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23 September, 2020

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

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## **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 (Bayne et al. 2016), 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**

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