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 15th Australian Rangeland Society Biennial Conference'. (Ed. D. Orr) 4 pages. (Australian Rangeland Society: Australia).

STREAM-SIDE EROSION: IMPLICATIONS FOR FUTURE RANGELANDS MANAGEMENT

P.C. Fanning

Graduate School of the Environment, Macquarie University, NSW 2109

ABSTRACT

Erosion along upland streams in arid rangelands of western New South Wales has been monitored over a fifteen-year period as part of ongoing research into rates of soil loss. Evidence suggests that erosion was accelerated by land cover disturbance when sheep grazing began in the region in the late 1800s, and it continues at very high rates in spite of the conservative stocking rates now observed. Land cover disturbance resulted in changes to the hydrologic regime of the upland catchments, manifested as channel enlargement and knickpoint retreat, which are still working their way through the channel systems and are threatening roads, watering points and other infrastructure on grazing leases and in national parks. The implications for the management of affected lands are addressed.

INTRODUCTION

Accelerated erosion is a ubiquitous land degradation problem in rural Australia, including the arid rangelands. Both wind and water erosion have been enhanced by changes which have taken place in land cover since the introduction of domestic and feral herbivores in the nineteenth century, leading to widespread topsoil loss, surface scalding, rilling and gullying, and wind drift. This paper reports the results of research into rates of soil loss on a property in the Barrier Range north of Broken Hill in western NSW, and investigations into the effects on catchment and channel processes of changes in the hydrologic regime which have resulted from land cover change.

RATES OF SOIL LOSS

Surface lowering via wind and water erosion has been measured over a ten-year period on an erosion pin plot adjacent to Homestead Creek on Fowlers Gap Station, about 110 km north of Broken Hill, NSW. Average rates of soil loss for vegetated, bare and gullied surfaces during the period from 1981 to 1991 range from 30 to 209 t/ha/yr (Fanning 1994). This is equivalent to 6000 t/yr over the valley floor of Homestead Creek, which is just 3% of the total catchment area (Fanning 1994). Somewhat lower rates would be expected over the rest of the catchment since the vegetation cover is more intact, but observations of mulga root exposure and lichen growth levels on rocks scattered over the slopes suggest that topsoil thicknesses of up to 15 cm have been lost over the whole of this, and adjacent, catchments (P. Mitchell, pers. comm.).

CHANNEL CHANGE

Homestead Creek is at present a rectangular channel ('arroyo') entrenched into the valley floor. Monitoring of bedload transport and bank collapse indicate that the channel is widening and incising. However, the presence of remnants of narrower, more sinuous channels (paleochannels) on the valley floor surface which are transected by the modern channel indicate that there has been a significant change in channel morphology. Entrenchment must have occurred after the uppermost layer of the valley floor sediment sequence was deposited by the paleochannels.

Because of its degraded state, there is a dearth of datable material along Homestead Creek itself. However, similar sedimentary sequences exist in catchments to the north and south, and in Mootwingee National Park, about 50 km to the east of Fowlers Gap. Charcoal from two Aboriginal hearths located near the top of the sedimentary sequence along the floor of Sandy Creek, immediately to the north of Homestead Creek, has been radiocarbon dated at 350 ± 50 years BP (Wk-4197) and 980 ± 60 years BP (Wk-4102). A sequence through an Aboriginal ceremonial site transected by Giles Creek at

Mootwingee has been excavated and has returned dates of 220 ± 50 years (Wk-3147) and 420 ± 110 years (Wk-3141) BP from hearths inset into the top unit of the original floodplain sediments. Incision of the stream channels at both of these sites has occurred after the sediments now exposed in the channel walls were deposited, as is the case in Homestead Creek at Fowlers Gap. These dates suggest, therefore, that stream incision has occurred in a number of upland catchments in the rangelands of western NSW within the last few hundred years and most likely since grazing of domestic animals began about 150 years ago.

Stream incision steepened hydraulic gradients and hence the erosive power of runoff channelled into them. As a result, the main and tributary channels have extended headwards by knickpoint retreat. Monitoring at Mootwingee between 1990 and 1995 recorded knickpoint retreat of up to 87 metres in a single runoff event (D. Witter, in Fanning 1995). Channels widened by 400% over the monitoring period, most commonly by undercutting and bank collapse, as is the case at Fowlers Gap.

The sediment eroded by these processes is carried out onto the lowlands of the Bancannia Basin, where the combination of declining discharge, increased transmission losses and abundant sediment load results in channel choking and abandonment.

CONSEQUENCES FOR RANGELAND MANAGEMENT

Sheet and wind erosion, rilling and gullying, channel enlargement and knickpoint retreat are threatening an array of infrastructure at Fowlers Gap and Mootwingee: fences have been buried by wind-blown sediment, watering points have been undermined and the pipes damaged, roads are threatened by stream widening and bank collapse, and the camping area at Mootwingee is in the path of rapidly advancing gully heads. This is occurring in spite of conservative stocking rates at Fowlers Gap (around 1 dry sheep equivalent (DSE) to 6 ha), and complete removal of domestic stock from Mootwingee (though native and feral herbivores remain). These are not isolated cases (see Pickard 1994, Williams *et al.* 1991). The alteration to catchment hydrodynamics of which these examples are symptomatic is common in rangelands in western NSW and reflects the impacts of domestic grazing in altering the balance between surface runoff and infiltration through changes in land cover. The changes are still working their way through the catchments and will continue to do so until adjustments of channel and hillslope gradients have been completed. The time span of this is difficult to predict, but may be decades to hundreds of years. In the meantime, land managers can ease the pressure by completely removing stock - and feral herbivores - from the most severely degraded areas and allowing perennial shrubs and grasses to regenerate, and by stocking conservatively elsewhere. Infrastructure and sites of cultural and heritage value can be protected by erosion control structures, but it must be remembered that such works are treating the symptoms, not the cause, and they may be short-lived in this geomorphically dynamic environment.

REFERENCES

Fanning, P.C. (1994). Long-term contemporary erosion rates in an arid rangelands environment in western New South Wales, Australia. *J. Arid Environments* 28: 173-187.

Fanning, P.C. (1995). Geomorphic Factors in Road Design and Maintenance at Mootwingee and Kinchega National Parks. Unpub. report to NSW NPWS for Gunninah Consultants.

Pickard, J. (1994). Post-European changes in creeks of semi-arid rangelands, 'Polpah Station', New South Wales. *In* 'Environmental Change in Drylands: Biogeographical and Geomorphological Perspectives'. (Eds A.C. Millington and K. Pye). John Wiley and Sons Ltd, pp. 271-283.

Williams, M.A.J., De Deckker, P., Adamson, D.A. and Talbot, M.R. (1991). Episodic fluviatile, lacustrine and aeolian sedimentation in a late Quaternary desert margin system, central western New South Wales. Geol. Soc. Aust. Special Publication No. 18. pp. 258-287.