

# Components, structure and fluxes of the microbial food web in a small, stratified lake

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**ABSTRACT:** We studied the planktonic community established in Lake Cisó (Girona, Spain) during summer stratification, with the aim of describing the food web of a system as completely as possible. The lake was sampled 19 times during 1990 and 1991. We first determined which populations contributed significantly to total summer biomass. Then, we determined the trophic role of these populations by several independent approaches, and aggregated the community into functional groups. The binary food web obtained indicated that the structure of the food web in Lake Cisó was similar to that found in other systems. Finally, we quantified the trophic fluxes among populations using a simple algorithm which considers the vertical distribution of organisms and the functional responses of the different predators. The trophic food web obtained revealed 2 interesting properties. First, the compartments with larger biomass were relatively stable during stratification and presented slow growth and low predatory losses. Second, there was a very inefficient transfer of organic matter from the lower levels (bacteria, algae and protozoans) to the higher levels (rotifers and zooplankton) of the food web. Both properties could be explained by the fact that most biomass of the system accumulated in the metalimnion, along opposite gradients of oxygen and sulfide, which determined an environment with reduced competition and predation. We postulate that metalimnetic communities above anaerobic hypolimnia can be regarded as sinks of organic matter off the epilimnion.

**KEY WORDS:** Lake Cisó · Binary food web · Trophic food web · Prey refuge

## INTRODUCTION

The description of the food web of an ecosystem is fundamental to understanding how it functions (Cohen 1989, Pimm et al. 1991). The food web structure determines how the energy and organic matter are channeled and dissipated through the different trophic levels, affecting their biomass and activity. There are several approaches to studying the food web of a particular system, each one requiring more data (Gaedke 1995). In the first approach, the abundance and size of all organisms are determined and the size distribution of the community is obtained. We used this approach with the Lake Cisó (Girona, Spain) community in a previous paper (Gasol et al. 1991b). Addition of the trophic role of each population results in the binary

food web, which qualitatively shows trophic links among living compartments. Next, fluxes among compartments can be quantified in order to obtain the trophic food web, which describes the flow of matter through the community. Finally, dynamic simulation models can be applied to understand and predict the temporal changes of the ecosystem. Each of these 4 approaches by itself gives interesting information about the structure, function and regulation of the food web.

The aim of the present work was to attempt as complete a description of the trophic food web of a pelagic system as possible. For this purpose, we chose Lake Cisó. Lakes are supposed to have a simpler food web than marine systems, since they are closed habitats with clear boundaries (Pomeroy 1991). In addition, Lake Cisó has some interesting advantages that made its study easier than the study of other lakes. It is a well known system (Pedrós-Alió & Guerrero 1993). In recent years, detailed data on the community composi-

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