# Ladybird Bioterrorists

**The Asian harlequin ladybird carries a biological weapon to wipe out competing species.**

By Ruth Williams | May 16, 2013



Harlequin ladybirds
ANDREAS VILCINSKAS

Asian harlequin ladybirds, introduced to Europe and other parts of the globe as an environmentally-friendly means of pest control, are causing their own ecological problems—they're wiping out native ladybird species. And one reason for the harlequin's global dominance could be its use of a biological weapon, according to a report published online today (May 16) in *Science*. The study reveals that harlequins carry a fungal parasite to which they are immune, but which kills other ladybird species.

"[We] should have seen this coming, because we knew all about it from human history," said Stuart Reynolds, emeritus professor of biology and biochemistry from the University of Bath in the U.K., who was not involved in the work. "When the Spanish conquistadores invaded Central and South America, there were tiny numbers of them and yet they managed to invade extremely successfully because they carried smallpox and diphtheria and measles." The harlequin ladybirds are successful invaders for essentially the same reason, he said.

Harlequin ladybirds (*Harmonia axyridis*) are good eaters, with each beetle consuming roughly 200 aphids per day. It is for this reason, that they were considered a great way to fight aphid infestations on agricultural crops, explained Andreas Vilcinskas, a professor of phytopathology and applied zoology at the Justus-Liebig Universität in Giessen, Germany.

But since their arrival in Europe 50 or 60 years ago, these pest-controllers have become pests themselves. "In the past 2 decades they have become invasive," Vilcinskas said. "In the autumn, when the temperature drops below 0 °C, they aggregate near houses, and sometimes you have 10 thousand beetles which aggregate and enter a house." Furthermore, native ladybird species are now almost impossible to find in some areas, he said.

*H. axyridis* are successful invaders for "many different reasons," said François Verheggen, an entomologist at the Université de Liège in Belgium, who was not involved in the study. Not only do they tend to eat more than other species, and so might limit available food for their competitors, they are also better at surviving cold temperatures and they produce larger amounts of toxic alkaloids—a defense mechanism against predators, he said.

Another possible reason is that the eggs and larvae of *H. axyridis* are toxic to other ladybird species, which consume one another's offspring. "The worst enemy for ladybirds is other ladybirds," said Vilcinskas.

The reason that *H. axyridis* can eat other species' young without penalty, while their own young are fatal to competitors, was thought to be because *H. axyridis* contains a particularly abundant alkaloid called harmonine in its hemolymph, or body fluids.

To test that theory, Vilcinskas injected purified harmonine into *Coccinella septumpunctata*, commonly known as the seven-spot ladybird. They found that even at high concentrations the compound did not kill the ladybirds, but that unpurified hemolymph did.

Vilcinskas thus turned back to *H. axyridis* hemolymph to find the culprit. "I never saw anything like it," he said. "[The beetles] were full of parasites." The parasites he found in the *H. axyridis* hemolymph were single-celled fungi, or microsporidia, of the *Nosema* genus. Vilcinskas purified the fungi and injected them into *C. septumpunctata*, killing them all within 2 weeks.

"Presumably, the ability of the Harlequins to tolerate this nasty intracellular microsporidian is something that has evolved over a very long period of coexistence," said Reynolds. Indeed past studies have

revealed that *H. axyridis* has evolved an impressive immune system, said Vilcinskas. "They have more than 50 antimicrobial peptides," he said, "No other insect has more."

Additionally harmonine itself has been found to have antimicrobial qualities, including activity against *Mycobacterium tuberculosis*, which causes human tuberculosis, and *Plasmodium falciparum*, which causes malaria. *H. axyridis*'s unique and powerful immune system could even be "a promising source for new drugs," said Vilcinskas.

So although the introduction of *H. axyridis* to Europe has been bad news ecologically speaking—indeed it may be too late to save some native species, feared Vilcinskas—the results of the research into this ecological problem may end up yielding some unexpected medical benefits.

**A. Vilcinskas et al., "Invasive harlequin ladybird carries biological weapons against native competitors," *Science*, 340:862-863, 2013.**

## Tags

parasites, insects, immune system, entomology, ecology, antimicrobial and agriculture



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May 17, 2013

Once again evidence is discovered, indicating biological conflicts that might arise from Earth humans visiting a foreign, would-be Goldilocks planet.

The likelihood, in such a scenario, that we carry organisms on our skin, in our respiratory and digestive systems that are benign or even on which we are symbiotically dependent, but which would devastate flora and fauna on such a planet. And, similarly, such a planet's biosphere might contain what are fatally pathogenic for us.

Let us coin the term Goldilocks Quotient, and reduce that to "GQ."

Even if the Kepler Mission were to discover a hundred million exoplanets, and even if we were to develop a way to visit them all, not only is our biosphere unique at any given time, but it has varied over millions of years, such that were we to develop a time machine that could transport a team of scientists to another time in our own planet's history, chances are high that the team would both carry pathogens that would play havoc "then/there" but, also, that the team would be by flora and fauna different by far in the evo-time/place visited, that it would be biologically overwhelmed. There are so many yet unnamed, or unfamiliar flora and fauna even in our own evo-time/place frame, we have no idea which of the ones unstudied by us (much less those known to us, but at a different evolutionary time/place, are benign or symbiotic for us, that would not in THAT form be so.

The particulars (to the nano-level) of a biosphere such as ours is not only astronomically to be incompatible with that of any "similar" exoplanet but, also, even incompatible with what ours might be if it could be exhaustively analyzed at spaced periods of, say, one million years, or ten million years, that our visiting such other eco-time/locus frames could be mutually hazardous for visitor and visited.

While I would not go so far as to predict that humans will never succeed in planting a colony successfully on any other planet, I estimate that the odds of such a colony's surviving would be infinitesimally small, or that we would find any flora or fauna there that is bio-compatible for our consumption.

Whereas on Earth, history indicates that it is possible for one species to


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split off from another geographically, such that the two are isolated for a few thousand years... and when the two groups remerge the original group carries pathogens it has co-evolved with, that are highly fatal to the split-off group, the possibility that the split-off group might be the one -- at least in some percentage of cases -- to have developed an ability to tolerate or carry micro-organisms fatally pathogenic to most of the other -- it is no a foregone certainty that there would be no cases in which the split-off group could be the ones that have developed tolerance of pathogens that might be more devastating to the older group (source group). There is a possibility, too, that each of two isolated groups -- even here on Earth -- will have "grown apart" evolutionarily to the extent each might carry pathogens the other cannot tolerate.

In Earth history, as we presently theorize, the pathogens that were poorly tolerated by Incas and Aztecs and other cultures were more tolerated by Europeans who had, during the separation phase, more exposed to domesticated animals that were not carried along with the group that split off. But we would not be on solid ground were we to extrapolate from that, that it would always be the older, or original group split off from, that would have been the more exposed to animal pathogens.

But the most important consideration here is that incompatibilities in immune systems can evolve on Earth, even similtaneously, much less over millions of Earth years.

While the current mobility of humans, may be healthy in making the whole of Earth's human population mutually compatible in immune responses, there is little likelihood that the mutual adaptation of a human colony on an exoplanet would have time to merge and develop mutual compatibilities in a mere few generations. Also, support from Earth, to cope with any kinds of challenges at all, would (so far as our current science and technology are capable of transporting information, drugs, weapons, at least) excruciatingly slow and enormously expensive.

Much speculation about what the odds would be of our colonizing even one sterile other planet in our own solar system might be less problematic than if we had another solar planet that is sterile. Even if that (imagined) other Goldilocks planet were capable of being infected with Earth life forms, bringing that planet up to date would likely take many thousands of years. Plants on Earth are adapted to soil that has thousands of benign and friendly species we may take for granted -- one dependent upon another, which is dependent upon another...

It staggers the imagination to think human might ever pull it off.

Of course, naivete' and simplistication allow such complexities to be ignored in contemplating what might be little more than imaginary greener grass on the other side of a veritable time/space fence that a rigorous study of might infathomably exceed our congnitive and technological capabilities, if not our marvelous, though simplisticating and reductionistic imaginations.

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May 20, 2013

Probably should have thought a little more before introducing a completely new species.

Loved the philosophical tangent , @jeenious.

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