

A simple model of group selection that cannot be analyzed with inclusive fitness

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A widespread claim in evolutionary theory is that every group selection model can be recast in terms of inclusive fitness. Although there are interesting classes of group selection models for which this is possible, we show that it is not true in general. With a simple set of group selection models, we show two distinct limitations that prevent recasting in terms of inclusive fitness. The first is a limitation across models. We show that if inclusive fitness is to always give the correct prediction, the definition of relatedness needs to change, continuously, along with changes in the parameters of the model. This results in infinitely many different definitions of relatedness — one for every parameter value — which strips relatedness of its meaning. The second limitation is across time. We show that one can find the trajectory for the group selection model by solving a partial differential equation, and that it is mathematically impossible to do this using inclusive fitness.

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