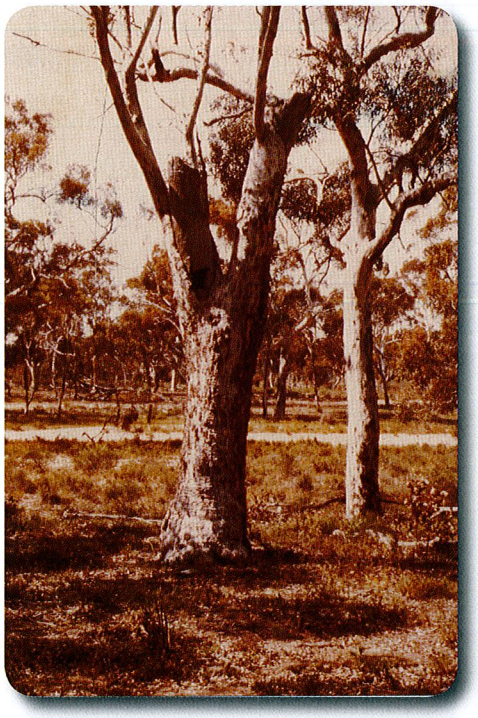
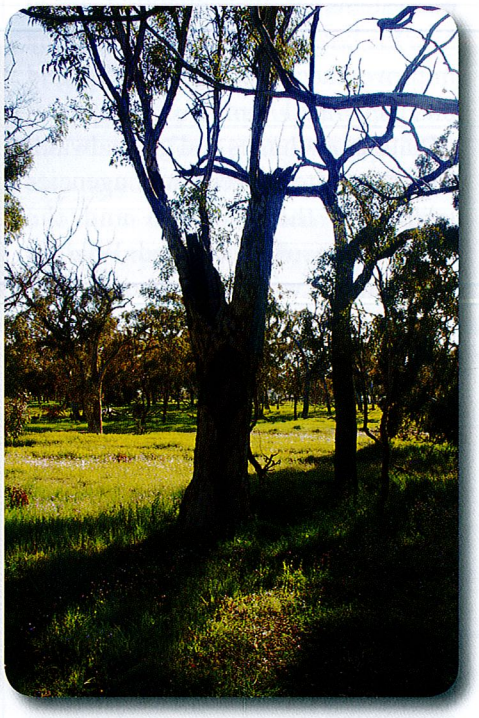
CARNABY'S COCKATOO, TREE HOLLOWS AND THE FATE OF LARGE HOLLOW-BEARING TREES

Denis Saunders, Peter Mawson and Rick Dawson

Carnaby's Cockatoo *Calyptorhynchus latirostris* is an obligate hollow nester, that is, it only nests in hollows in trees or in artificial hollows placed in trees or on poles. This black cockatoo is large; adult females are about 540mm long and 104mm across their shoulders with their wings closed and weigh around 650g. They also have a long tail of about 260mm; about half the length of their body. Unlike the Galah *Cacatua roseicapilla* and Western Corella *C. pastinator*, Carnaby's Cockatoo back into their nest hollows so the hollows they use must be large enough to allow them to manoeuvre their tail down the hollow. Hollows of this size are only found in large old eucalypts.



Tree 22 in 1970. This tree has two large hollows, both of which were regularly used in the same season by Carnaby's Cockatoos. The hollow in the left branch has an access hatch cut into the side and the hatch was in place when the hollow was not being inspected.
Photo: Denis Saunders



Tree 22 in September 2009, 39 years after the first photograph. Note that neither the tree nor the surrounding vegetation is much changed, however both hollows required renovations to make them suitable for use by Carnaby's Cockatoo.
Photo: Denis Saunders

One breeding population of Carnaby's Cockatoo at Coomallo Creek has been studied in detail since 1969 with at least two visits made to the area each breeding season for 22 of the years from 1969 to 1996 and then at least twice each year since 2009. During each visit, hollows known to be used by Carnaby's Cockatoo were inspected, the contents noted and if the nestling was at least three weeks old, the length of its folded left wing was measured (mm), it was weighed (g), sexed on the size and colour of its cheek patch, and banded with a uniquely numbered leg band. When a hollow was first found, its location was plotted on a map of the study area and it was assigned a unique number. The following characteristics and dimensions were taken; species of tree, entrance width and height (mm), depth (m) of the hollow from the lowest point of the entrance, aspect of the hollow (vertical, north, north-west, west, south-west, south, south-east, east or north-east), the height (m) of the hollow from the ground to the lowest point of the entrance, and if possible the diameter of the floor (mm). Each hollow was examined during every visit until the tree no longer stood or the hollow was no longer suitable for use by a Carnaby's Cockatoo. During each visit searches were made for any hollows in use that had not been previously located that were then added to the records. The breeding behaviour of the birds was also studied based on individually marked females; marked initially with leg bands and wing tags and then only with leg bands. In 2009 all hollow trees studied until 1996 which remained standing were re-measured.

Carnaby's Cockatoo at Coomallo Creek breeds in a 9km long uncleared strip of Wandoo *Eucalyptus wandoo* woodland, which is largely ungrazed by domestic livestock. This strip of woodland is an island of woodland habitat surrounded by cleared agricultural land and kwongan. At present native vegetation occupies about 35% of the study area. In addition, the birds breed in trees left in paddocks.

We established that breeding females demonstrate fidelity to nest hollows. They apparently prefer to nest in the same hollow they have used the previous season, provided they were successful in fledging young the previous year and the hollow was unoccupied when they next commenced breeding. For example, of 153 successive breeding attempts by individually marked females whose breeding outcome was

known; 44% successfully fledged at least one young and used the same hollow the next breeding season; 24% were successful, but moved hollows because the previous hollow was in use; 12% were successful, but moved hollows even though the previous hollow was apparently unoccupied; 19% were unsuccessful and moved to another hollow; and only 1% were unsuccessful, but used the same hollow as their previous breeding attempt. Breeding females also demonstrate location fidelity with 53% of breeding attempts made in the same hollow or one within 100m of their earlier hollow and 86% within 1km of their earlier hollow.

Fifteen females that fledged in the study area returned to breed. The average distance between the hollow from which they fledged and the one in which they were first recorded breeding was 2.2km with a range of 50m to 5.9km.

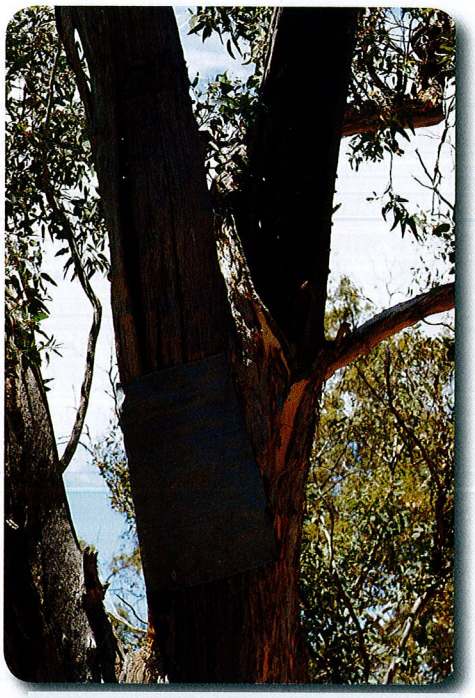
Two species of eucalypt provided the hollows used by the black cockatoos at Coomallo Creek; 228 were in Wandoo and three in Powderbark Wandoo (*E. accedens*). Over the period of the study, 1281 breeding attempts were made in Wandoo and 12 in Powderbark Wandoo. Hollow entrances were usually round, with an average entrance height of 271mm and width of 268mm. The average depth was 1.24m, average floor diameter of 407mm and average height above ground of 4.71m. 58% of the 221 hollows for which data on aspect were available opened vertically and the other 42% were randomly distributed around the eight compass classes (N, NE, E, SE, S, SW, W and NW). Basically our data indicate that females select hollows regardless of aspect and in proportion to their availability. Choice of aspect did not seem to confer any advantage for successful breeding.

Carnaby's Cockatoo need a hollow deep enough to prevent their nestlings from falling out and birds nesting in hollows less than 0.4m deep were less successful than those using hollows at least 1.00m deep. We saw a number of cases where birds in shallow hollows were poorly protected from rain and cold winds and this may have contributed to the higher failure rates.

Galah, Western Corella, Regent Parrot *Polytelis anthopeplus*, Barn Owl *Tyto alba*, Nankeen Kestrel *Falco cenchroides*, Southern Boobook *Ninox novaeseelandiae*, Australian Ringneck *Barnardius zonarius*, Laughing Kookaburra *Dacelo novaeguinea* and European Honey Bee *Apis mellifera* all used hollows that had been used by Carnaby's Cockatoo. On average these competitors used 10% of the available hollows while Carnaby's Cockatoo used 32%. In other areas Galah, Western Corella and European Honey Bees do pose threats to Carnaby's Cockatoo by competing for nest hollows, but at present none of these species pose a serious threat to Carnaby's Cockatoo at Coomallo Creek.

Data were available on the change in depth of 95 hollows over periods up to 41 years. On average, hollow floors fell by 29mm/year. The extreme changes in depth were one hollow floor which fell 4.4m over 38 years and one which rose by 1.8m over 37 years. Hollow floors fell because the decayed heartwood compressed over time or because a crack lower down allowed the filling to fall out. Hollow floors rose because decayed heartwood in the trunk above the entrance to the hollow fell into the hollow.

We recorded 252 hollow-bearing trees used by Carnaby's Cockatoo between 1969 and 2013. At the end of the 2013 breeding season 40% of these trees had been destroyed or damaged such that the hollows were no longer suitable for use by the black cockatoos, and only 22% had hollows suitable for use by the birds. Damage



Tree 15 showing repairs to the side of the hollow, the floor of which had been exposed and the hollow was no longer being used. After the repairs the hollow was used by Carnaby's Cockatoo. Photo: Denis Saunders

or loss was caused by wind throw/tree fall, deliberate fire or wildfire, agricultural clearing, parts of the tree breaking off or change in diameter of the floor.

In late December 2009, when a wildfire started by agricultural machinery swept through the southern end of the study area, there were 28 nest trees in the path of the fire. Twelve of these were in the bush and 16 in paddocks. Sixteen of these trees were destroyed by the fire. At the time, three contained Carnaby's Cockatoo nestlings and all were killed. After the fire there was no significant difference in the fate of large hollow-bearing trees situated in uncleared vegetation and in paddocks.

We predicted that, if only natural events that damage trees are considered, 80% of the 141 large hollow-bearing trees standing at Coomallo Creek in 2013 would still be standing at the end of 2125. However, when human activities such as agricultural clearing and

continued on page 8

continued from page 7

fire are also taken into account only about 29% would be standing at the end of 2125. However, although a large hollow-bearing tree may still be extant in 2125, that does not mean that it will contain a hollow suitable for use by Carnaby's Cockatoo. For example, 48 hollows (which represented 19% of hollow trees marked) were repaired by us or by volunteers from Birds Australia (now BirdLife Australia) as some damage had rendered the hollows unsuitable for use. Renovations were carried out when time permitted and involved repairs such as placing sheets of tin over holes in the sides and/or raising the floors with sterile woodchips. Fifteen of these renovated hollows were used at least once in 2012 or 2013 and another 15 were used in both years.

What are the conservation implications of this long-term study of one breeding population of Carnaby's Cockatoo? Over successive breeding seasons female Carnaby's Cockatoos will favour the same hollow they used the previous season, provided they were successful the previous year and the hollow was available when they return. They select hollows in proportion to availability, and not on any preferences for particular tree species, nor on particular aspect. They will nest in any hollow provided it is large enough for them to access.

At Coomallo Creek and throughout much of the range of Carnaby's Cockatoo, large hollow-bearing trees are being lost or destroyed at a greater rate than they are being created. While a large hollow-bearing tree may stand for hundreds of years, internal changes to any hollows they bear may have rendered them unsuitable for use by cockatoos. The rate of loss of trees and suitable hollows means two conservation actions need to be carried out. The first is extensive revegetation and regeneration of eucalypt woodland in Carnaby's Cockatoo breeding areas. This is a long-term measure as any revegetation and regeneration will not be large enough to support a hollow suitable for a black cockatoo for over 150 years. The second action is the maintenance of existing hollows to ensure they are repaired as soon as they become derelict. Without regular maintenance, existing hollows will be lost at a rate that is unsustainable. This may require the covering of holes in the side of the trunk, raising the floor with sterile woodchips or clearing out shards of wood that have fallen to the floor from inside the hollow. In addition, the number of available hollows may need to be boosted by installing artificial hollows that have a floor diameter of around 400mm and a depth of at least 1m. We are conducting a trial of 60 artificial hollows at Coomallo Creek at present and will be reporting on the results of this trial in the near future.

Who undertakes revegetation and hollow maintenance and who pays? The owner of the property on which the woodland occurs is the obvious source of maintenance. In the case of conservation reserves in the Crown estate, this should be the responsibility of the managing agency. In the case of private property, on which a considerable extent of woodland used by Carnaby's Cockatoo for breeding exists, it could be the property owner. However, this is beyond the duty of care that society has the right to expect of property owners without adequate compensation for their time and money. The debate about who does what and who pays for it is one that needs to be had soon as without stronger protection of existing woodland, including paddock trees, renovation of existing hollows, and extensive revegetation and regeneration of woodland, the future for those species dependent on large hollow-bearing trees is bleak.

Readers interested in the detailed results and discussion should consult the original paper. For further information contact Denis Saunders at denis.saunders@csiro.au

[* For references, contact Editor]

Denis Saunders works with CSIRO, Peter Mawson with the Perth Zoo and Rick Dawson with Parks and Wildlife.