

# TRACING THE FEEDING PATTERNS OF *CULICOIDES* FROM SPAIN

Martina Ferraguti,

J. Martínez-de la Puente, J. Navarro, S. Ruiz, R. Soriguer, J. Figuerola



The background of the slide is a dark, out-of-focus image showing numerous small, white, winged insects, likely mosquitoes, in flight. They are scattered across the entire frame, with some appearing closer and more detailed, while others are blurred in the background. The lighting highlights the delicate wings and bodies of the insects against the dark backdrop.

A diverse and  
widespread genus  
with more than  
**1400 species** in  
the world

# THE BITING MIDGES: *Culicoides*

(Diptera: Ceratopogonidae)

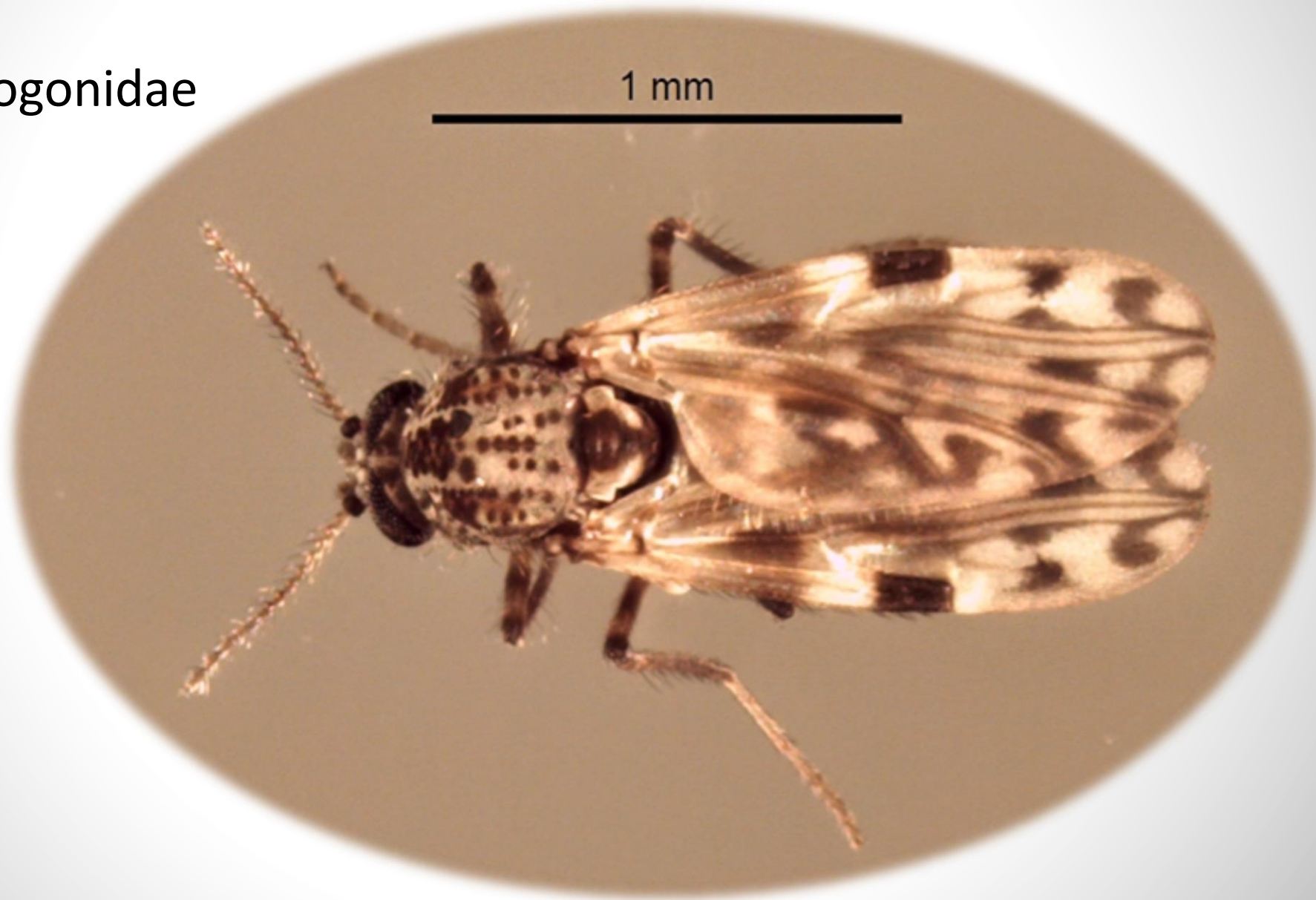
**> 80 species  
present in Spain**





# MINUTE SIZE (1 – 3 mm)

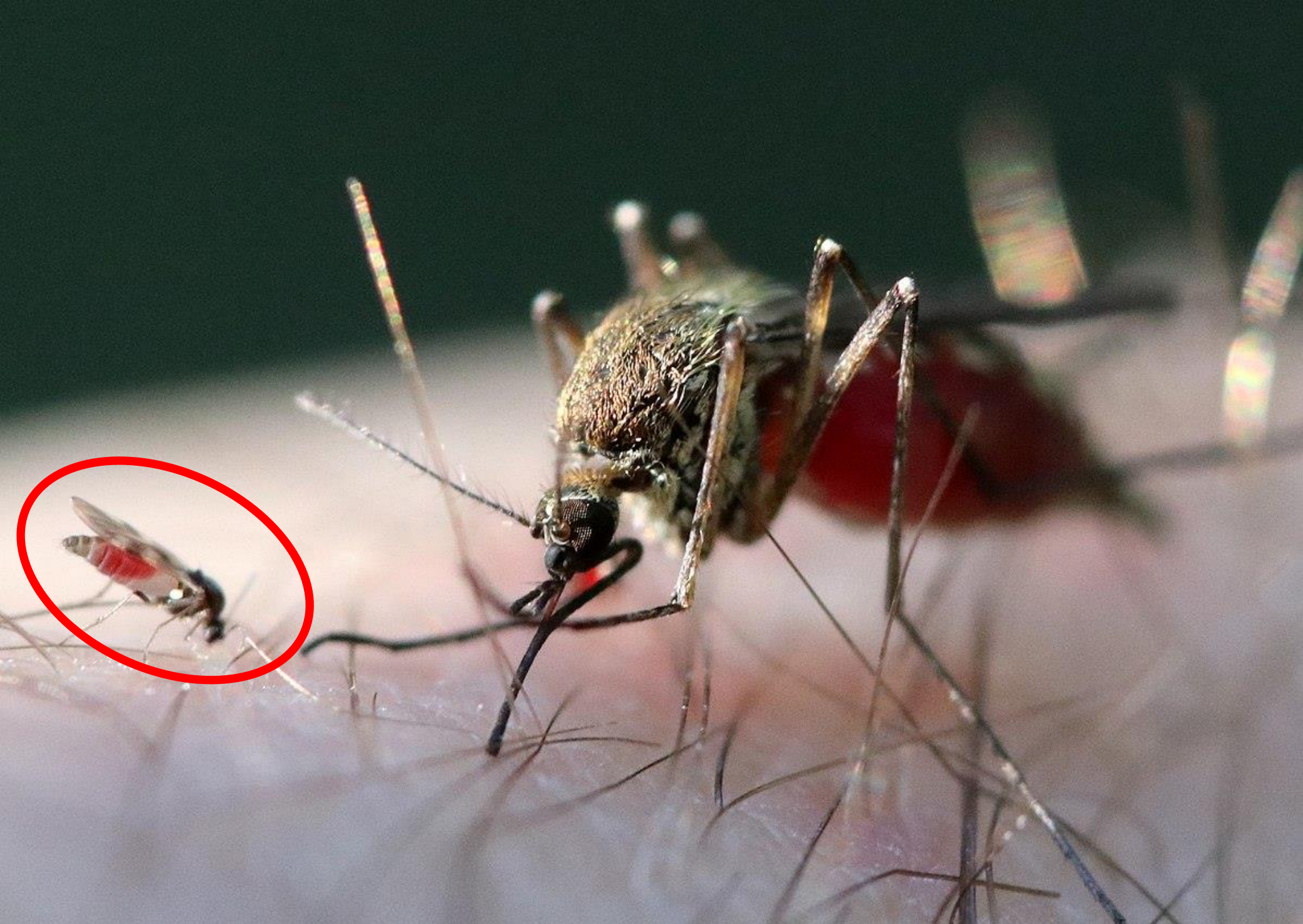
Diptera:  
Ceratopogonidae





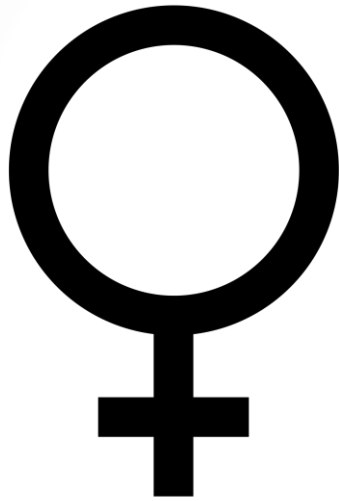








# ONLY FEMALES FEED ON BLOOD

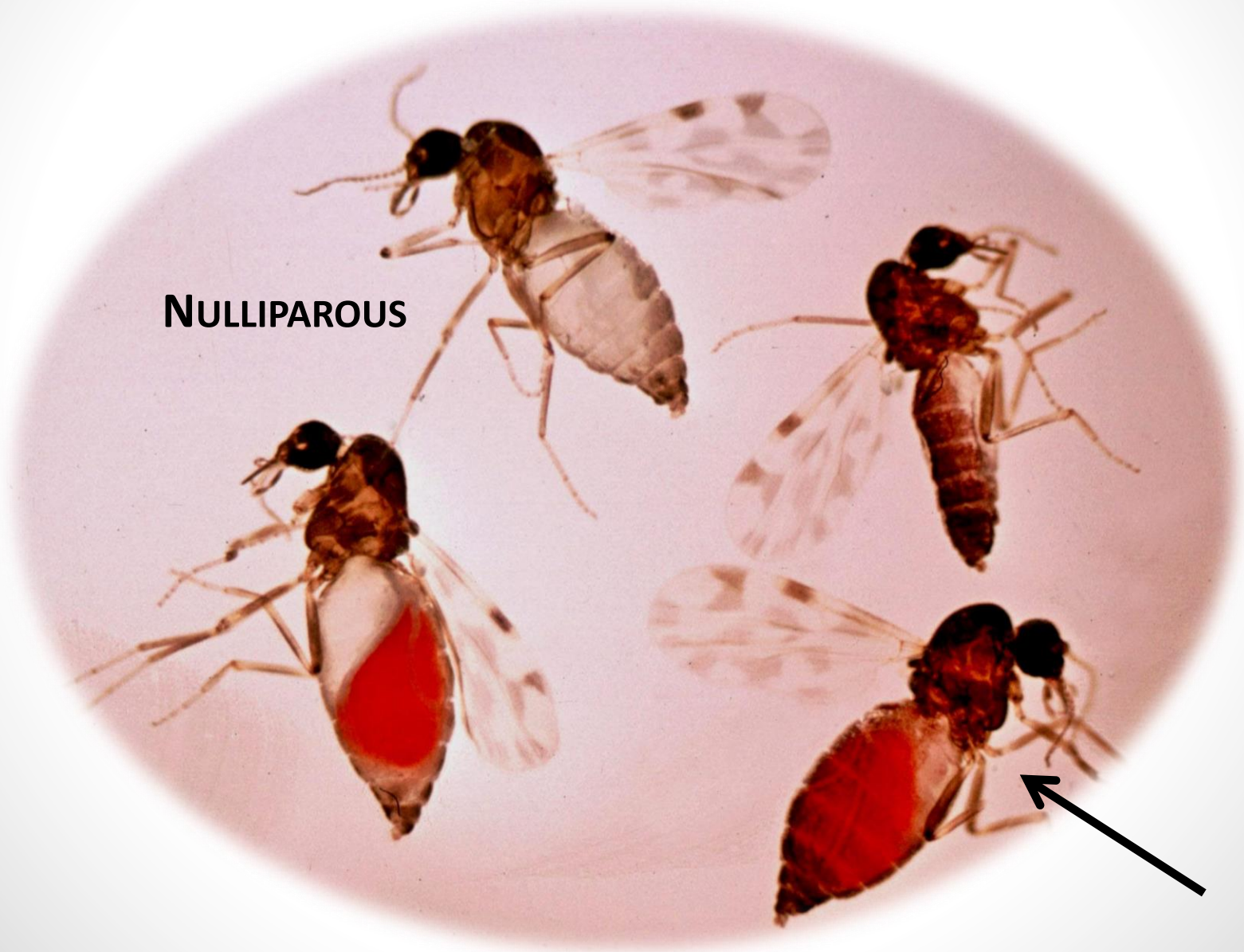




# NULLIPAROUS FEMALES



# ENGORGED FEMALES





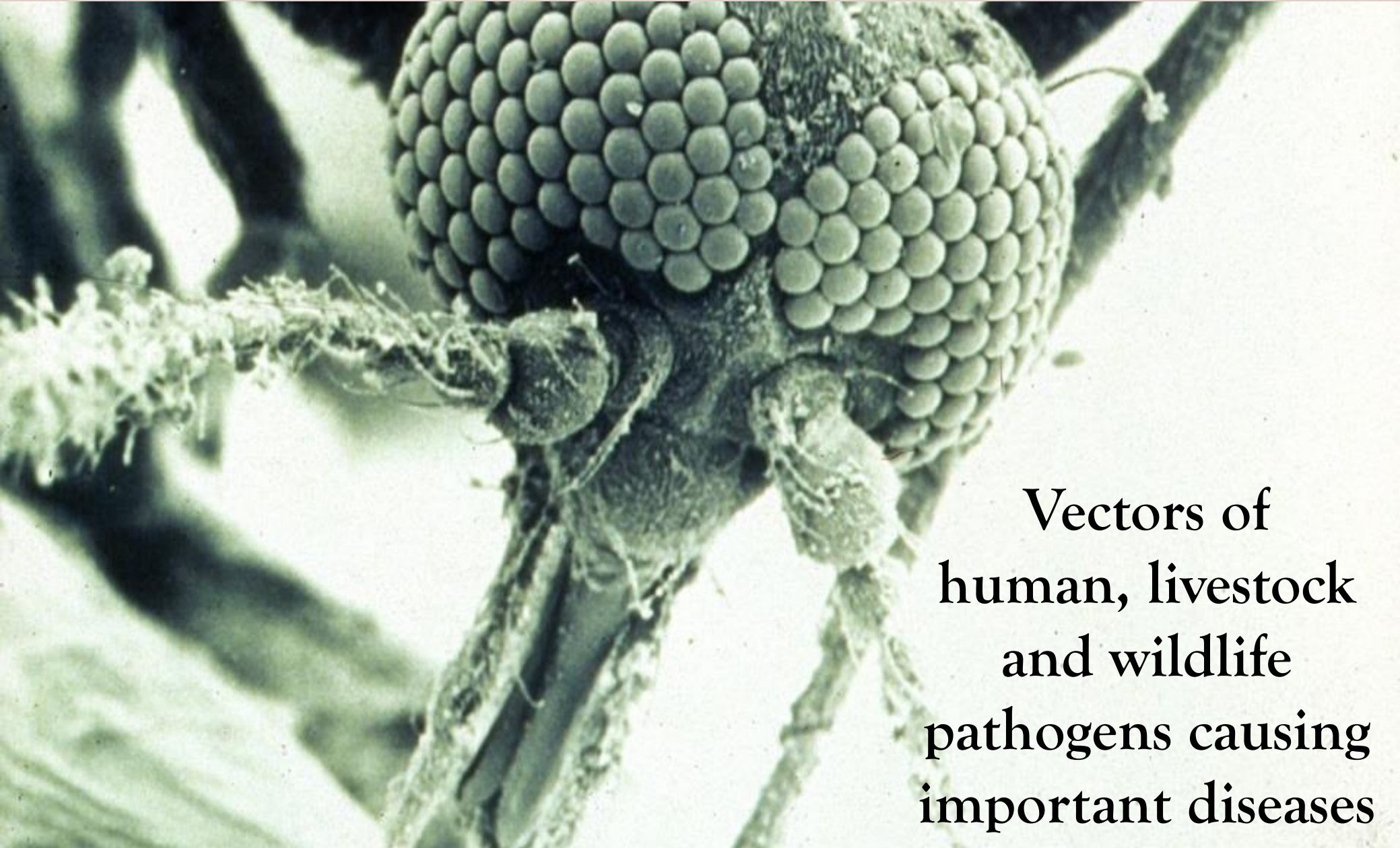
# PAROUS FEMALES



ENGORGED



# INSECT VECTORS



Vectors of  
human, livestock  
and wildlife  
pathogens causing  
important diseases

# SOME LIMITATIONS





# SOME LIMITATIONS

1) Engorged females are **gold!**











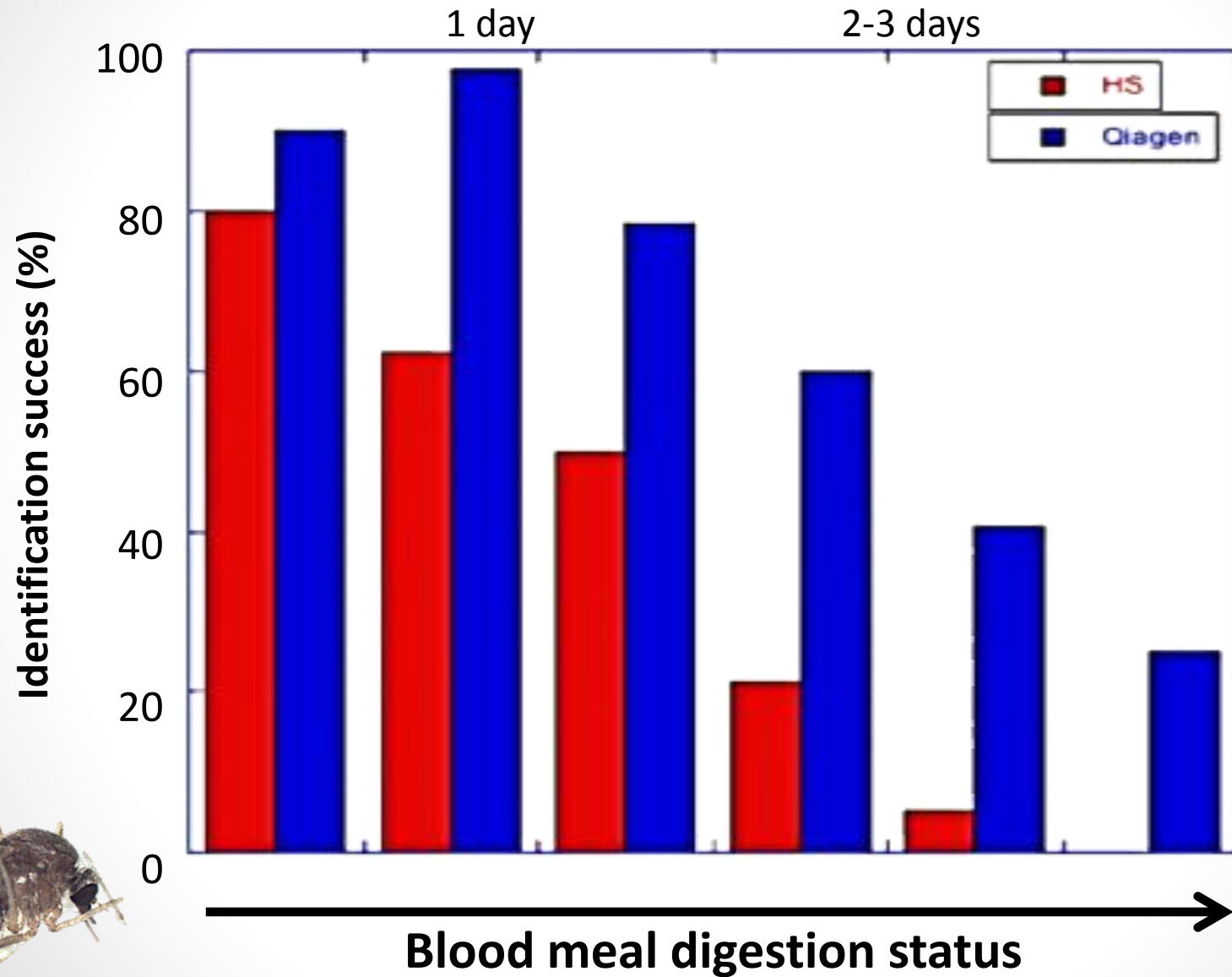
# SOME LIMITATIONS

## 2) Degraded DNA and extraction procedures





# SOME LIMITATIONS



## SOME LIMITATIONS

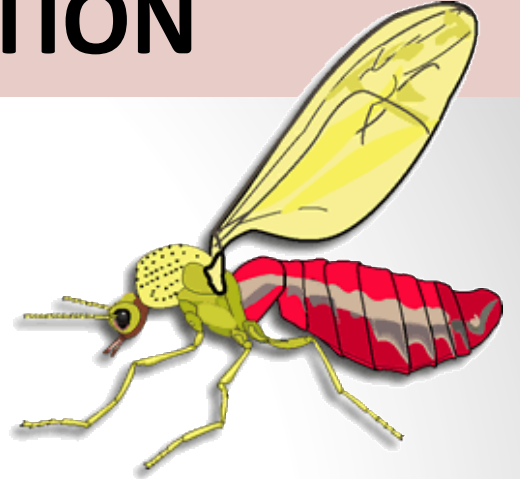
3) The cost of PCR amplification and sequencing is high





# BLOOD MEAL IDENTIFICATION

## DNA isolation and amplification:



### Species specific primers

Identification without sequencing (reduced costs)

Limited host range identification

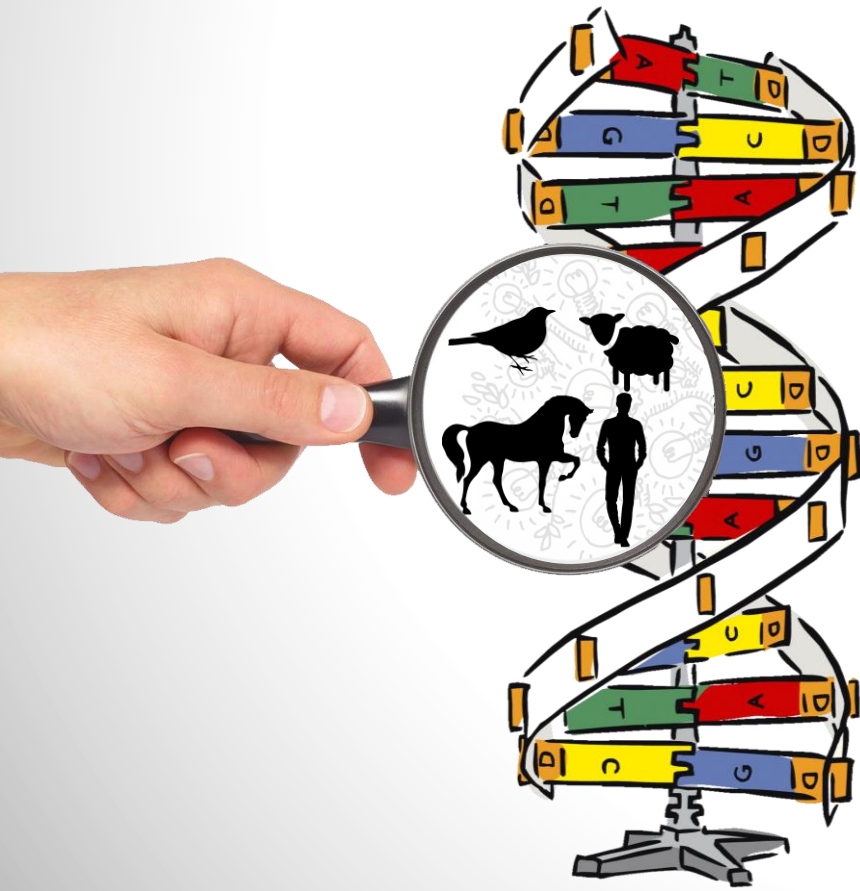
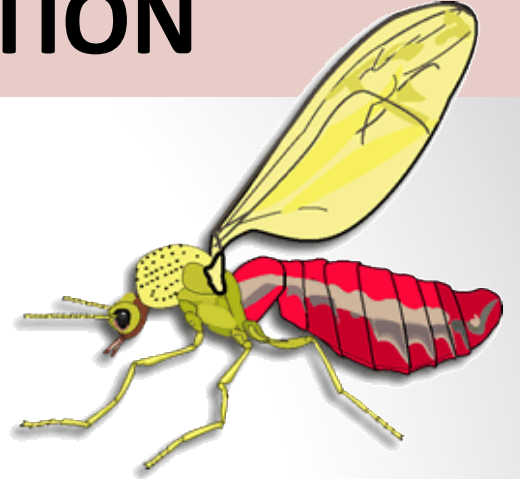
### Universal primers

Broad host range

Elevated cost of sequencing (large sample size)

# BLOOD MEAL IDENTIFICATION

**DNA isolation and amplification:**  
Mitochondrial COI, gene 758 bp



## Universal primers

Broad host range

Elevated cost of sequencing  
(large sample size)





**RESEARCH**

# Genetic characterization and molecular identification of the bloodmeal sources of the potential bluetongue vector *Culicoides obsoletus* in the Canary Islands, Spain

Josué Martínez-de la Puente<sup>1\*</sup>, Javier Martínez<sup>2</sup>, Martina Ferraguti<sup>1</sup>, Antonio Morales-de la Nuez<sup>3</sup>,  
Noemí Castro<sup>3</sup> and Jordi Figuerola<sup>1</sup>



# Canary Islands has one of the **highest densities** of small **ruminants** per hectare in Europe







It is essential to maintain **vigilance** of *Culicoides* vectors



The study the **feeding pattern** of *C. obsoletus* is a potentially important factor in BT virus transmission in case of introduction into the archipelago.

# *Culicoides (Avaritia) obsoletus* complex

**126 blood-fed** females were found to have fed on mammals in the Canary Islands:

		GRAN CANARIA	TENERIFE
 Goats  Sheeps	Goats	40	81
	Sheeps	4	1





# Hosts





# Hosts



# Vectors

O C É A N O   A T L Á N T I C O



LA PALMA



LA GOMERA



EL HIERRO



TENERIFE



GRAN CANARIA



FUERTEVENTURA

Provincia de Las Palmas

Provincia de Santa Cruz de Tenerife





**Hosts**



**Vectors**



**Blood meal**

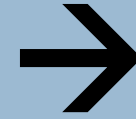




**Hosts**



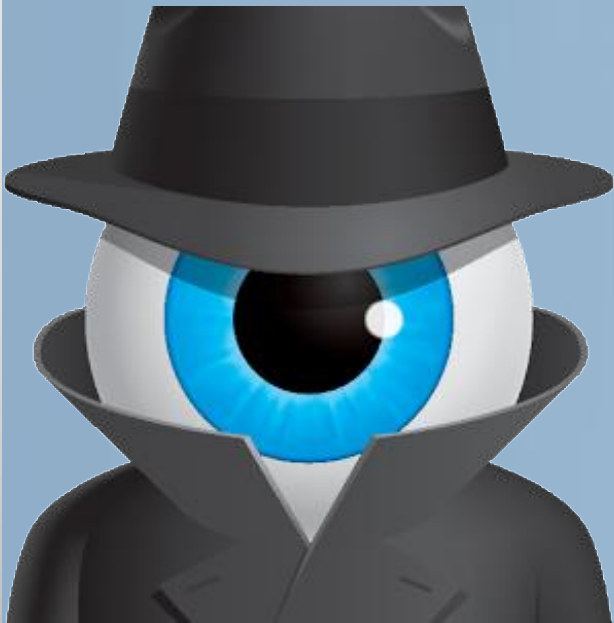
**Vectors**



**Blood meal**



An active **BT surveillance programme** and sanitary laws regarding air and sea transport of potentially contaminated insects and livestock must be enforced!!





# CURRENT *Culicoides* KNOWLEDGE



# CURRENT *Culicoides* KNOWLEDGE

✓ 1,360 individuals  
from 31 species

✓ 45 different host  
species identified:

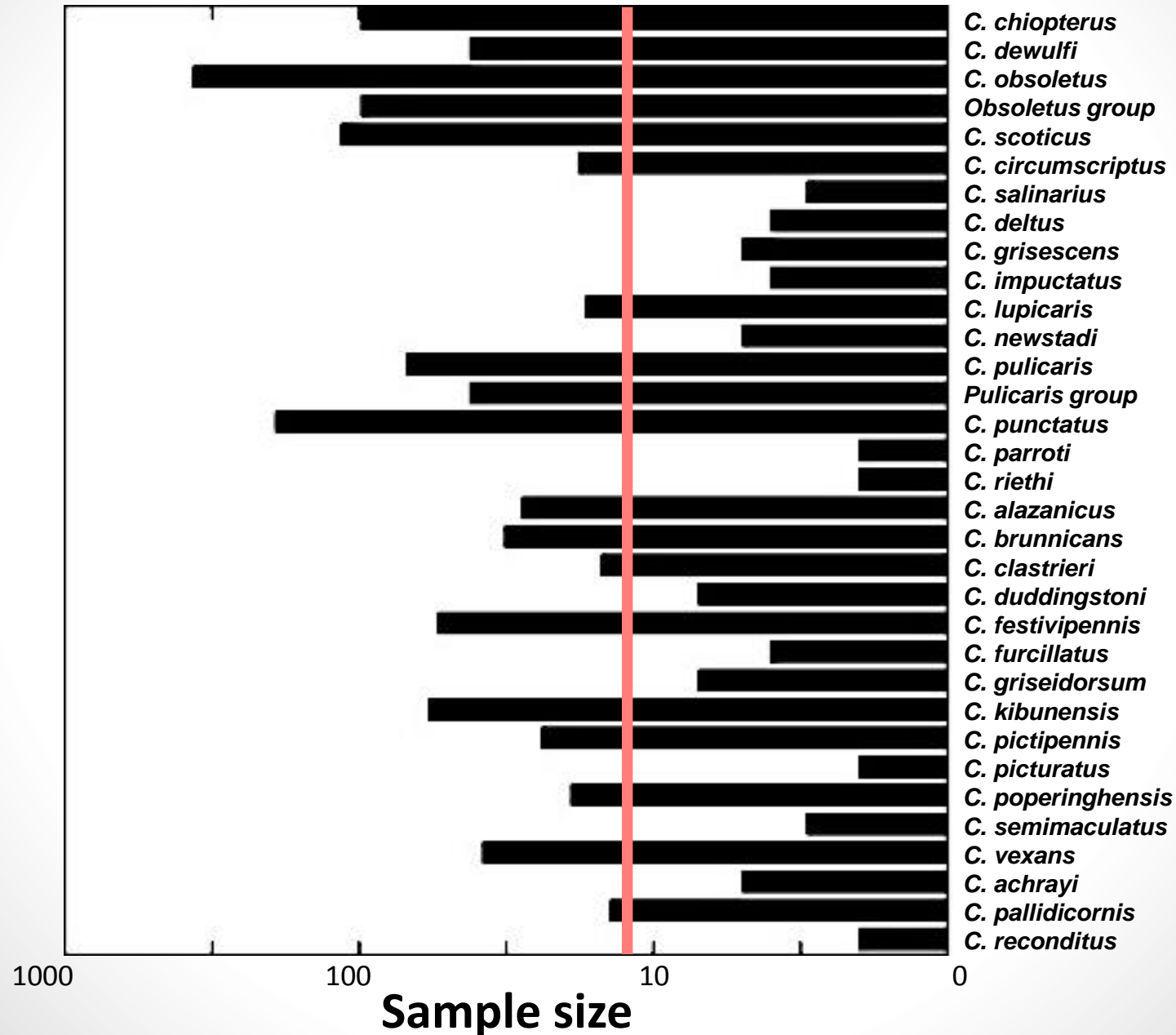
**33 bird** and 

**12 mammal** 

(Martínez-de la Puente *et al.* 2015. *Trends in Parasitology*)



# CURRENT *Culicoides* KNOWLEDGE






On average, each species **fed on 5 different host species**



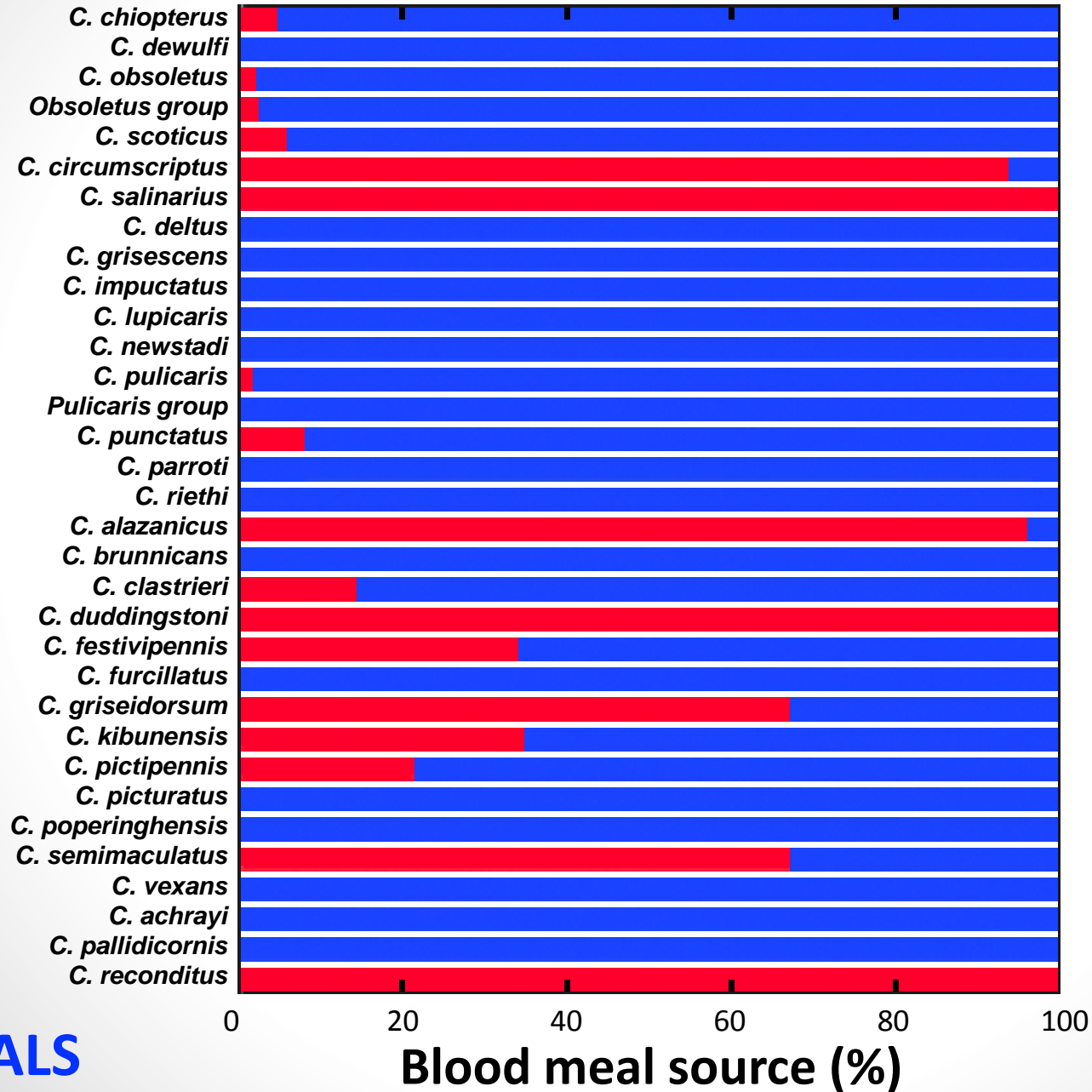
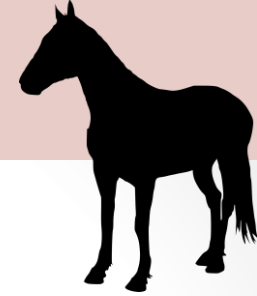


A photograph of Iker Casillas, a Spanish professional footballer, in his Real Madrid goalkeeper kit. He is wearing a bright yellow jersey with black stripes on the sleeves and the Adidas logo. He is also wearing yellow Reebok goalkeeper gloves. He has a determined expression with his mouth wide open, shouting or cheering. The background is a blurred stadium filled with spectators.

**And  
occasionally,  
on humans!!!**



# FEEDING PREFERENCES

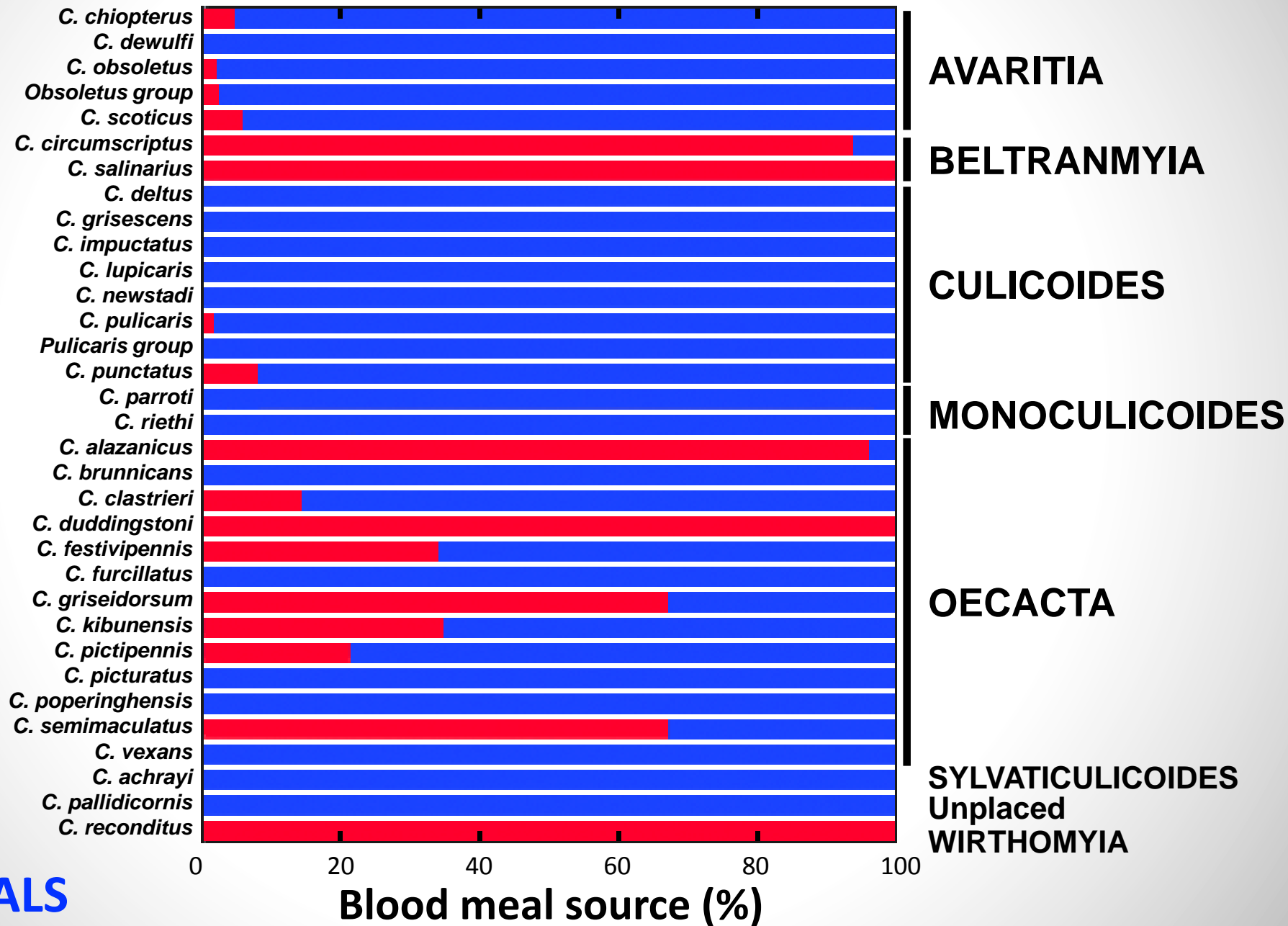


BIRDS

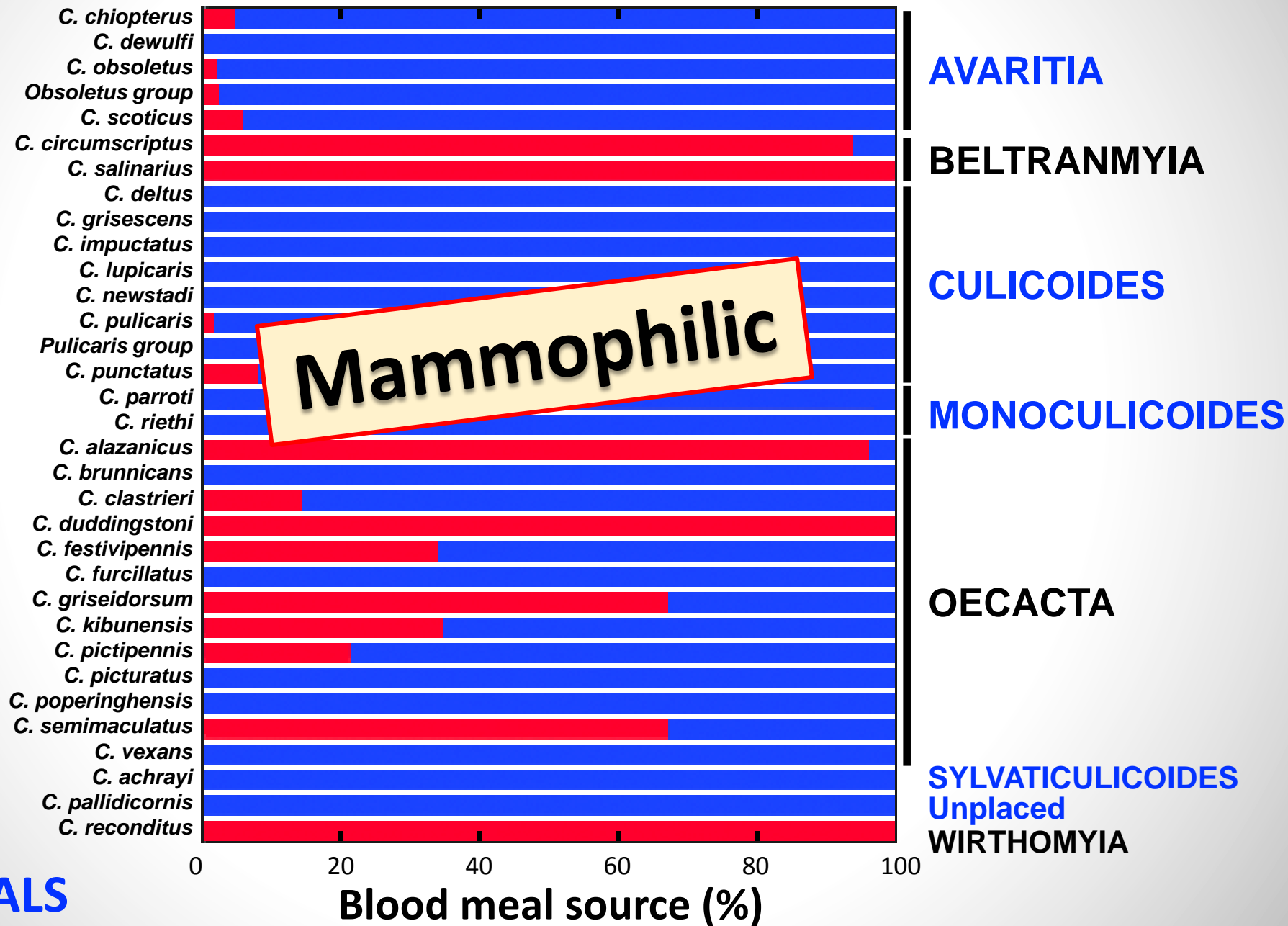
MAMMALS



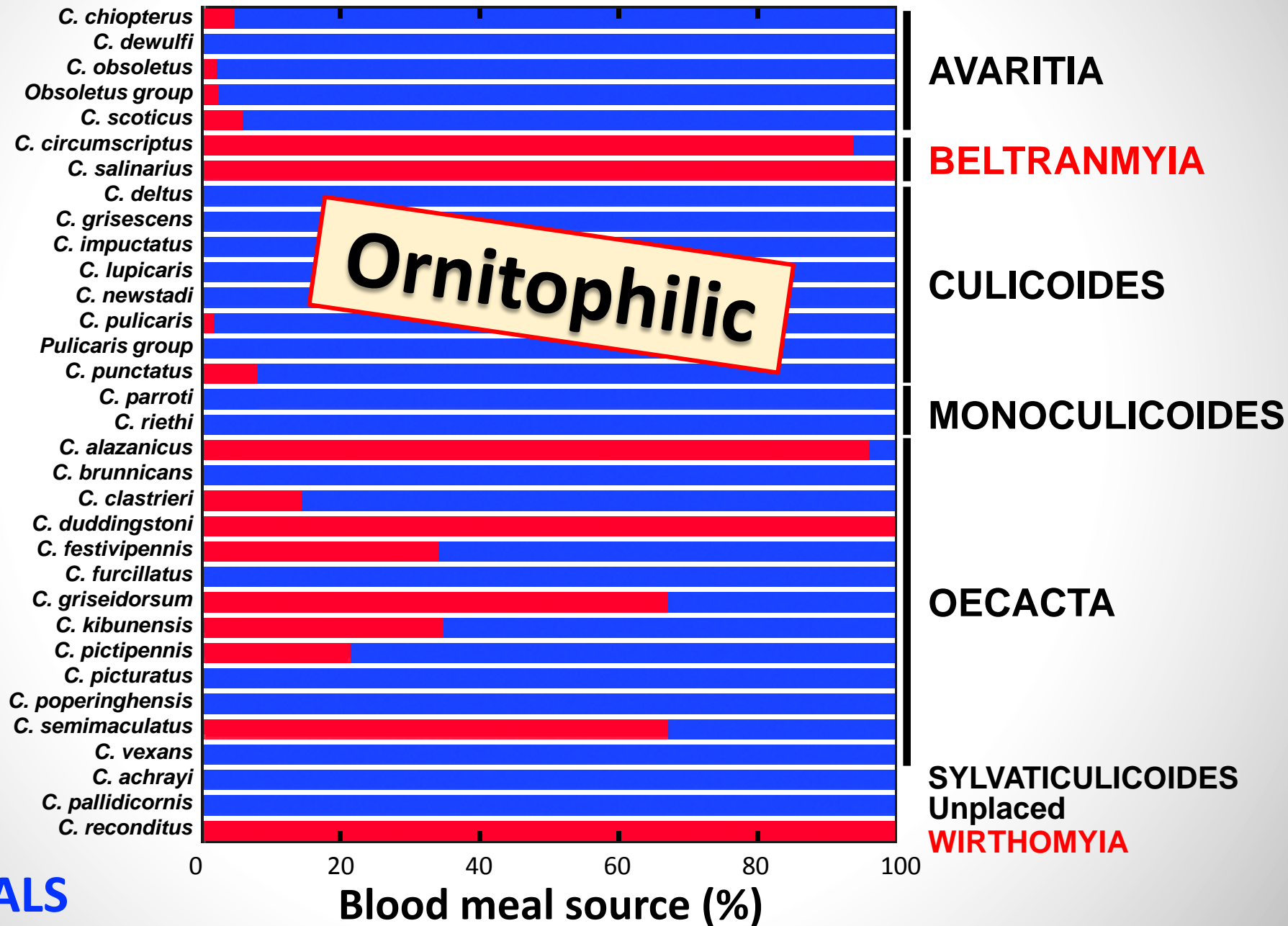
# 69% of the variance of the feeding pattern of *Culicoides* species



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# 69% of the variance of the feeding pattern of *Culicoides* species







Species of  
*Culicoides*  
**phylogenetically  
related**  
tend to feed  
on the **same**  
**vertebrates**  
**class.**

(Image from IIKC)

# Next steps?

Studies on additional individuals and species





# Next steps?

Studies on additional individuals and species:

- ✓ Most species with **less than 15** individuals identified



# Next steps?

Studies on additional individuals and species:

- ✓ Most species with less than 15 individuals identified
- ✓ Studies on  $> 45\%$  species from **Europe** are lacked





# Next steps?

Studies on additional individuals and species:

- ✓ Most species with less than 15 individuals identified
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- ✓ Few studies on **natural habitats**



# Next steps?

Studies on additional individuals and species:

- ✓ Most species with less than 15 individuals identified
- ✓ Studies on > 45% species from Europe are lacked
- ✓ Few studies on natural habitats
- ✓ The case of *C. imicola*







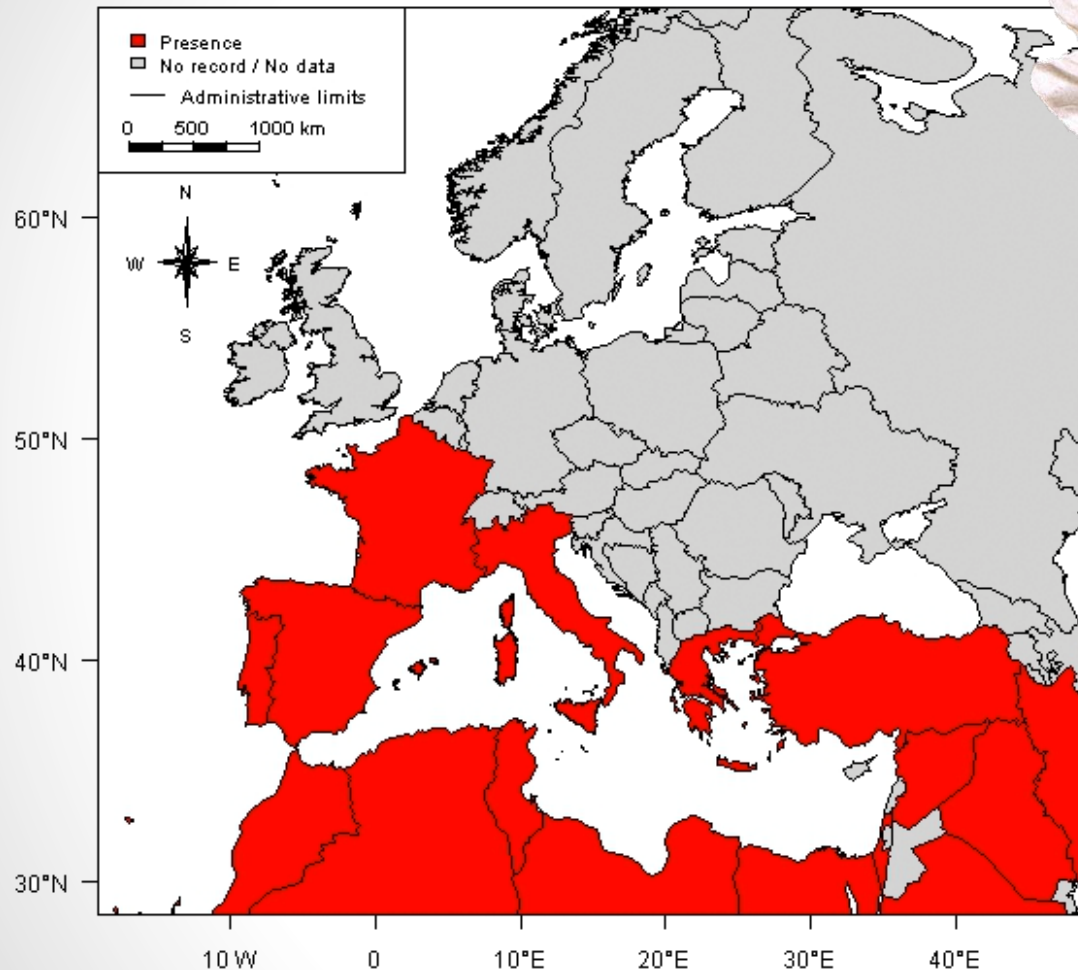
EDITOR'S CHOICE

**First molecular identification of the vertebrate hosts of *Culicoides imicola* in Europe and a review of its blood-feeding patterns worldwide: implications for the transmission of bluetongue disease and African horse sickness**

J. MARTÍNEZ-DE LA PUENTE<sup>1,2</sup>, J. NAVARRO<sup>3</sup>, M. FERRAGUTI<sup>1</sup>,  
R. SORIGUER<sup>1,2</sup> and J. FIGUEROLA<sup>1,2</sup>



# *Culicoides (Avaritia) imicola*



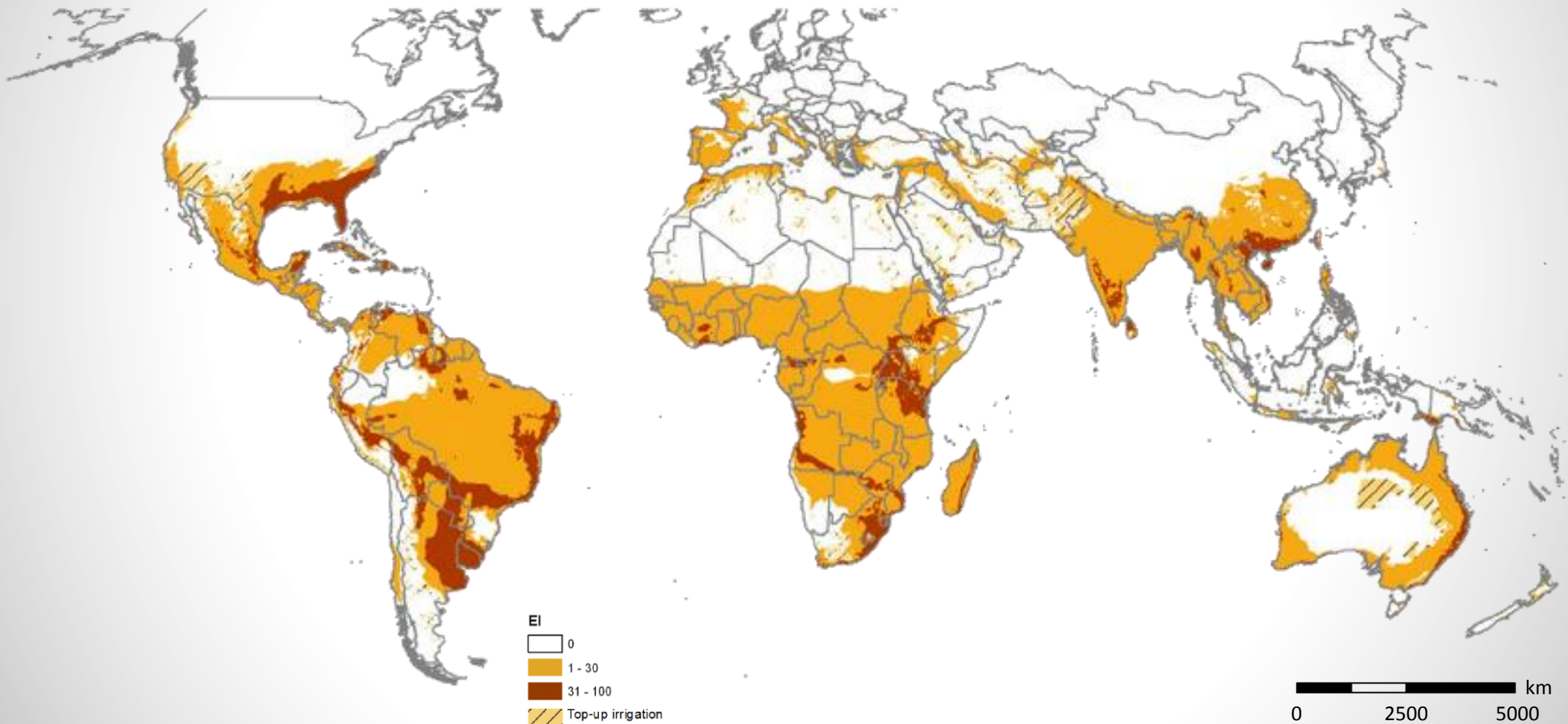
West Palearctic distribution map



Vector of  
diseases such as  
**Bluetongue (BT)**  
and **African horse  
sickness (AHS)**

# *Culicoides (Avaritia) imicola*

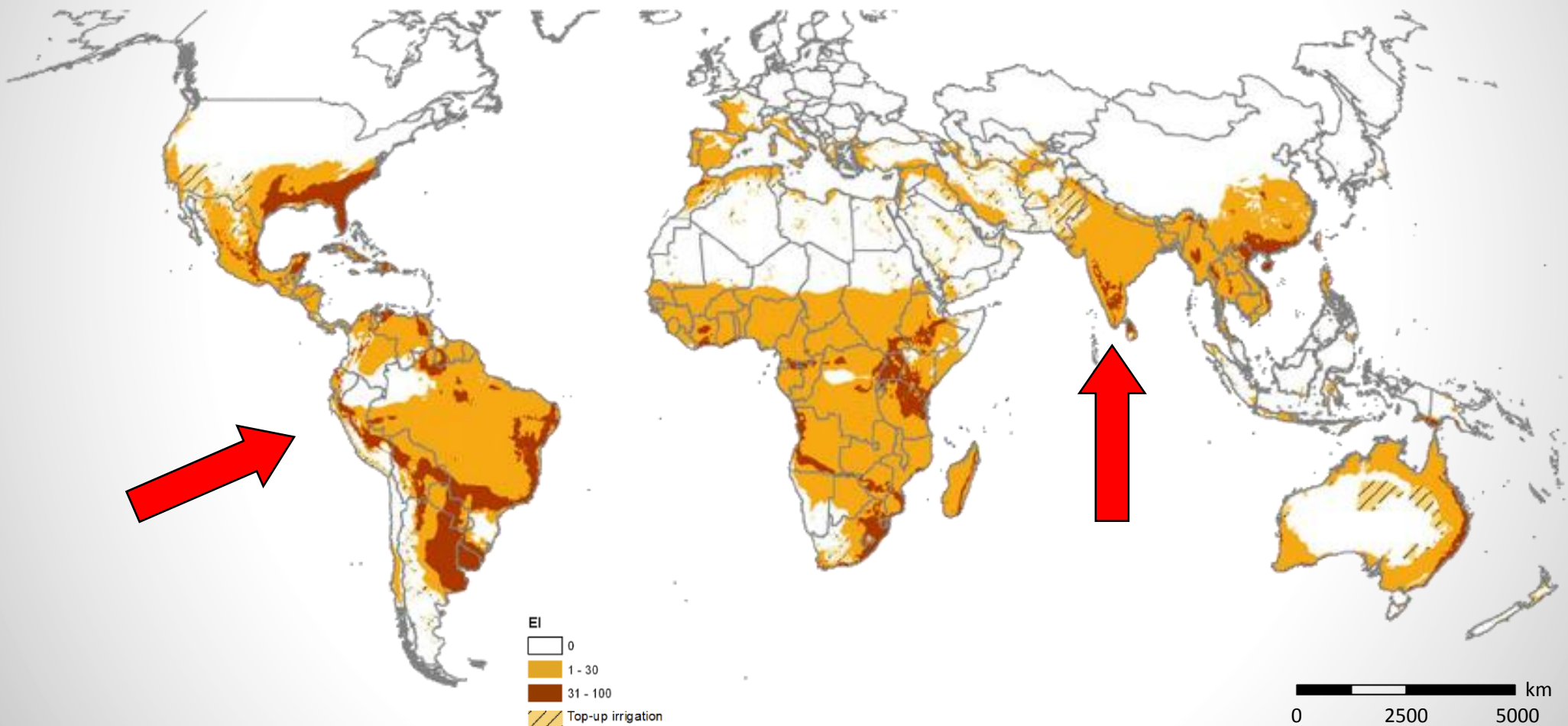
Potential distribution following predictive models:



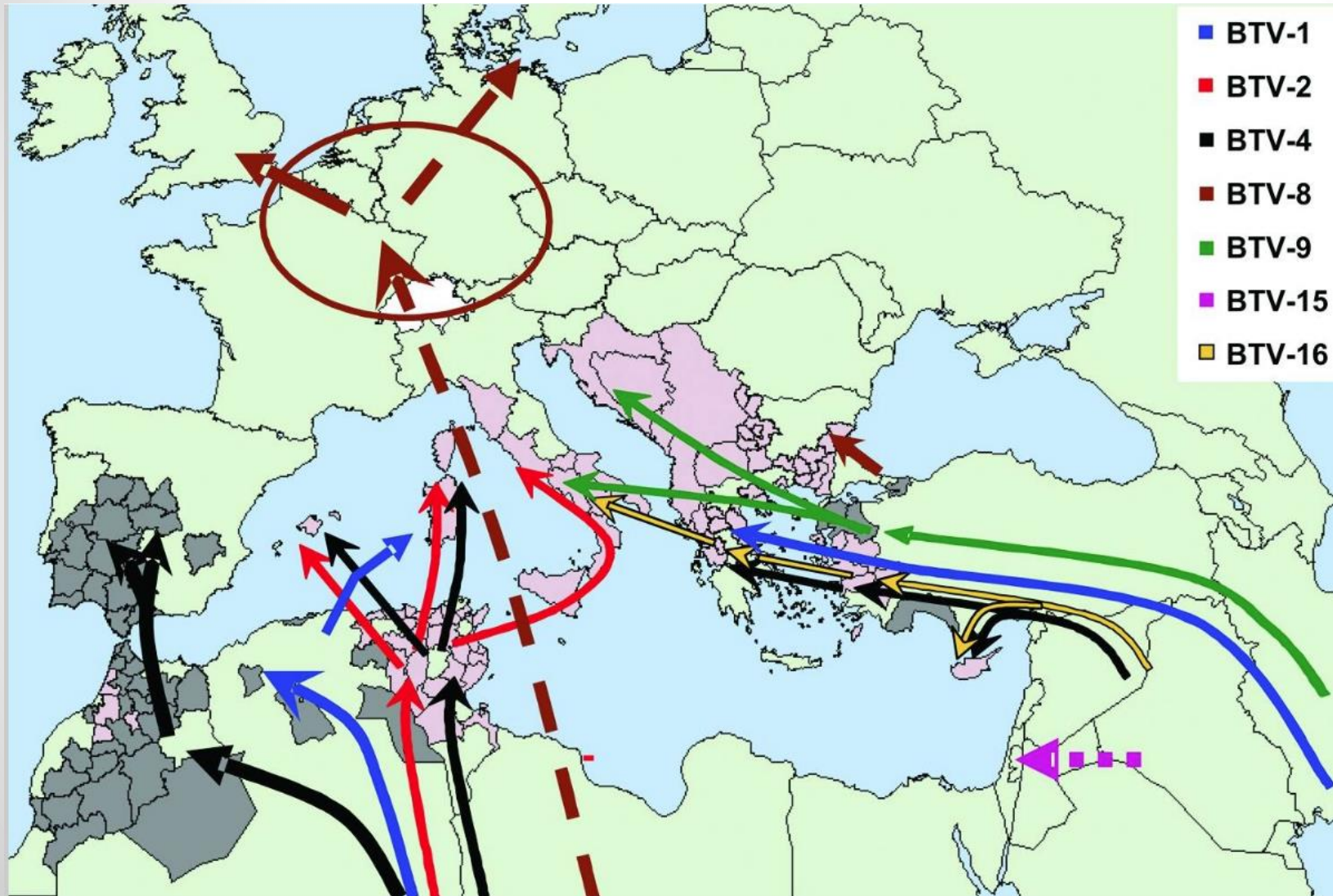


# *Culicoides (Avaritia) imicola*

Potential distribution following predictive models:

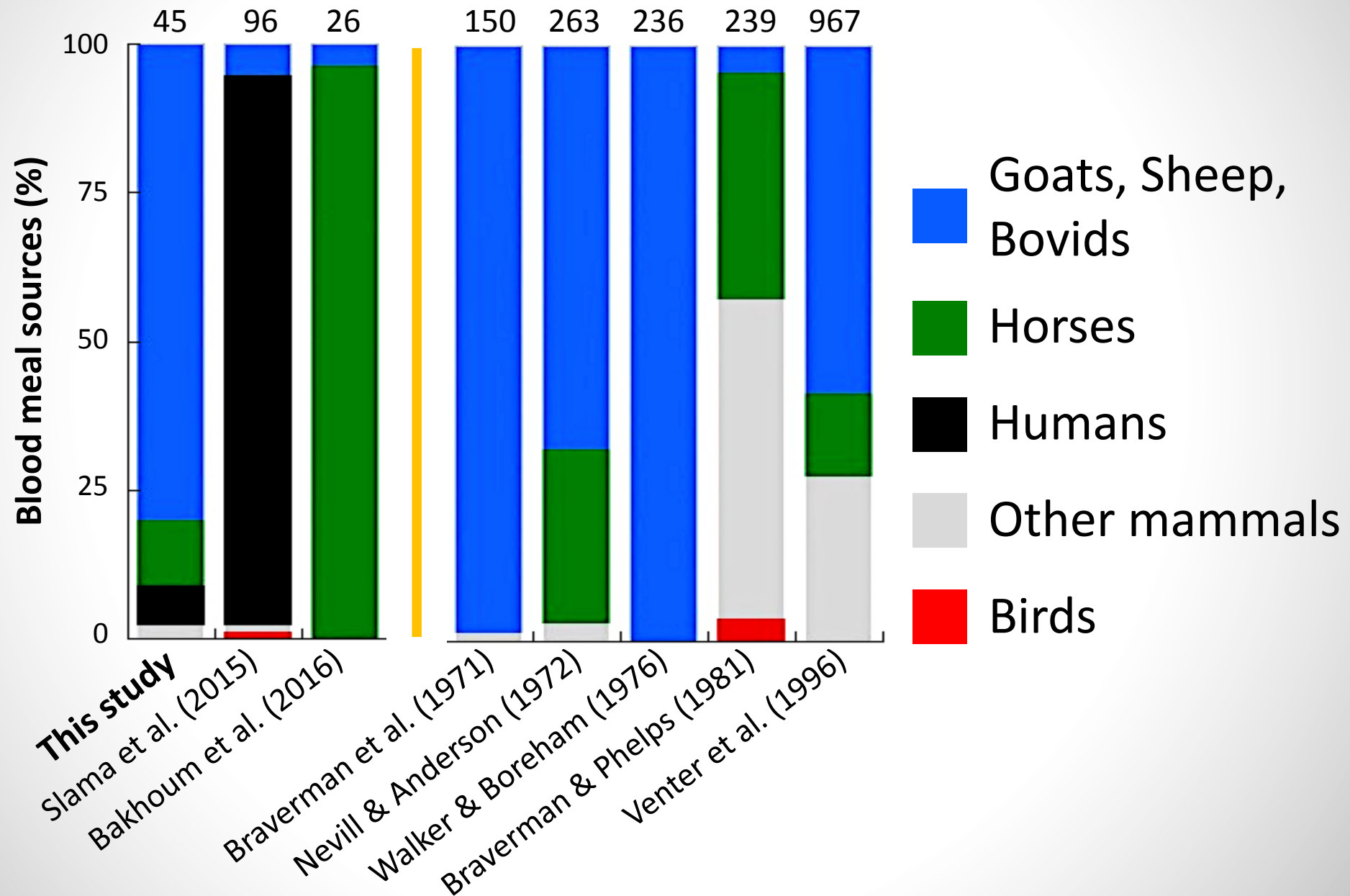


Since 1998, *C. imicola* (with *C. obsoletus* and *C. pulicaris*) has been associated with **BT outbreaks** in Europe!



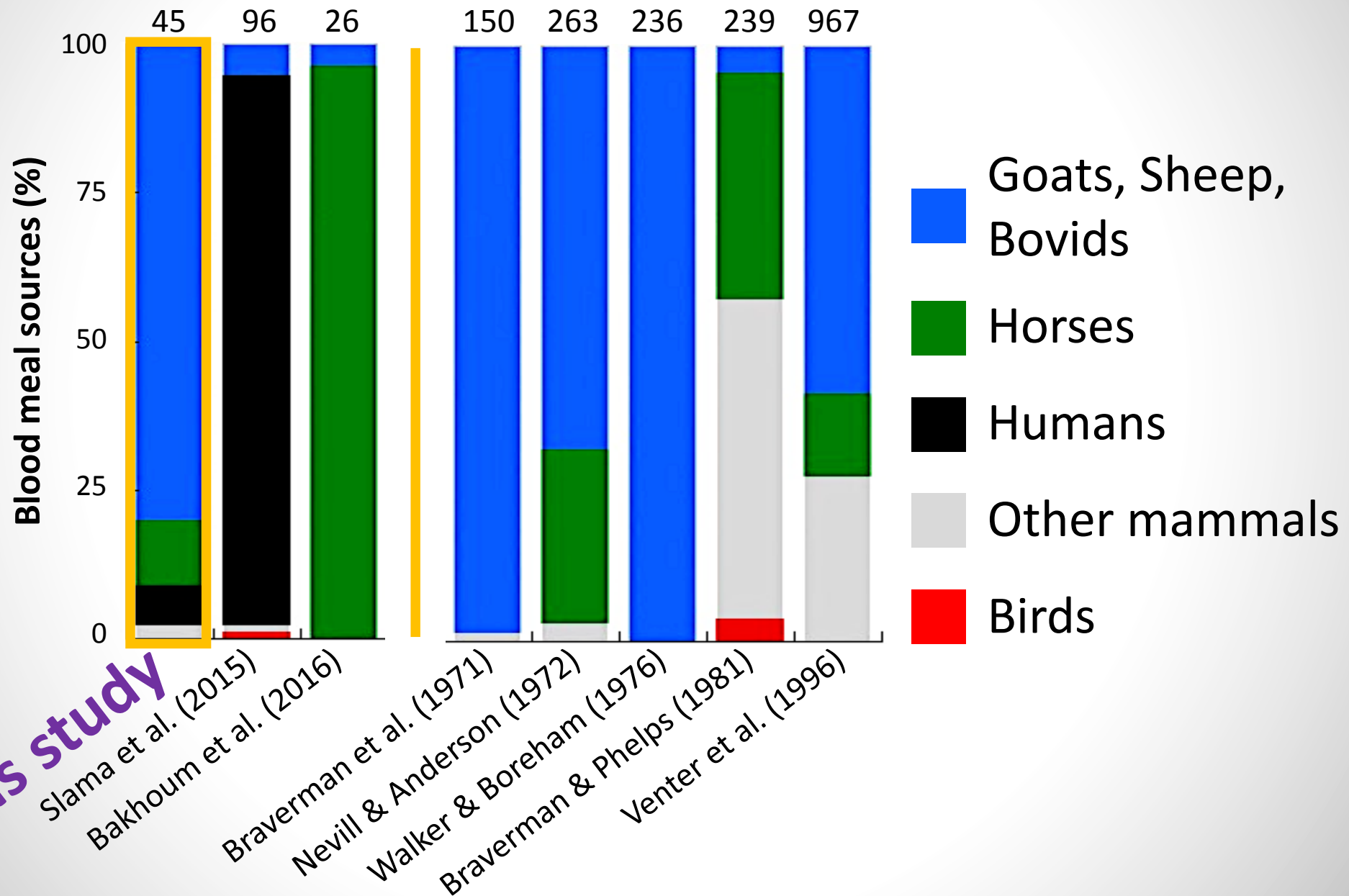
Cyprus,  
Greece,  
Italy,  
Portugal,  
Turkey,  
Spain.

# Hosts are grouped according to their relevance in the epidemiology of BT and AHS





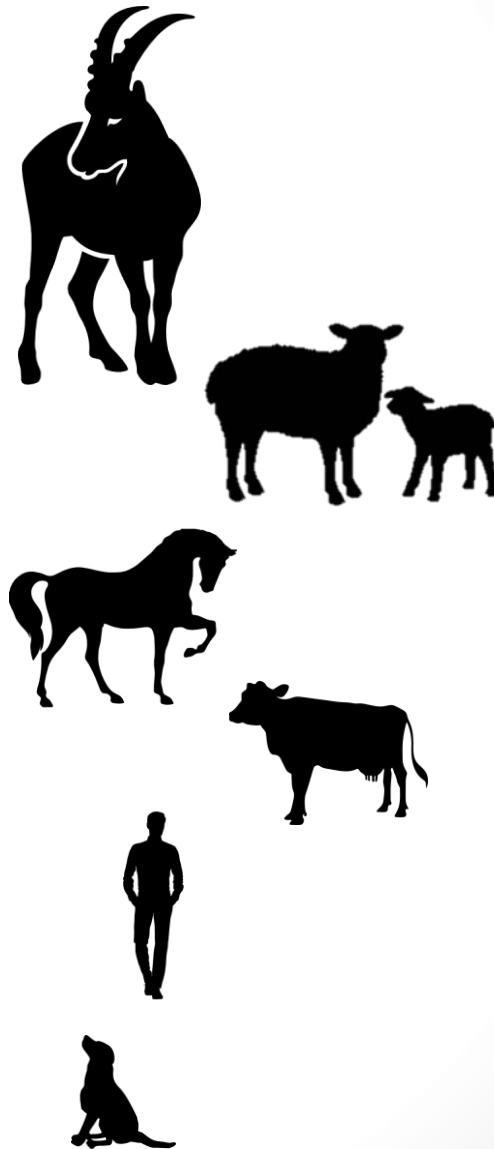
# Hosts are grouped according to their relevance in the epidemiology of **BT** and **AHS**



**This study**

# The **origins** of the **bloodmeals** of 45 *C. imicola* females were identified to species level

HOST	N
Goat	21
Sheep	11
Horse	5
Cow	4
Human	3
Dog	1



**Molecular tools** represent a key factor in studies on the **feeding preference** patterns of ***Culicoides***







# ESTACIÓN BIOLÓGICA DE DOÑANA

FigueroLab







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Ecology & Hydrology**  
NATURAL ENVIRONMENT RESEARCH COUNCIL



Joint Services  
Health Unit



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**Akrotiri Environmental  
Education Centre**


Κέντρο Περιβαλλοντικής Εκπαίδευσης Ακρωτηρίου

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 @M\_Ferraguti

