Overstory-Understory Interactions along Flooding Gradients in Everglades Tree Islands

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Understory vegetation & its importance

Contains 4.7% total aboveground biomass in managed forests in US (Smith et al. 2013)

Nutrient dynamics, forest regeneration, & forest succession. (Nilsson & Wardle 2005)

Understory Vegetation (shrubs, forbs, graminoids, & seedlings)

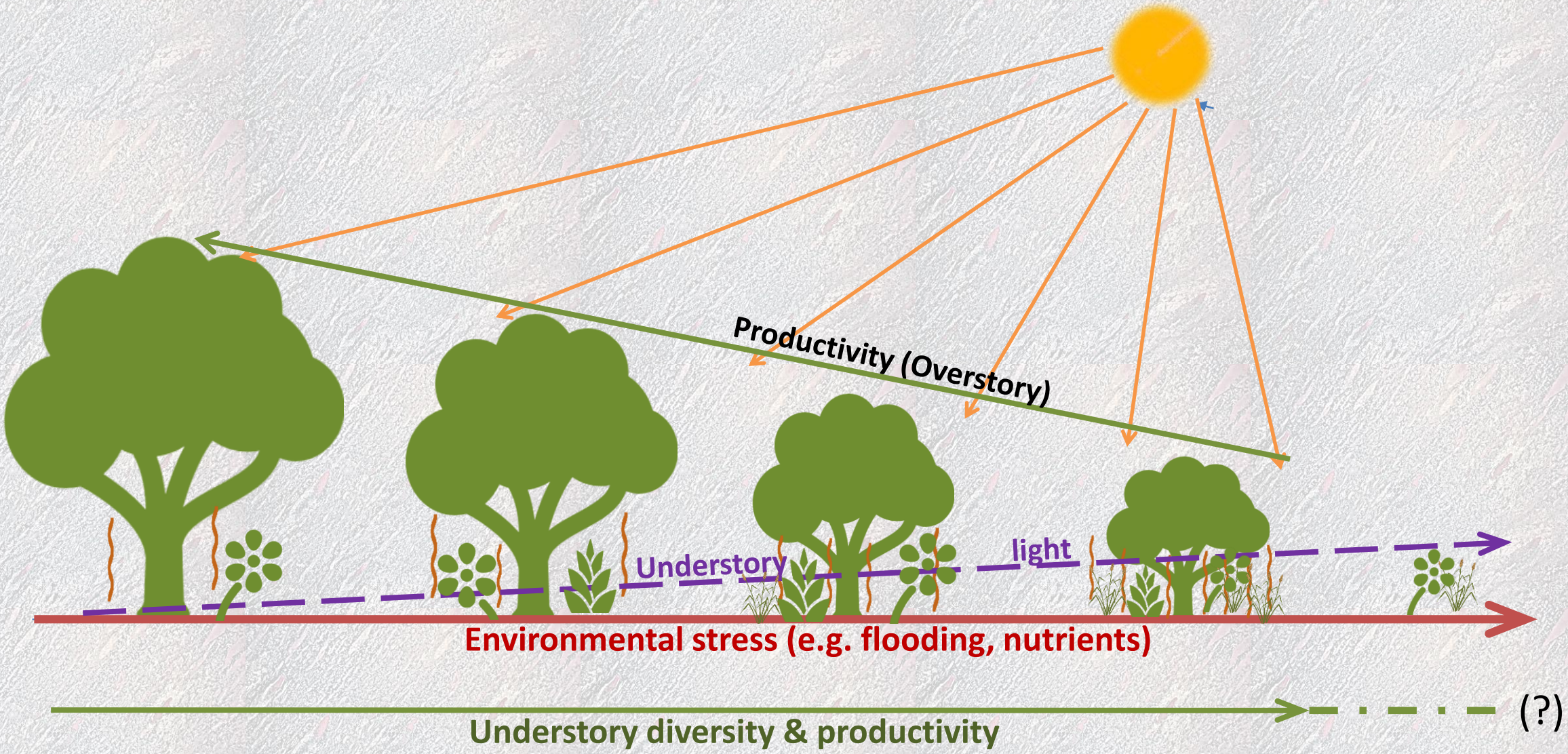
Provides NTFPs - medicines, fodder, fibers, etc.

Provides shelter and food resources for wildlife species, affecting their diversity and abundance (Hagar 2007)

In forest ecosystems:

- **Understory, especially herbaceous layer vegetation may,**
  - contribute up to 20% of nutrient-rich foliar litter to the forest floor
  - contain up to 90% of plant diversity (Gilliam 2007)

Overstory-Understory interaction along gradient



Everglades tree islands

- **A patch of broadleaf forest embedded within non-woody vegetation types, typically a freshwater or brackish marsh**

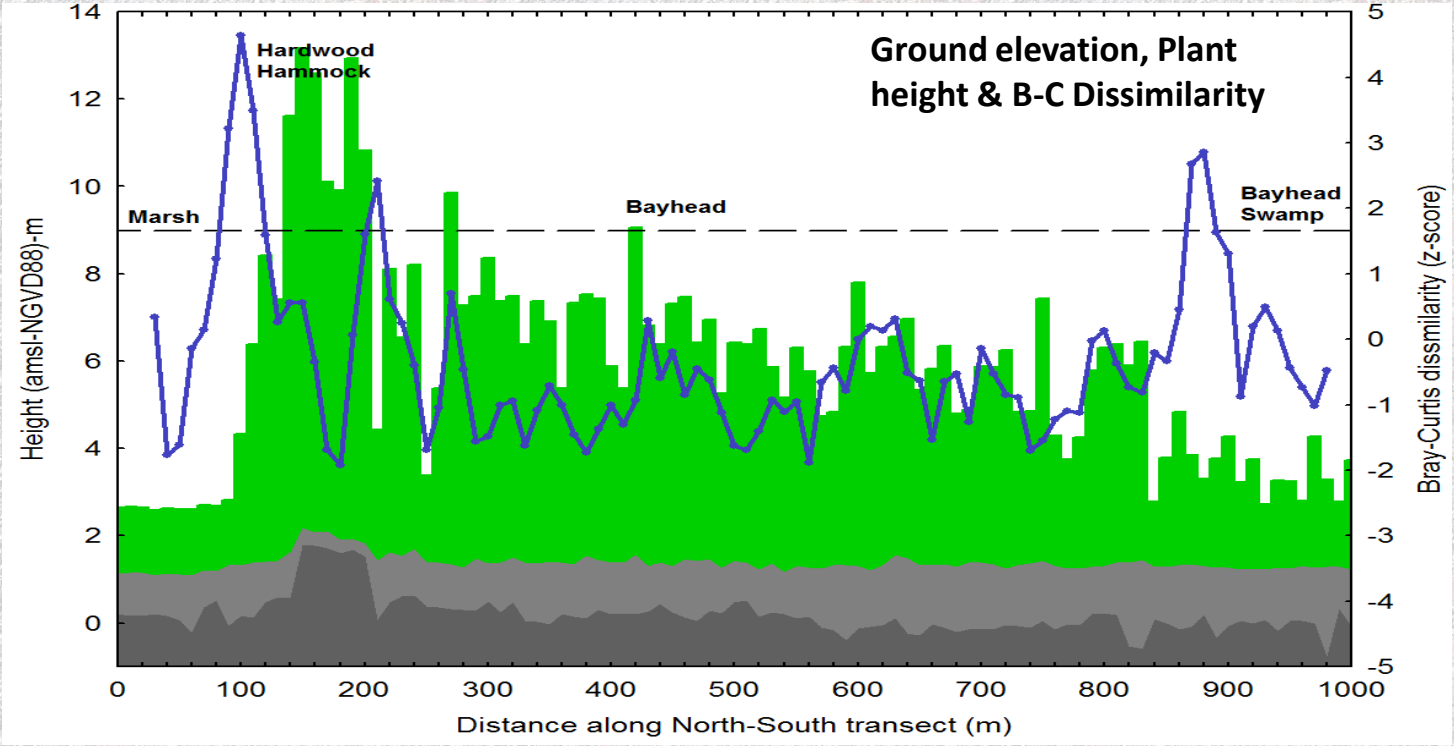
Tree islands

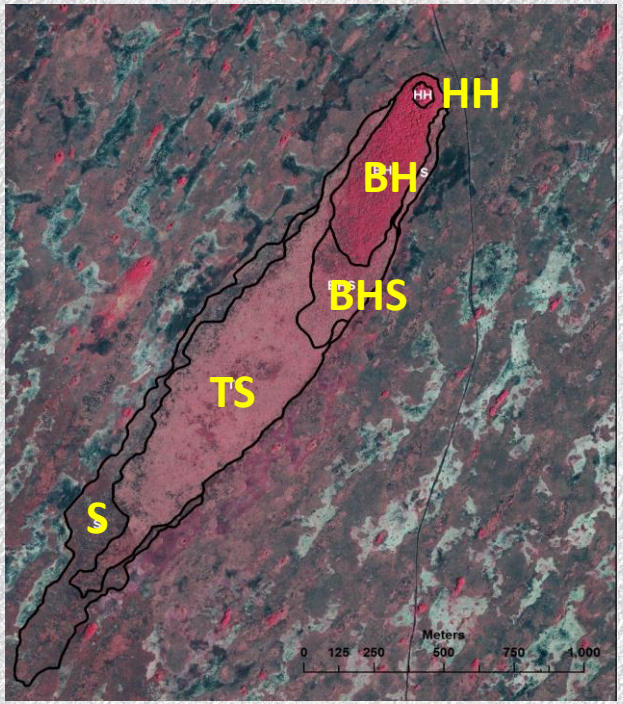
Ridge & Slough landscape

Marl prairie landscape

Tree islands are focal communities in the restoration efforts currently underway in the Comprehensive Everglades Restoration Plan (CERP).

Plant communities on a Shark Slough Tree Island



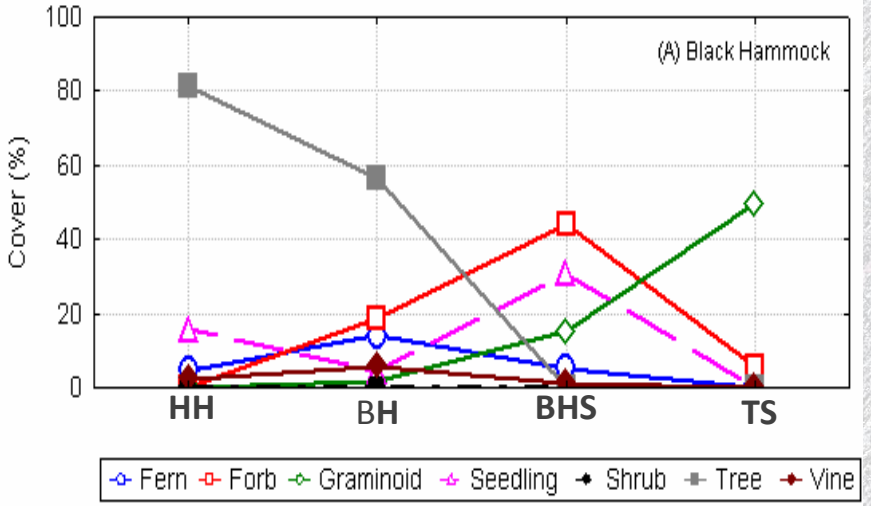


HH = Hardwood Hammock
BH = Bayhead Forest
BHS = Bayhead Swamp
TS = Tall Sawgrass
S = Sawgrass marsh

Hardwood Hammock

Bayhead

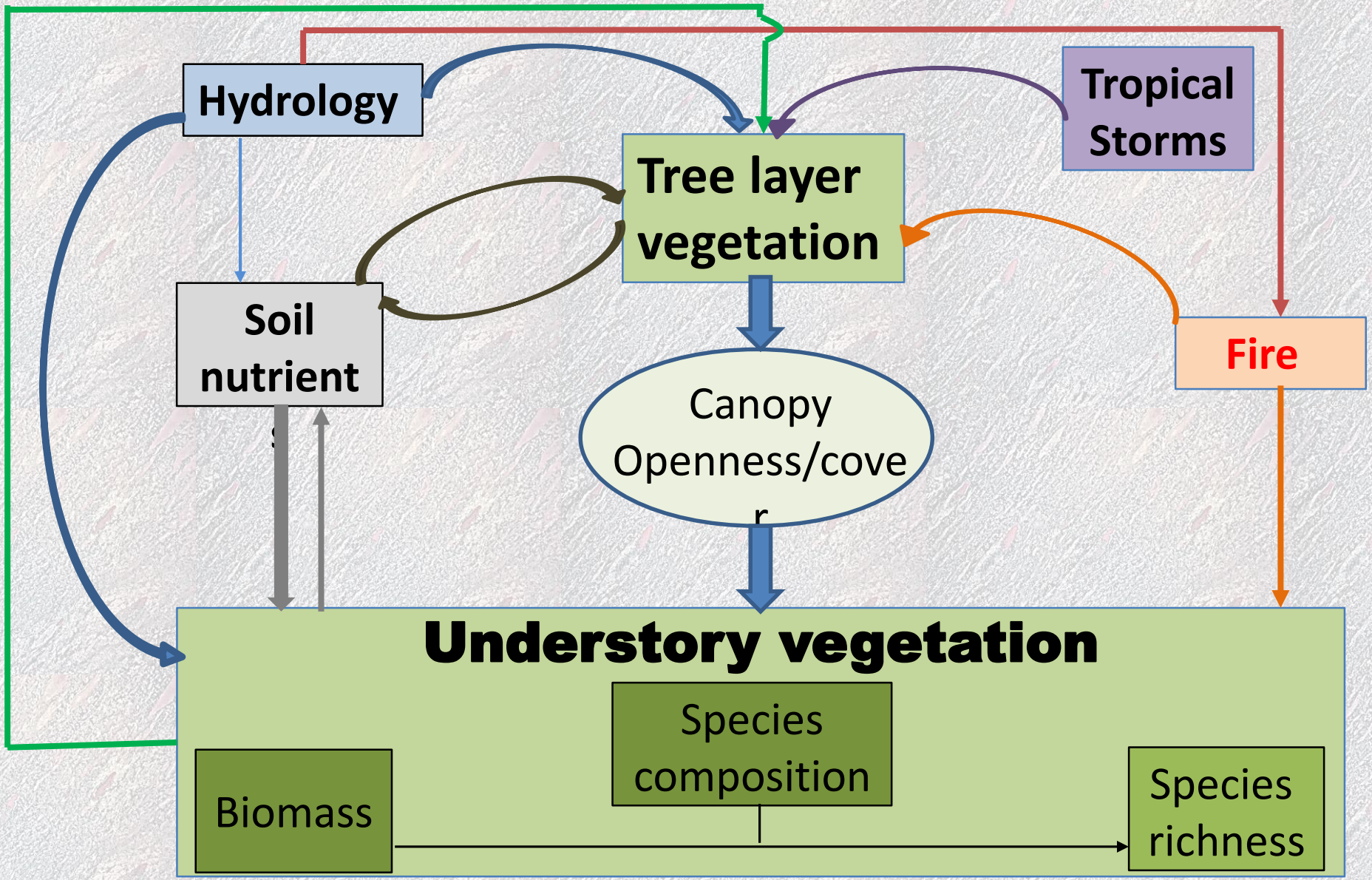
Bayhead Swamp



Sah et al. 2018)

Plant communities in and around tree islands - different stages of vegetation succession in ridge & slough landscape

Overstory-understory vegetation interaction in tree islands



Overstory-understory vegetation in tree islands

Questions:

a) How do the canopy cover and hydrology interact to influence understory species composition and diversity along a flooding gradient?

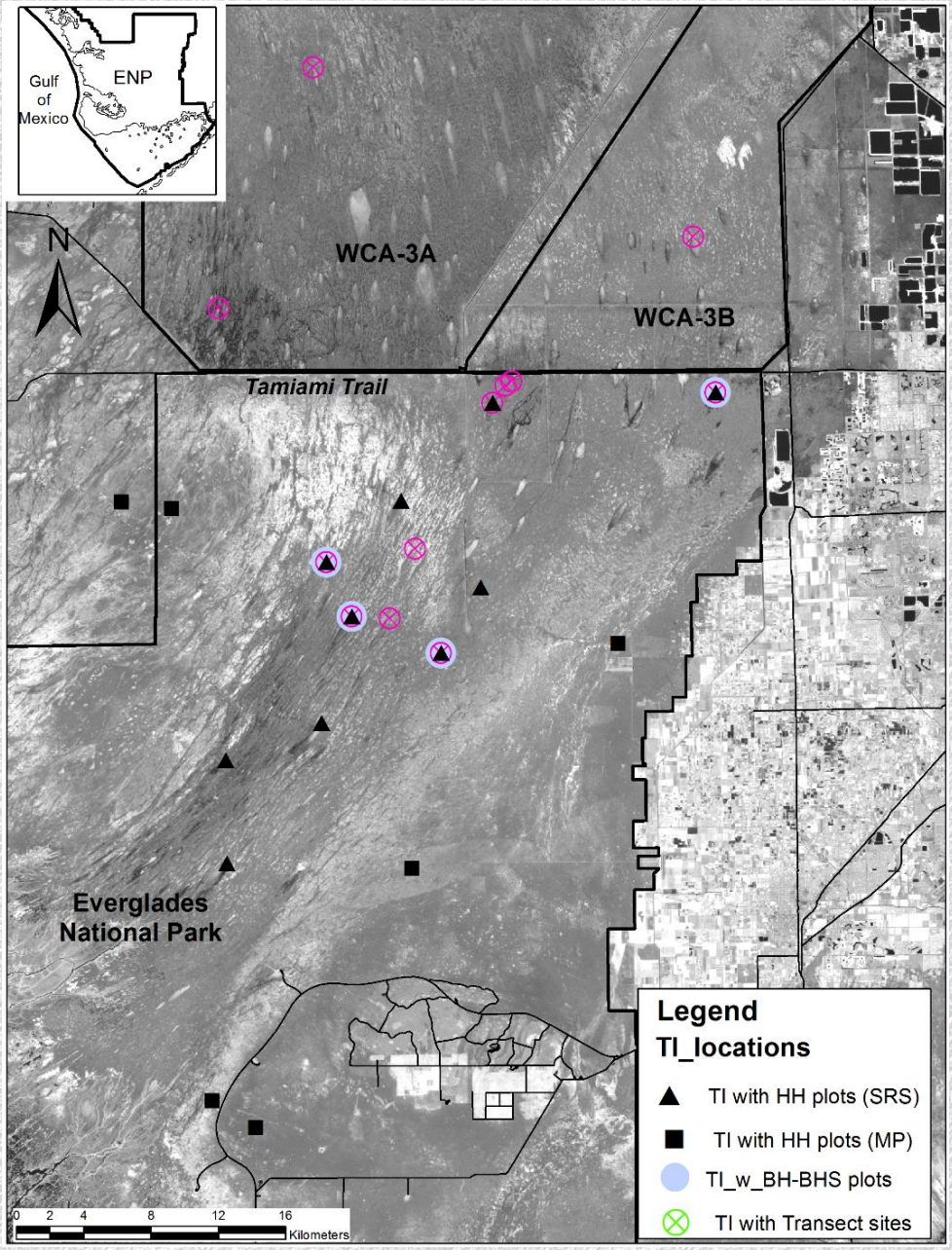
b) Is there a shift in their relative importance in affecting understory vegetation along the gradient?

Hypotheses:

a) Variation in understory plant community composition along a hydrologic gradient also depends on the overstory structure and composition

b) Canopy cover (shade) influences understory species composition more in elevated portions of the topographic gradient, with shorter periods of inundation, than in areas with prolonged hydroperiod.

Method: Study area



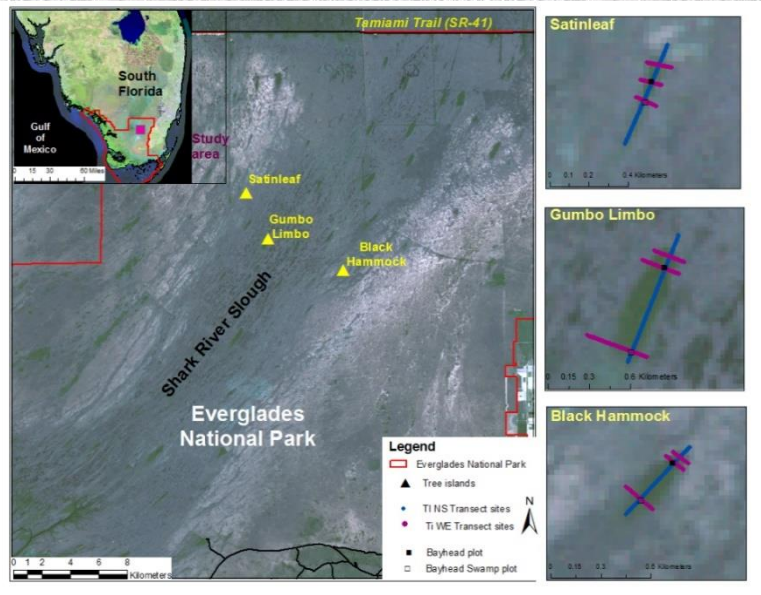
Within permanent plots (with 5 x5 m subplots)

Trees and saplings within 5 x 5 m sub-plot, shrubs and herbs in 1 m and seedling in 0.57 radius sub plots, respectively

Along transect:

Vegetation sampling in nested circular plots at 5 to 30 meter intervals

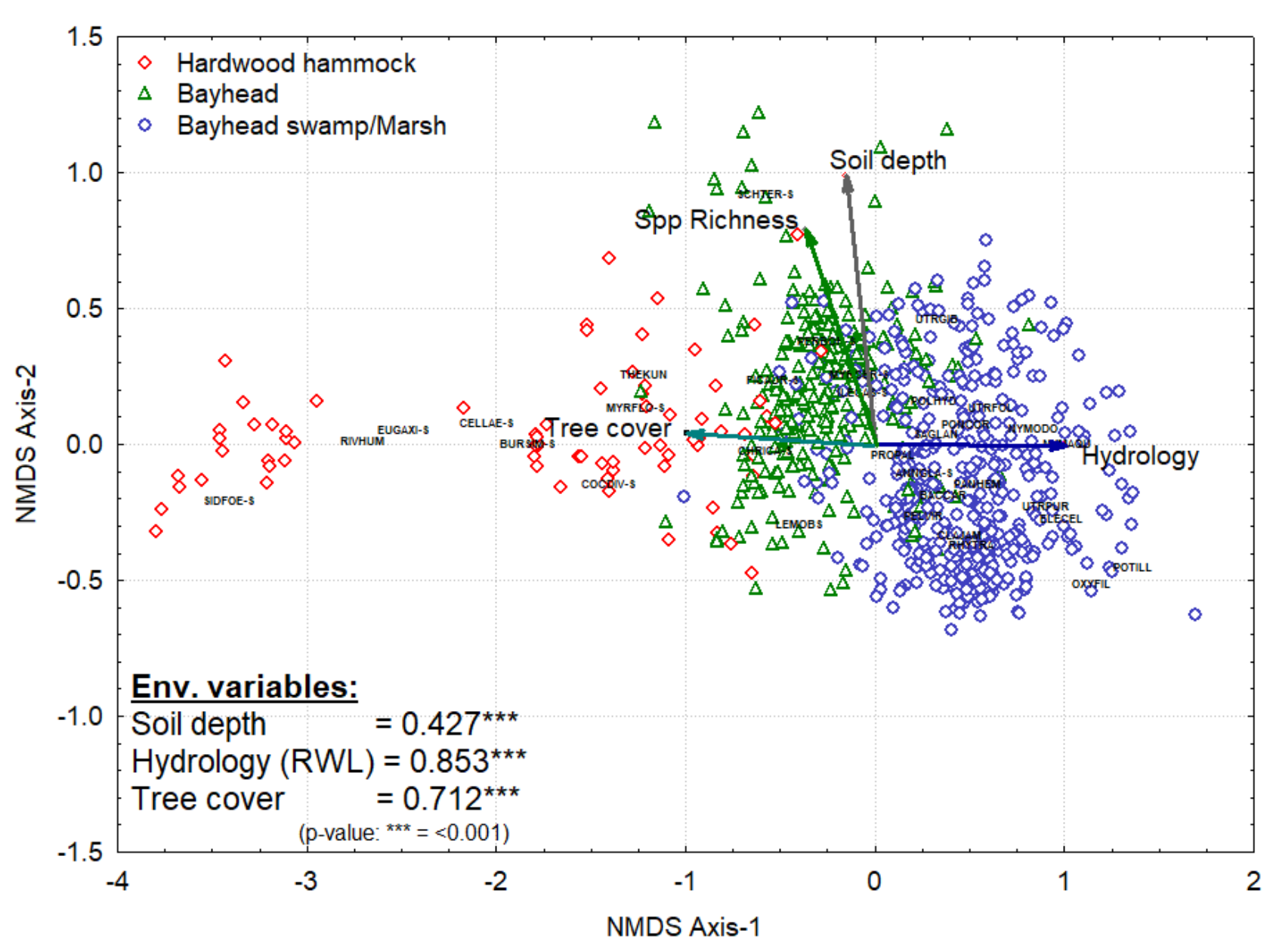
Trees and saplings in 2.5 m, shrubs and herbs in 1 m, and seedling in 0.57 m radius sub plots, respectively



In three tree islands,

transects (W-E), and Bayhead & Bayhead swamp plots sampled twice (2000/01 & 2011/12)

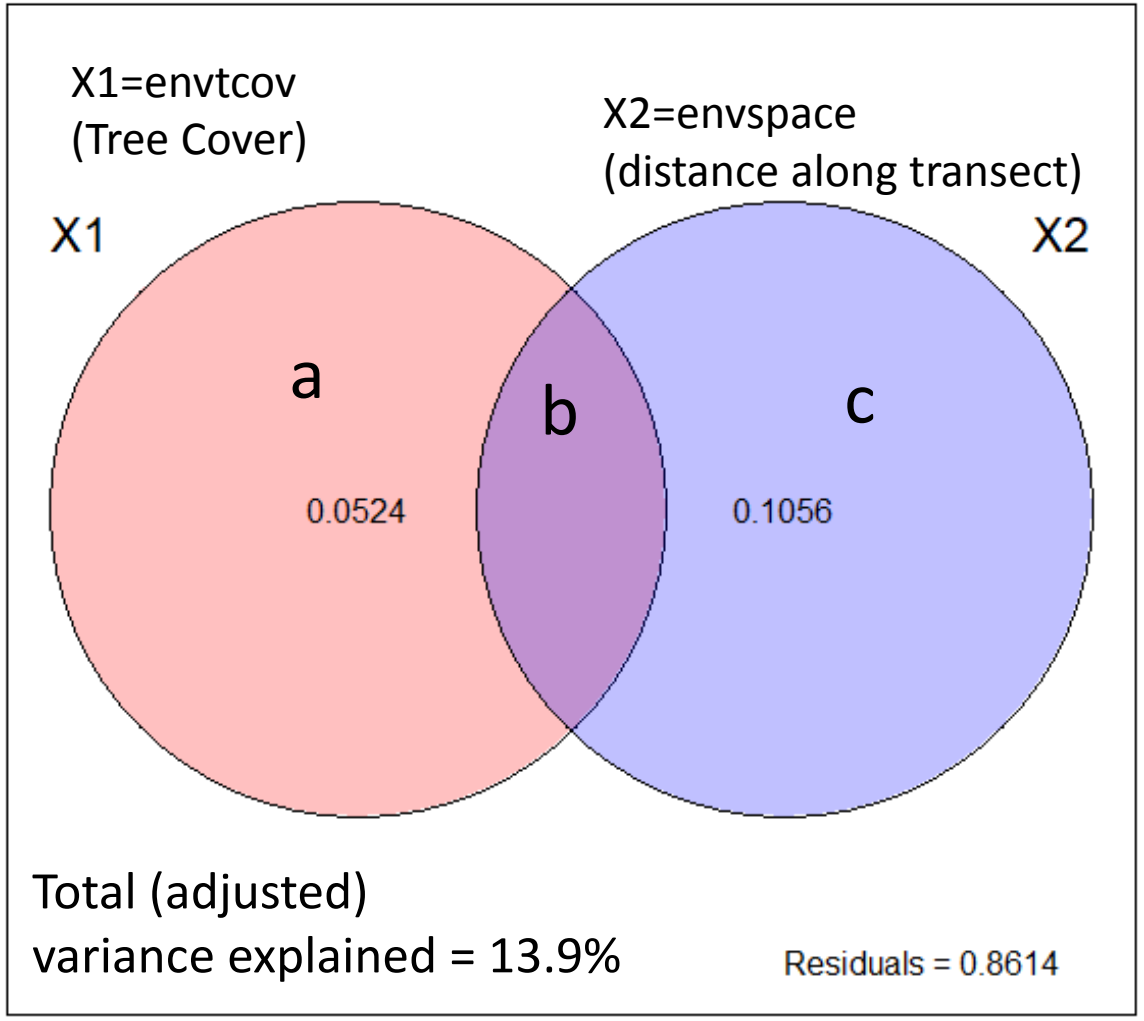
Results

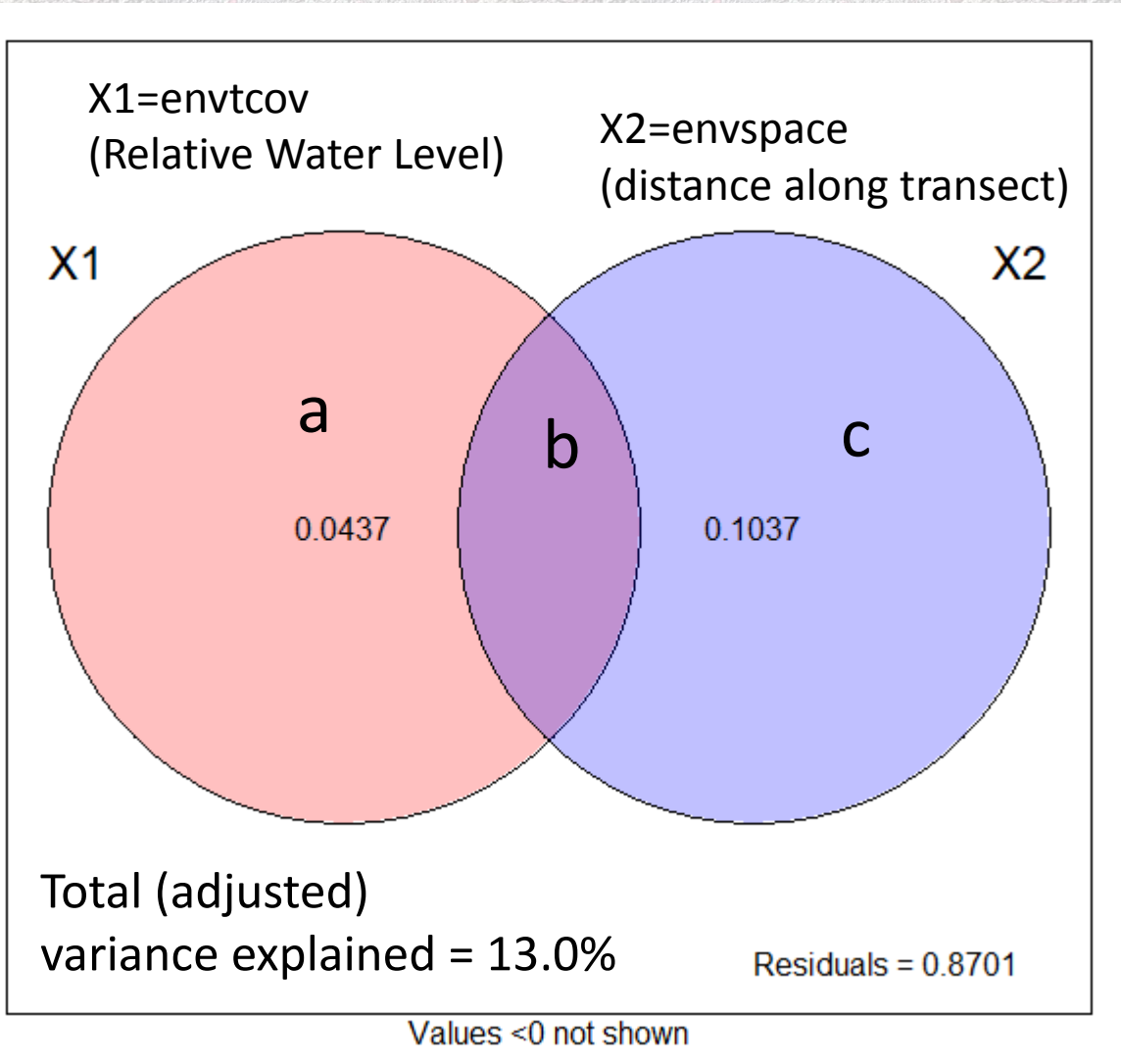


Tree cover varied along the hydrology gradient

Both hydrology and tree cover had strong effect on understory vegetation composition

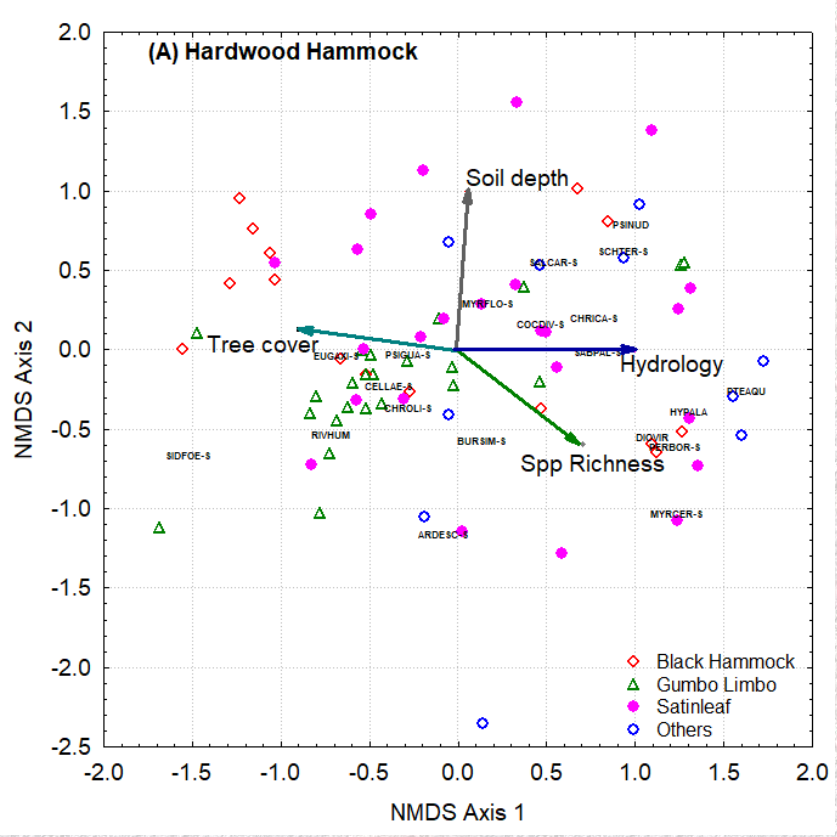
Results

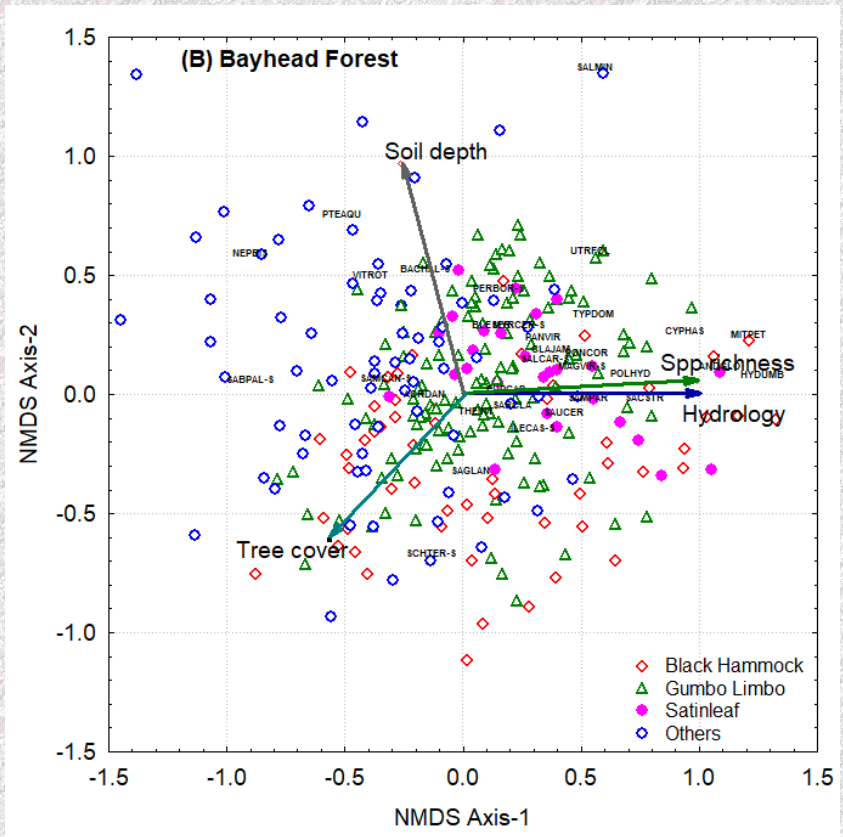


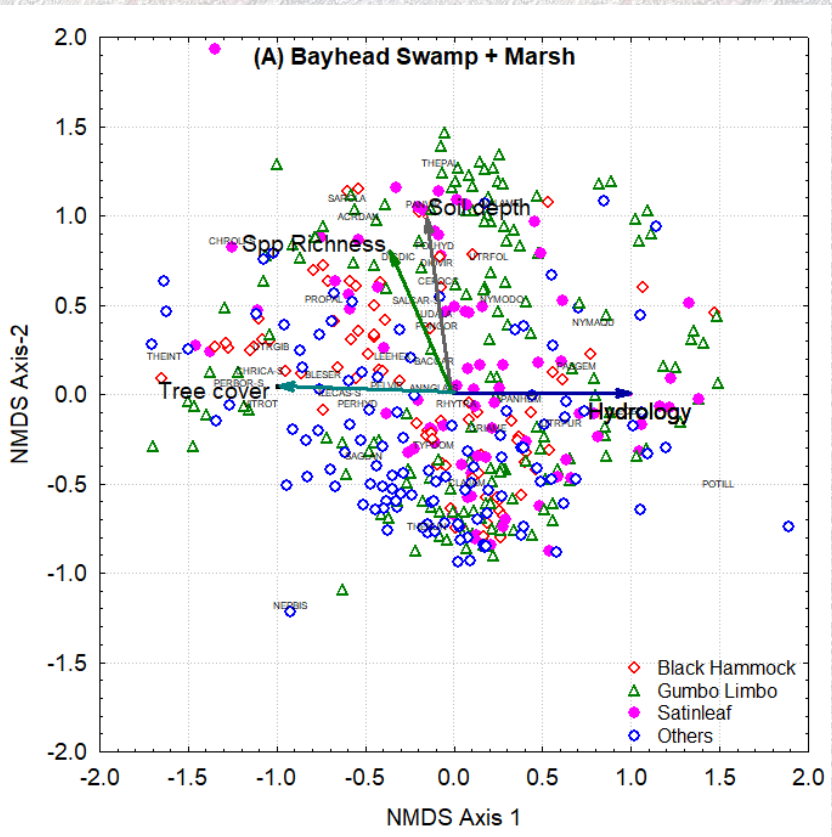


Along the gradient within an island (e.g. Gumbo Limbo) tree cover explains relatively higher variation in understory composition than relative water level.

Results



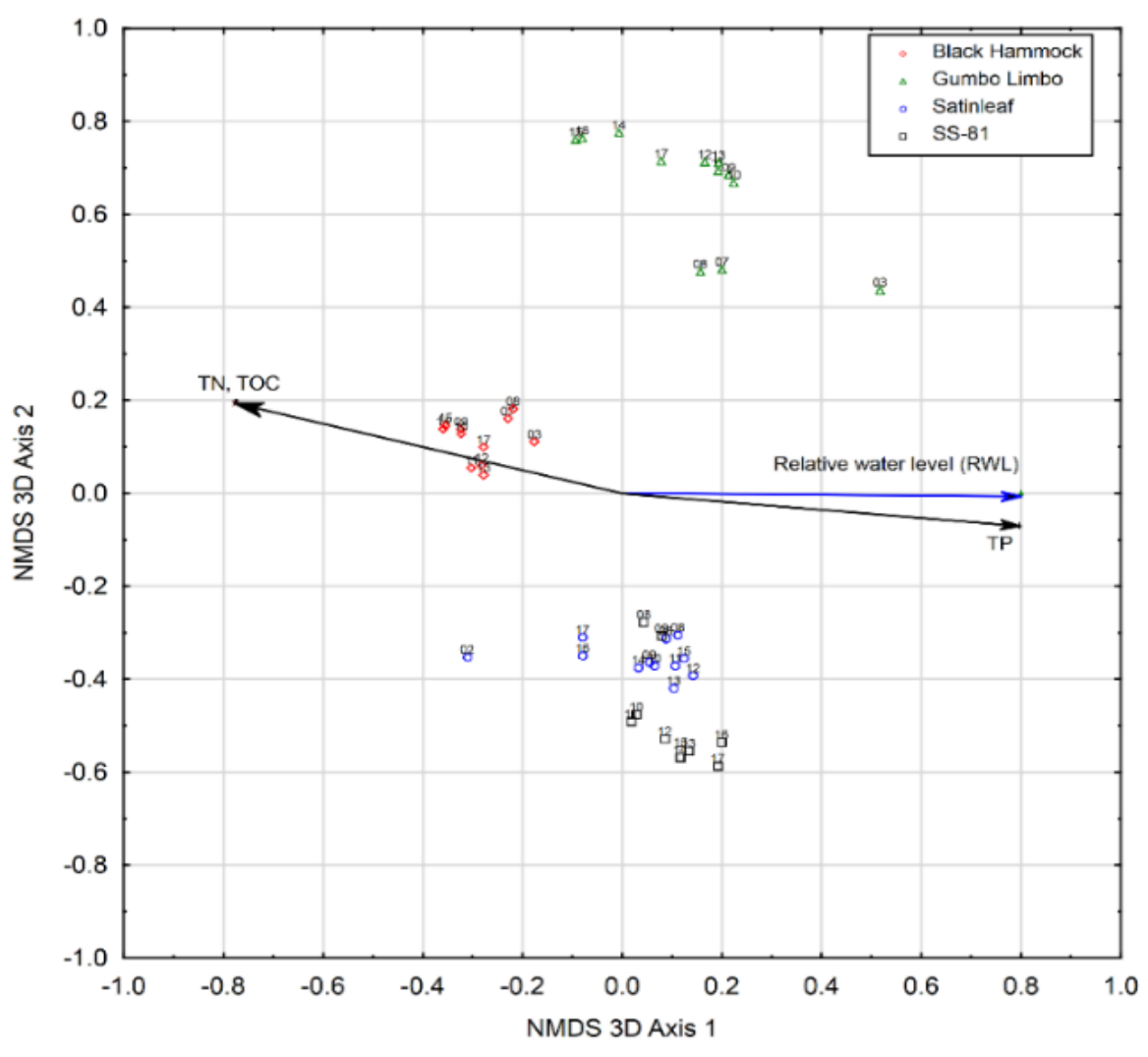


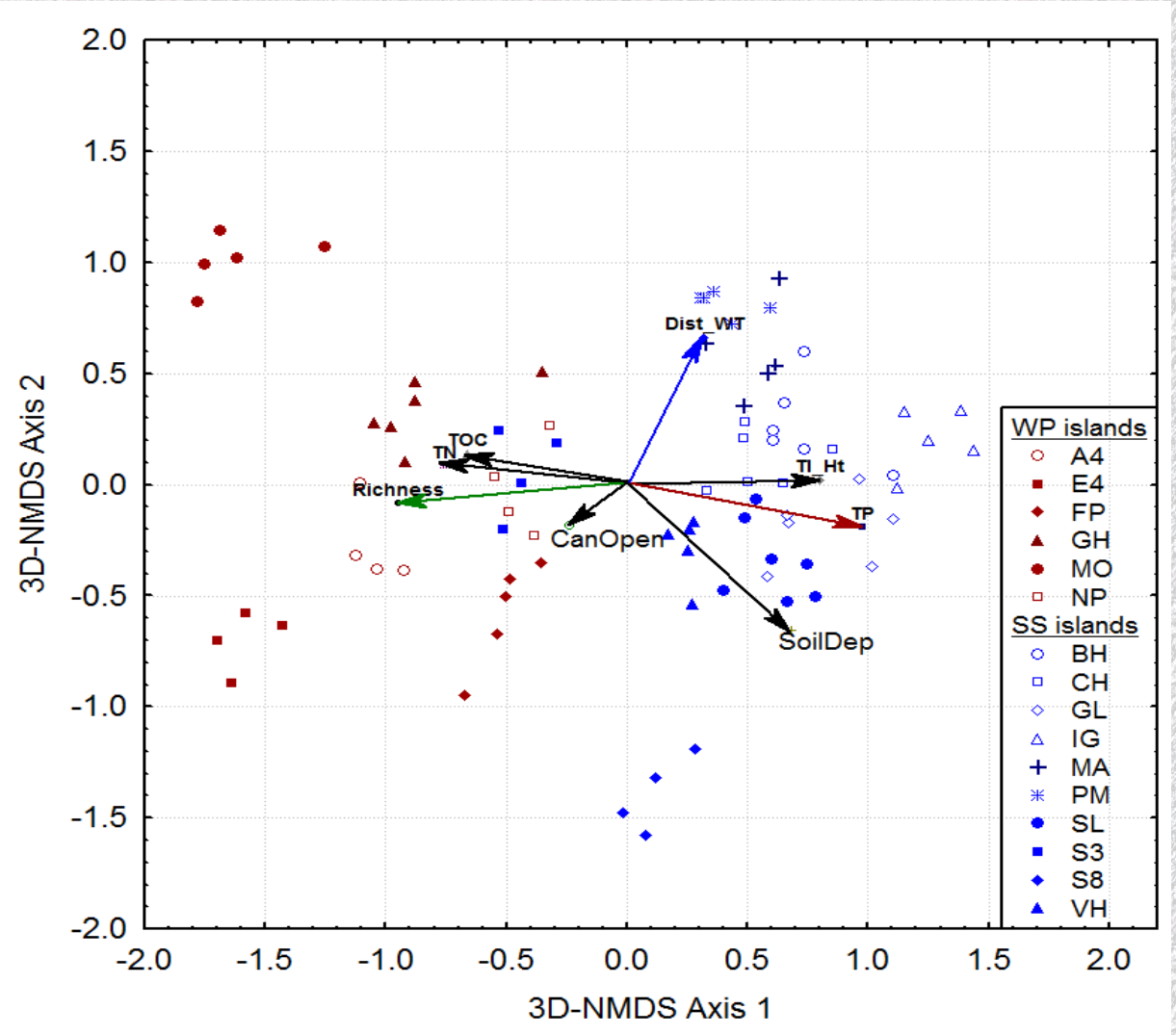


Env. Variables	HH	BH	BHS + M	HH	BH	BHS + M
Soil depth (cm)	0.35 ± 0.15	0.96 ± 0.36	0.75 ± 0.40	0.205^{ns}	0.435***	0.257***
Hydrology (RWL) (cm)	-53.9 ± 23.5	4.0 ± 12.6	19.2 ± 11.6	0.761***	0.201*	0.543***
Tree cover (%)	93.6 ± 45.8	70.5 ± 41.2	12.4 ± 20.9	0.591***	0.455***	0.491***

Correlation coefficient (r): p-value* <0.05, **<0.01, ***<0.001

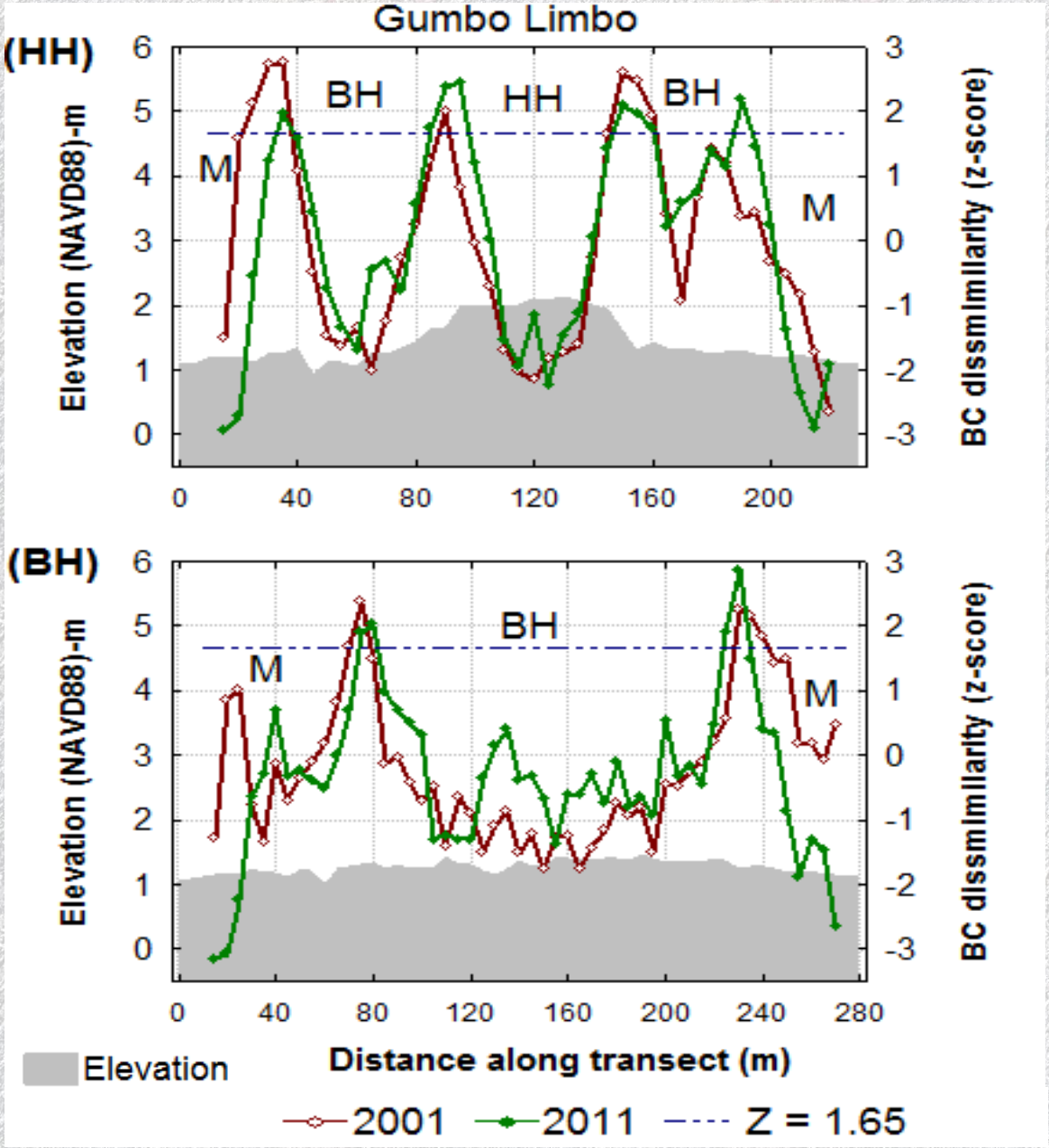
Results

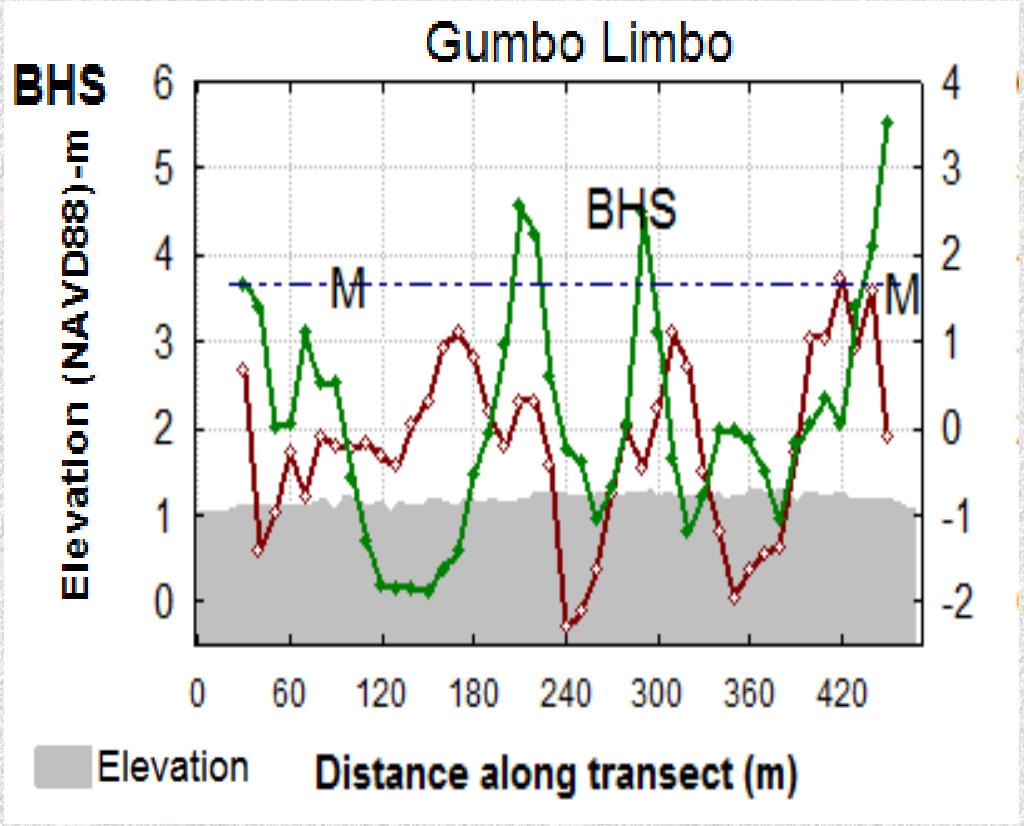




As canopy cover changes over time, understory vegetation composition also responds to such changes.

Results

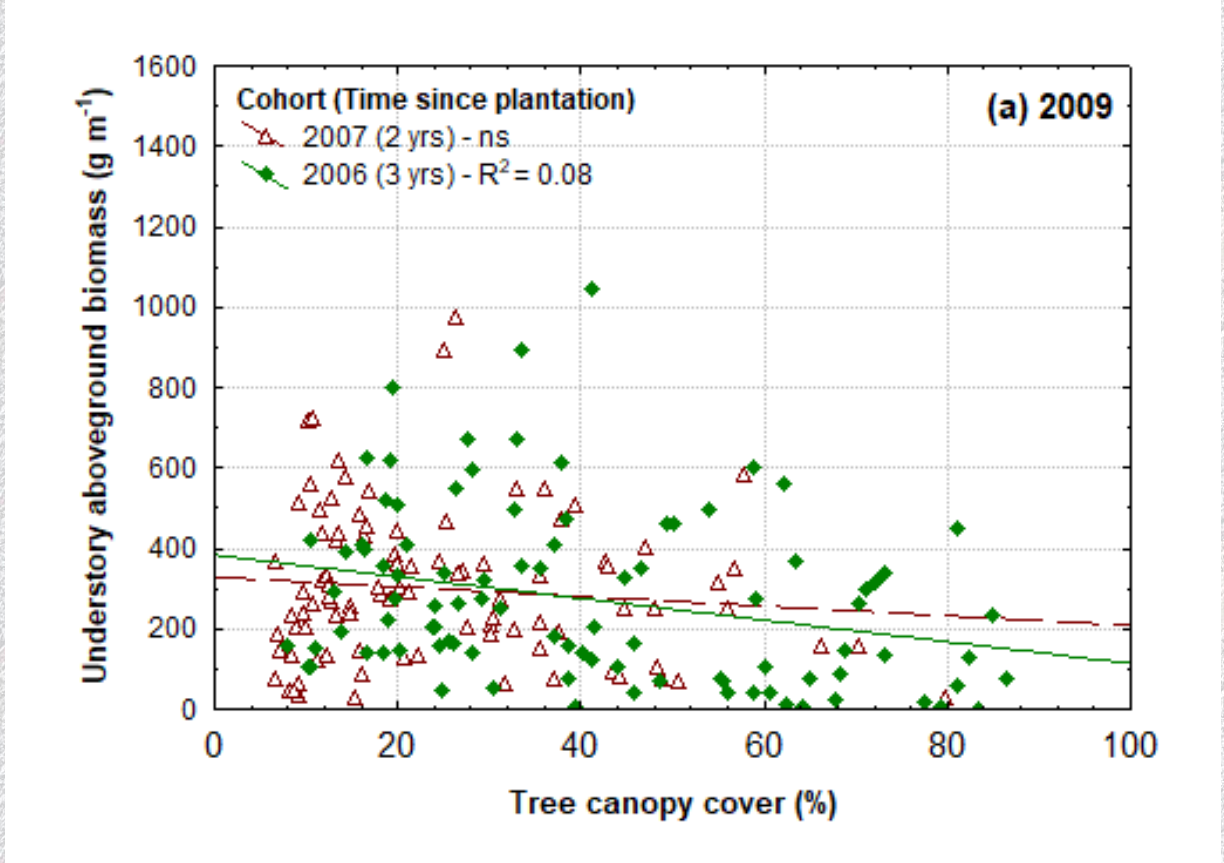


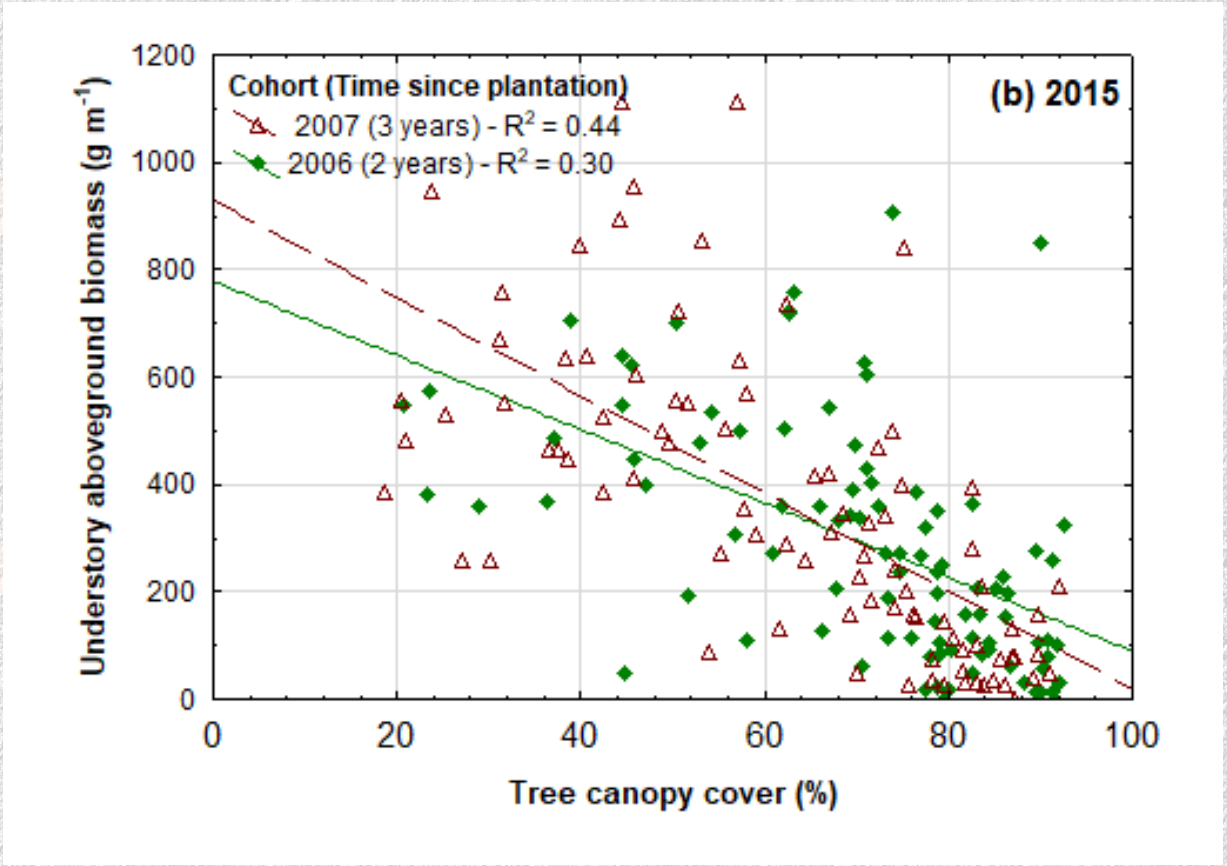


Changes in boundaries' position and attributes (sharpness) are usually minimal along hardwood and bayhead transects. But, the changes in boundaries' attributes and positions can be noticeable along bayhead swamp (BHS) transect, suggesting rapid changes in vegetation (including understory) composition in wettest part of islands.

(Sah et al. 2018)

Results





In the tree islands, as the forest develops (For instance, LILA site) or recovers from disturbance, inverse relationship between canopy cover and understory biomass becomes stronger.

Conclusions

a) Variation in understory plant community composition on tree islands depends on both hydrology and the overstory vegetation structure.

b) Canopy cover has relatively strong effects on understory species composition in elevated portions of the topographic gradient in tree islands.

c) In response to a change in hydrological condition over a decade, a shift in boundary in bayhead swamp (BHS) portion of tree islands where tree cover is relatively less suggests that change in ground layer (understory) vegetation is also important in tree island dynamics.

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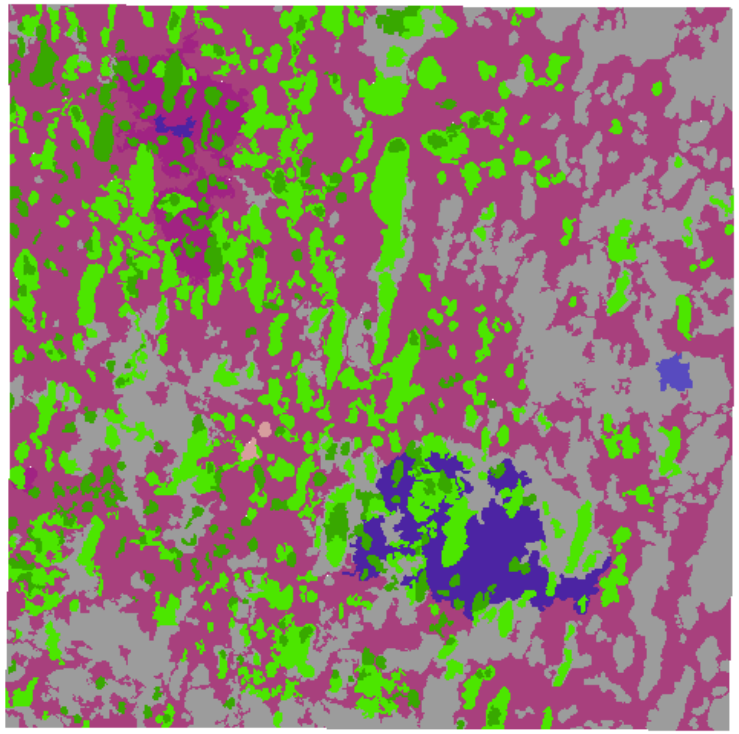

Thank you

Questions?