



Enhancing Biodiversity in the Australian Environment



Image source: http://4.bp.blogspot.com/-o-RjksjhBkg/T2leAl0EyGI/AAAAAAAAABEs/Fzy-ZBuZi6o/s400/Carnabys_black_cockatoo_flickr.jpg

Teacher Overview

This lesson is designed to enhance a student's knowledge and understanding of the concept of biodiversity. Through various activities, the lesson explores what biodiversity is, why it is important and how technology is transforming the study of biodiversity. The lesson contains a practical activity that allows students to work in groups to compare the level and variety of biodiversity within their school grounds or local area.

ForestLearning has created a resource that contains activities based on three important case studies of how various stakeholders are **positively** approaching biodiversity decline, while still maintaining commercial productivity of their land, through the utilisation of Agroforestry, Wildlife Corridors, and the proposal of increasing pine plantations to conserve the Carnaby's Cockatoo,



Stage

Year 9 Science

Syllabus Links

ACSSU176: Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems

AC SIS164: Formulate questions or hypotheses that can be investigated scientifically

AC SIS165: Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods

AC SIS166: Select and use appropriate equipment, including digital technologies, to collect and record data systematically and accurately

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Lesson Activities

NOTES:

All resource links and writing spaces for student responses are provided within the student worksheet resource.

Schools are responsible for producing their own risk assessments for practical activities contained in this document

Activity Suggested Timings

	Activity	Approx. Time (mins)
1	Introduction to biodiversity	2
1.1	What is biodiversity	10-15
1.2	What is biodiversity and why is it important?	10-15
1.3	Trees and biodiversity	5
1.4	Measuring biodiversity	60
1.5	Investigating biodiversity and technology	5-10
2	Introduction to Agroforestry	5
2.1	Case study Yan Yan Gurt West	20
3.1	Case study Yarra Yarra biodiversity corridor	5
3.2	Case study Yarra Yarra summary task	15-20
4.1	Case study Carnaby's Cockatoo	20-25
5.1	Enhancing your school's biodiversity	5-10

Activity 1

Introduction to Biodiversity

Teacher preparation:

- Photocopy and hand out a copy of the Biodiversity resource to each student.

Activity Outline

- Read through the text "Introduction to Biodiversity" and highlight the information with your students.



Activity 1.1: What is Biodiversity?

Teacher preparation:

- If completing **b)** as an individual task allow the use of BYOD, or book a class set of laptops/iPad for use in your classroom.

Activity Outline

- a) Coordinate a whole class discussion on organisms that your students believe to be extinct, endangered or vulnerable and have them record their ideas in the space provided. Teachers can record their students' ideas on the board, smartboard etc.
- b) Using the link provided below, students should research and edit their lists by ticking those that are correct and crossing out those that don't belong. You can edit the list on the board as the students locate the answers.

URL: <https://www.worldwildlife.org/species/directory>

Source: *WWF Worldwide Species Directory.*

Activity 1.2: Multimedia Task: What is biodiversity and why is it important?

Teacher preparation:

- If performing this activity as an individual task, teachers should book a class set of iPads, the school's computer lab or allow access to BYOD to view the multimedia source. Alternatively, teachers could project the multimedia source on screen if conducting the activity as a whole class task.

URL: <https://www.youtube.com/watch?v=7tgNamjTRkk>

Source: *What is biodiversity and why is it important? CSIRO, published 15 Jul 2014 (07.51)*

Activity Outline

- Students should view the CSIRO video and answer the questions in the spaces provided. If viewing as a whole class, teachers may wish to pause the multimedia source to allow students to write their answers.



Activity 1.3: Trees and Biodiversity

Activity Outline

- To gauge your students' knowledge and understating of the importance and role of trees in an ecosystem and their relationship to biodiversity, conduct a short brainstorming session on the topic and have students collate their data on their worksheets surrounding the tree diagram.
- At the conclusion of the session, teachers should add important features that students were unaware of (suggestions/ideas are provided in the answer section of this document).

Measuring Biodiversity

Activity Outline

- Read through the text and highlight the information in the introduction with students.

Activity 1.4: Measuring Biodiversity

Teacher preparation:

- Prior to the lesson it is encouraged that teachers view the suggested links detailing vertebrate sampling and select a method that best suits their class, time allowance and resources. Teachers may wish to use the methodology from their selected textbook.

URL: <https://australianmuseum.net.au/document/invertebrate-collection-manual>

Source: *Invertebrate Collection Manual*, Australian Museum, 2010 © Australian Museum

URL: <http://treeday.planetark.org/documents/doc-378-earth-alive-2012.pdf>

Source: *Planet Ark, Earth Alive. WS 5: Trapping Invertebrates (page 37) and WS 6: Bio Survey Data Sheet (page 39-40)*

URL: <https://australianmuseum.net.au/structuring-insect-field-observations>

Source: *Structuring Insect field observations*, Australian Museum. © Australian Museum

- Order all equipment necessary (depending on your method of collection and analysis).
- Complete any risk assessments that are required.
- Allocate students into groups with specific areas to test.



Activity Outline

- a) With your class, discuss areas around your school or local area that would feature the greatest amount of biodiversity, and then on a sliding scale a medium and low level of biodiversity. Record the place names in the provided table.

 **TIP:** Teachers may wish to project onto a smart board or screen the areas under discussion using Google Earth as the class are brainstorming ideas.

URL: <https://www.google.com.au/earth/>

Source: Google Earth

- b) As a class, select two accessible areas within the school grounds or local area that can be investigated for comparing the biodiversity in the leaf litter and soil. One area should be expected to have a high level of biodiversity and the other low (however, it should be a vegetated area that contains hopefully some organisms within the soil and leaf litter. Somewhere dry and hot would expect to have less biodiversity than somewhere beneath a heavily vegetated and moist environment).
- c) Assist your students in planning their comparative investigation by working through the subheadings on their worksheets. Students should conduct the investigation when they have progressed through the planning stages. Suggested answers are included in the answer section of this document.

Extension Activity 1.5: Investigating Biodiversity and Technology

Teachers may wish to allocate this short task as a homework activity or alternatively as an extension task for students who complete work quickly.

Teacher preparation:

- If performing this activity as an individual task, teachers should book a class set of iPads, the school's computer lab or allow access to BYOD to view the multimedia source. Alternatively, teachers could project the multimedia source on screen if conducting the activity as a whole class task.

URL: <https://www.youtube.com/watch?v=THvfu6shljg>

Source: *Insect collections going 3D, CSIRO, 11 March 2014 (4.28)*

Activity Outline

- Students should view the CSIRO video and answer the questions in the spaces provided. If viewing as a whole class, teachers may wish to pause the multimedia source to allow students to write their answers.



Examples of Improving Biodiversity in Our Environment.

Optional Task: Teachers may choose to show the following forest biodiversity multimedia source to highlight the care taken within the commercial forestry industry to enhance biodiversity within the forest system. The source explores how sampling of bats is performed and highlights how they are an indicator of forest health.

URL: <http://forestlearning.edu.au/find-a-resource/article/23/going-bush-a-biodiversity-melting-pot-in-northern-nsw.html>

Source: *Going Bush, A Biodiversity Melting Pot in Northern NSW. (6.13)*

Activity 2

Introduction to Agroforestry

Teachers will introduce the theory and definition of Agroforestry to the class (notes are provided on the student worksheet). Students should read and highlight their notes.

Activity 2.1: Case Study One; Yan Yan Gurt West

Students will view the multimedia source to gain a knowledge and understanding of how trees can be a profitable source of income on a property and how they can be introduced into a traditional farming enterprise to improve multiple outcomes.

Teacher preparation:

- If performing this activity as an individual task, teachers should book a class set of iPads, the school's computer lab or allow access to BYOD to view the multimedia source. Alternatively, teachers could project the multimedia source on screen if conducting the activity as a whole class task.

URL: <https://www.youtube.com/watch?v=4b26zrkwIPU&feature=youtu.be>

Source: *Low Impact Sustainable Agriculture – Regenerating the Family Farm. (4.58)*

Activity Outline

- a) Students should view the multimedia case study via the link.
- b) Students should record their notes in the provided table to identify how the farmers targeted problems on the property and how the property has improved as a result.



Activity 2.2: Photographic comparison study

Teacher preparation:

- The three photos displayed were taken at the same location of the farm (note the fence post as an indicator), on three different dates.
- 💡 TIP: These images could be projected on screen for discussion as students are completing the task.

Activity Outline

- Students will observe the three photos showing the timeline of changes at a location over the period of 1994-2013.
- Students should record their observations based on visual changes of the area.
- Teachers should encourage students to hypothesise what changes in biodiversity may have resulted from these changes.
- Teachers should work with their classes to complete the three related questions on the case study.

Activity 3

Students will read the introduction to wildlife corridors and how they assist biodiversity in the environment and stakeholders who own the land.

Activity 3.1: Yarra Yarra Biodiversity Corridor

Teacher preparation:

- If performing this activity as an individual task, teachers should book a class set of iPads, the school's computer lab or allow access to BYOD to view the multimedia source. Alternatively, teachers could project the multimedia source on screen if conducting the activity as a whole class task.
- If performing the task as a whole class, teachers may wish to pause the video at the appropriate times to allow students to answer the allocated questions.

URL: <https://www.youtube.com/watch?v=eTf6YF2F2S4>

Source: *Biodiverse Reforestation Project, Carbon Neutral, 4 May 2015 (0.00-2.41)*

Activity Outline

- Students should view the multimedia source and answer the questions in the spaces provided on their worksheets.



Extension Activity 3.2: Yarra Yarra Biodiversity Corridor Summary

Teacher preparation:

- The PDF document could be printed and placed around the classroom as workstations to allow the activity to be completed in groups or projected onscreen to perform the task as a whole class. Alternatively, if the task is being completed individually, teachers should order a class set of iPads/computer lab or allow access to BYOD to view the source material.

URL: <https://carbonneutral.com.au/wp-content/uploads/2017/09/Australian-Native-Reforestation-Gold-Standard-VER-FACT-SHEETe-i.pdf>

Source: Carbon neutral, Yarra Yarra Biodiversity Corridor, Australian Native Reforestation.

Activity Outline

- Students should read and highlight the PDF text.
- After reading the text, students (either in groups or individually) should use the word list provided to create a short summary text on the aims of the Carbon Neutral Project: Yarra Yarra Biodiversity Corridor.
- As students use the word list they should be checked off each square.

Activity 4

Activity 4.1: Carnaby's Cockatoo and Pine Plantations

Teacher preparation:

- Order the equipment necessary to complete the life-size diagram of the Carnaby Cockatoo
- Access an appropriate space in the classroom/school to complete task a).
- Print the Executive Summary of the paper *Cockatoos, Cones, Conifers and Conservation. Brad Barr Wespine Industries Pty Ltd 25/4/2013* for group/individual analysis. The paper can be found on pages 23-24 of this document.
- Allocate the students into the desired groups.

Activity Outline

- a) In allocated groups, students should create a life-sized diagram in an appropriate area of the class/school of a bird in flight (to show wingspan).
- b) Students should then read the Executive Summary of the paper: *Cockatoos, Cones, Conifers and Conservation. Brad Barr Wespine Industries Pty Ltd 25/4/2013* and highlight the



main features of the summary to show how the species may be protected by the implementation of more commercial pine plantations in southwest Australia.

- c) After highlighting the main points, students should annotate their diagrams with the main points of the paper.

*With special thanks to: Brad Barr (Resource Manager) Wespine Industries Pty Ltd for permission to use the paper **Cockatoos, cones, conifers and conservation** within this teaching resource. This paper was presented at The Institute of Foresters, Australia National Conference 2013.*

Activity 5

Activity 5.1: Enhancing Biodiversity in the Environment.

Activity Outline

- As a summary to the lesson sequence, it is encouraged that students are able to use their knowledge and understanding of biodiversity and apply it to their surrounding environment.
- Teachers should spend some time discussing ideas of how the local biodiversity could be improved around the school.
- Ideas are provided in the answer section of this document.



Sample Answers

Activity 1

Activity 1.1: What is Biodiversity?

- a) Will be dependent on individual class responses.
- b) Will also be dependent on individual class responses. The student's worksheet contains a link for consultation.

Activity 1.2: Multimedia Task: What is biodiversity and why is it important?

Multimedia Questions:

1. What is biodiversity?

The web of life, the full diversity of species around you in the natural environment

2. What components contribute to biodiversity?

Species diversity, genetic variability, diversification of ecosystems, evolutionary history, ecosystem functions.

3. When did the concept of biodiversity emerge?

1980's

4. Why did the concept of biodiversity emerge?

Because of the concern about the impact of human beings on the natural environment. It emerged to highlight the precious nature of the living world and highlight the need to think about the value and the need of biodiversity.

5. Why does biodiversity matter (categories)?

- Economic benefits
- Ecological life support
- Cultural support
- Recreational value
- Scientific values
- And * negative value

6. What are the three challenges facing biodiversity?

1. Addressing biodiversity decline
2. Understanding the complexity of biodiversity
3. Informing resource use discussions.



Activity 1.3: Trees and Biodiversity

Answers will vary depending on individual class responses to the brainstorming session.

Answers may include: photosynthesis, carbon storage, habitat for animals, nutrition for organisms, breeding area for organisms, harvestable food and fibre products, shade, shelter, adding organic matter to the soil to improve nutrient status, stabilisation of soil structure, prevention of erosion and salinity control.

Activity 1.4: Measuring Biodiversity

Areas selected will depend on the school's availability to vegetated areas.

Investigation title:

Comparing levels of leaf litter/soil biodiversity in the school environment.

Aim:

To investigate and compare the biodiversity of organisms in the leaf litter and soil in an (expected) highly diverse area and an (expected) poorly diverse area of {NAMED} school.

Hypothesis:

The area that is selected to have a high level of biodiversity in the soil/leaf litter will contain a greater variety and number of organisms than the second area.

How are you going to make your investigation valid, accurate and reliable?

Validity – ensure that the hypothesis is tested by the method, suitable equipment is used, variables are controlled (time of day, temperature is similar if collecting over different days, shading similar etc.), and measuring units are included.

Accuracy – use an appropriate design and equipment.

Reliable – the results are obtained consistently (multiple areas within the locations should be sampled and the information from groups collated).

SAMPLE Method:

NOTE: A risk assessment for this investigation should be prepared by the teacher.

Materials:

- Moisture meter
- 8 plastic ziplock bags per group
- Permanent marker
- Gloves
- 2 containers



- Thermometer or data logger
- Binocular microscopes
- Petri dish
- Forceps
- Soil microorganism key (two suggested links provided below)

Quick references:

URL: <https://australianmuseum.net.au/document/quick-invertebrate-guide>

Source: Quick Invertebrate Guide, Australian Museum, 2010 © Australian Museum

URL: <https://australianmuseum.net.au/document/invertebrate-guide>

Source: Invertebrate Guide, Australian Museum, 2010 © Australian Museum

Method:

1. Select two appropriate areas in the school groups/local area (one that is expected to be high in leaf litter/soil biodiversity (a lot of vegetation and high moisture and leaf litter content) and one that is expected to be low in leaf litter/soil biodiversity (little vegetation, hot, dry).
2. Divide the two areas into sections for each group to sample a particular location.
3. Measure and record the air temperature 1 metre above the ground in both locations.
4. Measure and record the temperature just below the leaf litter (but not in the soil) for each location.
5. Use a moisture meter to record this data for both locations.
6. Observe the surface of the leaf litter for any signs of biodiversity. If possible (and safe) collect the organisms and place them in one of the bags and label it appropriately (e.g. High biodiversity area: Top leaf litter).
7. Collect a sample of leaf litter from the grounds surface and place in in a second labelled bag (e.g. High biodiversity area: leaf litter).
8. Collect a third sample of the next layer underneath the leaf litter into another labelled bag. (e.g. High biodiversity area: Below leaf litter).
9. Finally, students are to collect approximately half a cup of soil and place it in the last labelled bag (e.g. High biodiversity area: Soil sample).
10. Repeat these samples for Area 2 - Low biodiversity area.
11. Return to your classroom and students are to use the binocular microscope and appropriate keys and books to identify and record the variety and amount of biodiversity in their samples from the two areas.
12. Safely and carefully return the student samples to their original location.

Results table:

Will depend on individual class/school sample areas.



Discussion of the comparison of the levels of biodiversity in the two selected areas

Teachers should spend some time at the conclusion of the investigation analysing the results. Ideas for discussion could include but are not limited to the question prompts found in the student work book including: the variety of different types of organisms in each area and why this occurred, the number of organisms found in each area and why there may have been differences, the variables that would impact on the variety and number of organisms, discuss ways that the diversity in each area could be increased.

Extension Activity 1.5: Investigating Biodiversity and Technology

Multimedia Questions:

1. **Why is understanding insects so significant to ecosystems and biodiversity?**
They are key components to ecosystems as they form one of the base layers of a food chain.

2. **How many images are collected to form one 3D image of an insect?**
4500 images.

3. **What are some of the projected uses of this 3D technology?**
Sharing information, informing quarantine, pest management, research, education.

Activity 2

Activity 2.1: Case Study One; Yan Yan Gurt West

Methods used to address environmental issues	Improvements to the environment/farm/productivity
Revegetated with 40 000 trees. Created corridors and well protected stock areas. Farm plan created	Restoration of hydrological features (30 m deep creek). New products and new opportunities of products, producing high value timber. Soil and stock are protected. Improves environment for family members and community.



Activity 2.2: Photographic comparison study

Area in 1994

Low levels - zero levels of trees, poor pasture/grass quality with areas completely free of vegetation.

Same view of area in 1999

Uniform grass/pasture cover, significant deep-rooted perennial vegetation has been established and is growing well.

Same view of area in 2013

The area is significantly 'forested' with large trees that are very well established and diverse in variety.

The area has been transformed over the period of time and turned from what visually appears to be an unproductive pasture/grass area to one that is diverse in vegetative mix and stable in terms of erosion risk and supporting plant life (and therefore animal life).

The reason for the increased diversity would be attributable to improved habitat, improved nutritional source for a variety of organisms, improved level of organic matter in the soil and therefore an increased number and variety of microorganisms within the soil.

Questions:

1. Discuss what the effect to biodiversity within Australia will be, if farmers do or do not adopt sustainable agricultural systems like the Stewart family have on Yan Yan Gurt West?

Adopt the system: Trees and grasses support a diverse variety and large number of organisms. Certain tree and shrub species would act to encourage pollinators to the area, more herbivorous animals would be supported, habitat would be provided and soil microorganisms would increase and improve the recycling of important nutrients within the soil making them available for plant growth and development.

Do not adopt the system: If monocultures are maintained and there is limited planting of deep rooted perennial vegetation, the biodiversity within a system will inevitably stabilise or continue to decline. Systems that lack trees and fertile soil will be unable to support a level of vegetation that also encourages a rich species mix. Issues in environmental degradation (such as erosion and dryland salinity) will



continue to worsen within areas that are lacking in trees and productivity will be further reduced.

2. What do you think are the main reasons why more farmers do not plant more trees on their farms are?

Financial reasons of up front purchasing the trees, time costs in the planning of tree positioning, fencing costs and time to install to minimize stock damage to trees, education of the benefits, time to establish, labour available to establish the plantations, perceived view that there will be loss of commercial area for grazing, crops etc.

3. What factors might help them to plant more trees on their farms?

- Subsidising the cost of trees seedlings and other implementation costs.
- Education programs on the benefits to not only the environment but also a commercial perspective (e.g.: decreasing the stress on animals from wind by using windbreaks with commercially saleable tree species, improved pasture yields associated with planting windbreaks, what trees to plant for commercial timber benefits),
- Education on the increased revenue from the sale of commercial plantings.
- Promoting data on the improvements/protection of specific organisms within an area.

Activity 3

Activity 3.1: Yarra Yarra Biodiversity Corridor

Multimedia Questions:

1. What number of trees has this project used and over what area to address issues in degraded farm land?
20 million trees across 10 000 hectares.
2. With respect to the Yarra Yarra area, identify where the seed has been sourced for this project?
Within 30 kms of the project area.



3. Explain why you think seeds have been collected from this area? (Not referred to in the video, teachers will need to help students with this answer)

So that the species that are planted are suited environmentally to the area and have a higher survival rate. The biodiversity is being replaced with what would have been originally removed, and as a result the organisms that are dependent on these species are likely to also return to the areas and carry out their “natural” functions within the ecosystem.

4. Identify four benefits of this project?

1. Employment
2. Reclaims salt land
3. Helped to prevent wind and water erosion
4. Provide significant habitat for flora and fauna

Extension Activity 3.2: Yarra Yarra Biodiversity Corridor Summary

NOTE: Words in bold/underline are the words contained in the “Word List”

- **Southwest Australia** is the location of the Yarra Yarra Biodiversity Corridor native restoration project.
- The revegetation project removes **1.897 million tonnes of carbon**.
- The project has the **goal of returning** the environment to its origin species and biodiversity.
- The **project aims** to remove existing carbon from the atmosphere and to recreate a healthy and functioning landscape from degradation.
- **Connectivity** is the aim of the current and future plantings for birds and **animals** to **transition** through the landscape.
- **Habitat** is provided for food, nests and protection from predators.
- The significance and importance of welcoming back **threatened species** such as Malleefowl, Bush Stone-curlew, Carnaby’s Black Cockatoo, Western Spiny-tailed Skink and the Woylie.
- **Biodiversity hotspots** are regions that have an exceptionally high number of plant and animal species found nowhere else in the world and account for 90% of all species on Earth.
- Acknowledgement of the **Traditional owners** and their connection to the country underpins the organisation’s cultural and environmental awareness, values and goals.
- The trees are protected for 100 years by a **Carbon Right and Carbon Covenant** registered on land titles.



Activity 4

Activity 4.1: Carnaby's Cockatoo and Pine Plantations

Considered rare and likely to become extinct, listed as endangered

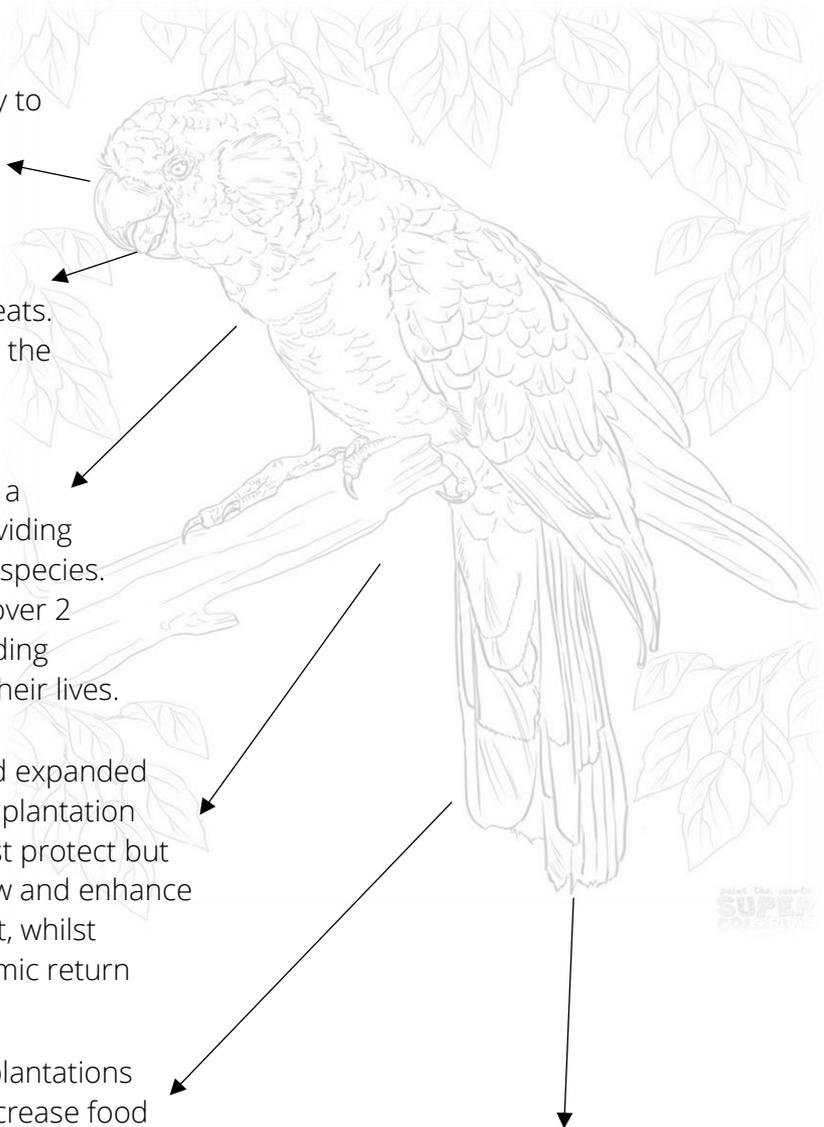
Habitat destruction and decline are the major threats. Loss of foraging habitat is the greatest risk

Pine plantations could be a significant method of providing nutritional stability to the species. 1 ha of pine will support over 2 birds for entire non-breeding season for every year of their lives.

A maintained and expanded commercial pine plantation estate will not just protect but manage and grow and enhance important habitat, whilst delivering economic return

Management of pine plantations could be tailored to increase food production with no impact on timber quality. Artificial dams and hollows could also be implemented

There are available areas of land (South of Perth) that would be suitable for implementation and have infrastructure for timber processing already. Profitability numbers are currently poor therefore State and Federal bodies need to address the need for a value on non-timber benefits and financial boosts for plantation projects.





Activity 5

Activity 5.1: Enhancing Biodiversity in your Environment.

Ideas for implementation could include:

- Researching local species of native flora and planting them within the school grounds.
- Researching species of local flora that encourage feeders and pollinators to the area.
- Native bee hives.
- Compositing and worm farming.
- Planting garden beds.
- Mulching areas within the school to improve soil habitats.
- Be involved in Outdoor classroom Day and/or National Schools Tree Day and get the whole school involved in your ideas!

References

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Appendix 1 - Cockatoos, Cones, Conifers and Conservation

A paper presented by Brad Barr, Wespine Industries Pty Ltd at The Institute of Foresters, Australia National Conference 2013.

Executive Summary: An Argument for New Commercial Pine Plantings Established for the Forage Habitat of Endangered Cockatoos in Western Australia.

Carnaby's Cockatoo (*Calyptorhynchus latirostris*) is considered rare or likely to become extinct. It is listed as endangered under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Habitat destruction and decline are major threats to the bird's survival. Loss of quality foraging habitat is thought to pose the greatest risk to the species. Since the late 1940s, cockatoos have been observed foraging on pine trees. Pine plantations have provided a source of nutritional stability in the face of disappearing and fragmenting native forage and roosting sources.

State and Federal Government environmental regulators are involved in the conservation of the species, particularly in areas of development planning where changes of land use will affect habitat. A National Recovery Plan is in place that stresses the enhancement of critical habitat and specifies deeding habitat of particular importance.

It is the fundamental thesis of this paper that a maintained and expanded commercial pine plantation estate will not just protect and manage, but grow and enhance important habitat, but do so efficiently, while delivering a positive economic return to proponents.

Pine plantations possess the unique attribute of providing a food source that is sufficiently abundant and densely distributed that birds can remain resident in an area for several months at a time. Experts consider pine an ideal food resource because of the timing of cone maturity and the energy gained for energy expended foraging.

Energy production predictions from a pine plantation can be incorporated into standard forest planning systems, and energy flow arising across the landscape modelled. One hectare of pines will support over 2 birds for the entire non-breeding season, for every year of the birds lives.

Management of the pine plantations (silviculture) can be tailored to increase cone production with little major impact on timber quality. Timing of forest thinning, and fertiliser choice, show the strongest prospects for improving forage value for cockatoos. Artificial hollows and location of fire-fighting dams also improve habitat value.

There are significant areas of cleared land to the south Perth, on the Swan Coastal plain, that would be suitable for either an expanded pine plantation estate, or as an area in which to relocate the threatened Gngangara pine plantation. Pines would also help to reverse the damaging eutrophication of waterways caused by build-ups of mineral fertiliser in soils from a history of pasture growing.



SW Western Australia has the benefit of a strong domestic processing industry. There are long established manufacturing facilities producing sawn timber for house construction, particle board, laminated veneer timber for heavy construction and local processing for the e3xport of forest wastes. It is forecast that at current population growth rates, WA will sadly become increasingly dependent on imported timbers for local house construction.

Viewed purely on the revenue from forest products, pine plantations are a middling to poor financial investment. This is due largely to high land access costs and long-time frames for return on investment. At present, the pine estate in WA is slowly shrinking. Prominent economics researchers have identified that for a revitalised plantation investment sector, a means to value the non-timber benefits that commercial forests provide to society needs to be found.

Bringing the pine industry, with its experience and know-how, together with the proponents of projects (like housing development and mining) who have desire for positive improvements in cockatoo prospects, is required.

The lynchpin to enable this to become a reality at any significantly large scale is the State and Federal environmental regulators. It is these bodies that determine what activities qualify as acceptable offsets. If a mitigating activity such as the establishment of a pine plantation is included or referenced in compliance related literature, it is certain that project proponents will seek out means to engage with the pine industry and cause plantations to be established. With active promotion by regulators, pine plantations could make a huge positive impact upon the prospects of this endangered species.

At a smaller scale, building on the voluntary carbon offset, it could be possible to create a voluntary “cockatoo habitat” market for the environmental services that a pine plantation provides. This would help to provide the financial boost the pine plantation needs to be economically viable and could be achieved by quantifying the food produced in a plantation project and offering for sale certificates attesting to the number of birds that will be supported by the contribution. Interested people and organisations could effectively sponsor cockatoos.

Pine plantations’ role in the conservation of Carnaby’s Cockatoo is just starting to be recognised. With the right regulatory environment and increased awareness, the capacity of pine plantations to contribute positively to future conservation and food security for the species looks bright.

*With special thanks to: Brad Barr (Resource Manager) Wespine Industries Pty Ltd for permission to use the paper **Cockatoos, cones, conifers and conservation** within this ForestLearning teaching resource.*