BirdLife Australia 2020 Black-Cockatoo

breeding survey report

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Front cover photo: A family of Forest Red-tailed Black-Cockatoos (Photo: Claire Greenwell)

Summary

This report details the work BirdLife Australia has done in 2020 to survey breeding of Black-Cockatoos in south western WA. The surveys involved 32 volunteers (approximately 1500 hours) and three staff members (approximately 300 hours) and took place between mid-September and mid-January. 39 sites were surveyed between Kalbarri in the North and Ravensthorpe in the Southeast. The methods used were 'tap and flush' and a method using pole mounted wireless cameras (Cocky Cam) to inspect nests. A total of 668 natural and 248 artificial hollows were surveyed this year. 250 Carnaby's Black-Cockatoo breeding attempts were recorded, 158 in natural hollows and 92 in artificial hollows. Five Forest Red-tailed Black-Cockatoos were recording breeding in natural hollows. This equates to 25% of natural hollows and 37% of artificial hollows surveyed being used. 9% of hollows were used by competitor species, the main ones being owls for natural hollows and Regent Parrots for artificial hollows. Six nests recorded Inland Red-tailed Black-Cockatoos breeding in 2020.

These surveys indicate that the tap and flush method underestimated breeding attempts by 5% in 2020 (birds are either absent at the time or do not flush). Cocky Cam is a much more accurate survey method and should be used whenever possible. It enables the gathering of details such as number of eggs and chicks, chick age, competitors and suitability of hollows for breeding.

The spread of estimated hatching dates was between early September and mid-November, with a peak between mid-October and mid-November (much later than usual). This indicates that the best time to survey was between mid-November and mid-December in 2020 (be aware that local factors can affect this and early and late breeding attempts may be missed if only one survey is completed).

Artificial hollows are obviously an effective way to boost breeding success for Carnaby's Black-Cockatoo. Sites for their installation should be carefully selected to ensure success and should ideally complement other conservation efforts such as revegetation, fencing and pest control.

BirdLife's surveys are a useful way to assess breeding activity of Carnaby's Black-Cockatoos. Nests of Forest Black-Cockatoos are more difficult to locate and Red-tails do not have such a distinct breeding season, so a lot more work and resourcing is recommended to monitor these species.

Thanks to all our hard working volunteers and the land owners who gave us access to their properties.

Background

Since 2003 BirdLife have done breeding surveys on Black-Cockatoos (mainly Carnaby's) in southwestern WA. This work has mostly been done by volunteers, with some done by staff. The aim of this work is to identify new breeding sites on private land for possible inclusion in Voluntary Management Agreements and to provide data which may help guide BirdLife's projects. The surveys also provide important information to government agencies such as The Department of Biodiversity, Conservation and Attractions (DBCA) to aid them in planning decisions (an updated copy of the BirdLife breeding database is provided to DBCA each year). It is important for volunteers, BirdLife staff and other groups to be informed of the survey results each year; that is the aim of this report. It is not a scientific paper since the data do not provide enough consistency and rigour or quantity to enable this. Neither is it an overall picture of Black-Cockatoo breeding in southwestern WA. Other groups (such as Denis Saunders and the WA Museum) do extensive work on Black-Cockatoo breeding. Information on Black-Cockatoo breeding biology can be found in the species' Recovery Programs at these links: Carnaby's; Forest Black-Cockatoos). The target audience of this report is primarily BirdLife volunteers; it may also be of interest to researchers in the field.

Methods

Trees in the database have been identified as either potential nesting trees (trees with suitable hollows where prospecting or chipping of hollows may have been recorded) or confirmed nesting trees (birds have been flushed or nests with eggs and/or chicks viewed). The traditional method for surveying nest hollows is called 'tap and flush'. The surveyor goes to the tree at some stage of the breeding season (between September and December normally). They tap the tree trunk with a stick or scratch the trunk in order to attempt to flush a sitting hen from the hollow. If no bird is flushed then it is assumed there is no breeding activity in that hollow. If a bird is flushed it is usually assumed that breeding is taking place. Sometimes surveyors climb the tree (by ladder or other means) to view inside the hollow, which allows more certainty since it is usually possible to see either chicks or eggs in the nest. However, climbing trees is risky and for this reason is rarely done any more. The bulk of BirdLife's historic data therefore uses the tap and flush methodology without climbing.

This method is unfortunately flawed in two respects, since there is potential for both false positive and false negative results. If a bird is flushed it is possible that it is simply prospecting the hollow and nesting does not occur in that tree. If a bird is not flushed it is possible that the hen is away from the nest, with a chick or chicks inside (this tends to be more likely the older the chick gets). Sometimes a sitting hen will simply not flush, especially if the hollow is very high and the tree trunk is of large diameter. So, many results from previous years should be treated with caution. The WA Museum has led the way in terms of inspecting nests with pole-mounted cameras. Their work led us to trial a pole-mounted camera in 2015 with some success. In 2016 a new methodology was introduced after Rick Dawson (ex DBCA) told us about work he was involved with on Glossy Black-Cockatoos at Kangaroo Island, South Australia. They have developed a method using a fibreglass telescopic pole with a mounted wireless camera. BirdLife ordered four of these and they are now known as 'Cocky Cams'. The 16.5m long poles enable us to view inside most hollows and inspect them by looking at a display screen which shows birds, chicks and eggs. A LED light on the camera helps to see inside the hollow. Some hollows are not viewable due to height, depth or shape.

Chimney style hollows are easiest to view with Cocky Cam since the camera can view from above and because natural light penetrates more easily. Side entry hollows are more challenging, but are mostly possible unless the entry is very small or the trunk is not vertical. Spout entry hollows are the hardest and most of the time it is unfortunately not possible to view inside the hollows. See Figures 1 and 2 with different entry types and the camera and pole.

These four cameras have been used by BirdLife staff (principally myself and Vicki Stokes) and loaned out to volunteers and many other groups with good results. Their weight is however an obstacle for some people and some volunteers declined using them. For this reason in 2017 BirdLife purchased two 12m poles and another one in 2019. These weigh half as much as the 16.5m poles, making their use much less strenuous and difficult. We encountered some problems with the cameras this year. It appears that the batteries are beginning to fail. In 2020 we trialled a new 'Gopro' style camera. The picture resolution was good but loss of connection between the camera and phone/tablet was problematic. BirdLife will continue to use new technology as it becomes available.

The other benefit of the camera is the ability to assess the suitability of hollows for breeding. It is often hard to assess hollow dimensions from the ground; large entrances give the impression that a hollow is deep and wide enough for breeding. However, this may not be the case and can be ascertained with Cocky Cam. Many unsuitable hollows in our database may have been surveyed year after year and this is obviously inefficient. This year we have started to delete unsuitable hollows and trees from the database based on this work (approximately 40 trees have been deleted so far).

The new methodology means that it is hard to compare data between years, however we still ask people to do a tap and flush prior to putting the camera up since this avoids the risk of a bird flying straight into the camera. It also enables us to compare tap and flush data between years. In the future we may be able to estimate the number of false positive and negative results by using both methods.

Most nests were visited once in the breeding season. Approximately 85 were visited more than once. Chick age was estimated visually using Denis Saunder's key (Saunders *et al*, 2015).

Tree tagging was carried out by hammering in small (approximately 70x25mm) aluminium tags at breast height (1.5m) with galvanised clouts (see photo below).

Figure 1. Different hollow types in the study, clockwise from top left. Side entry, artificial, spout, chimney on a stag (dead tree).

Figure 2. Adam Peck using 'Cocky Cam' to inspect hollows at Bindjareb Park, Pinjarra (photo courtesy of Landcare SJ).

Results

Volunteer/staff numbers and hours

A total of 35 volunteers participated in breeding surveys this year, along with three staff members. The number of volunteer hours is estimated to be 1,500 hours. The number of staff hours is estimated to be 300 hours for field work. This time includes travel to at times remote locations.

Sites

39 sites were surveyed in some form this year. The sites range from Kalbarri in the North to Ravensthorpe in the South East, with most sites being in the wheatbelt range of Carnaby's Black-Cockatoos (see Figure 3). The number of natural hollows per site ranged from 1 to 180, with a mean of 21. The number of artificial hollows per site ranged from 1 to 36, with a mean of 5.

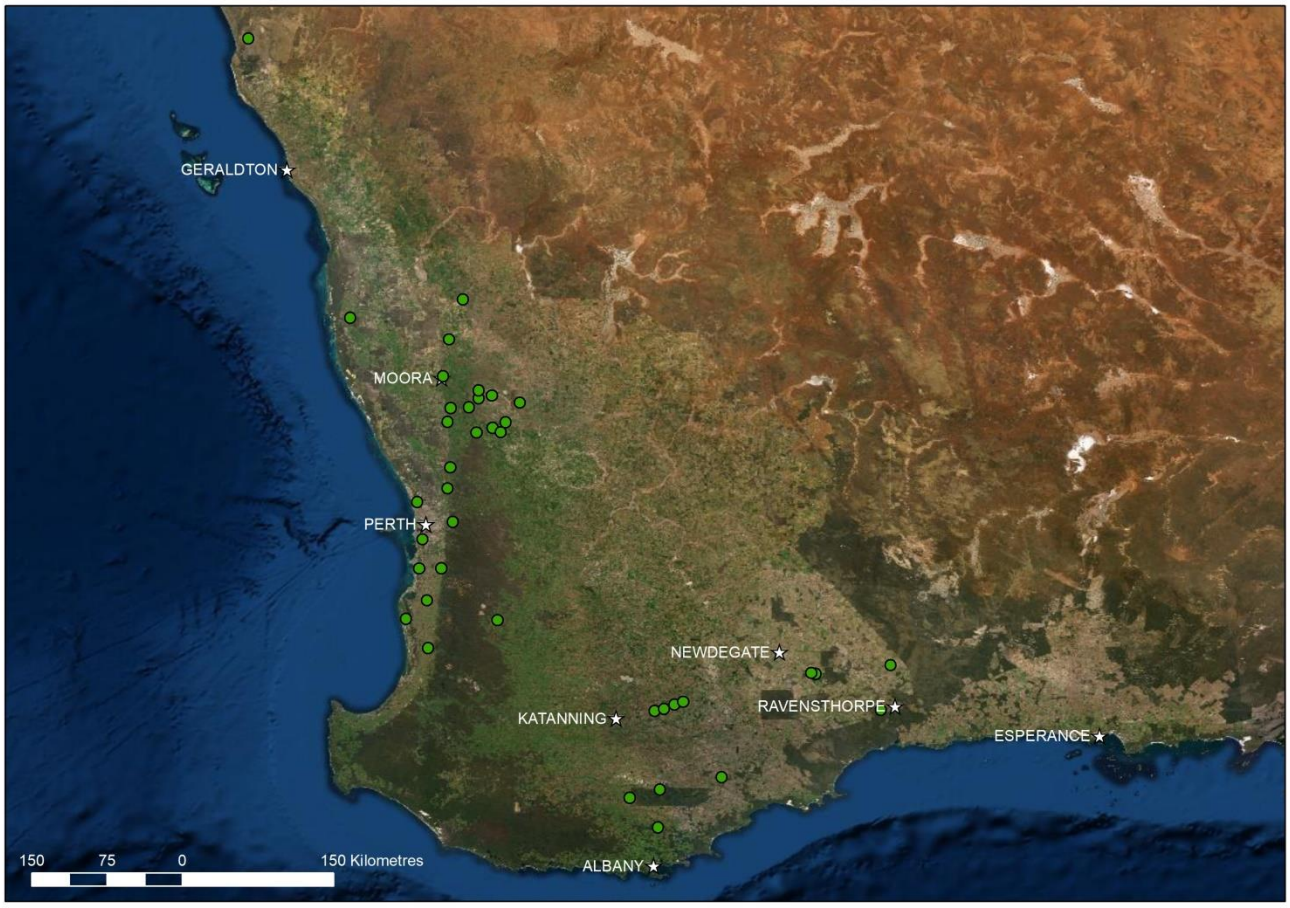

Figure 3. Site locations (green dots) of BirdLife breeding surveys in 2020. **NB**: Some sites are clusters of several properties. These are mostly small properties, with single artificial hollows within 6km of each other. They include Lake Clifton, Serpentine-Jarrahdale, Chittering and Waroona.

Survey method

Two survey methods were used, the tap and flush method and the Cocky Cam method. 773 of 916 hollows were surveyed using Cocky Cam, with all of those also using tap and flush. 143 hollows used tap and flush alone (see Table 1 for percentage breakdowns).

Table 1. Survey methods used in BirdLife's 2020 breeding surveys

	Hollows surveyed		
	All	Natural	Artificial
	916	668	248
Using tap and flush only	16%	21%	0%
% using cocky cam only	5%	1%	15%
% using tap and flush and Cocky Cam	80%	77%	85%

Tree tagging

Approximately 25 trees were tagged with small aluminium tags in 2020. 589 of 2,340 trees in the database are currently tagged (25%).

Hollows

The number of natural and artificial hollows surveyed this year was 668 and 248 respectively. The BirdLife breeding database now contains 2,340 hollows (147 new hollows were added in 2020), with at least 132 of these deemed unusable or fallen over. The most common tree species were Salmon Gum and Wandoo, the dominant woodland trees of the Wheatbelt. The most common hollow types were side entry and chimney, with a vertical aspect (see Table 2 below). Average Diameter at Breast Height (DBH) was 72cm for all trees surveyed, with a range of 25 to 150cm. Hollow heights ranged from 1.6 to 20m for active nests, with an average of 7m.

Table 2. Characteristics of trees and natural hollows surveyed.

Species	Number surveyed	Number with active nests (and % of the total)
E. salmonophloia	357	75 (21%)
E. wandoo	180	53 (29%)
C. calophylla	9	3 (33%)
Other	21	7 (33%)
Unrecorded	101	25 (25%)
Total	668	163
Live trees		45
Dead trees		8
Unrecorded status		110
Hollow type		
Chimney	145	43 (30%)
Side entry	188	64 (34%)
Spout	119	25 (21%)
Other	53	9 (17%)
Unrecorded	163	22 (13%)
Aspect of hollow		
N	62	13 (21%)
NE	52	13 (25%)
E	59	23 (39%)
SE	29	7 (24%)
S	46	10 (22%)
SW	48	15 (31%)
W	66	18 (27%)
NW	44	15 (34%)
Vertical	86	25 (29%)
Unrecorded	176	24 (14%)
Mean DBH (cm)	71.7	70.5
Mean height of hollow (m)	7.3	7.6
Minimum height of hollow (m)	1.6	1.6
Maximum height of hollow (m)	20	20

Breeding

30 of the 39 sites recorded active Carnaby's nests. Out of 916 hollows there were 227 active nests confirmed using Cocky Cam (135 natural hollows and 92 artificial with either eggs, chicks or both), with 133 eggs and 119 chicks. The chicks with known ages ranged in age from 1 to 10 weeks, with an average of five and a half weeks. The spread of estimated hatching dates is between September 3 and November 20, with a peak between mid-October and mid-November (Figure 5). Females were flushed at a further 28 hollows without using Cocky Cam, taking the total number of active nests to 255. From these numbers we assume that breeding is taking place in 28% of all hollows surveyed, in 25% of natural hollows and 37% of artificial hollows. The percentage of hollows with recorded breeding attempts varied greatly by site, with a minimum of 0% and maximum of 100% (a single hollow site). The mean was 32%. For sites with over 10 hollows surveyed the most successful sites were ones in Mundaring (75%), Watheroo (73%), Moora (53%), near Mount Lesueur (45%), Joondalup (44%),near Mogumber (43%), East Borden (43%), Stirling Range (40%), near Moora (42%) and near Ravensthorpe (30%).

Ten nests fledged two chicks, with one site alone fledging six sets of twins. Research shows this happens in about 5% of cases, which shows that the site with six must have had very good food resources close to the nests in 2020.

Table 3. Breeding attempts in BirdLife's 2020 breeding surveys

	All	Natural	Artificial
N hollows surveyed	916	668	248
N nests with female flushed (FF)	178	125	53
N nests active (viewed with camera)	227	135	92
Total N active nests (FF and viewed)	255	163	92
Active nests (FF and viewed)	28%	24%	37%
N eggs (viewed with camera)	133	93	40
N chicks (viewed with camera)	119	76	43

Figure 4. Carnaby's chick and egg, Carnaby's chicks viewed with Cocky Cam

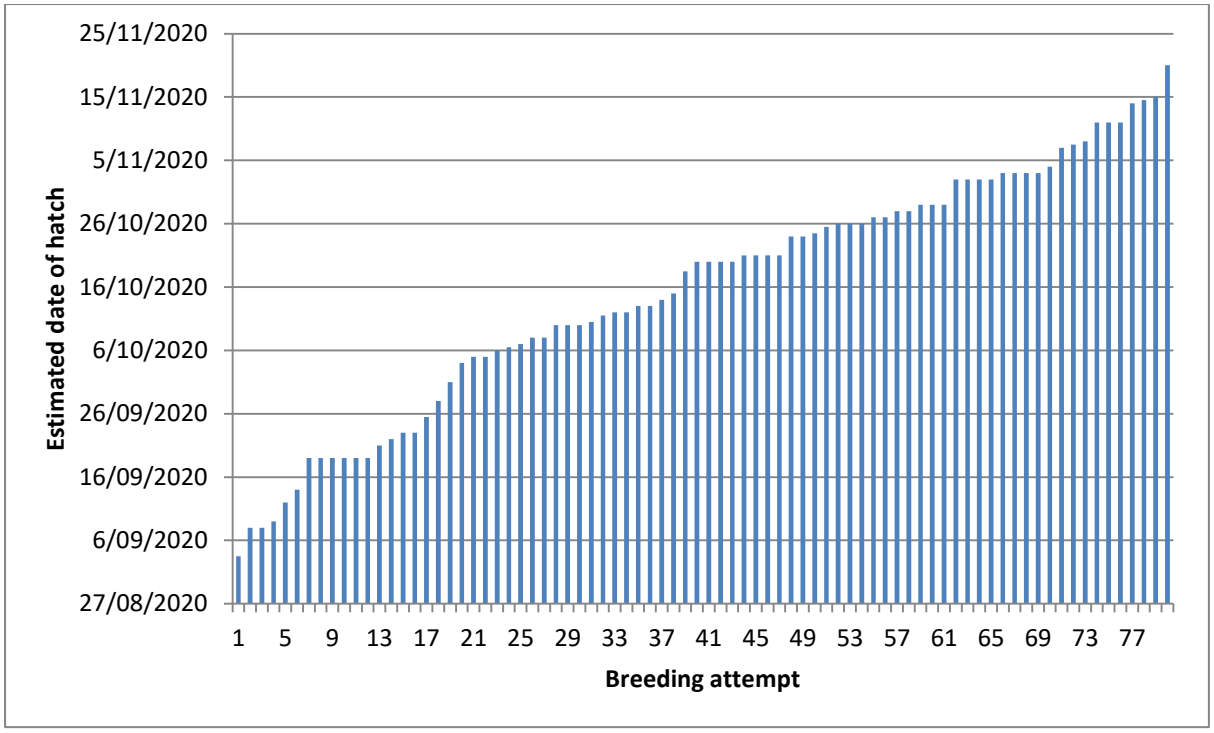

Figure 5. The spread of estimated hatching dates (80 chicks).

A historical perspective

A brief analysis of BirdLife's breeding records shows a sharp decline in breeding attempts (Table 4). The average breeding rate from 2004 to 2011 is 50%, since then the rate is 19%.

Table 4. A summary of Carnaby's breeding results in natural hollows, 2004-2020.

Year	Number of surveys	Number of breeding attempts	Breeding rate	Average breeding rate
2004	119	60	50%	50%
2005	119	76	64%	
2006	61	49	80%	
2007	110	65	59%	
2008	149	63	42%	
2009	332	97	29%	
2010	265	130	49%	
2011	509	124	24%	
2012	958	89	9%	19%
2013	436	71	16%	
2014	220	48	22%	
2015	744	80	11%	
2016	574	109	19%	
2017	736	131	18%	
2018	666	148	22%	
2019	840	212	25%	
2020	916	250	27%	

Hollow competition

Of all hollows surveyed, 74 were being or had been occupied by other bird species, four were occupied by possums and four were occupied by feral honey bees (Table 5). This accounts for 9% of hollows surveyed. The species recorded are listed below. These surveys showed that owls were the main competitors for natural hollows and Regent Parrots were the main competitors for artificial hollows. The results vary greatly by site. For example, 17 of 69 hollows were occupied by parrots at one site but very few at other sites.

Table 5. Hollow competitors either flushed from hollows or viewed with Cocky Cam.

Hollow competitors (N flushed or viewed with camera)			
	All hollows	Natural	Artificial
Bees	4	4	0
Galah	4	3	1
Regent Parrot	16	4	12
Ringneck Parrot	8	6	2
Corella	4	2	2
Owl	2	2	0
Barn Owl	8	8	0
Boobook Owl	3	3	0
Nankeen Kestrel	4	4	0
Brushtail Possum	4	0	4
Parrot	13	3	10
Inland Red-tailed Black-Cockatoo	6	5	1
Duck	4	3	1
Pigeon	2	0	2
Total	82	47	35
Occupied by competitors	9%	7%	14%

Figure 6. Hollow competitor photos in clockwise order from top left: Galah eggs with 'green spray' (leaf material brought in by adults); five Regent Parrot chicks in an artificial hollow; female Australian Wood Duck; two Nankeen Kestrel chicks.

Discussion

Survey Method

From the use of both tap and flush and Cocky Cam at 729 hollows it is possible to estimate the number of false positives and false negatives if only tap and flush were used. There were 11 false positive results and 54 false negative results. This is as expected, since it is common for the female to leave the nest on warm days and as the chick grows larger. It is less common to flush a hen which is prospecting for hollows. It therefore follows that if only tap and flush is used breeding success will be underestimated (by approximately 5% from these results). Hence, this study may have underestimated breeding by 7 nests (5% of the 143 hollows where only tap and flush was used). Another study at a single site with 174 hollows between 2004 and 2007 showed 10% false positives and 17% false negatives (J Lauri, pers comm.). We recommend that Cocky Cam be used whenever possible and we will attempt to encourage its use in future surveys. The other advantages of Cocky Cam (as stated earlier) are the ability to estimate chick age and to ascertain whether hollows are suitable for Black-Cockatoo breeding. Being able to estimate chick age gives an idea of the optimum time to survey (see also below) and helps guide when banding is done.

Tree tagging

Tree tagging is an effective way to mark trees for easy location and identification. It gives surveyors confidence that they are at the correct tree and enables researchers to follow the breeding history, health of trees and suitability of hollows over time. It is now seen as an essential part of Birdlife's Black-Cockatoo research. There is little (if any) evidence that tree tagging increases the risk of nest poaching, vandalism or other adverse outcomes. Birdlife will therefore continue to progressively tag trees unless land owners or surveyors are opposed.

Breeding attempts

It is clear from this study and others that artificial hollows are a successful way to encourage Carnaby's Black-Cockatoo breeding. For instance, breeding success has been increased by 25% at Coomallo Creek with the introduction of artificial hollows (R. Dawson, pers comm.). The WA Museum's trials at Cataby also show that suitable artificial hollow design and installation can boost breeding success (Johnstone *et al*, 2015). This study shows that 37% of artificial hollows are in use compared to 25% of natural ones. However, the preference for artificial hollows may be skewed. It is possible that some of the natural hollows surveyed are not suitable for breeding since we do not know the dimensions of them, though increasing use of the cameras in natural hollows will help to reduce this potential bias. In contrast we know exactly the dimensions of all artificial hollows and that they are all suitable for breeding.

Figure 6. Three week old Carnaby's chick and egg in an artificial hollow (J Tonga).

Numbers of breeding attempts varied greatly by site. This may be due to a number of factors which are hard to pinpoint, e.g. local weather pattern effects on forage plants in an area; hollow competition effects; levels of predation; the availability of suitable hollows; the amount of clearing; fire history and others. These effects may either be temporary or permanent. For example, low rainfall in an area should only affect food availability temporarily but clearing and fire can have a permanent impact on the availability of hollows and food leading to a consequent decline in breeding success (Saunders, 1979). As old hollow bearing trees senesce their breeding value can decline due to hollow floor or sides collapsing or trees falling over. This is having a negative impact on Black-Cockatoo breeding success since the hollows and trees lost are not being replaced at an adequate rate (Saunders et al, 2003). Due to their success and the loss of natural hollows it therefore seems inevitable that artificial hollows will play an important part in the conservation of Black-Cockatoos in south western WA. However, artificial hollows should not be seen as the 'magic bullet' to reverse the decline in populations of Black-Cockatoos. Two sites near Katanning show interesting results. Despite the presence of large flocks of birds and many known hollows, no more than a dozen nests are used each year. Given the large number of suitable, available hollows this suggests that hollow availability is not a limiting factor there. Food resources may be too poor in the area to support breeding. It follows that the installation of artificial hollows would not be beneficial under this scenario and that revegetation would be a more appropriate conservation approach. Denis Saunders' work at Manmanning and Coomallo clearly shows that the amount of food surrounding breeding hollows is critical for breeding success (Saunders, 1979). To successfully fledge chicks Black-Cockatoos need adequate food and water resources within 6-12km of nests. The location of artificial hollows therefore needs good planning for them to be successful. Revegetation will also be needed to increase the amount of food available and to cater for the long term replacement of natural hollows. Hollow repairs have also been shown to be a simple and efficient way to increase the life of natural hollows.

Some of the highest breeding rates in this survey were all in areas with artificial hollows installed. This should come as no surprise since the availability of suitable hollows is an important factor in breeding success. Sites with artificial hollows are selected for survey due to the presence of active breeding populations, which would lead to a bias in their favour. The location of one of these sites does come as a surprise, with a site in Joondalup having up to eight hollows occupied in the last few

years. Another site with nests of both Carnaby's and Forest Red-tailed Black-Cockatoos was also located in Mandurah with 3 of 6 artificial nests used in 2019 and a site in Baldivis had all four of its artificial hollows occupied by Carnaby's in 2020. Traditionally the Swan Coastal Plain is not often used by Carnaby's, although nests have been recorded at Lake Clifton (T. Kirkby, pers comm.) and Yanchep. The success at Joondalup, Mandurah and Baldivis may show once again the adaptive and resilient nature of these birds. Is this a trend of things to come as the availability of suitable hollows declines in their traditional breeding grounds? Interestingly this success is not mirrored at a site in Melville, where none of the 20 artificial hollows has been used by Carnaby's between 2016 and 2018 despite it being a major roosting site. The town site of Moora also shows remarkable breeding success rates, with 26 of 66 natural and 23 of 27 artificial hollows active in 2020. This success is despite the fact that the Kerkhof Carnaby's group were forbidden from feeding birds as they had in previous years. Another encouraging result is the discovery of Carnaby's breeding near Kalbarri. Breeding has been recorded in the area in the past, but not since the 1990s. This site is approximately 270km north of the nearest known, current breeding site. The fact that they are still breeding there is significant, given that the breeding range has contracted by roughly a third over the last 50 years. Climate change may be one of the factors forcing birds to abandon some sites in the eastern wheatbelt, but this does not appear to have affected the population on the northern edge of their range.

A review of all historical breeding rates is concerning (going from 50% pre 2011 to 19% post 2011). Obviously there are site and sampling effects in this result and it is not known if the results are representative of those throughout the range. Nonetheless, the results should sound alarm bells. The reasons for this decline are uncertain, factors could include loss of hollows; loss of feeding resources in both breeding and non-breeding (e.g. Gnangara pines) grounds; loss of water resources in a drying climate; poisoning from ingestion of agricultural chemicals (pers comm John Koch and Wally Kerkhof) and increased competition for hollows. Further research is needed to ascertain the factors involved and how best to address the issues to improve the breeding activity and success of this species. Further research is also required to estimate the number of breeding pairs successfully fledging chicks.

Some sites do not benefit from the installation of artificial hollows. For example at one site near Ravensthorpe with 21 artificial hollows none of them have been used since installation in 2016, whereas natural hollows have been used. Other sites (such as two reserves near Katanning) with many suitable natural hollows have little Carnaby's breeding. It appears that for these sites hollows are not a limiting factor and it follows that revegetation and/or fencing may be a more appropriate conservation strategy than the installation of hollows.

What is the best time to do surveys? Coomallo Creek surveys are done in mid-September and mid-November in order to optimise the number of chicks found and banded. However, it is not normally possible for volunteers to survey twice in a year due to the costs and time involved. Does it follow that the best time to survey once is mid-October? Carnaby's eggs are incubated for approximately 30 days and chicks fledge after 10-11 weeks (Saunders et al, 2015). Data from our surveys (80 chicks) shows a spread of hatching dates between early September and late November. Half hatched between mid-October and early November. However, the regional and localised effects of climate and weather patterns will have an impact on the timing of breeding. In general, breeding should occur earlier the further North one goes since temperatures are higher there and food crops should

be available sooner. Work at Coomallo Creek shows that most nesting attempts are started (defined as egg laying) in July and August (59%) and that only about 10% are started in October and November (Saunders and Ingram, 1998). Denis Saunders' latest work indicates that the most important factor in the timing of breeding is the amount of rainfall in the first half of autumn. Low rainfall leads to late breeding, high rainfall to early breeding (King, 2018). If rainfall is known for an area this should be a good guide to survey time.

In 2017 at Coomallo an egg was laid on June 8 and the chick was due to fledge on September 15 (the earliest recorded fledging date for Carnaby's). The latest estimated fledging date in BirdLife's 2020 study was January 29. So, all I can say is that it is not easy to say when is the best time to survey! My advice is to talk to the land owner to guide you in this area. They are the best placed person to talk to since they are at the location and can see what the birds' movements are. If this is not possible then it seems that some time in October through to December may be optimal, although it is inevitable that if a single survey is conducted some early and late nesting attempts will be missed.

Five Forest Red-tailed nests were located by these surveys. This is mainly because BirdLife has historically only surveyed for Carnaby's in the past and this is where the expertise and knowledge of sites is strongest. It is also due to the difficulty of locating Forest Black-Cockatoo nests which are found in dense, often remote forest, with the hollows often at great heights. Their breeding season is also less predictable than Carnaby's. This compares with Carnaby's nests which are normally at lower heights in open woodland, close to farm properties and whose breeding season is better defined.

Hollow competition

Black-Cockatoos face strong competition for nesting hollows from other species. This study found that 7% of natural hollows and 14% of artificial hollows were occupied by competitors. This rate is similar to some studies (e.g. Saunders *et al,* 2014) but differs to others (e.g. Saunders et al 2020) where 6% of natural and just 1% of artificial hollows were used by competitors. In this study the most common competitors in natural hollows were Barn Owls and Boobook Owls. The most common for artificial hollows were Regent Parrots. The type and dimensions of hollows appear to be a factor in hollow competition. Most parrots and Galahs prefer smaller hollows with side/spout entrances rather than the Black-Cockatoo's preferred hollows with large, chimney/vertical entrances. This means that they rarely compete with Black-Cockatoos for natural hollows. Johnstone *et al* (2015) also found that large top entry artificial hollows were rarely used by smaller parrots. However, Regent Parrots seem to have a liking for artificial hollows despite their size and design (vertical entry). Bees tend not to like vertical entry hollows due to the amount of ventilation (Johnstone and Kirkby, 2007). Ducks seem to like large hollows and are direct competitors for natural hollows with any type of entrance, but do not seem to use artificial hollows. This may be due to the difficulty they would have in climbing the ladder, although this is a guess.

It should be noted that some hollows may be used by multiple species through the year. For example, ducks normally breed in winter and Carnaby's may take up a hollow in the same year after ducks or parrots have fledged. On Kangaroo Island both Yellow-tailed and Glossy Black-Cockatoos have been recorded nesting in the same hollow recently (pers comm. Francis Smit).

The breeding of some birds (such as Regent Parrots, which have been reported to be in decline by both Johnstone and Storr, 2004 and Saunders and Ingram, 1995) in natural and artificial hollows

should be seen as a positive result. However, the presence of other species of non-endemic or over abundant local species such as Corellas and Galahs is less positive. Indeed, some land owners have spent many years controlling and discouraging these species by various means in order to encourage Black-Cockatoos. This has had positive results (Saunders and Doley, 2017), but this problem is unfortunately going to be an ongoing issue in conservation efforts.

Bees can be controlled by various means, but again this will be an ongoing problem and their control is both costly and difficult. Hopefully in the future longer term solutions can be found to the issue of both bees and bird competitors.

Threats to Black-Cockatoo breeding sites

There are many threats to these sites. The main threat is land clearing for agriculture, forestry and mining. For example, Cocanarup reserve is pegged for lithium and gold mining. There may be over 100 breeding pairs of Carnaby's visiting this site each year, making it the best known site in the south of the state. It would be a great loss to the species if any of the reserve were cleared and BirdLife will work hard to prevent this happening. The threats are principally the loss of hollow bearing trees, however the loss of any forage plants within 6-12km of nests is also a concern. These plants are essential to enable parents to feed chicks until fledging.

Use of technology

In 2019 BirdLife purchased two tablets for survey work (an Ipad Pro and a Samsung Tab A). The Ipad is cellular, with an internal gps and no SIM card. The Samsung is non-cellular and uses an external gps linked via Bluetooth for location). These both have Avenza Pro mapping apps installed on them and were used to locate nest trees in the field. Preparing for field surveys requires two steps. Firstly a geo-referenced map needs to be made (we use ArcGIS to make high resolution PDF maps). Secondly a kml file is made with the location date for each known nest (we use a free subscription to the Earth Point website to convert from Excel). This has proven invaluable for our surveys, particularly when trees are tagged. It enables easy location of trees in the field and thus saves time. In 2020 this was only used by staff, but in future years we may train volunteers to use this technology more.

The increasing use of technology (tablets, Cocky Cam, GoPro cameras and more) should help BirdLife to get more accurate data more efficiently. However, some of our volunteers may struggle to adapt to these methods so BirdLife will need to support them in whichever method they choose to be most appropriate for them.

Conclusion

The 2020 surveys have been very successful. The use of Cocky Cam is giving us a much higher degree of certainty in the results, especially regarding nest competitors and the suitability of hollows for Black-Cockatoo nesting. The number of trees tagged increased this year and this is very positive for future surveys.

BirdLife and others recognise the need to learn more about the quality and extent of habitat around breeding sites. Without this knowledge we cannot appropriately manage the threats to Carnaby's in the wheatbelt. BirdLife aims to secure funding in order to gain a better understanding of this in the future.

This year's report summarises a single year's surveys. The database has now been updated to standardise the results of all surveys between 2003 and 2020. It remains to be seen whether this data can be analysed to give meaningful trends on breeding rates.

One key volunteer retired in 2019 and two other important volunteers have signalled that they may retire soon. This is a great shame since their knowledge, skills and experience will be sorely missed. Surveying Black-Cockatoo nests is hard work, both physically and technically. Recruitment of new volunteers with the skills, knowledge, experience, time, resources and physical ability to do the work should be a high priority to enable the ongoing success of BirdLife's surveys.

The surveying of Forest Black-Cockatoos is much more difficult than Carnaby's. BirdLife do not currently have the time, funds or expertise to carry out this work and it may be best for us to continue our focus on Carnaby's until this situation changes.

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I would like to thank all the volunteers for their work this year and in previous years, without them this project would not be possible. The survey work is often quite arduous and travel times are often long. The time and money committed by volunteers are impressive. A conservative estimate for the dollar value of the 2020 breeding surveys done by volunteers is $45,000. We at BirdLife really appreciate the work you do and the time, experience and knowledge which you so generously donate. The land owners whose properties were surveyed are also in our debt. They often assist with the surveys and do much to help conserve Carnaby's and their habitat. Their support and the access they give us to their land is highly appreciated. Special thanks goes out to John Koch, Freda Blakeway, Sue Mather and the Cocanarup group for their ongoing effort.

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