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Stable Isotope Analyses in Aquatic Ecology (a review)

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Theory and practice of analyses of stable isotopes of carbon and nitrogen for food trophic studies in aquatic ecology are regarded basing on literature, published primarily in the last decade. Methods of measuring of the stable isotope ratios, $\delta^{13}C$ and $\delta^{15}N$, are described including those of compound specific isotope analyses. Differences in isotopic signatures between terrestrial and aquatic organisms as well as between taxa and life forms and habitats are generalized. Trophic fractionation of ^{15}N as the basis of quantitative estimation of trophic positions of organisms is described. Environmental factors affecting values of isotope ratios and limitations of the stable isotope method are discussed. Novel conceptions of aquatic ecology, developed on the basis of the stable isotope analyses are listed. As concluded, the stable isotopes are becoming a standard analytical tool in food web ecology. Careful use must be made of this tool, however.

Keywords: stable isotopes, aquatic ecosystems, trophic fractionation, trophic position

Introduction

Development of methods and equipments is one of the driving forces of progress of any science. Over the past two decades stable isotope analysis (SIA) has become an important technique in ecology. Stable isotopes of elements occurring in nature often form spatial and temporal patterns in their distributions in inorganic materials which are transferred to living organisms and so can be used to track their migrations. For instance, isotopic analysis of fish otoliths could be used to document migration patterns of fish species encountering coastal marine, estuarine, river, and lake environments throughout its life cycle (Hobson, 1999). The molecular isotopic signature of environmental contaminants can allocate a contamination to a specific source in order to allow appropriate means of risk reduction and/or to identify responsible parties in litigation (Schmidt et al., 2004). Many stable isotopes, including those of metals, sulfur (^{34}S) and deuterium can be used for above studies.

However a majority of ecologists use stable isotopes of carbon (^{13}C) and nitrogen (^{15}N) for examining trophic interactions and elucidating energy flow pathways through food webs and ecosystems. There are two main interrelated problems, solved on the basis of SIA. Firstly, the stable isotope analysis has increasingly being used for unraveling the structure of food webs (e.g., Pel et al., 2003). Secondly, SIA is used to trace flows and to estimate the relative importance of

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