Multiple Method Inference reveals instability of indexcalibration

experiments: counting tigers at macroecological scales

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Abstract: Progress in macroecology has relied heavily on synthesis of multiple studies in the form of "meta-analyses". Meta-analyses can yield poor inferences because they are usually oblivious to methodological uncertainties arising because multiple studies rarely use similar methods. We propose and demonstrate the power of the Multiple Method Inference (MPMI) approach of "meta-analyses" and resolve a long-standing debate about the value of index-calibration experiments based on linear regression in macroecology. The index-calibration experiment involves rigorous estimation of animal abundance at a small scale to calibrate a, less rigorously derived, "index" of abundance using the R^2 statistic. The calibrated index is then used to draw inferences about animal abundance at a large scale using the index. In this paper, we first derive the constituent elements of the R^2 statistic of such index-calibration experiments, and discuss the stability of such R^2 statistics. We then confront these theoretical derivations with an empirical study using the MPMI approach to 'link' results of some recent, large-scale, assessments of tiger *Panthera tigris* distribution and abundance across India. These results have overarching implications on similar macroecological, resource-intensive, studies that attempt to derive explanatory patterns in phenomena such as biological diversity, speciation, and disease ecology.