

KARYOTYPIC DATA FOR AFRICAN MAMMALS, WITH A DESCRIPTION OF AN *IN VIVO* BONE MARROW TECHNIQUE

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ABSTRACT

Basic information, which should be included in any publication on the chromosomes of mammals, is given. A field-tested bone marrow-*in vivo* method of karyotyping is presented. A re-

view of the literature concerning karyotypes of African mammals was done and these karyotypic data are listed for 292 species and subspecies of African mammals.

INTRODUCTION

Karyotypes have proven to be valuable data for evolutionary and systematic studies. A summary of chromosomal data for African mammals is presented in Appendix I. For maximum value, any publication on the chromosomes of a species should contain the following information:

1. A photomicrograph of the karyotype. This is necessary if this is the first report for a species or if your karyotypic data differs from that previously published for the species.
2. Diploid Number.
3. "Nombre fundamental" or number of arms of the autosomal complement.
4. Morphology of sex chromosomes.
5. Sex of specimens examined.
6. Number of specimens examined.
7. Geographic origin of specimen examined.
8. Museum where voucher specimens are deposited (with museum numbers, if possible).
9. Minimum number of spreads examined from any specimen included.

METHODS AND TECHNIQUES

Preparation of somatic chromosomes is a simple process which can be conducted in the field. For the bone marrow-*in vivo* technique described below, live animals are required. The following technique is modified after Baker (1970).

1. Inject the live animal intraperitoneally with a 0.03% Vinblastine (Velban of Eli Lilly & Co.) or colchicine solution at 0.01 ml per gram of body weight.

2. After two hours sacrifice the animal and remove a long bone, such as the femur in rodents or the humerus in bats, without damaging the proximal end. Remove the flesh and a chip of bone from the proximal end to expose the red bone marrow cavity. Flush the shaft with 3 ml of a 1.0% sodium citrate solution. Pipette vigorously to break up any cell clumps. The sodium citrate solution will support bacterial growth and should be prepared daily under field conditions.

3. Let the resultant cell-suspension set for about 10 min.

4. Centrifuge the suspension at 1,500 RPM for 4 min.

5. Discard as much of the supernatant fluid as possible, being careful to leave the button of cells undisturbed. Add 3 ml of freshly prepared Carnoy's fixative (3 parts absolute methanol:1 part glacial acetic acid). Floating material and lipids may be removed at this stage. Disrupt the cell button with a pipette until the cell suspension is homogeneous. Allow cells to fix for about 10 min.

6. Centrifuge for 4 min and decant supernate. Resuspend cells in 1.0 ml of fixative and centrifuge as before. This step is repeated at least three times. After final washing, cells are resuspended in 1.0 ml of fixative.

7. Place two or three drops of cell suspension on a clean slide and ignite. When the fire extinguishes itself, the residue is promptly slung from the slide. Four slides from each specimen are usually made.

8. Dry slides are stained for 12 min in a 2% Giemsa stain (1 ml of Giemsa's stock solution in 50 ml

of buffer). Buffer is made by mixing 0.469 g of NaH_2PO_4 and 0.937 g of Na_2HPO_4 in 1,000 ml of distilled water. The buffered stain can be used to stain three or four sets of slides. If the buffer solution is unavailable, then staining can be by other methods such as one part Giemsa's stock solution to eight parts distilled water for 15 min. If staining with the latter solution is poor, heating the stain to near 50°C will often help. This distilled water base stain can be used to stain only one set of slides and then new stain must be mixed.

9. When a slide is removed from the stain it must be quickly rinsed with distilled water or a film of stain will cover the slide. Slide should be dry before covering with balsam or permount and a 22 by 40 mm coverslip.

Voucher specimens, with accurate collection data, should be deposited in a reputable museum. The tag on the voucher specimen should show that this specimen was karyotyped and microscope slides should be cross referenced to the voucher specimen.

TERMINOLOGY

Metacentric is a biarmed element that has arms of equal length (ratio is not greater than 1:1.1). Submetacentric is a biarmed element that has an arm ratio greater than 1:1.1 but less than 1:2. Subtelocentric is a biarmed element that has an arm ratio greater than 1:2, but a second short arm is clearly visible. Acrocentric (=telocentric for practical purposes) is an element that appears to be unarmed when viewed with a light microscope. When cal-

culating the nombre fundamental or number of arms of the autosomal complement, each metacentric, submetacentric, or subtelocentric is given a value of 2, whereas each acrocentric is given a value of 1. The nombre fundamental (NF) of Matthey includes the arms of the sex elements and auto, whereas the "number of arms of the autosomal complement" (AA Appendix I) does not include the sex elements.

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Appendix I.—Chromosomal data for African mammals. Orders are listed in classical phylogenetic arrangement. Families, genera, and species are in alphabetical order. 2N = diploid number; NF = Nombre Fundamental, which includes sex elements; AA = number of arms of autosomal complements; BA = number of banded autosomes. M, SM, ST, and A are defined in text.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
Insectivora								
Erinaceidae								
<i>Erinaceus algirus</i>	48	—	—	—	—	—	—	Gropp and Natarajan, 1972
<i>Hemiechinus auritus aegyptius</i>	48	—	—	—	X:M Y:small A	—	—	Gropp et al., 1969b
<i>Hemiechinus auritus aegyptius</i>	48	—	92	46	X:M Y:small A	4	Egypt	de Hondt, 1974
Macroscelidae								
<i>Elephantulus rufescens</i>	34	—	—	—	—	—	—	Chu and Bender, 1962
<i>Elephantulus rupestris jamesoni</i>	30	—	—	—	—	—	—	Ford and Hamerton, 1956
<i>Elephantulus rozeti</i>	28	—	—	—	—	—	—	Matthey, 1954a
<i>Nasillo b. brachyrhynchus</i>	26	—	—	—	—	—	—	Stinson and Goodman, 1966
Soricidae								
<i>Crocidura bottegi eburnea</i>	40	—	—	—	—	—	Ivory Coast	Meylan, 1971
<i>Crocidura juvenetae ebriensis</i>	44	—	—	—	—	—	Ivory Coast	Meylan, 1971
<i>Crocidura occidentalis kiwu</i>	50	—	—	—	X:large ST Y:small A	—	—	Meylan, 1967
<i>Crocidura olivieri</i>	50	—	56	8	X:SM Y:small A	4	Egypt	de Hondt, 1974
<i>Crocidura poensis pamela pulchra</i>	52	—	—	—	—	—	Ivory Coast	Meylan, 1971
<i>Crocidura russula pulchra</i>	42	—	—	—	—	—	Ivory Coast	Meylan, 1971
<i>Crocidura suaveolens</i>	40	—	—	—	—	—	—	Meylan, 1966
<i>Crocidura theresae</i>	50	—	—	—	—	—	Ivory Coast	Meylan, 1971
<i>Sylvisorex megalura</i>	48	96	—	46	—	1♂	Ivory Coast	Meylan, 1975
Tenrecidae								
<i>Micropotamogale lamottei</i>	38	76	—	—	—	—	Ivory Coast	Vogel et al., 1977
Chiroptera								
Molossidac								
<i>Otomops martiensseni</i>	48	—	56	—	X:SM; Y:A	1	—	Dulić and Muter, 1973
<i>Platymops setiger</i>	48	—	54	—	X&Y:SM	1	—	Warner et al., 1974
<i>Tadarida bivitata</i>	48	—	54	8	X:M; Y:A	4	Kenya, Rhodesia	Peterson and Nagorsen, 1975
			57		Y:SM; Y:A	2		Dulić and Muter, 1973

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Tadarida fulminans</i>	48	—	54	8	X:SM; Y:A	4	Rhodesia	Peterson and Nagorsen, 1975
<i>Tadarida pumila</i>	48	—	58	—	X:SM; Y:SM	9	—	Dulić and Mutere, 1973
Nycteridae								
<i>Nycteris thebaica</i>	42	—	78	38	X:SM; Y:small M	6	Rhodesia	Peterson and Nagorsen, 1975
Pteropidae								
<i>Eidolon helvum</i>	34	—	—	—	—	—	—	Matthey, 1962
<i>Epomophorus anurus</i>	36	72	—	—	—	1♀	—	Dulić and Mutere, 1973b
<i>Epomophorus crypturus</i>	35 (♂) 36 (♀)	—	68	34	—	1♂, 1♀ 2♀	Rhodesia	Peterson and Nagorsen, 1975
<i>Epomophorus gambianus</i>	35	—	68	34	X:SM	2♀	Rhodesia	Peterson and Nagorsen, 1975
<i>Epomophorus wahlbergi</i>	36	72	—	—	X:SM; Y:A	1♂	—	Dulić and Mutere, 1973b
<i>Epomops franqueti</i>	36	—	68	34	—	2♀	Rhodesia	Dulić and Mutere, 1977
<i>Rousettus aegyptiacus leachi</i>	36	—	66	—	X:SM; Y:minute	2♀	Kenya	Peterson and Nagorsen, 1975
Rhinolophidae								
<i>Aselia tridens</i>	50	—	62	14	X:ST; Y:A	9	Tunisia	Baker et al., 1975
<i>Hipposideros caffer</i>	32	—	60	30	X:ST; Y:A	2	Rhodesia	Peterson and Nagorsen, 1975
<i>Rhinolophus clivosus</i>	58	—	62	6	X:large A; Y:small A	4	—	Dulić and Mutere, 1974
<i>Rhinolophus darlingi</i>	50	—	60	4	X&Y:ST	2	Rhodesia	Peterson and Nagorsen, 1975
<i>Rhinolophus denti</i>	58	—	62	6	X:ST	2	Rhodesia	Peterson and Nagorsen, 1975
<i>Rhinolophus euryale</i>	58	—	60	—	—	—	Europe	Bovey, 1949
<i>Rhinolophus ferrumequinum</i>	58	—	60	4	X:SM; Y:A	2♂	Tunisia	Manfredi Romanini et al., 1975 Baker et al., 1975

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Rhinolophus hildebrandti</i>	58	—	60	4	X&Y:ST	5	Rhodesia	Peterson & Nagorsen, 1975
<i>Rhinolophus hipposideros</i>	56	—	60	—	—	—	Europe	Capanna et al., 1967
<i>Rhinolophus mehelyi</i>	58	—	60	4	S:SM; Y:A	14	Tunisia	Baker et al., 1975
<i>Triaenops afer</i>	36	—	60	26	X:M; Y:small ST	3♂	—	Dulic and Mutere, 1977
Rhinopomatidae								
<i>Rhinopoma hardwickii</i>	36	—	—	—	—	—	—	Ray-Chandhuri and Pathak, 1966
Vespertilionidae								
<i>Barbastella barbastellus</i>	32	—	—	—	—	—	—	Bovey, 1949
	32	—	50	—	—	3♀♀	Europe	Manfredi Romanini et al., 1975
<i>Eptesicus capensis</i>	32	—	50	20	X:SM; Y:A	3	Rhodesia	Peterson and Nagorsen, 1975
<i>Eptesicus hottentotus</i>	50	—	58	0	X:SM	2	Rhodesia	Peterson and Nagorsen, 1975
<i>Eptesicus serotinus</i>	50	—	48	—	X:SM	5	Tunisia	Baker et al., 1975
<i>Mirototis schreibersi</i>	46	—	50	6	X:SM; Y:A	6	Europe	Manfredi Romanini et al., 1975
	44	—	50	8	X:SM; Y:A	36	Tunisia	Baker et al., 1975
<i>Myotis blythi</i>	44	—	50	—	—	—	Europe	Baker et al., 1975
<i>Myotis capaccinii</i>	44	—	50	—	—	—	Europe	Manfredi Romanini et al., 1975
<i>Myotis myotis</i>	44	—	50	—	—	—	Europe	Manfredi Romanini et al., 1975
<i>Pipistrellus kuhli</i>	44	—	50	8	X:SM; Y:A	9	Tunisia	Baker et al., 1975
<i>Pipistrellus nanus</i>	36	—	50	16	X:M; Y:A	1♂	Rhodesia	Peterson and Nagorsen, 1975
<i>Plecotus austriacus</i>	32	—	50	20	X:M; Y:A	16	Tunisia	Baker et al., 1975
<i>Scotophilus nigrita</i> = <i>S. dinganii</i>	36	—	—	—	—	1♀	Rhodesia	Peterson and Nagorsen, 1975
(see Robbins, 1978)								
Primates								
Loridae								
<i>Arctocebus calabarensis</i>	52	102	—	—	X:SM	—	—	Egozcue and Egozcue, 1966
<i>Galago alleni</i>	40	—	—	—	—	—	—	Chiarelli, 1974
<i>Galago crassicaudatus</i>	62	variable	—	—	X:SM; Y:SM or A	—	—	de Boer, 1972 ^a
								Chu and Bender, 1961
								Chiarelli, 1974

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Cercopithecus</i>								
<i>petaurista</i>	66	—	—	—	—	—	—	Chu and Giles, 1957
<i>butikoferi</i>	44	—	—	—	—	—	—	Kuhn, 1967
<i>Colobus badius</i>	44	—	—	—	—	—	—	Chiarelli, 1962
<i>Colobus polycomos</i>	54	—	—	—	—	—	—	Chu and Giles, 1957
<i>Erythrocebus patas</i>	54	—	—	—	—	—	—	Chiarelli, 1962
<i>Miopithecus talapoin</i>	54	—	86	38	X:SM; Y:small SM	—	—	Hsu and Benirschke, 5(248), 1971
<i>Papio</i> sp. (<i>anubis</i> ?)	42	—	80	40	X:SM; Y:small A	—	—	Darlington and Hague, 1955
<i>Papio cynocephalus</i>	42	—	—	—	—	—	—	Hsu and Benirschke, 5(248), 1971
<i>Papio getada</i>	42	—	—	—	—	—	—	Chiarelli, 1962
<i>Papio hamadryas</i>	42	—	—	—	—	—	—	Chiarelli, 1962
<i>Papio leucophaeus</i>	42	—	—	—	—	—	—	Chiarelli, 1962
<i>Papio papio</i>	42	—	—	—	—	—	—	Darlington and Hague, 1955
<i>Papio ursinus</i>	42	—	—	—	—	—	—	Ismael and Tobias, 1956
Pongidae								
<i>Gorilla gorilla</i>	48	—	78	32	X:large SM, Y:small SM	—	—	Hamerton et al., 1961
<i>Gorilla gorilla beringei</i>	48	—	80	34	X:SM; Y:small A	—	—	Hsu and Benirschke, 5(150), 1969
<i>Pan troglodytes</i>	48	—	—	—	—	—	—	Hamerton et al., 1963
<i>Pan troglodytes paniscus</i>	48	—	—	—	—	—	—	Young et al., 1960
Lagomorpha								
Leporidae								
<i>Lepus capensis tolai</i>	48	—	—	—	—	—	—	Chiarelli, 1962
<i>Oryctolagus cuniculus</i>	44	72	—	—	X:SM; Y:SM	—	—	Hsu and Benirschke, 3(148), 1969
								Chiarelli, 1961
								Vorontsov and Ivanitskaia, 1969
								Melander, 1956
								Hsu and Benirschke, 1(8), 1967

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
Rodentia								
Bathynagidae								
<i>Georchus capensis</i>	54	—	—	—	—	—	—	Matthey, 1956
Muridae								
Cricetinae								
<i>Mystromys albicaudatus</i>	32	—	60	30	X&Y:A	—	South Africa	Matthey, 1954c Hsu and Benirschke, 2(60), 1958
Dendromurinae								
<i>Dendromus insignis kivu</i>	48	—	—	—	—	—	—	Matthey, 1967
<i>Dendromus melanotis</i>	36	—	—	—	—	—	—	Matthey, 1970
<i>Dendromus mystacalis messorius</i>	38	—	—	—	—	—	—	Matthey, 1970
<i>Malacothrix typica</i>	38	—	—	—	—	—	—	Allenbach, 1964
<i>Saccostomus campestris</i>	46	—	—	—	X:SM	—	South Africa	Matthey, 1958
<i>Saccostomus mearnsi</i>	44	—	—	—	—	—	—	Ford and Hamerton, 1956
<i>Steatomys pratensis</i>	40-42	—	—	—	—	4	Ethiopia	Hubert, 1978a
	68	70	—	—	X:M; Y:SM	—	South Africa	Matthey, 1954c
Gerbillinae								
<i>Desmodillus aricularis</i>	52	70	—	—	X&Y:M	—	South Africa	Matthey, 1954c
<i>Gerbillus paeba</i>	36	—	—	—	—	—	—	Matthey, 1958
<i>Gerbillus allenbyi</i>	40	80	—	—	—	—	—	Wahrman and Zahavi, 1955
<i>Gerbillus amoenus</i>	52	61, 62	—	—	—	—	Egypt	Wassiff et al., 1969
<i>Gerbillus andersoni</i>	40	80	—	38	—	—	Egypt	Wassiff et al., 1969
	40	—	76	—	—	—	Tunisia	Cockrum et al., 1977
<i>Gerbillus aureus</i>	74	—	92-100	20-28	X:SM; Y:A?	—	Tunisia	Jordan et al., 1975
<i>Gerbillus calurus</i> (= <i>Sekeetamys calurus</i>)	38	74	—	—	—	—	Egypt	Wahrman and Zahavi, 1955 Wassiff et al., 1969
<i>Gerbillus campestris</i>	56	—	—	—	—	—	—	Matthey, 1953
	56	69-71	—	—	—	—	Egypt	Wassiff et al., 1969
	56	—	68	7	X&Y:SM	—	Tunisia	Jordan et al., 1975
<i>Gerbillus dasyurus</i>	60	66-68	—	—	—	—	Israel and N. Africa	Wahrman and Zahavi, 1955
<i>Gerbillus garamantis</i>								
<i>Gerbillus gerbillus</i>	60	69-70	—	—	—	—	Egypt	Wassiff et al., 1969
	54	—	—	—	—	—	—	Matthey, 1954c
	43 (♂)	79-81	—	—	—	—	—	Matthey, 1954d
	42 (♀)	—	—	—	—	—	—	Wassiff et al., 1969
	43 (♂)	—	74	18	X:ST;	—	Egypt	Jordan et al., 1975
	42 (♀)	—	—	—	YY (♂):M?	—	Tunisia	Jordan et al., 1975

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Gerbillus henleyi</i>	52	63-65	—	—	—	—	Egypt	Wassiff et al., 1969
<i>Gerbillus nanus</i>	52	66-68	—	—	—	—	—	Wahrman and Zahavi, 1955
	52	—	—	—	—	—	Egypt	Wassiff et al., 1969
	52	—	58	4	X:M; Y:A	9	Tunisia	Jordan et al., 1975
<i>Gerbillus nigeriae</i>	62-68	92-102	—	—	X:large A	—	Niger	Tranier, 1976a
<i>Gerbillus perpallidus</i>	40	—	—	—	—	—	—	Lay, 1975
<i>Gerbillus pulvinatus</i>	62	84	—	—	—	14	Ethiopia	Hubert, 1978b
<i>Gerbillus pyramidum</i>	40	80	74	18	—	—	Algeria	Matthey, 1952
	38	76	72	—	—	—	Egypt	Wassiff et al., 1969
	40	—	—	—	X&Y:M	—	Tunisia	Jordan et al., 1975
	40	78	—	—	—	1	Senegal	Hubert and Bohme, 1978
<i>Gerbillus simoni</i> (kaiserl)	60	68-69	—	8-10	—	—	Egypt	Wassiff et al., 1969
<i>Gerbillus tarabuli</i>	60	—	—	—	—	—	Tunisia	Cockrum et al., 1976
<i>Meriones crassus</i>	40	—	—	—	—	—	—	Lay, 1975
	60	60	—	—	—	—	—	Matthey, 1953
	60	74	—	—	—	—	—	Nadler and Lay, 1967
<i>Meriones libycus</i>	44	80-82	—	—	—	—	—	Matthey, 1953
	44	74	—	—	—	—	—	Nadler and Lay, 1967
	44	—	72	30	X:A; Y:SM	—	—	Hsu and Benirschke, 5(226), 1971
<i>Meriones shawi</i>	44	74	—	—	—	—	—	Matthey, 1957
	44	—	72	30	X&Y:SM	—	—	Hsu and Benirschke, 5(227), 1971
<i>Pachyuromys duprasi</i>	54	—	—	—	—	—	—	Matthey, 1954e
<i>Psammomys obesus</i>	48	—	—	—	—	—	—	Matthey, 1954e
	48	—	74	28	X:large SM; Y:small M	—	—	Hsu and Benirschke, 4(170), 1970
<i>Tatera afra</i>	44	70-76	—	—	—	—	South Africa	Matthey, 1954c
<i>Tatera brantsi draco</i>	44	70-76	—	—	—	—	South Africa	Matthey, 1954c
<i>Tatera gambiana</i>	52	—	—	—	X&Y:M	—	Senegal	Hubert et al., 1973
<i>Tatera guineae</i>	50	—	—	—	—	—	—	Matthey and Petter, 1970
<i>Tatera hopkinsoni</i>	48	—	—	—	—	—	Upper Volta	Matthey and Petter, 1970
<i>Tatera kempfi</i>	36	—	—	—	—	—	C.A.E.	Matthey and Petter, 1970
<i>Tatera nigrita</i>	48	66, 70	—	—	—	—	Chad	Tranier, 1974
<i>Tatera robusta</i>	46	—	—	—	—	—	—	Matthey and Petter, 1970
<i>Tatera schinzi</i>	42	70-76	—	—	X&Y:M	—	—	Matthey, 1954c
<i>Tatera valida</i>	52	—	—	—	—	—	—	Matthey, 1969
<i>Taterillus arenarius</i> *	30	—	36	—	X:large M; Y:?	1♀	Mauritania	Robbins, 1974

* (specimen =
T. nigeriae of
Matthey, 1969)

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Taterillus congicus</i>	54	68	—	—	—	—	C.A.E.	Matthey and Petter, 1970
	54	70	66	14	—	—	Chad	Tranier et al., 1974
	54	—	64	—	X:large SM; Y:small SM	—	C.A.E.	Genest and Petter, 1970
	23 (♂)	—	—	—	—	—	Senegal	Robbins, 1977
	22 (♀)	—	—	—	—	—	—	Matthey, 1969
<i>Taterillus gracilis</i>	37 (♂)	46, 48	—	—	X:M; Y:SM	—	Upper Volta	Matthey and Jotterand, 1972
	36 (♀)	—	—	—	—	—	Senegal	Robbins, in press
	37 (♂)	—	44	—	—	—	Senegal	Matthey and Petter, 1970
	36 (♀)	—	—	—	—	—	Upper Volta	Robbins, in press
	37 (♂)	—	42	—	—	—	Ghana	Matthey and Petter, 1970
	36 (♀)	—	—	—	—	—	Ivory Coast	Robbins, in press
<i>Taterillus harringtoni</i> * * (following specimens reported as <i>T. ermini</i>)	44	—	—	—	—	1	Somalia	Matthey, 1969
	44	—	—	—	—	1	Ethiopia	Genest and Petter, 1973
	44	—	62	—	X:large SM; Y:medium SM	—	C.A.E.	Robbins, 1973
	28	48	—	18	X:large M; Y:small M	2	Cameroon	Tranier et al., 1974
<i>Taterillus lacustris</i>	30	—	—	—	—	—	—	Matthey, 1969
<i>Taterillus nigeriae</i>	18 (♀)	32-34	26, 28	10, 12	X:large SM; Y:small M	4	Niger	Tranier, 1974b
<i>Taterillus</i> sp.	19 (♂)	—	—	—	—	—	—	Matthey, 1969
<i>Taterillus pygargus</i>	22-23	40-44	—	—	X:large SM; Y:small M, Y:medium SM	—	Senegal	Matthey, 1969
	23 (♂)	40-44	—	—	—	—	—	Petter et al., 1972
	22 (♀)	—	—	—	—	—	—	Matthey and Jotterand, 1972
Murinae								
<i>Acomyx airensis</i> (<i>calurus</i>)	42	70	—	28	—	—	Niger	Tranier, 1976b
<i>Acomyx subpinosus</i>	64	72	—	6	X:large SM	—	South Africa	Matthey, 1965
<i>Aethomys bocagei</i>	50	—	—	—	—	—	—	Matthey, 1963a
<i>Aethomys chrysophilus</i>	44	—	—	—	—	—	—	Matthey, 1958
<i>Aethomys granti</i>	32	—	—	—	—	—	—	Matthey, 1964
<i>Aethomys namaquensis</i>	24	—	—	—	—	—	—	Matthey, 1964
<i>Apodemus sylvaticus</i>	48	—	—	—	—	—	—	Matthey, 1936
	48	—	46	0	X&Y:A	—	Europe	Hsu and Benirschke, 4(176), 1970

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Speci- mens exam- ined	Country	Citation
<i>Arvicantthis abyssinicus</i>	62	—	—	—	—	—	—	Matthey, 1959
<i>Arvicantthis niloticus</i>	56	—	—	—	—	—	C.A.E.	Matthey, 1965
<i>Cricetomys gambianus</i>	78	—	—	—	X:SM	—	—	Matthey, 1953c
<i>Dasymys incomptus rufulus</i>	38	—	—	4	X&Y:A	—	Ivory Coast	Matthey, 1958
<i>Hybomys univittatus</i>	48	—	—	—	—	—	—	Matthey, 1959
<i>Hylomyscus aeta</i>	52	—	—	—	—	—	—	Matthey, 1963a
	52	—	—	—	—	2	Fernando Po	Eisenbraut, 1969
<i>Hylomyscus alleni</i>	46	—	—	—	—	3	Fernando Po, Cameroon	Eisenbraut, 1969
<i>Hylomyscus stella</i>	46	—	—	—	—	—	—	Matthey, 1963a
	46	—	—	—	—	4	Fernando Po, Cameroon	Eisenbraut, 1969
<i>Lemniscomys barbarus</i>	54	60	—	—	X&Y:M	—	—	Matthey, 1954c
<i>Lemniscomys bellieri</i>	56	78	74	10	X:M; Y:M	8	Ivory Coast	Van der Straeten and Verheyen, 1978
<i>Lemniscomys striatus</i>	48	—	—	—	—	—	—	Matthey, 1959
	44	72	68	26	X:M; Y:small M?	15	Ivory Coast	Van der Straeten and Verheyen, 1978
<i>Lophuromys aquilus</i>	70	—	—	—	—	—	—	Matthey, 1967a
<i>Lophuromys laticeps</i>	70	—	—	—	—	—	—	Dieterlen, 1976
<i>Lophuromys flavopunctatus</i>	60	—	—	—	—	—	—	Matthey, 1958
<i>Lophuromys s. sikapusi</i>	60	—	—	—	X:SM; Y:M	—	Ivory Coast	Matthey, 1958
<i>Lophuromys woosnami</i>	42	—	—	—	—	—	—	Dieterlen, 1976
<i>Malacomys edwardsi</i>	48	48	—	0	X&Y:A	—	Ivory Coast	Matthey, 1958
<i>Mastomys erythroleucus</i>	40	—	—	—	X:M; Y:SM	—	Ivory Coast	Matthey, 1958
	38	48-52	—	—	—	—	—	Matthey, 1966a, 1965
	38	54	—	—	—	—	Senegal, Morocco	Tranier, 1975
<i>Mastomys natalensis</i> (= <i>M. coucha</i>)	38	—	—	—	—	—	Zaire	Matthey, 1967a
	36	—	—	—	X&Y:SM	—	South Africa	Matthey, 1954c
	36	—	44	10	X:large SM; Y:ST	—	—	Petter and Genest, 1970
<i>Mastomys cf. huberti</i>	36	—	—	—	—	—	Rhodesia	Hsu and Benirschke, 2(71), 1968
	32	—	—	—	—	—	Zaire	Lyons et al., 1977
	32	—	—	—	—	—	Senegal	Matthey, 1966d
	32	52	—	—	—	—	Chad	Hubert et al., 1973
<i>Mus (Leggada) bellus</i>	30	32	—	—	X:M; Y:A	—	C.A.E.	Matthey, 1955
<i>Mus (Leggada) bufu</i>	36	36	—	—	X:SM; Y:A	—	—	Matthey, 1963a
								Jotterand, 1972
								Matthey, 1967c
								Jotterand, 1972

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Mus (Leggada) goundae</i>	16-19	30	—	—	X&Y:M	6	C.A.E.	Jotterand, 1972
<i>Mus (Leggada) haussa</i>	32-34	38	—	—	—	—	Ivory Coast	Matthey, 1967b Jotterand, 1972
<i>Mus (Leggada) indutus (deserti)</i>	36	36	—	—	—	—	South Africa	Matthey, 1964b Jotterand, 1972
<i>Mus (Leggada) mattheyi</i>	36	36	—	—	—	—	Ivory Coast	Matthey, 1966c Jotterand, 1972
<i>Mus (Leggada) minutoides</i>	36	36	—	—	—	—	Senegal	Petter et al., 1971
<i>Mus (Leggada) minutooides</i>	32	—	—	—	X:M; Y:SM	—	Ivory Coast	Matthey, 1958
<i>Mus (Leggada) musculooides</i>	18-34	36	—	—	variable	—	—	Jotterand, 1972
<i>Mus (Leggada) oubanguii</i>	28	30-34	—	—	X:M, Y:A	50	C.A.E.	Jotterand 1972
<i>Mus (Leggada) setulosus</i>	36	36	—	—	—	—	Ivory Coast	Matthey, 1964b Jotterand, 1972
<i>Mus (Leggada) triton</i>	32	34	—	—	—	—	Zaire	Matthey, 1966b
Form 1	20-22	34 (♂)	—	—	—	—	Tanzania	Matthey, 1963b
Form 2	—	32 (♀)	—	—	—	—	—	Jotterand, 1972
<i>Myiomys dybowski</i>	42	—	—	—	X:SM; Y:A	—	—	Matthey, 1970
<i>Myomys daltoni</i>	36	—	—	—	—	—	—	Matthey, 1964
<i>Oenomys hypoxanthus</i>	32	—	—	—	—	—	—	Matthey, 1963
<i>Pelomys campanae</i>	48	—	—	—	—	—	—	Matthey, 1963
<i>Praomys hartwigi</i>	34	—	—	—	—	—	Cameroon	Eisenraut, 1968
<i>Praomys jacksoni</i>	28	—	—	—	—	—	—	Matthey, 1958
	28	—	—	—	—	—	C.A.E.	Petter, 1964
<i>Praomys lukolelae</i>	42	—	—	—	—	—	C.A.E.	Matthey, 1970
<i>Praomys morio</i>	42	—	—	—	—	—	C.A.E.	Matthey, 1965
<i>Praomys taitae</i>	48	—	—	—	—	—	—	Matthey, 1965
<i>Praomys tullbergi tullbergi</i>	34	34	—	0	X&Y:A	—	Ivory Coast	Matthey, 1958
<i>Praomys t. minor</i>	34	—	—	—	—	—	C.A.E.	Petter, 1975
<i>Praomys verreauxi</i>	42	—	—	—	—	—	—	Matthey, 1965
<i>Rhadomys pumilio</i>	48	56	—	8	—	—	South Africa	Matthey, 1954c
<i>Thallomys paedulus</i>	48	—	—	—	—	—	—	Matthey, 1959
<i>Thamnomys surdaster</i>	52	66	62	12	X&Y:SM	—	C.A.E.	Matthey, 1971
	52	66	—	12	X&Y:SM	3	Ivory Coast	Petter and Tranter, 1975
<i>Thamnomys buntingi</i>	52	66	—	12	X&Y:SM	6	Ivory Coast	Petter and Tranter, 1975
<i>Thamnomys gazellae</i>	68-76	—	—	—	X:M	5	C.A.E.	Petter and Tranter, 1976

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Thamnomys rutilans</i>	50	—	—	—	—	—	—	Matthey, 1963
<i>Uranomys ruddi</i>	52	—	—	—	—	—	—	Matthey, 1970
Otominae								
<i>Otomys angoniensis pretoriae</i>	56	—	—	—	—	—	South Africa	Matthey, 1964
<i>Otomys unisulcatus</i>	28	—	—	—	—	—	South Africa	Matthey, 1964
Ctenodactylidae								
<i>Ctenodactylus joleaudi</i>	40	—	—	—	—	—	—	Matthey, 1956
Hystricidae								
<i>Hystrix cristata</i>	60	—	—	—	—	—	—	Renzoni, 1967
Rhizomyidae								
Tachyoryctinae								
<i>Tachyoryctes ruandae</i>	48	—	—	—	—	—	—	Matthey, 1967
<i>Tachyoryctes splendens</i>	48	—	—	—	—	—	—	Matthey, 1956
Sciuridae								
<i>Xerus rutilans</i>	38	—	70	34	X:SM; Y:minute M	7	Kenya	Nadler and Hoffmann, 1974
Spalacidae								
<i>Spalax ehrenbergi</i>	60	—	72	14	X:SM; Y:minute	16	Egypt	Lay and Nadler, 1972
Carnivora								
Canidae								
<i>Lycan pictus</i>	78	—	76	0	X&Y:M	—	—	Wurster and Benirschke, 1968
Otocyonidae								
<i>Otocyon megalotis</i>	72	—	—	—	X:SM; Y:small M	—	—	Hsu and Benirschke, 4(179), 1970
Vulpidae								
<i>Vulpes ruppelli</i>	40	—	—	—	—	—	—	Hsu and Benirschke, 3(122), 1969
<i>Vulpes vulpes</i>	38	—	—	—	—	—	—	Matthey, 1954b
	34-38	—	—	—	—	—	Europe	Makino, 1947
Felidae								
<i>Acinonyx jubatus</i>	38	—	70	34	X:SM; Y:A	—	—	Renzoni and Ormodeo, 1972
<i>Felis aurata</i>	38	—	—	—	—	—	—	Hsu et al., 1963
<i>Felis caracal</i>	38	—	—	—	—	—	—	Hsu and Benirschke, 5(234), 1971
<i>Felis chatus</i>	38	—	—	—	—	—	—	Malouf and Schneider, 1965
								Hsu and Arrighi, 1966
								Manna and Talukdar, 1965

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Felis margarita</i>	38	—	—	—	—	—	—	Jotterand, 1971
<i>Felis nigripes</i>	38	—	70	—	—	—	—	Hsu and Arrighi, 1966
	38	—	68	32	X:M; Y:small M	—	—	Hsu and Benirschke, 2(83), 1968
<i>Felis serval</i>	38	—	68	32	X:M; Y:small SM	—	—	Wurster and Benirschke, 1968
								Hsu and Benirschke, 5(235), 1971
<i>Panthera pardus</i>	38	—	68	32	X:medium SM; Y:small ST	—	—	Hsu, 1960
								Hsu and Benirschke, 2(84), 1968
Hyaenidae								
<i>Crocuta crocuta</i>	40	—	58	20	X:M; Y:SM	—	—	Wurster and Gray, 1967
								Hsu and Benirschke, 2(78), 1968
<i>Hyaena brunnea</i>	—	—	—	—	—	—	South Africa	Wallace and Fairall, 1970
<i>Hyaena hyaena</i>	40	—	70	—	X:SM; Y:A	—	—	Wurster, 1973
<i>Proteles cristatus</i>	40	—	68	30	X:M; Y:small M	—	—	Hsu and Arrighi, 1966
								Ulbrich and Schmitt, 1968
								Hsu and Benirschke, 3(123), 1969
Viverridae								
<i>Atilax paludinosus</i>	35 (♂) 36 (♀)	—	68	28	X:M; Y:?	—	—	Todd and Pressman, 1967
								Hsu and Benirschke, 3(124), 1969
<i>Bdeogale</i> sp.	36	—	68	28	X&Y:SM	—	—	Wurster and Benirschke, 1967a
								Hsu and Benirschke, 5(232), 1971
<i>Bdeogale nigripes</i>	36	—	—	—	—	—	—	Fredga, 1972
<i>Civettictis civetta</i>	38	—	—	—	—	—	—	Todd, 1967
<i>Crossarchus obscurus</i>	36 (♂)	—	—	—	—	—	—	Fredga, 1972
<i>Cynictis penicillata</i>	36	—	—	—	—	—	—	Fredga, 1972
<i>Genetta genetta</i>	54	—	—	—	—	—	—	Matthey, 1965b
<i>Genetta genetta neumanni</i>	52	—	92	46	X:SM; Y:A	—	—	Wurster and Benirschke, 1968
								Hsu and Benirschke, 3(126), 1969

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Heligale parvula</i>	36	—	—	—	—	—	—	Fredga, 1972
<i>Herpestes ichneumon</i>	48	—	—	—	—	—	—	Wurster and Benirschke, 1968
<i>Herpestes pulverulentus</i>	39 (♂)	—	—	—	—	—	—	Fredga, 1972
	40 (♀)	—	—	—	—	—	—	
<i>Herpestes sanguineus</i>	41 (♂)	—	—	—	—	—	—	Fredga, 1972
	42 (♀)	—	—	—	—	—	—	
<i>Ichneumia albicauda</i>	36	—	—	—	—	—	—	Wurster and Benirschke, 1967a
<i>Mungos mungo</i>	36	—	—	—	—	—	—	Wurster and Benirschke, 1967a
<i>Nandinia binotata</i>	38	—	—	—	—	—	—	Todd, 1967
<i>Suricata suricatta</i>	36	—	68	34	X:SM; Y:T	—	—	Todd, 1966
								Hsu and Benirschke, 1(30), 1967
Tubulidentata								
Orycteropidae								
<i>Orycteropus afer</i>	20	—	36	18	X:M; Y:SM	—	—	Benirschke et al., 1970
								Hsu and Benirschke, 5(238), 1971
Proboscidea								
Elephantidae								
<i>Loxodonta africana</i>	56	—	58	4	X:SM; Y:A	—	—	Hungerford et al., 1966
								Hsu and Benirschke, 6(288), 1971
Hyrracoidea								
Procaviidae								
<i>Procavia capensis</i>	54	—	62	10	X:SM; Y:small SM	—	—	Hungerford and Snyder 1969
								Hsu and Benirschke, 6(289), 1971
Perissodactyla								
Equidae								
<i>Equus asinus</i>	62	—	98	38	X:SM; Y:A	—	—	Benirschke et al., 1962
								Hsu and Benirschke, 1(33), 1967
								Benirschke and Malouf, 1965

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Equus burchelli antiquorum</i>	44	—	78	36	X:SM; Y:M	2	—	Benirschke and Malouf, 1965
	44	—	—	—	—	—	—	Benirschke et al., 1963
<i>Equus burchelli bohmi</i>	44	—	—	—	X:M; Y:small M	5	South Africa	Heinichen, 1970
<i>Equus burchelli burchelli</i>	44	—	—	—	—	—	—	Benirschke et al., 1963
	44	—	—	—	X:M; Y:small M	4	South W. Africa	Heinichen, 1970
<i>Equus burchelli crawshaii</i>	44	—	—	—	X:M; Y:small M	5	Rhodesia	Heinichen, 1970
<i>Equus grevyi</i>	46	—	76	32	X:M; Y:small M	—	—	Mutton et al., 1964 Hsu and Benirschke, 5(240), 1971
<i>Equus quagga</i>	44	—	76	34	X:M; Y:small A?	—	—	Benirschke and McFeeley, 1963 Hsu and Benirschke, 5(240), 1971
<i>Equus zebra hartmannae</i>	32	—	56	26	X:SM; Y:minute	2	—	Benirschke and Malouf, 1965
	32	—	56	24	X:SM; Y:minute	—	—	Benirschke, 1967 Hsu and Benirschke, 1(37), 1967
<i>Equus zebra zebra</i>	32	—	—	—	—	6	South Africa	Heinichen, 1970
	32	—	—	—	X:large SM; Y:small SM	4	South Africa	Heinichen, 1970
Rhinocerotidae								
<i>Ceratotherium s. simum</i>	84	—	—	—	X:M; Y:A	11	South Africa	Heinichen, 1970
Diceros bicornis	84	—	—	—	—	—	—	Hungerford et al., 1967
	84	—	—	—	X:M	2	South Africa	Heinichen, 1970
Artiodactyla								
Bovidae								
<i>Addax nasomaculatus</i>	58	—	—	—	—	—	—	Würster and Benirschke, 1968b
<i>Aepyceros melampus</i>	58-60	—	—	—	—	—	—	Wallace and Fairall, 1967a
	60	—	58	0	X:A; Y:M	—	—	Würster and Benirschke, 1967b Hsu and Benirschke, 4(188), 1970

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Speci- mens exam- ined	Country	Citation
<i>Alcelaphus boselaphus</i>	40	—	—	—	—	—	—	Wurster and Benirschke, 1967b
<i>Antidorcas marsupialis</i>	56	—	58	4	X:A; Y:small M	—	—	Wurster and Benirschke, 1967b Hsu and Benirschke, 2(89), 1968 Robinson and Skinner, 1976
<i>Ammotragus lervia</i>	58	—	58	2	X:A; Y:small M	—	—	Wurster and Benirschke, 1967b
<i>Capra ibex</i>	60	—	58	0	X:A; Y:small M	—	—	Hsu and Benirschke, 3(137), 1969 Hauschleek-Jungen and Melli, 1967 Hsu and Benirschke, 3(140), 1969
<i>Cephalophus dorsalis</i>	60	—	—	—	—	—	—	Hard, 1969
<i>Cephalophus grimmii</i>	60	—	—	—	—	—	—	Koufischer et al., 1967
<i>Cephalophus jentinki</i>	60	—	—	—	—	—	—	Hard, 1969
<i>Cephalophus maxwelli</i>	60	—	—	—	—	—	—	Hard, 1969
<i>Cephalophus niger</i>	60	—	—	—	—	—	—	Hard, 1969
<i>Cephalophus rufilatus</i>	60	—	—	—	—	—	—	Hard, 1969
<i>Cephalophus sylvicultor</i>	60	—	58	0	X:SM; Y:A	—	—	Hard, 1969 Hsu and Benirschke, 5(242), 1971
<i>Connochaetes gnou</i>	58	—	58	2	X&Y:A	—	—	Wurster and Benirschke, 1968b
<i>Connochaetes taurinus</i>	58	—	—	—	—	—	—	Hsu and Benirschke, 6(292), 1971
<i>Damaliscus dorcas</i>	38	—	58	22	X&Y:A	—	—	Wurster and Benirschke, 1968b Wurster and Benirschke, 1967b
<i>Gazella dama</i>	38	—	—	—	—	—	—	Hsu and Benirschke, 6(293), 1971
<i>Gazella dorcas</i>	31 (♂) 32 (♀)	—	—	—	—	—	—	Wurster and Benirschke, 1968b
<i>Gazella gazella</i>	35 (♂) 32 (♀)	—	—	—	—	—	—	Wurster, 1972 Wurster, 1972

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
<i>Gazella thomsoni</i>	58	—	60	4	X:medium SM; Y:small M	—	—	Nelson-Rees et al., 1967 Hsu and Benirschke, 2(93), 1968
<i>Hippotragus niger</i>	60	—	58	0	X:large ST; Y:small A	—	—	Wurster and Benirschke, 1968b Hsu and Benirschke, 3(142), 1969
<i>Kobus ellipsiprymnus</i>	50	—	—	—	—	—	—	Wurster and Benirschke, 1968b
<i>Kobus kob</i>	50	—	58	10	X:A; Y:M	—	—	Taylor et al., 1967 Hsu and Benirschke, 3(143), 1969
<i>Kobus megaceros</i>	52	—	—	—	—	—	—	Wurster and Benirschke, 1968b
<i>Oryx gazella</i>	56	—	58	4	X&Y:A	—	—	Hsu and Benirschke, 2(94), 1968
<i>Oryx tao</i>	58 (♀)	—	—	—	—	—	—	Wurster, 1972
<i>Raphicerus campestris</i>	—	—	—	—	—	—	—	Wallace and Fairall, 1967c
<i>Syncerus caffer caffer</i>	52	—	58	8	X:large A; Y:small A	—	—	Ulbrich and Fischer, 1967 Hsu and Benirschke, 3(145), 1969
<i>Syncerus caffer nanus</i>	54	—	58	6	X&Y:A	—	—	Wurster and Benirschke, 1967b
<i>Taurotragus oryx</i>	31 (♂) 32 (♀)	—	55-56	26	X:A; Y:A, translocated to an autosome	—	—	Hsu and Benirschke, 4(192), 1970 Taylor and Taylor, 1970
<i>Taurotragus eurycerus</i>	33 (♂) 55 (♂)	—	—	—	—	—	—	Hsu and Benirschke, 6(295), 1971
<i>Tragelaphus angasi</i>	56 (♀)	—	—	2	X&Y:?	—	—	Wurster, 1972
<i>Tragelaphus scriptus</i>	33 (♂) 34 (♀)	—	56-58	24-25	X:A; Y:A, translocated to an autosome	—	South Africa	Wurster and Benirschke, 1968b Hsu and Benirschke, 6(296), 1971 Wallace, 1977
<i>Tragelaphus spekei</i>	30	—	—	—	—	—	—	Wurster et al., 1968
<i>Tragelaphus strepsiceros</i>	31 (♂) 32 (♀)	—	55-56	26	X:A; Y:A, translocated to an autosome	—	—	Wallace and Fairall, 1967d Hsu and Benirschke, 6(297), 1971

Appendix I.—Continued.

Taxon	2N	NF	AA	BA	XY morphology	Specimens examined	Country	Citation
Giraffidae								
<i>Giraffa cameleopardis</i>	30	58	54	26	X:large SM; Y:small M	—	—	Wallace and Fairall, 1965
<i>Okapia johnstoni</i>	45	—	—	—	—	—	—	Hössi and Lang, 1970
Suidae								
<i>Phacochoerus aethiopicus</i>	34	—	—	—	—	—	—	Wallace and Fairall, 1967 <i>b</i>
<i>Sus scrofa</i>	36	—	60	26	X:M; Y:small M	—	—	McFee, 1965 Hsu and Benirschke, 1(39), 1967