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Adaptive evolution among socially parasitic allodapine bees

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Inquilinism is a form of social parasitism, where parasites have evolved to live largely within their host's colony. Among bees, the tribe Allodapini (Apidae; Xylocopinae) contains the greatest number of independent origins (> 10) of social parasitism, which is only otherwise known from *Bombus* which displays far fewer origins comprising the subgenus Psithyrus. In all allodapine cases, social parasites are phylogenetically related to their hosts, but origins vary widely in their age, from less than 1 Mya to approximately 15 Mya. Most species show convergence in parasitic traits (reduced scopae, proboscis, mandibles, eyes, wing venation), but some facultative parasites can nest independently, suggestive of incipient phases. A key question regarding inquilinism is how it manages to persist over evolutionary time, given that hosts should have high rates of adaptive evolution? Most molecular studies of adaptive evolution have focused on nuclear genes, but a there is a growing focus on mitochondrial DNA, with some studies indicating key adaptive changes associated with changes in life-history traits, including convergent evolution in some gene regions. It has been argued that a higher rate of molecular evolution in social parasites is due to their smaller effective population size (with increasing rates of genetic drift), but this hypothesis conflicts with theoretical predictions. Here we show that rates of mitochondrial evolution in allodapine bees tend to be higher in social parasites than their hosts. Results suggest that mitochondrial genes can play a critical role in social evolution, but the lack of recombination in these maternally inherited genes indicates a very different kind of evolutionary dynamic from nuclear genes. We hypothesize that these higher mitochondrial rates are due to common selective pressures arising from adaptations to life history strategies that entail low metabolic activity.