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Joint evolution of sex ratio and reproductive group size under local mate competition with inbreeding depression

Local mate competition (LMC) may involve some amount of inbreeding between siblings. Because sib-mating is generally accompanied by inbreeding depression, natural selection may favor a reduced rate of sib-mating, possibly affecting the evolution of sex ratio and reproductive group size. The present study theoretically investigated the evolution of these traits under LMC in the presence of inbreeding depression. When the reproductive group size evolves, the determination mechanism of sex ratio is important because the time scale of the sex ratio response to reproductive group size can affect the evolutionary process. We consider a spectrum of sex ratio determination mechanisms from purely unconditional to purely conditional, including intermediate modes with various relative strengths of unconditional and conditional effects. This analysis revealed that both the evolutionarily stable reproductive group size and ratio of males increase with higher inbreeding depression and with a larger relative strength of an unconditional effect in sex ratio determination. Unexpectedly, when the sex ratio is controlled purely conditionally, the reproductive group size cannot exceed three even under the severest level of inbreeding depression (i.e., lethal effect). The present study reveals the conditions for LMC to evolve through the analysis of the joint evolution of reproductive group size and sex ratio.