Restructuring reef-fish functional groups:

No-fishing consequences into a transitional area

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Understanding changes in transitional áreas of the Pacific– International Symposium, PICES 2018

INTRODUCTION

Cabo Pulmo

- National Marine Park
- 3 coral bars (25, 000 yr bp)
- SST° annual 18 – 27° C
- Fishing activities during decades
- MPA since 1995

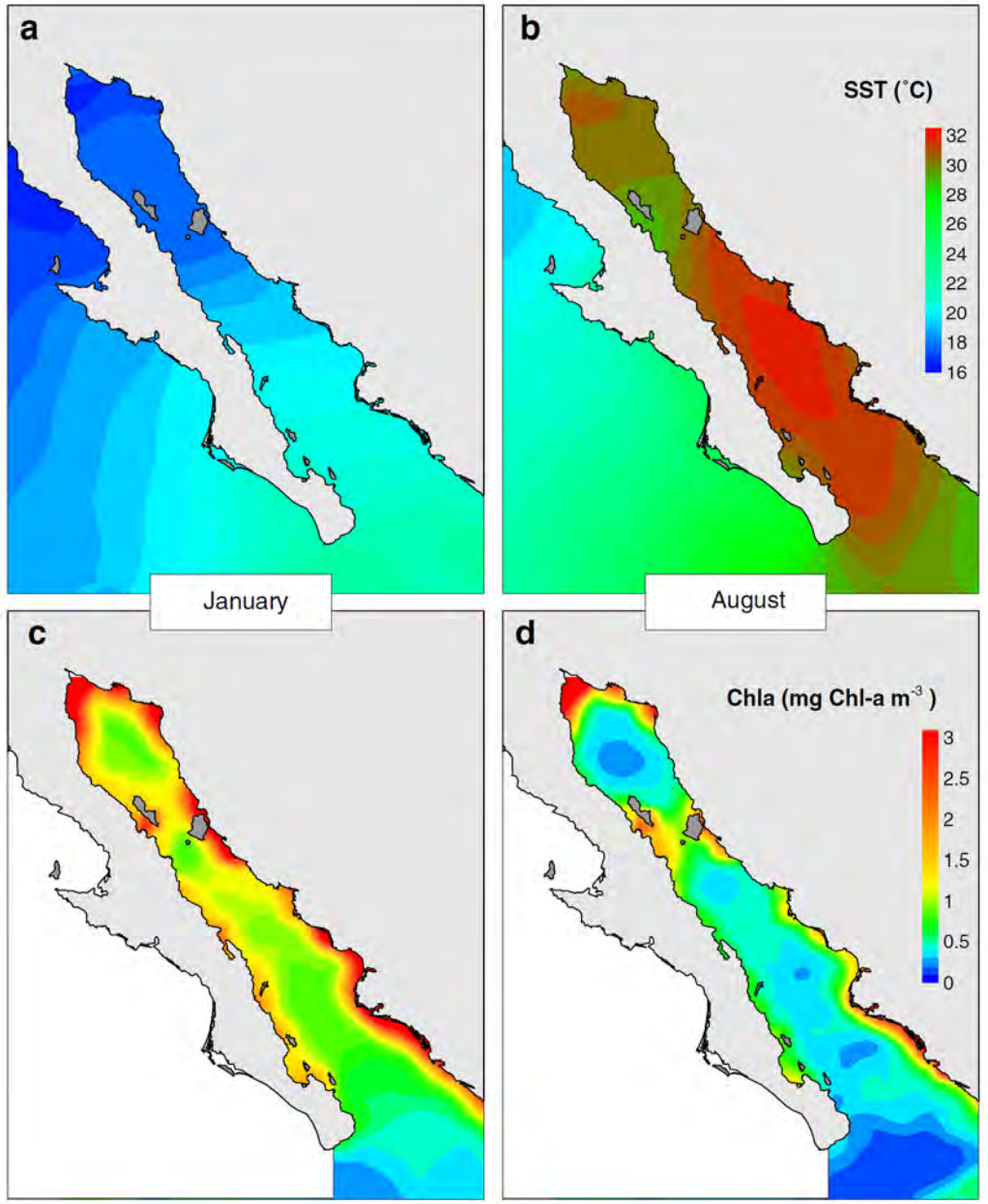
INTRODUCTION

Transitional area

California Current

Central Pacific

Tropical Pacific



Lluch-Cota et al., 2007

1.- How commercial species have changed through time?

2.- Which are the trends of community structure?

3.- Relationship between environment and ecological change?

Field Work

* Visual censuses

1987 - - - 2017

List of species

Abundance registers

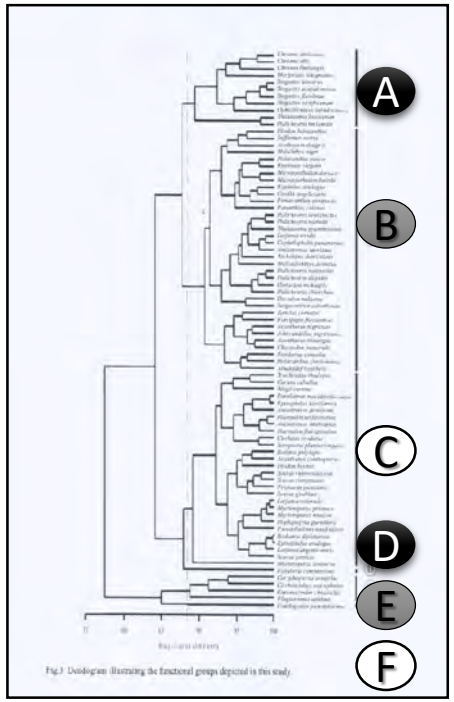
-Individuals / m^2 * 1000

15 m / 10 m

Fishes density:

All species

Functional groups



Commercial species

- Carta Nacional Pesquera, 2006.
- Carta Estatal Pesquera, 2009.
- Martínez-Guevara, 2008

Non commercial species

Functional groups were obtained by Alvarez-Filip and Reyes-Bonilla (2006),

using the following characteristics:

1) Trophic Group (carnivorous, herbivorous, detritivorous, planktivorous, omnivorous)

2) Position in water column

3) Total length (cm)

4) Ratio maxilla/head (cm)

5) Shape of the caudal fin (tuna type, forked, indented, lobed)

6) Ratio standard length / body height (in cm)

7) Residence (resident or vagrant)

8) Egg type (benthic or pelagic)

FUNCTIONAL GROUPS

A

B

C

D

E

F

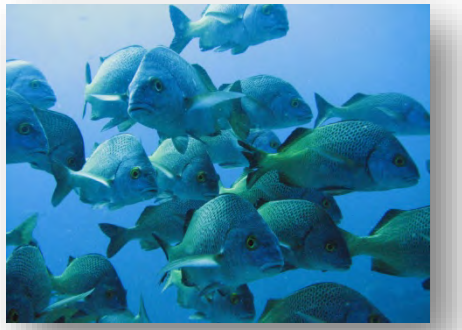
FUNCTIONAL GROUPS

A

B

C

E



S – SPECIES RICHNESS (# of species)

N – DENSITY (# Ind. / m^2 * 1000)

$$H' = -\sum_{i=1}^{S}\left(\frac{n_i}{N}\right)\log\left(\frac{n_i}{N}\right)$$

$$J' = \frac{H'}{\log(S)}$$

$$\lambda = \sum_{i=1}^{S} p_i^2$$

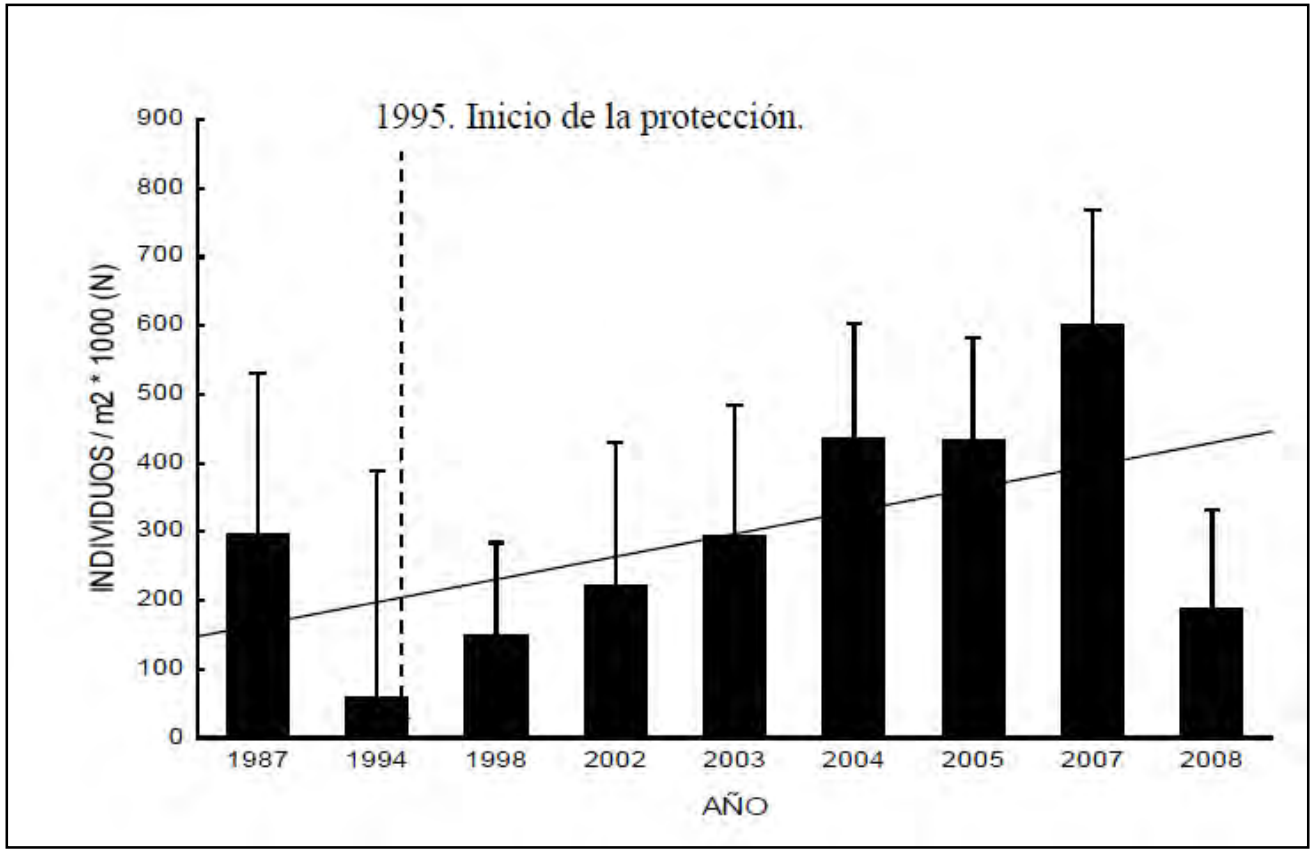
Ecological Indices

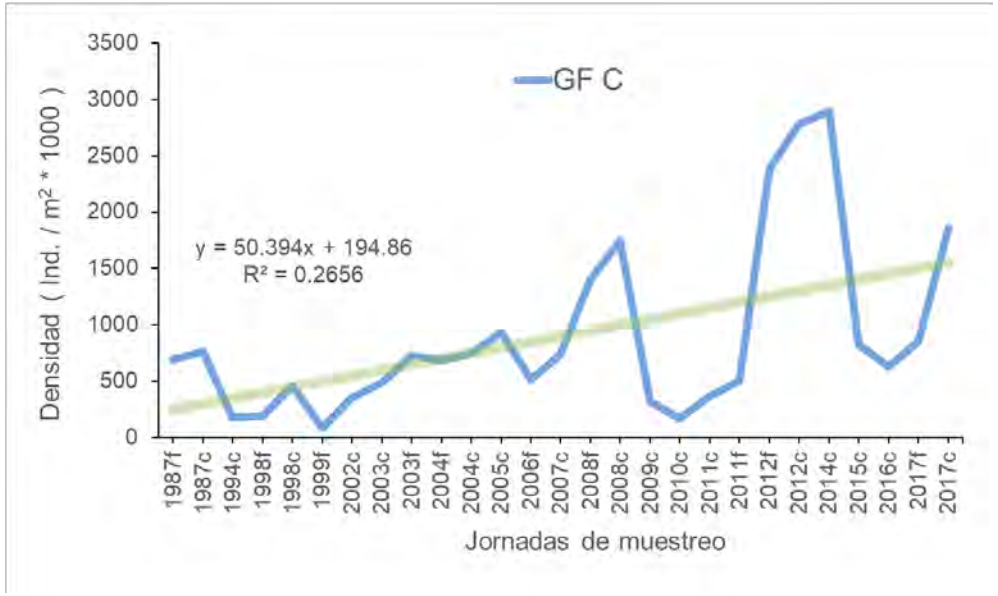
Statistical Analysis

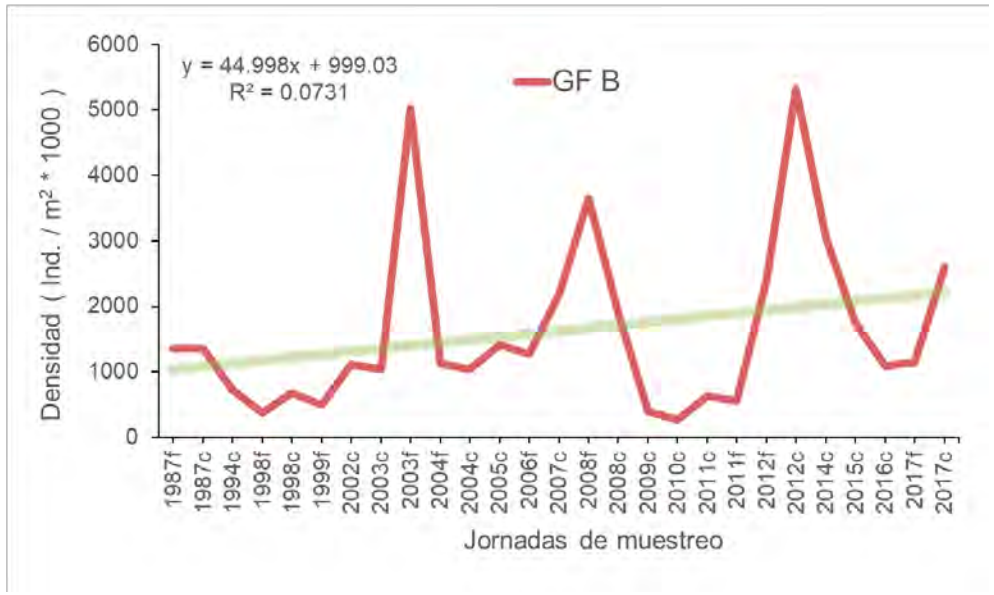
- Kruskal-Wallis → Nemenyi
- Regression & classification analysis (Linktree)
- MAFA “Max/min Autocorrelation Factor Analysis”

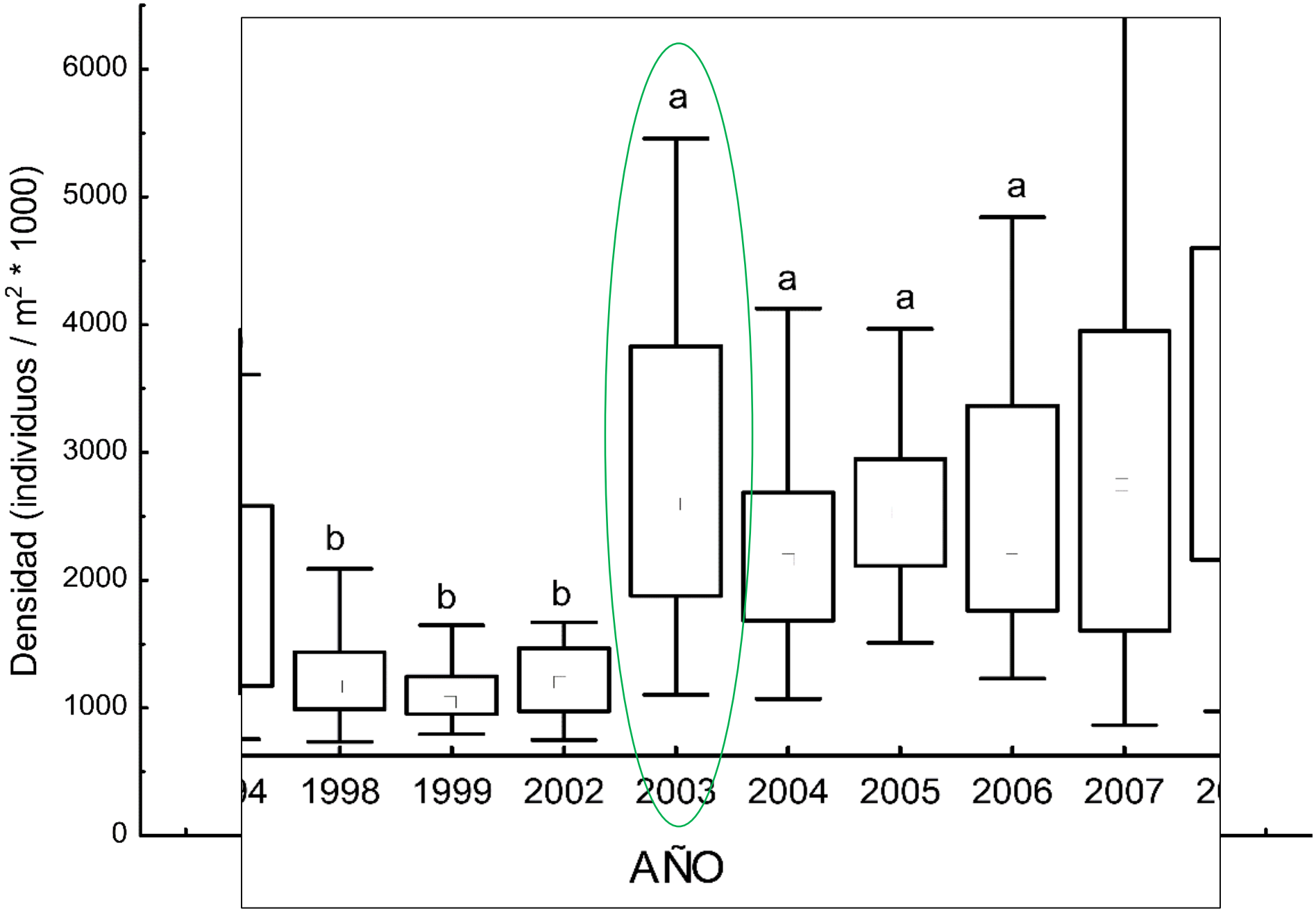
1.- How commercial species have changed through time?

The recovery



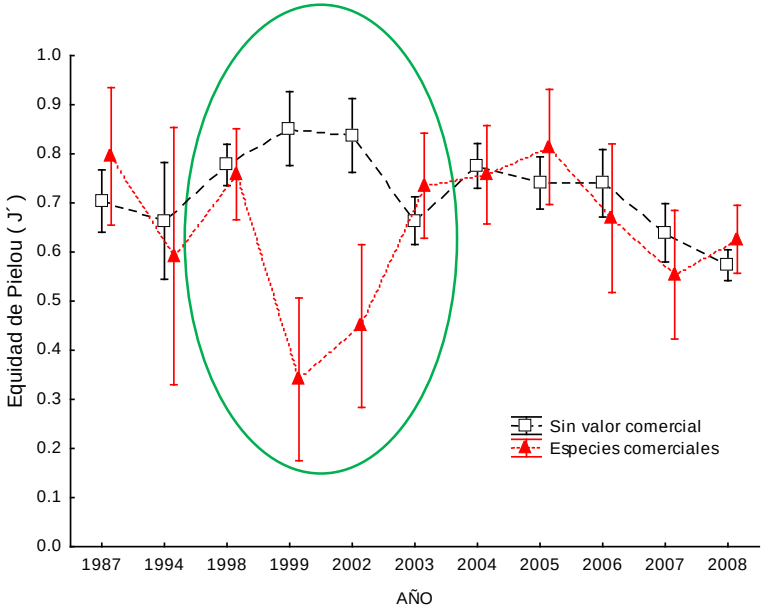




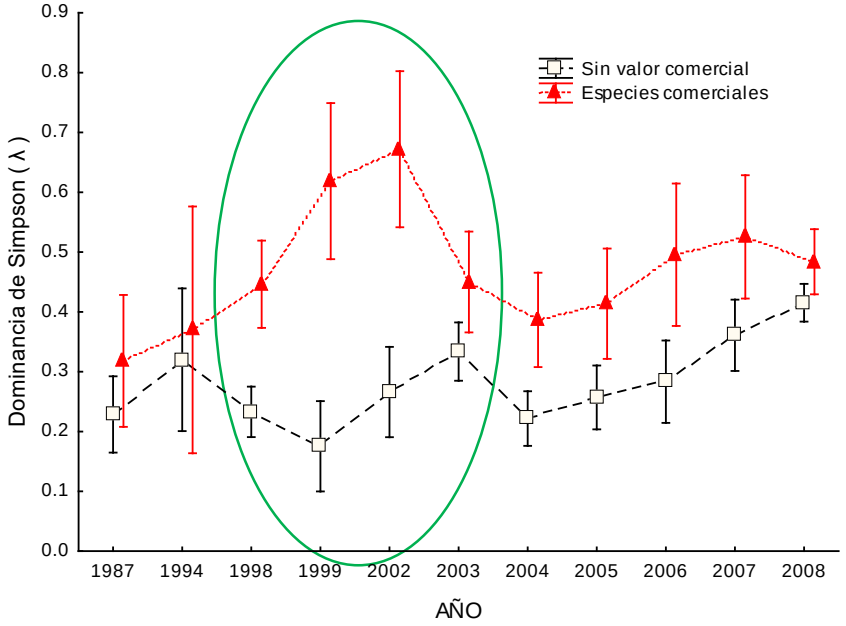

Densidad (individuos / m2 * 1000)
6000
5000
4000
3000
2000
1000
0
a
b
b
b
a
a
a
1998
1999
2002
2003
2004
2005
2006
2007
AÑO

Transition period
1998-2003

Eveness



Dominance



Fishing species

Opportunists

Competence

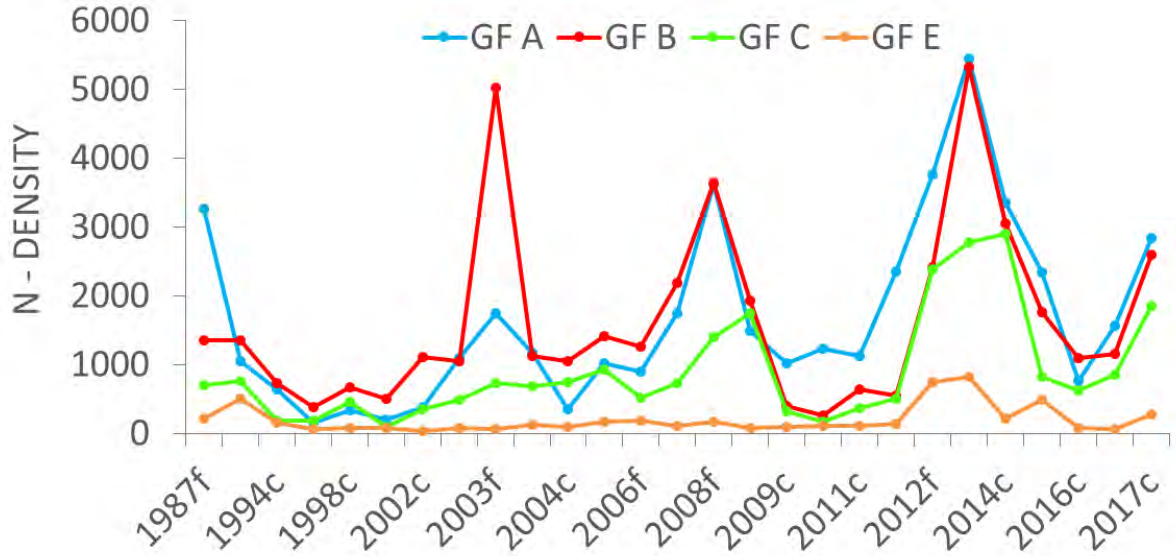
Dominance

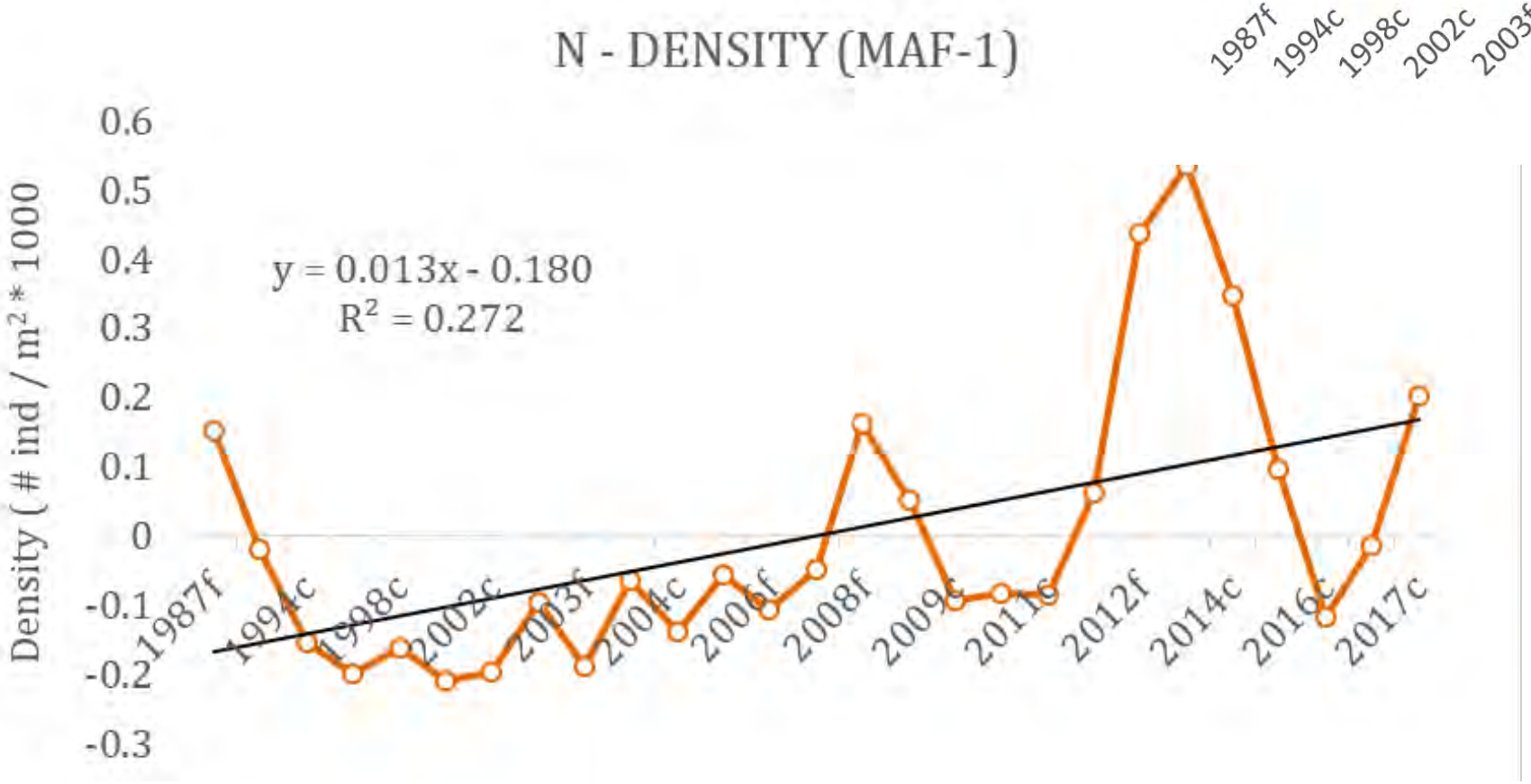
Sale, 1991; Syms y Jones, 2000; Rickleffs y Miller, 2000; **Siqueiros-Beltrones, 2005**

2.- Which are the trends of community structure?

N – Density

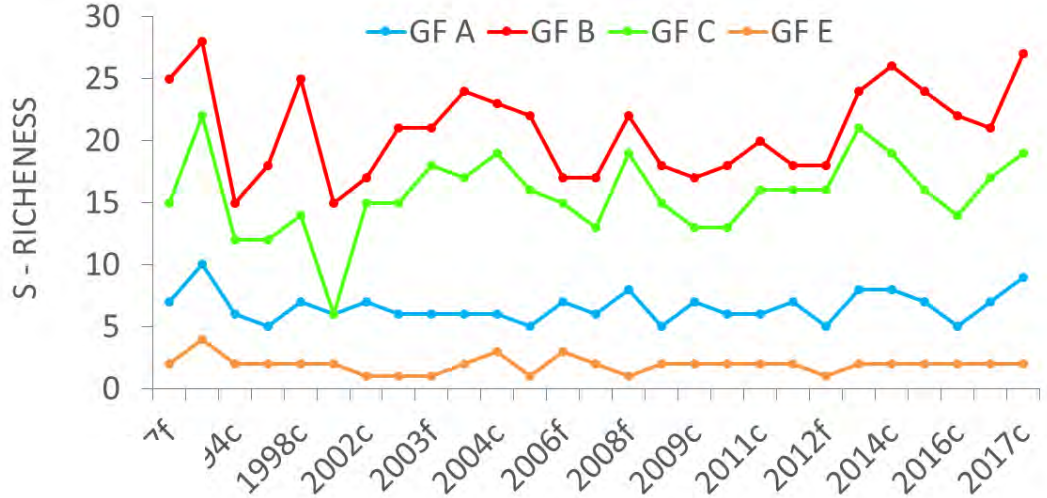
Correlations between Y and MAFA	
A	0.942
B	0.606
C	0.898
E	0.790

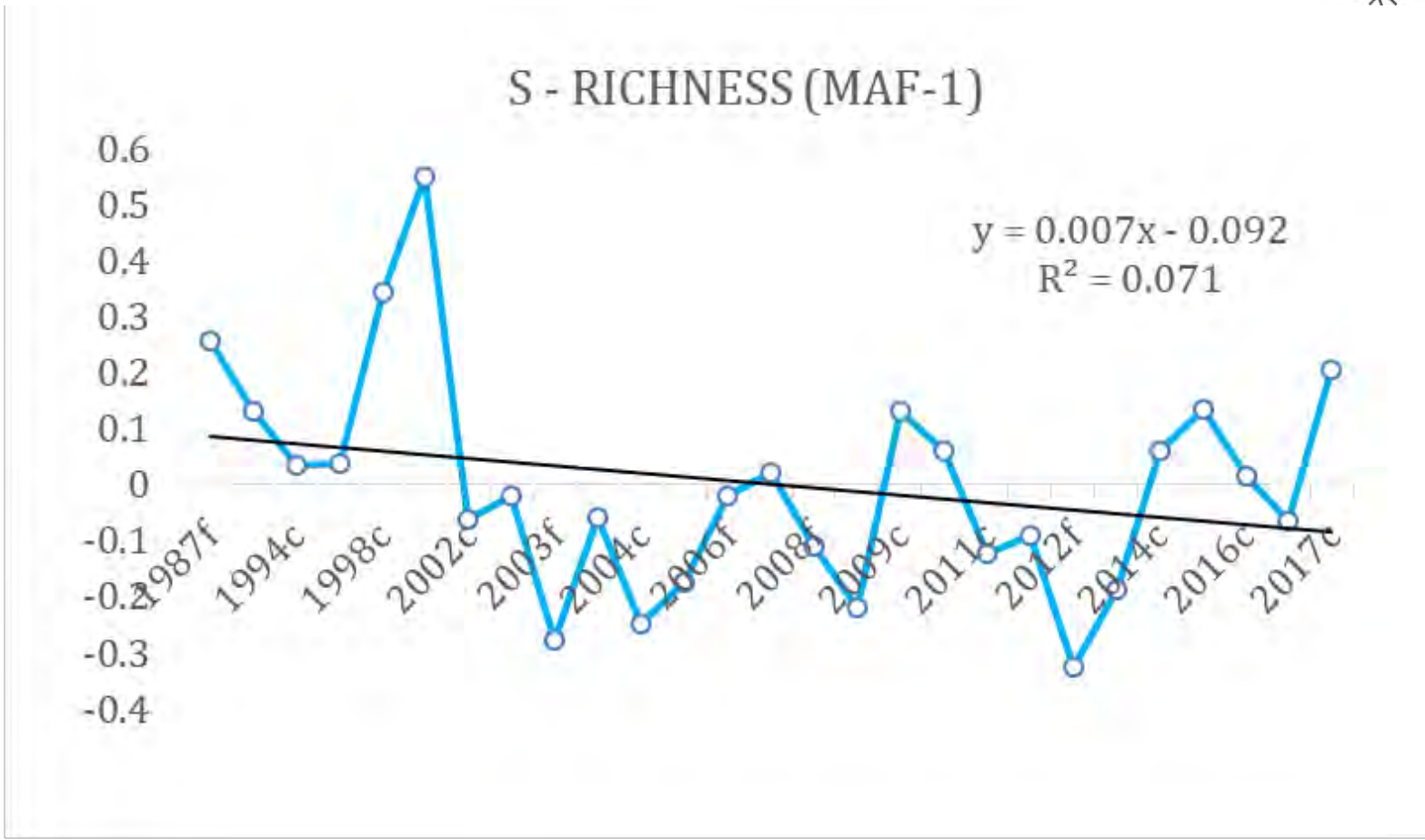




S – Richness

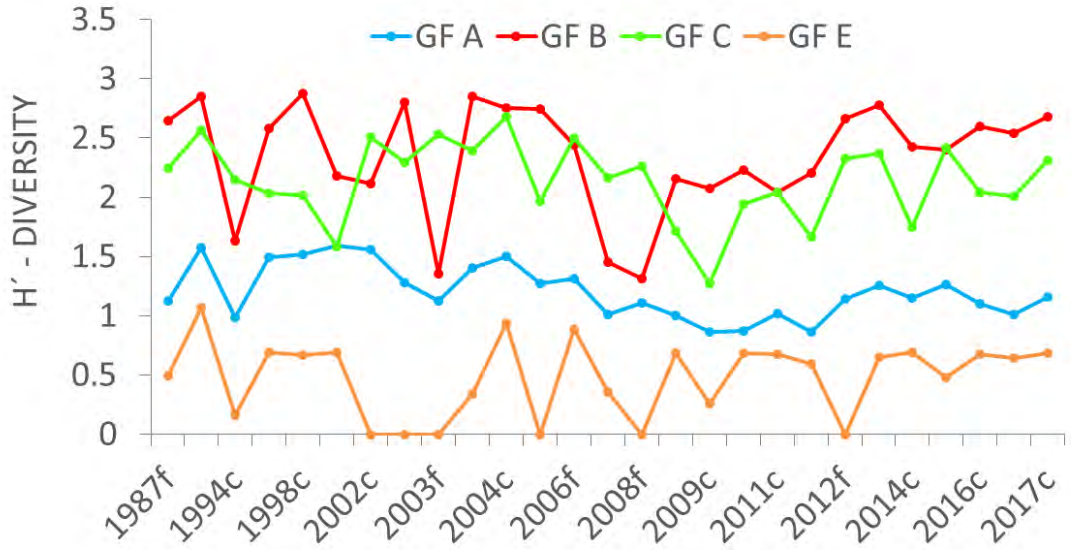
Correlations between Y and MAFA	
A	0.307
B	0.089
C	-0.497
D	0.280

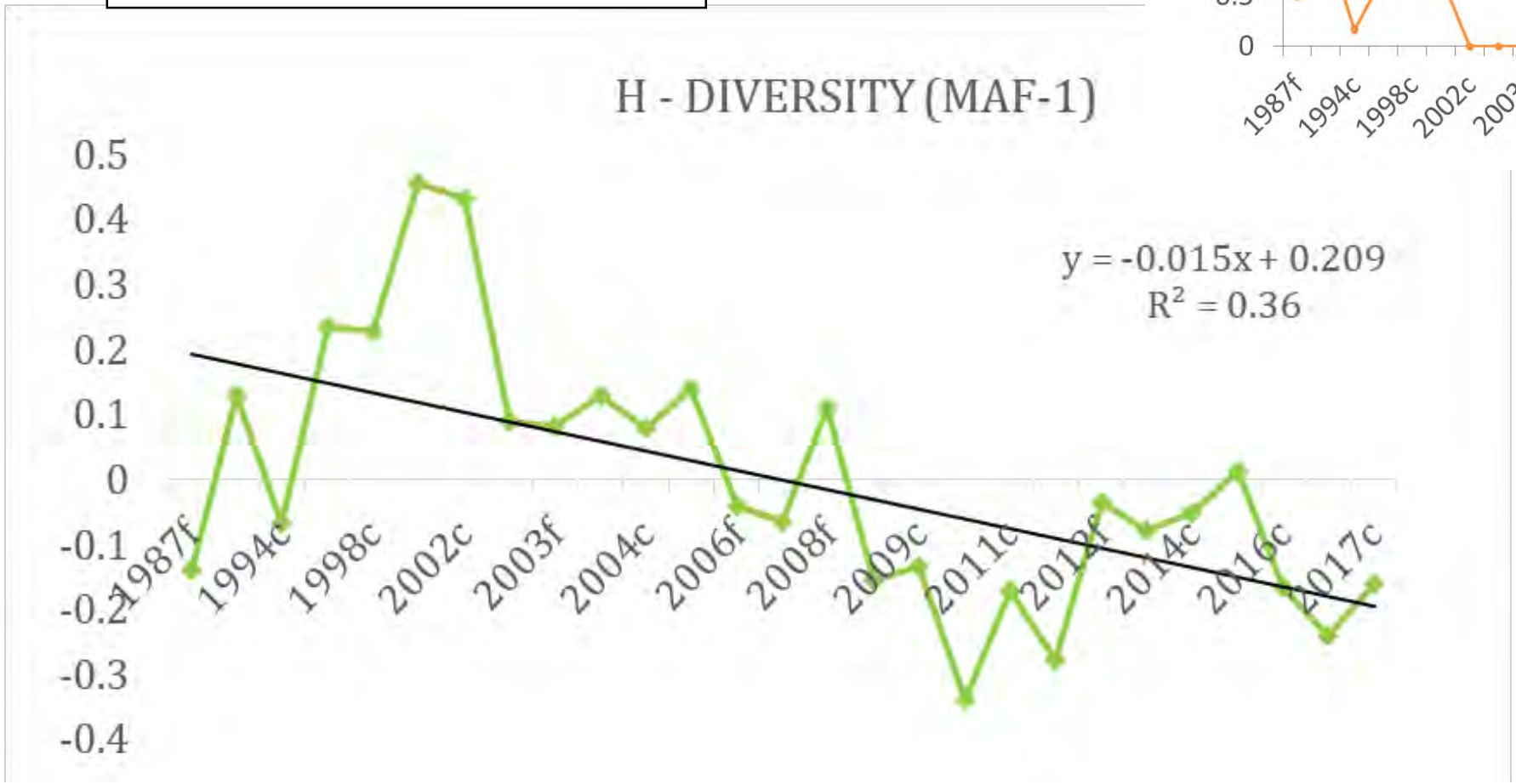




H´ - Diversity

Correlations between Y and MAFA	
A	0.855
B	0.054
C	0.233
E	-0.221





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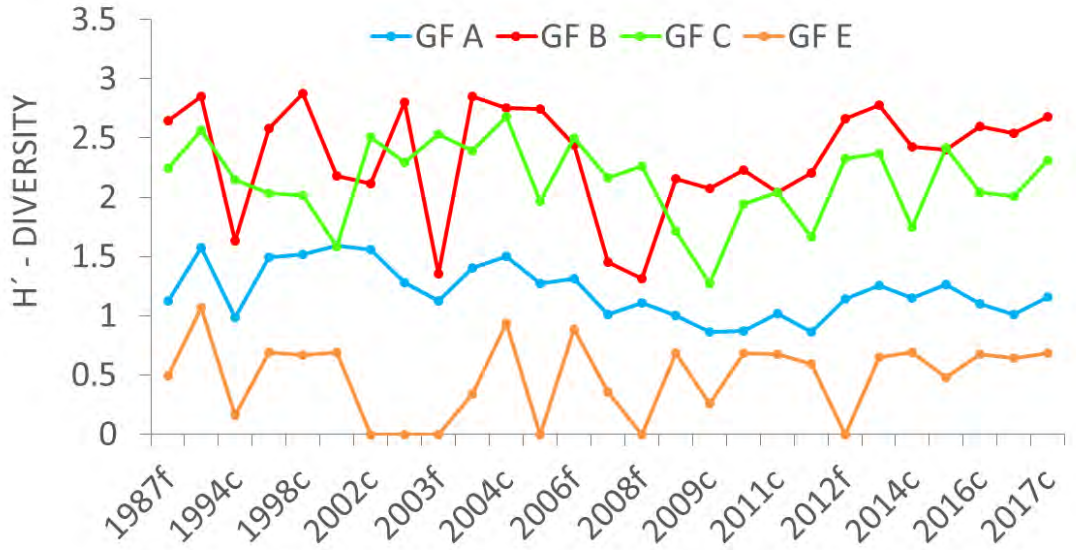
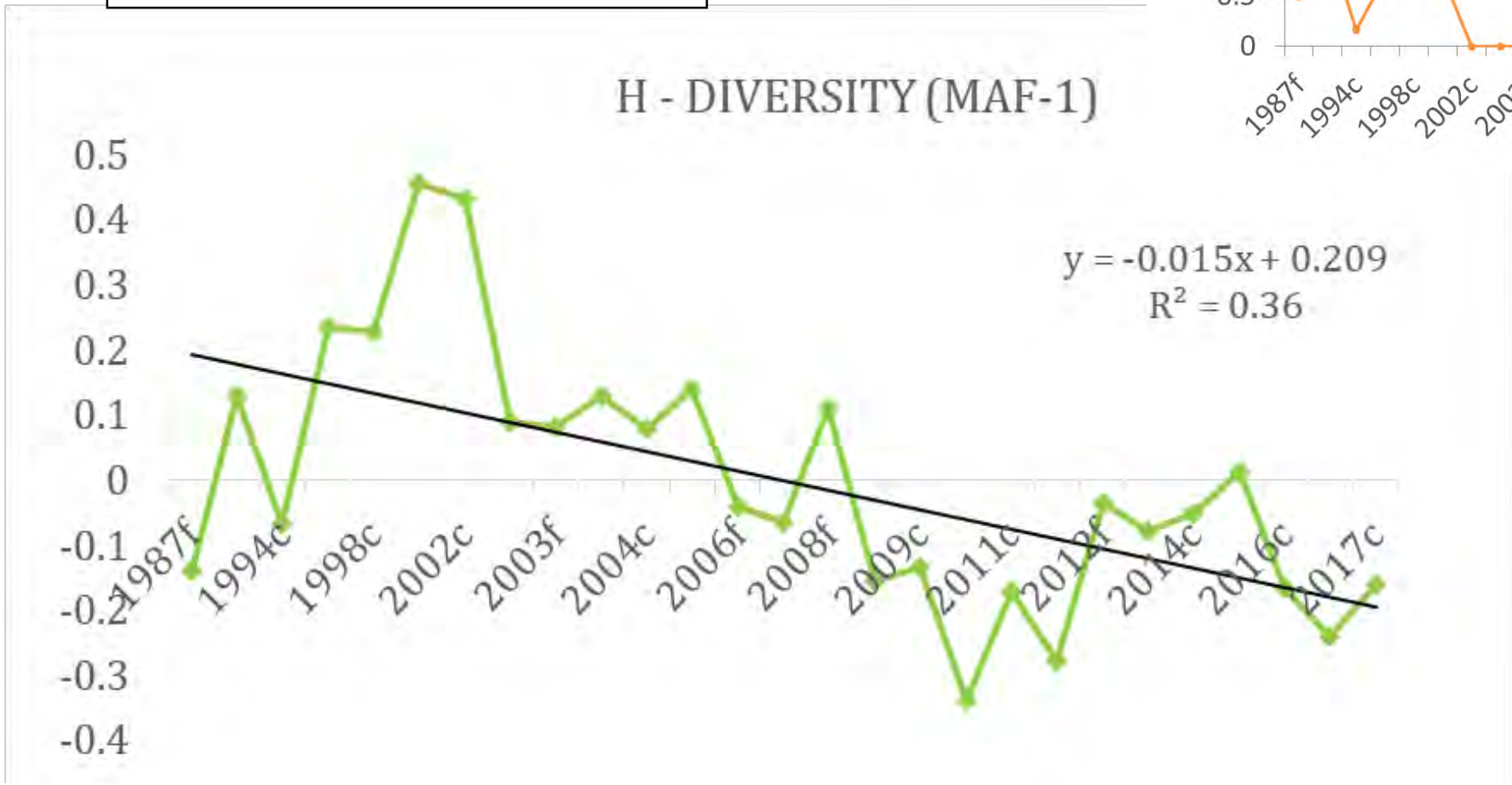
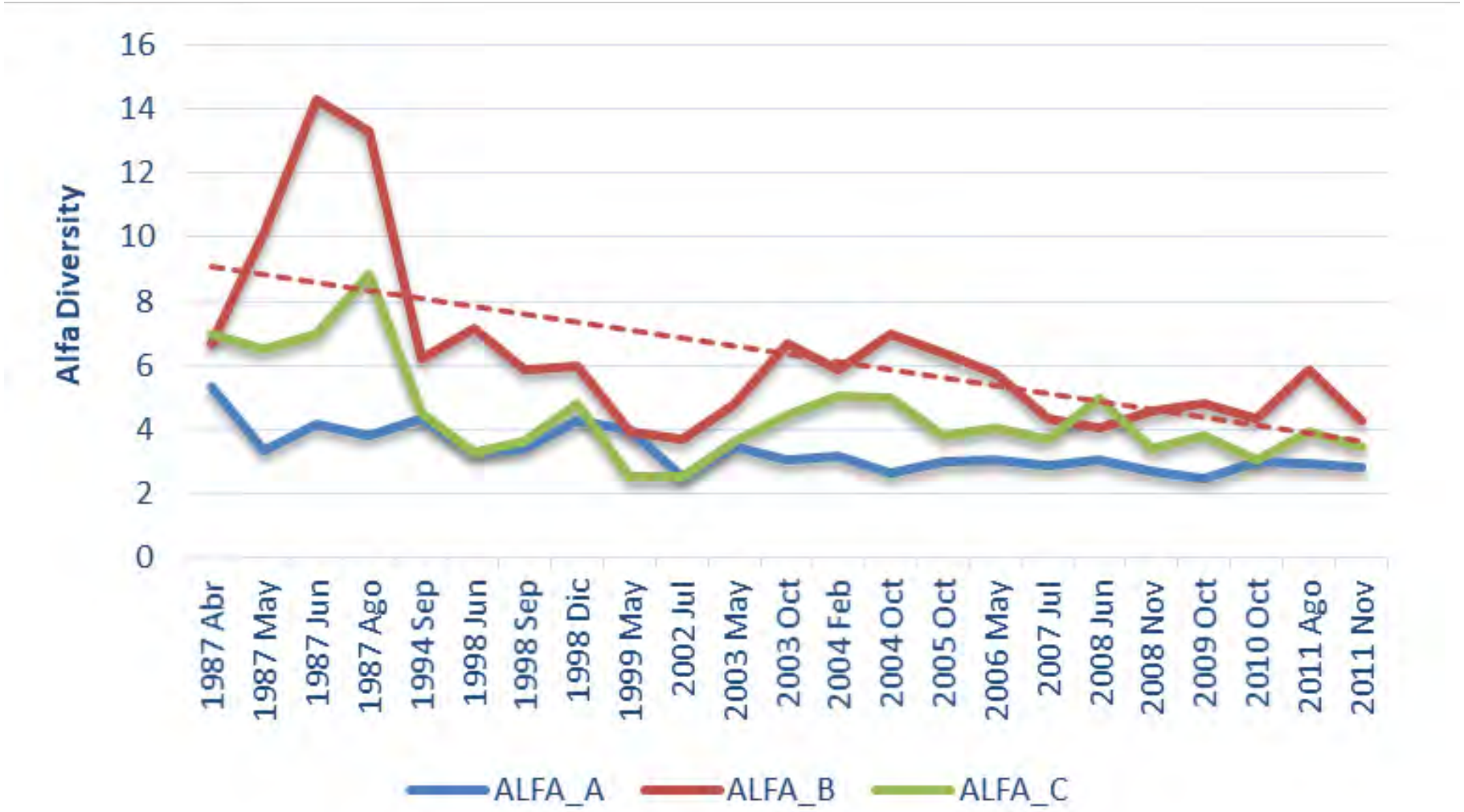


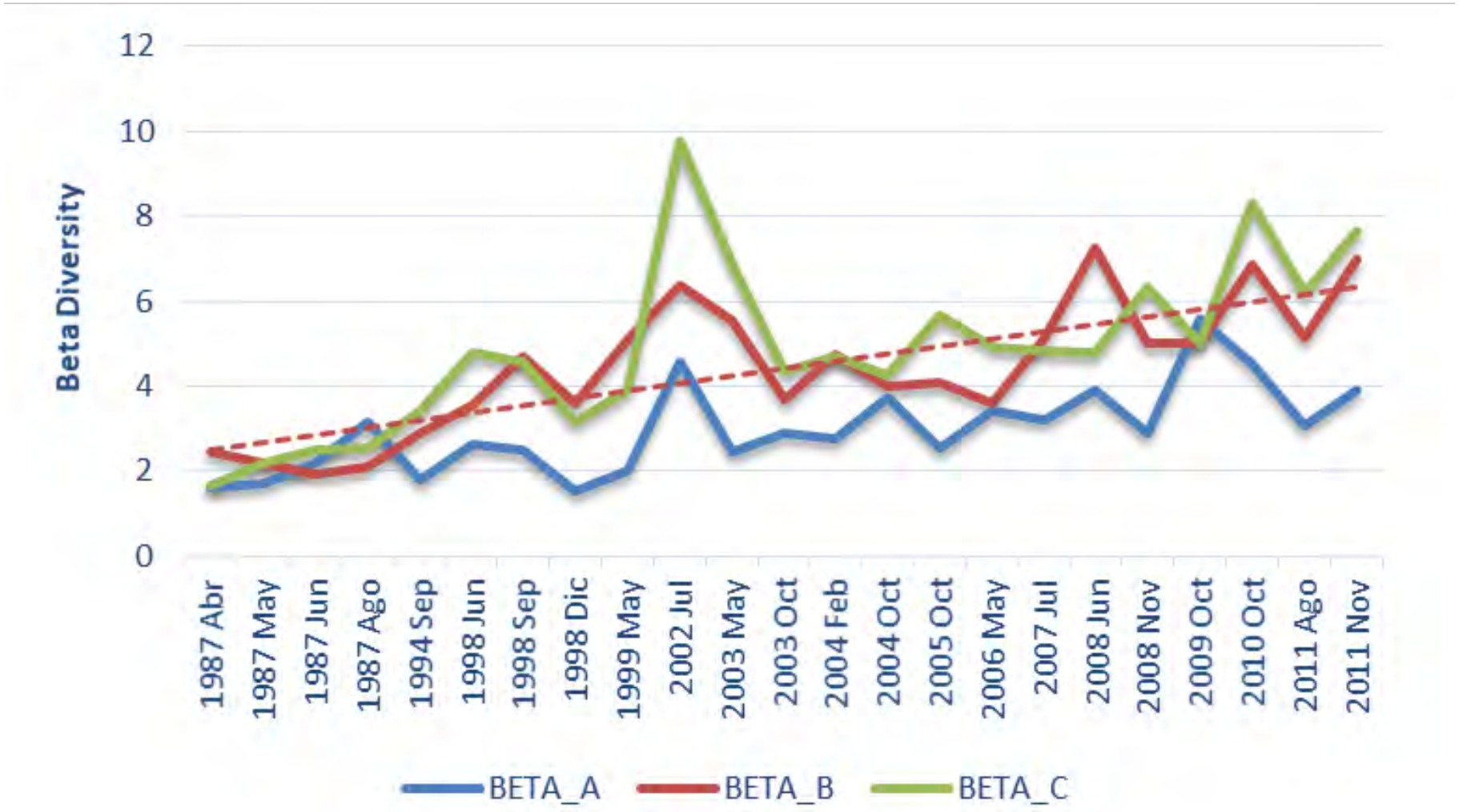


Negative consequences of protection?

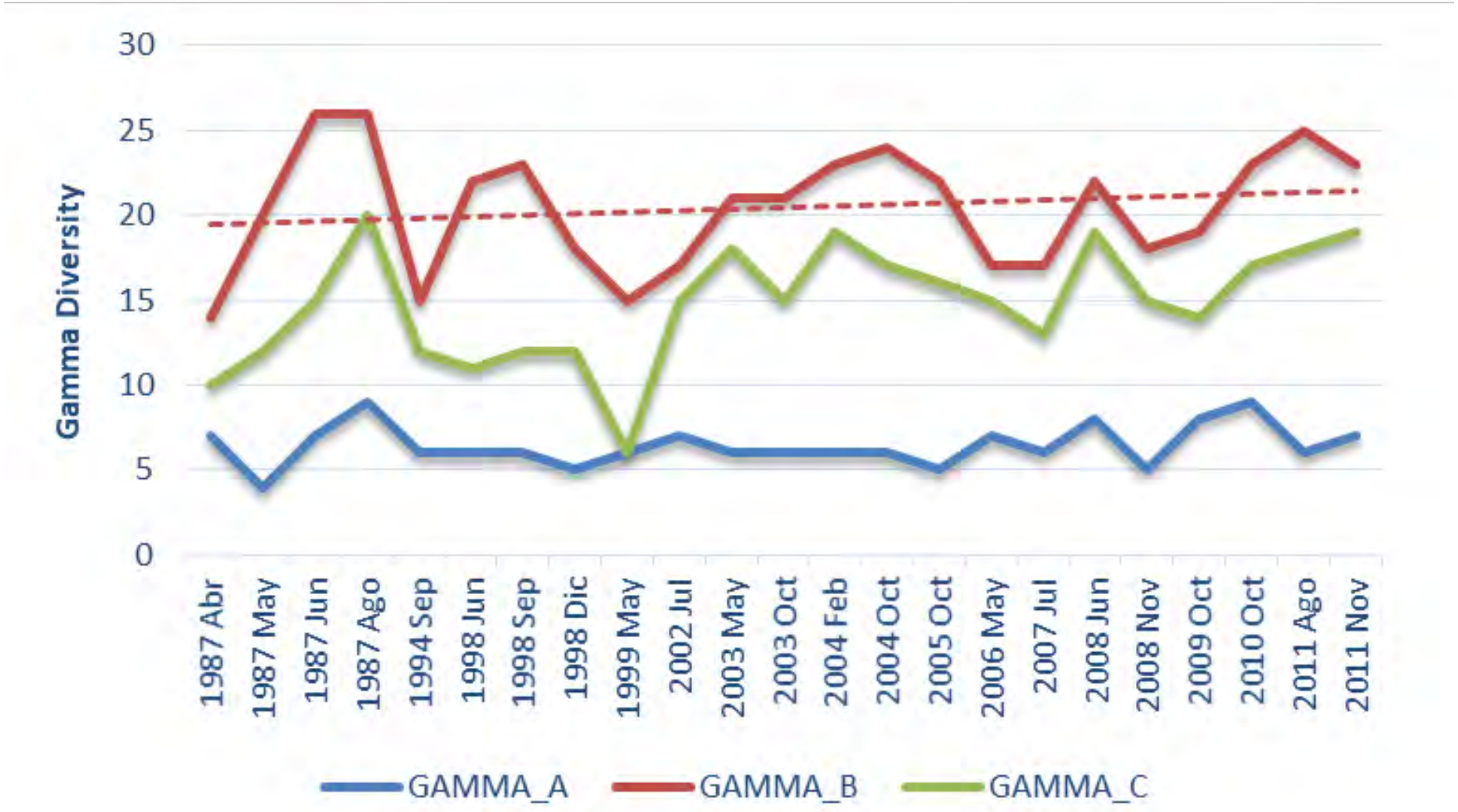
Alfa diversity (habitat)



Beta diversity (between habitats)

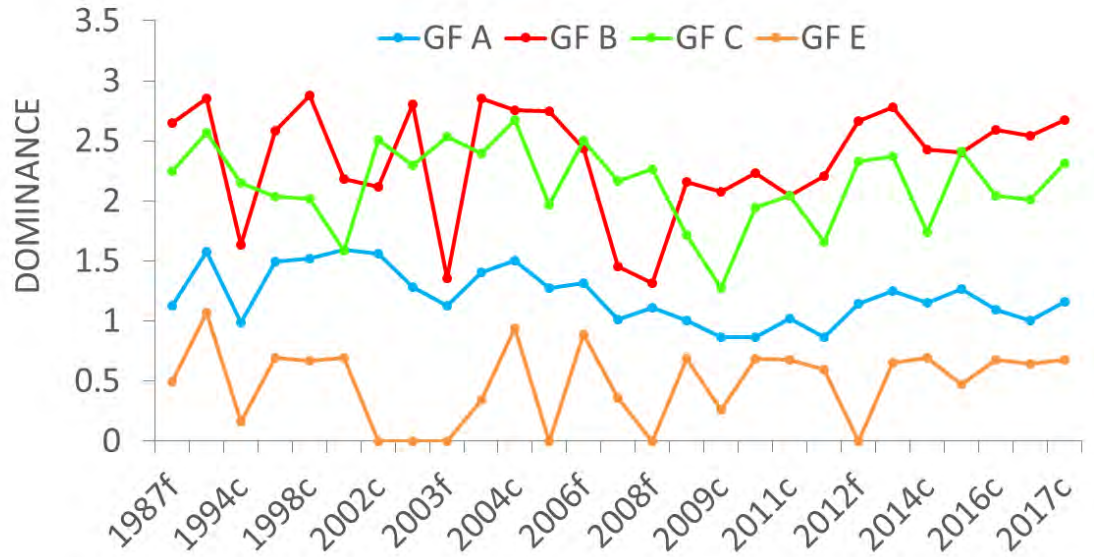


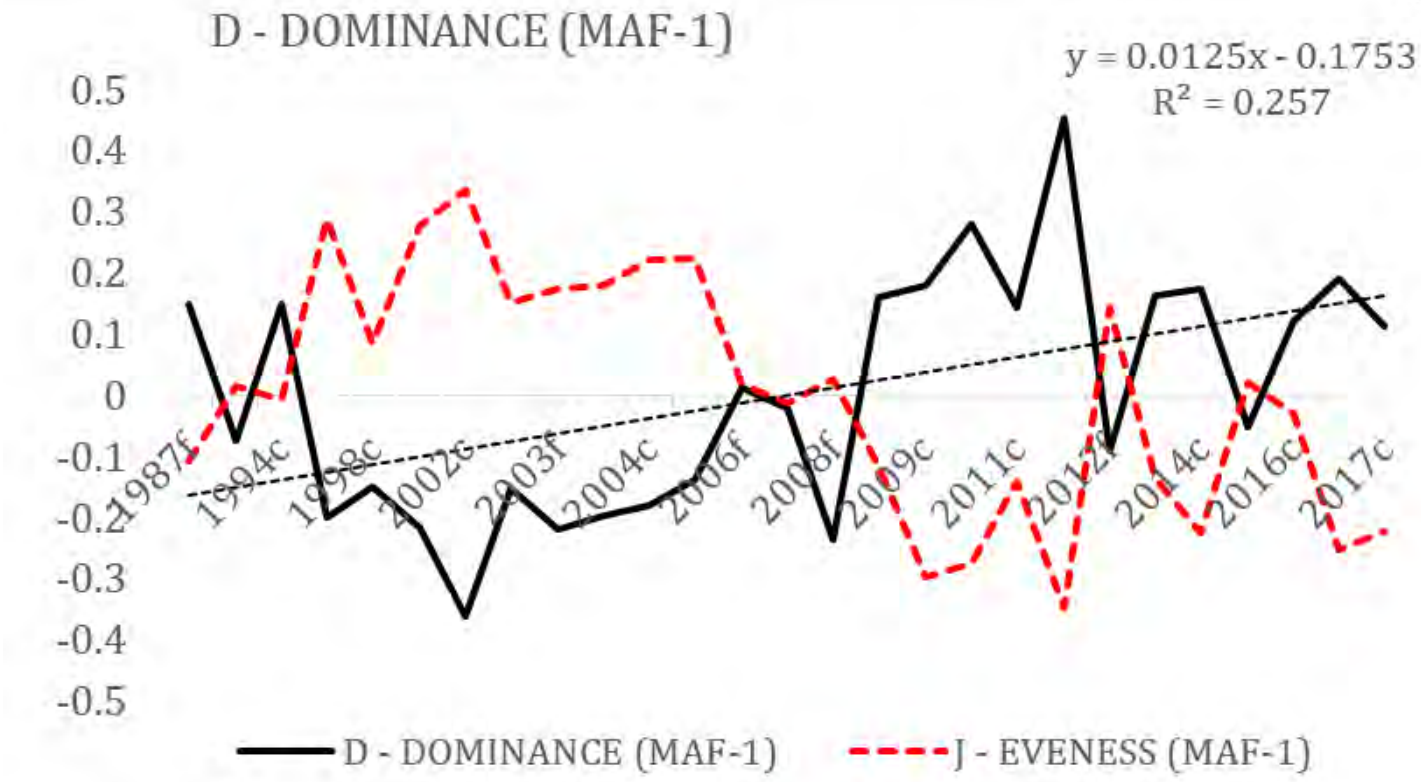
Gamma diversity (regional diversity)



λ - Dominance

Correlations between Y and MAFA	
A	0.820
B	-0.108
C	0.463
E	- 0.396

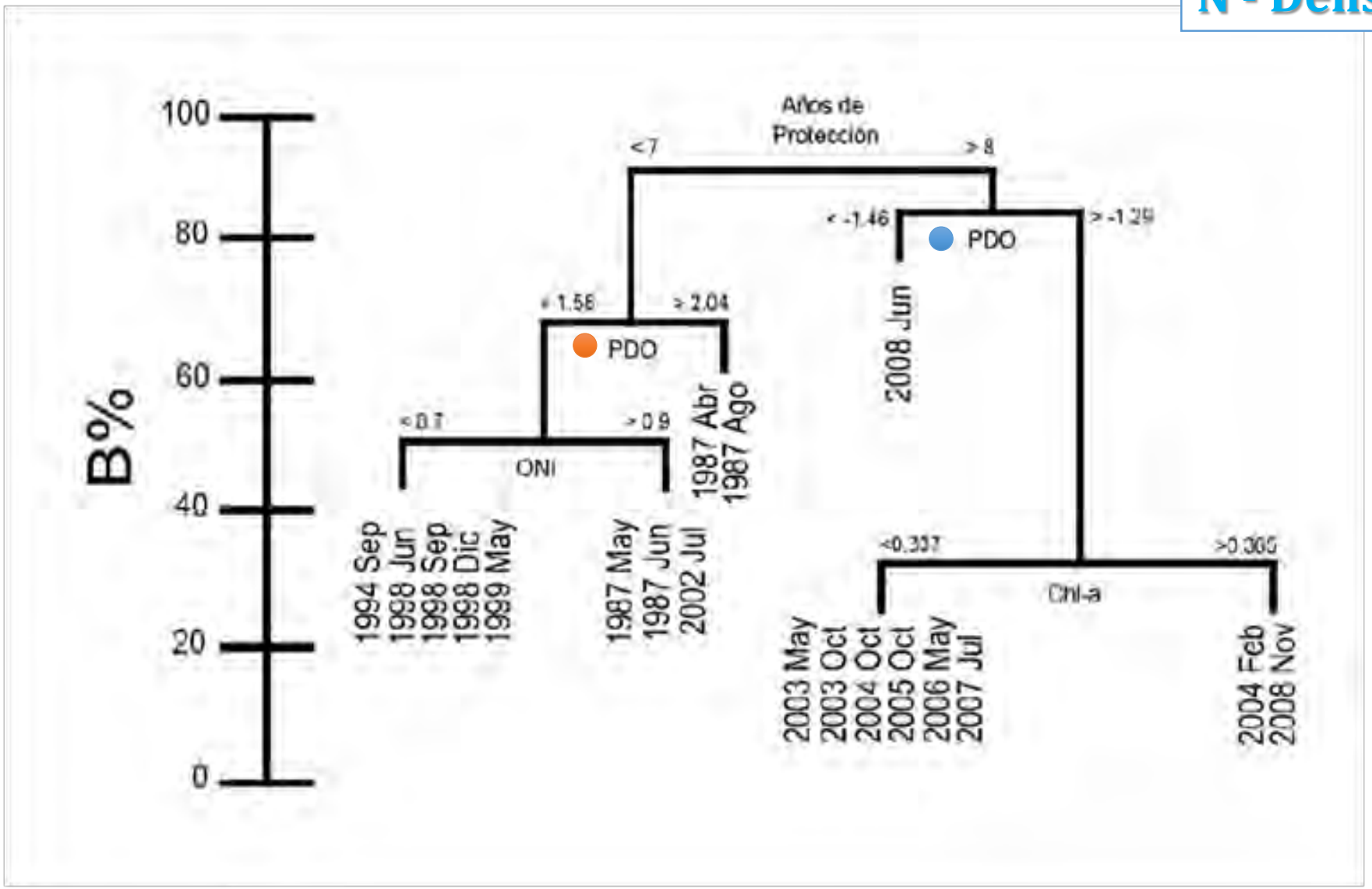




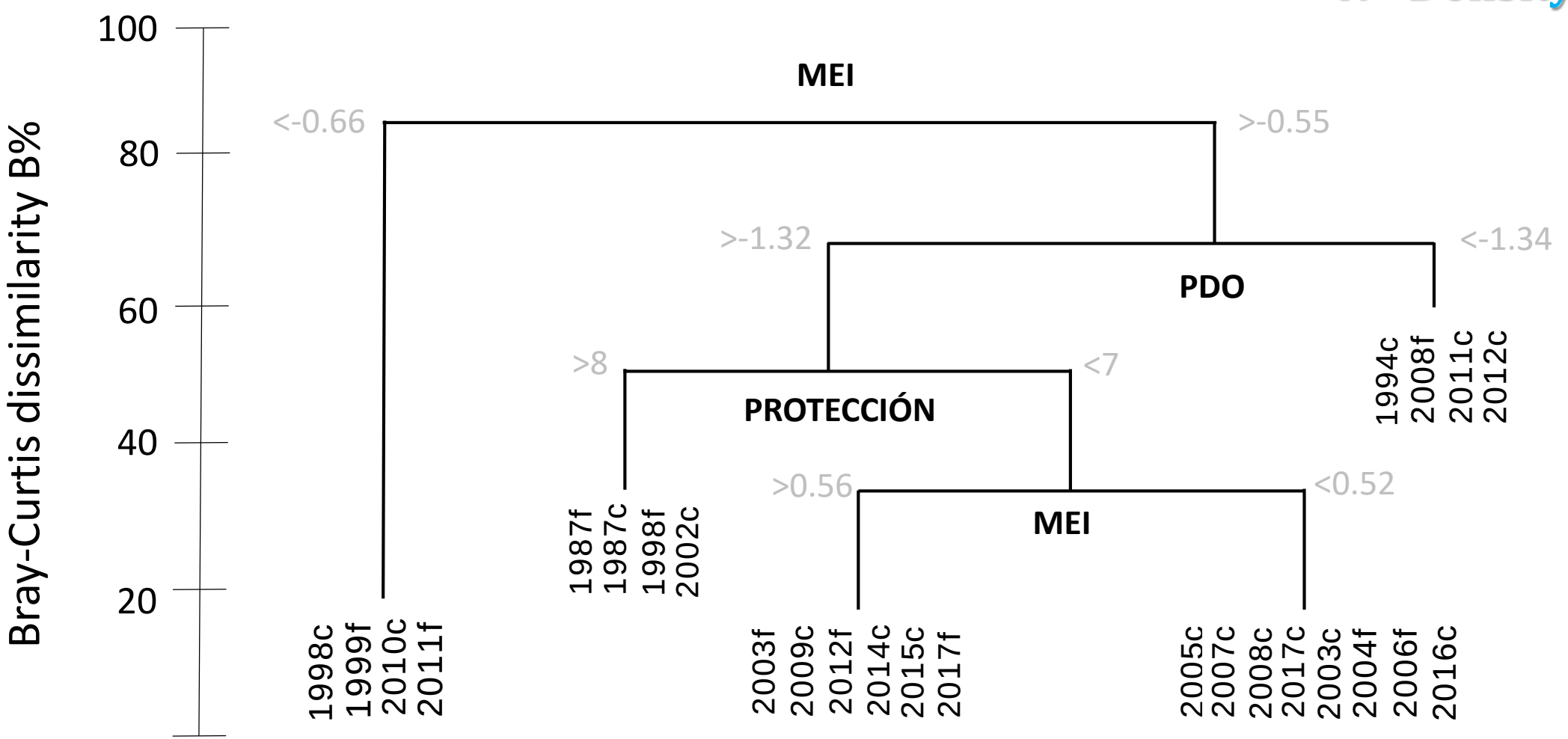
3.- Relationship between environment and ecological indicators?

From older analysis… (1987 – 2008)

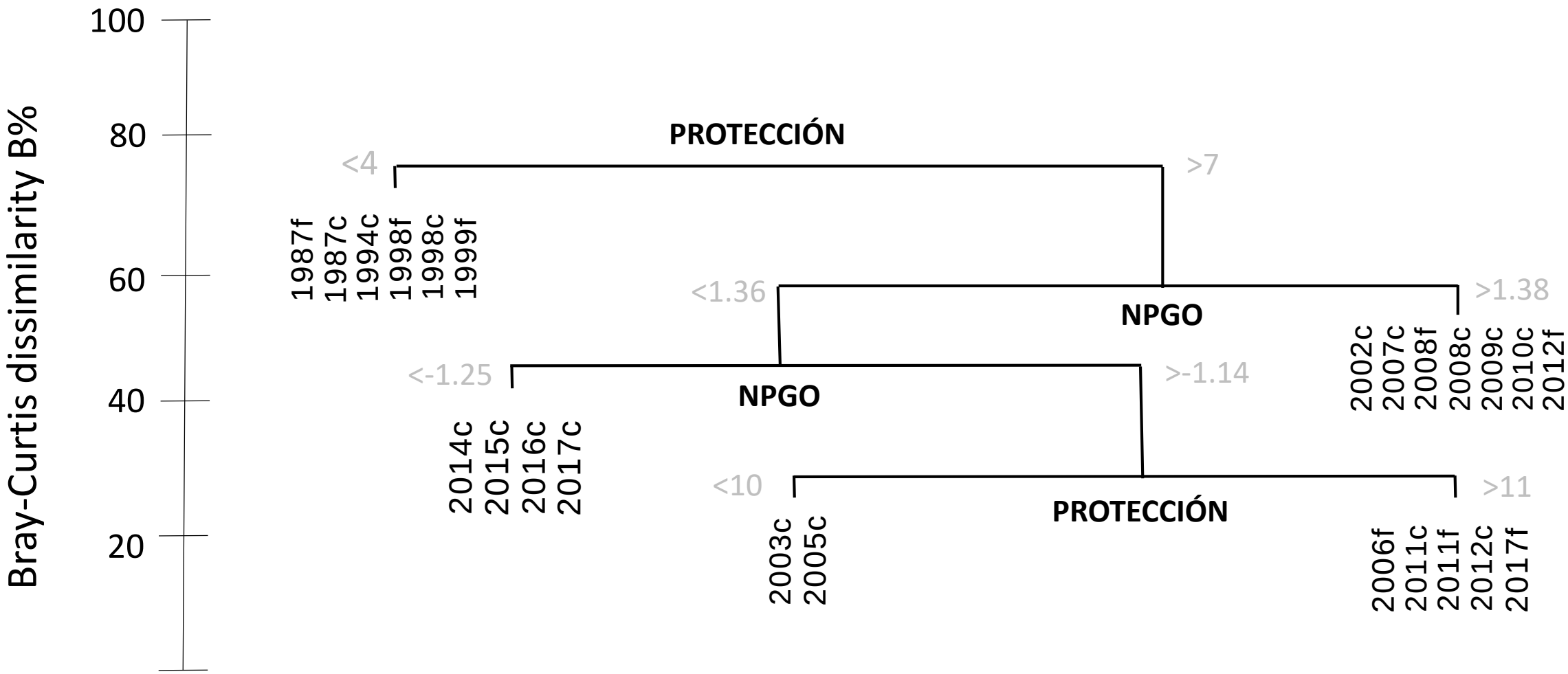
N - Density



N - Density


Bray-Curtis dissimilarity B%
100
80
60
40
20
MEI
<-0.66
>-0.55
>-1.32
<-1.34
PDO
>8
<7
PROTECCIÓN
>0.56
<0.52
MEI
1998c
1999f
2010c
2011f
1987f
1987c
1998f
2002c
2003f
2009c
2012f
2014c
2015c
2017f
1994c
2008f
2011c
2012c
2005c
2007c
2008c
2017c
2003c
2004f
2006f
2016c

S - Richness


Bray-Curtis dissimilarity B%
100
80
60
40
20
PROTECCIÓN
<4
>7
1987f
1987c
1994c
1998f
1998c
1999f
<1.36
>1.38
NPGO
2002c
2007c
2008f
2008c
2009c
2010c
2012f
<-1.25
>-1.14
NPGO
2014c
2015c
2016c
2017c
<10
>11
PROTECCIÓN
2003c
2005c
2006f
2011c
2011f
2012c
2017f

CONCLUSIONS

- **Recovery of commercial species has increased predation events**, regulating competence relationships and naturally dominant species have emerged, decreasing eveness and promoting alfa diversity to decrease.

- **Predators became an additional ítem of heterogenity and complexity** between hábitats, thus pushing beta diversity to increase.

- **The protection seems to start fading its effect** at the community structure level: we probably will see an increasing sincronization of Climate variability with reef-fish community fluctuations.

- Results support the idea about the **positive ecological effects** of A marine protected area into a transitional zone.

- Fluctuating behaviour and autocorrelation content of functional groups (representing diferent community attributes), migth be exploited to develop early warning systems of environmental and ecosystem change.

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