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Title:	Evolution of cooperative behaviour in haplodiploid chemically defended insect societies
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Abstract:	Sex-biased cooperation is a common phenomenon often observed in many insect societies. It entails that one sex is more proactive in cooperation or helping than the other. Hamilton's rule explains this bias based on the relatedness structure of haplodiploid insect societies. However, due to its central focus on only relatedness, Hamilton's rule only tells us why sisters should help their sisters; it does not help us understand sex biased helping in every scenario. Most theoretical models that study this bias use eusocial insects as their study organism, but sex biases also exist in other socially behaving insects. Pine Sawfly larvae are haplodiploids, they do not have cooperative breeding and they show sex-biased collected antipredator behaviour. When attacked by a predator, larvae regurgitate a resinous and unpalatable defensive fluid that deters potential predators. However, producing and losing this fluid impacts them negatively. This study employs a mathematical model to investigate the evolution of defence mechanisms in Pine Sawflies and the factors selecting sex bias in cooperative defence. Our findings reveal that the decision of which sex engages in defence is influenced by multiple factors, such as the cost of defence and sex ratios of the prey group. We see that a relatively high cost of defending results in the sex not taking part in the defence, and different group compositions can change this effective cost of defence.
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