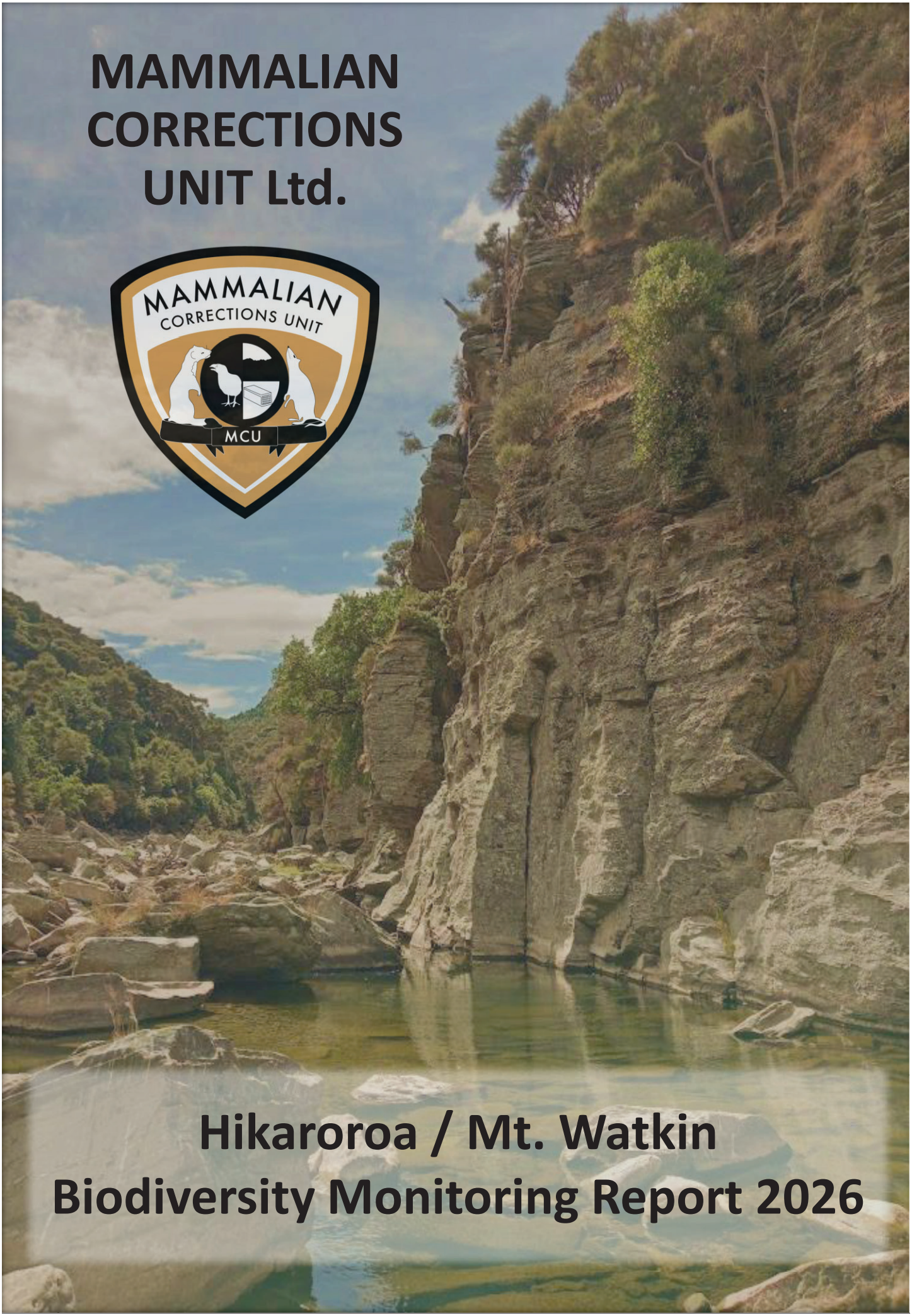
MAMMALIAN CORRECTIONS UNIT Ltd.



Hikaroroa / Mt. Watkin Biodiversity Monitoring Report 2026

Produced on behalf of the Dunedin City Council

&

the Hikaroroa / Mt. Watkin Conservation Group

By

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Table of Contents

A Note on Reporting Scope and Management Structure

The Hikaroroa landscape comprises both the 660 ha Dunedin City Council (DCC) Hikaroroa / Mt. Watkin Scenic Reserve and a network of surrounding privately owned properties managed collaboratively through the Hikaroroa / Mt. Watkin Conservation Group (HMWCG). Although these are separate management entities with different funding arrangements and operational responsibilities, together they form an interconnected ecological landscape. Native species, introduced pests, and ecological processes move freely across property boundaries, making landscape-scale management practical and essential for both parties.

Mammalian Corrections Unit Ltd. (MCU) provides contracted pest management, monitoring, and reporting services for both organisations. Monitoring and reporting undertaken within the DCC Scenic Reserve is funded through DCC's operational pest management programme, while monitoring and reporting on HMWCG-managed private land is funded through the Department of Conservation Community Fund Project Coordinator role. Although these monitoring programmes are funded separately, they have been presented together in this report in good faith to provide a more holistic understanding of ecological conditions across the wider Hikaroroa landscape that give useful insight to both management parties.

Results from DCC and HMWCG monitoring are presented separately to acknowledge differences in management history, survey timing, and land tenure. However, synthesising these datasets provides valuable context for adaptive management and supports coordinated decision-making between project partners working towards the shared goal of protecting and restoring the ecological values of Hikaroroa / Mt. Watkin.

Executive Summary

In 2023, the DCC began a biodiversity monitoring program alongside the pest control operations at Hikaroroa / Mt. Watkin Scenic Reserve to understand biodiversity recovery in response to their pest control investments. The Hikaroroa / Mt. Watkin Conservation Group replicated the DCC biodiversity program on the surrounding private land following the DOC Community Fund 2024 successful grant application. Biodiversity monitoring forms a key component of both project's adaptive management framework.

The current monitoring programme focuses on three indicators of ecological recovery: forest birds, terrestrial invertebrates, and forest regeneration. Together, these datasets, as well as biodiversity observations from field teams, aim to improve understanding of how pest management influences biodiversity outcomes across the project area. This report focuses on forest birds, terrestrial invertebrates, and biodiversity observations. Forest regeneration is discussed in a separate ungulate impact assessment.

Forest bird monitoring has been undertaken annually within the Scenic Reserve since 2022 and was expanded onto surrounding private land in 2025. Four years of monitoring indicate that native forest birds remain widespread throughout both the reserve and surrounding forest fragments. While no strong trends are yet evident, this is consistent with expectations, as measurable responses to pest management often require a minimum of 5–10 years of monitoring before clear patterns emerge.

Terrestrial invertebrate monitoring has been conducted annually since 2023 using pitfall traps co-located with rodent monitoring lines. Baseline monitoring identified a diverse and abundant forest-floor invertebrate community. Although insufficient data currently exist to assess trends, the programme is establishing a valuable long-term dataset that will help evaluate ecological responses to predator management over time.

Several significant biodiversity observations were recorded during the reporting period. Two successful kārearea nests fledged at least three chicks within the project area, while two additional native lizard species, tussock skink and kōrero gecko, were discovered. Both species are classified as At Risk – Declining and were previously unrecorded within the project area. The identification of tussock skinks within the stomach contents of a feral cat also provides direct evidence of predation on native reptiles and reinforces the importance of ongoing feral cat control.

Overall, the monitoring programme has established a strong foundation for long-term ecological assessment. While most datasets remain in the early stages of development, the information collected to date has improved understanding of the biodiversity values present at Hikaroroa and will help guide future pest control, threatened-species management, and adaptive conservation decision-making.

Biodiversity Monitoring Framework

General Information & Context

Ecological monitoring is a core component of the current framework of the Hikaroroa / Mt. Watkin Conservation Project. It provides part of the foundation for adaptive management, paired with pest monitoring (predator and browser monitoring), to evaluate the effectiveness of pest control operations, track changes in ecosystem health, and guide future management decisions.

The biodiversity monitoring programme is guided by the principles outlined in the Hikaroroa / Mt. Watkin Vertebrate Pest Management Strategy 2024, which emphasises adaptive management based on site specific generalized density impact functions.

The key objectives of the programme are to understand the relationship between introduced pest abundance and biodiversity indicators through time. Specifically, the project aims to identify the suppression levels of browsing and predation pressure that result in net recovery of forest bird species, larger bodied invertebrates, and palatable native vegetation **(Table 1).** These three biodiversity indicators were chosen to form the basis of the biodiversity monitoring program as they can be measured by affordable, proven methods that correlate to the key ecological values of the Hikaroroa area (regionally significant remnant dry forest (unnaturally rare) / volcanic boulderfield shrublands (naturally rare), regionally significant remnant forest bird & eastern falcon/kārearea (threatened - Nationally Vulnerable) populations, and rare invertebrate biodiversity (including lepidopteran species recognized as threatened - nationally critical).

Table.1 Overview of methodologies, frequency, and target of monitoring protocol.

Methodology	Species Monitored	Survey Quantities DCC	HMWCG	Current Frequency
5MBC - 5 minute bird count	Forest Birds	30 sites	27 sites	Annual (Oct/Nov)
Terrestrial Invertebrate Pitfall Transects	Terrestrial Invertebrates	5 transects	5 transects	Annual (Feb)
Biodiversity Observations	Any observed	NA	NA	Continuous

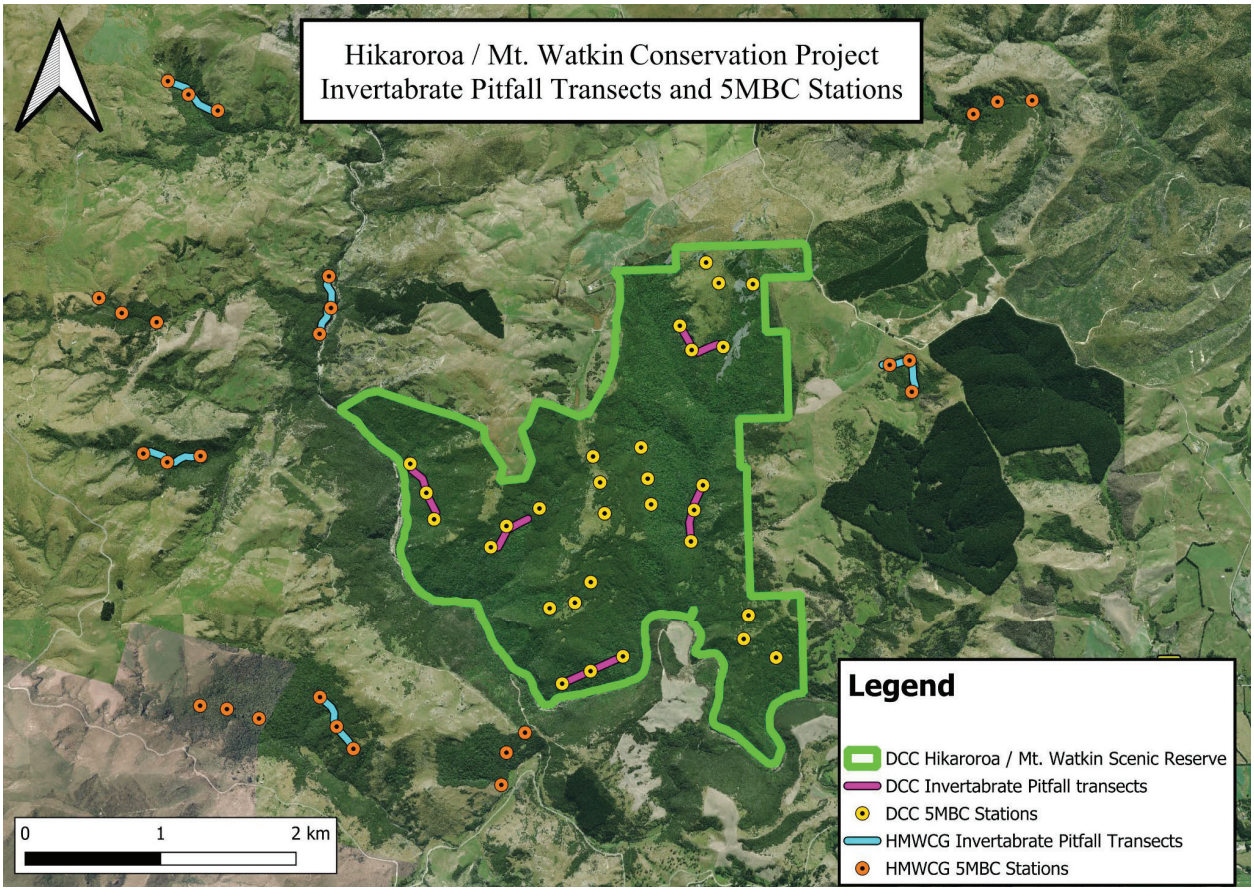
Together, the datasets of these ecological indicators will provide an evidence-based framework for evaluating conservation / pest control outcomes, thereby supporting the long-term restoration of the Hikaroroa / Mt. Watkin area.

This report seeks to provide project funders, project managers, and project partners an update on the current status of the forest bird and terrestrial invertebrate monitoring operations and outcomes. For

analysis of SRI (forest regeneration monitoring) please refer to the Hikaroroa / Mt. Watkin Ungulate Impact Assessment 2026.

The monitoring locations of 5-minute bird counts and terrestrial invertebrate pitfall transects span the Hikaroroa / Mt. Watkin Scenic Reserve and the surrounding Hikaroroa / Mt. Watkin Conservation Group managed private land (**Map 1**). Together they form the Hikaroroa / Mt. Watkin Conservation Project Biodiversity Monitoring network, alongside the SRI (seedling ratio index) transects, comprising 57 bird count stations and 10 pitfall transects.

5MBC monitoring has been undertaken at Hikaroroa / Mt. Watkin Scenic Reserve annually since 2022, and began in 2025 on the surrounding private land. Invertebrate pitfall monitoring has been undertaken across the project area annually since 2023, but only year 1 of data has been processed due to budget constraints. We are seeking MSc student support to take on further analysis of this project once sufficient data has been collected.



Map 1. Hikaroroa / Mt. Watkin Conservation Project 5mbc stations and invertebrate pitfall transects.

Methods

Forest Bird Monitoring (5MBC)

Rationale

Forest birds are widely recognised as indicators of ecosystem health and are expected to respond positively to sustained predator control and habitat restoration. Monitoring changes in forest bird communities provides an important measure of ecological outcomes and helps assess whether pest management efforts are contributing to biodiversity recovery within Hikaroroa / Mt. Watkin area.

In 2022, Parker Conservation Ltd developed a long-term forest bird monitoring strategy for Hikaroroa. The programme was designed to provide a simple, repeatable, and cost-effective method for tracking changes in bird abundance over time. The primary objective is to establish a long-term dataset capable of detecting trends in forest bird populations and evaluating their response to ongoing restoration efforts.

Five-Minute Bird Counts (5MBC) were selected as the preferred monitoring method due to their widespread use throughout New Zealand, ease of implementation, and ability to provide a robust index of relative bird abundance that can be compared through time and, where appropriate, between sites. While simple and cost effective, 5MBC monitoring provides noisy data due to a variety of external variables that can affect bird populations and detection rates at any specific point in time. Therefore, detectable changes are likely to emerge over medium to long timeframes. Binney et al. (2021) suggest that it might take 5-10 years before any real trend in native bird populations becomes evident.

Methodology

Forest bird monitoring is conducted using the Five-Minute Bird Count (5MBC) method following recommendations developed by Parker Conservation Ltd (2022). This method is consistent with other bird monitoring efforts across New Zealand (Fea et al., 2021).

Monitoring is undertaken annually during the spring breeding season between mid-October and mid-November, when forest birds are most vocal and breeding adults are most readily detected. Surveys are conducted during favourable weather conditions between approximately 6:30 am and 11:30 am.

The monitoring network consists of 57 count stations distributed across the project area using the existing tracking tunnel network. Three count stations are located on each of the ten tracking tunnel lines, with one station positioned at each end of the line and one at the midpoint. This design provides broad coverage of the reserve while utilising existing monitoring infrastructure.

At each station, observers record all birds seen or heard during a five-minute survey period. Counts include birds detected within approximately 100 metres of the observer, as well as birds flying overhead. Surveys are undertaken by experienced observers capable of accurately identifying forest bird species by both sight and call.

To maximise comparability between years, survey timing, methodology, and observer effort are standardised wherever possible. Since 2022, all bird surveys have been conducted by Stephen Parker who is experienced in bird monitoring. Data is recorded and stored in PDF format on the MCU Google Drive and uploaded to Trap.nz to enable long-term analysis of trends in bird abundance and species composition.

Terrestrial Invertebrate Pitfall Monitoring

Rationale

Terrestrial invertebrates play a fundamental role in forest ecosystems as decomposers, pollinators, predators, and prey for native birds, reptiles, and other wildlife. Many native invertebrate species are also vulnerable to predation by introduced mammals, making them useful indicators of ecosystem condition and ecological response to pest management.

The Hikaroroa / Mt. Watkin terrestrial invertebrate monitoring programme was developed with technical guidance from Jamie McAuley (DOC Senior Ranger) and Tara Murray (DOC Scientist), who have been investigating relationships between rodent abundance and terrestrial invertebrate communities through a monitoring trial in Fiordland. The monitoring design aligns closely with this project's adaptive management framework by pairing measures of pest abundance with measures of ecological response.

Statistical power analysis undertaken by Nathan Whitmore (Reproducible Ltd) identified pitfall monitoring of large-bodied invertebrates as a practical and cost-effective approach for long-term outcome monitoring. Modelling indicated that successful predator suppression should result in a gradual increase in the abundance of large-bodied invertebrates within the intensively managed core area relative to peripheral monitoring sites. While the monitoring design lacks a formal experimental control, long-term comparisons between the reserve core and surrounding farmland are expected to provide an indication of ecological recovery resulting from predator management.

Power analysis suggested that detectable changes are likely to emerge over medium to long timeframes, with monitoring periods exceeding five years required before robust trends become apparent. Due to the recovery rates of invertebrates being faster than forest birds, we should see earlier indications of ecological response to predator suppression compared to 5MBC monitoring.

Methodology

Terrestrial invertebrates are monitored using pitfall traps following Department of Conservation protocols for sampling ground-dwelling invertebrate communities.

To maximise efficiency and facilitate comparison with predator monitoring results, pitfall traps are co-located with tracking tunnel stations on five monitoring lines distributed across both reserve and private land. Pitfall traps are installed adjacent to tracking tunnel stations, allowing invertebrate and rodent monitoring data to be collected from the same locations and under the same environmental conditions.

Pitfall surveys have been undertaken concurrently with the annual 21-night tracking tunnel survey. Traps remain active throughout the monitoring period before being collected and processed at the completion of the survey.

Monitoring commenced in 2023 and has now been conducted annually in February across both reserve and private land. The first year's samples were processed by AgResearch to establish baseline methodologies and provide taxonomic identification. Due to the substantial cost of specimen processing, subsequent samples have been cleaned, labelled, and archived for future analysis. In consultation with DOC technical advisors, the project is pursuing a partnership with the University of Otago to support future processing and analysis through postgraduate research. Monitoring data collected to date are expected to provide a sufficient foundation for detailed statistical analysis as the dataset continues to mature (5-8 years).

Biodiversity Observations

Rationale

In addition to structured monitoring programmes, biodiversity observations collected by field staff, volunteers, landowners, and project partners provide valuable information on species presence, distribution, and ecological change within the project area. While these observations do not follow a formal sampling design and are therefore unsuitable for robust population trend analysis, they can contribute to the detection of uncommon species, identify emerging management opportunities, and improve understanding of biodiversity values across the landscape.

Particular emphasis is being placed on recording observations of species that are either culturally significant, threatened, difficult to detect using standard monitoring methods, or of specific management interest to the project.

Methodology

Biodiversity observations are recorded opportunistically by Mammalian Corrections Unit field staff, volunteers, landowners, and project partners during routine project activities.

In late 2025 we updated volunteer timesheets to include a record of kererū observations. Kererū were selected because they are readily identifiable by volunteers, reducing the likelihood of misidentification and providing a consistent dataset that may be used to develop a simple effort-based index of observations through time. As a culturally important mahika kai species, this information may also contribute to future discussions regarding ecosystem recovery and cultural harvest opportunities.

Observations of native lizards are also opportunistically recorded. Baseline lizard surveys undertaken in 2023 (Knox, 2024) detected only McCann's skink, a widespread and relatively common species considered unlikely to show a measurable response to current predator management. Consequently, a formal long-term lizard monitoring programme was not recommended at that time. However, observations of other lizard species are actively encouraged, as records of uncommon or threatened species may inform future monitoring priorities and management decisions.

Observations of kārearea (New Zealand falcon) are similarly recorded. Kārearea are a threatened species known to occur within the project area but are often poorly detected during standard Five-Minute Bird Count surveys due to their large home ranges, low densities and use of non-forest habitat. Landowners are encouraged to report nesting activity encountered during farm operations, while field staff pay particular attention to falcon behaviour during the breeding season to assist with nest detection and improve understanding of the species' distribution within the project area.

Analysis

Five-Minute Bird Count Analysis

Five-Minute Bird Count (5MBC) datasheets are scanned and saved on the MCU Drive and entered into a Trap.nz following each survey.

For each native forest bird species, total detections and percentage of surveys that detected them have been graphed across the years of monitoring as a relative abundance index and distribution index.

Results from the most recent survey (November 2025) have been included for reporting purposes of activities undertaken this financial year since we include both the DCC Scenic Reserve and the surrounding private lands of the Hikaroroa Mt Watkin Conservation Group for the first time.

Terrestrial Invertebrate Analysis

Pitfall trap samples were collected, labelled, and archived following field collection. The first year of monitoring (2023) was processed by AgResearch to provide taxonomic identification and baseline understanding of composition.

Subsequent samples (2024–2026) have been cleaned, sorted, labelled, and stored for future analysis. Detailed processing of these samples is planned through collaboration with the University of Otago, with the aim of assessing changes in invertebrate abundance, diversity, and community composition through time.

Future analyses will compare trends between reserve and peripheral monitoring sites to assess ecological responses to predator management.

Biodiversity Observation Analysis

Opportunistic biodiversity observations were compiled from volunteer timesheets, field records, and landowner reports. Kererū observations hope to be standardized using volunteer effort records to generate a simple effort-based index of observations through time. Due to the opportunistic nature of the dataset, results are intended to provide an indication of broad trends rather than robust estimates of abundance.

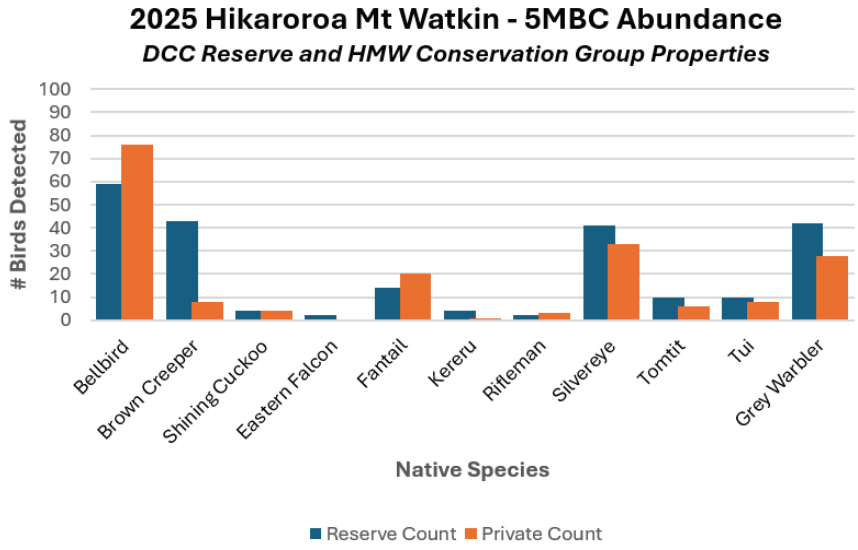
Observations of native lizards, kārearea, and other notable species were summarised descriptively where appropriate to improve understanding of species distribution and habitat use within the project area.

Results

Five-Minute Bird Count Results

In 2025, the annual 5MBC survey included the Conservation Group properties for the first time (previous surveys had only been conducted in the DCC Scenic Reserve). Thus, the 2025 results are presented in **Figure 1** as the first attempt to understand the native bird population across the entire Hikaroroa / Mt. Watkin Conservation Project area. Our intention is to continue monitoring in the future across these now-57 sites within the broader project area. The corresponding data table, **Table A-1**, can be found in the Appendix.

a) 2025 HMW Project Area Abundance



b) 2025 HMW Project Area Species Distribution

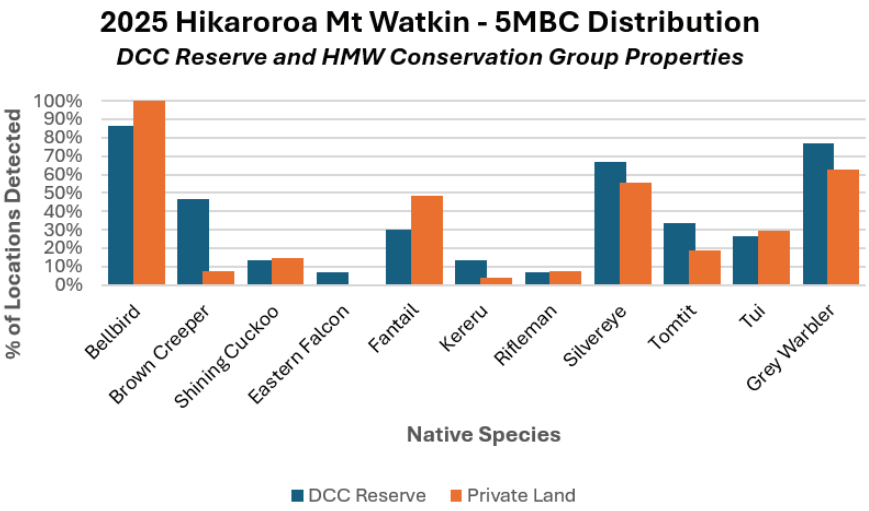
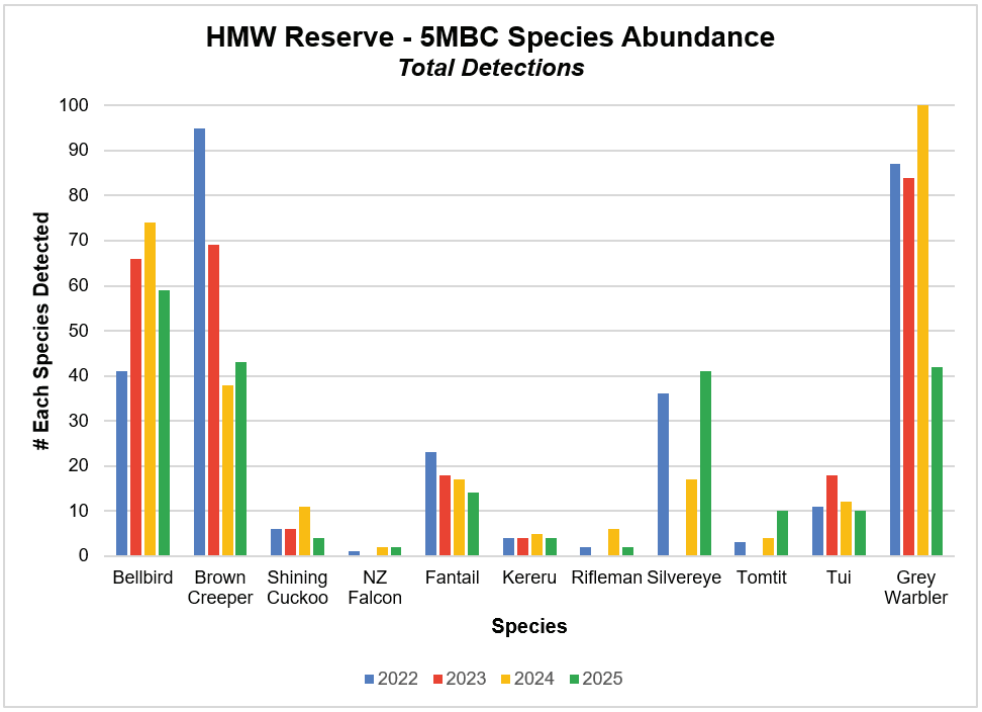


Figure 1. 2025 5 Minute Bird Counts at Hikaroroa Mt. Watkin Conservation Project area. Note: 30 stations were surveyed in the Reserve; 27 stations were surveyed on Private land.

Results within the DCC Scenic Reserve span four years of 5MBC surveys, as represented in **Figure 2**.Individual graphs for each species are presented in **Figure 3a-b-c** The underlying data for these graphs comes from **Tables A2 and A3** in the Appendix.



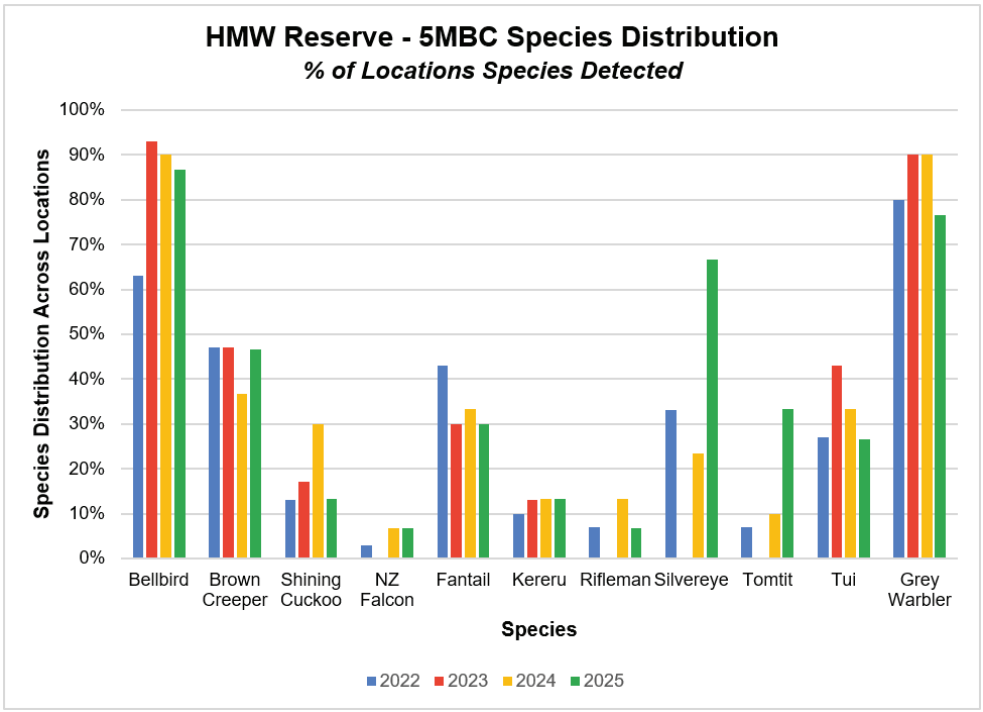


Figure 2. 5 Minute Bird Counts at Hikaroroa Mt. Watkin Over Time. Annual surveys across the DCC Reserve show total birds detected by species each year (top), as well as distribution of species (bottom) (measured as the percentage of survey locations reporting detection).

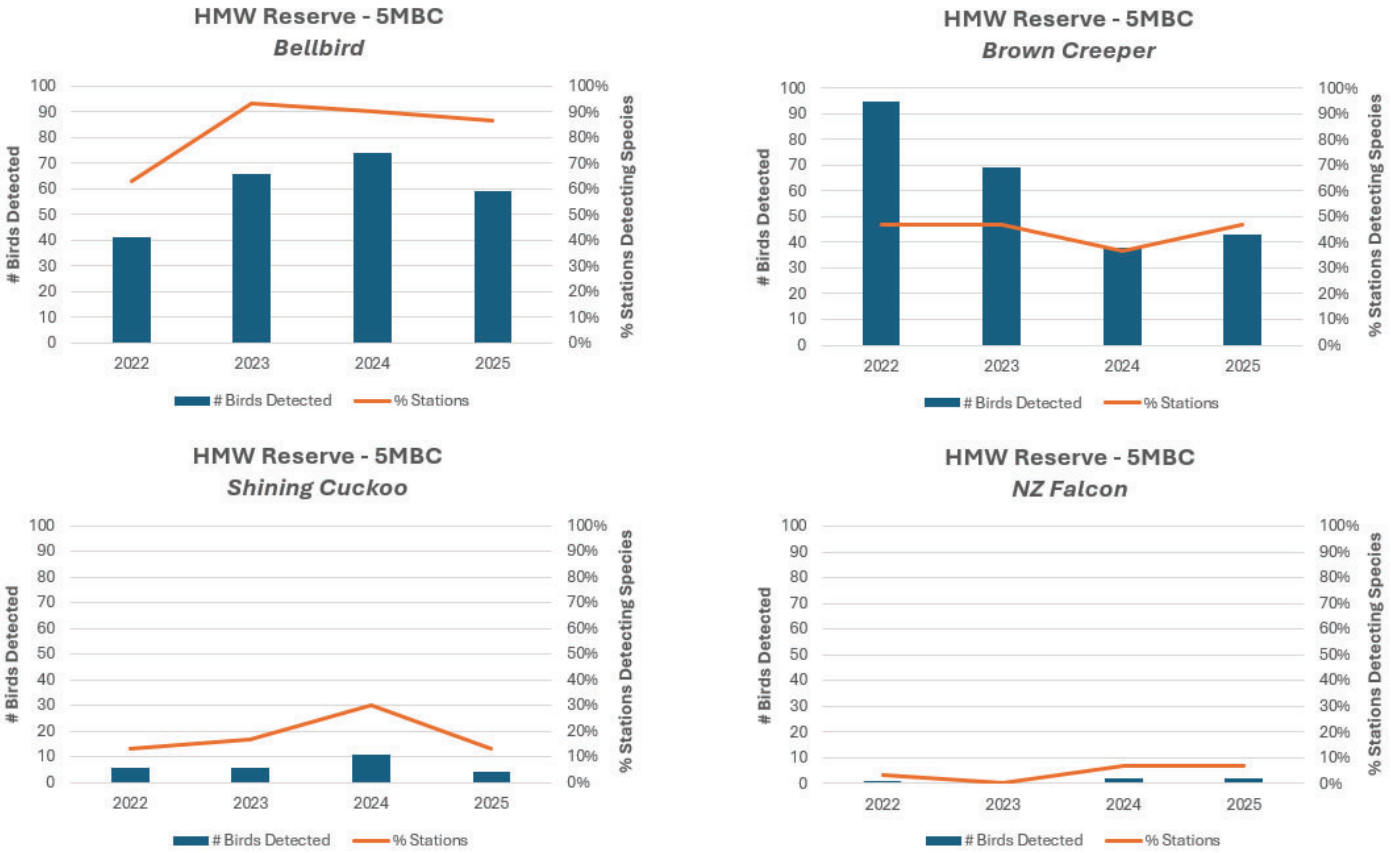


Figure 3a. 5MBC at Hikaroroa Mt Watkin Over Time - by Individual Species.

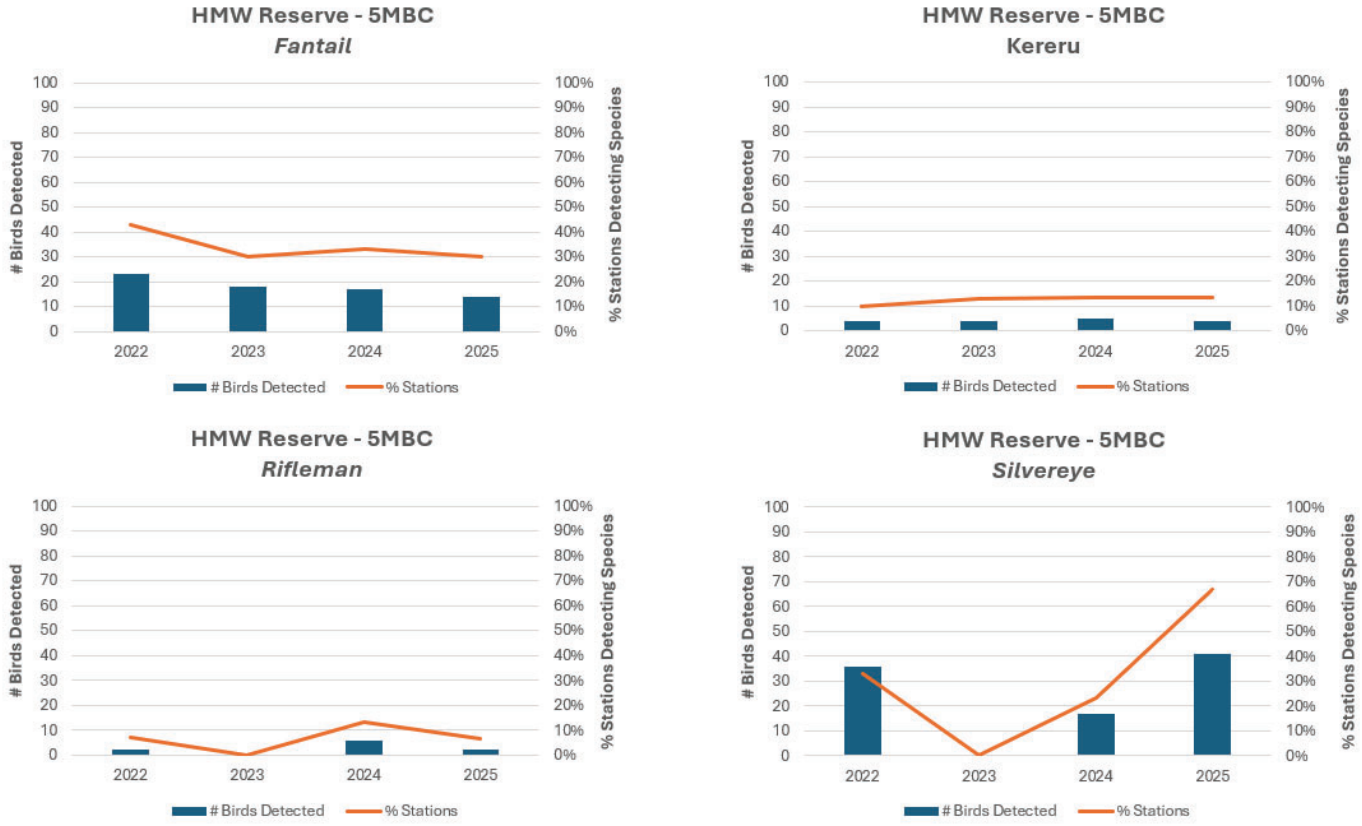
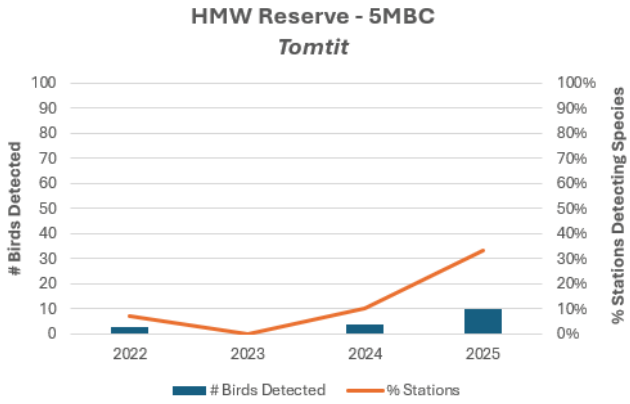
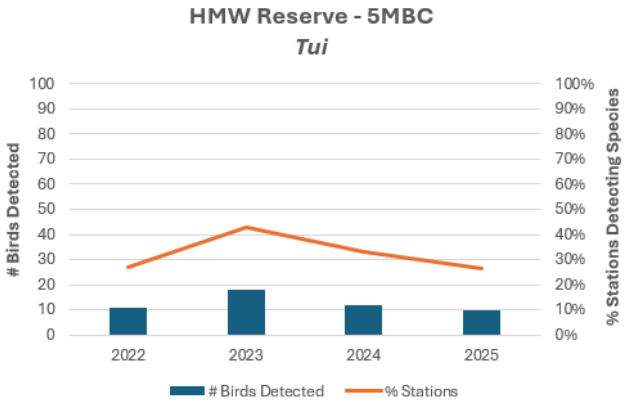


Figure 3b. 5MBC at Hikaroroa Mt Watkin Over Time - by Individual Species.





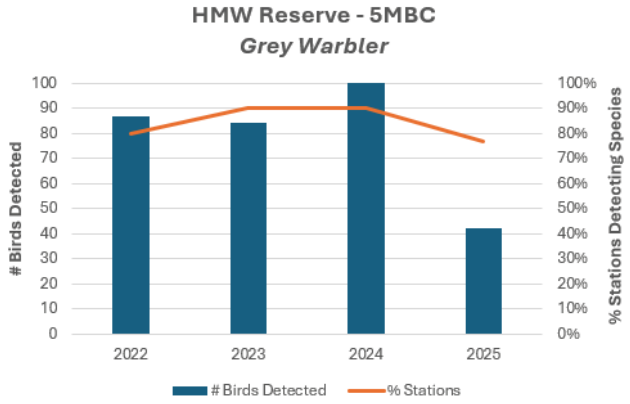


Figure 3c. 5MBC at Hikaroroa Mt Watkin Over Time - by Individual Species.

Terrestrial Invertebrate Results (Baseline Invertebrate Monitoring Results 2023)

The 2023 survey provides the first baseline assessment of ground-dwelling invertebrate communities within the Hikaroroa / Mt. Watkin monitoring network. A total of 2,531 individual invertebrates were recorded across a wide range of taxonomic groups, demonstrating substantial diversity within the reserve and surrounding monitoring areas.

Crustaceans were among the most abundant groups recorded, particularly amphipods, which accounted for 421 individuals. Beetles (Coleoptera) were also strongly represented, with numerous families detected including rove beetles (Staphylinidae), weevils (Curculionidae), darkling beetles (Tenebrionidae), scarab beetles (Scarabaeidae), and ground beetles (Carabidae). Small rove beetles were the single most abundant taxonomic group recorded, with 500 individuals detected.

Diptera (flies) were another prominent component of the invertebrate community, with 406 individuals recorded across larval and adult life stages. Lepidoptera larvae were also common, with 111 caterpillars detected. Arachnids were well represented, including spiders, harvestmen (Opiliones), and pseudoscorpions, with a combined total of 338 individuals recorded.

Several groups of particular ecological interest were present, including wētā (22 individuals), ground beetles (25 individuals), millipedes (57 individuals), and a range of predatory arthropods such as spiders, harvestmen, and pseudoscorpions. The presence of these taxa indicates a structurally complex forest-floor community with representation across multiple trophic levels.

The baseline survey establishes an important reference point against which future changes in abundance and community composition can be assessed. While interpretation of ecological trends is not yet possible from a single year of data, ongoing monitoring will allow evaluation of whether key indicator groups, particularly larger-bodied invertebrates identified by Whitmore (2024) as potential indicators of management success, increase in abundance over time in response to sustained predator control.

Table 2. 2023 Pitfall Summary at DCC Scenic Reserve.

2023 Pitfall Summary Table					
Group	**Recognizable Taxonomic Unit (RTU)**	**Sum**	**Group**	**Recognizable Taxonomic Unit (RTU)**	**Sum**
Annelids	Worms	22	**Diptera**	Diptera adult large	32
Annelids	Flatworms	17	**Diptera**	Diptera adult small	259
Gastropoda	Snails	6	**Diptera**	Diptera larvae	115
Gastropoda	Slugs	1	**Coleoptera**	Carabidae adults large	18
Arachnida	Opiliones	73	**Coleoptera**	Carabidae adults small	0
Arachnida	Spiders large	80	**Coleoptera**	Carabidae larvae	7
Arachnida	Spiders small	137	**Coleoptera**	Curculionidae	55
Arachnida	Pseudoscorpion	48	**Coleoptera**	Curculionidae larvae	1
Crustacea	Amphipoda	421	**Coleoptera**	Tenebrionidae large	11
Crustacea	Isopoda	11	**Coleoptera**	Tenebrionidae small	2
Myriapoda	Diplopoda	57	**Coleoptera**	Tenebrionidae larvae	8
Myriapoda	Chilopoda	5	**Coleoptera**	Staphylinidae large	6
Psocoptera	Psocoptera	31	**Coleoptera**	Staphylinidae small	500
Neuroptera	Neuroptera larvae	1	**Coleoptera**	Staphylinidae larvae	32
Blattodea	Cockroaches	2	**Coleoptera**	Pselaphidae	4
Orthoptera	Crickets	2	**Coleoptera**	Latridiidae	119
Orthoptera	Wētā	22	**Coleoptera**	Scarabaeidae adults	29
Hemiptera	Pseudococcidae	0	**Coleoptera**	Scarabaeidae larvae	7
Hemiptera	Pseudococcidae large	8	**Coleoptera**	Byrrididae	1
Hemiptera	Aphids	10	**Coleoptera**	Zopheridae	4
Hemiptera	Hemiptera other	38	**Coleoptera**	Leodidae	3
Thysanoptera	Thrips	6	**Coleoptera**	Ptiliidae	16
Hymenoptera	Wasps large	1	**Coleoptera**	Cerambicidae	3
Hymenoptera	Wasps small	58	**Coleoptera**	Beetle adult other	72
Hymenoptera	Ants	45	**Coleoptera**	Beetle larvae other	4
Lepidoptera	Lepidoptera adult	0	**Siphonaptera**	Flea	7
Lepidoptera	Lepidoptera larvae	111			
Lepidoptera	Bagmoth	3			

Biodiversity Observations

Kārearea (New Zealand Falcon)

Two kārearea nests were reported by project landowners during the 2025–26 breeding season. Both nests successfully fledged young, with a minimum of three eastern falcon chicks confirmed to have fledged across the two nest sites. These observations provide encouraging evidence that the project area continues to support a breeding population of this nationally threatened species.

An additional area along the Waikouaiti River between the reserve and 4 Rivers Farm was identified as likely supporting a breeding pair. However, due to the rugged terrain and limited access, a nest site was not located and breeding success could not be confirmed.

The successful fledging of multiple chicks demonstrates the ongoing importance of the Hikaroroa landscape for kārearea and highlights the value of landowner observations in detecting breeding activity that may otherwise be missed by formal monitoring programmes.

Photos credit: Jamie Hickling

Image. 1 Two Kārearea fledglings from a nest located at Mt. Watkins Farm. Blue colouration around the eyes indicates a juvenile.

Herpetofauna Observations

Two additional native lizard species were detected within the project area during the past year. These included tussock skink (*Oligosoma chionochloescens*) and kōrero gecko (*Woodworthia* "Otago-large"), both of which are currently classified as At Risk – Declining.

These observations are significant as previous targeted lizard surveys undertaken within the project area detected only McCann's skink (*Oligosoma maccanni*). The discovery of additional lizard species increases our understanding of the biodiversity values present within Hikaroroa and demonstrates the importance of maintaining ongoing opportunistic biodiversity observations alongside formal monitoring programmes.

Follow-up searches for kōrero gecko indicate that the species may occur as a relatively small and isolated population within the project area. Given its conservation status, this population may warrant further investigation and consideration within future management planning.

Tussock skinks were not directly observed during field surveys and were instead identified from the stomach contents of a feral cat removed from the project area. Examination of the stomach contents revealed the remains of 14 native skinks, comprising four tussock skinks and ten McCann's skinks. This finding highlights both the conservation significance of the newly detected lizard population and the predation pressure exerted by feral cats on native reptile communities.

Photo credit: Jamie Hickling

Image.2 Juvenile feral cat caught in May 2026 in an HMWCG DOC250. The stomach contents dissection showed 14 skinks and 1 bird (likely a blackbird). All skinks were swallowed mostly whole and were undigested. Stomach contents are being saved for all fresh feral cats moving forward to better understand their diet and impact on native fauna.

Photo credit: Jamie Hickling

Image. 3 A juvenile gecko in the *Woodworthia* genus with dark colouration and golden eyes. These have now been identified on two schist outcrops with some sign visible on surrounding outcrops. Approximately 10 individuals have been identified. These geckos are lumped into the common name of “Otago Large / Korero” geckos, but this genus has not yet had scientific description down to species level.

Kererū Observation Index

To develop a meaningful metric of observations, each month we tracked the number of volunteer hours of field time, the number of calendar days volunteers were in the field, and the number of individual volunteers working that month, along with the number of kererū sightings reported. We developed 2 metrics that can be used as indices to be tracked over time:

- Sightings per Field Day = number of kererū sighted per calendar day in the field each month
- Sightings per 100 VFD, where VFD = the number of calendar field days worked * number of individual volunteers working that month.

Table 3 provides results from our initial 4-month test of a Kererū Sighting Index. Some key learnings have already surfaced from this initial attempt to involve volunteers in wildlife reporting. First, we have seen that volunteer experience counts. Most of the sightings came from a few core volunteers who were spending significant time in the field each month. Second, big volunteer events, such as the 'possum weekend' in December where volunteers help service the AT220 network, distort the volunteer hours, coupled with relatively new volunteers in the field for these events. Inexperienced volunteers are more focused on getting the traps serviced (as they should do!) with less bandwidth to observe the winged wildlife around them. Because possum weekends occur every 6 months, we should be able to see explainable seasonal patterns in our volunteer reporting. Third, we will need to emphasise with all volunteers on an ongoing basis the need to observe the landscape and be on the lookout for kererū while in the field. Developing this awareness and skill level within our volunteer corps will enable us to eventually expand the number of species we can identify in the field in the future.

Table 3. Testing a Volunteer Index for Kereru Sightings

Month	Volunteer Hours	# Volunteers	# FieldDays	Kererū Sightings	Sightings/ FieldDay	Sightings per 100 Volunteer FieldDays
Nov-25	164	12	7	5	0.7	6.0
Dec-25	304.5	15	5	2	0.4	2.7
Jan-26	0	0	0	0		
Feb-26	97	3	7	10	1.4	47.6
	565.5	30	19	17	0.9	3.0

Discussion: Interpretation and Recomendations

Five-Minute Bird Count Interpretation

Forest bird responses to pest management are often complex and can vary considerably between species. Different bird species are affected by introduced mammals in different ways, with some being primarily limited by rat predation, others by mustelids or possums, and some through competition for food resources (Innes et al., 2010; Fea et al., 2021). Consequently, changes in bird abundance can take many years to become apparent, particularly where pest management targets only part of the introduced mammal community (Byrom et al., 2016). Innes et al. (2010) point out that predation and competition (limiting food supply) are the biggest concerns limiting New Zealand forest bird populations, with strong interactions between these primary factors. Competition for food can take place between native bird species that feel less predation pressure, between endemic/native and introduced birds, as well as by pest mammals themselves. Compiling material from Innes et al. (2010, along with personal communications with Rachelle Binny at the BioEconomy Science Institute (formerly Manaaki Whenua Landcare Research), **Figure 4** depicts the pest mammal impacts on native bird populations, as they are recognised as playing both predator and competitor roles. The eleven bird species identified in the previous 5 minute bird count reports are highlighted based on current knowledge from experienced ecologists.

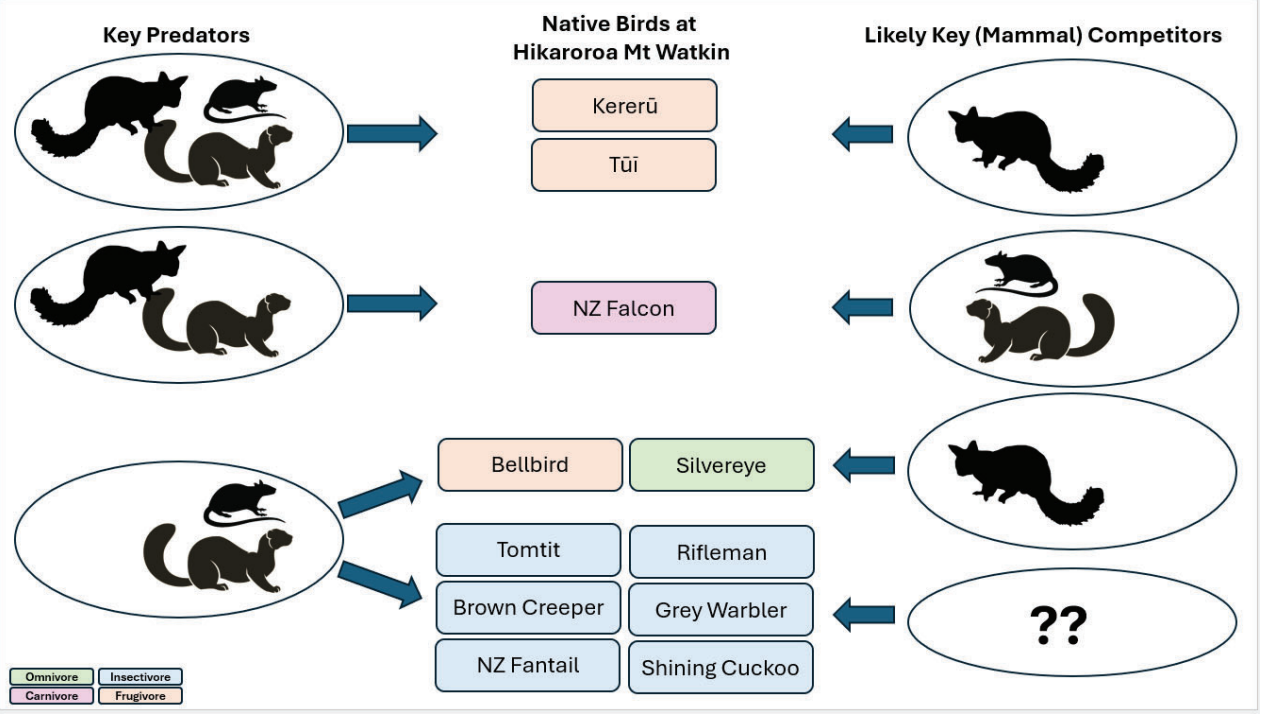


Figure 4. Pest control impacting native bird species at Hikaroroa. Note that feral cats were not included in the original Innes et al. (2010) publication, and are only beginning to be reported in the literature with respect to predation/competitor roles they might play in a forest ecosystem such as Hikaroroa Mt. Watkin.

Byrom et al., (2016) point out that overall benefits to native bird populations are strongest when possums, rats and mustelids are all controlled. When control efforts are limited to a particular species such as possums, the resulting effect is often an increase in ship rat populations. However, even when all predators

are controlled, some bird species will benefit more than others due to a complex network of competition between native and introduced birds and even between native species because predators are no longer suppressing their competitors (Fea et al., 2021). Recent research highlights not only the complexities of measuring benefits to native bird populations, but also the need for consistent and regular control over extended time periods.

At Hikaroroa, monitoring indicates that ship rat abundance has remained relatively low compared with many New Zealand forests, with annual tracking rates ranging from 0–21% and averaging approximately 9% since monitoring began in 2021. While these levels are comparatively low, most native forest bird species remain vulnerable to rat predation. The absence of landscape-scale rodent suppression may therefore limit the rate of bird population recovery and reduce the strength of any trends detected through bird monitoring.

After four years of monitoring, no strong positive or negative trends are yet evident. This is not unexpected, as forest bird responses to predator management are often only detectable after 5–10 years of consistent monitoring. Although the current dataset remains relatively small, several species, including riroriro (grey warbler), pīwakawaka (fantail), and pīpipi (brown creeper) have shown declining detectability over the monitoring period. At this stage these patterns should be interpreted cautiously, but they may indicate that current predator management alone is insufficient to fully address the factors limiting some forest bird populations or other environmental factors may be having greater influence.

The addition of monitoring on surrounding private land has provided useful insights into the distribution of forest birds across the wider project area. Most species were detected throughout both the reserve and surrounding forest fragments, suggesting that many native forest birds continue to utilise habitat across the broader landscape. Bellbirds and fantails showed slightly higher detectability on private land than within the reserve, potentially reflecting a greater tolerance of fragmented habitats. In contrast, pīpipi (brown creeper) were substantially more common within the reserve, with 43 detections across 14 surveys compared with only eight detections across two surveys on surrounding private land. This pattern may indicate that brown creepers are more dependent on large areas of contiguous indigenous forest and could serve as a useful indicator species for future monitoring.

Continued annual bird monitoring is strongly recommended. As the dataset matures, trend analysis will become increasingly powerful and may provide early warning of declines or evidence of ecological recovery. Consideration should also be given to future rodent suppression initiatives if forest bird recovery becomes a primary management objective, particularly for species known to be sensitive to rat predation such as pīpipi (brown creeper), miromiro (tomtit), and titipounamu (SI rifleman).

Baseline Invertebrate Monitoring (2023)

The 2023 baseline survey indicates that Hikaroroa / Mt. Watkin supports a diverse and abundant ground-dwelling invertebrate community, with representatives from a wide range of ecological groups including decomposers, herbivores, predators, and detritivores. Particularly notable was the abundance of amphipods, rove beetles, flies, spiders, and other predatory arthropods, suggesting a well-developed forest-floor ecosystem with a complex food web. The presence of larger-bodied taxa such as wētā, ground beetles, darkling beetles, and millipedes is encouraging, as these groups have been identified as potential indicators of ecological recovery under sustained predator management. While no conclusions regarding management outcomes can be drawn from a single year of monitoring, the survey establishes a valuable ecological baseline against which future changes in abundance and community composition can be assessed.

The terrestrial invertebrate monitoring programme is beginning to establish a valuable long-term dataset; however, the current four years of data are still considered insufficient for robust trend analysis. Previous power analysis undertaken by Nathan Whitmore indicated that ecological responses, particularly increases in large-bodied invertebrates associated with successful predator suppression, are unlikely to become clearly detectable until at least 5–8 years of monitoring have been completed, with weaker responses potentially requiring longer timeframes.

Continued annual collection of pitfall monitoring data is therefore recommended to strengthen the dataset and improve the statistical power available for future analysis. Priority should be given to maintaining consistency in survey timing, methodology, and site coverage.

As the dataset approaches five years of continuous monitoring, opportunities should continue to be explored for partnership with the University of Otago to support specimen processing, analysis, and postgraduate research. By 2027–2028, sufficient data may be available to undertake preliminary assessments of trends in large-bodied invertebrate abundance and evaluate whether ecological responses to predator management are emerging within the project area.

Biodiversity Observations

Biodiversity observations continue to provide valuable information that complements the project's formal monitoring programmes. During the 2025–26 monitoring period, at least three kārearea chicks successfully fledged from two confirmed nest sites, while a third potential breeding territory was identified but not confirmed. These observations indicate that Hikaroroa continues to support a breeding population of this nationally threatened species.

The discovery of tussock skink and kōrero gecko, both classified as At Risk – Declining, represents one of the most significant biodiversity findings recorded within the project area to date. Their detection increases our understanding of the conservation values present within Hikaroroa and highlights the importance of ongoing biodiversity observations by staff, volunteers, and landowners.

The identification of four tussock skinks and ten McCann's skinks within the stomach contents of a feral cat provides direct evidence that introduced predators are interacting with native lizard populations. This

finding further supports the continuation of targeted feral cat management and suggests that predator control may be particularly important for protecting vulnerable reptile populations within the project area.

To improve understanding of threatened species responses to management, the conservation group has applied for funding to establish more intensive kārearea nest monitoring and targeted lepidoptera monitoring programmes. These initiatives would provide more standardised and repeatable monitoring of threatened fauna while complementing the existing biodiversity monitoring framework.

The discovery of At Risk lizard populations also warrants consideration of additional reptile monitoring. Artificial cover-board monitoring may provide a cost-effective method for tracking occupancy, distribution, and population trends of kōrero gecko and tussock skink through time, helping assess whether these species are responding positively to ongoing predator management.

The kererū observation programme remains in an early stage of development and is currently limited by inconsistent recording effort. While the methodology has the potential to generate a useful long-term index, variation in timesheet completion and biodiversity observation reporting reduces confidence in comparison. To improve the robustness of this dataset, greater emphasis should be placed on the routine completion of volunteer timesheets and daily recording of observations by field staff and volunteers. During larger volunteer events, team leaders should actively collect and submit biodiversity observations for inclusion in the project database. With improved consistency and participant buy-in, the kererū observation programme has the potential to develop into a valuable long-term indicator of ecological/cultural recovery across the project area.

Acknowledgements

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Special thanks to the surrounding landowners whose ongoing support provides access to monitoring sites, biodiversity observations, and long-term stewardship of the wider landscape. We are particularly grateful to those who have contributed observations of kārearea nesting activity, native wildlife, and ecological changes occurring across their properties.

We acknowledge Dunedin City Council for their continued management of Hikaroroa / Mt. Watkin Scenic Reserve and their support of biodiversity monitoring and restoration activities throughout the project area. We also thank the Department of Conservation for technical advice and support, particularly Jamie McAuley and Tara Murray for their guidance in developing the terrestrial invertebrate monitoring programme.

We thank Kevin Parker of Parker Conservation Ltd for designing the project's long-term forest bird monitoring framework and Stephen Parker for undertaking annual Five-Minute Bird Count surveys.

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We thank John Innes and Rachelle Binny, scientists at the BioEconomy Science Institute (formerly Manaaki Whenua Landcare Research) for sharing their knowledge of New Zealand forest birds, particularly the extensive supporting information included in the 2010 article cited in this report, but continues to evolve and provide useful information to practitioners.

The project has also benefited from the support of the University of Otago Wildlife Management Programme. We thank the staff and students who have contributed ideas, field assistance, and research proposals that continue to strengthen the scientific foundation of the project.

Finally, we thank the volunteers, community members, and Mammalian Corrections Unit field staff whose countless hours in the field have made this monitoring programme possible. Their commitment to understanding and restoring the biodiversity of Hikaroroa / Mt. Watkin continues to build the knowledge needed to guide long-term conservation management.

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Appendix

Table A-1. 2025 5MBC at Hikaroroa Mt Watkin.
There were 30 survey sites in the DCC Reserve and 27 sites on private land.

	DCC RESERVE			PRIVATE LAND		
Species	Reserve Count	Distribution	% Occurrence	Private Count	Distribution	% Occurrence
Bellbird	59	26/30	87%	76	27/27	100%
Brown Creeper	43	14/30	47%	8	2/27	7%
Shining Cuckoo	4	4/30	13%	4	4/27	15%
Eastern Falcon	2	2/30	7%	0	0/27	0%
Fantail	14	9/30	30%	20	13/27	48%
Kereru	4	4/30	13%	1	1/27	4%
Rifleman	2	2/30	7%	3	2/27	7%
Silvereye	41	20/30	67%	33	15/27	56%
Tomtit	10	10/30	33%	6	5/27	19%
Tui	10	8/30	27%	8	8/27	30%
Grey Warbler	42	23/30	77%	28	17/27	63%

Table A-2. Annual 5MBC Detections at DCC Scenic Reserve

Measured as birds being either seen or heard across the same 30 locations used each year of the survey. Note that no observations were recorded for NZ Falcon, Rifleman, Silvereye or Tomtit species in 2023.

HMW Reserve -Detections

DATE	Bellbird	Brown Creeper	Shining Cuckoo	NZ Falcon	Fantail	Kererū	Rifleman	Silvereye	Tomtit	Tui	Grey Warbler
2022	41	95	6	1	23	4	2	36	3	11	87
2023	66	69	6		18	4				18	84
2024	74	38	11	2	17	5	6	17	4	12	100
2025	59	43	4	2	14	4	2	41	10	10	42

Table A-3. Annual 5MBC Species Distribution at DCC Scenic Reserve

Measured as a % of survey locations detecting the species. The same 30 locations are used each year of the survey. Note that no observations were recorded for NZ Falcon, Rifleman, Silvereye or Tomtit species in 2023.

HMW Reserve -% of Locations Detecting a Species

DATE	Bellbird	Brown Creeper	Shining Cuckoo	NZ Falcon	Fantail	Kererū	Rifleman	Silvereye	Tomtit	Tui	Grey Warbler
2022	63%	47%	13%	3%	43%	10%	7%	33%	7%	27%	80%
2023	93%	47%	17%		30%	13%				43%	90%
2024	90%	37%	30%	7%	33%	13%	13%	23%	10%	33%	90%
2025	87%	47%	13%	7%	30%	13%	7%	67%	33%	27%	77%