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A connected world gives viruses the edge

This release is available in French.

That's one conclusion from a new study that looked at how virulence evolves in parasites. The research examined whether parasites evolve to be more or less aggressive depending on whether they are closely connected to their hosts or scattered among more isolated clusters of hosts.

The research was led by Geoff Wild, an NSERC-funded mathematician at the University of Western Ontario, with colleagues from the University of Edinburgh. Their paper will be published on *Nature*'s Web site on May 27.

"Our study follows up on some recent findings that suggest that reduced dispersal of parasites across scattered host clusters favours the evolution of parasites with lower virulence – in the case of influenza, for example, a milder, possibly less deadly, case of flu," said Dr. Wild.

"Some researchers had contended from this that the parasites were evolving to support the overall fitness of the group," he added. "The argument for adaptation at the group level is that the parasites become more prudent to prevent overexploitation and hence to avoid causing the extinction of the local host population."

However, Dr. Wild and his colleagues were not convinced that Darwinian theory – so successful in providing explanations based on the notion that adaptation maximizes individual fitness – was ready for such a major makeover.

The researchers decided to move the arguments from words to harder science. Together they developed a formal mathematical model that incorporated variable patch sizes and the host parasite population dynamics. It was then run to determine the underlying evolutionary mechanisms, the results of which were published in the *Nature* paper.

"The model revealed solid reasons why lowered virulence enhanced individual fitness," said Dr. Wild.

The researchers used an "inclusive" notion of individual fitness that has been used by biologists in other situations since the 1960's. This "inclusive" approach recognizes that an individual has a vested interest not only in its own success, but also the success of its relatives (not the group as a whole, per se).

"Basically, we replace the notion of self-interest – an idea that underlies much early evolutionary theory – with the notion of self-and-family interest," he said. "The difference between self-and-family interest versus group interests is subtle, but important."

"There are several reasons why lowered virulence enhances the success of genetic lineages of parasites," he said. For one thing, he explained, it means lower host-to-host disease transmission.

"While the more virulent strain of parasite can move among hosts readily, it does so to the detriment not of the group, but rather certain members of the group (namely individuals of the same strain – its relatives)," said Dr. Wild.

"Besides settling an argument over adaptation, we now understand better the importance of dispersal to the evolution of parasites."

"The findings also suggest that as human activity makes the world more connected, natural selection will favour more virulent and dangerous parasites."

Dr. Wild said the modeling approach the group took makes it possible to expand virulence theory to examine a range of potentially important biological factors.

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