Selective fishing, balanced harvesting and sustainability of fisheries and ecosystems

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IUCN CEM FEG EBCD EUROPEAN BUREAU FOR CONSERVATION & DEVELOPMENT

Report on a scientific workshop on

Selective Fishing and Balanced Exploitation in Relation to Fisheries and Ecosystem Sustainability

Organized by the Fisheries Expert Group (FEG) of the IUCN Commission on Ecosystem Management
In Nagoya (Japan) 14-16 October 2010

Convened by: S.M. Garcia, J. Rice, J. Kolding, M-J. Rochet, S. Zhou

Coordination: EBCD

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Outline

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2. Selectivity concept
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4. Evolutionary problems
5. The food chain concept
6. Modeling results
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1. Introduction

- The selectivity paradigm is 50-year old and non ecosystemic
- It ignores trophic relations and predation
- The paradigm is to avoid catching juveniles and protected species
- There are recent calls to protect also old mature fish
- Bycatch and discards are hot issues
- There is also increasing concern about fishery-induced evolution
- But: EAF should maintain ecosystem structure and processes
- While: any selective removal will change the population and the community in a non-intuitive manner
- Hence: un-coordinated selectivity regulations may diminish rather than enhance the sustainability of the fishery system
- The selectivity paradigm needs to be reassessed in an ecosystem perspective!

1. Introduction

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Some questions

Are present practices making things better or worse for the ecosystem?

Could selectivity be optimized at population and ecosystem level?

Could selective harvest and protection be co-optimized?

2. Selectivity concept

- Selectivity is the process through which fishing obtains a catch with a composition (in size, sex, or species) that differs from that of the natural habitat on which it operates.
- It is the probability of a species, sex, size or age to be caught.
- It results from the appropriate selection of: (i) the fishing area and depth, (2) the fishing season and time, and (3) the fishing gear, its characteristics and operation.
- Selectivity is conventionally regulated to: (i) maximize long-term yield we obtain from each recruit of the target species and (ii) reduce catch of unwanted or protected species.
- Selectivity is used by fishers to maximize short-term economic returns
- Conventional selectivity regulations ignore trophic relations and predation.

3. Selectivity problems: Cod

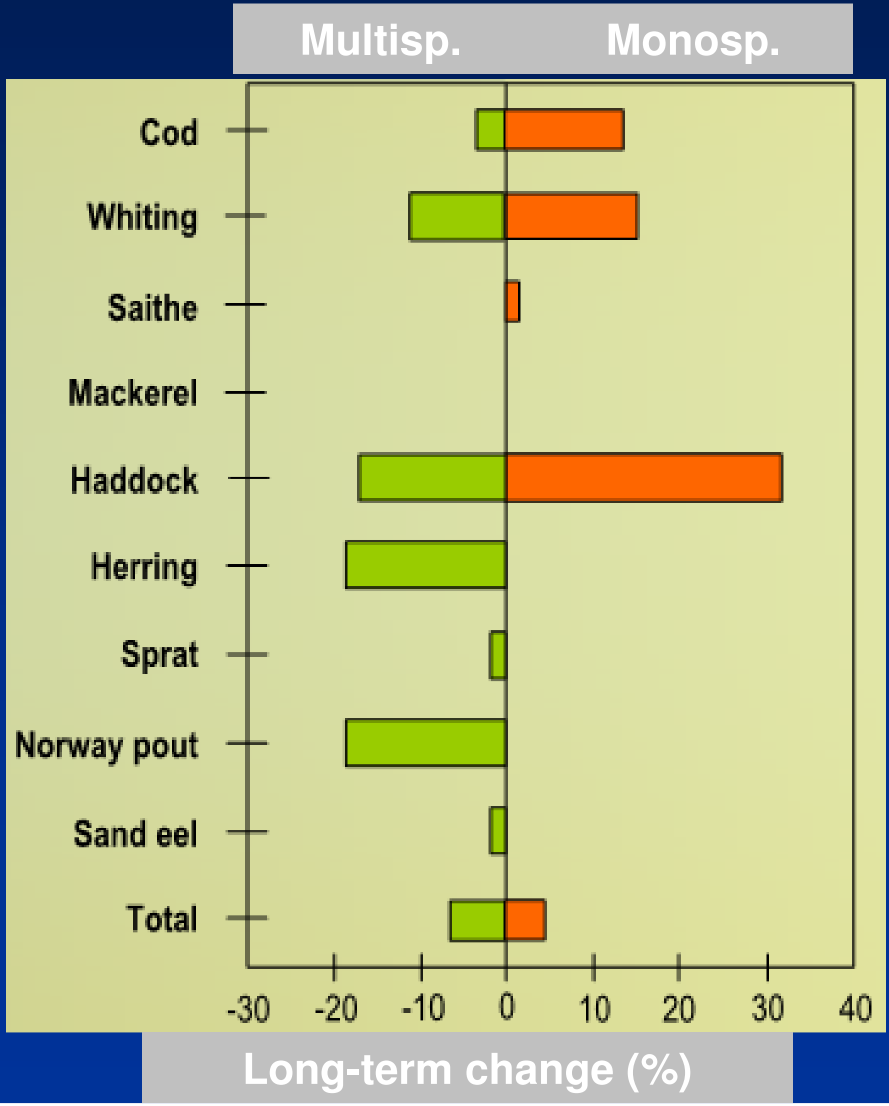
Long-term change in landings (in %) when passing from 80mm to 120 mm mesh for Cod.

The difference is the result of the additional predation of large fish released by the larger mesh size.

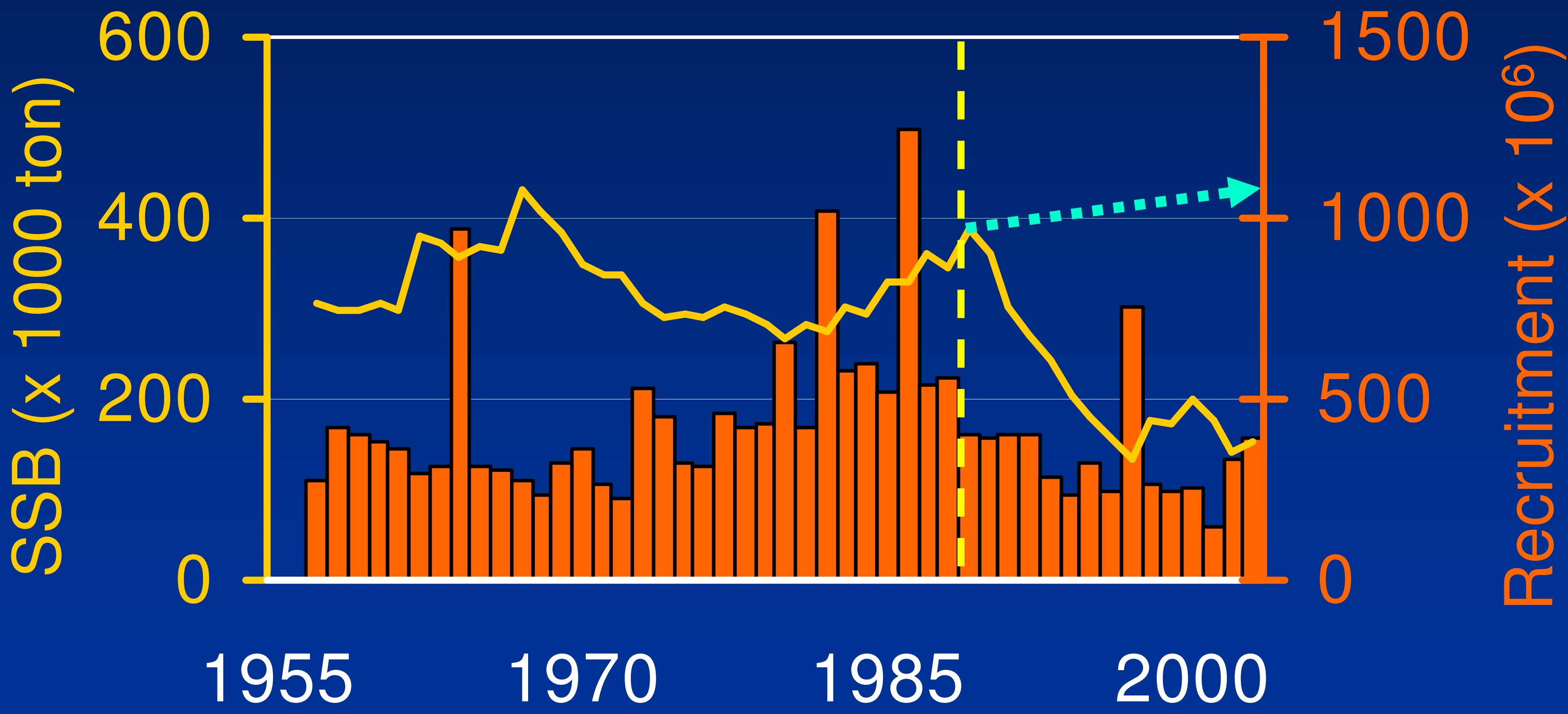
Source: North Sea Cod. ICES 1989. Multispecies assessment working group

Real results (since 2001) are different from both predictions

(Graham, pers. Comm.)

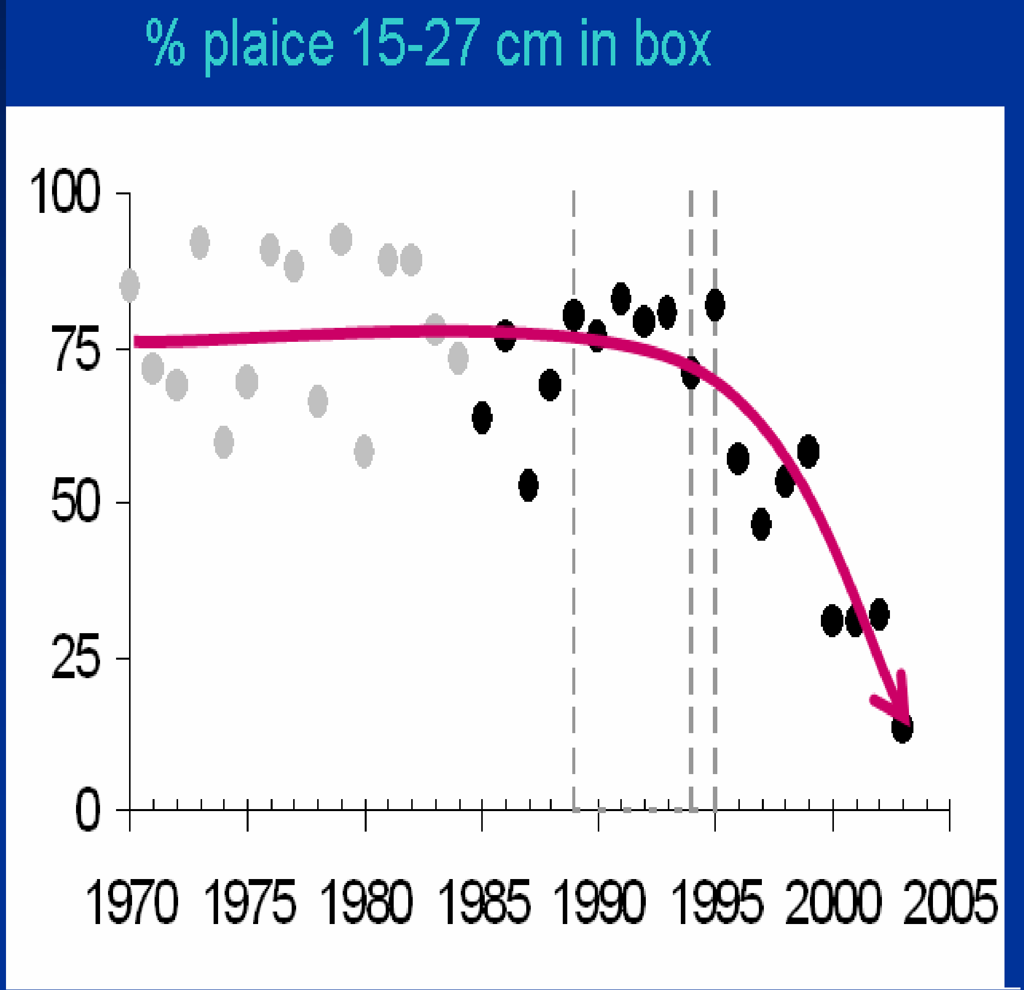


3. Selectivity problems: Plaice



Rijnsdorf et al 2010. FEG Nagoya meeting The plaice box

3. Selectivity problems: Plaice



But the fishery improved nonetheless because …increases in fuel cost reduced fishing mortality !

Rijnsdorf et al 2010. FEG Nagoya meeting The plaice box

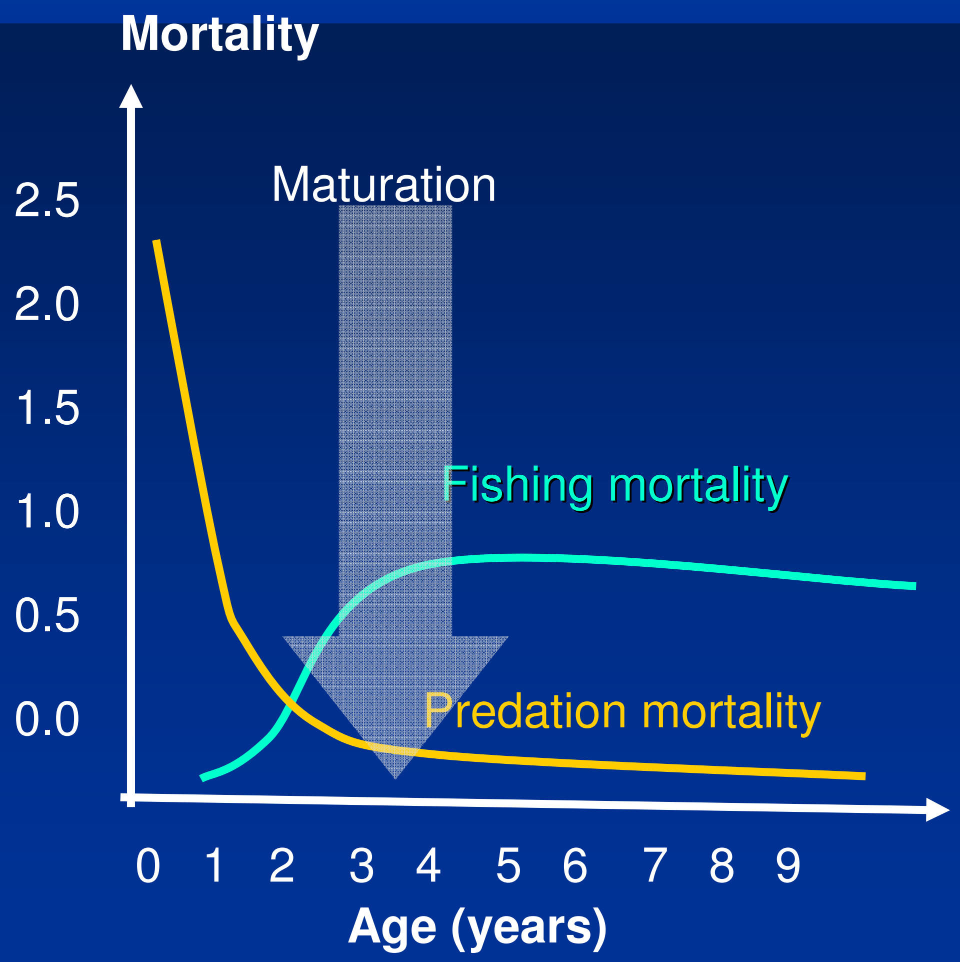
3. Selectivity problems: Tuna

East Pacific Tuna Purse seining

	Before dolphin protection	After dolphin protection
Yellowfin	18-22 Kg	3-6 Kg
Discard /set	0.1 t (1%)	4.6 t (10%)
Bycatch rate	1 dolphin 0.3 sailfish 0.2 manta ray	26 sharks 1.8 marlins 800 large bony fishes 1250 small fishes 0.04 turtles

This effect of selectivity was certainly not expected!

3. Selectivity problems: genetics

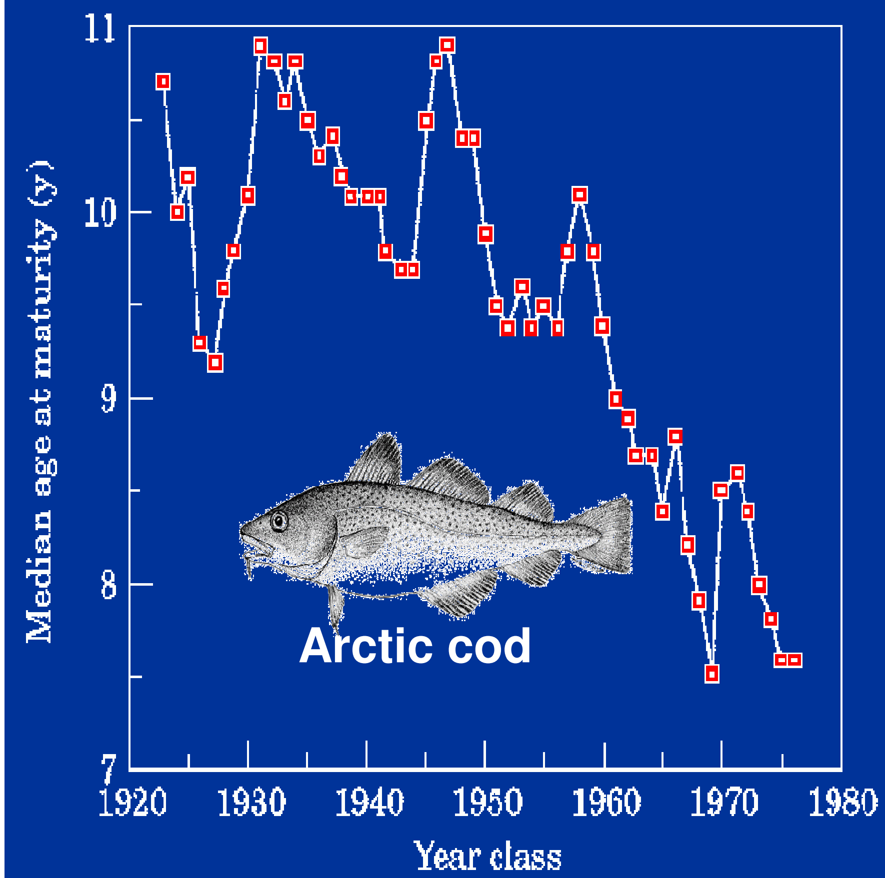


Example from North Sea Cod

Humans and natural predators "select" their targets differently !!

Growing big is not any more a good strategy!

3. Selectivity problems: genetics



- Selection of phenotypes
  - Reduced age and size at maturity
  - Reduces maximum body size
- Increased reproductive investment
- Increased resilience to high fishing
- Decreased resilience to environment
- Reduced resource productivity
- Reduced N° of subpopulations
- Reduced genetic variability
  - Selection of genotypes

Modeling shows that a reduction of fishing pressure at both ends of the size spectrum reduces evolutionary response in a population

Source: Rijnsdorp. 2010; Mikko 2010. . FEG Nagoya meeting

3. Selectivity problems: conclusions

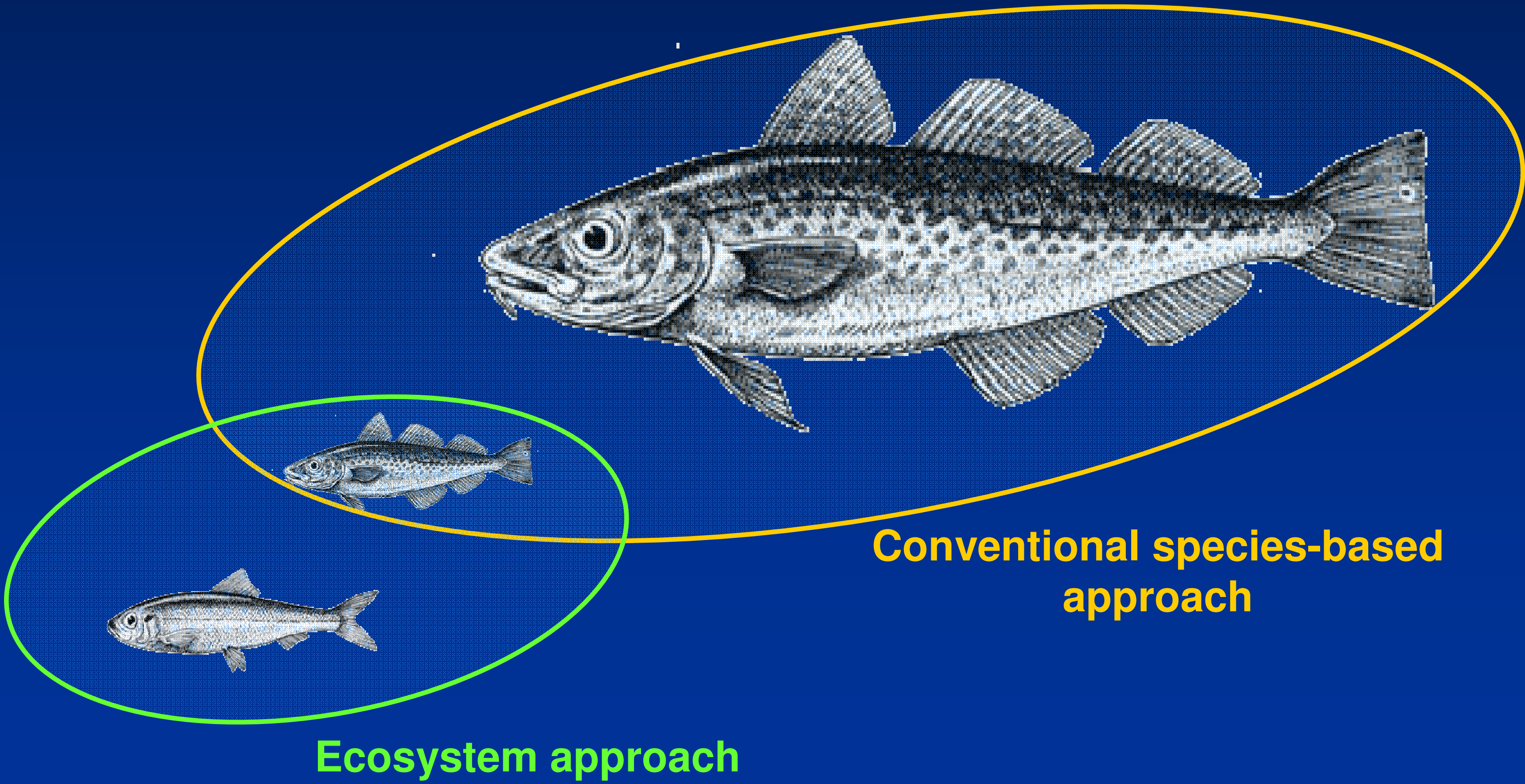
- Conventional regulation of selectivity has met with mixed results
- The single-species paradigm replacement is overdue
- Predicting multispecies/ecosystemic effects of selection is not easy
- Genetic/phenotypic forcing is an additional emerging concern.

There is no clear evidence that the conventional selectivity regulation (by gear or fishery) complies the EAF requirement to maintain ecosystem structure and properties.

The conventional selectivity paradigm needs to be revisited in an ecosystem perspective!

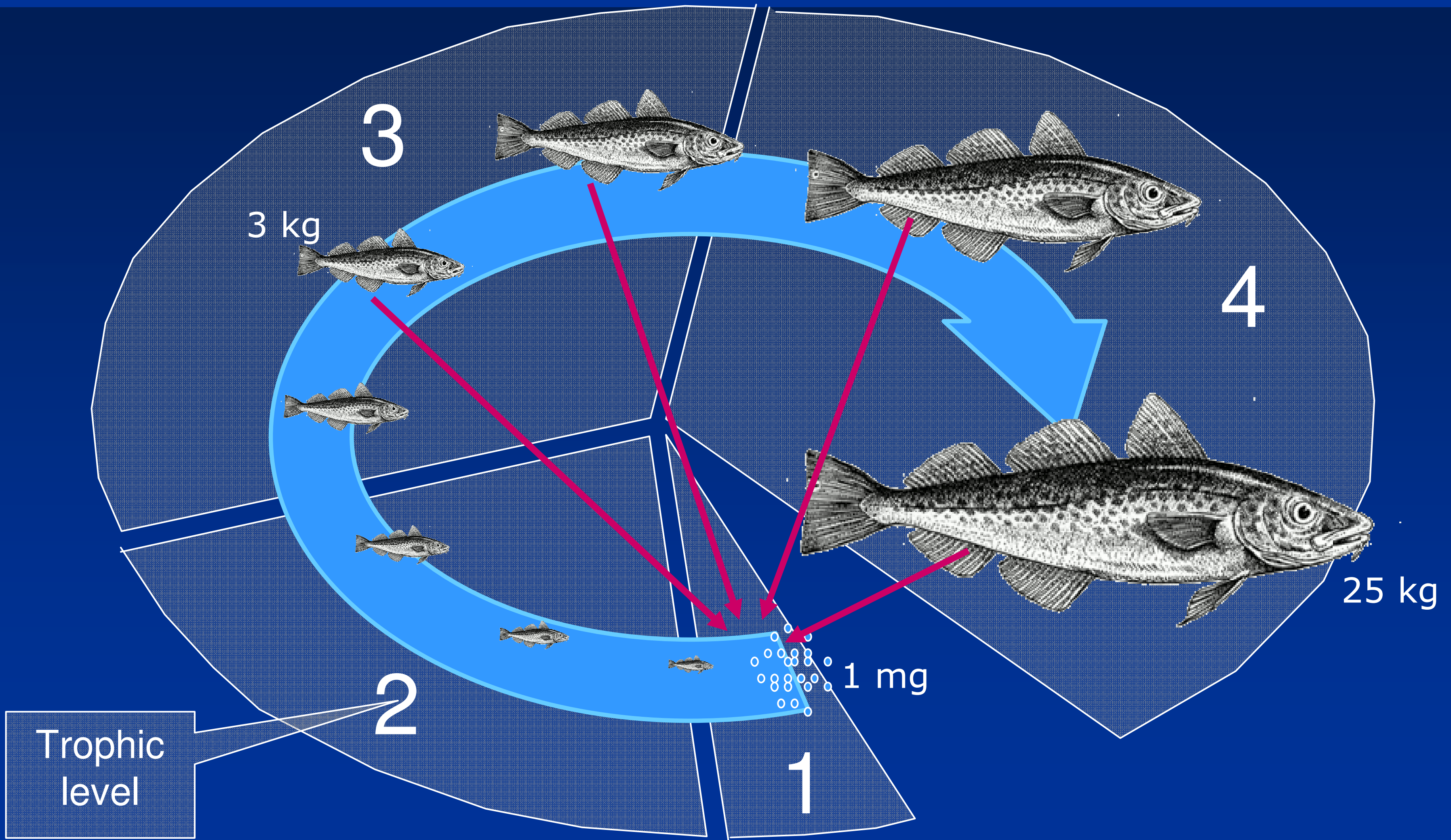
4. The food chain

Which are the two most similar fishes?



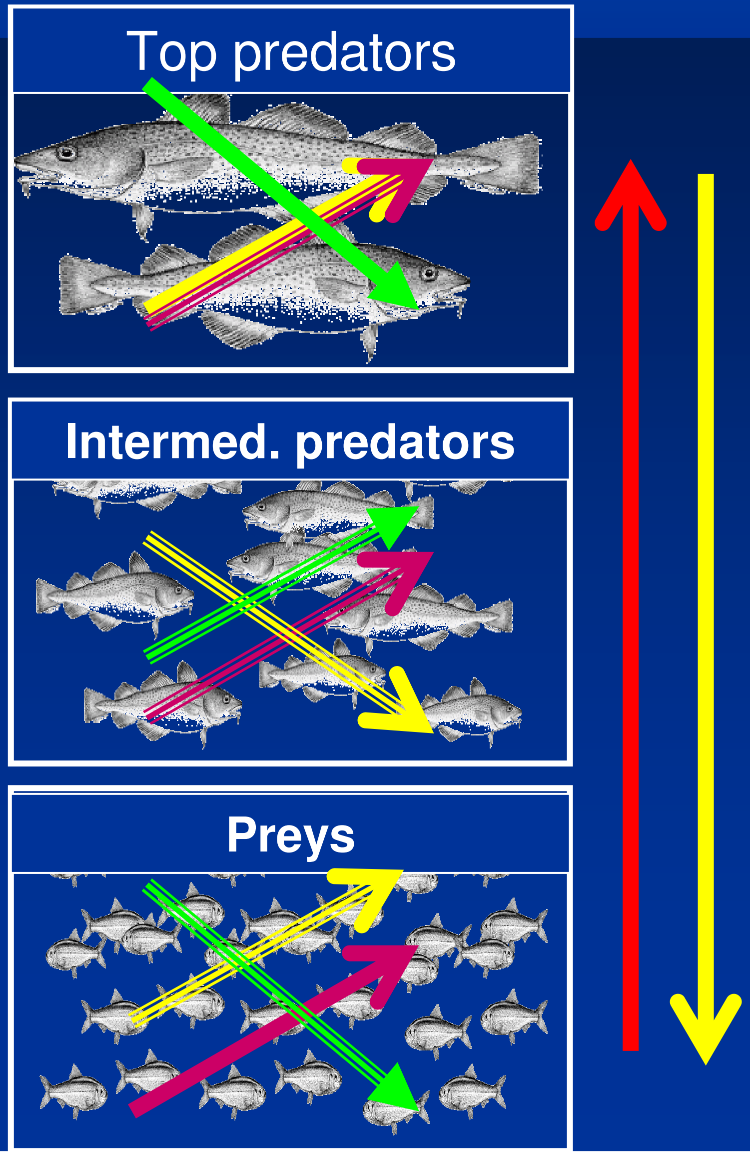
Source: Jan Beyer. Nagoya FEG meeting presentation 2010

4. The food chain: ontogenic shift



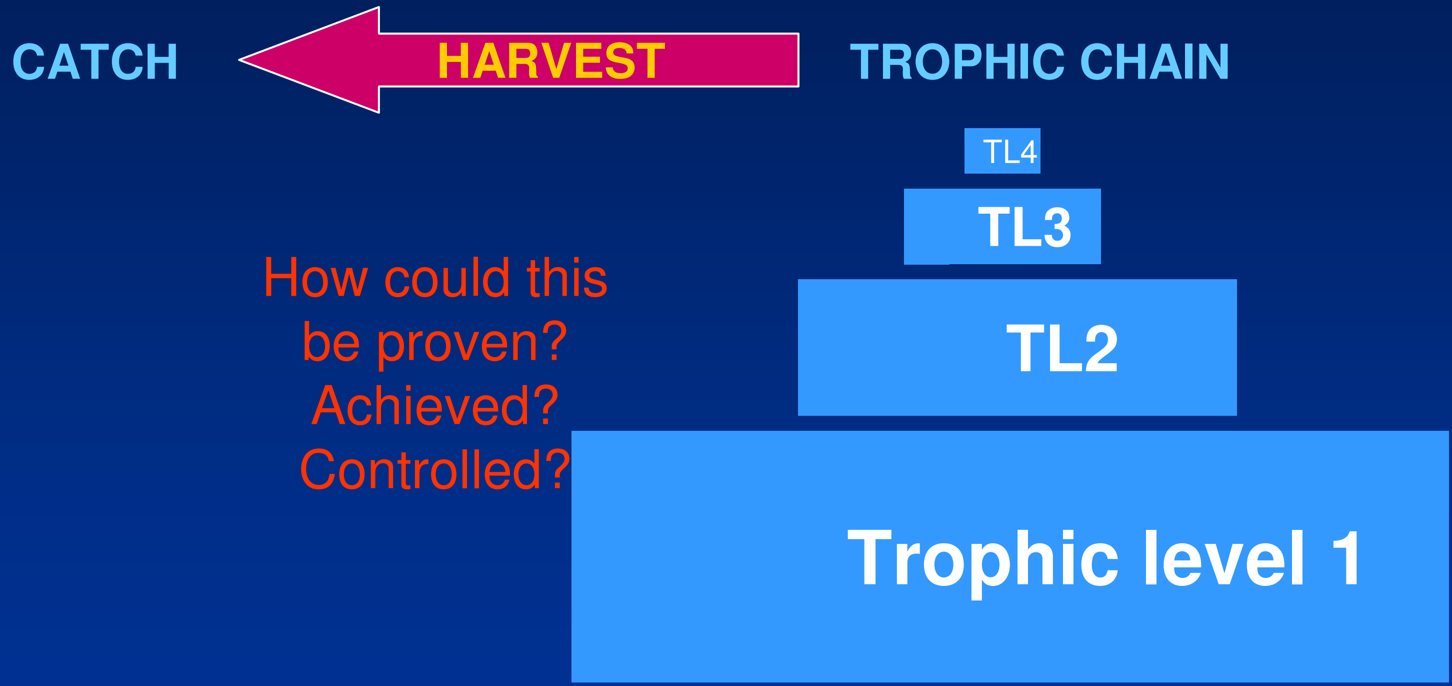
Source: Jan Beyer. Nagoya FEG meeting presentation 2010

4. The food chain: Trophic cascades



Any positive or negative change in any compartment generates a cascade of direct consequences upwards and/or downwards and feed-back responses

5: Modeling: The food chain model

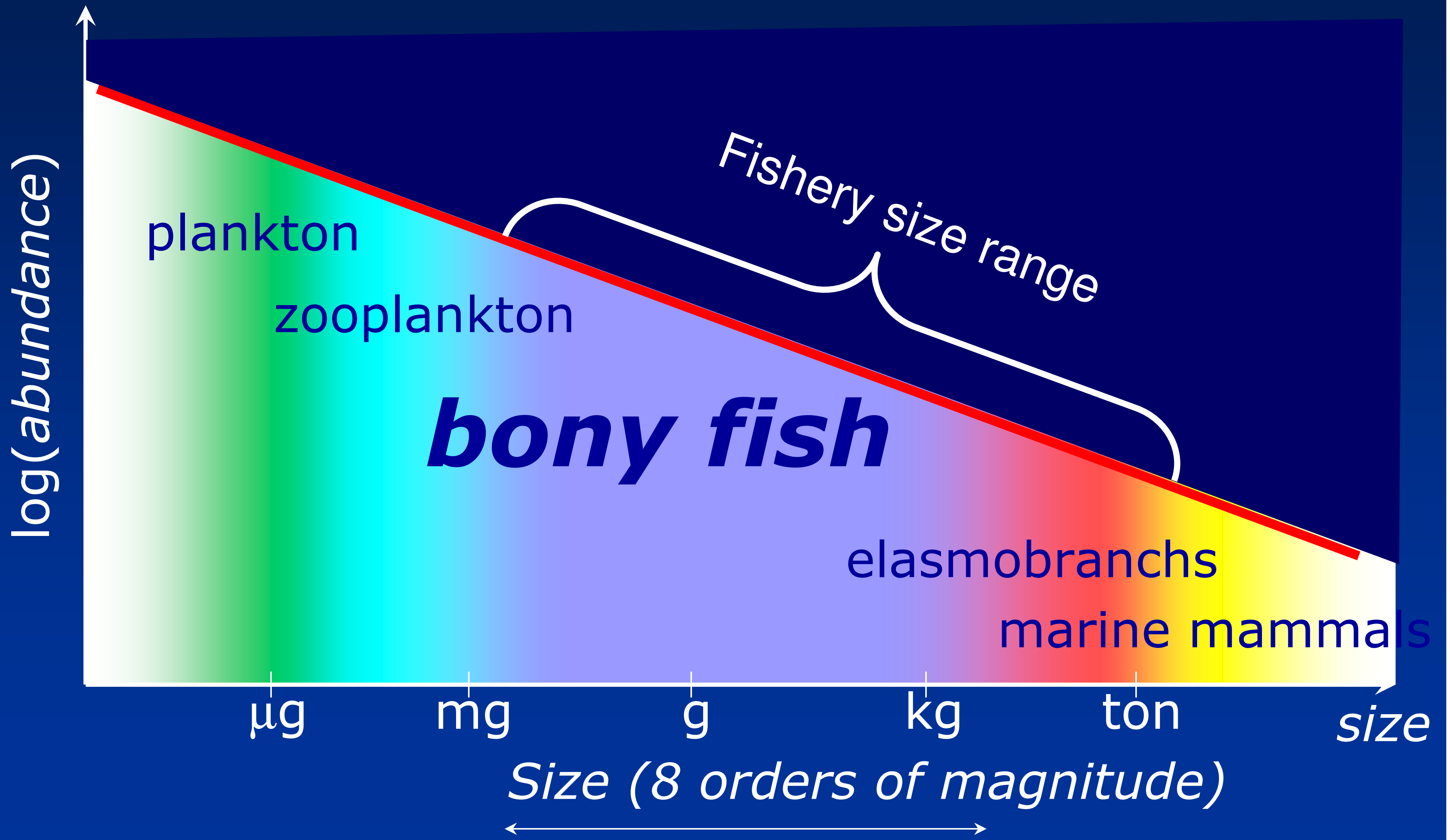


Balanced harvesting: a fishing strategy that maintains ecosystem structure by keeping fishing pressure moderate and distributing it across ecosystem components (species, sizes, and trophic levels) in proportion to their productivities

5: Modeling: The food chain model

<u>Balanced harvesting:</u> a fishing strategy that maintains ecosystem structure by keeping fishing pressure moderate and distributing it across ecosystem components (species, sizes, and trophic levels) in proportion to their productivities

5. Modeling: Biomass-Size spectra



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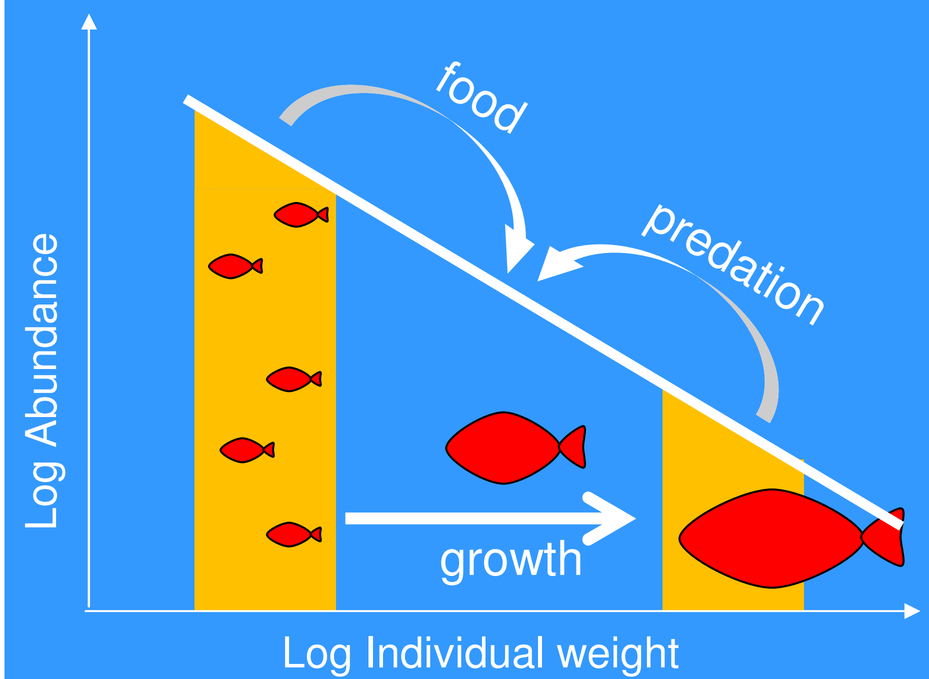
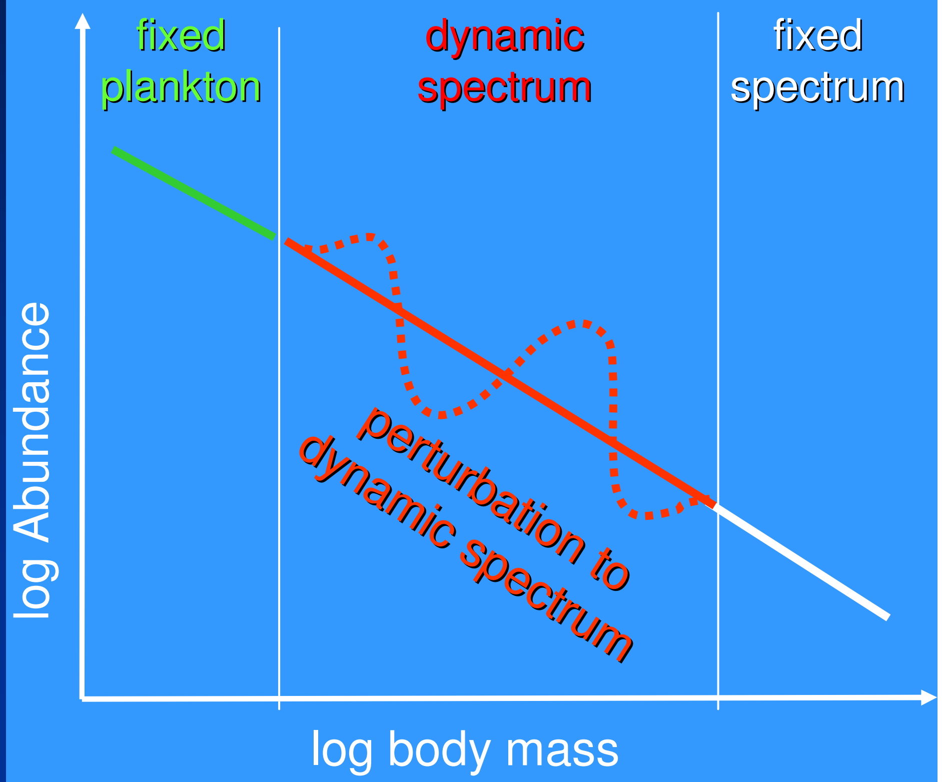


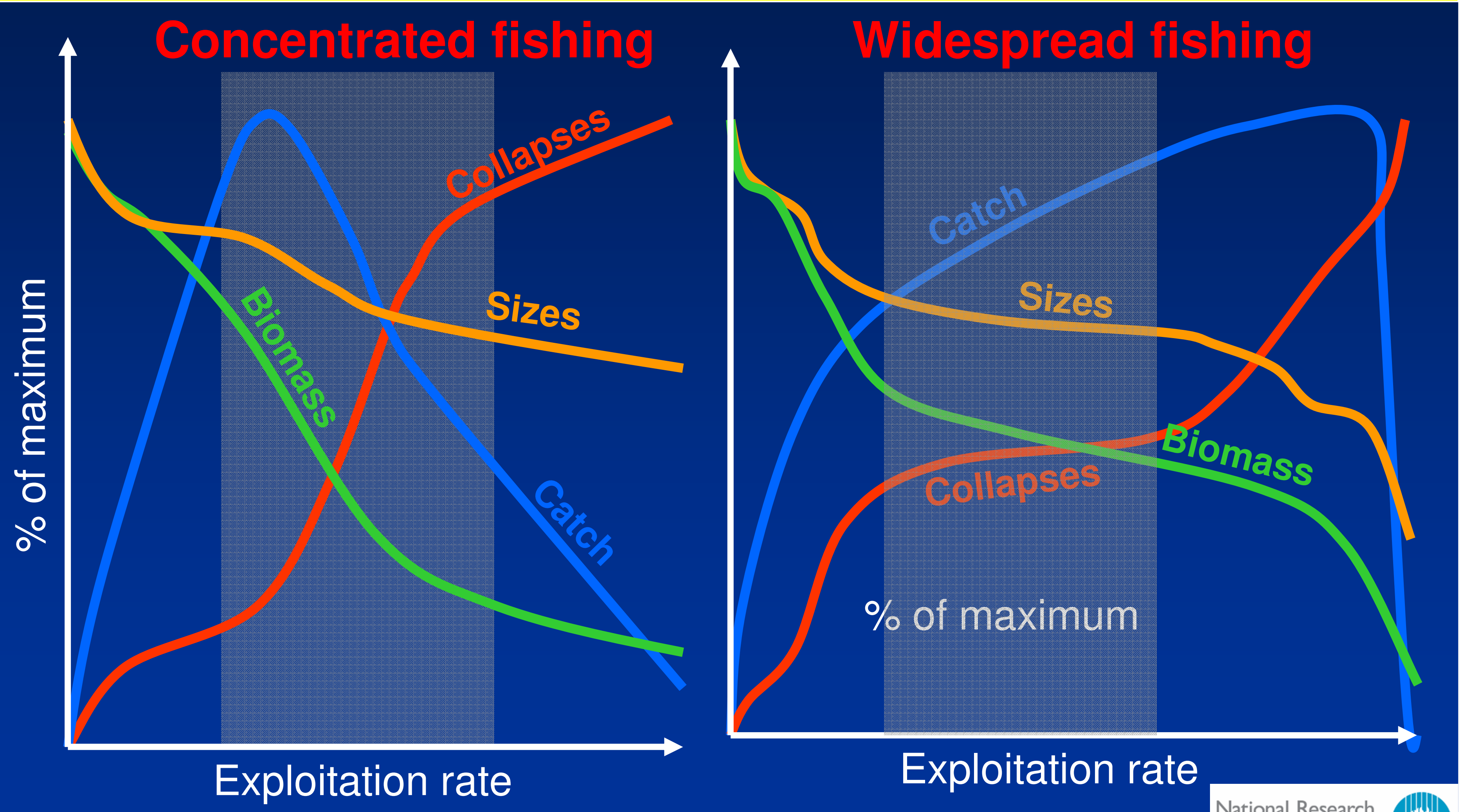


Beyer & Andersen

Law et al. 2010

5. Modeling: Ecosystems

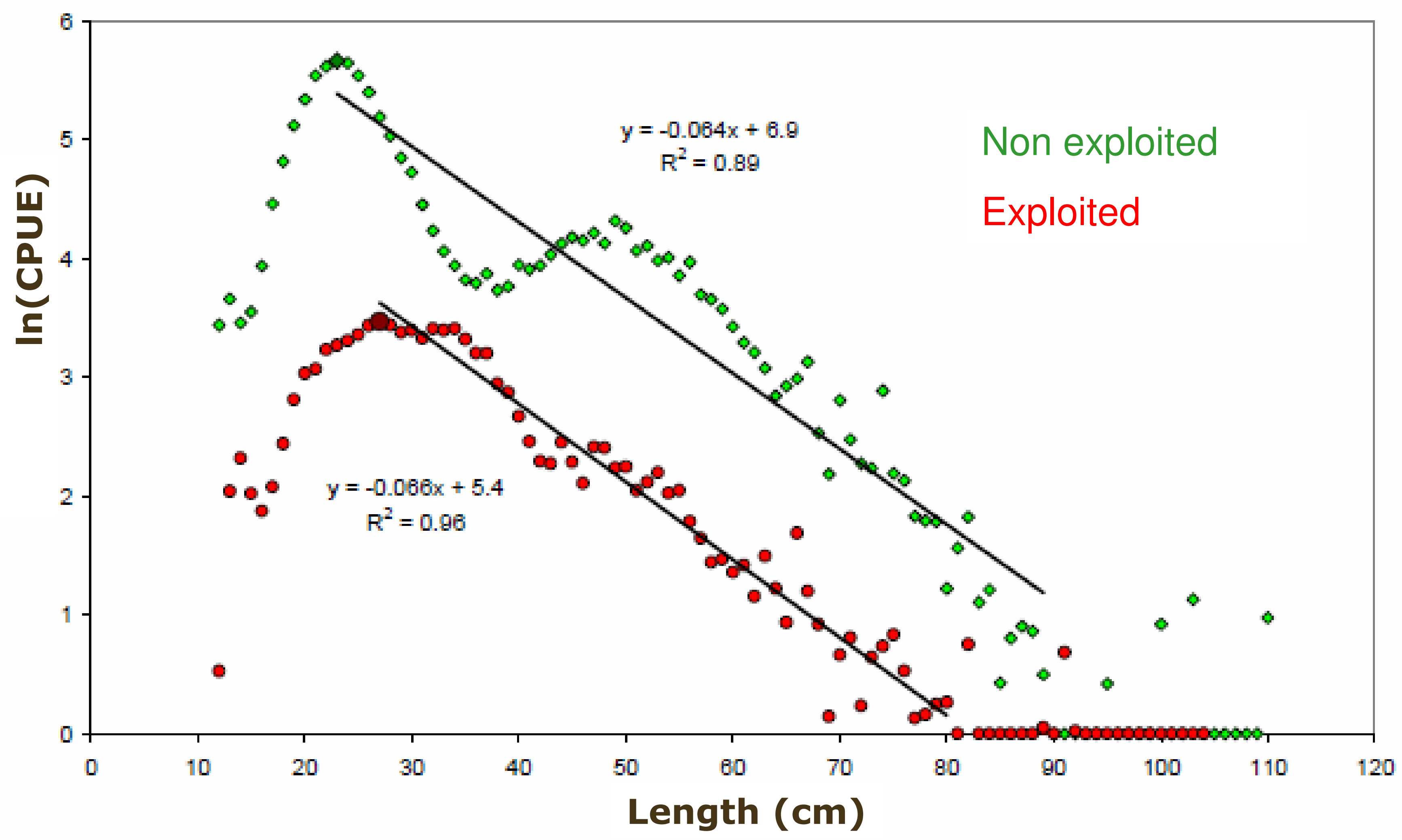
Not to be used without prior contact with A.M.D. Smith CSIRO Marine and Atmospheric Research. GPO Box 1538, Hobart. Tasmania 7001,



Source: Fulton et al. (Embargoed)

National Research FLAGSHIPS Wealth from Oceans CSIRO

6: Empirical evidence



Kolding and van Zwieten (2010)

7. Tentative conclusions

- All conclusions are provisional
- There are robust relations between individual size (body mass) and abundance that can be studied to analyze the impact of selective fishing on ecosystem structures and properties and develop appropriate indicators.
- Generally, models support the intuition that concentration of fishing on a narrow selection of species and sizes in an assemblage may not be the most sustainable way to use an ecosystem, maintaining its processes and properties.
- Spreading fishing pressure on the species and size spectrum appears theoretically preferable for ecosystem stability and, often, also for total yield.

7. Tentative conclusions

- At population level, reducing pressure on both juveniles and old spawners, may help stabilize the structure
- Conversely, the depletion of large sizes (old spawners) could have a destabilizing impact on the ecosystem structure and the species relationships.
- It has been impossible, however to verify empirically the ecosystem impacts predicted by the models but there are apparently some examples of sustainable ecosystem structures with widespread fishing pressure
- How to combine the conclusions of ecosystem-based and population-based modeling is not yet clear.

7. Tentative conclusions: management implications

Ecosystemic target: How to slice the pyramid?

- Strategies to be built around cumulative selectivity
- Evaluate performance of strategies already in place
- “Balance” in relation to: trophic levels? Sizes? Assemblages?
- Selection tool box: gear, time, area, market controls, rights, ecosystem tax, incentives, ecolabelling, novel food technology
- Strategy depends on starting point (ecological, (economic conditions)
- Strategy depends on scale (small, large), area (coastal, offshore, high seas), culture (Asia, Africa, Europe)

Discuss use and protection strategies TOGETHER

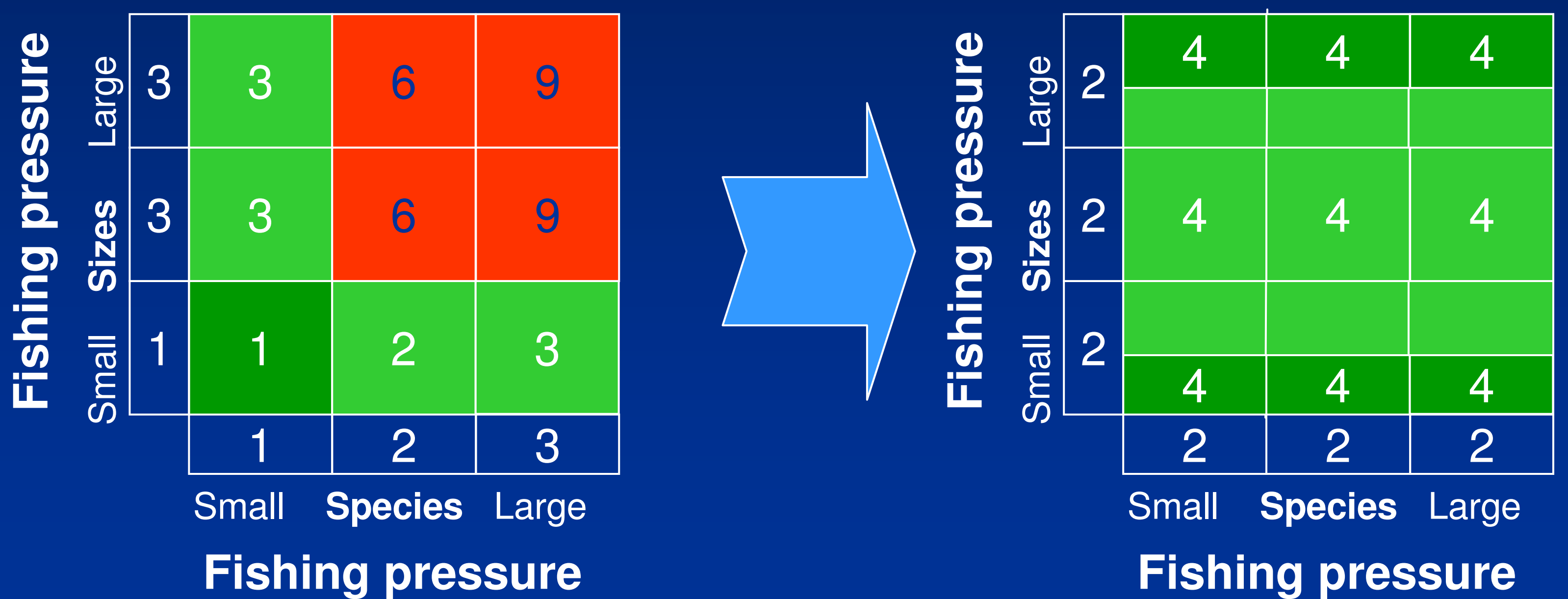
- Role of MPAs and reserves

7. Tentative conclusions: management implications

- Need to shift from single-species regulations to assemblages- and ecosystem-based regulations.
- Increase focus on diversity and diversification of harvest. Better distribute the impact across species and sizes. But also protect juveniles and old spawners
- Reduce overall impact by eliminating overfishing as a prerequisite for implementing and benefiting from balanced harvest
- Look for alternatives to modern increasing species-based segmentation of fishing rights or balance them across the wider spectrum of species and sizes.
- Use incentives to convince fishers to broaden the scope of harvest when appropriate

7. Tentative conclusions

A tentative interpretation of “balance”



Present: excessive selective

Future: balanced harvest ?

The urgent need is to start aiming at a correct structure and not only at a correct abundance

Thank you for your attention