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.

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.

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Kamloops (4 sites)
initial stages of outbreak
32 trapping events
230 specimens
206 species (~72% of inventory complete)

S. Okanagan (4 sites)
final stages of outbreak
32 trapping events
230 specimens
206 species (~72% of inventory complete)

Results – Genetic and Phylogenetic Diversity

The mean rarefied haplotype diversity and mean rarefied 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.

Results – Species Diversity

The mean rarefied 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 ($B=-0.402, p=0.001, R^2=0.853$).

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.

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. Macromoths 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: