Relative contributions of neighborhood and animal movements to *Coxiella burnetii* infection in dairy cattle herds

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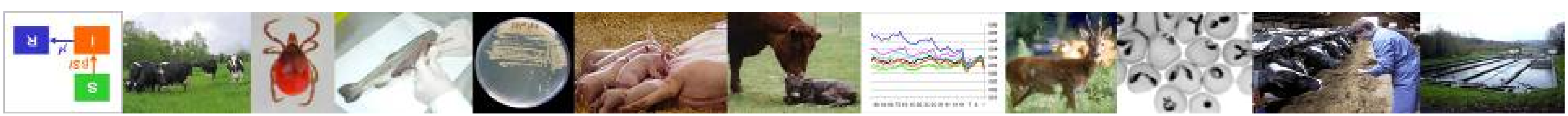
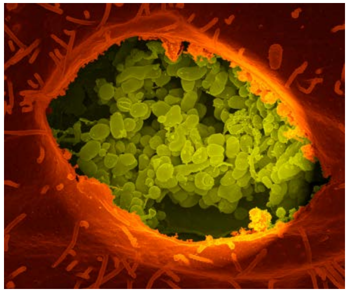
INRA SCIENCE & IMPACT

Biology, Epidemiology and Risk Analysis

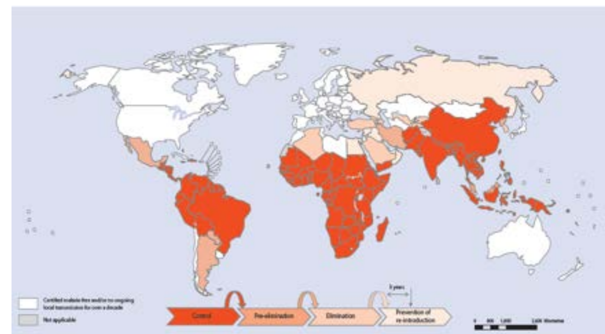


Context



Coxiella burnetii (Cb) = infectious agent responsible for Q fever infection

World wide spread zoonosis



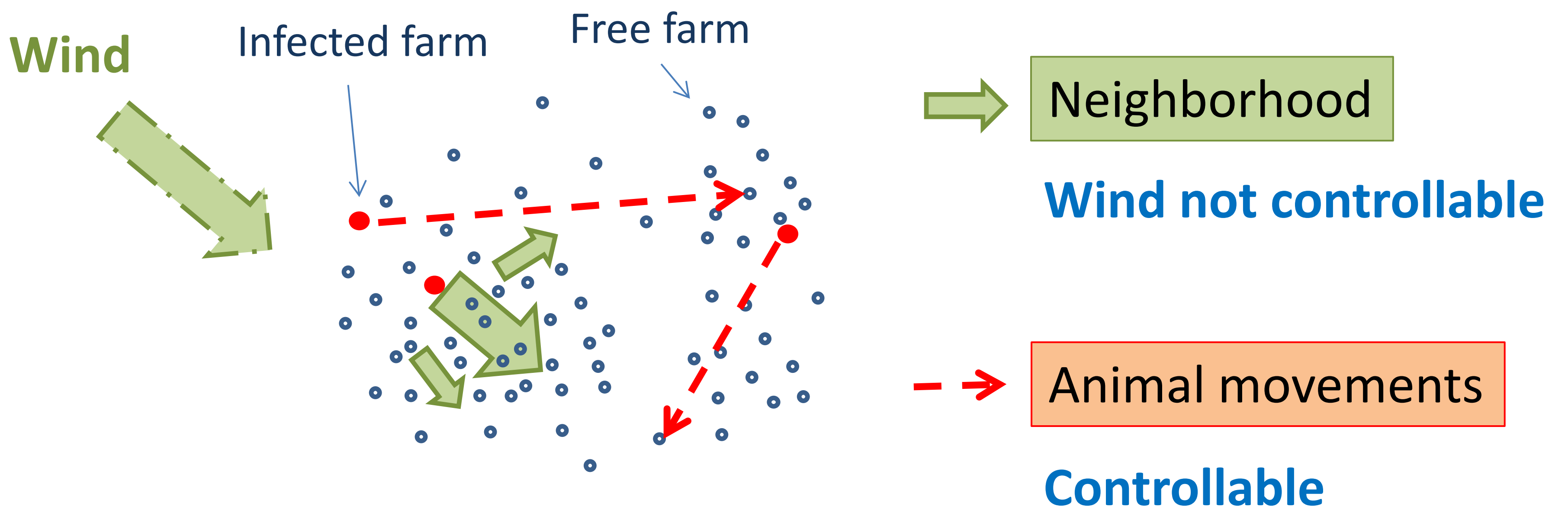
Shedding

(birth products > faeces, urine, milk)

Environment

Inhalation of contaminated aerosols

How a herd becomes infected ?



Relative contributions neighborhood / animal mvts ?

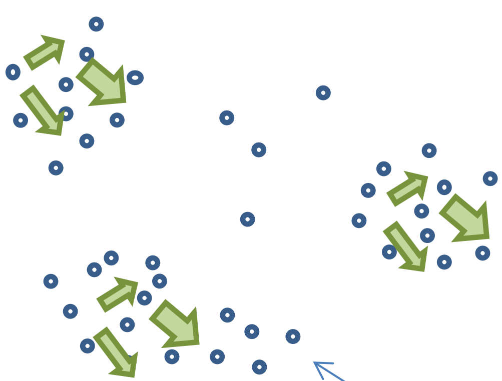
Control measures based on animal movements testing ?

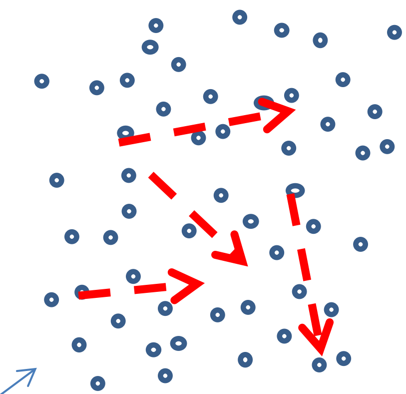
Spatial distribution

Hypothesis: spatial distribution of infected herds depends on the relative contributions of

Neighborhood

Animal movements





Infected farms

Objectives

To describe the spatial distribution of Q fever infected dairy herds in

- France
- Sweden

To quantify and compare the relative contributions of neighborhood and animal movements on the risk for a herd to be infected

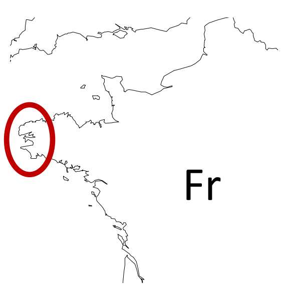
Data available

Cb infection status

Serological tests in BTM

2,829 french dairy herds

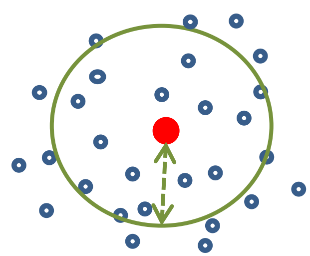
246 swedish dairy herds



Neighborhood

Local cattle density

Number of cattle in both dairy and beef herds

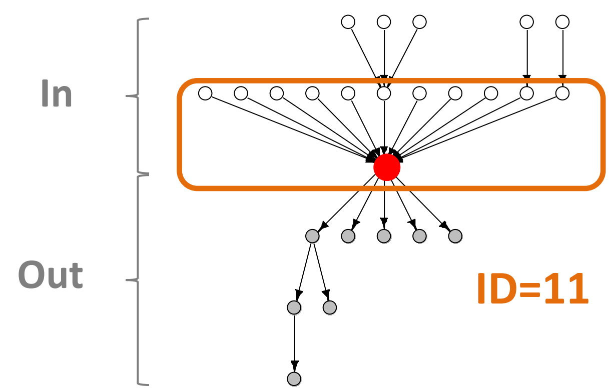


R=5km

Animal movements

Network parameter = In-degree

Number of herds from which each herd receives animal directly



Methods

To describe the spatial distribution of Q fever Ab-positive dairy herds

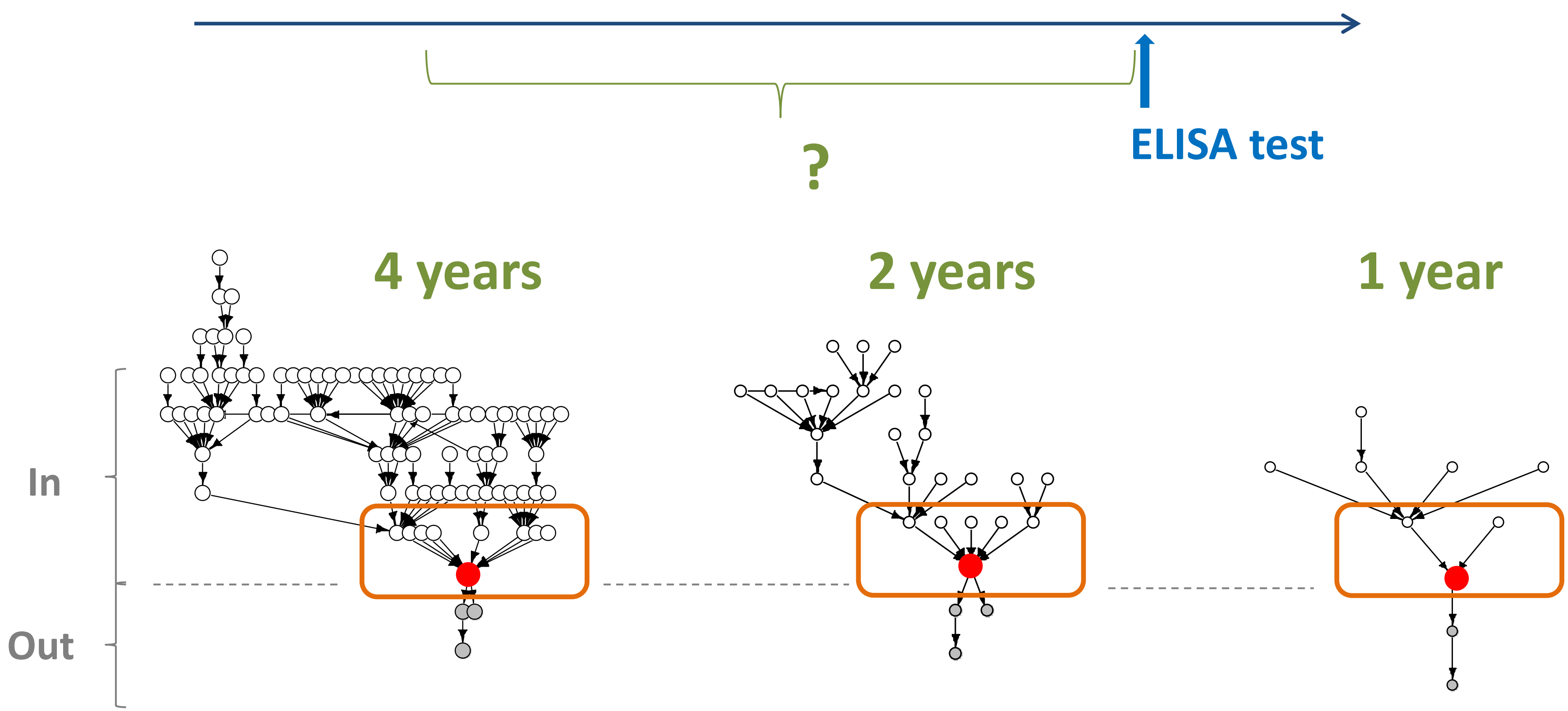
➡ **Cluster detection**

To quantify and compare the relative contributions of neighborhood and animal movements on the risk for a herd to be Ab-positive

➡ **Risk factors analysis (logistic regression)**

➡ **Population attributable fractions:**
% of positive herds that can be attributable to the risk factors

Time window for the in-degree



$ID_4 = 8$ | $ID_2 = 5$ | $ID_1 = 2$

Ab(Y/N) ~ ID_4
➔ OR_4, AIC_4

Ab(Y/N) ~ ID_2
➔ OR_2, AIC_2

Ab(Y/N) ~ ID_1
➔ OR_1, AIC_1

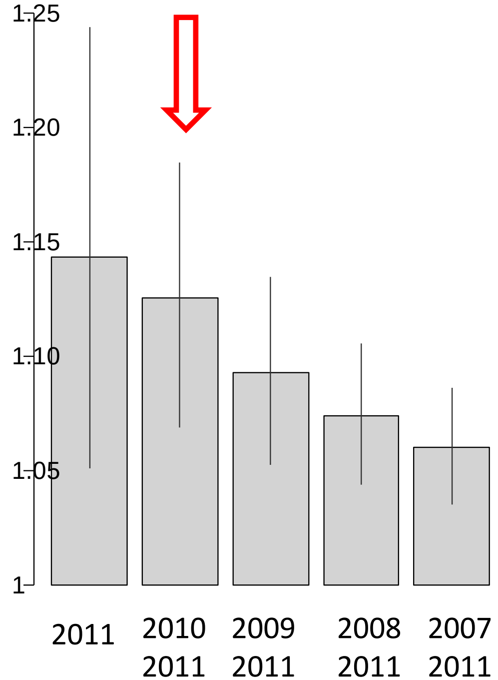
Time window for the in-degree

<u>Principle</u>: to maximize the OR and minimize the AIC

ELISA test

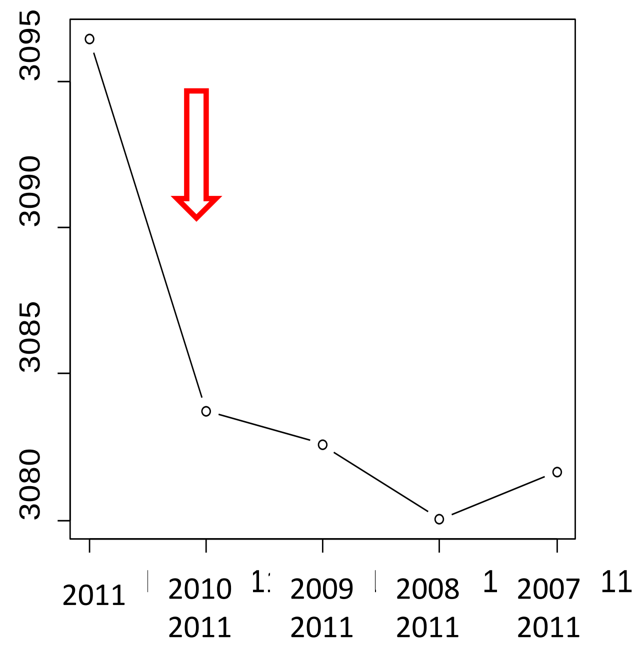
2012

OR



1 yr 2 yrs 3 yrs 4 yrs 5 yrs

AIC



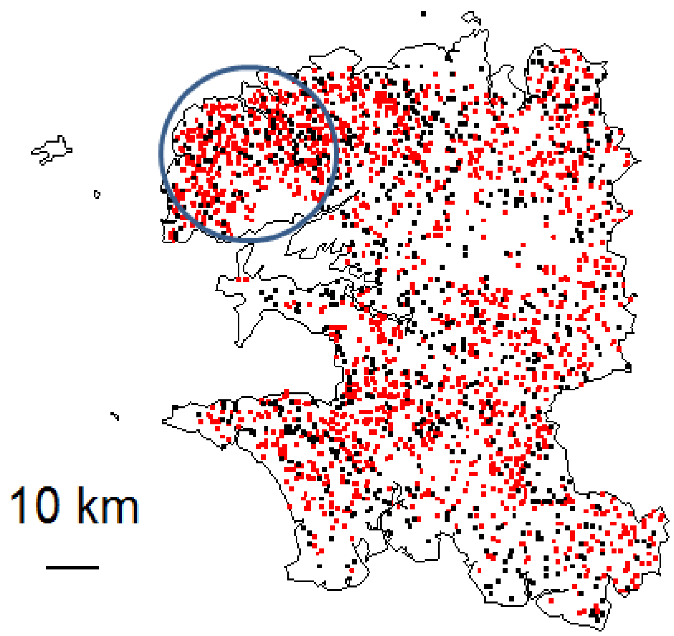
1 yr 2 yrs 3 yrs 4 yrs 5 yrs

Time window: 2 years before the ELISA test

Detection of cluster

Finistère, France

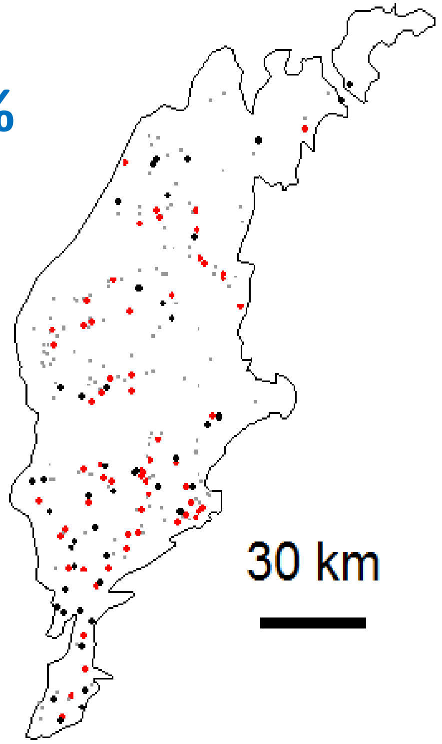
69%



One cluster
RR=1.20

Gotland, Sweden

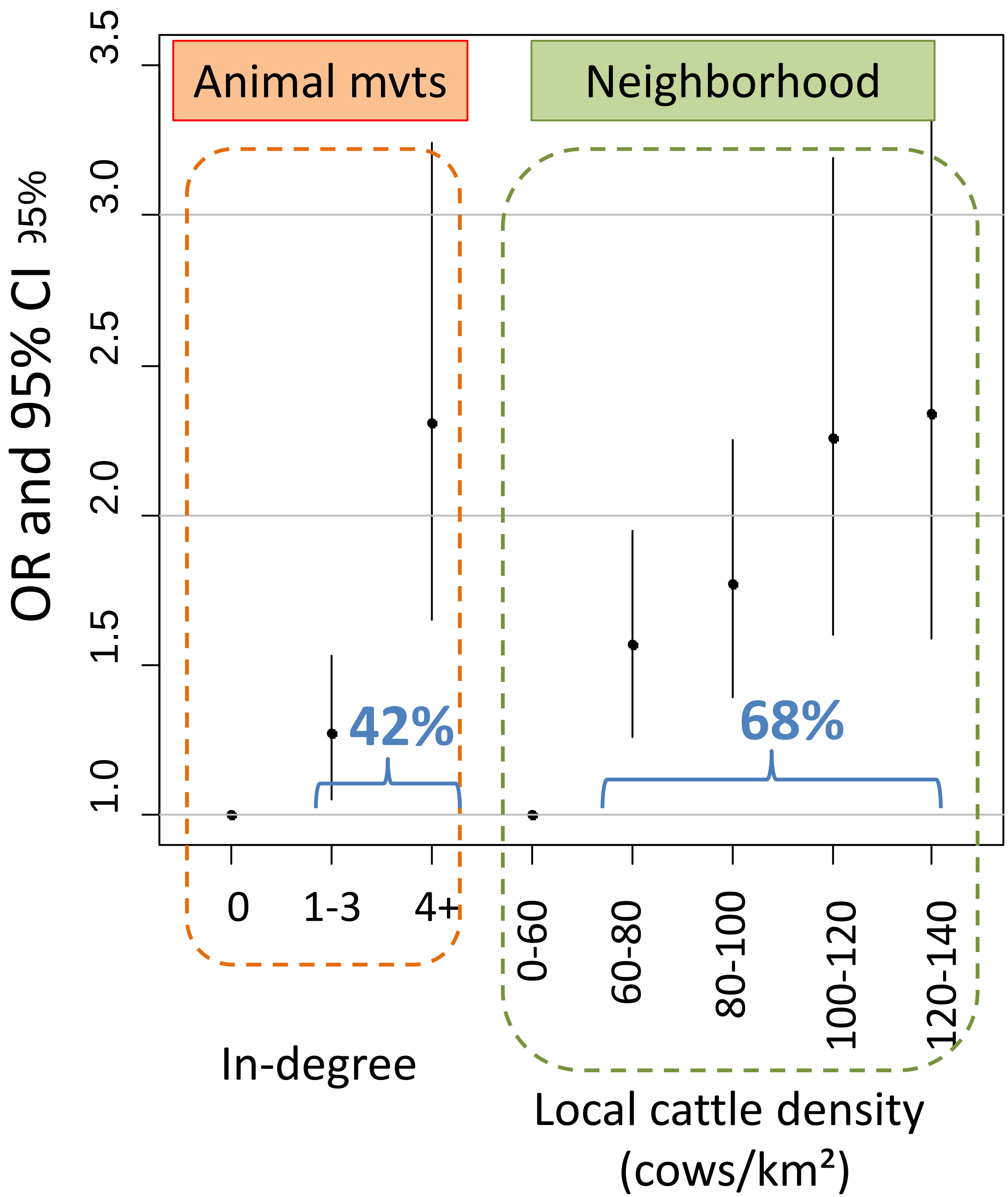
55%



No cluster

Effect of the density

Logistic regression



Population attributable fraction (AF)

$$AF = \frac{Prev \times (OR - 1)}{1 + Prev \times (OR - 1)}$$

Animal mvts		Neighborhood
16%	<	34%
Fr 15% Se 25%		Fr 35% Se 0%

Cluster analysis

Conclusion

Overall **Neighborhood** **AND** **Animal movements** contribute to the *Cb* infection of dairy cattle herds

Control measures should vary according to the cattle density

Low cattle density (<60 cows/km²)

No effect on risk of infection

⇩

Animal testing before purchase should be sufficient

High cattle density (≥60 cows/km²)

Increase risk of infection

⇩

Animal testing before purchase probably not sufficient

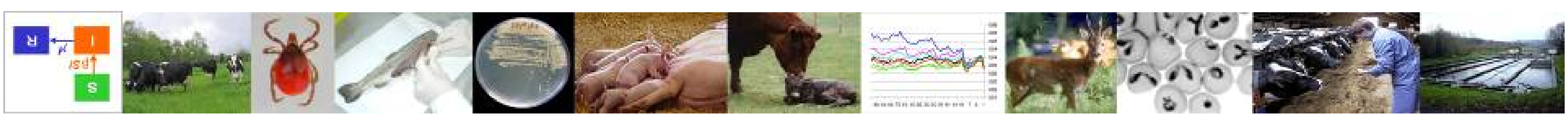
➡ **Vaccination**

Thank you for your attention

Acknowledgements:

France: French Research Agency, program Investments for the future, MIHMES project (ANR-10-BINF-07)

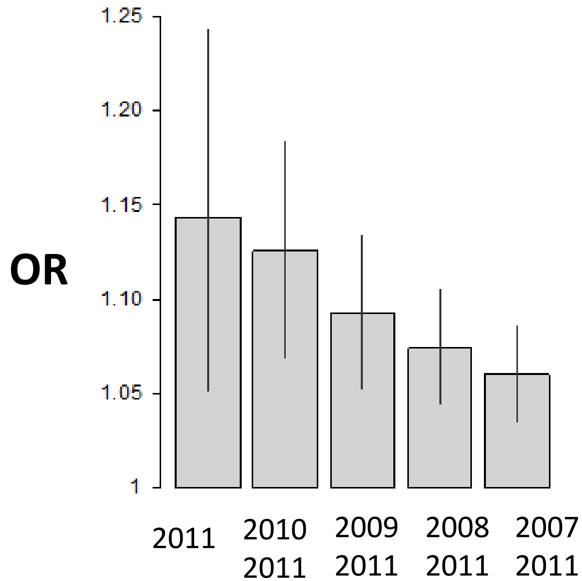
Sweden: C.F Lundström Foundation

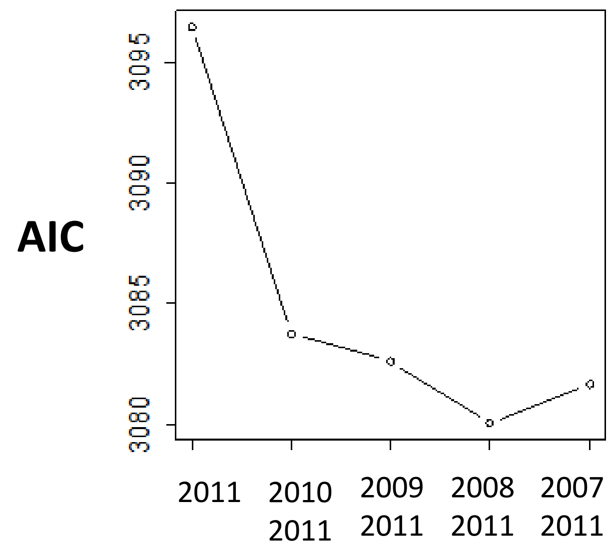


Time window for the calculation of the in-degree parameter

France

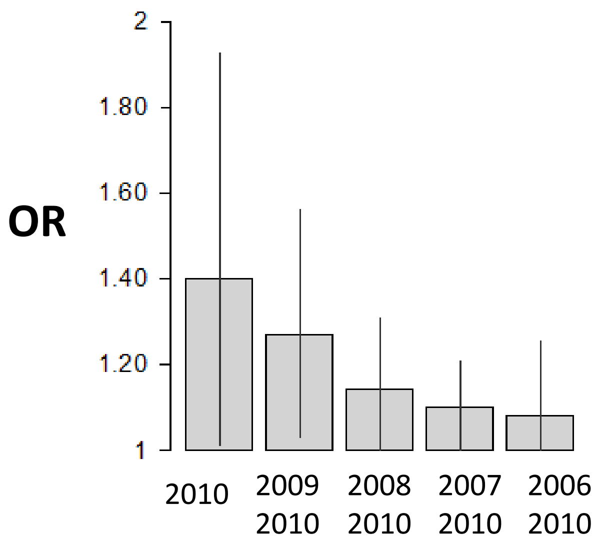
ELISA test
⇩
2012

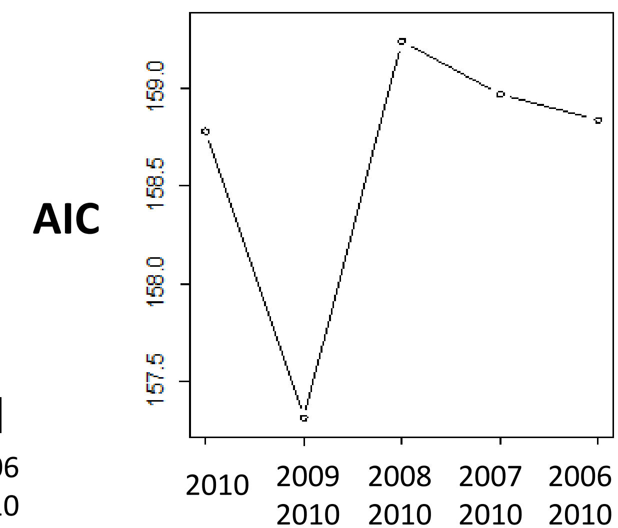




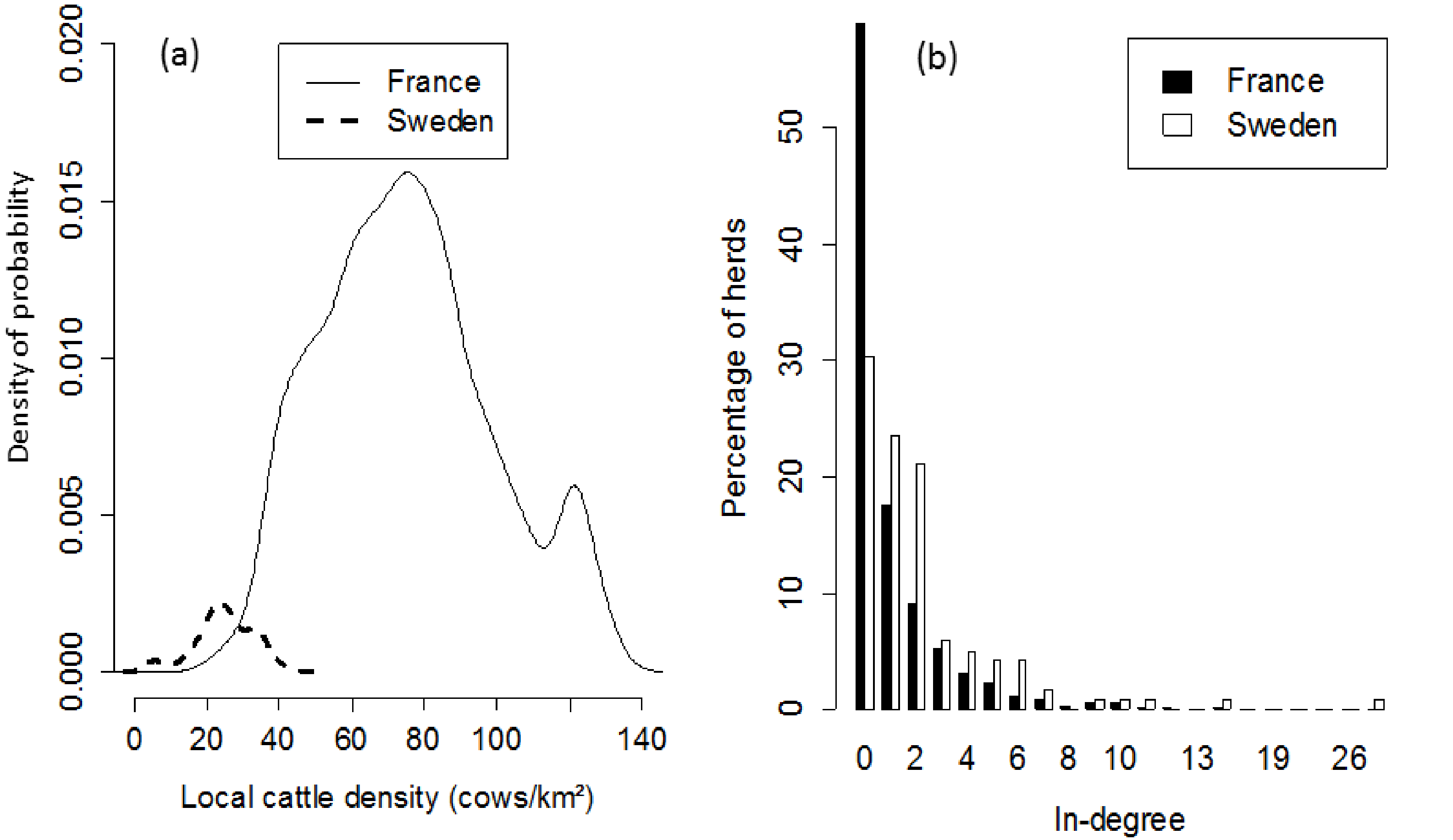
Sweden

ELISA test
⇩
2011





Descriptive results



Multivariate results

Variable	Exposure level	% of population	OR (IC95%)	p-value	Attributable fraction (AF)*	AF per country
In-degree (ID)	0	57.7	1		15.6	France 15.1
	1-3	32.4	1.27 (1.05-1.53)	0.01		Sweden 25.1
	4+	9.3	2.31 (1.65-3.24)	<0.001		
Local cattle density (DENS)	0-60	32.1	1		34.3	France 35.2
	60-80	30.1	1.57 (1.26-1.95)	<0.001		Sweden 0
	80-100	22.3	1.77 (1.39-2.25)	<0.001		
	100-120	8.7	2.26 (1.60-3.19)	<0.001		
	120-140	6.8	2.34 (1.59-3.43)	<0.001		
Country	France	96	1			
	Sweden	4.0	0.67 (0.44-1.004)	0.052	-	