Parasitoid turns its host into a bodyguard

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There are many examples of parasites that induce spectacular changes in the behaviour of their host. Flukes, for example, are thought to induce ants, their intermediate host, to move up onto blades of grass during the night and early morning. There, they firmly attach themselves to the substrate with their mandibles, and are thus consumed by grazing sheep, the fluke's final host. In contrast, uninfected ants return to their nests during the night and the cooler parts of the day. As another example, terrestrial insects parasitized by hairworms commit suicide by jumping into water, where the adult worms reproduce.

Behavioural changes like these are thought to be induced by the parasite so as to increase its transmission to the final host, but there are alternative explanations. It is possible, for example, that the hosts already behaved differently before becoming infected. Hence, infection is a consequence of different behaviour, not its cause.

Increased transmission can also be called into question: the behavioural changes of the host may result in increased attacks by other non-host animals, and this would seriously decrease the probability of transmission. Increased transmission should therefore always be tested under natural conditions.

In a recent publication in the online, open-access journal PLoS ONE, a research team from University of Amsterdam, the Netherlands, and the Federal University of Viçosa, Brazil, led by Arne Janssen, now offer evidence that behavioural changes of a host are indeed beneficial to the parasite in the field. In research supported by WOTRO, carried out in

Brazil, they studied a moth, the caterpillars of which feed on leaves of the native guava tree and on an exotic eucalyptus. Small caterpillars are attacked by an insect parasitoid wasp, which then quickly inserts up to 80 eggs into it.

Inside the caterpillar host, a cruel drama takes place: the eggs of the parasitoid hatch and the larvae feed on the body fluids of the host. The caterpillar continues feeding, moving and growing like its unparasitized brothers and sisters. When the parasitoid larvae are full-grown, they emerge together through the host's skin, and start pupating nearby. Unlike many other combinations of host and parasitoid, the host remains alive but displays spectacular changes in its behaviour: it stops feeding and remains close to the parasitoid pupae (see photo). Moreover, it defends the parasitoid pupae against approaching predators with violent head-swings (see movies of predatory bug attack in the article at PLoS ONE).

The caterpillar dies soon after the adult parasitoids emerge from their pupae, so there can be no benefit whatsoever for the caterpillars. In contrast, unparasitized caterpillars do not show any of these behavioural changes, but continue feeding and developing into adults. The research team found that, in the field, parasitoid pupae which were guarded by caterpillars suffered half as much predation as those which had no bodyguard. Hence, the behavioural changes of the host result in increased survival of the parasitoids due to the host that acts as a bodyguard of the parasitoid pupae.

Whereas it is still unclear how the parasitoid changes the behaviour of its host, it is tempting to speculate. The research team found that one or two parasitoid larvae remained behind in the host. Perhaps these larvae affect the behaviour of the caterpillar, and sacrifice themselves for the good of their brothers and sisters.

Citation: Grosman AH, Janssen A, de Brito EF, Cordeiro EG, Colares F, et al. (2008) Parasitoid Increases Survival of Its Pupae by Inducing Hosts to Fight Predators. PLoS ONE 3(6): e2276. doi:10.1371/journal.pone.0002276 -- www.plosone.org/doi/pone.0002276

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