

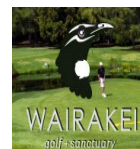
# TONGARIRO FOREST KIWI SANCTUARY ANNUAL REPORT

July 2018– June 2019

TONGARIRO DISTRICT OFFICE, CENTRAL NORTH ISLAND REGION



Ngati Hikairo ki Tongariro



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**Cover photo:** Clockwise from Top left: Kiwi ranger William Kahu holding a chick ready for release, James McLaughlin after a long night listening and kiwi capture in harsh condition with his dog Tui, Ferret caught in one of the strategically placed DOC 250 traps within Tongariro Forest, young volunteer Janette helping lifting eggs from breeding male Thunderbird and contractor Jeff Willis checking ferret traps on bordering farms.

## **PARTNERSHIPS**

Partnerships between the Department of Conservation and Ngati Hikairo, The National Kiwi Trust at Kiwi Encounter, Sanctuary Mountain Maungatautari, Project Tongariro, Wairakei Golf + Sanctuary and Kiwis for Kiwi Trust continue to be an essential part of the work in the Tongariro Forest Kiwi Sanctuary (TFKS).

### **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 via Operation Nest Egg™ (ONE). This season (2018/19), 39 kiwi eggs were taken to Kiwi Encounter and 29 chicks hatched successfully.

### **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 transporting kiwi eggs and chicks to and from The National Kiwi Trust at Kiwi Encounter and carrying out other advocacy work.

### **SANCTUARY MOUNTAIN MAUNGATAURI (SMM)**

Maungatautari is a forested volcanic cone in the Waikato and has been the site of an ecological restoration project aiming to eliminate all mammalian predators and re-introduce native species. In 2006, the Department of Conservation and Ngati Hikairo made an agreement with Ngati Koroki-Kahukura to contribute 20 founders to the kiwi population at SMM and have so far gifted 19 kiwi. In return, since 2010, 14 kiwi (the offspring of some of the original founders) have been released into TFKS.

However, since 2017, SMM has been transitioning to a five-year widescale ONE programme launched by the national charity trust “Kiwis for kiwi”, which should see its permanent kiwi breeding population boosted to 500 in the next five years. This is part of a long-term national

project focusing on growing source populations (Kōhanga) of brown kiwi in fenced sanctuaries and offshore islands which eventually will allow translocations all surplus offspring into predator controlled wild sites in the North Island. To stock SMM, which is a Kōhanga site for Western brown kiwi, the aim is to catch and put transmitters on at least 100 male kiwi in the Tongariro, Taranaki and Whanganui areas.

Seven new birds were caught this season at TFKS among which two are male breeders.

However, Ngati Hikairo have indicated that, at this time they will not support further transfers of kiwi from TFKS to Maungatautari over and above the original 20 founder agreement. Thus, no more birds will be caught in the coming season 2019/20.

## **NATIONAL KIWI CAPTIVE MANAGEMENT PROGRAMME**

Since 2010, there has been a nationwide initiative to release brown kiwi of Western Taxon 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. Thirteen kiwi including one breeding pair have been released at TFKS since 2012. For the first time this year, two kiwi were translocated from Willowbank Wildlife Reserve at Christchurch (all the others came from Otorohanga kiwi house).

## **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. This has created a pest free environment which can be used to benefit threatened plants and animals. The sanctuary is utilized as a kiwi crèche when undertaking Operation Nest Egg™. This season, a pair of breeding adults (that were lost as sub-adults within the Wairakei sanctuary) from the 2013/14 and 2015/16 cohorts were re-captured by a dog handler and released back into TFKS.

## **OWHANGO ALIVE**

Owhango Alive is a community driven association aiming at protecting the Ohinetonga reserve by the Owhango village, which is one of the two main gateways into the Tongariro Forest. The bridge over the Whakapapa river, linking the reserve to TFKS, is one of the main incursion routes for pests, in particularly ferrets. Thus, the intensive trapping regime undertaken by the volunteers has become crucial in the battle against pests re-invading the Tongariro Forest. Last season, 18 ferrets were captured in Ohinetonga reserve and the nearby farms, mainly in autumn and early winter.

## EXECUTIVE SUMMARY

Tongariro Forest Kiwi Sanctuary (TFKS) was established in 2000 for the development and testing of kiwi protection techniques, namely the use of Operation Nest Egg™ (ONE) and aerial 1080 operations. Up to 2010, TFKS aimed to achieve and maintain a representative sample of 200+ pairs of Western North Island brown kiwi by 2017 (Tongariro Forest Kiwi Sanctuary Operational Plan, 2009) and to involve the community and enhance public awareness. This target has been significantly compromised by ferret predation events in 2009-10-11 and 2014 leading to the revised objective in 2014 of growing the population to 100+ pairs by 2019 (National Kiwi Sanctuaries management plan 2015-2020). However, it became clear last season, following other ferret episodes in 2016/17 and 2017/18 that the target 100+ pairs wouldn't be achieved unless ferrets were controlled efficiently. Therefore, a long-term ferret trapping regime (Following Tongariro Forest Long-term Ferret Trapping Plan, June 2018) has been implemented this year since the end of the winter 2018.

A key research focus of TFKS is to assess the effectiveness of cyclic landscape-scale aerial 1080 (19,840 ha) operations on kiwi chick survival and long-term population growth. The population stopped declining in response to five-yearly aerial 1080 operations undertaken between 1995 and 2011, although this appeared insufficient for population recovery (TFKS annual reports 2013/14 and 2015/16). Therefore, the programme shifted to a three-yearly cycle from August 2011, aimed at achieving an annual growth rate of 4% (Population Modelling, TFKS annual report 2015/16), taking in account the ferret predation events that seemed to occur in year three after 1080. An additional regime of continuous ferret trapping was also recognized as a possibility to further increase population growth to 6 % (TFKS annual report 2017/18).

However, after the August 2017 1080 operation (third drop since the new 3-year cycle experiment was initiated in 2011), ferrets re-invaded the west side of the Tongariro Forest within seven months and killed 11 kiwi. This shows that ferret incursions could happen at any stage of a 1080 operation and that solely three-yearly 1080 may not be sufficient to prevent the TFKS kiwi population from becoming locally extinct. A permanent ferret trapping network in addition to 1080 operations has become essential and this was implemented this season 2018/19.

Twenty-six adult kiwi males were monitored in TFKS in 2018/19 (18 breeding males). There were 23 confirmed nests this season with a total of 39 eggs, resulting in 25 successfully hatched chicks being monitored at TFKS in the 2018/19 season. The survival rate was 51%, which is a very good result for year two after a 1080 operation.

Twenty sub-adults were also monitored this season for recruitment into the tagged breeding population. This monitoring also provides information about distribution of kiwi across the

forest and survivorship. Of these, two died from ferret predation, one died from dog predation, two died from misadventure and one died from unknown reason. Additionally, one lost its transmitter and two were lost.

Small mammal tracking rates continued to be measured in TFKS this year. After the initial rat knock down (0% of tracking rate) after the 2017 1080 operation in August 2017, rat tracking rate reached pre-1080 levels in September 2018 (70%), 13 months after the operation. This caused the mice to decline dramatically from above 40% tracking rate at its peak, to 7 % in January 2019. Mustelids tracking prints have been mostly undetected since the 1080 drop, with tracking rates only reaching 4% in January 2019, which suggest that stoats are taking longer to recover compared to previous operations. This year, an additional pest mammal monitoring method has been trialled using camera traps deployed along the SMI lines and this has shown much more sensitivity than tracking tunnels to detect mustelids.

## 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).

This involves determining survival rates of kiwi chicks before and after aerial 1080 operations (Table1). TB Free NZ in conjunction with the Department of Conservation carried out aerial 1080 operations as part of their regional TB-vector/possum control regime and for kiwi protection research in 2001, 2006, 2011, 2014 and August 2017 (Appendix 1). 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. Initial results have shown that aerial 1080 operations have benefited kiwi chick survival for two consecutive seasons in TFKS and other forest birds have also benefited from aerial 1080 operations with increased nest success for fantails for one or two consecutive seasons after 1080 operations, depending on the timing of the rat re-colonisation (Robertson *et al.* 2019).

Our research focus for the five years from 2014 onwards was to measure the benefits of low sowing rates of aerial 1080 to kiwi chick survival (Scrimgeour *et al.* 2015). We have moved from distributing 4kg/ha of toxin bait in 2006, to 2kg/ha in 2011 and down to 0.75kg/ha (with strip sowing) in 2014, monitoring chick survival in response (Table2).

However, the focus for testing and pushing for low sowing rates has been re-examined and it was decided, based on the latest results from TFKS and from the national predator control programme called “Battle For Our Birds” (BFOB) or Tiakina Nga Manu, that the recommended sowing rate for the proposed 2017 1080 operation would be 1.5kg per ha, with even broadcast sowing.

Other work includes ongoing monitoring of adult kiwi for survival and breeding purposes, monitoring of sub-adult kiwi for breeding recruitment and carrying out kiwi call surveys. Mustelid and rodent numbers are also monitored using the standard tracking tunnels methodology (small mammal indexing) and trialling a 11-day mustelid survey using camera traps along the existent tracking tunnel transects.

A review of work led by Andy Cox in the TFKS was undertaken in October 2017. The key recommendations emphasised for the current kiwi research to continue and focus on the need for effective ferret control, as it has become crucial to re-establish a high survival rate among

the adult population (i.e. > 95%) in order for the TFKS population not to become extinct. This needs to be a research-based approach to be applicable to other sites across the country (Table 1).

This report presents results from these key areas of work for the 2018/19 financial year.

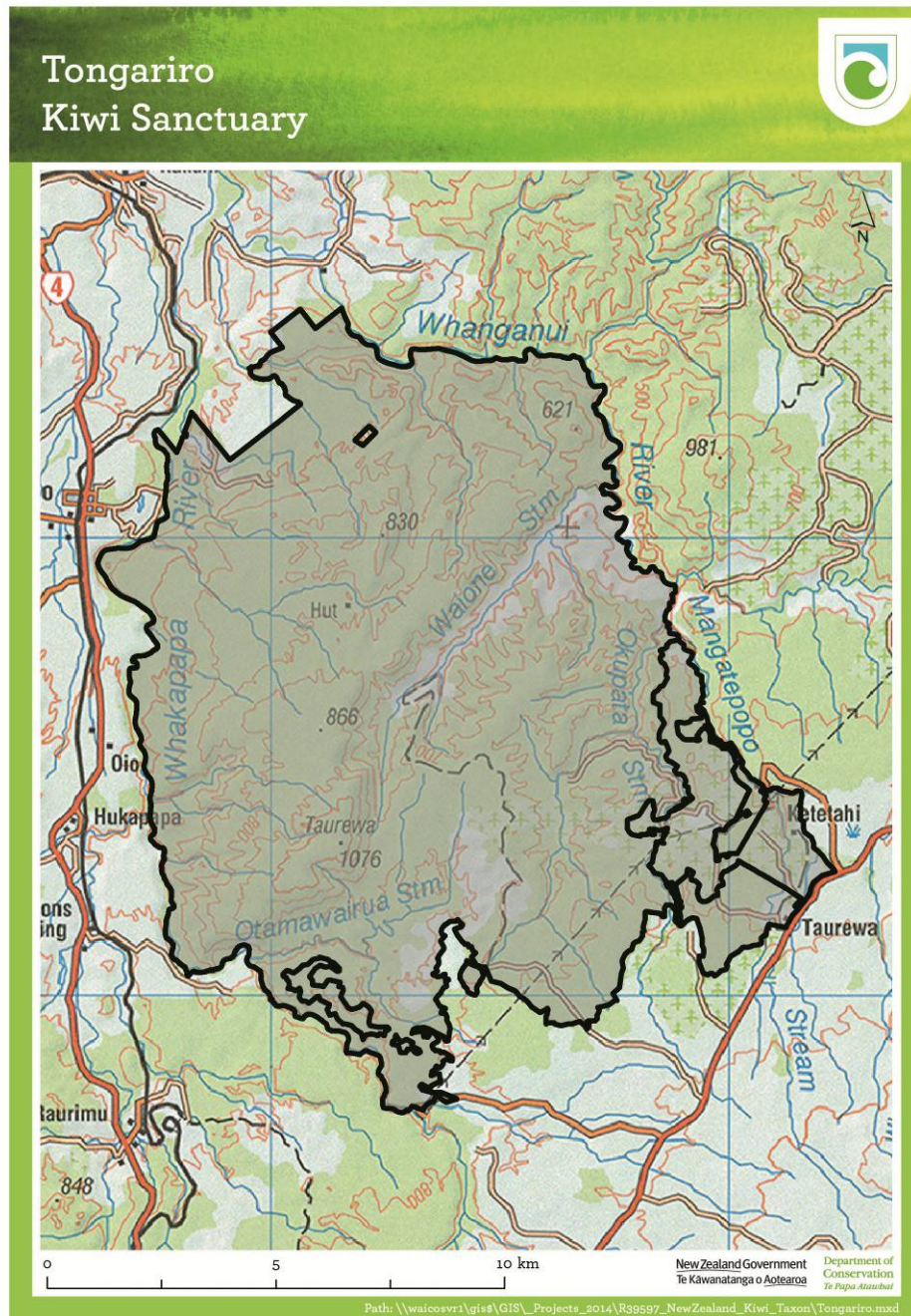


FIGURE 1: LOCATION MAP FOR TONGARIRO FOREST KIWI SANCTUARY, CENTRAL NORTH ISLAND REGION



## SANCTUARY OBJECTIVES AND ACTIONS

(National Kiwi Sanctuaries Management Plan 2015-2020 -DOC-1570100, Tongariro Forest Kiwi Sanctuary Ferret Trapping Plan -DOC-5510459, Kiwi Recovery Group Advise-Tongariro Forest Ferret Trapping -DOC-5541741, Tongariro Forest Kiwi and Whio review -DOC- 3207066)

TABLE 1: TFKS OBJECTIVES FOR 2020

<b>Purpose</b>
<ol style="list-style-type: none"> <li>1. Investigate the efficacy of 1080 as a tool to protect and recover kiwi populations (mainly by measuring chick survivorship).</li> <li>2. Investigate ferret control techniques to protect the TFKS adult kiwi breeding population.</li> <li>3. Protect a population of Western brown kiwi at Tongariro Forest.</li> </ol>
<b>Objectives</b>
<ol style="list-style-type: none"> <li>1. The benefits to kiwi populations of low sowing rates for aerial 1080 operations are measured and understood.</li> <li>2. The study is robust with adequate sample sizes and repetition to allow for clear conclusions and is applicable to other sites in New Zealand.</li> <li>3. Our understanding of the relationship between rabbit populations and any future ferret incursions is improved.</li> <li>4. Adult survivorship has improved by minimizing ferret impact.</li> </ol>

TABLE 2: TFKS ACTIONS FOR 2020

#	Actions	Accountability	Priority	Progress
4.1	Continue 3-yearly aerial 1080 with the next operation in 2020	DOC	Essential	On track
4.2	Measure chick survival for the two seasons after the 2017 aerial 1080 operations.	TFKS	Essential	achieved
4.3	Implement permanent trapping regime to control ferret inside TFKS and on surrounding farmlands	TFKS	Essential	On track
4.4	Measure chick survival during the 3 <sup>rd</sup> year after the 2017 aerial 1080 operation in relation to ferret trapping.	TFKS	High	On track
4.5	Implement rabbit survey in the surrounding landscape annually. Collaborate with Landcare research on ferret research opportunities	TFKS, Regional Council	High	Need additional funds to implement

4.6	Complete and publish the study on sub-adult survival, dispersal, territoriality and breeding age by 2016.	TFKS	Essential	On hold
4.7	Publish research on benefits of aerial 1080 on kiwi chick survival by 2014/15	TFKS & KRG	Essential	Achieved- Published January 2019

## **SMALL MAMMAL INDEXING (SMI) USING TRACKING TUNNELS**

Tracking tunnels for indexing rodent and mustelid (weasel, stoat and ferret) abundance are run during January, February, August and November to catch the peak in mustelid abundance. Methodology follows current DOC best practice (Gillies & Williams 2001). There are 15 lines within TFKS; each line is 450m long with ten tunnels, giving a total of 150 tunnels. TFKS is entering its 19<sup>th</sup> year of small mammal indexing data gathering, making it one of the longest tracking tunnel data sets in the country. This supports and increases our knowledge and understanding of small mammal population dynamics in relation to aerial 1080 use.

### **TRACKING TUNNEL RESULTS, SECOND SEASON AFTER THE AUGUST 2017 AERIAL 1080 OPERATION USING 1.5 KG/ HECTARE OF PELLETS (Appendix 1).**

The post-1080 season immediately after the August 2017 operation was a great success in terms of rat reduction as for the first time, rats were knocked down to a 0% tracking rate. This allowed mice to increase rapidly with tracking rates staying well above 40% until September 2018, when rats reached pre-1080 levels (about 13 months after the 1080 operation) and caused the mice population to decline (January 2019 results showed tracking at about 7%). Figure2.

Mustelids were also well suppressed immediately after the drop and their tracking rate has remained very low since (no prints were detected in five of the eight tracking tunnel operations that followed the 1080 drop). The mustelid tracking rate has risen to a mere 4% on February 2019, well under the usual 10-12% reached during the second post 1080 summer. The more sensitive outcome measure of kiwi chick survival also suggests that stoat numbers haven't recovered as quickly as they have done in precedent 1080 operations (see Chick Monitoring Section).

#### **Camera trap lines:**

During last season, another trial led by Craig Gillies has been conducted to assess the feasibility and practicality of using camera traps (for 10 consecutive nights) to monitor relative abundances of feral cats and mustelids. Camera trap lines were set along the 15 tracking tunnel lines consisting of four camera stations set at 200 metre spacings. Each camera was directed to a lure (fresh and dry rabbit meat) pegged to the ground about 60 cm in front of the device.

This has shown a real difference in mustelid detection sensibility and has allowed us to accurately identify weasels and stoats, whereas the traditional three- night tracking cards had detected none or little undifferentiated mustelid prints (Table3).

TABLE 3: COMPARISON BETWEEN THREE NIGHT TRACKING RATES AND 10 NIGHT CAMERA TRAPS:

	<b>3 night</b>		<b>10 nights (cameras)</b>	
	<b>mean % tracking per line</b>	<b>% lines tracked</b>	<b>mean % tracking per line</b>	<b>% lines tracked</b>
<b>Sept-18</b>	0	0	18.33	46.7
<b>Nov-Dec-18</b>	0	0	18.26	46.7
<b>Jan-Feb-18</b>	4	13.3	7.2	26.7

Other animals such as cat, dog, ungulates, rabbits, kiwi, tomtits, robins, fernbird, morepork and riflemen were also detected. Robins (which were detected in 73% of the lines in February 2019) and tomtits were spotted in such good numbers that camera traps could be also used to monitor their relative abundance overtime throughout the forest (Table 4).

TABLE 4: ROBINS AND TOMTITS DETECTION RATES ON CAMERAS

	<b>Robins</b>		<b>Tomtits</b>	
	<b>mean % tracking per line</b>	<b>% lines tracked</b>	<b>mean % tracking per line</b>	<b>% lines tracked</b>
<b>Sept-18</b>	8.3	41.7	9.4	41.7
<b>Nov-Dec-18</b>	10	26.7	1.7	6.7
<b>Jan-Feb-18</b>	26.6	73.3	3.3	13.3

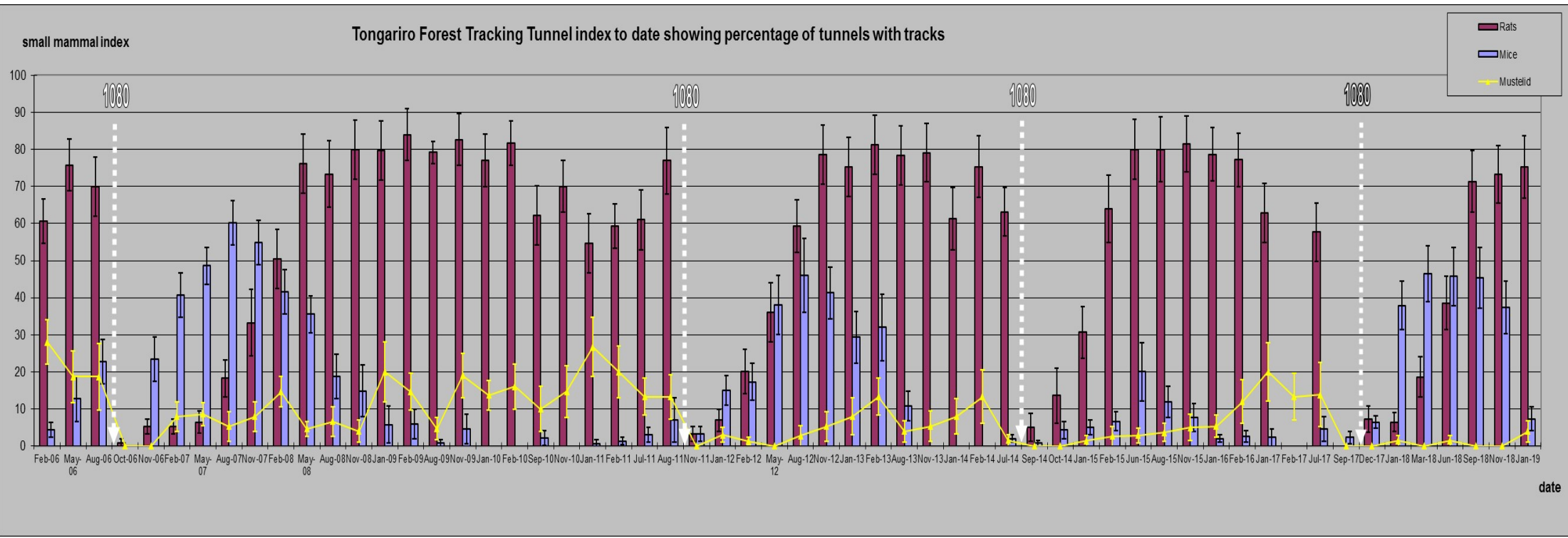


FIGURE 2: SMALL MAMMAL INDEXING RESULTS, TONGARIRO FOREST KIWI SANCTUARY, FEBRUARY 2005 – FEBRUARY 2019

## ADULT/SUB-ADULT KIWI MONITORING AND NESTING

In the 2018/19 season a total of 54 birds were tracked with radio transmitters, comprising of 34 adults and 20 sub-adults. This season six sub-adult kiwi died; two from ferret predations, one from dog predation, two from misadventure and one from an unknown reason. Additionally, one lost its transmitter and two were lost.

Of the 34 adults, 26 were male and eight were female (Table 5). Nineteen of the males had nesting signals obtained and 18 of these resulted in confirmed nests with eggs lifted and taken to Rainbow Springs Kiwi Encounter or chicks tagged at nest (Table 6).

Four adults were released back into TFKS from captivity (two from Willowbank and two from Wairakei) and seven were caught by a kiwi dog handler contracted by Kiwis for Kiwi (Table 8). Four adults died last season (3 males, one female), of which two were breeding males which were preyed upon by ferret on the western side of the forest (September/October 2018). This was the last fatalities of a series of casualties that caused the death of two sub-adults in August 2018 and of nine adult kiwi between March and May 2018. This was the first time that ferret incursions occurred within the first year following a 1080 operation. However, since October 2018, no kiwi died. This corresponded to the start of the implementation of the Tongariro Forest Long-term Ferret Trapping Plan (Beath 2018) towards the end of the winter 2018.

TABLE 5: MONITORED ADULT AND SUB-ADULTS 2018/19

Adult males		Adult females	Sub-adults	
Speedy	Lego	Oligo	Tokatoka ♂ *	Co3 ♀***
Hiver	Thunderbird	Mighty Dash*	Haututu ♀*	Har2 ♂
Zazu	Vontrapp***	Pohonga	Raumati ♂	Zaz1
Dino	Marohirohi	Ice***	Makariri ♀***	Ltm10 ♂
Dani	Kumara	Irirangi**	Ottoman ♂	Co4
Rocket	Harley	Tailgate**	Ottawa ♀*	Mtk1
Comet	Strike**	Georgie**	Azbro***	
Catamarca*	Jocko**	Zette**	Teh6***	
Pumpkin	Joe**		Elera ♀	
Little moa	Matata**		Saros ♂	
Te Hokinga*	Ruwhehua**		Dn16 ♀*	
Koroki	Te Aukaha Junior**		Rk17 ♀*	
Matariki			Mr21 ♀*	
Peter Pan*			Mx40 ♂*	

\* Died during season

\*\* Newly tagged this season

\*\*\* Dropped transmitter, failed transmitter or transmitter removed

## **FERRET INCURSION RESPONSE AND IMPLEMENTATION OF A LONG-TERM FERRET TRAPPING REGIME**

During the three preceding 1080 cycles, ferret predations seemed to be episodic and were only recorded from year three after each operation, suggesting that adult mortality from ferrets was always suppressed during the first two years of a 1080 operation. However, the 2017/18 season didn't follow this pattern, and just seven months after the August 2017 1080 drop, ferret predations occurred in different parts of the western side of TFKS, resulting in seven confirmed kiwi deaths from ferrets and four suspected ones (including seven breeding males).

This shows, despite the effectiveness of 1080, that ferret could re-invade TFKS at any stage of a 1080 operation and that it has become urgent to undertake further ferret control to prevent the population from becoming locally extinct. Since 2009, 54 monitored kiwi deaths (including 42 adults) have been attributed to ferret predation. It is unknown what impact ferrets have had on the unmonitored portion of the population. Appendix 3.

This season, two sub-adults were killed on the western side of the forest in August 2018 (2<sup>nd</sup> and 21<sup>st</sup>) along Top track (near Rocket and Thunderbird breeding territories) and 10 men hut area (near Peter Pan breeding territory). In addition to the permanent DOC 250 trap line already established along the Top Track and past Ten-Man Hut, about 25 cage traps and 5 DOC 250s were deployed at the kill sites and inside the three adult breeding territories to add extra protection. As part of the response, nearby kiwi were also checked as often as possible. One ferret was captured in one of the permanent DOC 250 traps on Top track near Rocket and Thunderbird territories (which are still alive at the time of writing). This was almost simultaneous to the killing of the sub-adult near-by. However, on the 20<sup>th</sup> of September, Peter Pan was killed by a ferret very close to the other sub-adult preyed upon earlier in August, indicating that a second ferret was still roaming around Ten-Man Hut. About ten DOC 250s were deployed at the kill site and near-by along the edge of the Taurewa ridge overlooking the Waione valley and directly above the end of Lucky's track to protect the numerous birds living down the bottom. No ferret was caught but to date no kiwi were proven killed by ferret in that area, suggesting that the limit of that ferret territory might have coincided with the top of the main ridge separating the western side from the eastern side of the Tongariro Forest.

In the meantime, another breeding adult (Catamarca) was killed by a ferret on the 1<sup>st</sup> of October in a less accessible area near the Whakapapa river about three kms south of Quartz creek. This suggest a third ferret was still present within the Tongariro Forest. In response and in addition to the traps already deployed where other kiwi were killed in May 2018 (only accessible by helicopter), about ten traps were set in Comet's territory near its nest, one kilometer north-east from the kill site, as it was the last monitored kiwi within that zone. To date no ferret was trapped and Comet is still alive. Predation has ceased since then as more permanent traps have been deployed through winter 2018 and at the start of spring, with about 280 DOC 250s being scattered around the surrounding farmlands, Owhango community (traps ran by Owhango

Alive) and within TFKS. As the season continued, more DOC 250s were laid out in the forest and bordering farms, extending the number of traps to about 400 by June 2019. This resulted in 18 ferrets caught (using DOC 250s and live traps) by Owhango Alive in Ohinetonga reserve and adjacent farms in autumn/early winter 2018 and 12 caught by DOC staff and contractor Jeff Willis within the TFKS and nearby farms. In total 61 ferrets were caught on the western side of the forest (n=16) and the nearby farms (n=45) since August 2016 when the first predation occurred on that side of TFKS (Appendix 4).

### **Trapping methodology and Discussion:**

#### *Tongariro Forest long-term ferret trapping plan DOC-5510459*

In the last three years, an unprecedented buildup in the ferret population on the surrounding farm landscape caused an increasing number of ferrets to disperse and expand their range further and further into TFKS. This has resulted into 25 radio-tagged kiwi (17 adults) preyed upon during that time. Therefore, the combination of a 3 yearly 1080 drop and a re-active trapping approach in response to kill events have not been effective enough to stop ferret expansion within the TFKS, and dispersal into TFKS. It appeared that a permanent trapping network would be more adequate to protect adult kiwi on a largescale and this seems to be achievable within Tongariro Forest as it is well bordered by major rivers which are likely to be natural barriers to ferret. In order to achieve this ground-breaking landscape-scale ferret trapping (this has never been attempted over an area of 20000ha before) with limited resources, the trap locations needed to be strategically selected to target preferred ferret sites such as open landscapes on surrounding farmland and boundaries of TFKS. Ferret dispersal pathways (linking directly the surrounding farms to the forest) and “hotspots” within TFKS were also identified as a priority. The main focus is to reduce the density of ferrets on bordering farmlands so that vacant territories outside the forest would be available again for young ferrets (in search of new territories) to fill. This would considerably decrease pressure on the TFKS boundaries and should reduce, in the medium-term, ferret dispersal into the forest. The other important focus is to target ferrets that are already present in the forest by reinforcing the number of traps in known ferret “hotspots” (the locations being decided based on previous kiwi kills, ferret sightings and ferrets captures). The camera traps (trail cams) that have been used on existing tracking tunnel lines since August 2018, could be a useful additional tool for monitoring ferrets.

Based on this, the proposed permanent ferret management regime was decided during winter 2018 and about 280 DOC 250s were deployed by October 2018. Traps have been added and moved as needed (i.e. if a ferret was caught at a site, more traps would be shifted into that area if not enough already in place) and more have been set up on surrounding farmlands, in particular the farms adjacent to the north margin of the forest. The trapping on Landcorp farm directly south of the forest has been also increased considerably as it provides an ideal ferret



dispersal route that funnels into TFKS without encountering any major obstacles. To date about 400 DOC 250s have been set up and are checked at least once a month. Appendix 4.

In the absence of ferrets, the estimated annual adult survival rate (SR) is 96.9% (using the Mayfield method) and the mean life expectancy is 32 years. Since 2006, ferret pressure has increased greatly and reduced the mean adult life expectancy to 10.8 years (Table 6).

TABLE 6: IMPACT OF FERRETS ON KIWI ADULT LIFE EXPECTANCY (*updated Oct. 19*)

	Before Sept 2006 (no ferrets)	To date (ferrets)
Annual survival rate (%)	96.9	90.74
Life expectancy (years)	32	10.80

SEE APPENDIX 2 for different population modelling scenarios.

## NESTING AND EGGS OUTCOME

During the 2018/19 season there were a total of 23 confirmed nests from 18 different males. A proportion of the eggs were lifted from nests in the wild and taken to Kiwi Encounter where they were incubated and hatched in captivity. Egg lifts took place after 60 days of incubation.

In total, 39 eggs were lifted, of which 29 hatched and the resulting chicks were released to TFKS, except four that were sent to Sanctuary Mountain Maungatautari (SMM). Nine eggs were not viable, while one chick died at Rainbow due to an obstruction of the trachea (Table 7). Twenty five monitored chicks were fitted with chick mortality transmitters and returned to their natal territory, or to a pre-determined release site within TFKS, at hatch weight (approximately two weeks of age)

TABLE 7: NEST AND EGG OUTCOME SUMMARY, 2018/19 SEASON

Male Kiwi (represents a breeding pair)	Unconfirmed nests*	Confirmed nests	Total eggs	Hatched & released to TFKS	Hatched & released to Maungatautari	Eggs not hatched	Chicks that died at Rainbow
Speedy		2	4	3		1	
Hiver	2	1	2	1		1	
Zazu		2	3	1		2	
Dino	1	1	2	2			
Dani		2	4	4			
Kumara		2	4	2'	2		
Harley		2	4	3			1
Koroki		1	2			2	
Rocket	1	1	2	1		1	
Thunderbird		1	1	1			
Lego		1	1			1	
Comet		1	2	2			
Strike		1	1		1'		
Pumpkin		1	2	1		1	
Little moa*	1	1	2	2			
Marohirohi		1	1		1		
Matariki		1	1	1'			
Jocko		1	1	1'			
Peter Pan**	1						
Total	6	23	39	25	4	9	1

\* Nesting signal obtained

\*\* Died during the season

' Hatched in the wild

## **NEW KIWI CAPTURES USING CALL RECORDERS AND KIWI DOG HANDLERS:**

In February 2019 kiwi dog handler James McLaughlin and his dog Tui returned to TFKS (contracted by Kiwis for kiwi) to locate more kiwi and attach radio transmitters to them. He was supported by two volunteers (Sheryl Peterson, Alana McLeod) and local DOC staff. To assist in this process, local DOC staff analysed a number of automatic call recorders placed in strategic locations to gain some knowledge as to where breeding pairs were likely to have established territories.

This work was undertaken as part of a Kiwis for kiwi initiative to change the current 2% decline in kiwi numbers to a 2% increase within a 5-15-year period (Kiwi Recovery plan 2018-2028). Chicks of any new birds found within the western taxa area (Whanganui, Taranaki, Waikato ranges), will eventually be helping to stock the Kōhanga site at Sanctuary Mountain Maungatautari with a genetically diverse population of founder birds of which the offspring will one day be used to re-populate areas where kiwi have become locally extinct or have very low genetic diversity (Kiwis for kiwi strategic plan, 2017). TFKS would also benefit as the offspring would remain in the forest in years when chick monitoring is taking place and the adult birds would help to replace those which have been lost to ferret predation. However, Ngati Hikairo have indicated that, at this time they will not support further transfers of kiwi from TFKS to Maungatautari over and above the original 20 founder agreement, so this part of the project is on hold for the time being.

James and the team managed to catch five new adult kiwi (three females, two males) which revealed an area of about one square kilometre with four breeding pairs (one of the males, called Raumati, was already monitored but was not known to be paired) living in adjacent territories. Among the males caught, one (named Strike) had a chick in its burrow. The chick was taken by James to MMS (Table 8). An extra unknown pair was heard (not searched) on call recorders nearby as well, which makes at least to five potentially breeding pairs living between the bottom of Top Track and the start of Pony Club track. An additional male, named Joe, was caught during James's second trip into the Tongariro Forest further along the 42T before the Waione river. During the listening prior to the capture, a female was also heard which takes the number of pairs discovered during this operation to six.

Independently to this and earlier in the season, a female sub-adult kiwi named Matata was randomly caught by dog handler Malcolm Swanney and his dog Fern along the 42T on the eastern side of the Forest towards the Waione river and was fitted with a transmitter (Table 8).

TABLE 8: NEW KIWI CAUGHT FEBRUARY 2019

<b>Name</b>	<b>paired</b>	<b>Transponder Present</b>	<b>Transmitter attached</b>	<b>Age class</b>	<b>Sex</b>	<b>Bill (mm)</b>	<b>Weight (gm)</b>
Jocko	Georgie	No	Yes	Adult	Male	98	1550
Georgie	Jocko	No	Yes	Adult	Female	131	3100
Zette	yes	No	Yes	Adult	female	125	2100
Female	Strike	No	no	Adult	Female	-	-
Strike	yes	No	Yes	Adult	male	-	-
Joe	yes	No	Yes	Adult	Male	97.7	1800
Strike's chick	N/A	N/A	translocated	Chick	-	-	-
Matata	unknown	No	yes	Sub-Adult	Female	94.8	1900

## **KIWI CHICK MONITORING**

Kiwi chicks have been monitored in 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 2001, 2006, 2011, 2014 and 2017 for possum control and also targeted rats and thus stoats via secondary poisoning.

The 2018/2019 season was the second season of monitoring after the 1080 operation carried out in August 2017.

### **MONITORING METHODS**

Since the 2010/11 season, eggs have been lifted from nests in TFKS and hatched in captivity during the early stages of each season to ensure a sample size of no less than 16 kiwi chicks. This is in response to a ferret predation event that occurred between February 2009 and September 2011, where the number of radio-tagged breeding male kiwi was greatly reduced. Chicks hatched in captivity were returned to their natal territory, or preselected release sites, at hatch-weight (approximately two to three weeks of age).

Chicks had radio-transmitters fitted and were monitored by obtaining a signal for them at least weekly. They were captured every three to four weeks to have their transmitter strap replaced (as they grew) and to undergo health checks with weight and bill measurements taken.

If a mortality signal was received from the transmitter during the weekly check, the carcass was located, and cause of death ascertained through scene investigation and examination of the remains by staff. Remains were sent to NZ Wildlife Health Centre - Massey University, for necropsy.

To compare chick survival over eleven breeding seasons, survival rates to 183 days were calculated for each season using the Kaplan-Meier procedure, as recommended by Robertson and Westbrooke (2005), with 95% confidence intervals.

### **KIWI CHICK OUTCOMES AND SURVIVAL**

This season, a total of 25 chicks were monitored in the TFKS. Four chicks hatched in the wild and 21 were hatched in captivity and brought back to TFKS when they reached their hatch weight, at approximately 2-3 weeks of age. Of the 25 chicks, 11 were released on the Western side of the forest, and 14 on the Eastern side.

The first chick was released into TFKS on 3/10/17 and the last chick was released on 8/3/18.

Where possible, the birds were released back into their natal territories. In cases where this was not feasible, an appropriate release site was chosen.

Of the 25 chicks being monitored this season, there have been a total of ten recorded mortalities. The first chick was killed on 22/10/18 from misadventure and the first predation occurred on the 22/12/18; The causes of death were determined by the Post-Mortem lab at the Massey University Wildlife Centre whenever possible and six of the ten deaths were deemed to be due to mustelid predation. The remaining four deaths were due to misadventure.

Of the remaining 15 chicks, two were lost due possibly to faulty transmitters, and thirteen chicks have survived to reach sub-adult status (>183 days of age) resulting in a very good kiwi chick survival rate in the second season of a 1080 operation; 50.8 % (Figure 3).

Six of those surviving chicks will continue to be monitored as sub-adults for recruitment and survivorship measurement.

In summary, 81% chick survival was achieved in 2017/18 (one season post 1080), and 51% survival was achieved in 2018/19 (two seasons post 1080). This makes the 2017 aerial 1080 operation the most successful one yet, in terms of kiwi chick survival over the two years after 1080. This indicates that a BFOB best practice regime of even bait sowing and 1.5kga/ha sowing rate, is the most effective one for kiwi chick survival.

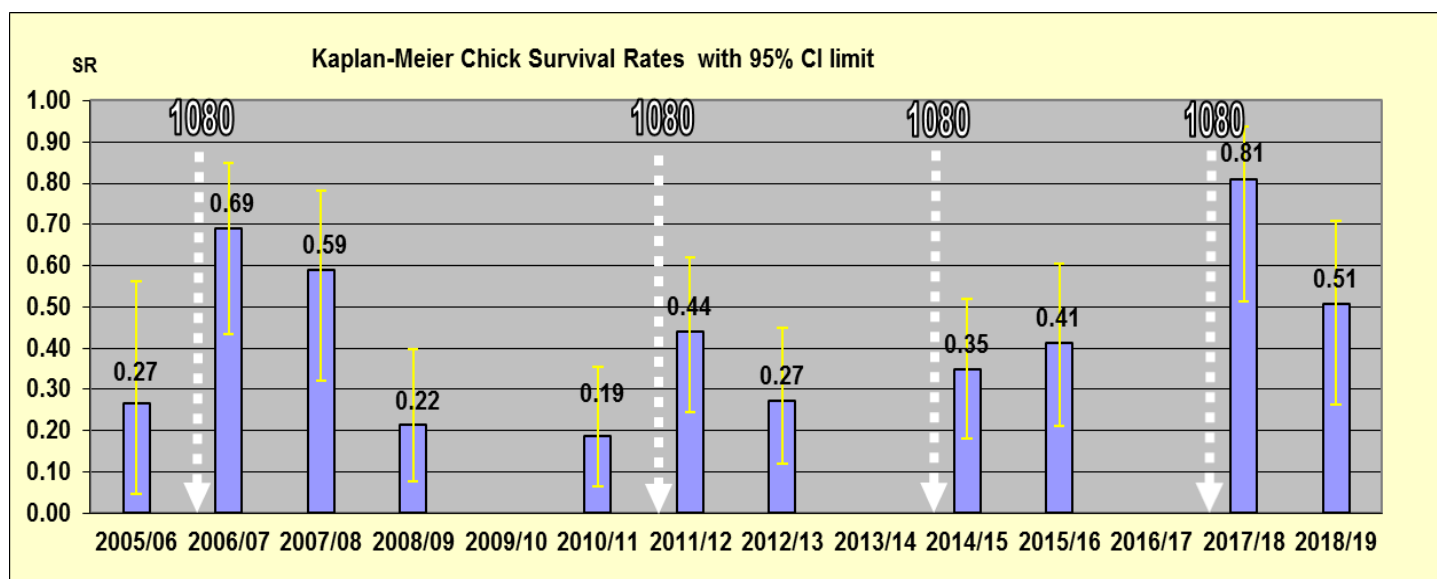


FIGURE 3: KAPLAN-MEIER KIWI CHICK SURVIVAL ESTIMATES FOR ELEVEN BREEDING SEASONS, 2005-2019\*

Traditionally there has been a marked difference between the eastern and western sides of Tongariro Forest, with the western side usually having a higher survival rate. However, the post 1080 season's results contradicted past correlations regarding chick survival on the east vs west (Figure 4). This season again has revealed more chicks dying proportionally on the western side

(55% on the west versus 35% on the east). This would be directly related to the ferret predation event on the western side.

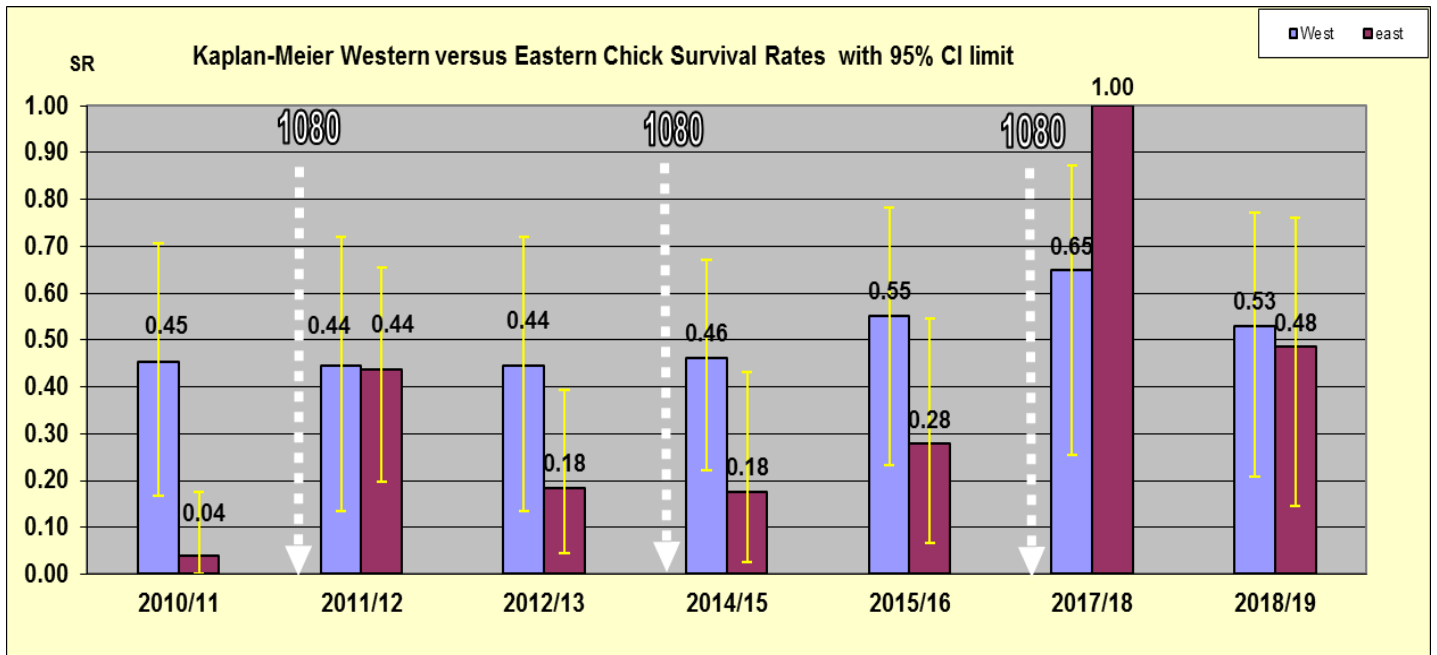


FIGURE4: COMPARISON KAPLAN-MEIER KIWI CHICK SURVIVAL ESTIMATES BETWEEN EAST AND WEST OF TONGARIRO FOREST\*

\*Data from the 2009/10 and 2013/14 seasons are not included as chicks were creched in predator proof fenced areas (Warrenbeip or Wairakei Golf+ Sanctuary)

## **FUTURE DIRECTIONS**

Currently, the Kiwi Recovery group and the DOC National Threats Advice team are looking at priorities in terms of ferret research nationally (understanding ferret movements, rabbit-ferret relationships etc..) to fill the gaps around ferret knowledge, especially on a landscape scale (10,000-50,000 ha) and Tongariro Forest is an ideal place for this to happen.

Ferret trapping will continue to be run along the boundaries of Tongariro Forest and on the surrounding landscape and more scarcely within the Sanctuary. This will continue to test whether ferret control can be achieved on a landscape scale using strategy.

Our research priorities around 1080 operations and kiwi chick monitoring are currently being reviewed.

Kiwi chick survival research will occur next season 2019/20 and may occur again through the following season 2020 1080 operation to measure the possible impact of the increase in ferret trapping on chick survival and to allow solid comparison with previous data with no ferret trapping.

Tracking tunnel monitoring will continue in the lead-up to the next scheduled Tongariro Forest aerial 1080 operation in spring 2020. The camera trap trial will also be continuing (extending to a 21-night trial), to keep refining this new method of monitoring mustelid abundance.



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New Zealand Government

## **Appendix 1**

### **AERIAL 1080 OPERATION AUGUST 2017 (OPERATIONAL DETAILS)**

Department of Conservation and TB Free NZ carried out a jointly funded aerial 1080 operation over TFKS in August 2017. This operation used 0.15% 1080 pellets in a cereal bait at a sowing rate of 1.5kg per hectare. Based on TFKS and “Battle For The Birds” programme research, the sowing rate was lifted from 0.75kg/ha to 1.5kg/ha and reverted from a strip sowing method (2014/15 TFKS Annual Report) to a more conventional even broadcast method (i.e. aiming for even coverage of baits throughout the forest with no gaps in bait coverage).

The result targets for this operation were:

- Less than 5% rat tracking September/October 2017; and
- 0% stoat tracking September/October 2017.

The outcome target was for kiwi chick survival to exceed 50% the season immediately after the operation.

## Appendix 2

### KIWI RECRUITMENT AND POPULATION GROWTH *(updated in October 2019)*

It appears that ferret events could happen at any stage of a 1080 operation and that a sole three-year 1080 regime may not be sufficient to grow the population as expected in the past years. It has become crucial to combine this with an effective ferret trapping regime to prevent the TFKS kiwi population from becoming locally extinct.

At this stage of the study, the population modelling shows a decline of 0.4% per year under a 3-year regime very much under what was predicted in the past (+4.3%).

If we were to have no management of the kiwi in Tongariro Forest, the population would decline at a rate of 19.8% per year into eventual extinction (Table 9).

To increase the population, a three yearly-1080 cycle combined with an efficient ferret trapping regime are necessary. This should grow the population by about 6.2% per year (Table 9).

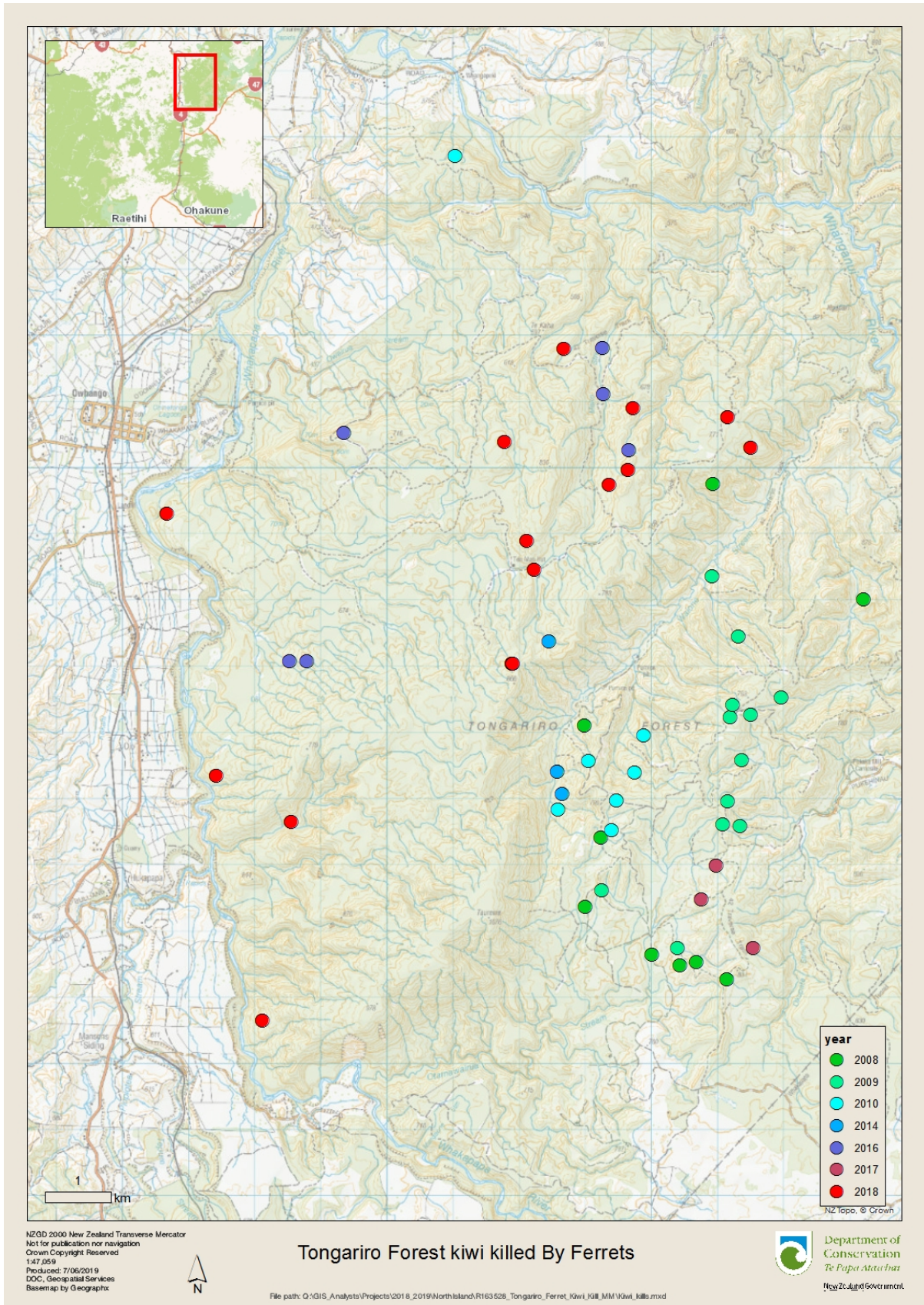
TABLE 9: RECRUITMENT AND ANNUAL GROWTH UNDER DIFFERENT MANAGEMENT REGIMES *(using October 2019 updated sub-adult survival rate (SR)=61.7%)*

Management regime	Mean chick SR 0-6mths (%)	Adult SR (%)	Recruitment (%) for stable population	Actual recruitment (%)	Annual growth (%)
3y 1080 cycle	34.8	88.2	22.7	21.5	- 0.4
5y 1080 cycle	26.3	79	40.3	16.2	- 9.2
No management	13.5	72.5	52.9%	8.6	- 19.8
3y 1080 cycle + DOC 250s	34.8*	96.9	6	23.7	+ 6.2

\*It is not known yet if ferret trapping has a significant impact on chick survivorship, thus, at this stage, the mean chick SR used is the same as the one used under a sole 3-year regime.

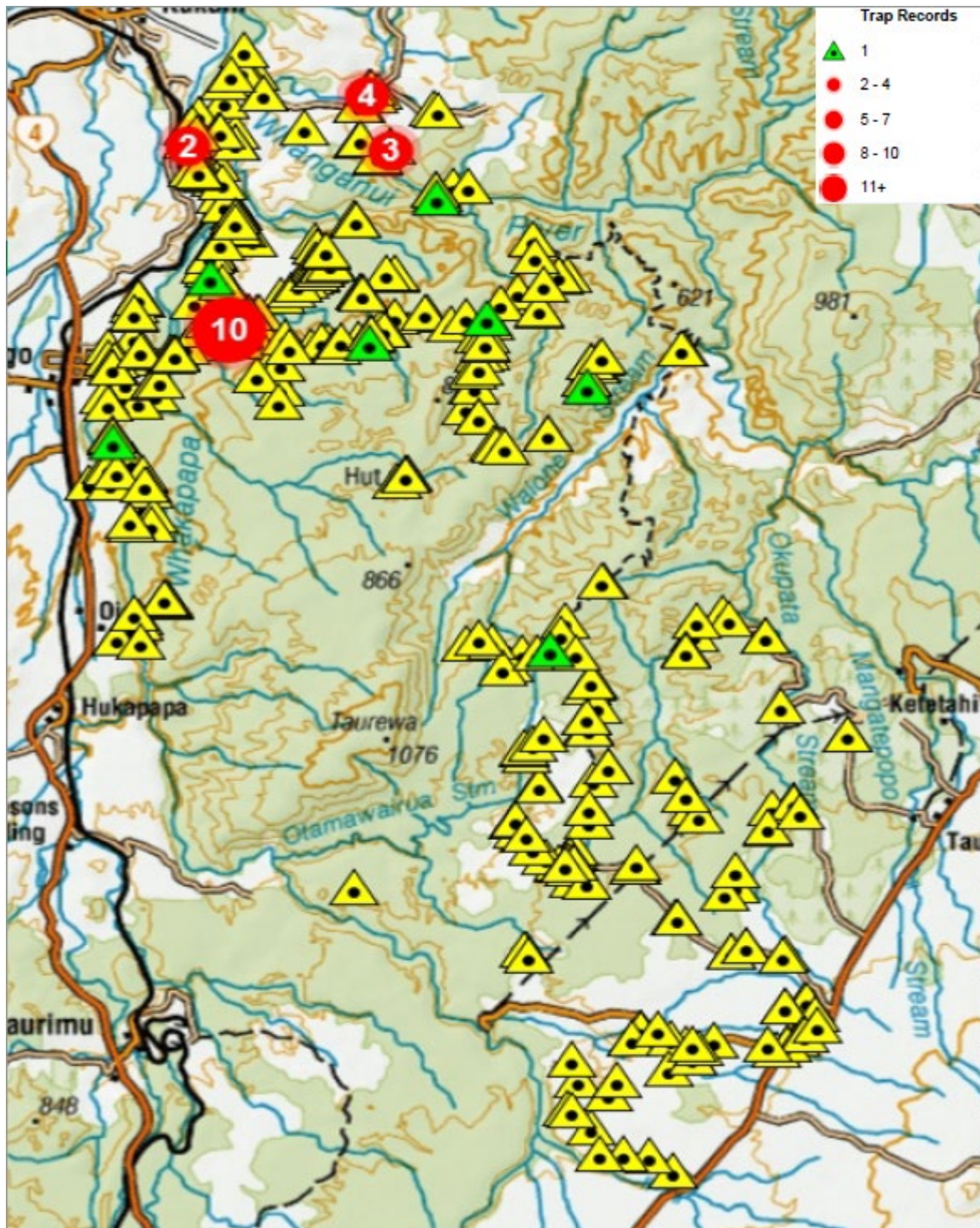
# Appendix 3

## KNOWN KIWI KILLED BY FERRETS SINCE 2008.



## Appendix 4

FERRET CAPTURES SINCE 2016\* AND FERRET DOC250 TRAPS AROUND AND INSIDE TFKS:



*\*Except for two captures in 2009 and 2010 on the eastern side*

*Yellow triangles are DOC 250s, green triangles are single ferret captures, red circles are multiple ferret captures (the captures in Obinetonga reserve and adjacent farms are not represented here)*

