Plants as ecosystem engineers in coastal landscapes
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Coastal ecosystem are often characterized by their vegetation. This vegetation provides a wide spectrum of valuable ecosystem services. However, increased disturbance and stress is threatening the stability of such ecosystems. It is therefore important to understand what mechanisms vegetation exert to influence their environment and how these mechanisms affect coastal ecosystems via landscape formation. In this colloquium landscape formation mechanisms are discussed via two sub-categories: the mechanisms that vegetation directly impose on the landscape and indirect effects on the landscape via mechanisms and processes on vegetation development and succession. In extension it is discussed how the mechanisms are affected when vegetation degrades and disappears. Ultimately these mechanisms are then taken into consideration for how coastal ecosystems can be conserved or restored. First this presentation discussed small-scale physical effects that emerge in the environment from the presence of vegetation. Then mechanisms behind distribution patterns are addressed providing causes for the emergence of spatial patterns in landscape formation. Thirdly it is discussed how vegetation composition and accompanying life-history traits affect landscape formation processes. Finally interaction between vegetation and other organisms and their effect on spatial patterns are examined. Next it was established how vegetation affect soil composition, provide shielding and induce self-facilitating feedback mechanisms, making the environment more habitable for other vegetation. These feedback loops are consecutively used to explain processes that occur once vegetation degrades. Examples are shown of how negative feedback loops change existing ecosystems and allow other ecosystems to encroach on the original ecosystem. In the end methods are discussed which can help reduce disturbance and reintroduce the positive feedback mechanisms that stabilize coastal ecosystems.
Vegetation in coastal landscapes

- Foundation species
- Identity ecosystem
Vegetation in coastal ecosystems

- Nutrient Cycling
- Water Purification
- Carbon Storage
- Flood protection
- + Tourism
- + Biodiversity
Coastal ecosystems under pressure

- Resource extraction
- Landscape modification
- Eutrophication
- Acidification
- Climate change
- Sea-level rise
How does vegetation cope with this external harassment?

- Role of coastal vegetation
- Processes underlying the role of vegetation in coastal areas.
- Implementation of vegetation processes in conservation / restoration efforts.
How does vegetation influence the formation of coastal ecosystems?

What mechanisms/processes drive vegetated landscape formation?

What mechanisms/processes drive vegetation development and succession in coastal ecosystems?
How does vegetation influence the formation of coastal ecosystems?

What processes/mechanisms take place in coastal ecosystems when vegetation is lost?

What requirements need to be met to restore/conserve vegetation in coastal ecosystems?
Physical impact of vegetation\textsuperscript{1,2}

- Flow pattern changes
- Reduced erosion
- Increased sediment deposition
Physical impact of vegetation

- Sediment stability
Spatial impact of vegetation

• Vegetation propagation
• Seed germination
Spatial impact of vegetation\textsuperscript{1,4}

- Vegetation expansion
Spatial impact of vegetation

- Landscape patterns
Spatial impact of vegetation

Interspecific interactions with grazers
Vegetation composition and landscape formation\textsuperscript{8}

- Plant traits affect geomorphology
- Life history traits > Plant characteristics

Landscape formation mechanisms
Vegetation development and succession

- Vegetation develop landscape
- Vegetation part of landscape
- Interactions within vegetation
Soil development by vegetation

Landscape changes -> Soil composition changes
Soil composition vital for vegetation
Vegetation development + succession

Vegetation shielding

- Reduce direct hydro/aerodynamic stress
- Protect shore-vegetation
Intraspecific feedback mechanisms

- Ameliorate environment
- Harbor protecting organisms
Ecosystem changes after vegetation loss

Geomorphologic changes
Soil degradation after vegetation loss

- Soil composition change
- Soil capability change
Coastal ecosystems after vegetation loss

• Physical protection loss

• Soil stability loss
Ecological community changes

Physical properties change -> community changes
Other ecosystem forms encroach
Ecological community changes

Physical properties change -> community changes
Other ecosystem forms encroach
Vegetation requirements for conservation/restoration\textsuperscript{13}

- Vegetation production very resilient but biodiversity not
- Ecosystem functions preserved via feedback mechanisms
Identifying threatened areas

• When is vegetation declining?
Decrease disturbance

- Remove structures hindering water/air flow
- Reduce salinity
Vegetation conservation and restoration

Accommodate vegetation growth$^{2,14}$

- Artificial sediment deposition
- Re-introduce native vegetation
Vegetation effects on landscape

- Vegetation affect abiotic context of landscape
- Life-history traits central for landscape development
- Feedback mechanisms determine the stability of the ecosystem
- Loss of vegetation reshapes coastal landscape
- Vegetation resilient but not all-solving
References


References


