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TOURISM IMPACTS ON EROSION IN AUSTRALIA'S RANGELANDS: SOME OBSERVATIONS FROM ULU<u>R</u>U-KATA TJU<u>T</u>A NATIONAL PARK

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ABSTRACT

Uluṟu has been the site of intense tourist activity since the early 1960s, much of which was uncontrolled in the early years. The result was the development of a number of access tracks and partly formed roads which have changed the hydrologic regime of several areas around Uluṟu, contributing to increased moisture stress on plant communities and the development of an active network of gullies. This paper presents a hydro-geomorphic model of the interaction between road and track development and rill and inter-rill erosion, presenting an explanation for the active gully network that can be observed at several sites around Uluṟu. Some management options are presented and research to develop best management practices is detailed.

INTRODUCTION

Twenty-three years ago it was pointed out that roads and tracks around Uluṟu were having a significant effect on the ecology and erosion of the area and that a systematic approach should be adopted to addressing the problems. Ovington *et al.* (1972) clearly identified erosion at a number of places, for example Muṯitjulu, Mala Puta, Ka<u>n</u>tju and Waṟayuki (Fig. 1). Other studies, such as those by Griffin and Nelson (1988), Reid *et al.* (1993) and Griffin (1994) also identified the erosion problem.

Partial solutions were adopted over the following years, and while some were moderately successful, most were failures, having a short-term benefit and then deteriorating. Gabion dams across the north-easterly flowing stream at Waṟayuki have been undercut, bypassed, and lie isolated in the bed of the stream, a former road which is now incised to a depth in excess of 1 m. Gully headwall structures between Mala Puta and Katji Tilkil, installed to control erosion of a south-westerly flowing stream that crosses the access path between the bus park and the commencement of the climbing track, have been locally successful for the last 13 years. However, these structures are now showing signs of deterioration and have done nothing to stop erosion in the headwater regions. Attempts at controlling erosion at gully heads using weed matting and angular cobbles have been successful at some sites, but in almost every gully inspected where this technique had been used erosion was bypassing most of the controls or the controls were being undercut and isolated.

This paper reports on a study which was directed towards identifying the causes of erosion around the base of Uluṟu, developing a hydro-geomorphic model that would explain the erosion and recommending management options.

EROSION AT THE BASE OF ULU<u>R</u>U

The current ring road is an effective barrier to the flow of water, both surface and shallow subsurface water, in a number of places. Of the 10.85 km of road approximately 6.5 km is above the general elevation of the surrounding land. The dam effect is most notable at Walputi, where the road to the north-west of the access path to Ka<u>n</u>tju has prevented flow from the Uluṟu catchment above Waṟayuki from flowing out onto the plain and has diverted water towards the north-east, which has contributed to the massive gullying along the old ring road in the Waṟayuki sacred site.

At Muṯitjulu major conservation works during the late 1960s and early 1970s, in the form of constructed contour banks, resulted in redirection of flow, apparently causing a stand of bloodwoods to become stressed. There is considerable disturbance of the area at the base of the climb and it appears that since the 1950s the drainage from the Mala area has been redirected from its north-westerly flow to a south-westerly direction, following an old road across the base of the access to the climb. Timber drop structures were installed (probably in the early 1980s) to control erosion along this flow line, and appear to have been successful in lowering the bed gradient and encouraging deposition of sediment. However, lateral gully headcutting has made considerable inroads into the perimeter apron in this vicinity. High volume pedestrian traffic at the base of the climb has removed vegetation from the area and compacted the soil, increasing runoff and reducing the possibility of natural revegetation. At Kantju there is major headward retreat of gullies and erosion of tracks, particularly the access track on the eastern side from the present ring road. The major cause of the erosion is flow diversion along the older tracks and old ring road, some of which are now major stream lines. Erosion at Warayuki, a men's sacred site, was triggered by the diversion of runoff along the old ring road in a easterly direction. Gully control structures (gabions) have been unsuccessful, having been eroded from their original locations within a few years of their emplacement. Tributary gullies are now advancing towards the base of Uluru, undermining some trees and removing soil water from others.

MODEL FOR EROSION

Erosion around the base of Uluru has to be understood in terms of the dynamics of flow from the base. There is a sequence in the hydrology, landforms, vegetation and sediments as one moves from the point where the water cascades down to the base of Uluru to where the dune systems dominate the landforms on the outer edge of the perimeter apron, a distance of up to one kilometre. Rills with distributary networks are common on the surface. Water infiltrates into the surface and replenishes the soil moisture stores on which the plants survive. A conceptual model of the natural system is presented in Figure 2.

Discontinuous gullies develop naturally on the apron surface from time to time. The fans that develop at the toes of these gullies act as controls and tend to fill the lower gully trench as the gully advances headwards. The presence of gullies does not mean an area is inherently unstable under natural conditions: it simply responds to short-term fluctuations in environmental conditions. Fragility of the environment should not be equated with instability.

Thus, the natural system of hydrology, landform and vegetation at the base of the rock is complex and highly interconnected. Problems arise when human intervention breaks or distorts one of the relationships. Such is the case with track and road construction. A track or road may appear stable for some time. But slight incision into the surface will intercept both overland flow and the throughflow. Over time the interception will lead to minor rill formation, cutting back up into the slope. The effect of these minor rills is to divert and concentrate overland flow, decrease subsurface flow and reduce the amount of water in the soil store through the lowering of local base level and rapid drainage. The reduction in soil water stresses plants, which means they are less effective in protecting the ground surface (e.g. the density of grass may decrease). The decreased protection leads to more runoff (possibly through crusting of the surface), stripping of nutrients and topsoil erosion. The system is in a feedback situation that continues to promote gully development (Fig. 3). This model explains why gully head structures may be unsuccessful. If a gully head structure prevents throughflow the water will build up behind the wall and then flow around to a point where it can escape. The new soil water path becomes the major axis for erosion.

MANAGEMENT OPTIONS

Erosion around the base of Uluru has a common cause, namely alteration of the geomorphic/hydrologic regime across the apron due to the location and design of walking tracks and/or roads. Selection of effective management options for both environmental and cultural attributes requires the availability of baseline data which emphasise and make use of the interrelationships between

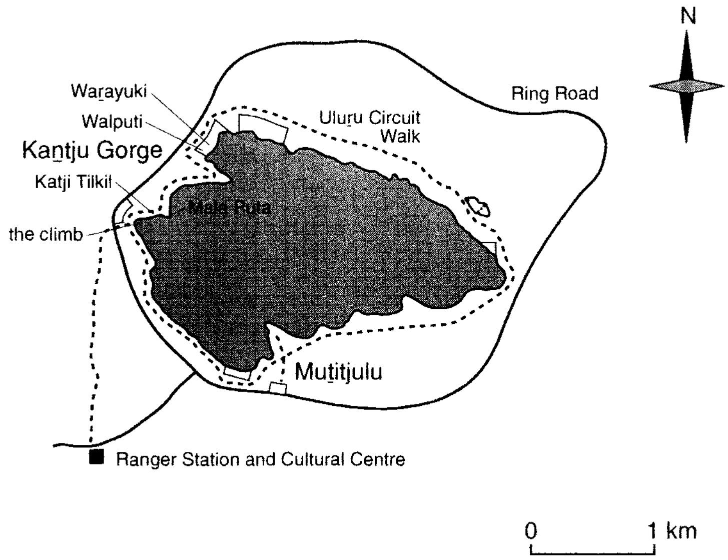

Figure 1. Map of Uluru showing places referred to in the text.

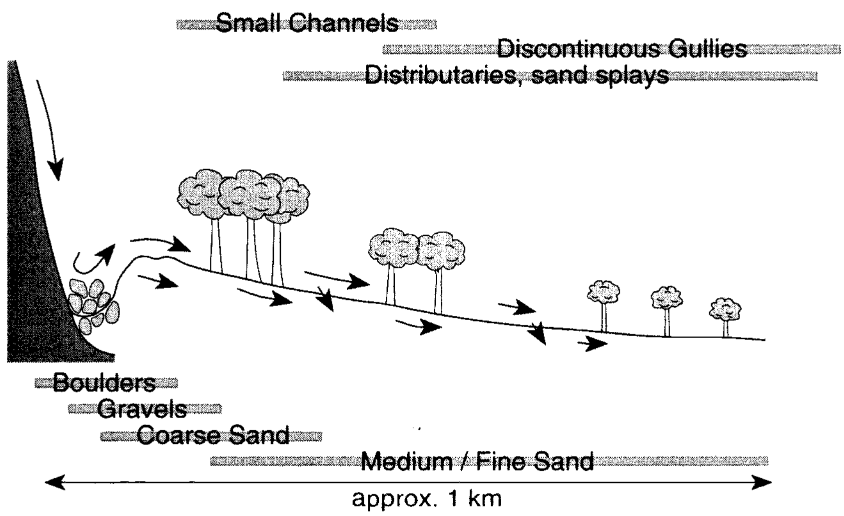

Figure 2. Conceptual model of natural hydrogeomorphic system around the base of Uluru (arrows represent direction and relative volume of water flow).

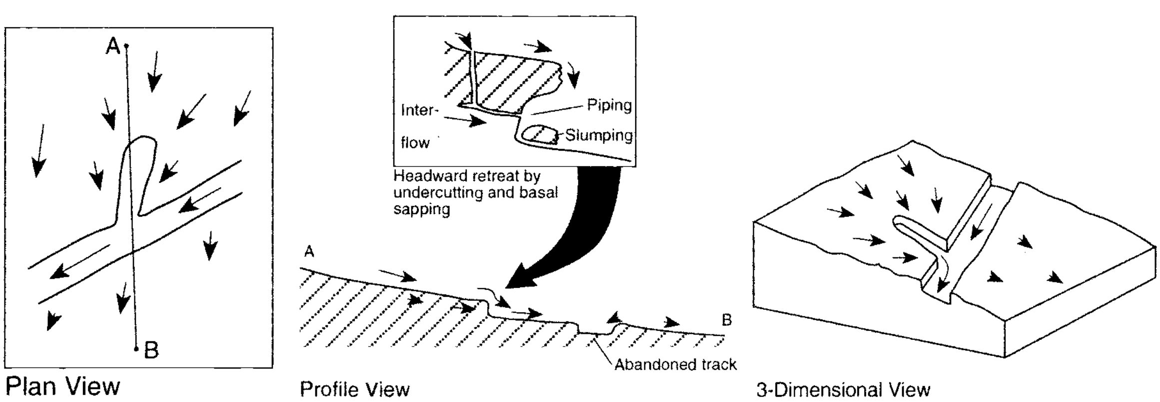

Figure 3. Model of gully development due to alteration of hydrogeomorphic regime following track construction.

individual attributes. Therefore, it is necessary to undertake a fully integrated survey of environmental attributes (e.g. surface topography, hydrology, soils and vegetation) around the perimeter apron of Uluru to confirm the model presented above and allow the design of best management options.

There are a number of recommendations that could be made for each site. For example, the access track at Kantju is a stream bed and it is entirely unsuitable to use it as a track in this fragile environment. The whole of the north-western area of the base of Uluru has active gully, rill and wash erosion, with serious erosion of old roads and tracks. The area is hydrologically interconnected and any attempt to work on one section may have an impact on another. The spatial variation of the ecology, geomorphology and hydrology of the area needs to be studied before any works or other management options are implemented.

Whatever management options are undertaken there will always be a degree of uncertainty about their success and impacts. An experimental approach to rehabilitation should be adopted, where the impact of options in small areas are monitored before being applied universally. It is highly likely that no single management option will suffice and a spectrum of management approaches will have to be used. This is yet another argument for comprehensive integrated surveys and an holistic approach to management.

CONCLUSION

Significant erosion around the base of Uluru can be related to degradation of old walking and road tracks. The diversion of surface flow, decrease in vegetation, exposure of mineral surfaces and return-flow discharge at headwalls operate together in a complex system to accelerate the disturbance caused by tourist activities. Previous attempts to remediate sites has only been partially successful and suggests that innovative management strategies may be required to reverse land degradation in this area.

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