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Incestuous insects in nature despite occasional fitness costs

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A recommendation – based on reviews by two anonymous reviewers – of
Collet M, Amat I, Sauzet S, Auguste A, Fauvergue X, Mouton L, Desouhant E. 2018. Insects and incest: sib-mating tolerance in natural populations of a parasitoid wasp. bioRxiv 169268, ver. 6 peer-reviewed by Peer Community In Evolutionary Biology. doi: https://doi.org/10.1101/169268

Inbreeding, or mating between relatives, generally lowers fitness [1]. Mating between genetically similar individuals can result in higher levels of homozygosity and consequently a higher frequency with which recessive disease alleles may be expressed within a population. Reduced fitness as a consequence of inbreeding, or inbreeding depression, can vary between individuals, sexes, populations and species [2], but remains a pervasive challenge for many organisms with small local population sizes, including humans [3]. But all is not lost for individuals within small populations, because an array of mechanisms can be employed to evade the negative effects of inbreeding [4], including sib-mating avoidance and dispersal [5, 6].

Despite thorough investigation of inbreeding and sib-mating avoidance in the laboratory, only very few studies have ventured into the field besides studies on vertebrates and eusocial insects. The study of Collet *et al.* [7] is a surprising exception, where the effect of male density and frequency of relatives on inbreeding avoidance was tested in the laboratory, after which robust field collections and microsatellite genotyping were used to infer relatedness and dispersal in natural populations. The parasitic wasp *Venturia canescens* is an excellent model system to study inbreeding, because mating success was previously found to decrease with increasing relatedness between mates in the laboratory [8] and this species thus suffers from inbreeding depression [9–11]. The authors used an elegant design combining population genetics and model simulations to estimate relatedness of mating partners in the field and compared that with a theoretical distribution of potential mate encounters when random mating is assumed. One of the most important findings of this study is that mating between siblings is not avoided in this species in the wild, despite negative fitness effects when inbreeding does occur. Similar findings were obtained for another insect species, the field cricket *Gryllus campestris* [12], which leaves us to wonder whether inbreeding tolerance could be more common in nature than currently appreciated.

The authors further looked into sex-specific dispersal patterns between two patches located a few hundred meters apart. Females were indeed shown to be more related within a patch, but no genetic differences were observed between males, suggesting that *V. canescens* males more readily disperse. Moreover, microsatellite data at 18 different loci did not reveal genetic differentiation between populations approximately 300 kilometers apart. Gene flow is thus occurring over considerable distances, which could play an important role in the ability of this species to avoid negative fitness consequences of inbreeding in nature.

Another interesting aspect of this work is that discrepancies were found between laboratory- and field-based data. What is the relevance of laboratory-based experiments if they cannot predict what is happening in the wild? Many, if not most, biologists (including us) bring our model system into the laboratory to control, at least to some extent, the plethora of environmental factors that could potentially affect our system (in ways that we do not want). Most behavioral studies on mating patterns and sexual selection are conducted in standardized laboratory conditions, but sexual selection is in essence social selection, because an individual's fitness is partly determined by the phenotype of its social partners (i.e. the social environment) [13]. The social environment may actually dictate the expression of female mate choice and it is unclear how potential laboratory-induced social biases affect mating outcome. In *V. canescens*, findings using field-caught individuals paint a completely opposite picture of what was previously shown in the laboratory, i.e. sib-avoidance is not taking place in the field. It is likely that density, level of relatedness, sex ratio in the field, and/or the size of experimental arenas in the lab are all factors affecting mate selectivity, as we have previously shown in a butterfly [14–16]. If females, for example, typically only encounter a few males in sequence in the wild, it may be problematic for them to express choosiness when confronted simultaneously with two or more males in the laboratory. A recent study showed that, in the wild, female moths take advantage of staying in groups to blur male choosiness [17]. It is becoming more and more clear that what we observe in the laboratory may not actually reflect what is happening in nature [18]. Instead of ignoring the species-specific life history and ecological features of our favorite species when conducting lab experiments, we suggest that it is time to accept that we now have the theoretical foundations to tease apart what in this "environmental noise" actually shapes sexual selection in nature. Explicitly including ecology in studies on sexual selection will allow us to make more meaningful conclusions, i.e. rather than "this is what may happen in the wild", we would be able to state "this is what often happens in nature".

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Appendix

Reviews by two anonymous reviewers: http://dx.doi.org/10.24072/pci.evolbiol.100047