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Trophic basis of fish assemblages in an Australian dryland river.

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Introduction

Dryland rivers are rivers that run through arid or semi-arid landscapes. In Australia, many of the river channels across the continent are classified as lowland rivers, most of which are described as dryland systems (Thoms & Sheldon 2000). Dryland rivers are often characterised by numerous channels and vast floodplains. Furthermore, they often exist as isolated and turbid waterholes. As these rivers flow through dryland regions with unpredictable rainfall and runoff, their flows are also highly variable.

Cooper Creek in the Lake Eyre Basin of Australia is hydrologically one of the world's most variable rivers (Puckridge *et al.* 1998). Its catchment covers 296000 km² of which approximately 35% is floodplain characterised by a vast network of anastomosing channels that connect during episodic floods. In Cooper Creek, the most common hydrological condition is that of disconnected, turbid waterholes. During extended periods of dry these waterholes serve as refugia for up to 12 species of native fish, a range of aquatic biota and other wildlife such as terrestrial birds and animals.

Results and Discussion

Light extinction (where photosynthesis can no take place) in Cooper Creek waterholes often occurs less than 30 cm below the water surface. Despite the high turbidity, rates of benthic primary production within waterholes are high compared with other rivers and streams in Australia (Bunn *et al.* 2003). Much of this production is associated with a narrow littoral band of algae, restricted to the photic margins. Stable isotope ratios of producers and consumers have shown that the food web supporting fish assemblages in these waterholes is fuelled largely by this "bath tub ring" of algae (Bunn *et al.* 2003). There is also evidence that pelagic production can be an important contributor to some species, however, terrestrial inputs appear to be minor. This apparent lack of importance of terrestrial inputs is somewhat surprising given that they represent significant drivers of aquatic production in other large floodplain river systems (Vannote *et al.* 1980; Junk *et al.* 1989).

Traditional diet analyses have confirmed the findings of the isotopic data, with fish feeding on consumers of benthic algae and zooplankton in dry season waterholes (Balcombe *et al.* in press). The volumes of zooplankton in the diet were higher than expected from the isotope findings, suggesting that fish may assimilate a disproportionate contribution to their biomass carbon from opportunistic feeding on large-bodied benthic invertebrates such as yabbies and prawns (*Cherax* and

Macrobrachium). It is likely that prey resources, especially benthic invertebrates were depressed on the two sampling occasions as these waterholes had not had any flow for at least 18 mo and no significant overland flood for seven years (Balcombe *et al.* in press). It does appear, however, that the Cooper Creek fish assemblage is comprised of trophic generalists that can opportunistically feed on whatever is available at any given time. This trait enables these fish to last out extended periods of no flow and low food resources.

During episodic flooding, the Cooper Creek floodplain provides a rich and abundant array of food such as ephemeral crustaceans, micro-crustaceans, dipteran larvae, other aquatic invertebrates and stranded terrestrial arthropods. Most species of fish in Cooper Creek use the

inundated floodplain during floods (unpubl. data). Not only does this allow dispersal among waterholes but also access to a rich food resource, much of which would be returned to waterhole when floods recede (Lewis *et al.* 2001).

Preliminary stable isotope results show that most fish species on the floodplain feed largely upon algal consumers, however, despite the presence of many stranded terrestrial arthropods, this potential food source does not appear to be an important source of carbon (Balcombe *et al.* in press). Direct diet analysis revealed that most species have very diverse diets, feeding on a large variety of aquatic production, including invertebrates and plants. Similar to fish in disconnected waterholes, those on the floodplain also do not feed on terrestrial matter to any great extent.

Conclusions

Given that Cooper Creek exists predominantly as a series of disconnected waterholes, the fish assemblages rely on the presence of permanent waterholes, whose food webs are fuelled by the algal bathtub ring. While floods provide a vast array of food sources in comparison to waterholes, inundation of the floodplain occurs irregularly. The long-term maintenance of fish assemblages, therefore, may rely more on the persistence of some permanent waterholes in the landscape and ultimately the benthic algae that supports the food web. Any changes to the natural flow pattern, as would occur through water resource development, such as waterhole abstraction, would impact on bathtub rings. These impacts would flow through the food web and ultimately to the fish assemblages they support.

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