

TONGARIRO FOREST KIWI SANCTUARY ANNUAL REPORT

July 2013– June 2014

TONGARIRO DISTRICT OFFICE, CENTRAL NORTH ISLAND REGION



Ngati Hikairo ki Tongariro



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Cover photo: Tongariro Forest Kiwi Sanctuary

PARTNERSHIPS

Partnerships between the Department of Conservation and Ngati Hikairo, The National Kiwi Trust at Kiwi Encounter, Maungatautari Ecological Island Trust, Project Tongariro, and Kiwis for Kiwi Trust continue to be an essential part of the work in the Tongariro Forest Kiwi Sanctuary (TFKS). Wairakei Golf + Sanctuary has taken up an important role as a kiwi crèche for our area.

THE NATIONAL KIWI TRUST AT KIWI ENCOUNTER

The National Kiwi Trust at Kiwi Encounter plays a crucial role in the success of the TFKS, through the incubation and successful hatch of eggs lifted from nests. This season (2013/14), 18 kiwi eggs were taken to Kiwi Encounter and 14 of these successfully hatched.

NGATI HIKAIRO

Ngati Hikairo plays an important part in the TFKS and has a role and responsibility as kaitiaki for the enhancement of Western North Island brown kiwi within their rohe. Ngati Hikairo support recovery efforts by the Department of Conservation and are intent on kiwi conservation goals and objectives being met within Tongariro Forest.

PROJECT TONGARIRO

Project Tongariro are involved in ecological projects throughout Tongariro National Park and surrounding areas. Their volunteers assist the TFKS team regularly with work such as small mammal indexing, transporting kiwi eggs to The National Kiwi Trust at Kiwi Encounter and other advocacy work.

MAUNGATAUTARI ECOLOGICAL ISLAND TRUST (MEIT)

Maungatautari is a forested volcanic cone in the Waikato, and is the site of an ecological restoration project headed by the Maungatautari Ecological Island Trust, aiming to eliminate all mammalian predators and re-introduce native species, including kiwi. TFKS and Ngati Hikairo have gifted 13 kiwi to Maungatautari and Ngati Koroki-Kahukura to be part of a founder population there. Since 2010, 14 kiwi (the offspring of some of the original founders) have been released into TFKS.

OTOROHANGA KIWI HOUSE

There has been a nationwide initiative to release brown kiwi of Western Taxa from captive breeding institutions into multiple wild sites, following the completion of a new western provenance DOC translocation plan. This is to enable captive institutes to have increased capacity to work with other (more endangered) species of kiwi. Five kiwi (one pair and three females) were released to Tongariro forest during the 2012/13 season and three females were released this season. Further releases are planned for the 2014/15 season.

WAIRAKEI GOLF + SANCTUARY

Wairakei Golf + Sanctuary is a privately owned golf course situated north of Taupo. A five kilometre “Xcluder” predator proof fence has been installed around the perimeter (Potae 2012). This has created a pest free environment which can be used to benefit threatened plants and animals. The sanctuary was officially opened in 2011. During the 2013/14 season, with support from Ngati Rangī and Ngati Hikairo, Wairakei has been utilized as a kiwi crèche for Operation

Nest Egg™. Three kiwi chicks from Southern Ruapehu and 12 kiwi chicks from Tongariro Forest were released at Wairakei Golf + Sanctuary. The use of Wairakei as a crèche for kiwi has afforded us with many advocacy opportunities this season and a variety of groups and individuals from the community have been able to be involved or attend kiwi releases.

EXECUTIVE SUMMARY

Tongariro Forest Kiwi Sanctuary (TFKS) was established in 2000 for the development of kiwi protection techniques, namely the use of BNZ Operation Nest Egg™ (O.N.E) and aerial 1080.

Up to 2010, TFKS aimed to achieve and maintain a representative sample of 200+ pairs of Western North Island brown kiwi by 2017 (Tongariro Operation Plan, 2010), and to involve the community and enhance public awareness. This target has been significantly compromised by ferret incursion events and the revised aim of growing the population to 100+ pairs by 2019 (Kiwi Sanctuaries Strategy draft 2014-2019) is a more realistic goal.

Twenty five adult male kiwi and four adult female kiwi were monitored in TFKS in 2013/14. Between April and June 2014, there were three kiwi deaths that were deemed likely to be or confirmed as mustelid or ferret predations. One was an adult male from the monitored breeding population, “Lucky” and two sub-adult kiwi. DOC 250 trap lines were then deployed near the sites where dead kiwi were found. No ferrets were captured.

During this season, which has been a non treatment year, we have undertaken Operation Nest Egg™ in order to increase the population of kiwi in TFKS. Eggs or chicks have been lifted from kiwi nests in TFKS, and the young chicks have been released at Wairakei Golf + Sanctuary. Kiwi have then been released at Tongariro Forest when they reach 1200g (“stoat proof” weight). A total of 18 eggs were taken to The National Kiwi Trust at Kiwi Encounter. Of these 14 eggs hatched. One chick was taken to Maungatautari, one was suffering from an unknown condition and was sent to Wildbase at Massey, and the remaining 12 chicks from TFKS were released to Wairakei Golf & Sanctuary.

Ninety eight O.N.E sub-adult kiwi have been released into TFKS since 2000. Of these, 92 have been closely monitored, along with 53 wild hatched sub-adults. The survival rate as at the end of the 2013/14 season was 63.9%, with female survival rate improving over the course of the study. The average age of first breeding is 3.71 years old. The total area within which kiwi have been known to distribute evenly is about 10400ha. Fourteen sub-adults are currently monitored.

A kiwi call survey was undertaken in May this year (as in 2013) using human observers in conjunction with acoustic recorders at the traditional seven sites throughout the TFKS. Additional recorders were also set at 16 extra sites. More calls were heard with acoustic recorders (1.24 calls per hour) than by the human observers (0.79 calls per hour). Within the 3542ha covered by acoustic recorders and during nine fine nights, 1.3 calls per hour were heard and 36 new birds were revealed.

Three seasons after the September 2011 aerial 1080 operation, rat tracking rates remain high (around 70%) but not as high as previous operations (about 80%) and mice have disappeared while the mustelid population increases steadily over time and has peaked at 13.33% in February this year.

At the end of the season, population modelling was used to understand the dynamics of the TFKS population better. It shows that with no management the population would be driven to extinction in twenty years. With the current five year 1080 cycle management, TFKS kiwi population has remained stable for the last ten to fifteen years with an annual growth of 0.6%. The highest projected population increase (6%) would result from a three yearly 1080 cycle, if there were no ferret predations.

INTRODUCTION

Tongariro Forest Kiwi Sanctuary (TFKS) is a 20,000ha area in the central North Island (Figure 1) established in 2000 for the protection and recovery of Western Brown Kiwi (*Apteryx mantelli*). It is one of five sanctuaries set up throughout the country to maintain significant populations of the different kiwi taxa, and to develop and improve techniques in kiwi protection, specifically aiming to increase the survivorship of young kiwi (Robertson 2004).

One of the key current research projects in TFKS has been the assessment of the effect of a large scale 1080 operation on kiwi chick survival. This involves determining survival rates of kiwi chicks before and after aerial 1080 operations carried out in September 2006 and 2011. These were TB Free NZ operations as part of their regional TB-vector/possum control regime, but done in conjunction with the Department of Conservation for kiwi protection research. This research is of national importance, indicating whether 1080 can be used as an effective tool for maintaining kiwi in large and/or relatively inaccessible areas throughout the country (McLennan 2006). Aerial 1080 operations have benefited kiwi chick survival for two consecutive seasons. Other forest birds also benefited from aerial 1080 operations with increased nest success for fantails for one or two consecutive seasons after 1080 operations. Sufficient data has been collected to write up the results for this part of the study.

Our proposed research focus for the next five years is to measure the benefits of lower sowing rates of aerial 1080 to kiwi chick survival (Kiwi Sanctuaries Strategy draft 2014-2019). The next proposed aerial 1080 operation is scheduled for September 2014, three years after the last 1080 operation. This adjustment to the timing of aerial 1080 operations is based on our previous research. Kiwi chicks will be monitored for two seasons after operations, however chicks will no longer be monitored during pre - 1080 seasons (non-treatment years) as we have established a good set of data showing results for kiwi chick survival in the absence of predator control (<= 22%). Fantail nest success will no longer be monitored.

The impact of ferrets on kiwi populations has been identified as a significant issue. To understand their unexpected incursions into TFKS it had been recommended to monitor rabbit abundance; sudden declines in nearby rabbit populations could be linked to any subsequent increase in ferret depredation of kiwi.

This season we have undertaken Operation Nest Egg™ as it is a non-treatment year. Eggs or chicks have been lifted from kiwi nests in TFKS, and the young chicks have been released at Wairakei Golf + Sanctuary. Kiwi were then released at Tongariro Forest when they reached 1200g (stoat proof weight). This has also provided an opportunity to continue to fulfil the original agreement with Maungatautari Ecological Island Trust to provide them with 20 western brown kiwi founders. So far we have gifted them with 13 kiwi, and they have gifted TFKS 14 kiwi; the offspring of the original founders.

In addition to this research, other work includes ongoing monitoring of adult kiwi for survival and breeding purposes, monitoring of sub-adult kiwi for survival, dispersal and breeding and kiwi call survey. Mustelid and rodent numbers are also monitored using tracking tunnels (small mammal indexing).

This report presents results from these key areas of work for the 2013/14 financial year.



FIGURE 1: LOCATION MAP FOR TONGARIRO FOREST KIWI SANCTUARY, CENTRAL NORTH ISLAND REGION

SANCTUARY OBJECTIVES AND ACTIONS (Kiwi Sanctuaries Strategy Draft 2014-2019 - DOC DM-1193783)

TABLE 1: TFKS OBJECTIVES BY 2019

Objectives	Status
1. Grow the kiwi population to 100 pairs by a combination of 1080 predator control and ONE in non-1080 years within the lifetime of this plan.	On-going. Current population estimate 192 (sub-adult and adult kiwi)
2. The benefits to kiwi populations of low sowing rates for aerial 1080 operations are measured and understood.	On-going
3. Rabbit monitoring is undertaken, to improve our understanding of the relationship between populations of this pest and any future ferret incursions.	Not started

TABLE 2: TFKS ACTIONS BY 2019

#	Actions	Accountability	Priority	Progress
4.1	Undertake low sowing rate aerial 1080 operations in late winter/spring of 2014 and 2017.	TBFree NZ	Essential	On track
4.2	Measure chick survival the season immediately after aerial 1080 operations in 2014 and 2017.	TFKS	Essential	On track
4.3	Undertake ONE in non-treatment years.	TFKS	High	On track
4.4	Implement rabbit abundance indexing in conjunction with Regional Council monitoring to determine whether rabbits act as predictor for ferret incursions. Undertake monitoring annually.	TFKS and Regional Council	Medium	Sanctuary budget reduction means this will not occur unless further funding found
4.5	Complete and publish the study on sub-adult survival, dispersal, territoriality and breeding age by 2016.	TFKS	Essential	Not started
4.6	Publish research on benefits of aerial 1080 on kiwi chick survival by 2014/15	TFKS & KRG	Essential	On track

ADULT KIWI MONITORING AND NESTING

A total of 29 adult kiwi were monitored in TFKS in 2013/14, consisting of 25 males and four females (Appendix 1). Of the 25 adult male kiwi, 20 have been found to be nesting this season. One adult male kiwi and one female had their transmitters fail during the 2013/14 season.

Ferret incursions

Between February 2009 and September 2011, there were 24 adult (60% of the monitored population) and two sub adult kiwi deaths; 13 of these were confirmed ferret predations. It is likely that many of the “unknown” deaths were due to ferret predation, but in some cases the condition of the carcass was such that the cause of death was unable to be confirmed.

This season, between April and June 2014, there were three kiwi deaths that were deemed likely to be or confirmed as mustelid or ferret predations. One was an adult male from the monitored breeding adult population, “Lucky” and two sub-adult kiwi. DOC 250 trap lines were then deployed near the sites where dead kiwi were found. No ferrets were captured.

These two incursions occurred from the third year following a 1080 operation.

Dog predation

On the 18th of June 2013, “Goff” was found dead in his territory on the eastern side of the Tongariro Forest. He had sustained some obvious injuries and was sent to Massey for necropsy. Upon examination, further injuries were discovered and it was determined that Goff had died due to a dog attack.

NESTING AND EGG OUTCOMES

For the 2013/14 season (non treatment), we have undertaken Operation Nest Egg™. Egg lifts took place after approximately 55 days of incubation. Lifted eggs were taken to The National Kiwi Trust at Kiwi Encounter where they were incubated and hatched in captivity. The subsequent chicks were released at Wairakei Golf + Sanctuary. Kiwi were then released at Tongariro Forest when they reached 1200g.

During this season, 18 viable eggs were taken to Kiwi Encounter. Four of these did not hatch. Due to the maximum capacity at the Wairakei Golf + Sanctuary being set at about fifteen chicks only a limited number of nests were monitored and eggs lifted.



Photo: Three eggs in Little Moa's nest

KIWI CALL COUNT MONITORING

Introduction:

Call surveys have been undertaken in Tongariro Forest Kiwi Sanctuary (TFKS) in 1993-1997, 2001, 2004-2007, 2011, 2013 and 2014 in an effort to detect long term population trends amongst Tongariro Forest kiwi. The Kiwi Best Practice Manual (2003) recommends that call surveys are to be done annually for three years, and then once every five years after that, to detect any large, long term changes in population density and distribution. However due to the deaths of 26 radio-tagged kiwi since 2009, it was considered advantageous to carry out the 2011 survey to better understand population dynamics, in order to repeat the 2008 territory mapping exercise. The 2008 territory mapping gave us a conservative population estimate of 180 kiwi.

In the years prior to 2013 these surveys were solely performed by human observers. For the 2013 and 2014 surveys, the seven human observer points were used in conjunction with automatic acoustic recording devices to make a comparison of the calls per hour and male to female ratio using the two different methods. In an effort to cover a greater area 16 additional acoustic recording devices were placed throughout the forest this season (Appendix 2). As it is an on-going trial needing some adjustment, only ten recorders were placed at the same location as last year and the rest were more evenly spaced throughout the forest. The same locations will be used for the call survey next season.

Method

Kiwi calls were recorded by human observers in TFKS at the seven locations previously used to conduct the kiwi call survey in 2011. Observers were listen at their designated locations for two hours per night from 1800 to 2000 for four consecutive nights (26th to the 29th of May 2014). Heavy rain prevented observers from listening on the night of the 29th May. A total of six hours were spent at each site. During the survey the weather was mainly fine and cold with light to no wind. Data and site location details are at DOCDM-1489274. Twenty three acoustic recorders were left in the forest from the 26th of May to the 25th of June and set to record from 1800 to 2200 each evening. Only data from the 26th of May to the 4th of June were analysed as there were enough fine nights during that period (nine nights) for optimal recording.

Results

Human versus Acoustic Recorders:

The human observers recorded 33 calls over a total of 42 hours giving a rate of **0.79 calls** per hour (Table 3). This was similar to 2011 results (0.77) and 2013 results (0.78) and had decreased when compared with 2007 results (1.21 calls per hour). The male to female ratio heard by human observers was 5.6:1. During the first two hours of listening, the acoustic recorders positioned at the human observer sites (n=7) picked up more calls than human observers; 52 calls over the 42 hours, giving a rate of **1.24 calls** per hour (Table 3).

More calls were picked up by recorders than humans (only 69.7% of the calls were heard by human observers whereas last year recorders picked up only 55% of the calls heard by humans). This is possibly due to better settings made to the sound programme Raven™ allowing the user to “zoom in” and pick up on very faint calls that a human observer is likely to miss and finding ways of scrolling through the sonograph very quickly (Jerome Guillotel pers.com.). *Two key*

settings were setting up the viewing page to one minute and highlighting and scrolling through 2 hours at a time.

For the call recorders that were set up (n=20) between the 26th and 28th of May, a total of 175 calls were recorded over 114 hours, giving a rate of 1.54 calls per hour. The male to female ratio was 4:1. When only considering the 10 recorders that were placed at the same location as last year, the call rate was 1.32 calls per hour this year compared with 0.53 calls per hour last season.

TABLE 3: COMPARISON BETWEEN HUMAN OBSERVERS AND ACOUSTIC RECORDERS FROM THE 26TH TO THE 28TH OF MAY (SEVEN SITES)

Human Observers:

$$\text{Calls Per Hour - Total} = \frac{33}{42} = 0.79$$

Acoustic recorders:

$$\text{Calls Per Hour - Total} = \frac{52}{42} = 1.24$$

This season, acoustic recorders were better positioned in relation to human observers and the results imply to continue the trial next year, therefore we will again use acoustic recorders in conjunction with human observers next year (May 2015).

Number of Kiwi Heard:

Analysing the overall data from nine nights of recording (23 recorders, 590 hours, 765 calls; 1.3 calls per hour - Table 4) and using a map of known kiwi territories in conjunction with estimated bearings and distances, the number of known and unknown kiwi has been established for the call recorders; a total of **65** individual kiwi were heard, 29 known and 36 unknown (assuming that a kiwi heard on a single recorder is always the same individual bird unless there is strong evidence to suggest otherwise).

Only two known females were not heard within the listening area. This gives a total of 67 kiwi within the study area.

TABLE 4: ALL ACOUSTIC RECORDERS COMBINED (DURING 9 FINE NIGHTS, 23 SITES)

$$\text{Calls Per Hour - East} = \frac{626}{350} = 1.79 \quad (15 \text{ recorders out of } 15 \text{ heard calls})$$

$$\text{Calls Per Hour - West} = \frac{139}{240} = 0.58 \quad (8 \text{ recorders out of } 8 \text{ heard calls})$$

$$\text{Calls Per Hour - Total} = \frac{765}{590} = 1.3$$

Population best estimate:

From previous call recorder surveys, kiwi practitioners' estimation of distances and topography of terrain, the range of the recorders is on average more realistically about 700 m (as opposed to 1 km as it was previously thought). This gives a circular listening area of 154 hectares and therefore a combined listening area of 1078 hectares for the human observers and 3542 hectares for the recorders. (Appendix 2).

Density= number of kiwi/surface area=67/3542=**0.0189 kiwi/hectare**

Within the sanctuary this can be extrapolated to about 10400 hectares which is known to contain kiwi that have or are settled evenly throughout (see sub-adult paragraph and Appendix 1); $10400 \times 0.0189 =$ **196 kiwi**. The remaining 7300 hectares situated mainly on the north west side of the forest (Owhango) and the south west border of the Sanctuary along the Whakapapa river (see Appendix 1) is considered as containing very few kiwi as none of the known kiwi have settled down in those areas so far. More needs to be done in terms of kiwi survey in those areas in order to have the most accurate estimation of the current population. The aim is to have more recorders next year (at least 50) evenly spread throughout the whole Tongariro Forest Kiwi Sanctuary.

SUB-ADULT KIWI MONITORING

Juvenile¹ and sub-adult² kiwi lifted from Tongariro Forest Kiwi Sanctuary (TFKS) as eggs, as part of the BNZ Operation Nest Egg™ (O.N.E) program, were released back into TFKS at between 1100g-1200g. A number of them have been radio-tagged to give data on the overall picture of population dynamics of kiwi (Robertson 2004), providing information on age at first breeding, survival and dispersal.

Ninety eight O.N.E sub-adults have been released since the creation of TFKS in 2000 (132 since the launch of O.N.E in the 1990's). Of the 132, 92 have been closely monitored, as well as 53 wild hatched sub-adults, which have been followed and treated as a separate sample in the study to determine if they behave differently. Fourteen sub-adults are currently monitored.

¹ 50 days < age > 183 days

² 183 days < age > 4 years (*reduced from 4.5 years to match new research findings and for consistency throughout the country*)

SURVIVAL RATES

Of the 150 (92 O.N.E., 53 wild hatched and five wild caught) continuously monitored sub-adults, 36 have died since 2000. The causes of mortality were predation (n=15), natural causes/misadventure (n=10) and unknown causes (n=11).

This season, four birds disappeared (could be from transmitter failure), one bird dropped its transmitter and four died (two were likely due to ferret predation). O.N.E. birds have a better survival rate 67.2% than wild hatched birds 58.9%. This could be due to the lower sample size for Wild Hatched birds (Table 5). As we advance through the experiment, it appears that males survive better through to adulthood than females. Survival rates were calculated using Kaplan-Meier procedure. Twenty eight males and fourteen females have been confirmed as reaching adulthood (4 years old or age of first breeding).

TABLE 5: SURVIVAL RATE OF SUB-ADULT KIWI IN TONGARIRO FOREST

	Survival Rates (SR %)	Female SR (%)	Male SR (%)	Sample size in transmitter years*
O.N.E (n=92)	67.2	62.6	71.5	156
Wild-hatched (n=53)	58.9	56.9	59.15	87
Wild caught (n=5)	N/A	N/A	N/A	9
Overall (n=150)	63.9	60.5	65.4	252

* Cumulated monitoring time from 1998 to 2014

TERRITORIALITY AND AGE AT FIRST BREEDING

We have sufficient information on territoriality for 56 kiwi, and age at first breeding for 27 kiwi (19 O.N.E. and eight wild hatched). We currently monitor seven wild hatched and seven O.N.E. sub-adults and one adult that have not started breeding yet.

Overall we currently have a sample size of 42 kiwi (27 O.N.E and 15 wild hatched kiwi) that can give us information on age at first breeding.

At present, the mean **age at first breeding** (n=27) is **3.71 ± 0.42** years old with not much difference between O.N.E and wild hatched kiwi. This is possibly an underestimate for O.N.E kiwi, as there is one bird which is 10.6 years old which has not yet started breeding, if it does the average would

markedly increase. Also seven O.N.E. kiwi between four years and ten years of age died before they started breeding. It appears that females start breeding at an earlier age (3.50 ± 0.39) than males (3.85 ± 0.66) (Table 6).

The mean age of **territoriality** (n=56) is 1.65 ± 0.19 years old, with no difference between wild hatched and O.N.E kiwi, but a slightly higher age for females (1.96 ± 0.25) than males (1.52 ± 0.28)- Table 6

TABLE 6: AGE AT FIRST BREEDING/TERRITORIALITY

	ONE		Wild hatched	
	male	female	male	female
Age at first breeding	3.84 (n=10)	3.51 (n=9)	3.86 (n=6)	3.47 (n=2)
Territoriality	1.54 (n=29)	1.96 (n=11)	1.45 (n=10)	1.98 (n=6)

Nine chicks from this season (2012/13) which have survived to sub-adulthood are currently scheduled to be released back from Wairakei into the TFKS.

DISPERSAL PATTERNS

The study of O.N.E sub-adult movements between 2002 and 2010 has shown most kiwi remain within an approximate 5000 ha area, situated on the eastern side of the forest, which is where O.N.E kiwi were initially released between 2002 and 2006. Approximately 10% of these kiwi have dispersed out of TFKS.

Since 2010, kiwi were released from the western side which was considered safer from ferret incursions. Their dispersal patterns (mainly through the western side), along with dispersal by wild hatched sub-adults, has allowed to re-define the distribution of kiwi within the sanctuary. An additional 3000 ha to the north of the Waione was revealed to be an extension of the 5000 ha area previously mentioned above and an approximate 1400 ha, situated around and south of quartz creek, has attracted a substantial number of birds which indicates the existence of a wild sub-population in that area (Appendix 1).

The total area within which kiwi have been known to distribute evenly is about 10400ha. Little is known about the rest of the Sanctuary partly due to the loss of many birds that had dropped or failed transmitters while dispersing. Only an extra small population around the Whakapapa intake is believed to subsist within the Sanctuary.

Outside the Sanctuary, two additional sub-populations could survive in the area north of OPC between the Mangatepopo and Whanganui Rivers and at the far north of the Sanctuary, in the Whangapeki area (Appendix 1).

The continuity of some sub-adults being monitored next season and a more extended kiwi survey will give us a more robust estimation of the population number and distribution by the end of the season 2014/15.

KIWI CHICK MONITORING

Kiwi chicks have been monitored Tongariro Forest Kiwi Sanctuary (TFKS) since 2005 to assess the effect of large scale pest control operations (aerial 1080) on kiwi chick survival. Kiwi chicks are exceptionally vulnerable to stoat predation (McLennan *et. al.* 1996). Aerial 1080 operations were carried out in September 2006 and 2011 respectively for possum control and also targeted rats and thus stoats via secondary poisoning.

The 2013/14 season was the third season after the 1080 operation carried out in September 2011.

KIWI CHICK MONITORING – WAIRAKEI GOLF + SANCTUARY

During the 2013/14 season (1st July 2013 to 30th June 2014) kiwi chicks were not monitored in the Tongariro Forest Kiwi Sanctuary (TFKS) and were instead released into Wairakei Golf + Sanctuary in Taupo (used as a kiwi crèche since 2012). Chicks were hatched at Rainbow Springs Kiwi Encounter and were released at two weeks old into Wairakei Golf + Sanctuary. They remained within the crèche until they reached 1200g at which time they were released into TFKS. Chicks were not monitored in TFKS due to the 2013/14 season being the third season of monitoring since the 1080 aerial operation in September 2011. With TFKS chick monitoring results for the 2012/13 season showing a survival rate of 27% dropping from 44% the previous season, the 2013/14 survival rate was likely to be very low, similar to that of the pre 1080 2010/11 season (19%).

MONITORING METHODS

DOC staff have been responsible for handling the kiwi and performing health checks at Wairakei with assistance from trained golf course employee Jeff Willis.

All chicks were captured regularly to obtain bill and weight measurements as well as replace the transmitters and straps as required. They were first caught once a month until they reached 850g and then every one to three months thereafter depending on the condition and sex of the bird. Signals were obtained twice a week on Mondays and Fridays by Jeff who notified the kiwi team as soon as possible if a mortality signal was detected. Any dead birds were sent to Massey University for necropsy to establish the likely cause of death.

CHICK OUTCOMES

This season a total of 12 TFKS chicks were held at Wairakei, all of which were a result of egg lifts followed by incubation and hatching at Rainbow Springs Kiwi Encounter. Not all nests detected in TFKS had eggs or chicks taken. The first chick was released into Wairakei on the 23rd of October 2013 and the last for the season on the 5th of March 2014.

As at the 30th of June 2014 two chicks had reached the safe weight of at least 1200g and been released back into TFKS. One chick, Hioby, was found dead on the 3rd of February. The post-mortem results showed no evidence of predation but his internal organs were too decomposed to be able to establish the exact cause of death. Another chick, Tailgate, had a failed transmitter, and she has not yet been found despite attempts at searching for her with a kiwi dog. The remaining nine chicks continue to be checked regularly, waiting to reach safe weight and be released back into TFKS.

POPULATION MODELLING

Between 2000 and 2005, the overall population was estimated to have increased at an average rate of 3.1% per annum (H.A Robertson, P.J. De Monchy, 2012). However, since 2005 a substantial amount of data has been accumulated within the Kiwi Sanctuary, giving us a much more robust sample size for the calculation of all the necessary parameters to study the TFKS population dynamic (data are from ONE/wild hatched birds combined). This, combined with the unforeseen ferret predation events, has contributed to the finding of a much lower growth rate since 2005.

LESLIE MATRICES:

We used a population matrix model. Data from different scenarios were analysed in life tables (Leslie matrices) in PopTools (Microsoft Excel add-in) which translated into a population growth rate (Table 7).

TABLE 7: LIFE HISTORY PARAMATERS AND POPULATION GROWTH RATES

scenarios	3 y. 1080 cycle with no ferret	3 y. 1080 cycle with ferret	5 y. 1080 cycle with no ferret	5 y. 1080 cycle with ferret	No management
Chick survival (0-1y. old)	0.309	0.309	0.235	0.235	0.124
Sub-adult survival (1-2y)	0.842	0.826	0.842	0.826	0.826
Sub-adult survival (2-3y)	0.909	0.924	0.909	0.924	0.924
Sub-adult survival (3-4y)	0.968	0.955	0.968	0.955	0.955
Annual adult survival	0.969	0.948	0.969	0.919	0.821
Life expectancy (years) <i>(based on Adult survival only)</i>	32	19.1	32	12.4	5.6
Leslie Matrix, λ	1.062	1.046	1.044	1.006	0.894
Annual population growth	6%	4.6%	4.4%	0.6%	-11.2%

**productivity of 0.52 chick per adult per year was also used in the matrices.*

Population modelling showed that the current five year 1080 cycle management has allowed the TFKS kiwi population to remain stable for the last ten to fifteen years with an annual growth of 0.6% (Table 5). With no management, the population would decline at a rate of 11.2% per year. The highest projected population increase (6%) would result from a three yearly 1080 cycle, if there were no ferret predations. Two confirmed ferret incursions from year three after the 2006 and 2011 1080 operations have had a significant impact on the adult kiwi of which survival is a determinant factor for the population to be sustainable. The projection for the new three year 1080 cycle experiment shows that there is real potential for the population to grow remarkably even in the case of ferret incursions from year three in every 1080 cycle (Figure 2).

It has become clear that the target of 200+ pair by 2017 won't be achieved; currently a revised best case scenario for achieving the above is 2030 (Figure 2). With no management, this population would decline to extinction in 20 years (Figure 2).

Tongariro Forest kiwi population scenario

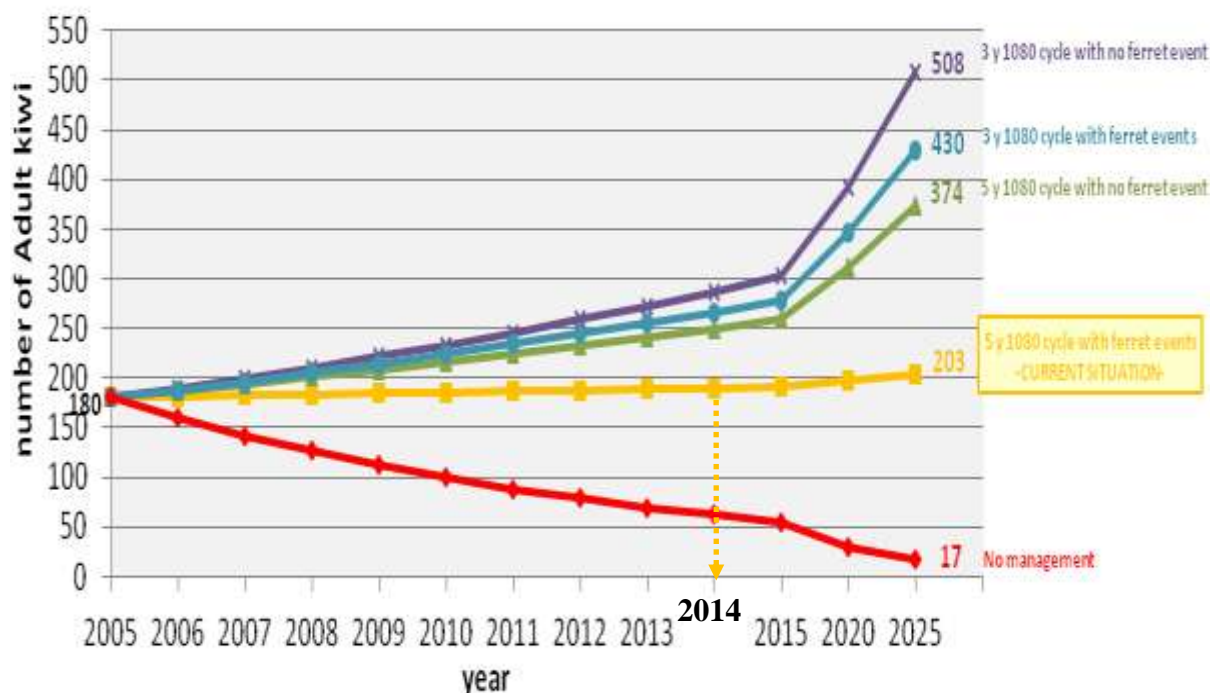


FIGURE 2: KIWI POPULATION PROJECTION BASED ON UPDATED RECRUITMENT RATES WITH 1080 OPERATIONS, SURVIVORSHIP AND PRODUCTIVITY.

Note that as this population has remained stable over the last 10 years, the year 2005 can be replaced by year 0 and this would show the trend for the next 20 years.

CRITICAL PARAMETERS:

Two critical parameters are illustrated below which show survivorship in relation to the post-1080 years. Year one and two after a 1080 operation are making a significant difference and are critical in terms of reducing the impact of stoat and ferret predation on chicks (Figure 3) and adults (Figure 4). It has become evident that from year three onwards the effect of 1080 has disappeared and rates are back to pre-1080 years.

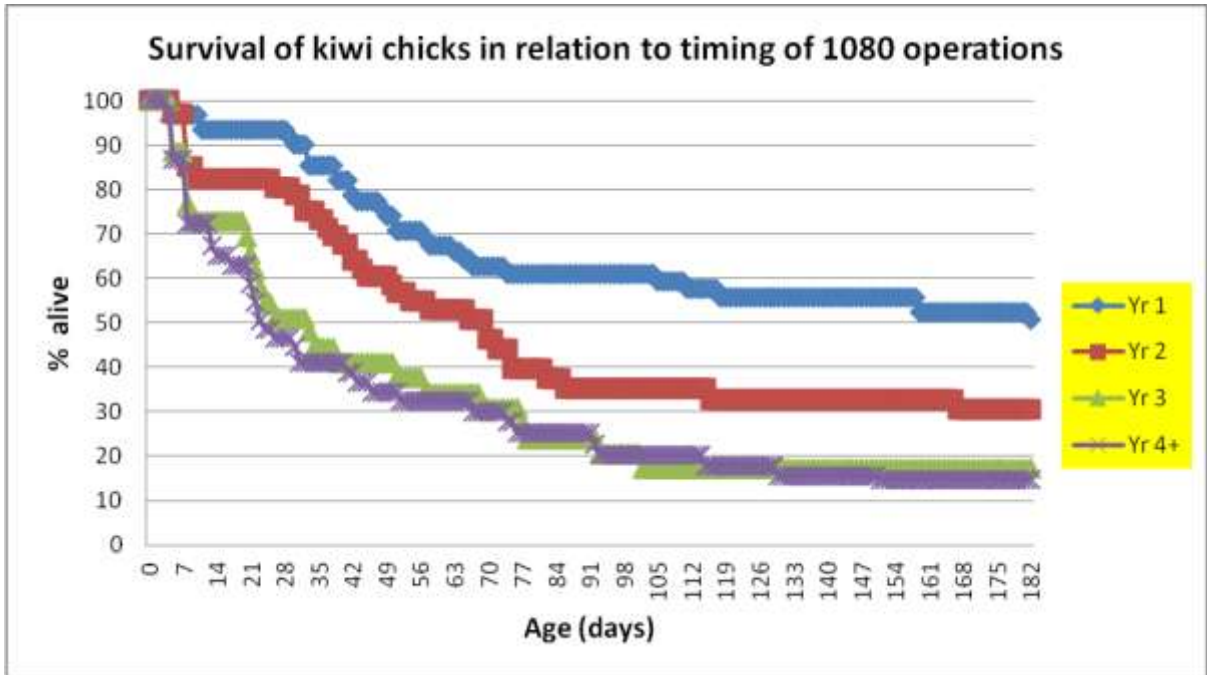


FIGURE 3: KIWI CHICK SURVIVAL RATES FROM 0 TO 6 MONTHS OLD IN YEARS 1 TO 4 POST-1080 OPERATION.

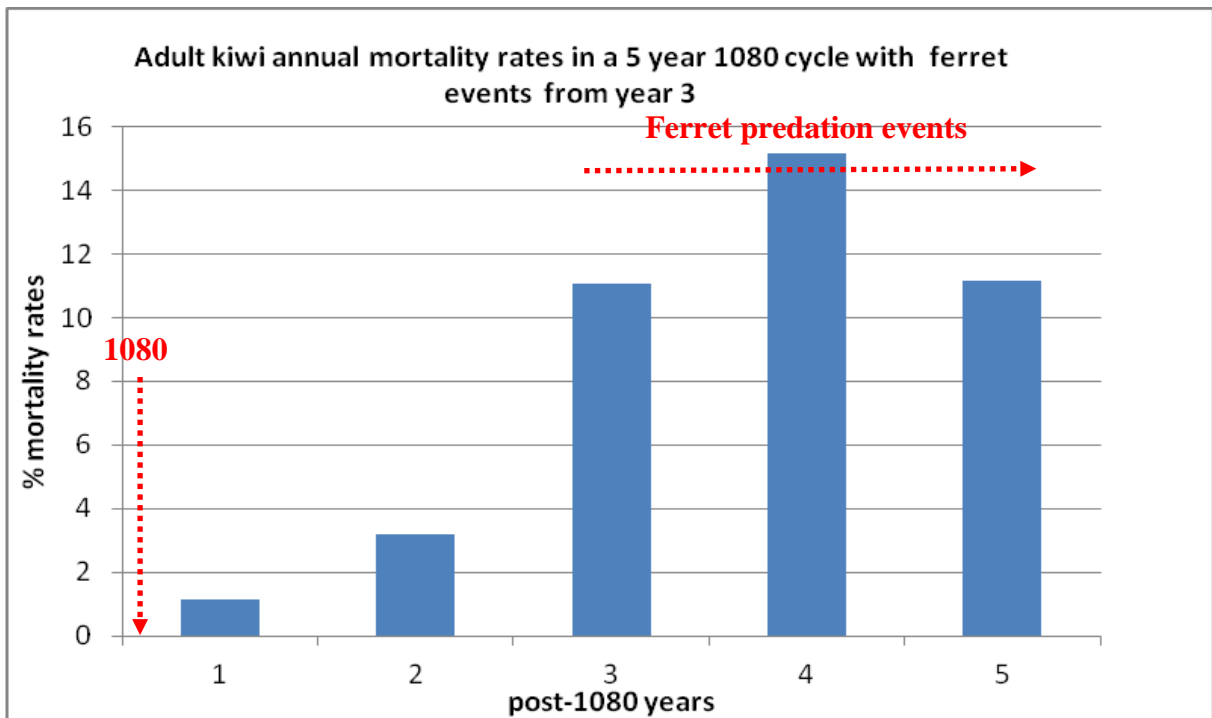


FIGURE 4: ADULT ANNUAL MORTALITY RATES IN YEARS 1 TO 5 POST- 1080 OPERATION WITH FERRET PREDATION EVENT FROM YEAR 3.

SMALL MAMMAL INDEXING (SMI) USING TRACKING TUNNELS

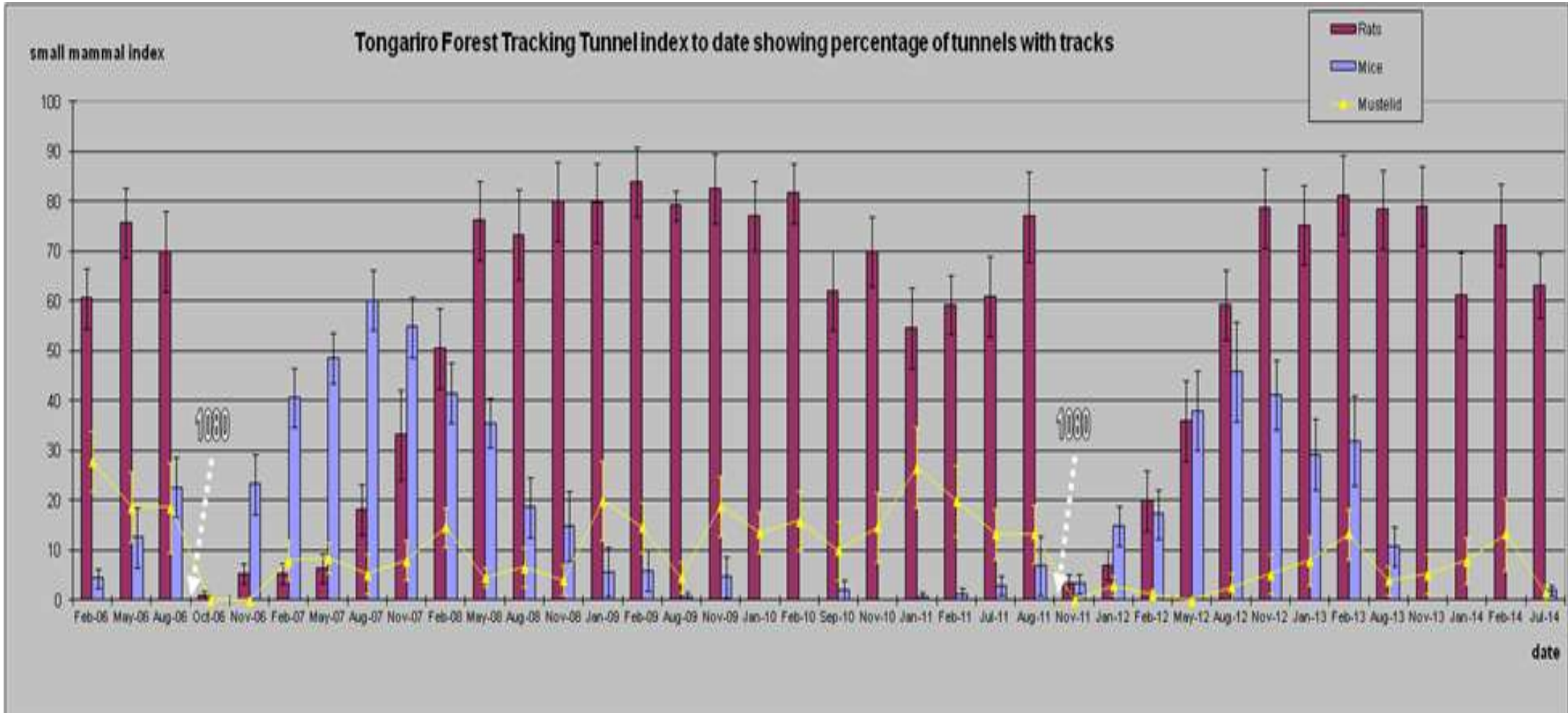
Tracking tunnels for indexing rodent and mustelid (weasel, stoat and ferret) abundance were run on the 'Operation Ark' timing (i.e. January, February, August and November) to catch the peak in stoat abundance. Methodology follows current DOC best practice (Gillies & Williams 2001). There are 15 lines within Tongariro Forest Kiwi Sanctuary (TFKS); each line is 450m long with ten tunnels, giving a total of 150 tunnels. Tracking tunnels have been run in TFKS since 2001.

TRACKING TUNNEL RESULTS THREE SEASONS AFTER THE 2011 AERIAL 1080 OPERATION (2kg/hectare of pellets)

In September 2011 TFKS was aerially treated with 1080. The result was a major decrease in both rat and mustelid tracking rates (Figure 5), rats were knocked down to 3.3%; they were tracking at 60% or greater prior to the operation. The mustelid tracking rate peaked at 27% in January 2011, but none were detected in any of the tunnels after the aerial 1080 operation (0% tracking rate) and adult deaths from ferret predation ceased instantly.

At this stage of the experiment, rat tracking rates remain high (around 70%) but not as high as previous operations (about 80%) and mice have disappeared while the mustelid population increases steadily over time and has peaked at 13.33% in February this year (Figure 5). Ferrets have come back in April this year (third season post-1080) and once more, are killing adult kiwi. The next 1080 operation is scheduled for August this year. With 1080 now being every three years, any ferret incursion events will not last as long as previous events (when 1080 operations were on a five-year cycle). It is expected that numbers of mustelids such as ferrets and stoats will be greatly reduced as a result of the 1080 operations. Whether or not the kiwi population will experience two good years of reproduction will depend on the time of re-colonisation from rats (previous operations have shown that it takes between 12 to 18 months for the rat population to recover) followed by mustelids.

FIGURE 5: SMALL MAMMAL INDEXING RESULTS, TONGARIRO FOREST KIWI SANCTUARY, FEBRUARY 2005 – AUGUST 2014



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