# PAPAROA WILDLIFE TRUST

## BNZONE 2007-2012 Summary Report

Report Produced for the Paparoa Wildlife Trust

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## 1. Summary

In 2007 the Paparoa Wildlife Trust began monitoring Roroa Great Spotted Kiwi *Apteryx Haastii* in the Southern Paparoa Ranges with 'Smart' transmitters. The aim was to test the feasibility of Bank of New Zealand Operation Nest Egg (BNZONE™) on roroa and to see if BNZONE™ raised birds would recruit into the wild population. Over five breeding seasons eighty seven breeding attempts were detected and 39 eggs and one chick were taken through BNZONE™. Of eggs taken 92% were fertile and 82% hatched with 18 sub adults released back into the Paparoa Range to date. Eleven of these birds are still being monitored. A further five chicks are in crèche at present.

Difficulties in crèching and releasing BNZONE™ birds were encountered but over time specific protocols were developed to maximize survival. Only two BNZONE™ birds have been found with wild birds. In upcoming breeding seasons we plan to increase our sample of BNZONE™ birds in the wild to 20-25 then cease BNZONE™ work. We will then focus on monitoring these birds to see if they recruit into the wild population and form breeding pairs.

# 2. Introduction

Kiwi (*Apteryx*) are presently divided into five species; the little spotted kiwi (*Apteryx owenii*), great spotted kiwi - roroa (*A. haastii*), brown kiwi (*A. mantelli*), rowi (*A. rowi*) and tokoeka (*A. australis*) (Holzapfel *et al.* 2008). The arrival of humans to New Zealand has lead to a significant decline of all kiwi species and they are currently threatened on the mainland. The roroa is the least well known of the kiwi species, and has not been researched extensively.

There are three main populations of roroa, northwest Nelson, Paparoa Range and the Central Southern Alps. Estimates of roroa abundance and their rate of decline are variable. Robertson (2003) estimated a total of 85,000 in 1996 declining to 57,000 by 2006. However, Holzapfel *et al.* (2008) estimated only 16,000 in 2008 declining to 13,000 by 2018. Roroa are classified as nationally vulnerable under the New Zealand Threat Classification System (Miskelly *et al.* 2008). Regardless of discrepancies in population estimates the consensus is that the roroa population is declining.

The main reason for the decline in kiwi is habitat loss and predation on eggs, chicks and adults by introduced mammals. Eggs and chicks are vulnerable to predation by stoats (*Mustela erminea*), possums, and cats (*Felis catus*;) while dogs *Canis lupis familiaris* are a threat to adult birds (Robertson 2004, McLennan & McCann 1994; McLennan *et al.* 1996). Roroa are flightless and largely nocturnal. They feed on a diet of invertebrates and fruit, and use hollow logs, rock caves or dense vegetation for day time burrows and nests (Holzapfel *et al.* 2008). The weight of adult ROROA can range between 1750g – 4300g (McLennan & McCann 1994) with females being the heavier sex. The breeding season is long ranging from late July until January. Unlike some of the kiwi species both the male and the female incubate the egg, with males typically incubating during the day and the female sharing incubation at night. Daily activity of adult ROROA drops when they begin incubating their egg. The egg is incubated for approximately 78 days before hatching. Age of first breeding is thought to be similar to other kiwi at 4-5 years old.

In 2007 a management technique successfully utilized on other kiwi species, Bank of New Zealand Operation Nest Egg (BNZONE) was first trialed on ROROA. BNZONE is expected to increase egg and chick survival of ROROA by removing the predation risk. Eggs are taken from nests in the wild, incubated and hatched in captivity before being creched in a predator free environment. Once they are big enough to avoid predation they are released back into the wild. BNZONE therefore increases kiwi survivorship by removing their most vulnerable life stage (Kiwi Recovery 2011).

ROROA could potentially lay another egg if their first egg is unsuccessful or taken for BNZONE. (Holzapfel *et al.* 2008). Other kiwi species can incubate two eggs in one season ie. brown kiwi (*A. mantelli*) or produce a second if their first is taken for BNZONE ie. Tokoeka. By producing a second egg the effectiveness of BNZONE will be increased. However, the proportion of roroa that lay a second egg is unknown. However, second laid eggs may not have the same hatch rate as the first.

The objective of this report is to summarize the last five season's BNZONE work undertaken by the PWT Paparoa Wildlife Trust. In doing so it aims to answer the following questions:

1. Can eggs be removed from ROROA burrows, incubated in a captive environment, successfully creched and released back to the Paparoa Range?
2. Will BNZONE birds recruit into the wild population and form breeding pairs?

# 3. Methods

## 3.1 STUDY SITE

The Paparoa Range study site consists of 3500 hectares of mixed podocarp/beech forest and tussock tops situated 15 km north-east of Greymouth. It is bordered by Blackball Creek/Roaring Meg Creek in the east and north, 10 Mile Creek in the west and the Roa Mine/Paparoa Creek in the South. Monitored adult birds are focused at three main sites: Croesus Track/Ces-Clark Hut, Mt Leitch/Kiwi Bivvy and Roa Mine/Road.

### 3.1.1 CRECHE SITES

Adele Island is located in Tasman Bay adjacent to Motueka. It is 88 hectares in size and predator free consisting of regenerating coastal forest and rising to 169m.a.s.l. at its highest point.

The Bois Gentil 'friendly forest' is located in Atarau only 10 kilometers from the main study area. It is a 12 hectare predator proof enclosure consisting of mixed lowland podocarp/beech forest and grassland on an old alluvial river terrace at 70m.a.s.l.

## 3.2 BIRD CAPTURE

Territories of breeding pairs were identified using call count surveys. Birds were then caught by day time dog searchers, calling the birds in using prerecorded kiwi calls then capturing, or by night time capture using a dog. Once birds were caught small leg mounted 'SMART' transmitters (tx) were attached (Robertson and Colbourne 2003).

## 3.3 MONITORING BREEDING ATTEMPTS

Breeding attempts were detected by activity outputs given by the transmitters. A drop in activity generally means the bird is incubating an egg. Breeding season monitoring consisted of the fortnightly collection of 'Egg Timer', 'Chick Timer' or 'Diagnostic' tx data from all monitored pairs. Tx output data indicates a drop in daily activity and the likelihood of incubation.

## 3.4 BNZONE

Birds incubating were targeted for egglifts after 30 days of incubation activity. Birds at the nest site were tracked down using telemetry and a trained kiwi dog. The nest burrow was then assessed for access. If the egg was accessible then the egg lift was undertaken straight away. Eggs were placed in a portable incubator at 30 – 35 °C for transport by either: 1) foot back to the road end, or 2) foot to a spot suitable for helicopter pick up, or 3) foot back to camp for overnight storage then helicopter pick up the following day. They were then driven straight to the Willowbank Wildlife Reserve (WWR) in Christchurch where they were incubated to term (~78 days). Eggs and then chicks were carefully monitored and hatch assisted if necessary. Veterinary care was administered on site if necessary. Once chicks re-gained their hatch weight and passed a health check they were deemed fit to be transferred. Healthy chicks were driven to either Adele Island (2007-09) or the Bois Gentil Crèche at Atarau (2010-12) and released. If the egg could not be accessed then the bird was left undisturbed before being revisited the following morning. If the bird had abandoned the egg then it was lifted and transported otherwise the bird was left to incubate.

## 3.5 DEFINITIONS

Throughout this report various terms are used to describe aspects of ROROA breeding. The following defines these terms. A *pair* is a potential breeding unit where ideally the male and female are fitted with a transmitter, but in some cases only one of the pair is monitored. Either an *Egg Timer* (ET), *diagnostic* (D) or *chick timer* (CT) transmitter was used for at least one of each pair. A pair is classed as having had a *breeding attempt* when Tx data indicates a change in activity. ET's do not reliably switch into incubation when utilized with ROROA therefore the actual output data must be interpreted. An egg may or may not be present when an incubation attempt is detected. The 30 day incubation mark is considered the optimum time to take an egg for ONE. Sometimes the output data indicated a switch back out of incubation prior to the 30 day mark, and in these cases the burrow was not necessarily visited. A nest is most often only given an identification if an egg was found or if there is sufficient evidence (whether from ET data or visual observations) to show definite signs of breeding. For the purposes of this report an egg is described as *viable* if it has hatched and *non-viable* if it has not (though a non-viable egg may or may not be fertile). A *chick* is only defined as such if it has been seen alive.

# 4. Results

1. Can eggs be removed from ROROA burrows, incubated in a captive environment, successfully creched and released back to the Paparoa Range?

**Breeding attempts**

We monitored an average of 17 breeding pairs of ROROA each season with each pair producing on average slightly over one breeding attempt per annum equating to 87 breeding attempts over the five year period. Of detected breeding attempts 46% (40/87) resulted in a successful egg or chick lift, 37% (32/87) failed and 17% (15/87) had an unknown outcome.

**Timing of breeding attempts**

Incubation attempts occurred between August and March peaking between September and December. Eggs were laid between late August and January with the majority being laid in August and September (figure 1). First breeding attempts where more successful with 52% (32/61) resulting in an egg. Second breeding attempts where not so successful with only 29% (7/24) resulting in an egg. One pair had a third breeding attempt that resulted in an egg. Average time to reclutch after egg taken was 105 days (n=3).

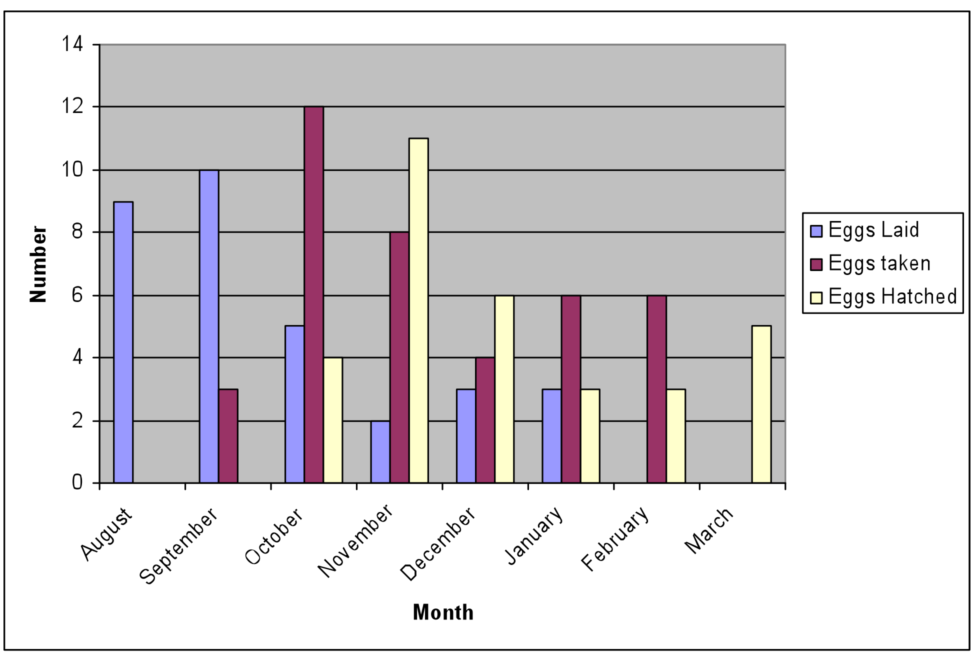

Figure 1 Summary of ROROA breeding relative to month monitored through BNZONE programme 2007-2012.

### Timing of egglifts

Egglifts were undertaken between late September and early February with 51% (20/39) being completed in October/November (Figure 1). Average age of eggs when taken was 44 days with a range of 25 to 69 days. This confirms most eggs were laid between mid August and October (Figure 1). Egg fertility was 92% (36/39) and 82% (32/39) of the eggs taken hatched. The peak in egg hatches was between November and December (Figure 1). The median hatch weight for chicks was 309g with some small variation between years (Figure 2).

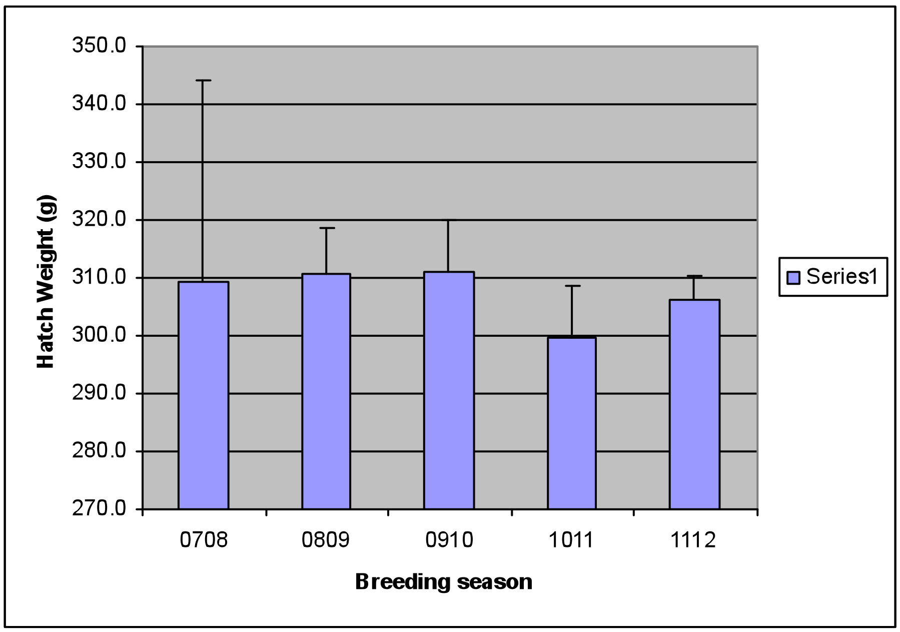


Figure 2: Hatch weights for Paparoa Great Spotted Kiwi Chicks at Willowbank 2007-2012 (n=38).

Only 71% (5/7) of second eggs hatched compared to 91% (29/32) of first eggs and only one bird from a second egg hatch is still alive in the wild ('Takarei') compared to 10 from first eggs.

Of the nine deaths at Willowbank four were eggs and five were chicks. Of the eggs one was kicked during the egglift and the embryo died shortly after arrival at WWR, two died during incubation and one died at external pip. Of the chicks three died post operation (one of these taken as a chick), one died due to a bacterial skin infection and one died 16 days after hatching for no apparent reason.

Twenty-seven chicks were released to crèche at a median age of 64 days and median weight of 475g. Chicks released to Adele Island crèche (n=9) were larger on average than chicks released to the Bois Gentil crèche (n=18) (609g vs 521g). Five chicks have died or disappeared presumed dead while in crèche. One bird on Adele Island disappeared after transmitter failure or drowned after first arrival; one bird disappeared in the Bois Gentil crèche and has never been located again, two birds died of starvation and one bird died as a result of disease. Five birds are currently still in the crèche.

Eighteen sub adults have been released to the wild at an average age of 397 days and weight of 1385g. Five of these birds died within the first month of release, several factors are likely to have contributed to these deaths. The birds needed to be caught on Adele Island before transfer across to the mainland. Logistically this was difficult; some birds had to be held in transfer boxes while other birds were caught. In one instance four birds were held overnight before being transferred. This added to the already stressful and long road trip from Motueka to Blackball.

In the first instance five birds arrived at Blackball and in deteriorating weather conditions were flown to the tops. Cloud meant they couldn't be dropped at the designated release site but with no contingency option they were released on a flat area near the bush line. This site turned out to have resident birds present; these territorial birds would have made it difficult for the new birds to settle. Ultimately four starved to death before a post release check could be completed. The surviving bird managed to find an area on the tops where it has stayed ever since suggesting it is outside of established territories and is now 3.5 years old.

In the second instance two birds were release below the Ces Clarke Hut. One bird was found dead 7 weeks later. It appeared to have starved but also had coccidiosis. It is likely that it was being harassed by resident birds and being in poor condition meant it would have being more susceptible to the underlying disease issue. The other bird struggled to put on weight and was removed from the Paparoa's to the Bois Gentil kiwi crèche. It put weight back on quickly and has been re-released outside of established territories and is doing well and now 3.5 years old.

The 13 sub adults still surviving in the wild a month after release were on average bigger and older at release than those that died (1423g/400days vs 1282g/352). However, taking into account crèche site the difference was a lot smaller (surviving 1303g/350days vs dead 1282g/352days).

Of the 13 sub adults that survived initial release eleven remain alive in the wild. One bird was run over and another dropped its transmitter but is presumed to be alive still.

2. Will BNZONE birds recruit into the wild population and form breeding pairs?

On the 21/7/2011 'Takarei' was first found with a wild bird 'Tairea' at 900 days old. On 15/2/2012 he was found with 'Tairea' again and a wild born adult female 'Lou'.

Another sub-adult 'Nikau' was found with a wild born sub adult 'Tawhai' during a tx change.

No other ONE sub-adults have been found with wild born birds.

# 5. Discussion

There have been high numbers of breeding attempts relative to number of eggs collected. What is reason for this high failure rate or is it typical of kiwi breeding? Predation of eggs on the nest maybe an issue along with egg fertility. The target age for taking eggs is 30 days but seems to be a happy median. The Save the Kiwi website suggests eggs <10 days have 1% chance of survival, eggs 10-20 days 20% and eggs at 30 days 75%. By taking eggs later in the incubation period the PWT have increased the probability that the eggs will be fertile ie infertile eggs will have been abandoned. This makes sense for BNZONE purposes as it means less wasted time and money on collecting infertile eggs. It also keeps WWR costs down as they don't need to incubate birds for as long. It also allows for error in calculating date of egg laying and onset of incubation resulting from lack of incubation data ie weather may have made data collection difficult.

If however predation is the main issue rather than egg fertility it would be wise to take the eggs earlier in the incubation period. This would minimize exposure to predation. The question therefore is how old does an egg need to be before it can be taken. The PWT have taken GSK eggs as young as 25 days (Waimakariri 18 days) and successfully raised them to point of wild release. This suggests that in cases where the onset of incubation is accurately known (assuming that the bird starts incubating as soon as the egg is laid and minimal time is spent in nest preparation) it wouldn't hurt to take egg earlier. This would test the assumption that many failed nests or incubation attempts with unknown outcomes are the result of egg fertility rather than predation. Therefore it is recommended we attempt to take some eggs prior to 30 days, ideally between 20-30 days. This would also mean birds that reclutch would do so earlier in the season. Overall, this may greatly increase our egg outputs and hence number of juveniles we can get back onto the hill.

Incubation of eggs at WWR was relatively trouble free with only two eggs dying during incubation, one dying during external piping and one dying shortly after arrival. This egg had been kicked during egglift which is a risk when undertaking this work. Three eggs had been taken off this particular bird prior this episode. Other observed behavioral changes in relation to repeated egglifts included: aggression towards the person attempting egglift, reluctance to get off the egg, locating eggs in increasingly deep burrows and abandoning the egg as soon as a person approached burrow. Some birds showed no change in behavior and had multiple eggs taken off them.

Type of burrow often dictated bird behavior. Birds in tight confined burrows were often the most difficult to complete egg lifts on. Generally a bird needed to abandon the burrow before the egg lift could be safely undertaken. In more spacious burrows the bird would often step away from the egg when coerced making the egglift relatively straight forward. In cases where the egg could not be reached birds generally sat tight and didn't abandon. Interestingly, in these situations no chicks were found at a later date suggesting the nest failed or the egg/chick was predated.

Five birds died at WWR post hatching, three of these were the result of complications post yolk sac removal operation, one died shortly after hatching from a bacterial infection and one died an unexplained death at 16 days old. Two of the chicks that had yolk sac removals had necropsy's completed and they showed they died of renal failure.

Birds released to crèche generally had good survivorship although birds were susceptible to rapid weight loss within the first week of release. This weight loss is typical of kiwi being moved into a new environment. Close order monitoring and supplementary feeding improved survivorship although birds were still lost for unknown causes (Appendix). One bird approaching release weight died in unusual circumstances. This bird had a history of health issues and was diagnosed with salmonella after hatching. When found the bird appeared uncoordinated and it didn't respond to medical treatment. Autopsy showed the bird had larval migrans in the brain. Hot dry conditions and lack of food meant the bird was in poor condition and probably resulted in reduced immunity and increased susceptibility to infection.

Other disease issues associated with the crèche included Strongyle, *Yersinia kristensenii* and Coccidia. These diseases are present in wild populations of kiwi and most bird species carry low levels of parasites without any detrimental effect.

Average age of birds released to the wild from crèche was 397 days (1385g). This created an issue as ideally sub-adults would be removed before the next seasons chicks are released into the crèche. This avoids potential competition between different age cohorts and also allows the crèche a chance to recover in terms of invertebrates. However, it also seems that larger chicks transition better into the wild. Options to address this issue include: releasing birds at lower weights, improving food supply in the crèche so birds reach heavier weight at younger age, separating age cohorts in the crèche or running fewer birds in the crèche.

Reducing release weight or lowering the numbers of chicks in the crèche is probably the easiest way to avoid this issue. Food supply in the crèche seems to be dependent mostly on moisture levels. When the crèche dries out birds seem to struggle to weight gain. Options to irrigate the crèche were considered but the cost of installing water storage tanks and irrigation pipes precluded this as an option. Separating different age cohorts in the crèche would involve fencing off suitably sized areas. While this is feasible it would require considerable effort to establish and maintain a fence in a forested environment. There may be other options to increase crèche productivity and it would be worth while investigating this. Presently focus should be on keeping numbers of chicks in the crèche at a manageable level and supplementary feeding if food supply diminishes in the crèche through dry conditions.

The last two seasons releases of birds into the wild have shown that survivorship can be high (see Appendix). This is provided birds are monitored frequently and are released into areas outside of resident pairs. If there are weight loss issues birds need to be removed back to the crèche to regain weight before re release. With these factors considered it should be possible to reduce the current target weight for release of 1400grms to facilitate getting sub adults out of the crèche quicker. The PWT has released Roroa as light as 1070g that have survived in the wild.

## 5.1 AIM FOR UPCOMING SEASONS

We plan to continue monitoring existing breeding pairs to identify breeding attempts with the aim to remove as many eggs as possible to build up numbers of BNZONE™ sub adults to 20-25. At our current rate this is likely to take a further 2-3 years. Once we have reached this target we will focus on monitoring BNZONE™ birds in the wild to see if they form breeding pairs with wild birds. Our oldest BNZONE™ birds in the wild come from the 2008/2009 breeding season and are likely too young to begin breeding yet. Only continued monitoring of these birds will give and indication of the success of BNZONE™.

## 5.2 QUESTIONS LEADING ON FROM CURRENT WORK

Why does a high proportion of nesting attempts fail before thirty days or is this typical of Roroa?

Can we improve the outcome of yolk-sac removal operation?

Can eggs be reliably removed earlier in incubation period to increase productivity?

Can food productivity in the crèche be increased?

# 6. Acknowledgements

This project was started by Jo Tilson, without her vision and dedication it would not have happened.

Thank you to the Bank of New Zealand Save the Kiwi Trust and the Roa Mining Company for their continued support of this project. Support has also been provided by Coastwide Helicopters (Chris Cowan and Stu Gorrie), Pub Charities, World Wildlife Fund for Nature, the Lion Foundation, New Zealand National Parks and Conservation Foundation on behalf of Solid Energy, the Honda Tree Fund and Wild West Adventures (Paul Schramm and Pete Diamond).

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# 8. Appendices

### Appendix 1. Breeding summary 2007-2012.

| *Breeding Summary* | 2007/08 | 2008/09 | 2009/10 | 2010/11 | 2011/12 | Total |
|---|---|---|---|---|---|---|
| Breeding attempts | 10 | 15 | 15 | 28 | 19 | 87 |
| Failures | 5 | 5 | 3 | 14 | 5 | 32 |
| Outcomes unknown | 1 | 1 | 3 | 5 | 5 | 15 |
| Successful attempts | 4 | 9 | 9 | 9 | 9 | 40 |
| No attempts | 3 | 7 | 5 | 1 | 3 | 19 |
| Single attempts | 6 | 4 | 9 | 11 | 7 | 37 |
| Two attempts | 2 | 5 | 3 | 7 | 6 | 23 |
| Three attempts | 0 | 0 | 0 | 1 | 0 | 1 |
| Successful 1st attempts | 3 | 7 | 7 | 8 | 7 | 32 |
| Successful 2nd attempts | 1 | 2 | 2 | 0 | 2 | 7 |
| Successful 3rd attempts | 0 | 0 | 0 | 1 | 0 | 1 |
| Pairs monitored | 11 | 17 | 17 | 20 | 18 | |

### Appendix 2. BNZONE™ summary 2007-2012.

| **ONE Summary 2007-2011** | **Count (% of total eggs)** |
|---|---|
| **Total chicks taken** | **1** |
| **Total eggs taken** | **39** |
| **Infertile eggs** | **3** |
| **Fertile eggs** | **36 (92%)** |
| **Fertile eggs that didn't hatch** | **4** |
| **Hatched eggs** | **32 (82%)** |
| **Chicks died at WWR** | **5*** |
| **Chicks at WWR** | **1** |
| **Chicks released to crèche site*** | **27 (71%*)** |
| **Chicks still in creche** | **4** |
| **Chicks died in creche** | **5** |
| **Chicks released to wild as sub adults** | **18 (47%*)** |
| **Sub adults died in wild** | **6** |
| **Sub adults surviving in wild** | **11 (29%*)** |
| **Sub adult transmitter lost** | **1** |
| ***Includes chick taken** | |

**Appendix 3.** *Chick to crèche release protocol*

1. Release chicks into the small enclosure located within crèche.
2. Provide supplementary food and water and check this each day.
3. Post Release check needs to be within 3 days of release.
4. The chick will be likely to lose weight with the average loss being 12-15% body weight (n=14) 6 days post release. The bird should then start weight gaining.
5. If weight loss is less than 12% monitor the bird again in two days time and look for trend of weight gain. This is what typically happens.
6. If weight loss is 12-15% monitor the bird again the next day.
7. If weight loss is greater than 15% of body weight and the chick is not weight gaining force feed chick daily until it starts weight gaining.
8. Keep monitoring daily until bird is consistently weight gaining.
9. Once chick has regained its release weight and is weight gaining open gate into main crèche and check weekly.

*Appendix 4. Sub adult to wild release protocol*

Draft release protocol (Newton *et al.*)

1. Timing - in a settled weather window in late spring – summer (Nov-December).
2. Assess readiness for release on a bird by bird basis in terms of weight – individuals will have different weight trends (start with high body weights – we can reduce this once we are comfortable they are doing ok)
3. Disease screening – two clear cloacal swab/faecal samples before release.
4. Release birds one by one unless paired with another bird.
5. Minimise translocation time (not really an issue now with the crèche)
6. Release outside of known territories as identified by call count monitoring.
7. Check weight/conditions within 7 days of release and from this data assess when next check is due (ideally want repeat checks so weight trend can be identified).
8. A loss of greater than 20% body weight is the intervention level to get them off the hill and back to crèche.