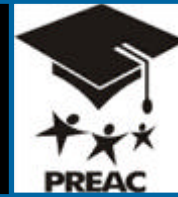




Reef Artisanal Fisheries – Brazil – Begossi, Lopes and Silvano.
Ecosystems 2010, Anchorage, Alaska, November 8-11, 2010.



Co-Management of Reef Fisheries in Brazil in an Human Ecological Context

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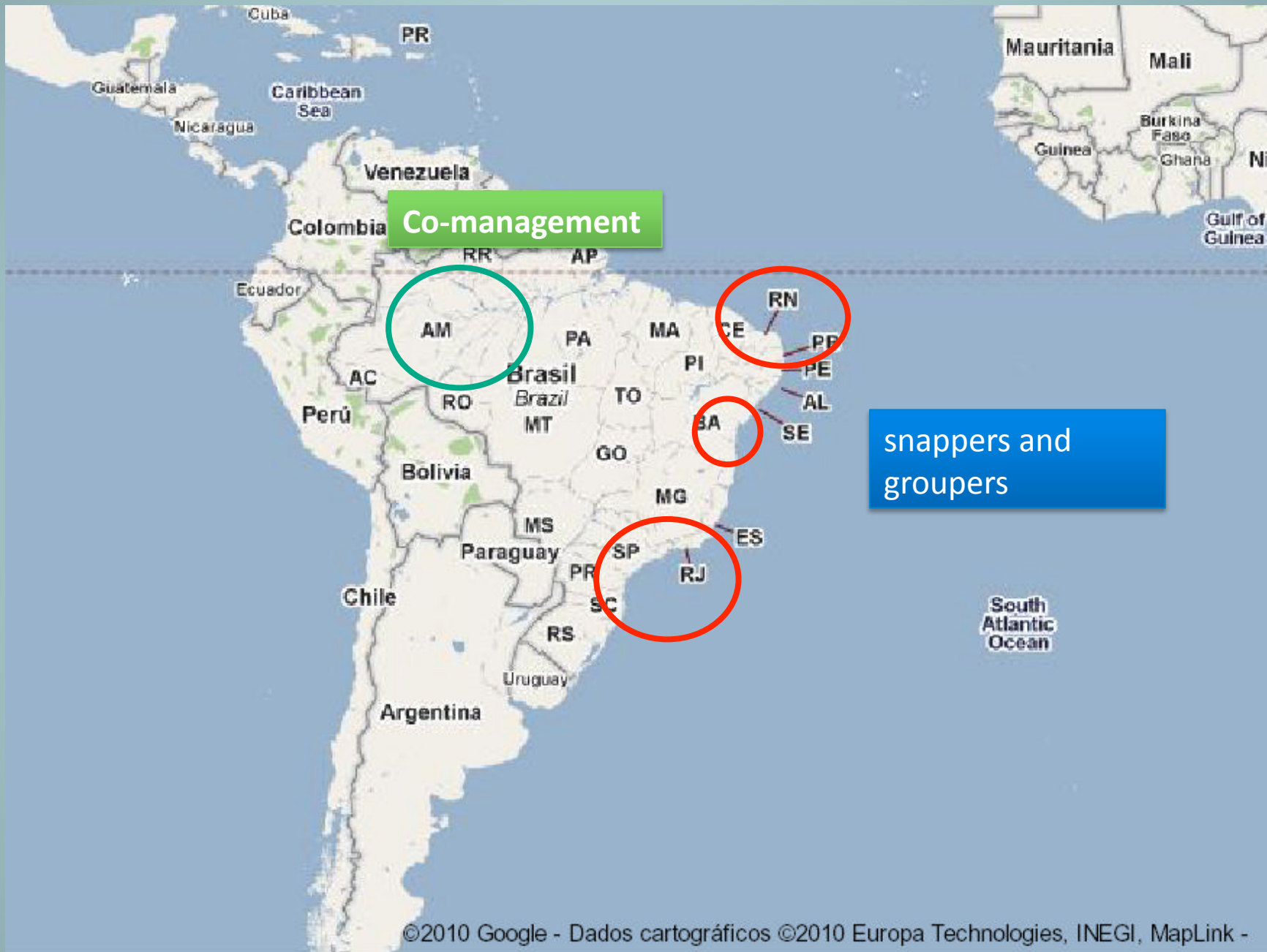
Acknowledgements



The University of Alaska/FAO

Overview

- Co-management processes
- Current state of coastal reef fish
 - ❖ Snappers and groupers
 - ❖ Length at first maturity
 - ❖ Local knowledge
- Co-management of reef fisheries:
 - Payment for environmental services



Co-Management Processes in Latin-America

Amazon,
Upper Juruá
Extractive
Reserve,
1990.



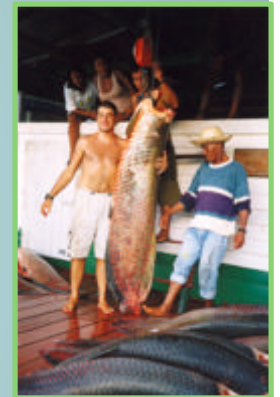
Chile

- **Coastal areas** (Management Exploitation Areas)
 - MEABR (*Management and Exploitation Areas for Benthic Resources*), territorial use rights to artisanal fisher unions.
- 547 MEABR.

Cordell (2006) and Castilla and Fernandez, (1998)

Brazil

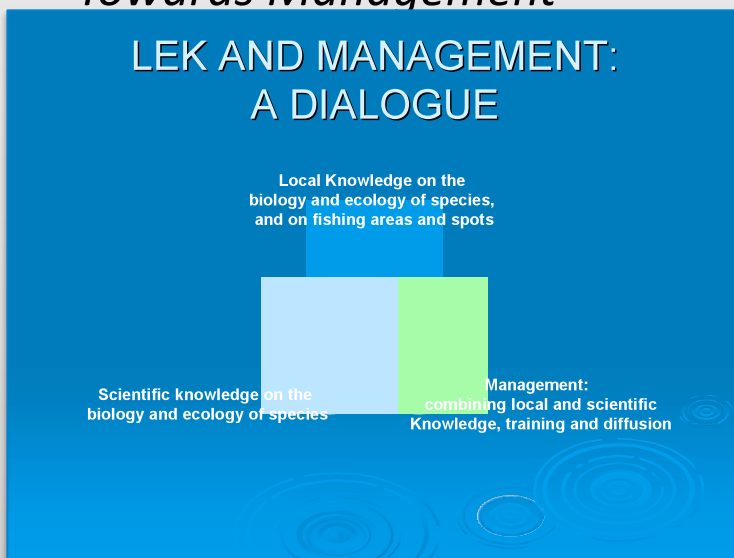
- *Extractive Reserves*
- *Sustainable Reserves*
 - (*Mamirauá Reserve*)
- Fishing agreements



Almeida and Menezes (1994),
Begossi and Brown (2003), Seixas (2006),
Seixas *et al.* (2008).

Co-Management: objectives and processes

- *Linking scientific and local knowledge*
- *Getting Urgent data*
- *Towards Management*



Begossi 2008
Env. Develop. Sustain.

- *Processes:*

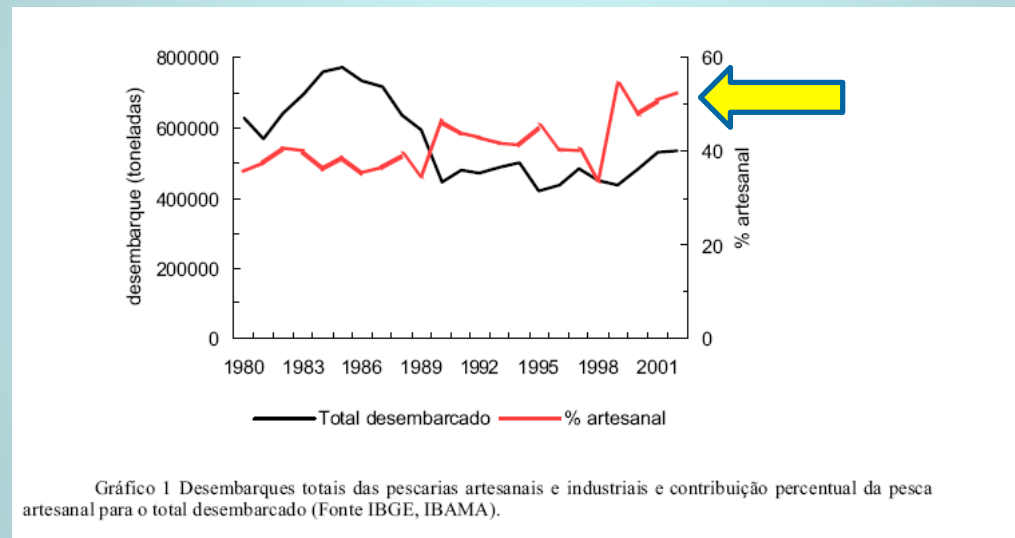
- **Monitoring**
- **Fishing agreements**
- **Payments [PES] (Wunder 2008, Muradian et al. 2010: *Ecol. Econ.*)**



- **Voluntary transactions**
- **Well defined environmental service**
- **Bought by a service buyer**
- **From a service provider**

Importance in Brazil

- Artisanal fishing is important in national production
- Livelihoods depend upon fish resources



- High diversity of species in artisanal fisheries: 70-100 spp.
- Reef fish important in artisanal fisheries

Importance of snappers and groupers in Brazilian artisanal fisheries

- Target species
- High market value
- Highly appreciated by local consumers



- Many fishing spots are located in islands, which could be important for spawning (no data available)

» [Sadovy 1996: fishing pressure on spawning sites in the Caribbean area]

Some fish even important in local medicine

1340

ALPINA BEGOSSI ET AL.

Ecological Applications
Vol. 14, No. 5

TABLE 4. Contingency tables, using the number of times the fish was cited in interviews.

Fish diet	Tabooed	Recommended	χ^2	<i>P</i>
Amazonian fish (freshwater)				
P	748 [sorubim, scaleless fish, catfishes, piranha]	110 [tucunaré, trahira]		
O, I, V, D	106 [black prochilodus]	368 [pacu, anchovy, bode, acará, piau, jaraqui]	557.51	<0.001†
Atlantic Forest coastal fish (marine)				
P	494 [tuna, sharks, cutlass fish, jack]	129 [grouper, snook]		
O, I, V, D	445 [rays, sea catfish, mullet]	778 [kingcroaker, porgy, weakfish, croaker-drum, mullet, sea chub]	76.42	<0.001†



Notes: H_0 : Fish diet is similar for both tabooed and recommended fish during illness. Fish diet is indicated by O (omnivorous), P (piscivorous), I (invertebrate consumer), D (detritivorous), and V (consumer of vegetal matter or algae).

† Significant *P* values indicate that H_0 should be rejected.

Methods:

Periods: 1986-1992 Buzios Island and Sepetiba Bay (3)
2002 to 2009: 11 communities, plus diet and gonads

- Interviews: 585
- Fish landings: 1,761
- Fish collected: 1,453
- Fish species in artisanal catch

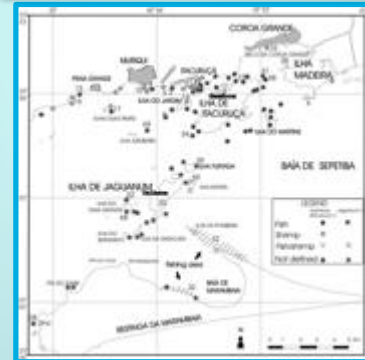
- Diet and gonad [volume and visible eggs] (2007-2009)



- No Lab needs
- Less time consuming
- Adequate for fishers

- From Ceará (NE Brazil) to Santa Catarina (S Brazil)
- 14 sites

Data on fishing spots [available]



Begossi (2001) *Reg. Environ. Change*
Begossi (2006) *Ecol & Soc.*

Fishing sites and communities

- Northeast Brazil



Mucuripe, CE



Ponta Negra,
RGN



Porto Sauípe BA

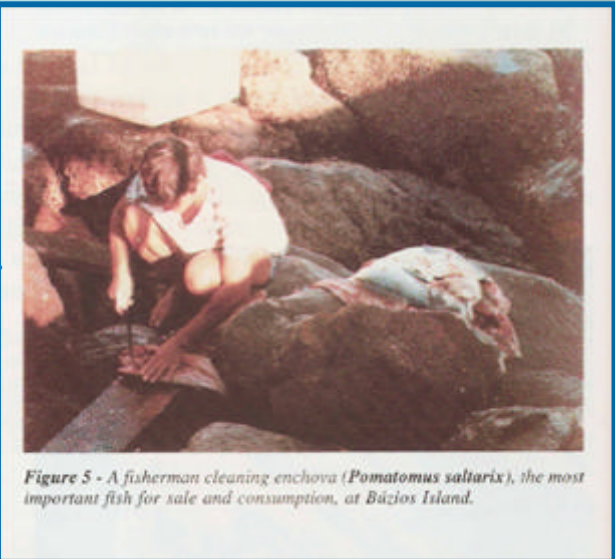
Fishing communities

- SE and S Brazil



Copacabana, Rio de Janeiro

Búzios Island SP,
(Begossi 1996)



Pântano do Sul,
Florianópolis, SC

Reef fishes, Brazil Snappers



L. synagris



O. chrysurus



L. analis



L. vivanus



L. bucanella

Reef fishes in Brazil

Groupers

- *Epinephelus marginatus*
- *Cephalopholis fulva*
- *Mycteroperca acutirostris*



Copacabana, Rio de Janeiro



Mucuripe, Fortaleza, Ceará

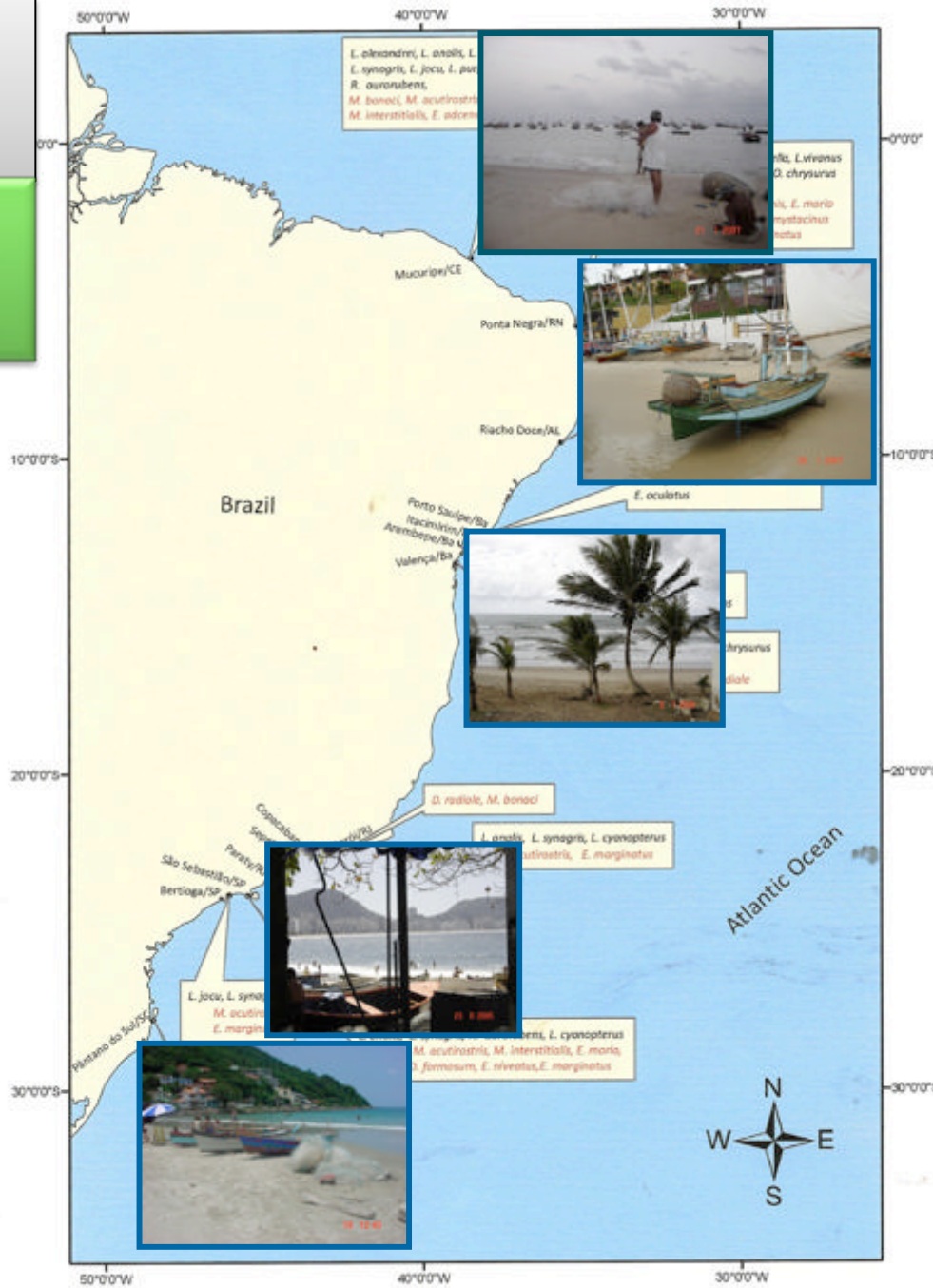
Epinephelus marginatus
[garoupa, dusky grouper]



Cronius ruber, Portunidae (cf.)

12 spp.
Lutjanidae
(Snappers)

16 spp.
Serranidae
(groupers)



Cephalopis fulva



Coney
170

Lutjanus synagris



Lane s.
54

L. analis



Mutton
S.
36

L. vivanus



Silk S
37

Ocyurus chrysurus



Yellowtail S.
66

Mycteroperca acutirostris



Comb G.
37

Epinephelus marginatus



Dusky G.
59

Reef fishes artisanal fishing
12 snappers (Lutjanidae) and 16 (Serranidae)

Lutjanidae

NE= 13 spp.

SE= 4 spp

- *Lutjanus*
 - 9 spp.
- *Ocyurus chrysurus*
- *Romboplites aurorubens*
- *Etelis oculatus*

Serranidae

NE= 13spp.

SE=6 spp, S= 3spp.

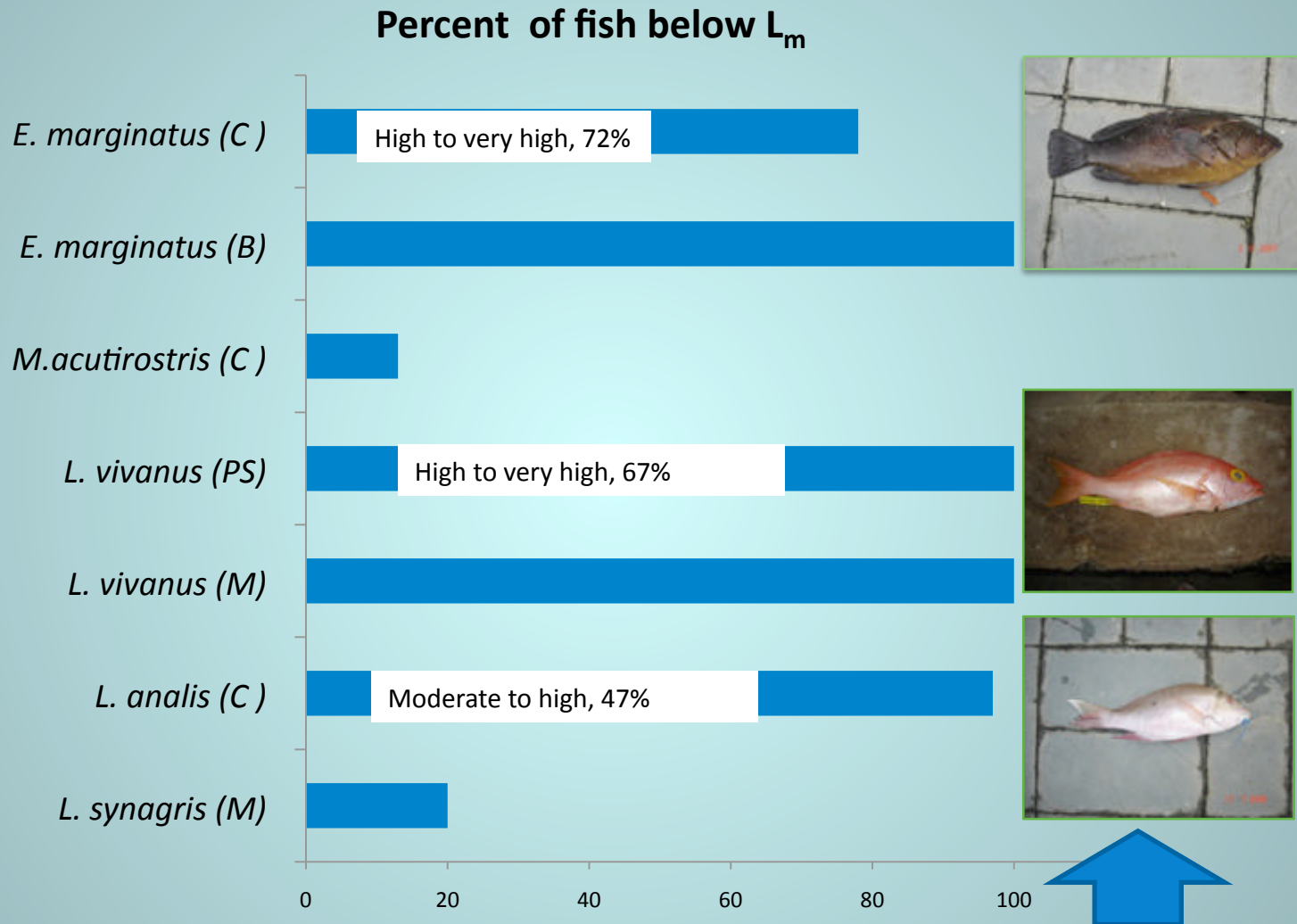
- *Epinephelus*
 - » 8 spp.
- *Mycteroperca*
 - » 2 spp.
- *Alphestes afer*
- *Cephalopholis fulva*
- *Diplectrum*
 - » 2 spp.
- *Dules auriga*
- *Paranthias furcifer*

Table 2. Average and minimum length (Total Length) of Lutjanidae caught in artisanal fisheries in NE Brazil (Maceió and Porto do Sauípe) and SE Brazil (Copacabana and Bertioga): comparisons with length at first maturity (TL)(Froese and Pauly, 2010, Begossi and Silvano 2008, Begossi et al 2010).

Species or Site	Mean Length of fish caught (mm) Artisanal Brazil	Minimum Length caught (L _{min}) (mm) Artisanal Brazil	Length at first maturity (FP), size at first reproduction (GO) (L _∞)(mm)	Vulnerability ^{FP} (UICN Red list status)	Vulnerability ^{FP} (Cheung et al. 2005)	Status of the stock (Lessa 2006) ^{LE}
Lutjanidae						
Mutton snapper <i>L. analis</i> (n=36)	434	300	520 ^{FP} 400 ^{GO}	Vulnerable	Moderate to high (47%)	overexploited
Lane snapper <i>L. synagris</i> (n=54)	379	240	253 ^{FP} 180 ^{GO}	Not evaluated	Moderate (38%)	overexploited
Silk snapper <i>L. vivanus</i> (n=37)	328	180	500 ^{FP}	Not evaluated	- High to very high (68%)	Near the maximum limit
Yellowtail snapper <i>O. chrysurus</i> (n=66)	388	320	237 ^{FP} 250 ^{GO}	Not Evaluated	High (59%)	overexploited
Vermilion snapper <i>R. aurorubens</i> (n=22)	336	260	200-230 ^{FP}	Not Evaluated	Moderate to high (50%)	-
Serranidae						
Coney <i>Cephalopis fulva</i> (n=170)	255	165	160 ^{FP}	Least concern	Moderate to high (51%)	-
Dusky grouper <i>Epinephelus marginatus</i> (N=59)	409	240	470 ^{FP}	Endangered	High to very high (72%)	-
Combgrouper <i>Mycteroperca acutirostris</i> (n=37)	404	310	320-360 ^{FP}	Least concern	High (58%)	

Minimum Weight-Length (W-TL) relationships: ^{FP}= Froese and Pauly 2010 (Total Length), ^{GO}= Gobert et al. (2005) [size at first reproduction, Fork length] ^{LE}= Lessa (2006).

Vulnerability
Cheung et al. 2005, *Biol. Conserv.*



Reproduction,

Diet,

and

Local Knowledge

Table 3. Visible eggs and sperm in snappers and groupers collected in artisanal fisheries in South and North Brazilian coasts.

Source for snappers: Begossi et al. (2010b).

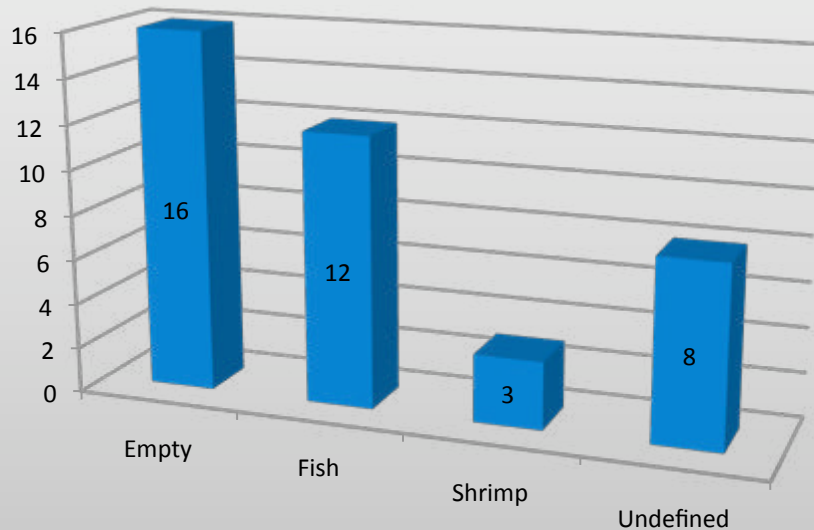
Species and Site	Site (number of individuals)	Month with visible egg (%)	Month with sperm (%)
<i>L. analis</i>	Copacabana (n=32)	April (12%)	
<i>L. synagris,</i>	Bertioga and Maceió (n=44)	May (50%)	May (11%)
		June (13%)	
		September (20%)	
		December (100%)	
		January (73%)	January (27%)
<i>L. vivamus,</i>	Porto Sauípe (n=29)	July (29%)	
		October (73%)	October (7%)
<i>O. chrysurus,</i>	porto Sauípe (n=66)	July (2%)	
		October (67%)	October (22%)
<i>R. aurorubens,</i>	Porto Sauípe (n=16)	October (8%)	October (42%)
<i>C. fulva</i>	Mucuripe (n=171)	January (2%)	
<i>M. acutirostris</i>	Bertioga and Copacabana (n=37)	January (5%)	
		March (3%)	

Table 4. Data on the diet of species of Serranidae according to local fishers, based on interviews performed with fishers 40 years old or up, 25 years living and fishing in the site. (2005-2006) (Number of citations).

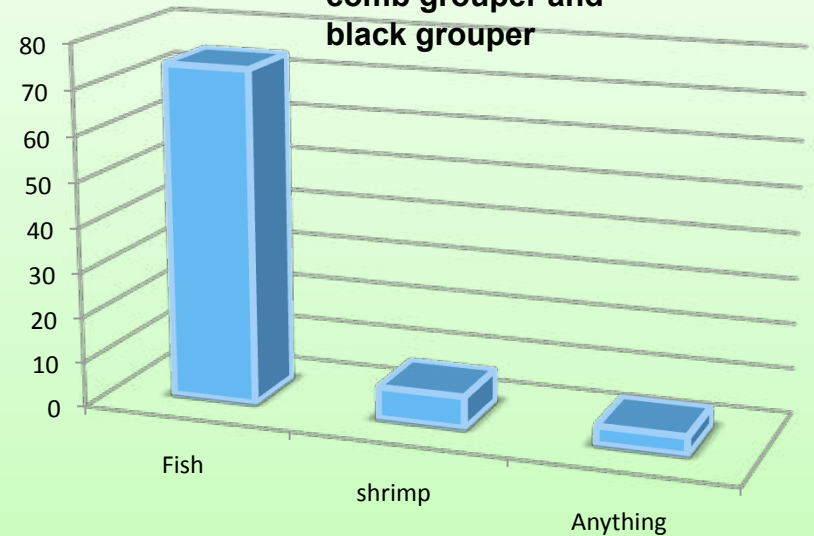
Site (No. fishermen)/	Diet Duskygrouper Redgrouper	Diet Snowy grouper Cherne	Diet Combgrouper Black grouper	Diet Coney Piraúna
	Garoupa <i>E.marginatus</i> (SE/S), <i>E.morio</i> (NE)	<i>Epinephelus niveatus</i>	Badejo (Sirigado in Mucuripe), <i>M.acutirostris</i> (SE), <i>M.bonaci</i> (NE).	<i>Cephalopisfulva</i>
NE: Mucuripe, Fortaleza, Ceará (14)	Fish=13	Fish=6 (many does not know)	Fish=14	Fish=13 Anything= 2
NE: Natal, Rio Grande do Norte (28) ^{MA}	Fish=26	--	Fish=23	Fish=21 Shrimp=14
NE: Itacimirim, Bahia (15)	Fish= 13	Fish = 5 (most does not know)	Fish= 14	--
SE: Copacabana, Rio de Janeiro (10)	Fish= 6	Fish=7 Shrimp=5	Fish=8 Shrimp=7	--
SE: Bertioga (11)	Fish=8 Anything/dead=7	Fish=6	Fish=4 Anything/dead=4	--
S: Pântano do Sul, Florianópolis (11)	Anything/dead=11 Fish= 5	Fish=8	Fish=11	--
Total (89)	Fish=71	Fish=32 (out of 61)	Fish=74	32 (out of 42)
Literature Froese and Pauly, 2010 (FP) and Begossi and Silvano, stomach contents (BS)	<i>E. marginatus</i> : Crabs, octopi, and fish ^{FP} Crabs and fish ^{BS} <i>E. morio</i> Fish and invertebrates ^{FP}	Fishes, gastropods, cephalopods, and brachyuran crustaceans ^{FP} *	<i>M. acutirostris</i> Probably feeds on plankton ^{FP} <i>M. bonaci</i> Fish (adults), crustaceans (juveniles) ^{FP}	Small fish and crustaceans ^{FP}
This study (stomach contents)	--	--	<i>M. acutirostris</i> (n=39) Empty= 16	<i>Cephalopis fulva</i> (n=170) Empty=150
			Fish=12 Shrimp=3 Undefined=8	Fish=5 Shrimp=4 Undefined=11

Sources: ^{MA}Martinelli, 2009., ^{FP}=Froese and Pauly, ^{BS}= Begossi and Silvano, ^{IS}=This study.

Stomach contents of comb grouper: *M. acutirostris* (n=39)



Interviews with fishers, n=74 comb grouper and black grouper



Literature [www.fishbase.org, Froese and Pauly 2010^{FP}, and Gibran [2007, *Neotrop. Ichthyol.*]^G

Mycteroperca

M. acutirostris (comb grouper)

Probably feeds on plankton^{FP}

Juvenile feeds on crustaceans (100%, n=30, 240-328g)^G

M. Bonaci (black grouper)

Fish (adults), crustaceans (juveniles)^{FP}

Possibilities of co-management collaboration: local knowledge

Mature Gonads (visible eggs)

- Spring [*L. synagris*, *L. vivanus*, *O. chrysurus*]
 - Summer [*L. synagris*]
 - Fishermen and direct observation
- » October field work

Diet (observed and interviews)

- General concordance literature and fishers (fish and shrimp eaters)
 - Except crabs (literature and fishers)

Possibilities of co-management and of collaboration

- Knowledge on reproduction
- Knowledge on fish biology [example of diet]
- Make conservation interesting to local fishers
 - » Including local knowledge into management
 - » Through payments for environmental services
 - Monitoring of islands, for example.
 - Systematic collection of data



Bahia



Rio

Next Steps



- Projects in Paraty Rio de Janeiro (Fapesp and IDRC)
- Collaborative research
 - Collecting data
 - Training
- Management
 - Fishing agreements
 - Payments for Environmental Services

Thank you!