THE REPRODUCTIVE PHYSIOLOGY OF THE PLAINS VISCHACHA, *LAGOSTOMUS MAXIMUS*

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**Summary.** Plains viscacha were established in the laboratory to investigate their reproductive physiology. The species was found to have a mean oestrous cycle length of 45.0 ± 1.2 days and a mean gestation period of 153.7 ± 0.5 days. There was rarely an immediate *post partum* oestrus but if the young died at birth, oestrus occurred 17.1 ± 3.6 days later. When the young suckled, the mother exhibited a lactation anoestrus of 55.9 ± 3.7 days. The litter size was nearly always two, and these well-developed young were frequently of opposite sex. In captivity, births occurred throughout the year.

**INTRODUCTION**

The plains viscacha (Pl. 1, Fig. 1) is the largest member of the Family Chinchillidae, which comprises only three genera (Text-fig. 1). There has been some controversy in the literature about the correct priorities for naming these genera (Thomas, 1901; Allen, 1901, 1902; Lahille, 1906; Tate, 1935), but the generic names shown in Text-fig. 1 are those which are now generally accepted (Simpson, 1945). Of the three, *Chinchilla* and *Lagidium* are more closely related than is either genus to *Lagostomus* (Bennett, 1833, 1835a, b). The plains viscacha was first described by de Blainville (1820) under the name of *Dipus maximus* and subsequently named *Lagostomus trichodactylus* by Brookes (1828). Only one species, *L. maximus* (by priority) is recognized, although there are probably at least three distinct geographical varieties (Cabrera, 1957–61).

The plains viscacha is restricted to the pampas in Argentina and the major part of the South American literature on this animal is concerned with the
damage it does to agricultural land because of its burrowing activities (Gibson, 1877; Campbell, 1877; Hudson, 1892; Ambrosetti, 1893; Fernandez, 1949; Llanos & Crespo, 1952). Viscacha form and live in large colonies in extensive burrow systems called viscacheras. The animals emerge at dawn and dusk to feed on the surrounding vegetation which, in some areas, is mainly the grass *Stipa brachycaepa* and is locally known as ‘viscacha grass’. A good English account of the habits of the plains viscacha, including some information on reproduction, was given by Hudson (1872).

A comprehensive study of the ecology of the viscacha was published in Spanish by Llanos & Crespo (1952), and some details of reproduction were given. The species has not often been displayed in Zoological Gardens, partly because its burrowing and nocturnal habits do not make it a good exhibit, and partly because it has been reputed by many authors, including Hudson (1892), to die of ‘hysteria’ after a few days in captivity. Giusti & Hug (1922) managed to keep several animals alive for 6 months but did not study the reproduction of the species.

The present report is of an investigation into the reproduction of the plains viscacha in captivity; this species will subsequently be referred to as the viscacha.

### ANIMALS AND METHODS

**Capture of animals**

The colony in London was founded with forty-one adult animals (ten ♂♂, thirty-one ♀♀) which were captured by the author in Argentina in August 1967. Two males and ten females were from the Province of Entre Ríos (33°S, 59°W) and were more grey in colour than the remainder which were caught in Buenos Aires Province (39°S, 62°W). This colour difference is probably a reflection of the soil difference in two areas, clay in Entre Ríos and sand south of Bahia Blanca. No differences in physiology have been observed and the two types of animal have been mixed successfully in the laboratory colony. The viscacha were caught in wire mesh, treadle-type traps (National Live Traps) placed at the exits of burrows, or were flushed from the viscacheras by flooding. Few losses were sustained in Argentina and nineteen of the females gave birth within 2 months of capture (Text-fig. 2).

**Husbandry of animals**

A detailed account of the care and handling of the viscacha is given by Weir (1970), who reported that husbandry is the biggest problem of keeping these animals in captivity. Although they are colonial and gregarious in the wild, they may be very aggressive to each other in captivity; once a group has been formed, it is usually impossible to add other animals to it.

**Observations** (September 1967 to December 1969)

The viscacha were examined daily for reproductive condition. The female has a vaginal closure membrane (Pl. 1, Fig. 3) which becomes perforate at oestrus. The length of the oestrous cycle was calculated from the 1st day of opening at
one oestrus up to, but not including, the 1st day of opening at the next. Vaginal smears were taken once daily during oestrus and the pens were searched for remains of copulatory plugs. Gestation lengths were calculated from the day of finding a plug or spermatozoa in the smear. All the animals, except the largest males, were weighed once a week as a check for health, growth and possible pregnancy. The birth, sex and weight of young were recorded.

Standard statistical tests were applied and mean values are given with the standard error of the mean.

**RESULTS**

**Breeding season**

Nineteen out of twenty-three females were pregnant when caught in August and littered during the next 2 months. If the gestation period is 5½ months, this confirms that March to April is the main breeding season but does not preclude matings at other times of the year. Since 1967, births in captivity have become more evenly spread throughout the year (Text-fig. 2).

**Oestrus**

At oestrus, when the vaginal closure membrane is perforate (Pl. 1, Fig. 4), the vulva becomes swollen and a yellowish mucus may be secreted. The vagina stays open for 7·3 ± 0·2 days (N = 213), and mating usually takes place towards
the end of this period. Mating could be inferred by the appearance of blood at the vaginal opening, and confirmed by the finding of copulatory plugs (Pl. 1, Fig. 2) or spermatozoa in the vaginal smear.

The occurrence of oestrus during the period of observation shown in Text-fig. 3 indicates a high frequency in the first half of 1968 and a bimodal distribution in 1969. Individual animals exhibited fairly regular cycles; mean cycle length in forty-six animals (Text-fig. 4) was 45.0 ± 1.2 days (N = 152) and 68% of these cycles were 30 to 35 days in length. The incidence of random cycles was low since the majority were associated with puberty, parturition and the cessation of lactation.

It is possible that the viscacha may have an immediate post partum ovulation, but mating at this time was not usual and only one post partum conception has occurred under these conditions of husbandry. The time of occurrence of oestrus after parturition appears to depend on whether or not the young are suckling. When the young die at, or soon after, birth, oestrus occurs 17.1 ± 3.6 days (N = 12) later. This is a significantly shorter period (P < 0.001) than that.
Fig. 1. An adult female plains viscacha. × 0·3.
Fig. 2. The gelatinous Y-shaped copulatory plug of a viscacha. × 1.
Fig. 3. The vulva of the viscacha showing the closed vaginal membrane (arrowed). × 0·5.
Fig. 4. In an oestrous viscacha, the closure membrane (arrowed) is perforated, the vulva is swollen and a mucous secretion is prominent. ×0·5.

(Facing p. 358)
of 55.9 ± 3.7 days (N = 41) which was found when lactation was concurrent. The majority of conceptions in viscacha take place at the postlactation oestrus.

**Pregnancy**
Detection of pregnancy in conscious viscacha by palpation was not practicable. Most pregnant animals did not show consistent increases in body weight and changes of the nipples were not observed. Some viscacha had one, or occasionally two, periods of vaginal opening during pregnancy. The first of these periods occurred at 62.5 ± 3.6 days (N = 15) and a slight vaginal haemorrhage was occasionally seen but there was no swelling of the vulva. No separation of the pubic symphysis was detected before parturition and it was assumed that all animals were pregnant and would litter at a date calculated from the earliest possible oestrus period. In the groups of viscacha, it was observed that females near to term either sat apart from the others in the pen area or were left in sole possession of the coal-bunker shelter.

Accurate gestation lengths were obtained for twenty-three animals and the mean length was 153.7 ± 0.5 days. In another nineteen animals, the date of mating was not known and the gestation period could only be calculated within the limits set by the number of days they had been in oestrus. Thus, the range observed for the duration of pregnancy was 145 to 166 days.

**Parturition and lactation**
Parturition took place very quickly, mostly before 08:00 hours, and the interval between births was rarely more than 30 min. Young viscacha are fully furred at birth, their eyes are open and they can be extremely aggressive. There are two pairs of mammae which are laterally situated on the thorax. Suckling appears to take place exclusively from the anterior pair. The young adopt a
sitting posture when suckling and as they maintain this type of contact with the mother for several weeks, and sometimes for several months, it was not possible to ascertain the duration of lactation.

**Litter size and sex ratio**

An analysis (Table 1) of the litters born shows that 90% were twins and 50% of these were of the opposite sex. The sex ratio was 100♀♀ : 82♂♂.

<table>
<thead>
<tr>
<th>Size of litter</th>
<th>No.</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singletons</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Twins</td>
<td>55</td>
<td></td>
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</tr>
<tr>
<td>Opposite sex</td>
<td>(27)</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Both males</td>
<td>(12)</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Both females</td>
<td>(17)</td>
<td></td>
<td></td>
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<tr>
<td>Triplets</td>
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<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>61</td>
<td>65</td>
<td>54</td>
</tr>
</tbody>
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**Growth and sexual development**

At birth, young females weighed 185·0±4·6 g (N = 49) and males weighed 207·0±6·1 g (N = 28); this difference between the sexes (Text-fig. 5) increased during adolescence and adult males (6 to 8 kg) were nearly twice as heavy as females (2 to 4 kg). Young viscacha were weaned at varying times depending on other problems of husbandry, and age at weaning ranged from 29 to 70 days. In general, males were weaned at an earlier age and, for twenty-nine males, mean weight at this time was 645·5±35·7 g and for forty-two females it was 659·0±18·3 g. The mean age of thirty-one females when the vagina first opened was 153·7±3·4 days but there was some indication that this interval was less in viscacha born in 1968 and 1969 than in those that were conceived in the wild in 1967. Only five viscacha conceived at their first oestrus, at 83, 172, 203, 206 and 220 days of age. The mean age at first conception was 253·8±20·2 days (N = 15) and the mean weight of fourteen of these animals was 2510·0±136·8 g. The youngest animal to conceive (at 83 days of age) was mated by a much older male; the female which conceived at 172 days of age was housed only with her sibling.

**DISCUSSION**

This study was undertaken to compare the reproductive patterns of the viscacha with those of other hystricomorphs and especially with those of its relatives, the chinchilla (Weir, 1966, 1967a) and mountain viscacha (Pearson, 1949). The Hystricomorpha, so far as is known, are characterized by having a vaginal closure membrane (all except the coypu), long pregnancies, long oestrous cycles and well-developed young. These characters are not exhibited by myomorph or sciuromorph rodents.
The existence of a vaginal closure membrane in this species was not indicated by Llanos & Crespo (1952), although they mentioned that during the non-breeding season, the vagina was "extremely stuck with a yellowish very dry secretion". These authors did not observe mating or copulatory plugs but Camus & Gley (1922) showed that coagulation resulted from admixture in vitro of the secretions of the prostatic and vesicular glands. Copulatory plugs are found in several mammalian species and especially in hystricomorphs (mountain viscacha: Pearson, 1949; chinchilla: Weir, 1966; acouchi: Weir, 1967b; degu, Weir, unpublished observation). The Y-shape of the viscacha plug (Pl. 1, Fig. 2) is unusual, and appears at first to be a cast of the lumina of the vagina and uterine horns. Close examination shows that the whole plug is covered by
sloughed cornified tissue and that the arms of the Y are formed by expansion of a very corrugated epithelium of the anterior fornices of the vagina.

It has been reported that viscacha in the wild have only one breeding season per year which begins in March (Llanos & Crespo, 1952) or April (Hudson, 1872). However, Llanos & Crespo stated that 36% of females have a second pregnancy later in the year, and Gibson (1877) noted that viscacha bred both in the autumn and the spring. It is possible that a second pregnancy occurs more frequently in the northern populations of viscacha but the author was informed that, in southern Buenos Aires Province, they breed only in March. In captivity, viscacha have not apparently retained a distinctive breeding season; males are fertile throughout the year as in the wild (Llanos & Crespo, 1952). In 1968 (Text-fig. 3), oestrous periods of females and their F₁ offspring in captivity were evenly distributed throughout the first 8 months of the year. A similar spread was seen in 1969, but a new peak occurred towards the end of that year. Analysis of the animals contributing to this peak revealed that they were mainly F₂-generation viscacha. This may indicate that viscacha are again becoming seasonal breeders, but with a 6-month shift in response to the change of hemisphere. However, this pattern must be masked to some extent by the high conception rate at the postlactation oestrus in captivity. A lactation anoestrus is not unusual for hystricomorphs since it occurs in the chinchilla (Weir, 1967a), acouchi (Weir, 1971a) and the wild guinea-pig, Galea musteloides (Rood & Weir, 1970).

It is agreed that normally there is no post partum oestrus in viscacha but the present finding of a recurrence of oestrus soon after loss of a litter may explain the variation in apparent conception time noted by Llanos & Crespo (1952). Some of their difficulties of correlation were due to a miscalculation of the length of gestation which they gave as 120 days. In 1872, Hudson said that it was 145 days or just less than 5 months and this was a closer value to the present finding of 154 days for gestation length in the viscacha.

Llanos & Crespo (1952) also found that in fourteen uteri, ten sets of twin embryos were of the opposite sex and three sets were both female; a set of triplets was all female. With the three single foetuses (1♂, 2♀), this gave a sex ratio of 100♀ : 52♂. The present study was of viscacha actually born and the sex ratio (100♀ : 82♂) was much higher. This was not due to a differential mortality in utero since the very high incidence of twins was maintained through to parturition. In this larger sample, several pairs of viscacha were both males and the triplets were of both sexes.

The differences found between the present study and that of Llanos & Crespo (1952) are due to the difficulties inherent in studying a burrowing species in the wild. An explanation of some of these differences and the opportunity to investigate this interesting species further (Weir, 1971b) are possible only when the animals can be kept and bred in captivity.

ACKNOWLEDGMENTS

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was achieved through the generosity of the Royal Society, the Medical Research Council and the Wellcome Trust.

ADDENDUM

On 15th September 1970, a female viscacha gave birth to four female young and three of these have been reared successfully. Her two previous litters had comprised a pair of opposite sex and two females.

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