Andrew D. Crosby

23 September, 2020

## Manuscript proposal for using big grids to look at cumulative effects at different spatial scales

## **Authors**

## Andrew D. Crosby,1,2 Lionel Leston,1,2 Erin M. Bayne1,2

## **Suggested co-authors**

## C. Lisa Mahon,3 Péter Sólymos,1,2,4 Judith D. Toms2,5

## 1Boreal Avian Modelling Project, 751 General Services Building, University of Alberta, Edmonton, Alberta T6G 2H1 Canada

## 2Department of Biological Sciences, University of Alberta, Edmonton, Alberta T6G 2E9, Canada

## 3Environment and Climate Change Canada, 91780 Alaska Highway, Whitehorse, Yukon Y1A 5X7 Canada

## 4Alberta Biodiversity Monitoring Institute, 1-107 Centennial Centre for Interdisciplinary Studies (CCIS), University of Alberta, Edmonton, Alberta T6G 2E9, Canada

## 5 Environment and Climate Change Canada, 9250-49th Street, Edmonton, Alberta T6B 1K5 Canada

## **Working Title:** Additive and interactive effects of forest disturbance on boreal bird species across spatial scales

### **Issue:** The western boreal forest of Canada is quickly transitioning form an intact to a variegated landscape due to rapid industrial development.

### **Relevance:** Many boreal bird species demonstrate negative responses to industrial disturbances, which leads to alterations in biodiversity and ecological functioning.

### **Hole:** It has been demonstrated that different disturbance types interact to increase the effects on many bird species. However, we do not know how these interactive effects might change with spatial scale.

### **Objective:** Quantify the interactive effects of multiple disturbance types on boreal bird populations at different spatial scales, and test for differences in effects among scales.

## A few thoughts for the introduction:

* If the effect of a given disturbance type is conditional on the area of another disturbance type, there is an interactive effect.
* Interactive effects may be synergistic (increased response) or antagonistic (decreased response) (Mahon et al. 2016)
* At smaller scales, it is more likely there will be fewer disturbance types, thus making it less likely that interactive effects will be detected.
* There may be thresholds in the area of a disturbance required to elicit a response or interaction (Bayne et al. 2005).
* There may be domains of scale over which interactive effects remain constant, and then change abruptly (i.e. a large change in the effect over a small change in spatial scale; Wiens 1989).

## **Alternative hypotheses for testing:**

1. Direct effect through loss of native vegetation at all spatial scales.
   * Cumulative area of disturbance explains density, regardless of disturbance type.
2. Direct effect through loss of vegetation is conditional on disturbance type at all spatial scales.
   * Additive effects of area of different disturbance types.
3. Direct and indirect effects independent of spatial scale.
   * Interactive effects remain constant across scales.
4. Scale-dependent interactive effects.
   * Interactive effects change with spatial scale.

## **Literature Cited**

Bayne, E. M., S. Boutin, B. Tracz, and K. Charest. 2005. Functional and numerical responses of ovenbirds ( Seiurus aurocapilla ) to changing seismic exploration practices in Alberta’s boreal forest. Écoscience 12:216–222.

Mahon, C. L., G. Holloway, P. Sólymos, S. G. Cumming, E. M. Bayne, F. K. A. Schmiegelow, and S. J. Song. 2016. Community structure and niche characteristics of upland and lowland western boreal birds at multiple spatial scales. Forest Ecology and Management 361:99–116.

Wiens, J. A. 1989. Spatial Scaling in Ecology. Functional Ecology 3:385.