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► To cite this version:

T. Lurier, Elodie Rousset, Carole Sala, Kristel Gache, Marie Laure Delignette-Muller, et al.. Coxiella burnetii within- and between-herd true seroprevalence assessment in domestic ruminants in France accounting for diagnostic uncertainty with latent class. ESCCAR International congress on Rickettsiae and 9th Meeting of the European Society for Chlamydia Research (ESCR), Aug 2022, Lausanne, Switzerland. , pp.#232. hal-03757842

HAL Id: hal-03757842

<https://hal.inrae.fr/hal-03757842>

Submitted on 2 Sep 2022

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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

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Context and objectives

Q fever : a worldwide 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

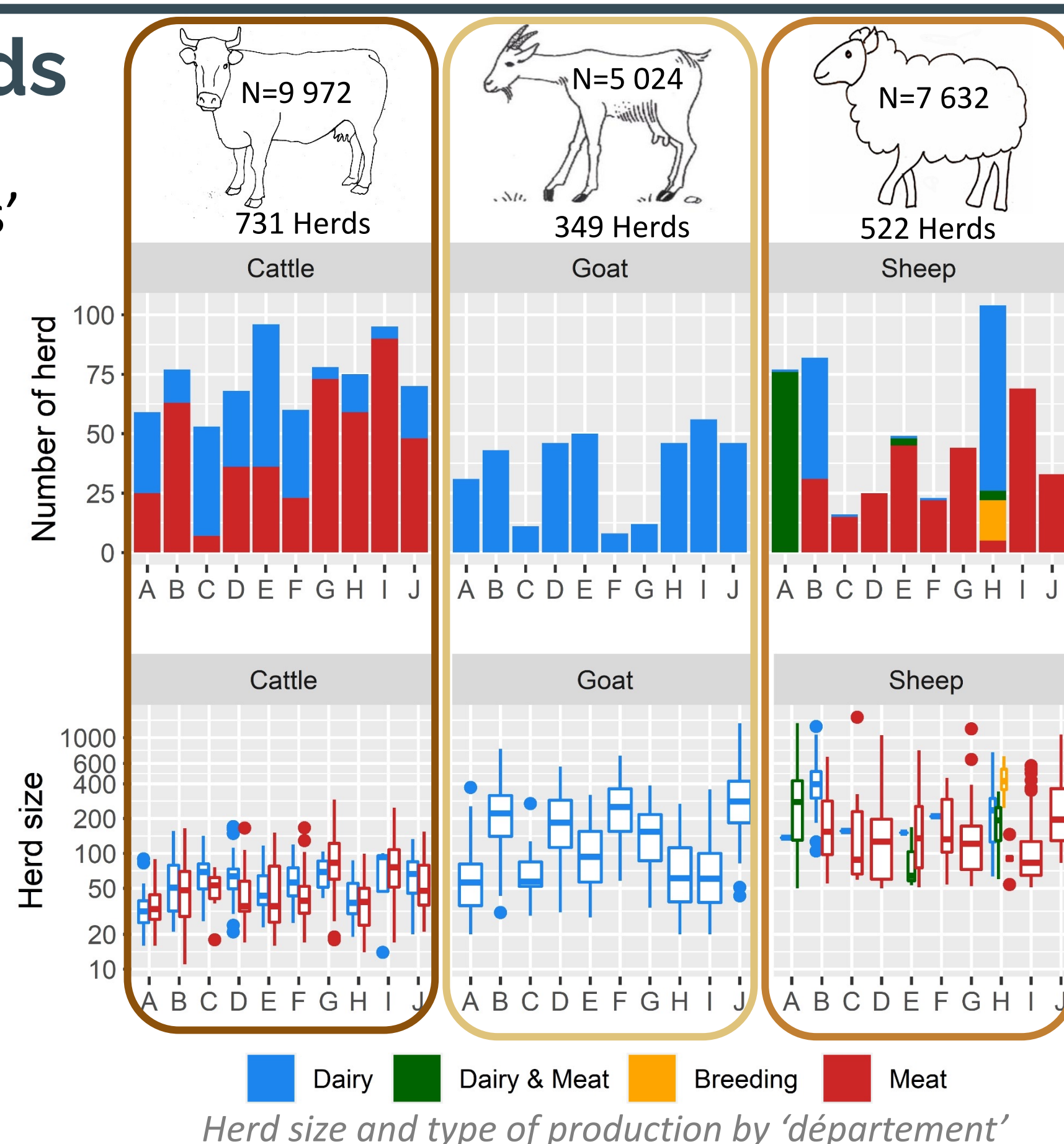
Objectives of the study

- ✓ 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**



Hierarchical logistic model

- Two intricate **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†	63,5*	47,1†	28,0*	36,7†
		[1,5 ; 19,5]			[5,6 ; 85,5]	21,6†	
	Dairy	54,4*	47,9†			78,5*	75,0*
		[20,3 ; 79,2]				[1,3 ; 76,2]	[2,7 ; 87]
Within-Herd seroprevalences	Meat	8,3*	39,4†	35,7*	63,6†	12,5*	22,9†
		[27,3 ; 57]			[53,4 ; 73,9]	36,9†	
	Dairy	21,4*	38,7†			20,0*	40,0*
		[30,5 ; 49,3]				[27,2 ; 48,6]	[44,5 ; 72]
						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

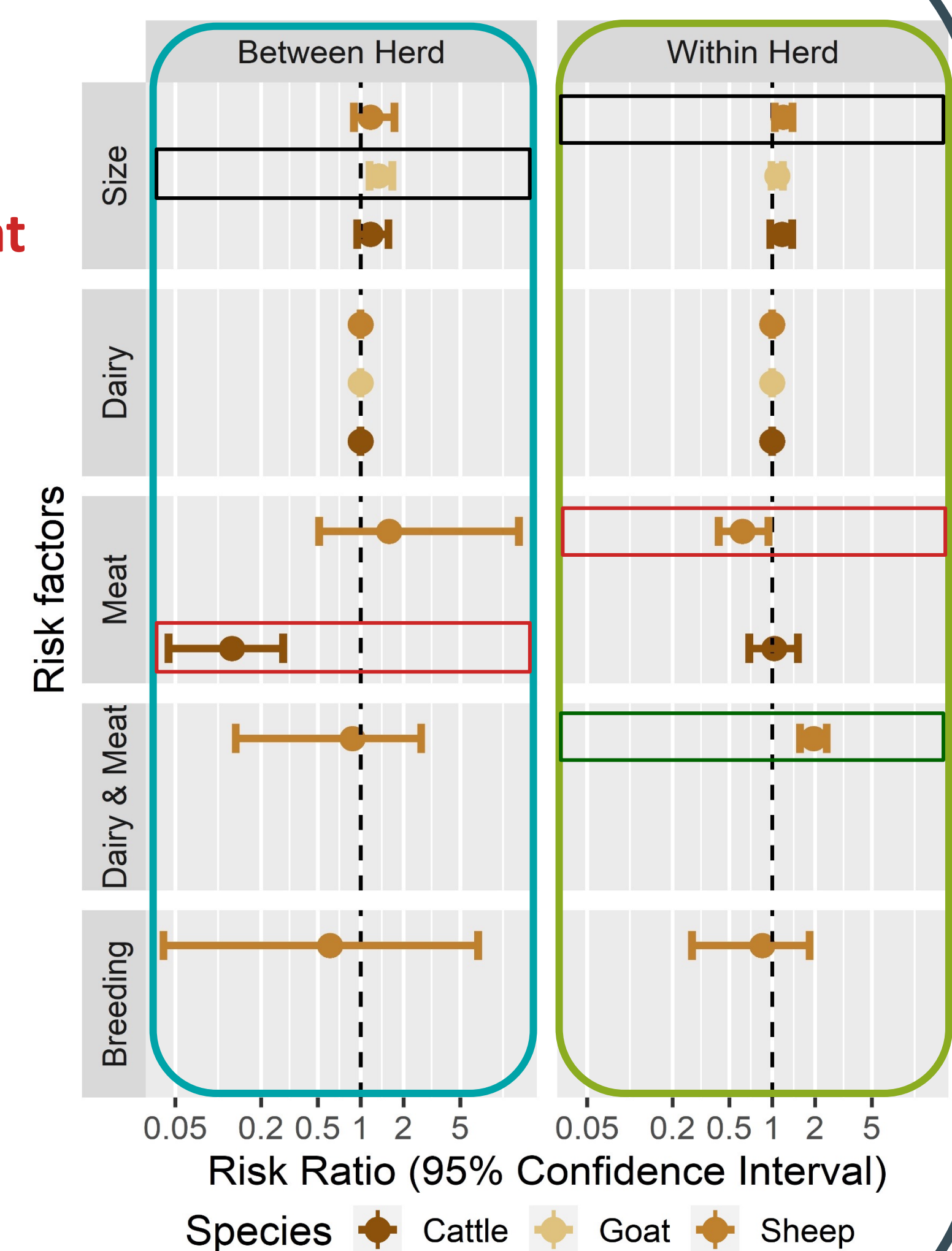
- **BHPs**
 - 7.9x higher in **dairy** vs. in **meat** herds

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

Discussion

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

