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

T. Lurier, Elodie Rousset, Carole Sala, Kristel Gache, Marie Laure Delignette-Muller, Elsa Jourdain, Florence Ayral

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

Thibaut Lurier[1,2], Elodie Rousset[3], Carole Sala[4], Kristel Gache[5], Marie Laure Delignette-Muller[6], Elsa Jourdain[1], Florence Ayral[2]
**1- UMR EpiA; 2- USC 1233; 3- Q fever RNL Q; 4- EAS Unit ; 5- GDS France; 6- UMR 5558**

## 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

**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)

**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

## 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[TM] 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'*
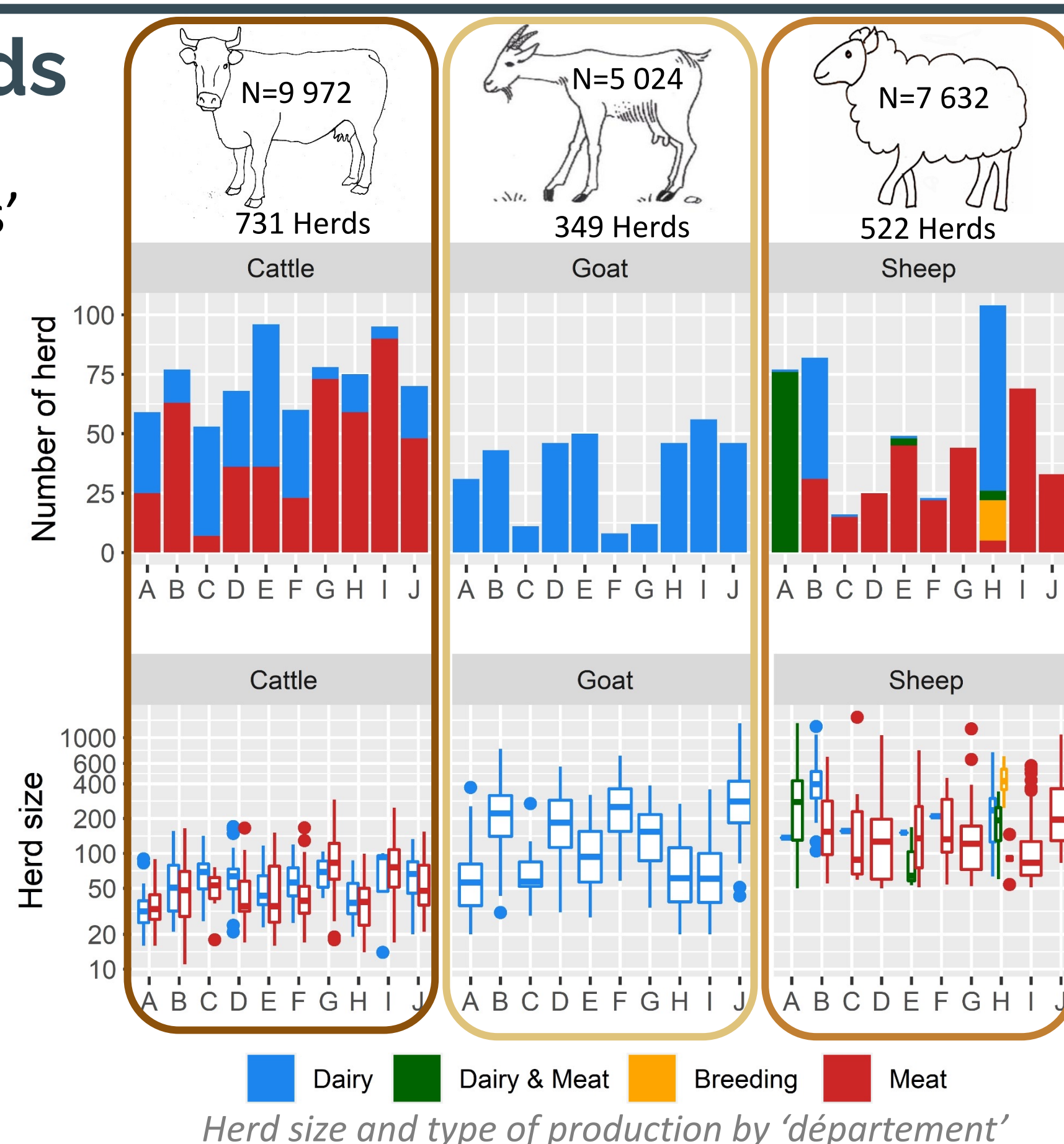
**Hierarchical logistic model**
- Two intricated **logistic regression models** for the distribution of :
⇒ The **between-herd prevalence** ($BHP_{ij}$): the proportion of truly seropositive herds in each 'département'
⇒ The **within-herd prevalence** ($WHP_{ij}$): the proportion of truly seropositive 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†<br>[1,5 ; 19,5] | Dairy | 63,5* | Meat | 28,0*<br>36,7†<br>[5,6 ; 85,5] |
| | | | | | 47,1†<br>[25,5 ; 67,2] | Dairy | 78,5*<br>21,6†<br>[1,3 ; 76,2] |
| | Dairy | 54,4* | 47,9†<br>[20,3 ; 79,2] | | | Dairy & Meat | 75,0*<br>32,7†<br>[2,7 ; 87] |
| | | | | | | Breeding | 52,9*<br>23,5†<br>[1 ; 100] |
| **Whitin-Herd seroprevalences** | Meat | 8,3* | 39,4†<br>[27,3 ; 57] | Dairy | 35,7* | Meat | 12,5*<br>22,9†<br>[17 ; 31,7] |
| | | | | | 63,6†<br>[53,4 ; 73,9] | Dairy | 20,0*<br>36,9†<br>[27,2 ; 48,6] |
| | Dairy | 21,4* | 38,7†<br>[30,5 ; 49,3] | | | Dairy & Meat | 40,0*<br>57,8†<br>[44,5 ; 72] |
| | | | | | | Breeding | 13,3*<br>18,7†<br>[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**
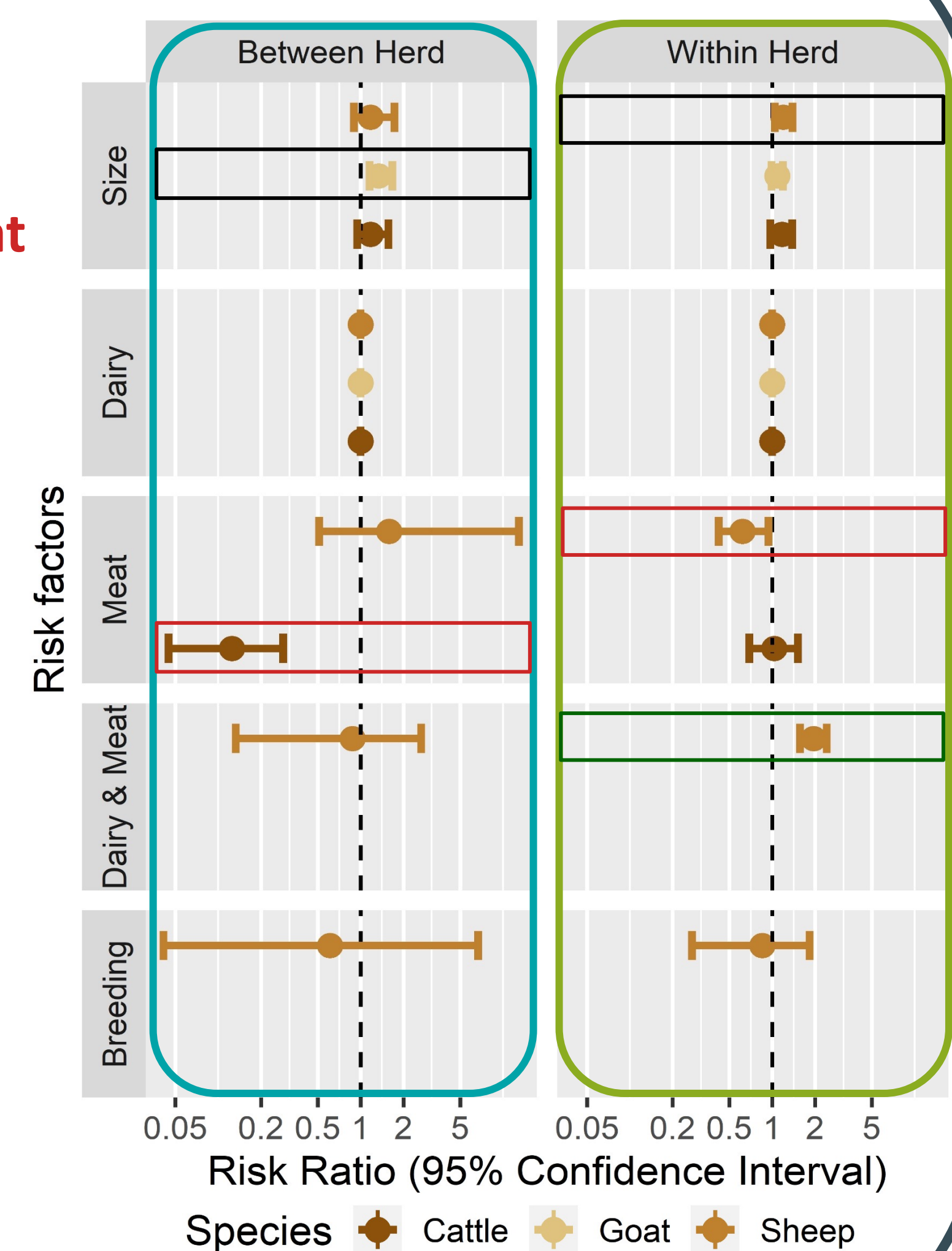⇒ Account for the **moderate sensitivity** of the ELISA test

## Results : Risk factors

- **Cattle**
**BHPs**
  o **7.9x higher in dairy *vs.* in meat** herds
- **Goats**
**BHPs**
  o **1.4x higher when herd size x2**
- **Sheep**
**WHPs** were :
  o **1.6x higher in dairy *vs.* in meat**
  o **2.5x higher in dairy & meat *vs.* in meat**
  o **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**

France
Auvergne Rhône Alpes

Thibaut.lurier@vetagro-sup.fr