Chromosomes of the squirrel *Funambulus palmarum bellaricus* Wroughton

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Summary. The chromosome complement of *Funambulus palmarum bellaricus* Wroughton (Mammalia - Rodentia - Sciuridae) has been studied for the first time, and the diploid number established to be 54, in contrast to the subspecies *F. p. palmarum* which has 2n = 46 chromosomes. The known karyotypes within the genus *Funambulus* are compared.

The genus *Funambulus* consists of 5 species, viz., *F. pennanti, F. palmarum, F. tristriatus, F. sublineatus* and *F. lyardi.* The diploid numbers of *F. pennanti, F. tristriatus* and *F. palmarum palmarum* have been reported[2-5]. In this communication, detailed karyotypic data of the 3-striped squirrel, *F. palmarum bellaricus* is presented for the first time and a comparative study is made on karyotypes of different species of the genus *Funambulus.*

Materials and methods. 20 specimens consisting of 9 males and 11 females collected from Poona University campus (Pune, India) were used for the present study. The taxonomic identification of the specimens was carried out by Dr M.S. Pradhan, Assistant Zoologist, In-charge of Mammals Section, Zoological Survey of India, Western Regional Station (ZSI, WRS), Pune, with the help of a key and other descriptions given by Ellerman[6,7].

The bone marrow technique of Raymond Lee[8] was used with slight modification. In place of 1.0% sodium citrate 0.563% potassium chloride was used for hypotonic treatment. The slides were stained with buffered Giemsa (pH 6.8). The karyotype was constructed from enlarged photomicrographs and morphometric analysis of chromosomes was carried out.

Results and discussion. All the specimens used showed the diploid chromosome number to be 54. The karyotype consists of 2 pairs of metacentric, 6 pairs of subacrocentric and 18 pairs of acrocentric chromosomes. The X chromosome is submetacentric and measures 6.37% of the total haploid genome. The Y chromosome is subacrocentric and is 3.98% of the total haploid genome. The smallest chromosome in the complement, the last acrocentric, contributes 0.53% of the total haploid genome (table, figs 1 and 2).

The karyotype of the species under this study shows considerable deviation from that of *F. palmarum palmarum.* The diploid set of *F. p. palmarum* has 46 chromosomes[5]. It includes 2 pairs of metacentric, 9 pairs of submetacentric, 11 pairs of acrocentric, and submetacentric X and Y chromosomes. *F. p. bellaricus,* however, shows reduction in the number of biarmed chromosomes, the total number of which is only 16. The number of the acrocentric chromosomes has gone up to 36. Both X and Y are biarmed in both subspecies. The karyotype of *F. tristriatus* (2n = 46) is similar to that of *F. p. palmarum* except for the presence of a large submetacentric Y in the latter[4].

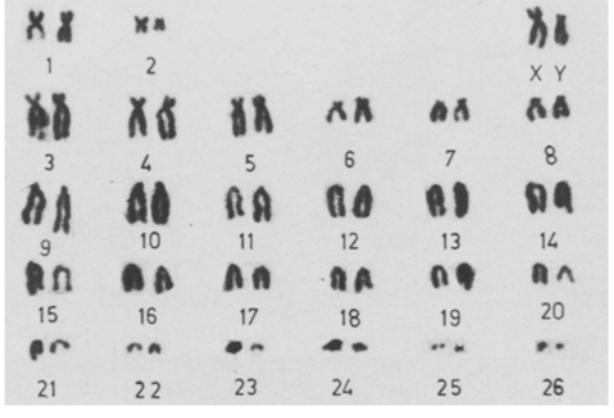

Figure 1. Karyotype of male *Funambulus palmarum bellaricus* (2n = 54).

A comparison between the karyotypes of different species belonging to the genus *Funambulus*

Species	2n	Autosomes* m-sm-sa a		X	Y	NA**
F. pennanti[3]	54	18	34	sm	a	70
F. tristriatus[4]	46	26	18	sm	a	70
F. palmarum palmarum[5]	46	22	22	sm	sm	66
F. palmarum bellaricus (present study)	54	16	36	sm	sa	68

* m, metacentric; sm, submetacentric; sa, subacrocentric; a, acrocentric. ** NA, number of major autosomal arms.

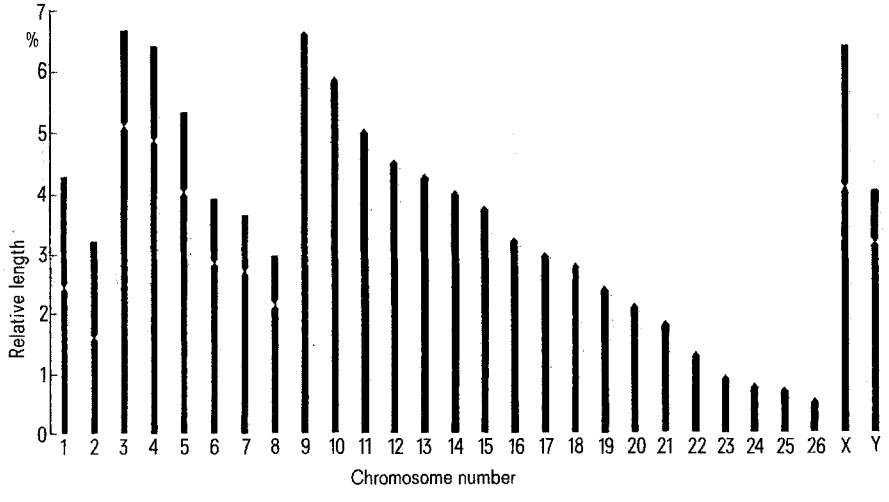

Figure 2. Idiogram of male *Funambulus palmarum bellaricus.*

The 5-striped squirrel, *F. pennanti,* shows a diploid number of 54[2,3]. *F. p. bellaricus* shows the same diploid number. However, it has 2 biarmed chromosomes less and 2 acrocentric chromosomes more than *F. pennanti.* X chromosomes of both are large biarmed chromosomes but the Y chromosome of *bellaricus* is a large subacrocentric unlike the small acrocentric Y chromosome of *F. pennanti.*

Assuming the modal number for the genus *Funambulus* to be 2n=46, *F. tristriatus* would appear to have arisen first and the other 4 species subsequently in the following order: *pennanti, palmarum, sublineatus* and *lyardi*[4]. Rao et al.[4] further state that the karyotype of *F. pennanti* seems to have arisen from that of *F. tristriatus* through the mechanism of centric fission. In the present case, however, it is difficult to ascertain the presumed Robertsonian changes with any precision.

Chromosomes are utilized in rodent taxonomy as characters for diagnosis and as a means for establishing phylogenetic relationships[9]. For instance, chromosomes are diagnostic in tree and flying squirrels of the genera *Sciurus, Tamiasciurus* and *Glaucomys*[10]. At times, even subspecies may be differentiated by their chromosomes as in the case of the ground squirrel, *Spermophilus richardsonii*[11] and in the present report. Thus, concerning the phylogenetic relationships in the genus *Funambulus,* chromosomes can possibly be used as indicators at specific and infraspecific levels.

1 We thank Prof. G.T. Tonapi for providing the laboratory facilities and the Zoological Survey of India, Western Regional Station, Pune for identifying the specimens.
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Inhibition of germination in *Striga* by means of urea

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Summary. In vitro seed germination percentages and radicle lengths of *Striga hermonthica* markedly decreased in the presence of urea at concentrations which could be expected in the field after standard application rates. Relatively high concentrations of ammonium sulphate brought about a similar effect while sodium nitrate was ineffective.

Striga species are very troublesome parasitic weeds which, especially in the Sahel area, cause great losses in the yields of the staple crops sorghum, millet and maize. Control is very difficult as considerable damage has been done to a host plant before the parasite emerges above the soil. Therefore handweeding, or chemical control, for example with 2,4-D, are not very effective. Moreover, the seeds remain viable for many years and only germinate in the presence of a germination stimulant(s), which occurs in the root exudate of host plants and certain non-host plants. *Striga* is particularly a pest of low fertility soils and usually the infestation decreases if nitrogenous fertilizers are applied[2-8]. However, it is unknown which stage(s) in the life cycle of the parasite is affected.

We have found that urea, at concentrations which may be expected to occur in the field after standard application rates, markedly inhibits in vitro seed germination of *S. hermonthica.* This is not only seen in the germination percentage, but also from the length of the radicles. In the presence of ammonium sulphate, at concentrations which were relatively high from an economic point of view, there was also a marked inhibition of the radicle length, while sodium nitrate was ineffective at the concentrations tested.

The seeds of *S. hermonthica* (Del.) Benth. which were used in the present study, had been collected in 1978 in Wad Medani in the Sudan and were received in February 1980 from Dr S.O. El Hiweris of the University of Khartoum. They were stored in our laboratory in the dark at a temperature of 5 °C and a relative humidity of approximately 70%. A synthetic germination stimulant, GR-24, was obtained from Dr A.W. Johnson of the University of Sussex, Brighton, UK.

The experiments were carried out in 9 cm diameter Petri dishes in an environmental chamber at 25±2 °C in the dark. During the conditioning period (14 days) as well as during the germination test (2 days) the seeds were exposed to various concentrations (pure laboratory chemicals were used) of urea, $(NH_4)_2SO_4$ and $NaNO_3$ (as well as NaCl in order to check any effect of salts). The pH was adjusted to 6 respectively 7.5 with 0.001 M KH_2PO_4/NaOH buffer. This

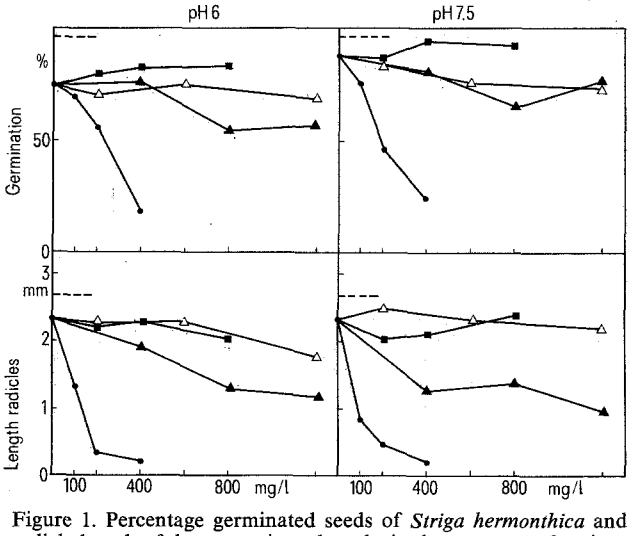

Figure 1. Percentage germinated seeds of *Striga hermonthica* and radicle length of these germinated seeds, in the presence of various concentrations of ● Urea ▲ $(NH_4)_2SO_4$, ■ $NaNO_3$ and △ NaCl added to a 0.001 M KH_2PO_4/NaOH buffer solution.
---- Germination percentage and radicle length when seeds were exposed to demineralized water only.