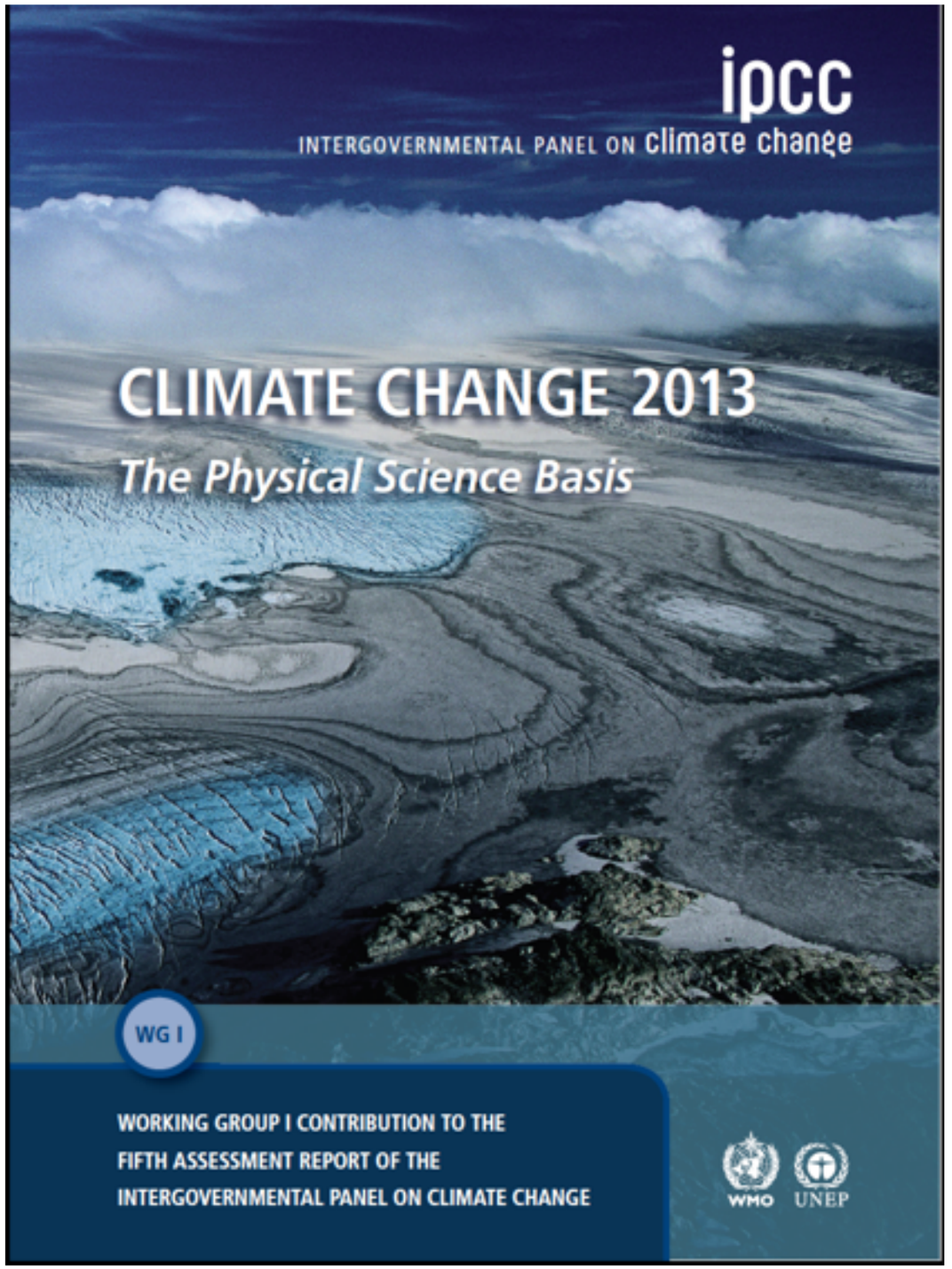
Risposte della biodiversità del Mediterraneo al cambiamento globale

ferdinando boero
Università del Salento, CoNISMa, CNR-ISMAR

L’ultimo report di IPCC

- The physical science basis

- ma sta per uscire Climate Change 2014: Impacts, Adaptation, and Vulnerability



Key risk	Adaptation issues and prospects	Climatic drivers	Supporting ch. sections	Timeframe	Risk for current and high adaptation
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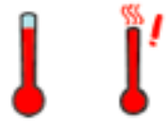
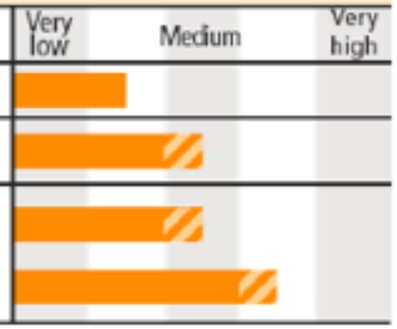
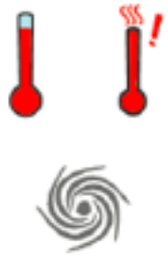
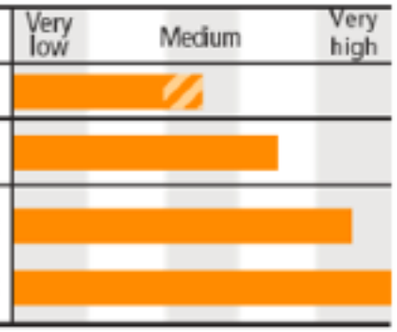
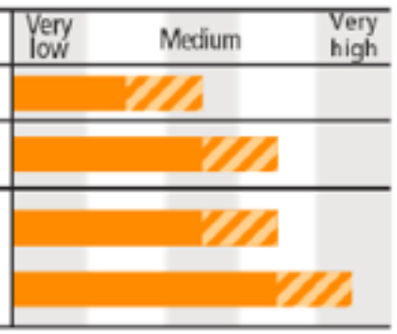
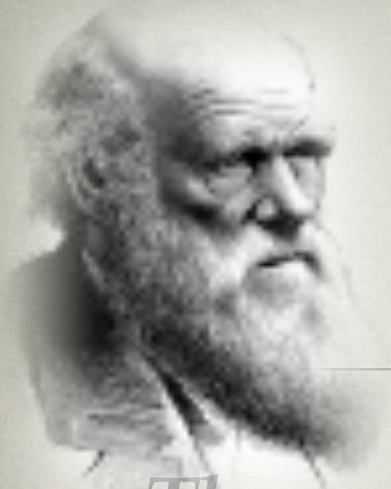
Distributional shift in fish and invertebrate species, and decrease in fishery catch potential at low latitudes, e.g., in equatorial upwelling and coastal boundary systems and sub-tropical gyres (*high confidence*)	• Evolutionary adaptation potential of fish and invertebrate species to warming is limited as indicated by their ongoing latitudinal shifts. • Human adaptation options: Large-scale translocation of industrial fishing activities following the regional decreases (low latitude) vs. possibly transient increases (high latitude) in catch potential; Flexible management that can react to variability and change; Improvement of fish resilience to thermal stress by reducing other stressors such as pollution and eutrophication; Expansion of aquaculture. ←		6.3, Box CC-MB	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	
Reduced biodiversity, fisheries abundance, and coastal protection by coral reefs due to heat-induced mass coral bleaching and mortality increases, e.g., in coastal boundary systems and sub-tropical gyres (*high confidence*)	• Evidence of rapid evolution by corals is very limited. Some corals may migrate to higher latitudes, but entire reef systems are not expected to be able to track the high rates of temperature shifts. • Human adaptation options are limited to reducing other stresses, mainly by enhancing water quality, and limiting pressures from tourism and fishing. These options will delay human impacts of climate change by a few decades, but their efficacy will be severely reduced as thermal stress increases.		5.4, 6.4, 30.3, 30.5, Box CC-CR	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	
Coastal inundation and habitat loss due to sea-level rise and intensified precipitation events, e.g., in coastal boundary systems and sub-tropical gyres (*medium* to *high confidence*)	• Human adaptation options are limited to reducing other stresses, mainly by reducing pollution and limiting pressures from tourism, fishing, and aquaculture. • Loss of ecosystems such as sea grass, mangroves, and coral reefs can be reduced by reducing deforestation and increasing reforestation of river catchments and coastal areas to retain sediments and nutrients.		5.5, 30.5-6, Box CC-CR	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	

Le previsioni per l'Oceano

Molto di quello che è "previsto" è già avvenuto…. ma si può prevedere il futuro di sistemi complessi?



ECOLOGIA E FISICA

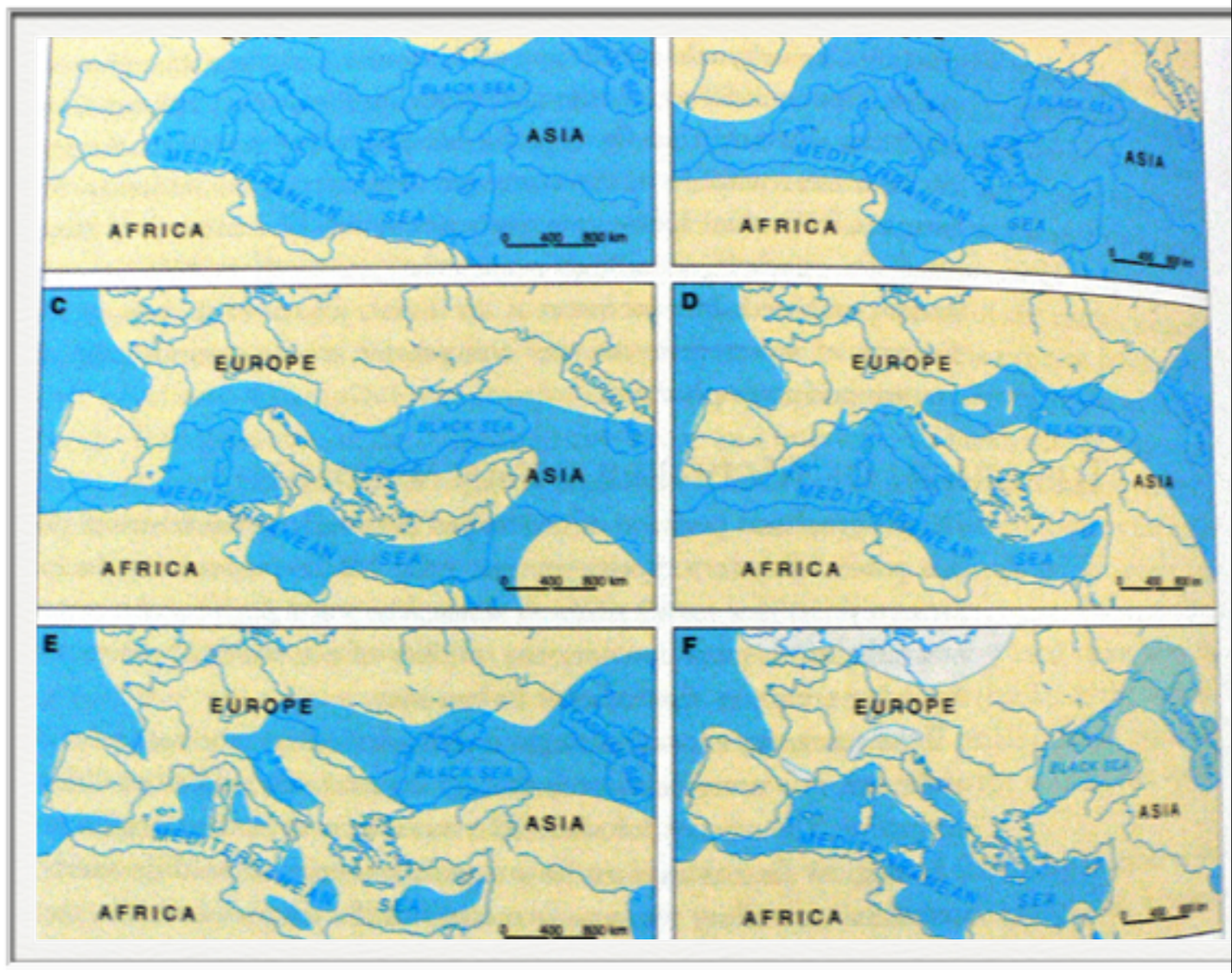
- *Throw up a handful of feathers, and all must fall to the ground according to definite laws*
- *but how **simple** is this problem compared to the action and reaction of the innumerable plants and animals which have determined, **in the course of centuries**, the proportional numbers and kinds of trees **now** growing on these Indian ruins*

Il presente è frutto del passato

- La storia del Mediterraneo è costellata di eventi drammatici

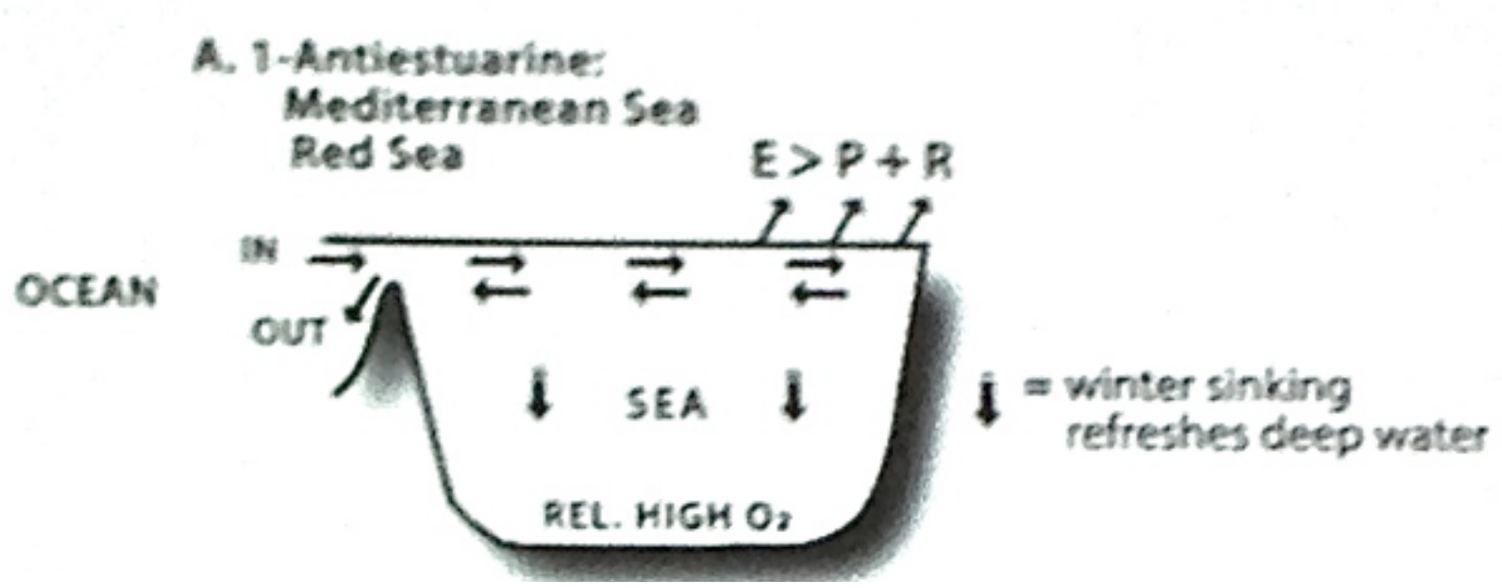
- il Mediterraneo di oggi è frutto della crisi del Messiniano

- 5 milioni di anni fa, dopo la crisi, i progenitori dei biota attuali penetrarono in Mediterraneo attraverso lo stretto di Gibilterra.



Il Mediterraneo oggi

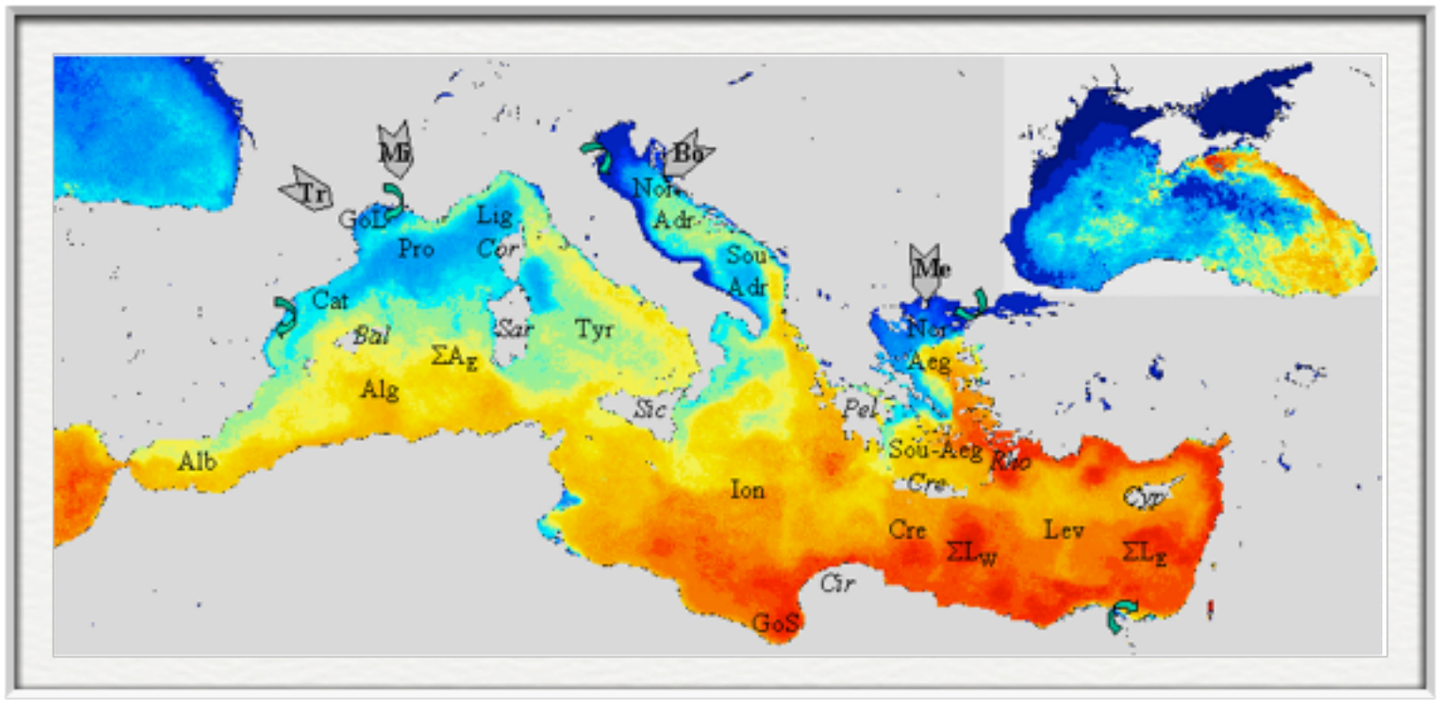
- Le acque atlantiche entrano in superficie, le mediterranee escono in profondità. Il Mediterraneo è una trappola senza uscita per le specie che vivono in superficie



- Le acque profonde si formano in corrispondenza dei motori freddi

- Estati brevi, dominate da specie ad affinità tropicale che vivono al di sopra del termoclino estivo

- Inverni temperati, dominati da specie ad affinità temperato-boreale



Quel che vediamo oggi non è destinato a restare inalterato.

La stabilità non esiste: evolvono le specie, le comunità, i biomi...

E ogni cambiamento innesca altri cambiamenti

Il Mediterraneo che conoscevamo non c'è più...le cose cambiano

Key risk	Adaptation issues and prospects	Climatic drivers	Supporting ch. sections	Timeframe	Risk for current and high adaptation
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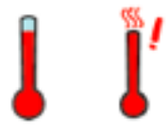
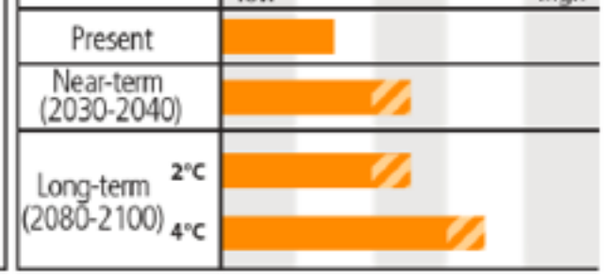
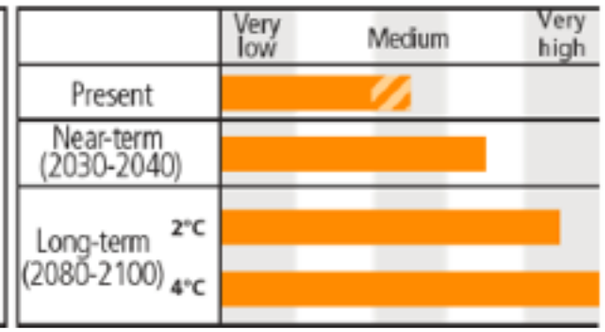
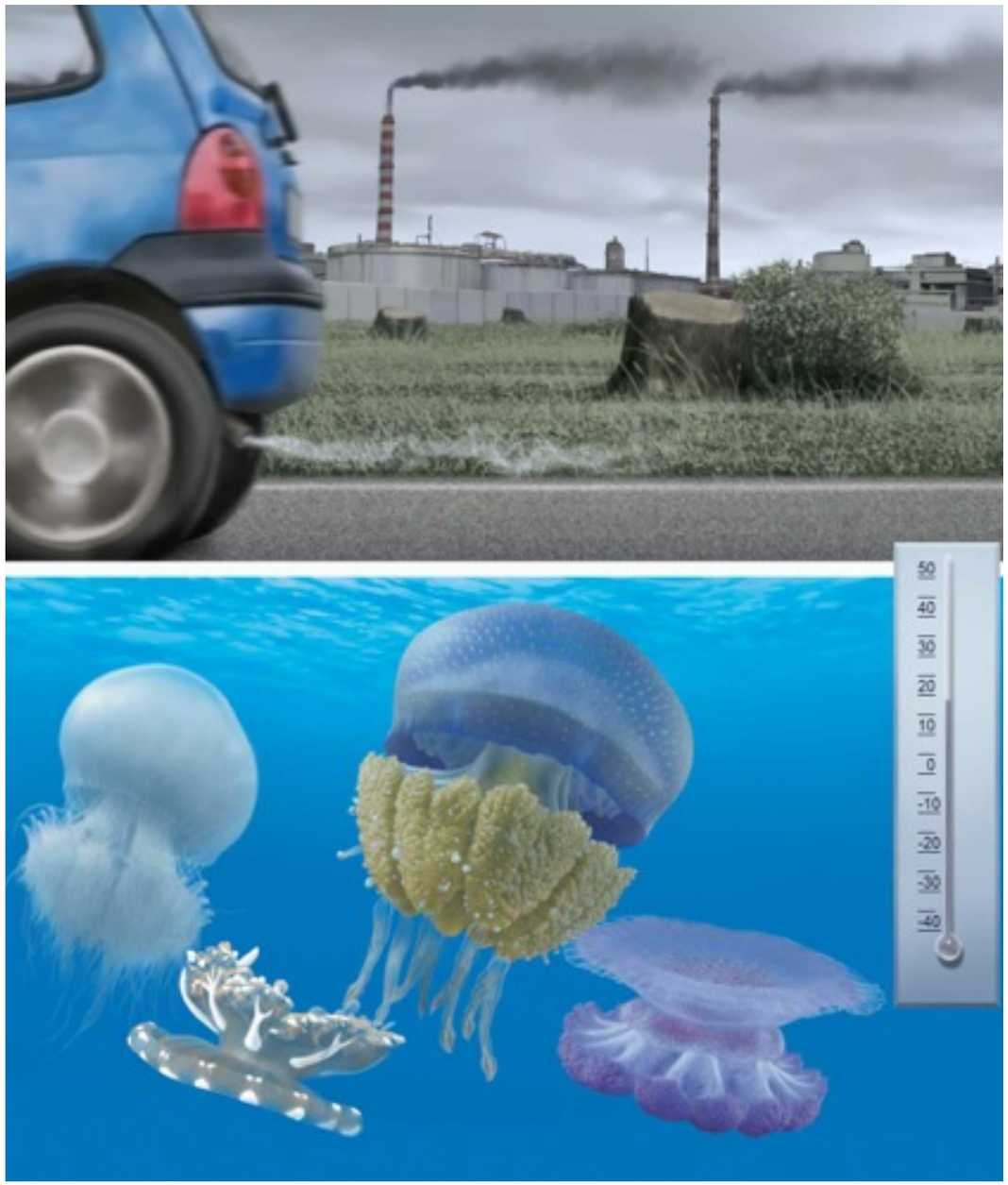
Distributional shift in fish and invertebrate species, and decrease in fishery catch potential at low latitudes, e.g., in equatorial upwelling and coastal boundary systems and sub-tropical gyres (*high confidence*)	• Evolutionary adaptation potential of fish and invertebrate species to warming is limited as indicated by their ongoing latitudinal shifts. • Human adaptation options: Large-scale translocation of industrial fishing activities following the regional decreases (low latitude) vs. possibly transient increases (high latitude) in catch potential; Flexible management that can react to variability and change; Improvement of fish resilience to thermal stress by reducing other stressors such as pollution and eutrophication; Expansion of aquaculture.		6.3, Box CC-MB		
Reduced biodiversity, fisheries abundance, and coastal protection by coral reefs due to heat-induced mass coral bleaching and mortality increases, e.g., in coastal boundary systems and sub-tropical gyres (*high confidence*)	• Evidence of rapid evolution by corals is very limited. Some corals may migrate to higher latitudes, but entire reef systems are not expected to be able to track the high rates of temperature shifts. • Human adaptation options are limited to reducing other stresses, mainly by enhancing water quality, and limiting pressures from tourism and fishing. These options will delay human impacts of climate change by a few decades, but their efficacy will be severely reduced as thermal stress increases.		5.4, 6.4, 30.3, 30.5, Box CC-CR		

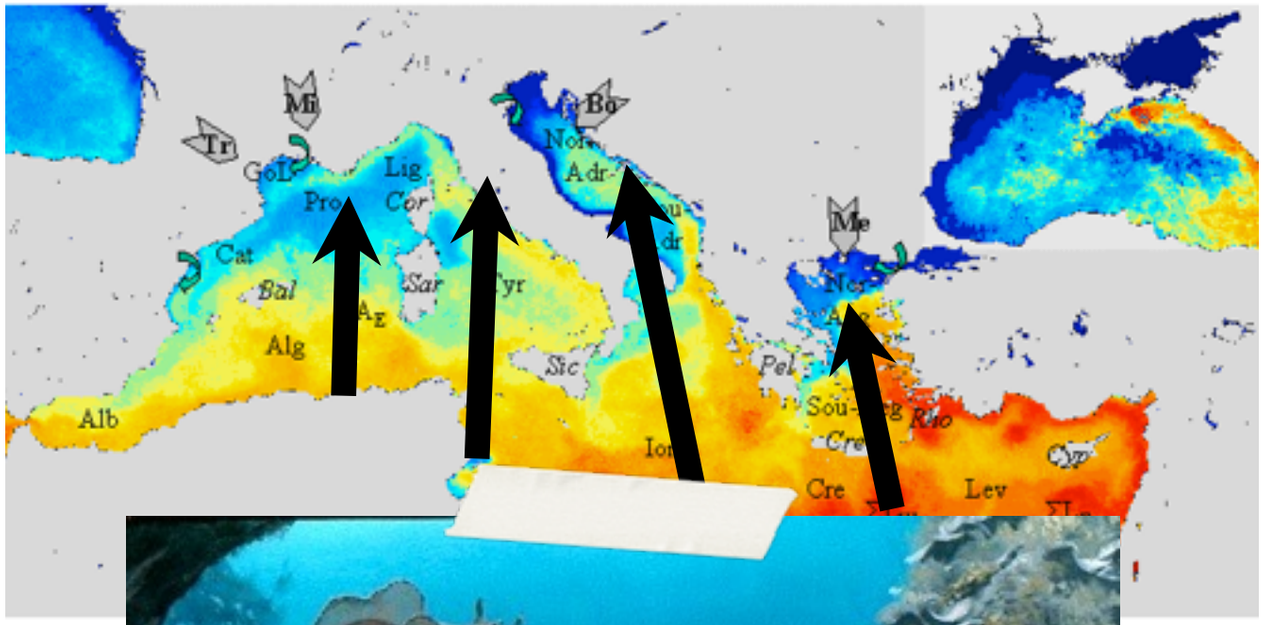
Molte di queste "previsioni" in Mediterraneo sono già avvenute (e non c'è solo la pesca ad essere influenzata dal cambiamento globale….), e le specie ad affinità fredda???? Sappiamo più di questo!

Il riscaldamento globale

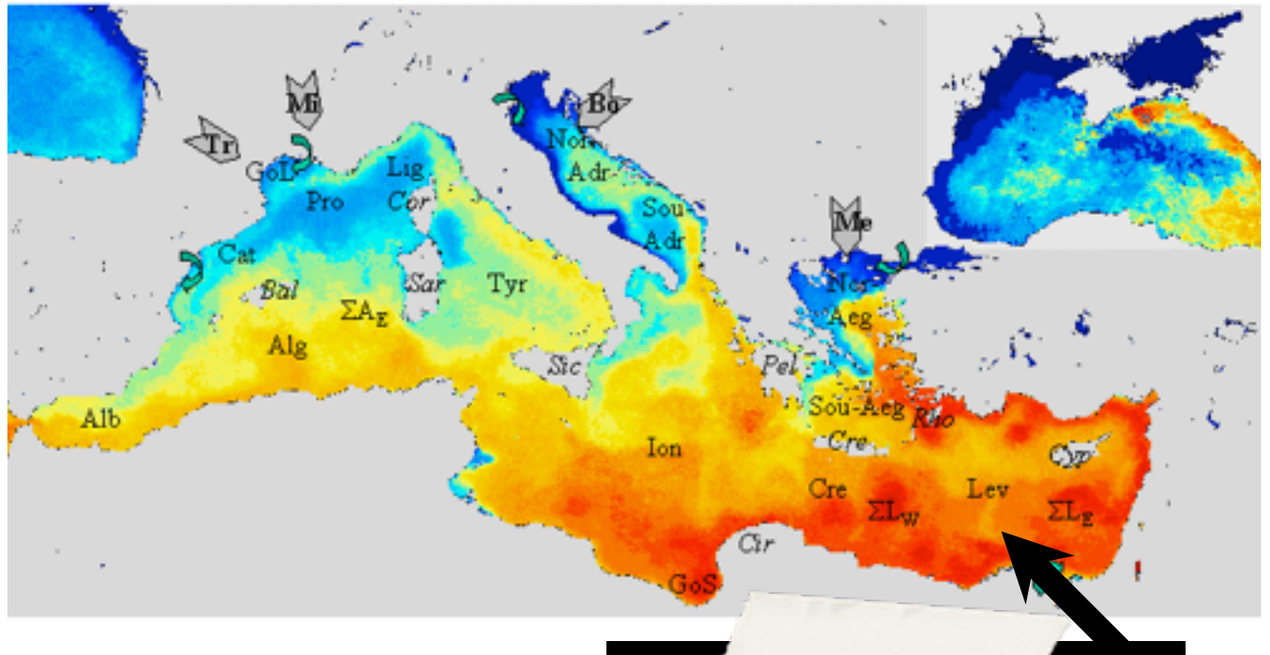
- La nostra economia è basata sulla combustione
- Consumiamo ossigeno e produciamo anidride carbonica
- Con la deforestazione abbiamo eliminato i produttori di ossigeno e di anidride carbonica
- L'aumento di anidride carbonica causa l'aumento di temperatura
- Il Mediterraneo risponde più rapidamente degli oceani
- La biodiversità si modifica con l'arrivo di specie tropicali che formano popolazioni stabili in Mediterraneo
- Su 100 specie di pesci penetrate recentemente in Mediterraneo, 98 sono tropicali
- Meduse prima assenti ora sono dominanti



Il Mediterraneo risponde rapidamente al cambiamento globale



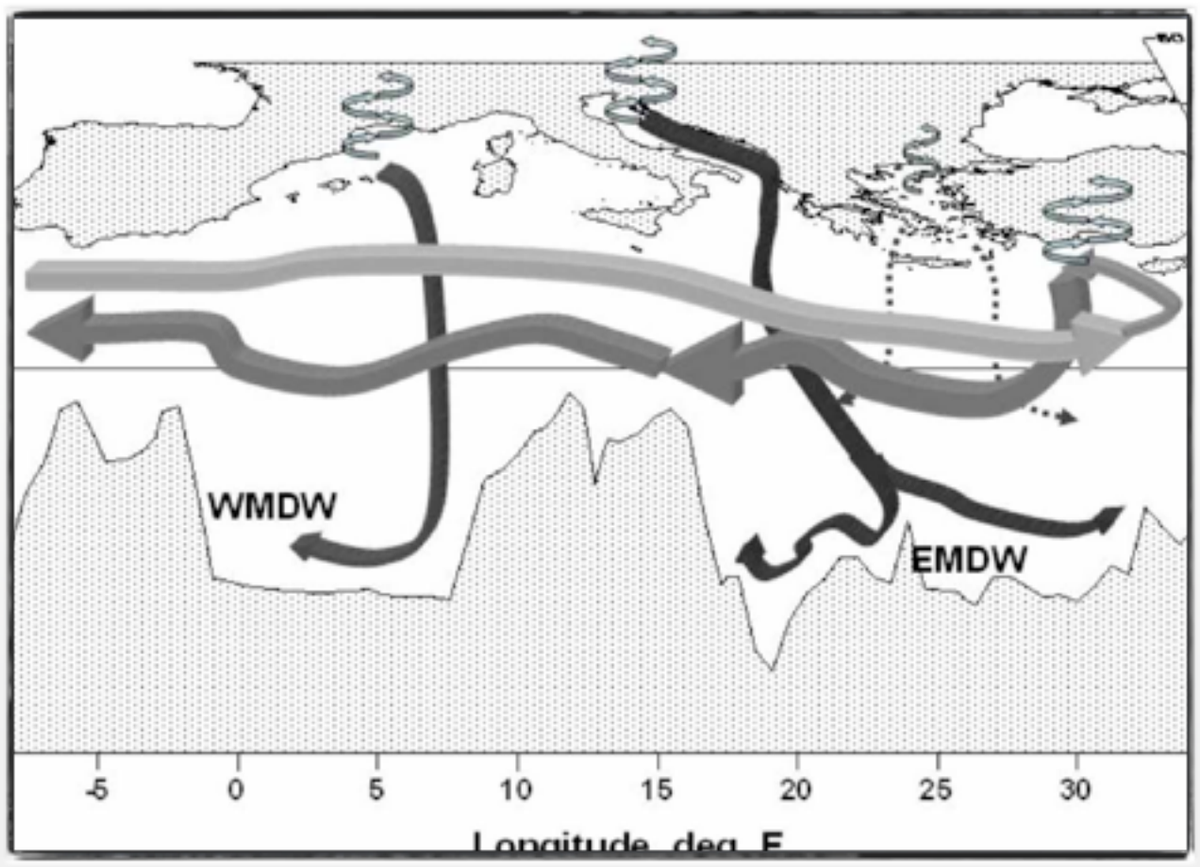
MERIDIONALIZZAZIONE



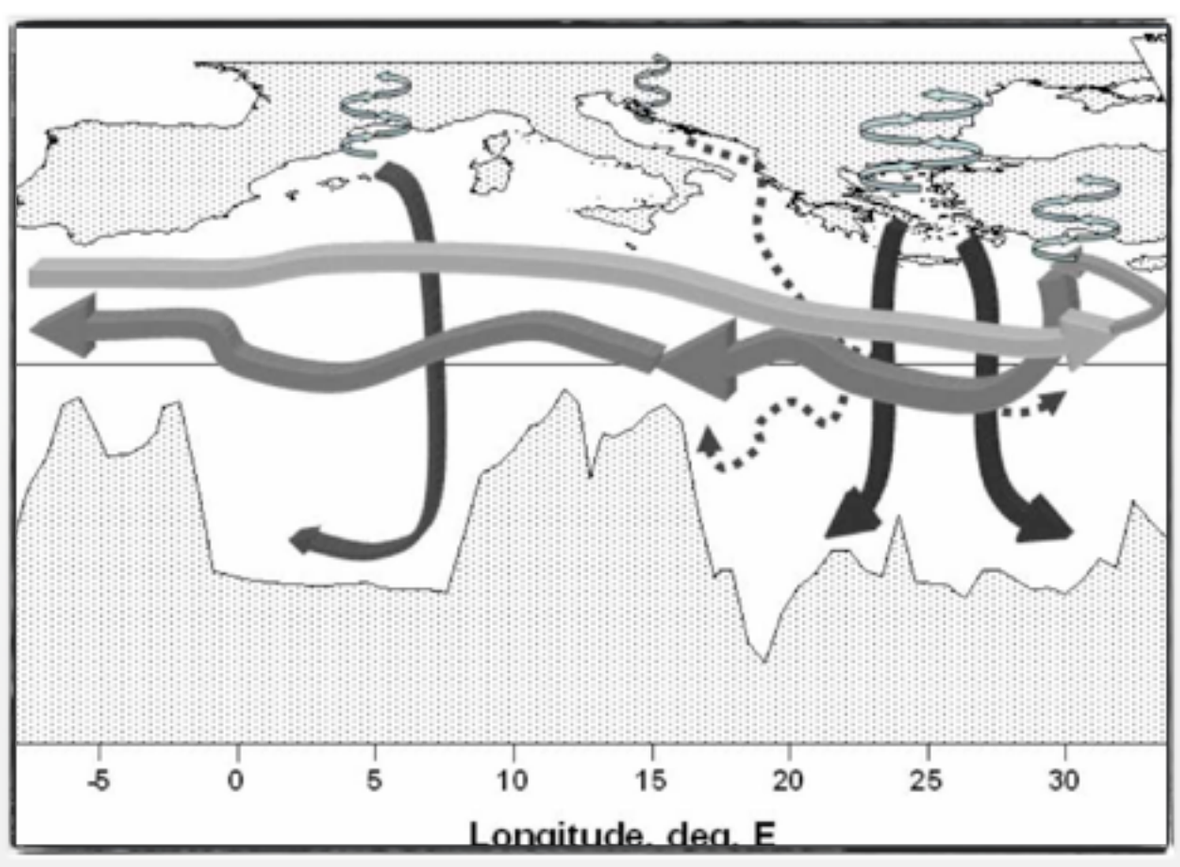
Si realizza la predisposizione tropicale del Mediterraneo Orientale!

TROPICALIZZAZIONE

Il Transient dei tardi ‘80

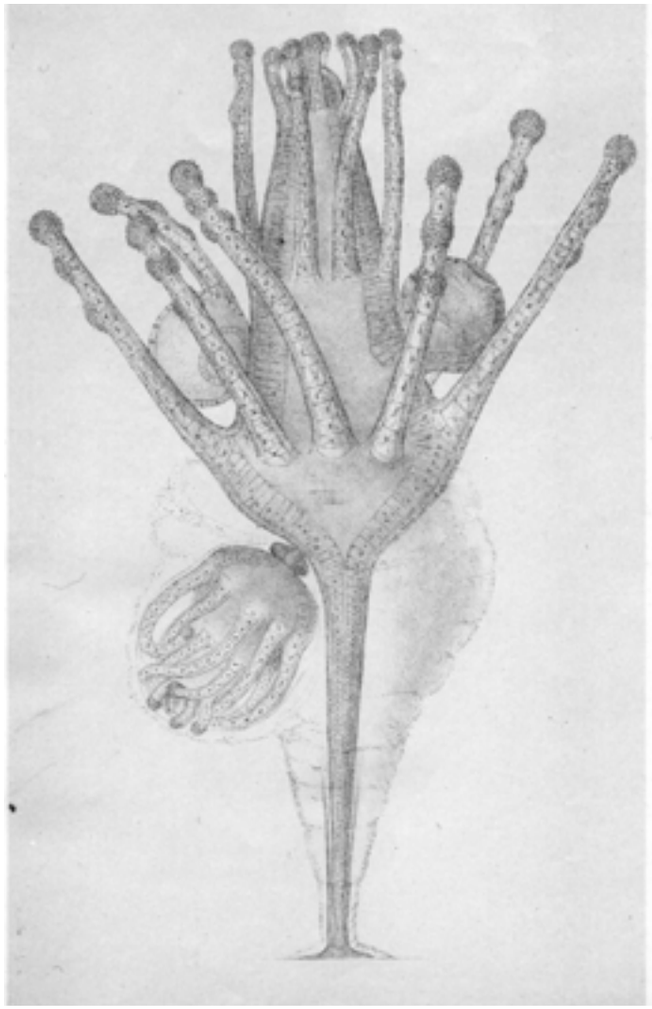


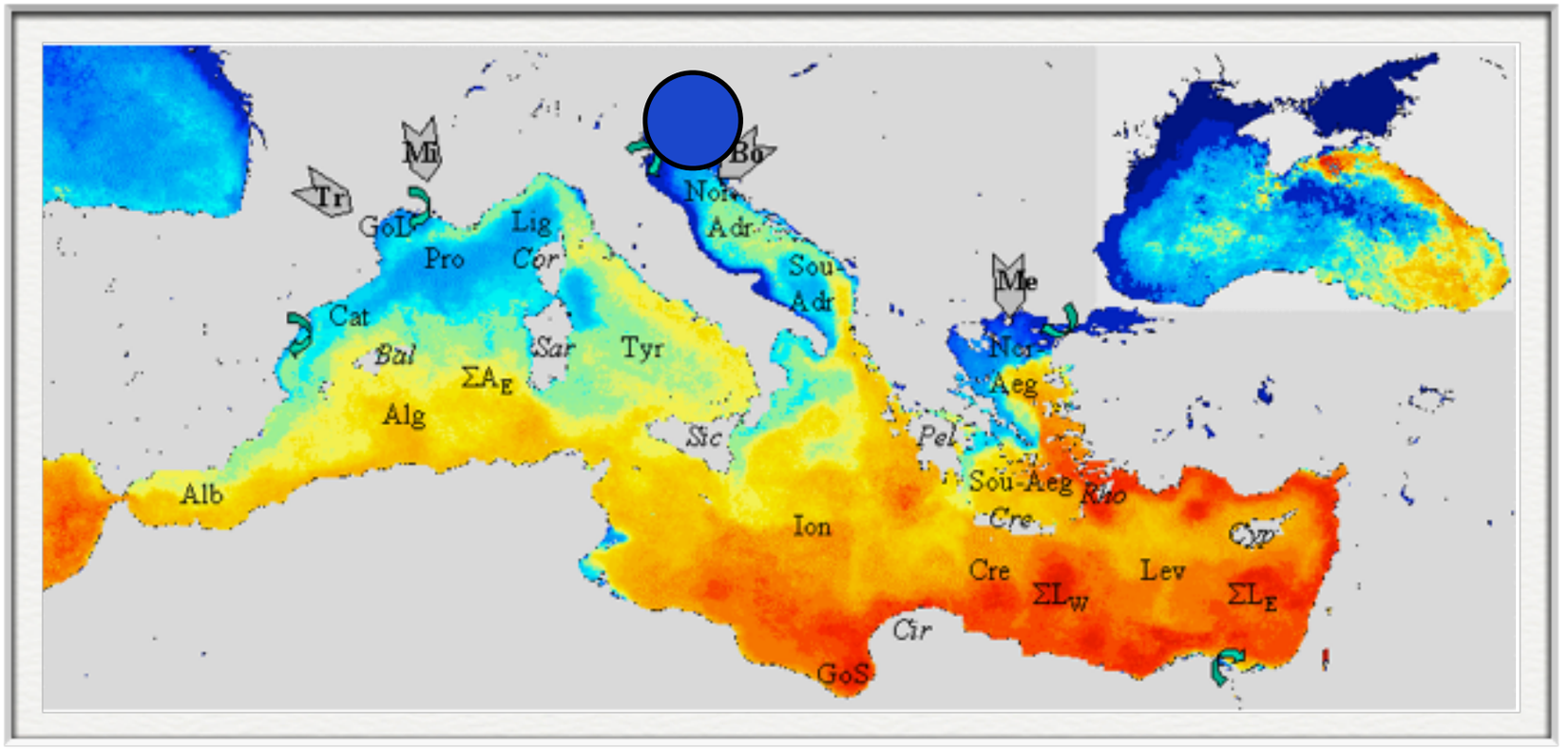
Le acque profonde del Mediterraneo si formano nel Gulfo del Leone (per il bacino occidentale) e nel Nord Adriatico (per quello orientale).



Il transient ha sconvolto questo schema: le acque profonde del bacino orientale si sono formate nel nord Egeo, e il contributo adriatico si è interrotto

Le specie tropicali si aggiungono alle locali
E le specie di acqua fredda?



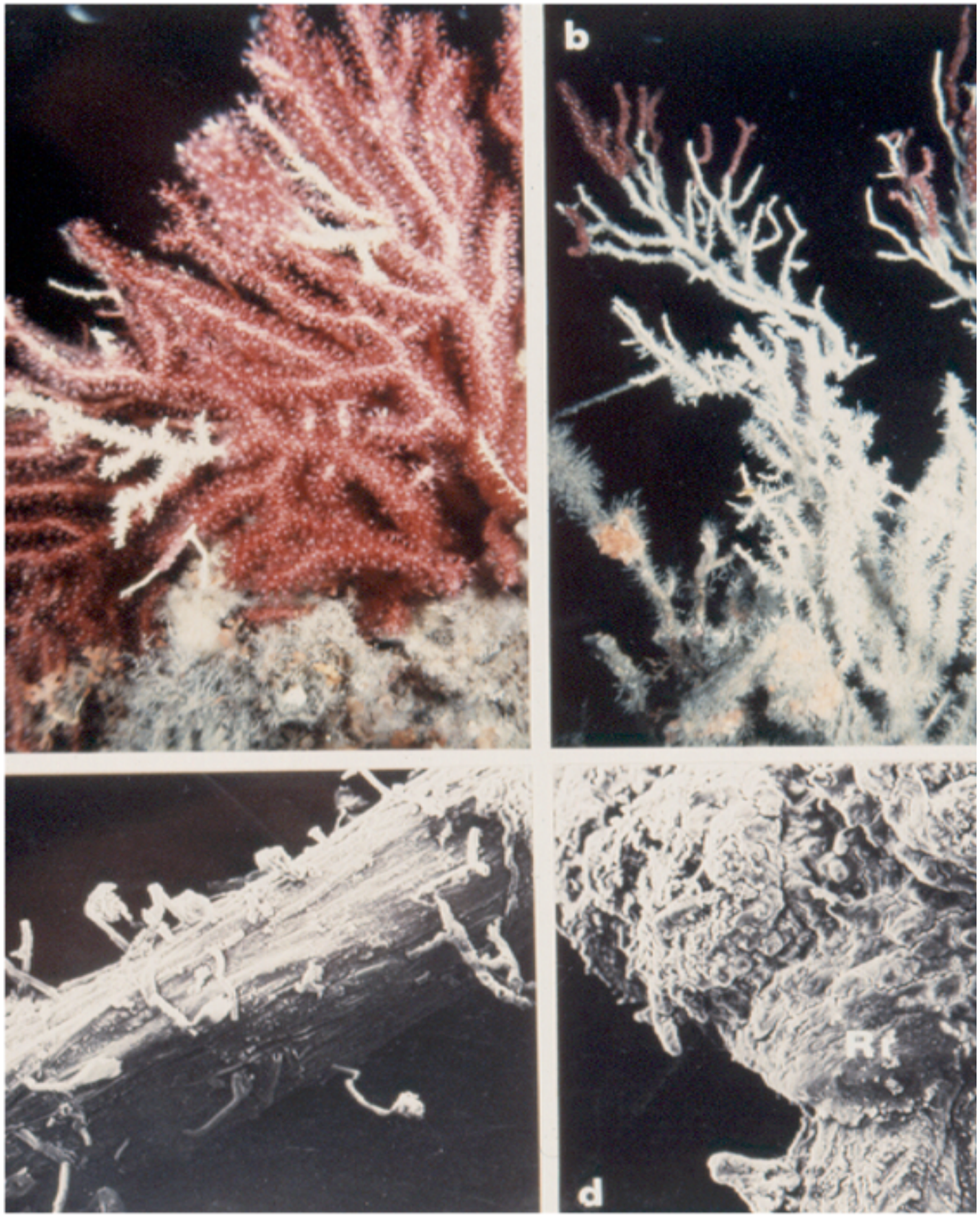


Tricyclusa singularis, l'unica rappresentante della famiglia Tricyclusidae, è stata trovata solo una volta in Mediterraneo, nel Gulfo di Trieste, dove fu descritta, nel 1865

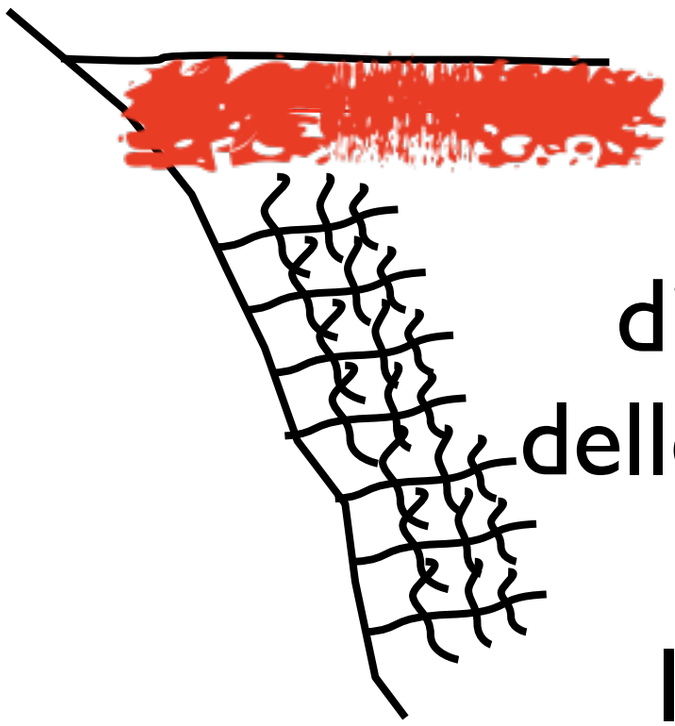
Risposte al riscaldamento globale? le mortalità massive sotto il termoclino estivo

Ottobre 1999: mortalità di massa per le gorgonie del Mar Ligure

il termoclino è sceso a 50 m, invece dei soliti 12, e le gorgonie sono sopravvissute solo al di sotto dei 50 m



ESTATE



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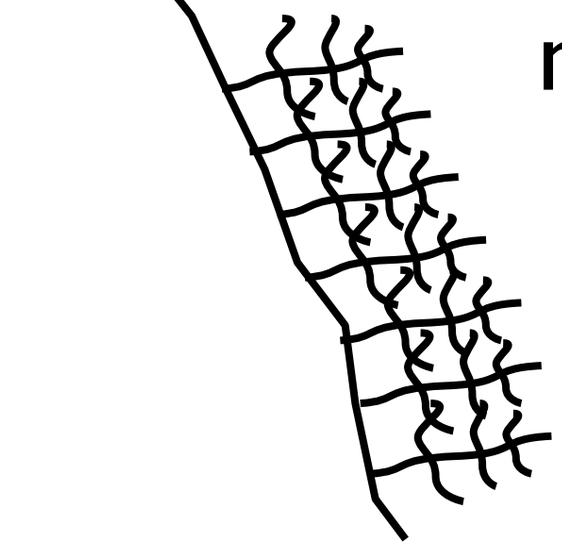
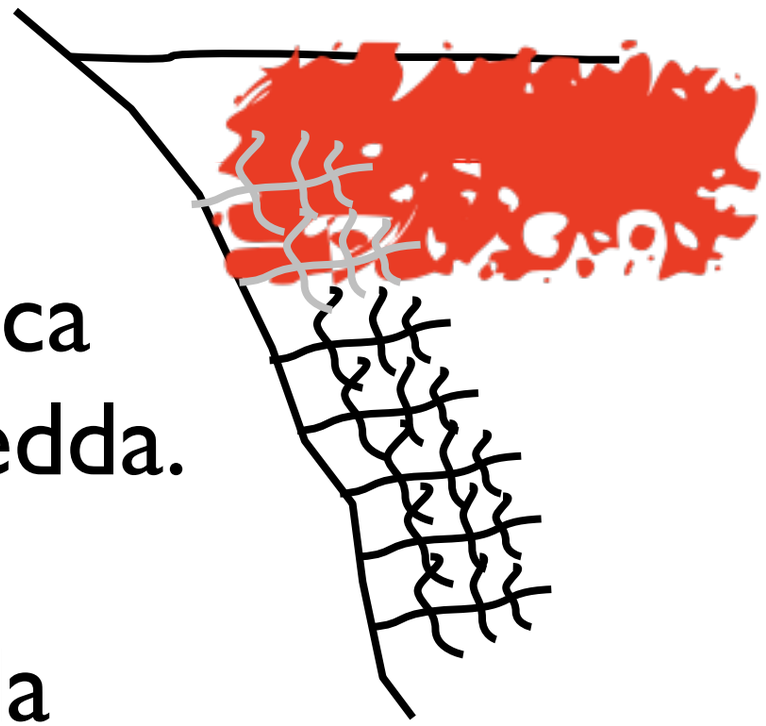


La stratificazione è temporanea, ma determina la distribuzione batimetrica delle specie ad affinità fredda.

Il limite superiore della distribuzione di queste specie mostra la profondità massima della stratificazione

Se la stratificazione si approfonda gli esemplari a bassa profondità muoiono

ESTATE



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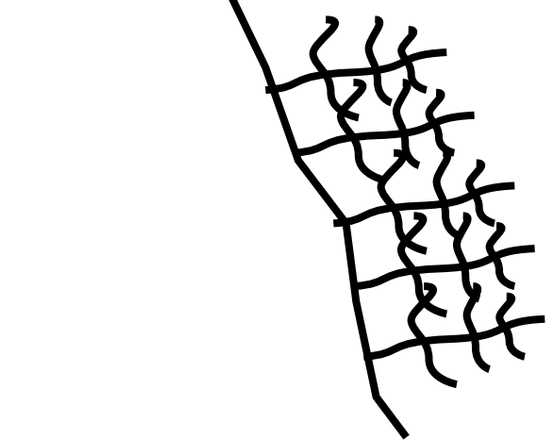


The Pace of Shifting Climate in Marine and Terrestrial Ecosystems

Michael T. Burrows,[1]* David S. Schoeman,[2,3] Lauren B. Buckley,[4] Pippa Moore,[5,6] Elvira S. Poloczanska,[7] Keith M. Brander,[8] Chris Brown,[7,9] John F. Bruno,[4] Carlos M. Duarte,[10,11] Benjamin S. Halpern,[12] Johnna Holding,[11] Carrie V. Kappel,[12] Wolfgang Kiessling,[13] Mary I. O'Connor,[14] John M. Pandolfi,[15] Camille Parmesan,[16] Franklin B. Schwing,[17] William J. Sydeman,[18] Anthony J. Richardson[7,9,19]

Climate change challenges organisms to adapt or move to track changes in environments in space and time. We used two measures of thermal shifts from analyses of global temperatures over the past 50 years to describe the pace of climate change that species should track: the velocity of climate change (geographic shifts of isotherms over time) and the shift in seasonal timing of temperatures. Both measures are higher in the ocean than on land at some latitudes, despite slower ocean warming. These indices give a complex mosaic of predicted range shifts and phenology changes that deviate from simple poleward migration and earlier springs or later falls. They also emphasize potential conservation concerns, because areas of high marine biodiversity often have greater velocities of climate change and seasonal shifts.

Climate warming is a global threat to biodiversity (*1*). Key mechanisms allowing species to cope with warming include shifting biogeographic ranges and altering phenology (the synchronous timing of ecological events) (*2*, *3*) to accommodate spatial and seasonal changes in ambient temperature. Considerable variation in species responses exists: Average range shifts have been reported as 6.1 km/decade for terrestrial communities (*2*), from 1.4 to 28 km/decade for marine communities (*4*), and 16.1 km/decade for a combination of both (*5*), whereas spring phenology has been reported as advancing on average by 2.3 to 2.8 days/decade on land (*2*, *6*) and by 4.3 days/decade at sea (*3*, *7*). One reason for variability in estimates of responses could be that patterns of climate change are dynamic and highly heterogeneous across Earth. Different regions are warming or even cooling at different rates, and air temperatures are rising faster than those of upper ocean waters (*8*), so uniform responses across the globe to climate change should not be anticipated. Instead, organism responses are expected to track the rate of isotherm migration over space and seasons to maintain their thermal niches (*9*, *10*).

Although organisms may respond to aspects of climate change other than temperature, our aim was to generate predictions for shifts in distribution and phenology from physical descriptions of the changing thermal environment, and to compare predictions among regions across the land and ocean. We used global surface temperatures (*11*, *12*) over 50 years (1960–2009) to calculate the distribution of the velocity and seasonal shifts of isotherm migration over land and ocean on a 1°-by-1° grid (*7*). The velocity of climate change (*10*) (in km/year) was calculated as the ratio of the long-term temperature trend (in °C/year)

[1]Department of Ecology, Scottish Association for Marine Science, Scottish Marine Institute, Oban, Argyll, PA37 1QA, Scotland, UK. [2]Environmental Sciences Research Institute, School of Environmental Sciences, University of Ulster, Coleraine, BT52 1SA, Northern Ireland. [3]Department of Zoology, Post Office Box 77000, Nelson Mandela Metropolitan University, Port Elizabeth, 6031, South Africa. [4]Department of Biology, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599, USA. [5]Institute of Biological, Environmental and Rural Sciences, Aberystwyth University, Aberystwyth, SY23 [illegible]. [6]Centre for Marine Ecosystems Research, [illegible] University, Perth, 6027, Australia. [7]Climate [illegible] Commonwealth Scientific and Industrial [illegible] Marine and Atmospheric Research, [illegible] eral Post Office Box 2583, Brisbane [illegible]001, Australia. [8]National Institute of Aquatic [illegible], Technical University of Denmark, Charlo[illegible] Slot, Jægersborg Allé 1, Charlottenlund, Denmark. [illegible] of Biological Sciences, University of Queensland, [illegible], Queensland 4072, Australia. [10]The University of [illegible]rn Australia Oceans Institute, University of We[illegible]ustralia, 35 Stirling Highway, Crawley 6009, Aus[illegible] Department of Global Change Research, Institut[illegible]náneo de Estudios Avanzados (Consejo Superior de Investigaciones Científicas, University of the Balearic [illegible], Esporles, 07190, Spain. [12]National Center for Ecological Analysis and Synthesis, University of California Santa Barbara, 735 State Street, Suite 300, Santa Barbara, CA 93101, USA. [13]Museum für Naturkunde at Humboldt University, Invalidenstrasse 43, 10115 Berlin, Germany. [14]Department of Zoology and Biodiversity Research Centre, University of British Columbia, Vancouver, Canada V6T 1Z4. [15]School of Biological Sciences, Australian Research Council Centre of Excellence for Coral Reef Studies, University of Queensland, Brisbane, Queensland 4072, Australia. [16]Section of Integrative Biology, University Station C0930, University of Texas, Austin, TX 78712, USA. [17]Southwest Fisheries Science Center, National Oceanic and Atmospheric Administration Fisheries Service, 1352 Lighthouse Avenue, Pacific Grove, CA 93950, USA. [18]Farallon Institute for Advanced Ecosystem Research, Post Office Box 750756, Petaluma, CA 94975, USA. [19]Centre for Applications in Natural Resource Mathematics, School of Mathematics and Physics, University of Queensland, St Lucia, Queensland 4072, Australia

*To whom correspondence should be addressed. E-mail: michael.burrows@sams.ac.uk

using light for energy or plants for food or having surface-living planktonic stages. For terrestrial species, the option exists to move to greater altitude to track thermal conditions, but depth changes have been reported for only a few marine organisms, such as fish (*15–17*) and hydroids (*18*). For species that cannot adjust their depth, range shifts may be limited by the availability of suitable habitat. Where such habitat is not aligned with the velocity of climate change, as happens on east-west coastlines (*19*), the velocity along the axis of the habitat could be much faster (*7*).

ORIGINAL ARTICLE

Long-term changes in hydroid (Cnidaria, Hydrozoa) assemblages: effect of Mediterranean warming?

Stefania Puce[1], Giorgio Bavestrello[1], Cristina Gioia Di Camillo[1] & Ferdinando Boero[2]

1 DiSMar, Università Politecnica delle Marche, Ancona, Italy
2 DiSTeBA, Università del Salento, Lecce, Italy

Keywords
Benthic assemblages; Cnidaria; global warming; Hydrozoa; marine hydroids; Mediterranean Sea.

Correspondence
Dr Stefania Puce, DiSMar, Università Politecnica delle Marche, Via Brecce Bianche, 60131 Ancona, Italy.
E-mail: s.puce@univpm.it

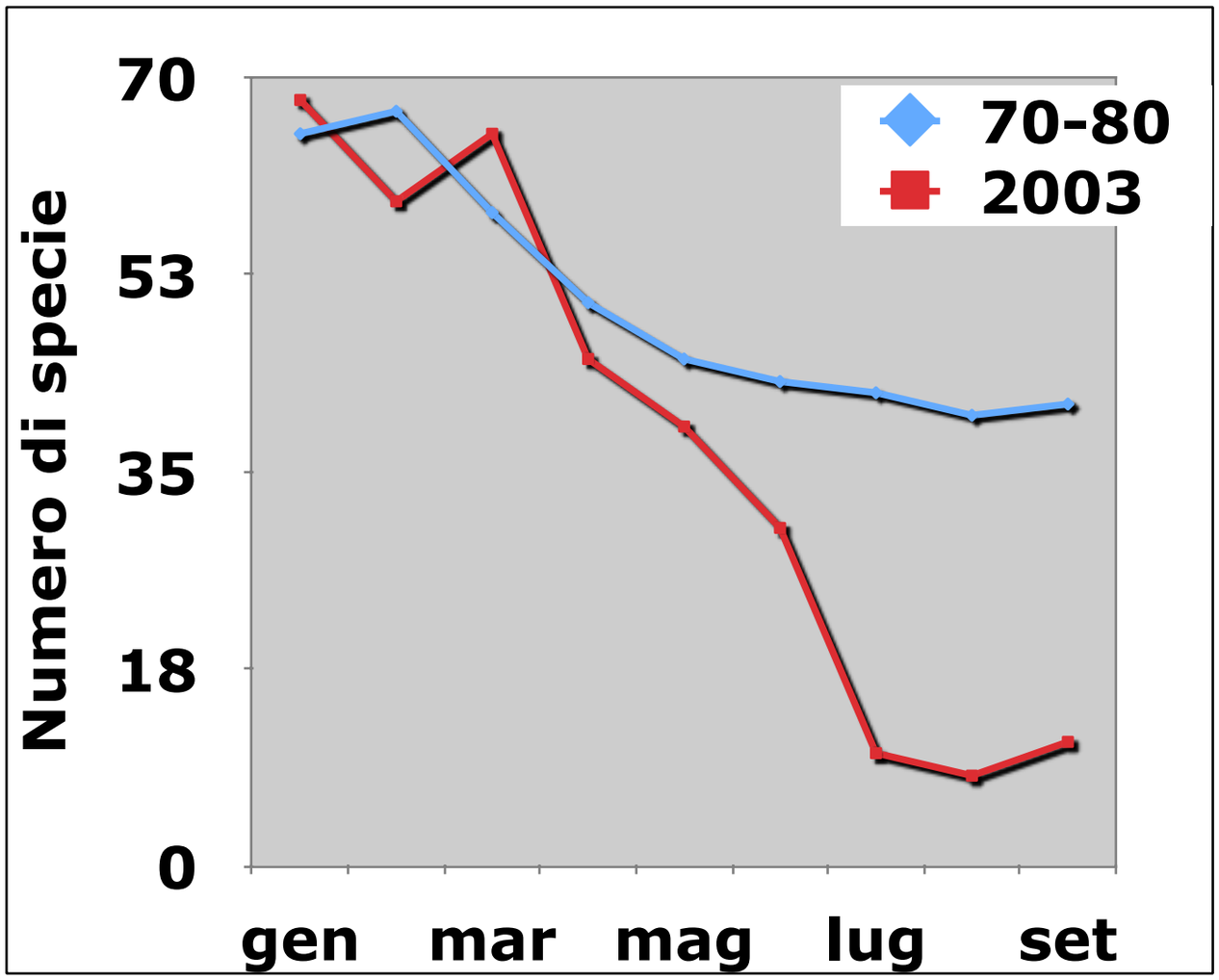
Accepted: 29 December 2008

doi:10.1111/j.1439-0485.2009.00283.x

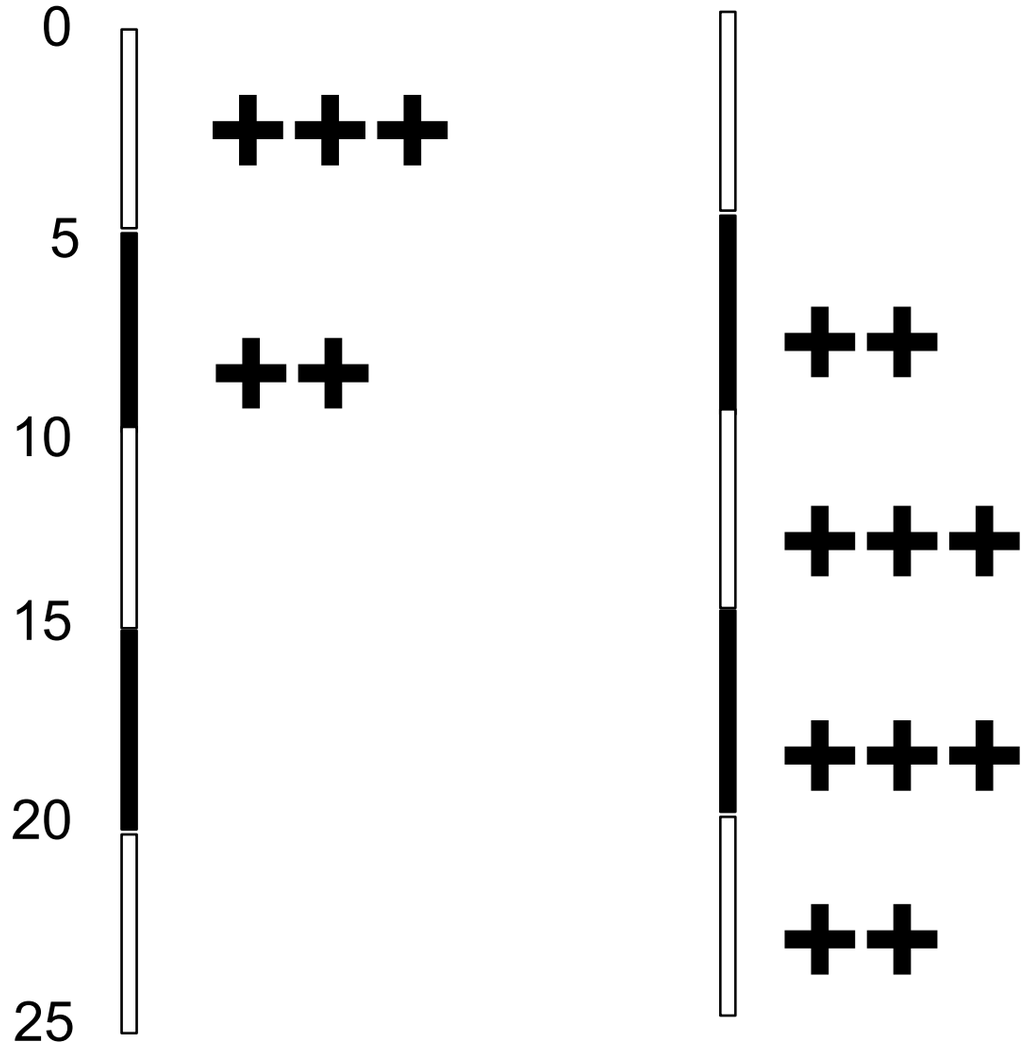
Abstract

Marine hydroids are markedly seasonal in temperate seas, being extremely sensitive to climatic changes disrupting seasonal patterns. Modifications in the composition, seasonality, bathymetric distribution and reproductive period of hydroid assemblages are useful to evaluate the influence of global warming on the marine ecosystem. The hydroids on the rocky cliff of the Portofino Promontory (Ligurian Sea, Italy) were carefully studied between 1976 and 1983; in particular, in 1980 the study was carried out along a vertical transect. The hydroids were sampled again throughout 2004, with the same techniques and along the same transect. Species diversity decreased slightly in the 2004 survey. Some species present in 1980 had disappeared in 2004, but other species with southern affinity, never recorded from the area, became abundant in 2004. Species that were present in summer in the first period were also present in winter in the second one. Furthermore, shallow summer species widened their bathymetric distribution, reaching deeper levels. These data strongly suggest that the Portofino hydroid assemblage reacted to the water temperature increase found in the Mediterranean Sea.

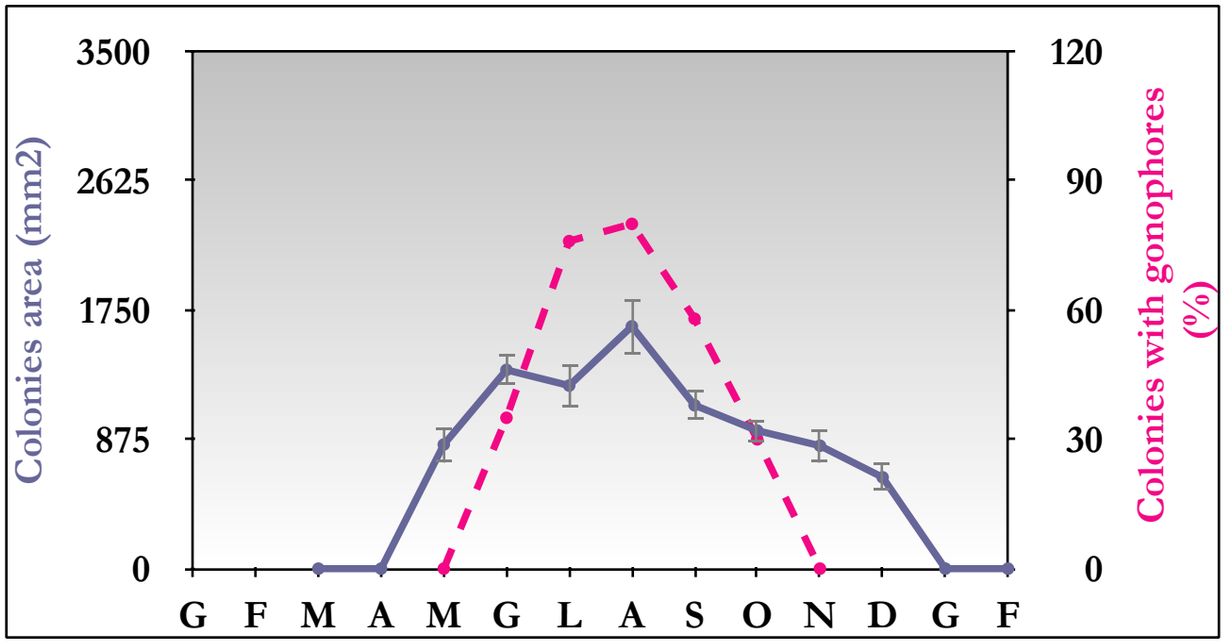
In inverno il numero di specie è sostanzialmente simile (60 nei 70-80, 55 nel 2003, 47 in comune) mentre in estate è drasticamente diminuito

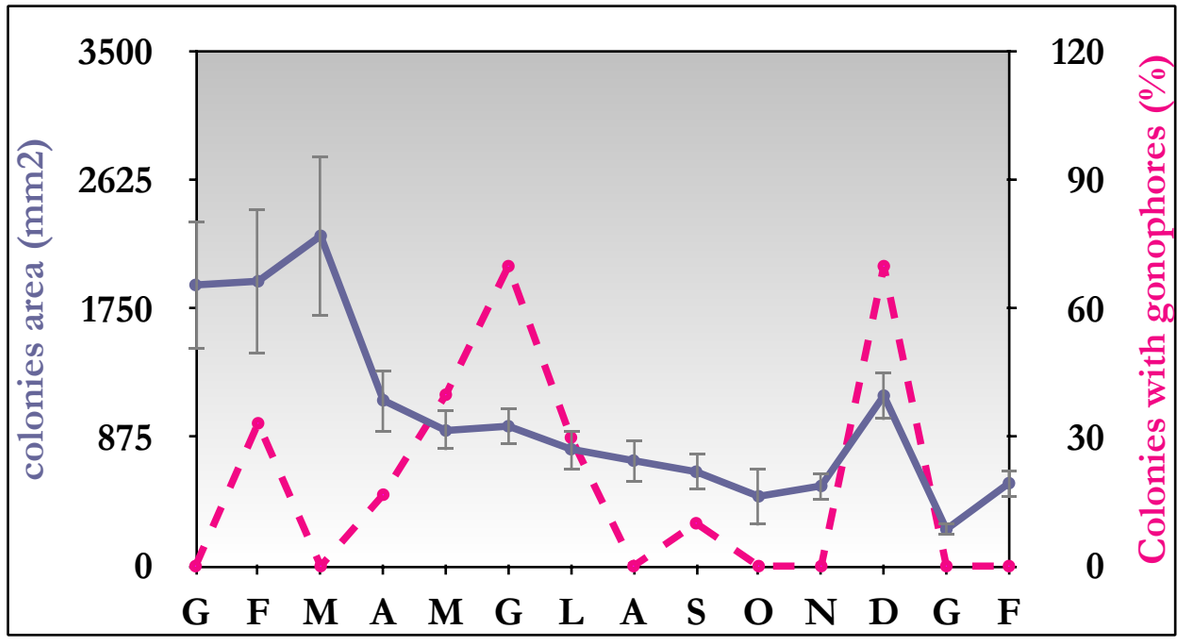


Altre specie hanno cambiato distribuzione batimetrica. *Hydractinia fucicola* e *Eudendrium capillare*, un tempo presenti nella fascia 0 – 5 m sono attualmente abbondanti fino a 25 m

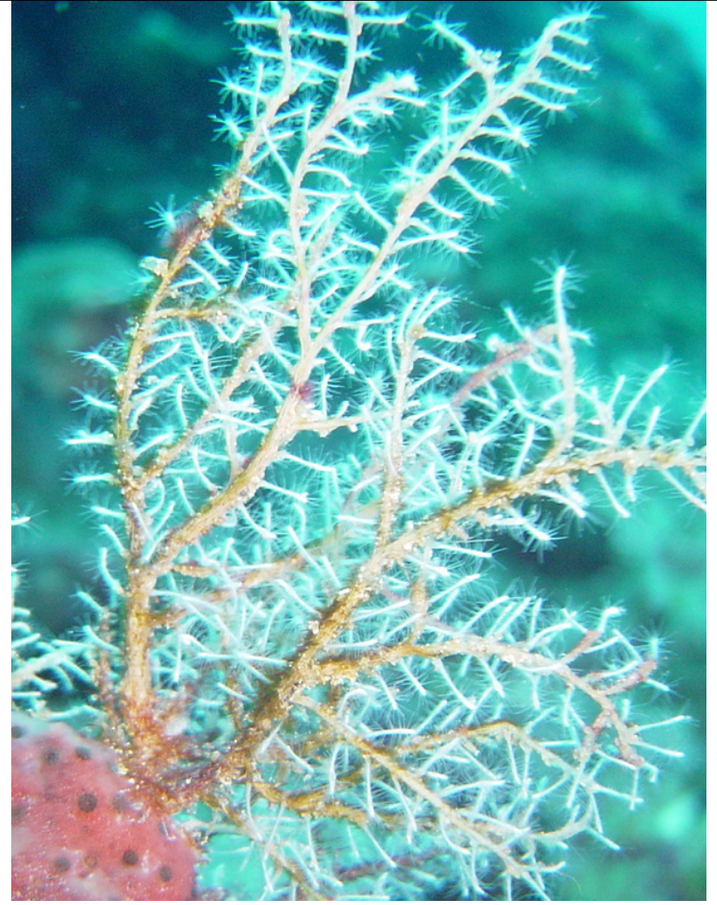


CAMBIANO LE FENOLOGIE





Eudendrium racemosum, un tempo decisamente estivo, è ora presente tutto l'anno



CAMBIANO LE SPECIE DOMINANTI

Prima abbondanti e ora rare:

Bougainvillia muscus
Obelia geniculata
Halecium spp.
Tubularia larynx

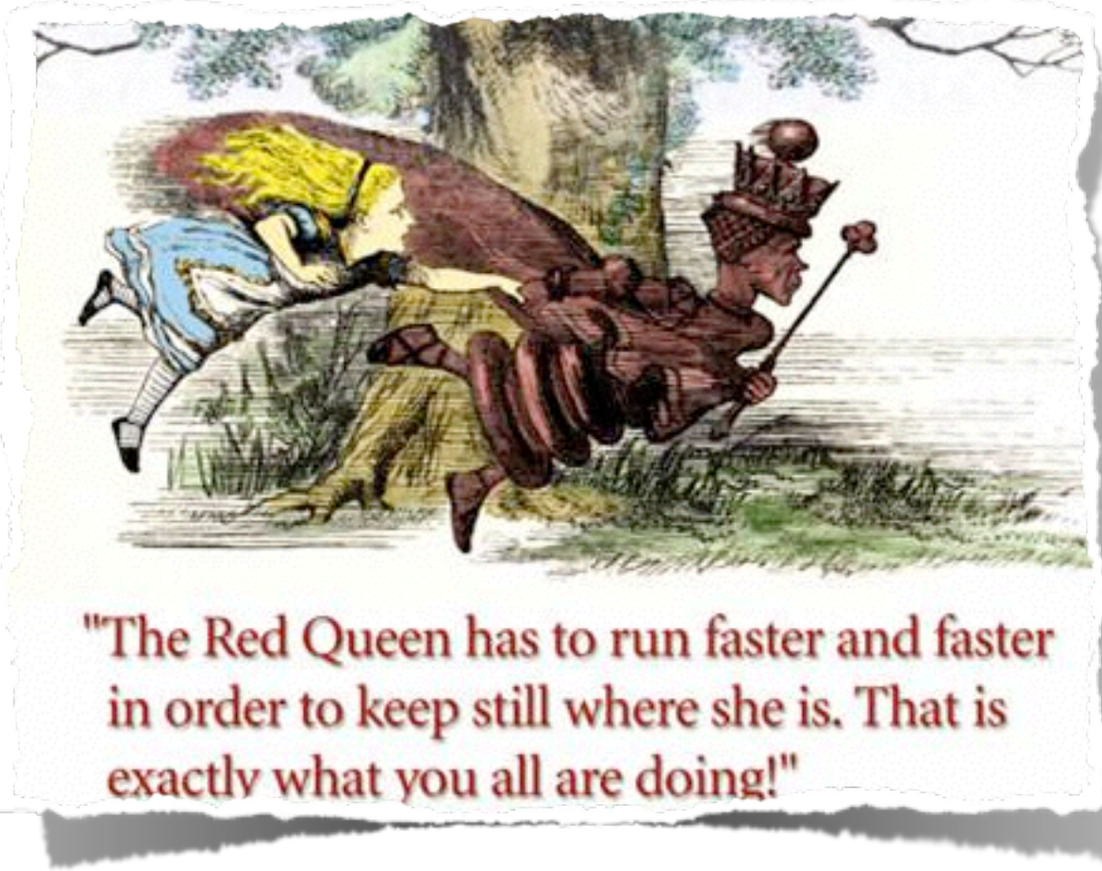
Prima assenti ora abbondanti:

Eudendrium moulouyensis
Filellum serratum
Corydendrium parasiticum
Pennaria disticha

La stabilità non esiste

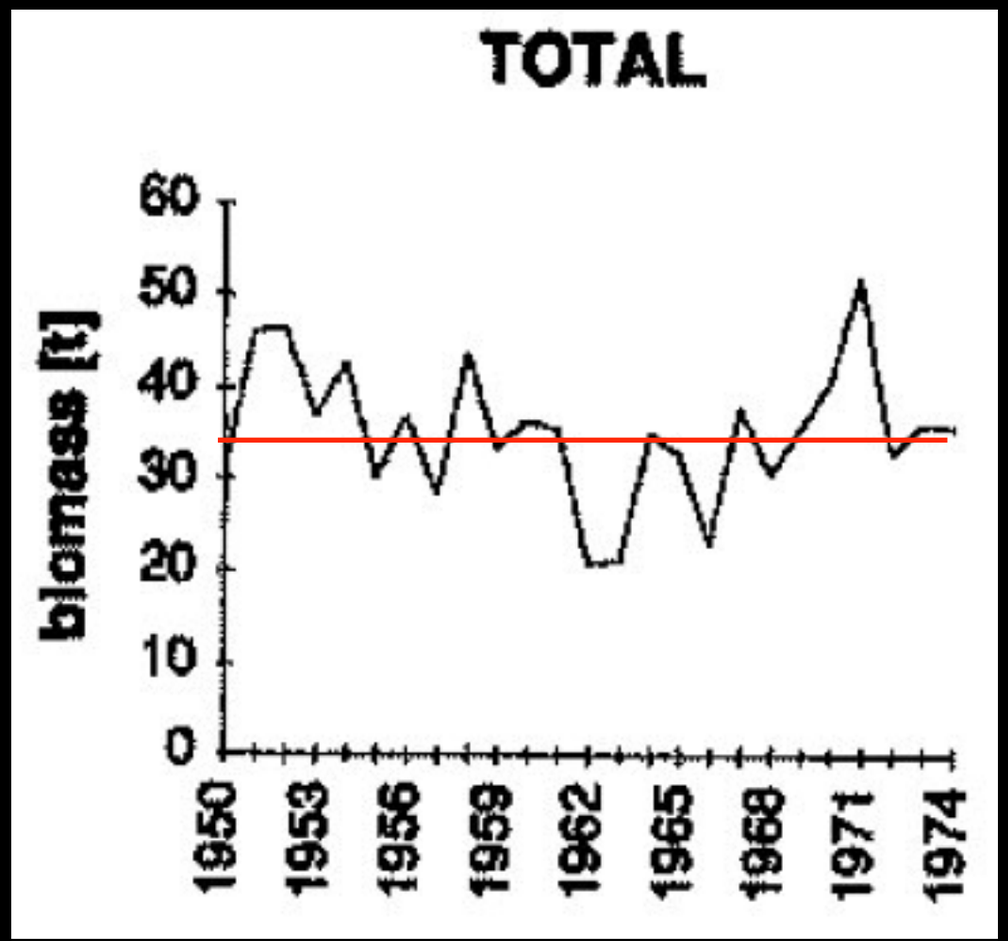
l'ecologia e l'evoluzione sono scienze storiche: osservando a scale temporali adeguate si vede che nulla rimane uguale!

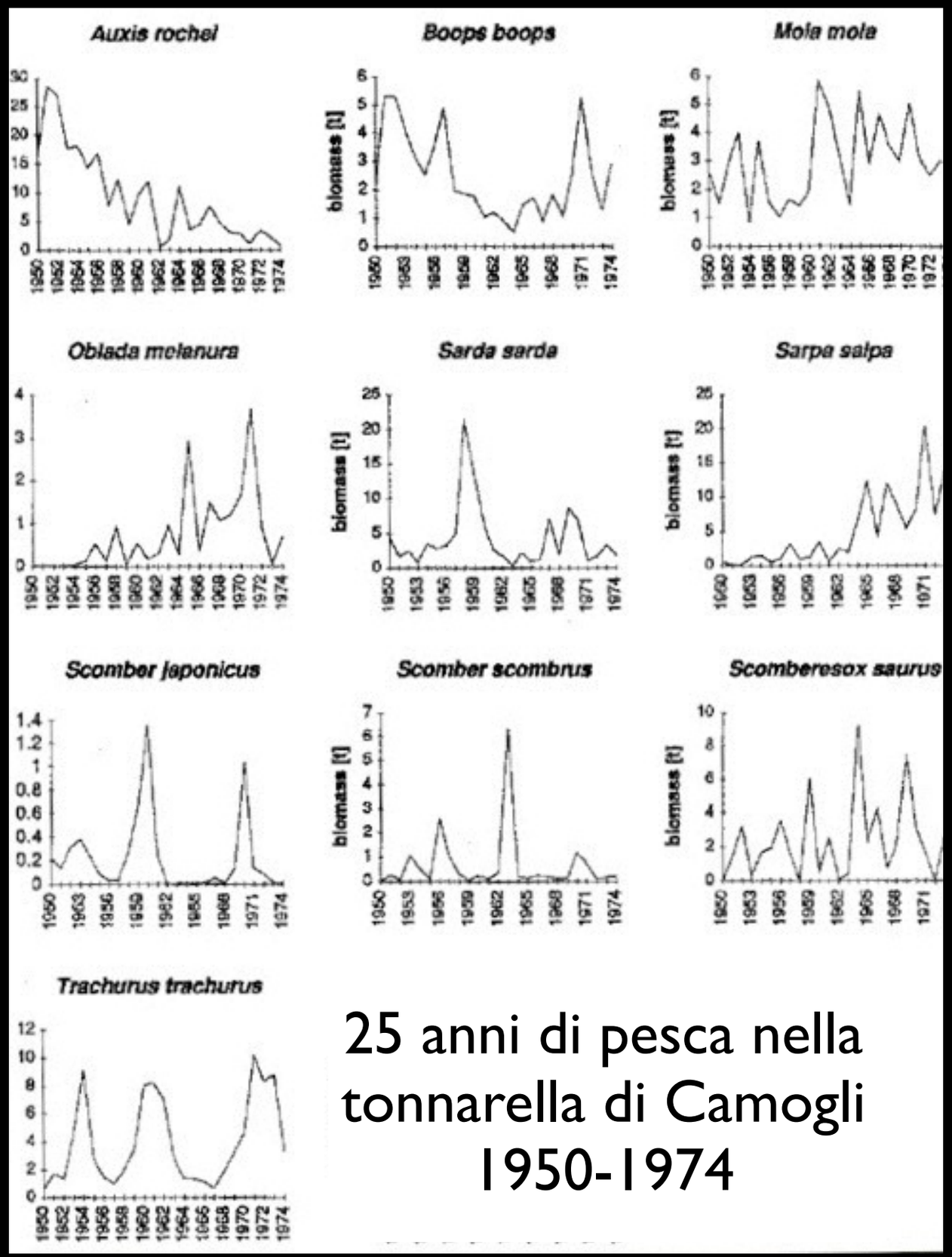
la biodiversità del Mediterraneo cambia continuamente



cambiava anche prima del riscaldamento globale….

La biomassa totale è costante, ma il contributo delle specie cambia

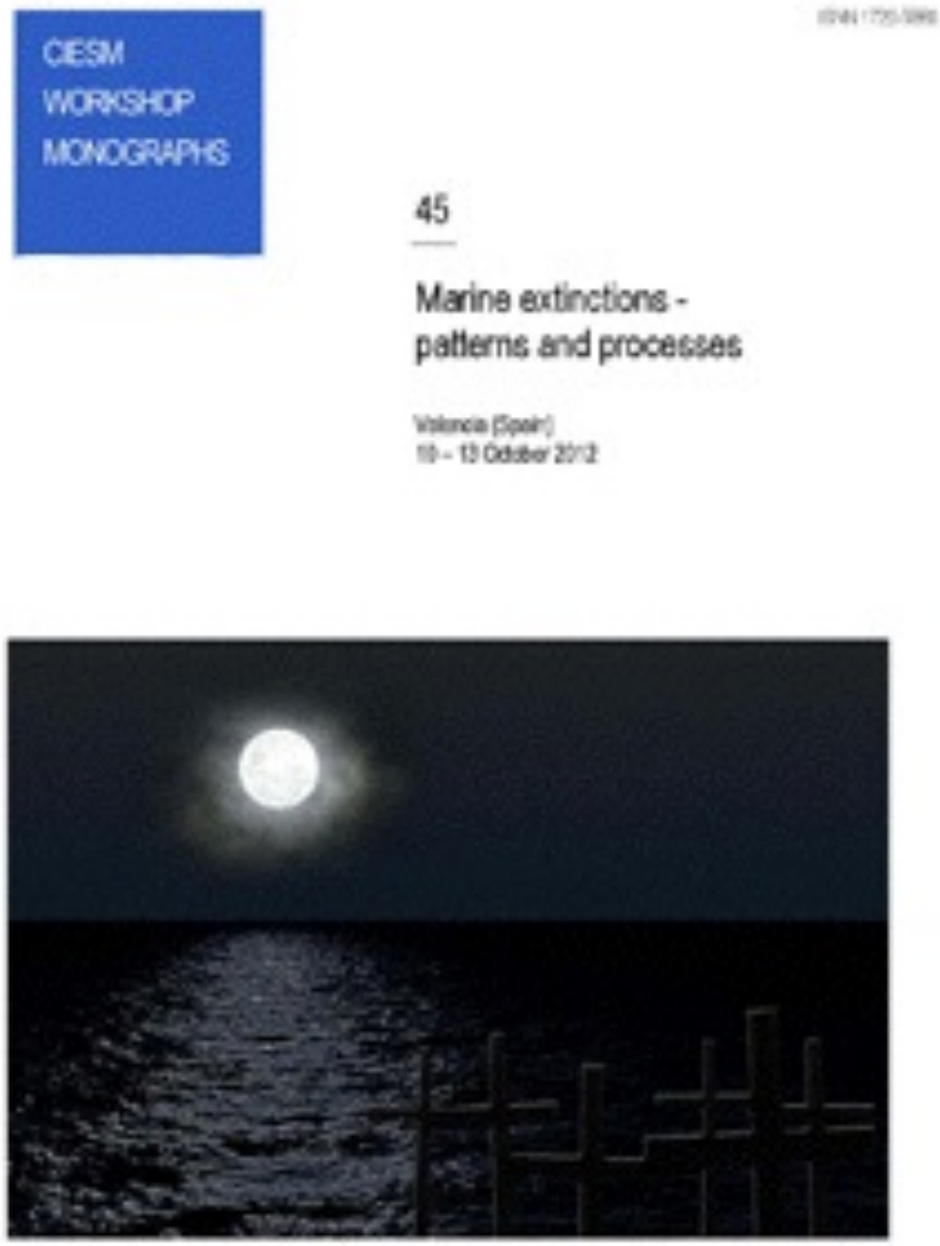




25 anni di pesca nella tonnarella di Camogli 1950-1974

Le specie si estinguono

anche se non è facile dimostrare le estinzioni in mare, ora possiamo capire le differenze tra oggi e ieri e fare liste di specie che non si trovano più

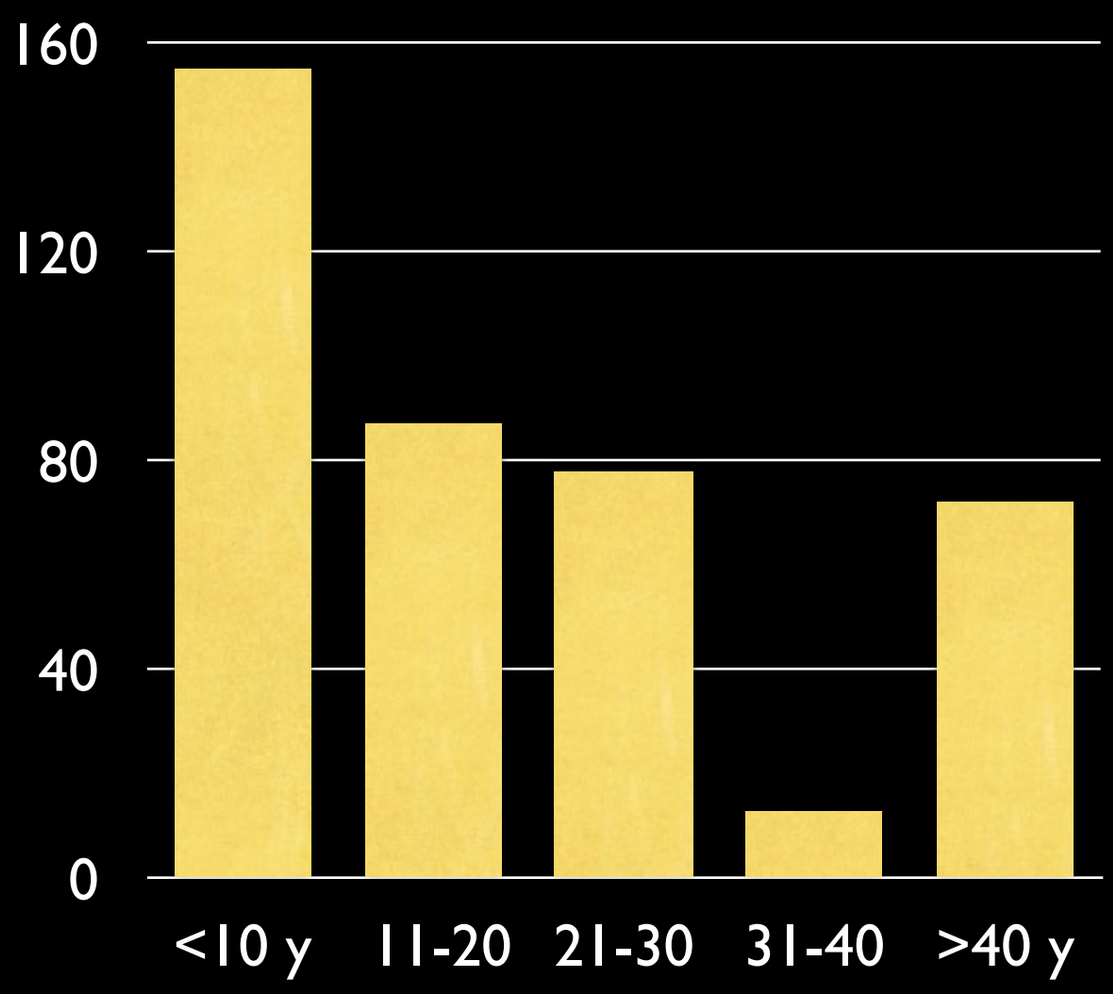


ciò che troviamo

- siamo attratti da ciò che troviamo e aggiungiamo le nuove segnalazioni alle vecchie
- le liste di specie si allungano (soprattutto con specie tropicali)
- apparentemente la biodiversità aumenta
- ma è anche importante documentare ciò che non troviamo più (e spesso sono specie ad affinità fredda)
- quando possiamo rimuovere una specie da una lista?

scavando nel record tassonomico

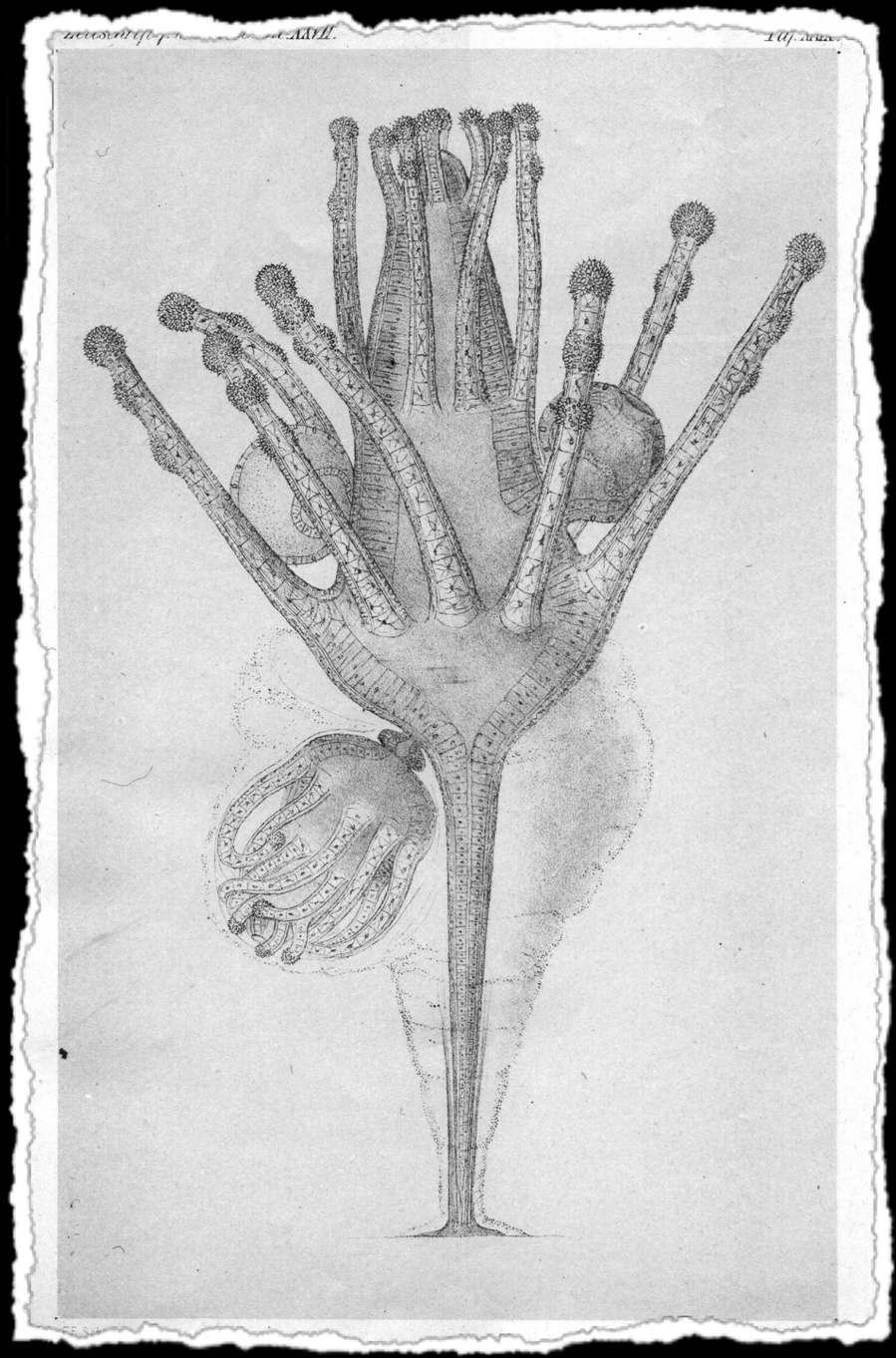
- Nel 1958 gli Hydrozoa conosciuti del Mediterraneo erano rappresentati da 198 specie
- Ora ne conosciamo 405 specie. 155 sono state trovate negli ultimi 10 anni, ma 72 non sono registrate da 40 anni.



dati elaborati da C. Gravili

missing

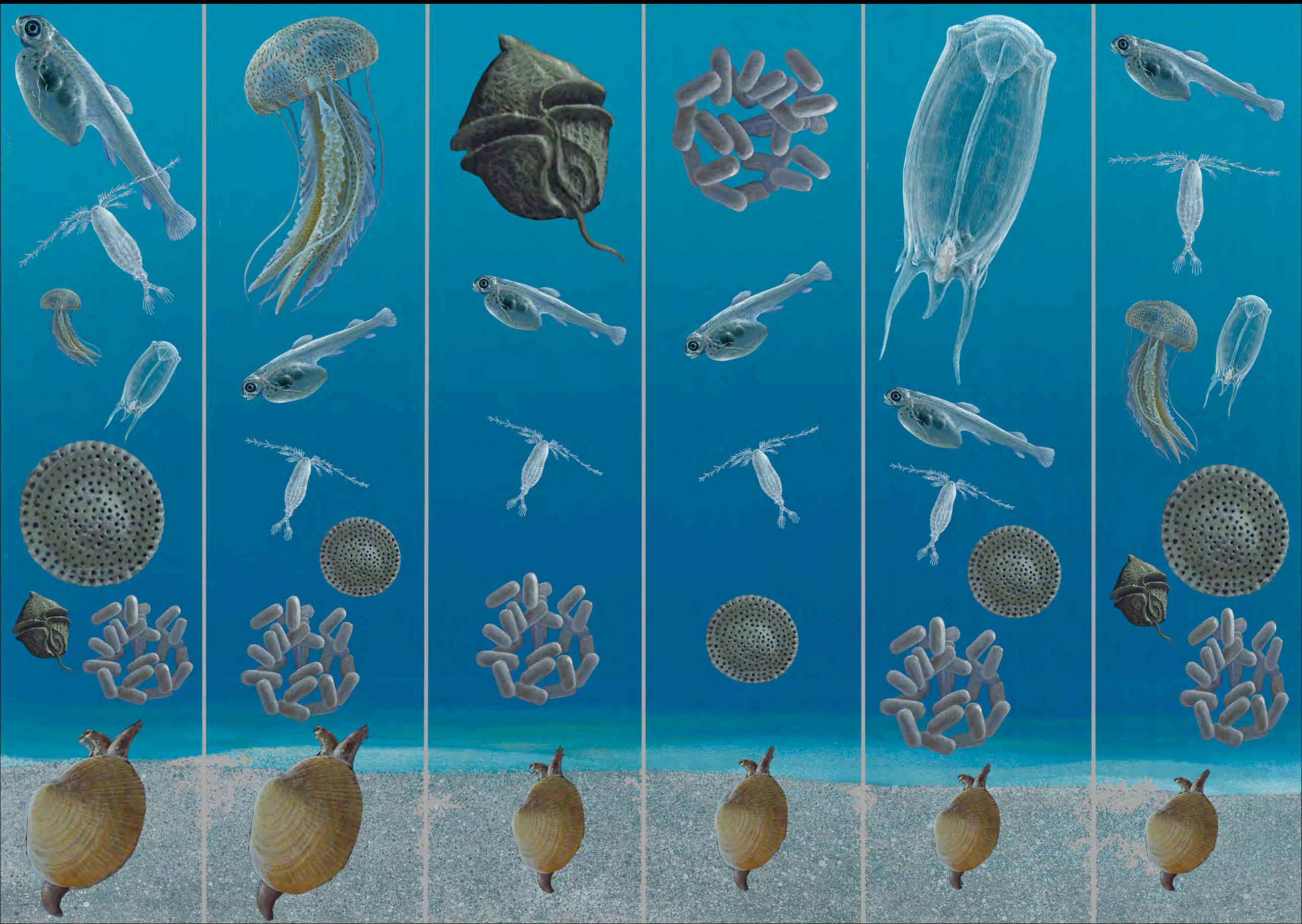
- Ditemi una specie estinta in Mediterraneo!
- Facile: *Tricyclusa singularis*
- Questa specie (unica rappresentante di un genere, e una famiglia) non è più stata trovata dal 1865, forse è estinta. Viveva nel golfo di Trieste, il posto più freddo del Mediterraneo!

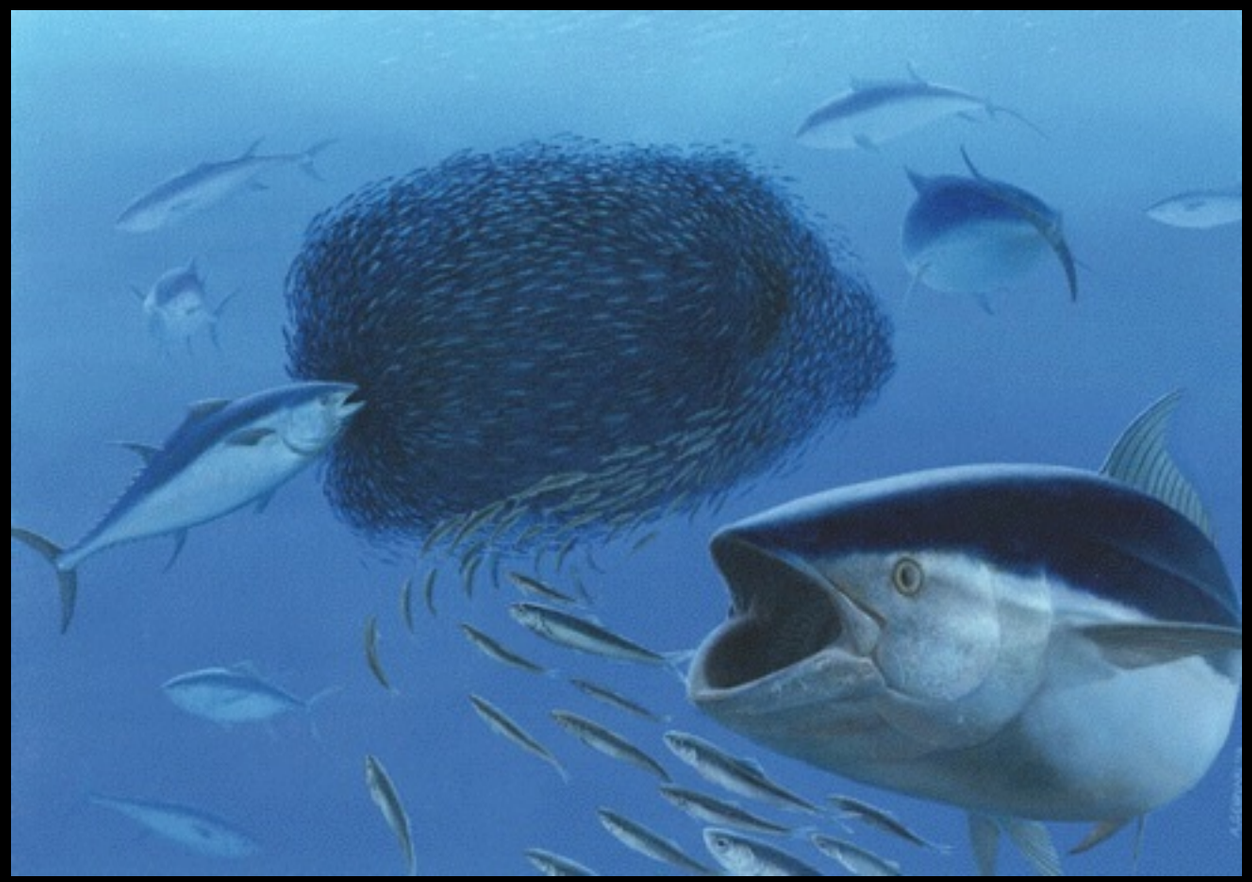


Il cambiamento è una cosa normale

- Nessun problema allora?
- Le specie che si aggiungono sono tutte ad affinità tropicale
- Quelle che non si trovano più sono ad affinità fredda
- Il riscaldamento globale sta condizionando il normale cambiamento dei biota, e lo sta velocizzando, sommandosi ad altri impatti

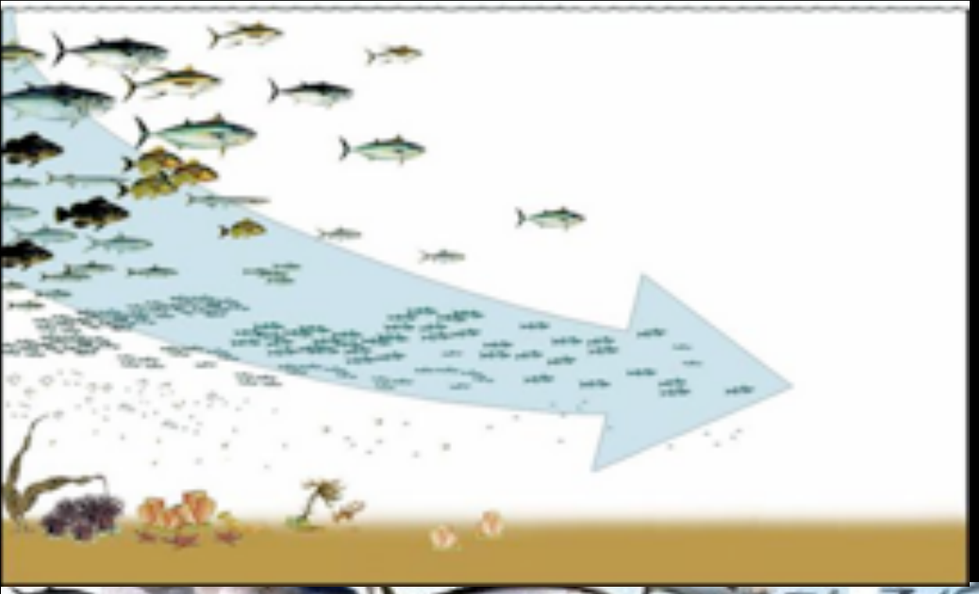
LA STORIA DELL'ADRIATICO





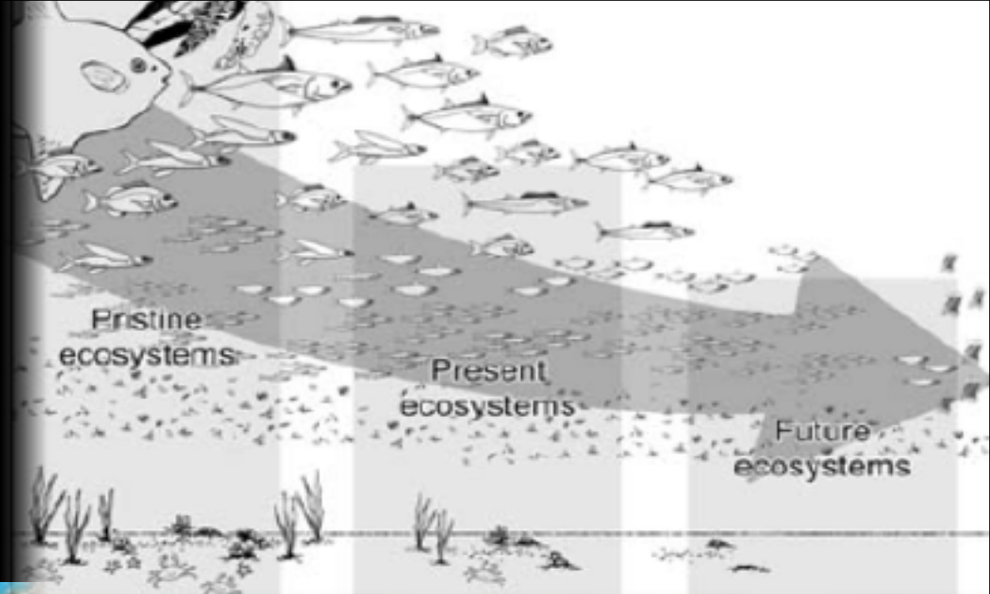
cambiamenti di regime

da un mare di pesci a un mare di meduse

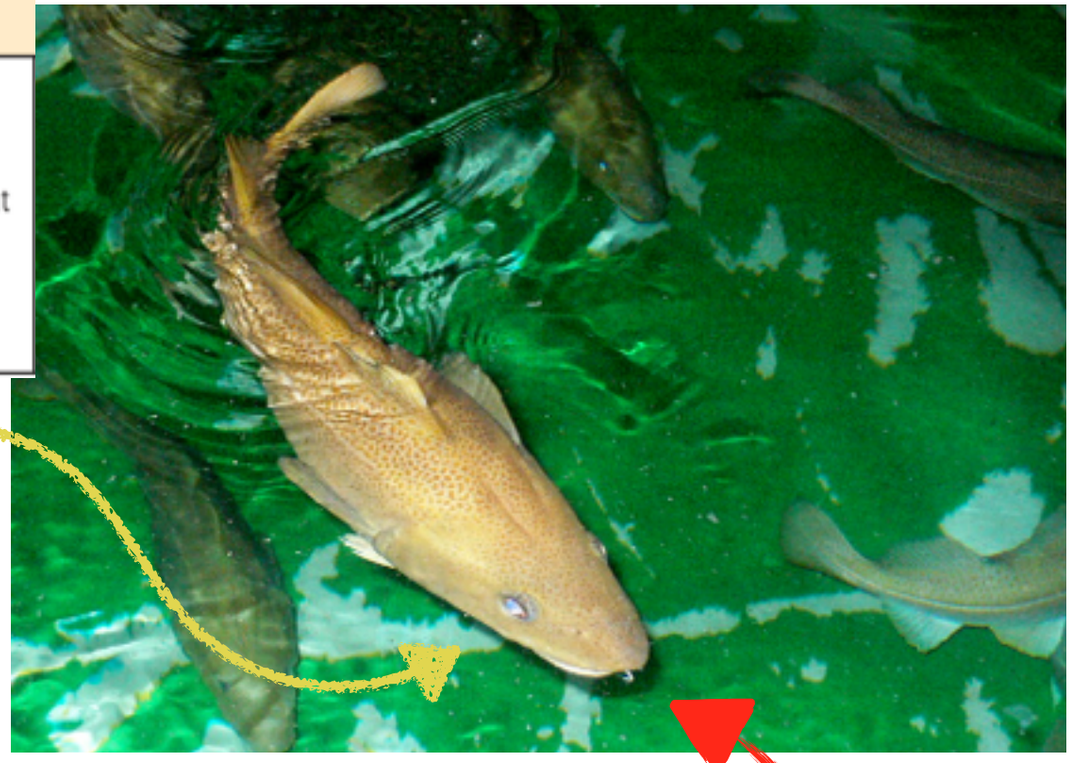


The future is inherently unpredictable!

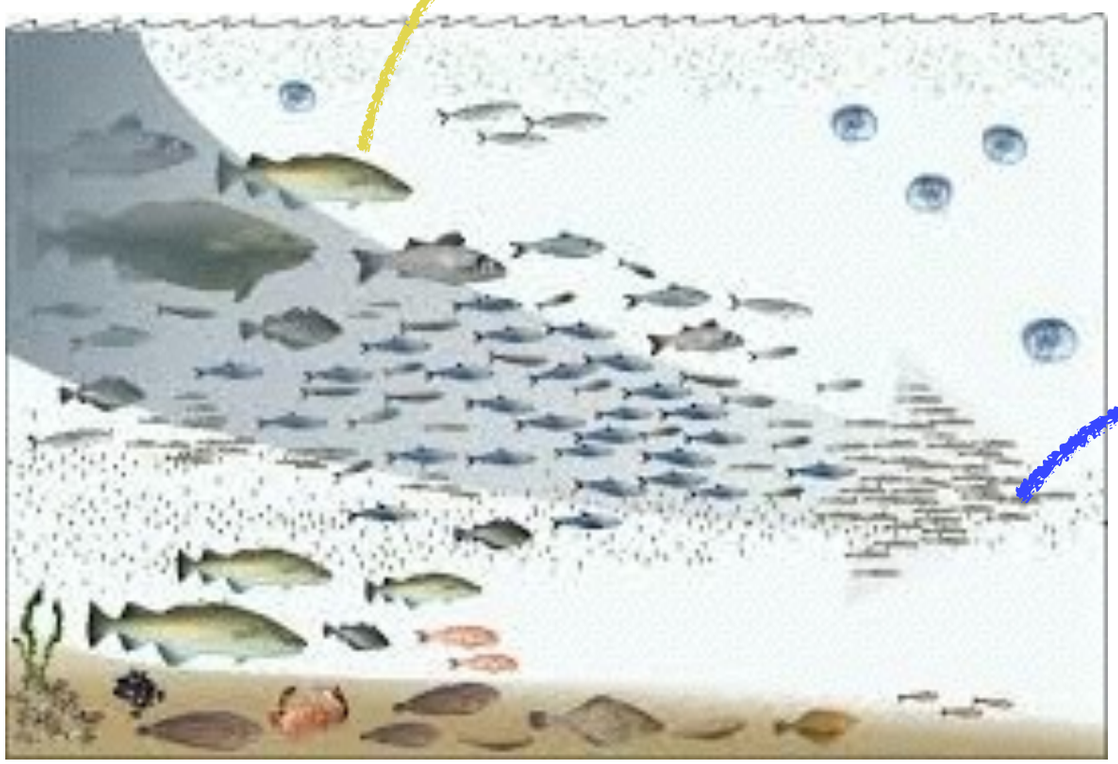
SCENARIOS

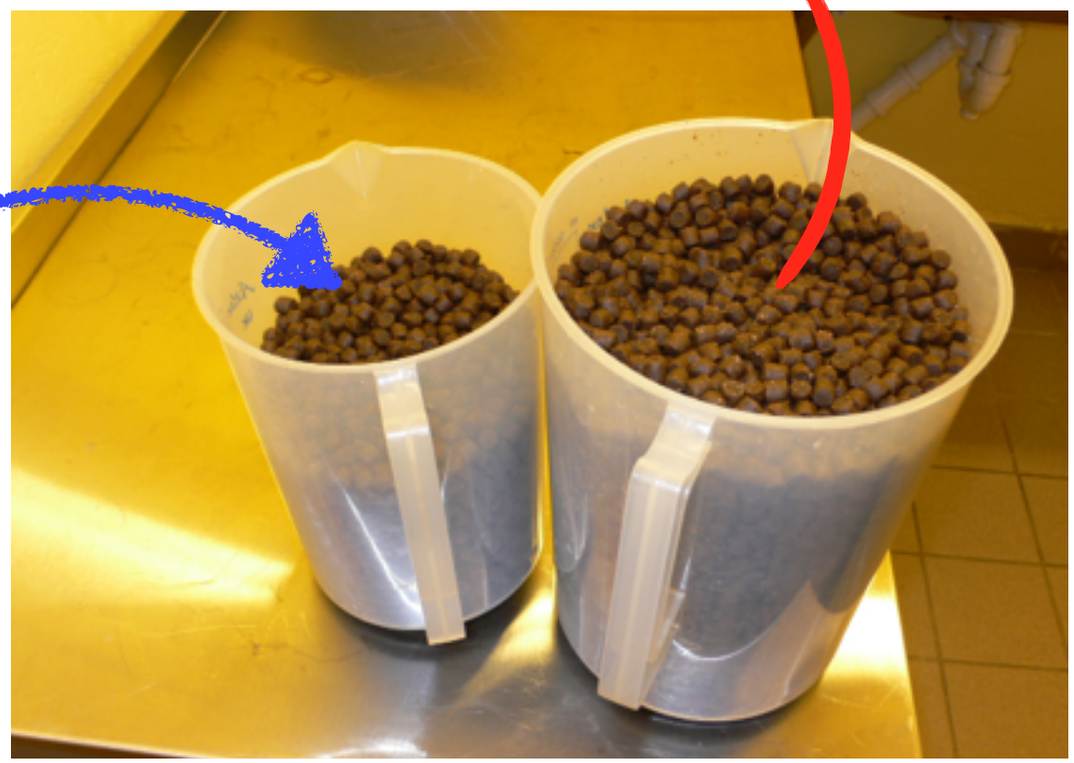


Key risk	Adaptation issues and prospects
	The Ocean
Distributional shift in fish and invertebrate species, and decrease in fishery catch potential at low latitudes, e.g., in equatorial upwelling and coastal boundary systems and sub-tropical gyres (*high confidence*)	• Evolutionary adaptation potential of fish and invertebrate species to warming is limited as indicated by their ongoing latitudinal shifts. • Human adaptation options: Large-scale translocation of industrial fishing activities following the regional decreases (low latitude) vs. possibly transient increases (high latitude) in catch potential; Flexible management that can react to variability and change; Improvement of fish resilience to thermal stress by reducing other stressors such as pollution and eutrophication; Expansion of aquaculture.



expansion of aquaculture???





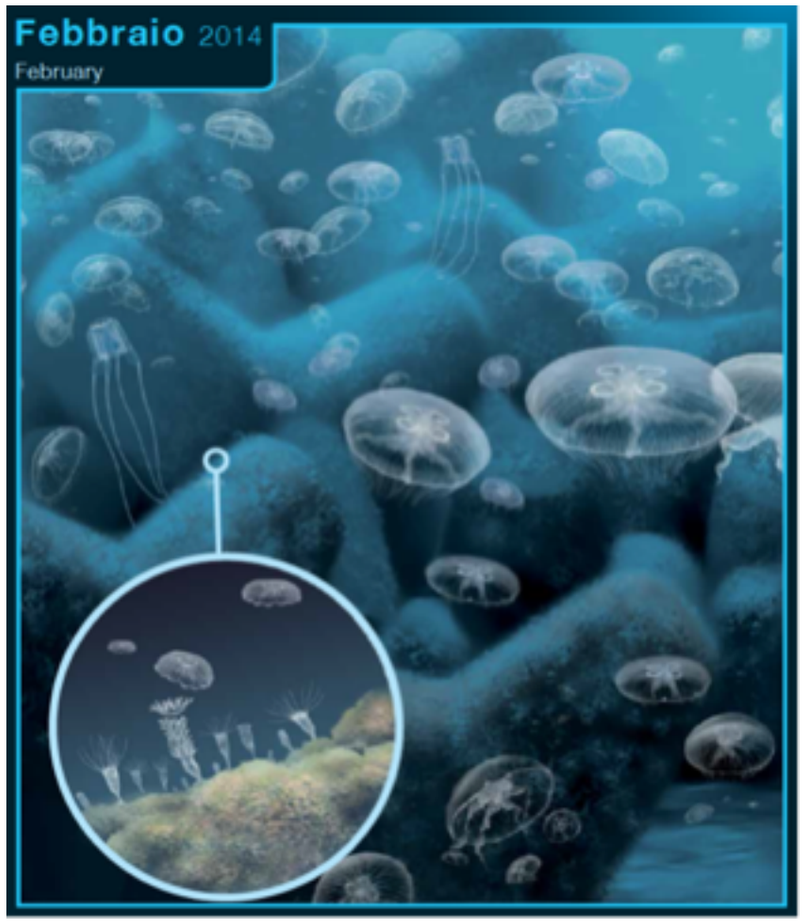
una previsione facile:
queste pratiche sono insostenibili!

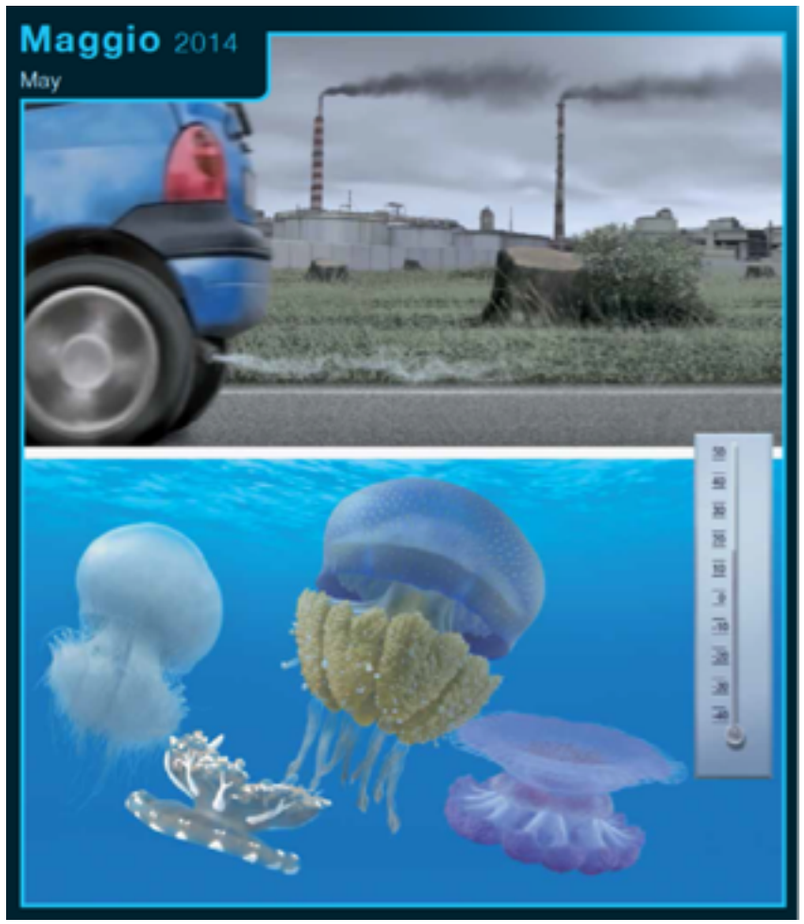
La biodiversità del Mediterraneo risponde molto velocemente

- La fisica indica che sono avvenuti cambiamenti
- Ma se non ci fosse risposta bio-ecologica i cambiamenti fisici avrebbero ben poco significato
- I sistemi bio-ecologici sono ottimi sensori di cambiamento globale

- Meridionalizzazione
- Tropicalizzazione
- Cambiamenti di fenologia
- Mortalità massive
- Possibili estinzioni
- Cambiamenti di regime

Causalità multipla





- In bio-ecologia le cause che determinano un fenomeno sono spesso molteplici

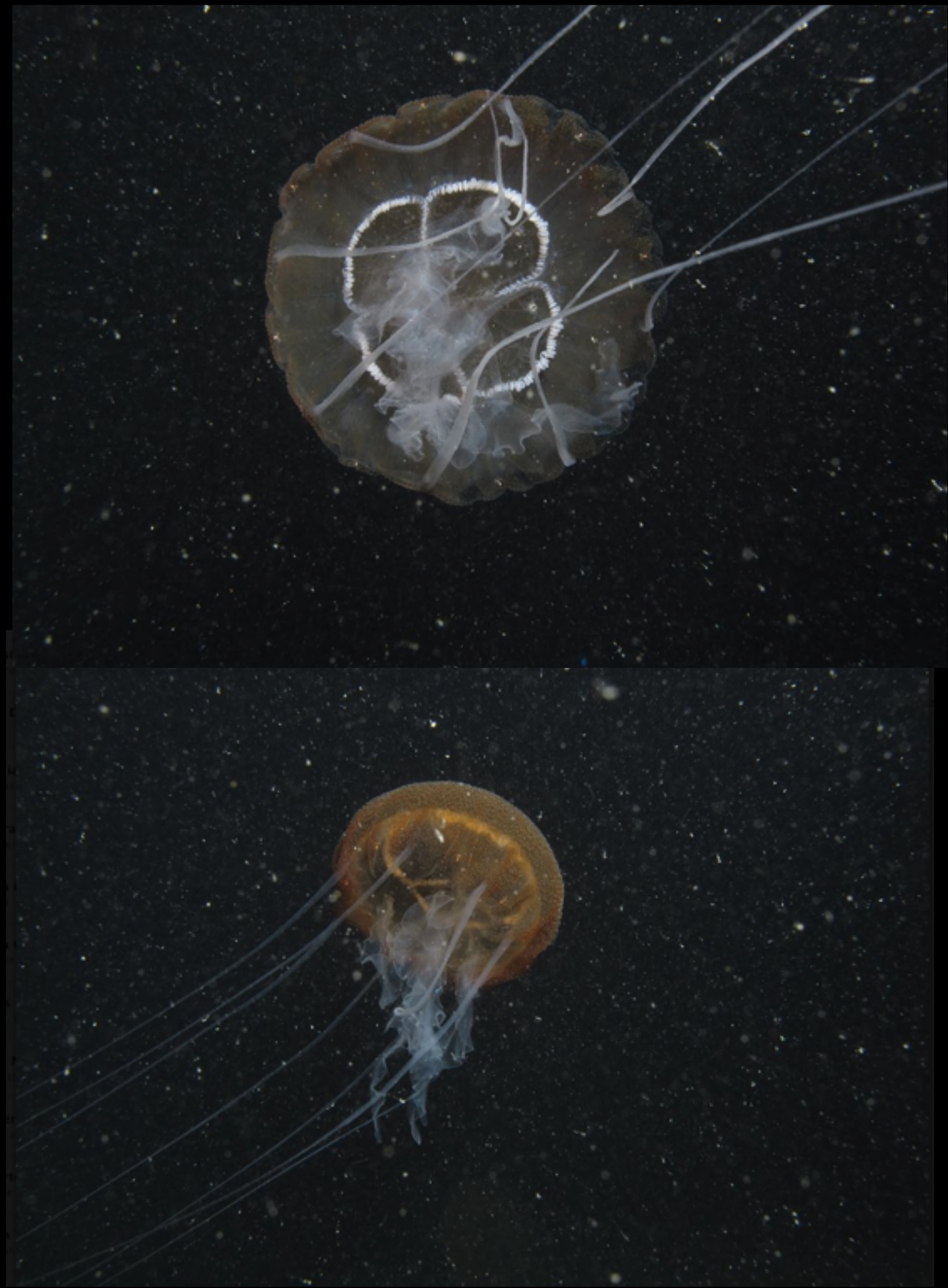
- Per il cambiamento di regime dai pesci alle meduse, per esempio, sono essenzialmente quattro

Novità

- Questa è una nuova specie di *Pelagia*, dedicata a Adam Benovic

- All'inizio del 2014 è apparsa una popolazione cospicua nel golfo di Venezia

- Probabilmente è arrivata con le acque di zavorra di qualche nave, da un posto dove la specie non è mai stata descritta.



Perciò chiunque ascolta queste mie parole e le mette in pratica, è simile a un uomo saggio che ha costruito la sua casa sulla **roccia**. Cadde la pioggia, strariparono i fiumi, soffiarono i venti e si abbatterono su quella casa, ed essa non cadde, perché era fondata sopra la roccia. Chiunque ascolta queste mie parole e non le mette in pratica, è simile a un uomo stolto che ha costruito la sua casa sulla **sabbia**. Cadde la pioggia, strariparono i fiumi, soffiarono i venti e si abbatterono su quella casa, ed essa cadde, e la sua rovina fu grande. (Matteo 7,24-27)

Abbiamo costruito la ferrovia adriatica sulla sabbia e ora la proteggiamo con la roccia….. adattamento o stupidità?

Perseverare è diabolico!

Non possiamo crescere all'infinito, eppure il paradigma della crescita continua a prevalere.

Se la nostra economia cresce qualcos'altro decresce: la Natura

Chi disegna l'economia dimenticando la Natura ci sta truffando