Networking via root grafts

- just a whim of nature or a strategy of trees to be more resilient in stressful environments?

Uta Berger[1], Marie-Christin Wimmler[1], Falk Schrewe[1], David Götz[1], Jorge López-Portillo[2], Cyril Piou[3], Alejandra Vovides[4]

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[2] Instituto de Ecología, A.C. (INECOL), Mexico
[3] CIRAD, Montpellier, France
[4] University of Glasgow, UK
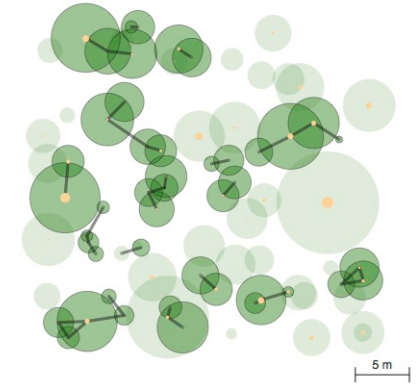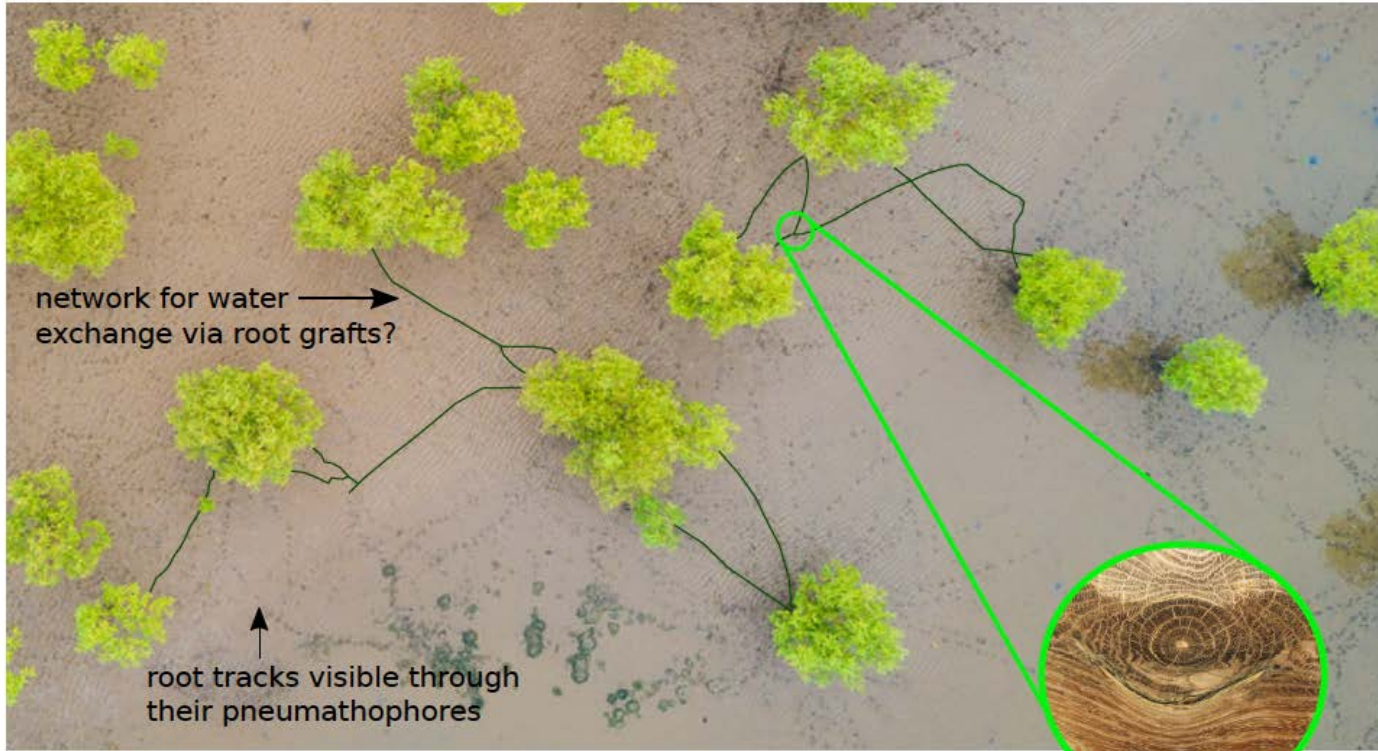
Old Tikjo
(Spruce) Sweden

Pando
(Aspen, USA)

J Zapell - http://www.fs.usda.gov/photogallery/fishlake/home/gallery/?cid=3823&position=Promo,
https://commons.wikimedia.org/w/index.php?curid=27865175

Clonal growth & grafting
- Exchange of resources
- Long living (9550 & 80,000 yrs)

Root networking
- Whim of nature?
- factor increasing resilience?

network for water exchange via root grafts?

root tracks visible through their pneumathophores

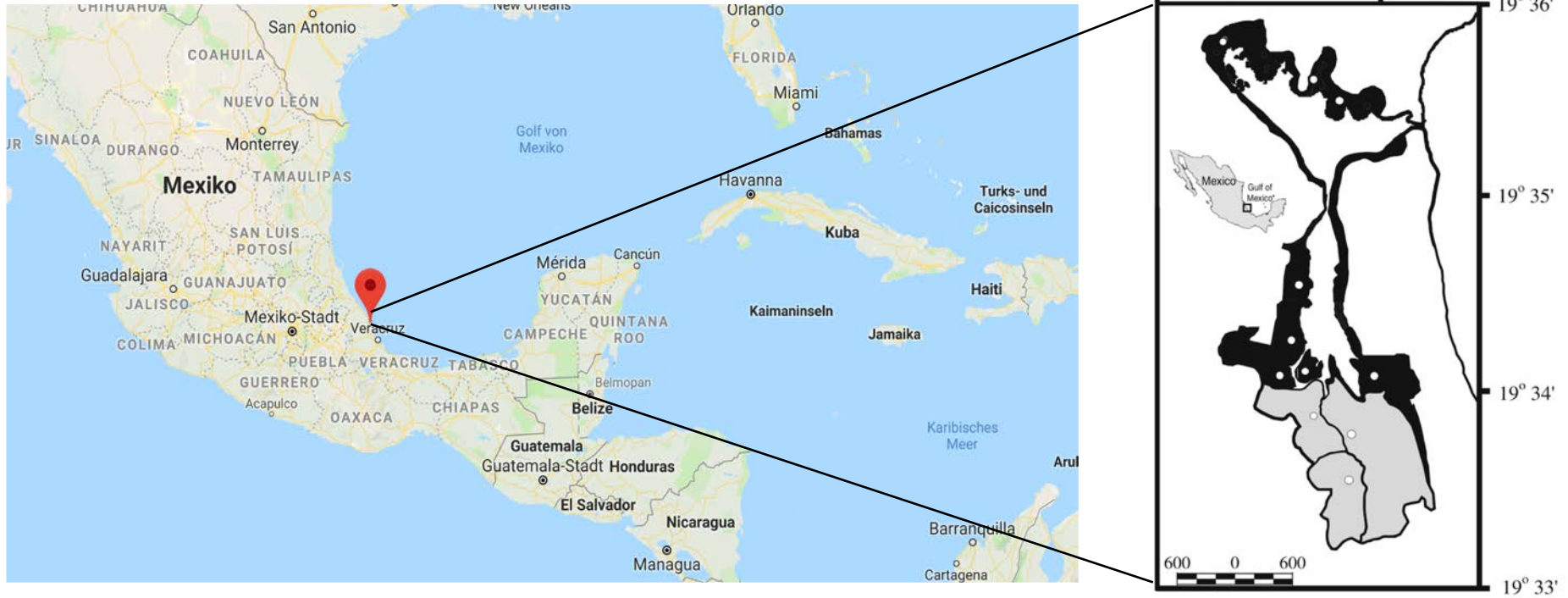cross section of a functional root graft

Mangroves
- Clonal growth (*Rhizophora mangle*)
- **Root grafting** (*Avicennia germinans*)

Possible explanation of root grafting
- Randomness
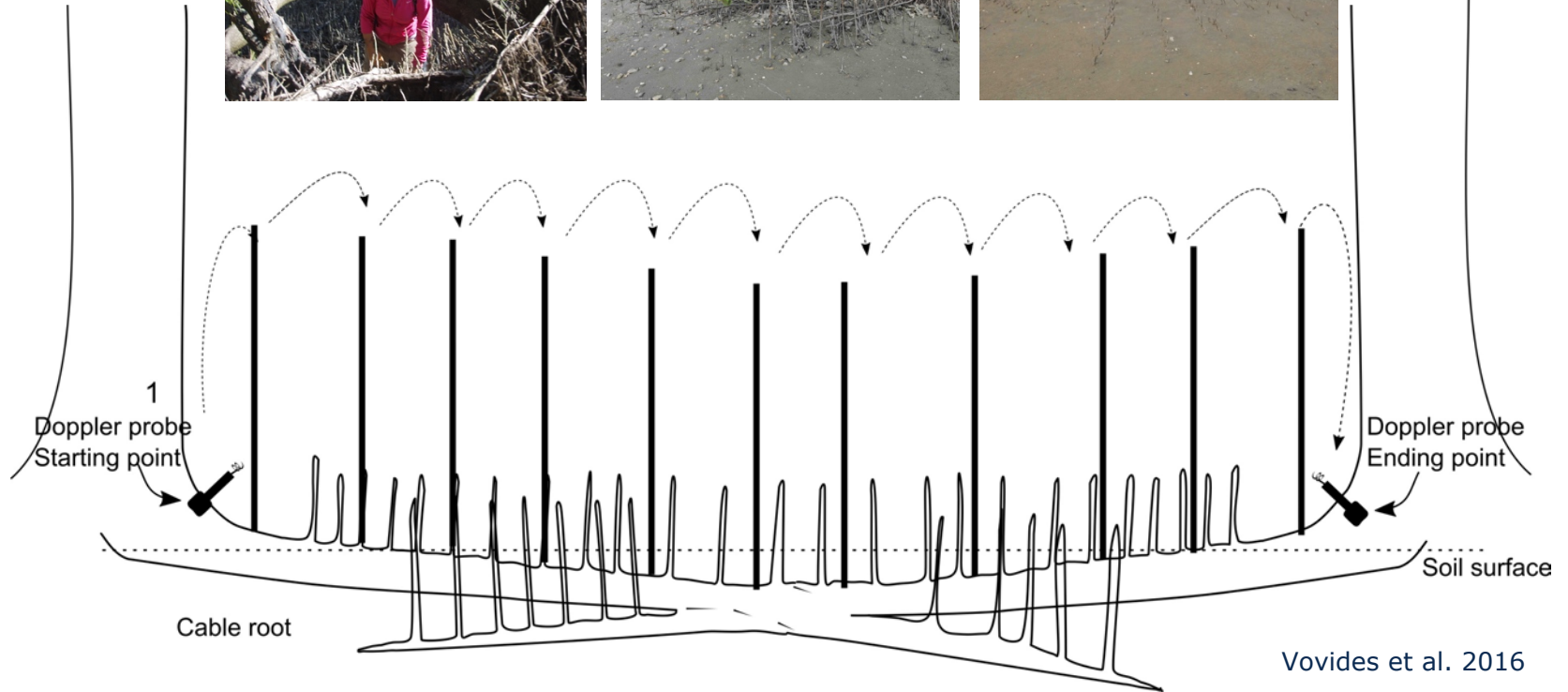- Parasitism
- Facilitation (e.g., sharing water)

5 m

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DRESDEN concept

Study site – La Mancha Lagoon, Veracruz, Mexico

Vovides et al. 2014

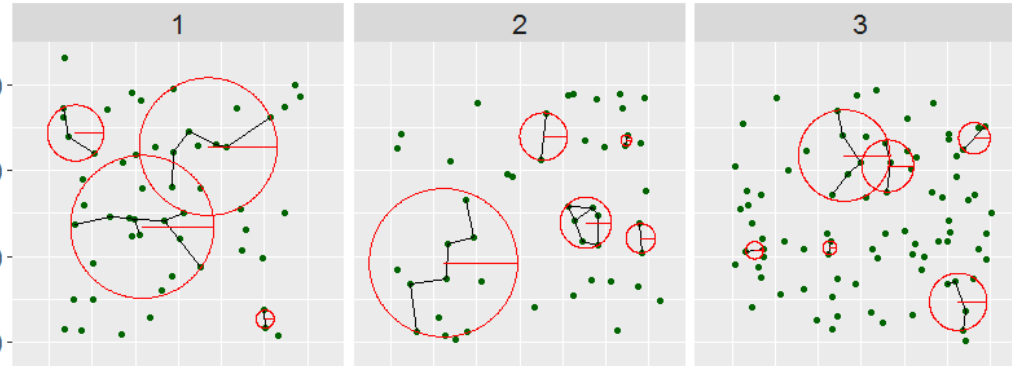# Methodology (Echosounder)

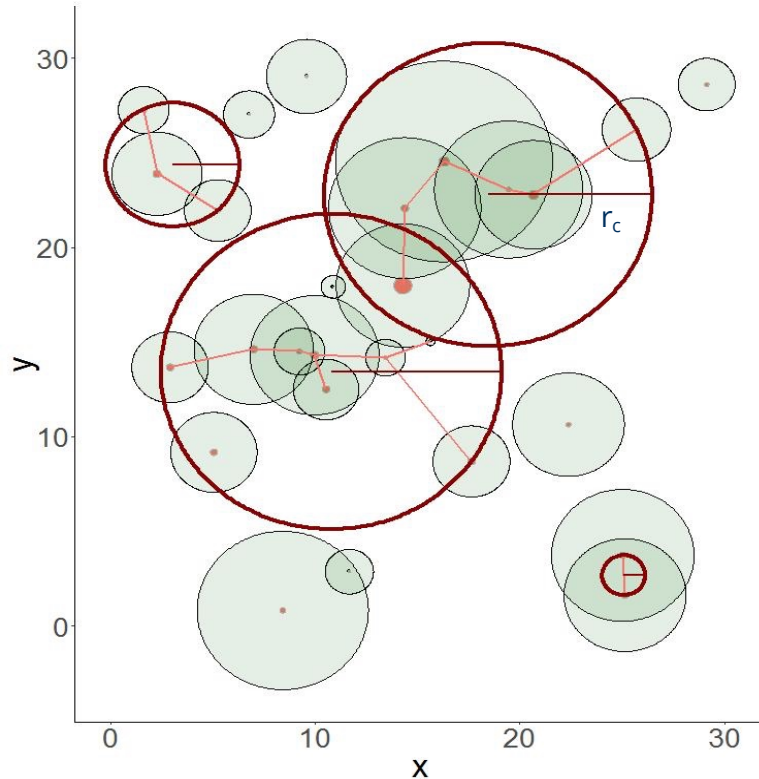Vovides et al. 2016

Examples of La Mancha *A. germinans* networks
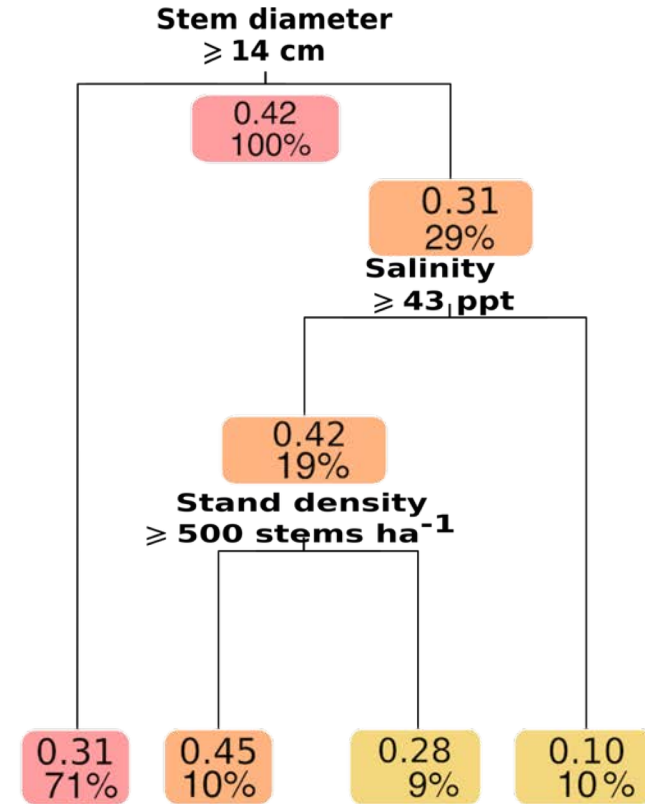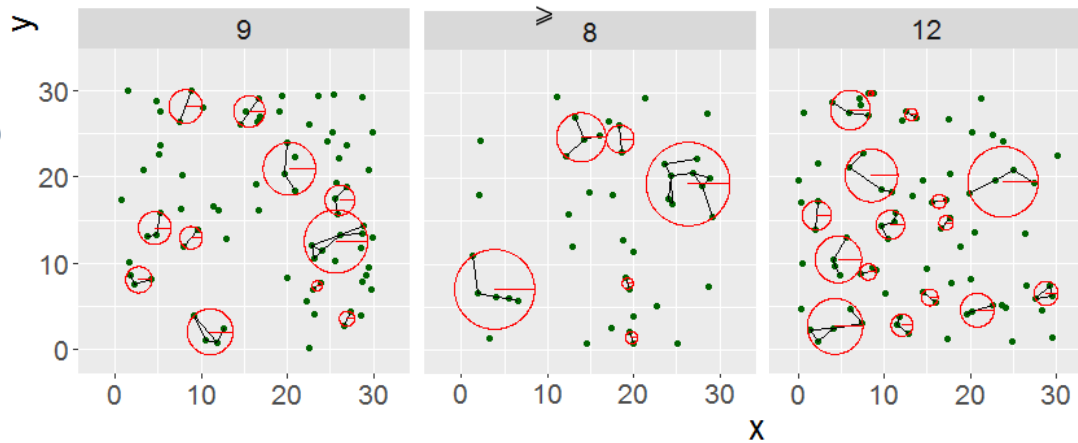
Root graft data represented as network

Network	**>>** Sampling plot
Node	**>>** Tree
Edge	**>>** Link between root grafted trees
Component	**>>** Group of linked trees

All networks are **undirected & unweighted**

# Nodes	27
# Links	15
# Groups	4
Edge density	0.043
Connectance	0.563
Mean distance	1.78
Mean diameter	3.25
% RG trees	66.7 %
# RG trees $\cdot$ ha^{-1}	200
# Groups $\cdot$ ha^{-1}	44.4

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VolkswagenStiftung

FOREST BIOMETRICS & SYSTEMS ANALYSIS

DRESDEN concept

Network data from **La Mancha**
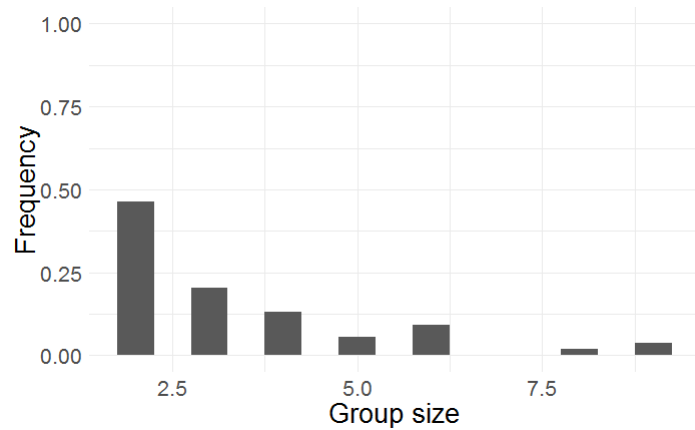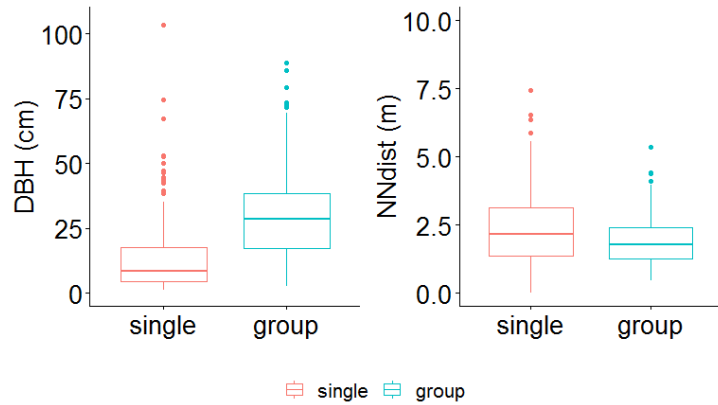
- 75% of grafted trees linked to closest neighbour
- linear structure
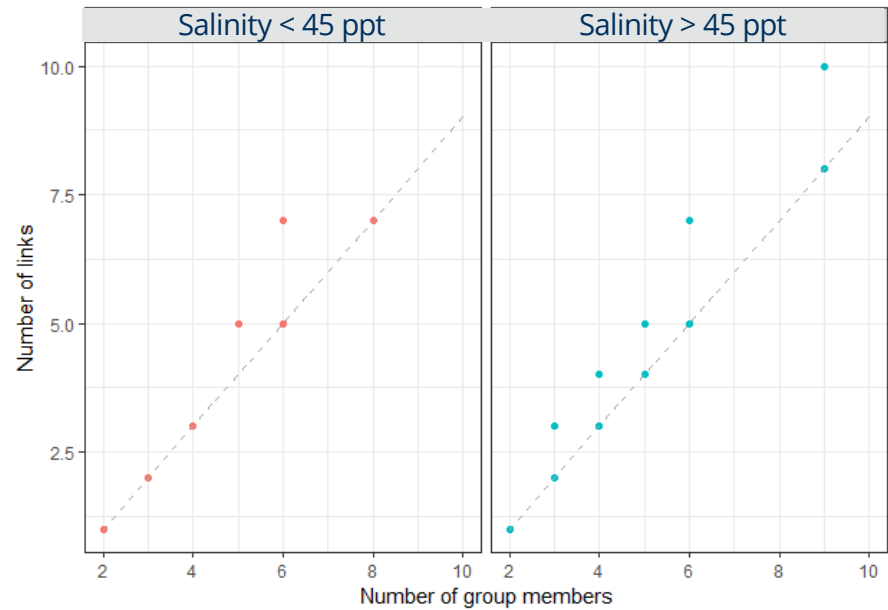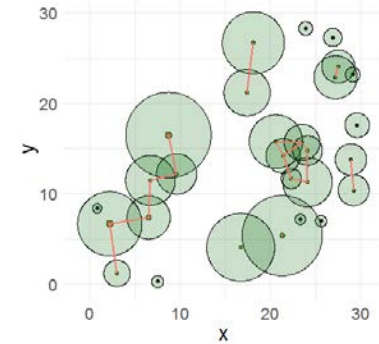
NULL model

Input: La Mancha data
- (x, y)

Random grafting
- each tree to one of its nearest neighbour
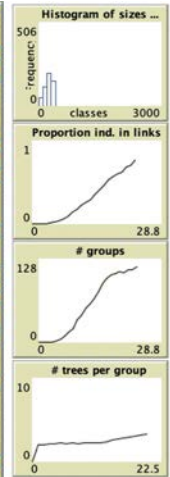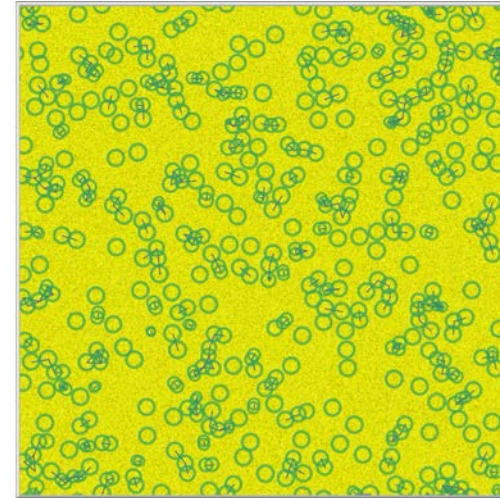- Random selection
- Probability according to field observations

Networks of
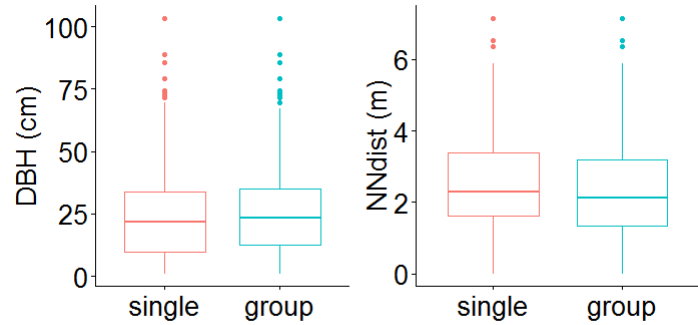La Mancha

randomness or process?
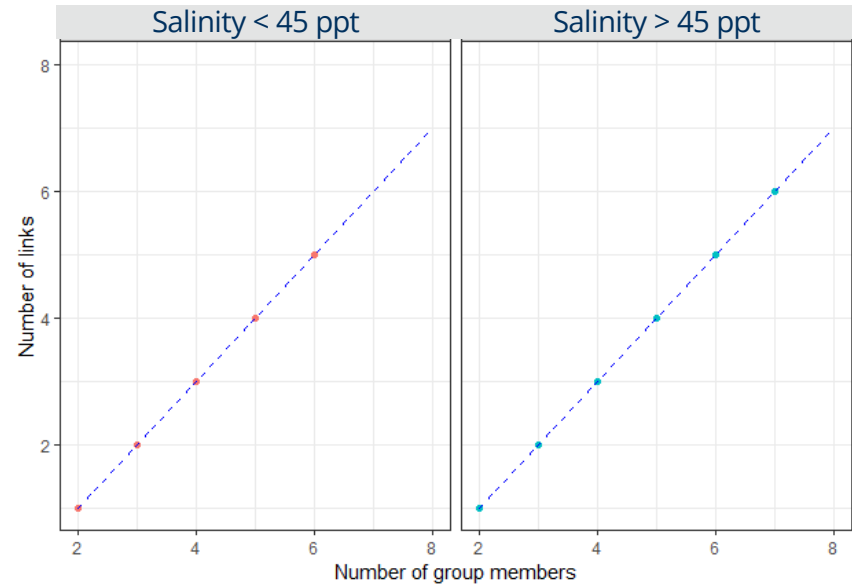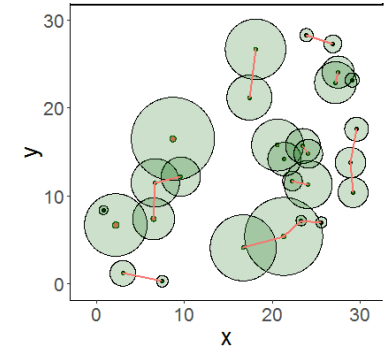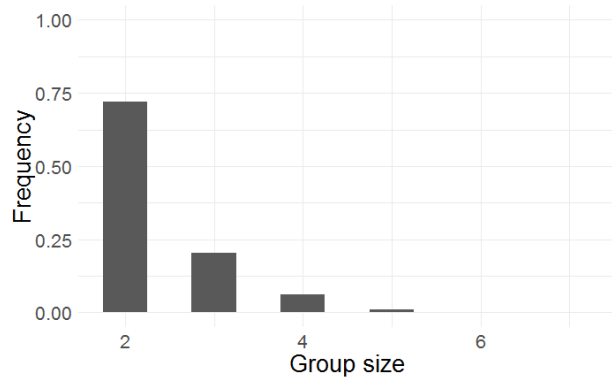
? **?**

AZOI forest model

Life processes of trees considered
1. Recruitment
2. Growth
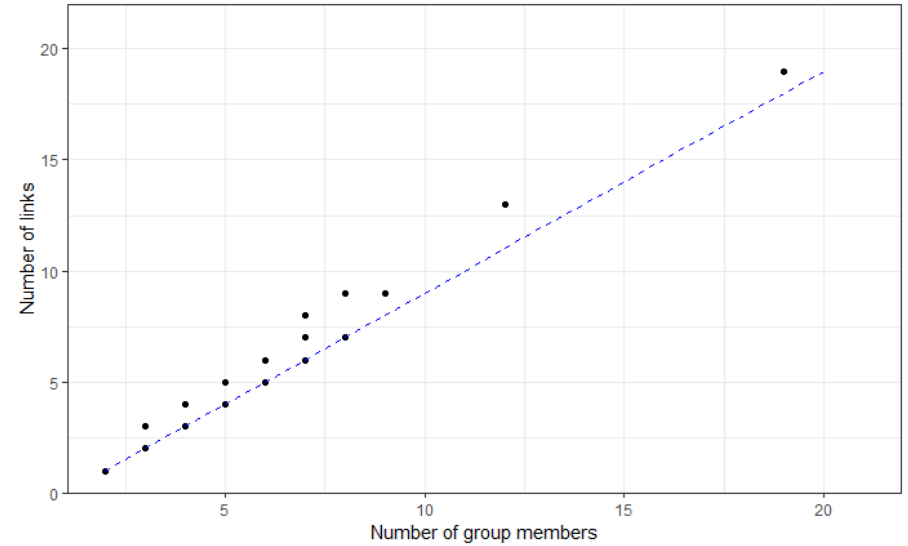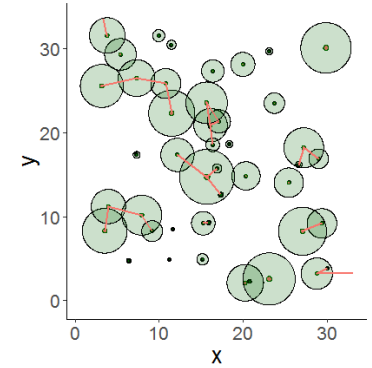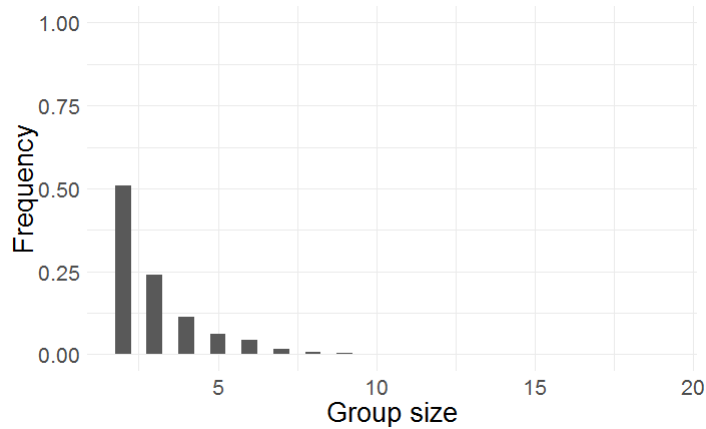3. Competition
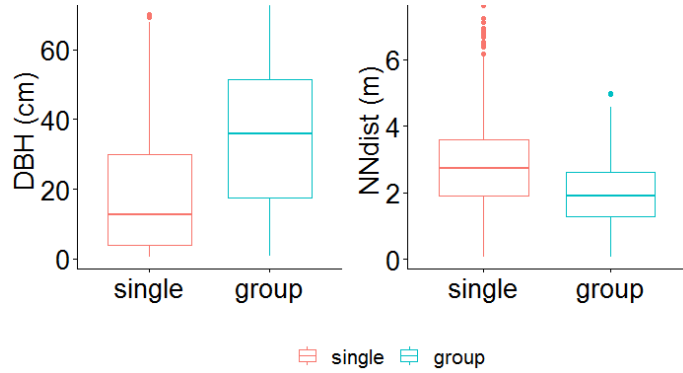4. Mortality
5. Grafting & Exchange of resources

Networking via root grafts. - Uta Berger   VolkswagenStiftung   FOREST BIOMETRICS & SYSTEMS ANALYSIS   Slide 9 (15)   DRESDEN concept

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Null model

AZOI Forest Model

Networking via root grafts. - Uta Berger

Direct comparison of La Mancha data with both models

group sizes of the networks

— La Mancha   — Random   — Not random
                        (NULL model)   (AZOI)

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DRESDEN concept

Direct comparison of La Mancha data with both models

Salinity > 45 ppt

Salinity < 45 ppt

Networking via root grafts. - Uta Berger
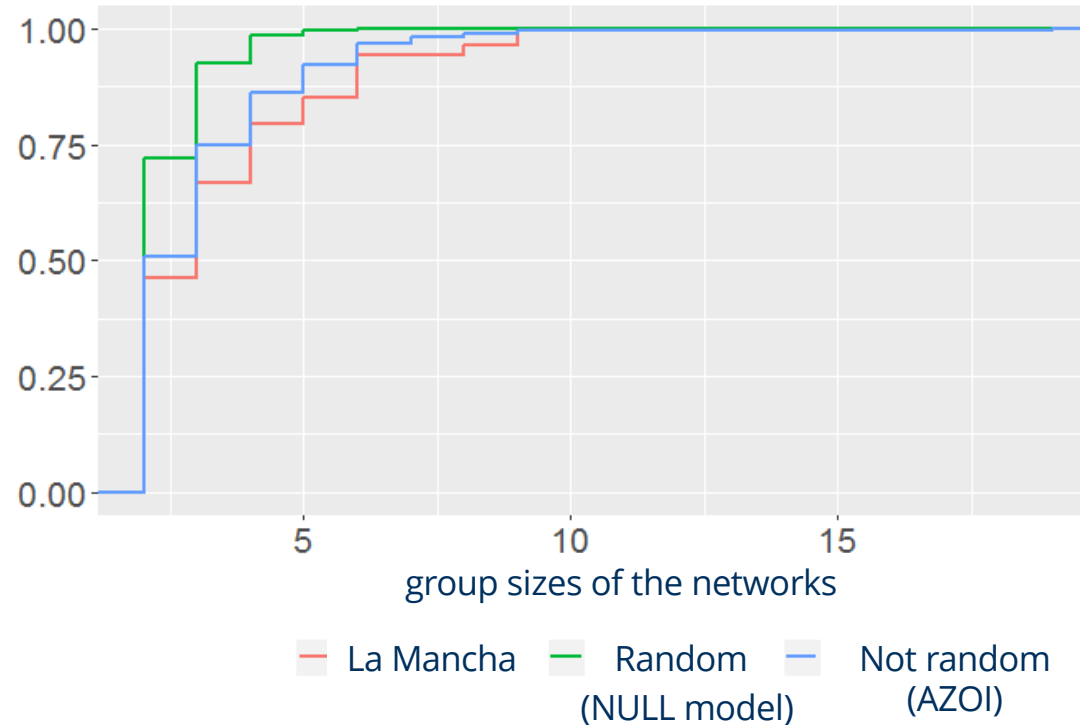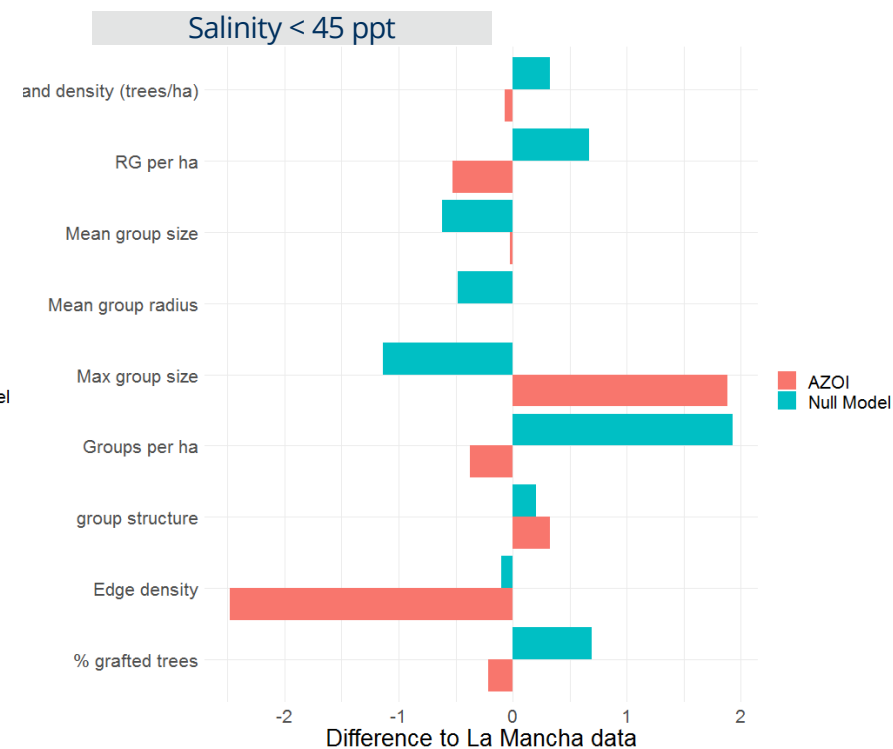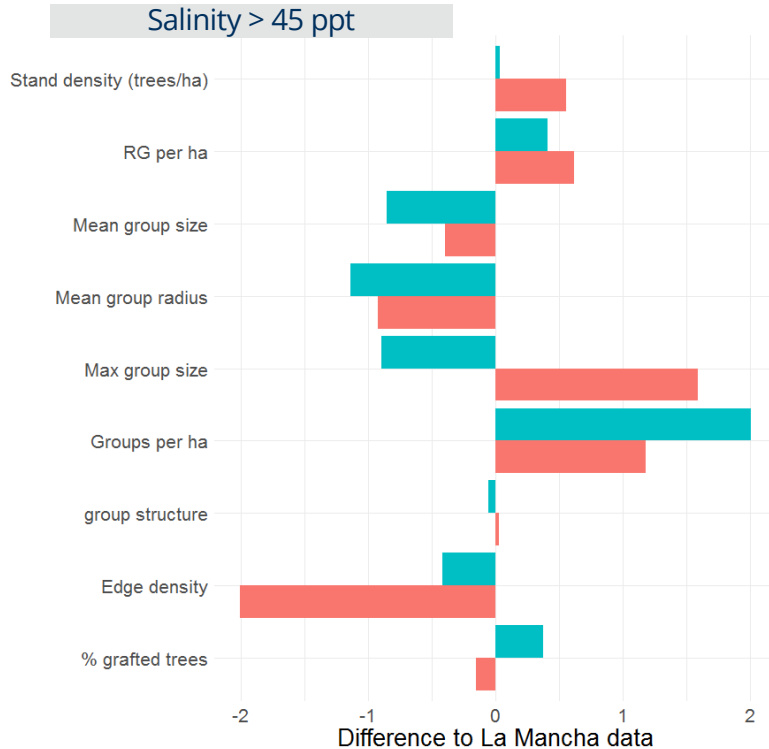
Grafts Interactions (GRIN project), funded by: Volkswagen Foundation [Az. 94844]
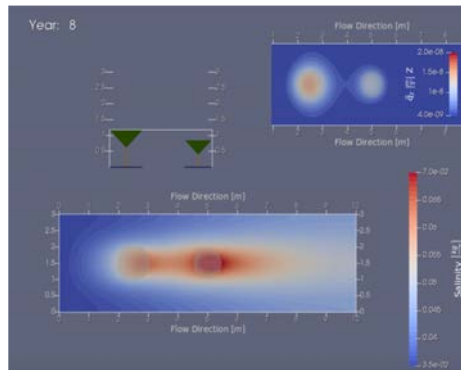
https://mangroverootnetworks.info/
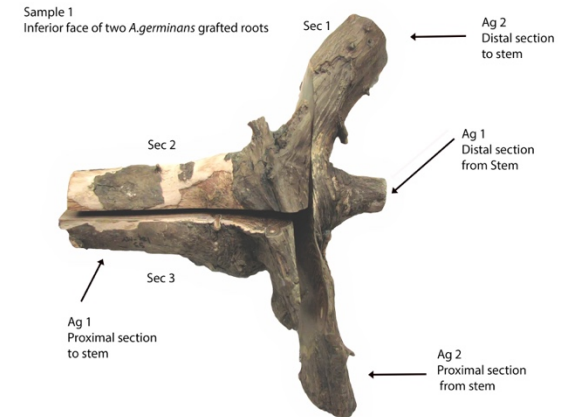
Outlook: MARZIPAN project (water – plant – interactions, founded bv German Research Foundation, DFG)
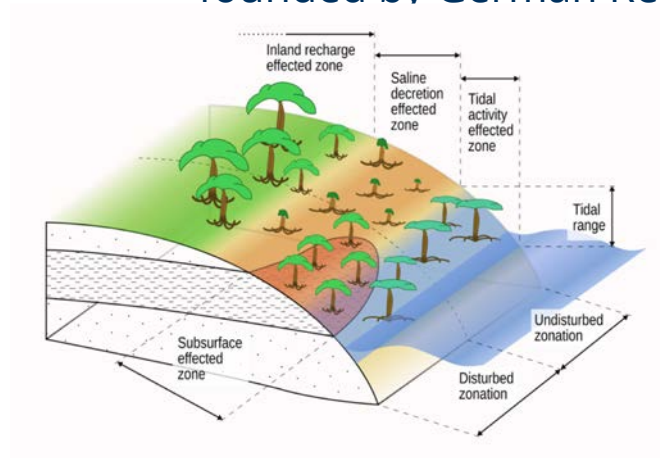
Ronny Peters (next but sick speaker)

Modelling the Effect of a Partial Dieback of *Avicennia* Trees as a Strategy to Survive Temporary Increases in Salinity

Jasper Bathmann (4th July, Session 6)

The Crucial Role of Tree-Soil-Water Feedback for Mangrove Zonation Patterns