Atlantic reef fish: linking biogeography, macroecology and evolution

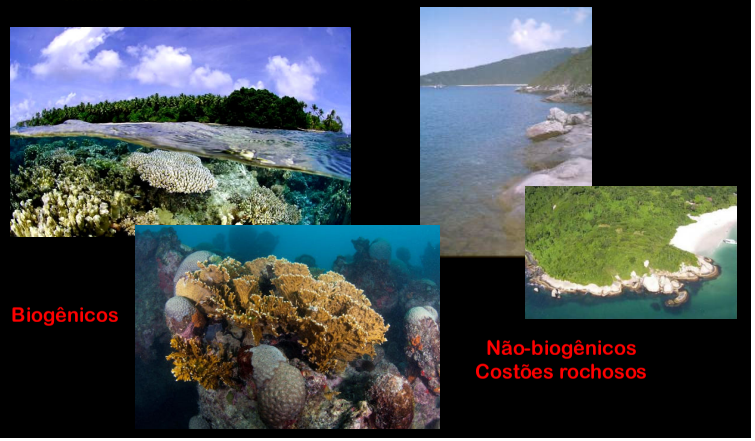
Community ecology in multiple scales

Sergio R Floeter

Universidade Federal de Santa Catarina
Brasil

www.lbmm.ufsc.br

Recifes = estruturas sólidas ou consolidadas que aumentam a complexidade tridimensional no ambiente marinho



Biogênicos

Não-biogênicos
Costões rochosos

Peixes recifais: DEFINIÇÃO

Peixes recifais: DEFINIÇÃO

Conceito operacional:

Peixes que utilizam ou se aproximam de substratos consolidados e/ou sistemas adjacentes, para suas atividades, ex. alimentação, descanso, abrigo contra predadores, reprodução e atividades de limpeza.

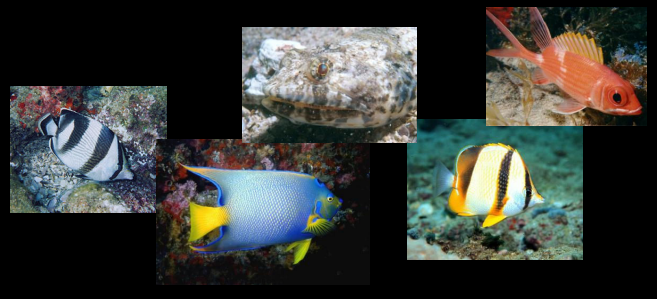
Por que estudar peixes recifais?

Imagina flutuar [meio liquido] **em uma floresta tropical!**

Por que estudar peixes recifais?

Dados quantitativos em ambiente estruturalmente complexo – super diverso

Relativa facilidade para identificação no campo [coleta não destrutiva]

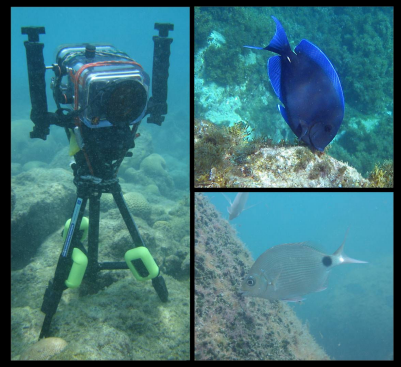


Por que estudar peixes recifais?

Dados quantitativos em ambiente estruturalmente complexo – super diversidade

Por que estudar peixes recifais?

Estudos comportamentais



Por que estudar peixes recifais?

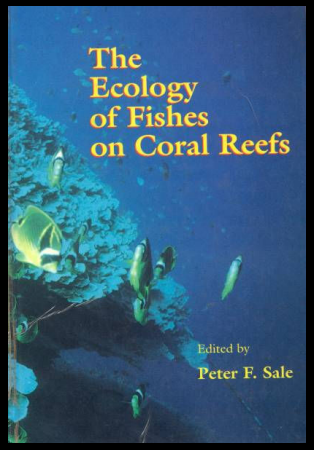
Dados quantitativos em ambiente estruturalmente complexo – super diverso

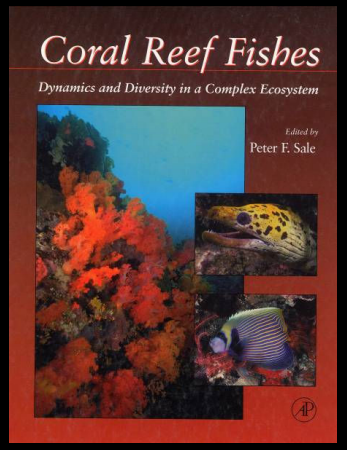
Relativa facilidade para identificação no campo [coleta não destrutiva]

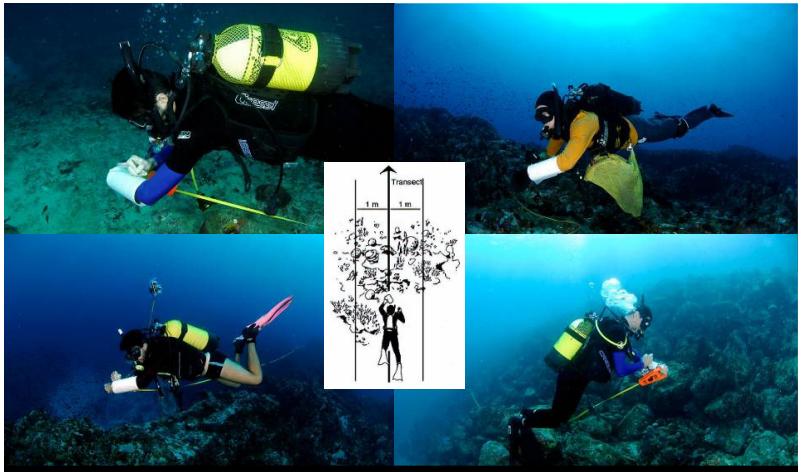
Taxonomia bem resolvida!

Grupos funcionais [grupos tróficos conhecidos]

Amostragem de comunidade inteira!







AMOSTRAGEM POR CENSO VISUAL

Community assembly

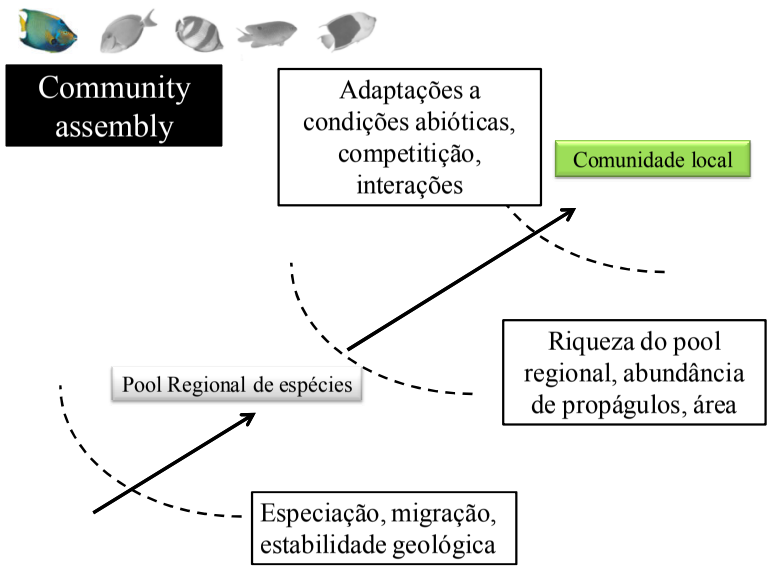
Filtro ambiental

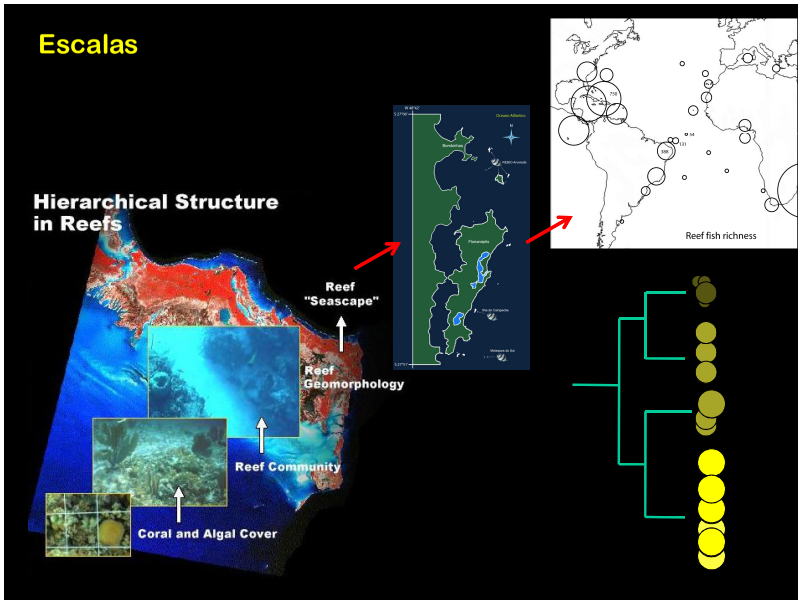
Comunidade local

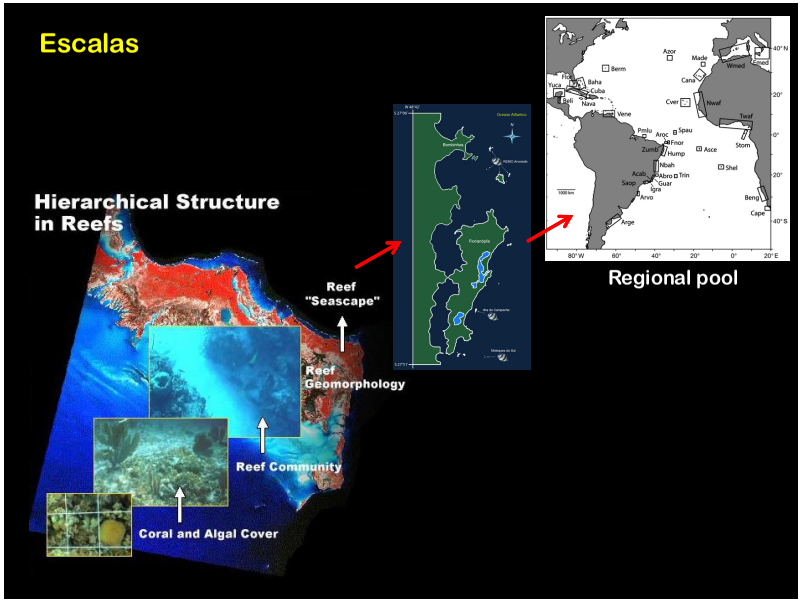
Pool Regional de espécies

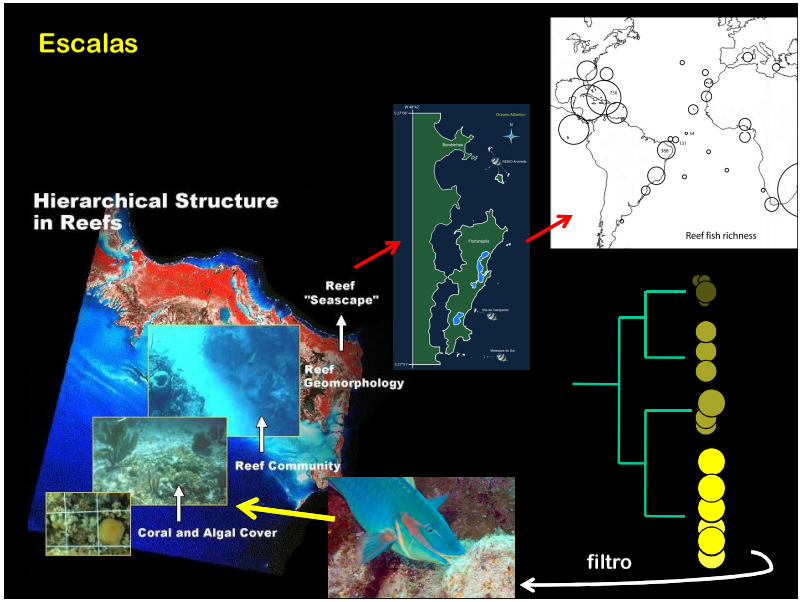
Filtro da dispersão

Filtro histórico


Community assembly
Adaptações a condições abióticas, competitição, interações
Comunidade local
Riqueza do pool regional, abundância de propágulos, área
Pool Regional de espécies
Especiação, migração, estabilidade geológica


Escalas
Hierarchical Structure in Reefs
Reef "Seascape"
Reef Geomorphology
Reef Community
Coral and Algal Cover
Reef fish richness


Escalas
Hierarchical Structure in Reefs
Reef "Seascape"
Reef Geomorphology
Reef Community
Coral and Algal Cover
Regional pool


Escalas
Hierarchical Structure in Reefs
Reef "Seascape"
Reef Geomorphology
Reef Community
Coral and Algal Cover
Reef fish richness
filtro

Escala do oceano

Journal of Biogeography (J. Biogeogr.) (2008) **35**, 22–47

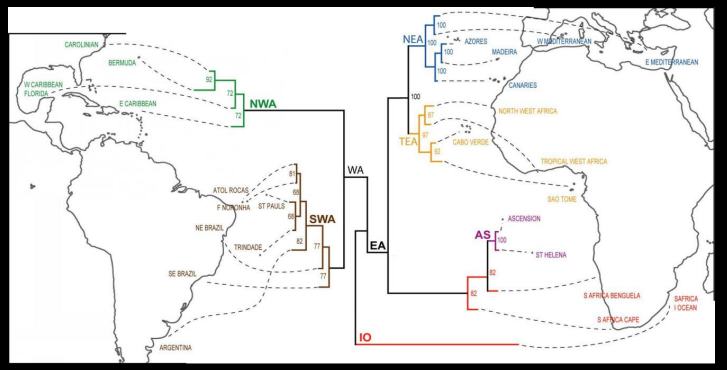
SPECIAL PAPER

Atlantic reef fish biogeography and evolution

S. R. Floeter[1,2]*, L. A. Rocha[3], D. R. Robertson[4], J. C. Joyeux[5], W. F. Smith-Vaniz[6], P. Wirtz[7], A. J. Edwards[8], J. P. Barreiros[9], C. E. L. Ferreira[10], J. L. Gasparini[5], A. Brito[11], J. M. Falcón[11], B. W. Bowen[3] and G. Bernardi[12]

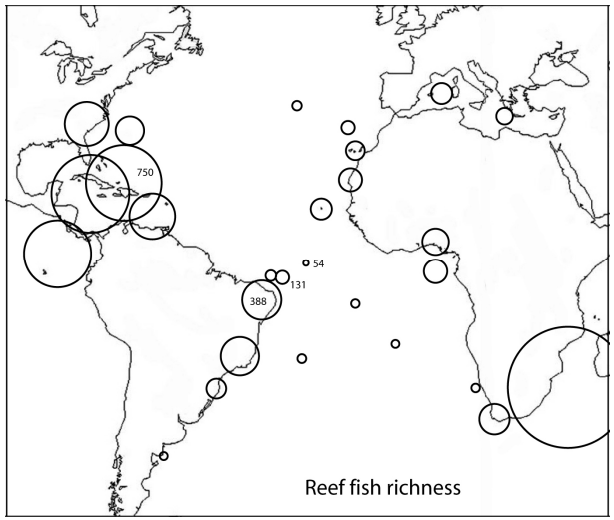
Citado 35 vezes segundo: ISI Web of Science (Maio 2010)
+ 2 livros texto internacionais

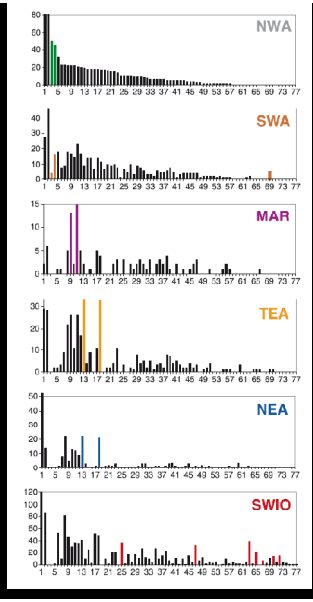
Relações entre as áreas: distribuições



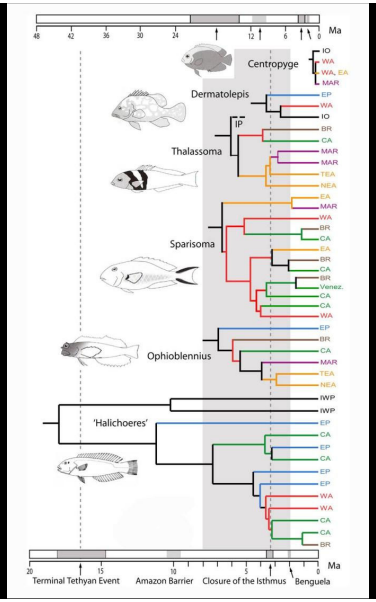
Análise de Parsimônia Máxima –
presença e ausência das spp.

Como a riqueza (taxonômica) se distribui



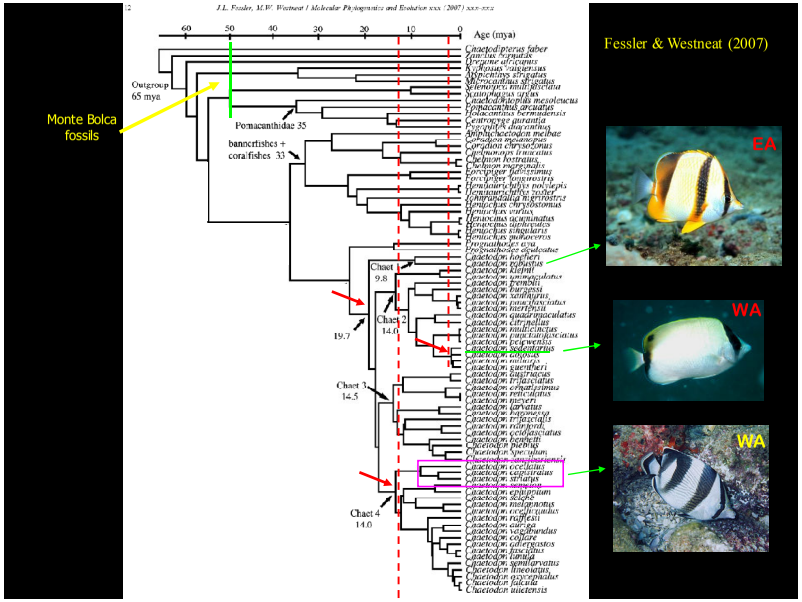


Diversidade taxonômica

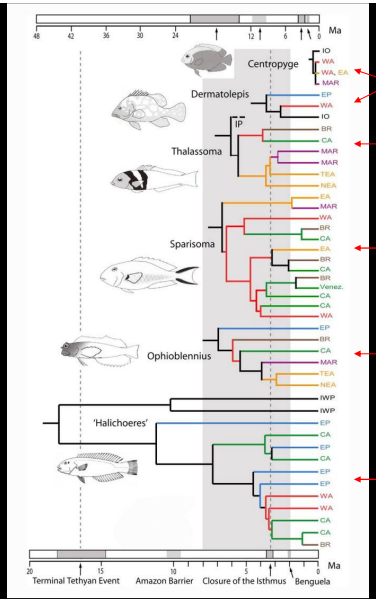


Origem da diversidade no tempo

Floeter et al. (2008)



Fessler & Westneat (2007)



Different origin in time!

Recent invasion via S Africa

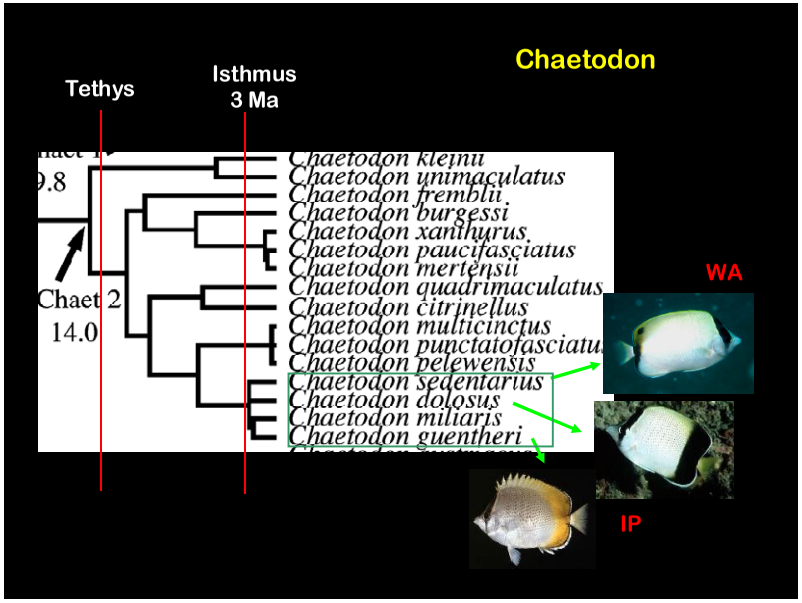
Eastward invasion

Amazon effectiveness fluctuation

Isthmus;
Amazon;
Eastward invasion

Tethys partition;
Invasion via open Isthmus;
Amazon vicariance

Floeter et al. (2008)



Diversidade de espécies vs. diversidade funcional:
redundância funcional e resiliência

Functional Ecology 2005
19, 166–172

FORUM

Neutral theory in community ecology and the hypothesis of functional equivalence

STEPHEN P. HUBBELL*

**Department of Plant Biology, University of Georgia, Athens, GA 30605, and Smithsonian Tropical Research Institute, Box 2072, Balboa, Panama*

Hubbell, S.P. (2001) *The Unified Neutral Theory of Biodiversity and Biogeography*. Princeton University Press, Princeton, NJ.

Como as comunidades são estruturadas?

Opinion *TRENDS in Ecology and Evolution* Vol.21 No.4 April 2006

Rebuilding community ecology from functional traits

Brian J. McGill[1], Brian J. Enquist[2], Evan Weiher[3] and Mark Westoby[4]

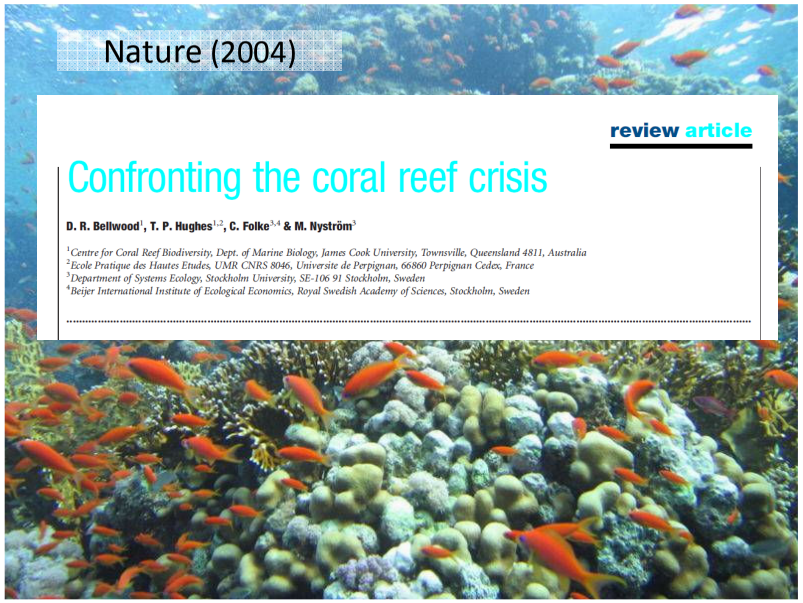
[1]Department of Biology, McGill University, Montreal, QC, Canada, H3A 1B1
[2]Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ 85721, USA
[3]Department of Biology, University of Wisconsin – Eau Claire, Eau Claire, WI 54702, USA
[4]Department of Biological Sciences, Macquarie University, NSW 2109, Australia

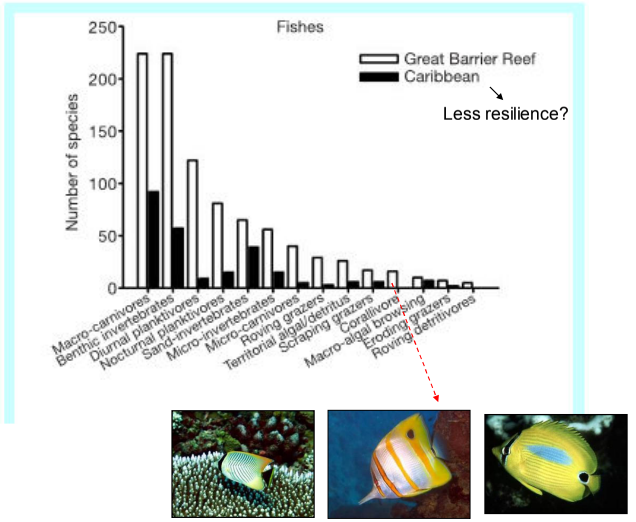
nature Vol 440|2 March 2006|doi:10.1038/nature04534

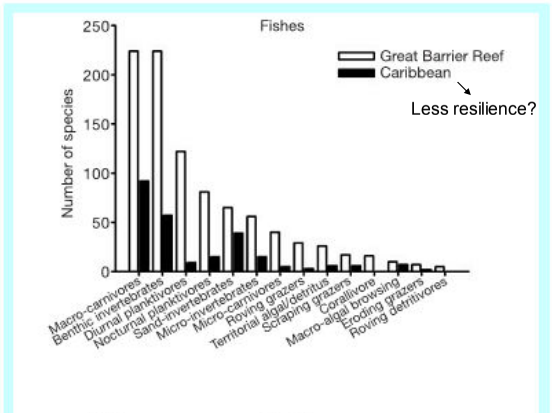
LETTERS

Coral reef diversity refutes the neutral theory of biodiversity

Maria Dornelas[1,2], Sean R. Connolly[1,2] & Terence P. Hughes[1]


Nature (2004)
review article
Confronting the coral reef crisis
D. R. Bellwood[1], T. P. Hughes[1,2], C. Folke[3,4] & M. Nyström[3]
[1]Centre for Coral Reef Biodiversity, Dept. of Marine Biology, James Cook University, Townsville, Queensland 4811, Australia
[2]Ecole Pratique des Hautes Etudes, UMR CNRS 8046, Universite de Perpignan, 66860 Perpignan Cedex, France
[3]Department of Systems Ecology, Stockholm University, SE-106 91 Stockholm, Sweden
[4]Beijer International Institute of Ecological Economics, Royal Swedish Academy of Sciences, Stockholm, Sweden


Fishes
Great Barrier Reef
Caribbean
Less resilience?
Number of species
250
200
150
100
50
0
Macro-carnivores
Benthic invertebrates
Diurnal planktivores
Nocturnal planktivores
Sand-invertebrates
Micro-invertebrates
Micro-carnivores
Roving grazers
Territorial algal/detritus
Scraping grazers
Coralivore
Macro-algal browsing
Eroding grazers
Roving detritivores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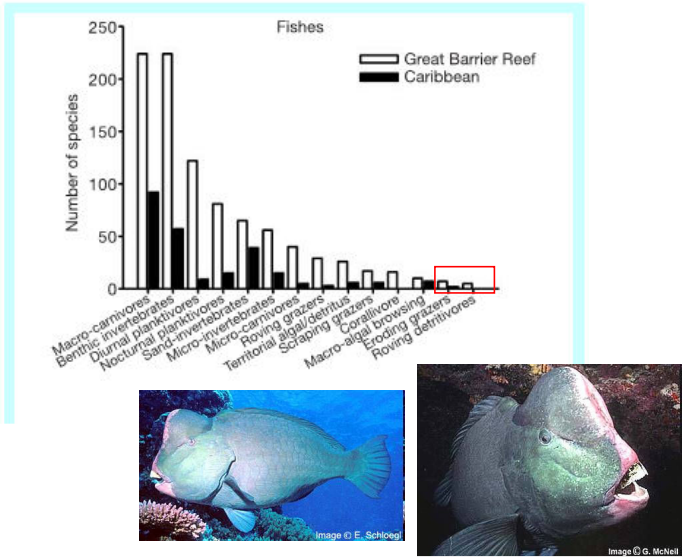
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Coralivore
Macro-algal browsing
Eroding grazers
Roving detritivores
Image © E. Schloegl
Image © G. McNeil

Critical funcional groups?

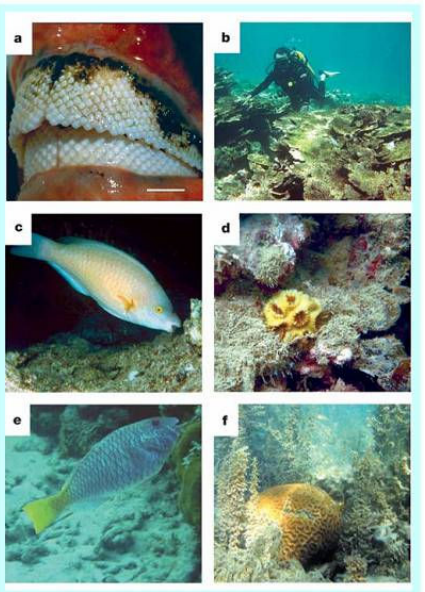
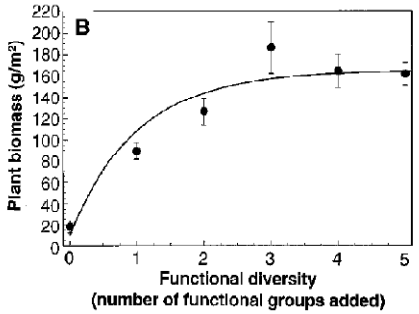


Figure 4 Three critical functional groups and their roles in facilitating reef recovery. **a**, The jaws of a bioeroding parrotfish (*Bolbometopon muricatum*), each individual ingests five tonnes of coral annually. Scale 1 cm. **b**, An extensive stand of dead coral in Samoa, killed by coral bleaching, remains intact because of reduced bioerosion by depleted fish populations. **c**, A scraping herbivore, the parrotfish (*Scarus flavipectoralis*) removes epilithic algae and sediment. **d**, A juvenile coral overwhelmed by algae and trapped sediment. **e**, A grazing parrotfish (*Sparisoma rubripinne*) reduces overgrowth of corals by competing macroalgae. **f**, An adult coral shaded and overgrown by fleshy macro-algae.

grasslands

The Influence of Functional Diversity and Composition on Ecosystem Processes

David Tilman,* Johannes Knops, David Wedin, Peter Reich, Mark Ritchie, Evan Siemann



Richness vs. functional diversity

- We know little about this relationship in natural communities...

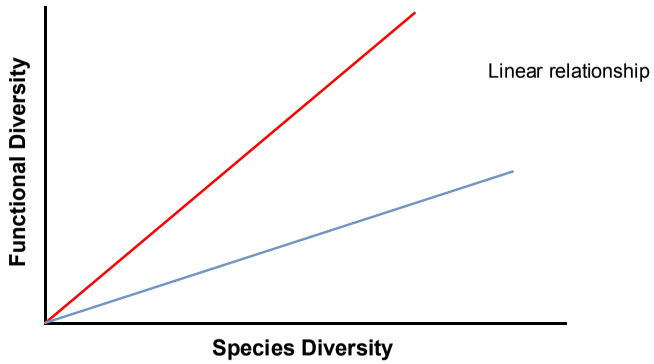
The Influence of Functional Diversity and Composition on Ecosystem Processes

David Tilman,* Johannes Knops, David Wedin, Peter Reich, Mark Ritchie, Evan Siemann

Science (1997)

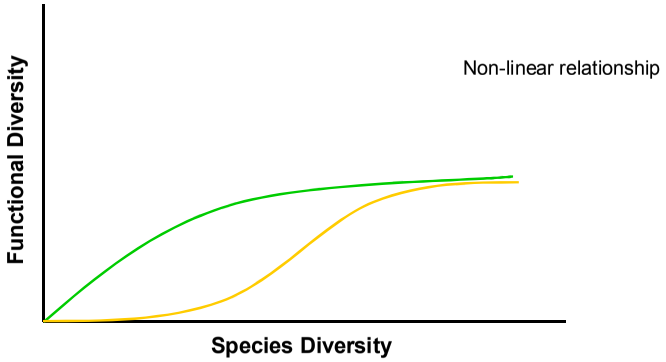
Functional redundancy and resilience

Species vs. functional diversity



Functional redundancy and resilience

Species vs. functional diversity



Vol. 364: 147–156, 2008
doi: 10.3354/meps07553
MARINE ECOLOGY PROGRESS SERIES
Mar Ecol Prog Ser
Published July 29

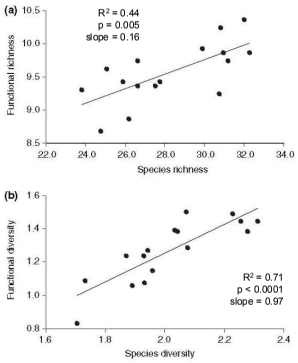
Functional diversity responses to changing species richness in reef fish communities

Benjamin S. Halpern[1,*], Sergio R. Floeter[1,2]

Ecology Letters, (2005) 8: 391–400 doi: 10.1111/j.1461-0248.2005.00731.x

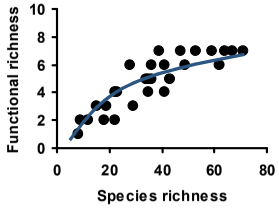
LETTER

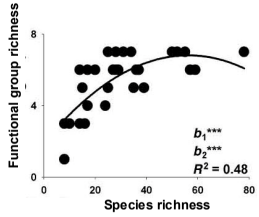
Low functional redundancy in coastal marine assemblages



Kelp forest database

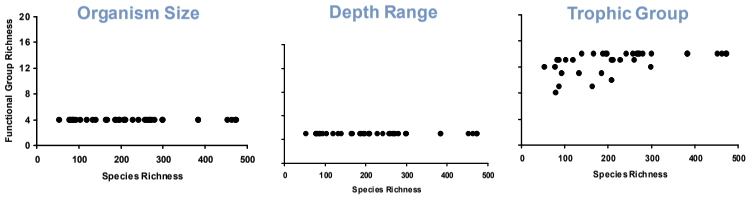
The ceiling effect





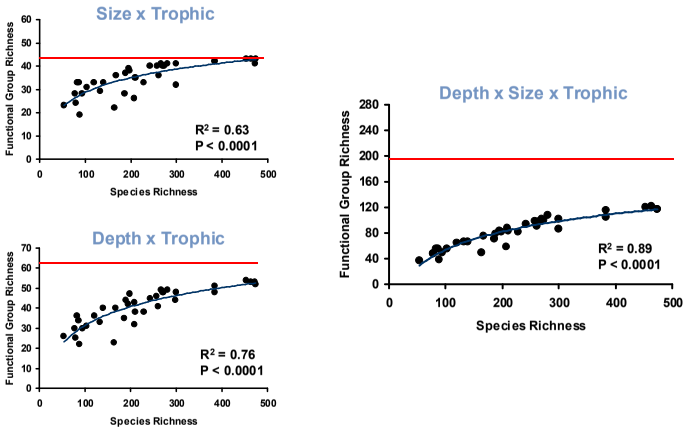
Stevens et al. 2003

Single variable functional groups



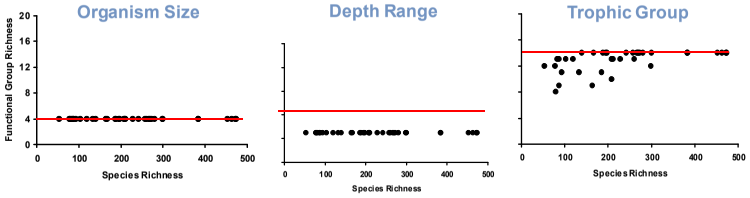
Halpern & Floeter, 2008

Two- and three-variable functional groups



Halpern & Floeter, 2008

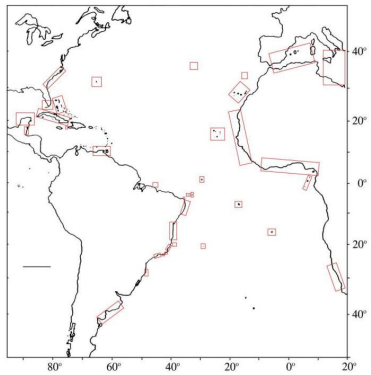
Single variable functional groups



→ 'ceiling effect'

Halpern & Floeter, 2008

Large-scale, whole community data



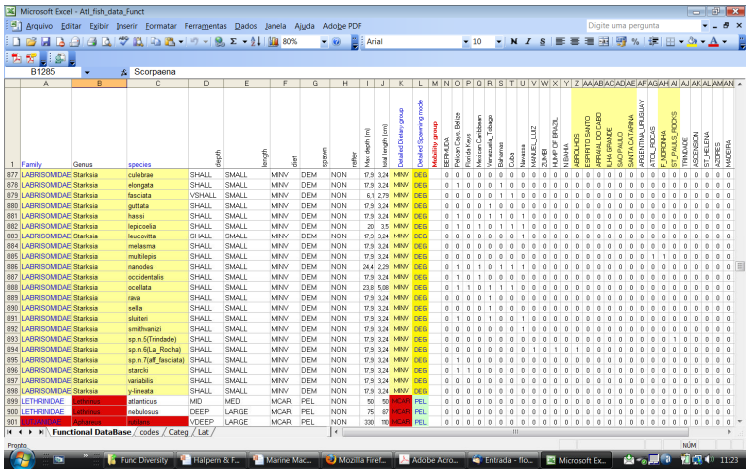
36 reef fish lists

- Functional Groups:
  - Trophic group (N= 14)
  - Organism size (N= 4)
  - Depth range (N= 5)
  - Trophic x size (N= 56)
  - Trophic x depth (N= 70)
  - Trophic x size x depth (N= 280)
- No. of Species:
  - Ranged from 54-474

Classifying fish

MAX. LENGTH GROUPS	
SMALL	0-10 cm
MEDSMALL	10-25 cm
MED	25-50 cm
LARGE	50 cm and greater

MAX. DEPTH GROUPS	
VSHALL	0-10 m
SHALL	10-25 m
MID	25-50 m
DEEP	50-100 m
VDEEP	100 m and greater



MCAR = Macro-carnivores
PISC = strict Piscivores
MINV = Mobile benthic invertivores/cleaners

SAND = Sand invertivores
SINV = Coral/colonial sessile invertivores
SPON = Spongivore/herb

DPLA = Diurnal planktivores
NPLA = Nocturnal planktivores

EXCV = Excavator/eroders
THER = Territorial Algae/detritus
TURF = Turf grazing
SCRP = Scrapers
MALG = Macroalgae browser

OMNI = General omnivores

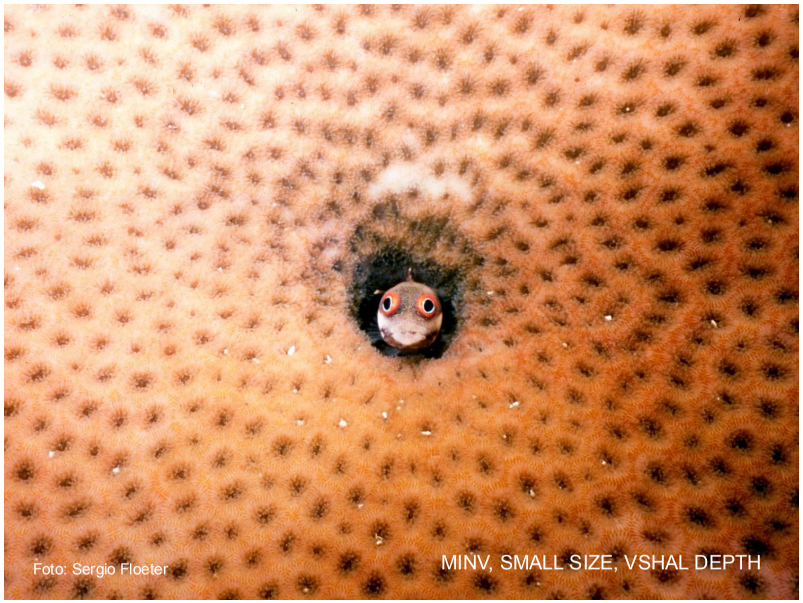


Foto: Sergio Floeter
MINV, SMALL SIZE, VSHAL DEPTH

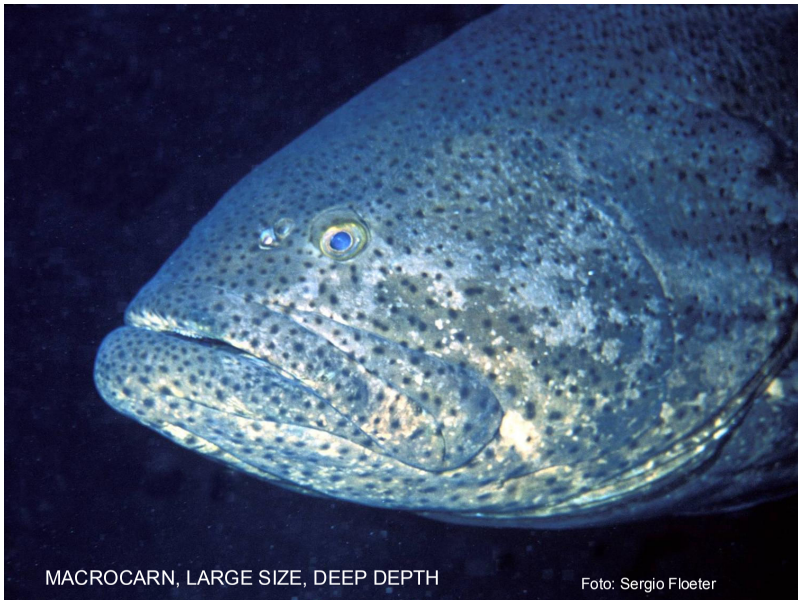
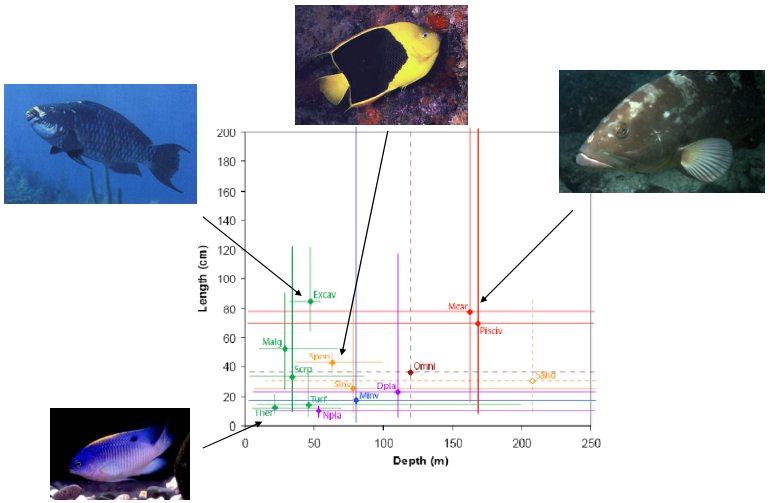
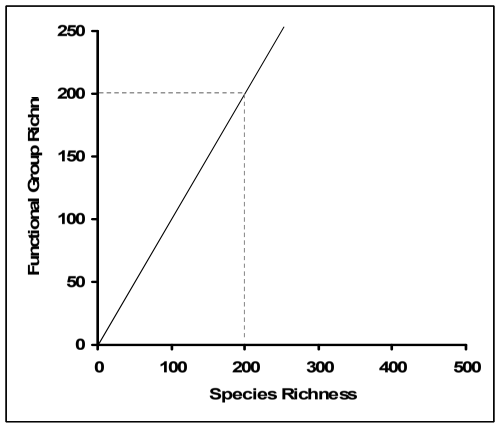
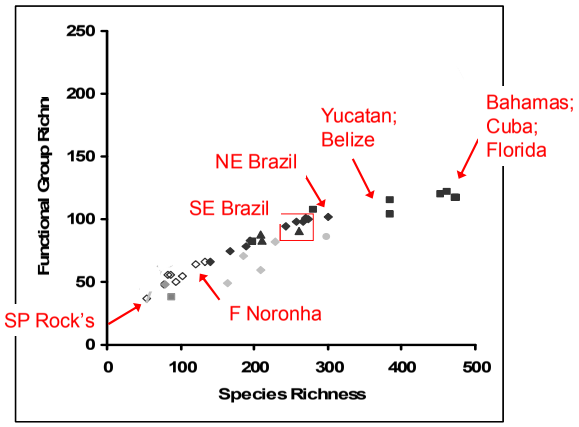

MACROCARN, LARGE SIZE, DEEP DEPTH
Foto: Sergio Floeter


Foto: Sergio Floeter
TURF ALGAE, MED SIZE, SHAL DEPTH

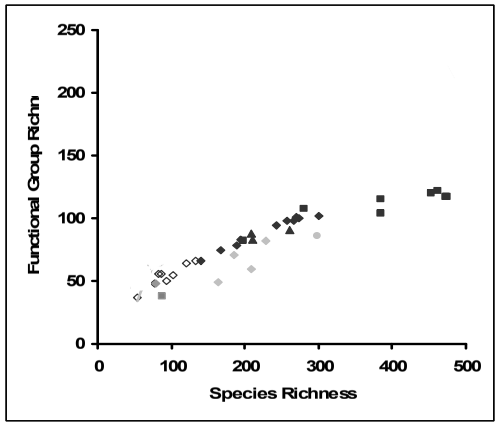

Length (cm)
Depth (m)
Excav
Malg
Scrp
Turf
Nipla
Thal
Minv
Epla
Omni
Sand
Mcar
Pisciv



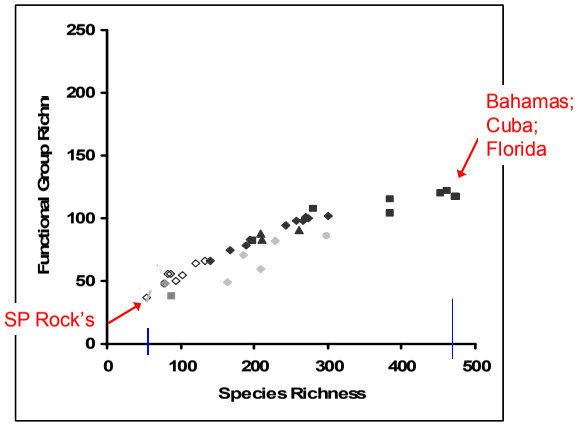
No redundancy = 1:1



Real data!



Real data! With redundancy

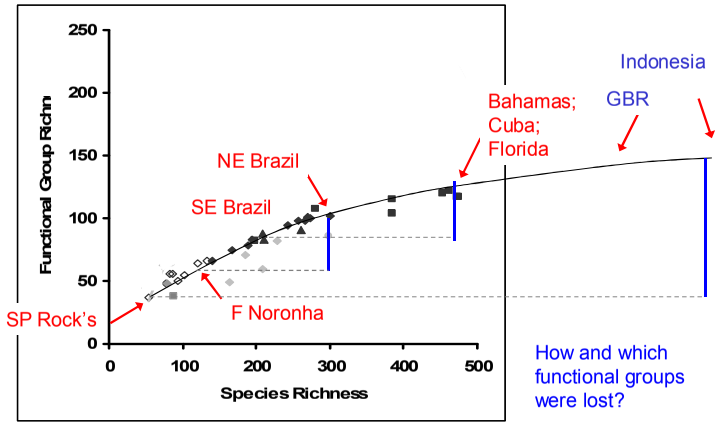


Real data!

How a species-poor community work?

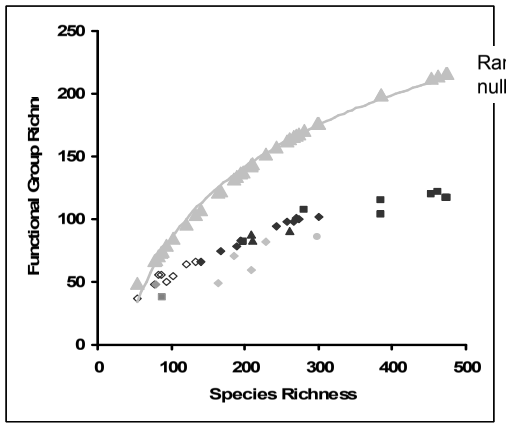
And a richer one?

How a very species-poor community work?



How and which functional groups were lost?

And their phylogenetic position?



Real data vs. Null model

PROCEEDINGS OF THE ROYAL SOCIETY B

Proc. R. Soc. B (2006) 273, 101–107
doi:10.1098/rspb.2005.3276
Published online 12 October 2005

Functional versatility supports coral reef biodiversity

D. R. Bellwood[1,*], P. C. Wainwright[2], C. J. Fulton[1] and A. S. Hoey[1]

Conclusion:

reef fish communities are not randomly established

"Assembly Rules" really exists!?

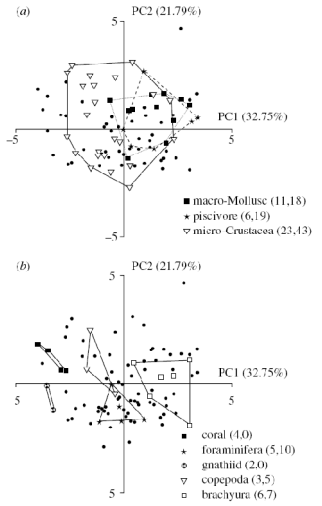
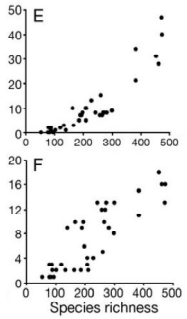


Figure 1. Functional morphospace occupation by eight feeding groups of wrasses. The PCA plot is based on 95 wrasse species,

Copeia, 2007 (3), pp. 543–555

Devil in the Details: High-Resolution Dietary Analysis Contradicts a Basic Assumption of Reef-Fish Diversity Models

KEN LONGENECKER

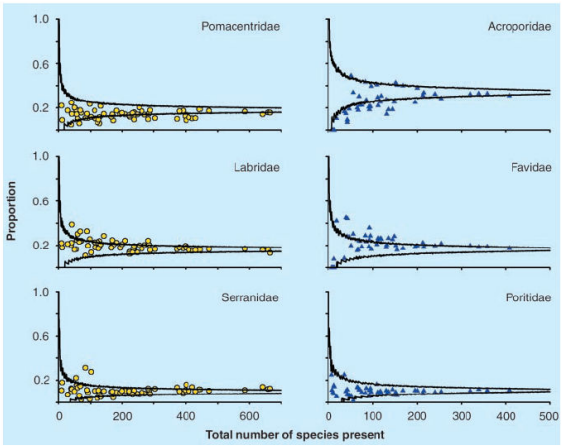


Food specialization

Mean dietary overlap among these fishes is similar to overlap in communities thought to be structured by fine-scale food specialization

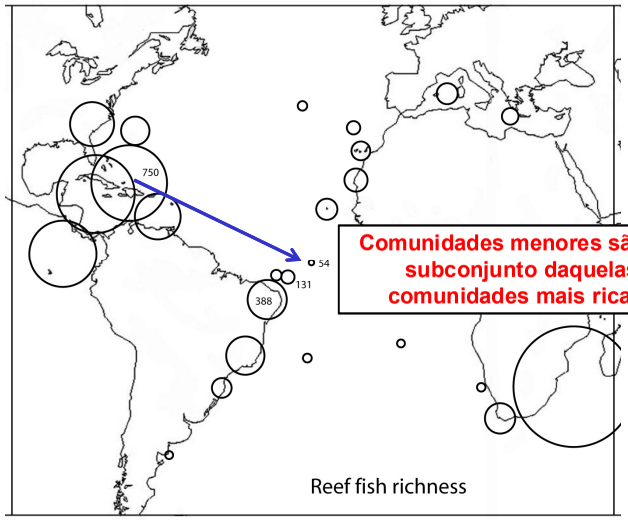
mobile benthic-invertebrate eaters

Proporções de espécies de peixes recifais e de corais no Indo-Pacífico (Bellwood & Hughes, 2001). Community assembly?

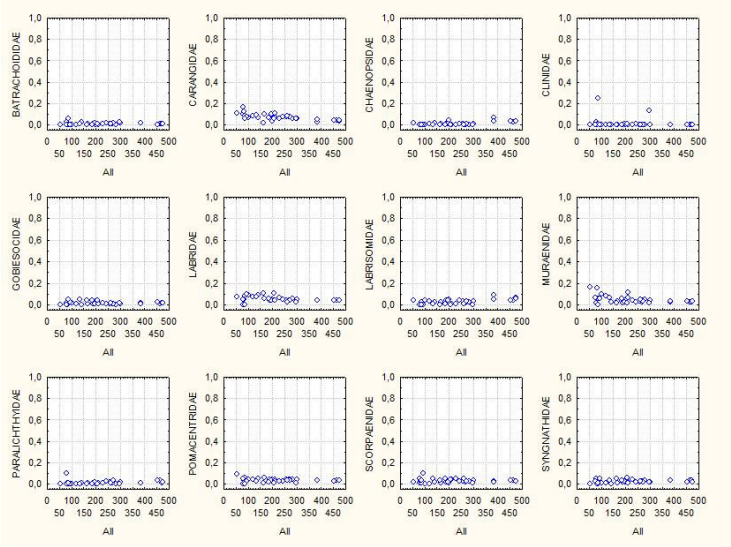


Estruturação das comunidades de peixes recifais em múltiplas escalas no Atlântico: aninhamento e raridade de grupos funcionais

Doutoranda: Mariana Bender
Orientador: Dr. Sergio Floeter
Co-orientador: Dr. Marcio Pie

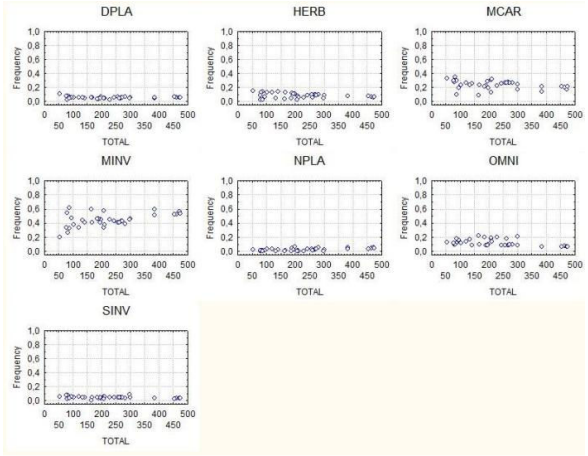


Comunidades menores são um subconjunto daquelas comunidades mais ricas?



Resultados preliminares

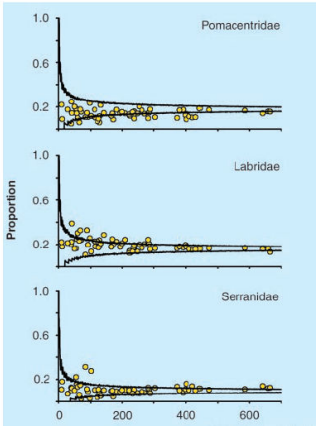
Grupos funcionais



REPORTS

Regional-Scale Assembly Rules and Biodiversity of Coral Reefs

David R. Bellwood* and Terry P. Hughes

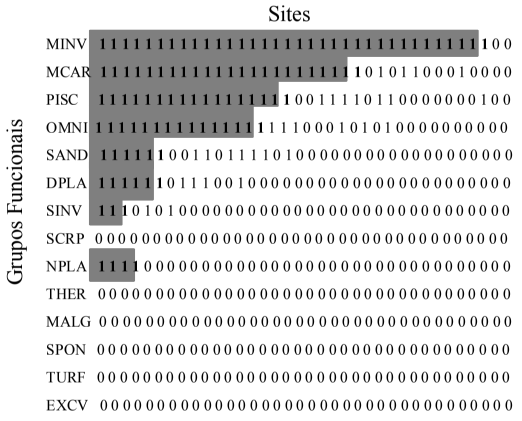


Resultados preliminares

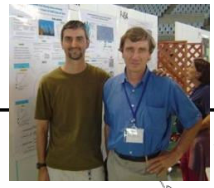
Matriz de aninhamento

Análise preliminar!

Assembly rules?

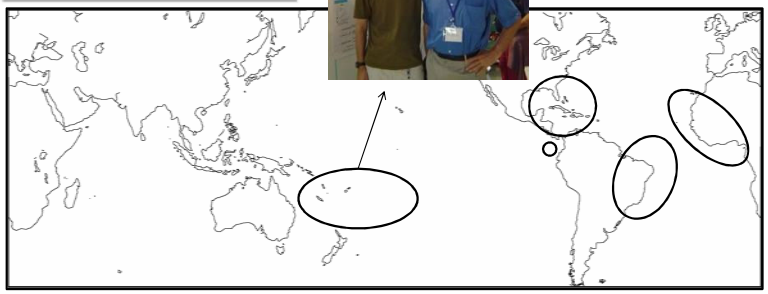


Metodologia



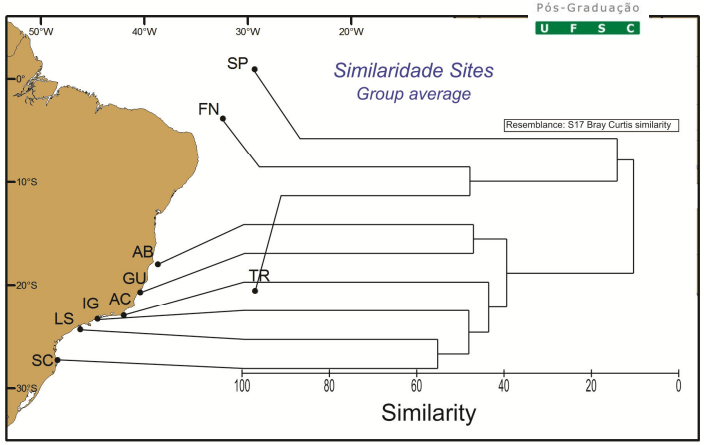
Dr. Michel Kulbicki
Perpignan, France

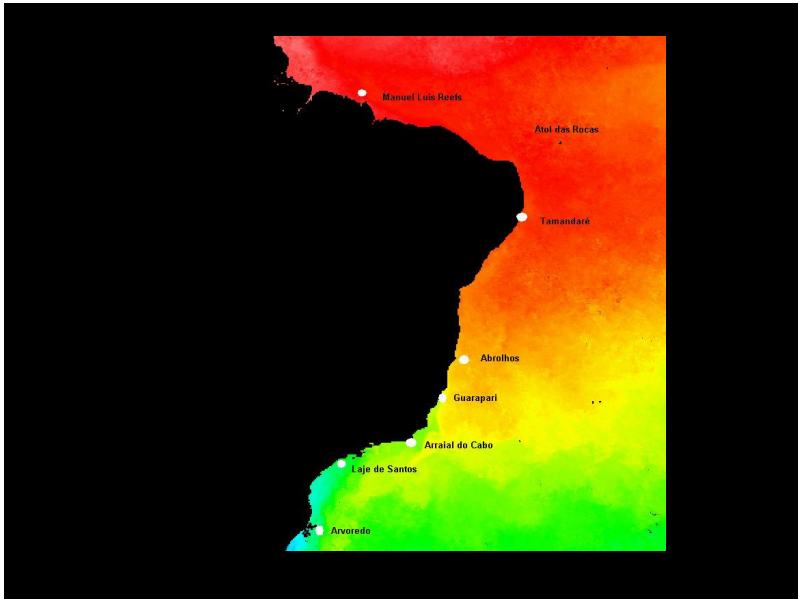
Dados quantitativos



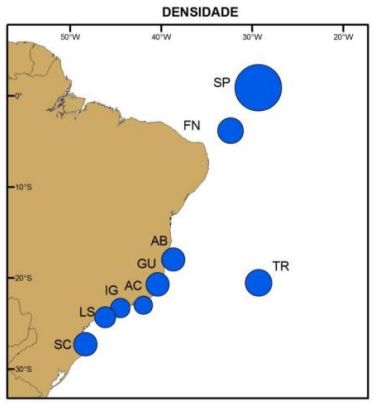
Resultados Preliminares:
Daniel Dinslaken

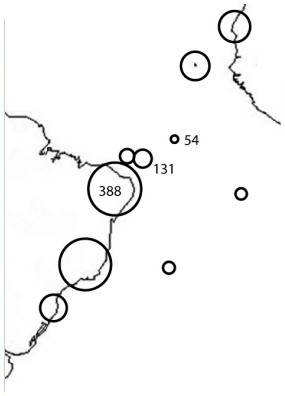
ecologia
Pós-Graduação
U F S C



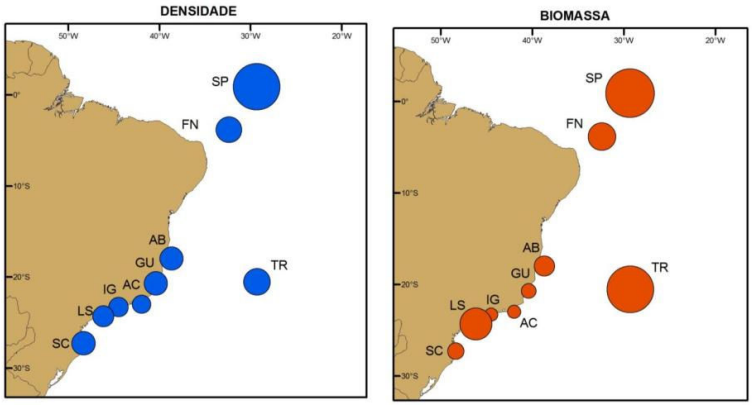


[dados padronizados;
Comunidade inteira]

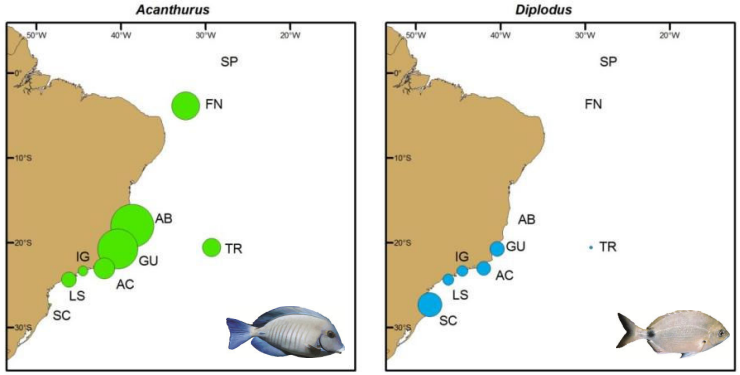




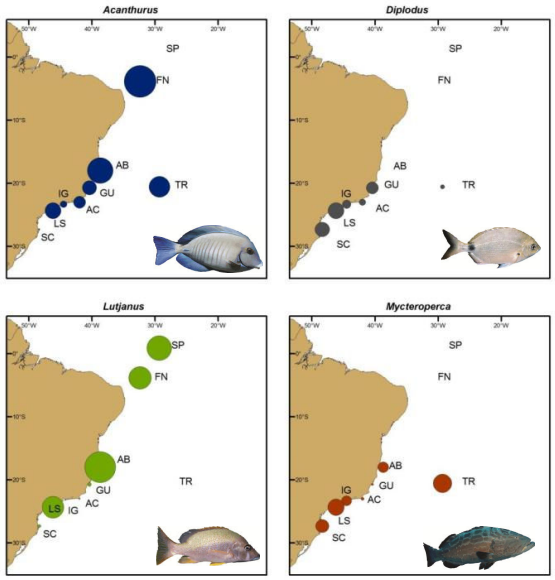
Reef fish



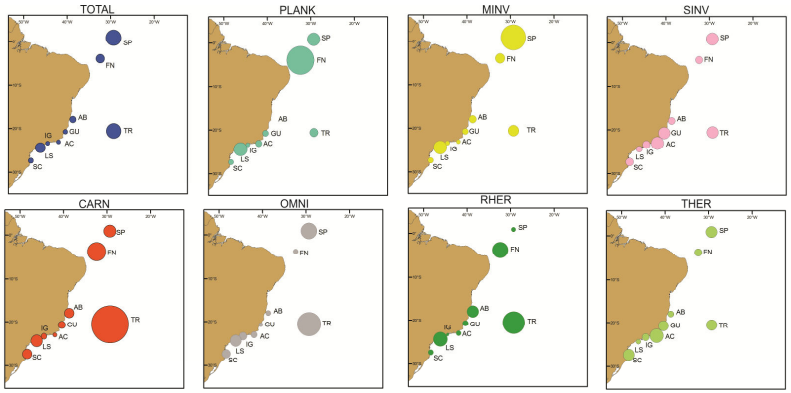
Densidade



Biomassa [dados padronizados]



Grupos Tróficos - biomassa

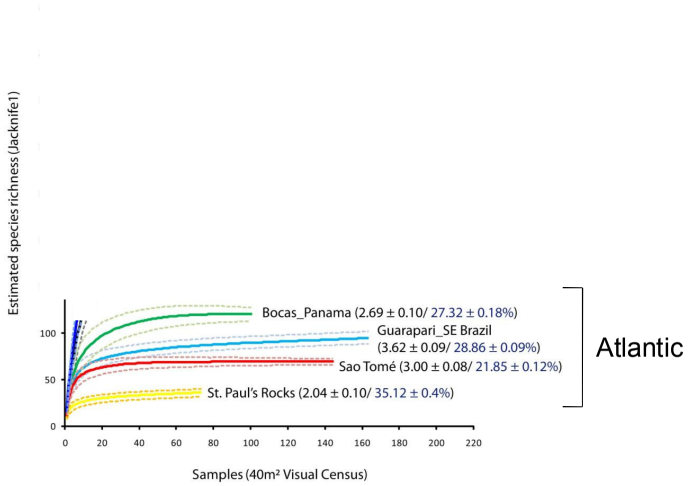


HOW DO SPECIES PACK IN SPACE? INSIGHTS FROM REEF FISHES

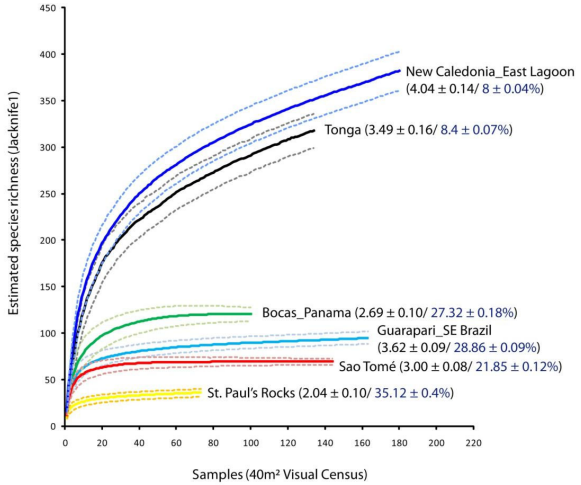
Diego R Barneche

Supervisor: Sergio R Floeter
M.Sc. Candidate of Ecology PPGE-UFSC
Lab. de Biogeografia e Macroecologia Marinha-ECZ

Riqueza (taxonômica e funcional) na escala do transecto (40m2)

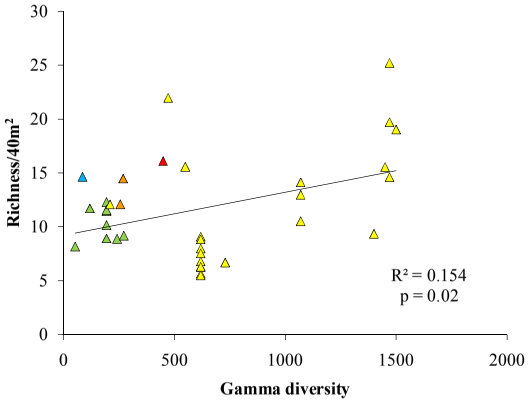


Reef fish species accumlation curves from different biogeographical areas. Mean richness/10m2 (black) and mean Jaccard's - between samples - simmilarity Index (blue) in parentheses ± SE.



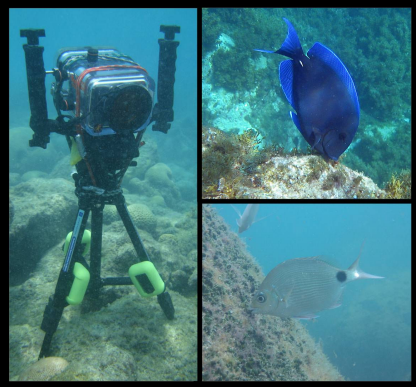
Reef fish species accumlation curves from different biogeographical areas. Mean richness/10m2 (black) and mean Jaccard's - between samples - simmilarity Index (blue) in parentheses ± SE.

Preliminary results

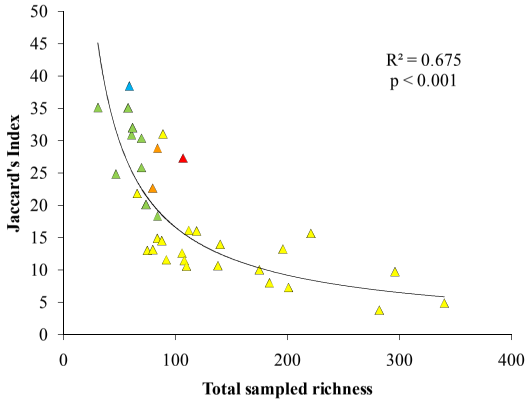


A escala local: interação

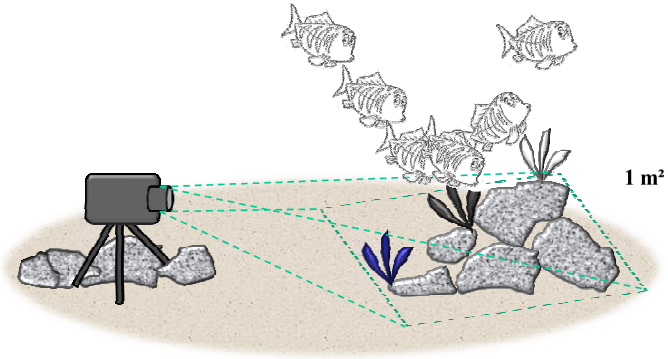
Comportamento alimentar: Impacto por unidade de área



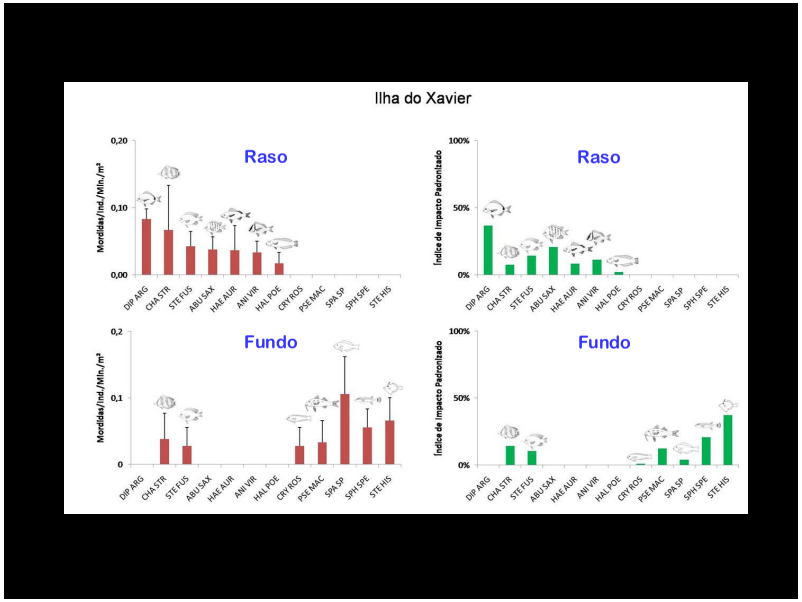
Preliminary results: (Beta diversity = species turnover)

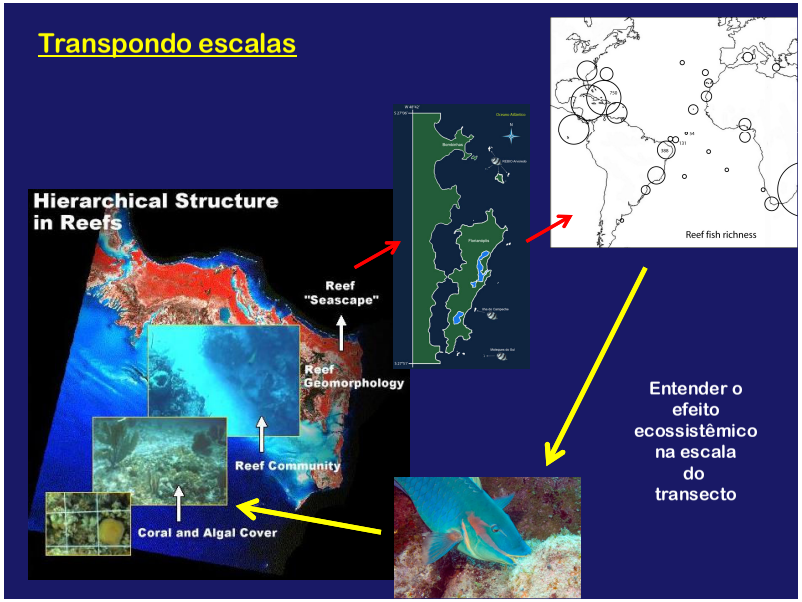


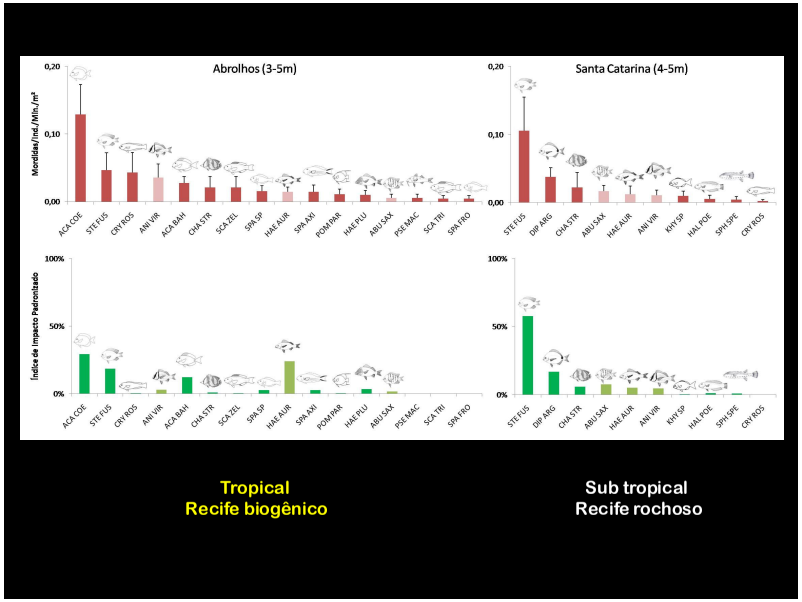
Comportamento alimentar: Impacto por unidade de área

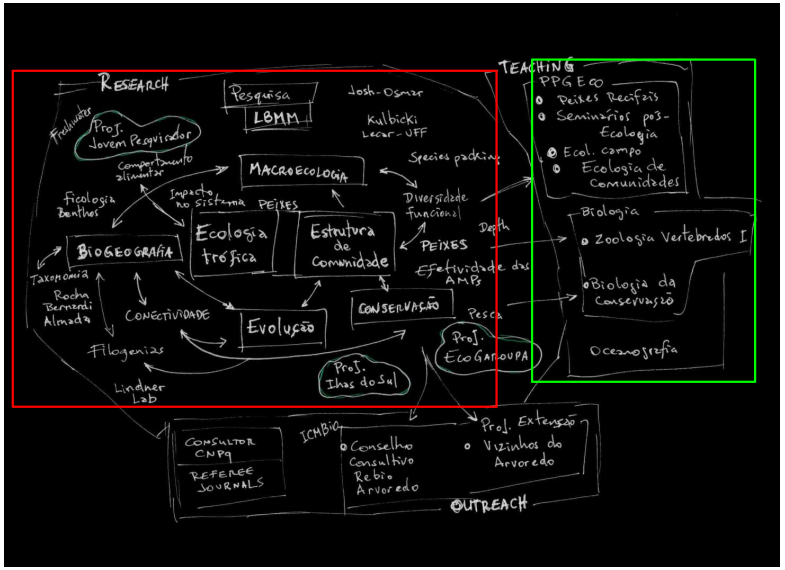


Mestrado: Guilherme O. Longo


Ilha do Xavier
Raso
Raso
Fundo
Fundo


Transpondo escalas
Hierarchical Structure in Reefs
Reef "Seascape"
Reef Geomorphology
Reef Community
Coral and Algal Cover
Reef fish richness
Entender o efeito ecossistêmico na escala do transecto


Abrolhos (3-5m)
Santa Catarina (4-5m)
Tropical
Recife biogênico
Sub tropical
Recife rochoso


RESEARCH
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Proj. EcoGarapuá
Proj. Extensão
Vizinhos do Arvoredo

Fontes financiadoras:

Sergio R Floeter

floeter@ccb.ufsc.br

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