ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

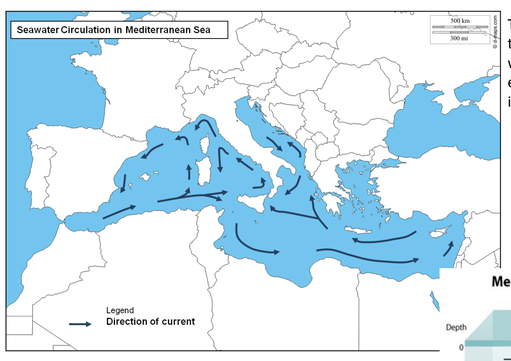
Marine food provision ecosystem services assessment using EO products

Authors: Emiliana Valentini[1], Federico Filipponi[1], Alessandra Nguyen Xuan[1], Francesco Maria Passarelli[1], Andrea Taramelli[2]
emiliana.valentini@isprambiente.it
1 - ISPRA – Istituto Superiore per la Ricerca e la Protezione dell'Ambiente, Rome, Italy; 2 - IUSS – Istituto Universitario di Studi Superiori, Palazzo del Broletto, Pavia, Italy

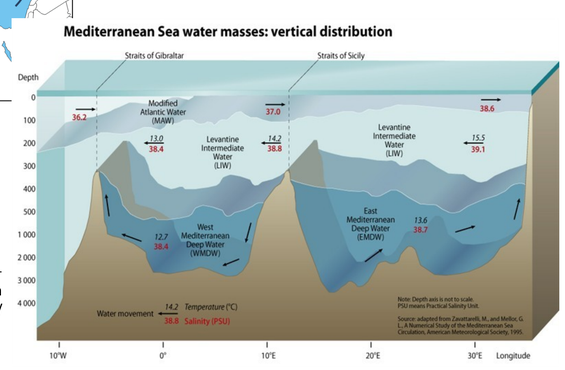
INTRODUCTION: Physical, chemical and biological characteristics of seawaters are primary descriptors to assess the spatial and temporal dimensions of ecopotential productivity performances in terms of **fish growth** from marine ecosystems. **Seawater temperature** is the key descriptor because it influences the variation of many other parameters and as consequence the entire life cycle of marine organism. Here we define the **Sea Surface Temperature** the **Essential Variable (EV)**.
We developed a method to identify **sites scenario with suitable fish growth conditions** in the Mediterranean Sea and, among these sites, to estimate the potential fish **growth rate**.
In order to assess **fish growth scenario** and **potential fish harvest** we defined a set of thresholds for other relevant parameters collected from Copernicus Marine Environment Monitoring Service (CMEMS).

LARGE MARINE AREA: MEDITERRANEAN SEA

salinity = 38 ‰
temperature = 30°C
Western and Eastern Mediterranean are seasonally different for both the salinity and the temperature in fact, the Eastern basin is warmer and more saline (Tortonese, 1969).



The circulation of the Mediterranean is counterclockwise. The surface water of the Atlantic enters the Mediterranean Sea beyond the Gibraltar Strait with a surface current flowing through all the Mediterranean. Due to high evaporation, water increases the salinity and temperature that causes an increase in density and sinks, forming a current that follows the northern

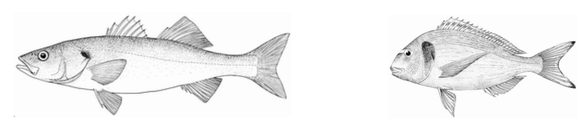


Adapted from Zavattarelli, M., and Mellor, G.L., A Numerical Study of the Mediterranean Sea Circulation, American Meteorological Society, 1995. http://www.grida.no/graphicslib/detail/mediterranean-sea-water-masses-vertical-distribution_d84b#

DATA & MATERIAL

Fish weight (W) is a function of growth rate and temperature (Stigebrandt 1999). Being $T_{t,f}$ (°C) is temperature at pixel f, weight W_t at time t (day), in year y, and on pixel f is modeled as:

$$W_{t,y,f} = (\alpha W_{t-1,y,f}^{\beta} \cdot e^{T_{t-1,f}\tau}) + W_{t-1,y,f}$$



sea bass
(*Dicentrarchus labrax*)

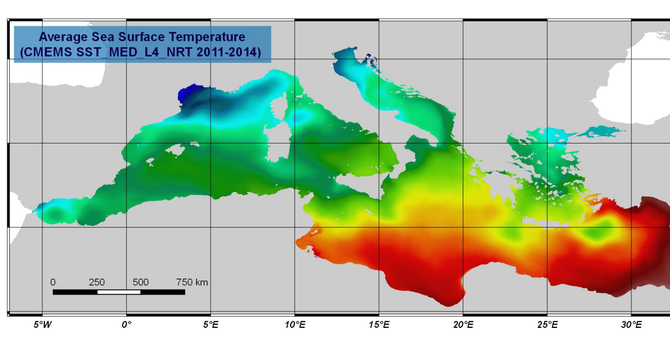
sea bream
(*Sparus aurata*)

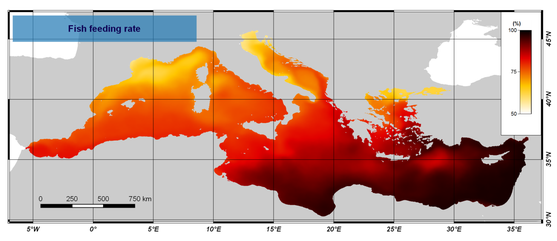
	Sea bass (Lanari et a., 2002)	Sea bream (Lupatsch & Kissil, 1998)
Growth parameters	α ($g^{1-b}day^{-1}$) = 0.010	α ($g^{1-b}day^{-1}$) = 0.0167
	β (non-dimensional) = 0.68	β (non-dimensional) = 0.621
Change in biochemical rates in fishes with an increase in water temperature	τ (C-1)= 0.05	τ (C-1)= 0.055

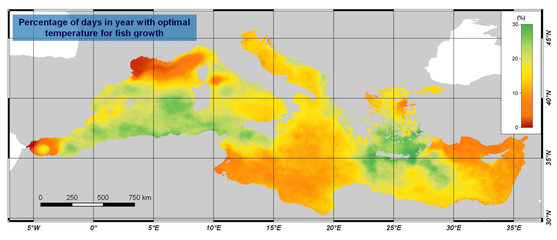
EO PRODUCTS & FISH VITALITY RANGES (parameters criteria and constraints relevant for fish survival and growth)

CMEMS product	Variable name	Acronym	Units	Spatial resolution	Temporal resolution	Source	Depth layers	Processed period	FISH VITALITY RANGES		
									MIN	MAX	REFERENCE
SST_MED_SST_L4_NRT_OBSERVATIONS_010_004	Sea Surface Temperature	SST	degrees (Kelvin)	1 km	Daily mean	Satellite-derived gap-filled	Surface layer	2008-2014	5	30	FAO
MEDSEA_REANALYSIS_PHYS_006_004	Currents*	Cur	m s-1	7 km	Daily mean	Modeled	Depth layers	2008-2014	0.02	0.51	Prata et al., 1992
MEDSEA_REANALYSIS_PHYS_006_004	Salinity*	Sal	PSU	7 km	Daily mean	Modeled	Depth layers	2008-2014	0-5	40**	Jensen et al., 1998
MEDSEA_REANALYSIS_BIO_006_008	Dissolved Oxygen*	dox	millimol m-3	7 km	Monthly mean	Modeled	Depth layers	2008-2014	133.8	--	Mallya, 2007
MEDSEA_REANALYSIS_BIO_006_008	pH*	pH	pH units	7 km	Monthly mean	Modeled	Depth layers	2008-2014	6.5	8.5	Panel EFSA, 2008
MEDSEA_REANALYSIS_BIO_006_008	Nitrates*	nit	millimol m-3	7 km	Monthly mean	Modeled	Depth layers	2008-2014	0	100	Directive 2014/101/EU
MEDSEA_REANALYSIS_BIO_006_008	Phosphates*	pho	millimol m-3	7 km	Monthly mean	Modeled	Depth layers	2008-2014	0	2.5	Directive 2014/101/EU
OCEANCOLOUR_MED_CHL_L4_REP_OBSERVATIONS_009_078	Chlorophyll	Chl	mg m-3	1 Km	Monthly mean	Satellite-derived	Surface layer	2008-2014		2.00***	Hopkins et al., 2013

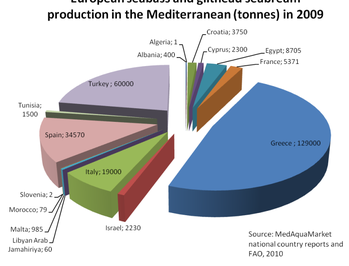
*analysys were performed on the first 12 depth layers (i.e. 0-50 m depth); ** Up to 50 *Dicentrarchus labrax*; (32 – 40) *Sparus aurata*; 30 Spawning *Sparus aurata*; *** High turbid water conditions





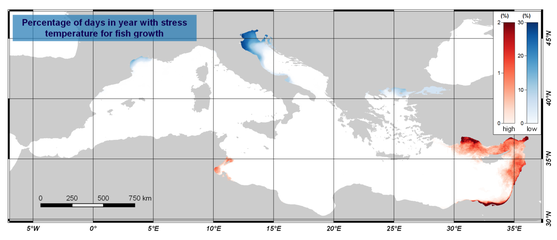


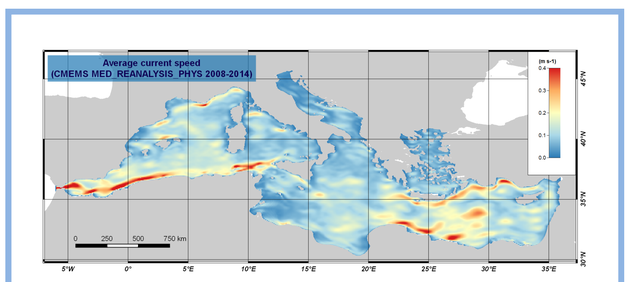
European seabass and gilthead seabream production in the Mediterranean (tonnes) in 2009

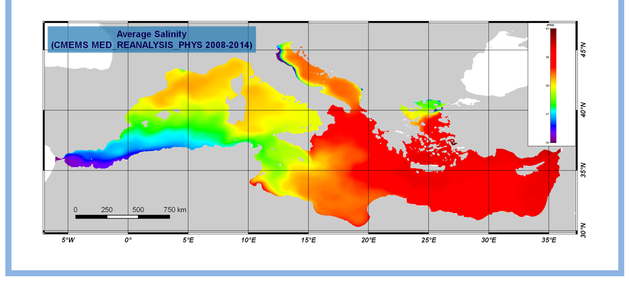


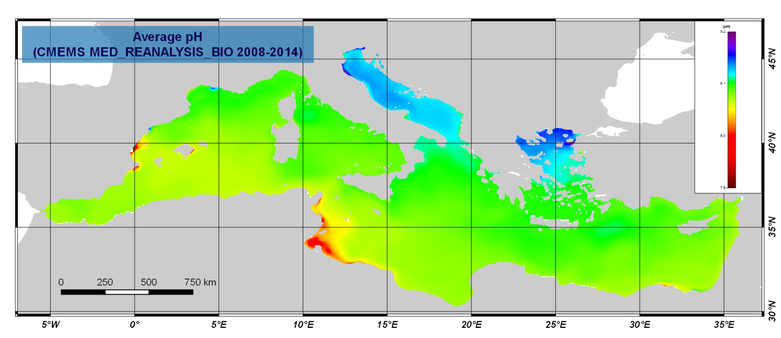
Source: MedAquaMarket national country reports and FAO, 2010

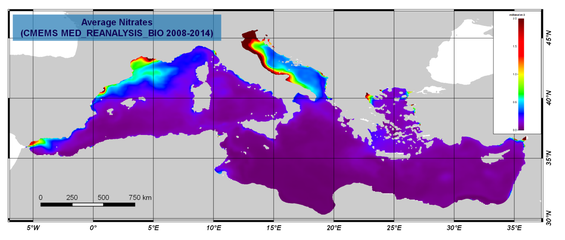
Regarding aquaculture, Greece, Turkey and Spain are the first producers in the Mediterranean Sea.

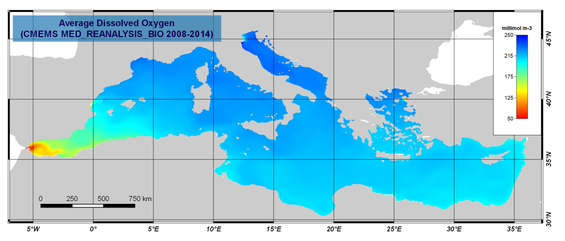


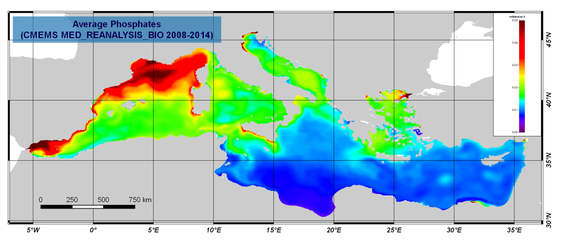


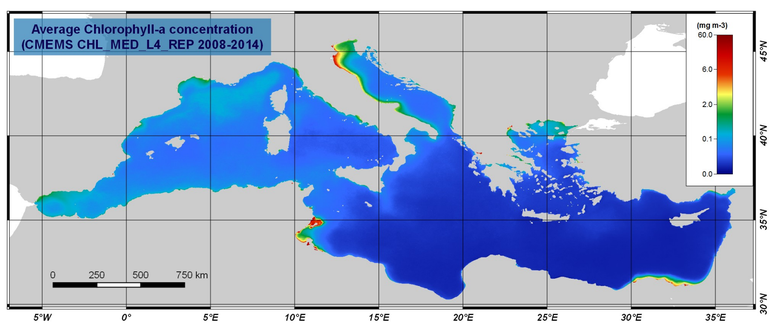




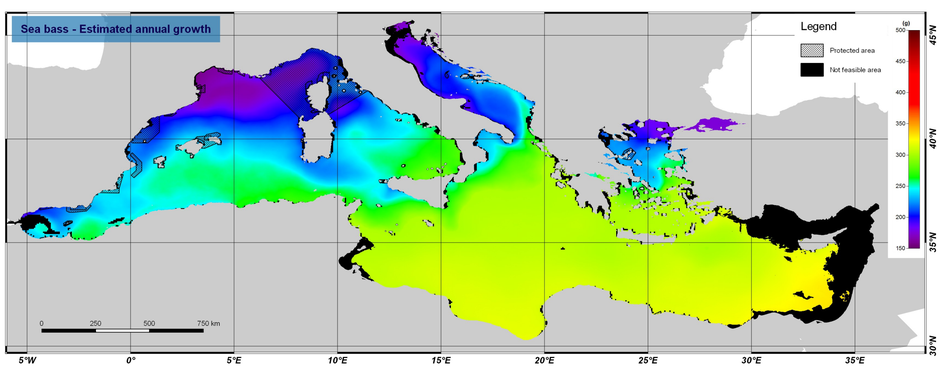






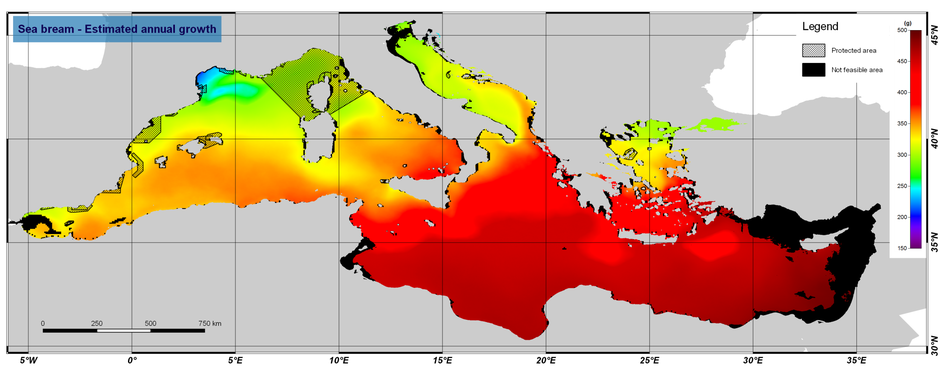


MEDITERRANEAN MARINE FOOD PROVISION ECOPOTENTIAL PRODUCTIVITY PERFORMANCES: POTENTIAL GROWTH FOR SEA BASS AND SEA BREAM



Estimated annual growth of sea bass and sea bream are different

Based on seawater temperature the Mediterranean Sea can be divided in two main areas



REFERENCE:
Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning
Lanari, D., D Agaro, E., & Ballestrazzi, R. (2002). Growth parameters in European sea bass (Dicentrarchus labrax L.): effects of live weight and water temperature. *Italian Journal of Animal Science*, *1*, 181-186.)
Stigebrandt, A., 1999. Turnover of energy and matter by fish—a general model with application to salmon. Fisken and Havet No. 5, Institute of Marine Research, Norway. 26 pp.
Lupatsch, I., & Kissil, G. W. (1998). Predicting aquaculture waste from gilthead seabream (Sparus aurata) culture using a nutritional approach. *Aquatic Living Resources*, *11*(04), 265-268.
Hopkins, J.; Lucas, M.; Dufau, C.; Sutton, M.; Stum, J.; Lauret, O.; Channelliere, C. Detection and variability of the Congo River plume from satellite derived sea surface temperature, salinity, ocean colour and sea level. *Remote Sens. Environ.* **2013**, 139, 365-385.
Directive 2014/101/EU of the European Parliament and of the Council amending Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy. Available online: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0101
Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission (Question N° EFSA-Q-2006-149) on animal welfare aspects of husbandry systems for farmed European seabass and Gilthead seabream. *The EFSA Journal.* **2008**, 844, 1-21. Available online: http://www.efsa.europa.eu/en/efsajournal/pub/844.htm
Tortonese, E. – 1969 La fauna del Mediterraneo e i suoi rapporti con quelle dei mari vicini. Pubbl. Staz. Zool. Napoli, 37 Suppl. 2: 369-384 è
Scientific report of EFSA prepared by Working Group on seabass/seabream welfare on Animal Welfare (Question N° EFSA-Q-2006-149) Aspects of Husbandry Systems for Farmed European seabass and gilthead seabream. Annex I to *The EFSA Journal* **2008**, 844, 1-89. Available online: http://www.efsa.europa.eu/en/efsajournal/pub/844.htm
Mallya Y.J. The effects of dissolved oxygen on fish growth in aquaculture. The United Nations University Fisheries Training Programme, Final Project. 2007
Jensen, M.K.; Madsen, S.S.; Kristiansen, K. Osmoregulation and salinity effects on the expression and activity of Na+, K+-ATPase in the gills of European sea bass, *Dicentrarchus labrax* (L.). *J. Exp. Zool.* **1998**, 282, 3, 290-300.

Acknowledgements go to the H2020 ECOPOTENTIAL No 641762 project for funding this research