



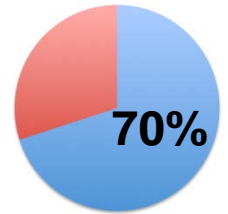
# La salute dell'oceano: la parola alla scienza

**Paolo Domenici**

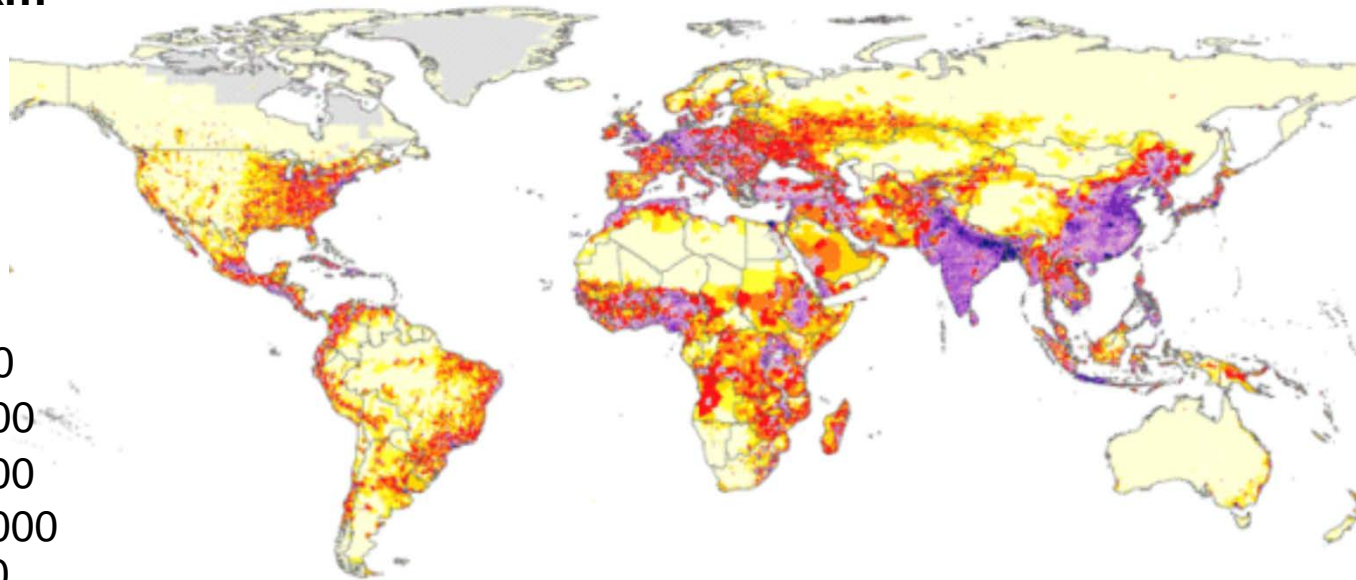
Institute for Coastal Marine Environment (IAMC)  
CNR, Oristano, Italy

# L'importanza degli oceani

•70% of cities with populations over eight million are located on coasts



Persons / Km<sup>2</sup>



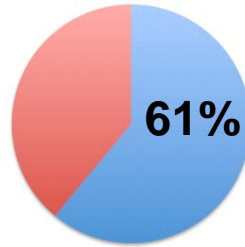
**Global population density estimates, 2015**

- 38% of the global human population lives along a narrow strip of coastal land (*constituting only 7.6% of the Earth's total land area*)

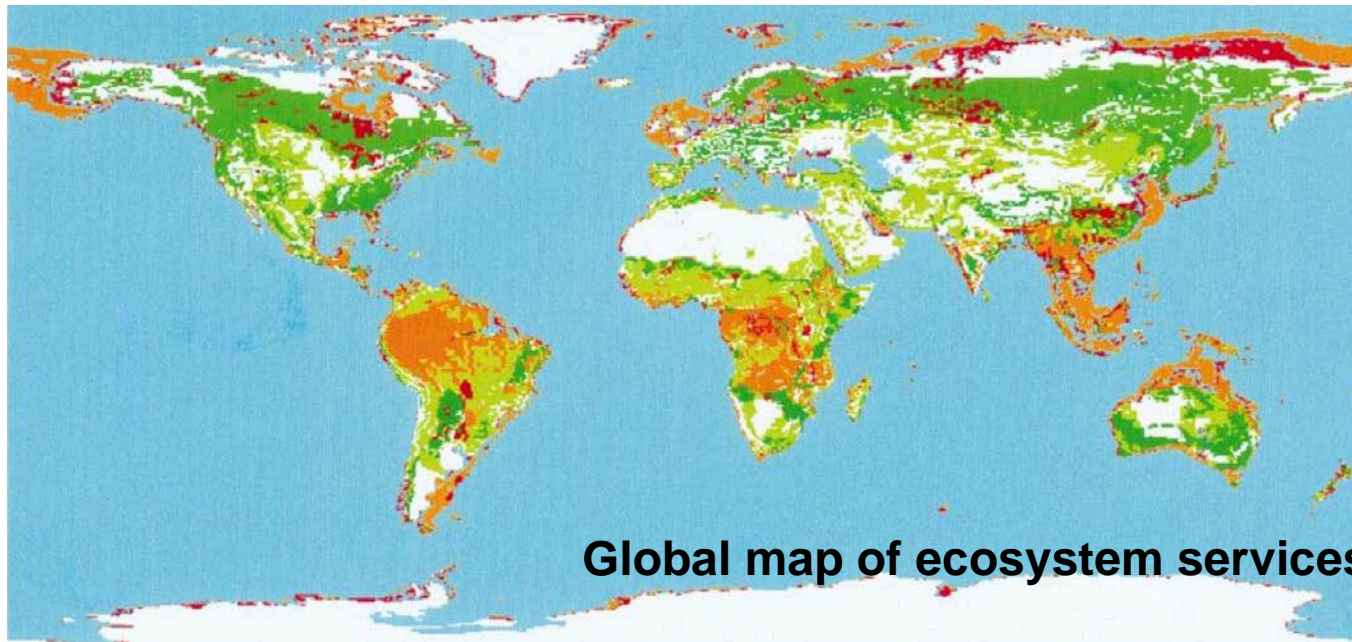
(Based on FAO WK 24; FAO & CIESIN)

# L'importanza degli oceani

61% of the world's total economic output comes from areas within 100 km of the coast



The oceans represent the 7<sup>th</sup> largest economy in the world.



**Global map of ecosystem services**

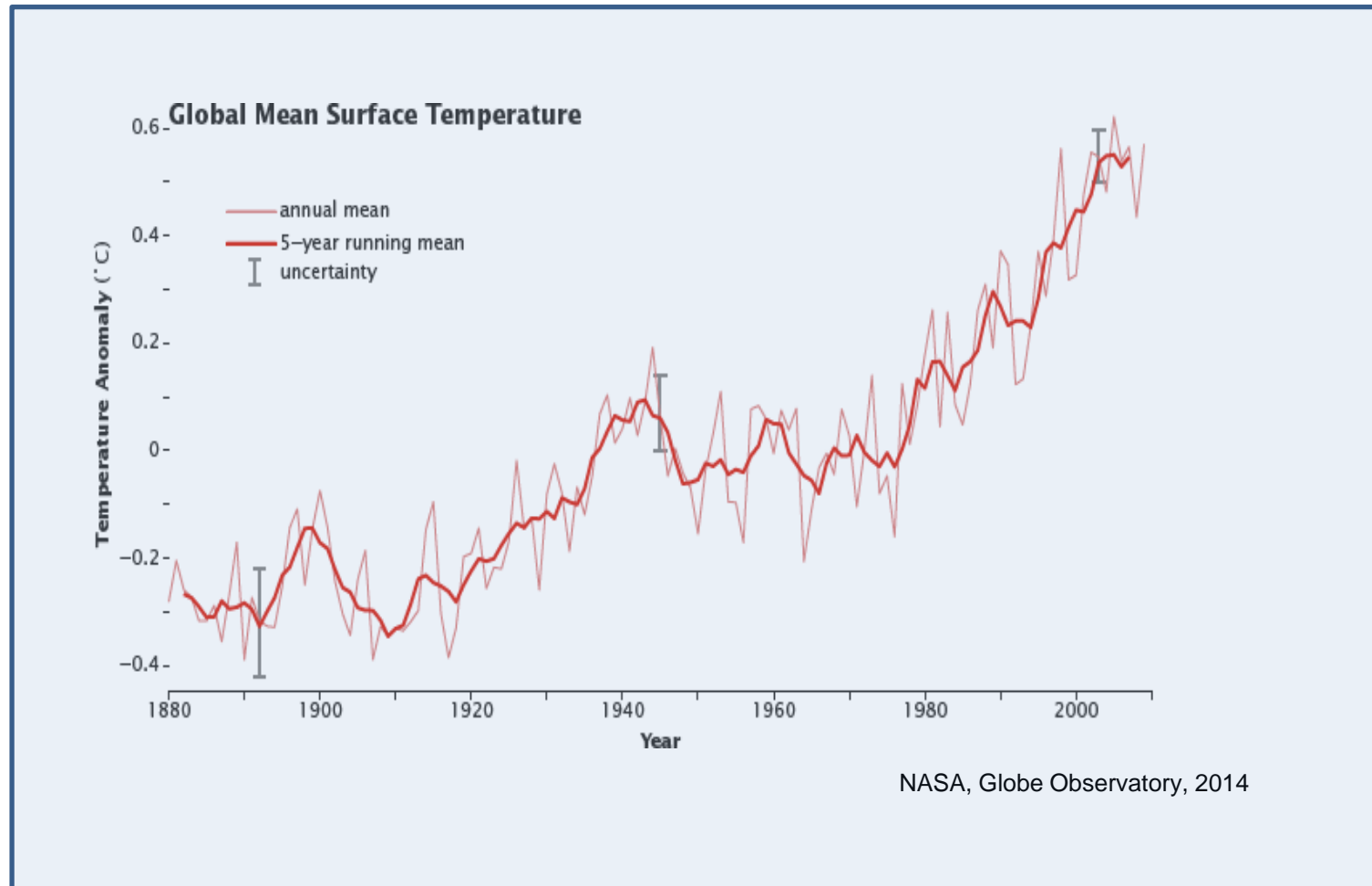
US \$ ha<sup>-1</sup> yr<sup>-1</sup>

Global estimates now include emerging coastal industries (*such as sea-bed mining, wind power, marine biotechnology and intangibles, such as the ocean's role in climate regulation*)

Costanza, 1997 (Nature)

# Le minacce per gli oceani

## Cambiamenti climatici

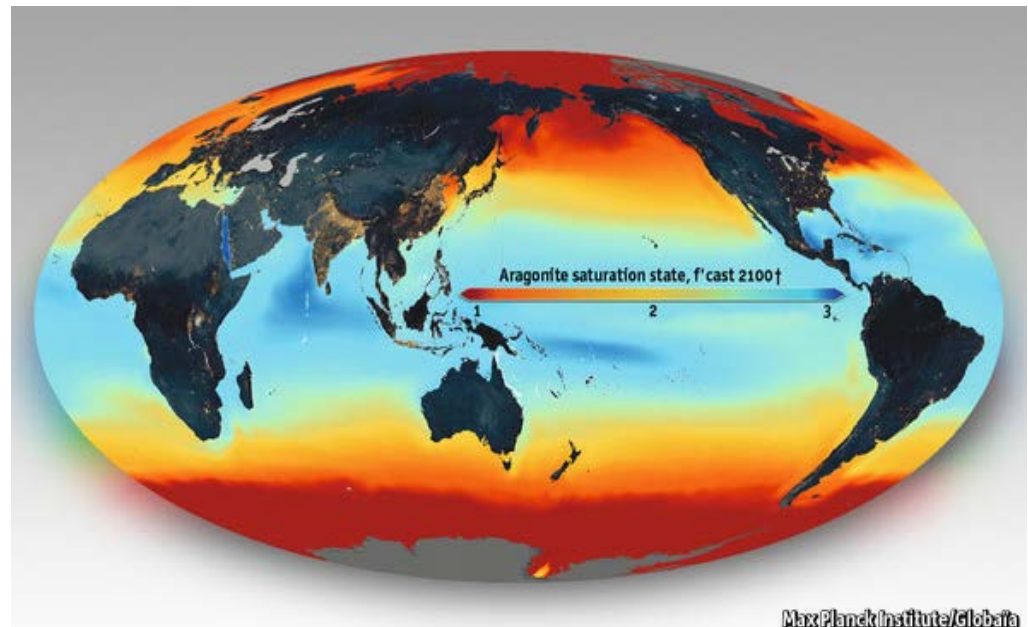
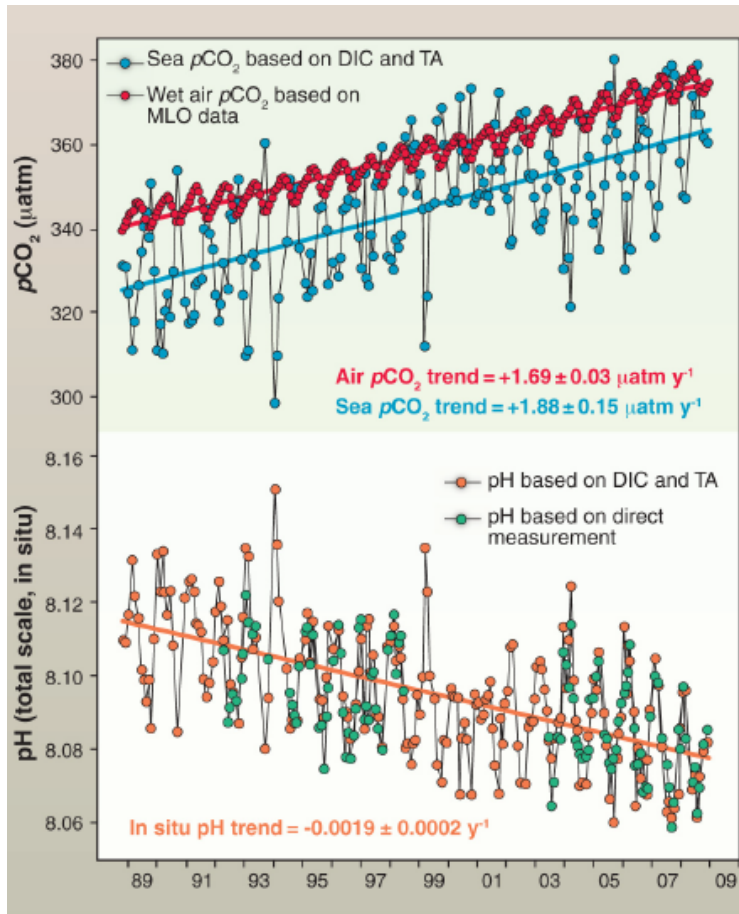


# Le minacce per gli oceani

Acidificazione

since 1980: + 12%

in 2100 : +170%



Changes in the ocean's chemistry due to an increase in CO<sub>2</sub> emissions are faster than at any point in the past 65m years

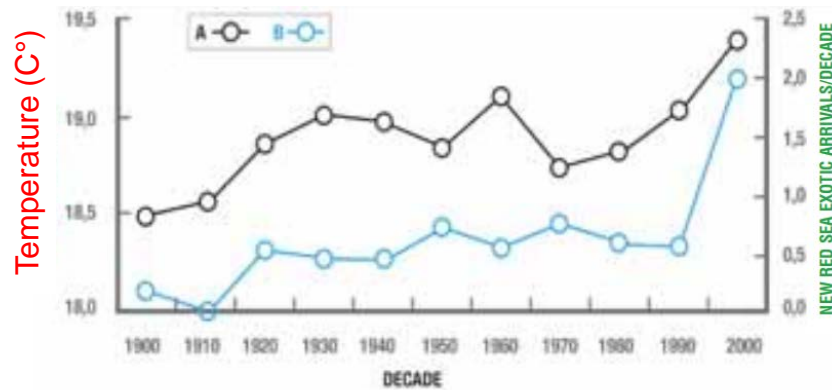
Doney et al (2010) Science

IPCC, 2014 (AR5)



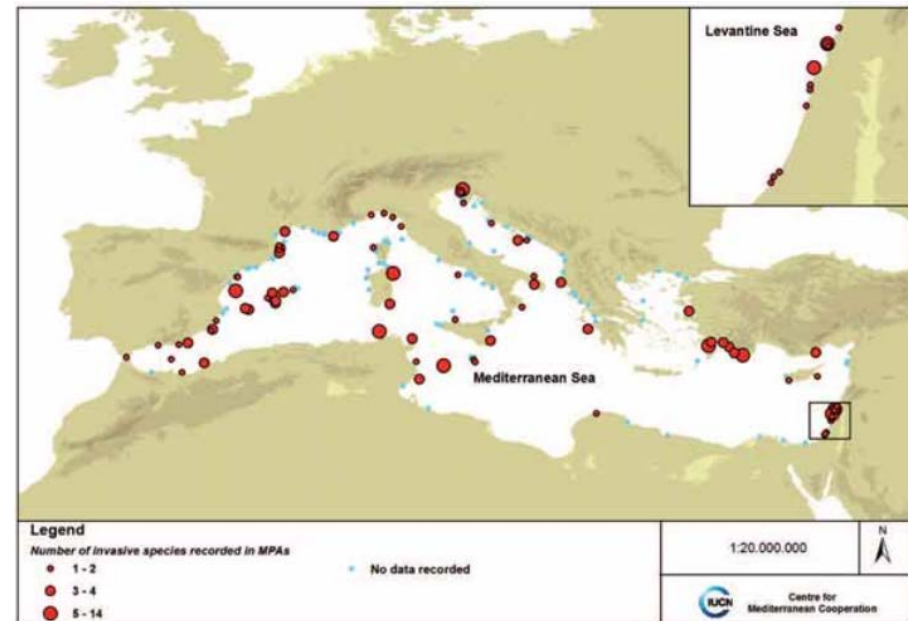
# Le minacce per gli oceani

## Le specie invasive (IAS - Invasive Alien Species)



**Fig. 9.** Historical invasion dynamic of alien fish species in the Mediterranean Sea (B) versus observed changes in the Mediterranean Sea water temperature per decade (A). From Ben Raïs Lasram F. and Mouillot D., 2009

Da: Otero, M., Cebrian, E., Francour, P., Galil, B., Savini, D. 2013. : IUCN. 136 pages.



**Fig. 3.** Invasive species in Mediterranean MPAs. Data collected from published and unpublished sources.

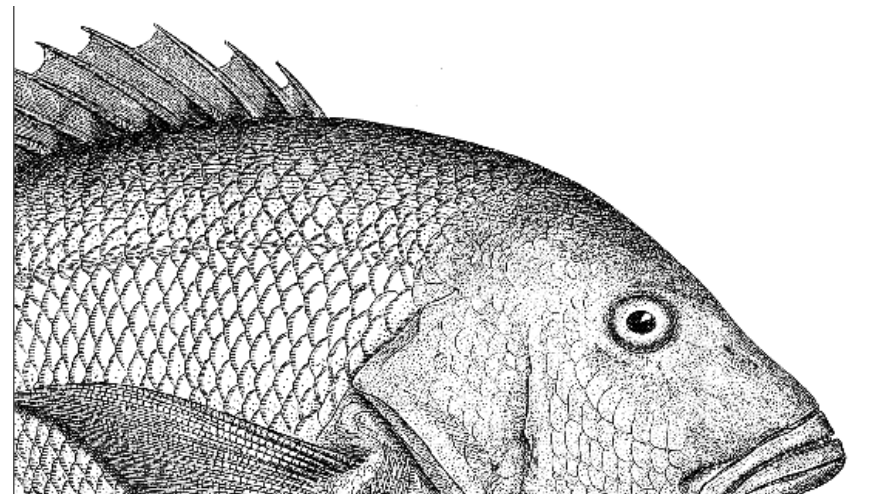
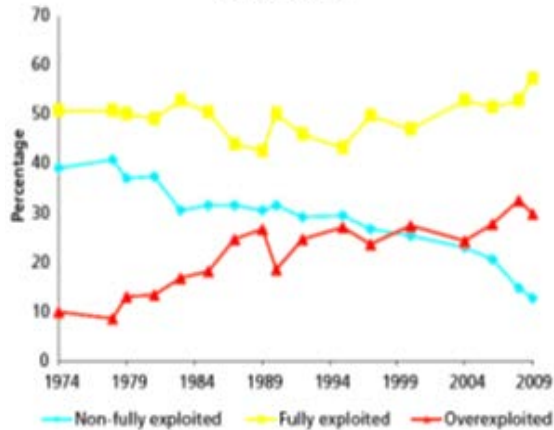
# Le minacce per gli oceani

## Overfishing

### The global fishery decline

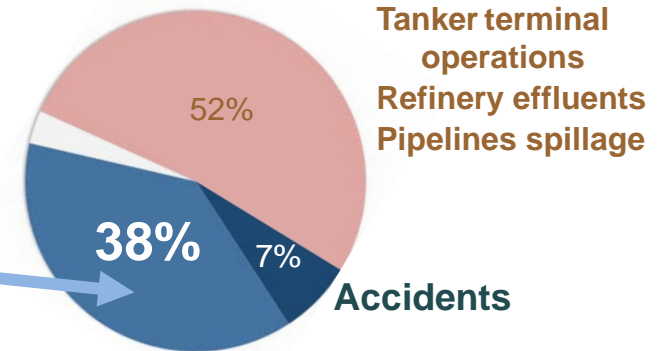
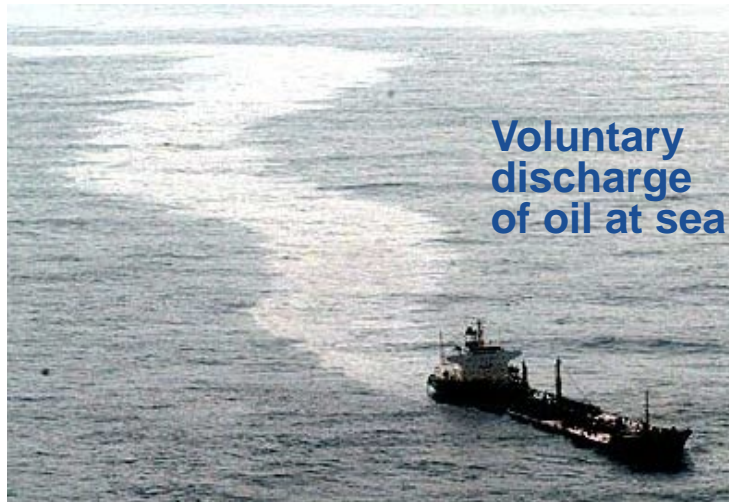
Fish stocks are declining worldwide. In past 50 years we have reduced the population of large commercial fish by 90%

Global trends in marine fish stock status from 1974 to 2009

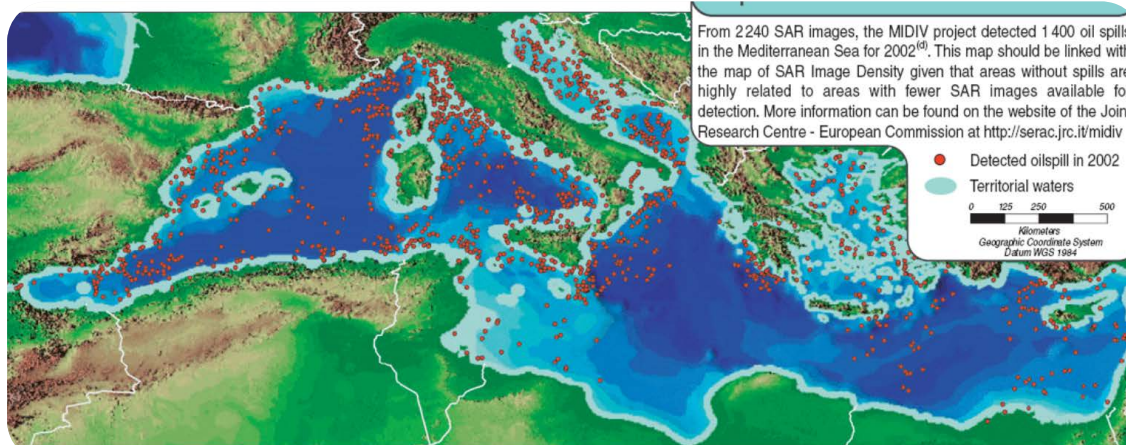


# Le minacce per gli oceani

## Inquinamento: il petrolio



1,2 m tons of transported oil is **intentionally discharged** at sea every year, five times more than lost by accident



**1400 oil spills** in the Mediterranean Sea for the year 2002.



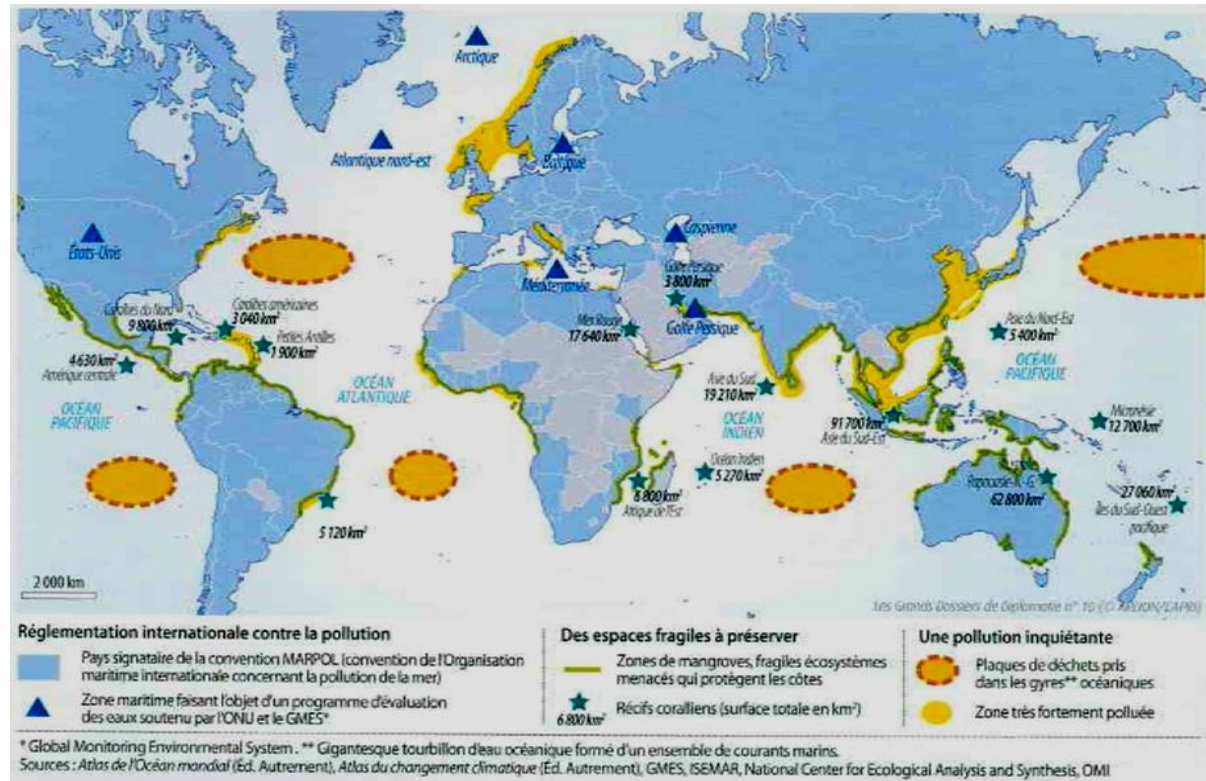
# Le minacce per gli oceani

## Inquinamento: Plastiche e Microplastiche

**Plastic production  
2008**

245million tonnes

Actual inputs of plastic  
to the oceans are yet  
unknown



Given the rise in global plastics production, input of marine plastic litter, and thereby micro-plastics will increase in those rapidly developing regions of the world lacking adequate solid waste management practices.

# Le minacce per gli oceani

## **Recenti risultati dell'IAMC-CNR su:**

- Cambiamenti climatici
- Acidificazione
- Specie invasive (IAS)
- Overfishing
- Inquinamento: Oil spills
- Inquinamento: Plastiche e microplastiche

# Cambiamenti climatici

## - Effetto sugli oceani

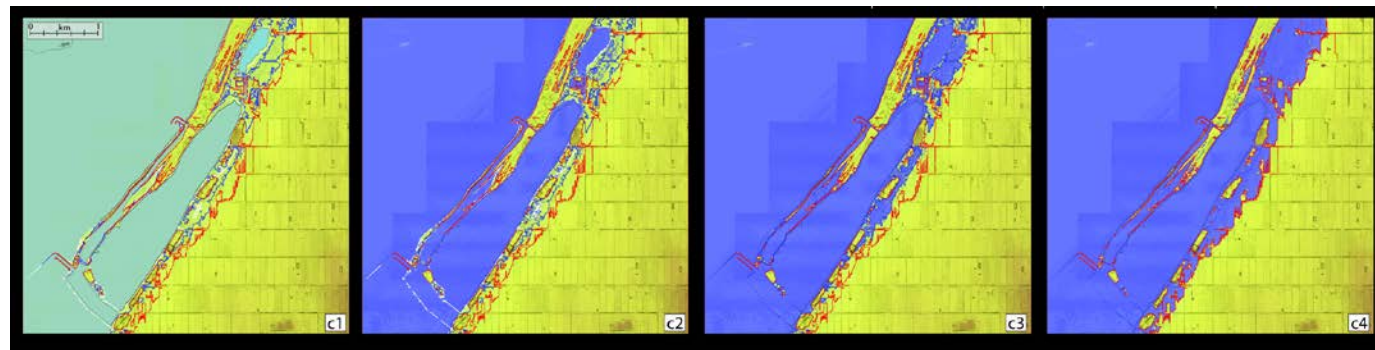
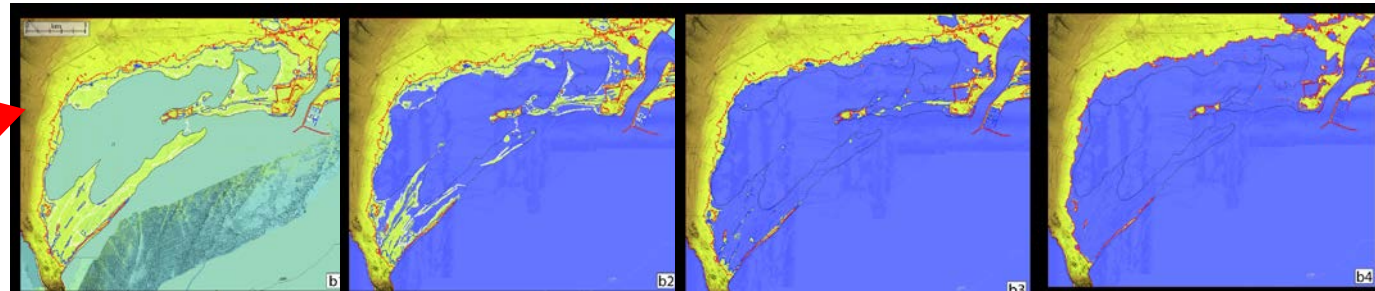
Previsioni per il 2100

Stato  
attuale

IPCC 2013 min  
54.4 cm

IPCC 2013 max  
94.9 cm

Rahmstorf (Science 2007)  
134.5 cm



Adattamento morfologico delle coste sabbiose all'innalzamento del livello del mare: modellistica numerica, morfodinamica, evoluzione di sistemi analoghi degli ultimi 10000 anni

*De Falco et al., Early cementation and accommodation space dictate the evolution of an overstepping barrier system during the Holocene. Marine Geology 2015.*

# Cambiamenti climatici

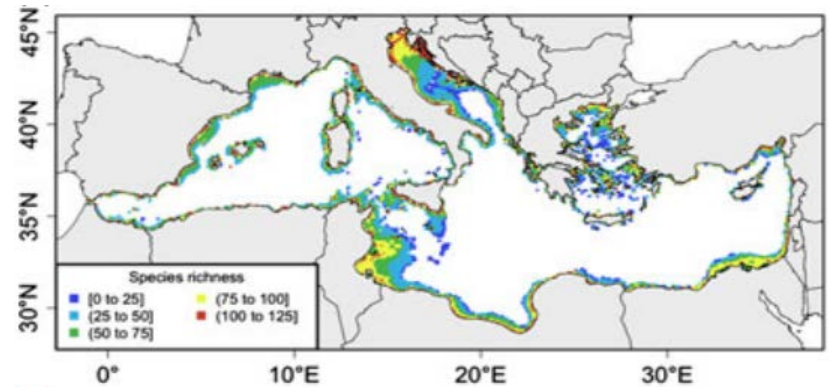
## Effetto sugli organismi marini

**Global Change Biology**

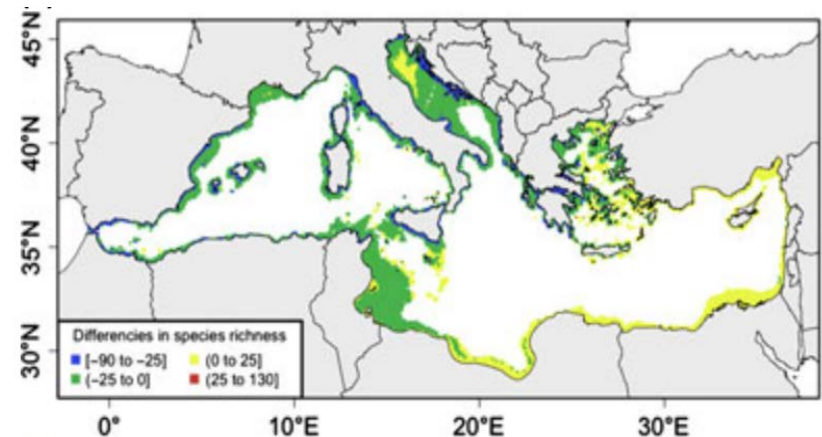
Global Change Biology (2013), doi: 10.1111/gcb.12467

**From projected species distribution to food-web structure under climate change**

CAMILLE ALBOUY<sup>1,2,3†</sup>, LAURE VELEZ<sup>1,2†</sup>, MARTA COLL<sup>4,5</sup>, FRANCESCO COLLOCA<sup>6</sup>, FRANÇOIS LE LOC'H<sup>2</sup>, DAVID MOUILLOT<sup>1,7</sup> and DOMINIQUE GRAVEL<sup>3</sup>



Species richness- Comparazione 1961-1980



Species richness- Comparazione Baseline (1961-1980) Vs. end of century (2080-2099)

## Specie indicatore (early warning indicator species)

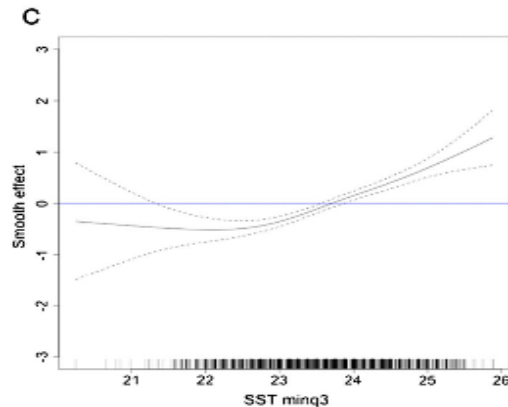
Contents lists available at ScienceDirect

**Journal of Marine Systems**

journal homepage: [www.elsevier.com/locate/jmarsys](http://www.elsevier.com/locate/jmarsys)

*Parapenaeus longirostris* (Lucas, 1846) an early warning indicator species of global warming in the central Mediterranean Sea

Francesco Colloca<sup>a,\*</sup>, Gianluca Mastrantonio<sup>b</sup>, Giovanna Jona Lasinio<sup>c</sup>, Alessandro Ligas<sup>d</sup>, Paolo Sartor<sup>e</sup>





# Acidificazione

## - Effetto sugli organismi marini



**The effect of elevated CO<sub>2</sub> on the behaviour of marine animals.** Abnormal behaviour (attraction to predator odour) and loss of lateralization in reef fish exposed to high CO<sub>2</sub>. (values for 2100)

nature  
climate change

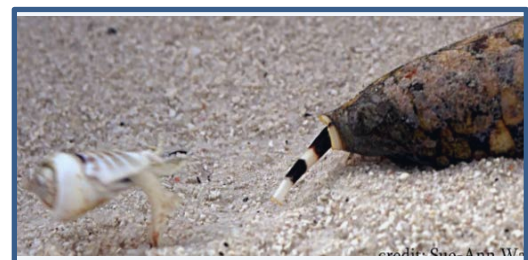
LETTERS

PUBLISHED ONLINE: 15 JANUARY 2012 | DOI: 10.1038/NCLIMATE1352

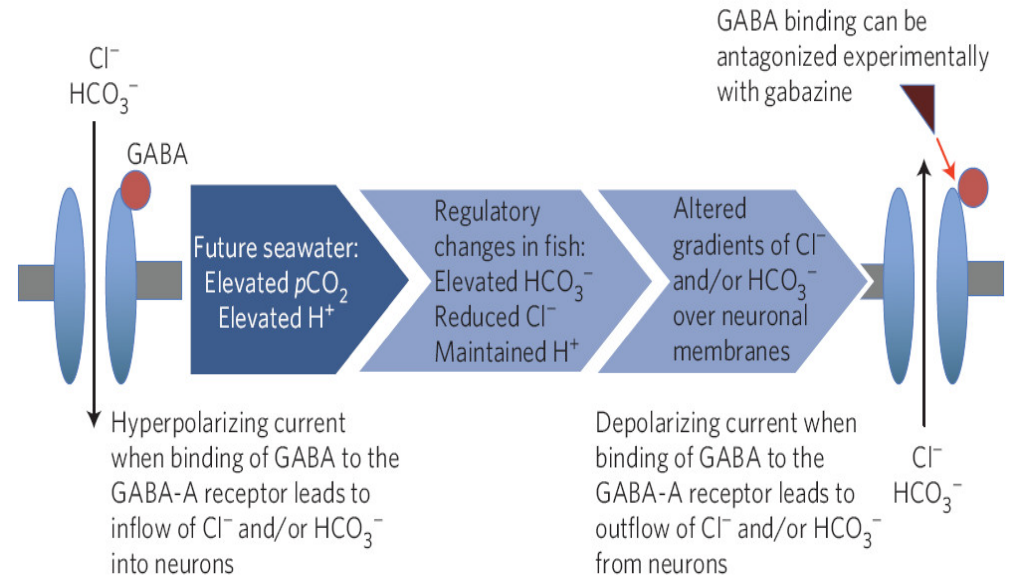
### Near-future carbon dioxide levels alter fish behaviour by interfering with neurotransmitter function

Göran E. Nilsson<sup>1\*</sup>, Danielle L. Dixon<sup>2</sup>, Paolo Domenici<sup>3</sup>, Mark I. McCormick<sup>2</sup>, Christina Sørensen<sup>1</sup>, Sue-Ann Watson<sup>2</sup> and Philip L. Munday<sup>2</sup>

**High CO<sub>2</sub> interferes with GABA-A receptor.** The behavioral anomalies due to high CO<sub>2</sub> disappear in the presence of a GABA-A receptor antagonist (gabazine). Further work shows the same phenomenon in molluscs (Jumping snail; Watson et al 2014).



**Jumping snail reacting to the predator**



Nilsson GE, Dixon DL, Domenici P, et al (2012) . Nature Climate Change 2 (3), 201-204  
Watson, S.A., Lefevre, S., McCormick, M.I., et al (2014). Proceedings RSB 281 2377-2395.

# Le specie invasive (IAS)

## Vettori di introduzione (Mari di Taranto)



*Gyrodinium uncatenum* *Planktoniella sol* *Ostreopsis ovata*

**Le microalghe sono presenti anche come stadi di resistenza nei sedimenti delle acque di zavorra**

Specie aliene rinvenute	
Macroalghe	15
Fito e zooplancton	11
Molluschi	7
Policheti	3
Ascidie	4
Crostacei	5
Spugne	1
Briozoi	1
<b>TOTALE</b>	<b>47</b>

Cecere E., Petrocelli A., Belmonte M., Portacci G. and Rubino F. (2015) Activities and vectors responsible for the biological pollution in the Taranto Seas (Mediterranean Sea, southern Italy): a review. Environmental Science and Pollution Research (in press) doi 10.1007/s11356-015-5056-8.

# Le specie invasive (IAS)

## - Cambiamenti climatici: Previsioni Thermal Habitat Suitability

Nativa

*Sarpa salpa*



Endemica del Mar Mediterraneo

VS.

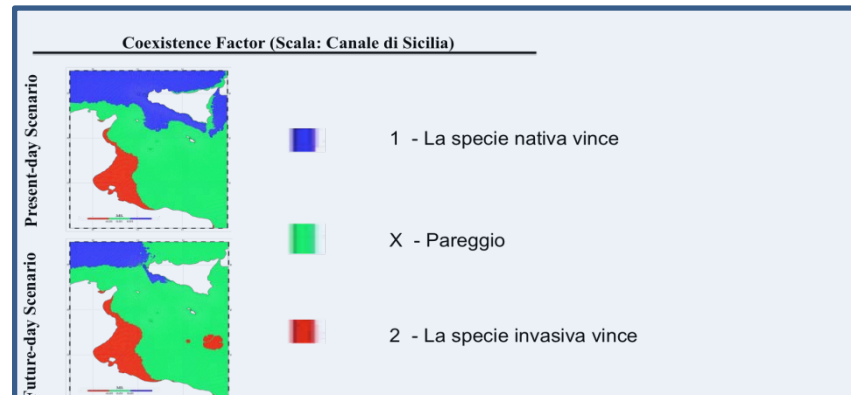
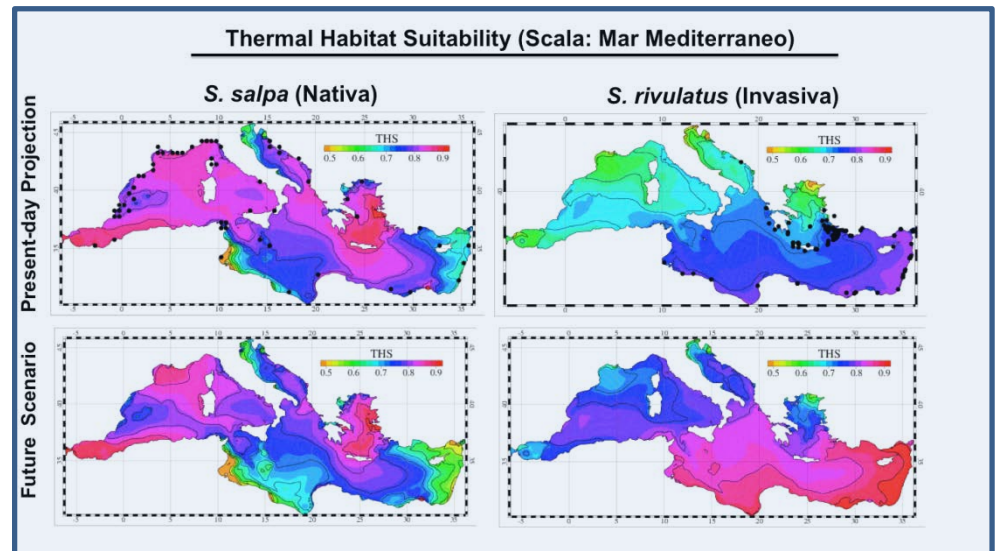
*Siganus rivulatus*

Invasiva



Specie Lessepsiana che è attualmente presente nel Mediterraneo Orientale

Studio basato sulla relazione tra potenziale metabolico e temperatura integrato con la modellistica oceanografica (presente e futuro-2050)



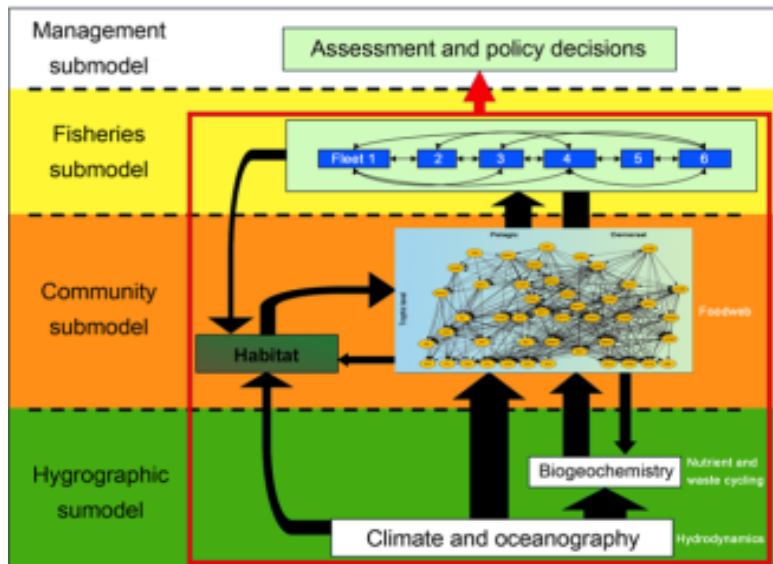


# Overfishing

-Modellistica per la gestione della pesca

## Modelli ecosistemici di supporto alla gestione della pesca

La pesca ha un impatto diretto e indiretto sull'ecosistema con effetti a cascata sulla catena trofica. L'approccio monospecifico convenzionale alla gestione delle risorse è insufficiente ad assicurare la sostenibilità della pesca, a salvaguardare gli «ecosystem services» e la conservazione degli habitat.



**Ritmare**

Ecopath with Ecosym

**MareFrame**

Atlantis + Gadget

EU 7 EU Framework Programme  
IAMC coordina il WP 5 (Apply new methods in Case Study area)

**MUSE** (superata la prima fase di valutazione)  
Horizon 2020

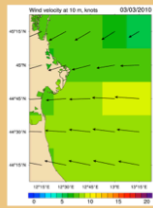


# Inquinamento: oil spills

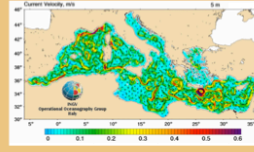
## - Modellistica della dispersione di idrocarburi

<http://www.seaforecast.cnr.it>

Meteorological analyses and forecast (ECMWF and MOON)



Oceanographic analyses and forecasts (GMES MCS and MOON)



Oil slick data from satellite data (EMSA-CSN)

OIL SPILL models for FORECASTING

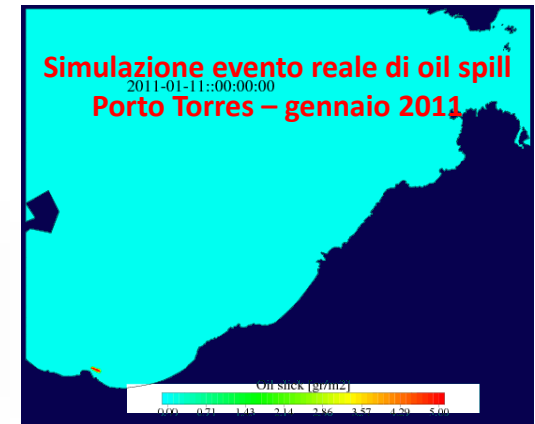
EMSA-CSN

WEB INTERFACE  
interactive access to the multi-model service scenarios

**Simulazione evento di oil spill  
Bocche di Bonifacio – ottobre 2013**



**Simulazione evento reale di oil spill  
Porto Torres – gennaio 2011**

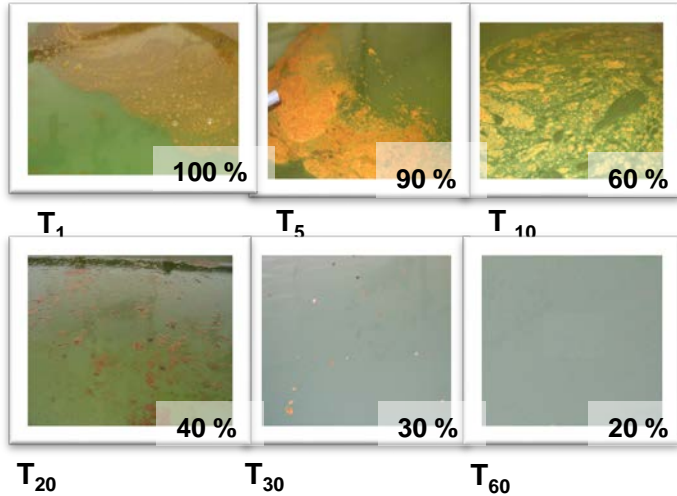


- Cucco A. et al., (2012), A high resolution real time forecasting system for predicting the fate of oil spills in the Strait of Bonifacio (western Mediterranean), Marine Pollution Bulletin, 64, 6, 1186–1200
- Olita A. et al., (2012), Oil spill hazard and risk assessment for the shorelines of a Mediterranean coastal archipelago, Ocean and Coastal Management, 57, 44-52
- Sorgente B. et al. (2012), Effects of protection rules and measures in an important international strait area: the Bonifacio Strait, Journal Operational Oceanography, 5, 1, 35-44

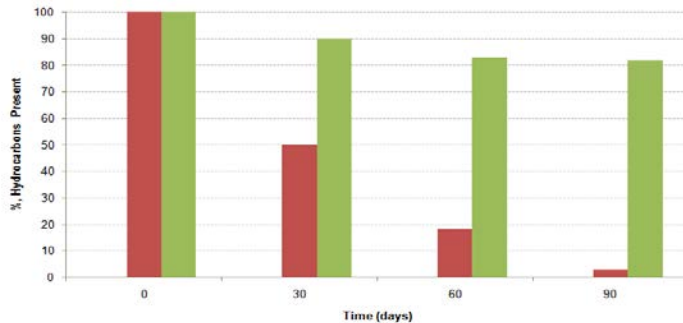
# Inquinamento: oil spills

## -Bioremediation, oil pollution mitigation

### Potential of biodegradative capability of Bacteria



Photographic set of **visible degradation** with relative percentage of crude oil (Kashagang Fresh Oil) during a long biodegradation experiment performed in the “Mesocosm Facility” at IAMC-CNR of Messina

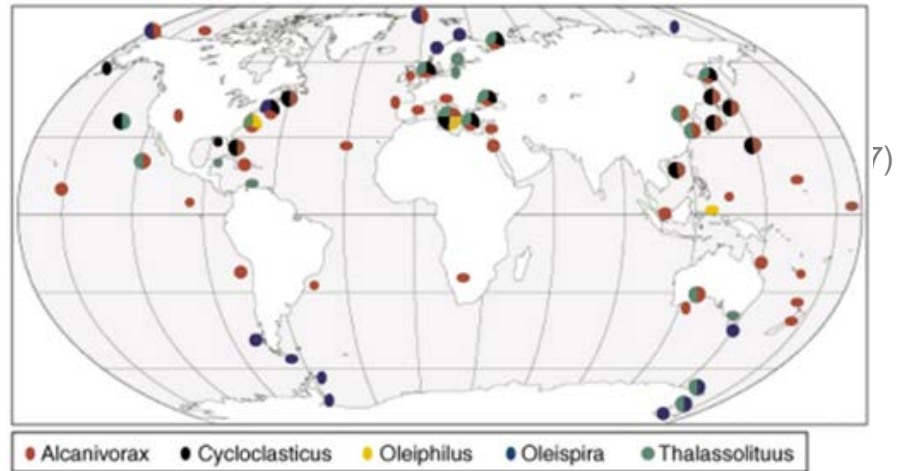


Relative percentage of hydrocarbons in sediment in control (AN) and biostimulated system (OXIC). *Genovese et al., 2014 Frontiers in Microbiology*



### Marine oil-eating bacteria

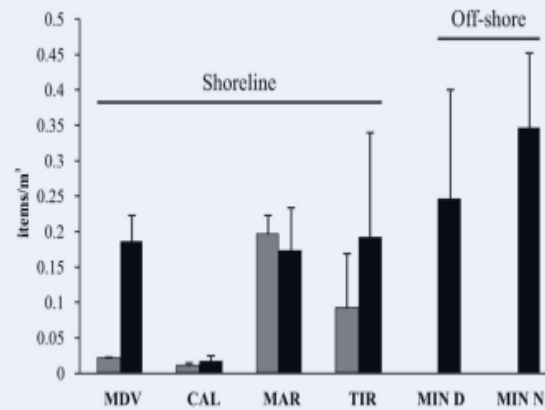
Specialised single-cell organisms, found in seawater all over the planet, aid in keeping the ocean healthy by eating naturally seeping oil. **Without their presence, the world's oceans would be covered in a thick film of oil.** The organisms surge in response to hydrocarbons.



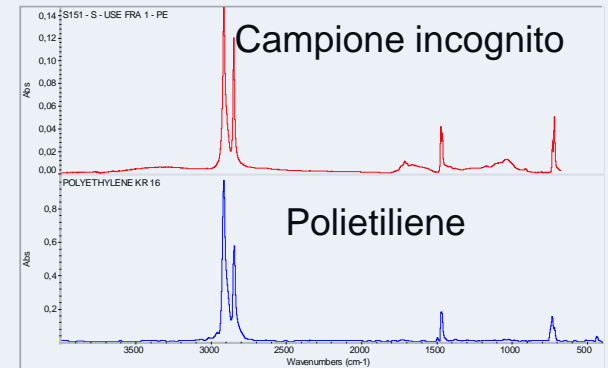
**Geographic distribution** of Marine hydrocarbon-degrading bacteria, the obligate hydrocarbonoclastic bacteria (OHCB) *Yakimov et al., 2007 Current Opinion in Biotechnology*

# Inquinamento: plastica

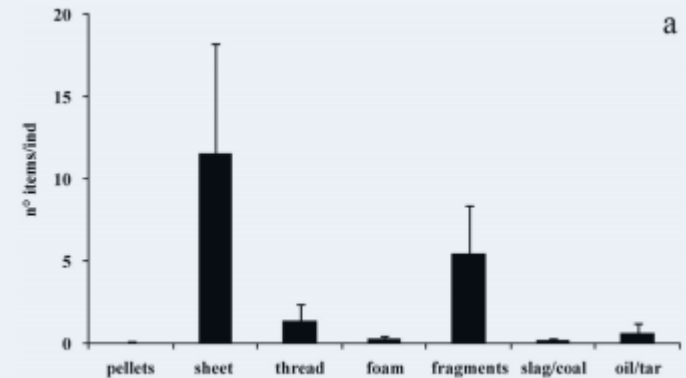
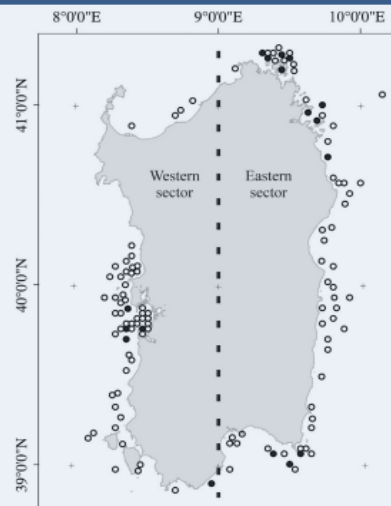
## -Plastica e microplastica



### ANALISI Spettroscopica FTR



de Lucia et al (2014) Mar Env Research



Cammedda et al (2014) Mar Env Research

# Conclusioni

- L' Istituto IAMC si sta occupando di diversi aspetti relativi alla salute degli oceani (Cambiamenti climatici, Acidificazione, Specie invasive, Overfishing, Oil spills, Plastiche e microplastiche)
- L'Istituto IAMC sta rafforzando la rete di collaborazione tra i vari gruppi, per poter integrare i risultati relativi agli effetti dell'impatto antropico sulla fisica e chimica dei mari, con quelli sugli organismi marini e la biodiversità