Return to previous file: sfc279

3. Floodplain habitats of braided rivers

3.1 MAIN CHANNEL AND SIDE BRAIDS

Most braided reaches will include one or more larger channels which persist between flood and drought events. These larger channels usually have multiple side channels which exemplify the characteristics of a braided river (Fig. 3). Flow regimes in the main channels and side braids can be highly variable.

The substrate of the main channel can be highly unstable. In the upper Waimakariri River, Gray (2005) recorded 99% movement of cobble-size tracer stones over a 6-month period. In the lower reaches of the same river, Hicks et al. (in press) estimated that 88% of the riverbed had undergone significant (> 0.2 m vertical erosion or deposition) change during a 3-year period. Whilst main channels and side braids are part of a continuous surface network, they are not always subject to the same disturbance regime. Side braids may have more stable substrates, as evidenced by algal growths, but also be subject to more regular de-watering with river stage fluctuations. Furthermore, the hydrological source of the river (alpine or foothill) will influence the regularity and intensity of physical disturbance in all channels.

Main and braided channels are major conduits for sediment transport. Estimated sediment yields from New Zealand's braided rivers may be among the highest for rivers anywhere in the world and, despite amounting to only 0.2% of the world's landmass, New Zealand produces 1% of the sediment input to the world's oceans (Griffiths 1979; Hicks et al. 2004).

Temperature regimes in the main channels and side braids are influenced by variations in channel discharge, and the relative contributions of groundwater and surface water runoff (Mosley 1983b). Mosley (1983a) found that during


Figure 3. A typical braided river main channel in the Hopkins River.

autumn and spring, maximum temperatures of the main channels in the Rakaia River and Ashley River/Rakahuri were inversely proportional to discharge. However, Grant (1977) reported that main channel temperatures in the Ngaruroro River in Hawke's Bay were lower when the river was at base flow than at high flow, because of the increased influence of groundwater. Thus, the ground or hyporheic water may buffer the main channel against relatively warmer surface water runoff and atmospheric temperature fluctuations. Under low-flow conditions water temperatures can, however, become very high in the absence of groundwater exfiltration and, in mid-summer, water temperatures in excess of 25°C have been recorded in Canterbury rivers (Mosley 1982b).

3.2 SPRINGS

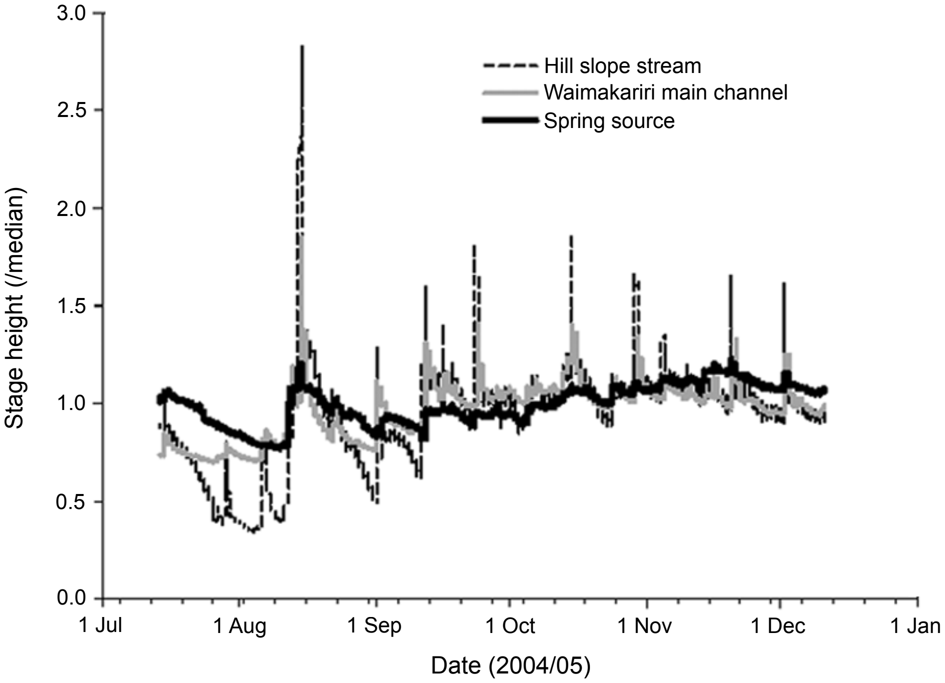
Springs can be common in braided river floodplains, but constitute only a small proportion of the wetted surface area of a braided river. The roles of springs within the braided river landscape are discussed in this review, and put into the larger context of other spring types (e.g. Karst springs) nationally in Scarsbrook et al. 2007. Springs have distinct physical and chemical characteristics (Fig. 4) compared with the main channels of rivers (cf. Fig. 3 and see also section 3.4).

Braided river springs often derive their flow from aquifers. Therefore, although some springs are very stable and permanently wet, others may be subject to drying. Spring permanence appears to be linked to the position of the spring in relation to the main channel and the height of the spring relative to the water table of the floodplain (Poole et al. 2002; Poole et al. 2004). Spring discharge is characteristically stable (Fig. 5) and frequently reflects the broad-scale trends in discharge of the main river, but without the dramatic peak flows characteristic of streams fed by surface run-off (Death 1991; Barquin 2004; Gray 2005).

Consequently, the substrate within spring-fed streams is usually very stable and the water clarity high. Gray (2005) estimated the percentage of substrate movement in floodplain springs in the Waimakariri River to range from 2 to

Figure 4. A floodplain spring in the Hawdon river, Arthur's Pass National Park. Note the abundant macrophytes and mosses.

Figure 5. Stage height (standardised to the median value) of a hillslope stream, a spring-source and the main channel of the Waimakariri River (Gray 2005).



12% per annum. Similarly, Death (1991) detected no substrate movement over 2.5 years in Slip Spring, also in the Waimakariri River basin. The substrate composition of spring creeks is frequently a result of historic deposition and occasional flooding from adjacent surface-fed streams and rivers, rather than in-stream processes. Overbank flooding tends to introduce fine sediment to springs; this input may be augmented by aeolian (windblown) deposits (Reinfelds & Nanson 1993).

Temperature regimes of floodplain streams in New Zealand that are spring-fed are more stable than those of main channels and approximate the local mean annual air temperature (Death 1991; Gray 2005) (Fig. 6). Thus, spring creeks tend to be warmer in winter and cooler in summer compared with surface-fed streams (Mosley 1983b). However, temperature fluctuations increase with distance from the point of up-welling (Barquin 2004).

3.3 GROUNDWATER AND HYPORHEIC ZONES

Groundwaters beneath a braided river are generally subdivided into two intergrading zones—the hyporheic zone and the phreatic zone. The hyporheic zone has been defined by White (1993) as the saturated interstitial areas beneath the streambed, and into the stream banks, that contain some proportion of channel water, or that have been altered by channel water infiltration. Beyond this point the water contained within the interstices is referred to as groundwater within the phreatic zone, where voids are permanently saturated with groundwater. Thus the depth of the hyporheic zone and the points where the hyporheic and phreatic zones merge vary from reach to reach and are unknown in most rivers.

The physico-chemistry of groundwater associated with braided rivers is dictated by a combination of the proximity of the recharge reach of the river from which they are derived and catchment morphology and geology (Rosen 2001; White

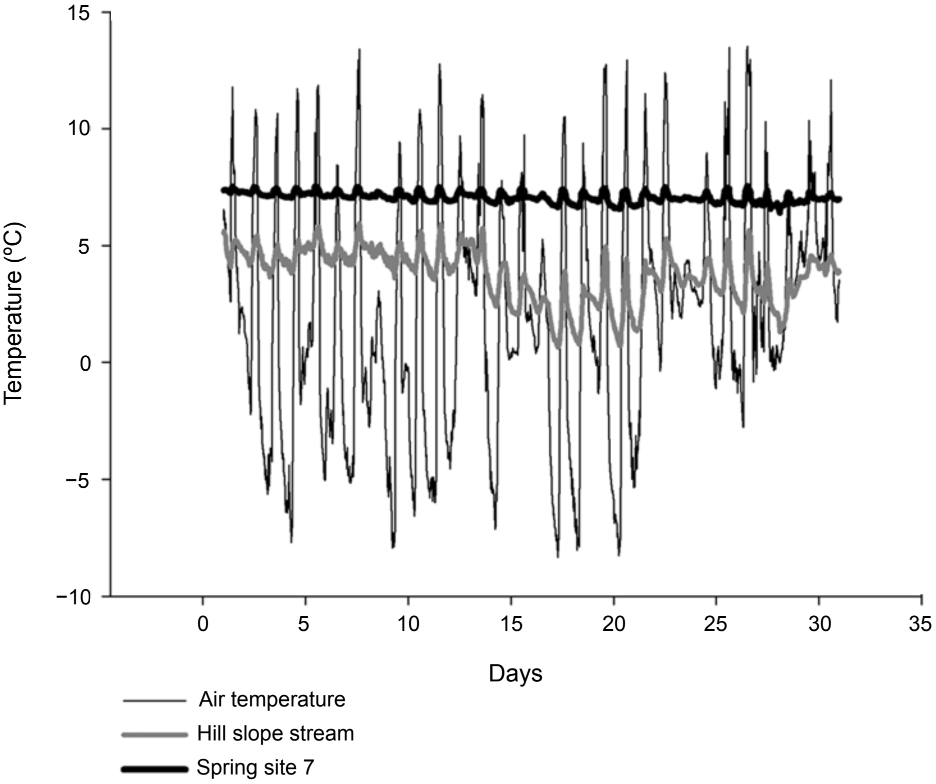


Figure 6. Temperature regimes for a spring-fed and a surface runoff stream between the 15th July and 13th August 2004. (Gray 2005).

et al. 2001). With increasing residence time within an aquifer, hyodrochemistry becomes more like that of true groundwater. White et al. (2001) made measurements in wells positioned at increasing distances from recharge zones of the Waimakariri River and showed an increase in Cl^-, HCO_3^- and nitrate-nitrogen away from the river. Similarly, Scarsbrook & Fenwick (2003) found that dissolved oxygen concentration and temperature were lowest in groundwater samples farthest from the Ngaruroro and Waipawa rivers in Hawkes Bay. Gray et al. (2006) sampled groundwater beneath and adjacent to the lower Waimakariri River and found that temperature and electrical conductivity were highly variable compared with spring sources in the upper river and did not show a predictable correlation with surface water. Temperatures were more similar to those in the main channel, probably reflecting the recent source of groundwater and residence time within the substrate. See also section 3.4 for a summary of this information.

Fenwick et al. (2004) reviewed the general characteristics of groundwater habitats, many of which are probably similar to those of alluvial aquifers of braided rivers. They found that as a consequence of the lack of light and, thus, photosynthetic activity, almost all organic matter is imported. In addition, groundwater habitats are contained within an immoveable matrix of alluvial deposits. The size, chemical reactivity and heterogeneity of the matrix pores dictate many of the physico-chemical characteristics of alluvial groundwater. In New Zealand, the generally inert nature of the substrate and the constricted pore space are associated with slow temporal changes in water chemistry.

Several studies have considered the physico-chemistry of the shallower, hyporheic zones of braided rivers (Burrell 2001; Fowler & Scarsbrook 2002; Olsen & Townsend 2003). Olsen & Townsend (2003) found that up-welling

Continue to next file: sfc279b