June 2024

Waikereru Eco-Sanctuary Pest Management Plan

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1.0 Introduction

Longbush Reserve and the Waikereru hills are located at the southern end of the Waimatā Valley, 8 km north-west of Gisborne city (Figure 1). These sites lie within the Waiapu Ecological District in the East Coast Ecological Region.

Longbush Reserve c. 15 ha runs adjacent to the Waimatā River and the Waikereru hill block c. 113 ha is situated west of the reserve. Together, Longbush and the Waikereru Hills compose an area of c.128 ha (Figure 2), known as Waikereru EcoSanctuary.

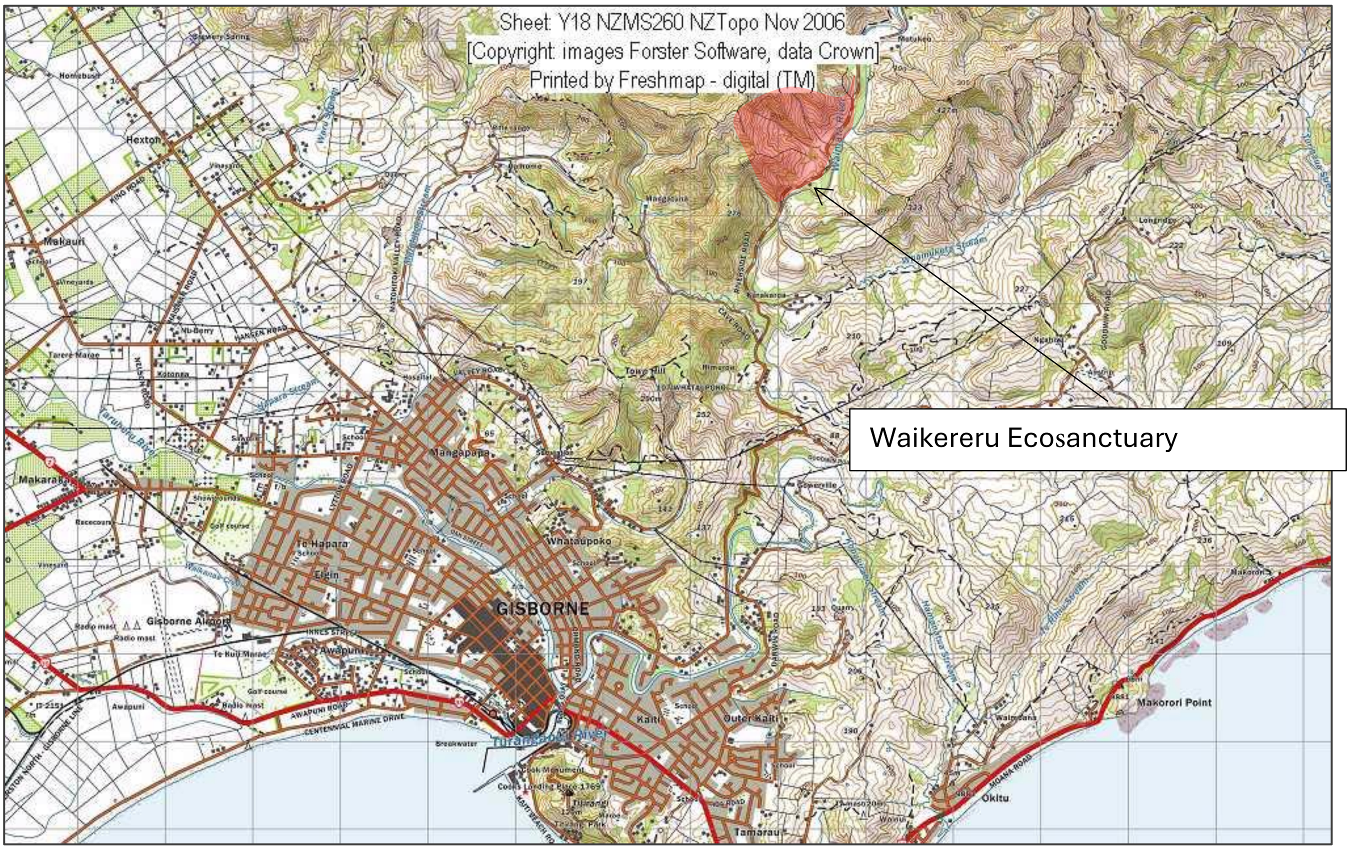


Figure 1: Location map of Waikereru Ecosanctuary in relation to Gisborne City

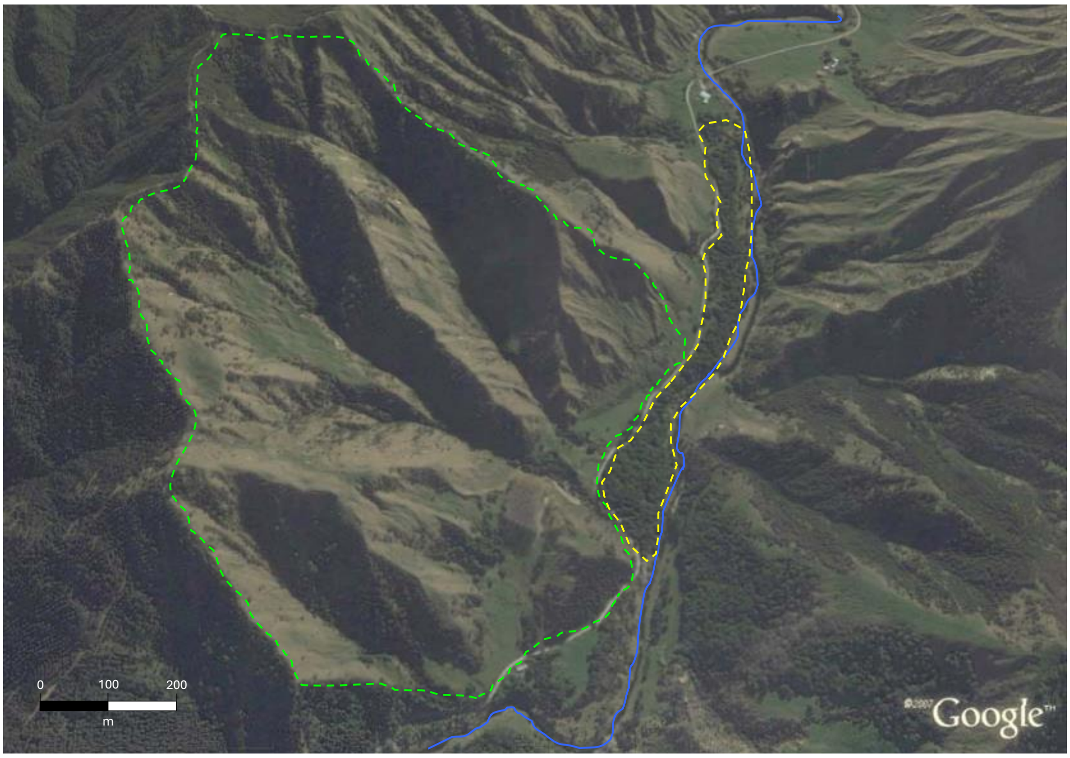


Figure 2: Composite aerial photograph of the project area. Longbush Reserve, c. 15 ha (yellow dashed line); Waikereru hills, c. 113 ha (green dashed line); path of the WaimatA River (solid blue line).

2.0 Pre-human flora and fauna

Prior to forest clearance, lowland Poverty Bay would have been covered in mature podocarp-hardwood forest. Peat core samples taken from the area indicate that mataī (*Prumnopitys taxifolia*) and kahikatea (*Dacrycarpus dacrydioides*) were historically dominant (McGlone et al. 1984). Common species found on well drained alluvial terraces like Longbush Reserve would have included tawa (*Beilschmiedia tawa*), tītoki (*Alectryon excelsus*), puriri (*Vitex lucens*), matai and tōtara (*Podocarpus totara*). On the hill faces, kohekohe (*Dysoxylum spectabile*), karaka (*Corynocarpus laevigatus*), puriri, kōwhai (*Sophora spp.*), ngaio (*Myoporum laetum*), māhoe (*Melicytus ramiflorus*) and five finger (*Pseudopanax arborea)* would have dominated (Clarkson and Clarkson 1991). Kānuka (*Kunzea ericoides*) forest would have been common around forest margins and in areas of steep or unstable terrain. Today's critically endangered plants, such as kaka beak (*Clianthus puniceus*), William's broom (*Carmichaelia williamsii*), Cooks scurvy grass (*Lepidium oleraceum*) and *Plantago picta* were likely to have been abundant with a lack of mammalian browsers present.

The wildlife on the plains and surrounding hills would have been extremely diverse. Several species of moa were present in the Poverty Bay area, including large bush moa (*Dinornis novaezealandiae*) and little bush moa (*Anomalopteryx didiformis*) (Huynen et al. 2006). A range of land-based bird species including brown kiwi (*Apteryx australis*), kākā (*Nestor meridionalis*), kākāpō (*Strigops habroptilus*), huia (*Heteralocha acutirostris*), kokako (*Callaeas cineria wilsoni*) and weka (*Gallirallus australis*) would have also been numerous and widespread.

Within coastal forests, tuatara (*Sphenodon punctatus*) and a plethora of lizard species would have been abundant as well as a diversity of pelagic seabirds, in particular petrels (*Pterodroma spp.*) and shearwaters (*Puffinus spp.*). Massive volumes of guano, produced by these seabirds would have fertilised the forests and created productive nutrient-rich soils. At night the forest would have been an unruly clamour of seabirds, kiwi (*Apteryx spp.*), ruru (*Ninox novaeseelandiae novaeseelandiae*), laughing owl (*Sceloglaux albifacies*) and stridulating tree weta (*Hemideina spp.*).

During the last 800 years New Zealand's natural habitats have been dramatically modified by humans. To produce horticultural and agricultural land, forests were burnt and felled while wetlands were drained. Indigenous forest clearance on the East Coast intensified around 1880, reaching its peak between 1890 and 1910 (Clarkson and Clarkson 1991). Now only a fraction of original forest cover is still intact and of the surviving forest the majority has been severely degraded.

Humans also introduced pest weed and animal species. Exotic species have been directly implicated in the ongoing decline and mass extinction of New Zealand's endemic wildlife. When Maori arrived in New Zealand in 1200-1300 they introduced kiore or Pacific rat (*Rattus exulans*) and kurī or Pacific dog (*Canis lupus familiaris*).

Europeans arrived in the early to mid-19th century along with a plethora of mammalian predators such as stoats (*Mustela erminea*), ferrets (*Mustela furo*), possums (*Trichosurus vulpecula*), Norway rats (*Rattus norvegicus*), cats (*Felis catus*), ship rats (*Rattus rattus*), house mice (*Mus musculus)* and hedgehogs (*Erinaceus europaeus occidentalis*). Europeans also brought a suite of vertebrate grazers including goat (*Capra hircus*), pig (*Sus scrofa*), horse (*Equus ferus caballus*), sheep (*Ovis aries*) and cattle (*Bos primigenius*).

Sub-fossil records indicate that many species extinctions occurred soon after the arrival of the first human settlers. New Zealand's endemic wildlife had not evolved in the presence of mammalian predators and most could not adapt to prevent population crashes, local extinctions and then total extinctions from occurring. By the early 1900's, 32% of all the land-based avifauna were extinct including 14 species of moa, the huia, piopio and many others. The cause of these extinctions was predominantly human hunting, predation by introduced mammals and the loss of habitat. Most locally extinct species that still survive nationally appear to have disappeared from Poverty Bay by the early 1930's.

3.0 Significance of Longbush/Waikereru to the Waiapu Ecological District

Today indigenous vegetation in the Waiapu Ecological District is reduced to isolated primary remnants and small patches of secondary scrub. Most of the cleared land has been converted to farming and more recently exotic forestry.

The biodiversity values and indigenous habitats of the Poverty Bay region have been described as 'Acutely Threatened' (Dr W. Green, 'LENZ Threat Category') with less than 10% indigenous cover remaining. The biodiversity values of the Longbush/ Waikereru area are still high and regionally significant. In 2005 Longbush Reserve was recognised as a Priority 1 RAP (recommended area for protection) by the Department of Conservation. Conservation action should be a priority at Longbush/Waikereru as many of the species present are classified as threatened with Category A, B or C rankings (Tisdall 1994).

4.0 Human settlement in the Longbush/Waikereru area

Prior to 1887, Waikereru/Longbush and the surrounding land 'Whataupoko block' were under Maori ownership in the rohe of Whānau a Iwi, a hapū of Te Aitanga a Māhaki (Jackman 1999). In 1886 Raharuhi Rukupō (a local chief), contracted Henry Parker and Robert Thelwall to establish a sheep farm on the area that is now Waikereru (Jackman 1999).

There is a significant assemblage of archaeological sites at Waikereru which indicate Maori occupation and settlement in pre-European times. Pā hill was probably a small unfortified Maori village that centred on the cultivation of kūmara and harakeke/New Zealand flax. Archaeological features still present today include a series of pits and terraces (Jackman 1999).

In 1887 Jack Dunlop purchased the Waikereru block c. 3330 acres (Tombleson 1997), this area included Longbush Reserve and the Waikereru hills. Henry Hegarty and his son William immigrated from Australia and bought the land in 1923. By this time the land was predominately pasture with only remnant patches of indigenous vegetation. The Hegartys were attracted to the property because natural springs on the Waikereru hills meant cattle had a year round water reserve (J. Hegarty pers. comm.). The Waikereru hills were, however, steep which made farming difficult (J. Hegarty pers. comm.). Cattle, sheep (Romney and Cheviot) and then Angora goats were run on the hills before the Hegarty's finally sold the property in the early 1990s (Tombleson 1997). A 1988 aerial photograph of the region illustrates the barren and erosion-prone Waikereru hill block next to Longbush Reserve (Figure 3).

Figure 3: An aerial photograph taken in 1988 of Waikereru.

5.0 Waikereru Restoration Project

Jeremy and Dame Anne Salmond purchased Longbush Reserve and the Waikereru hills in 2000. In 2002 they placed Longbush Reserve under a QEII covenant and in 2006 covenanted a further 113 ha 'Waikereru hills'. The Longbush Ecological Charitable Trust was formed to provide a separate and independent legal entity to assist with fund raising opportunities and restoration.

The western ridge of the Waikereru hills joins a large block of indigenous podocarp forest which was placed under a QEII covenant by the previous landowners Kate and Herman MacDonald. Together Longbush, Waikereru hills and the MacDonald block effectively form a c. 330 ha area of indigenous forest. The Waikereru project alone is the largest fully protected (pest and weed control) area of indigenous forest in the Tūranganui and Waiapu Ecological Districts.

6.0 Project Objectives

The vision for Waikereru is to provide a unique 130 ha predator free sanctuary where the endemic biodiversity of the East Cape can be restored to its modern day potential. The site includes a range of locally extinct species within a predator controlled and weed-free forest ecosystem.

The objectives for this site can be divided into two broad categories: Ecological and Community-based.

6.1 Ecological Objectives

Maintain and enhance the existing biodiversity values of Waikereru and the surrounding region through:

1) Control and surveillance of invasive weed species and abundance.
2) Removal and ongoing control of vertebrate grazers
3) Controlling mammalian predators to near low densities
4) Re-introducing locally rare or nationally threatened species that would have naturally occurred in the area
5) The freshwater resources are restored to provide habitat for a range of aquatic species.
6) Encouraging population growth of locally rare or nationally threatened species; eventually using the re-introduced population to provide a source population for other local conservation projects
7) Restoring the forest to a self-sustainable level, where minimal human management is necessary
8) Longbush becomes part of a wider ecological corridor, being connected to surrounding landscapes to enable the dispersal and migration of indigenous species.

7.0 Pest Management Opportunities

During the last thirty years there has been a paradigm shift in ecosystem and species management in New Zealand. We have gained a greater understanding regarding the impacts of pests on our indigenous biodiversity. We now know a great deal about how to control these pest species and what level of control is required to protect and provide recruitment of individuals into a breeding endemic population, i.e. ship rats at <10% RTTI to maintain NI robin, double set stoat tunnels at 200 metres to protect kiwi. New Zealand conservation managers help lead the world with their pioneering island eradications, endangered species translocations and general ecosystem and species management. We need to do something as we not so proudly own 11% of the total world extinction list!

We also have a good understanding regarding vertebrate pest ecology, density and dispersal and the level of control or ongoing population management is required specifically in New Zealand forest types to maintain pest densities at specific target levels, i.e. three yearly aerial baiting to maintain kiwi chick survival. There have also been major advances in the development of trapping technology, bait design and its presentation to the target pest species. This research and development is ongoing, i.e. AT220, Good-nature, SA traps and AI camera technology; modern pest control programmes have to be flexible and willing to adapt to changing best practice methodologies being developed worldwide. However, we believe we could always do better and opportunities exist to develop additional technologies which remove these introduced pests from the New Zealand landscape.

The following information outlines the current recommended best practice methodology for pest control projects, with site specific controls and targets for each of the species within the scope of this plan.

An exciting opportunity exists at Waikereru to restore a wide range of both extirpated and or rare endemic species. Recent conservation projects across New Zealand have shown we have the ability to restore nationally significant threatened species such as tuatara, kiwi, titi and pateke. Waikereru offers an incredible opportunity to expand threatened species populations such as the North Island weka, reptiles, endangered carnivorous snails, bats, North Island kaka, fernbird and many more. Many rare and endangered Tairāwhiti plant species have already been restored to the 1769 Seed Orchard at Waikereru, a major gain for ecological values in the region.

Vertebrate pest control and the sustained management of these introduced species is the foundation of any species recovery operation within New Zealand. Using best practice methods, the latest trap design and standardised baseline survey, result and outcome monitoring enables us to not only record the progress of these projects but also allows us to measure, replicate or modify these processes in the future. High quality results and outcome monitoring is as important as controlling the stoats, cats and other vertebrate pests. It is not how many pests you eliminate the important part is how many remain. Using standard best practice survey and monitoring allows us to use a comparable baseline across projects on a regional and national basis.

The benefits of sustained pest control operations are well known and include:

- Improvement of vegetation cover and complexity of understory development leading to increased rainfall interception, reduced erosion impact of rain on the soil structure and increased stability of soils, and therefore reduced potential for erosion and sedimentation of downstream freshwater and marine habitats.

- Reduction in feral animal numbers and subsequent risk of faecal contamination within catchments

- Protection of indigenous biodiversity and threatened species and ecosystem process.

- Assistance with the control of Bovine Tuberculosis, toxoplasmosis (feral cats) and Leptospirosis (rodents)

Introduced mammals are widespread throughout mainland New Zealand and have the single largest negative impact on our forest ecosystems function.

Table 1: Mammalian Pests found at Waikereru.

Common name	Species
European rabbit	*Oryctolagus cuniculus*
Hare	*Lepus europaeus*
Brushtail possum*	*Trichosurus vulpecula*
Norway rat	*Rattus norvegicus*
Ship rat	*Rattus rattus*
Red deer	*Cervus elephus*
Feral goat	*Capra hircus*
Feral pig	*Sus scrofa*
Mouse	*Mus musculus*
Stoat	*Mustela erminea*
Ferret	*Mustela furo*
Weasel	*Mustela nivalis*
Feral cat*	*Felis catus*
European hedgehog	*Erinaceus europaeus*

Rodents, possum, mustelids, deer, goat, feral cat and even hedgehog are impacting on everything from our emergent podocarp canopy species to our beach nesting seabirds twenty four hours a day, seven days a week. These mammalian pests have major impacts on wildlife by attacking, killing, and consuming eggs, chicks and adult birds, roosting bats, skinks, geckos, weta, native fish and our endemic invertebrates. They also have a significant competitive impact on target foods such as possums competing with kereru for *Pseudopanax* species, German wasps competing for with kākā for honey dew in beech forests.

Deer, goats, pigs and possums can severely impact the composition and age class structure of native forests by consuming over 100 native plant and tree species and subsequently forming monocultures, thereby preventing or seriously inhibiting forest succession. Seedlings are at risk, not only from being consumed, but also from being trampled by larger browsers. Trees such as kotukutuku (tree fuchsia) and broadleaf species are at risk from ring barking as browsers feed on the bark during winter. Browsing of palatable species can skew the forest to monocultures such as bush rice grass and pepperwood that are unpalatable (Rate *et al*, 2006).

If unchecked, browsing can lead to severe erosion and a subsequent flow on effect impacting on stream values such as water clarity and sedimentation. Faecal contamination of waterways is also a concern where introduced mammals exist in forest environments in large numbers.

Continued goat, deer and possum browsing will result in a severely degraded forest, a loss of forest age class tiers; seedlings, shrub and sub-canopy species. Many of New Zealand's second growth broadleaf tree species are extremely palatable to introduced vertebrates therefore forest sites which should contain putaputaweta, mahoe, *Coprosma* and *Pseudopanax* for example are seriously devoid of seedling, shrub and sub-canopy tiers. This in turn impacts directly on the survival of endemic species such as tree weta, important target food for the morepork and suitable tree species for puriri moth larvae, a lack of *Coprosma* fruit for autumn feeding bellbirds and kereru. Not only do we lose forest tiers we lose these unique ecological processes which have been occurring in New Zealand for many millions of years, i.e. specialist nectar feeders pollenating native mistletoe and rata.

Forest fragmentation is also a significant threat to our biodiversity; it can result in areas being too small for species home ranges such as kiwi or kokako; or too small to find suitable breeding partners due to dispersal becoming much more difficult. Once fragmentation occurs the open forest edges allow more weed species to enter, more invasive grasses to grow and sites for browsers to feed. The forest edges are also opened to wind events which can lead to an accelerated collapse of the mature canopy which provide the seed material for regeneration. These processes continuously decrease the size of the fragments to smaller and smaller patches, effectively inhibiting species population stability.

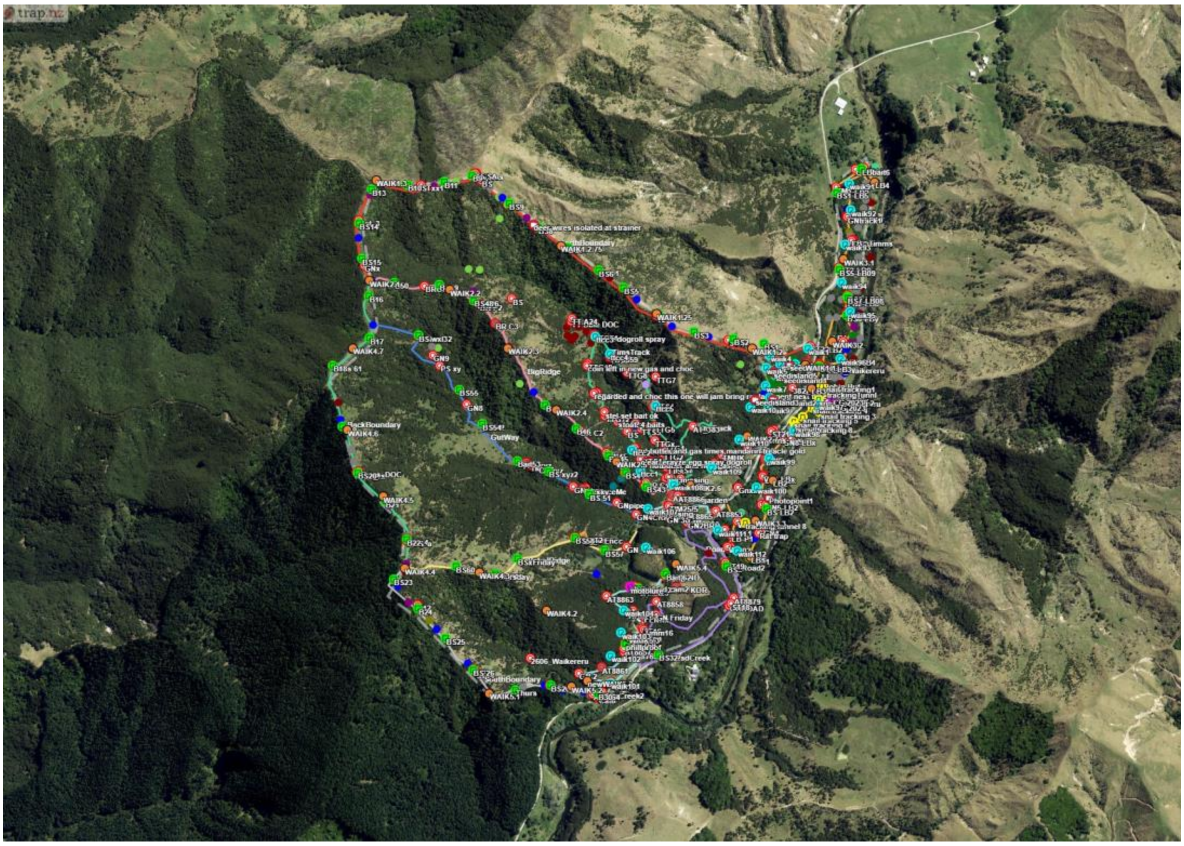


Fig 5: Over two hundred traps currently operate at Waikereru to protect critically threatened species.

The following summary outlines a range of vertebrate pest management options for Waikereru.

7.1 Ungulates -feral goat and deer

Feral goats and deer are controlled within Waikereru using experienced contract hunters.

Over 4.5 kms of deer fence is in place (right) around the Waikereru boundary and this excludes the majority of deer and goats. Ungulates can enter occasionally along Riverside Road however. A sustained but manageable culling programme is maintained using professional hunters to target these species to ensure forest seedling and shrub layer recovery.

Thermal drones, trained indicator dogs and thermal hunting methods are employed to ensure most if not all ungulates are removed from Waikereru.

Monitoring of deer and goat abundance can be undertaken in a number of ways. Pellet or seedling transect counts have been the most common measure of changes in deer and goat abundance. Exclosure plots can also be used to record changes in seedling and shrub recovery or loss. Photo-points and permanent recce or vegetation sampling plots are also a good measure. Hunter kill rates are also a very good immediate measure when working with a trusted and competent professional.

This can be a way of obtaining a relative index of abundance by measuring hunter kill rates/day or hour. Contract hunters will provide gps track and kill location waypoints for each animal. When deer are in high density in steep podocarp-hardwood forest high kill rates can be in excess of 12-15 kills/day. Our aim at Waikereru is to maintain kill rates of <1 deer/goat kill/hunter man day.

At Waikereru camera trap images (above), thermal monitoring, hunter kill rates and seedling plot monitoring provide an effective measurement tool to understand the relative presence or abundance of these species.

Fig 8 : One of thirty one seed islands established at Waikereru Sanctuary. Combined with permanent photo-points and pest and weed monitoring a robust picture can be formed as to deer and goat population densities within an area and likely forest recovery.

7.2 Brush Tailed Possum

Possums are an opportunistic predator of native bird's eggs and nestlings (Cowan 2001). Possums also prey directly on foliage, seeds and seedlings which can suppress the level of forest regeneration. Uncontrolled possum populations can cause complete defoliation of indigenous forest canopies and ring bark a range of forest species such putaputaweta, *Fuchsia* and mahoe. Possum home range in New Zealand native forest is generally 1-4 hectares (Landcare Research) however this can be considerably larger depending on possum population density, forest type and altitude. Possum home range appears to be dictated by the number of other individuals in a forest area and access to target food species. Possums have been recorded traveling 1.8 km's to reach grassland on forest edge and hold a home range of >50 hectares where the possum population is low.


Figs 9-10 : Possums and ship rats are monitored at Waikereru using chew cards. Guido Haag of Ecoworks NZ deploys a chew card line through Waikereru. Mice, ship rats and possum are detected and incisor dentition patterns are recorded to assess the density of pest species throughout indigenous forest areas.

There are numerous control methods used for possum control in New Zealand. In this situation we are dealing with a smaller sized control area 128 ha requiring a sustained kill trapping method over a long period which also operates when staff are not on site.

Trapping technology has developed rapidly during the last 5 years with the development of automatic kill traps and auto bait dispensers. Further advances are underway where the new AT220 will be programmed to pre-feed for multiple weeks prior to resetting to kill mode, therefore ensuring localised possums are comfortable feeding from the trap and in turn achieving a greater kill rate.

3.2.1 Control Method – The AT220 is now our preferred trap of choice at Waikereru and many other sites across Tairawhiti.The auto trap is specifically designed for possum control in New Zealand. Here are some benefits of the AT220 auto trap for possum control:

1. Efficiency: The AT220 is an automated trap, capable of resetting itself after each capture. This makes it highly efficient compared to traditional traps that require manual resetting after each use.
2. Continuous Operation: Due to its automatic resetting mechanism, the AT220 can operate continuously without constant human intervention. This is particularly useful

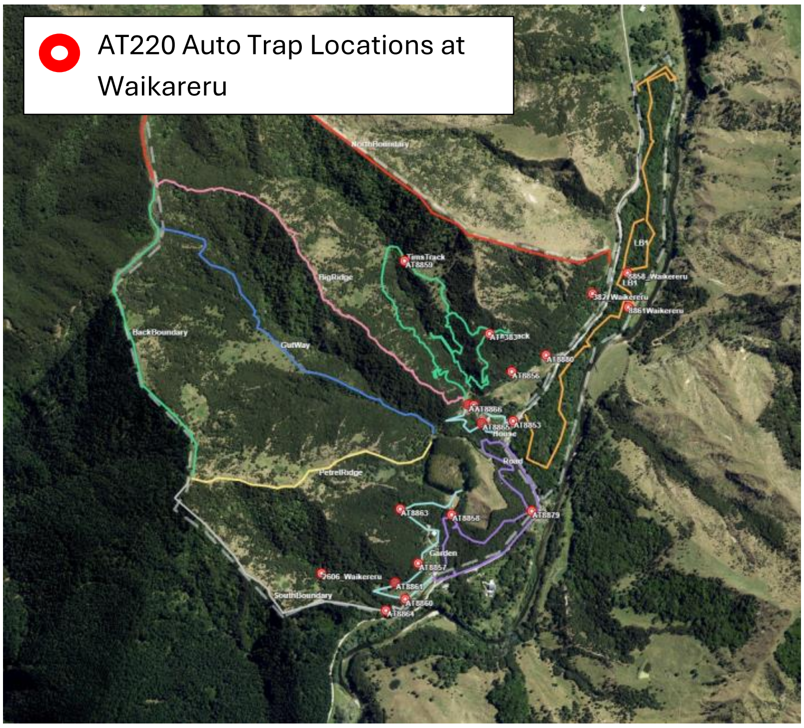
in remote or difficult-to-access areas where regular monitoring and maintenance are challenging.

3. Targeted Control: The trap is designed specifically for possums, which are a significant threat to New Zealand's native flora and fauna. It effectively targets possums while minimizing the risk to non-target species.
4. Safety: The AT220 is designed with safety features to ensure that it operates without posing a danger to non-target animals, including domestic pets and native wildlife.
5. Cost-effectiveness: Although initially more expensive than traditional traps, the automated nature of the AT220 reduces labour costs associated with manual trapping and monitoring. Over time, this can lead to significant cost savings. The At220 will also remove some feral cats, stoats and ship rats. The wifi unit within the trap allows us to monitor kill rates and identify species captured. The recent design upgrade to the pouch makes the trap even more effective and we are finding that trap checks are only required every 3 months.

Overall, the AT220 auto trap offers a modern, efficient, and targeted approach to possum and rat control in Waikereru.

Monitoring is undertaken annually using chew cards and peanut butter. This is a fast and effective method to establish possum indices across this site. Thermal monitoring is also undertaken at night along roads, tracks and the river margin. Waikereru and Longbush are a small area and will continue to attract possums from non-controlled neighbouring properties as the habitat improves. Chew card monitoring during January 2024 produced an exceptional result of 0.78% chew card index for possums. Well below the 3-5% target.

Fig 12: Distribution of Auto Traps across Waikereru and Longbush Reserves.



7.3 Feral Cats

Feral cats also pose a significant threat to New Zealand's endemic wildlife. Feral cats prey on a wide range of species including kereru, petrels, pateke, skinks, geckos, saddleback, weta and even species of native fish. Cats are long-lived and can have large home ranges of up to 350 ha (S. Sawyer *pers.obs* Whitikau Radio Tracking Study, DOC). Some of the largest feral cats captured have been recorded to weigh 4-6 kilogrammes. One captured at Lake Waikaremoana during 2003 weighed over 6 kilogrammes.

Anecdotal reports indicate larger weights than this can be attained.

Trap Type

SA feral cat traps have proven to be a highly effective trap design. They are also easy to bait, trapper friendly and set quality is not dependent on the experience level of the trapper. They are spaced at 300 m intervals on 500 mm raised sets to avoid non target species (higher if weka are present). Individual cats can be shy of a specific trap design therefore varying the trapping methodology is important. The earlier model SA cat trap is also an effective trap when used correctly however is no longer manufactured. AT220 auto traps will remove some cats from the area.

Bait Type

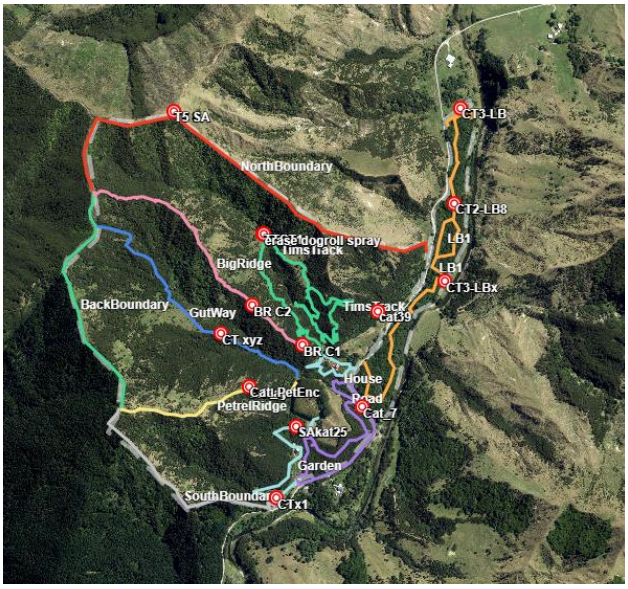
Baits include either finely cut pilchard, minced chicken pet food; seafood flavoured tinned cat food, rabbit or hare and cat biscuits are effective. Fish based tuna oil lures are very effective and should be used around all cat sets. A small quantity of bait is positioned on the run in front of the trap as a pre-feed and lure. The majority of the bait is positioned behind the trap trigger.

Pre-feed must also be laid on the ground below or in front of the trap and on the ramp leading up to the raised set itself.

SA Trap Raised Set

When kill traps are set in an area where farm dogs, children, ground nesting birds or other protected species are present traps need to be set at least 500 mm above ground level. In weka areas traps need to be a minimum 1100 mm above ground level.

SA Feral Cat Trap Locations at Waikereru



Traps are set at the top of a wooden ramp. The ramp is an 800mm length of 150 x 25mm H3 radiata. It runs at a 10-15° angle and extends from the tree, 40mm below the trap, and the lower end is nailed into the top of a 50 x 50mm tanalised wooden fence batten driven into the ground to a depth of 200mm (Refer photo attached).

Figs 14: Correctly positioned raised cat set.

Trap Maintenance

Traps should be checked and maintained on a minimum monthly rotation. Fortnightly is optimal however our experience is that the economics of most projects dictate a minimum monthly trap rotation. This is fine as long as you have an appropriate number of traps onsite. In summer, baits are fly blown quickly and need regular replacing. Again, baits should be cut finely and pre-feed should be scattered on the ground around the trap encouraging incoming cats to build their confidence near a foreign object.

Rat traps or bait stations should be operational nearby (within 5 m) to control rats which will take fish baits readily often without tripping the trap. This also provides multiple target pest sign to attract pests to a specific trapping station.

Trap Spacing and Position

Traps should be spaced at 300 metre intervals as feral cats have a large home range. Traps should be positioned near established walkways or animal runs and tracks as cats prefer using human walk tracks, roadsides, sheep tracks, animal runs, dry ridges and forest edges. Small blocks of forest <5 ha should contain at least one trap unless high intensity trapping is required to protect target species, i.e. brown teal/pateke.

In larger blocks of forest, traps should be positioned on dry ridges or existing game trails or trapper's tracks. Cats generally prefer dry ridges, spurs and faces. Traps should also be established on the perimeter of larger blocks. This is an area where there is often a greater bio-mass and diversity of target food species and therefore rodent numbers are often higher, producing an attractive feed area for feral cats.

Warning Signs

Warning signs must be visible at public access points into the control area to warn visitors about the presence of kill traps.

Trap Catch Recording

All trap catches at Waikereru are recorded on Trap.nz app.

1) Date Caught

2) Trap No. & Location

3) Sex

4) Any other relevant details, weight, colour, gut content.

Monitoring

Currently no population monitoring methodology exists in New Zealand to determine pre control or residual feral cat densities. Outcome monitoring or using camera traps at key sites to record cat pass indices is becoming an accepted tool for this purpose. As long as the process is repeatable annually, i.e. location, duration of monitoring and time of year. Cameras have a very limited life span in the field and can be an expensive monitoring tool.

Waikereru is showing good signs of recovery with forest bird levels increasing in distribution and density as an outcome measure, i.e. North tomtit.

8.0 Rodent Control

Four species of rodent are found in New Zealand.

-Norway Rat (*Rattus norvegicus*)

-Ship Rat (*Rattus rattus*)

-Kiore (Pacific) Rat (*Rattus exulans*)

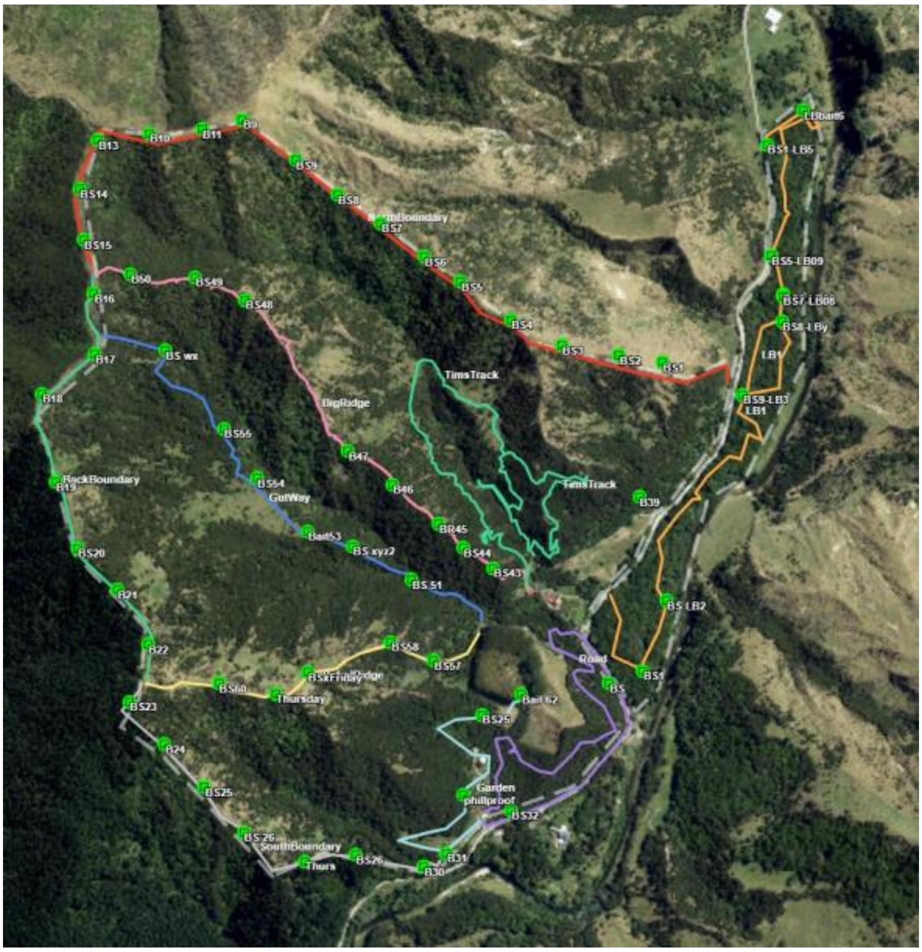
Mouse (Mus musculus)

The most significant rodent threat to wildlife at Waikereru will come from ship rats. Ship rats not only act as significant predators of wildlife but they also attract stoats to a site if they are in high density. The mouse is most abundant in rank grassland sites where grass seed and invertebrates are plentiful and in beech forest after beech seed or 'mast' episodes. Though the mouse is small (c.30 g) it is a major predator of native skinks, weta and other invertebrates and attracts weasels to a site. Mice like ship rats also have a significant impact on native tree seed such as Miro (*Prumnopitys ferruginea)*. Often much of the native seed material lying on the forest floor contains rodent incisor damage to the endocarp with the seed missing.

Poison baiting is the only effective way of controlling rodents. Bait stations across Waikereru containing double tap and Rata-bait specifically have maintained rats at c.1% RTTI for many years.

In lowland areas with grass seed and native cricket's available mouse numbers can climb rapidly to over 100% residual tracking and population peak occurs in these areas during February and March annually. This in turn attracts weasels to a site which also impact lizard, endemic frog and invertebrate populations. Maintaining rodents across a landscape has multiple benefits for ecological restoration.

Fig 16: Bait Stations across Waikereru and Longbush Sanctuary.



Ship Rat

Ship rats are the most wide- spread and abundant rat species in New Zealand. They are generally arboreal (tree climbers) and will nest above ground in the tree canopy where they consume birds, invertebrates and reptiles. They consume large volumes of seed material, drupes, fruit and shoots. They are voracious predators and have been recorded attacking much larger species such as nesting petrels and shearwaters, kereru, tuatara and kokako. Densities in podocarp forest can range between 10-20 individuals per hectare. Ship rat populations can increase fivefold after possum control has occurred so multi species control is important (Sweetapple & Nugent). Populations also erupt post beech mast years which increases the success of stoats. When rat numbers decrease the following winter stoats alter their target food and prey switching can occur having a major and rapid impact on reptile, bird and invertebrate populations in an area, i.e. yellowhead (*Mohoua ochrocephala*) and orange fronted parakeet (*Cyanoramphus malherbi*). This is not so noticeable in North Island podocarp forest, however the pressure from ship rats occurs all year due to the diversity of fruit and material constantly available.

Kānuka forest across the upper slopes of Waikereru holds significantly lower ship rat numbers than Longbush podocarp-hardwood forest due to the lack of species diversity and the domination of kanuka regeneration. However to achieve full restoration of broad-leaved and podocarp-hardwood forest across Waikereru, ship rat control is vital.

Proposed Control Method

At present, a combination of Goodnature self-setting traps, AT220 and striker baiting is used at Waikereru with excellent results. Cholecalciferol striker baits have largely replaced bait stations which means bait can be deployed easier and faster across the sanctuary at key times of year. It is attached to trees with a gun-stapler which is time efficient and produces a good knockdown affect.

We have recorded excellent success throughout Longbush Reserve (13 ha) using A24 auto traps. One of the downfalls of these traps is that they are expensive at $149.00 each (right) however have the potential to maintain efficacy while reducing labour costs significantly by producing 24 kills per CO2 cannister.

To maintain ship rats at low levels, bait or poison should ideally be deployed at 50-75 metres apart. Particularly in high biodiversity value areas such as Longbush where long-tailed bat, endemic *Rhytida* snails and forest birds are found, this is important.

Norway rat

The Norway rat is also known as the water rat. They are burrowers and can grow to over 500 grammes in weight. They will eat almost anything but prefer to feed on invertebrates, worms and gastropods in or around waterways. They are poor climbers and do not pose a significant threat to forest birds or other arboreal species. They are most common in warmer climates to about 400 metres a.s.l. They are avid consumers of birds, their eggs and chicks and even burrowing adult seabirds. They generally make up a large percentage of mustelid tunnel bi-catch species in coastal and riverine habitats. They are distinct from ship rats in that they are larger and have a brown coat with crème belly fur. They have a rounded snout and their ears do not reach their eyes when pulled forward over the face.

Fig 18: A large Norway rat, 518 grammes, captured in a mustelid tunnel, Nicks Head Station, Gisborne.

Control method – Toxin baiting is the most effective method of controlling Norway rats. In the case of Waikereru, Norway rats are most prolific within the Waimata River riparian forest margin.

They are in lower numbers in higher altitude zones in grassland and regenerating kanuka forest. Norway rats are poor climbers, however are happy to access tunnels and trap cover holes.

9.0 Mustelids

Mustelids are significant predators of wildlife in New Zealand and all three species of mustelid are present at Waikereru.

Their prey includes invertebrates, reptiles, native fish, birds and even our endemic bat species. Stoats in particular are the primary predator of juvenile kiwi and other ground nesting bird species. They can range significant distances during their lifetime and populations can grow to high levels following rodent population increases.

Stoats can swim several kilometres at sea, climb into mature forest canopy and are fast enough to catch a rabbit. They are aggressive and determined predators.

Trap catch rates peak between October and February when juveniles of all three species are dispersing. Female mustelids in New Zealand breed from September onward. They will give birth to one litter of 4-9 offspring per annum. The females within the litter are impregnated by a male prior to leaving the nest and delayed implantation occurs. Therefore mustelid populations (particularly stoats) increase rapidly. During the following autumn and into early winter 90% of the year's offspring will die. Catch rates will generally start to slow during March -April with another spike in late May-June due to a reduction in invertebrate and rodent availability, traps become more attractive for hungry stoats. Catch rates will slowly tail off over winter and begin to climb again during September each year.

Stoats are estimated to make over 350 kills per year (DOC website). With a high metabolic rate they need energy. Ship rats are their primary target food species in forested areas. By eliminating ship rats a forest site does not remain as attractive to stoats, so less ship rats often means less stoats. The same can be seen with ferrets, less rabbits less ferrets and less mice means less weasels. The number of prey items available determines presence and the success of predators and not the other way around as many people believe. Stoats have a devastating impact on wildlife and probably contributed to the extinction of many bird species on the New Zealand extinction list. Introduced during the late 1890's over the following 40 years many mainland bird populations became extinct, i.e. mainland petrel colonies c.1930, huia 1904-07, laughing owl 1914, pio-pio 1900, pateke 1920. Many of these species extinctions were possibly caused by the widespread establishment of the stoat in New Zealand.

Ferret populations are strongest where rabbits are abundant as rabbits are their key target food species. Ferrets can become trap shy if traps are not managed well and numerous records exist throughout New Zealand where ferrets or 'a ferret' has decimated adult kiwi populations over a short time frame, i.e. Otamatuna, Kaweka, Pukaha, Motu, Boundary Stream. Ferrets also have a major impact on North Island weka.

Weasels are considerably smaller and generally target mice, lizards and invertebrates. Weasel catch rates increase rapidly in areas where mouse populations are high. Weasels are the most common mustelid captured at Waikereru due to the grassland habitat and mice being present.

Trap Type

The most effective control method for use on all species of mustelids is the 'DOC 200' kill trap and the Fenn No.6 kill trap. Two traps (double set) are placed in the centre of a wooden tunnel and baited with a single, holed hen's egg, minced or salted rabbit or minced chicken pet food and eraze dried rabbit either in dried or paste form. Therefore the three bait types are presented at any one time. Double set traps also out-perform single set boxes (Cam Speedy, Predator Free Trust, *pers.comm*)

Wooden Set

The set is a wooden tunnel 600mm in length (800mm in weka areas). It is constructed of treated H3 radiata pine. Both 200 x 25mm for the sides and 250 x 25mm rough sawn H3 for the base. The box is screwed together using no.2 square drive screws. The lid is made of 17mm plywood and cut 600 x 250mm. A warning sign and project name must be stencilled on the lid with black spray paint,

A plastic triangular track marker must also be screwed to the lid with the trap number on it. The lid is screwed at diagonally opposite corners with a square drive 40mm no.2 square drive or tech screw to prevent access to anyone other than the trapper.

Netting Hole Size

Particularly in areas where ground nesting species such as blue penguin, kiwi and weka are present a double mesh screen is required. These screens also help direct mustelid's onto the 'trip plate'. Twelve millimetre square aviary mesh is used or stainless steel screens (right) are now being used which keep trap boxes in better condition and are easier to remove for cleaning. Entrance holes are positioned in each screen to prevent the direct entry of wildlife which you are trying to protect. In sensitive areas a hole 70mm x 70mm will allow access to all mustelids (including ferrets) and keep out protected wildlife.
Where people are present a warning sign must be posted at entry points to the trapping block and the tunnels themselves should be attached to a tree or fence post with a small coach bolt or tech screw to prevent theft.

Trap and Set Management

(1) Wooden tunnels must be set on a <u>level</u> surface. They must be firmly sitting on the ground.

(2) Trap lids must sit flat and firm. Buckled lids must be replaced.

(3) The traps must be set in the centre of the tunnel. They need to be placed on either side of the bait with springs on opposite sides of the tunnel. The traps must be positioned so that trap arms are 20mm away from the bait and sitting square in the box. Correct trap placement in the tunnel is vital when trapping stoats.

(4) A no.5 hen's egg is positioned dead centre of the tunnel. The egg sits in a 20mm hole drilled into a small piece of ply and screwed to the floor of the tunnel. A hole is placed in the top end of the egg before it is placed into the trap tunnel White hens eggs should be used if available. Eggs require changing every 2 weeks in summer and monthly in winter. Salted or fresh rabbit meat is attached to a nail top centre of the trap and erayz is also used which holds scent for a considerable time until the next bait change.

(5) Trap tunnels need to be scraped clean of rat hair, hedgehog spines and other foreign matter, inside and out. Use a paint scrapper to clean the tunnel floor during <u>each</u> trap check.

(6) If using Fenn Traps the brass trap 'dog' and the hook must be lightly filed at least monthly so that they are free of corrosion and trip efficiently under the lightest touch, i.e. a weasel.

(7) The galvanised trap plate must also be scraped clean both top and bottom removing built up grime. The trap plate hinges and underside must be checked and cleared of cobwebs and other debris with a wire brush so that it operates easily. If the trap plate is not sitting flush with the trap arms when set it will require modifying.

(8) Set all traps finely and on the tip of the brass dog so that the lightest touch from a weasel is enough to trigger and catch quickly and smoothly.

(9) Again, the tunnel must be clean and clear of debris including grass at the entrance hole, rat hair, hedgehog spines etc. Traps need to be kept clean and free of unwanted debris allowing un-restricted access for mustelids and so that they can see an easy escape route at the opposite end of the tunnel.

If trapping in grassland hand clear around the tunnel. Clear 600mm out from either end of the tunnel and a strip 200mm wide along the sides of the tunnel. This means grass will not inundate the trap between checks and the trap will look well presented to your target pest.

Trap Spacing and Placement

Trap Tunnels need to be spaced at a distance of 200 metres. Use a gps to get this accurate. Sometimes trap tunnels are positioned closer than 200 metres to protect high value sites. Generally any less than 200 m is inefficient and any greater than 200 metres a female stoat can be missed because of their smaller territory.

Trap lines are run centrally along valley floors, preferably near a stream or down ridges and major spurs on hill country. Valley systems require only one line to be run centrally along its floor even if a river system is present. Small to moderate sized rivers and streams are no barrier or deterrent to the movement of mustelids.

If valleys, ridges or spurs are not present then traps should be placed on forest edges or beach boundaries. This is a favourable site for mustelids to find food, particularly rodents and lagomorphs.

Traps must be placed in accessible and visible locations. Visual and olfactory senses both play a key role in attracting mustelids. It also means you can find the trap again. Trap tunnels must be positioned on and run parallel with existing animal runs such as possum runs or stock trails. These are natural routes which different animal species in the area will prefer to use.

A good site to position tunnels is near log piles, stock or possum runs/trails, clay banks, or natural features which hold prey species or routes which mustelids and/or other animals may tend to use.

Trap Catch Recording

All trap catches must be recorded. The data to be recorded must include:

1) Species
2) Trap No. & Date
3) Sex & other features,i.e. bait used.

Species Identification

Ensure you can identify the three mustelid species in New Zealand effectively prior to commencing a trapping programme. Ferrets are the largest mustelid reaching lengths of 550 mm and are generally black and crème with a black facial mask. Stoats are chestnut brown with a white-crème belly and have a bushy tail with a <u>black tip</u>. The white belly fur forms a smooth line laterally along the body. Weasels are the smallest mustelid to be introduced to New Zealand they are similar to a stoat but have several discerning features. They are smaller than stoats, the cream coloured belly fur forms an <u>irregular lateral line</u> along the body, and a weasel does <u>not have a black bushy tail</u>. The ears are also smaller and more rounded in proportion to the head.

Mustelid Population Monitoring

Mustelid population indexing has been undertaken with mixed results throughout New Zealand. It is still largely a developing science with various methodologies being tried within DOC Mainland Island Sites (i.e. Hurunui MI) and by Landcare Research. AI cameras are now beginning to provide more accurate camera trap data.

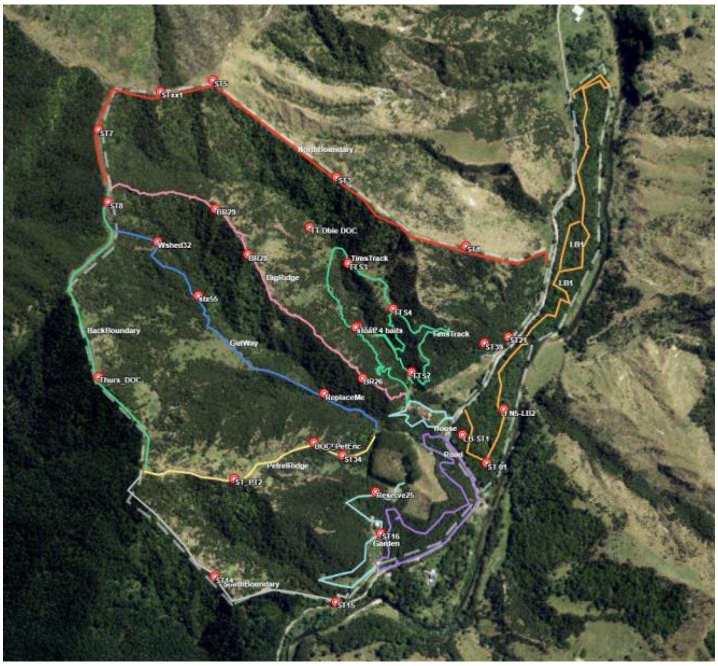
Tracking tunnel indexing has been used in many areas using meat baits. This has produced variable results (P.Dilkes, DOC, Eglinton Valley Yellow Head Research, *pers.comm*) with radio collared stoats living beside but not entering tracking tunnels.

Camera traps and outcome monitoring have proven the best measures of success. This will include 5 minute forest bird counts, kiwi chick and weka chick survival rates. We know that well set and well baited double set Fenn and Doc 200 traps catch mustelids and successfully protect kiwi, pateke and other species. The key is to maintain high quality trapping programmes overseen by an experienced operator.



Stoat Ferret Weasel *(Web Photos)*

Fig 25: Mustelid sets across Waikereru-



Bi-Catch

Several species are captured within mustelid tunnels as bi-catch to any control operation. Hedgehogs are the most common and can be found at a range of altitudes from coastal areas to beech forest. They are voracious consumers of invertebrates and coastal ground nesting birds. An adult hedgehog can consume 60 grammes of invertebrates each night. It is believed that hedgehogs can have an impact on invertebrate populations which can impact on kiwi and other native species dependent on invertebrates. Hedgehogs are a valued target/bi-catch species at Waikereru.

Hedgehogs are a significant threat in coastal and wetland area where ground nesting birds such as banded dotterel require protection.

Other bi-catch species can include Norway rats, blackbirds, starlings, thrushes, green bell frogs and occasionally young rabbits.

1.0 Lagomorphs

Hares and Rabbits are primarily a threat to native re-forestation projects and can modify habitats such as dune-lands which would otherwise be utilised by native species such as skinks. They can have a secondary impact by attracting mustelids and feral cats to an area because of the high target food levels, i.e. Boundary Stream MI and Cape Sanctuary and therefore threaten extant wildlife species.

The most effective control method is to undertake thermal night shooting for both hares and rabbits. Pindone, brodificoum and 1080 poison can be a useful tool in difficult sites for rabbits.

Thermal shooting is the only effective method of controlling hares. While staff are targeting hares they will control rabbits at the same time. Cage trapping works for rabbits, particularly large Havahart cage traps however results can be mixed. Night shooting with a thermal imaging scope and suppressor produces excellent results as rabbits in particular become light shy and sensitive to the sounds of ATV’s approaching and learn to make themselves scarce.

Table 2: Vertebrate Pest Management Targets

Target Pest Species	Control Method Options	Control or Outcome Target
Brush Tailed Possum	Sentinel traps spaced c.150m will maintain possums at low densities.	<2.5-3.0 % rtc – 3 yearly indexing.
Mustelids – ferret, stoat and weasel.	DOC 200 and Fenn No.6 Double sets at 200m spacing.	100% survival of juvenile NIBK to >1000g. Increase in forest bird 5 minute bird counts indices.
Feral Cat	Raised set Steve Allen kill traps at 300m spacing.	100% survival of juvenile NIBK to >1000g over time. Use of remote camera traps as monitoring tool.
Ship and Norway rat	Goodnature A24 & Trapping – Victor Pro snap traps. Rat control is imperative if possum control is in place. Baiting most economic control option.	Annual tracking tunnel indexing target rate of <5%.
Mouse	Not specifically targeted incidental control during ship rat operation.	Tracking tunnel indexing rate of <10%
Lagomorph – rabbits and hares	Night shooting roads and farmland. Lagomorphs can attract mustelids to a site.	<3/hunter man hour, spotlighting.
Feral Pig	Contract Hunter & pest staff	<1.0 kills/hunter man day + camera traps indices
Red Deer	Contract Hunter & pest staff	<1.0 kills/hunter man day + camera traps indices
Feral goat	Contract Hunter & pest staff	<1.0 kills/hunter man day + camera traps indices

11.0 Summary

Good conservation management at Waikereru and elsewhere in New Zealand is based around managing or eliminating introduced vertebrate predators, browsers and grazers. Due to our high levels of endemism and species which have evolved without the presence of predatory mammals over 70 million years our biodiversity is unique and extremely vulnerable to these introduced mammals.

If we can maintain vertebrate pest populations at low levels at Waikereru consistent with recognised best practice to see biodiversity and habitat recovery and protection we will be winning and we will see substantial recovery of many species and protection of high quality waterways and other habitats. The key is having proven methods, clear and effective operating procedures and dedicated personnel on the hill who can become part of the long term vision. As with every mainland conservation project in New Zealand a point which is often over-looked is that the predator management is the most important part of any project.

Maintaining a significantly reduced or predator free environment allows you to take incredible steps forward and provide a much higher level and increased speed of recovery and protection.

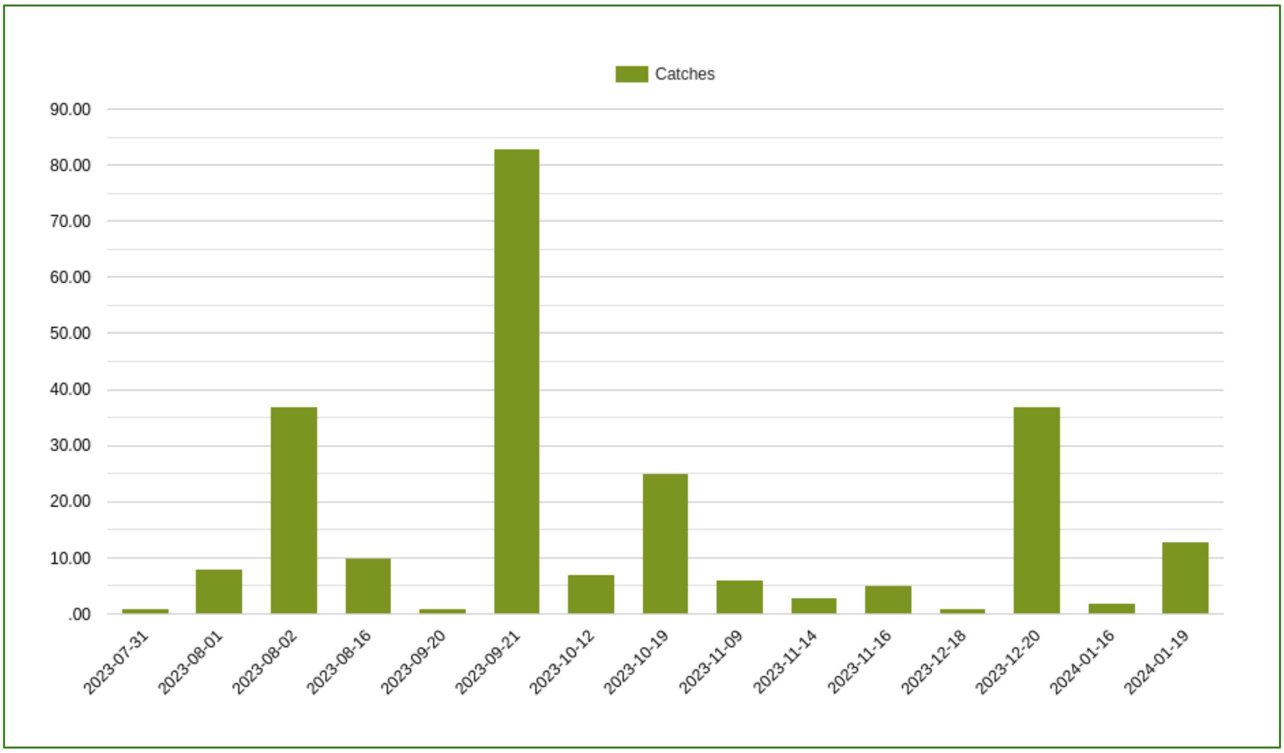
Table 3: Kill Tallies from 20/7/2023 to 20/1/2024

Month	Bird	Cat	Ferret	Hedgehog	Mouse	Possum	Rat	Stoat	Weasel	Total pests	None	Total checks	% Success
Jul 2023	0	1	0	0	0	0	0	0	0	1	47	48	2%
Aug 2023	0	0	0	0	8	3	58	1	2	72	117	189	38%
Sep 2023	0	0	1	0	1	6	86	0	0	94	35	129	73%
Oct 2023	0	0	1	1	1	3	48	2	2	58	107	165	35%
Nov 2023	1	1	0	1	1	1	9	1	0	15	103	118	13%
Dec 2023	0	0	0	0	10	3	39	2	3	57	91	148	39%
Jan 2024	0	0	0	0	0	3	22	0	0	25	113	138	18%
Total	**1**	**2**	**2**	**2**	**21**	**19**	**262**	**6**	**7**	**322**	**613**	**935**	**34%**

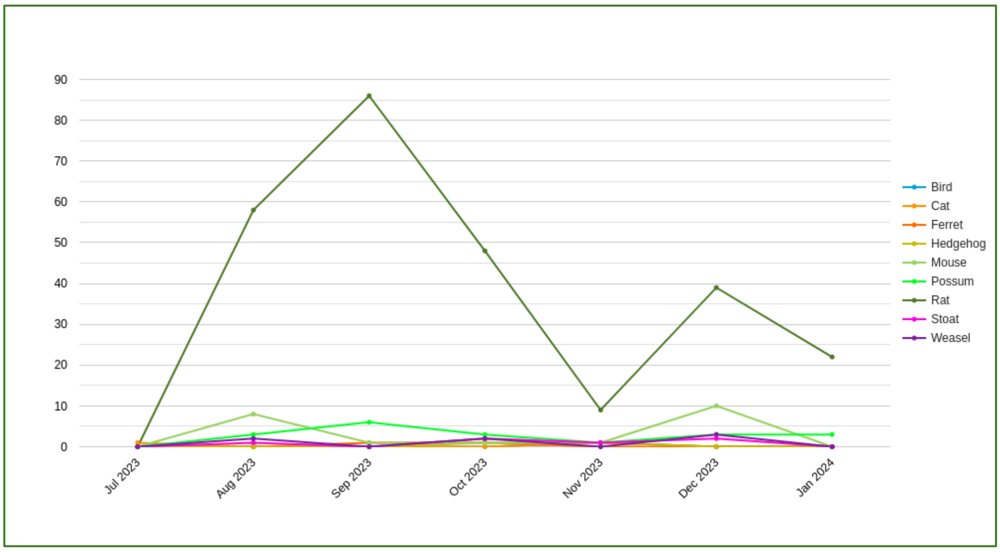
*The ‘bird’ shown in the table above was a thrush

Fig 26: Month by month chart of total kills

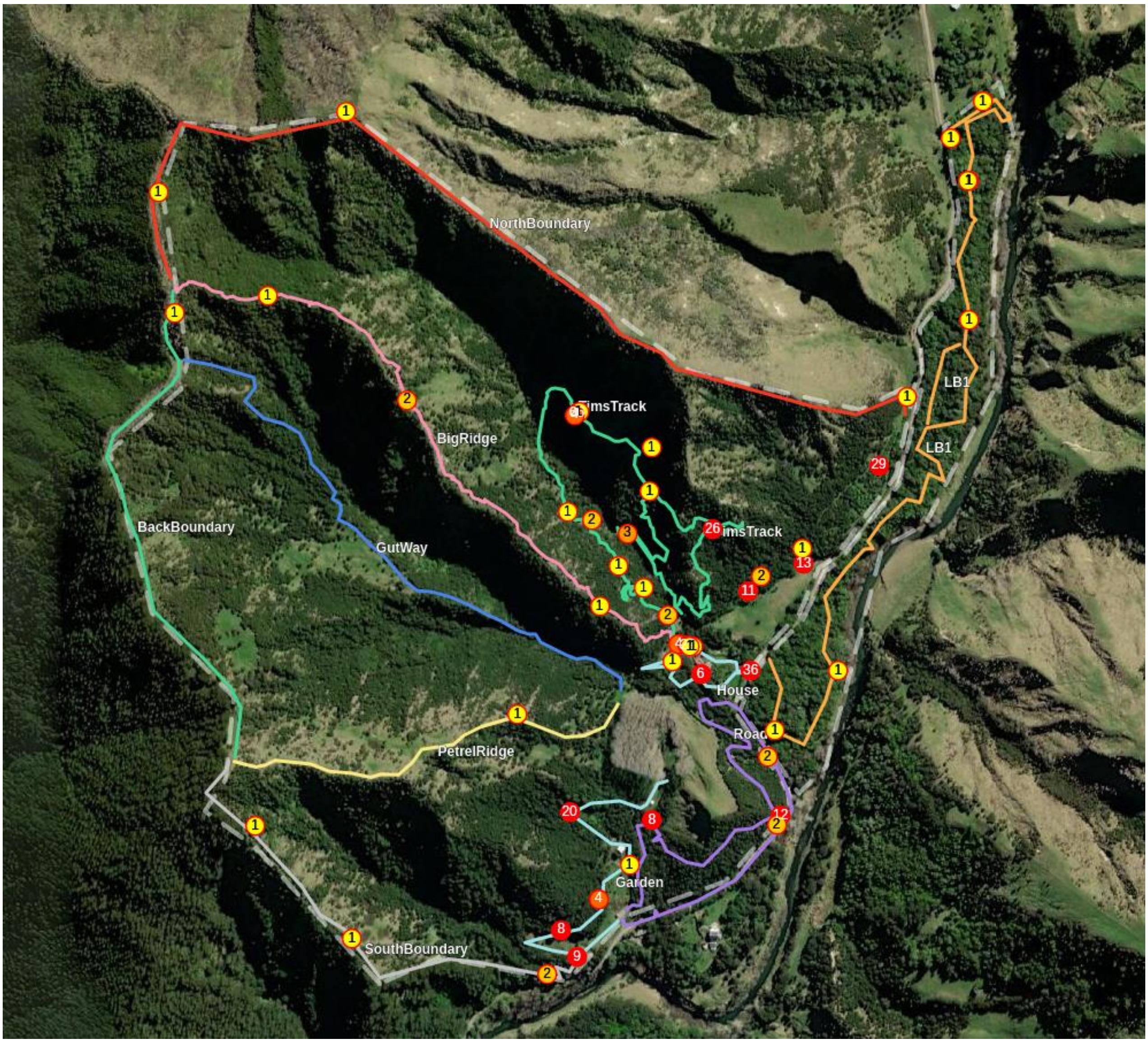
(Large spikes relate to accumulated auto trap kills)



<u>Fig 27: Monthly kills by species</u>



<u>Fig 28: Total trap kills by location</u> (Locations with zero kills not shown)



<u>Fig 29: Trap kills as a heatmap</u>.

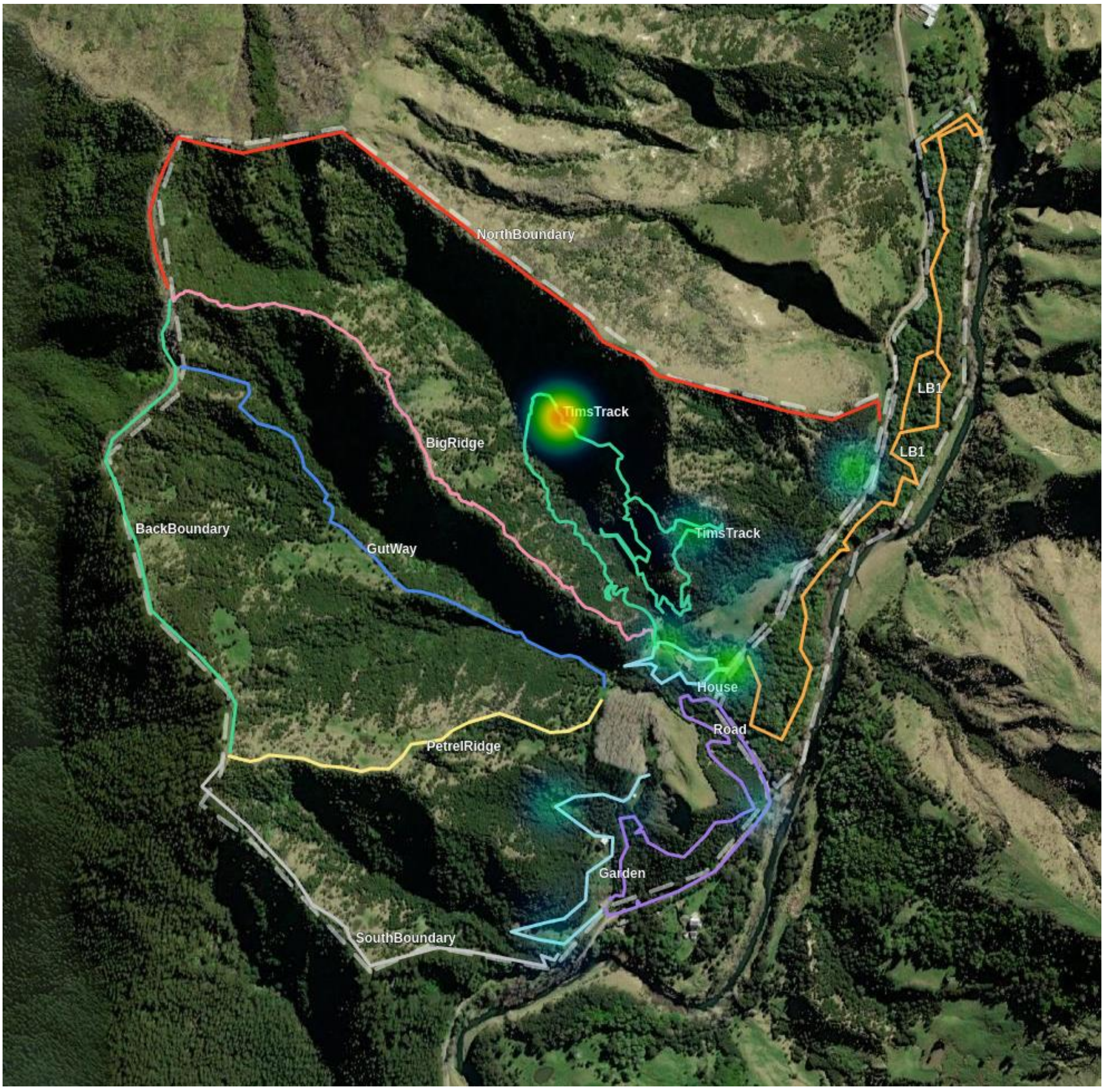


Fig 30: Waikereru heat map of trap kills without AT220's

(To prevent data skew from high kill rates of AT220 auto traps)

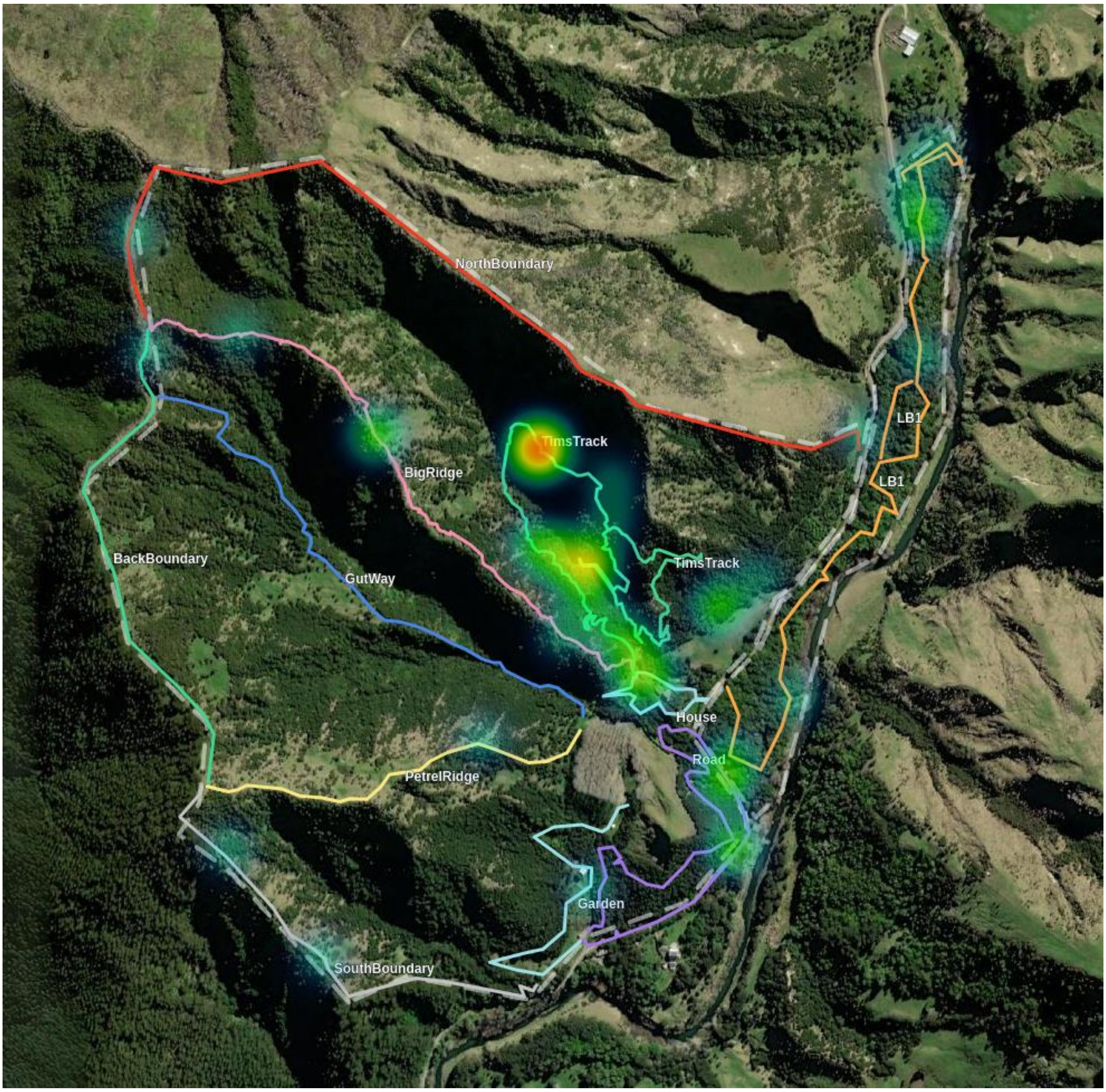
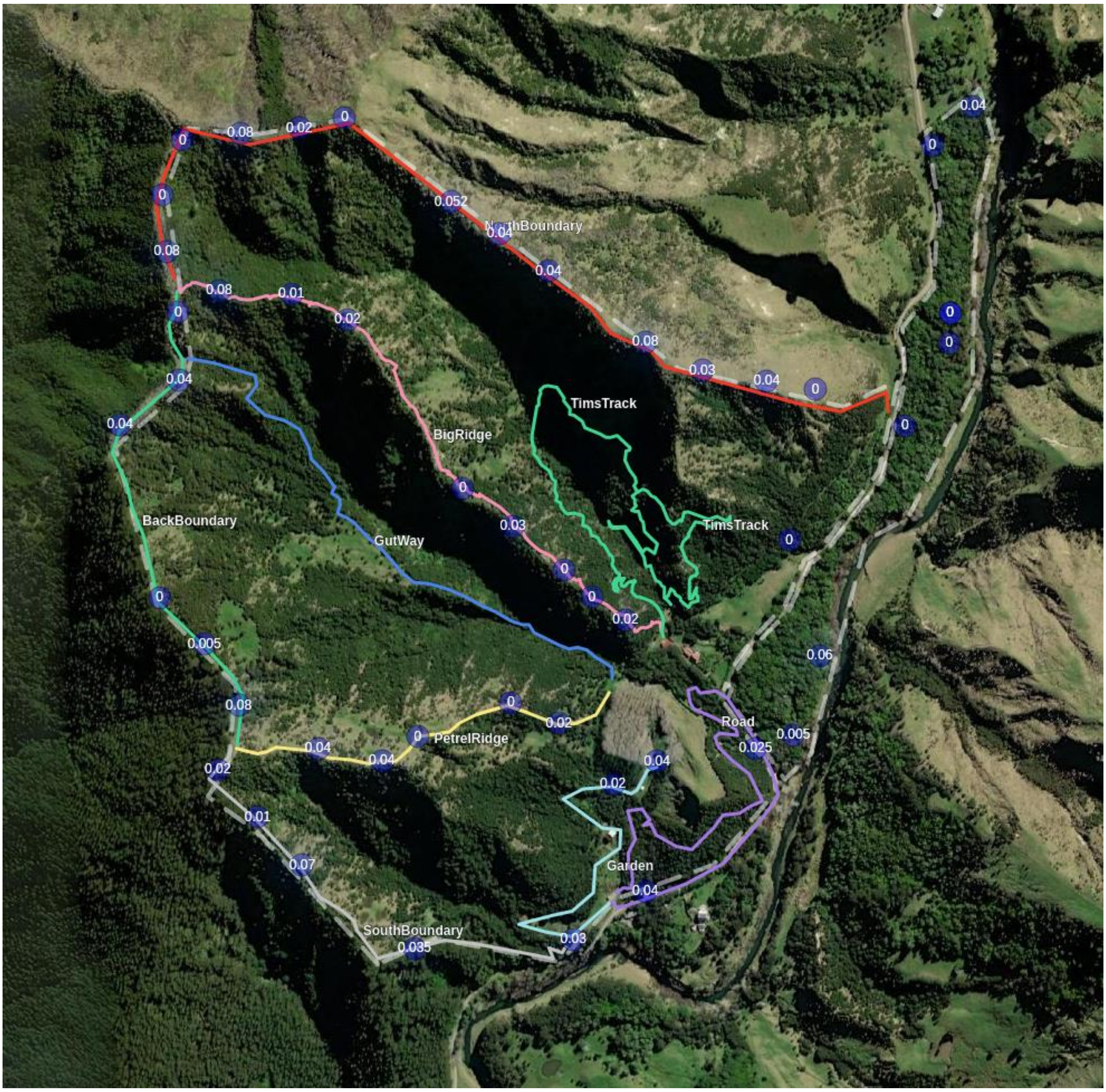
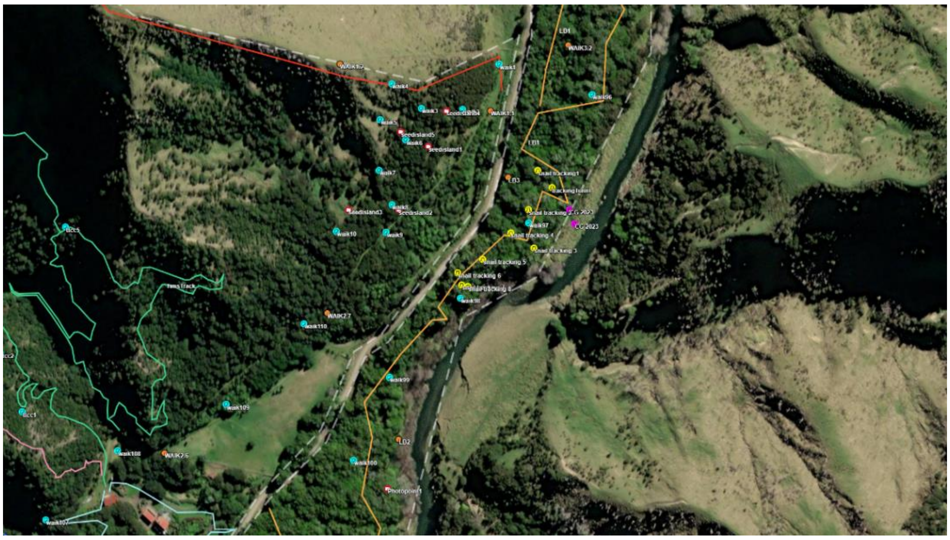


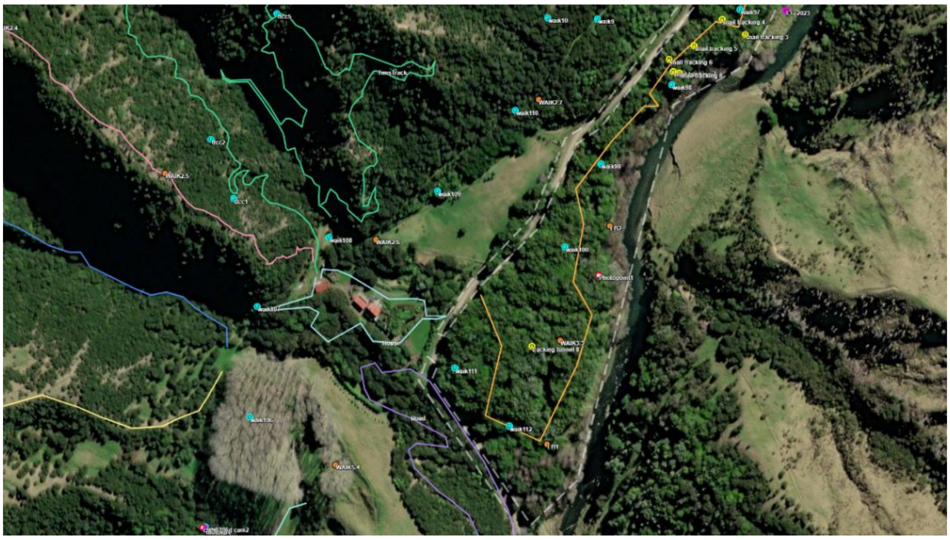
Fig 31: Map of Rat bait taken

(Representing kilograms of "Double tap" bait)



Chew Card Lines January 15-19th 2024.





Ecoworks NZ Environmental Management Services:

-Bird Survey and Indexing

-Macro-Invertebrate Survey and Indexing

-Water Quality Monitoring & Rapid Habitat Assessment

-Freshwater Fish Survey

-Environmental DNA Monitoring

-Bird & Reptile Species Survey

-Spectral Bat Survey & Monitoring

-Pest Population Survey & Indexing

-Threatened Species Recovery & Translocations

-Forest Vegetation Survey, Plot Establishment, Photo-point Monitoring

- Acoustic Spectrogram Survey for Birds

-Vertebrate Pest Control Design and Planning

-Drone Survey & Project design