

Four principles for improved statistical ecology

Sound statistical research practices are difficult to accomplish without proper training or guidelines. Poor practices such as HARKing, cherry-picking, and inadequate reporting practice are common in ecology, as with most sciences, and can lead to high false positive rates, lack of replicability and other research waste. A discussion group at vISEC2020 considered how to help ecologists understand and prioritise the most impactful and important statistical research practices, identifying four guiding principles:

1. First, define a precise research question, then plan sampling and analysis to answer it.
2. Develop a model that accounts for the distribution and dependence of your data.
3. Emphasise effect sizes to replace statistical significance with ecological relevance.
4. Report your methods in sufficient detail so that your research is valid and reproducible.

They are listed in approximate order of importance and impact. Defining research questions precisely before any data is collected can completely eliminate HARKing, especially when paired with registration, which has the additional benefit of eliminating cherry-picking. Developing a plan for sampling helps to better answer research questions, leading to more meaningful and impactful results, and increases the likelihood true effects are found (statistical power) with better sampling design. Correctly modelling data also increases power, and controls the rate of false positives. Emphasising effect sizes puts the focus on ecological relevance, which is the most meaningful result of ecological research. Comprehensive reporting of methods allows others to successfully replicate your study, thereby lending more weight to findings and moving the field forward.