

# Changes in gully erosion along the Upper Burdekin River frontage in north Queensland.

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## Abstract

Gully erosion has been identified as a significant source of sediment in the seasonally dry tropical savannas of the Burdekin catchment with the upper Burdekin subcatchment having the highest incidence of gullies. A simple method of calculating changes in gullied areas is provided. A 22% expansion of one gully network over a 58-year period was calculated using a time series of aerial photographs and satellite imagery. This work supported by mid-19<sup>th</sup> century explorer diaries clearly indicates that gully erosion in this area commenced well before the introduction of domestic livestock in the 1860s. The need for wider-scale quantification of gully erosion is also highlighted.

## Introduction

The effects of terrestrial sediment and nutrients on the Great Barrier Reef (GBR) is well documented (Furnas 2003). A study of yttrium concentrations in *Porites* coral in the northern Townsville-Whitsunday Management Zone of the GBR suggests that sediment deposition from the Burdekin River has increased by 40 to 50 percent since 1860 (Lewis *et al.* 2007) when domestic livestock were first introduced to the Burdekin catchment.

To estimate current sediment losses, Dight (2009) developed a catchment atlas for the Burdekin using the SedNet model. The modelling was ground truthed with ground cover traverses, stream gauging data and analysis of wet season runoff samples. Stream banks, gullies and hillslopes were identified as generating 23, 18 and 59 % respectively of sediment

leaving the Upper Burdekin (30 % of the total Burdekin catchment). The upper Burdekin is generating more sediment from gully erosion than any of the other five subcatchments that make up the total Burdekin catchment (Dight 2009). Satellite imagery shows that a 177km length of the upper Burdekin River from Greenvale to the Basalt River junction is heavily impacted by gully erosion. This paper quantifies the areal expansion of one of these gully networks.

## Materials and methods

An area of extensive gullying near the confluence of the Burdekin and Clarke Rivers (19° 11'18"S, 145° 27'43"E) was selected. The area has a seasonally dry tropical climate with a median annual rainfall of 631mm. The gullied soils are deep, poorly structured alluvial tenosols (Rogers *et al.* 1999) with a sparse vegetation cover of Reid River box (*Eucalyptus brownii*) with a whitewood (*Atalaya hemiglauca*) and currant bush (*Carisa ovata*) understory. The area of the gully network was measured using a time series of remotely sensed images (aerial photos captured in 1951, 1967, 1979, 1991 and 2002 and SPOT satellite imagery 2009.) The images were enlarged to a scale of 1:10,000 and the gullied area measured manually using a five millimetre grid.

## Results and discussion

The area of the gully network near the junction of the two rivers expanded from 20.96ha in 1951 to 25.55ha in 2009, an increase of 22% (average 0.071ha/year or 0.31%/yr). The gullied area (A) for any given year was calculated as:

$$A = 0.07085Y - 117.2 \quad (p < 0.001, \text{adjusted } R^2 = 93.6\%)$$

where Y is the calendar year. Although tenuous when used as a hind-cast, this formula indicates that gullies were present near the Burdekin-Clarke confluence in the 1840's. This is supported by the diary of the explorer Ludwig Leichhardt (Leichhardt, 1847) that mentions gullies in this area in 1845. These gullies therefore clearly existed prior to the introduction of domestic livestock in 1860's, suggesting not all erosion is initiated by grazing domestic livestock. In addition to erosive forces of raindrop impact and surface runoff, gullies in this

area are inundated during large floods in the Burdekin River. The floods are still backwaters that could cause slumping as they recede. While the flood induced erosion from has not been quantified, it is thought to be less than that from other causes.

## Conclusion

The remotely sensed imagery indicates a relatively constant rate of gully erosion in the study area from 1951 to 2009. As this erosion commenced prior to the introduction of domestic livestock in the 1860s, some geomorphologically induced change in the behaviour of the Burdekin River in this area is considered to be the probable trigger. The extent of the gullying at the time of settlement was not recorded; therefore the subsequent impact of livestock grazing cannot be determined. Future work using more sophisticated remote sensing technologies, should be undertaken to determine the actual volume of soil lost from these gully systems since 1951. This will further ground truth the predictions of computer models such as SedNet and support targeted remedial actions to improve water quality under programs such as Reef Rescue and the Reef Protection Package.

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