The impact of typhoon disturbance on key mangrove ecosystem engineers in Can Gio, Vietnam

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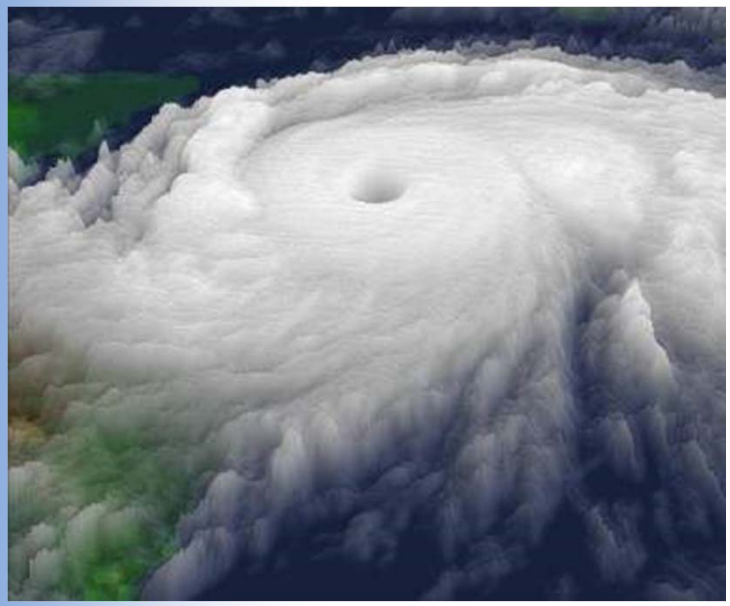

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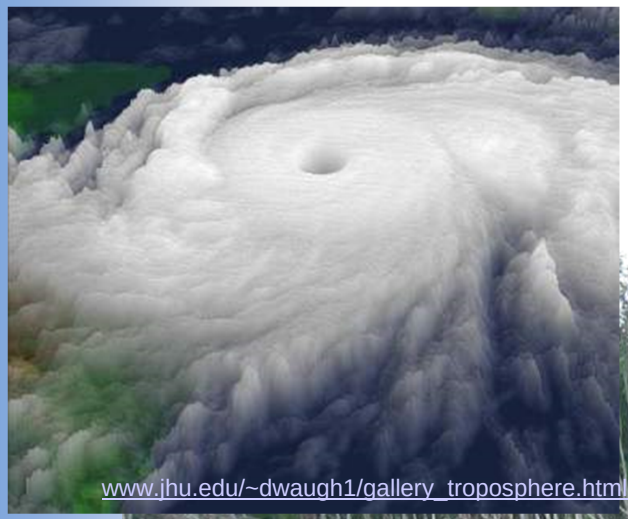
Diele et al. (2013) *Global and Planetary Change*

carbon storage

Lee et al. (2014): Ecological role and services of tropical mangrove ecosystems: A reassessment. *Global Ecology and Biogeography*



Can Gio Biosphere Reserve
Typhoon Durian, December 2006

Vegetation recovery of storm-damaged forests:
Spackman et al. 1964,Craighead 1971, Sherman et al 2001, Milbrandt et al. 2006, Palin et al. 2008, Smith et al. 1994, 2009)

?? How is mangrove *fauna* affected ??

Crab burrow cast ©Stieglitz

Crabs -> Ecosystem engineers

Burrowing species

-> modify sediment properties -> improve tree growth & establishment of seedlings

Litter feeding species

-> speed up nutrient cycling

-> may prefer propagules of particular tree species -> influences forest structure

etc etc…..

Drastically altered environment:

Parameter	Total loss of canopy
Light	Increased
Humidity	Decreased
Redox potential	Decreased (?)
Sulfid concentration	Increased (?)
Downed wood	Increased
Leaf litter	Decreased

-> community composition of crabs will change
-> alteration of functional groups - biological processes

Modified after Smith et al. 1994

Research Questions

How vulnerable (or robust) are mangrove crabs to typhoon disturbance?

(1) Does the crab fauna differ between intact forests and gaps?

- species richness, diversity
- crab abundance & biomass
- species dominance, community composition

(2) Shifting „functional“ groups?

- From leaf litter feeders to deposit feeders

(3) Do crabs accelerate vegetation recovery -> future study, management implications

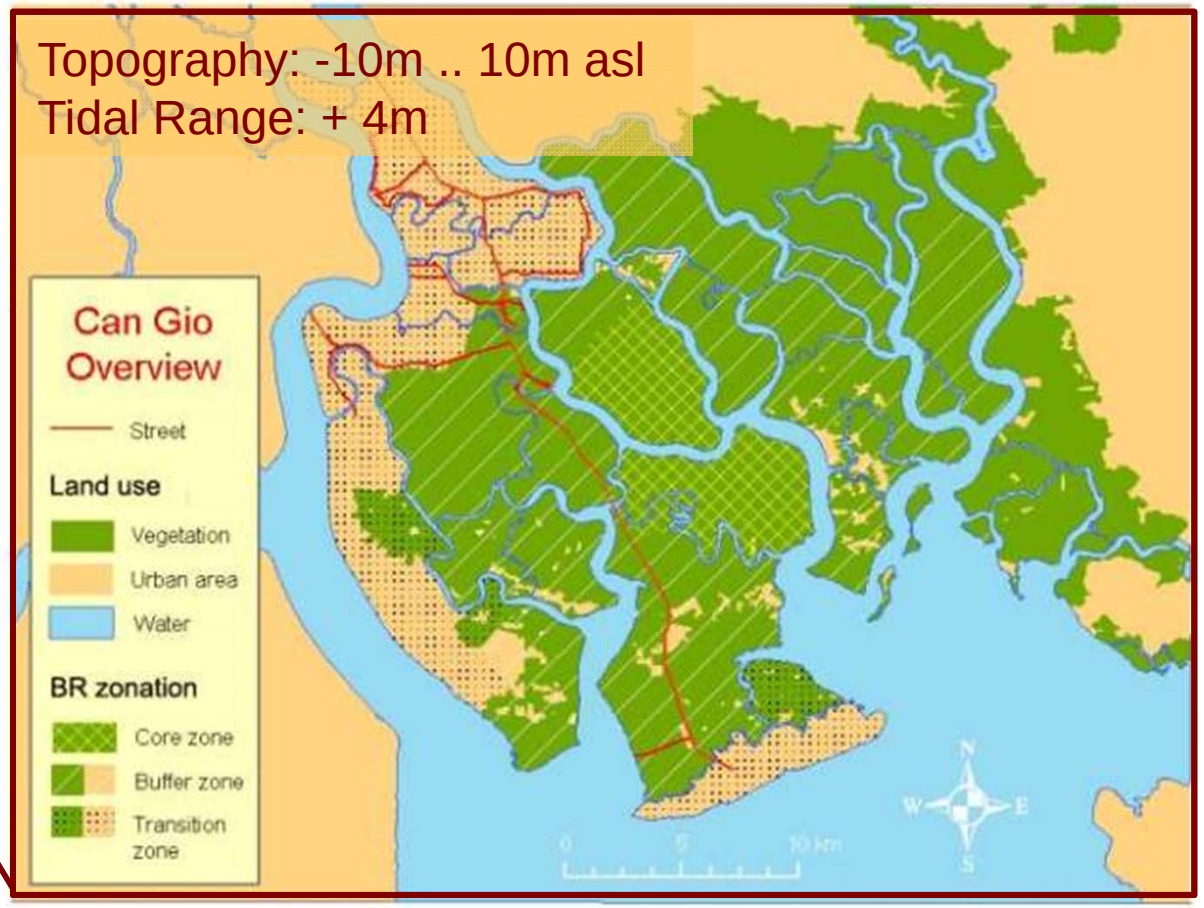
Study design and site characteristics

Field work 14 and 20 months after Durian
dry season (March) & wet season (September)

Project complements larger Vietnamese 10 yrs-study (wood decomposition, forest recovery etc)

Study Site: Can Gio Biosphere Reserve, S-Vietnam

worldmap.com



Information from UNESCO.org:
Core area: 4,721 ha
Buffer zone: ~41,139 ha

History

Le Minh Truong © National Geographic Society

V.N. Nam

Method

Comparing the effect of three „treatments“ on crab fauna

D1: F / Gcut / Gnat / ■■■

D2: F / Gcut / --- / □□ **--**

F: closed forest (= “control”)

Gcut: logs removed (normal)

Gnat: Gap with logs

Method

Seven 100 m^2 replicates per treatment

Crab capture: 4 persons handsampling 30 min in each replicate plot
-> „index“ of crab abundance / biomass

Environment: Water content, grain size; CN; Corg, °C sediment
canopy coverage, # logs, # roots .....

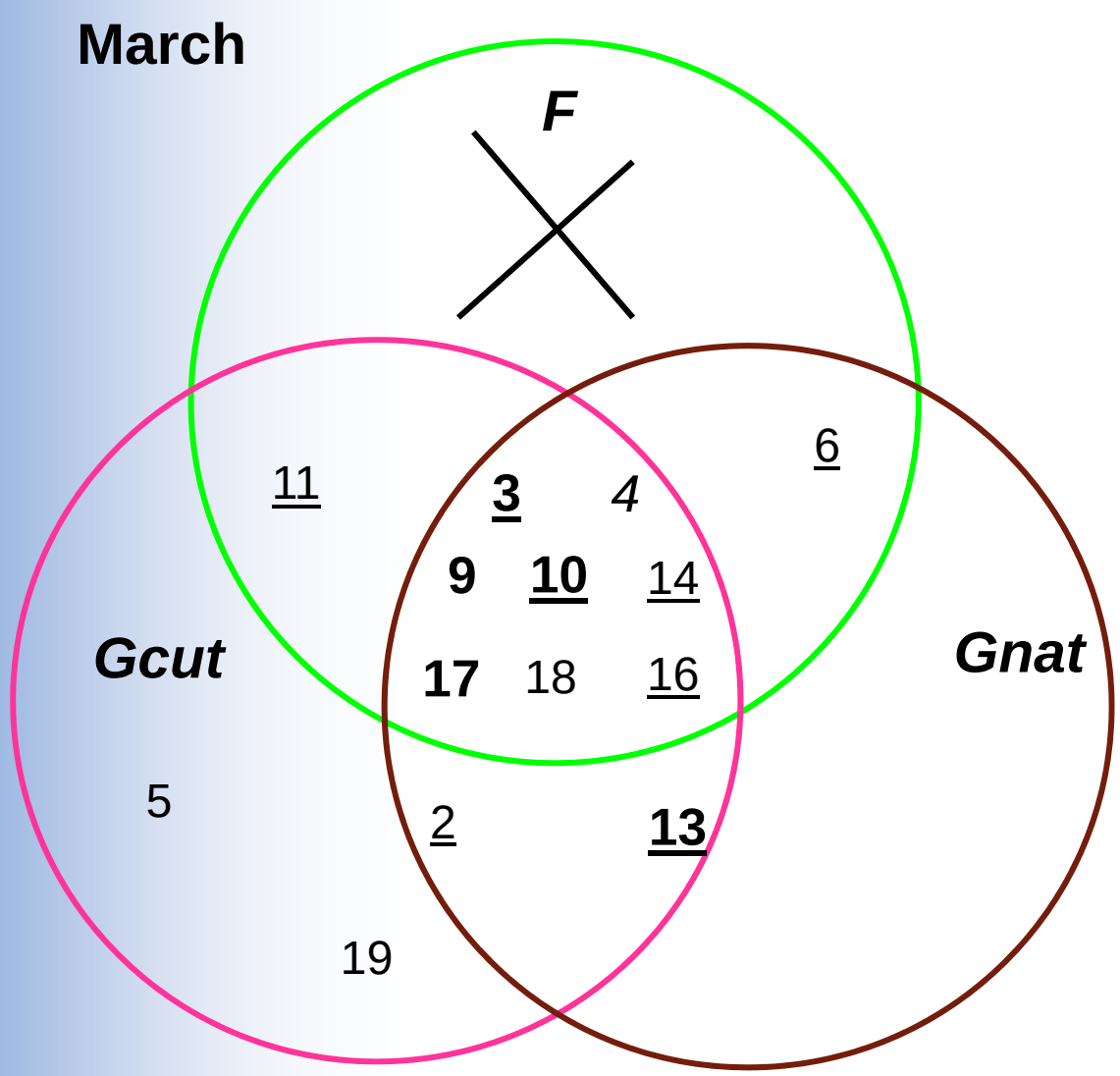
*Results** Species Richn., Presence/Absence, Diversity

In total 21 different species (70 plots)
14 species in March, 20 in September

	# species
D1Gcut	19
D1Gnat	14
D1F	12
D2Gcut	18
D2 F	9

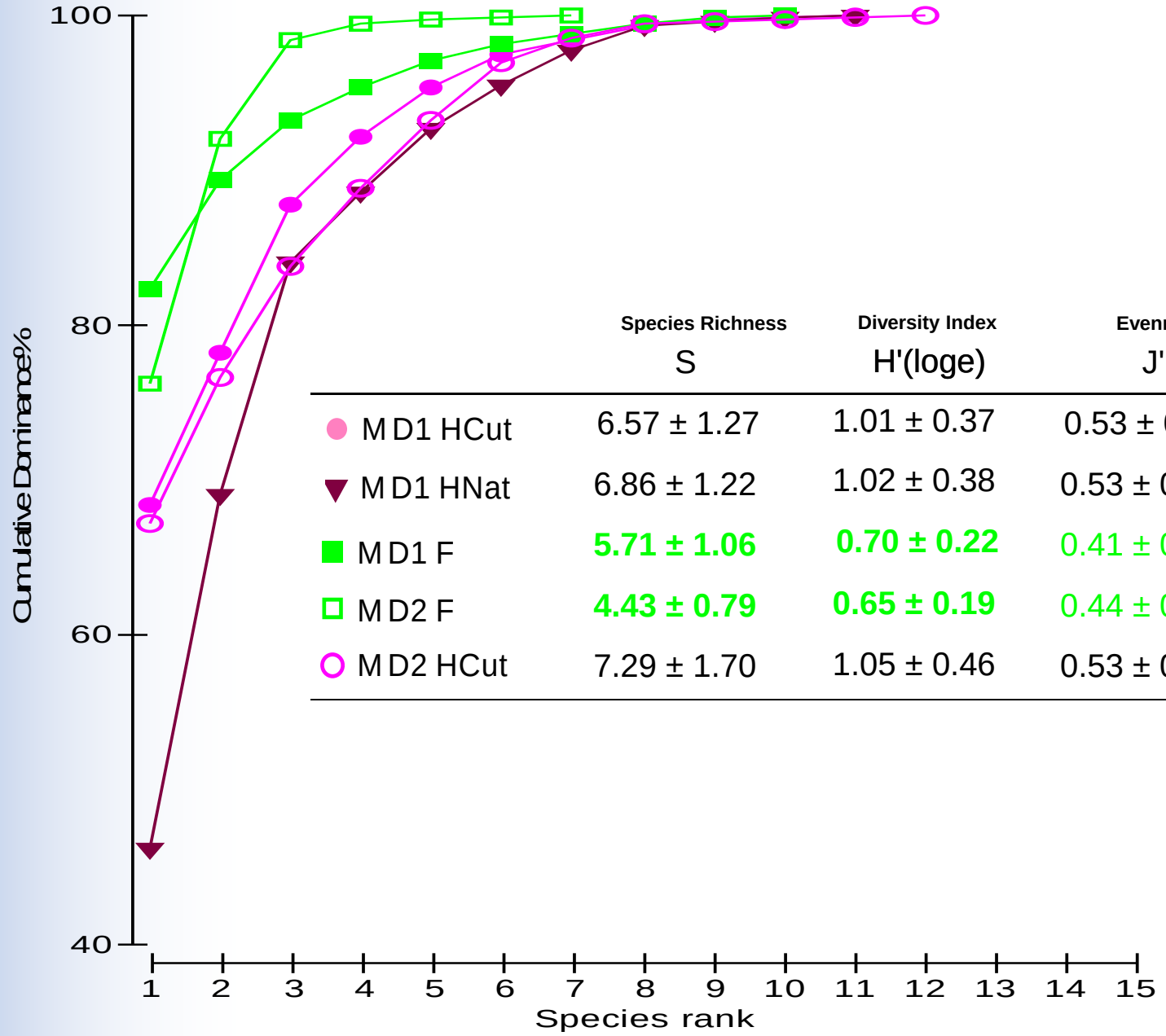
* Diele et al. (2013) Global and Planetary Change

Results Species Richn., Presence/Absence, Diversity



1 *Epixanthus dentatus*
2 ***Metopograpsus latifrons***
3 ***Clistocoeloma merguiense***
4 ***Episesarma palawanense***
5 ***E. singaporense***
6 ***E. versicolor***
7 *Nanosesarma batavicum*
8 *Neosesarma gemmiferum*
9 ***Parasesarma plicatum***
10 ***Perisesarma eumolpe***
11 ***Sarmatium germaini***
12 *S. striaticarpus*
13 ***Metaplax elegans***
14 ***Paracleistostoma sp.1***
15 *Paracleistostoma sp.2*
16 ***Uca dussumieri***
17 ***U. flammula***
18 ***U. forcipata***
19 ***U. lactea***
20 *U. sp.5*
21 *u. sp.6*.

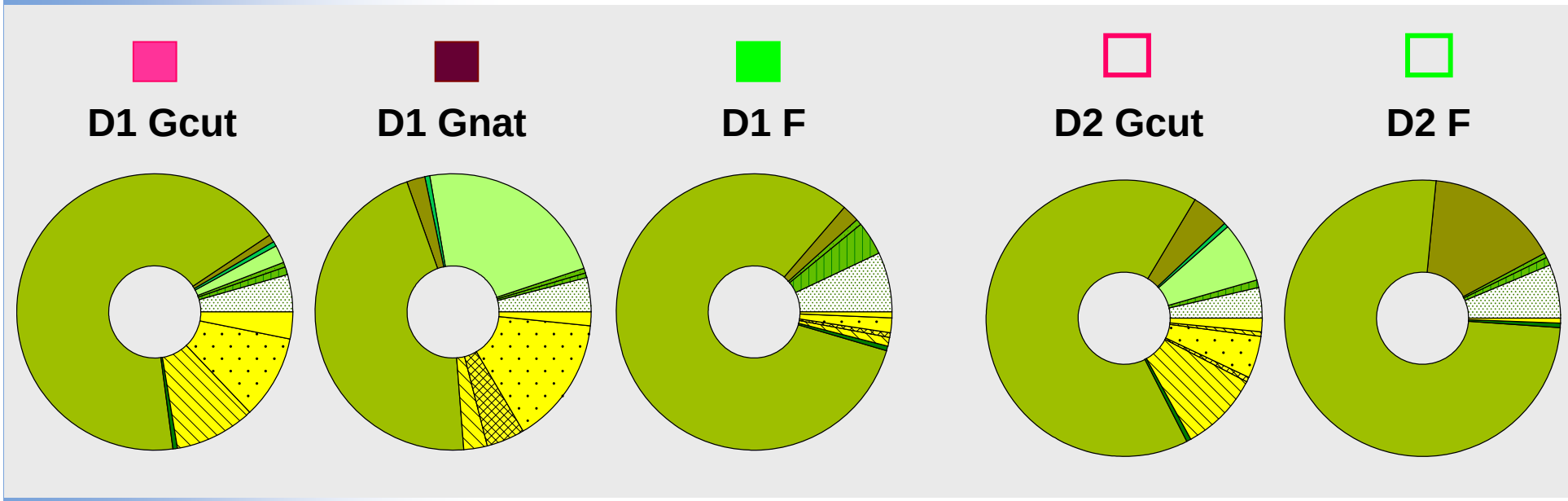
Abundance March „Rank Species Abundance Dominance curve“



	Species Richness S	Diversity Index H'(loge)	Evenness J'
M D1 HCut	6.57 ± 1.27	1.01 ± 0.37	0.53 ± 0.15
M D1 HNat	6.86 ± 1.22	1.02 ± 0.38	0.53 ± 0.18
M D1 F	**5.71 ± 1.06**	**0.70 ± 0.22**	0.41 ± 0.08
M D2 F	**4.43 ± 0.79**	**0.65 ± 0.19**	0.44 ± 0.12
M D2 HCut	7.29 ± 1.70	1.05 ± 0.46	0.53 ± 0.20

Percentage species distribution per site

(Abundance, March)



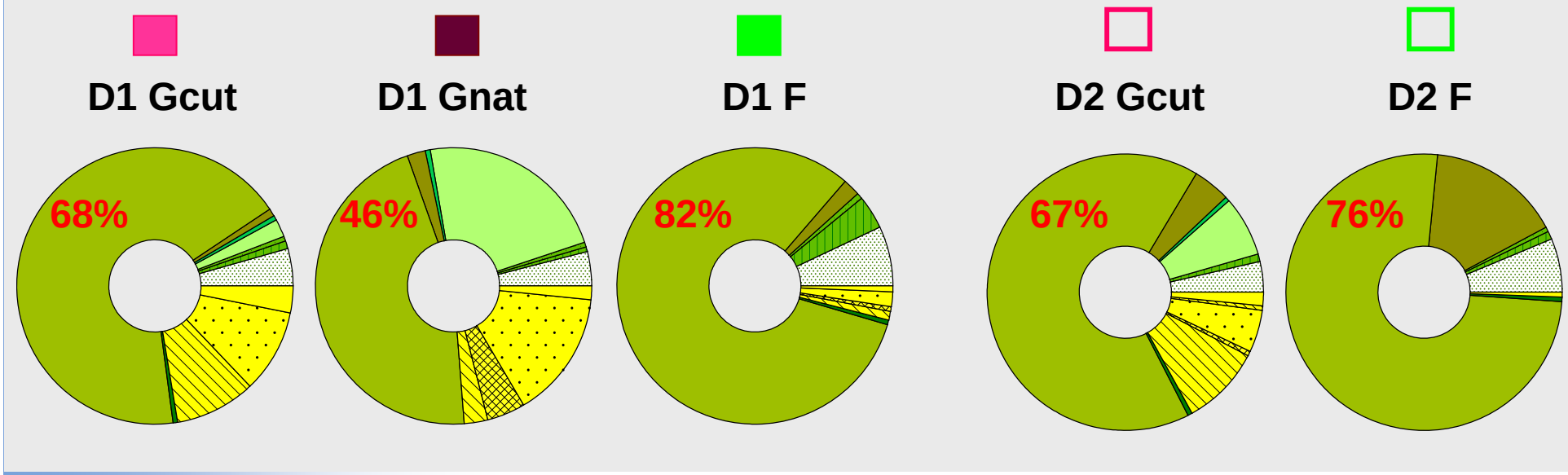
Ocypodoidea

- Uca coarctata flammula
- U. dussumieri
- U. forcipata
- U. lactea
- Paracleistostoma sp.

-> 10 fold more abundant in gaps than in forest

Percentage species distribution per site

(Abundance, March)



Grapsoidea

- Clistocoeloma merguiense
- Episesarma palawanense
- E. singaporense
- E. versicolor
- Metaplax elegans
- Metopograpsus latifrons
- Parasesarma plicatum
- Perisesarma eumolpe
- Sarmatium germaini

Ocypodoidea

- Uca coarctata flammula
- U. dussumieri
- U. forcipata
- U. lactea
- Paracleistostoma sp.

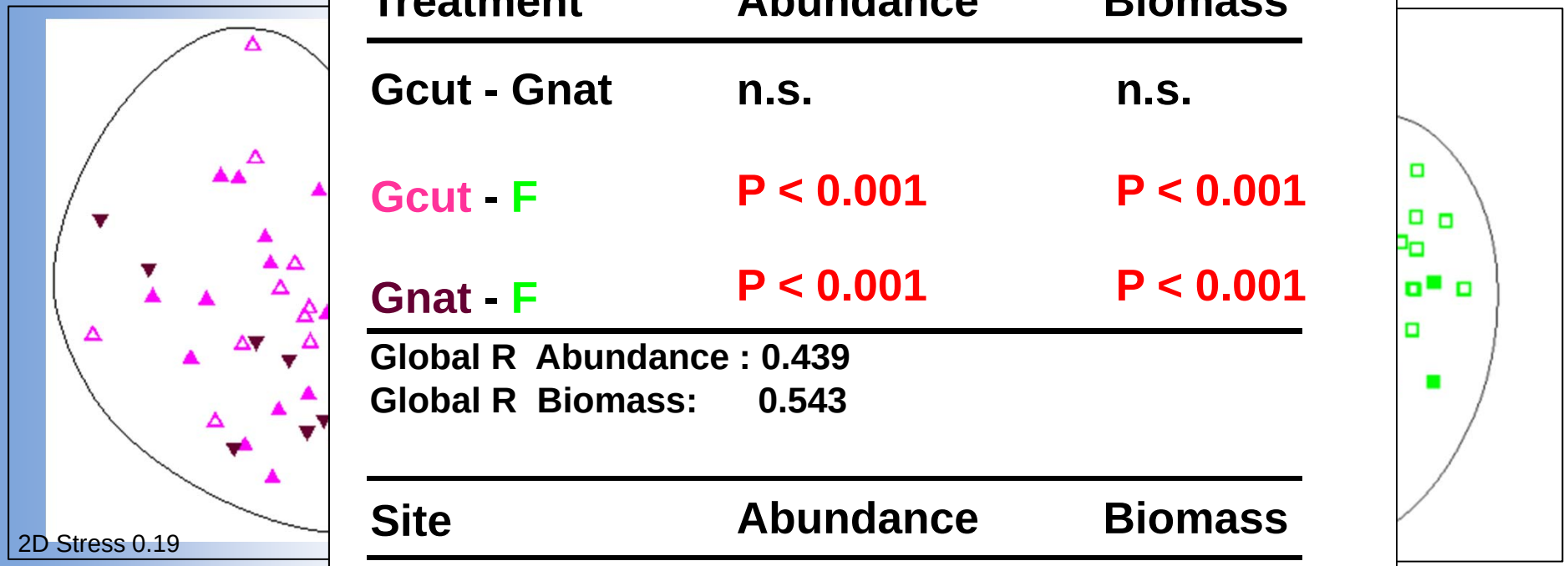
Perisesarma eumolpe

Results Abundance / Biomass – multivariate

MDS ordination

4rth root transformed; Resemblance S17 Bray Curtis Similarity: both months pooled

Abundance



-> crab *com*

ANOSIM (-> Bray-Curtis dissimilarity matrix)

Treatment	Abundance	Biomass
Gcut - Gnat	n.s.	n.s.
Gcut - F	P < 0.001	P < 0.001
Gnat - F	P < 0.001	P < 0.001

Global R Abundance : 0.439
Global R Biomass: 0.543

Site	Abundance	Biomass
D1 - D2	P < 0.05	P < 0.05

Global R Abundance: 0.121
Global R Biomass: 0.151

Research Questions

How vulnerable (or robust) are mangrove crabs to typhoon disturbance?

Does the crab fauna in forests and gaps differ?

- species richness *yes* and identity no forest excl. but ten gap excl.species
- Shannon diversity *yes*
  - the dominating species ***no***
  - total crab abund. *no*; total crab biomass *yes*
  - community composition (multivariate): abund. & biomass *yes*

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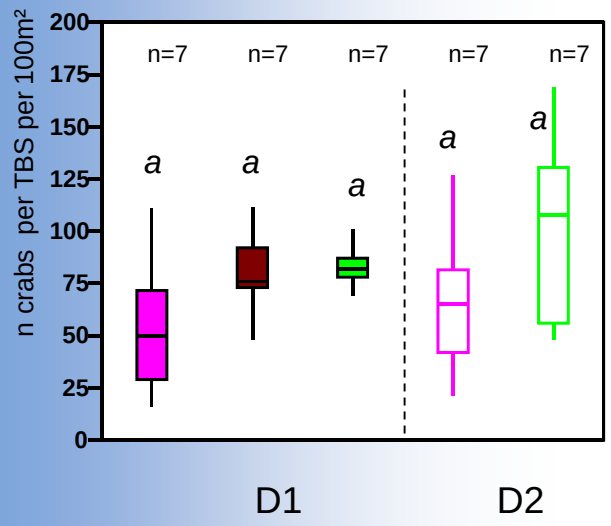
- Shannon diversity *yes*
  - the dominating species ***no***
  - total crab abund. *no* total crab bi
  - community composition (multivar

Perisesarma eumolpe:
important leaf litter feeder

Perisesarma eumolpe

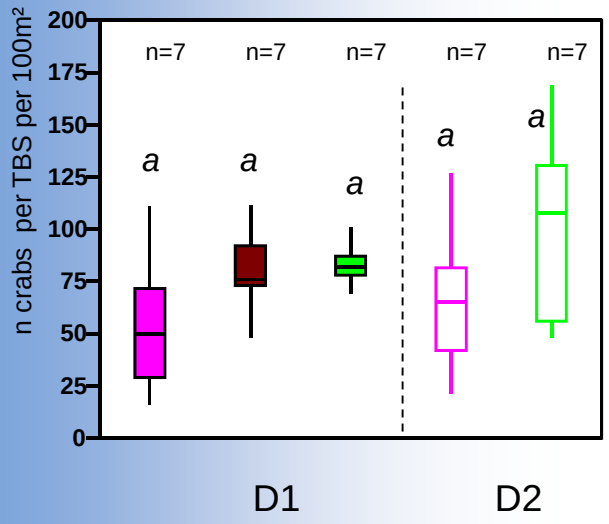
Abundance



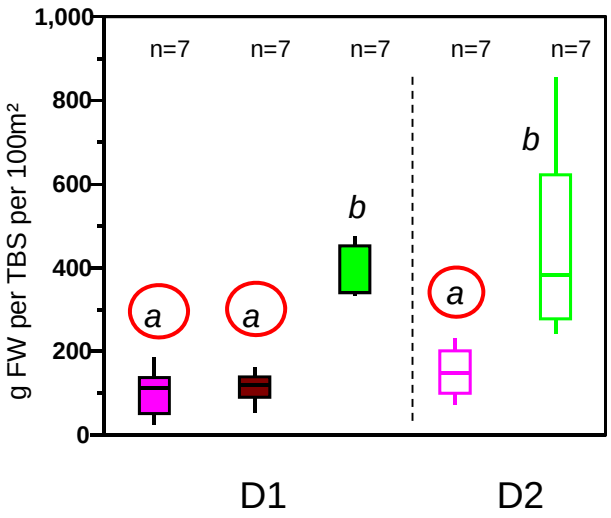
Gaps and Forest:
Similar crab abundance

Perisesarma eumolpe

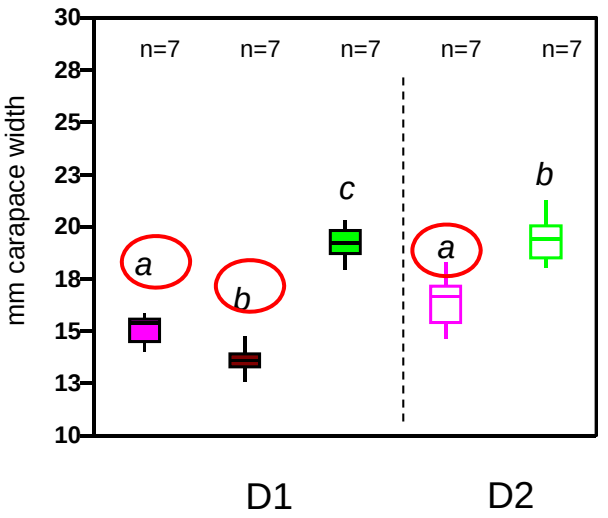
Abundance



Biomass



Size



Gaps:

Similar crab abundance but significantly smaller biomass & size

-> food limitation?

-> physiological stress?

Perisesarma eumolpe

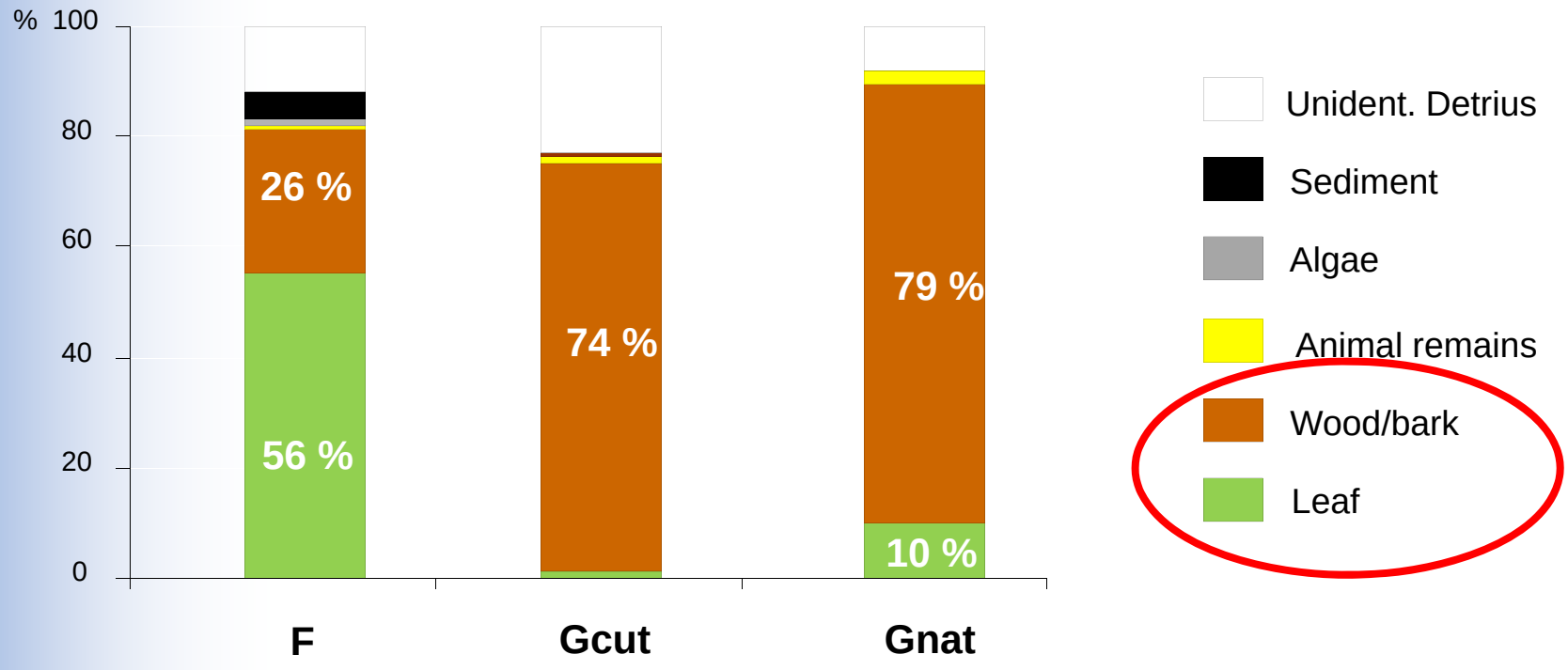
- **Average stomach fullness**

  lower in gap (25%) than in forest crabs (52%)

- **Type of food in crab stomachs**

  crabs seem to be able to assimilate cellulose

  (carbohydrate rich but difficult to digest due to crystalline structure)



Conclusion & Outlook

- typhoon disturbance did change the crab community BUT…
- … no shift in dominance from burrowing litter-feeders to phytobenthos feeders

→ robustness of „forest-crabs“ through ability to process/ assimilate woody debris

⬇

enhanced nutrient cycling & sediment desalination in gaps

- ➢ are crabs important drivers for forest recovery by facilitating tree establishment?
  positive vs negative feedbacks…?
- ➢ manipulative experiments needed to determine their role in gap dynamics !