EcoTroph to assess changes in marine ecosystems

- Application to the Bay of Biscay and Celtic sea case study -

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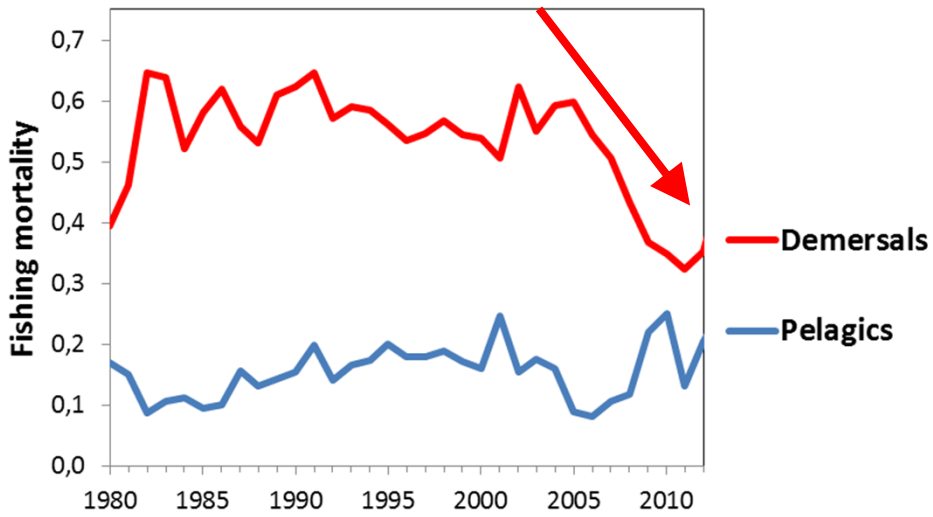
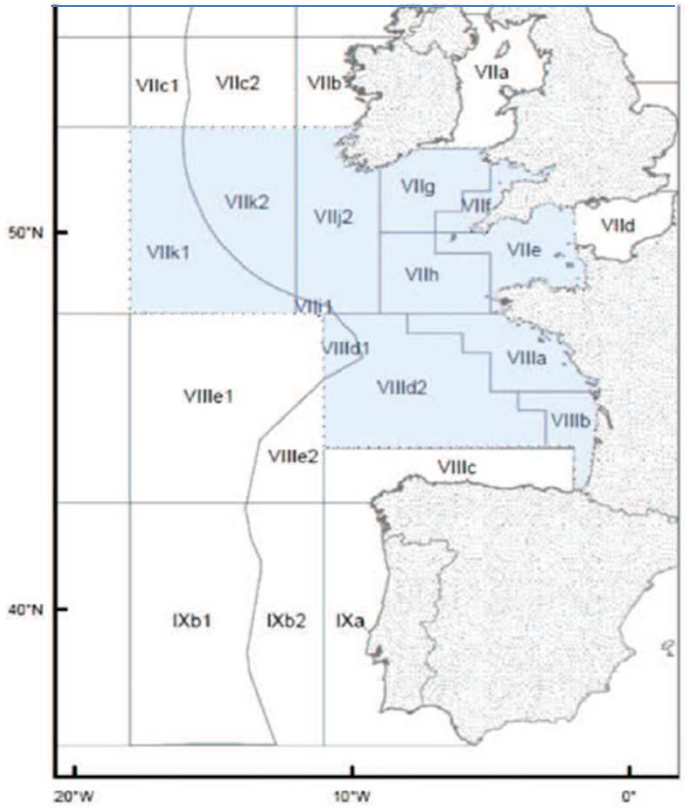
Introduction

- The Celtic sea and Bay of Biscay ecosystem (330 000 km2)
- Landings around 600 000 tons (≈ 15 % of European seas)
- A decreasing fishing pressure over the last 10 years





➢ **Has the ecosystem started to recover?**

Method

- Synthesis of stocks **assessments** from ICES
- Two **Ecopath** models 1980 and 2012 (38 groups, with details for all stocks assessed by ICES)

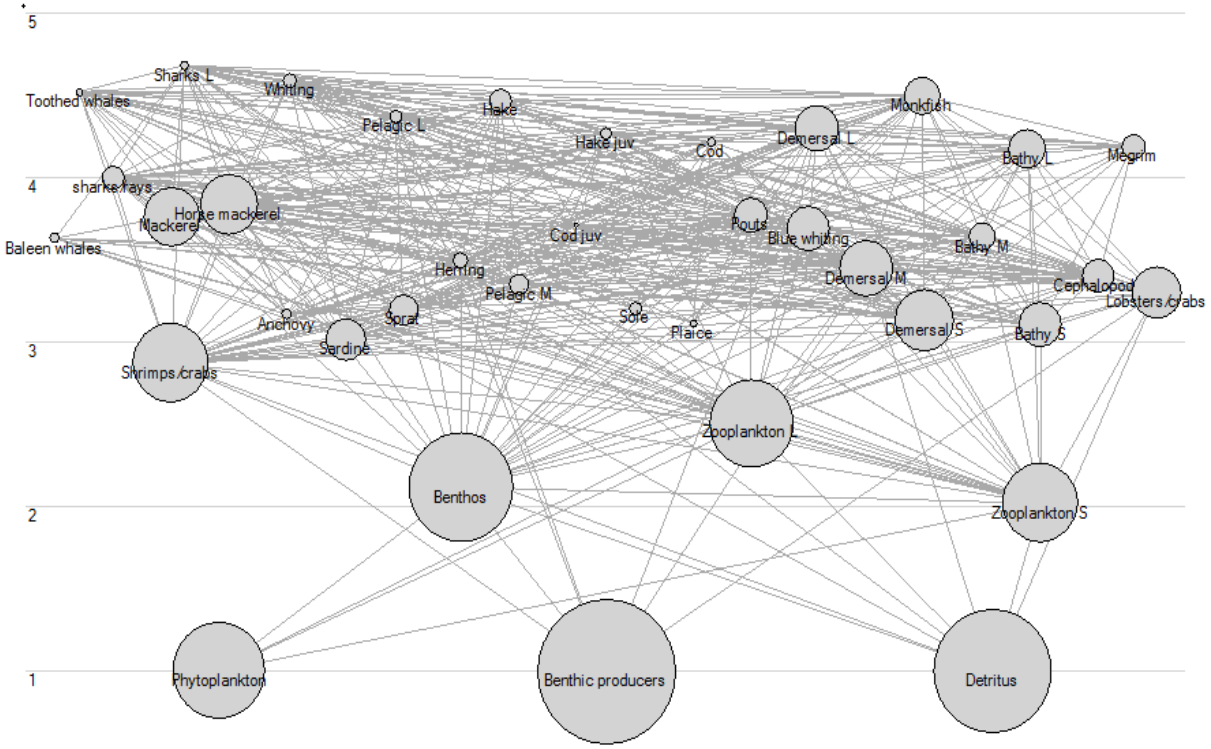
	Group name	TL	%B
6	**Mackerel**	3,64	3,2%
7	**Horse mackerel**	3,57	2,0%
8	**Anchovy**	3,17	0,0%
9	Sardine	3,02	0,6%
11	**Herring**	3,49	0,1%
14	**Hake**	4,68	0,2%
15	Hake juv	4,35	0,1%
16	**Cod**	4,34	0,0%
17	**Cod juv**	3,82	0,0%
5	**Whiting**	4,33	0,1%
18	**Sole**	3,47	0,1%
19	**Plaice**	3,39	0,0%
25	Monkfish	4,55	0,6%
27	**Megrim**	4,32	0,3%
12 (+2) boites stocks ICES			*7,5%*

3	Sharks L	4,75	0,0%
4	sharks/rays	4,14	0,3%
10	Sprat	3,20	0,4%
12	Pelagic M	3,41	0,2%
13	Pelagic L	4,19	0,1%
21	Pouts	3,84	0,5%
22	Blue whiting	3,71	0,9%
20	**Demersal L (Haddock)**	3,98	1,3%
23	Demersal M (Boarfish)	3,53	2,0%
24	Demersal S	3,28	1,6%
26	Bathy L	4,27	1,0%
28	Bathy M	3,75	0,4%
29	Bathy S	3,25	1,2%
30	Cephalopods	3,62	0,4%
31	Lobsters/crabs	3,37	1,2%
32	Shrimps/crabs	3,04	8,2%
+16 boites autres ressources			

1	Baleen whales	3,78	0,1%
2	Toothed whales	4,60	0,0%
33	Benthos	2,39	44,9%
34	Zooplankton L	2,51	14,3%
35	Zooplankton S	2,02	13,6%
36	Phytoplankton	1	
37	Benthic producers	1	
38	Detritus	1	

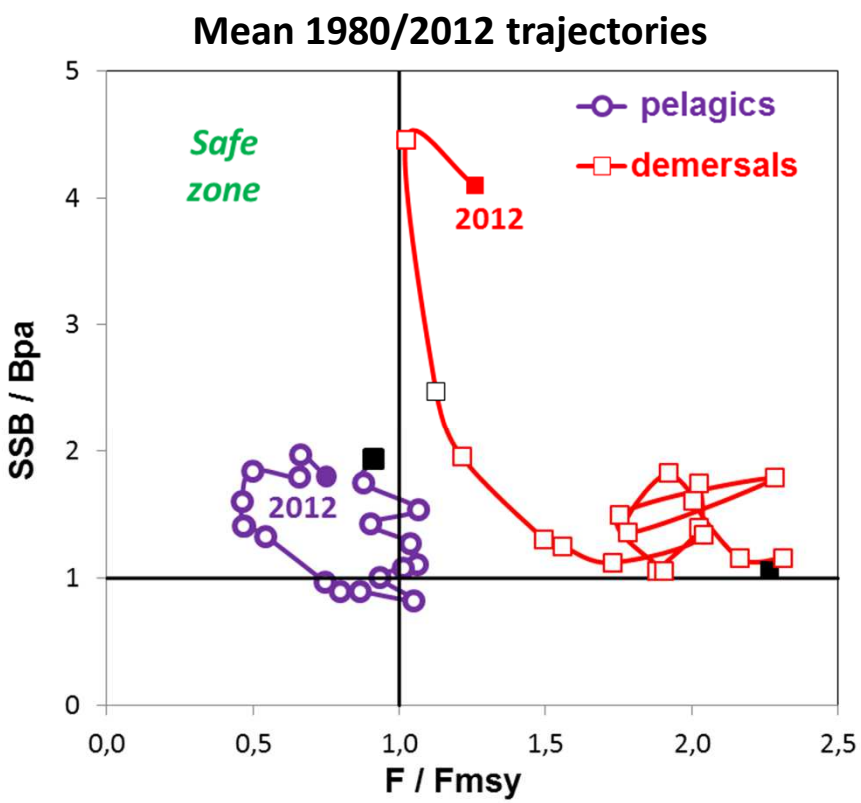
Method

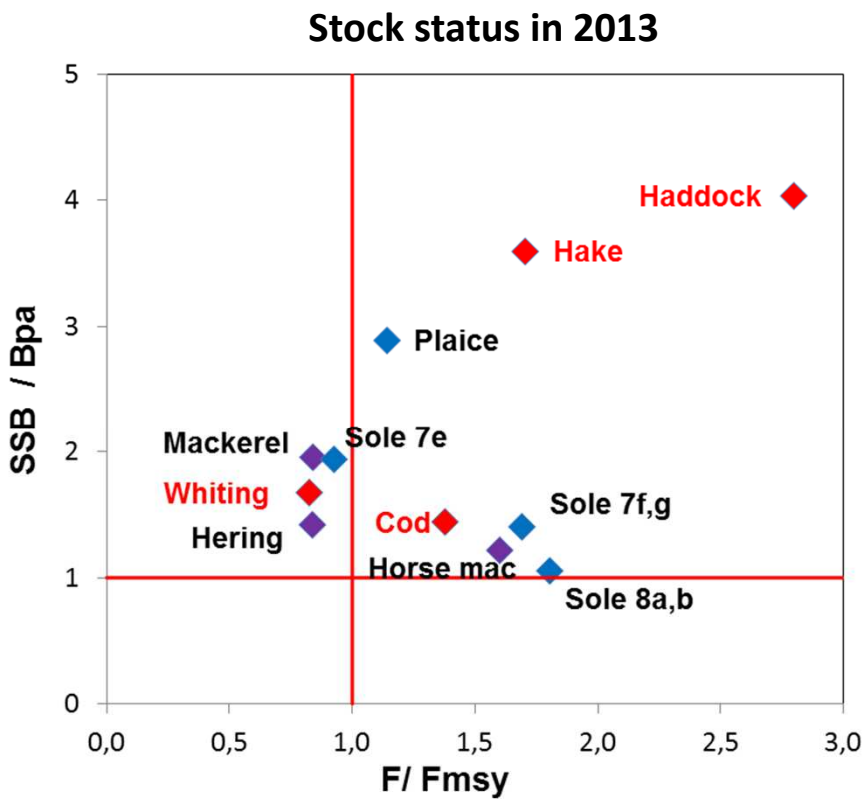
- Synthesis of stocks **assessments** from ICES
- Two **Ecopath** models 1980 and 2012 (38 groups, with details for all stocks assessed by ICES)
- **Ecosim** 1980/2012 (using time series for fishing mortalities, biomass and recruitment)
- **EcoTroph**



Synthesis of stock assessment

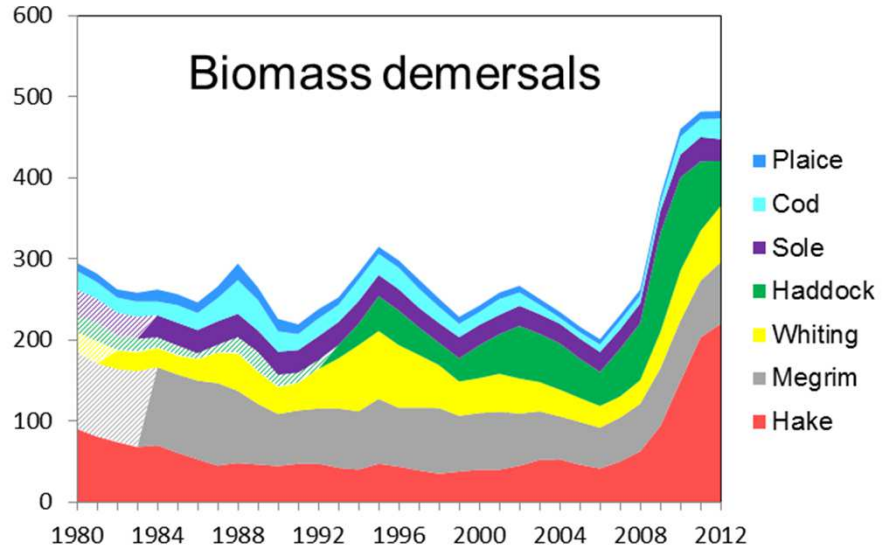
- An improving trend in the mean trajectory for demersals
- 7 stocks still overexploited in 2013 (among 11 stocks)

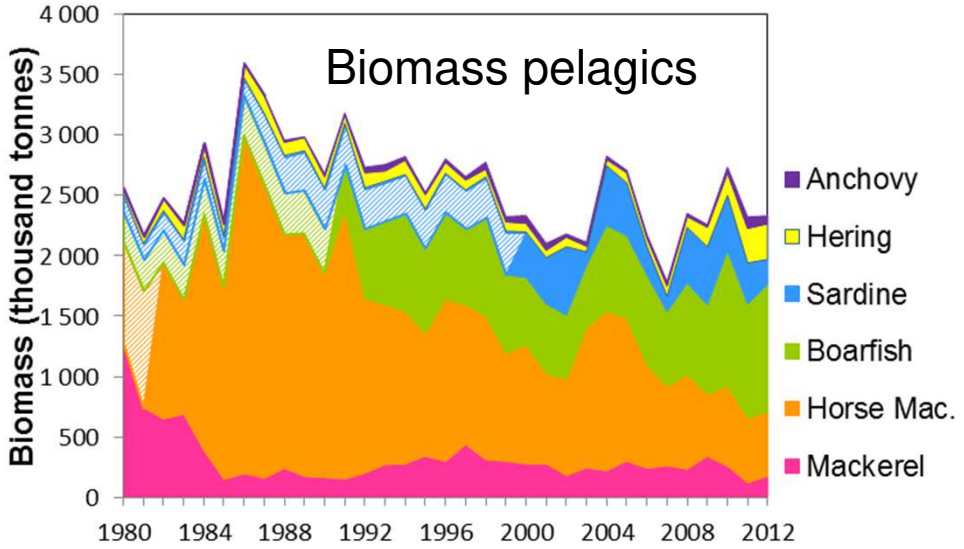




Synthesis of stock assessment

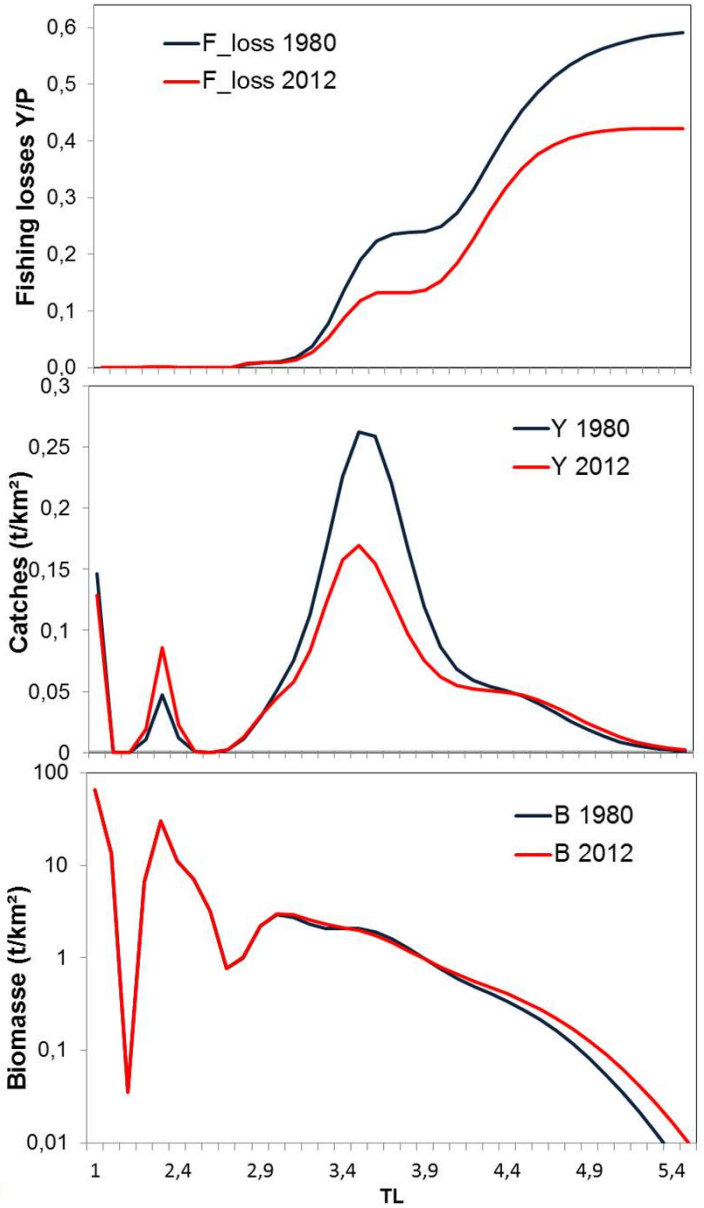
- An increase in the biomass of demersal fish, mainly due to hake
- A declining trend for pelagics, over the past 25 years
- Mackerel, then horse mackerel, and now boarfish





Comparison 1980 / 2012 using trophic spectra

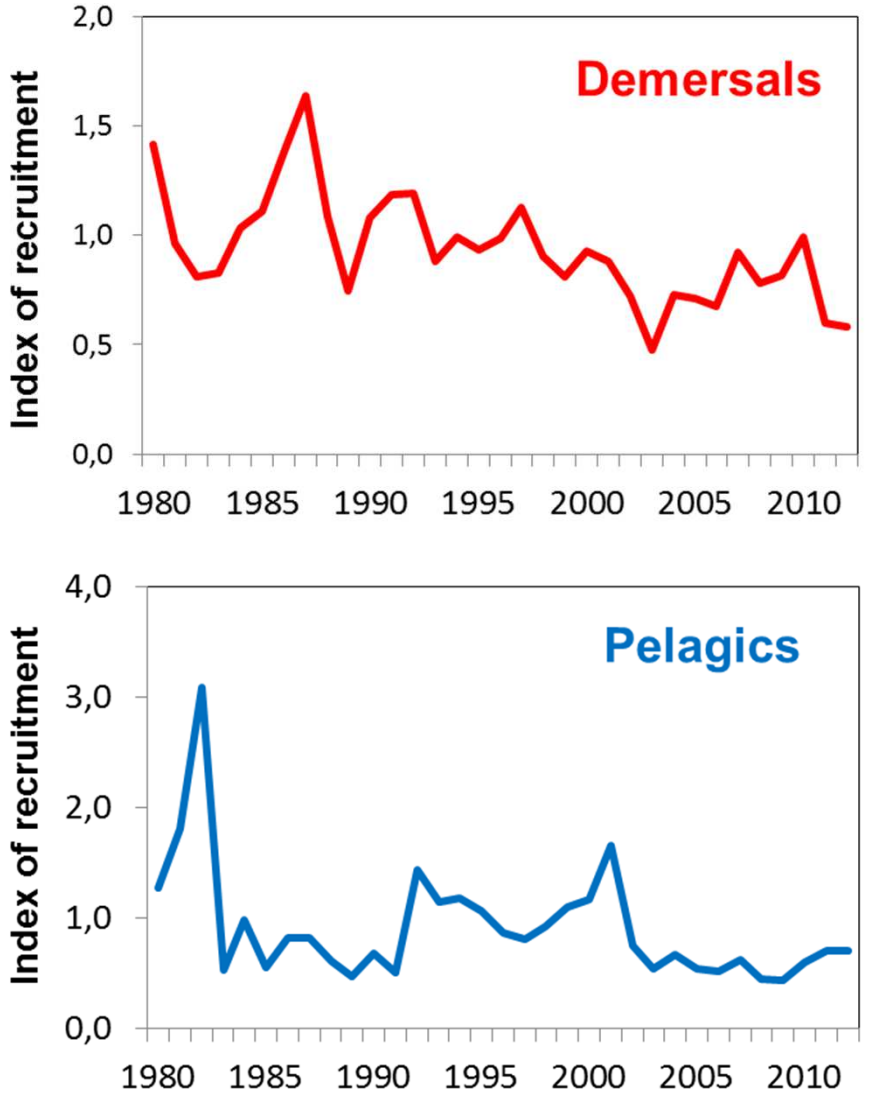
- High TLs are the most targeted
- Very high F_loss (from 60 to 40%)
- The decrease in the fishing pressure is observed for all TLs
- A decrease in catch for intermediate TLs (pelagics)
- Only high TLs exhibit a (limited) increase in biomass



Trends in recruitment

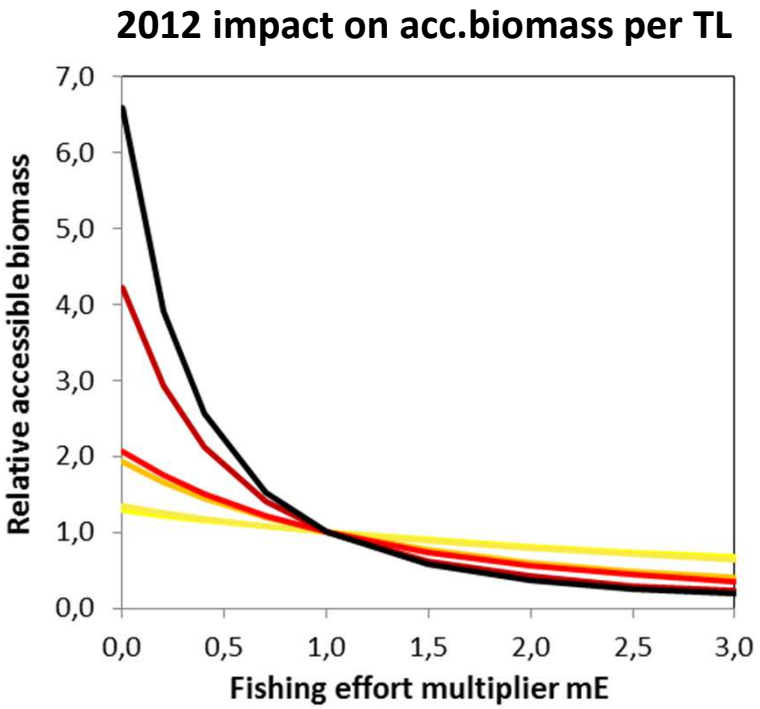
- An decrease in the mean recruitment for both demersals and pelagics

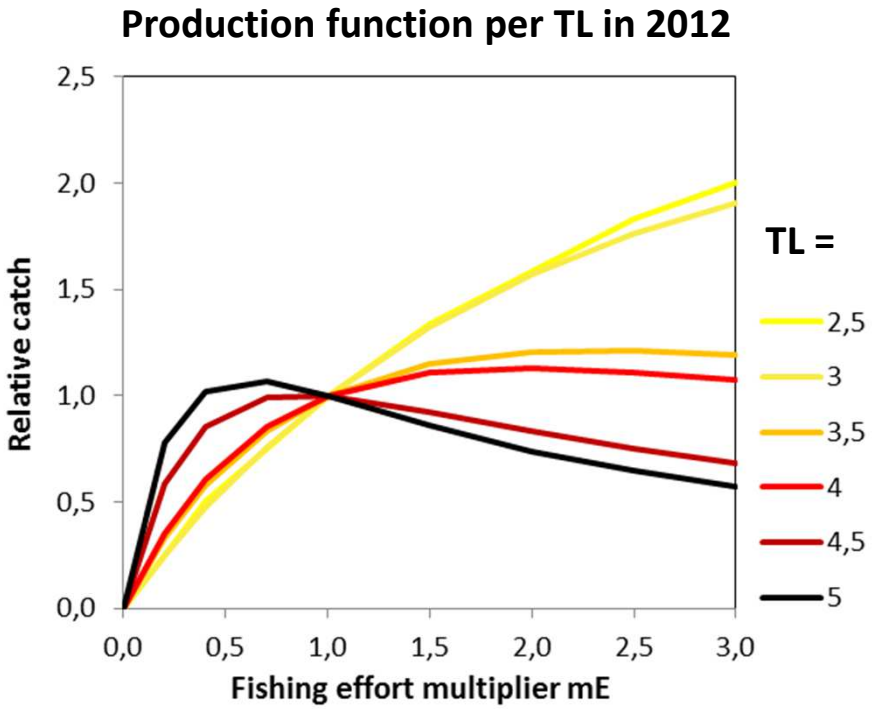
➢ **Changes due to the environment?**



EcoTroph diagnosis

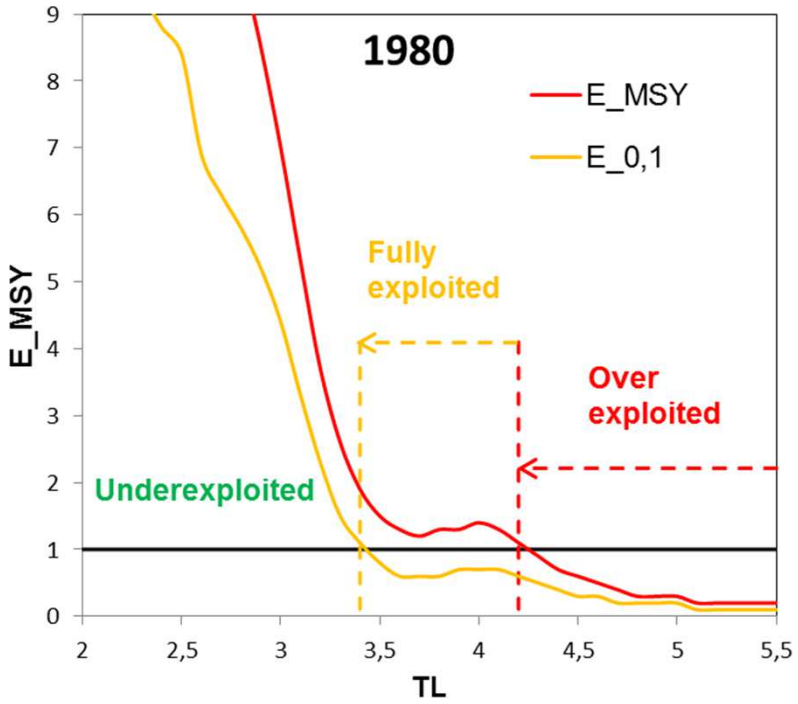
- High trophic classes are the most impacted (-76% in the accessible biomass for TL=4.5, comparatively to the unexploited state)
- High trophic classes are still strongly overexploited in 2012
- Intermediate TLs close to full exploitation

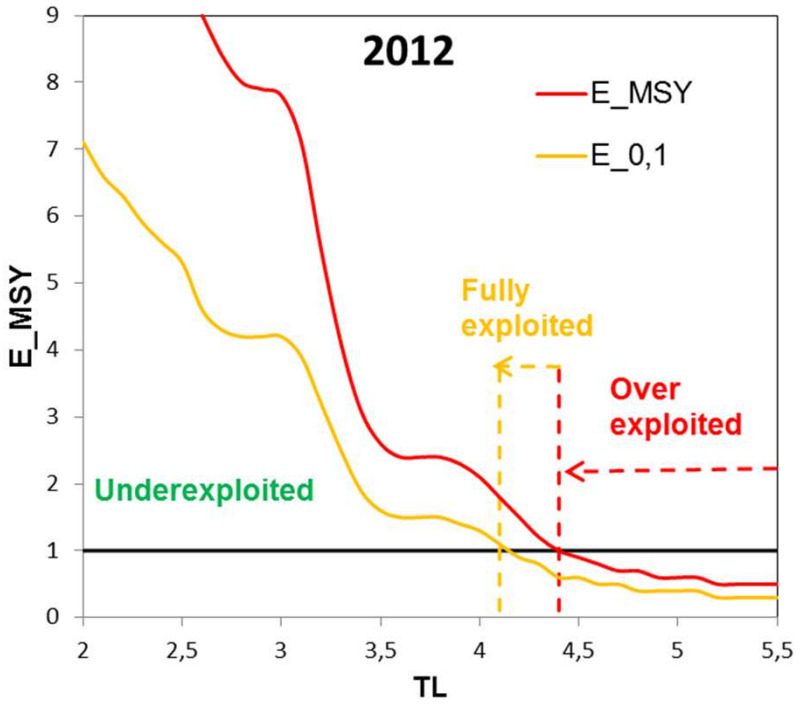




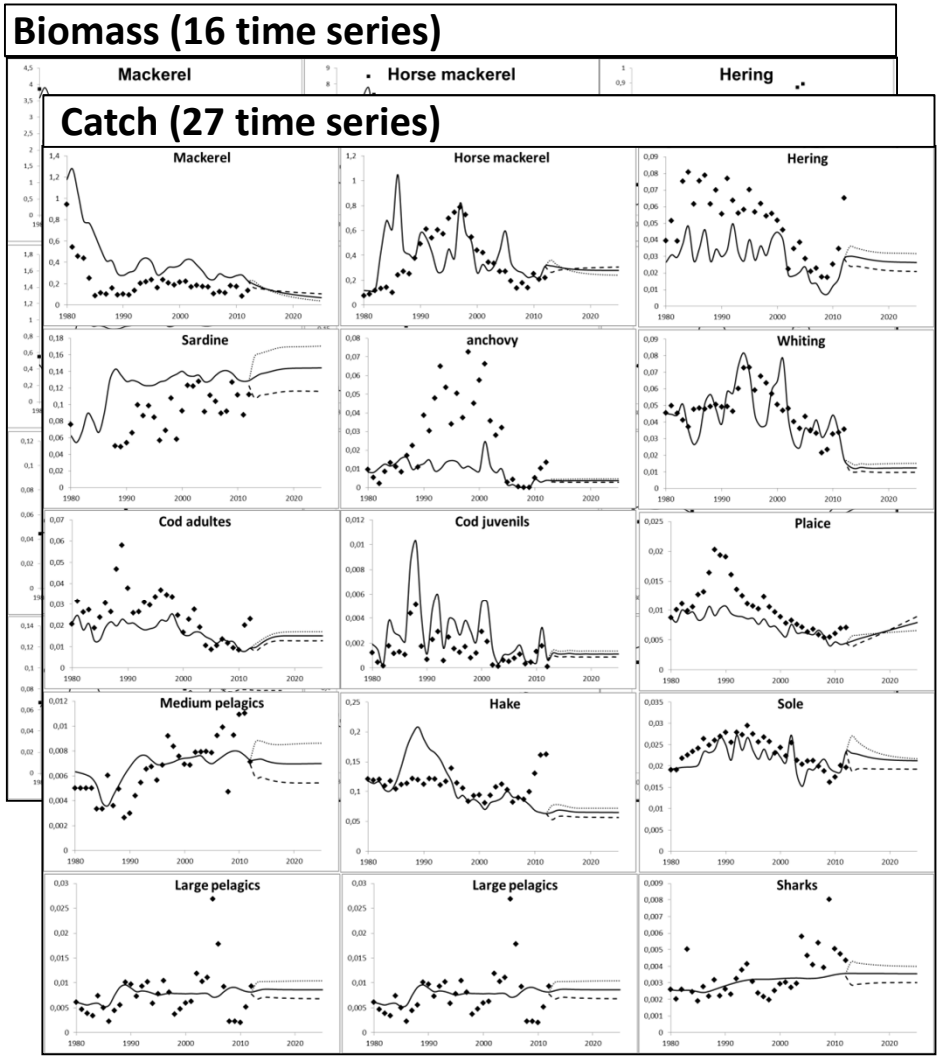
EcoTroph diagnosis

- In 1980, full exploitation started at TL=3.4 (overexploitation at 4.2)
- In 2012, improvement: full exploitation starts at TL=4.1 (overexpl. at 4.4)





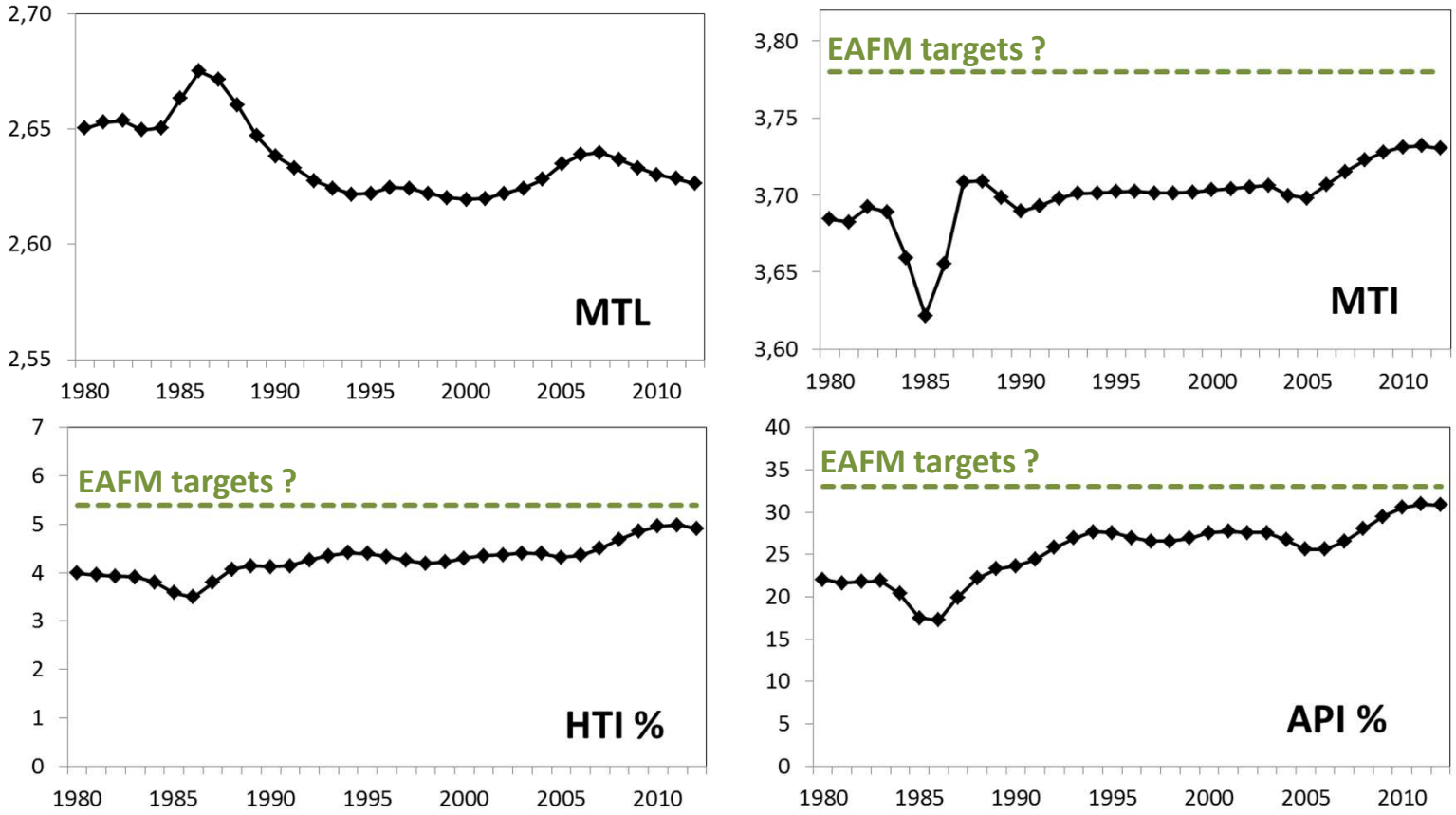
Ecosim: fit 1980/2012 and simulations 2013/2025



- Model driven by F (12 time series)
- Biomass and/or catch are expected to:
  - decrease for: mackerel
  - increase for: cod, plaice, megrim, large bathypelagics
- The most sensitive species to a change in the fishing pressure are:
  - Mackerel, horse mackerel, plaice, sole

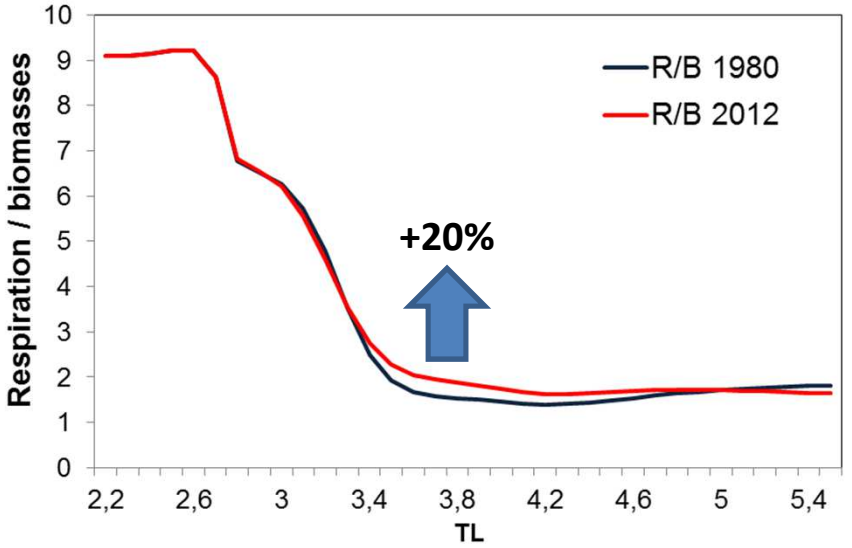
Trends in trophic indicators

- Mean trophic level MTL (from Ecosim) still low
- High TL indicators (MTI, HTI and API) exhibit a consistent improving trend, but still below the EAFM targets *(preliminary values)*

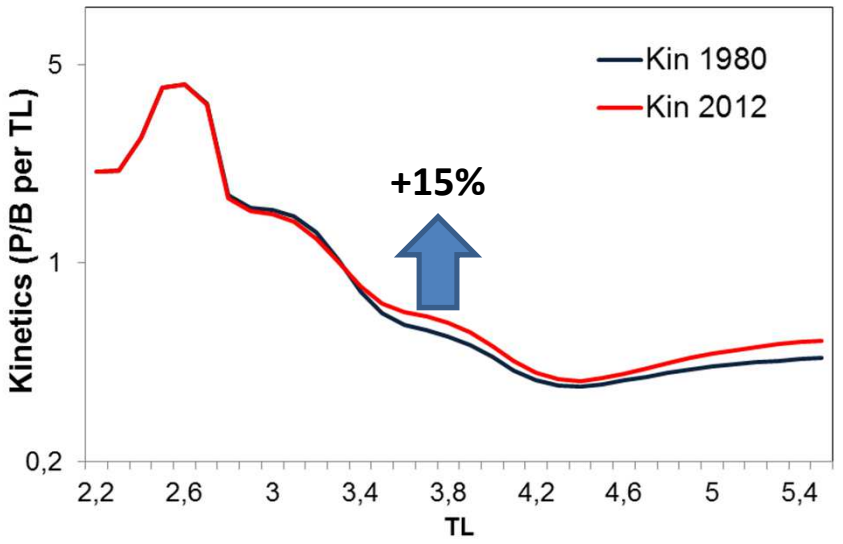


Changes in parameters of the trophic functioning

- An increase in respiration
  - Due to changes in prey fish (from sardine, to mackerel, then to boarfish ?)
  - Leading to higher natural losses and lower net trophic efficiencies



- An increase in kinetics
  - Decrease in the mean life expectancy
  - Faster transfers leading to lower biomass in high TLs



A less efficient food web?

Conclusion

- A decreasing fishing pressure
- Some stocks recovering, with increasing biomass
- Overexploitation starting at higher TLs
- Improving indicators for high TLs

- Many stocks still overexploited and/or depleted, with low biomass
- High TLs remain globally overexploited
- A decreasing trend in recruitment
- Indicators still below the EAFM targets
- A less efficient food web (lower transfer efficiencies, faster transfers)

A step towards the (long) way of the good environmental status


Ecopath 30 years
Modelling dynamic ecosystems: beyond boundaries with EwE
Conference & workshops, Barcelona 4-14 November 2014

Thank you!