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Trophic pathways of omega-3 fatty acids in stream food

Abstract

The well-established River Continuum Concept suggests that headwater streams in temperate forests are strongly dominated by terrestrial organic matter (t-OM). At the same time, these streams are typical habitats for freshwater salmonids, such as trout and charr, which are rich in omega-3 polyunsaturated fatty acids (n-3 PUFA). However, n-3 PUFA required for salmonids do not occur in t-OM. Thus, the high dietary omega-3 PUFA supply for salmonids and other headwater consumers, such as benthic invertebrates, may be too low. This research project targets this conundrum and will investigate, a) spatial and seasonal variation in consumer dependence (benthic invertebrates and fish) on elemental (C and N and their stable isotopes) and molecular (lipids and their fatty acids) composition of basal resources along a longitudinal, pre-alpine stream gradient (ecosystem approach), b) under different light conditions, the effect of allochthonous and autochthonous diet sources in headwater streams on dietary supply and retention of fatty acids in headwater benthic invertebrates (experimental approach), and, c) using radioactive hepatocyte bioassays, the ability of freshwater fish to convert precursor fatty acids to DHA to compensate for a lack of dietary DHA (hepatic lipid metabolism in freshwater fish). This research will use state-of-the-art methods, including flume experiments and fish hepatocytes bioassays, linked with field investigations and apply stable isotopes and fatty acids. Results will shed considerable light on the long-standing question of how consumers in headwater streams, but also in lowland streams, manage or fail to obtain essential nutrients and high quality forms of energy. This research project will contribute to a more comprehensive understanding of trophic energy transfer and lipid dynamics in stream organisms along increasing trophic levels.