NSW GOVERNMENT

SAVING OUR SPECIES

Regent Honeyeater: On the Edge

A Woodland Birds of the Hunter Project

Teacher Resource

environment.nsw.gov.au/sos

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Regent honeyeater (*Anthochaera phrygia*) Bruce Thompson/DPIE

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1. About this resource

This resource is for teachers to use with senior students when teaching about how conservation agencies monitor and manage threatened species. By looking at the biodiversity of the Hunter Region, using the regent honeyeater as a case study, combined with geographic information system (GIS) mapping, students will learn how to interpret visual data and examine ecological issues relevant to the protection and management of ecosystems.

The glossary at the back of this resource lists specific terms used with explanations. **Bolded text** throughout the resource indicates a term is listed in the glossary.

Throughout this resource you will find icons that aim to draw your attention to specific information. These include:

Indicates where students are to write their answers. In this teacher resource answers have been included in green-coloured text.

Indicates that students need to record data on the GIS task worksheet.

Indicates instructions for using the GIS viewer.

Please let us know about any issues or challenges you had using this resource. We welcome your feedback. If you have any questions or suggestions, please contact us via email: rog.hcc@environment.nsw.gov.au

This resource is linked to the following science stage 6 subjects for the year 11 and 12 syllabus for New South Wales schools, which incorporates the Australian Curriculum. Each module and relevant subjects are listed with a brief description about what each subject covers.

1.1 Biology

Module 4: Ecosystem dynamics

Future ecosystems

BIO11/12-3 Conduct investigations to collect valid and reliable primary and secondary data and information.

BIO11/12-4 Select and process appropriate qualitative and quantitative data and information using a range of appropriate media.

BIO11/12-5 Analyse and evaluate primary and secondary data and information.

BIO11-11 Analyse ecosystem dynamics and the interrelationships within an ecosystem.

1.2 Earth and environmental science

Module 4: Human impacts

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

EES11/12-2 Design and evaluate investigations in order to obtain primary and secondary data and information.

EES11/12-3 Investigate environments and ecosystems to collect valid and reliable primary and secondary data and information.

EES11-11 Describe human impacts on the environment in relation to hydrological processes, geological processes and biological changes.

Module 8: Resource management

Inquiry question: How can humans manage natural resources sustainably?

EES11/12-5 Analyse and evaluate primary and secondary data and information.

EES11/12-7 Communicate scientific understanding using suitable language and terminology for a specific audience or purpose.

1.3 Investigating science

Modules 1 and 2: Cause and effect

INS11/12-1 Develop and evaluate questions and hypotheses for scientific investigation.

Module 3: Scientific models

INS11/12-4 Process qualitative and quantitative data and information.

INS11/12-6 Solve scientific problems using primary and secondary data, critical thinking skills and scientific processes.

1.4 Science extension

Module 2: The scientific research proposal

SE-1 Apply the 'working scientifically' process in relation to scientific research.

Module 3: The data, evidence and decisions

SE-6 Analyse and report on contemporary issues using publicly available data sets.

1.5 Depth study

Regent honeyeater on the edge

Data analysis using statistics and GIS analysis, secondary sourced investigations and information on the regent honeyeater and its management from the NSW Department of Planning, Industry and Environment – Environment, Energy and Science website as a starting point for a depth study. You'll find a profile of the regent honeyeater in the Saving our Species database as well as details about how this species is being managed.

2. Introduction to threatened species

Threatened species include plants and animals that are endangered and at risk of extinction in the near future. Research programs that monitor threatened species use the information gathered to inform conservation management decisions.

2.1 About threatened species

Do you know how scientists and the NSW Government define a 'threatened species'? Research the Threatened species topic area on the Department of Planning, Industry and Environment – Environment, Energy and Science website and answer the following questions.

Question 2.1.1
List the criteria for a species to be classified as threatened.

- **there is a reduction in its population size**
- **it has a restricted geographical distribution**
- **there are few mature individuals.**

Question 2.1.2
Besides species, list what else can be considered threatened and explain why.

An ecological community is a naturally occurring group of native plants, animals, and other organisms living a unique habitat. A significant reduction in any of these species across a region can lead to a decline in ecological function.

Question 2.1.3
Based on what you've just learned, how would you explain the NSW Biodiversity Conservation Act 2016?

The purpose of the Biodiversity Conservation Act is to 'maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development'.

- **conserving biodiversity at bioregional and state scales**
- **maintaining the diversity and quality of ecosystems and enhancing their capacity to adapt to change and provide for the needs of future generations.**

2.2 Regent honeyeater

The regent honeyeater *(Anthochaera phrygia)* is a critically endangered Australian species. The distribution of this woodland bird used to extend from Adelaide to the central coast of Queensland but is now limited to north-eastern Victoria and a few valleys in New South Wales.

Historical records from the mid-1800s enthusiastically describe regent honeyeaters occurring in the thousands in many locations. In the early 1900s they were at times the most common species in an area and often seen overhead in flocks of hundreds. Today, between 350 and 400 adults are estimated to survive in the wild.

The Regent Honeyeater: On the Edge project provides quality educational material for teachers and secondary school students. It aims to increase understanding of threatened species conservation and conservation management.

The project involves two student tasks:

1. **Identify the most suitable location in the Hunter Valley for protecting the regent honeyeater (secton 5.1).**

Geographic information system (GIS) tools are used to complete this task. Integrated digital tools can be used to explore spatial or geographical data. By transforming numbers into visual layers, these tools allow you to handle, process, and analyse data more easily. Visual layers can be laid over each other to see where a range of features intersect.

2. **Estimate the size of the regent honeyeater population using an established survey method (section 5.2).**

The capture-mark-recapture (CMR) method is used to complete this task. (CMR) is a survey system used to calculate population size.

To complete these tasks, you will need to apply the **scientific process**. GIS tools are used to answer conservation management questions.

Instructions and worksheets to complete these tasks are included in this booklet along with follow-up questions. The first task (section 5.1) uses a publicly accessible, online GIS.

3. Background

Is the Hunter's most iconic bird about to disappear?

A yellow flash no more! Only high-quality research and a good management plan can save the regent honeyeater.

Saving our Species is a state-wide program that aims to safeguard threatened plants and animals across New South Wales (NSW).

3.1 Investigation practice

Read the Saving our Species regent honeyeater management strategy Help save the regent honeyeater.

Briefly summarise each management site, threats that may exist, and actions that could be taken to counter these threats in Table 1. We have done Site 1 for you.

Table 1 Investigation practice

Site	Threats	Actions
Site 1: Bundarra–Barraba	• historical loss, fragmentation and degradation of habitat • degradation of habitat by clearing for agricultural and residential development • suppression of natural regeneration of overstorey tree species and shrub species from overgrazing	• target 500 hectares of high-quality habitat over 20 years for landholder covenants • community engagement to raise awareness • liaise with relevant agencies to ensure species' requirements are considered in future management planning
Site 2: Mudgee–Wollar	• **historical loss, fragmentation and degradation of habitat** • **competition from larger aggressive honeyeaters** • **key habitats continue to degrade from lack of recruitment**	• **community engagement to raise awareness** • **liaison with Local Land Service and landholders to protect and enhance habitat** • **implement shooting program at key locations**
Site 3: Lower Hunter Valley	• **continuing loss of key habitat tree species and remnant woodlands** • **historical loss, fragmentation and degradation of habitat**	• **target 250 hectares of small blocks of high-quality habitat over 10 years** • **community engagement to raise awareness**
Site 4: Capertee Valley	• **competition from larger aggressive honeyeaters** • **historical loss, fragmentation and degradation of habitat** • **disturbance at nesting sites**	• **implement shooting program at key locations** • **target 500 hectares of high-quality habitat for landholder covenants** • **community engagement to raise awareness**

Question 3.1.1
What is the most common threat to the regent honeyeater habitat?

- **historical loss, fragmentation and degradation of habitat.**

Question 3.1.2
List the three most common actions (not including monitoring) across all sites.

- **targeting high-quality habitat**
- **shooting programs for aggressive species**
- **community engagement to raise awareness.**

3.2 Regent honeyeater habitat

The Lower Hunter Region of NSW is a critically important area for regent honeyeaters. This is because large remnant **temperate woodlands** exist here, which provide an excellent habitat for the birds to forage as well as numerous breeding sites in spring, autumn and winter. Because the regent honeyeater mainly feeds on nectar from old and large blossoming trees, maintaining these woodlands is a priority. Their favourite tree species include:

- white box *(Eucalyptus albens;* Figure 1)
- yellow box *(Eucalyptus melliodora;* Figure 1)
- mugga ironbark *(Eucalyptus sideroxylon;* Figure 1)
- spotted gum *(Corymbia maculata)*
- swamp mahogany *(Eucalyptus robusta)*
- river sheoak *(Casaurina cunninghamiana).*

Along with these trees, however, regent honeyeaters also feed on long-flowered mistletoe *(Dendropthoe vitellina;* Figure 1) which occurs in spotted gum-ironbark forests.
Box mistletoe *(Amyema miquelli;* Figure 1) which grows in box-ironbark forests.
Needle-leaf mistletoe *(Amyema cambagei;* Figure 1) which grows on river sheoak.

White box (*Eucalyptus albens*)

Main photo: Steve Lewer/DPIE
Circle: GM Browne/Australian Plants Society NSW

Yellow box (*Eucalyptus melliodora*)

Main photo: Steven Douglas/DPIE
Circle: Flagstaffotos

Mugga ironbark (*Eucalyptus sideroxylon*)

Main photo: Barry Collier/DPIE
Circle: John Rawlings

Needle-leaf mistletoe (*Amyema cambagei*)

Main photo and circle: Barry Collier/DPIE

Long-flowered mistletoe (*Dendropthoe vitellina*)

Main photo: Tony Rodd
Circle: John Tann

Box mistletoe (*Amyema miquelli*)

Main photo: Ern Perkins/Castlemaine Field Naturalist Club
Circle: Kevin Thiele

Figure 1 Some of the regent honeyeater's favourite native trees and mistletoe. Circles contain close-up images of the flowers of each species.

3.3 Regent honeyeater threats

The regent honeyeater is critically endangered as its population has decreased to very low numbers. The number of mature birds that remain is estimated to be between 350 and 400. These estimates come from capture-mark-recapture (CMR) programs in NSW and Victoria, as well as from monitoring of the species coordinated by the Regent Honeyeater Recovery Team and BirdLife Australia.

Many factors have contributed to the regent honeyeater's critically endangered status:

- **Fragmentation** or **ongoing loss** of key habitats such as temperate woodlands
- small population size, which means that any disturbance (e.g. disease) can result in no birds being available to replenish the population.

Sometimes conservation efforts can also be threatened by:

- planning decisions that result in the continuing loss of important habitats
- increased potential for **invasive bird** species to establish.

3.3.1 2019–2020 fire impact update

There have been 169 regent honeyeater nests identified from 2015 to 2019. Using a buffer of 1 kilometre around these nests to encompass their foraging area, we overlayed the most recent fire layer (at 10 January 2020) and found that 80 (47%) of these sites had been impacted by fire.

Note: This only captures the impact of the fires on breeding areas. The effects of fires on preferred woodland habitats of regent honeyeaters were yet to be assessed at the time of publishing.

Figure 2 Regent honeyeater, noisy friarbird, and noisy miner sharing a water dish during heatwave conditions in New South Wales in early January 2020. Photo: Gary McGuigan

4. How to navigate geographic information systems

Teacher tips

If students get confused, encourage them to refresh the page to start the GIS program again.

The 'Layer List' can be accessed by two icons, one at the top of the screen and one at bottom left. Tell students both icons are equally efficient.

4.1 Using the layer list

The geographic information system (GIS) viewer for this task is located at: Regent Honeyeater: On the Edge.

4.1.1 Opening page

1. Click on Regent Honeyeater: On the Edge and you will arrive at the opening page (Figure 3).
2. The map you will see on the GIS is orientated with the north at the top.
3. Open the 'Layer List' in the top menu.
4. GIS data are displayed in layers. Layers can be switched on and off using the tick boxes in the Layer List.

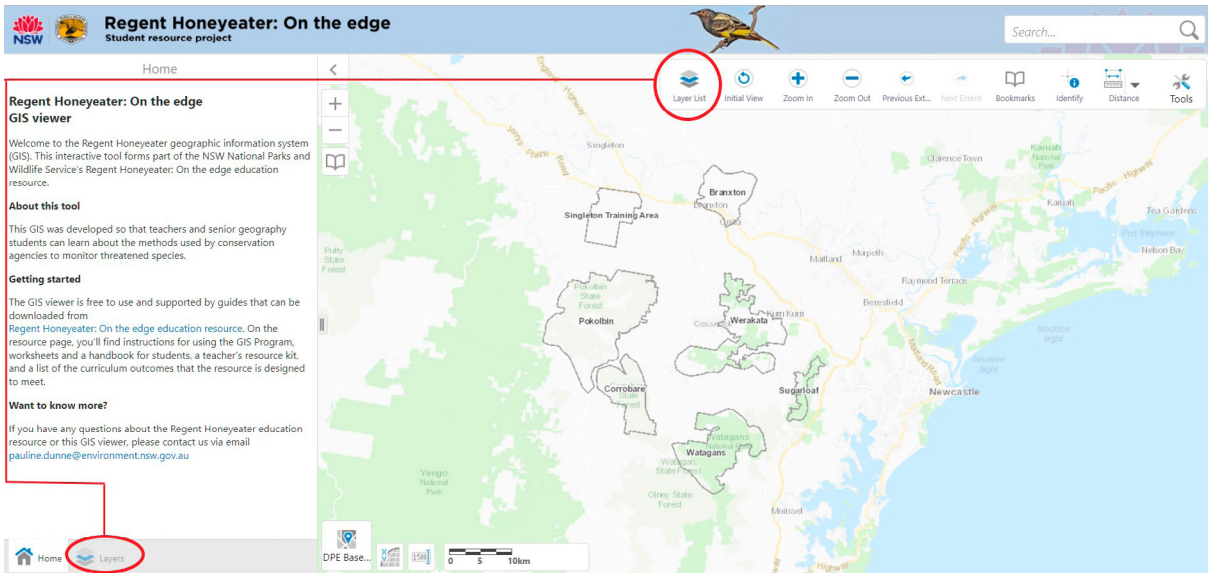


Figure 3 Screenshot of the opening page of the Regent Honeyeater: On the Edge viewer.

4.2 Changing layers

The GIS viewer for this task is located at: Regent Honeyeater: On the Edge.

Teacher tip

You can alter the transparency of colour to provide better contrast. Have your students try it with the DPE Basemap by sliding the filter icon to the left or right and have them notice that the national parks change from white to bright green.

4.2.1 Initial view

This button returns you to the initial view of the study area (Figure 3).

4.2.2 Bookmarks

This button brings up a list of pre-set areas of the map. Click on any of the areas to switch between sections on the map.

4.2.3 Layer details

Plus and minus signs are used to open the GIS layers and allow further detail of a layer to be explored.

Within the layer list, click on the '+' beside Tenure. This will display additional layers.

Tick the Tenure box to see more options. The 'State Forest Estate' and 'National Parks and Wildlife Service (NPWS) Managed Land' boxes will both be ticked (Figure 4). When the boxes are ticked, state forest and national park areas can be seen on the map.

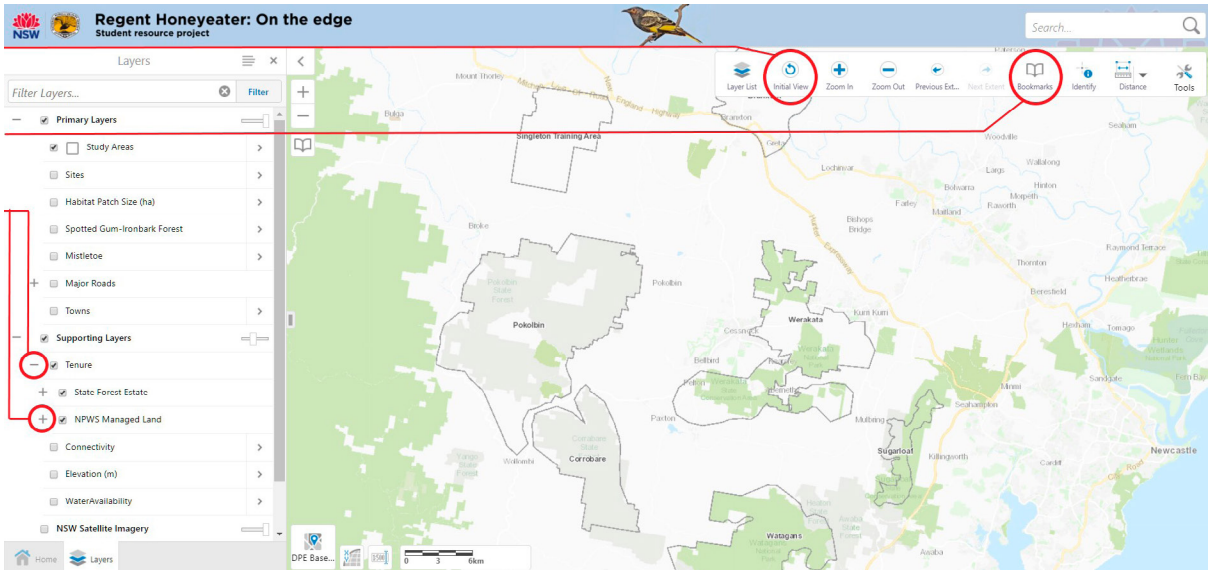


Figure 4 Screenshot of the Regent Honeyeater: On the Edge viewer showing state forest and national areas.

4.3 Using the distance tool

The GIS viewer for this task is located at: Regent Honeyeater: On the Edge.

Teacher tip

If students are using a mouse, they can use the mouse wheel to zoom in and out of the map.

4.3.1 Zoom in/zoom out

When you select the distance tool, instructions on its use appear at the top of the page.

Make a single click to start measuring and a double click to end. This will also show the distance (Figure 5). Once you've finished measuring, click the distance tool icon to turn it off.

To delete a measurement or shape, left click on the line or shape and select 'delete' from the information box.

You can also return to the initial view.

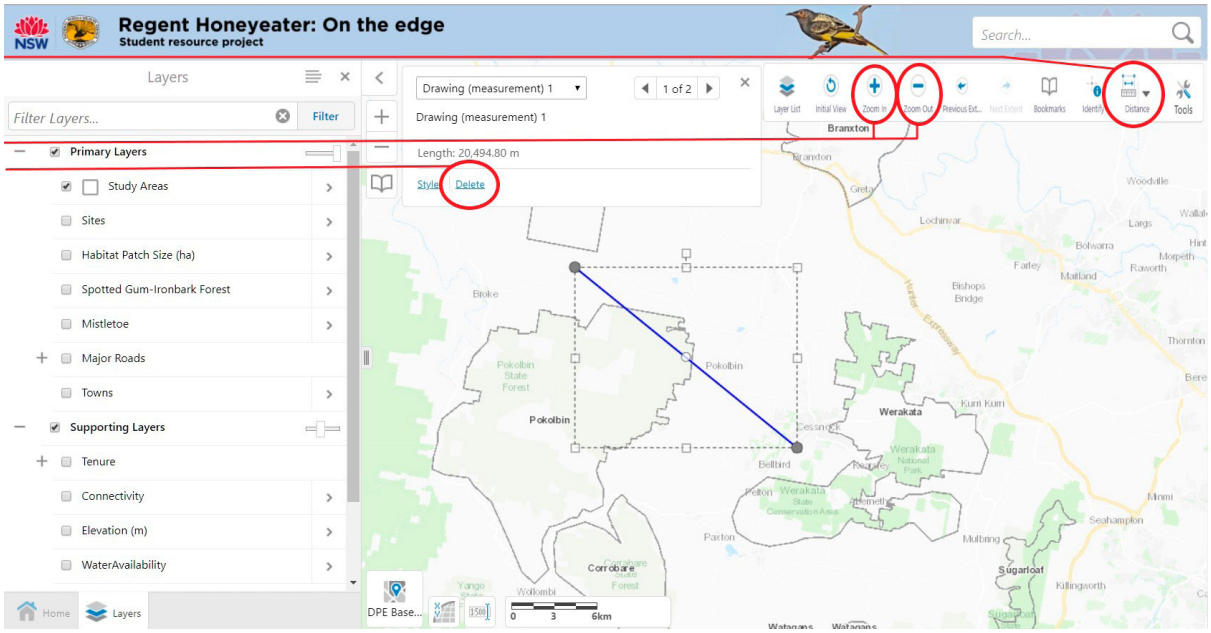


Figure 5 Screenshot of the Regent Honeyeater: On the Edge viewer showing the distance tool in use.

4.4 Using the identify tool

The GIS viewer for this task is located at: Regent Honeyeater: On the Edge.

Teacher tip

This tool will not be used in the tasks for the student workbook. It's an optional extra to show the students the power of GIS as a program.

Select the identify tool and click on a feature on the map to reveal more information about that feature.

Additional information appears on the left-hand side of the map.

An example of features are the seven study areas on the map (Figure 6).

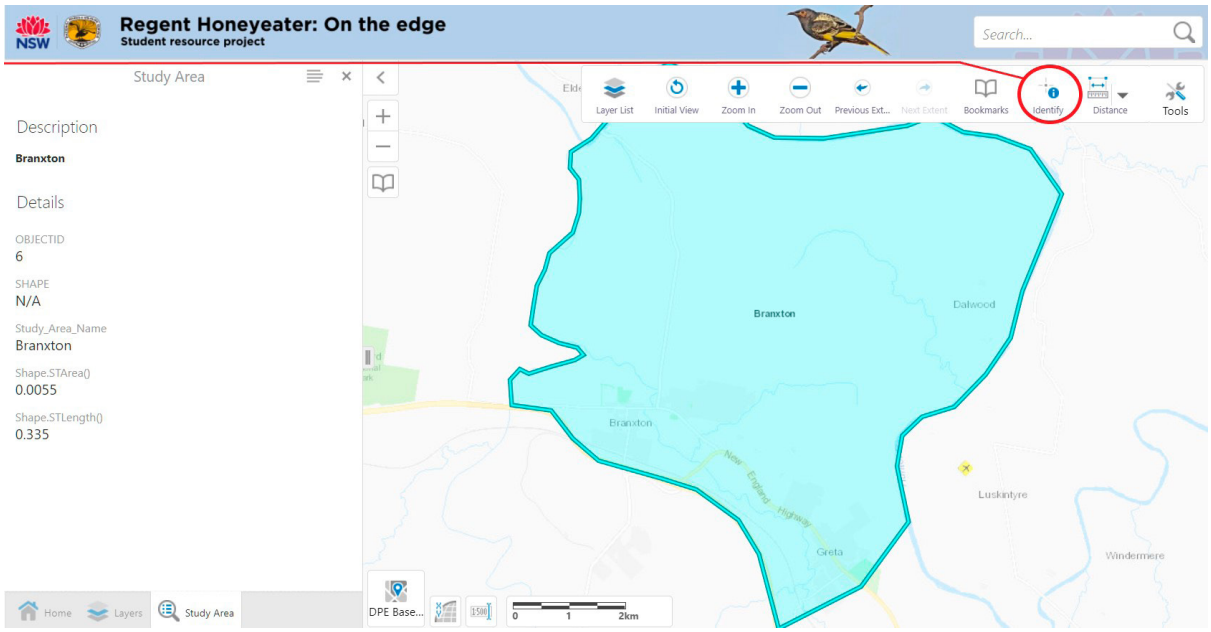


Figure 6 Screenshot of the Regent Honeyeater: On the Edge viewer showing the 'identify' tool being used to identify the Branxton study area.

5. Student tasks

5.1 Using the regent honeyeater geographical information system

The geographic information system (GIS) viewer for this task is located at: Regent Honeyeater: On the Edge.

5.1.1 Investigating elevation and habitat patch size

Seven study areas or sites in the Lower Hunter Region have been chosen because they are within the **elevation** range where regent honeyeaters have previously been found (Figure 7). They also have areas of **spotted gum–ironbark forest**, an essential habitat for the regent honeyeater to breed and forage. The study areas include:

Area one: Singleton

Area two: Branxton

Area three: Pokolbin

Area four: Corrabare

Area five: Werakata

Area six: Watagans

Area seven: Sugarloaf.

Your task for this section is to investigate the **elevation** and **habitat patch size** for each of the seven study areas. Then determine which study area/s has/ve the best habitat conditions for regent honeyeaters.

GIS **Use the GIS task worksheet to record your data (see Table 2).**

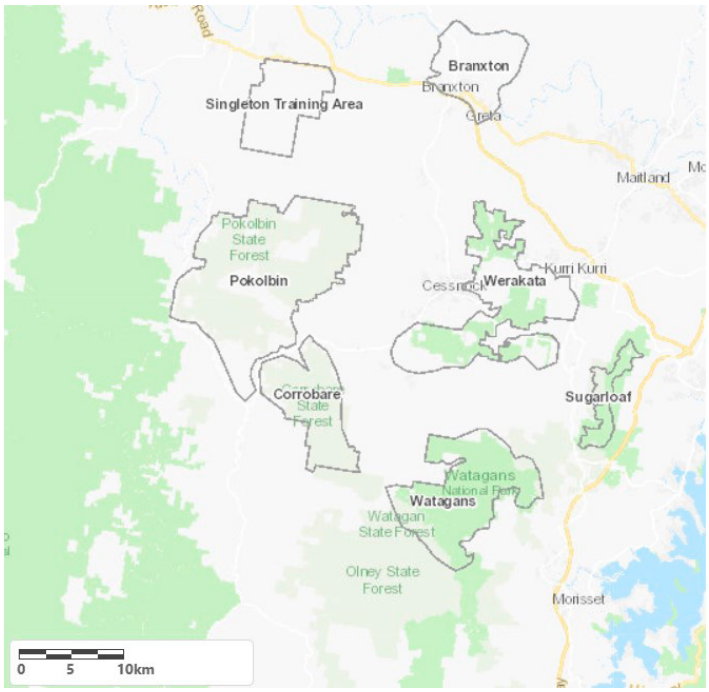


Figure 7 Screenshot of the Regent Honeyeater: On the Edge viewer showing the seven study areas on the map.

Elevation

The GIS viewer for this task is located at: Regent Honeyeater: On the Edge.

Elevation is measured using metres (m) above sea level (ASL). Research indicates that regent honeyeaters prefer areas of lower elevation.

To find the elevation of each site:

1. Start at the home page in the GIS viewer, click the tool icon, click the layer icon.
2. Click on the 'Study Areas' box.
3. Use the 'Bookmarks' tool to switch between the seven study areas.
4. Switch on the 'Elevation' layer, the elevation key will be displayed (Figure 8).
5. Record the elevation at each study area.

Review the elevation of the seven bookmarked study areas and give each study area a score, with the following range:

- 1 = greater than >218 m
- 2 = 6–218 m
- 3 = less than <6 m.

GIS **Use the GIS task worksheet to record your data (see Table 2).**

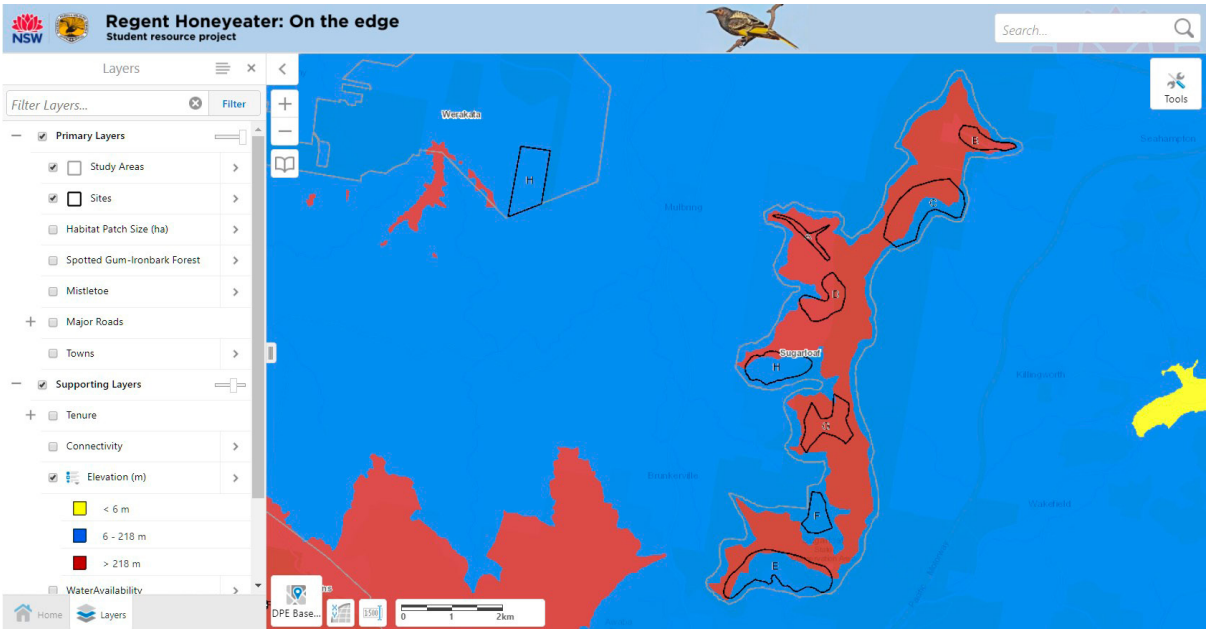


Figure 8 Screenshot of the Regent Honeyeater: On the Edge viewer with the elevation layer on.

Habitat patch size

The GIS viewer for this task is located at: Regent Honeyeater: On the Edge.

Although regent honeyeaters occur in a variety of landscape settings (e.g. large forest blocks, roadside vegetation), they are primarily considered to be open forest/woodland specialists. Habitat assessments confirm that most regent honeyeater sightings occur in habitat patches of >1000 hectares (ha).

To investigate the patch size of sites within each study areas:

1. Switch off the 'Elevation' layer.
2. Switch on the 'Sites' layer.
3. Switch on the 'Habitat Patch Size' layer (Figure 9).

Use the bookmark icon to move between the study areas and give each site (A-H) within a study area a score:

- 1 = <1 ha
- 2 = 1–100 ha
- 3 = 100–1000 ha
- 4 = >1000 ha.

Use the GIS task worksheet to record your data (see Table 2).

Rank study areas

Based on your examination of elevation and habitat patch size data, rank the seven study areas. Add up your total score for elevation and patch size for each site. Describe what makes each study area suitable or not suitable for regent honeyeaters. Rank each study area based on the highest total.

The study area with the highest total ranking is the area most likely to provide the best conditions for regent honeyeaters. The worst sites will have the lowest number.

Use the GIS task worksheet to record your data (see Table 2).

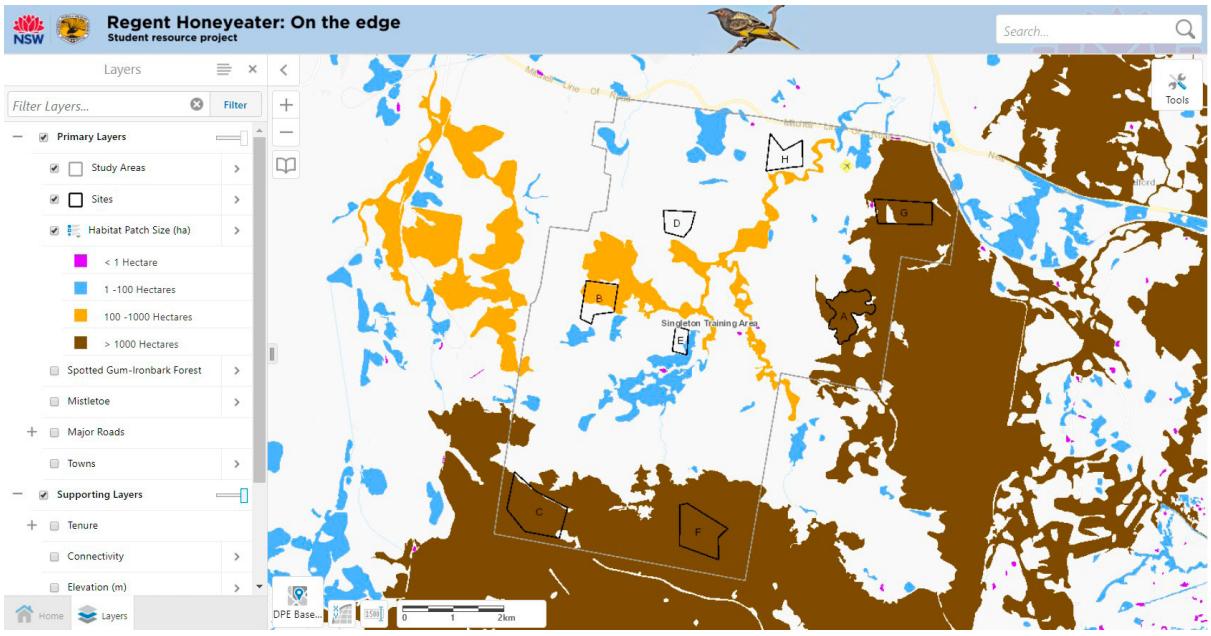


Figure 9 Screenshot of the Regent Honeyeater: On the Edge viewer with the habitat patch size layer on.

5.1.2 Record your findings

Table 2 Geographic information system task worksheet

Study area	Step 1 Measure elevation		Step 2 Record habitat patch size			Step 3 Rank study areas
	Height in metres	Score	Site	Size in hectares	Score	Describe suitability of study area
Site 1 Singleton	6–218	2	A	> 1000	4	Study area has a few habitat patches, but not enough to support regent honeyeaters.
			B	100–1000	3	
			C	>1000	4	
			D	0	0	
			E	0	0	
			F	>1000	4	
			G	>1000	4	
			H	0	0	
Total score		2		+	19	= 21 (Step 1 score + Step 2 score)
Site 2 Branxton	6–218	2	A	0	0	Study area has no habitat patches large enough to support regent honeyeaters.
			B	0	0	
			C	100–1000	3	
			D	1–100	2	
			E	100–1000	3	
			F	1–100	2	
			G	0	0	
			H	100–1000	3	
Total score		2		+	13	= 15 (Step 1 score + Step 2 score)

Study area	Step 1 Measure elevation		Step 2 Record habitat patch size			Step 3 Rank study areas
	Height in metres	Score	Site	Size in hectares	Score	Describe suitability of study area
Site 3 Pokolbin	>218	1	A	>1000	4	This study area has habitat patches, but its high elevation is not suitable for regent honeyeaters.
			B	>1000	4	
			C	>1000	4	
			D	>1000	4	
			E	>1000	4	
			F	>1000	4	
			G	>1000	4	
			H	>1000	4	
Total score		1		+	32	= 33 (Step 1 score + Step 2 score)
Site 4 Corrabare	>218	1	A	>1000	4	This study area has the right habitat patches, but its high elevation is not suitable for regent honeyeaters.
			B	>1000	4	
			C	>1000	4	
			D	0	0	
			E	>1000	4	
			F	>1000	4	
			G	>1000	4	
			H	0	0	
Total score		1		+	24	= 25 (Step 1 score + Step 2 score)

Study area	Step 1 Measure elevation		Step 2 Record habitat patch size			Step 3 Rank study areas
	Height in metres	Score	Site	Size in hectares	Score	Describe suitability of study area
Site 5 Werakata	**6–218**	**2**	A	**>1000**	**4**	**This is the best study area. It has both habitat patch size and elevation that regent honeyeaters prefer.**
			B	**>1000**	**4**	
			C	**>1000**	**4**	
			D	**0**	**0**	
			E	**>1000**	**4**	
			F	**>1000**	**4**	
			G	**>1000**	**4**	
			H	**>1000**	**4**	
Total score		**2**		**+**	**28**	**= 30** (Step 1 score + Step 2 score)
Site 6 Watagans	**>218**	**1**	A	**>1000**	**4**	**This study area has the right habitat patches, but its elevation is one that regent honeyeaters do not prefer.**
			B	**>1000**	**4**	
			C	**>1000**	**4**	
			D	**>1000**	**4**	
			E	**0**	**0**	
			F	**>1000**	**4**	
			G	**>1000**	**4**	
			H	**>1000**	**4**	
Total score		**1**		**+**	**28**	**= 29** (Step 1 score + Step 2 score)

Study area	Step 1 Measure elevation		Step 2 Record habitat patch size			Step 3 Rank study areas
	Height in metres	Score	Site	Size in hectares	Score	Describe suitability of study area
Site 7 Sugarloaf	>218	1	A	>1000	4	This study area has the right habitat patches, but its elevation is one that regent honeyeaters do not prefer.
			B	>1000	4	
			C	>1000	4	
			D	>1000	4	
			E	>1000	4	
			F	>1000	4	
			G	>1000	4	
			H	>1000	4	
Total score		1		+	32	= 33 (Step 1 score + Step 2 score)

Question 5.1.1
Based on elevation, which three study areas would be most likely to support regent honeyeaters?

1. **Werakata**
2. **Branxton**
3. **Singleton**

Question 5.1.2
Based on your overall ranking, and taking into consideration elevation, the study area with the most suitable conditions for regent honeyeaters is: Werakata

5.1.3 Field study – getting out and about

Transects and quadrats

In the next section, you will 'tick' on and off different layers of information. Mistletoe for example is one of these layers. The information to put these layers together was obtained using common ecological sampling methods. Transects and quadrats are two of these methods and they allow us to quantify the **relative abundance** of different species and/or **ecological communities** in an area.

To understand transects and quadrats, imagine a school classroom with chairs, desks, backpacks, pencils, books, etc. Let's assume the classroom is square (Figure 10a).

Now, I ask you to tell me the number of backpacks in the classroom. 'Easy', you say since you can count the backpacks. This is time consuming and I point out you'll waste your afternoon counting them. There's a faster way to count the backpacks and that's to use a transect line.

A transect line is a line that is marked at regular intervals. You can lay it diagonally across an area (Figure 10b) and count the backpacks that touch the line. This will give you an estimate of the backpacks in the classroom and will be much quicker than counting each one. The square classroom is the quadrat. Before continuing to part two, find a green area around your school. Could you make a quadrat? How about a transect line? What questions could you ask? If you're unsure about how to proceed get in touch with the experts: National Parks and Wildlife Service Discovery Rangers via the NPWS School excursions webpage.

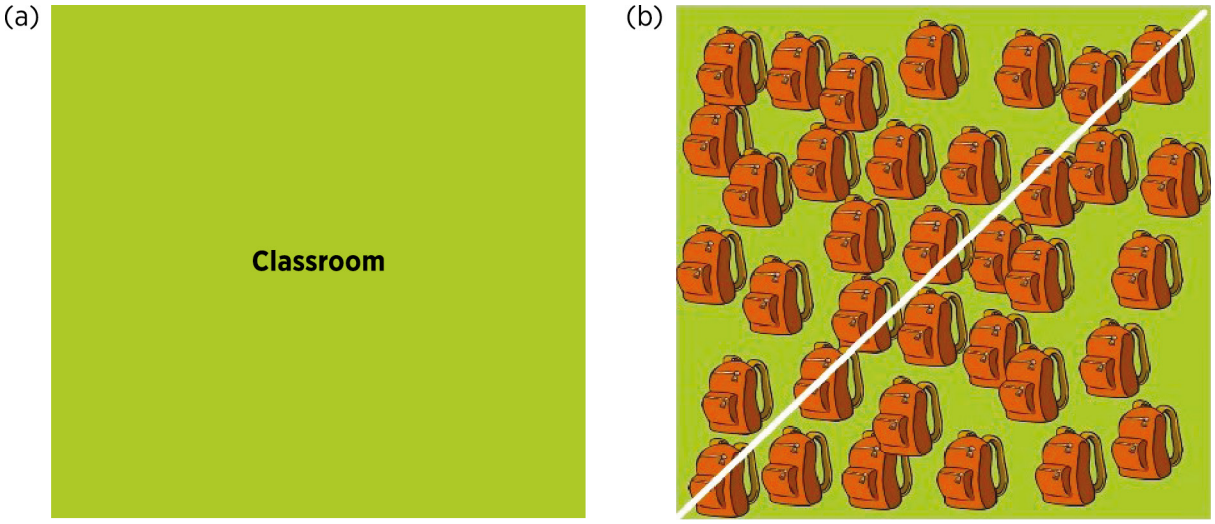


Figure 10 Diagram of (a) classroom (quadrat) and (b) quadrat with transect line.

5.1.4 Investigating study-area-specific environmental factors

The GIS viewer for this task is located at: Regent Honeyeater: On the Edge.

Site-area-specific environmental factors

Hint: This should be your answer for question 5.1.2.

Study area chosen: **Werakata**

Background

Spotted gum–ironbark-dominated woodlands are a preferred habitat for regent honeyeaters. Due to land clearing, there are now less of these woodlands. In addition, **biotic** and **abiotic** factors make some woodland forests higher-quality habitat than others for the regent honeyeater.

These factors include:

- water availability
- connectivity of habitat
- diversity of habitat and food tree species
- available food, importantly spotted gum, ironbark and mistletoe.

Use these factors to work out the most suitable site within your identified study area that will support regent honeyeaters.

Water availability

Regent honeyeaters prefer woodland habitats, but their presence in these habitats is often restricted by distance to waterways. Regent honeyeaters also often have site **affinity** with standing water within the landscape, for example dams and creeks. Previous studies have shown that the proximity of a waterway can influence the food available for these birds and therefore their presence in the environment.

Within a habitat or site, the availability of water can vary with the seasons and across locations within a site. The different colours represent different water availabilities where blue is very good, and orange is moderate availability of water. For example, Site C has poor (grey), moderate (orange), and good (light blue) water availability in different parts of the site (Figure 11). In this case, you would record the water availability for this site as moderate because the orange colour covers most of the study site.

To record the water availability for a study area:

1. Open the 'Layer List'.
2. Tick on the 'Water Availability' layer.
3. Record the value of each study site in Table 3 (A through H).

Assess the water availability for each study site and give each site a score.
Use the ranking system:

1 = poor

2 = moderate

3 = good

4 = very good.

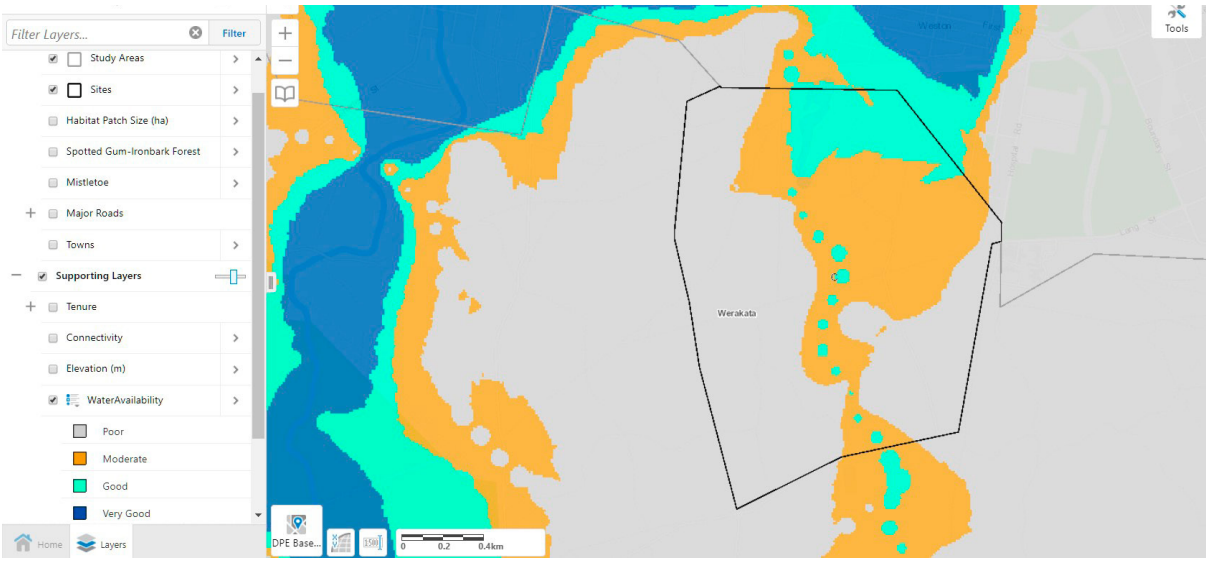


Figure 11 Screen shot showing that site C has poor, moderate, and good water availability in different parts of the site.

Connectivity

The GIS viewer for this task is located at: Regent Honeyeater: On the Edge.

Habitat fragmentation is a major threat to the regent honeyeater. The loss of habitat areas and connecting **green corridors** limits the ability of the birds to find food and to breed.

Connectivity is the distance between areas of habitat. In previous studies, regent honeyeaters were more likely to be seen in areas of high connectivity (85.5%) and less likely to occur in sites with low connectivity (3%).

For example, Site G (Figure 12) has medium connectivity because it occurs within a national park, but is not connected to a green corridor.

1. Open the 'Layer List'.
2. Tick on the 'Connectivity Layer'.
3. Make sure that 'DPE Basemap' is ticked.
4. Record the value of each study area in Table 3.

Assess the connectivity for each study site and give each site a score. Use the ranking system:

1 = low, isolated from all green spaces

2 = medium, connected to either type of green space

3 = high, connected to both types of green spaces.

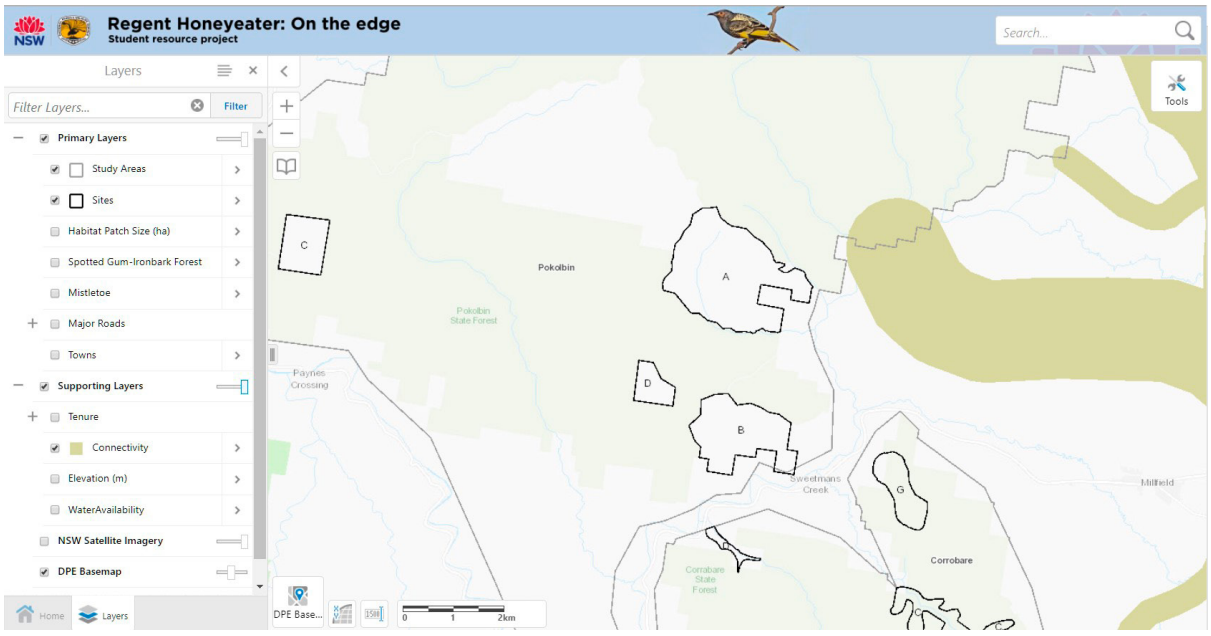


Figure 12 Screen shot showing Site G has medium connectivity.

Preferred woodland habitat

The diversity of tree species within preferred woodland habitats is crucial for robust regent honeyeater populations. The higher the diversity of flowering tree species, the more likely the woodland will support regent honeyeater populations.

Most studies on regent honeyeater habitats have identified box-ironbark eucalypt woodlands as important. In the Lower Hunter spotted gum–ironbark woodlands are regionally important **foraging** and breeding habitats for the birds. Many sites in the Lower Hunter have a high diversity of tree species (more than four species). Habitat assessment studies have found that 49.2% of sites with regent honeyeaters present had a high tree species diversity, whereas 13% of the sites with regent honeyeaters present had a low tree species diversity (only one or two species).

For example, Site B has medium–high and high ranking habitat and would be ranked as high for preferred woodland habitat (Figure 13).

1. Tick on the 'Spotted gum–Ironbark Forest' layer.
2. Use the 'Zoom In' and 'Zoom Out' (+ and –) features to investigate each site.
3. Record the presence of spotted gum–ironbark forest for each study area in Table 3.

Assess each study site for spotted gum–ironbark forest and give each site a score. Use the ranking system:

0 = almost none

1 = poor

2 = low

3 = medium

4 = medium–high

5 = high.

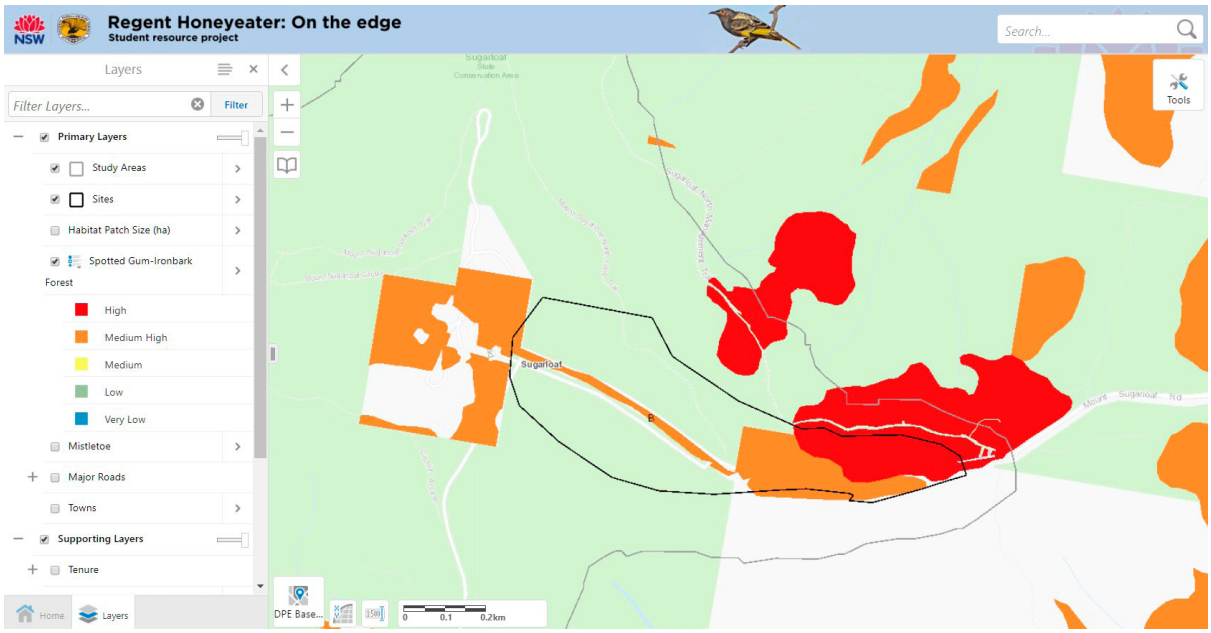


Figure 13 Screen shot showing that Site B has medium–high- and high-ranking preferred woodland habitat.

Mistletoe presence

Regent honeyeaters are often referred to as generalist foragers and, like most honeyeaters, rely on habitats with blossoming trees where there is abundant nectar flow. The relatively small number of eucalypt species that regent honeyeaters feed on produce high volumes of nectar from their blossoms. Several mistletoe species that live on eucalypts are also important sources of nectar and fruit for the regent honeyeater, including the long-flowered mistletoe *(Dendropthoe vitellina)*, box mistletoe *(Amyema miquelli)*, and needle-leaf mistletoe *(Amyema cambagei)*. These key mistletoe species are crucial components for woodland habitats to support healthy regent honeyeater populations.

For example, Site F (Figure 14) has areas of low and high mistletoe. This site would be ranked as 1 or low because the mistletoe present is mostly low.

1. Tick on the 'Mistletoe' layer.
2. Use the 'Zoom In' and 'Zoom Out' (+ and –) features to investigate each study area.
3. Record the mistletoe for each study area in Table 3.

Assess each study area for the presence of mistletoe and give each area a score. Use the ranking system:

0 = mistletoe **not** present

1 = low mistletoe present

2 = high mistletoe present.

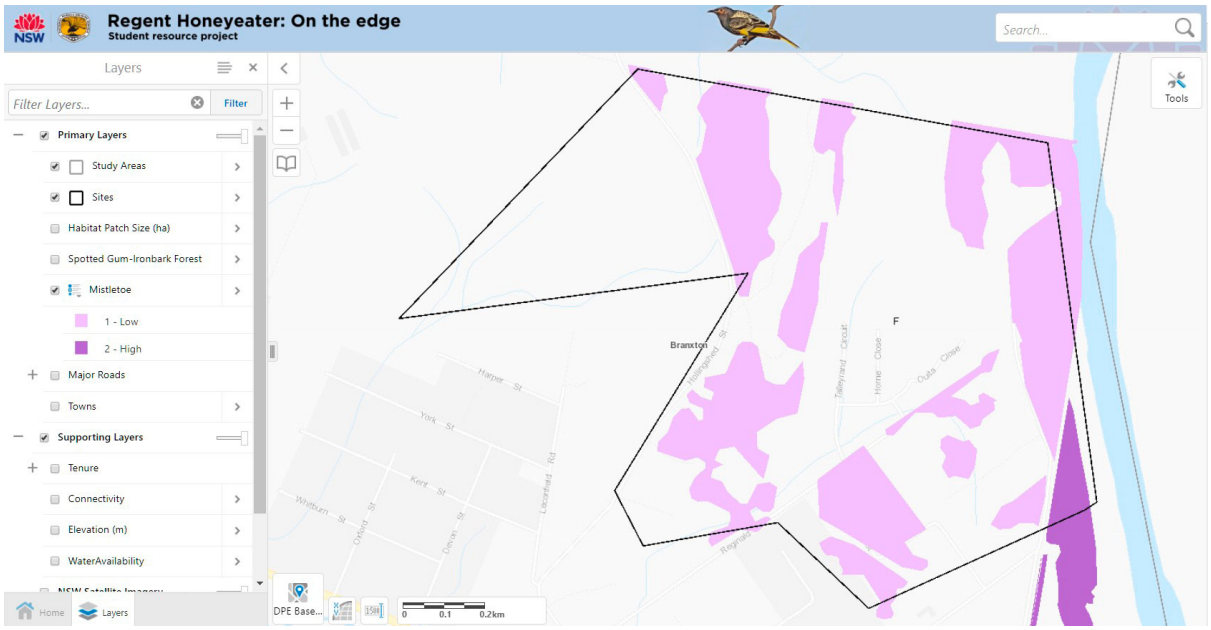


Figure 14 Screen shot showing that Site F has areas with low and high amounts of mistletoe.

Study-area-specific environmental factors

Hint: This should be your answer for question 5.1.2.

Study-area chosen: Werakata

Table 3 Site-area-specific environmental factors

	Water availability	Connectivity	Preferred woodland habitat	Mistletoe presence	Site total
A	Poor – 1	High – 3	High – 5	Low – 1	10
B	Poor – 1	High – 3	High – 5	High – 2	11
C	Moderate – 2	Medium – 2	High – 5	High – 2	11
D	Poor – 1	Medium – 2	None – 0	None – 0	3
E	Moderate – 2	High – 3	High – 5	High – 2	12
F	Poor – 1	High – 3	High – 5	High – 2	11
G	Poor – 1	High – 3	High – 5	High – 2	11
H	Poor – 1	Medium – 2	None – 0	None – 0	3

Question 5.1.3
Based on the site-specific environment factors you have assessed, which site within your identified study area is the most suitable for regent honeyeaters?

Site E is the most suitable site.

5.1.5 Scenario

After studying the regent honeyeater, you and your friends form an organisation to help conserve the species. The 20 Million Trees Program works with the community to re-establish green corridors and urban forests. Your organisation applied for a grant and was successful! The grant is for $100,000.

From the results of your research you chose Werakata as the most suitable study area.

5.1.6 Questions

Question 1.
Briefly summarise the characteristics that make your site suitable for regent honeyeaters.

The site has large habitat patches and the elevation is adequate. The high presence of spotted gum–ironbark forest, mistletoe, and connectivity makes it very suitable for regent honeyeaters.

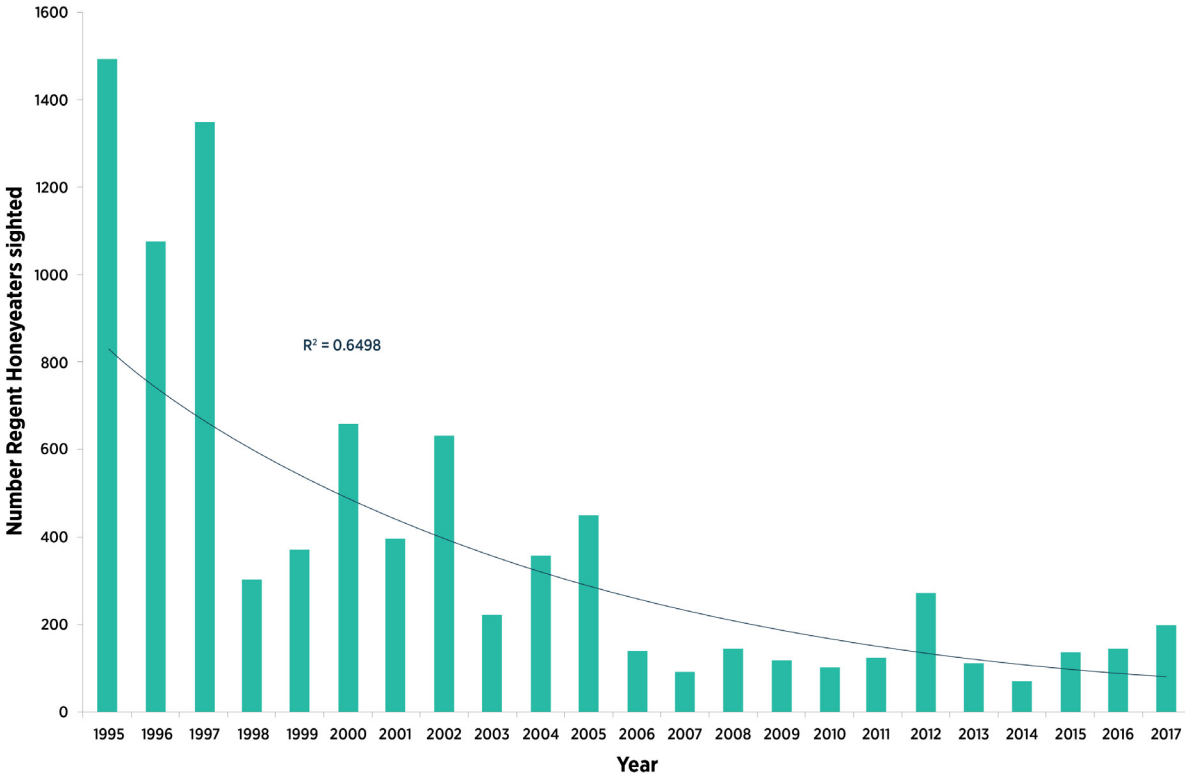


Figure 15 Example graph included in grant application showing number of regent honeyeaters sighted between 1995 and 2017; R^2 = **coefficient of determination**.
Source: Mick Roderick, BirdLife Australia 2020.

Question 2.
Figure 15 is a graph that you included in your grant application. Why was it included?

Figure 15 was included in the grant application to show the committee the rapid decline of regent honeyeater populations and how vital conservation projects are to protect the few in number remaining.

Question 3.
List your top management action and justify why it's important (look back at the investigation practice section 3.1).

Preserving important habitat is my top management action. Without these large open woodlands, the regent honeyeaters will not have a place to forage for food or a place to breed.

Question 4.
Estimate how much it will cost to carry out this management action. Take into consideration the costs of equipment, surveying, etc. How long will the project run for? What will happen when the money/project ends?

This answer should include some of the following points:

- Budget – The students can use all of the $100,000 but they need to clearly state why they used all their money in just one action plan.
- Equipment and surveying have costs associated with them.
- The question of 'what happens when the money/project ends' should mention the need to establish long-term projects that are beneficial to regent honeyeaters, even when the money has run out; i.e. changing people's behaviours and attitudes towards conservation of the regent honeyeater.

Question 5.
You hold a community meeting to get the project off the ground. At the meeting two people ask questions. Respond to their questions.

a. **Fourth generation farmer: I'm concerned I won't be able to keep my farm going and I don't see why the bird is so important. How will this project help me?**
   By doing regeneration projects (e.g. planting more trees), the value of his property will improve. Projects exist to help do this exact type of work via Local Land Services and the Biodiversity Conservation Trust.

b. **A self-described 'green' couple just moved into the area: We're excited to bring back the regent honeyeater but we don't want to wait and feel everyone needs to do something immediately. How do you channel their energy?**
   Channel their energy into raising awareness about the project by having them do the ground work and talk to people.

5.2 Capture-mark-recapture

5.2.1 Regent honeyeater population management

Where it is too difficult to count every individual in a species, capture-mark-recapture (CMR) is a commonly used method in ecology to estimate a population.

A population is a group of individuals from the same species that live within a defined area and compete to use the same resources (e.g. food, shelter and breeding partners).

It is important to know how many individuals exist within a population and how that number changes over time. When the size of a population is known, it's possible to track increases and decreases in the number of individuals.

Natural resource managers who work on threatened species conservation use CMR programs to monitor and learn whether a population is in decline. A CMR program traps and captures individuals from a population and tags them.

The tag can be an ear tag, a collar or in the case of the regent honeyeater a banding system attached to a bird's leg. After an animal is tagged, it is released. Individuals from the same population are trapped and tagged at the same time the following year.
The proportion of tagged animals caught the second time represents the proportion of the total population that has been tagged.

Using the following formula, you can calculate the approximate population size:

$$P = \frac{M \times S}{R}$$

where,

P = population size

M = marked animals (animals caught and tagged in first capture)

S = size of sample (animals caught in second capture)

R = recaptured marked animals (animals caught in second capture that were already tagged).

Example calculation

Teacher tip

Emphasise to your students that marking or tagging an animal are synonymous.

The original number of birds caught, tagged and released was 20. The number of birds captured in the second capture was also 20. The number caught in the second capture that were previously tagged was 7. Note that it is very unlikely that you would capture the same number of birds twice.

$$P = \frac{20 \times 20}{7}$$

The population size estimate in the example calculation is 57 individuals.

5.2.2 Capture-tag-capture card exercise

Teacher tips

Print, laminate and cut out the regent honeyeater cards (Figure 16). The lamination will make it easier for the students to mark the cards.

Make sure that each set of has at least 60 cards in it.

We recommend that each group has a maximum of 4 students.

Do not tell the groups how many cards are in their set.

Make sure the students shuffle the cards between each exercise.

For this exercise, you will need the following materials:

- a set of regent honeyeater (RH) cards (Figure 16)
- a dry erase marker
- paper towel.

Your task for this exercise is to use the regent honeyeater cards to complete the following simulations. Use the spaces provided to complete the formulas as you complete each step. Make sure to use table 4 to write in your P values.

Capture-mark-recapture 1

$$P = \frac{M \times S}{R}$$

Capture 1: Catch and tag 20 regent honeyeaters (RH). This is your M value.

Capture 2: Release RH back into the population shuffle all the cards).

Catch 20 RH. This is your S value.

How many of these were tagged? This is your R value.

Capture-mark-recapture 2

$$P = \frac{M \times S}{R}$$

Capture 1: Catch and tag RH (more or less than 20). This is your M value.

Capture 2: Release RH back into the population (shuffle all the cards).

Catch 20 RH. This is your S value.

Count how many were tagged. This is your R value.

Capture-mark-recapture 3

$$P = \frac{M \times S}{R}$$

Capture 1: Catch and tag 20 RH. This is your M value.

Capture 2: Release RH back into the population (shuffle all the cards).

Catch a number of RH (more or less than 20). This is your S value.

Count how many were tagged. This is your R value.

Record your data

Table 4 Results for each capture-mark-recapture (CMR) exercise

Exercise	Results
CMR 1	
CMR 2	
CMR 3	

Teacher tips

For CMR1, the students are carrying out the example calculation. The only difference is that this time they may or may not capture 7 as in the example.

For CMR2, the students are changing M.

For CMR3, the students are changing S.

Analyse your data

When collecting data in the field the larger the sampling size the more accurate your population estimate will be. When you analyse your data, think about how close your estimate is to the original population i.e. number of cards you started with.

Discussion

Does altering the values of M or S impact the accuracy of the population estimates?

6. More information

Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion, NSW Department of Environment & Climate Change, Published August 2007, Date accessed: 16 January 2020, https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/threatenedspecies/EECLowerHunterSpottedGumLowRes.ashx

NSW Threatened Species Scientific Committee webpage, Department of Planning, Industry and Environment – Environment, Energy and Science, Date accessed: 16 January 2020, https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee

Our local fauna webpage, Cessnock City Council, NSW Government, Date accessed: 16 January 2020, http://www.cessnock.nsw.gov.au/environment/biodiversity/cessnocklocalfauna

Regent honeyeater (*Anthochaera phrygia*) conservation management webpage, NSW Department of Planning, Industry and Environment – Environment, Energy and Science, Date accessed: 16 January 2020, www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10841

Regent Honeyeaters at Quorrobolong, Lower Hunter Valley NSW, May 2017, www.youtube.com/watch?v=73k8ZIx6Zqo

Regent honeyeater webpage, BirdLife Australia, Date accessed: 16 January 2020, http://www.birdlife.org.au/projects/woodland-birds-for-biodiversity/regent-honeyeater-wl

Regent honeyeater webpage, NSW Department of Planning, Industry and Environment – Environment, Energy and Science, Date accessed: 16 January 2020, www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10841

Saving our Species Program webpage, NSW Department of Planning, Industry and Environment – Environment, Energy and Science, Date accessed: 16 January 2020, https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/saving-our-species-program

Significant breeding event of Regent Honeyeaters *Anthochaera phrygia* near Kurri Kurri, New South Wales, during spring 2007, Australian Field Ornithology 2014, http://www.birdlife.org.au/documents/IBAiD-Roderick_et_al_2014-Regent_HE_HEZ_breeding_event.pdf

Swift Parrots and Regent Honeyeaters in the Lake Macquarie City Council area New South Wales, Published June 2014, Date accessed: 16 January 2020, http://www.environment.gov.au/system/files/pages/25570c73-a276-4efb-82f4-16f802320e62/files/regent-honeyeater-swift-parrot-report.pdf

Swift Parrots and Regent Honeyeaters in the Lower Hunter Region of New South Wales, Published May 2013, Date accessed: 16 January 2020, https://www.environment.gov.au/system/files/pages/25570c73-a276-4efb-82f4-16f802320e62/files/birdlife-swpa-reho.pdf

Threatened Fauna of the Hunter & Mid Coast, Local Land Service, NSW Government, Published March 2019, https://hunter.lls.nsw.gov.au/__data/assets/pdf_file/0008/1118564/regent-honey-eater.pdf

Threatened species topic area webpage, NSW Department of Planning, Industry and Environment – Environment, Energy and Science
www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species

Our Bushland with Tim Faulkner, Cessnock City Council, NSW Government, 2018, www.youtube.com/watch?v=AojHcD5ePZ4&t=1s

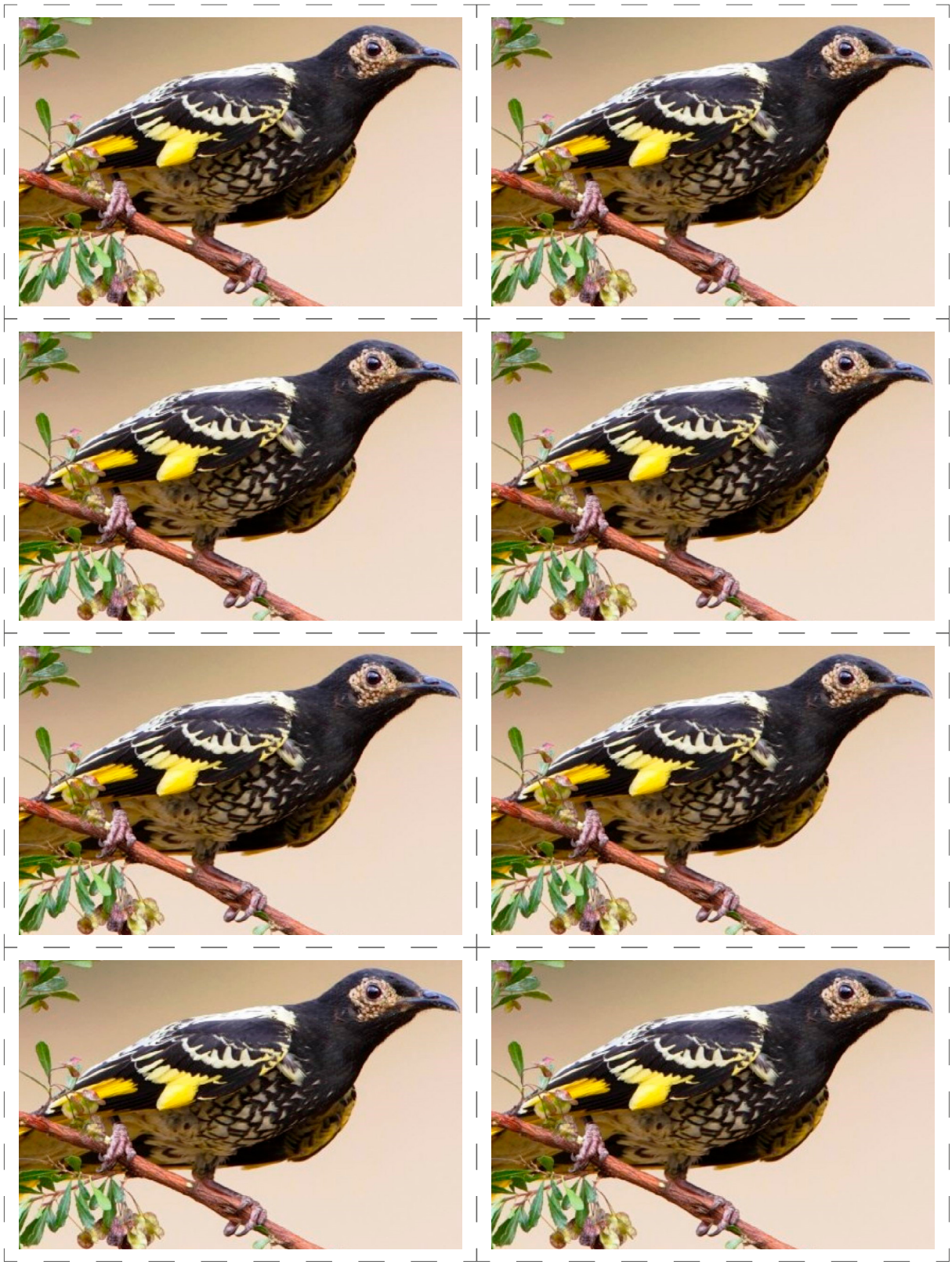


Figure 16 Images of regent honeyeater to use to make capture-mark-recapture cards
Photo: Dean Ingwersen/BirdLife Australia

Glossary

Abiotic
Relating or resulting from nonliving parts of an ecosystem.

Affinity
A natural liking for or connection with something.

Coefficient of Determination (R^2)
A measure used in statistical analysis that assesses how well a model explains and predicts future outcomes. Its value ranges from 0 to 1.

Biotic
Relating to life or resulting from living organisms.

Ecological community
Naturally occurring group of plants, animals and other organisms that are interacting in a unique space/area.

Elevation
Height above sea level.

Forage
When an animal species searches for wild food resources.

Fragmentation/ongoing loss
Process by which habitat loss results in the division of large continuous habitats into smaller, more isolated habitat fragments.

Green corridors
Areas of habitat that connect wildlife populations with other areas of habitat that have been separated by human activities or structures.

Habitat patch size
Term used to describe the size of an ecosystem.

Invasive bird
A bird species that is not native to an area and threatens the local ecosystem.

Relative abundance
Used when talking about biodiversity and refers to how common or rare a species is relative to other species in a defined space or community

Scientific process
A method of research in which a problem is identified, relevant data are gathered, a hypothesis is formulated from these data, and the hypothesis is empirically tested.

Spotted gum–ironbark forest
A type of forest community that is characterised by spotted gum (Corymbia maculate) and various ironbarks (predominantly Eucalyptus fribrosa).

Temperate woodlands
Term generally used to describe ecosystems which contain widely spaced trees where the crowns do not touch. In Australia, woodlands are mainly dominated by eucalyptus species.

Appendix A: Example depth study plan - Kurri Kurri Highschool

Unit Name: EES Depth Study – Regent Honeyeater

Teacher: Bailey **Class:** Year 11 Earth Science

Planned Time:

3 Weeks

Date Started:	Date Completed:

Overview / Background Information

The Regent Honeyeater Project and the accompanying online geographic system tool resource supports the mandatory 15 hours depth study component of Earth and Environmental Science. This information has been provided as a draft copy as of March 2019 by the Office of Environment and Heritage and will be trialed at Kurri Kurri High School for the Year 11 course under their guidance.
The project relies on the use of and online Geographical Information System (GIS) to assess the biodiversity of the Hunter Region, focusing on the Regent Honeyeater, and provided students with the opportunity to interpret and collate visual data and examine ecological issues relevant to the protection and management of local ecosystems.

Class Profile:

Literacy Class ☐ Enrichment Class ☐ Boys/Girls Class ☐ PLPs reviewed ☐ Learning Plans ☐ SMART data ☐ CAPA class ☐

Why this learning matters:

Literacy & Numeracy Focus:

Data collection and analysis
Subject specific terminology

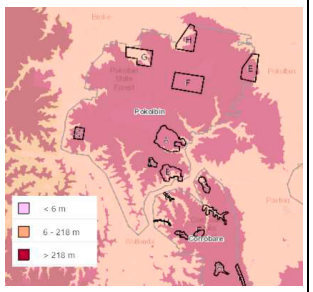
Language:

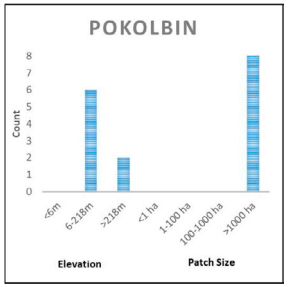
Differentiation:

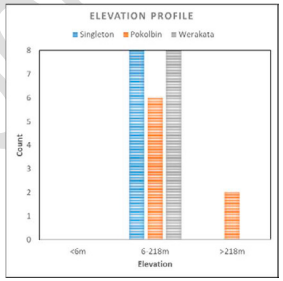
Outcomes	References and Resources
› develops and evaluates questions and hypotheses for scientific investigation EES11/12-1 › selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media EES11/12-4 › analyses and evaluates primary and secondary data and information EES11/12-5 › communicates scientific understanding using suitable language and terminology for a specific audience or purpose EES11/12-7 › describes human impact on the Earth in relation to hydrological processes, geological processes and biological changes EES11-11	Tarbuck (2014) – Earth Science: Global Edition (14e) Exploring Earth and Environmental Science (2016) Dot Point – NSW Earth and Environmental Science (2018) Spotlight - NSW Earth and Environmental Science (2018) Geoscience Australia Website (www.ga.gov.au) Regent Honeyeater Workbook – Department of Planning, Industry and Environment

Key Concepts

Must	Should	Could
*Complete a Depth Study equivalent to 15 hours *Complete Assessment Task #2		

Depth Study (15 hours)		
Content	**Teaching and Learning Activities**	**Registration**
› describes human impact on the Earth in relation to hydrological processes, geological processes and biological changes EES11-11	**Depth Study Introduction** Learning Intention: To understand the skills that will be focused on during this depth study and the choice of project for the next three weeks. • Students are provided with background information of the project and the knowledge and skills to be developed. Students highlight the key terms in each outcome, i.e., **FoR_M;** • EES11-11 describes human impact on the Earth in relation to hydrological processes, geological processes and biological changes • EES11/12-1 develops and evaluates questions and hypotheses for scientific investigation • EES11/12-4 selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media • EES11/12-5 analyses and evaluates primary and secondary data and information • EES11/12-7 communicates scientific understanding using suitable language and terminology for a specific audience or purpose	
› develops and evaluates questions and hypotheses for scientific investigation EES11/12-1 › describes human impact on the Earth in relation to hydrological processes, geological processes and biological changes EES11-11	**Field Trip to KKHS Bushland** Learning Intention: To contrast the bushland around Kurri Kurri with areas of residential housing and businesses. • Notes are collected and parent calls made, if required, to obtain permission for students to leave the school grounds • The class is taken on an excursion to the neighbouring bushland and discussions are held about the types of animals and plants that can grow and survive in this area – **QLE2; S1; S5; IQ6** • Students are challenged to consider how this locations (Site A) varies from the local TAFE (Site B) known to foster kangaroo and Biralee oval (Site C) – **S1;S3;** 	
› selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media EES11/12-4	**Geographic Information System (GIS)** Learning Intention: To introduce and explicitly model the data collection approach using the GIS software package linked to the project (**QLE1**). • Computer access is booked for the class and students are linked to the following using Canvas: • https://webmaptest.environment.nsw.gov.au/Html5Viewer291/index.html?viewer=RegentHoneyeater • Students are shown how to view 'sites' and add the 'elevation data' for each area of interest as shown • Each area is investigated, and any difficulties students face in understanding the information are explained 	

Depth Study (15 hours)		
Content	**Teaching and Learning Activities**	**Registration**
› develops and evaluates questions and hypotheses for scientific investigation EES11/12-1	**Regent Honeyeater Habitat Qualities** Learning Intention: To explore the key factors required in a given location for the Regent Honeyeater to survive and breed. • Students watch the following two videos on the Regent Honeyeater Project – **QLE2** • https://www.youtube.com/watch?v=zByfOpxdcZM&t=12s • https://www.youtube.com/watch?v=Z8t0JqYCPk8&t=4s • Students are then provided with information on the following four factors that will be examined in their assessment task and challenged to write a hypothesis linking each factor to the survival of the Regent Honeyeater (**FoR_P; S3; QLE3**): ○ Water Availability; Connectivity of Habitat; Food Tree Species; Mistletoe Availability	
› selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media EES11/12-4	**Primary Data Collection** Learning Intention: To work in small groups to collect the elevation and patch size data for each of the seven areas available on the GIS database **(C1; C3; C4; QLE5; QLE6)** • Students access the GIS website and collect elevation and patch size data for each of the seven areas • The modelled data set gathered in the prior lesson is provided to students and they are expected to produce a similar table for each area • Students are expected to work together in groups of 2-3 when collecting data and to discuss the issues that come up, such as which category is most appropriate when more than one fits the data, and come to a group consensus before recording. Pokolbin | Elevation | Patch Size A | >218m | >1000 ha B | >218m | >1000 ha C | >218m | >1000 ha D | >218m | >1000 ha E | >218m | >1000 ha F | >218m | >1000 ha G | 6-218m | >1000 ha H | 6-218m | >1000 ha	
› analyses and evaluates primary and secondary data and information EES11/12-5 › communicates scientific understanding using suitable language and terminology for a specific audience or purpose EES11/12-7	**Primary Data Analysis** Learning Intention: To analyse the data collected by counting, tabulating and graphing • Students are shown an example of how the raw data collected for one site can be converted into frequency data – **QLE1** • This data is then graphed, as per the exemplar, and the information discussed – **IQ6** • Students are challenged to work in small groups to covert the data they have collected in frequency data and represent this information graphically – **C1; C4** • Out of the seven areas, the three most suitable to the Regent Honeyeater are then decided on the basis of their preference for low elevation and large patch size – **C4; IQ6** 	

Depth Study (15 hours)		
Content	**Teaching and Learning Activities**	**Registration**
› selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media EES11/12-4 › analyses and evaluates primary and secondary data and information EES11/12-5	**Secondary Data Analysis** Learning Intention: To independently apply data collection/ analysis skills. • For the three locations most suitable for the Regent Honeyeater, students are tasked to collect data on the following factors using the given categories: • Water availability (poor, moderate, good, very good) • Connectivity (low, medium, high) • Preferred habitat (poor, low, medium, m-high, high) • Mistletoe (absent, low levels, high levels) • Students are challenged to graphically compare this information as shown in the exemplar – **QLE1; QLE3; IQ2** 	
› analyses and evaluates primary and secondary data and information EES11/12-5 › communicates scientific understanding using suitable language and terminology for a specific audience or purpose EES11/12-7	**Visitors from Biodiversity and Conservation Division - DPIE** Learning Intention: To gains an appreciation for the value of environmental science in the local area through discussions held with external experts in the field • Freddy Herrera and Mark Cameron are introduced to the class and give the students a presentation of the importance of the Regent Honeyeater to the local ecosystem • Students are exposed to a range of useful information on the Regent Honeyeater and provided with resources on locating and identifying local plant and animal species • Students are given the opportunity to provided meaningful feedback to the visitors regarding the project and any challenges they have faced in terms of using the GIS software • Issues related the discrepancies between the legend and visual display are discussed and the variability between computer screens and iPads are clarified so that each student is confident in the data they are recording	
› communicates scientific understanding using suitable language and terminology for a specific audience or purpose EES11/12-7 › describes human impact on the Earth in relation to hydrological processes, geological processes and biological changes EES11-11	**Assessment Notification** Students are to prepare a depth study report on the Regent Honeyeater using data gathered from the GIS system. This report must be organised into the following four sub sections: *Introduction* – addressing the importance of the Regent Honeyeater and the key factors affecting its survival *Data Collection* – including a hypothesis for each factor investigated and the tabulated data obtained for the three selected areas (Pokolbin, Werakata and Watagans) *Data Analysis* – a series of graphs that effectively display the factor variation in each area and graphs that compare a single, chosen factor across the three chosen areas *Discussion and Conclusion* – addressing the importance of the information shown in each of the above graphs and how this links to the impacts humans are having on the environment in the local area	

Unit Evaluation					
How did the unit rate in these areas:	**Low**	**Medium**	**High**	**What worked well? Why?**	**What can be improved? How?**
Time:					
Time allocated for topic					
Location in scope and sequence					
Student Learning and Engagement:					
Student understanding of content					
Opportunities for student reflection on learning					
Assessment for, as and of learning included					
Suitability of resources					
Student feedback sought and received					
Teaching Strategies:					
Variety of teaching strategies used					
Literacy strategies used					
Numeracy strategies used					
Integration of ICT					

Comments on unit / Changes to be made for future years:

APPENDIX: CODING KEY

Quality Teaching

Intellectual Quality	*Quality Learning Environment*	*Significance*
IQ1 Deep knowledge	QLE1 Explicit quality criteria	S1 Background knowledge
IQ2 Deep understanding	QLE2 Engagement	S2 Cultural knowledge
IQ3 Problematic knowledge	QLE3 High expectations	S3 Knowledge integration
IQ4 Higher-order thinking	QLE4 Social support	S4 Inclusivity
IQ5 Metalanguage	QLE5 Students' self-regulation	S5 Connectedness
IQ6 Substantive communication	QLE6 Student direction	S6 Narrative

8 Ways of Learning

- Story Telling - Learning Maps	- Non-Verbal - Symbols and Images	- Land Links Deconstruct/Reconstruct	- Non-Linear - Community Links

21st Century Learning

C1: Collaboration	C2: Creativity	C3: Communication	C4: Critical Thinking

Focus on Reading

Predicting: FoR_P Summarising: FoR_S	Visualising: FoR_V Monitoring: FoR_M	Making Connections: FoR_MC Questioning : FoR_Q

Focus on Writing

Cohesive devices: FoW_CD Connectives: TEEEC Given-New	*Precision Devices: FoW_PD* Expanded Noun Groups Subject Specific Language Nominalisation	*Quick Fixes: FoW_QF* Passive Voice

Regent honeyeater
(*Anthochaera phrygia*)
Bruce Thompson/DPIE