



Highly Commended

Science Investigation

Year 11 - 12

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Prescribed Burning: Balancing bushfire management objectives with soil degradation and loss of biodiversity

To what extent does time since prescribed burning (13 years vs 30 years since burn) affect ground cover of *Oxalis pes-caprae*, hydrogen ion activity (pH), and soil percolation rate (cm min^{-1}) in Anstey Hill Recreation Park, South Australia?

Word Count¹: 2013

Note: Justifications are in pink text

¹ Excluding titles, subheadings, data tables, equations, captions, footnotes and in-text referencing

Questioning:

To what extent does time since prescribed burning (13 years vs 30 years since burn) affect ground cover of *Oxalis pes-caprae*, hydrogen ion activity (pH), and soil percolation rate (cm min⁻¹) in Anstey Hill Recreation Park, South Australia?

Background:

Context: An unplanned bushfire can be started by natural causes or human activities, leading to loss of life and infrastructure destruction. The consequences of such bushfires convinced many foresters of the need for prescribed fire to reduce fuel hazard and, therefore, wildfire damage. Prescribed burning, is defined as ‘the controlled application of fire under specified environmental conditions to a predetermined area and at the time, intensity, and rate of spread required to attain planned resource management objectives’ (The Australasian Fire and Emergency Services Authorities Council, 2012). They limit speed & intensity of bushfires which makes them easier to control (A Shared Responsibility: Keelty et al, 2011). It is a common in-situ conservation² strategy in Australia’s northern tropical savannahs that has great potential to lessen carbon emissions.

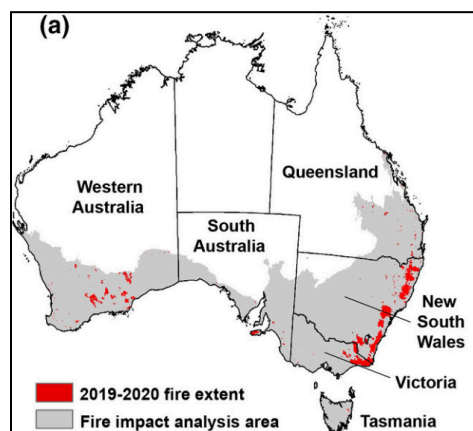


Figure 1: The scope of impact of disastrous wildfires in 2019-2020 Australia (red) and areas most at risk of impact (grey)

² involves protecting species within their natural habitats by maintaining ecosystems and natural processes

Prescribed burning causes an immediate decrease in vegetation cover; burned organic material is deposited onto the soil as alkaline compounds, increasing its pH (Figure 2) However as vegetation recovers and precipitation leaches away the alkaline ash, pH falls back to pre-fire levels. In 2022-23, Indigenous prescribed burning in Kimberley, Australia avoided over 180,000 tonnes of greenhouse gas emissions from fires and continues to deliver significant improvements in fire patterns across the region.

The findings of this study would discuss the effectiveness of prescribed burning in ecological succession³, change in pH & soil chemistry after burn, and to restore and conserve biodiversity in fire-adapted landscapes.

Predicting:

Alternate hypothesis: If the time since fire increases, then *O. pes-caprae* cover (%) will increase, soil pH will stabilize near neutral and percolation rate will decrease.

Null hypothesis: There is no significant difference in vegetation cover, soil pH, or percolation between 1995 and 2012 sites.

³ describes how ecosystems evolve after a disturbance over time, ranging from gradual changes to rapid transformations

Site Description:

Anstey Hill Recreation Park is a 362-hectare protected area located approximately 19 kilometres northeast of Adelaide, South Australia (Figure 4)→Ideal location for this investigation as it is subject to frequent, deliberately lit fires with a path winding up the hill providing a fire break.



Figure 2: Aerial shot of park location with fire breaks outlined in yellow

This fire break (in Figure 5) is what allows two differing burn areas to be studied, inspecting the efficiency of prescribed burns in ecosystem rejuvenation. A large proportion was burnt down in 1995 and another controlled burn occurred in 2012 to reduce bushfire risks within the park.



Figure 3: Site Location from above (left) and street view (right) - Google Earth

Given the scope and temporal constraints of the investigation these 2 burn sites were valid and provided closest estimates in ecosystem recovery

Variables:

Table 1: Independent Variable

Independent variable	Sampling	Why is it suitable
Time since Prescribed Burns (different sites) ↓ Controlled laboratory burn instead of observing burn sites is invalid as real world field burns capture authentic ecological processes	Collection of samples from more recent 2012 burn (12 years ago) vs 1995 burn (30 years ago) displays stratified sampling ⁴ .	It's a suitable IV as there is a quantifiable cause-effect relationship observed and is a feasible measurement for a school-level investigation.

Table 2: List of dependent variables

Dependent variables	How is it measured	Why is it suitable
Ground cover of <i>O. pes-caprae</i> :  Figure 4: <i>O. Pes-caprae</i> in Anstey Hill Recreation Park - Taken by Author	Population measured using a 5x5 Quadrat and percentage cover (%) was estimated. → 5 replicate quadrat data was collected to reduce the impact of anomalies and improve data reliability.	Suitable DV as: common bushland weed widespread across Australia, making it an effective indicator of disturbance from prescribed burning.

⁴ population is divided into subgroups (strata) based on shared characteristics, and then random samples are drawn from each stratum

Soil pH	Measured using soil pH test kit and color change compared to pH chart (provided with kit)	Suitable DV as it is measurable, continuous. → Triplicate samples from each site which were tested for 5 trials each increases reliability of data and reduces anomalies.
Soil Percolation Rate ⁵ : 	Soil samples collected from 5-inch depth and measured using percolation test set-up and time to drain water was recorded; soil percolation rates were calculated (cm min^{-1}). ↓ 5-inch sampling represents topsoil most affected by fire and relevant for seed germination/root recovery	Suitable DV as: numerical measure that allows statistical comparison between sites burned at different times.

Figure 5: 5-inch dug soil from Anstey Hill Recreation Park - Taken by Author

→ Percolation is more informative than simply measuring soil moisture or organic content, because the movement of water through the soil is crucial for understanding ecosystem health & nutrient transport

⁵ the speed at which water moves downward through the soil.

Table 3: List of controlled variables

Controlled Variables	How is it controlled	Effect on data <i>if uncontrolled</i>
Sampling method & Location	All samples collected using same method & at consistent distances using a transect	Varying pH & soil physical properties
Stable weather conditions	Sampling on the same clear, humid day	Increased surface runoff, stirring up sediments
Volume of soil and water poured during soil percolation test	Same volume of soil (200 cm ³) & amount of water used to measure drainage time (100 mL)	Reduced validity of results & provide inaccurate time readings
Sample handling time and conditions	Tested 1 day after collection and kept in consistent temperature	Time delay/Temperature difference between collection & testing can lead to chemical changes
Stopwatch start time	Start stopwatch consistently and at same endpoints	(Some human lag unavoidable) Less reliable data and no fair comparison between samples.

Table 4: Uncontrolled variables

Uncontrolled variables	How is it uncontrolled
Estimation bias in quadrat cover	Cannot control accuracy of percentage cover; different observers may judge the quadrat differently leading to observer bias
Past rainfall	Sampling after mild rain for 3-4 days. Can increase soil moisture content and slightly alter pH
Soil type variation	Naturally differs across varying quadrats due to changes in pH & moisture; can't be standardised either

Sampling Strategy:

All data and sample collection was done near Gate 7 entrance of Anstey Hill Recreation Park after mild rain on 8/7/2025 from 2 - 4pm. Studying the effect of prescribed burning across 2 different sites allows for capturing the variation in the intensity of the burn, i.e. vegetation near the fire break may be shaded and less burnt than plants further along the transect (away from break).

Materials⁶:

Table 5: List of Materials used

Quantity	Specification	Equipment	Uncertainty
1	Volume: 290.57cm ³ , Height: 25cm	Soil Column Percolation Test Kit	±0.1cm
1	Barium sulphate powder included	Manutec Garden Care Products Soil pH Test Kit	N/A
1	50cmx50cm Grid	Quadrat	±5cm
1	10m	Transect	±0.04m
1	30 cm	Ruler	±0.05cm
1	Appropriate Size	Pair of Latex Gloves	N/A
30	Medium size	Ziplock Bags	N/A
1	N/A	Stopwatch	Human Reaction Time (±0.2s)
6	100 mL each	Beaker of tap water	±0.5mL
1	With bosshead clamp	Retort Stand	N/A

Colourimetric kits are less precise than digital probes, but affordable and accessible at school level. Multiple replicates were taken to offset reduced precision.

10m transect to balance coverage with time constraints; past studies show vegetation variability can be captured within this distance (Glaser et al).

⁶ always rinse all equipment with distilled water between and after uses to prevent contamination, and follow all lab guidelines including personal protective equipment.

Method (See Figure 5 for site map):

1. Quadrat Sampling⁷

- 1.1. Unravel 10m transect starting from edge of the fire break towards the RB⁸ site.
- 1.2. Place a quadrat within 0 - 2m on one side of the transect as shown in Figure 8.
- 1.3. Look at the population of *O. pes-caprae* in each square of the quadrat and record the number of squares with a population estimate of more than half.
- 1.4. Since a 5x5 quadrat is used, each square is 4% of the 100% grid. Note the estimated population in a quadrat by multiplying the number of squares with 4%.



Such systematic sampling using a transect ensures a structured approach to analyse species distribution across gradients

Line intercept or point sampling were considered but quadrats chosen as they capture spatial heterogeneity more effectively.

Figure 6: Quadrat in RB site with estimated population of 24% - Taken by Author

- 1.5. Repeat this process by placing the quadrat in 4 other locations within the first transect distance.
- 1.6. Then, perform 5 trials every 2m of the transect (until 10m) of the RB site. (i.e. Total of 25 quadrat samples in this site)
- 1.7. Next, repeat quadrat sampling for LB⁹ site.

Repeated trials help ensure that the results are consistent and not due to random chance. If similar results are obtained across multiple trials, it increases reliability of findings.

2. Soil samples collection

- 2.1. Use a shovel to dig approximately 5-inches within the first 3m of transect.
- 2.2. Collect plenty of soil to fill a medium sized zip-lock bag and store tight.

⁷ This is done in the beginning to avoid disturbance of plant species while collecting samples (trampling)

⁸ For the purpose of simplicity of method RB - Recently Burned

⁹ For the purpose of simplicity of method LB - Burned Long ago

- 2.3. Repeat every 3m of RB site until 9m, then collect from LB site. Remove small plants and rocks manually to maximum extent possible.



Figure 7: Soil sample from LB site (left) & all 6 samples (right) - Taken by Author

3. Soil pH test

- 3.1. Take a small amount of soil from RB Sample I and spread it on a white surface.
- 3.2. Add 5-6 drops of universal indicator from Manutec Soil pH test kit and mix into a paste.
- 3.3. Dust some Barium Sulphate (BaSO_4) powder onto the paste and wait for 1 minute.
- 3.4. Observe the color change and compare with the provided color chart. Record the approximate pH.
- 3.5. Conduct another 2 trials with more soil from RB Sample I. Then, repeat the process for RB Sample II, RB Sample III, and all LB Samples.



Figure 8: Soil mixed with indicator (left) & Color change comparison (right) - Manutec Youtube channel

4. Soil Percolation Rate

- 4.1. Use funnel to add soil (from RB Sample I) in the cylindrical column affixed to a retort stand, up to ~18 cm height.
- 4.2. Make sure stopcock is closed and pour 100mL of tap water from above.
- 4.3. Open the stopcock and immediately turn on the stopwatch. Record time to drain water.
- 4.4. Calculate the percolation rate using formula. Repeat for other 2 RB Samples¹⁰ and conduct the tests for 3 LB Samples.

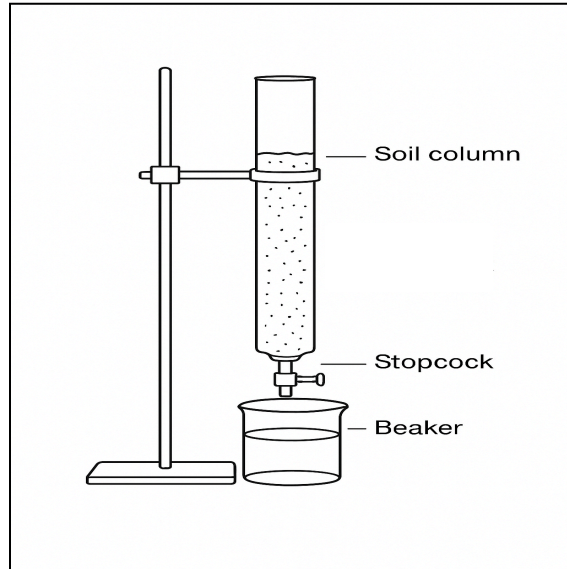


Figure 9: Soil Column Percolation test setup

¹⁰ Not possible to conduct multiple percolation test trials on same sample, as water content and soil composition change after 1st trial

Risk Assessment:

Table 6: List of Field & Lab Hazards

Field Hazard	Risk	To minimise risk
Field Work	Sun exposure → sunburn, dehydration. Debris and broken twigs, steep slope risks, uneven rocky ground, and snake/spider encounters (common in SA bushland) may obstruct movement/cause tripping	Boots with ankle support. Bring water. Gloves when handling samples
Sample Collection Location	Working in remote areas may isolate individuals, cannot call for help in case of emergency	Have a medium of communication (phone), extra peers for assistance
Fire risk	Prescribed burns can occur or high fire danger days (low-medium risk due to fall season)	Check CFS (Country Fire Service) warnings
Lab Hazard	Risk	To minimise risk
BaSO ₄	Inhalation can cause irritation in respiratory system (high-likelihood; low-severity). Harmful if swallowed (low-likelihood; moderate-severity)	Wear gloves & mask, avoid ingestion
Accidental injury	Cylindrical tube/beaker may either break & fragments can cut. Shovel may crush hand (low-moderate likelihood and severity)	Handle equipment with care and dispose properly if broken
Soil handling	Soil can contain pathogens, fungi, and faecal material.	Wear gloves, wash hands thoroughly after handling.

Table 7: Ethical considerations

Ethical Concerns
1) Compliance with ethical guidelines: Regular walking and shovelling can crush small plants. May compact the soil, reducing water absorption. Ensure minimal disruption of habitat.
2) Attached organisms: Unintentional harm to other plant/microorganism species by scooping them along with soil sample; disruption of microecosystems (moderate). Inspect samples before removal. Return attached organisms.
3) Informed permission: Permission from park managers obtained and ensured work was done only in publicly accessible areas used for recreation.
4) Disposal: Samples' soil chemistry altered by adding reagents to test for pH → cannot be dumped back into the forest soil. Make sure post-experiment, contaminated soil is sealed and disposed via school science department waste stream.

Raw Data:Table 8: Quadrat Data - Ground cover of *O. pes-caprae*

Site	Quadrat Number	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
1995 Burnt	Q1 (0-2m)	60%	67%	63%	66%	64%
	Q2 (2-4m)	45%	50%	52%	46%	47%
	Q3 (4-6m)	42%	47%	41%	43%	47%
	Q4 (6-8m)	86%	81%	83%	87%	83%
	Q5(8-10m)	90%	91%	95%	94%	90%
2012 Burnt	Q1 (0-2m)	50%	55%	49%	53%	53%
	Q2 (2-4m)	6%	10%	9%	7%	8%
	Q3 (4-6m)	22%	25%	27%	21%	25%
	Q4 (6-8m)	18%	22%	20%	19%	21%
	Q5(8-10m)	3%	5%	4%	4%	4%

Table 9: Soil pH Data

Sites	Sample	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
1995 Burnt	I (0-3m)	7.5	7.5	7.5	7.5	7.5
	II (3-6m)	7.5	7	7.5	7.5	7.5
	III (6-9m)	7.5	7.5	7	7.5	7.5
2012 Burnt	I (0-3m)	8	8	8	8.5	8
	II (3-6m)	8	8	8.5	8.5	8
	III (6-9m)	8	8	8	8	8

Table 10: Percolation Time

Sites	Sample	Time to drain (minutes)
1995 Burnt	I (0-3m)	11.64
	II (3-6m)	11.0
	III (6-9m)	12.0
2012 Burnt	I (0-3m)	5.93
	II (3-6m)	6.56
	III (6-9m)	5.03

Processed Data (Mean Values):

Table 11: Mean Quadrat Data

Sites	Quadrat	Average of each sample (%)	Mean of all Quadrat percentages (%)	Standard Deviation (%)
1995 Burnt	Q1	64	66.4	21.3
	Q2	48		
	Q3	44		
	Q4	84		
	Q5	92		
2012 Burnt	Q1	52	21.6	18.9
	Q2	8		
	Q3	24		
	Q4	20		
	Q5	4		

Table 12: Mean Soil pH

Sites	Sample	Soil pH Average	Mean of all samples' pH	Standard Deviation
1995 Burnt	I	7.5	7.43	0.06
	II	7.4		
	III	7.4		
2012 Burnt	I	8.1	8.13	0.06
	II	8.2		
	III	8.1		

Table 13: Calculated soil percolation rate

Sites	Sample	Soil Percolation Rate (cm min ⁻¹)	Mean of all rates	Standard Deviation
1995 Burnt	I	1.55	1.56	0.07
	II	1.64		
	III	1.50		
2012 Burnt	I	3.03	3.12	0.43
	II	2.74		
	III	3.58		

Table 14: Two Sample T-Test Results

Data Type	P - value	T - statistic
Vegetation percentage cover	0.00041	3.52
Soil pH	0.00000003	-19.08
Soil Percolation rate	0.00052	-8.01

→ If the p-value is lower than the standard significance level of 0.5, the data is less likely a chance occurrence and rejects the null hypothesis.

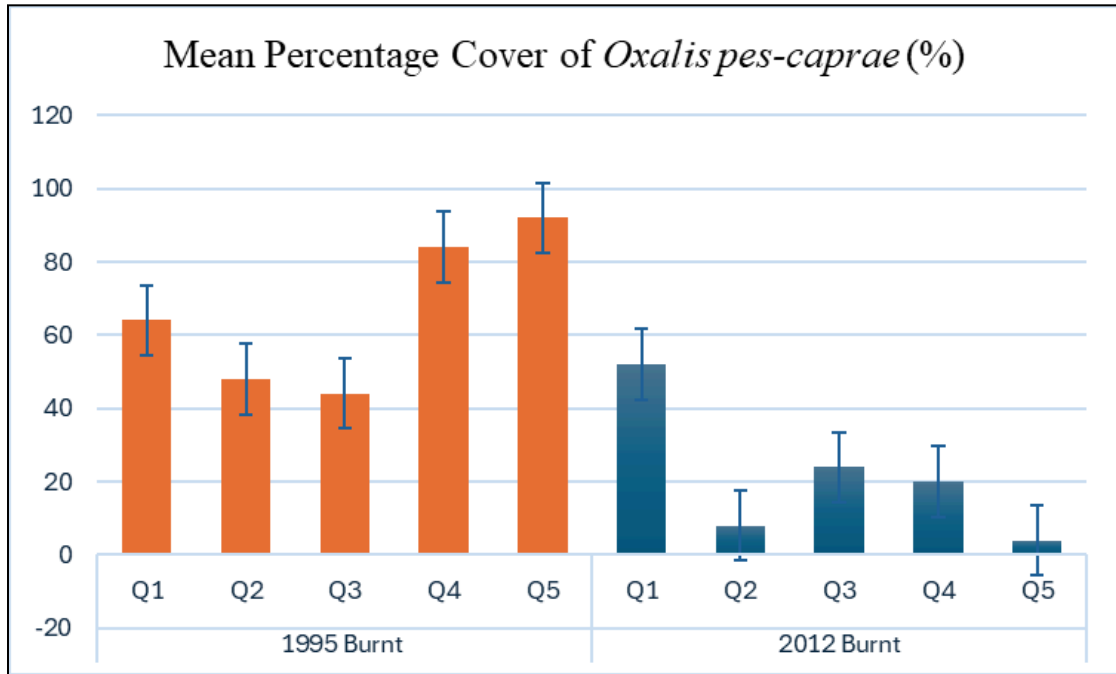
Calculations:

Table 15: List of calculations used

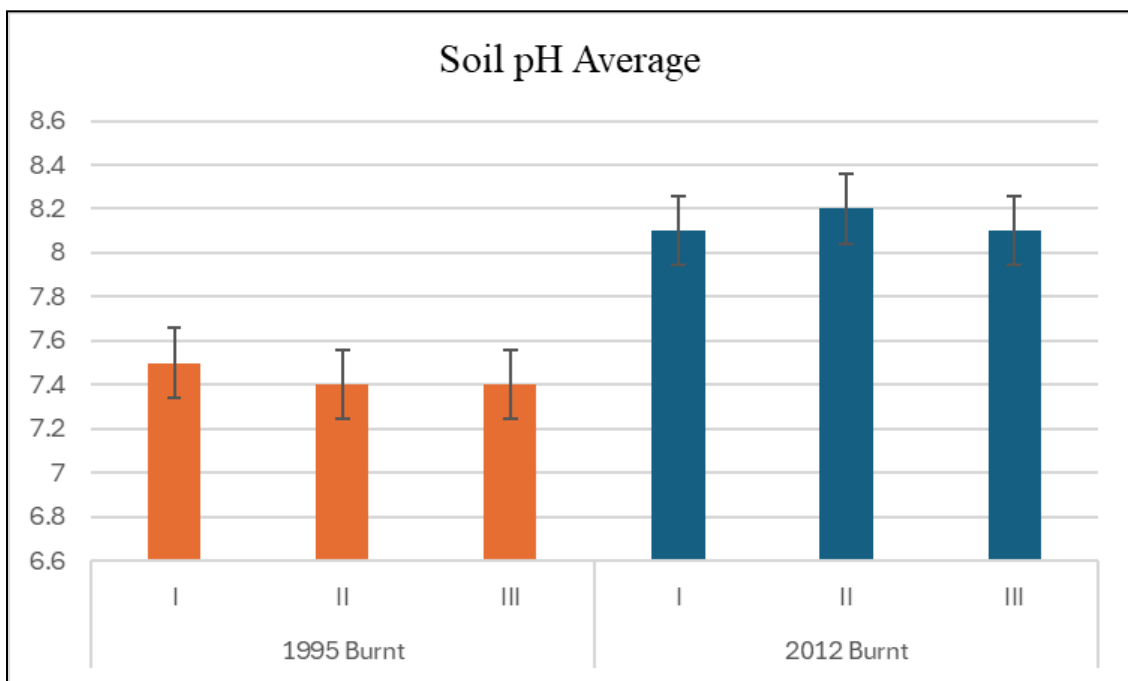
Formula	Explanation	Sample calculation
Mean/Average $\bar{x} = \frac{\sum x}{n}$ <i>n</i> = total number of samples	The sum of all sample values divided by number of samples gives average	Avg of Q1 from 1995 burnt site (60% + 67% + 63% + 66% + 64%) / 5 = 64%
Soil Percolation Rate Rate = $\frac{\text{Height of soil}}{\text{Time to drain water}}$	The speed at which water moves downward through the soil	Soil percolation rate of Sample I from 1995 burnt site (Height = 18cm for all samples) $\frac{18}{11.64} = 1.55 \text{ cm min}^{-1}$
Standard Deviation $\sigma^2 = \frac{\sum (xi - \mu)^2}{N}$ <i>N</i> = size of population μ = population mean <i>xi</i> = each value from the population	A measure of how spread out data points are from their average value (mean). It quantifies the dispersion or variability within a dataset.	Standard deviation of collective quadrat percentage from 2012 burnt site $\sqrt{\frac{924.16+184.96+5.76+2.56+309.76}{4}} = 18.9$
Welch's T-Test $\frac{(x1 - x2)}{sp(\sqrt{1/n1 + 1/n2})}$ where <i>x1</i> , <i>x2</i> - sample means <i>n1</i> , <i>n2</i> - sample sizes	Used to determine if there's a statistically significant difference between the means of 2 burn sites.	Used online two sample t-test calculator (statskingdom.com, 2017)

Graphs:

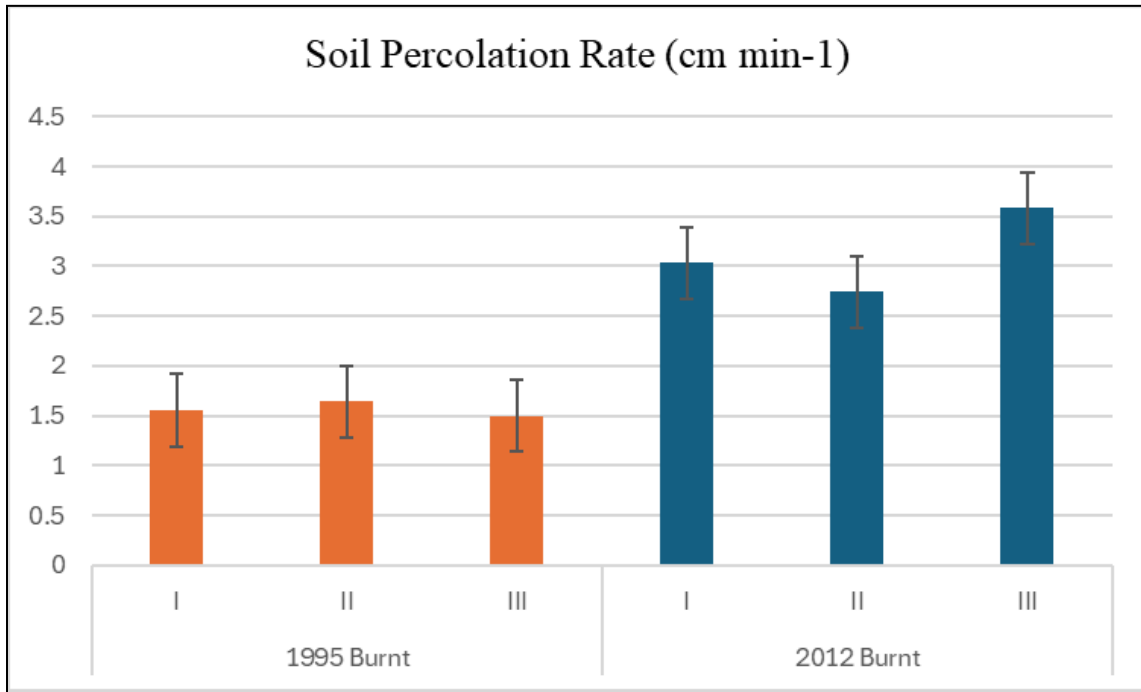
Graph 1: Mean *O. pes-caprae* cover 1995 vs 2012 with error bars



Graph 2: Mean soil pH 1995 vs 2012 with error bars



Graph 3: Mean soil percolation rates 1995 vs 2012 with error bars



Analysis:

Graph 1 reveals higher cover of *O. pes-caprae* in the site burned in 1995 than the site burned in 2012. The results from the Welch's T-Test (see Table 14) display a p-value of 0.00041 (<0.05), implying that the observed difference in *O. pes-caprae* cover between the 2 sites is unlikely to be a matter of chance. The higher t-statistic of 3.52 suggests a statistically significant difference between the percentage means, relative to the variability within the data set.

Graph 2 shows higher pH levels in the site burned in 2012 compared to the site burned in 1995. This means that the soil from the site burned relatively recently is more alkaline than older soil, likely due to the deposition of ash and combustion of organic litter materials during prescribed fires. The pH level of soil from the 1995 burned site is close to a neutral pH of 7, allowing growing vegetation to thrive with near-optimal availability of essential nutrients. The standard deviation of data from both sites is 0.06 (Table 12) and the lower value indicates homogenized soil pH. This supports the hypothesis that prescribed fires remove acidic organic matter and instead distributes alkaline ash evenly & reduces variation. The p-value 3×10^{-8} ($<$ significance level of 0.5) and the t-statistic is very large (see Table 14), indicating that there is random variability.

Graph 3 evidences a higher rate of soil percolation in samples from the site burned in 2012 (mean of 3.12 cm min⁻¹) than the samples from 1995 burned site (see Table 13). As hypothesized earlier, this suggests that post-prescribed burning, water infiltrates the soil improving uptake in plant roots, and reduces soil compaction. A standard deviation of 0.43 shows high variability of soil percolation across the site. Since p-value 0.00052 (< significance level of 0.5), there is a larger difference between downward-water movement in 1995 burned and 2012 burned sites. The larger and negative t-statistic (-8.01) shows that the difference is not a random occurrence, rather a meaningful distinction caused by reduced leaf litter and burning increasing porosity of soil.

Conclusion:

Therefore, this investigation suggests that the long-term impacts of prescribed burning are indeed worth the temporary disruption of the existing ecosystem. The results propose that prescribed burning causes healthier nutrient cycling and establishment of new communities of plant species. Prescribed burning reduces the risk of more harmful wildfires and has a lesser impact on overstorey trees. Carefully planned burns can be used to create the habitats required by some species (as seen in the regrowth of *Oxalis pes-caprae* and neutralising of soil pH over time).

Evaluation of Conclusion:

Statistical data with lower p-values and higher t-values indicate that the differences between the sites are significant; which strengthens the reliability of the conclusion that there are major impacts on the burned ecosystem.

Limitations of this investigation:

- a) Random errors such as estimation of quadrat cover by human eye could be semi-quantitative and have subjective bias. This would have led to overestimation or underestimation of the number of plants per quadrat, affecting the consistency of results.
- b) Using *Oxalis pes-caprae* as a representative for recovery may skew biodiversity interpretation. Such invasive species inflate biodiversity counts artificially. Abundance of this species may be caused by its favorable conditions and cannot reflect overall ecosystem recovery.
- c) Inaccuracy of pH colorimetric test kits (± 0.2) is a systematic error limiting the precision of hydrogen ion activity. Storing soil in ziplock bags may have increased its compaction and altered its moisture content.
- d) As it was a field investigation, extraneous environmental conditions could not be controlled. Recent precipitation could have increased the moisture content in the soil and variation in sunlight could have influenced vegetation growth.

Modifications for further research:

Use soil probes instead of colorimetric test kits to improve accuracy. Repeat across multiple seasons to ensure consistency in results. Extend to multiple post-burning times (5, 10, 20, 30 years) for congruous data. Replicate research in other ecosystems to investigate variability in data.

Application:

Based on the results of this investigation, it takes around 30 years or longer for the Adelaide Hills ecosystem to balance fuel reduction and biodiversity recovery. As seen in 66.4% cover of *O. pes-caprae* in the 1995 burnt site, this is attributed to the increased number of years available for the site to maintain forest health by recycling nutrients bound up in litter and twigs. It has only been 13 years since the other site was burned in 2012; which had destroyed the major population of the species, altered soil chemistry, but did not have enough time to regenerate yet.

These results can be used to inform governments and forest authorities on the optimal time interval between consecutive prescribed burns while drafting fire management strategies. When replicated on a larger scale, if data shows soil & vegetation recovery after about 20–30 years longer intervals between prescribed burns should be supported. And if data shows incomplete recovery at 13 years, the risks of burning too frequently must be taken into consideration. Implementing fire management policies that provide time for ecosystem rejuvenation and enhanced biodiversity can help attain the maximum benefits of controlled burning. Additionally, such results could guide whether areas require supplementary revegetation after burns (e.g., planting native species if invasive *Oxalis pes-caprae* dominates).

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Log Book:

Ideation:

Investigation ideas	Status	Why/Why not
What are the varying effects of freshwater or greywater irrigation on the soil quality (phosphate levels, nitrate levels, pH and moisture content) and environmental sustainability in community gardens/school gardens across Adelaide, South Australia?	No	- Hard to obtain permission from schools to conduct field research. - Background on the type of irrigation in sites not available publicly. - Multiple variables making it impossible to explore all in detail within the word limit.
To what extent does human recreational activities impact water turbidity, pH, phosphate & nitrate levels of an urban stream (Torrens River) compared to the impact on a natural stream (Onkaparinga River) in Adelaide, South Australia?	No	- 'Recreational activities' could not be defined or limited to few as it was a public site. - No phosphate/nitrate tests available at school that were accurate enough.
To what extent does prescribed burning affect soil moisture content, pH, and plant concentration in a recently burned area vs an area burned 10 years ago in Anstey Hill Recreation Park, Adelaide, South Australia?	Yes	- Highly relevant in South Australia and research could be applied to sustainable goals. - Less frequently used area by residents so less pollutants affecting the ecosystem. - Manipulation of IV already done on the field.

(Risk Assessment form below and in Tables 6 & 7)

Commencement of investigation:

Date	Activity	Notes
19/6/2025	Risk assessment and lab booking approved on RiskAssess	Collect quadrat data and soil samples on 7/7/2025. Email Lab technician to have prepared, 1 x Quadrat 6 x Ziplock bags 1 x Pair of gloves 1 x Shovel Lab 2SC03 is assigned to me for testing; need to book a time.
7/7/2025	Initial scouting of site	Checked the weather forecast for the next day (cloudy). Went to Anstey Hill park and selected suitable testing site near Gate 7 as there are few joggers and no traffic nearby.
8/7/2025	Soil samples collected	Went back to site and collected quadrat data first as digging into the soil will disrupt the natural vegetation cover. Then, collected 3 soil samples each in both site conditions. Collected soil across varying distances on the transect to account for variation.
9/7/2025	Soil samples set up at home in controlled conditions	Will let them acclimate over Sunday as school lab is closed. Currently in ziplock bags, near an open window.
11/7/2025	15 Trials each of pH testing for LB & RB site completed (5 per ziplock bag - 3 bags per site)	Used minimal amounts of soil to test pH; large amount still available for soil percolation tests tomorrow
12/7/2025	3 trials each per site completed	Soil percolation tests add moisture content so cannot repeat more trials per bag.

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Table 9: Soil pH Data

Sites	Sample	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
1995 Burnt	I (0-3m)	7.5	7.5	7.5	7.5	7.5
	II (3-6m)	7.5	7	7.5	7.5	7.5
	III (6-9m)	7.5	7.5	7	7.5	7.5
2012 Burnt	I (0-3m)	8	8	8	8.5	8
	II (3-6m)	8	8	8.5	8.5	8
	III (6-9m)	8	8	8	8	8

Table 10: Percolation Time

Sites	Sample	Time to drain (minutes)
1995 Burnt	I (0-3m)	11.64
	II (3-6m)	11.0
	III (6-9m)	12.0
2012 Burnt	I (0-3m)	5.93
	II (3-6m)	6.56
	III (6-9m)	5.03

Acknowledgement of AI:

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OSA RISK ASSESSMENT FORM

for all entries in (✓) ☐ Models & Inventions and ☐ Scientific Inquiry

This must be included with your report, log book or entry. One form per entry.

STUDENT(S) NAME: Dishitha Ayyar ID: 190-7809

SCHOOL: Glenunga International High School

Activity: Give a brief outline of what you are planning to do.

Investigate the effectiveness of prescribed burning on vegetation and soil properties through the measure of the ecosystem's recovery

Are there possible risks? Consider the following:

- Chemical risks: Are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal risks: Are you heating things? Could you be burnt?
- Biological risks: Are you working with micro-organisms such as mould and bacteria?
- Sharps risks: Are you cutting things, and is there a risk of injury from sharp objects?
- Electrical risks: Are you using mains (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation risks: Does your entry use potentially harmful radiation such as UV or lasers?
- Other hazards.

Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Risks	How I will control/manage the risk
1) Ziplock bags could lead to suffocation or might melt when in contact with high temperatures 2) Shards from broken glass beakers/petri dishes could cause cuts and serious injury 3) Microorganisms and pathogens present in the soil sample could be harmful to researcher or lab environment 4) Disruption of natural habitat when collecting samples on the field	- Use PPE kits while testing samples in the lab - Wear boots, gloves and drink plenty water during field work - Conduct investigation in publicly accessible areas used for recreation that ensures lowest disruption of habitat - Avoid ingestion of plant samples and use gloves while handling glass beakers.

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Dishitha Ayyar

SIGNATURE(S): Dishitha

☒ By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

TEACHER'S NAME: Ian Lau

SIGNATURE: IL DATE: 16/06/26

Log Book:

Ideation:

Investigation ideas	Status	Why/Why not
What are the varying effects of freshwater or greywater irrigation on the soil quality (phosphate levels, nitrate levels, pH and moisture content) and environmental sustainability in community gardens/school gardens across Adelaide, South Australia?	No	- Hard to obtain permission from schools to conduct field research. - Background on the type of irrigation in sites not available publicly. - Multiple variables making it impossible to explore all in detail within the word limit.
To what extent does human recreational activities impact water turbidity, pH, phosphate & nitrate levels of an urban stream (Torrens River) compared to the impact on a natural stream (Onkaparinga River) in Adelaide, South Australia?	No	- 'Recreational activities' could not be defined or limited to few as it was a public site. - No phosphate/nitrate tests available at school that were accurate enough.
To what extent does prescribed burning affect soil moisture content, pH, and plant concentration in a recently burned area vs an area burned 10 years ago in Anstey Hill Recreation Park, Adelaide, South Australia?	Yes	- Highly relevant in South Australia and research could be applied to sustainable goals. - Less frequently used area by residents so less pollutants affecting the ecosystem. - Manipulation of IV already done on the field.

(Risk Assessment form below and in Tables 6 & 7)

Commencement of investigation:

Date	Activity	Notes
19/6/2025	Risk assessment and lab booking approved on RiskAssess	Collect quadrat data and soil samples on 7/7/2025. Email Lab technician to have prepared, 1 x Quadrat 6 x Ziplock bags 1 x Pair of gloves 1 x Shovel Lab 2SC03 is assigned to me for testing; need to book a time.
7/7/2025	Initial scouting of site	Checked the weather forecast for the next day (cloudy). Went to Anstey Hill park and selected suitable testing site near Gate 7 as there are few joggers and no traffic nearby.
8/7/2025	Soil samples collected	Went back to site and collected quadrat data first as digging into the soil will disrupt the natural vegetation cover. Then, collected 3 soil samples each in both site conditions. Collected soil across varying distances on the transect to account for variation.
9/7/2025	Soil samples set up at home in controlled conditions	Will let them acclimate over Sunday as school lab is closed. Currently in ziplock bags, near an open window.
11/7/2025	15 Trials each of pH testing for LB & RB site completed (5 per ziplock bag - 3 bags per site)	Used minimal amounts of soil to test pH; large amount still available for soil percolation tests tomorrow
12/7/2025	3 trials each per site completed	Soil percolation tests add moisture content so cannot repeat more trials per bag.

Raw Data:

Table 8: Quadrat Data - Ground cover of *O. pes-caprae*

Site	Quadrat Number	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
1995 Burnt	Q1 (0-2m)	60%	67%	63%	66%	64%
	Q2 (2-4m)	45%	50%	52%	46%	47%
	Q3 (4-6m)	42%	47%	41%	43%	47%
	Q4 (6-8m)	86%	81%	83%	87%	83%
	Q5(8-10m)	90%	91%	95%	94%	90%
2012 Burnt	Q1 (0-2m)	50%	55%	49%	53%	53%
	Q2 (2-4m)	6%	10%	9%	7%	8%
	Q3 (4-6m)	22%	25%	27%	21%	25%
	Q4 (6-8m)	18%	22%	20%	19%	21%
	Q5(8-10m)	3%	5%	4%	4%	4%

Table 9: Soil pH Data

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