Coxiella burnetii within- and between-herd true seroprevalence assessment in domestic ruminants in France accounting for diagnostic uncertainty with latent class

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Context and objectives

Q fever : a wordwide zoonosis still difficult to control

- **Human outbreaks** regularly occur over the world
- In Europe, most human cases are related to **domestic ruminant exposure**
- **Unbiased estimation of the prevalence** is crucial to detect and assess epidemiological changes

Apparent seroprevalence levels in France and potential bias

First large epidemiological study (Gache *et al*. 2017) :

⇒ **Animal-level seroprevalence** of 22.2% in **cattle**, 41.5% in **goats** and 25.7% in **sheep**

⚠ **Only apparent seroprevalence** were assessed (*i.e.* Se and Sp considered = 100%)
See Poster #231 : **Se = [54% ; 75%]** and **Sp = [97% and 99%]**

⇒ **Without accounting for the diagnostic uncertainty,** results were potentially biased with an under or over estimation of true seroprevalences

Objectives of the study

✓ Reassess the **between-** and **within-herd seroprevalence** in cattle, sheep and goats from the results published by Gache *et al*. 2017
✓ Quantify the importance of two potential **risk factors of seropositivity** at the animal and herd level (type of production and herd size)

Material and methods

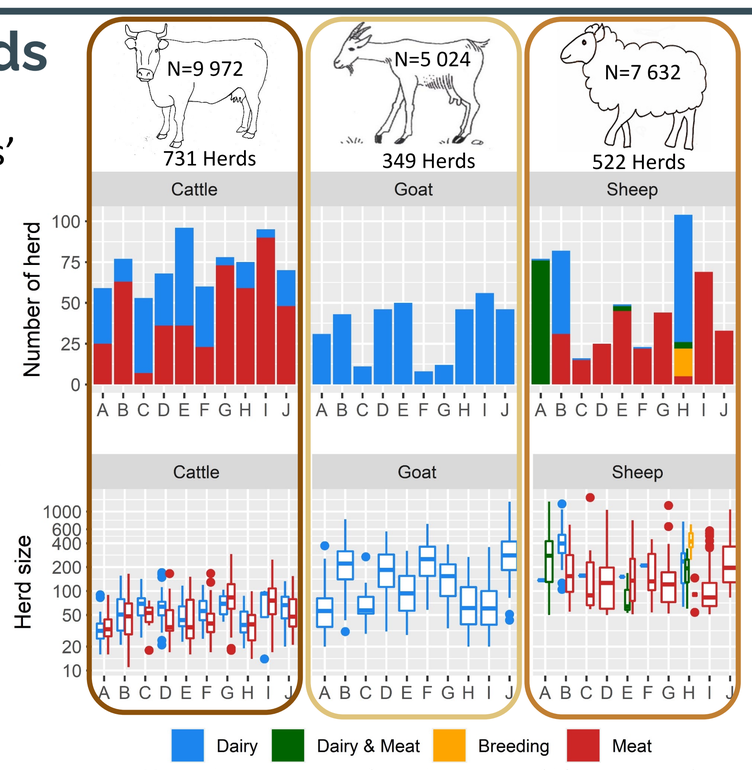
Data

- Sampling in 10 French 'départements'

- Random selection of 19 to 106 herds by 'département' and species
- Convenience sample of 10 to 15 animals by herd

- **Serum analysis** in 10 veterinary laboratories with Priocheck™ ELISA test
- **Additional informations**

⇒ Herd size = number of :
Females for **cattle**
Animals for **sheep** and **goats**
⇒ Types of production
Dairy/**meat** for **cattle** and **goats**
Dairy/**meat**/**dairy & meat**/**breeding** for **sheep**



Herd size and type of production by 'département'

Hierarchical logistic model

- Two intricated **logistic regression models** for the distribution of :

⇒ The **between-herd prevalence** (BHP_{ij}): the proportion of truly seropositive herds in each 'département'
⇒ The **within-herd prevalence** (WHP_{ij}): the proportion of truly seropositive animals in each seropositive herd

- The **number of tested seropositive animals** in each herd was then supposed to follow a binomial distribution which depends on :

⇒ the number of animals sampled
⇒ the herd status (seropositive or not)
⇒ the WHP_{ij}
⇒ the **sensitivity and specificity of the ELISA test**

Results : Seroprevalence

Median of observed and assessed seroprevalence levels in each species and type of production

		Cattle		Goat		Sheep		
Between-Herd seroprevalences	Meat	16,3*	5,7† [1,5 ; 19,5]	Dairy	63,5*	47,1 † [25,5 ; 67,2]	Meat	28,0*	36,7† [5,6 ; 85,5]
	Dairy	54,4*	47,9 † [20,3 ; 79,2]				Dairy	78,5*	21,6 † [1,3 ; 76,2]
							Dairy & Meat	75,0*	32,7 † [2,7 ; 87]
							Breeding	52,9*	23,5 † [1 ; 100]
Whitin-Herd seroprevalences	Meat	8,3*	39,4 † [27,3 ; 57]	Dairy	35,7*	63,6 † [53,4 ; 73,9]	Meat	12,5*	22,9 † [17 ; 31,7]
	Dairy	21,4*	38,7 † [30,5 ; 49,3]				Dairy	20,0*	36,9 † [27,2 ; 48,6]
							Dairy & Meat	40,0*	57,8 † [44,5 ; 72]
							Breeding	13,3*	18,7 † [5,9 ; 52,1]

** Observed median of the apparent seroprevalences*
† Assessed median of the true seroprevalence

BHPs assessed† were lower than the observed apparent* **BHPs**
⇒ Account for the **imperfect specificity** of the ELISA test

WHPs assessed† were higher than the observed apparent* **WHPs**
⇒ Account for the **moderate sensitivity** of the ELISA test

Results : Risk factors

- **Cattle**

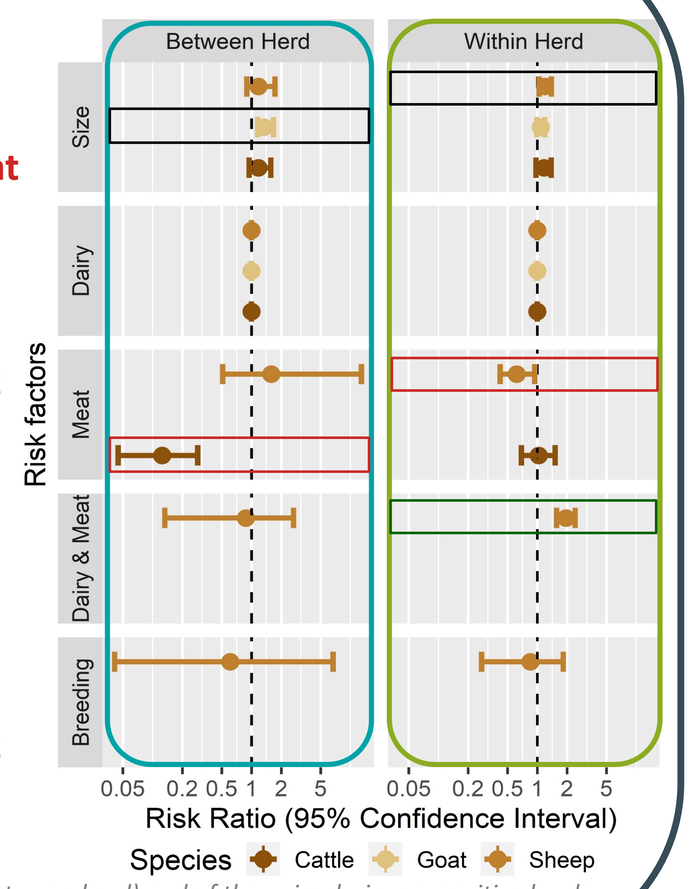
BHPs
- **7.9x higher in dairy** *vs*. in **meat** herds

- **Goats**

BHPs
- **1.4x higher** when **herd size x2**

- **Sheep**

WHPs were :
- **1.6x higher in dairy** *vs*. in **meat**
- **2.5x higher in dairy & meat** *vs*. in **meat**
- **1.3x higher** when **herd size x2**



Risk ratio of seropositivity of the herd (between-herd) and of the animals in seropositive herds (within-herd). The reference herd is a dairy herd of medium size in each species

Conclusion

- **Better knowledge of the true within- and between-herd seroprevalence levels in France**
- **Identification and quantification of some relevant risk factors**

Discussion

- **Results must be carefully extrapolated**
  Potential non-representativeness of the 10 'departments' included
  Random selection of herds without information on abortion occurrence

⇒ **New insights related to the epidemiology of *Coxiella burnetii* in domestic ruminants in France**

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