P1.18

Can zooplankton fed allochthonous carbon diets support and sustain juvenile fish?

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Abstract

Freshwater inflows and terrestrial resource inputs have long been linked to fish abundance and catch rates in estuaries but the role of terrestrial carbon in this process is still debated.We performed a study testing the effects of varying levels of terrestrial dissolved organic matter (tDOM) additions to a food limited diet of juvenile Australian bass (*Macquaria novemculeata*). Crustaceous zooplankton *Artemia franciscana* (*Artemia*) were reared for two days under control conditions (no addition) or with additions of tDOM leachate at dissolved organic carbon (DOC) concentrations of 5 mg/L or 10 mg/L. *Artemia* were fed to juvenile bass in their treatment tanks over 42 days at feeding rates reduced by 65-75% of *ad libitum*. Juvenile fish fed the 5 mg/L reared *Artemia* exhibited no statistical difference for weight, standard length, fork length or total length compared to the control treatment. However, fish fed *Artemia* grown in the 10 mg/L tDOM treatment had significant increases ($p < 0.05$) in all length parameters after 28 days compared to other treatments and were significantly greater in weight and dorso-ventral depth by 42 days. Stable isotope analysis of fish tissue did not show significant changes towards signatures of the terrestrial carbon. Decreased highly unsaturated fatty acid (DHA, EPA and ARA) concentrations of fish tissue and weights of juveniles across all treatments suggested utilisation of endogenous lipids and proteins to facilitate growth under food limitation. We suggest that increased terrestrial resource availability in juvenile fish diets subsidised energetic needs, allowing greater proportions of endogenous resources to contribute to growth and development, resulting in greater lengths of fish where tDOM was available. In this manner, organic material of terrestrial origin brought to estuaries by inflows may ecologically link the improved recruitment of juvenile Australian bass and other species to increased freshwater discharge.

Keywords

Allochthnous, Carbon, Fish, Freshwater Inflows