

## Books

## The Stockholm paradigm

Presenting a new evolutionary explanation of the emerging disease crisis, *The Stockholm Paradigm: Climate Change and Emerging Disease* by Daniel Brooks and colleagues pulls no punches. Climate change has opened Pandora's box of unknown pathogens that could have an untold impact on humanity unless we act now. Emerging infectious diseases already cost a trillion US dollars a year. More than half of all species on the planet are parasites, 1400 of these infect humans, 58% of which have a zoonotic origin. And yet, less than 10% of extant parasites are documented. So, how are we to tackle the current rise in emerging infectious diseases?

The Stockholm paradigm combines four ecological concepts (ecological fitting, the geographical mosaic theory of co-evolution, taxon pulses, and the oscillation hypothesis) to explain past, current, and predicted epidemics and pandemics. During climatic stability, species tend to be isolated and specialised; parasites exploit these stable conditions. By contrast, during periods of rapid climate change, many species are at risk and some go extinct, but these changing environments also create opportunities for new species to colonise and evolve. The five great mass extinction events were followed by rapid rediversification, highlighting the remarkable capacity for renewal of global biodiversity. Such evolutionary reset points demonstrate biosphere resilience. But biotic expansion fosters parasite exploration too, creating parasite pollution and the potential for increased virulence with the recombination of strains. Infectious diseases are also threat multipliers for all other elements of climate change. Throughout history, advances in civilisation—agriculture, domestication, urbanisation, and globalisation—have all been accompanied by increasing disease risk. But never before has the human population been larger, living at such high densities, and so hyperconnected. We are now approaching a storm of spiralling disease risk. Evolutionary biology theory is used in this book to explain how climate change provides these new opportunities for emerging infectious diseases.

The inspiring introductory chapter has enough sensationalism to interest and stir the reader, balanced with pragmatism and a sense of humour. The historical, psychological, and truism arguments highlight the weaknesses of humans and, of course, scientists are no exception! The bottom line is that we have stuck our heads in the sand for too long about climate change and associated disease emergence.

Two historic chapters follow. "How did we get into this mess?" and "Dawning awareness" move from disease awareness, theories of evolution, and the problem of

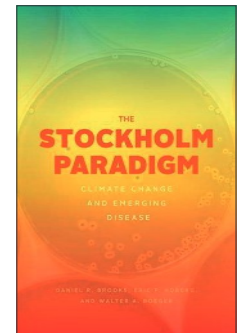
ecological specialisation, to medicinal plants and vaccine development, and vector identification and control. The account includes classic Pasteur and Jenner examples, but with hidden gems too; who, for example, remembers Julius Petri? Myths, such as "selection always reduces pathogenicity" and "parasites with wide host range are less well adapted" are dispelled, and there are informative summaries of climatological research, from work by Arrhenius to Milanković.

The next four chapters examine the empirical and modelling evidence for the Stockholm paradigm from the perspective of the parasite, the host, and the climate, and then all three in combination. In this middle section of the book, the general reader might get a bit lost in semantics (origins of pre-adaptive traits, for example, and the turns and twists of scientific speculation and discovery), but we love this, and the last three chapters are worth waiting for!

Rather than waiting for the next pandemic to arrive, we need a precautionary approach to predict the emergence of new infectious diseases, whether caused by animal or human pathogens. Never before has there been a greater need for medicine to meet ecology: a true One Health, nay, planetary health approach. Historically, vets have often led the way in disease diagnosis, but although we started working together to understand animal and human disease as soon as treatments were discovered, doctors, understandably, focused on solving problems of the present, rather than thinking towards the future. We need to move beyond the era of medicate, vaccinate, eradicate and shine a spotlight on the wider "parascap". The authors of the book offer a solution: document, assess, monitor, and act (DAMA). Rather than focus on the known major pathogens, we should embark on the mammoth task of documenting all parasites, focusing on unknown infections, particularly those in reservoir hosts. Considering the multitude of parasites and scarcity of taxonomists, is this a pipe dream? Perhaps not, as the authors argue, if global funds (eg, from astrophysics and military expenditure) are diverted here, and we make full use of new technologies to handle the inevitable big data. But cooperation across disciplines and countries would still be needed to embrace a biodiversity and health ethic.

Whether you are a health professional, ecologist, evolutionary biologist, historian, ecowarrior, extinction rebel, or member of the public, this book could not be timelier. It is a fascinating read for anyone interested in local, national, and global challenges. Greta Thunberg would be proud...as long as we do act now.

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**The Stockholm Paradigm: Climate Change and Emerging Disease**

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