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Evolutionary Biology

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Born in 1994 in Taunton, United Kingdom

Studied Biological Sciences at the University of Oxford and Evolutionary Biology at the University of Edinburgh

FELLOWSHIP

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## PROJECT

# Density Dependence and Disease Dynamics: A Cross-System Synthesis

A fundamental paradigm in disease ecology states that individuals inhabiting high-density areas should have greater disease burdens because they have more social contacts, so they are more often exposed to pathogens. This assumption is often baked into epidemiological models or leveraged for disease control interventions, as in the recent "social distancing" measures used to curb the spread of SARS-CoV-2. Understanding this process is therefore vital for understanding the societal distribution of disease and the consequences of environmental change. Surprisingly, the evidence for density effects is relatively scarce and is often based on social behaviours, while spatial behaviours are generally neglected. Consequently, despite being fundamental to disease ecology, it is unclear how often density effects manifest as expected, or whether they are counteracted or undermined by a range of spatially structured processes like cooperation, competition, or resource availability.

To address this gap, I will conduct a series of spatial-social analyses across a range of wildlife disease datasets. I will meta-analyse the findings to identify general trends, building eco-evolutionary models to test mechanistic hypotheses and to address complex, long-term processes. In doing so, I will develop predictive models of density-dependent host-pathogen dynamics, incorporating elements of behaviour, immunity, virulence, and more. As well as providing fundamental insights into the ecology and evolution of sociality, this project will provide a framework for understanding and predicting how increasing population density might alter disease dynamics in a rapidly changing world.

## Recommended Reading

Albery, Gregory F., Evan A. Eskew, Noam Ross, and Kevin J. Olival (2020). "Predicting the Global Mammalian Viral Sharing Network Using Phylogeography." *Nature Communications* 11: 2260. <https://doi.org/10.1038/s41467-020-16153-4>.

Albery, Gregory F., Chris Newman, Julius Bright Ross, David W. MacDonald, Shweta Bansal, and Christina Buesching (2020). "Negative Density-Dependent Parasitism in a Group-Living Carnivore." *Proceedings of the Royal Society B* 287, no. 1941: 20202655. <https://doi.org/10.1098/rspb.2020.2655>.

Albery, Gregory F., Alison Morris, Sean Morris, Josephine M. Pemberton, Tim H. Clutton-Brock, Daniel H. Nussey, and Josh A. Firth (2021). "Multiple Spatial Behaviours Govern Social Network Positions in a Wild Ungulate." *Ecology Letters* 24, no. 4: 676-686. <https://doi.org/10.1111/ele.13684>.

# One Hand Washes the Other: How Social and Spatial Behaviours Drive and Prevent Infection

Pathogens rely on their hosts socialising to spread and survive. How hosts move, meet, and make friends fundamentally determines pathogen transmission in a given system, and therefore untangling the complex interactions between behaviour and infection is vital for understanding and predicting disease dynamics. Host density, or the number of individuals in a given space, is a central component of a given disease system; across many layers of biological organisation, greater density should produce higher rates of interactions between individuals, driving greater exposure to pathogens and, consequently, a greater burden of disease. Currently, our limited understanding of this process restricts not only our ability to model endemic diseases, but our ability to predict the future of disease on a densifying planet.

In this talk, I will use a number of biological systems to demonstrate how individual-level behaviour influences (and is influenced by) disease dynamics. I give a series of case studies taken from deer in Scotland, badgers in Oxfordshire, 17th Century Edinburgh, and 21st Century Germany. As well as talking about density-disease interactions, I cover a number of complex effects of group living on disease, including benefits of nutrition, avoidance, punishment, medical care, and death. Finding similarities between animals and humans, and the way we all deal with disease, I discuss what we can learn from the conflicts and cooperation surrounding public health in animal societies. Ultimately, I look beyond these case studies to their broader implications and my work at Wissenschaftskolleg, seeking to unite lessons from a range of disparate ecological systems to form a predictive framework for density-dependent disease dynamics.

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PUBLICATIONS FROM THE FELLOWS' LIBRARY

Albery, Gregory (Oxford [u.a.],2023)

Behavioural defences against parasites across host social structures

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1855147149>

Albery, Gregory (Chicago, Ill.,2023)

Social familiarity and spatially variable environments independently determine reproductive fitness in a wild bird

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1853178934>

Albery, Gregory (S.l.,2022)

Behavioural ecology at the spatial-social interface

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1830582518>

Albery, Gregory (Cambridge [u.a.],2022)

Helminth parasites are associated with reduced survival probability in young red deer

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1830577212>

Albery, Gregory (Cold Spring Harbor,2022)

Understanding spatiotemporal effects of food supplementation on host-parasite interactions using community-based science

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1830555790>

Albery, Gregory (London,2022)

Ageing red deer alter their spatial behaviour and become less social

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1815022892>

Albery, Gregory (Oxford [u.a.],2022)

Exposure and susceptibility : the twin pillars of infection

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1805895036>

Albery, Gregory (Cold Spring Harbor,2022)

Novel pathogen introduction rapidly alters evolved movement strategies, restructuring animal societies

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1805893564>

Albery, Gregory (Oxford [u.a.],2021)

Multiple spatial behaviours govern social network positions in a wild ungulate

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1764597028>

Albery, Gregory ([London],2020)

Predicting the global mammalian viral sharing network using phylogeography

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1764598156>