

Geology and tree species distributions in tropical forests of Panama

Beta-diversity in species-rich forests

- Chinese Academy of Sciences
- Chinese Institute for Botany

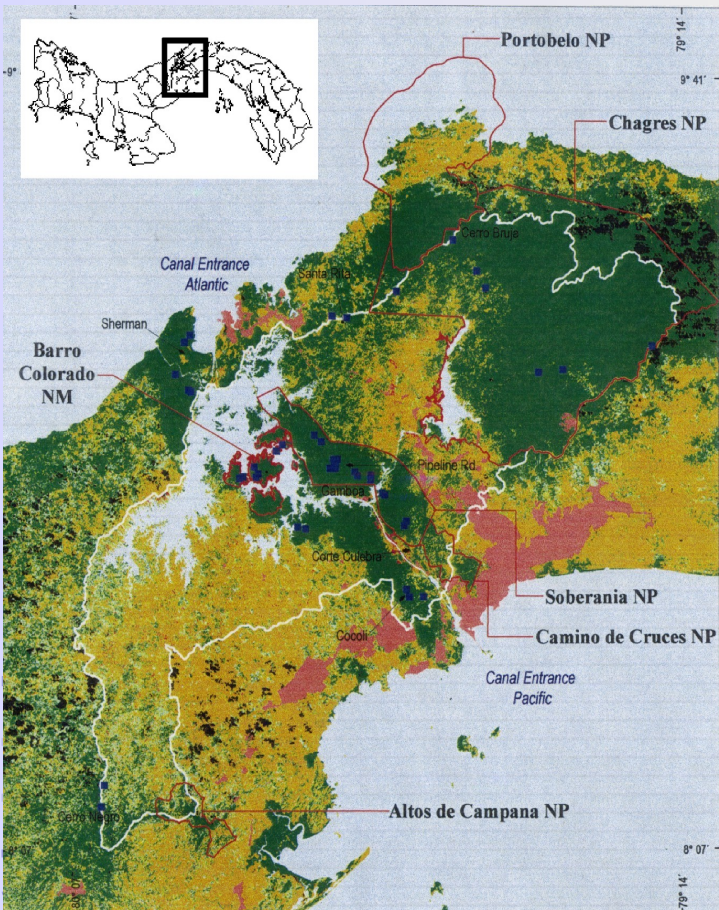
December 2017



Robin Foster







Portobelo NP

Chagres NP

Canal Entrance
Atlantic

Santa Rita

Cerro Bruje

Sherman

Barro
Colorado
NM

Pipeline Rd.

Gamba

Cerro Culebra

Soberania NP

Camino de Cruces NP

Canal Entrance
Pacific

Cocli

Altos de Campana NP

Cerro Negro

79° 14'

9° 41'

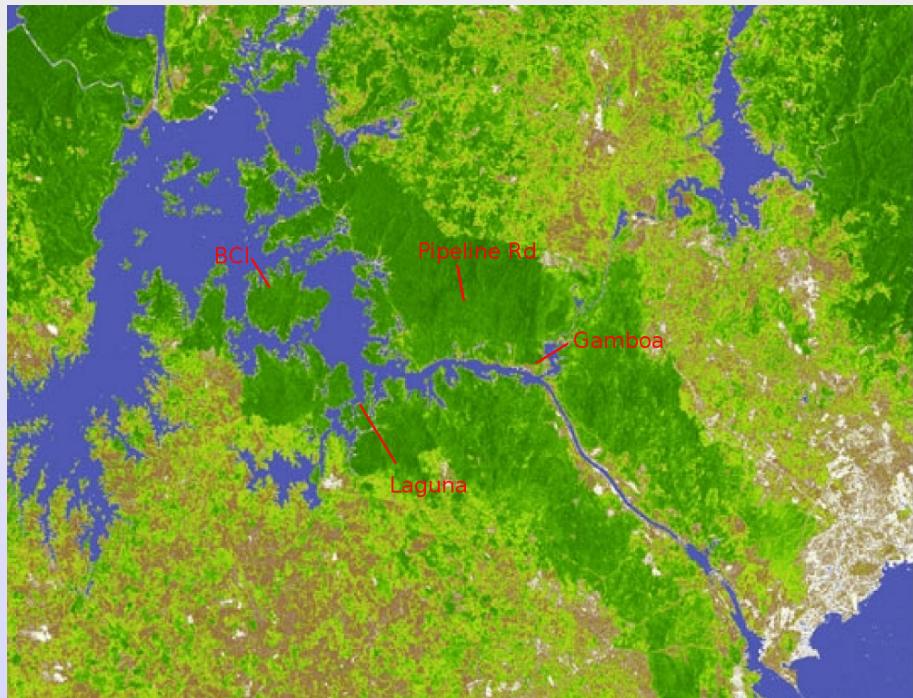
8° 07'

79° 14'

Forest Composition in Tropics of Panama

- 1 Climate (dry season)
- 2 Geology
- 3 Soil Chemistry
- 4 Tree Response to Phosphorus and Moisture





BCI

Pipeline Rd

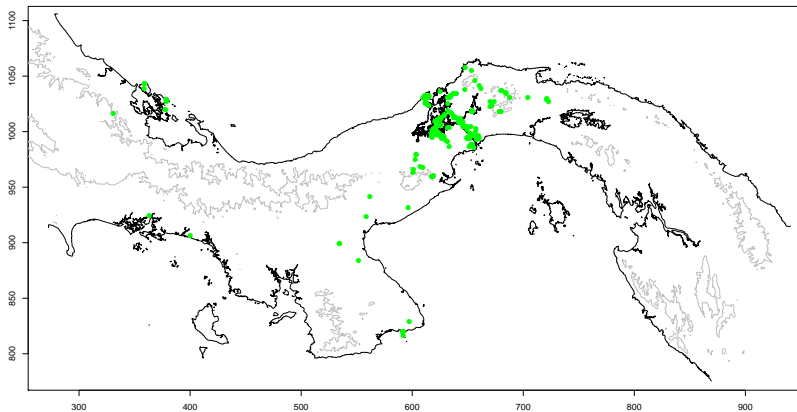
Gamboa

Laguna

Surveys of Tree Species

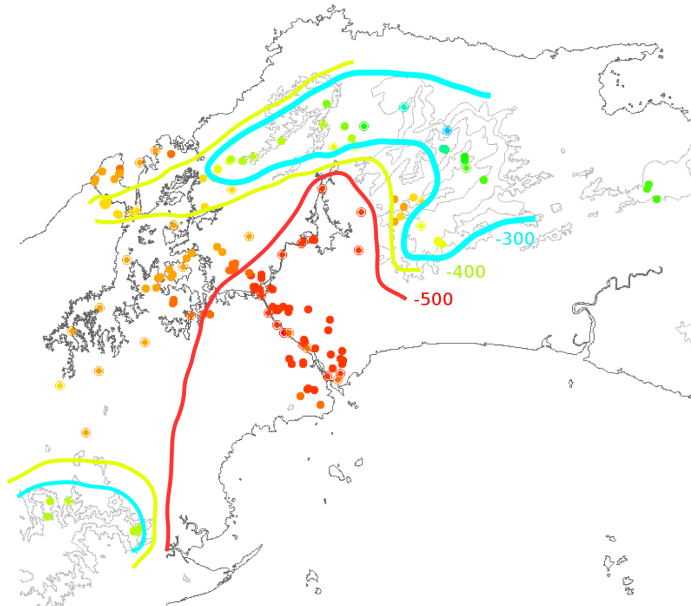
183 sites in Panama:

61 plots (full tree census) & 122 inventories (presence-absence)



Tree inventories

Estimated dry season intensity at each

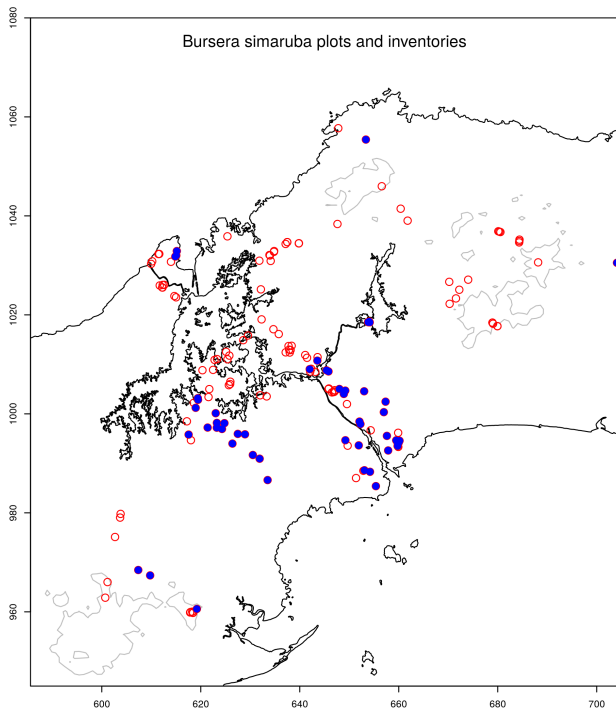


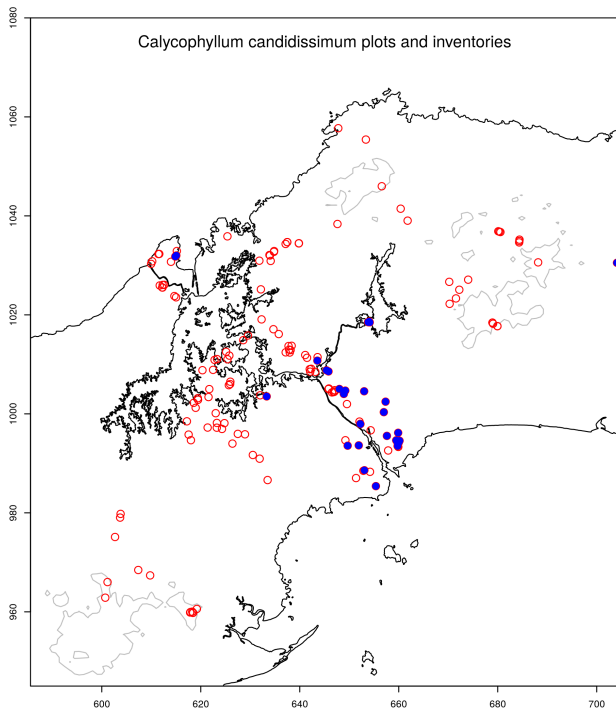


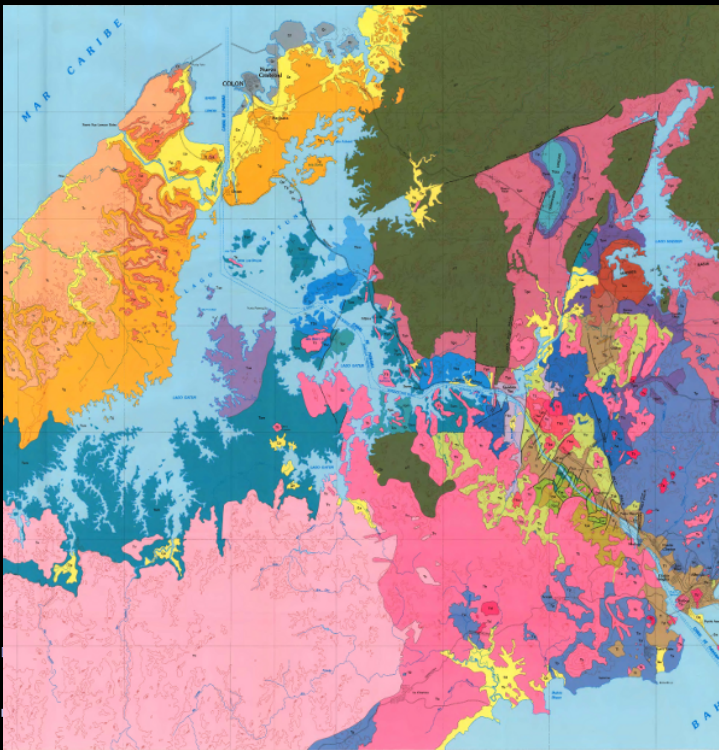




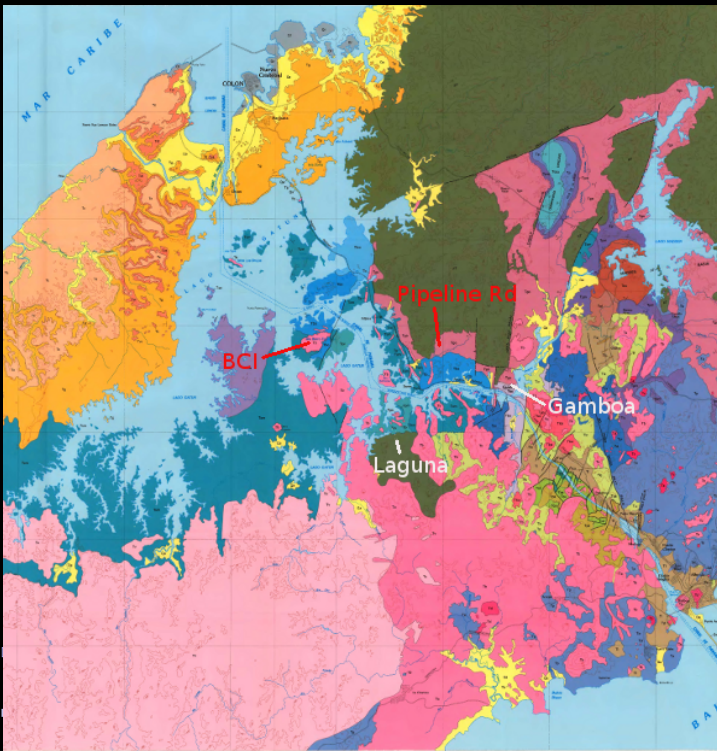
Deciduous species and limestone



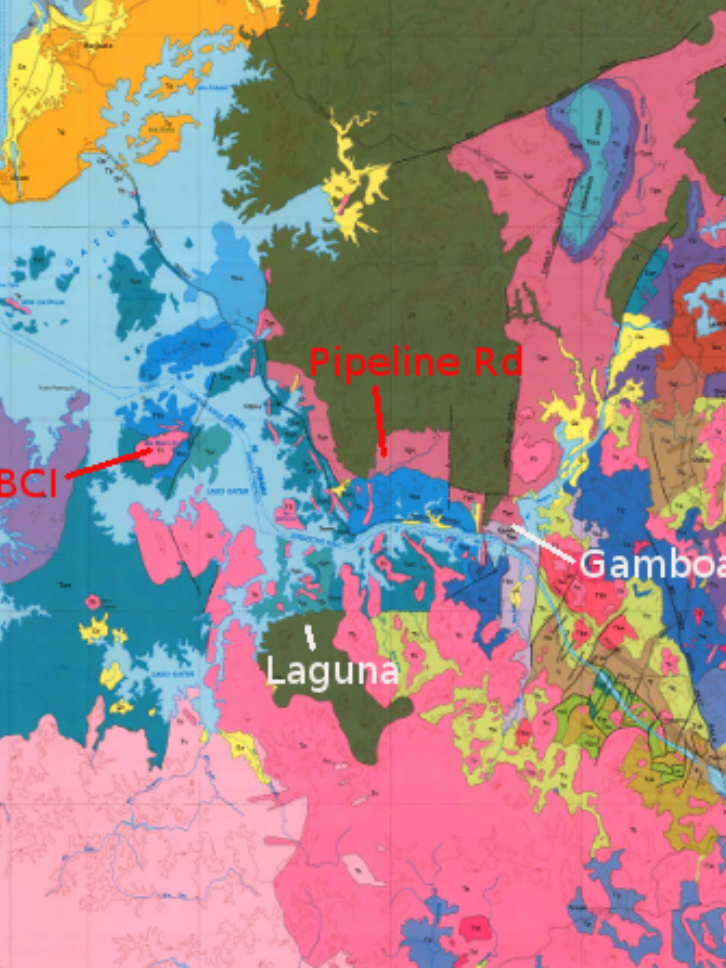




Woodring geology map (1982)



Woodring geology map (1982)

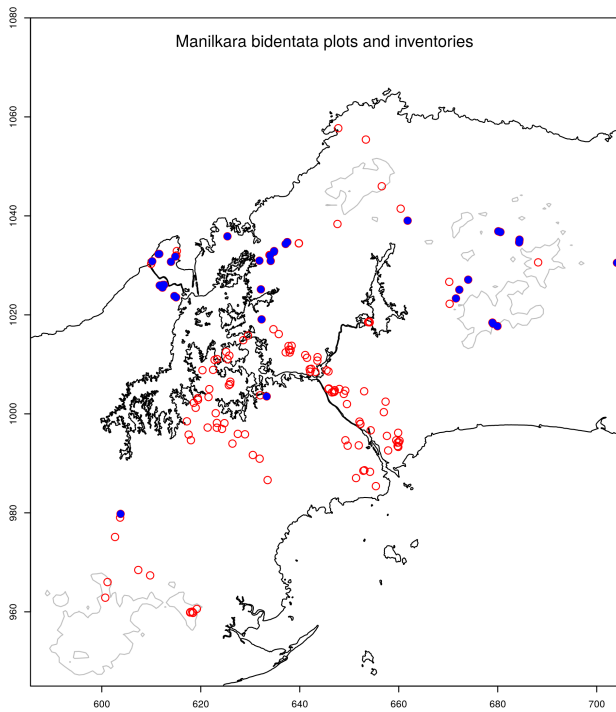


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Pipeline Rd

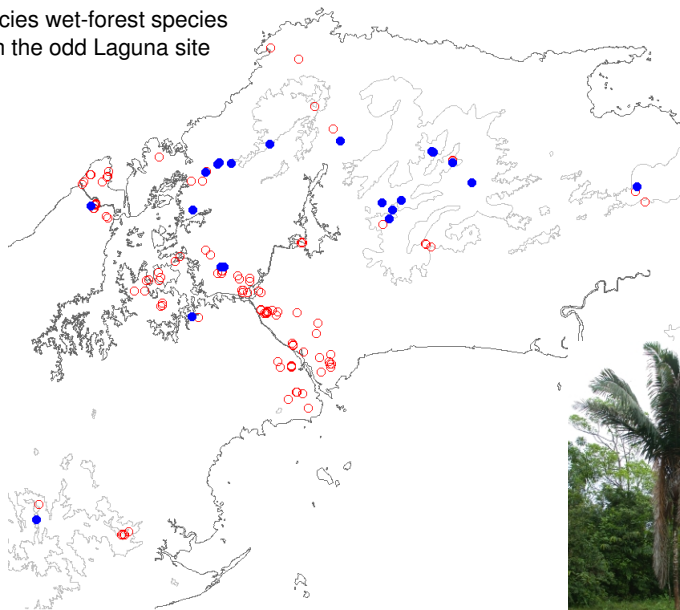
Laguna

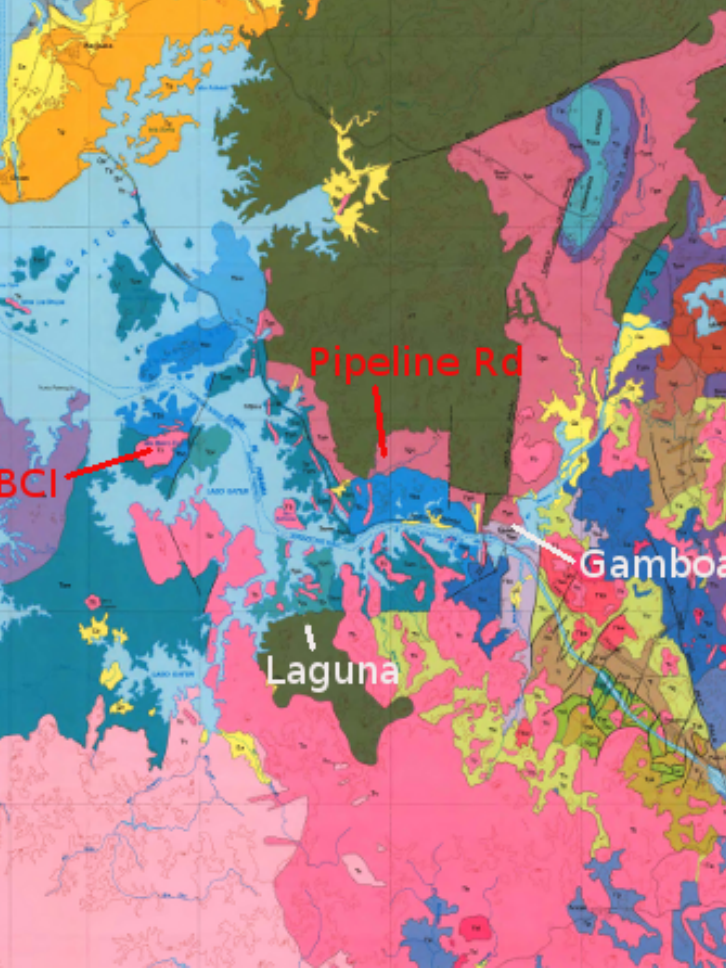
Gamboa



Welfia regia plots and inventories

32 species wet-forest species
reach the odd Laguna site





Pipeline Rd

BCI

Gamboa

Laguna



2015 / 2 /



2015/2

Oxisols
(Typic Eutrudox)



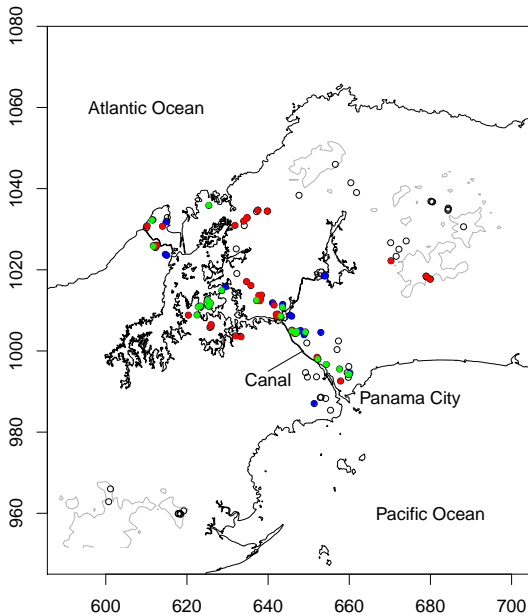
Alfisols and Ultisols
(Oxyaquic Vertic Hapludalf)



Mollisols (?)



Phosphorus Map



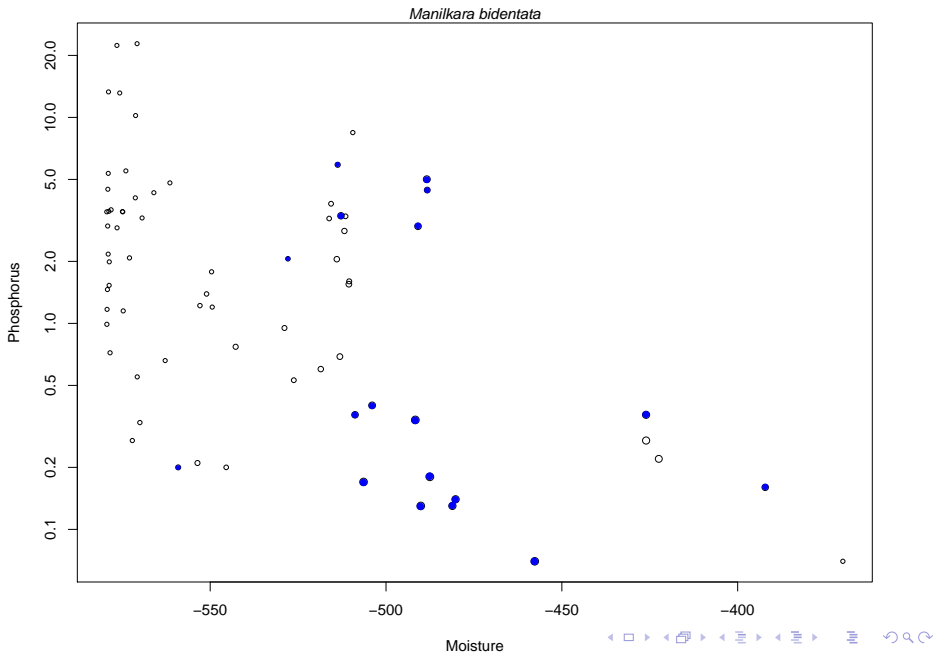
Low phosphorus
Medium phosphorus
High phosphorus

Soil nutrient comparison

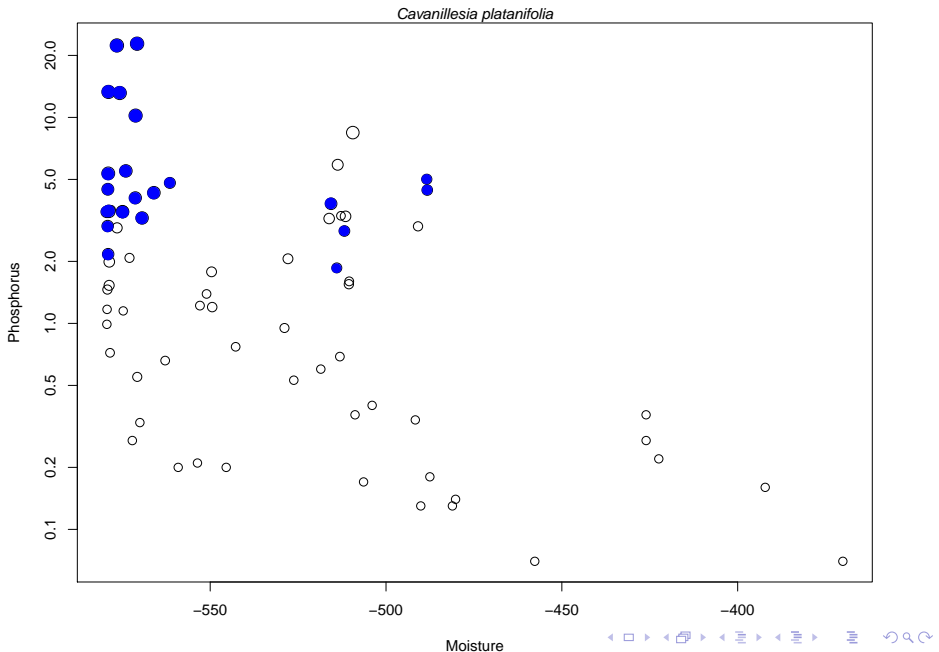
	Panama		Amazon*	
	Min	Max	Min	Max
Ca	25.00	9738.60	2.90	3402.00
K	12.30	351.90	3.80	197.00
P(resin)	0.07	22.80	1.00	21.80
TotalP	72.20	1552.80	25.00	968.00

* Phillips *et al.* 2003, Quesada *et al.* 2011

Phosphorus-Moisture Relation



Phosphorus-Moisture Relation

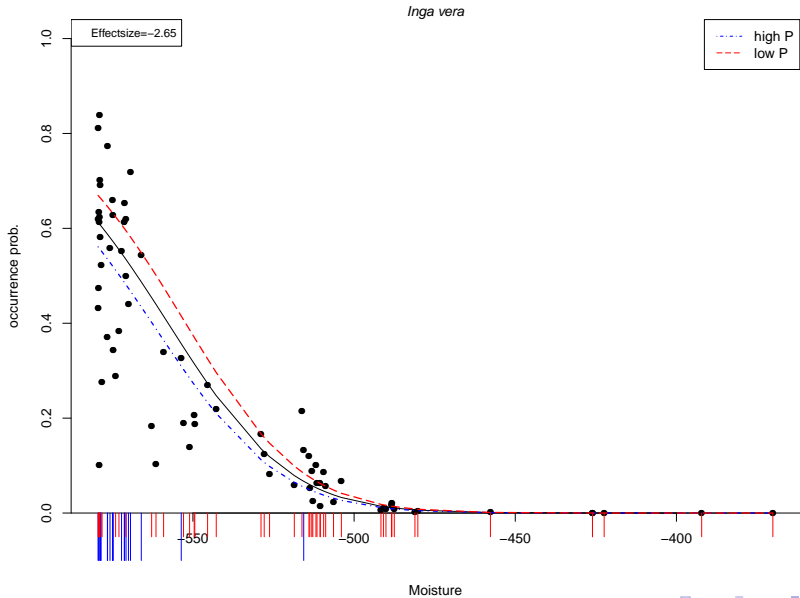


Habitat response model

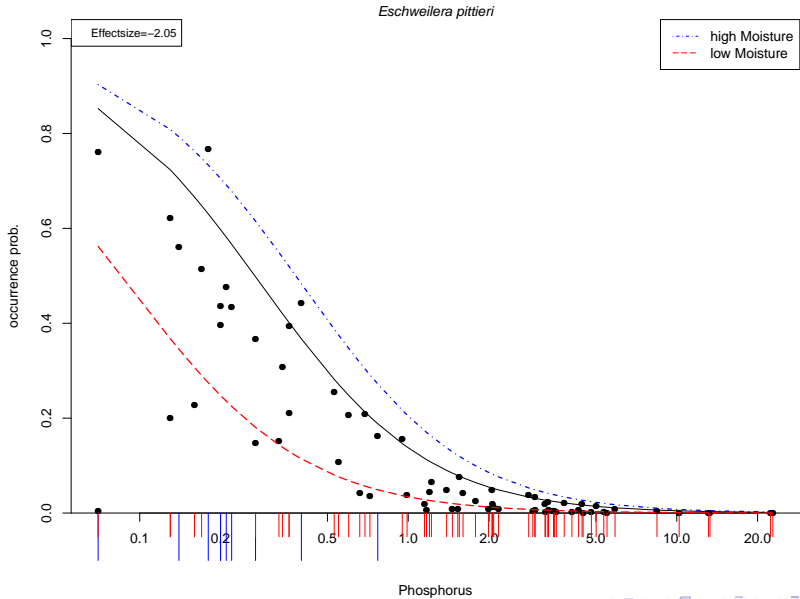
Multiple logistic regression Hierarchical component for species

- Multiple logistic regression
 - standard for occurrence modeling against many resources
- OccurrenceProb \sim InverseLogit(Climate + Soil + Climate² + Soil²)
- Eight predictors in model:
 - Dry season moisture
 - Al
 - Ca
 - Fe
 - K
 - P (plant available)
 - Zn
 - N (inorganic)

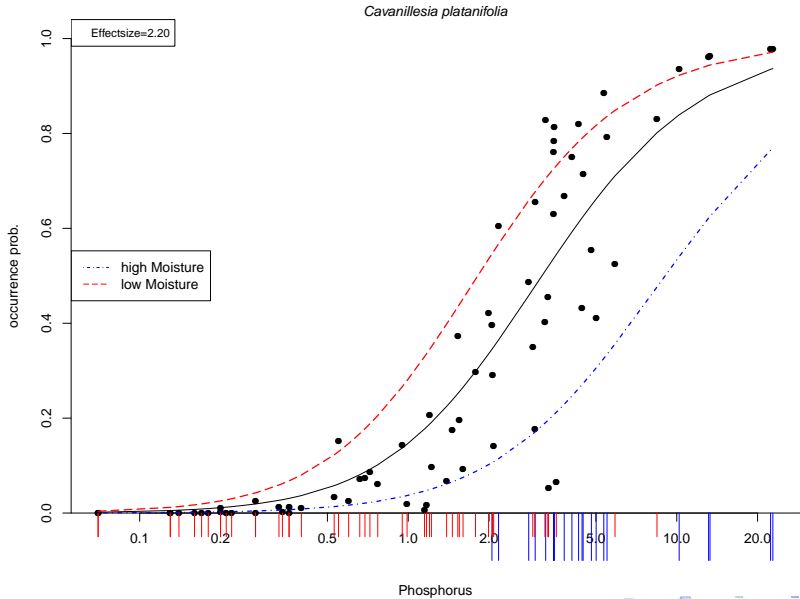
Habitat response model



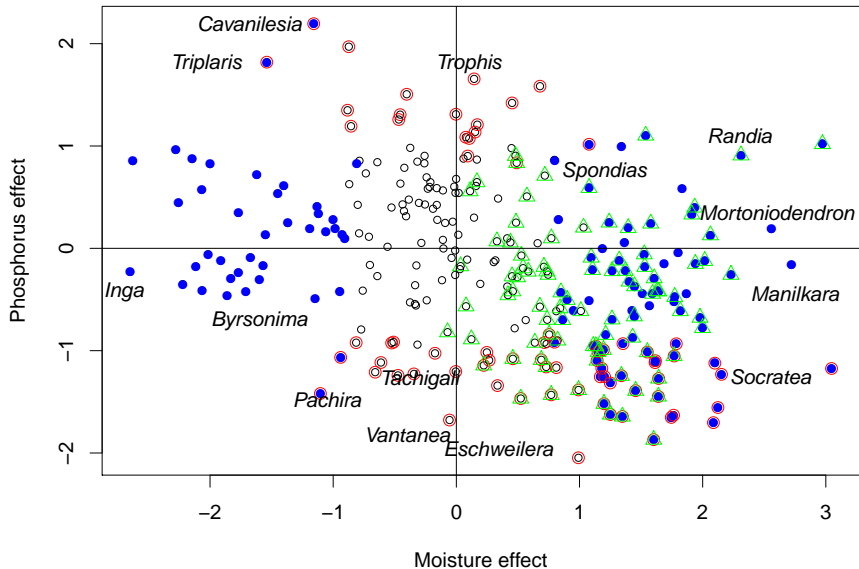
Habitat response model



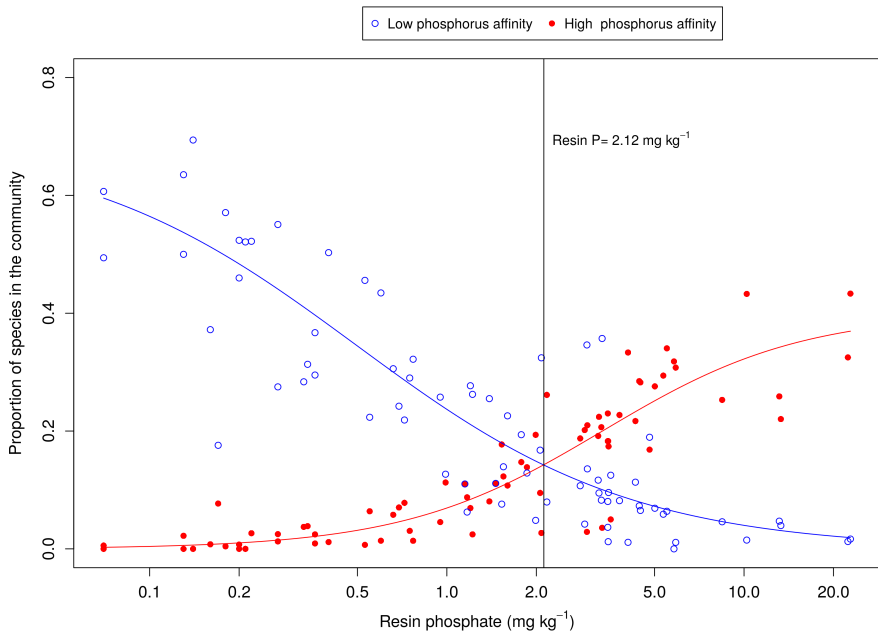
Habitat response model



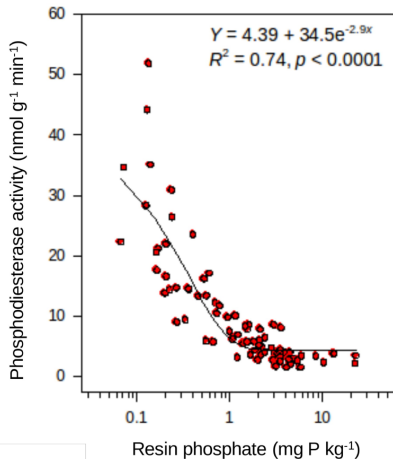
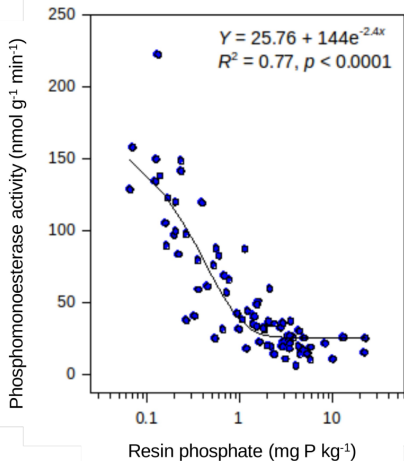
Bivariate Responses, Moisture and P



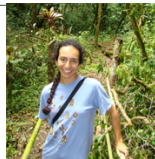
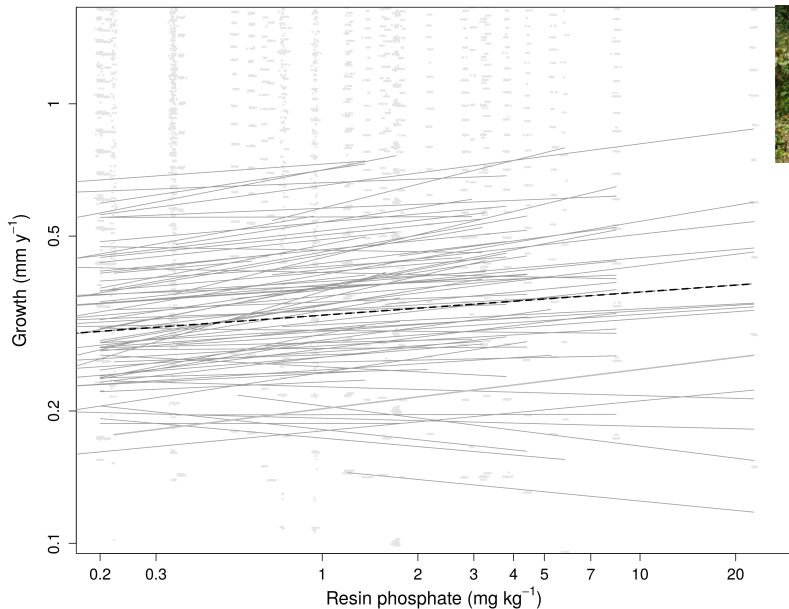
Turnover of Specialists



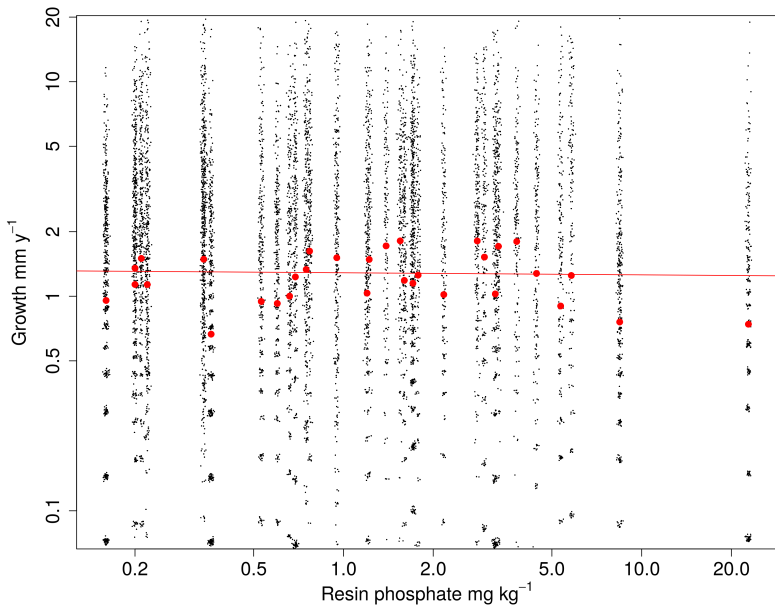
Microbial Response to Phosphorus



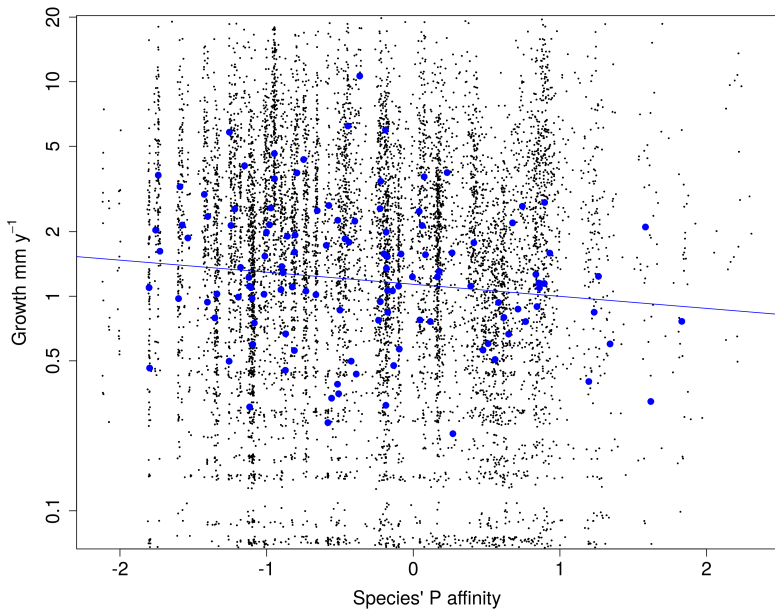
Individual Species Growth Response to Phosphorus



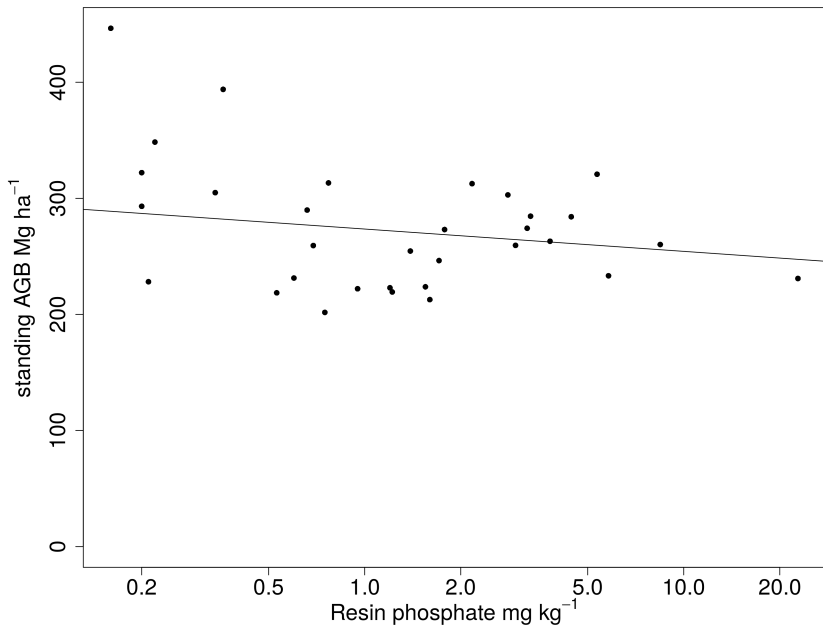
Mean Forest Growth and Phosphorus



Mean Species Growth and Phosphorus Affinity



Forest Biomass and Phosphorus



My understanding of Panama's forests:

Environmental variation and species composition

Climate and forest

- Species composition varies greatly with dry season variation
- But there is far more variation than wet vs. moist of Holdridge
- And there are no distinct forest types

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Geology and forest

- Parent rocks can alter forest beyond the climate
- Many species limited by phosphorus: avoiders and demanders
- Forest community is not limited by phosphorus

