OCCASIONAL PAPER NO. 176

RECORDS OF THE ZOOLOGICAL SURVEY OF INDIA

A Catalogue of Chromosome Numbers of Indian Mammals

Part 1. Orders : CARNIVORA and CHIROPTERA

Part 2. Orders : CETACEA, INSECTIVORA, LAGOMORPHA, PHOLIDOTA, PRIMATES, PROBOSCIDEA, SCANDENTIA

ASHOK K. SINGH
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Zoological Survey of India
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INTRODUCTION

A number of mammalian species occurring in the Indian subcontinent have been studied for their chromosomes during the past 3-4 decades. However, a systematic compilation of accumulated information in the form of a compendium for researchers was yet to be done. This work is an attempt to compile the karyotype number in the different mammals studied up to date.

Mammalian cytogeneticists in the laboratories of Kurt Benirschke and T. C. Hsu in U. S. A. did considerable ploughing in the early and mid 1960s, and published an historical resume on the subject (Hsu, 1979). Most of the Indian species of Mammals in the American zoos have been studied by them. In India, publications of Pathak (1965), Manna and Talukder (1965) and Ranjini (1966) were the initial works on the subject, dealing mainly with Chiropteran and Carnivoran species. Workers had two purposes : first to compare closely related species or genera to discover the karyotypic variability and certain trend of karyological evolution where data might also help mammalogists as additional set of characteristics for distinguishing species and other taxonomic categories, and second to find out model species with low diploid numbers, or anomalous sex-chromosome mechanisms, and other unexpected bonuses, for further cytological researches.

In the present paper, chromosome numbers of 47 species of Carnivora and 37 species of Chiroptera have been reported from various literature and/or unpublished data. Species are arranged alphabetically under their respective families. Ellerman and Morrison-Scott (1966) and Honacki et al. (1982) have been consulted for taxonomic history, geographic distribution and current status of mammalian species. The authors found difficulties in presenting karyotype figures because (i) karyotype presentation is not uniform In the publictions and (ii) in cases where extensive polymorphism is known, only one conventional karyotype cannot represent that genomic flux of the species.

The following indications have been made on the references below each species :

* An asterisk signifies the presence of normal karyotype;

** Double asterisks signify the presence of banding patterns of that specise; and

\+ A plus sign signifies the presence of some unique remark in the publication.

Order : CARNIVORA

Family : CANIDAE

1. ***Canis aureus*** Linnaeus, 1758. Syst. Nat., 10th ed., 1 : 40
   (Asiatic Jackal)

   2n = 78

   FN = 80

   Autosomes : 76 Acro-and subtelocentrics.

   Sex chromosomes : XX/XY
   X Large meta-or Submetacentric.
   Y Small acro-or subtelocentric.

REFERENCES

29, *125, *126, 133, **140, *159, 176

2. ***Canis familiaris*** Linnaeus, 1758. Syst. Nat., 10th ed., 1 : 39
(Domestic Dog)

2n = 78
FN = 80

Autosomes : 76 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Large meta-or submetacentric.
Y Small meta-or submetacentric.

REFERENCES

3, 6, *20, 22, 23, 28, 29, *37, 38, 39, 47, 50, 58, *65 (Folio 20), 75, 77, 89, *90, *92, 102, *103, 104, 106, 118, 119, 121, *134, **142, 148, *157, 163, 168, 169, 176, 177.

3. ***Canis lupus*** Linnaeus, 1758. Syst. Nat., 10th ed., 1 : 39.
(Wolf)

2n = 78
FN = 80

Autosomes : 76 Acro-or subtelocentrics.

Sex chromosomes : XX/XY
X Large meta-or submetacentric.
Y Small acro-or submetacentric.

REFERENCES

29, 68, 176, 177, 180.

4. ***Vulpes bengalensis*** *(Shaw,* 1800). Gen. Zool. Syst. Nat: Hist., 1(2) : 330.
(Bengal Fox).

2n = 60
FN = 72

Autosomes : 10 Meta-and submetacentrics.
48 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium sized meta or submetacentric.
Y Small acro-or subtelocentric.

REFERENCES

11, 12, 83, *124, *126, 133, *156, 176.

5. ***Vulpes vulpes*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 : 40.
(Common Red Fox).

2n = 34-38
FN = 68-76

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Large meta-or submetacentric.
Y Small meta-or submetacentric.

Marker chromosomes : Two pairs of submetacentrics or microchromosomes bear satellites.

REFERENCES

2, 7, 29, *51, 52, 53, *65 (Folio 380), 73, 76, 77, 91, *136, 137, 167, 176.

Family : FELIDAE

6. ***Acinonyx jubatus*** (Schreber, 1776). Saugethiere, 3 : pl. 105 (text 3 : 392, 1777).
(Cheetah).

2n = 38
FN = 74

Autosomes : 34 Meta-and submetacentrics.
2 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Minute subtelocentric.

Marker chromosomes : One pair of meta-or submetecentric bears satellites.

REFERENCES

*56, *62, *65 (Folio 234), *67, **120, 139, 176.

7. ***Felis bengalensis*** Kerr, 1792. Anim. Kingdom, 1 : 151.
(Leopard Cat).

2n = 38
FN = 74

Autosomes : 34 Meta-and submetacentrics.
2 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small meta-or submetacentric.

Marker chromosomes : One pair of small submetacentric bears satellites.

REFERENCES

*65 (Folio 82), 69, *74, 77, 80, 172, *173, 176, **178.

8. ***Felis chaus*** Guldenstaedt, 1776. Nova Comm. Acad. Sci. Petrop., 20 : 483. (Jungle Cat).

2n = 38
FN = 72

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small meta-or submetacentric.

Marker chromosomes : One pair of meta-or submetacentric bears satellites.

REFERENCES

83, *159, 176, **178.

9. ***Felis manul*** Pallas, 1776. Reise Prov. Russ. Reichs., 3 : 692. (Pallas's Cat).

2n = 38
FN = 72

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Submetacentric.
Y Acrocentric.

REFERENCES

*65 (Folio 431), 120.

10. ***Felis marmorata*** Martin, 1837. Proc. Zool. Soc. Lond., 1836 ; 108.
(Marbled Cat).

2n = 38
FN = 72

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small meta-or submetacentric.

Remarks : G-band pattern of *F. marmorata* is identical to that of *F. tigris*.+

REFERENCES :

*65 (Folio 430), *179+.

11. ***Felis rubiginosa*** I. Geoffroy, 1831. Zool. Voy. de Belanger Indes Orient. Zool., p. 140.
(Rusty-spotted Cat).

2n = 38

Autosomes : Only comments on the karyological features of this species is available in the publication.

Sex chromosomes : XX/XY

REFERENCES :

74.

12. ***Felis silvestris*** Schreber, 1777. Saugethiere, 3 : 397.
(European Wild Cat).

2n = 38
FN = 72

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small meta-or submetacentric.

Marker chromosomes : One pair of meta-or submetacentric bears satellites.

Remarks : *F. lybica, F. chaus* and *F. catus* have shown identical G-bands.+

REFERENCES

*31, **36, **54, 58, 60, *65 (Folio 31), *65 (Folio 432), 66, 69, 77, 81, 88, 103, 104, 120, **122, *126, 133, 138, 139, *142, 143, 158, 160, 161, 176, 178+

13. ***Felis temmincki*** Vigors and Horsfield, 1827. Zool. J., 3 : 451.
(Golden Cat).

2n = 38
FN = 72

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small subtelocentric.

Marker chromosomes : One pair of small submetacentric bears satellites.

Remarks : G-band pattern of the species is unique.+

REFERENCES

*170, *175, 176, **178+, 179.

14. ***Felis viverrina*** Bennett, 1833. Proc. Zool. Soc. Lond., 1833 : 68.
(Fishing Cat).

2n = 38
FN = 74

Autosomes : 34 Meta-and submetacentrics.
2 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Small submetacentric.

Marker chromosomes : One pair of small submetacentric bears satellites.

Remarks : G-band pattern of *F. bengalensis* and *F. viverrina* is reported identical.+

REFERENCES

*65 (Folio 236), 74, *173, *176, 178+.

15. ***Lynx caracal*** (Schreber, 1776). Saugethiere, 3 : pl. 106 (text 3 : 413, 1777).
(Caracal Lynx).

2n = 38
FN = 72

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and submetacentric.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small meta-or submetacentric.

Marker chromosomes : One pair of meta-or submetacentric bears satellites.

REFERENCES

*64, 69, 176, **178.

16. ***Lynx lynx*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 : 43.
(European Lynx)

2n = 38
FN = 72

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Small subtelocentric.

Marker chromosomes : One pair of small submetacentrics bears satellites on he short arms.

REFERENCES

*9, *65 (Folio 385), 176.

17. ***Neofelis nebulosa*** (Griffith, 1821). Descrip. Anim. (Carn.), p. 37, pl.
(Rusty-spotted Cat)

2n = 38

Autosomes : 4 Acrocentrics,
32 Meta-and submetacentrics.

Sex chromosomes : XX/XY
X Medium-sized meta or submetacentric.
Y Small acrocentric.

REFERENCES :

*170,

18. ***Panthera leo*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 : 41.
(Lion).

2n = 38
FN = 74

Autosomes : 34 Meta-and submetacentrics.
2 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small meta-or submetacentric.

Marker chromosomes : One pair meta-or submetacentrics bears satellites.

REFERENCES

27, *67, 69, 70, 77, 80, 120, 176, **178, 179.

19. ***Panthera pardus*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 : 41
(Leopard).

2n = 38
FN = 72

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small meta-or submetacentric.

Marker chromosomes : One pair meta-or submetacentrics bears satellites.

REFERENCES

61, *62, *65 (Folio 84), *67, 120, 160, 175, 176.

20. ***Panthera tigris*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 : 41.
(Tiger).

2n = 38
FN = 72

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small meta-or submetacentric.

Remarks : G-band pattern of *P.leo* and *P. tigris* is similar.+

REFERENCES

4, *65 (Folio 85), 66, 139, 161, 175, 176, 178+, 179.

21. ***Panthera uncia*** (Schreber, 1775). Saugethiere, 3 : pl. 100 (text 3 : 386, 1777). (Snow Leopard).

2n = 38
FN = 72

Autosomes : 32 Meta-and submetacentrics.
4 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Large submetacentric.
Y Small submetacentric.

Marker chromosomes : The third smallest submetacentric pair is satellited.

REFERENCES

*65 (Folio 386), *171.

Family : HERPESTIDAE

22. ***Herpestes auropunctatus*** (Hodgson, 1836). J. Asiat. Soc. Bengal., 5 : 236. (Small Indian Mongoose).

2n = ♂ 35 : ♀ 36
FN = 66

Autosomes : 10 Metacentrics.
14 Submetacentrics and
8 Subtelocentrics.

Sex chromosomes : X_1X_1 X_2X_2/X_1X_2Y
X_1 Medium-sized meta-or submetacentric.
X_2 Acrocentric.
Y Acrocentric.

Marker chromosomes : Y chromosome with diminutive short arm.

REFERENCES

*30, *40, 41, 44, *45, *46, 47, *65 (Folio 185), 84, 103, 123, *126, 132, 133, **144, 146, 147, 158, *159, 164, 176.

23. ***Herpestes edwardsi*** (E. Geoffroy, 1818). Descrip. de L'Egypte, 2 : 139.
(Indian Grey Mongoose).

2n = ♂ 35 : ♀ 36
FN = 66

Autosomes : 12 Metacentrics,
16 Submetacentrics and
4 Acrocentrics.

Sex chromosomes : X_1X_1 X_2X_2/X_1X_2Y
X_1 Medium-sized metacentric.
X_2 Medium-sized acrocentric.
Y Medium-sized acrocentric.

Marker chromosomes : Y chromosome with diminutive short arm. Two pairs of autosomes show dimorphism and both morphological types are larger than the corresponding pairs in other species.

REFERENCES

45, * 46, 47, **48, 84, 118, 127, 132, 133, **144.

24. ***Herpestes fuscus*** Waterhouse, 1838. Proc. Zool. Soc. Lond., 1838 : 55.
(Indian Brown Mongoose).

2n = ♂ 35 : ♀ 36
FN = 66

Autosomes : 10 Metacentrics,
18 Submetacentrics and
4 Subtelocentrics.

Sex chromosomes : X_1X_1 X_2X_2/X_1X_2Y
X_1 Medium-sized metacentric.
X_2 medium-sized acrocentric.
Y Medium-sized acrocentric.

Marker chromosomes : Y chromosome with diminutive short arm.

REFERENCES

45, *46, 47, 165.

25. ***Herpestes urva*** (Hodgson, 1836). J. Asiat. Soc. Bengal, 5 : 238.
(Crab-eating Mongoose).

2n = ♂ 35 : ♀ 36
FN = 66

Autosomes : 10 Metacentrics,
12 Submetacentrics
10 Subtelocentrics.
2 Acrocentrics.

Sex chromosomes : X_1X_1 X_2X_2/X_1X_2Y
X_1 Medium-sized metacentric.
X_2 Medium-sized acrocentric.
Y Medium-sized acrocentric.

Marker chromosomes : Y chromosome with diminutive short arm.

Remarks : The general appearance of the karyotype of *H. urva* is similar to that of *H. auropunctatus.*[+]

REFERENCES

45, *46[+], 47.

Family : HYAENIDAE

26. ***Hyaena hyaena*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 : 40.
(Striped Hyaena).

2n = 40
FN = 72

Autosomes : 30 Meta-and submetacentrics.
8 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Large meta-or submetacentric.
Y Small, not specified in the publications.

Marker chromosomes : One pair meta-or submetacentric bears satellites.

REFERENCES

*64, 161, 176.

Family : MUSTELIDAE

27. ***Aonyx cinerea*** (Illiger, 1815). Abh. Preuss. Akad. Wiss., 1815 : 99.
(Oriental Small–clawed Otter).

2n = 38
FN = 66

Autosomes : 26 Meta-and submetacentrics.
10 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small acro-or subtelocentric.

Marker chromosomes : One pair acro-or subtelocentric is marked by a constriction in the long arms.

REFERENCES

*64, *65 (Folio 79), 172, 176.

28. ***Lutra perspicillata*** I. Geoffroy, 1826. Dict. Class. Hist. Nat., 9 : 519.
(Smooth-coated Indian Otter).

2n = 38
FN = 66

Autosomes : 28 Meta-and submetacentrics.
10 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
Sex chromosome features not reported.

REFERENCES

83, *159, 176.

29. ***Martes flavigula*** (Boddaert, 1785). Elench. Anim., 1 : 88.
(Yellow-throated Marten).

2n = 40
FN = 72

Autosomes : 30 Meta-and submetacentrics.
8 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Not specified in the publications.

Marker chromosomes : Long arms of one pair of small submetacentrics possess an achromatic region adjacent to the centromere.

REFERENCES

*42, *170, 172, *176.

30. ***Martes foina*** (Erxleben, 1777). Regn. Anim. 1 : 458.
(Beech Marten, or Stone Marten).

2n = 38
FN = 74

Autosomes : 22 Subtelocentrics.
14 Meta-and submetacentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small acrocentric.

Marker chromosomes : One small pair with a pericentric heteropycnotic region.

REFERENCES

33, 85, *135, 172; 176.

31. ***Melogale moschata*** (Gray, 1831). Proc. Zool. Soc. Lond., 1831 : 94.
(Chinese Ferret-Badger).

2n = 38
FN = 74

Autosomes : 34 Meta-and submetacentrics.
2 subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Small submetacentric.

Marker chromosomes : The largest pair metacentrics is satellited, and two large submetacentrics possess satellites on the long arms.

REFERENCES

78, 161, *170, 172, *176.

32. ***Mustela altaica*** Pallas, 1811. Zoogr. Rosso-Asiat., 3 : 98.
(Alpine Weasel)

2n = 44
FN = 72

Autosomes : 34 Submetacentrics.
8 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Minute submetacentric.

REFERENCES

*65 (Folio 382), *166.

33. ***Mustela erminea*** Linnaeus, 1758. Syst. Nat., 10th ed., 1 : 46.
(Stoat).

2n = 44
FN = 62

Autosomes : 16 Meta-and submetacentrics.
26 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Smallest member of chromosome set.

Marker chromosomes : Prominent secondary constriction in the proximal part of the long arms of a medium-sized chromosome.

REFERENCES

35, 42, 43, *65 (Folio 80), **82, 86, *87, 149, 176.

34. ***Mustela nivalis*** Linnaeus, 1766. Syst. Nat., 12th ed., 1 : 69.
(Weasel).

2n = 42
FN = 70

Autosomes : 26 Meta-and submetacentrics.
14 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Small metacentric.

Marker chromosomes : One medium-small acrocentric pair with non-staining area in the long arms.

REFERENCES

43, **48, **82, 105, *171, 176.

35. ***Mustela putorius*** Linnaeus, 1758. Syst. Nat., 10th ed., 1 : 46.
(European Polecat).

2n = 40
FN = 70

Autosomes : 28 Meta-and submetacentrics.
10 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Small meta-or submetacentric.

Marker chromosomes : One of the smallest pairs of acrocentrics bears a secondary constriction on the long arm near the centromere. Two other pairs meta and submetacentrics possess an achromatic region.

REFERENCES

5, *42, 43, **48, 49, *64, *65 (Folio 27), 72, 105, 107, 118, 120, 172, 176.

36. ***Mustela sibirica*** Pallas, 1773. Reise. Prov. Russ. Reichs., 2 : 701.
(Siberian Weasel).

2n = 38
FN = 68

Autosomes : 28 Meta-and submetacentrics.
8 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta–or submetacentric.
Y Small meta-or submetacentric.

REFERENCES

76, 77, *79, 176.

Family : PROCYONIDAE

37. ***Ailurus fulgens*** F. Cuvier, 1825. Hist. Nat. Mamm., 5 (50) : 3.
(Red Panda).

2n = 36
FN = 66

Autosomes : 2 Acrocentrics.
32 Meta and submetacentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Small acrocentric.

REFERENCES

*65 (Folio 182), 162, *170.

Family : URSIDAE

38. ***Helarctos malayanus*** (Raffles, 1821). Trans. Linn. Soc. Lond., 13 : 254.
(Malayan Sun Bear).

2n = 74
FN = 88

Autosomes : 58 Acrocentrics.
14 Meta and submetacentrics.

Sex chromosomes : XX/XY
X Large metacentric.
Y Minute acrocentric.

REFERENCES

*65 (Folio 181), *170.

39. ***Melursus ursinus*** *(Shaw, 1791). Nat. Misc., 2 (unpaged) pl. 58.*
(Sloth Bear).

2n = 74
FN = 84

Autosomes : 8 Meta-and submetacentrics.
64 Acrocentrics.

Sex chromosomes : XX/XY
X Large submetacentric.
Y Not specified in the publication.

Marker chromosomes : One pair of small acrocentrics exhibits conspicuous secondary constrictions.

REFERENCES

*57.

40. ***Ursus thibetanus*** G. Cuvier, 1823. Rech. Oss. Foss., 4 : 325.
(Asiatic Black Bear).

2n = 74
FN = 84

Autosomes : 8 Meta-and submetacentrics.
64 Acrocentrics.

Sex chromosomes : XX/XY
X Large meta-or submetacentric.
Y Small acrocentric.

Marker chromosomes : Secondary constrictions in more than two pairs of chromosomes reported.

REFERENCES

8, *9, *65 (Folio 22), 102, 176.

Family : VIVERRIDAE

41. ***Arctictis binturong*** (Raffles, 1821). Trans. Linn. Soc. Lond., 13 : 253.
(Binturong).

2n = 42
FN = 66

Autosomes : 22 Meta-and submetacentrics.
18 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small submetacentric.

Marker chromosomes : One pair of small submetacentrics bears a secondary constriction on the short arms. Identification of the X is unequivocal.

REFERENCES

*64, *65 (Folio 29), 172, 176.

42. ***Arctogalidia trivirgata*** (Gray, 1832). Proc. Zool. Soc. Lond., 1832 : 68.
(Small-toothed Palm Civet).

2n = 40
FN = 66

Autosomes : 24 Meta-and submetacentrics.
14 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-large submetacentric.
Y Tiny submetacentric.

Marker chromosomes : The smallest pair of metacentrics has prominent satellites.

REFERENCES

*65 (Folio 384), *171.

43. ***Cynogale bennettii*** Gray, 1837. Proc. Zool. Soc. Lond., 1836 : 88.
(Otter–Civet).

2n = 42
FN = 72

Autosomes : 28 Meta-and submetacentrics.
12 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Medium-large submetacentric.
Y Medium-sized acrocentric.

Marker chromosomes : The smallest submetacentric pair bears prominent satellites.

Remarks : The type of marker chromosome is common among the civets.[+]

REFERENCES

*171[+].

44. ***Paguma larvata*** (H. Smith, 1827). In Griffith, Cuvier's Anim. Kingd., 2 : 281.
(Masked Palm Civet).

2n = 44
FN = 68

Autosomes : 22 Meta-and submetacentrics.
20 Acrocentrics.

Sex chromosomes : XX/XY
X Large metacentric.
Y Small submetacentric.

Marker chromosomes : One pair of small submetacentrics bears satellites on the short arms.

REFERENCES

*170, 172, *176.

45. ***Paradoxurus hermaphroditus*** (Pallas, 1777). In Schreber, Die Saugethiere, 3 : 426. (Common Palm Civet or Toddy Cat).

2n = 42
FN = 66

Autosomes : 20 Meta-and submetacentrics.
4 Large subtelocentrics and
16 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Smallest subtelocentric.

Marker chromosomes : The 4th pair of median chromosomes has a distinct gap in one of the arms.

REFERENCES

12, *16, *65 (Folio 233), *126, *131, 133, 158, 176.

46. ***Viverra zibetha*** Linnaeus, 1758. Syst. Nat., 10th ed., 1 : 43. (Large Indian Civet).

2n = 38
FN = 64

Autosomes : 18 Meta-and submetacentrics.
18 Acro and subtelocentrics.

Sex chromosomes : XX/XY.
X Medium sized subtelocentric.
Y Small acrocentric.

Marker chromosomes : One pair of small sized submetacentrics has satellites in the short arms.

REFERENCES

10, *115.

47. ***Viverricula indica*** (Desmarest, 1817). Nouv. Dict. Hist. Nat. Paris, 7 : 170. (Rasse, or Small Indian Civet).

2n = 36
FN = 64

Autosomes : 26 Meta-and submetacentrics.
8 Acro-and subtelocentrics.

Sex chromosomes : XX/XY
X Large submetacentric.
Y Medium-sized acrocentric.

Marker chromosomes : Smallest pair of metacentrics bears satellites.

REFERENCES

10, *65 (Folio 128), 141, 172, 174, *176.

Order : CHIROPTERA
Family : EMBALLONURIDAE

48. ***Saccolaimus saccolaimus*** (Temminck, 1838). Tijdschr. Nat. Gesch. Physiol., 5 : 14. (Pouch-bearing Bat).

2n = 44
FN = 64

Autosomes : 22 Meta-and submetacentrics.
20 Acrocentrics.

Sex chromosomes : XX/XY
X Large meta-or submetacentric.
Y Minute acrocentric.

REFERENCES

**99, 100.

49. ***Taphozous longimanus*** Hardwicke, 1825. Trans. Linn. Soc. Lond., 14 : 525.

2n = 42
FN = 64

Autosomes : 24 Meta-and submetacentrics.
16 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized metacentric.
Y Minute acrocentric.

REFERENCES

*65 (Folio 306), *93, *112, 128, *130.

50. ***Taphozous melanopogon*** Temminck, 1841. Monogr. Mamm., 2 : 287.
(Black-bearded Tomb Bat).

2n = 42
FN = 64 Mainlands
FN = 62 Andamans

Autosomes : 24 Meta-and submetacentrics.
16 Acrocentrics. (Mainland)
22 Meta-and submetacentrics.
18 Acrocentrics. (Andaman Islands)

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small acrocentric.

REFERENCES

*19, *93, 100, *112, *113, 128, *130, 151, **152.

51. ***Taphozous nudiventris*** Cretzschmar, 1830. In Ruppell, Atlas Reise Nordl. Afr., Saugeth., p. 70.
(Naked-bellied Tomb Bat).

2n = 42
FN = 66

Autosomes : 26 Meta-and submetacentrics.
14 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Minute acrocentric.

REFERENCES

*150.

Family : MEGADERMATIDAE

52. ***Megaderma lyra*** E. Geoffroy, 1810. Ann. Mus. Hist. Nat. Paris, 15 : 190.
(Indian False Vampire).

2n = 54
FN = 104

Autosomes : 40 Meta-and submetacentrics.
12 Acrocentrics.

Sex chromosomes : XX/XY
X Large submetacentric.
Y Minute dot.

Marker chromosomes : One homologue of the 8th pair carries prominent satellite in the short arm.

REFERENCES

**98,*112, *114, 128, *130.

Family : MOLOSSIDAE

53. ***Chaerephon plicata*** (Buchanan, 1800). Trans. Linn. Soc. Lond., 5 : 261.
(Wrinkle-lipped Bat).

2n = 48
FN = 54

Autosomes : 6 Metacentrics..
2 Submetacentrics.
38 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Small acrocentric.

REFERENCES

*150.

Family : PTEROPODIDAE

54. ***Cynopterus sphinx*** (Vahl, 1797). Skr. Nat. Sclsk. Copenhagen, 4(1) : 123.
(Short-nosed Fruit Bat).

2n = 34
FN = 58

Autosomes : 26 Meta-and submetacentrics.
6 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized subtelocentric in Varanasi population and submetacentric in Mysore population.
Y Minute acrocentric.

Marker chromosomes : Pair no. 6 in order of decreasing size bears achromatic zone in the short arms. Presence of this marker in other megachiropterans studied by Pathak (1967) viz. *C. sphinx gangeticus, C. s. sphinx, Rousettus leschenaulti* and *Pteropus giganteus giganteus* indicates their close evolutionary relationship.

REFERENCES

96, 108, *112, *116, *129, *150.

55. ***Eonycteris spelaea*** (Dobson, 1871). Proc. Asiat. Soc. Bengal, p. 105, 106.
(Dobson's Long-tongued Fruit Bat).

2n = 36
FN = 68

Autosomes : 32 Meta-and submetacentrics.
2 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Minute acrocentric.

REFERENCES

*93, 96.

56. ***Pteropus giganteus*** (Brunnich, 1782). Dyrenes Historie, 1 : 45.
(Indian Flying Fox).

2n = 38
FN = 72

Autosomes : 30 Meta-and submetacentrics.
6 Subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Minute acrocentric.

Marker chromosomes : Pair no. 6 in order of size bears achromatic zone in the long arms.

REFERENCES

*15, **32 *65 (Folio 304), 71, 83, **97, 109, *129, **142.

57. ***Rousettus leschenaulti*** (Desmarest, 1820). Encyclop. Method. Mamm., 1 : 110.

2n = 36
FN = 68

Autosomes : 26 Meta-and submetacentrics.
8 Subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized subtelocentric.
Y Minute acrocentric.

Marker chromosomes : Pair no. 6 in order of size has prominent scondary constriction in the long arms.

REFERENCES

*65 (Folio 305), *93, 96, 111, *112, *129.

Family : RHINOLOPHIDAE

58. ***Hipposideros alter*** Templeton, 1848. J. Asiat. Soc. Bengal, 17 : 252.

2n = 32
FN = 60

Autosomes : 24 Meta-and submetacentrics.
6 Subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Small acrocentric.

Marker chromosomes : One pair submetacentrics bears achromatic gap proximal to the centromere in the long arms.

REFERENCES

55, *130, **155.

59. ***Hipposideros bicolor*** (Temminck, 1834). Tijdschr. Nat Gesch. Physiol., 1 : 19.
(Bicoloured Leaf-nosed Bat)

2n = 32
FN = 60

Autosomes : 24 Meta-and submetacentrics.
6 Subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Small acrocentric.

Marker chromosomes : One submetacentric pair bears achromatic gap proximal to the centromere in the long arms.

REFERENCES

55, *112, 128, *150, **155.

60. ***Hipposideros cinaraceus*** Blyth, 1853. J. Asiat. Soc. Bengal, 22 : 410.

2n = 32
FN = 60

Autosomes : 24 Meta-and submetacentrics.
6 Subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Small acrocentric.

Marker chromosomes : A submetacentric pair bears achromatic gap proximal to the centromere in the long arms.

REFERENCES

55, 101, **155.

61. ***Hipposideros fulvus*** Gray, 1838. Mag. Zool. Bot., 2 : 492.
(Bicoloured Leaf-nosed Bat).

2n = 32
FN = 60

Autosomes : 24 Meta-and submetacentrics.
6 Subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized metacentric.
Y Small acrocentric.

Marker chromosomes : One pair of submetacentrics distinct on an achromatic gap close to the centromere in the long arms.

REFERENCES

55, 101, *130, **155.

62. ***Hipposideros lankadiva*** Kelaart, 1850. J. Sri Lanka Branch Asiat. Soc., 2(2) : 216.

2n = 32
FN = 60

Autosomes : 24 Meta-and submetacentrics.
6 Subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized metacentric.
Y Minute acrocentric.

Marker chromosomes : One submetacentric pair bears achromatic gap in the long arms close to the centromere.

REFERENCES

55, 101, **155.

63. ***Hipposideros speoris*** (Schneider, 1800). In Schreber, Die Saugethiere, pl. 59b.
(Schneider's Leaf-nosed Bat).

2n = 32
FN = 60

Autosomes : 24 Meta-and submetacentrics.
6 Subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized subtelocentric.
Y Minute acrocentric.

Marker chromosomes : One pair submetacentric bears achromatic gap close to the centromere in its long arms.

Comments : In *H. lankadiva* and *H. speoris* the first pair of subtelocentrics are relatively larger than the corresponding chromosomes in other species of *Hipposideros*.+

REFERENCES

55, 101, **155+.

64. ***Rhinolophus ferrumequinum*** (Schreber, 1774). Saugethiere, 1 : 174, pl. 62.
(Greater Horseshoe).

2n = 58
FN = 62

Autosomes : 6 Meta-and submetacentrics.
50 Acro-and Subtelocentrics.

Sex chromosomes : XX/XY
X Large - sized submetacentric.
Y Minute acrocentric.

Marker chromosomes : One pair of acrocentrics, 13th in the karyotype, bears achromatic gap proximal to the centromere.

REFERENCES

**1, *21.

65. ***Rhinolophus lepidus*** Blyth, 1844. J. Asiat. Soc. Bengal, 13 : 486.

2n = 62
FN = 64

Autosomes : 60 Acrocentrics.

Sex chromosomes : XX/XY
X Large subtelocentric.
Y Small acrocentric.

REFERENCES

*93.

66. ***Rhinolophus luctus*** Temminck, 1835. Monogr. Mamm., 2 : 24.
(Great Eastern Horseshoe Bat).

2n = 32
FN = 60

Autosomes : 30 Meta-and submetacentrics.

Sex chromosomes : XX/XY
X Medium-sized metacentric.
Y Smallest acrocentric.

REFERENCES

1, 94, *95.

67. ***Rhinolophus rouxi*** Temminck, 1835. Monogr. Mamm., 2 : 306.

2n = 56
FN = 60

Autosomes : 2 Metacentrics.
4 Subtelocentrics.
54 Acrocentrics.

Sex chromosomes : XX/XY
X Large subtelocentric.
Y Minute acrocentric.

REFERENCES

*93, 94.

Family : RHINOPOMATIDAE

68. ***Rhinopoma hardwickei*** Gray, 1831. Zool. Misc., 1 : 37.
(Lesser Rat-tailed Bat).

2n = 36
FN = 68

Autosomes : 30 Meta-and submetacentrics.
4 Subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Minute dot.

REFERENCES

*112, 128, *129, *150.

69. ***Rhinopoma kinneari*** Wroughton, 1912. J. Bombay N. H. Soc., 21 : 3 : 767.

2n = 36
FN = 72

Autosomes : 34 Meta-and submetacentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Smallest submetacentric.

Marker chromosomes : One pair of small metacentrics bears non-staining gap at the centromere.

REFERENCES

13, *14.

Family : VESPERTILIONIDAE

70. ***Miniopterus schreibersi*** (Kuhl, 1819). Ann. Wetterau Ges. Naturk., 4(2) : 185.
(Schreiber's Bat. Long-winged Bat).

2n = 46
FN = 50

Autosomes : 6 Meta-and submetacentrics.
38 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Minute dot.

Marker chromosomes : One pair of small acrocentrics bears achromatic gap close to the centromere.

REFERENCES

*21, *93.

71. ***Myotis daubentoni*** (Kuhl, 1819). Ann. Wetterau Ges. Naturk., 4(2) : 195.
(Daubenton's Bat. Water Bat).

2n = 42

Autosomes : 40
The publication is too old with camera lucida drawings. Karyological features are not given.

Sex chromosomes : XX/XY

REFERENCES

*21.

72. ***Myotis mystacinus*** (Kuhl, 1819). Ann. Wetterau Ges. Naturk., 4(2) : 202.
(Whiskered Bat).

2n = 44

Autosomes : 42
The publication is too old with camera lucida drawings. Karyological features are not given.

Sex chromosomes : XX/XY

REFERENCES

*21.

73. ***Pipistrellus affinis*** (Dobson, 1871). Proc. Asiat.Soc. Bengal, p. 213.
(Chocolate Bat).

2n = 36
FN = 48

Autosomes : 14 Meta-and submetacentrics.
2 Subtelocentrics.
18 Acrocentrics. (microchromosomes form the smallest pairs)

Sex chromosomes : XX/XY
X Small-sized metacentric.
Y Small acrocentric.

REFERENCES

*65 (Folio 309), *112, *117, 128.

74. ***Pipistrellus ceylonicus*** (Kelaart, 1852). Prodr. Faun. Zeylanica, p. 22.
(Kelaart's Pipistrelle).

2n = 36
FN = 48

Autosomes : 14 Meta-and submetacentrics.
20 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized metacentric.
Y Minute dot.

REFERENCES

*150.

75. ***Pipistrellus coromandra*** (Gray, 1838). Mag. Zool. Bot., 2 : 498.
(Indian Pipistrelle)

2n = 30
Fn = 56

Autosomes : 22 Meta-and submetacentrics.
6 Subtelocentrics.

Sex chromosomes : XX/XY
X Medium-sized submetacentric.
Y Small subtelocentric.

Marker chromosomes : The longest subtelocentric pair reveals constriction in the long arms.

Remarks : Sarkar and Manna (1989) reported 2n = 36, consisting of 10 metacentric, 2 submetacentric and 22 acrocentric autosomes. The X, long metacentric and the Y very small acrocentric have also been recognized in their material. +

REFERENCES

*93, **142+.

76. ***Pipistrellus dormeri*** (Dobson, 1875). Proc. Zool. Soc. Lond., 1875 : 373.
(Dormer 's Bat).

2n = 36
FN = 50

Autosomes : 14 Meta-and submetacentrics.
20 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized metacentric.
Y Minute dot.

REFERENCES

*150.

77. ***Pipistrellus kuhlii*** (Natterer, 1819) In Kuhl. Ann. Wetterau Ges. Naturk., 4(2) : 199.
(Kuhl's Pipistrelle).

2n = 44
FN = 50

Autosomes : 8 Meta-and submetacentrics.
34 Acrocentrics.

Sex chromosomes : XX/XY
X Meta-or submetacentric.
Y Small acrocentric.

REFERENCES

24, *25

78. ***Pipistrellus mimus*** Wroughton. 1899. J. Bombay Nat. Hist. Soc., 12 : 722. (Indian Pygmy Pipistrelle).

2n = 38
FN = 48

Autosomes : 12 Metacentrics.
24 Acrocentrics.
4 Microchromosomes.

Sex chromosomes : XX/XY
X Small metacentric.
Y Small acrocentric.

Marker chromosomes : One pair of acrocentrics shows secondary constriction near the centromere.

REFERENCES

*15, 17, 18, *65 (Folio 310), 83, *93, *112, *117.

79. ***Pipistrellus mordax*** (Peters, 1866). Monatsb. Preuss. Akad. Wiss. Berlin, p. 402.

2n = 34
FN = 46

Autosomes : 14 Meta-and submetacentrics.
14 Acrocentrics.
4 Microchromosomes.

Sex chromosomes : XX/XY
X Small metacentric.
Y Minute acrocentric.

REFERENCES

*112, *117.

80. ***Pipistrellus pipistrellus*** (Schreber, 1774). Saugethiere, 1 : 167.

2n = 42

Autosomes : 40
The publication is too old with camera lucida drawings. Karyological features are not given.

Sex chromosomes : XX/XY

REFERENCES

21.

81. ***Pipistrellus savii*** (Bonaparte, 1837). Fauna, Ital., 1, fasc. 20.
(Savi's Pipistrelle)

2n = 44
FN = 50

Autosomes : 8 Metacentrics.
34 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized metacentric.
Y Small acrocentric.

REFERENCES

*26

82. ***Plecotus auritus*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 : 32.

2n = 32

Autosomes : 30
The publication is too old with camera lucida drawings. Karyological features are not given.

Sex chromosomes : XX/XY

REFERENCES

*21.

83. ***Scotophilus heathi*** (Horsfield, 1831). Proc. Zool. Soc. Lond., 1831 : 113.
(Greater Yellow Bat).

2n = 36
FN = 52

Autosomes : 18 Meta-and submetacentrics.
16 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized meta-or submetacentric.
Y Minute dot.

Marker chromosomes : The smallest metacentric pair has an achromatic gap in the short arms. This pair shows a polymorphic condition.

Remarks : Intra-specific chromosomal variatian is reported+.

REFERENCES

*12, *15, *145, **153+, 154, 158.

84. ***Scotophilus kuhli*** Leach, 1822. Trans. Linn. Soc. Lond., 13 : 71.

2n = 36
FN = 52

Autosomes : 10 Metacentrics.
4 Submetacentrics.
20 Acrocentrics.

Sex chromosomes : XX/XY
X Medium-sized metacentric.
Y Small acrocentric.

Marker chromosomes : The smallest acrocentrics is marker pair with faintly stained proximal region near the centromere. In Nanded (Maharastra) population the smallest metacentrics is reported to have prominent secondary constriction in the short arms (Pathak and Sharma, 1969).

REFERENCES

110, *112, *117, 128, **153, 154.

SUMMARY

Chromosomal accounts of 84 species of Indian mammals, belonging to two Orders Carnivora and Chiroptera, are provided. A total of 47 species of Carnivora belonging to 8 families, viz. Canidae, Felidae, Herpestidae, Hyaenidae, Mustelidae, Procyonidae, Ursidae and Viverridae; and a total of 37 species of Chiroptera belonging to 7 families, viz. Emballonuridae, Megadermatidae, Molossidae, Pteropodidae, Rhinolophidae, Rhinopomatidae and Vespertilionidae are dealt with. For each species, chromosomal details include the diploid number (2n), fundamental number (FN), autosomal and sex-chromosome features and marker chromosomes. Relevant references are also given alongwith.

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INTRODUCTION

The catalogue presents numbers and morphology of the chromosomes of 45 species belonging to 7 orders of mammals reported from the Indian subcontinent.

We have catalogued the details from enormous mass of literature published in many different places and languages and in diverse ways. In publications, uniformity in morphological identification of chromosomes is not evident where location of the centromere is the most useful land mark and one which is characterized by great constancy. For example, a chromosome is often reported subtelocentric by one worker and acrocentric by other. The "Nombre Fondamental" (NF of Matthey, 1945) represents autosomes in one publication and in other arms of the sex chromosomes (XX/XY) have also been included. Thus, a relatively correct picture of the chromosomes of a species had so far not emerged.

We found the anomalies sufficient for re- examination of the reports and designed their presentation in the form of this catalogue.

For uniformity in morphologic identification of the chromosomes, classification according to arm ratio suggested by Levan *et al.* (1964) has been followed throughout (refer Table 3 "Nomenclature recommended"). Our objective measurement of large number of chromosomes secured their place in metacentrics, submetacentrics, subtelocentrics and acrocentrics. Karyotypes with Levan's nomenclature have been retained as such except telocentric (t) is replaced by the term acrocentric (acrocentric chromosomes also have their centromere in the terminal (t) region; arm ratio 7-∞). Telocentric symbolized with T in Levan's system refers to the end point of the chromosome (arm ratio ∞). In the present context, not a single element of these species could be designated T. Where arm ratio is not reported, this has been worked out and is presented for at least sex chromosomes. Position of the sex chromosomes in the karyotypes have also been located which is always based on the order of decreasing size of the elements. Marker chromosomes are mostly the nucleolar organizers. Remarks include different views of workers. Taxonomic status of some species is also provided in the column. A mammalogist is supposed to be curious about karyotype evolution in *Suncus murinus*. A detailed account of this common insectivore is available here.

The information in the catalogue is indispensible to the mammalogist who wishes to use them in determining the degree of affinity between species belonging to the same genus or family or even higher systematic categories. The synthesis of large literature on the 45 species of mammals is also presumed to provide basic information in arranging breeding plan for an endangered one in the zoos.

We apologise for any errors or omissions, which due to the complexity of the work of this nature, are inevitable.

The following indications have been provided with the reference numbers in the text

* An asterisk signifies the presence of normal karyotype.

** Double asterisks signify the banding patterns of that species in the publication.

Page number in parenthesis relate to taxonomical part of the species.

Order CETACEA

Family BALAENOPTERIDAE

1. ***Balaenoptera acutorostrata*** Lacepede, 1804. Hist. Nat. Cetacees, p. 37, 134. (Little Piked Whale; Lesser Rorqual; Minke Whale).

2n = 44

FN = 80

Autosomes	18 Metacentrics 10 Submetacentrics 6 Subtelocentrics 8 Acrocentrics
Sex chromosomes	XX/XY X Metacentric (arm ratio 1.37), 2nd largest metacentric chromosome and 8th largest in the complement in order of decreasing size. Y Submetacentric (arm ratio 2.87), smallest chromosome.
Marker chromosomes	Short arms of the smallest submetacentric pair reveals NOR site by silver staining technique.
Remarks	Above features have been ascertained from Arnason (1974 and 1981). Size heteromorphism is pronounced in the 1st submetacentric pair of his male and female karyotypes. He (Arnason, 1974) summarised the karyological studies in cetacea as follows "All cetaceans so far studied, except the sperm and pygmy sperm whales, have 2n=44. The sperm and pygmy sperm whales have 2n=42 and karyotypes entirely different from the 2n=44 karyotypes." Also, "All 2n=44 cetaceans, except the killer whale, have a highly uniform karyotype which can be referred to as the general cetacean karyotype"
REFERENCES	4, **5, **6, 10, **13, 87 (Page 714-715), 100, 121 (Page 302), *125 (Folio 427), 311(Page 237), 327 (Page 349-350).

2. ***Balaenoptera borealis*** Lesson, 1828. Compl. Oeuvres Buffon Hist. Nat., 1 342. (Sei Whale)

2n = 44

FN = 80

Autosomes	14 Metacentrics 14 Submetacentrics 6 Subtelocentrics 8 Acrocentrics
Sex chromosomes	XX/XY X Metacentric (arm ratio 1.66), largest metacentric chromosome and 10th largest in order of decreasing size. Y Metacentric (arm ratio 1.21), smallest chromosome in the complement.
Marker chromosomes	Short arms of the smallest submetacentric pair carry satellites (reveals the presence of nucleolar organizing region). This is also the smallest pair in the karyotype.
Remarks	Above features have been ascertained from Arnason (1974). The 1st submetacentric pair of his female karyotype shows striking heteromorphism which coincides with the marked size difference of the C-bands, both in the terminal and interstitial position. The sei whale is the only cetacean, so far studied, showing C-bands in the terminal regions of the long arms of two telocentric pairs (Arnason, 1974).
REFERENCES	2, *3, 4, **5, 10, 87 (Page 715), 100, 121 (Page 302), *125 (Folio 428), 311(Page 237), 327 (Page 350).

3. ***Balaenoptera edeni*** Anderson 1878. Anat. Zool. Res., p. 551. (Bryde's Whale)

2n = 44

Sex chromosomes	XX/XY
Remarks	Arnason (1989) in his review "Phylogeny of marine mammals—evidence from chromosomes and DNA"

recorded only repetitive DNA components of this species (refer Table 1). So far we have not seen any publication from where we could ascertain its chromosomal features. At present we can only presume that 2n = 44 with XX/XY mechanism might also be prevailing in this balaenopterid species.

REFERENCES 10, 87 (Page 714-715), 100, 121 (Page 303), 311 (Page 237), 327 (Page 350).

4. ***Balaenoptera musculus*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 76.
(Great Blue Whale)

2n = 44

FN = 80

Autosomes	14 Metacentrics 14 Submetacentrics 6 Subtelocentrics 8 Acrocentrics
Sex chromosomes	XX/XY X Metacentric (arm ratio 1.39). This is the 2nd largest metacentric chromosome and 10th largest in the complement in order of decreasing size. Y Smallest element in a C-band karyotype. Its centromeric position is not distinct in the plate.
Marker chromosomes	The smallest submetacentric pair which is also the smallest pair in the complement is bearing a nucleolar organizing region on the short arms.
Remarks	The above features have been worked-out from Arnason *et al.* (1985, Fig. la,b) and Arnason and Widegren (1989, Fig. la,b). In blue whale as in other cetacean karyotypes, interstitial and terminal C-bands are more conspicuous than centromeric C-bands. One characteristic feature of the blue whale is the centromeric C-band in the 3rd largest

submetacentric pair and an interstitial band in the long arm of 5th submetacentric pair. C-bands have not been found in these positions in other balaenopterids (Arnason, 1985).

REFERENCES 10, **11, 15, **16, 87 (Page 716), 100, 121 (Page 303), 177, 266, 311 (Page 237-238), 317 (Page 309-310), 327 (Page 350).

5. ***Balaenoptera physalus*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 75.
(Common Rorqual; Finback)

2n = 44

FN = 80

Autosomes
16 Metacentrics
12 Submetacentrics
6 Subtelocentrics
8 Acrocentrics

Sex chromosomes XX/XY

X Subtelocentric, largest in the complement with arm ratio 3.72.
Y Metacentric, smallest chromosome with arm ratio 1.20.

Marker chromosomes The smallest submetacentric pair bears satellites on the short arms. By silver staining technique NOR has been located at this site.

Remarks The above features are ascertained from Arnason (1969 and 1981). The magnitude of size difference between the unusually large X and the smallest Y is among the greatest so far found in mammals (Arnason 1969). Also, the most unique element in terms of C-band pattern is the X, where the distal half of its long arm is totally C-band positive (refer Arnason 1974, Fig. 26a and Jalal *et al.* 1974, Fig. 1a). The 5th, 6th and 7th largest metacentric pairs are not found to be safely identifiable owing to small length

difference and similar arm ratios. But in G-banding, it is possible to identify and pair all the chromosomes of this species (refer Arnason 1974, Fig. 25a and b). The largest acrocentric pair is also to be recorded here as assymmetric in a male karyotype (refer Arnason 1969, Fig. 2). This however is not so visible in other karyotypes investigated by us.

REFERENCES *2, 4, **5, **6, 10, 15, 87 (Page 715-716), 100, 121 (Page 303), *125 (Folio 283), **134, 177, 266, 311 (Page 237), 327 (Page 350).

6. ***Megaptera novaeangliae*** (Borowski, 1781). Gemein. Naturgesch. Thier., 2(1) 21. (Humpback Whale)

2n = 44

Sex chromosomes XX/XY

Remarks As far as known to us, 2n = 44 of this species is only listed by Arnason (refer Arnason 1989, Table 1). Karyological details are expected in Ph.D. thesis of Duffield (1977).

REFERENCES 10, 87 (Page 717), 100, 121 (Page 303), 311 (Page 238), 312, 327 (Page 350).

Family DELPHINIDAE

7. ***Delphinus delphis*** Linnaeus, 1758. Syst. Nat., 10th ed. 1 77. (Common Dolphin)

2n = 44

FN = 79

Autosomes 14 Metacentrics
16 Submetacentrics
4 Subtelocentrics
8 Acrocentrics

Sex chromosomes XX/XY

X Metacentric (arm ratio 1.46). This is the largest metacentric chromosome and 7th largest in the complement.
Y Minute (? acrocentric).

Marker chromosomes — Short arms of the smallest submetacentric pair is indicative of bearing NOR. This is also distinct as the smallest pair in the complement.

Remarks — The above features are worked-out from Arnason (1974). Because of the smallness of the Y, the arms have not been measured. Arnason (1974) reported similar arm ratios of the metacentrics, and their gradual decrease in size. He also found that, except the chromosomes of the 1st acrocentric pair, the other 6 members of this group can not be paired with certainity owing to their very similar size.

REFERENCES — 4, *5, 10, 87 (Page 730-731), 100, 121 (Page 291), *125 (Folio 329, *D. bairdii*), *152 (*D. d. bairdi*), 311(Page 232), 317 (Page 312-313), 327 (Page 352).

8. ***Globicephala macrorhynchus*** Gray, 1846. Zool. Voy. H.M.S. "Erebus" and "Terror", 1 33.

(Indian Pilot Whale , Short Finned Pilot Whale)

2n = 44
FN = 79

Autosomes
12 Metacentrics
16 Submetacentrics
6 Subtelocentrics
8 Acrocentrics

Sex chromosomes — XX/XY
X Submetacentric (arm ratio 1.79). This is 2nd largest submetacentric pair and 6th largest in the complement.
Y Minute, probably acrocentric.

Marker chromosomes — Short arms of 8th submetacentric pair which is also the smallest in the complement is indicative of bearing NOR.

Remarks — Autosomal features have been ascertained from the details of a female individual published by Arnason (1974). In karyotype of a male published by Walen and Madin (1965), Y is a minute element. The X of the species is slightly larger and less metacentric than the X of other species of family Delphinidae. Short arm of one homologue of submetacentric pair 2 is considerably larger than its counterpart. This increase coincides with a large heterochromatic block in the terminal part of the short arm. This block is completely lacking in the smaller arm (refer Arnason, 1974, Fig. 9a and 11). Arnason (1974) found most distinct C-bands out side the centromeres, and also, lot of heteromorphic appearances of C-bands on their homologues.

REFERENCES — 2, 4 (*G. scammonii*), **5, 10, 87 (Page 740-741), 100, 121 (Page 292), 165 (*G. scammonii*), *285 (*G. scammonii*), 311 (Page 234), 327 (Page 352).

9. ***Orcinus orca*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 77.
(Killer Whale ; Crampus)

2n = 44

FN = 88

Autosomes
12 Metacentrics
18 Submetacentrics
4 Subtelocentrics
8 Acrocentrics (characteristic of the general 2n = 44 karyotypes).

Sex chromosomes
XX/XY
X Metacentric (arm ratio 1.25).
Y Minute element.

Marker chromosome — This species is distinct on the presence of two NOR sites. The satellite fibers of the submetacentric pair 9 extends from the long arm while in other 2n = 44 karyotypes the fibers extend from the short arm (Arnason *et al.* 1980).

Also, the long arm appears fully C-band positive and a 1,579-bp highly repetitive component is located in all C-band positive regions of the karyotype except this long arm (refer Widegren *et al.* 1985, Fig. 8a and b). The second NOR site is located in the short arm of acrocentric pair 4. In one female karyotype the short arm heteromorphism is striking due to variable size of C-band (refer Arnason 1981, Fig. 7b).

Remarks

The above features have been ascertained from two female karyotypes presented by Arnason (1981). Karyotype of the species is strikingly different from others in the absence of the acrocentric group. The acrocentric pairs characteristic of the 2n = 44 cetacean karyotypes have become masked due to the accumulation of heterochromatin in the short arms (Arnason *et al.* 1980). Conspicuous C-band polymorphism occurred in their 6 killer whales rendering each specimen karyotypically unique. We measured the accumulated heterochromatic arms of the 4 acrocentric pairs of a female karyotype presented by Arnason (1981, Fig. 7a). Arm ratio of homologues of 4 pairs (1—4) have been calculated as 1 (1.84 2); 2 (1.62 2.2); 3 (1 1.3) and 4 (2 1.2). This reflects striking C-band polymorphism in this individual. Widegren *et al.* (1985) also investigated this species where C-bands are predominantly located in terminal and interstitial chromosome positions.

A heteromorphic submetacentric pair is located in a male karyotype presented by Kulu *et al.* (1971). One homologue of this pair appears to have a portion of the smaller arm deleted. In a female karyotype presented in this paper, both the homologues have distinct small arms of the same length. In the karyotypes they have assigned the X chromosome submetacentric of the size of their 1st or 2nd largest submetacentric pair (refer Fig. 3 male & female karyotypes). Both the karyotypes have also been published

by Hsu and Benirschke. (1973, Folio 330), where Y chromosome is reported to have short arm in good preparations.

Thus the killer whale karyotype is differing from the general 2n = 44 karyotype in two respects—

i) Absence of acrocentric chromosomes,

ii) Presence of two NOR sites.

On these two features, Arnason *et al.* (1980) opined that *Orcinus* karyotype evolved from the 2n = 44 karyotype.

REFERENCES 4, **6, 9, 10, **14, 40 (*O. rectispinna*), 87 (Page 739-740), 100, 121 (Page 294), *122, *125 (Folio 330), 135, *152, 165, **287, 311 (Page 234), 327 (Page 354-355).

10. ***Stenella attenuata*** (Gray, 1846). Zool. Voy. H.M.S. "Erebus" and "Terror", 1 : 44. (Bridled Dolphin)

2n = 44
FN = 79

Autosomes
12 Metacentrics
18 Submetacentrics
4 Subtelocentrics
8 Acrocentrics

Sex chromosomes XX/XY

X Metacentric (arm ratio 1.46). This is the largest metacentric chromosome and 9th largest in its karyotype. Y Acrocentric, minute element.

Marker chromosomes Submetacentric pair 9 reveals NOR in the short arms.

Remarks The chromosomal features of the species are summarised from the karyotypes presented by Arnason (1974). The largest chromosome is the 1st subtelocentric pair and the 2nd largest is the 1st submetacentric pair. The smallest autosome is the marker pair. All the 6 metacentric pairs

are small. Submetacentric pairs 4 to 8 can not be identified unequivocally as their decrease in size is gradual and are reported to have similar arm ratios. Of the 4 acrocentric pairs, short arms of the 3rd one are quite distinct. In G-banding all the chromosomes are evenly paired. C-band picture of the species shows a striking pattern (refer Arnason 1974,, Fig. 3 for details). Any short arm of the Y is nowhere perceptible.

REFERENCES **5 (*S. dubia*), 10, 87 (Page 731-732), 100, 121 (Page 296), 311 (Page 232), 327 (Page 356).

11. ***Tursiops truncatus*** (Montagu, 1821).Mem. Wernerian Nat. Hist. Soc., 3 75. (Bottlenosed Dolphin)

2n = 44
FN = 79

Autosomes
12 Metacentrics
18 Submetacentrics
4 Subtelocentrics
8 Acrocentrics

Sex chromosomes XX/XY
X Metacentric (arm ratio 1.52). This is the largest metacentric chromosome and 6th largest in the karyotype.
Y Acrocentric, minute element.

Marker chromosomes Submetacentric pair 9 bears NOR in the short arm.

Remarks The above features have been summarised from the details of 3 female karyotypes presented by Arnason (1974). The karyotype is very similar to that of Bridled dolphin just described. One can compare C-, G- and conventionally stained karyotypes for locating certain minor differences between them as pointed out by Arnason (1974). This species is also investigated by Walen and Madin (1965) and Prasad *et al.* (1970). Both have placed the

chromosomes into 3 and 4 groups respectively on size and centromeric position in the karyotypes. Walen and Madin (1965) have not designated the X pair in two karyotypes of a female specimen. Prasad *et al.* (1970) designated X a submetacentric pair of the size of 6th largest submetacentric pair. The Y is a considerably minute acrocentric element in their male karyotype.

REFERENCES 2, 4 (*T. truncatus* and *T. gilli*), **5 (*T. gilli*), 10, 87 (Page 735), 100, 121 (Page 297), *125 (Folio 331), 165, *192, *285, 311 (Page 233), *313, 327 (Page 357).

Family PHYSETERIDAE

12. ***Kogia breviceps*** (Blainville, 1838). Ann. Franc. Etr. Anat. Phys., 2 · 337. (Pygmy Sperm Whale)

2n = 42
FN = 84

Autosomes
18 Metacentrics
16 Submetacentrics
6 Subtelocentrics

Sex chromosomes XX/XY

X Metacentric (arm ratio 1.09). This chromosome is slightly smaller and more metacentric than the 3rd largest metacentric pair.

Y Metacentric (arm ratio 1.44). This is the smallest element in the complement.

Marker chromosomes Short arm of the smallest submetacentric pair 8 is indicated for bearing NOR.

Remarks The chromosomal features have been ascertained from Arnason and Benirschke (1973). The karyotype is characterised by the absence of acrocentric chromosomes. One most significant difference between the two physeterids viz. pygmy sperm whale and the sperm whale is in the

location of nucleolar organizing region (refer *P. macrocephalus*). Hsu and Benirschke (1974, Folio 379) recorded Y submetacentric and presence of 2 acrocentric chromosomes in the species.

REFERENCES : 4, 5, 10, *12, 87 (Page 721), 100, 121 (Page 299), *125 (Folio 379), 135, 165, 311 (Page 235), 327 (Page 359).

13. ***Physeter macrocephalus*** Linnaeus, 1758. Syst. Nat., 10th ed., 1 76. (Sperm Whale)

2n = 42

FN = 84

Autosomes	20 Metacentrics 18 Submetacentrics 2 Subtelocentrics
Sex chromosomes	XX/XY X Metacentric (arm ratio 1.31). Size and arm ratio of the X are very close to the values of 3rd largest metacentric pair. Y Submetacentric (arm ratio 3.01, i.e. on the border line of the submetacentric and subtelocentric group). The Y is smaller than the smallest pair.
Marker chromosomes	The 2nd largest metacentric pair is having a distinct secondary constriction in the middle of the short arm. This also bears NOR as ascertained by positive silver staining reaction.
Remarks	These features have been worked-out from 3 publications viz. Arnason and Benirschke (1973) and Arnason (1981a and 1981b). The 2n = 42 karyotype differs radically from the 2n = 44 general cetacean karyotype. The most conspicuous difference is the absence of acrocentric chromosomes. In C-banding, the species has not shown any accumulation of C-heterochromatin that might mask

the presence of acrocentric chromosomes in a similar way as in the killer whale *(Orcinus orca).* The overall C-band pattern further underlines the radical difference (refer Arnason 1981b, Fig. 4). Hsu and Benirschke (1973, Folio 332) recorded X submetacentric and Y metacentric.

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*3 (*P. catodon*), 4 (*P. catodon*), 5 (*P. catodon*), **6, **7, 10, **12 (*P. catodon*), *24 (*P. catodon*), 87 (Page 721), 100, 121 (Page 299), *125 (Folio 332, *P. catodon*), 135, 165 (*P. catodon*), 311 (Page 235), 317 (*P. catodon*, Page 311-312), 327 (Page 359).

Family PLATANISTIDAE

14. ***Platanista minor*** Owen, 1853. Descrip.Cat.Osteol.R.Mus.Coll.Surgeons, p.448.

(Indus River Dolphin)

2n = 44

Sex chromosomes XX/XY

Remarks

The Indus river dolphin *Platanista indi* treated as *Platanista minor* Owen by Klinowska and Cooke (1991) has been listed by Arnason (1989) for chromosome numbers and for characteristics of highly repetitive DNA components (refer Table 1.) However its 2n is not recorded in the table. Morrison-Scott (1966) and Prater (1971) treated *Platanista indi* as synonym of *Platanista gangetica* (Ganges river dolphin), whereas Honacki *et al.* (1982) synonymized *P. indi* to *P. minor* Owen, 1853. Reeves and Brownell (1989) reviewed and doubted the identity of these two dolphins as separate species. Gorbet and Hill (1992) have doubted even subspecific separation on external features.

Kulu *et at.* (1971) noted much similarity in the karyotypes of *India geoffrensis* (Amazon dolphin; Family Platanistidae), *Delphinus delphis* (Common dolphin; Family Delphinidae)

and *Phocoenoides dalli* (Dall's porpoise; Family Phocoenidae) worked-out by them. Arnason *et al.* (1984) have also mentioned strikingly similar karyotypes in them.

REFERENCES 10, 87 (Page 719 - 720), 121 (Page 290), 152, 309, 311 (Page 229), 317 (Page 313-314), 324 (Page 35), 325, 327 (Page 360).

Family ZIPHIIDAE

15. ***Ziphius cavirostris*** G. Cuvier, 1823. Rech. Oss. Foss., 5 350.
(Cuvier's Beaked Whale ; Goosebeak Whale)

2n = 42

FN = 74

Autosomes
22 Metacentrics
4 Submetacentrics
4 Subtelocentrics
10 Acrocentrics

Sex chromosomes
XX/XY
X Submetacentric (arm ratio 2.95). This is 2nd largest pair in the complement, close to the largest subtelocentric pair (B_1).
Y No report.

Marker chromosomes
No pair is reported for depicting NOR features in the karyotype.

Remarks
We have ascertained the above features after calculating arm ratio of all the 42 chromosomes (given below) of the karyotype presented by Benirschke and Kumamoto (1978).

Group–A		
Pair No.	Arm ratio	Chromosome designation (according to Levan *et al.* 1964).
1	1.60	m
2	1.76	sm
3	1.31	m
4	1.25	m
5	1.44	m
6	1.05	m/M
7	1.36	m
8	1.70	m
9	1.19	m
10	1.13	m
11	1.50	m
12	1.38	m
Group–B		
1	4.98	st
2	2.88	sm
3	3.88	st
Group–C		
1-5		Acrocentrics
XX	2.95	sm

In group–A of metacentrics, pair 6 is distinct as M (metacentric) on arm ratio 1.05, and pair 2 submetacentric instead of metacentric on arm ratio 1.76. Group–B chromosomes include 2 subtelocentric pairs (B_1 and B_3) and 1 submetacentric pair (B_2). We are presenting the chromosomal features of another 2 species of family Ziphiidae for

cytotaxonomic comparison viz., *Mesoplodon europaeus* and *M. carlhubbsi* worked-out by Arnason *et al.* (1977).

Category	*Z. cavirostris*	*M. europaeus*	*M. carlhubbsi*
Metacentric (m)	22	26	22
Submetacentric (sm)	4	6	10
Subtelocentric (st)	4	6	8
Acrocentric	10	2	Nil
XX	sm	st	st

Arnason (1989) while tracing phylogeny of marine mammals stated the presence of only 3 pairs of telocentric chromosomes in the family Ziphiidae. But in the present analysis, this has not been acceded to. In *europaeus* and *carlhubbsi* the Xs are unusually large, while in *cavirostris* this is 2nd largest in the complement. Moreover, the Xs of *cavirostris* possess the same large amount of C-heterochromatin on the long arm as do *carlhubbsi* and *europaeus*, but the large amount of C-heterochromatin observed on the long arms of B_1 and B_3 chromosomes of *cavirostris* are not visible on the corresponding pairs of other two species (refer Benirschke and Kumamoto 1978, Fig. 2 and Arnason *et al.* 1977, Figs. 2b and 5b for total C-band comparison).

Thus, chromosomal features allow clear identification of each species.

REFERENCES

10, ** 28, 87 (Page 724), 100, 121 (Page 302), 135, 311 (Page 236), 327 (Page 364).

Order INSECTIVORA
Family . ERINACEIDAE

16. ***Hemiechinus auritus*** (Gmelin, 1770). Nova Comm. Acad. Sci. Petrop., 14 519. (Long-eared Hedgehog)

2n = 48
FN = 96

Autosomes	36 Metacentrics
	8 Submetacentrics
	2 Subtelocentrics
Sex chromosomes	XX/XY
	X Metacentric, 22nd pair in order of decreasing size.
	Y Subtelocentric, smallest in the complement.

Remarks

The above features are of the individuals collected from Mosul, Iraq (Bhatnagar and El-Azawi 1978). Gropp *et al.* (1969) reported X sub-acrocentric and comparatively bigger in his *H. auritus aegyptius* collected from Egypt. However, have expressed some doubt regarding recognition of the X. The Y chromosome of *H. auritus* resembles closely to that of *H. a. aegyptius*. On identical karyotypes and similar DNA replication pattern of *H. auritus aegyptius* and *H. megalotis* (trapped near Kabul, Afghanistan), Gropp *et al.* (1969) opined *megalotis* a subspecies of *H. auritus*. Another subspecies *H.a. collaris,* collected from Rajasthan in India is also reported for 2n = 48 (Sharma *et al.* 1970, 1971, 1975; Sobti and Gill 1980), but consists of 2 very large submetacentrics, 4 large metacentrics, 32 submeta to metacentrics, 4 small submetacentrics and 4 minute metacentrics. Also, the X is large chromosome and takes the position next to the 1st pair of the largest submetacentrics. The Y is metacentric of the size of the minutes. However, in this species complex uniformity in 2n and FN is evident as reported in specimens from different geographic regions (refer Reumer and Meylan 1986).

REFERENCES

*29, 36, 63 (*H. auritus aegypticus*), 87 (Page 24-26), 108, **109 (*H. auritus aegyptius* and *H. auritus megalotis*), 121 (Page 66), 133, 137, 165 (*H. auritus aegyptius* and *H. megalotis*), 180 (*H. auritus calligoni*), 182, 211, 212 (*H. auritus aegyptius*), 244, 246 (*H.a. collaris*), 247, 248 (*H.*

auritus collaris), 265 (*H. auritus collaris*), 277, *304, 311 (Page 21-22), 317 (Page 166-167), 327 (Page 78).

17. ***Paraechinus hypomelas*** (Brandt, 1836). Bull. Sci. St. Petersb., 1 32. (Brandt's Hedgehog)

2n = 48

Remarks — *Paraechinus hypomelas hypomelas* from Turkmenistan is reported for 2n = 48 (Boulatova and Vorontsov 1969 ; also refer Reumer and Meylan 1986). This is the only publication on the species so far.

REFERENCES — 36 (*P. hypomelas hypomelas*), 87 (Page 28-29), 108, 121 (Page 67), 165 (*P. hypomelas hypomelas*), 211, 277, 311 (Page 22-23), 327 (Page 78).

18. ***Paraechinus micropus*** (Blyth, 1846). J. Asiat. Soc. Bengal, 15 170. (Indian Hedgehog)

2n = 48

FN = 82

Autosomes — 26 Meta and submetacentrics
2 Subtelocentrics
14 Acrocentrics
4 Extremely small chromosomes

Sex chromosomes — XX/XY

X Metacentric, 5th largest pair in the complement.

Y Nearly the size of the smallest autosomes. The Y and two pairs of small chromosomes in different mitotic and meiotic stages appear to be meta-submetacentrics (Shah *et al.* 1977a).

Marker chromosomes — One metacentric pair appears to be marker element in showing very bright fluorescence at secondary constriction region with QM (Shah *et al.* 1977d). This region is not fluorescing differentially with Hoechst 33258 and is also C-band negative.

Remarks : The chromosomal features have been ascertained from the individuals of both the sexes collected in the fields around Ahmedabad, India (Shah *et al.* 1977a). *P. micropus* stands distinct from genera *Erinaeceous* and *Hemiechinus* on the large number of acrocentric pairs (refer Gropp *et al.* 1969 and Bhatnagar and El-Azawi 1978). In C-banding it is revealed that C-band regions are G-band negative except for the centromeric regions of two pairs of metacentrics and the X which are both C-and G-band positive (Shah *et al.* 1977d). This is also noted that constitutive heterochromatin reflected relatively dull fluorescence than the rest of the complement with Hoechst and QM.

REFERENCES 87 (Page 28), 108, 121 (Page 67), 211, *238, 239, 240, 241, 277, 311 (Page 22), 317 (Page 166), 327 (Page 78).

Family SORICIDAE

19. ***Anourosorex squamipes*** Milne-Edwards, 1872. Rech. Mamm., p. 264. (Szechuan Burrowing Shrew)

2n = 50

FN = 100

Autosomes 38 Metacentrics

8 Submetacentrics

2 Subtelocentrics

Sex chromosomes XX/XY

X Submetacentric, 5th largest in the complement.

Y Submetacentric and the smallest chromosome.

Marker chromosomes One pair of metacentrics, No. 21 in order of decreasing size (arm ratio 1.62), bears secondary constriction in the long arm.

Remarks The above features are of a karyotype of conventionally stained chromosomes belonging to *yamashinai,* a subspecies collected from Mt. Ari Taiwan (refer Harada and Takada 1985 Fig. 2).

We measured chromosomes and calculated arm ratio of all the 50 elements as presented in table -

Chromosome pair	Arm ratio	Chromosome designation
1	3.37	St
2	1.34	m
3	1.35	m
4	1.66	m
5	2.82	Sm
6	1.24	m
7	1.28	m
8	1.87	Sm
9	1.91	Sm
10	1.38	m
11	1.54	m
12	1.03	m
13	1.69	m
14	1.59	m
15	1.46	m
16	1.05	m
17	1.00	M
18	1.02	m
19	1.07	m
20	1.04	m
21	1.62	m
22	1.44	m
23	1.25	m
24	1.72	Sm
X	2.48	Sm
Y	2.71	Sm

C- and G-band karyotypes are available in the paper where pairs 1, 5, 10, 12, 15 and 24 have been reported for small C-bands while 3, 6, 7, 8 and 9 have no distinct C-bands at all. The X has revealed a C-band in the centromeric region while being intensely stained all along its length.

REFERENCES 87 (Page 87), ** 115 (*A. squamipes yamashinai*), 121 (Page 67), 211, 277, 311 (Page 33-34), 327 (Page 105-106).

20. ***Crocidura attenuata*** Milne-Edwards, 1872. Rech. Mamm., p. 263.
(Grey Shrew)

2n = 50

Sex chromosomes XX/XY

Remarks A researcher can get chromosomal details in publication No. 281 (Tsuchiya *et al.* 1979), where *C. attenuata attenuata* collected from Thailand is reported to have been karyotyped. A reprint of this only publication on the species was awaited from the authors.

REFERENCES 87 (Page 83), 121 (Page 70), 211, 277, 281 (*C. a. attenuata*), 311 (Page 43-44), 327 (Page 82).

21. ***Crocidura horsfieldi*** (Tomes, 1856). Ann. Mag. Nat. Hist., 17 23.
(Horsfield's Shrew).

2n = 38
FN = 48

Autosomes 2 Metacentrics
2 Submetacentrics
4 Subtelocentrics
28 Acrocentrics

Sex chromosomes XX/XY

X Metacentric, 4th largest in the complement and measures 6.5% of the haploid genome.

Y Submetacentric, 16th largest and measures 3.7% of the haploid genome.

Remarks

These features are of the individuals of both the sexes collected from Mysore, South India (Krishna Rao and Aswathanarayana 1978). Yosida *et al.* (1968) reported 2n = 26 from Okinoerabu Island, Japan, and Tsuchiya *et al.* (1968), Tsuchiya (1970 and 1985) the same diploid number in subspecies *watasei* also from Japan. Harada *et al.* (1985) further confirmed 2n = 26 and FN = 48 in the subspecies. The chromosomal features of the S. Indian taxon differ from the Japanese taxon (Yosida *et al.* 1968) where 12 metacentric, 8 submetacentric, 4 subtelocentric autosomes and X metacentric and Y submetacentric are evident. This karyotype seems to be more advanced than the S. Indian taxon (FN = 48) in having large number of chromosome arms (FN = 52) and in absence of acrocentric chromosomes. This situation can be derived from the S. Indian taxon by proposing fusions and inversions. Krishna Rao and Aswathanarayana (1978) have speculated them to be polymorphic, while Reumer and Meylan (1986) opined S. Indian *horsfieldi* a different taxon. Among all the karyologically known species of *Crocidura*, the karyotype of C. *suaveolens* (Pallas) with 2n = 39-42 and FN = 50-54 and *C. dsinezumi* (Temminck) with 2n = 40 and FN = 52-54 show a close resemblance to the karyotype of S. Indian *horsfieldi* (refer Reumer and Meylan 1986).

Chromosomal evolution in the genus *Crocidura* is extremely interesting. 2n is ranging from 26 (*C. horsfieldi*) to 60 (*C. bicolor*) and FN from 48 (*C. horsfieldi*) to 84 (*C. wimmeri*) (refer Reumer and Meylan 1986). We realize that through fissining high diploid numbers evolved from low numbers.

REFERENCES

87 (Page 75-76), 116 (*C. h. watasei*), 121 (Page 76), *148, *149, 165, 211, 277, 278 (*C. h. watasei*), 279 (*C. h. watasei*), 280, 303, 311 (Page 45), 327 (Page 87).

22. ***Crocidura russula*** (Hermann, 1780). In Zimmermann, Geogr. Gesch., 2 : 382. (Common European White-toothed Shrew).

2n = 42

FN = 62

Autosomes
10 Metacentrics
8 Subtelocentrics
22 Acrocentrics

Sex chromosomes
XX/XY

X Metacentric (arm ratio 1.60), the largest metacentric in the complement.

Y Subtelocentric, 18th largest element, and bigger than the smallest pair of subtelocentrics in the karyotype.

Remarks
Survey of literature provides wide geographic distribution of this species (Catzeflis *et al.* 1985), while in India has been reported only from Kashmir (Ellerman and Morrison-Scott 1967; Honacki *et al.* 1982). Schmid (1968) presented a karyotype of this species from individuals collected in Winterthur, Switzerland. The above features have been ascertained on the measurements of this karyotype. Robbins and Baker (1978) reported 2n = 42 of *C. r. pulchra* from Ivory coast and Jimenez *et al.* (1984) 2n = 42 of the populations in South-east of the Iberian peninsula, Spain. Jimenez *et al.* (1984) have shown X submetacentric (arm ratio is 2.0) and Y the smallest acrocentric element. C-bands in the centromeric and telomeric regions of the X are also evident (refer Fig. 2 d-e). Thus, morphology of the sex chromosomes are not corresponding to what has been found in the karyotype of Schmid (1968). 2n = 42 and FN = 60 have been obtained from another three populations viz. Morges in Switzerland, Unhais in Portugal and Azrou and Qukaimeden in Morocco (Catzeflis *et al.* 1985).

REFERENCES : 37, 38, 41, 42, 43 (*C. r. auct*), 87 (Page 78-82), 121 (Page 81), 136, 163 (*C.r. yebalensis*), 165 (*C. r. dsinezumi*), 167 (*C. r. russula* and *C. r. pulchra*), 169 (*C. r. russula* and *C. r. pulchra*), 171, 188, 211, 212 (*C. r. pulchra*), *231, 277, 303, 327 (Page 94).

23. ***Sorex minutus*** Linnaeus, 1766. Syst. Nat., 12th ed., 1 73.
(Pygmy Shrew)

2n = 42

FN = 54

Autosomes
6 Metacentrics
4 Submetacentrics
2 Subtelocentrics
28 Acrocentrics

Sex chromosomes XX/XY

X Acrocentric, of the size of acrocentric pairs 6 to 9 as placed in order of decreasing size in the karyotype.

Y Acrocentric, of the size of the smallest pair of autosomes.

Remarks The above features have been ascertained from the specimens caught in the Bialowieza Primeval forest, Poland (Fedyk and Michalak 1982). Authors have also presented a description of a G-band karyogram. 2n = 42 is also reported from several populations viz. Swiss population (Meylan, 1965), Moscow district (Orlov and Alenin, 1968), Siberian populations (Fedyk and Ivanitskaya, 1972, Kozlovsky, 1973) and Kuhmo, N.E. Finland (Halkka and Halkka, 1974). But, Orlov and Alenin (1968), Kozlovsky (1973) and Halkka and Halkka (1974) have reported FN = 56 in their populations. This minor difference can be resolved since Fedyk and Michalak, (1982) have mentioned that "on some plates pair nr. 20 appears to be two-armed, but this is not visible on the majority of metaphase plates (Fig. 1, see Plate 1)" On the strength of these data one can conclude that there exist wide-spread

uniformity within this species. Phylogeny based on karyological findings in genus *Sorex* has been discussed by Fedyk and Michalak (1982).

REFERENCES 87 (Page 47-48), *93, **94, 113, 121 (Page 95), *142, 165, 167, *168, 169, *181, 211, 277, *304, 327 (Page 117-118).

24. ***Soriculus caudatus*** (Horsfield, 1851). Cat. Mamm. Mus. E. India Co., p. 135.

2n = 40

FN = 55

Autosomes
4 Metacentrics
2 Submetacentrics
8 Subtelocentrics
24 Acrocentrics

Sex chromosomes XX/XY

X Metacentric (arm ratio 1.68).

Y Acrocentric, smallest chromosome in the complement.

Remarks The above features are of a karyotype of *Soriculus caudatus fumidus* collected from Mt. Ari, Taiwan. Harada and Takada (1985) reported its X submetacentric, but on our measurements it is a metacentric element with arm ratio 1.68. However, is at the border line of meta-submetacentric category. 3 pairs of meta-submetacentric autosomes consists of 2 pairs of metacentrics and 1 pair of submetacentrics.

REFERENCES 87 (Page 59), *115 (*S. c. fumidus*), 121 (Page 98), 211, 277, 311 (Page 31-32), 327 (Page 122).

25. ***Suncus etruscus*** (Savi, 1822). Nuovo Giorn. de Letterati, Pisa, 1 60. (Savi's Pygmy Shrew).

2n = 42

FN = 77

Autosomes
18 Metacentrics
6 Submetacentrics

10 Subtelocentrics

6 Acrocentrics

Sex chromosomes XX/XY

X Submetacentric (arm ratio 2.7), and 2nd largest chromosome in the complement.

Y Acrocentric, a considerably minute element.

Marker chromosomes Sex chromosomes appear to be the marker elements where entire small arm of the X is C-band positive and Y is largely heterochromatic.

Remarks Aswathanarayana *et al.* (1987) reported the above features from the specimens of *Suncus etruscus perotteti* collected from Mysore, South India. In C-banding, centromeric band is distinct on all the autosomes except a few smaller ones. Meylan (1968) had also obtained 2n = 42 and FN = 77 in his single male individual from Southern France. Apart from overall similarity of both the karyotypes, its acrocentric Y chromosome is not so minute to be readily identifiable in the complement as it is found in the individuals of the Mysore population. The Y in Meylan's karyotype (refer Fig. 2) is not smaller than the last two acrocentric pairs.

REFERENCES 19 (*S. e. perrotteti*), **23 (*S. e. perrotteti*), 41, 87 (Page 68-69), 121 (Page 100), 148, 165, *170, 211, 277, 304, 311 (Page 38-39), 327 (Page 102).

26. ***Suncus murinus*** (Linnaeus, 1766), Syst. Nat., 12th. ed., 1 74.
(House Shrew)

2n = 40

FN = 54

Autosomes 6 Metacentrics

6 Submetacentrics

26 Acrocentrics

Sex chromosomes XX/XY

X Metacentric with arm ratio 1.40. This is the largest chromosome, 9.94% of the total haploid genome.

Y Submetacentric, arm ratio 2.23. Second largest in the complement with 7.70% relative length.

Marker chromosomes Rogatcheva *et al.* (1997) have located genes for major ribosomal RNA on chromosomes 5,9 and 13 of their basic karyotype of 2n = 40 chromosomes. They ascertained this feature by silver staining and fluorescence in situ hybridization using the human 28 s RNA genes as probe.

Remarks The above autosomal and X Y features have been published by Sharma, T. *et. al.* (1970) from specimens of both the sexes collected from Varanasi, India.

This small terrestrial mammal is most common in India. Because of commensal habits, the species has been passively transported by humans and is now spread over the entire old world tropics (Yosida 1982). Chromosomal (Yosida 1982 and Rogatcheva *et al.* 1997) and genetical (Yamagata *et al.* 1987 and 1990) evidences suggest that the species originated in the Indian subcontinent. In terms of karyological evolution, the species is equally interesting. The diploid number varies from 2n = 30 to 2n = 40. At least 9 diploid numbers have been described. A karyotype with 2n = 40 consisting mostly acrocentric chromosomes has been recognized as a standard for comparison etc. (Rogatcheva *et al.* 1996). The species has shown phenomenal chromosomal variability of the Robertsonian type. Variation of sex chromosomes between and within population has been intriguing. Raman and Nanda (1986) have provided answer to the varied nature of the sex chromosomes while investigating cytological changes in the unusually large sex chromosomes of specimens collected from Varanasi, India. By C-, G-, H-banding, olivomycin

fluorescence and by the study of temporal sequence of replication they found heterochromatinization playing key role in differentiation of sex chromosomes. Also, late replication in them is the cause not the consequence of heterochromatinization. They observed that the smaller acrocentric Y of the Japanese population might have evolved through the loss of the late replicating segment present in the Indian morph.

Instead of a review of total work we are presenting summary of individual findings in chronological order, so that one can have a picture of chromosomal evolution within this wide spread single taxon. –

Manna and Talukdar (1967) counted 2n = 40 in one male specimen collected from Kalyani, West Bengal. They have designated Y the smallest acrocentric and X submetacentric and 4th largest in a karyotype of camera lucida tracings. In this karyotype, they have reported 4 metacentrics, 4 submetacentrics and 30 acrocentrics.

Sharma *et al.* (1969) and Rao, *et al.* (1970c) reported 2n = 40 with 12 meta- submetacentrics and 26 acrocentrics in individuals collected from Delhi, India. The X is the largest metacentric, 11.2% of the total haploid complement with arm ratio 1.37. The Y is submetacentric, with arm ratio 2.24. This is the second largest chromosome with 8.6% of the total haploid complement. Both the chromosomes are readily identifiable in the metaphase plates.

Chatterjee and Majhi (1971) reported 2n = 40 and FN = 50 with 4 metacentric, 4 submetacentric and 30 acrocentric autosomes in *Suncus m. soccatus* trapped in Darjeeling in East Himalayas, India, at an altitude of 6500 feet. The X is submetacentric, ranking between No. 5 and 6 and Y acrocentric similar to the size of the 12th pair in the karyotype of camera lucida tracings.

Satya Prakash and Aswathanarayana (1972) discovered 2n = 32 in a male from Mysore, S. India. This represents a case of numerical polymorphism where Robertsonian fusion in 8 pairs of acrocentric chromosomes of the normal complement (2n = 40) is evident. A heteromorphic pair is also noted where later deletion in both the arms of one partner produced the smaller element.

Yong (1974) discribed 24 acrocentric, 6 metacentric, 2 submetacentric and 6 subtelocentric autosomes and meta-submetacentric X and submetacentric Y in 2n = 40 of the individuals collected from Malacca, West Malaysia. The X is the largest element and Y is always noted to be significantly greater than half the total length of the X chromosome. In this taxa an extra pair of small subtelocentric autosomes has been noted with a corresponding reduction in the acrocentric members. Yong has mentioned the polymorphic features of X and Y known so far, and realized this an interesting topic of research in this species.

Satya Prakash and Aswathanarayana (1976) reported 2n = 40, 32 and 30 in the species inhabiting peninsular India and designated them as "chromosome races" 2n = 30 is the lowest number discovered from the peninsular India so far. These karyotypes have been shown to be related in terms of Robertsonian translocations. The X is metacentric with relative length 9.8%. Thus of the duplicate type on which they speculated its banding to be of particular interest. The Y is submetacentric and has not shown any well defined banding pattern instead of being diffuse and darkly stained along the entire length. The X is the most conspicuous element where distal portion of both the arms are composed of large bands while the centromeric region is bereft of heterochromatin - an unusual feature.

Aswathanarayana and Krishna Rao (1979) added two new chromosome numbers to *S. murinus* from peninsular India.

Specimens of both the sexes from Trichur and Calicut in Kerala and Nagercoil, Cape Comorin in Tamil Nadu showed 2n = 31, and specimens from Trivandrum in Kerala showed 2n = 37. Karyotypes of both the forms have been presented. Shrews trapped in Trichur, Nagercoil and Cape Comorin are heterozygous for the large metacentric pair No. 4, and animals of Trivandrum (2n = 37) are heterozygous for large translocation metacntric pair No. 2. They have pleaded 2n = 31 and 37 as another two "chromosomal races" evolving independently in peninsular India.

Ando *et al.* (1980) investigated C-band pattern of the Japanese house shrew, *Suncus m. riukiuanus,* which adds to our understanding of autosome and sex chromosome polymorphism within *S. murinus.* In its 2n = 40, submetacentric X is distinct on broad C-band, covering the distal one third of the long arm and a small terminal C-band on the short arm. The submetacentric Y is pronounced with centromeric C-band and large blocks of interstitial heterochromatin on the long arm. Autosomes are classifiable into 2 groups on their C-band pattern which also serve as material for discussion where uniarmed elements give rise to the additional biarmed ones found in Malaysian and Indian populations. Differences in the amount of constitutive heterochromatin has been suggested to be a chief factor in variation regarding shape and size of the X and Y. They have suggested that prototype Y in this species was probably a small acrocentric.

Satya Prakash and Aswathanarayana (1984) investigated meiotic behaviour of characteristically large biarmed X and Y with huge segments of C-band material in non-centromeric areas. A chiasma is distinct in the short arms of the X and Y. The heterochromatic regions in the bivalents show desynapsis in the form of a bulge.

Kumari and Aswathanarayana (1985a) discovered yet another 2n and FN in the specimens from Bhadravati in Karnataka State (S.W. India). Female karyotype reveals 2n = 36 and FN = 48 with large metacentric X measuring 9.4% of the haploid genome. Male specimens of this race were to be explored.

Kumari and Aswathanarayana (1985b) reported polymorphism in the 2n = 31 chromosomal type from specimens collected from Calicut city, Calicut University Campus and Kanya-kumari. In their table 1, comparison of the 3 karyotypes has been presented. No variation is available between autosomal features of the Kanya-kumari and Calicut University Campus individuals, both having FN = 54. But relative length of their X is 10.5% and 9.6% respectively. Karyotype of the Calicut city individuals is strikingly distinct both in autosomal as well as in X Y features. These individuals have 9 large metacentrics (m), 6 small metacentrics (m), 4 sub-metacentrics (sm), 4 subtelocentrics (st) and 6 acrocentrics (t) with FN = 52, instead of corresponding 9 (m), 8 (m), 4 (sm), 4 (st) and 4 (t) combination of the other two. Also, the Y is smaller and metacentric instead of submetacentric. Authors have stated the karyotypic feature of Calicut city individuals "unique" on 6 "smaller" metacentrics and small Y. They have opined that karyotypes of S. Indian shrews with 8 "smaller" metacentrics including those with 2n = 40 ancient ones than with 6 "smaller" ones, because, this seems to be of recent origin to them involving pericentric inversion.

Rogatcheva *et al.* (1996) have provided nomenclature and identifying features for all the 40 chromosomes of *S. murinus*. This is based on the analysis of G-banded chromosomes of different degree of condensation at metaphase, prometaphase and prophase. The karyotype represents a wild population of Kathmandu, Nepal. They have considered the karyotype a representative of a basic autosomal karyotype in *S. murinus* and have claimed it standard for the species and suitable for

unified description of chromosome races and individual variants. Chromosome number smaller than this as reported in several races have been attributed to Robertsonian events.

Rogatcheva *et al.* (1996) provided support to the suggestion of Yosida (1982) that metacentric carrying shrews colonized Malaya from Sri Lanka by sea route and hybridization of these immigrants with the individuals of standard karyotype i.e. 2n = 40 (that had already occupied Malaya) generated Robertsonian polymorphism now observed. By high resolution G-banding technique they have described G-band karyotype of metacentric carrying shrews from Sri Lanka. Five metacentrics have been shown to be the product of Robertsonian fusion of acrocentric chromosomes identical to those in the standard karyotype as defined by Rogatcheva *et al.* (1996). On comparison with similar data already available for Malayan shrews (Sam *et al.* 1979), two of the metacentrics have been found to be the same. The chromosomal marker thus provide reasonable information on the colonization history of this species by fulfilling the expectation that the metacentrics in Malaya should be the same as those in Sri Lanka. They also observed in laboratory that metacentric homozygotes or heterozygotes have no indication of reduced viability or that any form of assortive mating is occuring. On colonization of Malaya, authors have suggested that both, shrews with the standard 40 chromosome karyotype and shrews with a metacentric karyotype arrived by a sea route.

Ruedi *et al.* (1996) assessed phylogenetic relationship of several phenotypically variable Asian populations of *S. murinus* by protein electrophoresis. Genetic survey of both wild and commensal *S. murinus* from certain parts of S. India, Indonesia, Philippines, Japan and Nepal revealed them a wide spread single taxon. Unusual patterns of genetic divergence observed in *S. murinus* from the northern parts of

the Indian subcontinent has been opined as past partial introgression between *S. murinus* and *S. montanus*. *S. montanus* has been found to be a closely related taxon to *S. murinus* which authors suggest may coexist without introgression at least in S. India and Sri Lanka. Authors have pointed out that "The examination of the small bodied, a dark brown *S. murinus nemorivagus* living in the Himalayan foot hills and Assam (Corbet and Hill 1992) is particularly interesting in this context because its external morphology is similar to that of *S. montanus* from S. India."

REFERENCES

**1 (*S. m. riukiuanus*), *20, 21, 30, *47 (*S. murinus soccatus*), 68 (*S. m. murinus*), 87 (Page 65-68), 105, 121 (Page 100), *125 (Folio 257), 148, *153, *154, *161, 165 (*Crocidura murina* L.), 167, 173, **194, 196, 201, 207, 208,211, **217, *218, *221, 224, **225, 226, *260, *261, *267, 277, 278 (*S. m. riukiuanus*), 279 (*S. m. riukiuanus*), 280 (*S. m. riukiuanus*), **290, 294, 295, 296, 297, *298, 299, 300, 301, 302, 303, 311(Page 35-37), 316 (*S. m. riukiuanus*), 317 (Page 168-169), **318, **319, 320, 321, 322, 323,327 (Page 103).

Order LAGOMORPHA
Family LEPORIDAE

27. ***Lepus capensis*** Linnaeus, 1758. Syst. Nat., 10th ed., 1 58.
(Cape Hare ; Tolai Hare).

2n = 48
FN = 83

Autosomes
6 Metacentrics
10 Submetacentrics
18 Subtelocentrics
12 Acrocentrics

Sex chromosomes XX/XY
X Metacentric, medium-sized chromosome. It is not always

possible to distinguish the X from 2nd and 3rd largest metacentric pairs in the complement.

Y Acrocentric, smallest in the complement.

Remarks — The above features have been ascertained from a karyotype of *Lepus europaeus* Pallas presented by Gustavsson (1971). In another karyotype of the species presented by Schroder *et al.* (1978) the X is a submetacentric chromosome (arm ratio 2.28). The smaller chromosome number in *Oryctolagus cuniculus* (2n = 44) is the outcome of two centric fusions (Stock, 1976).

A race of this wide spred Cape hare viz., *L.c.tibetanus* Waterhouse is found in Kashmir and N. - W. Frontier province (Prater 1971). Honacki *et al.* (1982) and Corbet and Hill (1992) have synonymized *europaeus*, *tibetanus* and *tolai* to *Lepus capensis* Linnaeus.

REFERENCES : 87 (Page 429-433), 121 (Page 599), 165 (*L.c. tolai*), 212 (*L.c. tolai*), **232, 284, 308 (*L.c. tolai*), 311 (Page 415-416), 317 (Page 218-219), 327 (Page 815-816).

28. ***Lepus nigricollis*** F. Cuvier, 1823. Dict. Sci. Nat., 26 307.
(Indian Hare ; Black-naped Hare).

2n = 48
FN = 89

Autosomes — 16 Submetacentrics
24 Subtelocentrics
6 Acrocentrics

Sex chromosomes — XX/XY

X Metacentric, medium-sized chromosome.

Y Acrocentric, smallest in the complement.

Remarks — Chromosomal features of the species are ascertained from Bhatnagar (1980).

REFERENCES 30 (*L. n. ruficaudatus*), *31 (*L. n. ruficaudatus*), 87 (Page 437-438), 121 (Page 600), *172, *195 (*L. n. ruficaudatus*), 208, 305 (*L. n. ruficaudatus*), 311 (Page 413-415), 317 (Page 219-220), 327 (Page 819).

29. ***Oryctolagus cuniculus*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 · 58. (Rabbit)

2n = 44

FN = 84

Autosomes 18 Metacentrics

8 Submetacentrics

12 Subtelocentrics

4 Acrocentrics

Sex chromosomes XX/XY

X Metacentric, 13th largest in the complement.

Y Submetacentric, smallest element.

Remarks This species is having worldwide distribution as domesticated forms. We have ascertained the above features from a karyotype presented by Gustavsson (1964). In another karyotype of the species presented by Hsu and Benirschke (1967, Folio 8), 20 metacentric autosomes instead of 18 and 10 subtelocentric instead of 12 have been scored. Ford *et al.* (1980) have presented identifying features of all the chromosomes on their G-bands. Hageltorn and Gustavsson (1979) have published G, Q and R-band karyotypes of the species.

REFERENCES 30, 32, **46, 62, **64, **66, 71, 72, **73, 87 (Page 443-444), **98, 99, *111, **112, 121 (Page 601), *125 (Folio 8), 132, *141, 165, *166, *174, 178, *210, 212, 215, 219, **232, 251, 262, 268, 269, **272, 275, *288, 305, 311 (Page 418), 327 (Page 822)

Family OCHOTONIDAE

30. ***Ochotona macrotis*** (Gunther, 1875). Ann. Mag. Nat. Hist., 16 . 231.
(Large-eared Pika)

2n = 62

Sex chromosomes XX/XY

Remarks This species has been investigated by Vorontsov and Ivanitskaia (1969), (refer *The Mammals, Evolution, Karyology, Taxonomy, Fauna,* Edited by Vorontsov, N.N. 1969). Publications of this book could not be procured as it is hardly accessible to the wide circle of zoologists.

REFERENCES 87 (Page 451), 121 (Page 596), 165 (*O. m. sacana*), 308 (*O. m. sacana*), 311, 317, 327 (Page 810).

31. ***Ochotona rufescens*** (Gray, 1842). Ann. Mag. Nat Hist., 10: 266.

(Afghan Pika)

2n = 60

FN = 87

Autosomes 18 Metacentrics

8 Submetacentrics

32 Acrocentrics

Sex chromosomes XX/XY

X Metacentric, arm ratio 1.16. This is 9th largest chromosome in order of decreasing size.

Y Minute element.

Remarks The above features have been ascertained by measuring all the biarmed chromosomes of a karyotype presented by Nadler *et al.* (1969). The animals were collected from West Pakistan (Chiltan mountains). Hsu and Benirschke (1974, Folio 357)

have recorded 24 metacentrics and submetacentrics & 34 acrocentrics and subtelocentrics. They have also designated X submetacentric and Y minute (metacentric ?), in the karyotypes of animals captured in Afghanistan.

REFERENCES 87 (Page 452), 121 (Page 597), *125 (Folio 357), 165, 311 (Page 418), 327 (Page 812), *328.

Order PHOLIDOTA

Family MANIDAE

32. ***Manis pentadactyla*** Linnaeus, 1758. Syst. Nat., 10th ed., 1 36. (Chinese Pangolin)

2n = 36

FN = 69

Autosomes
14 Metacentrics
12 Submetacentrics
6 Subtelocentrics
2 Acrocentrics

Sex chromosomes XX/XY

X Medium-sized submetacentric, 9th largest in the complement.

Y Acrocentric, smaller than the last pair of autosomes.

Remarks Ray-Chaudhuri *et al.* (1969) described chromosomal features as given above from a male specimen collected from Chakia near Varanasi (U.P.). Satya Prakash and Aswathanarayana (1972) also reported 2n = 36 from a female specimen collected from Mysore. Chakrabarti *et al.* (1982) reported 2n = 40 in 2 ♂♂ and 2 ♀♀ collected in the environs of West Bengal and Tripura state. Makino and Tateishi (1951) had counted 2n = 42 in a male pangolin collected from Japan. We calculated arm ratio of all the chromosomes in the karyotypes presented by the Indian workers to ascertain the number of

chromosomes in different category, which is presented in table. (The category assigned as recommended by Levan *et al.* 1964, table 3).

Table :

Authors	m	sm	st t (Acrocentric)	FN	X	Y	2n	FN
1. Ray-Chaudhuri *et al.* (1969)	14	12	6	2	66	sm	t	36	69
2. Satya Prakash and Aswathanarayana (1972)	18	12	2	2	66	sm	—	36	69
3. Chakrabarti *et al.* (1982)	18	14	2	4	72	m	sm	40	76

In the table each complement is different. This also exists on visual comparison of the karyotypes. One largest subtelocentric pair is common in them, while other two subtelocentric pairs equally distinct in the karyotype of Ray-Chaudhuri *et al.* (1969) are not seen in others. Alone acrocentric pair the smallest in the complement is represented in all the three karyotypes. A similar pair thus clearly becomes an addition in the karyotype of Chakrabarti *et al.* (1983), apart from one meta or submetacentric pair, which is not so easily noticeable. Differences are also existing in the morphology of the sex chromosomes. Chakrabarti *et al.* (1982) designated X metacentric and Y submetacentric. In others, X is submetacentric and Y acrocentric. When we compare the autosomal FN of all the three complements, we arrive at a conclusion that 1 biarmed pair (with FN = 4) and the acrocentric pair (FN = 2) become additional in the complement of Chakrabarti *et al.* (1982) (i.e. FN = 72 – 6 = 66). However, we can not assign exact nature of the pair at present.

The major difference visible in the karyotypes presented by Ray-Chaudhuri and Satya Prakash are in the number of 4 subtelocentric and 4 metacentric chromosomes. This can be accommodated by pericentric inversion where 4 subtelocentric chromosomes might have given rise to 4 metacentrics or vice versa. Reciprocal translocation of unequal length can also

produce changes without altering 2n.

On being chromosomally so distinct, we presume that all the forms do not belong to the same species *pentadactyla.* However, the one very small pair of acrocentrics and two small chromosomes paired at the end (19th) in the karyotype of Chakrabarti if considered supernumeraries, (Both resulted FN 2 + 4 = 6) then latter two complements come closer in similarity and represent the same species. (We have included the 19th element as 2 metacentrics in the table, but the characterization of both on the centromeric position remains ambiguous, and tending to be a complex of non-regular elements). Thus, the animal of Ray-Chaudhuri collected from Chakia in U.P. belongs to a congeneric species of *Manis.* Only two species viz., *M. pentadactyla* and *M. crassicaudata* (Indian Pangolin) are known from the Indian sub-continent.

Personal communications regarding chromosome numbers in *M. pentadactyla :*

1. Prof. Makino had written to Prof. S. P. Ray-Chaudhuri that "Data from classical methods should be revised by current techniques"
2. Prof. Makino had written to Dr. S. Chakrabarti that "the variation noted may be due to technical shortcomings" because "our study based on paraffin sectioning method".
3. Prof. S. P. Ray-Chaudhuri had written to Dr. S. Chakrabarti that "the specimen they studied may be a different species"

REFERENCES

22. **45, 87 (Page 214), 121 (Page 344), 157, 165, *209, *222, 311 (Page 18–19), 317 (Page 301-303), 327 (Page 415).

Order PRIMATES

Family CERCOPITHECIDAE

33. ***Macaca arctoides*** (I. Geoffroy, 1831). Zool. Voy. de Belanger Indes Orient., p. 61 (Stump-tailed Macaque)

2n = 43
FN = 83

Autosomes	16 Metacentrics 22 Submetacentrics 2 Subtelocentrics
Sex chromosomes	XX/XY X Submetacentric, 7th largest in the complement. Y Minute.
Marker chromosomes	One pair of metacentrics ranking 8 in order of decreasing size of autosomes is seen with a long achromatic region near the centromere.
Remarks	Egozcue (1971) preferred the term "marked" to define normal chromosomes with such morphological characteristics, e.g., strikingly noticeable, conspicuous, and the term "marker" to chromosomes with structural abnormalities. Egozcue (1975) recorded Y non-acrocentric and Chiarelli *et al.* (1979) submetacentric in their tables. Chiarelli (1962) recognised one pair of subtelocentrics in only three species viz., *M. sylvana, M. speciosa* and *M. niger.*
REFERENCES	35 (*M. speciosa*), 48, 49, 53, 75 (*M. speciosa*), 77 (*M. speciosa*), 81 (*M. speciosa*), 84 (*M. speciosa*), 87 (Page 199), 121 (Page 235), *128, 165 (*M. speciosa*), 213 (Page 67-83), 270, *310 (Page 254), 311 (Page 171), 327 (Page 266).

34. ***Macaca assamensis*** (M'Clelland, 1840). Proc. Zool. Soc. Lond., 1839 148. (Assamese Macaque)

2n = 42
FN = 83

Autosomes	16 Metacentrics

22 Submetacentrics
2 Subtelocentrics

Sex chromosomes — XX/XY
X Submetacentric, 7th largest in the complement.
Y Dot like.

Marker chromosomes — One pair of metacentrics ranking 8 in order of decreasing size of autosomes is seen with a wide achromatic region in the small arm near the centromere.

Remarks — The 2nd largest in the complement is located at the border line of meta and submetacentric categories (arm ratio 1.7). We however have included this pair in the metacentrics. Egozcue (1975) recorded Y non- acrocentric and Chiarelli *et al.* (1979) submetacentric in their tables.

REFERENCES — 26, 48, 49, 51, 53, 59, 81, 87 (Page 198), 121 (Page 235), 165, 213 (Page 84-87), 270, *310 (Page 258), 311 (Page 168-169), 317 (Page 37-38), 327 (Page 266).

35. ***Macaca fascicularis*** (Raffles, 1821). Trans. Linn. Soc. Lond., 13 246.
(Long-tailed Macaque Crab-eating Macaque Cynomolgus Macaque).

2n = 42
FN = 83

Autosomes — 18 Metacentrics
22 Submetacentrics

Sex chromosomes — XX/XY
X Metacentric, 8th largest in the complement.
Y Minute acrocentric.

Marker chromosomes — One pair of metacentrics ranking 10 in order of decreasing size of autosomes bears a wide achromatic region in small arm near the centromere.

Remarks — Chu and Bender (1961) reported both X and Y metacentric. Chiarelli (1962) recognized X metacentric in his

morphometric analysis. Fernandez-Donoso *et al.* (1970) and Ward *et al.* (1994) identified Y as an acrocentric. Ward *et al.* (1994) also reported chromosomes with centromeric C-band and Y non heterochromatic element. Their silver staining revealed heteromorphic AgNORs on the marker pair. Fernandez-Donoso *et al.* (1970) investigated X by autoradiography.

REFERENCES 26, 33, 48, 49, 51, 53, 54, 58, 59 (*M. irus*), **65, **70, 81 (*M. irus*), 84 (*M. irus*), 87 (Page 196-197), *96, 121 (Page 235), *125 (Folio 400), *138, 155 (*M. irus*), 165 (*M. irus*), 213 (Page 88-96), 270, **286, *310 (Page 258), 311 (Page 170 - 171), 327 (Page 266).

36. ***Macaca mulatta*** (Zimmermann, 1780). Geogr. Gesch. Mensch. Vierf. Thiere, 2 195.

(Rhesus Macaque)

2n = 42

FN = 83

Autosomes 18 Metacentrics

22 Submetacentrics

Sex chromosomes XX/XY

X Submetacentric, ranks 5th in decreasing order of size.

Y Acrocentric, minute.

Marker chromosomes 8th largest of the autosomal pairs shows a long achromatic region in the small arm near the centromere.

Remarks This is the most extensively studied species in the group. Rothfels and Siminovitch (1958) found Y to be an acrocentric. They presented an idiogram of haploid complement where we suggest 16 metacentric, 22 submetacentric and 2 subtelocentric chromosomes. They observed heteromorphic alternates to the X chromosome. Their metacentric X (arm ratio 1.4) ranks 8th in decreasing

order of size and alternate a submetacentric (arm ratio 1.99) is not differing in total length. Farber (1966) reported 16 metacentrics and 24 submetacentrics. He noted the Xs of female consistently dimorphic with homologues differing in arm ratio (metacentric submetacentric) but not in total length. This pair also ranks 8th in decreasing order of size. 16 metacentrics, 24 submetacentrics and a metacentric X is visible in comparative metric study of Chiarelli (1962). Apart from these findings we calculated arm ratio of all the chromosomes of a male from a composite karyogram of 3 *Macaca* species presented by Egozcue (1969, Fig.1). This provided 18 metacentrics, 22 submetacentrics, and a submetacentric X ranking 5th largest in the complement. We further calculated arm ratios from a C-band karyotype of a female presented by Sharma and Garg (1974). This provided 22 metacentrics 18 submetacentrics and submetacentric Xs ranking 5th largest in the complement. We found its 2 metacentric pairs very close to submetacentric category, which they have arranged with the submetacentric ones in the karyotype. All the chromosomes revealed intensely stained C-band in the centromeric regions. Stock and Hsu (1973) reported Y clearly biarmed in good metaphases.

REFERENCES

26, 33, 35, *39, 48, 49, 51, 53, 54, 56, 58, 59, 60, **65, **70, 75, 77, 79, 80, 81, **82, 84, 87 (Page 197-198), 90, **91, *92, 106, **118, 121 (Page 235), *125 (Folio 147), 129, 155, *162, 165, 175, **183, **184, 185, **189, **190, 213 (Page 97-174), 214, **218, 228, 229, 244, 247, *252, 253, **256, **264, 270, 271, **273,, 292, *310 (Page 256), 311 (Page 169 - 170), 317 (Page 36-37), 327 (Page 267).

37. ***Macaca nemestrina*** (Linnaeus, 1766). Syst. Nat., 12th ed., 1 35. (Pig-tailed Macaque)

2n = 42

FN = 83

Autosomes	18 Metacentrics
	22 Submetacentrics
Sex chomosomes	XX/XY
	X Metacentric, 5th largest in the complement.
	Y Minute.
Marker chromosomes	One of the autosomal pairs ranking 8 in decreasing order of size is seen with a conspicuous achromatic region in the small arm near the centromere.
Remarks	We calculated arm ratio of all the chromosomes from a female karyotype presented by Chiarelli *et al.* (1979, Page 257). This provided both the Xs metacentric alongwith 18 meta and 22 submetacentric autosomes. This species is also reported to have 20 metacentrics, 20 submetacentrics and a submetacentric X in comparative morphometric study of several *Macaca* species by Chiarelli (1962). Egozcue (1975) recorded all the chromosomes non acrocentric and Chiarelli *et al.* (1979) recorded X and Y submetacentric.
REFERENCES	26, 33, 48, 49, 53, 54, 56, 57, 58, 59, 61, 75, 81, 84, 87 (Page 195-196), 121 (Page 236), 155, 165, 213 (Page 175-190), 270, **283, *310 (Page 257), 311 (Page 166 - 167), 327 (Page 267).

38. ***Macaca radiata*** (E. Geoffroy, 1812). Ann. Mus. Hist. Nat. Paris, 19 98. (Bonnet Macaque)

2n = 42

FN = 83

Autosomes	18 Metacentrics
	18 Submetacentrics
	4 Subtelocentrics
Sex chromosomes	XX/XY

X Metacentric, largest in the complement.

Y Minute dot.

Marker chromosomes — 11th largest autosomal pair is seen with a conspicuous achromatic region in the short arm near the centromere.

Remarks — We have scored 2 subtelocentric pairs in a karyotype presented by Chiarelli *et al.* (1979). This karyotype is also seen in an earlier publication of Chiarelli (1962) where X is the largest in the complement but no subtelocentric pair is revealed in his morphometric analysis of the chromosomes. Chiarelli *et al.* (1979) have recorded X submetacentric in their table 3.

REFERENCES — 35, 48, *49, 51, 53, 54, 81, 84, 87 (Page 195), 121 (Page 236), 145, 146, 147, 165, 213 (Page 191-216), 270, *310 (Page 256), 311 (Page 168), 317 (Page 35-36), 327 (Page 267).

39. ***Macaca silenus*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 26.
(Lion-tailed Macaque)

2n = 42

FN = 83

Autosomes — 16 Metacentrics

22 Submetacentrics

2 Subtelocentrics

Sex chromosomes — XX/XY

X Metacentric, largest in the complement.

Y Minute.

Marker chromosomes — One pair of metacentrics ranking 9 in order of decreasing size of autosomes has a long achromatic zone on the short arm near the centromere.

Remarks — One pair of subtelocentrics becomes distinct in our calculated numerical values of the chromosomes of a karyotype presented by Chiarelli *et al.* (1979). No

subtelocentric pair is revealed in the numerical values presented by Chiarelli (1962). However the X pair is of metacentrics, and largest in the complement. Chiarelli *et al.* (1979) have recorded X and Y submetacentric in their table 3.

REFERENCES 26, 48, 49, 53, 54, 59, 81, 84, 87 (Page 195), 121 (Page 236), 165, 213 (Page 217-222), 270, *310 (Page 253), 311 (Page 166), 317 (Page 38-39), 327 (Page 267 - 268).

40. ***Presbytis entellus*** (Dufresne, 1797). Bull. Sci. Soc. Philom. Paris, Ser. 1, 7 49. (Hanuman Langur)

2n = 44

FN = 85

Autosomes
24 Metacentrics
14 Submetacentrics
2 Subtelocentrics
2 Acrocentrics

Sex chromosomes XX/XY

X Metacentric, of the size of pair ranking 15 (a submetacentric pair) in order of decreasing size.

Y Acrocentric, smallest in the complement.

Marker chromosomes One pair of small metacentrics ranking 18 bears a conspicuous achromatic region near the centromere.

Remarks Egozcue (1975) recorded X non-acrocentric, and Chiarelli (1979) submetacentric in their tables. Sharma and Garg (1974) reported C-band in the centromeric region of only 3 pairs of autosomes, one metacentric, one submetacentric and one acrocentric. The X revealed no band but distal region of Y showed intensely stained characteristic band. This C-band peculiarity was found to be consistent.

REFERENCES 26, 35 (*P. e. entellus*), 51, 53, 54, 55, 58, 59, *78,*81, 84, 87 (Page 204-206), 107, 121 (Page 238), *125 (Folio

349), 143 (*P. e. entellus*), 145 (*P. e. entellus*), 146 (*P. e. entellus*), 147 (*P. e. entellus*), 157, 165, 213 (Page 234-270), **218 (*P. e. entellus*), *243, *252 (*P. e. entellus*), **256, *259, 270, 282, 289, *310 (Page 271), 311 (Page 175 - 176), 317 (Page 39-41), 327 (Page 273).

Family HYLOBATIDAE

41. ***Hylobates hoolock*** (Harlan, 1834). Trans. Am. Philos. Soc., 4 52. (Hoolock Gibbon)

2n = 44

FN = 88

Autosomes	24 Metacentrics 16 Submetacentrics 2 Subtelocentrics
Sex chromosomes	XX/XY X Metacentric. Y Probably acrocentric, very minute.
Marker chromosomes	One pair of metacentrics ranking 14 in order of decreasing size, bears a prominent secondary constriction in small arm.
Remarks	Bender and Chu (1963) reported karyotype of a female *hoolock*, composed of meta and submetacentrics. We assign its 7th pair subtelocentric on arm ratio 3.21 instead of submetacentric. They have not located the Xs in the camera lucida tracings. Karyotype of congeneric species *lar* and *hoolock* have been suggested identical (Bender and Chu 1963). In *lar*, X is metacentric (arm ratio 1.52) which is difficult to differentiate from pair 6 or 8, and Y is very minute probably acrocentric (Hamerton *et al.* 1963). Egozcue (1975) recorded all the 44 chromosomes non-acrocentric. Chiarelli *et al.* (1979) recorded X and Y submetacentric.

REFERENCES *26, 48, 50, 53, 54, 55, 58, 59, 81, 87 (Page 212), 114, 121 (Page 241), 165, 213 (Page 315-318), 270, *310 (Page 277), 311 (Page 183 - 184), 317 (Page 33-34), 327 (Page 275).

Family LORISIDAE

42. ***Loris tardigradus*** (Linnaeus, 1758). Syst. Nat., 10th ed., 1 29.
(Slender Loris)

2n = 62

FN = 98

Autosomes 14 Metacentrics

20 Submetacentrics

26 Acrocentrics

Sex chromosomes XX/XY

X Large submetacentric, similar in size to pairs Nos. 1 to 3.

Y Small metacentric of the size of pair No. 25.

Marker chromosomes X shows a secondary constriction towards the distal end of the long arm (Rao and Seshadri 1969).

Remarks Egozcue *et al.* (1966) have reported the autosomal and X Y features as above. Manna and Talukdar (1968) designated Y a minute acrocentric of the size of pair No. 29 in their camera lucida tracings. However, the matter can not be settled on such tracings.

REFERENCES 35, 81, *85, 87 (Page 190-191), 121 (Page 220), *162, 165, 202 (*L. tardigradus lydekkarianus*), 204 (*L. tardigradus lydekkarianus*), 213 (Page 49-56), *252 (*L. tardigradus lydekkarianus*), *310 (Page 217), 311 (Page 162 - 163), 317 (Page 44-45), 327 (Page 248).

43. ***Nycticebus coucang*** (Boddaert, 1785). Elench. Anim., p. 67.
(Slow Loris)

2n = 50-52

FN = 100

Autosomes	18 Metacentrics 30 Submetacentrics
Sex chromosomes	XX/XY X Large submetacentric, ranking 5 in order of decreasing size. This is similar in size and arm ratio of pair No. 4. Y Metacentric, ranking 18 in the same order.
Marker chromosomes	X shows a secondary constriction in the long arm (Rao *et al.* 1970). Short arms of pair No. 1 is also reported for a secondary constriction. The constriction is always more visible in one of the members (Garcia *et al.* 1978).
Remarks	Egozcue and Vilarasau de Egozcue (1966) reported pair No. 5 dimorphic alongwith the above autosomal and X Y features. One of the chromosomes of this metacentric pair 5 is visibly shorter than the other. This is applied to both the long and short arms. Chu and Bender (1962) made an identical count of 50 from *N. coucang bengalensis* but no karyotypic data is available. Boer (1972) reported 2n = 52 in a male of this species. This included two small supernumeraries metacentric in nature. The two largest chromosomes are also acrocentrics instead of metacentrics. This male had differed in colour from others. Egozcue (1975) explained the variation (52 to 50) through a mechanism of centric translocation. Chiarelli *et al.* Ed. (1979) have recorded Y submetacentric. Garcia *et el.* (1978) found all the pairs (including X Y) individually identifiable in G-banding.
REFERENCES	26, 27, *33 , 58, 59 (*N. coucang* and *N. c. bengalensis*), 74, *81, *86, 87 (Page 191-192), **102, 121 (Page 221), *140, 165 (*N. coucang* and *N. c. bengalensis*), 206, 213 (Page 57-61), *310 (Page 218), 311 (Page 163), 317 (Page 43-44), 327 (Page 248).

Order PROBOSCIDEA
Family ELEPHANTIDAE

44. ***Elephas maximus*** Linnaeus, 1758. Syst. Nat., 10th ed., 1 33.
(Indian Elephant)

2n = 56
FN = 70

Autosomes
6 Metacentrics
4 Submetacentrics
2 Subtelocentrics
42 Acrocentrics

Sex chromosomes
XX/XY
X Metacentric, 5th largest in the complement.
Y Submetacentric, small.

Remarks
We have identified the largest pair subtelocentric on arm ratio 4.42. This can serve as a marker element. Hsu and Benirschke (1971, Folio 239) have included this pair in their submetacentric category. We have also identified the X a metacentric pair instead of submetacentric on its arm ratio 1.62. Olivier (1984) has mentioned 3 living subspecies of the Asian elephant (*E. maximus*) on their long term total geographical isolation. These are *E. m. maximus* in Sri Lanka, *E. m. indicus* on the Asian main land and *E. m. sumatranus* in Sumatra. The 4th one *E. m. borneensis* of Borneo, however, is yet to be recognized as a subspecies on this criteria.

Singh *et al.* (1997-98) investigated this ideal large mammal species to estimate the influence of isolation on its genetic variation and divergence. Indian elephant is now found in widely separated regions viz., northwestern, northeastern, central and southern India. No contiguity of habitat between the northern and southern populations is evident for the past two thousand years (refer Singh *et al.* 1997-

98 *Annual Report* CCMB, page 38). On analysis of multilocus DNA finger printing by their BKM probe and sequencing of mitochondrial cytochrome b-gene, they have found that split between two populations viz., southern Indian elephants and north-eastern Indian elephants have occurred recently, even though, the populations have diverged enough for the geographic distinctiveness to be observed in them.

REFERENCES 87 (Page 336), 100, 121 (Page 307), *125 (Folio 239), *130 1·65 (*E. indicus*), *176, 179, 199, 311 (Page 240), 317 (Page 222-223), 326, 327 (Page 367).

Order SCANDENTIA

Family TUPAIIDAE

45. ***Tupaia glis*** (Diard, 1820). Asiat. J. Mon. Reg., 10 478.
(Common Tree Shrew)

2n = 62

FN = 75

Autosomes
6 Metacentrics
6 Submetacentrics
48 Acrocentrics

Sex chromosomes
XX/XY
X Medium-sized dimorphic pair of submetacentrics, 7th largest in order of decreasing size.
Y Acrocentric, smallest in the complement.

Marker chromosomes
One acrocentric pair No. 22 has a long achromatic region in the median region.

Remarks
We have described the above features after measuring all the biarmed chromosomes in a karyotype of a female tree-shrew presented by Egozcue *et al.* (1968, Fig. 1). The chromosome morphology is identical to that presented by Klinger (1963). All the meta and submetacentric pairs are individually identifiable on their size and morphology.

Three submetacentric pairs are dimorphic in size and arm ratio as given below -

Pair No.	Arm ratio	
	Large	Small
11	1.75	1.90
25	1.87	2.18
XX	2.68	2.58

Chu and Bender (1962), Hsu and Johnson (1963) and Arrighi *et al.* (1969) have reported 2n = 60 for this species. In a female karyotype of 60 chromosomes presented by Hsu and Benirschke (1968, Folio 97), 8 metacentrics, 6 submetacentrics, 44 acrocentrics have been scored. The X pair is of metacentrics, and the 5th largest in the complement. This karyotype has one more pair of large metacentric chromosomes but lacks 2 pairs of medium-sized acrocentrics. Thus, a Robertsonian fusion is indicated. In tree shrews wide variation in the chrmosome numbers is already known, for example 2n = 44 FN = 80 for *Urogale everetti* to 2n = 68 FN = 74 for *Tupaia montana* (Arrighi *et al.* 1969). Study of this grup for its evolutionary relationship with primates or with insectivora is therefore suggested by modern techniques.

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SUMMARY

Chromosomal features of 45 species of mammals reported from the Indian subcontinent have been catalogued. These species represent 15 families under 7 orders viz., Cetacea (Balaenopteridae, Delphinidae, Physeteridae, Platanistidae, Ziphiidae) ; Insectivora (Erinaceidae, Soricidae); Lagomorpha (Leporidae, Ochotonidae) ; Pholidota (Manidae) ; Primates (Cercopithecidae, Hylobatidae, Lorisidae) ; Proboscidea (Elephantidae) and Scandentia (Tupaiidae). For all the species, diploid number (2n), fundamental number

(FN), morphological features of autosomes sex chromosomes and marker chromosomes have been presented. Remarks column of species includes different views of workers. Relevant references are also listed alongwith.

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