



Simpósio  
Acadêmico de  
Biologia Marinha

# Como e por que contamos peixes? Biologia e manejo dos estoques pesqueiros

Marie-Christine Rufener

macrufener@gmail.com

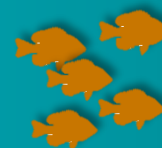
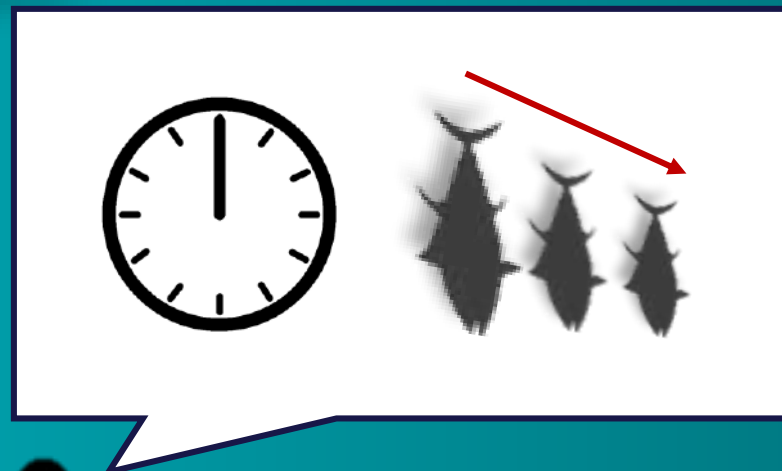
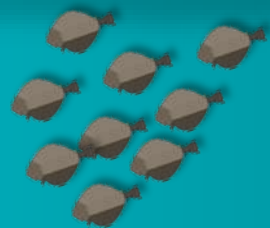
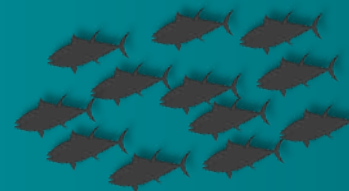


# Tupilândia











Thomas H. Huxley

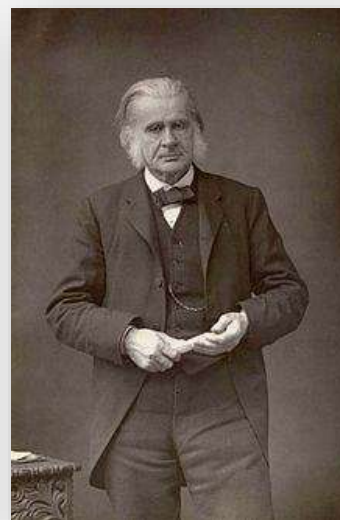
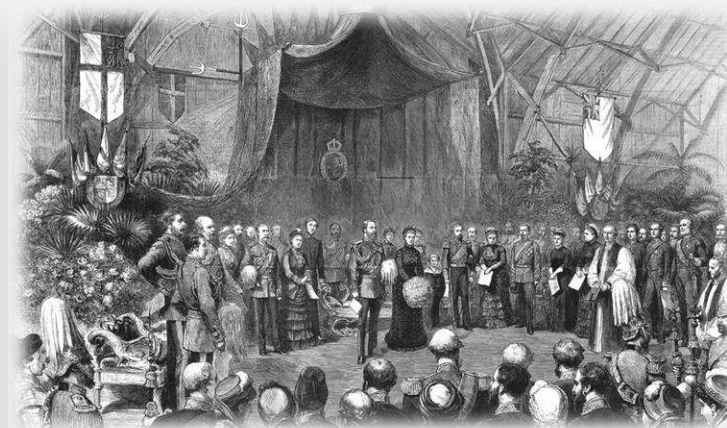


Foto: Wikimedia.org

Abertura da Exibição Internacional da Pesca, 1883



"I believe then that the cod fishery, the herring fishery, pilchard fishery, the mackerel fishery, and probably all the great sea fisheries are inexhaustible: that is to say that nothing we do seriously affects the numbers of fish. And any attempt to regulate these fisheries seems consequently, from the nature of the case to be useless."



## Garret Hardin

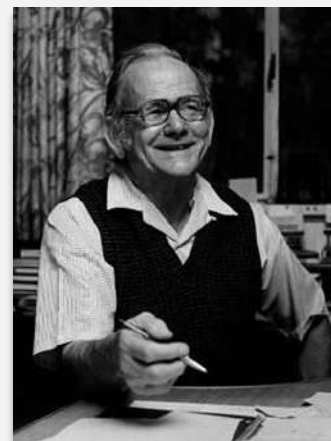


Foto: [mathbench.umd.edu](http://mathbench.umd.edu)

## The Tragedy of the Commons

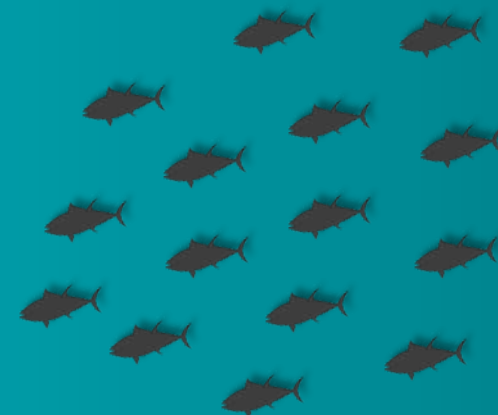
The population problem has no technical solution;  
it requires a fundamental extension in morality.

- Conflito entre necessidades individuais e o bem comum de uma sociedade (e.g., recursos pesqueiros)
- Se um recurso tem livre acesso, tende-se a sobre explorar o recurso





Quantos?







Reprodução

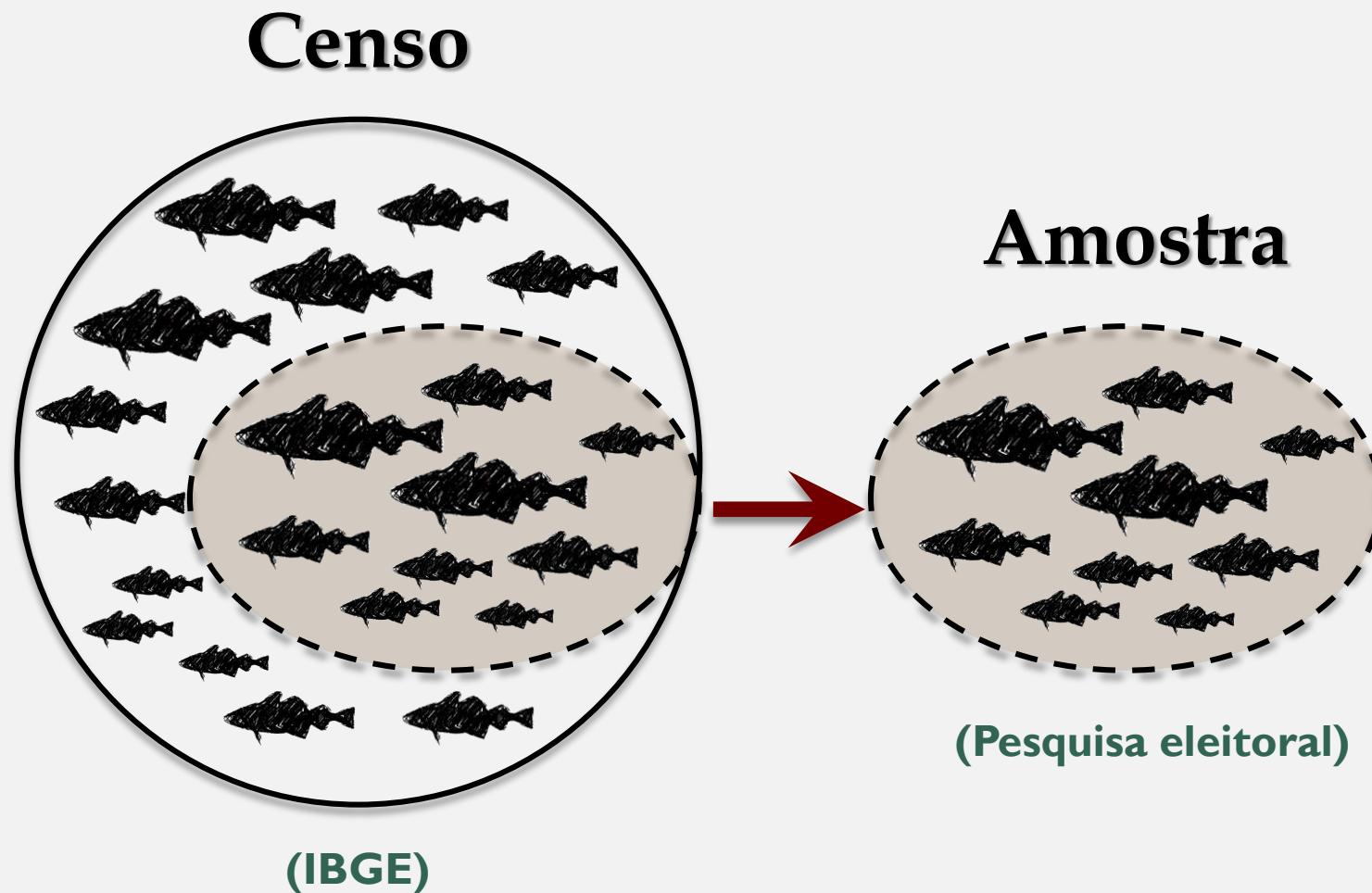


Alimentação





*“Contar peixes é como contar árvores – exceto que são invisíveis e estão em constante movimento”*





## DADOS INDEPENDENTS DA PESCA



Imagem: [santosshiplovers.blogspot.com/2011/01/navios-do-dia-23012011.html](http://santosshiplovers.blogspot.com/2011/01/navios-do-dia-23012011.html)



Imagem: [commons.wikimedia.org/wiki/File:RV\\_Dana\\_-\\_Ystad-2016.jpg](https://commons.wikimedia.org/wiki/File:RV_Dana_-_Ystad-2016.jpg)

## DADOS DEPENDENTS DA PESCA



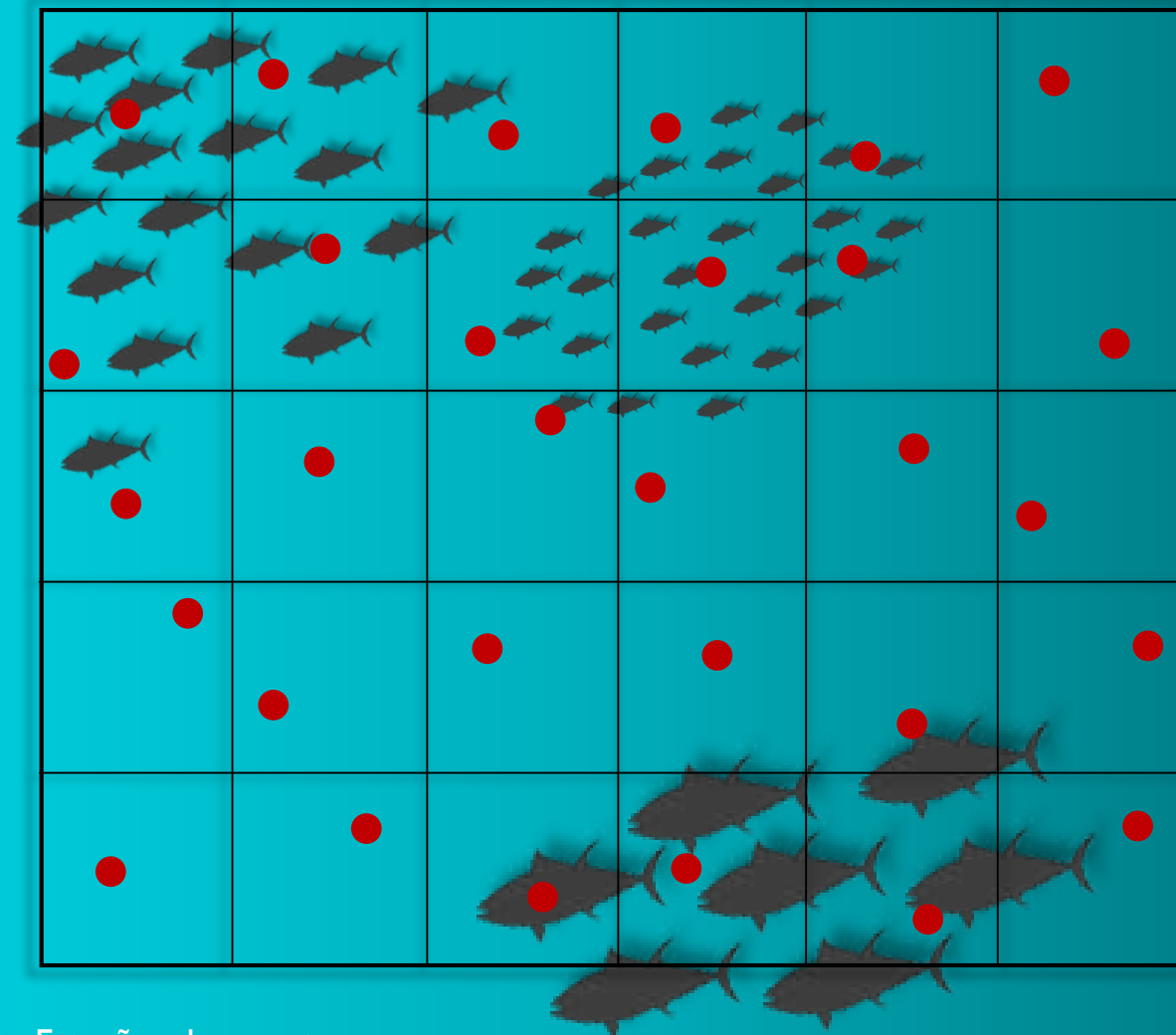
Imagem: [nature.com/articles/d41586-020-03625-2](https://nature.com/articles/d41586-020-03625-2)



Imagem: Acervo pessoal

## DADOS INDEPENDENTES DA PESCA

- **Desenho amostral:**
  - Sistemático e/ou aleatoriamente estratificado
- **Arte de pesca:**
  - Padronizada
- **Esforço pesqueiro:**
  - Padronizado
- **Cobertura especial:**
  - Extensa
- **Cobertura temporal:**
  - Restrita
- **Custo:**
  - Alto (\$\$\$)

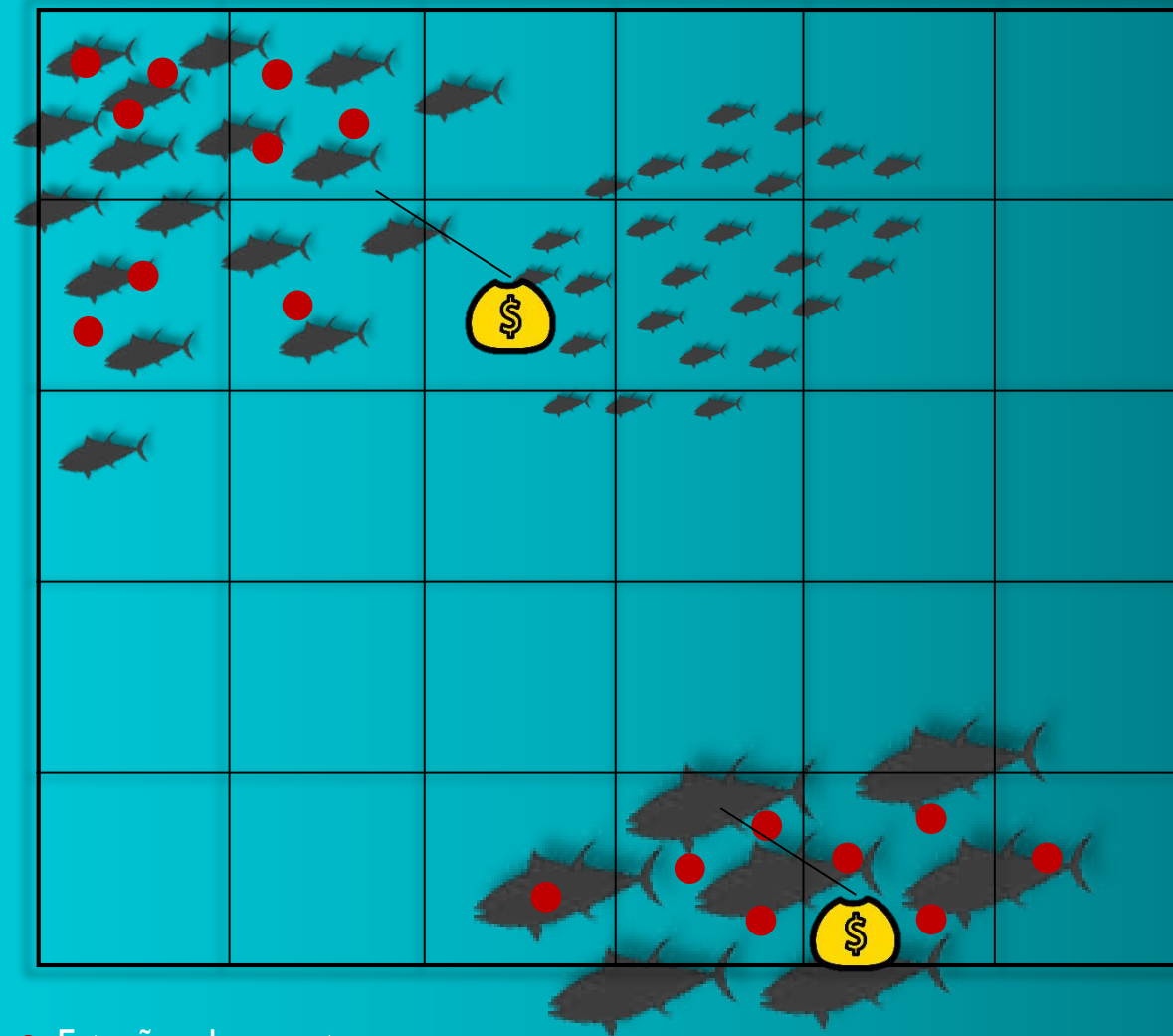


● Estações de amostragem

## DADOS DEPENDENTES DA PESCA

- **Desenho amostral:**
  - Não há
- **Arte de pesca:**
  - Diversificada
- **Esforço pesqueiro:**
  - Variado
- **Cobertura especial:**
  - Restrita (agregada)
- **Cobertura temporal:**
  - Extensa
- **Custo:**
  - Baixo (\$)

## Amostragem preferencial!

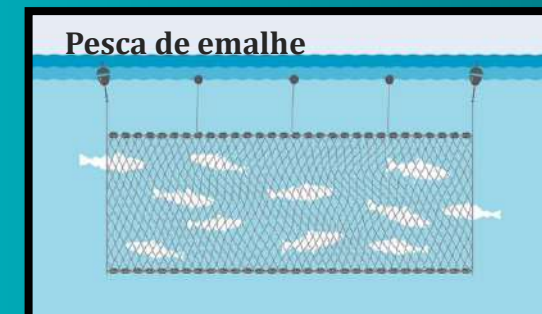


● Estações de amostragem



## DADOS DEPENDENTES DA PESCA

- **Desenho amostral:**
  - Não há
- **Arte de pesca:**
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  - Baixo (\$)



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  - Restrita (agregada)
- **Cobertura temporal:**
  - Extensa
- **Custo:**
  - Baixo (\$)

## Seletividade

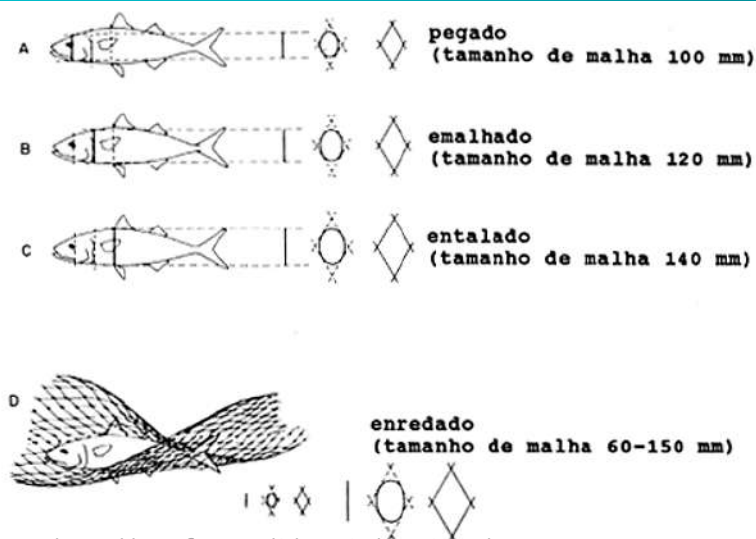


Imagem: <http://www.fao.org/3/w5448p/W5448P11.htm>

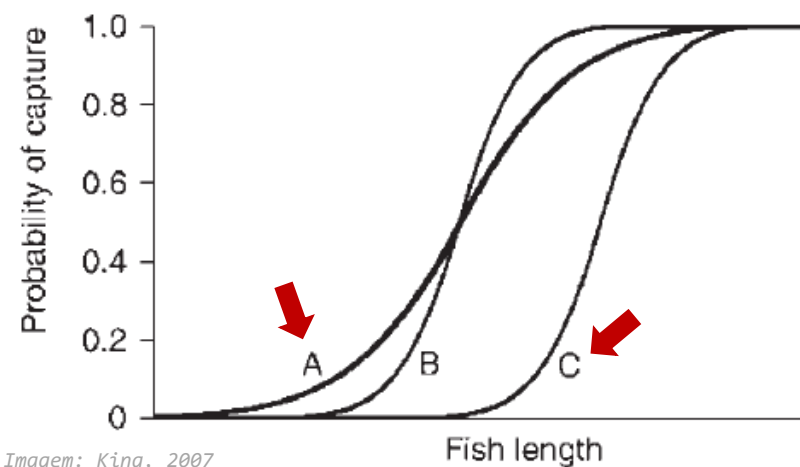
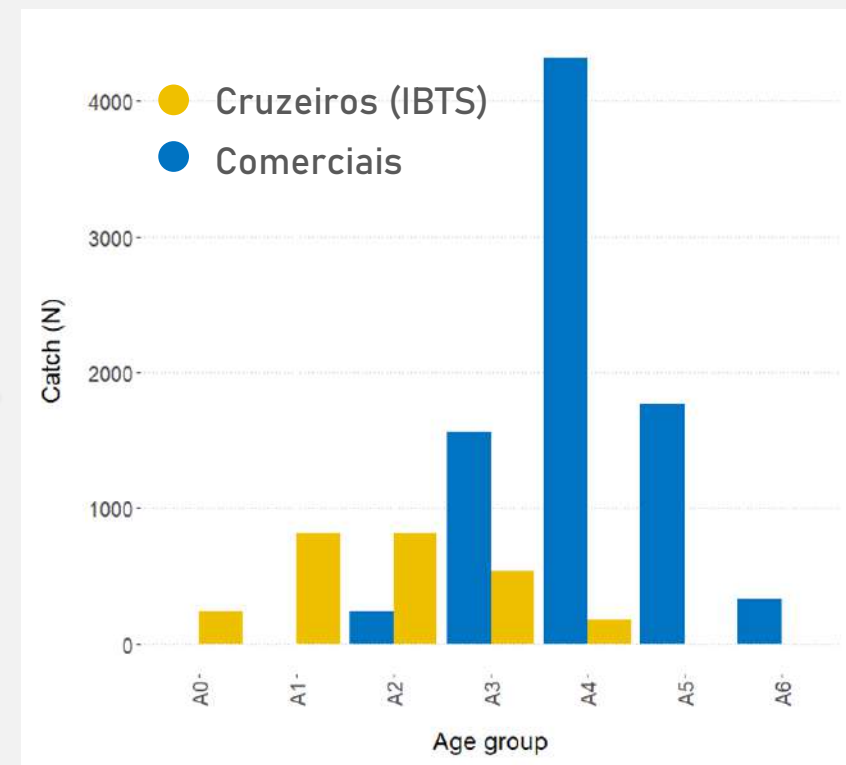
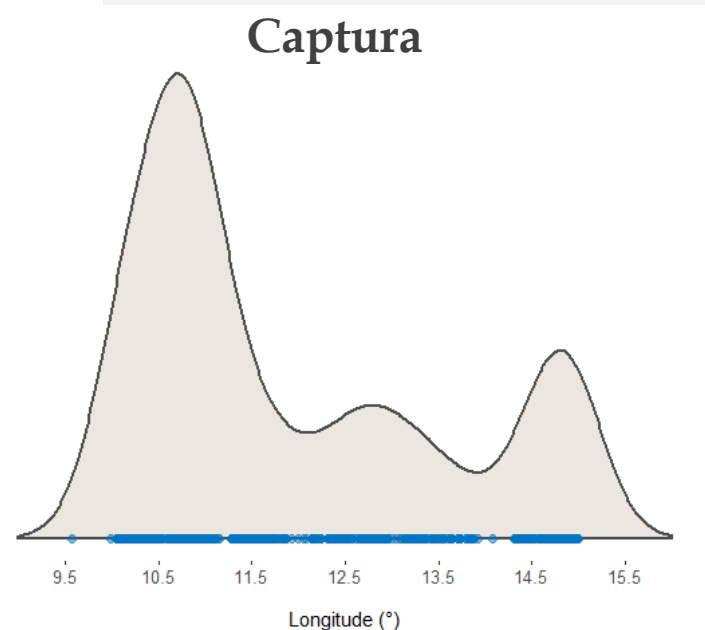
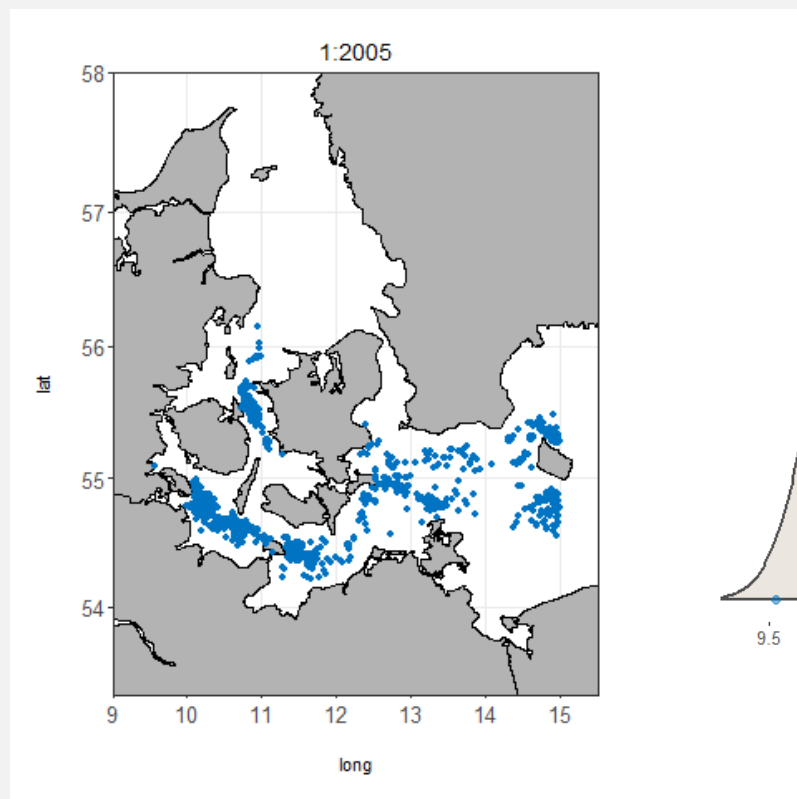
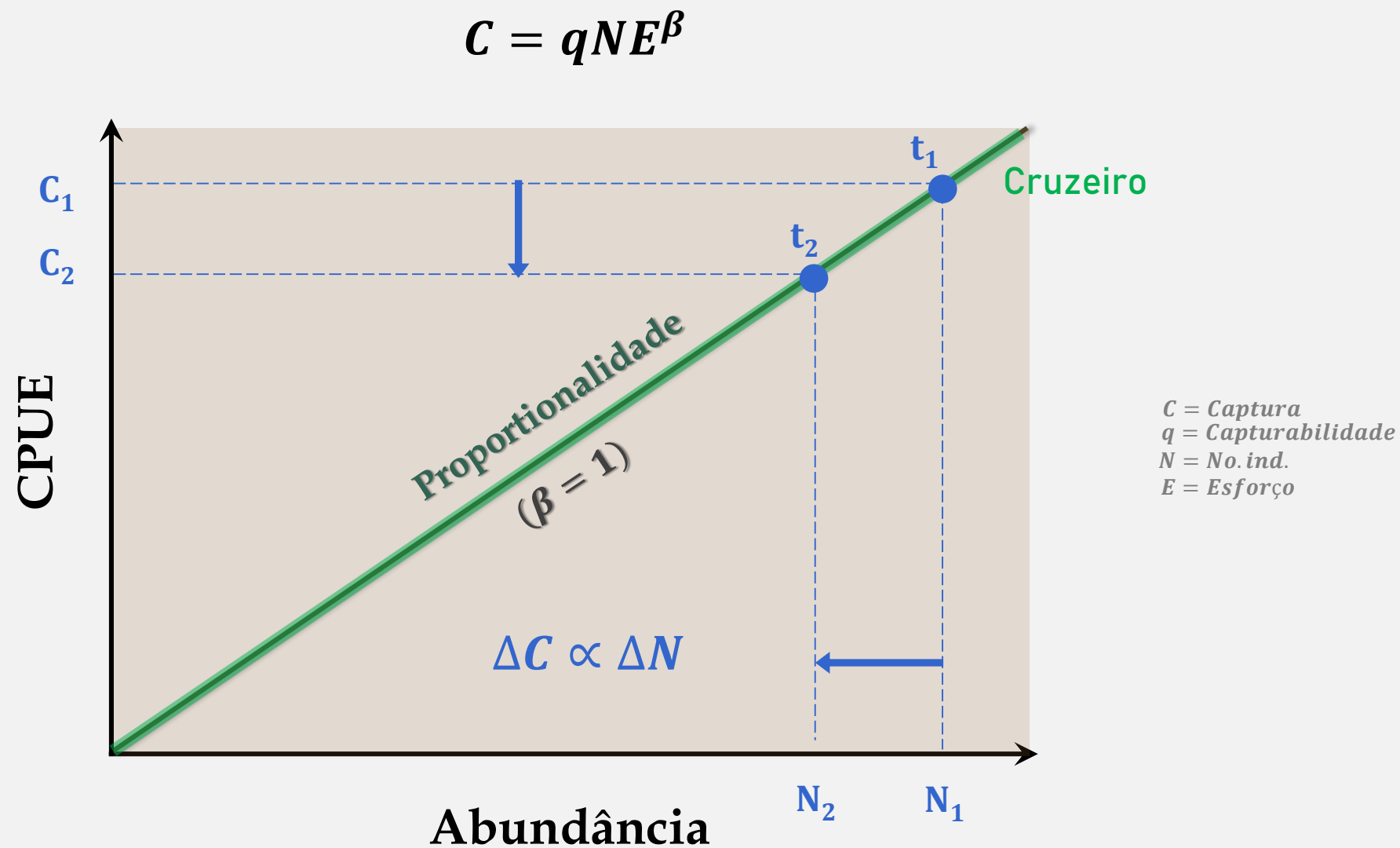


Imagem: King, 2007

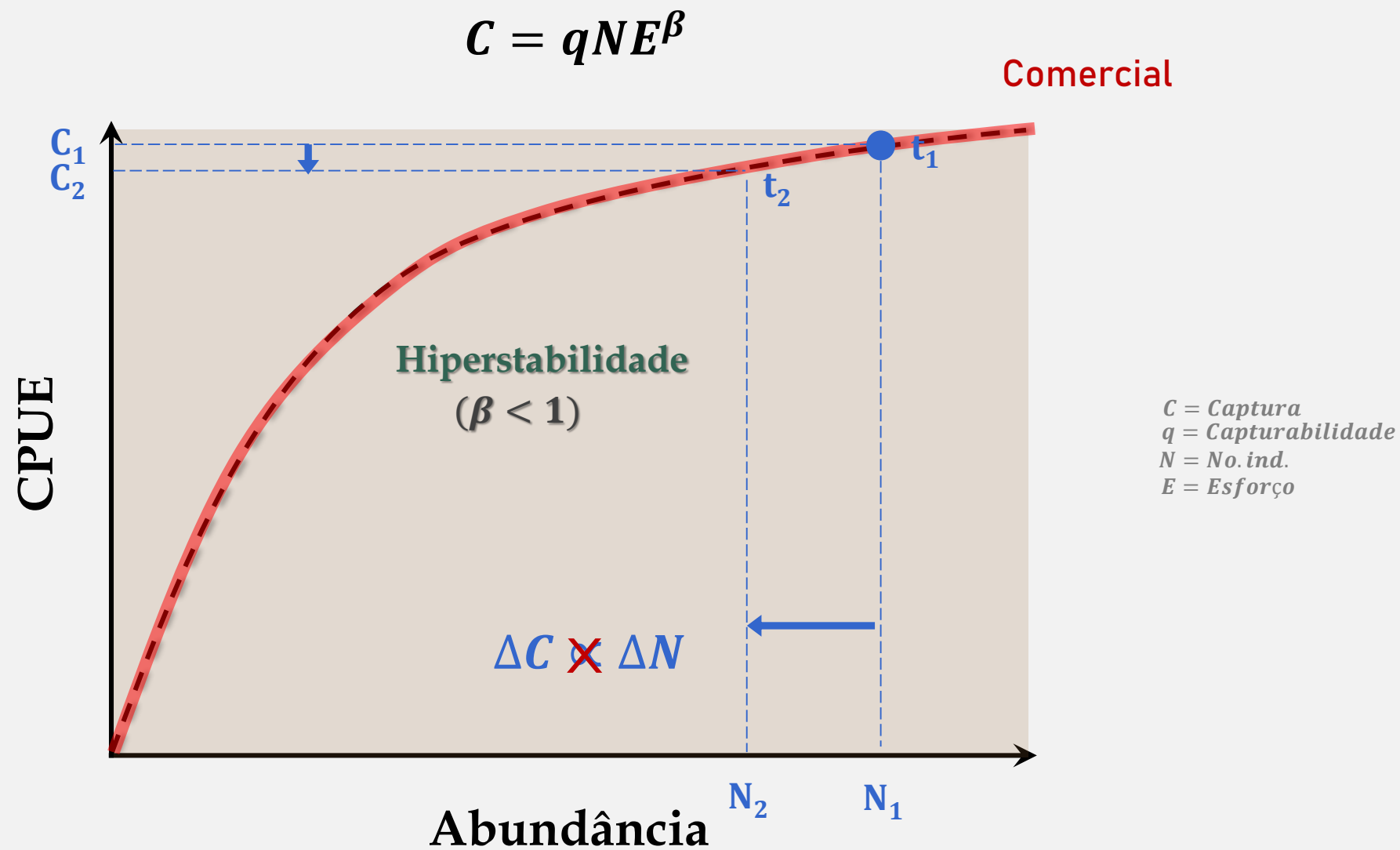


Exemplos da pesca de arrasto do bacalhau na região do Kattegat & Báltico ocidental (Rufener, 2020)





CPUE = Captura por unidade de esforço



CPUE = Captura por unidade de esforço

### Rapid worldwide depletion of predatory fish communities

Ransom A. Myers  & Boris Worm

*Nature* **423**, 280–283(2003) | [Cite this article](#)

**4202** Accesses | **1825** Citations | **207** Altmetric | [Metrics](#)

#### RESEARCH ARTICLE

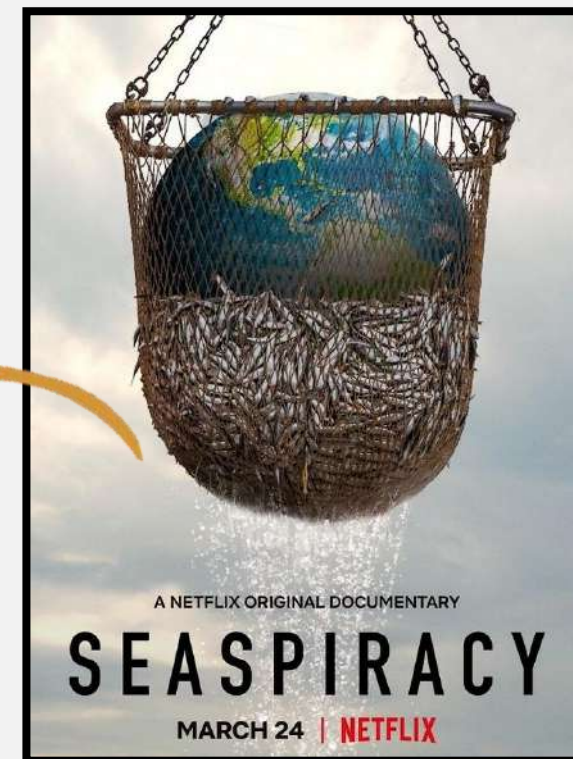
### Impacts of Biodiversity Loss on Ocean Ecosystem Services

Boris Worm<sup>1,\*</sup>, Edward B. Barbier<sup>2</sup>, Nicola Beaumont<sup>3</sup>, J. Emmett Duffy<sup>4</sup>, Carl Folke<sup>5,6</sup>, Benjamin S. Halpern<sup>7</sup>, Jeremy ...

[+ See all authors and affiliations](#)

*Science* 03 Nov 2006:  
Vol. 314, Issue 5800, pp. 787-790  
DOI: 10.1126/science.1132294

### Falácia do Seaspiracy



Todos os recursos pesqueiros  
irão colapsar até 2048



## O dilema de Pauly-Hilborn

Pauly



Imagem: [europe.oceana.org/en/about-oceana/people-partners/board-directors/dr-daniel-pauly](https://europe.oceana.org/en/about-oceana/people-partners/board-directors/dr-daniel-pauly)

Hilborn

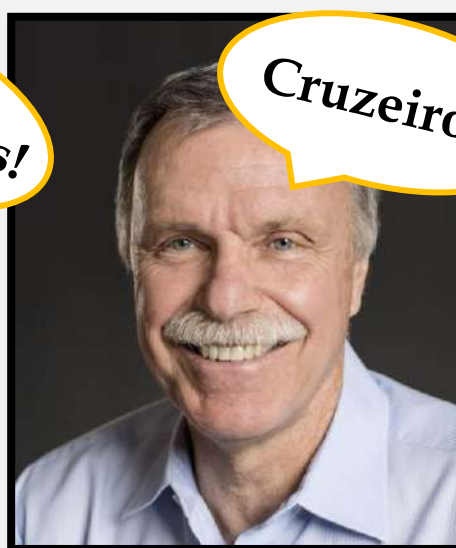


Imagem: [sustainablefisheries-uw.org/staff/](https://sustainablefisheries-uw.org/staff/)

Comerciais!

Cruzeiros!

### ESSAY: PROFESSIONAL ISSUES

#### Faith-based Fisheries

The scientific community gave a collective sigh of relief just before Christmas 2005 when Judge John E. Jones III ruled that intelligent design is not a scientific theory and cannot be taught alongside evolution as an alternative scientific hypothesis. There is no better way to unite any group of fractious scientists than to bring up creationism and intelligent design as alternative scientific hypotheses—scien-

tial system, not the authors of the papers. Casey and Myers' paper on barndoor skate (Casey and Myers 1998) argued that these skates were headed towards extinction. Analysis by others more familiar with the data showed that the survey data came from areas that are not the core of the range of the species (Kulka et al. 2002), and subsequent evaluation of the status of barndoor skate in New England by the

Ray Hilborn

Hilborn is the Richard C. and Lois M. Worthington Professor of Fisheries Management at the School of Aquatic and Fisheries Sciences, University of Washington, Seattle. He can be contacted at [rayh@u.washington.edu](mailto:rayh@u.washington.edu).

Daniel Pauly / September 28, 2009

## Aquacalypse Now

*The End of Fish*

**Our oceans have been** the victims of a giant Ponzi scheme, waged with Bernie Madoff-like callousness by the world's fisheries. Beginning in the 1950s, as their operations became increasingly industrialized--with

## Fisheries: Does catch reflect abundance?

Daniel Pauly , Ray Hilborn  & Trevor A. Branch 

*Nature* **494**, 303–306 (2013) | [Cite this article](#)

**16k** Accesses | **184** Citations | **206** Altmetric | [Metrics](#)

## ECOLOGICAL APPLICATIONS

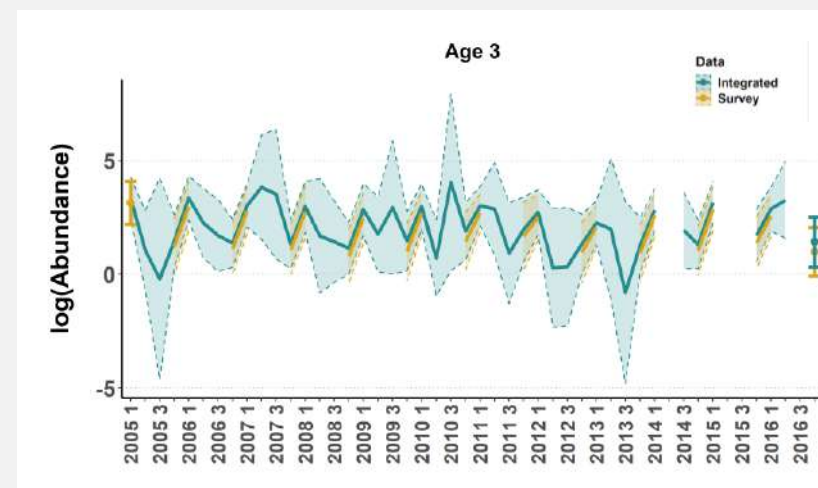
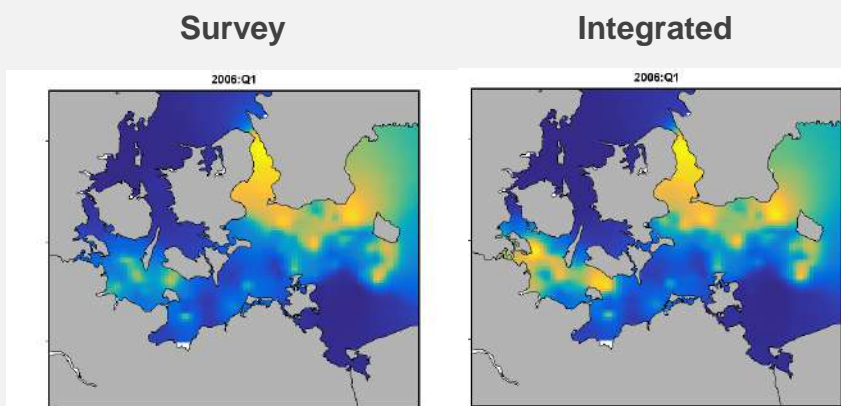
ECOLOGICAL SOCIETY OF AMERICA

ARTICLE

### Bridging the gap between commercial fisheries and survey data to model the spatiotemporal dynamics of marine species

Marie-Christine Rufener ✉, Kasper Kristensen, J. Rasmus Nielsen, Francois Bastardie,

First published: 14 September 2021 | <https://doi.org/10.1002/eap.2453>



- **Havendo a captura, o que se faz com as amostras (peixes)?**



Imagem: Cortesia Felipe O. Torquato



Imagem: acervo pessoal | DOL-UFRN



- **Pesagem**



Imagem: shutterstock.com



Imagem: Cortesia José Garcia Jr.



- **Comprimento**

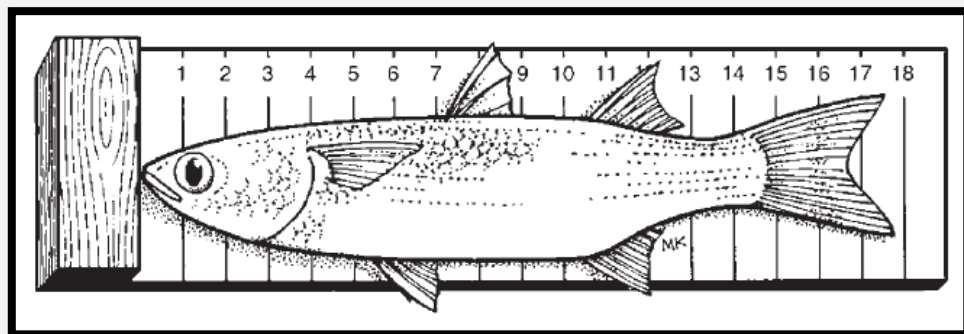


Imagem: King (2007)



Imagem: Cortesia José Garcia Jr.

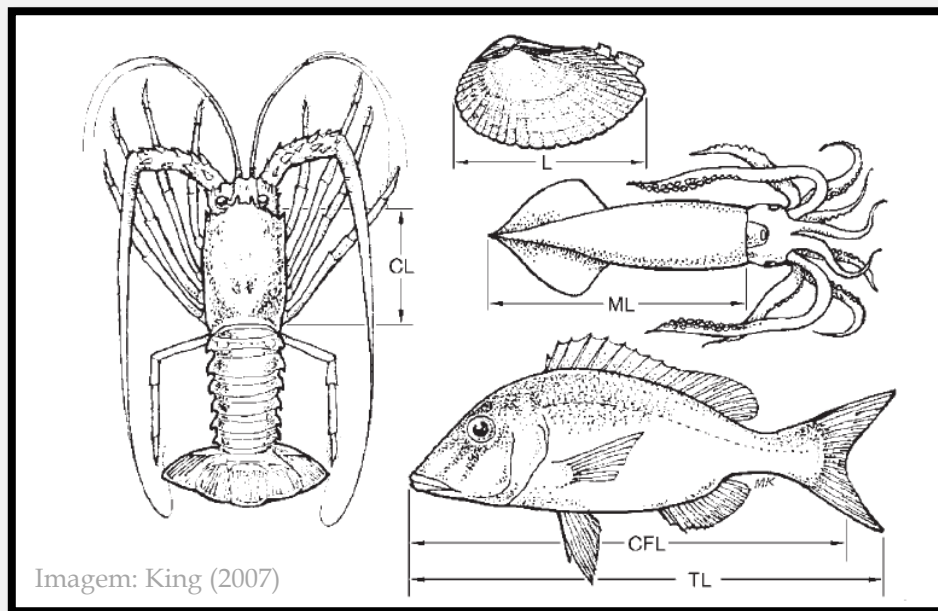


Imagem: King (2007)



Imagem: [riptidenfish.com/dungeness-crab-in-westport-washington/](http://riptidenfish.com/dungeness-crab-in-westport-washington/)

- Idade

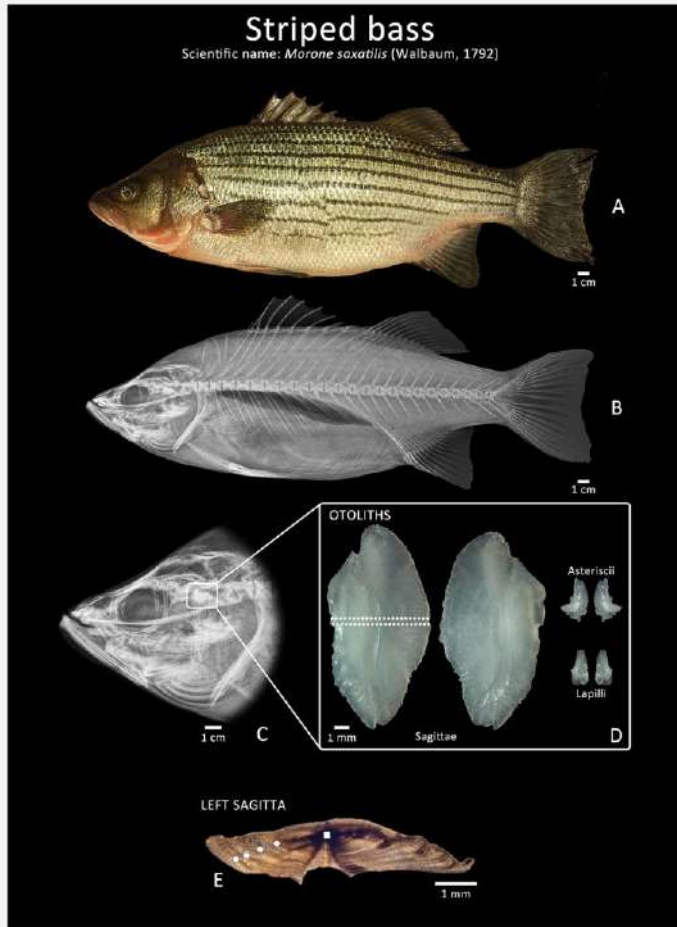


Imagem: Moraes et al. (2018) | *Frontiers for young minds*

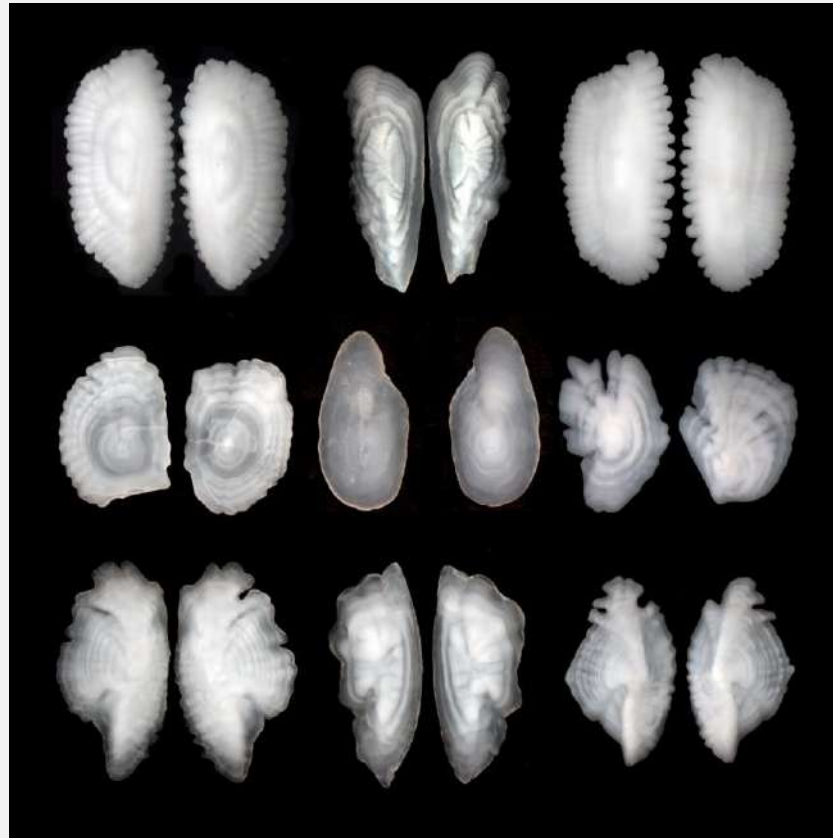


Imagem: fisheries.noaa.gov

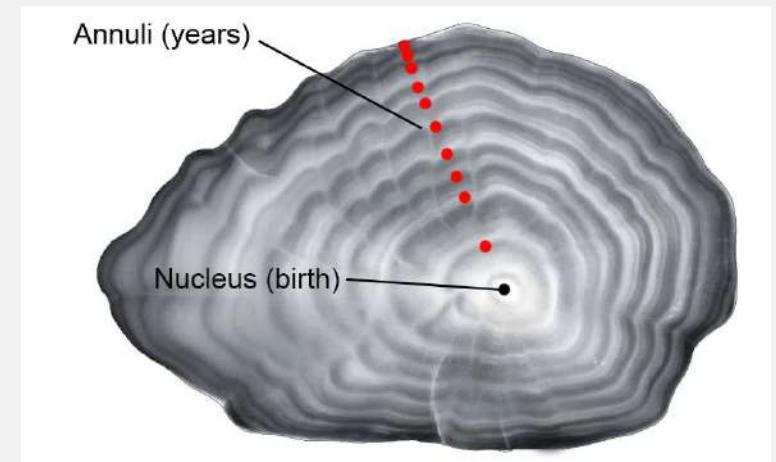


Imagem: offthescaleangling.ie



- Sexagem e estágio maturacional



Imagem: Acervo pessoal



Imagem: Acervo pessoal

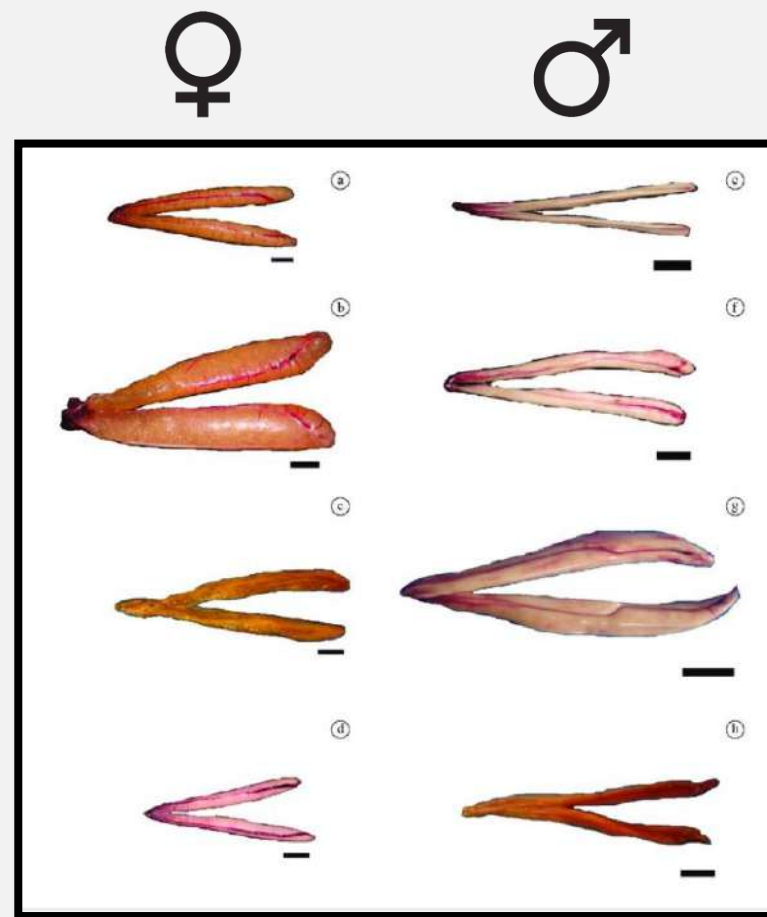


Imagem: Oliveira et al. (2015) | *Brazilian Journal of Biology*

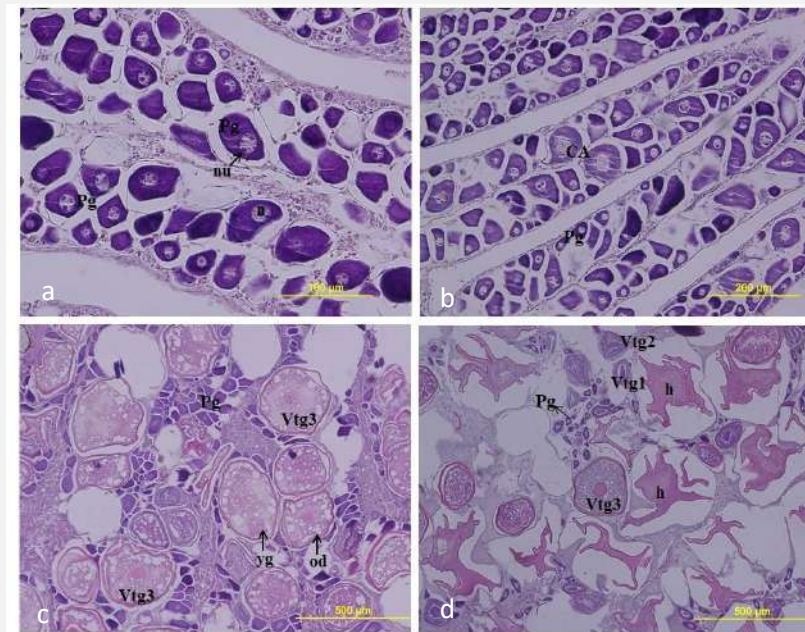


Imagem: Cortesia Felipe O. Torquato

- **Conteúdo estomacal**



Imagem: fishpathogens.net



Imagem: twitter.com/bearddley/



**A final, por que e como manejamos os recursos  
pesqueiros?**

# Por que manejamos peixes?

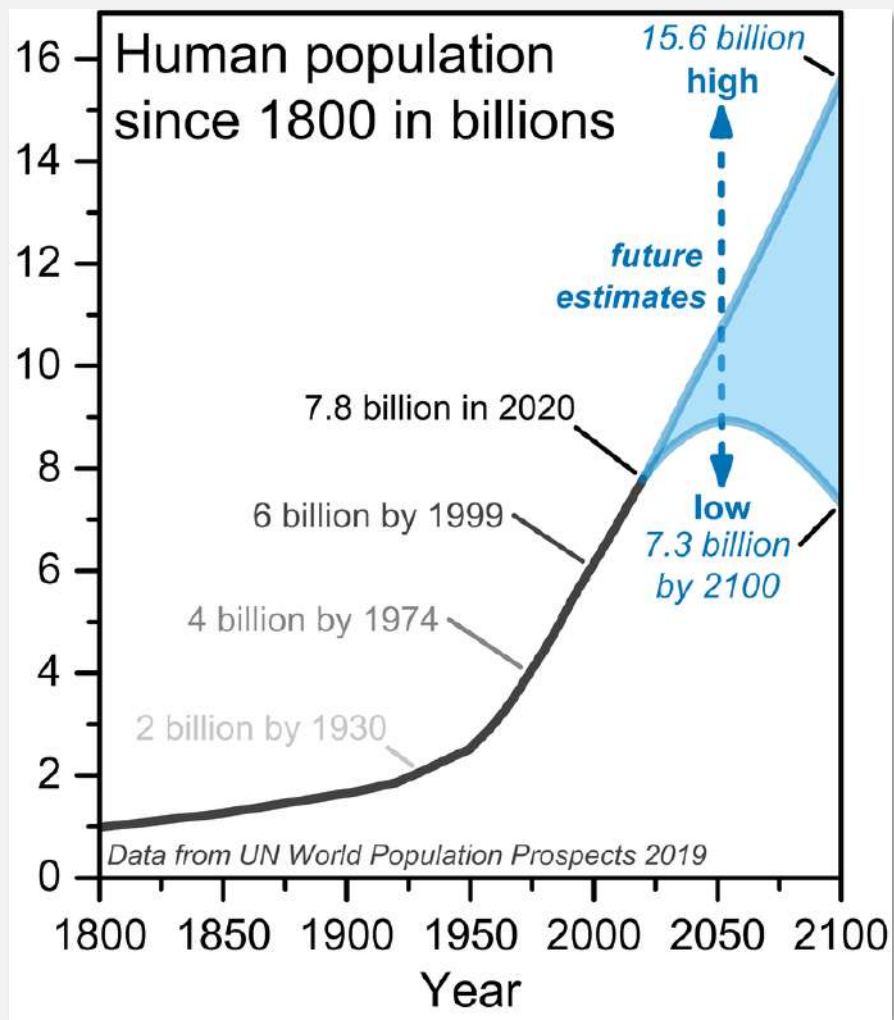
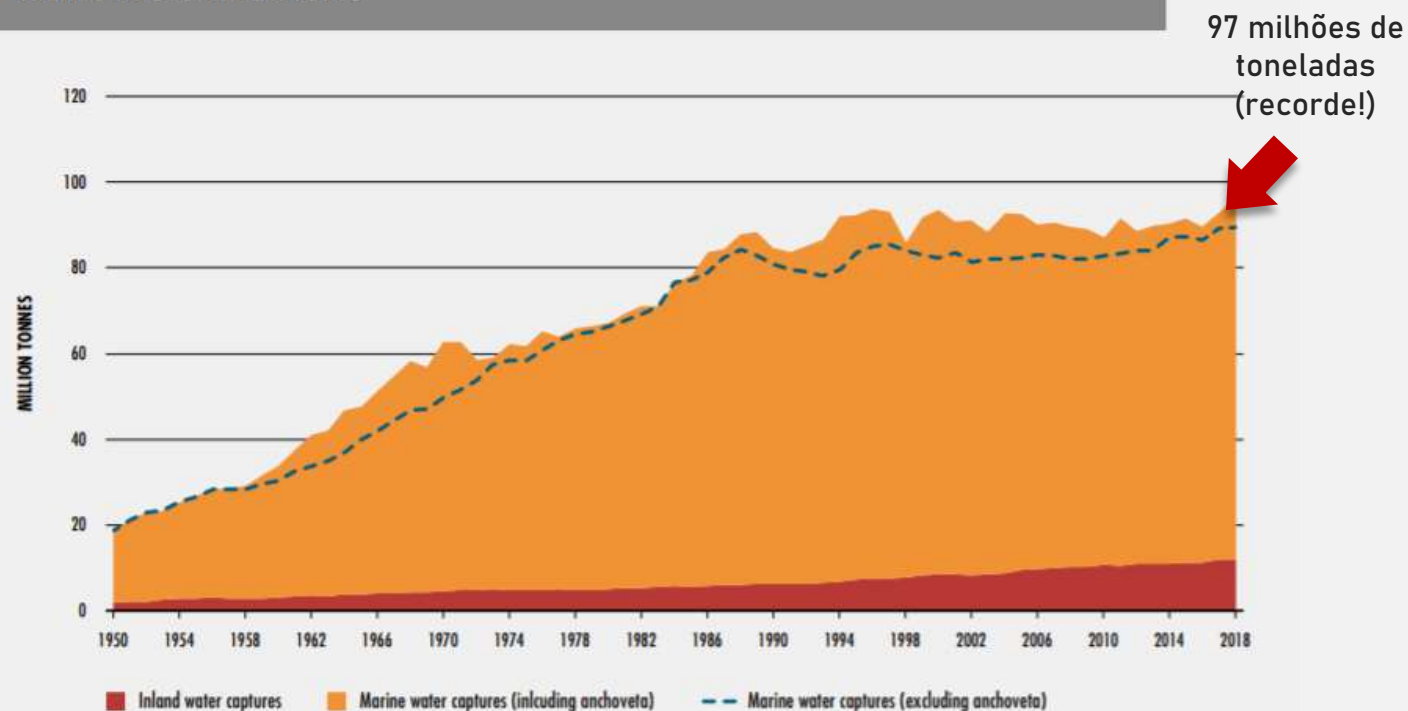


Imagem: [population.un.org/wpp/](https://population.un.org/wpp/)

FIGURE 4  
TRENDS IN GLOBAL CAPTURES

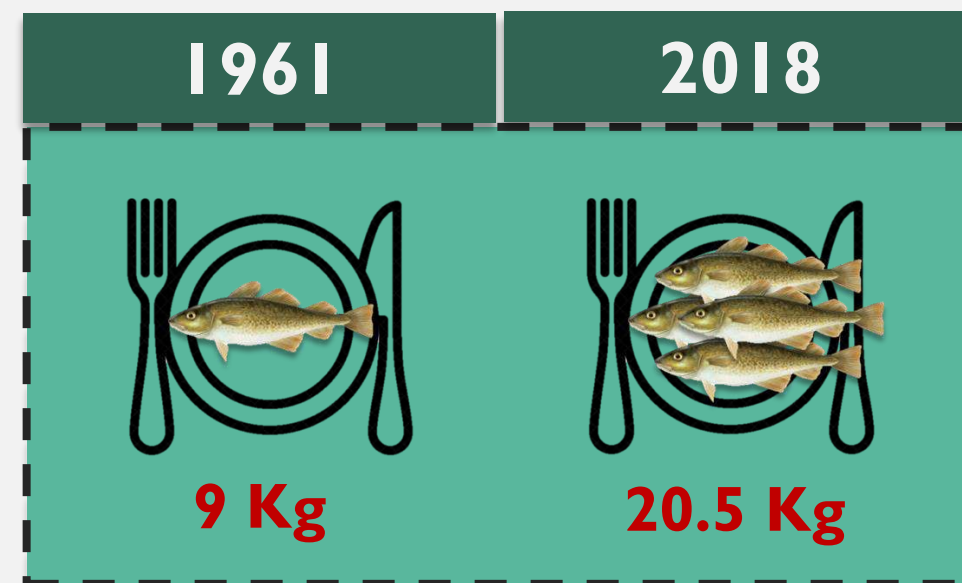


Fonte: FAO (2020)

## Segurança alimentar!

- 3.3 bilhões de pessoas dependem dos recursos pesqueiros para consumo alimentar
- 38 milhões de pessoas tem empregos direto na industria pesqueira

### Consumo per capita




**Taxa de consumo de peixe (3.1%) > taxa de crescimento populacional (1.6%)**



Article | [Open Access](#) | Published: 15 September 2021

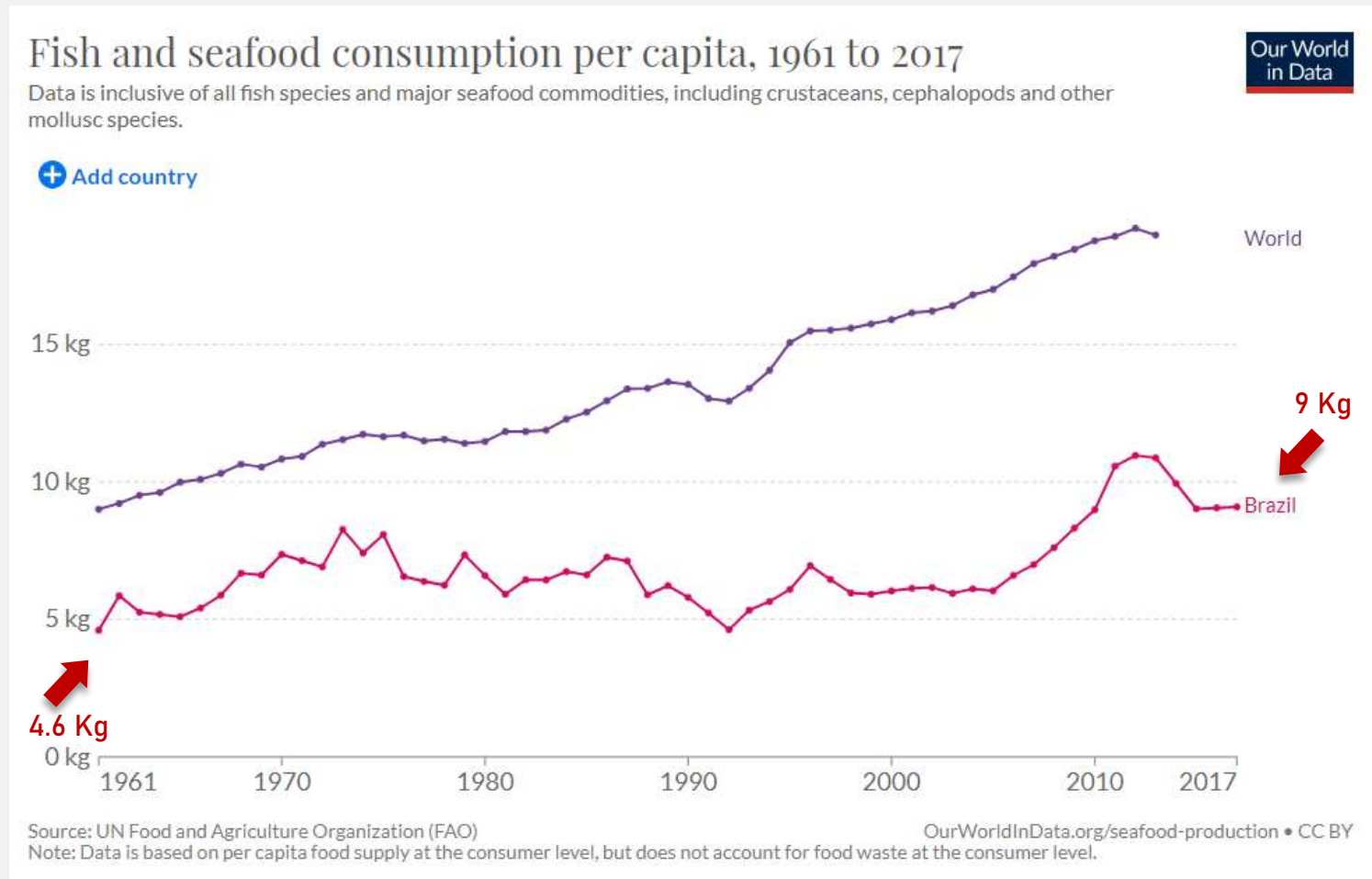
## Blue food demand across geographic and temporal scales

Rosamond L. Naylor , Avinash Kishore, U. Rashid Sumaila, Ibrahim Issifu, Blaire P. Hunter, Ben Belton, Simon R. Bush, Ling Cao, Stefan Gelcich, Jessica A. Gephart, Christopher D. Golden, Malin Jonell, J. Zachary Koehn, David C. Little, Shakuntala H. Thilsted, Michelle Tigchelaar & Beatrice Crona

*Nature Communications* **12**, Article number: 5413 (2021) | [Cite this article](#)

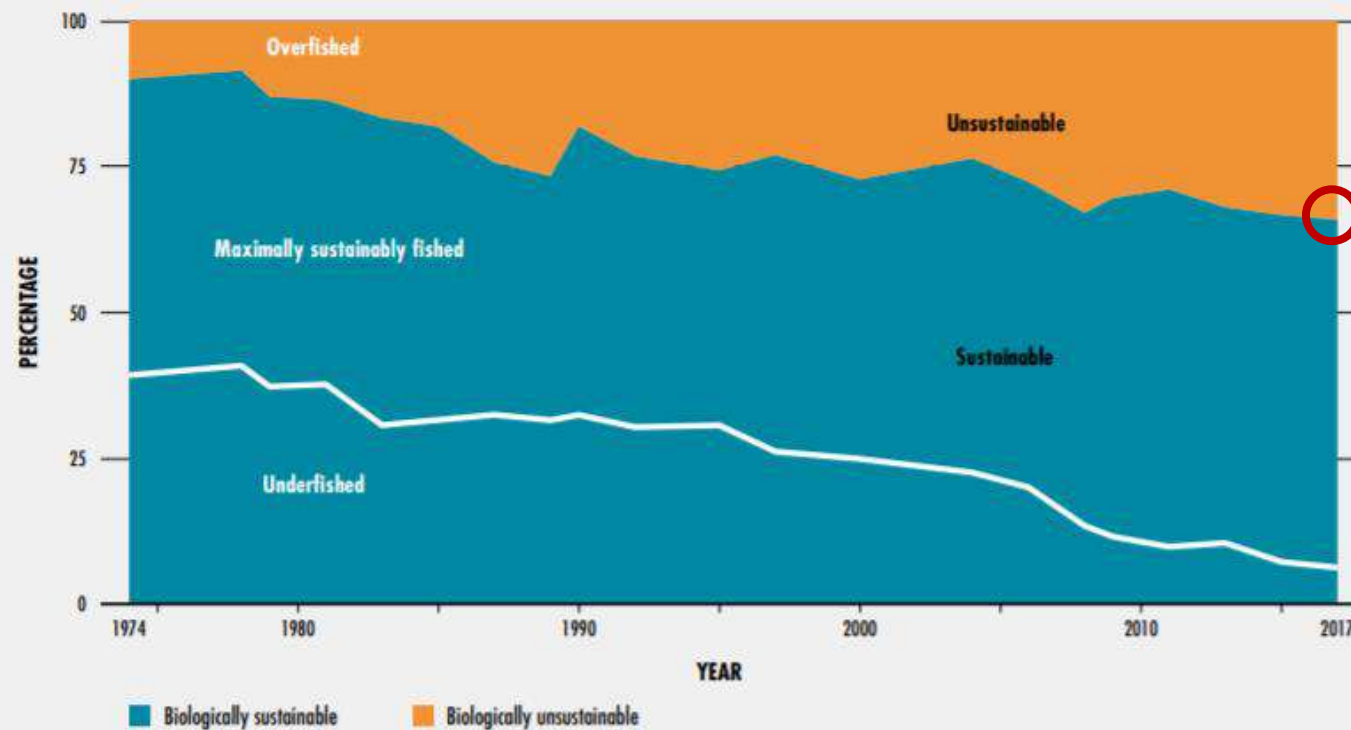


## E no Brasil?



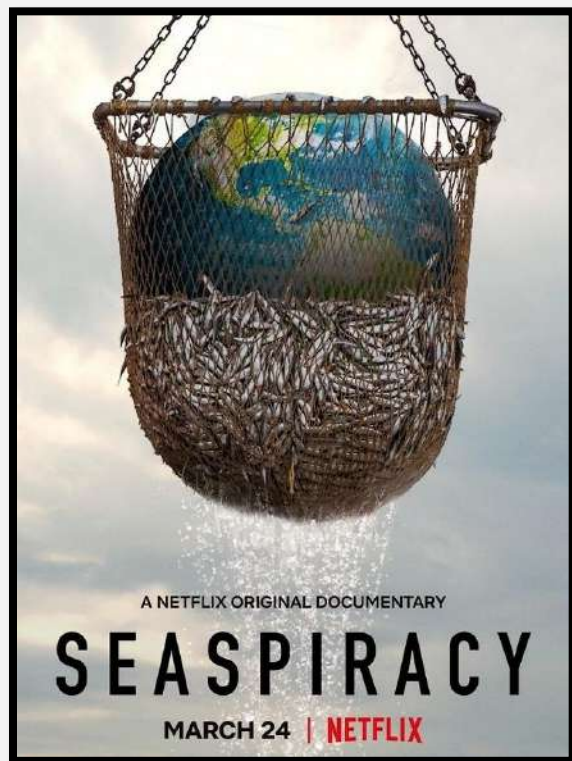
# Por que manejamos peixes?

FIGURE 19  
GLOBAL TRENDS IN THE STATE OF THE WORLD'S MARINE FISH STOCKS, 1974–2017

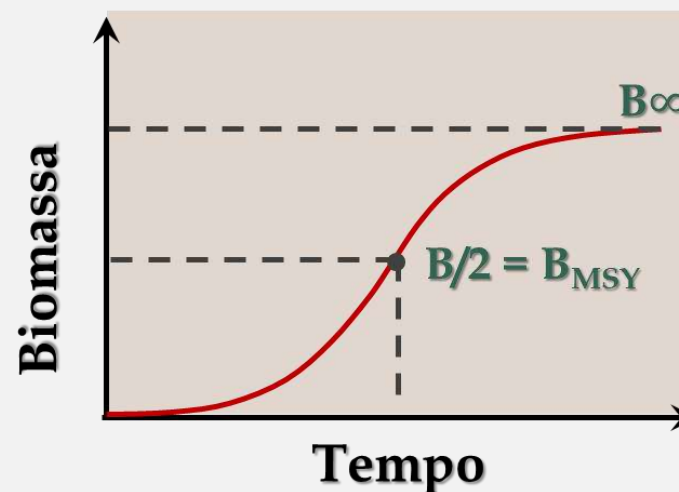


- ~66% estão dentro de limites sustentáveis de exploração
- ~34% são pescados de forma insustentável

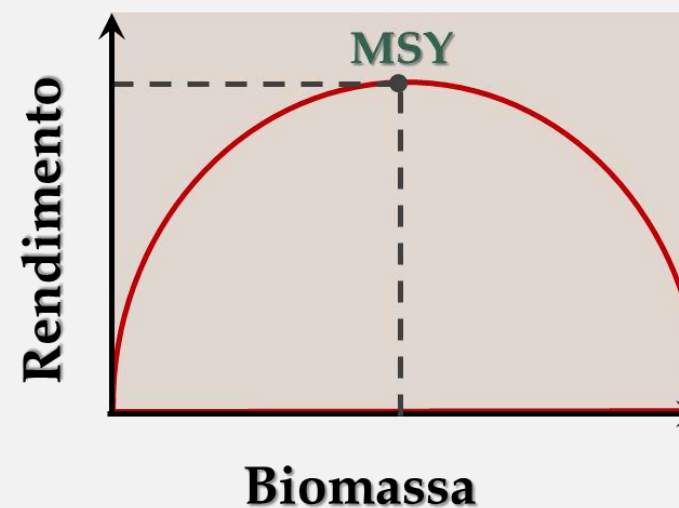
## Falácia do Seaspiracy



Expõe de **forma errônea** que não há pesca sustentável



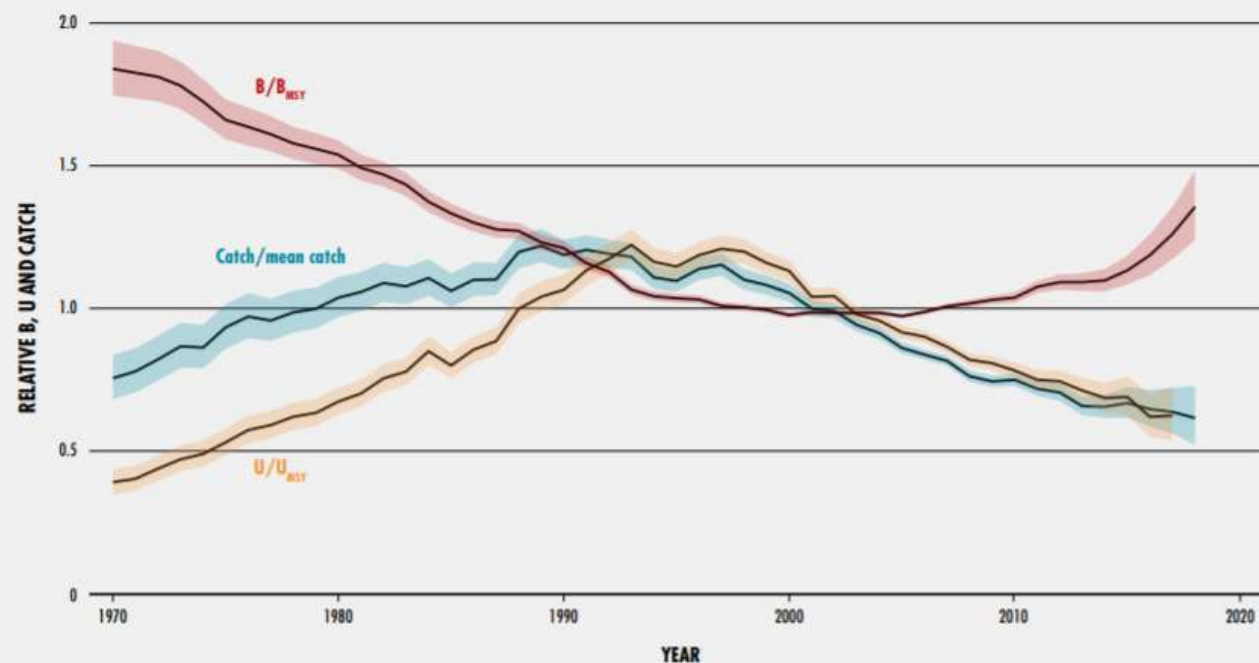
MSY = Maximum Sustainable Yield  
(Rendimento Máximo Sustentável)



# Por que manejamos peixes?

## BOX 4 (CONTINUED)

GEOMETRIC MEAN BIOMASS  $B/B_{MSY}$ ,  $U/U_{MSY}$  AND CATCH / MEAN CATCH, 1970–2016, ESTIMATED BY A STATE-SPACE MODEL<sup>1</sup>



<sup>1</sup>  $B$  = biomass;  $B_{MSY}$  = biomass that can produce maximum sustainable yield (MSY);  $U$  = fishing pressure;  $U_{MSY}$  = fishing pressure at MSY.




 Ray Hilborn,  Ricardo Oscar Amoroso, Christopher M. Anderson, Julia K. Baum,  Trevor...  
[+ See all authors and affiliations](#)

Received: 25 January 2021 | Revised: 11 March 2021 | Accepted: 15 March 2021

DOI: 10.1111/faf.12560

### ORIGINAL ARTICLE

## Global status of groundfish stocks

Ray Hilborn<sup>1</sup>  | Daniel J. Hively<sup>1</sup> | Nicole Baker Loke<sup>1</sup> | Carryn L. de Moor<sup>2</sup> | Hiroyuki Kurota<sup>3</sup> | Johannes N. Kathena<sup>4</sup> | Pamela M. Mace<sup>5</sup> | Cólín Minto<sup>6</sup> | Ana M. Parma<sup>7</sup> | Juan-Carlos Quiroz<sup>8</sup> | Michael C. Melnychuk<sup>1</sup>

Marine Policy 93 (2018) 159–170

Contents lists available at ScienceDirect

Marine Policy

journal homepage: [www.elsevier.com/locate/marpol](http://www.elsevier.com/locate/marpol)



## Status and rebuilding of European fisheries

Rainer Froese<sup>a,\*</sup>, Henning Winker<sup>b,c</sup>, Gianpaolo Coro<sup>d</sup>, Nazli Demirel<sup>e</sup>, Athanassios Donna Dimarchopoulou<sup>f</sup>, Giuseppe Scarcella<sup>g</sup>, Martin Quaas<sup>h</sup>, Nele Matz-Lück<sup>i</sup>

[> Curr Biol.](#) 2013 Aug 5;23(15):1432–7. doi: 10.1016/j.cub.2013.06.016. Epub 2013 Jul 18.

## Reversal of fish stock decline in the Northeast Atlantic

Paul G Fernandes<sup>1</sup>, Robin M Cook

Affiliations [+ expand](#)

PMID: 23871238 DOI: [10.1016/j.cub.2013.06.016](https://doi.org/10.1016/j.cub.2013.06.016)

## Identifying management actions that promote sustainable fisheries

Michael C. Melnychuk , Hiroyuki Kurota, [...]Ray Hilborn

*Nature Sustainability* 4, 440–449 (2021) | [Cite this article](#)

## Improved management is the main driver behind recovery of Northeast Atlantic fish stocks

Fabian Zimmermann , Karl Michael Werner

First published: 31 January 2019 | <https://doi.org/10.1002/fee.2002> | Citations: 12

## LETTERS

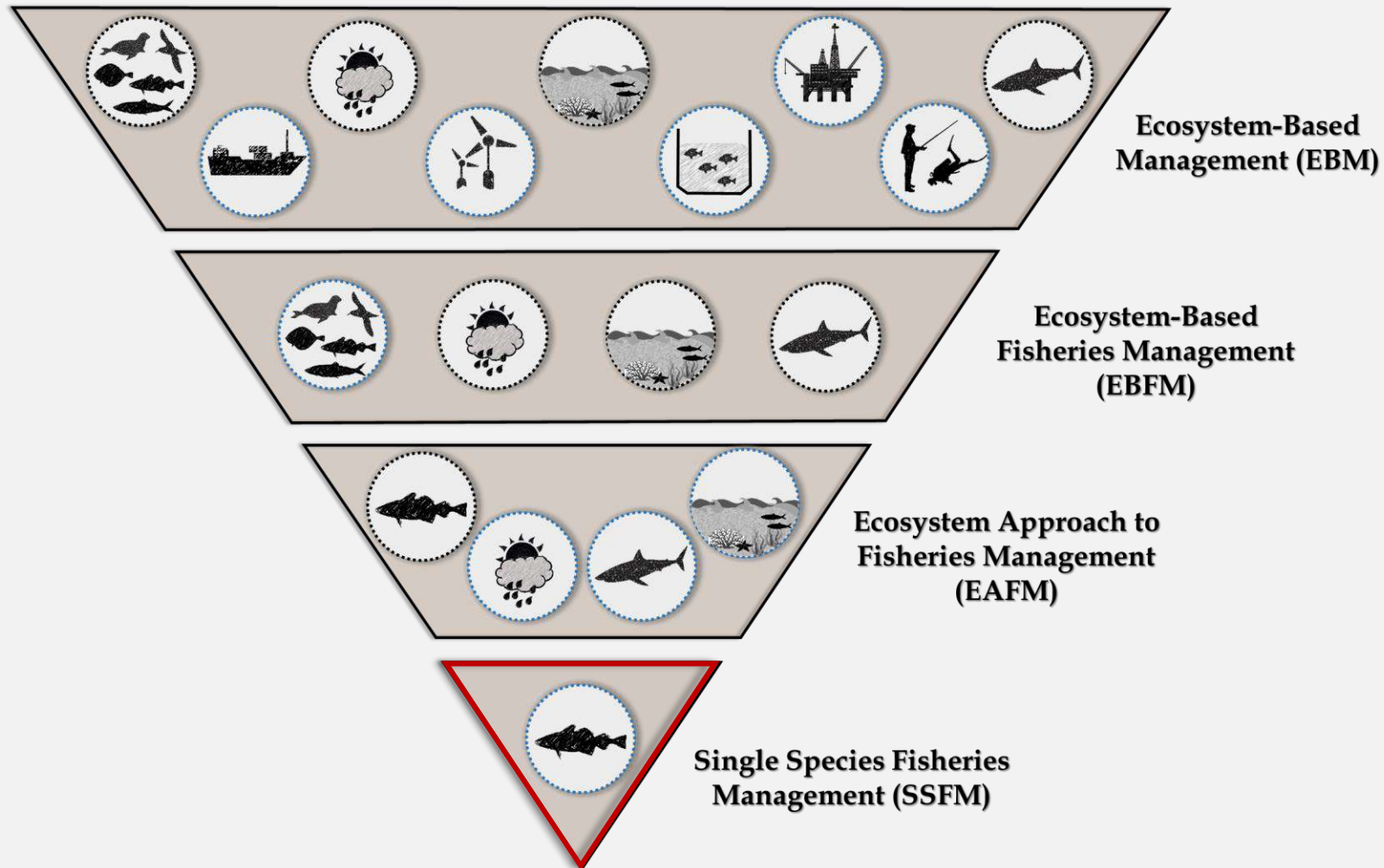
# Prevent bottom trawling in southern Brazil

Luís Gustavo Cardoso<sup>1,\*</sup>, Manuel Haimovici<sup>1</sup>, Patrícia Raggi Abdallah<sup>2</sup>, Eduardo Resende Secchi<sup>1</sup>, Paul Gerhard Kinas<sup>3</sup>

+ See all authors and affiliations

Science 09 Apr 2021:  
Vol. 372, Issue 6538, pp. 138  
DOI: 10.1126/science.abh0279



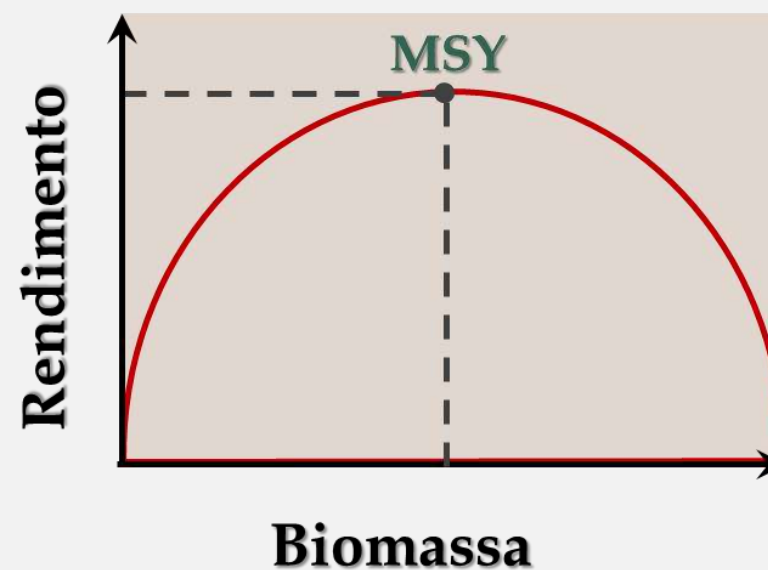
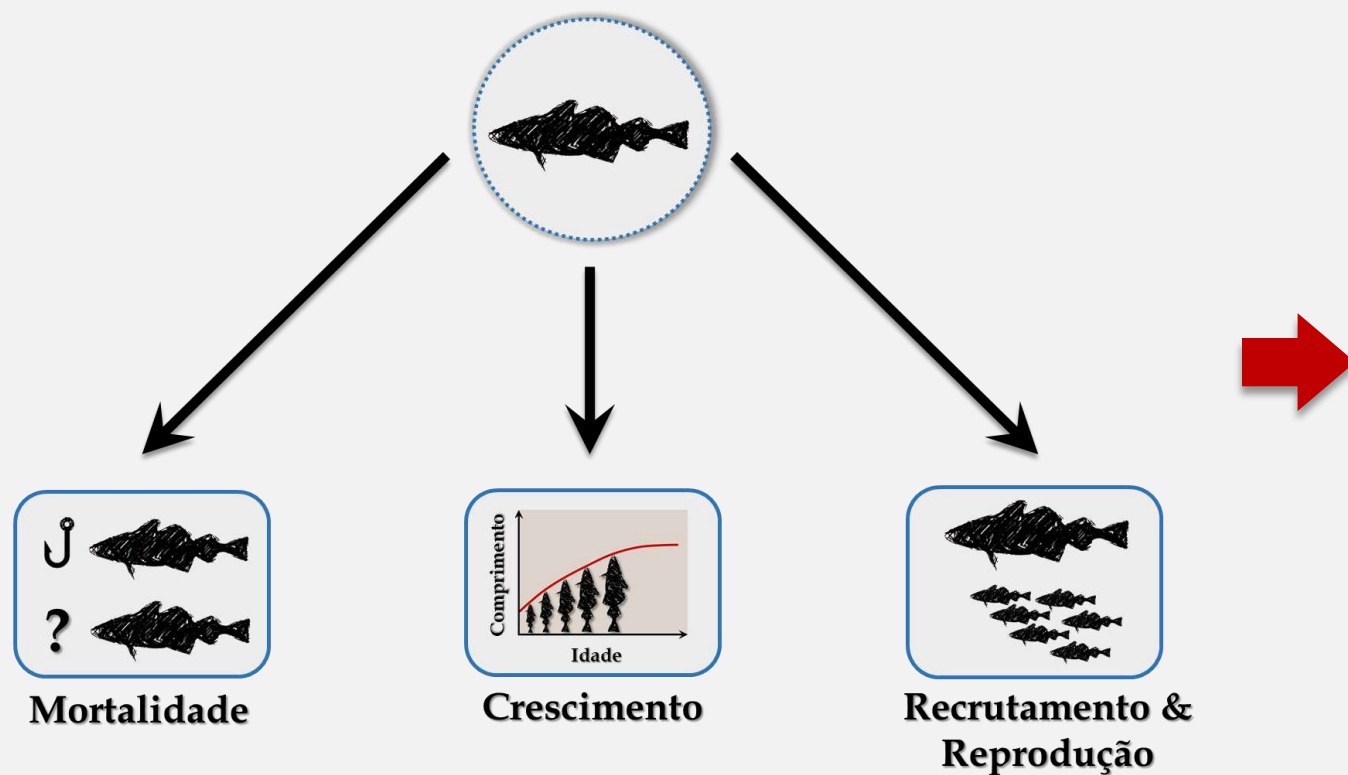


Visão  
holística



- Manejo a nível de estoque (SSFm)

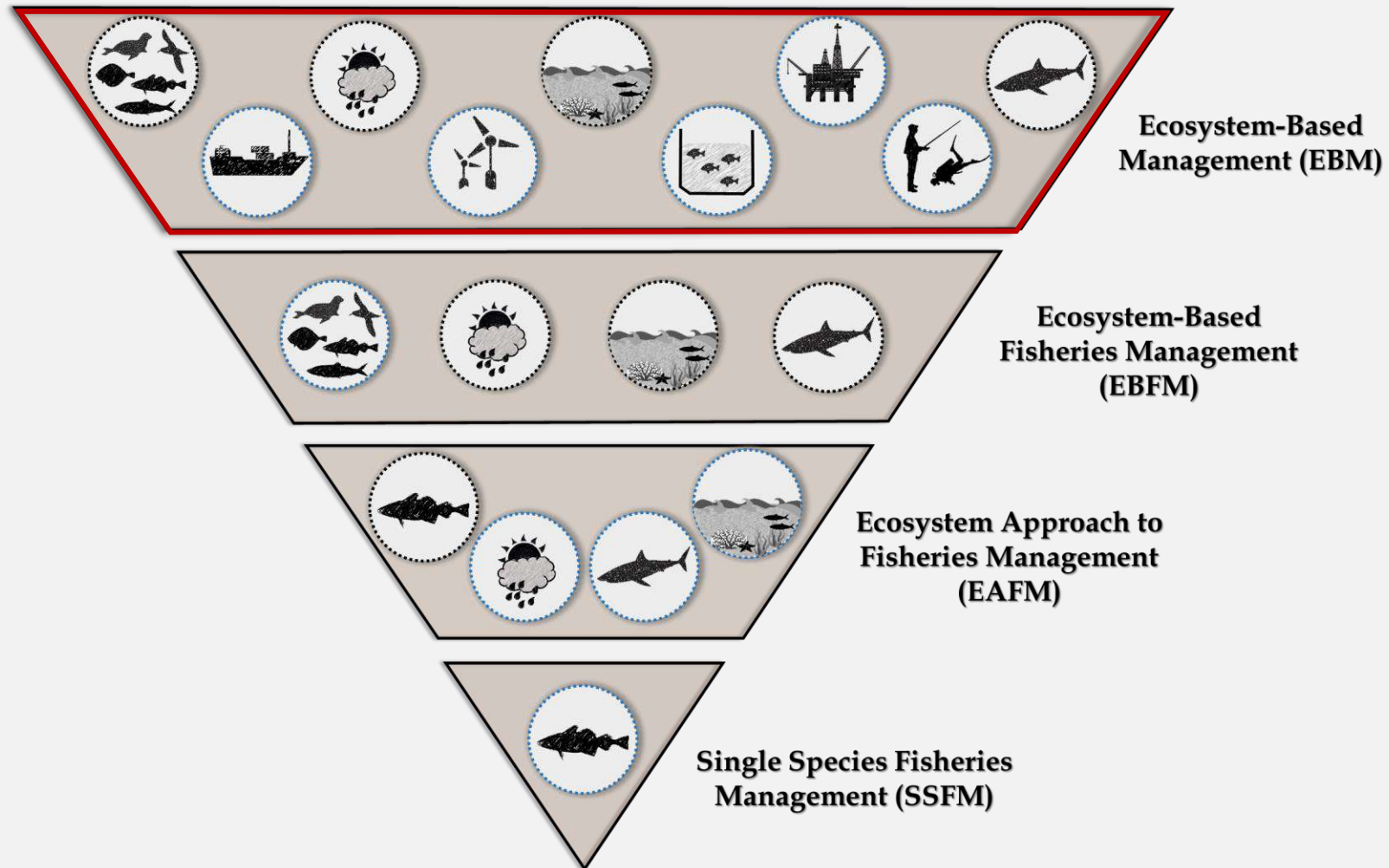
## Processos biológicos



\*MSY = Maximum Sustainable Yield (Rendimento Máximo Sustentável)

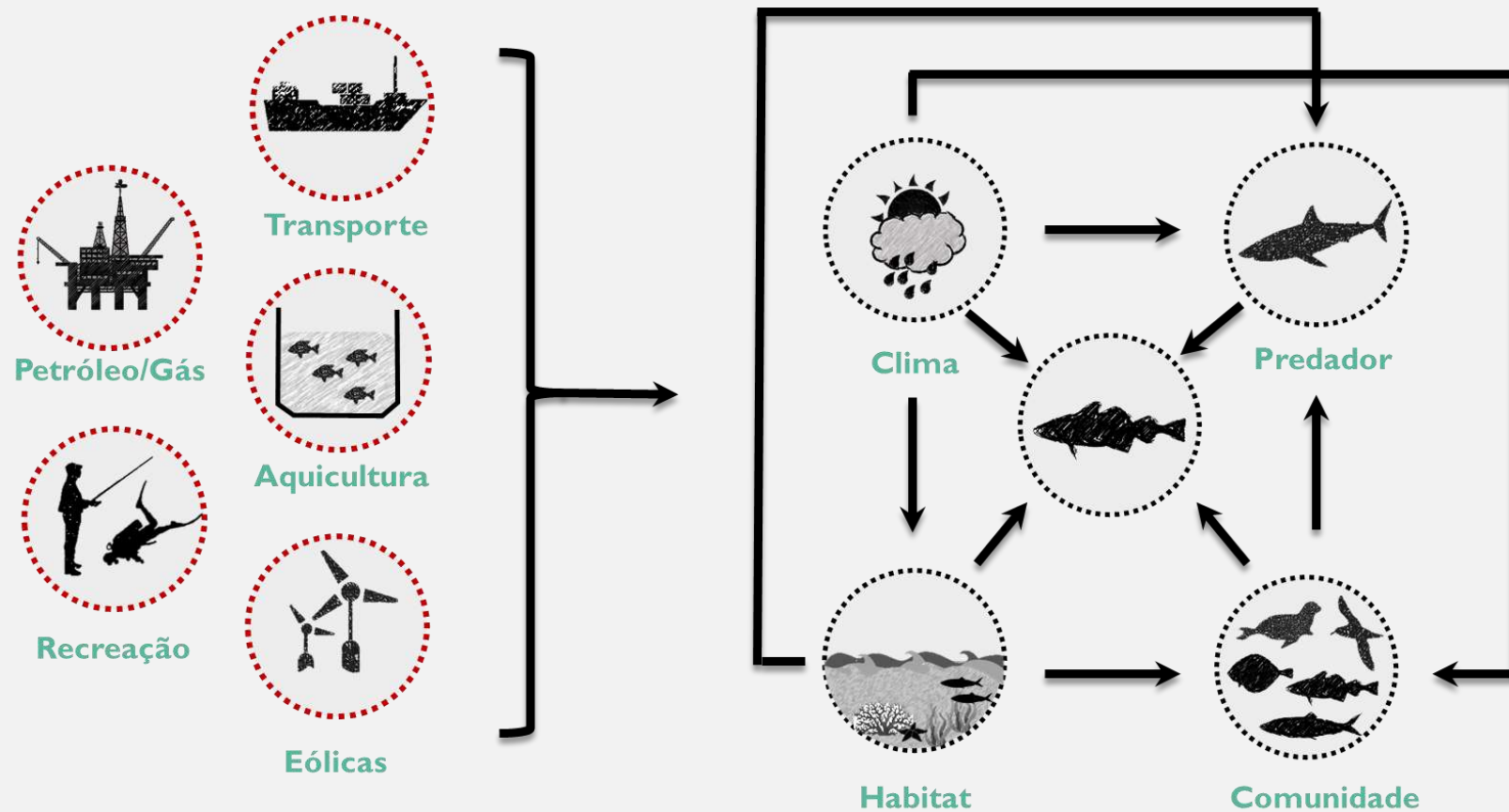


# Como manejamos peixes?





- **Manejo a nível de ecossistema (comunidade de peixes)**

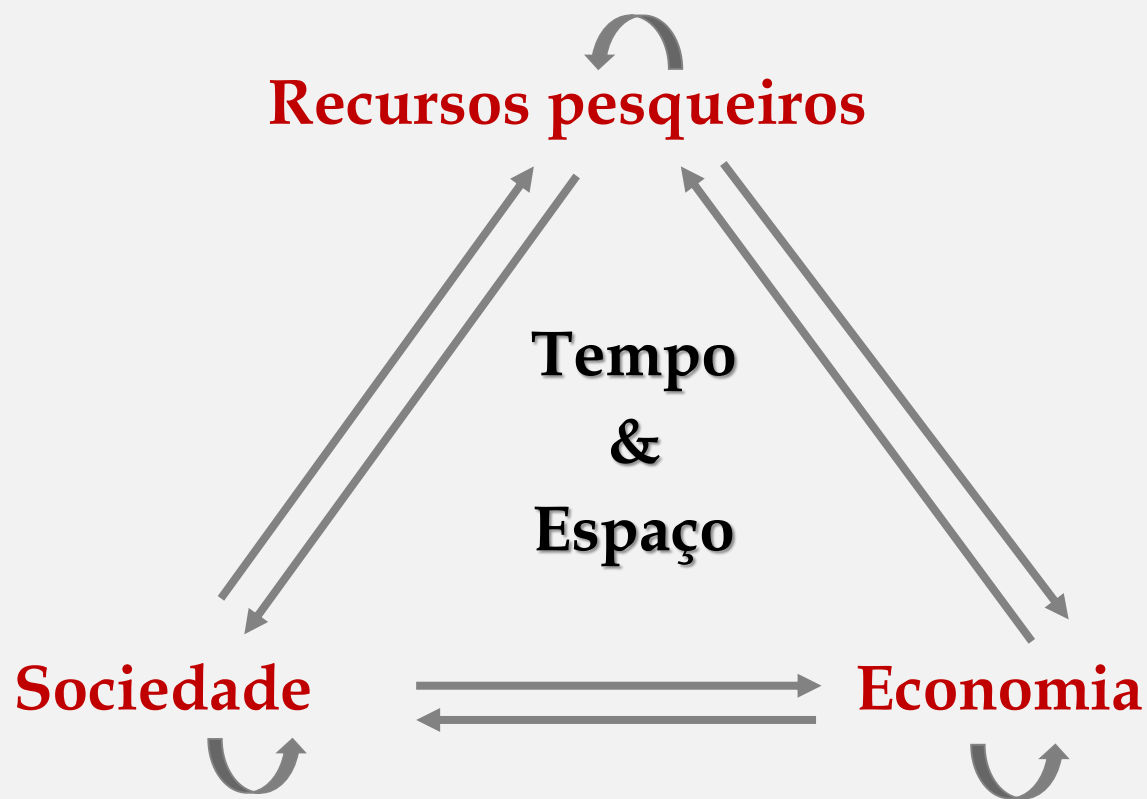


- Marine Spatial Planning
- Coastal management

## Take home message:

*“Manejar as pescarias é  
manejar as pessoas”*

**Hilborn, 2007**





# Leituras complementares...

