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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

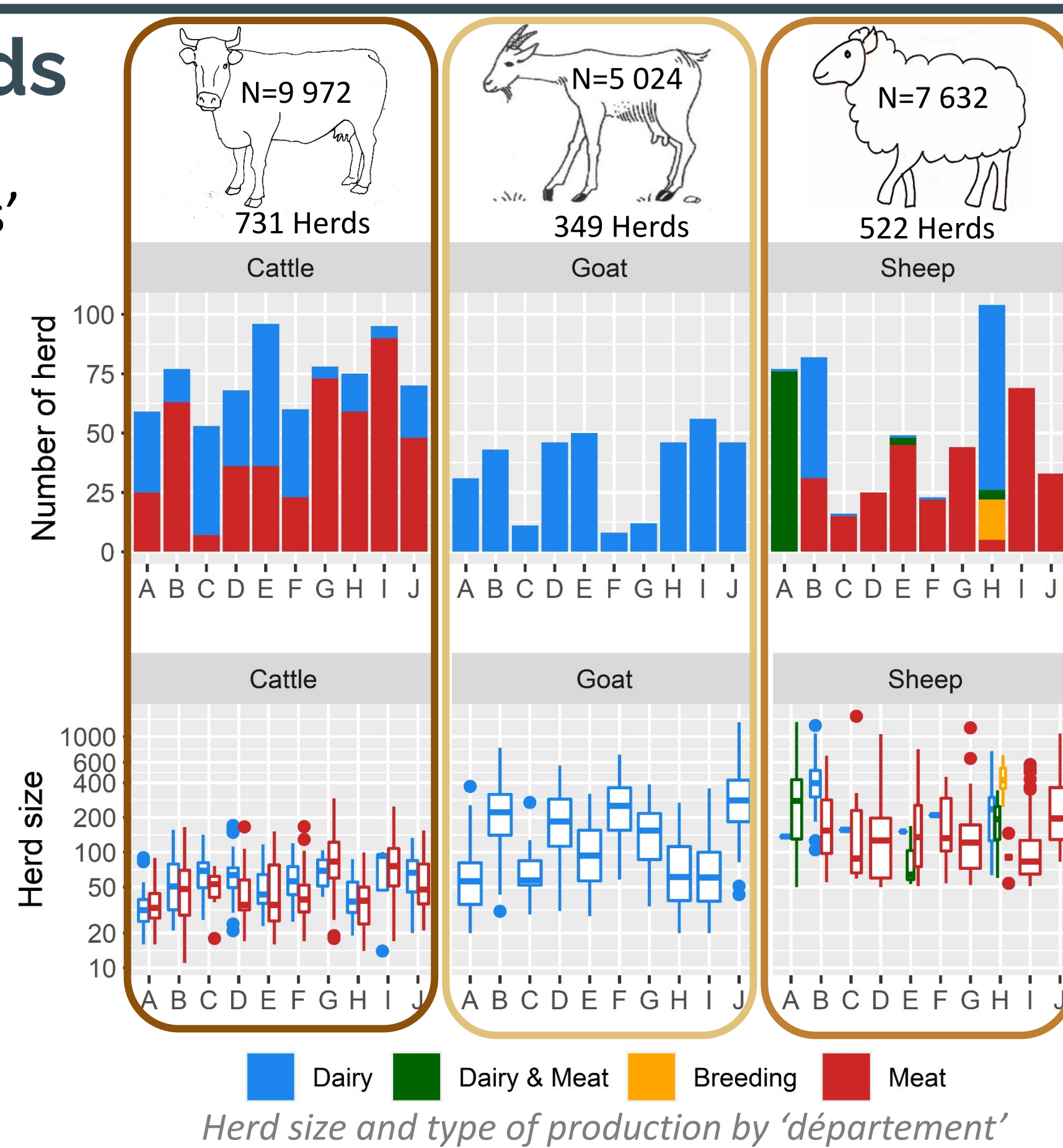
Objectives of the study

- ✓ 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]			[25,5 ; 67,2]	[5,6 ; 85,5]	
	Dairy	54,4*	47,9†			78,5*	21,6†
		[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]	[17 ; 31,7]	
	Dairy	21,4*	38,7†			20,0*	36,9†
		[30,5 ; 49,3]				[27,2 ; 48,6]	[44,5 ; 72]
						40,0*	57,8†
						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

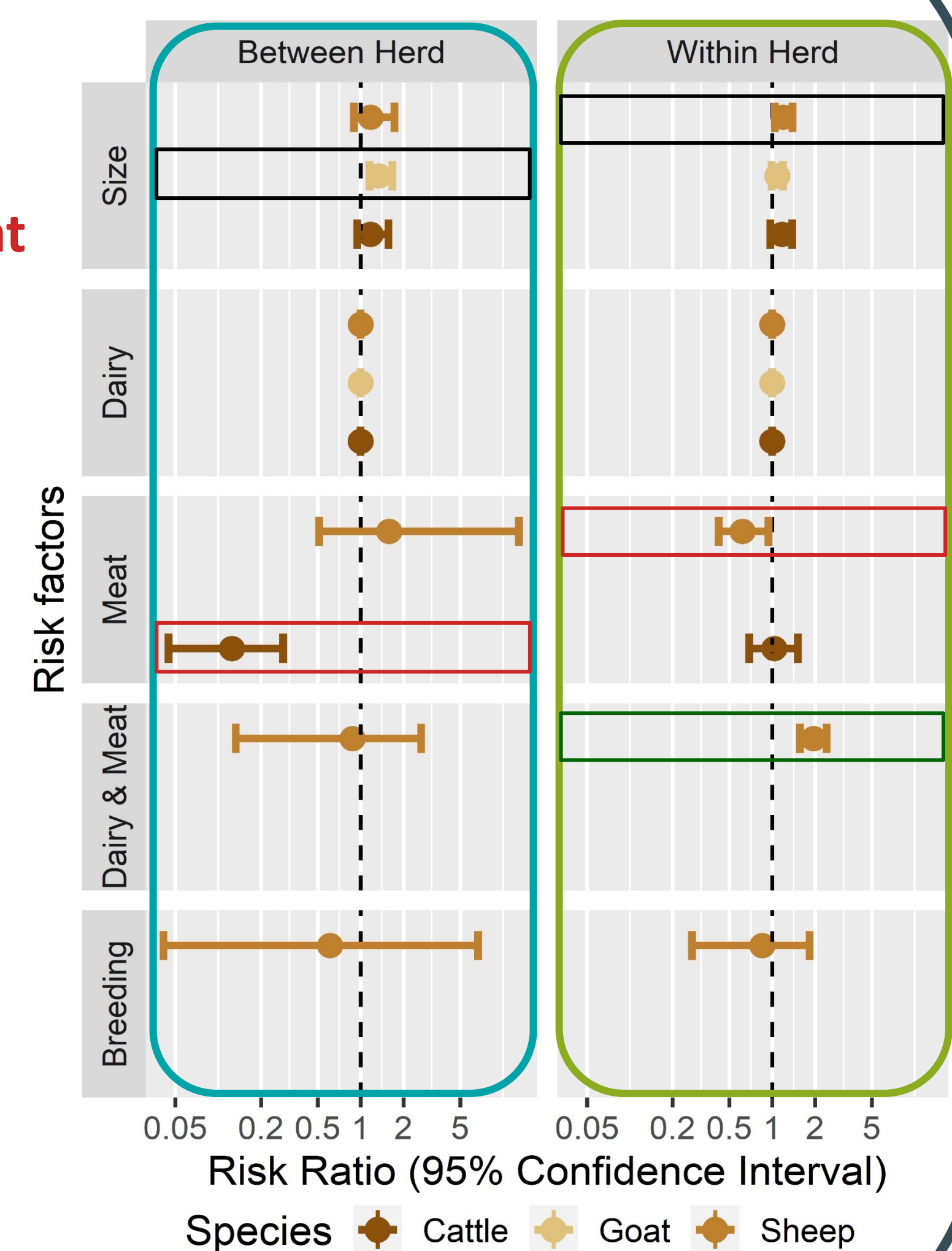
- BHPs
 - 7.9x higher in dairy vs. in meat herds

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

