# Optimizing ecological surveys for conservation

Jeffrey O. Hanson\*1, Jenny L. McCune2, Iadine Chadès3, Caitlyn A. Proctor1, Emma J. Hudgins1, Joseph R. Bennett1

1Department of Biology, Carleton University, Ottawa, Canada

2Department of Biological Sciences, University of Lethbridge, Lethbridge, Canada

3CSIRO Ecosystem Sciences, Ecosciences Precinct, Dutton Park, Australia

^\*^email jeffrey.hanson@uqconnect.edu.au

## Abstract

### Background/Question/Methods

Protected area systems need to safeguard biodiversity with limited funding and incomplete information. To help achieve this, ecological surveys can locate species and, in turn, inform plans for protected area systems. However, conducting surveys reduces funding available for protected area establishment and, in turn, could lead to worse conservation outcomes. Here we present a novel framework based on value of information to evaluate and optimize survey plans. Our framework evaluates survey plans according to how they can improve coverage of species within resulting protected area systems. Critically, it accounts for survey and land acquisition costs. We applied our framework to a case study involving nine plant species in Ontario (Canada). We also tested the performance of this framework compared with conventional approaches used for designing surveys.

### Results/Conclusions

Our framework successfully identifies survey plans that are likely to substantially improve the performance of plans for protected areas. We also show that conventional approaches for designing survey plans – based on statistical, biogeographical, or economic criteria – can impede conservation planning by squandering limited funding on surveying places that might not improve decision making. For example, sampling places where species are most likely to occur had the worst performance. This is because simply verifying the presence of species in places where they are already thought to occur is unlikely to update existing information and, in turn, improve management decisions. Moreover, survey plans based on conventional approaches had the worst performance under limited budgets that are typical of real-world scenarios. Our findings highlight the importance of carefully considering how new data has the potential to alter conservation outcomes when designing data collection plans.