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Status of small pelagics in the Adriatic Sea and the effects of environmental changes on these stocks

FG Adriatic, Online, 16th April 2024

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National Research Council (CNR) Institute for Marine Biological Resources and Biotechnology

The main research activities of the CNR–IRBIM focus on:

- the biology and ecology of marine organisms, including alien species,
- population structure and distribution of fishery resources,
- sustainable management of fisheries and conservation of resources,
- marine microbial ecology and microbial biotechnology,
- fishery technologies and marine bioacoustics,
- sustainable aquaculture,
- sea observation and anthropogenic impacts on marine ecosystems.





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Personal information

Stock assessment coordinator for the stocks of anchovy and hake in the Adriatic Sea, national expert for the stock assessment of sardine in the Adriatic Sea.

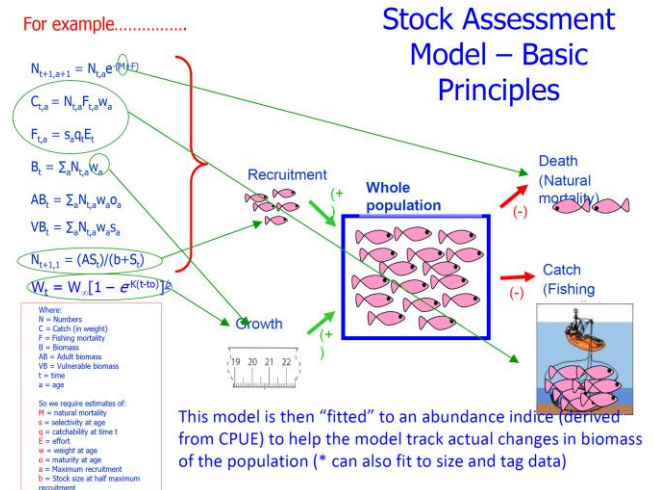


Stock Assessment

“Stock assessment is the part of Fisheries Science that studies the status of a fish stock as well as the possible outcomes of different management alternatives. It tells us if the abundance of a stock is below or above a given target point and by doing so lets us know whether the stock is overexploited or not.” (Musick and Bonfil, 2005).

Input data:

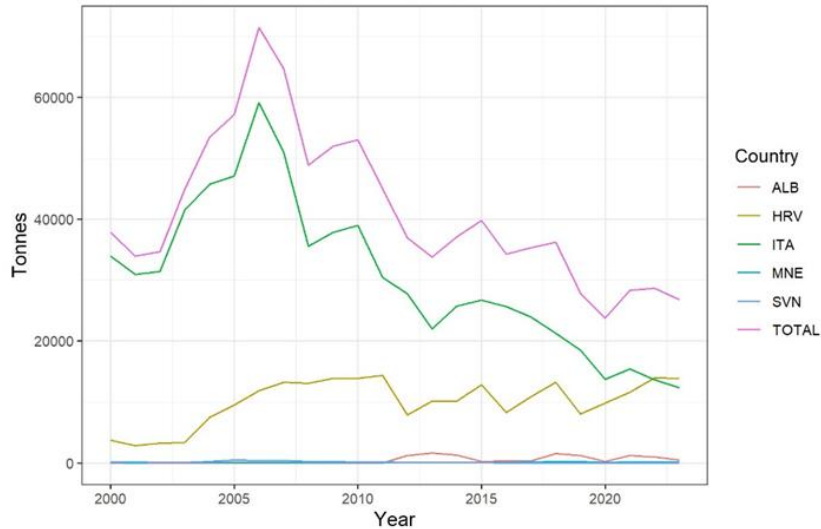
- Catch
- Length frequency Distributions (LFDs) and /or age data
- Biological information (e.g. growth parameters, maturity)
- Natural mortality
- Survey index



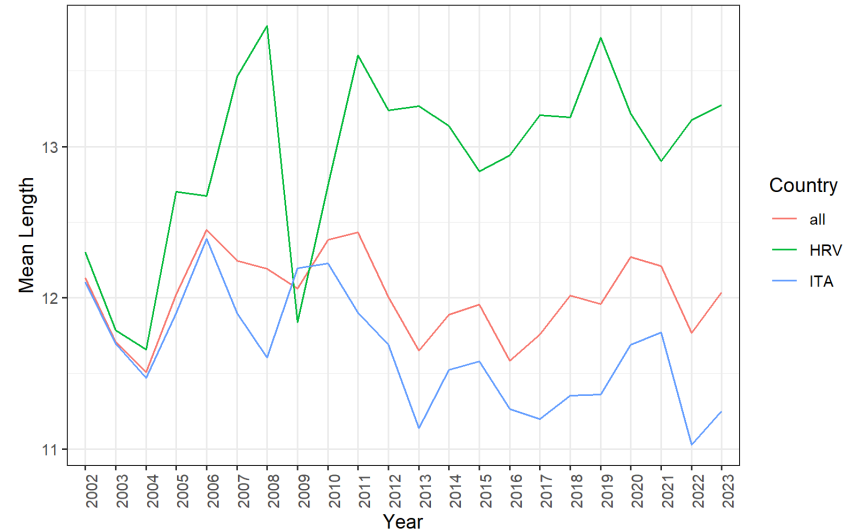


Stock assessment – European anchovy

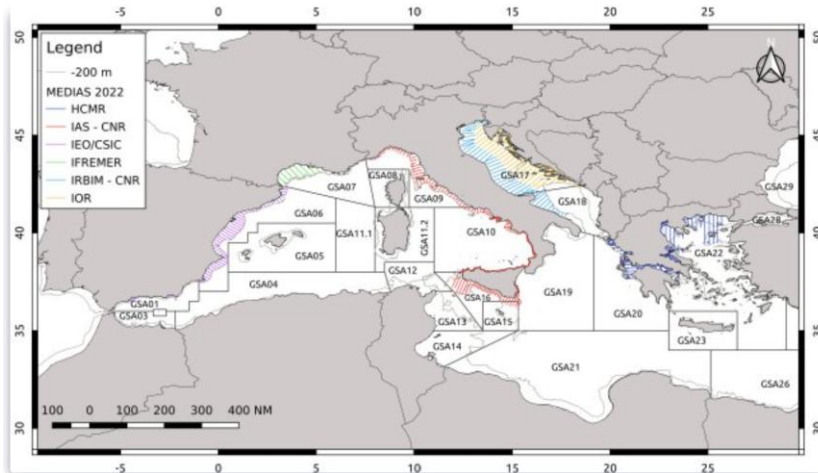
Anchovy - Catch by country



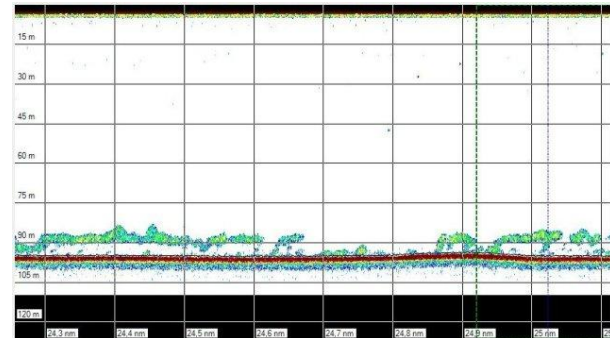
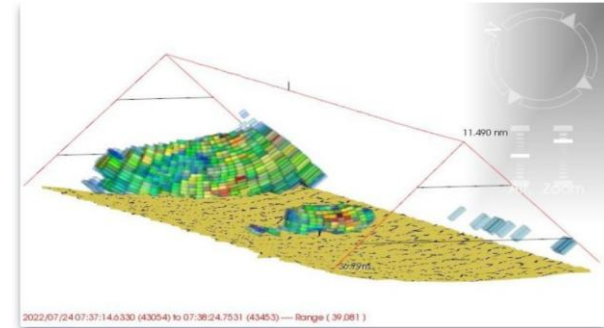
ANCHOVY - MEAN LENGTH



Stock assessment – ACOUSTIC SURVEY

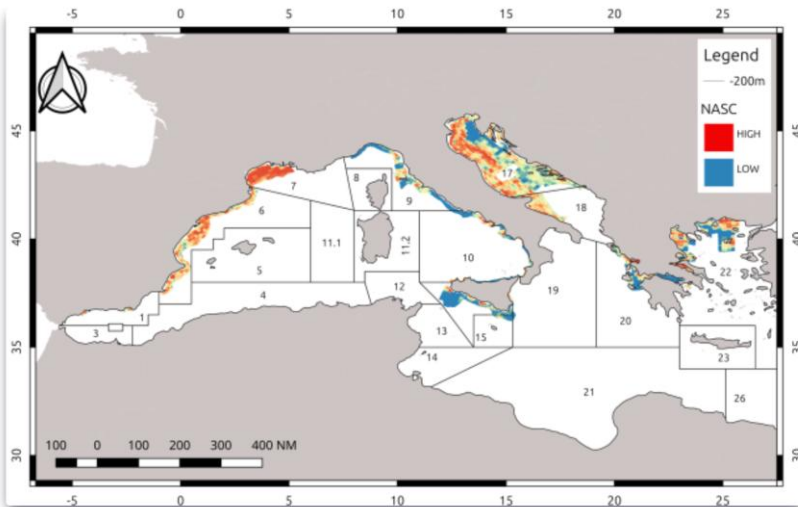


Source: MEDIAS website

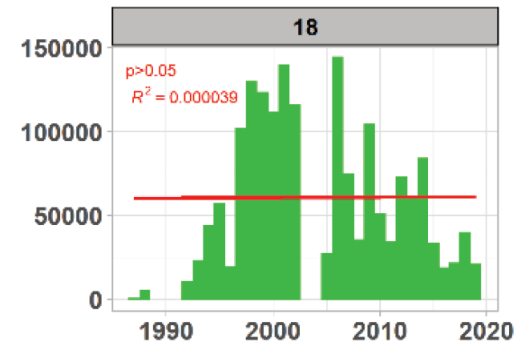
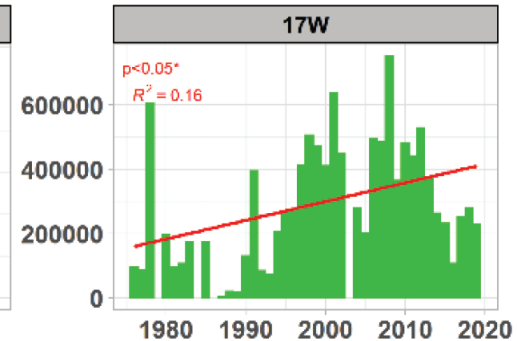
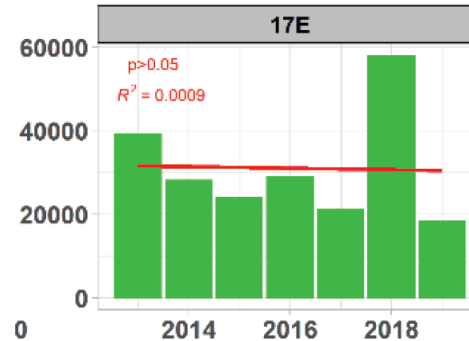




Stock assessment – European anchovy

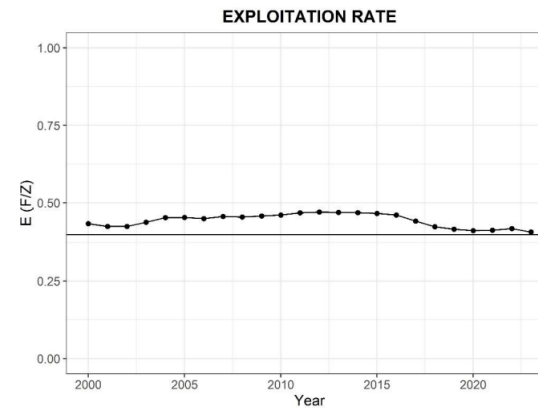
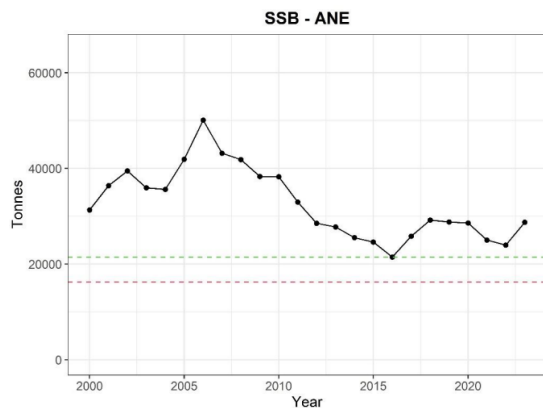
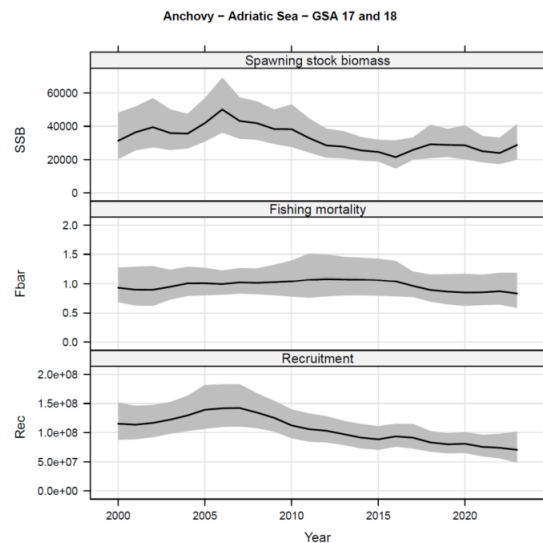


Source: MEDIAS website



Leonori et al.,
2021

Results of the last GFCM stock assessment – European anchovy

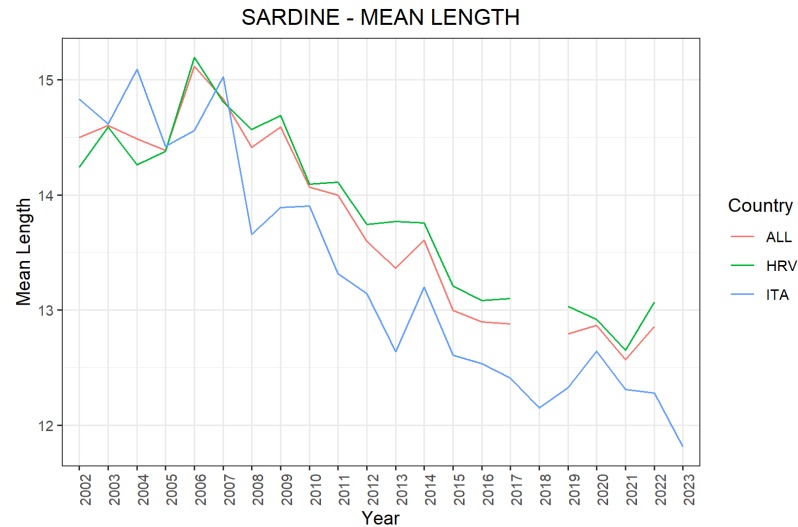
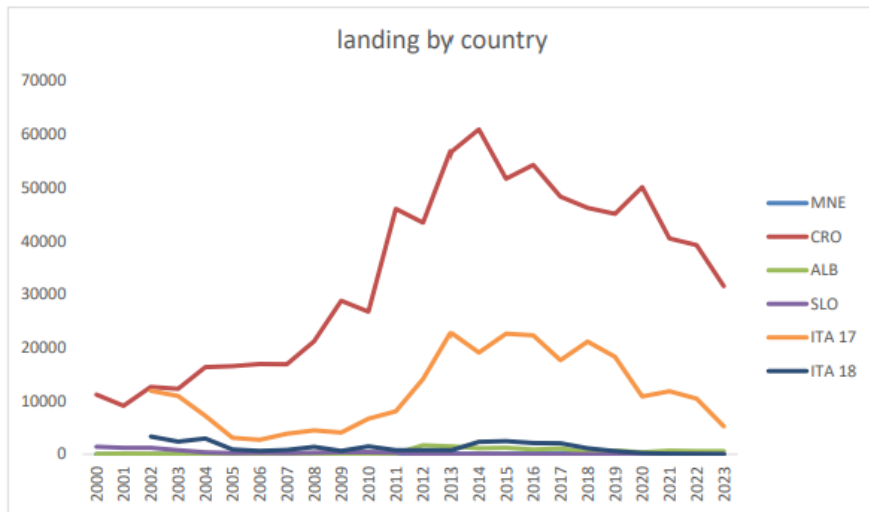


GSA	Species	Methodology used	$F/F_{MSY}^*(E)$	B/B_{MSY} $*B/B_{pa}$ $**B/B_{lim}$	Stock status	Management advice	% F reduction ¹¹
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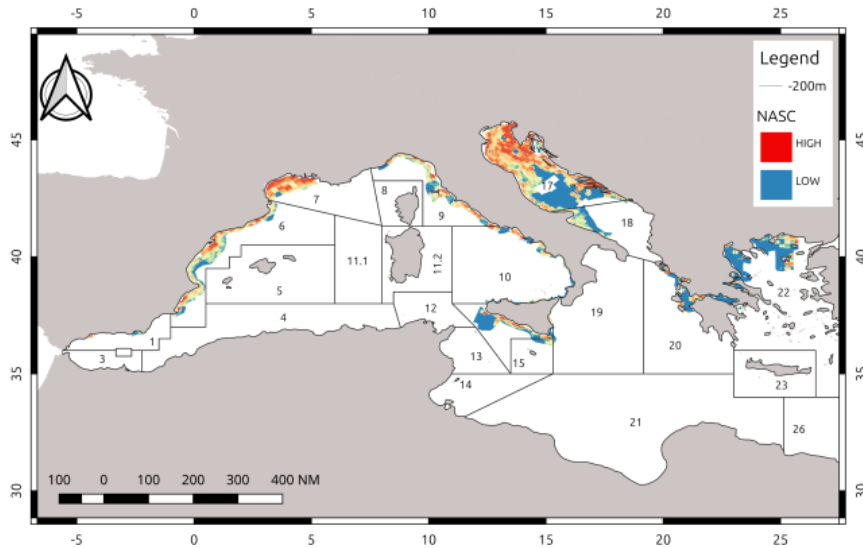
ADRIATIC SEA

17-18	Anchovy	FLSAM	$F/F_{target} = 1.03$	$B/B_{pa} = 1.34,$ $B/B_{limit} = 1.77$	Biomass above reference point and in overexploitation	Reduce fishing mortality	2.9%
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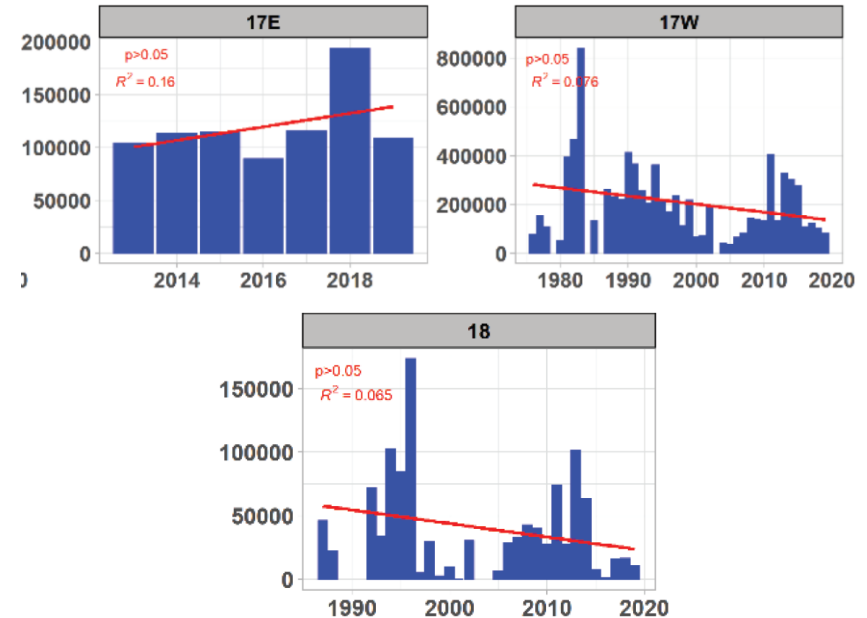
Stock assessment – European sardine



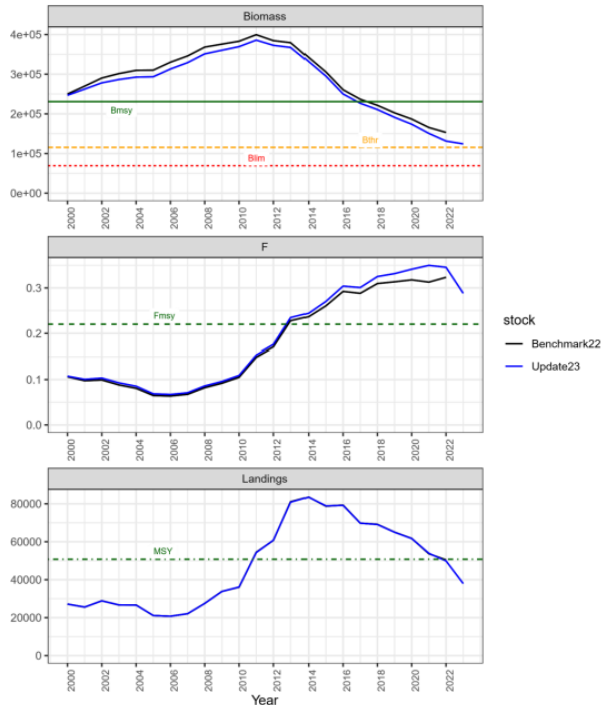
Stock assessment – European sardine



Source: MEDIAS website



Results of the last GFCM stock assessment – European sardine



GSA	Species	Methodology used	$F/F_{MSY}^*(E)$	B/B_{MSY} $*B/B_{pa}$ $**B/B_{lim}$	Stock status	Management advice	% F reduction ¹¹
ADRIATIC SEA							
17-18	Sardine	SPICT	$F/F_{target} = 1.45$	$B/B_{msy} = 0.52$, $B/B_{pa} = 1.04$, $B/B_{limit} = 1.74$	Increased risk of being overexploited and in overexploitation	Reduce fishing mortality	31.0%

Management of small pelagics in the Adriatic Sea

Recommendation GFCM/44/2021/20

on a multiannual management plan for the sustainable exploitation of small pelagic stocks in the Adriatic Sea (geographical subareas 17 and 18)

The General Fisheries Commission for the Mediterranean (GFCM),

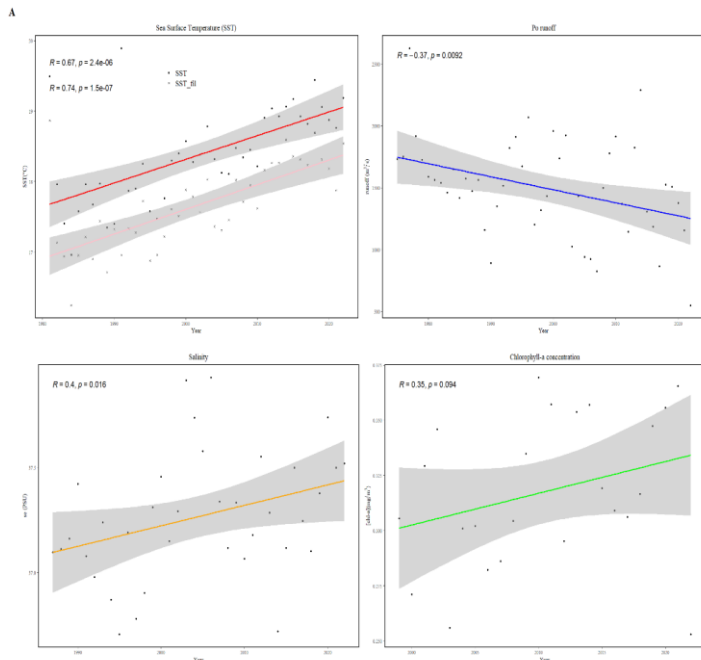
CONSIDERING that the objective of the Agreement for the establishment of the General Fisheries Commission for the Mediterranean (GFCM Agreement) is to ensure the conservation and sustainable use, at the biological, social, economic and environmental level, of marine living resources in the GFCM area of application;

RECALLING that, in giving effect to the objective of the GFCM Agreement, the GFCM shall adopt recommendations on conservation and management measures aimed at ensuring the long-term sustainability of fishing activities, in order to preserve the marine living resources and the economic and social viability of fisheries and that, in adopting such recommendations, the GFCM shall give particular attention to measures to prevent overfishing and minimize discards as well as to the potential impacts on small-scale fisheries and local communities;

CONSIDERING that the GFCM shall adopt management measures based on an ecosystem approach to fisheries to guarantee the maintenance of stocks at levels which can produce maximum sustainable yield (MSY);

Official Journal of the European Union		EN L series	
2025/219		4.2.2025	
COUNCIL REGULATION (EU) 2025/219			
of 30 January 2025			
fixing for 2025 the fishing opportunities for certain fish stocks and groups of fish stocks applicable in the Mediterranean and Black Seas			
1. Small pelagic stocks – GSAs 17 and 18			
(a) Maximum level of catches expressed in tonnes live weight			
Species	Small pelagic species (anchovy and sardine)		Zone: Union and International waters of GFCM GSAs 17 and 18
	<i>Engraulis encrasicolus</i> (ANE/GF1718)	<i>Sardina pilchardus</i> (PIL/GF1718)	
Italy	15 733,7	8 962,549	Maximum level of catches
Croatia	10 608,3	36 267,45	
Slovenia	111	189	
Union	26 453	45 419	
TAC	Not relevant		

Environmental changes



Caserta et al., submitted

Long-term ecological studies reported significant modifications of the environmental conditions in the Adriatic, due to climatic fluctuations and changes of the anthropogenic pressures.

These environmental changes have relevant consequences for the ecosystem, which responses are:

- a reduction of the phytoplankton biomass and the intensity /frequency of late winter diatom blooms due to a decrease of TP concentrations, particularly in the western North Adriatic;
- a mesozooplankton increase both in number of individuals and in biomass;
- an increase in the abundance of thermo-philic and thermo-tolerant species and the disappearance or rarefaction of ‘cold’ steno- thermal species;
- a decreasing trend in small pelagic fish catches

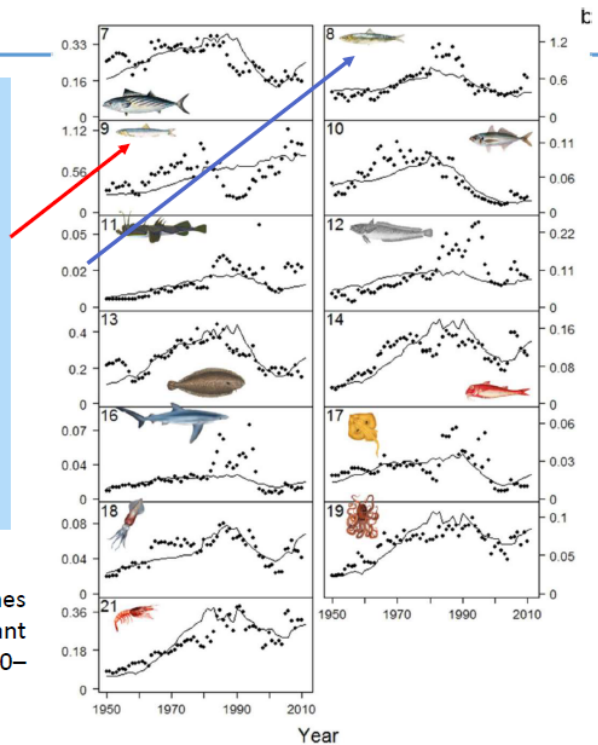
Effects of environmental changes

Some simulation of multispecies dynamics in the Adriatic sea using a Ecopath with Ecosim (EwE) food web model

Both changes in Primary Production (PP) and fishing pressure played an important role in driving species dynamics but, PP was the strongest driver upon the Mediterranean Sea ecosystem.

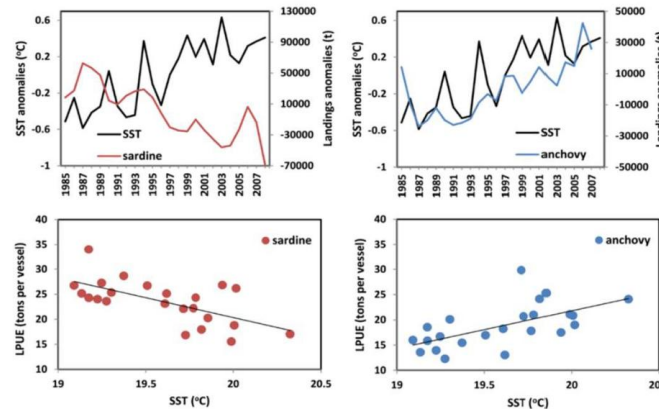
Ecological indicators, with exception of total catch and biodiversity, show overall Adriatic ecosystem degradation from 1950 to 2011.

Predicted (solid lines) versus observed (dots) catches ($t \cdot km^{-2} \cdot year^{-1}$) for main commercially important functional groups of Adriatic ecosystems (1950–2011). **Anchovy** and **sardine** catch are marked.




Effects of environmental changes


The different ecological optimal temperature of Sardine (SST range 12 - 14 °C) and Anchovy (SST range 17– 19°C) (by Palomera et al., 2007)



Tzanatos et al. 2014; Stergiou et al. 2016



Increasing water temperature, particularly during winter when sardine reproduces, may decrease breeding performance and cause population declines



Warming may have resulted in an improvement of the spawning success or period duration (summer) for anchovy

..by the way...the optimal SST for Round sardine is > 23°C

The tropicalization of fish assemblages



Climate change is restructuring fish resources.

Species from warmer waters are progressively replacing those traditionally caught in many fishing activities worldwide.

Climate change is causing a reduction in the sizes of fish species.

The increase in temperatures accelerates the metabolism of pelagic species, increasing their energy requirements and reducing their body growth due to the lower availability of oxygen and resources

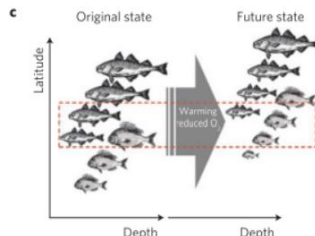
LETTER

Signature of ocean warming in global fisheries catch
William W. L. Cheung¹, Rug Watson² & Daniel Pauly¹

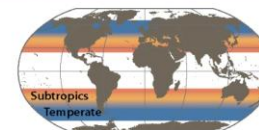
nature climate change

LETTERS

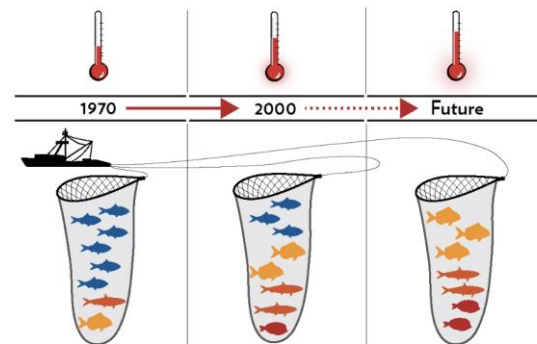
Shrinking of fishes exacerbates impacts of global ocean changes on marine ecosystems
William W. L. Cheung^{1*}, Jorge L. Sarmiento², John Dunne³, Thomas L. Frithsen⁴, Vicki W. Y. Lam¹, M. L. Deng Palomares⁵, Rug Watson⁶ and Daniel Pauly¹



Subtropic and temperate ocean

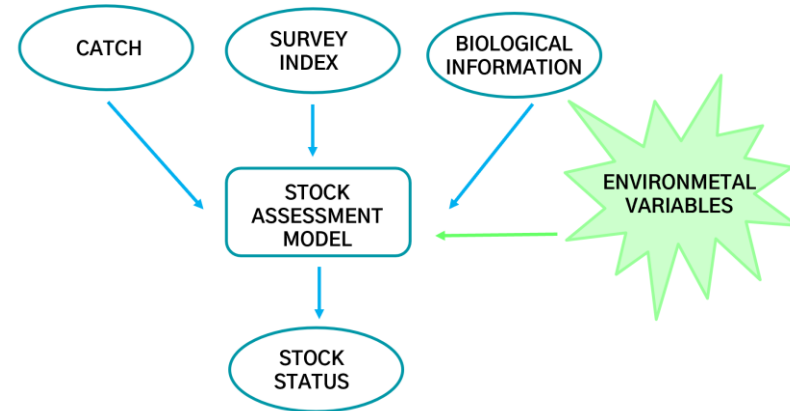


From 1970 to 2006, as open temperatures were rising, catch composition in the subtropic and temperate areas slowly changed to include more warm-water species and fewer cool-water species.



The management of fisheries resources under climate change

- Climate and environmental factors can have a large impact on population and community dynamics (Harley et al., 2006; Pinsky et al., 2013; Rowe and Terry, 2014).
- There has been a recent push to move from single-species towards ecosystem-based fisheries management (EBFM; Pikitch et al., 2004), where environmental factors are taken into consideration to manage the ecosystem as a whole. Therefore, there is a desire to explore various methods for incorporating time-varying growth into assessments.
- Little guidance is available for whether or when to incorporate environmentally driven growth variables into the stock assessments used as the basis for advice to managers to support fisheries decision making (Lee et al., 2018).





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Thank you for your
attention.

Silvia Angelini

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