

COCKATOOS MAY HAVE A ROLE IN URBAN FOREST MANAGEMENT TOO

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Abstract

For many years I had been curious about the feeding on plants by sulphur-crested and yellow-tailed black cockatoos, but had no time to research behaviours in detail. Covid 19 lockdowns in Melbourne in 2020 changed things by providing the time and opportunity to investigate matters further. The harvesting of onion grass, *Romulea rosea*, corms by flocks of sulphur-crested cockatoos, *Cacatua galerita*, was researched by noting flock size, bird feeding habits, the depth of corms, the time taken to remove corms from the ground and the number of eaten, and lifted but uneaten corms.

From the data it was estimated that an individual cockatoo can extract and eat about 200 plants per hour. Corms were typically within 20mm of the soil surface and were removed primarily by the beak, but the left foot was sometimes used to excavate the corm from the soil. Flock feeding sessions lasted from about 0.5 to 2.5 hours. Plants that had been removed from the soil appeared to have intact corms, but all that was left were the outer scales. Of the plants removed from the soil, only 6% had intact corms. The removal of large numbers of onion grass plants could impact on weed population numbers over time if there was repeated annual harvesting.

Yellow-tailed black cockatoos, *Calyptorhynchus funereus*, consume seeds and boring insect larvae from woody-fruited species such as *Acacia*, *Hakea*, *Casuarina*, *Allocasuarina*, *Eucalyptus* and *Banksia*, but also feed on the cones of introduced pine species. In 2020 a single Monterey (Radiata) pine, *Pinus radiata*, was visited by small flocks of yellow-tailed black cockatoos. The feeding behaviour of birds was observed and the fallen debris of small and large needle-bearing shoots and cones was collected, sorted and categorised. Needle-bearing shoots were counted and weighed. The cockatoos harvested 721 large and small needle-bearing shoots with a total mass of 19,552 g and 392 cones weighing nearly 17 kg. The removal of so many cones could reduce the weed potential of introduced species, especially if trees are visited by flocks repeatedly. Some basic interactions of bird and plant species have been reported, but often there have been few detailed studies. The work on yellow-tailed black cockatoos is ongoing to provide a comprehensive list of tree species harvested and to determine the levels of grazing on selected tree species.

Introduction

Onion grass, *Rolumea rosea* is a South African herbaceous perennial, but naturalised in many parts of Australia, where it is a significant weed that is difficult to control in native grasslands, pastures and recreational turf (Gibson Roy et al. 2010; Moore 2021). It is small and usually inconspicuous with grass like leaves and is only noticed when it produces pretty pink yellow-throated flowers in spring. Its common name of onion grass refers to its habit and the presence of a small corm. It is a prolific seeder and its reproduction by both seed and corm contributes to its rampant weediness. The number of *R. rosea* plants found in grasslands and pastures can be very high with reports of densities reaching 4790 plants/m² in spring in a grazed native pasture (Nie et al. 2012). The corms of onion grass are found close to the soil surface, which may explain why scraping techniques that remove 100 mm of surface

soil used in grassland revegetation were effective in greatly reducing onion grass numbers (Gibson Roy et al. 2010; Moore 2021).

The sulphur-crested cockatoo, *Cacatua galerita*, feeds on berries, seeds, nuts, roots and corms. It is well-known in rural Australia and in suburban and peri-urban parts of cities in eastern Australia, where people have a love/hate relationship with the species (Figure 1). It is not uncommon to find large flocks feeding on *R. rosea*, to an extent that can significantly damage recreational turf. Being both sociable and creatures of habit, cockatoos are known to revisit feeding sites and to use their beak and feet when feeding. Generally, if not exclusively, sulphur-crested cockatoos tend to use their left foot when feeding (Brown 2011; Moore 2021).



Figure 1. Sulphur-crested cockatoos, *Cacatua galerita*, and little corellas, *Cacatua sanguine*, feeding on *Romulea rosea*.

Cockatoos had been observed feeding on onion grass within Brimbank Park, Keilor, west of Melbourne. The results of this research then led to a subsequent examination of yellow-tailed black-cockatoo, *Calyptorhynchus funereus*, feeding on a Monterey pine, *Pinus radiata*, tree (Moore 2022). The yellow-tailed black cockatoo, *Calyptorhynchus funereus*, is Australia's longest black cockatoo, at 55-65 cm, and it is unusual in that it consumes both seeds and boring insect larvae (Way and van Weenen 2008). It feeds on the seeds and boring larvae of *Acacia*, *Hakea*, *Casuarina*, *Allocasuarina*, *Eucalyptus* and *Banksia*, but also feeds on exotic species such as Aleppo pine, *Pinus halepensis*, Monterey (Radiata) pine, *Pinus radiata*, and Bhutan cypress, *Cupressus torulosa* (Way and van Weenen 2008). Moore (2022) provides a fuller paper on this aspect of the presentation. Yellow-tailed black cockatoos are known to revisit feeding sites, day after day and year after year (Way and van Weenen 2008).

The serotinous cones of Monterey Pine often require a trigger such as heat or fire for the release of seeds. The scales are capable of remaining closed for several years but can open and then reclose depending on environmental conditions, releasing small numbers of viable seeds over a couple of decades. A large Monterey pine in Keilor was visited by yellow-tailed black cockatoos during a Covid-

19 lockdown period in Victoria in 2020 which allowed the collection of data on the harvesting of cones and the removal of needle-bearing shoots.

Method

Flocks of various sizes of sulphur-crested cockatoos were observed feeding on onion grass in Brimbank Park, west of Melbourne between 20th July and 10th August, 2020. Yellow-tailed black cockatoos arrived at the pine tree on 1st October, 2020. The following data were collected

- Flock numbers were counted
- The length of feeding sessions to the nearest quarter hour were determined
- Which foot birds used in extracting the plant from the soil and/or eating it was noted

To allow quantification of feeding sessions that involved different flock numbers and different durations, a concept of bird feeding hours was utilised where the number of feeding birds was multiplied by the feeding time in hours. A more detailed explanation of the methods can be found in Moore (2021; 2022).

For the onion grass study:

- The time taken for onion grass to be pulled from the ground was recorded
- Plants that birds had extracted from the ground were collected from 7 sites
- The plants were batched into groups of 50 for later inspection
- The depths at which 20 corms occurred in the soil at each site were measured – from soil surface to the top of the corm
- The total number of *R rosea* plants harvested in a feeding session and per hour were calculated

For the pine tree study

- All of the small and large needle-bearing shoots dropped from the tree were collected
- Needle-bearing shoots were separated into three groups – small shoots, large shots and shoots that had undamaged cones attached
- For each group, shoots were counted and weighed to determine the mass of material removed
- All of the cones that were dropped were collected
- The site was inspected daily for 10 days after the departure of the birds to collect any cones or needle-bearing shoots that had been snagged
- The number, size and weight of the cones that had been removed were determined
- The cones were categorised according to the degree of discernible damage done using a seven point scale: 0 (no damage), + (minor damage), 1(<10%), 2(11-30%), 3(31-50%), 4(51-70) and 5(>71%)

Results

Onion grass study

Flocks of birds varied in number from 8 to 63 birds; the shortest feeding session was 0.5 hours and the longest was just over 2.5 hours (Table 1). Birds used their beaks to extract and consume the corms. The shortest time taken to extract and consume a plant was 6 seconds and the longest successful

attempt was 30 seconds (Table 1). Between 1 and 2 seconds elapsed between the consumption of one plant and the beginning of the next removal. Birds used their beaks to pull plants from the ground and to dig at the soil surrounding the corm. The use of feet in the process of harvesting *R.rosea* was uncommon, and usually the left foot was used. The consumption of the corm was done with the beak and tongue, but occasionally the left foot was used to manipulate the plant.

Table 1. Corm depth, flock size, feeding session duration, time taken and the number of *Romulea rosea* plants harvested by sulphur-crested cockatoos (modified from Moore 2021).

| Variable | Range | Average |
|---|---------|---------|
| Corm Depth in soil (mm) | 7-32 | 17.8 |
| Flock size (number of birds) | 9-63 | 37 |
| Duration of feeding sessions observed (hours) | 0.5-2.5 | 1.5 |
| Time taken to extract plants (seconds) Wet soil | 6-16 | 14 |
| Time taken to extract plants (seconds) Dry soil | 13-30 | 18 |
| Estimated number of harvested plants (hr ⁻¹) Wet Soil | | 225 |
| Estimated number of harvested plants (hr ⁻¹) Dry Soil | | 180 |

On an initial inspection of harvested plants in the field, plants appeared to be undamaged as the outer scales of the corms seemed to be intact. However, closer inspection revealed that an average of 87.4% of the corms had been consumed by the birds (Figure 2). Only 21 (6%) of the 350 plants sampled had retained intact corms. Corms that were not consumed appeared to be full and healthy. Of the lifted plants, some (6.6%) had neither corms nor scales evident. Most of the corms were within 20 mm of the soil surface, with only 4 of the 140 plants measured having corms at 30 mm or greater depth and 42 plants being 15 mm or closer to the surface (Table 1). Holes left in the soil by the birds extracting the onion grass were shallow and small, with the largest divot observed measuring approximately 40 x 15 mm.



Figure 2. *Romulea rosea* plants harvested by sulphur-crested cockatoos. What appear to be complete corms are only the husks or outer scales.

By taking the average time taken to harvest a plant and adding the time taken to move to the next plant (1-2 seconds) and rounding to the nearest second, it was possible to determine the approximate number of *R. rosea* harvested by birds in a feeding session (Table 1). The number of plants harvested was very high, with a small flock harvesting about a thousand plants in half an hour, while a large flock harvested 35,000 plants in a few hours. A single bird could harvest between 180 and 225 plants per hour depending on whether the soil was wet or dry (Table 1).

Pine tree study

Yellow-tailed black cockatoos used their left foot to manipulate cones. The beak was used to dismantle the cones and to sever twigs and cones from the tree (Figure 3). Over three days, the cockatoos harvested 668 small shoots and 53 larger needle-bearing shoots weighing between 100 g and 898 g from the tree (Table 2). Some of these larger shoots were over 600 mm in length. The total mass of large and small needle-bearing shoots removed from the tree was 19,552 g (Table 2).



Figure 3. *Yellow-tailed black cockatoos, Calyptorhynchus funereus, feeding on a curbside Hakea.*

The most obvious result of the cockatoos feeding was the large number of cones found on the ground. These were cones only, without any foliage attached. Of the cones removed, 40 showed no damage from the feeding and of these 34 were cones that had not opened at all. The other 6 cones were older fully open cones without any retained seeds (Table 2). It was interesting that many of the cones opened by the birds were approximately the same size in width and length.

There were 151 dropped cones that had very slight damage usually, to the smallest scales at the tip of the cone (114), to the tip and middle scales (28) and rarely at the base of cones (9). On these cones none of the scales had been completely removed as was the case for the more significantly damaged cones (Figure 4). Furthermore, 40 (10.0%) of the cones were undamaged and mostly closed and another 151 (38.52%) had very little damage and no evidence of seed removal. There were 67

(17.09%) cones that had been damaged but many of these cones still contained seeds. Once damage to the cones exceeded 50% no seed was found within.

Table 2. Feeding on cones and needle-bearing shoots of Monterey pine by yellow-tailed black-cockatoos (Modified from Moore 2022).

| Variable | Number of birds | Duration (hours) | Feeding hours | Needle-bearing shoots | | Cones | |
|---------------------|-----------------|------------------|---------------|-----------------------|------------|--------|------------|
| | | | | Number | Mass (g) | Number | Mass (g) |
| | 2-8 | 1.0-1.5 | | 97.4-467.6 | 2642-12682 | 53-254 | 2271-10899 |
| Total | 14 | 3.75 | 18.5 | 721 | 19552 | 392 | 16803 |
| Hypothetical | 1 | 1 | 1 | 38.97 | 1056.86 | 21.19 | 908.27 |

There were 201 dropped cones that showed more significant damage (>10%) (Table 2; Figure 4). The combined mass of all harvested cones was nearly 17 kg. After the feeding sessions, there was a lot of fine debris on the ground consisting of scales, bits of scales that had been removed from cones, and some winged seeds. Three feeding sessions were observed (Table 2). In the first session, 8 birds fed for 1.5 hours, in the second 2 birds fed for 1.25 hours and in the final session 4 birds fed for 1.0 hour. Using the feeding hour concept, in 18.5 hours of feeding the yellow-tailed black-cockatoos removed 721 foliage-bearing shoots with a mass of 19,552 g and 392 cones with a mass of 16,803 g from the tree. Dividing these totals by the feeding hours (18.5 hour) the rates of harvesting of cones and removal of needle-bearing shoots were calculated.



Figure 4. Damage to Monterey pine, *Pinus radiata*, cones caused by yellow-tailed black cockatoos, *Calyptorhynchus funereus*.

Discussion

The harvesting of onion grass by sulphur-crested cockatoos is well known, but the number of plants harvested by a large flock in a few hours is significant and could impact on the persistence of onion grass on a site that is regularly harvested. Generally, corms were found close to the soil surface – rarely deeper than 30mm and not closer than 7mm to the surface. Disturbance of the soil surface by the harvesting of onion grass was quite extensive with relatively shallow divots of soil displaced. This disturbance might have a role in preparing a seed bed for seeds of *Romulea rosea* after flowering and seeding, which could compensate for the plants lost through harvesting by sulphur-crested cockatoos. The close proximity of the corms and the shallow soil disturbance may explain the effectiveness of the scraping technique, typically to a depth of 80 to 100 mm, used in some revegetation works in reducing the occurrence of onion grass significantly (Gibson Roy et al. 2010).

The number of extracted but uneaten corms was low. These corms appeared to be in good condition and the reason that they were discarded remains unclear. However, it is possible that in harvesting plants, due to the very high density of the onion grass, sometimes more than one corm may have been lifted at a time and that in such cases a corm may have been overlooked by the bird as it consumed the other corm(s) it had lifted. The apparent preferred use of the left foot by sulphur-crested cockatoos when harvesting and consuming onion grass was not anticipated, but is consistent with reports that the species like many parrots tends to be left-footed and to a greater degree than other parrots (Brown and Magat 2011).

This study revealed the significant role that sulphur-crested cockatoos play in harvesting onion grass. The very large numbers of plants that are extracted from the soil and the large numbers of corms consumed indicate that the role of the birds could be considered significant in managing onion weed. If herbicidal weed controls are to be applied. It would seem sensible to delay any weed control measures until after cockatoos have harvested plants. Such an approach could benefit both the welfare of the birds and ensure that resources were not wasted on managing plants that were going to be harvested anyway. It is also possible that the intense harvesting of onion grass by sulphur-crested cockatoos could change the composition of the remaining flora over time.

The impact of a flock of yellow-tailed black cockatoos feeding on a tree is significant. Even a small flock of birds can harvest and remove large numbers and masses of cones and needle-bearing shoots. The birds harvest cones and feed on the winged seeds within, using their left foot to manipulate the twigs and cones and their beaks and tongues to sever the plant parts and extract seeds. All of the birds observed used the left foot for manipulation, which is consistent with other work that reports that cockatoos tend to be left footed (Brown and Magat 2011).

The birds systematically lifted and removed scales to harvest an average of 21.19 cones in an hour, spending less than 3 minutes on each cone. Only 134 cones (34.18%) with damage greater than 51% had all seeds removed and so would have taken a longer time for the removal of scales and seeds. Cones that suffered greater than 51% damage were similar to those illustrated for Aleppo pine by Way and van Weenen (2008). The pattern of the most severe damage done to the cones usually saw the smaller scales toward the apex left intact (Figure 3) and scales in the centre and towards the base removed from the axis of the cone entirely. This pattern was consistent in cones that suffered more than 51% damage, and particularly when damage exceeded 71%. It is likely that the apical scales contained no seeds and so the birds did not waste time or energy in damaging them.

The cockatoos removed over 36 kg of material from the tree. The harvesting of cones to feed on the winged seeds within is well-known, but 40 (10.0%) of the cones were undamaged and mostly closed and another 151 (38.52%) had very little damage and no evidence of seed retrieval. That nearly 50% of the cones removed from the tree yielded no seed seems to be inefficient, as does the removal of large shoots bearing cones that were all closed and undamaged by the birds.

There were so few, if any cones of the type harvested by the yellow-tailed black cockatoos remaining on the tree that it would not seem worth their while returning to the tree for some years. The tree has been visited on three occasions over the past decade and a feeding visit every three years or so would seem likely to yield an appropriate number of cones of suitable size and age to make the visit productive for the birds.

Yellow-tailed black-cockatoos have been reported as spreading Monterey pine seeds and contributing to the distribution of the species as a weed (Gill and Williams 1996). In this study, the birds were not seen carrying any shoots, cones or other material from the site. All material that was dropped by the birds fell in the immediate vicinity of the trees, usually immediately below the canopy. The feeding by yellow-tailed black cockatoos significantly reduced the number of cones and seeds held on the plant. While the harvesting does not eliminate the risk that the tree might self-seed and present as a weed, it may significantly reduce its weed potential by lowering the seed bank, especially when the tree is regularly and repeatedly grazed. The influence of yellow-tailed black cockatoos on the seed stored in harvested trees warrants further research.

The fine debris consisting of cone scales remained on the ground after the feeding sessions for weeks and became part of the mulch below the tree, adding to the quantity and the particle size diversity of the litter, which previously consisted almost entirely of pine needles. Such a change could impact on the biodiversity of the organisms present in the litter. The removal of non-cone but needle-bearing shoots has a visible impact on the canopy of a tree in a number of ways, but is still a relatively small proportion of a large canopy. However, it opens up the canopy and the shoots removed tend to bear the younger greener foliage and so the tree did not look as healthy as it did prior to feeding sessions. While the overall effect is likely to be a reduction in overall photosynthetic activity, the longer term implications remain unknown and are worthy of further study.

These studies revealed some interesting aspects of cockatoo behaviour and provided some insight into the sophisticated and intricate relationships between urban plants and the wildlife associated with and dependent upon them. Further research into these relationships is warranted as it may inform tree and urban forest management as climate change takes effect. There would seem to be both environmental and economic sustainability benefits that might ensue.

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