Influence of forest stand structure on productivity in comparison to the effect of species identity. A study based on global forest inventory data

Laura Zeller
Chair for Forest Growth and Yield Science
Technical University of Munich
Background

Mixed forests more productive\textsuperscript{1,2}

Structured forests more\textsuperscript{3}/less\textsuperscript{4} productive

global forest inventory data

Diversity vs. Structure -> productivity?


\textsuperscript{3}Bohn, F.J., Huth, A., 2017. The importance of forest structure to biodiversity-productivity relationships. The Royal Society.

Background

Stand productivity

Forest structure

Dependencies?

Tree species richness
Inventory plots US

~ 576’000 plots
Inventory plots Germany

~ 50’000 plots
Methods

• Generalized additive models
• Interaction terms
Methods

- Generalized additive model
- Interaction terms

\[ P_i = a + f_1(LON_i, LAT_i) + f_2(Temperature_i, Precipitation_i) \]

\[ + f_3(N.SP_i, CVd_i) + f_4(SDI_i, Dq_i) + \varepsilon_i \]

location \hspace{3cm} climate

diversity vs. structure \hspace{3cm} stand density vs. tree size
Results – USA

(a) Effect of location

(b) Effect of climate

(c) Effect of diversity and structure

(d) Effect of stand density and tree size

- negative effect on productivity
- positive effect on productivity
Results – Germany

(a) Effect of location

(b) Effect of climate

(c) Effect of diversity and structure

(d) Effect of stand density and tree size

- **negative effect on productivity**
- **positive effect on productivity**

Inaugural Global Forest Biodiversity Initiative Conference & GFBI-FECS Joint Symposium, September 6-9, 2017, Beijing, China
## Results - Summary

<table>
<thead>
<tr>
<th>Effect</th>
<th>Productivity</th>
<th>USA</th>
<th>GER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry and warm climate</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tree Species richness</td>
<td>+</td>
<td>(+)</td>
<td></td>
</tr>
<tr>
<td>Tree size heterogeneity</td>
<td>(-)</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Stand density</td>
<td>0</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

Inaugural Global Forest Biodiversity Initiative Conference & GFBI-FECS Joint Symposium, September 6-9, 2017, Beijing, China
# Results - Summary

<table>
<thead>
<tr>
<th>Effect</th>
<th>Structural heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>USA</td>
</tr>
<tr>
<td>Temperature</td>
<td>0</td>
</tr>
<tr>
<td>Precipitation</td>
<td>-</td>
</tr>
<tr>
<td>Stand density</td>
<td>+</td>
</tr>
<tr>
<td>Tree species richness</td>
<td>+</td>
</tr>
</tbody>
</table>
Interpretation

Stand productivity

Forest structure

Tree species richness

Competition for resources

Optimal combination?

Inaugural Global Forest Biodiversity Initiative Conference & GFBI-FECS Joint Symposium, September 6-9, 2017, Beijing, China
Conclusion

-> mixing, not too much structuring

-> productivity ↑
Outlook

• Other forest ecosystem functions?
• More joint analyses (structure vs. mixing)
• Study area

-> optimal combination of structure and mixing?
Thank you!