MareFrame

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Ecological trends in the Cantabria Sea ecosystem: A modeling approach including trophic controls

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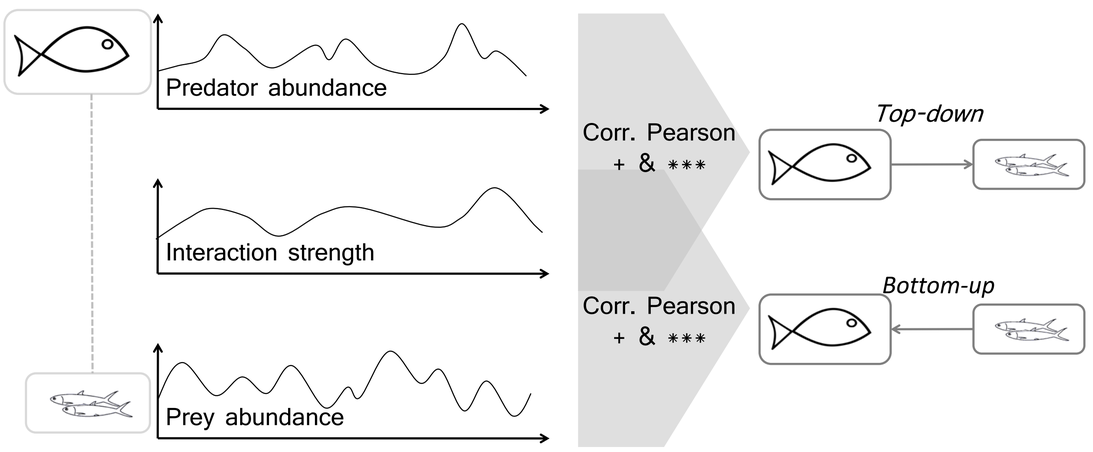
Our aim in this work is to empirically determine trophic controls on food web interactions and integrate this information in the EwE ecosystem model of the Cantabrian Sea. Using this modeling approach we explore the system's trophodynamics following the fisheries effort release of the last two decades, assessing the ecosystem evolution using trend indicators of its structure and health.

Annual diet data were used to investigate the trophic controls at key interactions. The predator-prey **interaction strength** is the fraction that a given prey represents from the total predator diet (measured in volume).

When the Pearson correlation value between predator biomass and diet variability was positive and statistically significant (p-value < 0.05), we assumed a top-down control of the interaction, while if the correlation value between prey biomass and diet variability was positive and statistically significant we assumed a bottom-up control.



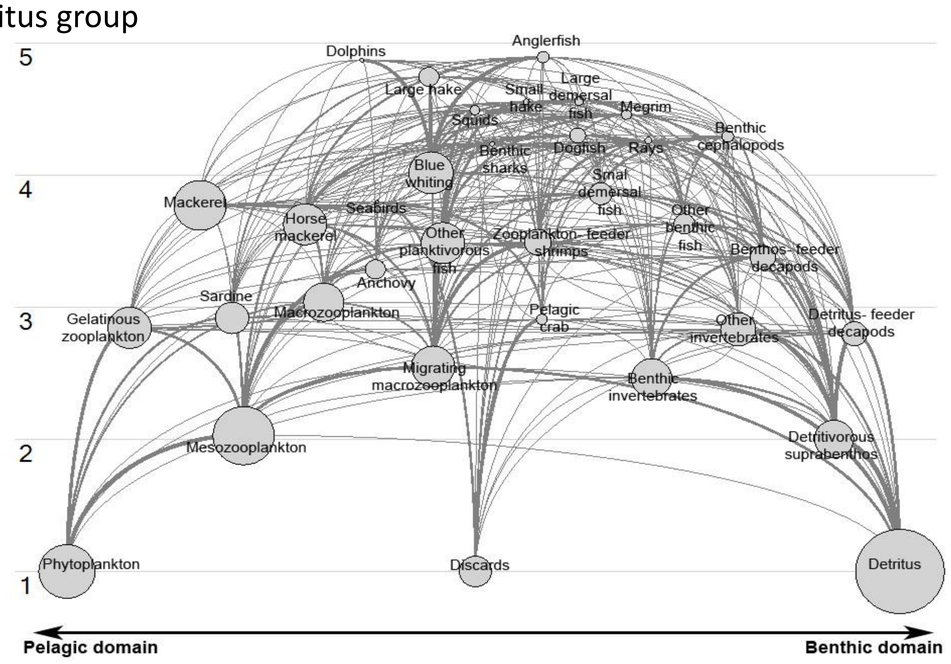
We assigned the **vulnerabilities** based on the correlation value, v_{ij} = 1 if the interaction was bottom-up and v_{ij} = 100 if it was determined as top- down.

Prey \ predator	3	4	5	6	7	8	9	12	13	16
3 Anglerfish										
4 Large Dem Fish										
5 Dogfish										
6 Large Hake	1									
7 Megrim										
8 Benthic sharks	1									
9 Rays										
10 Squids	1					100				
11 Benthic Cephalop				100		100				
12 Small Hake		100	100		100					
13 Other benthic fish										
15 Blue Whiting		1		1	1	1		1		
16 Small Dem Fish							1		100	
18 Anchovy				100						100
21 Pelagic crab		1	1			1	1			
22 Zooplankton feeding shrimps			1	1						
23 Benthos-feeder decapods	100	100	1					1		1
24 Detritus-feeder decapods		100								
25 Polychaetes			1							
26 Other Invert	100				1					
27 Migrating macrozooplankton	100									
29 Detritivorous supreabenthos	100									
30 Macrozooplankton		100			100					

Ecopath with Ecosim model (1994-2013)

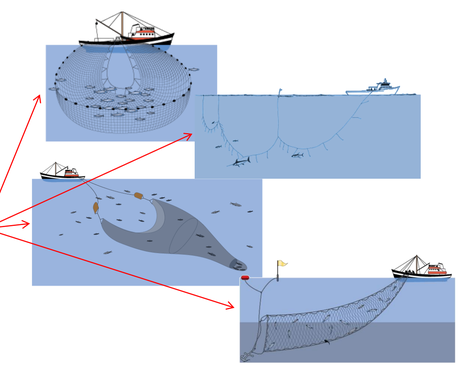
With **34 functional groups** representing a compromise between common trophic guilds, life history characteristics and the amount of available information

- 16 fish groups
- 6 groups of benthic invertebrates
- 7 groups of pelagic invertebrates
- 1 of marine mammals
- 1 seabird group
- 1 primary producer
- 1 detritus group



The **best model performance** was obtained when fishing pressure was introduced in the model forcing the simulation. The primary production anomaly, however, did not improve the model fit.

	Hypothesis	N	minSS	K	AIC	AICc	Better (%)
1	Base model	880	514.2	0	-205.3	-205.3	
2	Base model + PP anomaly (4 sp)	880	508.1	4	-201.9	-201.9	-1.69
3	Base model + Fishing pressure	960	524.4	0	-252.1	-252.1	22.77
4	Base model + Fishing pressure + PP anomaly (4 sp)	960	517.3	4	-249.8	-249.8	21.63



The model reproduced credibly biomass variability of high trophic level groups, but had limited ability to simulate that of mid- and low-trophic level groups. This suggest a strong top down control of the fishery on the fish predators, and higher variability (environmentally driven?) of the lower trophic levels.

The **ENA indices** (such as ascendency or AMI) displayed a relative maximum in the year 2000 and a steep increase after 2005. This relative maximum seems to be caused by changes in the fishery effort around that year. The **mean trophic level indices** (MTL) showed a general increase along the time series. Only when setting the threshold in mTL ≥ 3.25 this increase was not apparent (data not shown).

MareFrame Scientific Conference "Advances in Ecosystem-based Fisheries Management"

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