MINISTERIO DE CIENCIA E INNOVACION

INSTITUTO ESPAÑOL DE OCEANOGRAFÍA
CENTRO OCEANOGRÁFICO DE CANARIAS

GOBIERNO DE ESPAÑA
MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO

SECRETARIA GENERAL DEL MAR

Reserva Marina Canaria
RESMARCAN



LA PALMA MARINE RESERVE

CASE STUDY

P. Martín-Sosa y J.M. Falcón

PEXLAPALMA

Fishery prospection surveys to estimate abundance and biomass trends of the fishery resources of the southwestern coast of La Palma (Canary Islands, Atlantic Ocean) after the implementation of a marine reserve

PEXLAPALMA

- **What we were looking for**

- **The way we did it**
  - **AREA & SAMPLING DESIGN**
  - **ANALYSIS OF DATA**
    - VARIABLES
    - MULTIVARIATE
    - UNIVARIATE
      - GILLNET MODEL
      - LONGLINE MODEL

- **What came about**
  - **GILLNET CATCHES**
    - MULTIVARIATE
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- **To discuss**
- **To conclude**

LA PALMA MARINE RESERVE (hereafter LPMR)

LOCAL FISH POPULATIONS AND ASSEMBLAGES (20-500 M)

¿RESERVE EFFECT?

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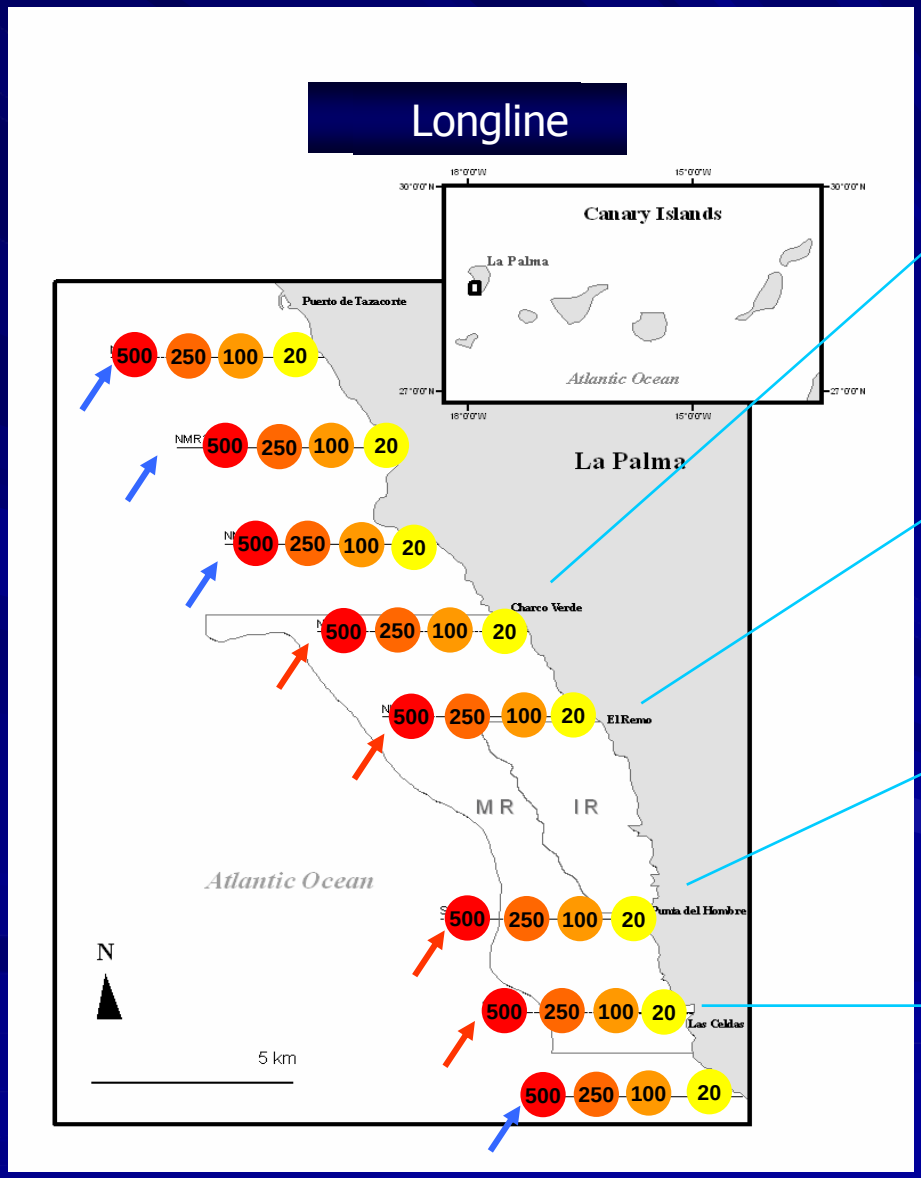

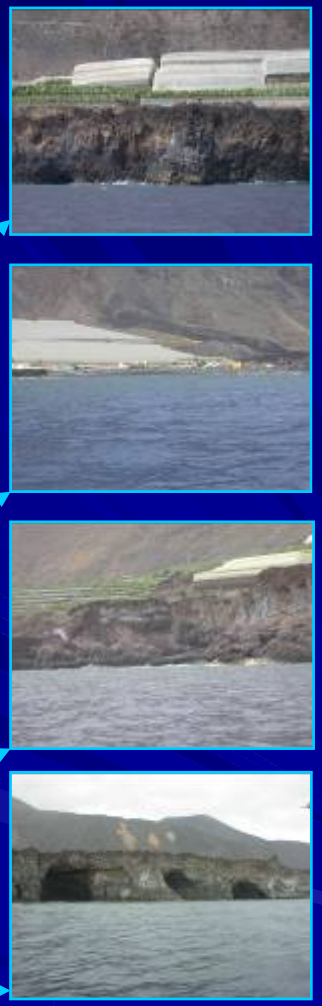

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Total
Pooled species categories
Individual species

Biomass → Standardization → Per unit effort → BPUE (g/h or g/(h*100 hooks)

Abundance → Per unit effort → NPUE (ind/h or ind/(h*100 hooks)

Community parameters
Richness
Diversity
Evenness

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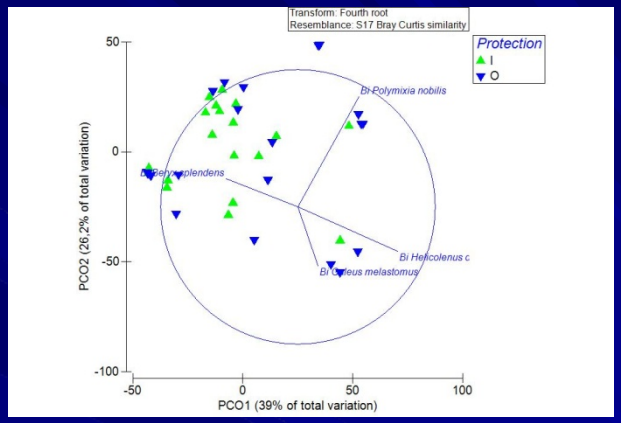

Multivariate analysis

- Exploratory methods:
  - PCO
  - Cluster, MDS, SIMPROF
  - SIMPER
- Tests:
  - PERMANOVA

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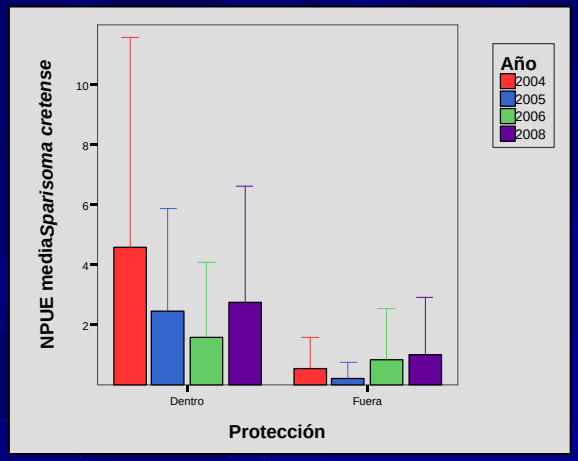

Univariate Analysis

- Exploratory methods:
  - Statistical descriptives
  - Graphic representation
- Tests:
  - ANOVA by permutations

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Gillnet: Partially hierarchical model

Protection (Pr)
Fixed factor, 2 levels
inside vs. outside

Year (Yr)
Fixed factor, 4 levels:
2004, 2005, 2006, 2008

Site (Si)
Random factor, nested
in Protection, 3 levels

6 replicates

$$X_{ijkz} = \mu + Pr_i + Y_j + Si(Pr)_{k(i)} + Pr \times Y_{ij} + Y \times Si(Pr)_{jk(i)} + e_{z(ijk)}$$

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Longline: model with orthogonal factors

Protection (Pr)
Fixed factor, 2 levels
inside vs. outside

Year (Yr)
Fixed factor, 5 levels:
2003, 2004, 2005,
2006, 2008

4 replicates

$$X_{ijkz} = \mu + Pr_i + Y_j + Pr \times Y_{ij} + e_{k(ij)}$$

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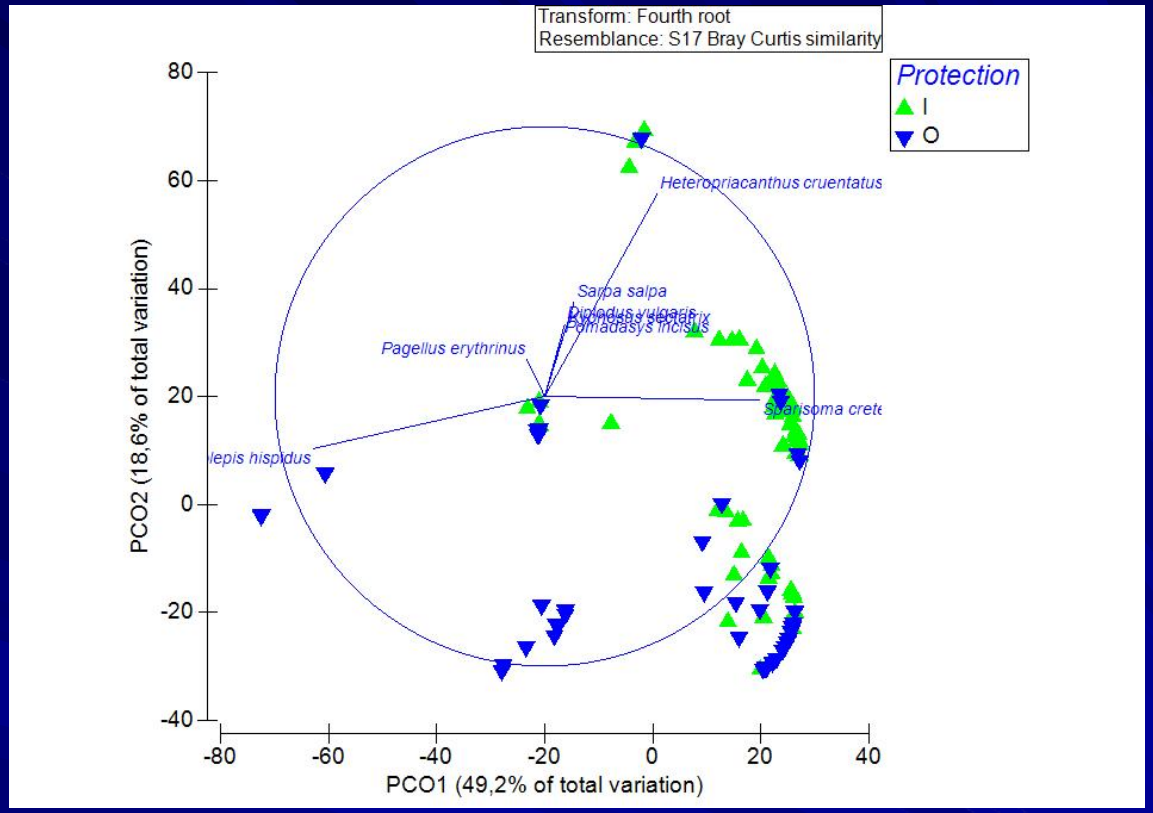

PERMANOVA:

Pr	***
Yr	ns
Si(Pr)	**
Yr x Pr	ns
Yr x Si(Pr)	***

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Gillnet: PERMANOVA results

	Ye	Pr	Si(Pr)	YexPr	YexSi(Pr)
Total abundance	ns	**	ns	ns	ns
Total biomass	ns	ns	ns	ns	ns
Species richness	**	ns	***	ns	ns
Diversity index H'	**	ns	***	ns	ns
Cat. commercial	ns	**	ns/*	ns	ns/*
Cat. non commercial	**	*	ns	ns	ns
Cat. target	ns	***	ns	ns	ns
Cat. non target	**/ns	ns	***	*/ns	ns
Fish assemblage	ns	***	**	ns	***
D. vulgaris	ns	ns	*/ns	ns	**/ns
H. cruentatus	ns	*/**	*/ns	ns	ns
K. sectator	ns	ns	**	ns	ns/*
P. erythrinus	ns	ns	ns	*	ns
P. incisus	ns	ns	***	ns	***
S. cretense	ns	***	ns	ns	ns
S. hispidus	*/**	*	**/*	*/**	ns
S. salpa	*	ns	ns	*	ns

Gillnet: community parameters & commercial categories

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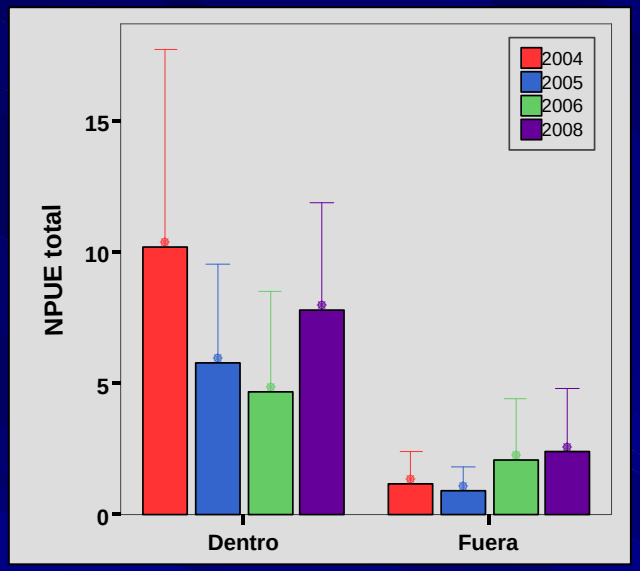

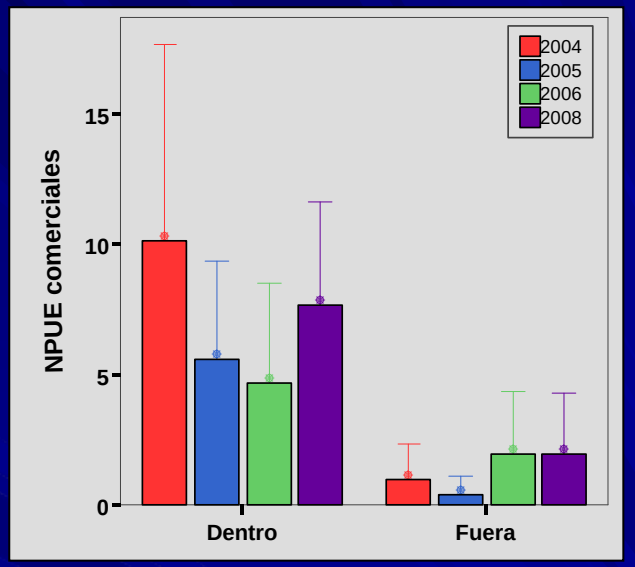

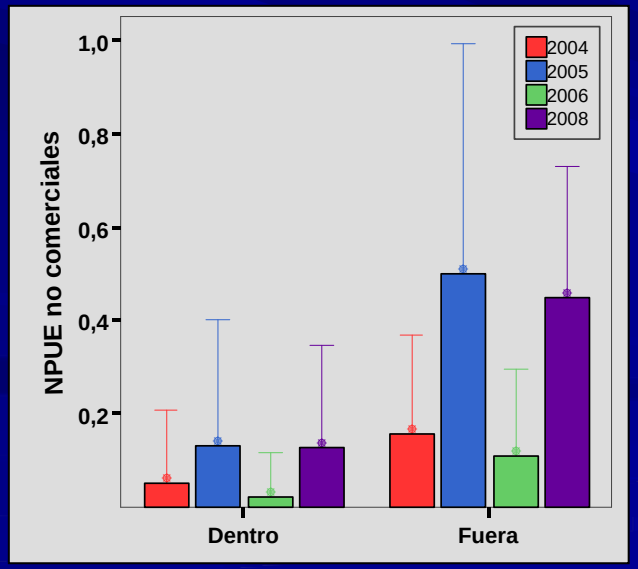

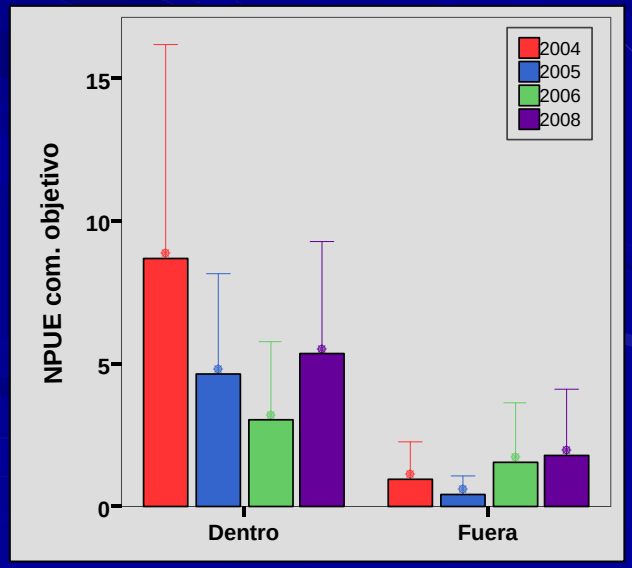

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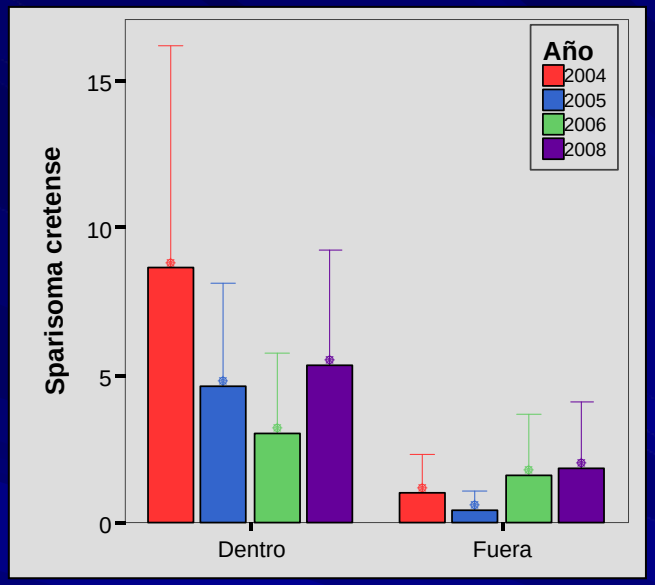
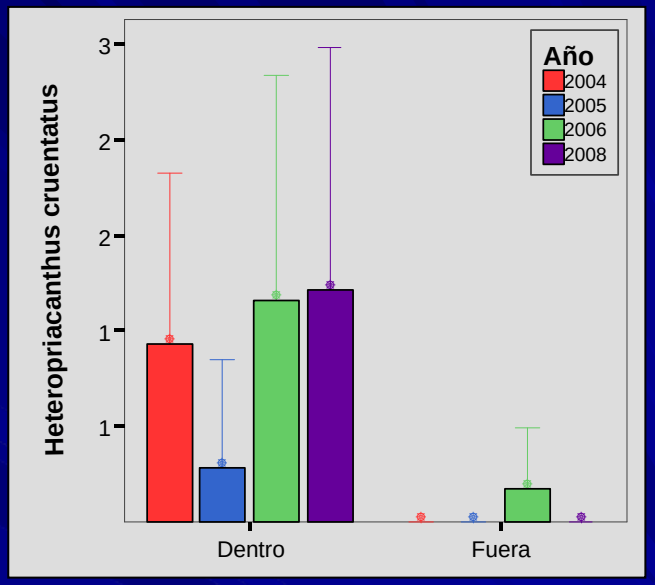
Gillnet: single species





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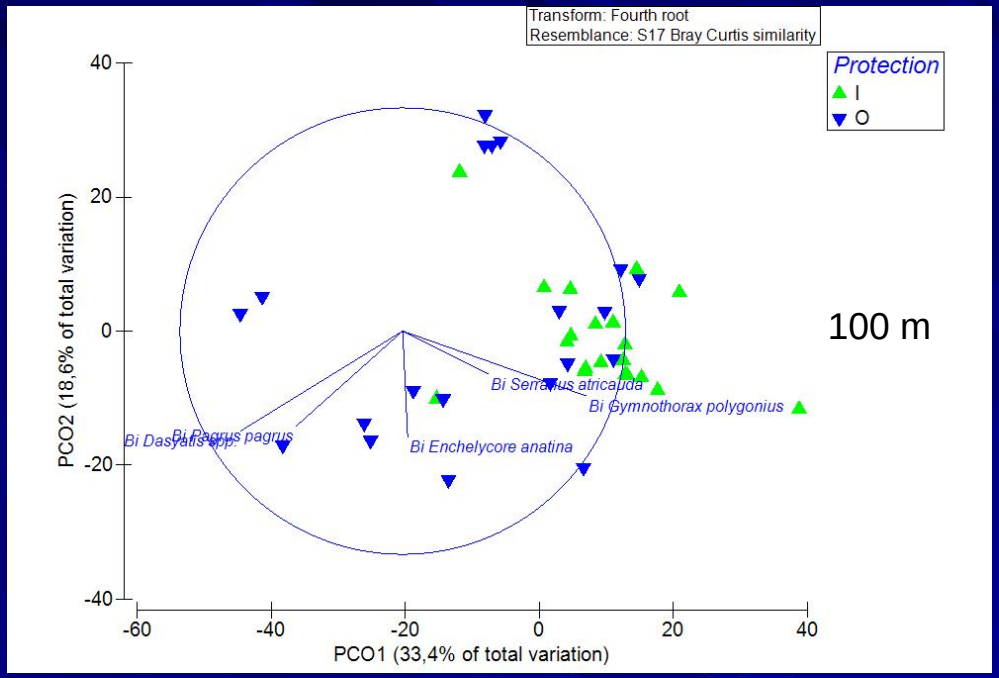
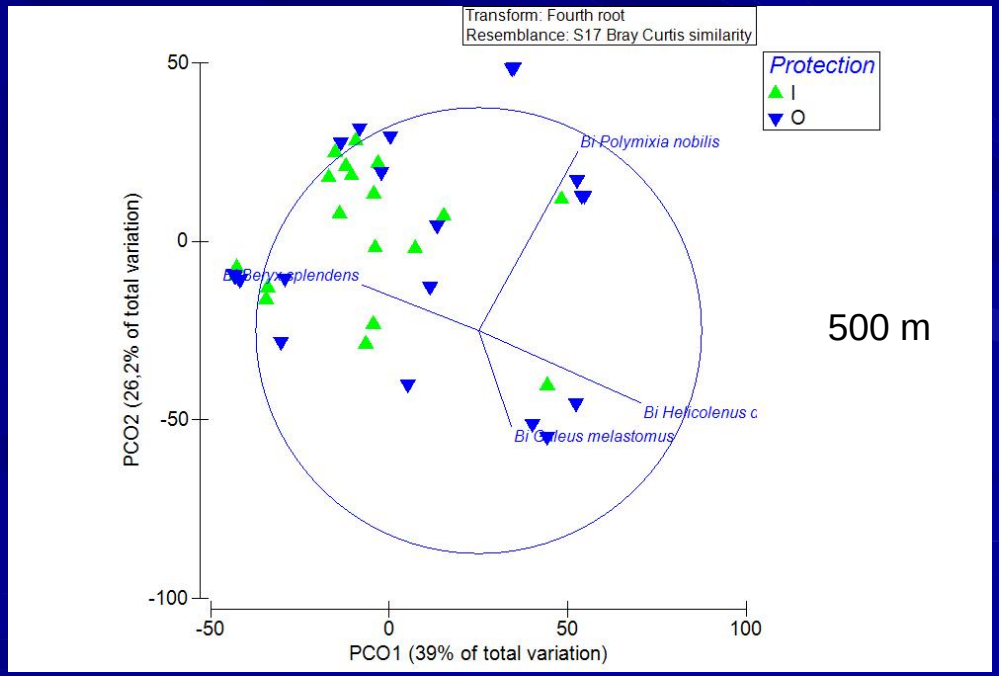


100 m

PERMANOVA:
Pr **
Yr ns
Yr x Pr ns

Idem NPUE



500 m

PERMANOVA:
Pr *
Yr ns
Yr x Pr ns

Idem NPUE

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Longline: PERMANOVA results

20 m	Ye	Pr	YexPr
Total abundance	*	*	ns
Total biomass	ns	ns	ns
Species richness	ns	ns	ns
Diversity index H'	ns	ns	ns
Cat. commercial	*	**/*	ns
Cat. non commercial	ns	ns	ns
Cat. target	**	***/**	ns
Cat. non target	ns	ns	ns
Fish assemblage	ns	ns	ns
Dasyatis spp.	ns	ns	ns
C. sufflamen	*/ns	ns	ns
E. anatina	ns	ns	ns
M. augusti	*/ns	*/ns	ns
S. atricauda	ns	**	ns
P. pagrus	ns	*/ns	ns
M. aquila	ns	ns	ns
100 m	**Ye**	**Pr**	**YexPr**
Total abundance	**	*	*
Total biomass	**	ns	*
Species richness	ns	*	ns
Diversity index H'	ns	*	ns
Cat. commercial	**/*	**/ns	*/ns
Cat. non commercial	ns	**/*	ns
Cat. target	**/*	*/ns	ns
Cat. non target	ns	*	*/ns
Fish assemblage	ns	**	ns
Dasyatis spp.	ns	**/*	ns
E. anatina	ns	ns	ns
G. polygonius	ns	**	ns
M. helena	ns	ns	ns
P. kuhlii	ns	ns	ns
P. pagrus	*	ns	ns
P. phycis	ns	ns	ns
S. atricauda	**	**	ns

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Longline: PERMANOVA results

250 m	Ye	Pr	YexPr
Total abundance	***	ns	ns
Total biomass	***	ns	ns
Species richness	**	ns	ns
Diversity index H'	*	ns	ns
Cat. commercial	***/**	ns	ns
Cat. non commercial	ns	ns	ns
Cat. target	***	ns	*/ns
Cat. non target	ns	ns	ns
Fish assemblage	ns	ns	ns
G. galeus	ns	ns	ns
G. polygonius	***	ns	ns
P. pagrus	**	ns	ns
P. kuhlii	*/ns	ns	ns
P. nobilis	ns	ns	ns
S. atricauda	***	**/***	***

500 m	Ye	Pr	YexPr
Total abundance	ns	ns	ns
Total biomass	ns	ns	ns
Species richness	ns	*	ns
Diversity index H'	ns	*	ns
Cat. commercial	ns	ns	ns
Cat. non commercial	ns	ns	ns
Cat. target	ns	ns	ns
Cat. non target	ns	ns	ns
Fish assemblage	ns	*	ns
B. decadactylus	ns	ns/*	ns
B. splendenx	ns	ns	ns
C. conger	ns/*	*	ns/*
G. melastomus	ns	ns	ns
H. dactylopterus	ns	ns	ns
P. nobilis	ns	ns	ns
P. prometheus	ns	*/ns	ns

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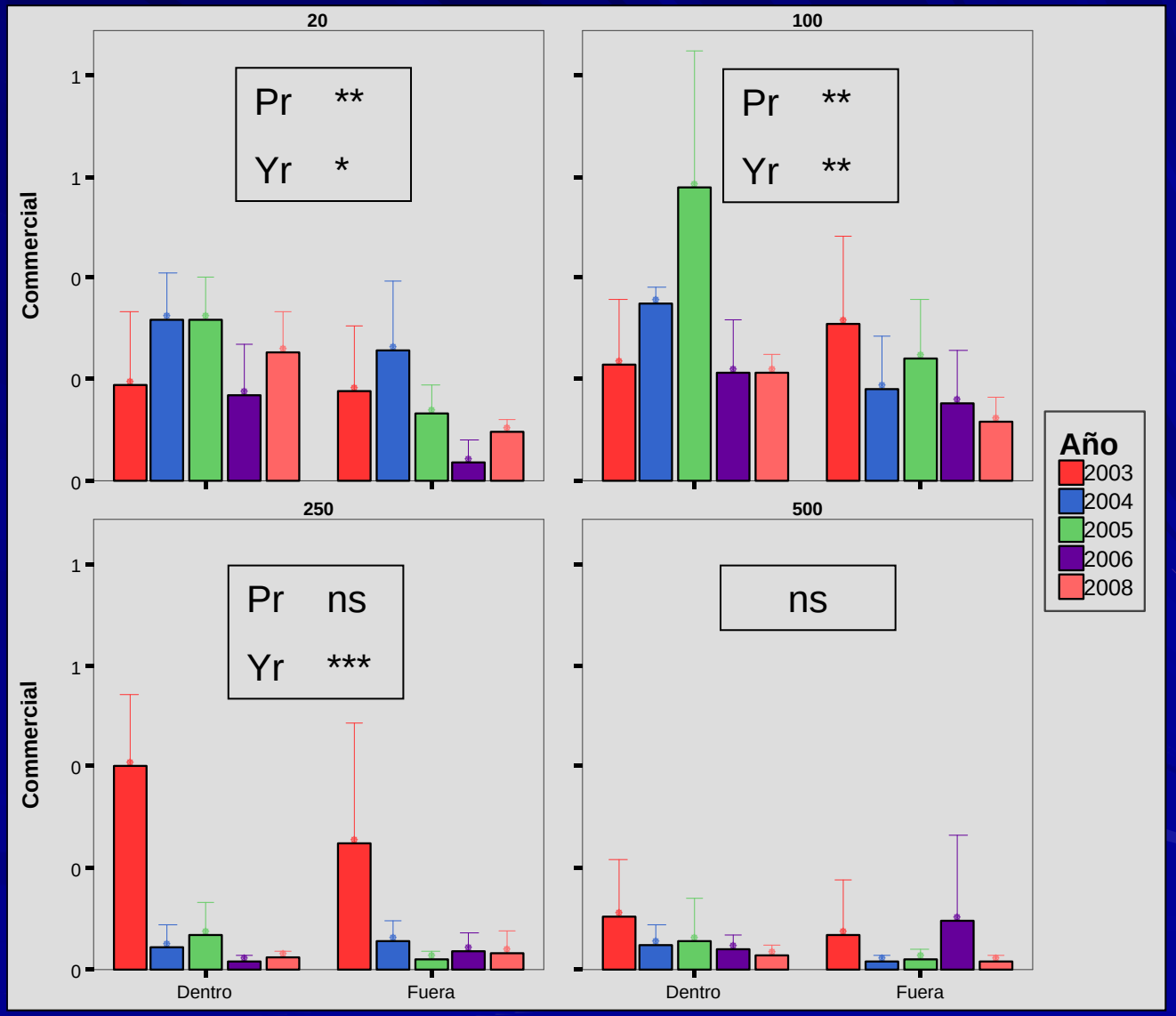
Longline: Commercial species NPUE



Longline: 20 m

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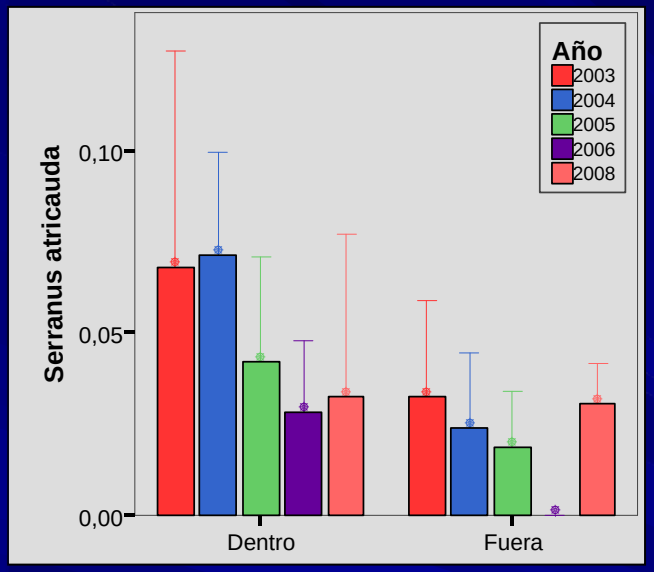

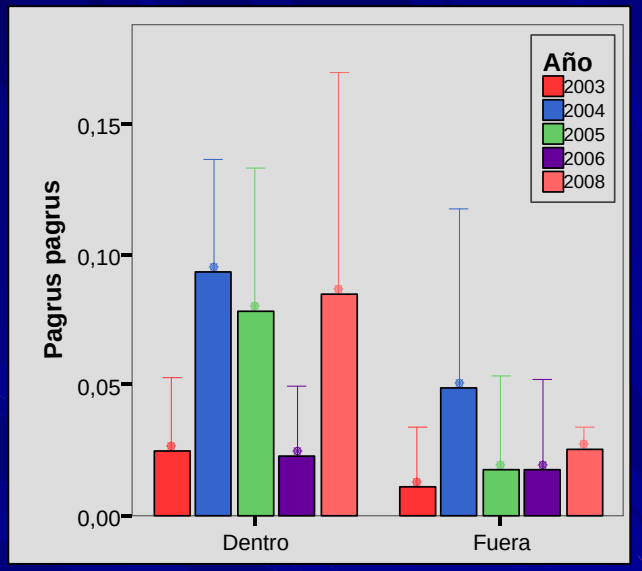

Longline: 100 m

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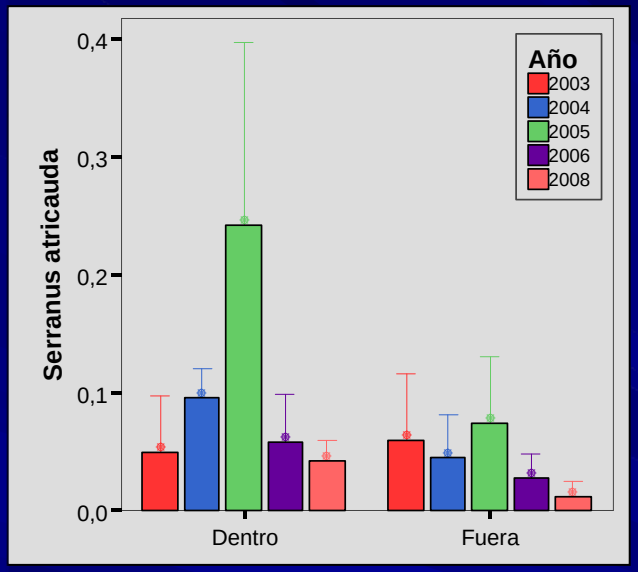

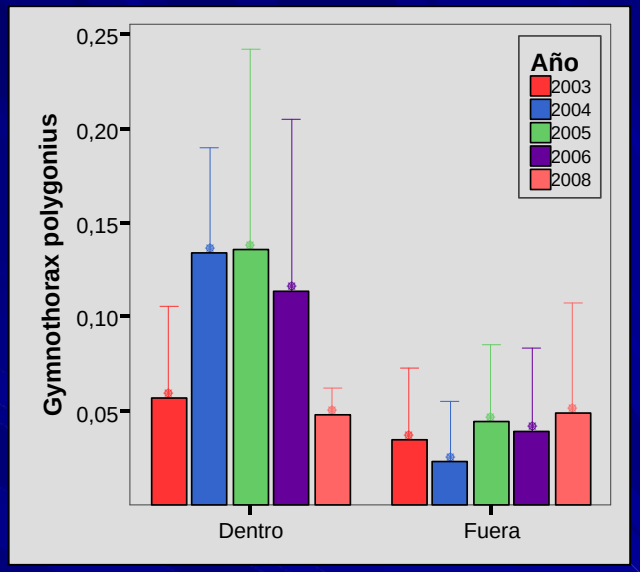

Does MR enhance local fisheries?

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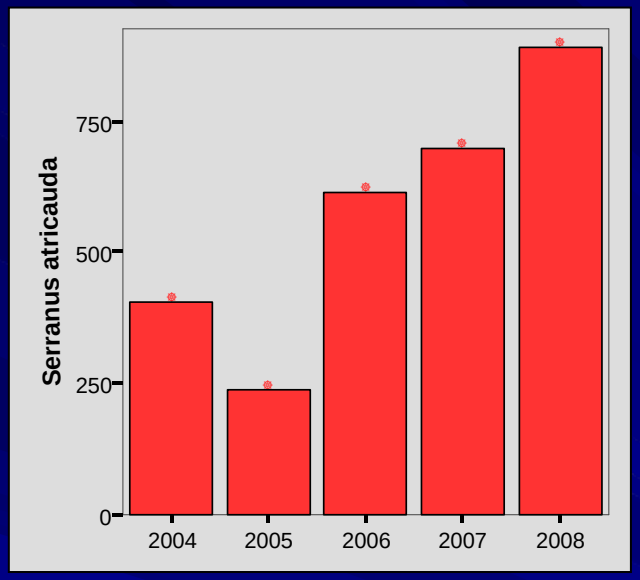
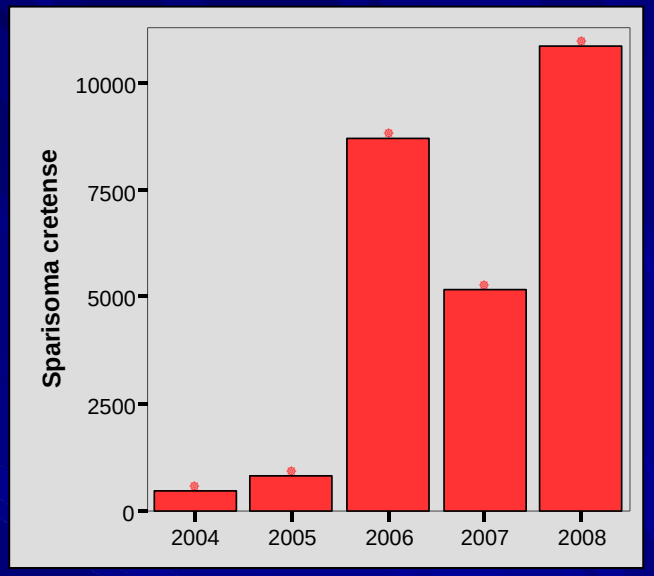
- **To discuss**
- **To conclude**





- Lack of georeferenced data
- Some fleet units profitting from some MR resources (*)
- Subexploited resources: morays

(*) Source: MR Coord. Service (pers. comm.)

PEXLAPALMA

- What we were looking for

- The way we did it

- **AREA & SAMPLING DESIGN**
- **ANALYSIS OF DATA**
  - VARIABLES
  - MULTIVARIATE
  - UNIVARIATE
    - GILLNET MODEL
    - LONGLINE MODEL

- What came about

- **GILLNET CATCHES**
  - MULTIVARIATE
  - UNIVARIATE
- **LONGLINE CATCHES**
  - MULTIVARIATE
  - UNIVARIATE

- **To discuss**
- **To conclude**

1. Limitations:
   - Lack of “before” data
   - Uncertainty about quality of deeper fishery bottoms
   - Forced (ethical & economically) low no. of replicates
2. Clear Reserve Effect (RE) on species traditionally afected by gillnetters: parrotfish & glasseye
3. Not so clear RE respecting longline catches (slow rate growth & reproduction carnivores fished)
4. Anyways, signs of RE on some species: morays, blacktail comber, red porgy, etc.
5. Need of commercial catches georeferentiation
6. Need of non-intrusive assessment methods (visual census) for coastal resources, including no-take core in the study