How much is enough? Estimating the minimum sampling required for effective monitoring of African reserves

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Abstract. Effective biological monitoring in developing countries requires a balance of rigour and practicality. Unfortunately, there exist few general guidelines to help practitioners design monitoring programs that reach this balance. Here, we analyse a 33-year monitoring program from Ghana, West Africa, to provide both specific and general suggestions for monitoring in developing countries. Since the late 1960s the Ghana Wildlife Division has monitored more than 40 wildlife species with monthly surveys at sites throughout Ghana's nature reserves. These data present unparalleled opportunities to illuminate the scale and pattern of changes in animal abundance over time and the forces that drive these changes. We used sub-sampling of the Ghana monitoring data for four species in two savanna reserves to identify the minimum level of monitoring necessary to reliably detect changes in wildlife populations over 5-year intervals. We used a similar approach to estimate the minimum sampling needed to infer changes in abundance of hunters in reserves. Our results highlight the relative importance of comprehensive spatial and temporal sampling and suggest a requirement of no less than one monitoring site per every 285 km^2 in large reserves and 65 km^2 in smaller reserves. We discuss briefly the cost of effective monitoring and the relevance of our results to other regions of Africa and the world.

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