

Secrets revealed: What we've learnt from EagleCAM

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EagleCAM live-streams the secret lives of a pair of White-bellied Sea-Eagles as they nest and raise their young each year. Over the twelve years that the program has been running, much has been learnt about the breeding behaviour of these magnificent birds – how they build their nest, how they incubate their eggs and raise their chicks, and how the chicks develop from hatching to fledging. The study has found that the eagle pair both contribute to nest preparation, incubation and care of the young and has indicated delayed incubation after the laying of the first egg. The program is run by BirdLife Australia Southern NSW, and has also proven to be a highly successful engagement and education tool. There have been over 5 million views by people from 194 different countries since streaming began, and research information generated by the program feeds into school and community education packages.

Introduction

The White-bellied Sea-Eagle *Haliaeetus leucogaster* is a fairly common sight along the coasts and inland rivers of Australia, as well as further afield. Along the Parramatta River of Sydney however, there is only one known pair. This pair is often seen during the day on their prominent mangrove perch, loafing or feeding on a mullet or other fish from the wetlands. They may also be seen soaring overhead on up-swept wings.

At the beginning of this project, little was known about the complete breeding cycle of Sea-Eagles from nest building to fledging. A huge nest of large sticks is commonly placed in a high tree and the nest may be used for many years in succession. Sea-Eagles are however easily disturbed at their nest sites, which are now few and far between in the Sydney area. The combination of a reduction in nesting success and the number of active nests, and increased mortality, indicates this species is declining. The Sea-Eagle is listed in NSW as 'vulnerable' under the *Biodiversity Conservation Act 2016*.

There has been a Sea-Eagle nest in Newington Nature Reserve for many years, with a succession of eagle pairs renovating a nest in the breeding season each year. The Reserve contains the critically endangered Sydney Turpentine-Ironbark Forest community, and has highly restricted access to both people and service vehicles. The only probable predators at the nest would be other large raptors.

There were few records of successful breeding in the local area however (successful fledging of one chick in 2003 is the only confirmed record of breeding prior to 2008) and in the past several adult eagles were found dead in and around the Homebush Bay area, possibly due to acute poisoning. Autopsy also



revealed bioaccumulation of organochlorides, which has been linked to reproductive failures. Life is hard in the city and several other factors may have contributed to their breeding failure over the years. Further study of breeding outcomes was recommended and led to initiation of the EagleCAM project.

Following the failed breeding of Sea-Eagles in 2004, regular observations of the eagles began in 2008 by observers stationed in a hide near the nest, and in the adjacent areas of the forest and riverside.

EagleCAM was established in 2009 to more comprehensively monitor the eagles throughout the entirety of the breeding season, whilst minimising impacts of human disturbance. EagleCAM is a live remote feed operating out of the BirdLife Discovery Centre in Newington Armory at Sydney Olympic Park. EagleCAM was started and funded by a small group of BirdLife Australia volunteers, who continue to develop and operate the technology that brings the Sea-Eagles to the screen. Each year their nest has been monitored and valuable observations made.

BirdLife Australia is a national organisation whose primary objectives are the conservation, understanding and appreciation of our native birds and their habitats. EagleCAM has proved to be one of BirdLife Australia's most celebrated awareness-raising tools, for visitors to the BirdLife Discovery Centre at Sydney Olympic Park, for on-line viewers, and in developing education programs.

EagleCAM now has three CCTV cameras installed on branches near the current nest and at a nearby roost, with remote zoom lens and focus. Infra-red provides vision at night. All power comes from the Discovery Centre and video is fed back via a cable link. This video data is recorded onto digital media and is available for detailed study. A live feed is displayed to visiting members of the public at the Discovery Centre and via YouTube live stream.

EagleCAM is operated under a BirdLife Australia Research Agreement, working in partnership with the NSW National Parks & Wildlife Service and Sydney Olympic Park Authority. Our objective is to observe and learn about White-bellied Sea-Eagle biology without interfering in their behaviour or the processes that they undergo in the natural environment. These are wild birds and it is our privilege to observe their breeding behaviour. Our Policy is for non-intervention, unless in an extreme situation.

What have we learned about the secret lives of these magnificent raptors?

Reproductive success 2008-2019

A Sea-Eagle pair has nested in the forest of Newington Nature Reserve every year since 2008 with an average of just below one young fledged per breeding attempt. Two eggs have been laid each year. Compared to other studies conducted over several years they still maintain a normal "success" rate. Records are presented at Appendix 1. Between 2008 and 2019:

- A total of 22 eggs have been laid, 18 of these have hatched successfully
- 10 young have fledged – "fledged" is defined as young that flew from the nest and eventually left the area

- The total mortality on the nest over this period is 10 ("mortality" is defined as eggs that failed to hatch or young that died in the nest). This gives a nest mortality rate of 45% (Appendix 1).

Pair Bonds

The eagles are monogamous, faithful to their partner, until something happens to one of the pair. Juveniles or unattached birds or floaters may then move in, searching for a mate or territory. When the original female "Mum" disappeared in 2016, a young female, "Lady" moved into her place within just seven weeks.



Duetting on the nest or nearby strengthens the pair bond and often stimulates mating. This continues before and during the nest renovation period and even after.

Nest building

Both adults share nest building, bringing sticks to the nest, and green leaves to line the nest bowl. Each year, nest renovation begins around March, with the eagles building up the rails of the nest, creating a bowl again, to cup the coming eggs. As the breeding season progresses, the nest is built up, until before the nestlings fledge it is almost a platform. At the beginning of each season, the nest rails are built up again until the nest is massive. The current nest is about 20m above ground. The male brings most food during the nest-building and incubation periods.



Nest building (top) and the view of the nest from the ground (bottom)

Incubation

The incubation period is around 40 days with the second chick usually hatching in a shorter time, after delayed incubation of the first egg. This gives the second hatchling a chance to “catch up”.

Our study indicates that both parents incubate though usually only the female incubates at night.

Over all these years of observations, (though initially there was no night time footage), there seems to be a definite trend for delayed incubation between the first egg laid and the second. The time between laying of the two eggs varied from 3 to 4 days when we were able to observe the lay.

Detailed observations of delayed incubation were made in 2019 (Box 1).



Infra-red cameras enable nocturnal observation

Box 1: Observations of delayed incubation 2019



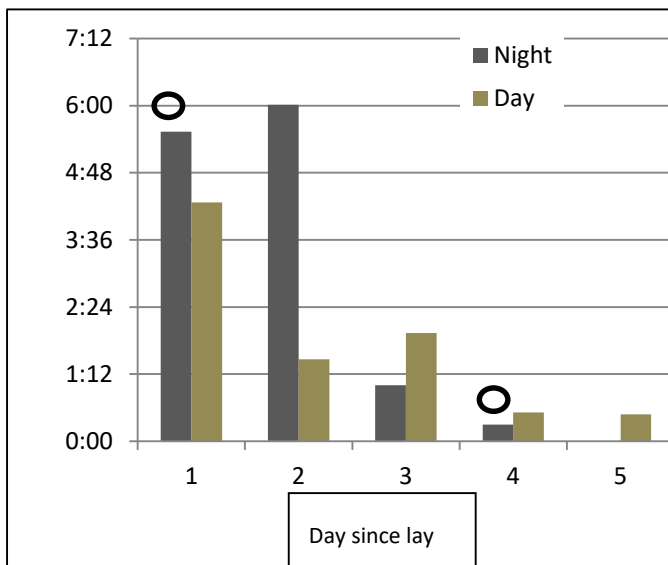
In the 2019 nesting season, two eggs were laid some 73 hours apart:

- Egg 1 SE23 was laid at 17:37 on June 16.
- Egg 2 SE24 was laid at 18:43, on June 19.

The first night after egg 1 was laid, when the weather was cold (dropping to 5 degrees overnight), the female incubated for only 5 hours, leaving the egg uncovered for 5.5 hours. As usually it is the female incubating at night, it was unusual to see that the male incubated for over 2 hours after 3:00am, possibly due to disturbance nearby.

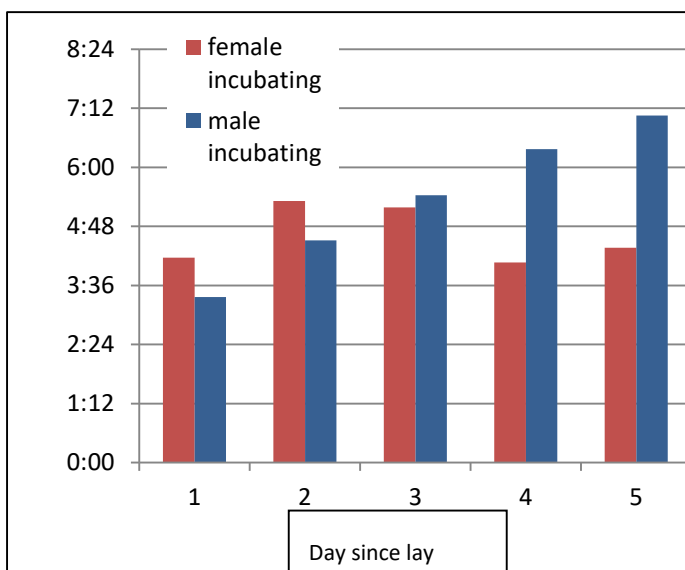
The next day, both adults shared daytime egg duty, with the egg uncovered for over 4 hours. On the second night the female again left the egg uncovered, for nearly 6 hours, despite the cold weather. Daytime incubation and care at the nest was again shared by both adults. As lay of the second egg approached, incubation time increased until the second egg was laid. Full incubation then continued, with the female on at night, assisted by the male during the day.

Graph 1 Number of hours the first egg was uncovered during Incubation before laying of egg 2



Egg 1 was uncovered nearly 13 hours total at night and nearly 9 hours by day before egg 2 was laid

Graph 2 Comparison of daytime Incubation by male and female between egg 1 and egg 2



During the day, both adults incubated, with the female a total of 23 hours and the male nearly 27 hours

Nestling Development

Sea-Eagles are devoted and caring parents, with both bringing food and feeding the young, though initially the male brings most food. Both brood the chicks during the day, with the female mainly at night. As the nestlings grow and develop strength, they learn to grab food and eventually feed themselves on the nest, with food the adults bring. After fledging, the adults continue to bring food to the young birds, though observations are harder when no longer visible on the nest cameras. This project has observed little information on their behaviour once the fledged youngsters



leave their natal area and disperse, or how they learn their hunting technique. One juvenile SE21 was identified, after dispersing, in Broken Bay. Though unfortunately not banded, her injured wing feathers allowed identification. Nestling development week-by-week is shown at Appendix 2.

As the nestlings grow, they lose their initial fluff, develop feathers and strengthen their legs and wings as they grow. Initially they are fed bill to bill by the adults, until they gradually grab food from the parents, or one another, learning to tear apart their prey. When older, they rush to grab prey from the parent making the delivery.

As they grow, the nestlings practice on the nest, jumping up and down, flapping their wings, and gradually getting enough courage to “branch” – flapping from the nest to reach a nearby branch – then back to safety. Finally, with enough strength to fledge, they take the first flight away from the nest.

Nest defence

Both adults have been observed to defend their territory against other raptors. In 2017, the newly hatched chick perished and the second egg failed to hatch when the parents left their brooding duties to defend their territory against an intruding female Sea-Eagle. Other large birds, like Australian Ravens, Magpies and Currawongs, may follow the eagles to the nest and even swoop the young. A newly fledged eagle fell to the ground last year and was threatened by a fox. The eaglet defended itself against the fox, with outstretched wings and defensive behaviour, until the fox was frightened off by a volunteer and staff. The adults were not seen to intervene at all in defending against the fox.

Sibling Rivalry

Raptors may exhibit "siblicide," in which the larger chick kills its smaller sibling. We have not observed this in our study. We have observed some sibling rivalry – mainly competition for food. Although usually there has been delayed incubation, allowing some “catch up” between the two chicks, there has been some initial competition. The bigger, first-laid chick initially always receives the first feed and may peck at its sibling often, causing it to retreat in submission. This competition has been seen early after hatching, and gradually lessens as both chicks grow. The parents do not intervene in this competition, and feed the closest begging chick.

In three seasons (2010, 2012 and 2019), two chicks hatched and both survived to fledging, despite this competition.

In 2018, the death of the smaller nestling was caused by sibling rivalry. For an unknown reason, possibly injury, the male brought no food for some days. While food was scarce, the older stronger nestling monopolised the food, causing the starvation of its sibling. The bigger chick did not actually kill its sibling, though it pecked it aggressively and pulled out feathers, leading to its submissive behaviour.

Prey

The eagles bring a wide variety of prey to the nest (Appendix 3). Most common are fish – of many species, including mullet, whiting, bream, leatherjacket, flounder, carp and eels; birds, most commonly Silver Gulls; and carrion. Their prey may cause injury, as from fish hooks, or illness from contamination or disease carried by their avian prey. Rock Doves, or feral pigeons, are of particular concern with respect to diseases. Prey, particularly fish, may be contaminated by Persistent Organic Pesticides, a legacy of past industrial use in Homebush Bay.



The bigger nestling is being fed as the weaker chick covers in submission and received no food for several days (top and centre)

The female removing the body of the smaller nestling, which has died from lack of food (bottom)

Conditions observed to cause nest failure or risk to chicks

Close monitoring of the nest over the twelve years of the project has generated substantial knowledge of the risks to survival faced by each new generation of birds in this urbanised environment. Our observations have included:

- Possible poisoning of young chick caused by being fed a pigeon affected by the poison 'Scatterbird' – Amino Pyridine

- Extreme weather affecting a possibly already weaker chick
- Entanglement of the nestlings in fishing line with hook, brought to the nest by a parent bird in fish prey
- Trichomoniasis or Frounce– caused by a Protozoan parasite usually carried by pigeon prey, causing lesions to grow, and leading to the death of the affected bird
- Circovirus or Beak and Feather Disease. In 2015, the eaglet SE15 was seen to have deformed feathers and failed to fledge. It was diagnosed with Beak and Feather disease. His condition worsened and euthanasia was deemed necessary. This information may contribute towards the understanding of how this virus affects raptors
- Though there are foxes in the area, the nest is high in the tree and inaccessible to foxes, cats or dogs. However, in 2019 a fox threatened the newly fledged SE24, which had fallen to the ground
- Accidental fall – SE 21 landed clumsily and fell, becoming trapped by a wing in a branch. She was taken into care and after rehabilitation, released in her natal territory
- An eagle intruder at the nest, causing the nesting pair to abandon their nestling and unhatched egg
- Starvation caused by sibling rivalry, when food was scarce and there was insufficient food for both nestlings
- Unexplained failure to thrive after fledging, with the fledgling SE23 apparently not fed by the adults
- Infertile eggs or undeveloped embryo



2012 intervention, when nestlings were tangled in fishing line and SE9 had swallowed a fish hook. Both survived to fledge and left the area.



SE15 showing damaged feathers, affected by Circovirus

Community Interest and Engagement

This on-going project contributes to knowledge about the ecology and life history of the White-bellied Sea-Eagle and contributes to better management of its habitat. EagleCAM also educates the public about the Sea-Eagle and promotes the conservation and protection of the species.

EagleCAM has proved a valuable tool promoting the conservation work of BirdLife Australia and Sydney Olympic Park Authority to both local and International audiences. Many visitors to the BirdLife Discovery Centre have marvelled at the eagles and millions have watched their progress on the EagleCAM website. There have been many positive media reports over the

years. BirdLife volunteers have developed education programs for school students using this footage including for activities during Science Week and the Youth Eco Summit held at Sydney Olympic Park, and have presented papers about the program at regional and national ornithological conferences.

EagleCAM–Public–Engagement–Snapshot 2020

- Facebook, Sea-EagleCAM (official FB page) 9,700 Likes, with 21,637 people reached per month as of March 2020
- Facebook, Sydney Sea Eagles Cam, (Group): 2,438 members
- Sea-EagleCAM Web page, has had: 1,603,276 total visits
- Sea-EagleCAM Web page: 194 countries have visited the web page with ~ 50% of the visitors from the USA.
- 'Ustream' Live streaming views: 4,690,745 (this service finished 19 July 2018)
- Youtube Live streaming, started in July 2018, and has had about 77,500 watched hours

There are about 200,000 views per year and at peak time the daily views to the Live Stream is up to about 16,500.

The viewers are about 70% female in the age group of 45+, most being in 50 to 60 range.

The origins of the viewers are Sea-EagleCAM.org = 67%, Facebook = 12%, and Birdlife = 2.5%.

Acknowledgements

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We acknowledge the essential assistance from the current EagleCAM team – Judy Harrington, Geoff Hutchinson, Bob Oomen and Chris Bruce, for camera installation and maintenance and Shirley McGregor for managing the daily operations. Special thanks to Dasha, Marsha and Pat, for monitoring nesting observations and Dasha and Helen for camera operations. Additionally, we also have a wonderful team of volunteers including Facebook admins, chat moderators, ground observers and more (too many to mention here). Above all, thank you to our Supporters, for funding this project.

Visit EagleCAM at:

<https://www.birdlife.org.au/visit-us/discovery-centre/eagle-cam>

or

















<https://www.sea-eaglecam.org/video.html>

APPENDIX 1

EagleCAM nest records

		Delayed Incubation	Time between eggs laid	Time between hatching	Eggs hatched	Mortality on nest	Success? Fledged and left
2008 Nest 1 in historic site. Male died, replaced by current male "Dad" with female "Mum"	SE1 fledged, but died in care SE2 died on nest				2	1	
2009 Nest 1 in historic nest site	SE3 fledged SE4 died on nest				2	1	1
2010 Nest 1 in historic nest site	SE5 & SE6 both fledged	YES			2		2
2011 Old nest collapsed New nest in same tree	SE7 died on nest, possible poisoning from Scatterbird SE8 fledged	YES	72 hours	28 hours	2	1	1
2012 Nest 2 - new nest in another tree (Blackbutt)	SE9 & SE10 both fledged after intervention to remove fishing line		Un-known	48 hours est.	2		2
2013 Nest 2 in Blackbutt	SE11, SE12 - neither egg hatched		72.5 hours	NA	0	2	0
2014 Nest 2 Began Nest 3 in <i>E. fibrosa</i> . After possible disturbance returned to Nest 2 in Blackbutt	SE13 died at 30 days from Trichomoniasis SE14 failed to hatch		77.5 hours	NA	1	2	0
2015 Nest 3 in <i>E. fibrosa</i>	SE15 was diagnosed with Beak and Feather Disease and euthanased SE16 fledged	YES	78 hours	14.5 hours	2		1
2016 Original female "Mum" disappeared. Female 2 "Lady" Nest 3	SE17 fledged SE18 died on the nest at 10 days, possibly from a combination of sibling rivalry, poor weather	YES	77 hours	36.5 hours	2	1	1
2017 Female 2 "Lady" Nest 3	SE19 died on the nest at 3 days from cold and no food SE20 failed to hatch Intruder disturbed breeding	YES	81 hours	NA	1	2	0
2018 Female 2 "Lady" Nest 3	SE21 fledged, was injured, in care, then left the area SE22 died on the nest at 33 days - sibling rivalry	YES	73 hours	37 hours	2	1	1
2019 Female 2 "Lady" Nest 3	SE23 fledged but died at 103 days, failed to thrive SE24 fledged and left the area	YES	73 hours	33 hours	2		1

APPENDIX 2 - Summary of development from Hatch to Fledge week by week

 Hatch	 Week 01	 Week 02	 Week 03
 Week 04	 Week 05	 Week 06	 Week 07
 Week 08	 Week 09	 Week 10	 Week 11
 Week 12	 Week 13	 Week 14	 Week 15



SE 21 branched at 11 weeks, fledged at 12 weeks

APPENDIX 3 Recorded prey species

