



Long-term climate variability effects on the trophodynamics of a South American temperate estuarine ecosystem

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PICES

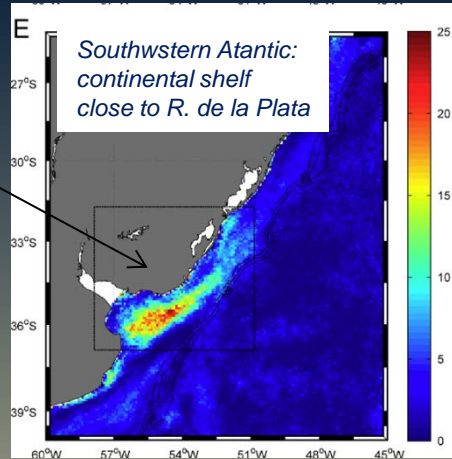


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BACKGROUND

Marine ecosystems are influenced by drivers that operate and interact over multiple scales, resulting in nonlinear or abrupt responses to perturbation (Fu et al., 2012)

Quadri-year cycle related to positive Río de la Plata runoff anomalies influenced by El Niño



source: Garcia & Garcia, 2008

Certain environmental drivers are affecting the dynamics of marine ecosystems at inter-annual time scale, such as ENSO events

Watters et al., 2003

Baltic Sea

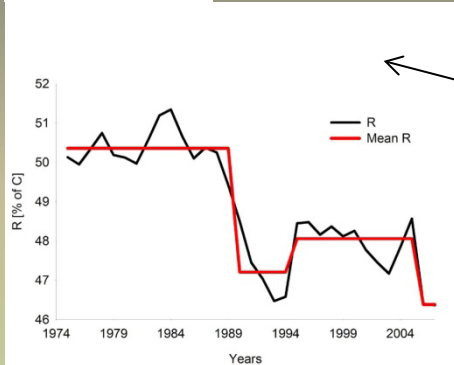
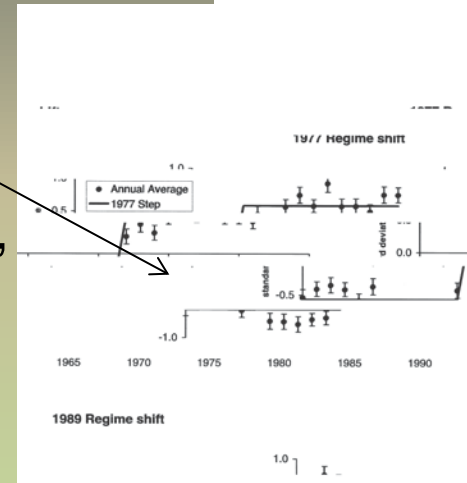


Figure 6. Time dynamics of redundancy (R) as percentage of capacity (C) in black and the red line represents the regime tested by the regime shift analysis for the period 1974–2006. doi:10.1371/journal.pone.0075439.g006

source: Tomczak et al., 2013

Others drivers are acting at inter-decadal time scale, such as regime shifts

North Pacific



source: Hare & Mantua, 2000

BACKGROUND

Previous modeling works

...using static mass balance **ECOPATH** model

Biol Invasions
DOI 10.1007/s10530-011-0023-x

ORIGINAL PAPER

Impacts of two invasive mollusks, *Rapana venosa* (Gastropoda) and *Corbicula fluminea* (Bivalvia), on the food web structure of the Río de la Plata estuary and nearshore oceanic ecosystem

Diego Lercari · Leandro Bergamino

Received: 1 October 2010 / Accepted: 9 May 2011
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2011

...to quantitatively describe the trophic impact of two invertebrates' invasive species in this estuary

Hydrobiologia
DOI 10.1007/s10750-014-1964-8

PRIMARY RESEARCH PAPER

A food web analysis of the Río de la Plata estuary and adjacent shelf ecosystem: trophic structure, biomass flows, and the role of fisheries

Diego Lercari · Sebastian Horta ·
Gastón Martínez · Danilo Calliari ·
Leandro Bergamino

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2014

...to analyze the ecosystem level attributes and the effects of fishing activities

Estuaries and Coasts
DOI 10.1007/s12237-012-9545-4

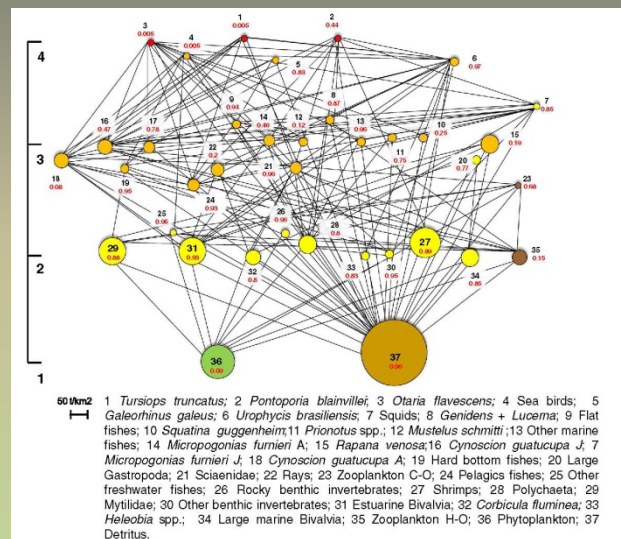
Trophic Impacts of Marine Mammals and Seabirds in the Río de la Plata Estuary and the Nearshore Oceanic Ecosystem

Leandro Bergamino · Diana Szteren · Diego Lercari

Received: 8 September 2011 / Revised: 17 July 2012 / Accepted: 18 July 2012
© Coastal and Estuarine Research Federation 2012

2012

...to examine the trophic role of marine mammals and seabirds in this system



JUSTIFICATION

The temporal ecosystem-level monitoring about the trophodynamics of the Río de la Plata ecosystem have not been evaluated.

GOAL

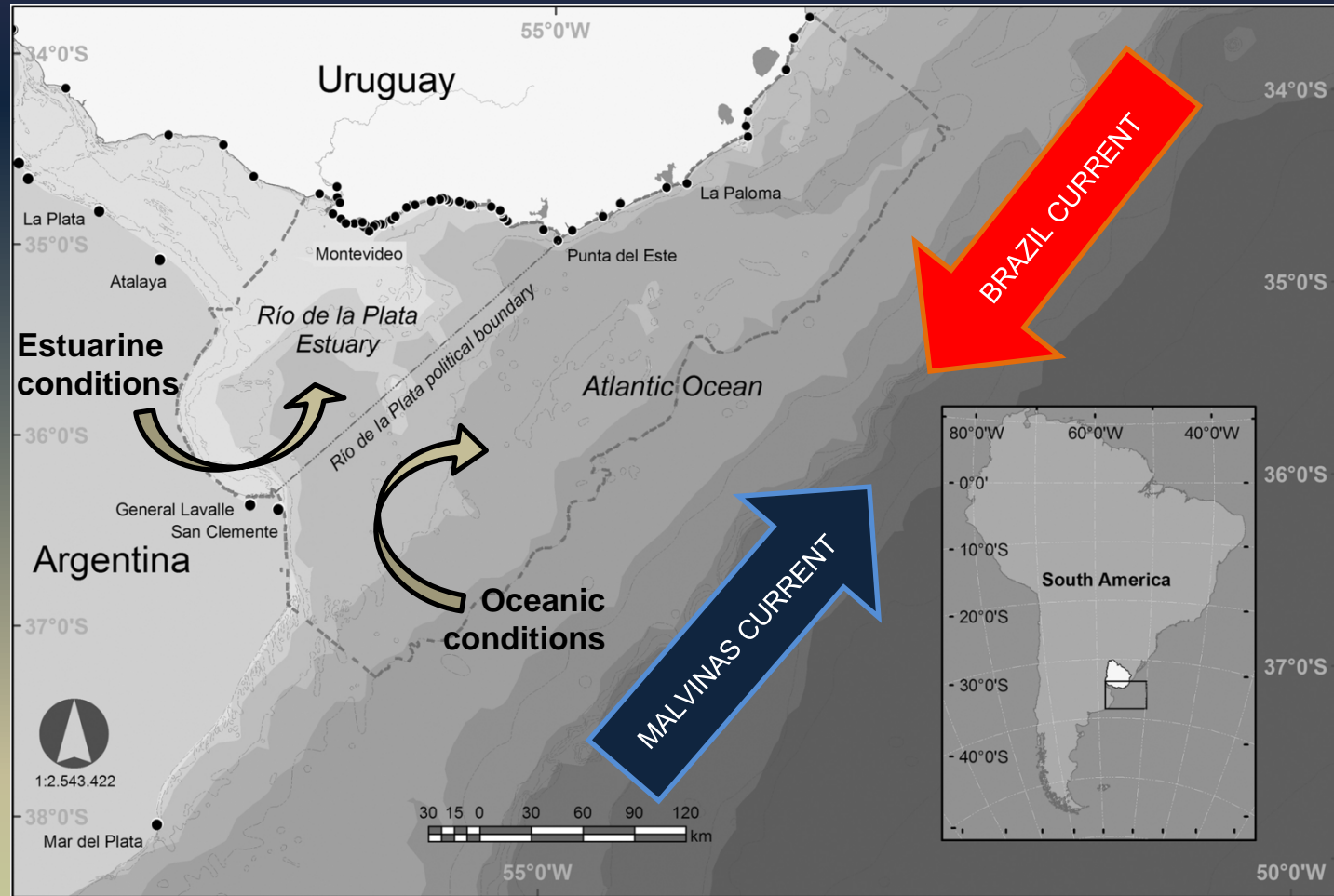
We analyze the long-term fluctuations (60 years: 1948 to 2008) of the functional group's biomass, from primary producers to top predators, assessing their relationship with two physical factors; the Río de la Plata runoff (a local forcing) and the Atlantic Meridional Mode (a regional forcing).

THE ECOSYSTEM...

Río de la Plata estuary and adjacent continental shelf

Modeled area:
70,500 km²

Fisheries:
- Artisanal and Industrial,
with high activity



Main coastal resources:

- Two Scianidae species
- (*Micropogonias furnieri*, *Cynoscion guatucupa*)

Oceanographic dynamics:

- Río de la Plata frontal zone
- Brazil-Malvinas confluence

CALCULATION

ECOSIM: dynamic model

Simulations period: 1948-2008

Forcing factors effects on simulated biomasses and trophic levels

-Hindcast scenarios

-Two forcing factors:
Atlantic Meridional Mode
Río de la Plata runoff

ECOPATH: trophic model

37 FUNCTIONAL GROUPS

- 3 marine mammals
- 1 coastal bird
- 17 fishes
- 12 invertebrates
- 2 zooplankton species
- 1 phytoplankton species
- Detritus
- 4 fishing fleets

on main commercial fish species:
Micropogonias furnieri (whitemouth croaker)
Cynoscion guatucupa (striped weakfish)

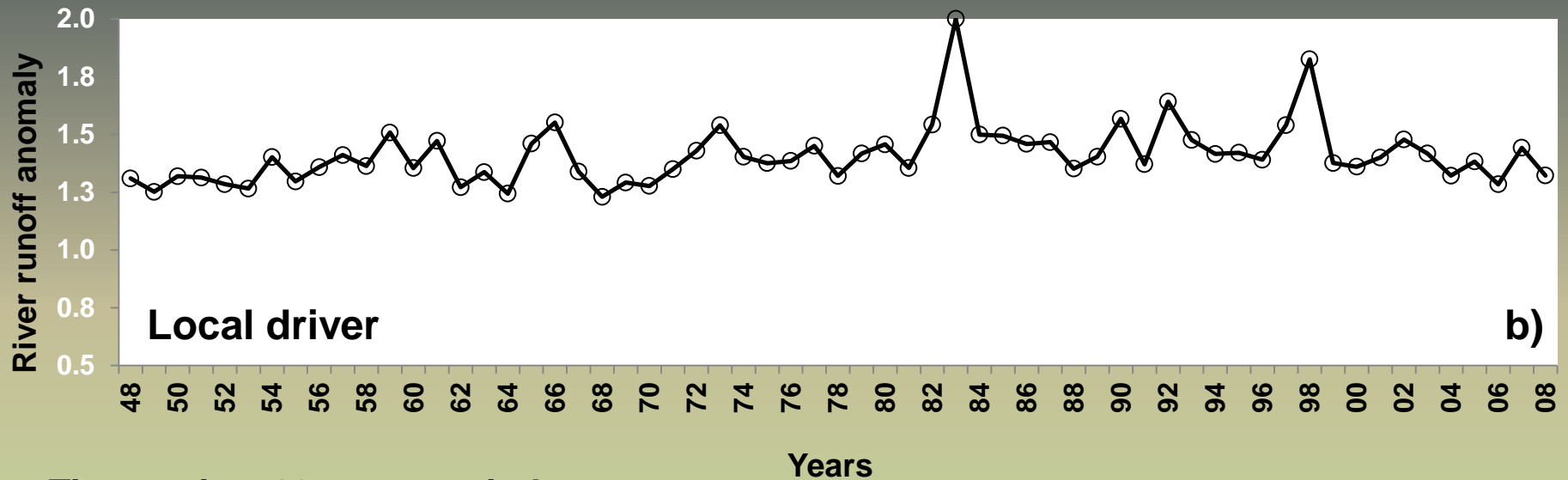
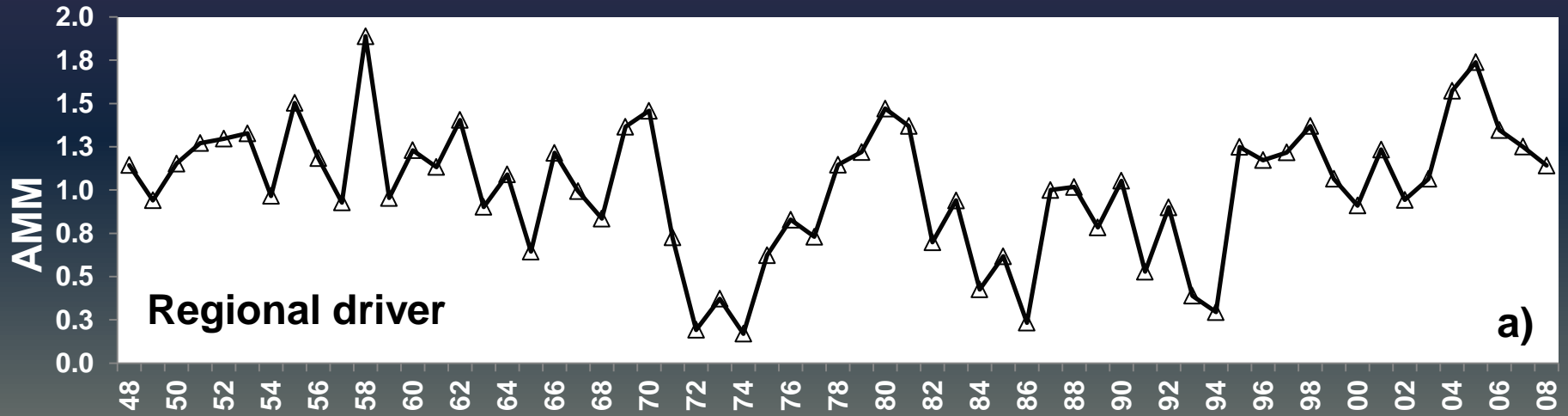
*Trophic web attributes
Ecosystem structure indicators*

-Biomass per trophic level
-Ascendency (A)
-Development Capacity (C)
-Entropy: $1 - (A/C)$

*Fitting the model
and validation*

-Reference biomass time series
vs
-Model predictions

FORCING DRIVERS



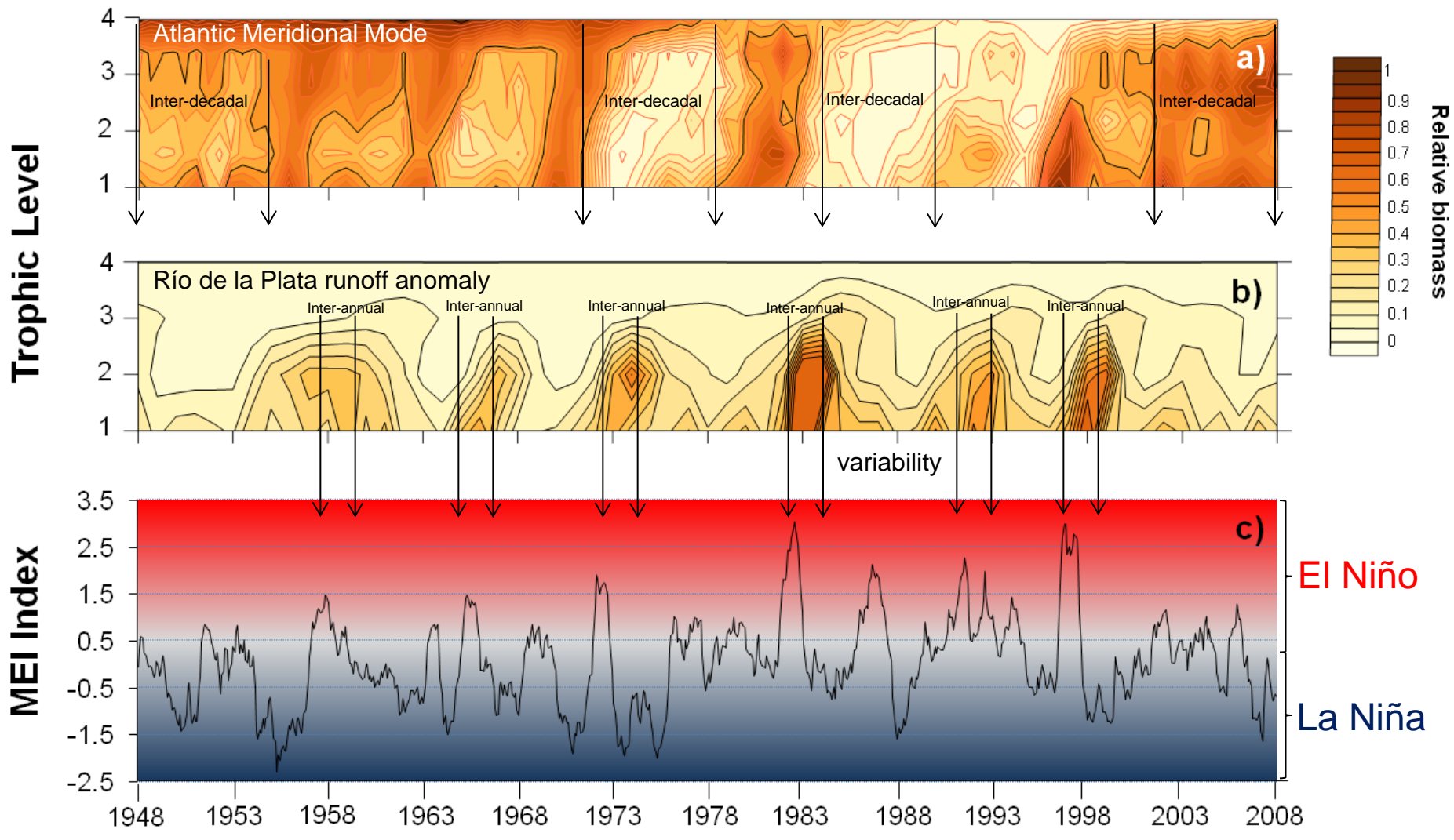
Time series: 60 years period.

(a) Atlantic Meridional Mode index (AMM)

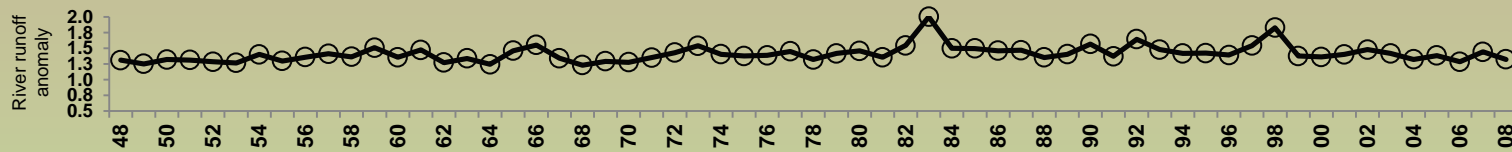
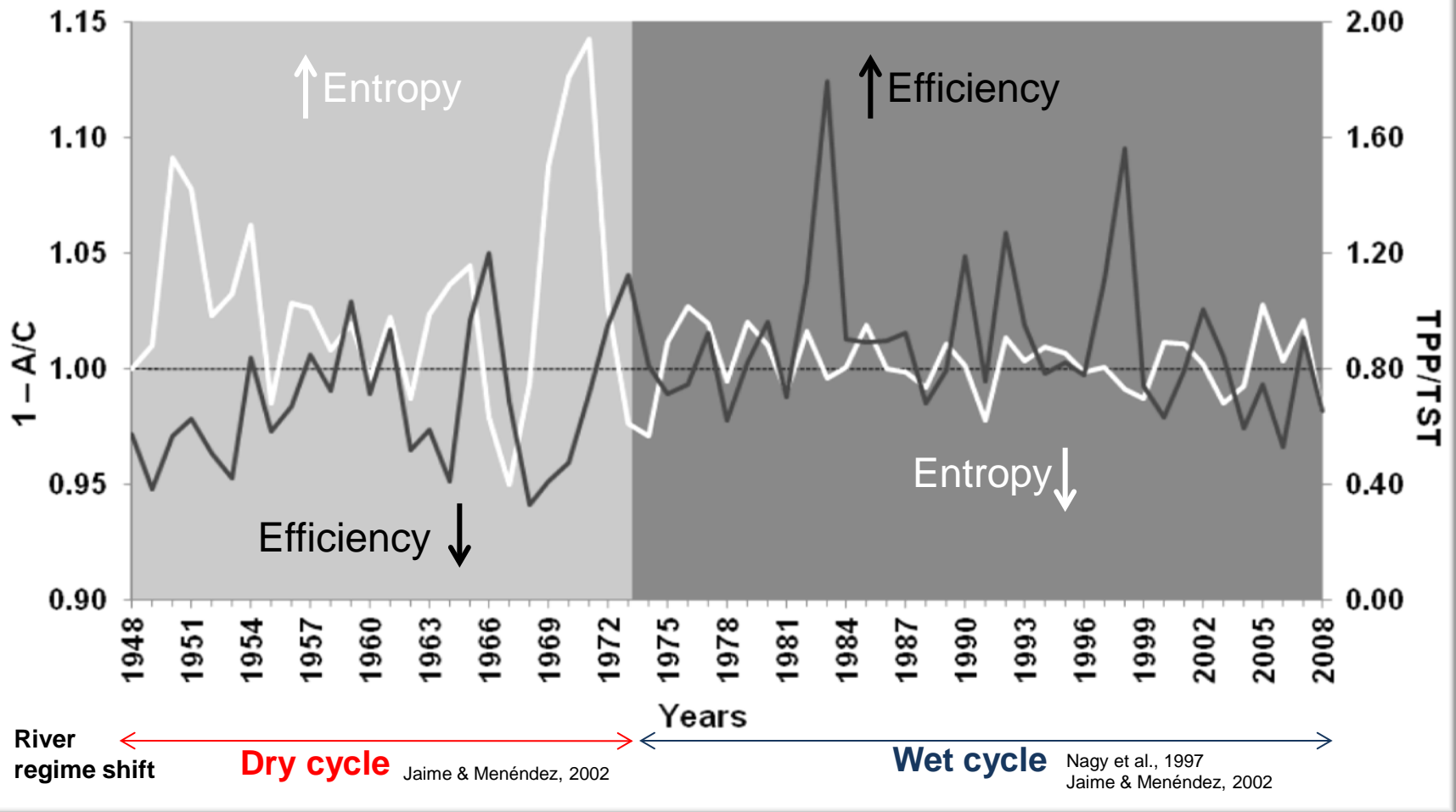
(b) Annual anomaly of Río de la Plata runoff

ECOSIM SIMULATIONS

Forcing drivers effects on relative biomasses and trophic levels



ECOSYSTEM STRUCTURE INDICATORS

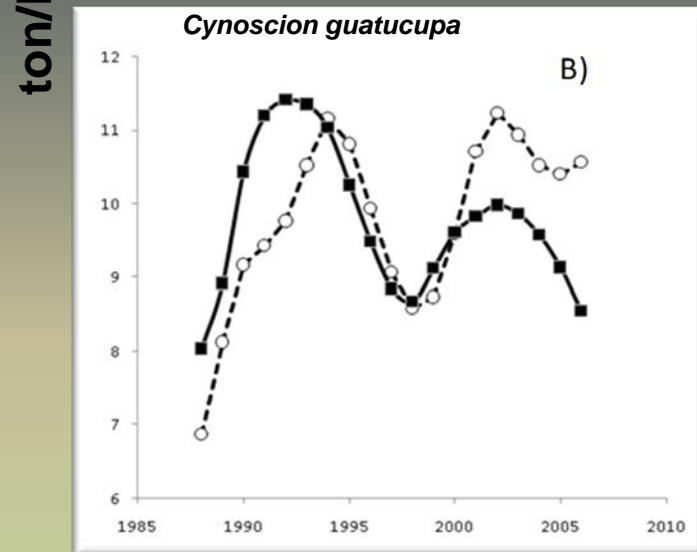
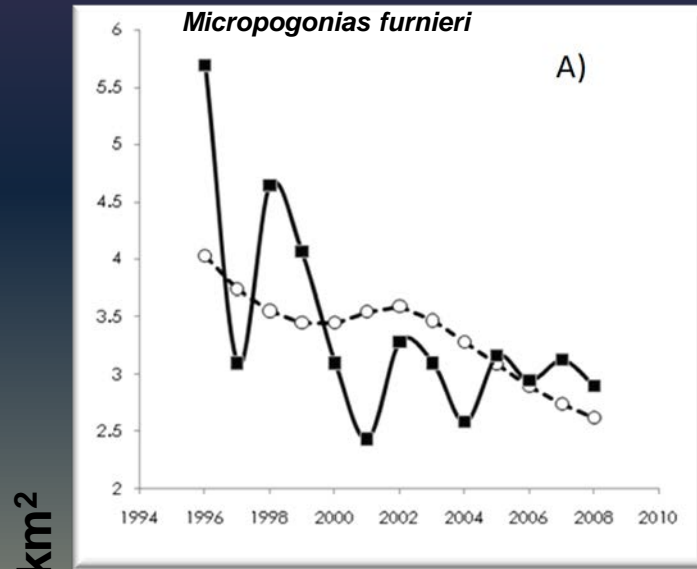


Entropy (white line) and Efficiency (black line) of the Río de la Plata ecosystem, from 1948 to 2008. A: Ascendency. C: Development Capacity. TPP: Total Primary Production. TST: Total System Throughput.

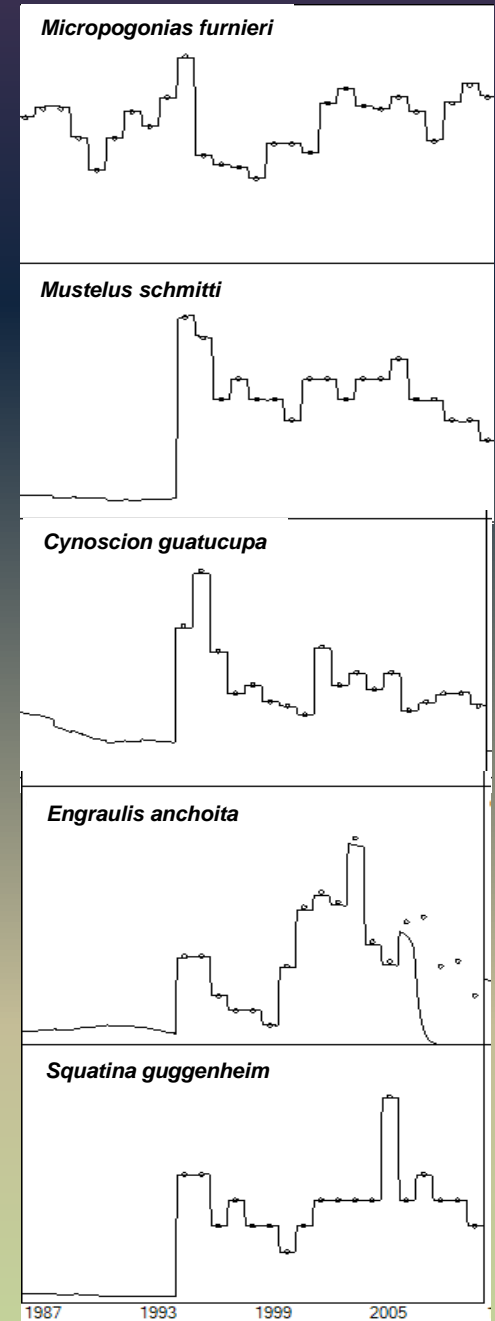
Catches

MODEL VALIDATION

Absolute biomass



Observed values: solid line,
Model estimates: dashed line



CONCLUSIONS

- The temporal ecosystem-level monitoring about the trophodynamics of the Rio de la Plata estuary and adjacent coastal waters ecosystem was established for first time.
- The regional forcing had influenced the ecosystem at decadal and inter-annual scale.
- At decadal scale, the Atlantic Meridional Mode affected from phytoplankton to top predators.
- At inter-annual scale, the Atlantic Meridional Mode affected from primary producers to secondary consumers.

CONCLUSIONS

- The runoff effects were detected at inter-annual scale, influencing from phytoplankton to secondary consumers.
- Occurrence of highest (lowest) effects of the local forcing were coupled with the strongest El Niño (La Niña) events, since 1950 until 2008.
- High system entropy occurred until early '70 decade, with low system efficiency.
- A sustainable loss of system entropy and high efficiency was detected after 1973 until recent years.

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