Does the positive body size-trophic level relationship hold at the species level?

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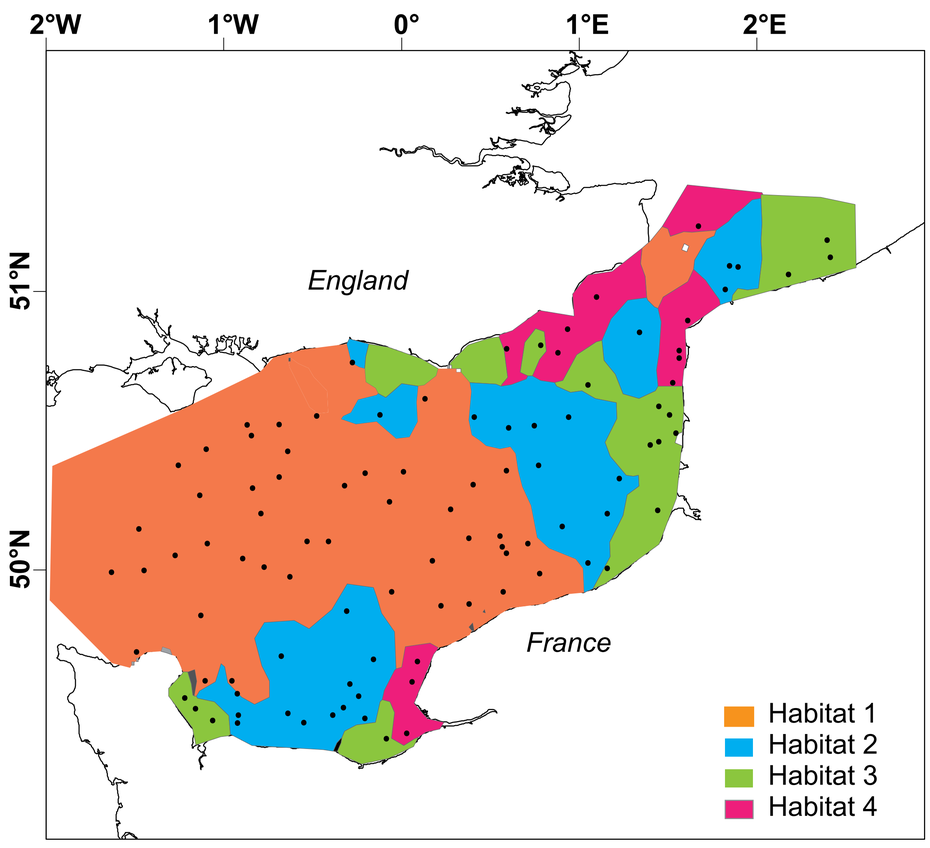
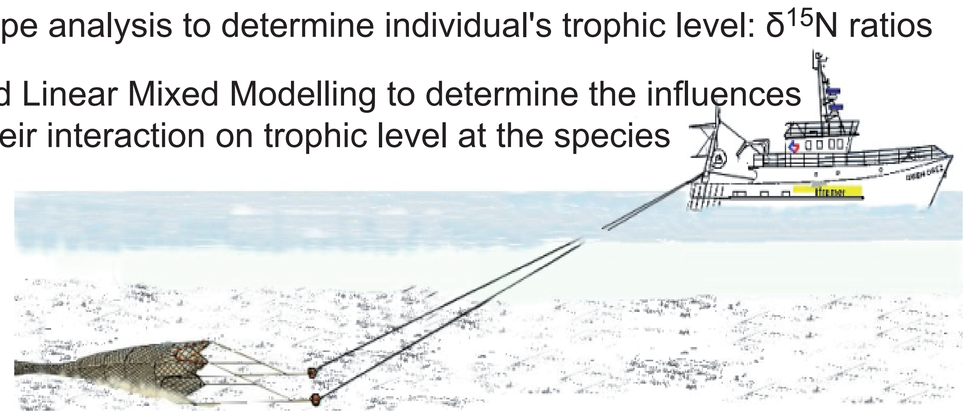
1 Study context and objective

The structure, dynamics and productivity of marine ecosystems depend mainly on their underlying food webs. Seasonality, habitat diversity and variability of available organic matter sources are all external factors affecting the trophodynamics of these networks. Concurrently, intrinsic factors such as the structure of the food webs will also constrain these dynamics. Food web structure can be partly characterized by individuals' or species' trophic level. At the community scale, trophic level appears positively correlated to individuals' body size, especially when considering marine fish assemblages. Given the large range of body sizes expressed by a given marine fish species throughout its life cycle and the potential associated ontogenic niche shift, a question is whether the community scale relationship between body size and trophic level also holds within-species and whether this within-species relationship is affected by external factors such as habitat diversity. We assessed how trophic level depends on individuals' body size and habitats at the species and community scale based on six model fish species from the eastern English Channel.

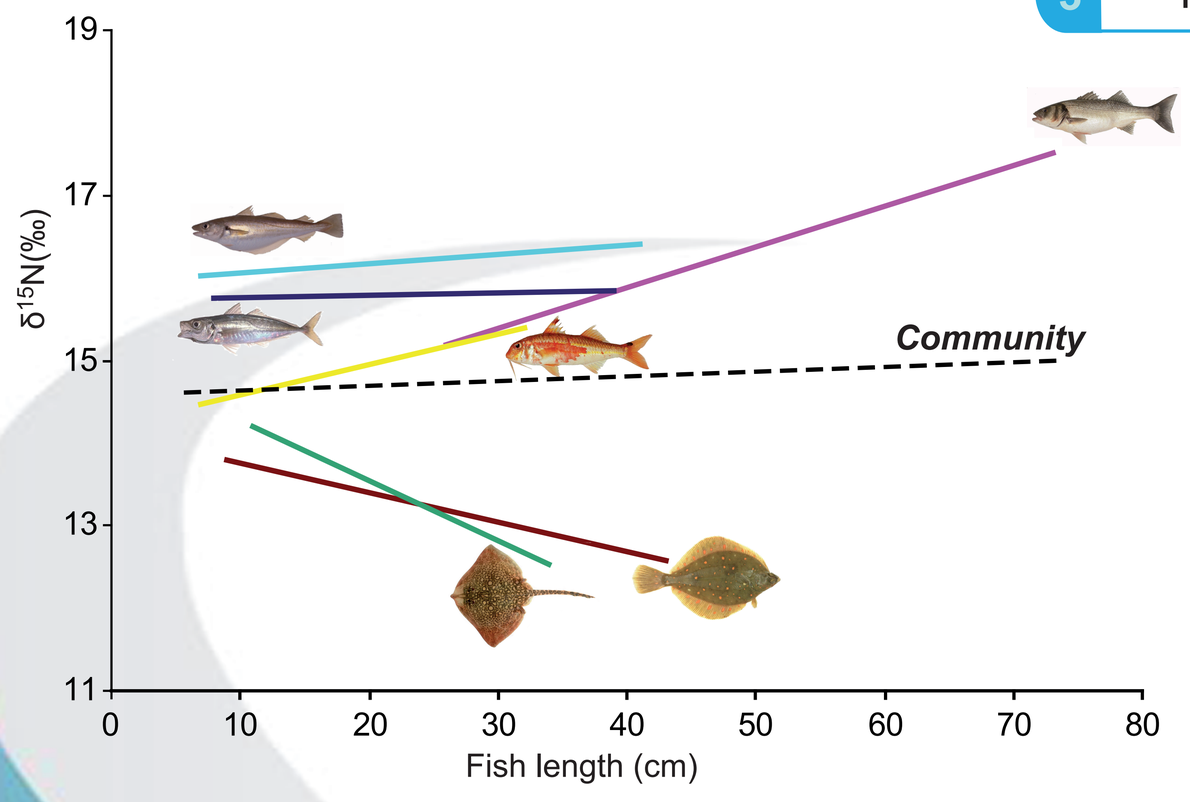
2 Material and Methods

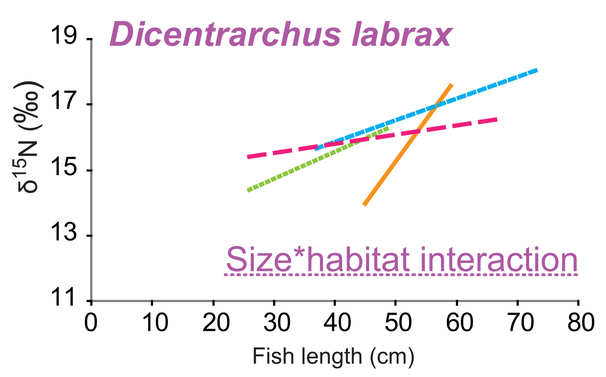


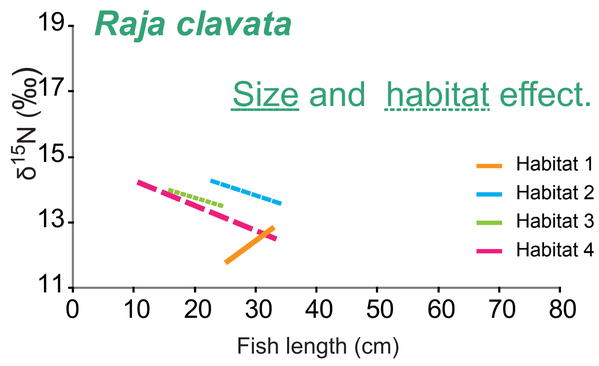
- Location: Eastern English Channel
- Sampling design: four habitats characterized by distinct fish communities (Vaz *et al*. 2007)
- Scientific survey: Channel Ground Fish Survey on board of the Gwen Drez Research Vessel
- Fishing gear: Grande Ouverture Verticale (GOV) demersal trawl
- Fish species: plaice *Pleuronectes platessa*, whiting *Merlangius merlangus*, thornback ray *Raja clavata*, red mullet *Mullus surmuletus*, horse mackerel *Trachurus trachurus* and seabass *Dicentrarchus labrax*
- Laboratory analysis: Stable isotope analysis to determine individual's trophic level: $\delta^{15}N$ ratios
- Statistical modelling: Generalized Linear Mixed Modelling to determine the influences of fish body length, habitats and their interaction on trophic level at the species and community scale

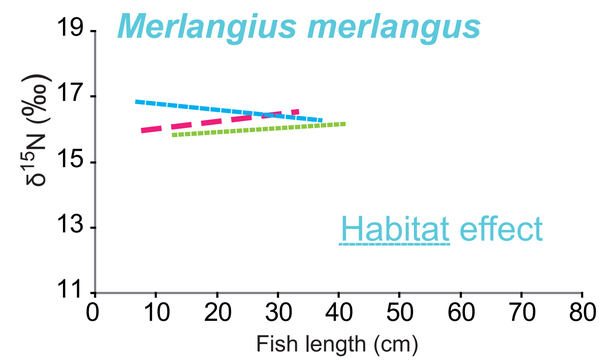


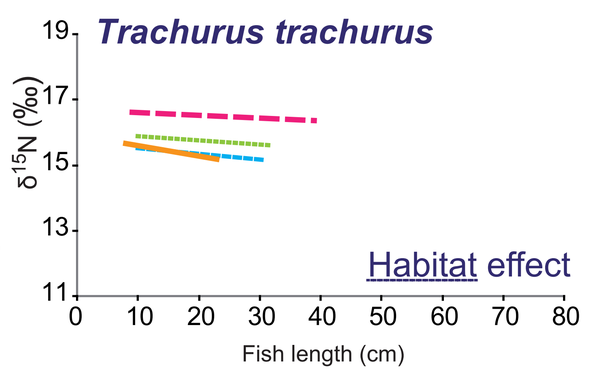
3 Results











Size effect for *Mullus surmuletus*.

No size or habitat effects for *Pleuronectes platessa*.

Results suggested different trends in trophic level according to fish body size depending on the scale and the species considered:

- As expected, a positive trend was observed at the community scale suggesting that, irrespective of fish species, individuals feed at higher trophic level with increasing body size;
- Similar positive trends were found within some demersal species. The change in feeding resources with body size is sometimes accompanied by a habitat effect: the increase of trophic level with body size is larger in some habitats than in others probably due to differences in the availability of preys;
- However, negative trends were observed within benthic species meaning that as body size increases, fish feed at lower trophic level (possibly due to a shift in predation behavior or prey preferences, e.g., from feeding on carnivore benthic species to suspension-feeder organisms);
- Also, no size-based changes in trophic level were observed within some species but only a significant habitat effect probably due to differences in prey availability or differences in the food web baseline among habitats.

In conclusion, the body size-trophic level relationship observed at the community scale cannot be generalized at the species scale and the sign and strength of the latter may depend on the functional group considered (pelagic, demersal or benthic) and habitat.

4 Perspectives

- Extend the study to other species to determine whether our results can be generalized: further analyses are currently under way on 4 species (cod, mackerel, common sole and small-spotted catshark).
- Examine relationships between body size/habitats and $\delta^{13}C$ signatures. As the Channel is strongly spatially structured, one may expect changes in organic matter sources during ontogeny indicated by changes in organisms $\delta^{13}C$.
- Comparison to comparable ecosystems, such as the North Sea where a more size-structured foodweb has been observed (Jennings *et al*. 2001).

References:
Jennings et al (2001) J Anim Ecol 70: 934-944
Vaz et al (2007) ICES J Mar Sci 64 : 761-767

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