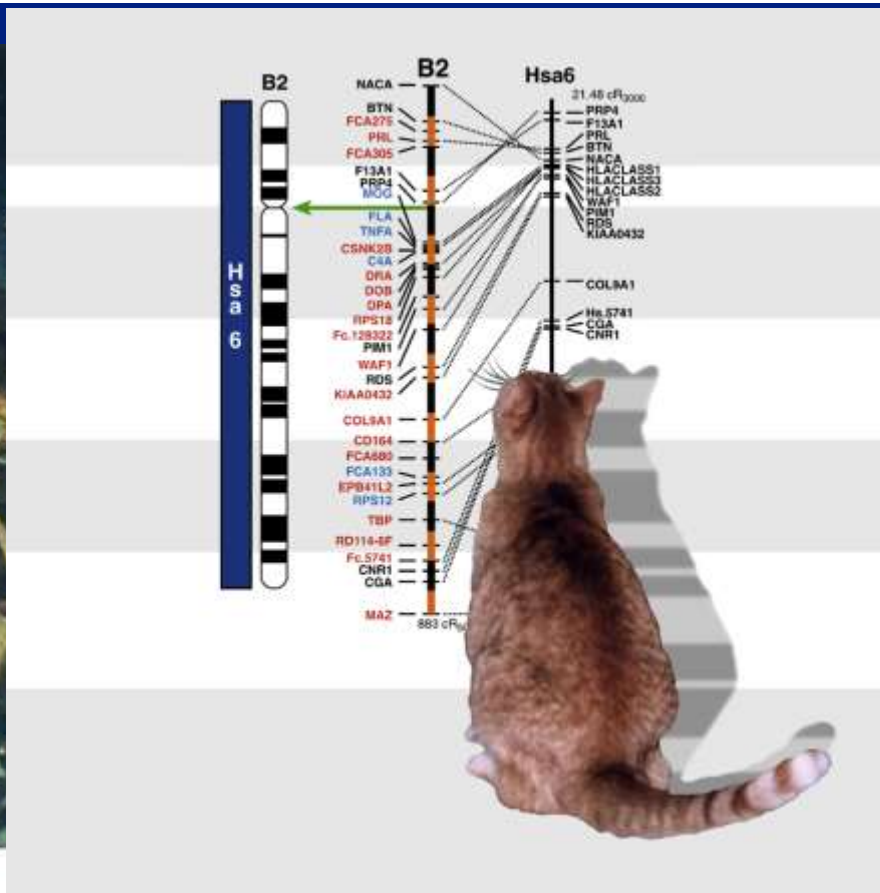
"The Taming of the Cat
Stephen J. O'Brien

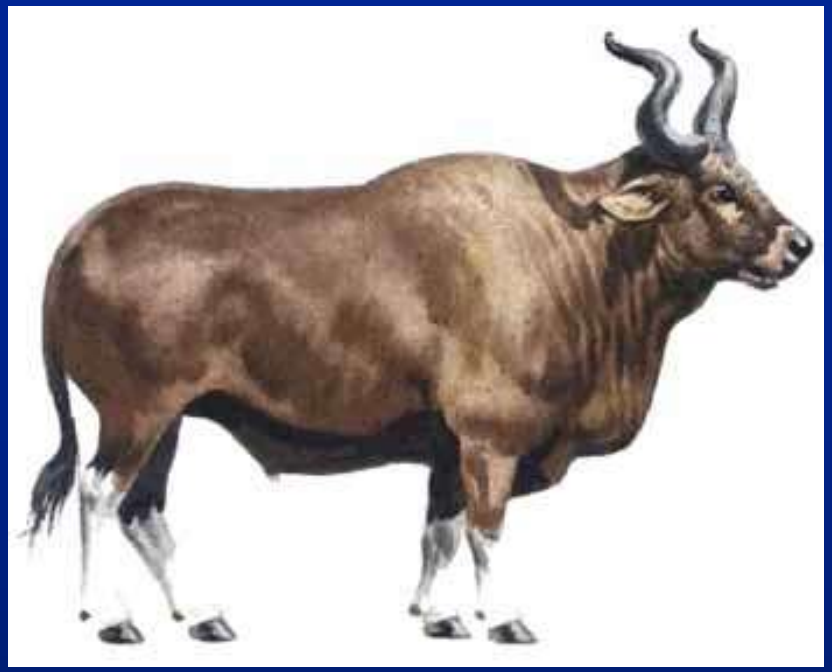
BELYAEV CONFERENCE

a triumphant event in commemoration
of the centenary of the birth of

Academician
Dmitri Belyaev

Some Pictures and Some Stories





Beauceron

Berger Allemand

Borders Collies

Westie

Yorkshire

Bouviers Bernois

D.Bordeaux

Whippet

Epagneul Breton

Boxer

As stated many times

A cat is not a dog

Cocker Anglais

Pointer

Caniche moyen

Coton de Tuléar

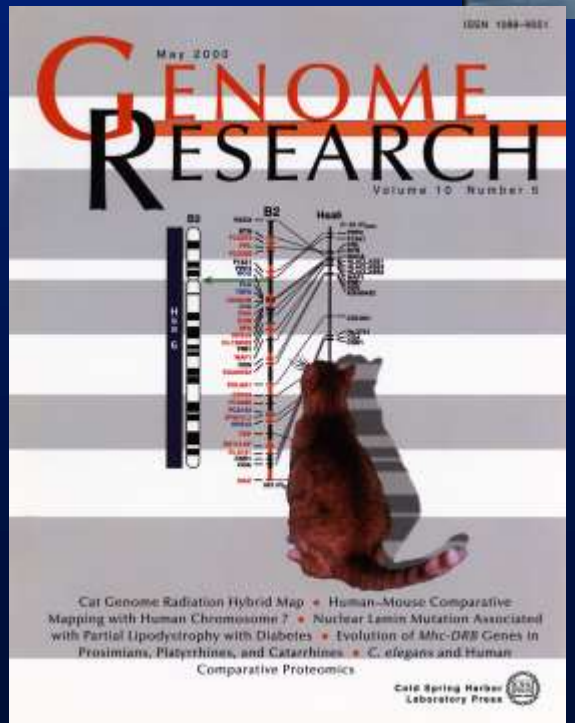
Labrador

Lhassa-Apso

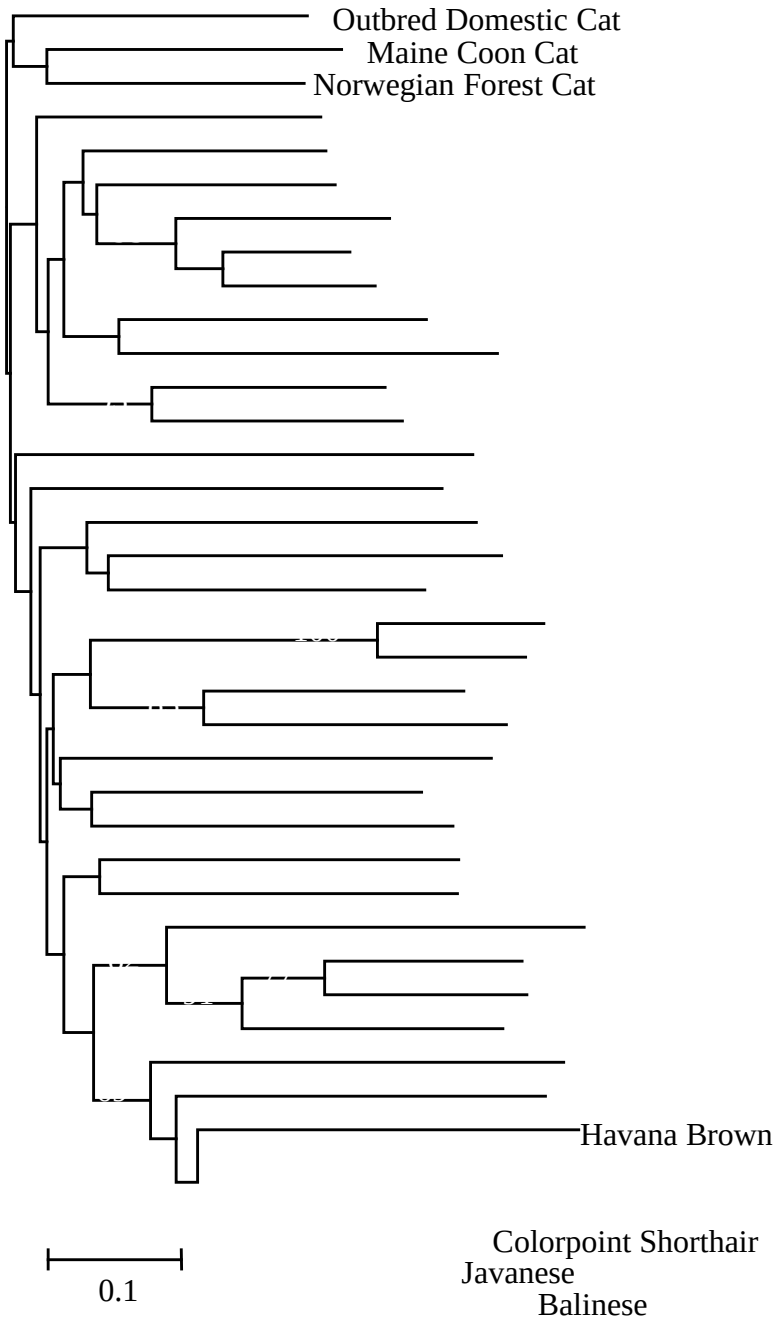
Shih Tzu

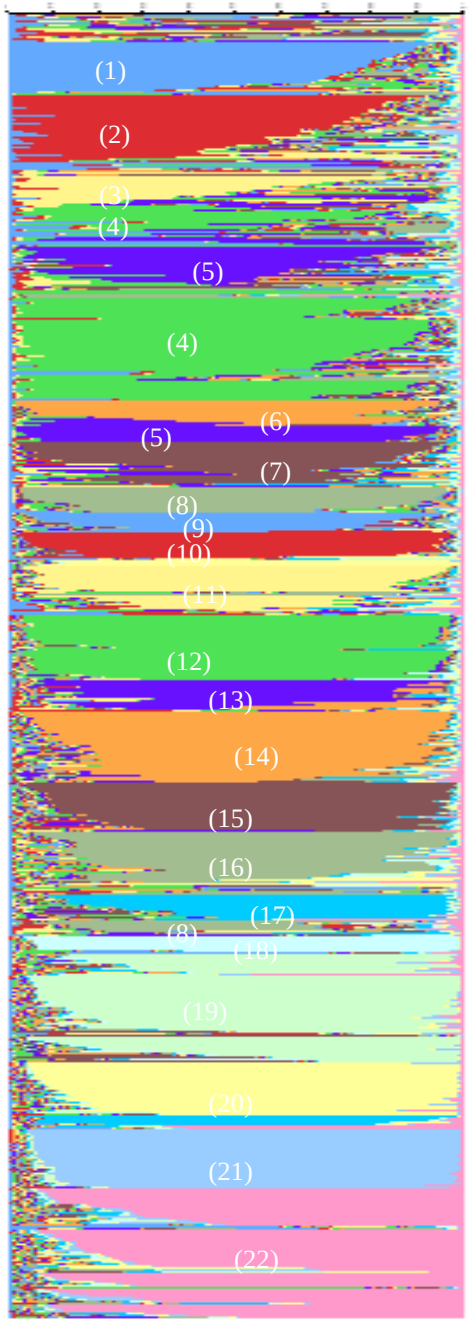
Setter Gordon


20
breeds of
cats


ISSN 1088-9051
May 2003
GENOME RESEARCH
Volume 10 Number 5
Cat Genome Radiation Hybrid Map • Human–Mouse Comparative Mapping with Human Chromosome 7 • Nuclear Lamin Mutation Associated with Partial Lipodystrophy with Diabetes • Evolution of Mhc-DRB Genes in Prosimians, Platyrrhines, and Catarrhines • C. elegans and Human Comparative Proteomics
Cold Spring Harbor Laboratory Press

A lingerring question … 'where did the domestic cat come from????'


Outbred Domestic Cat
Maine Coon Cat
Norwegian Forest Cat
Havana Brown
0.1
Colorpoint Shorthair
Javanese
Balinese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African wild cat
Felis libyca

Chinese mountain cat,
Felis bieti

Sand cat, *Felis margarita*

European wild cat
Felis silvestris

Domestic cat
Felis catus

Black-footed cat
Felis nigripes

Jungle cat,
Felis chaus

DOMESTIC CAT LINEAGE

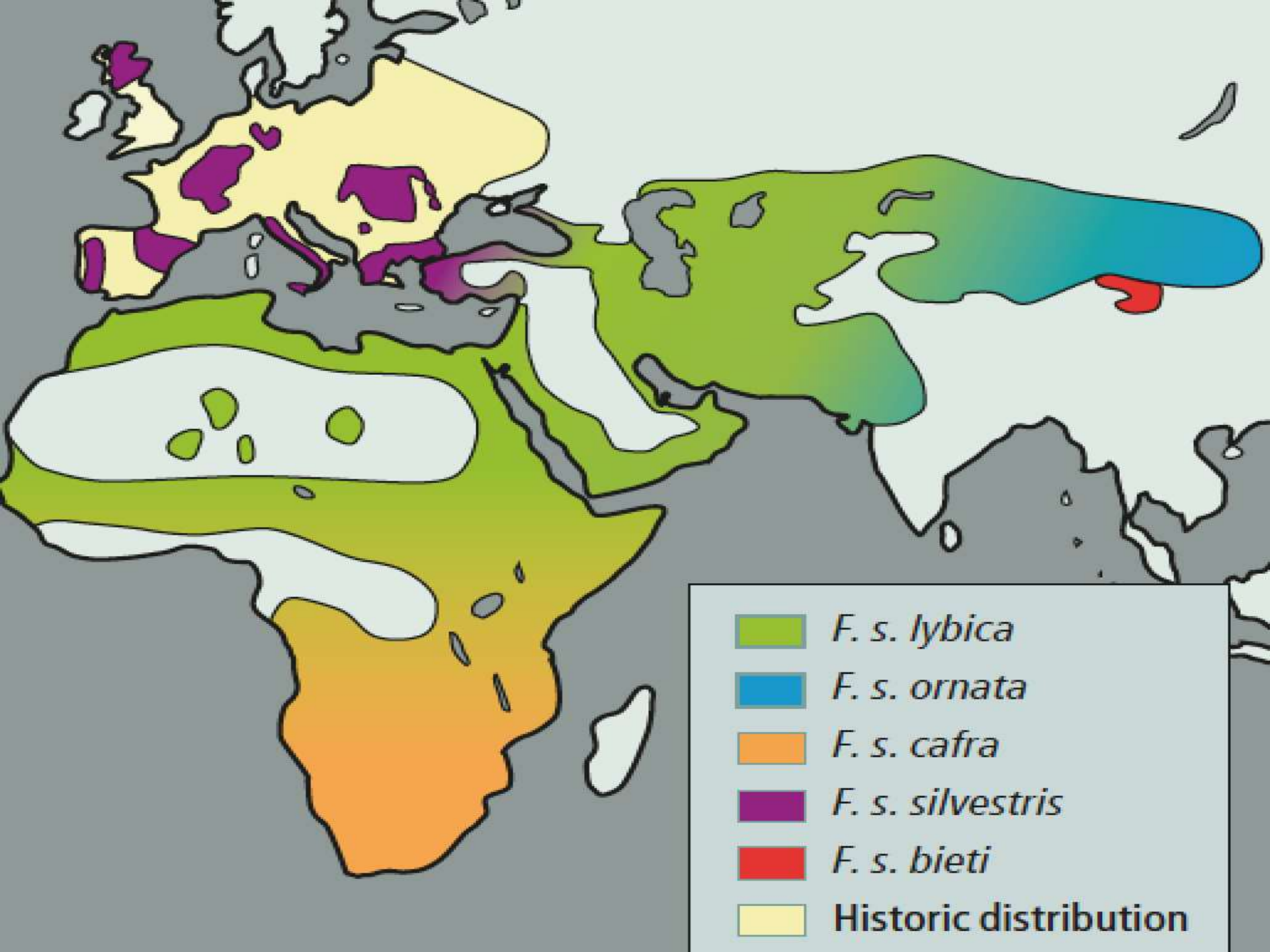
European
F. silvestris silvestris

Asiatic
F. s. ornata

African/Mid East
F. s. libyca

Chinese
F. s. bieti

So African
F. s. caffra


F. s. lybica
F. s. ornata
F. s. cafra
F. s. silvestris
F. s. bieti
Historic distribution

a common site around human settlements in the Fertile Crescent

3,600 YEARS AGO Artists paint domesticated cats from Thebes, Egypt; oldest clear evidence of fully domesticated cat

◀ **2,900 YEARS AGO** Cats become "official deity" of Egypt in the form of the goddess Bastet; huge number of cats sacrificed and mummified in her sacred city indicates that Egyptians were breeding domestic cats

2,300 YEARS AGO The height of cat worship in Egypt; the Ptolemeic rulers maintain strict bans on the export of cats

Science
AAAS

The Near Eastern Origin of Cat Domestication

Carlos A. Driscoll,[1,2]* Marilyn Menotti-Raymond,[1] Alfred L. Roca,[3] Karsten Hupe,[4] Warren E. Johnson,[1] Eli Geffen,[5] Eric H. Harley,[6] Miguel Delibes,[7] Dominique Pontier,[8] Andrew C. Kitchener,[9,10] Nobuyuki Yamaguchi,[2] Stephen J. O'Brien,[1]* David W. Macdon

The Taming of the Cat

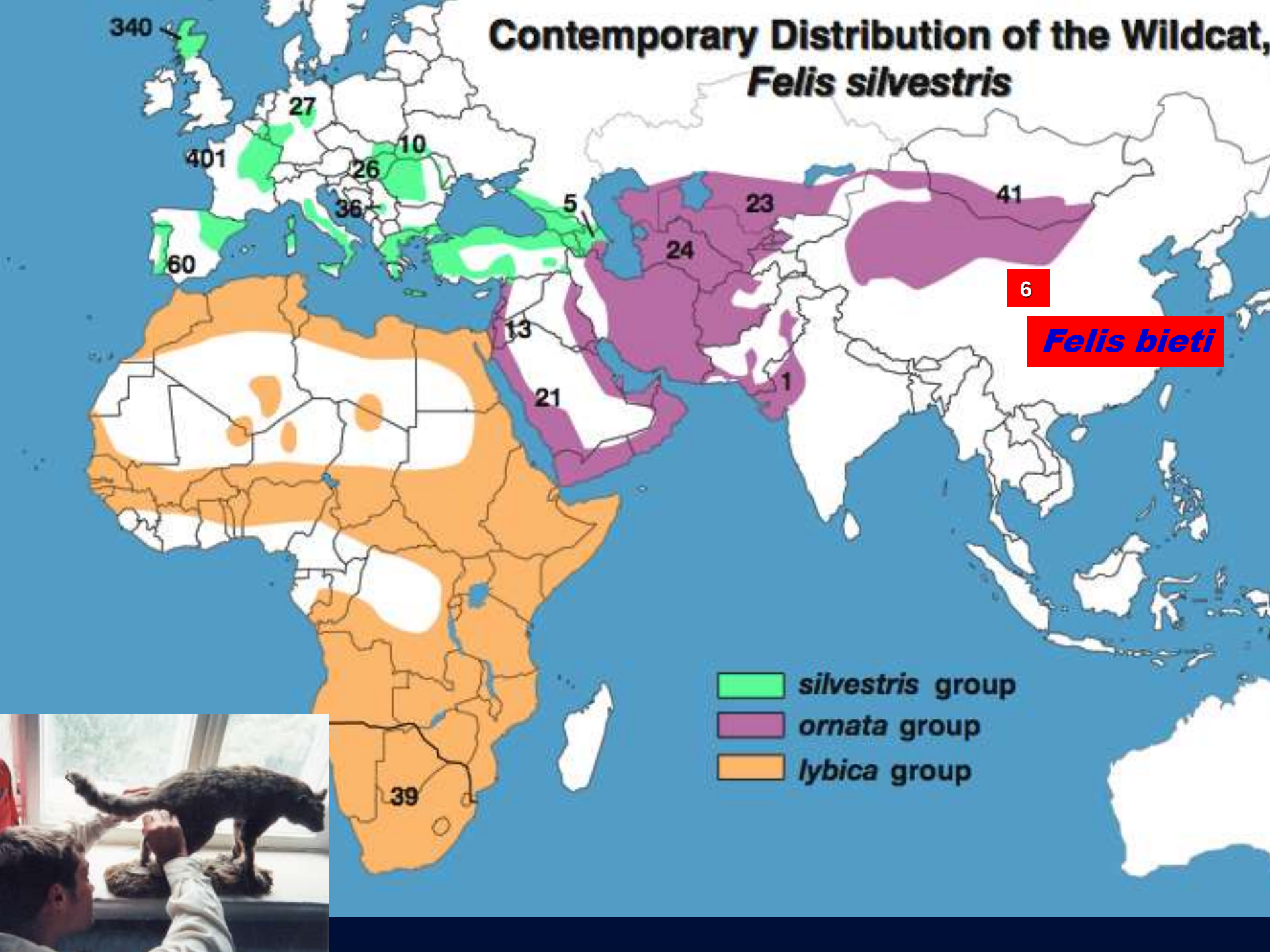
From wild animals to domestic pets, an evolutionary view of domestication

Carlos A. Driscoll[a,b], David W. Macdonald[a], and Stephen J. O'Brien[b,1]

[a]Wildlife Conservation Research Unit, Department of Zoology, University of Oxford, Tubney House, Abingdon Road, Tubney, Oxon OX13 5QL, United Kingdom; and [b]Laboratory of Genomic Diversity, National Cancer Institute, Frederick, MD 21702

Artificial selection is the selection of advantageous natural variation for human ends and is the mechanism by which most domestic species evolved. Most domesticates have their origin in one of a few historic centers of domestication as farm animals. Two notable exceptions are cats and dogs. Wolf domestication was initiated late in the Mesolithic when humans were nomadic hunter-gatherers. Those wolves less afraid of humans scavenged nomadic hunting

development of urban life and a suite of innovations encompassi
most of what we today think of as culture (4, 5). Much of moderni
is an indirect consequence of artificial selection. The plow has con
to symbolize the Neolithic Revolution, but viewing history in th
light of evolution we see that it was intelligently designed chang
to the genetic composition of natural biota that made the real too
In some sense, Neolithic farmers were the first geneticists a


Contemporary Distribution of the Wildcat,
Felis silvestris
340
27
401
10
26
36
5
23
41
24
60
6
Felis bieti
13
21
1
39
silvestris group
ornata group
lybica group

Mitochondrial DNA-Phylogeny

- ND5 & ND6
- 2604 total characters
- 186 variable, informative
  - Mr. Bayes, NJ, MP, ML result in identical tree topology
- Coalescent dating estimates

Microsatellite Loci

- 36 loci mapped to 16 chromosomes
- STRUCTURE Population genetic analyses
- Phyogenetic Analyses
  - Dkf, Dps result in identical tree topology

Middle Eastern wildcat
Felis silvestris lybica
and domestic cats

Central Asian wildcat
F. s. ornata

Southern African wildcat
F. s. cafra

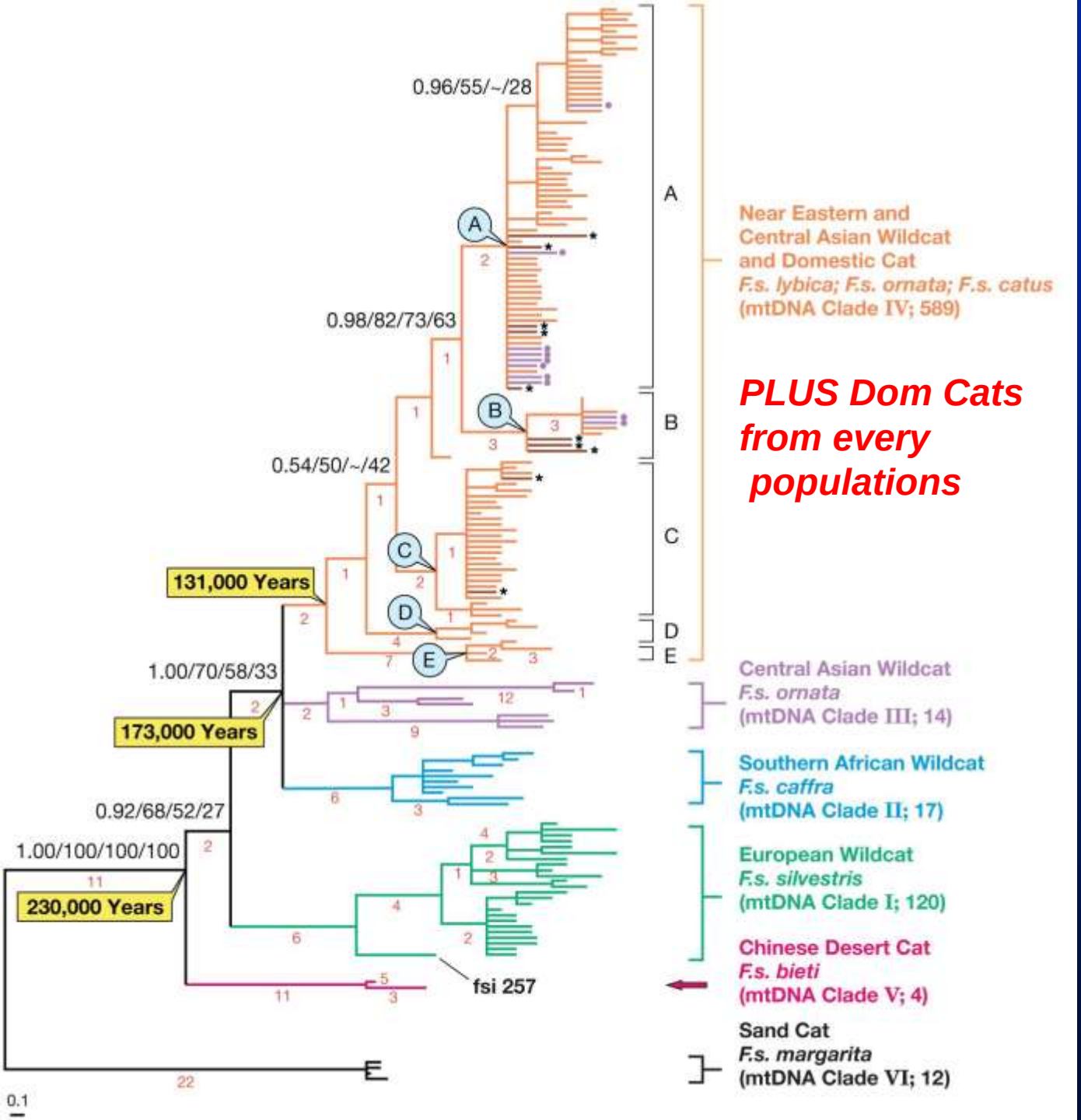
European wildcat
F. s. silvestris

Chinese mountain cat
F. s. bieti

Sand cat
F. margarita
(closest living relative of *F. silvestris*)

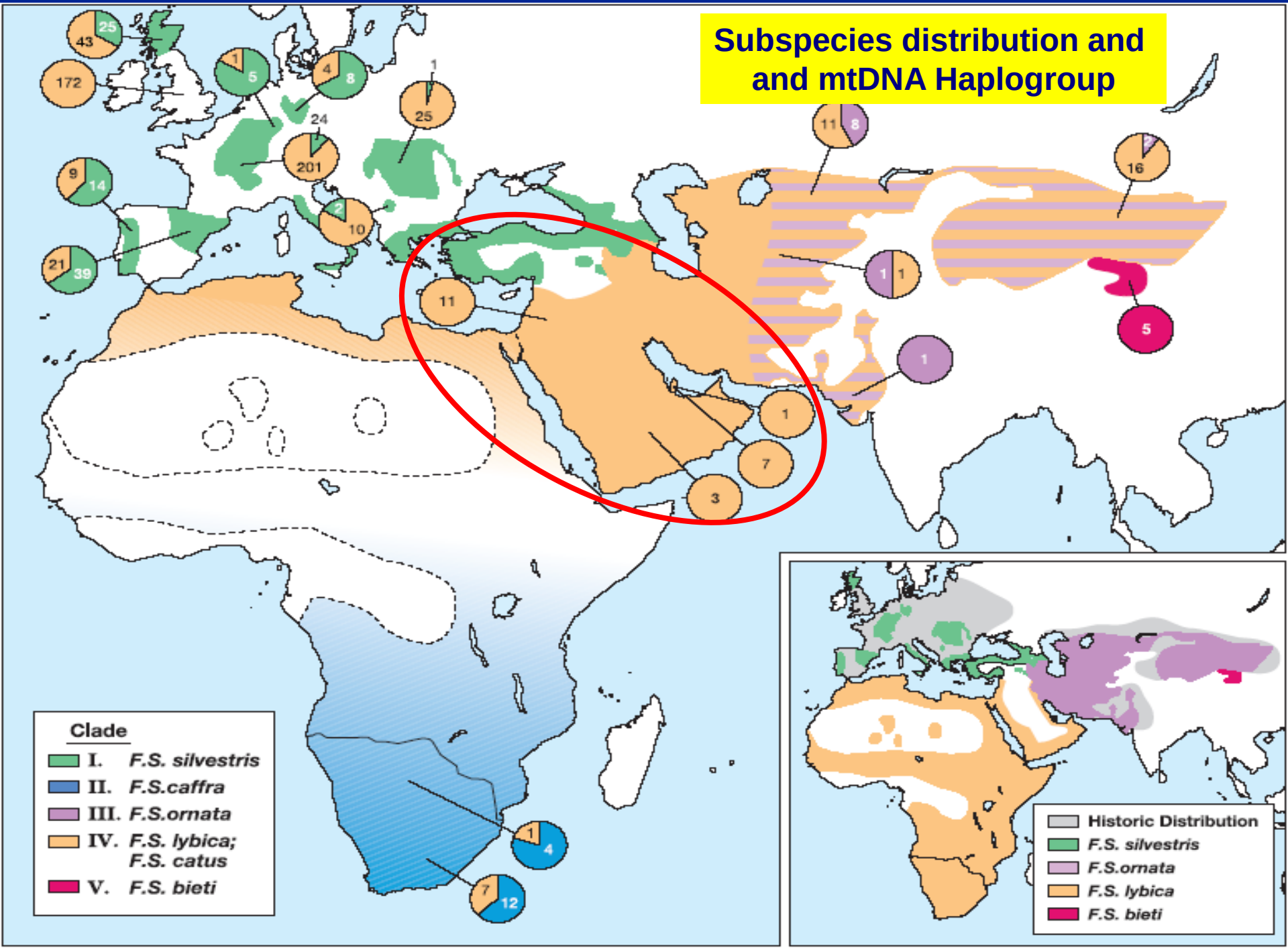
What Carlos saw

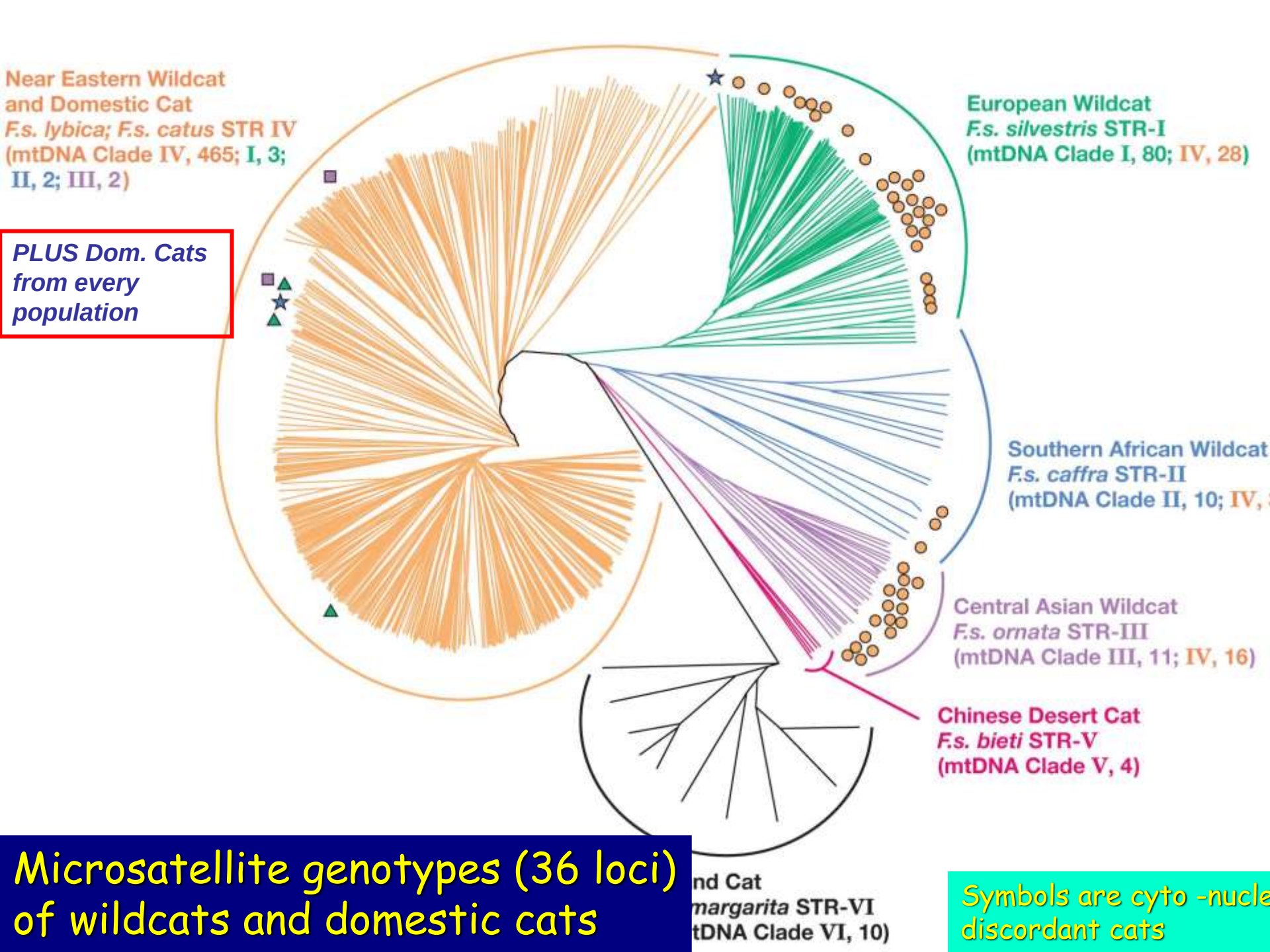
Details



MitoDNA genotype of wildcats across the world

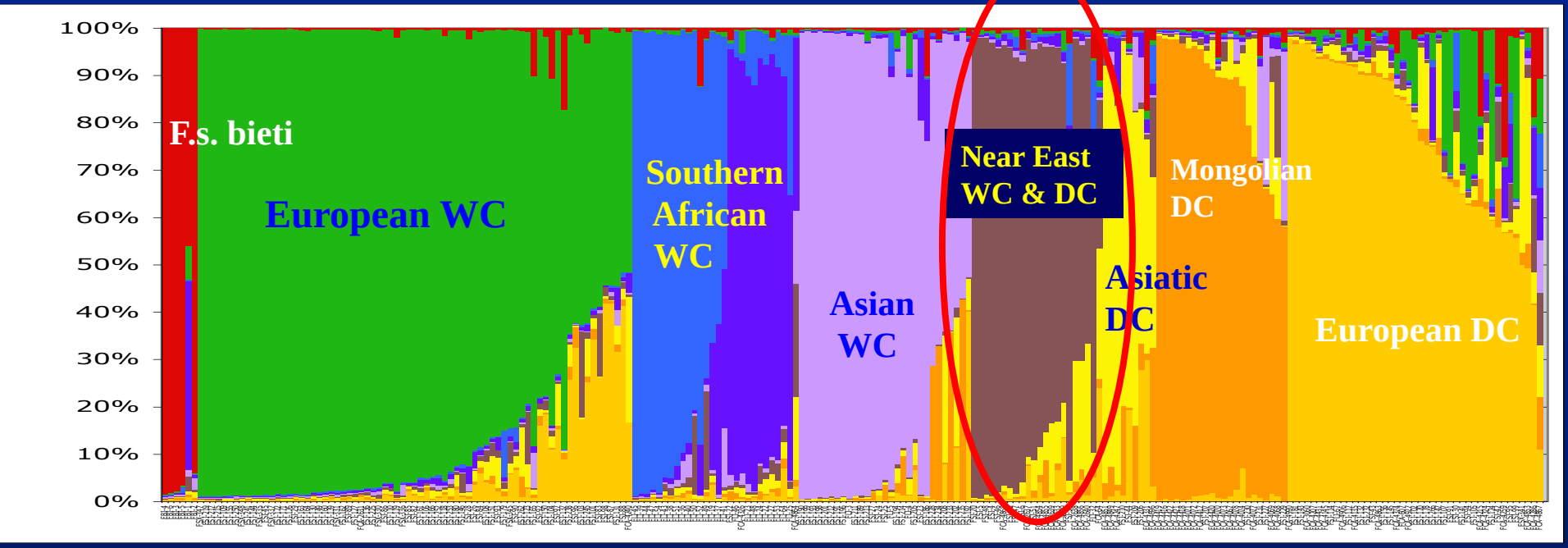
2606 bp;
245 PI sites
176 genotypes


Subspecies distribution and and mtDNA Haplogroup
Clade
I. F.S. silvestris
II. F.S.caffra
III. F.S.ornata
IV. F.S. lybica; F.S. catus
V. F.S. bieti
Historic Distribution
F.S. silvestris
F.S.ornata
F.S. lybica
F.S. bieti


Near Eastern Wildcat
and Domestic Cat
F.s. lybica; F.s. catus STR IV
(mtDNA Clade IV, 465; I, 3;
II, 2; III, 2)
PLUS Dom. Cats
from every
population
European Wildcat
F.s. silvestris STR-I
(mtDNA Clade I, 80; IV, 28)
Southern African Wildcat
F.s. caffra STR-II
(mtDNA Clade II, 10; IV,
Central Asian Wildcat
F.s. ornata STR-III
(mtDNA Clade III, 11; IV, 16)
Chinese Desert Cat
F.s. bieti STR-V
(mtDNA Clade V, 4)
nd Cat
margarita STR-VI
tDNA Clade VI, 10)
Microsatellite genotypes (36 loci)
of wildcats and domestic cats
Symbols are cyto -nucle
discordant cats

Wildcats

Domestic cats



STRUCTURE

(LD and HWE based for microsatellites)

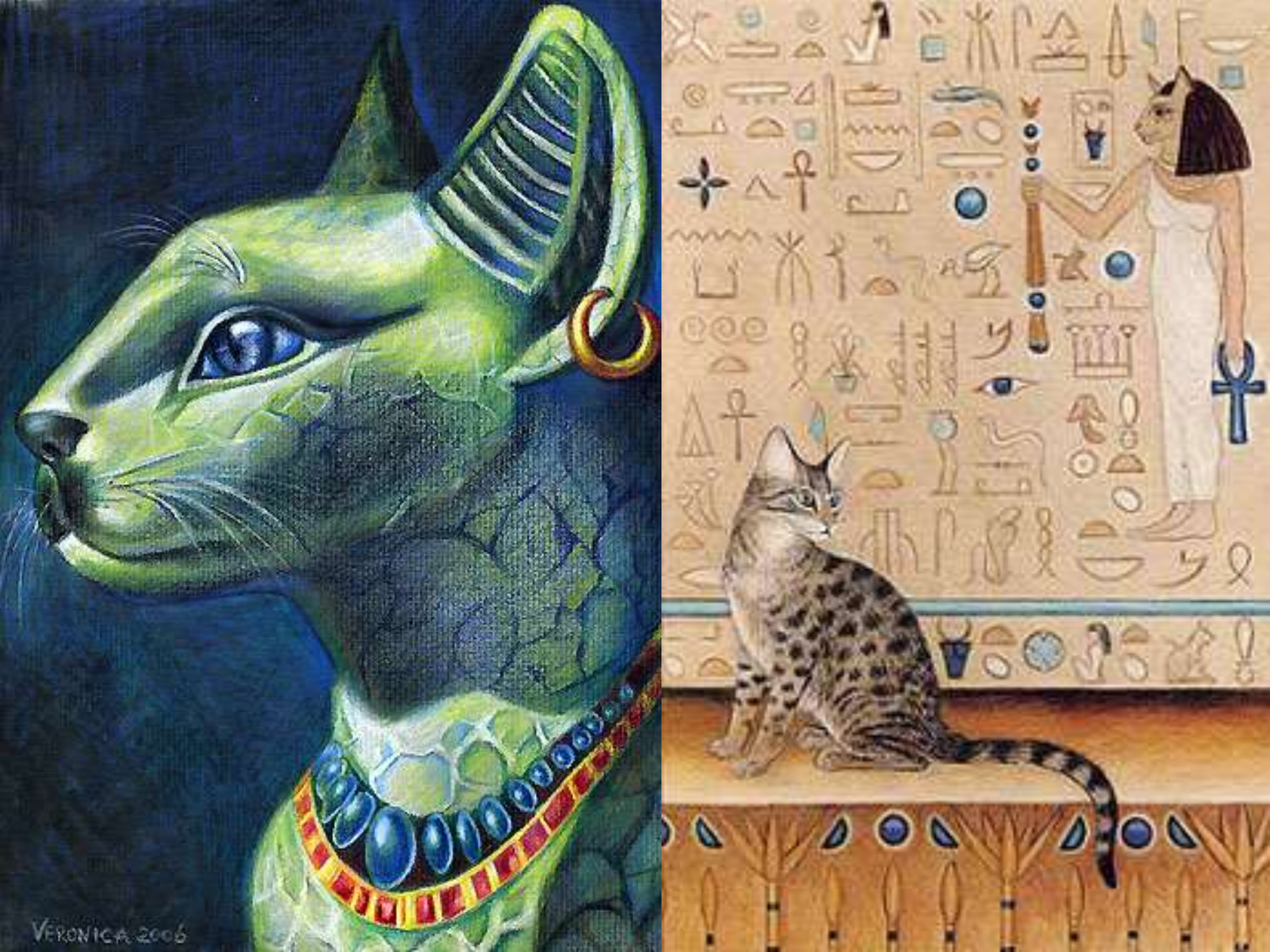
Some Archaeology

- Human burial in Cyprus with cat skeleton, bottom, that is estimated to be 9,500 years old.

- *Jen-Denis Vigne Museum Nat Hist. Paris 2004*

The research team of National Museum of Natural History in Paris uncovered the carefully buried cat on Cyprus, placed just inches from a human burial that also contained polished stones, shells, tools and jewelry

EGYPT


VERONICA 2006

On the Origin of CATS!!

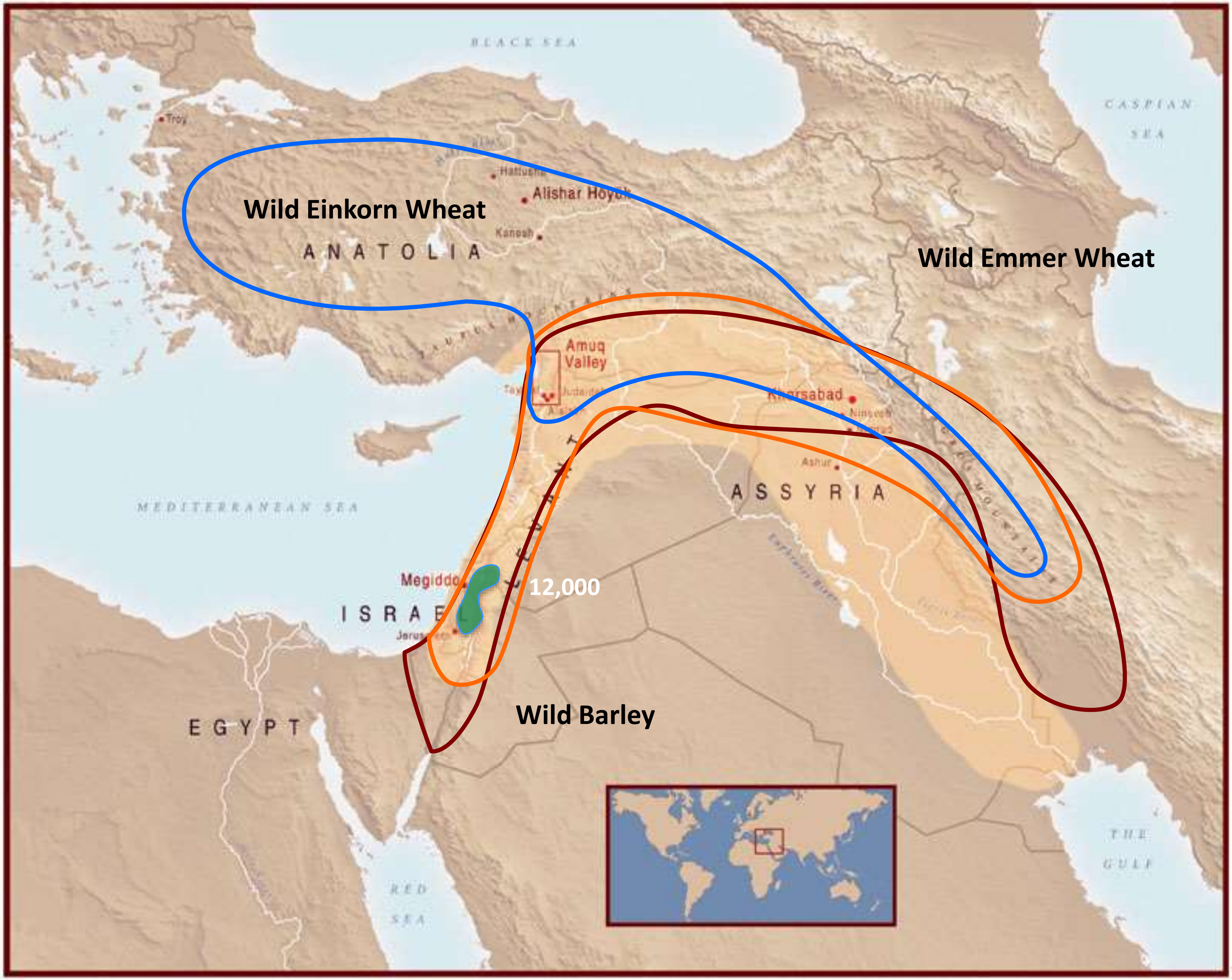
- Five *Felis silvestris* continental subspecies form a closely related five-way radiation that dates to 230,000 years ago:
  - ***Felis silvestris sylvestris*** **European wildcat**
  - ***Felis silvestris cafra*** **African wildcat**
  - ***Felis silvestris ornata*** **Central Asian wildcat**
  - ***Felis silvestris bieti*** **East Asian wildcat**
  - ***Felis silvestris lybica*** **Near Eastern wildcat**

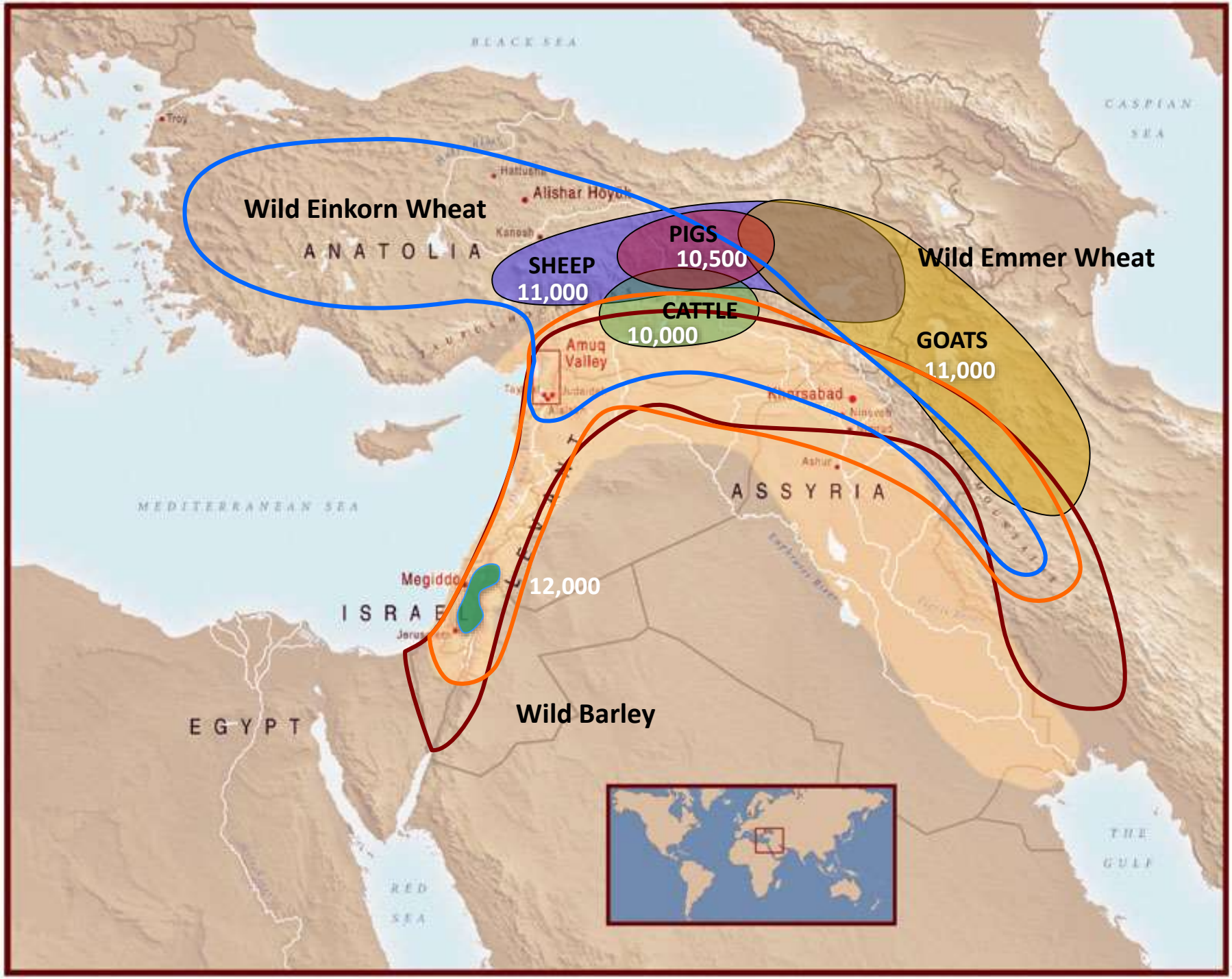
- Domestic cats & Near East Asia cats fall in one clade originating and living today in the **NEAR EAST Asia**

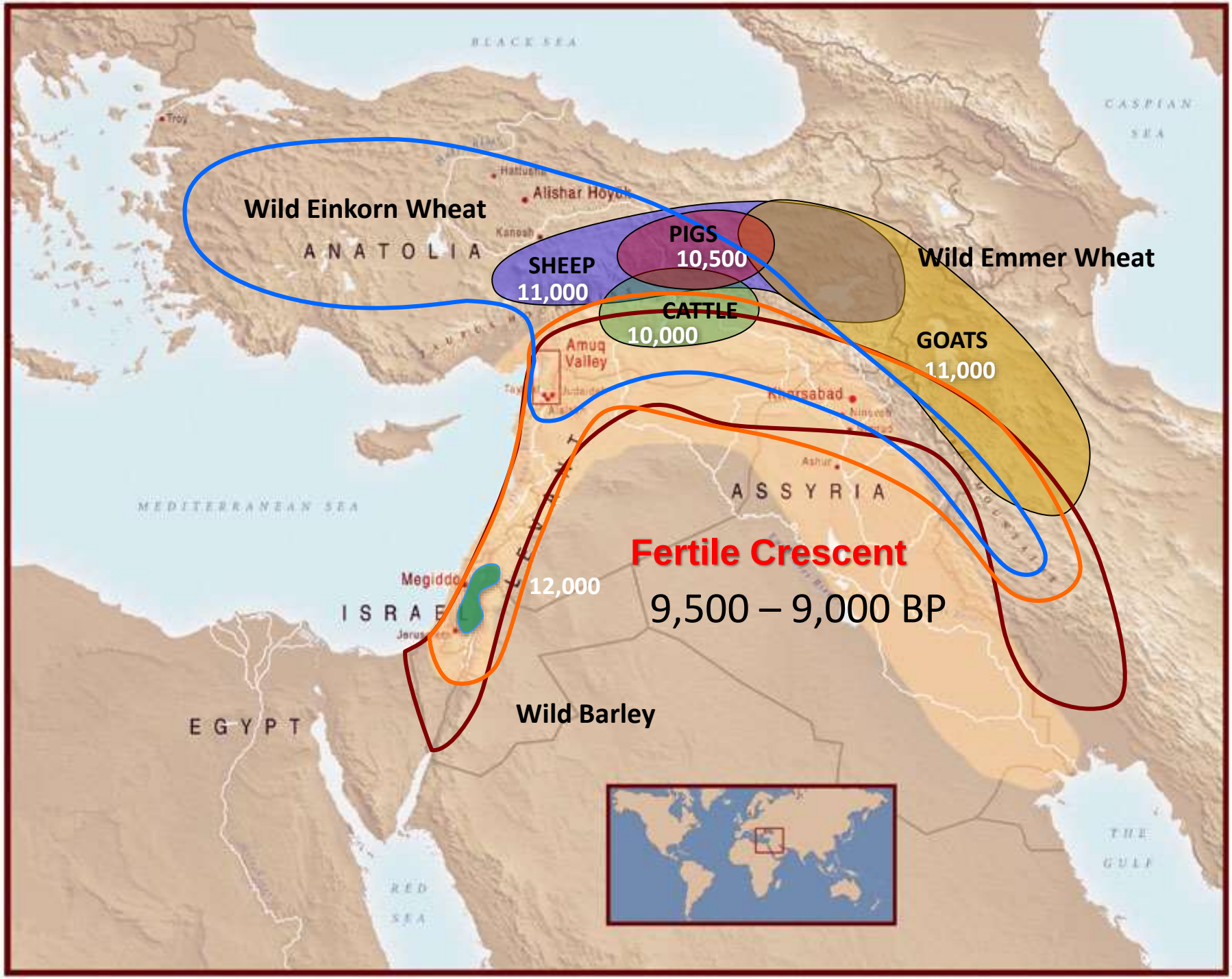
- First archaeological record of cat and people was ~10,000 years ago in Middle east (Cyprus).
- Cats were domesticated along with plants and farm animals in the early agricultural villages in the Near East

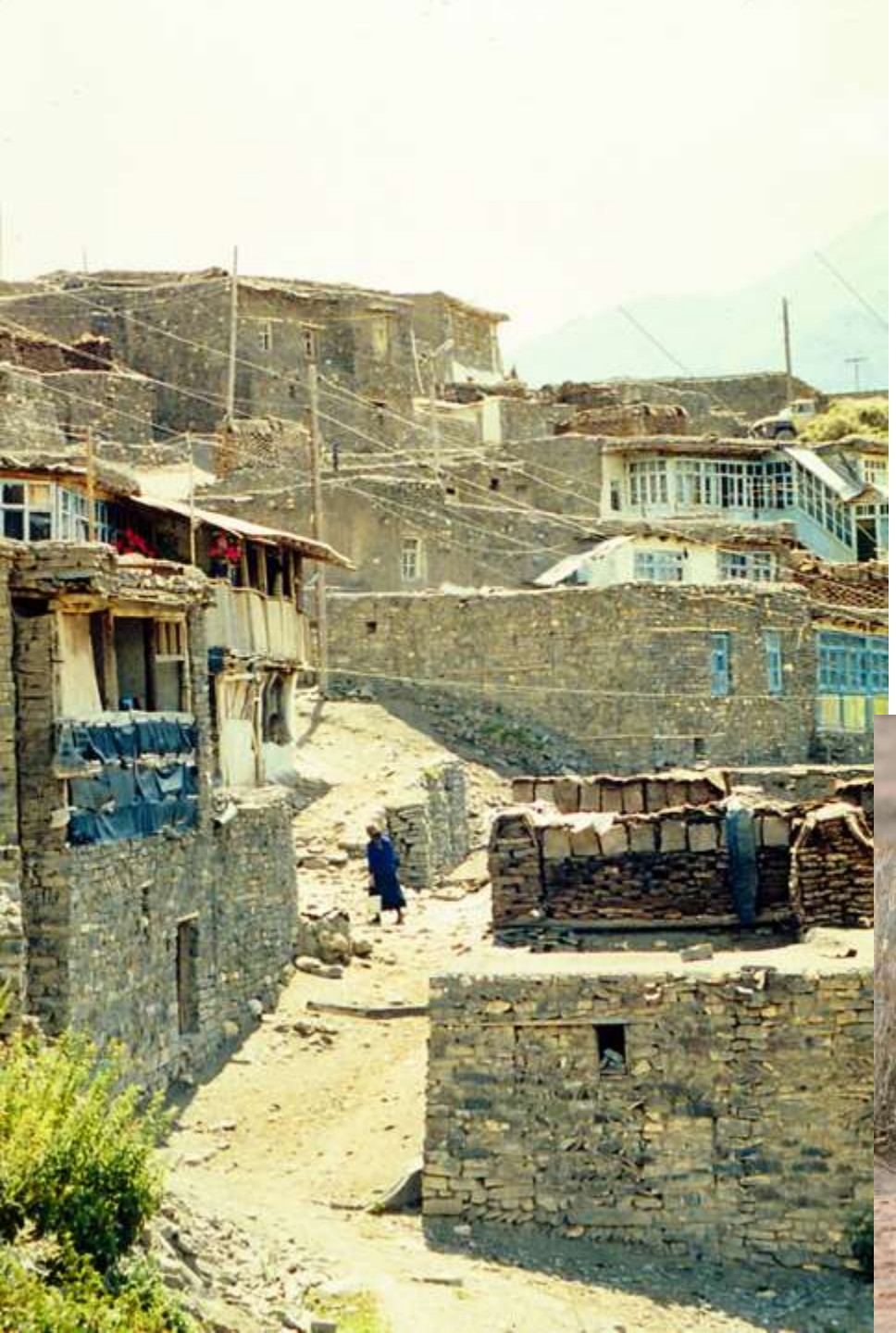
- **> 5 matrilinial events dating to 130,000 yrs**
  - No geographic structure to 5 mtDNA lineages

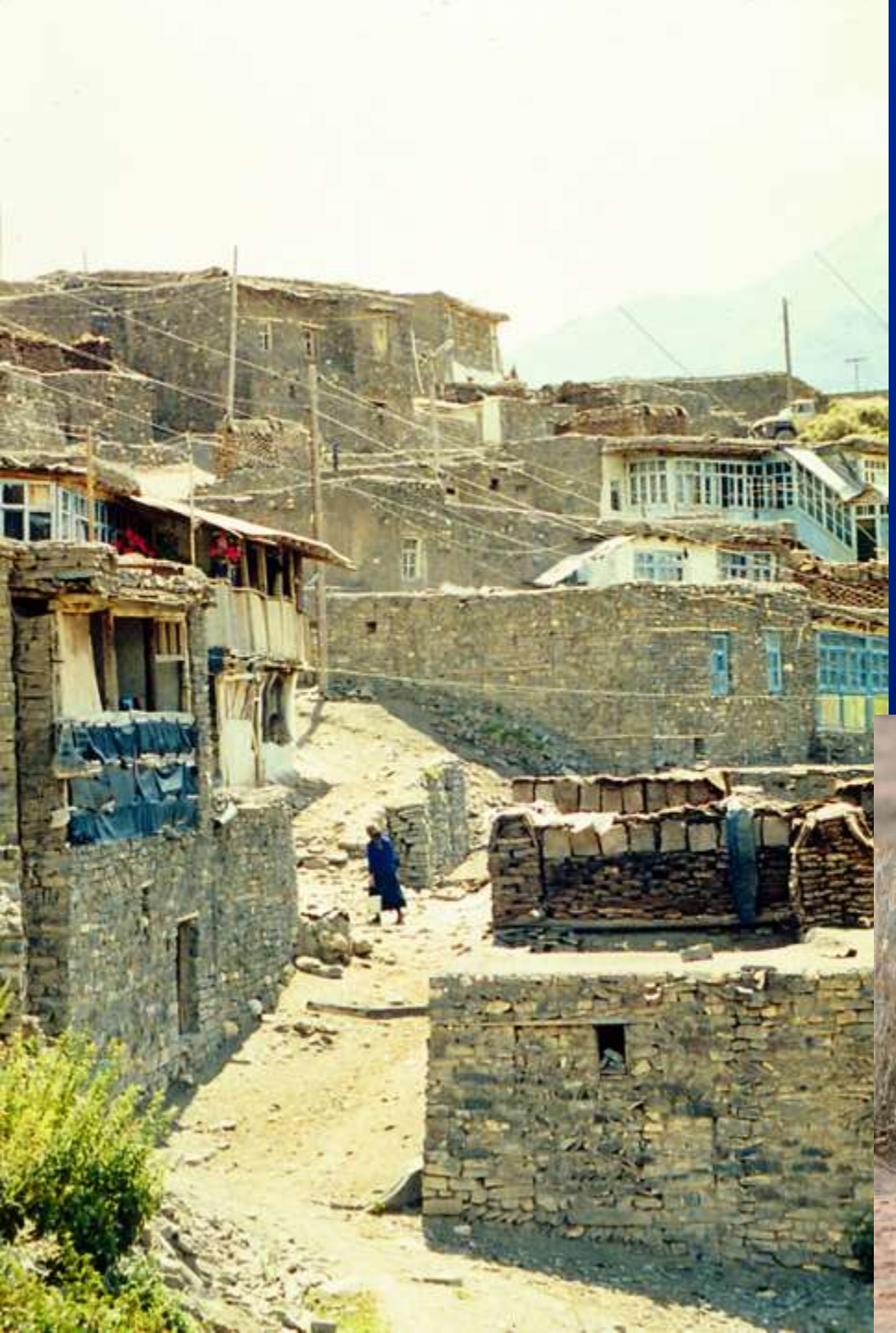
So How did cat domesticatin happen?


BLACK SEA
CASPIAN SEA
Troy
Hattusha
Kanesh
Wild Einkorn Wheat
ANATOLIA
Wild Emmer Wheat
Amuq Valley
Khorsabad
Ashur
ASSYRIA
MEDITERRANEAN SEA
Megiddo
12,000
ISRAEL
EGYPT
Wild Barley
RED SEA
THE GULF


Wild Einkorn Wheat
ANATOLIA
SHEEP
11,000
PIGS
10,500
CATTLE
10,000
Wild Emmer Wheat
GOATS
11,000
Amuq
Valley
ASSYRIA
12,000
Wild Barley
EGYPT
BLACK SEA
CASPIAN
SEA
MEDITERRANEAN SEA
RED
SEA
THE
GULF


Wild Einkorn Wheat
ANATOLIA
SHEEP
11,000
PIGS
10,500
CATTLE
10,000
Wild Emmer Wheat
GOATS
11,000
Amuq
Valley
ASSYRIA
Fertile Crescent
9,500 – 9,000 BP
12,000
Wild Barley
EGYPT
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA
RED SEA
THE GULF





A closing thought

Was cat domestication

sympatric speciation?

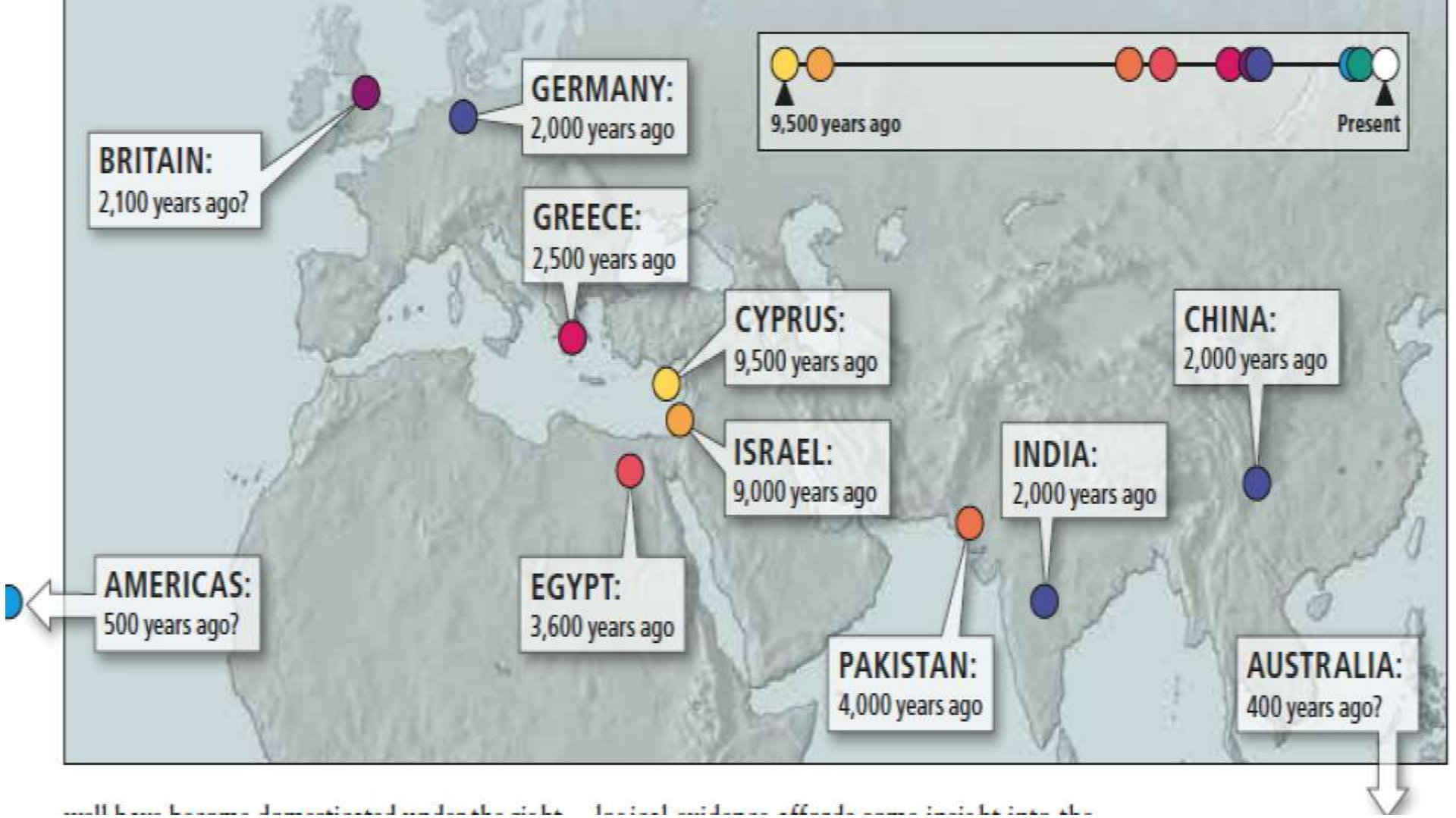
Perhaps!


Coca-Cola

[DISPERSAL]

HAVE CATS, WILL TRAVEL

As agriculture and permanent human settlements spread from the Fertile Crescent to the rest of the world, so, too, did domestic cats. The map below shows the earliest putative occurrences of house cats in regions around the globe.



well have become domesticated under the right ... logical evidence affords some insight into the






How far we have come

Table 1. Common western domestic animals and their context

Domestic animal		Wild ancestor		Earliest human association/domestication		
Common name	Scientific name	Common name	Scientific name	Time	Locus	First special breed formation
Dog	*Canis familaris*	Grey wolf	*C. lupus*	13,000–17,000 BP	Central Europe	3000–4000 BP
House sparrow	*Passer domesticus*	Sparrow	*Passer predomesticus*	Earliest Neolithic	Fertile Crescent	None
Pigeon	*Columba livia*	Rock dove	Same	Upper Pleistocene?	Fertile Crescent	Unknown
House mouse	*Mus domesticus*	Grey mouse	*Mus musculus*	12,000 BP	Fertile Crescent	< 300 years
Black rat	*Rattus rattus*	Same	Same	<12,000 BP	SE Asia	None
Brown rat	*Rattus norvegicus*	Same	Same	<5500 BP	Central Asia	1856
Goat	*Capra hircus*	Bezoar	*Capra aegagrus*	11,000 BP	SE Anatolia-Zagros	>5000 BP
Sheep	*Ovis aries*	Mouflon	*O. orientalis*	12,000 BP	SE Anatolia; Iraq	6000–5500 BP
Taurine cattle	*Bos taurus*	Auroch	*Bos primigenius primigenius*	11,000–10,500 BP	SE Anatolia; Upper Euphrates	> 4500 BP
Zeboid cattle	*Bos indicus*	Auroch	*Bos primigenius namadicus*	9000 BP	NW South Asia	Unknown
Pig	*Sus domesticus*	Wild boar	*Sus scrofa*	10,500 BP	At least six; includes SE Anatolia	Neolithic
Donkey	*Equus asinus asinus*	African wild ass	*Equus asinus africanus*	4800 BP	Eastern Africa	Unknown
Horse	*Equus caballus*	European forest horse (Tarpan)	*Equus ferus*	5000–4000 BP	Pontic steppes, Central Asian steppes	> 2800 BP
Dromedary camel	*Camelus dromedarius*	Same	Same	~5000 BP	Arabia	Unknown
Bactrian camel	*Camelus bactrianus*	Same	Same	4600 BP	East Iran	Unknown
Cat	*F. silvestris catus*	Wildcat	*F. silvestris lybica*	9700 BP	Cyprus/Fertile Crescent	< 300 years

*These species were commensals that seized advantage of anthropogenic habitat

Cinnamon - The Genomics Cat.!!

G3-2016

A High-Resolution SNP Array-Based Linkage Map Anchors a New Domestic Cat Draft Genome Assembly and Provides Detailed Patterns of Recombination

Gang Li,*,[1] LaDeana W. Hillier,†,[1] Robert A. Grahn,†,[§] Aleksey V. Zimin,** Victor A. David,††
Marilyn Menotti-Raymond,†† Rondo Middleton,‡‡ Steven Hannah,‡‡ Sher Hendrickson,§§,***
Alex Makunin,*** Stephen J. O'Brien,†††,*** Pat Minx,† Richard K. Wilson,† Leslie A. Lyons,‡,§
Wesley C. Warren,†,[2] and William J. Murphy*,[2]

Expansion of the feline chemosensory system for detecting pheromones at the expense of odorant detection.

PNAS

Comparative analysis of the domestic cat genome reveals genetic signatures underlying feline biology and domestication

Michael J. Montague[a,1], Gang Li[b,1], Barbara Gandolfi[c], Razib Khan[d], Bronwen L. Aken[e], Steven M. J. Searle[e], Patrick Minx[a], LaDeana W. Hillier[a], Daniel C. Koboldt[a], Brian W. Davis[b], Carlos A. Driscoll[f], Christina S. Barr[f], Kevin Blackistone[f], Javier Quilez[g], Belen Lorente-Galdos[g], Tomas Marques-Bonet[g,h], Can Alkan[i], Gregg W. C. Thomas[j], Matthew W. Hahn[j], Marilyn Menotti-Raymond[k], Stephen J. O'Brien[l,m], Richard K. Wilson[a], Leslie A. Lyons[c,2], William J. Murphy[b,2], and Wesley C. Warren[a,2]

Tamazian et al. GigaScience 2014, 3:13
http://www.gigasciencejournal.com/content/3/1/13

(GIGA)n SCIENCE

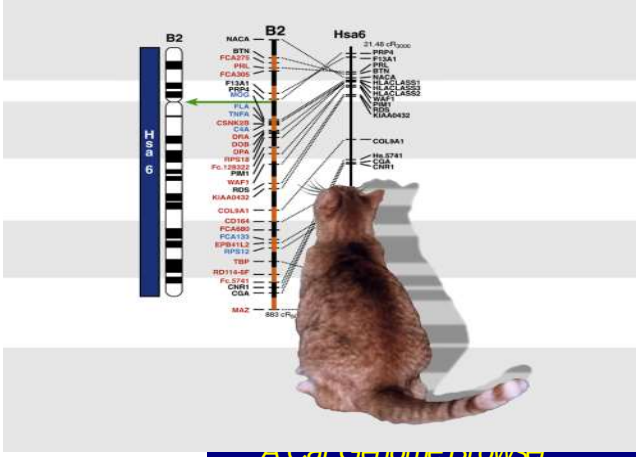
DATA NOTE **Open Access**

Annotated features of domestic cat – *Felis catus* genome

Gaik Tamazian[1], Serguei Simonov[1], Pavel Dobrynin[1], Alexey Makunin[1], Anton Logachev[1], Aleksey Komissarov[1], Andrey Shevchenko[1], Vladimir Brukhin[1], Nikolay Cherkasov[1], Anton Svitin[1], Klaus-Peter Koepfli[1], Joan Pontius[1], Carlos A Driscoll[2], Kevin Blackistone[2], Cristina Barr[2], David Goldman[2], Agostinho Antunes[3], Javier Quilez[4], Belen Lorente-Galdos[5], Can Alkan[6], Tomas Marques-Bonet[5], Marylin Menotti-Raymond[7], Victor A David[7], Kristina Narfström[8] and Stephen J O'Brien[1,9*]

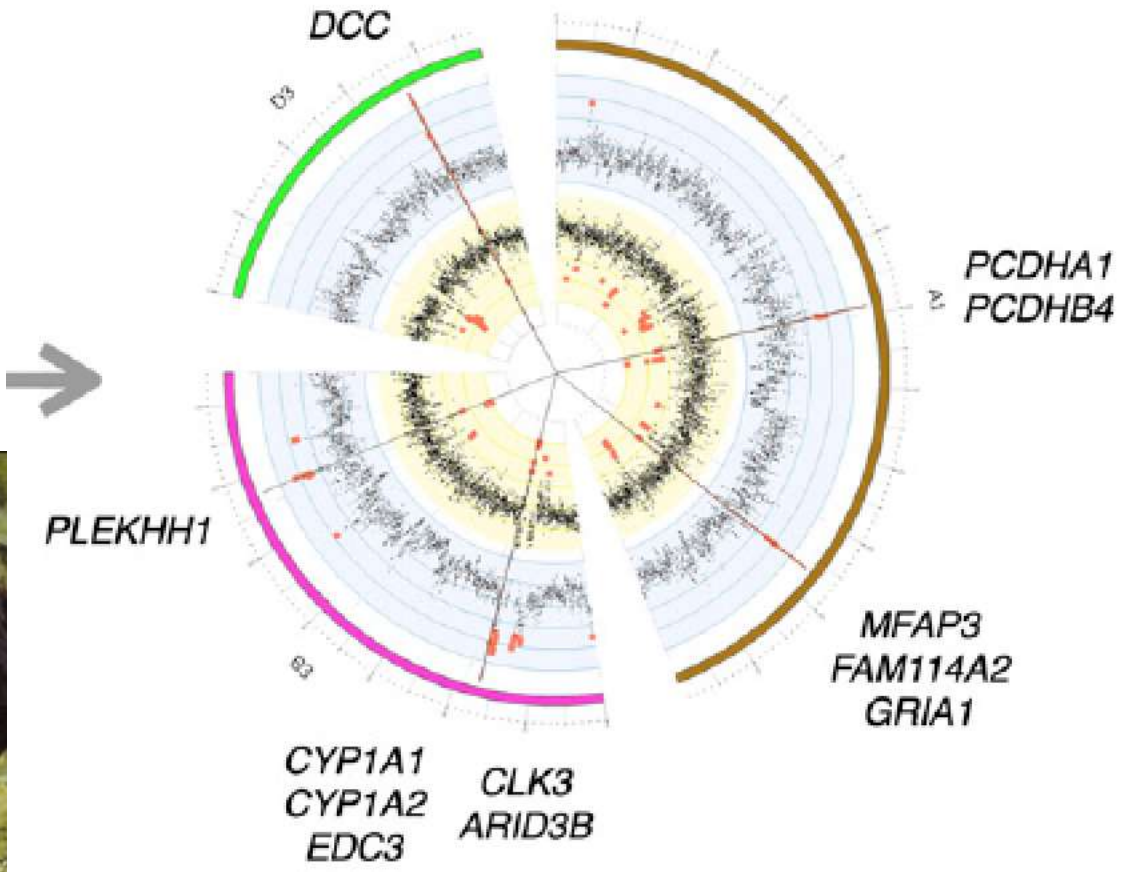
Table 1 Annotated cat genome features available in GARField2

Feature
I. Assembly of *Felis catus* genome Fca-6.2
II. GARField2 Genome Browser for domestic cat genome
III. Gene annotation **20,343**
IV. DNA variants
a. SNPs
b. Indels
V. Repeats content in *Felis catus* genome (Fca-6.2)
a. Interspersed repeats
b. Tandem repeats
• Complex Tandem Repeats
• Short Tandem Repeats (STRs)
• STR primer sequences
VI. Evolutionary Constrained Elements (ECE) among mammals
VII. Feline endogenous retrovirus-like elements
a. RD114
b. enFeLV
c. FERVs
d. Other ERV families
VIII. Methylation Sites in the cat genome
IX. Micro-RNA
X. Nuclear mitochondrial segments (*Numts*) in Fca-6.2
a. Lopez Tandem Numt Chr-D2
b. Dispersed Numts
XI. Segmental duplications in the domestic cat genome
XII. Assisted assembly of *Felis silvestris* genome
a. SNPs within *F. silvestris*
b. SNPs between *F. silvestris* and *F. catus*

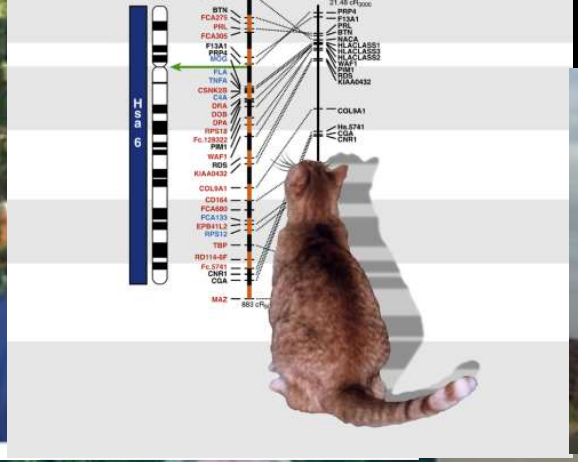


A Cat Genome Browser
http://lgd.abcc.ncifcrf.gov/

Selected genes in 5 regions candidates for cat domestication behavior



And now I really would like to say "Thanks" to…



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NATIONAL CANCER INSTITUTE

Laboratory of Genomic Diversity

Annual Retreat Boardwalk

Ocean City October 2005

STEPHEN J.OBRIEN

For Theodosius Dobzhansky Center for Genome Bioinformatics

St. Petersburg State University

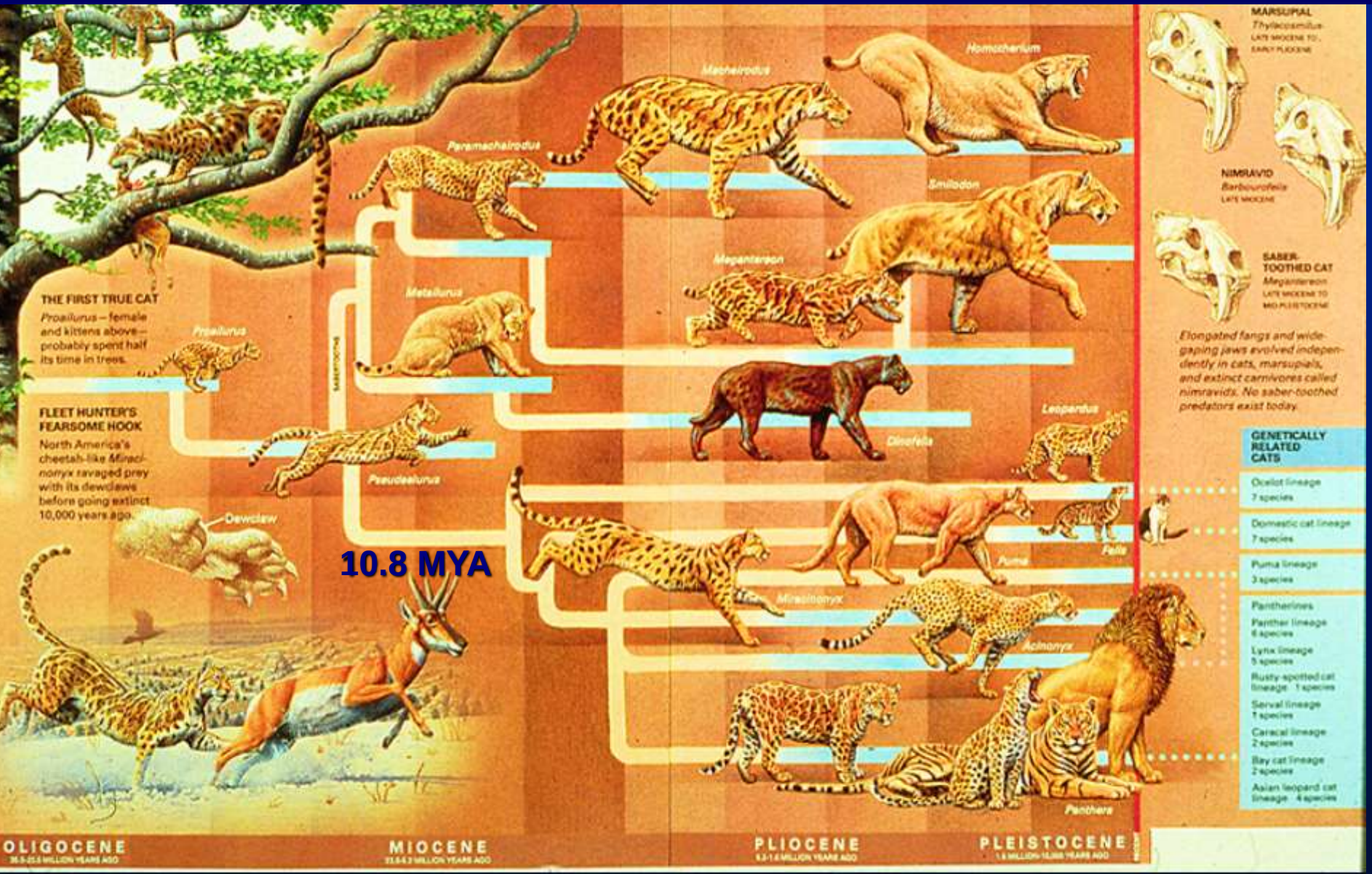
The Promise of Genome Bioinformatics i biomedical and environmental health scien

South African Genetics Society

September 21, 2016


Thanks !!

The Evolutionary History of Felidae



Special Thanks to :

Al Roca

Eduardo Eizirik

Warren Johnson

Bill Murphy

Bill Nash

Joan Menninger

Marilyn Menotti-Raymond

Victor David

John Page

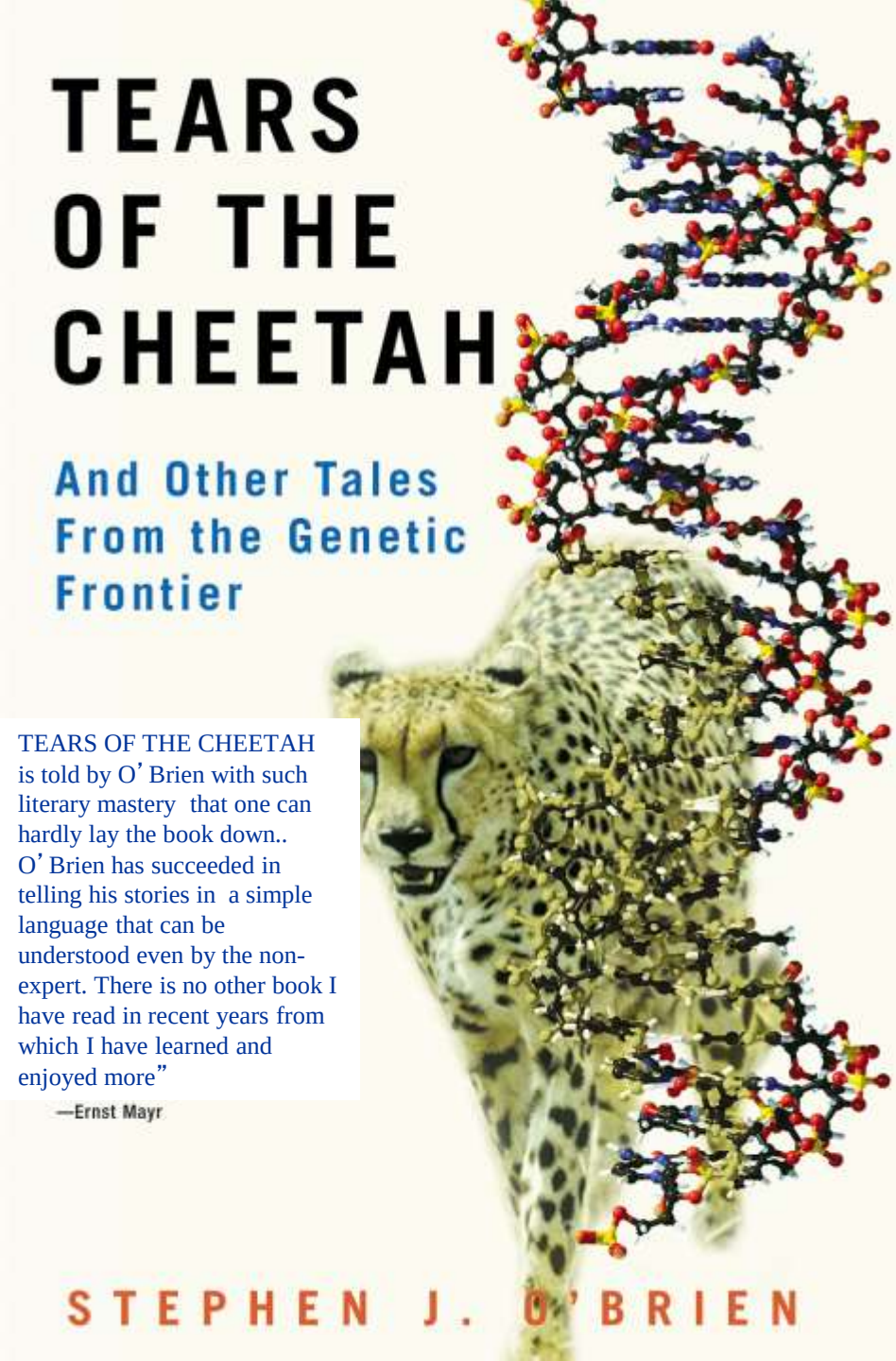
Emma Teeling

John Arthur

Stan Cevario

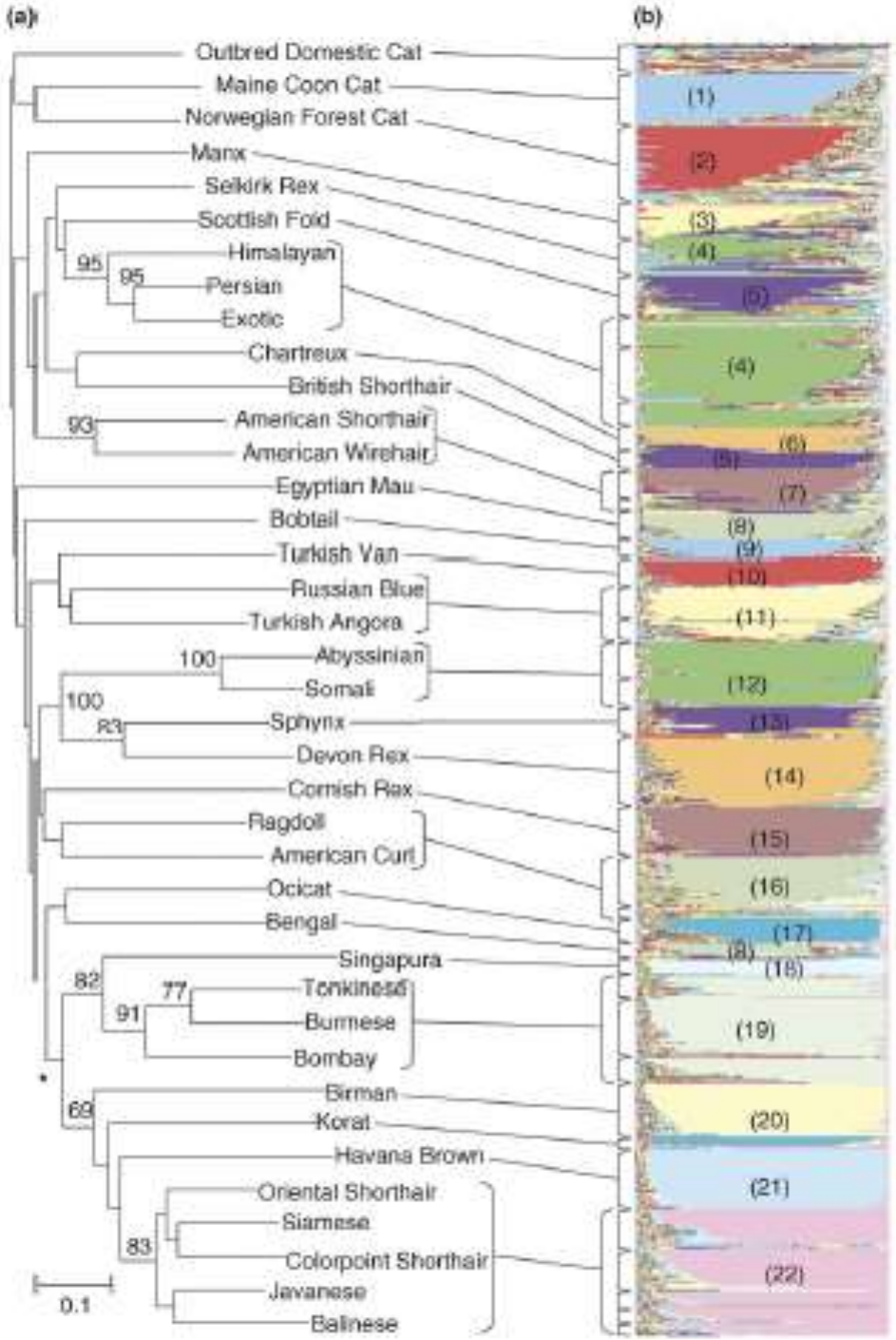
Amy Klar

& Valerie Beason



TEARS OF THE CHEETAH is told by O'Brien with such literary mastery that one can hardly lay the book down.. O'Brien has succeeded in telling his stories in a simple language that can be understood even by the non-expert. There is no other book I have read in recent years from which I have learned and enjoyed more"

—Ernst Mayr


(a)
(b)
Outbred Domestic Cat
Maine Coon Cat
Norwegian Forest Cat
Manx
Selkirk Rex
Scottish Fold
Himalayan
Persian
Exotic
Chartreux
British Shorthair
American Shorthair
American Wirehair
Egyptian Mau
Bobtail
Turkish Van
Russian Blue
Turkish Angora
Abyssinian
Somali
Sphynx
Devon Rex
Cornish Rex
Ragdoll
American Curl
Ocicat
Bengal
Singapura
Tonkinese
Burmese
Bombay
Birman
Korat
Havana Brown
Oriental Shorthair
Siamese
Colorpoint Shorthair
Javanese
Balinese
95
95
93
100
100
83
82
77
91
69
83
0.1
(1)
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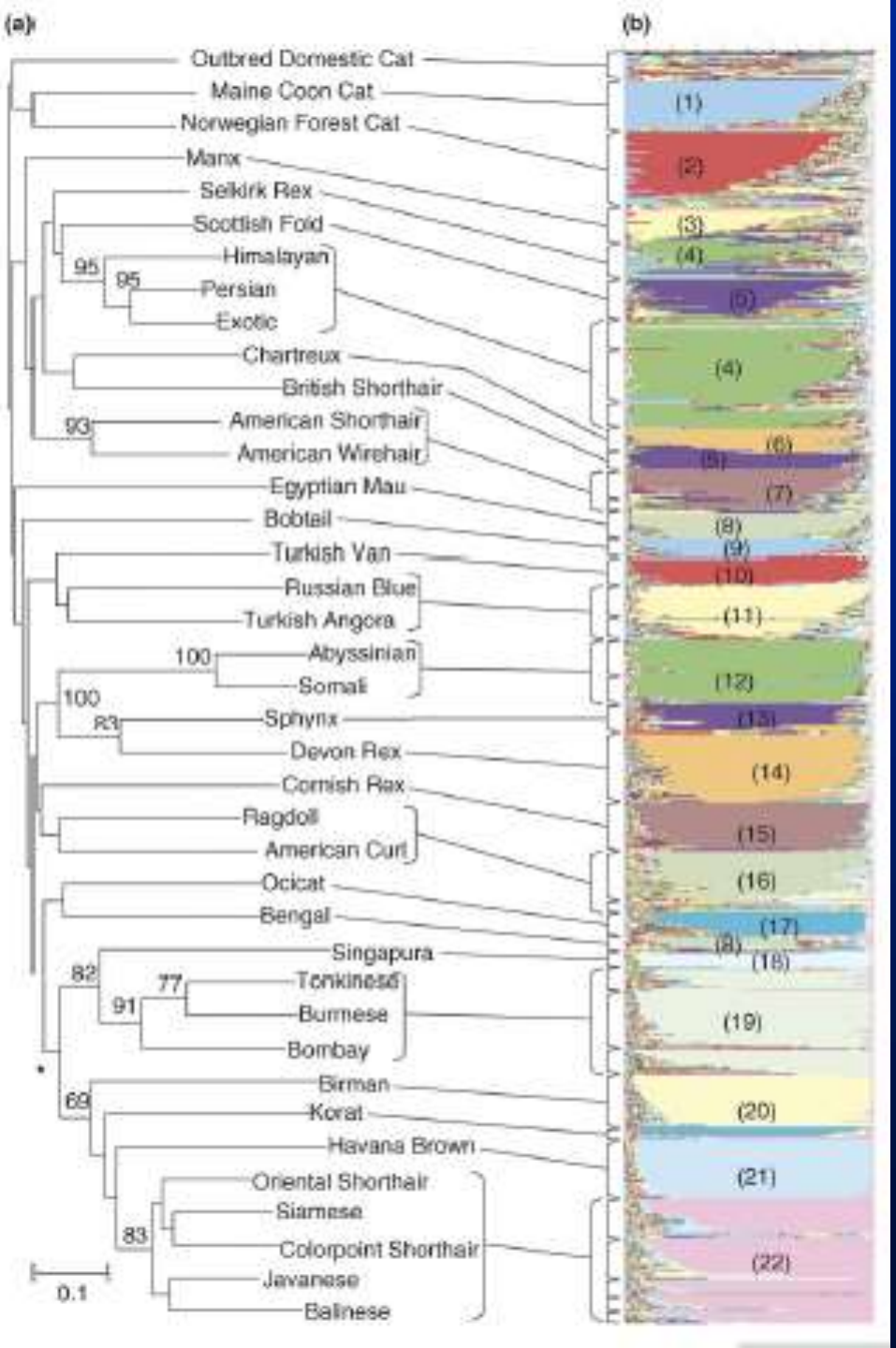
(a)
(b)
Outbred Domestic Cat
Maine Coon Cat
Norwegian Forest Cat
Manx
Selkirk Rex
Scottish Fold
Himalayan
Persian
Exotic
Chartreux
British Shorthair
American Shorthair
American Wirehair
Egyptian Mau
Bobtail
Turkish Van
Russian Blue
Turkish Angora
Abyssinian
Somali
Sphynx
Devon Rex
Cornish Rex
Ragdoll
American Curl
Ocicat
Bengal
Singapura
Tonkinese
Burmese
Bombay
Birman
Korat
Havana Brown
Oriental Shorthair
Siamese
Colorpoint Shorthair
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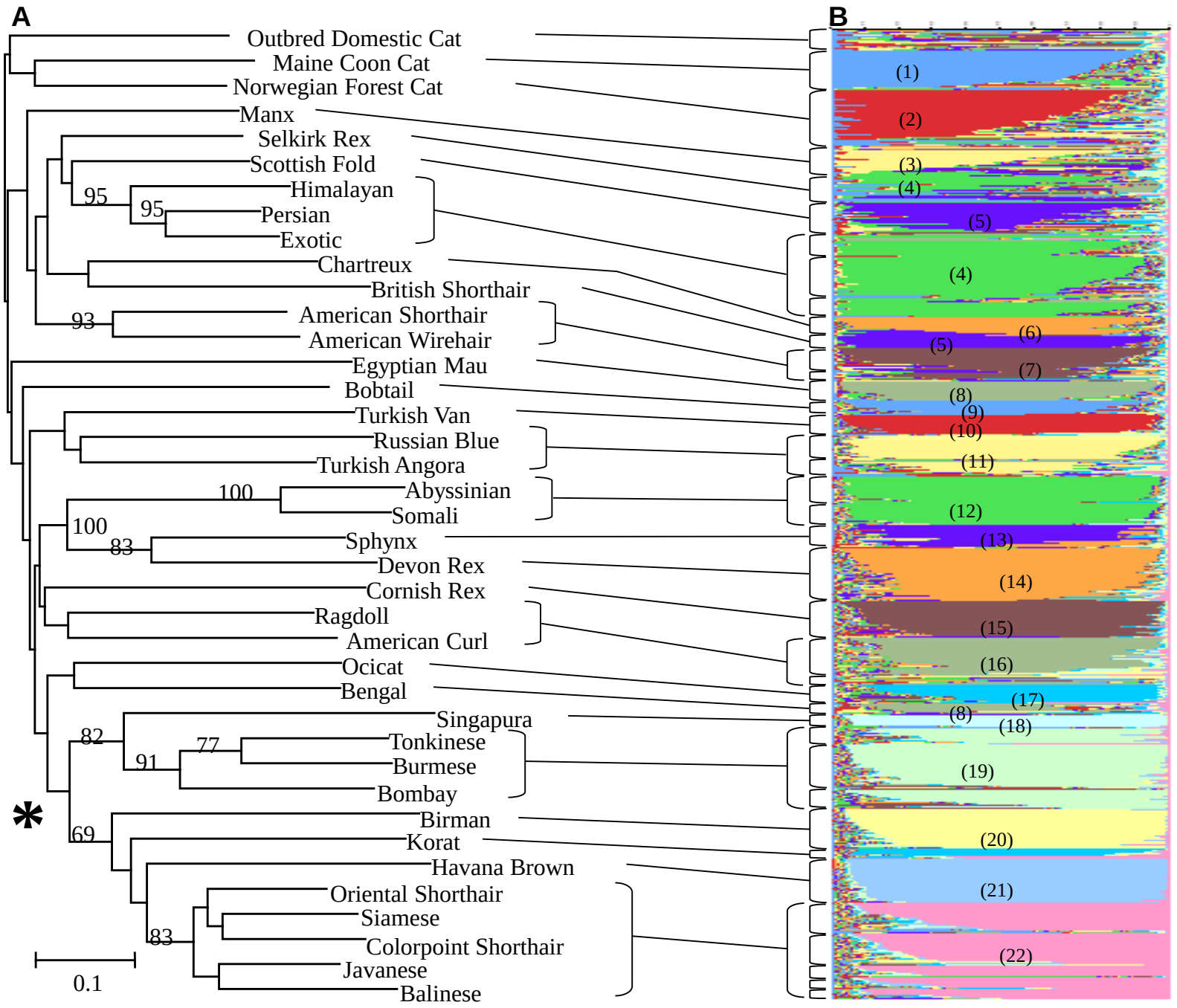
A
B
Outbred Domestic Cat
Maine Coon Cat
Norwegian Forest Cat
Manx
Selkirk Rex
Scottish Fold
Himalayan
Persian
Exotic
Chartreux
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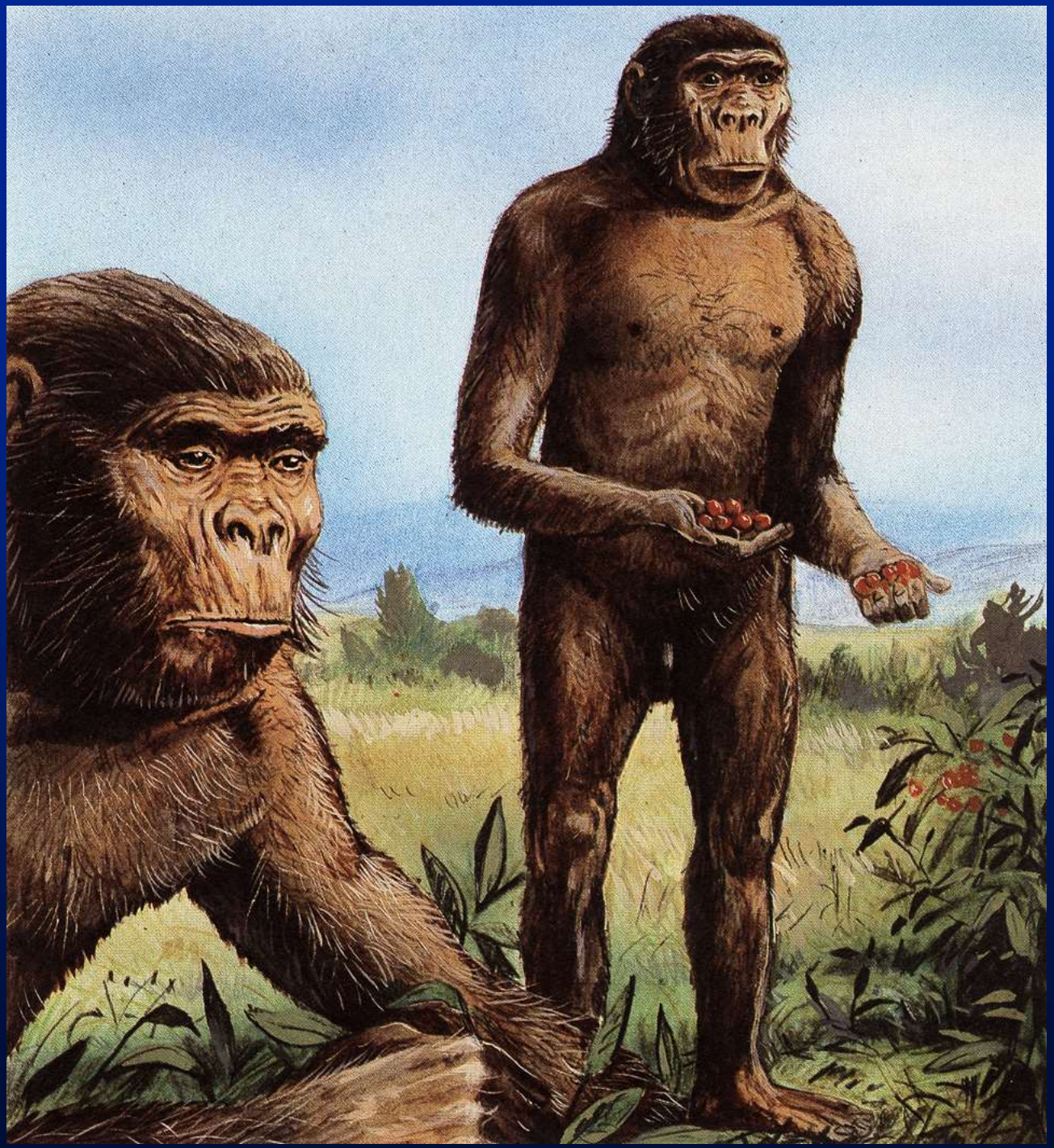


The Felidae Family is made up of 37 species that all arose in the last ten million years

So where did all these cat species come from??

North Asia

Snow leopard, *Uncia uncia*
Chinease mountain cat, *Felis bieti*
Manul, *Otocolobus manul*
Asiatic wildcat, *Felis silvestris*
Eurasian lynx, *Lynx lynx*

North America

Bobcat, *Lynx rufus*
Canada Lynx, *Lynx canadensis*
Puma, *Puma concolor*
Jaguar, *Panathera*

Europe

Iberian lynx, *Lynx pardinus*
European wildcat, *Felis silvestris, silvestris group*

Tropical Asia

Tiger, *Panthera tigris*
Bornean bay cat, *Catopuma badia*
Clouded leopard, *Neofelis nebulosa*
Asiatic golden cat, *Catopuma temmincki*
Flat-headed cat, *Prionailurus planiceps*
Rusty-spotted cat, *Prionailurus rubiginosus*
Fishing cat, *Prionailurus viverrinus*
Marbled cat, *Pardofelis marmorata*
Leopard, *Panthera pardus*
Jungle cat, *Felis chaus*
Leopard cat, Prionailurus bengalensis

Sub-Sahara Africa

Black-footed cat, *Felis nigripes*
African golden cat, *Profelis aurata*
Cheetah, *Acinonyx jubatus*
African lion, *Panthers leo*
Serval, *Leptailurus serval*
Leopard, *Panthera pardus*
Caracal, *Caracal caracal*
African wildcat, *Felis silvestris, libyca group*

South America

Ocelot, *Leopardus pardalis*
Margay, *Leopardus wiedi*
Kodkod, *Oncifelis guigna*
Andean mountain cat, *Oreailurus jacobitus*
Oncilla, *Leopardus tigrinus*
Geoffroy's cat, *Oncifelis geoffroyi*
Pampas cat, *Oncifelis colocolo*
Jaguar, *Panthera onca*
Puma, *Puma concolor*
Jaguarundi, *Herpailurus yaguarondi*

Our Strategy

Sampling of all 37 felid species and seven outgroup species
Test of 35 genes for phylogenetic congruence

A comprehensive gene sampling
37 Felidae species & outgroups

5 X-linked (3,230 bp):
ALAS,ATP-7A,IL2RG,PLP,ZFX
4 Y-linked (4,457 bp):
SMCY,SRY,UBEY,ZFY
6 mtDNA gene fragments (3,936 bp):
ND2, ND4, ND5, ATP8,CYTB,16S
20 autosomal gene fragments (11,166 bp):
APP,CALB1,CHRNA1,CLU,CMA1
DGKG2,FES,GATA3,GHR,GNAZ,GNB1,HK1,NCL
PNOC,RAG2,RASA2,SIL,TCP1,TTR

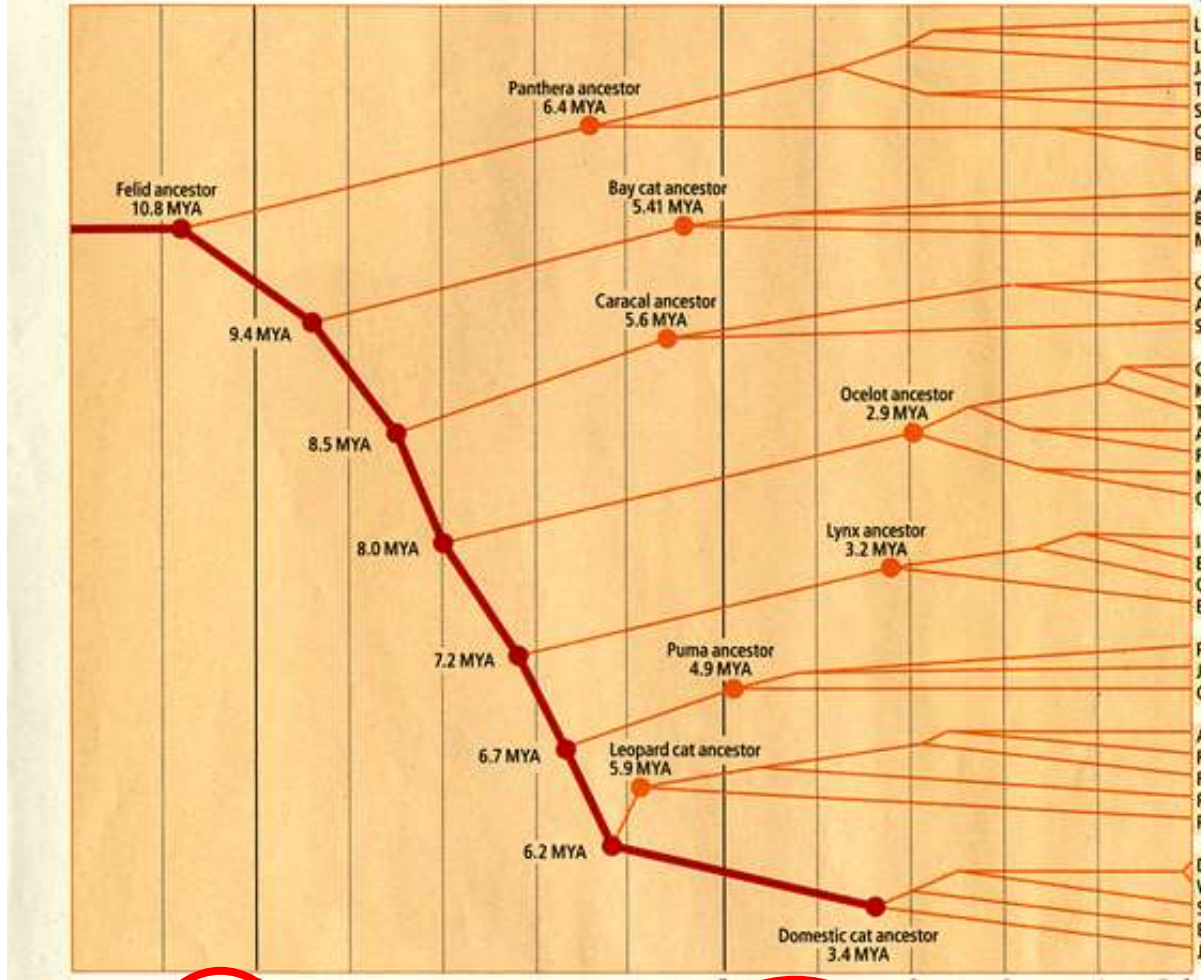
- 22,789 bp (total)

Timing calibrated with
16 Felidae species' fossils

Johnson et al Science 311:74
January, 2006

THE CAT FAMILY TREE

Scientists compared DNA sequences in all 37 species of cats to determine the tree's branches. Fossils provided dates that indicate when major branching occurred.



37 SPECIES

Lion *Panthera leo*
Leopard *Panthera pardus*
Jaguar *Panthera onca*
Tiger *Panthera tigris*
Snow leopard *Panthera uncia*
Clouded leopard *Neofelis nebulosa*
Bornean clouded leopard *Neofelis diardi*

Asian golden cat *Pardofelis temmincki*
Bornean bay cat *Pardofelis badia*
Marbled cat *Pardofelis marmorata*

Caracal *Caracal caracal*
African golden cat *Caracal aurata*
Serval *Caracal serval*

Geoffroy's cat *Leopardus geoffroyi*
Kodkod *Leopardus guigna*
Tigrina *Leopardus tigrinus*
Andean mountain cat *Leopardus jacobita*
Pampas cat *Leopardus colocolo*
Margay *Leopardus wiedii*
Ocelot *Leopardus pardalis*

Iberian lynx *Lynx pardina*
Eurasian lynx *Lynx lynx*
Canada lynx *Lynx canadensis*
Bobcat *Lynx rufus*

Puma *Puma concolor*
Jaguarundi *Puma yaguarondi*
Cheetah *Acinonyx jubatus*

Asian leopard cat *Prionailurus bengalensis*
Fishing cat *Prionailurus viverrina*
Flat-headed cat *Prionailurus planiceps*
Rusty-spotted cat *Prionailurus rubiginosus*
Pallas's cat *Otocolobus manul*

Domestic cat *Felis catus*
Wildcat *Felis silvestris*
Sand cat *Felis margarita*
Black-footed cat *Felis nigripes*
Jungle cat *Felis chaus*

8 LINEAGES

1 PANTHERA
These medium- to large-siz
predators in the ecosystem
species. The lion, tiger, jag
them to roar. The two clou

2 BAY CAT
This poorly known group o
(two to 16 kilograms) is re
tropical Southeast Asia. Be
taxonomists did not consis

3 CARACAL
These medium-size cats (fi
but were not typically grou

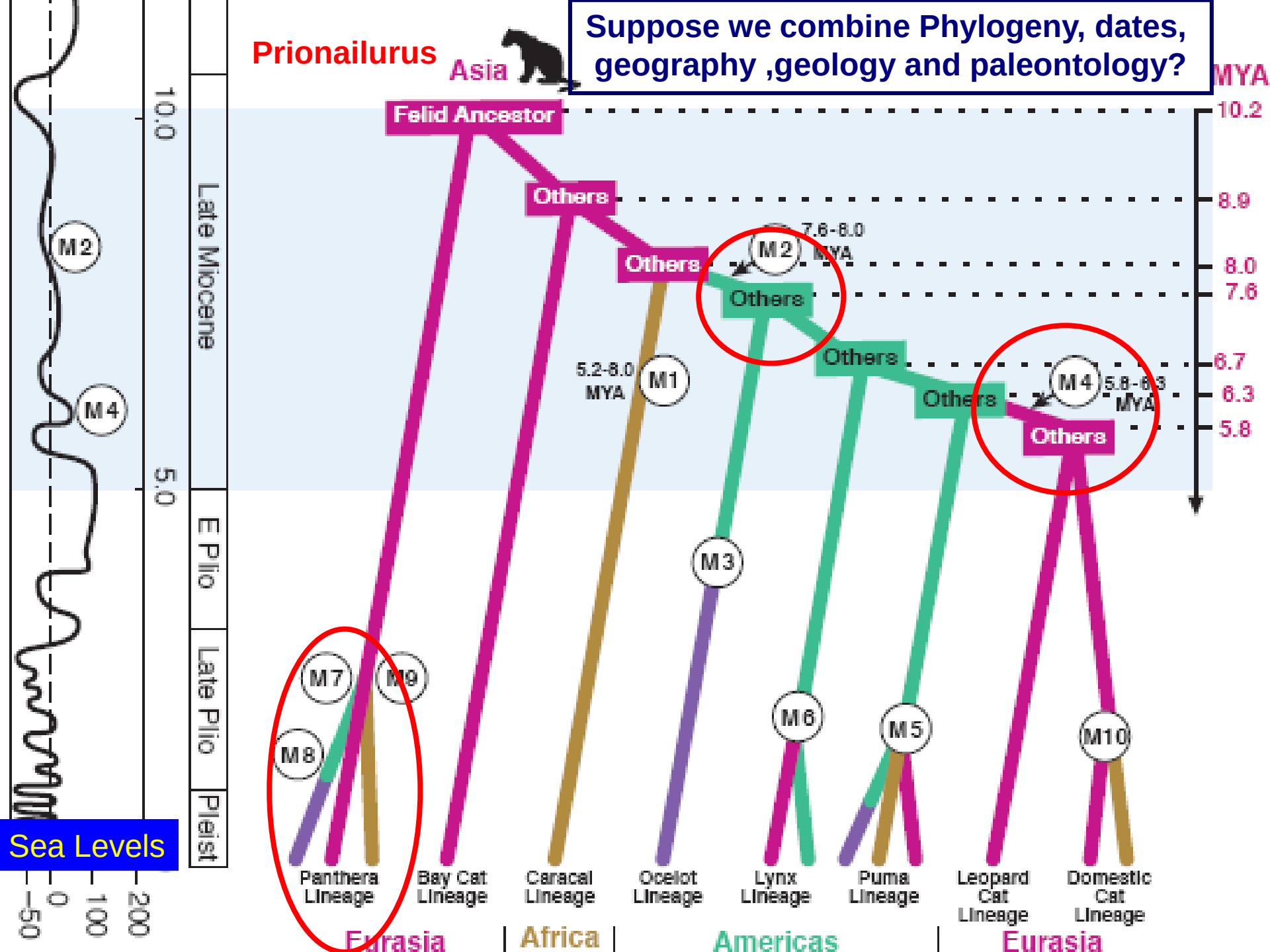
4 OCELOT
These small- to medium-si
Central and South America
than other Felidae species

5 LYNX
These medium-size cats (s
ears. They live in temperat
and tend to specialize on h
these species have been a

6 PUMA
These diverse cats, from th
originated in North Ameri
Pumas can be locally comm

7 ASIAN LEOPARD CA
These small cats (two to 1
forest to Mongolian stepp

8 DOMESTIC CAT
These small cats (one to 1
which is worldwide, have


Suppose we combine Phylogeny, dates, geography ,geology and paleontology?
Prionailurus
Asia
MYA
10.2
8.9
8.0
7.6
6.7
6.3
5.8
Felid Ancestor
Others
Others
Others
Others
Others
Others
7.6-8.0 MYA
5.2-8.0 MYA
5.8-6.3 MYA
M1
M2
M3
M4
M5
M6
M7
M8
M9
M10
Panthera Lineage
Bay Cat Lineage
Caracal Lineage
Ocelot Lineage
Lynx Lineage
Puma Lineage
Leopard Cat Lineage
Domestic Cat Lineage
Eurasia
Africa
Americas
Eurasia
Late Miocene
E Plio
Late Plio
Pleist
10.0
5.0
Sea Levels
200
100
0
-50

ONE AMAZING JOURNEY

On the Origins of Cat

Prof.Taras Oleksyk

Miocene Migrations

8-9 MYA

Precursor of Puma, Lynx, Ocelot lineages

M2

Asia

M1

8-9 MYA

Precursor of Caracal lineage

Europe

Africa

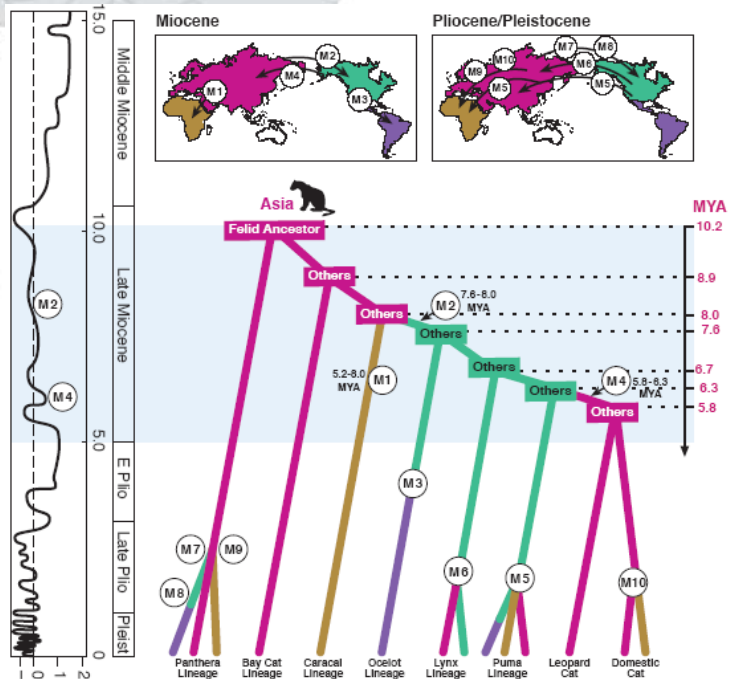
North America

M3

2.7 MYA

Ocelot lineages

South Americ



Late Pliocene Migrations

1-3 MYA

Lynx and cheetah

M4

M8 M9

Lions and jaguars

M7

Cheetah

M5

M6

Blackfooted cat

Lions

Europe

Asia

Africa

North America

Puma

M12

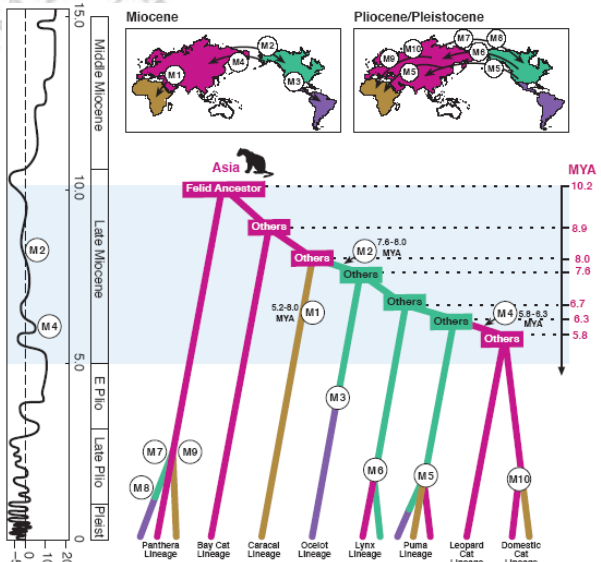
M10

M11

Puma lineage and Jaguars

8-10,000 MYA

South America



Coalescence of modern Panthera species
Tiger: 72,000-108,000 yrs ago
Leopard: 470,000-825,000 yrs ago
Asian leopard: 170,000-300,000 yrs ago
Jaguar: 280,000-510,000 yrs ago

ALT

AMO

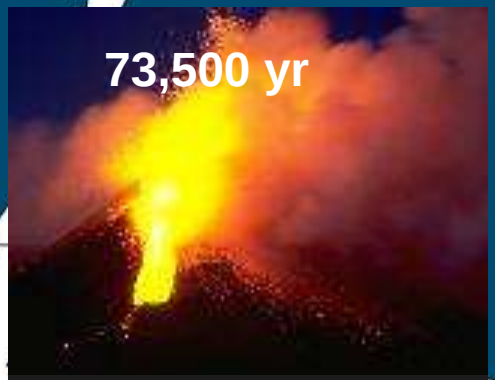
TIG

COR

Isthmus of Kra

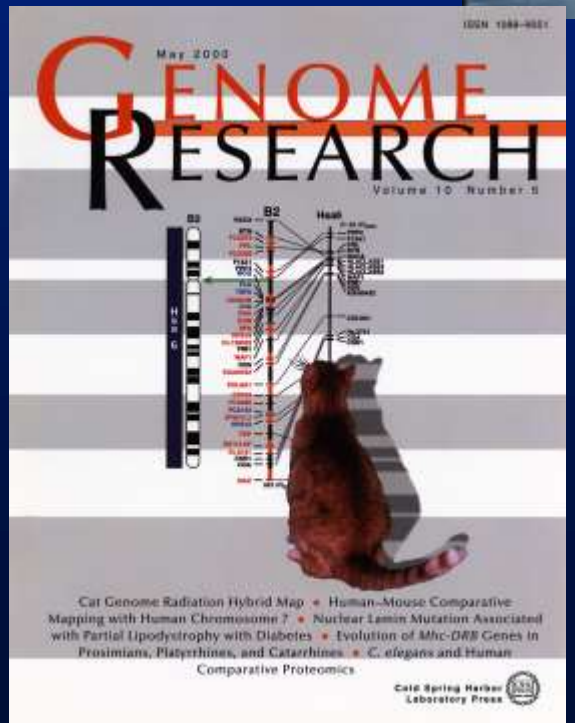
JAX

SUM



Toba Super-eruption

And that's How we believe the modern cats came to be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Volume 10 Number 5
Cat Genome Radiation Hybrid Map • Human–Mouse Comparative Mapping with Human Chromosome 7 • Nuclear Lamin Mutation Associated with Partial Lipodystrophy with Diabetes • Evolution of Mhc-DRB Genes in Prosimians, Platyrrhines, and Catarrhines • C. elegans and Human Comparative Proteomics
Cold Spring Harbor Laboratory Press