EUROFLEETS<sup>+</sup> Floating University "State and sustainable use of the ocean biological resources: the case of the *Nephrops norvegicus* (Norway lobster)" Onboard the R/V Mário Ruivo

Portugal, June 15 – July 5



# OCEAN ECOSYSTEM SERVICES AND OCEAN GOVERNANCE

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MARE-UL







Base Naval de Lisboa, 14 June 2021



## **Our marine planet**



### The global Ocean:

- 70.9% of Earth's surface
- 3688 m average depth
- 356 000 km of coastline
- 97% of all the water on Earth
- 99% of the habitable space on the planet

Eakins, B.W. and G.F. Sharman, Volumes of the World's Oceans from ETOPO1, NOAA. National Geophysical Data Center, Boulder, CO, 2010. NASA

How inappropriate to call this planet Earth when it is quite clearly Ocean Arthur C. Clarke (J. Lovelock, 1990)







Colaço, A., Carreiro e Silva, M., Giacomello, E., Gordo, L., Vieira, A., Adão, H., Gomes-Pereira, J. N., Menezes, G., Barros, I., (2017). Ecossistemas do Mar Profundo. DGRM, Lisboa, Portugal. www.sophia-mar.pt.

## **Our life-support system**



Ecosystem services (ES) the ecological characteristics, functions, or processes that directly or indirectly contribute to human wellbeing:
the benefits that people derive from functioning ecosystems (Costanza et al., 1997; Millennium Ecosystem Assessment (MEA), 2005).

### SUPPORTING

- Nutrient cycling (ocean absorbs c. 25% CO<sub>2</sub> emissions)
- Primary production (>50% of the oxygen we breathe)
- ... PROVISIONING
- Food
- Energy
- Resources
- \_\_\_\_

### REGULATING

- Climate regulation
- .

### CULTURAL

- Aesthetic / Spiritual
- Educational
- Recreational
- ..

## **Spaceship Earth**

## Who is the crew and who are the passengers?



### SUPPORTING

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**Prochlorococcus** is a <u>genus</u> of very small (0.6 µm) <u>marine cyanobacteria</u> with an unusual pigmentation (<u>chlorophyll a2 and b2</u>). These bacteria belong to the <u>photosynthetic</u> <u>picoplankton</u> and are probably the most abundant <u>photosynthetic</u> organism on Earth

https://en.wikipedia.org/wiki/Prochlorococcus

Prochlorococcus, is the smallest [known] photosynthetic organism on Earth but produces up to 20% of the oxygen in our entire biosphere. That's a higher percentage than all of the tropical rainforests on land combined.

https://oceanservice.noaa.gov/facts/ocean-oxygen.html

Prochlorococcus marinus

### **BLUE GROWTH / BLUE ACCELERATION**

## **BLUE DEGRADATION**

### The ocean is taking the heat!

(the ocean absorbs most of world's extra heat)



#### Warming Acidification Deoxygenation Decreasing Increasing POC flux POC flux 200 m SA Continental Submarine slope canvon 2000-3000 m 3000-4000 m Continental rise 4000-6000 m Volcanic Abyssal Seamount Oceanic arc plain ridge Trench Fishing Oil and gas Litter Mining 8000 to 11000 m

### The deep ocean under climate change

Lisa A. Levin<sup>1\*</sup> and Nadine Le Bris<sup>2</sup>

13 NOVEMBER 2015 • VOL 350 ISSUE 6262 sciencemag.org SCIENCE

### The Blue Acceleration: The Trajectory of Human Expansion into the Ocean

Jean-Baptiste Jouffray,<sup>1,2,\*</sup> Robert Blasiak,<sup>1</sup> Albert V. Norström,<sup>1</sup> Henrik Österblom,<sup>1</sup> and Magnus Nyström<sup>1</sup> 'Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden 'Stockholm: Opnamics and the Biosphere Academy Programme, Royal Swedish Academy of Sciences, Stockholm, Sweden 'Correspondence: jean-baptiste.jouffray@su.se https://doi.org/10.1016/j.onees.2019.12.016

## Impacts to ocean ecosystems from CC

ipcc

**@** 

The Ocean and Cryosphere

in a Changing Climate

Principality of Monaco 24th September 2019

Summary for Policymakers





Figure SPM.3 | Projected changes, impacts and risks for ocean regions and ecosystems.

## Marine heatwaves around the globe



http://www.marineheatwaves.org/



## Impacts of ocean acidification



https://www.bioacid.de/reaching-the-paris-climate-target/?lang=en

## **Ocean deoxygenation**

# DEOXYGENATION

### A Wake Up Call To Save Our Suffocating Seas

Climate change is now accelerating the loss of life-sustaining oxygen from the ocean. This deoxygenation will adversely impact food security and human populations the world over.

#### DEOXYGENATION IS activated primarily by OCEAN

Heated ocean water resulting from climate change holds less soluble oxygen and leads to greater

#### STRATIFICATION.

IING

Increased separation of upper and lower water columns reduces circulation and oxygen exchange between atmosphere and water, intensifying stress on marine species throughout the ocean.

#### CULTURAL **FO I** EUTROPHICATION.

Excess nutrient runoff from agriculture, sewage and fossil fuels are another key contributor to oxygen decline in coastal waters. Global ocean oxygen inventory losses from 1960 to 2010 approx.

**DI HBI F DXYGF** 

Low oxygen zone

expansion in open ocean

**IUCN** 

https://www.iucn.org/theme/marine-and-polar/our-work/climate-change-and-oceans/ocean-deoxygenation

Upper Column

oastal hvooxii

lead zones

×++++

4

LIMITED

**U** Lower Column

SLOWER OCEAN CIRCULATION

VERTICAL MIXING

## **Ocean deoxygenation**



https://www.iucn.org/theme/marine-and-polar/our-work/climate-change-and-oceans/ocean-deoxygenation

## **Ocean dead zones**





"the oceans' carrying capacity is near or at its limit" (1<sup>st</sup> World Ocean Assessment. UN, 2016)



Continuing ocean acidification threatens the marine environment and ecosystem services (UN SDG report, 2020)



"Changes in the ocean have impacted marine ecosystems and ecosystem services with regionally diverse outcomes, challenging their governance" (IPCC ocean and cryosphere report, 2019)



Global Biodiversity Outlook 5 The direct driver with the second highest relative impact on the oceans is the many changes in the uses of the sea and coastal land (IPBES report, 2019)

Aichi target 10 (coral reefs and VMEs) has not been achieved by

# Need for urgent and concerted efforts fostering **transformative change**

cross-sectoral thinking and approaches

## **United Nations 2030 Agenda**

# SUSTAINABLE G ALS



## "the Ocean goal"

14 LIFE BELOW WATER







# CBD's post-2020 GBF

**Global biodiversity framework** 



#### Summary of the transition:

Protecting and restoring marine and coastal ecosystems, rebuilding fisheries and managing aquaculture and other uses of the oceans to ensure sustainability, and to enhance food security and livelihoods. This transition recognizes the long-term dependency of marine food supplies and other benefits from the oceans on healthy ecosystems.

Key components of the transition **Promote Marine Spatial Planning Sustainably manage and rebuild fisheries Ensure the sustainability of mariculture production Protect critical habitats Reduce pollution Control invasive species spread** 



MSP is **the most endorsed** management regime for *sustainable development* in the marine environment

# MARINE SPATIAL PLANNING (MSP)

a process by which authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives



## Who owns the Ocean?



### Treaty of Tordesillas, 1494





### Mare clausum

Hugo Grotius, 1609

### UNITED NATIONS CONVENTION ON THE LAW OF THE SEA (UNCLOS) SIGNED IN MONTEGO BAY (JAMAICA) 10 DECEMBER 1982 EFFECTIVE 16 NOVEMBER 1994

Conscious that the problems of ocean space are closely interrelated and need to be considered as a whole,

Recognizing the desirability of establishing through this Convention, with due regard for the sovereignty of all States, a legal order for the seas and oceans which will facilitate international communication, and will promote the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment,



http://en.wikipedia.org/wiki/United\_Nations\_Convention\_on\_the\_Law\_of\_the\_Sea#/ media/File:United\_Nations\_Convention\_on\_the\_Law\_of\_the\_Sea\_parties.svg



https://oceanexplorer.noaa.gov/okeanos/explorations/ex1810/ecs/welcome.html



https://www.msp-platform.eu/file/morecomplicatdts-eezdiagrampng-0



The rights of the coastal State over the continental shelf do not depend on occupation, effective or notional, or on any express proclamation. (Art. 77)



COVERNO DE PORTUGAL

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# A role for ocean sciences over the next decade





### "There are no passengers on spaceship Earth. We are all crew."

Marshall McLuhan

Thank you maferreira@fc.ul.pt



https://www.planeta.com/pacific/