Assessing the recovery of forest understory vegetation after clearcut logging across a 445-year chronosequence in the Siskiyou Mountains of southwestern Oregon, USA

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BACKGROUND & QUESTIONS

The conversion of natural forested lands to managed forests has **reduced the amount of older, structurally diverse forests** worldwide. In conifer forests of the Pacific Northwest (USA) – where the understory plant communities comprise only 1% of forest biomass but represent 90% of the plant species richness – the **long-term impacts of timber harvesting** are not fully understood. In 2021, we remeasured[1] a chronosequence of forests in the Siskiyou Mountains of southwestern Oregon that ranged from 25 to 445 years of age to **compare changes in plant communities** in early seral logged (i.e., managed) stands with that of stands in mature and old growth conditions over 18 years.

Questions:
1. Have the **relationships of forest understory plant communities with stand age** changed in the 18-yr period?
2. Have the **community composition of the understory plant communities changed** and what is their **developmental trajectory**?

WHERE & HOW

- Fig. 1: Location of the study area of the Sucker Creek watershed within Josephine County, Oregon, USA

- 13 50m[2] plots with similar elevation, aspect, slope, and forest type initially sampled in 2003[1] and resampled in 2021

- Developmental stages:
  - early seral (**ES**; 5 plots)
  - mature (**M**; 3 plots)
 - old-growth (**OG**; 5 plots)

Fig. 1
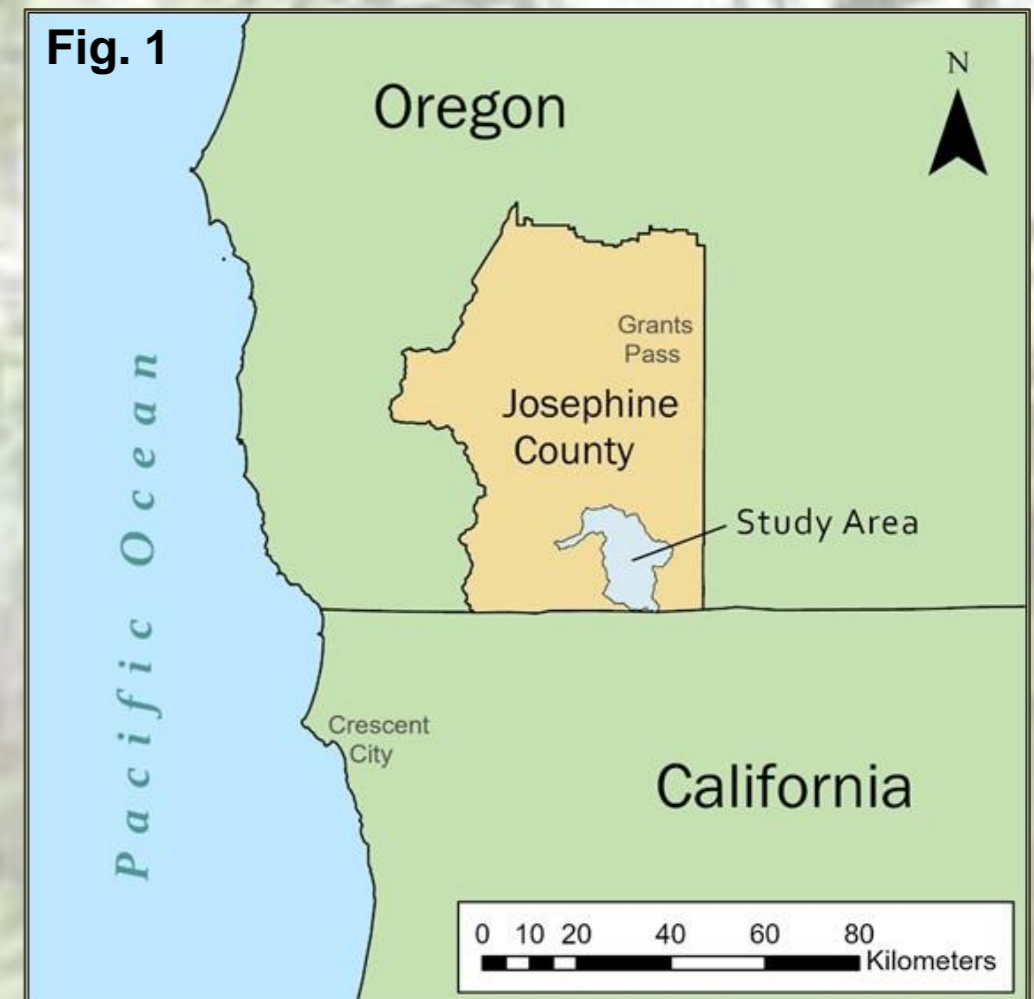
RESULTS & DISCUSSION

- **Canopy cover increased** (24%) in the ES stands ($Z = -1.888$, $P = 0.063$) and was no longer sig. different from the M stands (2003: $X^2 = 7.54$, $P = 0.023$; 2021: $X^2 = 3.62$, $P = 0.164$)

- Fig. 2: **Loss of richness in ES** plots ($X^2 = 6.586$, $P = 0.037$)

- Fig. 2: **Decline in evenness in OG** plots ($Z = -1.534$, $P = 0.063$)

- Fig. 2: **Decline in diversity across all developmental stages** ($Z = -1.534$, $P = 0.063$)

- Decline in evenness and diversity in M and OG stands in 2021 may be attributed to an **increase in dominance of shade tolerant plants** (e.g., a. *Achlys triphylla*, b. *Adenocaulon bicolor*, and c. *Chimaphila umbellata*)[3].

- Fig. 2: **Minimal changes in beta-diversity** (2003: $X^2 = 7.051$, $P = 0.029$; 2021: $X^2 = 8.079$, $P = 0.018$)

Fig. 2
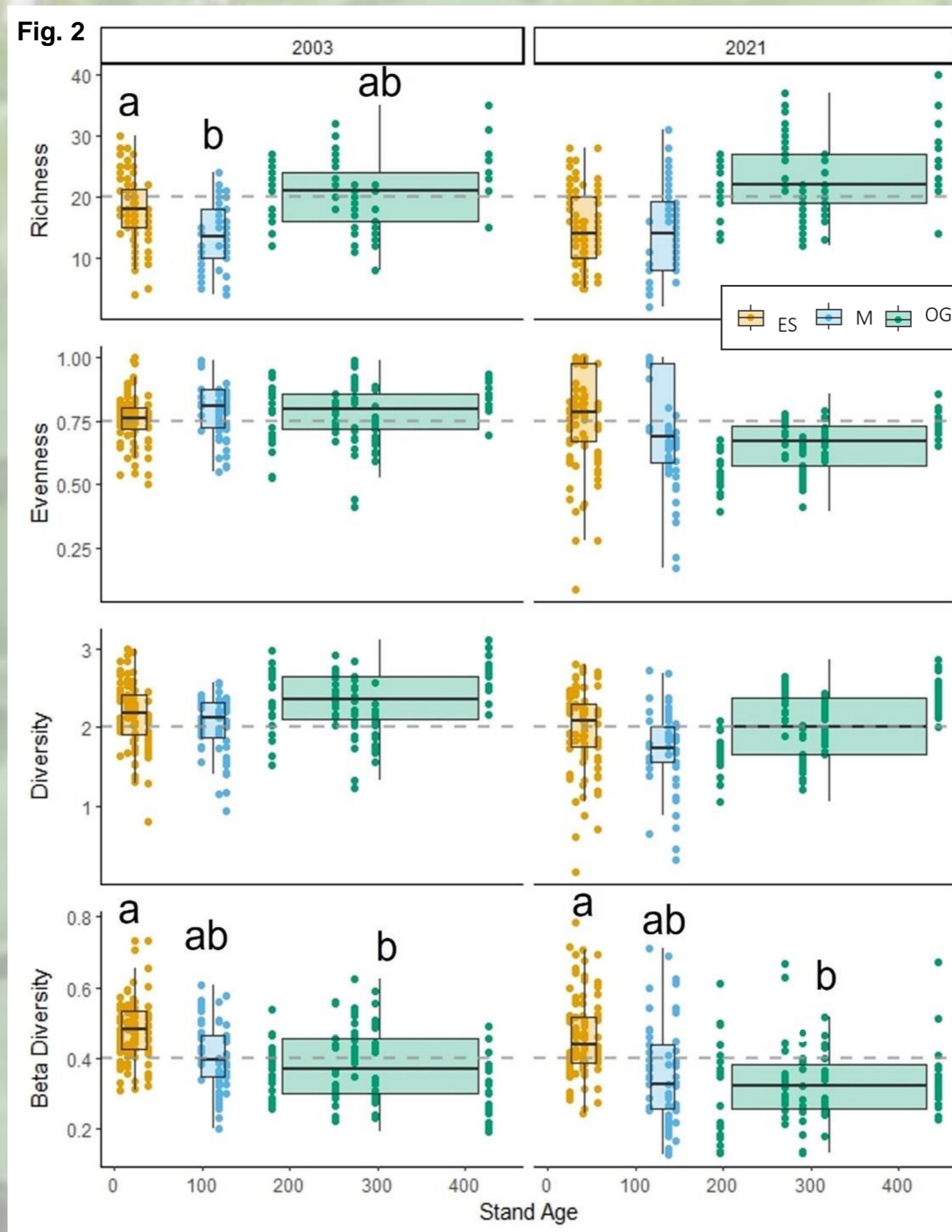
- Fig. 3: Richness predicted to peak ~250 yr, potentially due to **reinitiation of high shade tolerant understory species**

- Relationship between **richness and stand age** has **similar pattern** in 2021

- Fig. 4: **Largest shift in community composition in ES plots** that have shifted towards a more similar composition as M stands

- Fig. 4: Community composition in the **M plots are not shifted towards the OG composition**

Fig. 3 GAMMs
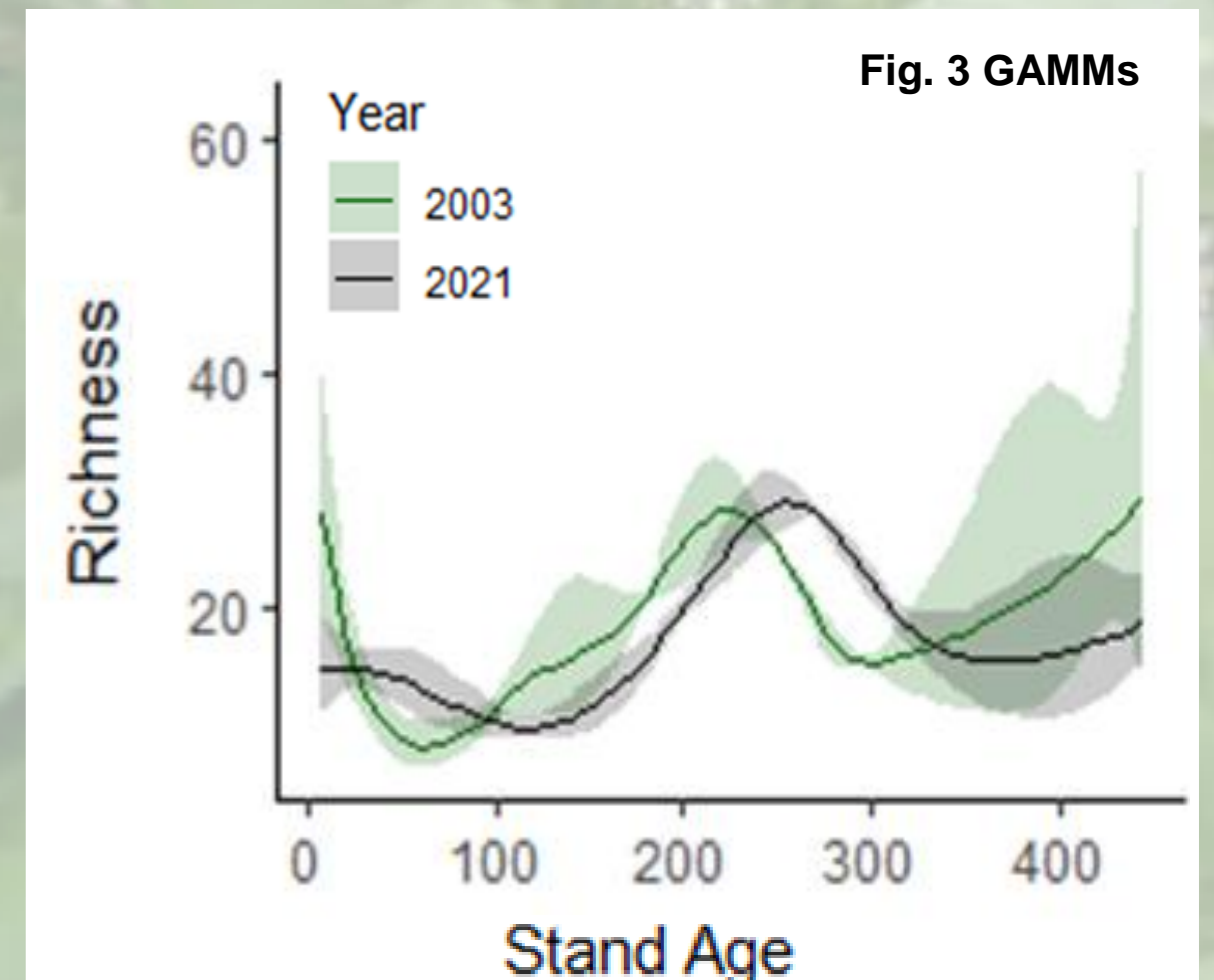
ES Indicator Species
- Loss of association of species with **low shade tolerance** (d. *Rubus ursinus*; 2003 IV: 0.78, 2021 IV: 0.0)

- Weakening of association of species with **intermediate shade tolerance** (e. *Ribes sanguineum*; 2003 IV: 0.65, 2021 IV: 0.32)
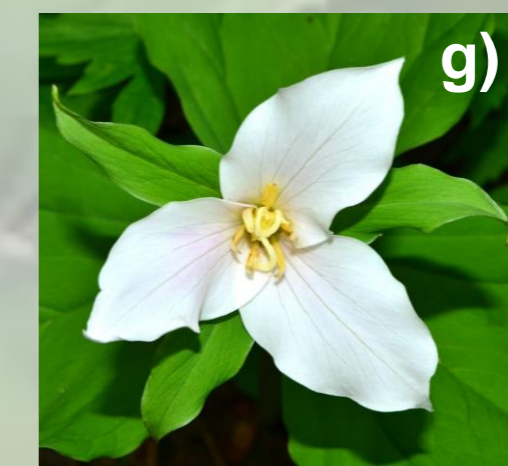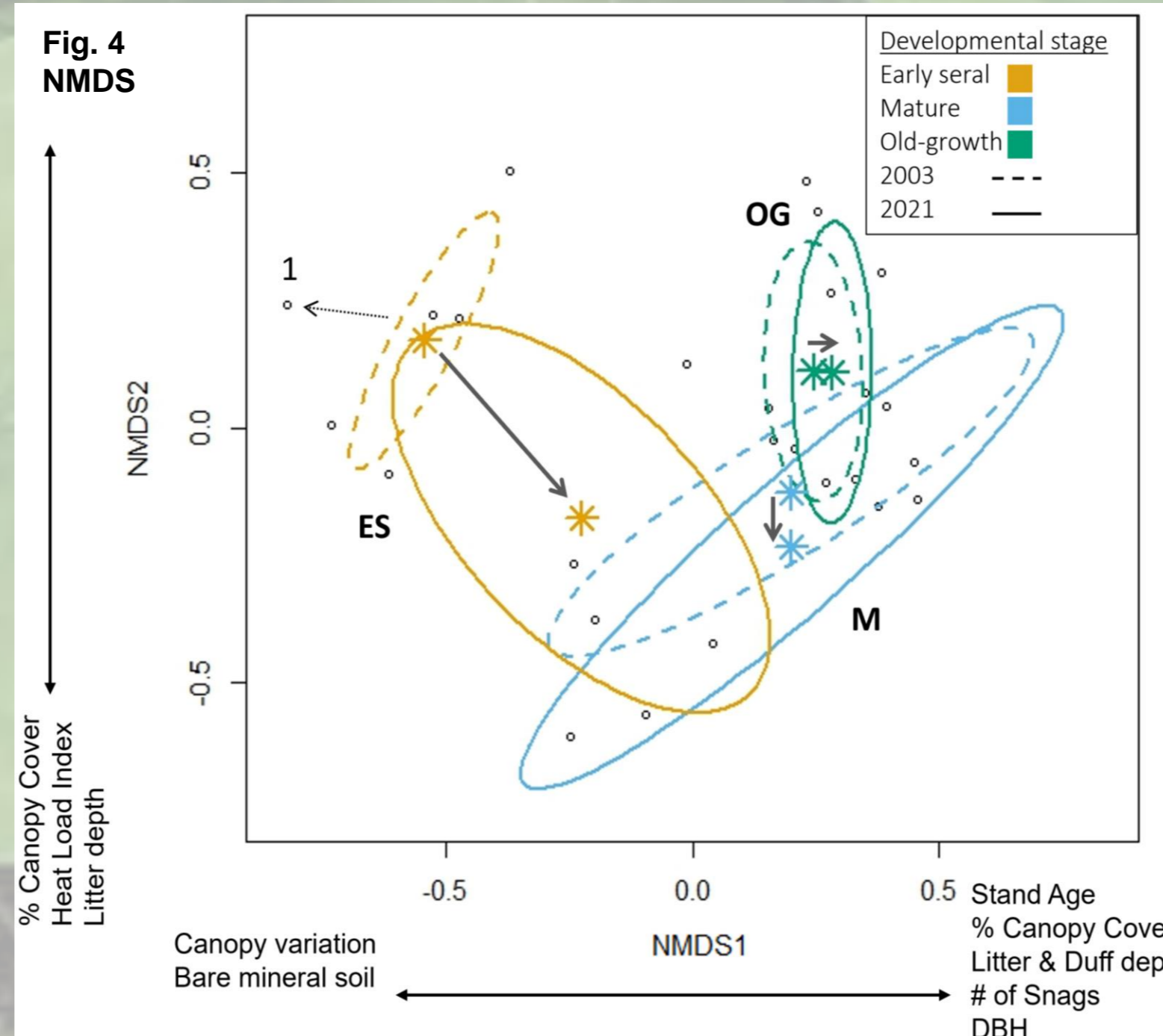
M Indicator Species
Only *Polystichum munitum*, a **highly shade tolerant** fern (f., 2003 IV: 0.48, 2021 IV: 0.48)

Fig. 4 NMDS

M & OG Indicator Species
Suite of species with **perennial rhizomatous habit and high shade tolerance** (a. *A. triphylla*, 2003 IV: 0.84, 2021 IV: 0.90; g. *Trillium ovatum*, 2003 IV: 0.64, 20021 IV: 0.64)

OG Indicator Species
Species that may take a **longer time to recover from disturbance** (h. *Clintonia uniflora*, 2003 IV: 0.63, 2021 IV: 0.69; i. *Maianthemum stellatum*, 2003 IV: 0.67, 2021 IV: 0.78)

CONCLUSION

Early seral forest stands
- Increase in canopy cover
- Loss in plant species richness
- Community composition is now more similar to mature forest stands
- Highest community variation

Mature forest stands
- No sig. change in species richness
- Community composition does not appear to be on a trajectory towards OG

Old-growth forest stands
- No sig. change in species richness
- Decline in evenness and diversity
- Lowest community variation

Our work demonstrates the **legacy effect of a phase of clearcut logging**. Understanding if these managed stands are developing towards conditions that will allow recovery of the understory plant community is important for maintaining the **biodiversity and overall forest resilience** in the face of a changing climate[4]. Adopting **silvicultural methods and incorporating fire** where appropriate could help to **restore stand conditions** and promote **understory richness and diversity**[7,8,9].

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