Adaptation and the evolution of parasite virulence in a connected world.

Wild G, Gardner A, West SA

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Selected by | António Rodrigues and Akiko Satake / Vincent Jansen
First evaluation 13 Jul 2009 | Latest evaluation 17 Sep 2009
Relevant Sections

Faculty Comments & Author Responses

Faculty Member	Comments
António Rodrigues and **Akiko Satake** Hokkaido University, Japan Ecology Hypothesis New Finding	**In this paper, inclusive fitness theory is applied to the evolution of parasite virulence in a structured population. The results indicate that lower direct benefits of producing offspring and higher competition for the focal individual and their relatives are the reasons behind lower virulence in response to limited parasite dispersal.** Group selection arguments have been given to explain lower virulence as a response to limited parasite dispersal. However, using a mathematical model according to inclusive fitness theory, the authors give a formal argument that explains why limited dispersal can favour lower virulence and thus rendering group selection arguments unnecessary. The reasons that underlie this phenomenon can be decomposed into two components - direct fitness and indirect fitness. Limited dispersal reduces the relative value of producing offspring and increases the competition for available hosts (self-shading). On the other hand it also increases the competition experienced by relatives (kin shading). This study once more confirms previous results saying that as the human society becomes more connected strains with higher virulence are favoured. This paper uncovers possible mechanisms that drive the evolution of virulence in structured populations. **Competing interests:** None declared Evaluated 13 Jul 2009 How to cite this evaluation
Vincent Jansen Royal Holloway, University of London, United Kingdom Ecology Confirmation	**This paper shows that parasite evolution in a spatially structured host population can be understood using inclusive fitness theory. This is an important contribution to the current debate about how traits that are costly for an individual can evolve.** Recently, the old debate about whether cooperative and altruistic traits result from kin or group selection has been rekindled by the formulation of new rules that govern the evolution of such traits {1}. One such an example is the way parasites exploit their hosts: prudent parasites make their own life difficult, but

spatial models of host-pathogen interactions have shown that a spatial structure could select for more prudent pathogens {2-3}. Although it has been argued that this result could be understood using either a group selection or a kin selection perspective {4}, an inclusive fitness analysis of this problem was lacking. This paper provides an analytical solution to this problem, thereby showing that this evolutionary process can be interpreted using inclusive fitness theory. This is not a priori obvious interpretation, and it is enormously helpful as it contributes towards a unified perspective on the way selection operates. Although this is an important contribution, it seems that the cause for this debate to surface once again is that many of our theories are based on models with a very simplified ecology (in this paper, for instance, there is no multiple infection, and the maximal size of a deme is fixed). It is, therefore, relatively simple to construct special cases not obviously covered by these models and, currently, one would have to deal with such cases piecemeal to show that a unified view holds for all these cases. What really would help is a framework that would cover much more complicated scenarios. This paper is a step in this direction.

References: {1} Nowak MA, Science 2006, 314:1560-3 [PMID:17158317]. {2} Boots and Sasaki, Proc Biol Sci 1999, 266:1933-8 [PMID:10584335]. {3} Haraguchi and Sasaki, J Theor Biol 2000, 203:85-96 [PMID:10704294]. {4} van Baalen M, "Contact Networks and the Evolution of Virulence." In: Adaptive Dynamics of Infectious Diseases: In Pursuit of Virulence Management. Dieckmann U et al. (eds) Cambridge: Cambridge University Press, 2002:85-101.

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