Warrumbungle National Park

Environmental Education Centre

Module 4 - Human Impacts Depth Study

Population dynamics - a study of the impact introduced species have on grassy box woodland ecosystems.

Student Name: _____ Date: _____

WOODLAND RESTORATION DEPTH STUDY

Warrumbungle National Park EEC

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NSW GOVERNMENT Education

EZEC Environmental and Zoo Education Centres

Health and Safety Issues

As you are working out in the field you need to be aware that:

- Ground material is often covered in loose material and can be very slippery.
- Rocks, uneven ground and dense undergrowth can lead to a tripping hazard.
- Fallen trees can be rotten and weak.
- Some animals can deliver painful or venomous bites.
- Branches of all sizes fall from trees.
- Exposure to the weather - UV, cold, heat, rain, hail, wind etc…

Inquiry Question:

"How do introduced species affect the Australian environment and ecosystems?"

Outcomes:

Students:

● *outline the biotic and abiotic effects of introduced species*
● *conduct an investigation into a local introduced species, including:*
– reason for introducing the species
– biotic and abiotic effects of the species
– area affected by the species
– human impacts that favour the introduced species
– control or mitigation methods – economic impact of the species
– different views about the value of and/or harm caused by the introduced species, including the views of Aboriginal and Torres Strait Islander Peoples
● *analyse ways in which human activity can upset the balance of ecosystems and favour introduced species (ACSES027)*
● *describe ways in which introduced species contribute to the decline or extinction of native Australian species (ACSES081)*

Student Tasks

- To create a specific inquiry question relating to the inter-relationship of the Eastern Grey Kangaroo and Blue Heliotrope (major agricultural weed and introduced species) and the possible introduction of dingoes to the area.
- The impact of excluding selective herbivory of native vegetation by larger animals and the reintroduction of coarse woody debris (CWD) in a degraded natural landscape.
- Predict/hypothesise an outcome of your field study based on your research of Eastern Grey Kangaroo/Blue Heliotrope/Dingo population dynamics and benefits of coarse woody debris (CWD) in a woodland environment.
- Complete a first hand investigation as part of a field trip to collect primary and secondary data.
- Process and analyse the data to help solve the problem presented by your inquiry question.
- Communicate your scientific findings using a video production.

Before the excursion: Visit https://warrumbung-e.schools.nsw.gov.au/

Complete your pre-excursion research in this booklet by addressing the following questions:

Pre-Excursion Work

1. Terminology – define these important terms

term	definition	term	definition
ecosystem		coarse woody debris (CWD)	
biodiversity		niche	
conservation		terrestrial	
transect		species	
quadrat		population	
abiotic		community	
biotic		woodland	
distribution		tree	
abundance		shrub	
igneous		forb	
sedimentary		grass	
monoculture		predator	
commensalism		parasitism	
mutualism		competition	
weed		herbivory	
Trophic Cascade			

2. Describe the four (4) main processes that can influence population density of a species

I. _____

_____

II. _____

III. _____

IV. _____

3. Outline two sampling methods ecologists use to estimate population density in both plants and animal populations.

I. _____

II. _____

The Species in focus

Eastern Grey Kangaroo (Macropus giganteus), Blue Heliotrope (Heliotropium amplexicaule) and Dingo (Canis lupus dingo)

We are interested in the relationship between these three species in an ecological community. Complete some research into each species to answer the following: (helpful links provided on our website)

i. **<u>Eastern Grey Kangaroo</u> - distribution, diet, habitat, breeding, threats, ecological niche**

ii. **<u>Blue Heliotrope</u> – origins, distribution, mechanism of spread, physical appearance, habitat, toxicity, impact on animals, competition with other flora**

iii. **<u>Dingo</u> - distribution, diet, habitat, breeding, threats, ecological niche**

iv. **Research any known facts about the inter-relationships between the Eastern Grey Kangaroo, Blue Heliotrope and Dingo populations.**

1. How the Wolves Changed the Yellowstone Ecosystem

Watch the How Wolves Change Rivers

a. Where in the food chain does a trophic cascade begin?

i. Bottom
ii. Top
iii. Middle
iv. Scientist are not sure

b. Which organisms were introduced in Yellowstone National Park in the United States that caused a trophic cascade?

i. Elk
ii. Grizzly Bears
iii. Beavers
iv. Wolves

c. Deer multiplied in the park, what was the result?

i. Lots of human-deer interaction
ii. A population crash
iii. An increase in the number of wolves
iv. Overgrazing of the vegetation

d. As a result of the introduction of the wolves, which of the following happened?

i. Tree height increased
ii. Valleys and gorges regenerated
iii. Aspen, cottonwood and willow tree abundance increased
iv. All of the above

e. Along with the wolves, which organisms listed below are an ecosystem engineer?

i. Migratory birds
ii. Song birds
iii. Deer
iv. Beavers

f. List the organisms that thrived as a result of the beaver arrival.

_____

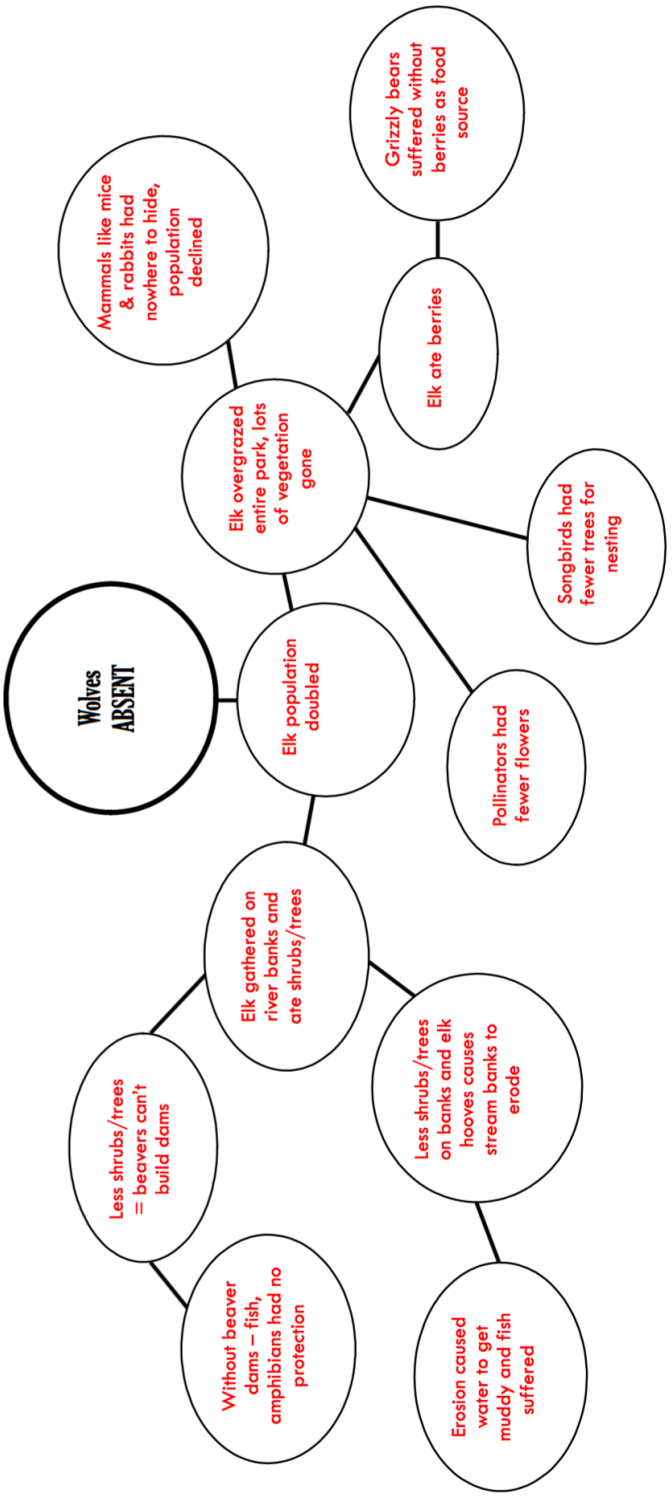
_____

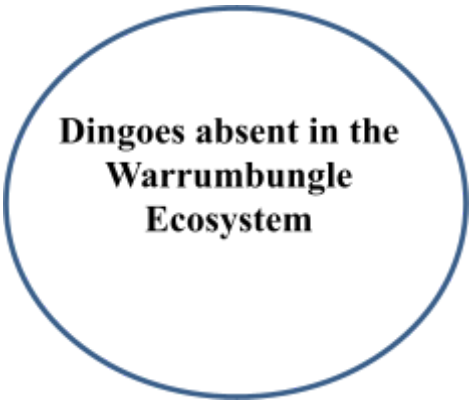
_____

_____

_____

g. From the film a bubble map below shows all of the things that happened in the Yellowstone ecosystem in the absence of wolves. On the next page construct a bubble map that represents the Warrumbungle ecosystem in the absence of Dingoes.




Dingoes absent in the
Warrumbungle
Ecosystem

The Study Site

1. **View these links:**
    a. **Virtual Tour of the sites where the field work will be conducted**

2. **Sketch a map to show the location of the Warrumbungle National Park in relation to NSW towns and also Aboriginal traditional language groups.**

3. **The Gomeroi traditional custodians for thousands of years had a clear understanding how one species impacted other species in a community and this led to a sustainable environment for this area. Research Aborginal traditional land management practices of grassy-box woodlands and the ecological benefits.**

Traditional land management practice	**Ecological Benefit**

4. **Research the major land use patterns around Warrumbungle National Park and how it has changed since European settlement.**

5. **The study sites are 'dry sclerophyll' and mainly consist of Yellow box-Blakely's red gum grassy woodland – <u>explain</u> what this means and the national conservation status of these ecological communities.**

_____

_____

_____

_____

_____

_____

6. **Identify some factors that would influence the distribution and abundance of Eastern Grey Kangaroos, Blue Heliotrope and Dingoes around the Warrumbungle National Park.**

- _____
- _____
- _____
- _____
- _____

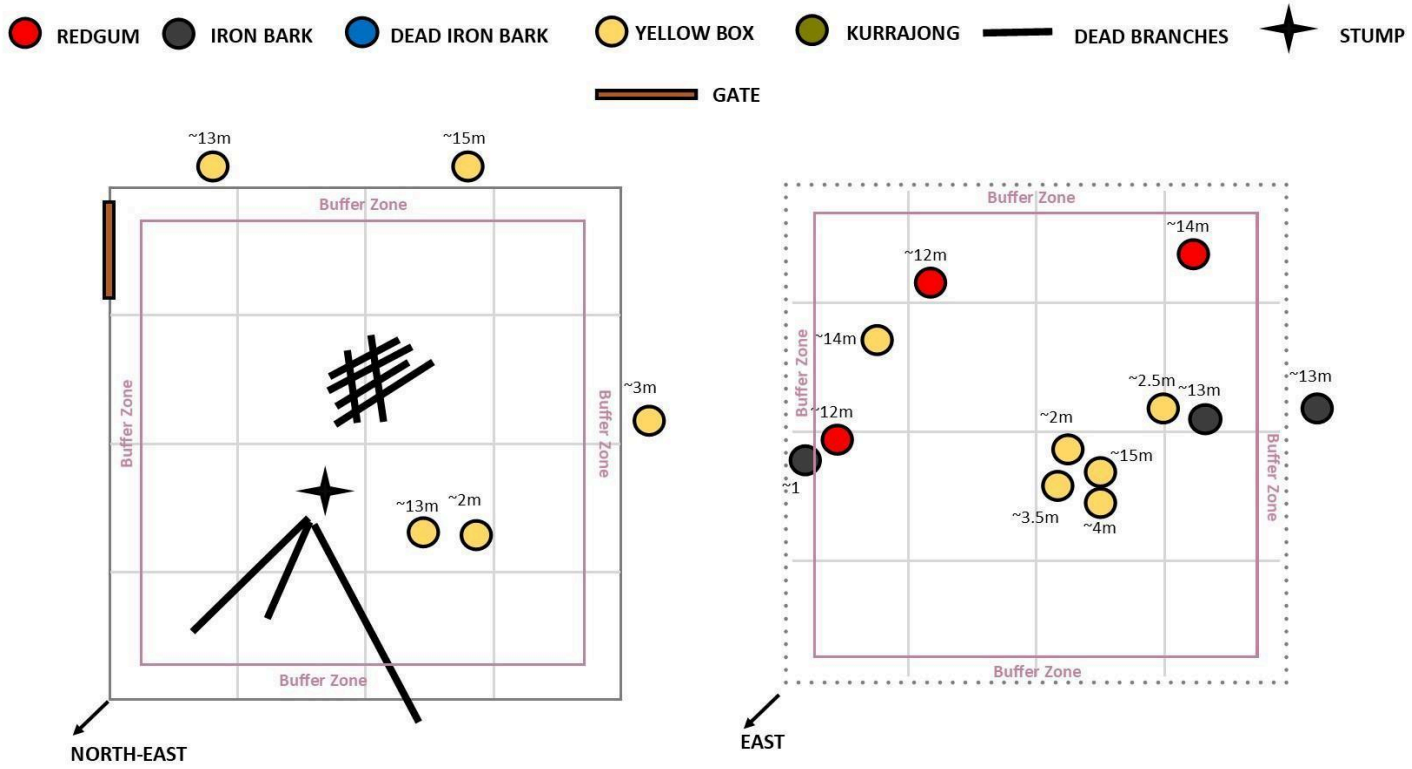
6.

Outline the recent geological history of the Warrumbungle area which makes it so unique.	

7. The four study sites that will form part of your depth study investigation are shown by the aerial view sketch below.

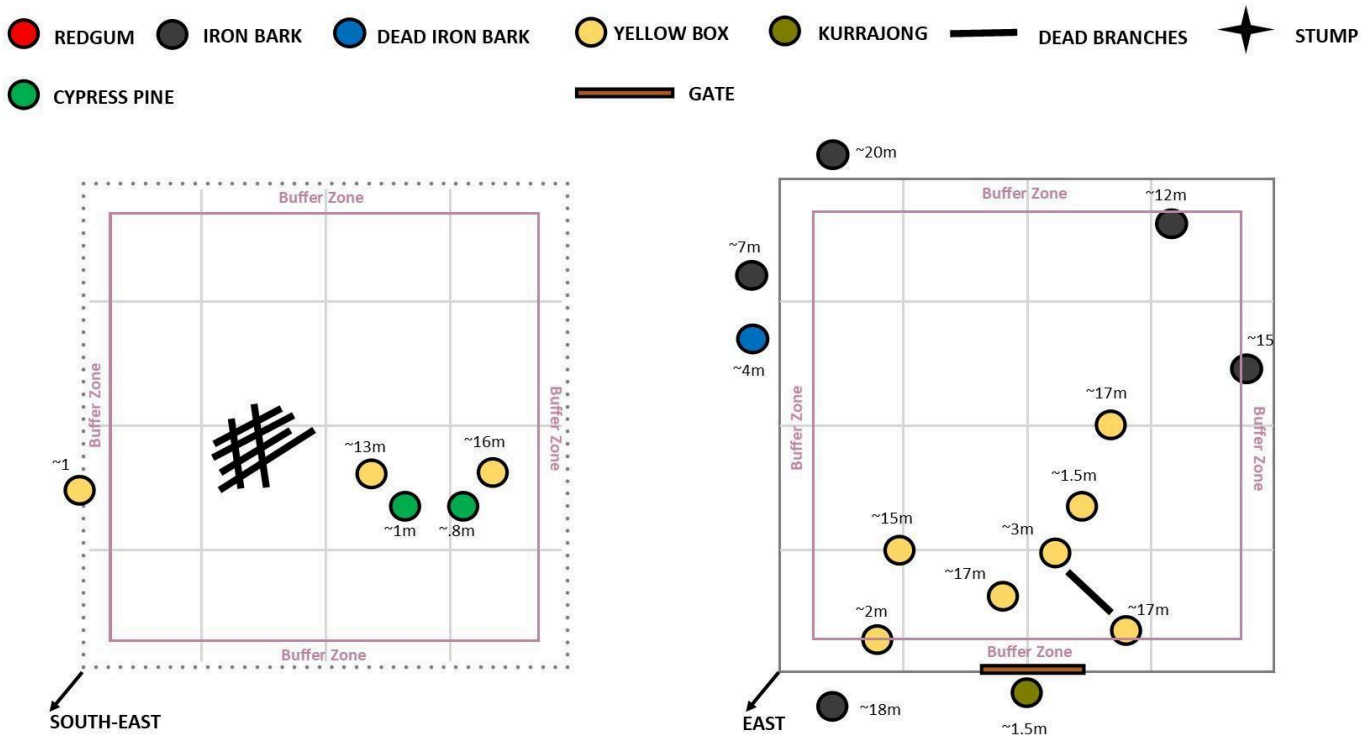
1. EXCLUSION ZONE—Closest to Env. Centre

2. NON-EXCLUSION ZONE



3. NON-EXCLUSION ZONE

4. EXCLUSION ZONE—Furthest from Env. Centre



a. What information is identified by these study site sketches?

_____
_____
_____

b. What is the control site and why?

_____
_____
_____

c. What patterns and anomalies do you see between the sites?

_____
_____
_____
_____
_____
_____

8. Impact of Abiotic Factors

Using secondary sources <u>identify</u> four (4) abiotic factors that could be measured at the WNPEEC study sites, and <u>explain</u> how they might impact on the fauna and flora.

Identify	Explain

The Field study/excursion

Overall inquiry question "How do introduced species affect the Australian environment and ecosystems?"

1. **Create your own inquiry question specific to the proposed excursion to WNPEEC and the target species, coarse woody treatment and exclusion status .**

   _____

   _____

   _____

2. **What type of data will you need to collect and what first hand investigation methods could you use in the field to answer this question?**

   _____

   _____

   _____

   _____

   _____

3. **Now that you have examined some secondary research, develop a hypothesis that you are going to investigate while at the WNPEEC.**

   _____

   _____

   _____

Purpose of the investigations

Belougery Flat's provide sites within the Warrumbungle National Park that will offer a good comparison between exclusion zones, non-exclusion zones and a treatment or no treatment of coarse woody debris (CWD) within a woodland ecosystem. We will analyse primary data to investigate one of our goals – to identify and measure various abiotic and biotic factors that have created niche environments allowing certain organisms to thrive in these ecosystems. Our second goal is to investigate the intricacies of human impacts by analysing the relationships between organisms and how ecosystem health is related to balanced ratios between organisms. We will also use secondary data to investigate how humans have impacted on the ecological history of the Warrumbungle area.

STUDENTS MUST HAVE:	Minimal Impact: Sites must be left how they found it or better.	Students are responsible for the equipment
A full water bottle, a hat, sturdy shoes.	If scientists don't do this, when another scientist attempts to replicate their study the results will vary.	Students must return the equipment in a clean and well packed order. Take note of how the kit is packed.

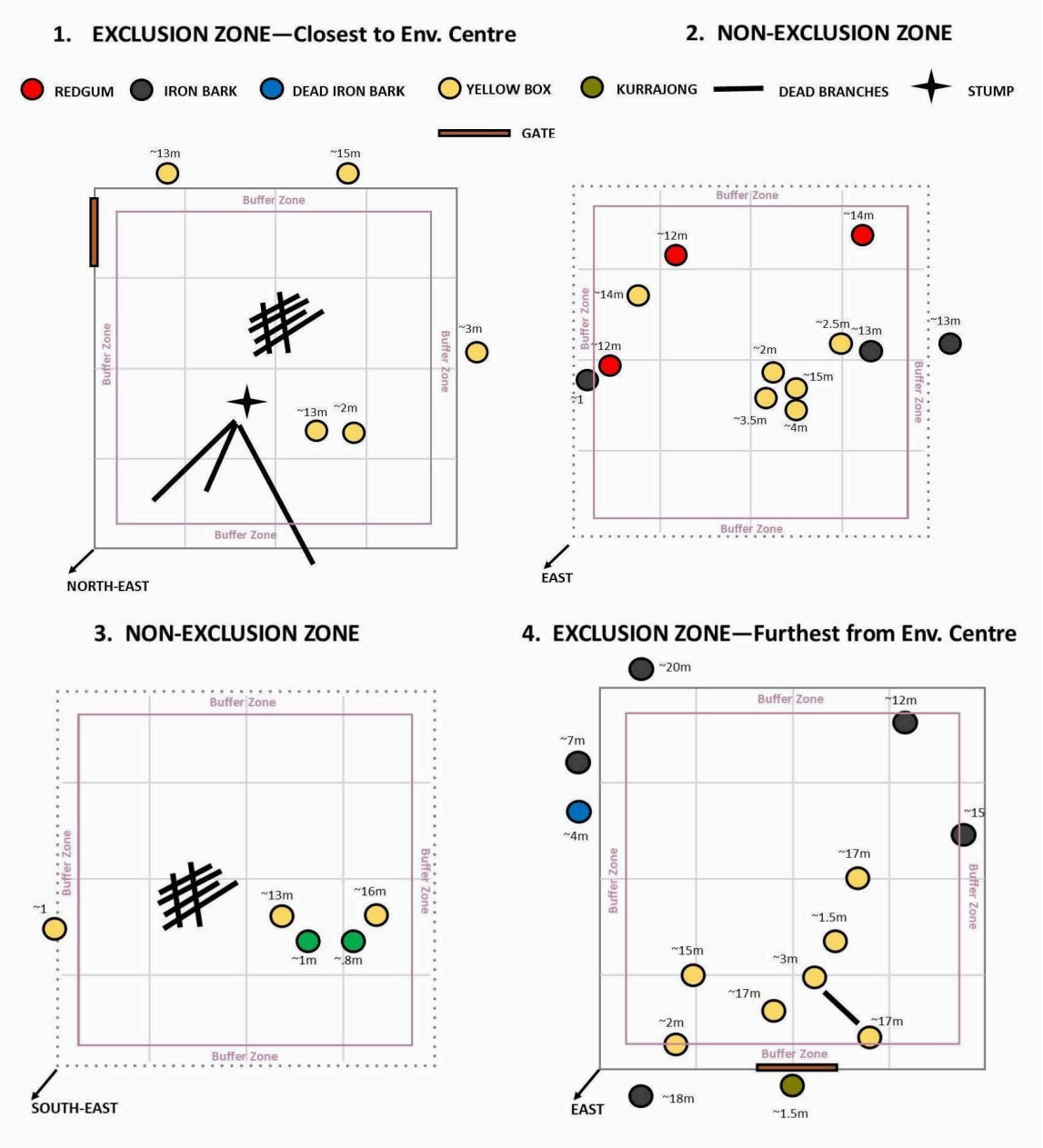
Excursion Investigation

Inquiry Question: ***How do introduced species affect the Australian environment and ecosystems?***

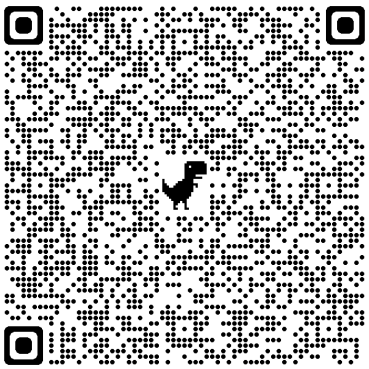
First hand data collection methods involve:

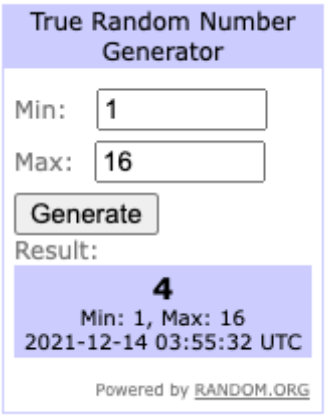
1. **Quadrat**
    a. Biotic
        i. Evidence of living things
        ii. Abundance and diversity of plants
    b. Abiotic
2. **Herbivory**
3. **Plot vegetation sketch**

Quadrat: Examining the impact of biotic and abiotic factors within the ecosystem



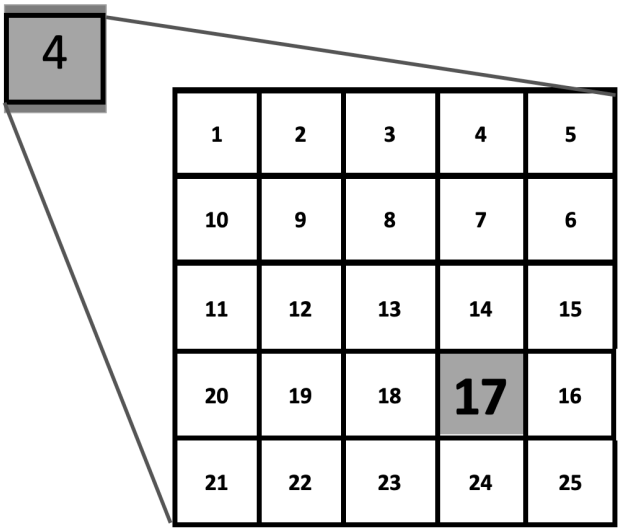
1. Using two builders lines and 4 students mark out the 20 m x 20 m plot into 16, 5 m x 5 m quadrats.
2. Using this QR Code random number generator and set to 16 to determine your group's quadrat for all four plots.





1	2	3	4
8	7	6	5
9	10	11	12
16	15	14	13

3. Then to determine the placement of your 1m x 1m quadrat within your (5m x 5m) survey plot quadrat you will need to complete *step 2* but you will need to change the maximum random number generator to 25.



This is the placement of your 1m x 1m study quadrat

Now that you've located the sample quadrat site for each plot, now it's time to undertake your quadrat studies.

Place the quadrat at the exact location within your 5 m x 5 m quadrat. You can use the tape measure to determine the approximate location. Please limit travel across the entire plot by skirting around the edge of the plot where possible. **It is important to cause minimal impact to this site. This includes trampling, removal of vegetation, mulch, soil, etc..**

Results Table 1. Evidence of animals - record using 1 m x 1m quadrat				
Type of evidence	**Plot 1 - X, CWD**	**Plot 2 -**	**Plot 3 - CWD**	**Plot 4 - X**
scats				
tracks				
fur				
feather				
bone				
invertebrates				
X - Exclusion Fence CWD - Coarse woody debris				

The layers in a **eucalypt woodland** are:

- the **ground covers** which consist of **grasses** and **forbs**. Grasses can grow quite high while forbs are herbaceous flowering plants growing no higher than 50cm.
- the **shrub layer** or **understorey**. This layer consists of **flowering plants** with woody stems growing between 0 - 8 metres high.
- the **canopy layer**. This layer is the **tree layer** and includes trees 5 metres or higher.

At each quadrant site record how many trees, shrubs, forbs, and grasses fall in the 1 m x 1 m quadrat bounds and also how many different species of those organisms there are. Remember a quadrat is a slice through the biosphere so we are not just looking on the ground but through the three-dimensional space held by the 1 m x 1 m x infinity invisible square prism. If a tree falls into quadrat count it only once. Use pegs and builders line to assist with this.

Results Table 2. Evidence of abundance and diversity of plants - record using 1 m x 1m quadrat

Vege Type	**Trees**			**Shrubs**		**Forbs**			**Grasses**	
Plot	# of plants	# of species	height of trees	# of plants	# of species	# of plants	# of species	# of BH	# of plants	# of species
Plot 1 - X, CWD										
Plot 2 -										
Plot 3 - CWD										
Plot 4 - X										
X - Exclusion Fence CWD - Coarse woody debris										

Measuring the Abiotic factors

– read and follow instructions to complete Results table 3. (Next page)

Abiotic Factor	Equipment and instructions
Latitude and Longitude	Using the GPS, press power on and leave to find satellites for 5 minutes. Then on the bottom of the home screen there are signal bars. Press on these and it will latitude and longitude.
Altitude	Using the GPS press the touch screen of the GPS on the signal bar section - altitude will be shown
Organic ground cover	Is there any organic ground cover at your sites? Place the quadrat over the site and record and estimate organic ground cover as a percentage.
Aspect	Use the compass. The aspect is the direction the slope is facing relative to North.
Air temperature	This can be determined by a number of ways: using the field multimeter thermometer, temperature is displayed at the top of the screen for all readings; or, using the anemometer thermometer temperature reading.
Wind speed	Hold the anemometer facing it into the wind for one minute above your head. Record the greatest wind speed in this time period.
Humidity	Using the field multimeter, take the Relative Humidity (%) reading displayed at the top of the screen for all readings.
Light intensity	Using the multimeter's light meter, switch to Lux X 10 mode. Face multimeter sensor towards the ground ensuring no shadow is being made. Place finger on the HOLD button before turning around to take reading. Press HOLD button again to switch off reading.
Soil depth	Use the tent peg to see how far you can push it into the soil. If it stops before the full depth of the peg, measure this with the ruler on the compass or transect tape measure.
Soil temperature	Place the soil thermometer carefully into the hole in the soil created by the tent peg. Leave for a moment to allow it to adjust to its environment then take reading.
Soil texture	Using a small amount of soil in your palm, wet it to be malleable not soggy. Assess this using the 'determining soil texture' slip in the black folder.
Soil pH	1.Place a small amount of soil in the lid of specimen container. 2. Place three or four drops of Universal indicator on the soil. 3. Sprinkle some barium sulphate (white powder) on the surface of the soil and allow it to absorb and watch for a colour change. Compare colour to the chart in the black folder.
Soil colour	Using a small amount of moist soil on your finger, smear the soil in the provided recording cell.

Results Table 3. Abiotic variables

Abiotic variable	Plot 1 - X, CWD	Plot 2 -	Plot 3 - CWD	Plot 4 - X
Time				
date				
Lat./Long.				
Altitude (m)				
Organic ground cover (%)				
Aspect				
Air temperature ( )				
Wind speed ( )				
Humidity (%)				
Light intensity (Lux*10)				
Soil depth (cm)				
Soil temperature ( )				
Soil texture				
Soil pH				
Soil colour				

X - Exclusion Fence CWD - Coarse woody debris

Herbivory - Trophic Interactions

Herbivory is a measure of the impact of insect herbivores on a plant. It can be used as an indicator of the health or balance of an ecosystem.

1. Collect 10 leaves from eucalyptus trees within the plots and estimate the percentage of each one which has been damaged by herbivores. When picking leaves you can't look for ones that suit what you want. You must choose an unbiased method such as the 3rd leaf from the end or a branch..
2. When counting herbivory, count the pieces that are missing and any brown areas.
3. With just ten leaves the sample is not large enough to reach a valid conclusion. Results for the whole class need to be combined to work out the average leaf area eaten and recorded in Results Table 4.

Results Table 4. Herbivory Results

Leaf % eaten	Plot 1 - X, CWD	Plot 2 -	Plot 3 - CWD	Plot 4 - X
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Group Average				
Class average				

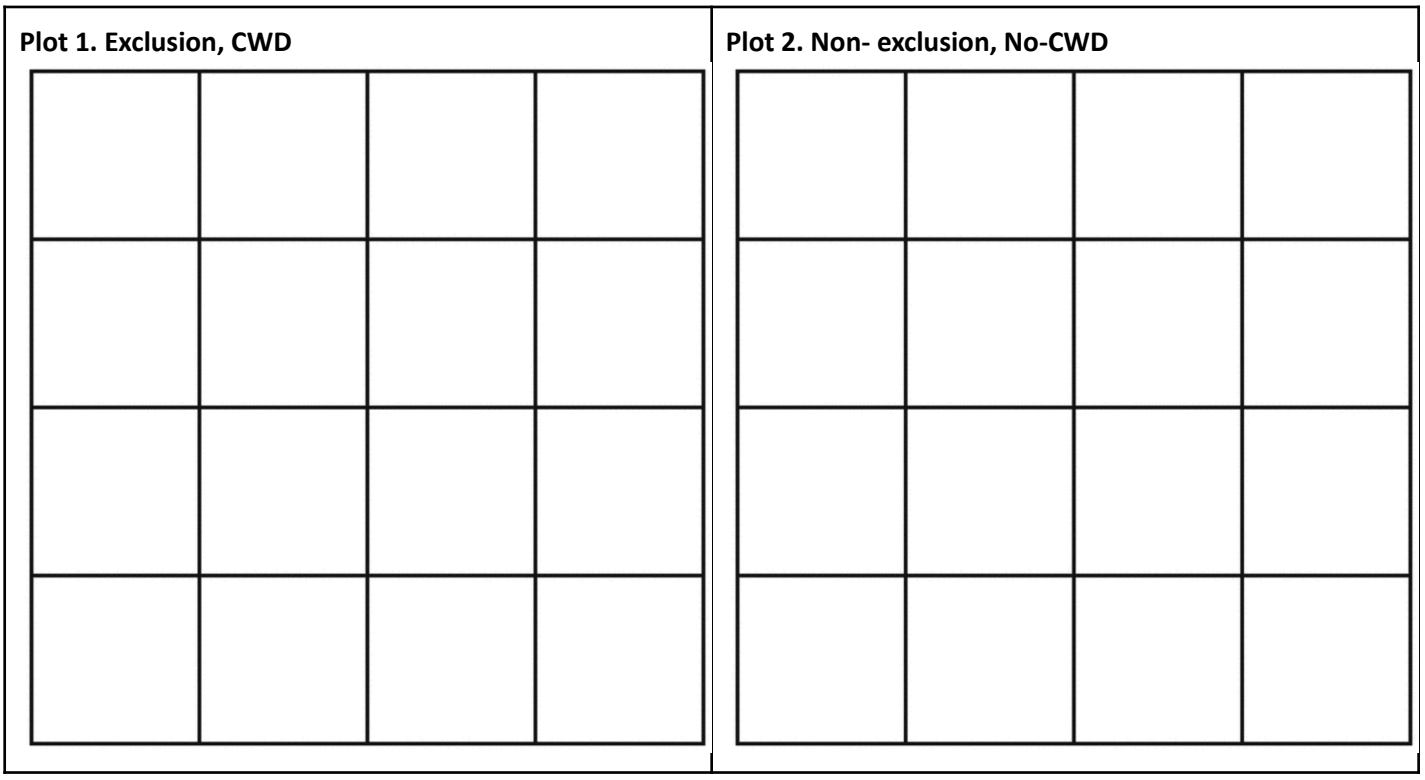
A healthy ecosystem has 15% to 20% herbivory.

Herbivory questions for discussion

- Can you explain why a healthy ecosystem would have 1/5th of its leaves chewed?
- How would less herbivory show that the ecosystem is unhealthy?
- How does your average compare with that of a healthy ecosystem's figures? Can you explain the difference if there is one?
- What does this activity tell you of the importance of eucalypts in the local ecosystem?

Quadrat Distribution Diagram - Vegetation type, abundance and height

Distribution of a species determines where it is found. A quadrat can be used to determine distribution. Using the 20m x 20m plot quadrat record vegetation species, type and height for each location on the graph below. Draw a line or shade for each vegetation type with a key that represents that species. See page 16 for ideas how to start



Plot 3. Non- exclusion, CWD	Plot 4. Exclusion, No-CWD

Trophic Interactions in the past, present and possible future Warrumbungle Ecosystem

Below, create a **food web** using the living organisms listed below in a food web arrows point in the direction of the energy transfer.

Grass	**Eucalypts**	**Sugar Glider possum**	**Eastern Grey kangaroo**
Ant	**Feral Goats**	**Echidna**	**Dingo**
Rabbits	**Mistletoe**	**Blue Heliotrope**	**Red Necked Wallaby**
Powerful Owl	**Native bee**	**Mistletoe bird**	**Goanna**

Tertiary

Secondary Consumers

Primary Consumers

Producers

What has happened to this food web since the Dingo has been excluded?

Assessing the validity and reliability of first-hand data

Validity	**The extent to which the processes and resultant data measure was intended.**
Reliability	**The degree with which repeated observations and/or measurements taken under identical methodologies achieved the same results.**
Accuracy	**The degree to which a measured value represents the true value of the factor that is being measured.**

Use available **evidence** to discuss the **reliability and validity of the data** collected in your field work investigation.

If a future investigation was to take place, what recommendations would you make so that the scientists could increase the reliability and accuracy of the data collected?

DEPTH STUDY RESOURCES:

- Importance of tree density on understorey diversity and weed abundance in restoration of endangered grassy box woodland PowerPoint by lead scientist Andrew Denham

- Importance of tree density on understorey diversity and weed abundance in restoration of endangered grassy box woodland MP4 recording by lead scientist Andrew Denham

- Scientific article -
    - Bringing forward the benefits of coarse woody debris in ecosystem recovery under different levels of grazing and vegetation density