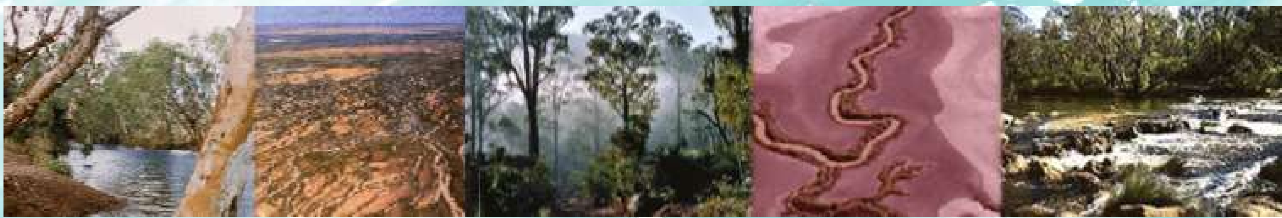

Assessing impacts of recreational use of mountain bike trails on Mounts Clarence and Adelaide, Albany 2017 - 2019.

June 2019

Report No CENRM154

Prepared by Barbara Cook & Ben Ford
Centre of Excellence in Natural Resource Management,
University of Western Australia

Centre of Excellence in Natural Resource Management
The University of Western Australia

TITLE **Assessing impacts of recreational use of mountain bike trails on Mounts Clarence and Adelaide, Albany 2017 - 2019.**

PRODUCED BY Centre of Excellence in Natural Resource Management,
University of Western Australia,
[redacted]

PRODUCED FOR **City of Albany**
CONTACT [redacted]
DATE **June 2019**

PUBLICATION DATA **Assessing impacts of recreational use of mountain bike trails on Mounts Clarence and Adelaide, Albany 2017 - 2019.** Report No CENRM154. Centre of Excellence in Natural Resource Management, University of Western Australia.

Cover Photograph Demonstration Mountain Bike trail, Mt Clarence, Albany

Table of Contents

Tables

Figures

Introduction

The City of Albany has developed an environmental monitoring program aimed at quantifying the impacts of recreational use of trails on the biodiversity and cultural values of Mount Clarence and Mount Adelaide. Locations of cultural interest on Mount Clarence and Mount Adelaide (together forming the Albany Heritage Park) include the Mount Clarence Memorial, The National ANZAC Centre and the 'Forts' complex (Princess Royal Fortress Military Museum and other structures dating from World War II), as well as a number of areas with high Aboriginal heritage value. A recent Aboriginal survey (February 2017) identified a lizard trap and quartz flake on the length of proposed trails, and noted that additional material could be unearthed during trail construction.

For the purposes of this plan, monitoring focused on the demonstration mountain bike trail on Mount Clarence in the Albany Heritage Park (opened for use in February 2017), although the impacts of recreational use of walking trails is also of interest, and future monitoring activities could be extended to include these trails. With its 'hardened' surface consisting of 'blue metal gravel' (a construction aggregate which is crushed and screened to a consistent size), and frequent grade reversals (brief changes in elevation) to promote water shedding, this demonstration trail is an example of a carefully designed and constructed mountain bike trail aimed at focusing bike traffic on a relatively narrow band of durable substrate (Wimpey and Marion 2010). The City of Albany aims to eventually have 20-25 km of mountain bike trails circumnavigating Mount Clarence and Mount Adelaide, undeveloped reserve land vested in the City. Construction of this demonstration trail is part of a push in WA to create sustainable, low impact trails (Newsome et al. 2016), with the objective of this demonstration trail being to show that a low level of disturbance and impact on the environment can be achieved using modern trail construction techniques.

Prior to this study, monitoring of the environmental impacts of mountain biking on the demonstration and other trails has been limited to monitoring of Western Ringtail Possum abundance along the Demonstration Trail in an attempt to identify impacts on this species. This report extends these monitoring activities to include impacts on other environmental values.

Methods

Data collection

To assess impacts on soil and vegetation along the demonstration mountain bike trail, a stratified point measurement method was employed to sample 43 transects placed perpendicular to the trail tread at four categories of trail features (uphill, downhill, flat/trough and corner). Starting from the beginning of the trail ('trailhead'), a measuring wheel was used to identify the location of transects, and their boundaries (end-points defined by visually pronounced changes in amount of blue metal gravel) were marked using temporary pegs placed discretely under vegetation for concealment. These boundaries were assumed to contain >95% of bike traffic (Marion 2006). The coordinates for each transect were recorded using a handheld Global Positioning System (GPS), and a digital camera was used to capture images of each transect. For each transect, the following parameters were measured: trail feature (uphill, downhill, flat/trough or corner), trail grade (sometimes referred to as aspect or slope), trail width, maximum incision depth, presence of collision scars on trees, abundance of weeds, and presence of litter. Transects were assigned to one of four slope categories (< 5%, 5-10%, 10-20% and > 20%) for statistical analysis. Further details regarding data collection is available in Cook (2019), which is the report describing the baseline results of this study. Sampling was performed in 2017, 2018, and 2019, dates are provided in Table 1.

Table 1. Sampling event details

Year	Date	# transects
2017	28/07/2017	13
	31/07/2017	5
	8/09/2017	25
2018	8/05/2018	43
2019	9/01/2019	43

Data analyses

A repeated measures approach was used to test for changes in trail width (mm), maximum incision depth (mm), and proportion of scarred trees among trail feature categories and trail slope categories. Paired Wilcoxon tests were used to test for differences between 2017-2018, 2017-2019, and 2018-2019 for each feature and slope category, with holm adjustment for multiple comparisons. Boxplots were created to visually assess changes, with values depicting transect measurements from the latter year minus the corresponding transect measurements of the earlier year, thus a positive value represents an increase over time. Boxplots can be interpreted as representing the distribution of data values, the line through the middle of the box is the median, the box contains 50% of values, with the 'whiskers' the upper and lower 25% each of data points. Circles above or below the whiskers represent outliers, or values which can be thought of as anomalous. Maps were also created of changes in the above variables and abundance of weeds to assess spatial distribution of measurements. Due to very low non-zero values, no statistical tests were performed on weed abundance data.

Results

Change in trail width

Overall, trail width demonstrated a mean increase of 68mm from 2017 to 2018, a mean increase of 124mm from 2018 to 2019, and a mean increase of 185mm from 2017 to 2019. From 2017 to 2018, the sites near the top of the trail typically demonstrated the greatest increase in width (Figure 1). From 2017 to 2018, more sites demonstrated an increase in width, with sites from the upper and middle regions of the trail showing the greatest increase (Figure 2).

In general, trail width demonstrated an increase over time, although not always statistically significant. For “Downhill” regions, trail width increased from 2018 to 2019, and from 2017 to 2019, indicating that the greatest change from 2017 to 2019 occurred between 2018 and 2019. Trail width also increased in “Uphill” regions from 2017 to 2019 (Figure 3).

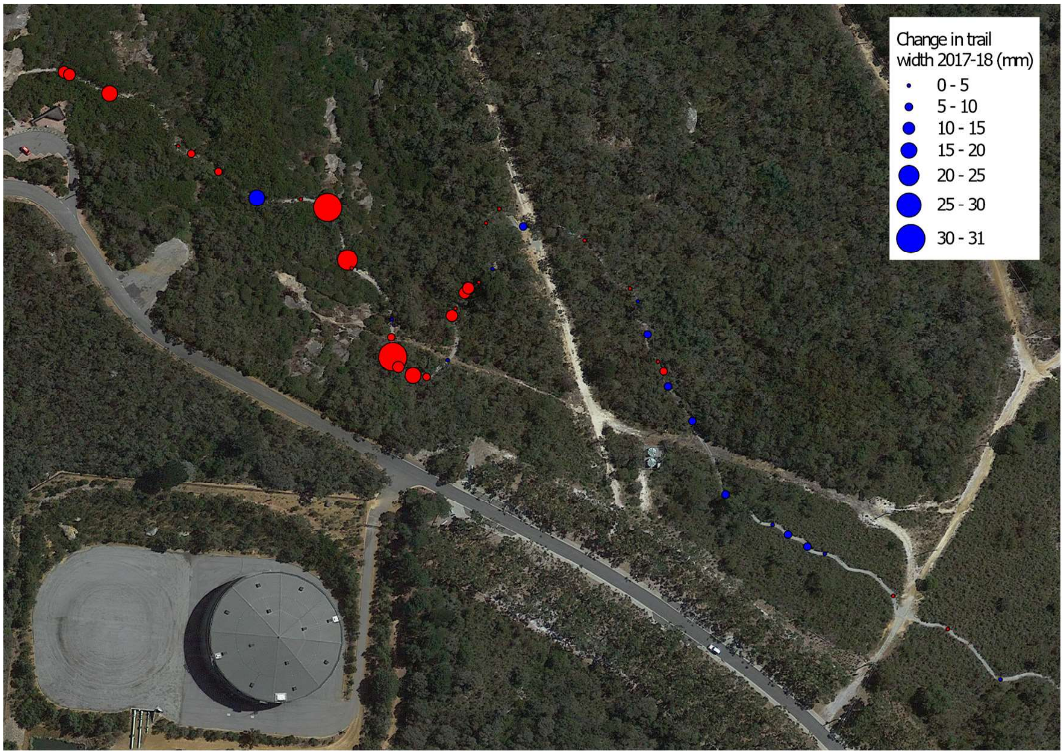

Figure 1. Change in trail width (mm) between 2017 and 2018. Red circles indicate an increase, blue circles indicate a decrease.

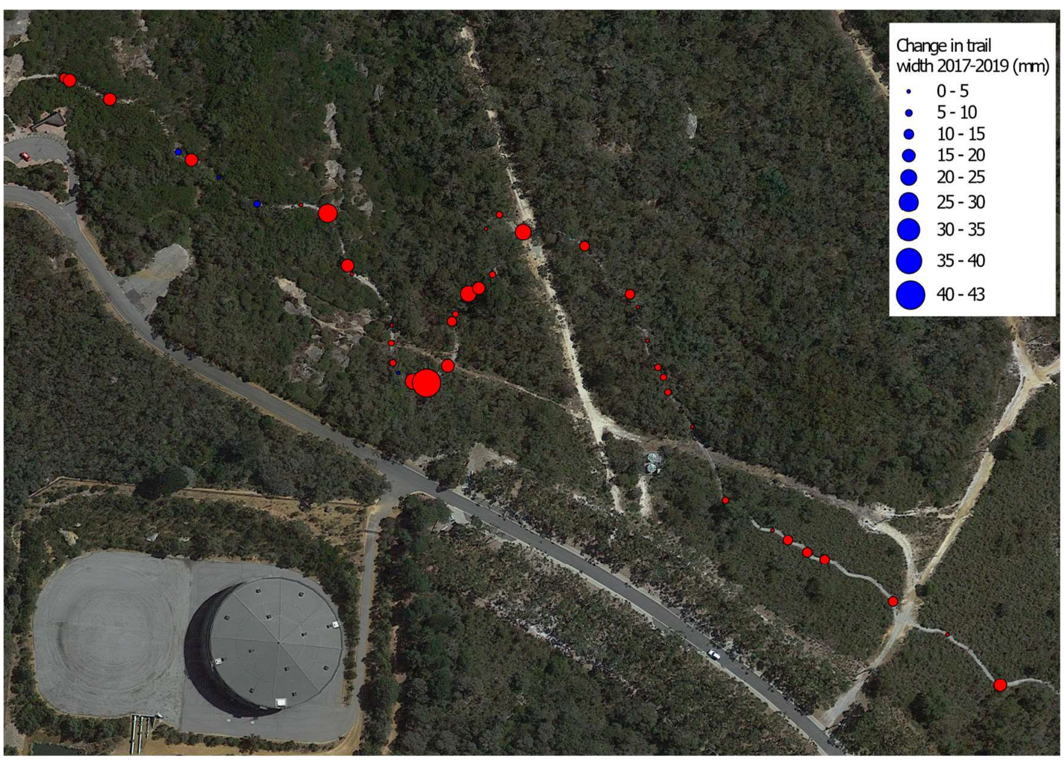

Figure 2. Change in trail width (mm) between 2017 and 2019. Red circles indicate an increase, blue circles indicate a decrease.

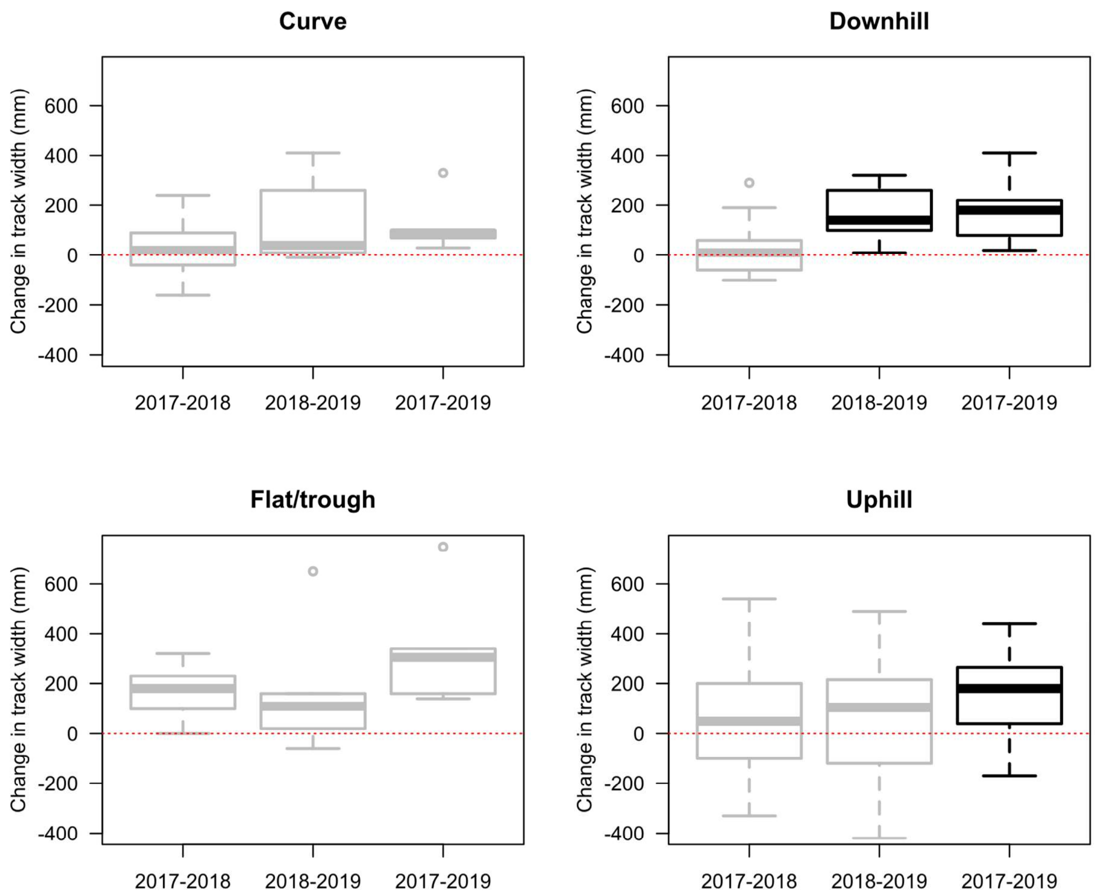

Figure 3. Changes in trail width over time and among trail feature categories. Black boxes indicate significant changes between years compared, Positive values indicate an increase in width between years.

Over slope categories, trail width increased significantly from 2018 to 2019, and 2017 to 2018 in the “5-10%” slope category, with much of the change from 2017 to 2019 occurring in 2018 to 2019 (Figure 4). Trail width was also found to increase from 2017 to 2019 in the “10-20%” slope category (Figure 4).

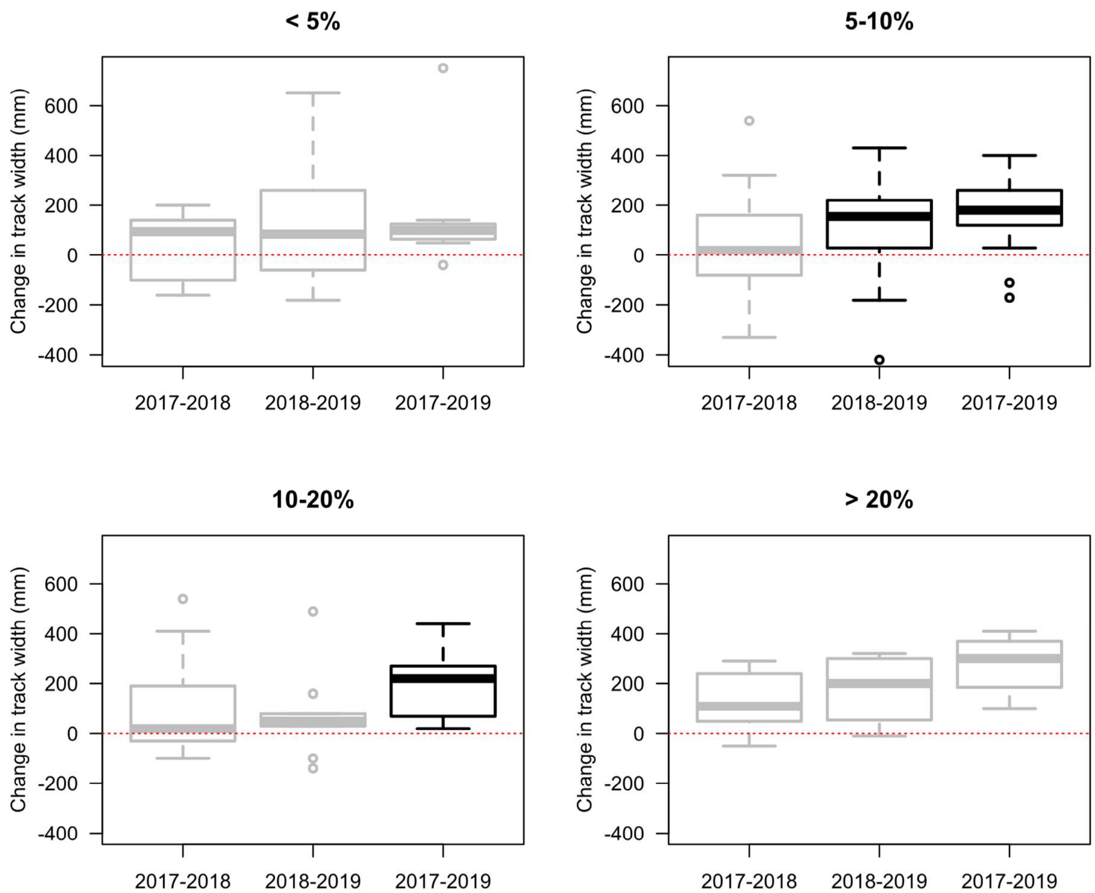

Figure 4. Changes in trail width over time and among trail slope categories. Black boxes indicate significant changes between years compared, Positive values indicate an increase in width between years.

Maximum trail incision

Overall, trail incision depth had a mean increase of 17mm between 2017 and 2018, and mean increase of 48mm between 2018 and 2019, and a mean increase of 71mm between 2017 and 2019. The greatest changes in incision depth between 2017 and 2018 tended to occur in the middle region of the trail (Figure 5). A similar pattern can be observed from 2017 to 2019, with the middle region typically displaying greater changes in incision depth, although with less variability than from 2017 to 2018 (Figure 6).

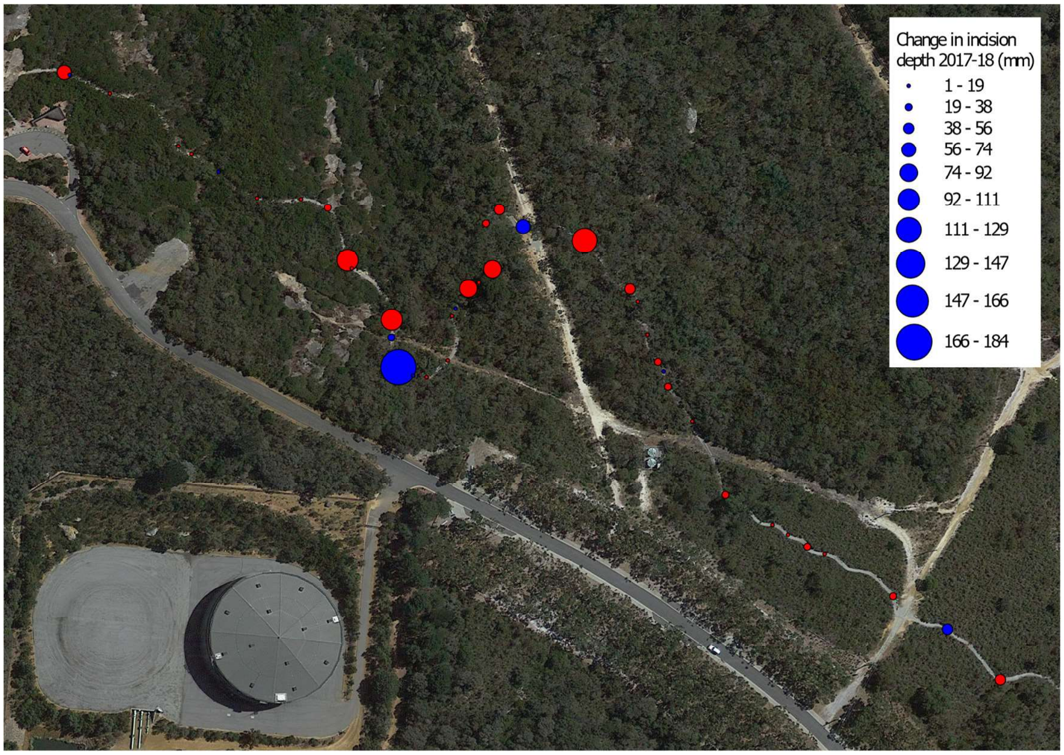

Figure 5. Change in trail incision depth (mm) between 2017 and 2018. Red circles indicate an increase, blue circles indicate a decrease.

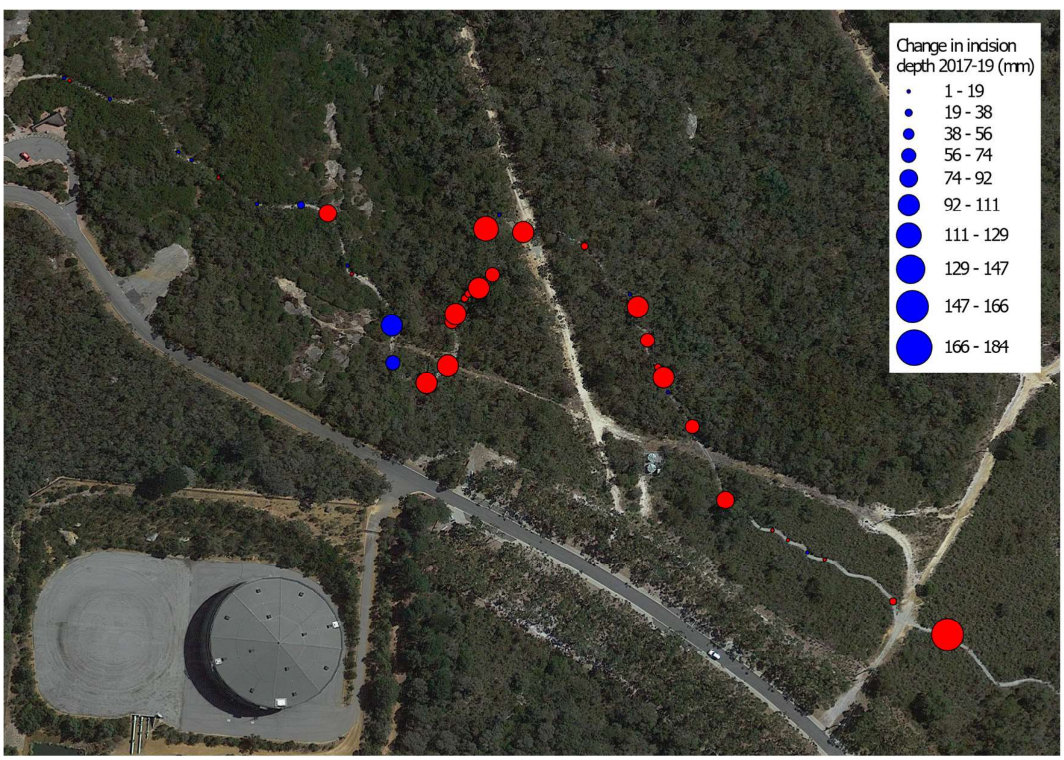

Figure 6. Change in trail incision depth (mm) between 2017 and 2019. Red circles indicate an increase, blue circles indicate a decrease.

Trail maximum incision depth also showed a general trend of increasing over time, with the greatest changes occurring in the "Downhill" feature category. The maximum incision depth for the "Uphill" category appears to have increased from 2017 to 2018, and then stabilised. No differences were found for the "Curve" and "Flat/trough" categories (Figure 7).

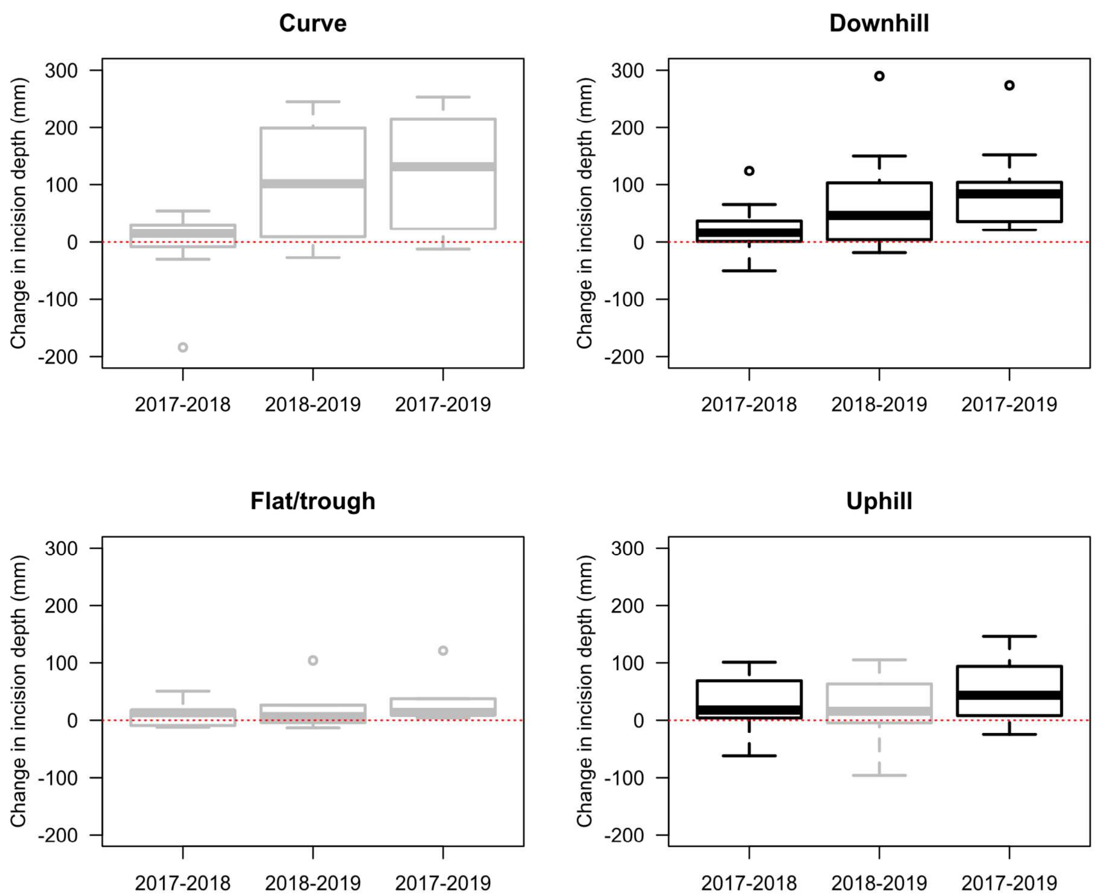

Figure 7. Changes in incision depth over time and among trail feature categories. Black boxes indicate significant changes between years compared, Positive values indicate an increase in depth between years.

Maximum incision depth increased over time for all but the "> 20%" slope category. Incision depth for the "<5%" category demonstrated greatest increases between 2018 and 2019. The "< 5%" slope category had the greatest increases in incision depth, with most of this change between 2017 and 2018, with no difference between 2018 and 2019 (Figure 8).

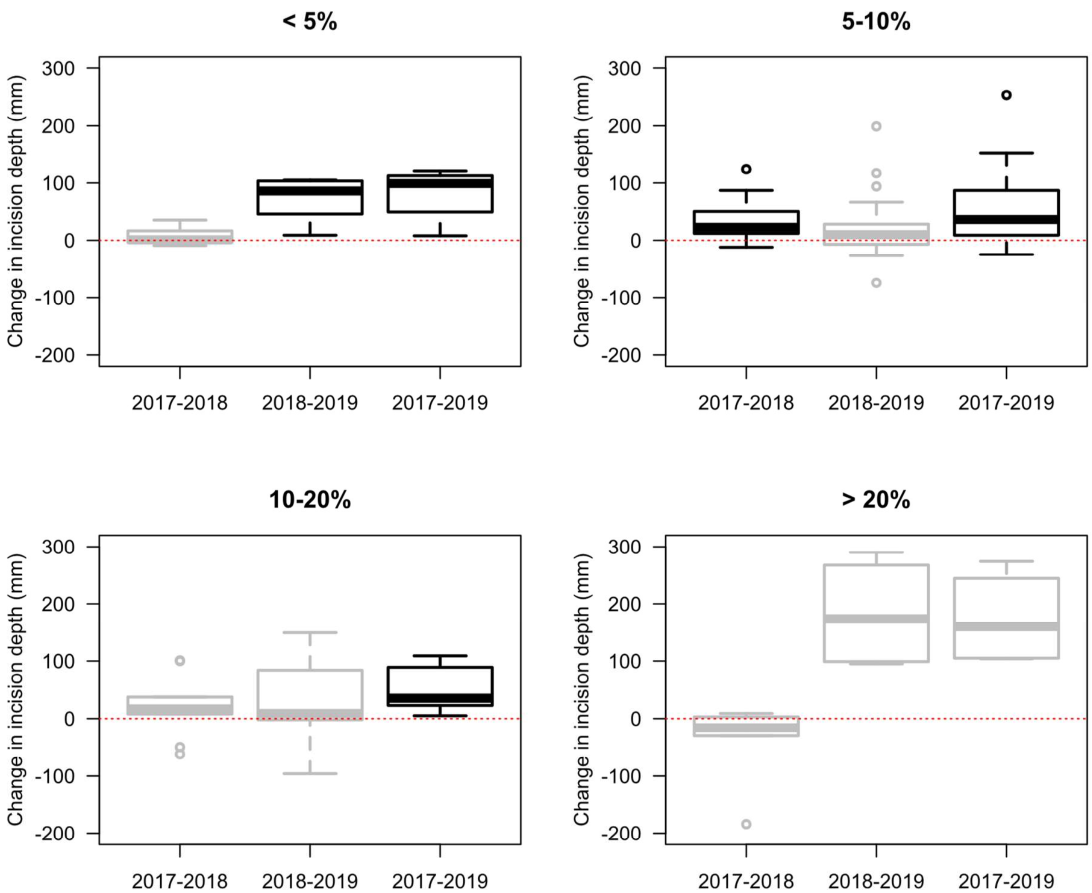

Figure 8. Changes in incision depth over time and among trail slope categories. Black boxes indicate significant changes between years compared, Positive values indicate an increase in depth between years.

Vegetation damage

The upper transects typically contained more trees than the lower regions of the trail (Figure 9). In 2018, the middle region of the trail had higher proportions of trees with scars (Figure 10), with a similar pattern observed in 2019 (Figure 11).

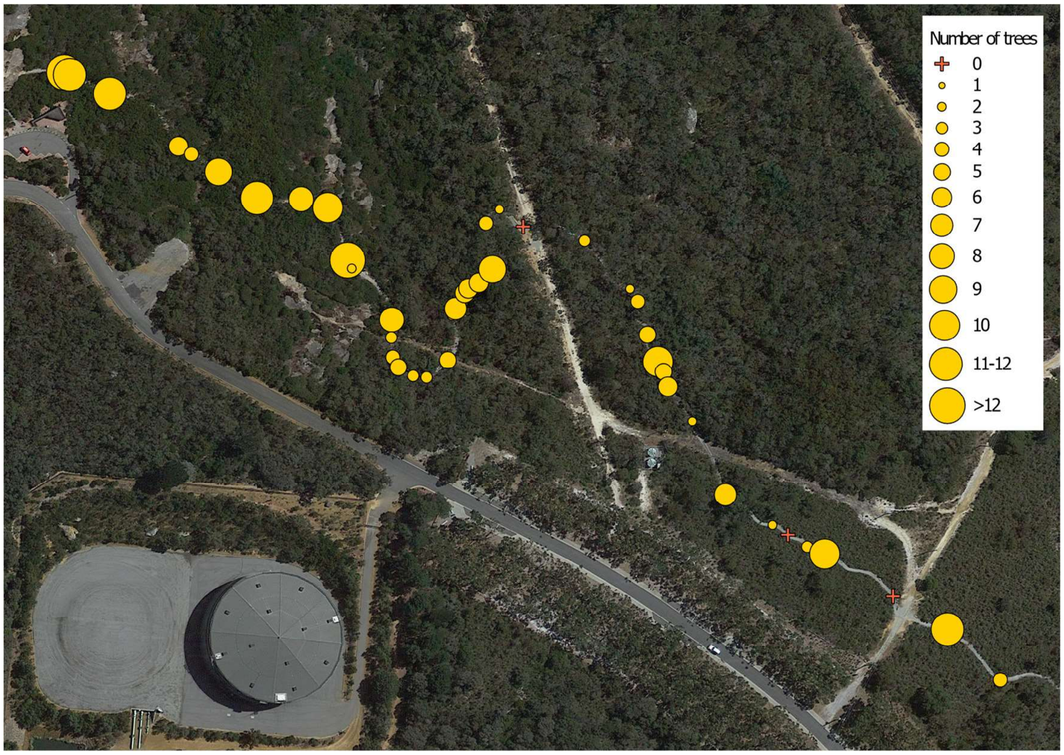

Figure 9. Total number of trees in transects along the trail.

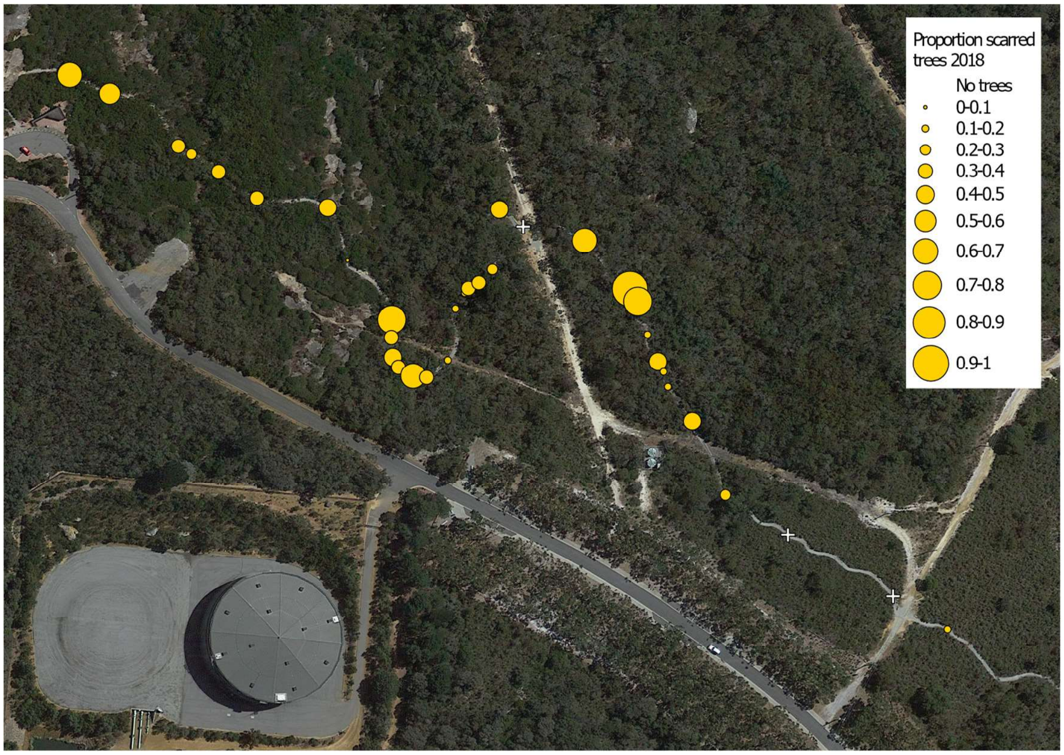

Figure 10. Proportion of trees with scars in 2018.

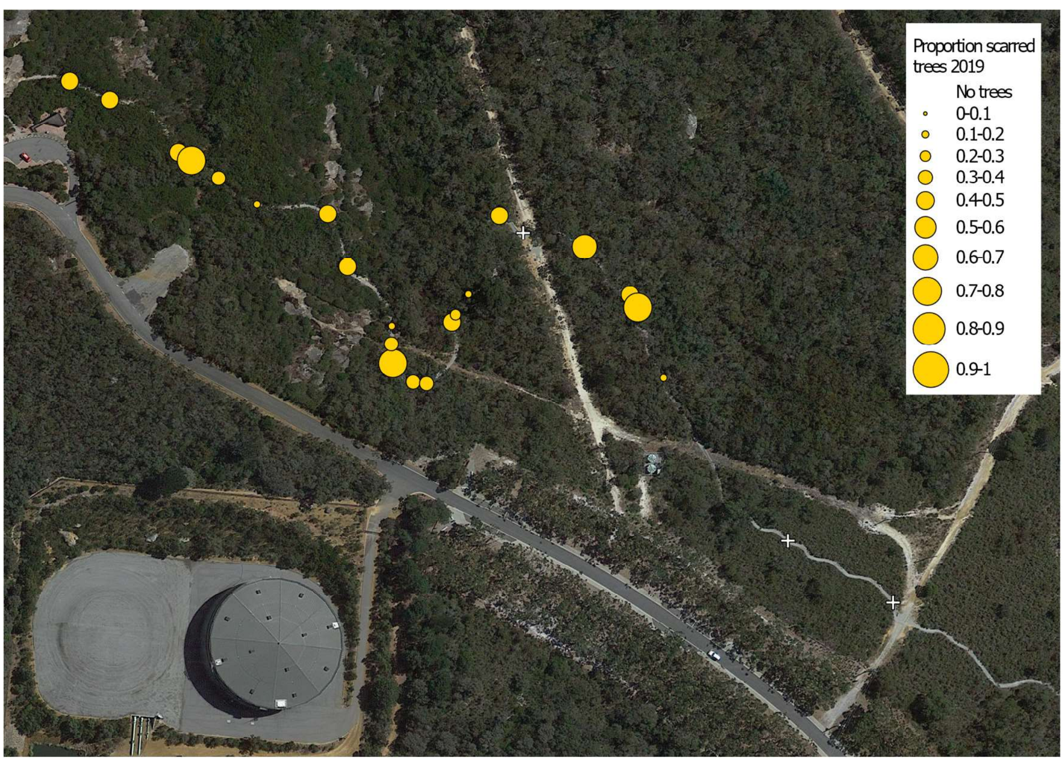

Figure 11. Proportion of trees with scars in 2019.

Very few trail features appear to influence the changes in number of scars on trees over time, with only the “Downhill” category significantly decreasing between 2018 and 2019 (Figure 12).

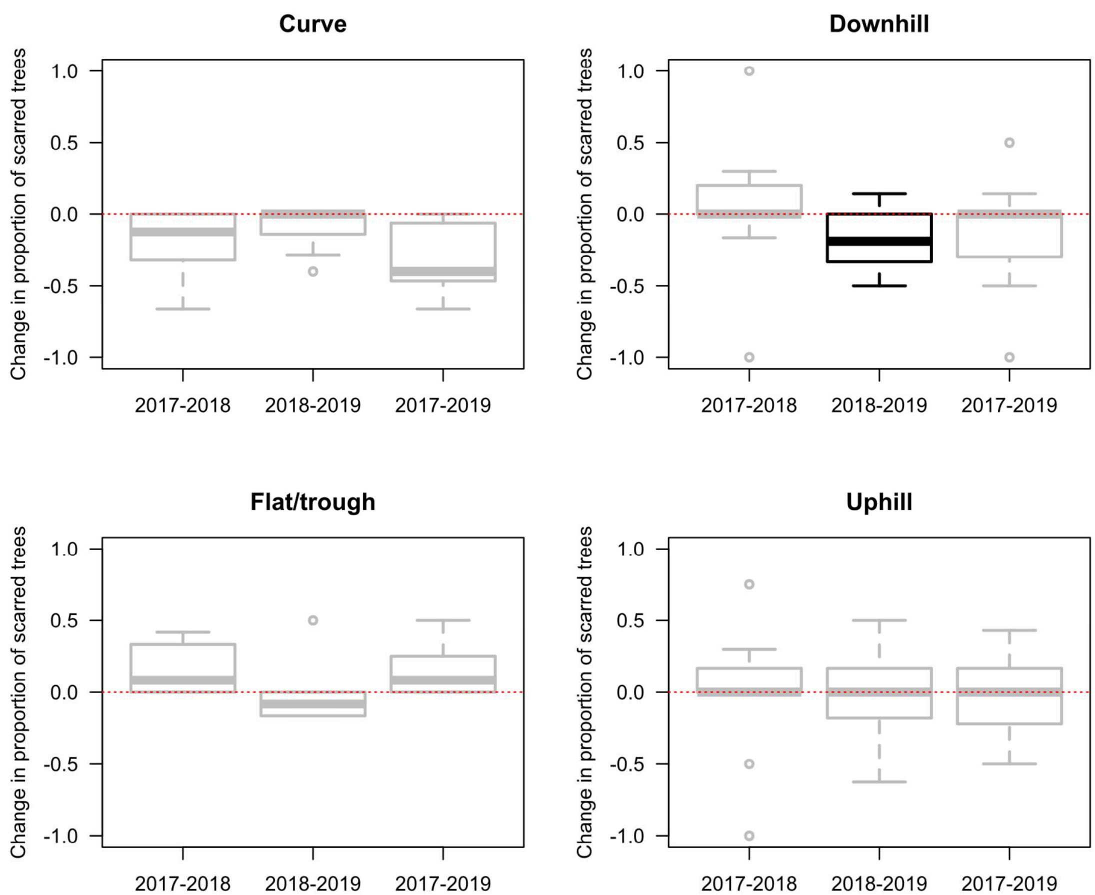

Figure 12. Changes in proportion of scarred trees over time and among trail feature categories. Black boxes indicate significant changes between years compared, Positive values indicate an increase in proportion of scarred trees between years.

No significant differences were found in number of scarred trees over time for any of the trail slope categories (Figure 13).

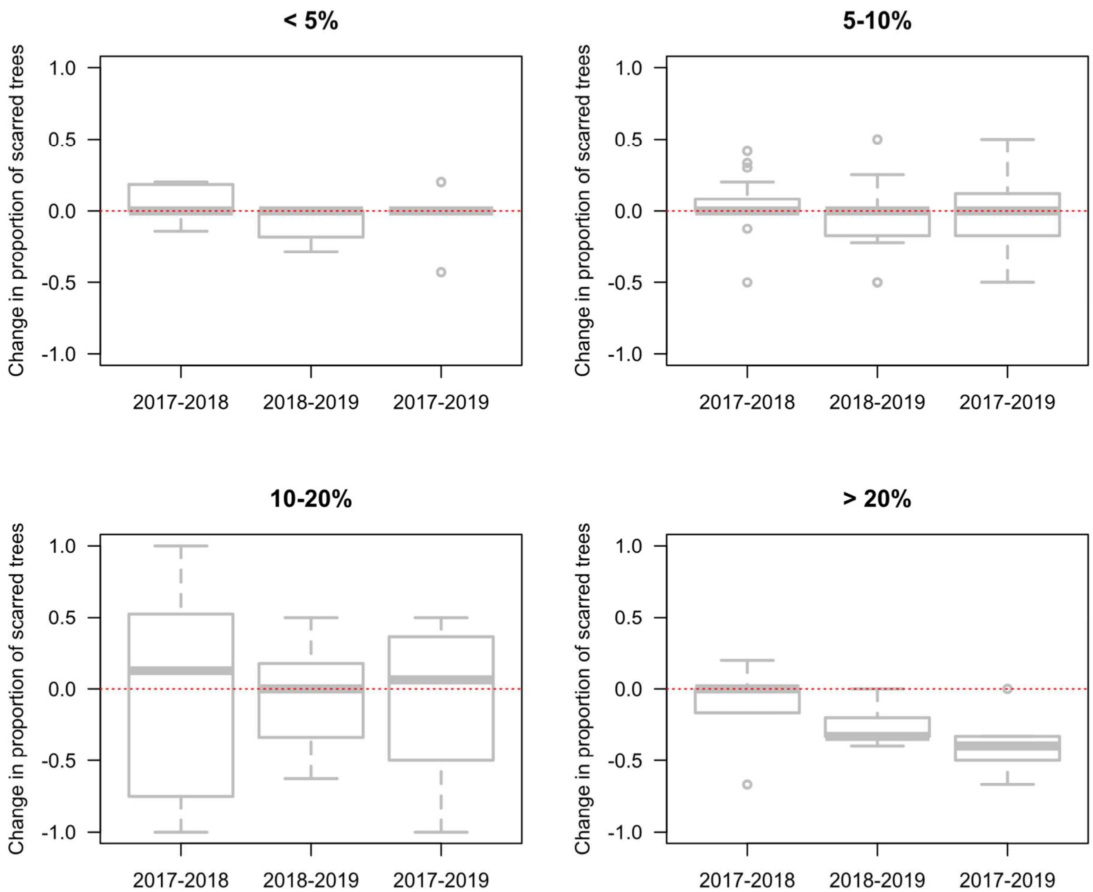

Figure 13. Changes in proportion of scarred trees over time and among trail slope categories. Black boxes indicate significant changes between years compared, Positive values indicate an increase in proportion of scarred trees between years.

Prevalence of weeds

Weeds were not found on the mountain bike trail with the exception of a section of the trail which crosses a fire break (Figure 14). This section of the trail has become infested with *Pelargonium capitatum* (Rose pelargonium). In a 10m section of the trail where it crosses the fire break, 49 Rose pelargonium plants were counted in 2018, and this figure had increased to 58 in 2019.

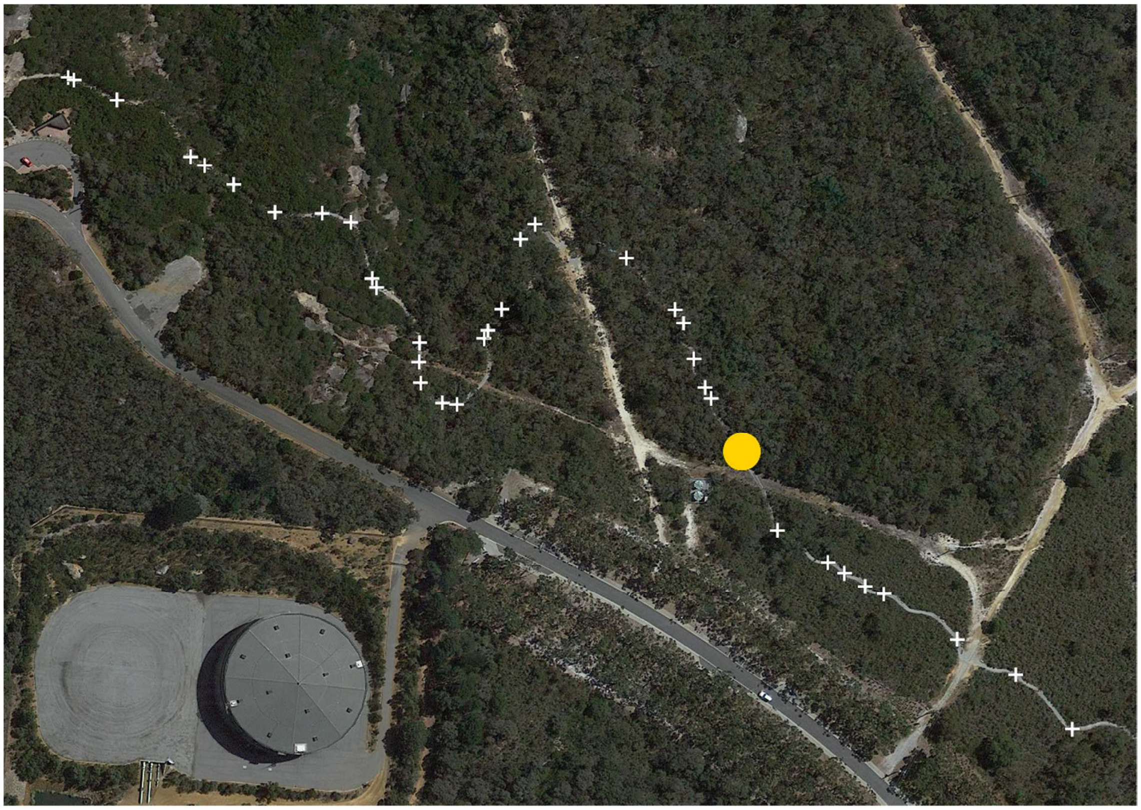

Figure 14. Location of transect with high abundance of weeds.

Conclusions

To summarise the results,

- The upper regions of the trail were found to widen more in 2017 – 2018, the lower regions are widening, but at a slower rate.
- The greatest trail widening was observed in the “Downhill” features, followed by the “Uphill” features.
- Of the slope categories, trail widening was greatest in the moderate (“5-10%” and “10-20%”) categories.
- Maximum incision depth had the greatest change in the middle region of the track in 2017 – 2018, but greater increases in the lower regions in 2017 – 2019.
- Similar to trail width, maximum incision depth increased the most in the “Downhill” feature category, followed by the “Uphill” feature category.
- Maximum incision depth increase was greatest in the lower (“< 5%” and “5 – 10%”) slope categories.
- The highest proportion of trees with scars are in the middle region of the trail.

- Proportion of scarred trees does not seem to be associated with trail feature of slope categories.
- Weeds are highly localised on the trail and appear to be a associated with the presence of a fire break.
- Continuing annual monitoring is recommended.

References

Cook, B.A. 2018. Monitoring plan for assessing impacts of recreational use of mountain bike trails on Mounts Clarence and Adelaide, Albany. Report No CENRM146. Centre of Excellence in Natural Resource Management, University of Western Australia.

Marion, J.L. (2006). Assessing and understanding trail degradation: results from Big South Fork National River and Recreational Area. Final research Report, National Park Service, United States Department of the Interior.

Newsome, D., Stender, K., Annear, R., & Smith, A. (2016). Park management response to mountain bike trail demand in South Western Australia. Journal of Outdoor Recreation and Tourism, 15, 26-34.

Wimpey, J.F., & Marion, J.L. (2010). The influence of use, environmental and managerial factors on the width of recreational trails. Journal of Environmental Management, 91, 2028-2037.