The trophic ecology of Taiwanese deep-sea sharks through stable isotopes analysis

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Introduction

In marine ecosystems, sharks often play the role of top or mesopredators and their presence can shape the entire food web. However, the importance of deep-sea species is less known because of the relative inaccessibility to deep-sea ecosystems. Most of the information comes from stomach contents and data still lack for the majority of the species. The use of methods such as stable isotope analyses has thus proven relevant to estimate the trophic role of these sharks. Here, we obtained samples from six deep-sea shark species living in Taiwanese waters, including *Squaliolus aliae*, the smallest shark in the world. Their isotopic niches were calculated on muscle tissues using a SIBER analysis with $\delta^{15}N$ and $\delta^{13}C$ values. The same data were collected for liver tissues as they have a higher turnover rate and might indicate temporal changes in diet. In addition to that, 16 species of organisms living in the same ecosystem were also sampled to determine the position of the sharks in their food web.

Materials and methods

Samples obtained from fishermen

Squaliolus aliae ± 20cm

Etmopterus splendidus ± 24cm

Etmopterus brachyurus ± 34cm

Etmopterus molleri ± 30cm

Galeus sauteri ± 37cm

Danea profundorum ± 47cm

- Extraction of lipids using a 2:1 dichloromethane/methanol solution
- Removal of nitrogenous compounds with deionized water

Results

1) You better eat like a shark

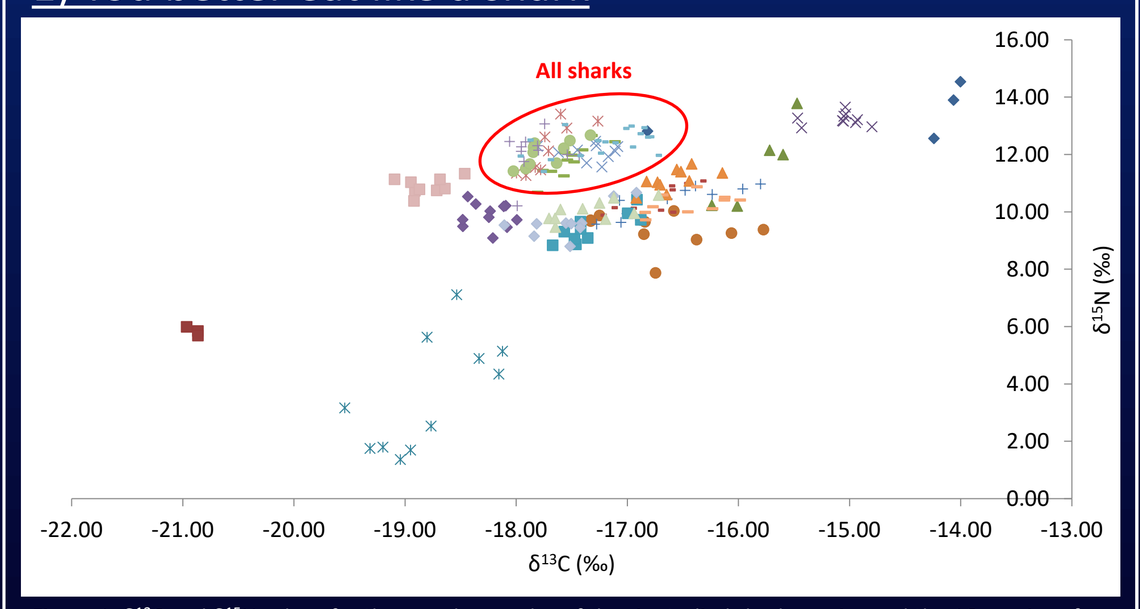

Figure 1: $\delta^{13}C$ and $\delta^{15}N$ values for the muscle samples of the six studied shark species and the 16 species of the same food web. The values of all sharks are circled in red.

On a global visualization, all the sharks are grouped together.

2) To share resources or not to share resources

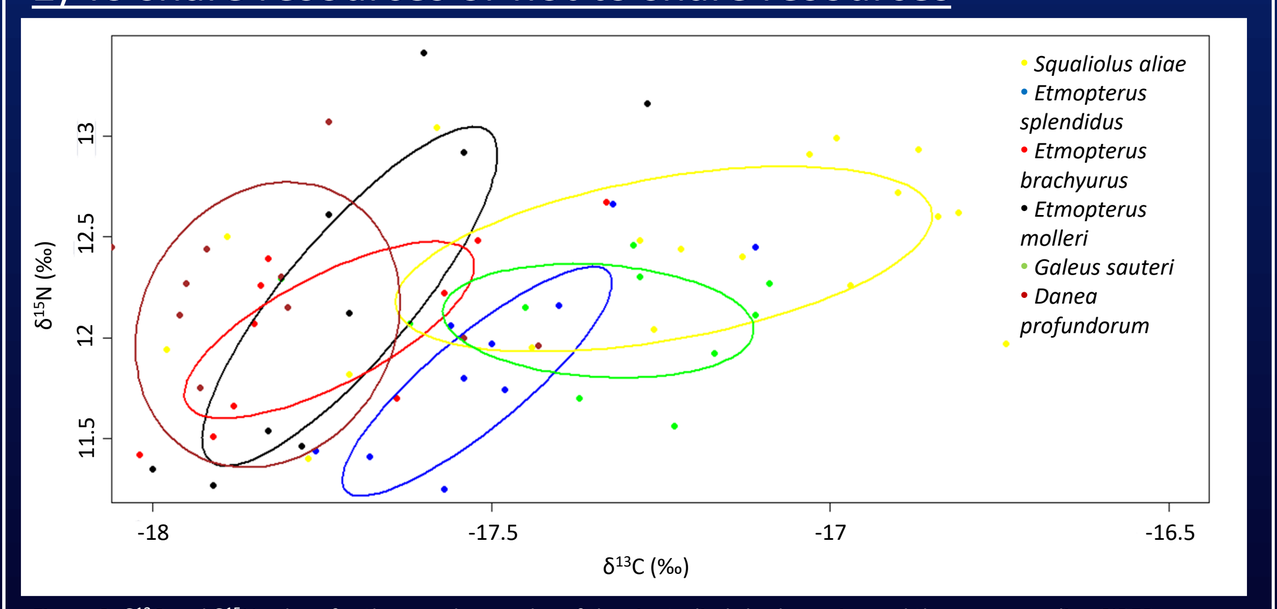

Figure 2: $\delta^{13}C$ and $\delta^{15}N$ values for the muscle samples of the six studied shark species and the corresponding SIBER ellipses.

E. brachyurus, *E. molleri* and *D. profundorum* seem to share a pool of commune resources. The same thing can be seen for *S. aliae*, *G. sauteri* and, on a smaller scale, *E. splendidus*.

The isotopic niches of *S. aliae* and *D. profundorum*, the smallest and largest species, are well separated. Most of the isotopic niche of *G. sauteri*, the second largest species, overlaps with *S. aliae*.

S. aliae presents the largest ellipse area, a difference mostly due to its $\delta^{13}C$ range.

The isotopic niches of *E. brachyurus* is almost entirely comprised inside the isotope niche of *E. molleri*.

3) I am on a special diet

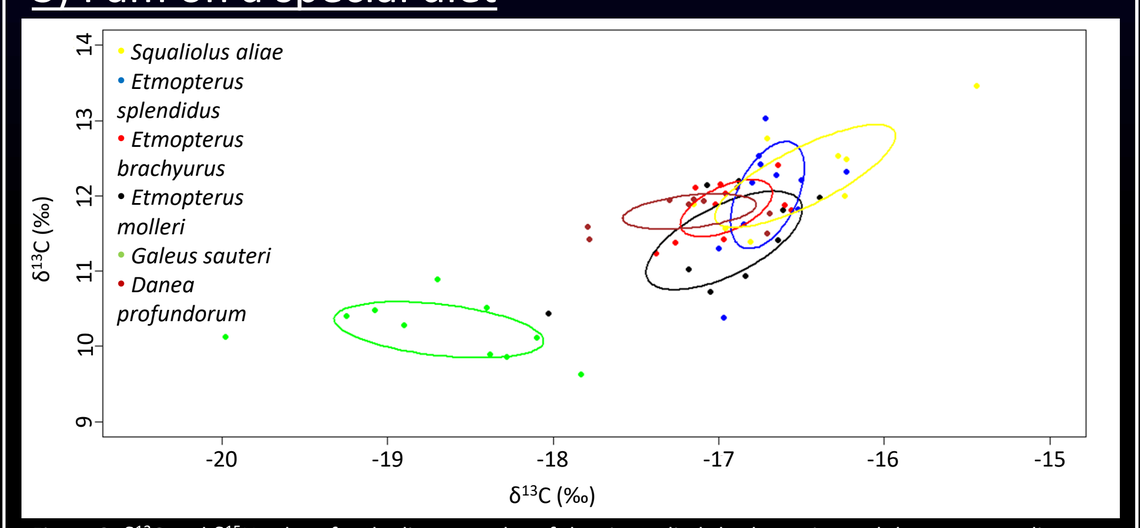

Figure 3: $\delta^{13}C$ and $\delta^{15}N$ values for the liver samples of the six studied shark species and the corresponding SIBER ellipses..

There is a more overlap between the different species except for *G. sauteri* which separates from the other isotopic niches.

Conclusions

1) All the sharks seemed to occupy a similar trophic role in their food web.
2) The isotopic niches of the different shark species are all relatively close and overlapping with each other. The important size difference between *S. aliae* and *G. sauteri* doesn't lead to niche separation. However, *G. sauteri* is found in shallower waters (Pollerspöck and Straube, 2021), both species thus relying on different food webs. The large overlap between *E. brachyurus* and *E. molleri* is not surprising given the high morphological similitude of the two species but little is known about their trophic ecology.
3) When looking at liver values, the changes between the different species might be explained by changes in prey availability on a temporal scale. However, the critical change in *G. sauteri* might be indicative of an important change in diet due to specific prey changes over time or a potential migrating behavior of this shark.

Reference

Pollerspöck, J. & Straube, N. 2021, www.shark-references.com, World Wide Web electronic publication, Version 2021

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