ELSEVIER

Ecological Modelling 75/76 (1994) 435–445

ECOLOGICAL MODELLING

Seasonal changes of trophic transfer efficiencies in a plankton food web derived from biomass size distributions and network analysis

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Abstract

The trophic transfer efficiencies in the planktonic food web of large, deep, and meso-eutrophic Lake Constance were derived independently from biomass size distributions and from mass-balanced carbon flow diagrams based on comprehensive data for biomass, production, and food web structure. The main emphasis was on the transfer of primary production to herbivores since this process dominates the flow of matter within the food web. Biomass size distributions offer an ecosystem approach which relies only on measurements of biomass and a few general assumptions, whereas network analysis is predominantly based on production estimates and requires more detailed knowledge of the ecosystem. Despite these differences, both approaches give consistent results for both the absolute values of the transfer efficiencies and seasonal trends. Estimates of the seasonally averaged transfer efficiency (dominated by the utilization of primary production by herbivores) range from 0.20 to 0.27. They are considerably lower in late winter and spring (0.05 to 0.21) than in summer and autumn (0.25 to 0.38, extreme values: 0.20 and 0.42).

Key words: Biomass; Food webs; Network analysis; Plankton; Seasonality

1. Introduction

The efficiency with which organic matter is transferred from a lower to a higher trophic level (here called trophic transfer efficiency) is of great importance for both practical and theoretical ecosystem analysis (e.g. Ducklow, 1991). For example, the trophic efficiency influences food web structure and fish yield, and it is

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SSDI 0304-3800(94)00008-6