Global changes and marine resources

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# A thin layer of life in peril: the biosphere (Folke et al 2021)



# GAIA Hypothesis

- Hypothesis of climatologist James Lovelock and microbiologist Lynn Margulis in the 1970s
- The Earth is said to be "a dynamic physiological system that includes the biosphere and has kept our planet for over three billion years in harmony with life"
- 2° C warming: imagine the temperature of the human body constantly rising to 39° C

# Numerous pressures on the Oceans

(McCauley et al Science et al 2015)

# A connected world fully exploited (Folke et al 2021)

HUMAN SETTLEMEN FISHING SUBMARIN TRANSMISSION ROUTES CABLES



# ...and many impacts hot, acidic, polluted and overexploited ocean



# Transformation of the Oceans

IPCC Ocean report 2019 Burke et al 2018-Easac 2021





Catch that are stagnating at the global level and industrial fishing that consumes ever more fossil energy for lower yields .... (Tickler et al., Sci. Adv. 2018)







A 1950s











A growing appetite for fish..... made possible by expanding aquaculture! (Fao Sofia 2022)

#### Evolution of the situation of world marine fish stocks from 1974 to 2019 (FAO Sofia 2022)



#### Vanishing marine species (Soldo com. pers.)

SPECIES RECORDS	
1-10 DURING LAST	
10 YEARS	

#### NO SPECIES RECORDS DURING LAST 10 YEARS

Carcharodon carcharias Squatina squatina Carcharias taurus Odontaspis ferox Heptranchias perlo Squatina oculata Sphyrna zygaena

**DURING LAST 10-**

RECORDS

NO SPECIES RECORDS MORE THAN 30 YEARS

Isurus oxyrinchus Pristis pectinata

















# Overexploitation = less abundant and smaller fish



# Biodiversity and climate change

(Smale et al Nature CC 2019, Cheung et al GCB 2016)







## Future of cod ? Loss of habitats if global warming exceeds 1.5°C (Dahlke et al. Sci Adv 2018)



Change in maximum potential egg survival (PES, %)

Conceptual diagram illustrating the relationship between estimated catch potential, and its change over time driven by climate considerations and realized catch

Global catches will decrease: Primary production would fall by 7-16% A decrease in potential fisheries catches of 20-24% by the end of the 21st century

> (Free et al Science 2019 IPCC report 2019 FAO 2019)







Role of pelagic fish in wasp-waisted ecosystems

(Cury et al 2000)



# 'Jellification' of the Namibian ecosystem!

Méduses (*Cnidaria, Medusozoa*) négligeables avant 1970, ont atteint 40 MMT dans les années 1980 et 12.2 MMT en 2000s (Lynam et al. 2006), approximativement 2.5 fois la biomasse combinée des poissons exploités.





"For these fishermen [jellyfish] have become an increasingly irritating nuisance"

(Venter 1988)



# African penguins and gannets have declined by 77% and 94% respectively



2. Ecosystem Approach to Fisheries – EAF:Fisheries management that integratesbiodiversity... and the climate



Ecosystem Approach to Fisheries (EAF): Reconciling exploitation and conservation of marine species in a context of climate change (Worm et al science 2009)

Maintaining biodiversity



Maintaining high catch



Maintaining high employment



### Reducing Fossil energy



# AEP approach is more conservative than the conventional approach (Cury et al 2011, Pikitch et al 2012, 2017)

### and a higher floor on forage fish biomass

PRECAUTIONARY

100% of unfished biomass (B<sub>0</sub>)

CONVENTIONAL

**Minimum biomass** 

#### Forage yield (% of MSY)







# Agenda 2030 of the UN defines sustainability today





### Studying the interactions, synergies et compromises between the SDGs (Moatti - Cury 2017, GSDR 2019)

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OBJECTIFS DURABLE



### **Ev**-Osmose model Yunne Shin et col.



## **Ev-Osmose model**

OSMOS



# **Ev-Osmose model**



# **Ev-Osmose model**

Schenk, Barrier, Quaas et al. In prep.



## **Application to the North Sea**





http://roliveros-ramos.github.io/calibraR/

#### **Confronting to observations**



#### **Confronting to observations**



#### **Future projections under climate change (RCP8.5)** (CMIP5, MPI-ESM-LR ERSEM)



# The level of protection of marine biodiversity will influence the future of the oceans - 30% in 2030?

Grorud et al 2021 – Science - 10 Septembre



# Increasing but insufficient protection

(Lubchenco Science 2015)



PIPA no-take



The Guide for MPAs Grorud-Colvert et al. Science 2021

Legend: Maximum allowed impact of activity

None

Minimal

Low N

Moderate

High

## Sustainability Science : Marine protected areas and adaptation to climate change Callum et al 2017 PNAS





Fig. 1. Eight illustrative pathways by which MPAs can mitigate and promote adaptation to the effects of climate change in the oceans.

## Contribution of Strong Marine Reserves to Climate Change Mitigation and Adaptation Jacquemeont et al; One Earth 2022





# Towards a blue transformation ?

- Promote the implementation of the SDGs and the 2030 Agenda
- Remove subsidies harmful to climate change and biodiversity loss
- Prioritize subsidies for social and economic ecological transitions
- Promote sustainable artisanal fisheries (selective fishing gear, saving fossil energy, creating jobs for women, etc.)
- Do what we promised to do and what we do not do (30% AMPs with 10% with full protection sensu MPA guide)
- Eat sustainable fish

# Il n'est pas nécessaire d'espérer pour entreprendre ni de réussir pour persévérer

Guillaume d'Orange-Nassau, dit le Taciturne 1568



# Merci de votre attention







資源結為の最先端をいく漁業。 狂い始めた生態系。 おれわれの食料はどうなるのか、 そして輸入大国日本の責任とは? 率い産業をよれ、人物等、損効等生態学校成から、油の発展可能な利用を考える

