

Satellite Tracking Rehabilitated Raptors to Determine Survivability and Efficacy of Rehabilitation Techniques

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Abstract:

Post release survival rates of rehabilitated raptors in Australia have not been evaluated before and as such, the efficacy of rehabilitation techniques is unknown. To address this gap, ARCC Inc has initiated an ongoing study using satellite tracking to evaluate survival rates of rehabilitated raptors post release with the aim of determining if specialised rehabilitation techniques allow the birds to develop a level of fitness that is required for survival in the wild. This study tracked the movements of seven booted eagles - Wedge-tailed Eagles and White-bellied Sea-eagles – that were rehabilitated by Peggy McDonald from 2016-2018 at the Higher Ground Raptor Centre using the Peter Spitzer Free Flight aviary. Considering many raptor species are threatened, it is biologically significant that these birds can survive and return to a breeding population. It was estimated that a minimum of 4 weeks survival post release would suggest that a rehabilitated booted eagle was fit enough to find food and thrive in the wild. The birds were fitted with tail mounted Argos transmitters under anaesthetic at the Southern Highlands Veterinary Centre and six out of the seven birds were tracked for a minimum of four weeks. The results of these data will provide invaluable information regarding the efficacy of specialised rehabilitation techniques that will be collated and eventually provided to carers in Australia to ensure that post-release survival rates of rehabilitated raptors are optimised.

Keywords: *Satellite Tracking, Raptor, Wedge-tailed Eagle, White-bellied Sea-eagle, Rehabilitation, Argos, Higher Ground Raptor Centre, Australian Raptor Care and Conservation Inc, ARCC Inc*

Introduction:

Rehabilitation of raptors is a very specialised field, due to the delicate nature of the patient and the requirement of unique equipment, skills, facilities and resources.¹ Many wild raptors are rehabilitated and released, however post-release survival rates are not evaluated and as such, the efficacy of rehabilitation techniques is unknown. To address this, Australian Raptor Care and Conservation Inc. (ARCC Inc.) has begun an ongoing study using satellite tracking to determine survival rates of rehabilitated raptors post- release.

A comparable study has never been performed in Australia, the closest being a study by Holtz et al (2006) performed in Victoria, which compared two fitness programs used in the rehabilitation of Brown Goshawks and Peregrine Falcons, with pre-release fitness used as an indicator of survivability in the wild. In this study, the birds were exercised using falconry

techniques or by stimulating flight within the aviary, however both methods have their downfalls, including stress and mal-imprinting.²

The use of falconry techniques has been prohibited in New South Wales (NSW) since 1991 according to the New South Wales Parks and Wildlife Services' (NPWS) guidelines for the rehabilitation of raptors and as such, carers in NSW rely on alternative methods to develop pre-release fitness in raptors they are rehabilitating.¹

Raptors being rehabilitated in NSW are placed in flight or holding aviaries prior to release, most of which are rectangular and according to the guidelines, are a minimum of 15 x 10m for large raptors or 5 x 3m for small raptors.³ These facilities allow the bird to fly lengths of the aviary only, which is short and does not replicate what the bird would be required to fly upon release and for survival in the wild. Additionally, the aviary size prevents the bird from practising basic aerial manoeuvres that are imperative for development and maintenance of fitness.⁴ It is likely that the pre-release exercise program a raptor undertakes will have a high impact on the ability of the bird to survive once released.² Considering that healthy, wild raptors may only catch prey once out of seven attempts, it is imperative that birds being rehabilitated are assessed to be at an adequate level of fitness prior to release to ensure they will be able to catch food.⁵ Therefore, the data accumulated in this study will determine the efficacy of specialised rehabilitation techniques which will be useful for raptor rehabilitators in Australia to optimise survival rates of birds they are rehabilitating.

The raptors used in this study are Wedge-tailed Eagles (WTE) and White-bellied Sea-eagles (WBSE) rehabilitated by Peggy McDonald at the Higher Ground Raptor Centre (HGRC), who uses rehabilitation techniques that are modelled on those used by world leaders in raptor medicine at the Abu Dhabi Falcon Hospital.⁶ All raptors used in this study undergo the final stage of their rehabilitation in the Peter Spitzer Free Flight rehabilitation aviary according to ethics approval from NPWS, to ensure that the birds can develop the highest standards of pre-release fitness currently available.

Using satellite tracking allows the locations of the birds to be followed for a minimum of 4 weeks, providing answers into whether rehabilitated raptors are fit enough to find their own food and thus survive in the wild after their time in captivity, as well as insights into where they would go. A study performed by García-Rodríguez, et al, found that common buzzards could tolerate thirteen days of complete food deprivation,⁷ whereas research in American kestrels determined that these birds are expected to die of starvation if complete food deprivation lasts for five days.⁸ Furthermore, data by Duke, Redig, and Jones suggest that a minimum of 6 weeks survival indicates a raptor's ability to find food.⁹ Taking into account this information, the authors estimated that Australian booted eagles would be determined as surviving with the ability to locate food after a minimum of 4-weeks.

1. Materials and methods

1.1 Aviary System

The Peter Spitzer Free Flight aviary located at the HGRC is based on aviary design used by the Abu Dhabi Falcon Hospital. Important aspects of the design of this aviary include its size and shape – circular in nature and containing a central, circular pavilion, it allows the birds to fly freely in circles without fixating on an endpoint that forces them to land. The aviary stands at a height of 8 m with an internal circumference of 100 m, with multiple roosting spots, feeding areas, baths and alcoves that allow for privacy from other birds in the aviary.^{4,10}

The HGRC's rehabilitation facility contains a series of enclosures that a raptor graduates through as its treatment progresses. This standard aviary system is used by all raptor rehabilitators and includes the following: an intensive care housing (warm and quiet with minimal disturbances and large enough to allow the housed bird to stand fully erect and maintain normal posture)¹¹; an intensive care aviary for birds that still require treatments but no longer need hospital cage housing¹¹; and a holding or flight aviary for raptors that no longer have serious injuries requiring intensive care.¹¹ Following graduation from this aviary system at the HGRC or a similar rehabilitation facility, a raptor is placed in the specialised Peter Spitzer Free Flight aviary to develop fitness at its own pace prior to its release. The birds are monitored without disturbance while in this aviary using a close circuit television (CCTV) system. Rehabilitated raptors must be observed performing various behaviours and manoeuvres within this aviary and undergo a pre-release veterinary health check before being deemed adequately fit for release.

1.2 Birds Tracked

Birds are selected for release after demonstrating an ability to take off and land appropriately, perform aerial manoeuvres, and fly distances considered reasonable for the species.⁴ For this study, booted eagle species – Wedge-tailed Eagles (*Aquila audax*) and White-bellied Sea-eagles (*Haliaeetus leucogaster*)¹² - were selected as their anatomy is more suitable for the size of current satellite trackers on the market.

WTE 009 was a recently fledged juvenile that was found unable to fly. A clinical exam performed at the Southern Highlands Veterinary Centre found weakness, emaciation and severe feather dysplasia. The bird was hospitalised at the HGRC and as its body condition improved it graduated through the aviary system until it was ready to be placed in the Peter Spitzer Free Flight Aviary where it resided for nine months. During this time, WTE009 went through two moults before developing normal plumage and regaining its ability to fly.

WTE 016 was a mature bird that had been caught in a dog trap and suffered bruising and lacerations to the right foot. Radiography showed a partially healed oblique fracture of the distal left femur with callus formation. The laceration was treated with antibiotics and allowed to heal. The fracture was slightly misaligned however orthopaedic specialist advice

determined it stable and healing was continued without intervention. The eagle was then allowed to recover its strength and flight fitness at the HGRC.

WBSE 001 was rescued in 2017 after being trapped in a chicken pen as a recent fledgling. It was weak and starving but hadn't suffered any injuries. After it had fully recovered and regained its strength and fitness, the young sea-eagle was released on the Central Coast.

WTE 024 presented as a juvenile, weighing 2.9 kg. It was found by the roadside and was assumed to have been hit by a vehicle. On arrival at the HGRC, the bird couldn't stand but was bright and responsive. Radiographs didn't show any abnormalities but the white cell count was highly elevated – the diagnosis was assumed spinal trauma. The bird was treated with Clavulox (Amoxicillin and Clavulanic acid) at 125 mg/kg PO for 10 days¹³. It was held in intensive care for a week and hand fed, received meloxicam at 0.5 mg/kg PO¹³ and hydrated before graduating into the central pavilion of the Peter Spitzer aviary. Pre-release CBC showed the white cell count was back to normal.

WTE 025 was a nestling that fell out of its nest following a severe weather event. The bird was severely malnourished and had a very low body condition score, so it was deemed unsuitable for return to its nest. No other abnormalities were found on physical examination and the bird went through a period of intensive care including hand feeding and rehydration, before graduating into the Peter Spitzer aviary.

WBSE 006 arrived at the HGRC in late 2017 but was with another carer for three weeks prior. Physical examination showed the bird to be in good body condition and to be bright and responsive. It was likely that the bird was a nestling that attempted to fledge too early, however it was impossible to return the bird to its nest because of its location. A nest was built in the Peter Spitzer aviary and it was fed by throwing food into the nest to prevent humanisation. The bird was soon flying circuits of the aviary and was released after reaching a normal dispersal age.

WBSE 007 was an adult White-bellied Sea-eagle weighing 2.26kg. The bird was known to frequent a local fish farm and ended up caught in a net. On physical examination the bird was found to have severe soft tissue damage under the left wing, which was slightly dropped. Scar tissue began to develop in the area while being held in ICU as the bird was unable to extend the wing. The bird was moved to the Peter Spitzer Free Flight aviary to allow the wing to stretch out and was released after demonstrating that it was able to fly and manoeuvre appropriately.

1.3 GPS Tracking System

The tracking system utilised in this study is Argos, a satellite-based data and location tracking system. Birds were tracked using Kiwisat 303 Argos transmitters (model K3H 154A, Sirtrack Ltd, Auckland New Zealand)¹⁴ and Pinpoint GPS Argos 120. Both platforms integrate a transmitter certified by Argos through which data is relayed to processing centres and interpreted by members of the ARCC Inc committee.¹⁵ Each platform has a unique identification number (outlined in Table 2) that is specific to its transmission settings, and

messages are periodically transmitted based on the transmission frequency, repetition period, platform identity and collected data. Locations of the platforms are then calculated based on all messages transmitted and received during a satellite pass by measuring the Doppler Effect on the transmission frequency. Because the Doppler Effect is used as the basis of measurement, the transmission frequency must be stable for the location of the platform to be computed.¹⁵ When the frequency received by the satellite is equal to the frequency transmitted by the Argos platform, the satellite is directly above the platform. Two possible positions of the transmitter are calculated by Doppler location and Argos determines one as being the most plausible which is then verified by whoever is analysing the data.^{9,15}

Tracker Number	Model	Weight	Bird ID
159784	Kiwisat 303 Argos	35g	WTE 009
159785	Kiwisat 303 Argos	35g	WTE 016
159786	Kiwisat 303 Argos	35g	WTE 024
159787	Kiwisat 303 Argos	35g	WTE 025
159788	PinPoint GPS Argos 120	7.5gm	WBSE 001
159789	PinPoint GPS Argos 120	7.5gm	WBSE 006
159790	PinPoint GPS Argos 120	7.5gm	WBSE 007

Table 2: Platforms used

Messages received by the satellite are transferred to a ground receiving station which is then sent to a processing centre. Results are stored and made available to Argos users within 4 hours of the data being received.¹⁵

Trackers used were battery powered as the objective of this study was to track the birds for a relatively brief period to determine their survival following time in captivity. Solar powered trackers can remain functional for years, but transmissions can be irregular as they are dependent on sunlight to recharge⁹. It was determined that daily transmissions for a minimum of one month would be most suitable for answering questions posed by this study, hence battery powered trackers were selected. The trackers are programmed to transmit at certain times, and it should be noted that the more frequently transmission occurs, the faster the battery is depleted. Kiwisat 303 Argos transmitters 159784 (WTE 009) and 159785 (WTE 016) were programmed to transmit every 90 seconds over three hours every evening, starting at 18:00. The Kiwisat 303 Argos transmitters fixed to WTE 024 and 025 were set to transmit 3 times a day in the morning, at midday and mid-afternoon. PinPoint GPS Argos 120 attached to WBSE 006 and 007 were programmed to transmit twice a day at 03:00 and 10:00 and lastly, the PinPoint GPS Argos 120 transmitter attached to WBSE 001 was programmed to transmit at 10:00 and 22:00.

Transmitters are attached under anaesthetic to the dorsocranial surface of the rachis of the two first rectrices (tail feathers). Tail mounted Argos Satellite trackers were selected for this study as they do not constrict the birds in any way, there are less chance of abrasions as there is no harness around the bird that can rub, they are light and are dropped when the feathers

moult - considering these are previously compromised birds, it is imperative that the trackers used do not impede the birds in any way.

2. Results

Bird ID	Date Released	Final Tracking Date	Total Days Tracked
WTE 009	18/09/2016	18/11/2016	61 days
WTE 016	18/09/2016	16/11/2016	60 days
WTE 024	2/02/2018	6/03/2018	39 days
WTE 025	12/01/2018	18/02/2018	37 days
WBSE 001	30/03/2017	29/04/2017	30 days
WBSE 006	22/1/2018	16/2/2018	25 days
WBSE 007	6/02/2018	Still transmitting	-

Table 3: Tracking results

Table 3 outlines the total number of days each bird was tracked for. It is important to note that each transmission received for each bird was from a different location, implying movement and therefore survival of the subject and for the sake of keeping the results concise, each transmission will not be outlined. It should also be noted that on some days, transmissions from the platforms were received but not at a frequency of high enough quality to determine the location, so a location data point might not have been received for every day the bird was tracked.

WTE 009 and 016 were soft released on site at the HGRC - transmissions were received for 61 days for WTE 009 and 59 days for WTE 016. WTE 016's tracker was found 36 days after transmissions had ceased, attached to a moulted feather beside a kangaroo carcass, 106km North-West of the release site. WTE016 initially stayed within the radius of its release near Moss Vale, then started making longer flights over the Southern Highlands and further inland (figure 1). WTE 009 stayed in the general vicinity of the point of release around Fitzroy Falls (figure 2).

WTE 024 was released in South Marulan, near where the bird was first found – most fixes were within an approximately 25 km radius around the site of release (figure 3), however from the 23rd of February, no fixes were of a high enough quality to get an exact location of the bird. It was tracked for a total of 39 days and is still regularly spotted in South Marulan with two adult birds, presumably its parents.

WTE 025 was released on site at the Higher Ground Raptor Centre and tracked until the 18/02/2018 for a total of 37 days, however the last location fix was received on the 4/2/2018. This bird also initially stayed around the release site but soon most fixes received were in an area between the towns of Crookwell and Oberon, approximately 80 km from the site of release (figure 4).

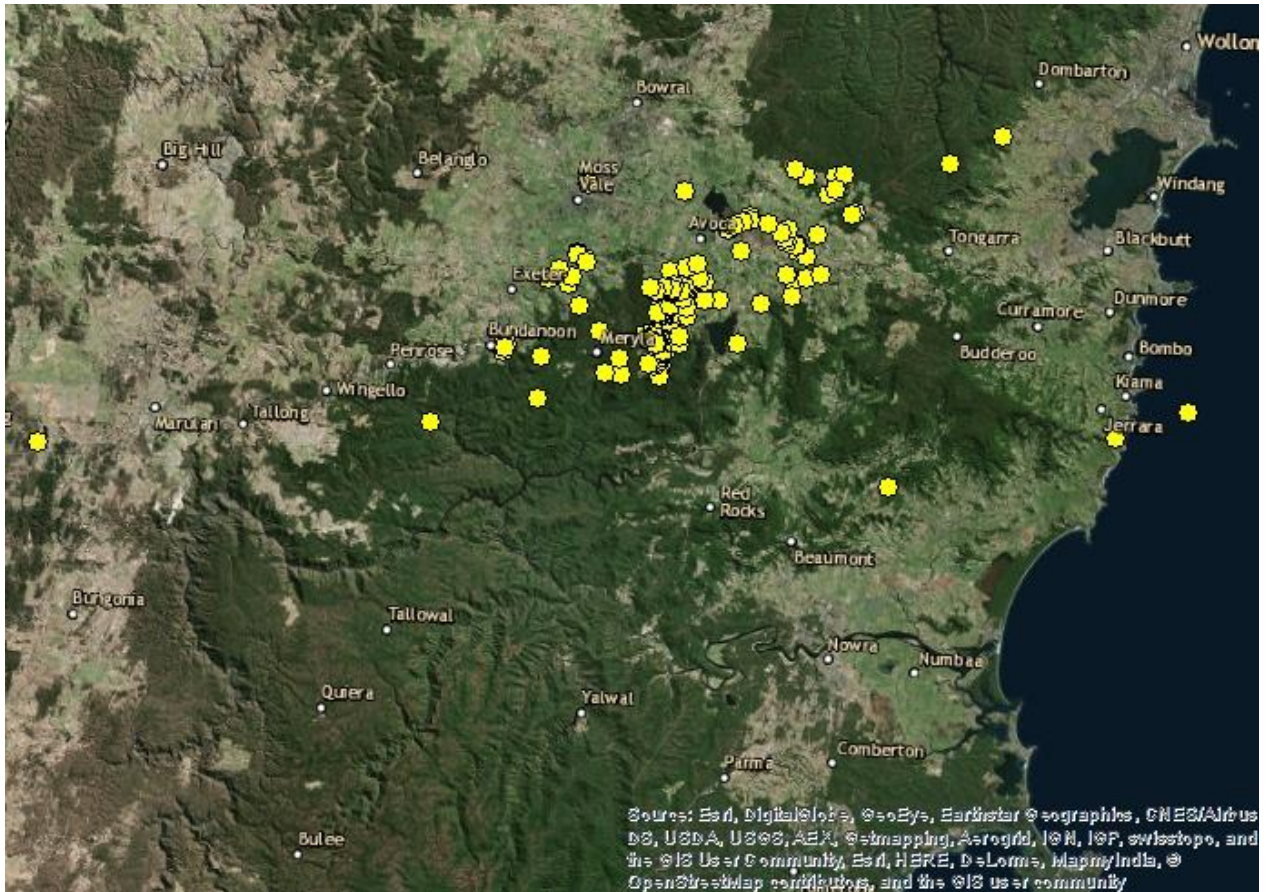


Figure 1: WTE 016 location data points¹⁶

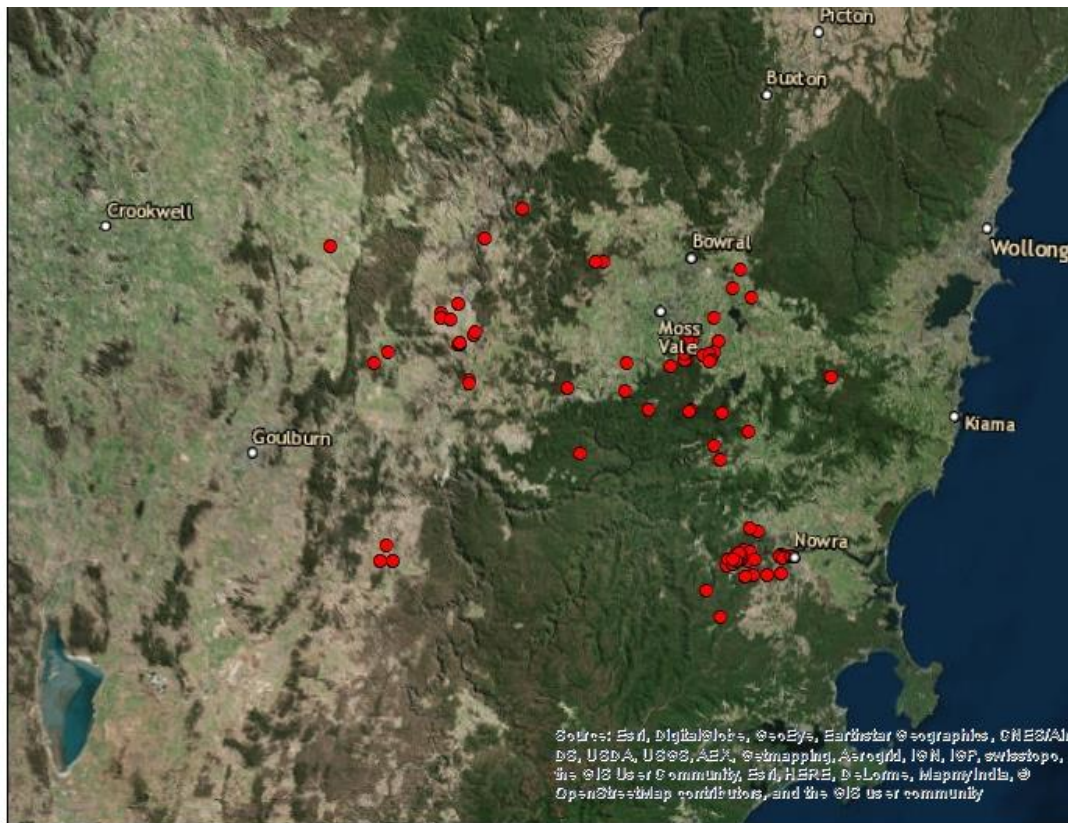


Figure 2: WTE 009 location data points¹⁶

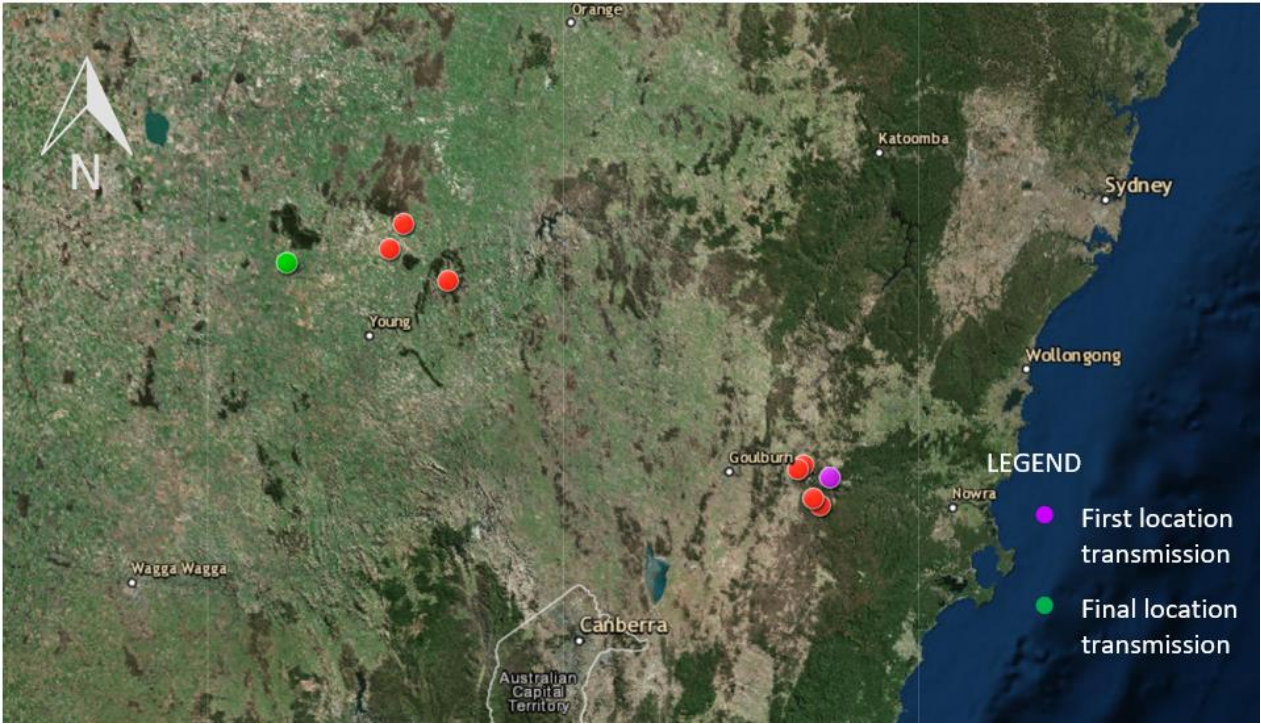


Figure 3: WTE 024 data points

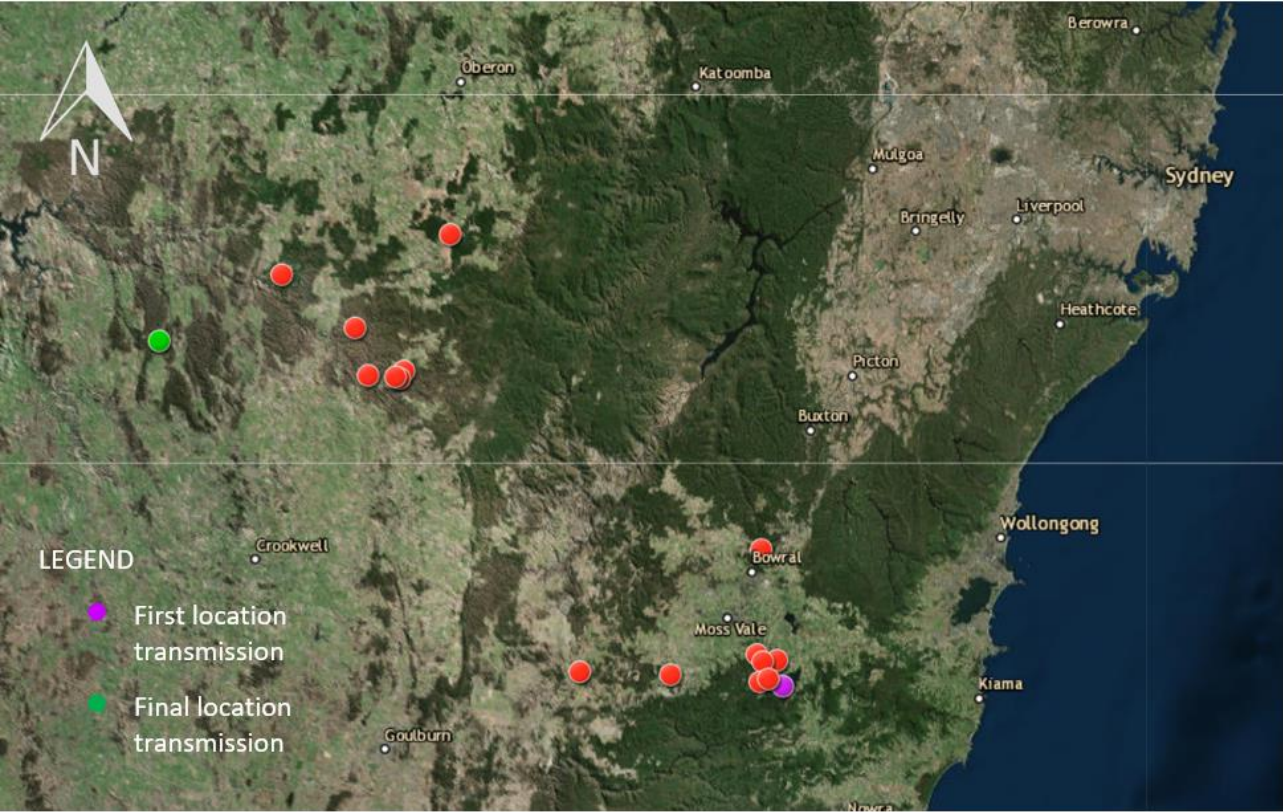


Figure 4: WTE 025 location data points

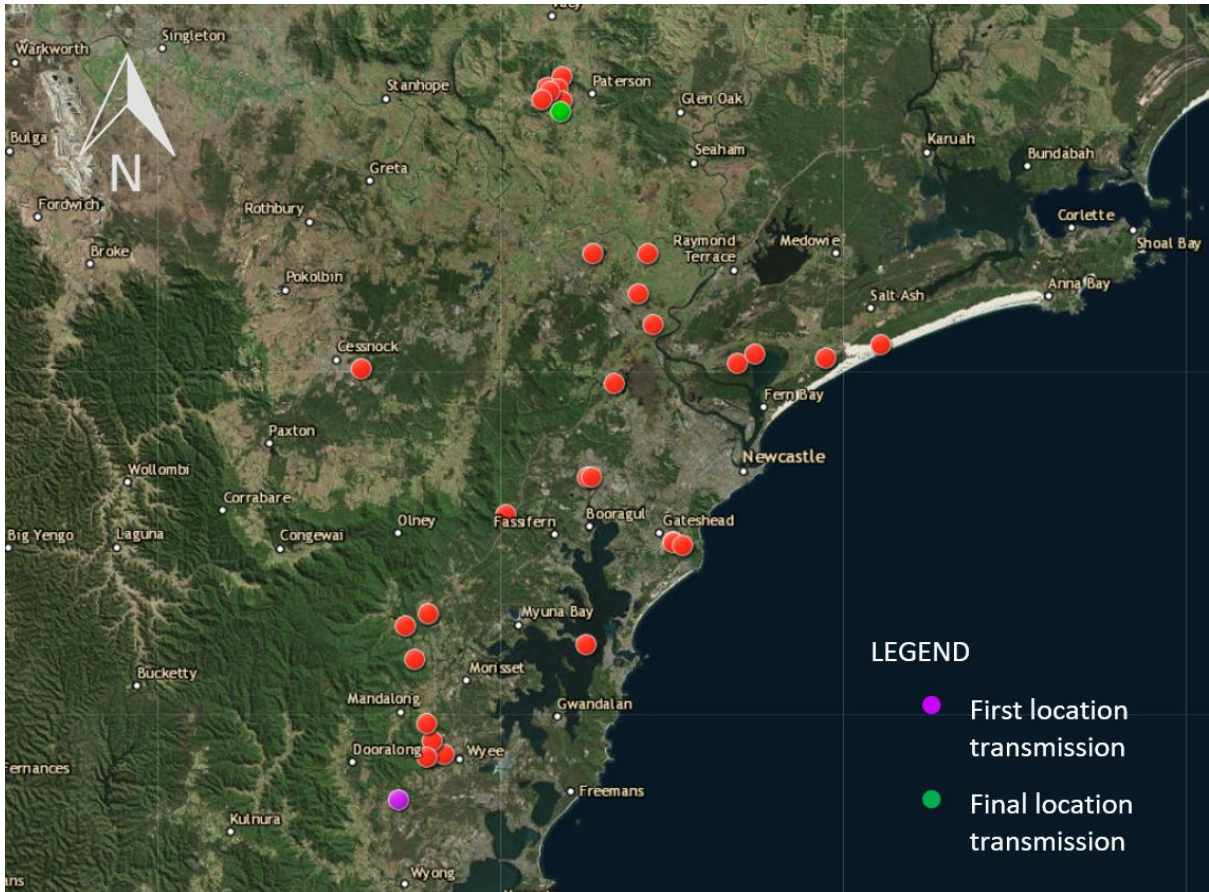
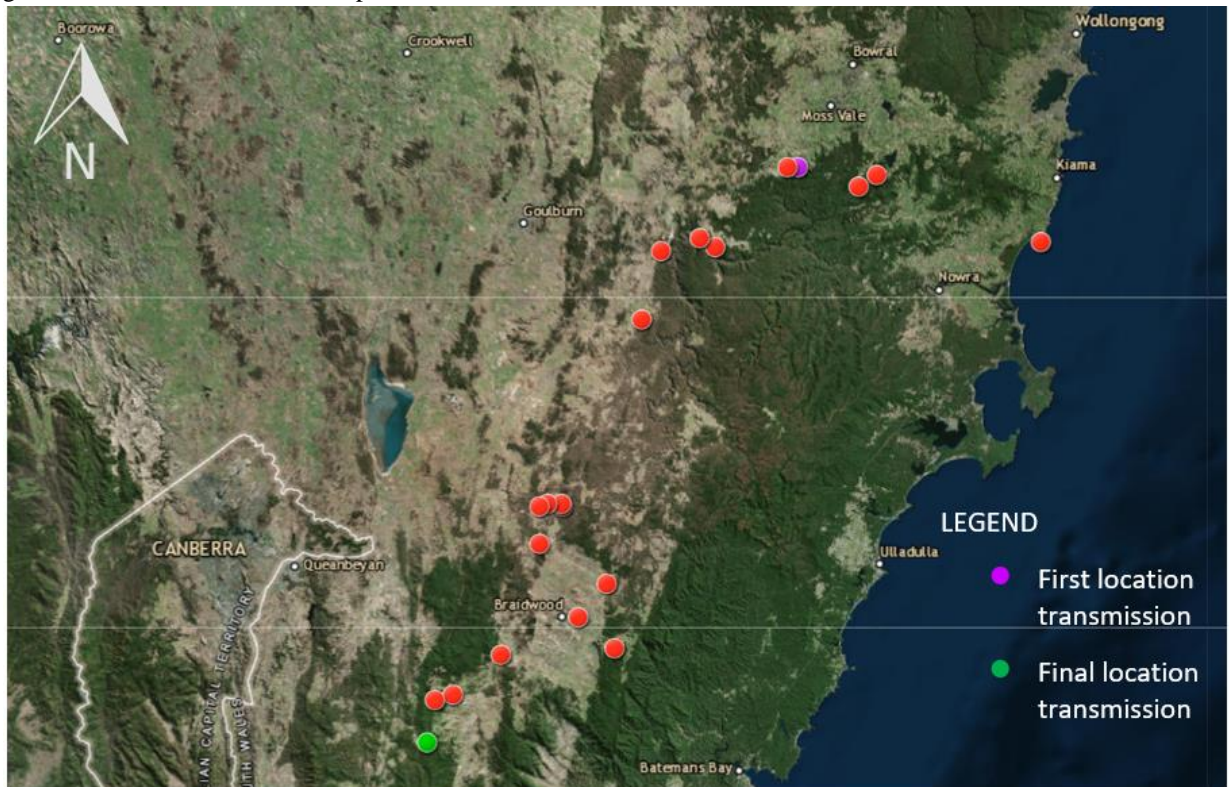


Figure 5: WBSE 001 location data points

Figure 6: WBSE 006 location data points



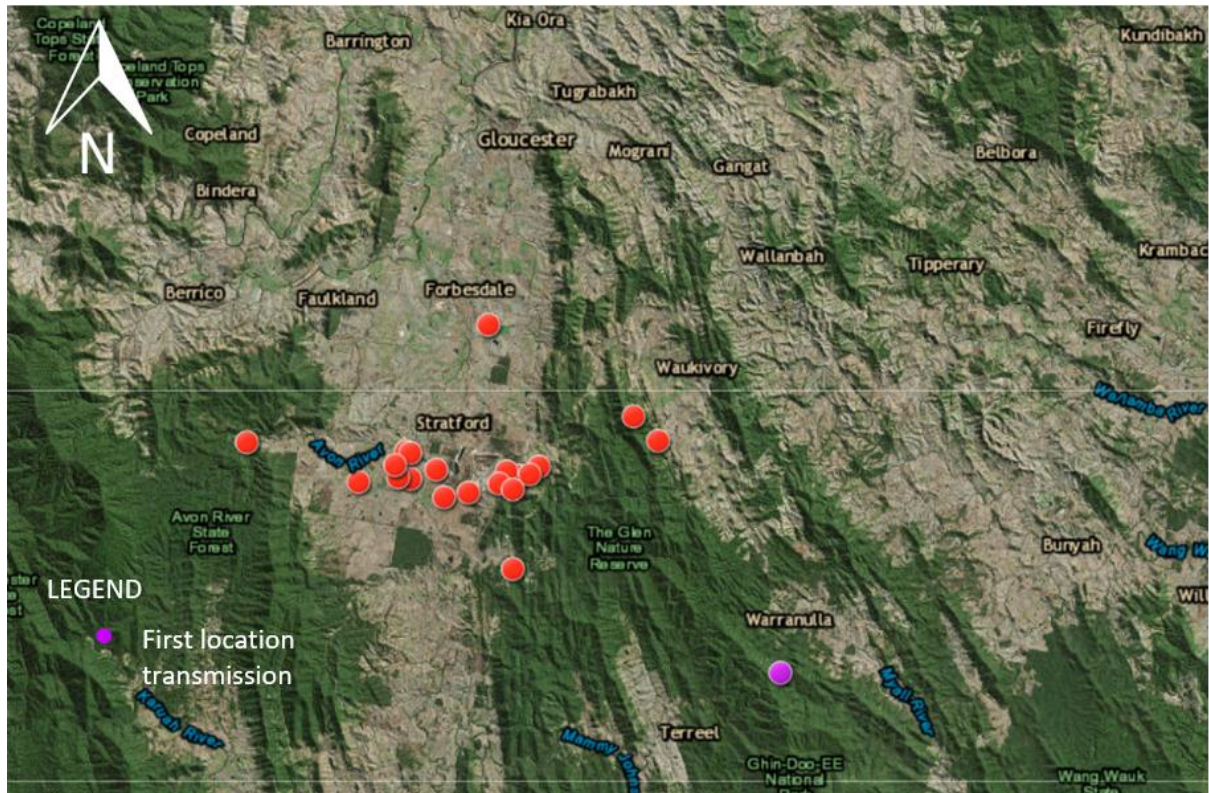


Figure 7: WBSE 007 location data points

3. Discussion

The results of this study show that the use of the Peter Spitzer Free Flight aviary in the rehabilitation of Wedge-tailed Eagles and White-bellied Sea-eagles is effective in developing a level of fitness in raptors required for survival post release. Tracking did not last for as long as expected, with the average life span of the Kiwisat 303 Argos being 124 days and the PinPoint GPS Argos 120 being approximately 360 days for simple programs under ideal conditions. Considering that transmissions ceased as opposed to receiving regular transmissions from a bird from the same location, it is likely that transmissions were stopped not because the eagle being tracked had perished, but rather because the trackers had ceased to function while the birds remain alive.¹⁷ It is suspected that battery failure was the cause of transmissions ceasing prematurely, as the Kiwisat 303 Argos platforms were a non-rechargeable model. Another possible cause for premature ceasing of transmissions is damage to the antennae, as seen in the Kiwisat 303 Argos (ID 159785) attached to WTE 016. It is also possible for transmissions to cease prematurely for no identified reason – it is generally impossible to determine the exact cause, particularly if the transmitter is never recovered.¹⁷ A manufacturing error meant that data for WBSE 006 was not received by ARCC Inc in real time, so results had to be followed up after tracking had ceased.

Despite this, the data acquired demonstrates an ability of released birds to survive in the wild and travel great distances as depicted in the above maps, implying that rehabilitation techniques utilised by the Higher Ground Raptor Centre set the birds up with a prominent level of fitness that is required for life in the wild.

4. Conclusions

With six out of seven birds having been tracked for a minimum of four weeks, it is confirmed that the birds were released following rehabilitation with a level of fitness that is adequate for survival. This report is preliminary in that the permit acquired to perform this study allows the tracking of ten birds in total which will be undertaken in the future, results of which will be cumulated with current data. Further funding is required to complete this project, so please contact ARCC Inc if you are interested in supporting this important research!

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