8th International Symposium on Gully Erosion

Virginia Park Field Trip

24 July 2019

Contents

1. Welcome

The Virginia Park Field trip is an all-day trip beginning at 7:00 AM and concluding at 4:30PM. All attendees are required to wear closed shoes (no sandals, thongs of flip flops) as there will be some short walking (~100-200 m) through bushland. Although it is winter time, it is recommended that attendees wear a wide brimmed hat, long pants and a long sleeved shirt for sun protection.

We will be travelling in 20 seater mini-buses which allow us to venture around the Virginia Park Station. A snack box and bottle of water will be provided to each person before boarding a bus and lunch will be provided at the Virginia Park station homestead. Sunscreen and additional drinking water will be available at each stop.

The fieldtrip will take us across the alluvial coastal plain, past some limestone ranges and then up the granitic Mingela Range into the Upper Burdekin River catchment, which drains to the south into the Burdekin Falls Dam and then out to the coast. The gullies we will visit are set in the shallow soils of the Ravenswood Granodiorite (410-470 My). Relative to many areas this may be an ancient and stable landscape, yet the historical changes are significant.

Each gully is unique in its own way, yet all gullies are formed by a mix of related processes. What we see will serve to illustrate and discuss the contrasting geography and history within which gully erosion occurs, and the methods we use to investigate it. We will discuss a range of the research which has progressively refined our understanding of gully erosion in the area, from continental and regional sediment budget modelling to sediment source tracing, to field measurements of erosion and sediment transport, soil and vegetation surveys, hydrologic investigations, grazing trials and recent gully rehabilitation experiments.

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2. Background

Virginia Park Field Trip Wednesday July 24, 2019

This tour takes us to the Burdekin River which is the fifth largest river catchment in Australia. It is an important regional water supply and the highest exporter of fine sediment to the Great Barrier Reef lagoon.

We will enjoy the hospitality of the Bennetto family, the owners of Virginia Park Station, a commercial grazing property within the Burdekin basin, and host to over 18 years of scientific research activity.

Here we will explore the gullies of the Weany Creek catchment to examine the spatial patterns and temporal dynamics of the landscape, measurement techniques, sampling approaches, instrumentation systems and modelling methods, and share some recent research results.

Participants will also gain insight to the challenges faced by land holders, approaches used by regional natural resource managers, and the value of long-term scientific research.

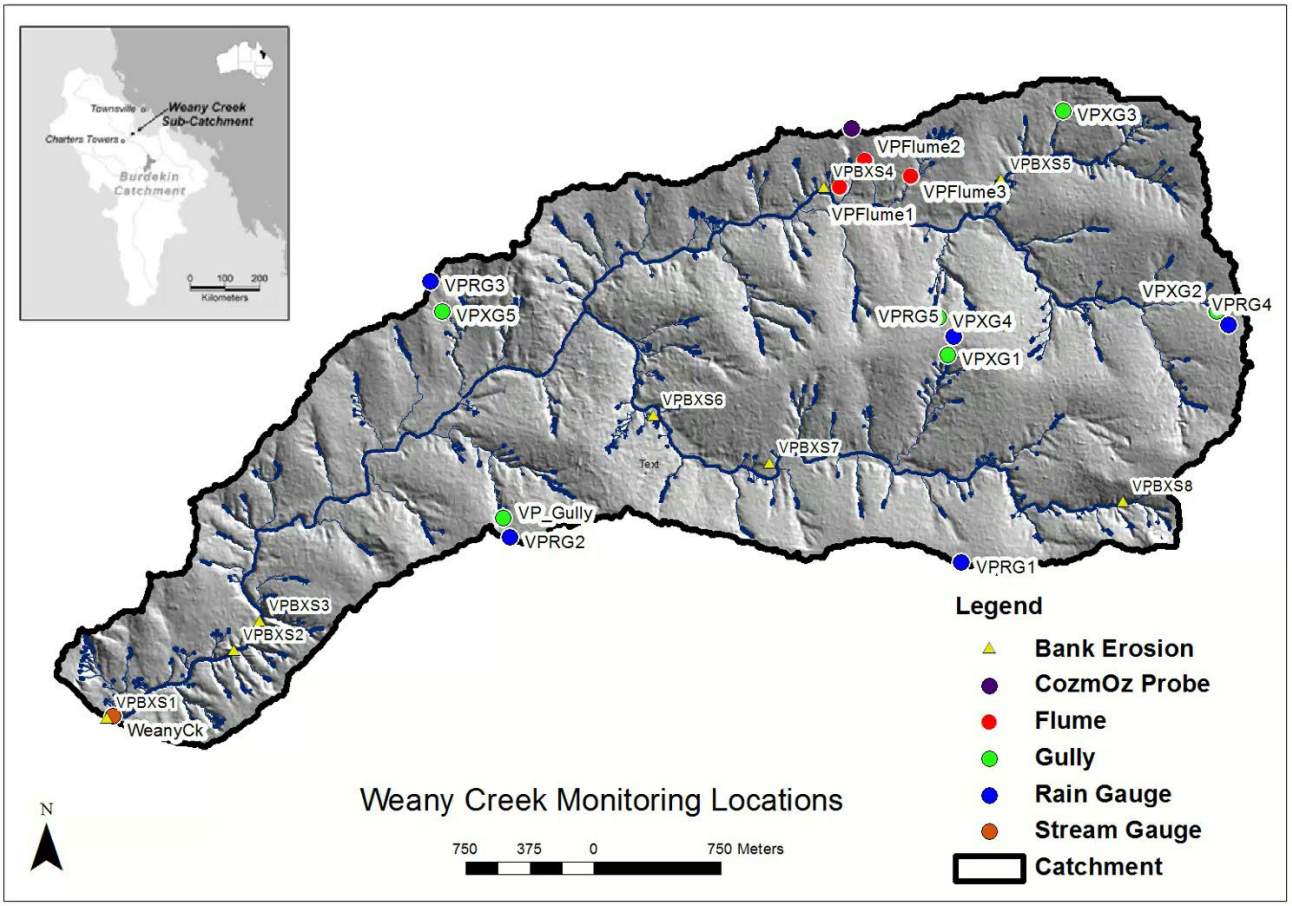


FIGURE 1 TOUR ROUTE

3. Itinerary

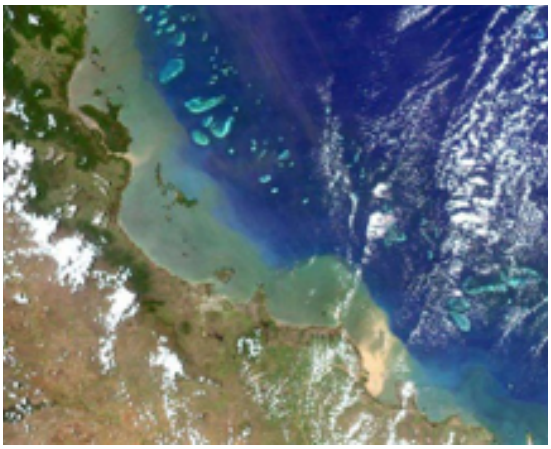
Stop	Time	Location	Notes
	7:00 AM	Assemble at Rydges Hotel	23 Palmer St, South Townsville QLD 4810
	7:30 AM	Depart Rydges	Discussion points on buses
Flood Markers	9:00 AM	Macrossan Bridge Scott Wilkinson (CSIRO)	Catchment Science in the Burdekin 1. Overview of research sites and programs across the region. 2. Recent floods, source tracing, sediment budget modelling and river load estimates.
1	10:00 AM	Virginia Park Station: VPG0/NESP Control 1. Anne Henderson (CSIRO) 2. Jack Koci (USC) 3. Rebecca Bartley (CSIRO)	Long term Gully Monitoring/NESP Control site 1. Monitoring methods – Gully Chronosequence – Erosion measurement, land condition, water quality 2. Structure from Motion survey methods 3. Program Overview – History of monitoring – NESP project
2	11:00 AM	Virginia Park Station: Weany Creek Gauge Aaron Hawdon (CSIRO)	Weany Creek Gauge – River monitoring purposes, techniques for remote locations. – Weany Creek Sediment budget. – Comparison with other study catchments.
3	11:30 AM	Virginia Park Homestead Rob Hunt (NQ Dry Tropics)	Meet and greet Bennetto family Grazing, gullies, soils and landholder engagement – overview of NQ Dry Tropics programs.
	12:00 PM	**Virginia Park Homestead**	**Lunch**
4 and 5	1:00 PM	**Virginia Park Station:** **Group 1:** VPG5/NESP Treatment: Scott Wilkinson (CSIRO) **Group 2:** VPFlume 1: Grazing management and Hillslope hydrology: Anne Henderson (CSIRO) Brett Abbott (CSIRO) Aaron Hawdon (CSIRO) (30 min each site and 30 min swap over)	**Group 1:** – Overview of gully remediation, evolution of gully 5 (projects focus through time). – Hillslope gully remediation / Reef Trust Toolbox. **Group 2:** – Changes in cover and pasture species, hillslope runoff and sediment loss at the site. – Impact of grazing practices on above – general context and regional assessment. – Cosmic-ray neutron soil moisture sensor
6	2:30 PM	**Virginia Park Station:** Grazing trials and practices Matt Bennetto (Virginia Park Station) Sam Skeat (NQ Dry Tropics)	**One Group** – Planned grazing practices that improve water quality. – Utilisation and recovery cycles. – Priority infrastructure requirements.
	3:00 PM	Depart Virginia Park Station	
	4:30 PM	Arrive Rydges	

7:30am Depart Rydges Hotel, 23 Palmer St, South Townsville

Our 90 minute drive take us past coastal granite ranges and plains, through the Mingela Range into the Burdekin basin.

As we drive we will discuss the background of the region:

- Changes in catchment condition since Ludwig Leichhardt passed through (1848).
- Some local history including legume pastures, livestock numbers, drought events, pasture degradation.
- Scientific evidence that water quality is damaging the GBR world heritage area.
- The role of NQ Dry Tropics and the diversity of programs implemented to tackle the NRM (natural resource management) challenges of the Burdekin region.



©COURTESY NASA MODIS IMAGERY

9:00am Upper Burdekin River

Our first stop is the Burdekin River at the Macrossan Bridge, which has been swamped by floodwaters several times in recent years.

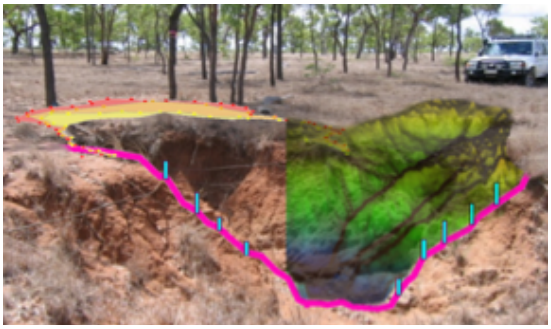
Scott Wilkinson will discuss vignettes of catchment science in the Burdekin and Great Barrier Reef catchments. This will include:

- Overview of research sites across the region.
- Recent floods, source tracing, sediment budget modelling, and river load estimation in a variable climate.

10:00am Virginia Park Station

We start our exploration of the Weany Creek catchment on the very site where gully monitoring first began. Rebecca Bartley, Anne Henderson and Jack Koci will discuss:

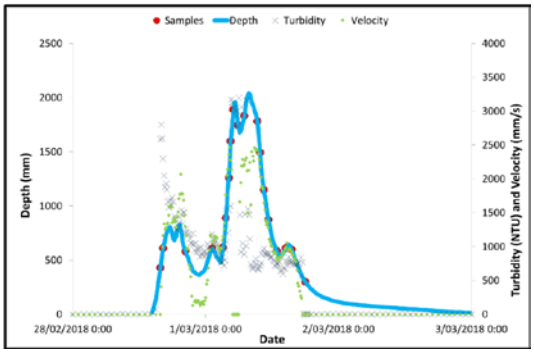
- Overview of historical and current monitoring programs at Virginia Park.
- Gully monitoring methods used for estimating erosion.



11:00am End of Catchment Monitoring

The Weany Creek gauging station was first installed in 1999. There have been a number of refinements to the station since that time which has led to the development of a standard design suitable for remote monitoring:

- Stream monitoring purpose and sites
- Techniques for monitoring in remote locations in a variable climate
- Comparison of Weany Creek to other study catchments



11:30am Virginia Park Homestead

Welcome from the Bennetto family

Here we will meet the Bennetto family who have hosted research on their property since 1999 and are actively involved in education and training, Landcare, local government and regional NRM matters.

Sustainable management of grazing lands

NQ Dry Tropics is an independent, not-for-profit company delivering on-ground NRM activities aimed at sustaining the region's natural resources for the benefit of current and future generations. Rob Hunt will discuss:

- Sustainable agriculture projects.
- Working with landholders.
- Tackling gully erosion.

12:00pm Lunch

Time for informal discussion while enjoying a catered lunch.

1:00pm: Gully and Hillslope Remediation

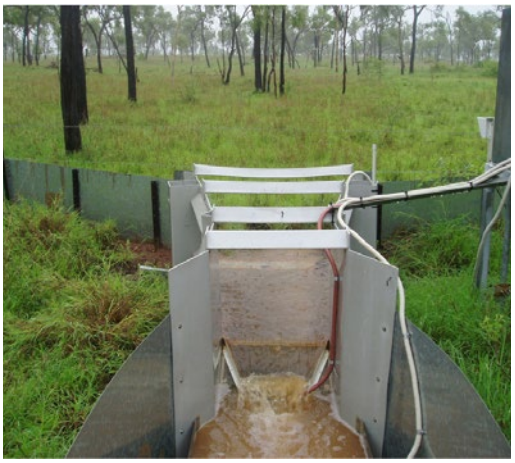
After a short drive we will arrive at an instrumented gully with a remediation trial underway and a hillslope where the benefits of sustainable grazing management practices has been monitored for 16 years.

Gully Remediation Site (VP Gully 5)

- Evolution of gully monitoring at the site.
- Overview of implemented gully remediation activities.
- Informing policy.
- Development of the Reef Trust Gully Toolbox.

Hillslope recovery after wet season spelling

- Impact of grazing practices on land condition.
- Changes in cover and pasture species, hillslope runoff and sediment loss at the site.
- Cosmic-ray neutron soil moisture sensor (not Cosmic-ray soil moisture neutron probe as soil moisture neutron probes are very different and radioactive.



2:30pm Landholder Gully Remediation and Grazing Trials

NQ Dry Tropics and the Bennetto family have recently established a new grazing management trial on the property.

Sam Skeat and Matt Bennetto will discuss:

- Landholder perspective on land management.
- Overview of trials and expected outcomes.
- Design and implementation process.

3:00pm Depart Virginia Park Station

4:30pm Arrive Rydges Townsville

4. Sponsors

Gold

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Supporting

INTERNATIONAL GEOGRAPHICAL UNION
UNION GÉOGRAPHIQUE INTERNATIONALE
COMMISSION ON LAND DEGRADATION & DESERTIFICATION

5. Summary of selected publications from research conducted at Virginia Park and surrounding area

VIRGINIA PARK

Bartley, R., Roth, C.H., Ludwig, J., McJannet, D., Liedloff, A., Corfield, J., Hawdon, A. and Abbott, B., 2006. Runoff and erosion from Australia's tropical semi-arid rangelands: influence of ground cover for differing space and time scales. Hydrological Processes, 20: 3317-3333.

Bartley, R., Hawdon, A., Post, D.A. and Roth, C.H., 2007. A sediment budget in a grazed semi-arid catchment in the Burdekin basin, Australia. Geomorphology, 87: 302-321.

Bartley, R., Corfield, J.P., Hawdon, A.A., Abbott, B.N., Wilkinson, S.N. and Nelson, B., 2010. Impacts of improved grazing land management on sediment yields, Part I: hillslope processes. Journal of Hydrology, 389: 237-248, doi:10.1016/j.jhydrol.2010.06.014

Bartley, R., Wilkinson, S.N., Hawdon, A.A., Abbott, B.N. and Post, D.A., 2010. Impacts of improved grazing land management on sediment yields, Part 2: catchment response. Journal of Hydrology, 389: 249-259, 10.1016/j.jhydrol.2010.06.014.

Bartley, R., Corfield, J.P., Hawdon, A.A., Kinsey-Henderson, A.E., Abbott, B.N., Wilkinson, S.N. and Keen, R.J., 2014. Can changes to pasture management reduce runoff and sediment loss to the Great Barrier Reef? The results of a 10-year study in the Burdekin catchment, Australia. The Rangeland Journal, 36(1): 67-84, http://dx.doi.org/10.1071/RJ13013.

Bastin, G., Scarth, P., Chewings, V., Sparrow, A., Denham, R., Schmidt, M., O'Reagain, P., Shepherd, R. and Abbott, B., 2012. Separating grazing and rainfall effects at regional scale using remote sensing imagery: A dynamic reference-cover method. Remote Sensing of Environment, 121: 443-457, 10.1016/j.rse.2012.02.021.

Hawdon, A., McJannet, D. and Wallace, J., 2014. Calibration and correction procedures for cosmic-ray neutron soil moisture probes located across Australia. Water Resources Research, 50(6): 5029-5043, 10.1002/2013wr015138.

Kinsey-Henderson, A.E., Post, D.A. and Prosser, I.P., 2005. Modelling sources of sediment at sub-catchment scale: an example from the Burdekin Catchment, North Queensland, Australia. Mathematics and Computers in Simulation, 69: 90-102

Koci, J., Jarihani, B., Leon, J.X., Sidle, R.C., Wilkinson, S.N. and Bartley, R., 2017. Assessment of UAV and Ground-Based Structure from Motion with Multi-View Stereo Photogrammetry in a Gullied Savanna Catchment. International Journal of Geo-Information, 6(11), 10.3390/ijgi6110328.

Ludwig, J.A., Bartley, R., Hawdon, A., Abbott, B. and McJannet, D., 2007. Patch configuration amplifies loss across scales in a grazed catchment in north-east Australia. Ecosystems, 10: 839-

Wilkinson, S.N., Kinsey-Henderson, A.E., Hawdon, A.A., Hairsine, P.B., Bartley, R. and Baker, B., 2018. Grazing impacts on gully dynamics indicate approaches for gully erosion control in northeast Australia. Earth Surface Processes and Landforms, 10.1002/esp.4339.

TRACING, DATING, RAINFALL, RUNOFF AND SOIL STUDIES IN SURROUNDING LANDSCAPES

Bartley, R., Croke, J., Bainbridge, Z.T., Austin, J.M. and Kuhnert, P.M., 2015. Combining contemporary and long-term erosion rates to target erosion hot-spots in the Great Barrier Reef, Australia. Anthropocene, 10: 1-12, 10.1016/j.ancene.2015.08.002.

Bartley, R., Thompson, C., Croke, J., Pietsch, T., Baker, B., Hughes, K. and Kinsey-Henderson, A., 2018. Insights into the history and timing of post-European land use disturbance on sedimentation rates in catchments draining to the Great Barrier Reef. Marine Pollution Bulletin, 131: 530-546, https://doi.org/10.1016/j.marpolbul.2018.04.070.

Jarihani, B., Sidle, R.C., Bartley, R., Roth, C.H. and Wilkinson, S.N., 2017. Characterisation of the hydrological response to rainfall at multi spatio-temporal scales in savannas of semi-arid Australia. Water, 9(540), doi:10.3390/w9070540.

Roth, C., 2004. A framework relating soil surface condition to infiltration and sediment and nutrient mobilisation in grazed rangelands of north-eastern Queensland. Earth Surface Processes and Landforms, 29: 1093-1104.

Wilkinson, S.N., Hancock, G.J., Bartley, R., Hawdon, A.A. and Keen, R., 2013. Using sediment tracing to assess processes and spatial patterns of erosion in grazed rangelands, Burdekin River basin, Queensland, Australia. Agriculture, Ecosystems and Environment, 180: 90-102, DOI: 10.1016/j.agee.2012.02.002

OTHER RELATED TOPICS ON LAND MANAGEMENT, CLIMATE AND MODELLING

Ash, A.J., Corfield, J.P., McIvor, J.G. and Ksiksi, T.S., 2011. Grazing Management in Tropical Savannas: Utilization and Rest Strategies to Manipulate Rangeland Condition. Rangeland Ecology & Management, 64(3): 223-239, 10.2111/rem-d-09-00111.1.

Gardener, C.J., McIvor, J. and Williams, J., 1990. Dry tropical rangelands: solving one problem and creating another. Proc. Ecol. Soc. Aust., 16: 279-286.

Gladish, D.W., Kuhnert, P.M., Pagendam, D.E., Wilke, C.K., Bartley, R., Searle, R.D., Ellis, R.J., Dougall, C., Turner, R.D.R., Lewis, S.E., Bainbridge, Z.T. and Brodie, J.E., 2016. Spatio-temporal assimilation of modelled catchment loads with monitoring data in the Great Barrier Reef. Annals of Applied Statistics, 10(3): 1590-1618, DOI: 10.1214/16-AOAS950.

Gordon, I.J., 2007. Linking land to ocean: feedbacks in the management of socio-ecological systems in the Great Barrier Reef catchments. Hydrobiologia, 591(1): 25-33.

Leuning, R., Cleugh, H.A., Zegelin, S.J. and Hughes, D., 2005. Carbon and water fluxes over a temperate Eucalyptus forest and a tropical wet/dry savanna in Australia: measurements and comparison with MODIS remote sensing estimates. Agricultural and Forest Meteorology, 129(3-4): 151-173, 10.1016/j.agrformet.2004.12.004.

Pagendam, D.E., Kuhnert, P., Leeds, W.B., Wikle, C., Bartley, R. and Peterson, E., 2014. Assimilating catchment processes with monitoring data to estimate sediment loads to the Great Barrier Reef. Environmetrics, DOI: 10.1002/env.2255, DOI: 10.1002/env.2255.

Stokes, C.J., McAllister, R.R.J., Ash, A.J. and Gross, J.E., 2008. Changing Patterns of Land Use and Tenure in the Dalrymple Shire, Australia. In: K.A. Galvin, R.S. Reid, R.H.B. Jr and N.T. Hobbs (Editors), Fragmentation in Semi-Arid and Arid Landscapes: Consequences for Human and Natural Systems. Springer Netherlands, Dordrecht, pp. 93-112.