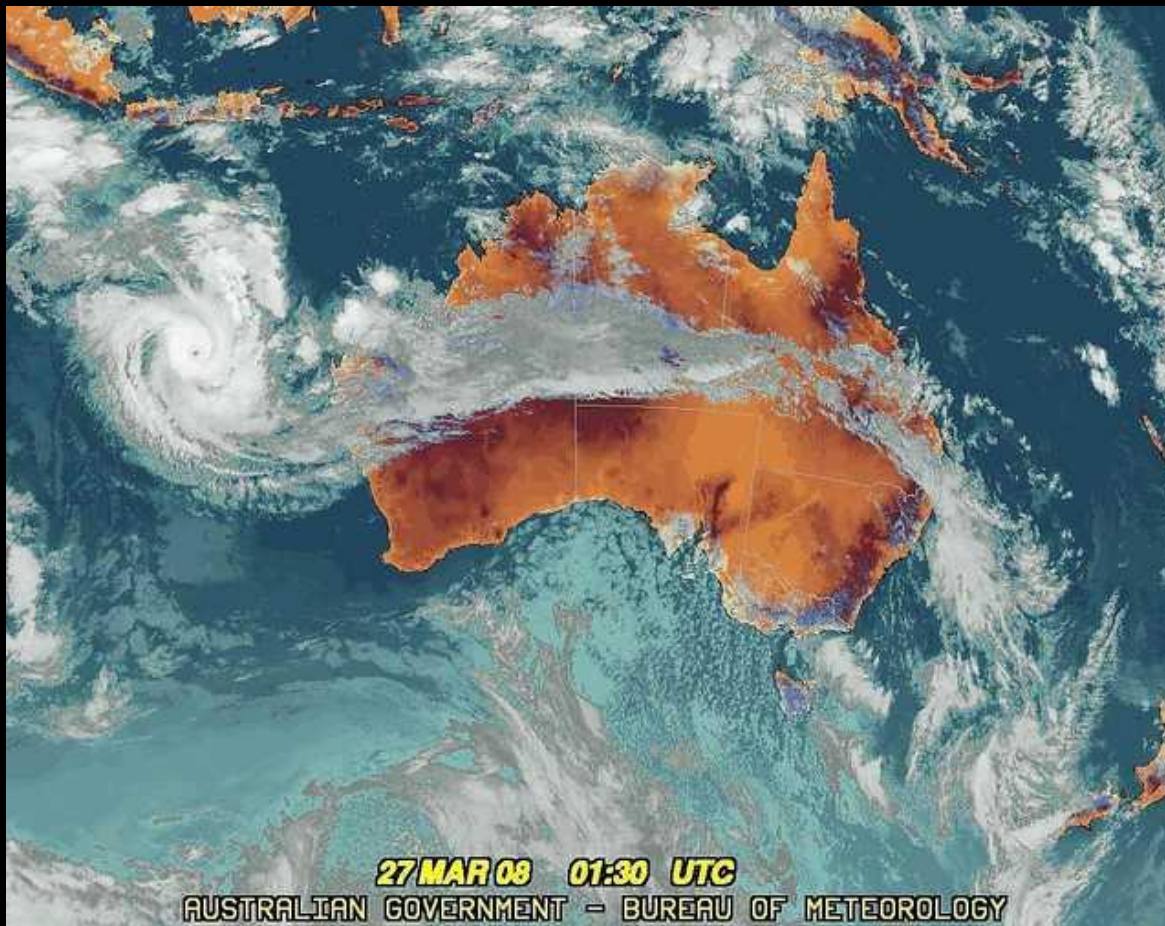


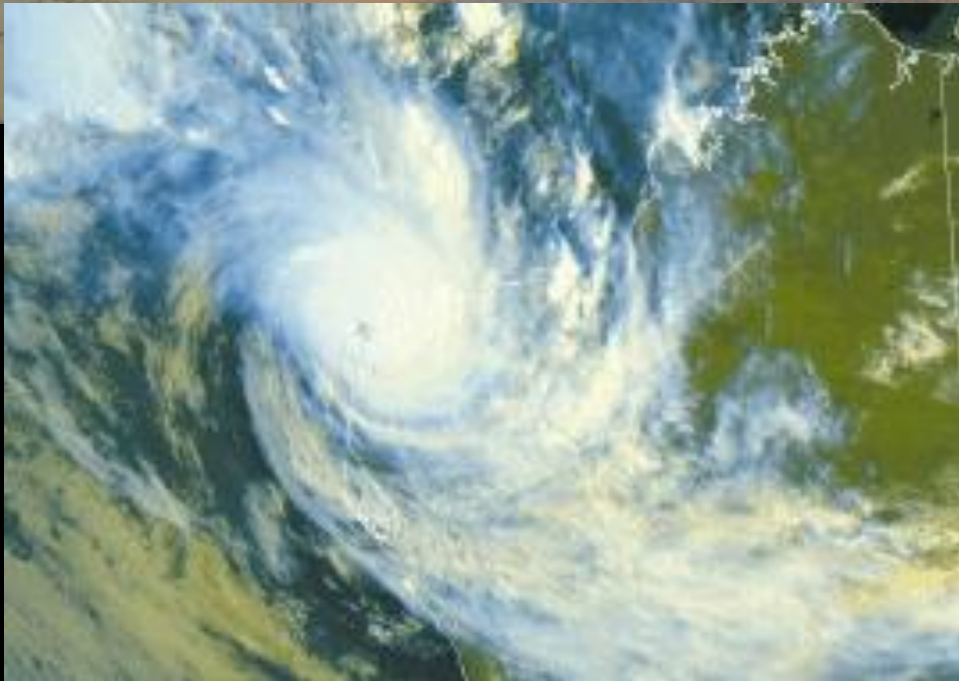
Cyclone Pancho increases growth and relieves nutrient limitation in mangroves in the Exmouth Gulf



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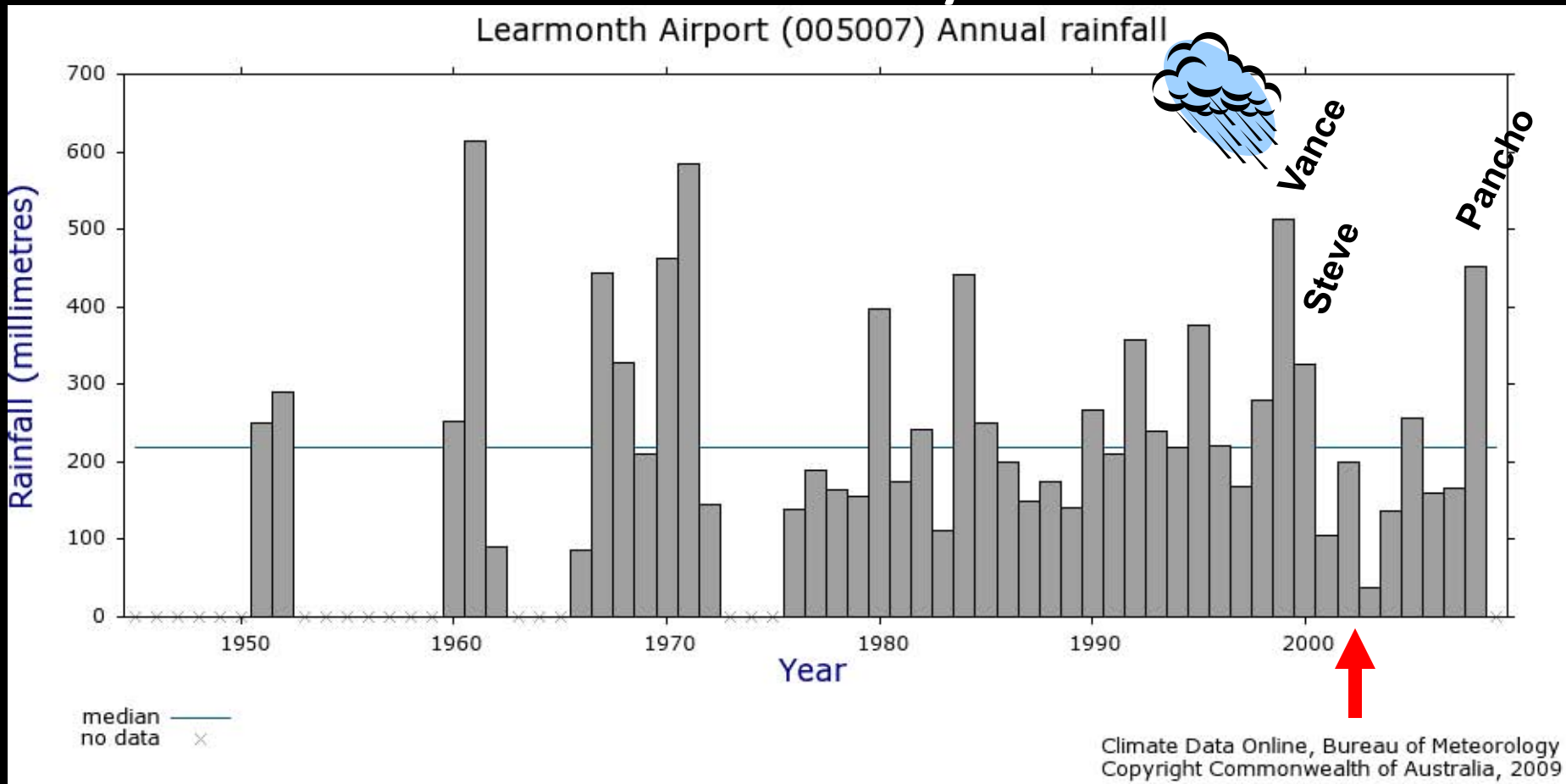






- Cyclones (and hurricanes) are significant disturbances
- Evidence of damage and recovery is often documented for extreme events
- Stress-subsidy hypothesis (Odum) predicts enhanced productivity with intermediate levels of “stress”
- What are the ecological impacts of cyclonic events?

Rainfall in Exmouth region is associated with Cyclones



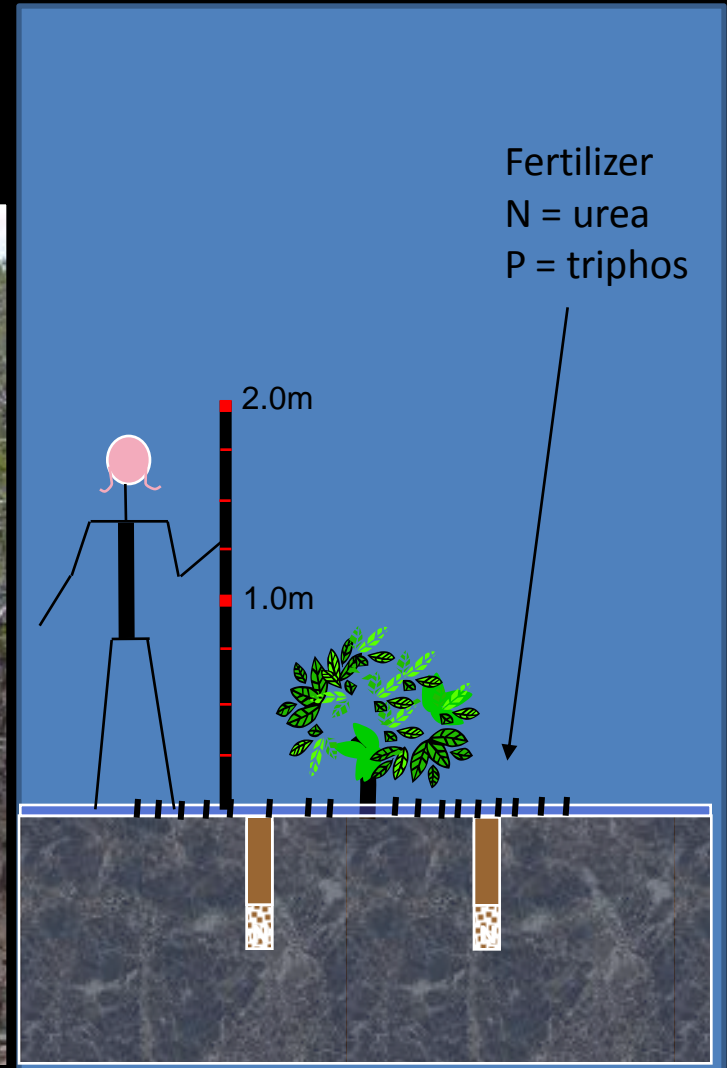
- Project starts in the “gap” between Cyclone Steve and Pancho





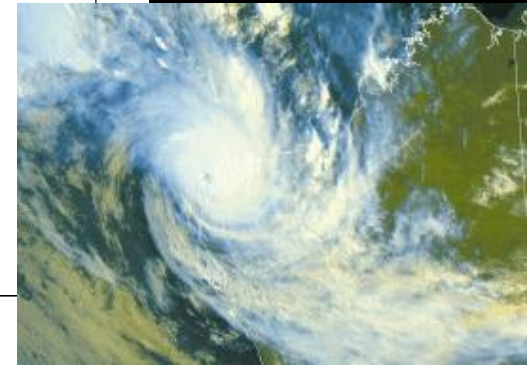
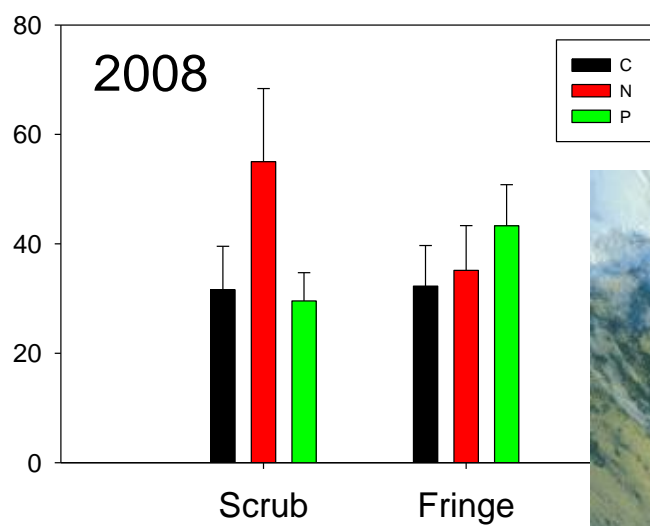
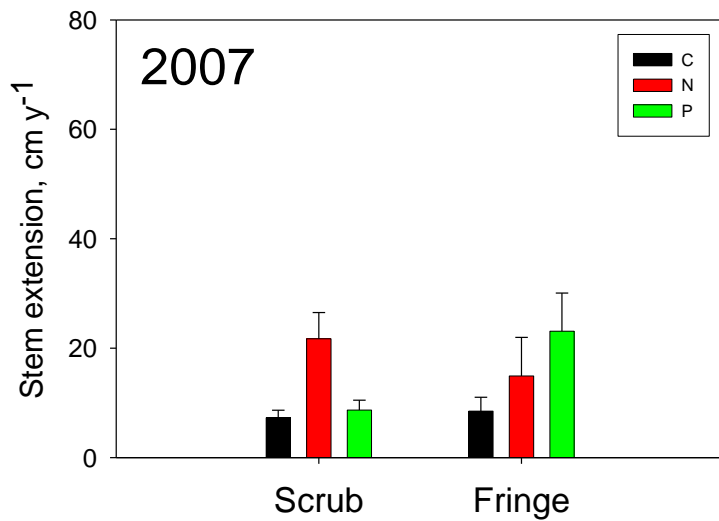
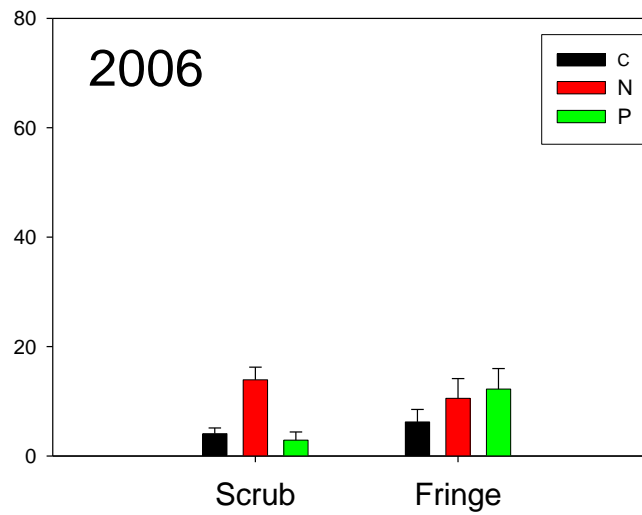
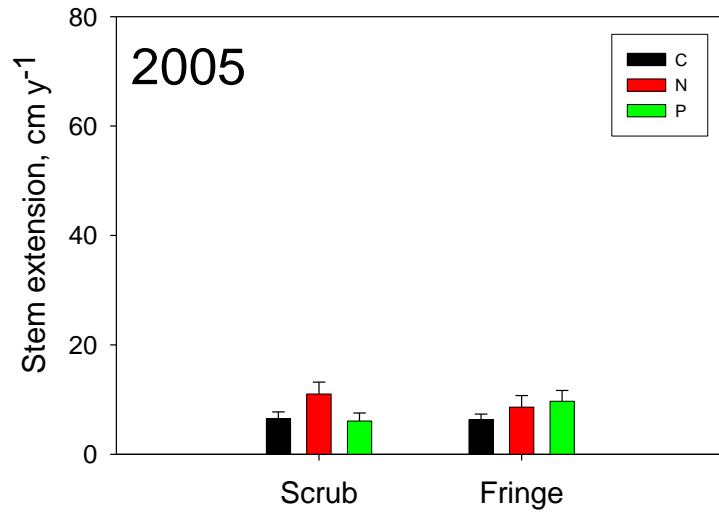
Background: Patterns of nutrient limitations

- Fertilize individual trees (9 reps per treatment) in fringe and scrub (landward) forests



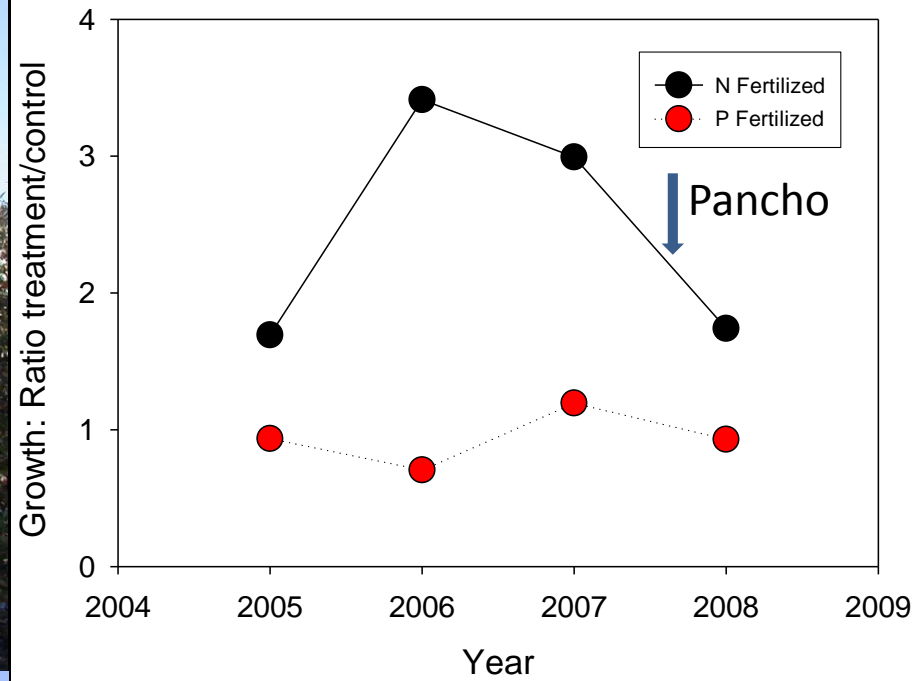


Tree growth



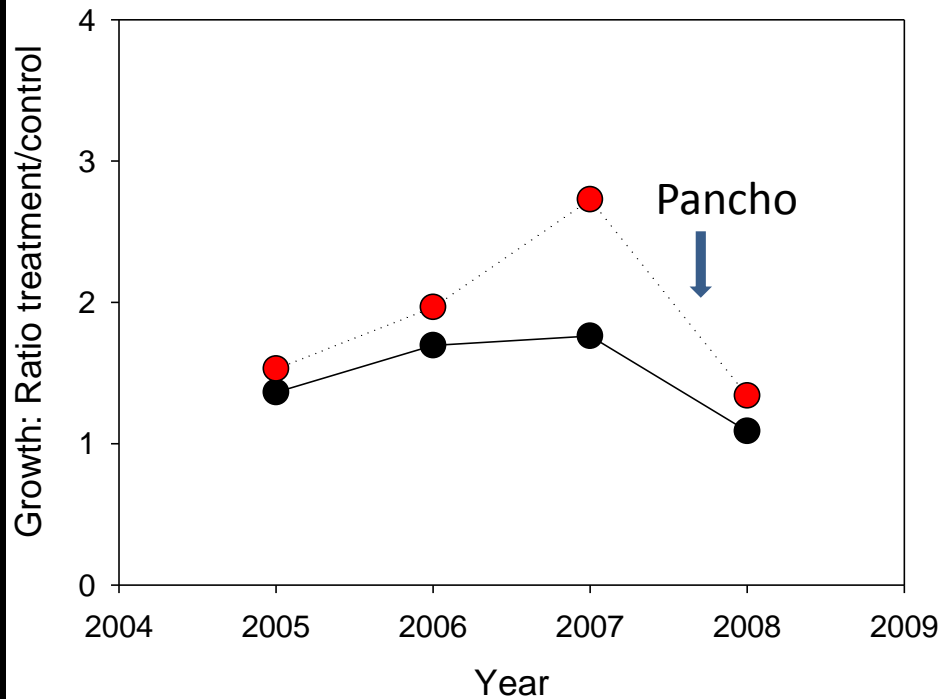


LANDWARD SCRUB

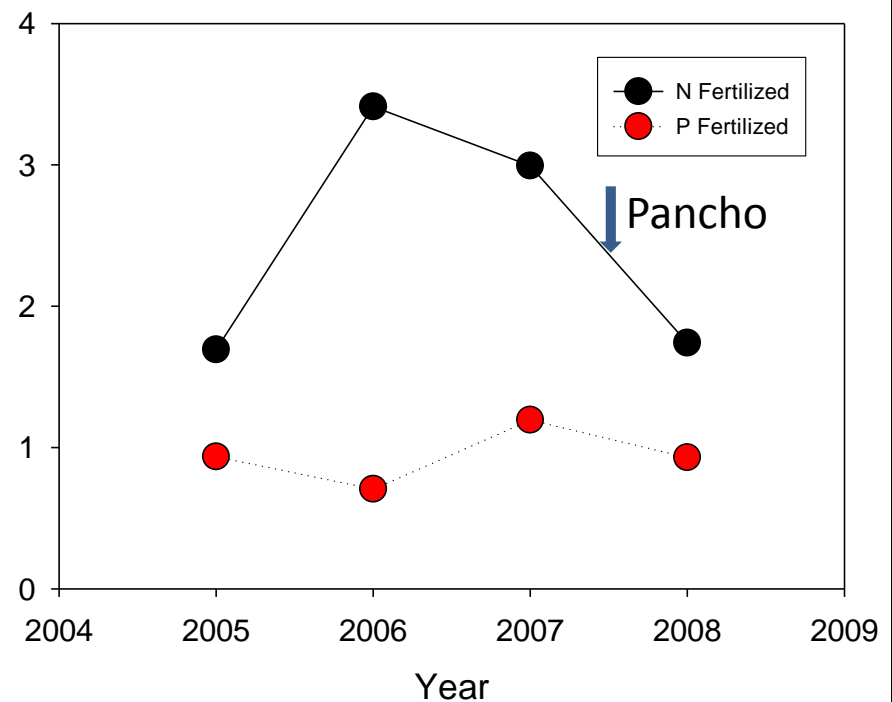


- N limitation to growth in the scrub forest

SEAWARD FRINGE



LANDWARD SCRUB



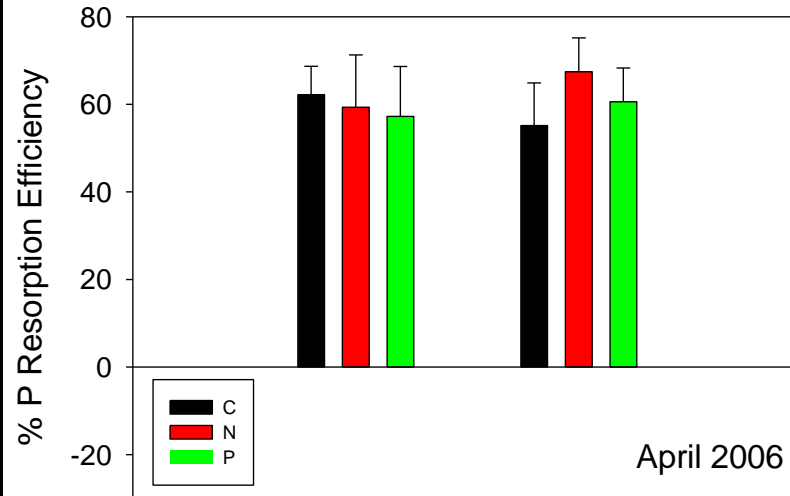
- Fringe is N and P limited initially
- P limitation intensifying through time
- After Cyclone Pancho no evidence of nutrients limiting growth

Plant internal nutrient cycling

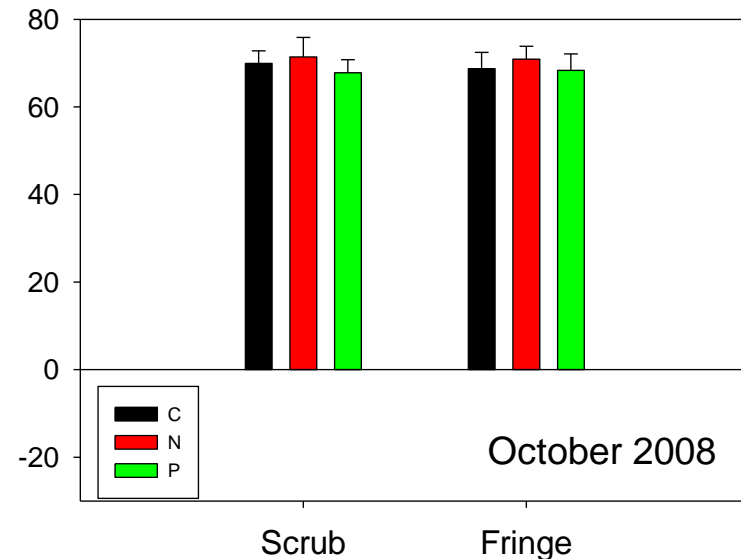
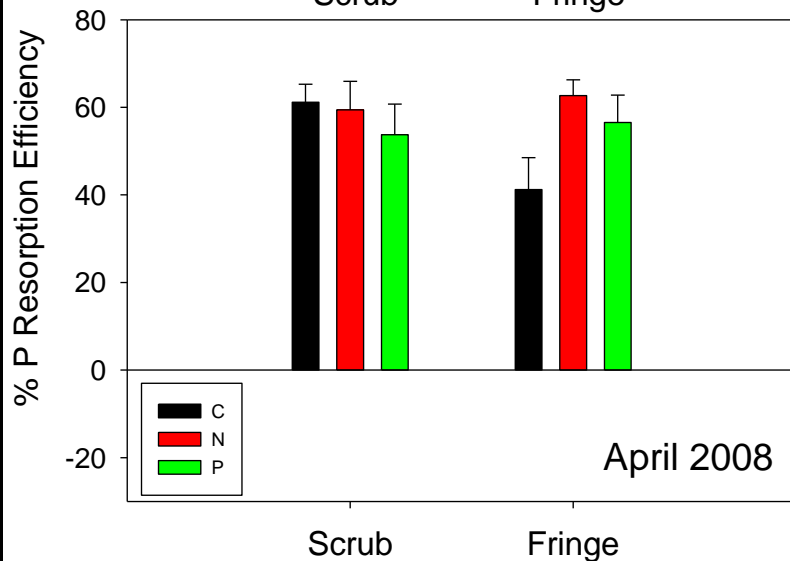
- Changes in nutrient resorption from senescing leaves gives information about nutrient availability and nutrient demand for growth



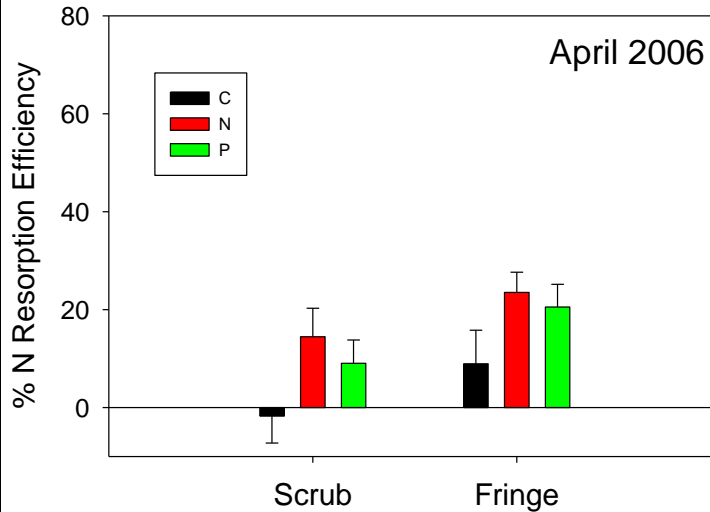
Phosphorus resorption efficiency



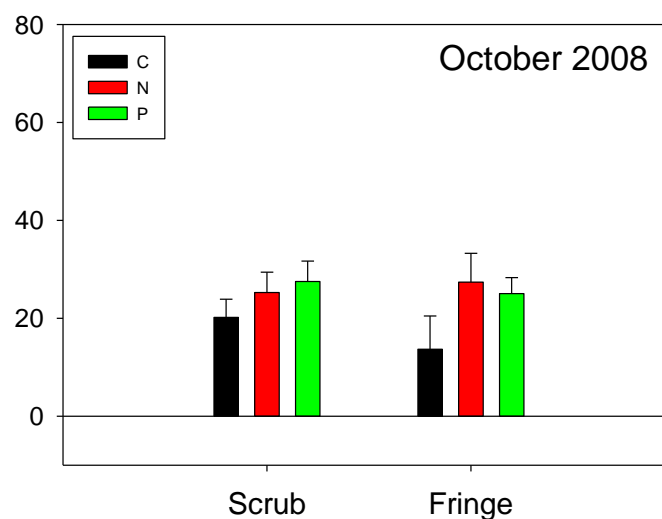
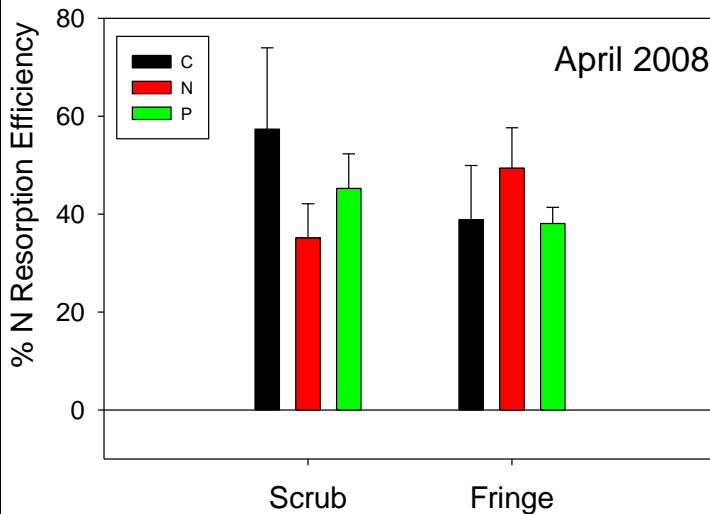
- P resorption is initially high
- Pre cyclone %PRE is enhanced compared to controls in P and N fertilized plants
- After Cyclone Pancho becomes high in all plants



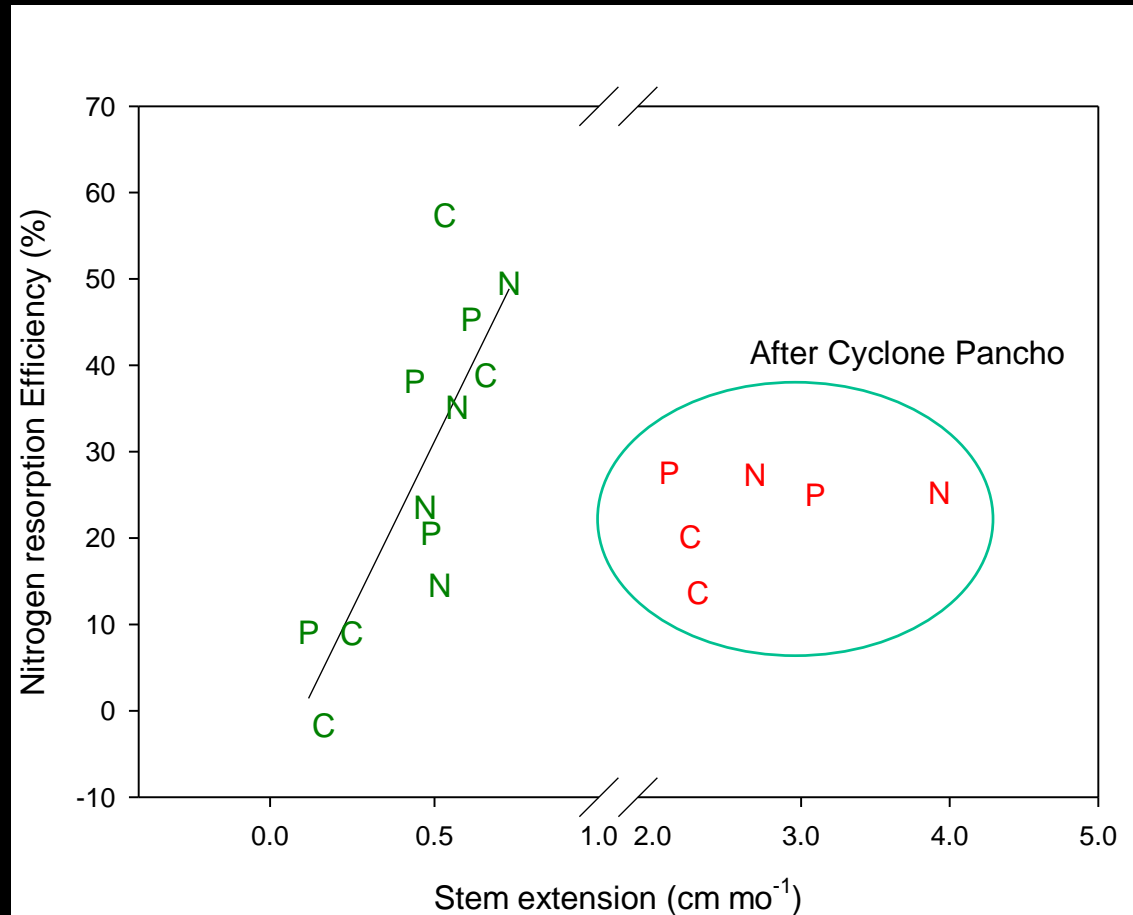
Nitrogen resorption efficiency



- Initially %NRE is low but enhanced by fertilization
- %NRE increases in 2008
- %NRE back to 2006 levels after Cyclone Pancho



Nitrogen resorption and growth



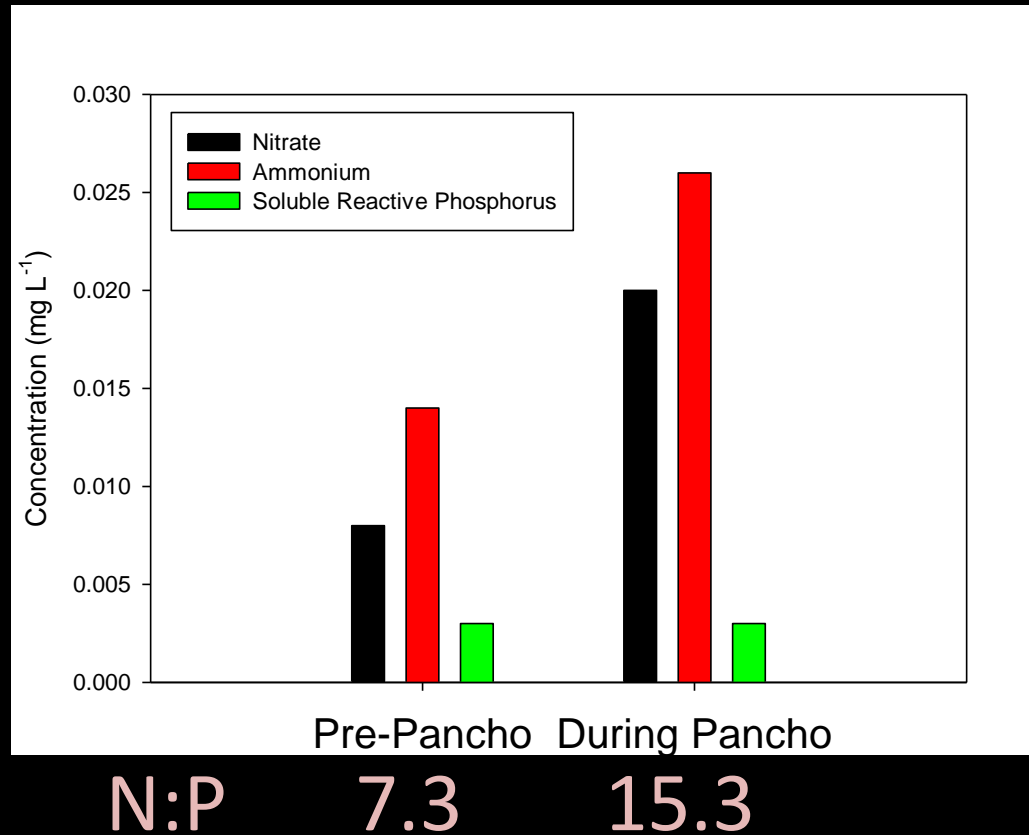
- Before the cyclone N resorption efficiency directly correlated with demand (growth rate)
- After the storm there are high growth rates with no increase in %N Resorption Efficiency – supply exceeds demand

Summary of tree responses

- Tree growth is enhanced after Cyclone Pancho
- Effects of fertilization on growth decreased in fringing forest
- N limitation still apparent in the landward scrub forest
- N Resorption efficiency declines after the cyclone (despite higher demand)
- New hypothesis: Nutrients are delivered to the forest during cyclones

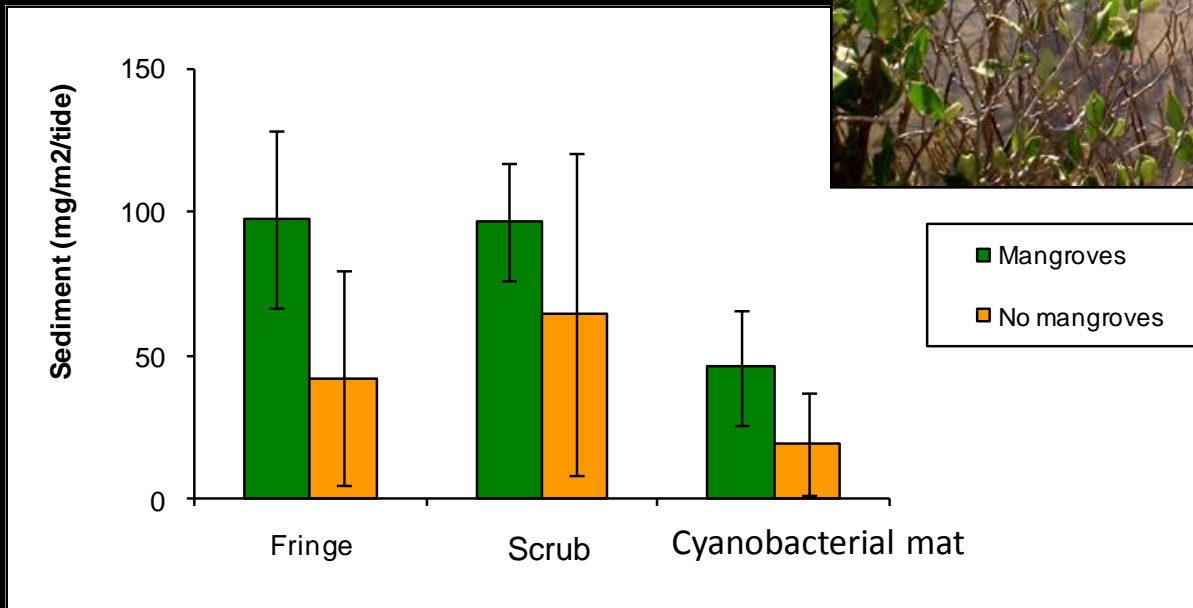
Sources of nutrients

- Nutrients in water during the cyclone were enhanced and N:P in water increased with the onset of the cyclone

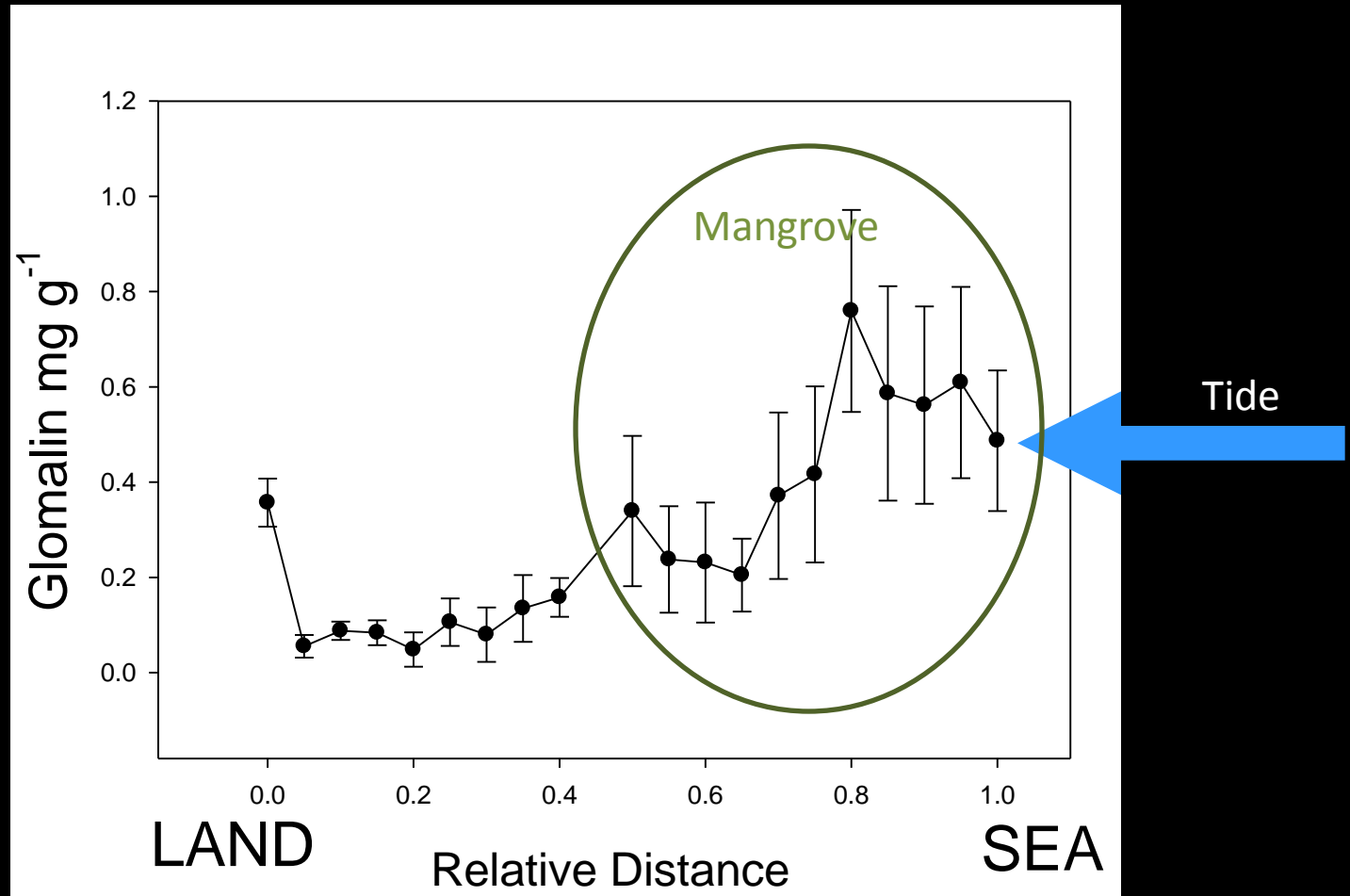


Sedimentation in mangroves in the Gulf

- Sedimentation is higher in the mangroves compared to sites without mangroves
- Decreases from fringe to landward



Terrestrial soil signature in mangrove sediments



Conclusions

An aerial photograph of a mangrove wetland. The landscape is a complex network of winding, reddish-brown channels and meanders, likely filled with water or mud. The surrounding areas are covered in dense, green vegetation, characteristic of mangrove forests. The sky above is a deep, overcast blue with some lighter clouds. The overall scene is a vast, flat expanse of natural wetland.

- Mangrove productivity is enhanced after cyclones
- Nitrogen is delivered in water and probably in sediments
- N is of terrestrial origin (maybe)

Acknowledgements

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