

An Ancient DNA perspective on the origins and spread of domestic cats in Europe



Egyptian cat mummies
(photo: British Museum)

Claudio Ottoni

University of Rome Tor Vergata, Department of Biology

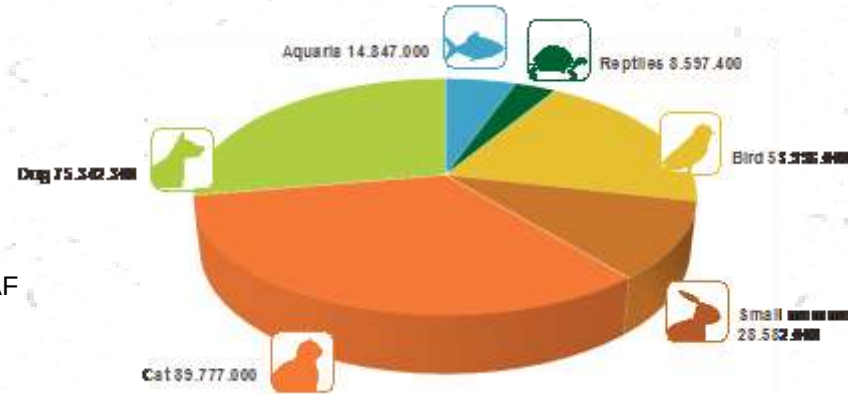
EAAP Workshop on Companion Animals, 14-16 May 2025

Popularity of Cats

24%

of European households (dog: 21%)

Source: FEDIAF



6,5 billion
photos

Source: BBC



Lil Bub

2 million

videos

Source: CNN



Tardar Sauce (Grumpy Cat)



Motimaru

The cat domestication conundrum

No evident physical skeletal changes
What is wild? What is domestic?



Felis silvestris lybica
(ancestor of domestic cats)



Felis silvestris catus
(domestic cat)

GMM of mandibles, higher resolutions, more promising

(Vigne et al. 2016)

The cat domestication conundrum

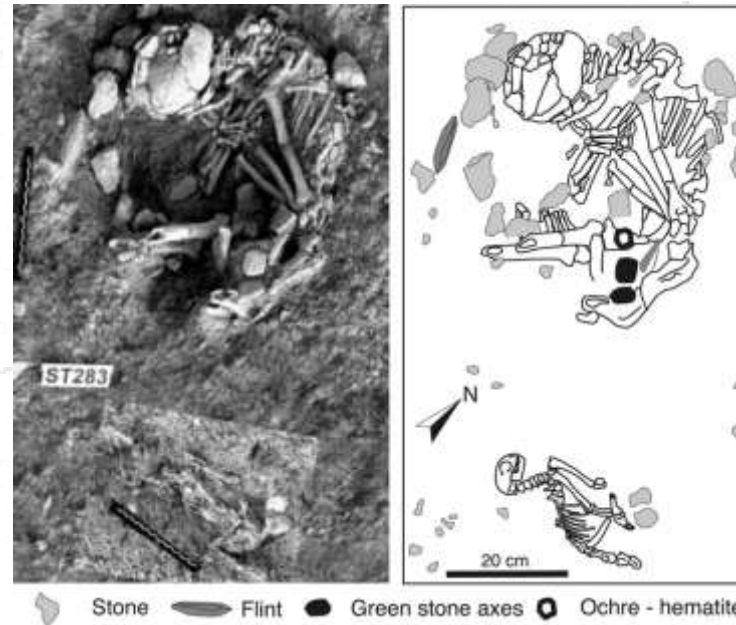
Cats are (relatively) rare
in the archaeological records



Traditional zooarchaeological
approaches are difficult

Archeological evidence

Cyprus



Cats are not native to Cyprus

Their earliest introduction is documented by remains at Klimonas, 11,100-10,600 ya (PPNA)

Shillourokambos – 9,500 ya

Archeological evidence

Cyprus



Shillourokambos – 9,500 ya

Archeological evidence

Cyprus

Spiritual link
between cats and
humans?



Shillourokambos – 9,700 ya

(Guilaine 2000)

Archeological evidence

Cyprus & the Levant

The Neolithic – onset of farming in the Near East ~11,500 ya.



Commensalism

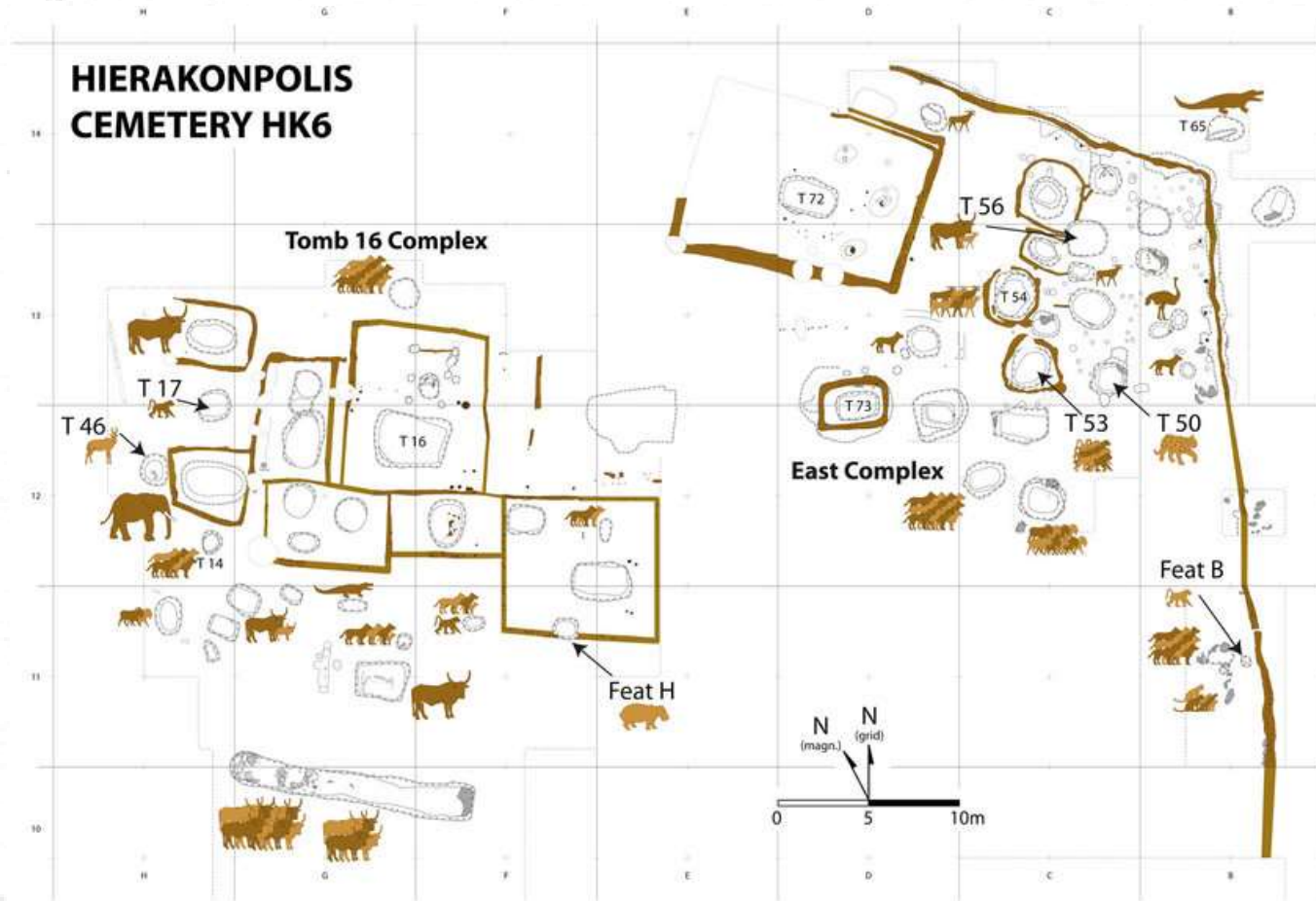
Cats were attracted by pests, vermin and food scraps, keeping them away from food storage areas.

Reconstruction of a granary in Jordan at Dhra', 11 kya

(Kuijt & Finlason 2009, PNAS)

Archeological evidence

Egypt



Hierakonpolis – 5,700 ya

Archeological evidence

Egypt



Cats held in captivity

Earliest evidence of cat-human interaction in Egypt based on archaeozoological evidence.

Hierakonpolis – 5,700 ya

Archeological evidence

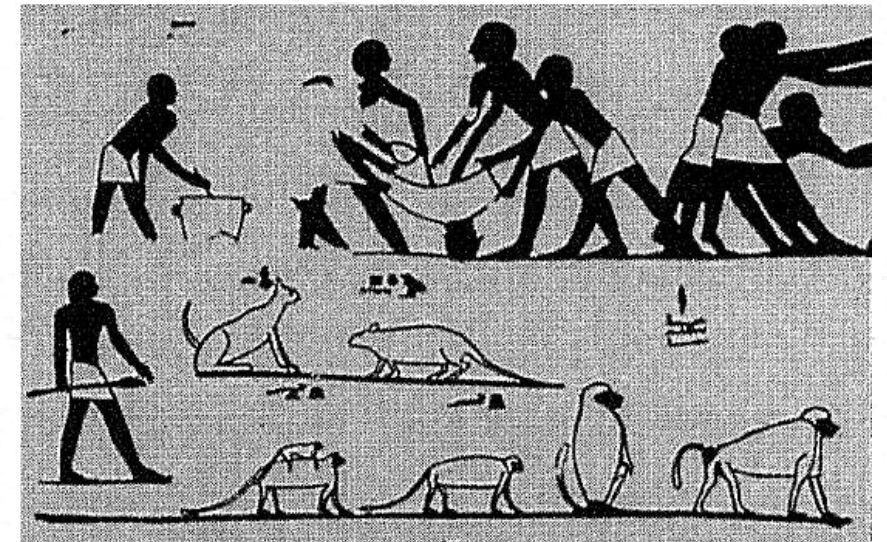
Egypt



Wall relief at El-Lisht (2236-2143 BC)



Saqqara (1950 BC)



Tomb of Beni Hasan (1950 BC)

Funerary contexts – 4,000 ya

Archeological evidence

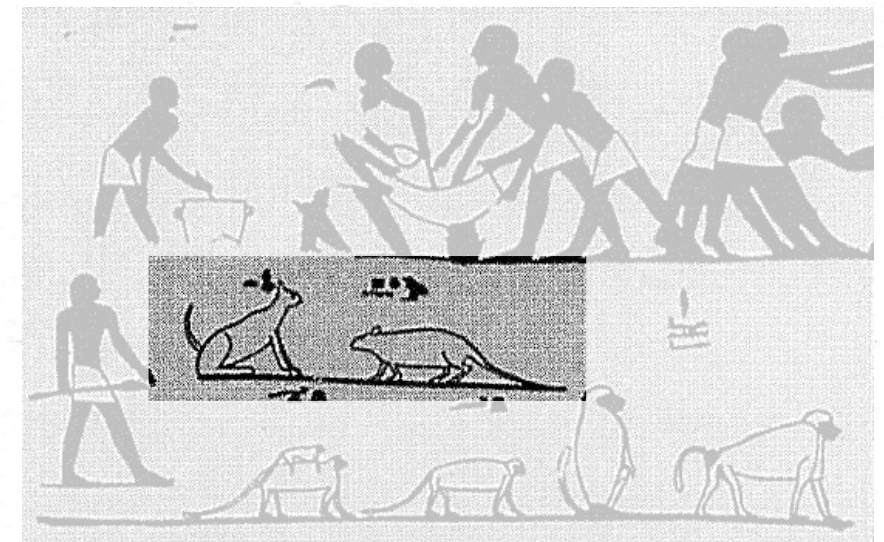
Egypt



Wall relief at El-Lisht (2236-2143 BC)



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Tomb of Beni Hasan (1950 BC)

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Tomb of Ipuy (1250 aC)



Tomb of Nebamun and Ipuky (1360 aC)

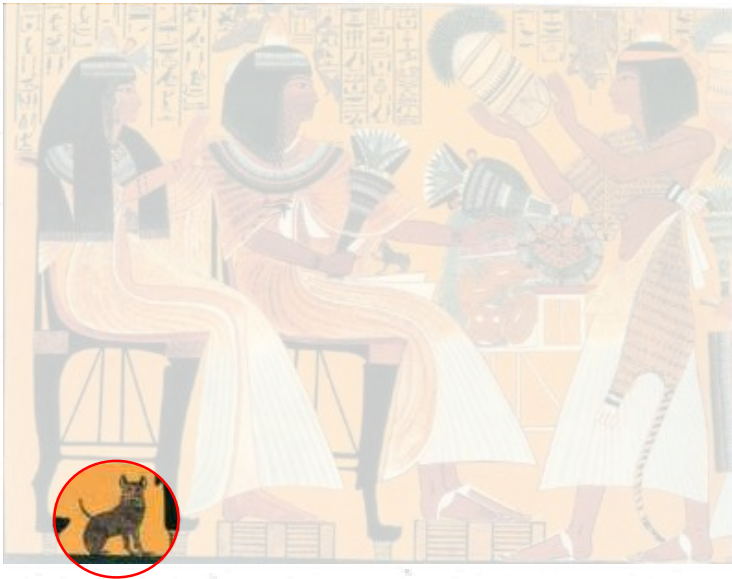


Tomb of May (1450 aC)

Iconography – 3,500 ya

Archeological evidence

Egypt



Tomb of Ipuy (1250 aC)



Tomb of Nebamun and Ipuky (1360 aC)



Tomb of May (1450 aC)

Iconography – 3,500 ya

Archeological evidence

Egypt



Cult of the goddess Bastet

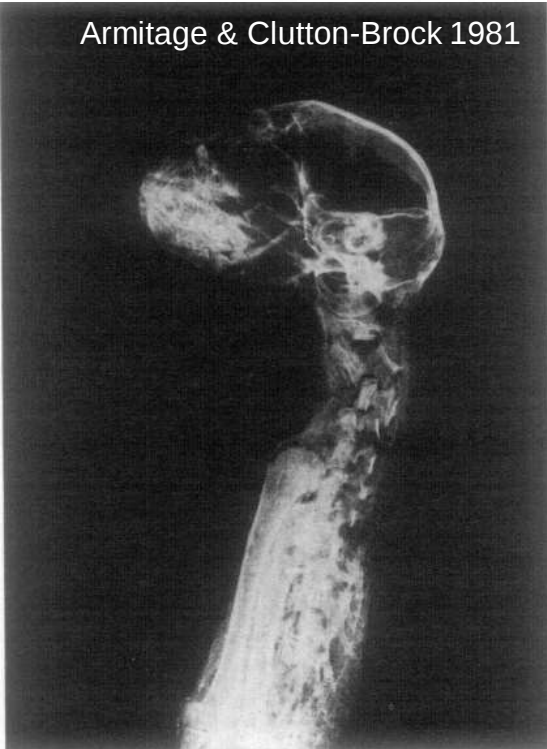
Cat statuette and Bastet statuette
(photos: Metropolitan Art Museum New York)

1st mill BC – 4th cent. AD

Archeological evidence

Egypt

Armitage & Clutton-Brock 1981



Egyptian cat mummy
(credits: NHM)

Votive offerings

Cats were held in households, but also in temple precincts and killed as votive offerings to the goddess Bastet.

1st mill BC – 4th cent. AD

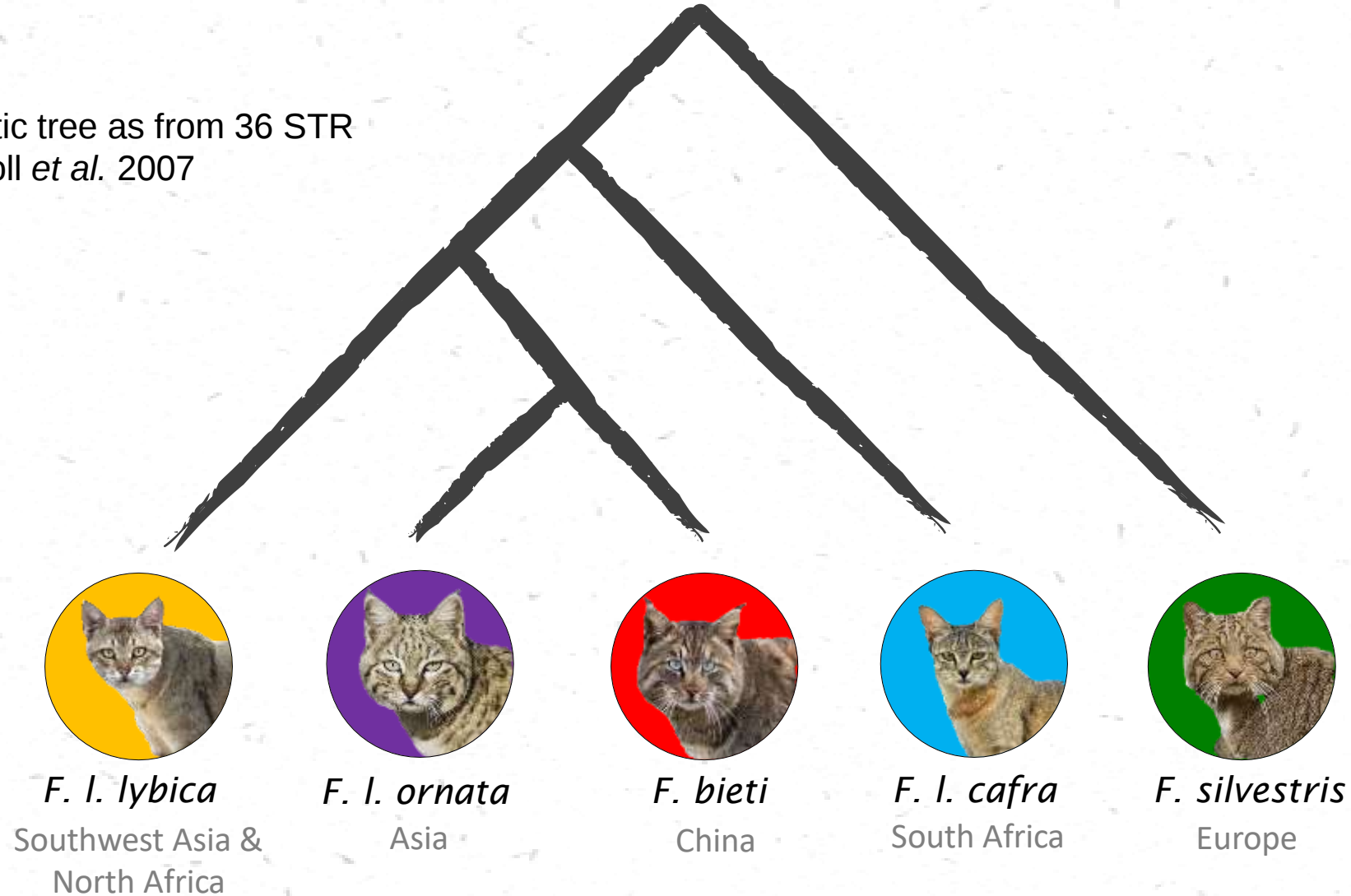
Wildcat distribution



Genetic evidence

Modern DNA

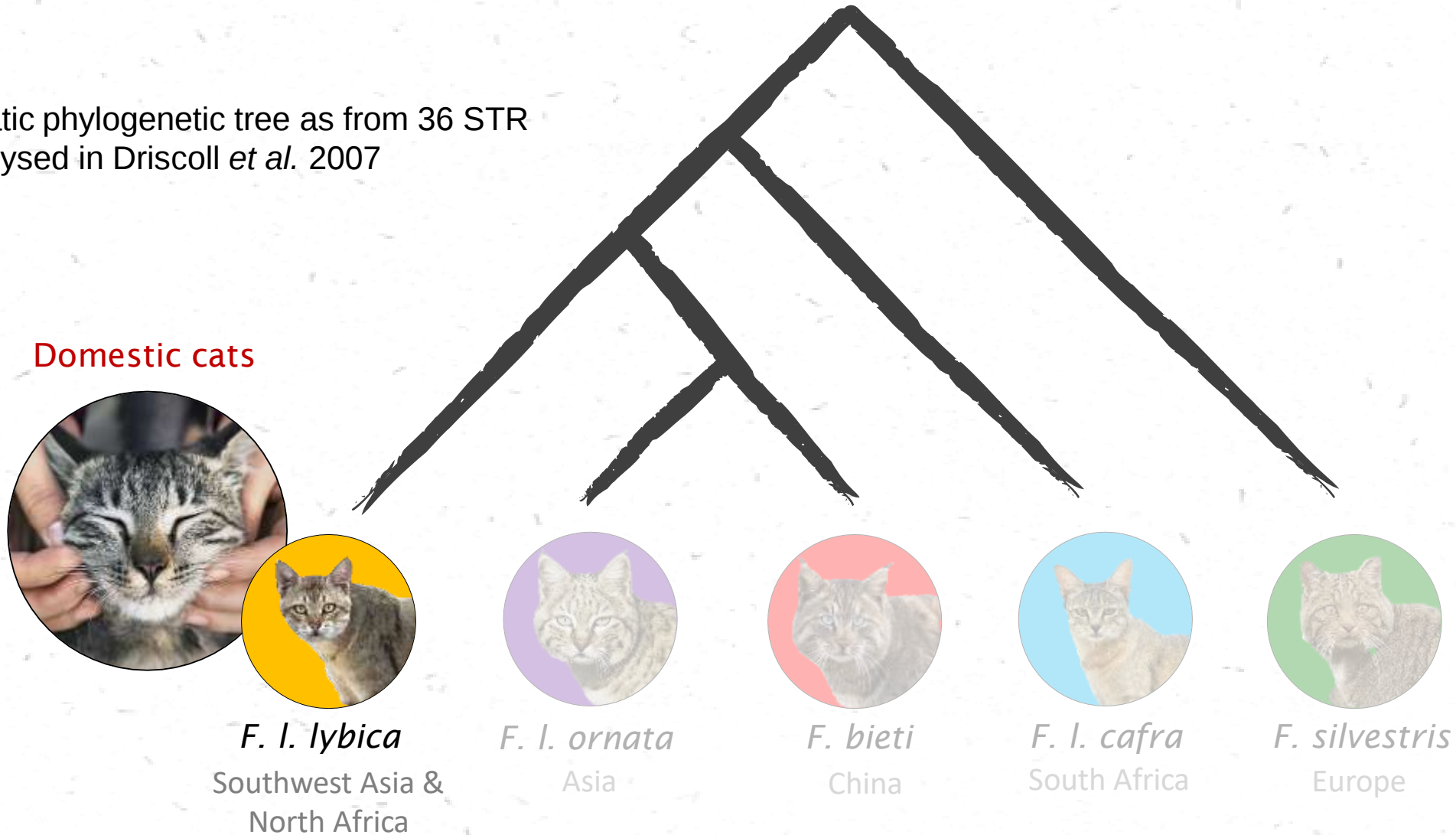
Schematic phylogenetic tree as from 36 STR loci analysed in Driscoll *et al.* 2007



Genetic evidence

Modern DNA

Schematic phylogenetic tree as from 36 STR loci analysed in Driscoll *et al.* 2007



Genetic evidence

Ancient DNA

Over 350 specimens investigated (of which 52 mummies)
209 mtDNAs reconstructed



Sampling cat mummies at the
NHM of London (2012)



Eva-Maria Geigl



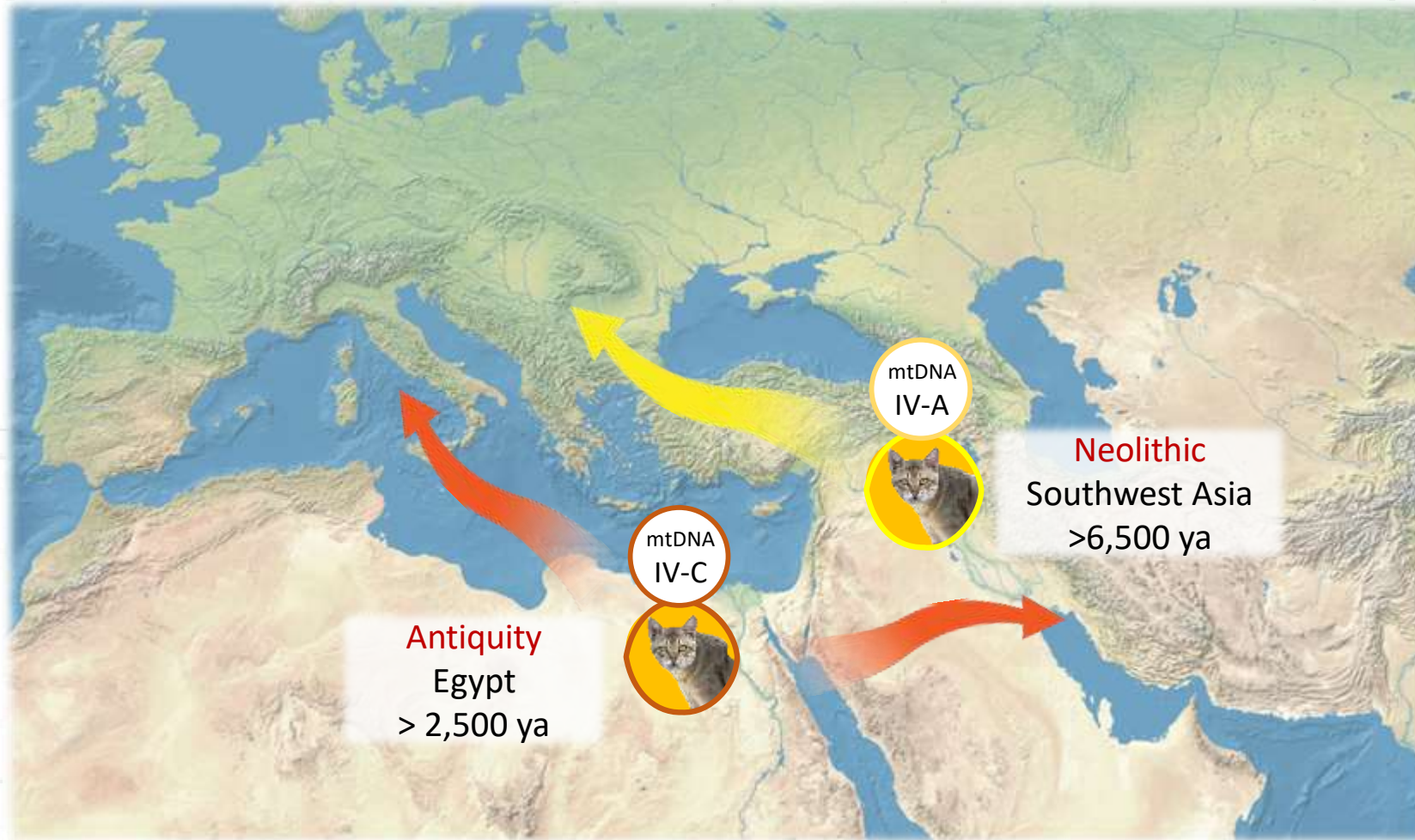
Thierry Grange

Wim Van Neer
Bea De Cupere
Ronny Decorte

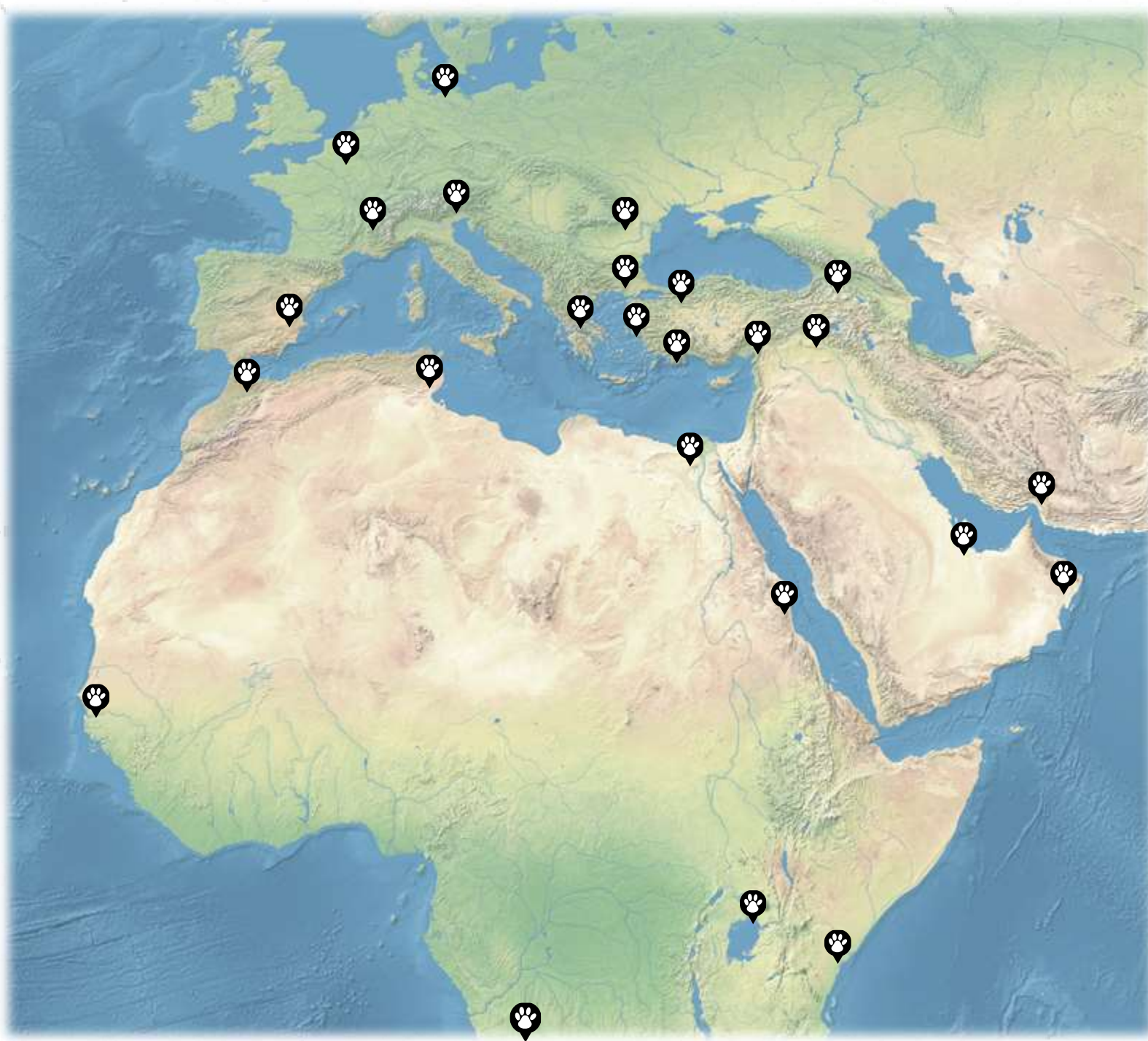


mtDNA from ancient cats

Two main genetic contributions



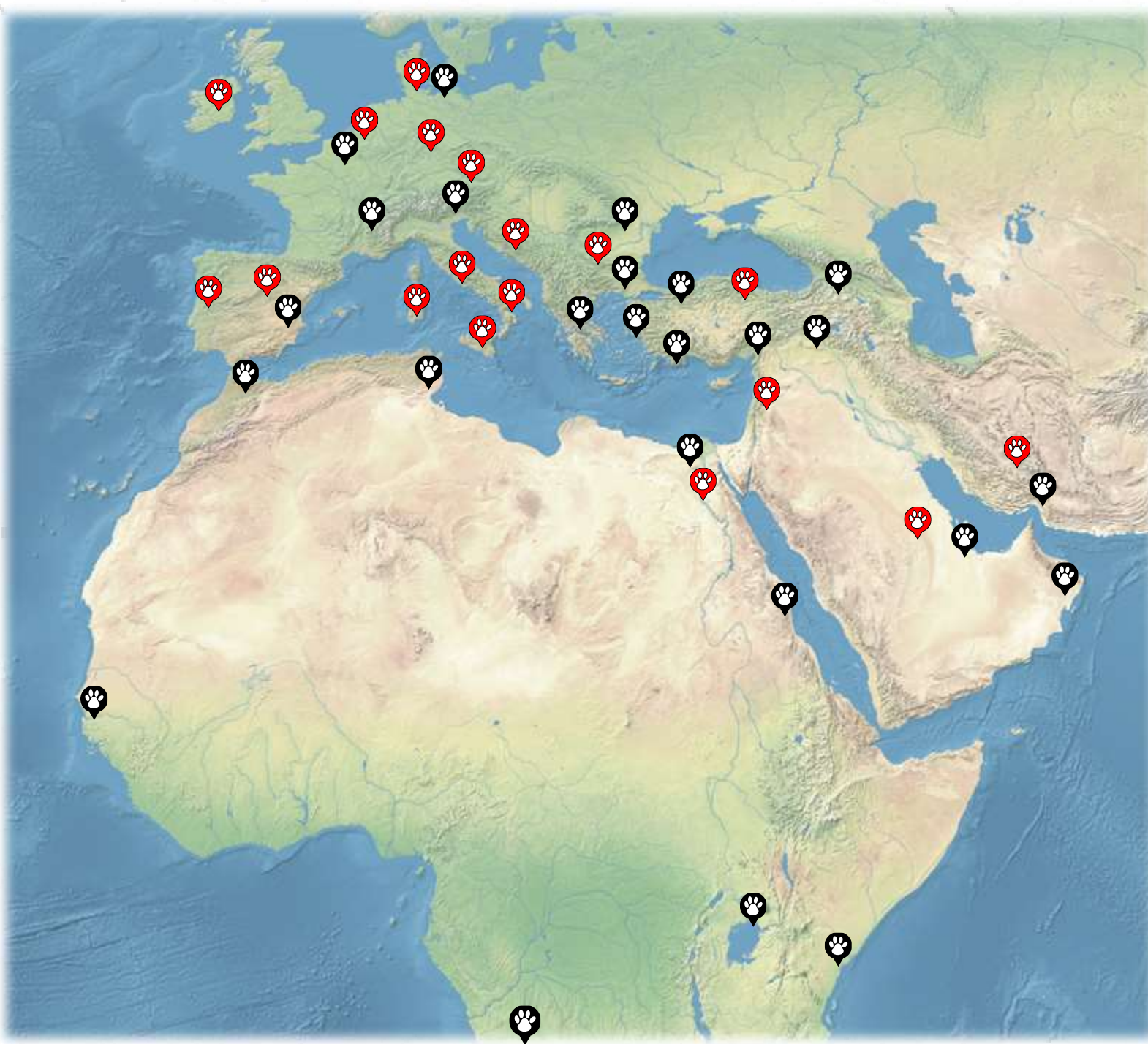
Samples



European Research Council
Established by the European Commission

Samples

- More than 1000 specimens
- From more than 20 kya to the 19th century
- Modern wildcats



European Research Council
Established by the European Commission

Times of cat dispersal into Europe



Genome-wide data generated



De Martino et al. (biorXiv, in review)

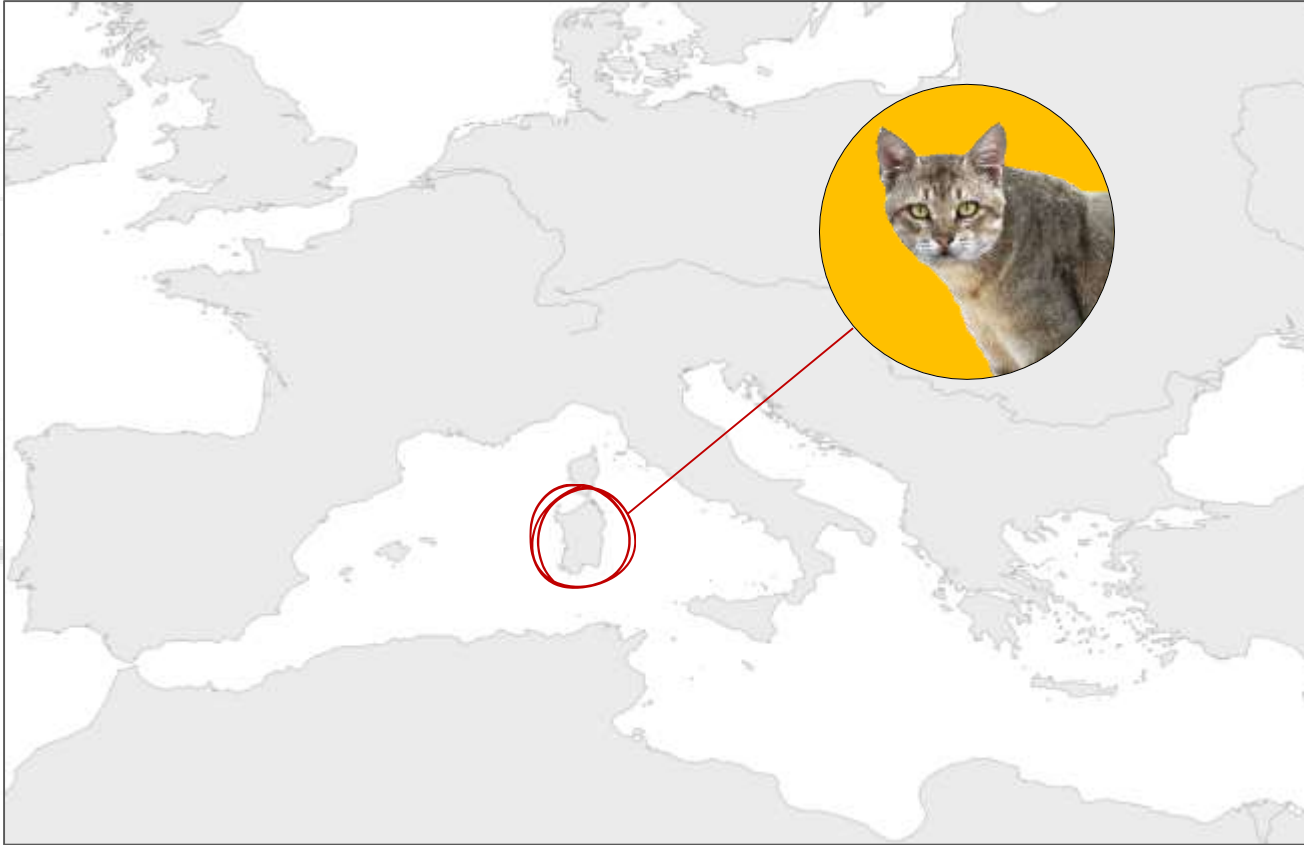
70 Ancient cats
coverage 0.2–1.4 X
from the last 12,000 years

14 Present-day wildcats
coverage 6–14 X
4 from Sardinia (*F. l. lybica*)
2 from North Africa (*F. l. lybica*)



- ⊠ Paleolithic/Mesolithic
- ◆ Neolithic/Chalcolithic
- + Bronze/Iron Age
- ▼ Antiquity/Roman
- post-Roman
- 20th cent. CE wild
- △ modern

Wildcats in Sardinia



***F. l. lybica* in Sardinia**

Introduced in the Neolithic ?
Feral form of domestic cats ?

Reference genome data

44 Modern high-coverage genomes publicly available



13 *F. silvestris* (Germany, Scotland)



3 *F. l. lybica* (Israel)



4 *F. l. ornata* (Kazakhstan, Tajikistan, China)



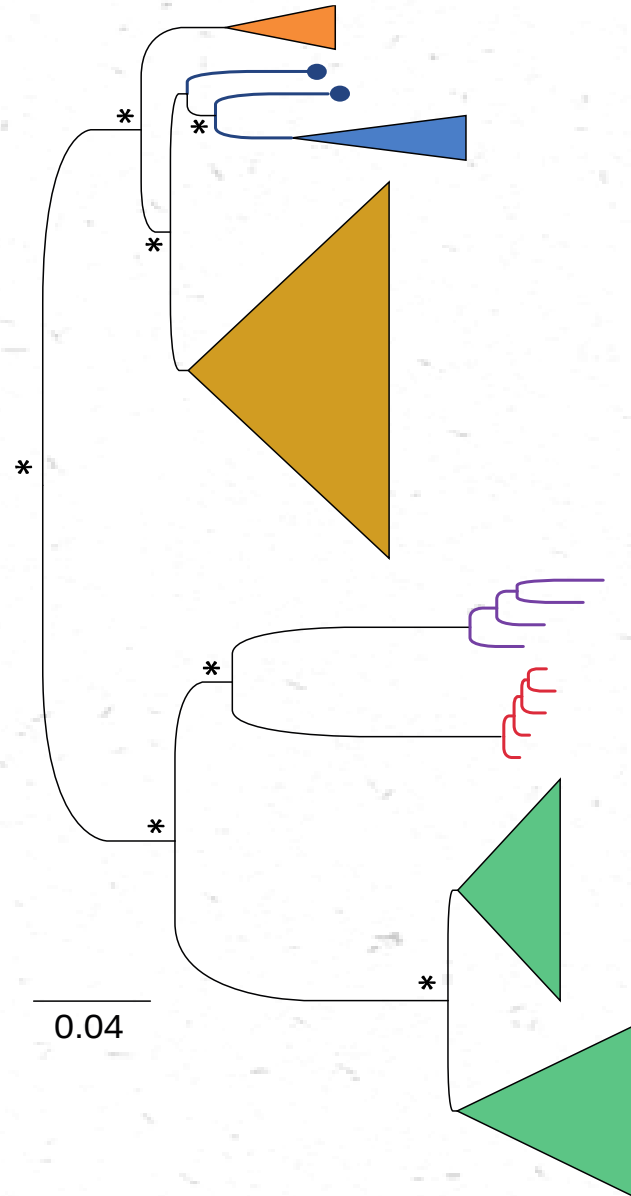
5 *F. bieti* (China)



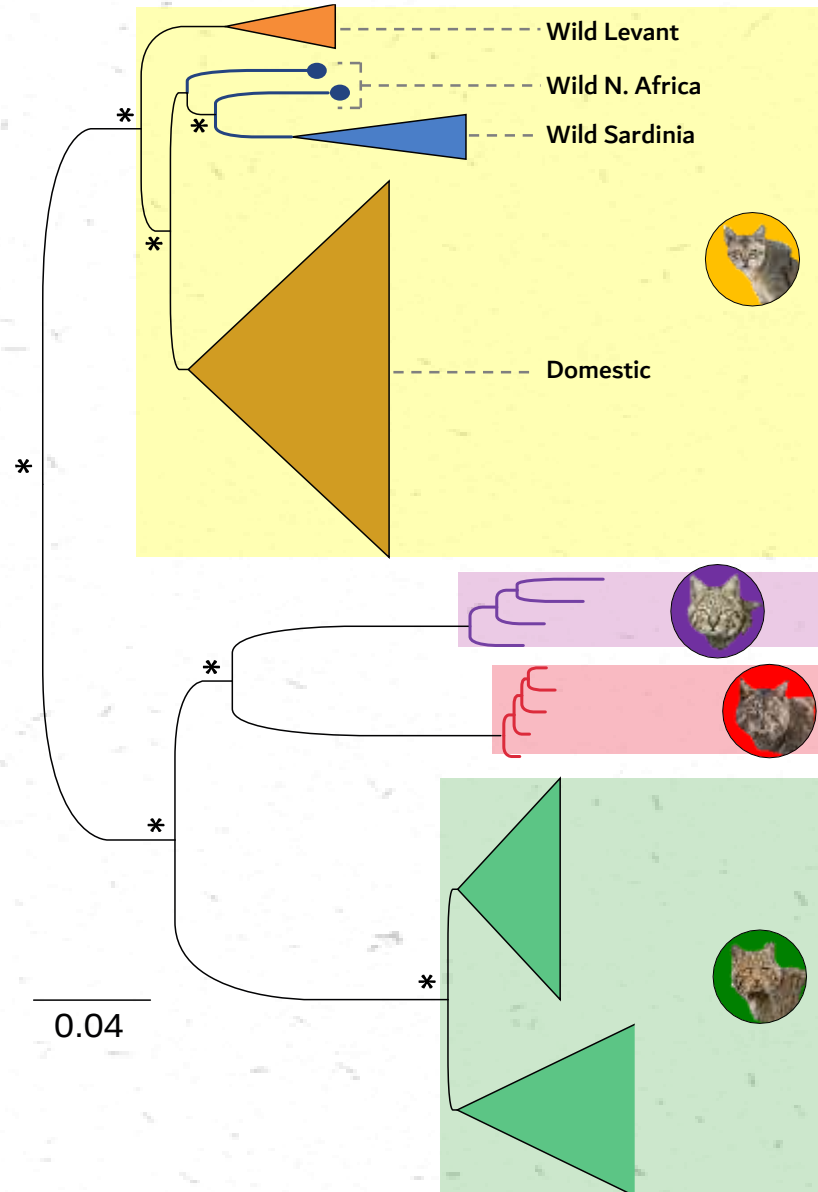
18 Domestic cats (breeds & random-bred)



+1 *Felis chaus*
(outgroup)



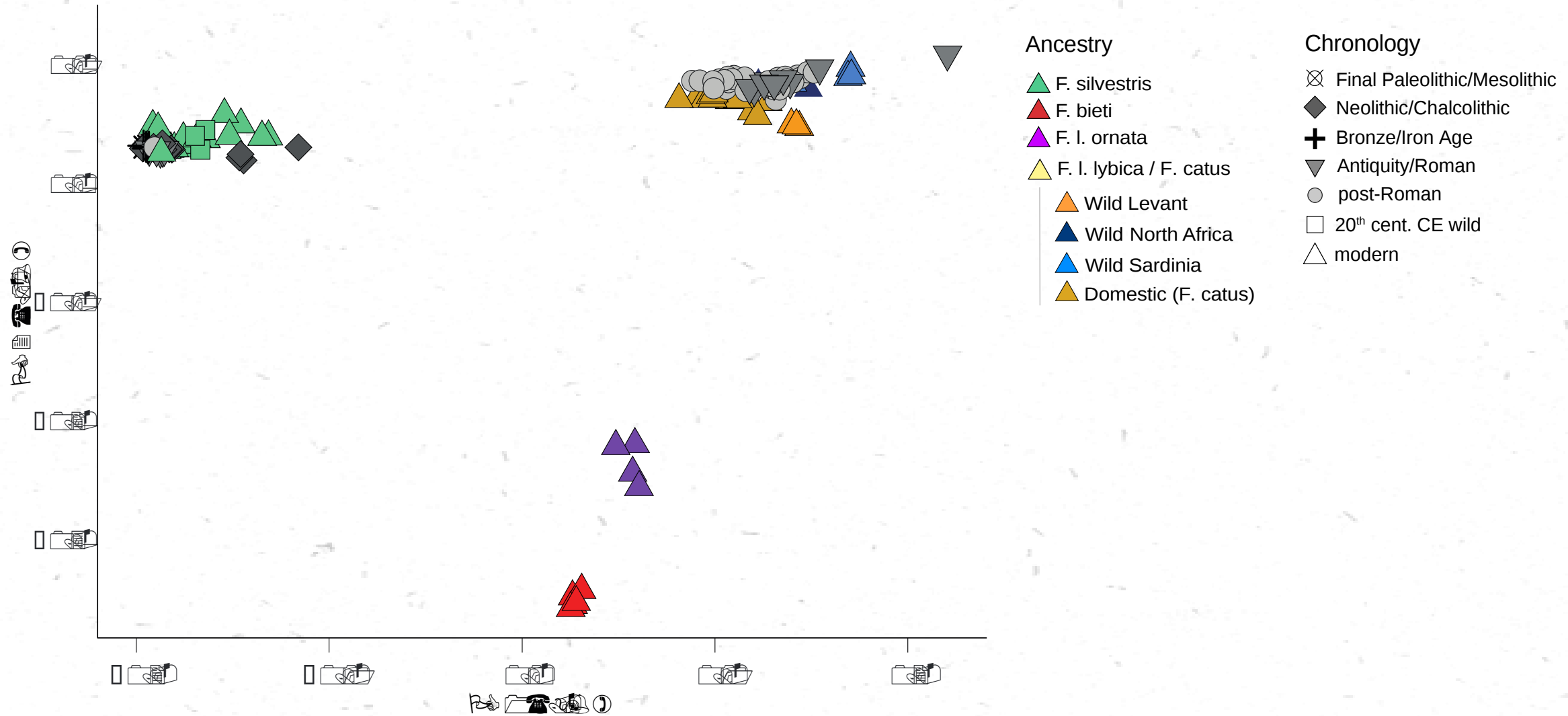
Supermatrix tree of modern genomes



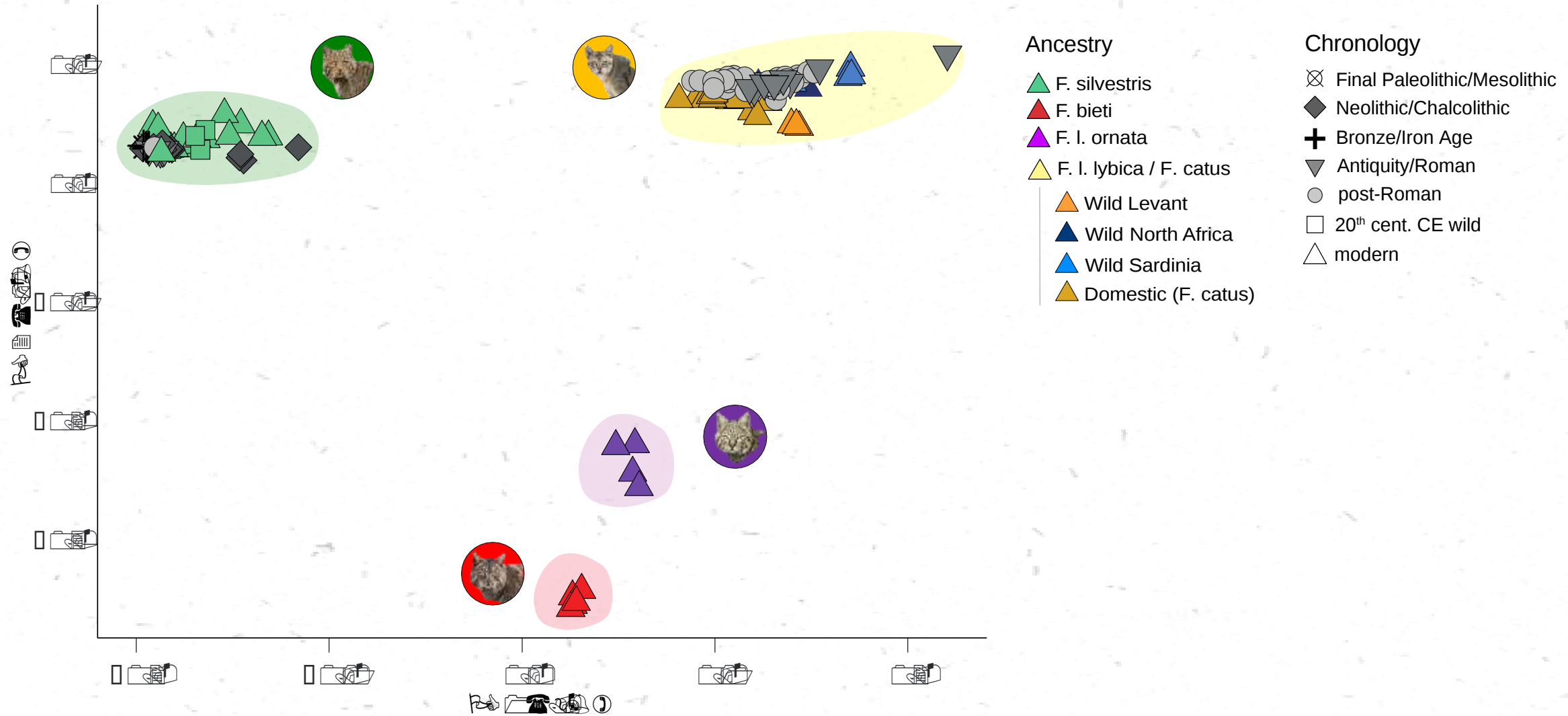
Supermatrix tree of modern genomes

- Genetic structure in *F. l. lybica*
Wildcats from the Levant, wildcats from North Africa and domestic cats are distinct.
- Sardinian wildcats are not feral
They originated from North African wildcats.

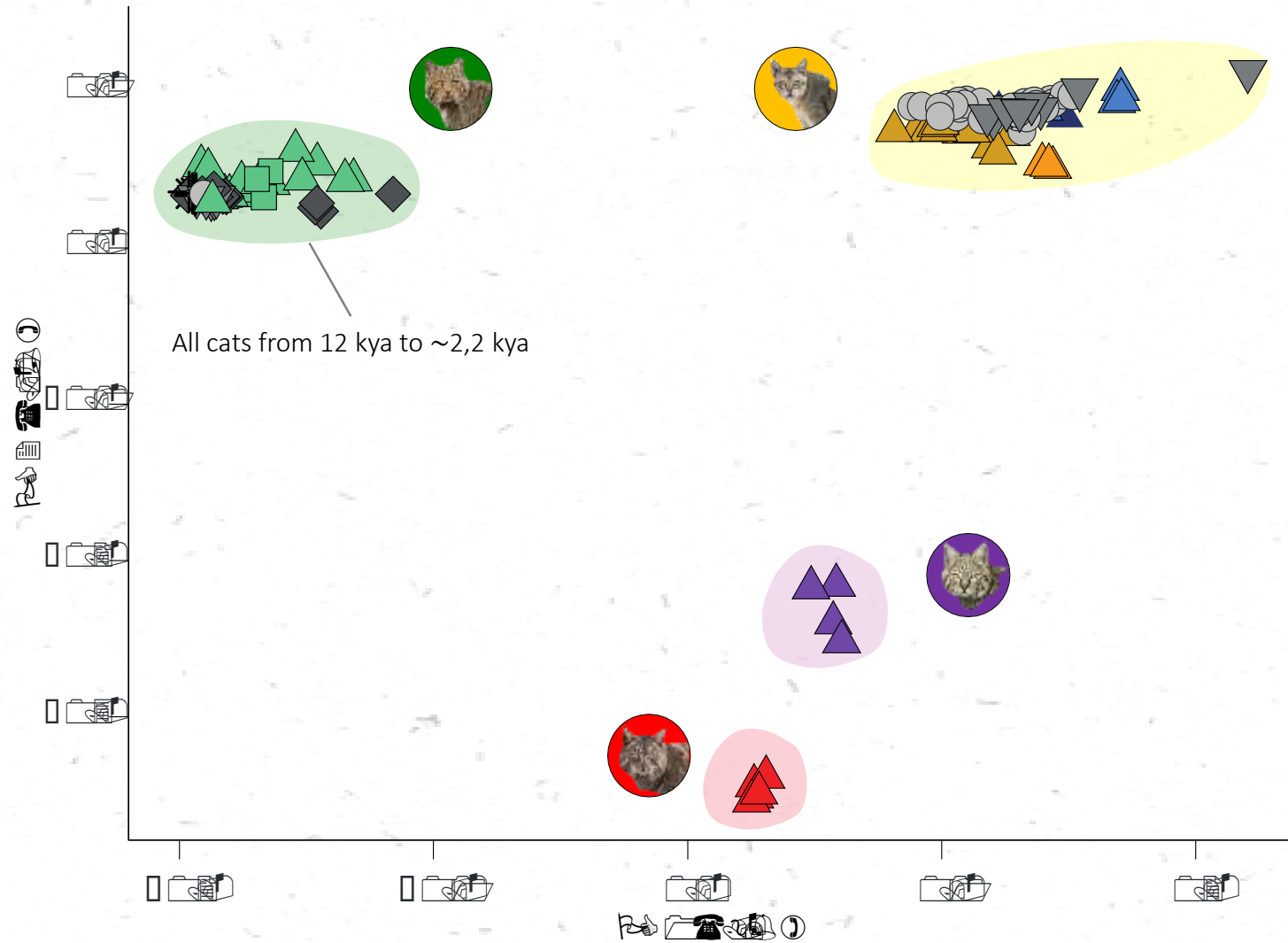
PCA



PCA



PCA



Ancestry

- ▲ *F. silvestris*
- ▲ *F. bieti*
- ▲ *F. l. ornata*
- ▲ *F. l. lybica* / *F. catus*
- ▲ Wild Levant
- ▲ Wild North Africa
- ▲ Wild Sardinia
- ▲ Domestic (*F. catus*)

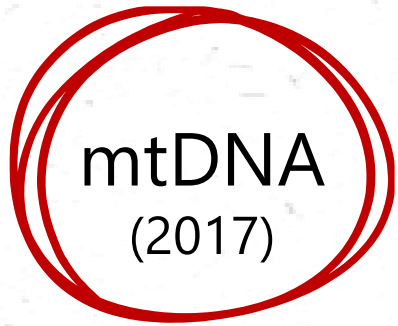
Chronology

- ⊗ Final Paleolithic/Mesolithic
- ◆ Neolithic/Chalcolithic
- ⊕ Bronze/Iron Age
- ▼ Antiquity/Roman
- post-Roman
- 20th cent. CE wild
- △ modern

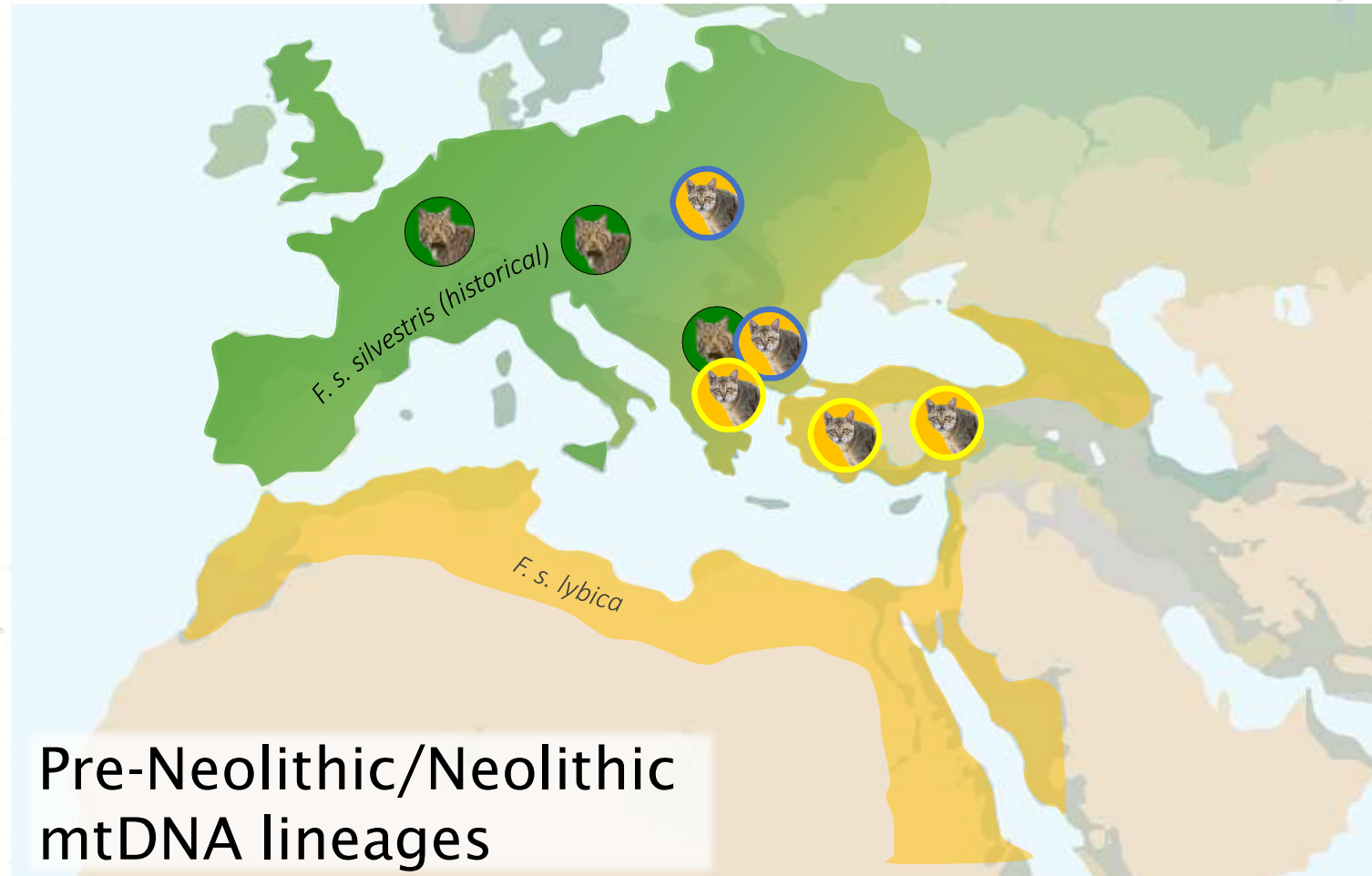
>10,000 to ~2,200 ya
No *F. lybica/catus* was
found in Europe or
Anatolia

Ancient cat genomes

European and Near Eastern ancestries

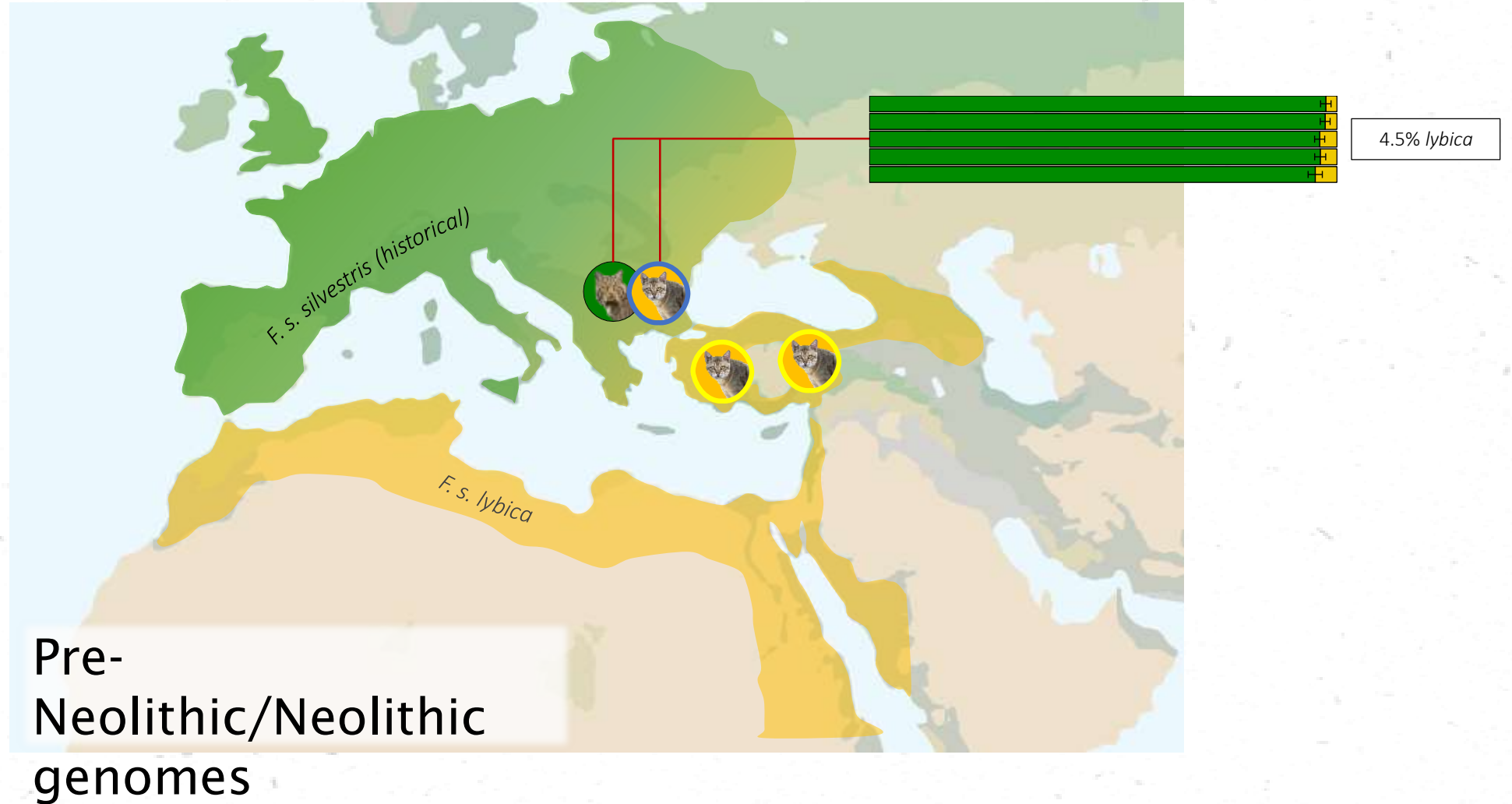
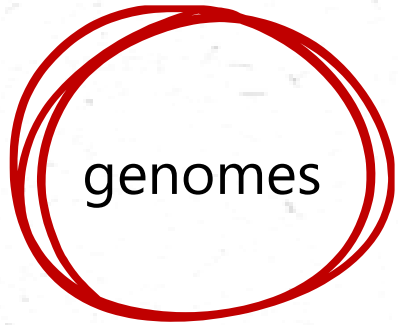


F. lybica in
Anatolia?



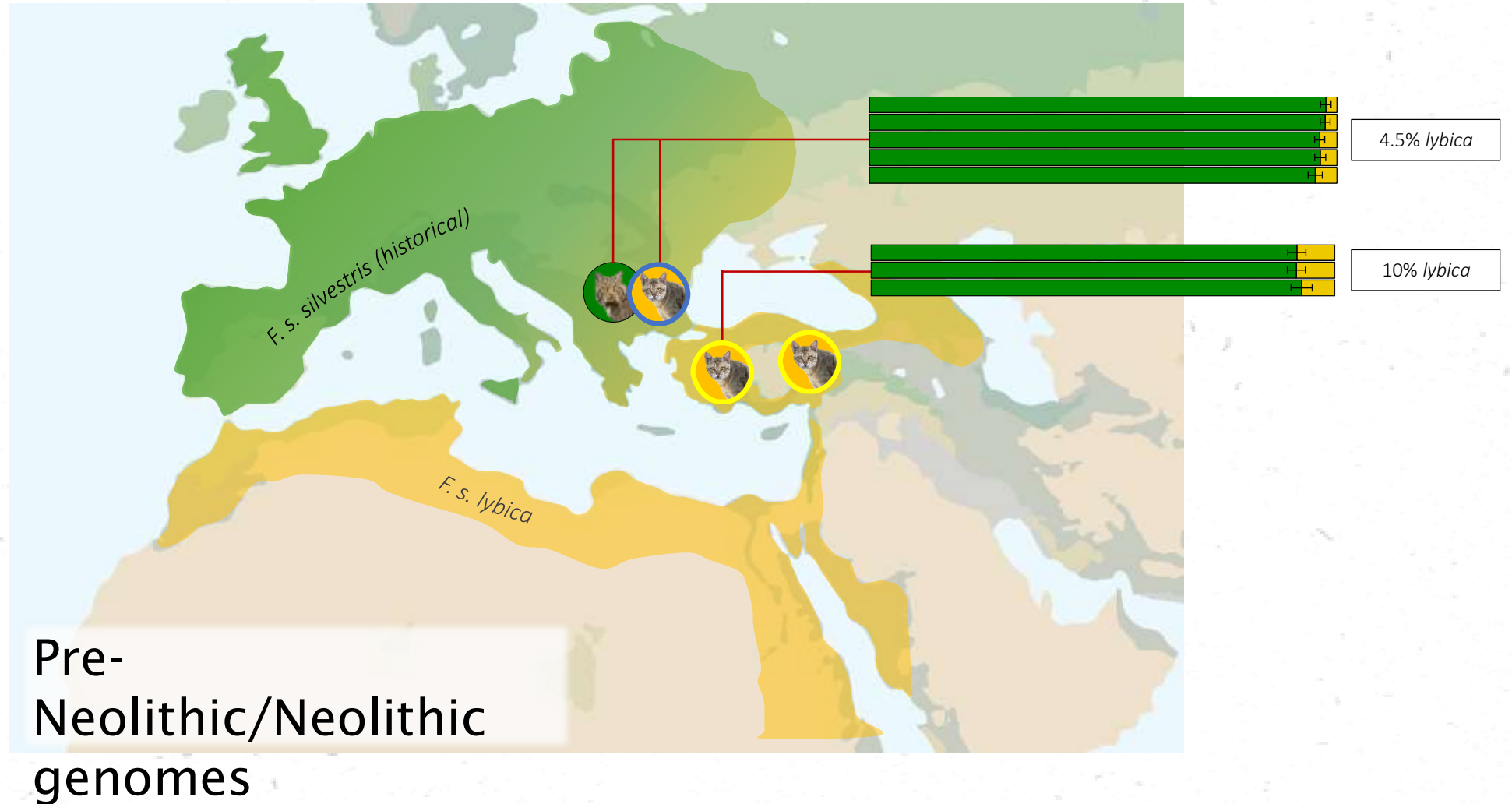
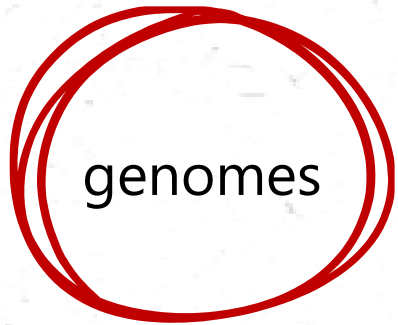
Ancient cat genomes

European and Near Eastern ancestries



Ancient cat genomes

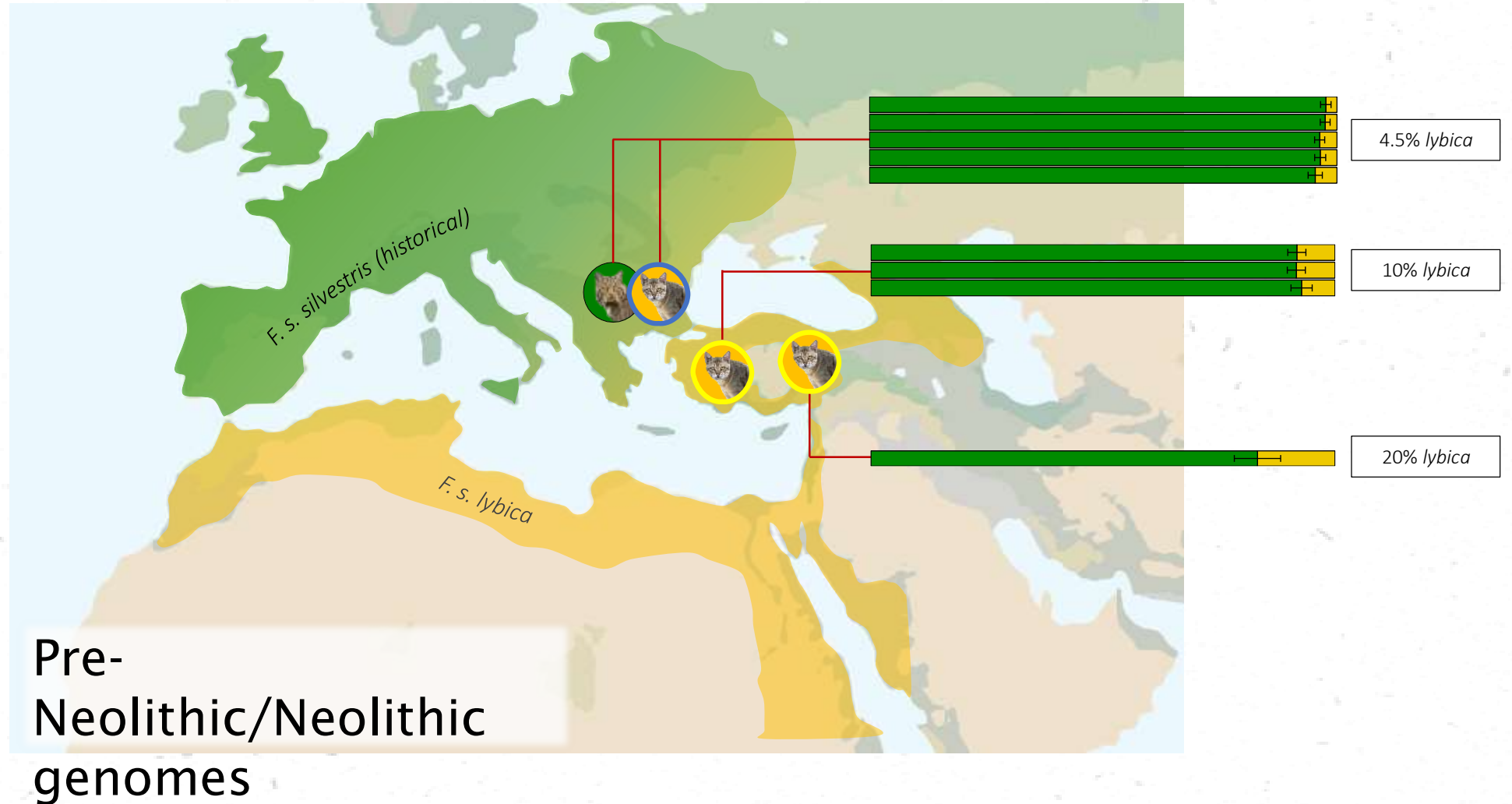
European and Near Eastern ancestries



Ancient cat genomes

European and Near Eastern ancestries

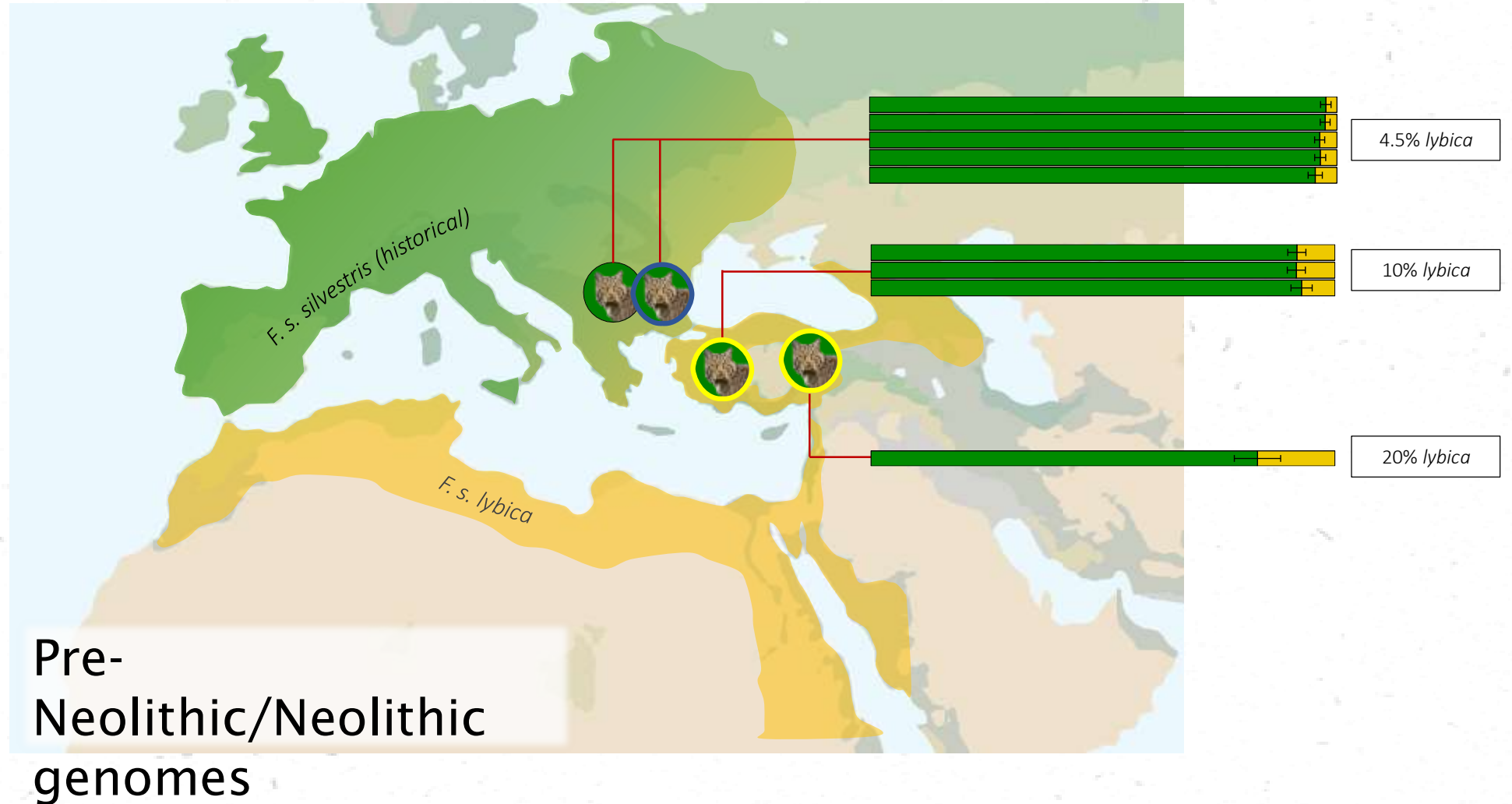
genomes



Ancient cat genomes

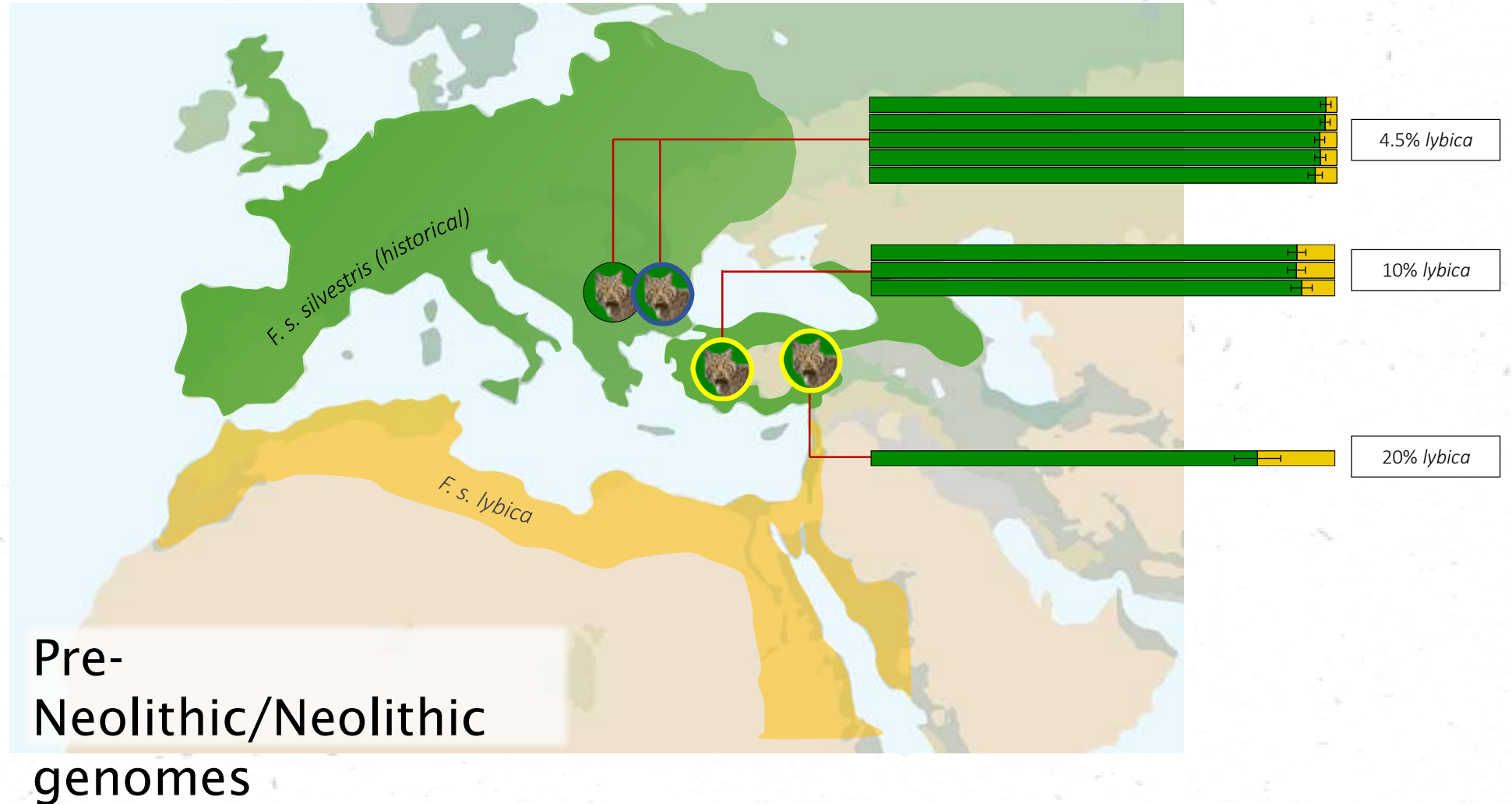
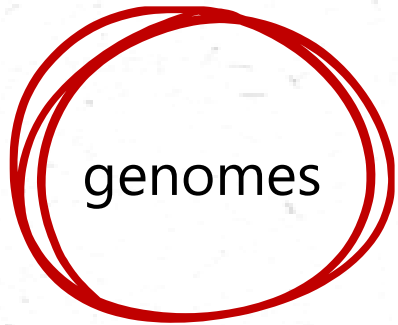
European and Near Eastern ancestries

genomes



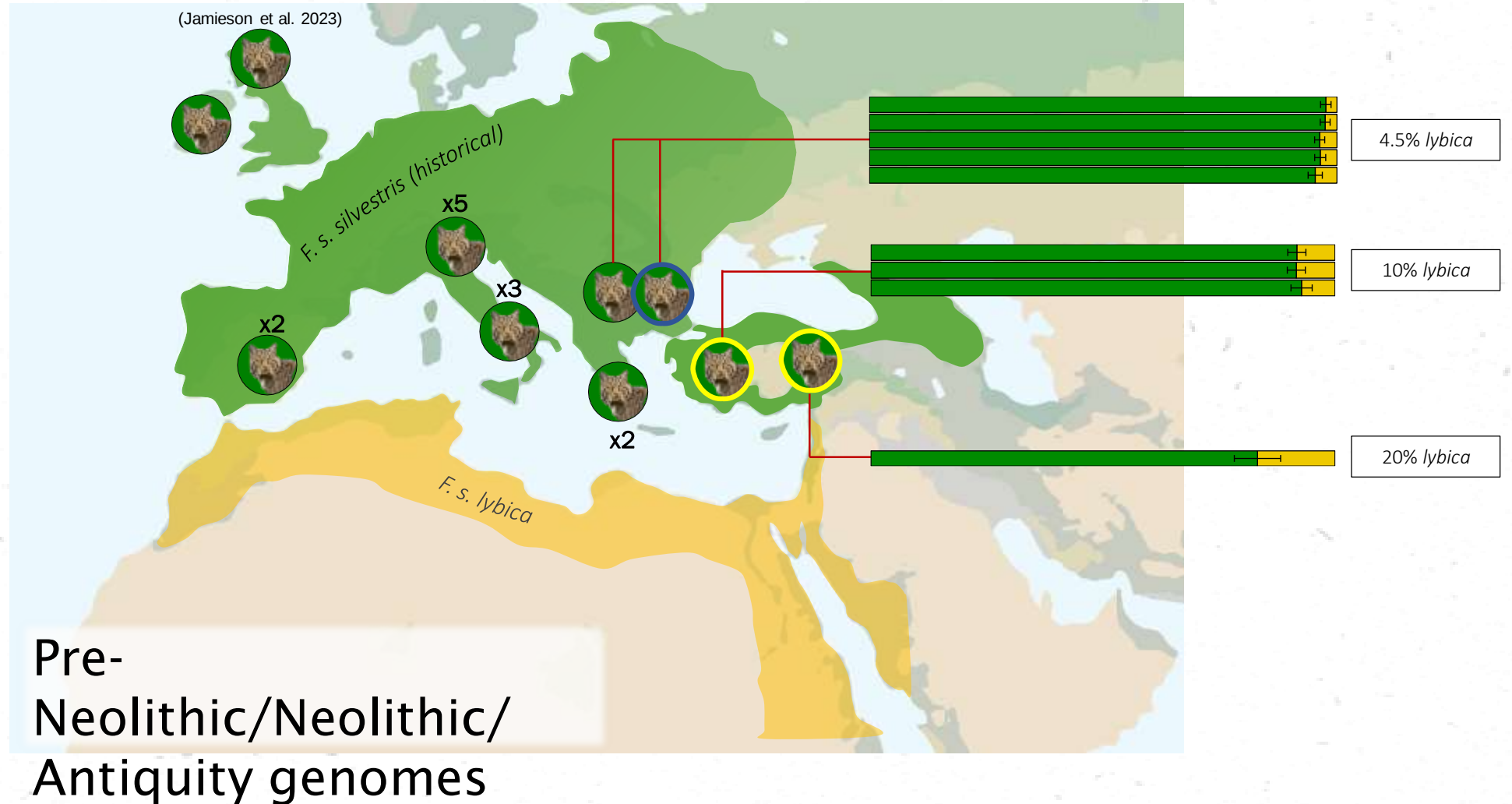
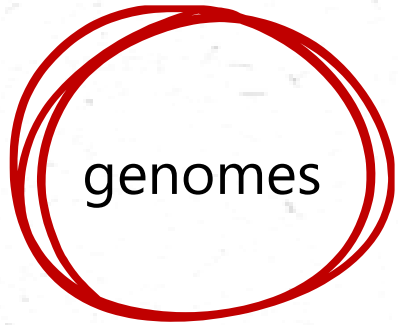
Ancient cat genomes

European and Near Eastern ancestries



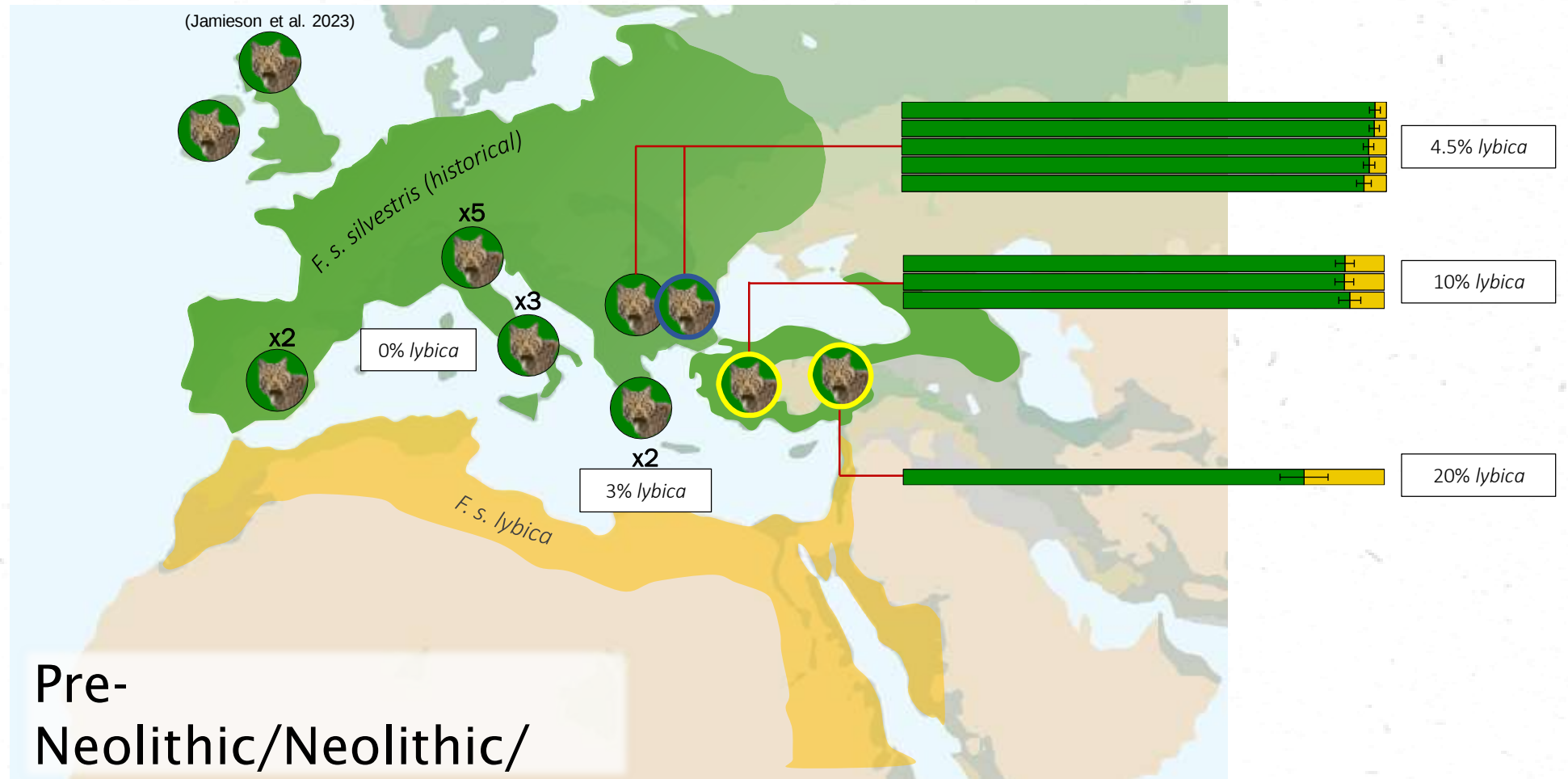
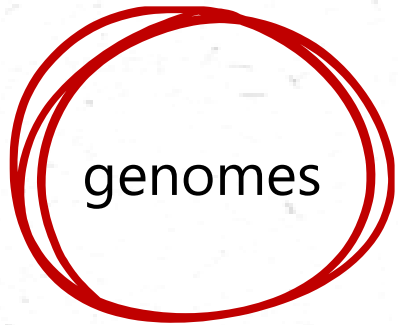
Ancient cat genomes

European and Near Eastern ancestries



Ancient cat genomes

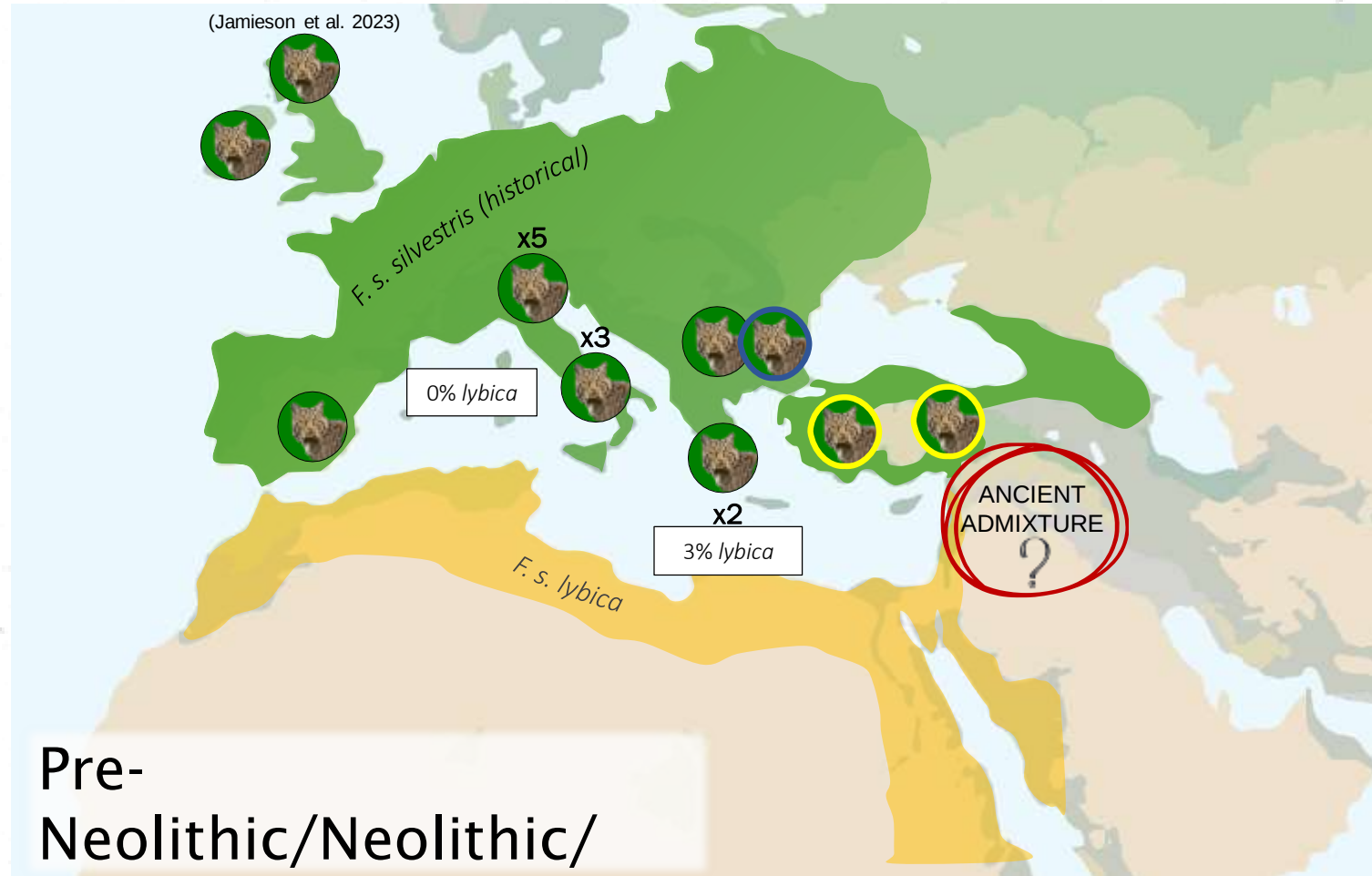
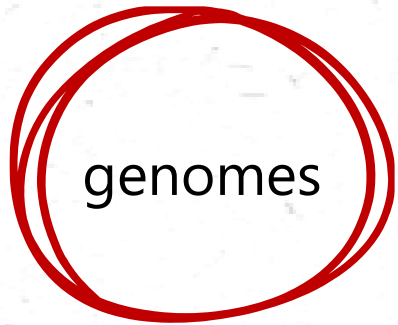
European and Near Eastern ancestries



Pre-
Neolithic/Neolithic/
Antiquity genomes

Ancient cat genomes

European and Near Eastern ancestries



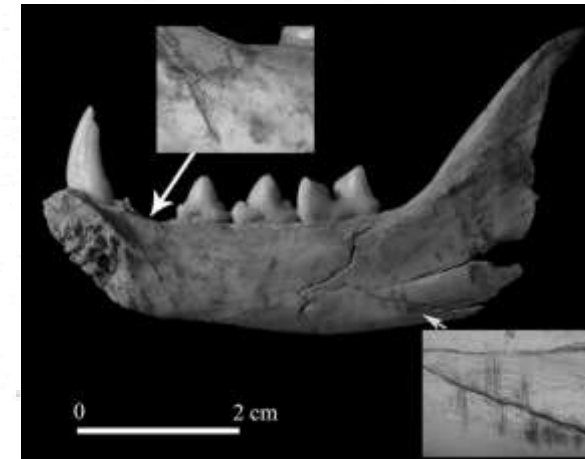
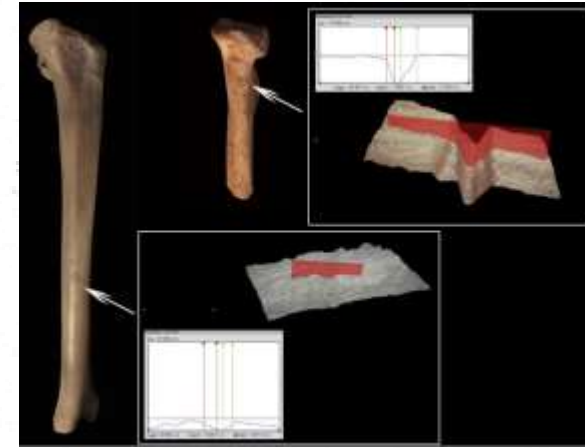
Pre-
Neolithic/Neolithic/
Antiquity genomes

European wildcats & humans

Fur extraction n



British Isles, Danish Ertebølle
Mesolithic
Exploitation of fur bearing mammals.



Dos de la Forca (Northeast Italy)
Mesolithic, 8500-7500 cal BC
Cut marks features and localisation suggest
use of *F. silvestris* as food.

(Crezzini et al. 2014)

Food

European wildcats & humans

Cult ?

Stretto Partanna, Sicily (Italy)

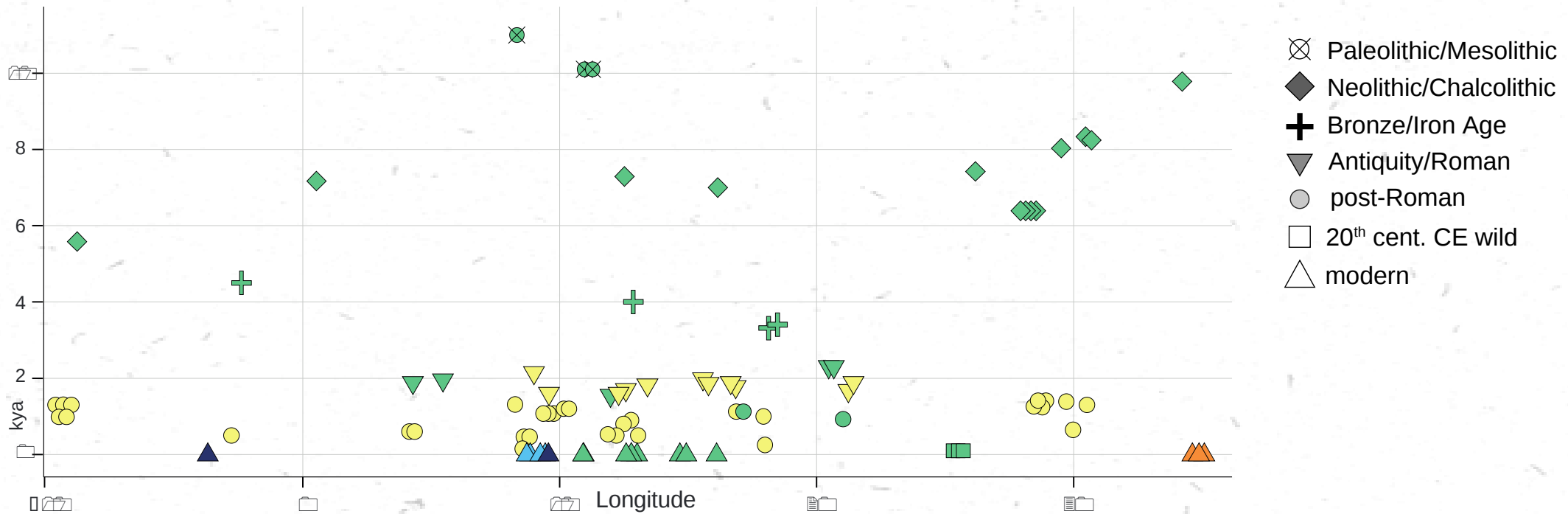
Early Bronze Age

Archaeologists interpreted the context as an expression of religious activities related to a **cult of water**. Inside the large bell-shaped vase, a cat skull was found with other faunal remains

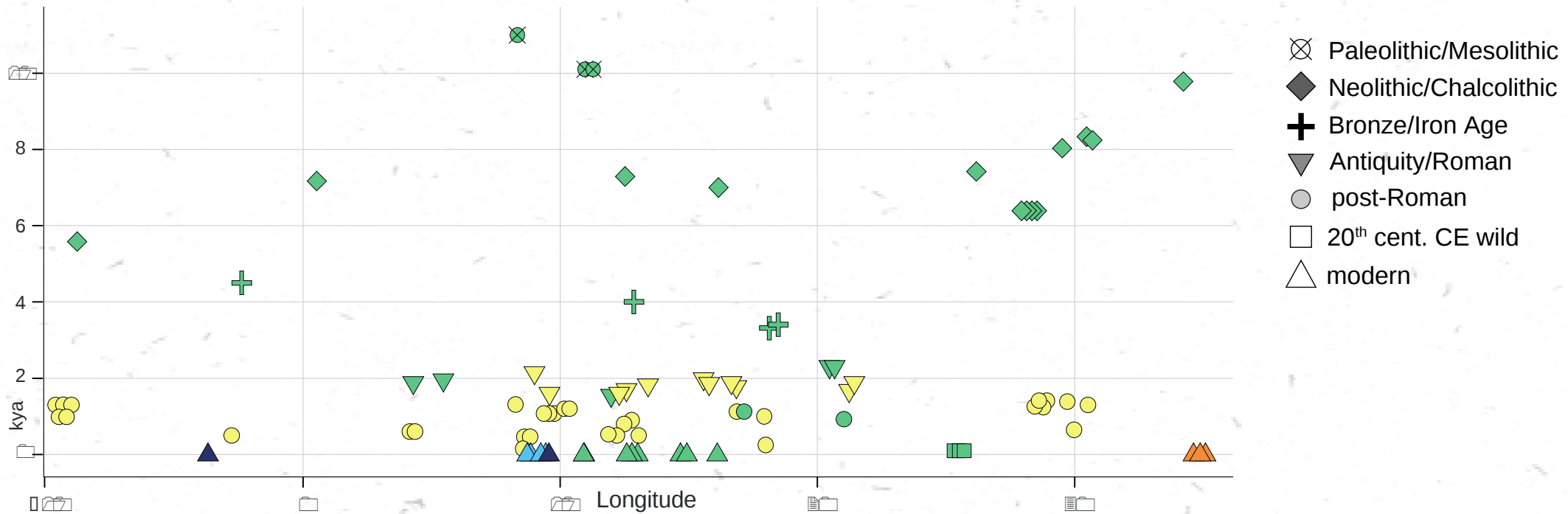


(Micciché et al. 1997)

Cats were not introduced to Europe by farmers during the Neolithic

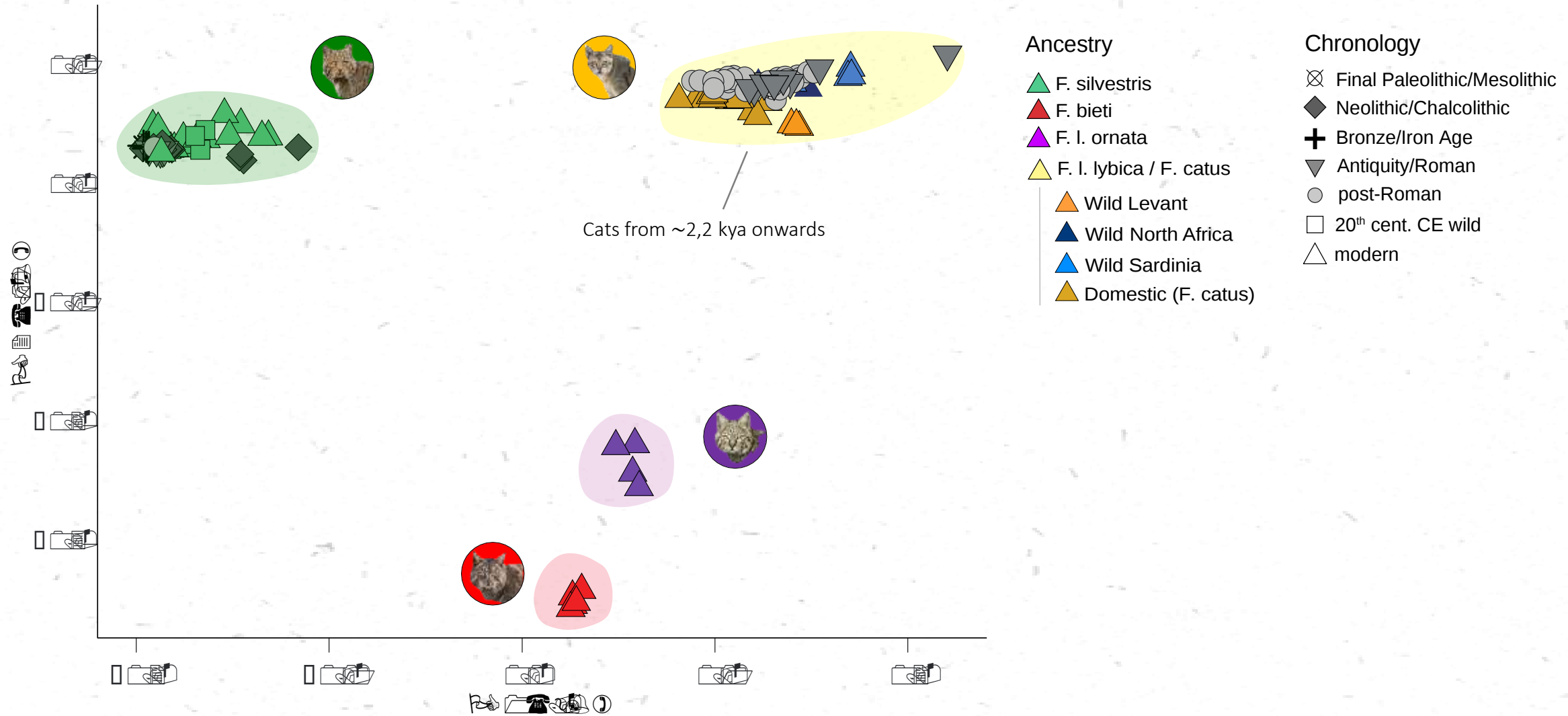


Cats were not introduced to Europe by farmers during the Neolithic



No genetic trace of *F. lybica/catus* in Europe until the 2nd cent. BCE

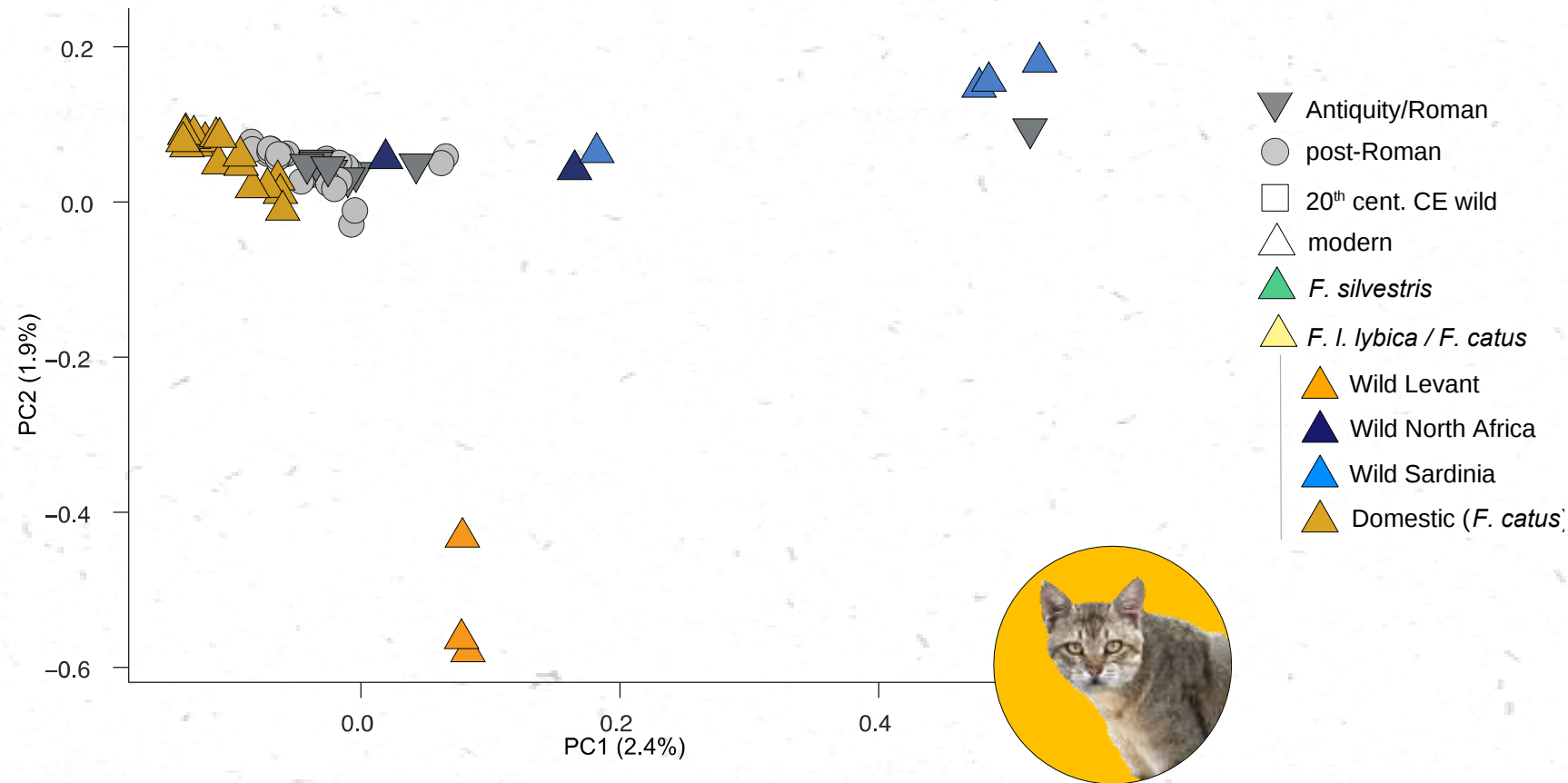
PCA



Places and circumstances of cat dispersal

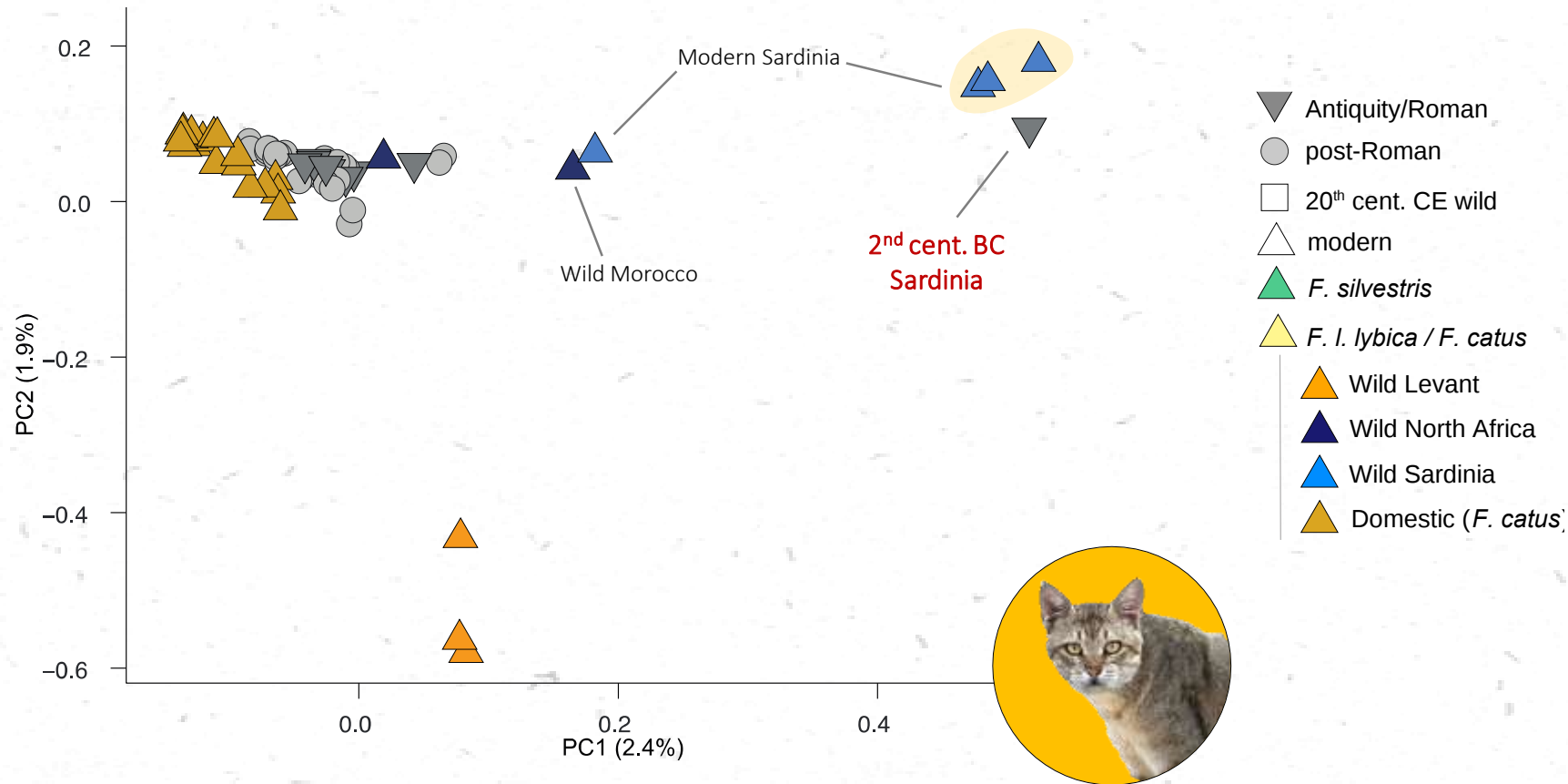


PCA of *Felis lybica*



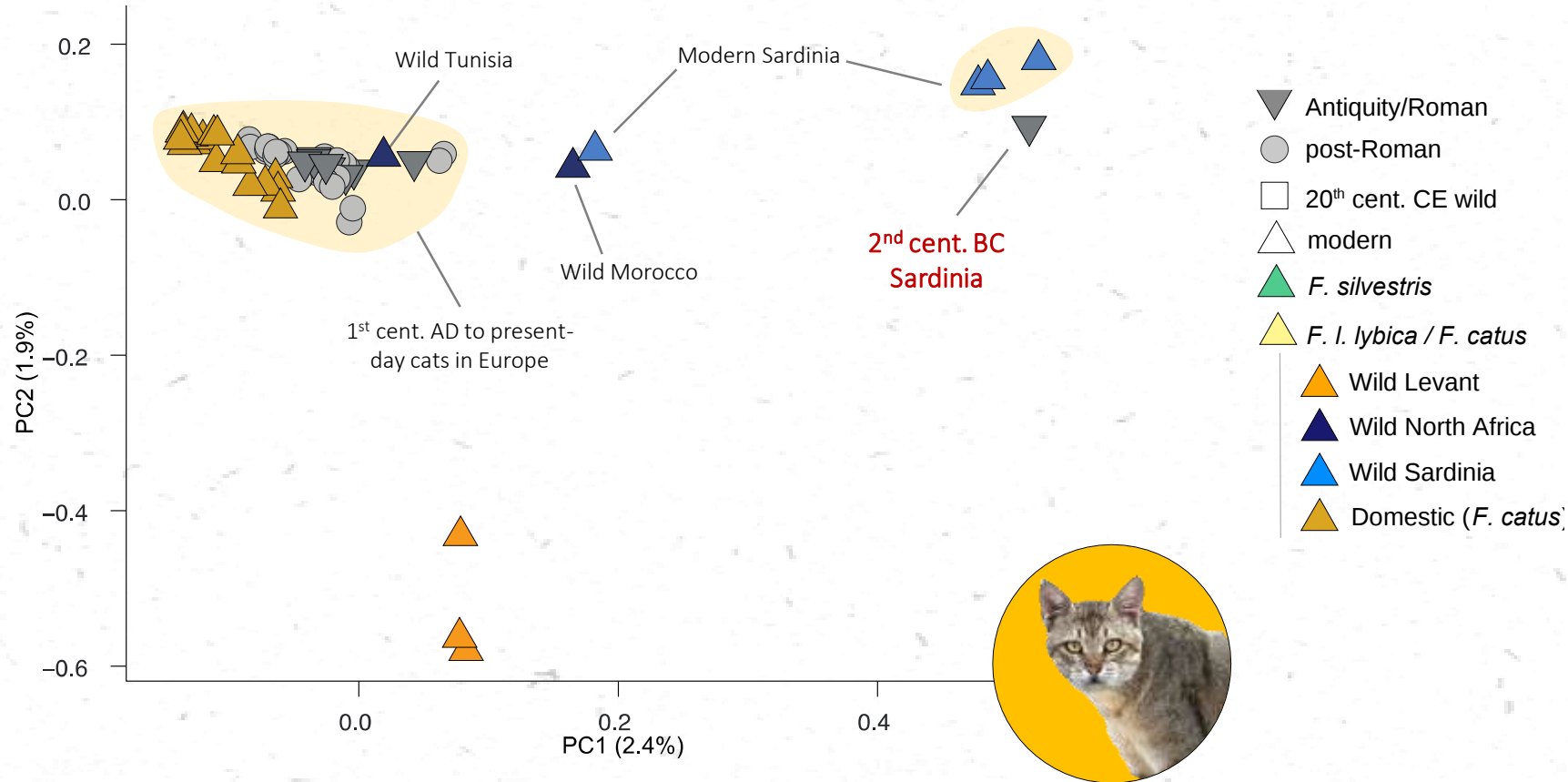
(based on trasversions, ancient samples projected on modern variation)

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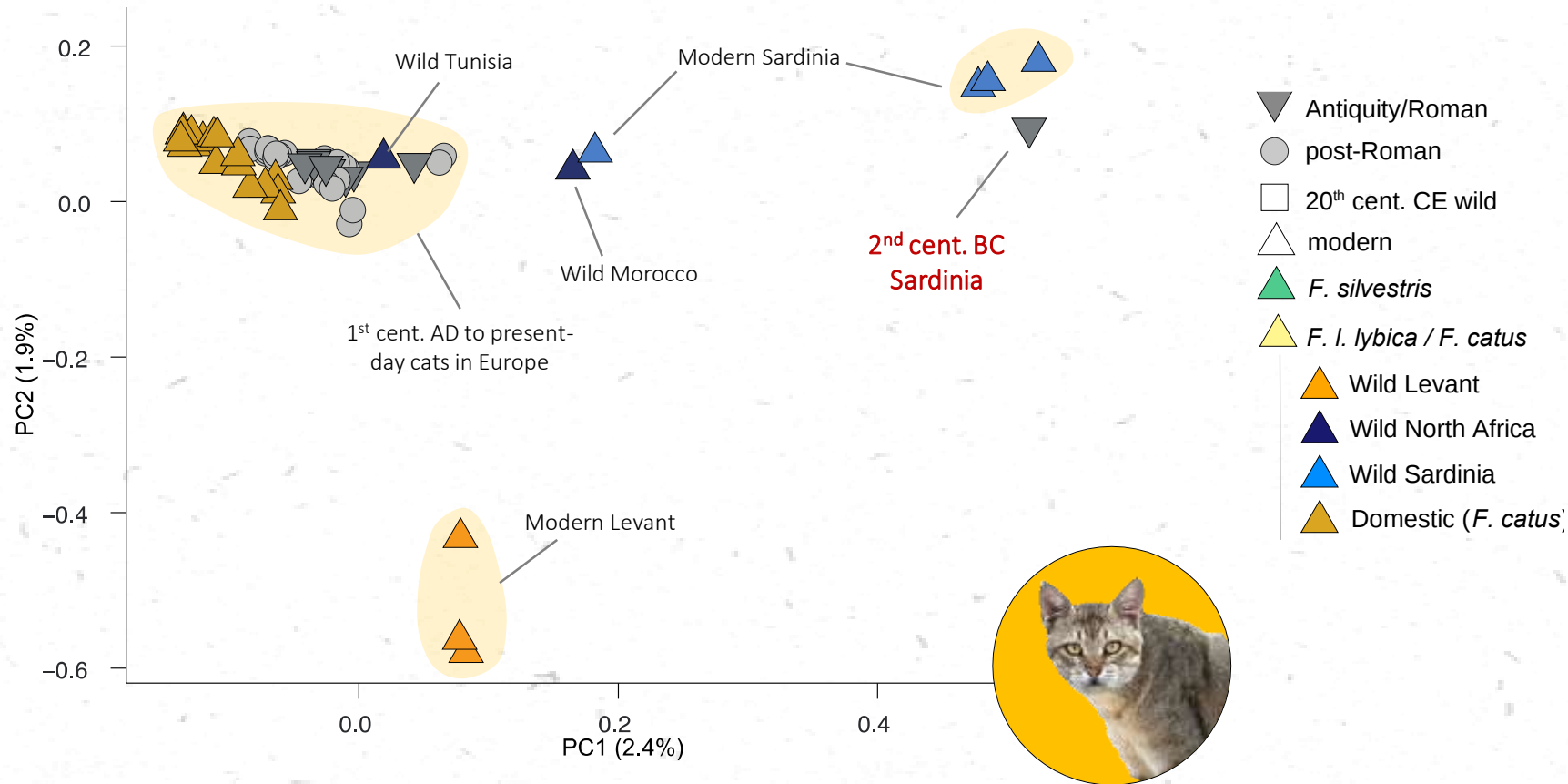


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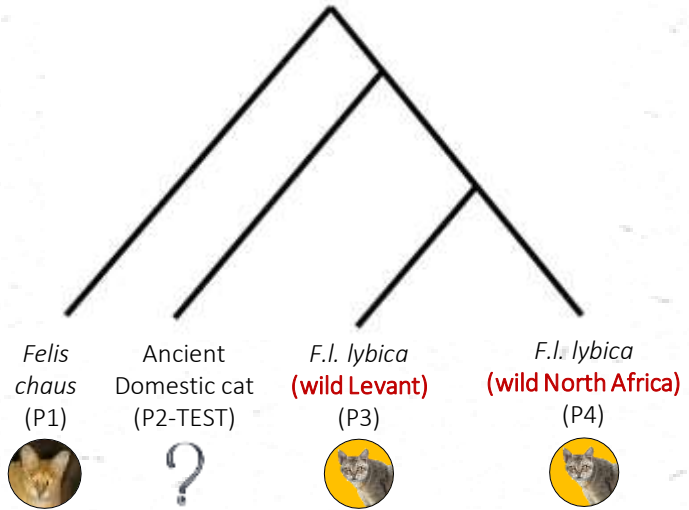


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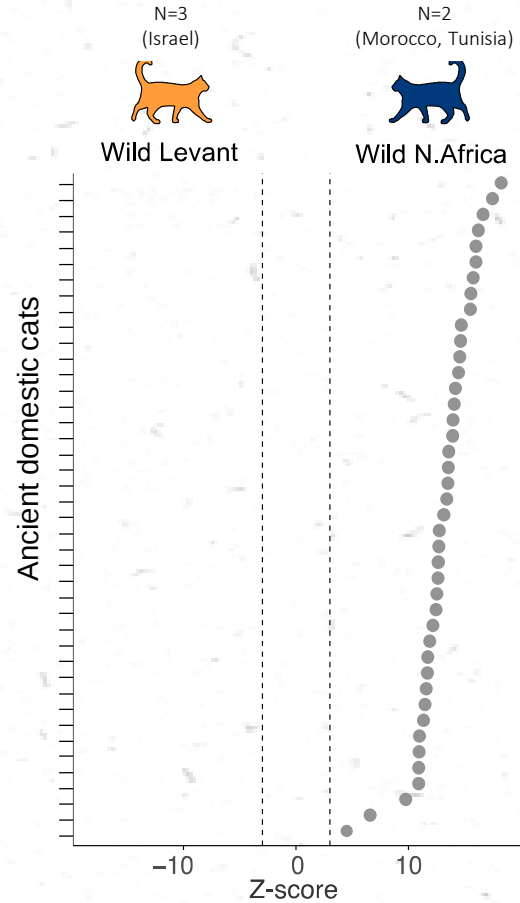
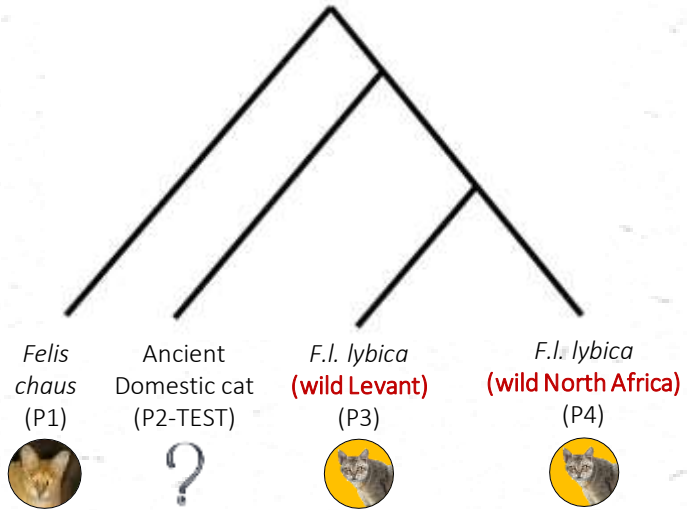


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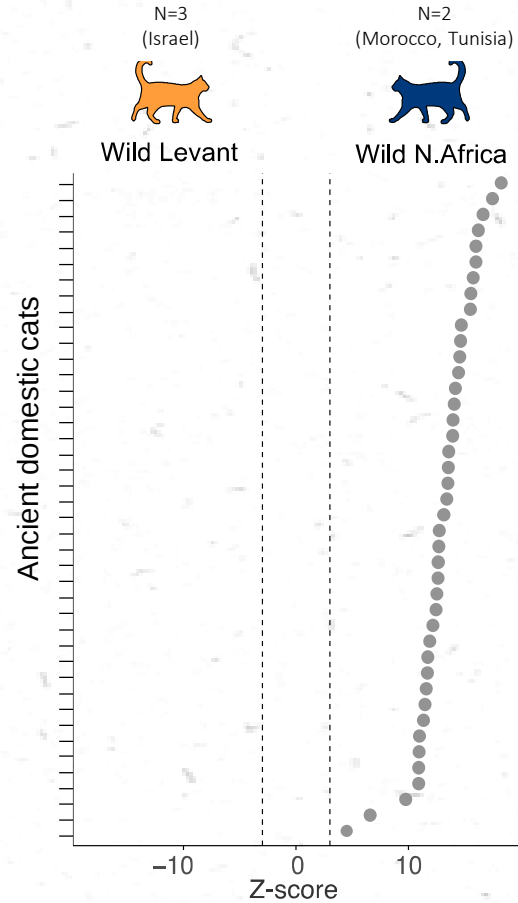
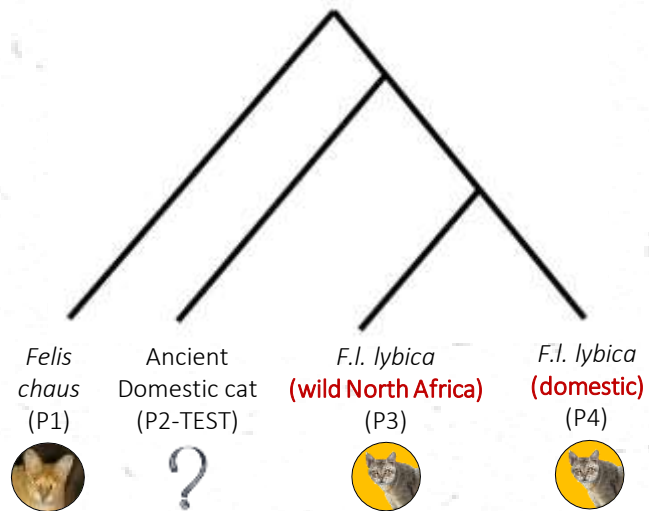
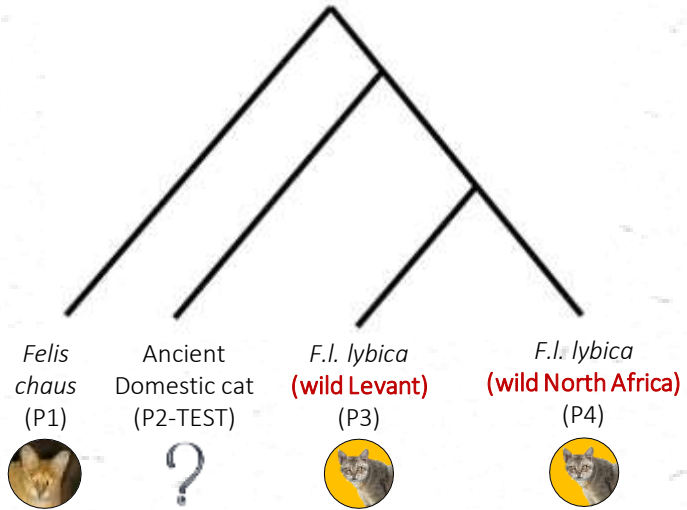
D stats



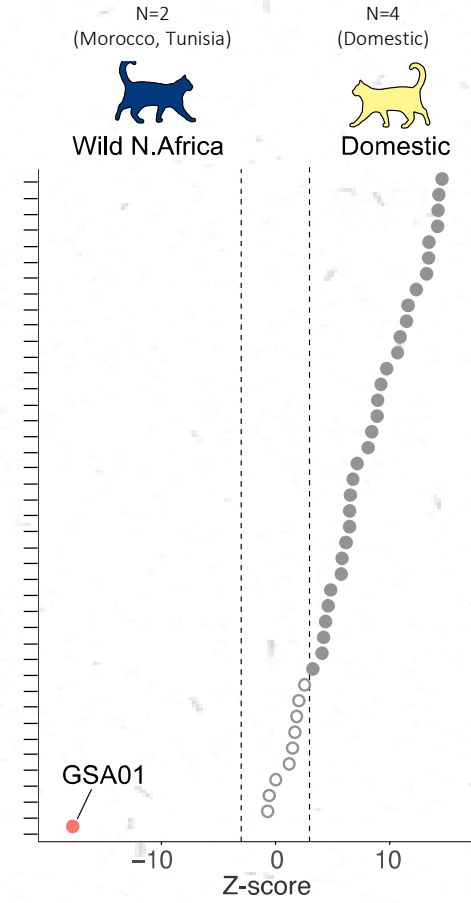
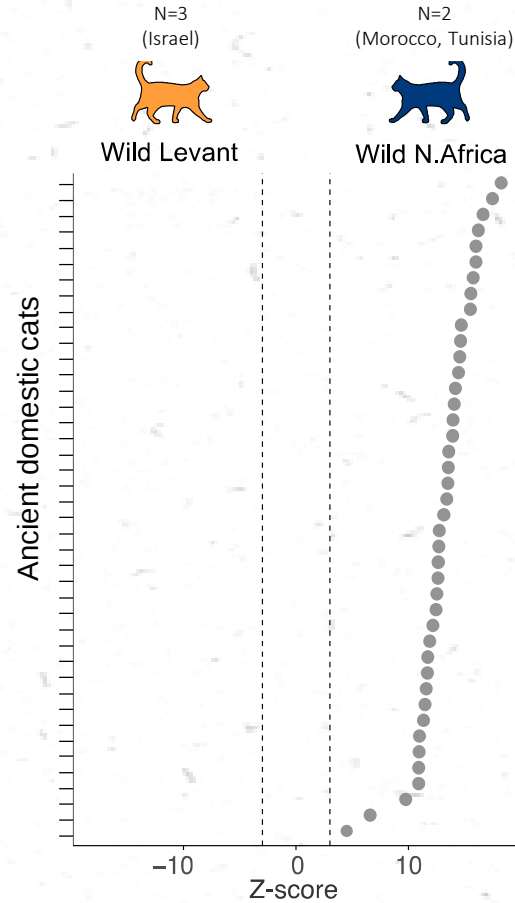
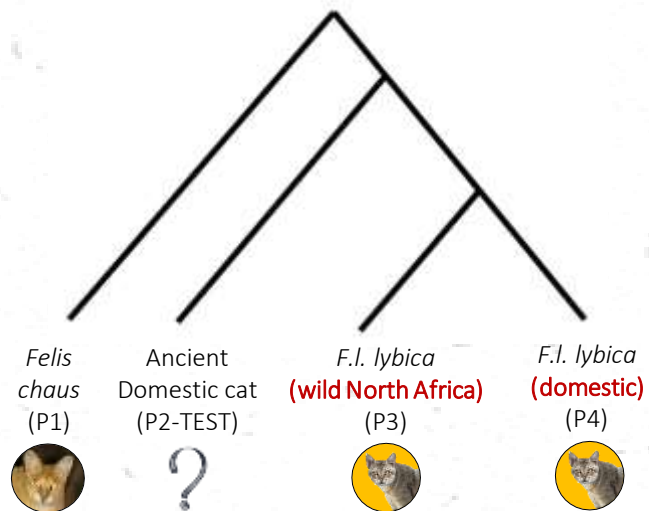
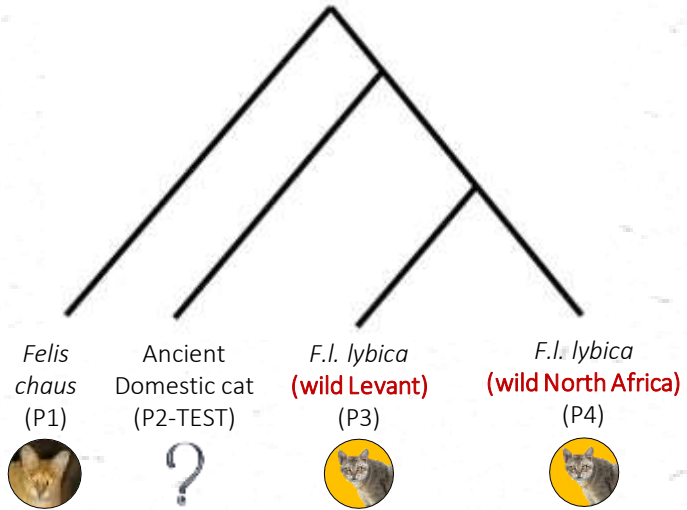
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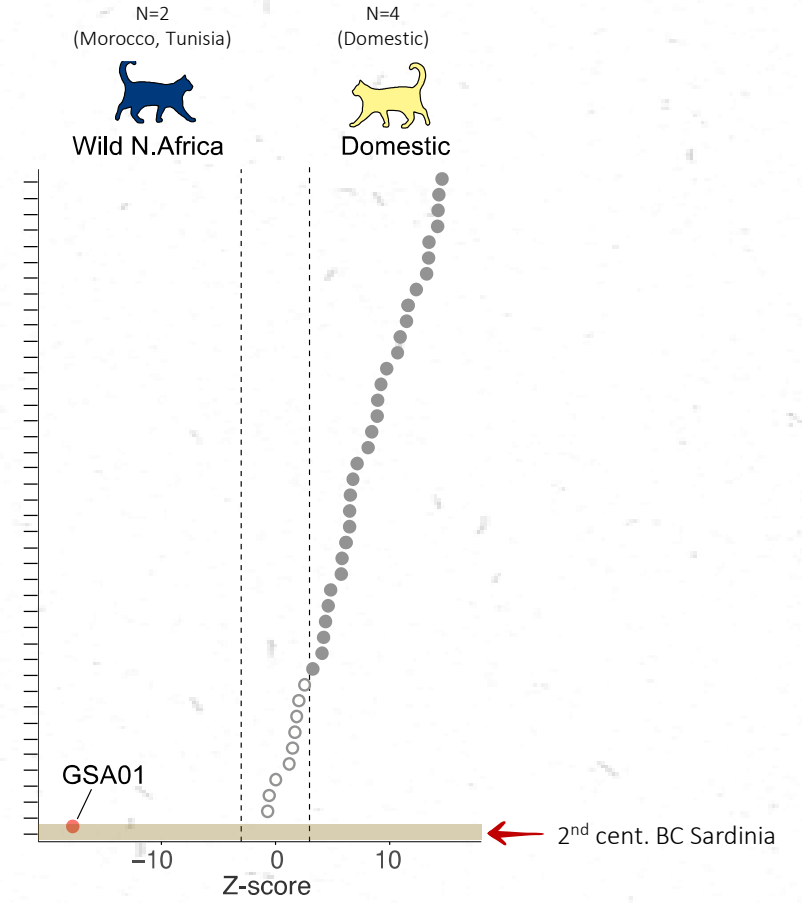
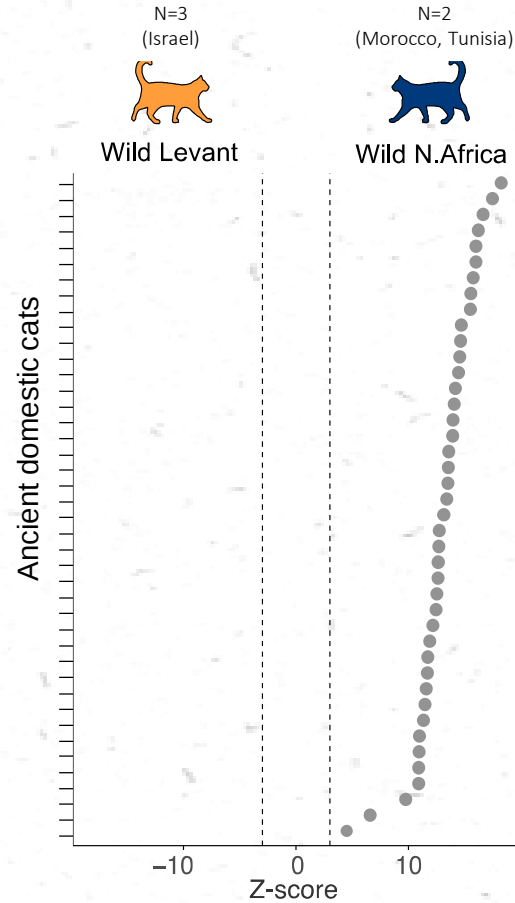
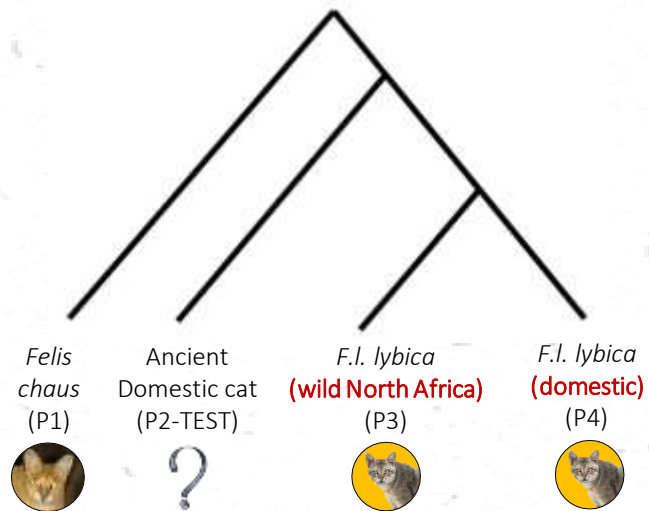
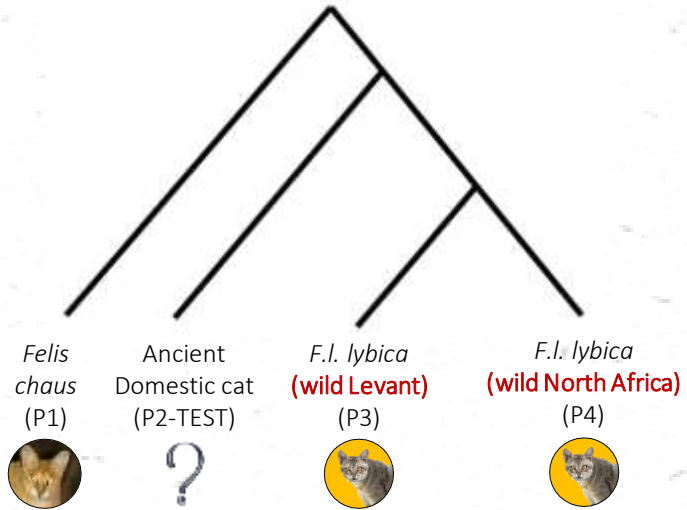
D stats



D stats



D stats





Genoni Santu Antine, Sardinia

Monumental buildings (Nuraghi) typical of the Bronze and Early Iron Age in Sardinia (Nuragic Age, 1900-238 BC).

Fortification reused in the Punic era (from 6th cent BC) and Roman era (from 238 BC).



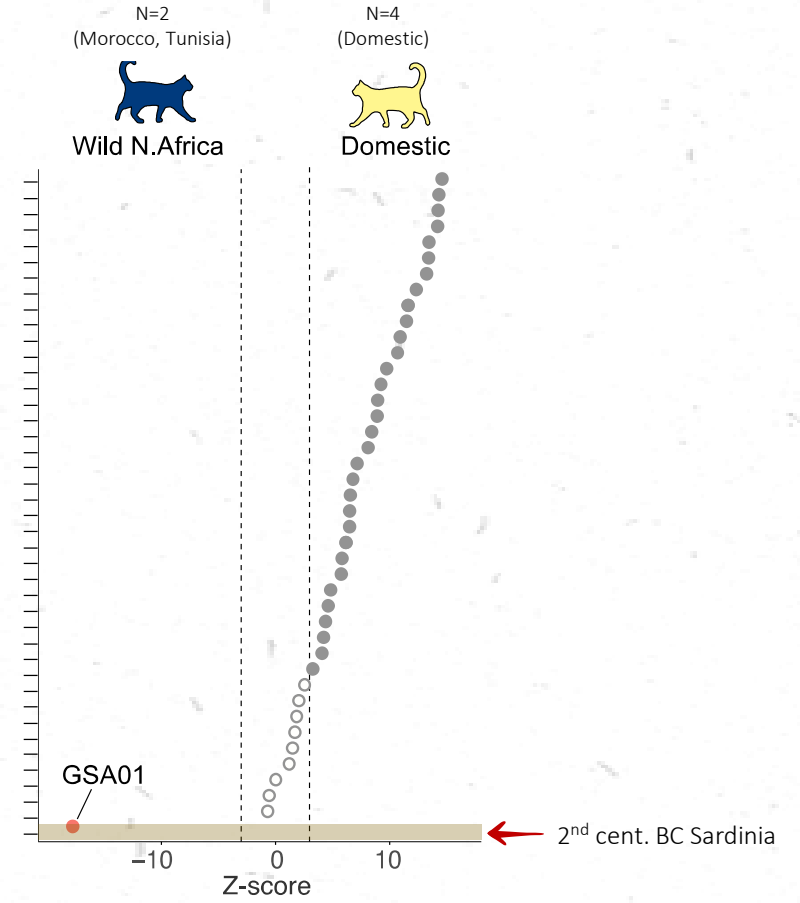
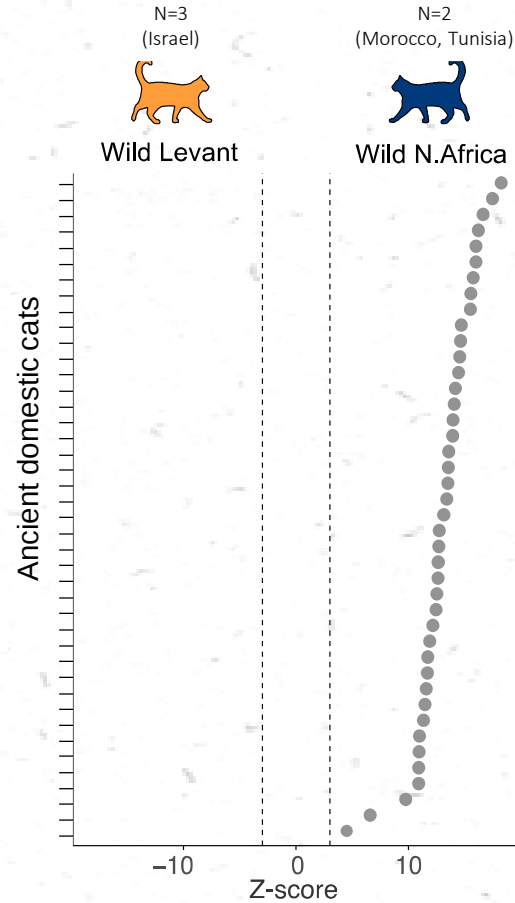
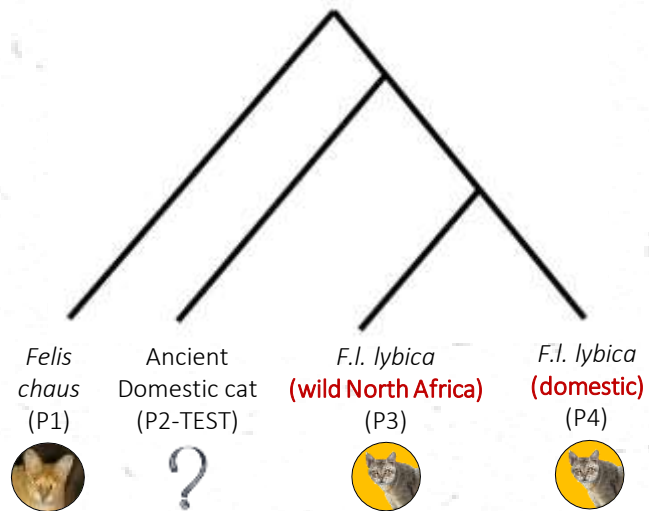
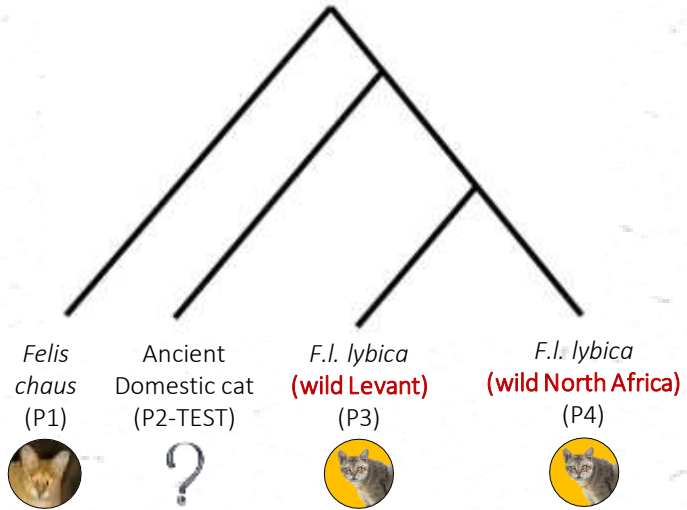
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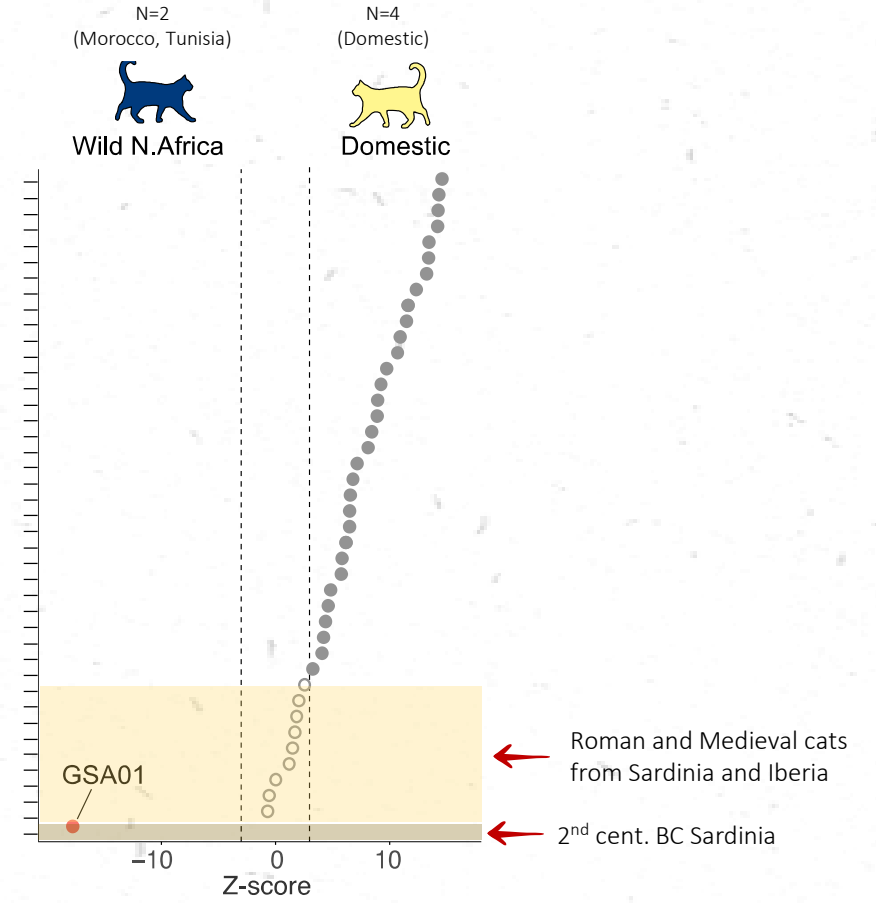
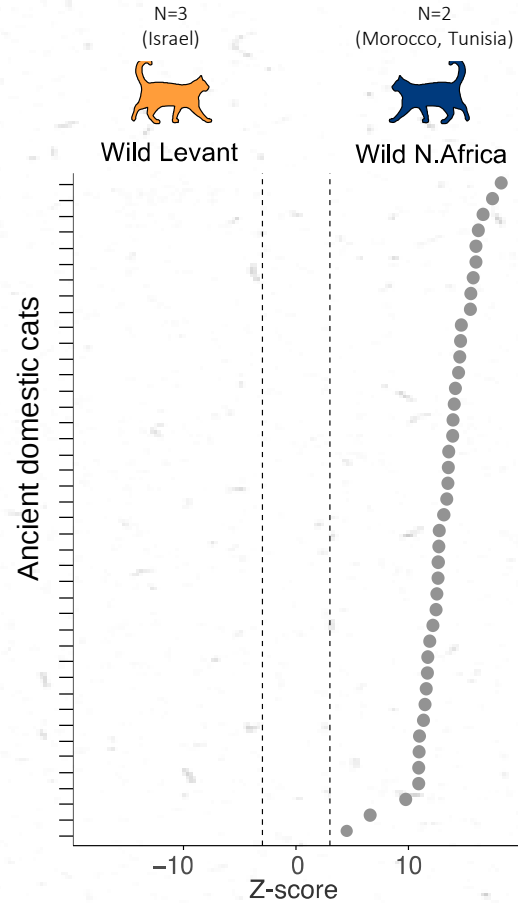
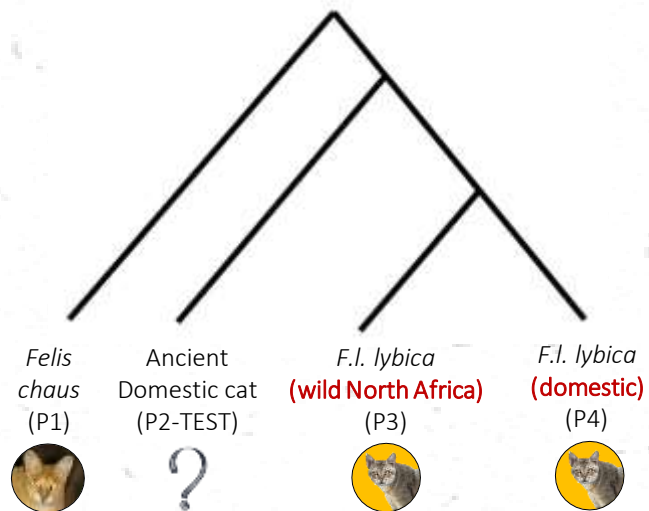
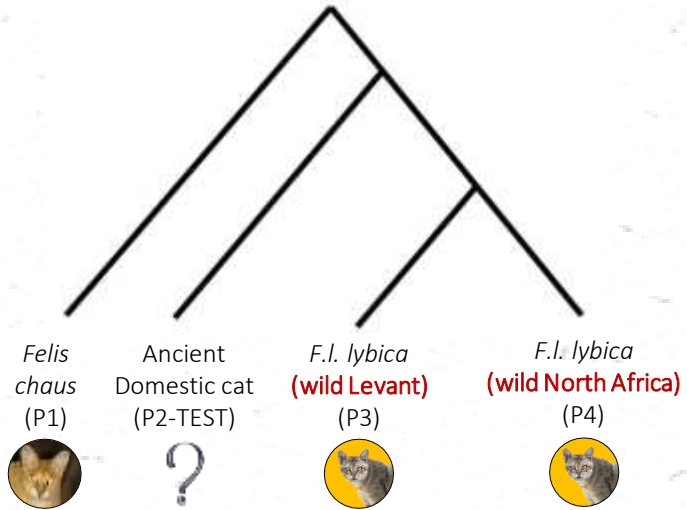
Fortification reused in the Punic era (from 6th cent BC) and Roman era (from 238 BC).

Introduction of
(wild)cats from
Northwest Africa in
Genoni with the Punic
people or Romans.

D stats



D stats



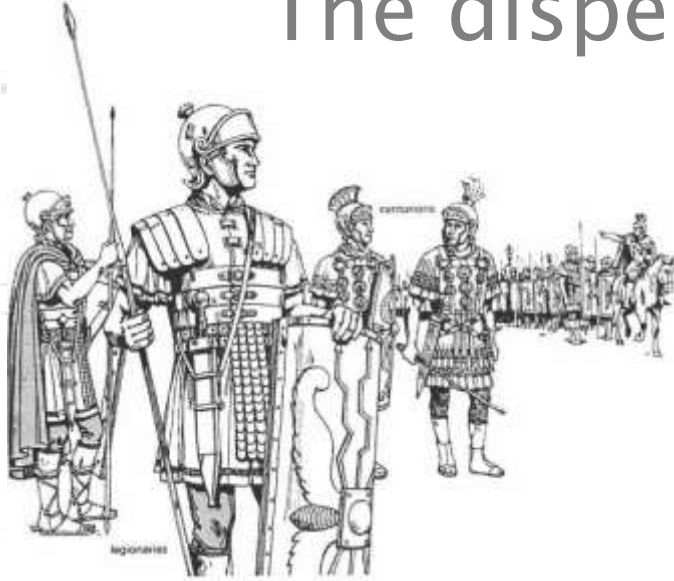
Dual introduction of cats in Sardinia (and Iberia?)

- 1st introduction from Northwest Africa that originated the Sardinian wildcat population.
- 2nd introduction of domestic cats (following the dispersal Europe-wide).



Ancient cat genomes

The dispersal of cats with humans



Black rats gnawing leather and food
Leather straps, leather material, bow strings



Gloucester (UK), Roman military camp



Mosaic in Pompeii (1st cent BC)



Stele depicting a fight between a dog and a cat in 510 BC

Conclusions

- Cats were not introduced to Europe by farmers during the Neolithic (>6,000 y.a.)
- Domestic cats were spread in the last 2,000 years, probably from North Africa
- In Sardinia, an earlier introduction of *F. lybica* originated the wildcat population still present today

Conclusions



Bastet statuette
(photo: Metropolitan Art Museum New York)



Egyptian cat mummy (photo: NHM London)

Original source population?

More ancient and modern (wild) African genomes are needed!

Religious motivation?

Cults associated with cats in Mediterranean civilizations and role of cats as pest-control agents in trade routes.



Doherty et al. (bioRxiv, in review)

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Anna Gręzak (University of Warsaw)



(2012-2017 study)

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Nicolai Spassov (National Museum of Natural History at the Bulgarian Academy of Sciences)
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Olivier Putelat (Archéologie Alsace)
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Felix team



**Marco
De Martino**
(PhD student, aDNA)



**Valentina
Rovelli**
(post-doc, aDNA)



**Partizia
Serventi**
(post-doc aDNA)



**Betty
Mouraud**
(PhD aDNA)



**Gene
Shev**
(post-doc isotopes)



**Tullia
Di Corcia**
(post-doc aDNA, project
manager)



Bea De Cupere
(archaeozoology, RBINS)



Wim Van Neer
(archaeozoology, RBINS)



Steven Bouillon
(geochemistry,
KU-Leuven)



**Marica
Baldoni**
(post-doc, aDNA
metagenomics)



**Anastasia
Brozou**
(post-doc isotopes,
until Feb 2023)

Other collaborators

Joris Peters (LMU Munich)
Ben Fuller (University of Toulouse)
Emanuela Cristiani (Sapienza
University)
Federica Mattucci (ISPRA)
Romolo Caniglia (ISPRA)

Team of
Anthropology
Olga Rickards
Cristina Martinez-Labarga
Gabriele Scorrano
Giulia Orefice
Federica Galfano
Giuseppina Scano

2012-2017 study

Eva-Maria Geigl (IJM Paris)
Thierry Grange (IJM Paris)
Julien Daligault
Silvia Guimaraes
Ronny Decorte (KU Leuven)

Thanks for your attention



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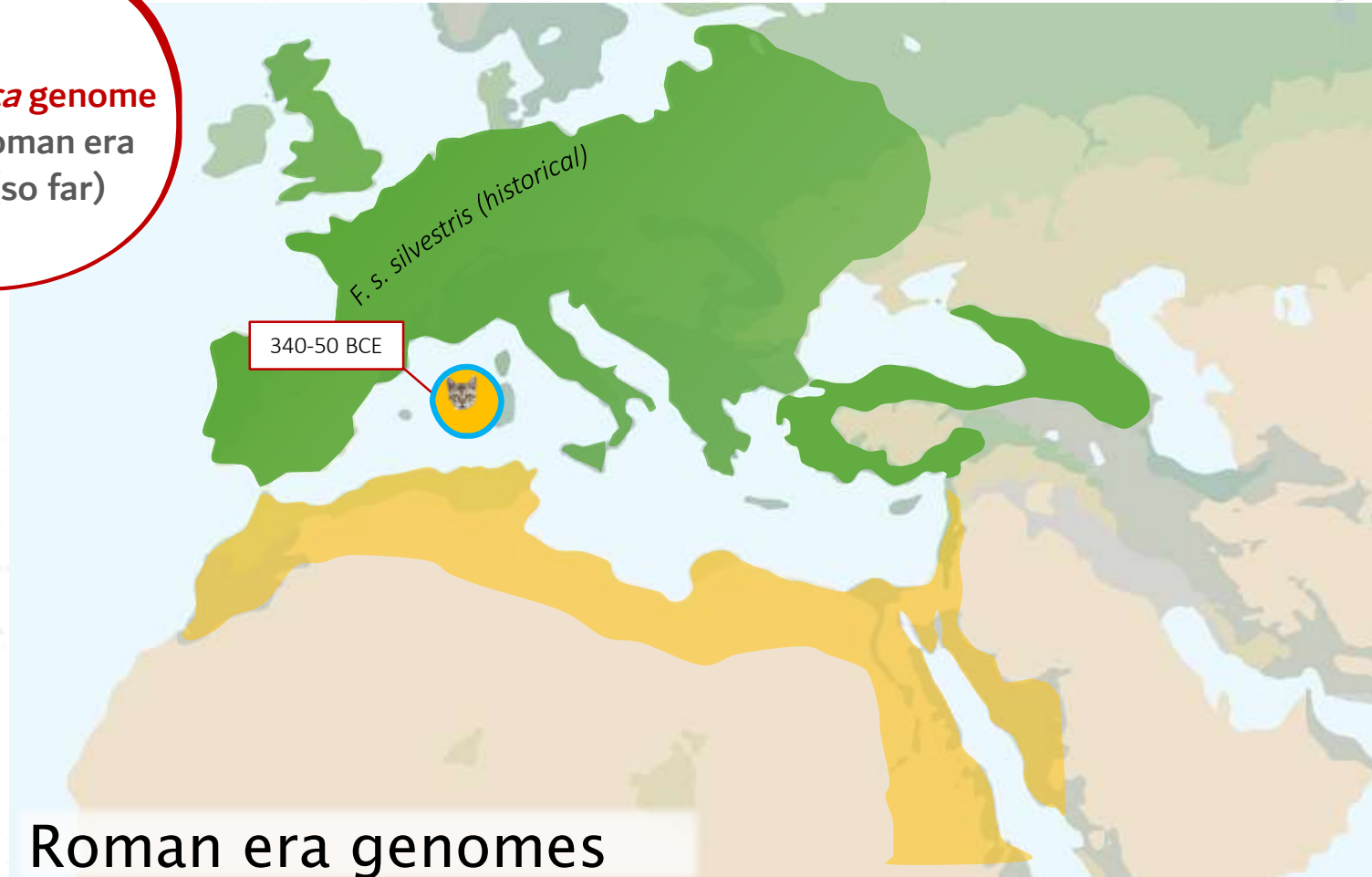


Photo credits: Thomas Peter/Reuters

Ancient cat genomes

The dispersal of cats with humans

Earliest *lybica* genome
in Punic/Roman era
Sardinia (so far)



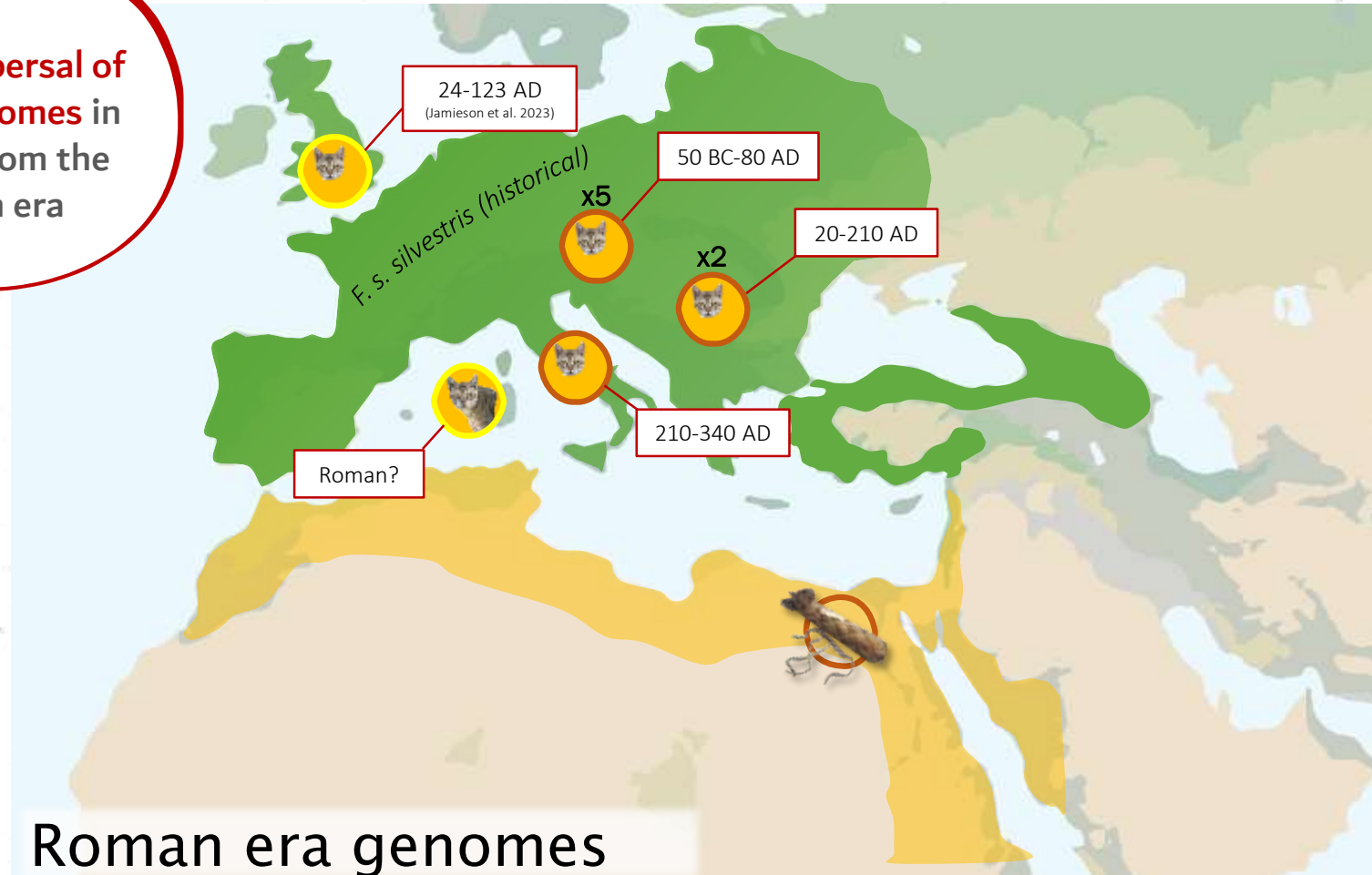
Roman era genomes

NOTE: outline colors indicate mtDNA lineages

Ancient cat genomes

The dispersal of cats with humans

Wider dispersal of
lybica genomes in
Europe from the
Roman era



NOTE: outline colors indicate mtDNA lineages

Spread marked by
mtDNA lineages
A and C
(the lineage C was found
in Egyptian mummies!)