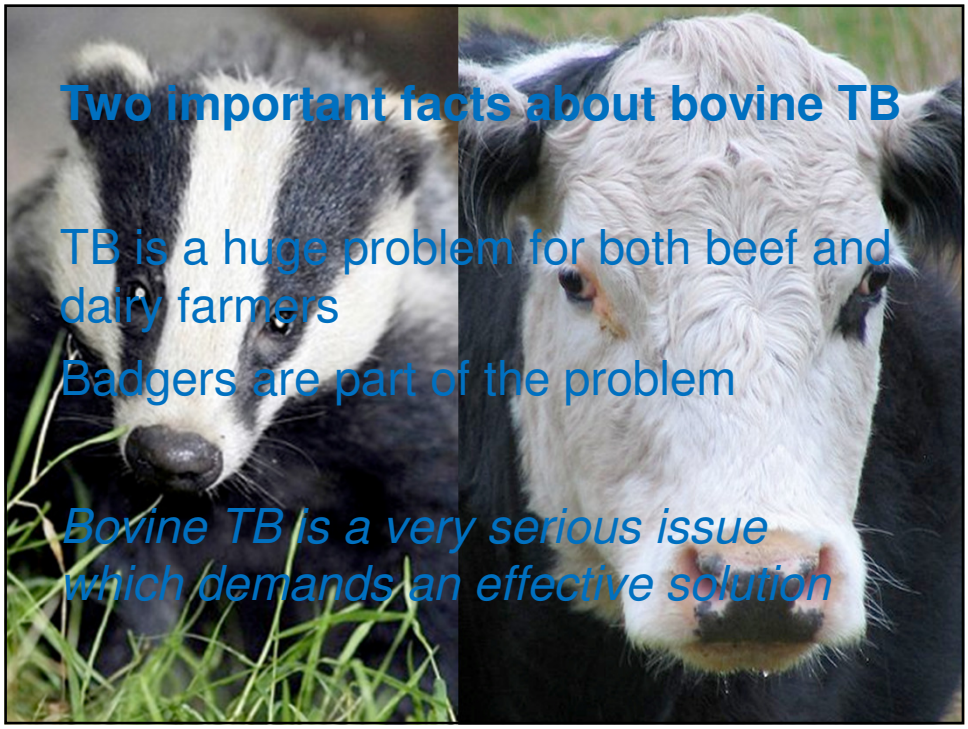

Epidemiological effects of badger culling and vaccination
ZSL
LIVING CONSERVATION
Rosie Woodroffe
Zoological Society of London


Two important facts about bovine TB
TB is a huge problem for both beef and dairy farmers
Badgers are part of the problem
Bovine TB is a very serious issue which demands an effective solution


Epidemiological effects of badger vaccination and culling
Introduction to disease dynamics
Badger culling
Badger vaccination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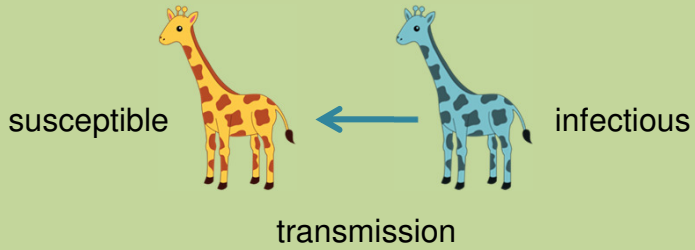
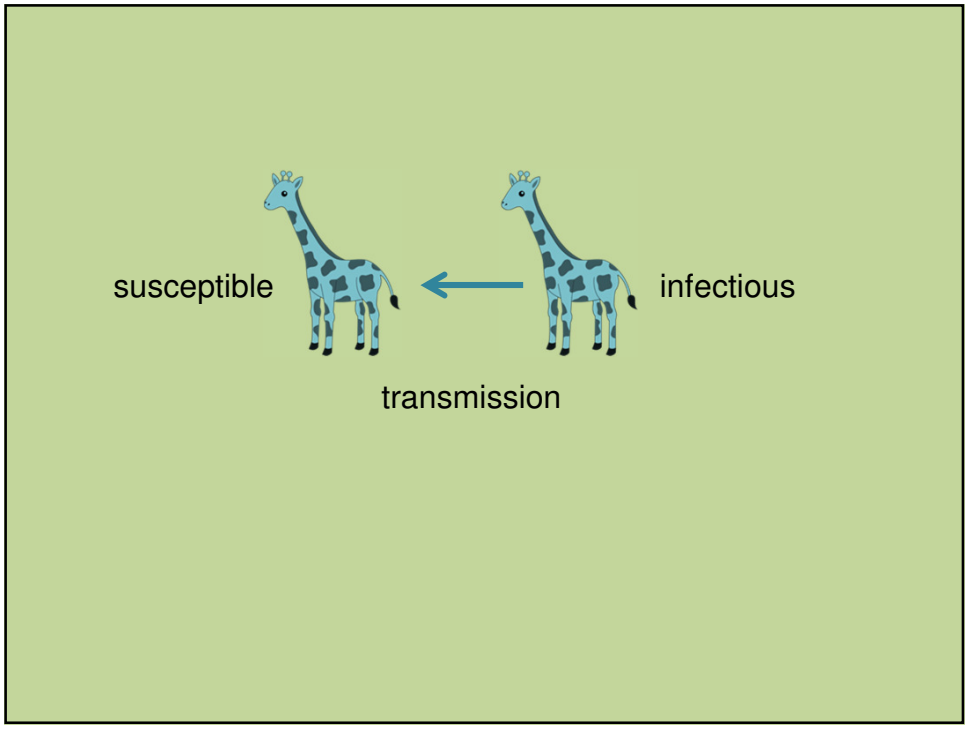
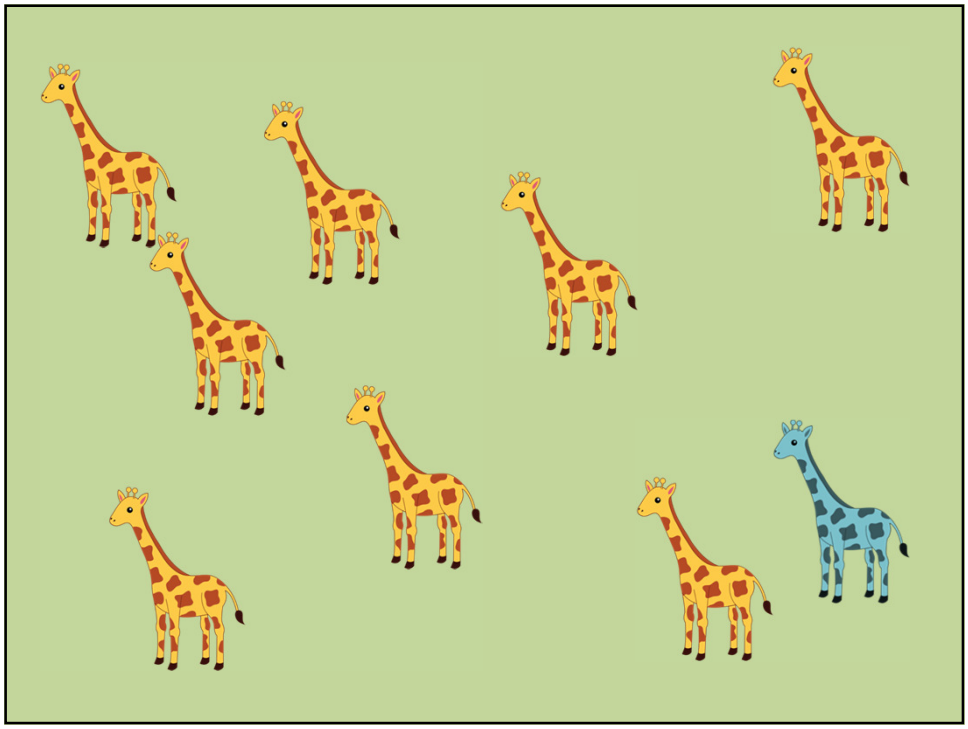
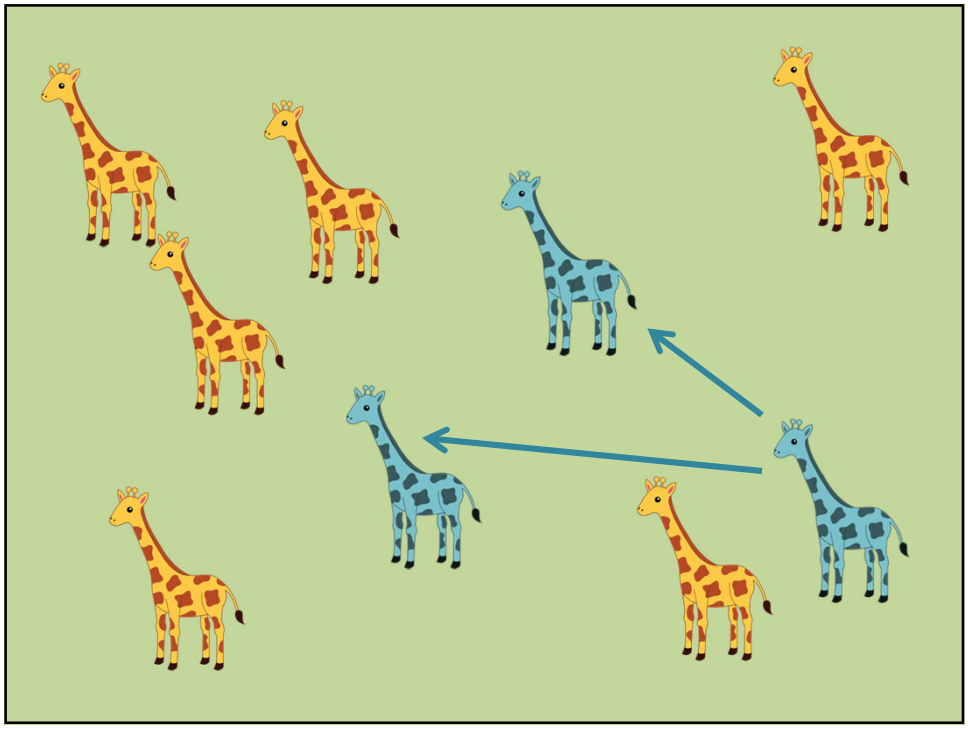
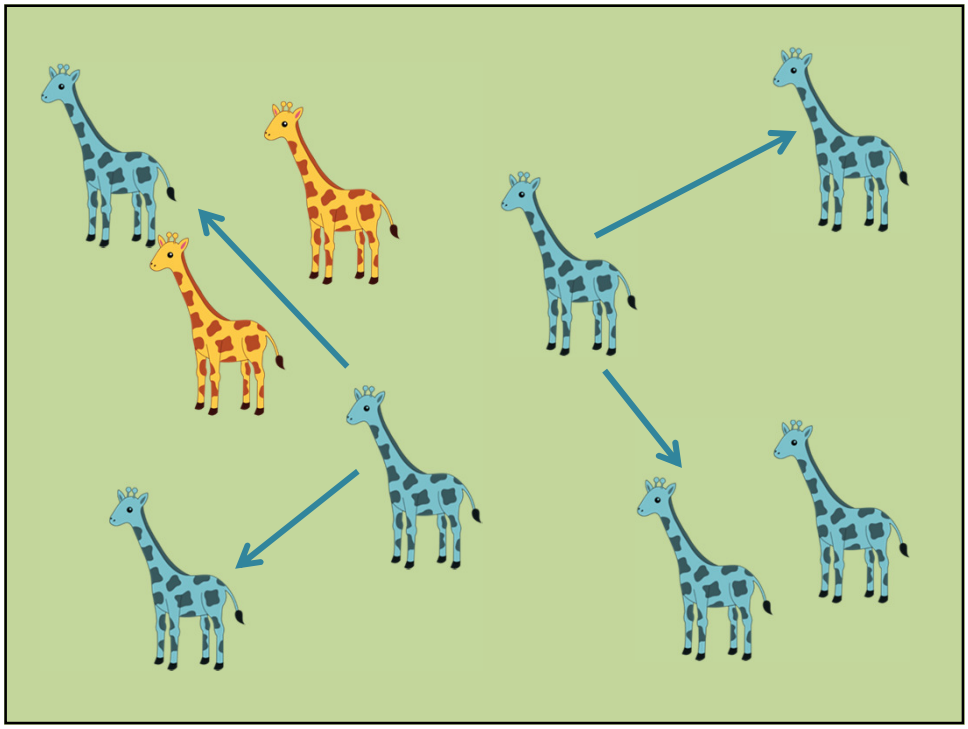
Susceptible and infectious hosts

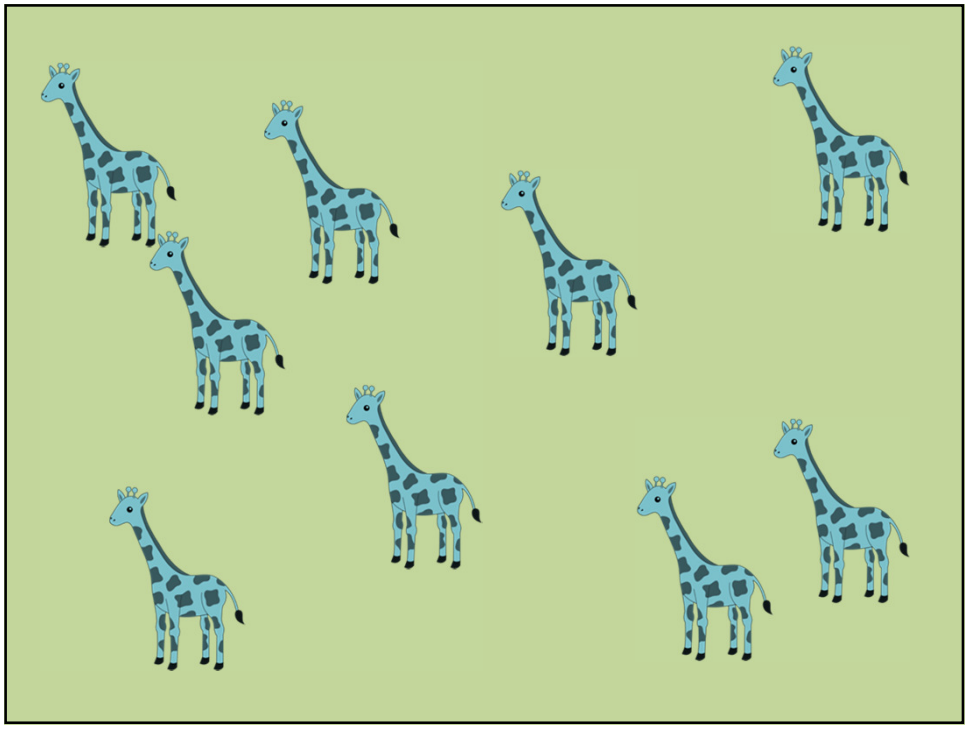



susceptible
infectious
transmission

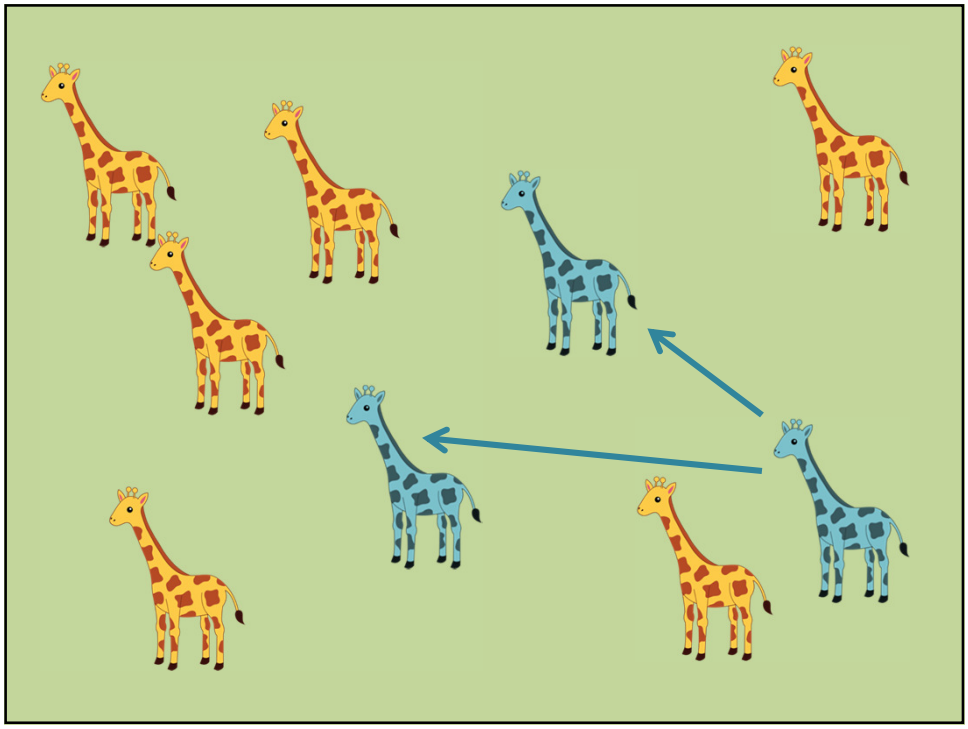


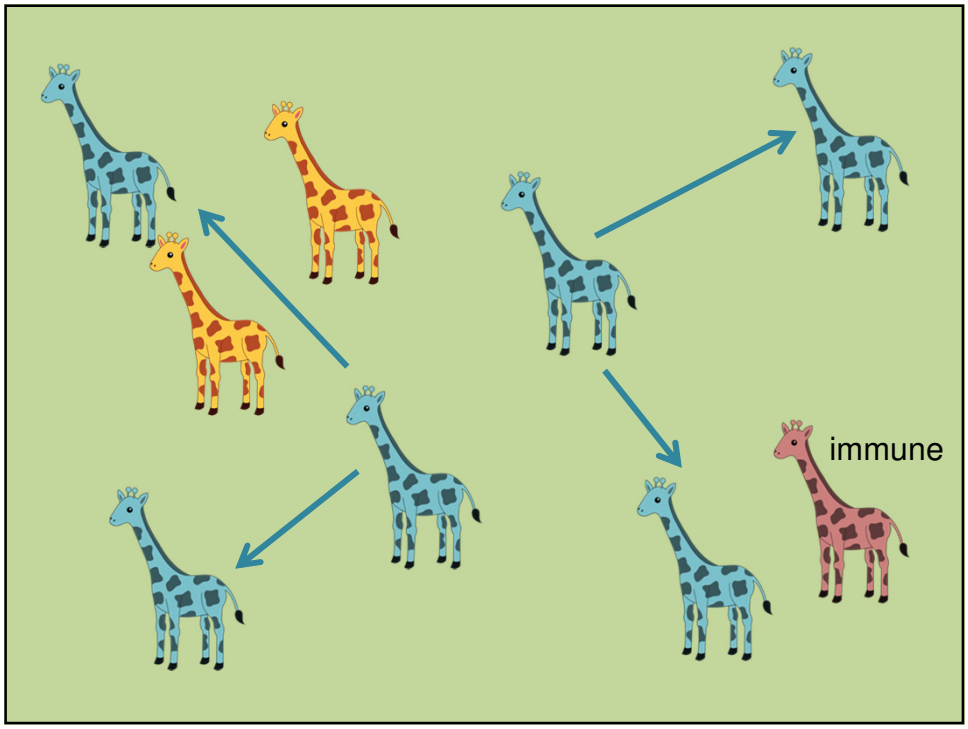


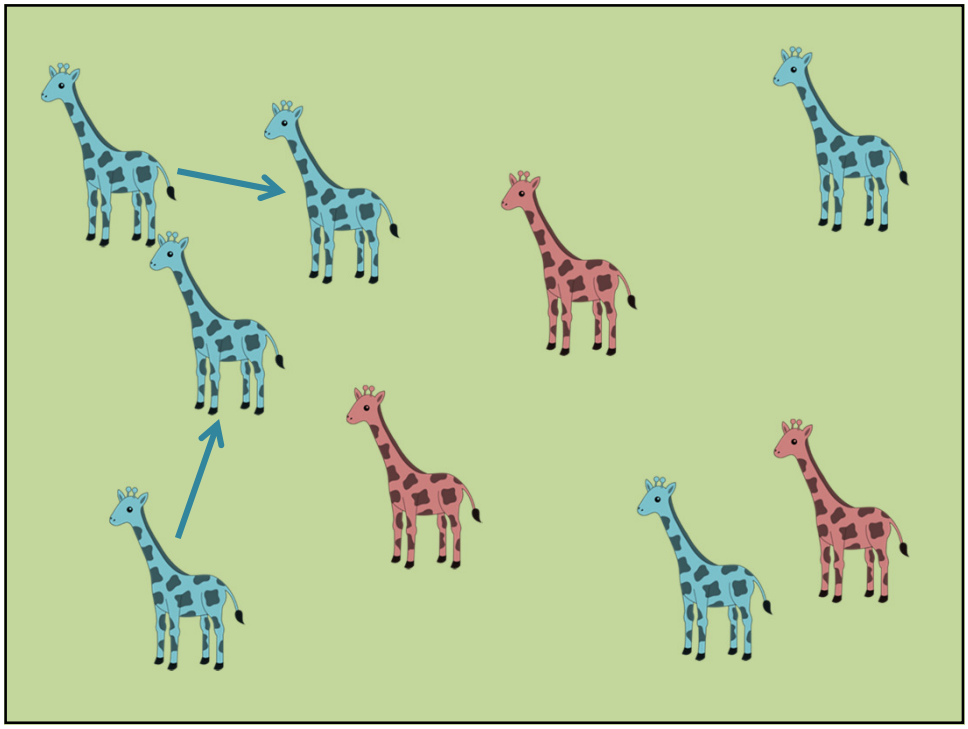


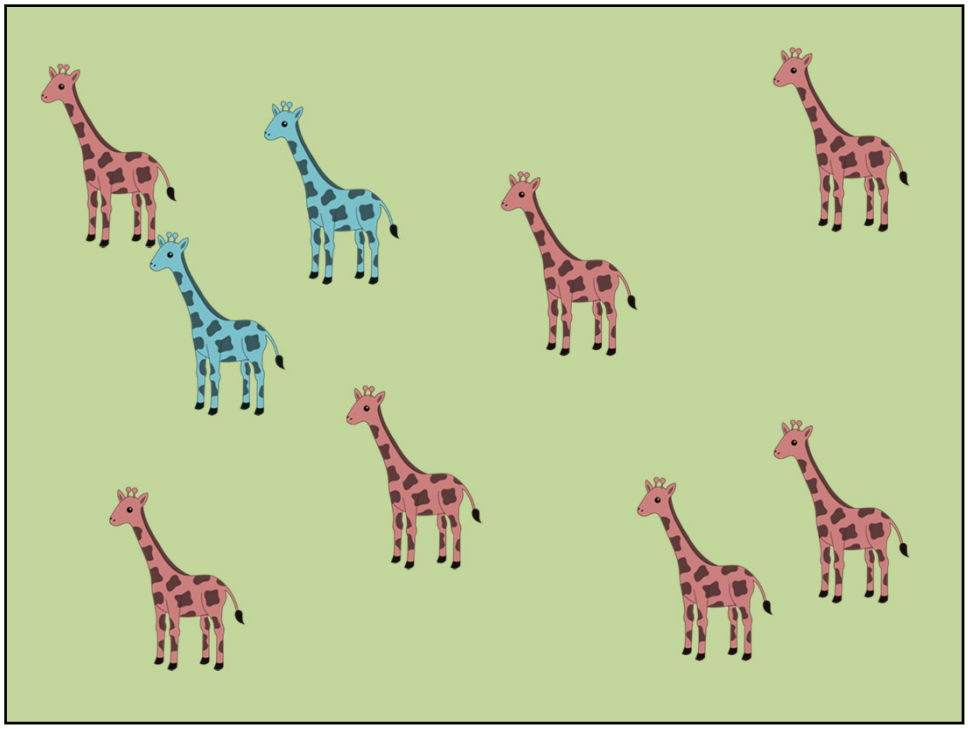


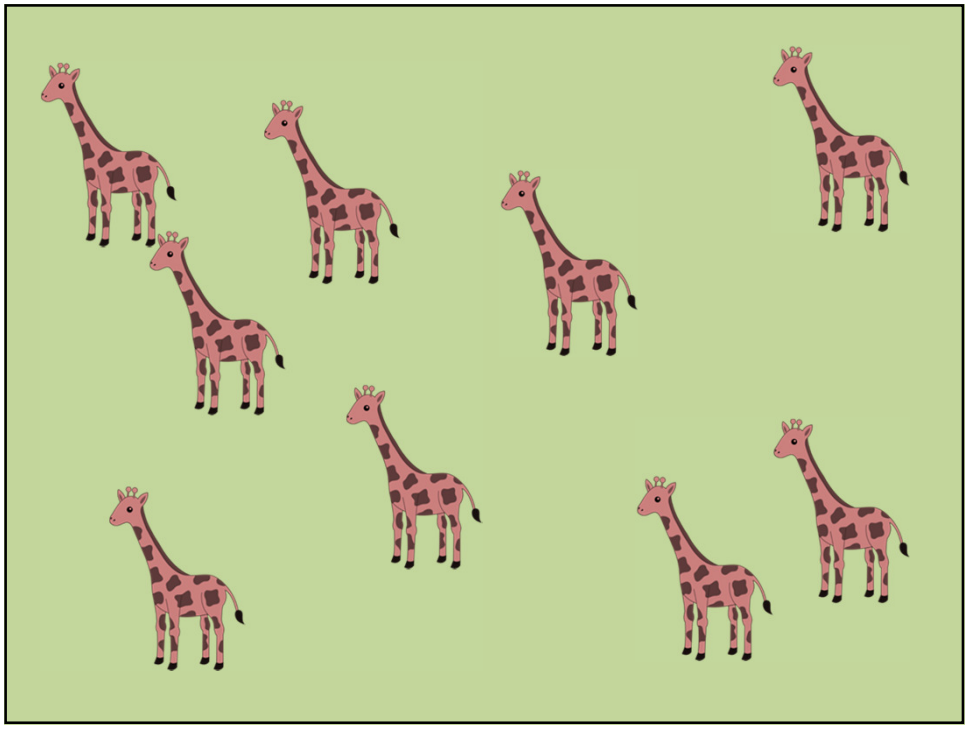
Immunity

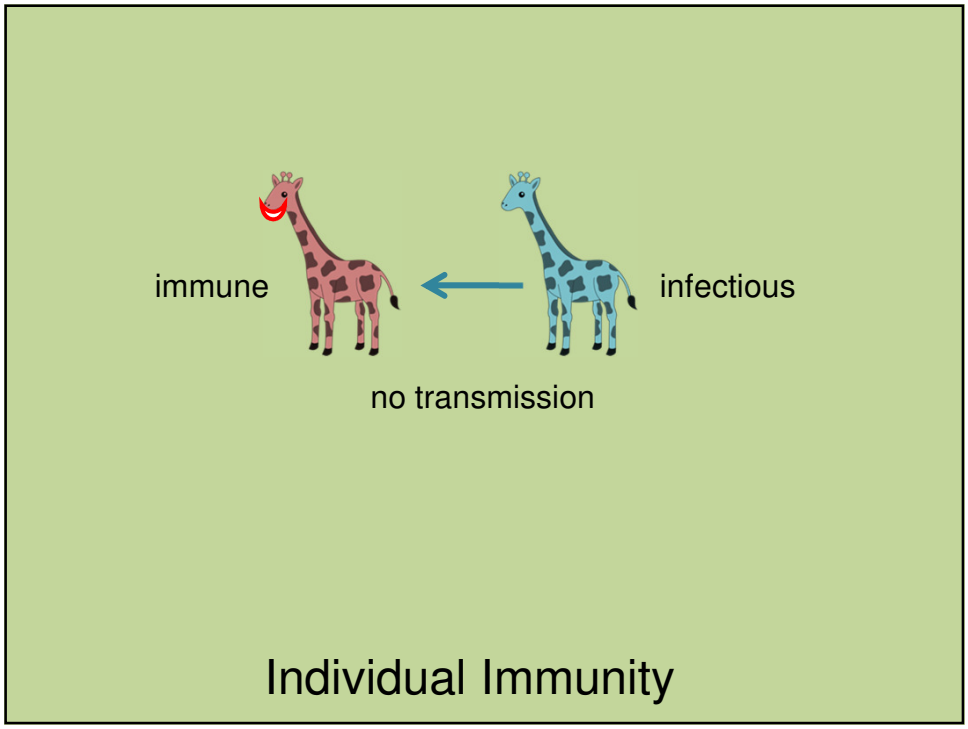



immune

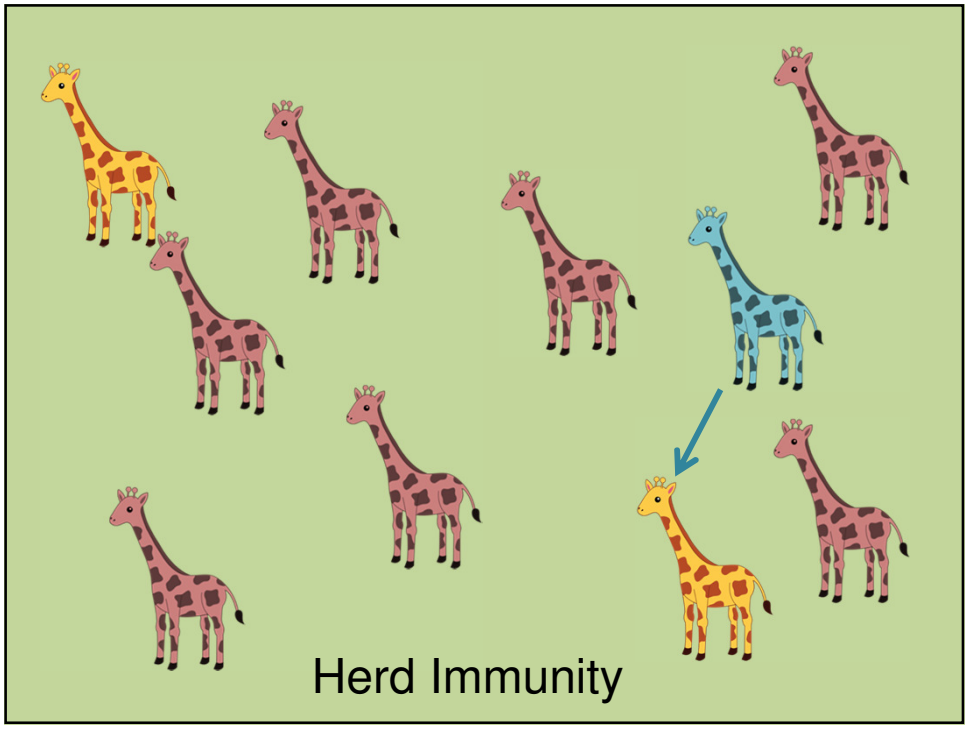


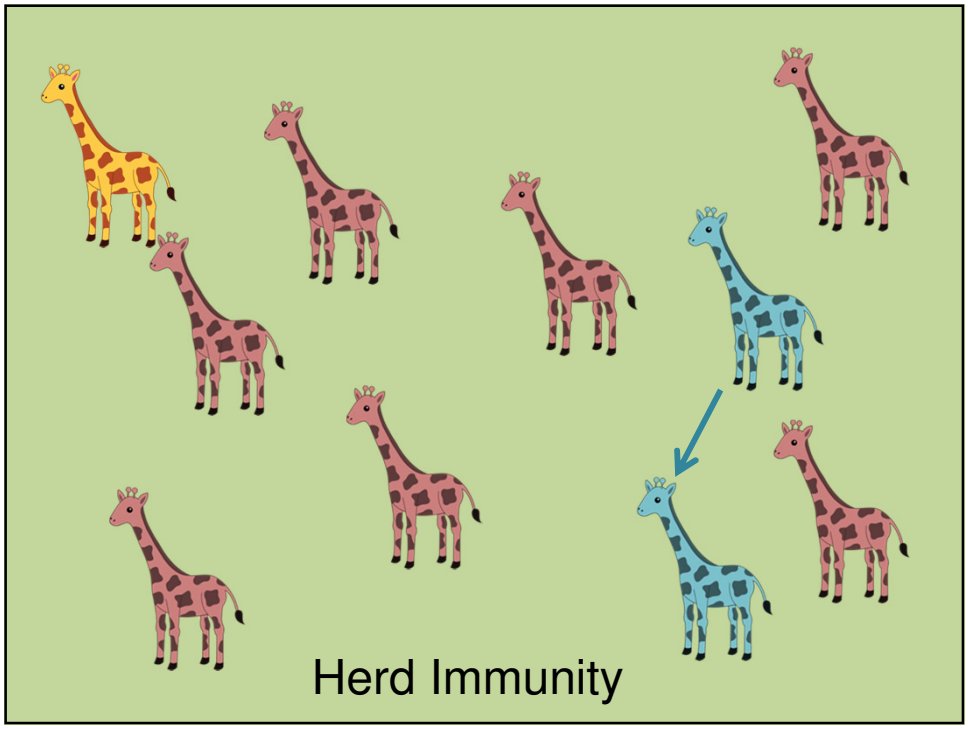


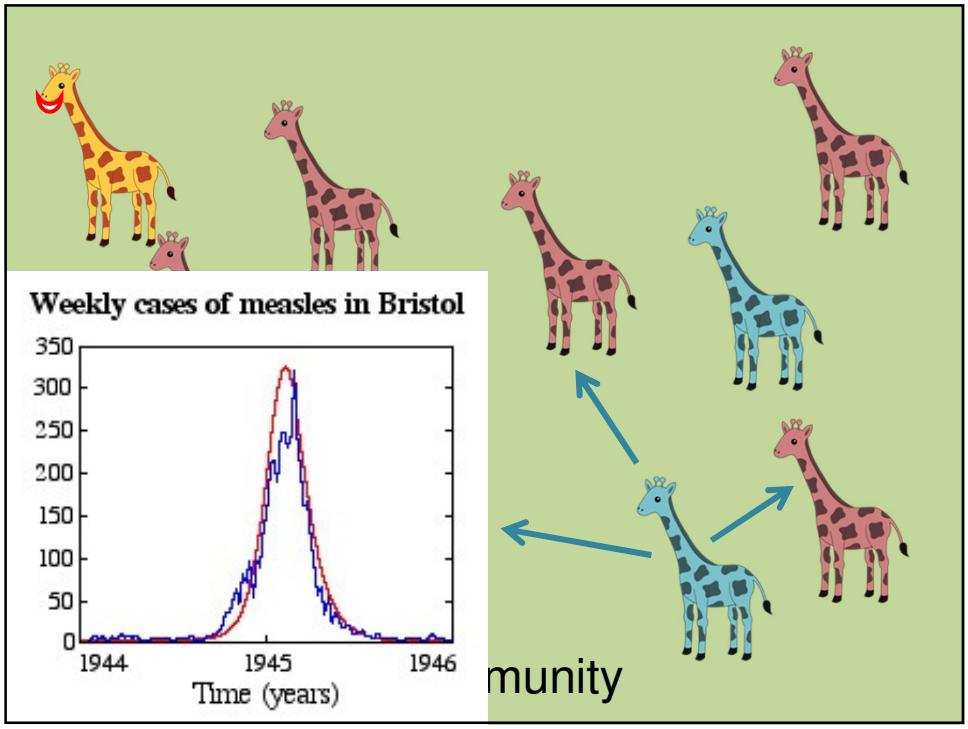


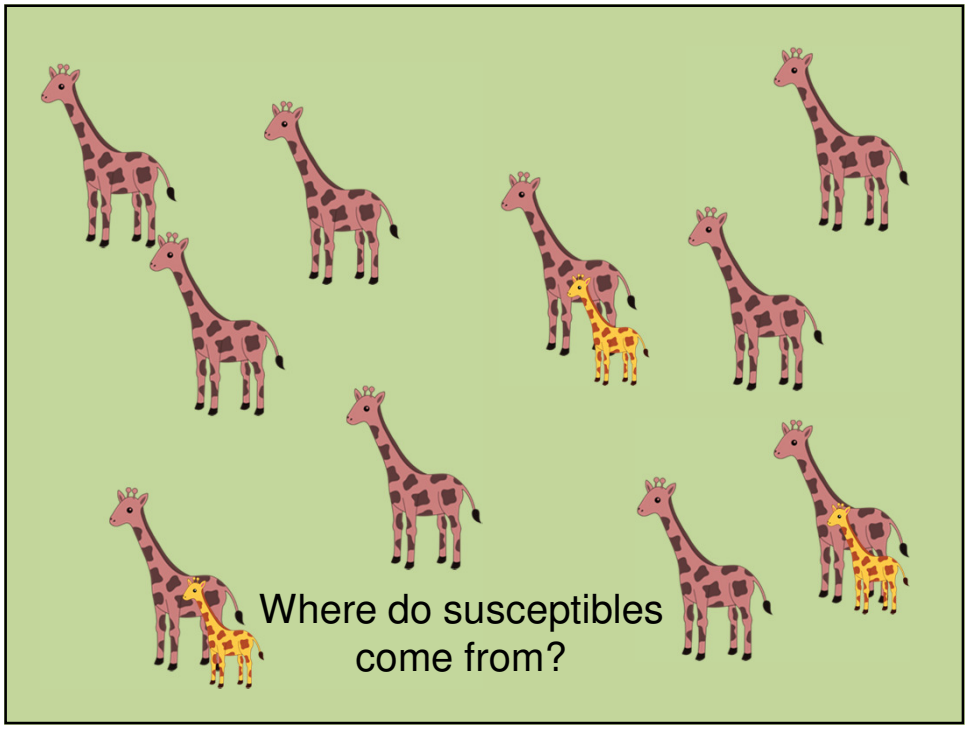


Individual Immunity

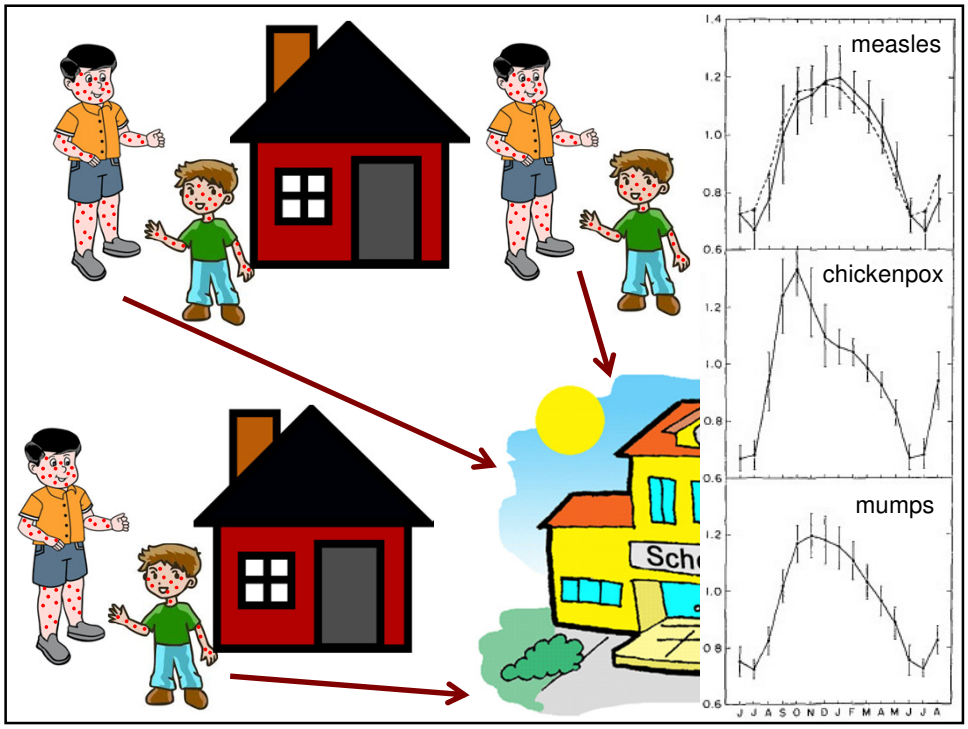

Herd Immunity

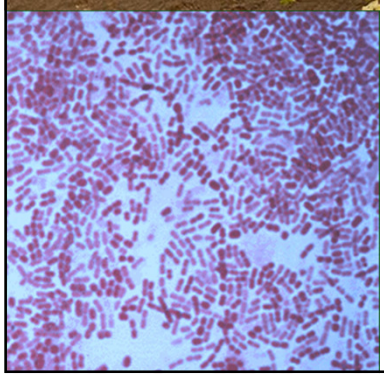

Herd Immunity

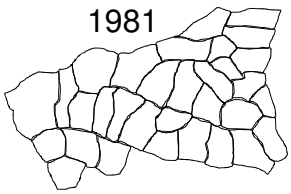

Weekly cases of measles in Bristol
350
300
250
200
150
100
50
0
1944
1945
1946
Time (years)
munity


Where do susceptibles
come from?

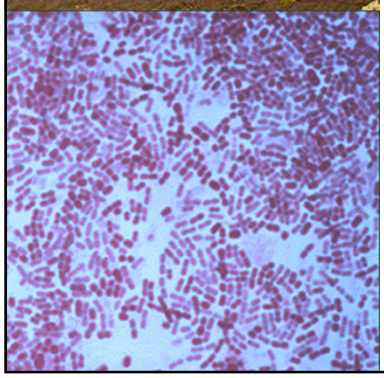
Population structure is important

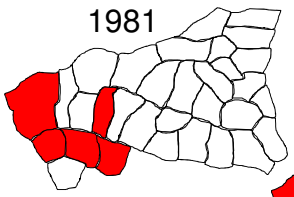


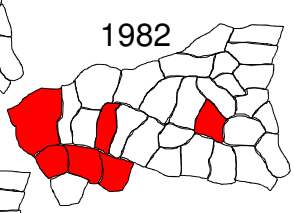



1981

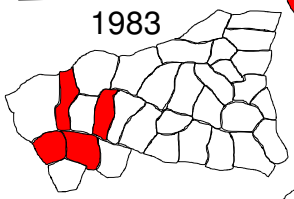

0
1km

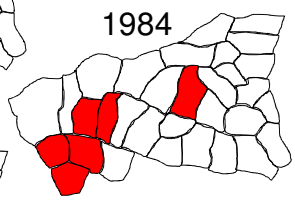


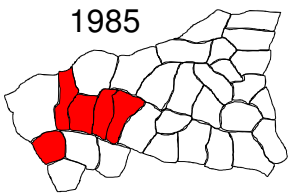

1981


1982

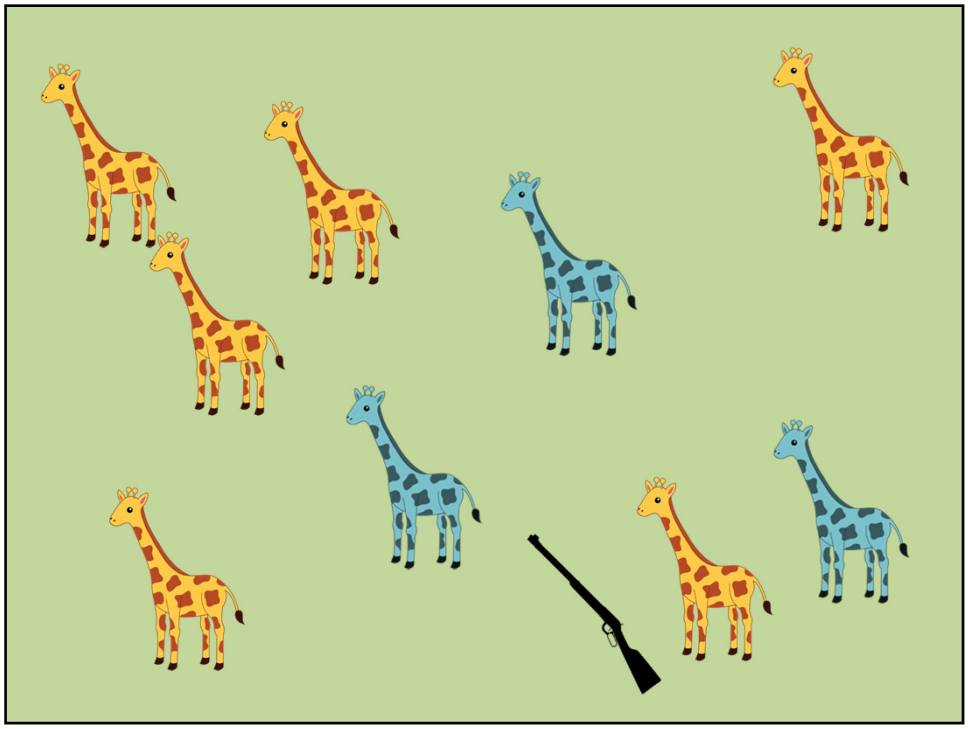

0
1km

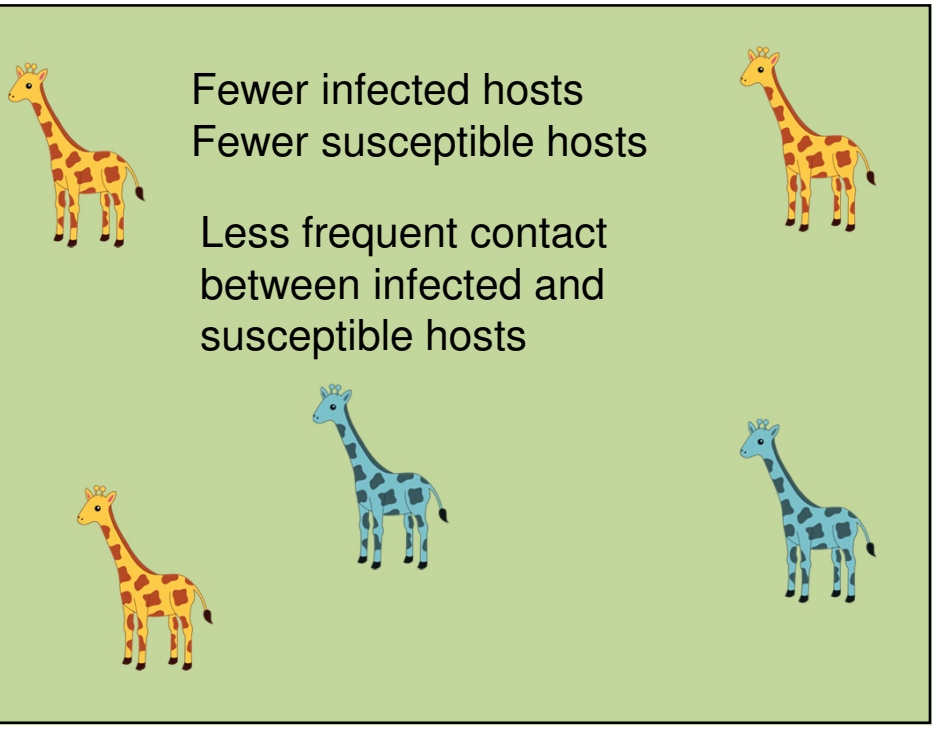

1983

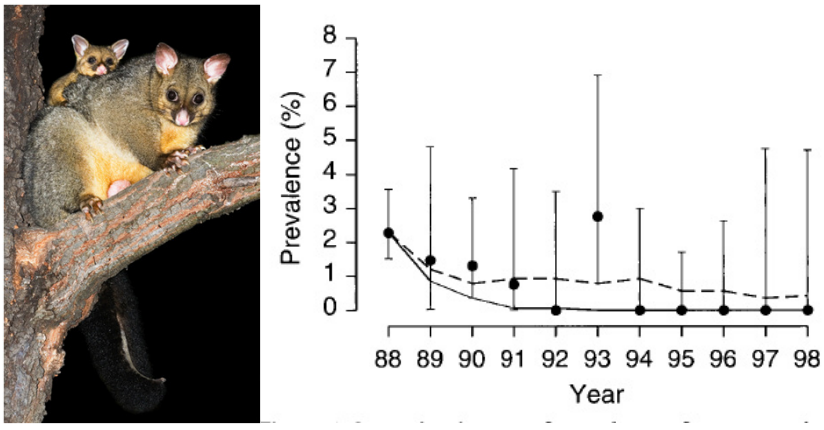

1984

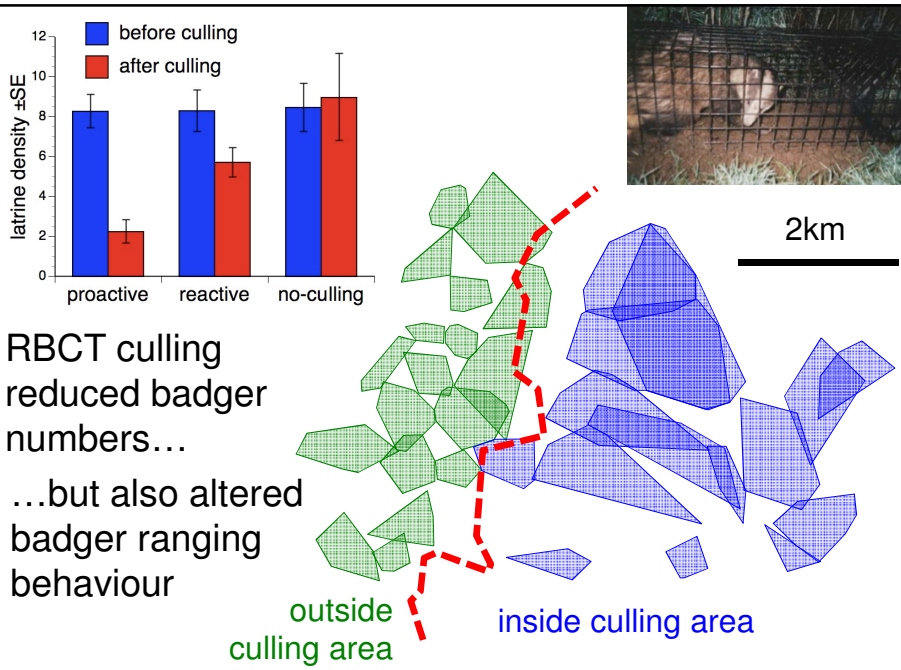

1985

Culling



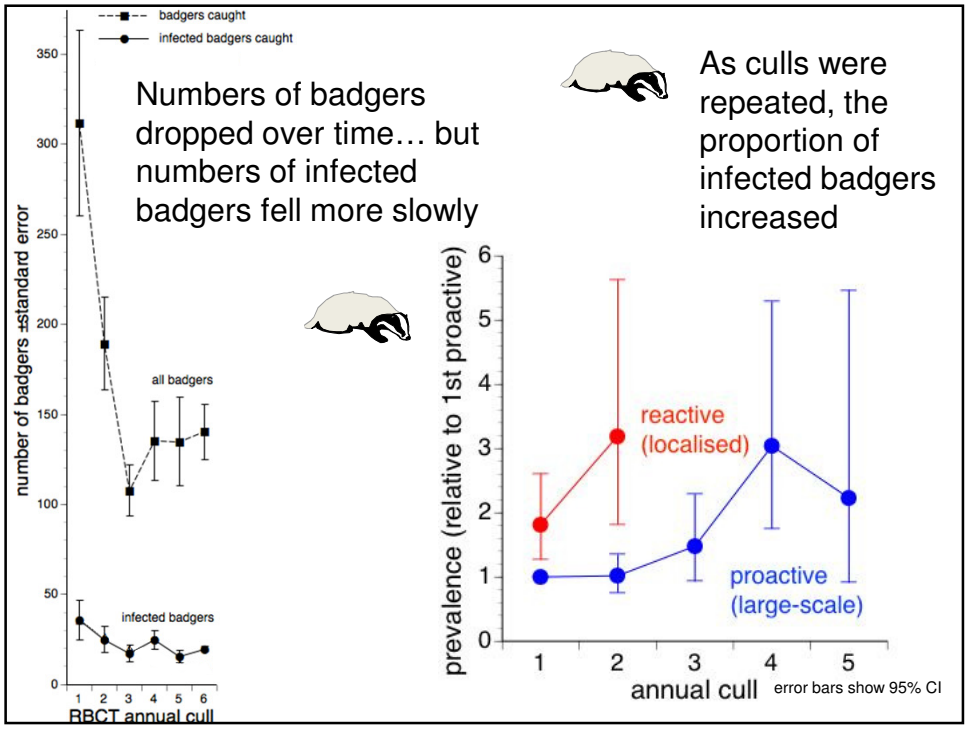

Fewer infected hosts
Fewer susceptible hosts
Less frequent contact between infected and susceptible hosts


Prevalence (%)
0
1
2
3
4
5
6
7
8
88 89 90 91 92 93 94 95 96 97 98
Year



RBCT culling reduced badger numbers…

…but also altered badger ranging behaviour

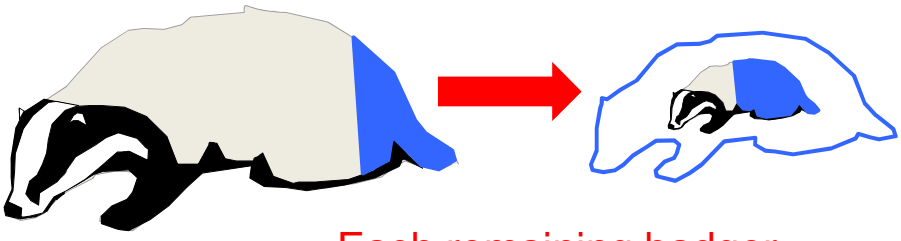


Numbers of badgers dropped over time… but numbers of infected badgers fell more slowly

As culls were repeated, the proportion of infected badgers increased

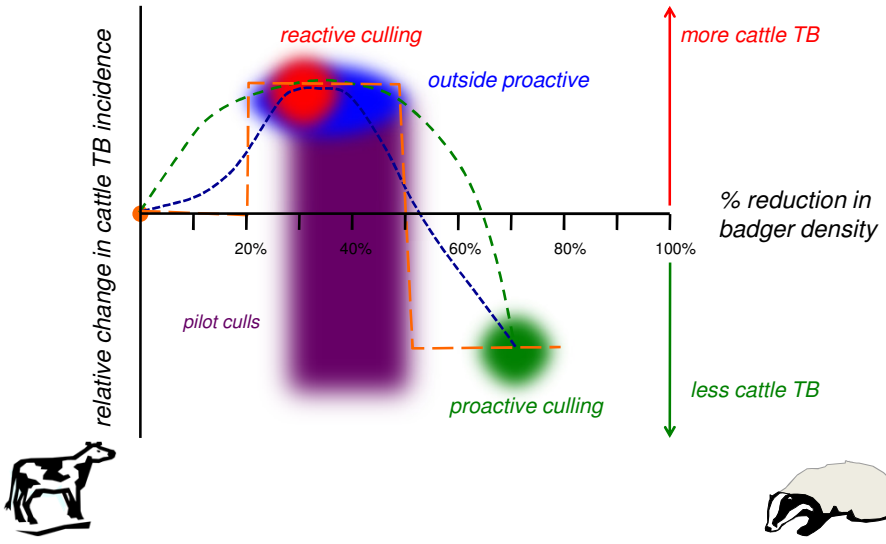
Badger culling has two opposing consequences

Fewer badgers - good

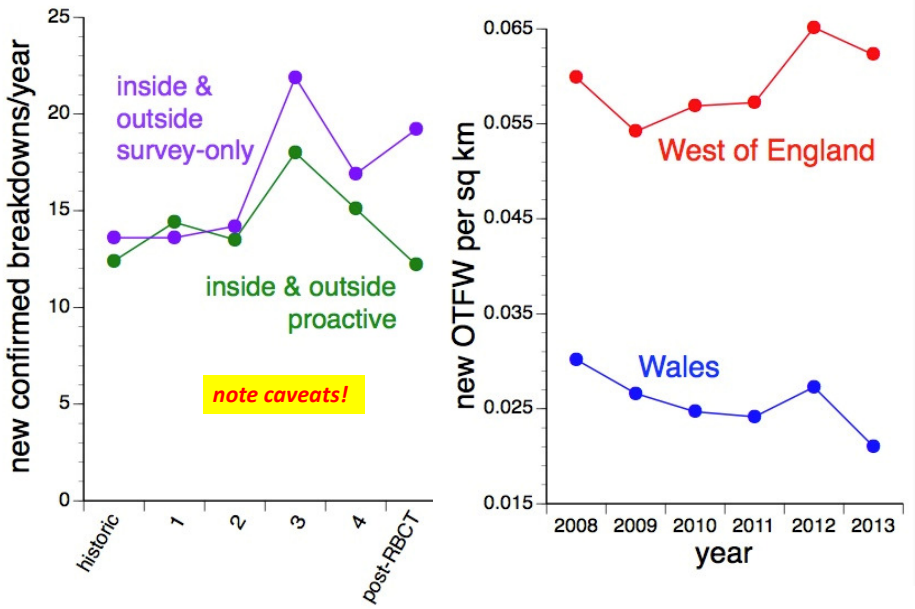


Each remaining badger more infectious – bad

How does changing badger density influence TB risk to cattle?



Absolute changes in numbers of new confirmed TB breakdowns



Approach	Badger numbers	Badger TB	Cattle TB	Annual cost/km^2

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Large scale cull	much reduced	increased	relatively less inside more outside	culling: (£300-£2,500) policing: £4,400


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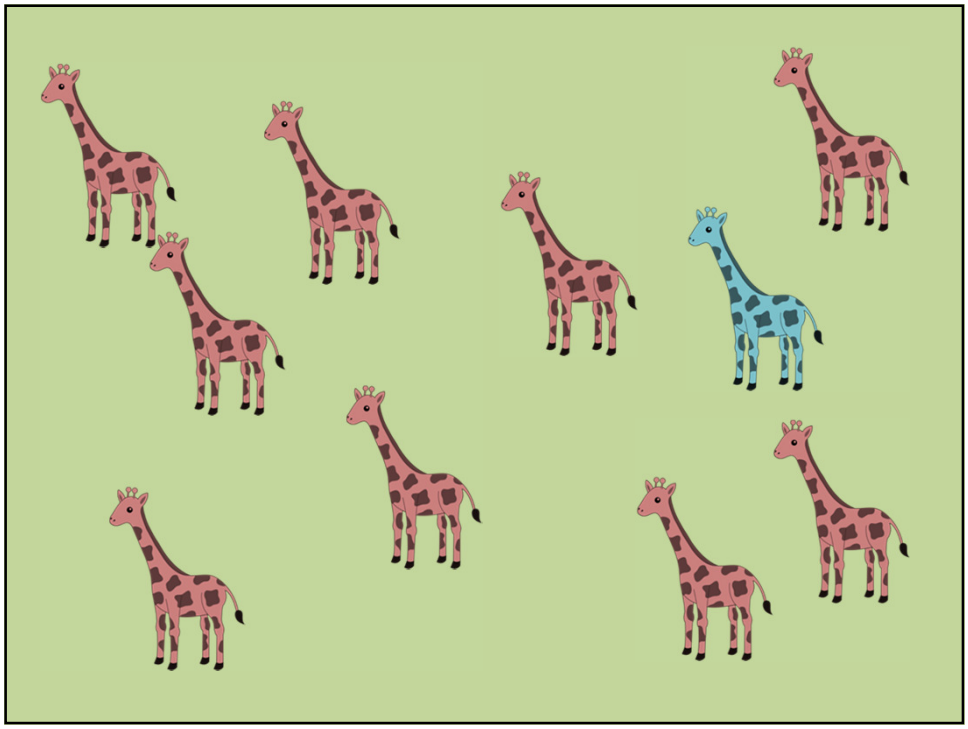
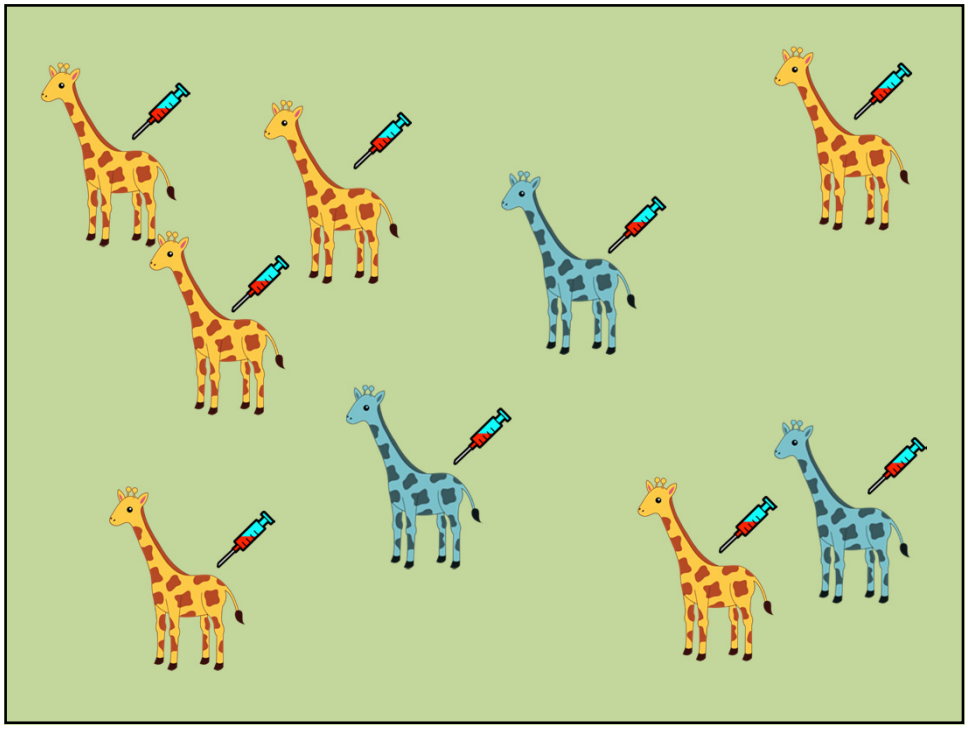
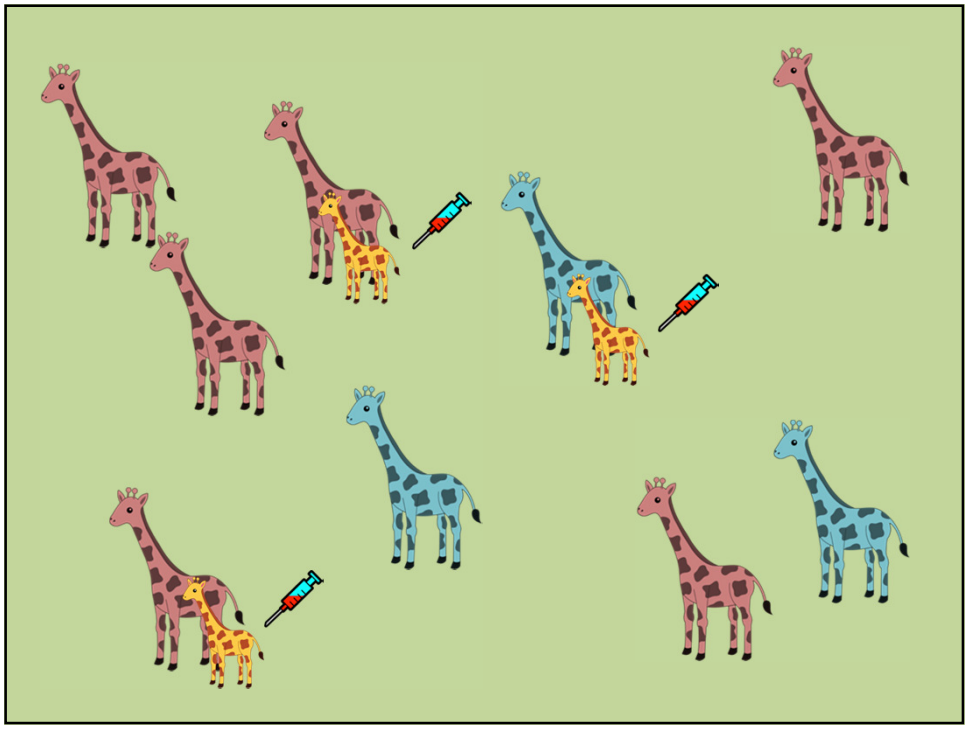
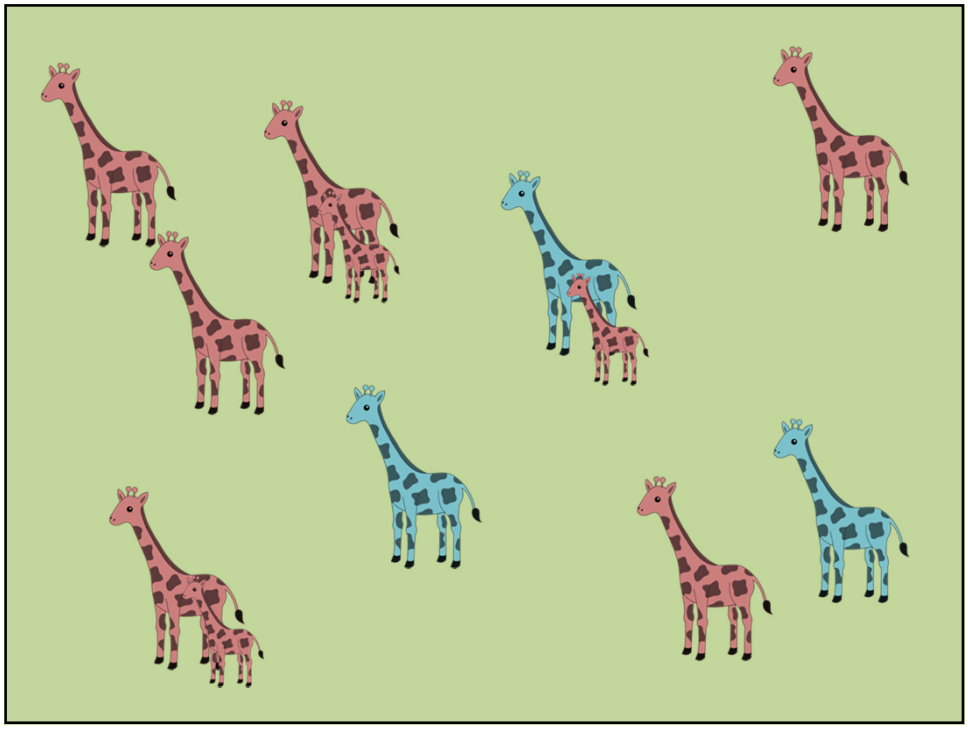
Small scale cull	somewhat reduced	increased	more	–

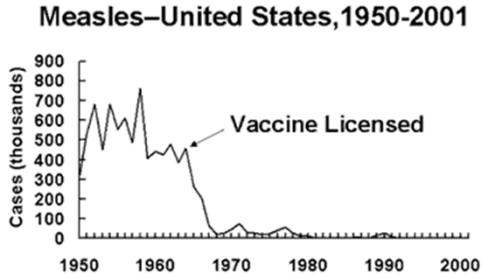

Vaccination

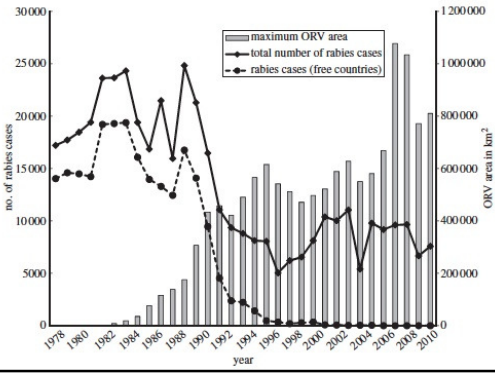












Vaccination

Removes susceptibles by making them immune

No impact on those already infected

Nevertheless, helped eradicate smallpox and rinderpest, and to control many other diseases e.g. measles, rabies, human TB

Badger vaccination

- injectable vaccine for badgers available now
- reduces individual risk of new infection by 76%
- reduces risk of unvaccinated cubs becoming infected by 79% if ≥30% of adults vaccinated in group
- leaves badger territory structure intact, which may enhance effectiveness of vaccination
- as transmission to other badgers is reduced, transmission to cattle also likely to be reduced
- wildlife sector keen to contribute to deployment

Approach	Badger numbers	Badger TB	Cattle TB	Annual cost/km^2
Large scale cull	much reduced	increased	relatively less inside more outside	culling: (£300-£2,500) policing: £4,400
Small scale cull	somewhat reduced	increased	more	–
Vaccination	unchanged	(reduced)	(less)	£1,330-£4,000

Conclusions

Culling and vaccination function by different mechanisms but both have the potential to control wildlife disease

Population structure has a major impact on disease transmission rates

Culling alters badger population structure in ways which accelerate transmission, undermining benefits for TB control

By contrast, badger population structure may enhance the efficacy of vaccination

Badger vaccination is likely to be cheaper than culling, and is unlikely to cause harm; however its contribution to cattle TB control is not yet known