

## Monitoring with trail cameras of Yellow-footed Rock-wallaby and other animals in Vulkathunha-Gammon Ranges National Park.

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### Abstract

The severe drought years of 2018-19 contributed to the decline in Wallaby and Kangaroo populations in Vulkathunha-Gammon Ranges National Park. The above median annual rainfall in 2021 and 2022 allowed their populations to recover. From 2022 Yellow-footed Rock-wallaby observations were commonplace indicating population recovery. Also showing an increase in observations from 2023 were Euro, Red Kangaroo and Emu. Quoll began to be seen from October 2023. Feral goat was seen sporadically. No Dingo, Fox or Rabbit were observed. Very few Cats were observed and none since October 2023.

### Introduction

The remote Vulkathunha-Gammon Ranges National Park (VGRNP) is located about 600km north of Adelaide, in the arid northern Flinders Ranges of South Australia adjacent to the southern boundary of the Arkaroola Wilderness Sanctuary and 100 km to the east of Copley. The Ranges are home to Yellow-footed Rock-wallaby (*Petrogale xanthopus xanthopus*) which is listed as Vulnerable under Australia's Commonwealth EPBC Act, and Endangered in South Australia. The Friends of Vulkathunha-Gammon Ranges National Park Inc. (FoVGRNP) have been monitoring the permanent water and fish in Weetootla Creek, a tributary of the Balcanoona Creek in VGRNP since 2018 (Caon *et al.* 2021). Beginning in April 2021, members of the FoVGRNP placed six remote cameras (trail cameras) at locations within the National Park to record the wildlife that drinks from the water and passes nearby.

Camera traps have been used extensively to monitor for the presence or absence of Australia's rock-wallabies (*Petrogale spp.*) (Lavery, Eldridge, Legge *et al.*, 2021) and to determine a relative abundance index (number of observations per 100 camera nights). Fixed trail cameras can establish the presence of an animal at a location (but not necessarily its absence). The Arid Recovery team along with Arabana Rangers deployed 50 motion-sensing camera-traps across Jackboot Paddock (between Kati Thanda-Lake Eyre North and South) to monitor the activity and density of animals and photographed: Camel, Cats, Dingo, Fox, Rabbits and Wedge-tailed Eagle. However, their interest was stimulated when Mulgara (*Dasymercus sp.*) were unexpectedly found to be present (Arid Recovery, 2025).

Because they are in place for an extended period, cameras can record the presence of animals that cannot otherwise be seen during a single day visit. They may hide when humans are present, be nocturnal, or be too rare to be seen by searching at a particular time. Furthermore, as no humans are present to disturb the animals, the cameras capture the animals' normal behaviours. Long term camera monitoring of Australian vertebrate species in difficult to access areas, is rare (Bruce, Amir, Allen *et al.* 2025). Two of our cameras in VGRNP have been in place continuously for more than four years.

The years 2018 and 2019 were years of severe drought in the northern Flinders Ranges, when annual rainfall totals of 66mm and 41mm (respectively) were recorded at the Arkaroola

weather station. This amount of rain was the lowest recorded for a two-year period since records began in 1938. As a consequence, most of the macropod marsupials died from lack of food. In May of 2019 their desiccating carcasses were a common sight in VGRNP (FoVGRNP Newsletter 10, 2019). In the years from 2021 onwards, the populations have recovered as annual rainfall increased. February 2020 Arkaroola had 74mm while 2021 and 2022 had above median rainfalls of 271 and 395mm respectively. Using the images captured by the remote cameras, the increasing population of animals - most commonly Euro (*Osphranter robustus*), Red Kangaroo (*Osphranter rufus*) and Emu (*Dromaius novaehollandiae*) - as their populations recovered from the drought, could be monitored. The cameras in Weetootla Gorge were used to monitor the Yellow-footed Rock-wallabies (YFRW) present in the vicinity, while the cameras placed near the western coast of Munda-Lake Frome were used to record the animals that had produced the plethora of tracks that were evident in the sand. In 2022, Western Quoll (*Dasyurus geoffroii*) were released in the VGRNP after which they began showing in the images captured by the cameras (for example at Weetootla spring head in October 2023).

The aim of the study was to document the presence of YFRW in Weetootla Gorge in the Vulkathunha-Gammon Ranges National Park and their recovery since the drought of 2018 & 2019 via their appearance in photographs captured by trail cameras. Another aim was to record what other wildlife passed in front of the cameras.

## Methods

The work was conducted under a South Australian Government Department for Environment and Water Permit to conduct scientific research numbers: Q26980-2 to Q26980-6. The trail cameras of type: *Reconyx* HF2X Hyperfire 2 Outdoor Cameras, were powered by twelve rechargeable NiMH AA Cells, of 1900 mAh and each contained a *Scandisc Ultra* 32 GB SDHC memory card. Each camera was mounted on a star dropper (see Fig. 1), locked and labelled with a tag with the Scientific Research Permit holder's name, the words 'Scientific Research Permit' and the Permit Number before placement. The cameras are faced south so that the rising and setting sun did not trigger the cameras. As the cameras are located in a location remote from Adelaide, where most of the members of FoVGRNP reside, they were visited twice each year to retrieve and replace the secure digital (SD) cards and refresh the batteries.

Between late April of 2021 and \*\*\*\*September of 2025, four cameras were located adjacent to the Weetootla creekbed containing permanent pools of water fed by the Weetootla Spring. Two at the Weetootla Springhead (one on each creekbank), one at the "Lovely Pool" all of which recorded animals coming to drink. One camera was placed on the gorge wall above the Lovely Pool at the location of a resident YFRW colony. The cameras on the eastern side of the Weetootla Springhead and at the YFRW colony remained in place for the duration of the study. The camera on the western side of the Springhead was relocated after being dislodged by floodwater, while the camera at the Lovely Pool was relocated in May 2024 when growing vegetation blocked its view. In September of 2022, two more cameras were placed in the sand dunes close to the western shore of Munda-Lake Frome. These cameras were located outside (east of) the dog fence.

The cameras trigger when an object of temperature different from the background is detected in which case three images each 1s apart are captured. The images recorded on the retrieved SD cards were scored according to date and time of photo, species captured and location of camera. Not every camera produced a continuous record of captured images between the

dates above. Night time triggers elicit a flash of light to allow an image to be recorded. However, the light flash uses more battery resources. Consequently, when the after-dark animal traffic is heavy, the AA cells are discharged after two, or three or four months of photographic activity and well before the camera's SD card is retrieved. This leaves significant gaps in the otherwise consecutive months of recorded activity. Such gaps occurred in the photographic record provided by the camera placed at the Weetootla Springhead. To partly compensate for this, in the months when the camera did not operate for the whole month, the number of observations was extrapolated to produce a number of observations that may have occurred if the camera had operated for the full month. To achieve the extrapolation, the number of days on which a YFRW was observed, was divided by the number of days that the camera was operational. This result was then multiplied by the number of days in that month. For example, in April 2022, the camera operated for 17 days and YFRW were observed (obs.) on 12 of those days. April has 30 days, hence:

$$(12\text{obs.}/17\text{days}) \times 30 \text{ days} = 21\text{obs. (extrapolated)}$$

Thus, for the camera placed in the YFRW colony the number of days in April 2021, April 2022, September 2023 and April 2024 in which YFRW were observed were multiplied by 3.3, 1.76, 3.0, and 3.75 respectively. Figure 2 displays the (extrapolated) numbers of days per month on which at least one YFRW was observed. For the Weetootla spring head camera (see Fig 3), the number of days in which an animal was observed in February, September, October 2023, were multiplied by 3.0, 1.5 and 1.35 respectively. In April, May, August and November 2024, the numbers of observed days was multiplied by 3.33, 2.82, 5.17 and 6.2 respectively.

At other times a camera stopped recording due to battery failure or being displaced by floodwater in the creek. On four occasions, a camera was shifted to a different location as the previous location proved to be unsuitable; or vegetation had grown to obscure its view; or the images captured by the camera had provided the hoped-for evidence of bird presence, and hence were no longer required at that location.

The camera at the Weetootla Springhead, and another serendipitously placed at a location within a YFRW colony on the gorge wall above the Lovely Pool, remained in place for the entire recording period (from April 2021 until September 2025\*\*\*\*\*) reported here.



Figure 1. Trail Camera as mounted on a star-dropper

## Results

### Yellow-footed Rock Wallaby monitoring

Figure 2 displays the number of days per month on which the camera placed at the YFRW colony photographed a wallaby, plotted against the month of the year, from April 2021 and September 2025. Note that for April 2021, April 2022, September 2023 and July 2025, the number of observations was adjusted by the factors described above. For example, for July 2025, the actual number of observation days was 15, while the extrapolated number of observations was 26 ( $26 = (15/18) \times 31$ ). Where the graph shows no observations in a particular month, the camera was not operating.

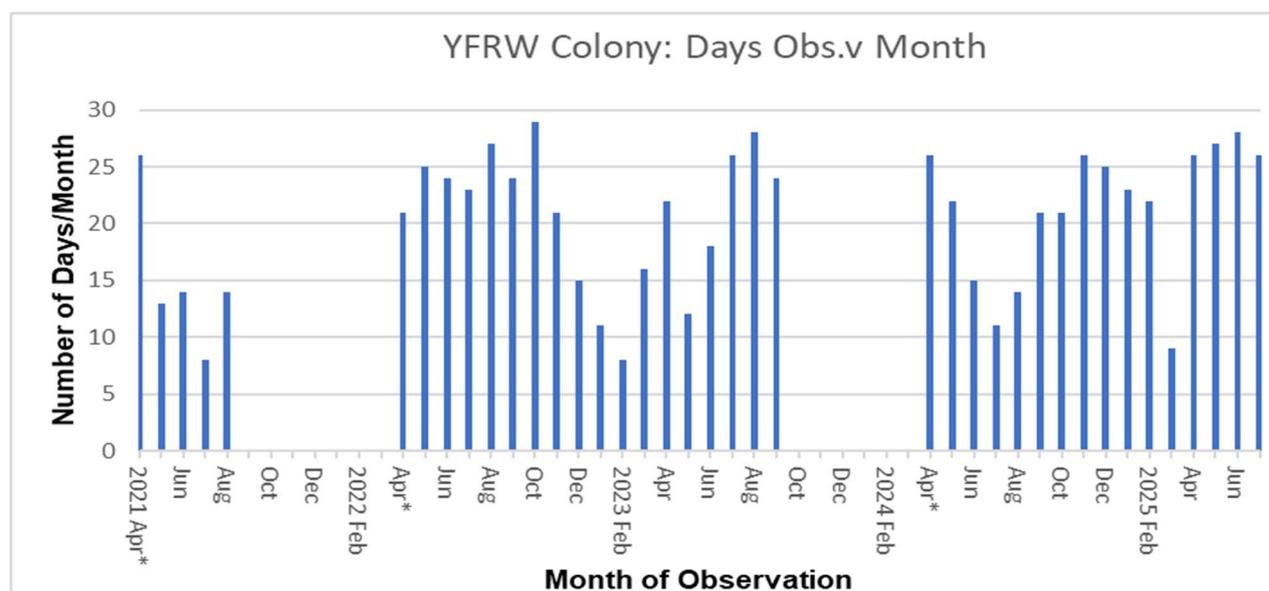


Figure 2. YFRW colony camera: The number of days in the month that a YFRW was observed vs the month of observation.

Figure 3 displays the number of days per month on which a YFRW was photographed at the Weetootla springhead, plotted against the month. Figure 4 displays the number of days per month on which an Emu, Euro or Red Kangaroo was photographed at the Weetootla springhead, plotted against the month, from April 2021 and April 2025. From about November 2022, multiple animals were photographed multiple times each night with flash light. This caused the batteries to be discharged before they could be replaced, and resulted in months where no photographs were taken. In Figures 3 and 4 those months show no sightings per month.

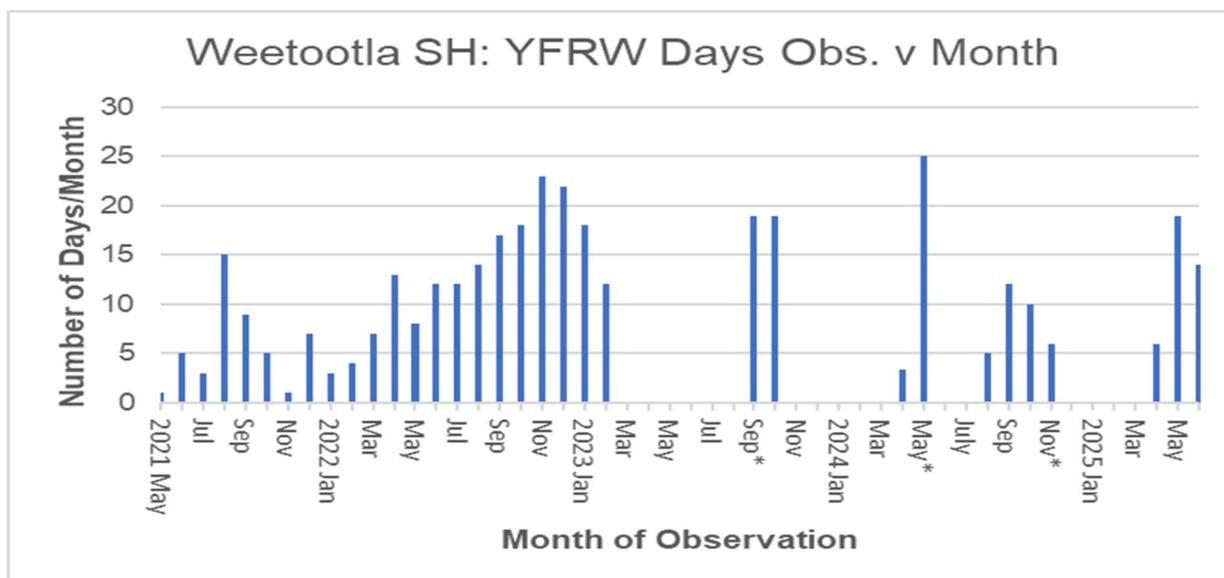


Figure 3: Weetootla Springhead camera: the month that a YFRW was observed vs the number of days in the month that a YFRW was observed.

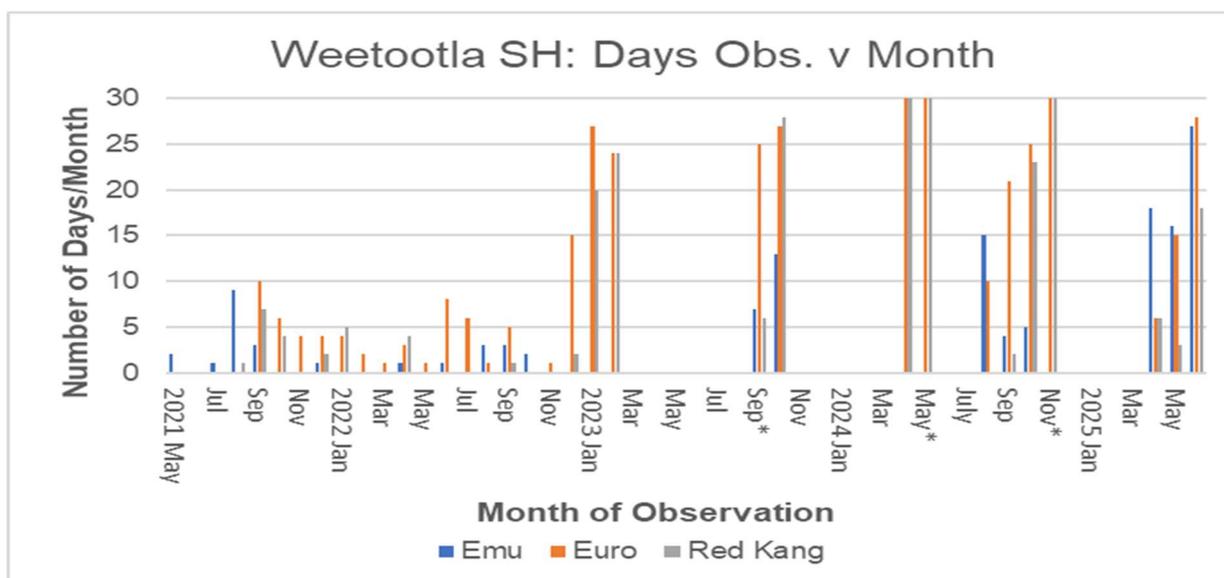


Figure 4: Weetootla Springhead camera: the month that an Emu, Euro or Red Kangaroo was observed vs the number of days in the month that an observation was made.

The Weetootla Springhead camera (Figs. 3 and 4) captured animals coming in to drink at the springhead pool. The number of days on which a YFRW was observed by the camera showed an increase between May of 2012 and January of 2023. However, the number of observations of Emu, Euro and Red Kangaroo for the same period was low. After about January 2023, the number of times that these three species were observed increased markedly. At times, an individual animal would remain within a camera's field of view for some time, or multiple individuals of each species would move past the camera and so the camera was triggered many times for the one recorded observation (Figs. 5 to 7).



Figure 5: Emu (*Dromaius novaehollandiae*) at the Weetootla springhead.



Figure 6: Euro (*Osphranter robustus*).



Figure 7: Red Kangaroo (*Osphranter rufus*) at the Weetootla springhead.

The increase in Emu, Euro and Red Kangaroo may signify the recovery of these species following the drought of 2018-2019 when many animals starved to death. The large number of photos taken caused the camera's batteries to discharge and further images were not taken until the batteries were replaced. Hence in Figures 3 and 4 gaps in the record of observations occur.

The camera at the YFRW colony site recorded sequences of images where a wallaby would remain in front of the camera, triggering images for an extended period of time. Such image sequences recorded: mating behaviour (Figure 8) with 796 images over 15 minutes; grooming behaviour (Figure 9) with 436 images over 16 minutes; and fighting behaviour (Figure 10) with 200 images over 3 minutes and 20 seconds. These sequences of contiguous images (and others) also contributed to the discharge of the batteries before a replenishment visit.

Other animals observed by various cameras were: dingo, echidna, feral cat, feral goat, feral rabbit, sand goanna and western quoll (see Figures 11 to 17). No fox were recorded.



Figure 8: One from a sequence of 796 images. This wallaby mating continued for more than 15 minutes.



Figure 9: One from a sequence of 436 photos showing grooming behaviour.



Figure 10: One of 200 consecutive images, showing wallaby fighting behaviour.



Figure 11: Dingo (*Canis familiaris*) outside the dog fence, near Lake Frome.



Figure 12: Echidna (*Tachyglossus aculeatus aculeatus*) in Weetootla Gorge.



Figure 13: Feral cat (*Felis catus*) near Lake Frome.



Figure 14: Feral goat: (*Capra hircus*) in Weetootla Gorge.



Figure 15: Feral rabbit (*Oryctolagus cuniculus*) near Lake Frome.



Figure 16: Sand goanna (*Varanus gouldii*) near Lake Frome.



Figure 17: Western quoll (*Dasyurus geoffroii*) at the Weetootla springhead.

Many birds passed in front of the cameras (for example Figures 18, 19), those that could be identified are listed in Table 1.



Figure 18: Wedge-tailed Eagle (*Aquila audax*) near Lake Frome.



Figure 19: Great cormorant (*Phalacrocorax carbo*) at the Weetootla springhead.

Table 1. Birds opportunistically recorded by the cameras

<b>Common Name</b>	<b>Binomial nomenclature</b>
Collared Sparrow hawk	<i>Accipiter cirrocephalus</i>
Wedge-tailed eagle	<i>Aquila audax</i>
Australian ring-necked parrot	<i>Barnardius zonarius</i>
Little Corella	<i>Cacatua sanguinea</i>
Wood Duck & chicks	<i>Chenonetta jubata</i>
Swamp Harrier	<i>Circus approximans</i>
Grey Shrike-thrush	<i>Colluricincla harmonica</i>
Australian Raven	<i>Corvus coronoides</i>
Grey Butcherbird	<i>Cracticus torquatus</i>
Emu & chicks	<i>Dromaius novaehollandiae</i>
White faced Heron	<i>Egretta novaehollandiae</i>
Crimson chat	<i>Epthianura tricolor</i>
Australian Magpie	<i>Gymnorhina tibicen</i>
Budgerigar	<i>Melopsittacus undulatus</i>
Tree martin	<i>Petrochelidon nigricans</i>
Great cormorant	<i>Phalacrocorax carbo</i>
Tawny frogmouth	<i>Podargus strigoides</i>
White-plumed honeyeater	<i>Ptilotula penicillata</i>
Willie wag tail	<i>Rhipidura leucophrys</i>



Figure 20: A dingo seemingly aware of the camera.



Figure 21: A YFRW noticing the camera.

## Discussion

The benefit of trail cameras is that they record the presence of animals during an extended time period when human observers cannot be present. They also record the date, time and temperature at the location where the photo was taken. They may record the presence of animals that would remain hidden in the presence of humans. Additional information such as the daily level of activity, judged from the number of camera triggers per day, and breeding activity in the form of images of Emu chicks or joeys in pouch can be obtained. Our monitoring showed that YFRW, Euro and Red Kangaroo were all breeding during the survey period.

Some photos show the animal looking directly at the camera which seems to indicate that the animal is aware of and interested in the camera (Figs. 20 and 21). This awareness, if indeed it is awareness, did not seem to otherwise affect their behaviour. Unsurprisingly, Emu and Goat are recorded in daylight only, while Quoll are recorded only after sunset. YFRW seem most active at early morning and late evening as well as at night. Euro and Red Kangaroo, while often photographed after nightfall, can also be active in daylight hours.

One of our cameras was placed on a gorge wall, high above permanent water in the Weetootla Creek where Wallabies had been sighted. Fortuitously this location was a place that was frequented by Wallabies (see Fig. 2). They often presented themselves directly in front of the camera and within a few metres of it for extended periods, which produced high quality candid photographs of their behaviour. For example, in August 2021 two Wallabies had a fight that resulted in a sequence of more than 200 images, each 1s apart (Fig. 10). In May 2025 a sequence of images lasting for more than 15 minutes showed two Wallabies joined while mating (Fig. 8). In another sequence lasting more than 8 minutes a wallaby pauses in front of the camera while grooming itself (Fig. 9). The daily observations from this camera (Fig. 2) indicate that from April of 2022, YFRW sightings were commonplace and probably more common than from April to August of 2021. Hence YFRW numbers at this colony had recovered from the drought years of 2018-19. No dingo, fox or rabbit were captured on camera, and since October 2023, no cats indicating the success of the feral control program within the Park. The absence of predators may also have allowed the YFRW population to increase. In addition, the above median rainfall in 2021 and 2022 would have allowed vegetation to regrow and the YFRW population to increase.

The observations recorded by the Weetootla springhead camera indicate an increase in YFRW between May 2021 and February 2023 (Fig. 3) while Emu, Euro and Red Kangaroo numbers were low (Fig. 4). After February 2023, the number of observations of these three species increased markedly. So much so that the camera batteries were discharged leading to four interruptions to the monthly record of photographs (Fig. 4). The increase in observations of Emu, Euro and Red Kangaroo indicate that from Jan 2023, if not before, these species had recovered from the depression of their numbers caused by the drought. The increase in daily observations of these species may have contributed to the decreased number of observations of YFRW (e.g. between August and November 2024). The decrease may be because different species were never photographed together by a camera (except for one image of a Euro and Red Kangaroo) and the presence of other species kept YFRW away from the camera. The decrease may also only be an apparent decrease as the larger number of photographs taken discharged the camera batteries for periods during their placement.

Trail cameras also have shortcomings in that they only record what passes in front of them. Much nearby activity is missed if out of field of view. When animals are recorded passing in front of camera, it may be a stream of different individuals passing by, or it may be the same individual(s) being recorded as they make multiple passes in front of the camera. Furthermore, when vegetation grows in front of a camera, the wind-blown movement leads to many false triggers during a windy day.

Cameras may record the same animal multiple times during the 24-hour period, or different animals just once in a day. This may or may not indicate periods of high activity by some individuals, or of many animals being in the vicinity. Consequently, using camera images to estimate population size may result in an over-estimate. However, often more than one

individual is recorded in the field of view, and this may indicate that there is a mob of Red Kangaroo (say) visiting the water hole near the camera (Fig. 7). At other times, an individual may pass the camera beyond its field of view and so be undetected. Hence, the efficacy of a remote camera as a population size measuring device is limited. Nevertheless, the Newhaven Wildlife Sanctuary (in the Northern Territory) used a grid of 101 trail cameras to determine that Bilby (*Macrotis lagotis*) presence had increased, in what was deemed to be their optimal habitat, from about 10% in June 2022 – when Bilbies were re-introduced - to about 90% in December 2024 (Figure 4 in, Mihailou, Henderson, Mulvena et al. 2025). Furthermore, Lavery et al. (2025) used camera traps to estimate abundance (as determined from relative abundance indices) for West Kimberly Black-flanked Rock-wallaby (*Petrogale lateralis kimmerleyensis*).

Cameras may be placed in an unfavourable location with unsuitable or unattractive habitat and so not record animals. When this was the case for one of our cameras, it was shifted to another location. By placing several cameras spread over a few kilometres, this drawback may be overcome. Different cameras will have different fields of view – some smaller some larger depending on the adjacent topography and the angle to the ground that they are pointing. So different cameras may record from areas that are not of similar extent and hence the levels of activity that they indicate may not be comparable.

### **Bird images captured by remote cameras**

Birds were not the intended subjects of this monitoring project, apart from establishing the presence of piscivorous birds that may be feeding on the Flinders Ranges Mogurnda (*Morgunda clivicola*) that are present in waters of Weetootla Spring. Images of such birds were captured (Fig. 19) which established that birds such as White-Faced Heron (*Egretta novaehollandiae*) and Great Cormorant were likely predators of the fish.

Birds did trigger the cameras as they alighted nearby or flew past, while the images were often of low quality, many bird species were identifiable from the images (see Table 1). For a more complete list of birds that may be seen in the National Park, along with photographs, see the brochure produced by the Friends group: <https://friendsofgammons.org.au/wp-content/uploads/2023/08/Bird-brochure-final-web-version.pdf> .

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