



Macro-Anatomy of Male Reproductive Organs of African Striped Ground Squirrel (*Xerus Erythropus*).

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ABSTRACT

*In this study, ten African striped ground squirrels (ASGS) (*Xerus erythropus*) obtained in Zaria and environs with the aid of traps between January and May, 2017 were transported in iron cages to the research laboratory in the Department of Veterinary Anatomy, Ahmadu Bello University, Zaria. After acclimatization for twenty-one days, the animals were weighed separately using a weighing balance (Fuji Keiryo weighing scale K-1, 210 × 210, 200g - 8kg) and then Thiopental sodium was administered at the dose of 30mg/kg to euthanize the animals. The testes, epididymis, ductus deferens and penis were then obtained by making an abdomino-pelvic incision and exposing the organs. Each organ was studied grossly. Observations for shape, colour and general architecture were made and photographs taken using a digital camera (Samsung SH100, 14.2 megapixels). From this study the testes of ASGS is dark-red in colour. The left and right epididymis is closely attached on the left and right testis. Each epididymis is anatomically divided into caput, corpus and caudal epididymis. The caudal epididymis has two aspects as the fixed and free part of the caudal epididymis. The penis is long and slender with an average length of 8.5 cm, and appears white in colour. The glans is covered by an external prepuce in the non-erectile state. The baculum is a sickle shaped single bone on the glans, and it has an average length of 1.9 cm. The prostate gland is a single gland just below the urinary bladder, the bulbourethral gland is located in the ischio-cavernosus muscle at the crura of penis, and closely attached to the distal aspect of the pelvic urethra linking the penis. The seminal vesicles are paired, and oval shaped glands proximal to the urinary bladder. In conclusion, the gross appearance of the male reproductive organs of the ASGS has anatomic modifications which is suggestive of its mating tendencies in the wild.*

Keywords: Male, Squirrel, Reproductive, Gross, Anatomy

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INTRODUCTION

Squirrels belong to a family of medium-sized rodents called Sciuridae [22], and include tree squirrels, ground squirrels [6], chipmunks [4], marmots and flying squirrels [5]. The African striped ground squirrel is pale sandy to reddish and dark-brown in colour [8]. Hairs are flat in cross section and longitudinally grooved for part or all of their length [22]. Tail is bushy and is covered by long multi-coloured hairs that form alternating light and dark bands [8]. Stripped ground squirrels are terrestrial and their relatively short claws are adapted for digging than climbing [16], although in some instances, they climb into shrubs in search of fruit [8]. Adults weigh between 0.5 and 1 kilogram [11]. The African striped ground squirrel (*Xerus erythropus*) is found typically in Africa. Ground-dwelling squirrels have been considered as the perfect model group of rodents for studying reproductive strategies in wild rodents. Most of the species of ground dwelling squirrels are diurnal, burrowing, obligate hibernators living in open landscapes and active for a short season above ground [23].

Ground squirrels are a group of rodents that exhibit a wide diversity of mating systems [23] varying from obligate monogamy, for example, in Alpine marmots (*Marmota marmot*), through various forms of polygyny as in (*M. flaviventris*) or prairie dogs (*Cynomys gunnisoni*), (*C. ludovicianus*), (*C. parvidens*) to promiscuity, as in *Ictidomys tridecemlineatus* [5]. The study of gross morphology is important to establish the various species adaptations due to varying levels of sexual tendencies and reproduction.

There is paucity of information on the macro-anatomy of the male reproductive organs of ASGS (*Xerus erythropus*). It is therefore imperative that each species be studied and the modifications compared and linked to their sexual behavioural characteristics to further understand the function of each organ. This is because most break-throughs in human reproductive health are a direct result of research in animal models. Furthermore, animal models have contributed a great extent, to our understanding and advancement in the field of reproductive medicine, and many current medical and surgical therapies in sexual medicine are also

the direct result of the development of such animal models.

MATERIALS AND METHODS

Ten (10) apparently healthy adult male African striped ground squirrels (*Xerus erythropus*) were caught alive and unharmed from the wild between the months of January and May, 2017 by use of specialized traps in Zaria and environs and conveyed in cages to the Department of Veterinary Anatomy, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria where the research was conducted. Ethical clearance was sought and obtained from the Care on Animal Use Committee (CAUC), Ahmadu Bello University, Zaria with reference number ABUCAUC/2018/025. The parameters routinely used for determining the age of rodents such as body weight and closure of the epiphyseal growth plate were used to ascertain the maturity of the squirrels. Research animals were acclimatized after being brought from the wild for a period of twenty-one days, and during the period, they were fed with groundnut, sweet potatoes, tomatoes, cabbage and water *ad libitum*. Blood samples were analysed at the Department of Parasitology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria for haemo-parasites. The body weights of the animals were obtained using a weighing balance (Fuji Keiryo weighing scale K-1, 210 × 210, 200g - 8kg) and then euthanized with 30mg/kg body weight of thiopental sodium anaesthesia. The body length (distance from the top of the nose, to the tip of the tail) of each animal was measured using a measuring ruler. And then placed on dorsal recumbency and an incision made on the skin of the scrotum to gently reflect and expose the testes with the epididymides and ductus deferens firmly attached. Photographs of the organs were taken repeatedly for the various animals and weighed separately using electronic balance GG 1000 USA, with sensitivity 0.01.

RESULTS

Macro-Anatomical findings

The scrotal sac of the ASGS is moderately large and flabby (**Plate 2**). The testicles are paired, dark red in colour and bean shaped and well vascularized (**Plates 3, 4 and 5**). The epididymis is visible on the

medial aspect of both testes and anatomically divided into caput (most cranial), corpus and caudal epididymis (most distal) (**Plate 3**). The caudal epididymis is further divided into fixed and free portions (**Plate 3**).

The ductus deferens is a continuation of the epididymis at the point of the cranial aspect of both testes and run cranially from both testes and it is translucent in appearance. (**Plate 4**).

The accessory male glands of the ASGS include; the coagulating glands, seen as paired projections beneath and behind the prostate, the prostate is a spherical gland seen below the urinary bladder, and the bulbourethral gland is visible just below the prostate (**Plate 8**). The penis of the ASGS are long and slender in appearance (**Plate 7**), with an average length of 8.5cm. The penis has three divisions; a root, body and glans. A sickle-shaped baculum of average length 1.9 cm is prominent on the glans (**Plates 6 and 7**). The anogenital distance is the length between the anal opening and the penis, and has an average length of 8.9cm (**Plate 2**).

DISCUSSION

The testes of ASGS (*Xerus erythropus*) are dark-red in colour. The colour of testes changes depending on the state of reproduction. A sexually active testes usually appear white in colour due to accumulation of lipids [10]. The testes of ASGS is highly vascularized as multiple blood vessels are seen grossly as they cover the cross-sectional area of the testes. [9] gave a similar report in the bull. In his findings, he stated that the degree of convolutions and the dimensional area of the testicular blood vessels is thought to be significant in the thermoregulatory mechanism of the testes. Also, it is thought that, there exists an intimate relationship between the testicular blood vessels and the pampiniform plexus, especially for the temperature regulating mechanism of the testicular blood. In the ASGS it may be imperative to note that vascularization of the testes may be a sign of an adaptation for a good thermoregulatory ability to enable the sperm cells survive in adverse tropical climates. [12] studied the testes of two species of rodents (*Apodemus sylvanus* and *Apodemus flavicollis*) and reported that the testes of both

rodents are white in appearance. The disparity in these findings suggests that the sexually active and sexually in-active testis vary in their gross appearance.

A sickle-shaped baculum is visible on the glans of ASGS. The baculum is a collection of smaller bones made up of hyaline cartilage which ossifies during puberty [2]. It is thought that the baculum functions in conjunction with hydrostatic mechanisms, to provide rigidity required for a successful mating, which is required mostly in the promiscuous species like the *Xerus erythropus*. Variation in anatomical modifications of the male organs among species of mammals may be linked to their sexual activity and mating tendencies [14]. It has been observed that males co-existing with other males in the presence of females tend to have longer penises than those males existing without their male counterparts. In wild populations subjected to higher levels of sperm competition, males developed bacula that were significantly wider than males from low sperm competition populations [18]. In this specie, three accessory male sex glands are present, namely, the coagulating gland, prostate and bulbourethral gland. The anogenital distance is the distance from the anal opening to the scrotal sac [7], and has an average length of 8.9cm. The 8.9 cm is a baseline value for anogenital length in the sexually mature ASGS. The value of anogenital distance tends to increase with body weight.

Conclusion

In conclusion, the present study established that all the features of the male reproductive organs of ASGS have been anatomically modified to suit its mating and reproductive needs.

Conflict of Interest

The authors declare that they have no competing interests.

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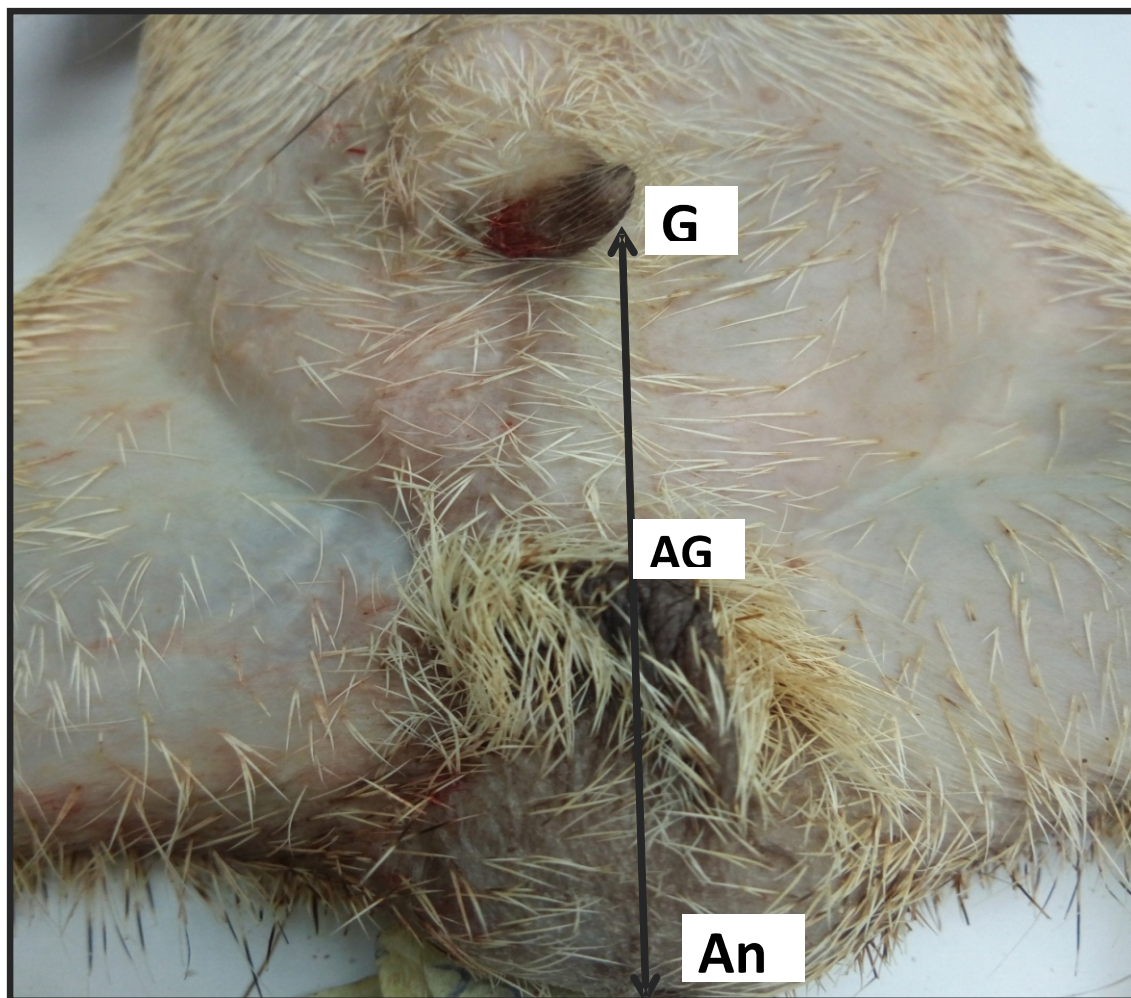


Plate 1: Photograph of the genital area of ASGS (*Xerus erythropus*) showing anogenital distance (AGD) indicated by the black arrow which extends from the glans penis (Gp) to the anus (An).

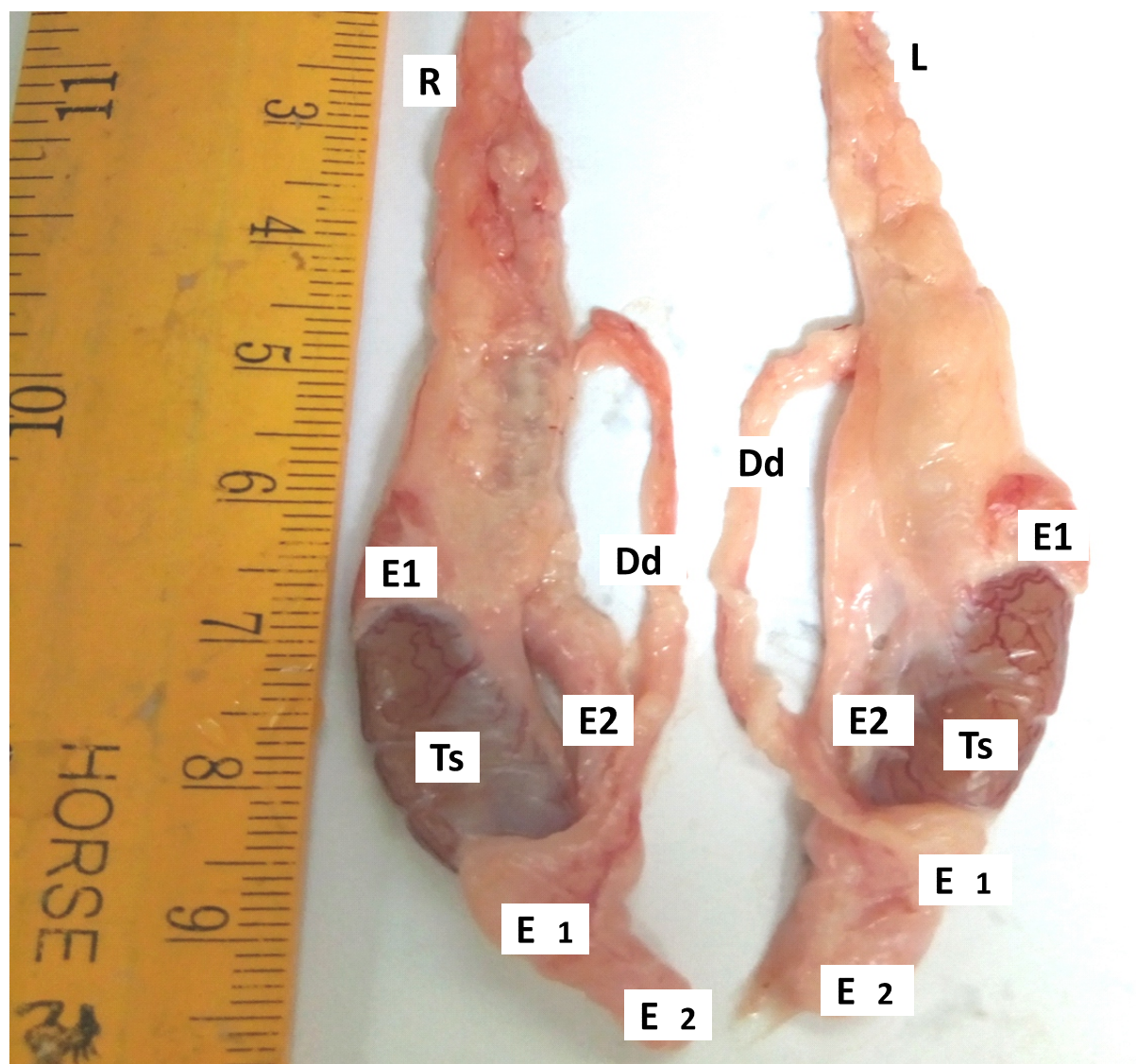


Plate 2: Photograph of both right (**R**) and left (**L**) testes of the ASGS (*Xerus erythropus*) showing the Testis (**Ts**), caput epididymis (**E1**), corpus epididymis (**E2**), fixed caudal epididymis (**E3₁**), free caudal epididymis (**E3₂**) and ductus deferens (**Dd**).

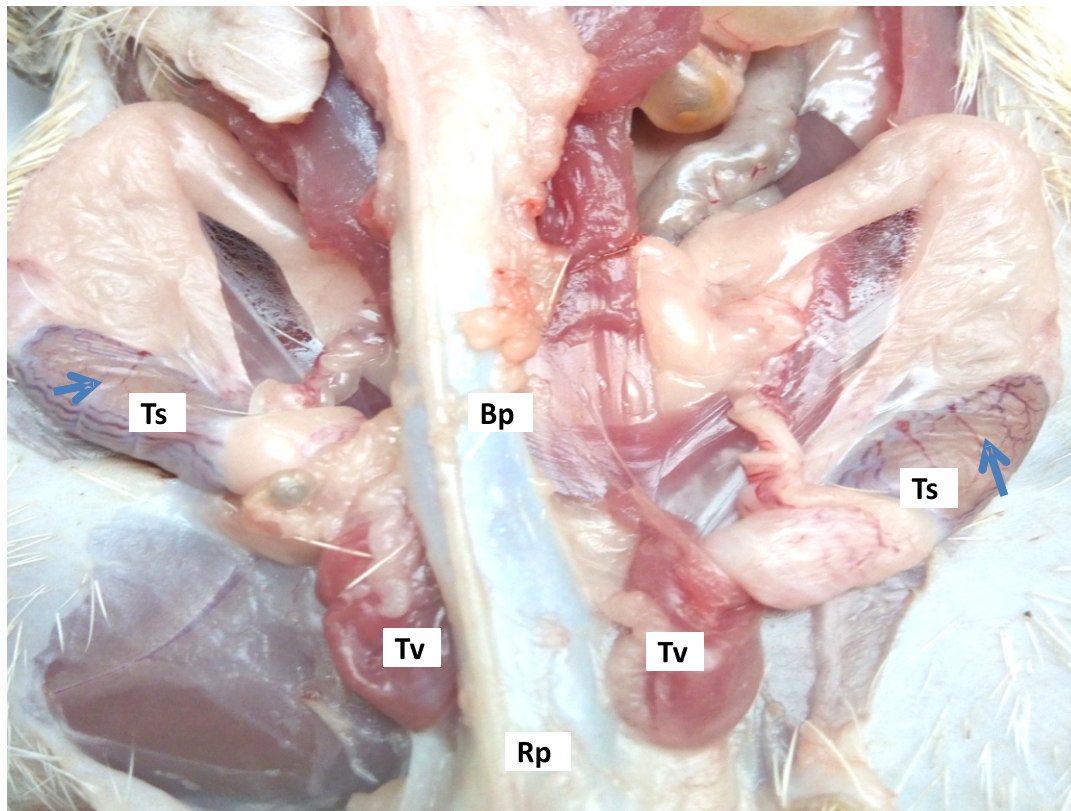


Plate 3. Photograph of the gross presentation of the male reproductive organs of the ASGS (*Xerus erythropus*) *in situ*. Note the testis (Ts), root of the penis (Rp), body of penis (Bp), the tunica vaginalis (Tv). Note the testicular blood vessels (Blue arrows).

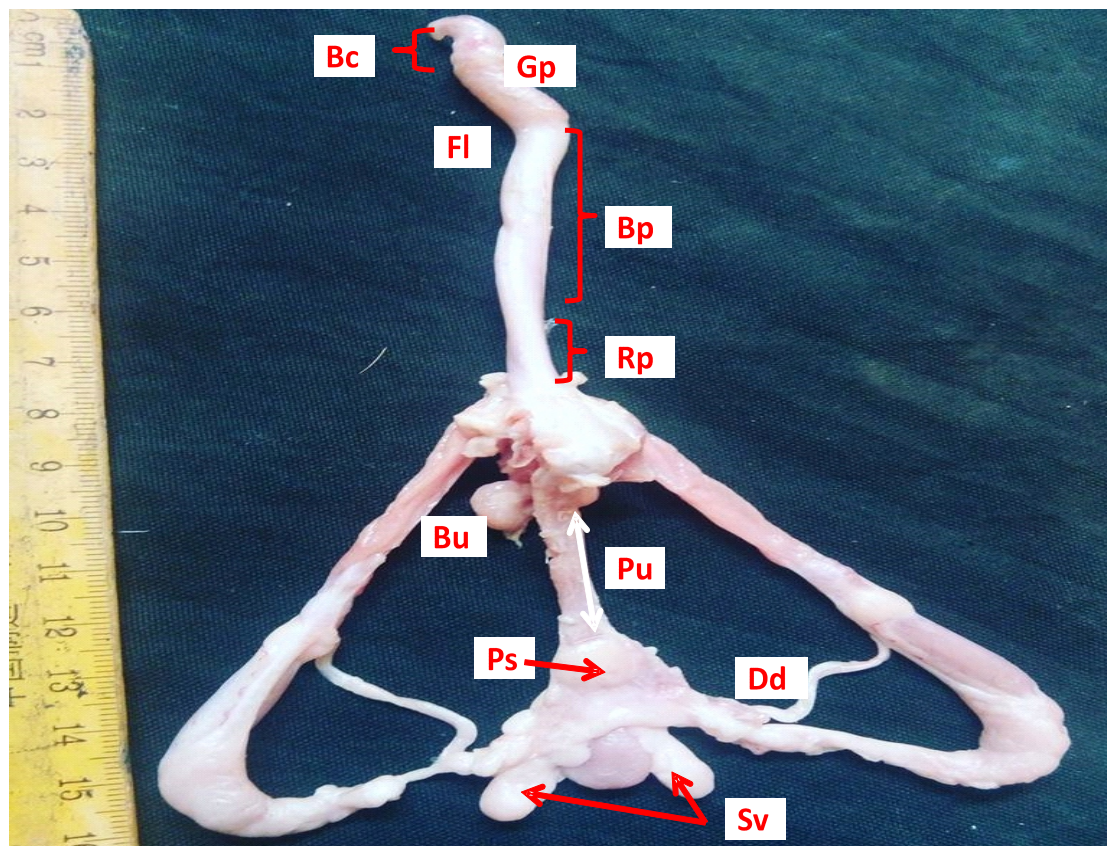


Plate 4 : Posterior-ventral view of the male reproductive organs of ASGS (*Xerus erythropus*). Note the paired seminal vesicles (Sv), prostate (Ps), ductus deferens (Dd), bulbourethral gland (Bu), root of penis (Rp), body of penis (Bp), glans penis (Gp), the flexion (Fl) and os penis or baculum (Bc). Note also, the pelvic urethra (Pu) is marked by white arrow.

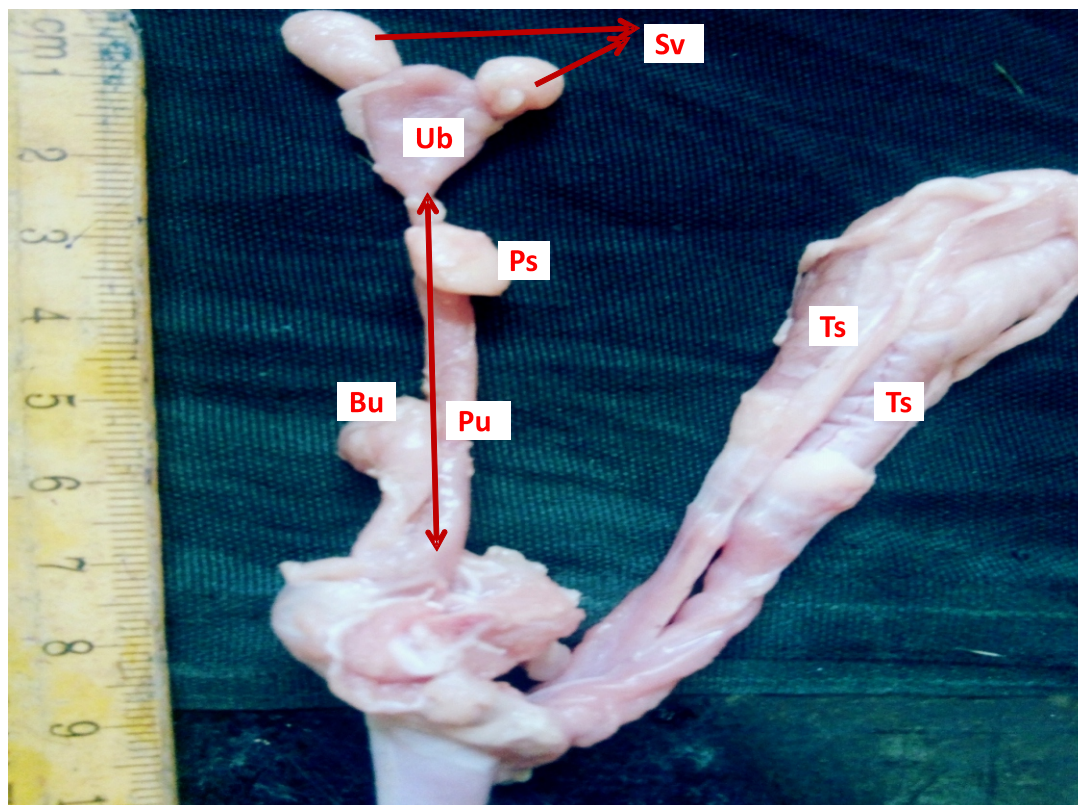


Plate 5: Anterior-ventral view of the male reproductive organs of ASGS (*Xerus erythropus*) showing the paired seminal vesicles (Sv), separated by the urinary bladder (Ub), prostate (Ps), bulbourethral gland (Bu), the paired testes (Ts) and the pelvic urethra (Pu) marked by red arrow.

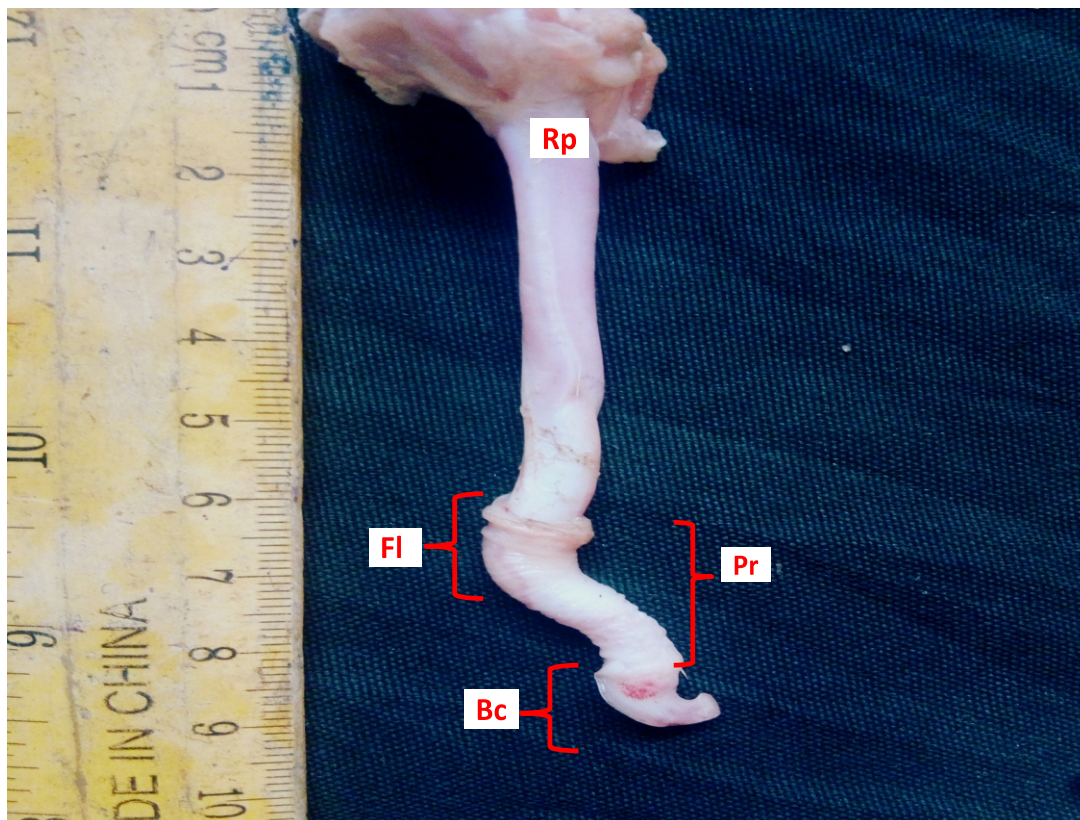


Plate 6: Lateral view of the penis of ASGS (*Xerus erythropus*). Note the flexion (Fl), fore-skin or prepuce (Pr), the Os penis or baculum (Bc) and the base or root of penis (Rp).