SIZE OF TESTES AND SCENT GLANDS IN CAPYBARAS, *HYDROCHAERIS HYDROCHAERIS* (RODENTIA: CAVIOMORPHA)

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The volume of the morrillo (snout scent-gland) of adult capybara (*Hydrochaeris hydrochaeris*) males was found to correlate significantly with testes mass ($r = 0.359$, $d.f. = 110$, $P < 0.0001$). This was independent of body size. Males in better condition did not have larger testes or morrillos, whereas age did correlate with size of the morrillo and testes. These results were related to the higher rates of scent marking and reproductive success of dominant males reported in previous studies.

Key words: ***Hydrochaeris hydrochaeris*, scent glands, testes, Venezuela**

The testes of mammals have two major functions, production of sperm and production of steroid hormones (Bronson, 1989; Flowerdew, 1987). Development of secondary sexual characters in males is largely under the control of sexual hormones (Flowerdew, 1987), and the hormonal status of an animal has been found in some species to be related to its social rank (Sachser and Pröve, 1986, 1988). Thus, a correlation between testes activity and size, social status and development of secondary sexual characters is to be expected. In the case of scent glands (often secondary sexual characters—Flowerdew, 1987), the production of a sometimes varied and complex group of chemicals (Macdonald et al., 1984; Somers et al., 1990; Stoddart et al., 1975) also is likely to be related to the hormonal status of the individual (Ebling, 1977), while scent-marking behavior commonly plays a role in social-status signalling (Brown, 1979; Kappeler, 1990). In capybaras (*Hydrochaeris hydrochaeris*), for instance, rates of scent marking and the size of a scent gland have been found to correlate significantly with rank (Herrera, 1986).

Capybaras, 50-kg caviomorph rodents, possess two scent glands. One gland, located on top of the snout, is called the morrillo (Macdonald et al., 1984), first described as a secondary sexual character by Rewell (1949). It consists of a black, shiny protuberance, in the shape of a half oval. The morrillo is highly developed in males, but generally invisible in females, hence its use to distinguish males from females in the field (Ojasti, 1973). Histologically, however, the gland appears to be present in both sexes (Macdonald et al., 1984). The other scent gland found in capybaras consists of a pair of pockets located next to the anus. This gland is developed in both sexes, although, structurally, there are important differences between males and females (Macdonald et al., 1984).

Capybaras live in stable social groups (Herrera and Macdonald, 1987) with a marked dominance hierarchy among the males (Herrera, 1986). In these groups, both sexes frequently use the anal gland, but females rarely use the morrillo while dominant males scent mark with the morrillo more often than subordinates (Herrera, 1986). Also, dominant males have a bigger morrillo, are heavier and mate more often than subordinates (Herrera, 1986). As a first approximation to understanding the relationship between testes activity and scent gland function in capybaras, and its rele-

vance to social dominance, I investigated the possible existence of a correlation between testes mass and morrillo size.

Materials and Methods

Material for this study was obtained from the capybara slaughter carried out in February (dry season) of each year at a ranch called Hato El Frío (7°45′N, 68°55′N), located in the seasonally flooded savannas of Venezuela (Estado Apure). In 1990, a randomly chosen sample of males was taken from those killed (adults only are killed) and the following data were collected for each animal: body mass to nearest 1.0 kg (excluding the gut, since workers removed the digestive tract too quickly to allow weighing of the whole animal), testes mass (nearest 0.5 g), length, width and height of the morrillo (nearest 1.0 mm), and heart mass (nearest 0.5 g). To assess skeletal size, the humerus was collected and measured (nearest 1.0 mm). This bone also was used to classify animals into age classes according to the ossification of sutures as determined by Ojasti (1973). An index of condition was calculated by dividing the mass of the heart by the cube of the length of the humerus (L. M. Gosling, pers. comm.). Morrillo volume was calculated by approximating its shape to that of a half oval and using the formula $(1/2)(4/3)\pi$ abc, where a, b and c are the three radii of the oval (one-half the length, one-half the width, and the height of the morrillo, respectively). Note that, since the slaughter of 1990 was the first after 3 fallow years, the population had time to recover to some extent from a possible effect of the slaughter on age structure or body size.

Results and Discussion

My results show that, as expected, there was a significant, positive correlation between testes mass (average of both testes) and morrillo volume ($r = 0.359$, $d.f. = 110$, $P < 0.0001$, Fig. 1). This result could be affected by the fact that larger males have both heavier testes and larger morrillos, since both of these variables correlate significantly with body mass (testes mass and body mass, $r = 0.433$, $d.f. = 111$, $P < 0.0001$; morrillo volume and body mass, $r = 0.375$, $d.f. = 109$, $P < 0.0001$). To take this into account, the partial correlation coefficient (Sokal and Rohlf, 1969) between testes mass and morrillo volume using body mass as covariant was calculated and found significant ($r_p = 0.235$, $n = 108$, $P < 0.05$). Also, as another method to account for the effect of body size, both morrillo volume and testes mass were divided by body mass. The correlation between these two indices also was significant ($r = 0.208$, $d.f. = 105$, $P < 0.05$). Since these data were collected in the dry season, a time of minimal sexual activity (Herrera, 1986) and when testes mass is reduced (Ojasti, 1973), differences in testes size among males at this time also are likely to be less marked. I expect the trend to be enhanced when sexual activity peaks in the wet season.

The trend found suggests that males with greater activity of sex glands, irrespective of body size, are able to maintain a greater morrillo, characteristic of dominant males who also have greater sexual activity (Herrera, 1986). Similar results have been found in a number of other species of rodents (Barnett et al., 1980; Bronson and Marsden, 1973).

Herrera (1986) found one possible function of scent marking with the morrillo to be status signalling. If, as the present results suggest, the chemical composition of the scent secretion, both in quantity and quality, is somehow related to, or even controlled by, hormones produced in the testes, then scent could be a difficult to cheat (Krebs and Dawkins, 1984) status-signalling mechanism. This way, scent could help in the maintenance of the rigidly linear-dominance hierarchy observed in capybaras (Herrera, 1986).

No significant correlation was found between morrillo volume or testes mass and condition index ($r = 0.135$ and $r = 0.116$, respectively). Since Herrera (1986) found little evidence to support the hypothesis that dominant males had better access to food or other vital resources, this result is expected. Receptive females are certainly the major resource to which dominant males have priority of access (Herrera, 1986).

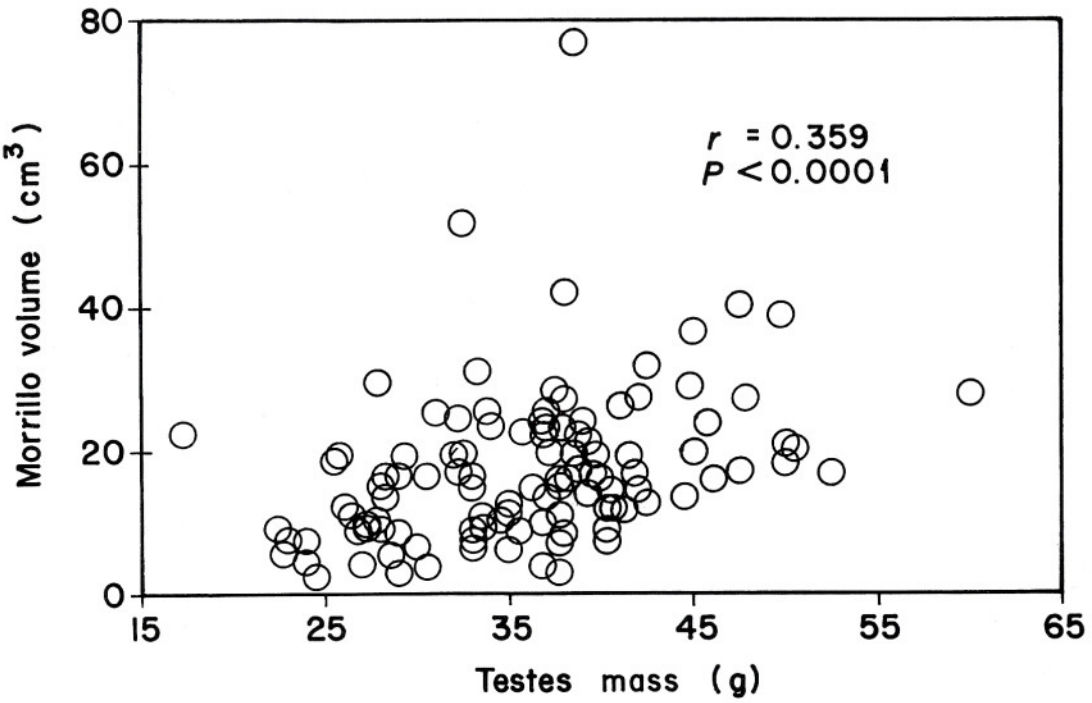

FIG. 1.—Correlation between scent-gland (morrillo) volume and testes mass (average of both testes) of capybaras (*Hydrochaeris hydrochaeris*) in Venezuela, $n = 110$.

Morrillo volume and testes mass both correlated significantly with age class (Spearman rank correlation coefficient, $r_s = 0.538$, $P < 0.001$, $n = 114$; $r_s = 0.326$, $P < 0.01$, $n = 116$, respectively), suggesting that older males tended to have greater sex and scent gland activity and were therefore more likely to be dominant. Such a correlation between age, dominance status and reproductive success has been found in a number of other mammalian species (e.g., Clutton-Brock et al., 1982; Le Boeuf and Reiter, 1988). In the case of capybaras, this result suggests that males line up for dominant positions, with older males ranking higher than younger ones. Some males, however, are able to retain the dominant position for at least 3 years (Herrera, 1986). Since capybaras in the wild probably live a maximum of 7 years (Ojasti, 1973) and groups may have up to five subordinates (Herrera and Macdonald, 1987), many males will certainly fail to reach the top-ranking position within their lifetimes.

According to the equation that predicts testes mass (sum of both testes) from body mass for rodents obtained by Kenagy and Trombulak (1986), the mass of testes of capybaras should be 137.0 g. It is in fact 72.5 g, nearly one-half the predicted value. Furthermore, Harcourt et al. (1981), Heske and Ostfeld (1990) and Kenagy and Trombulak (1986) conclude that monogamous and single-male polygynous mammals should have relatively small testes, while those living in multi-male groups should have larger testes than predicted. In the social system of capybaras, more than one male in the group mates and it is possible that the same female is mated by more than one male (Herrera, 1986). Under such circumstances, there is opportunity for sperm competition and hence for large testes, as predicted by the authors mentioned above. One possible reason for the discrepancy between the predicted testes size and the actual size is the fact that the capybara is an unusually large rodent and the data set (133 species) used

by Kenagy and Trombulak (1986) is mostly composed of small species, where testes occupy a greater proportion of body mass, regardless of the mating system. Thus, it is possible that the equation is biased toward small body size and large testes size. An alternative approach would be to use the equation for Artiodactyla, many of whose species are closer to capybaras in body size and ecological niche (Dubost, 1968). The new predicted value is 84.6 g, much closer to that of capybaras. Perhaps the occurrence of multiple matings in groups of capybaras is rarer than it appears, or the short estrus of females makes a second mating unlikely to be successful (López-Barbella, 1982). Nevertheless, body size and ecological circumstances must be considered when attempting to relate social systems to anatomical features, since they can be more important than taxonomic groupings.

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