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www.publish.csiro.au/journals/mfr *Marine and Freshwater Research*, 2010, **61**, 909–917

Food web dynamics in an Australian Wet Tropics river

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Abstract. In Australia's Wet Tropics rivers, perennial base flows punctuated by wet season floods drive instream responses across a range of spatial and temporal scales. We combined gut-content and stable-isotope analyses to produce preliminary webs depicting trophic links between fish, their main prey items and basal productivity sources. We then used these webs to test the applicability of general food web principles developed in other tropical systems. Although a range of sources appeared to underpin fish productivity, a large portion of total energy transfer occurred through a subset of trophic links. Variability in food web structure was negatively correlated with spatial scale, being seasonally stable at river reaches and variable at smaller scales. Wet Tropics rivers are similar to those in other tropical areas, but exhibit some unique characteristics. Their high degree of channel incision improves longitudinal connectivity, thereby allowing fish to move between mesohabitats and target their preferred prey items, rather than shifting their diet as resources fluctuate. However, this also inhibits lateral connectivity and limits terrestrial energy inputs from beyond the littoral zone.

Additional keywords: connectance, disturbance, flood, movement, pulse, scaling, seasonality.

Introduction

Food webs provide tractable depictions of biodiversity, species interactions and ecosystem function (Dunne *et al.* 2002). In large rivers, food webs reflect their environmental setting – they are complex, yet exhibit high degrees of organisation (Power and Dietrich 2002). Natural patterns of wetting and drying affect connectivity and alter the relative importance of various autochthonous and allochthonous productivity sources (Junk *et al.* 1989; Thorp and Delong 2002; Zeug and Winemiller 2008). However, standing biomass is usually dominated by a core set of species connected by several short food chains, with an abundance of weaker food chains linking rarer species (Winemiller 2005). Fishes are conspicuous, important components of these webs because they are both abundant and highly mobile (Winemiller and Jepsen 1998). For example, they have an ability to increase food web stability by spatially coupling smaller, otherwise disparate groups of prey (McCann *et al.* 2005).

We previously documented the influence of wet season floods on instream habitat structure, prey availability, fish assemblages and fish feeding in the lower Mulgrave River, north-eastern Australia (Pusey *et al.* 1995*a*, 1995*b*; Rayner *et al.* 2008, 2009). Unlike larger tropical rivers, this system is small and laterally confined. Floods rarely escape the deeply-incised main channel and tend to act as disturbances rather than gentle flood pulses. Prey availability is reduced during the wet season, but fish exhibit specialised dietary preferences and move between habitats within the main channel to access their preferred food items (Rayner *et al.* 2009). These dynamics differ markedly from those documented in larger tropical river–floodplain systems, where seasonal shifts in fish diets are typical (Goulding 1980).

Douglas *et al.* (2005) developed five general food web principles for the rivers of Australia's tropical north. These were: (1) seasonal hydrology is a strong driver of ecosystem processes and food web structure; (2) hydrological connectivity is largely intact and underpins important terrestrial-aquatic food web subsidies; (3) river and wetland food webs are strongly dependent on algal production; (4) a few common macroconsumer species have a strong influence on benthic food webs; and (5) omnivory is widespread and food chains are short. We aimed to test the applicability of these principles to the Mulgrave River in light of the spatial confinement, consumer mobility and dietary specialisation observed in this system (Rayner *et al.* 2008, 2009).

Methods

Rayner *et al.* (2008, 2009) presented full details of the study area and methodology used for this study. Briefly, surveys of fish and

 10.1071/MF09202 1323-1650/10/080909