Choose well your diet:
Transfer of polyunsaturated fats from brown, green and blue sources

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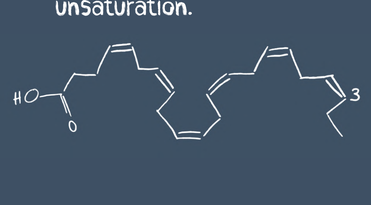
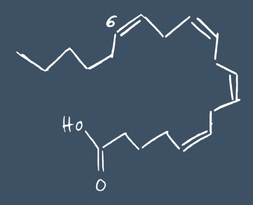
Polyunsaturated fats in nature, not only in blue sources

Polyunsaturated fatty acids (PUFAs) are fatty acids with several unsaturations (carbon double bonds), classified in omega-3 or omega-6 depending on the carbon of the first unsaturation.

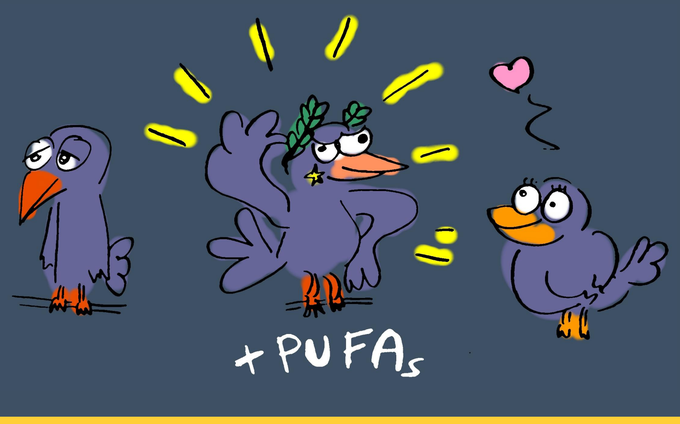


Omega-3 example:
Docosahexaenoic acid, DHA



Omega-6 example:
Arachidonic acid, ARA

PUFAs are vital molecules for consumers' performance (reproduction, growth, activity, etc…) and therefore play a key role in food webs.



We studied the coupling of amino acids and PUFAs transfer to riparian spiders.
To do that, we measured PUFAs concentrations and amino acid isotopes in spiders and their prey.

Ecosystems, such as this riparian area in Switzerland, are complex puzzles of organisms. Predators, such as spiders, rely on different sources, including soil (brown), plants (green) and aquatic (blue).

We found that brown, green and blue consumers differ in their PUFAS' composition, as well as their predators, spiders (Figure 1). Does diet choice influence PUFAS concentration? Can we use PUFAS as biomarkers in food webs?

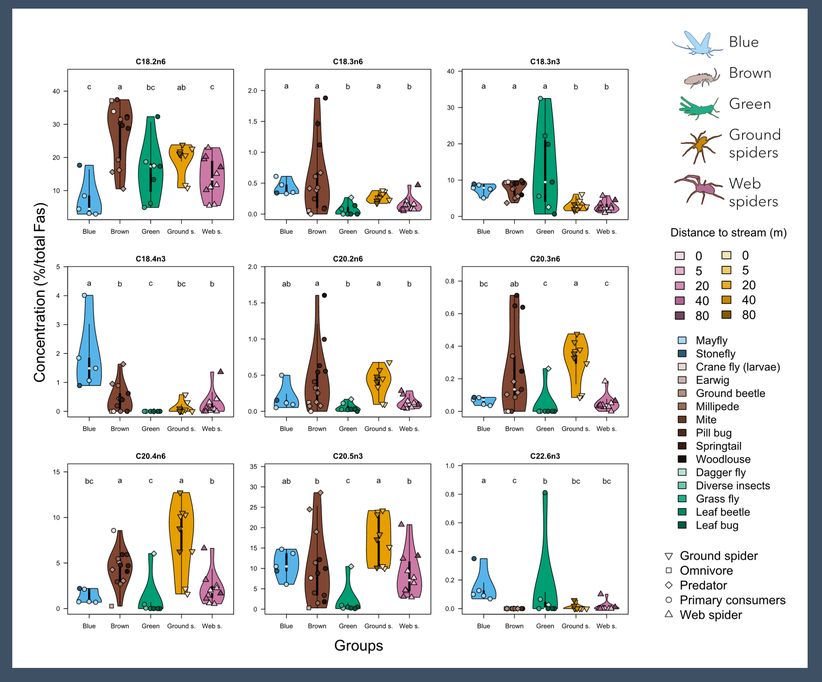
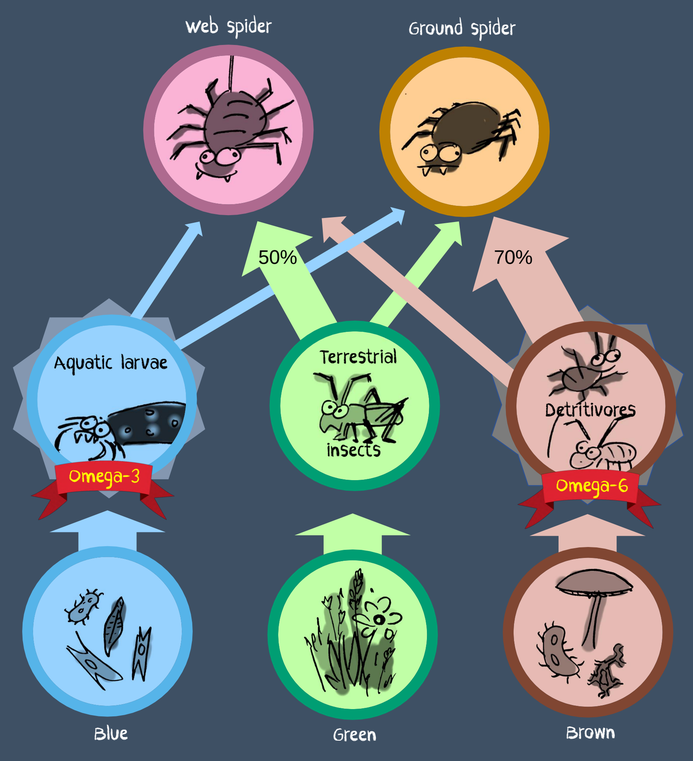


Figure 1. *Relative abundance of PUFAs (given as % total FA) in the different sources and spider types. Colours refer to species or distance to stream for sources and spiders, respectively. Symbol shapes show presumed role in food web.*

Can we reconstruct spiders' use of blue, green and brown sources?



Simplified food web, inferred from EAA δ13C (Figure 2). We found that brown sources were predominant, while few spiders caught at the shore specialized on blue sources.

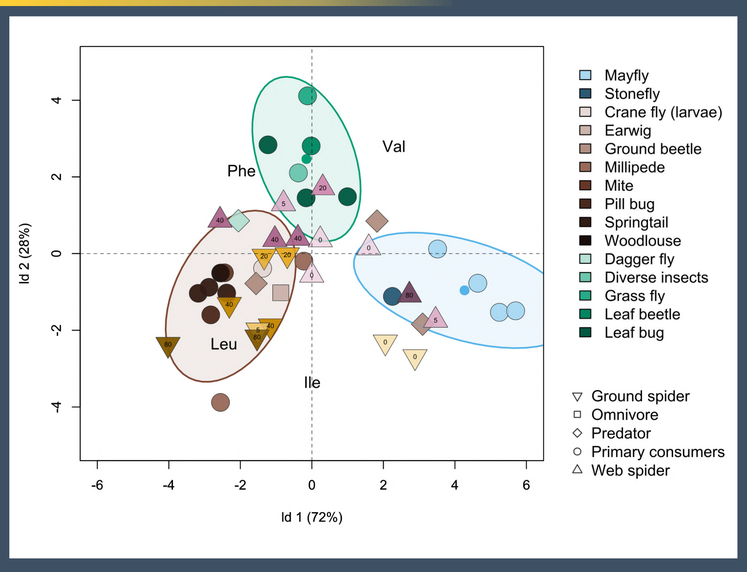


Figure 2. *LDA of blue, green and brown sources based on 4 EAA δ13C of primary consumers of the three groups. Ile, Leu, Phe and Val positions show their relative contribution to the LD axis. Ellipses show 50% confidence intervals of the sources. Colours and shape show species and presumed food web position, respectively (see legend).*

We use carbon isotopes of essential amino acids (Figure 2) to reconstruct source reliance. Spiders rely on all sources, especially brown and green for ground and web spiders, respectively.

Collembola (brown sources) are rich in omega-6, do we find such pattern in their predators?

Can we use polyunsaturated fats as diet markers?

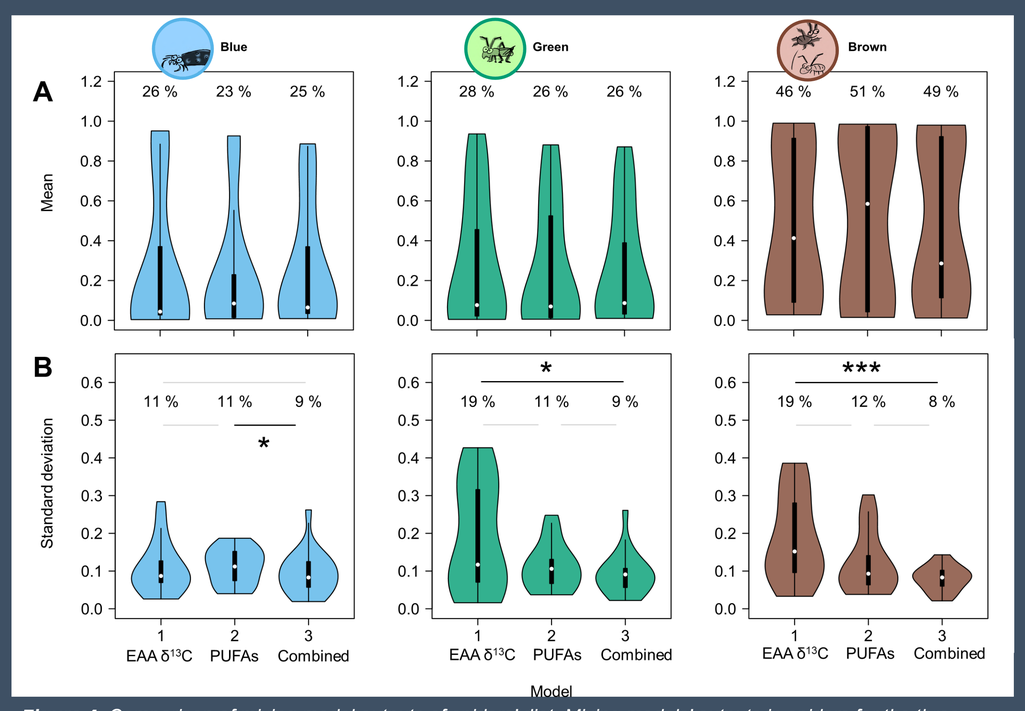


Figure 4. *Comparison of mixing model outputs of spiders' diet. Mixing models' outputs in spiders for the three sources, from left to right: blue, green and brown. A and B show the distribution of mean and standard deviation estimates, respectively. Numbers on top show the mean estimate for all spiders. Stars show significant differences based on Mann–Whitney U test: (***) P < 0.001, (*) P < 0.05.*

Are polyunsaturated fats linked to carbon source?

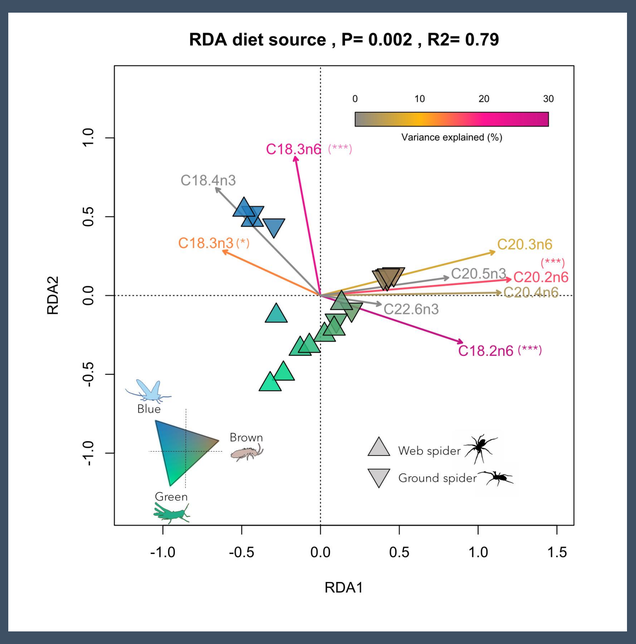
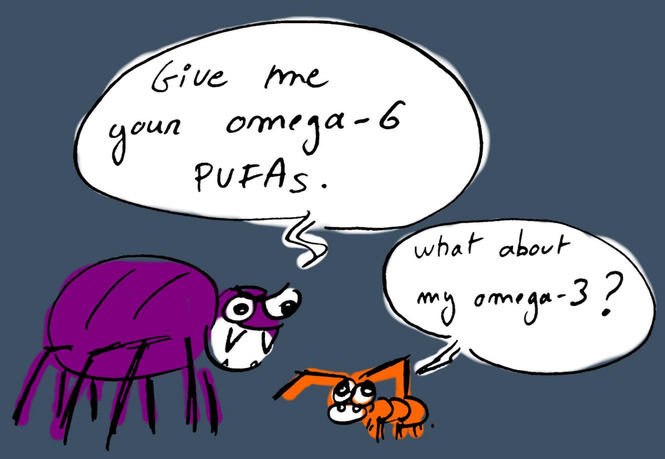
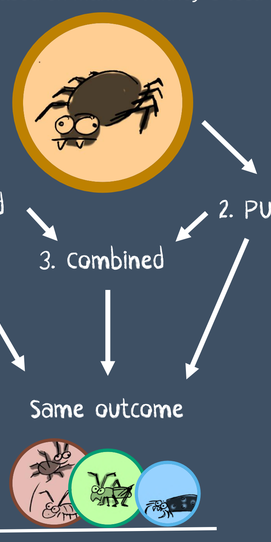


Figure 3*. PUFAs' profiles in spiders correlate with protein origin. Redundancy analysis on the diet reliance of spiders (as predicted by amino acid stable isotopes), constrained by PUFAs concentration, relative to total fatty acid concentration. Dot colours and shape show diet source (see bottomleft triangle) and spider family (see bottomright legend), respectively. Arrows show the relative contribution of PUFAs to the RD axis. Colours show the proportion of variance explained in the spiders' diet (see upright legend). Stars show significance of ANOVA test:, (***) P < 0.001, (*) P < 0.05.*

We found that omega-6 are good predictor or carbon source (Figure 3). However, most of PUFAS were poorly linked to source reliance. This was the case of EPA or DHA, two omega-3 that are believed to be strongly associated with carbon source.

Can we still use PUFAS as diet biomarkers?





For the first time, we compared mixing models based on PUFAs' concentrations and amino acid stable isotopes. We found that models yielded similar results (Figure 4), in terms of mean and standard deviation. Combining the two tracers only improved the accuracy, not the mean estimates.

Conclusion

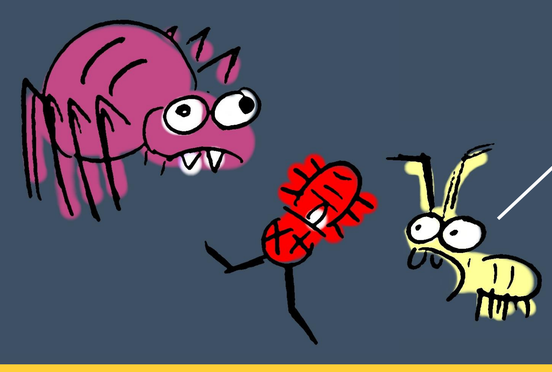
-Carbon sources differ in PUFAS' concentration

-Brown sources are especially rich in omega-6 PUFAS

-Most of PUFAS are bad predictors of carbon source…

-…But overall, PUFAS are still good to make inference on carbon fluxes…

-…But the drivers of PUFAS pattern in predators is still unclear!



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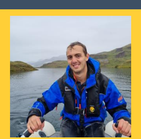

See https://www.eawag.ch/en/department/surf/projects/ecology-of-food-chain/

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