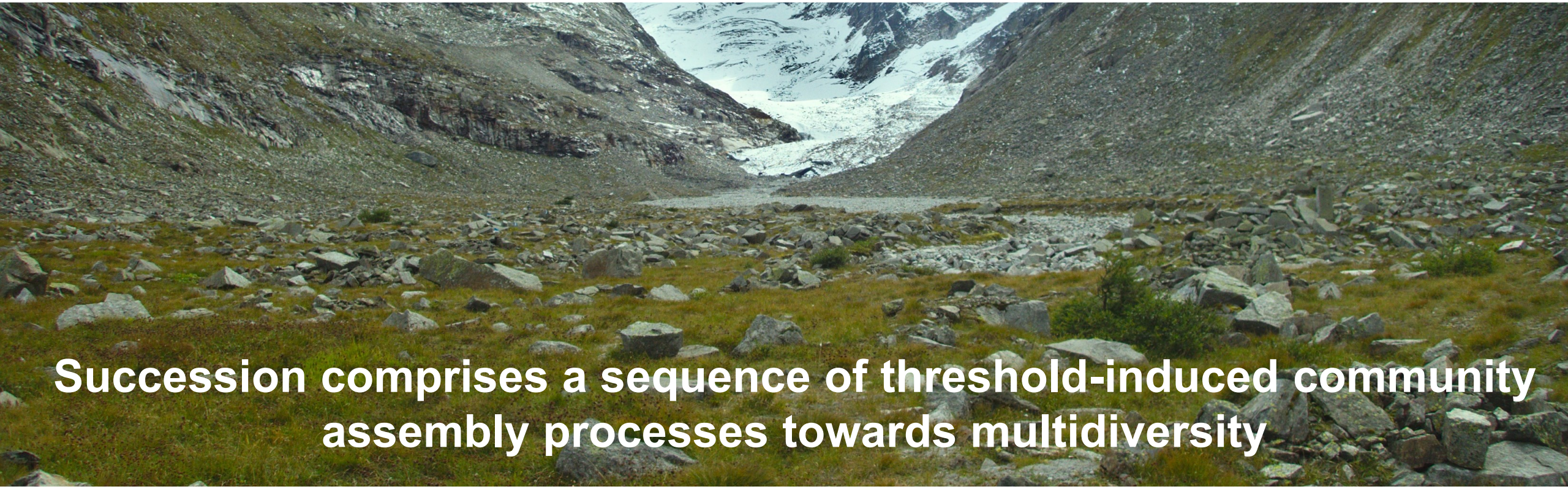
PARIS LODRON UNIVERSITÄT SALZBURG

Philipps Universität Marburg



Succession comprises a sequence of threshold-induced community assembly processes towards multidiversity

EVOECOPLANT

JUNKER LAB

@max_hanusch

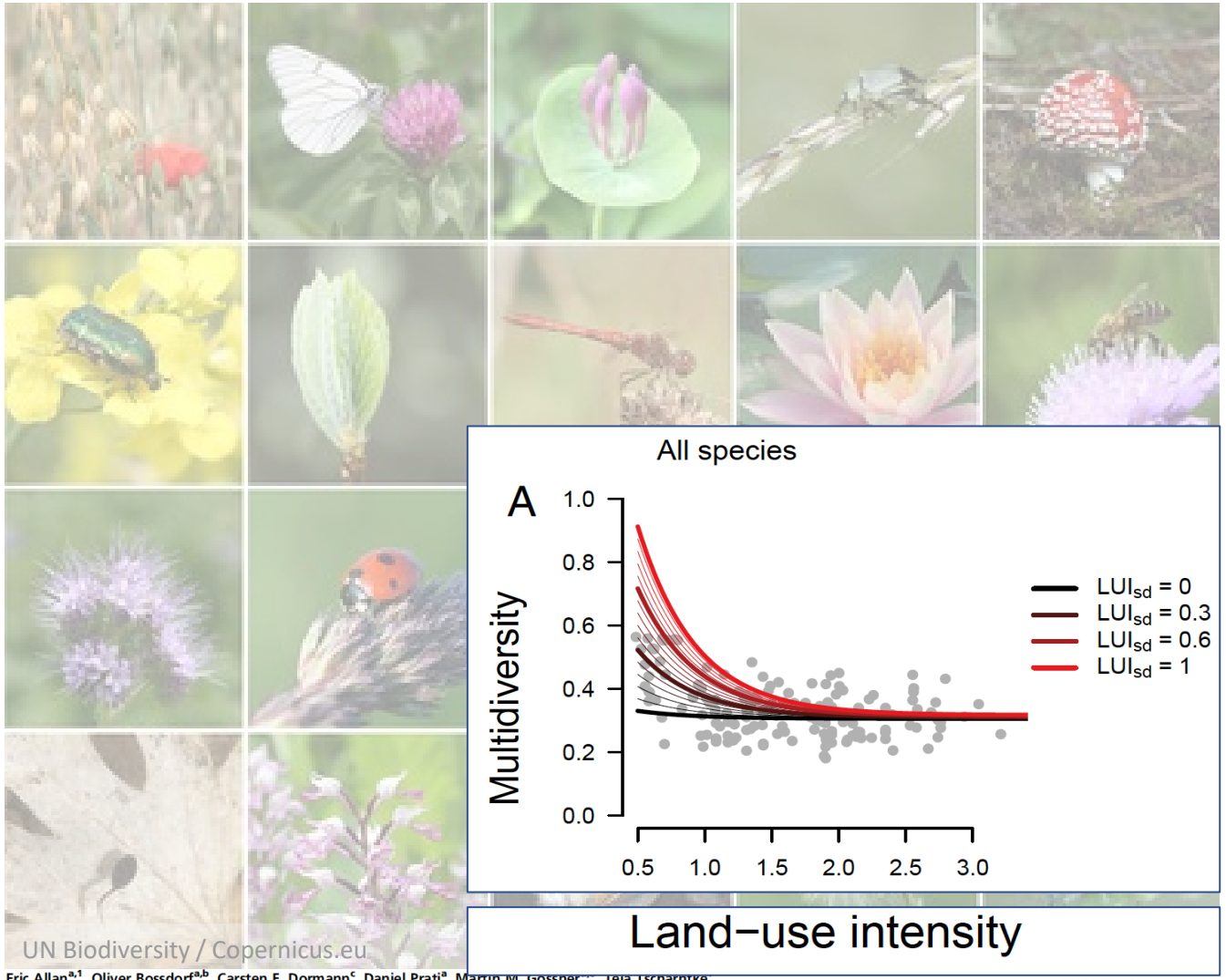
Maximilian Hanusch

What is Multi-diversity?

Diversities of taxa are not independent!

→ Multidiversity

What is Multi-diversity?



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Diversities of taxa are not independent!

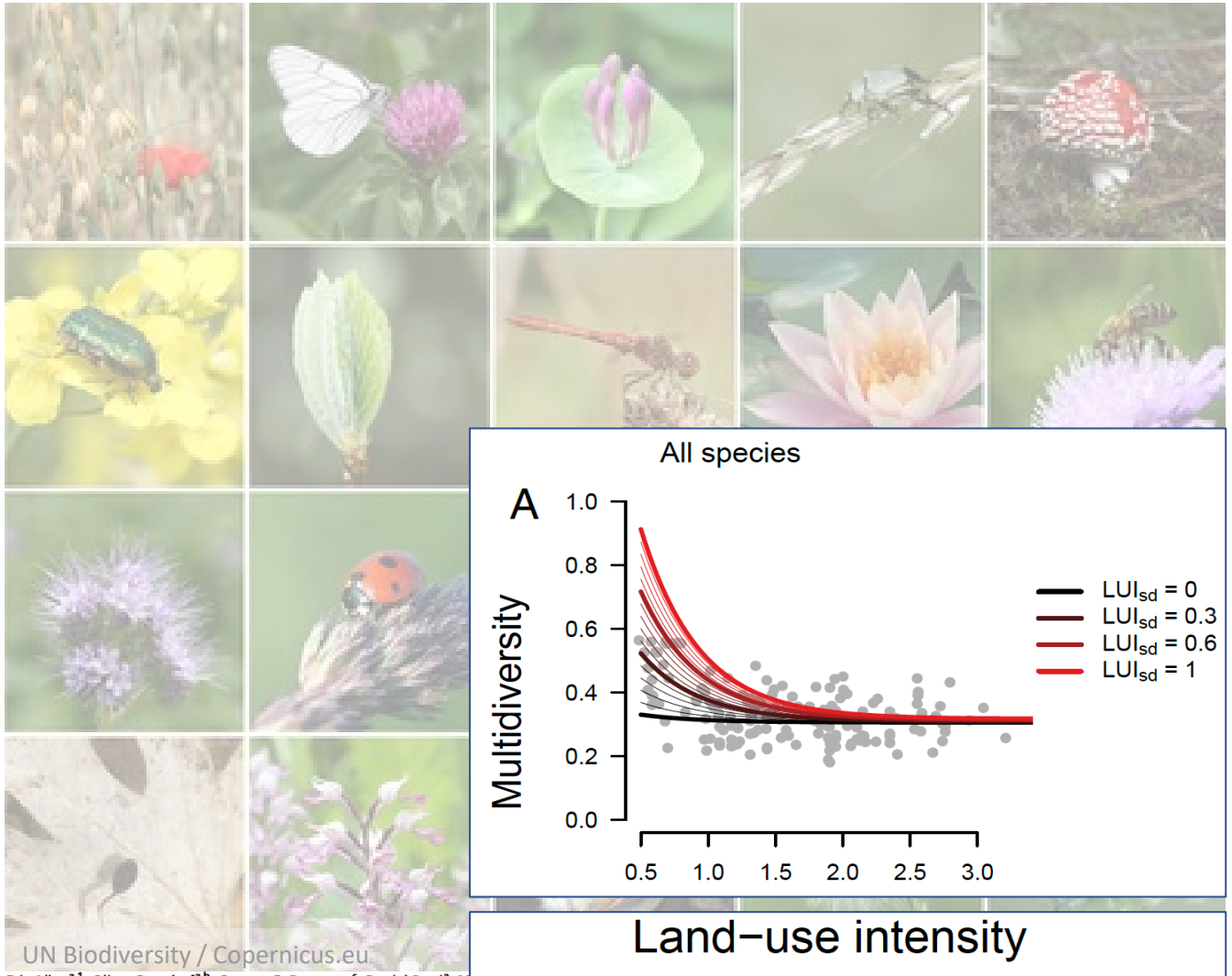
→ Multidiversity

We know how anthropogenic activities **reduce** multidiversity

Eric Allan[a,1], Oliver Bossdorf[a,b], Carsten F. Dormann[c], Daniel Prati[a], Martin M. Gossner[...], Teja Tscharntke[...], Nico Blüthgen[g], Michaela Bellach[h], Klaus Birkhofer[i], Steffen Boch[a,j], Stefan Böhm[j,k], Carmen Börschig[f], Antonis Chatzinotas[l], Sabina Christ[m], Rolf Daniel[n], Tim Diekötter[o], Christiane Fischer[n,p], Thomas Friedl[q], Karin Christine Hallmann[q], Ladislav Hodac[q], Norbert Hölzel[r], Kirsten Jung[k], Alexandra Maria Klein[s], Valentin H. Klau[...] Till Kleinebecker[r], Jochen Krauss[h], Markus Lange[d,t], E. Kathryn Morris[u,v], Jörg Müller[w], Heiko Nacke[n], Esther P[...] Matthias C. Rillig[v,x], Christoph Rothenwöhrer[f], Peter Schall[y], Christoph Scherber[f], Waltraud Schulze[z,aa], Stephanie A. Socher[a], Juliane Steckel[h], Ingolf Steffan-Dewenter[h], Manfred Türke[d,e], Christiane N. Weiner[h], Michael Werner[h], Catrin Westphal[f], Volkmar Wolters[o], Tesfaye Wubet[bb,cc], Sonja Gockel[e], Martin Gorke[p], Andreas Hemp[dd], Swen C. Renner[k,ee], Ingo Schöning[t], Simone Pfeiffer[p], Birgitta König-Ries[ff], François Buscot[bl] Karl Eduard Linsenmair[h], Ernst-Detlef Schulze[t], Wolfgang W. Weisser[d,e], and Markus Fischer[a,p,w]

biodiversity exploratories
functional biodiversity research

What is Multi-diversity?



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Little knowledge on the emergence of multidiversity in natural ecosystems!

Eric Allan[a,1], Oliver Bossdorf[a,b], Carsten F. Dormann[c], Daniel Prati[a], Martin M. Gossner[d], Teja Tscharntke[e], Nico Blüthgen[g], Michaela Bellach[h], Klaus Birkhofer[i], Steffen Boch[a,j], Stefan Böhm[j,k], Carmen Börschig[f], Antonis Chatzinotas[l], Sabina Christ[m], Rolf Daniel[n], Tim Diekötter[o], Christiane Fischer[n,p], Thomas Friedl[q], Karin Christine Hallmann[q], Ladislav Hodac[q], Norbert Hölzel[r], Kirsten Jung[k], Alexandra Maria Klein[s], Valentin H. Klau Till Kleinebecker[r], Jochen Krauss[h], Markus Lange[d,t], E. Kathryn Morris[u,v], Jörg Müller[w], Heiko Nacke[n], Esther P Matthias C. Rillig[v,x], Christoph Rothenwöhrer[f], Peter Schall[y], Christoph Scherber[f], Waltraud Schulze[z,aa], Stephanie A. Socher[a], Juliane Steckel[h], Ingolf Steffan-Dewenter[h], Manfred Türke[d,e], Christiane N. Weiner[h], Michael Werner[h], Catrin Westphal[f], Volkmar Wolters[o], Tesfaye Wubet[bb,cc], Sonja Gockel[e], Martin Gorke[p], Andreas Hemp[dd], Swen C. Renner[k,ee], Ingo Schöning[t], Simone Pfeiffer[p], Birgitta König-Ries[ff], François Buscot[bl] Karl Eduard Linsenmair[h], Ernst-Detlef Schulze[t], Wolfgang W. Weisser[d,e], and Markus Fischer[a,p,w]

biodiversity exploratories
functional biodiversity research

Multi-diversity

Alpine successions are ideal study systems to study the emergence of multidiversity and ecosystem complexity!

→ **Ödenwinkel** research platform

Junker, R. R. et. Al. *Web Ecol.*, 20: 95–106.

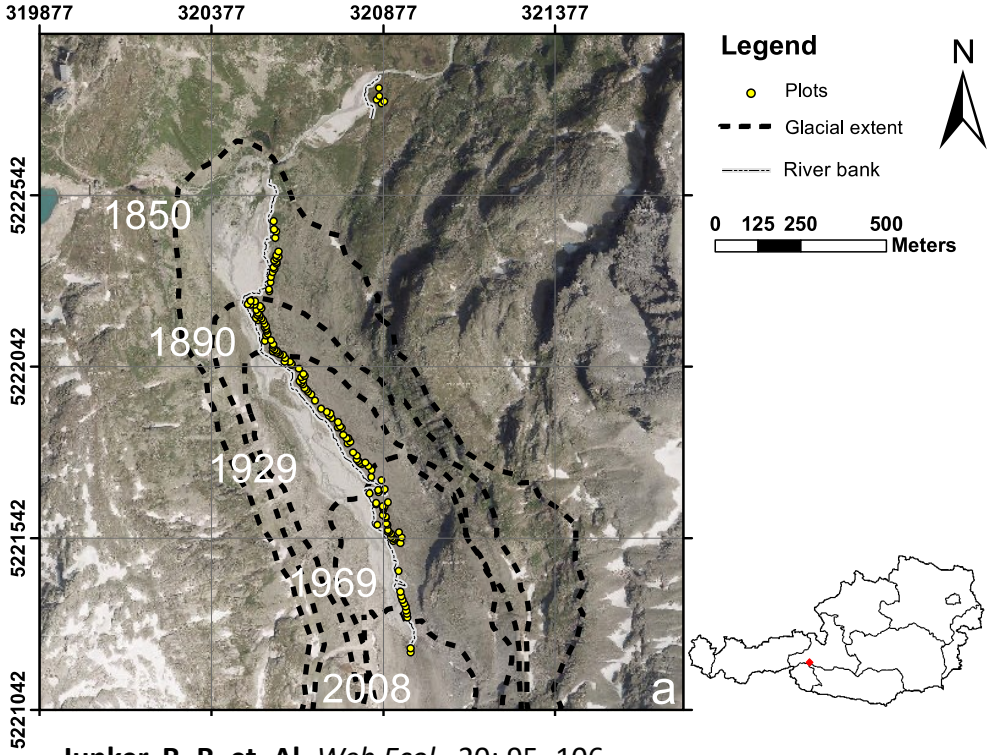
Robert R. Junker

Victoria Ruiz

Xie He

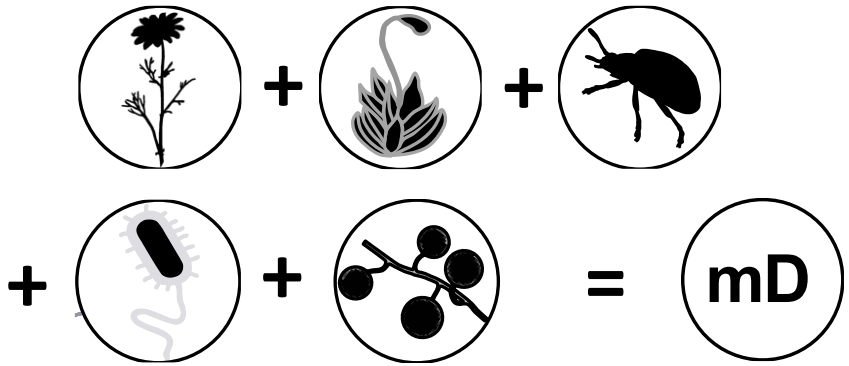
FWF

Der Wissenschaftsfonds.



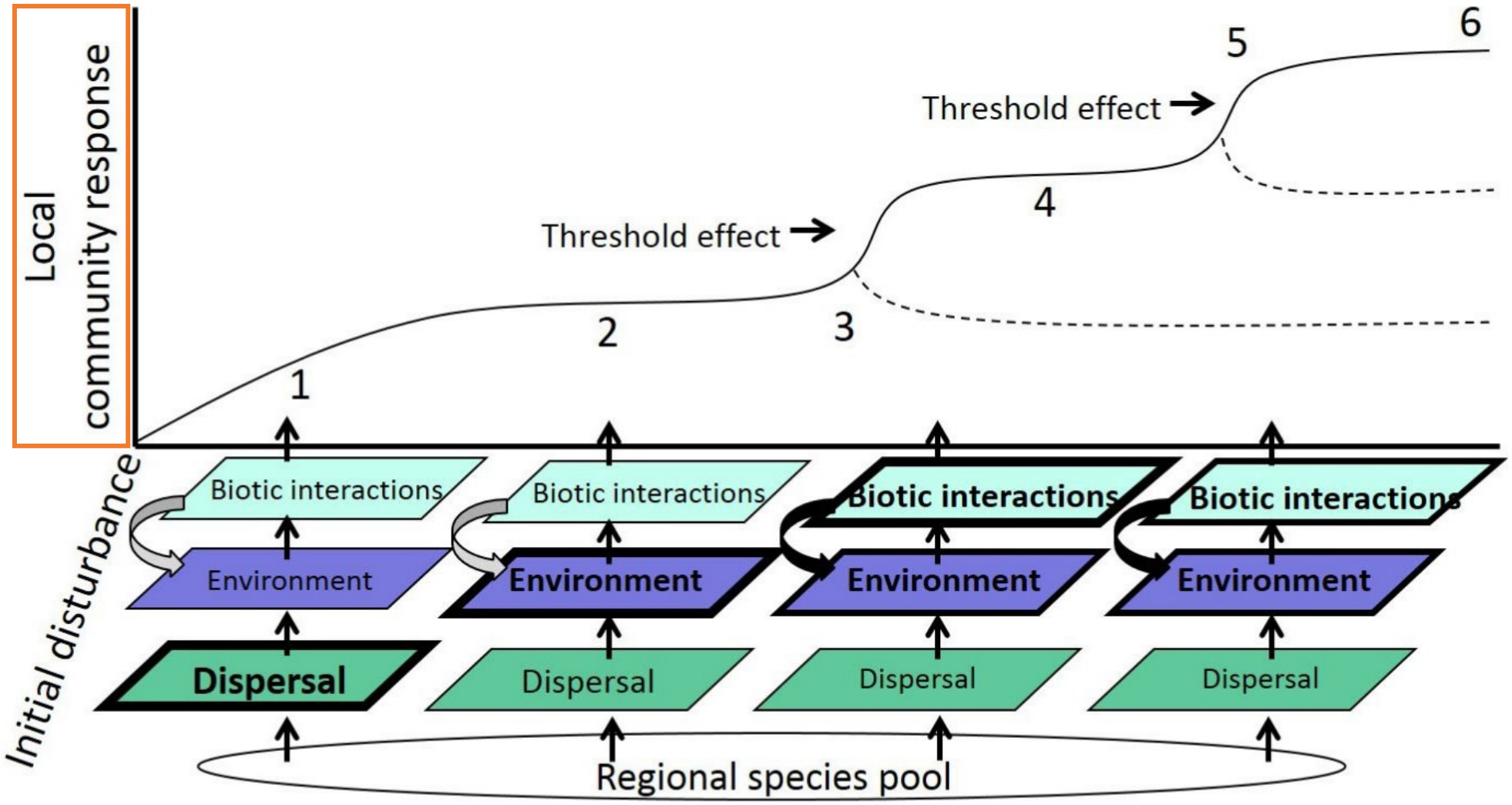
Junker, R. R. et. Al. *Web Ecol.*, 20: 95–106.

Multidiversity @ Ödenwinkel



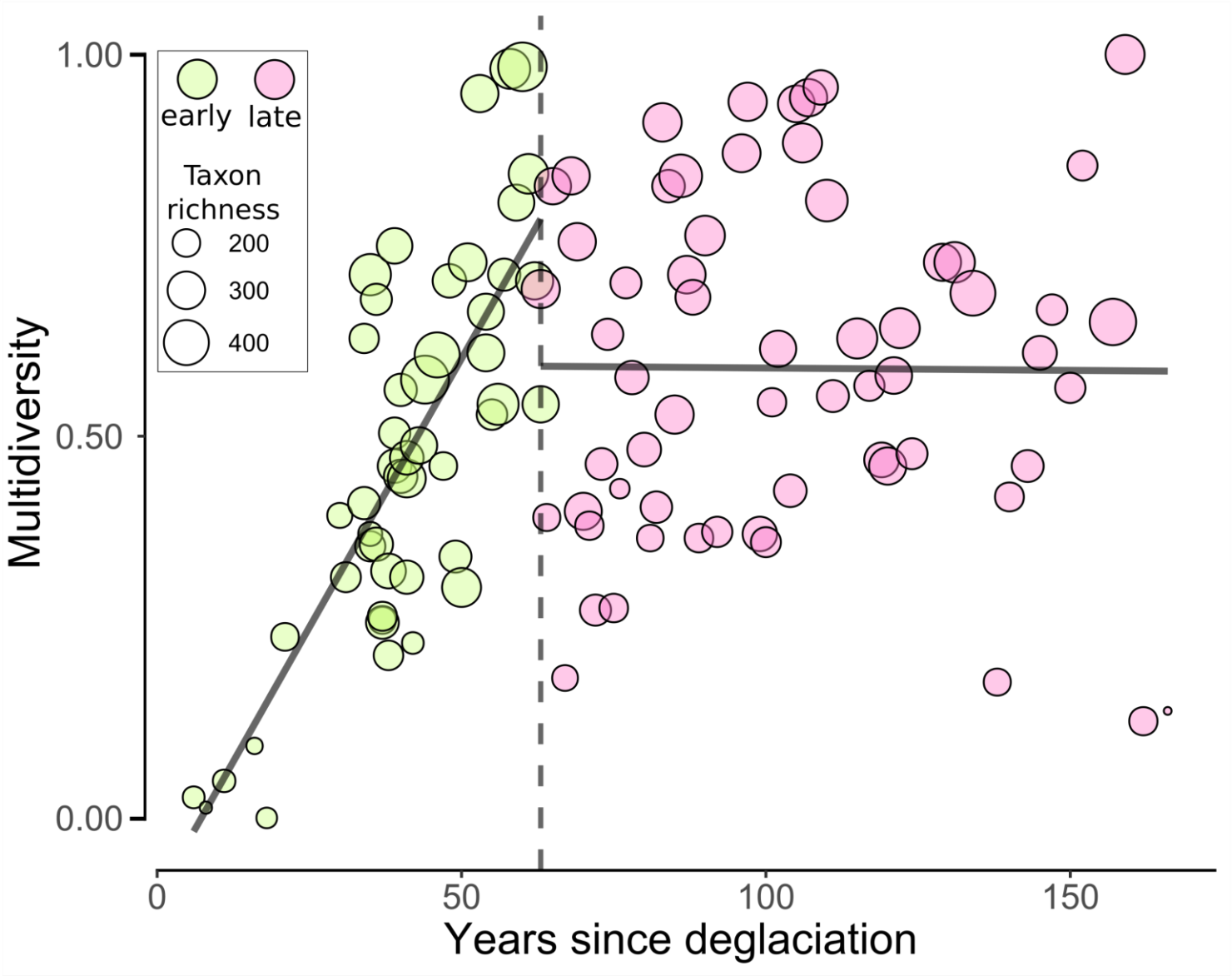
Threshold in succesion

Multidiversity



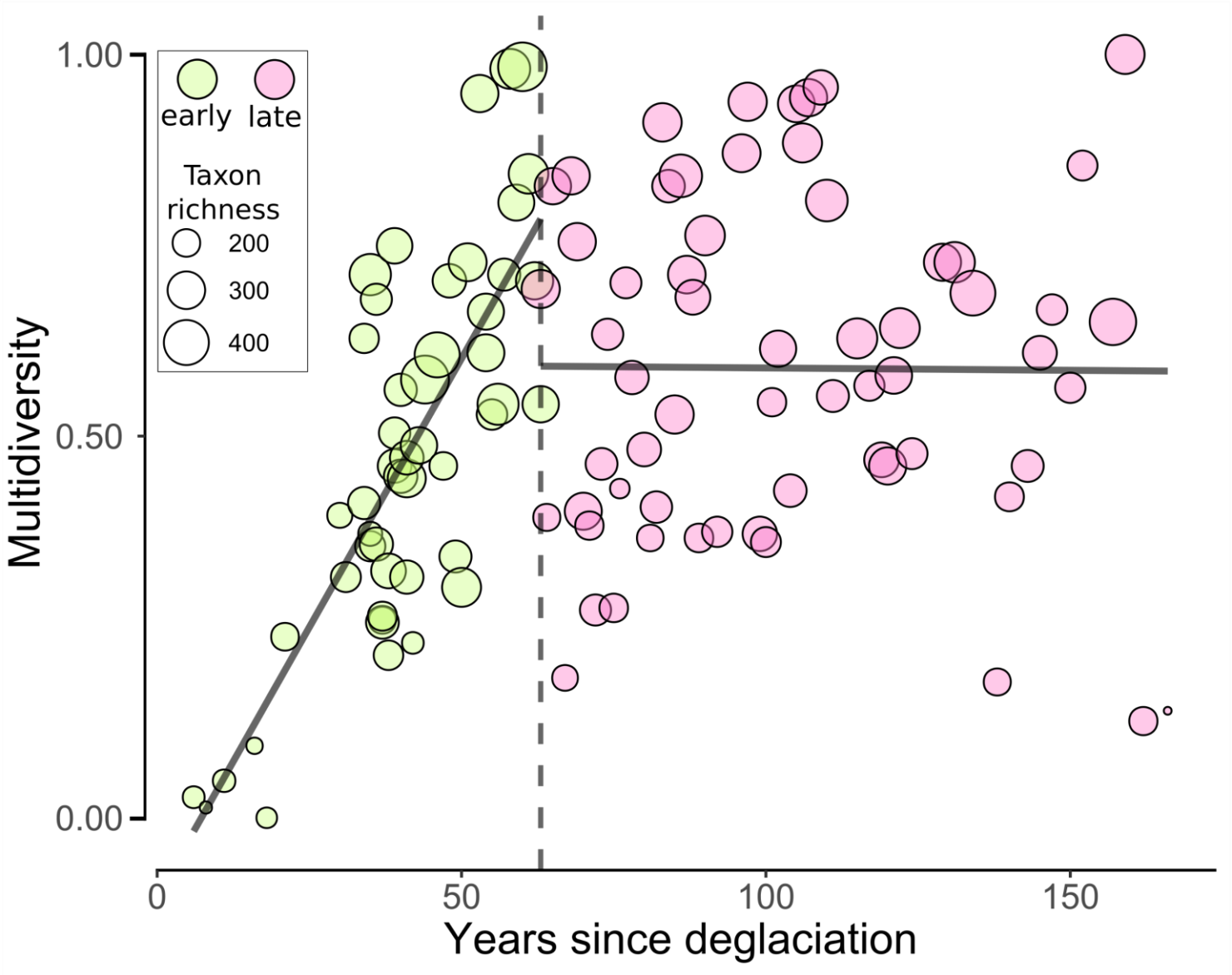
Chang, C., & HilleRisLambers, J. 2016. Integrating succession and community assembly *F1000Research*, 5: 1–10.

Breaking point



Hanusch *et al.* (submitted)

Breaking point

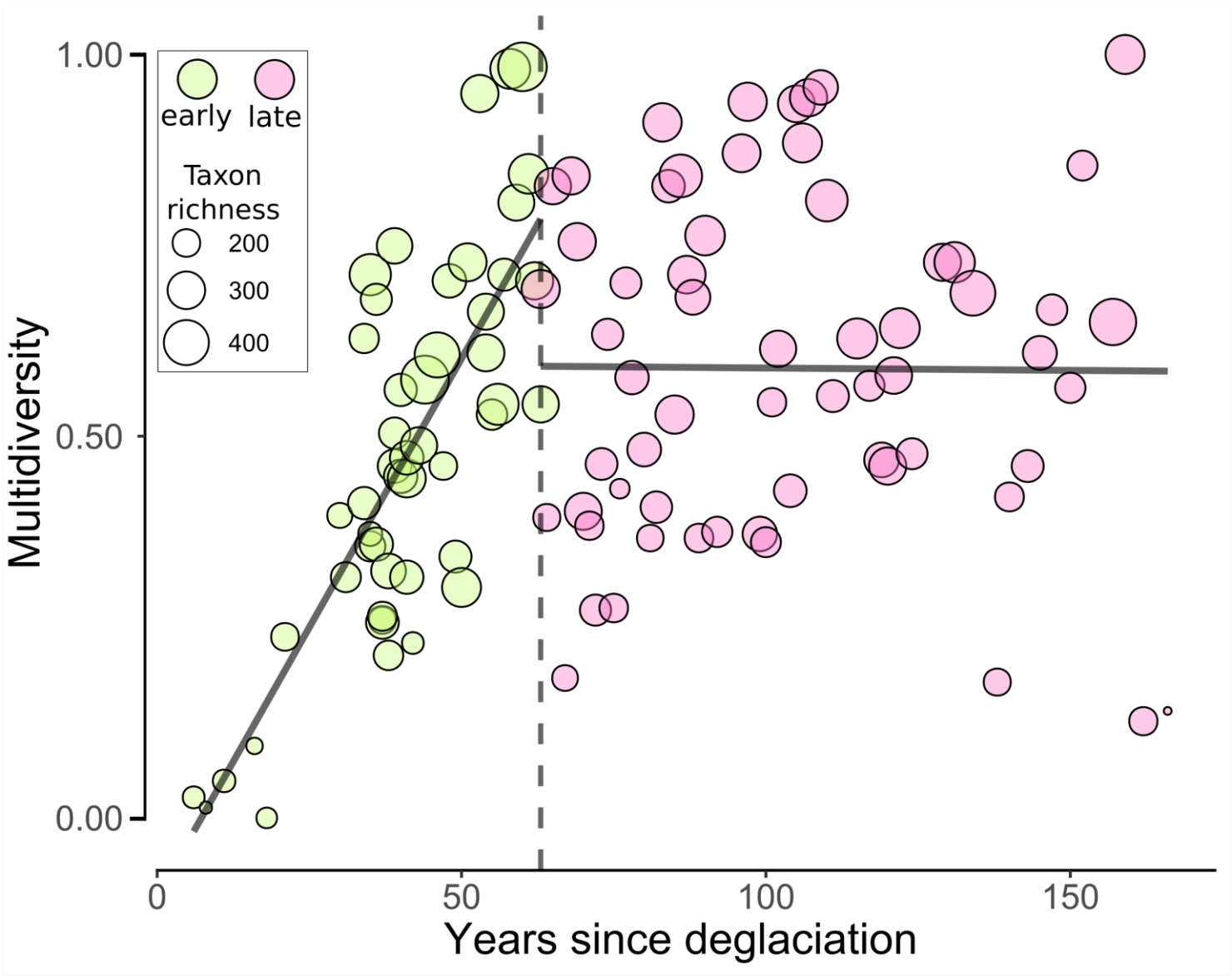


Hanusch *et al.* (submitted)

Groffman (2006):

Ecological threshold represent a change in the association of the responses in ecological systems to natural processes.

Breaking point



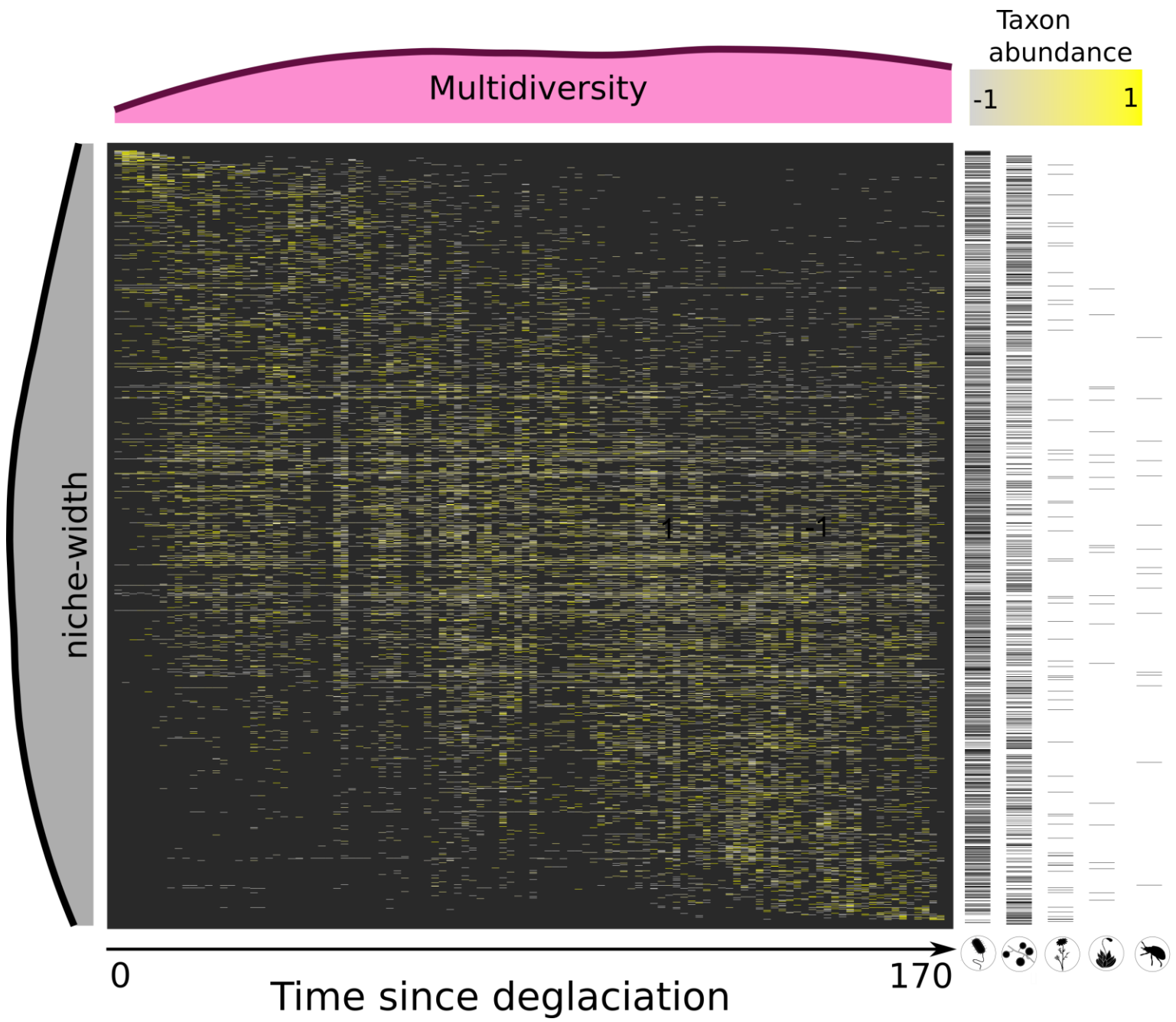
Groffman (2006):

Ecological threshold represent a change in the association of the responses in ecological systems to natural processes.

Threshold passed after about 60 years of succession

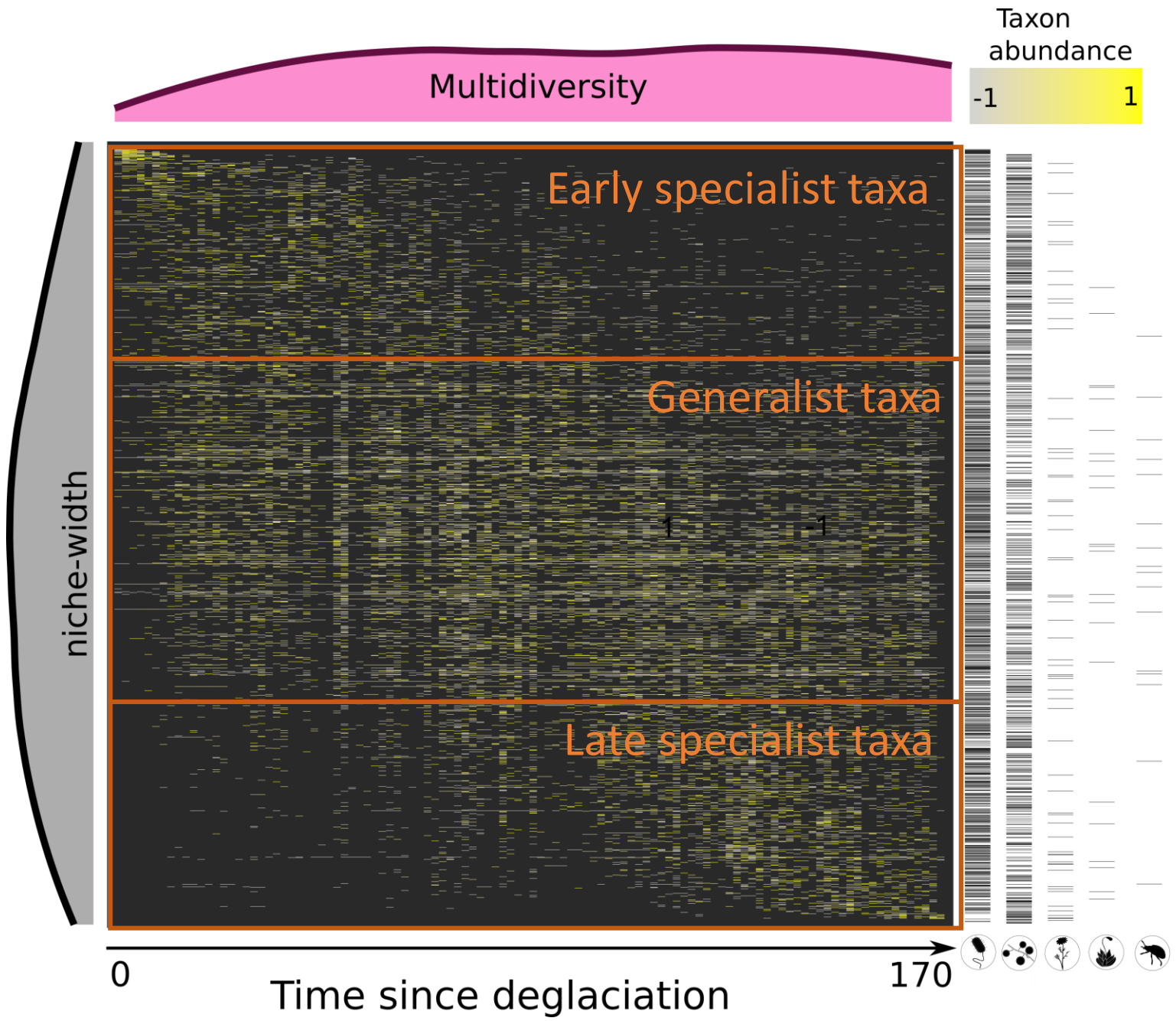
Hanusch *et al.* (submitted)

Community



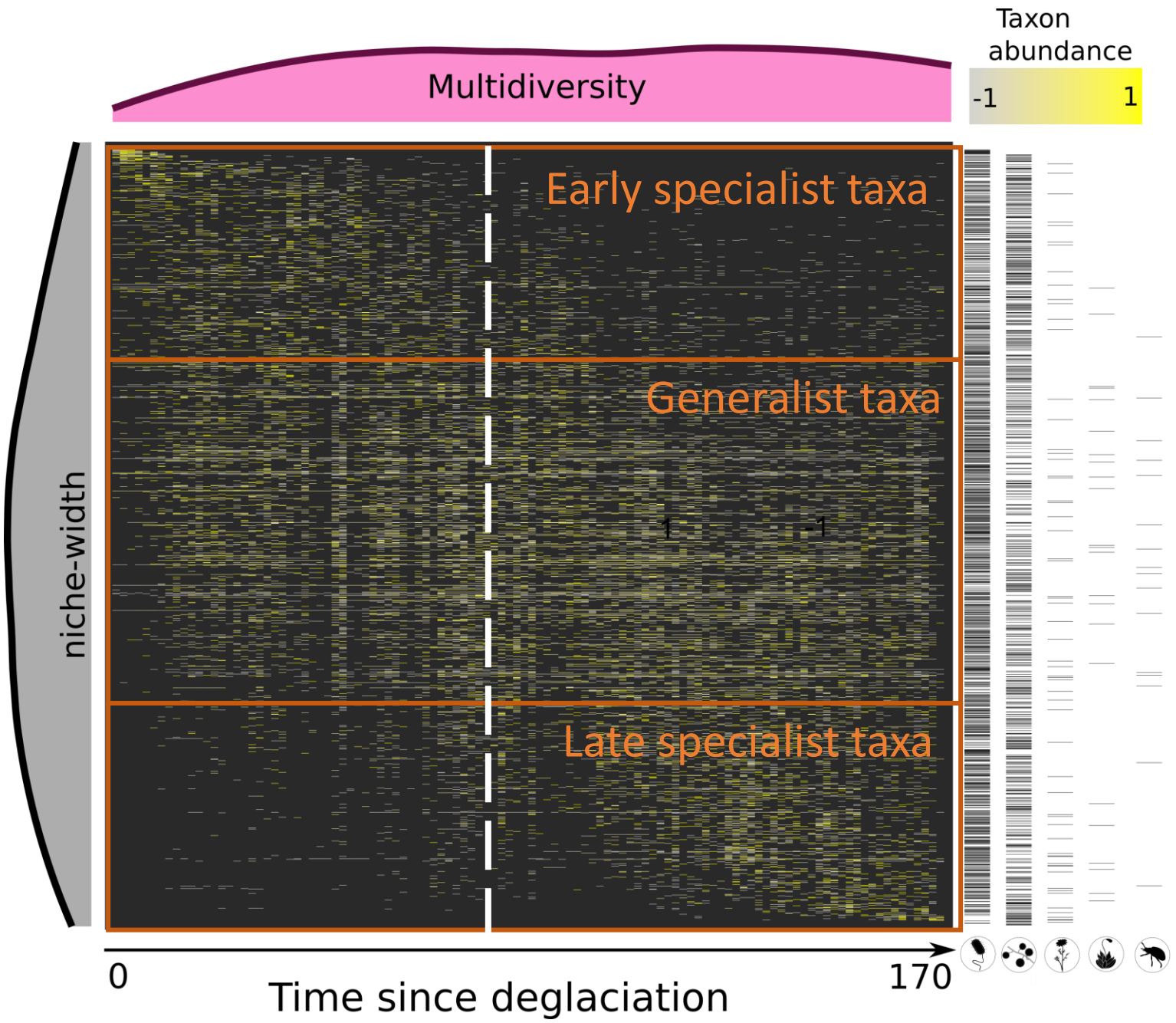
Hanusch *et al.* (submitted)

Community



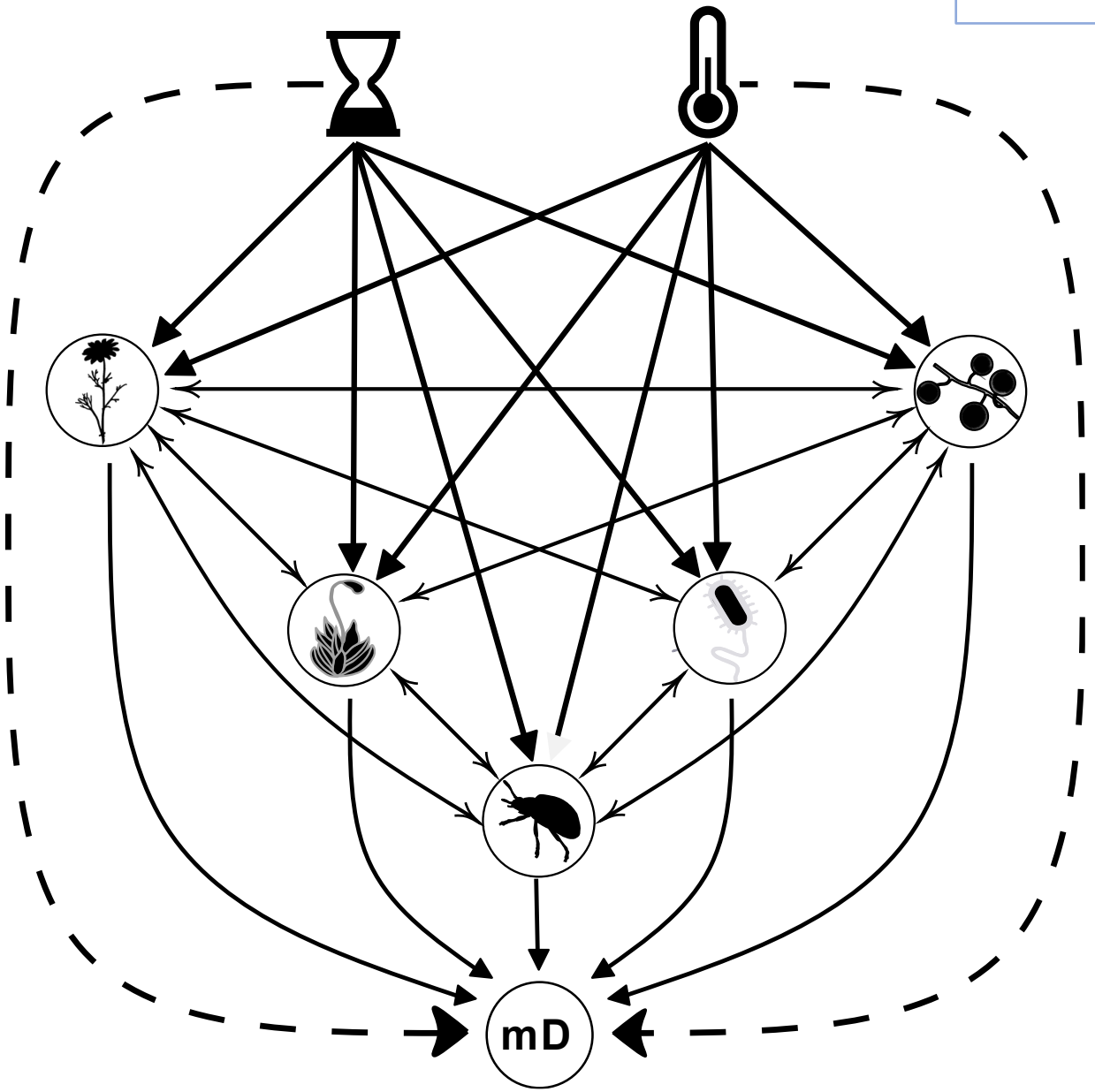
Hanusch *et al.* (submitted)

Community

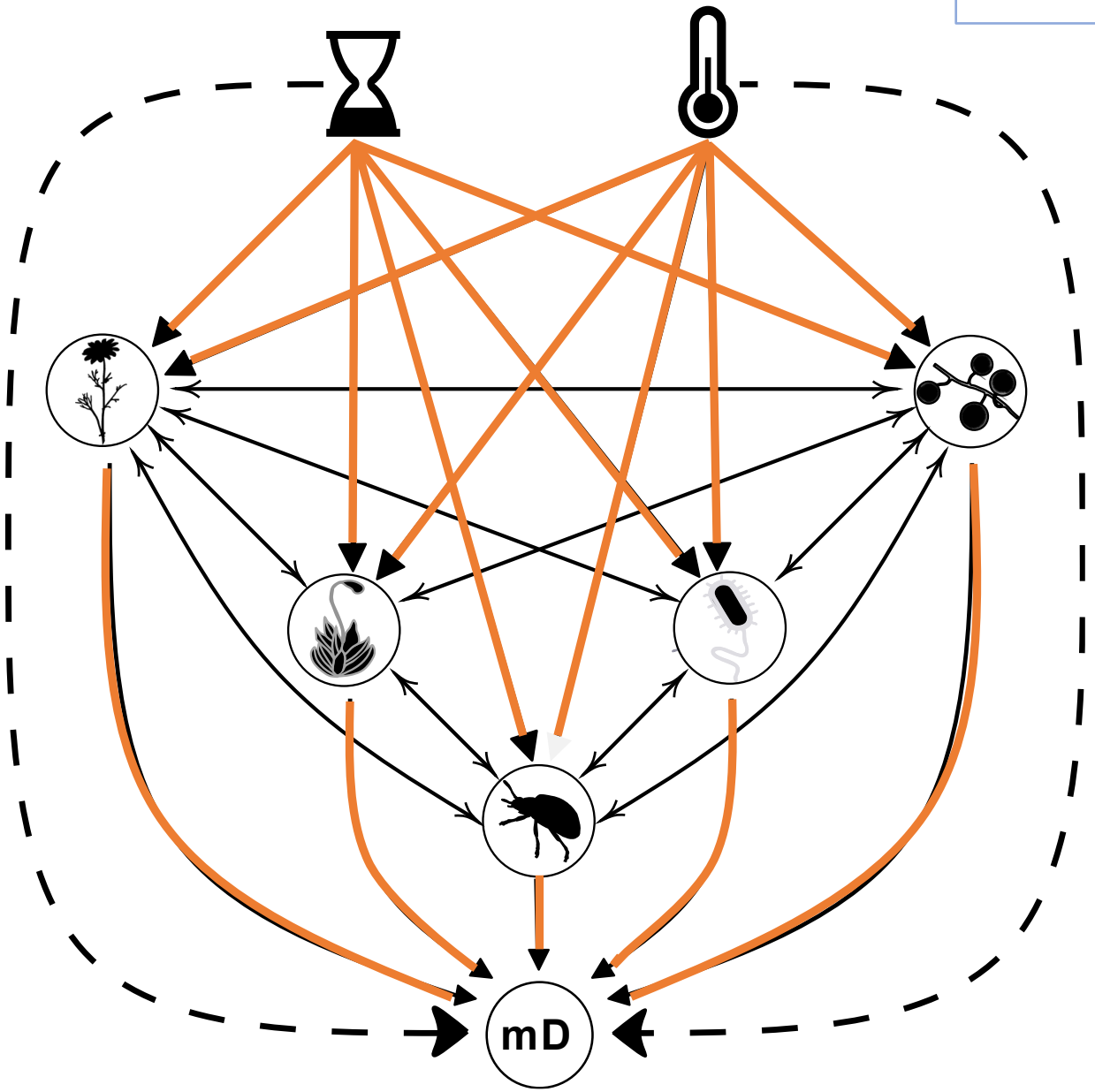


Hanusch *et al.* (submitted)

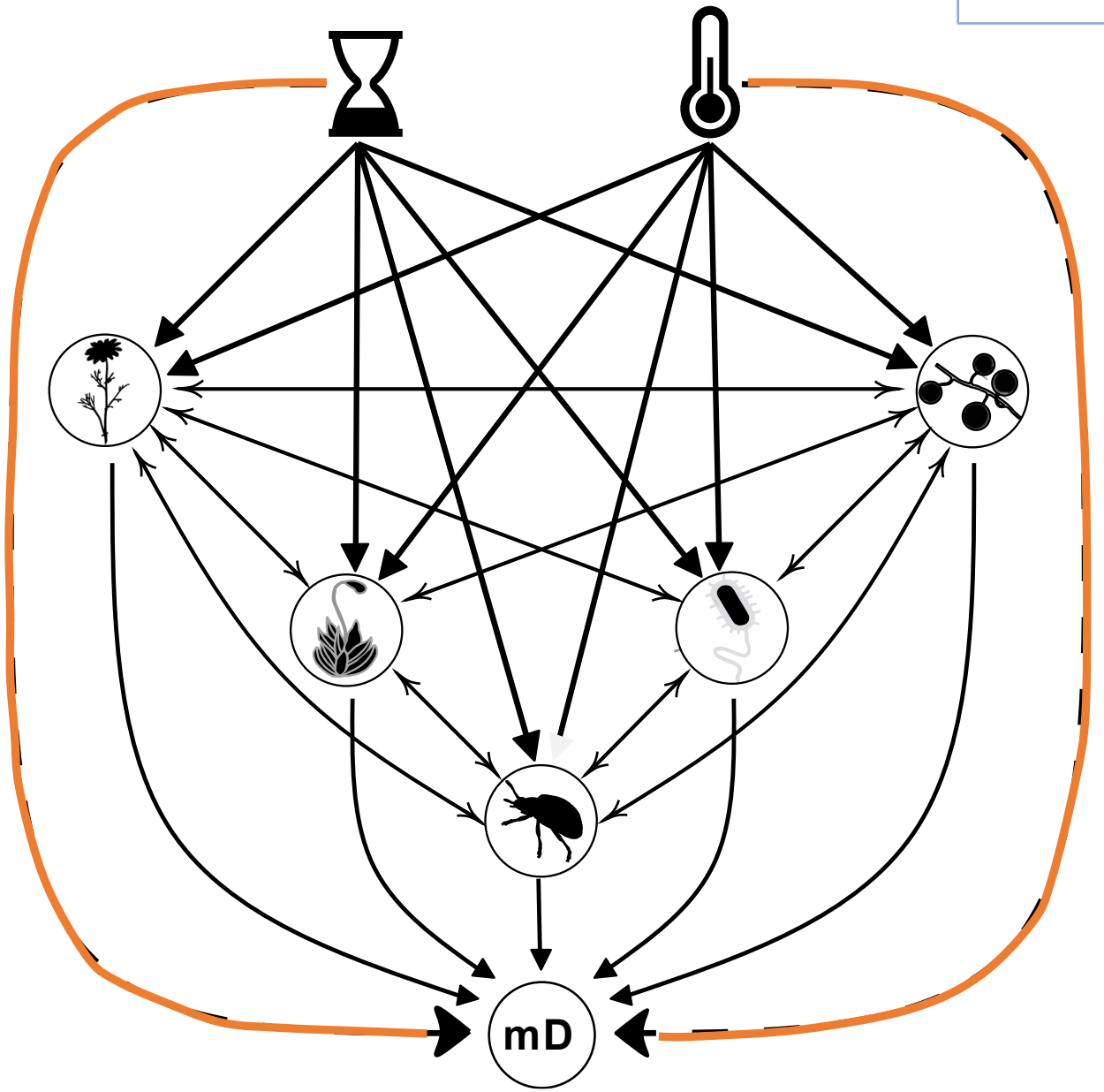
Path analysis



Path analysis

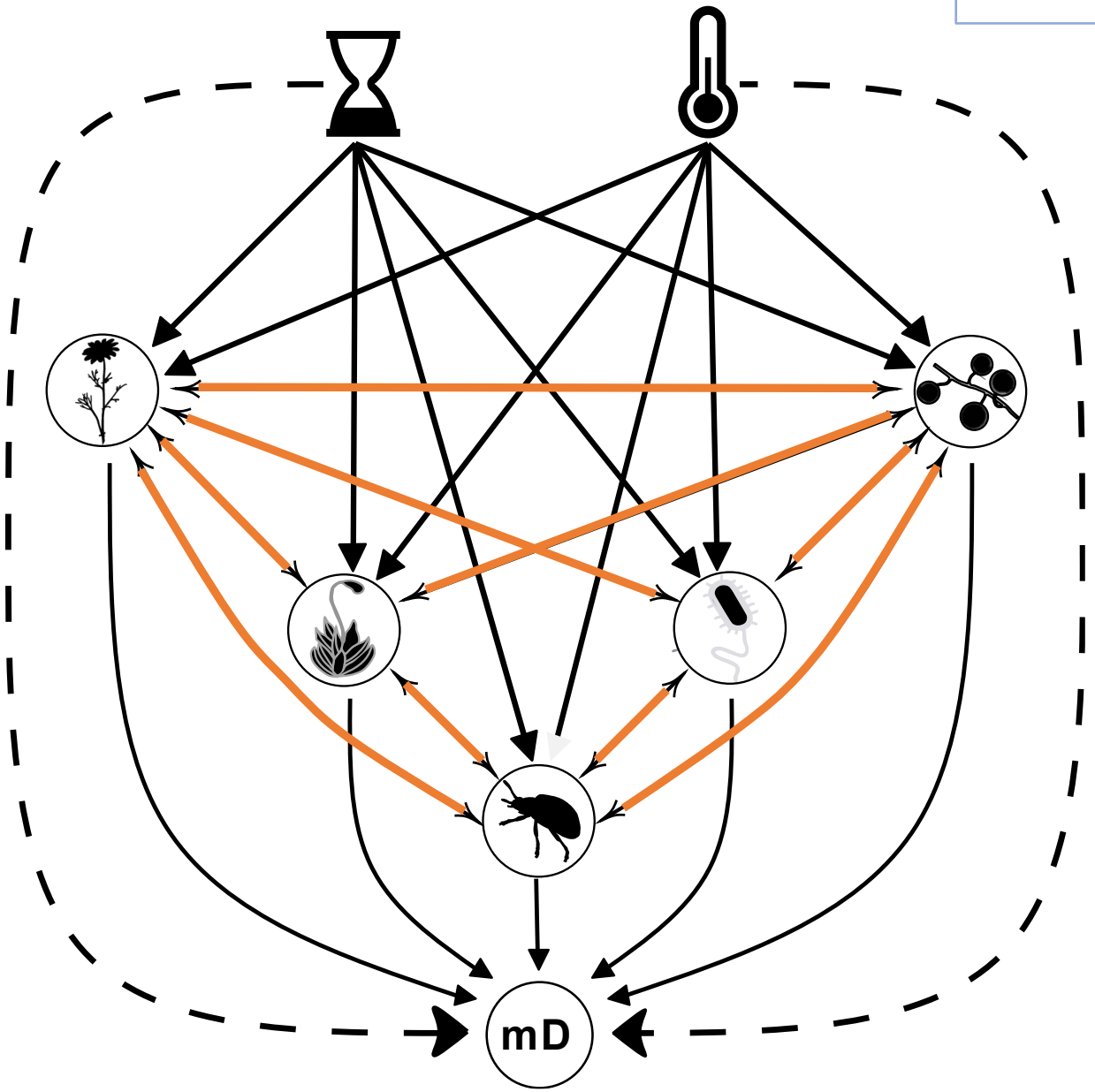


Path analysis

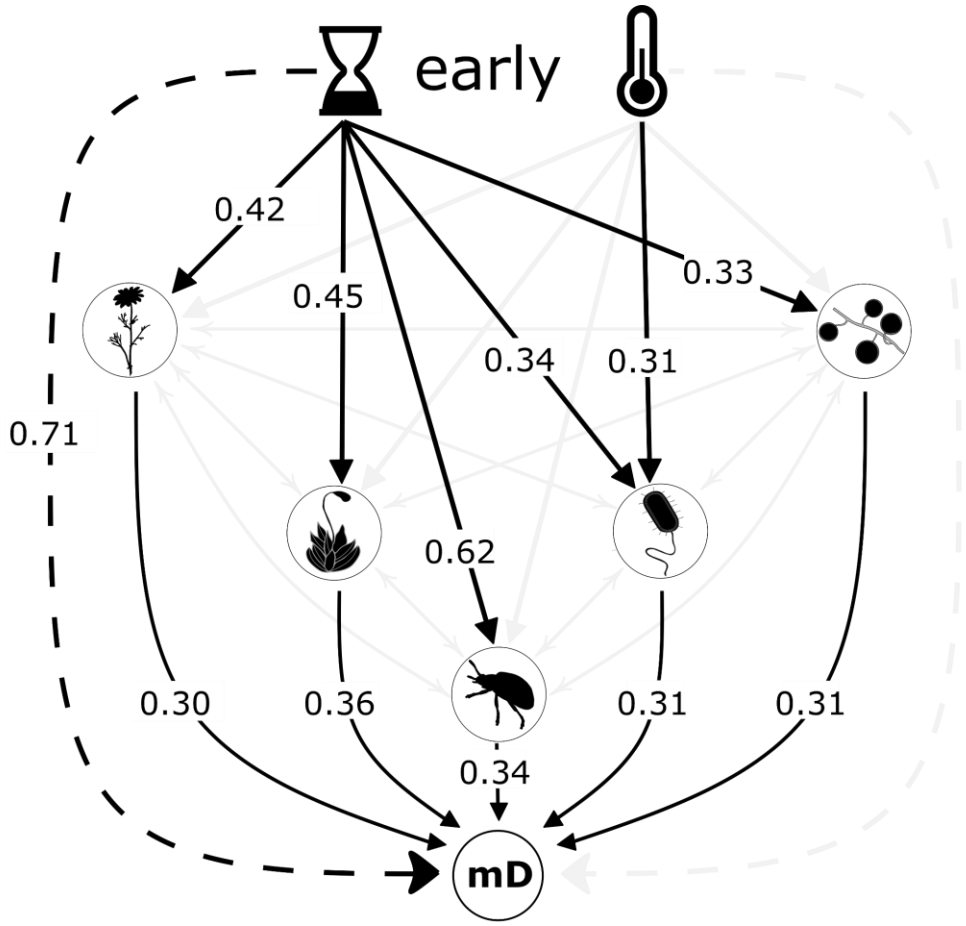


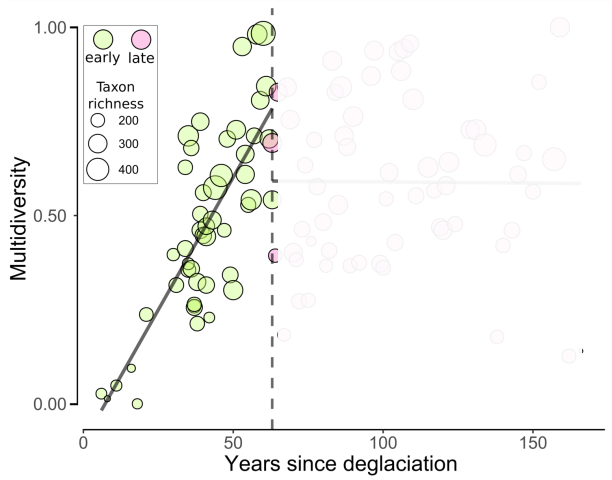
Path analysis

Biotic interactions can be expressed as community covariances
(Houlahan & al., 2007)



Path analysis



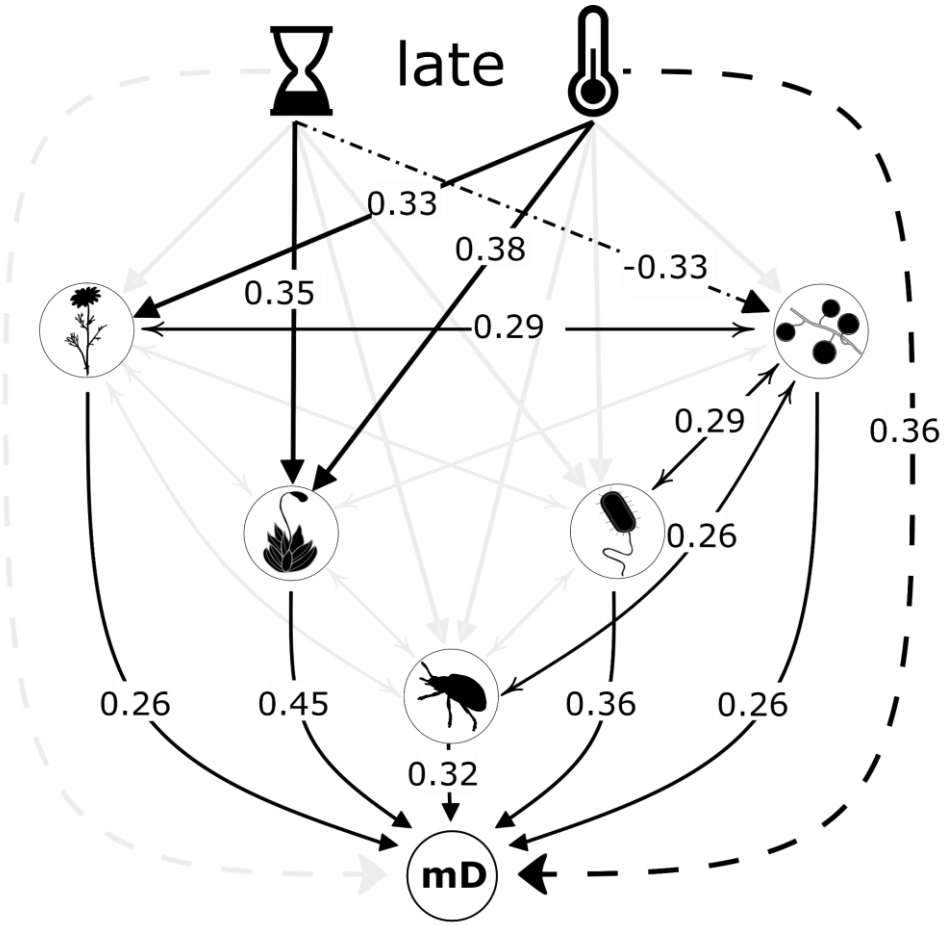


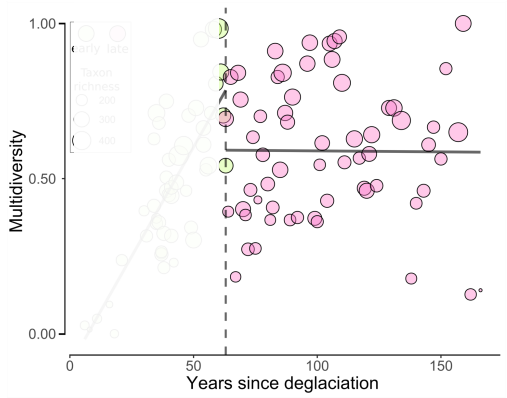
time since deglaciation
mean soil temperature
vascular plant diversity
bryophyte diversity
invertebrate diversity
bacterial diversity
fungal diversity
multi-diversity
mD

positive significant
negative significant
non-significant
direct effect
residual covariance
indirect effect

Hanusch *et al.* (submitted)

Path analysis

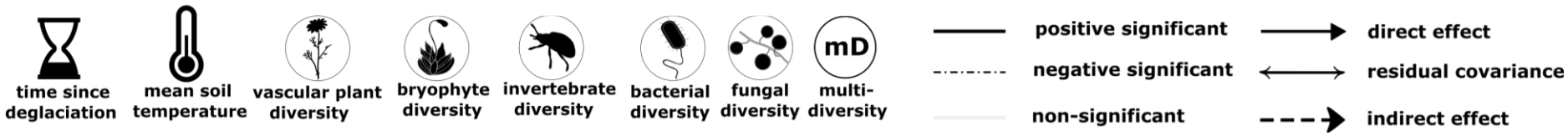




Strong interdependencies

-> aggregated co-occurrence patterns

-> low beta-diversity.



Hanusch *et al.* (submitted)

Multi-beta-diversity

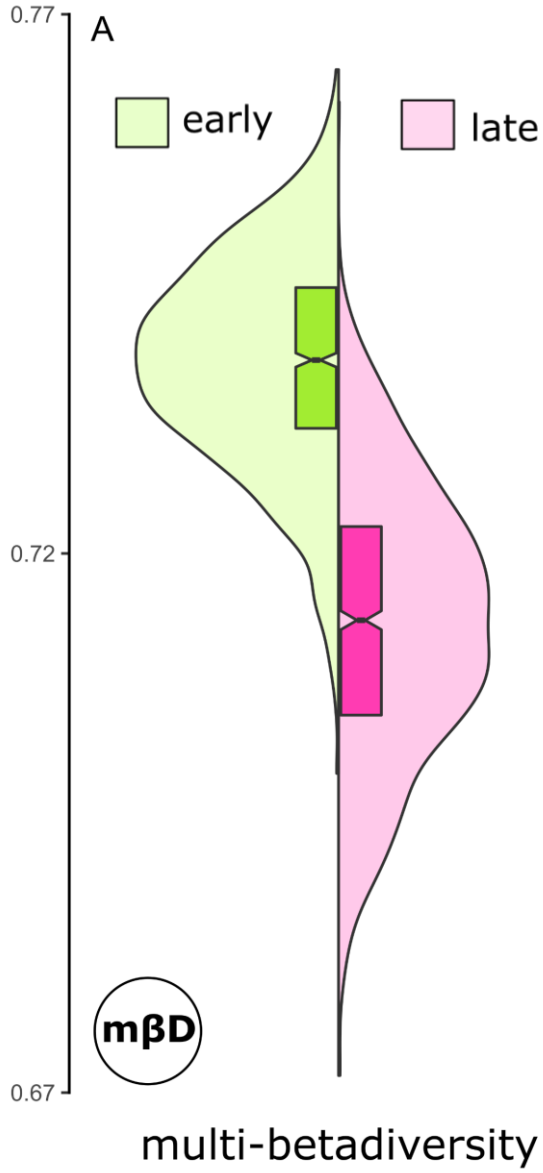
Bray-Curtis dissimilarity

→ Mean BC-dis

↕ Bootstrapping 1000x

mβD

Multi-beta-diversity



Strong interdependencies

-> aggregated co-occurrence patterns

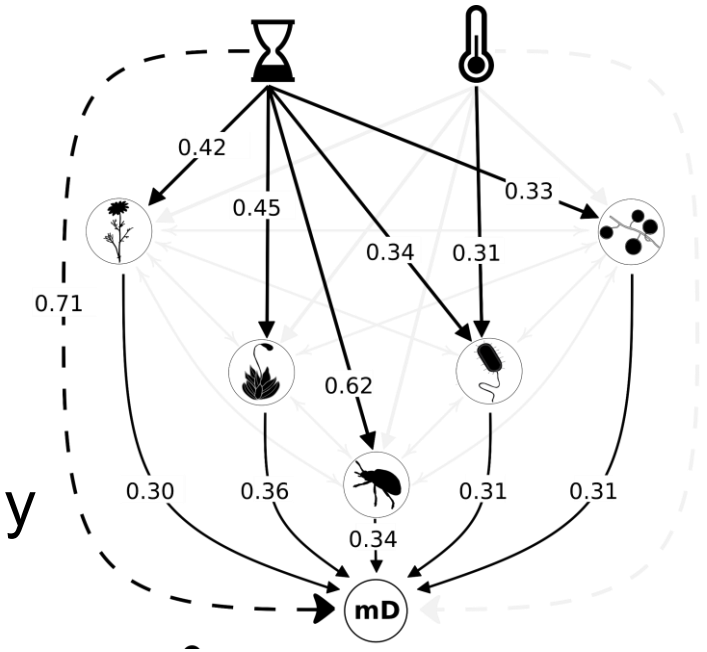
-> low beta-diversity.

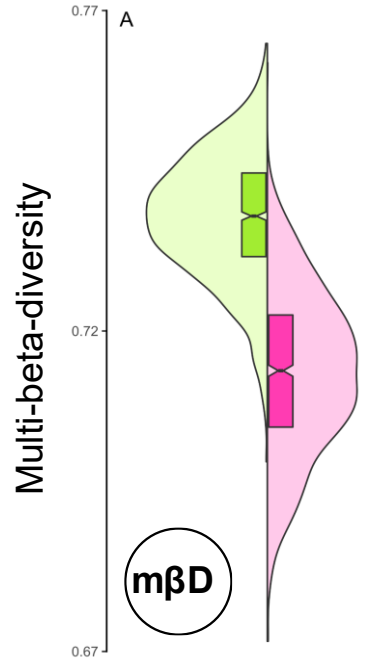
Hanusch *et al.* (submitted)

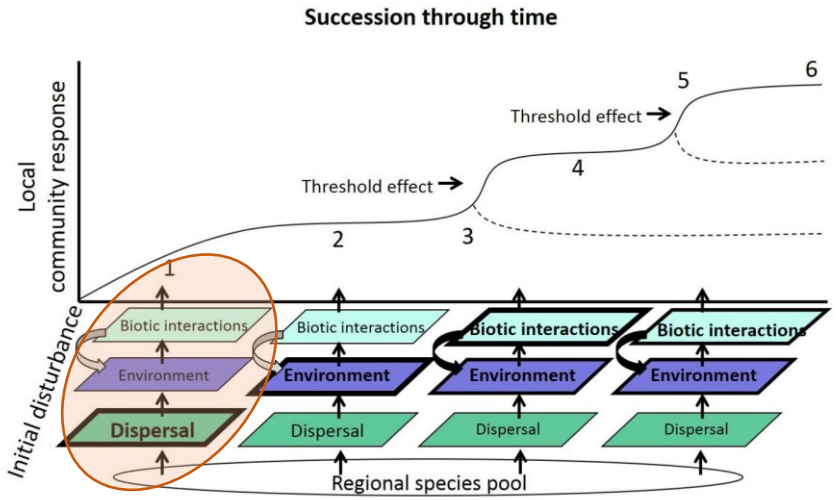
Conclusion

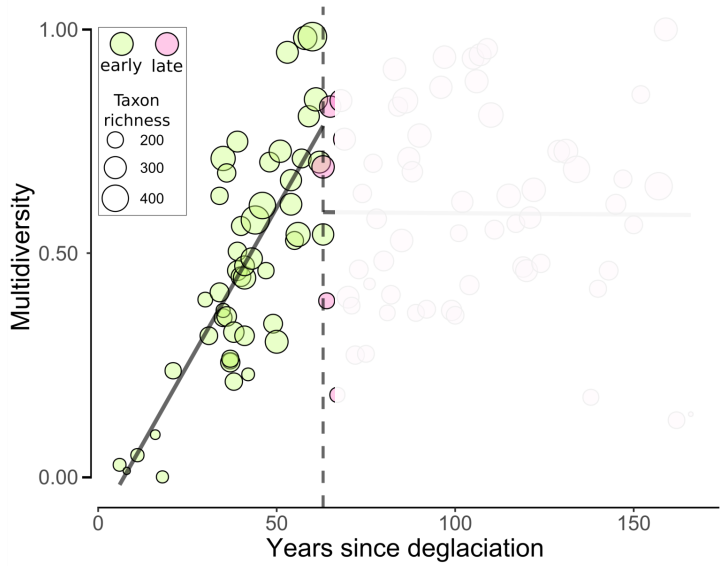
Early succession:

- Time since deglaciation is the main driver of multidiversity
- Free niches allow species to (randomly) enter the system.
- Dispersal driven, stochastic assembly

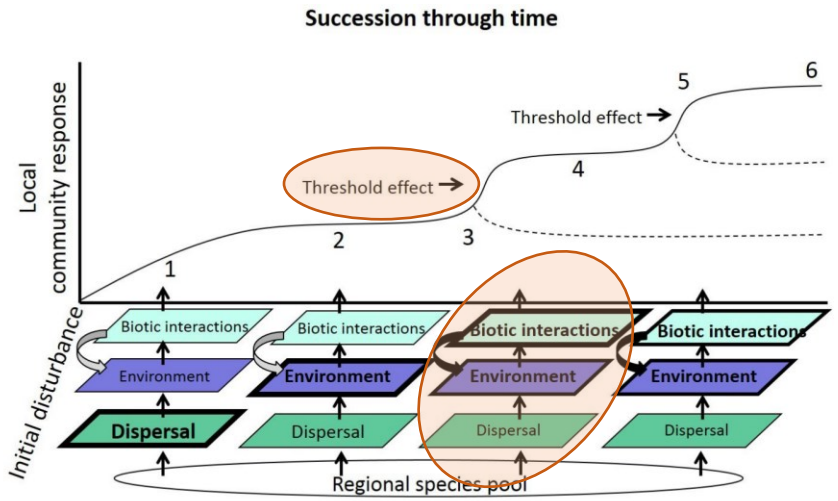


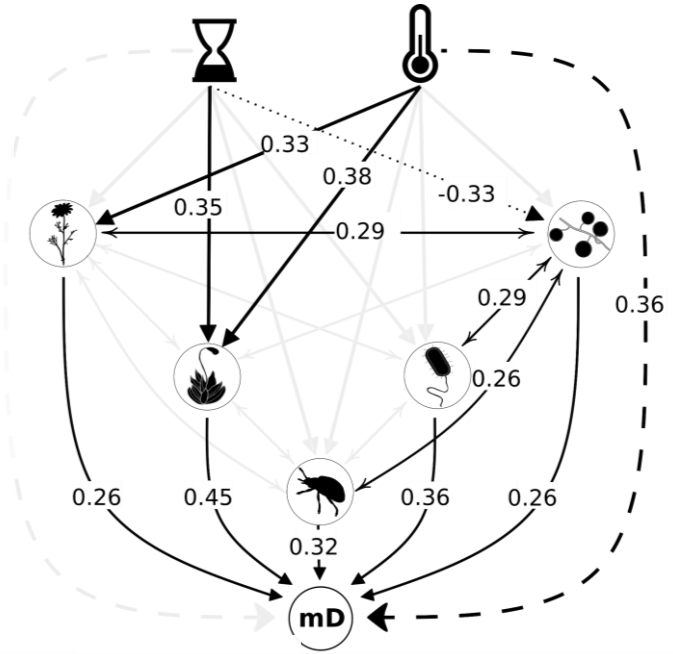


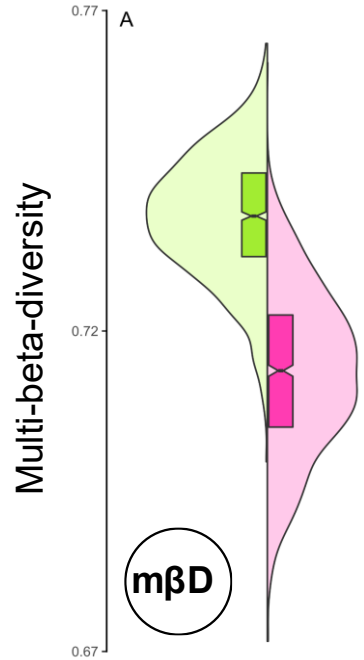




Conclusion

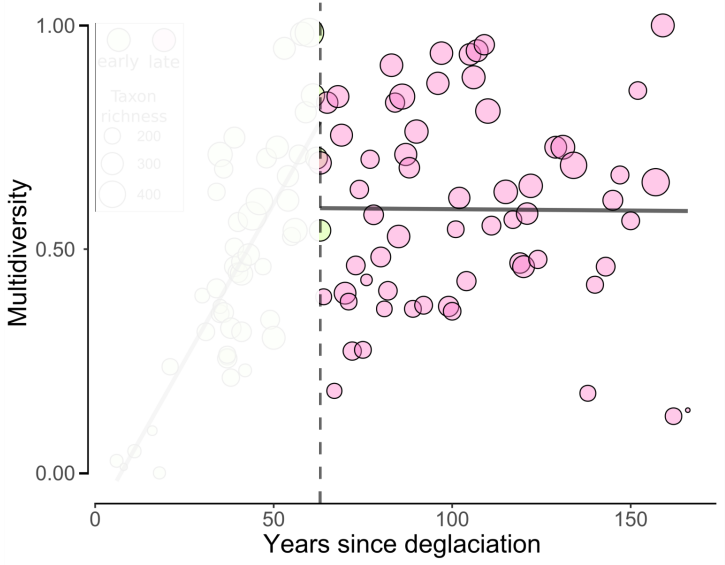






Late succession:

- Interactions between taxa become more important
- Environmental conditions modulate multidiversity
- Niche-based processes



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FWF
Der Wissenschaftsfonds.

Nationalpark Hohe Tauern