Applications of isotope ratio mass spectrometry in aquatic ecosystems at the University of Liège

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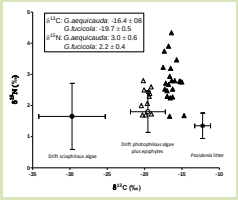
Since at least 35 years, at Prof Dauby initiative, applications of stable isotopes as marine ecological tracers through isotope ratio mass spectrometry have been developed at the University of Liège. One research axis, within the Laboratory of Oceanology and the Laboratory of Animal Systematic and Diversity, is the measurement of stable isotope compositions (C, N, S) in organic matter to delineate trophic web structure and study animal diet, their trophic niches and their alteration by human activities. Coupling between trophic ecology and ecotoxicology, as well as the study of biogeochemical processes are other areas of investigation.

Studying trophic ecology

- **Delineation of marine trophic web**



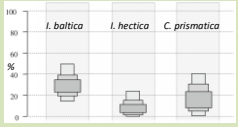
The fact that the isotopic composition of an animal is strongly determined by the isotopic composition of its food, allow the use of natural isotope abundance (C, N, S) as food web tracers.

Example of $\delta^{13}C$ and $\delta^{15}N$ of crustacean amphipods and potential food items (mean ± SD) sampled in Posidonia litter in the Gulf of Calvi, France (Lepoint et al 2006)

- **Description of the trophic niche**

The trophic niche width can be evaluated using methods estimating the degree of individual specialisation within a population.

- **Mixing modelling**



The use of mixing models allow to calculate the contribution of different potential food sources to the diet of a species.

Modelling with SIAR. Dietary contributions (%) of the food source "Crustaceans" to the diet of 3 isopods (Sturaro et al 2010). Black and grey boxes are the 50, 75 and 95% credibility intervals

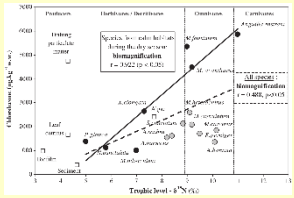
Coupling trophic ecology and ecotoxicology

Stable isotope compositions (C, N , S) allow us to investigate potential relations between animal diet and their pollutant contaminations.

- **Applications**

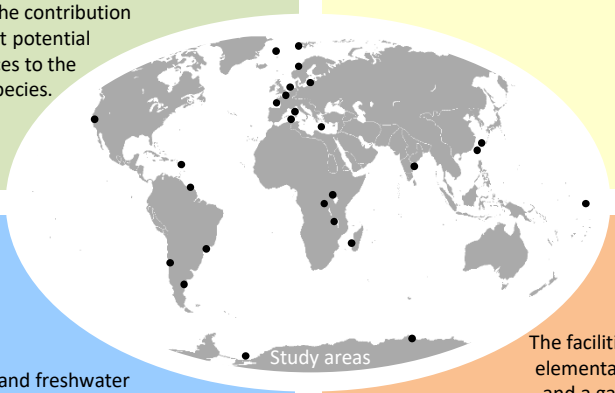
This approach has been applied mainly to marine vertebrates (fish, turtles, mammals, birds) and freshwater ecosystems. Targeted pollutants are trace elements (e.g. Hg) and organo-chlorated or brominated pollutants.

Stable isotope compositions may also help to explain spatial variability of pollutant contaminations.



Chlordecone concentrations versus trophic level in invertebrates colonizing a river of Guadeloupe with different water regimes (Coat et al. 2011)

Case study: Stable isotope compositions of feathers allow to discriminate the 3 habitats of the White-tailed eagle in relation with brominated flame retardant contamination (Eulaers et al 2014)



Investigating various ecosystems and species

- **Ecosystems**

We are investigating different marine and freshwater ecosystems (e.g. seagrass meadows, macrophytodetritus accumulations, Antarctic benthic systems, coral reefs and wetlands), in polar, temperate and tropical areas.

Mediterranean seagrass meadows (Italy)

Coral reefs (Taiwan)

Amazonian marshes (French Guiana)

- **Species**

Marine mammals, marine turtles, crocodilian, bird and fish species, Mediterranean and Antarctic benthic invertebrates.

Our equipment

- **The Laboratory of Oceanology**

The facilities, renewed in 2012, are composed of an elemental analyser (Vario MICRO cube, Elementar) and a gas chromatography (Agilent) coupled to an isotope ratio mass spectrometer (Isoprime 100, Isoprime). The GC is also equipped with a quadrupole mass spectrometer.

More recently, the laboratory has been attempting to develop the measurement of stable isotope ratios of specific compounds such as amino acids, which should allow to determine more precisely the trophic position of consumers.

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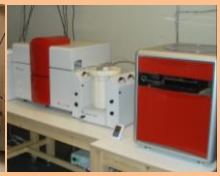
Publications: http://www2.ulg.ac.be/oceanbio/Publications.html



Left: GC-C-IRMS & MSD (Isoprime, Agilent) of the Laboratory of Oceanology

Right: EA-IRMS (Isoprime, Elementar) of the Laboratory of Oceanology