Response of a Papyrus Wetland Ecosystem to Seasonal Changes in Hydrology and Livelihood Pressures

9th INTECOL Wetlands Conference, Orlando, Florida
3-8 June 2012

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VIREO

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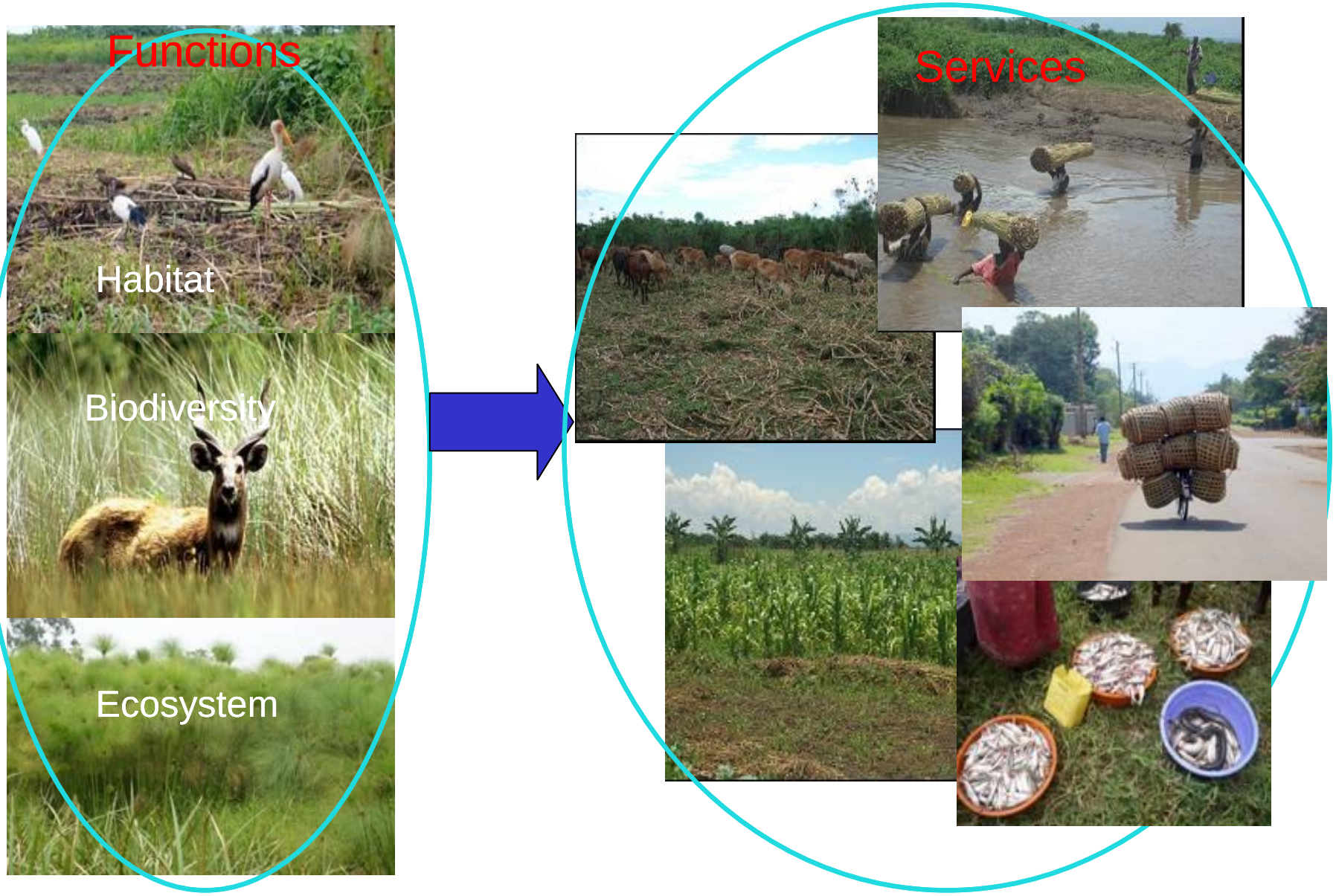
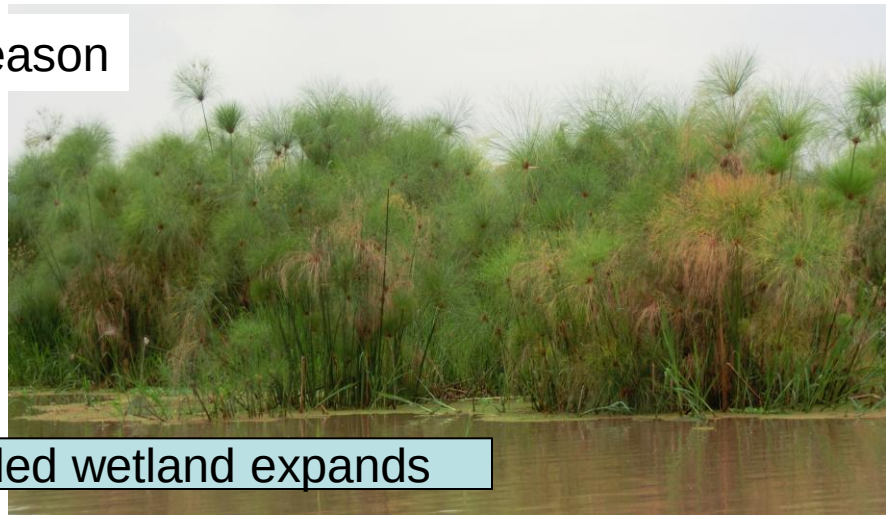
Introduction: Importance of papyrus wetland



Introduction: Hydrological gradient



Permanently flooded wetland expands

Upland ⟷ Lake/river

Seasonally flooded wetland expands

Introduction: Disturbance gradient

Burning to expand agriculture

Seasonally flooded ⟷ Permanently flooded

Harvesting opens up areas for grazing

Objectives

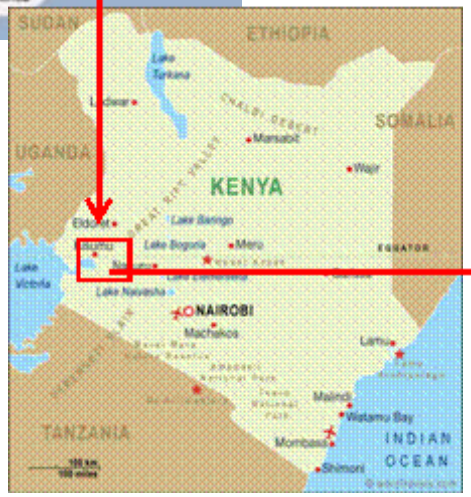
Overall objective

- Understand the response of papyrus wetland vegetation to changes in hydrology (wetting and drying) and exploitation for livelihoods

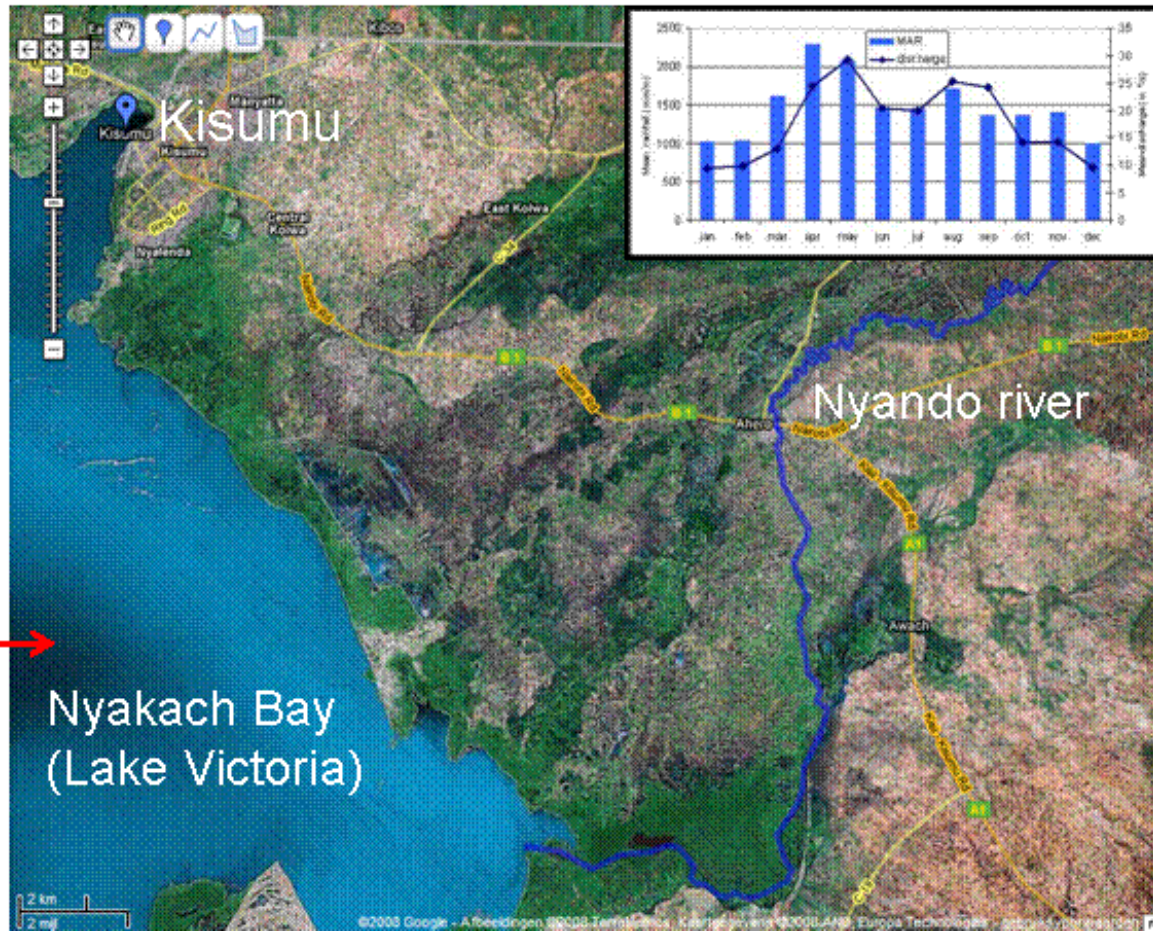
Specific objectives

- Compare species composition, abundance and diversity between dry and wet conditions in three sites with different levels of disturbance
- Compare species composition, abundance and diversity between natural papyrus and converted wetland in these three sites
- Compare some growth characteristics of *C. papyrus* in the three sites

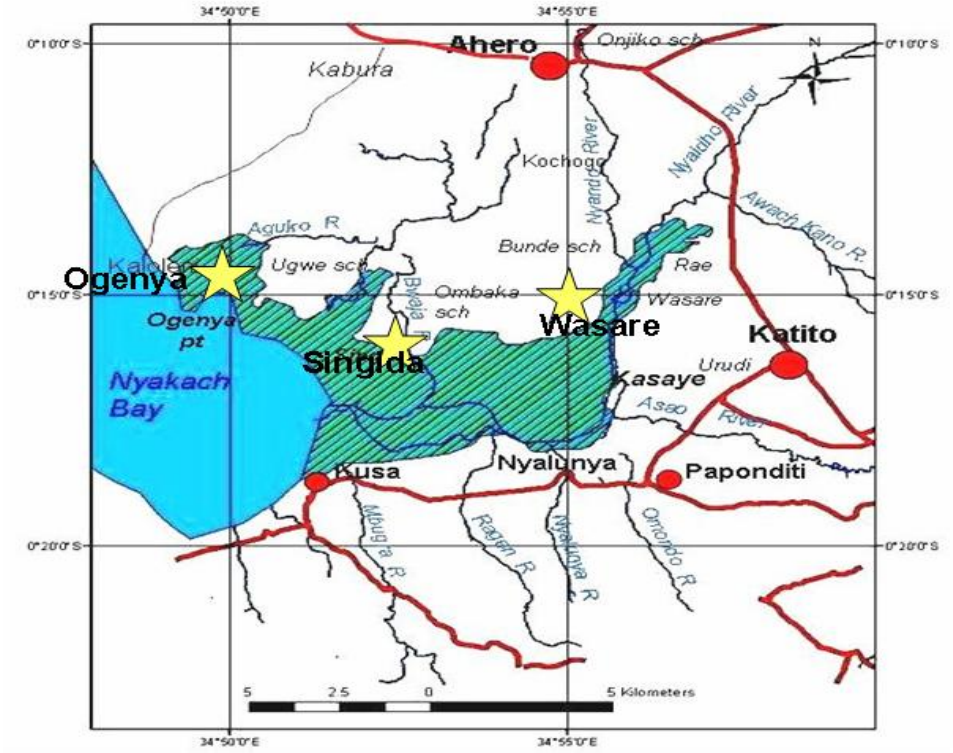
Study site: Nyando floodplain wetland



Nyando basin: 3587 km^2
Nyando wetland: 50 km^2



Study sites



- One transect at each site from lake or river through permanent to seasonal wetland and to dry land
- Disturbance:
  - Ogenya – intermediate
  - Singida – low
  - Wasare – high

Transect	Hydrology	Disturbance (Land use)	
		Permanently flooded	Seasonally flooded
Ogenya	Lake	Papyrus harvesting, fishing	Agriculture
Singida	River/lake	Fishing	Agriculture
Wasare	River	Papyrus harvesting	Livestock grazing, agriculture

Methods

- Hydrology:
  - Wet versus dry conditions
    June 2010 versus May 2011
    (in permanent wetland)
- Disturbance
  - Natural wetland versus crop land (in dry season, May 2011)
- Five 1-m^2 Quadrats
- Plant species composition
- Density

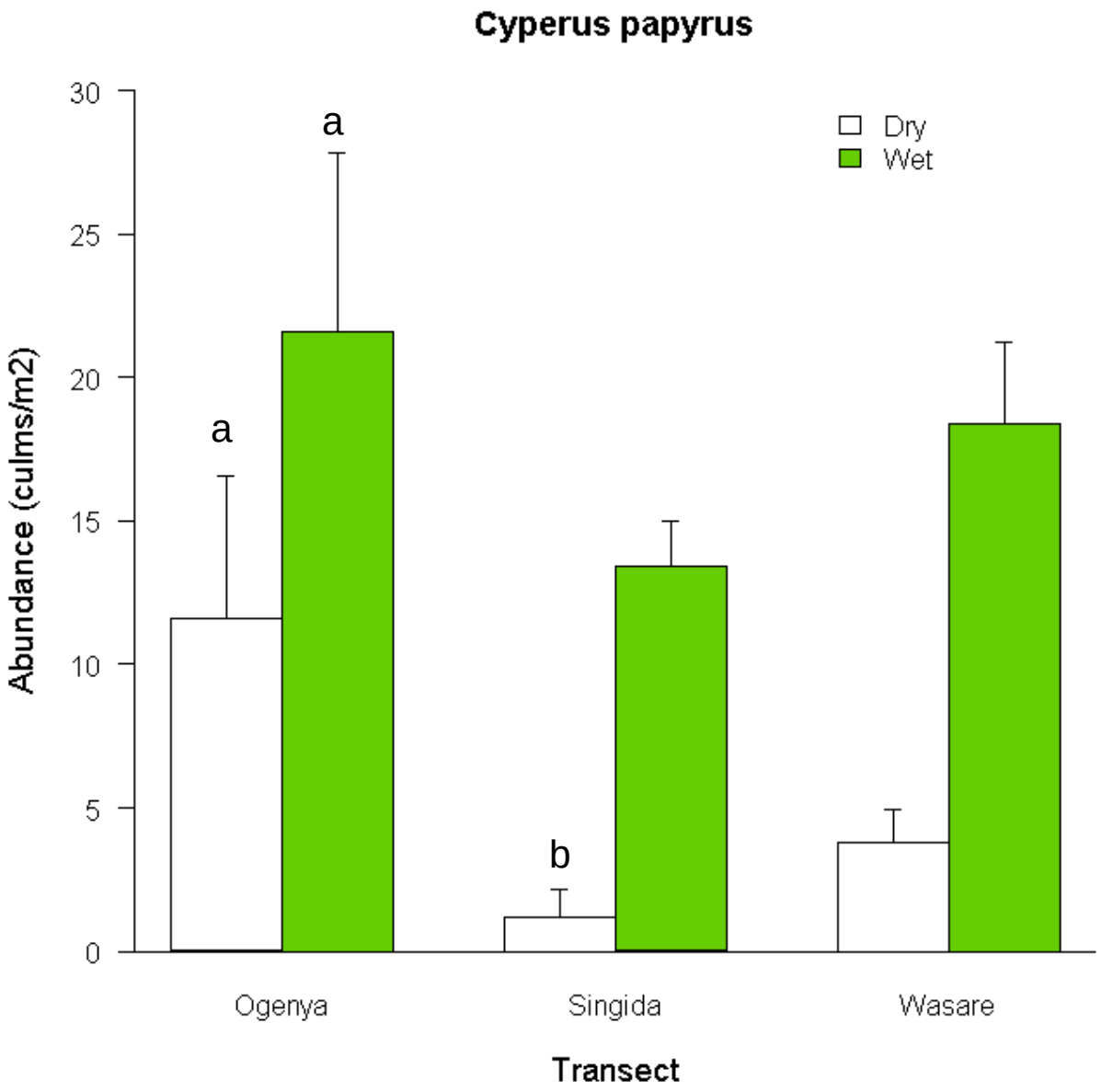
Methods

- July - December 2010
- 3 Quadrats of 1 m^2 each in permanent wetland
- Papyrus length and girth (cm)
- Water depth (cm) - staff gauge

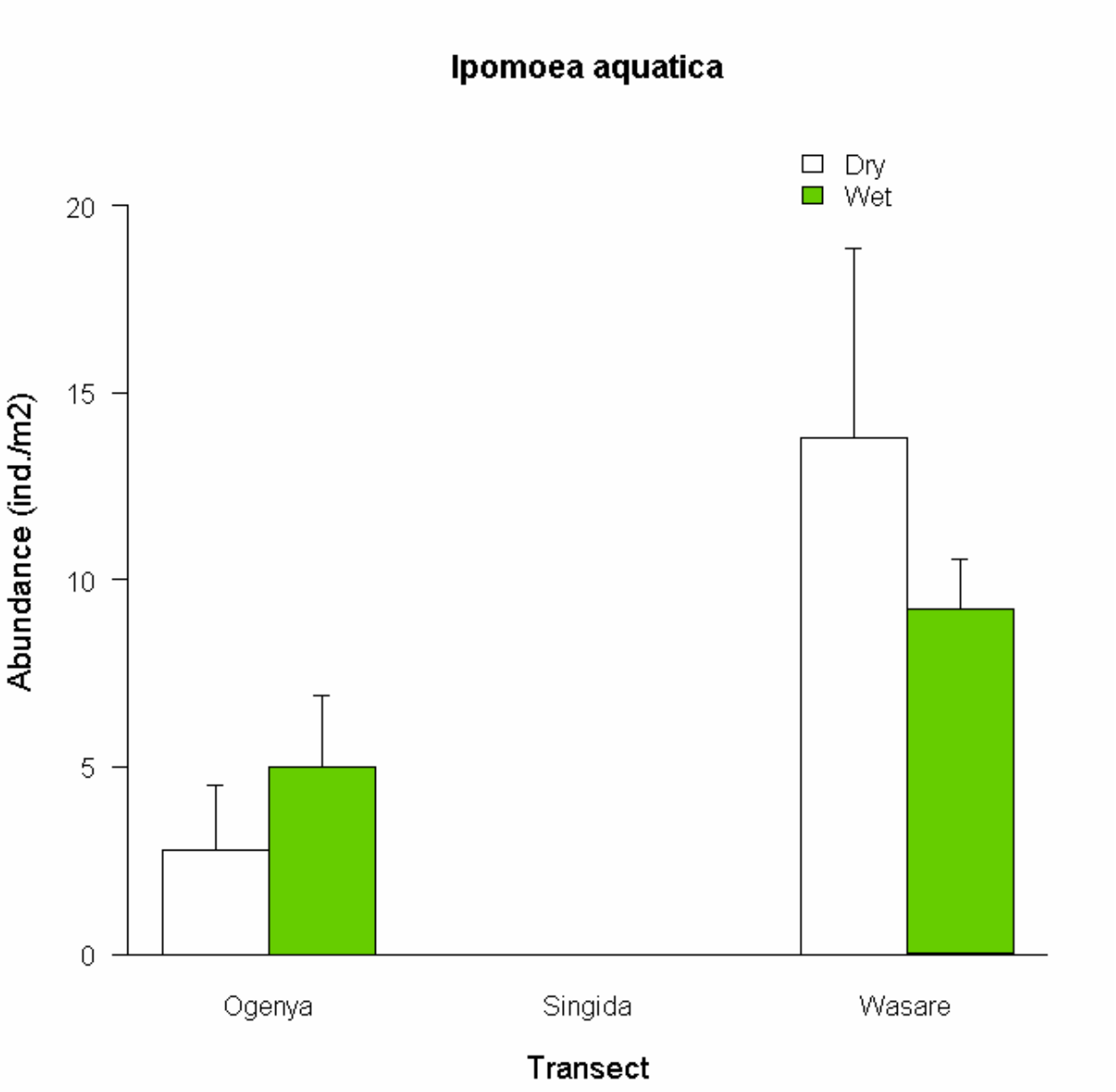
Results: species composition dry versus wet

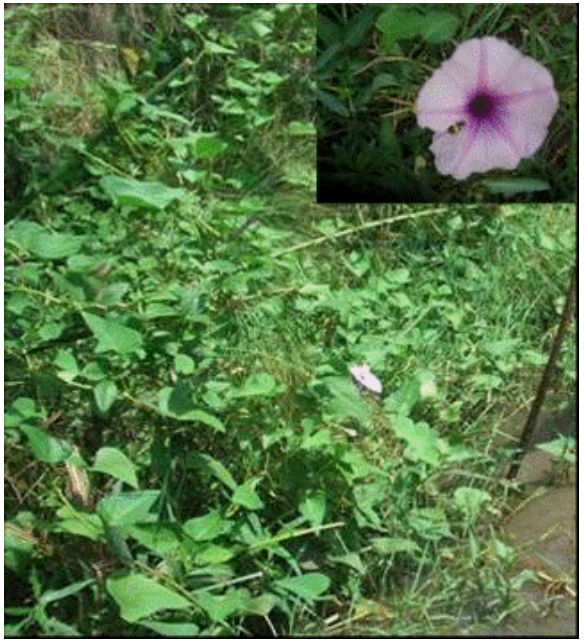
Plant species composition and distribution in dry and wet conditions						
	Wet			Dry		
Name of species	Ogenya	Singida	Wasare	Ogenya	Singida	Wasare
Cyphostema babuseti			X			X
Cyperus papyrus	X	X	X	X	X	X
Commelina species	X			X		X
Ipomoea aquatica	X		X	X		X
Ranunculus species					X	X
Cucumis species				X		X
Amaranthus spinosa						X
Polygonum pulcrum						X
Leersia hexandra						X
Vossia cuspidata	X	X	X	X		
Penicetum species				X		
Digitaria species				X		
Cyperus species				X		
Sphaeranthus species				X		
Hibiscus species				X		
Ipomea whightii		X			X	
Polygonum senegalensis		X				
Cyphostema species			X			

Results: plant density dry versus wet

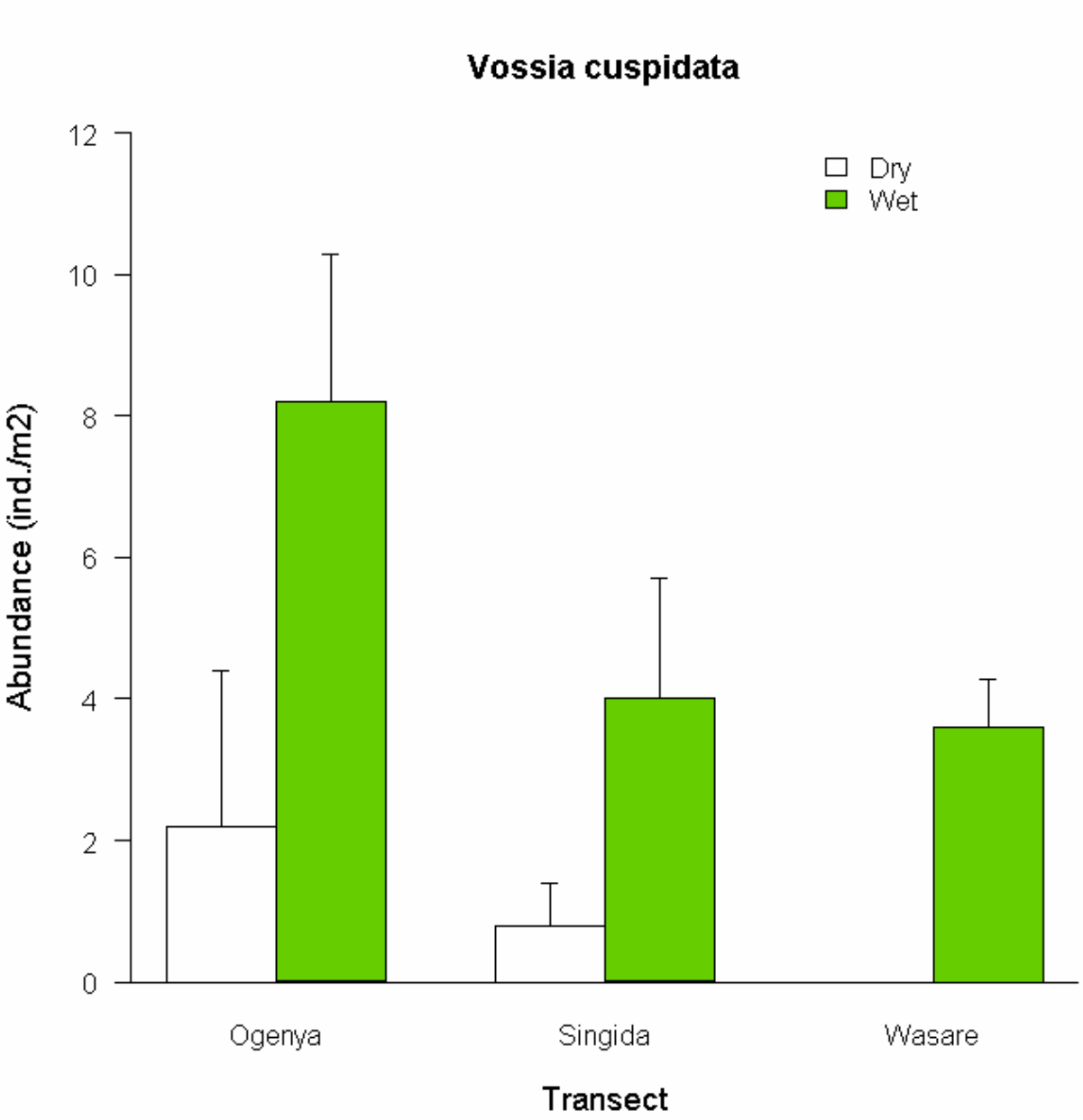


Results: plant density dry versus wet

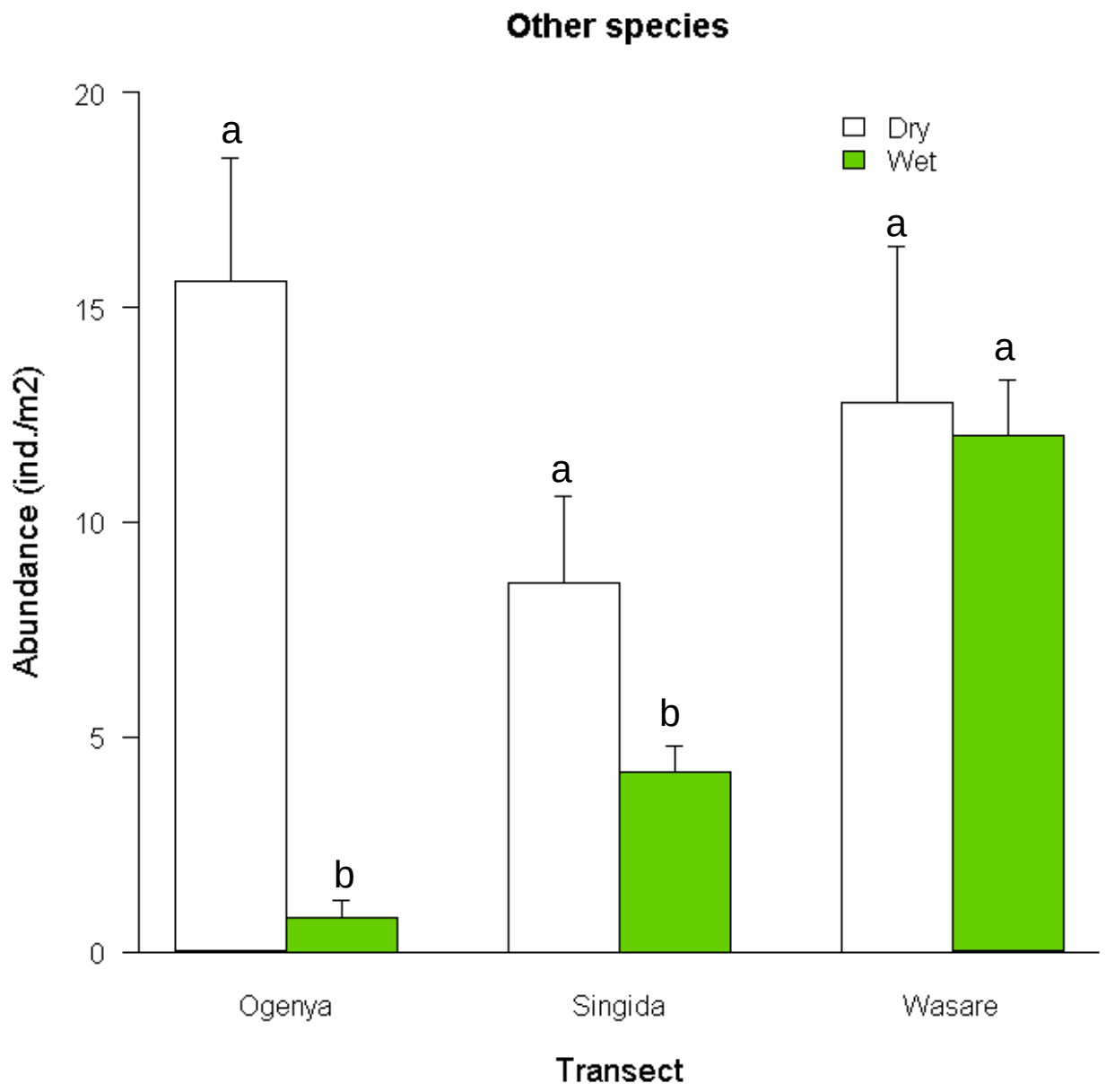




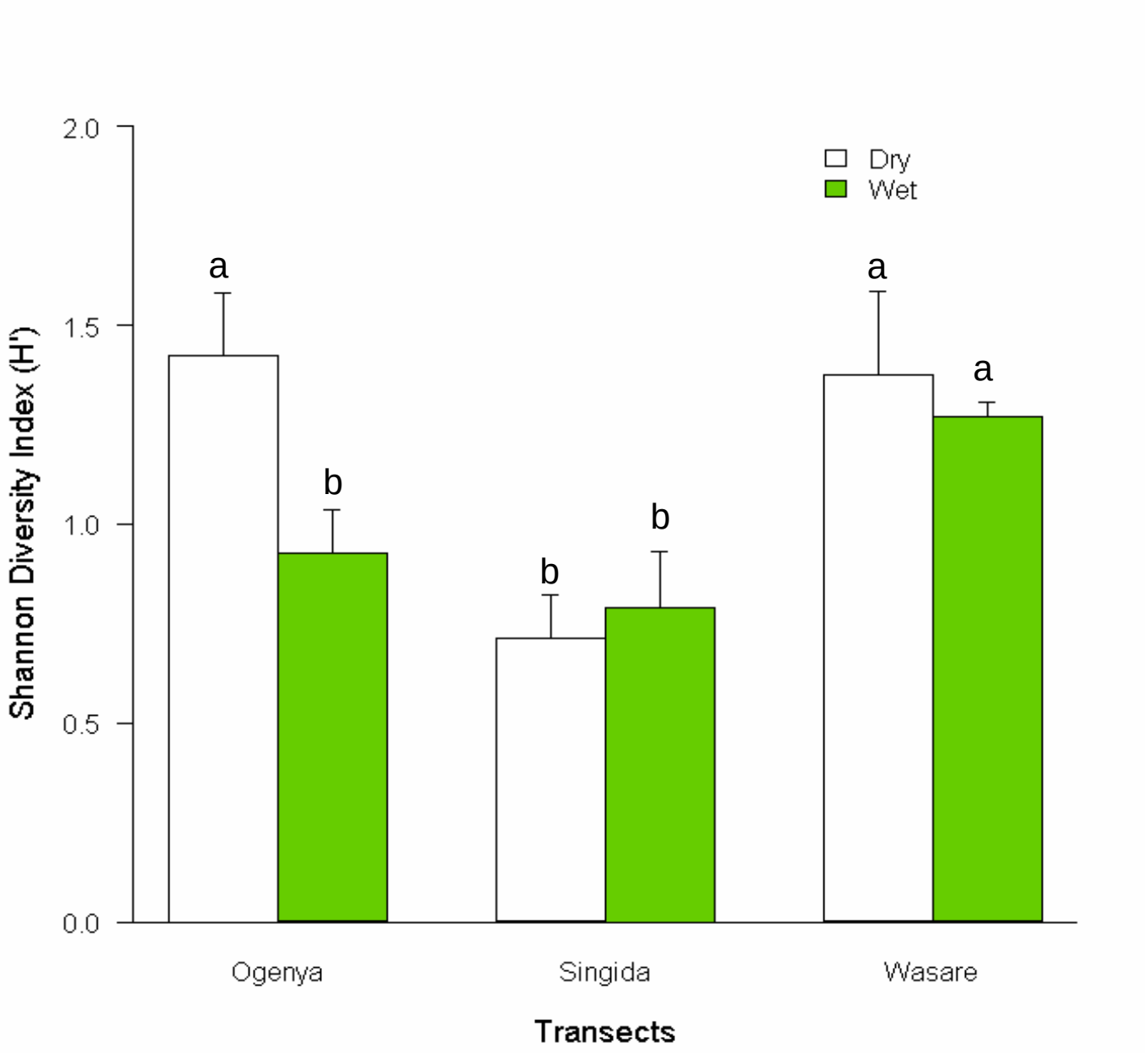
Results: plant density dry versus wet



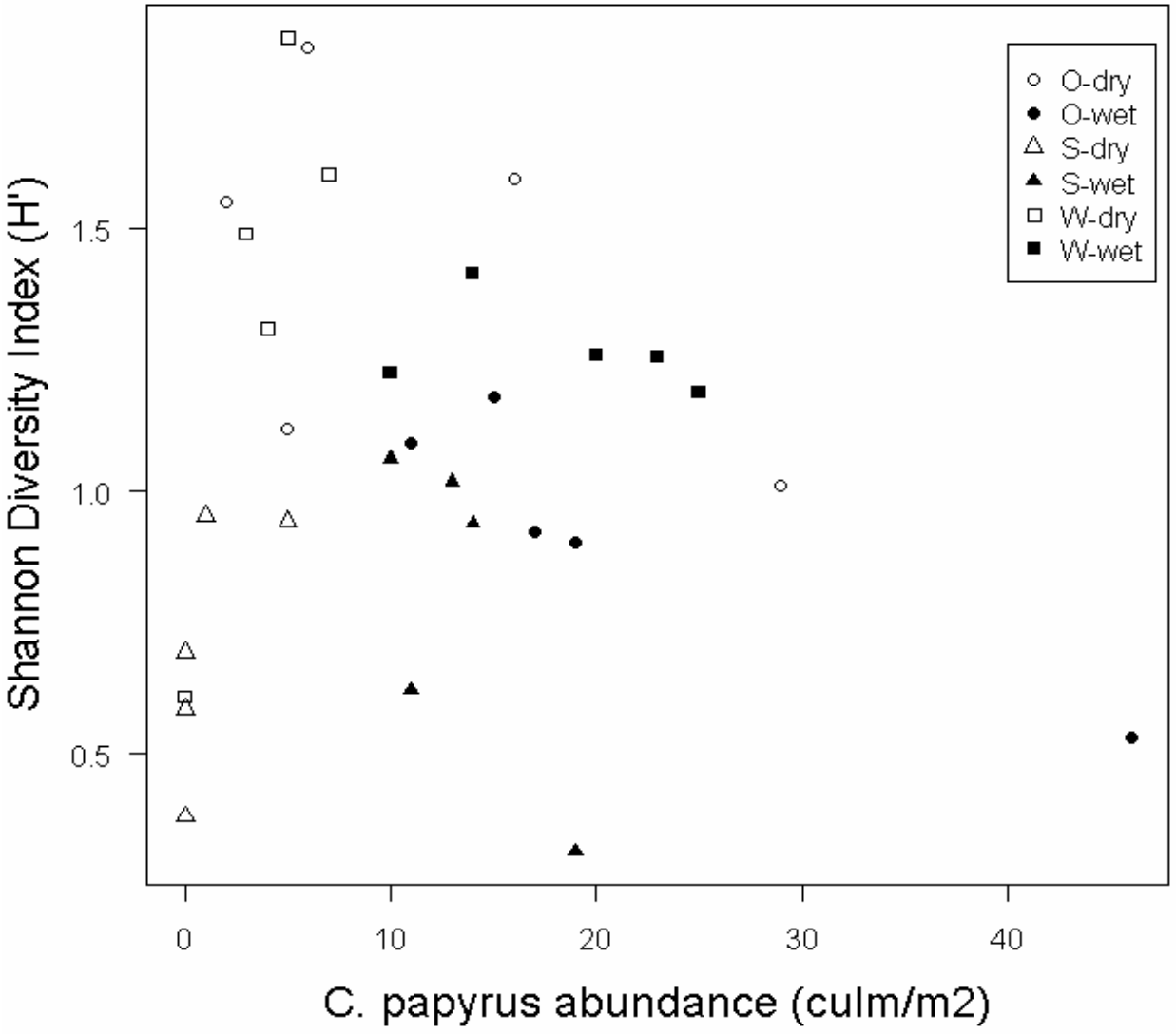
Results: plant density dry versus wet



Results: Shannon Diversity Index dry versus wet



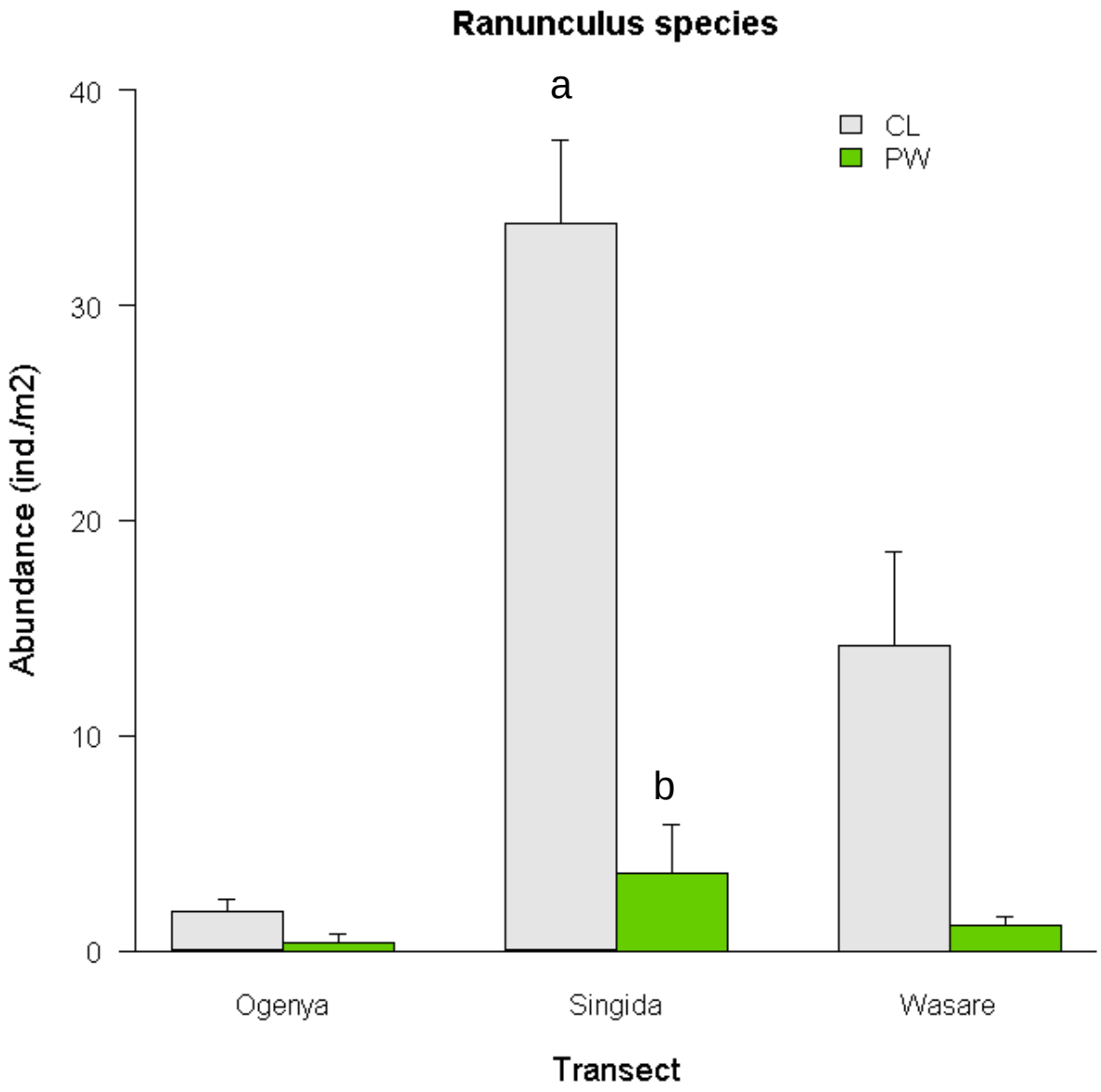
Relationship between diversity and *C. papyrus*



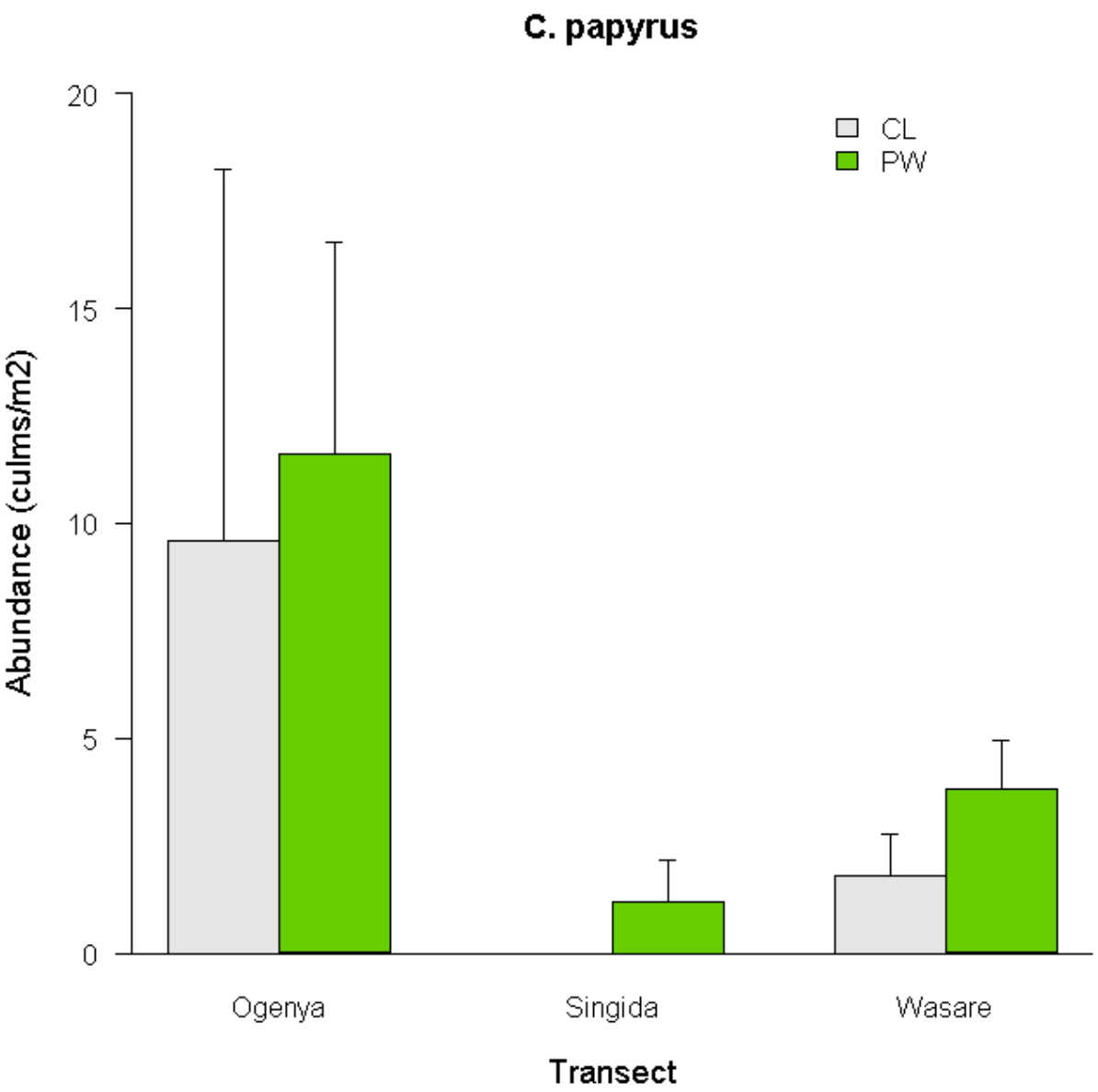
Results: species in natural versus cropland

Plant species composition and distribution in natural and converted wetland						
	Natural wetland			Converted to cropland		
Name of species	Ogenya	Singida	Wasare	Ogenya	Singida	Wasare
Cyphostema babuseti						X
Cyperus papyrus	X	X	X	X		X
Commelina species	X		X	X	X	X
Ipomoea aquatica					X	X
Ranunculus species		X	X	X	X	X
Cucumis species				X		X
Amaranthus spinosa				X		X
Amaranthus hybridus				X		
Polygonum pulcrum					X	X
Leersia hexandra				X		X
Datura species						X
Penicetum species	X				X	
Cyperus species				X	X	
Sphaeranthus species	X					
Hibiscus species	X					
Ipomea whightii		X				
Cyphostema species					X	
Gomfrina species						X
Oryza species						X
Solanum nigra						X
Mimosa pigra						X
Ageratum consoides				X		
Sesbania species				X		
Cynodon dactylon				X		
Sida species				X		
Eragrostis species				X		
Abutilon species				X		

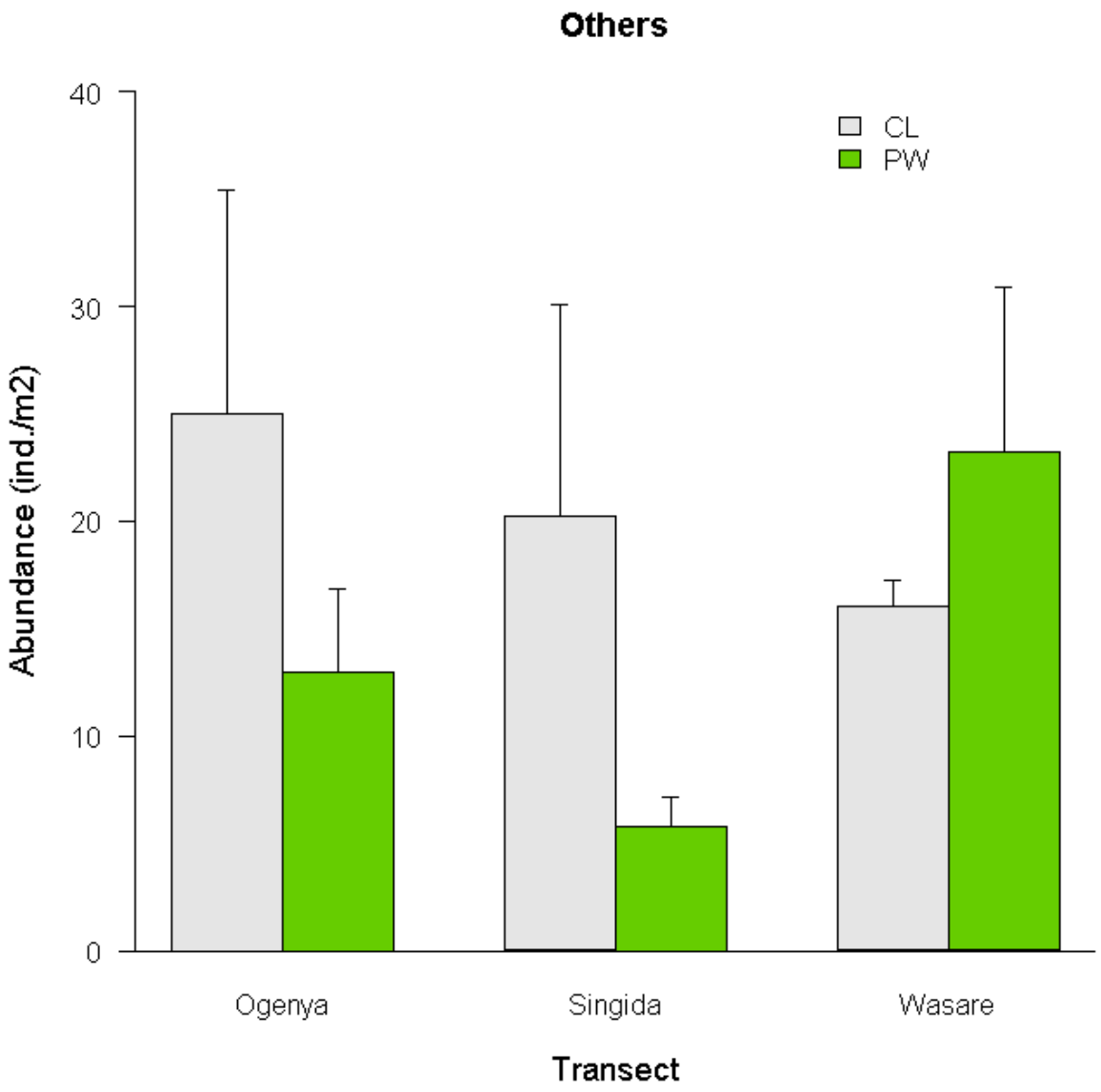
Results: Plant density in natural versus crop land



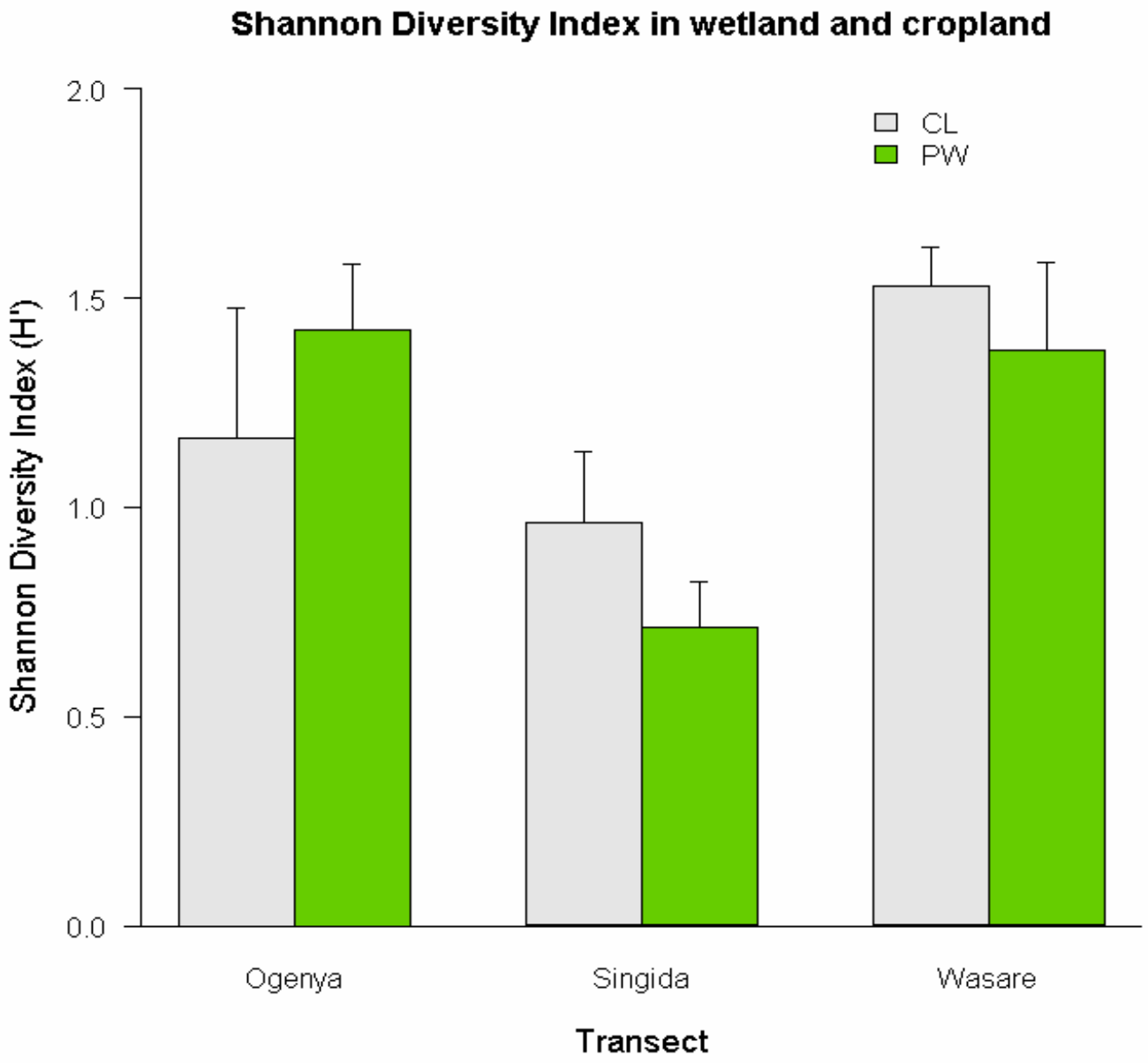
Results


C. papyrus
CL
PW
Abundance (culms/m2)
20
15
10
5
0
Ogenya
Singida
Wasare
Transect

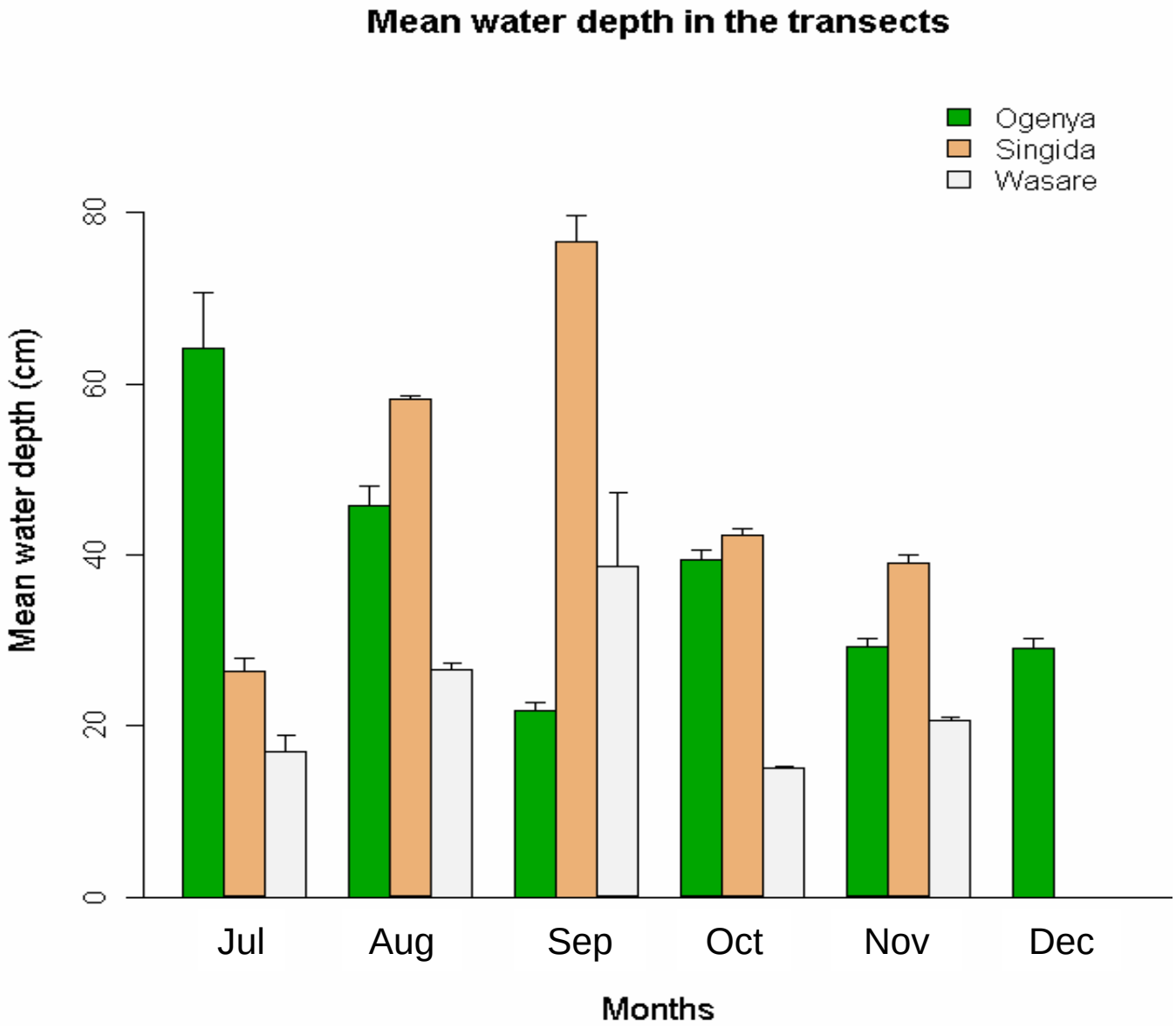
Results: Other species natural versus crop land



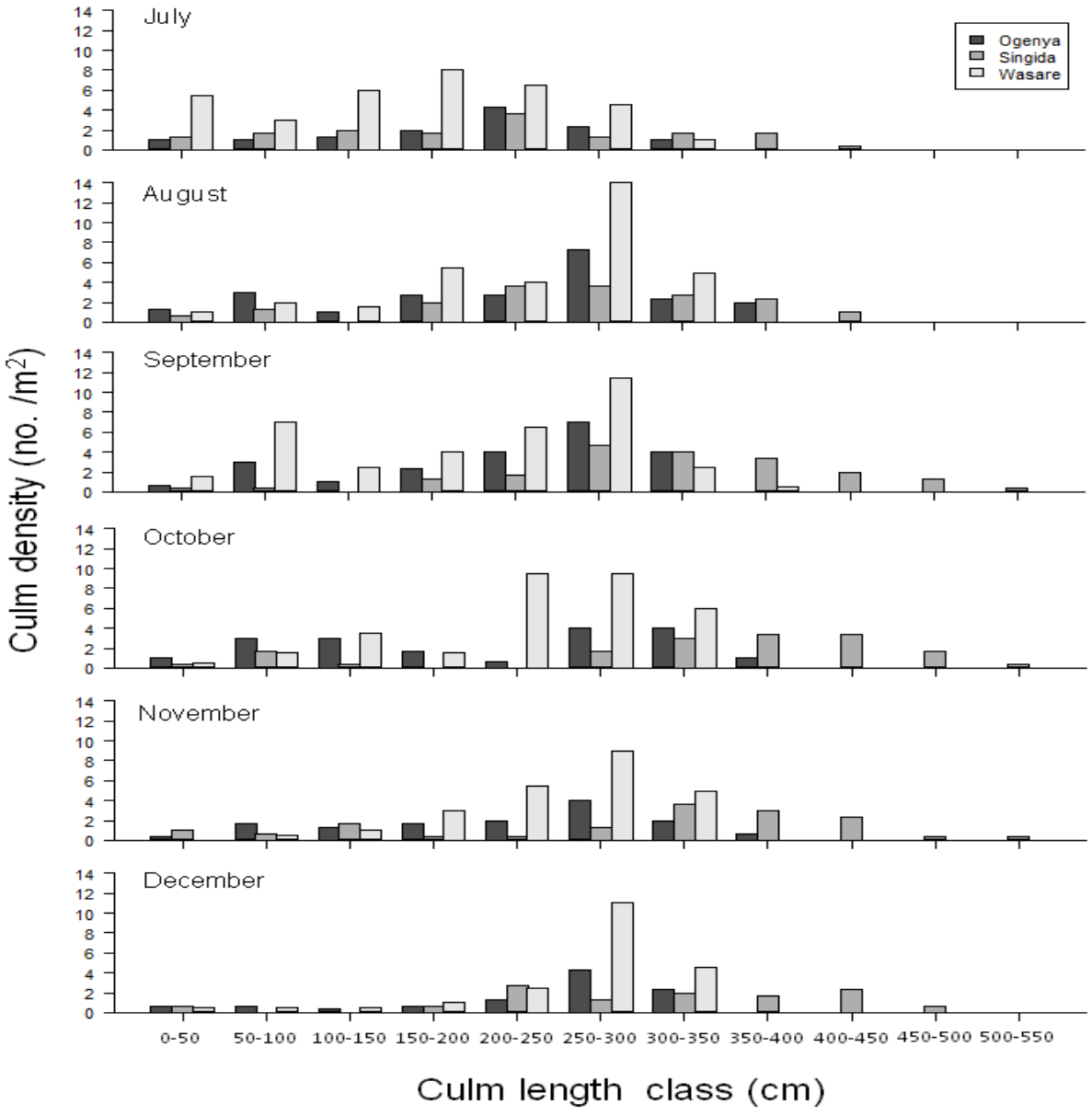
Results: Diversity Index natural and crop land



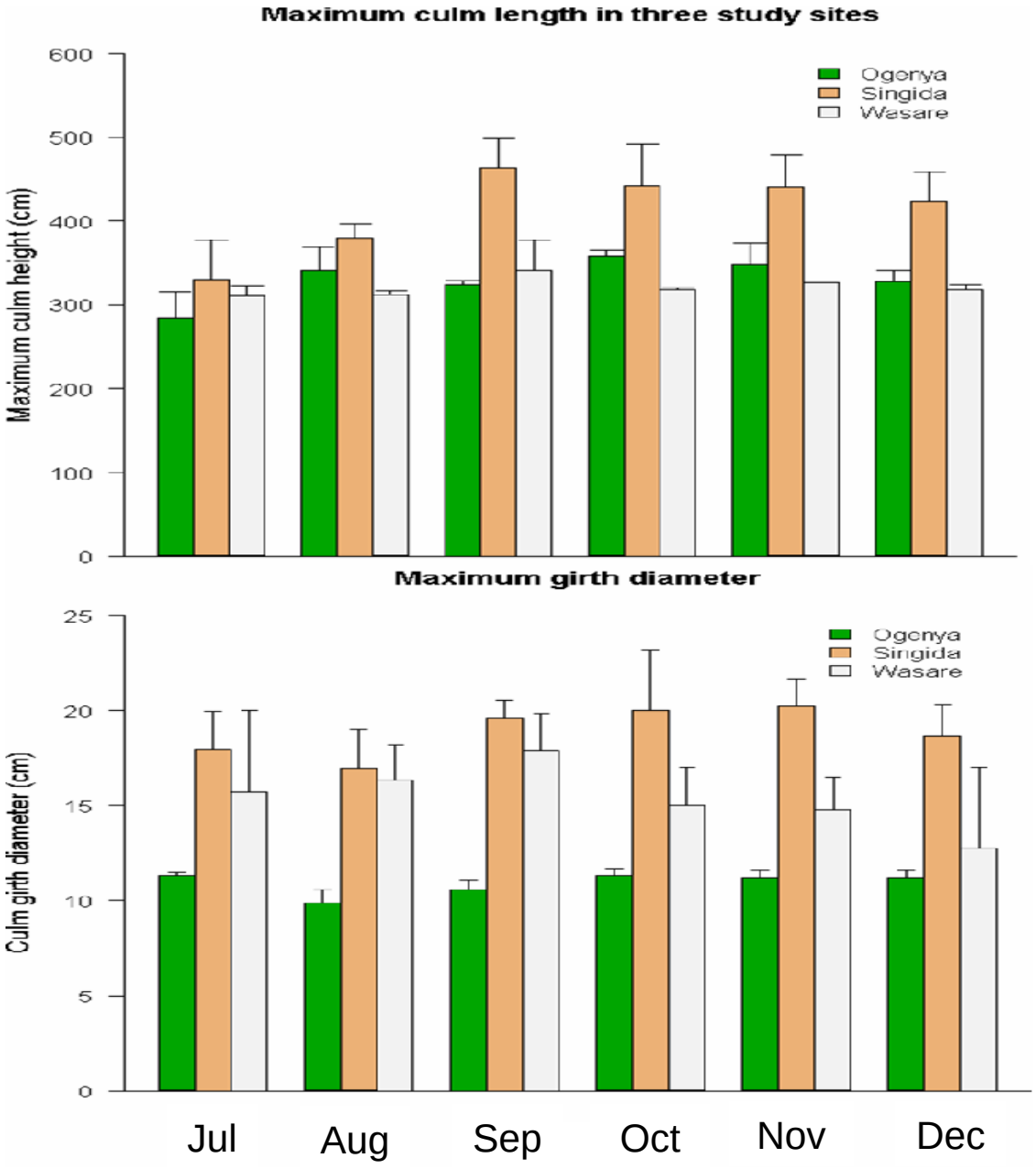
Results: Mean water depth levels



Frequency distribution of culm length class densities



Results: Maximum culm length and girth



- Maximum culm height
  - Ogenya 280 – 350 cm;
  - Singida 340 - 500 cm
  - Wasare 300 - 310 cm
- Maximum girth diameter
  - Ogenya 10cm;
  - Singida 21 cm
  - Wasare 17 cm

Discussion

- Species composition in wet conditions were dominated by *C. papyrus* and *V. cuspidata* while in dry conditions other species such as *Commelina sp., I. whightii* and *A. spinosa*.
- Natural wetland was dominated by other species such as *Cyperus species, Commelina sp.,*and *I. aquatica* while crop lands were dominated by *Ranunculus sp., C. dactylon* and *A. hybridus* in dry conditions.
- Diversity of plant species was low in areas with higher papyrus abundance.
- Water depth determined the level of disturbance which in turn determined the growth of papyrus vegetation characteristics – Singida highest water level, low papyrus density, low diversity, Highest maximum culm length, larger girth, low disturbance; Wasare driest part, high diversity, intermediate culm length and girth but highest disturbance

Conclusion

- ✓ 30 species were identified in Nyando wetland and 12 species were found only in the crop land area
- ✓ In Nyando wetland, wet papyrus abundance (Ogenya 23, Singida 13–Wasare 17 culms/m^2) and in dry (13, 3, 5 culms/m^2 respectively) which was reduced in the crop land area (9, 0, 3 respectively).
- ✓ Other species dominated in the dry conditions in Ogenya (*Cyperus sp., Hibiscus sp. Sphaeranthus sp*.) and Wasare (*A. spinosus, L. hexandra, Mimosa sp.)* which had moist and dry conditions respectively.
- ✓ Diversity index may not be a good indicator of papyrus wetland ecosystem health as diversity of vegetation was low in the natural wetland but was higher in areas with disturbance.
- ✓ Wet and dry conditions are closely linked with the human-induced disturbance – Wasare high disturbance, Ogenya intermediate and Singida low – influencing the density of class length, maximum length and culm girth growth of papyrus vegetation.


Thank you