

Describing the food web of Bay of Biscay's continental shelf using an OSPAR common indicator: the Mean Trophic Level indicator

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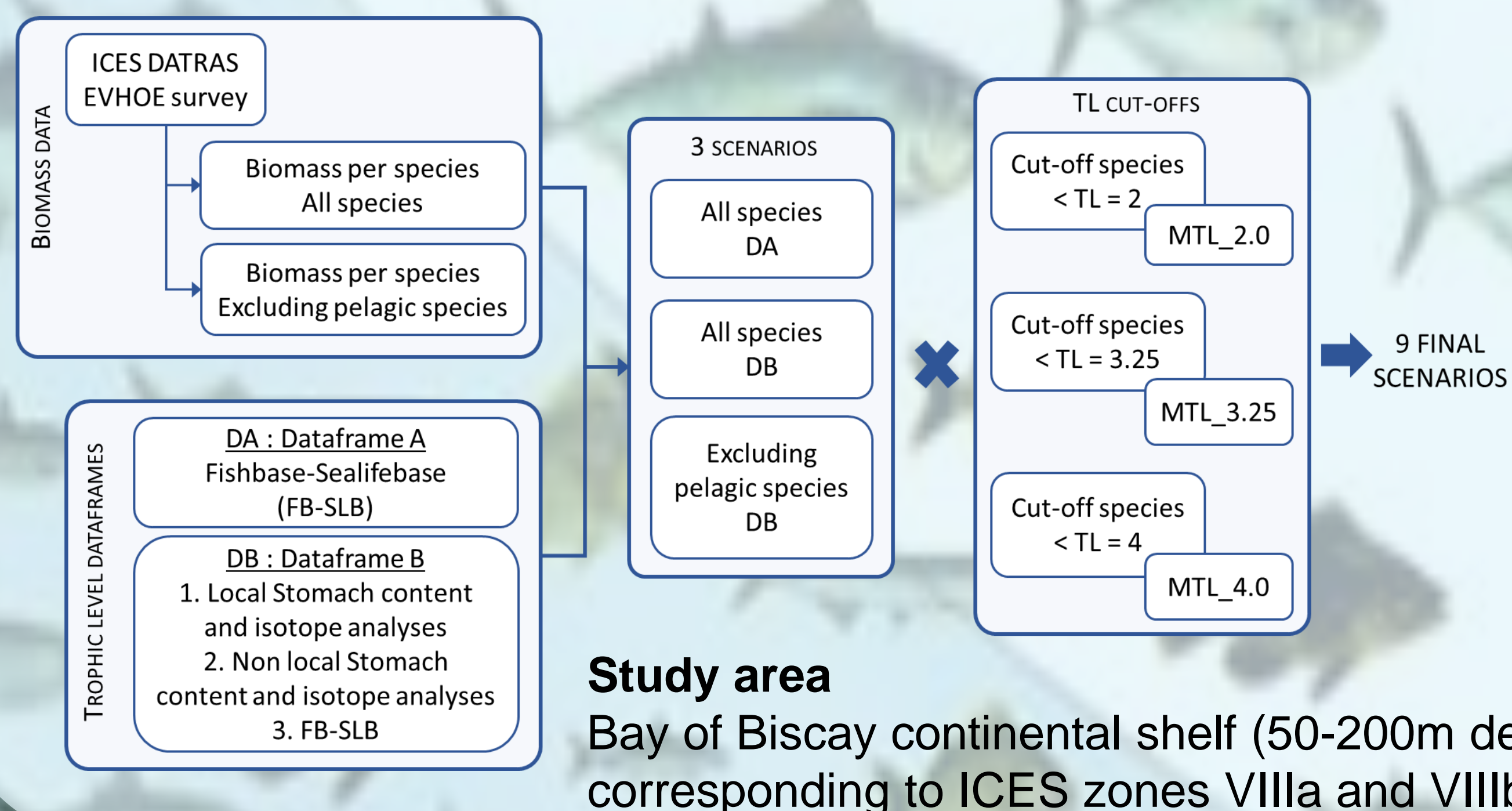
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INTRODUCTION

Mean trophic level (MTL) is an ecosystem indicator based on two metrics (*i.e.* biomass and trophic level of species), each representing an important measure of the food webs. This indicator reflects the well known concept of "**Fishing down marine food webs**" introduced by Pauly et al. (1998). However, MTL metrics are prone to several improvements to increase their accuracy. Among these improvements, we have chosen :

- (i) To use survey **biomass** data to capture the structure evolution of the ecosystem instead of landings biomass
- (ii) To test regionalised **trophic level (TL)** estimations versus worldwide estimations available online (*e.g.* Fishbase)
- (iii) To **investigate the influence of species** (*e.g.* species having higher biomasses and from specific compartments) on MTL indicator combining different cut-offs (*e.g.* focusing on high predators)

MATERIALS AND METHODS

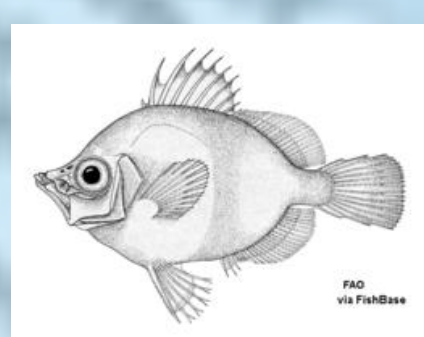


RESULTS

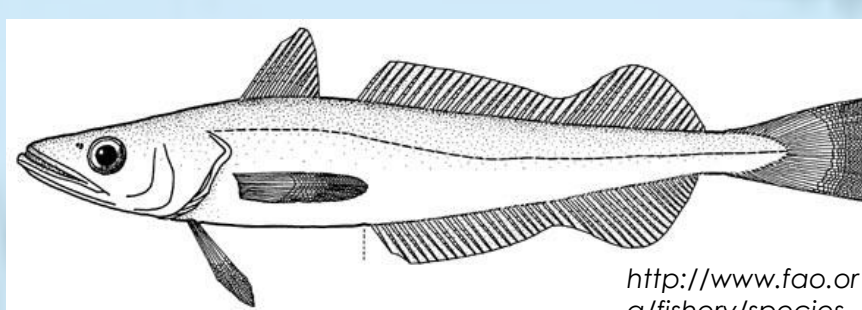
1. The use of worldwide TL estimations exhibited high uncertainty around the MTL indicator whereas this uncertainty was reduced when using regionalised TL (**Fig. 1**)
2. The cut-off of low TL species increased the significance of the trends observed for MTL. This was mainly marked for the MTL_3.25 after excluding pelagic species (**Fig. 1f**)

RESULTS

3. Excluding pelagic species allowed the inclusion of mollusk species (*i.e.* cephalopods) in the list of main species influencing the MTL trends (**Table 1 c,f,i**) and increased the significance of the indicators' trends.
4. Species influence on the MTL trends was assessed by integrating one species at a time following a decreasing order in species biomass. Two species were driving the indicator trends when included into the analyses (**Table 1**) :



- **Capros aper** (low TL species) exerted its influence on MTL_2.0. *C. aper* was the only species responsible of the non-significant trend in MTL_2.0.



- **Merluccius merluccius**, a structuring high TL species drove the MTL trend in all scenarios tested.

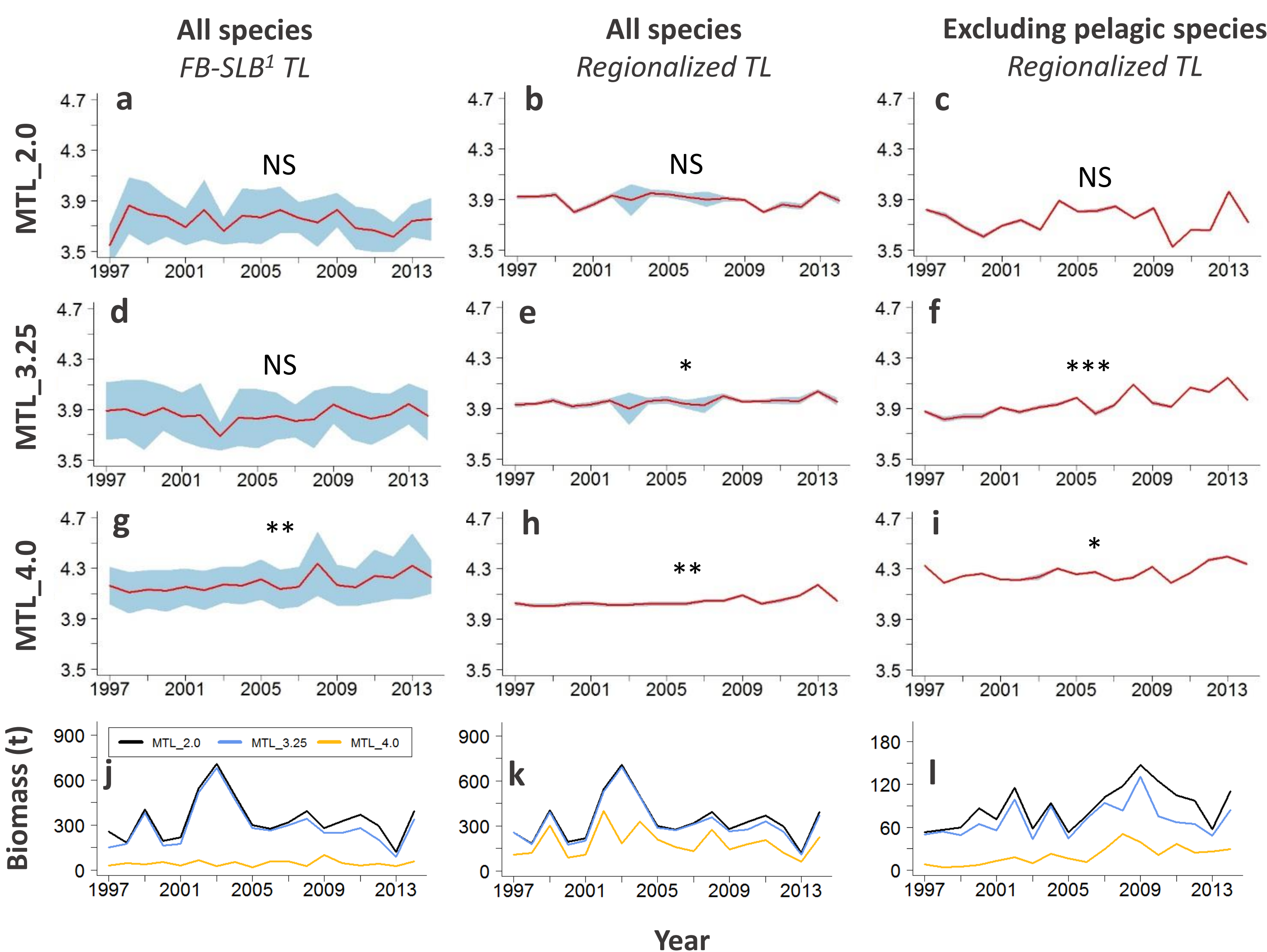


Fig. 1: Trends in Mean Trophic Level (MTL) from Bay of Biscay continental shelf ecosystem (*a to i*) based on EVHOE survey biomass (*j, k, l*). Results are mean MTL values (red model) with the uncertainty (in blue) around the model.

CONCLUSIONS

Results obtained here point the appropriateness of

- (i) using local TL estimations to reduce uncertainty around the MTL indicator,
- (ii) considering a **combined use of cut-offs** and of species included (*i.e.* all species vs excluding pelagic species) in the MTL indicator to have a **more holistic description** of ecosystem structure evolution.

All species	Excluding pelagic species
MTL_2.0	MTL_2.0
MTL_3.25 or MTL_4.0	MTL_3.25 or MTL_4.0

Combination of 4 to 6 scenarios to describe the food web

- (iii) investigating the **underlying drivers of the MTL trends** (*i.e.* *C. aper* and *M. Merluccius* here in the northern Bay of Biscay)

	All species FB/SLB TL			All species Regionalized TL			Excluding pelagic species Regionalized TL		
	Species 95% total biomass	Percentage of total biomass (%)	TL ± se	Species 95% total biomass	Percentage of total biomass (%)	TL ± se	Species 95% total biomass	Percentage of total biomass (%)	TL ± se
MTL_2.0	<i>T. trachurus</i>	48,8	3.84 ± 0.59	<i>T. trachurus</i>	48,8	4.00 ± 0.03	<i>M. poutassou</i>	37,9	3.77 ± 0.05
	<i>S. scombrus</i>	17,4	3.60 ± 0.20	<i>S. scombrus</i>	17,4	3.86 ± 0.32	<i>C. aper</i>	19,7	2.94 ± 0.03
	<i>M. poutassou</i>	9,9	4.10 ± 0.30	<i>M. poutassou</i>	9,9	3.77 ± 0.05	<i>T. minutus</i>	11,6	3.90 ± 0.02
	<i>C. aper</i>	5,1	3.10 ± 0.30	<i>C. aper</i>	5,1	2.94 ± 0.03	<i>S. canicula</i>	9,3	4.08 ± 0.02
	<i>S. pilchardus</i>	3,7	3.10 ± 0.10	<i>S. pilchardus</i>	3,7	3.80 ± 0.06	<i>M. merluccius</i>	8,3	4.56 ± 0.02
	<i>E. encrasicolus</i>	3,6	3.10 ± 0.45	<i>E. encrasicolus</i>	3,6	3.90 ± 0.09	<i>T. luscus</i>	2,5	4.00 ± 0.03
	<i>T. minutus</i>	3,0	3.80 ± 0.50	<i>T. minutus</i>	3,0	3.90 ± 0.02	<i>A. sphyraena</i>	1,7	3.80 ± 0.09
	<i>S. canicula</i>	2,4	3.70 ± 0.60	<i>S. canicula</i>	2,4	4.08 ± 0.02	<i>C. cuculus</i>	1,4	3.86 ± 0.02
	<i>M. merluccius</i>	2,2	4.40 ± 0.80	<i>M. merluccius</i>	2,2	4.56 ± 0.02	<i>Z. faber</i>	1,2	4.47 ± 0.19
							<i>I. coindetii</i>	0,8	3.91 ± 0.02
						<i>L. naevus</i>	0,8	3.87 ± 0.04	
MTL_3.25	<i>T. trachurus</i>	55,9	3.84 ± 0.59	<i>T. trachurus</i>	51,5	4.00 ± 0.03	<i>M. poutassou</i>	47,3	3.77 ± 0.05
	<i>S. scombrus</i>	20,0	3.60 ± 0.20	<i>S. scombrus</i>	18,4	3.86 ± 0.32	<i>T. minutus</i>	14,4	3.90 ± 0.02
	<i>M. poutassou</i>	11,3	4.10 ± 0.30	<i>M. poutassou</i>	10,4	3.77 ± 0.05	<i>S. canicula</i>	11,6	4.08 ± 0.02
	<i>T. minutus</i>	3,5	3.80 ± 0.50	<i>S. pilchardus</i>	3,9	3.80 ± 0.06	<i>M. merluccius</i>	10,4	4.56 ± 0.02
	<i>S. canicula</i>	2,8	3.70 ± 0.60	<i>E. encrasicolus</i>	3,8	3.90 ± 0.09	<i>T. luscus</i>	3,1	4.00 ± 0.03
	<i>M. merluccius</i>	2,5	4.40 ± 0.80	<i>T. minutus</i>	3,2	3.90 ± 0.02	<i>A. sphyraena</i>	2,1	3.80 ± 0.09
MTL_4.0	<i>M. poutassou</i>	73,9	4.10 ± 0.30	<i>T. trachurus</i>	88,58	4.00 ± 0.03	<i>S. canicula</i>	39,9	4.08 ± 0.02
	<i>M. merluccius</i>	16,2	4.40 ± 0.80	<i>S. canicula</i>	4,41	4.08 ± 0.02	<i>M. merluccius</i>	35,7	4.56 ± 0.02
	<i>Z. faber</i>	2,3	4.50 ± 0.80	<i>M. merluccius</i>	3,94	4.56 ± 0.02	<i>T. luscus</i>	10,5	4.00 ± 0.03
	<i>I. coindetii</i>	1,6	4.11 ± 0.85				<i>Z. faber</i>	5,1	4.47 ± 0.19
	<i>L. forbesii</i>	1,1	4.29 ± 0.82				<i>L. forbesii</i>	2,4	4.00 ± 0.03
							<i>L. whiffiaonis</i>	1,7	4.26 ± 0.02

Table 1: Main species lists (*i.e.* species representing 95% of total biomass) in each scenario

Reference

Pauly, D., Christensen, V., Dalsgaard, J., Froese, R. & Torres Jr, F., 1998. Fishing down marine food webs. *Science* 279, 860-863.



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