VESPULA QUEEN WASP CONTROL 2024

WHAKATĀNE RESERVES – ŌHOPE SCENIC RESERVE, KŌHĪ POINT SCENIC RESERVE, MOKORUA BUSH SCENIC RESERVE AND NGĀTI AWA KĀWENATA.

Report prepared for the Whakatāne Kiwi Trust by Michelle Howard,
Mamaku Environmental Ltd

"Ruthless invader and ingenious predator" (Lester, 2018)

1.0 Contents

2.0 Summary

A trapping programme using a ‘targeted habitat’ method for queen *Vespula* wasp control in reserves near Whakatāne continued for the fourth consecutive year. Trapping took place within four bush reserves: Kōhī Point Scenic Reserve, Mokorua Bush Scenic Reserve, Ōhope Scenic Reserve (North and South) and the Kāwenata on Ngāti Awa farm. The methodology was the same as the previous seasons using No Pests® dome traps set out and lured with No Pests® wasp lure. Traps were placed at approximately 200m spacing along ridges and spurs, avoiding gullies or narrow stream valleys. Traps were placed and opened between mid to late August and all traps were closed and removed by the end of the third week of December. Traps were checked and captures identified, recorded, and removed, weekly to two-weekly depending on volunteer availability and suitable weather. Wasp nests located were destroyed using KiwiCare® ‘No Wasps’™ Permethrin Powder. There were 19 Volunteers who gifted approximately 500 hours of their time.

There were 766 queen wasps caught in 2024, essentially the same as 2023, higher than the number caught in 2022 but lower than the number in 2021. The total number of queens caught shows no obvious trend however captures have remained below the peak number caught in 2021. Comparative observations from the trap capture analysis show that after the inaugural 2021 season the queen capture rate has remained less than half, which may be showing a promising trend of keeping the wasp numbers/nests at a lower level. For the fourth consecutive year the highest rate of queen captures was from the western ridge of the Mokorua Bush SR.

The total number of workers caught appears to show a fluctuating trend. Captures were high in 2024, much greater than the number in 2023 and 2021 but less than in 2022. This may possibly indicate density dependence where a low number of wasps one year is followed by high numbers the next year.

Queen wasp heat mapping is showing some cooling of activity in some reserves. The Mokorua Bush SR remains the site with the greatest intensity, however when looking at the four-year heat map collection it appears that the 2024 season had more of a spread of queen captures and there is a general cooling of hot spot activity. The worker heat map for the 2024 season shows higher intensity in a few areas. These areas of greater activity can be targeted for potentially more intense trapping in the 2025 season.

Analysis of trap performance shows that half the traps over the last three seasons have caught one or no queen wasps. Trap placement and maintenance is essential for good capture rates. Pre-season review of captures and nest site location allows targeted trap site location and intensity in areas of higher activity for the coming season.

In the 2024 season male wasps (drones) were caught indicating overwintering nests or interrupted nest cycles. Their identifying features passed on to volunteers to aid data collection and analysis. Bycatch contained the usual suite of insects: flies (various types), moths (various types), ants, a small number of hunting wasps (various species), ladybird type beetles and cockroaches. In general, bycatch was less than the previous year.

Weather data for 2024 generally showed an average temperature, except for March which was cooler than average. There was average to below average rainfall, without any major rainfall events. An environment without climatic extremes is likely one that suits hibernating queen survival and subsequent nest establishment. Food availability, & disease risks are other factors that influence wasp nest densities, Lester et al 2017.

In general, anecdotal reports are that wasp activity remains lower than when control was not in place. “I feel safer doing kiwi work in our reserves than at Maungatautari this year. The teams capturing kiwi for translocations were getting hit regularly with wasp nests” (Keturah Bouchard, WKT Kiwi handler). You guys must be doing something right, I’m getting less call outs to treat wasp nests” Graeme Lewer, WDC contractor.

The 2024 queen wasp capture season appeared to follow a similar pattern as the 2023 season. The data suggests that initial queen emergence (from hibernation) commenced early in Mokorua Bush and Kōhī Point SR therefore it is recommended these traps are operational by early August and all other traps by late August. It is also recommended that the annual trapping programme be continued and the use of ’monitoring traps’,

to better understand the impacts of the trapping programme be considered. Adjoining landowner engagement is recommended to support efforts to reduce wasp nest densities in hot spot areas.

3.0 Introduction

Wasps (*Vespula vulgaris* and *Vespula germanica*) and their nests have for many years been frequently encountered by members of the public, contractors and volunteers in the Ōhope, Kōhī Point and Mokorua Bush Scenic reserves and the Ngāti Awa farm Kāwenata (Figure 5). The individual reserves combined cover 881 hectares and are located near or adjacent to each other. They are administered/managed by the key stakeholders – Whakatāne District Council, Bay of Plenty Regional Council, Department of Conservation, Ngāti Awa, Whakatāne Kiwi Trust. The reserves are a combination of old and secondary growth, lowland coastal Pohutukawa, broadleaf forest on moderate to steep contours with multiple water courses. Over the cooler months of the year and due to the coastal location, the area is generally frost free.

The purpose of wasp control is for ecological enhancement as well as public safety and contractor/volunteer safety. Wasps can cause a fatal allergic reaction in some people, have detrimental impacts on native ecosystems (particularly through invertebrate consumption and food competition), cause economic losses for beekeepers and can disrupt recreational activities (Manaaki Whenua Landcare Research).

The control focuses on the wasps belonging to the *Vespula* genus. In the reserves there are two species of *Vespula*: *V. germanica* (German wasps) and *V. vulgaris* (common wasps). Both species were introduced unintentionally in the twentieth century; in the 1940s for German wasps and in the 1970s for common wasps. These species look very similar and have the classic well-known look of the yellow and black striped abdomen, a painful sting, a buzzing sound, and a liking for sweet foods. *Vespula* species utilise both sweet and protein-based foods in their diet such as fruit or nectar for sugars & carbohydrates and dead animals or insects they kill or scavenge on for protein. They are social creatures and can make large nests that can contain thousands of wasps. The easiest way to tell the two species apart is by their black facial marking: German wasps have a stripe and 2 distinct dots on the lower face, whereas the common wasp has an anchor shaped marking on its lower face (Lester, 2018). The German wasp is generally larger than the common wasp. See Appendix 6 for further information to distinguish between German and common wasps.

There are currently three commonly used methods of wasp control. Firstly, individual nests are destroyed by directly applying a toxic substance. Secondly, a toxic bait e.g Vespex, may be applied in bait stations: here the wasps feed on the bait and take it back to the nest. One bait station has the potential to destroy multiple nests. Thirdly, wasps are captured using traps containing non-toxic liquid (lure) which wasps are attracted to, become trapped in, and die by drowning. Potentially, by using a targeted trapping programme capturing queen wasps prior to nest development, the number of nests established could be reduced and therefore the overall biomass of wasps and their negative effects reduced.

In 2019, the Whakatāne Kiwi Trust (WKT) trialled a method to capture queen wasps by using a small number of dome style traps with non-toxic lure set during spring/early summer. This was a trial of the potential effectiveness in capturing queen wasps and thereby providing another way of managing *Vespula* wasp numbers in the reserves[1]. The trial demonstrated that Vespula queen wasps could be caught using this method and subsequently this control method was expanded and used in various reserves from 2020 to 2024. Broadscale trapping was used in 2020[2] while targeted habitat trapping was used in 2021-24[3]. The control method of queen wasp capture is designed to be used in the early phase of wasp nest production when the queen has come out of hibernation and is searching for food while she is looking for a suitable nest site, building a nest or/and feeding her offspring (workers). Once she has produced enough workers,

[1] The Whakatane Kiwi Trust was delivering wasp control via a Vespex bait station operation in the Whakatane-Ōhope reserves between 20217-2019

[2] A 200m x 200m grid was used in Ōhope SR to test optimal trap site locations

[3] Optimal sites along Ridge, spur and edge terrain chosen for trap locations, with low lying terrain, riparian areas under canopy excluded from trap site locations,

she will remain in the nest for the rest of her life with the role of egg production (Figure 1: Source Maanaki Whenua website).

Queen wasps can travel a long way from where they hatched and hibernated, up to several kilometres, but many will likely only travel a few hundred metres before finding a suitable nest site (Lester, 2018). In general, the queen will find a warm, dry, and dark site that may have a sunny aspect. It is generally built in soil; however dead tree trunks or branches can also be used. They make the nest from wood which they harvest from trees and mix with saliva to make a pliable mixture to form the nest structure.

4.0 Methods

A 'targeted habitat' method was chosen for the 2024 queen wasp capture season. Trap sites were identified using the following criteria: previously known high wasp activity and/or ridges or spurs. For ease of trap access the existing public tracks, management tracks or reserve boundaries were utilised. Higher altitude sites or edge sites with morning sunshine were chosen over cooler shadier low altitude sites. Traps were placed approximately 200m apart and GPS locations recorded. See Figures 6 and 7 for trap locations.

The trap itself is a plastic dome shaped container with a hole in the base for the wasp to fly up through and a circular basin holding the lure. The upper half of the trap is of clear plastic and the lower half is a bright yellow colour (Figure 2). The lure is a nontoxic pheromone based liquid preparation called 'No Pests Wasp Lure ®' and is distributed by Key Industries Ltd (Figure 2). It is designed to lure the wasp into the liquid and hold them until they die. The lure has been designed so that it does not attract bees. The dome traps can be purchased from the same company. The lure was changed monthly and topped up as required depending on lure condition and level remaining in the trap. Approximately one 5L container of No Pests® Wasp Lure can be used to service 20 traps for one month (250ml per trap), if minimal top ups are necessary.

One hundred and seventy-nine traps were placed into the five reserves and were operational from mid- to late-August 2024. Traps were progressively closed from mid-November (week 12) with all traps closed and removed by the end of the third week of December.

Trap checks were done by volunteers, and one contractor. Traps were checked weekly or two-weekly depending on volunteer availability and suitable weather. The number of wasps, type of wasp (worker or queen) and wasp species (if the volunteer was confident to do this) was recorded. To determine a queen wasp from a worker wasp the length of the wasp (nose to tail) and width of the abdomen was used where a wasp is considered a queen if it is 20mm or longer and wide-bodied, and a worker if it is slim-bodied and 16mm or less long (Figure 3). To determine the species of wasp the markings on the head/body of the wasp were used; these are described in Appendix 6.

At times, estimates for the number of workers in a trap were recorded when worker numbers were high, and time taken to count them was beyond available volunteer commitment. Bycatch identification was encouraged to a general level e.g., crane fly, house fly, moth, ant etc.

Figure 2: Wasp dome trap (left) and trap base with NoPests® Wasp Lure (right)

Figure 3 : Typical size differences between queen (bottom) and worker (top) Vespula wasps

Trap checking included trap maintenance to keep the trap in good working condition. Typically, when checking a trap (Figure 5), the lure was sieved of all captures and then replaced and/or topped up as required. If ants had invaded a trap and to reduce reinvasion, the trap was washed and moved to another location, less than 50m away.

Recorded data was forwarded to the team leader for data inputting, analysis, and ongoing season updates for key participants in the form of a data dashboard (Table 3).

The volunteers were provided with equipment (Table 1, Figure 4): as well as trapping guidelines, a map, and identification information to distinguish between queen and worker wasps, and German and common wasps.

Table 1: Vespula queen wasp trapping equipment

Item	Use
No Pests wasp lure	Lure wasp to the trap
Magnifying reading glasses	Assist the identification of the wasp species
Ruler	Measure the wasp for determination of queen vs worker
Sieve	Sieve trap contents and clear the lure
Tweezers	Manipulate captures for extraction, identification
Lidded container	Sieve lure into for returning to the trap
Lidded container	Carry implements in (sieve, ruler, tweezers)
Bottle of water + cloth	Clean the trap - usually of ants, ant residue/scent

Figure 4: Equipment for trap check (bottle of water + cloth not shown)

Figure 5 : Volunteers checking a wasp trap and replacing lure

If wasp nests were located in the reserves, they were reported to the project coordinator and subsequently treated with KiwiCare® 'No Wasps'™ which contains permethrin powder. A follow-up check was made to ensure the success of the control.

The number of traps used this year (179) was the same as 2023, however, there was some 'rearranging' of traps with some sites that were used last year not used this year while some new sites were added. Low performing trap sites in the northern part of Mokorua Bush SR were not used but more traps put out in the southern part of the reserve where captures are usually very high. One new trap line was added to the OSR south, one trap line in Kōhī Point SR was re-routed, and one trap line in the Kāwenata was extended.

5.0 Results

The total number of Vespula queen wasps caught in 2024 was 766 (179 traps) which is essentially the same as 2023 (770, 179 traps) and higher than the number caught in 2022 (573, 179 traps) but lower than the number in 2021 (977, 101 traps) (Table 2). There were over 30,000 worker wasps caught, many more than in 2023 (7957) and 2021 (15747) but fewer than the 2022 (45741) season (Table 2).

Comparative observations from the trap capture analysis (Table 2) have shown the following: the 2024 queen trap capture rate was the same as the 2023 season - 4.3 queen captures per trap, less than half of the 2021 season (9.6) but higher than the 2022 season (3.2). There was a much higher rate of worker wasps caught per trap (168) than in 2023 (44.5), which was similar to the rate for 2021 (156) however lower than in 2022 (256).

Table 2: Vespula wasp trap captures and capture rates (wasps per trap) for Whakatāne Reserves, 2021 - 2024

Year	Number of traps	Queen wasps	No. queens per trap	Worker wasps [Note]	No. workers per trap
2021	101	977	9.6	15747	156
2022	179	573	3.2	45741	256
2023	179	770	4.3	7957	44
2024	179	766	4.3	30076	168

Note: At times, the number of worker wasps captured was estimated

Comparing captures by reserve (SR = Scenic Reserve), for the fourth consecutive season the highest number of queen wasps captured (342) was in Mokorua Bush SR and the highest number of workers (9122) were caught in Ōhope North SR, also for the fourth consecutive season (Table 3).

The heat maps (Figures 6 and 7) provide a visual reflection of the areas capturing the greater number of queen and worker wasps. The hot spot on the southern edge of Mokorua Bush SR in 2024 (Figure 6) was the result of 54 queen wasp captures from one trap (7% of total captures) as well as captures in neighbouring traps.

Table 3: 'Snip' of the Vespula wasp trapping final dashboard for Whakatāne Reserves, 2024

WKT Queen Wasp Trapping Dashboard 2024 Season					
Data as of: 19/01/2025					
Reserve	**Number of traps**	**Queen wasps**	**Worker wasps**	**No. queens per trap**	**No. workers per trap**
Kōhi Point	34	169	5807	5.0	170.8
Mokorua	47	342	8446	7.3	179.7
Ōhope North	55	132	9122	2.4	165.9
Ōhope South	25	37	3951	1.5	158.0
Kāwenata	18	86	2750	4.8	152.8
Total	**179**	**766**	**30076**	**4.3**	**168.0**

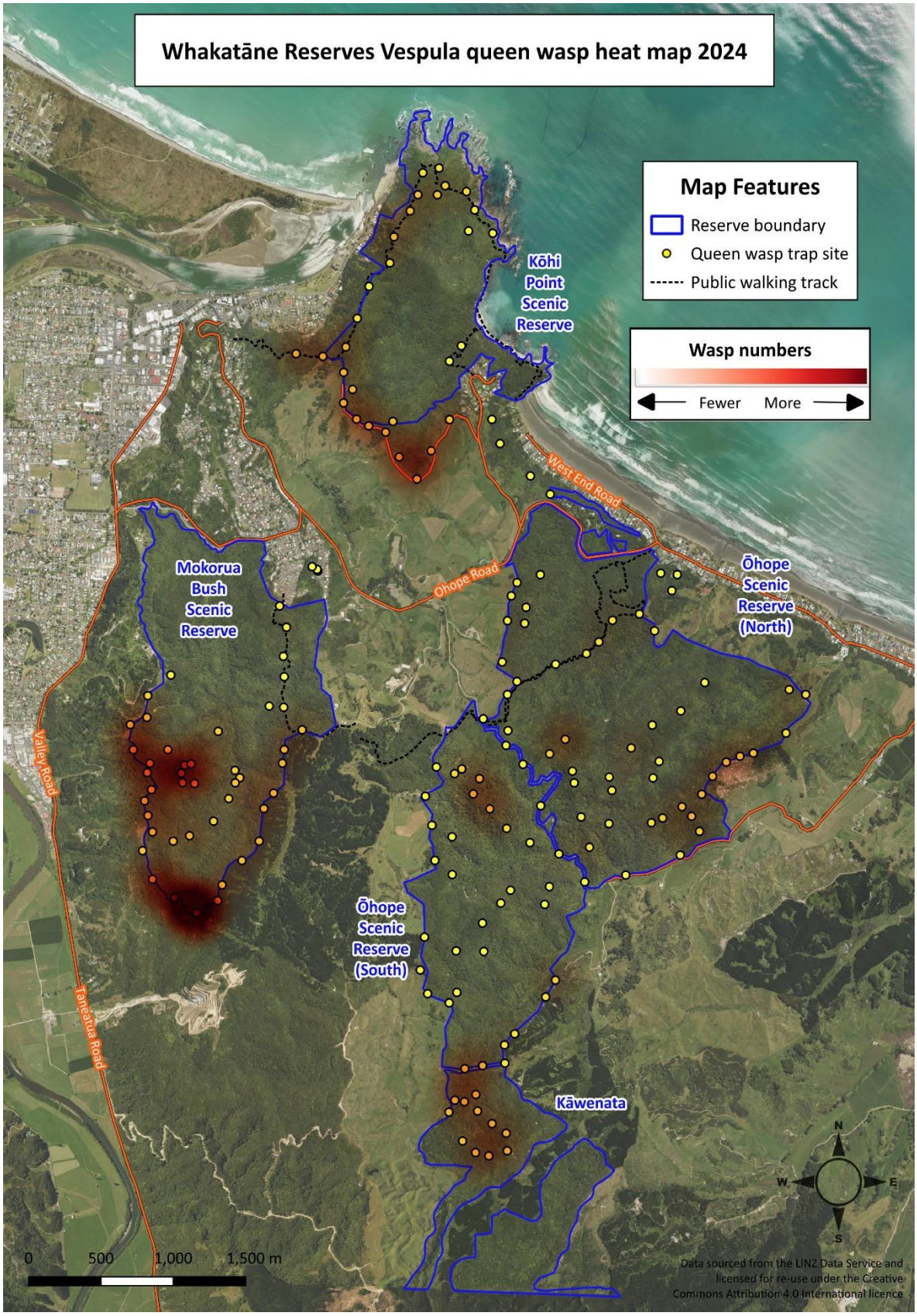


Figure 6: Heat map for *Vespula* queen wasp captures (both species) in Whakatāne Reserves, 2024.

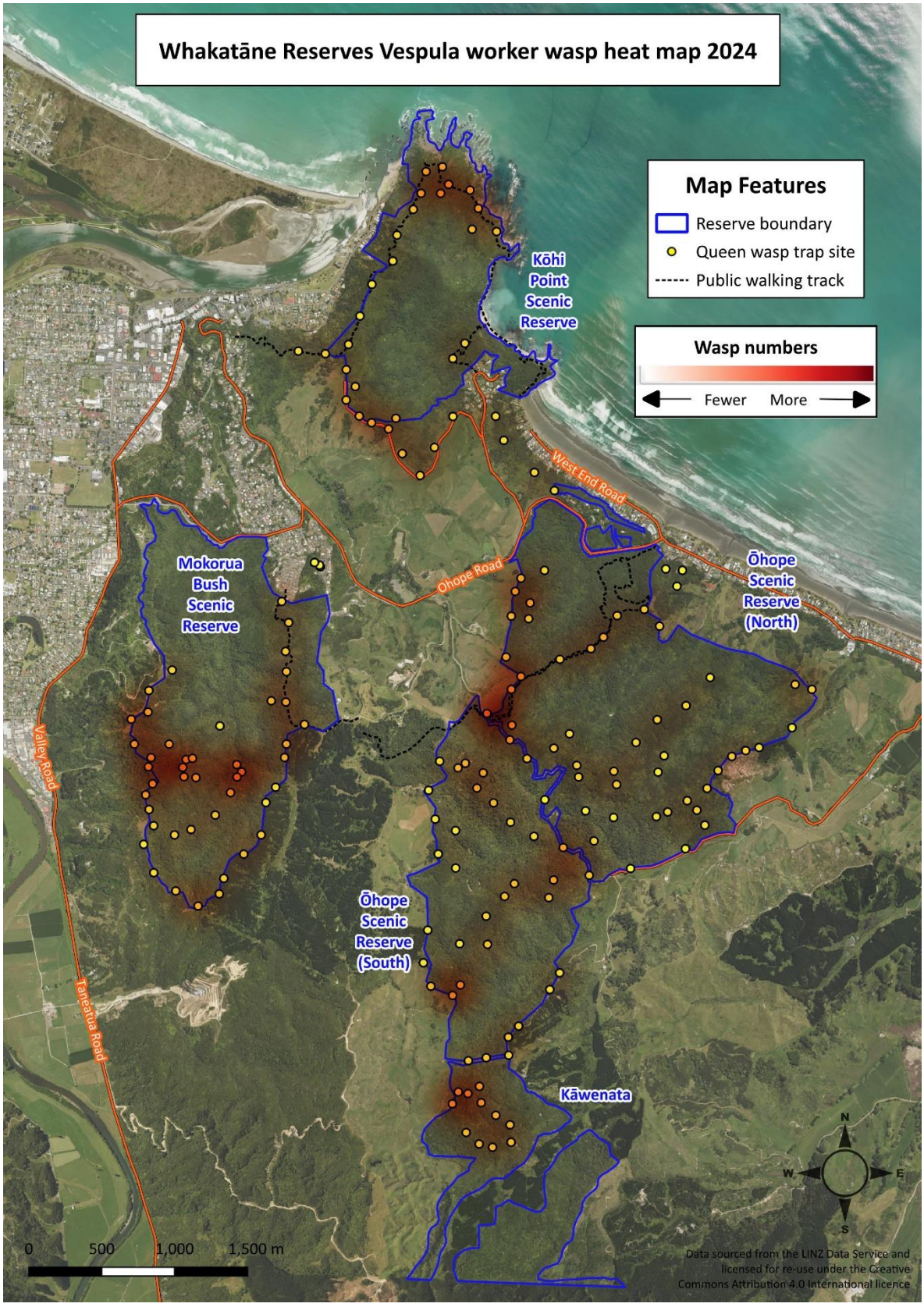


Figure 7: Heat map for *Vespula* worker wasps (both species) in Whakatāne Reserves, 2024.

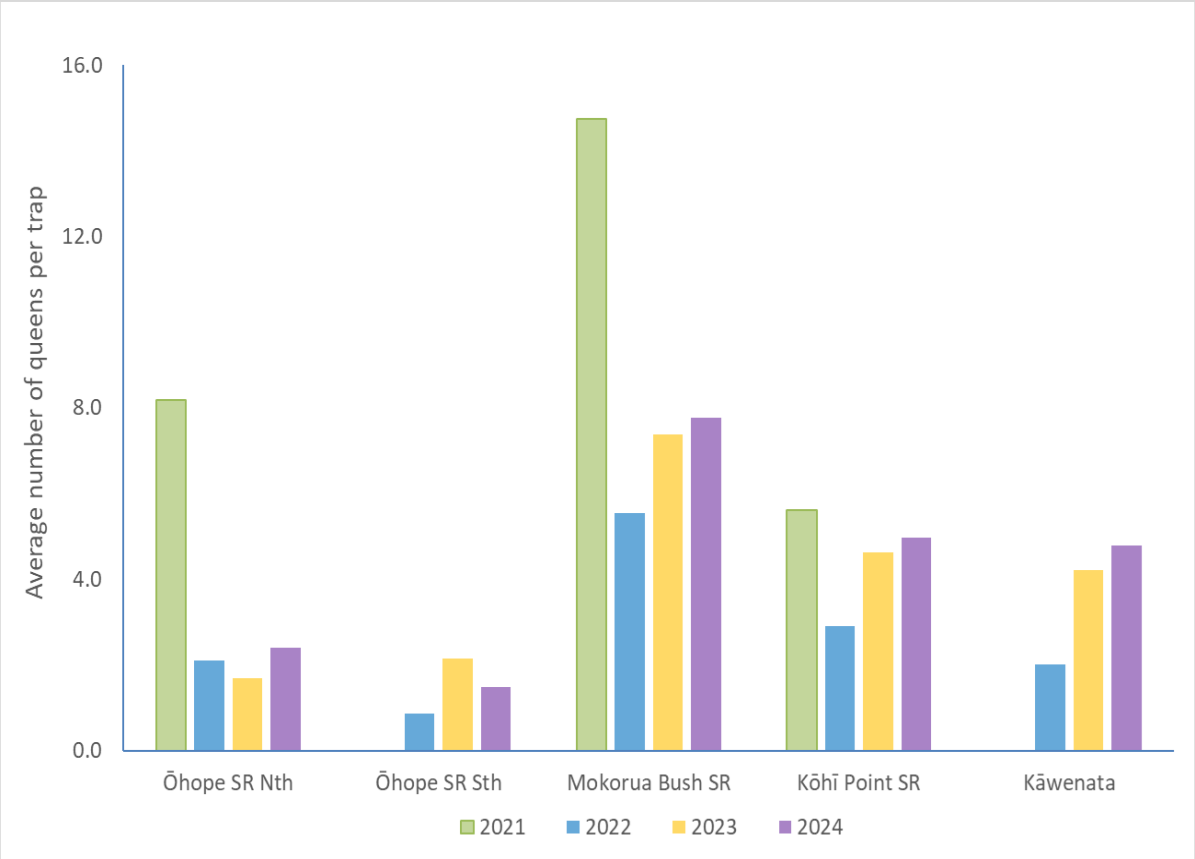


Figure 8: Trap capture rates of queen Vespula wasps in Whakatāne Reserves, 2021-2024

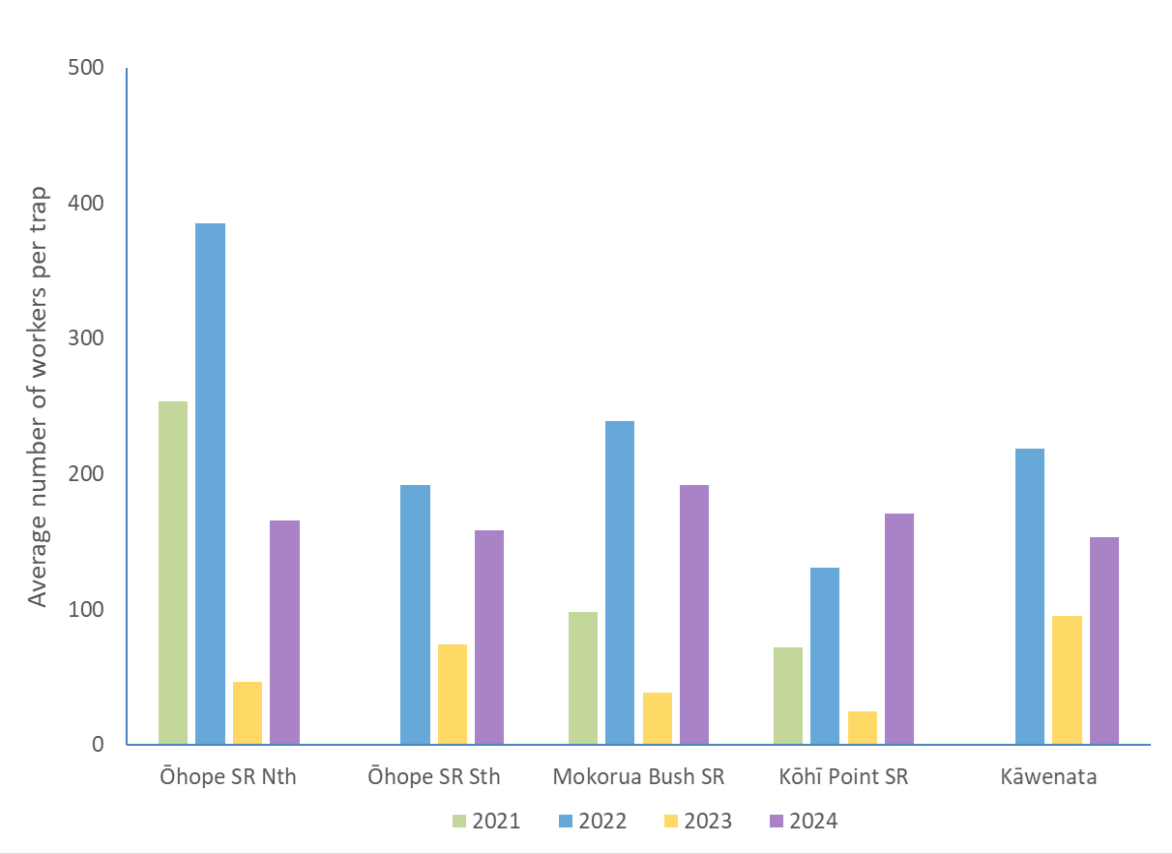


Figure 9: Trap capture rates of worker Vespula wasps in Whakatāne Reserves, 2021-2024

Figures 8 and 9 show the trap capture rates for queen (Figure 8) and worker (Figure 9) wasps between reserves and across years (2021-2024). The trapping rate considers the different number of traps in each reserve in any one year. Mokorua Bush SR clearly had the highest rate of queen captures per trap in each year while the worker wasp capture rates per year were much more even across the reserves. These results are also portrayed in the heat maps shown in Appendices 3 and 4.

Analysis of trap performance shows that over the last three years 42 – 55% of the traps caught one or no queen wasps (Table 4), while 9 -13% of traps caught 10 or more queen wasps. Trap performance rates differed in the 2021 season due to the higher total queen capture (977); here the proportion of traps with one or no captures was 27% while 31% of the traps had ten or more captures.

Table 4: Trap performance Vespula queen and worker wasp trap captures and trap performance in Whakatāne Reserves, 2021-2024

Measure	2021	2022	2023	2024
Number of traps	101	179	179	179
Total number queens caught	977	573	770	766
Average number queens per trap	9.7	3.2	4.3	4.3
Total number workers caught	15747	45741	7957	30076
Average workers per trap	156	256	44	168
% Traps with zero queen captures	18%	36%	26%	27%
% Traps with one queen capture	9%	19%	18%	15%
% Traps with one or no queen captures	27%	55%	44%	42%
% Traps with four or fewer queen captures	42%	81%	73%	69%
% Traps with 10 or more queen captures	31%	9%	13%	11%
% Traps with 20 or more queen captures	11%	2%	4%	2%

Trap checks began in early September reducing by week 12 in mid-November as traps began to be closed, Figure 10 shows increasing queen wasp captures over the season until trap closure with peaks and troughs included. Its noted the trough in week 8 was also apparent in 2021 and 2024, and appears present in 2023 but was absent in 2022.

Figure 11 shows the absence of worker wasps until week 6 (mid-October) when they began to be caught, with captures peaking in week 12 (mid-November) when trap closures begin. This peak is consistent with 2021 and 2022 but with a marked difference to 2023 where the peak did not occur until week 14 (early December).

Although not shown in tables or figures, new 2024 trap lines or trap line re-route, or additions had mixed capture results. The line added in Ōhope South SR had minimal catches; the extension of the line in the Kāwenata caught well; the trap line reroute in Kōhī Point SR was very successful, and the extra traps added to the Mokorua Bush SR hot spot area had mixed results.

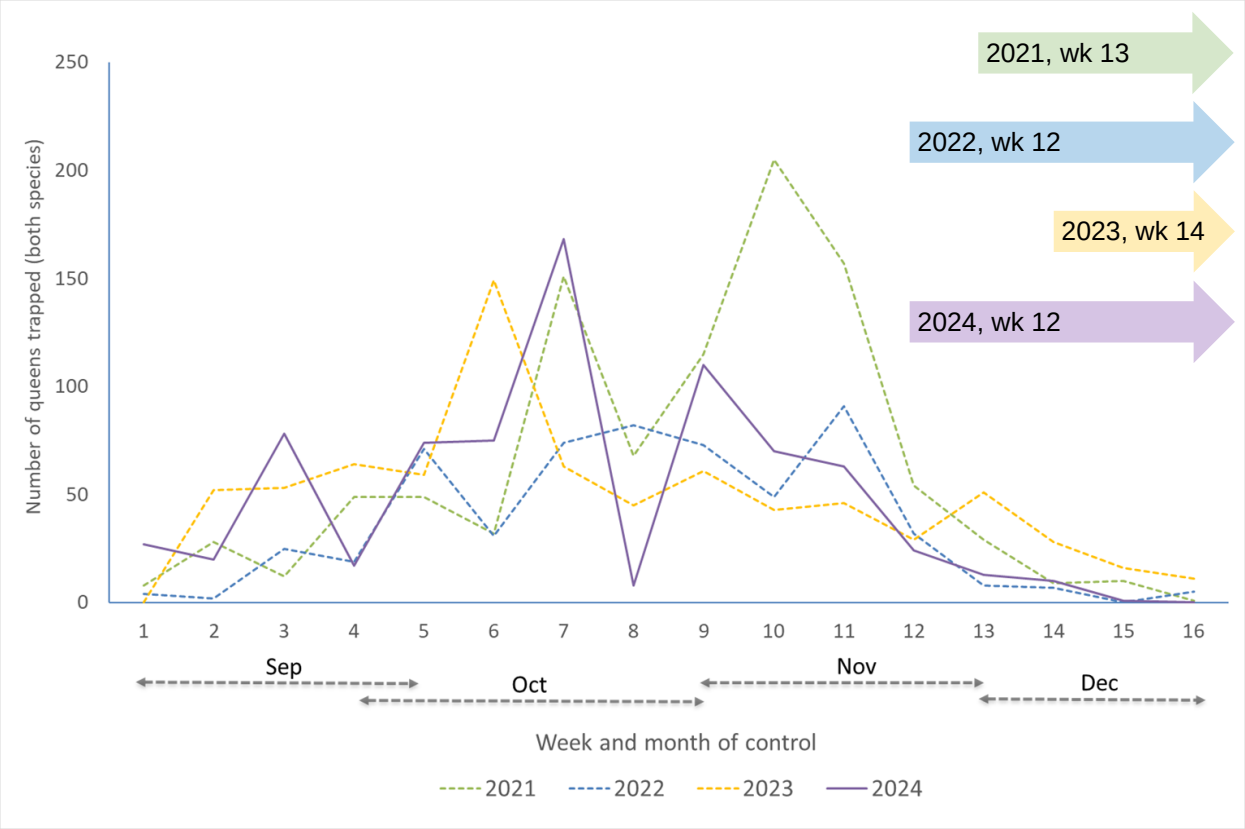


Figure 10: Number of *Vespula* queen wasps (both species) trapped per week, 2021 - 2024. Coloured arrows indicate period over which traps were closed down.

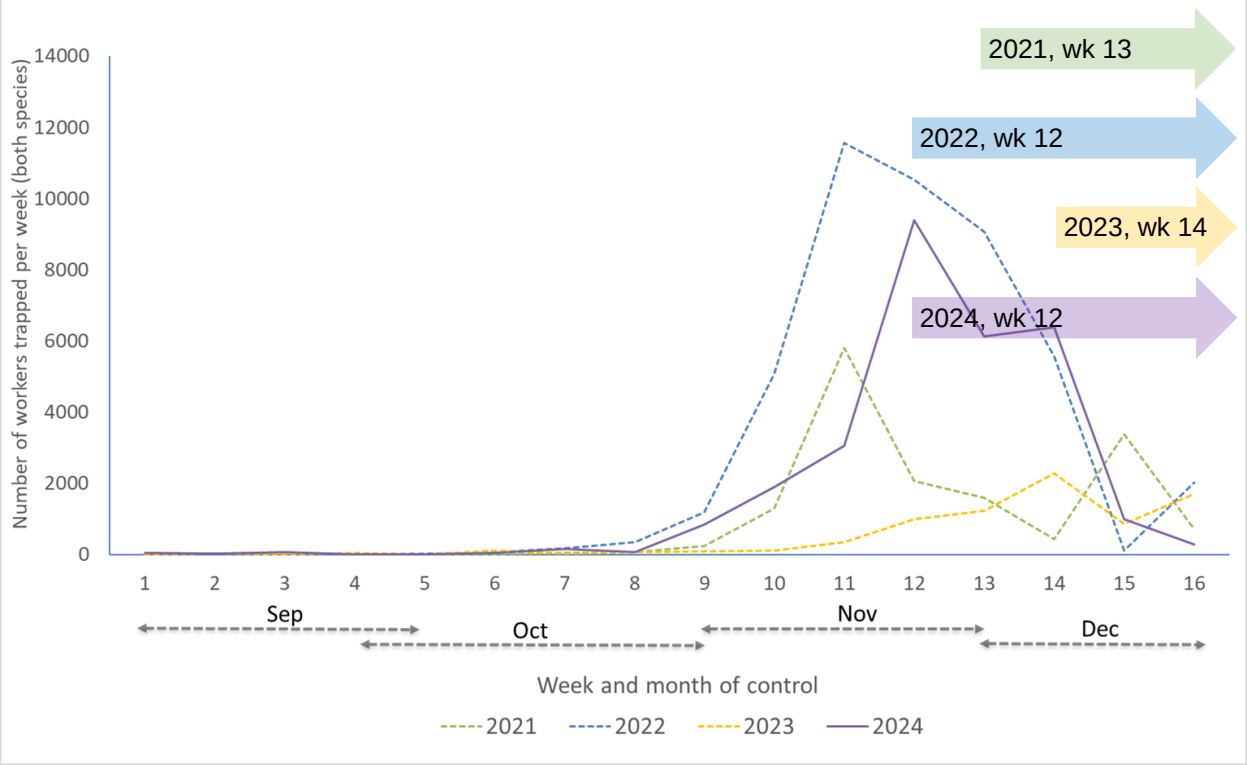


Figure 11: Number of Vespula worker wasps (both species) trapped per week, 2021 - 2024. Coloured arrows indicate period over which traps were closed down.

Several drones (male wasps) were captured in Mokorua Bush SR traps during October. These were identified by their size (intermediate size between worker and queen), blunter and longer abdomen with an extra abdominal segment, longer curved antennae and no stinger (Appendix 7).

Bycatch was dominated by flies (various types), moths (various types) and ants. Also caught were small numbers of native hunting wasp species, cockroaches and ladybird beetles. See Appendix 8 for photographic examples of bycatch.

Weather data for 2024 (Appendix 1) showed a generally average temperature except for March where it was 3.6 degrees Celsius cooler. In 2024, there was average- to below-average monthly rainfall, with the annual total 15% lower than the historical average. In contrast, annual rainfall in 2023 was considerably higher (35%) than the historical average.

The proposed monitoring traps (Section 6.2; Appendix 5) show the fluctuations occurring from trapping season to season at an individual trap level. The Ōhope North SR traps show a general lowering of captures after the initial peak as do most of the Kōhī Point SR and Mokorua Bush SR traps, the Ōhope South SR and Kāwenata traps presently have a fluctuating rate.

6.0 Discussion

6.1 Trapping effectiveness and limitations of trapping programme

This has been a 'research-by-management' programme which means that to learn and improve our outcomes, we have adjusted operational aspects (such as the number of traps and trap locations) between the years although the methods and delivery effort have been consistent, including the trapping period and trap check effort. Further, we must always acknowledge that this programme, as with most, has been constrained by resources, and so at different times, decisions needed to be made to optimise the geographic span of control while still attempting to achieve reductions in wasp numbers.

It seems that the queen wasp trapping has made a difference in the reserves: anecdotal reports from contractors and volunteers indicate that wasp activity is lower than when control was not in place. One measure that has been useful is the number of wasp nests reported by contractors and volunteers who are regularly visiting the reserves, and again anecdotally, the number of nests reported has decreased since before control had started.

What has been challenging is trying to tease out the actual impacts on wasp nest densities , and what the capture rate of queens means in terms of absolute wasp numbers present in the reserves. For example, it is known that wasp population levels naturally fluctuate from year-to-year (Lester 2018), so in any one year, based on capture rates, it can be difficult to understand the level of the impact of the trapping. While a sample of traps have been maintained in the same locations each year to provide an indication of the change in trap captures of queens, what has been missing from the control programme is an independent monitoring programme, both for wasp abundance and for ecological and human impact outcomes. Having reliable measures to understand effectiveness is a key part of ecological management and there could be an opportunity within this project to develop methods for monitoring wasps.

The positive news is that trapping for queen Vespula wasps does appear to have an impact. Over three thousand queens have been removed over the past four years, and as above, anecdotal reports indicate there are fewer wasps seen and fewer wasp nests found. It was hoped that consistent management effort would continue to reduce wasp numbers, as indicated by queen wasp capture rates. The number of queens captured after the inaugural 2021 season has remained less than half of that year which may be showing a promising trend that the queen wasp trapping is keeping the wasp numbers at a lower level than if there was no trapping. However, the similar results for queen wasp captures over the past two seasons has tentatively indicated that the impacts of the trapping effort could be plateauing; however, this conclusion is based on only a few years' worth of data, and clearer trends would likely emerge if a similar trapping programme were to continue.

The number of worker wasps caught appears to be fluctuating from year-to-year. After four seasons of trapping its possible a trend is emerging of alternate years of higher and lower worker captures. This has been described in Lester (2018) as density dependence - a low number of wasps one year is followed by high numbers the next year. During low wasp years food competition is less therefore queens are well fed and in excellent condition to hibernate for the winter with a higher chance of survival and nest establishment the following season.

The 2021 season, being the first using targeted habitat trapping, had markedly higher capture rates than any of the following seasons and this could be explained by it being the first year of this type of control; however, capture rates could also have been inflated because it was a year with naturally higher wasp numbers. Conversely, capture rates in 2022 were lower than in any of the other years, perhaps indicating a naturally lower wasp year as well as the impact of the trapping programme of the previous year.

Further complicating the results is the wider geographic landscape in which the control is happening, and particularly the fact that control is occurring in reserves which are not contiguous. The key implication here is that there are large areas adjoining the reserves where no or very little control is occurring, with queens as well as foraging workers able to invade the management reserves and therefore maintain a certain level of wasp presence. However, this impact does not seem to be evenly spread across the reserves as some parts of the reserves appear to consistently have lower wasp numbers, for example, the northern part of Mokorua Bush SR, the interior of Kōhī Point SR and Ōhope Scenic Reserve south. With this in mind there is opportunity in those areas with consistently high queen captures to liase with adjoining landowners and expand the trapping network to allow for a buffer type zone between the private and reserve land.

6.2 Future monitoring

In an effort to assess trapping effectiveness ‘Monitor Traps’ have been identified. These traps would be in sites used annually for comparison purposes whether a trap line was operating in the area or not. By uitlising historical trapping data, a review of past trap captures may be used to identify 20 - 30 successful trap sites e.g. sites that have annually captured several queen wasps, within the four reserves (Appendix 5). Year on year comparisons can be made to evaluate wasp activity and if trapping is stopped in an area potentially show an increase in activity due to the reduced control. Data already reviewed from these traps (see Appendix 5) show fluctuating numbers of captures rather than a consistent lowering trend. As more data is collected and this potential monitoring system ‘tweaked’ more information is hoped to be gained from it.

Wasp nest occurrence can also be used to generally gauge wasp activity. Contractors, volunteers and public reports of nest locations can be recorded, mapped and used comparatively over time potentially linking nest abundance with climatic conditions, density dependence theory and food availability.

6.3 Seasonal and habitat effects

Wasp populations can be influenced by many factors other than trapping and these need to be considered when interpreting the data. Density dependence is influenced by weather (climate effects), food supply, presence or absence of disease/parasites, and land cover around the reserves. Climate, for example, could determine if a wasp nest survives through the winter months; if so, it could go on to become a very large nest, producing vast numbers of workers and hundreds or even thousands of queens. As the climate warms, the potential for greater numbers of these over-wintering nests will increase .

If there is warmer weather in late-winter hibernating queens may emerge earlier. Queens busy finding suitable nest locations, building nests and raising young broods need calories, if the spring food supplies have not emerged then some of these early queens may starve and die. High rainfall events can drown nests especially those vulnerable to water incursion such as those in the ground or near water courses. Wet weather can also wash nectar from flowers making food collection less efficient for the workers as it becomes more time and energy consuming.

The habitat within the Whakatāne reserves is similar (i.e. old and secondary growth coastal/Pohutukawa or lowland forest with steep terrain and multiple water courses); however, the habitat outside the reserves varies, comprising of pastureland, pine forest, cutover pine forest, housing, regenerating native forest, and

coast. These differing habitats may influence localised wasp populations as some may provide greater food availability or suitable nesting and/or hibernating habitat. Those habitats with large areas of northerly aspect may be more wasp friendly, being warmer and drier.

6.4 Capture location

Reviewing capture location through data analysis provides good information for trapping in the next capture season such as optimising trap location and trapping intensity to provide the most effective trapping effort with the resources available.

Analysis for the 2024 season has provided the following information to utilise:

- The highest number of queens were caught in the Mokorua Bush SR and the highest number of workers were caught in the Ōhope SR. Mokorua Bush SR had the highest number of both queens and workers per trap.
- Heat maps show wasp activity levels, where higher activity is indicated by the more intense colour. The heat map covering the four-year period 2021 to 2024 (Appendix 3) provides an insight over time of the areas where queens are most concentrated. This heat map highlights the Mokorua Bush SR hotspot on the Western Ridge and spurs. This may be influenced by habitat e.g. sunny ridge faces on both sides, cut over pine area on the western side of the ridge with open sparse vegetation spaces providing a warm and dry environment. There is also no wasp control on the Western ridge face. This ridgeline has been a hotspot for queen captures for the previous three seasons (Appendix 4). The precise location of the trapping hot spot appears to shift from year to year but remains in the same general area. However, the heat mapping is indicating a cooling in this area as trapping continues. The worker wasp heat map shows several areas in the reserves with continued significant worker activity and therefore wasp nest establishment.
- Areas identified with high wasp activity in 2023 had additional traps put in and some lines extended or rerouted. This mostly had positive results with more captures than would otherwise have happened.

6.5 Timing of captures through the season

Graph analysis shows the peaks and troughs during the capture seasons. In the 2021 and 2022 seasons the bulk of queen captures occurred in October and November however in the 2023 season the captures were occurring in significant numbers from the second week of September. The 2024 season though was different again with significant captures made during the first and second weeks of September in both the Mokorua Bush SR and the Kohi Point SR.

Traps in Mokorua Bush SR were filled with lure on 20-21 August and regular checks commenced from the first week of September. Kōhī Point SR traps were filled with lure on the 25 August and checked the second week of September. This indicates that both the Mokorua Bush SR and Kōhī Point SR queen emergence can commence in August and therefore trap readiness from early August may be indicated.

Graphing also indicates a dip in captures around week 8 (except in 2022) this possibly follows a mass emergence then a lull occurring before the next emergence. This phenomenon may be influenced by climatic factors or possibly food availability. In general, queen captures begin to drop around week 11 (mid-November) which is when worker captures start peaking indicating the nests are maturing and producing large numbers of workers.

Workers were appearing in the traps from week 7 (mid-October) with a steep rise in numbers from week 11-12 (mid-November) consistent with data from 2021 and 2022. The worker captures in 2023 were low in number and did not follow this pattern; they were 2-3 weeks behind in first appearance and peaking. They started to appear in week 10 and rise in week 14 (early December). This may have been influenced by that year's climate with high rainfall in September when nests were being established. Traps are usually being closed from mid-November which is reflected in the downward trend of worker captures after this time and consistent with previous seasons: volunteers are encouraged to close traps if large numbers of worker wasps are feeding and emptying the traps of lure rather than being caught, and few if any queen wasps are being captured.

The capture of drones (male wasps) in October was unexpected. Drones normally appear in late summer (February – March) when the nest is at its peak activity. Drones may have been present at the same time in previous seasons however they were not being looked for therefore may have been identified as large workers or small queens. If a nest overwinters it is expected that the nest will mature and produce drones at different times of the year. A nest was located while setting up a wasp trap line on 20th August in the Mokorua Bush SR on top of the main ridge. This nest had possibly been there for some time. If the region's climate warms, then overwintering nests may become more common and identifying drones may be a way of establishing their frequency of occurrence. Drones can also be produced by nests whose queen has died. Without the pheromone which inhibits sexual development and behaviour of female workers the workers will become reproductively active. As the workers have not mated the eggs will have a single set of chromosomes and so produce males only (Lester 2018).

6.6 Trap performance

Analysis shows that almost half the traps over the last three seasons have caught one or no queen wasps. This appears disappointing but may reflect the trapping effort reducing queen wasp presence in some areas as the inaugural 2021 season had a different result with only a third of the traps with one or no captures likely due to higher queen numbers for that year. Trap placement and maintenance is essential for good capture rates therefore a pre-season review of captures and recorded nest site locations provides information to the trap site planner for mapping the following season's trap locations - with the aim to increase the chance of capture. Volunteer training provides information on trap maintenance to ensure lure presence and cleanliness of traps.

6.7 Bycatch

Trapping by-catch comprised the usual suite of insect types, dominated by flies (various types), moths (various types) and ants, with a small number of hunting wasps (various species), ladybird-type beetles and cockroaches. There generally appeared to be fewer moths, midge-like flies, and blowflies than in the previous season. Honeybees and native bees are not attracted to the lure with less than 10 found in traps over the last 4 years.

6.8 Weather

Weather data for 2024 generally showed an average temperature, except for March where the 'lows' were 3.6 degrees Celsius cooler on average. There was average- to below-average rainfall, without any major rainfall events especially when compared to the previous year.

An environment without climatic extremes is probably one that suits hibernating queen survival. A wet and or cold environment can negatively affect hibernating queen wasp survival, which is generally 2.2% per year (Lester 2018). A more favourable environment will increase that survival rate and subsequent wasp nest establishment. Heavy rainfall can damage to a nest mostly due to water inundation-drowning.

6.9 Drone captures

Observations over the last few years of wasp captures has identified a small but ongoing problem with identifying queen versus worker wasps in the intermediate size category. Size is generally used to differentiate between them but may not always be the best/easiest indicator. A small number of the wasps captured could either be small queens or large workers. A queen is generally determined as being a wasp 20mm or more in length. However, some captures, often measuring about 17mm in length were conspicuously larger than the 'usual' worker but smaller than the typical queen (appendix 7). Further observations of these intermediate size wasps have resulted in some being identified as drones (male wasps). Drones can be identified by observing the following anatomical features: longer blunter abdomen (7 terga segments rather than the 6 in the female), long antennae which usually curve back and no sting. The identifying features for drones can be passed on to volunteers to assist them in the field with their data recording.

7.0 Recommendations for next queen wasp capture season

- Open traps in Mokorua Bush SR and Kōhī Point SR in early August and other reserves by late August.
- Intensify trap numbers in the hot spot areas by reducing spacing to approximately 100m.
- If funding and access allows consider installing buffer trap lines in adjoining uncontrolled areas near hot spots.
- Focus trap sites on ridges and spurs especially near worker and queen wasp capture hot spots.
- Traps in exposed locations, where evaporation rates are likely to be higher, should be checked weekly to ensure lure is maintained in good condition.
- Use ‘monitor traps’ in all reserves to observe for change in trapping effectiveness over time.
- Collect, collate, review and map wasp nest location data.
- Continue to collect more data to provide more pattern/trend information for greater clarity of any conclusions formed.

8.0 Acknowledgements

Approximately 500 hours (most likely more) were gifted by 19 volunteers for wasp control. They were Phil and Peta Barker, Chris van Beek, Mike Collins, Jude and Pete Ferguson, Dave Hall, Dave Howard, Allan McDougall, Vanessa Searcy, Graham and Marion Henton, Richard Barnett, Rob Van Rossen Theo Duvestyn, Gil and Vicky Clark, Greg Moorcroft (Mamaku Environmental Ltd) - data analysis and trap checks, Graeme Lewer - wasp nest destroyer.

Volunteers assisted with trap preparation, trap line set up, trap checks and maintenance, data collection, retrieving and cleaning traps, drone wasp identification.

This wonderful team of volunteers, of which many have assisted with the wasp control for many seasons, and whom I am so grateful too as without them this work would not happen – they are all human wonders😊.

I would also like to acknowledge the continued support of Key Industries Ltd who produce the No Pests® wasp products used in the queen wasp control program, particularly Warren Wright. He has followed with great interest our annual control program and catches up with the program team leads regularly for an update.

9.0 References

9.1 References cited

Lester, P. 2018. The Vulgar Wasp. The story of a ruthless invader and ingenious predator. Victoria University Press, Wellington, New Zealand

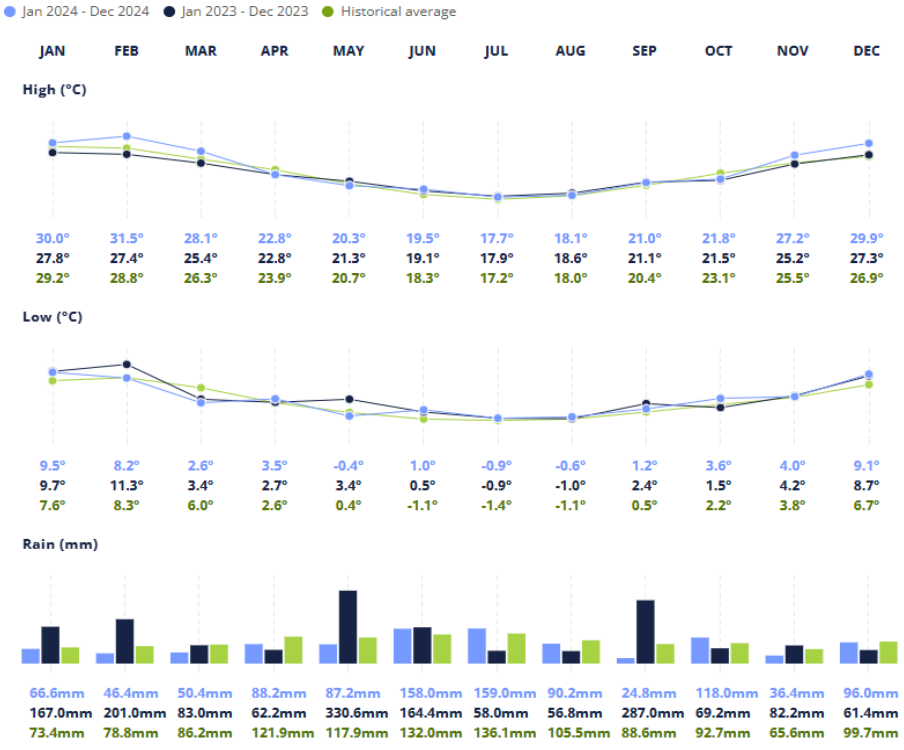
9.2 Reference Material Used

- Queen wasp trapping reports prepared for the Whakatane Kiwi Trust for queen Wasp Control in years 2020, 2021, 2022, 2023.

10.0 Appendices

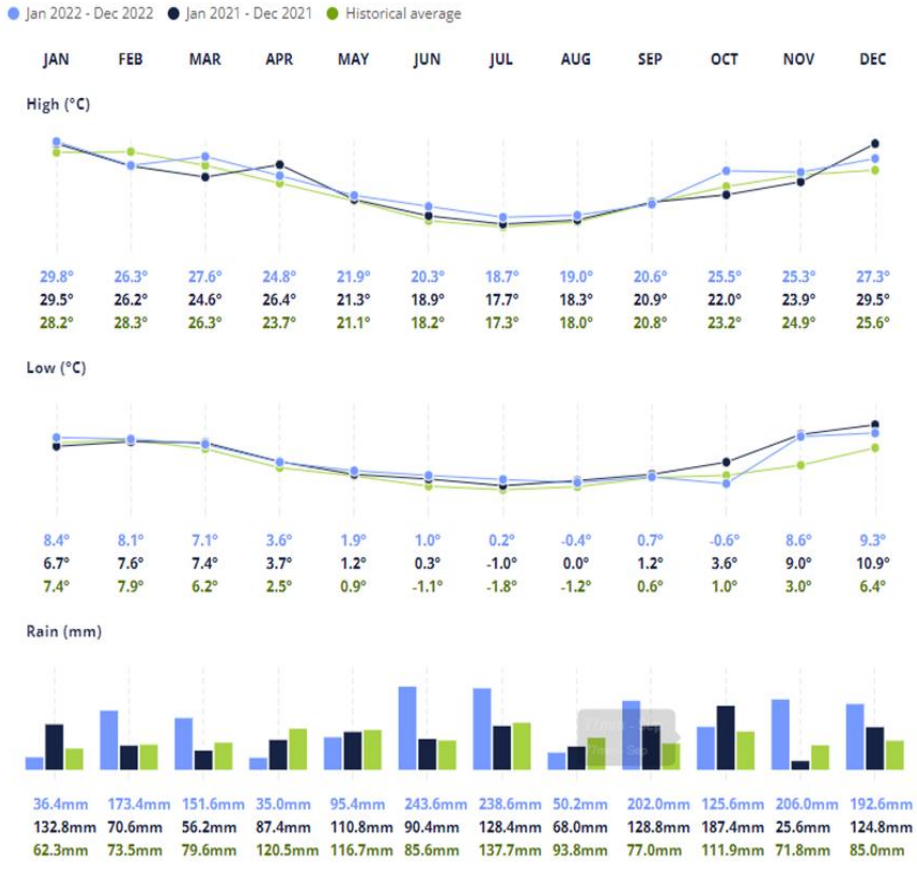
10.1 Appendix 1

Weather data for Whakatāne 2024 and 2023 (source: MetService)



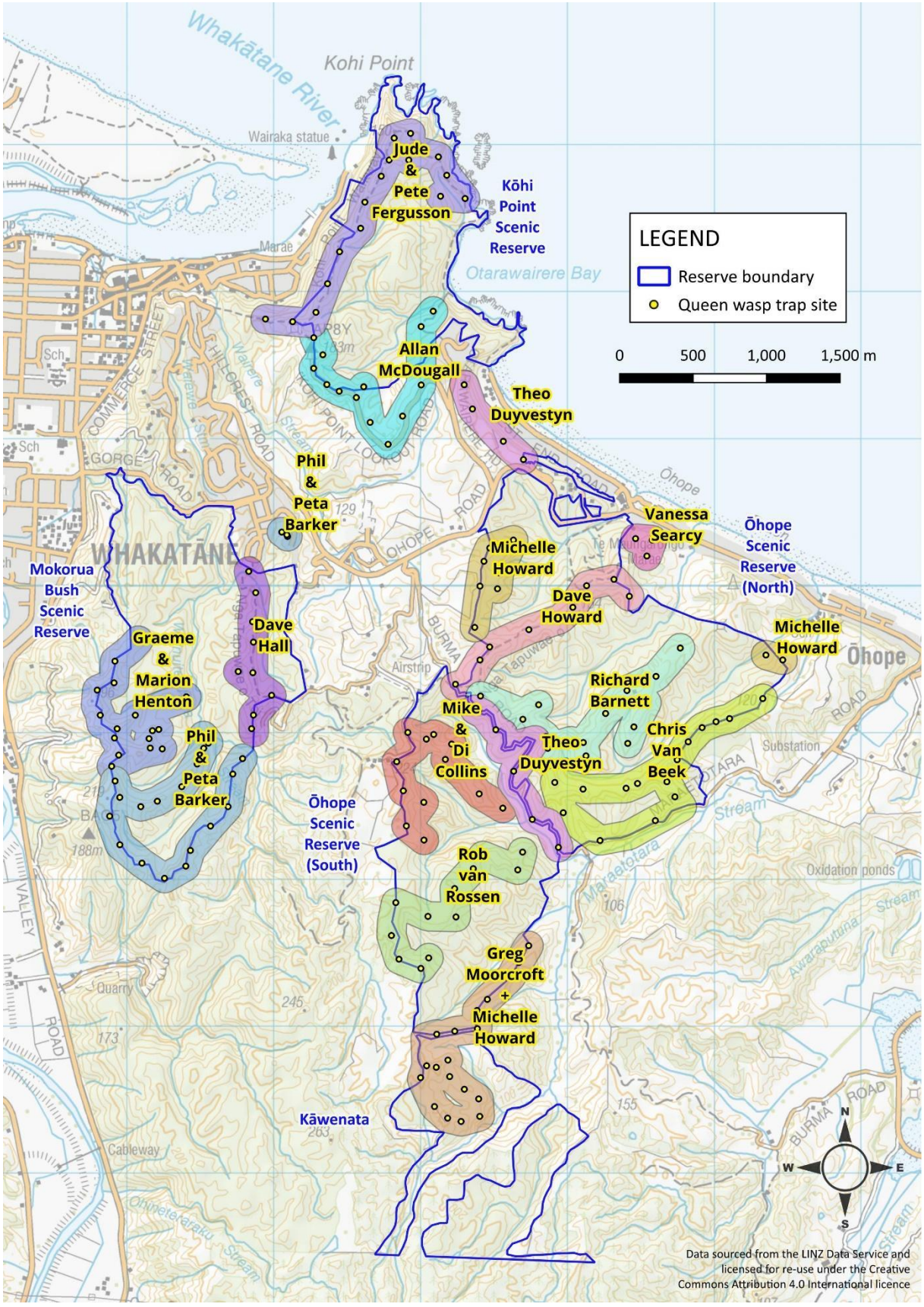
The shade of the bar indicates the year or historical average.
Temperature The historical data is the extreme maximum air temperature for the month averaged over a historical period (e.g. 10 years) and the extreme minimum air temperature for the month averaged over a historical period. The data for the previous two years is the highest maximum and lowest minimum recorded for the month.
Rainfall The total rainfall that fell during the month
Observations recorded at Whakatāne Airport (AWS-93191)

Weather data for Whakatāne 2022 and 2021 (source: MetService)



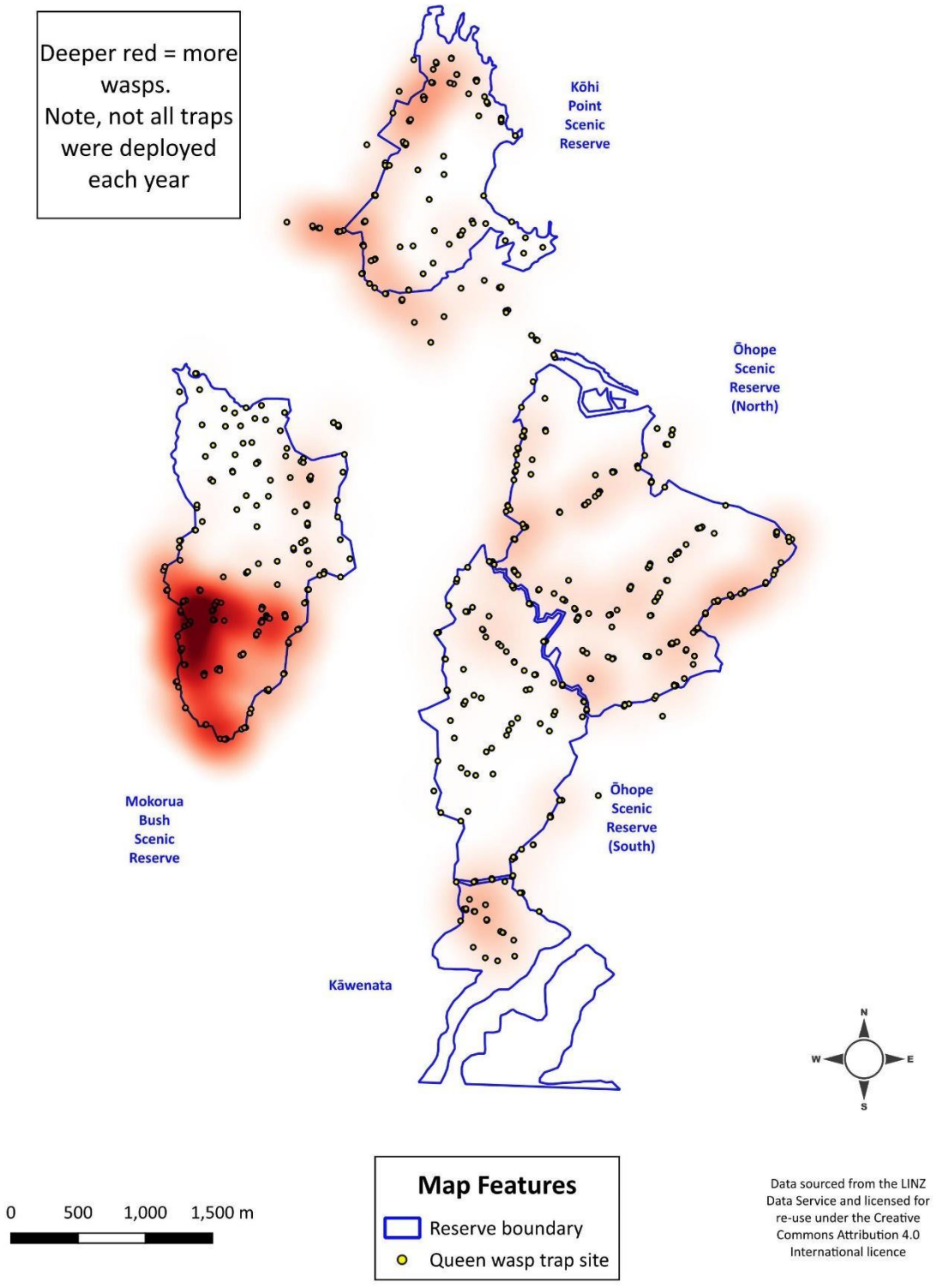
10.2 Appendix 2

Location of *Vespula* queen wasp volunteer trap lines, 2024



10.3 Appendix 3

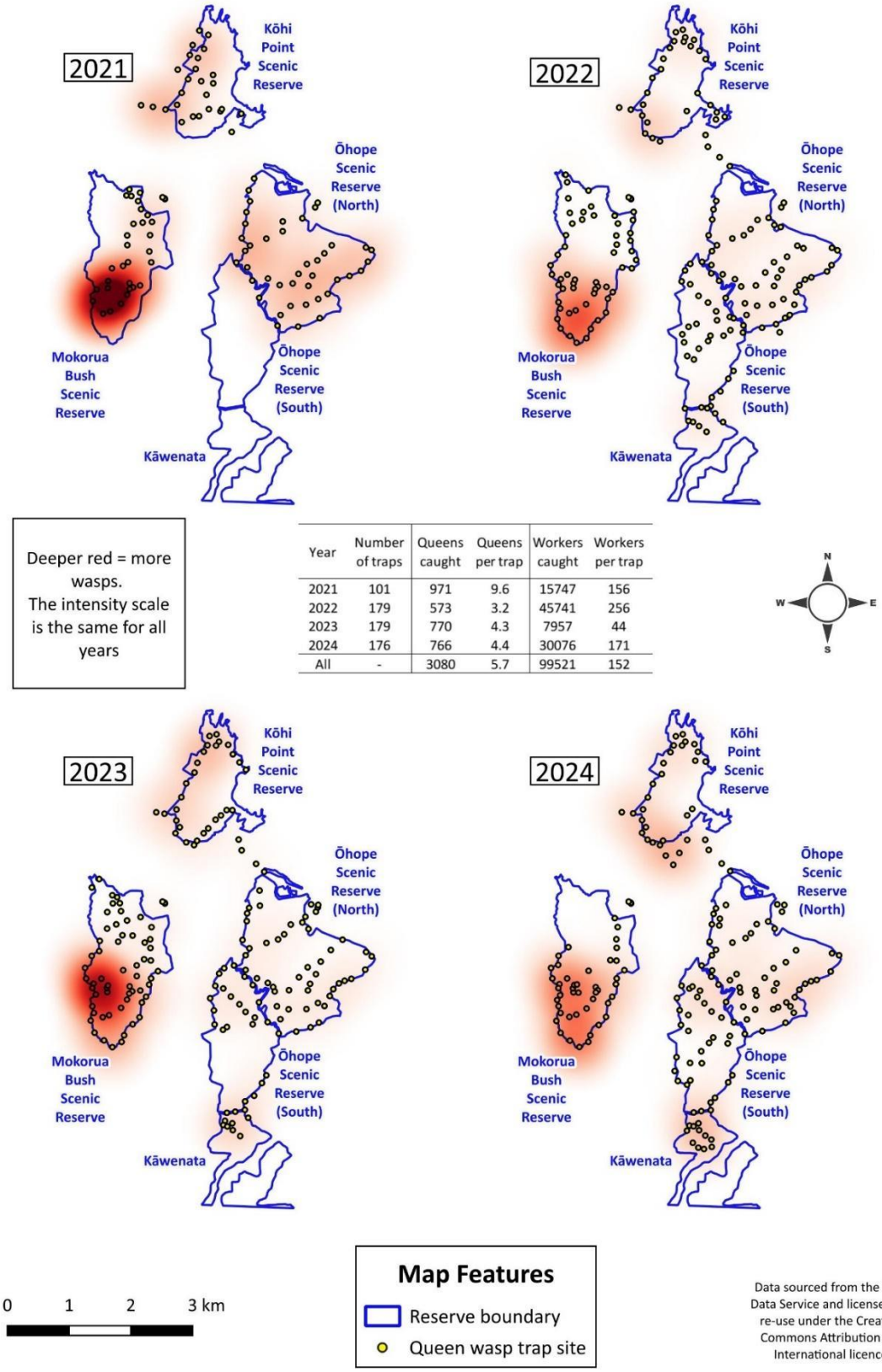
Combined years heat map for *Vespula* queen wasp trapping in Whakatāne Reserves, 2021 - 2024



10.4 Appendix 4

Individual year heat maps for *Vespula* queen wasp trapping in Whakatāne Reserves, 2021 - 2024.

(Note: the intensity scale in each of these maps is the same, therefore the sites can be compared between years; however, the intensity scale for the 2024 queen wasp heat map in Appendix 3 is different (lower) to the one used here).

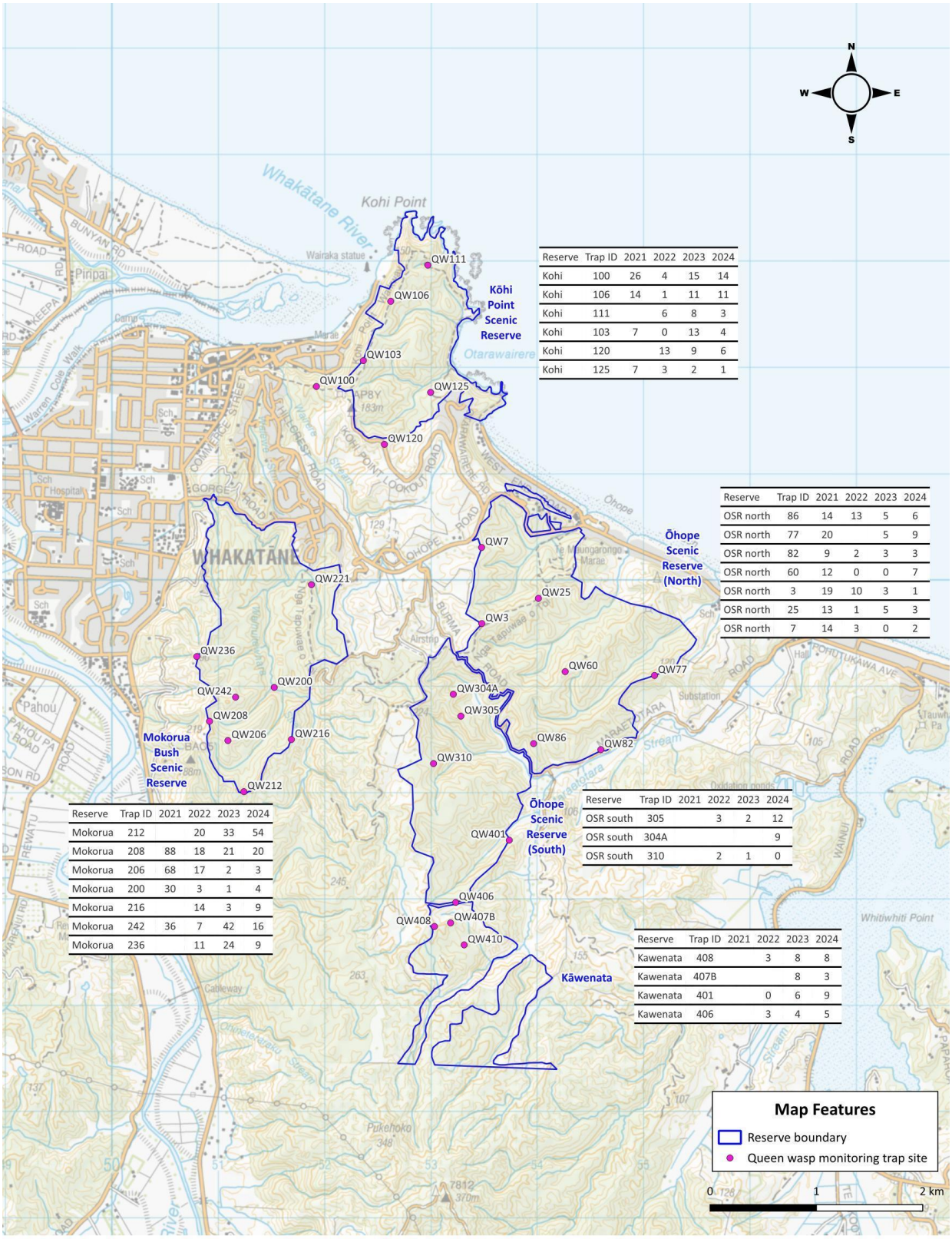


Year	Number of traps	Queens caught	Queens per trap	Workers caught	Workers per trap
2021	101	971	9.6	15747	156
2022	179	573	3.2	45741	256
2023	179	770	4.3	7957	44
2024	176	766	4.4	30076	171
All	-	3080	5.7	99521	152

10.5 Appendix 5

Proposed monitoring trap locations

Note: tables show queen wasp capture records in years when a trap was open at a site



Reserve	Trap ID	2021	2022	2023	2024
Kohi	100	26	4	15	14
Kohi	106	14	1	11	11
Kohi	111		6	8	3
Kohi	103	7	0	13	4
Kohi	120		13	9	6
Kohi	125	7	3	2	1

Reserve	Trap ID	2021	2022	2023	2024
OSR north	86	14	13	5	6
OSR north	77	20		5	9
OSR north	82	9	2	3	3
OSR north	60	12	0	0	7
OSR north	3	19	10	3	1
OSR north	25	13	1	5	3
OSR north	7	14	3	0	2

Reserve	Trap ID	2021	2022	2023	2024
Mokorua	212		20	33	54
Mokorua	208	88	18	21	20
Mokorua	206	68	17	2	3
Mokorua	200	30	3	1	4
Mokorua	216		14	3	9
Mokorua	242	36	7	42	16
Mokorua	236		11	24	9

Reserve	Trap ID	2021	2022	2023	2024
OSR south	305		3	2	12
OSR south	304A				9
OSR south	310		2	1	0

Reserve	Trap ID	2021	2022	2023	2024
Kawenata	408		3	8	8
Kawenata	407B			8	3
Kawenata	401		0	6	9
Kawenata	406		3	4	5

Wkahatāne Kiwi Trust
Queen wasp monitoring traps
February 2025

Whakatāne Kiwi Trust

10.6 Appendix 6

Key differences between German and common Vespula wasp species

(The following information has been sourced from the Manaaki Whenua / Landcare Research site: https://www.landcareresearch.co.nz/science/plants-animals-fungi/animals/invertebrates/invasive-invertebrates/wasps/identification/key-differences)

German and common wasps are very similar in appearance. The dorsal markings on the abdomen have often been used to distinguish these two species in New Zealand. However, these markings are variable and are not always accurate. **The marking on the side of the head and face are more reliable.**

German wasps (*Vespula germanica*)	Common wasps (*Vespula vulgaris*)
Side of head	
	
A complete yellow band behind the eye.	A black mark behind the eye.
Face	
	
Black dots or a vertical black line.	Anchor-shaped mark.

10.7 Appendix 7

Determining queen, male and worker Vespula wasps

Male Vespula wasps, germanica on left, vulgaris on right. Dave Holland. 2020. iNaturalist observation: Photo 66722148

From left worker, male, queen Vespula wasps. Dave Holland. 2020. iNaturalist observation: 42536795.

10.8 Appendix 8

Photographic examples of captures in queen wasp traps, including bycatch

Ants feeding on lure

Bycatch – craneflies, blow flies, ants (note, lure has lost its colour but still performing)

Queen wasp captures

Vespula wasp captures plus bycatch including moths, ants and midges