

ATLAS OF MAMMALIAN CHROMOSOMES

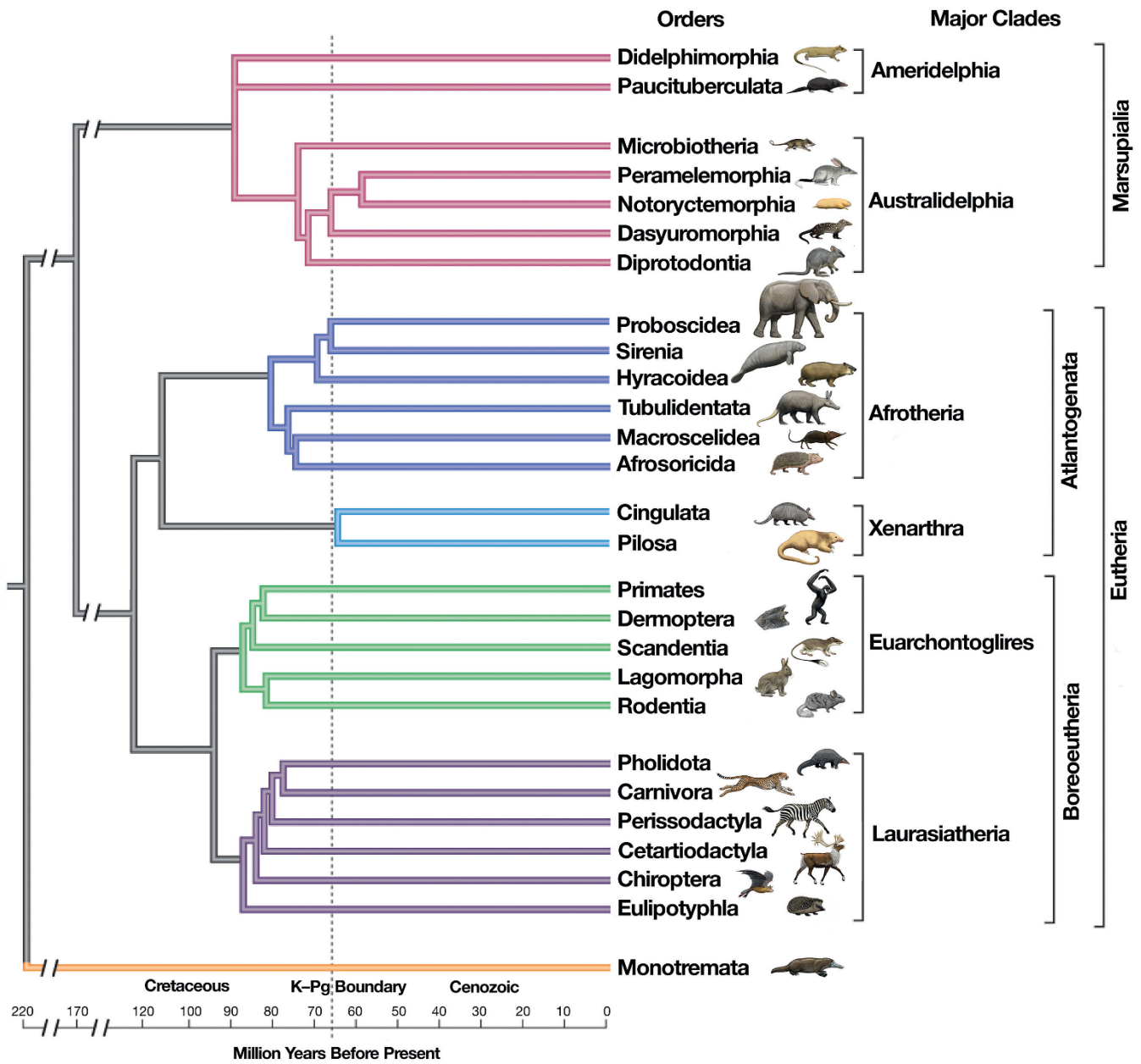
SECOND EDITION



EDITED BY

ALEXANDER S. GRAPHODATSKY · POLINA L. PERELMAN
STEPHEN J. O'BRIEN

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The diagram on the Frontispiece is an evolutionary tree illustrating phylogenetic divergence for the living orders of mammals. The atlas presents updated karyotype images available for each of the living orders. The divergence nodes and their respective dates of divergence represent a consensus view of molecular genetics and morphological and fossil interpretations. Details can be found in the following references: Amrine-Madsen et al. (2003); Foley et al. (2016); Meredith et al. (2011); Murphy et al. (2001a, 2001b); Springer et al. (2003, 2004, 2017); Nilsson et al. (2003, 2004). This consensus tree was reviewed and inputted by William Murphy and Mark Springer. Images of individual species were created by Carl Buell; copyright John Gatesy. Timetree: www.timetree.org

ATLAS OF
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Chromosomes



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CONTENTS



Acknowledgments 1
Contributors li
Foreword 1 by Malcolm A. Ferguson-Smith lviii
Foreword 2 by Denis M. Larkin lxiii
Introduction lxviii

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
MAMMALIA Time Tree					1
MONOTREMATA Time Tree					2
Order Monotremata					3
Family Tachyglossidae					
<i>Tachyglossus aculeatus</i> (F)	Short-Beaked/Short-Nosed Echidna	64	<i>Ornithorhynchus anatinus</i> (OAN)	J. A. M. Graves Rens et al. (2007)	3
<i>Tachyglossus aculeatus</i> (M)	Short-Beaked/Short-Nosed Echidna	63		J. A. M. Graves Rens et al. (2007)	3
Family Zaglossidae					
<i>Zaglossus bruijini</i> (F)	Long-Beaked/Long-Nosed Echidna	64		J. A. M. Graves Graves et al. (unpublished)	4
<i>Zaglossus bruijini</i> (M)	Long-Beaked/Long-Nosed Echidna	63		J. A. M. Graves Graves et al. (unpublished)	4
Family Ornithorhynchidae					
<i>Ornithorhynchus anatinus</i> (F)	Platypus	52	<i>Tachyglossus aculeatus</i> (TAC)	J. A. M. Graves Rens et al. (2007)	5
<i>Ornithorhynchus anatinus</i> (M)	Platypus	52			5
MARSUPIALIA Time Tree					6
Order Didelphimorphia					7
Family Didelphidae					
<i>Marmosops incanus</i>	South American Mouse Opossum	14		Svartman (1998)	7
<i>Marmosa</i> sp.	Mouse Opossum	14		Aniskin (1994a)	7
<i>Micoureus demerarae</i>	Woolly Mouse Opossum	14		Svartman (1998)	8
<i>Thylamys elegans</i>	Elegant Fat-Tailed Mouse Opossum	14		V. M. Aniskin Shchipanov et al. (1996)	8
<i>Metachirus nudicaudatus</i>	Brown Four-Eyed Opossum	14		Aniskin et al. (1991)	9

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Monodelphis domestica</i>	Short-Tailed Opossum	18	<i>Aepyprymnus rufescens</i> (ARU), <i>Notamacropus eugenii</i> (NEU), <i>Trichosurus vulpecula</i> (TVU), <i>Sminthopsis crassicaudata</i> (SCR)	P. Perelman Rens et al. (2001, 2003b)	10
<i>Monodelphis domestica</i> (Ideogram)	Short-Tailed Opossum	18	<i>Homo sapiens</i> (HSA)	Graphodatsky et al. (2011)	11
<i>Caluromys philander</i>	Bare-Tailed Woolly Opossum	14		C. Sotero-Caio Souza et al. (2013)	12
<i>Philander opossum</i>	Black Four-Eyed Opossum	22		M. Svartman (1998)	12
<i>Didelphis marsupialis</i>	Common/Large American Opossum	22		Aniskin et al. (1991)	13
<i>Didelphis virginiana</i>	Virginia Opossum	22		San Diego Institute for Conservation Research (unpublished)	13
Order Paucituberculata					14
Family Caenolestidae					
<i>Rhyncholestes raphanurus</i>	Chilean "Shrew" Opossum	14		Gallardo and Patterson (1987)	14
Order Microbiotheria					14
Family Microbiotheriidae					
<i>Dromiciops australis</i>	Monito del Monte	14F/13M		Gallardo and Patterson (1987)	14
Order Dasyuromorphia					15
Family Dasyuridae					
<i>Antechinus flavipes</i>	Yellow-Footed Marsupial "Mouse"/Antechinus	14		Rofe (1979)	15
<i>Planigale maculata</i>	Flat-Skulled Marsupial "Mouse"/Pygmy Planigale	14		Rofe (1979)	15
<i>Sminthopsis crassicaudata</i>	Fat-Tailed Marsupial "Mouse"/Dunnart/ Sminthopsis	14	<i>Aepyprymnus rufescens</i> (ARU), <i>Monodelphis domestica</i> (MDO), <i>Notamacropus eugenii</i> (NEU), <i>Trichosurus vulpecula</i> (TVU)	P. Perelman Rens et al. (1999, 2001, 2003b)	16
<i>Ningau sp.</i>	Ningauis	14		Rofe (1979)	17
<i>Antechinomys laniger</i>	Kultarr	14		Rofe (1979)	17
<i>Dasyuroides byrnei</i>	Kowari	14		Rofe (1979)	18
<i>Dasyurus maculatus</i>	Spotted-Tailed/Tiger Quoll	14		San Diego Institute for Conservation Research (unpublished)	18
<i>Dasyurus hallucatus</i>	Northern Quoll/Northern Native "Cat"/Njanmak	14		Rofe (1979)	19
<i>Dasyurus viverrinus</i>	Eastern Quoll/Native "Cat"	14		Rofe (1979)	19
<i>Sarcophilus harrisii</i>	Tasmanian Devil	14	<i>Notamacropus eugenii</i> (NEU), BAC maps	J. Deakin San Diego Institute for Conservation Research (unpublished) Deakin et al. (2012, 2013)	20
Order Peramelemorphia					21
Family Thylacomyidae					
<i>Macrotis (Thylacomyis) lagotis</i>	Greater Bilby/Bilby/ Rabbit-Eared Bandicoot	18F/19M		D. Hayman Martin and Hayman (1967)	21
Family Peramelidae					
<i>Isodon obesulus</i>	Short-Nosed Bandicoot	14		Rofe (1979)	21
<i>Perameles nasuta</i>	Long-Nosed Bandicoot	14		Rofe (1979)	21
Order Notoryctemorphia					22
Family Notoryctidae					
<i>Notoryctes typhlops</i>	Marsupial Mole	20		P. G. Johnston Calaby et al. (1974)	22

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
Order Diprotodontia					22
Family Phascolarctidae					
<i>Phascolarctos cinereus</i>	Koala	16		San Diego Institute for Conservation Research (unpublished)	22
Family Vombatidae					
<i>Vombatus ursinus</i>	Common/Coarse-Haired Wombat	14		Rofe (1979)	23
<i>Lasiorhinus latifrons</i>	Southern Hairy-Nosed/ Soft-Furred Wombat	14	<i>Notamacropus eugenii</i> (NEU)	J. Deakin De Leo et al. (1999)	23
Family Phalangeridae					
<i>Trichosurus vulpecula</i>	Common Brush-Tailed Possum	20	<i>Aepyprymnus rufescens</i> (ARU), <i>Monodelphis domestica</i> (MDO), <i>Notamacropus eugenii</i> (NEU), <i>Sminthopsis crassicaudata</i> (SCR)	P. Perelman Rens et al. (1999, 2001, 2003b)	24
Family Potoroidae					
<i>Potorous tridactylus</i>	Long-Nosed Potoroo	12	<i>Aepyprymnus rufescens</i> (ARU), <i>Trichosurus vulpecula</i> (TVU), <i>Notamacropus eugenii</i> (NEU)	P. Perelman Rens et al. (1999, 2003a,b)	25
Family Macropodidae					
<i>Thylogale billardierii</i>	Red-Bellied Pademelon	22		R. Rofe (1979)	26
<i>Thylogale thetis</i>	Red-Necked Pademelon	22		Eldridge et al. (1992a)	26
<i>Petrogale xanthopus celeris</i>	Yellow-Footed Rock Wallaby	22		Eldridge et al. (1992a)	26
<i>Petrogale xanthopus xanthopus</i>	Yellow-Footed Rock Wallaby	22		Eldridge et al. (1992a)	27
<i>Petrogale lateralis lateralis</i>	Black-Footed Rock Wallaby	22		Eldridge et al. (1992a)	27
<i>Petrogale penicillata</i>	Brush-Tailed Rock Wallaby	22		R. Rofe (1979)	27
<i>Petrogale concinna</i>	Little Rock Wallaby	16		Eldridge et al. (1992b)	28
<i>Petrogale brachyotis</i>	Short-Eared Rock Wallaby	20		Eldridge et al. (1992b)	28
<i>Wallabia bicolor</i>	Swamp Wallaby	10F/11M	<i>Notamacropus eugenii</i> (NEU)	J. Deakin Toder et al. (1997)	29
<i>Macropus parma</i>	Parma Wallaby	16		San Diego Institute for Conservation Research (unpublished)	29
<i>Macropus rufogriseus</i>	Red-Necked Wallaby	16		Rofe (1979)	30
<i>Macropus giganteus</i>	Eastern Gray Kangaroo	16		Rofe (1979)	30
<i>Macropus parryi</i>	Whiptail Wallaby	16		Rofe (1979)	31
<i>Macropus fuliginosus</i>	Western Gray Kangaroo	16		Rofe (1979)	31
<i>Macropus robustus</i>	Common Wallaroo	16		Rofe (1979)	32
<i>Macropus rufus</i>	Red Kangaroo	20		Rofe (1979)	32
<i>Notamacropus eugenii</i>	Tammar Wallaby	16	<i>Aepyprymnus rufescens</i> (ARU), <i>Monodelphis domestica</i> (MDO), <i>Trichosurus vulpecula</i> (TVU), <i>Sminthopsis crassicaudata</i> (SCR)	P. Perelman Rens et al. (1999, 2001, 2003b)	33
Family Burramyidae					
<i>Cercartetus concinnus</i>	Western Pygmy Possum	14		Rofe (1979)	34
Family Acrobatidae					
<i>Acrobates pygmaeus</i>	Pygmy Gliding Possum/ Feather-Tailed Glider	14		Rofe (1979)	34
Family Pseudocheiridae					
<i>Pseudocheirus peregrinus</i>	Common Ring-Tailed Possum	20		Murray et al. (1980)	35
<i>Petropseudes dahli</i>	Rock Ring-Tailed Possum	16		Murray et al. (1980)	36
<i>Hemibelideus lemuroides</i>	Lemuroid/Brush-Tipped Ring-Tailed/Greater Gliding Possum	20		McQuade (1984)	36

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
Family Petauridae					
<i>Petaurus norfolcensis</i>	Lesser Gliding Possum/ Squirrel Glider	21		Rofe (1979)	37
Family Tarsipedidae					
<i>Tarsipes rostratus</i>	Honey Possum	24		Hayman (1990)	37
AFROTHERIA Time Tree					38
Order Afrosoricida					39
Family Chrysochloridae					
<i>Chrysochloris asiatica</i>	Cape Golden Mole	30	<i>Homo sapiens</i> (HSA)	Robinson et al. (2004)	39
<i>Chlorotalpa duthieae</i>	Duthie's Golden Mole	30		Bronner (1995a)	40
<i>Chlorotalpa sclateri</i>	Sclater's Golden Mole	30		Bronner (1995a)	40
<i>Cryptochloris zyli</i>	Van Zyl's Golden Mole	30		Gilbert et al. (2006)	41
<i>Amblysomus robustus</i>	Robust Golden Mole	36		Gilbert et al. (2008)	41
<i>Amblysomus hottentotus longiceps</i>	Hottentot Golden Mole	30		Gilbert et al. (2008)	42
<i>Amblysomus hottentotus meesteri</i>	Hottentot Golden Mole	30		Gilbert et al. (2008)	42
<i>Amblysomus hottentotus pondoliae</i>	Hottentot Golden Mole	30		Gilbert et al. (2008)	43
<i>Amblysomus iris</i>	Zulu Golden Mole	34		E. Nevo Capanna et al. (1989)	43
<i>Chrysofalax trevelyani</i>	Giant Golden Mole	30		Gilbert et al. (2006)	44
<i>Eremitalpa granti</i>	Grant's Golden Mole	26		Gilbert et al. (2006)	44
<i>Calcochloris obtusirostris</i>	Yellow Golden Mole	28		Gilbert et al. (2008)	45
<i>Neamblysomus julianae</i>	Juliana's Golden Mole	30		Gilbert et al. (2008)	45
Family Tenrecidae					
<i>Hemicentetes nigriceps</i>	Streaked Tenrec	38		Benirschke (1969)	46
<i>Echinops telfairi</i>	Small Madagascar "Hedgehog"	40		Benirschke (1969)	46
<i>Microgale dobsoni</i>	Dobson's Shrew Tenrec	30		Gilbert et al. (2007)	47
<i>Microgale cowani</i>	Cowan's Shrew Tenrec	38		Gilbert et al. (2007)	47
<i>Microgale fotsifotsy</i>	Pale Shrew Tenrec	32		Gilbert et al. (2007)	48
<i>Microgale soricoides</i>	Shrew-Toothed Shrew Tenrec	32		Gilbert et al. (2007)	48
<i>Microgale taiva</i>	Taiva Shrew Tenrec	32		Gilbert et al. (2007)	49
<i>Microgale thomasi</i>	Thomas's Shrew Tenrec	56		Gilbert et al. (2007)	49
<i>Microgale parvula</i>	Pygmy Shrew Tenrec	32		Gilbert et al. (2007)	50
<i>Microgale longicaudata</i>	Lesser Long-Tailed Shrew Tenrec	30		Gilbert et al. (2007)	50
<i>Microgale principula</i>	Greater Long-Tailed Shrew Tenrec	30		Gilbert et al. (2007)	51
<i>Microgale majori</i>	Major's Long-Tailed Shrew Tenrec	30		Gilbert et al. (2007)	51
<i>Oryzorictes hova</i>	Mole-Like Rice Tenrec	32		Gilbert et al. (2007)	52
Order Sirenia					53
Family Trichechidae					
<i>Trichechus manatus latirostris</i>	Florida Manatee	48	<i>Homo sapiens</i> (HSA)	R. Stanyon Kellogg et al. (2007)	53
<i>Trichechus manatus latirostris</i>	Florida Manatee	48	<i>Procapra capensis</i> (PCA), <i>Loxodonta africana</i> (LAF)	Pardini et al. (2007)	54
Order Proboscidea					55
Family Elephantidae					
<i>Elephas maximus</i>	Asian/Asiatic/Indian Elephant	56	<i>Homo sapiens</i> (HSA)	P. Perelman Yang et al. (2003a)	55
<i>Elephas maximus</i> C-bands	Asian/Asiatic/Indian Elephant	56		Perelman et al. (unpublished)	56

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Loxodonta africana</i>	African Savanna Elephant	56	<i>Procavia capensis</i> (PCA), <i>Trichechus manatus</i> (TMA), <i>Homo sapiens</i> (HSA)	P. Perelman Yang et al. (2003a), Frönicke et al. (2003), Pardini et al. (2007) Perelman et al. (unpublished)	57 58
<i>Loxodonta africana</i>	African Savanna Elephant	56			59
Order Hyracoidea					
Family Procaviidae					
<i>Procavia capensis</i>	Hyrax/Rock Dassie	54		L.Frönicke (unpublished)	59
<i>Procavia capensis</i>	Hyrax/Rock Dassie	54	<i>Trichechus manatus</i> (TMA), <i>Loxodonta africana</i> (LAF)	Pardini et al. (2007)	60
Order Tubulidentata					
Family Orycteropodidae					
<i>Orycteropus afer</i>	Aardvark	20	<i>Loxodonta africana</i> (LAF), <i>Trichechus manatus</i> (TMA), <i>Procavia capensis</i> (PCA), <i>Homo sapiens</i> (HSA), <i>Canis familiaris</i> (CFA)	P. Perelman Yang et al. (2003, unpublished), Pardini et al. (2007)	61
Order Macroscelidea					
Family Macroscelididae					
<i>Macroscelides proboscideus</i>	Short-Eared Elephant Shrew	26	<i>Homo sapiens</i> (HSA)	Svartman et al. (2004)	62
<i>Elephantulus rupestris</i>	Western Rock Elephant Shrew	26	<i>Homo sapiens</i> (HSA)	Robinson et al. (2004)	63
XENARTHRA Time Tree					
Superorder Xenarthra					
Order Pilosa					
Family Megalonychidae					
<i>Choloepus didactylus</i>	Linnaeus's Two-Toed Sloth	53		W. Nash (unpublished)	65
<i>Choloepus didactylus</i>	Linnaeus's Two-Toed Sloth	66	<i>Homo sapiens</i> (HSA)	W. Nie Yang et al. (2006)	66
<i>Choloepus hoffmanni</i>	Hoffmann's Two-Toed Sloth	50	<i>Homo sapiens</i> (HSA)	Svartman et al. (2006)	67
<i>Bradypus torquatus</i>	Maned Sloth	50	<i>Homo sapiens</i> (HSA)	M. Svartman Azevedo et al. (2012)	68
<i>Bradypus variegatus</i>	Brown-Throated Sloth	54	<i>Homo sapiens</i> (HSA)	M. Svartman Azevedo et al. (2012)	69
Family Myrmecophagidae					
<i>Myrmecophaga tridactyla</i>	Giant Anteater	60		San Diego Institute for Conservation Research (unpublished)	70
<i>Tamandua tetradactyla</i> (<i>longicaudata</i>)	Lesser Anteater/Tamandua	54	<i>Homo sapiens</i> (HSA)	M. Svartman Yang et al. (2006), Svartman et al. (2006)	71
Family Cyclopedidae					
<i>Cyclopes didactylus</i>	Silky Anteater	64		Jorge (2000)	72
Order Cingulata					
Family Chlamyphoridae					
<i>Chaetophractus villosus</i>	Hairy Armadillo/Peludo	60		Jorge et al. (1977)	73
<i>Euphractus sexcinctus flavimanus</i>	Six-Banded Armadillo	58	<i>Homo sapiens</i> (HSA)	W. Nie Liu et al. (2011)	74
<i>Zaedyus pichiy</i>	Pichi	62		Jorge et al. (1977)	75
<i>Cabassous centralis</i>	Northern Naked-Tailed Armadillo	62		Benirschke (1969)	76
<i>Cabassous tatouay</i>	Greater Naked-Tailed Armadillo	50		Benirschke (1969)	76
<i>Tolypeutes matacus</i>	La Plata Three-Banded Armadillo	38		San Diego Institute for Conservation Research (unpublished)	77

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
Family Dasypodidae					
<i>Dasypus septemcinctus</i>	Seven-Banded/Long-Nosed Armadillo	64		H. Seuanez Barroso and Seuanez (1991)	77
<i>Dasypus novemcinctus</i>	Nine-Banded/Long-Nosed Armadillo	64	<i>Homo sapiens</i> (HSA)	Svartman et al. (2006)	78
<i>Dasypus hybridus</i>	Southern Long-Nosed Armadillo	64		K. Benirschke Jorge et al. (1977)	78
EUARCHONTOGLIRES Time Tree					79
Order Scandentia Time Tree					80
Family Tupaiidae					
<i>Tupaia belangeri</i>	Northern Tree Shrew	62 (F)		Bigoni and Stanyon (unpublished)	81
<i>Tupaia belangeri</i>	Northern Tree Shrew	62 (M)		Nie et al. (2008)	82
<i>Tupaia minor</i>	Pygmy Tree Shrew	66	<i>Homo sapiens</i> (HSA)	R. Stanyon Dumas et al. (2012)	83
Order Dermoptera					84
Family Cynocephalidae					
<i>Cynocephalus volans</i>	Philippine Flying Lemur	38		Rickart (2003)	85
<i>Galeopterus variegatus</i>	Malayan Flying Lemur	56	<i>Homo sapiens</i> (HSA)	Nie et al. (2008)	86
Order Primates Time Tree					87
Family Lorisidae					
<i>Loris tardigradus</i>	Slender Loris	62		San Diego Institute for Conservation Research (unpublished)	88
<i>Nycticebus pygmaeus</i>	Pygmy Slow Loris	50		San Diego Institute for Conservation Research (unpublished)	89
<i>Nycticebus coucang</i>	Slow Loris	50	<i>Homo sapiens</i> (HSA), <i>Galago moholi</i> (GMO)	W. Nie Stanyon et al. (2002), Nie et al. (2006)	90
Family Galagidae					
<i>Galago moholi</i>	Mohol Bushbaby	38	<i>Homo sapiens</i> (HSA)	Stanyon et al. (2002)	91
<i>Otolemur crassicaudatus</i>	Brown Galago	62	<i>Homo sapiens</i> (HSA)	Stanyon et al. (2002)	92
Family Daubentonidae					
<i>Daubentonia madagascariensis</i>	Aye-Aye	30		San Diego Institute for Conservation Research (unpublished)	93
Family Indriidae					
<i>Propithecus verreauxi coquereli</i>	Coquerel's Sifaka	48		San Diego Institute for Conservation Research (unpublished)	94
<i>Propithecus tattersalli</i>	Golden-Crowned Sifaka	42		San Diego Institute for Conservation Research (unpublished)	94
Family Lepilemuridae					
<i>Lepilemur ruficaudatus</i>	Red-Tailed Sportive Lemur	20		Rumpler et al. (1985)	95
<i>Lepilemur leucopus</i>	White-Footed Sportive Lemur	26		Rumpler et al. (1985)	95
<i>Lepilemur septentrionalis</i>	Northern Sportive Lemur	34		Rumpler et al. (1985)	96
Family Cheirogaleidae					
<i>Microcebus murinus</i>	Gray Mouse Lemur	66		San Diego Institute for Conservation Research (unpublished)	97
Family Lemuridae					
<i>Eulemur macaco</i>	Black Lemur	44	<i>Homo sapiens</i> (HSA)	Müller et al. (1997, 2004)	98
<i>Eulemur fulvus sanfordi</i>	Sanford's Lemur	60		San Diego Institute for Conservation Research (unpublished)	99
<i>Eulemur fulvus</i>	Common Brown Lemur	60	<i>Homo sapiens</i> (HSA)	Müller et al. (1997, 2004)	100

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
Family Tarsiidae					
<i>Tarsius bancanus</i>	Western Tarsier	80		Poorman et al. (1985)	101
<i>Tarsius syrichta</i>	Philippine Tarsier	80		Rickart (2003)	102
Family Pitheciidae					
<i>Pithecia pithecia</i>	White-Faced Saki	48		San Diego Institute for Conservation Research (unpublished)	103
<i>Pithecia irrorata</i>	Rio Tapajós Saki	48	<i>Homo sapiens</i> (HSA)	J. Pieczarka Finotelo et al. (2010)	104
<i>Cacajao calvus rubicundus</i>	Red Uakari	45	<i>Homo sapiens</i> (HSA), <i>Saguinus oedipus</i> (SOE)	S. Müller Finotelo et al. (2010)	105
<i>Callicebus (Torquatus) lugens</i>	Black Titi	16	<i>Homo sapiens</i> (HSA)	R. Stanyon Bonvicino et al. (2003), Stanyon et al. (2003a)	106
<i>Callicebus pallescens</i>	White-Coated Titi	50	<i>Homo sapiens</i> (HSA)	R. Stanyon Dumas et al. (2005)	106
<i>Callicebus cupreus</i>	Coppery Titi	46	<i>Homo sapiens</i> (HSA)	R. Stanyon Dumas et al. (2005)	107
<i>Callicebus nigrifrons</i>	Black-Fronted Titi	42		Nagamachi et al. (2003)	108
<i>Callicebus personatus</i>	Atlantic Titi	44	<i>Homo sapiens</i> (HSA)	J. Pieczarka Rodrigues et al. (2011)	109
<i>Callicebus donacophilus pallescens</i>	White-Eared Titi	50	<i>Homo sapiens</i> (HSA), <i>Saguinus oedipus</i> (SOE)	S. Müller Barros et al. (2003)	110
<i>Callicebus hoffmannsi</i>	Hoffmann's Titi	50		J.C. Pieczarka (unpublished)	111
<i>Callicebus coimbrai</i>	Coimbras Titi	44		J. Pieczarka Rodrigues et al. (2006)	112
<i>Callicebus torquatus</i>	Collared Titi	22		J. Pieczarka Barros et al. (2000)	112
<i>Chiropotes utahicki</i>	Uta Hick's Bearded Saki	50	<i>Homo sapiens</i> (HSA)	S. Müller Stanyon al. (2004b)	113
Family Cebidae					
<i>Callimico goeldii</i>	Goeldi's Marmoset	48 (F)/ 47 (M)		Dumas et al. (2007)	114
<i>Saguinus imperator</i>	Emperor Tamarin	46		San Diego Institute for Conservation Research (unpublished)	114
<i>Saguinus midas</i>	Red-Handed Tamarin	46		Bigoni et al. (unpublished)	115
<i>Callithrix jacchus</i>	Common Marmoset	46		Bigoni et al. (unpublished)	116
<i>Callithrix (Mico) argentata</i>	Silvery Marmoset	44		R. Stanyon Dumas et al. (2007)	116
<i>Callithrix emiliae</i>	Emilia's Marmoset	44		Nagamachi et al. (1996)	117
<i>Callithrix humeralifer</i>	Santarem Marmoset	44		Nagamachi et al. (1996)	117
<i>Callithrix chrysoleuca</i>	Gold And White Marmoset	44		Nagamachi et al. (1996)	118
<i>Callithrix mavesi</i>	Maves Marmoset	44		Nagamachi et al. (1996)	118
<i>Callithrix geoffroyi</i>	White-Headed Marmoset	46		Nagamachi et al. (1997b)	119
<i>Cebuella pygmaea</i>	Pygmy Marmoset	44		Dumas et al. (2007)	120
<i>Leontopithecus chrysopygus</i>	Black Lion Tamarin	46		Seuanez et al. (1988)	121
<i>Leontopithecus rosalia</i>	Golden Lion Tamarin	46		Nagamachi et al. (1997a)	121
<i>Aotus nancymae</i>	Nancy Ma's Night Monkey	54	<i>Homo sapiens</i> (HSA)	Stanyon et al. (2004b, 2005)	122
<i>Aotus lemurinus griseimembra</i>	Gray-Handed Night Monkey	54	<i>Homo sapiens</i> (HSA)	Stanyon et al. (2011)	122
<i>Aotus azarae</i>	Azara's Night Monkey	50		Garcia et al. (2002)	123
<i>Aotus vociferans</i>	Spix's Night Monkey	46		Pieczarka et al. (1992)	123

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Cebus capucinus</i>	White-Headed Capuchin	54		R. Stanyon Campa and Stanyon (1992)	124
<i>Cebus albifrons albifrons</i>	White-Fronted Capuchin	54		San Diego Institute for Conservation Research (unpublished)	125
<i>Cebus albifrons</i>	White-Fronted Capuchin	52	<i>Homo sapiens</i> (HSA), <i>Saguinus oedipus</i> (SOE)	J. Pieczarka Amaral et al. (2008)	125
<i>Cebus apella</i>	Tufted Capuchin	54		J. Pieczarka Clemente et al. (1987)	126
<i>Cebus apella paraguayanus</i>	Tufted Capuchin	54	<i>Homo sapiens</i> (HSA), <i>Saguinus oedipus</i> (SOE)	J. Pieczarka Amaral et al. (2008)	126
<i>Cebus olivaceus</i>	Weeper Capuchin	54		García et al. (2002a)	127
<i>Cebus olivaceus</i>	Weeper Capuchin	52	<i>Homo sapiens</i> (HSA)	J. Pieczarka Amaral et al. (2008)	127
<i>Saimiri sciureus</i> + Ideogram	Squirrel Monkey	44	<i>Homo sapiens</i> (HSA)	S. Müller Stanyon et al. (2000)	128
<i>Saguinus oedipus</i> <i>Cebuella pygmaea</i> <i>Callithrix argentata</i> <i>Callithrix jacchus</i> <i>Callimico goeldii</i>	(alignment of homologous chromosomes)		<i>Homo sapiens</i> (HSA)	Neusser et al. (2001)	129
Family Atelidae					
<i>Lagothrix lagotricha</i>	Woolly Monkey	62	<i>Homo sapiens</i> (HSA)	R. Stanyon Stanyon et al. (2001)	130
<i>Alouatta seniculus macconnelli</i>	Red Howler	46	<i>Homo sapiens</i> (HSA), <i>Saguinus oedipus</i> (SOE)	S. Müller de Oliveira et al. (2002)	131
<i>Alouatta sara</i>	Bolivian Red Howler	50	<i>Homo sapiens</i> (HSA)	R. Stanyon Consigliere et al. (1996)	132
<i>Alouatta belzebul</i>	Red-Handed Howler Monkey	50 (F), 49 (M)	<i>Homo sapiens</i> (HSA)	R. Stanyon Consigliere et al. (1998)	133
<i>Alouatta caraya</i>	Black Howler Monkey	54	<i>Homo sapiens</i> (HSA)	R. Stanyon de Oliveira et al. (2002)	134
<i>Alouatta fusca clamitans</i>	Brown Howler	45 (M), 46 (F)	<i>Homo sapiens</i> (HSA), <i>Saguinus oedipus</i> (SOE)	J. Pieczarka de Oliveira et al. (2002)	135
<i>Alouatta guariba</i>	Brown Howler	50	<i>Homo sapiens</i> (HSA)	R. Stanyon Stanyon et al. (2011)	136
<i>Alouatta arctoidea</i>	Ursine Howler	44	<i>Homo sapiens</i> (HSA)	R. Stanyon Consigliere et al. (1996), Stanyon et al. (2011)	137
<i>Ateles belzebuth marginatus</i>	Red-Faced Spider Monkey	34	<i>Homo sapiens</i> (HSA), <i>Saguinus oedipus</i> (SOE), <i>Lagothrix lagotricha</i> (LLA)	J. Pieczarka de Oliveira et al. (2005)	138
<i>Ateles geoffroyi</i>	Geoffroy's Spider Monkey	34	<i>Homo sapiens</i> (HSA)	R. Stanyon Morescalchi et al. (1997)	138
<i>Ateles paniscus</i>	White-Bellied Spider Monkey	34		Pieczarka et al. (1989)	139
<i>Brachyteles arachnoides</i>	Southern Muriqui	62	<i>Homo sapiens</i> (HSA), <i>Saguinus oedipus</i> (SOE), <i>Lagothrix lagotricha</i> (LLA)	S. Müller de Oliveira et al. (2005)	140
Family Cercopithecoidea					
<i>Erythrocebus patas</i>	Patas Monkey	54	<i>Homo sapiens</i> (HSA)	R. Stanyon Stanyon et al. (2005)	141
<i>Chlorocebus aethiops</i>	African Green Monkey	60	<i>Homo sapiens</i> (HSA)	R. Stanyon Finelli et al. (1999)	142

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Cercopithecus nictitans</i>	Greater Spot-Nosed Monkey	70		Ponsà and Egozcue (1981)	143
<i>Cercopithecus ascanius schmidti</i>	Schmidt's Spot-Nosed Guenon	66		San Diego Institute for Conservation Research (unpublished)	144
<i>Cercopithecus neglectus</i>	De Brazza's Monkey	62	<i>Homo sapiens</i> (HSA)	R. Stanyon Stanyon et al. (2005)	145
<i>Cercopithecus mona campbelli</i>	Campbell's Guenon/Mona Monkey	66		M. Ponsà Clemente et al. (1990)	145
<i>Cercopithecus cephus</i>	Mustached Guenon	66		M. Ponsà Clemente et al. (1990)	146
<i>Cercopithecus diana</i>	Diana Monkey	58		Ponsà (1986)	147
<i>Cercopithecus pogonias</i>	Crested Mona Monkey	72		M. Ponsà Ponsà and Egozcue (1981)	147
<i>Cercopithecus lhoesti</i>	L'Hoest's Monkey/Guenon	60		San Diego Institute for Conservation Research (unpublished)	148
<i>Cercopithecus mitis</i>	Blue Monkey	72		Bigoni and Stanyon (unpublished)	149
<i>Cercopithecus petaurista</i>	Lesser Spot-Nosed/White- Nosed Guenon/Monkey	66		M. Ponsà Clemente et al. (1990)	149
<i>Miopithecus talapoin</i>	Talapoin	54		Ponsà et al. (1980)	150
<i>Allenopithecus nigroviridis</i>	Allen's Swamp Monkey	48		San Diego Institute for Conservation Research (unpublished)	151
<i>Cercocebus galeritus</i>	Tana River Mangabey	42		Bigoni and Stanyon (unpublished)	152
<i>Cercocebus torquatus</i>	Collared/Red-Capped Mangabey	42		García et al. (2002b)	153
<i>Macaca fascicularis</i>	Crab-Eating Macaque	42		M. Ponsà Ruiz-Herrera et al. (2002)	153
<i>Macaca mulatta</i>	Rhesus Monkey	42	<i>Homo sapiens</i> (HSA)	R. Stanyon Bigoni et al. (unpublished)	154
<i>Macaca sylvanus</i>	Barbary Macaque	42		Stanyon et al. (unpublished)	155
<i>Macaca nigra</i>	Celebes Crested Macaque	42		Stanyon et al. (unpublished)	155
<i>Macaca fuscata</i>	Japanese Macaque	42	<i>Homo sapiens</i> (HSA)	Wienberg et al. (1992)	156
<i>Papio hamadryas</i>	Hamadryas Baboon	42		Bigoni and Stanyon (unpublished)	157
<i>Papio anubis</i>	Olive Baboon	42		Bigoni and Stanyon (unpublished)	157
<i>Mandrillus sphinx</i>	Mandrill	42		Ponsà et al. (unpublished)	158
<i>Trachypithecus obscurus</i>	Dusky Leaf Monkey	44		Ponsà (1983)	158
<i>Trachypithecus cristatus</i>	Silvered Leaf Monkey	44		Bigoni et al. (1997a)	159
<i>Pygathrix nemaeus</i>	Douc Langur	44	<i>Homo sapiens</i> (HSA)	Bigoni et al. (2004)	160
<i>Colobus guereza</i>	Mantled Guereza	44	<i>Homo sapiens</i> (HSA)	R. Stanyon Bigoni et al. (1997b)	161
<i>Colobus angolensis palliatus</i>	Angola Colobus	44		M. Houck (unpublished)	162
<i>Theropithecus gelada</i>	Gelada	42		M. Houck (unpublished)	163
<i>Nasalis larvatus</i>	Proboscis Monkey	48	<i>Homo sapiens</i> (HSA)	R. Stanyon Bigoni et al. (2003)	164
<i>Semnopithecus entellus</i>	Northern Plains Gray Langur	44	<i>Homo sapiens</i> (HSA)	Stanyon (unpublished)	165
Family Hylobatidae					
<i>Symphalangus syndactylus</i>	Siamang	50	<i>Homo sapiens</i> (HSA)	R. Stanyon Müller et al. (2003)	166
<i>Hylobates lar</i>	Lar Gibbon	44	<i>Homo sapiens</i> (HSA)	R. Stanyon Jauch et al. (1992), Müller et al. (2003)	167

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Hoolock hoolock</i>	Hoolock Gibbon	38	<i>Homo sapiens</i> (HSA), <i>Hylobates leucogenys</i> (HLE)	Nie et al. (2001)	168
<i>Hoolock leuconedys</i>	Eastern Hoolock Gibbon	38	<i>Homo sapiens</i> (HSA)	R. Stanyon Capozzi et al. (2012)	169
<i>Nomascus concolor</i>	Black Crested Gibbon	52	<i>Homo sapiens</i> (HSA)	R. Stanyon Müller et al. (2003)	170
<i>Nomascus leucogenys</i>	Northern White-Cheeked Gibbon	52		Nie et al. (unpublished)	171
<i>Nomascus siki</i>	Southern White-Cheeked Gibbon	52		Nie et al. (unpublished)	172
<i>Nomascus gabriellae</i>	Yellow-Cheeked Gibbon	52		Nie et al. (unpublished)	173
Family Hominidae					
<i>Pongo abelii</i>	Sumatran Orangutan	48	<i>Homo sapiens</i> (HSA)	R. Stanyon Jauch et al. (1992)	174
<i>Gorilla gorilla</i>	Lowland Gorilla	48	<i>Homo sapiens</i> (HSA)	R. Stanyon Jauch et al. (1992)	175
<i>Pan troglodytes</i>	Common Chimpanzee	48	<i>Homo sapiens</i> (HSA)	R. Stanyon Jauch et al. (1992)	176
<i>Pan paniscus</i>	Pygmy Chimpanzee/ Bonobo	48	<i>Homo sapiens</i> (HSA)	R. Stanyon Jauch et al. (1992)	177
<i>Homo sapiens</i>	Human	46		P. Nash (unpublished)	178
<i>Homo sapiens</i> Ideogram 1 Part I Chromosomal homologies between human and primate species	Human	46	<i>Nomascus concolor</i> (NCO), <i>Hylobates leucogenys</i> (HLE), <i>Symphalangus syndactylus</i> (SSY), <i>Hoolock hoolock</i> (HHO), <i>Hylobates lar</i> (HLA), <i>Colobus guereza</i> (CGU), <i>Erythrocebus patas</i> (EPA), <i>Chlorocebus aethiops</i> (CAE), <i>Cercopithecus neglectus</i> (CNE), <i>Callicebus pallescens</i> (CPA), <i>Lagothrix lagothricha</i> (LLA), <i>Saimiri sciureus</i> (SSC), <i>Aotus nancymaeae</i> (ANA), <i>Callimico goeldii</i> (CGO), <i>Cebuella pygmaea</i> (CPY), <i>Callithrix argentata</i> (CAR), <i>Galago moholi</i> (GMO), <i>Otolemur garnettii</i> (OGA), <i>Nycticebus coucang</i> (NCO), <i>Eulemur macaco</i> (EMA), <i>Galeopterus variegates</i> (GVA), <i>Tupaia belangeri</i> (TBE)	L. Biltueva Bigoni et al. (1997a), Müller et al. (1997, 1998, 1999), Finelli et al. (1999), Stanyon et al. (2001, 2004b, 2005, 2006), Ferguson-Smith et al. (2005), Dumas et al. (2005, 2007), Nie et al. (2001, 2008)	179
<i>Homo sapiens</i> Ideogram 1 Part II Chromosomal homologies between human and primate species	Human	46	continued	continued	180
<i>Homo sapiens</i> Ideogram 1 Part III Chromosomal homologies between human and primate species	Human	46	continued	continued	181
<i>Homo sapiens</i> Ideogram 1 Part IV Chromosomal homologies between human and primate species	Human	46	continued	continued	182
<i>Homo sapiens</i> Ideogram 2 Part I Chromosomal homologies between human and non-primate species	Human	46	<i>Loxodonta africana</i> (LAF), <i>Orycteropus afer</i> (OAF), <i>Oryctolagus cuniculus</i> (OCU), <i>Sciurus carolinensis</i> (SCA), <i>Mus musculus</i> (MMU), <i>Castor fiber</i> (CFI), <i>Tamias sibiricus</i> (TSI), <i>Cavia porcellus</i> (CPO), <i>Sus scrofa</i> (SSC), <i>Camelus dromedarius</i> (CDR), <i>Equus caballus</i> (ECA), <i>Felis catus</i> (FCA), <i>Mustela vison</i> (MVI), <i>Canis familiaris</i> (CFA)	L. Biltueva Balmus et al. (2007), Goureau et al. (1996), Graphodatsky et al. (2002), Korstanje et al. (1999), Stanyon et al. (2003b), Yang et al. (1999, 2000a, 2003a, 2004), Beklemisheva et al. (2011), Romanenko et al. (2015)	183

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Homo sapiens</i> Ideogram 2 Part II Chromosomal homologies between human and non-primate species	Human	46	continued	continued	184
<i>Homo sapiens</i> Ideogram 2 Part III Chromosomal homologies between human and non-primate species	Human	46	continued	continued	185
Order Rodentia Time Tree					186
Family Gliridae					
<i>Muscardinus avellanarius</i>	Common Dormouse/Hazel Mouse	46		A. Graphodatsky (unpublished)	187
<i>Glis glis</i>	Fat Dormouse	62		A. Graphodatsky (unpublished)	188
<i>Dryomys nitedula</i>	Forest Dormouse	48		A. Graphodatsky (unpublished)	189
<i>Eliomys quercinus</i>	Garden Dormouse	48		A. Graphodatsky (unpublished)	190
<i>Eliomys melanurus</i>	Asian Garden Dormouse	48	<i>Homo sapiens</i> (HSA)	Sannier et al. (2011)	191
<i>Myomimus personatus</i>	Masked Mouse-Tailed Dormouse	44		A. Graphodatsky (unpublished)	192
Family Sciuridae					
<i>Tamias sibiricus</i>	Chipmunk	38	<i>Homo sapiens</i> (HSA), <i>Castor fiber</i> (CFI)	Beklemisheva et al. (2011)	193
<i>Sundasciurus philippinensis</i>	Sunda Tree Squirrel	38		Rickart (2003)	194
<i>Marmota monax</i>	Groundhog	38		Beklemisheva and Perelman (unpublished)	194
<i>Marmota himalayana</i>	Himalayan Marmot	38	<i>Homo sapiens</i> (HSA), <i>Sciurus carolinensis</i> (SCA)	W. Nie Li et al. (2006a)	195
<i>Marmota baibacina</i>	Gray Marmot	38	<i>Tamias sibiricus</i> (TSI)	Beklemisheva et al. (2011)	196
<i>Marmota kastschenkoi</i>	Forest-Steppe Marmot	36	<i>Tamias sibiricus</i> (TSI)	Beklemisheva et al. (2011)	197
<i>Spermophilus erythrogegens</i>	Red-Cheeked Ground Squirrel	36	<i>Tamias sibiricus</i> (TSI)	Beklemisheva et al. (2011), Graphodatsky and Sablina (unpublished)	198
<i>Spermophilus undulatus</i>	Long-Tailed Siberian Suslik/Ground Squirrel	32	<i>Tamias sibiricus</i> (TSI)	Beklemisheva et al. (2011), Graphodatsky and Sablina (unpublished)	199
<i>Spermophilus alaschanicus</i>	Alashan Ground Squirrel/ Suslik	38		Graphodatsky and Sablina (unpublished)	200
<i>Spermophilus major</i>	Russet Ground Squirrel	36	<i>Tamias sibiricus</i> (TSI)	Beklemisheva et al. (2011)	201
<i>Spermophilus suslikus</i>	Speckled Ground Squirrel	34	<i>Tamias sibiricus</i> (TSI)	Beklemisheva et al. (2011)	202
<i>Spermophilus pygmaeus</i>	Little Ground Squirrel	36		Beklemisheva et al. (unpublished)	203
<i>Ictidomys tridecemlineatus</i>	Thirteen-Lined Ground Squirrel	34		V. Beklemisheva Beklemisheva, Perelman, Lemskaya, McMullen, Hallenbeck (unpublished), Lemskaya et al. (2018)	204
<i>Petaurista albiventer</i>	Red Giant Flying Squirrel	38	<i>Homo sapiens</i> (HSA)	W. Nie Li et al. (2006a)	205
<i>Xerus erythropus</i>	Striped Ground Squirrel	38	<i>Homo sapiens</i> (HSA), <i>Sciurus carolinensis</i> (SCA)	W. Nie Li et al. (2006a)	206
<i>Sciurus carolinensis</i>	Gray Squirrel	40	<i>Homo sapiens</i> (HSA)	W. Nie Li et al. (2006a), Stanyon et al. (2003b)	207
<i>Sciurus vulgaris</i>	Red Squirrel	40	<i>Tamias sibiricus</i> (TSI)	Beklemisheva et al. (2011)	208
Family Geomyidae					
<i>Thomomys talpoides attenuatus</i>	Northern Pocket Gopher	48		Thaeler (1968)	209
<i>Thomomys talpoides pygmaeus</i>	Northern Pocket Gopher	48		Thaeler (1968)	209

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
Family Heteromyidae					
<i>Dipodomys merriami</i>	Kangaroo Rat	52		A. D. Stock Mascarello et al. (1974)	210
Family Castoridae					
<i>Castor fiber</i>	Eurasian Beaver	48	<i>Homo sapiens</i> (HSA), <i>Tamias sibiricus</i> (TSI)	V. Beklemisheva Graphodatsky et al. (2008b), Beklemisheva et al. (2011)	211
<i>Castor canadensis</i>	North American Beaver	40		A. Graphodatsky Ward et al. (1991)	212
Family Dipodidae					
<i>Sicista napaea</i>	Altai Birch Mouse	42		A. Graphodatsky (unpublished)	213
<i>Sicista betulina</i>	Northern Birch Mouse	32		V. Aniskin and V. Volobouev Kovalskaya et al. (2011)	213
<i>Sicista betulina</i>	Northern Birch Mouse	32	<i>Homo sapiens</i> (HSA)	S. Romanenko Graphodatsky et al. (2008b)	214
<i>Sicista strandi</i>	Strand's Birch Mouse	44		V. Aniskin and V. Volobouev Kovalskaya et al. (2011)	215
<i>Sicista severtzovi</i>	Severtzov's Birch Mouse	26		V. Aniskin and V. Volobouev Kovalskaya et al. (2011)	215
<i>Sicista subtilis nordmanni</i>	Southern Birch Mouse	26		V. Aniskin and V. Volobouev Kovalskaya et al. (2011)	216
<i>Sicista subtilis subtilis</i>	Southern Birch Mouse	24		V. Aniskin and V. Volobouev Kovalskaya et al. (2011)	216
<i>Sicista</i> sp. 1	Birch Mouse	22–24		V. Aniskin and V. Volobouev Kovalskaya et al. (2011)	217
<i>Sicista</i> sp. 2	Birch Mouse	16–22		V. Aniskin and V. Volobouev Kovalskaya et al. (2011)	218
Family Pedetidae					
<i>Pedetes capensis</i>	South African Springhare/ Springhaas	38	<i>Homo sapiens</i> (HSA)	L. Biltueva Graphodatsky et al. (2008b)	219
Family Spalacidae					
<i>Spalax ehrenbergi</i>	Middle East Blind Mole-Rat	52–60		Ivanitskaya et al. (2005)	220
<i>Spalax ehrenbergi</i>	Middle East Blind Mole-Rat	52–60	<i>Homo sapiens</i> (HSA)	L. Biltueva L. Biltueva et al. (unpublished)	221
Family Nesomyidae					
<i>Dendromus lachaisei</i>	Lachaise's Climbing Mouse	30		V. Aniskin and V. Volobouev Denys and Aniskin (2012)	222
<i>Eliurus minor</i>	Lesser Tufted-Tailed Rat	76		Solano et al. (2011)	223
<i>Eliurus majori</i>	Major's Tufted-Tailed Rat	58		Solano et al. (2011)	223
<i>Nesomys rufus</i>	Island Mouse	60		Solano et al. (2011)	224
<i>Cricetomys emini</i>	Emin's Pouched Rat	80		S. Romanenko (unpublished)	225
<i>Cricetomys gambianus</i>	Gambian Pouched Rat	80		V. Aniskin and V. Volobouev (unpublished)	226

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
Family Cricetidae					
Subfamily Arvicolinae					
<i>Myodes rufocanus</i>	Gray Red-Backed Vole	56		V. Aniskin Sokolov et al. (1990)	227
<i>Myodes sikotanensis</i>	Sikotan Vole	56		V. Aniskin Sokolov et al. (1990)	228
<i>Myodes rutilus</i>	Northern Red-Backed Vole	56	<i>Microtus agrestis</i> (MAG), <i>Dicrostonyx torquatus</i> (DTO), <i>Mesocricetus auratus</i> (MAU)	N. Lemskaya Romanenko et al. (2016)	229
<i>Myodes gapperi</i>	Southern Red-Backed Vole	56		Modi (1987)	230
<i>Myodes californicus</i>	Western Red-Backed Vole	56		Modi (1987)	230
<i>Myodes glareolus</i>	Bank Vole	56		V. Aniskin Sokolov et al. (1990)	231
<i>Myodes centralis</i>	Tien Shan Red-Backed Vole	56		V. Aniskin Sokolov et al. (1990)	232
<i>Myodes regulus</i>	Royal Vole	56		O. Sablina et al. (unpublished)	233
<i>Eothenomys miletus</i>	Large Oriental Vole	56	<i>Eothenomys proditor</i> (EPR)	W. Nie Li et al. (2006b)	234
<i>Eothenomys proditor</i>	Yulungshan Vole	32		W. Nie Li et al. (2006b)	234
<i>Alicola argentatus</i>	Silver High Mountain Vole	56		O. Sablina et al. (unpublished)	235
<i>Alicola macrotis</i>	Large-Eared Vole	56		O. Sablina et al. (unpublished)	236
<i>Alicola barakshin</i>	Gobi Altai Mountain Vole	56		N. Lemskaya and S. Romanenko (unpublished)	237
<i>Alicola strelzowi</i>	Flat-Headed Vole	56		N. Lemskaya (unpublished)	238
<i>Alicola olchonensis</i>	Olkhon Mountain Vole	56		S. Romanenko (unpublished)	238
<i>Phenacomys intermedius</i>	Heather Vole	56		W. Modi (unpublished)	239
<i>Arvicola amphibius</i>	European Water Vole	36	<i>Microtus agrestis</i> (MAG), <i>Dicrostonyx torquatus</i> (DTO), <i>Mesocricetus auratus</i> (MAU)	S. Romanenko et al. (2016), O. Sablina et al. (unpublished)	240
<i>Chionomys nivalis</i>	European Snow Vole	54		O. Sablina et al. (unpublished)	241
<i>Chionomys roberti</i>	Robert's Snow Vole	54		O. Sablina et al. (unpublished)	242
<i>Chionomys gud</i>	Caucasian Snow Vole	54		O. Sablina et al. (unpublished)	243
<i>Blanfordimys afghanus</i>	Afghan Vole	58		O. Sablina et al. (unpublished)	244
<i>Blanfordimys bucharicus</i>	Bucharian Vole	48		O. Sablina et al. (unpublished)	245
<i>Neodon juldaschi</i>	Juniper Vole	54		O. Sablina et al. (unpublished)	246
<i>Microtus (Terricola) subterraneus</i>	European Pine Vole	54		O. Sablina et al. (unpublished)	247
<i>Microtus (Terricola) subterraneus</i>	European Pine Vole	52		O. Sablina et al. (unpublished)	248
<i>Microtus (Terricola) nasarovi</i>	Nasarov's Vole	42		O. Sablina et al. (unpublished)	249
<i>Microtus (Terricola) daghestanicus</i>	Daghestan Pine Vole	54	<i>Microtus agrestis</i> (MAG)	Lemskaya et al. (2010)	250
<i>Microtus (Terricola) savii</i>	Savi's Pine Vole	54		S. Romanenko (unpublished)	250
<i>Microtus (Terricola) majori</i>	Major's Pine Vole	54		O. Sablina et al. (unpublished)	251
<i>Microtus (Terricola) schelkovnikovii</i>	Schelkovnikov's Pine Vole	54		O. Sablina et al. (unpublished)	252
<i>Microtus agrestis</i>	Field Vole	50	<i>Dicrostonyx torquatus</i> (DTO), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2016)	253
<i>Microtus (Microtus) kirgisorum</i>	Tien Shan Vole	54		O. Sablina et al. (unpublished)	254
<i>Microtus (Microtus) socialis</i>	Social Vole	62	<i>Microtus agrestis</i> (MAG)	Lemskaya et al. (2010), O. Sablina et al. (unpublished)	255
<i>Microtus (Microtus) schidlovskii</i>	Schidlovsky's Vole	60		O. Sablina et al. (unpublished)	256
<i>Microtus (Microtus) dogramacii</i>	Dogramaci's Vole	48	<i>Microtus agrestis</i> (MAG)	Lemskaya et al. (2010)	256
<i>Microtus (Microtus) guentheri</i>	Günther's Vole	54	<i>Microtus agrestis</i> (MAG)	Lemskaya et al. (2010), O. Sablina et al. (unpublished)	257

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Microtus (Microtus) qazvinensis</i>	Qazvin Vole	54		O. Sablina et al. (unpublished)	258
<i>Microtus (Microtus) arvalis</i>	Common Vole	46	<i>Microtus agrestis</i> (MAG)	Lemskaya et al. (2010), O. Sablina et al. (unpublished)	259
<i>Microtus (Microtus) obscurus</i>	Altai Vole	46		V. Aniskin Tougard et al. (2013)	260
<i>Microtus (Microtus) levis</i>	East European/Sibling/ Southern Vole	54	<i>Microtus agrestis</i> (MAG)	Lemskaya et al. (2010), O. Sablina et al. (unpublished)	261
<i>Microtus (Microtus) transcaspicus</i>	Transcaspian Vole	52		O. Sablina et al. (unpublished)	262
<i>Microtus (Alexandromys) oeconomus</i>	Tundra Vole	30	<i>Microtus agrestis</i> (MAG), <i>Dicrostonyx torquatus</i> (DTO), <i>Mesocricetus auratus</i> (MAU), <i>Mus musculus</i> (MMU)	N. Lemskaya Sitnikova et al. (2007), Romanenko et al. (2016), O. Sablina (unpublished)	263
<i>Microtus (Alexandromys) montebelli</i>	Japanese Grass Vole	30		O. Sablina et al. (unpublished)	264
<i>Microtus (Alexandromys) mongolicus</i>	Mongolian Vole	50		O. Sablina et al. (unpublished)	265
<i>Microtus (Alexandromys) hyperboreus (middendorffii)</i>	North Siberian Vole	50		O. Sablina et al. (unpublished)	266
<i>Microtus (Alexandromys) sachalinensis</i>	Sakhalin Vole	50		O. Sablina et al. (unpublished)	267
<i>Microtus (Alexandromys) fortis</i>	Reed Vole	52		O. Sablina et al. (unpublished)	268
<i>Microtus (Alexandromys) evoronensis</i>	Evoronsk Vole	39–40		N. Lemskaya O. Sablina et al. (unpublished)	269
<i>Microtus (Alexandromys) maximowiczii</i>	Maximowicz's Vole	44	<i>Microtus agrestis</i> (MAG)	Lemskaya et al. (2010)	270
<i>Microtus (Alexandromys) mujanensis</i>	Musk Vole	38	<i>Microtus agrestis</i> (MAG)	Lemskaya et al. (2010, 2015)	270
<i>Microtus (Alexandromys) gromovi</i>	Gromov's Vole	44		N. Lemskaya (unpublished)	271
<i>Microtus (Alexandromys) clarkei</i>	Clarke's Vole	52	<i>Eothenomys proditor</i> (EPR)	W. Nie Li et al. (2006b)	271
<i>Microtus breweri</i>	Beach Vole	46		Modi (1986)	272
<i>Microtus townsendii</i>	Townsend's Vole	50		Modi (1987)	272
<i>Microtus oregoni</i>	Creeping Vole	17–18		Modi (1987)	273
<i>Microtus californicus</i>	California Vole	53		Modi (1987)	273
<i>Microtus pennsylvanicus</i>	Chihuahua/Meadow Vole	46		Modi (1986)	274
<i>Microtus mexicanus</i>	Mexican Vole	48		Modi (1987)	274
<i>Microtus pinetorum</i>	Woodland Vole	62		Modi (1987)	275
<i>Microtus ochrogaster</i>	Prairie Vole	54		Modi (1987)	275
<i>Microtus richardsoni</i>	North American Water Vole	56		Modi (1987)	276
<i>Microtus longicaudus</i>	Long-Tailed Vole	56		Modi (1987)	276
<i>Lasiopodomys brandtii</i>	Brandt's Vole	34		V. Aniskin and V. Volobouev (unpublished)	277
<i>Lasiopodomys brandtii</i>	Brandt's Vole	34	<i>Microtus agrestis</i> (MAG), <i>Dicrostonyx torquatus</i> (DTO)	S. Romanenko Gladkikh et al. (2016)	278
<i>Lasiopodomys (Microtus) gregalis</i>	Narrow-Headed Vole	36	<i>Microtus agrestis</i> (MAG), <i>Dicrostonyx torquatus</i> (DTO)	S. Romanenko Lemskaya et al. (2010), Gladkikh et al. (2016)	279
<i>Lasiopodomys mandarinus</i>	Mandarin Vole	48		V. Aniskin and V. Volobouev (unpublished)	280
<i>Lasiopodomys mandarinus</i>	Mandarin Vole	47		Gladkikh et al. (2016)	281
<i>Prometheomys schaposchnikowi</i>	Long-Clawed Mole Vole	56		O. Sablina et al. (unpublished)	282
<i>Dicrostonyx torquatus</i>	Palaearctic Collared Lemming	45 + B's	<i>Microtus agrestis</i> (MAG), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2016)	283
<i>Lagurus lagurus</i>	Steppe Lemming	56		Modi (1987)	284
<i>Neofiber alleni</i>	Round-Tailed Muskrat	52		Modi (1987)	284
<i>Ondatra zibethicus</i>	Common Muskrat	54		N. Lemskaya (unpublished)	285
<i>Lemmus sibiricus</i>	True Lemming	50		Modi (1987)	286
<i>Synaptomys cooperi</i>	Bog Lemming	50		Modi (1987)	286

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Ellobius lutescens</i>	Transcaucasian Mole Vole	17	<i>Microtus agrestis</i> (MAG), <i>Mesocricetus auratus</i> (MAU), <i>Mus musculus</i> (MMU), Ancestral <i>Ellobius</i> Karyotype (AEK)	Romanenko et al. (2007)	287
<i>Ellobius fuscocapillus</i>	Southern Mole Vole	36		P. Perelman and A. Graphodatsky (unpublished)	288
<i>Ellobius talpinus</i>	Northern Mole Vole	54	<i>Microtus agrestis</i> (MAG)	Bakloushinskaya et al. (2012)	289
<i>Ellobius tancrei</i>	Zaisan Mole Vole	54, 30	<i>Microtus agrestis</i> (MAG)	Bakloushinskaya et al. (2012, 2013)	290
Family Cricetidae					
Subfamily Cricetinae					
<i>Phodopus sungorus</i>	Dzhungarian Hamster	28	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2007), S. Radjabli et al. (unpublished)	291
<i>Phodopus sungorus campbelli</i>	Campbell's Hamster	28	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2007), S. Radjabli et al. (unpublished)	292
<i>Phodopus roborovskii</i>	Small Desert Hamster	34	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2007), S. Radjabli et al. (unpublished)	293
<i>Cricetus cricetus</i>	European Hamster	22	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2007), S. Radjabli et al. (unpublished)	294
<i>Allocricetulus eversmanni</i>	Eversmann's Hamster	26	<i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2013)	295
<i>Allocricetulus curtatus</i>	Mongolian Hamster	20	<i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2013)	296
<i>Allocricetulus pseudocurtatus</i>	Eversmann's Hamster	26	<i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2013)	297
<i>Cricetulus migratorius</i>	Gray Dwarf Hamster	22	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2007), S. Radjabli et al. (unpublished)	298
<i>Cricetulus barabensis</i>	Striped Dwarf Hamster	20		Radjabli et al. (unpublished)	299
<i>Cricetulus pseudogriseus</i>	Transbaikal Dwarf Hamster	24		Radjabli et al. (unpublished)	300
<i>Cricetulus griseus</i>	Chinese Hamster	22	<i>Mesocricetus auratus</i> (MAU), <i>Mus musculus</i> (MMU)	Romanenko et al. (2006) S. Radjabli et al. (unpublished)	301
<i>Cricetulus obscurus</i>	Gobi Hamster	20		Radjabli et al. (unpublished)	302
<i>Cricetulus longicaudatus</i>	Lesser Long-Tailed Hamster	24	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2007), S. Radjabli et al. (unpublished)	303
<i>Cricetulus sokolovi</i>	Sokolov's Dwarf Hamster	20	<i>Mesocricetus auratus</i> (MAU)	S. Romanenko Poplavskaya et al. (2017)	304
<i>Tscherskia (Cricetulus) triton</i>	Greater Long-Tailed Hamster	28	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2007), S. Radjabli et al. (unpublished)	305
<i>Mesocricetus brandti</i>	Brandt's Hamster	42	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2007), S. Radjabli et al. (unpublished)	306
<i>Mesocricetus auratus</i>	Syrian Golden Hamster	44	<i>Cricetulus griseus</i> (CGR), <i>Microtus agrestis</i> (MAG), <i>Dicrostonyx torquatus</i> (DTO), <i>Mus musculus</i> (MMU)	Romanenko et al. (2013, 2016), Radjabli et al. (unpublished)	307
<i>Mesocricetus raddei</i>	Ciscaucasian Hamster	44	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU)	Romanenko et al. (2007), S. Radjabli et al. (unpublished)	308
<i>Mesocricetus newtoni</i>	Romanian Hamster	38		Radjabli et al. (unpublished)	309
Family Cricetidae					
Subfamily Neotominae					
<i>Neotoma albigula/Neotoma micropus</i>	White-Throated Woodrat/ Southern Plains Woodrat	52		S. Pathak Mascarello et al. (1974)	310
<i>Peromyscus eremicus</i>	Cactus Mouse	48	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU), <i>Mus musculus</i> (MMU), <i>Rattus norvegicus</i> (RNO)	Da Silva et al. (2015), Romanenko et al. (2007), S. Radjabli et al. (unpublished)	311
<i>Peromyscus maniculatus</i>	North American Deer Mouse	48	<i>Mus musculus</i> (MMU)	Mlynarski et al. (2008)	312
<i>Peromyscus boylii</i>	Brush Mouse	48		Greenbaum et al. (1994)	312
<i>Peromyscus truei</i>	Piñon Mouse	48		Greenbaum et al. (1994)	312

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
Family Cricetidae					
Subfamily Sigmodontinae					
<i>Eligmodontia puerulus</i>	Andean Gerbil Mouse/ Altiplano Laucha	50		M. H. Gallardo Kelt et al. (1991)	313
<i>Eligmodontia</i> sp.	Gerbil Mouse/Laucha	32		M. H. Gallardo Kelt et al. (1991)	313
<i>Maresomys (Auliscomys) boliviensis</i>	Bolivian Big-Eared Mouse/ Pericote	22		A. E. Spotorno Walker and Spotorno (1992)	314
<i>Auliscomys sublimis</i>	Andean Big-Eared Mouse	28		A. E. Spotorno Walker and Spotorno (1992)	314
<i>Loxodontomys (Auliscomys) micropus</i>	Southern Big-Eared Mouse	34 (F), 32 (M)		A. E. Spotorno Walker and Spotorno (1992)	314
<i>Euneomys chinchilloides petersoni</i>	Patagonian Chinchilla Mouse	36		M. H. Gallardo Reise and Gallardo (1990)	315
<i>Euneomys mordax</i>	Biting Chinchilla Mouse/ Large Euneomys	42		M. H. Gallardo Reise and Gallardo (1990)	315
<i>Oryzomys yunganus</i>	Yungas Rice Rat	58		V. M. Aniskin Volobouev and Aniskin (2000a)	316
<i>Oryzomys nitidus</i>	Elegant Rice Rat	80		Volobouev and Aniskin (2000a)	316
<i>Oryzomys megacephalus</i>	Azara's Broad-Headed Rice Rat	54		Volobouev and Aniskin (2000a)	317
<i>Oligoryzomys flavescens</i>	Yellow Pygmy Rice Rat	66		Aniskin and Volobouev (1999)	318
<i>Oligoryzomys flavescens</i>	Yellow Pygmy Rice Rat	64	<i>Mus musculus</i> (MMU)	S. Müller Hass et al. (2008)	318
<i>Oligoryzomys microtis</i>	Small-Eared Pygmy Rice Rat	64		Aniskin and Volobouev (1999)	319
<i>Necomys lasiurus</i>	Hairy-Tailed Bolo Mouse	34	<i>Mus musculus</i> (MMU)	S. Müller Hass et al. (2008)	319
<i>Amphinectomys savamis</i>	Water Rat	50		V. M. Aniskin Malygin et al. (1994)	320
<i>Abrothrix (Akodon) sanborni</i>	Sanborn's Grass Mouse/ Akodont	52		Gallardo (1982)	321
<i>Abrothrix (Akodon) longipilis</i>	Long-Haired Grass Mouse/ Akodont	52		Gallardo (1982)	321
<i>Abrothrix (Akodon) olivaceus</i>	Olive Grass Mouse/ Akodont	52		Gallardo (1982)	321
<i>Akodon simulator</i>	Gray-Bellied/White-Throated Grass Mouse	36		Aniskin et al. (1996)	322
<i>Akodon toba</i>	Chako Grass Mouse	42		Aniskin et al. (1996)	322
<i>Akodon cursor</i>	Cursor Grass Mouse	15	<i>Mus musculus</i> (MMU)	S. Müller Hass et al. (2008)	323
<i>Akodon montensis</i>	Montane Grass Mouse	24	<i>Mus musculus</i> (MMU)	S. Müller Hass et al. (2008)	323
<i>Akodon montensis</i>	Montane Grass Mouse	24	<i>Hylaeamys megacephalus</i> (HME)	J. Pieczarka Suárez et al. (2015)	324
<i>Akodon</i> sp.	Grass Mouse	10	<i>Hylaeamys megacephalus</i> (HME)	J. Pieczarka Pereira et al. (2016)	324
<i>Akodon serrensis</i>	Serra do Mar Grass Mouse	46	<i>Mus musculus</i> (MMU)	S. Müller Hass et al. (2008)	325
<i>Akodon paranaensis</i>	Parana Grass Mouse	44	<i>Mus musculus</i> (MMU)	S. Müller Hass et al. (2008)	325
<i>Thaptomys nigrita</i>	Blackish Grass Mouse	52	<i>Mus musculus</i> (MMU), <i>Hylaeamys megacephalus</i> (HME)	S. Müller, J. Pieczarka Hass et al. (2008), Suárez et al. (2015)	326

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Cerradomys langguthi</i>	Terraced Rice Rat	46	<i>Hylaeamys megalcephalus</i> (HME)	J. Pieczarka Nagamachi et al. (2013)	327
<i>Hylaeamys (Oryzomys) megalcephalus</i>	Large-Headed Rice Rat	54		J. Pieczarka Nagamachi et al. (2013)	328
<i>Oecomys paricola</i>	Brazilian Oecomys	68–70		J. Pieczarka Rosa et al. (2012)	329
<i>Neacomys dubosti</i>	Dubost's Neacomys	64		J. Pieczarka Da Silva et al. (2015)	330
<i>Neacomys paracou</i>	Paracou Neacomys	56		J. Pieczarka Da Silva et al. (2015)	330
<i>Neacomys</i> sp. 1	Neacomys	58		J. Pieczarka Da Silva et al. (2015)	330
<i>Sigmodon arizonae</i>	Arizona Cotton Rat	22	<i>Sigmodon hispidus</i> (SHI)	C. Sotero-Caio Swier et al. (2009)	331
<i>Sigmodon mascotensis</i>	Mexican Cotton Rat	28	<i>Sigmodon hispidus</i> (SHI)	C. Sotero-Caio Swier et al. (2009)	331
<i>Sigmodon fulviventor</i>	Tawny-Bellied Cotton Rat	30	<i>Sigmodon hispidus</i> (SHI)	C. Sotero-Caio Swier et al. (2009)	331
Family Muridae					
Subfamily Deomyiinae					
<i>Lophuromys melanonyx</i>	Black-Clawed Brush-Furred Rat	60		Aniskin et al. (1997a)	332
<i>Lophuromys brevicaudus</i>	Short-Tailed Brush-Furred Rat	68		Aniskin et al. (1997a)	333
<i>Lophuromys chrysopus</i>	Ethiopian Forest Brush-Furred Rat	54		Aniskin et al. (1997a)	334
<i>Acomys dimidiatus</i>	Eastern Spiny Mouse	38		S. Romanenko (unpublished)	335
Family Muridae					
Subfamily Gerbillinae					
<i>Tatera nigricauda</i>	Large Naked-Soled Gerbil	40		Qumsiyeh (1986)	336
<i>Tachyoryctes macrocephalus</i>	Big-Headed/African Mole-Rat	50		Aniskin et al. (1997b)	337
<i>Tachyoryctes splendens</i>	East African Mole-Rat	48		Aniskin et al. (1997b)	338
<i>Gerbillus rupicola</i>	Rocky/Northern Pygmy Gerbil	52		V. Volobouev Granjon et al. (2002)	339
<i>Gerbillus occiduus</i>	Occidental Gerbil	40		Aniskin et al. (2006)	340
<i>Gerbillus perpallidus</i>	Pale Gerbil	40		Aniskin et al. (2006)	341
<i>Gerbillus pyramidum</i>	Greater Egyptian Gerbil	38		Aniskin et al. (2006)	342
<i>Gerbillus tarabuli</i>	Tarabul's Gerbil	40		Aniskin et al. (2006)	343
<i>Gerbillurus tytonis</i>	Dune Hairy-Footed Gerbil	36		V. Aniskin Volobouev et al. (2007)	344
<i>Gerbilliscus gambianus</i>	Gambian Gerbil	52		V. Aniskin Volobouev et al. (2007)	345
<i>Gerbilliscus guineae</i>	Guinean Gerbil	50		V. Aniskin Volobouev et al. (2007)	346
<i>Gerbilliscus kempfi</i>	Northern Savanna Gerbil	48		V. Aniskin Volobouev et al. (2007)	347
<i>Gerbilliscus leucogaster</i>	Bushveld Gerbil	40		V. Aniskin Volobouev et al. (2007)	348
<i>Gerbilliscus robustus</i>	Fringe-Tailed Gerbil	36		V. Aniskin Volobouev et al. (2007)	349
<i>Gerbilliscus</i> sp.	Gerbil	46		V. Aniskin Volobouev et al. (2007)	350
<i>Meriones crassus</i>	Sundevall's Jird	58		V. Aniskin J. Darvish and V. Volobouev (unpublished)	351

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Meriones libycus</i>	Libyan Jird	44		V. Aniskin J. Darvish and V. Volobouev (unpublished)	352
<i>Meriones persicus</i>	Persian Jird	42		V. Aniskin J. Darvish and V. Volobouev (unpublished)	353
<i>Meriones rex</i>	King Jird	38		V. Aniskin J. Darvish and V. Volobouev (unpublished)	354
<i>Meriones unguiculatus</i>	Mongolian Jird	44		V. Aniskin J. Darvish and V. Volobouev (unpublished)	355
<i>Meriones meridianus</i>	Midday Jird	50		S. Romanenko (unpublished)	356
<i>Rhombomys opimus</i>	Great Gerbil	40		S. Romanenko (unpublished)	356
<i>Taterillus petteri</i>	Petter's Gerbil	19		Dobigny (2002a)	357
<i>Taterillus pygargus</i>	Senegal Gerbil	22		Dobigny (2002a)	357
<i>Taterillus arenarius</i>	Robbins's Gerbil	31 (M)		Volobouev et al. (1996)	358
<i>Taterillus tranieri</i>	Tranier's Gerbil	15		Dobigny et al. (2003)	358
<i>Taterillus congicus</i>	Congo Gerbil	54		Dobigny (2002a)	359
<i>Taterillus</i> sp. 1	Small Naked-Soled Gerbil	23		Dobigny (2002a), Dobigny et al. (2002b)	360
<i>Taterillus</i> sp. 2	Small Naked-Soled Gerbil	37		Dobigny (2002a), Dobigny et al. (2002b)	361
<i>Taterillus</i> sp. 3	Small Naked-Soled Gerbil	20		V. Volobouev and V. Aniskin (unpublished)	362
<i>Taterillus</i> sp. 4	Small Naked-Soled Gerbil	19		V. Volobouev and V. Aniskin (unpublished)	363
Family Muridae					
Subfamily Murinae					
<i>Apodemus peninsulae</i>	Korean Field Mouse	48 (+Bs)		O. Sablina et al. (unpublished)	364
<i>Apodemus sylvaticus</i>	Long-Tailed Field Mouse	48	<i>Mus musculus</i> (MMU)	Stanyon et al. (2004a), O. Sablina et al. (unpublished)	365
<i>Apodemus uralensis</i>	Ural Field Mouse	48		Volobouev and Aniskin (unpublished)	366
<i>Apodemus agrarius</i>	Striped Field Mouse	48		Sablina et al. (unpublished)	367
<i>Apodemus flavicollis</i>	Yellow-Necked Mouse	48+B's		Sablina et al. (unpublished)	368
<i>Apodemus mystacinus</i>	Broad-Toothed Field Mouse	48		Sablina et al. (unpublished)	369
<i>Mus musculus</i>	House Mouse	40	<i>Homo sapiens</i> (HSA), <i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU), <i>Peromyscus maniculatus</i> (PMA), <i>Rattus norvegicus</i> (RNO)	S. Romanenko Romanenko et al. (2006), Mlynarski et al. (2008), Graphodatsky et al. (2011)	370
<i>Mus macedonicus</i>	Macedonian Mouse	40		E. Nevo Ivanitskaya et al. (1996)	371
<i>Mus mahomet</i>	Mahomet Mouse	36		Aniskin et al. (1998)	371
<i>Mus mattheyi</i>	Matthey's Mouse	36	<i>Mus musculus</i> (MMU)	Volobouev and Aniskin (unpublished), Veyrunes et al. (2006)	372
<i>Mus minutooides</i>	Southern African Pygmy Mouse	33		Volobouev and Aniskin (unpublished)	373
<i>Mus minutooides</i>	Southern African Pygmy Mouse	18–34		Veyrunes et al. (2004)	374
<i>Mus pahari</i>	Gairdner's Shrewmouse/ Indochinese Shrewlike Mouse	48	<i>Mus musculus</i> (MMU)	Veyrunes et al. (2006)	375
<i>Mastomys natalensis</i>	Natal Mastomys/ Multimammate Mouse/ African Soft-Furred Rat	32		Volobouev et al. (2002a)	376

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Mastomys erythroleucus</i> (Cytotype 3)	Guinea Multimammate Mouse/Reddish-White Mastomys	38		Volobouev et al. (2002a)	377
<i>Mastomys awashensis</i>	Awash Mastomys/ Multimammate Mouse	32		Volobouev et al. (2002a)	378
<i>Mastomys huberti</i>	Hubert's Mastomys	32		Volobouev et al. (2002a)	379
<i>Mastomys kollmannspergeri</i>	Kollmannsperger's Mastomys/Verheyen's Multimammate Mouse	38		Volobouev et al. (2002a)	380
<i>Mastomys coucha</i>	Southern Multimammate Mouse/Southern African Mastomys	36		S. Romanenko (unpublished)	381
<i>Praomys daltoni</i>	Dalton's Mouse/Dalton's Praomys	36		Volobouev et al. (2002a)	382
<i>Arvicanthis niloticus</i> (Cytotype 1a)	African Arvicanthis/African Grass Rat	62		Volobouev et al. (2002b)	383
<i>Arvicanthis niloticus</i> (Cytotype 1b)	African Arvicanthis/African Grass Rat	62		Volobouev et al. (2002b)	384
<i>Arvicanthis ansorgei</i>	Sudanian Arvicanthis/ Sudanian Grass Rat	62		Volobouev et al. (2002b)	385
<i>Arvicanthis rufinus</i>	Guinean Arvicanthis/ Guinean Grass Rat	62		Volobouev et al. (2002b)	386
<i>Lemniscomys barbarus</i>	Barbary Striped Grass Mouse	54		S. Romanenko (unpublished)	387
<i>Otomys irroratus</i>	Southern African Vlei Rat	28 + Bs	<i>Mus musculus</i> (MMU)	R. Stanyon Engelbrecht et al. (2006)	388
<i>Rhabdomys pumilio</i>	Four-Striped Grass Mouse	46	<i>Mus musculus</i> (MMU)	Rambau and Robinson (2003)	389
<i>Dasymys incomtus</i>	African Marsh Rat	36		Volobouev et al. (2000)	390
<i>Dasymys rufulus</i>	West African Shaggy Rat	36 + Bs		Volobouev et al. (2000)	391
<i>Stenocephalemys albicaudata</i>	Ethiopian Narrow-Headed Rat/White-Tailed Stenocephalemys	54		V. Aniskin Lavrenchenko et al. (2001)	392
<i>Stenocephalemys griseicauda</i>	Gray-Tailed Narrow- Headed Rat/Gray-Tailed Stenocephalemys	54		V. Aniskin Lavrenchenko et al. (2001)	393
<i>Stenocephalemys albipes</i>	Ethiopian White-Footed Rat/White-Footed Stenocephalemys	46		V. Aniskin Lavrenchenko et al. (2001)	394
<i>Hapalomys delacouri</i>	Delacour's Marmoset Rat	48 + Bs	<i>Rattus norvegicus</i> (RNO)	Badenhorst et al. (2012)	395
<i>Leopoldamys edwardsi</i>	Long-Tailed Giant Rat	44		O. Sablina et al. (unpublished)	396
<i>Rattus norvegicus</i>	Norway Rat	42	<i>Maxomys surifer</i> (MSU), <i>Mus musculus</i> (MMU)	O. Sablina et al. (unpublished), Badenhorst et al. (2011), Helou et al. (2001), Nilsson et al. (2001)	397
<i>Rattus rattus</i>	Black Rat	38		O. Sablina et al. (unpublished)	398
<i>Rattus rattus ideogram</i>	Black Rat	38	<i>Mus musculus</i> (MMU), <i>Rattus norvegicus</i> (RNO)	Cavagna et al. (2002)	399
<i>Rattus tanezumi</i>	Tanezumi Rat	42		V. Aniskin and V. Volobouev (unpublished)	400
<i>Rattus flavipectus</i>	Buff-Bellied Rat	46		O. Sablina et al. (unpublished)	401
<i>Nesokia indica</i>	Short-Tailed Bandicoot Rat	42		O. Sablina et al. (unpublished)	402
<i>Niviventer confucianus</i>	Confucian Niviventer	46		V. Aniskin and V. Volobouev (unpublished)	403
<i>Maxomys surifer</i>	Red Spiny Rat	52	<i>Rattus norvegicus</i> (RNO)	Badenhorst et al. (2011)	404

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
<i>Phloeomys cumingi</i>	Slender-Tailed Cloud Rat	44		E. Rickart Rickart and Heany (2002)	405
<i>Crunomys suncoides</i>	Sulawesian Shrew Rat	36		E. Rickart Rickart and Heany (2002)	405
<i>Archboldomys luzonensis</i>	Isarog Shrew Mouse	26		E. Rickart Rickart and Heany (2002)	406
<i>Celaenomys silaceus</i>	Luzon Striped Rat	44		E. Rickart Rickart and Heany (2002)	406
Family Calomyscidae					
<i>Calomyscus urartensis</i>	Urar Mouse-Like Hamster	32		S. Romanenko Graphodatsky et al. (2000a)	407
<i>Calomyscus</i> sp. 1	Mouse-Like Hamster	52	<i>Cricetulus griseus</i> (CGR), <i>Mesocricetus auratus</i> (MAU)	S. Romanenko Romanenko et al. (2007)	408
<i>Calomyscus mystax</i>	Great Balkhan Mouse-Like Hamster	44		S. Romanenko S. Romanenko (unpublished)	409
<i>Calomyscus bailwardi</i>	Zagros Mountains Mouse-Like Hamster	46		S. Romanenko S. Romanenko (unpublished)	410
<i>Calomyscus elburzensis</i>	Goodwin's Brush-Tailed Mouse	44		S. Romanenko S. Romanenko (unpublished)	411
<i>Calomyscus</i> sp. 2	Mouse-Like Hamster	30		Graphodatsky et al. (2000a)	412
<i>Calomyscus</i> sp. 3	Mouse-Like Hamster	37		Graphodatsky et al. (2000a)	413
<i>Calomyscus firiusaensis</i>	Firiuza Mouse-Like Hamster	44		Graphodatsky et al. (2000a)	414
Family Hystricidae					
<i>Hystrix indica</i>	Indian Crested Porcupine	66		S. Romanenko (unpublished)	415
Family Dinomyidae					
<i>Dinomys branickii</i>	Pacarana	58		San Diego Institute for Conservation Research (unpublished)	416
Family Chinchillidae					
<i>Lagostomus maximus</i>	Argentine Plains Viscacha	56		A. Graphodatsky D. Graphodatskaya and A. Graphodatsky (unpublished)	417
Family Capromyidae					
<i>Capromys pilorides</i>	Cuban Hutia	40		P. Perelman et al. (unpublished)	418
<i>Mysateles prehensilis</i>	Prehensile-Tailed Hutia	34		N. Bulatova Milishnikov et al. (1990)	418
Family Echimyidae					
<i>Myocastor coypus</i>	Nutria/Coypu	42	<i>Homo sapiens</i> (HSA)	L. Biltueva L. Biltueva and A. Graphodatsky (unpublished)	419
<i>Proechimys brevicauda</i> (Cytotype 1)	Huallaga/Short-Tailed Spiny Rat	28		Aniskin (1994b)	420
<i>Proechimys steerei</i>	Steere's Spiny Rat	24		Aniskin (1994b)	421
<i>Proechimys simonsi</i>	Simon's Spiny Rat	32		Aniskin (1994b)	422
<i>Proechimys</i> sp. 1	Terrestrial Spiny Rat	30		Aniskin (1994b)	423
<i>Proechimys</i> sp. 2	Terrestrial Spiny Rat	34		Aniskin (1994b)	423
<i>Proechimys goeldii</i>	Goeldi's Spiny Rat	26F/27M, 24F/25M		Rodrigues Da Costa et al. (2016)	424
<i>Proechimys longicaudatus</i>	Long-Tailed Spiny Rat	16F/17M		Amaral et al. (2013)	425
<i>Proechimys roberti</i>	Roberto's Spiny Rat	30		Ribeiro et al. (2011)	425
<i>Lonchotrix emiliae</i>	Tuft-Tailed Spiny Tree Rat	60		Aniskin (1994b)	426
<i>Isotrix sinnamariensis</i>	French Guiana Brush-Tailed Rat/Toros	28		Vié et al. (1996)	426
<i>Dactylomys dactylinus</i>	Amazon Bamboo Rat/Coro-Coro	94		Aniskin (1993)	427

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
Family Abrocomidae					
<i>Abrocoma bennetti</i>	Chinchilla Rat/Chinchillone	64		Spotorno et al. (1995)	428
Family Ctenomyidae					
<i>Ctenomys rionegrensis</i>	Rio Negro Tuco-Tuco	50		Garcia et al. (2002b)	429
<i>Ctenomys talarum</i>	Los Talas Tuco-Tuco	48		Garcia et al. (2002b)	429
<i>Ctenomys maulinus brunneus</i>	Maule Tuco-Tuco	26		Gallardo (1979)	430
<i>Ctenomys maulinus maulinus</i>	Maule Tuco-Tuco	26		Gallardo (1979)	430
<i>Ctenomys magellanicus magellanicus</i>	Magellanic Tuco-Tuco	34		Gallardo (1979)	430
<i>Ctenomys opimus</i>	Highland Tuco-Tuco	26		Gallardo (1979)	431
<i>Ctenomys fulvus</i>	Tawny Tuco-Tuco	26		Gallardo (1979)	431
<i>Ctenomys (fulvus) robustus</i>	Tawny Tuco-Tuco	26		Gallardo (1979)	431
<i>Octodon degus</i>	Degu	58		S. Romanenko (unpublished)	432
<i>Octodon lunatus</i>	Moon-Toothed Degu	78		Spotorno et al. (1995)	433
<i>Spalacopus cyanus</i>	Coruro	58		Spotorno et al. (1995)	433
<i>Aconaemys fuscus</i>	Chilean Rock Rat	56		M. H. Gallardo Gallardo and Mondaca (2002)	434
<i>Aconaemys sagei</i>	Sage's Rock Rat	54		Gallardo and Mondaca (2002)	434
<i>Aconaemys porteri</i>	Porter's Rock Rat	58		Gallardo and Mondaca (2002)	434
<i>Tympanoctomys barrerae</i>	Plain's Red Viscacha Rat	102		R. Stanyon Gallardo et al. (2004)	435
Family Erethizontidae					
<i>Chaetomys subspinosus</i>	Bristle-Spined Rat	52		Vilela et al. (2009)	436
<i>Sphiggurus villosus</i>	Orange-Spined Hairy Dwarf Porcupine	42		Bonvicino et al. (2000)	436
Family Dasyproctidae					
<i>Dasyprocta fuliginosa</i>	Black Agouti	64–65		Ramos et al. (2003)	437
Family Caviidae					
<i>Hydrochaeris hydrochaeris</i>	Capybara	66		San Diego Institute for Conservation Research (unpublished)	438
<i>Dolichotis patagonum</i>	Patagonian Mara	64		S. Romanenko S. Romanenko (unpublished)	438
<i>Cavia porcellus</i>	Guinea Pig	64	<i>Homo sapiens</i> (HSA)	S. Romanenko S. Romanenko et al. (2015)	439
<i>Cavia tschudii</i>	Montane Guinea Pig	64		S. Romanenko S. Romanenko (unpublished)	440
Family Bathyergidae					
<i>Heterocephalus glaber</i>	Naked Mole-Rat	60		S. Romanenko (unpublished)	441
<i>Bathyergus janetta</i>	Namaqua Dune Mole-Rat	54	<i>Heterocephalus glaber</i> (HGL)	Deuve et al. (2008)	442
<i>Fukomys hottentotus damarensis</i>	Southern African Mole-Rat	80	<i>Heterocephalus glaber</i> (HGL)	Deuve et al. (2008)	443
<i>Fukomys darlingi</i>	Darling's Mole-Rat	54	<i>Heterocephalus glaber</i> (HGL)	Deuve et al. (2008)	444
<i>Fukomys mechowii</i>	Giant Mole-Rat	40	<i>Heterocephalus glaber</i> (HGL)	Deuve et al. (2008)	445
<i>Heliophobius argenteocinereus</i>	Silvery Mole-Rat	62	<i>Heterocephalus glaber</i> (HGL)	Deuve et al. (2008)	446
Family Thryonomyidae					
<i>Thryonomys swinderianus</i>	Greater Cane Rat	44	<i>Heterocephalus glaber</i> (HGL)	Deuve et al. (2008)	447
Family Laonastidae					
<i>Laonastes aenigmamus</i>	Laotian Rock Rat	38–42	<i>Homo sapiens</i> (HSA)	F. Richard Richard et al. (2016)	448
Family Ctenodactylidae					
<i>Ctenodactylus gundi</i>	North African Gundi	40		George (1979)	449
<i>Ctenodactylus vali</i>	Val's/Sahara Gundi	40		George (1979)	449
<i>Felovia vae</i>	Felou Gundi	36		George (1979)	450
<i>Massoutiera mzabi</i>	Mzab Gundi	36		George (1979)	450
<i>Pectinator spekei</i>	Speke's Pectinator/Gundi	40		George (1979)	450

SPECIES	COMMON NAME	2n	PAINTING PROBES	SOURCE	PAGE
Order Lagomorpha Time Tree					451
Family Ochotonidae					
<i>Ochotona princeps</i>	American Pika	68		Stock (1976)	452
<i>Ochotona forresti</i>	Forrest's Pika	54	<i>Homo sapiens</i> (HSA), <i>Oryctolagus cuniculus</i> (OCU)	W. Nie Ye et al. (2011)	453
<i>Ochotona hyperborea</i>	Northern Pika	40		P. Perelman and A. Graphodatsky (unpublished)	453
Family Leporidae					
<i>Oryctolagus cuniculus</i>	European/Domestic Rabbit/Coney	44	<i>Homo sapiens</i> (HSA), <i>Tamias sibiricus</i> (TSI)	V. Beklemisheva Korstanje et al. (1999), Robinson et al. (2002), Beklemisheva et al. (2011)	454
<i>Pronolagus rupestris</i>	Red Rabbit	42	<i>Oryctolagus cuniculus</i> (OCU)	V. Beklemisheva Robinson et al. (2002)	455
<i>Bunolagus monticularis</i>	Bushman Rabbit	44	<i>Oryctolagus cuniculus</i> (OCU)	V. Beklemisheva Robinson et al. (2002)	456
<i>Romerolagus diazi</i>	Volcano Rabbit	48	<i>Oryctolagus cuniculus</i> (OCU)	V. Beklemisheva Robinson et al. (2002)	457
<i>Brachylagus idahoensis</i>	Pygmy Rabbit	44	<i>Oryctolagus cuniculus</i> (OCU)	V. Beklemisheva Robinson et al. (2002)	458
<i>Sylvilagus aquaticus</i>	Swamp Rabbit	38		Robinson et al. (1983)	459
<i>Sylvilagus palustris</i>	Marsh Rabbit	38		Robinson et al. (1983)	459
<i>Sylvilagus transitionalis</i>	New England Cottontail	46		Robinson et al. (1983)	460
<i>Sylvilagus floridanus</i>	Eastern Cottontail	42	<i>Oryctolagus cuniculus</i> (OCU)	V. Beklemisheva Robinson et al. (1983, 2002)	460
<i>Sylvilagus nuttallii</i>	Mountain Cottontail	42		Robinson et al. (1984)	461
<i>Sylvilagus audubonii</i>	Desert Cottontail	42		Robinson et al. (1984)	461
<i>Lepus californicus</i>	Black-Tailed Jackrabbit/ Hare	48		Robinson et al. (2002)	462
<i>Lepus saxatilis</i>	Cape Scrub Hare	48	<i>Oryctolagus cuniculus</i> (OCU)	V. Beklemisheva Robinson et al. (2002)	462
<i>Lepus timidus</i>	Mountain Hare	48	<i>Tamias sibiricus</i> (TSI)	Beklemisheva et al. (2011)	463
<i>Lepus mandshuricus</i>	Manchurian Hare	48		V. Beklemisheva and I. Kartavtseva (unpublished)	464
<i>Lepus tolai</i>	Tolai Hare	48		V. Beklemisheva and S. Romanenko (unpublished)	464
LAURASIATHERIA Time Tree					465
Order Eulipotyphla (Insectivora) Time Tree					466
Family Solenodontidae					
<i>Solenodon paradoxus</i>	Hispaniolan Solenodon	34		Benirschke (1969)	467
Family Erinaceidae					
<i>Neohylomys hainanensis</i>	Hainan Gymnure	32		Li et al. (2008)	467
<i>Neotetracus sinensis</i>	Shrew Gymnure/ Hedgehog	32	<i>Homo sapiens</i> (HSA)	W. Nie Ye et al. (2006)	468
<i>Hylomys suillus</i>	Short-Tailed Gymnure	48		L. Biltueva S. Pavlova (unpublished)	468
<i>Podogymnura truei</i>	Mindanao Gymnure/ Philippine Wood Shrew	40		Rickart (2003)	469
<i>Erinaceus europaeus</i>	Eurasian/West European Hedgehog	48		A. Graphodatsky S. Radjabli and A. Graphodatsky (unpublished)	469