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KARYOTYPIC DATA ON RODENTS FROM SENEGAL

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ABSTRACT

New karyological data on rodents from Senegal are presented and compared with previous reports from other parts of Africa. Among the murid rodents, two clearly differentiated forms of *Arvicanthis* are described ($2n = 62$, NFa = 64 and 74), which confirms the probable polytypic structure of *A. niloticus*. On the other hand, such species as *Myomys daltoni* and *Praomys tullbergi* appear chromosomally stable over a large geographic range. Among the Gerbillidae studied, the karyotype of *Desmodilliscus braueri* ($2n = 78$, NFa = 104) is presented, as well as those of two species of *Gerbillus* newly reported for Senegal, *G. henleyi* ($2n = 52$, NFa = 59/60), and *Gerbillus cf pyramidum* ($2n = 40$, NFa = 74).

INTRODUCTION

Until recently karyological investigations on rodents of Senegal have mainly focused on Gerbillidae, and particularly the genera *Tatera* and *Taterillus*. These studies made it possible to distinguish two sibling species of *Taterillus*, namely *T. gracilis* (with a diploid number of $2n = 36/37$) and *T. pygargus* (with $2n = 22/23$, Matthey, 1969; Matthey and Jotterand, 1972; Petter et al., 1972), and to characterize the two species of *Tatera*, *T. gambiana* ($2n = 52$) and *T. guineae* ($2n = 50$, Matthey, 1969; Matthey and Petter, 1970; Hubert et al., 1973). In the family Muridae, data on the two previously known species of *Mastomys*, *M. erythroleucus* ($2n = 38$) and *M. huberti* ($2n = 32$) have been published (Hubert et al., 1973, 1983; Petter, 1977), but recent extensive studies of this genus in Senegal revealed the presence of a third species, *M. cf natalensis*, morphologically indistinguishable from *M. huberti*, and having the same diploid number, but with distinct ecological preferences and a specific fundamental number (NFa = 54 vs 44 for *M. huberti*, Duplantier, 1988; Duplantier and Granjon, 1988; Duplantier et al., 1990).

The success karyological studies have had in clarifying the systematics of tropical rodents led us to undertake a preliminary chromosomal characterization of other rodent

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species from Senegal. We present data for several species of Muridae, with particular emphasis on *Arvicanthis niloticus*, which is actually thought to include several species (see Volobouev et al., 1988 and Kaminski et al., 1987). We also describe the karyotypes of species newly reported for Senegal (Duplantier et al., 1991), belonging to the genera *Gerbillus* (family Gerbillidae) and *Jaculus* (Family Dipodidae). Additional data are also presented for two large species widely distributed throughout Africa, *Cricetomys gambianus* and *Thryonomys swinderianus*.

MATERIALS AND METHODS

Twenty-seven individuals belonging to 13 different species were karyotyped. They are listed in Table 1 and their locality of origin is indicated in Fig. 1. Voucher specimens (skin and/or skull) for each karyotypic form are deposited in the ORSTOM collections in Senegal.

Karyotypes were prepared from bone marrow cells according to the "air drying" technique after yeast stimulation (Lee and Elder, 1980). Slides were observed and photographed using a Zeiss "Axiophot" microscope, after conventional staining (Giemsa). Chromosomes were classified into metacentric (M), submetacentric (SM), and acrocen-

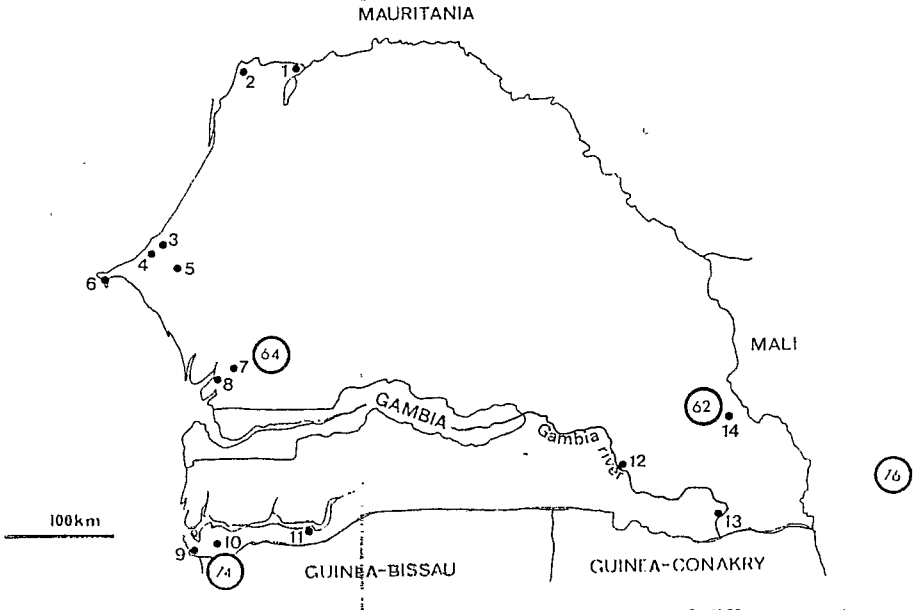

Fig. 1. Map of Senegal, with the autosomal fundamental numbers of different specimens of *Arvicanthis* (circled numbers), according to this study and that of Volobouev et al. (1988). 1 – Richard-Toll, 2 – Djoudj National Park, 3 – MBaouane, 4 – Retba Lake, 5 – Keur Moussa, 6 – Dakar, 7 – Nema Nding, 8 – Missira, 9 – Kabrousse, 10 – Basse Casamance National Park, 11 – Diattacounda, 12 – Niokolo-Koba National Park, 13 – Kedougou, 14 – Bransan.

Table 1
List, sex (m = male, f = female), diploid numer (2*n*), fundamental autosomal number (NFa), morphology of the sex chromosomes and origin (see Fig. 1) of the individuals studied

Species	Sex	2n	NFa	Sex Chrom.	Locality
Arvicanthis niloticus	m	62	64	X = SM; Y = M	Nema NDing (7)
	f	62	64	X = SM	id
	m	62	74	X = SM; Y = SM	B. Casamance National Park (10)
	f	62	74	X = SM	id
	m	62	–	–	Bransan (14)
	m	62	–	–	Richard-Toll (1)
Dasymys incomtus	m	36	48	X = A; Y = A	Retba Lake (4)
	f	36	48	X = A	B. Casamance National Park (10)
Mus musculus	m	40	38	X = A; Y = A	Dakar (6)
	f	40	38	X= A	Richard-Toll (1)
Myomys daltoni	m	36	34	X = SM; Y = SM	Missira (8)
	f	36	34	X = SM	Niokolo-Koba National Park (12)
	f	36	34	id	B. Casamance National Park (10)
	f	36	34	id	Nema NDing(7)
Praomys tullbergi	m	34	32	X = A; Y = A	Diattacounda (11)
Rattus rattus	m	38	58	X = A; Y = A	Kabrousse(9)
	m	38	58	id	MBaouane (3)
Uranomys ruddi	m	50	64(NF)	–	Niokolo-Koba National Park (12)
	f	50	64(NF)	–	B. Casamance National Park (10)
Desmodilliscus braueri	m	78	104	X = M; Y = M	Djoudj National Park (2)
	f	78	104	X = M	id
Gerbillus henleyi	m	52	60	X = SM; Y = A	Djoudj National Park (2)
	f	52	59	X = SM	Richard-Toll (1)
Gerbillus cf pyramidum	f	40	74	X = M	Djoudj National Park (2)
Jaculus jaculus	f	50	90(NF)	–	Djoudj National Park (2)
Cricetomys gambianus	m	80	82	X = SM; Y = A	Keur Moussa (5)
Thryonomys swinderianus	f	44	84(NF)	–	B. Casamance National Park (10)

tric (A), and the autosomal fundamental number (NFa) was determined by considering that both M and SM chromosomes carry two arms whereas A ones have only one.

RESULTS AND DISCUSSION

The diploid and autosomal fundamental numbers are provided in Table 1, along with a description of the morphology of the sex chromosomes.

FAMILY MURIDAE

Arvicanthis niloticus

The six individuals studied display a diploid number of 62, but the NFa's differ considerably between southern animals (Basse Casamance National Park, NFa = 74, Fig. 2a) and those north of the Gambia river (Nema Nding, NFa = 64, Fig. 2b). The latter karyotype, although similar to that from Bransan (southeastern Senegal) described by Volobouev et al. (1988) as ANI-1 ($2n = 62$, NFa = 62), presents an additional pair of very small M (Fig. 2b). It should also be noted that the two other M differ slightly in size, and thus may not be homologous. Although one of these may correspond in size to the M pair in ANI-1 (Viegas-Péquignot et al., 1983), definite comparison requires G-banding analyses. The increase in NFa to 64 was also observed in two female specimens from Niamey (Niger) in which two pairs of small M were present (unpublished results). In this instance, however, there were no discrepancies in size within each pair. In the karyotypes of two additional males from Senegal (Bransan, Richard-Toll), at least three small M could be identified unambiguously. This variation in NFa may be indicative of a chromosomal polymorphism within this karyotypic form.

The karyotypes of the specimens from Basse-Casamance seem to be closely related to those described as ANI-3 (2n = 62, NFa = 76) by Volobouev et al. (1988) from Burkina-Faso and Mali. The differences involve the presence of an additional pair of small M and the absence of the four medium-sized SM in the Senegalese individuals, which reduces the NFa to 74. In this instance also, the results may reflect a chromosomal polymorphism.

Allozymic studies on *Arvicanthis* have shown that specimens from southern Senegal (Basse Casamance and Kedougou) were closely related to each other and to those of Burkina-Faso, but clearly different from the ones north of the Gambia river (Kaminski et al. 1987). These results suggest that the chromosomal groups observed here may correspond to these genetically differentiated forms. Furthermore, R- and C-banding comparisons of the ANI-1 and ANI-3 specimens led Volobouev et al. (1988) to suggest that they correspond to two chromosomal species with the same diploid number but different NFa's due for a large part to pericentric inversions. Owing to the similarity in NFa's between our data and that of Volobouev et al. (1988) and to their geographic distribution (see Fig. 1), we tentatively follow these authors' proposition in suggesting that two chromosomally polymorphic species are present in Senegal, *A. niloticus* ($2n = 62$, NFa = 62–64) distributed north of the Gambia river, and *A. solatus* ($2n = 62$, NFa = 74–76) covering the whole Casamance region eastward to Kedougou. However, definite species

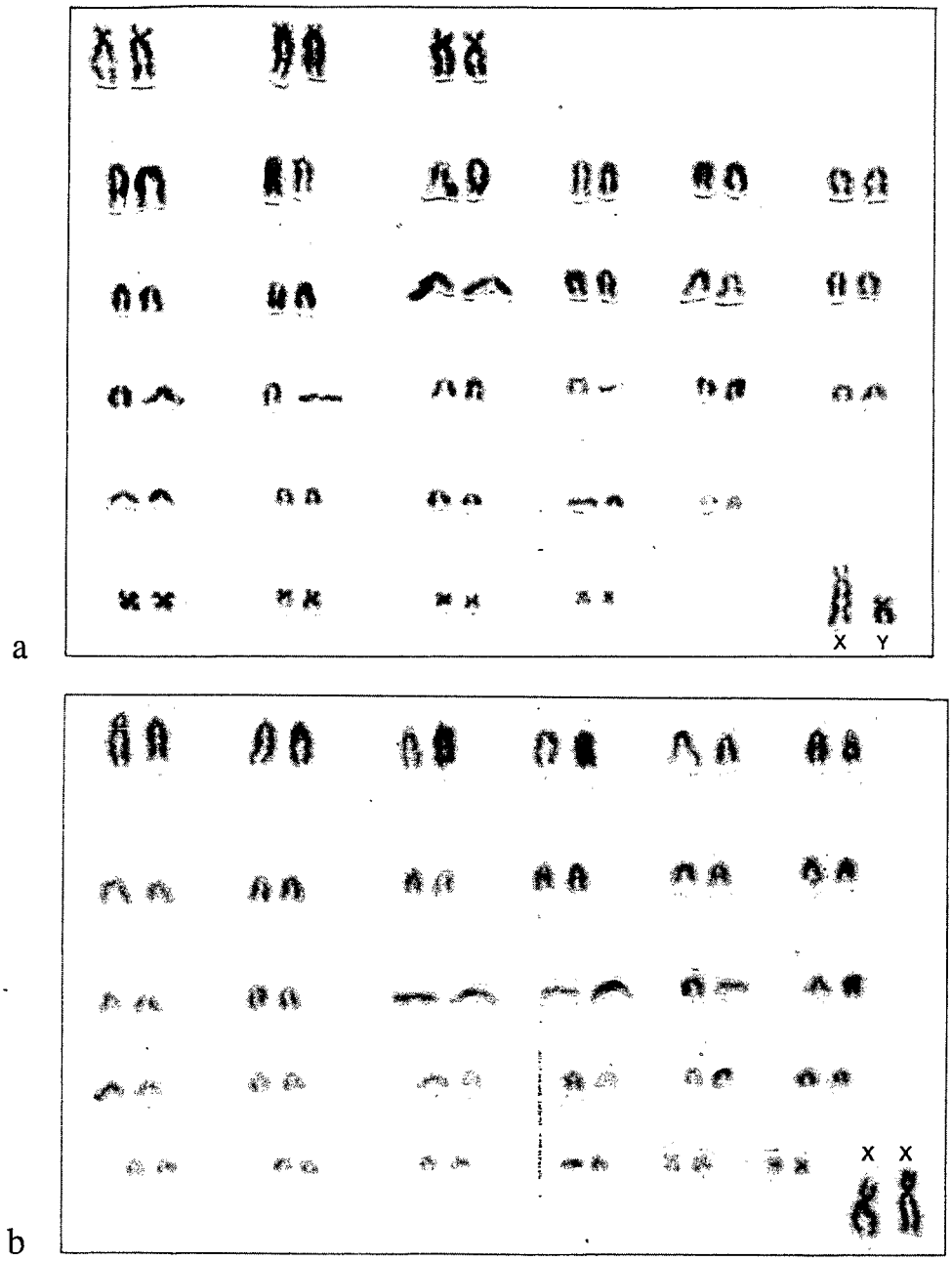

Fig. 2. Karyotypes of *Arvicanthis* specimens from a: Basse Casamance National Park ($2n = 62$, NFa = 74) and b: Nema Nding ($2n = 62$, NFa = 64).

status and assignation requires G- and C-banding comparisons between the two karyotypes described here and those of ANI-1 and ANI-3, as well as experimental crosses in captivity.

Dasymys incomtus

The two karyotypes described here have a diploid number of 36 chromosomes, with a NFa = 48 (Fig. 3). The two individuals come from distant populations, the one from Retba lake probably being the most northwestern one for this species in Africa. Tranier and Gautun (1979) also described a $2n = 36$ individual in Ivory Coast, but with only six pairs of M/SM. Differences in diploid number and NFa have already been found in this species, both in Ivory Coast ($2n = 38$, Matthey, 1958) and in Burundi ($2n = 40$, NFa = 50, Maddalena et al., 1989), which probably indicates the presence of different species, as suggested by Maddalena et al. (1989).

Mus musculus

Forty all-acrocentric chromosomes characterize the house mice of Senegal, and represent the standard karyotype of the species.

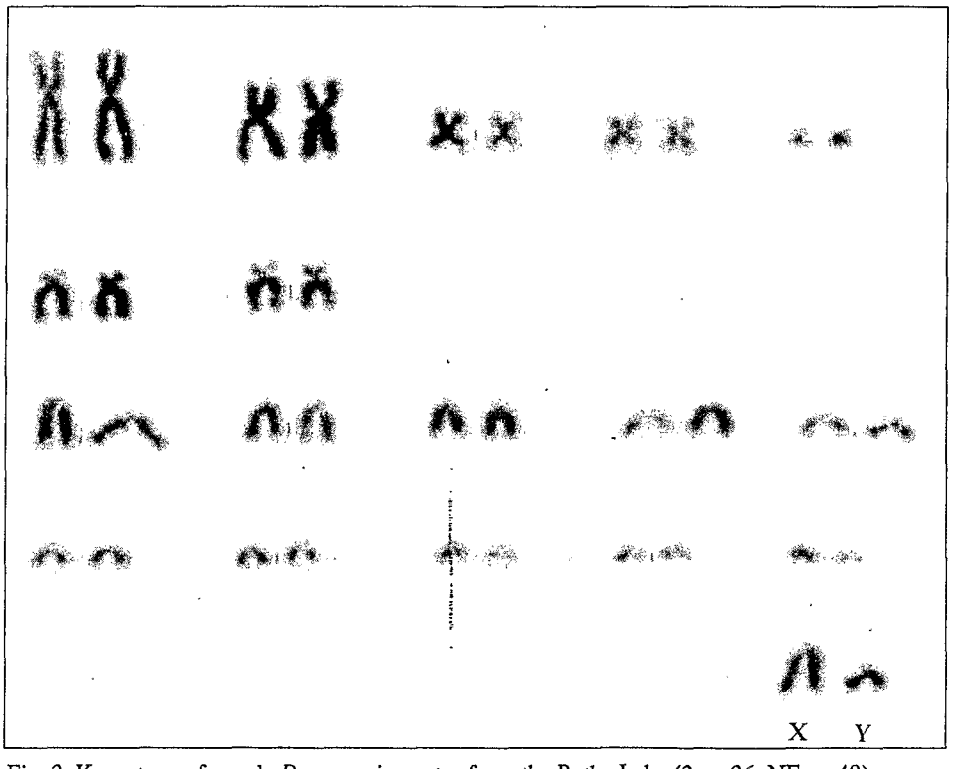

Fig. 3. Karyotype of a male *Dasymys incomtus* from the Retba Lake ($2n = 36$, NFa = 48).

Myomys daltoni

The four individuals studied originate from various parts of the country and display the same karyotype of $2n = 36$ chromosomes with 34 acrocentric autosomes, identical to the one presented by Viegas-Péquignot et al. (1983) from Bandia (Senegal). The X sex chromosome is a large SM, the Y a medium-sized one. This karyotype seems to be very stable, as Matthey (1964) found exactly the same one in Ivory Coast.

Praomys tullbergi

A karyotype of $2n = 34$ all acrocentric chromosomes was found, which corresponds to the one described by Matthey (1958) for a specimen from Ivory Coast. A similar result was found in the Central African Republic, with the exception that the X and Y sex chromosomes were metacentric (Matthey, 1970).

Rattus rattus

The two males have a diploid number of $2n = 38$ and NFa = 58, which is the most common form observed in West-European *Rattus rattus* (Capanna and Civitelli, 1971), which are the probable ancestors of the West-African populations of black rats.

Uranomys ruddi

Both specimens studied showed a diploid number of $2n = 50$, with 14 biarmed autosomes and 18 pairs of acrocentrics, some of which displayed very small short arms (Fig. 4). Although both a male and a female specimen were karyotyped, the sex chromosomes could not be identified (NF = 64). The diploid number of this species appears very variable throughout its range, since Matthey (1970) found an individual with $2n = 52$ in the Central African Republic, and Viegas-Péquignot et al., (1983), a female with $2n = 58$ from Ivory Coast.

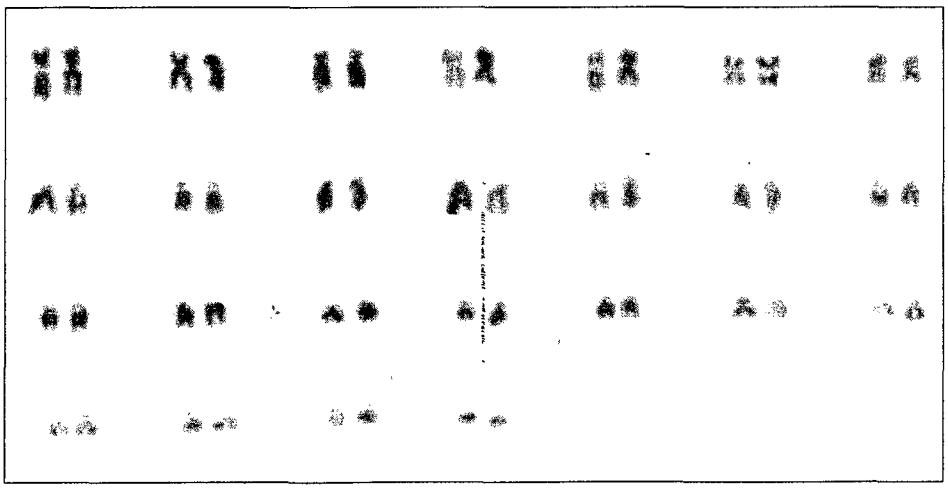

Fig. 4. Karyotype of a male *Uranomys ruddi* from Niokolo-Koba National Park ($2n = 50$, NF = 64).

FAMILY GERBILLIDAE

Desmodilliscus braueri

A karyotype of $2n = 78$, NFa = 104 was observed in both individuals from northern Senegal. The X chromosome is a large M, the Y a medium-sized one (Fig. 5). This represents the first published karyotype for this species.

Gerbillus henleyi

This species, only recently recorded in Senegal, seems to be present all along the lower valley of the Senegal river since it has been captured in locations ranging from the National Park of the Djoudj in the west (i.e., not far from the Atlantic Ocean) to 13°W eastwards (Duplantier et al., 1991). A diploid number of 52 chromosomes was observed in both individuals studied. The male sample displayed a NFa of 60 with 5 pairs of SM (Fig. 6a), whereas the NFa in the female was only 59, showing 8 SM and one medium-sized metacentric not present in the male karyotype (Fig. 6b). This variability in NFa suggests the presence of a complex chromosomal polymorphism, since the female additionally displays two pairs of very large acrocentric instead of only one as in the male (Fig. 6b). Chromosomal variation in arm number has already been observed in specimens from Burkina Faso (NFa = 62, Maddalena et al., 1988) and Morocco (NFa = 58, Lay et al., 1975).

Gerbillus cf pyramidum

This specimen yielded a karyotype of $2n = 40$, NFa = 74 (Fig. 7), and was tentatively

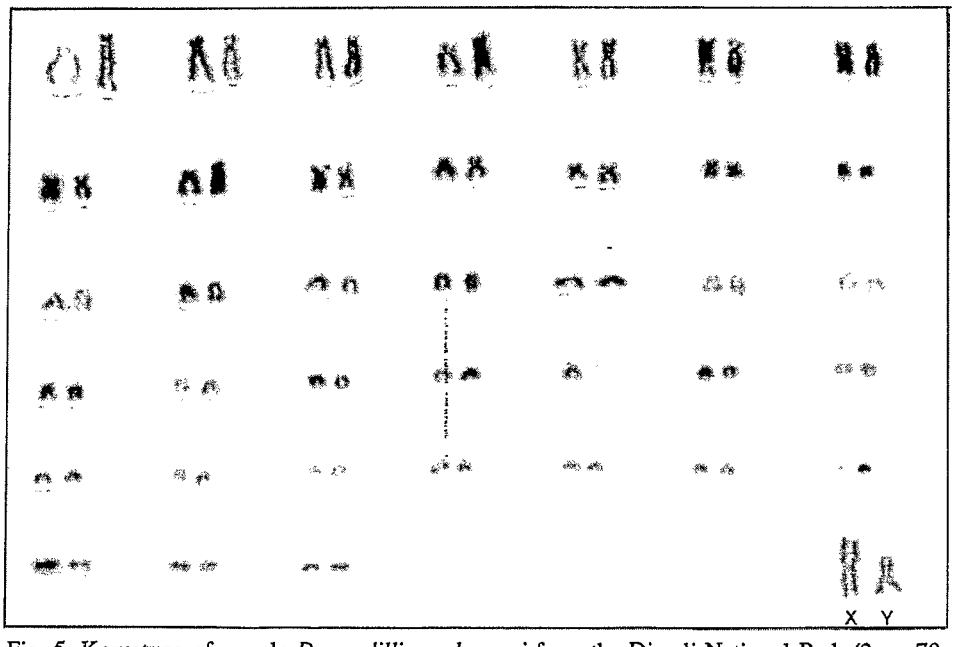

Fig. 5. Karyotype of a male *Desmodilliscus braueri* from the Djoudj National Park ($2n = 78$, NFa = 104).

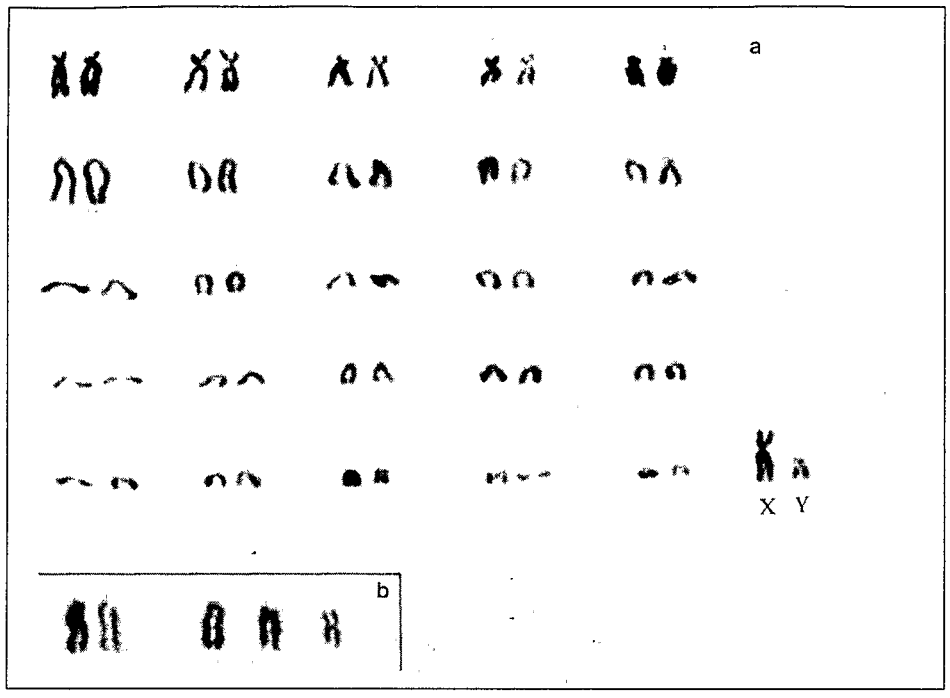

Fig. 6. (a) Karyotype of a male *Gerbillus henleyi* from Djoudj National Park ($2n = 52$, NFa = 60). (b) insert showing the metacentric and the four very large acrocentrics present in a female specimen from Richard–Toll ($2n = 52$, NFa = 59).

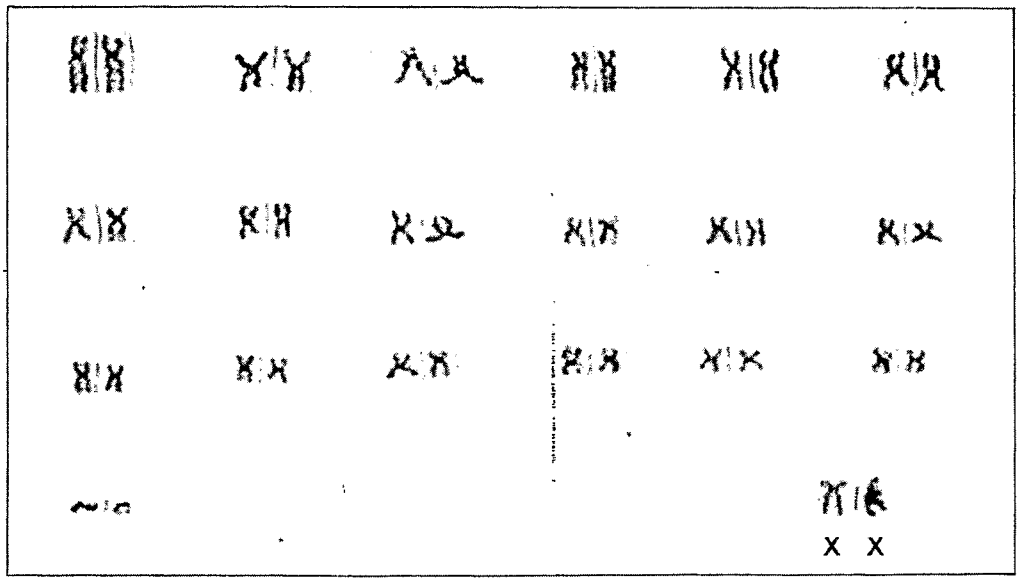

Fig. 7. Karyotype of a female *Gerbillus cf. pyramidum* from Djoudj Nat. Park ($2n = 40$, NFa = 74).

assigned to the species *G. pyramidum*, which has been recently rediscovered in Senegal (Duplantier et al., 1991) after its first and unique capture 15 years ago (Hubert and Böhme, 1978). However, further studies are needed to ascertain the taxonomic status of this sample since Lay (1983) suggested that *G. pyramidum* be characterized by a diploid number of $2n = 38$, whereas specimens with $2n = 40$, NFa = 74 be considered as either *G. tarabuli* or *G. riggenbachi* distributed in Tunisia, Algeria, Morocco, and Senegal (see Lay, 1983).

FAMILY DIPODIDAE

Jaculus jaculus has probably only recently reached Senegal from Mauritania where it was previously known to occur (Duplantier et al., 1991). The karyotype of one female from the Djoudj National Park had 50 chromosomes and a NF of 90 (Fig. 8, sex chromosomes not identified).

FAMILIES CRICETOMYIDAE AND THRYONOMYIDAE

A diploid number of 80 (NFa = 82) was determined for *Cricetomys gambianus* showing only two small pairs of SM chromosomes (Fig. 9). The only published data is provided by Matthey (1953, in Robbins and Baker, 1978) who found $2n = 78$ for a *C. gambianus* of unknown origin. *Thryonomys swinderianus* displayed a diploid number of 44 chromosomes (NF = 84) with only two pairs of small acrocentrics (Fig. 10). The cane rat apparently shows chromosomal variability in diploid number since Viegas-Péquignot et al. (1986) described a karyotype with $2n = 40$ chromosomes for a *Thryonomys sp*, the origin of which was not mentioned.

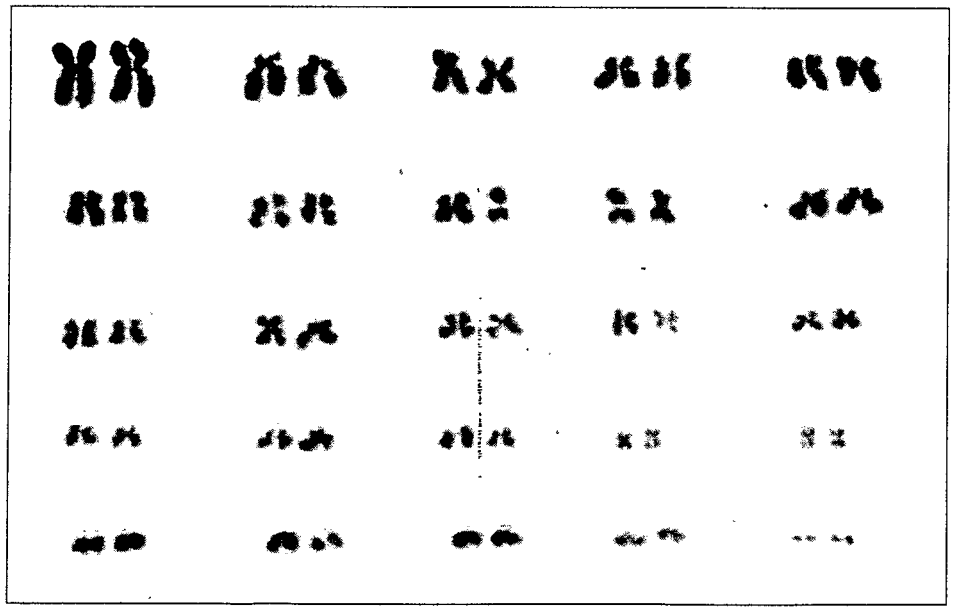

Fig. 8. Karyotype of a female *Jaculus jaculus* from the Djoudj National Park ($2n = 50$, NF = 90).

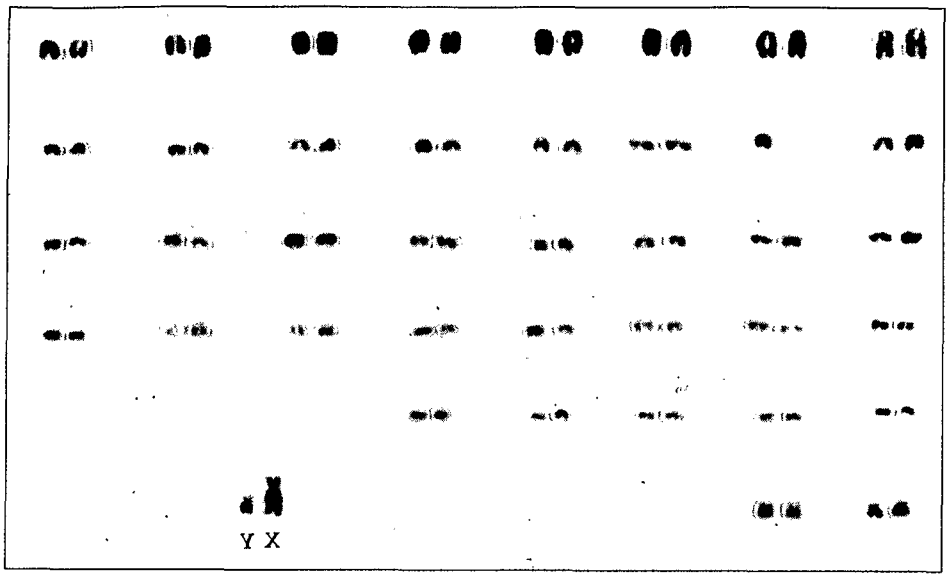

Fig. 9. Karyotype of a male *Cricetomys gambianus* from Keur Moussa ($2n = 80$, NFa = 82).

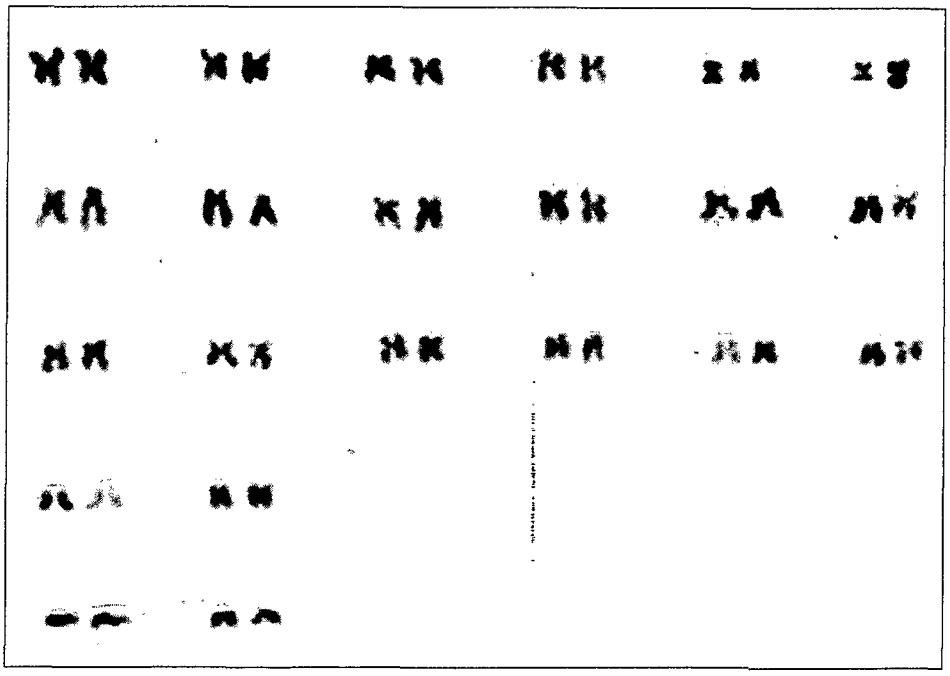

Fig. 10. Karyotype of a female *Thryonomys swinderianus* from Basse Casamance National Park ($2n = 44$, NF = 84).

CONCLUDING REMARKS

The taxonomy of African rodents is far from being definitely established, at the specific, but also generic, and even familial (or subfamilial) level. One clear example of this complexity concerns the systematics of the *Mastomys–Praomys–Myomys* complex (Petter, 1975; Van der Straeten and Verheyen, 1978; Duplantier, 1988; Robbins and Van der Straeten, 1989; Qumsiyeh et al. 1990, etc.). One key to the understanding of the complex relationships between these African rodent species probably lies in relating ecological and genetical characteristics to morphological variation on a large geographic scale. The results presented here (see also Duplantier, 1988; Duplantier et al., 1990) show that even at the scale of a relatively small country, new findings are observed. This has been the case for *Arvicanthis*, and further studies are now needed to determine the nature of the chromosomal variability and its taxonomic implications both within and between the two forms distinguished here. On a larger scale, comparisons with data from other parts of the species' ranges may help to determine the systematics or geographic variation of such "species" as *Dasymys incomtus*, *Uranomys ruddi*, and to understand the relationships between species within genera such as *Praomys* or *Gerbillus*.

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