

AS
36
P7X
SI

(505.73)
(P4P6842)

ISSN 0097-4463

ANNALS of CARNEGIE MUSEUM

CARNEGIE MUSEUM OF NATURAL HISTORY

4400 FORBES AVENUE • PITTSBURGH, PENNSYLVANIA 15213

VOLUME 53

14 DECEMBER 1984

ARTICLE 18

KARYOTYPES OF SOUTHERN AFRICAN GERBILS, GENUS *GERBILLURUS* SHORTRIDGE, 1942 (RODENTIA: CRICETIDAE)

DUANE A. SCHLITTER

Associate Curator, Section of Mammals

I. L. RAUTENBACH¹

C. G. COETZEE²

ABSTRACT

Standard karyotypic data are presented for the species of the southern African rodent genus *Gerbillurus*. *Gerbillurus paeba* and *G. tytonis* have a diploid number of 36 and 68 autosomal arms. The karyotypes are morphologically similar to each other. *G. vallinus* and *G. setzeri* have a diploid number equaling 60, but the karyotypes differ in chromosome morphology. The autosomal arm number is 80 for the former and 76 for the latter species. Speculations on phylogenetic relationships are presented.

INTRODUCTION

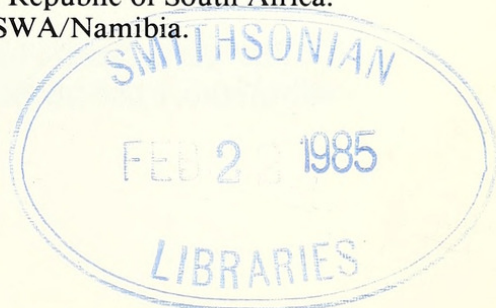
Among the gerbilline rodents of Africa, the genus *Gerbillurus* Shortridge, 1942, is endemic to the more arid and semi-arid regions of southern Africa. It ranges through southwestern Angola, South West Africa/Namibia, Botswana, southwestern and southern Zimbabwe, southcentral Mozambique, northern Transvaal, western Orange Free State, as well as the western, central, and southeastern Cape Province (De Graaff, 1981).

The generic status of *Gerbillurus* Shortridge, 1942, with type species

¹ Address: Transvaal Museum, P.O. Box 413, Pretoria 0001, Republic of South Africa.

² Address: State Museum, P.O. Box 1203, Windhoek 9000, SWA/Namibia.

Submitted 17 May 1984.



G. vallinus, has been unclear. *Gerbillurus* has been regarded as a synonym of *Gerbillus* Desmarest, 1804, by Ellerman et al. (1953). Shortridge (1942), Bauer and Niethammer (1960), Herold and Niethammer (1963), and Schlitter (1973) regarded it as a subgenus of *Gerbillus*. Roberts (1951), Lundholm (1955), Lay (1972), Davis (1975), Schlitter (1976), Pavlinov (1982), Honacki et al. (1982), and Petter (1983) considered *Gerbillurus* as a distinct genus. Pavlinov (1982:30) described a new subgenus, *Progerbillurus* to include *Gerbillus paeba* A. Smith, 1836 (cited by Pavlinov as 1834) and Petter (1983:266) proposed a new subgenus, *Paratatera*, to include *Gerbillurus tytonis* (Bauer and Niethammer, 1960).

The karyological study reported upon here was undertaken to supplement a morphometric analysis of species parameters, in an attempt to acquire a wider perception of species limits and relationships. The taxonomic treatment of Davis (1975) was used as the basis for examining the karyological relationships of the species of *Gerbillurus*. Davis (1975) recognized four species—*G. paeba* (A. Smith, 1836); *G. vallinus* (Thomas, 1918); *G. tytonis* (Bauer and Niethammer, 1960); and *G. setzeri* (Schlitter, 1973). Davis (1975) also listed a fifth, unnamed species from the Cape Flats, which he thought showed close morphological affinity to *G. paeba*, but which is here treated as conspecific with *G. paeba*. Because the latter species is by far the most widespread of the genus and also as a consequence of certain incongruent results in the morphometric analyses of this species, the karyotypes of each of the four subspecies of *G. paeba* listed by Davis (1975) were examined individually.

MATERIAL AND METHODS

Standard karyotypes were prepared in the field, employing the *in vivo* bone marrow technique described by Patton (1967) and Robbins and Baker (1978). Determinations of diploid number (2N) and autosomal arm number (AA) were based on counts of a minimum of ten mitotic spreads per specimen. Nomenclature of chromosome morphology follows that of Patton (1967). Voucher specimens were prepared as conventional museum skins and skulls. These, as well as the microslides, are deposited in the Transvaal Museum (TM), Pretoria; Carnegie Museum of Natural History (CM), Pittsburgh; Kaffrarian Museum (KM), King William's Town; and State Museum (SMW), Windhoek. See lists of specimens examined for localities and museum holdings.

RESULTS

The karyological properties of the four species examined in this study are discussed below. The material examined for each species is listed.

Gerbillurus paeba (A. Smith, 1836)

2N = 36, AA = 68. Fig. 1

The autosomal complement consists of 17 pairs of metacentric or submetacentric autosomes ranging in size from the very largest to the

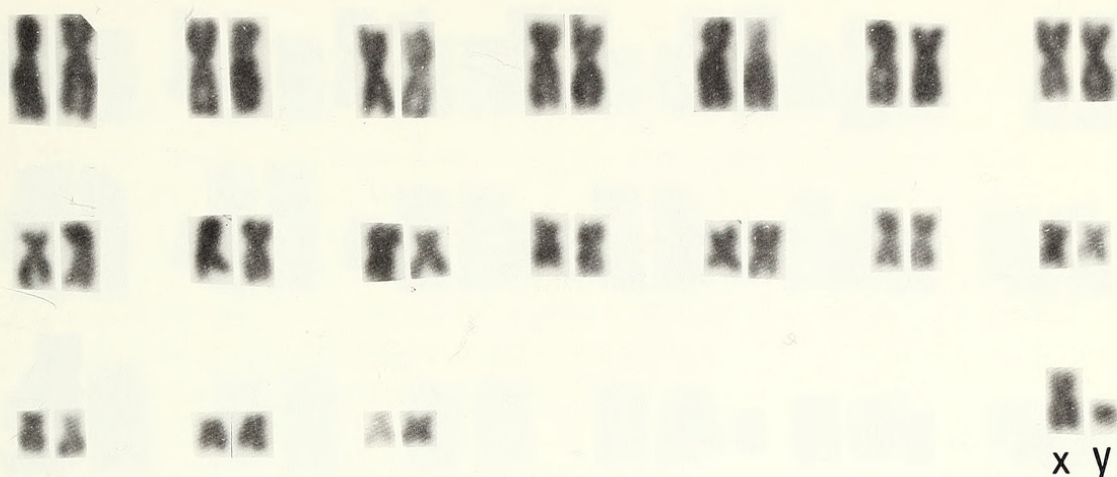


Fig. 1.—The standard karyotype for *Gerbillurus paeba* ♂ (TM 28910), $2N = 36$, $AA = 68$.

smallest (exclusive of the Y sex chromosome) elements in a complete spread. The X chromosome is a medium-sized submetacentric, whereas the Y chromosome is a very small acrocentric. No marker chromosomes could be distinguished. Our findings agree with that of Matthey (1958), who recorded $2N = 36$ for *G. paeba*.

Specimens examined (84).—SOUTH AFRICA: Cape Province, 6.5 km S, 50.3 km W Alexandria, 2 ♂, 1 ♀ (KM); Augrabies Falls National Park, 1 ♂ (CM); Dankbaar, Kalahari Gemsbok National Park, 1 ♀ (TM); Karoo National Park, 9 km NW Beaufort West, 1 ♀ (TM); Farm Kersbos, 10 km NNE Bitterfontein, 3 ♂, 3 ♀ (TM); Farm Kleintuin, 6 km NW Williston, 1 ♂, 1 ♀ (CM); Farm Skipperskloof, 6 km NW Williston, 1 ♂, 3 ♀ (CM); Mitchell's Plain, 25 km SE Cape Town, 9 ♂, 8 ♀ (CM); Transvaal Province, Farm Evergreen, Alldays, 1 ♀ (TM). SOUTH WEST AFRICA/NAMIBIA: Farm Kanaan 104, 5 ♂, 12 ♀ (12 CM, 5 TM); Ganab, Namib Desert Park, 2 ♂, 3 ♀ (TM); Namib Desert Ecological Research Station, Gobabeb, 8 ♂, 14 ♀ (TM); Homeb, 25 km upriver from Gobabeb, 1 ♀ (SMW); Huab River at Jack Scott Bridge, 1 ♂ (SMW); Tumasberg, Namib Desert Park, 2 ♀ (SMW).

***Gerbillurus tytonis* (Bauer and Niethammer, 1960)**

$2N = 36$, $AA = 68$. Fig. 2

The standard karyotype of this species is indistinguishable from that of *G. paeba* described above.

Specimens examined (26).—SOUTH WEST AFRICA/NAMIBIA: Namib Desert Ecological Research Station, Gobabeb, 3 ♂, 4 ♀ (TM); Homeb, 25 km upriver from Gobabeb, 2 ♂, 3 ♀ (SMW); Farm Kanaan 104, 7 ♂, 5 ♀ (9 CM, 3 TM); Narra Valley, 10 km W Gobabeb, 2 ♂ (TM).

***Gerbillurus vallinus* (Thomas, 1918)**

$2N = 60$, $AA = 80$. Fig. 3

The autosomal chromosomes consist of five pairs of metacentrics, six pairs of submetacentrics, and 18 pairs of acrocentrics. The X chro-

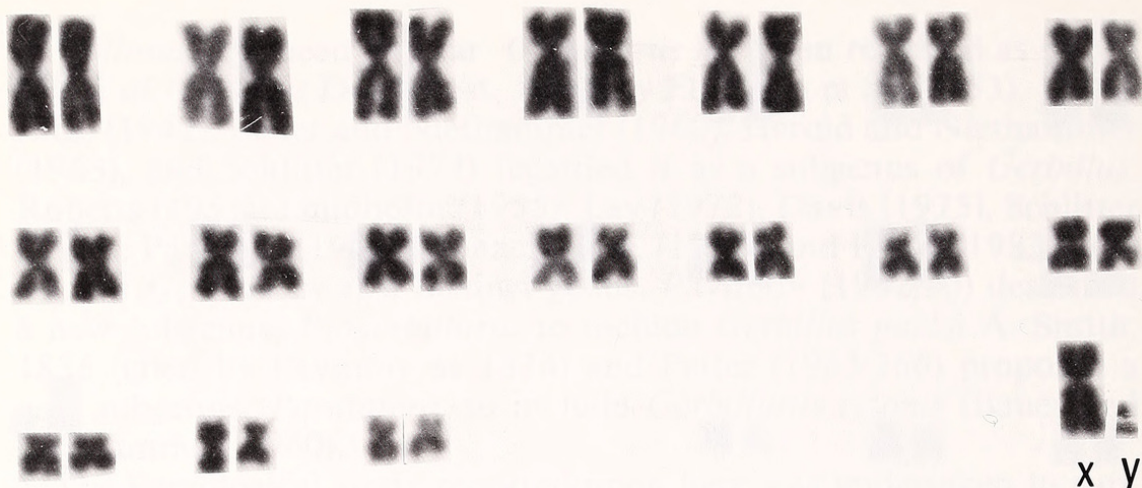


Fig. 2.—The standard karyotype for *Gerbillurus tytonis* ♂ (SMW 7620), $2N = 36$, $AA = 68$.

mosome is metacentric and the largest chromosome. The Y is a small acrocentric chromosome.

This species differs significantly in its karyotypical properties from *G. paeba* and *G. tytonis* with respect to its higher diploid and autosomal arm numbers.

The two samples obtained are essentially topotypes for the nominate subspecies in South Africa and for *G. v. seeheimi* in Namibia.

Specimens examined (13).—SOUTH AFRICA: Cape Province, Farm Visservil, 25 km SW Kenhardt, 2 ♂♂, 4 ♀♀ (TM). SOUTH WEST AFRICA/NAMIBIA: Farm Rheinfels 125, 35 km SSW Keetmanshoop, 5 ♂♂, 2 ♀♀ (TM).

Gerbillurus setzeri (Schlitter, 1973)

$2N = 60$, $AA = 76$. Fig. 4

Autosomal chromosomes consist of nine pairs of metacentrics and submetacentrics and 20 pairs of acrocentrics. Thus, apart from autosomal arm number, this species also differs in chromosome morphology from *G. vallinus*. As in the other *Gerbillurus* species, the X sex chromosome is a submetacentric, although in this species and in *G. vallinus* it is the largest element present. This, together with a similar $2N$, set these two species apart from *G. paeba* and *G. tytonis*. The Y sex chromosome is a small acrocentric, similar to the other three *Gerbillurus* species.

Specimens examined (11).—SOUTH WEST AFRICA/NAMIBIA: Brandberg West Mine, 1 ♂ (SMW); 13 km SSE Doros, 2 ♂♂ (SMW); Namib Desert Ecological Research Station, Gobabeb, 3 ♀♀ (TM); 33 km E Hentiesbaai, 2 ♂♂ (SMW); Homeb, 25 km upriver from Gobabeb, 1 ♂, 1 ♀ (TM, SMW); Ugab River mouth, 1 ♀ (TM).

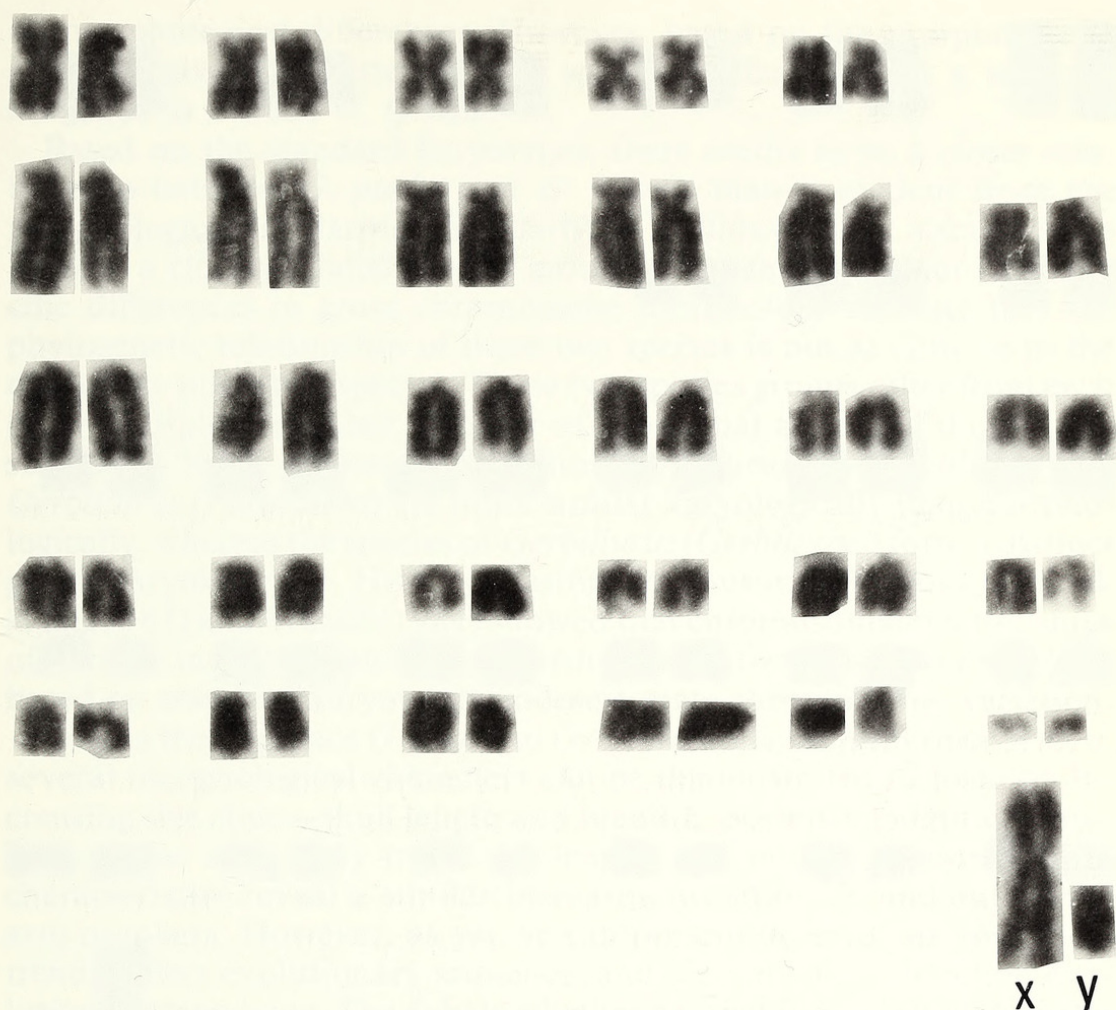


Fig. 3.—The standard karyotype for *Gerbillurus vallinus* ♂ (TM 32456) $2N = 60$, $AA = 80$.

DISCUSSION

No differences in the karyotypes of *G. paeba* were found in 84 specimens examined from localities selected throughout the broad geographic range of this species in South Africa and Namibia. Specimens of all four subspecies (*G. p. coombsi* from the Soutpansberg district, *G. p. exilis* from the Port Elizabeth district, *G. p. infernus* from the Skeleton Coast of the Namib Desert, and *G. p. paeba* from the remainder of the South African range of the species) were examined and found to be all karyotypically similar. In addition, specimens of the *Gerbillurus* from the Cape Flats, which were listed by Davis (1975) as a potentially unnamed distinct species, also possess karyotypes identical to those found in other *G. paeba*. Because the karyotypic data are the same and the skulls of these specimens are morphologically similar



Fig. 4.—The standard karyotype for *Gerbillurus setzeri* ♂ (SMW 7619), $2N = 60$, $AA = 78$.

to *G. paeba*, we provisionally place the Cape Flats specimens in *G. paeba* and assign them to *G. p. mulleri*, originally described from Eendekuil in the western Cape Province north of Cape Town.

Both Schlitter (1973) and Davis (1975) recognize two species groups among southern African *Gerbillurus*, that is, the *paeba* group consisting of *G. paeba* as well as the unnamed taxon of Davis from the Cape Flats, and the *vallinus* group of *G. tytonis*, *G. vallinus*, and *G. setzeri*. Subsequently, Pavlinov (1982) has described the subgenus *Progerbillurus* to include the *G. paeba* group as it is currently understood and Petter (1983) described *Paratatara* for *G. tytonis*. We concur that the *G. paeba* group deserved to be separated as a distinct subgenus based

on morphological differences. However, based on the morphological evidence given by Petter (1983), we doubt the need for a separate subgenus to include *G. tytonis*.

Based on the standard karyotypes, there seems to be a closer relationship between *G. paeba* and *G. tytonis* than is evident from the morphological similarities. Similarly, *G. vallinus* and *G. setzeri* seems to form a closely related species group, although here minor interspecific differences in gross chromosome morphology indicate that the phylogenetic relationship of these two species is not as close as in the case of the other two species. These two species groups differ from each other in diploid number, number of autosomal arms and the relative size of the X sex chromosomes. Thus *Gerbillurus (Progerbillurus)* and *Gerbillurus (Paratatera)* are more similar karyologically than morphologically, whereas the species of *Gerbillurus (Gerbillurus)* form a distinct group karyologically. However, using chromosomal banding, Haiduk et al. (1981) and Wassif (1981) showed that chromosomal relationships of African megachiroptera and North African *Gerbillus* and *Dipodillus* based on standard karyotypes underestimate chromosomal variation.

Within the sequence *G. paeba* to *G. tytonis* to *G. vallinus* to *G. setzeri*, several morphological characters can be demonstrated to form an increasing size cline—skull length and breadth, posterior palatine foraminae, bullae size, body mass, tail length, and pilosity. Chromosomal characteristics reveal a similar increasing trend in $2N$ and autosomal arm numbers. However, as yet we can present no evidence that these trends reflect evolutionary sequence, and if so in which direction evolution is progressing. The debate whether derived forms exhibit a higher or lower $2N$ through chromosomal fission or fusion respectively, continues unresolved, and in this particular case fails to shed any light on the question of evolutionary direction. A *Gerbillurus* karyotype of $2N = 36$ can be explained to have given origin to a $2N = 60$ as is described above, through alternating processes of Robertsonian translocations and pericentric inversions. Conversely, however, the possible derivation of the $2N = 36$ karyotype from a $2N = 60$ can also be explained in the same fashion. Further studies on chromosome banding may throw some light on chromosomal evolution in *Gerbillurus*.

ACKNOWLEDGMENTS

Financial support for this study was provided by the South African Council for Scientific and Industrial Research and the Johnson Fund of the American Philosophical Society. Field assistance was provided by Messrs. D. A. Wolhuter, T. Simoes, S. Rantlakwe and S. Mothlasedi. Pierre Swanepoel, Kaffrarian Museum, King William's Town, graciously allowed us to include the karyotypes of *G. paeba exilis* in this study. We especially thank him for doing so. We are also indebted to the conservation authorities of the Transvaal and Cape provinces, and of South West Africa/Namibia for granting collecting permits.

LITERATURE CITED

- BAUER, K., AND J. NIETHAMMER. 1960. Über eine kleine Säugetierausbeute aus südwest-Africa. *Bonn. Zool. Beitr.*, 10:236–262 (for 1959).
- DAVIS, D. H. S. 1975. Part 6.4, Genera *Tatera* and *Gerbillurus*. Pp. 1–7, in *The Mammals of Africa: an identification manual* (J. Meester and H. W. Setzer, eds.), Smithsonian Institution Press, Washington, D.C.
- DE GRAAFF, G. 1981. The rodents of Southern Africa [:] Notes on their identification, distribution, ecology and taxonomy. Butterworths, Durban, xviii + 267 pp.
- ELLERMAN, J. R., T. C. S. MORRISON-SCOTT, AND R. W. HAYMAN. 1953. Southern African mammals 1758 to 1951: a reclassification. Trustees British Museum, London, 363 pp.
- HAIDUK, M. W., R. J. BAKER, L. W. ROBBINS, AND D. A. SCHLITTER. 1981. Chromosomal evolution in African megachiroptera: G- and C-band assessment of the magnitude of change in similar karyotypes. *Cytogenet. Cell Genet.*, 29:221–232.
- HEROLD, W., AND J. NIETHAMMER. 1963. Zur systematischen Stellung des Südafrikanischen *Gerbillus paebsi* Smith, 1834 (Rodentia: Gerbillinae) auf Grund seines Alveolenmusters. *Säugetierk. Mitt.*, 11:49–58.
- HONACKI, J. H., K. E. KINMAN, AND J. W. KOEPL. 1982. Mammal species of the World [:] A taxonomic and geographic reference. Allen Press, Inc., and The Association of Systematics Collections, Lawrence, Kansas, ix + 694 pp.
- LAY, D. M. 1972. The anatomy, physiology, functional significance and evolution of specialized hearing organs of gerbilline rodents. *J. Morph.*, 138:41–120.
- LUNDHOLM, B. G. 1955. Descriptions of new mammals. *Ann. Transvaal Mus.*, 22:279–303.
- MATTHEY, R. 1958. Les chromosomes et la position systématique de quelques Murinae africains (Mammalia-Rodentia). *Acta Trop.*, 15:97–117.
- PATTON, J. L. 1967. Chromosome studies of certain pocket mice, genus *Perognathus* (Rodentia: Heteromyidae). *J. Mamm.*, 48:27–37.
- PAVLINOV, I. Y. 1982. Phylogeny and classification of the subfamily Gerbillinae. *Byull. Mosk. Obshch. Ispyt. Prirody, Otd. Biol.*, 87:19–31 (in Russian).
- PETTER, F. 1983. *Paratatera*, sous-genre nouveau de *Gerbillurus* Shortridge, 1942 (Rongeurs, Gerbillides). *Mammalia*, 47:265–266.
- ROBBINS, L. W., AND R. J. BAKER. 1978. Karyotypic data for African mammals, with a description of an *in vivo* bone marrow technique. *Bull. Carnegie Mus. Nat. Hist.*, 6:188–210.
- ROBERTS, A. 1951. The mammals of South Africa. Trustees "The Mammals of South Africa Book Fund," Johannesburg, xlviii + 700 pp.
- SCHLITTER, D. A. 1973. A new species of gerbil from South West Africa with remarks on *Gerbillus tytonis* Bauer and Niethammer, 1959 (Rodentia: Gerbillinae). *Bull. South. Calif. Acad. Sci.*, 72:13–18.
- . 1976. Taxonomy, zoogeography and evolutionary relationships of hairy-footed gerbils, *Gerbillus* (*Gerbillus*), of Africa and Asia (Mammalia: Rodentia). *Dis. Abst. Int.*, 37(6):1–2.
- SHORTIDGE, G. C. 1942. Field notes on the first and second expeditions of the Cape Museum's mammal survey of the Cape Province; and descriptions of some new subgenera and subspecies. *Ann. South African Mus.*, 36:27–100.
- WASSIF, S. 1981. Investigations on the relationships of the genera *Gerbillus* and *Dipodillus* (Rodentia, Cricetidae) by the use of chromosome banding techniques. *Bull. Zool. Soc. Egypt*, 31:139–155.

GAZETTEER

Alexandria, 6.5 km S, 50.3 km W, Cape Province
Augrabies Falls National Park, Cape Province

33°42'S; 25°52'E
28°35'S; 20°21'E

Brandberg West Mine, SWA/Namibia	21°01'S; 14°04'E
Dankbaar, Kalahari Gemsbok National Park, Cape Province	25°03'S; 20°08'E
Doros, 13 km SSE, SWA/Namibia	20°50'S; 14°18'E
Evergreen Farm, District Alldays, Transvaal Province	22°43'S; 29°06'E
Ganab, Namib Park, SWA/Namibia	23°03'S; 15°08'E
Hentiesbaai, 33 km E, SWA/Namibia	22°10'S; 14°37'E
Homeb, 25 km upriver Gobabeb, Namib Park, SWA/Namibia	23°39'S; 15°10'E
Huab River at Jack Scott Bridge, Namib, SWA/Namibia	20°52'S; 13°31'E
Kanaan 104 Farm, Luderitz District, SWA/Namibia	25°53'S; 16°07'E
Karoo National Park, 9 km NW Beaufort West, Cape Province	32°20'S; 22°33'E
Kersbos Farm, 10 km NNE Bitterfontein, Cape Province	30°57'S; 18°12'E
Kleintuin Farm, 6 km NW Williston, Cape Province	31°20'S; 20°55'E
Mitchell's Plain, 25 km SE Cape Town, Cape Province	ca 33°52'S; 18°23'E
Namib Desert Ecological Research Station, Gobabeb, Namib Park, SWA/Namibia	23°30'S; 15°03'E
Narra Valley, 10 km W Gobabeb, Namib Park, SWA/Namibia	23°30'S; 15°03'E
Rheinfels 125 Farm, 35 km SSW Keetmanshoop, SWA/Namibia	26°55'S; 17°56'E
Skipperskloof Farm, 6 km NW Williston, Cape Province	31°20'S; 20°55'E
Tumasberg, Namib Park, SWA/Namibia	23°10'S; 15°31'E
Ugab River mouth, SWA/Namibia	21°12'S; 13°38'E
Visservil Farm, 25 km SW Kenhardt, Cape Province	29°23'S; 20°54'E



Schlitter, Duane A., Rautenbach, I. L., and Coetzee, C. G. 1984. "Karyotypes of southern African gerbils, genus *Gerbillurus* Shortridge, 1942 (Rodentia: Cricetidae)." *Annals of the Carnegie Museum* 53, 549–557.

<https://doi.org/10.5962/p.330491>.

View This Item Online: <https://www.biodiversitylibrary.org/item/216357>

DOI: <https://doi.org/10.5962/p.330491>

Permalink: <https://www.biodiversitylibrary.org/partpdf/330491>

Holding Institution

Smithsonian Libraries and Archives

Sponsored by

Biodiversity Heritage Library

Copyright & Reuse

Copyright Status: In Copyright. Digitized with the permission of the rights holder

Rights Holder: Carnegie Museum of Natural History

License: <https://creativecommons.org/licenses/by-nc-sa/4.0/>

Rights: <https://www.biodiversitylibrary.org/permissions/>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.