TECHNISCHE UNIVERSITÄT DRESDEN

Department of Forest Science, Professorship in Forest Biometrics and Forest System Analysis

The importance of conspecific facilitation in promoting establishment and recruitment

A case study from degraded mangrove forests

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(Manuscript in Preparation)

Introduction:

- Situation
- Concept
- Objectives

Description:

- Study sites
- Measurements
- Hypotheses

Results:

- Plant characteristics
- Interaction intensity
- Spatial point pattern

Conclusion

Mangrove forests

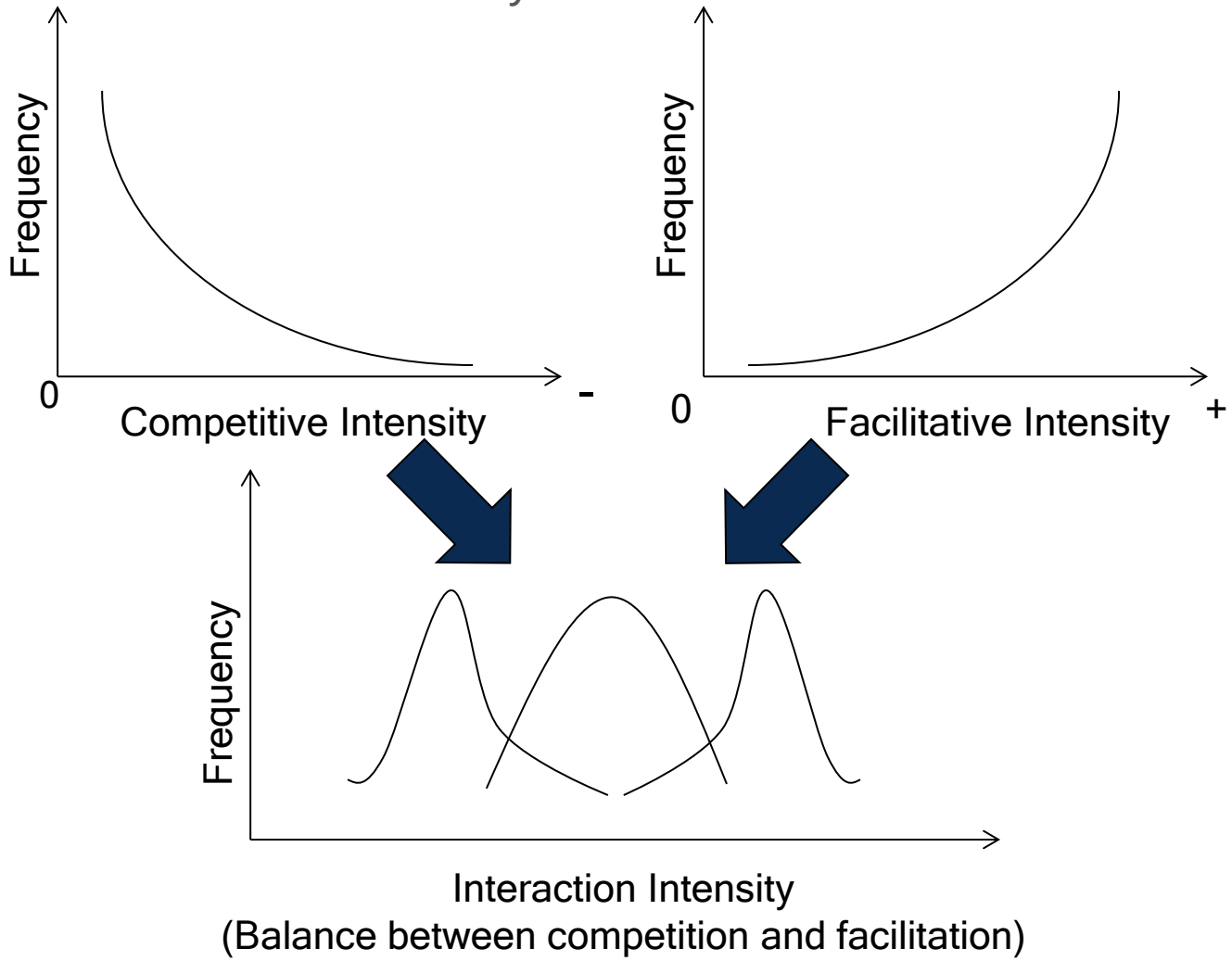
- High loss rates world wide
- Great efforts to restore ecosystem functions after loss
- Basis for an successful restoration:
  - ➢ Understand the behavior of pioneer trees under harsh conditions

Establishment and recruitment processes

- Main focus to competitive interactions by using resources
- Facilitation (of e.g. nurse plants) by ameliorating harsh environment often disregarded
- Balance and changes between competition and facilitation rarely considered

Competition vs. Facilitation

Conceptual model of the abundance **distribution of individual plants** along local interaction intensity under stressful conditions



Objectives

i) Describe mangrove plant characteristics on recolonizing degraded site

ii) Illustrate density related plant interactions intensities

iii) Detect spatial distribution of plants and their distances to each other

Study site

- Degraded mangrove area in Bragança North Brazil:
- Road construction 1974 resulted in destruction of higher elevated mangroves

Environmental conditions

- Between June to December drought stress
- High salinity values (95 ppt)
- Naturally recolonizing with *Avicennia germinans*

➢ **Dry, hot and salty**

Field design:

- 3 development stages
- 20 x 20 m
- 2 replications for each stage
- Mapping of mangroves

Field measurement

- Species composition
- x-y Position within the plot
- Plant height, diameter, crown diameter
- Distinction between seedlings and saplings

Research questions

1. Does the interplay between competition and facilitation shape the abundance distribution of *Avicennia* mangrove seedlings ?
2. Does the interplay between competition and facilitation change at different developmental stages?

Plant characteristics

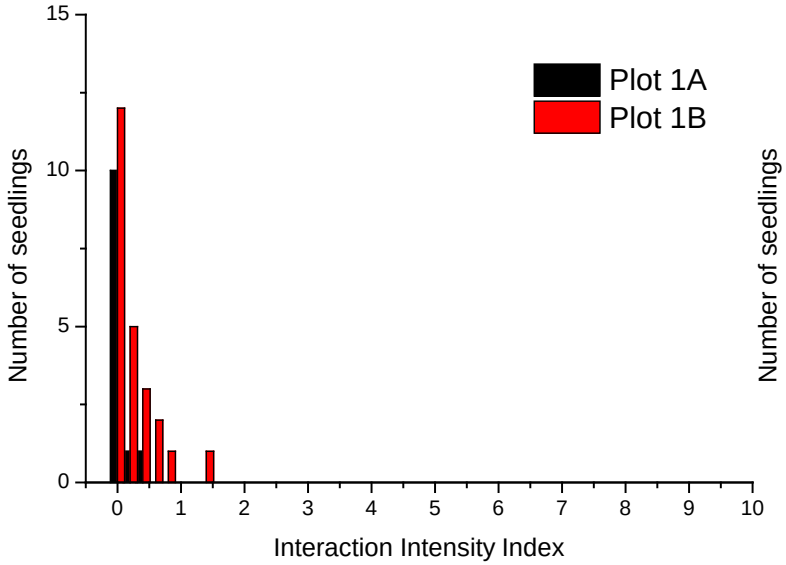
	Plot 1	Plot2	Plot3
Seedlings:			
Number	12/24	129/1722	916/937
Saplings:			
Number	54/68	244/647	644/350
Height (cm)	24/22	25/38	88/141
Crown radius (cm)	6/6	7/14	19/47

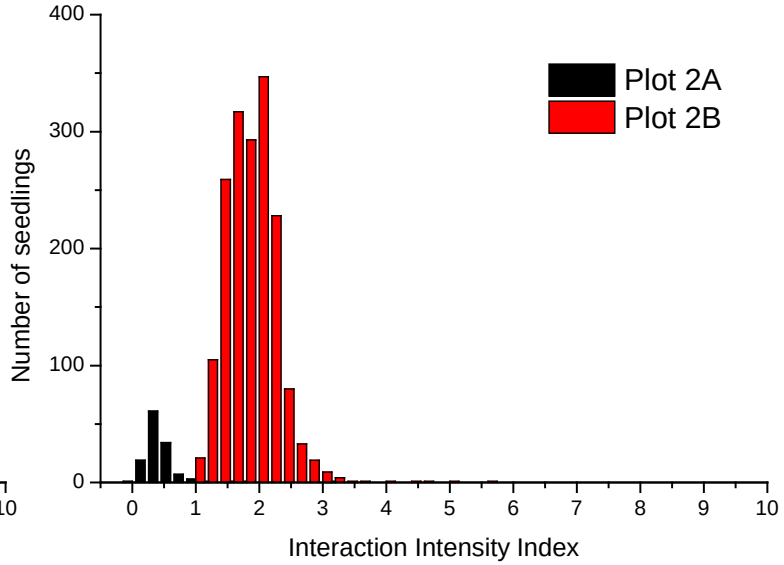
Local interaction intensity:

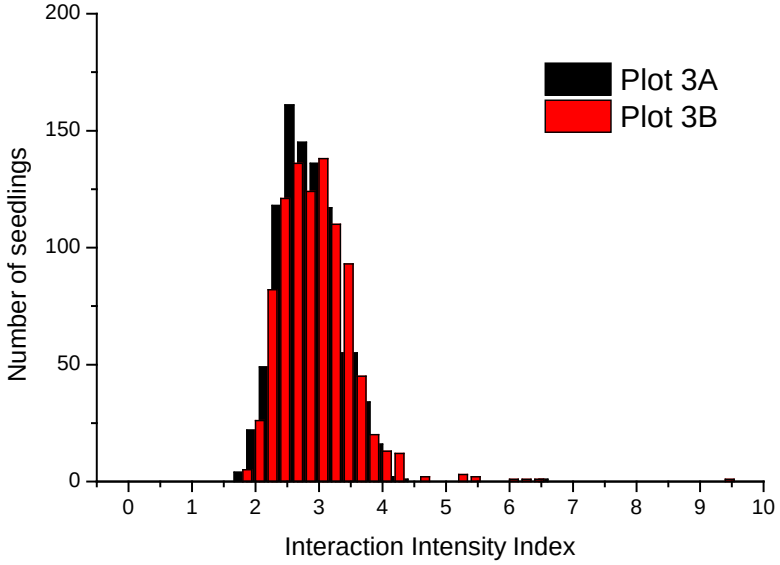
- Based on the Hegyi competition index (CI)
- Interplay of competition and facilitation among neighboring plants

$$CI_i = III_i = \sum_{j=1}^{N_i} \left(\frac{cr_j}{cr_i}\right)\left(\frac{1}{d_{ij}}\right), \qquad for \quad i \neq j$$

Seedling interaction intensity



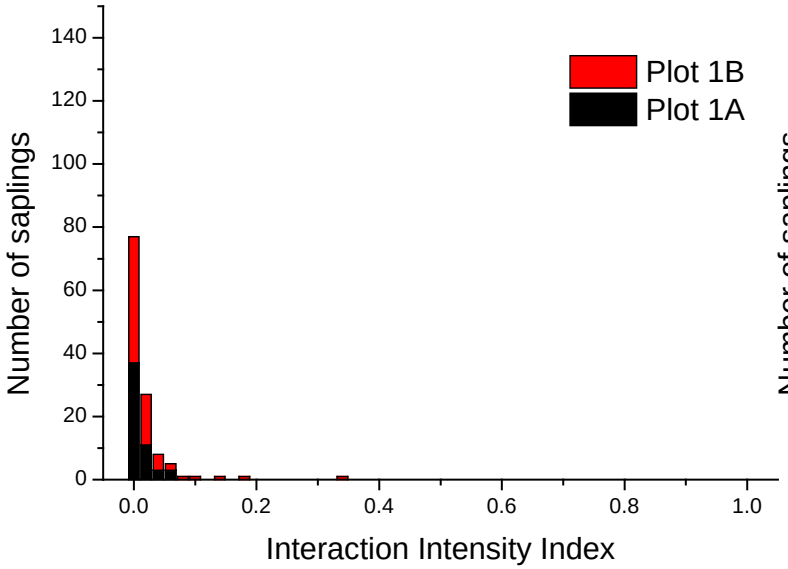


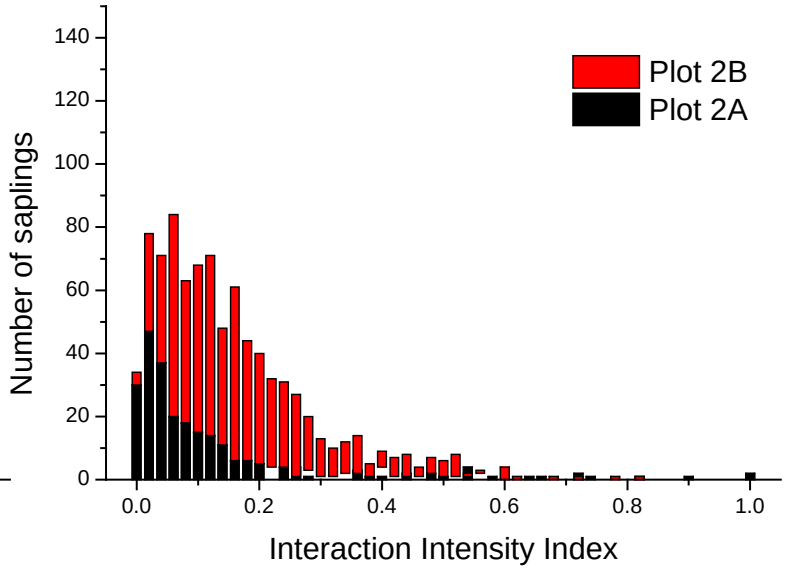


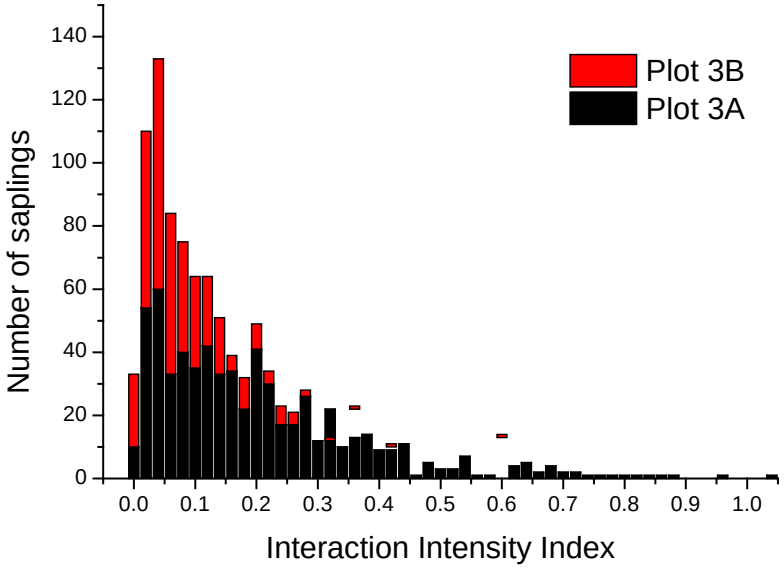
Humped shapes of seedling establishment

- **Balance between competition and facilitation**

Sapling interaction intensity







Humped shapes is modified by a increasing of density-dependent mortality

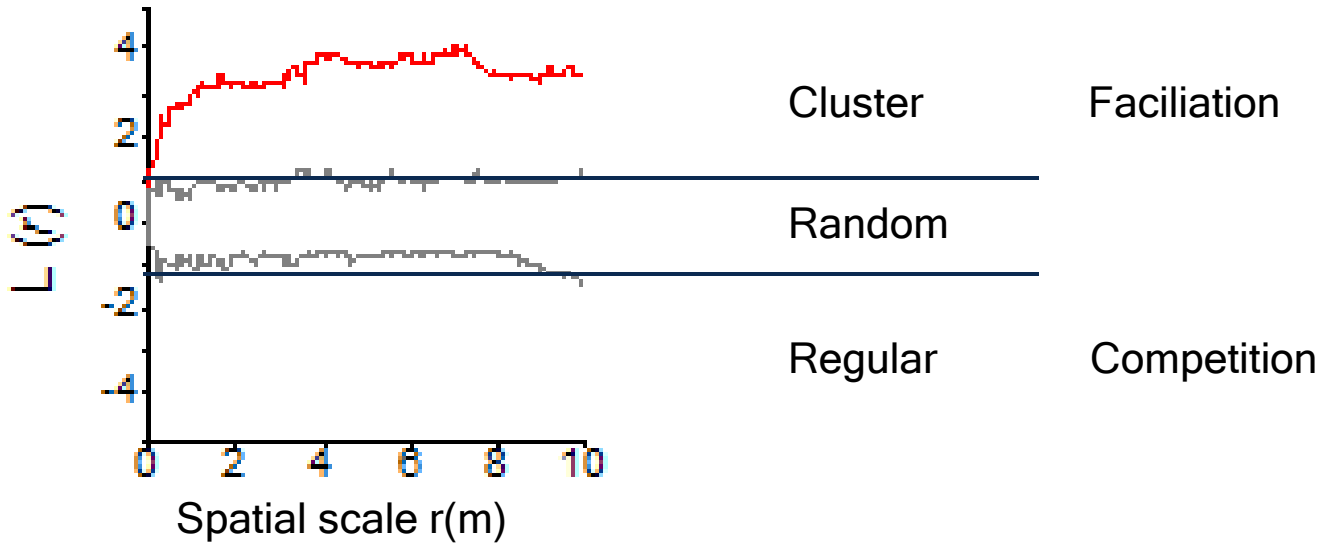
- **Switch of facilitation to competition**

Spatial point pattern

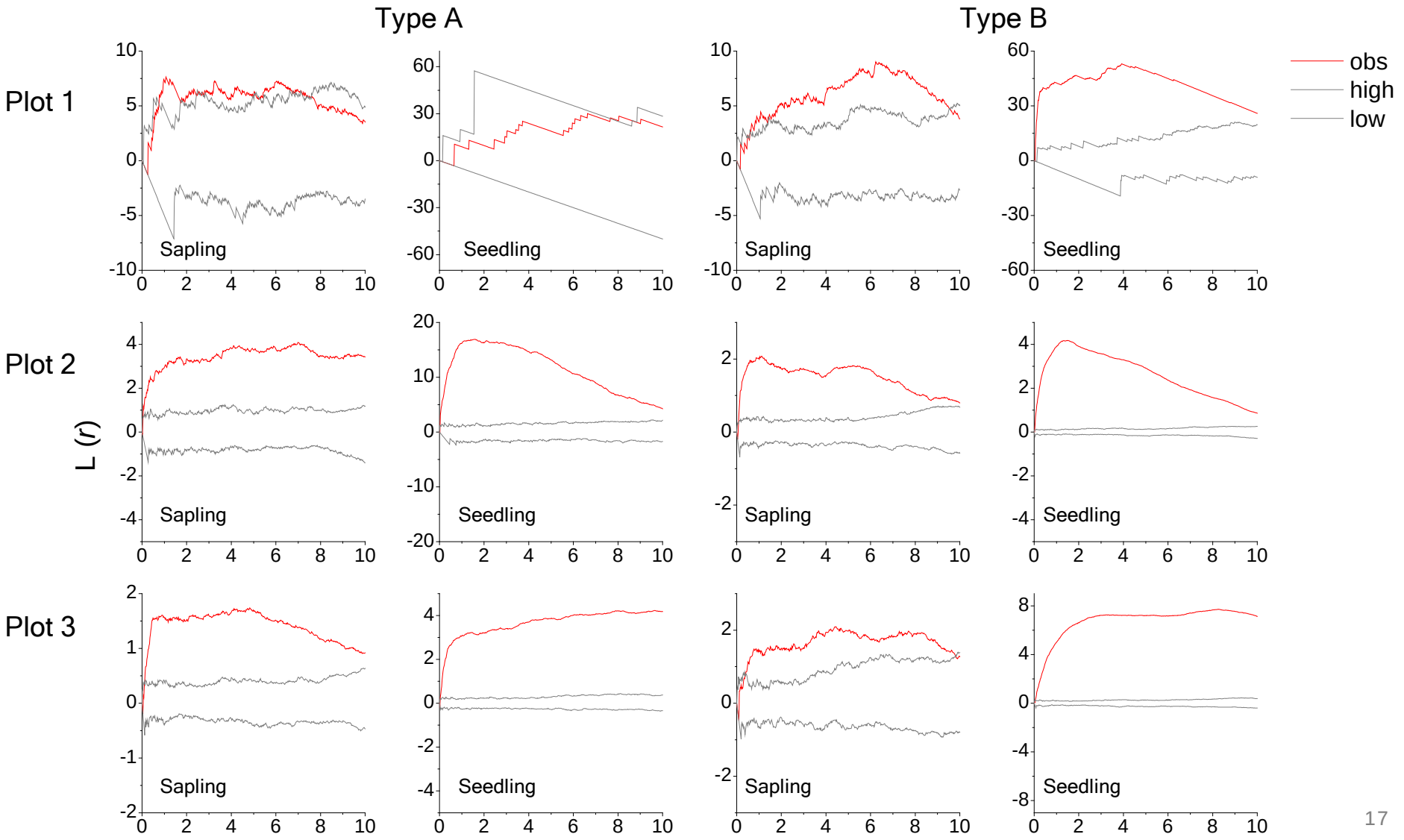
L-function:

$$L(r) = \sqrt{\frac{K(r)}{\pi}} \text{ with } K(r) = \pi r^2$$

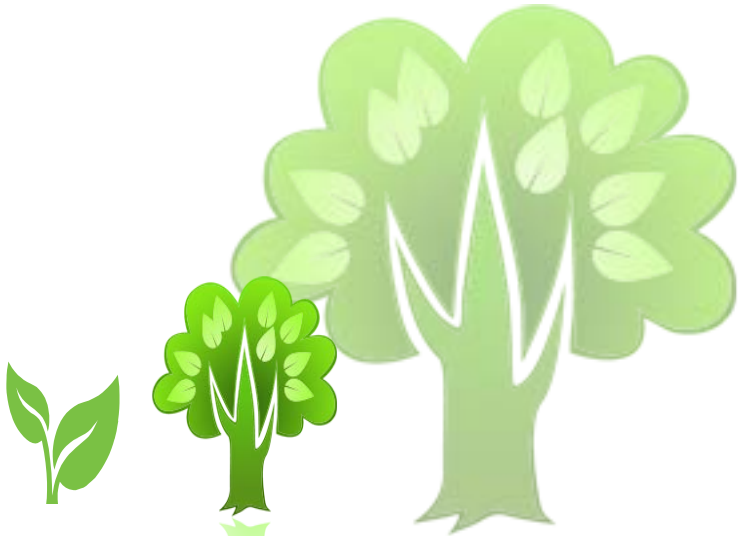
Example:



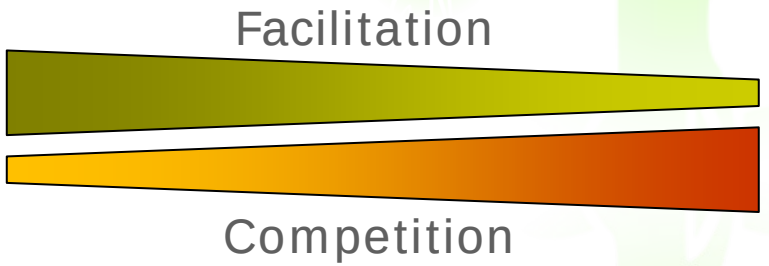
Spatial point pattern



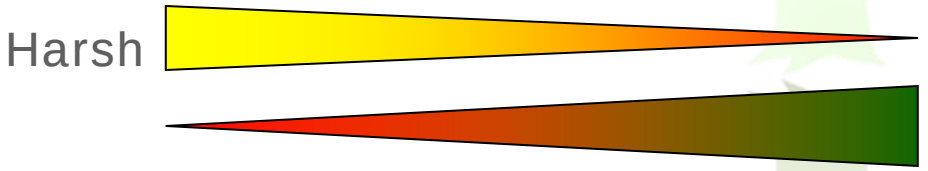
Developmental stage:



Plant interaction:



Environmental conditions:



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Thank you for your attention