger (*Thryonomys swinderianus*) weighs 9 kg or more and has a head-and-body length of up to 60 cm. The smaller species (*Thryonomys*

gregorianus) may occasionally reach 8 kg and a body length of 50 cm.

Both species have yellow-brown to gray-brown bodies, with whitish bellies. The fur is extremely coarse, firm, and bristly - reflecting the animal's kinship to the porcupine. The tail is scaly and has short, sparse hairs.

Both species have thick, heavy claws and enormous orange incisors that can chew through even the toughest vegetation. (Grasscutters have been known to tear holes in corrugated iron fences.) Nevertheless, they do not bite when handled, although their claws sometimes cause injuries.⁴

DISTRIBUTION

Grasscutters occur in grassland or in wooded savanna throughout the humid and subhumid areas of Africa south of the Sahara. They often live in forest-savanna habitats where grass is present. They do not inhabit rainforest, dry scrub, or desert, but they have colonized the road borders in forest regions. Distribution is determined by availability of adequate or preferred grass species for food. Specifically, *Thryonomys swinderianus* occurs in virtually all countries of west, east, and southern Africa. *Thryonomys gregorianus* occurs in savannas in Cameroon, Central African Republic, Zaire, Sudan, Ethiopia, Kenya, Uganda, Tanzania, Malawi, Zambia, Zimbabwe, and Mozambique.

STATUS

Despite heavy hunting, these animals are not threatened with extinction. Nonetheless, many individual populations are well below carrying capacity, or are extinct because of local overexploitation.

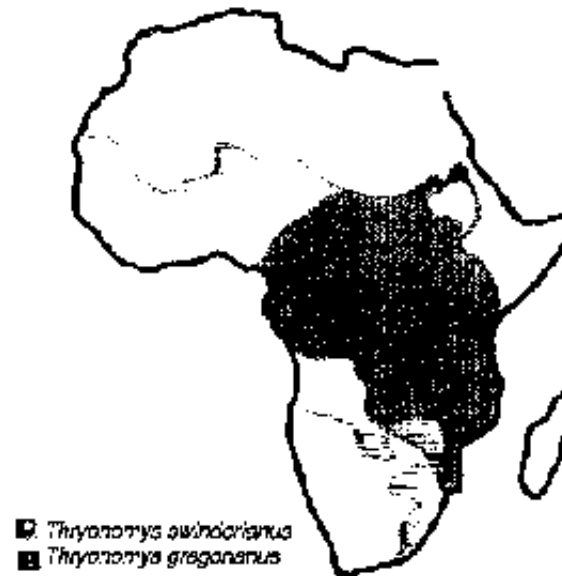
HABITAT AND ENVIRONMENT

The larger grasscutter (*T. swinderianus*) generally lives in swampy, low-lying areas, especially along river banks and the borders of lakes and streams. Occasionally, it is found on higher ground among bushes and rocks, living where savanna grasses are dense and tangled enough to afford good cover. In Ivory Coast and southern Guinea, for instance, grasscutters are found (and hunted) throughout the savanna zones. And they can occur in close proximity to farmlands and people (for example, in southwest Nigeria).

BIOLOGY

Although the precise diet in the wild has not been determined, grasscutters are vegetarian. They consume nuts, bark, and the soft parts of grasses and shrubs. They particularly favor elephant grass and sweet potatoes. They commonly "raid" cassava and yam plantations, and are considered local pests.

Grasscutters reproduce year-round, although the births seem to peak at certain times of the year, correlated with weather conditions.⁵ Probably one male takes several females, and the family group possibly has more than one generation of young. The gestation is about 152 days. Apparently, litters normally contain between 2 and 4 young, but in Benin and Togo some litters of up to 11 or 12 are reported.⁶ Newborns are fully developed, their eyes are open, they weigh approximately 80 g, have thick fur, and quickly become accomplished runners.



Grasscutters occur across tropical Africa and through the grasslands of East Africa, as far south as the eastern Cape. Throughout this region, where other meat is often expensive and scarce, a grasscutter makes a welcome meal.

figure

BEHAVIOR

Although they commonly forage in groups, grasscutters are generally solitary. They are nocturnal, and they travel at night through trails in reeds and grass, often to water. Most specimens seen in markets are males, possibly because males lead the groups and are thus most prone to being trapped.

When alarmed, these animals stamp their hind feet and give a strange booming grunt. When fleeing, they can run very fast and, given a chance, will take to water. They swim with ease.

For shelter, grasscutters usually weave nests of matted vegetation or scoop out

shallow burrows.

USES

In a broad geographic band across sub-Saharan Africa, cattle raising is severely limited by trypanosomiasis. There, other sources of animal protein, including rodents, are traditionally used. Thus, grasscutter meat constitutes an important food for many Africans. The animals are mostly caught and eaten by families for their own use, but some are sold in markets and especially in roadside stalls. Many families depend exclusively on selling bushmeat, particularly that of grasscutters. In Accra, Ghana, during one year, 73 tons of grasscutter meat were sold in the local market. This represented more than 15,000 animals. In southern Africa, too, people find that these rodents make tasty food, although they may cut off the tail to make the carcass look less ratlike.

The meat is usually eaten smoked, and is so much in demand that grasscutters are hunted in organized drives with spears, dogs, and sometimes fire. It is considered excellent, especially when cooked in soups and stews or barbecued.⁷ It has been described as resembling venison in flavor, but it is dark like the meat of wild duck.

HUSBANDRY

In the savanna area of West Africa, people have traditionally captured wild grasscutters and raised them at home. As an extension of this, organized grasscutter husbandry has been initiated in West Africa. The animals are provided with marshy, tightly fenced areas with plenty of plant cover. The young are harvested from these areas and raised separately.

Ghanaian researcher Emanuel Asibey, a pioneer of this research, reports success at getting such captive stocks to reproduce. To this end, farmers are provided with breeding boxes and foundation grass cutter colonies. They are taught how to rear and feed the animals for home consumption or for cash income. Basically, the farmers make available large sheds where the animals can move freely. To prevent escape, the walls may be reinforced with cement plaster. The farmers also provide piles of grass, sugarcane, and other foods. A grasscutter reportedly takes about a month to adjust to such confinement. High mortality can occur in this period. The average weight of a mature, home-raised grasscutter is 4-7 kg. The average killing-out (dressed carcass) is 64 percent.8

The Wildlife Domestication Unit of Ibadan University in Nigeria, another pioneer of rodent domestication, has also reported the potential of domesticated grasscutter colonies.9

Research on grasscutter breeding, husbandry, and feeding is similarly being implemented by the Ministry for Rural Development in Benin and at the Lacena in Ivory Coast (see Research Contacts).

ADVANTAGES

The demand for grasscutter meat is so large that it is not being met. Markets for it already exist over much of Africa,

LIMITATIONS

Grasscutters can devastate such crops as rice, sugarcane, soybeans, peanuts, yams, cassava, sweet potatoes, oil-palm seedlings, maize, young rubber, sorghum,

and wheat. Therefore, as with most rodents, they should be reared only in areas where they already exist.

In past years, captive animals in Benin have suffered fatal Clostridium infections during September and October. In 1986, a broad-spectrum antibiotic was given with outstanding results. During this season, the animals also suffered from ascarid worms, which were also successfully treated with standard drugs.¹⁰

RESEARCH AND CONSERVATION NEEDS

Research is needed in the following areas:

- Digestive physiology, feeding habits, feed preferences, feed conversion and growth rate;**
- Diseases (pathogens and parasites);**
- Captive breeding and management (growth rates, space requirements, feed needs, etc);**
- Performance under different environments;**
- Productivity; and**
- Basic biology (for example, chromosome type, reproductive physiology, and social behavior both in its wild state and under controlled conditions).**

Moreover, specimens should be gathered from different regions for comparative

evaluation. A particular need is to select and breed docile specimens because today, even after several generations in captivity, the animal must still be handled with caution.

Although domestication of the grasscutter is encouraged, wild populations might also be managed to maximize and sustain production through habitat manipulation.

20 Guinea Pig



FIGURE

Guinea pigs (*Cavia porcellus*) are promising microlivestock because they require little capital or labor; provide an inexpensive, readily available, palatable meat; have no odor, and are suitable for keeping indoors. In the highlands of the Andes, many Indians raise them to supplement diets based on grains and vegetables. Families eat them mostly on special occasions such as weddings and first communions, or they sell them to restaurants or peddle them in village markets.

The low cost of these small animals makes them available even to many landless peasants. For both the small farmer and apartment dweller, the guinea pig is a

possible food reserve. It converts kitchen scraps and marginal wastelands into meat. According to estimates, 20 females and 2 males may produce enough meat year-round to provide an adequate meat diet for a family of 6.2

Since husbandry practices are simple and cheap, the guinea pig is an excellent source of supplementary income. An FAO study at Ibarra, Ecuador, showed that on small mountain farms the guinea pig provided more profit than either pigs or dairy cows, partly because its meat fetched high prices.

Although domesticated guinea pigs are mainly a food resource of Latin America, their use has also spread to parts of Africa and Asia. They are raised, for instance, in Nigeria, Cameroon, Ghana, Sierra Leone, Togo, and Zaire. In southern Nigeria, at least 10 percent of all households raise guinea pigs for food, with colonies of up to 30 animals per household. Guinea pigs are also raised in small cages or cardboard boxes by small farmers in the Philippines.³

The feeding efficiency is high: studies have shown that it takes between 3.2 and 5.7 kg of forage to produce 1 kg of growth. This makes guinea pigs more efficient than most farm mammals.

Guinea pigs seem especially adapted to the climate and forages of high-altitude zones, but the fact that they are being raised in Central and West Africa indicates that they are also adapted to the lowland tropics.



The native distribution of the guinea pig's wild ancestor

AREA OF POTENTIAL USE

Worldwide.

APPEARANCE AND SIZE

Guinea pigs have stocky bodies, fairly short hind legs, and short, unfurred ears. Adults can weigh up to 2 kg, but an average-sized specimen is about 0.5 kg. They are 20-40 cm long (average 28 cm) and have no tail. In domesticated forms, the pelage may be smooth or coarse, short or long, and in some types the hairs form rosettes.⁴ Domesticated types come in colors ranging from white to dark brown, as well as piebald.⁵

DISTRIBUTION

The original home of the wild guinea pig is believed to have been the central highlands of Peru and Bolivia. Its domesticated descendants are important as meat animals mainly in that same area, but, as noted, they are also important in certain African and Asian countries.

A few strains are distributed worldwide as laboratory animals and pets.

STATUS

Domesticated guinea pigs, as a whole, are in no danger of extinction, although some rare strains are threatened.

HABITAT AND ENVIRONMENT

These extremely adaptable animals are found in temperate zones and in the highland tropics, but they are usually kept indoors and protected from the extremes of weather. In Lambayeque and other departments of Peru, they are reared at elevations from sea level to more than 4,000 m. In areas where they are raised, daily temperatures fluctuate as much as 30°C. In the Bolivian or Peruvian puna region, for instance, day temperatures can be 22°C, while night temperatures are -7°C. However, they cannot survive freezing temperatures and they may not perform well when exposed to the full tropical heat and sunlight. Many people of the Peruvian highlands keep the animals in darkness (for example, in wood boxes with little or no light).⁶

The animal's original wild habitat is believed to have been an area of grasslands,

forest edges, swamps, and rocks.

BIOLOGY

These herbivores can be raised on kitchen scraps, garden wastes, and weedy vegetation plucked from backyards or roadsides. Andean peasants mainly feed them potato peels, scraps of cabbage, lettuce, carrot, wild grasses, corn stalks, and the foliage of miscellaneous wild plants. Some barley and alfalfa is grown specifically for guinea pigs; it is cut green and sold in small bundles in the markets.

Guinea pigs mate throughout the year except when climate is excessively adverse. Domestic breeds average 2-3 young per litter, although larger litters sometimes occur. The gestation period is 65-70 days with an average of 67. Females come into estrus every 13-24 days, and there is a fertile postpartum estrus.

Females can become pregnant when merely 3 months old, and many produce 4 litters every year from then on. In principle, a farmer starting with 1 male and 10 females could see his herd grow to 3,000 animals in one year.

Newborns are so large that the female's pubic bones must separate for the birth. They emerge fully developed, with fur and open eyes. They look like miniature adults, and they start eating grass and other feedstuffs within hours. (For this reason, babies orphaned at birth have been known to survive.) Weaning may be reached as early as 21 days of age.

The life span in captivity is as long as 8 years, but animals used for breeding usually live only 3.5 years.

SUPER GUINEA PIGS

Even in their native region, guinea pigs have traditionally received little research attention. However, that began changing in the 1970s with the onset of meat shortages in Peru. (For a time the government restricted beef sales to only 15 days a month.)

For instance, in 1972 Peru began a guinea pig improvement project. Researchers from the Molina National Agrarian University traveled throughout Peru gathering many kinds of guinea pigs short haired long haired black, white, yellow, brown, and even purple. Practically all the guinea pigs eaten in Peru are home grown, and researchers observed that the bigger ones were generally winding up in the stew, leaving the smaller ones for breeding. The people inadvertently were making the animals smaller. (This is a common phenomenon for many animals.)

To overcome it, the university research workers compared the mature size and growth rates of all the different guinea pigs. They selected and cross-bred the biggest, meatiest, and fastest-growing ones. This program, later taken over by Instituto Nacional de Investigacion y Promocion Agropecuaria (INIPA), produced remarkable results. The starting animals averaged little more than 0.5 kg, the resulting ones averaged almost 2 kg.

Peru's "super guinea pigs" are now getting international recognition. They have been introduced into the highlands of Honduras, where the animal is also part of the Indian cuisine. The FAO has shipped some to the Dominican Republic. In addition, Bolivia, Ecuador, and Colombia have all begun their own guinea pig improvement programs.

Within Peru the government has established 11 breeding stations to encourage the farming of guinea pigs for food. The goal is to provide better stud males to the people so that future animals will grow more quickly and reach a greater weight.

BEHAVIOR

Guinea pigs generally congregate in small groups, normally made up of 5-10 adults. In favorable areas, however, such groups may coalesce into large colonies. The animals communicate incessantly among themselves, emitting a variety of squeaks and other noises.

Males, although good-natured with other species, often fight fiercely among themselves.

USES

Guinea pigs are raised mainly for meat. Peru has about 20 million, which annually provide 16-17,000 tons of meat (only 4,000 tons less than Peru's sheep meat production).

Guinea pigs are used worldwide for studies on disease, nutrition, heredity, and toxicology, as well as for the development of serums and other biomedical research.

HUSBANDRY

Guinea pigs require so little space that a small cage or pit can house up to 10 females and 1 male. They can be raised in cages with wire floors of small mesh as

well. The labor required is low. A colony of 1,000 females reportedly can be properly cared for by one person. A layer of wood shavings, shredded paper, straw, and dried corncobs is usually recommended for bedding. The droppings are odorless, so the bedding does not need changing as often as with other animals. When the diet mainly consists of greens, much urine is produced, and then the beds have to be changed frequently.

When grown for meat, the young are weaned at 3-4 weeks and are ready for market in a matter of 10-13 weeks. Weight gain is rapid for the first 4-6 weeks, and then decreases. The carcasses normally dress out at about 65 percent, including the skin and legs. The meat's protein content is approximately 21 percent.⁷

In a few regions of Peru, guinea pigs are "herded" on the open range and retired at night into small adobe coops.

ADVANTAGES

This small, inoffensive animal rarely bites, is easy to manage, and has no smell. It is an excellent supplemental meat supply. The improved breeds cannot climb or jump so that they are easy to contain. (Primitive "criollo" types, however, can jump.) If kept dry and given green vegetation, grain, and water, it survives in many environments.

LIMITATIONS

A major constraint is consumer reluctance. Even in Latin America, attempts to promote guinea pig consumption outside the Indian communities have failed.

When raised in a clean environment and under normal feeding conditions, guinea pigs thrive and reproduce and do not need routine vaccinations or antibiotics that cattle, sheep, and pigs often require. However, guinea pigs can be carriers of Chagas' disease and salmonella. Further, they are susceptible to pneumonia if temperatures change abruptly when conditions are wet. Coccidiosis and internal and external parasites are also common.

Green forages and surplus fruits or by-products are critical to provide vitamin C, which the animal is unable to synthesize for itself.

RESEARCH AND CONSERVATION NEEDS

Since the greatest concentration of guinea pigs is found in the Andes, particular efforts should be directed towards this region. Already, research on guinea pigs has begun in some universities and government research stations in Colombia, Ecuador, Venezuela, Peru, and Bolivia, but more work is needed on matters such as:

- Breeding "elite" stock for distribution;**
- Feeding and nutritional-requirement trials, especially for creating alternate feeds that peasants and commercial producers can use during seasons when conventional feeds are hard to get;**
- Diseases and parasites that may limit production in small farming systems;**
- Management practices concerning reproduction, housing, herd size, and feeding;**
and

- The genetic basis for weight gain and productivity.

Some research should be directed towards developing rations or introducing drought-resistant forages for the dry season because green forage is needed year-round. A range of practical and economical diets needs to be created.

Animal geneticists in Latin American countries should establish "elite" populations that can provide superior stock throughout the world. It can be anticipated that applying modern breeding methods to existing improved strains will result in great advances in a relatively short period and at little cost (see sidebar).

Three species of wild cavies (*Cavia aperea*, *C. fulgida*, and *C. tschudii*), close relatives of the guinea pig, are native to South America and are declining drastically. Research to preserve them is urgently needed. *C. aperea* is a widely used item of food in rural Brazil and other parts of South America.

21 Hutia



Hispaniolan Hutia

The first meat Christopher Columbus tasted in the New World was probably hutia, a rodent avidly hunted by the Carib Indians. Hutia bones have been unearthed from kitchen middens of pre-Columbian inhabitants of all the Greater Antilles. Indians carried live hutias on voyages possibly in a semidomestic state as a source of food. On some islands, hutias were so eagerly sought that their populations were destroyed long before Europeans arrived. Slaves in the cane fields also hunted hutias for food. The surviving species later suffered when forests were cleared and cats, dogs, mongooses, and other predators were introduced. Consequently, the majority of hutia species died out, and today most surviving members of the family (Capromyidae) are facing extinction. Human predation continues in some areas (for instance, in Jamaica) where the tradition of "coneyhunting" still endures in a few regions.

Hutias should be tested as possible microlivestock: success could create the incentive for their complete protection. The animals seem to take well to captivity. The Jamaican hutia is already overproducing in zoos, causing a local glut of animals. And hutias are, or were until recently, kept in barns by some people in Cuba, who fed them on banana and other vegetable waste and ate them regularly.'

POTENTIAL AREA OF USE

The Caribbean.

APPEARANCE AND SIZE

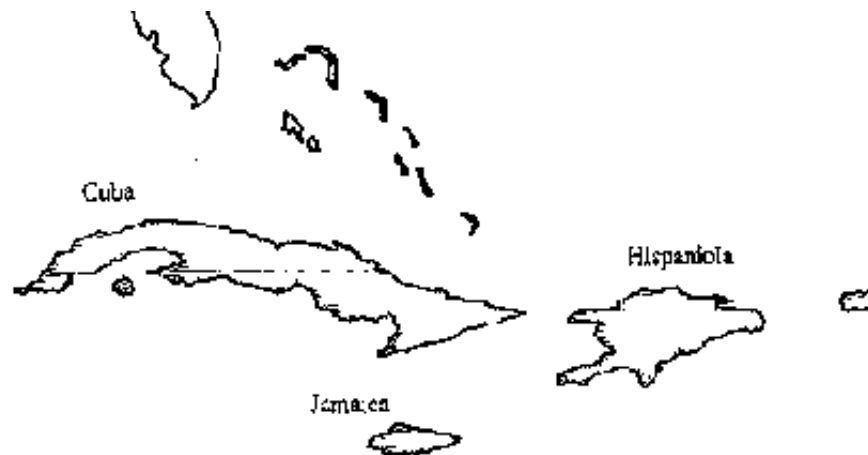
Hutias are broad-headed, short-legged, robust animals with small eyes and ears.

The various species are from 20 to 60 cm long and weigh from 1 to 9 kg - a size range from that of a guinea pig to that of a small dog. They walk with a slow, waddling motion, but can hop quickly if frightened or pursued. They also climb well.

The 10 living species are all big enough to be candidates for microlivestock. The best known and easiest species to keep in captivity are the Cuban hutia (*Capromys pilorides*) and Jamaican hutia (*Geocapromys brownii*).

The Cuban hutia (also called hutia conga) is about 60 cm long, with coarse fur, a raccoon-shaped body, and a thick tail covered with sparse bristles. A forest dweller, it weighs up to 7 kg.

The short-tailed Jamaican hutia is smaller: it is 33-45 cm long and weighs up to 2.5 kg.



The hutia's native range .

DISTRIBUTION

Hutias are found only in the Caribbean (Greater Antilles and Bahamas). Most species are confined to a single island, where they represent the only remaining indigenous land mammals. The Cuban hutia is found only in Cuba. The Jamaican hutia is found only in Jamaica, although a close relative occurs on East Plana Cay, Bahamas.

STATUS

This once widely distributed and plentiful family is now failing. Of the 30 or so known recent taxa, more than half are already extinct, and the remainder all suffer from habitat alteration, predation by introduced animals, and hunting by man. With the exception of the Cuban hutia, all species are included on the list of the world's threatened mammals.

HABITAT AND ENVIRONMENT

Hutia ranges have been so reduced that these animals survive only in the most inaccessible forests and rocky drylands. Both the Cuban and the Jamaican hutias occur in a variety of habitats from montane cloud forests to arid coastal semideserts.

BIOLOGY

Most species are terrestrial, but some live in trees. The Cuban and Jamaican species are terrestrial, but they can climb trees if circumstances demand. They maneuver well on trunks and larger branches, descending head first like squirrels.

Hutias are primarily vegetarian, their diets consisting of leaves, bark, fruits, and

twigs, as well as incidental catches of small animals such as lizards and invertebrates.

Hutias seem to breed year-round, generally giving birth to litters of 1-4 offspring after a gestation period of 16-20 weeks. The young are well developed at birth, fully haired, open eyed, and capable of most adult movements. After 10 days they begin taking solid food, although they are not fully weaned for at least a month and a half (5 months for the Cuban hutia). Sexual maturity is at 10 months; life expectancy is 8-11 years in captivity.

The Jamaican hutia has one of the highest diploid chromosome numbers ($2n = 88$) of any mammal.

BEHAVIOR

Most hutias are wary and secretive and are easily displaced by human encroachment. They live like rabbits, hiding among tangled vegetation, in holes, and among rocks - communicating by voice and scent markings. They build shelters mainly in rock crevices, but also in the base of thick bushes or in natural cavities in trees. The Cuban hutia is often diurnal, whereas the Jamaican hutia is largely nocturnal.

HISPANIOLAN HUTIA

The Hispaniolan hutia, or zagouti (*Plagiodontia aedium*) as it is known in Haiti is smaller than the two Capromyids discussed here, weighing just 1.2 kg. It is difficult to breed in captivity and has a lower reproductive rate than either the Jamaican or Cuban hutia. It is therefore less suitable as an economic or food

source.

However, there is a significant need for supplemental protein sources in both Haiti and the Dominican Republic. It might be possible to develop a special captive-breeding program for this animal, but it should be done with great care. It is important that a hunting tradition for this animal not be reestablished in rural areas of Haiti or the Dominican Republic, and that local organizations not be misled into believing that there will be a rapid increase in the numbers of this species in captivity.

USES

Hutia meat is relished, especially in Jamaica. The animals are still hunted, often by using dogs that smell them out and retrieve them from a hole or hold them at bay in treetops.

HUSBANDRY

Experiences of zoos suggest that the Cuban and Jamaican hutias will thrive in captivity. The animals are generally long-lived and have survived up to 17 years. They are often friendly with their keepers and, when tame, can be held and carried about without any particular danger. However, if angered they can inflict deep bites and should normally be handled with considerable caution.

ADVANTAGES

These animals are already much in demand. Their meat has an excellent flavor and they are big enough to provide a worthwhile quantity. If husbandry could be

developed on a sustainable basis, it could be used as a mechanism for both economic development and for saving the remnant populations.

LIMITATIONS

Wild populations are threatened. Any captive population must be built up without endangering them.

All hutias are susceptible to predation by domestic cats, mongooses, dogs, and human poachers, so care must be taken to design predator-proof breeding facilities.

These animals are carriers of eastern equine encephalomyelitis, a serious disease of horses.

RESEARCH AND CONSERVATION NEEDS

Hutias deserve urgent conservation attention. In particular, the following steps should be taken:

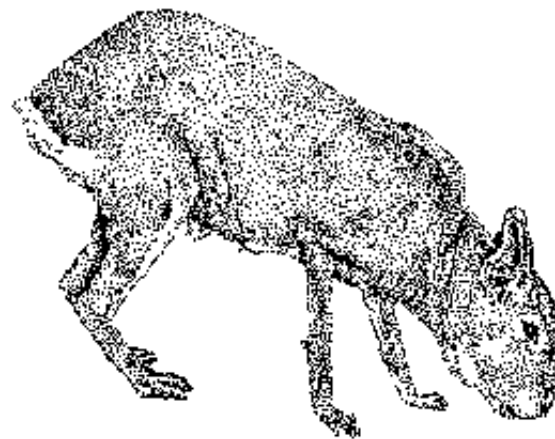
- Establish reserves in natural habitats containing breeding populations to ensure the survival of the genetic diversity of these animals.**
- Build up breeding populations in suitable zoos and livestock research centers.**
- Gather specimens from different regions for comparative evaluation.**
- Investigate hutia biology, including chromosome type, reproductive physiology,**

nutrition, and diseases.

- **Assess experiences of zoos.**
- **Perform captive breeding trials, measuring growth rates, space requirements, food needs, and social behavior (both in its wild state and under controlled conditions).**
- **Study the social organization and tameability.**

Colonies of some species could be established on uninhabited islands, as has been done with the Bahamian hutia *Geocapromys ingrahami*. Even this rare species might eventually be raised to yield meat for local inhabitants, as it is well adapted to dry and barren environments and was a regular food of the pre-Columbian Indians.

22 Mara



FIGURE

Many wild relatives of the guinea pig are native to South America. Some, such as the guinea pig itself, are small; others, such as the mare, are much bigger. Maras1 (Dolichotis patagonum) are as tall as terriers and, at first glance, look like dwarf antelopes or huge hares. They have large ears and eyes, long legs, and short tails. They generally behave like hares or wild rabbits, but, like deer, they run with a stiff-legged gait when pursued by predators.

These strange-looking creatures are found in temperate regions in the southern half of South America. They are dry-country animals, living on the thorn-scrub, desert plains of Argentina and the stony wastes of Patagonia.

Although exceedingly shy, restless, and watchful, mares tame easily, make good pets, and are much favored by the local populace. They were introduced to France last century, and in Victorian times Europeans sometimes bred them. These big, handsome rodents, grazing in little herds, were considered an attractive addition to the lawns of country estates.

POTENTIAL AREA OF USE

Maras are best kept in their native region of southern South America. With care, however, they could be used in other areas because they are slow breeders and their population growth is easy to control.

APPEARANCE AND SIZE

At first sight, these large rodents look like some weird hybrid. They have the long ears of a hare and the tidy body and spindly legs of a small antelope. Although related to guinea pigs, they are long legged. The tail is short; the ears are long and

erect.

Average-size mares weigh about 8 kg, but large ones can be 1 m long and weigh up to 16 kg.2 Females are larger than males. The coat is light in color, with grey upper parts and whitish underparts. The limbs and feet are tinged a yellowish brown. The pelage is dense, with individual hairs standing at nearly right angles to the skin. This gives a harsh texture, even though the hairs are soft and fine.

These animals can hop, walk, gallop, or run. They are extremely swift and can reach 45 km per hour over long distances. They are also accomplished jumpers, often leaping 2 m high from a standing start. The feet are compact and rather hooflike, but with sharp claws. The hind foot has three digits; the front foot has four.

DISTRIBUTION

The mare's range in the thorn-scrub desert and Patagonian steppe of Argentina extends from about 28°S to 50°S.

STATUS

Endangered. These animals, once plentiful, are now threatened because of the introduction of the European hare, which is more successful at competing for food. In many of the eastern parts of its distribution (see map) it is now extinct.

HABITAT AND ENVIRONMENT

Maras inhabit open, dry plains and other treeless semidesert areas of coarse grass

or scattered shrubs.

BIOLOGY

Maras are pure vegetarians. They feed on short grasses and herbs that are sparsely distributed between patches of dry desert scrub. Usually, they are satisfied with a few coarse weeds and the shoots of bushes. However, their overall diet consists of any available vegetation: leaves, roots, fruits, and stems.

Female mares become sexually receptive within a few hours after giving birth. The estrous cycle is 35 days, plus or minus 5 days.³ The gestation period is 77 days. Each female gives birth to 1-3 young at the mouth of the den; the pups crawl inside to safety. Newborns are well developed, and within a few hours they begin grazing vegetation. They remain in the vicinity of the den for up to 4 months.

Initially, at least, the young are nervous and easily frightened.

BEHAVIOR

Maras shelter in a burrow that they either construct for themselves or "borrow" from another animal that has abandoned it. They are active during the day and spend considerable time basking in the sun. They are always alert for danger. When alarmed, they flee at high speed. The white rump patch flashes a warning to the others, who then follow this "flag."

A fundamental element of their social system is the monogamous pair bond. Certainly in captivity, and probably in the wild as well, the bond between a pair lasts for life. When breeding, 20 or more pairs may band together temporarily to

share a single den for the pups.4

The animals stand on straight legs, sit on bent haunches with the forepart of the body resting on the fully extended front legs, or recline in a catlike position with the front legs folded under the chest, an unusual position for a rodent. They travel in single file, with the female usually leading. Members of a pair maintain contact by means of a low grumble. Although the long legs can quickly carry it to safety, a mare usually stops every 20-30 m and turns to peer at its pursuer.

The animals clean themselves by licking their sides and apparently by "combing" their fur with their teeth. They wipe their faces as cats do, with the inside of a foreleg.



The mara's native range

USES

Although the light-colored meat is said to be dry and flavorless, it is widely consumed in South America.

HUSBANDRY

Maras have been successfully raised and bred in many zoos, and, as noted, have been kept as pets.

Adults make little use of any shelter; they seem fond of being out and about in all weather. As long as they have a protected burrow for the use of the pups, mare populations can thrive in severe climates.

In zoos, diets include straw, vegetables, and crushed oats. Drinking water is supplied, although the animals rarely take it if they are feeding on fresh plant materials. They like to have salt blocks, however.

In South America, one mare lived in captivity for almost 14 years; most specimens do not live beyond 10 years.

ADVANTAGES

Maras are a good size for microlivestock. They have a short gestation period, and they are social and easy to maintain in groups. They can be successfully kept in pens and can be fed relatively low-quality forage. Colonies can grow to be quite large.

LIMITATIONS

These animals can easily dig under the edges of cages and escape. Extra-deep foundations are needed.

Following heavy rains, care must be taken to keep them from drowning in their subterranean burrows.

If suddenly disturbed, mares can become hysterical, leaping away regardless of anything in the way, and often seriously injuring or even killing themselves as a result. They fear bodily contact.

The mare's monogamous nature in the wild is a likely limitation. But perhaps, like chinchillas, the animal will become polygamous in captivity.

The animals are sensitive to tuberculosis when kept in humid conditions.

RESEARCH AND CONSERVATION NEEDS

Research needs to increase understanding of the mare include:

- Nutritional trials;**
- Husbandry experiments - measurements of growth rates, space requirements, feed needs;**
- Productivity tests;**
- Grazing-efficiency measurements;**

- **Exploration of commercial details; and**
- **Determination of diseases and parasites.**

23 Paca

Pacas (Agouti paca)^{1,2} are large, white-spotted, almost tailless rodents with the potential to become a source of protein for the American tropics. They are found in lowlands from Mexico to northern Argentina. The meat is white and is considered the best of all Latin American game meat. It is common in local markets and restaurants. Tasting like a combination of pork and chicken, it sells at higher prices than beef and is a regular item of diet in some areas. In Costa Rica, paca is served on special occasions such as weddings or baptisms. It has a higher fat content than the lean meat of agoutis, rabbits, and chickens, and has no gamey taste.

Paca has promise as a microlivestock. In several countries, Belize and Mexico for example, people already keep them in cages beside their homes and fatten them on kitchen scraps. In Costa Rica, some are bred on farms, under houses, and even in apartments. Research on raising paces in captivity is under way at the Universidad Nacional in Heredia, Costa Rica; at the Smithsonian Tropical Research Institute in Balboa, Panama (see page 196); and at the Instituto de Historia Natural in Tuxtla Gutierrez, Mexico. In Turrialba, Costa Rica, an entrepreneur is already breeding and raising paca commercially.

While the paca has potential as a food source, many problems still must be resolved before it can be recommended for mass rearing. If solved, however, this

species would become an attractive microlivestock.

AREA OF POTENTIAL USE

The pace has potential for use throughout its vast geographical range in Latin America.

APPEARANCE AND SIZE

In general appearance, paces are somewhat like giant guinea pigs. The legs are short, the forefeet have four "fingers," and the hindfeet have five small, hooflike "toes." The feet are partially webbed and are adapted both for digging and for swimming. Pacas burrow with all four feet as well as their teeth; even large roots are no obstacle.

Adults weigh 6-14 kg, males being somewhat larger than females. Although they may become bulbously fat, paces remain "one of the fastest things on four feet." From a standing start, even a fat specimen can jump at least 1 m off the ground. Pacas are also agile. However, their skin's epidermal layer is thin and fragile, and large strips may be ripped off as they rush headlong through spiky undergrowth. However, such wounds heal astonishingly fast - frequently within days.

Pacas are chocolate brown in color. The head is somewhat lighter in shade than the body, and the underparts are whitish or buff colored. There are usually four longitudinal rows of white spots that may merge into stripes along each side of the body. The fur is coarse, spiny, and slippery, and has no underwool. Each hair is stiff, relatively sharp, and very smooth, which makes paces extremely difficult for predators to hang on to.

Parts of the cheekbones are enlarged, and the cheeks can open to form special pouches. This is more developed in adult males than in females - indeed, adults can be readily sexed by head shape. The pouches are outside of the mouth and are fully haired. The animals use them mainly to create a resonating chamber for their booming bark and noisy tooth grinding. These enlarged cheeks push the large bulging eyes toward the top of the skull. The eyes are suited for nocturnal conditions, the senses of smell and hearing are uncannily acute, and there is an array of long whiskers that is used when maneuvering at night.

DISTRIBUTION

Lowland paces are found throughout most of Latin America from east central Mexico to northern Paraguay, Argentina, and Minas Gerais, Brazil. This includes all of Central America and most of Colombia, Ecuador, Peru, Venezuela, and the Guianas. The animal has also been introduced into Cuba.



The paca's native range

STATUS

Burgeoning human populations are severely reducing many of Latin America's native animal resources, and the paca is one of the most persecuted. It has been exterminated within hunting range of virtually all cities, towns, and villages.

Several governments, recognizing the paca's plight, have passed laws prohibiting the hunting and marketing of its meat. Nevertheless, people continue to take it, usually at night, using trail dogs and headlights.

HABITAT AND ENVIRONMENT

Pacas thrive in a variety of tropical habitats but are most common in forests, swamps, and partly cleared grazing lands. They inhabit most types of forests from deciduous woodland to rainforest. Usually, they stay near streams or rivers, but they often live where there is no permanent water. They are abundant only in little-disturbed forest areas. Although preferring low, dense tree cover, paces sometimes inhabit open rocky areas and farmland.

BIOLOGY

These herbivores feed mainly on fruits, young seedlings, and some seeds. However, when fruits are scarce they may switch to browsing leaves and roots. They probably sometimes eat large insects, and, on rare occasion, may perhaps eat small vertebrates. Captive paces, like many other "frugivores," seem to develop a protein deficiency and will eagerly eat meat scraps on occasion.

The young are usually born singly after a gestation period of 146 days. There are probably 2 births a year. Females have an estrous period that begins shortly after giving birth. If mating does not take place at this time, the female becomes unreceptive until after the 3-month (sometimes 4- to 6-month) lactation is over. The length of the estrous cycle is 30 days.

During daylight hours, paces seclude themselves in brushy cover, in or under fallen logs, or in extensive underground burrows. The burrows, which may be several meters long, are dug in moist soil or taken over from other animals; they are often in river banks, on slopes, among tree roots, or under rocks. Usually, several exits are provided, often being plugged with leaves as a disguise.

BEHAVIOR

In the wild, paces dig large holes and rummage about the forest floor at night, gnawing on fruits. Pairs inhabit a defended area, sometimes living together in the same burrow, sometimes not. Also, they usually travel alone, following paths that lead to feeding grounds and water. Individual home ranges are small (1-3 hectares).

Although paces are terrestrial, they enter water freely, they swim well, they copulate in water, and, when alarmed, they generally attempt to escape by swimming. They are also lively and playful; however, they can be exceedingly obstinate. Sometimes fighting among themselves becomes very savage. When angered they growl, sometimes noisily, and they can suddenly jump on aggressors, real or imagined, delivering frightful wounds with their chisel-like front teeth thrust forward like a spear.

USES

As noted, pace meat is tasty and brings high prices in the markets. It is considered a delicacy in fine restaurants and was served to Queen Elizabeth during her October 1985 visit to Belize. In Mexico, paces, like pigs, are usually boiled unskinned. Even the skin is then edible.

HUSBANDRY

If treated appropriately when young, paces become manageable. They undergo "imprinting," a characteristic of most species that have been domesticated. An imprinted pace becomes so tame that it seeks out human company, follows people

around like an amiable dog and, if turned out of its cage, returns voluntarily. (To achieve this degree of tameness it is necessary to remove the animal from its mother at an early age.)

Although wild paces are almost entirely nocturnal, tame paces are more active during daylight hours.

Young or partly grown paces are commonly exhibited in zoos. They eat prodigious quantities of almost any vegetation and have been called, "a good substitute for a large garbage pail." Diets can include rolled oats, raw vegetables, bananas, apples, and bread. They probably need additional protein occasionally, and seem to appreciate some fat in their diet.

ADVANTAGES

If husbandry can be developed, the clamor for pace meat throughout tropical America would be a big economic incentive for farming these animals. The excellence and wide acceptance of the meat is an indication that pace farming would be taken up both in rural and urban areas and by many levels of society.

LIMITATIONS

Pacas can harbor human diseases, including leishmaniasis and Chagas' disease.

Apart from the project in Panama (see page 194), paces have bred only sporadically in captivity, with few offspring surviving. However, successes have been recorded in zoos in London, San Diego, and Washington, D.C., and in a research project in Tuxtla Gutierrez, Mexico. In Costa Rica, they are also

reportedly breeding well, with a survival rate of 90 percent since 1982, and 80 percent of the females are reproducing.³

All adult paces can be aggressive and dangerous. Their powerful incisors can inflict serious wounds. (They can even rip through planks.) Intraspecific aggression is one of the most serious impediments to captive breeding.

Unlike the capybara, the pace not only has a long gestation but usually bears a single young. Thus, the output of a single breeding female may be, at best, two offspring per year (at least this is the expected production in the wild). This "slow" breeding is a limitation. In captivity, however, there is a possibility that it can be speeded up.⁴ The fact that paces bond together in pairs is a limitation. If every female has to be accompanied by a male, then many (otherwise unnecessary) males have to be fed and maintained.

Male paces are considered difficult to keep as household pets because they spray females (or human substitutes) with a mixture of urine and glandular secretions. This can occur several times a day. In addition, they have anal glands that produce a musky odor that some people find objectionable.

RESEARCH AND CONSERVATION NEEDS

Although paces are common in some areas over the vast region from Mexico to Argentina, they are little understood, even by zoologists. In fact, most data concerning this animal have come from interviews with local hunters. Intensive field work is needed to develop an understanding of the pace's biology, status, and habitat requirements.

The popularity of pace meat makes it urgent to start this work as well as to begin breeding paces on an organized basis. Such projects would lay the groundwork for preserving the species.

Particular research needs concern the following:

- Age structure and reproductive performance;**
- Growth rates and feeding habits;**
- Behavioral patterns in captivity;**
- Nutritional requirements;**
- Meat quality;**
- Helminth and arthropod parasites;**
- Role in transmitting or perpetuating diseases;**
- Reproduction (such as external manifestations of estrus in females); and**
- Genetic variations that would allow the selection of animals adapted to captivity and females that produce multiple offspring - twins, triplets, or more.**

Ways must be found to introduce more than one female to each male without inciting aggression.

24 Vizcacha



FIGURE

Vizcachas (*Lagostomus maximus*) are soft-furred South American rodents that look like long-tailed guinea pigs. They can weigh as much as 8 kg and are resilient animals, inhabiting dry pampas and shrub lands in northern Argentina and neighboring countries. They seem to have promise for producing meat and hides in marginal zones within their native habitat.

Like chinchillas, these rodents provide a prized furry pelt. They also provide meat that reportedly tastes "as good as hare," which in Europe is considered the epitome of dining. They are easily trapped alive in cheap, homemade, multiple-catch, funnel traps. And they are thought to be suitable for farming on a large scale.

On the other hand, vizcachas are currently considered pests because they take grazing from cattle and sheep and because they build large burrows that undermine the land. Government campaigns have eradicated them in the richer agricultural areas of Argentina, but the animals are still common in marginal

zones. There is evidence that they become more abundant when domestic livestock overgraze the land. In impoverished marginal sites, where other livestock enterprises are unsuitable, the potential exists for game-ranching vizcachas.

AREA OF POTENTIAL USE

Because of the potential hazard to new areas, vizcachas can be used only in the pampas regions of southern South America where they are already widespread.

APPEARANCE AND SIZE

Vizcachas have short front legs, long, muscular hind legs, and round eyes and ears. Their heads seem oversized in proportion to their bodies. Males weigh 5-8 kg, females 2-4.5 kg.

Members of the same rodent subfamily as the chinchilla, they have a thick, soft, valuable fur that is grey or brown above, whitish or greyish below. They are, however, much larger than chinchillas.

Although basically running animals, vizcachas often jump bipedally (like kangaroos), and they sit erect while eating or grooming. The forefeet have four long flexible digits used to grasp food. Their soles and palms are naked and have fleshy pads (pallipes).

DISTRIBUTION

Vizcachas once swarmed widely over the savannas of southern Paraguay, Bolivia,

and Argentina, but they are being systematically exterminated. Today they inhabit isolated areas of north, central, and western Argentina and southern Paraguay.

STATUS

Since 1907, these animals have been mercilessly hunted. The governments of the Argentine provinces where they are mostly found, reward hunters for killing this "pest." However, the numbers are so reduced that now there is no need for a bounty system.

HABITAT AND ENVIRONMENT

Vizcachas live in flat, dry, steppelike plains; in dry woodland (Chaco), and in low mountains.

BIOLOGY

The fact that these rodents eat their own droppings (coprophagy) augments their ability to utilize natural forages, and allows them to abound in degraded zones. They feed on any plant materials they can find near their colonies, particularly grasses. In feeding trials, their daily dry matter intake was 2-5 percent of the body weight. The metabolic efficiency (dry matter per kg) was 33-56 percent; the digestive efficiency was 50-60 percent.²

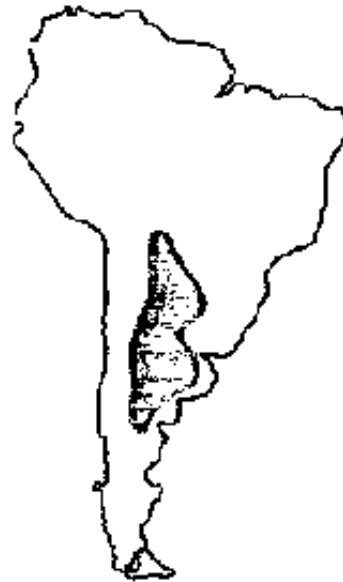
Male vizcachas become sexually mature at about seven months of age and remain fertile throughout the year. The gestation period is long: 154 days. Litters contain one or two young. Newborns are well developed, fully furred, and open eyed, although they cannot fend for themselves for at least three weeks. In the wild, one

or two litters are reared each year.

BEHAVIOR

Vizcachas are nocturnal and are active year-round. They inhabit underground burrows, living in colonies often containing many individuals. They collect a variety of materials (for example, bones, sticks, and stones), and heap them in piles above the entrances to their burrows.

Their hearing and sense of smell are acute.



Vizcacha's native range

USES

Vizcachas have long been hunted for food as well as for their fur. Their meat is

often consumed in pickled form in southern South America.

The skins are fabricated into table runners, rugs, bedspreads, slippers, and belts. The skins are also popular for overcoats.

Vizcachas can be kept in captivity without major difficulty.

HUSBANDRY

In zoos, vizcachas are fed the typical diets furnished for vegetarian rodents: rolled oats, green vegetables, bananas, apples, and bread. They are usually kept indoors in wire-fronted cages, about 1 x 2 m in size, and provided with sleeping boxes.

Little is known about vizcacha husbandry, but in one trial, weight rose most rapidly in males until age 18 months (the average size was then 5.3 kg) and subsequently slowed. The heaviest male was 7.3 kg at 30-32 months. The female's weight gain was greatest until 16-18 months (average size 3.3 kg).³

ADVANTAGES

The animals seem well adapted to harsh sites where the climate and forage make raising conventional livestock difficult.

The meat is white and has a good nutritive value because of its high digestibility, low levels of saturated fats, and high levels of proteins.

In marginal zones of the pampas, these rodents appear far more productive than traditional livestock.⁴

LIMITATIONS

Vizcachas may do considerable damage by foraging in cultivated crops. As noted, ranchers claim that they take grazing away from domestic animals, 10 vizcachas eating as much as a sheep. In addition, they claim, vizcachas destroy pasture with their acidic urine. And the large burrow systems sometimes create a hazard.

Because their reproductive rate is low and their growth rate is only moderate, their commercial breeding might not be profitable except in well-designed projects with clear markets.

Vizcachas require sturdy pens, which implies a high initial cost for materials such as concrete and brick.

Vizcachas can be aggressive to one another, especially in captivity.

RESEARCH AND CONSERVATION NEEDS

There are several possible research projects, including:

- Gathering specimens from different regions for comparative evaluation of characters such as biology, chromosome type, reproductive physiology, social behavior (both in its wild state and under controlled conditions);**
- Attempting captive rearing and small-scale husbandry;**
- Assessing performance under various environments; and**

- Quantifying productivity and population dynamics in relation to rangeland use and improvement practices.

A rational cropping program based on wild stocks is perhaps more viable than captive breeding. This could be organized so as to keep vizcacha numbers in check while sustaining a small chain of processing plants by providing a constant supply of meat and skins.

25 Other Rodents

The 10 previous chapters have described some rodent species that show promise as microlivestock. Rodentia, however, is one of the largest families of mammals, and the species highlighted by no means exhaust the possibilities. In this chapter we briefly mention others that deserve consideration and exploratory research. These might prove to be potential resources, at least in localized situations. Several are fast nearing extinction and they deserve protection and immediate attention from animal scientists.

CHINCHILLAS

In the high Andes of South America are found the short-tailed chinchilla (*Chinchilla brevicaudata*) and the long-tailed chinchilla (*Chinchilla lanigera*). These plump little rodents have fur that is possibly the thickest, softest, and warmest of any animal's.

On the surface they would seem to be ideal candidates for microlivestock in Third World regions. Indeed, in recent years chinchilla-rearing has been successfully carried out in northern India. However, raising these animals for commercial

markets is a highly specialized and costly business because only rare and expensive breeding stock produces top-quality pelts, and all other pelts are worthless in today's marketplace.

These guinea-pig-sized animals have round ears, a bushy tail, and range from 25 to 50 cm long. Adult males rarely weigh more than 500 g, but females may weigh up to 800 g.

PACARANA

The pacarana (*Dinomys branickii*) is the third-largest living rodent- only capybaras and some beavers are larger. But little is known about this seldom-encountered, forest-dwelling species. Nevertheless, pacaranas appear to be likely candidates for domestication. They are amazingly even-tempered and peaceful, and become surprisingly tame.

Because these animals are endangered they are unlikely candidates for microlivestock in the short run, but their large size and good meat could be the stimulus for an international effort to study, protect, and rear them in large numbers before it is too late.

Pacaranas are found along the eastern foothills of the Andes, including parts of Bolivia, Brazil, Colombia, Ecuador, and Peru. Their area of potential use is in Latin America and the Caribbean.

It would be advantageous for livestock scientists to investigate this species in captivity. Studies are needed of the animal's general biology, including its nutritional requirements, reproductive capacity, behavior, and physiology. For

wildlife specialists, there is a compelling need to protect this species.

SPRINGHARE

Scattered through the dry lands of eastern and southern Africa - on numerous grasslands, plains, fossil lake beds, hill slopes, and floodplains - is the springhare (or springhaas). With its powerful hind legs, tiny forelegs, upright stance, and hopping gait, it looks something like a tiny kangaroo. It is commonly seen at night, eyes glowing a characteristic red in the headlights.

This animal is an important source of food and skins for rural peoples throughout southern Africa. In Botswana, it is the principal bushmeat in the human diet.

Springhares are 35-40 cm long and weigh 3-4 kg. There is one species (Pedetes capensis) and two subspecies: the East African springhare and the Cape springhare (formerly Pedetes cafer).

ROCK CAVY

The rock cavy (Kerodon rupestris) is closely related to the guinea pig and occurs in the impoverished semiarid region of northeastern Brazil. It is large and lean and has a face somewhat resembling a dog's. It is hunted extensively and is an important source of meat for country people, who consider it a delicacy.

This creature might be suitable as a microlivestock. It consumes leaves and bark, and breeds well in captivity. Famine is a serious periodic problem in the often-drought-stricken area, and protein deficiency is common. The rock cavy, like the guinea pig, may be amenable to domestication and may be able to provide the

people with better nutrition. However, it is difficult to keep in a cage because it moves fast, climbs well, and easily slips out.

Because these rodents occur in rare and patchily distributed habitats, they are in desperate need of protection, whether or not they prove to have any long-term utility.

SALT-DESERT CAVY

A smaller relative of the mare (page 256), the salt-desert cavy (*Dolichotis salinicola*) is rabbitlike in appearance and behavior. It has large ears and eyes, long legs, and a short tail. It lacks the mare's white rump patch.

This animal inhabits dry, salty areas of the Chaco desert, particularly areas of dry, woody brush. Specifically, it is found in the saline western Chaco of Paraguay and northwestern Argentina, as well as in the extreme south of Bolivia. It is about 45 cm long and weighs up to 4 kg.

Although it might make a useful microlivestock in its native habitat, the salt-desert cavy breeds rapidly and can cause much devastation; it should never be introduced to new regions.

The salt-desert cavy's life in the wild is largely unknown; however, some have been successfully raised and bred in zoos. Exploratory research on keeping and managing these little creatures is warranted.

OTHERS

As noted earlier (page 193), it has been estimated that 42 peoples of various cultures eat rodents. Most of these eat locally available species, some of which are listed below. Whether any have long-term usefulness is uncertain, but study of them in the wild and in captivity could result in some interesting and valuable scientific discoveries.

Solomon Islands Rodents

The Solomon Islands in the southwest Pacific are home to a collection of six rare giant rodents that live in the rainforest canopy. At one time they were important food items. Archeologists have dug up tens of thousands of rodent bones on sites where people lived as long as 30,000 years ago. These mysterious animals were classified last century, but most have not been seen by biologists for decades. However, one, the thinking rat (*Solomys sapientis*), was rediscovered in 1987 - the first time it had been reported seen since 1901. The others may also be inhabiting the dense and undisturbed forests.'

The thinking rat was located on the island of Santa Isabel. It proved to be gentle, unafraid, and friendly. It lives in the forest canopy, weighs up to 1 kg, and feeds on nuts and fruits. Efforts to build up the population are urgently needed. The other species should also be sought.

Such animals could be a resource for rainforest production (perhaps in the manner of butterfly farming in Papua New Guinea²). They may never be plentiful enough to be food sources again, but they could nonetheless become valuable. Zoos the world over are likely first customers for these scientific curiosities if production can be boosted and the populations secured.

Giant New Guinea Rat

The giant New Guinea rat (*Mallomys rothschildi*) is often eaten in New Guinea. It is little known to science but is odorless and easily tamed. It grows so fast that it becomes as big as a guinea pig even before it is weaned. It feeds on a wide variety of tubers and vegetable products. An attractive species native to mountain forests, it has a long heavy tail and black fur with white ticking.

Porcupines

Porcupines, brush-tailed porcupines, and their relatives are distantly related to guinea pigs and are widely consumed as food in tropical regions. Examples are:

- Indian porcupine (*Hystrix indica*) and other species of South Asia.**
- Cape porcupine (*H. africae australis*) of southern Africa.**
- Prehensile-tailed porcupine (*Coendou prehensilis*), which inhabits Central and South America. These nocturnal creatures live in the thick, leafy crowns of trees or in hollow trees or holes in the ground. Although often belligerent among themselves, they can be very friendly and tame toward humans.**

Kiore

The kiore (*Rattus exulans*) was formerly an important component of the diet of most Polynesians, including the Maoris of New Zealand. It has been successfully reared in captivity in recent times. Unlike many other rodents, this animal is normally not a scavenger; it is a clean, even fastidious feeder that is basically a

vegetarian (flowers, berries, nuts, and seeds) and is reckoned remarkably good eating.

Soft-Furred Rat

The soft-furred rat (*Praomys*) is relatively large and slender and is found in the tropical forests of Africa from sea level to more than 3,000 m. Among the most common rodents of the African jungle, it is trapped almost everywhere. It feeds largely on plants, but eats large quantities of ants and other insects. It has been raised successfully in captivity and is eaten by villagers in Malawi.

Giant Squirrels

The giant squirrel (*Ratufa bicolor*) occurs throughout Indonesia, Malaysia, and Sri Lanka. It is the largest squirrel on earth, almost the size of a cat. A related species, the palm squirrel (*Funambulus*), also gets very large. It can crop nuts in the very high treetops that are inaccessible to people. It is widely used as food.

Squirrels

Squirrels of the genus *Callosciurus* (notably *C. notatus* and *C. prevostii*) are significant pests on cocoa, oil palm, and mixed fruit plantations in Southeast Asia. They can be reared and bred on a diet of most types of fruit as long as a little protein, in the form of insects or cooked wheat, is available. The systematic use of this animal may offer a chance to turn a pest to advantage.

Cloud Rat

Two species of slender-tailed cloud rats (*Phlocomys* spp.) are found only in southeastern Asia. They live in tree cavities, climb well, and are well adapted to tree life.

One of these (*P. cumingi*) lives in the northeastern part of Luzon in the Philippines, where it appears to be thriving. It has a large body and long tail and is the largest member of the mouse subfamily.

The other (*Crateromys schadenbergi*) has long, thick hair and a thick, bushy tail. It lives in the mountainous areas of northern Luzon. A nocturnal animal, it feeds on buds, bark, and fruits.

Both are attractive, even fascinating, creatures that are relentlessly hunted for food. They might make useful livestock in forest situations.

Spiny Rat

The Cayenne spiny rat (*Proechimys guyannensis*) is found throughout most of South America. It is tasty, easily kept in captivity, and is popularly used in Colombia for food. A nocturnal animal, it is one of the most common mammals in many areas. It has been raised in captivity on bananas, sweet corn, coconut, grain, and various seeds.³

Bamboo Rat

The bamboo rat (*Rhizomys* spp.) is the largest rodent on the island of Sumatra in Indonesia; it weighs 2-4 kg and the body can be as long as 45 cm. It prefers to live in bamboo thickets and is hunted and eaten by many local peoples.

There is a need - in considering any sort of game farming - to relate the animal's "preferred" conditions (range, feed, temperature, etc.) to the varying land and climate types not being effectively utilized. In other words, rather than looking at animals that might be farmed, it might be necessary to consider the terrain and climate and then seek animals that would "do" well under those conditions. One major fault with traditional farming has been the tendency to force traditional livestock onto unsuitable land. This has given rise to numerous serious problems. In many cases the most suitable use of an area is provided by several species grazing together to mutual benefit (e.g., goats and sheep on New Zealand hill country improve grazing for each other if ratios are right).

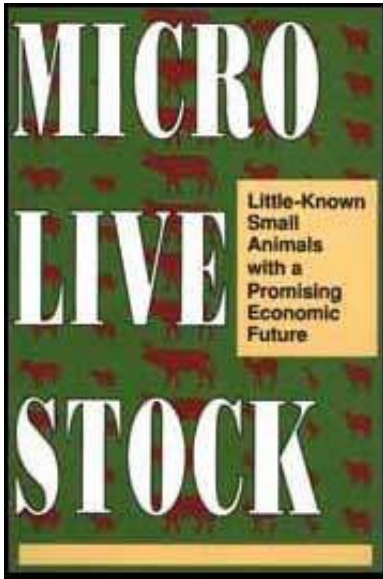
David Yerex











FIGURE

 **Micro-livestock: Little-known Small Animals with a Promising Economic Future (BOSTID, 1991, 435 p.)**

  **Part V : Deer and Antelope**



-  **(introduction...)**
-  **26 Mouse Deer**
-  **27 Muntjac**
-  **28 Musk Deer**
-  **29 South America's Microdeer**
-  **30 Water Deer**
-  **31 Duikers**
-  **32 Other Small Antelope**

Micro-livestock: Little-known Small Animals with a Promising Economic Future (BOSTID, 1991, 435 p.)

Part V : Deer and Antelope

Several types of tropical deer' and antelope are no bigger than an average-size dog. These "microdeer" and "microantelope"² are the smallest of all ruminants. Although there is considerable experience with rearing and utilizing the larger species, little is known about these miniature ones.

Given research, mouse deer, muntjac, musk deer, pudu, brocket, huemul, and water deer, as well as half a dozen small antelope, might prove to have considerable potential. Collectively, they come from diverse habitats, ranging from equatorial to subarctic and from moist rainforest to arid savanna. They are adapted to some environmental conditions that are only marginal for production of

conventional livestock because of drought, heat, diseases, altitude, or other constraints.

DEER FARMING

Deer appear to be unlikely candidates for livestock, but reindeer were probably among the first domesticated animals and have been draft animals for perhaps 20,000 years. Even today, tens of thousands of reindeer pull sleighs in the European arctic. On military expeditions, the ancient Romans took along herds of fallow deer as a source of meat, and more than 1,000 years ago deer were annually herded off the Scottish Highlands for winter meat supplies.

In recent years, there have been breakthroughs in the "domestication" of deer. Species already being [armed are: red deer (New Zealand, Australia, Taiwan, Korea, Russia, China, Scotland, the United States), elk (New Zealand, Canada, the United States), fallow deer (New Zealand, Australia, England, Denmark, Sweden, Switzerland, Germany, the United States), ruse deer (Australia, Mauritius, New Zealand, Papua New Guinea), sika deer (Taiwan, New Zealand), musk deer (China, India), and PFre David's deer (New Zealand). Although not truly domesticated, even the moose has been tamed in Scandinavia and the Soviet Union, the calves being bottle-raised from three days of age.

New Zealand has made particular progress in domesticating large deer (see sidebar). It seems probable, therefore, that similar success with small deer could be achieved. For those seeking interesting, pioneering research, microdeer are good candidates.

ANTELOPE RANCHING AND FARMING

The worldwide experiences in domesticating various deer species suggest that the organized production of small antelope should also be considered. Several large species have already been studied and are used in game farming in eastern and southern Africa. Similar research on the smaller species, which so far have received little or no attention, is one of the more speculative ideas in this report. We put it forward only for consideration by researchers, but if exploratory studies prove successful, this is a topic deserving international support.

In some parts of Africa there are large expanses of uninhabited lands, and producing any sort of livestock there is limited by aridity and by the presence of tsetse flies. But in this habitat live tiny antelope such as dikdik, suni, and klipspringer. In the rainforests and secondary forests are found duikers and the royal antelope. All these creatures have advantages that justify their consideration as microlivestock: they have a more rapid turnover than the big species, and they produce a high yield of quality meat. In addition, compared with cattle, these native ungulates make better use of the habitat. Cattle select a limited number of grass species; antelopes choose a wider range, and also include forbes, bushes, and trees.

More important perhaps is their resistance to many diseases. Most, if not all, are resistant to trypanosomiasis, the disease carried by the tsetse fly. They are not immune to this and other tropical diseases, but they are less susceptible than cattle. However, part of this may be owing to their ability to roam widely; if confined and treated like domestic animals, they may also require some protection against parasites and diseases.

Antelopes are also more productive than cattle; that is, they produce a given quantity of meat more quickly because they breed better in the African hinterlands and grow more rapidly on its existing forages. On the other hand, they generally require a richer diet than cattle.

Finally, in their favor, antelopes affect the habitat less than the same density of cattle does; they spread out more while feeding and thereby cause less erosion.

There are two ways of exploiting this potential. One is by "cropping"-taking a controlled offtake from free-ranging populations without depressing the overall population. Several methods for producing meat this way from large antelope have been attempted in countries such as Kenya, Tanzania, and Mozambique. Few have persisted. Often this has been due to opposition from the vested interests of the cattle industry and from stringent veterinary requirements. Nonetheless, game ranching offers a means by which marginal lands could produce food of a high nutritional quality on a sustained basis.

The other method is by farming - that is, domesticating or partially domesticating the animals, keeping them in pens or herding them like cattle. Experiments in farming antelopes have been less common than game ranching, but one of the most interesting is that conducted on the Galana Ranch in Kenya. Three wild species - buffalo, eland, and oryx - were selected for comparison with cattle. Half-grown animals were preferred for capture, and it was found that if they were kept in the dark for the first week after capture, and then gradually provided with more and more space while they became familiar with people, after about six weeks they could be released into the open and herded from place to place. Grazing during the day under the eye of a herdsman, they allowed themselves to be herded

back to a pen at night in the traditional African manner, where they would sleep around the campfire. This was a promising advance in behavior modification leading toward domestication. The oryx, for example, gained weight on grazing that would not even sustain cattle, and it required only a quarter of the amount of water.

At bottom, the question is not what contribution antelopes can make to the African larder, for they already make a significant contribution through (largely illegal) hunting. The question is whether farming could make them a sustainable asset rather than their being senselessly squandered, as is the case at present. Although its potential has yet to be realized, antelope farming is not a panacea for Africa's food problems, and certainly not the world's, but it might pave the way to a new and more gentle way to make savannas useful.

TAME GAME

Since the 1970s, deer have taken the place of sheep on many New Zealand pastures, and today the country has more than 5, 000 deer farms carrying over one million head, mainly red deer. It is now common along country roads to see tall fences surrounding graceful deer quietly grazing ryegrass and clover. And there are all the appurtenances for deer that exist for cattle and sheep. Auctions and shows are held regularly. Deer farmers have a professional association and produce their own glossy magazine. Government scientists publish pamphlets on the care and management of deer. There are recognized stud stags, computerized recording schemes for breed improvement, and even veterinary services specifically for deer. Hybridization between wapiti and red deer, and PFre David's deer and red deer, is accepted practice. The animals are moved by use of dogs

(which command by mere presence rather than by bark or bite), and herds of up to 80 are shifted by truck. Slaughter facilities specifically for deer are in operation throughout the country.

This transformation of a nervous, jumpy, and retiring wild species into a farm animal is a remarkable achievement. Once accustomed to people, many specimens become gentle, even affectionate, and will come at a farmer's call. Males are generally as easy to handle as females, except during the rutting season when they become aggressive and cannot be handled at all.

However, even at the best of times the farmed deer must be handled gingerly. If the causes of stress are not quickly suppressed, hysteria can erupt throughout a herd; in an instant, quiet animals can be leaping suicidally in all directions, disoriented, diving head-on into fences, charging gates. Chronic stress, the causes of which are not always obvious, can result in illness or death, although this trait diminishes in subsequent generations of farm-born stock.

A deer farm has to be laid out to certain special specifications. To prevent escapes, the boundary fences must be 2 m high with netting of 15- or 30-cm mesh. Inner fences need only be 1.5 m high. Water troughs are placed in the middle of the fields, and nothing is allowed to jut inwards from the fences because the animals tend to walk fencelines and take comfort from the illusion of openness. Because deer like to wallow in hot weather, some farmers also provide shallow waterholes.

Deer yards can be of any design, but the sides of the passageways and holding pens should be solid, as deer do not see fences very well, particularly when under pressure, and may injure themselves in a leap towards what appear to be wide

open space. (New Zealanders usually make the sides of plywood.) Also, the holding pens should be roofed, as semidarkness has a calming effect. Animals that in the sunlight become hysterical on seeing a person in the distance, can, in the relative darkness of a roofed shed, be touched and even given injections.

Despite the special facilities, however, handling deer takes time and care and experience. The most successful farmers spend much time among the deer so that the animals become accustomed to human presence. This helps to make yard work easier. Also, new arrivals are allowed to wander through the yards on their own to become familiar with them. In addition, special tame deer are used as leads or decoys to encourage the rest of the herd to follow. Using such simple techniques, a formerly intractable species has become almost fully domesticated.

26 Mouse Deer



Lesser Malayan Deer

Mouse deer1 (Tragulus spp. and Hyemoschus aquaticus) are among the smallest ruminants known. The lesser mouse deer of Southeast Asia is probably the

smallest; an adult stands only 20 cm high and weighs a mere 1-2.5 kg.

Although they look vaguely like tiny deer, mouse deer differ in several particulars. The stomach is simpler and (like the camel's) has three instead of four effective compartments. Rumination occurs, but mouse deer are the most primitive of all ruminants. Indeed, they share a number of characteristics with nonruminants, including lack of horns or antlers; continually growing, tusklike upper canines in males; sharp-crowned premolars; and four fully developed toes.

Virtually unchanged in 25 million years of evolution, these are solitary, nocturnal, retiring animals that have seldom received detailed research. Whether they might make suitable microlivestock is unknown. However, they seem to be tractable, and people in Southeast Asia (Sarawak, for instance) have traditionally kept at least one of the species as backyard pets. Moreover, mouse deer are indigenous to tropical lowland regions and withstand the heat and humidity that are stressful to most conventional livestock species. They probably also are resistant to many diseases of those torrid regions.

In the United States, mouse deer are being raised as laboratory animals for basic research on ungulates. This is because the animals are easier to handle than large deer or goats.

APPEARANCE AND SIZE

Mouse deer are graceful, lithe, and look somewhat like large rodents. The Asian species are the shape and size of an agouti (see page 198); the African species is more like the paca (see page 262). All have short legs, a small head, and a pointed

snout. Adults weigh from 1 to 5 kg, depending on species. The head and body are only 04-1 m long, and the shoulder height is merely 20-36 cm. Males are generally smaller than females.

In most species the body is a rich brown with white spots and stripes. The belly is usually white. The animals stand on the middle toes, so that the lateral ones do not touch the ground. Neither sex bears antlers. In males the upper canines form long tusks that may extend outside the lips and even to below the line of the jaw.

DISTRIBUTION

Twenty-five million years ago, early forms of mouse deer existed throughout Asia, Africa, and Europe. Today's species are restricted to tropical forests and mangrove thickets of Southeast Asia and Central Africa.

Of the three Asian species, the Indian mouse deer occurs in southern India and Sri Lanka; the larger Malayan mouse deer occurs on the mainland of Southeast Asia and the lesser Malayan mouse deer occurs on Java as well. The water chevrotain, a related African animal, is found from eastern Zaire to the Atlantic coast.



Range of Asian mouse deer: (1) Indian mouse deer; (2) larger and lesser Malayan mouse deer.

figure



Range of water chevrotain .

STATUS

In recent years, human encroachment into the forest has caused the destruction of the mouse deer habitats and has put various mouse deer species under a pressure that is causing their populations to decline.

HABITAT AND ENVIRONMENT

These animals inhabit equatorial forests and mixed secondary tropical forest. They generally live among undergrowth on the edges of dense lowland rainforests. They especially haunt rivers and swampy bush areas, seeking escape by water when in danger.

BIOLOGY

Little about these animals is recorded. Essentially vegetarians, they feed chiefly on fruits, supplemented by leaves. They also eat insects (for instance, ants), if available. They do not seem to eat grass.

The premolars of the mouse deer are designed for piercing and chopping food rather than for chewing. As noted, the stomach consists of three functional compartments: the rumen, the reticulum, and the abomasum. (The omasum of ruminants is represented only by a rudimentary area.) The stomach occupies almost the whole of the abdominal cavity, extending from the diaphragm to the pelvic inlet, which provides this small animal with large food-storage capacity.

The blood has a very high erythrocyte (red blood corpuscle) count as well as the smallest erythrocyte size of any mammal. The flesh is "white" and the muscles

contain little myoglobin.

Mature females reproduce almost continuously, and usually regardless of season. In the female larger Malayan mouse deer, mating occurs within 2 days of giving birth. In the African species, many births are synchronized with the rainy seasons, when fruits are plentiful. The gestation period is about 5-6 months, depending on the species. There is only one young per birth. Weaning normally occurs at 2-3 months, but can occur as early as 3 weeks, with sexual maturity achieved at 4-5 months (Asian species) and 10 months (African species). The young stay alone, hidden in vegetation during the first month or two.

BEHAVIOR

Mouse deer are shy, keeping to dense jungle and depending on concealment for protection. Although often present in large numbers, they are seldom seen. Preferring to be near lakes, rivers, or streams, they can nevertheless wander 1 km or more from water. They feed mostly at dusk or at night, sheltering in undisturbed areas or under shady bushes during the day. They utter weak, bleating sounds, and when frightened, jump a meter or more in the air.

Communication is by scent and calls. The African species possess anal and preputial glands, with which, along with urine and feces, they mark their home ranges. Males of both Asian and African species possess a chin gland to mark either the vegetation or their mates.

Mouse deer are among the most excitable, nervous, and jumpy animals. One must tread softly in their presence for fear of causing absolute pandemonium and

mishap.

USES

Mouse deer are widely sought by native people for food, and their meat is highly regarded. Dressed carcasses have a high proportion of muscle (84 percent in Asian species), low proportion of bone (15 percent), and an insignificant amount of fat. The ratio of muscle to bone is large - 5.6:1. The mean dressing percentage of 62.1 percent is greater than that reported for cattle, water buffalo, or goat.⁵

HUSBANDRY

Adults are wild, generally intractable, and "flighty," but young animals (at least of the Asian species) tame readily and make good pets. Nevertheless, these are delicate creatures and must always be handled gently. Individuals caught in the wild tend to bash against the sides of cages.

Despite an unpromising temperament, Asian mouse deer are regularly bred in zoos, including those in Amsterdam, New York, and Zurich. They also have been reared successfully in small enclosures at several research institutes, such as the I.R.E.T. Institute, Makokou, Gabon; the Institute of Medical Research in Kuala Lumpur, Malaysia; and at Fort Detrick in the United States.

Perhaps the best way to breed this animal is by using the battery system of small units comprising one male and two females per cage. The costs are mostly for obtaining suitable enclosures and for feeding and watering troughs.⁶ The cages must be covered with mesh because the mouse deer can jump. However, the covering must be sufficiently high to allow the male to stand with its body vertical

during copulation.7 They can be fed a variety of foods and grow well on stems of bean plants.

ADVANTAGES

As noted, these are small, seemingly tractable creatures that are at home in the heat, humidity, and diseases of tropical lowlands. They might play a particularly important role as livestock for tropical rainforests; the forests could be left standing while the animal still produces meat. Today, in a widely condemned process, tropical rainforests are being felled in order to raise cattle for meat.

LIMITATIONS

Small size makes mouse deer easy prey for various predators. In the wild, snakes, crocodiles, eagles, and forest cats feed on them.

Mouse deer are among the most excitable, nervous, and jumpy animals. One must tread softly in their presence for fear of causing absolute pandemonium and mishap.

The different species are solitary, and it is difficult to keep many individuals (especially males) in a restricted space. They must be kept in a quiet enclosure, with cover or good shelters.

RESEARCH AND CONSERVATION NEEDS

The survival of these four "living fossils" depends on conserving their rainforest habitat and restricting hunting, especially night hunting. But studies of their

propagation and management are also imperative.

In particular, research is warranted on various aspects of their husbandry, such as enclosure design, space requirements, and health. A special research need is to understand the animal's nutritional requirements and to develop diets for use in captivity.

27 Muntjac



FIGURE

Muntjac, or barking deer (*Muntiacus* species), are among the most widespread but least known of all Asian animals.¹ They are almost the size of an average dog and they bark, but they are true deer. These little animals adapt well to captivity and have been introduced to zoos and wildlife collections throughout the world.

In recent years one species, the Reeves' muntjac, has become established in England, and a few specimens have settled into semicaptivity - staying behind fences, accepting human presence, and even eating out of people's hands. In Sarawak, villagers have also been known to keep muntjac, feeding them a diet of rice with some leafy matter occasionally added.² Such experiences show that these small, shy deer can be calm and adaptable. It also shows that they can be raised on practical, artificial diets and that they are not strictly browsers. This creates the possibility (admittedly highly speculative) that they might make future microlivestock.

Muntjac produce lean, palatable venison and perhaps could be farmed on an organized basis. They are native to severe environments where heat, humidity, and endemic diseases make raising conventional livestock difficult. In future, given research, muntjac might become widespread contributors to Asian economic development. The lessons learned in captive breeding could also be important for conserving endangered muntjac species.

One species, the Indian muntjac, has an incredibly low chromosome number ($2n=7$ in males; $2n=6$ in females), which makes them particularly promising candidates for mammalian genetic studies. This species has regularly bred well in both zoos and research institutions.

APPEARANCE AND SIZE

Muntjac are small and slender. Reeves' muntjac, the smallest, has a shoulder height of 45-60 cm. Fully grown, it weighs less than 20 kg; commonly it is merely 10-12 kg. The Java subspecies of the Indian muntjac is the biggest, with a

shoulder height of 58 cm and a mature weight of 43 kg.

Antlers on the males usually include a main prong as well as a much shorter brow tine. Even the main prong is no larger than a finger, but its pointed tip is hooked and must be treated with caution. There are also two tusklike canine teeth that protrude from the mouth. These have sharp points and a knifelike posterior edge, capable of cutting to the bone a person's finger or another muntjac's rump.

Coloration varies from deep brown to yellowish or greyish brown with cream or whitish markings, depending on the species.

DISTRIBUTION

Muntjac are native to a vast region from eastern China to Nepal, India, Sri Lanka, and Indonesia.

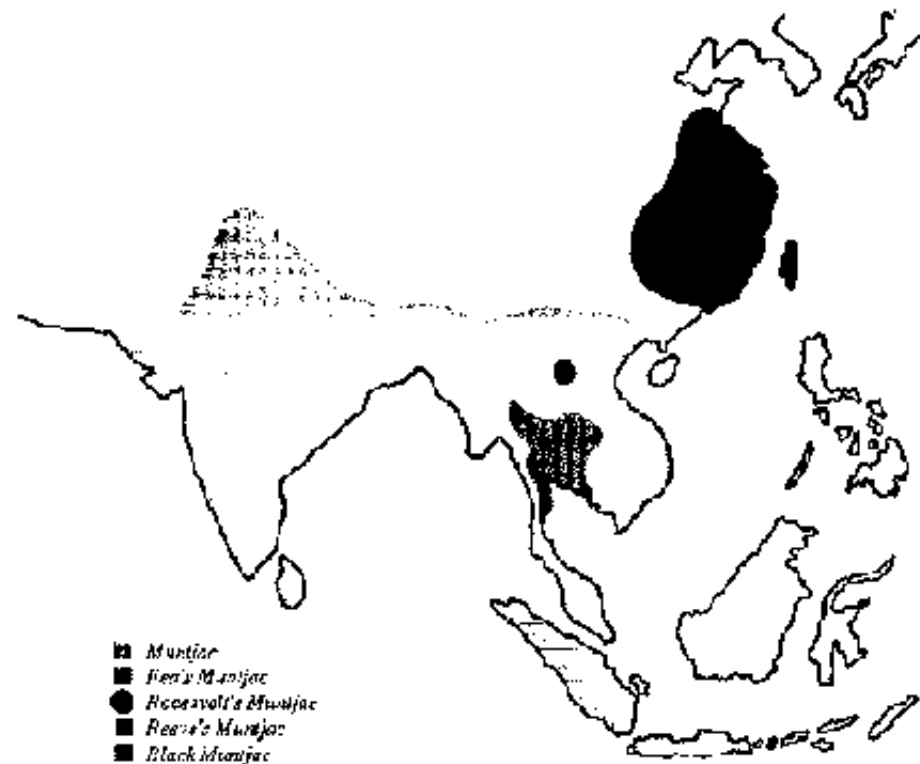
Almost a century ago, Indian and Reeves' muntjac were introduced to a deer park in southeast England. Some escaped, and (as noted) the Reeves' muntjac has adapted, spread, and settled down to life in the countryside.

STATUS

Of the five muntjac species, the Reeves' and the Indian are well known and in no danger. For instance, recent estimates of annual game production have shown that there are about 650,000 Reeves' muntjac in China. The other three are threatened with extinction. Black, Roosevelt's, and Fea's muntjacs are virtually untried in captivity, but the success of raising Reeves' muntjac in English country gardens suggests that perhaps their populations could be saved through captive breeding.

HABITAT AND ENVIRONMENT

In their native habitats, these small deer are usually found in dense vegetation on hilly ranges at elevations up to at least 3,000 m.



The native ranges of the various muntjacs

BIOLOGY

Muntjac seem to be primarily browsers. However, in captivity they eat fresh grass, alfalfa hay, and feed pellets. They also readily eat root crops such as potatoes, carrots, and parsnips. They are "concentrate selectors," preferring foods low in fiber and rich in protein and nutrients. Captive specimens reportedly need; a

supply of cut browse.

Breeding may occur year-round, but in practice it is synchronized with certain seasons. The first conception can occur as early as 6 months of age. One, occasionally two, young are born after a gestation of about 200 days. They weigh around 1 kg at birth, and the fawns usually remain hidden until they can move about with the mother. The females mate within a few days of giving birth. Life spans up to 16 years have been recorded.

As noted, the Indian muntjac is a species of great cytogenetic interest. It has the lowest diploid chromosome numbers yet found in a mammal.⁴ The large, easily distinguishable chromosomes are a great advantage in tissue culture, and many laboratories now have muntjac cell lines. The karyotypes of the different species' chromosomes are very different; the Indian and Reeves' muntjac can hybridize, but the offspring are infertile.

BEHAVIOR

Muntjac are dainty and have a captivating charm. Always on the alert, they are active both day and night. Often they will bark for an hour or more, but typically they bark for only a minute or two. When panicked, captive muntjac may rush into fences or walls. They can easily leap barriers 1.5 m high.

Males are highly territorial and defend their territories vigorously. Adult females also inhabit a specific territory, which they defend against strange individuals.

Males mark the ground at intervals by lowering the head and rubbing the frontal glands on the ground and by scraping their hooves against the ground. They mark

trees by scraping the bark with the lower incisors and rubbing the base of their antlers.

USES

In Asia, muntjac are hunted for meat, skins, and antlers.

HUSBANDRY

Muntjac thrive and, at least under ideal conditions, breed freely in captivity. However, they may stop breeding if they are crowded.

In England, zoos and private collections keep as many as six muntjac in an area of 40 x 20 m. Plenty of cover is provided for the animals to hide in. Fences almost 2 m high are used. (Lower fences are reportedly adequate where there is no risk of the deer being panicked by dogs or people.)

ADVANTAGES

Like other deer, muntjac produce extremely lean meat.

They seem to be healthy animals. In Britain, wild and captive muntjac have few gastrointestinal worms, and ectoparasites such as ticks and lice are not a problem.

MUNTJAC

In England, far from Asia's forests and mountains, the Reeves' muntjac is the subject of a peculiar chapter in the otherwise unhappy history of introduced

species. Charmed by the deer's odd characteristics, the British have welcomed its invasion into gardens around the country. Now, there are tens of thousands of muntjacs on the loose, and some people have even adopted them as pets.

Although other alien species have wreaked havoc on native plants and animals, muntjacs appear to be a merciful exception. At least over the short term, muntjacs "have proven to be an almost innocuous asset to the countryside. They give pleasure to thousands and pain to few. Eating mostly ivy, grass, leaves, and prickly bushes, they rarely feed in one place long enough to do much damage except to an occasional suburban garden."

Life for many muntjacs is made soft by homeowners who find the deer's large, dewy eyes and tiny antlers irresistible. The kind-hearted suburbanites put out salt licks, water, and kitchen scraps, and they built snug little shelters against the cold north wind. "All our adult deer will take food from the hand," says Walter Buckingham, who has kept muntjacs for five years in his garden in the county of Hertfordshire, just north of London.

The adaptable immigrant is colonizing new areas so rapidly, say biologists, that soon there may be more in England than in Asia. "In time," predicts muntjac-researcher Oliver Dansie (pictured opposite), "it may eventually establish itself as our most widely distributed deer species."

LIMITATIONS

In the wild these animals are not gregarious and are generally found alone or in pairs. Because of their strong territorial instincts, large males may not be able to

be kept together without fighting. The upper canine teeth can inflict serious wounds. Some females are intolerant of each other as well.

Muntjac are fragile; they cannot be held by the legs, for example.

Some infectious diseases may prove to be of epizootic importance: foot-and-mouth disease, mucosal disease, epizootic hemorrhagic disease, rinderpest, and tuberculosis (all three types). This may be a problem, especially when people are raising the animals by hand.

RESEARCH AND CONSERVATION NEEDS

To ensure a better understanding of their potential as microlivestock, muntjac deserve research and recognition from animal scientists and conservationists from Nepal to China. The English experience shows how populations of the endangered species might be built up. At present, however, none are receiving any husbandry research; only the two most common species can generally be found in zoos.

These animals deserve investigation into physiology, reproductive requirements, fertility, nutrition (for example, food preferences, feeding strategies, and food utilization), growth, adaptability and environmental tolerance, diseases, management, social structure, and selection for calm temperament.

28 Musk Deer

The musk deer (*Moschus species*)¹ is so small that (like other ungulates in this section) it is only as large as an average-size dog. A gland in males produces musk, a thick, oily secretion that is one of the most valuable substances in the

animal kingdom. Musk is used in Oriental Medicine as well as in Europeans perfumes, and in recent year it has sometimes sold for as much as three times the price of gold.

Musk is traditionally obtained by killing these deer and removing their glands. The dried glands, called pods, contain a reddish brown musk powder that has been a commodity in international commerce for more than 1,000 years. Despite bans in India (1972) and Nepal (1973), musk continues to be illegally exported, mainly via Hong Kong, for use in Japan and Europe. In Japan, for example, it is an ingredient in more than 200 different medicines.² In Europe, musk goes into some of the most famous perfumes.

The international trade in Himalayan musk, originating from both northern and southern sides of the Himalayan divide, amounts to 200 kg per year, representing an annual slaughter of 20,000-32,000 male deer.

The commercial value of the animal makes it highly attractive for development as a livestock species. The economic force causing its slide toward extinction could be employed to protect and restore both the species and its habitat. Ranching these deer might put musk production on a sustainable footing. It might also encourage habitat protection, because in the harsh climate of the high Himalayas, rearing musk deer could be much more profitable to villagers than raising crops or cattle.

Musk deer are already being farmed under primitive conditions in China, where techniques for extracting musk without killing the animal have been developed. In India, small collections of musk deer have been established by the forest

departments of Himachal Pradesh and Uttar Pradesh. For several years authorities in Nepal have successfully extracted musk from an adult male at the Kathmandu Zoo' without apparent harm to the animal.³ These experiences suggest that musk might become a farmed product. So far, however, success has been limited. The Chinese animals, for example, have a high mortality rate and the musk is said to be of poor quality. Nonetheless, these examples are valuable pioneering case studies that deserve recognition, support, and further development.⁴

APPEARANCE AND SIZE

With their long ears, arched back, and bounding gait, these diminutive deer remind one of large hares. The pointed face and large ears make their heads strikingly reminiscent of kangaroos. The coarse hair gives them a stocky appearance. The color varies according to species (and subspecies) from rich reddish brown to dark grey or black. The peculiarly brittle and wavy hair probably has good insulating properties, as it consists of air-filled cells arranged like a honeycomb.

Musk deer have an average mature weight of about 6-11 kg and a body length of 50-90 cm. They stand 50-60 cm high at the shoulder and 5 cm higher at the rump because the hind legs are longer than the forelegs. Some dwarf types are only 40-46 cm high. The tail is short, and in males it is naked, except for a terminal tuft of hair, because they mark their territories by constantly rubbing the caudal gland, which is located near the tail, onto objects.

All four toes are flexible, which, compared to the rigid hoof of other ungulates, gives a firmer grip on precipitous slopes. The dew claws are enlarged and,

together with the central digits, splay out, to minimize sinking in soft snow.

Neither sex possesses antlers, but males have long upper canine teeth that project well below the lips. The lower front teeth have a spatulate form that probably helps the animals scrape lichens from the surfaces of rocks and trees in winter, when most vegetation is snow covered.



The musk deer's native range.

DISTRIBUTION

The genus is distributed patchily throughout the forested mountainous parts of most of Asia. One population extends from just north of the Arctic Circle southward to the northern edge of Mongolia and Korea. Others occur in China, northern Vietnam, and the Himalayan region including Bhutan, Assam, Tibet, the Indian Himalayas, Nepal, and northern Pakistan.

STATUS

During this century, the musk deer has rapidly declined throughout its former regions. In many parts of Afghanistan, Pakistan, India, Nepal, and probably Tibet, it is already regarded as rare, with a distribution that is becoming increasingly localized. Possible exceptions are Bhutan and most of China, where its population is thought to be stable. In southern China, a recent estimate puts the musk deer population at 100,000 head. In western and northwestern China, the population is estimated at 200,000-300,000 head.⁵

It is the uncontrolled hunt for musk that in most places is driving this animal toward extinction, but its habitat is also being increasingly destroyed by livestock and woodcutters. Part of the loss to hunters is owing to the mindless way in which the animals are caught. Most are snared in traps or nets or killed by poisoned stakes set on trails. This kills all the animals indiscriminately, even females and fawns, which produce no musk. This waste of reproductive animals is extremely destructive to the populations and is senselessly hastening the musk deer's extinction.

HABITAT AND ENVIRONMENT

Musk deer mainly occur in upland woodland and scrub areas. They prefer remote, dense vegetation, especially birch-rhododendron forests in mountainous terrain. They are seldom found in treeless regions or areas thickly populated by people. In the Himalayas, the upper limit coincides approximately with the tree line, which is as high as 4,600 m at the eastern end.⁶

BIOLOGY

Despite its economic importance and wide distribution, little is known of the musk deer's biology. Nonetheless, it is known that musk deer have a gall bladder, a bovid feature that distinguishes it from the true deer.

The animals are browsers, relying on young leaves, buds, fruits, and flowers. During the winter, as snow deepens, they depend more on lichens growing above the snow on rocks or tree bark, although in shallow snow they scrape for vegetation with their hooves.

The male's musk sac is unique among deer. Situated between the umbilicus and penis, it contains the gelatinous, odoriferous oil. The amount varies with the season and the age of the animal, but pods of adult males usually weigh about 30 g; occasionally up to 45 g.

Males also have a caudal gland under the tail, which secretes a viscous yellow substance with a goatly smell. They mark vegetation with this secretion by rubbing their hindquarters against stems and branches.

Males become sexually mature at about 18 months, but females seem capable of reproducing in their first year. The estrous cycle is 18-25 days; the receptive period lasts 36 60 hours. Gestation varies from 178 to 192 days. Each female usually bears one or two fawns, rarely three. The fawn is precocious - able to stand and move within 15 minutes.

BEHAVIOR

Musk deer are shy, furtive animals with keen senses of hearing, smell, and sight. They are normally solitary and are most active at dawn and dusk. Only under cover of darkness do they frequent the more open spaces. Except in the rutting season, more than two animals are seldom seen together; groups usually consist only of a female and her young. The alarm call, a loud hiss, is often accompanied by a highstepping, springy gait.

In the wild, musk deer lead "orderly" lives. They use well established trails connecting well-established feeding places, resting places, and "latrines" where they deposit their droppings. Migration is uncommon.

Remarkably sure footed, musk deer climb cliffs and even the trunks of leaning trees. Being small and solitary, they rely on camouflage to avoid predators but flee through established escape routes when disturbed. If cornered, males defend themselves by slashing with their tusks, often inflicting deep cuts and severe injuries.

USES

The strong-smelling, reddish-brown musk is obtainable only from this animal.⁷ It is used as a fixative in expensive perfumes to increase the retention of the fragrance on the skin. In Oriental medicines it is used in stimulants, sedatives, and other products. Some medicinal properties appear to be genuine.⁸ Recently, highly purified musk has been selling for as much as \$27 a gram.

Trade in the Himalayan musk deer or its products is banned by all countries that are parties to the Convention on International Trade in Endangered Species of

Wild Fauna and Flora (CITES). However, products from musk deer in the Soviet Union and China can be traded legally under license. It seems likely that if formal, self-sufficient, musk-deer farming projects can be established elsewhere, with safeguards to minimize poaching, a wider trade would be officially sanctioned.

HUSBANDRY

Since at least 1919, Chinese scientists have been experimenting with the extraction of musk without killing the males. When the sexual activity is at its peak, the males are caught and musk removed from the pod with a runcible spoon (curved fork) inserted into the sac's aperture. The procedure takes only minutes. There are records of up to 9 g being recovered at a time.

As noted, China established formal musk deer farms in 1958. They are clustered in the Maerkang, Miyalo, and Manchuan areas of Sichuan Province; the Zhenping county of Shanxi Province; and the Fuziling area of Anhui Province. Despite heavy initial losses of animals, mainly during transportation and acclimatization, the Chinese now breed musk deer in considerable numbers. However, juvenile mortality is still high and longevity relatively short. Zoos in other parts of the world have also had difficulties maintaining the animals.⁹

In captivity, musk deer readily accept many foods: lettuce, carrots, potatoes, apples, rolled oats, hay, alfalfa, bananas, some grass, bamboo leaves, and pumpkins, for example.

LIMITATIONS

The musk deer's social system may represent an impediment to its successful

reproduction in captivity. It is irascible and scares easily. In close confinement, males fight and may have to be isolated from each other.

There is an inherent danger in any captive-breeding scheme in the Himalayas: resumption of legal trade in natural musk could damage the remaining populations by stimulating the market and providing an outlet for illicit musk from poached animals. Some biologists (notably in India) consider that a total ban on the trade in natural musk from all sources is essential.

So far, removing the musk without damaging the animals has not proved commercially successful because of market resistance. Most purchasers require the entire pod in order to be certain that they are receiving the genuine product. Given a regularized farming program, however, it seems likely that mutual trust would circumvent this lack of confidence.

RESEARCH AND CONSERVATION NEEDS

To protect this species will not be easy. It occurs in vast, remote areas that are difficult to patrol. The local people are poor and traditionally have used it as a source of income and food. The value of musk is so high that smuggling is already well organized and will be difficult to eradicate.

It is imperative that the status of existing musk deer populations be established. This is especially important in Nepal. The total population may be not more than 500 in the wild.

No matter what is achieved in farming, pressure on populations will only be reduced by protecting the wild specimens. Thus, the dietary requirements and

behavior of musk deer should also be evaluated with a view to building up the wild populations directly. If the techniques of breeding and handling can be improved, farming the animal may also indirectly help wild populations by reducing the pressure to harvest them.

An alternative to captive breeding might be ranching the wild animals. In this process, males would be caught periodically and the musk extracted before releasing them. The organized, sustainable harvesting is particularly attractive if developed at the rural level with revenue going directly to local people; it would provide them incentive to conserve not only "their" musk deer but also its habitat. For this purpose, today's musk deer hunters could be trained to extract musk from live animals, releasing and recapturing them on a controlled basis.

Another alternative could be controlled culling at a sustainable level, as is now done in the Soviet Union, where about 5 percent of the population is harvested each year. However, elsewhere annual culls at any level would not be feasible for at least 10 years because the populations are now so low.



FIGURE

29 South America's Microdeer

South America contains three types of tiny, indigenous deer. None are well known to science, yet they are of microlivestock size, and if given research attention at least two might respond to rearing in captivity.



Pudu

PUDU

The pudu (pronounced "poo-doo") is native to temperate forests of the Andean region. It is among the smallest of all true deer, adult males being merely the size of small terriers and the females being smaller still. It is very shy and retiring and is endangered.

All things considered, this animal would appear to be an unlikely candidate for microlivestock. But wherever it is found, the pudu is mercilessly hunted, and captive rearing might be the only way to save its populations from extinction. Indeed, it is already being raised in experimental herds in Chile and Argentina.

Pudus (also called the Andean dwarf deer) once ranged widely through the foothills, valleys, and lowlands of the Andes. They prefer the dark, dank underbrush of the cool rainforest, particularly thick bamboo stands. There are two species: Pudu pudu is distributed in parts of southern Bolivia and throughout much of southern Chile nearly to the Straits of Magellan. It is also found on islands off the Chilean coast. Pudu mephistophiles is distributed throughout the highlands of Ecuador, where it occurs only in cool areas at great height.

With their short legs, stocky bodies, and compact heads, pudus do not look much like deer - more like small antelopes with foxlike faces and spiky antlers. Full grown, they are only 40 cm tall and weigh less than 12 kg. They have thick fur ranging from reddish brown to pale gray.

Because of the pudu's small size, shy and secretive nature, and forbidding habitat, few people have ever even seen one. Nonetheless, these animals tame easily and reportedly were once kept by South American Indians. Several generations were also once bred in a Paris apartment and were treated exactly like domestic dogs, which most people who saw them for the first time thought they were.'

In recent years, habitat destruction has greatly reduced the range and numbers of these attractive and fascinating little creatures. The International Union for the Conservation of Nature already lists them as vulnerable to extinction. Pudu studies

are highly recommended, and raising pudus promises to be an interesting and valuable activity that may one day lead to one of the most intriguing microlivestock of all.

BROCKET

Brockets (*Mazama* spp.) are small deer that occupy the place in South America's environment that duikers occupy in Africa (see page 326). They typically reside in thick brush. They occur widely throughout South America and are found in every country except Chile and Uruguay. They also occur in Central America, the West Indies, and Mexico.

There are four species:

- Red brocket (*Mazama americana*), the most common and widespread, is found from Mexico to Argentina. It is also the largest species, with a mature weight of about 20 kg.**
- Gray (brown) brocket (*Mazama gouazoubira*) is also found throughout Latin America. It is slightly smaller, weighing about 17 kg.**
- Lesser brocket (*Mazama rufina*)² resides in small and scattered locations in Venezuela, Ecuador, Peru, Bolivia, Brazil, Argentina, and Paraguay. It weighs 10-20 kg.**
- Dwarf brocket (*Mazama chunyi*) is found only in pockets of forest and brush on certain mountainsides in Venezuela, Colombia, Ecuador, and northern Peru. The smallest brocket, it weighs only 8-12 kg.**

Except for their size and color, all brockets look alike. The head, neck, and tail are short; the ears are wide. The lumbar region is higher than the shoulders, and this, together with an arched back, gives them a hunched appearance not unlike a duiker's. The antlers are simple spikes, never longer than a person's hand.

The different species are similar in behavior, too.³ They generally wander around singly or in pairs. Although frequenting dense cover during the day, they emerge at night to feed in open areas. Little is known of their food preferences. But farmers know only too well how fond they are of melons, beans, peppers, and corn. Doubtless, wild forest fruits dominate their native diet.

Although extensively hunted, brockets are so adept at dodging into dense brush that relatively few get caught. However, small size makes them vulnerable to many other predators: puma, jaguar, ocelot, and eagles and other large birds of prey. Near villages the domestic dog is probably their worst enemy. (Infuriated vegetable growers commonly set their dogs on them.)

Although at first sight these retiring, nervous, and agile creatures seem unlikely to be even potential microlivestock, young brockets are sometimes caught and raised by people. It is not uncommon to find them as pets on farms and in gardens. They seem to become very tame and might therefore make useful livestock at some future time. At least one species, the grey brocket, adjusts particularly well to life in and around human settlements.

HUEMUL

The third type of South American microdeer, the huemul,⁴ is a much less likely

candidate. It is very rare, very shy, and has so far shown little likelihood of settling into captivity. However, huemul conservation is critical: without urgent attention, the animal will become extinct. Although totally protected by law, it is declining owing to poaching, farm dogs, habitat loss and diseases transmitted by cattle and other livestock.

There are two species:

- The Chilean huemul (*Hippocamelus bisulcus*)⁵ occurs in high altitude forests, thickets, and grasslands in the Andes of southern Chile and Argentina.**
- The Peruvian huemul, or taruca (*H. antisepsis*), occurs in parts of the Andes of southern Peru and Bolivia as well as of northern Chile and Argentina.**

Both species live in small herds above the tree line. They are very shy, and even though the Chilean national seal bears the depiction of a huemul, almost no Chilean (or anyone else, for that matter) has ever seen a live one.

At less than 85 cm tall and probably weighing under 15 kg, huemuls are sized to be microlivestock. However, previous attempts at rearing them in Chile have met with little success. Nevertheless, huemuls have been kept in zoos in Germany, and such experiences - together with the increasing knowledge of how to raise red deer and other species - may eventually provide the keys to their continued existence.



FIGURE

30 Water Deer



FIGURE

Little is known about the water deer' (*Hydropotes inermis*), but it should be considered along with mouse deer, muntjacs, musk deer, and others as a possible species for microlivestock development. It is comparable in size, and it is unusual

among deer for producing large litters: births of triplets or more are common.

As with the other species in this section, this is a highly speculative notion; however, there is some justification for it. The Zoological Society of London has successfully established breeding colonies, and other zoos have also bred the animal in captivity. The water deer has the advantage of rapid growth, early maturity, and high fecundity. Indeed, given protection, its populations have been known to increase rapidly.

APPEARANCE AND SIZE

The animal has a graceful and delicate appearance, its best known characteristic being the male's long tusks. Both sexes are about the same size, standing 45-55 cm at the shoulder and weighing up to 19 kg. Body length is up to about 1 m, and the tail is so tiny that it is barely noticeable. The round-tipped ears are characteristically held erect above the head.

Water deer are somewhat like muntjacs, but they are longer in the leg and lighter in build. Their forelegs are shorter than their hindlegs so that they stand slightly higher at the haunches than at the shoulders. This gives them a hunched appearance.

The hair is generally thick and coarse, longest on the flanks and rump. The backs and sides are usually yellowish brown, finely stippled with black. In winter, the coat is thick and variable in color; pale fawn and peppery gray-brown are common shades. In summer, the coat is sleek and reddish. Fawns are white spotted at birth, but this dappling soon fades.

Neither sex has antlers. The upper canine teeth, especially in the males, are enlarged, forming curved tusks 7 cm long. These are much bigger than those in muntjacs and can protrude well below the jawline.

In both sexes there is a small inguinal gland present between the hind legs, the only instance among deer.

DISTRIBUTION

In China the water deer has a wide distribution range. It is mainly found in the provinces of Jiangsu, Zhejiang, Anhui, Jiangxi, Hunan, Hubei, and Fujian, the mid and lower Yangtze River Basin, and coastal areas and islands in central and eastern China. It is also found in Guilin, southern Sichuan Province, Guangxi Province, and Guangdong Province in the south.²

In Korea, the animal lives along the lower reaches of most rivers, except those in the extreme northeast. Its northern limit of distribution is probably about latitude 43°N.

At Woburn Park in England, a few escaped from a herd early this century and have increased and become established in a number of counties, particularly Bedfordshire, Hertfordshire, Cambridgeshire, and Norfolk.

STATUS

In China, owing to increasing reclamation and cultivation of wetlands, the habitat of the water deer is gradually shrinking. At present the animal is protected by the government, which designates appropriate hunting seasons. It is estimated that

about 10,000 are killed each year by hunters. In Korea the water deer is still plentiful. As noted, in England it is maintaining itself and is thriving in some protected parks. It is also reported to be present in France.

HABITAT AND ENVIRONMENT

In its home range, the water deer is usually found among reeds and rushes in swampy areas. It also frequents the tall grasses and sparse shrubs of mountainsides and cultivated fields. In England it has adapted to a variety of habitats, including woodlands.



Native range of the water deer.

BIOLOGY

The water deer is chiefly a grazer. It feeds mainly on reeds, coarse grasses, and some tree leaves.

As previously mentioned, this is the most prolific species of deer. Up to seven fetuses have been observed in a single pregnant female, although the normal litters are two or three. The gestation period is about 176 days. Fawns are born in late spring or early summer, and weigh only about 0.5 kg at birth. Within 4 days the newborns can live almost exclusively on grasses. Usually, however, they are fully weaned after 4-8 weeks, but remain socially attached to the mother. They appear to become independent after about 4 months. Males become sexually mature at about 5-6 months; females at about 7-8 months.³

BEHAVIOR

Water deer are generally seen alone. Even where abundant, they seldom congregate in herds. Females are sometimes intolerant of each other, as are adult males or young males. However, in captivity, several females can graze and rest in loose aggregations. The peak period of grazing activity occurs around dusk. Feeding sessions are interspersed with periods of passive cud-chewing.

Water deer "bark" at intruders. During the rut, males are especially noisy and aggressive, and defend their territories with vigor. Fighting involves striking their tusks into the shoulder or back of their opponents. ³ Information from Lu Houji. These are extremely excitable little animals. When upset, they often "hump" their backs and bound away like rabbits. They are also good swimmers.

USES

In China the water deer are hunted for their meat and skins, and newly born fawns are killed to obtain the mother's colostrum for medicinal purposes. In a few

localities in England, the species has become a game animal.

HUSBANDRY

The water deer is not yet known on "farms." However, it seems to be easily kept, has bred well in zoos, and has thrived in many British wildlife parks.

ADVANTAGES

The assets of early maturity and high fecundity mean that the potential exists for rapid population expansion. Such an event occurred at Britain's Whipsnade Zoo. In 1929 and 1930, 32 deer were released into undeveloped pasture; by 1937, 120 fawns had been raised.

Because they are relatively small, and because in the wild state they aggregate only under exceptional conditions, water deer are unlikely to have any appreciable impact on vegetation in forests, farms, or gardens. Nonetheless, they can damage crops, and Chinese farmers, who consider them pests, often illegally kill them out of season.

LIMITATIONS

These animals are swift and adept at escaping captivity. It is possible that because of territoriality only a single pair will live in a given area. Moreover, males are aggressive and must be kept apart.

They seem able to withstand chilly weather well, but a combination of wet and cold is harmful. Their heavy winter coat, essential to survival in the Far East,

renders the animal susceptible to dehydration and heat exhaustion in comparatively mild climates, such as England's.

At birth, the tiny fawns are extremely vulnerable to a variety of predators, both birds and mammals. The species may need areas of dense cover or some shelter from wind.

RESEARCH AND CONSERVATION NEEDS

The water deer has been successfully kept in semicaptivity for many years; however, for it to reach a level of domestication suitable for use as microlivestock, research is needed in the following areas:

- Reproduction;**
- Performance under a range of environments;**
- Grazing efficiency;**
- Basic physiology;**
- Captive breeding and domestication - measurements of growth rates, space requirements, and feed needs; and**
- Modifying behavior to overcome territoriality - for instance, imprinting on humans, selection of docile specimens, hand rearing, and castration.**

The water deer is not an endangered species; however, efforts should be made to

preserve the populations in their native ranges and habitats.

31 Duikers



Red Duiker

Duikers (Cephalophus and Sylvicapra species) are small African antelopes. Although they are ruminants like cattle, sheep, and goats, some are hardly bigger than hares or rabbits. One, the blue duiker, is less than 40 cm high and usually weighs a mere 4-6 kg. It and some of the slightly larger duikers might be suitable for household husbandry because their meat is an extremely popular food throughout much of Africa. In West Africa, for example, it is one of the most common meats sold in both rural and urban markets.

This idea, however, is highly speculative because, despite their popularity, little is known about these tiny animals. Their husbandry has been attempted only a few times, but the results were encouraging, and rearing duikers deserves further investigation. They are already being raised in captivity in the United States,¹ Zimbabwe,² Togo,³ and Gabon. Researchers in Nigeria have bred blue duikers to the fourth generation and found that, if the animals were first handled by people

while young, they remained docile.4 Even blue duikers caught in the wild tame quickly if they are very young, but by the time they reach 3.5 months, they become barely tolerant of man's presence.

If duiker husbandry can be developed, it might provide not only a more regular source of meat, but also a lessening of the hunting pressures, thereby giving the wild populations a better chance of survival.

AREA OF POTENTIAL USE

These antelopes are suitable for testing as microlivestock only in their native region, sub-Saharan Africa. Eventually, they might prove to have wider applicability.

APPEARANCE AND SIZE

Duiker species vary from about the size of a small dog to that of a small donkey. Most are similar in shape and are characterized by short front legs, arched back, and pointed hoofs. The tail is stubby, often with a terminal tuft. The coat varies from reddish brown to nearly black, although a few species are blue-grey and one is zebra striped.

Females are slightly larger than males, but the sexes look alike. In most species, both sexes bear small straight horns that project backward from the skull, frequently hidden in a long tuft of hair.

DISTRIBUTION

Duikers inhabit virtually all regions of Africa below the Sahara- from Gambia in the west to Ethiopia in the east, and all countries as far south as South Africa.

STATUS

Duikers are so shy that they are rarely encountered by people. But almost anywhere in Africa (other than North Africa), the observant traveler may glimpse them ducking into forests or thickets. Although there are still countless numbers, people are eating so many that in some localized areas the populations are fast heading toward extinction.

HABITAT AND ENVIRONMENT

All but one species are found in rainforests or dense woodlands. The grey duiker, however, is found in savannas. If the vegetation is juicy, only a few of the species need a separate water source, so they can thrive in very dry sites.

BIOLOGY

The main foods are fruits and seeds supplemented by leaves and shoots. Fruits, which they eat to a much greater degree than other antelopes, are an important part of their diet. Some rare species (for example, the red-flanked duiker, *C. rufilatus*) can graze. Occasionally (especially in captivity), duikers are also omnivorous, eating fish, crabs, insects, snails, frogs, small animals, or carrion; they also readily accept chopped meat.

Duikers reach sexual maturity at 9-15 months; gestation lasts about 7-8 months. In some species, females conceive a few days after calving on a 3- to 5-day

postpartum estrus. Apparently one calf per birth is normal. A newborn blue duiker weighs between 0.4 and 0.7 kg.

Before one year of age, young duikers leave their parents to find their own mates and territories. Life expectancy is more than 10 years.

BEHAVIOR

In spite of habitat differences, most duikers behave alike. In the wild they are nervous, shy, and retiring. When alarmed, they plunge into the protection of dense vegetation - hence the origin of the name duiker, which means "diver."

Nonetheless, their behavior allows them to be easily netted. An experienced hunter can imitate duiker sounds and call the male out of the bush. Also, a startled animal freezes, thereby facilitating its capture.

Moving easily through dense vegetation, the head carried low, these tiny animals use regular runs. Forest duiker species are largely diurnal, although a few, such as the bay duiker, are nocturnal. Bush duikers are mainly nocturnal, feeding from early evening until morning. Such nocturnal species shelter during the day in holes (presumably dug by other animals) or inside fallen trees; the diurnal ones lie directly on the ground.

Blue duikers are the best-known species and are probably the most likely candidates for microlivestock (see page 332). They seem to be monogamous and apparently mate for life. Unlike most antelopes, their population densities can be high. The pairs reside in territories of 2-4 hectares, which both male and female stoutly defend against rivals. Other species appear to be polygamous and live in

large territories (up to 80 hectares).

In captivity, the animals are generally calm. However, both males and females can be aggressive toward unfamiliar individuals of their own species. In an enclosure, one male can serve several females.

Large glands, located beneath each eye, exude a scent that is rubbed onto fences, trees, and other objects as territorial marking. In another form of marking the horns are rubbed against tree trunks.

USES

As noted, duiker meat is much sought in many African countries, and the animals are regularly hunted. The meat is lean with little or no intramuscular fat (marbling).

Duikers also have promise as experimental animals. They are true ruminants, with four-part stomachs, and they produce cud. Some are only rabbit size, they need far less room or feed than sheep, and thus are potentially an efficient test animal for determining the nutritional value of forages. Blue duikers, for instance, have a digestion efficiency comparable to that of sheep, but, because of their small size, a test needs only four rabbit cages and 5-10 kg of feed. Sheep, by comparison, require much more spacious facilities and 150 kg of feed.

In Nigeria, blue duiker pelts are used in making karosses, a traditional dress. A single garment may contain up to 60 pelts.

HUSBANDRY

Almost nothing is known about rearing duikers, but they seem to tame easily and perhaps may be kept in backyards like goats. Indeed, they reportedly make good house pets when hand raised. They are attractive, and from the day of capture young ones can be handled and petted.5

The Nigerian researchers who bred blue duikers to the fourth generation bottle-fed young specimens five times a day. Older animals were given feeds that included banana, plantain, and papaya; leaves of hibiscus, cassava, and banana; and dried corn. Variety seemed to be important, and the researchers could not predict the quantity of particular foods the animals would choose on any given day. In addition to varied vegetables, a small dish of salt or a salt lick was sometimes required.6

Duikers are unlikely to run away, except when startled. However, providing an enclosure is worthwhile. It enables them to establish a territory by marking poles, bushes, and fences. Although needing space in which to run, as little as 10 m² is reportedly sufficient for 24 animals.

Satisfactory shelters include an open-ended oil drum laid on its side, a lean-to made of palm frond, or a small hut made of local matting. Apart from providing shade and protection, shelters should be built so that excited animals can run through them. When cornered, duikers tend to either flee for shelter or jump upwards; a run-through shelter can prevent a frightened one from accidentally leaping over the fence.

Based on their own experiences, researchers at Pennsylvania State University in the United States report that blue duikers raised in captivity are easy to maintain,

reproduce well, and are not fussy about environmental conditions. In fact, they say, blue duikers seem to enjoy living in cages.⁷

In order to raise duikers successfully, post-pubertal males must be separated. A female should be bred with the same male throughout her productive life span.

THE BLUE DUIKER

In one sense, the blue duiker is the most important animal in Africa. It is the only one found throughout the continent south of the Sahara. It occurs at a greater range of altitudes than most - as low as sea level in many places to almost 5,000 m elevation in Kenya. It occurs in habitats from dense rainforests to dryland savannas. And, in sub-Saharan Africa as a whole, the blue duiker is eaten more than any other animal (although in West Africa it is generally called Maxwell's duiker).

This very small antelope, caught by snare or net, can be found in the meat markets of villages, towns, and cities in all countries from Senegal to Madagascar. It is a source of food for tens of millions. Bushmen, Pygmies, Dinkas, and Mandingos, thousands of miles apart; all share the same fondness for duiker meat and for duiker-skin clothes.

Nevertheless, scientifically speaking, this is one of the world's least-known animals. And its numbers are diminishing rapidly. Areas that used to have plenty now have few or none. Overhunting and destruction of the rainforests are jointly contributing to their decline.

Despite the losses, people are snaring as many as they can, and there is no sense

of concern - not even among most conservationists. However, in many locations there is already evidence that the animals won't be around much longer. Unless something is done - and soon - people will lose their major source of animal protein. If that happens, it is likely that they will move on to larger animals, such as gorillas, which would be an even worse disaster.

The best long-term solution is to organize duiker husbandry. Learning to rear duikers would benefit people throughout Africa. The blue duiker is the most suitable species; it is the most common and the most important. Also, it inhabits the edges of the forest and could therefore become a suitable species for ranching without denuding the forest.

Blue duikers are easy to maintain in captivity. They tame readily and like to shelter and sleep in boxes or cages. They are good converters of vegetation and produce top-quality lean meat. In addition, they are neither affected by tsetse flies nor are very susceptible to diseases.

The key now is to learn how to keep these very timid creatures under different conditions. We need to know their foods (especially foods that might be harvested from forests) and reproductive biology. We need to know the right numbers to house together. Most of all, we need projects aimed at rearing and breeding them in captivity under village conditions.

Vivian J. Wilson

ADVANTAGES

Many African countries already have a ready market for duiker meat. It is

somewhat similar to goat meat, but most people agree that it is superior.

The animal can live on fibrous vegetation. Unlike conventional ruminant livestock, it is suitable for feeding an average family at one meal.

The ability to forage in undergrowth where other domestic livestock do not thrive makes duikers potential livestock for tropical forest and bushland regions. They can be raised for meat without cutting the trees or bushes to create pastures.

LIMITATIONS

Duikers are easy prey for predators: eagles, pythons, wildcats, and people, among others. Thus, they probably require more sophisticated management than common livestock such as goats. However, the quality of their meat could more than compensate for the extra effort.

Some species are territorial, which means that they may do poorly in captivity, unless their social organization can be altered.

Under good conditions, the ideal slaughtering age reportedly occurs at 8-10 months, when the blue duiker can weigh 4 kg. Compared to rabbits and guinea pigs, production is relatively slow because of long gestation and lack of multiple births.

Duikers are resistant to trypanosomiasis.

One general problem is that duikers have short, sharp horns designed specifically for jabbing. This could be a potential danger, especially since the males of some

species become aggressive when their females are receptive. However, the horns can easily be clipped and taped to limit the danger.

RESEARCH AND CONSERVATION NEEDS

Because of the duikers' secluded lifestyle, much has still to be learned about their habits. Specific information on behavior and breeding is needed.

Animal scientists in Africa should gather small herds for comparative studies. This will provide insights into whether duiker temperaments facilitate or hinder their utilization. In addition, assessments of diet, growth rates, behavior in captivity, reproductive rate, adaptability, and future potential can be made. Management considerations include clipping horns, trimming hooves, and controlling lice and fleas.

Research of particular value would be chemical analysis of duiker milk and of other characteristic glandular secretions. The latter lend themselves especially to a study of animal communication.

Parming duikers might help rescue the wild populations by relieving hunting pressures. Programs in this area are recommended for locations where overhunting is occurring.



FIGURE

32 Other Small Antelope



Klipspringer

The least known and most obscure of all antelope are the delicate African creatures called dikdik, suni, royal antelope, pygmy antelope, and klipspringer. The smallest is a West African form of the royal antelope that stands a mere 25 cm high and weighs less than 2 kg. The four-horned antelope of South Asia is a similarly tough, tractable animal that is also the size of a small dog.

None of these has previously been seriously considered for use as livestock, but

they are possibly amenable to rearing in captivity and they provide some of the finest game meat in the world. Given New Zealand's experience with various deer species (see page 288) and Africa's experience with large antelopes, basic research to test out the possibility of organized dwarf-antelope production could prove to be rewarding.

AREA OF POTENTIAL USE

The areas where these antelopes might be used are sub-Saharan Africa for the African species and South Asia for the four-horned antelope.

APPEARANCE AND SIZE

Of these animals, some, such as the pygmy antelopes, have a crouched appearance with an arched back and short neck; others have a more upright posture with a long neck and a raised head. In all species, the males are smaller than the females and bear tiny spikelike horns.

DISTRIBUTION

Collectively, these antelopes have native ranges covering huge areas of Africa and part of Asia.

Dikdik: Six species occur in two discontinuous distributions - one from Somalia and Ethiopia southward through Kenya and Tanzania, the other in Namibia and Angola.

Sunis: Eastern Africa, from Kenya to South Africa.

Royal antelope: West African forests.

Pygmy antelope: Central Africa from southeastern Nigeria to Zaire.

Klipspringer: Ethiopia to the Cape of Good Hope.

Four-horned antelope: India.

STATUS

Many forms are protected by local laws, but none of the species is on the international endangered-species list.

HABITAT AND ENVIRONMENT

The animals occupy habitats from dense, moist forests to dry, rocky outcrops and even to deserts. Their ranges have almost certainly been affected by humans - sometimes for the better, since many prefer the secondary growth that invades disturbed areas, notably after overgrazing or slash-and-burn agriculture.

Although dikdik and klipspringer usually frequent dry areas with scattered brush, the other dwarf antelopes normally stay in dense vegetation. All seem to live in definite areas and do not migrate. For instance:

- Dikdik live near streambanks.

- Sunis inhabit dry country with thick bush, but they can also be found in reed scrub along rivers and in forests up to 3,000 m elevation.

- **Klipspringers live on stony mountain slopes, rocky outcrops' or the sides of steep gorges at altitudes from sea level to 4,000 m.**
- **Four-horned antelopes live in undulating or hill country and shelter in tall grass and open jungle, a terrain more common to deer than to antelope.**

BIOLOGY

Most of these antelope browse on shrubs. They are "concentrate selectors," taking easily digested vegetation such as buds, fruit, and succulent young leaves.

Also, most obtain much of their water requirement from dew and the vegetation they consume. Klipspringers, for example, are able to live for months without drinking. Sunis and four-horned antelope, on the other hand, drink regularly and seldom live far from water sources.

Little is known of the reproduction and general performance of these animals. Females become sexually mature at about 6 months in the smaller species and 10 months in the larger. Males become sexually mature at about 14 months. The young are born throughout the year, but births peak with the vegetation flush following the first rains. Where there are two rainy seasons a year, two birth peaks occur. Usually a single calf is born. Dikdik is the only one whose reproduction has been studied in detail. Its pregnancy lasts 172 days, one young is born at a time, and the birth weight is 600-800 g.

Their longevity is unknown but is probably in the range of 10-12 years.

BEHAVIOR

These tiny creatures have some of the habits of deer. They are shy and elusive and generally rely on concealment to escape detection. Their first response to a predator is to freeze, and then to flee like hares - dashing off in a series of erratic, zigzag leaps.

They live alone, in pairs, or in small family groups, but sometimes congregate in larger groups in thorn thickets. The species that have been studied most (dikdik and klipspringer) are strongly pair bonded. (A male, a female, and one or two young is typical, and a klipspringer rarely moves more than 5 m from its mate.) However, the royal and pygmy antelopes and the suni are more solitary in their behavior. Four-horned antelope are usually seen alone or in pairs.

These animals feed mostly in the early morning and late afternoon. Some species deposit dung and urine on particular sites. And they repeatedly daub secretions from glands in front of the eyes onto plant stems, where a sticky mass accumulates. Glands near the hooves mark the ground along frequently traveled pathways. Males also mark females with the scent, thus reinforcing the bond.

The four-horned antelope has a whistling call, which helps keep the family group together. Males repeat it frequently in hot weather. Gestation is 8-8.5 months. If taken young, they reportedly tame easily.

HUSBANDRY

Much more research needs to be done before attempts are made to convince anyone to domesticate these antelope. There are likely to be considerable difficulties. Guinea pigs, rabbits, and giant rats can successfully be kept in cages

or small enclosures, but most antelope probably cannot. Larger enclosures will be needed.

The food habits and general behavior of these small animals must be studied closely. They are strictly monogamous, and it may be necessary to keep them in pairs. Reproduction, growth, and general performance must become understood under different environmental and nutritional conditions. Mixing species is another aspect to be examined - whether these antelope can be kept with other species in the same enclosure (typical of livestock farming in most poor nations) is not known.

To settle such questions, representative species of microantelope should be gathered for comparative assessment. Researchers should focus on the animals' social structure, on husbandry methods for maintaining them over generations, and on how best to breed them. If the findings are promising, then a campaign to domesticate these antelope could be mounted.

USES

Throughout most of their ranges these animals are highly sought "bushmeats." The meat is lean and of extremely high quality. In Zaire's Ituri Forest, for example, pygmies net and kill large numbers of pygmy antelope, hanging the carcasses on sticks by the roadside for sale.

Because of their small size, these species might make good laboratory animals for ruminant studies. The dikdik, for instance, becomes a fully functioning ruminant at a body weight of about only 1.5 kg.² However, their digestive physiology is quite

different from that of cattle, sheep, and goats, which makes them atypical ruminants.

Given organized production, it is likely that dwarf-antelope pelts could become commercially important. North Africa exports the hides of medium-size antelopes to Europe for use in fine sueded leathers. Hides of the small species would almost certainly be in demand as well if a steady supply could be obtained as a by-product of meat production.

ADVANTAGES

Microantelope provide some of the finest game meat. They are small and perhaps tractable. Most are already widely eaten and are being eliminated over broad areas of their range. Turning them into a sustainable, economic food source could provide motivation for their conservation.

These antelope can digest, and are adapted to, the indigenous forage over vast areas of Africa and South Asia. They are native to tropical habitats, where cattle and other livestock often grow poorly. They also appear to be resistant to trypanosomiasis.

LIMITATIONS

Some African peoples (for example, the Kalahari Bushmen) have superstitions or social injunctions that prohibit the eating of some of these species.

Small antelope are probably not as efficient as larger ruminants in digesting fiber: the retention time in the rumen may be too short. On the other hand, quickly

digestible cell walls of lush green plants can be used efficiently.3

The territorial behavior of most of these species may limit their rearing in large numbers under captive conditions.

RESEARCH AND CONSERVATION NEEDS

As noted, preliminary research on dwarf antelope husbandry is required. Specifically, studies should be conducted to assess:

- Growth rates, feed efficiency, and reproductive rate;**
- Carcass quality;**
- Economics and the likely cost of production per animal unit; and**
- Studies of digestion.4**

**The few statistics available today on the use of wildlife as food are probably much below actual consumption. Most food consumption surveys record food obtained by hunting or trapping under the indiscriminate heading of "Bushmeat" and neglect to include the many small animals that are normally collected by children. In Africa, an amazing variety of wildlife is eaten, including all wild ungulates, primates, all cats, and many species of birds and reptiles.
Food and Agriculture Organization Ceres magazine**

All the world's people must begin to overcome in themselves - and even more so in their children - senseless taboos about what is edible and what is not. Only then

can we stop today's universal animal-protein wastage. How ironic it would be, in this scientific age, for mankind to starve largely because of a bunch of old wives' tales, irrational beliefs, silly associations, and the lack of a sufficient spirit of culinary and gustatory adventure.

Calvin W. Schwabe Unmentionable Cuisine

Iguana is really good, a thousand times better than chicken.

**Omero Asinto, waiter Pochote Bar and Restaurant
Barranca, Costa Rica**

