BARCODE-FACILITATED INVENTORIES ELUCIDATE THE INFLUENCE OF A NATIVE PEST OUTBREAK ON THE MOTH DIVERSITY OF A PONDEROSA PINE FOREST SYSTEM

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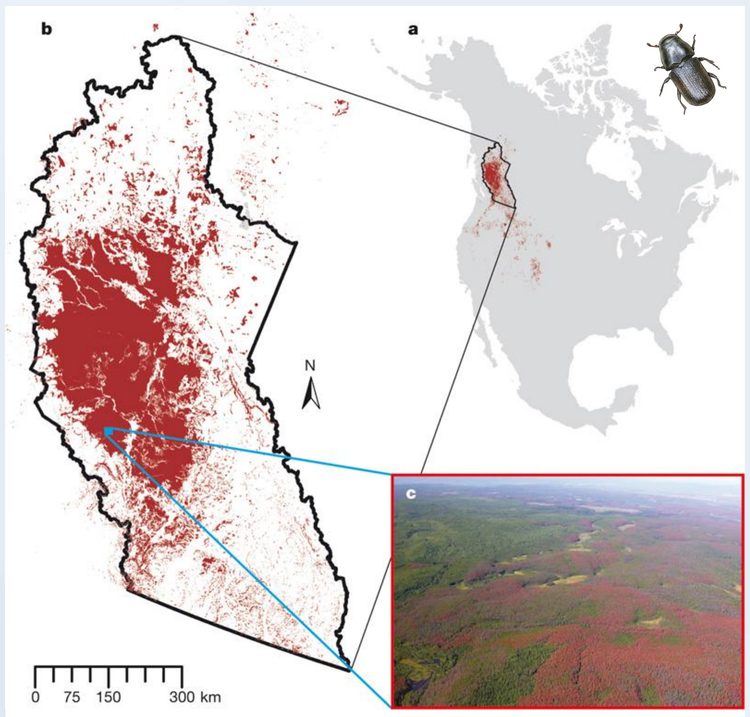
Bark Beetle Outbreak

The recent outbreak of mountain pine beetle and related bark beetles (*Dendroctonus* spp.) in British Columbia (BC) is the most extensive and severe epidemic on record. The consequences of the death of most mature pine trees have been well-studied for birds and other vertebrates intricately tied to the resource pulse, but very little has been done to determine what effect the severe change in habitat is having on comparatively neutral residents.



Extent of the mountain pine beetle outbreak in a) North America and b) the interior of BC. The mortality of trees is evident by the red-brown colouration (c) (Kurz et al 2008).

We investigated the ecological consequences of the outbreak on resident biotic communities by measuring its effect on a species-rich component, the macro-moths (Lepidoptera).

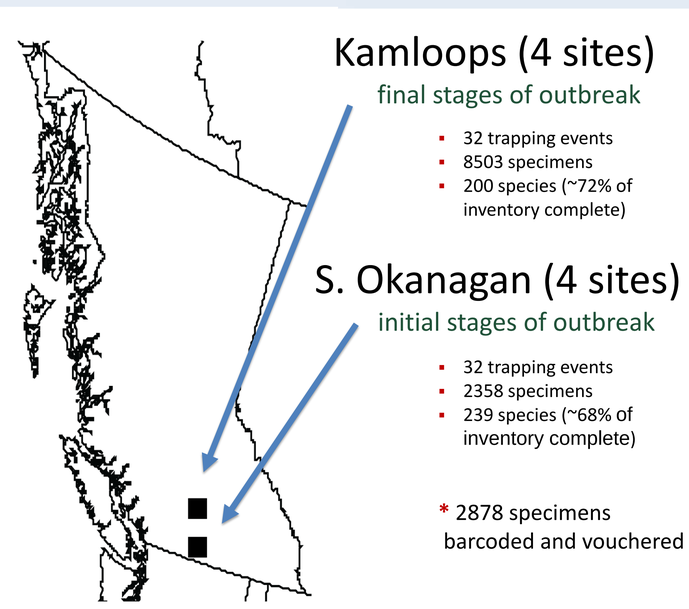
Study Objectives

We conducted faunal inventories for two BC ponderosa pine forests and investigated the impact of the recent bark beetle outbreak on three levels of moth diversity. This permitted us to test two hypotheses:

- That an older and more severe bark beetle attack will negatively affect moth diversity
- That the variation of moth diversity between sites can be predicted by one or more biological attributes that gauge the health and structure of the forest stand.

Methods

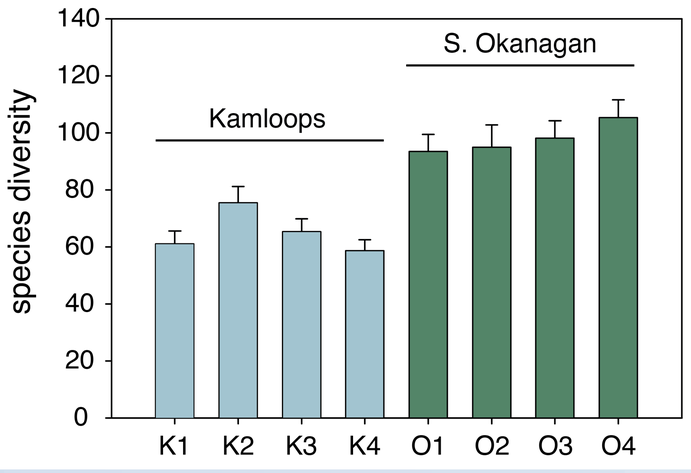
We inventoried moth diversity at eight ponderosa pine stands in British Columbia that differed widely in attack by *Dendroctonus* bark beetles. We used standardized trapping and employed DNA barcoding for rough sorting and species identification of the 10,861 macromoth specimens collected.



Three levels of diversity — species, genetic, and phylogenetic — were then estimated for each of the eight sites and pooled for the two locations. In addition, we performed a linear regression analysis of several site attributes and the diversity values.

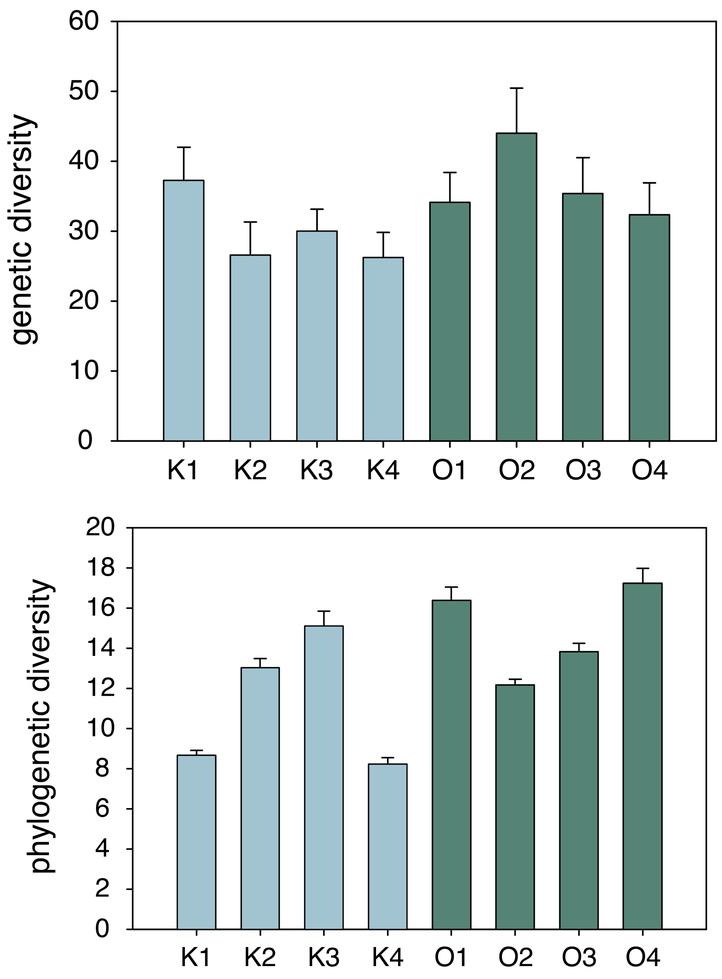
Results – Species Diversity

The mean rarified species richness for the four heavily impacted sites in Kamloops, the bars in blue, was significantly lower than that of S. Okanagan (unpaired t-test, $t = 7.2$, $p < 0.001$). Moreover, the linear regression analysis of site attributes and diversity estimates revealed that approximately 85% of the variance in species diversity is explained by ponderosa pine mortality ($B=-0.402$, $p=0.001$, $R^2=0.853$).



Results – Genetic and Phylogenetic Diversity

The mean rarified haplotype diversity and mean rarified phylogenetic diversity were both lower in Kamloops (K1 – K4) versus S. Okanagan, but neither were statistically significant. The linear regression analysis of site attributes also revealed no significant associations with these two diversity levels.



Conclusions

DNA barcoding facilitated these inventories, important for tracking long-term effects in these forests that will take decades to recover. We determined that species diversity was significantly lower where the beetle outbreak has already peaked and a large proportion of its variance was explained by disturbance severity. Macro-moths have a proven record as indicators of habitat integrity and their perceived depression in species richness may therefore be representative of the larger biotic system. The ecological consequences of increased pest outbreaks cannot be ignored when other natural and human-induced agents of disturbance are likewise increasing.

Reference:

Kurz, W. A. et al. 2008. Nature 452: 987–990.

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