Introduction

• The last deglaciation brought about rapid climate changes and megafaunal extinctions in North America, with habitat loss being one of many hypotheses for these extinctions (Gill et al. 2009).

• Byun et al. (2021) used novel methods and identified tree taxa indicative of wetlands to predict the location and cover of possible wet forest environments (WFEs) in the Great Lakes region during the Belling-Allerød warming period (14.6-12.8 ka).

• Giant beavers (Castoroides ohiensis Foster, 1838) depended on aquatic plants in wetland environments (Plint et al. 2019). Mastodonts (Mammut Americanum Kerr, 1792) were browsers that fed on leafy material in wet forests (Cocker et al. 2021). Stag-moose (Cervulus scotti Lydkekkers, 1898) also fed on leafy vegetation in marshes and peat bogs (Long & Yahneke 2011).

• This study investigates the relationship between the distributions of wetland-associated taxa and deglacial wetland habitats.

Methods

• Fossil data for the three species were downloaded from the Paleobiology Database (https://paleobiodb.org/) and extracted via an SQL query from the Neotoma Paleoecology Database (https://www.neotomadb.org/).

• Fossil data were filtered to include only those within the study area of Byun et al. (2021) and those temporally overlapping the Belling-Allerød.

• Fossil data were projected onto the WFEs projected by Byun et al. (2021) where each grid cell is 50x50 km².

• The number of localities that fell on projected WFEs and the number that occurred per grid cell distant from a projected WFE were counted. Counts were divided by the total number of localities per species to get proportion of overlap.

• Species distribution models (SDMs) predict species’ distributions based on environmental conditions they may have preferred and were created in R using MaxEnt and paleoclimate data from PaleoClim (http://www.paleoclim.org/) for the Belling-Allerød.

Results & Discussion

1. How much overlap is there between the species’ distributions and wetland cover?

• The fossil localities closely follow the projected WFEs of Byun et al. (2021) (Fig. 1), with overlap per species quantified in Table 1.

2. Are these species found in higher prevalence within hypothesized wetland areas than outside of them?

• Fig. 2 shows that not only are these fossils significantly overlapping with the projected areas, but very few are found with increasing distance from projected WFEs.

3. How much overlap is there between the distributions of the three species due to their habitat?

• SDMs show the highest probability of occurrence for the three species within a similar region, so they occurred in areas with similar climatic conditions, with temperature and precipitation seasonality being the most important predictors.

Table 1. Overlap counts between fossil localities and projected WFEs for each species.

<table>
<thead>
<tr>
<th>C. ohiensis</th>
<th>M. americanum</th>
<th>C. scotti</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falls within a projected WFE</td>
<td>40 specimens (67%)</td>
<td>286 specimens (75%)</td>
</tr>
<tr>
<td>Doesn’t fall within a projected WFE</td>
<td>20 specimens (33%)</td>
<td>94 specimens (25%)</td>
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Table 2. Probability of Occurrence

• Probability of Occurrence

• Probability of Occurrence

Figure 3. Species distribution models for the three species.

Limitations of the Study

• There is a lack of precise temporal data for the vertebrate fossil specimens, making it difficult to pinpoint them to the Belling-Allerød.

• Collector’s bias can be seen with more sampling in metropolitan areas and a large sample of mastodonts in present-day Michigan.

• SDMs have many biases when used for fossil data, including taphonomic biases and a lack of good-quality, meaningful environmental data as predictors (Varela et al. 2011).

Conclusion

The megafauna taxa considered here likely inhabited wetlands and thus provide an independent line of evidence for the extensive forested wetlands during the deglaciation. Byun et al. (2021) show that these extensive wetlands rapidly dried up just after the Belling-Allerød, suggesting an important change in habitat availability. I encourage future investigation into the role that the loss of wetlands might have played on the end-Pleistocene megafauna extinctions.

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References


Distribution of Pleistocene megafauna and deglacial wetlands

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