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Assessing Bias and Robustness of Social Network Metrics in Large Herbivores

Animal social network analysis allows biologists to investigate the causes and consequences of animal interactions and have a better understanding of ecological and behavioural processes. It serves in testing a wide range of hypotheses about social evolution, behaviour, dynamical processes, and transmission events such as the spread of disease and social learning. Wild biological data are prone to the biases caused due to sampling protocols and the species under study and hence, sampling of animals from a wild population has been recognised as a concern. The suitability of using network metrics derived from a partial population has been investigated through various simulation studies. In this research, we use data from five different species of ungulates to determine the effects of sampling protocols on the accuracy of network summary statistics. We apply network permutation techniques, bootstrapping approach, correlation, and regression analysis to ascertain the suitability of available sample as a representative of the species behaviour. We show that the bias in the calculation of network metrics such as density, mean strength and transitivity of the network is inversely proportional to the proportion of individuals in the subsample and could be corrected for even when as low as 30% of the individuals are present in the subsample. We also present a way of obtaining confidence intervals around the network metrics estimates based on the given sample. We have created an R package to act as a readymade toolkit for ecologists to statistically analyse animal social network data and guide methodological decisions.