

Spatio-temporal attributes of water temperature and macroinvertebrate assemblages in the headwaters of the Bushmans River, southern Drakensberg

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ABSTRACT

Currently, there is little understanding of the controls that instream thermal limits and hydraulic biotype diversity have on macroinvertebrate assemblages, particularly in association with changing altitude within given southern African mountain drainage systems. Thus, the aim of this research was to examine aquatic macroinvertebrate assemblage changes in response to spatial and temporal geo-hydrological contexts (temperature and hydraulic biotype) along the upper Bushmans River, southern Drakensberg. Instream temperature was continuously logged at 3 altitudes (1 760, 2 030, 2 280 m amsl) along the Bushmans River to the east of the Great Escarpment, and in the headwaters of the Sani River (2 860 m amsl) to the west of the escarpment, for the period January–May 2007. Aquatic macroinvertebrates were sampled during early December 2006, late March 2007, and late May 2007. The study demonstrates that decreasing water temperatures, both spatially (with increasing altitude) and seasonally (from summer to winter), and/or decreasing diversity of hydraulic biotypes associated with stream-channel narrowing in Drakensberg rivers/streams, are associated with a general decrease in the absolute number of macroinvertebrate families, a lower dissimilarity coefficient along the Bushmans River altitudinal transect, and a decreasing variance in the numbers of macroinvertebrate families across various hydraulic biotypes.

Keywords: Aquatic macroinvertebrates, water temperature, hydraulic biotypes, Drakensberg

INTRODUCTION

Considerable international work has focused on macroinvertebrate assemblages in a variety of fluvial settings (e.g. Power et al., 1995; Céréghino et al., 2001; Wong et al., 2004; Compin and Céréghino, 2007). Apart from the focus on understanding instream macroinvertebrate biology (e.g. Céréghino et al., 2001; Moor and Palmer, 2005), a primary research thrust has been on developing theories and models on the abiotic controls of in-stream macroinvertebrate species composition, community structures, fine-scale spatial distributions, and associated ecosystem functioning. Emphasis has been on how channel geomorphology (e.g. Huryn and Wallace, 1987; Lamberti et al., 1989; Brown and Brussock, 1991; Wang et al., 2009), channel substratum and sediment delivery, entrainment and deposition (e.g. Beisel et al., 1998; Larsen and Ormerod, 2010), and channel flow regimes including water velocity and depth (e.g. Jowett and Richardson, 1990; Dewson et al., 2007), may influence macroinvertebrate assemblages. Important controls influencing the spatial variability of macroinvertebrate species richness and abundance in mountain catchments include hydraulic biotypes (e.g. Bonada et al., 2006; Davy-Bowker et al., 2006; Curry et al., 2012) and fluvial-environmental changes associated with altitudinal gradients (e.g. Andrew et al., 2003; Jacobsen, 2004). In addition, there has been growing concern and emphasis on establishing climate change impacts on mountain stream temperatures and

consequent implications for aquatic biosystems (including aquatic macroinvertebrates) (e.g. Hari et al., 2006; Durance and Ormerod, 2007; Chessman, 2009; Lawrence et al., 2010).

Hydrobiological studies have a relatively long and well established history in South Africa, having emerged from the early descriptive approaches by the likes of Barnard (1927) and Hutchinson (1929) but then gradually becoming more applied towards bioassessments for river ecosystem and health functions (e.g. Chutter, 1972; King and Louw, 1998; Roux et al., 1999; Dickens and Graham, 2002; Bate et al., 2004; Dallas, 2004, 2007; Ollis et al., 2006; Malherbe et al., 2010). Although it is internationally well recognised that altitudinal gradients and associated water temperatures impact macroinvertebrate diversity, community structure and survival (e.g. Jacobsen et al., 1997; Cox and Rutherford, 2000; Smith et al., 2003; Finn and Poff, 2005), there has been little, if any, work in southern Africa investigating altitudinal trends in mountain water temperatures and the associated aquatic macroinvertebrate population biology. To this end, the aim of this study was to provide a preliminary investigation into aquatic macroinvertebrate assemblage changes in response to spatial geo-hydrological and temporal contexts along the upper Bushmans River, southern Drakensberg. In so doing, hydrological (or hydro-geomorphological) biotypes (Rowntree and Wadson, 1999) and their linkages to sediment supply and habitat heterogeneity were recognised and considered (Yarnell et al., 2006), which consequently define the riverine microhabitats and macroinvertebrate structures.

STUDY SITE AND METHODS

The upper Sani and Bushmans Rivers are located in the Ukhahlamba Drakensberg Park and should represent 'pristine' stream settings with limited anthropogenic impacts

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