Tracking habitat associations of European neophytes across residence time

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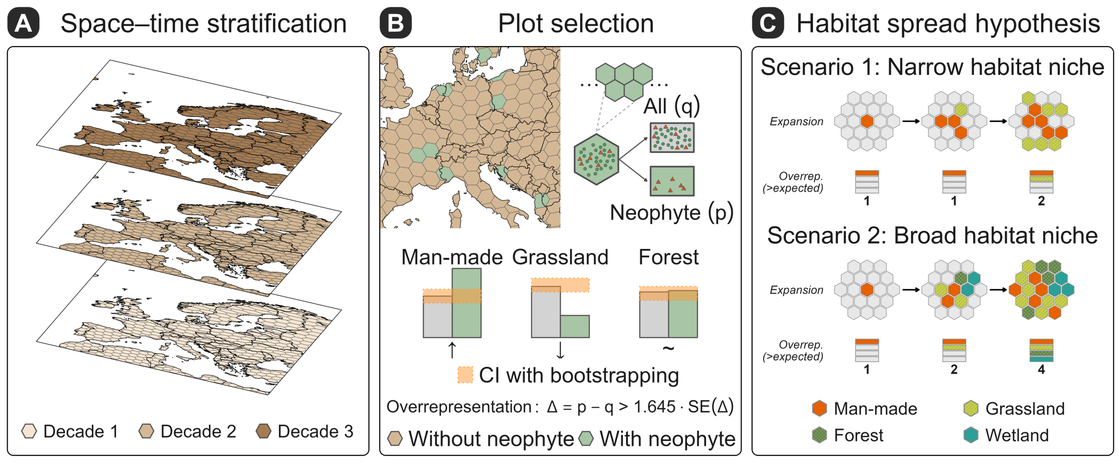
BACKGROUND

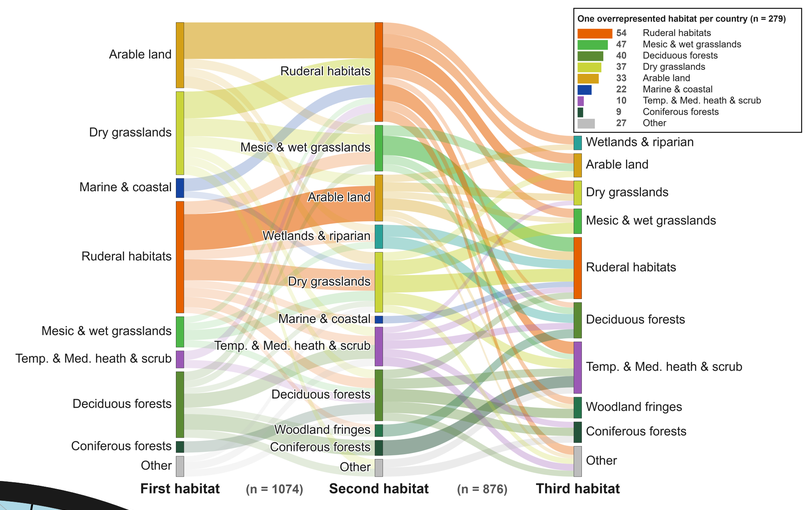
Across Europe, alien plants occur mostly in **disturbed, human-modified vegetation.** Do these **gateway habitats** confine the alien flora, or are they a **springboard** into wider, more natural vegetation?



We grouped **1,357 alien plant species** by **residence time** and asked in which habitats each is **overrepresented** relative to local habitat availability.

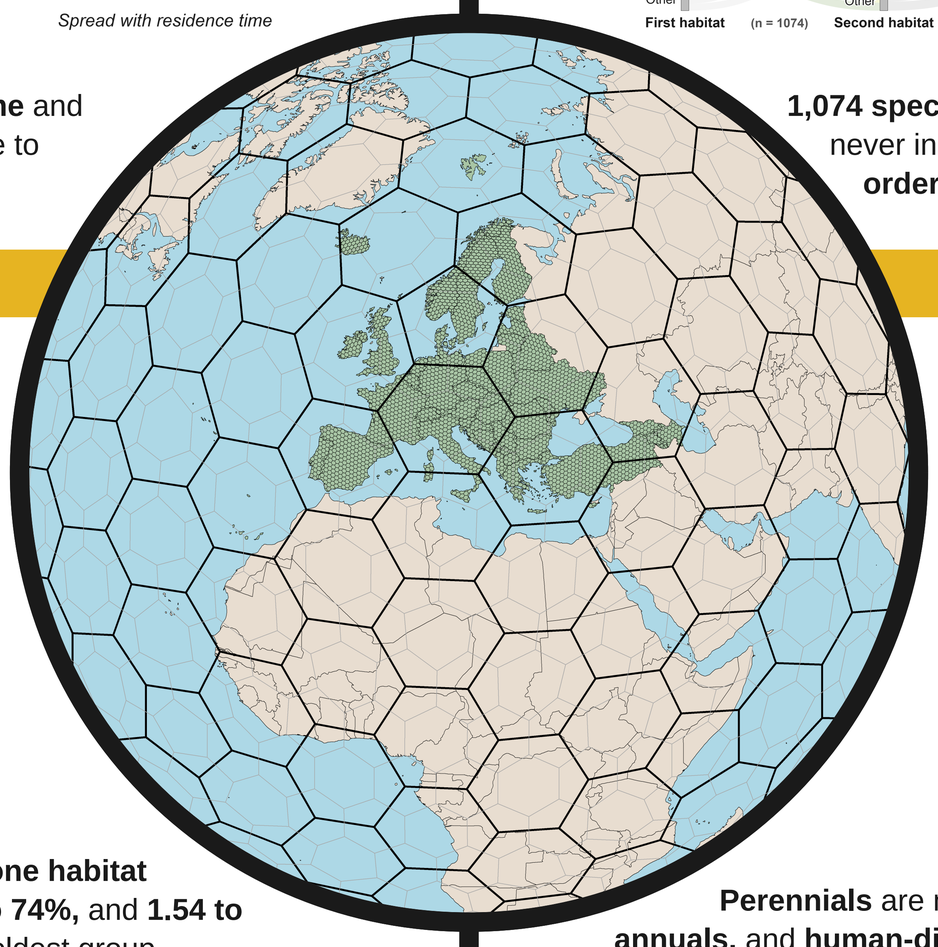
HABITAT PATHWAYS

Ordering each species' overrepresented habitats by its **earliest vegetation record, ruderal habitats** come first most often **(19.7%),** ahead of **dry grasslands (15.4%)** and **deciduous forests (14.1%).**



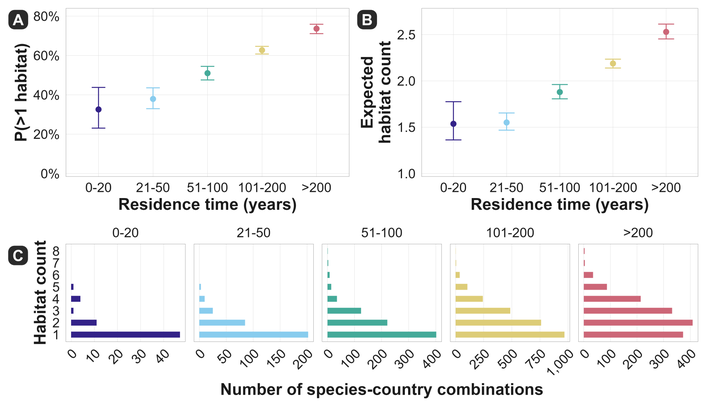
- **Ruderal habitats and arable land** account for **32%** of earliest records
- Of species overrepresented in **two or more** habitats, **82%** are overrepresented in **three or more**
- The recorded orders are **recurring,** not random

1,074 species are overrepresented in two or more habitats; **279** never in more than one within a country. These are **recorded orders,** not observed colonisation histories.



HABITAT BREADTH

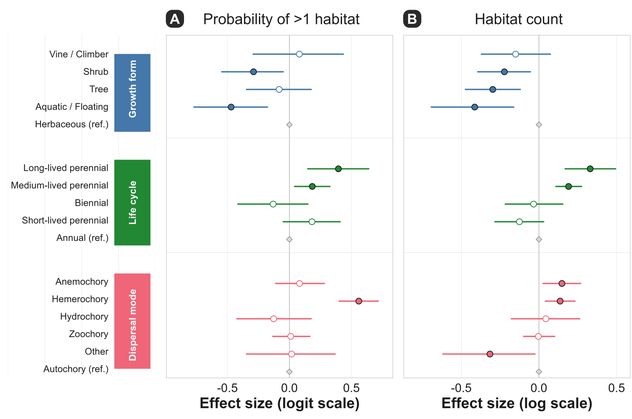
A **Bayesian hurdle model** separates two things:



(A) whether a species is overrepresented in **more than one habitat** and **(B)** how many. Both rise with residence time: **33% to 74%,** and **1.54 to 2.53** habitats. The gradient **does not flatten** toward the oldest group.

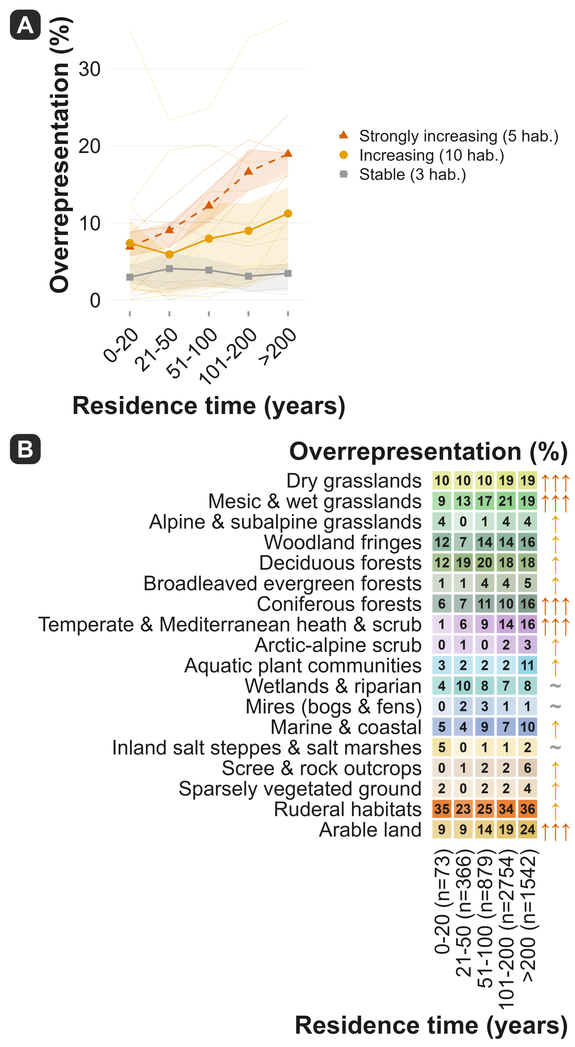
SPECIES TRAITS

Growth form, life cycle and **dispersal mode** are associated with habitat niche breadth.



Perennials are more often overrepresented in several habitats than **annuals,** and **human-dispersed** species more often than **self-dispersed** ones. **Aquatics and shrubs** hold narrower niches.

DATA & APPROACH



Dataset

- **1,023,883 vegetation plots** from the European Vegetation Archive, **1930–2023, 55 countries and territories**
- **1,357 alien species** (post-1492) in **5,614** species–country combinations
- **18 habitat groups** (EUNIS Level 2), taxonomy harmonized against World Flora Online
- First-record dates from four sources (GBIF, Seebens et al. 2018, EVA plot records, national lists)
- Spatial grain: **863 km²** hexagonal grid cells (ISEA3H DGGS)

Overrepresentation

- Compare habitat **occurrence against background availability** within the same grid cell and decade
- **'Overrepresented'** = species occurs more often than expected **(one-sided test, p < 0.05)**
- Controls for **spatial and temporal sampling bias**
- **(A)** three change patterns; **(B) ruderal habitats** most invaded **(23–36%), arable land** steepest **(9→24%)**

TAKE-HOME

Key Findings

- **Habitat niche breadth widens with residence time:** overrepresentation in more than one habitat rises from **33%** to **74%**
- **Ruderal habitats** are the most invaded in every residence-time group **(23–36%); arable land** rises most steeply **(9% to 24%)**
- Increases are **not confined to human-made habitats:** heath and scrub **1→16%,** coniferous forests **6→16%,** mesic and wet grasslands **9→19%**
- **Alpine and nutrient-poor habitats** stay rarely invaded: mires **0–3%,** arctic–alpine scrub **0–3%,** alpine grasslands **0–4%**
- **Perennials** and **human-dispersed** species hold **broader habitat niches** than annuals and self-dispersed species
- Aliens already present could still reach **natural habitats that remain largely free of them today**

Open Questions

Incorporate **abundance data** to separate habitats where alien plants occur at low density from those where they dominate. Test whether **related species** share habitat associations, which would help anticipate where newly arrived species turn up. Ask how **climate change** may shift habitat availability as warming relaxes constraints.

Our Team

- **BioInvasions, Global Change, Macroecology** group, University of Vienna
- Part of the **European Vegetation Archive** network (2.1M+ vegetation plots)

Scan me!

References

[1] Chytry et al. (2016) Appl Veg Sci 19:173
[2] Chytry et al. (2020) Appl Veg Sci 23:648
[3] Essl et al. (2011) PNAS 108:203
[4] Seebens et al. (2018) PNAS 115:E2264

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