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## African swine fever as an arboviral disease

*Ornithodoros* tick-vector ecology, distribution  
& role in transmission of ASFV

# What is an arbovirus?

- Most arboviruses are RNA viruses, only few DNA arboviruses have been described so far, including ASFV, MHV-68 and probably LSDV ([Kúdelová & Štibrániová, 2018](#))
- Arboviruses are viruses that are maintained in nature principally, or to an important extent, through biological transmission between susceptible vertebrate hosts by haematophagous arthropods or through transovarian and possibly venereal transmission in arthropods; the viruses multiply and produce viremia in the vertebrates, multiply in the tissues of arthropods, and are passed on to new vertebrates by the bites of arthropods after a period of extrinsic incubation ([WHO 1985](#))

# ASFV association with ticks

- First noted for *Ornithodoros erraticus* ticks in Spain (Botja, 1963);
- Experimentally confirmed as an arbovirus in African *O.moubata* s.l. by [Plowright et al.](#) (1970);
- ASFV has been experimentally shown to replicate in some other *Ornithodoros* ticks (*O. turicata*, *O. coriaceus*, *O. puertoricensis*, *O. parkeri* and *O. savignyi*) but not in hard ticks ([EFSA 2010](#); Carvalho Ferreira et al. 2014).

# Soft ticks vs hard ticks

## Family Argasidae:



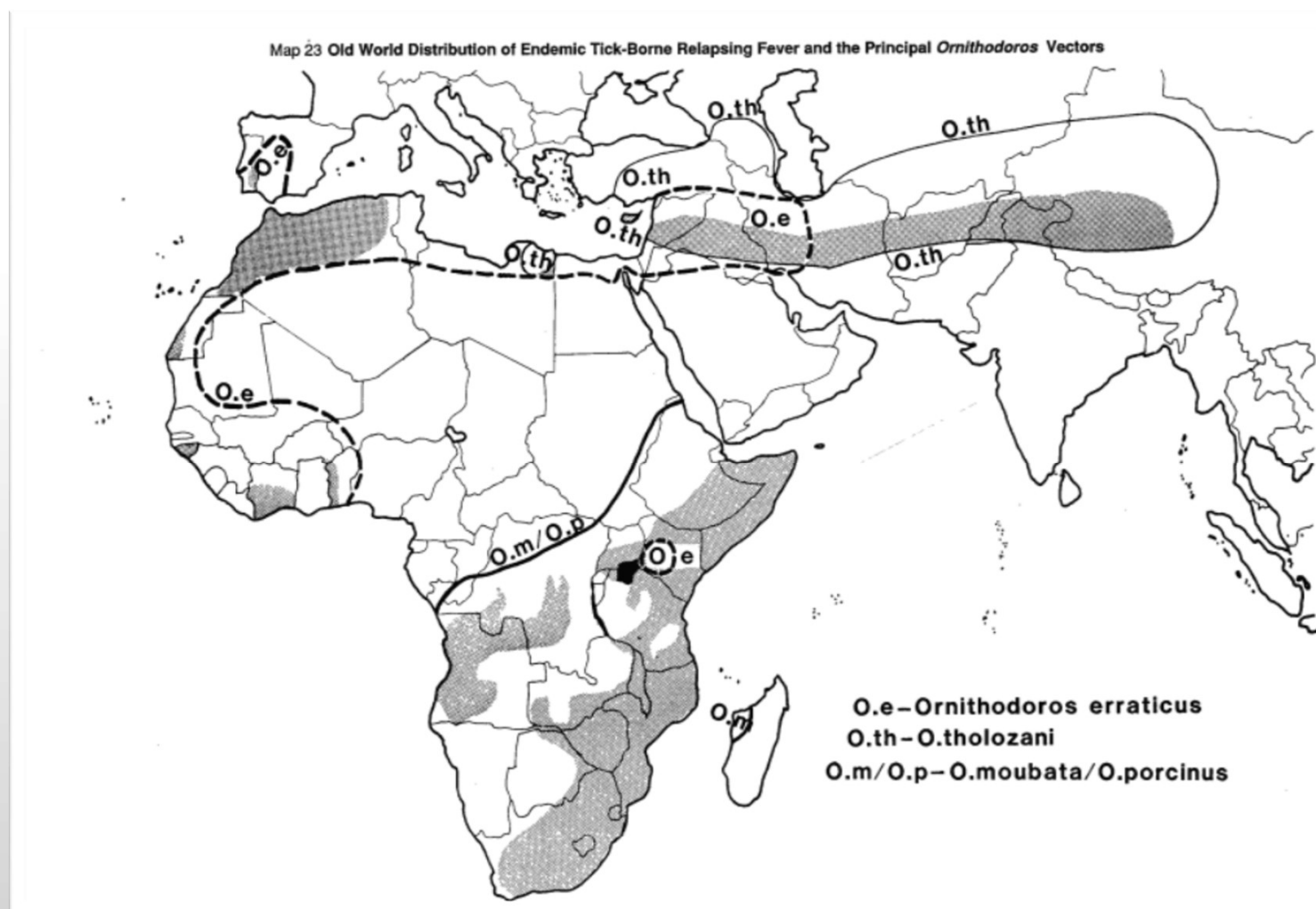
- ca. 200 spp.;
- mostly rapid indiscriminate feeders (minutes-hours);
- endophilic;
- multiple life stages feed on blood (larva, nymphs 1-7, adult);
- long individual life;
- known mostly as vectors of TBRF *Borrelia*

## Family Ixodidae:



- ca. 700 spp.;
- mostly host specific, prolonged feeding (days);
- mostly exophilic;
- 3 life stages that feed on blood (larva, nymph & adult);
- short lived species;
- well-known vectors of viruses, bacteria and protozoa.

# Known distribution of potential vectors in the Old World



*O. tholozani*  
 cx= *tholozani*,  
*asperus*,  
*crossi*,  
*verrucosus*,  
*papillipes*

*O. erraticus*  
 cx= *erraticus*,  
*marocanus*,  
*normandi*,  
*alactagalis*,  
 etc.

*O. moubata*  
 cx= *moubata*,  
*porcinus*,  
*phacochoerus*,  
 etc.

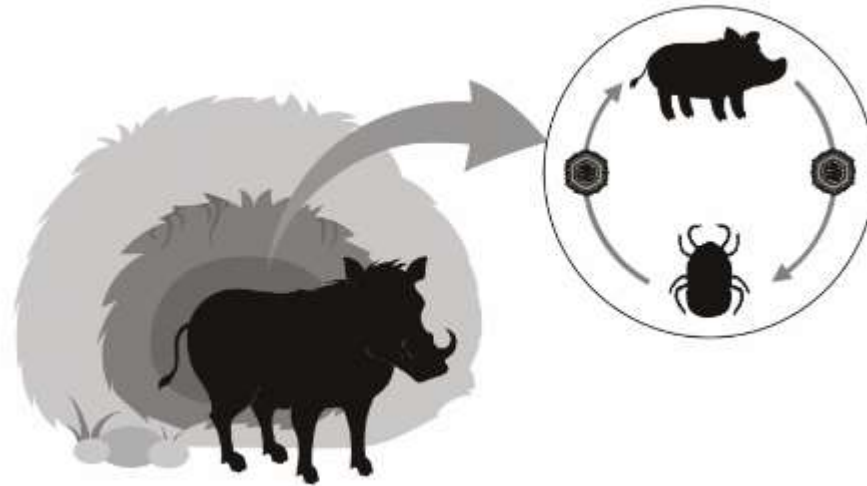
[WHO 1989](#)

# Epidemiological cycles of ASF



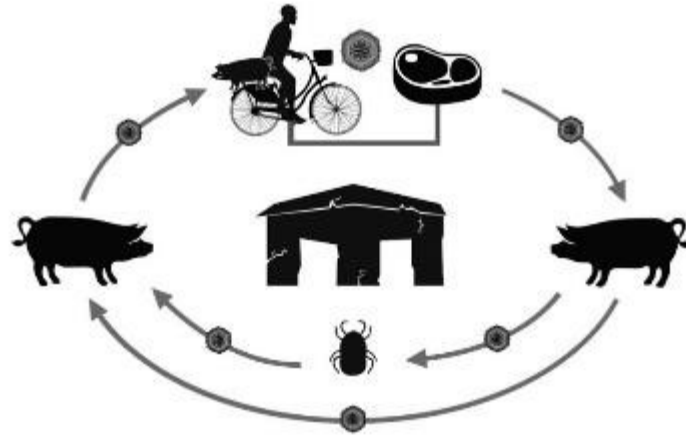
[Chenais et al. 2018](#)

# Ancient sylvatic cycle



- Involves *O. moubata* s.l. ticks and *Phacochoerus spp.*
- Known to occur only in South-Eastern Africa;
- Co-evolution between the ticks and ASFV?

# Domestic pig-tick cycle



- Involves *O. erraticus* s.l. and *O. moubata* s.l. ticks;
- Ticks act as an additional reservoir hosts for the virus;
- Described both in Africa (e.g. Malawi) and SW Europe (Spain & Portugal);
- No known links between the 2 cycles.



# Conditions permissible for existence of the domestic cycle



[McCall et al. 2007](#)



[Boinas et al. 2014](#)

# Situation in Sardinia (enzootic since 1978)



[Mur et al. 2017](#)

- No evidence of soft tick presence or involvement into ASF epidemiology

# Situation in Eastern Europe (Ukraine)

## (ASF enzootic since 2014)



- Potential vector species (*O. verrucosus*) is present in the south but no current evidence for its involvement with ASFV (unpublished data, Filatov S.)



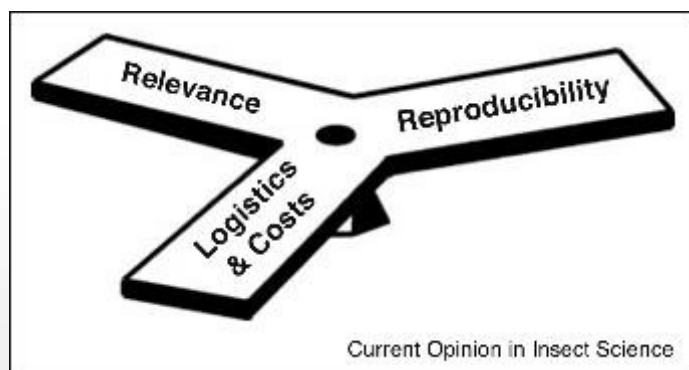
# Situation in the Caucasus

(Georgia, Armenia, Azerbaijan, current ASF status is uncertain)



- Two *Ornithodoros* spp. (*O. verrucosus* and *O. alectagalis*);
- No evidence for involvement of ticks in ASF epidemiology

# Implications of vector competence experiments for ASF epidemiology



[Wilson & Harrup, 2018](#)

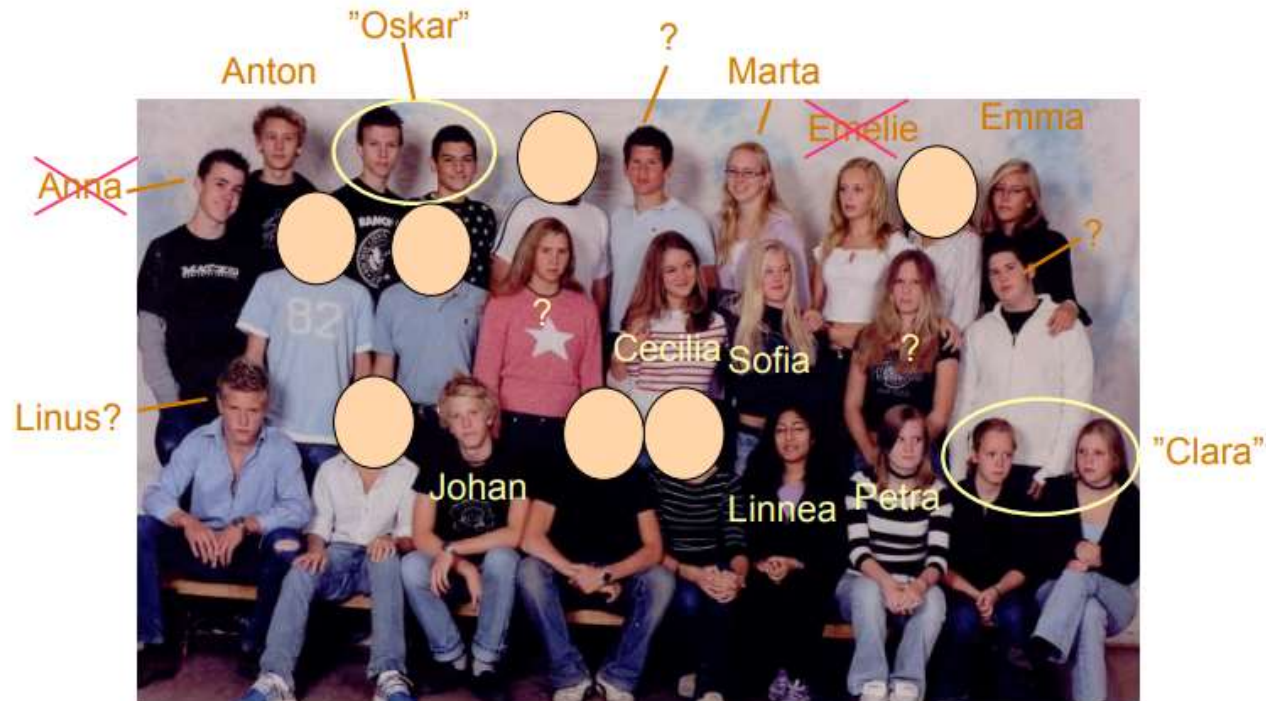
Vector competence= genetically determined ability of a given vector sp. (or population) to acquire & transmit pathogen;

Vectorial capacity = vector competence + all relevant for transmission traits (ecology, microbiome, etc.);

Vector competence studies are only proxies of what is going on in the field!

[de la Fuente et al. 2017](#)

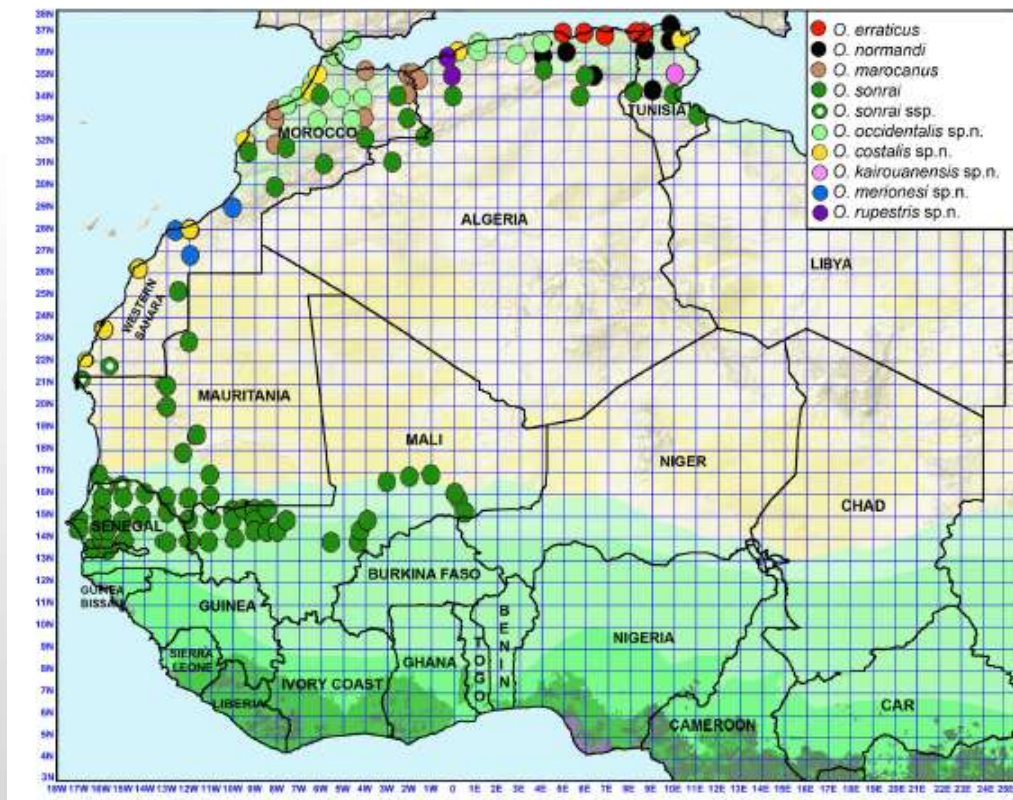
# Implications of unresolved taxonomy for pathogen transmission



A typical taxon in need of revision

[Liljeblad & Gärdenfors](#),  
Swedish Species Information Centre

# Implications of unresolved taxonomy for pathogen transmission (example of *O. erraticus*)



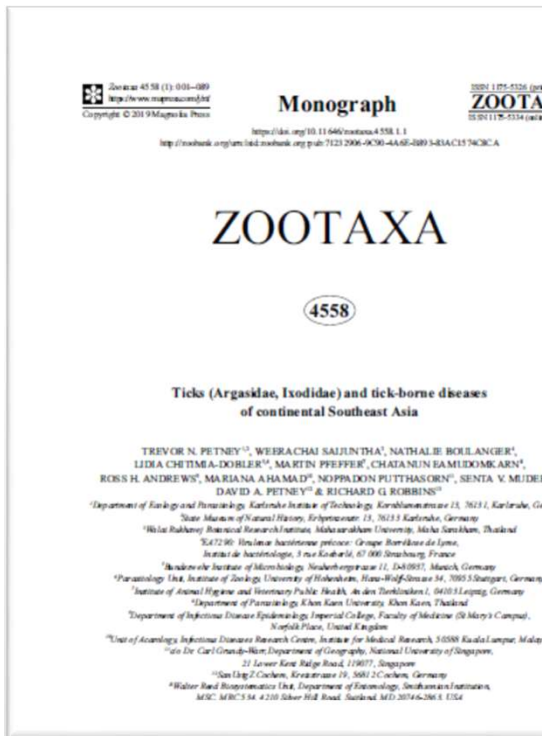
[Trape et al. 2013](#)

In the literature Iberian ticks are referred to either as *O. erraticus* or *O. maroccanus*;

*O. sonrai* has been found naturally infected with ASFV in Senegal but its role in ASF epidemiology is rather unknown ([Vial et al. 2007](#))



# What do we know about current soft tick distribution in Asia?



[Sun et al. 2019](#)

[Petney et al. 2019](#)

[Zhang et al. 2019](#)



- Ticks of *O. tholozani* complex are widely distributed in Central Asia and occur in NW and Central China (Xinjiang, Shanxi);
- Recent discovery of a species closely related to *O. moubata* in Gansu, China;
- No records of *Pavlovskyella* or *Ornithodoros* s.s. ticks from SE Asia



# Future directions of work

- Field sampling to increase our knowledge about distribution and ecology of vectors;
- Colonization of different tick species to study vector biology in the lab;
- Resolving taxonomic problems within *Pavlovskyella* using integrative approaches (classical taxonomy + systems biology);
- Vector competence studies to fully assess the risk of involvement of ticks into ASFV circulation

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