Kākāpō Recovery science update

AUGUST 2014

Breeding season 2014

MAST

A mast is when a tree species flowers heavily and produces a mass of seeds or fruit. They usually only occur every 2–5 years.

Codfish Island/Whenua Hou – The marginal rimu fruit mast was reduced from 14% to 8% by November 2013 resulting in seven nests; half the number predicted. Nesting females were most likely to be those that had a few rimu with higher than average fruit crops in their home range.

Fallen ripe rimu fruit. Photo: Don Merton

Te Hauturu-o-Toi/Little Barrier Island – The monitored kauri and beech did not mast. However, one female bred and was found to be feeding on tawa during incubation and green kahikatea fruit once her chick hatched.

BOOMING

Booming is the call of the male kākāpō during the breeding season, used to attract females to the breeding grounds.

Whenua Hou had a short booming season that ended 2–3 weeks early in mid February. It is uncertain if this was to do with the low rimu mast or starting supplementary food for males in November (only 4–6 weeks prior to the beginning of booming), or a combination of both.

Three of the six 5-year old males boomed for varying times, but they were generally later in the season and inconsistent. However, all 5- and 3-year old males spent a lot of time closely observing adult booming males.

On Te Hauturu-o-Toi, booming was not closely monitored, but three males are known to have been booming.

MATING

On Whenua Hou, mating predictions from spring air temperature gave accurate indications of breeding timing.

On Whenua Hou seven females mated 13 times with five males; while on Te Hauturu-o-Toi one female mated 3 times with one male.

During capture of two females on Whenua Hou for artificial insemination, post mating and prior to nesting, it was observed that their brood patch was already developed. A brood patch is a bare patch on the female's chest that allows her body heat to transmit to the egg during incubation. It seems highly likely that the loss of down during mating is when the brood patch is formed, as the female is vigorously pressed to the ground.

Huhana, a 5-year old hand-reared female, is the youngest known kākāpō to begin nesting. She mated three times with two males, laid two fertile eggs and successfully fledged a chick. She is the fourth hand-reared female to nest; three of whom have successfully fledged chicks.

Kākāpō RECOVERY

Department of Conservation
Te Papa Atawhai

NZAS New Zealand Aluminium Smelters Limited

Forest & Bird®
GIVING NATURE A VOICE

ARTIFICIAL INSEMINATION

Artificial insemination of two females was attempted; both clutches were infertile.

FERTILITY

This year had the highest rate of infertility on Whenua Hou; 9 of 15 eggs (60%). We have not determined any reason for the infertility. Most of the females that bred were young (5–15 years), so aging females is not an issue. Five of the seven females mated twice, which improves fertility. On Whenua Hou, only the three females that mated with Blades produced fertile eggs, producing six fertile and one infertile egg between them

On Little Barrier, the three fertile eggs were sired by Dobbie. Neither Dobbie nor Blades were supplementary fed, whereas the other four males involved in mating were supplementary fed.

The use of ultra high frequency aerials on the transmitters made semen collection more difficult this season and therefore may have interfered with matings, so this year's transmitters were ordered with a thinner gauge aerial that will bend and move out of the way during next season's mating.

NESTING

There were seven nests on Whenua Hou with 15 eggs and one nest on Te Hauturu-o-Toi with 3 eggs. The mothers were spending excessive time off nests foraging so all eggs were collected between the ages of 7 and 25 days, with the exception of Heather's first egg on Te Hauturu-o-Toi. The extra foraging was probably due to a lack of rimu fruit and perhaps the change of supplementary food type to a new trial pellet during incubation (see *Pellet Trial*).

Artificial incubation (where eggs are removed from the nest and hatched in an incubator by the recovery team) progressed seamlessly, with all eggs hatching normally and on time in the incubator. The 2–7 day old chicks were then fostered to mothers.

Heather's youngest egg was transferred from Te Hauturu-o-Toi to an incubator on Whenua Hou, as it was five days younger than the first and we didn't want Heather's first non-supplementary fed nesting on Te Hauturu-o-Toi to put two chicks at risk.

Lisa accidentally crushed her 25-day old egg, five days prior to hatching. A third of the shell was severely cracked and caved in. Fortunately the membranes were not broken, but there was dirt and contamination under the shell. Jo Ledington, Senior Ranger, did a fantastic job of repairing the egg with tape and glue, providing structural strength and reducing dehydration. This, along with the team manually rolling the egg hourly until internal pipping, allowed it to hatch normally. Internal pipping is where the chick breaks the internal shell membrane through to the egg's aircell; it usually occurs 2 days before to hatching. Due to membrane contamination, the chick was given precautionary antimicrobial treatment, which delayed returning it to a nest.

PATERNITY

The paternity of chicks has not yet been confirmed with DNA testing.

Senior ranger Jo Ledington counts rimu seed on Whenua Hou/Codfish Island, March 2014. *Photo: Tui De Roy*

CHICKS

Too few mothers produced too few chicks on Whenua Hou to provide a meaningful assessment of sex determination and maternal condition.

7 eggs hatched (6 on Whenua Hou and 1 on Te Hauturu-o-Toi) – all chicks hatched normally, but one chick (female) died unexpectedly about 5 hours later. The necropsy indicated kidney failure due to necrosis and loss of renal tubular cells. This may have been due to a sudden uptake of hyperosmolar solution such as the vytrate (glucose) solution fed 20 minutes prior to death. Although this solution was fed initially to other chicks for their first few meals without incident, the risk means that we will avoid this in the future.

Three chicks had to be hand reared due to a lack of weight gain or health issues requiring them to be removed from the nest.

Heather1 (hatched on Te Hauturu-o-Toi) was hand reared at Auckland Zoo until disease screening cleared her for transfer south, where she continued to be hand reared with Lisa1 and Rakiura2.

Three chicks (Huhana2, Rakiura3 and Heather2) were wild reared by their mother/foster mother.

All chicks have now fledged and are living free on Whenua Hou with access to supplementary feed. Chicks are being routinely weighed and monitored to ensure survival.

Rakiura3 became the youngest wild reared bird to leave his mother at just 121 days (average is 246 days).

One chick has been given its permanent name – Huhana2 has been named Moorhouse by the recovery team. This is in honour of our previous scientist Ron Moorhouse, who retired from DOC in 2013 after being the kākāpō team scientist for 10 years.

Whenua Hou mother	**Eggs** Inf = infertile Ft = fertile Ede = early dead embryo in first trimester	**Chicks** D = Died M = male F = female	**Fledged a chick** M = male F = female
Aranga	2 Inf		Failed
Esperance	2 Inf		1 M
Huhana	2 Inf	1 D-F, 1 M	1 M
Lisa	2 Ft (1 ede)	1 M	Not attempted
Pearl	2 Inf		Not attempted
Rakiura	1 Inf 2 Ft	2 M	1 F
Tumeke	2 Inf		Failed
Little Barrier mother			
Heather	3 Ft (1 ede)	2 F	Failed

Table 1: Mother and outcome of nesting attempt 2014 breeding season.

Lisa One being hand-reared at 1 day old.

Population dynamics

POPULATION SIZE

In the 2014 breeding season, eight nests produced six juveniles.

Four adult kākāpō died, bringing the current population to 126 individuals.

DEATHS

Ben (died 12/3/14) – Euthanised due to rapid deterioration of body condition, articular gout and kidney failure all likely due to age-related processes. Over the preceding 3–4 years on Whenua Hou there had been a gradual decline in his vigour, body condition and participation in booming.

Ben was found as an adult on Stewart Island in January 1988. He had a very high frequency of abnormal sperm and did not produce any offspring under the management programme. His mating events resulted in infertile eggs or his sperm was outcompeted by other males. However, DNA analysis shows that he fathered Heather on Stewart Island in 1981 and she has since produced six chicks.

Fresh muscle cells were collected immediately after death for use in cells cultures and cryopreservation for future use, and for cell lines used for cloacitis virology investigations (tests done to determine if any viruses are occurring in the cloaca, which is the cavity that serves as the opening for the intestinal, genital, and urinary tracts).

Lionel (died 2/4/14) – Cause of death is unknown. He died 68 days after transfer at which time he was booming and in peak condition.

Lionel was found as a juvenile on Stewart Island in October 1982 and probably hatched in 1978 or 1981. He had no offspring and all of his breeding attempts resulted in infertile eggs. Lionel had the greatest frequency of abnormal sperm assessed of any kākāpō.

Taonga (died 15/4/14) – Died following a period of low weight from which she did not respond positively to supplementary feeding. She was captured on 12/4/14 and found to be emaciated and had a high number of faecal coccial oocysts (parasite eggs found in faecal samples). She was given treatment for the parasite and hand fed twice a day. After an initial positive result her condition deteriorated rapidly. She was taken to Invercargill and put on an IV drip but died overnight. Necropsy results suggested organ failure due to emaciation, which may or may not have been due to a high burden of internal parasites – although parasite eggs were present there was no obvious organ damage.

Taonga was a 3-year-old, hand reared juvenile female, one of Rakiura's eight progeny. Her illness in the peak of the breeding season meant it was difficult for us to respond quickly.

Maggie (died 20/5/14) – Buried in a slip caused by heavy rain. Necropsy showed a blunt trauma to the back of the head had knocked her unconscious, cause of death was asphyxiation. This is the first death in the managed population from a natural stochastic (randomly occurring) event.

Maggie was captured as an adult on Stewart Island in April 1980; her weight suggests she may have hatched in 1978. She nested in 1990, 1991, 1995 and 2002 but has no surviving offspring. She was caught 10 days before her death and feather pulp collected, which has been cultured and cryopreserved for future potential use.

DEMOGRAPHIC TABLES

Table 1: Current kākāpō population demographics

	Adults (breeding age)	Juveniles (< 5 years old)	Total
Females	51	9	60
Males	59	7	67
Total	110	16	126

Table 2: Number of current known aged birds of each sex

	Known age	Unknown age	Total
Females	46	14	60
Males	48	18	66
Total	94	32	126

Managed sites

CODFISH ISLAND/WHENUA HOU

Transmitter change for all the birds on Whenua Hou was recently completed by the team. This is done annually as the battery life of transmitters used by the project range from 12–19 months.

All birds were also given thorough health checks, as for many birds this will be the only time the team sees them during the year.

All birds had cloacal swabs (swab of the cavity that serves as the opening for the intestinal, genital, and urinary tracts) taken for virology testing. Some birds were randomly selected for additional routine surveillance health screening, including for *Salmonella, Yersinia*, chlamydia, parasites, and blood haematology and chemistry.

ANCHOR ISLAND

With no breeding occurring this year on Anchor Island things have been pretty quiet.

Routine monitoring shows all the birds are alive and well and the annual transmitter change captures will occur over the coming months.

TE HAUTURU-O-TOI/LITTLE BARRIER ISLAND

After the excitement of the first kākāpō breeding occurring on Te Hauturu-o-Toi since 1999, we returned in June to do routine monitoring and the annual transmitter change trip.

As on Whenua Hou, a portion of the population was randomly selected for additional surveillance health screening.

Lisa was transferred to Te Hauturu-o-Toi from Whenua Hou in July. Her transfer north completes the aim of having 10 birds on Te Hauturu-o-Toi. Lisa has 10 living offspring, and has passed on 97% of her genetic variation to the next generation.

Codfish Island/Whenua Hou

Phenology

Whenua Hou – No breeding is predicted on Whenua Hou in 2015 as new rimu seed percentage is 2%.

Anchor – No breeding is predicted on Anchor Island in 2015 as new rimu seed percentage is <2%.

Te Hauturu-o-Toi – No predictions are available for Te Hauturu-o-Toi to date. Kauri and beech penology will be checked in spring. However, the chance of two successive breeding years is very low.

Research

AGING STUDY

All skin biopsy samples were collected in 2013 and 2014. These will be used to test the level of pentosidine (a chemical that accumulates in the tissue of an animal over its lifespan) in the hope of aging all individuals in the kākāpō population.

Finalising permits has progressed very slowly, however the samples were sent to West Virginia University, USA in early August and results will hopefully be obtained within the next few months.

Technical advisor Daryl Eason assessing sperm quality, February 2014. *Photo: Tui De Roy*

PELLET TRIAL

Once females had mated this year on Whenua Hou and established a nest, their supplementary food was changed from Harrison's High Potency pellets to a specifically designed pellet called Yvette's (named after Yvette Cottam, the MSc student who helped formulate them).

These pellets have a protein-calcium ratio that more closely mimics rimu fruit than any commercially available pellet.

It was hoped that these pellets would reduce the need for hand rearing, result in fewer ill chicks requiring medical intervention, and possibly stimulate females to breed.

The results were inconclusive but we found that mums fed these pellets can successfully fledge chicks (3 out of 6 chicks were raised in nests).

We need to wait for a larger breeding season and start feeding Yvette's from the start of the season to more robustly test the food.

CLOACITIS

Substantial effort has gone into establishing a cause of the cloacitis (crusty bum) cases a number of birds have suffered from. This can be a recurring infection in individuals and may have caused the death of Barnard in 2012.

A cause and treatment for cloacitis is high on the research priority list for the recovery team and the team is pursuing several lines of enquiry through collaborations with several institutions.

Sperm collection, February 2014. *Photo: Tui De Roy*

Review of historic cases

A preliminary review of historic cloacitis cases has confirmed that the condition has been clustered geographically on Whenua Hou. There is no clear temporal association.

Virology

ESR/Landcare – Next-generation sequencing by an ESR/Landcare group led by Dan Tompkins has produced some evidence for the presence of an *E. coli* bacteriophage (LF82) in a diseased bird that was not present in eight healthy birds.

The bacteriophage is associated with humans (it is implicated in Crohn's disease), indicating that cloacitis in kākāpō may be of human origin.

The study also found differences in the *E. coli* community structure between the diseased and healthy birds. The authors caution that further sampling is necessary, since only one diseased bird was sampled. The study was published in the *New Zealand Veterinary Journal.*

Ministry for Primary Industries (MPI) – Cloacal swabs are currently being collected during transmitter change to send to MPI for virology investigations, conducted by Wlodek Stanislawek. The viral isolation is dependent on establishing a psittacine cell culture; work that has been started by Andria Green at AgResearch.

Bacteriology

David Waite, University of Auckland – David is close to completing his PhD, which includes an assessment of kākāpō bacteria. David has been able to provisionally establish that cloacitis in kākāpō does not have a bacterial cause. A bacterium that is associated with disease in humans was found in kākāpō samples, but it was spread throughout the population, so if it is associated with cloacitis it presents asymptomatically in most birds. David has published several papers on the findings from his PhD:

- Waite, D.M.; Eason, D.K.; Taylor, M.W. 2014: Influence of hand-rearing and bird age on the faecal microbiota of the critically endangered kākāpō. *Applied and Environmental Microbiology* | AEM.00975-14
- Waite, D.M.; Taylor M.W. May 2014: Characterizing the avian gut microbiota: membership, driving influences, and potential function. *Frontiers in Microbiology*| doi: 10.3389/fmicb.2014.00223
- Waite, D.M.; Deines, P.; Taylor M.W. 2013: Quantifying the Impact of Storage Procedures for Faecal Bacteriotherapy in the Critically Endangered New Zealand Parrot, the Kākāpō (*Strigops habroptilus*). Zoo Biology 32: 620-625 | www.ncbi.nlm.nih.gov/pubmed/24019012

ADVOCACY

Sirocco – Sirocco is on display at Sanctuary Mountain Maungatautari until 19 September 2014. He then travels to Orokonui Ecosanctuary near Dunedin where he will be on display until 6 October 2014.

Chick display – The three hand reared chicks spent a successful day on public display at Arrowtown, viewed by approximately 1,000 people.

Upcoming work and strategic planning

OPERATIONAL

Upcoming transfers – We plan to transfer five males over the coming year. This is to remove males from Whenua Hou who have contributed more than 7 offspring to the population, allowing specific second generation males (those whose parents have died without contributing many offspring) a chance to breed and contribute their genetics to the population.

TECHNOLOGY

Developments – The recovery team is currently working with Stu Cockburn from DOC's Electronics team to upgrade the technology used to monitor kākāpō.

This is a significant piece of work and involves upgrades to our snarks (dataloggers), smarthoppers, and radio nest snarks. Stu is also working with John Wilks from Wildtech to produce a remote datalogger that will record mating data from the male transmitters and send this back to the hut via the cell network. It is hoped that these permanent solar powered stations will significantly reduce ranger time on the hill.

STRATEGY

Kākāpō Recovery Group – It was decided at the June 2014 meeting that the team needs to look at what productivity gains might be expected through reducing numbers of females on Anchor Island, in favour of placing them on Te Hauturu-o-Toi; and to determine how will this impact the timeframe for testing the suitability of both sites.

Kākāpō Recovery Plan – The current plan will expire in 2016. The recovery team will start drafting a new plan (2016–2026) in the coming months and hope to have the recovery group ratify the plan in June 2015.

RESEARCH

New projects

Alexander Boast (PhD, University of Adelaide) – faecal analysis: changes in diet and parasites in ancient and modern samples.

Janet Wilmshurst (Landcare) – faecal analysis: diet on Te Hauturu-o-Toi, pollen assemblage and seeds, then DNA depending on funding. Comparison with coprolites and interested in dactylanthus.

Karin Schwartz (PhD, George Mason University, USA) – conservation management: investigating data management processes both in situ and ex situ for endangered species recovery programs in order to build a framework for proposed use of ISIS Zoological Information Management System for holistic data management.

Caitlin Schindler (MSc, Oxford University) – kākāpō charisma: what makes kākāpō popular to public and science, and do these groups have different perceptions of kākāpō?

Cloacitis

Possible causative factors (further investigations) – modelling to determine if there is a temporal/weather/genetic link between cases.

Occurrence for *E. coli* bacteriophage using frozen samples (further investigations) – next generation sequencing is preferred if funding can be found, but less expensive methods for searching for the bacteriophage will be explored.

Reservoir species: teal and petrels – faecal/cloacal sampling of Campbell Island teal and petrels on Whenua Hou will be conducted to investigate virology in these species. This work will use next generation sequencing to compare with the kākāpō virus results, if funding can be found.

Published by: Department of Conservation, Murihiku/Invercargill Office, PO Box 743, Invercargill 9840, New Zealand