Austral Ecology (2005) **30**, 58–73

Food web structure in a tropical stream ecosystem

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Abstract This study investigated the structure and properties of a tropical stream food web in a small spatial scale, characterizing its planktonic, epiphytic and benthic compartments. The study was carried out in the Potreirinho Creek, a second-order stream located in the south-east of Brazil. Some attributes of the three subwebs and of the conglomerate food web, composed by the trophic links of the three compartments plus the fish species, were determined. Among compartments, the food webs showed considerable variation in structure. The epiphytic food web was consistently more complex than the planktonic and benthic webs. The values of number of species, number of links and maximum food chain length were significantly higher in the epiphytic compartment than in the other two. Otherwise, the connectance was significantly lower in epiphyton. The significant differences of most food web parameters were determined by the increase in the number of trophic species, represented mainly by basal and intermediate species. High species richness, detritus-based system and high degree of omnivory characterized the stream food web studied. The aquatic macrophytes probably provide a substratum more stable and structurally complex than the sediment. We suggest that the greater species richness and trophic complexity in the epiphytic subweb might be due to the higher degree of habitat complexity supported by macrophyte substrate. Despite differences observed in the structure of the three subwebs, they are highly connected by trophic interactions, mainly by fishes. The high degree of fish omnivory associated with their movements at different spatial scales suggests that these animals have a significant role in the food web dynamic of Potreirinho Creek. This interface between macrophytes and the interconnections resultant from fish foraging, diluted the compartmentalization of the Potreirinho food web.

Key words: compartmentalized food web, food chain length, food web, omnivory, pyramid of number, spatial variation, taxonomic resolution, tropical stream.

INTRODUCTION

The main goal of food web theory is to understand the patterns exhibited by natural communities (Pimm *et al.* 1991). Early analyses of large collections of published food webs from many different habitats suggested that food webs show consistent structural patterns (Briand & Cohen 1984; Cohen *et al.* 1990; Pimm *et al.* 1991). However, these patterns were widely debated in the literature. The main points of debate were limitations in the collections of data used for these analyses, such as the poor quality of many food web data, the small subsets of species analysed (an average of 20 species or less), differences in the methodologies used, the definition of a link, the level and standardization of taxonomic resolution, and mathematical artifacts (Lawton 1989; Winemiller 1990; Hall & Raffaelli 1991; Martinez 1991, 1993; Closs *et al.* 1993; Thompson & Townsend 2000). In recent years food webs constructed with a higher taxonomic resolution (Hall & Raffaelli 1991; Martinez 1991; Tavares-Cromar & Williams 1996; Schmid-Araya *et al.* 2002a) invalidated some earlier generalizations and showed that features such as long food chain and omnivory are common in food web structure.

Another aspect of food web studies is that, initially, most food webs were depicted as static representations of a cumulative web, lumping together species and interactions recorded within a habitat over a relatively long period of time (Winemiller 1990; Hall & Raffaelli 1991; Martinez 1991). However, static representations fail to capture the dynamic nature of communities, and may obscure significant temporal and spatial variation in their structure, resulting in food webs that are completely unrealistic (Closs & Lake 1994; Polis *et al.* 1996; Tavares-Cromar & Williams 1996; Woodward & Hildrew 2002). Thus, the determination of temporal and spatial scales is crucial given that they will influence the structure of the resultant web (Polis 1991; Closs & Lake 1994).

Despite widespread recognition of the dynamic nature of habitats, communities, and trophic interactions, relatively little attention has been given to the scale of variation involved in describing food web structure (Polis *et al.* 1996). In variable systems such as streams, some work showed temporal variation in food web structure (Closs & Lake 1994; Tavares-Cromar &

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Accepted for publication April 2004.