PROCEEDINGS OF THE AUSTRALIAN RANGELAND SOCIETY BIENNIAL CONFERENCE

Official publication of The Australian Rangeland Society

Form of Reference

The reference for this article should be in this general form;

Author family name, initials (year). Title. *In*: Proceedings of the nth Australian Rangeland Society Biennial Conference. Pages. (Australian Rangeland Society: Australia).

For example:

Anderson, L., van Klinken, R. D., and Shepherd, D. (2008). Aerially surveying Mesquite *(Prosopis* spp.) in the Pilbara. *In*: 'A Climate of Change in the Rangelands. Proceedings of the 15^{th} Australian Rangeland Society Biennial Conference'. (Ed. D. Orr) 4 pages. (Australian Rangeland Society: Australia).

The Australian Rangeland Society

LANDSCAPE HISTORY CONTROLS VEGETATION ECOLOGY: FORMATION OF MID-CREEK FLOODOUTS IN WESTERN NSW

G.A. Wakelin-King

School of Environmental Science, La Trobe University, Bundoora, Melbourne, Vic. 3086
Email: g.wakelin-king@latrobe.edu.au

ABSTRACT

Floodouts at tributary junctions formed during major floods when sediment was dumped in the flow path. Dense vegetation grows in the floodouts in a geomorphological/ecological feedback: the vegetation maintains the landform and *vice versa*. If erosion allows a channel to establish through the floodout, the cycle reverses and the area becomes unproductive. Circumstances which promote erosion may include floods, vegetation thinning, or linear disturbances eg roads or fences. The floodouts are important drought refugia, and are ecologically equivalent to riparian zones. Because of their efficiency in trapping floodwaters, floodouts in western NSW often contain dams, contributing to the prosperity of grazing properties.

INTRODUCTION

The many small dry creeks of western NSW don't provide large-scale water resources, and so appear insignificant in comparison with larger rivers. However, they contribute economically to the grazing and tourist industries, by supplying stock and station watering points, and by forming part of the tourist landscape.

One such creek is Fowlers Creek. Fifty-five km long, it arises in the low hills of the Barrier Range (Fig. 1) and leaves the range to flow across flat plains, where it terminates. The area is vegetated by open chenopod shrubland. In Fowlers Creek's trunk and terminal floodout zones, (Fig. 1) river red gums (*Eucalyptus camaldulensis*) dominate dense riparian vegetation, but in the uplands zone, red gums are uncommon except at certain tributary confluences. Fowlers Creek experiences hot, dry summers and mild winters; rainfall is sparse and greatly exceeded by evaporation. Fowlers Creek is usually dry, but may flow several times a year, to sub-bankfull, bankfull or flood levels; extreme flow events also occur on multi-century and millennial timescales (Jansen 2001). Fluvial processes were investigated along Fowlers Creek by mapping sediment and landform distribution, examining sedimentary structures, measuring grain size, and dating sediments by Optically Stimulated Luminescence. Comparison of old and modern sediments has allowed understanding of fluvial processes over the last several thousand years.

GEOMORPHOLOGY IN THE UPLANDS

A wide network of channels (Fig. 1) is incised into the red silty floodplains which separate the low rubbly hills of the Fowlers Creek uplands. The main central channel is a long arroyo (has a rectangular cross-section with steep banks and a generally flat floor). The smaller tributary creeks are usually also arroyos, some of which connect directly to the main central channel. In others, the drainage is disconnected: reaches with an arroyo alternate with channel-less flood-prone river flats (floodouts). Unchannelled floodouts are especially characteristic of tributary confluences (Fig. 1). Mid-creek floodouts have an upstream area, where the single arroyo channel may divide into many shallow distributary channels, and the central area where there are no channels and water spreads across the surface as shallow unconfined sheetflow (Fig. 2A).

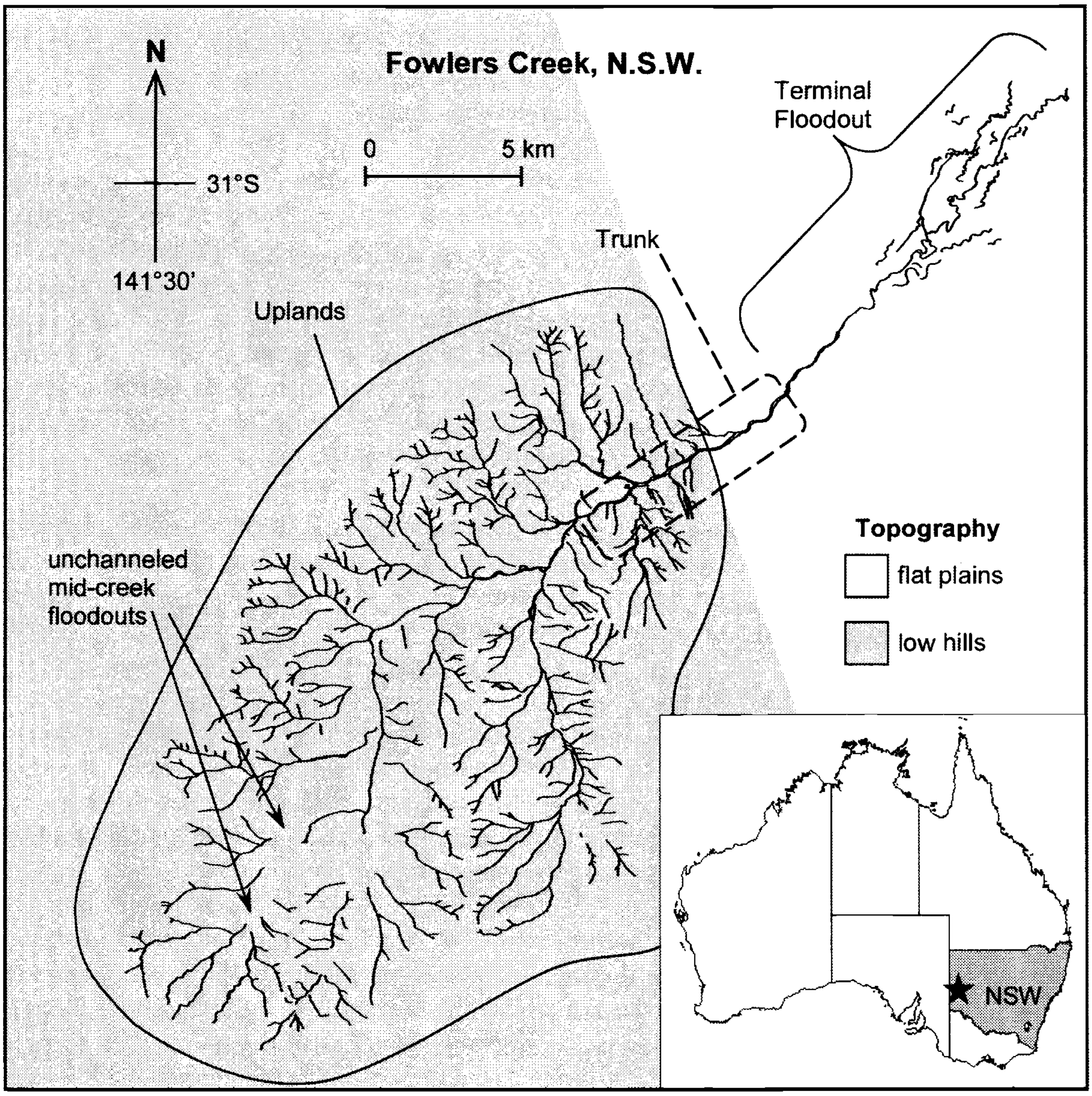


Figure 1: Fowlers Creek: location and geomorphic zones (uplands, trunk, terminal floodout)

Downstream from the floodout, a network of gullies captures the sheetflow and directs it into the next arroyo downstream. Although apparently different types of creek, discontinuous channels and their floodouts are complementary parts of the same fluvial system (Wakelin-King and Webb, in press): a type of erosion cell (Pickup 1985, 1988; Bourke and Pickup 1999) known as a discontinuous ephemeral stream (Bull 1997). In the study area, many floodouts are notable for their dense vegetation, especially the abundant tall red gums which are growing without a nearby channel – a situation which does not occur elsewhere in Fowlers Creek. In November 2002, when the region was suffering hard drought, the floodout vegetation was green and flourishing.

LANDSCAPE HISTORY AND MODERN PROCESSES

Floodouts in the study area originated thousands of years ago during extreme flow events. Sediment-laden floodwaters travelled down the narrow tributary valleys until they entered the larger main valley. As the floodwaters ceased to be confined by the valley walls they spread widely, decreased in depth, slowed down, and dropped their sediment load (Fig. 2B). Seeds and organic material were also deposited; a new cohort of vegetation germinated in the damp silt, and under favourable rainfall conditions survived to maturity.

Once a floodout is formed, the vegetation and the landform combine in a self-reinforcing ecological feedback (Wakelin-King and Webb, in press). The low down-valley slope and absence of channels, first formed by the wedge of sediment dumped in the flow path, encourages later flows to spread out, slow down, and drop sediments, seeds, and organics. The slow shallow water has time to be absorbed into the floodout surface. This relatively damp, organic-rich environment is favourable for the survival of vegetation (Fig. 2C). The dense vegetation makes a rough, crowded surface, which discourages erosion (therefore discouraging channel formation) and encourages slow, shallow sheetflow. Thus, the land shape promotes the vegetation and the vegetation sustains the land shape.

However, if a direct flow path cuts through the floodout (Fig. 2D), the feedback system operates in reverse. The water bypasses the floodout and its vegetation diminishes and eventually dies. Without the vegetation, the floodout surface retains little water; infiltration and germination become unlikely, and erosion and channel formation are promoted.

DISCUSSION AND CONCLUSIONS

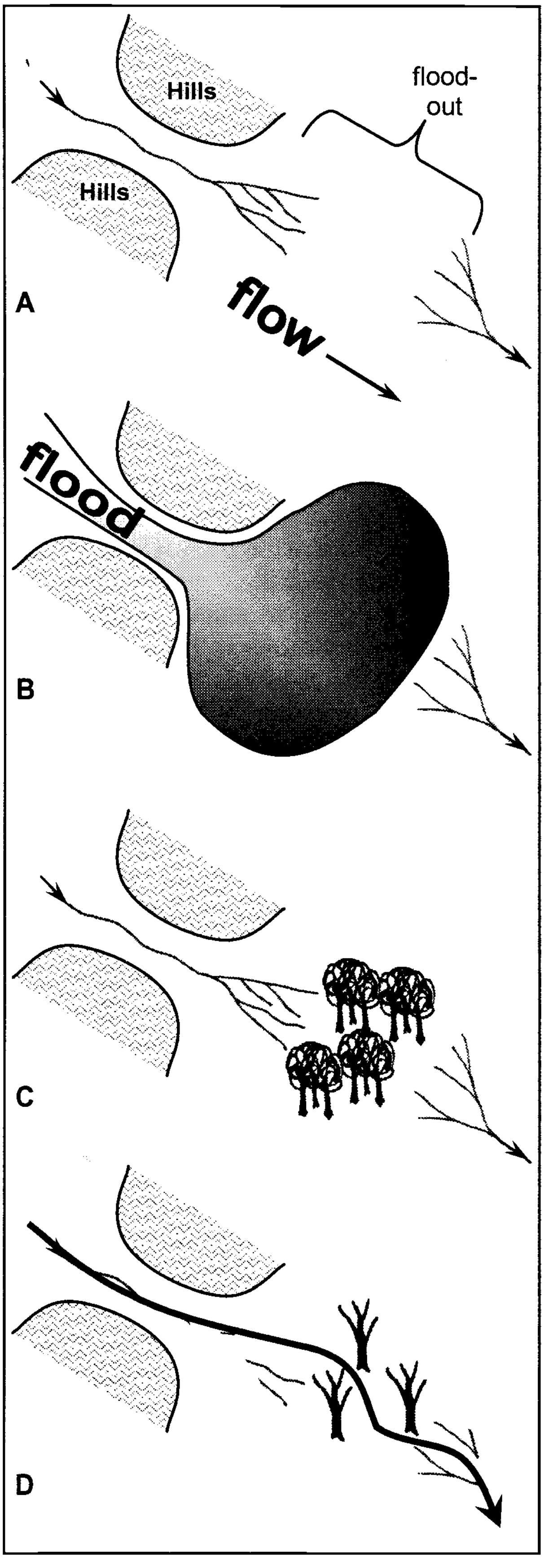
Because of their efficiency in trapping floodwaters, floodouts are ecologically and economically valuable. They often contain dams or watering points, contributing to the prosperity of grazing properties. They are especially important as drought refugia, and after drought can be a source of seed and of animals in breeding condition. Feral plants and animals also shelter in floodouts, and drought may be an opportunity for targeted pest control.

Floodout vegetation is crucial in maintaining landform stability. Thinning or removal of vegetation, or the replacement of low bushy-branched plants (eg chenopods) by widely-spaced central-stemmed plants, will promote faster water flow and eventually erosion. Other factors which may trigger erosion are large floods, or linear ground disturbances such as tracks, fences, or buried polypipe. The dense vegetation protects the ground from erosion, but only up to a point: once that point has been crossed, erosion and channel establishment will progress rapidly. The area will become unable to trap water, productivity will decline, and the increased throughflow will also contribute to downstream fluvial instability.

Floodouts' dense vegetation and reliance on nearby water make them ecologically equivalent to riparian zones. However, the absence of channel banks means they are unlike the riparian zones of "normal" (temperate, perennial) rivers. Where catchment management plans have goals or funding which is tied to certain landforms (eg riparian zones), it is important that criteria should be equally applicable to dryland rivers, by recognising their different landforms and processes.

ACKNOWLEDGEMENTS

I would like to thank the owners of Corona, Floods Creek, The Selection and Fowlers Gap Stations for access to Fowlers Creek, and acknowledge the support of La Trobe University's Department of Earth Sciences, and an Australian Postgraduate Award.



REFERENCES

Bourke, M.C. and Pickup, G. (1999). Fluvial form variability in arid central Australia. *In* 'Varieties of Fluvial Form.' (Eds Miller, A.J.G. and Gupta, A.). John Wiley & Sons, Chichester, pp. 249-271.

Bull, W.B. (1997). Discontinuous ephemeral streams. *Geomorphology* 19: 227-276.

Jansen, J.D. (2001). 'Bedrock Channel Morphodynamics and Landscape Evolution in an Arid Zone Gorge: Sandy Creek, Northern Barrier Range, South-Eastern Central Australia.' Ph.D. Thesis, Macquarie University, New South Wales.

Pickup, G. (1985). The erosion cell - a geomorphic approach to landscape classification in range assessment. *Austr. Rangel. J.* 7: 114-121.

Pickup, G. (1988). Modelling arid zone soil erosion at the regional scale. *In* 'Fluvial Geomorphology of Australia' (Ed. Warner, R.F.). Academic Press, Sydney, pp. 105-127.

Wakelin-King, G.A., and Webb, J.A. (*in press* 2006). Threshold-dominated fluvial styles in an arid-zone mud-aggregate river: the uplands of Fowlers Creek, Australia. *Geomorphology*.

Figure 2: A) a mid-creek floodout. As the channel leaves the confining hills, it divides into a distributary pattern. The central area has no channels. Downstream from the floodout, sheetflow is captured by a new channel net-work. B) floodout formation: floodwaters spread out and drop their sediments at the tributary junction. C) dense vegetation grows on the floodout. D) if a new channel cuts through the floodout the ecological feedback is reversed and the vegetation dies