Changing of assembly rules during secondary succession: are there trends?

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Introduction

- **Assembly rule** – (Diamond 1975, Keddy 1992): ecological process selecting species from regional species pool and thus determining local community composition (HilleRisLambers et al. 2012, Götzenberger et al. 2012)

- Rules ~ filters

- Dispersal, environmental and biotic filters

- Aiming to detect possible processes from observed data
Study of assembly rules

• Species-based or trait-based approach
• Appropriate spatial scale, environmental gradient, heterogeneity
• Detect the assembly rule = detect the departure from random pattern,
• Trait specific pattern
• An example: Lhotsky et al. 2016, J of Ecology – trait based, long environmental gradient

![Graph showing Specific Leaf Area vs. NDVI]

- Convergence in trait distribution → Environmental filter is present
- Divergence in trait distribution → Biotic filter

Less productive end, ~dry grassland

More productive end, ~wetland
New: Succession can be also an environmental gradient

- Hypothesis: Community composition assembling during the succession are also partly non-random, there are assembly rules forming the new community and these change with time
- After crossing the dispersal limitation, environmental filtering will be dominant at the beginning of succession
- Biotic interactions will be important later in the succession
- Use of traits help in generalization
- Describe the pattern of changes of functional traits during old-field succession

- Determine the presence and changes of assembly rules during the succession on basis of selected traits

- Comparing the assembly rules on old-fields assumed on the basis of space-for-time substitution and on long-term observation.
Methods

- Kiskun-LTER field site network
- 40 permanent vegetation plot, 4x4 m
- 4 age – group (10 plot/AG),
  - abandoned between 1994-1999
  - abandoned between 1994-1989
  - abandoned between 1988-1975
  - abandoned between 1965-1974
- Traits of vascular plant species
- Functional diversity (Rao’s quadratic entropy) of plots compared to random
- Effect sizes from the comparision for every plot
- Changes of CWM and effect sizes were checked by linear mixed effect modell
Pictures from old-fields
Studied plant traits

**Connected to regeneration:**
- Seed weight
- Clonality
- Flowering start, end, long, (in months)

**Connected to vegetative growth:**
- SLA (specific leaf area, mm²/mg)
- LDMC (leaf dry matter content, mg/g)
- Leaf size, mm²
- Generative maximum height
- Life span
- Lateral spread

**Data source:**
- LEDA, Hungarian Flora,
- Török et al. 2014, 2016 – for seed weight,
1. Changes of community weighted mean (CWM) of traits between 2000-2010
   Life span: annuals ↓, perennials ↑
   SLA ↓,
   LDMC ↑, start, end and length of flowering time ↑, generative height ↑, leaf size ↑
   Seed weight: no changes in CMW (average)
2. Detection of assembly rules:
a.) No changes during the succession in trait dispersion:
   seed weight, lateral spread : divergent
   leaf size : convergent
2. Detection of assembly rules:
b.) Changes during the succession in trait dispersion: SLA, LDMC, life forms, generative height, flowering start, end and length
several patterns, e.g. life form: convergent
2. Detection of assembly rules:
b.) Changes during the succession in trait dispersion:

Results

2. Detection of assembly rules:
b.) Changes during the succession in trait dispersion:
LDMC: divergence

![Graph showing changes in LDMC over years.](image)
3. Comparing space-for-time substitution and the long-term observation

SFT:
- CWM of traits change where already detectable
- Assembly rules: very few, only in SLA

short:
More detectable changes in long-term observation
Detectable slowing of changes
Conclusions

• CWM of traits changes similar to the expectation
• First long-term observation about the changes of several traits during succession
• Non-random trait distribution was detectable in this situation
• Distribution of 3 traits did not change (e.g. seed weight) with time = „constant assembly rules”
• Distribution of 7 traits show changes during succession, however many types of changes = „changing assembly rules”
• Only LDMC change according to the expectation
• Environmental filtering act through the life form and SLA distribution
Take home message

• There are assembly rules during succession → non-random process
• However, every trait dispersion shows different pattern, no clear trends → different speed and direction of changes?
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Thank you for your attention!
Paldies!