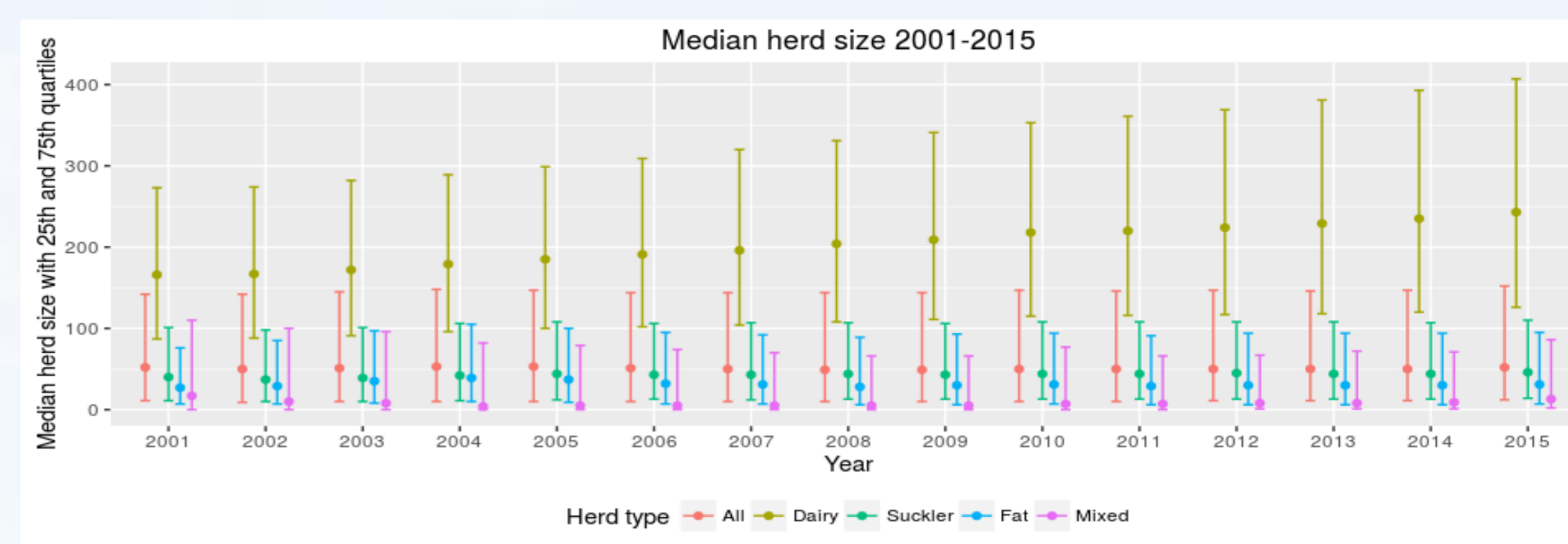




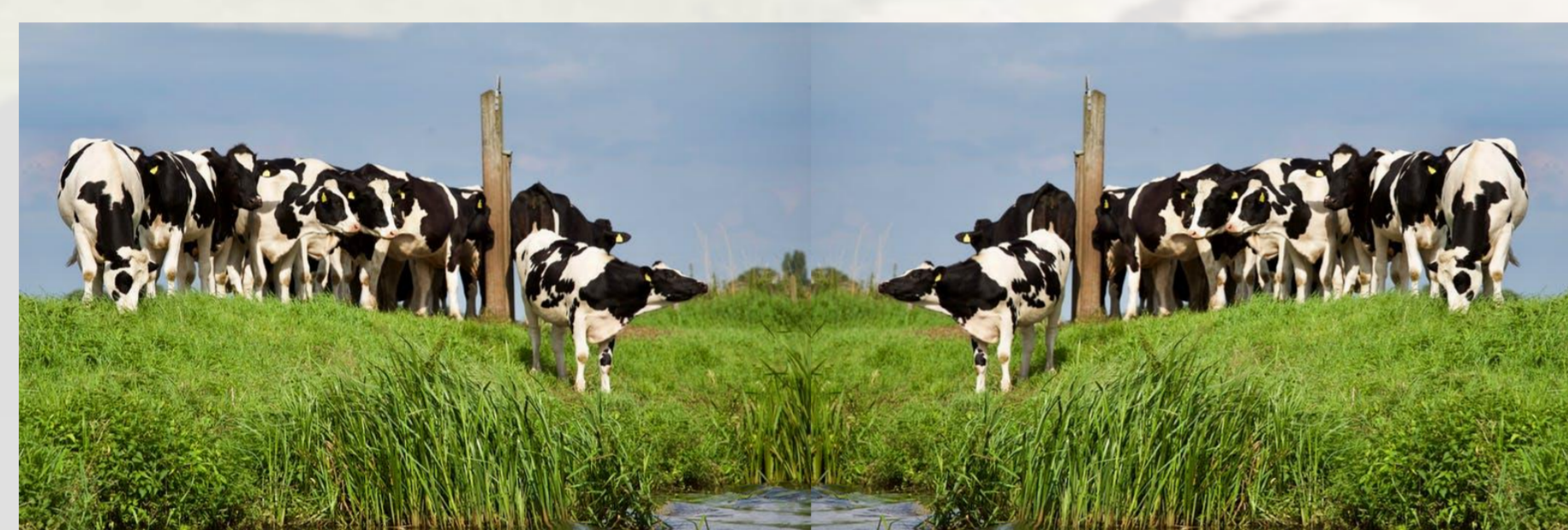
Why are large herds more risky?

Cattle herd sizes in Britain are increasing, mainly due to a trend for fewer, larger dairies. Large herd sizes have been implicated as a risk factor for bovine tuberculosis¹ (bTB) and Bovine Viral Diarrhoea² infection, yet there are still unanswered questions. This poster raises some of the factors we might investigate to better understand the mechanisms behind this effect.



1. Herds reach a 'critical community size'

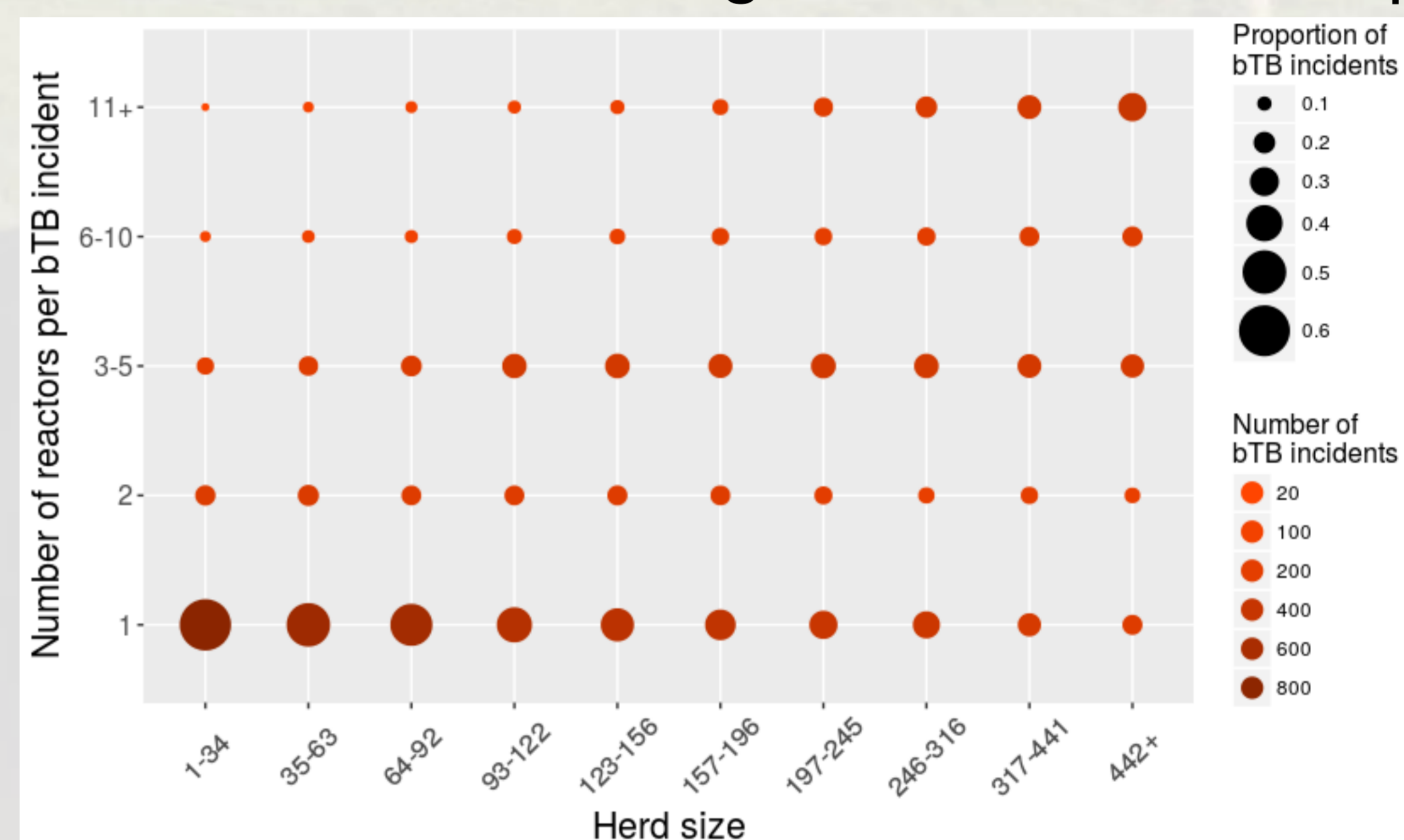
This is the size of a population in which disease will persist without any new imports. This is estimated at ~800 cattle for bTB¹, so it is one factor involved in the higher level of persistence found in larger herds.



However, anecdotally, large herds over approximately 200 typically split up into smaller, potentially epidemiologically distinct management groups which would affect the dynamics of within-herd spread and negate the effect of critical community size.

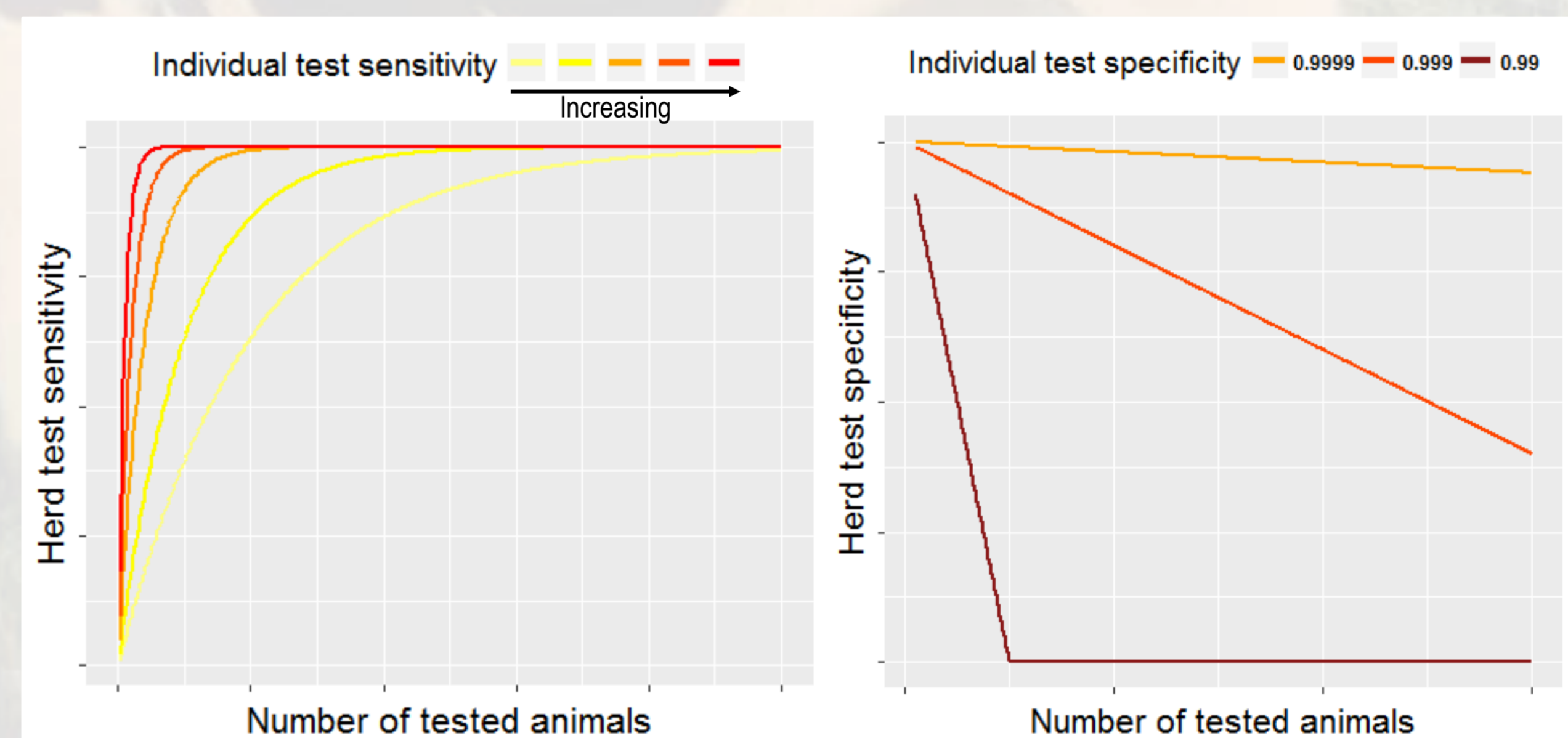
2. Higher R_0 in larger herds³

Assuming a homogenous contact structure, stochastic models suggest that there is an increased reproductive ratio (R_0) in larger herds for bTB. This offers a mechanism for higher rates of infection seen in larger herds, however, in practice – why does this occur? And is a homogenous contact structure in these larger herds a valid assumption?



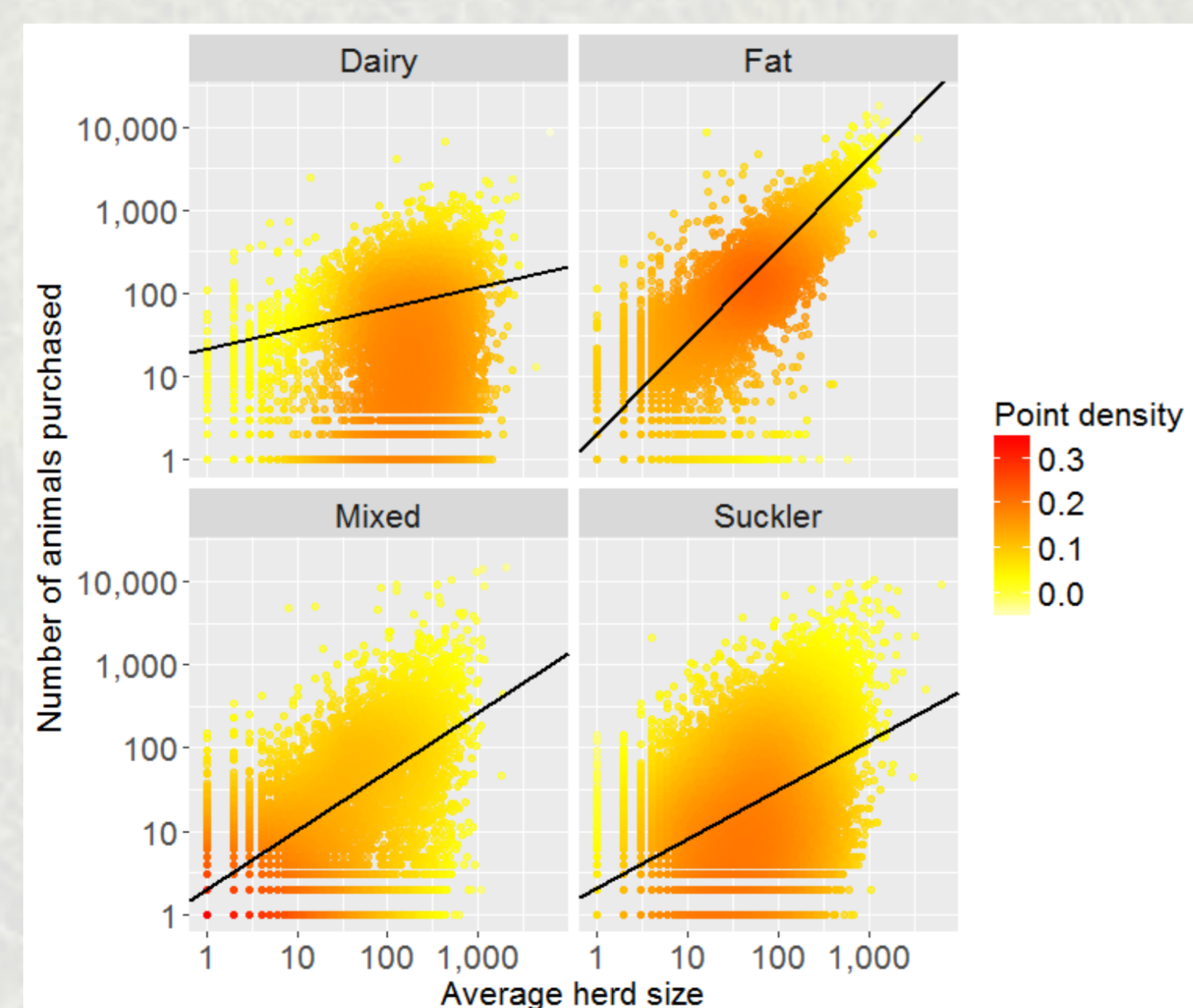
3. Herd sensitivity and specificity

For a fixed herd prevalence, herd sensitivity increases as more animals are tested and therefore positive animals are more likely to be identified in larger herds⁴. Additionally, if test specificity is < 1, herd specificity decreases in large herds, increasing the risk of false positives. These aspects of test performance in different sized herds are important to account for when evaluating risks associated with herd size.



4. Higher risk of importing infection?

Do larger herds buy in more animals?¹ As more animals are purchased, we expect the risk of importing infection to increase. Overall, there is a weak positive relationship between herd size and number of animals purchased.



However, the relationship between the number of animals purchased and herd size is strong in fattening herds and very weak in dairy herds, which tend to make up most larger herds in Britain.

5. Increased contact with neighbouring cattle and wildlife?

If farms with large herds occupy greater areas or perimeters, they might be at higher risk of infection from local herds and wildlife. A DEFRA report⁵ showed that badgers actually visited the buildings of larger, busy farms **less** than smaller, quieter farms.



Summary: The increased risk of disease as herd sizes grow may be attributed to factors presented here, however the complex relationships in certain cases suggest some influences are not accounted for. In view of the trend for increasing herd size, further research is warranted into the underlying mechanisms and how we might ameliorate the risk of infection.

1. Brooks-Pollock, E. & Keeling, M. Herd size and bovine tuberculosis persistence in cattle farms in Great Britain. *Prev. Vet. Med.* **92**, 360–365 (2009). 2. Byrne, A. W. *et al.* Assessment of concurrent infection with bovine viral diarrhoea virus (BVDV) and *Mycobacterium bovis*: A herd-level risk factor analysis from Northern Ireland. *Prev. Vet. Med.* **141**, 38–47 (2017). 3. Conlan, A. *et al.* Estimating the Hidden Burden of Bovine Tuberculosis in Great Britain. *PLoS Comput. Biol.* **8**, e1002730 (2012). 4. Martin, S. W., Shoukri, M. & Thorburn, M. A. Evaluating the health status of herds based on tests applied to individuals. *Prev. Vet. Med.* **14**, 33–43 (1992). 5. DEFRA report – unpublished.