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

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The use of stable isotopes as ecological tracers through isotope ratio mass spectrometry has a long history at the University of Liège, Belgium. Since at least 35 years, applications of stable isotopes in aquatic ecosystems have been developed within the Laboratory of Oceanology and the Laboratory of Animal Systematic and Diversity. One research axis is the measurement of stable isotope composition (carbon, nitrogen and sulfur) in organic matter to delineate food web structure and to study animal diet, their trophic niches and their alteration by human activities. This approach assumes that the isotopic composition of a consumer (i.e. the $^{13}C/^{12}C$, $^{15}N/^{14}N$ and $^{34}S/^{32}S$ ratios) is a proportional mix of the isotopic compositions of its food sources, with a slight enrichment towards the heavier isotope. We have successively applied this approach in different marine and freshwater habitats and ecosystems (e.g. seagrass meadows, macrophytodetritus accumulations, Antarctic benthic systems and coral reefs), in polar, temperate and tropical areas. Mediterranean food web and fish trophic ecology have received a peculiar attention. Furthermore, it has been applied to marine mammals, marine turtles, crocodilian species, Mediterranean and Antarctic benthic invertebrates, and the study of symbiotic associations (fish-sea cucumbers, tropical echinoderms and hydrothermal crustaceans). Stable isotope labelling is also used in our laboratory to study and quantify various ecological processes such as inorganic nitrogen incorporation and trophic transfers. Coupling between trophic ecology and ecotoxicology is another area of investigation. The laboratory's facilities, renewed in 2012 and managed by Dr Gilles Lepoint, are composed of an elemental analyser and a gas chromatography coupled to an isotope ratio mass spectrometer. The gas chromatography 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. Overall, here we aim to provide insights into the use of isotope ratio mass spectrometry and illustrate their utility and potential applications to better understand food web structures and species diet in aquatic ecosystems.