Hydrobiologia **466:** 307–316, 2001.
J.M. Melack, R. Jellison & D.B. Herbst (eds), Saline Lakes.

Food-web structure in two shallow salt lakes in Los Monegros (NE Spain): energetic vs dynamic constraints

Paloma Alcorlo, Angel Baltanás & Carlos Montes
Department of Ecology, Universidad Autónoma de Madrid, E-28049 Madrid, Spain

Key words: food web patterns, ecosystem functioning, connectance, trophic interactions

Abstract

Energetic and dynamic constraints have been proposed as rival factors in determining food-web structure. Food-web length might be controlled either by the amount of energy entering the web (energetic constraints) or by time span between consecutive disturbances relative to time needed to build up a population (dynamic constraints). Dynamic constraints are identified with processes functioning at a regional scale such as climate, lithology and hydrogeology. Energetic constraints are related with processes operating both at a regional and a local scale. We studied the contribution of energetic constraints to food-web organization in two temporary saline lakes with similar dynamic constraints. Lakes were sampled fortnightly during two hydroperiods (1994/1995 and 1995/1996). Differences in energetic constraints between lakes result in divergent assemblages of primary producers. Consumer assemblages in both lakes, however, are similar in species composition although differ in total biomass and species abundances. Food-webs are short with a high proportion of omnivores. To simulate an increase in the energy input entering to these systems, an addition of nutrients (to a final concentration of 100 $\mu g \cdot l^{-1}$ P-PO_4^{3-}) was done in mesocosms placed within the lakes in order to obtain an increase in the phytoplankton biomass. No significant response to nutrient enrichment was found in food-web structure (composition, density or biomass).

Introduction

Relative importance of processes responsible for the structure of food webs are subject to considerable debate. An explanation based on energetic constraints suggests that food web complexity is limited by the availability of energy entering the food web, i.e. longer food chains are expected in more productive ecosystems (Hutchinson, 1959; Fretwell, 1977, 1987; Oksanen, 1983, 1991; Oksanen, et al., 1981; Yodzis, 1981, 1984). An alternative explanation hypothesizes that short food chains are more stable than long ones because of their faster return times after environmental disturbances because food chain length is driven by population dynamics, i.e, dynamic constraints (Pimm & Lawton, 1977; Pimm, 1982; Pimm et al., 1991; but see Sterner et al., 1997 for a critique). As long food chains take time to develop, frequent unpredictable disturbances should promote short food chains. Thus, food chain length may reflect environmental predictability (Pimm & Lawton, 1977; Pimm, 1982; Pimm & Kitching, 1987; Pimm et al., 1991; Havens, 1994). Some studies which have considered the influence of both kinds of constraints on food webs of ephemeral aquatic ecosystems have shown that an increase in productivity cannot increase food chain length beyond the capacity of the community to provide new predators (Pimm & Kitching, 1987; Jenkins et al., 1992).

Ephemeral salt lakes are systems that experience a wide range of dynamic and energetic constraints. Disturbance appears as episodes of either high salinity or desiccation with a variable degree of predictability (Comín et al., 1991; Florín & Montes, 1998). Primary production is also highly variable among lakes (Hammer, 1986; Javor, 1989). Quite frequently, although not necessarily, each kind of constraint is associated with factors operating at regional or local scales. Climate, geology and lithology are controlled at a regional scale and bound the main factors determining salt lake dynamic constraints. Energetic constraints are more tightly related with features operating at a local scale like landscape microtopography, sediment granulometry, nutrient dynamics or water–sediment interactions.