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Zoologger: Attack of the self-sacrificing child clones

16:49 12 May 2010 by Michael Marshall
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Zoologger is our weekly column highlighting extraordinary animals – and occasionally other organisms – from around the world

Species: Copidosoma floridanum

Habitat: Throughout the US, in the vicinity of luckless caterpillars

At just 1 millimetre long, the wasp Copidosoma floridanum hardly looks like it's the source of a devastating clone army that devours its victims from the inside out.

This epic battle generally takes place inside a caterpillar called the cabbage looper, an agricultural pest that lays its eggs one at a time on the surfaces of leaves. Once laid the egg is vulnerable – if found by a female Copidosoma she will lay one or two eggs in it.

One egg might not sound so bad, but this is no ordinary egg. It is polyembryonic, meaning that the single embryo cell at its heart can repeatedly clone itself. As a result, just one egg can produce up to 2000 offspring.

It's not enough for the Copidosoma egg to get inside the moth egg: it has to work its way into the moth embryo at its heart, and clone itself there. But how does it get into the embryo, and why does the host not destroy it?

To find out, Kikuo Iwabuchi and colleagues of the Tokyo University of Agriculture and Technology, Japan, studied Copidosoma embryos as they broke into the embryos of a moth closely related to the cabbage looper called the Chrysanthemum golden plusia.

Embryo invasion

They found that the invading Copidosoma embryo caused little or no visible damage to the host embryo. In fact, the host seemed to be positively obliging, building up a cyst of its own cells around the parasite embryo and allowing it to develop uninterrupted.

The host also allowed the invader to form links called gap junctions between its own cells and those of the host. These give the parasite information on the stage of development the host has reached, allowing it to time its own growth accordingly.

Both the parasite and the host also formed many thin tendrils called microvilli, which become tangled together. Such tangles are normally a way of exchanging nutrients, so the host may be unwittingly handing food to the parasite.

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Laying an army (Image: Max E. Badgley, published with permission of the Max E. Badgley Estate)

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Partners

Iwabuchi's team suggest that the *Copidosoma* embryo must "deceive" its host in some way, perhaps by producing chemicals that the host mistakenly recognises as belonging to itself. That is pretty sneaky, but it is only round one of a very long fight, which ends in siblicide.

Parasitic army

Once the host embryo develops into a caterpillar, the *Copidosoma* clones form an army. Yet the clones [are not identical](#). Instead they are [divided into castes](#), just like bees in a hive.

The most common caste of larvae is essentially maggots. They feed by drinking the host caterpillar's blood and, all being well, eventually emerge and become adult wasps. They are called [reproductive larvae](#) and there could be 1000 in a single caterpillar.

The second caste is the [precocious larvae](#). These [develop earlier](#) than the reproductive larvae – hence their name – and they look quite different, with a thinner body and larger mandibles. They have no sex cells and will never become adults or reproduce. These are the child soldiers.

Copidosoma larvae may well find themselves sharing the caterpillar's body with competing parasites laid by another species of wasp. The precocious larvae are there to [kill these competitors](#), and are [produced in greater numbers](#) if competitors are detected.

This turns out to be a [pretty effective way of dealing with competing species](#), but the precocious larvae face other threats too. If more than one *Copidosoma* egg is laid in the same host, the two armies go to war.

It is not surprising that the offspring of two different females would fight over a caterpillar's body. But the precocious larvae don't stop there, as [Michael Strand](#) of the University of Georgia and colleagues have shown over the last two decades.

Civil war

If the same wasp laid two eggs in one host, the precocious larvae from one egg will [attack reproductive larvae](#) from the other, despite being related to them. That might seem like a stupid thing to do, but in fact it makes evolutionary sense.

A precocious larva from one clone army is of course related to a reproductive larva from the other, but not as closely as it is to the genetically identical reproductive larvae in its own army. So it is in the larva's genetic interests for it to [kill larvae from the other group](#) and promote its own group's survival.

Things get worse if the two parasite embryos are of different sexes. Female precocious larvae will [kill any males they come across](#) to ensure that there are [more females than males](#).

That might also seem odd, but the embryos in a single caterpillar all emerge as adult wasps pretty much simultaneously, giving them all a chance to mate. In these circumstances, [only a few males are needed](#) to fertilise all the females.

No such conflicts arise if two sets of male embryos wind up in the same host. In fact [they will co-exist peacefully](#) because [male precocious larvae are pacifists](#).

Journal reference: [Journal of Morphology](#), vol 271, p 750

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