



Mondego estuary - Impacts of the interruption between north and south arms on the environmental quality

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IMAR-Instituto do Mar (Institute of Marine Research)
INAG - Sessão Técnica "A Eutrofização em Sistemas Aquáticos" - 29 de Junho de 2006

Foto: J.M.Neto



Involvement



IMAR – Instituto do Mar



INAG – Instituto Nacional da Água

Aim:

to report anthropogenic impacts (interruption between north-south arms) on the environmental quality (physico-chemical and biological elements) of the Mondego estuary.

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Mondego Estuary Analysis

System evaluation according to the principal environmental components:

- Water quality;
- Benthic communities evolution;
- Macrophyte beds (*Zostera noltii*).

Link the evolution of environmental components with the morphological changes occurred on the system.

Information sources:

IMAR research activities since 1985;
INAG-IMAR cooperation since 2003;
Aerial photography analysis.

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Worldwide Scenario

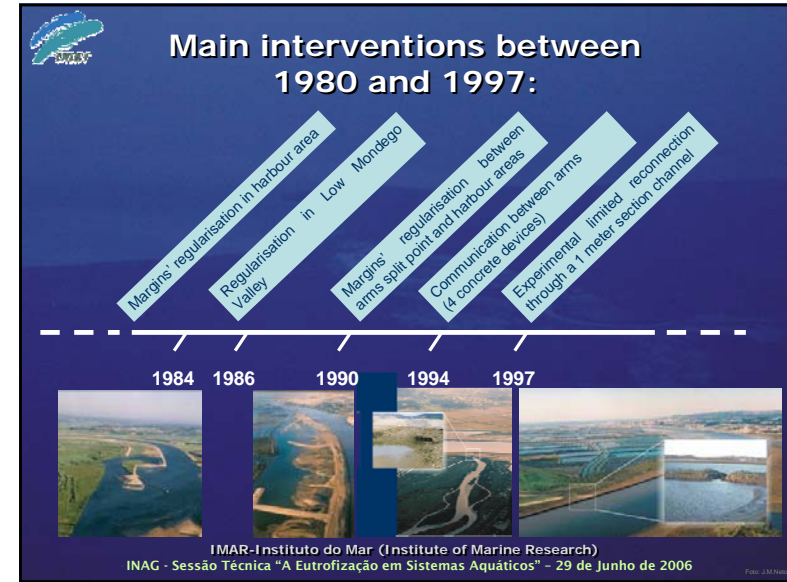
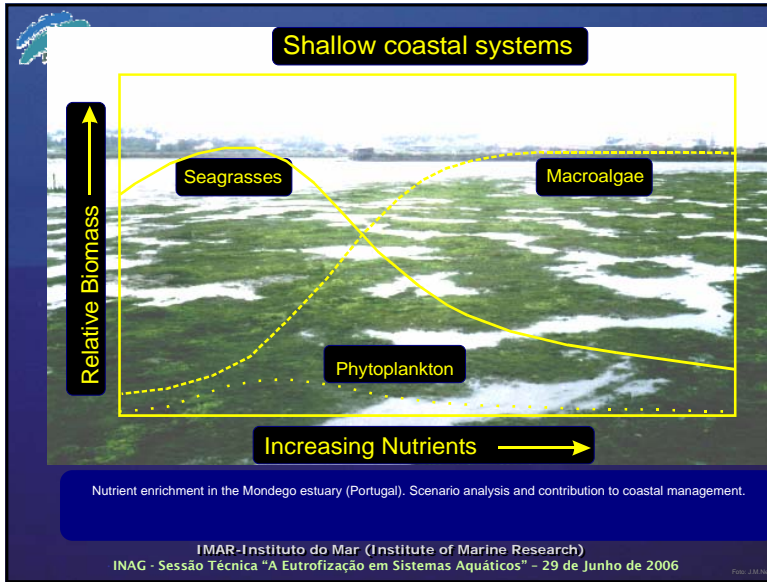
Eutrophication processes observed in coastal and transitional waters are mainly due to increase of nutrient loadings into these systems;

The main symptom of eutrophication is the shift of primary producers, replacement of rooted plants (e.g. *Zostera* sp.) and slow growth macroalgae (e.g. *Fucus* sp.) by opportunistic fast growth macroalgae (e.g. *Ulva* sp.) and phytoplankton;

Loss of these aquatic meadows also leads to changes in associated biological communities and to shifts on important functions, services and materials that rooted plants supply to the surrounding environment.

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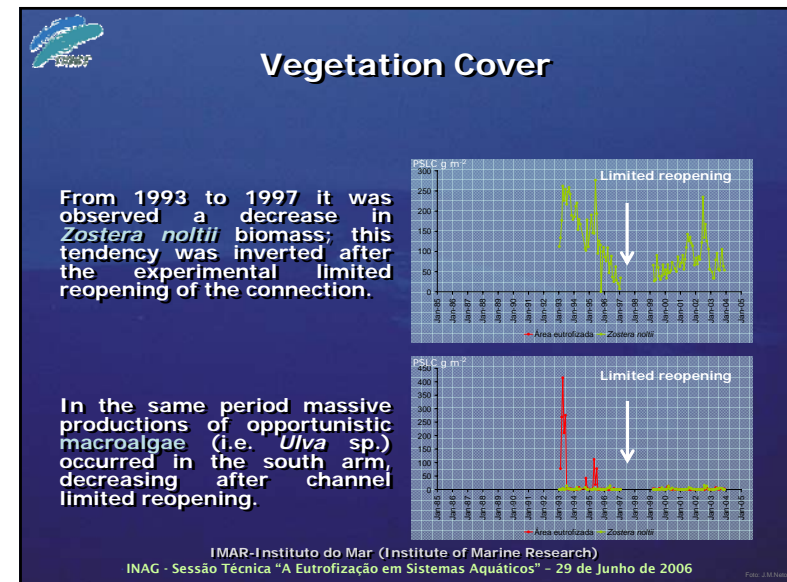
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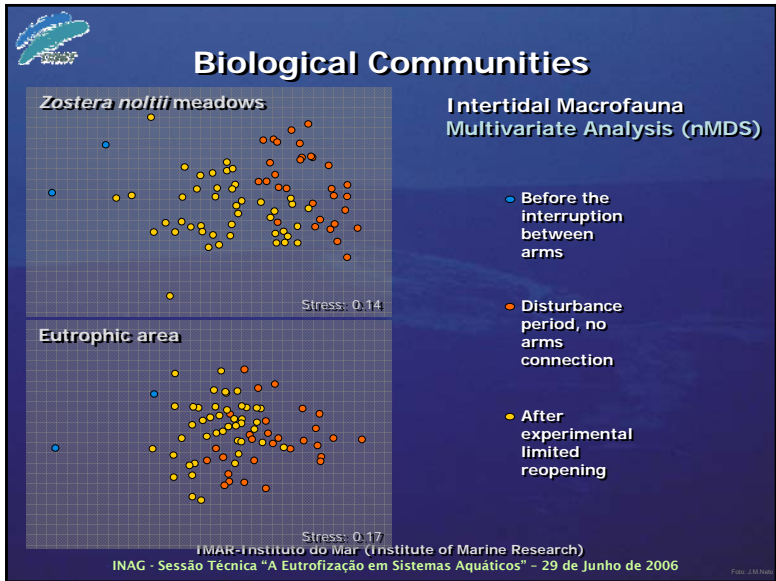
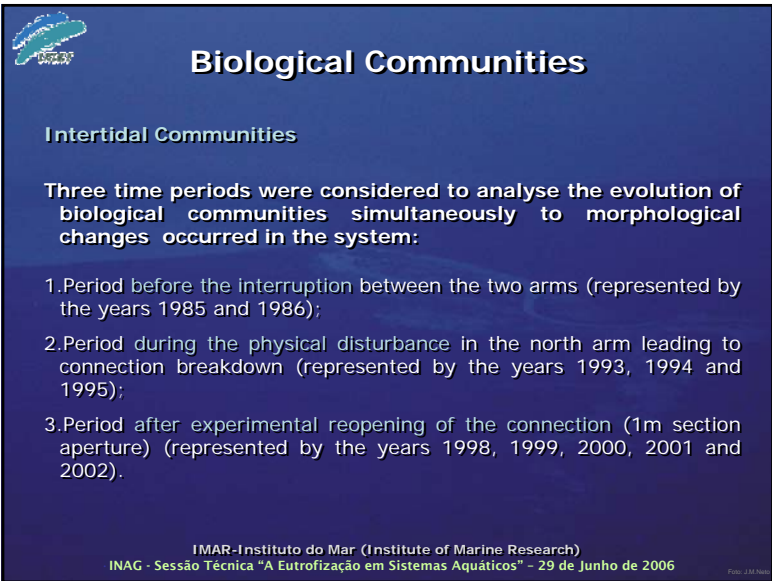
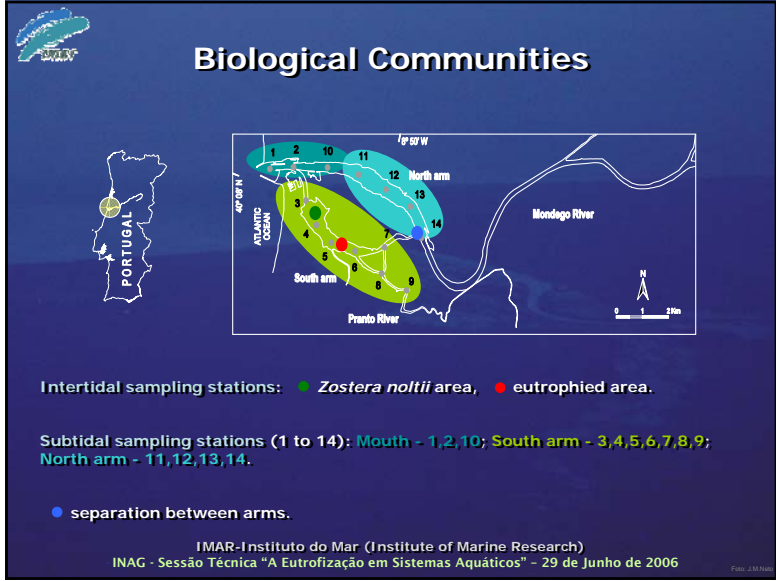
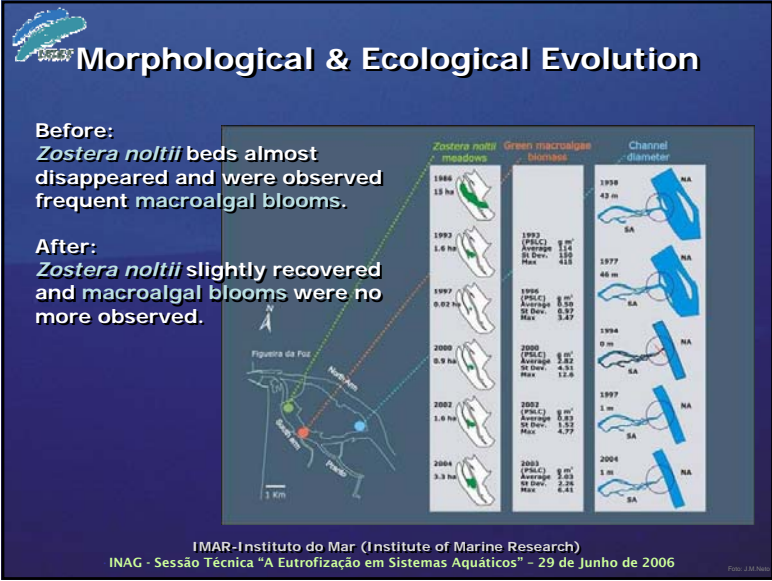


Water Quality

	Water column			Sediment
	NH ₄ ⁺	PO ₄ ⁻	NO ₃ ⁻	O.M.
Intertidal	Decreased after experimental limited reopening in 1997.	Increased after limited reopening until nowadays.	No significant variations were observed during study period.	Higher percentage during interruption period.
Subtidal	---	Higher values in bottom waters during interruption period.	No significant variations were observed during study period.	Increased in south arm upstream areas during interruption period.

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Biological Communities

Intertidal Macrofauna Conclusions

The interruption between both arms had negative effects at different levels:

Zostera noltii meadows declined;

Macrofaunal community structure changed, with an expressive increase of opportunistic species;

The experimental limited reopening improved the ecological status of the system:

Zostera noltii meadows is recovering;

Macrofaunal community is improving, getting closer to late 80' structure, but still distinct from the initial undisturbed situation.

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Biological Communities

Subtidal Communities

Two time periods were considered to analyse the evolution of biological communities simultaneously to morphological changes occurred in the system:

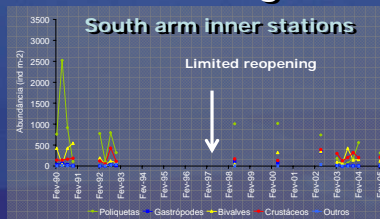
1. Period during the physical disturbance in the north arm leading to connection breakdown (represented by the years 1990 and 1992);
2. Period after experimental reopening of the connection (1m section aperture) (represented by the years 1998, 2000, 2002, 2003, 2004 and 2005).

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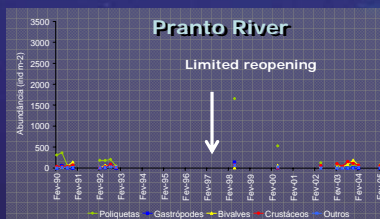
Biological Communities



Subtidal Macrofauna Taxonomic groups

Taxonomic groups substitution after experimental limited reopening in the inner parts of the estuary (stations 5-9):

1. Polychaeta decreased;
2. Abundance recovery of some sensitive species.



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Subtidal Macrofauna Ecological Quality Status (WFD)

Benthic Invertebrates Transitional and Coastal waters:

1. Specific composition;
2. Abundance;
3. Presence/absence of sensitive species or species indicators of pollution.

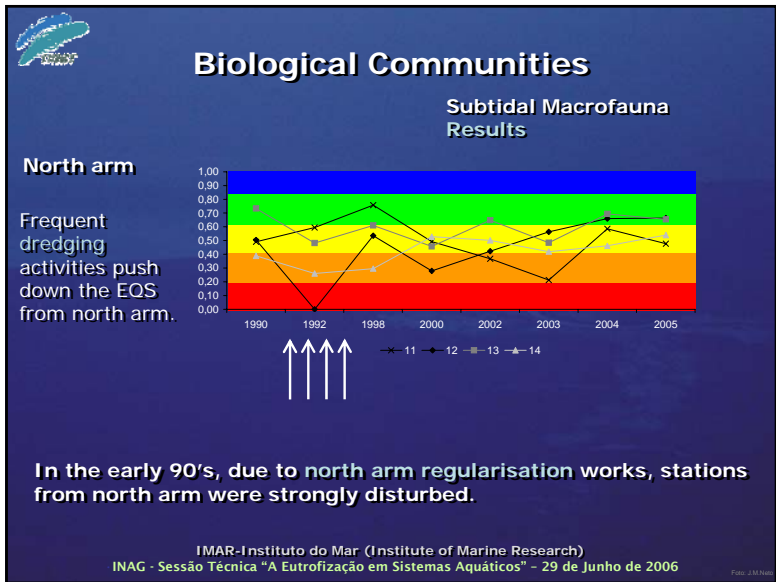
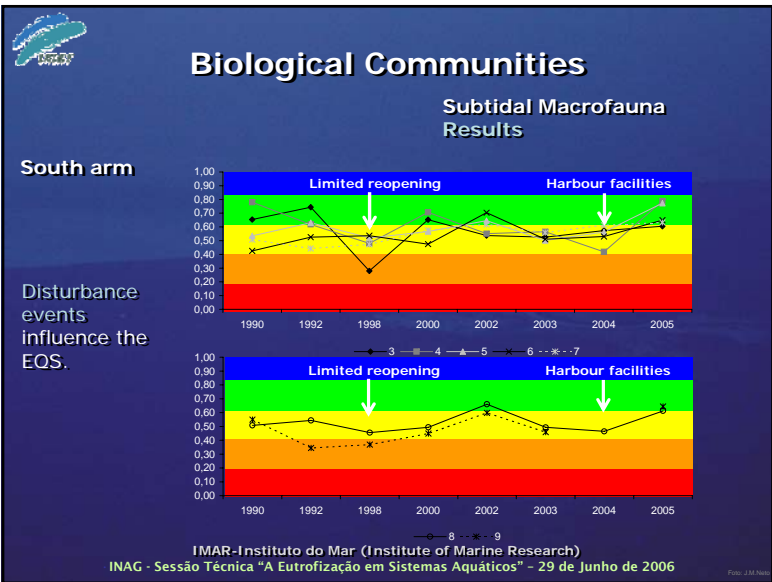
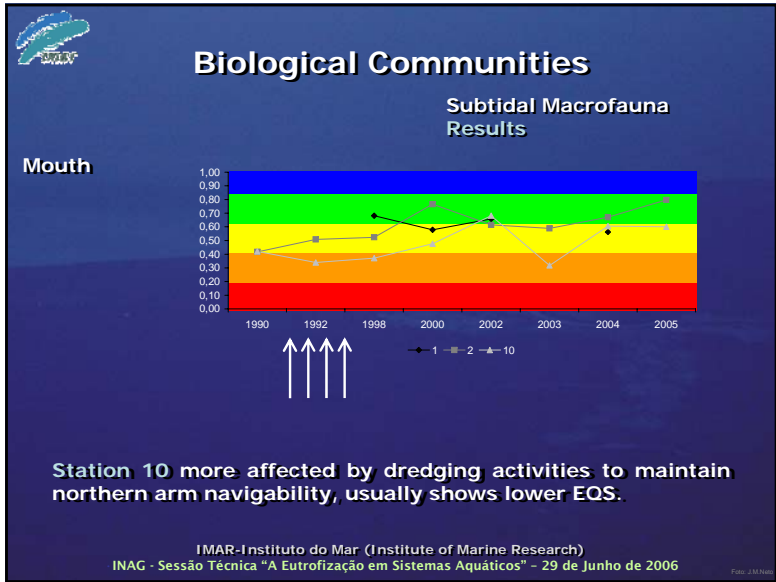
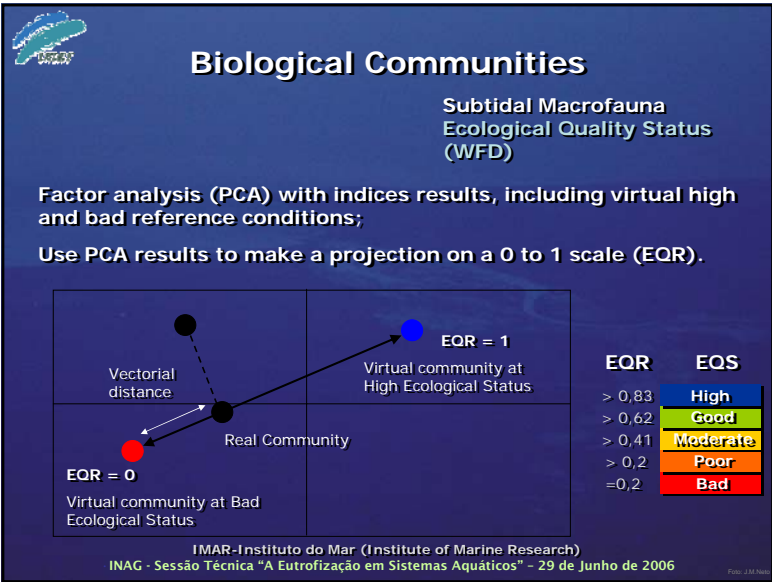
Margalef: $D = (S-1) / \log_2 N$

Shannon-Wiener: $H' = -\sum p_i \log_2 p_i$

AMBI (Marine Biotic Index): $AMBI = \frac{(0\%GI) + (1,5\%GII) + (3\%GIII) + (4,5\%GIV) + (6\%GV)}{100}$

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Biological Communities

Subtidal macrofauna Conclusions

Subtidal diversity was higher in River Mouth and in Southern Arm downstream areas;

During the 1990-2005 period, the lowest diversity was found in South Arm inner areas;

Although Polychaetes were the dominant group in all areas, since 2003 their abundance decreased in the south arm, being replaced by Crustacean and Bivalves;

Methodology used to determine EQS (based on subtidal macrobenthic communities) reflects the disturbance events occurred at the system, pressing down the ecological status for those periods.

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General Conclusions

Environmental conditions degraded during disturbance periods, with nutrients increase, shift of primary producers, and changes on macrofaunal communities' structure with occurrence of opportunistic species.

Experimental limited reopening reduced south arm residence time, leading immediately to improvements in physico-chemical parameters, and reduction of green macroalgal blooms (frequency and magnitude).

Long term effects were the increase of *Zostera noltii* meadows; reduction of opportunistic macrobenthic species (intertidal and subtidal areas), with community structure getting closer to the late 80' situation, reflecting the new conditions.

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Comments and Suggestions

The analysed information clearly showed that south arm ecological condition declined with the connection cut off;

After experimental limited reopening (1 m section channel), the environmental conditions improved;

These results support the suggestion that a connection enlargement could lead to a further ecological status improvement in the southern arm area.

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