



## 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](http://4.bp.blogspot.com/-o-RjksjhBkg/T2leAl0EyGI/AAAAAAAAABEs/Fzy-ZBuZi6o/s400/Carnabys_black_cockatoo_flickr.jpg)

### Australian Curriculum Outcomes

**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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## Introduction to Biodiversity

According to CSIRO<sup>1</sup>, **biodiversity** is the term used to encompass the **variety of all living organisms on Earth**, including their genetic diversity, species diversity and the diversity of marine, terrestrial and aquatic ecosystems, together with their associated evolutionary and ecological processes. Biodiversity makes human life on Earth possible, yet it goes beyond mere measurable scientific facts; understanding biodiversity highlights the benefits of the natural world, many of which are at risk due to the pressures of human resource-use.



Image: <https://c.tribune.com.pk/2015/10/976384-biodx-1445374974-149-640x480.JPG>

Authors of the book *"Trees and Biodiversity"* explain that:

Australia's declining biodiversity is often cited as one of our greatest environmental threats. We have already lost 19 species of mammals, 23 species of birds and 68 species of plants.

Thousands of animal and plant species are vulnerable or endangered, and an unknowable number of insects, fungi and microbes either have become extinct or are endangered. With the disappearance of these species, we also lose the many ecosystem services they provide — services that are intimately connected to the productivity of our agricultural landscapes.

One of the primary causes of this decline is the widespread clearing of native vegetation to make way for agriculture: nationwide, we have cleared 43 per cent of our forests, nearly 90 per cent of our temperate woodlands and mallee, and 75 per cent of our rainforests. Along with the decline in biodiversity, this has resulted in a loss of productive land to salinity and widespread declines in water quality.

*Quote from "Trees and Biodiversity", David Salt, David Lindenmayer and Richard Hobbs, Joint Venture Agroforestry Program 2004.*

<sup>1</sup> Morton, S. and Hill, R. (2014) "What is biodiversity, and why is it important". Chapter 1 in Science and Solutions for Australia – Biodiversity, CSIRO Publishing.



## Activity 1

**Biodiversity** is defined as: “The variety of all life forms on Earth - the different plants, animals and micro-organisms and the ecosystems of which they are a part.”

*Australian Government, Department of the Environment and Energy.*

### Activity 1.1: What is Biodiversity?

- a) As a class, brainstorm any living things that you are aware of that are extinct, endangered or vulnerable species on Earth. Record your ideas in the box below.

- b) Using the internet link below, review your list and place a line through any species your class has listed that should not be included on the list and place a tick beside those that belong on the list.

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?

- a) View the multimedia source from the link below and answer the following questions.

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

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

Multimedia Questions:

1. What is biodiversity?

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2. What components contribute to biodiversity?

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3. When did the concept of biodiversity emerge?

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4. Why did the concept of biodiversity emerge?

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5. Why does biodiversity matter (categories)?

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6. What are the three challenges facing biodiversity?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_





### Activity 1.3: Trees and Biodiversity

- a) As a class, collate your ideas about “Why are trees important to ecosystems and biodiversity?” Annotate your thoughts and those of your class members around the diagram below.



### **Measuring Biodiversity**

There is no definitive measure of biodiversity, and there is no universally accepted unit of measure for it. Most people however, acknowledge that as it is an attempt to quantify the variety of life, then the most common method of measuring it, is to count the number of difference species of biota in an area.

Thought must also be given not just to the **number of species** but also the variation within the species (**genetic diversity**, i.e. genes that allow a plant to grow faster, or genes that allow an organism to be more resistant to environmental extremes or disease resistance) and the **diversity of the ecosystem** (the relationships between the groups of species within an ecosystem).



### Activity 1.4: Measuring Biodiversity

- a) As a class, brainstorm three different areas within your school grounds, or local area, that you would all expect to have high, medium and low levels of biodiversity within the soil and leaf litter. (💡 TIP: You may wish to access Google Earth to more accurately observe the areas that are being discussed.)

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

Source: *Google Earth*

Areas within your school grounds or local area that you expect to have:		
High Biodiversity	Medium Biodiversity	Low Biodiversity

- b) Select:
- i. **one** high biodiversity areas in your school/local area, and
  - ii. a low biodiversity vegetated area that you believe will have the **least** amount of biodiversity within the leaf litter and soil.
- c) Conduct an investigation to compare the amount of biodiversity between the two areas. 💡 TIP: There are many ways to sample invertebrates in soil and leaf litter. Care must be taken to avoid damaging the organisms found during your investigation and when returning them to their original locations. Consider your safety during invertebrate collection as some may bite, sting or cause skin irritations. Wear gloves during your sampling. Your teacher will provide you with the methodology for your investigation.

A link to an invertebrate key has been provided to assist you with your study.

URL: <https://australianmuseum.net.au/document/quick-invertebrate-guide> or a shorter version of the link: <http://bit.ly/2sRCH37>

Source: *Quick Invertebrate Guide, an introduction to identifying Australian invertebrates. The Australian Museum*





*Activity 1.4 – Student Investigation*

Investigation title:

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Aim:

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Hypothesis:

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Equipment:

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Extension Activity 1.5: Investigating Biodiversity and Technology

- a) View the multimedia footage and answer the questions.

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

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

**Multimedia Questions:**

1. Why is understanding insects so significant to ecosystems and biodiversity?

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

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3. What are some of the projected uses of this 3D technology?

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## Examples of improving biodiversity in our environment.

To slow, or attempt to reverse, the loss of biodiversity in the environment, improved agricultural and environmental land use, land management and productivity strategies can be adopted.

A significant challenge arises from this pursuit because in order to make land use changes sustainable in the long term for landholders and stakeholders, the land must ideally continue to offer economic productivity that is improved, or at least consistent, with current land use practices,

In the following activities, three case studies are outlined that demonstrate how stakeholders can and are addressing the need to protect and enhance the biodiversity of organisms within the environment whilst maintaining economic productivity of the land.

### Optional Task/viewing:

The following multimedia source on forest biodiversity highlights that within a commercial industry, the upmost care is given to the animals and biodiversity within the system. The source explores how the sampling of bats is performed and highlights how they can be used as 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 – Case Study: Yan Yan Gurt West Farm Agroforestry



*Photo: B. Welden, Stewart family's Yan Yan Gurt West Farm*

### Introduction to Agroforestry

Agroforestry is the introduction of trees, such as exotic commercial timber trees (e.g. Radiata Pine), or native timber tree species (e.g. Spotted Gum), to an existing farming system by agricultural producers. These trees form part of a larger land management plan for a property for land improvement gains, diversification of the farming system to spread farm risk, as well as economic gains for the producer upon harvesting of the trees for timber.

The Food and Agriculture Organisation of the United Nations (FAO) says of Agroforestry:

“As world population increases, the need for more productive and sustainable use of the land becomes more urgent. According to the United Nations, more than 7 billion people populated the Earth in 2011, and this number is expected to go up to 9.3 billion by the mid-century. To meet the demand for food by 2050, production will have to increase by over 60%. These figures, coupled with current problems borne out of past and existing non-sustainable land use practices, provide the case for changing the way we manage lands and our production of agricultural and tree goods. Thanks to its multifunctional properties, agroforestry is part of the solution to addressing these issues, whether they be environmental, economic or social. Agroforestry systems include both traditional and modern land-use systems where trees are managed together with crops and/or animal production systems in agricultural settings. They are dynamic, ecologically based, natural resource management systems that diversify and sustain production in order to increase social, economic and environmental benefits for land users at all scales.”

*FAO, Agroforestry. Oct 3, 2017.*



## Activity 2.1: Case Study One; Yan Yan Gurt West

Yan Yan Gurt West is a regenerative sheep and agroforestry farm located in the Otway Ranges, Victoria, Australia. It is a case study that provides information in sustainable agricultural production – balancing the needs of the animals, the pastures and the environment along with the health of those who live and work there.



- View the multimedia case study source of Farm Forestry/ Agroforestry.  
 URL: <https://www.youtube.com/watch?v=4b26zrkwlPU&feature=youtu.be>  
 Source: *Low Impact Sustainable Agriculture – Regenerating the Family Farm. (4.58)*
- Identify the strategies and changes in management that the producers have implemented to reverse issues of environmental degradation on their property. Record any information on the subsequent improvements to the environment and productivity of the farm that have resulted from their management changes.

Methods used to address environmental issues	Improvements to the environment/farm/productivity



### Activity 2.2: Photographic comparison study

The Stewart family, owners of Yan Yan Gurt West farm, have made considerable farming management changes since they began their implementation of agroforestry on their farm that has significantly changed the appearance of their landscape. The three images in the table below were taken at the same point within Yan Yan Gurt West farm (Victoria) from 1994 (when they began implementation of Agroforestry) - 2013.

- a) In the table below, record your observations about the visual appearance and changes in the area over this period of time and identify what changes to the biodiversity in the area you believe that might have occurred during these times.

<p><b>1994 - Artificially created drainage channel on Yan Yan Gurt West Farm</b></p> 	<p><u>1994 – before Agroforestry</u></p>
<p><b>1999: Same view after five years</b></p> 	<p><u>Same view in 1999</u></p>







2. What factors might prevent a farmer from planting a greater number of trees on their farm?

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3. What factors might help them to plant more trees on their farms or increase their levels of biodiversity?

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### Activity 3 – Case Study: Yarra Yarra Biodiversity Corridor

Fragmentation, the separation of otherwise joined habitats, is a major threat to the biodiversity of wildlife. Wildlife corridors are areas in the landscape that provide connections between two or more habitats. They form a link between areas, so that organisms can move more freely in their natural environment and allow them to access more easily the resources they need such as nutrition, shelter and water. Corridors also increase the potential of gene flow and breeding of organisms.

There are added benefits to landholders too. Treed areas on farms offer windbreak protection to pasture and crops and have been found to improve the microclimates of these neighbouring areas improving yield and growth (therefore productivity) of both plants and animals/stock. Trees in a landscape can also serve to mitigate issues such as erosion and dryland salinity.

#### Activity 3.1: Yarra Yarra Biodiversity Corridor

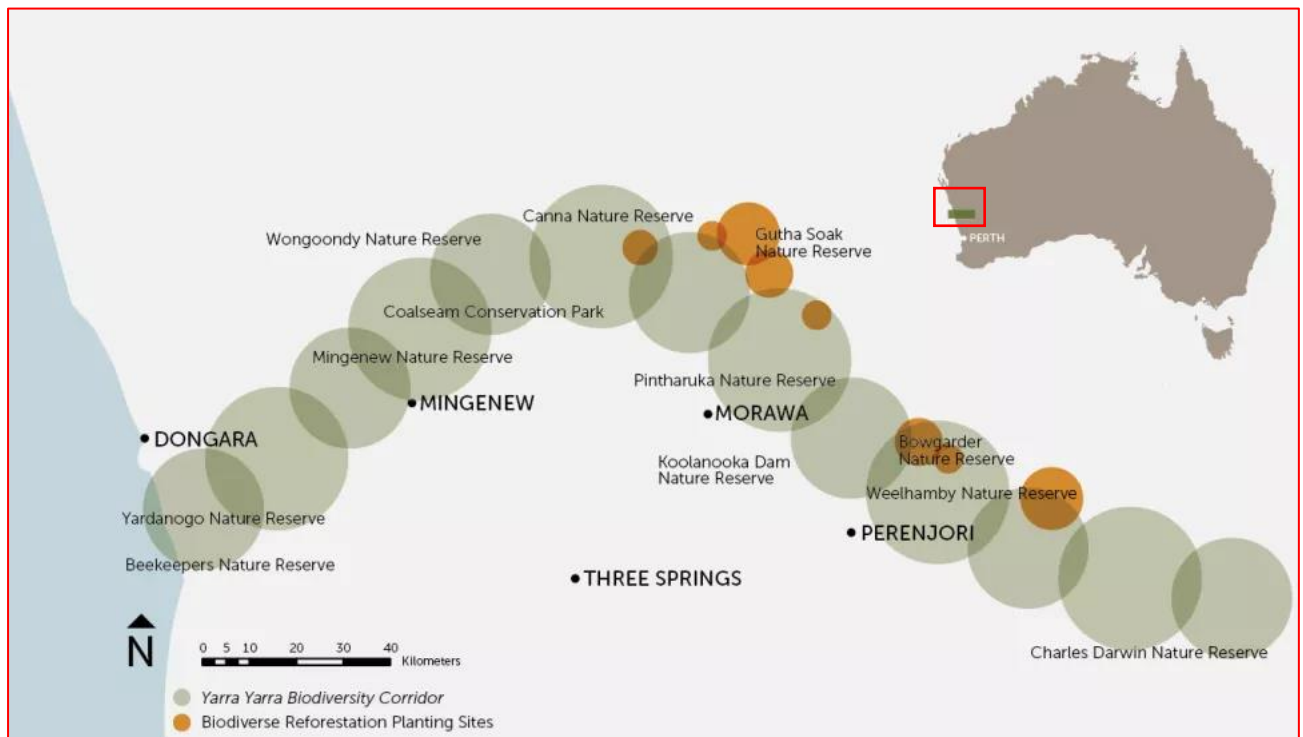


Image Source: [https://i2.wp.com/carbonneutral.com.au/wp-content/uploads/2017/09/map\\_WIP\\_05-Biodiverse-Reforestation-Planting-01.png?resize=966%2C551&ssl=1](https://i2.wp.com/carbonneutral.com.au/wp-content/uploads/2017/09/map_WIP_05-Biodiverse-Reforestation-Planting-01.png?resize=966%2C551&ssl=1)





- a) View the multimedia source using the link below and answer the following questions.

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

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

### Multimedia Questions:

1. What number of trees has this project used, and over what area, to address issues in degraded farm land?

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2. Identify where the seed has been sourced for the Yarra Yarra area project

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3. Explain why you think seeds have been collected from this area? (*answer not contained in video, discuss with your teacher and class as a group*)

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4. Identify 4 benefits of this project?

1.	2.
3.	4.



### Extension Activity 3.2: Yarra Yarra Biodiversity Corridor Summary

- a) Access the link below to view a summary PDF of the Yarra Yarra Biodiversity Corridor project.

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

- b) Using the word list below, create a summary of the project. As you include each word/topic or phrase, check them off by placing a tick beside them.

#### WORD LIST

- |   |   |
|---|---|
| <input type="checkbox"/> Southwest Australia            | <input type="checkbox"/> Animals                          |
| <input type="checkbox"/> 1.897 million tonnes of carbon | <input type="checkbox"/> Habitat                          |
| <input type="checkbox"/> Goal of returning...           | <input type="checkbox"/> Threatened species               |
| <input type="checkbox"/> Project aims...                | <input type="checkbox"/> Biodiversity hotspots            |
| <input type="checkbox"/> Connectivity                   | <input type="checkbox"/> Traditional owners               |
| <input type="checkbox"/> Transition                     | <input type="checkbox"/> Carbon Right and Carbon Covenant |

#### Summary of the Yarra Yarra Biodiversity Corridor



Summary of the Yarra Yarra Biodiversity Corridor continued

A large, empty rectangular box with a thin black border, intended for a student to write a summary of the Yarra Yarra Biodiversity Corridor.



## Activity 4 – Case Study: The Carnaby's Cockatoo

The Carnaby's Cockatoo (*Calyptorhynchus latirostris*) is classified as “fauna that is rare or likely to become extinct” under the WA Wildlife Conservation Act 1950.

*Barr, Wespine Industries, 2013.*

### The Carnaby's Cockatoo background

- Is a black bird with white tail panels, white cheek patches and a short bill.
- Is a large bird with adults growing up to 53 cm in length.
- Has a wingspan of 110cms.
- Has a mass of between 520-790g.
- Lives up to 50 years in the wild.
- Is endangered (Environment Protection and Biodiversity Conservation Act 1999).
- Only lives in southwest Australia.
- Require a close association between breeding and feeding sites during the breeding season. If these two very different habitats are not within a reasonable distance of each other, breeding attempts fail.
- Populations have decline by over 50% in the past 45 years.



Image source: [https://upload.wikimedia.org/wikipedia/commons/thumb/d/df/Calyptorhynchus\\_funereus\\_%28male%29\\_-\\_Wamboin-8.jpg/1200px-Calyptorhynchus\\_funereus\\_%28male%29\\_-\\_Wamboin-8.jpg](https://upload.wikimedia.org/wikipedia/commons/thumb/d/df/Calyptorhynchus_funereus_%28male%29_-_Wamboin-8.jpg/1200px-Calyptorhynchus_funereus_%28male%29_-_Wamboin-8.jpg)

### Activity 4.1: Carnaby's Cockatoo and Pine Plantations

- Working in an allocated group, use a piece of butcher's paper, a white board or chalk on an appropriate area of the school grounds etc., to sketch a life size model of a Carnaby Cockatoo in flight by using the above dimensions and information.
- Read the executive summary provided by your teacher titled; **Cockatoos, Cone, Conifers and Conservation**. Brad Barr Wespine Industries Pty Ltd 25/4/2013
- Working in groups, annotate the provided diagram with the key features that this paper explores related to **conserving the cockatoo by increasing the area of commercially viable pine plantations**.

*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; Managing our Forests into the 21<sup>st</sup> Century.*





## Activity 5 – Improving Biodiversity at school

### Activity 5.1: Enhancing Biodiversity in your Environment.

Positive moves are being made to address the significant issues in biodiversity decline in the Australian environment.

Using your knowledge of biodiversity, and the case studies you have investigated that are aimed at improving biodiversity in different Australian environments, spend some time as a class brainstorming ways that you may be able to improve local biodiversity throughout your school. Many of the ideas you discuss may be simple and feasible for implementation.





## References

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16. Carbon Neutral, Yarra Yarra Biodiversity Corridor, Australian native Reforestation Project Brief. <https://carbonneutral.com.au/wp-content/uploads/2017/09/Australian-Native-Reforestation-Gold-Standard-VER-FACT-SHEETe-i.pdf> Accessed 3/2/2018.
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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 Gnampteryx 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 export 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.

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*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.*