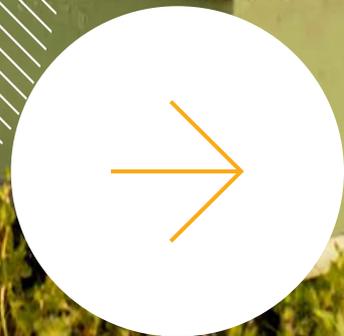




# Australian Honey Bee & Pollination Industry National Colony Loss Survey

2024 and 2025  
key results



By Michael J. Holmes and Sasha Mikheyev  
November 2025



NATIONAL  
**Varroa Mite Management**  
PROGRAM



**AgriFutures<sup>®</sup>**  
Honey Bee  
& Pollination

# **Australian Honey Bee & Pollination Industry National Colony Loss Survey - 2024 and 2025 key results**

Michael J Holmes

Sasha Mikheyev

November 2025

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# Foreword

The Australian honey bee and pollination industry plays an important role in Australian agriculture, contributing an estimated \$4.6 billion annually to the economy through pollination services, and hive products, primarily honey. However, the industry faces significant challenges, particularly after September 2023, when the parasitic mite, *Varroa destructor*, was declared to be established in New South Wales.

Internationally, varroa is often the leading cause of honey bee colony losses and similar impacts are anticipated in Australia. Identifying the need to understand the effects of varroa on bee colonies and other causes of colony loss, the industry initiated the Australian Colony Loss Survey for the 2023-24 and 2024-25 production seasons. These surveys aimed to establish comprehensive data to monitor and assess the factors driving honey bee colony losses across Australia.

The survey revealed a national annual colony loss rate of 6.8% in 2023-24 and 10.5% in 2024-25. In NSW, varroa was identified as a leading cause of colony loss, imposing substantial economic burdens on beekeepers. Analysis of varroa treatments indicated that synthetic acaricides were most effective in both years, with the highest efficacy and the lowest incidence of adverse effects. However, international experience indicates that varroa rapidly develops resistance to such chemicals, underscoring the need for an integrated pest management strategy to maintain effectiveness.

These initial surveys provide valuable data for the industry. Subsequent surveys may be conducted to collect more data and monitor changes in colony loss over time. These surveys will provide essential information to guide the Australian honey bee industry through its transition to managing varroa, with the goal of fostering a resilient, informed and sustainable future.

This project was completed as part of the AgriFutures Honey Bee & Pollination Program, which aims to foster a more productive, sustainable and profitable Australian beekeeping industry, and to secure the pollination of Australia's horticultural and agricultural crops. For more information and resources, visit [agrifutures.com.au/honey-bee-pollination](https://agrifutures.com.au/honey-bee-pollination).

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## About the authors

Michael J Holmes and Sasha Mikheyev are researchers at the Australian National University with expertise in honey bee biology, ecology and the impacts of pests and diseases on apiculture.

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This project would not have been possible without ongoing consultation from Dr Pike Stahlmann-Brown (Manaaki Whenua Landcare Research New Zealand). Dr Stahlmann-Brown provided the New Zealand Colony Loss Survey Questionnaire, on which our survey was based, as well as invaluable advice for every stage of the project.

AgriFutures Australia acknowledges the First Nations people of Australia as the traditional custodians of the lands and waters on which we live, learn and work. We pay our respects to past, present and future Elders of these nations. In particular, we acknowledge the Wiradjuri people of Australia, the traditional custodians of the lands and waters where AgriFutures' head office is located.

## Abbreviations

<b>Abbreviation</b>	<b>Definition</b>
AHBIC	Australian Honey Bee Industry Council
ANU	Australian National University
DWV	deformed wing virus
EFB/AFB	European Foulbrood/American Foulbrood
IPM	Integrated Pest Management
SHB	small hive beetle

# Contents

- Foreword ..... 3
- About the authors ..... 4
- Acknowledgements..... 4
- Abbreviations..... 4
- Executive summary ..... 6
- Introduction..... 8
- Methodology.....10
- Results .....14
- Discussion.....25
- Recommendations.....29
- References .....31
- Appendix I: 2024 Australian Colony Loss Survey Questionnaire .....33
- Appendix II: 2025 Australian Colony Loss Survey Questionnaire .....37
- Appendix III: Infographics based on survey data.....49
- Appendix IV: Supplementary results tables (2024–25).....51

## Executive summary

The Australian honey bee and pollination industry, a cornerstone of the nation's agricultural sector, is facing an unprecedented challenge with the establishment of the parasitic mite *Varroa destructor* in New South Wales (NSW) in September 2023. To address the urgent need for robust, evidence-based management strategies, the Australian Honey Bee & Pollination Industry National Colony Loss Survey was launched in 2025. To date, two surveys have been conducted. This report presents the findings of these surveys, establishing a critical baseline of colony health and identifying the initial impacts of varroa on the industry.

The inaugural (2024) survey, which ran from February to April 2025, covered the 2023-24 production season and garnered 990 usable responses from beekeepers who manage a total of 124,808 colonies. Commercial beekeepers (managing  $\geq 50$  hives) were significantly overrepresented in the sample, accounting for 15% of respondents but 96% of all managed colonies.

Similarly, the 2025 survey, from September to November 2025, covered the 2024-25 production season and garnered 744 usable responses from beekeepers managing 140,499 colonies. Commercial beekeepers accounted for 23% of respondents and 97% of managed colonies. These numbers indicate that the data gathered in both years provides an informative snapshot of hive health in Australia.

The key national findings were an overall annual colony loss rate of 6.8% in 2024 and 10.5% in 2025, comparable to overall loss rates reported internationally. In both years and across nearly every demographic, losses were higher in the warm season, which exemplifies the unique challenges faced by beekeepers in Australia compared with the rest of the world. In most beekeeping countries, most losses occur over winter. In contrast, Australia's hot, dry summers present a greater challenge for beekeepers than our relatively mild winters.

Data from NSW, which still harbours the vast majority of Australia's varroa population, serves as a harbinger of future challenges. In 2024 in NSW, varroa was already a leading cause of colony loss, accounting for 1.4% of all colony losses in the state (Table 4). This number rose to 2.6% in 2025. Losses due to varroa were second only to queen failure for beekeepers in NSW.

The economic burden of varroa is substantial, due to direct colony losses and higher costs in terms of time and cash outlay. Commercial beekeepers in NSW reported spending an average of 22 minutes and \$22.18 per hive on varroa management in 2024, and 27.1 minutes and \$19.19 per hive in 2025. Operational costs of varroa for commercial beekeepers in 2025 were \$19,590. In addition, regulation and compliance costs averaged

\$90,362. Commercial operators reported 27 minutes of management per hive, which represents a substantial increase in workload to the industry. It should be noted that both the time and cost values show considerable variability. Differences in their means were not statistically significantly different across years, so any apparent trends should not be interpreted literally.

Analysis of varroa treatments revealed that synthetic miticides were perceived as the most effective and with the fewest adverse effects in both years. However, international experience demonstrates that varroa rapidly develops resistance to these chemicals, highlighting the urgent need for a national Integrated Pest Management (IPM) strategy to preserve their efficacy. However, 45% of respondents reported no rotation of hard acaricide classes, which will lead to a rapid evolution of resistance, indicating a need for continuing education. The survey also uncovered a correlation between varroa and small hive beetle (SHB); losses to the latter were significantly higher in apiaries where varroa losses were also reported. While this may suggest a synergistic interaction where mite infestation compromises colony defences against beetles, it is important to note that this correlation may also be driven by geographic factors because current varroa zones in NSW overlap heavily with regions where SHB is endemic. Regardless of the mechanism, beekeepers in these zones face a compounded threat.

A significant methodological finding of the 2024 survey was the high proportion of losses attributed to 'Unsure' or 'Other reasons'. The omission of 'queen problems' as a specific loss category, a major driver of loss in international surveys, likely masked a fundamental issue in Australian colony losses. This option was added to the 2025 survey questionnaire, and indeed was shown to be the leading cause of colony losses in all states. As such, we corrected this important methodological flaw and will retain this option in future surveys.

This report recommends a multi-faceted approach. Beekeepers must adopt rigorous monitoring and IPM principles. Industry bodies should lead targeted education campaigns and advocate for survey improvements. These early data provide insights into the immediate costs of varroa already felt by beekeepers in NSW and other affected areas, which will be felt by the industry more broadly. Data provided by this survey should enable financial planning and mitigation strategies to help beekeeping operations remain profitable.

# Introduction

## The Australian beekeeping industry at a critical juncture

### The economic and agricultural cornerstone of Australian pollination

The Australian honey bee and pollination industry is an indispensable component of the nation's horticulture and broader agricultural economy. Managed honey bees (*Apis mellifera*) provide essential pollination services to 67 distinct agricultural industries, with some crops being entirely dependent on commercial beekeepers for production (Clarke and Le Feuvre 2024). The economic value of these services is significant, contributing an estimated \$4.6 billion to the Australian economy each year (Gillespie et al. 2024). Beyond this, the direct production of honey, beeswax, queen bees, and other hive products adds a further \$264 million in farmgate value (Clarke and Le Feuvre 2024).

The contribution of honey bee pollination extends beyond crop quantity. Effective pollination is a critical determinant of crop quality, directly improving fruit and vegetable development time, commercial grade, and shelf life (Klatt, Holzschuh et al. 2014; Kamper and Klein 2025; Ramos and Oliveira 2025). Research has demonstrated that bee-pollinated fruits are typically heavier, have fewer malformations, and are firmer, which translates to fewer post-harvest losses and higher market value (Klatt, Holzschuh et al. 2014; Klatt, Klaus et al. 2014). This vital, yet often underappreciated, aspect of pollination underpins the profitability and sustainability of a significant portion of Australia's food production system.

### A new and formidable threat: the arrival of *Varroa destructor*

For decades, the Australian beekeeping industry has operated with a unique global advantage: freedom from the world's most destructive honey bee pest, the ectoparasitic mite *Varroa destructor* (Genersch et al. 2010; Guzmán-Novoa et al. 2010). This situation shifted in September 2023, when it was determined that varroa eradication was no longer feasible, and it was officially declared established in NSW (Holmes et al. 2024; Australian Government 2023). *Varroa* represents an extreme threat to honey bee health. The mite feeds on the fat bodies of larval and adult bees—organs critical for immune function, pesticide detoxification, and nutrient storage—thereby weakening individual bees and the colony as a whole (Traynor et al. 2020; Ramsey et al. 2019).

More perniciously, *varroa* is a highly efficient vector for a suite of debilitating and lethal viruses, most notably Deformed Wing Virus (DWV) (Traynor et al. 2020; Wilfert et al. 2016). In *varroa*-infested regions globally, the mite's ability to transmit viruses directly into the bee's haemolymph transforms otherwise low-level viral infections into colony-killing epidemics, leading to widespread and catastrophic colony losses (Traynor et al. 2020; Ramsey et al. 2019). While the full impact of *varroa* on Australian apiculture is yet to be realised, international experience and preliminary expert assessments suggest it will be severe, fundamentally altering beekeeping management practices and the economic

landscape of the industry (Chapman et al. 2023; Holmes et al. 2024; Stahlmann-Brown et al. 2022).

## Rationale for the inaugural National Colony Loss Survey

The arrival of varroa, coupled with existing challenges such as implementing effective management strategies, has created an urgent need for a comprehensive, data-driven understanding of the factors driving honey bee colony losses across Australia. A key objective of the National Strategy for managing varroa is to foster a ‘honey bee industry composed of well-resourced, informed and successful beekeepers’ (Chapman et al. 2023). Achieving this goal is impossible without robust, national-scale data.

The timing of the first two Australian Colony Loss Surveys is therefore of national and global significance. The 2024 survey, conducted in the immediate aftermath of varroa’s establishment in a single state, provides a unique and invaluable baseline dataset. The data from varroa-free states captures the condition of the national beekeeping industry on the cusp of a continental-scale biological invasion, representing the last large-scale, pre-varroa datasets in the world (Stahlmann-Brown et al. 2022; Chapman et al. 2023). Simultaneously, the data from NSW offers a real-time case study of the mite’s initial biological and economic impacts. In turn, the 2025 survey is an immediate follow-up for the subsequent season, providing potential early indications of the post-varroa trajectory the industry may take. It also allows for an insight into the success of transition to management (T2M) and other education campaigns. This report, therefore, is not merely a summary of losses; it is a foundational document designed to establish a benchmark against which future impacts can be measured, to identify immediate management priorities, and to guide the strategic allocation of resources to ensure the long-term resilience of this vital Australian industry.

# Methodology

## Designing and implementing a national survey

### Project objectives

There were four primary objectives of this project:

- Conduct the first two national surveys of honey bee colony losses in Australia for the 2023-24 and 2024-25 production seasons.
- Establish a robust, national baseline for annual and seasonal colony loss rates, and assess whether any detectable changes occurred between these two seasons.
- Quantify the initial impacts of *Varroa destructor* on colony losses and management costs in the affected region of NSW in the 2023-24 production season and in all states with varroa in the 2024-25 production season.
- Identify the major perceived drivers of colony mortality across different states and beekeeping operation scales to inform industry strategy and future research priorities.

### Survey design and questionnaire development

#### *2024 Australian Colony Loss Survey*

The 2024 Australian Colony Loss Survey was designed to be the first of its kind in the country, covering the period from 1 September 2023 to 31 August 2024. This timeframe was chosen specifically to encompass the first full production season and winter after the declaration of varroa establishment in NSW (Chapman et al. 2023).

The survey instrument was structurally adapted from the established New Zealand Colony Loss Survey; its most recent iteration was the 2023 report (Stahlmann-Brown and Robertson 2024). To ensure international comparability, the questionnaire incorporated core questions from the globally standardised prevention of honey bee colony losses survey framework (Zee et al. 2013). This foundation was supplemented with questions tailored to the unique apicultural context of Australia, accounting for its broad range of climatic and geographic conditions. To capture seasonal variations without creating an excessively long questionnaire, the survey period was divided into two distinct seasons: a 'warm' season (1 September 2023 – 31 March 2024); and a 'cool' season (1 April 2024 – 31 August 2024), with respondents answering parallel sets of loss-related questions for each period.

A dedicated block of questions was developed to address varroa management. This section used conditional logic (branching) so that it was presented only to respondents who indicated they operated in an area where varroa was present during the survey period. This approach minimised the time burden on beekeepers in varroa-free regions.

The questionnaire was reviewed rigorously in two stages. In November 2024, an initial draft was sent to a panel of scientific and industry experts to review its scientific merit and alignment with international standards. After this feedback was incorporated, a test version was given to the Australian Honey Bee Industry Council (AHBIC) Member Body Delegates in December 2024. This group served as a crucial test audience of commercial beekeepers, providing feedback on the clarity, relevance, and user experience of the survey. The final questionnaire was submitted to the Australian National University Human Research Ethics Committee, which granted full approval on 31 January 2025 (Protocol 2024/1189).

**Table 1. Expert panel for survey review.**

Expert	Field	Institution
Keegan Blignaut	Beekeeper	Duxton Bees
Nadine Chapman	Researcher, Beekeeper	NSW DPI
Michael Clarke	Researcher, Beekeeper	AgEconPlus
Theotime Colin	Researcher	Macquarie University
Allan Cotton	Beekeeper	Capilano Honey
Danny Le Feuvre	Beekeeper	AHBIC
David Lyall	Beekeeper	Bee Innovative
Ben Oldroyd	Researcher, Beekeeper	University of Sydney
Michael Palmer	Beekeeper	Tasmanian Pollination Services
Cornelia Sattler	Researcher	Macquarie University

### *2025 Australian Colony Loss Survey*

The 2025 Australian Colony Loss Survey, covering 1 September 2024 to 31 August 2025, was built upon the questionnaire developed for the 2024 survey. A panel of industry and scientific experts met to update the questionnaire, based on the results from the 2024 survey and feedback from surveyed beekeepers. Most of the questions and the structure were retained, with some modifications, of which the most important were:

- As varroa had spread beyond NSW by the 2025 survey period, the varroa-specific questions were opened to all survey participants who indicated that varroa was present in areas in which they operate, rather than being exclusive to those operating in NSW.
- More response options were added to some questions to capture data that was missed earlier. Specifically, ‘queen failure’ was added as a response to causes of colony losses. Fields to enter text responses were added to questions with ‘Other’ as an option, helping respondents specify exact reasons for colony losses, treatments used, and so on.
- Previously, NSW-specific questions about whether NSW DPIRD had provided varroa-specific assistance or whether beekeepers had lost hives from euthanasia

as part of the varroa response were removed because transition to management was well underway by the 2025 survey period.

*Note: Appendices I and II contain the full 2024 and 2025 questionnaires.*

## Survey administration and data collection

Both surveys were delivered online using the Qualtrics platform. It was selected for its robust capabilities, particularly its support for complex survey logic (branching) and its function for automatically compiling and housing response data, which eliminates the need for manual data entry and reduces the potential for error.

The 2024 survey was open to the general beekeeping population from 3 February 2025 to 10 March 2025. It was reopened from 1 April 2025 to 11 April 2025 to facilitate a targeted distribution to AgriFutures Australia levy-payers. The 2025 survey was open to the general beekeeping population from 1 September 2025 to 1 November 2025.

## Communications and beekeeper engagement

### *2024 Survey Communications Strategy*

A multichannel communications and engagement strategy was implemented to maximise survey participation across all sectors of the beekeeping community. The primary approach focused on using trusted industry and government sources to build credibility and encourage participation. Key channels included:

- **Industry engagement:** AHBIC and AgriFutures Australia distributed electronic direct mail (EDM) campaigns and website articles. In addition, the AHBIC CEO contacted commercial beekeepers in multiple states via text message.
- **Government channels:** State government departments of primary industries promoted the survey through their established communication channels, including EDMs and social media platforms.
- **Media activities:** An AgriFutures media release on 10 February 2025 resulted in coverage in mainstream agricultural outlets. The research team's explanatory articles were also published on specialist platforms, such as the ExtensionAUS Professional Beekeepers website and in the ANU Reporter.
- **Social media:** A coordinated social media campaign on the platforms of all project stakeholders (ANU, AHBIC, AgriFutures Australia, and state governments) was supported by promotional material from the ANU media team and the NSW DPIRD Varroa T2M Public Information team. A dedicated Facebook page for the survey was also established to engage directly with the beekeeping community.

### *2025 Survey Communications Strategy*

The 2025 survey used the 2024 communications and engagement strategy, with some other channels added:

- **Leveraging of 2024 results:** Key findings from the 2024 survey were used in all key channels to raise awareness and to emphasise the benefit and importance of participating in the survey. Preliminary 2024 survey results were presented at industry conferences in winter 2025 to raise general awareness of the upcoming 2025 survey. During the survey period, key results were highlighted on social media, media articles and on the Australian Colony Loss Survey website. In several radio interviews, Michael Holmes (ANU) discussed the 2024 results and promoted the 2025 survey. Additionally, a podcast detailing the importance of the survey and impacts of varroa, featuring Michael Holmes (ANU) and Bianca Giggins (AHBIC), was released before the 2025 survey launch.
- **Cold calling campaign:** 72 commercial beekeepers who had given contact details after the 2024 survey were cold called to personally invite them to complete the 2025 survey. Those who did not answer were invited via SMS or email.
- **Leveraging amateur beekeeping clubs:** To promote the survey, amateur beekeeping clubs were given social media tiles and content to include in newsletters and email updates to their members.

## Statistical analysis

To ensure statistical robustness, all analyses of colony loss percentages used parametric statistics (binomial for mortality data and t-test for others). This method was used to calculate the mean percentage loss and to generate 95% confidence intervals for all reported loss rates. The confidence intervals were computed per-statistics and do not account for the complex correlational structure of the dataset. Furthermore for some statistics that sample sizes are small and any differences in means, even if supported by differences in confidence intervals should be taken with a degree of caution.

# Results

## National beekeeper demographics and overall colony losses

### Profile of survey respondents

For the 2025 analysis, 744 beekeepers managing a collective total of 140,499 colonies provided usable responses (Table 2). While the total number of respondents was less than in the 2024 survey (n=990), the coverage of the national apiary increased significantly. The 2025 dataset represented 15,691 more colonies than the previous year.

This increase in colony coverage is driven by greater engagement from the commercial sector. In 2025, 171 commercial beekeepers (defined as managing more than or equal to 50 hives) participated, managing 136,580 colonies, which accounts for 97.2% of the total colonies in the dataset. In contrast, the 573 amateur respondents managed just 3,918 colonies (Table 2). Consequently, the colony-weighted loss data presented in this report provides a reliable reflection of the commercial industry.

Crucially, the survey captured the expanding footprint of varroa in Australia. The number of respondents operating in varroa-present zones rose to 308 (up from 262 in 2024), with 62,505 colonies reported as being treated for varroa during the 2025 season (Table 2).

**Table 2. Respondent profile summary, by year.**

Year	Respondents	Amateur	Commercial	Total colonies	Amateur colonies	Commercial colonies	Respondents with varroa	Colonies treated for varroa
2024	990	837	153	124,808	4,678	120,129	262	Not asked
2025	744	573	171	140,499	3,918	136,580	308	62,505

## National and seasonal colony loss rates

The headline finding for the 2025 production season is a national overall colony loss rate of 10.5% (95% CI: 10.3–10.6%), a notable increase from the 6.8% (95% CI: 6.7–6.9%) recorded in the 2024 baseline survey (Table 3).

When disaggregated by season, the data confirm a persistent and unique Australian trend: colony mortality is significantly higher during the warm season than the cool season.

- **Warm season:** National losses rose to **12.7%** (95% CI: 12.5–12.8%), up from 7.4% in 2024.
- **Cool season:** National losses were lower at **8.1%** (95% CI: 8.0–8.3%), though still up, from 6.1% in 2024.

This seasonal distribution contrasts with international norms where winter losses typically dominate.

**Table 3. National colony-weighted percent losses (95% CI), by season and year.**

Year	Season	Loss % (colony-weighted, 95% CI)	Loss % Amateur (95% CI)	Loss % Commercial (95% CI)
2024	Warm	7.4% (7.3–7.6)	11.3% (10.4–12.2)	7.3% (7.1–7.4)
2024	Cool	6.1% (6.0–6.3)	7.6% (6.9–8.4)	6.1% (5.9–6.2)
2024	Overall	6.8% (6.7–6.9)	9.5% (8.9–10.1)	6.7% (6.6–6.8)
2025	Warm	12.7% (12.5–12.8)	16.2% (15.1–17.4)	12.6% (12.4–12.7)
2025	Cool	8.1% (8.0–8.3)	9.0% (8.0–10.0)	8.1% (8.0–8.3)
2025	Overall	10.5% (10.3–10.6)	12.9% (12.2–13.7)	10.4% (10.3–10.5)

## Commercial vs. Amateur resilience

The aggregated data mask a significant divergence in resilience between commercial and amateur operations.

- **Commercial operations:** Commercial beekeepers reported overall annual losses of 10.4% of colonies (Table 3). While there was a sharp spike in warm season losses (12.6%), their cool season losses remained relatively stable at 8.1%.
- **Amateur operations:** Amateur beekeepers faced significantly higher mortality, with an overall loss rate of 12.9%. This sector was particularly vulnerable during the warm season, recording a loss rate of 16.2% (Table 3).

This disparity is most evident when losses are analysed on varroa presence. In 2025 amateur beekeepers in varroa-present zones suffered 21.5% losses, nearly triple the rate of those in varroa-

free zones (8.5%) (Table S5). In contrast, in the same year, commercial operators maintained a much narrower gap, with losses of 10.5% in varroa zones versus 9.8% in varroa-free zones (Table S6), indicating that professional management practices may currently be effective at suppressing mite-induced mortality, with the important caveat that the data are self-reported.

## Analysis of colony loss drivers

### Overview of attributed causes

Respondents attributed losses to a defined list of causes, with the 2025 survey introducing ‘queen failure’ as a specific category. This addition fundamentally altered the attribution profile of the survey, revealing that queen failure is a leading cause of colony loss nationally, which was not captured in the 2024 survey (Table 4).

### Primary causes of loss in commercial operations, by state

For commercial beekeepers, the drivers of loss varied significantly by state, reflecting regional environmental conditions and the staggered spread of varroa. Table 4 gives the full list of causes, with some highlights below:

- **New South Wales (NSW):** As the epicentre of the incursion, NSW reported the highest warm season losses, at 14.0% (Table S3). While varroa was a significant factor (3.4% of losses), queen failure was the leading biotic stressor, accounting for 3.9% of warm season losses.
- **Tasmania (TAS):** Tasmania recorded a dramatic increase in warm season losses, reaching 17.6%. It was not driven by varroa (0.0%), which is currently absent, but rather by reported queen failures (10.3%) and starvation (2.8%), suggesting severe localised issues with queen quality or mating conditions.
- **Western Australia (WA):** Losses rose to 8.8% in the warm season, driven primarily by starvation (2.9%) and queen failure (3.0%) (Table S3).

### Direct contribution to colony losses

Data from NSW provides the clearest signal of varroa’s direct impact. In 2025, losses directly attributed to varroa in NSW nearly doubled in the warm season, rising to 3.4% (95% CI: 3.3–3.6%) (Table 4). Overall, varroa accounted for 2.6% of all colony losses in the state for the full year.

**Table 4. Colony-weighted percent losses (95% CI) by cause, state, and season. Numbers are given for the 2024 season with a column indicating differences from the 2024 season ( $\Delta$  (25–24)). Note that the number of responses within each category per state is mostly too low to infer directional patterns between years with statistical certainty.**

Cause	Season	NSW N = 271		QLD N = 160		SA N = 55		TAS N = 70		VIC N = 111		WA N = 85	
		Loss (%)	$\Delta$ (25–24)										
Varroa	Warm	3.4 (3.3–3.6)	+1.7	0.0 (0.0–0.1)	+0.0	0.1 (0.1–0.2)	+0.1	0.0 (0.0–0.0)	+0.0	0.0 (0.0–0.0)	-0.0	0.0 (0.0–0.0)	+0.0
	Cool	1.7 (1.6–1.8)	+0.7	0.0 (0.0–0.1)	+0.0	0.0 (0.0–0.0)	+0.0	0.0 (0.0–0.1)	+0.0			0.0 (0.0–0.1)	+0.0
	Overall	2.6 (2.5–2.7)	+1.2	0.0 (0.0–0.0)	+0.0	0.1 (0.0–0.1)	+0.1	0.0 (0.0–0.0)	+0.0	0.0 (0.0–0.0)	-0.0	0.0 (0.0–0.1)	+0.0
AFB	Warm	0.5 (0.5–0.6)	+0.2	1.2 (1.1–1.4)	-1.3	1.0 (0.9–1.2)	+1.0	0.0 (0.0–0.1)	-0.1	1.5 (1.3–1.7)	+1.4	0.4 (0.3–0.5)	+0.4
	Cool	0.2 (0.2–0.2)	-0.4	0.5 (0.4–0.6)	-0.0	0.2 (0.1–0.3)	+0.2	0.0 (0.0–0.1)	-0.0	0.2 (0.1–0.3)	+0.1	0.0 (0.0–0.1)	+0.0
	Overall	0.4 (0.3–0.4)	-0.1	0.9 (0.8–1.0)	-0.6	0.6 (0.5–0.7)	+0.6	0.0 (0.0–0.1)	-0.0	0.8 (0.7–1.0)	+0.7	0.2 (0.2–0.3)	+0.2
EFB	Warm	0.1 (0.1–0.1)	+0.1	0.1 (0.1–0.2)		0.0 (0.0–0.0)		0.0 (0.0–0.0)		0.1 (0.0–0.1)	+0.1	0.0 (0.0–0.0)	
	Cool	0.0 (0.0–0.1)	+0.0	0.1 (0.0–0.1)		0.0 (0.0–0.1)		0.0 (0.0–0.1)		0.0 (0.0–0.0)	+0.0	0.0 (0.0–0.0)	
	Overall	0.1 (0.0–0.1)	+0.1	0.1 (0.1–0.1)		0.0 (0.0–0.0)		0.0 (0.0–0.0)		0.0 (0.0–0.1)	+0.0	0.0 (0.0–0.0)	
Robbing	Warm	0.1 (0.1–0.2)	+0.1	0.0 (0.0–0.1)	+0.0	0.0 (0.0–0.1)	-0.1	3.8 (3.4–4.2)	+2.9	0.1 (0.1–0.2)	-0.3	0.2 (0.2–0.3)	+0.2
	Cool	0.1 (0.1–0.2)	+0.1	0.0 (0.0–0.1)	+0.0	0.8 (0.7–1.0)	+0.1	0.0 (0.0–0.1)	-0.0	0.0 (0.0–0.1)	-0.4	0.0 (0.0–0.1)	-0.0
	Overall	0.1 (0.1–0.2)	+0.1	0.0 (0.0–0.1)	+0.0	0.4 (0.3–0.5)	-0.0	2.1 (1.8–2.3)	+1.6	0.1 (0.0–0.1)	-0.3	0.1 (0.1–0.2)	+0.1
Starvation	Warm	0.7 (0.6–0.7)	-2.1	0.5 (0.4–0.7)	+0.3	4.9 (4.5–5.3)	+4.2	2.8 (2.5–3.2)	+1.7	1.6 (1.4–1.9)	-0.2	2.9 (2.5–3.2)	+2.0
	Cool	1.5 (1.4–1.5)	-1.2	0.1 (0.1–0.2)	-2.4	4.2 (3.9–4.6)	+2.9	0.8 (0.6–1.0)	+0.2			3.1 (2.7–3.4)	-0.6
	Overall	1.0 (1.0–1.1)	-1.6	0.3 (0.3–0.4)	-1.3	4.6 (4.3–4.8)	+3.6	1.9 (1.7–2.1)	+1.0	1.6 (1.4–1.9)	-0.2	3.0 (2.7–3.2)	+0.7
Nosema and other diseases	Warm	0.6 (0.5–0.6)	+0.0	0.4 (0.3–0.5)	+0.3	1.9 (1.7–2.2)	+1.8	0.6 (0.5–0.8)	+0.3	0.0 (0.0–0.0)	-0.1	0.6 (0.5–0.8)	+0.6
	Cool	0.7 (0.6–0.7)	+0.1	0.0 (0.0–0.0)	-2.5	0.2 (0.2–0.4)	+0.2	0.0 (0.0–0.1)	+0.0			0.9 (0.7–1.1)	+0.9
	Overall	0.6 (0.6–0.7)	+0.1	0.2 (0.1–0.2)	-1.1	1.1 (1.0–1.2)	+1.0	0.3 (0.2–0.4)	+0.2	0.0 (0.0–0.0)	-0.1	0.8 (0.6–0.9)	+0.8
SHB	Warm	1.8 (1.7–1.9)	+0.2	2.5 (2.2–2.7)	+1.3	0.0 (0.0–0.1)	+0.0	0.0 (0.0–0.0)	-0.0	0.1 (0.1–0.2)	-0.0	0.2 (0.1–0.3)	+0.2

Cause	Season	NSW N = 271		QLD N = 160		SA N = 55		TAS N = 70		VIC N = 111		WA N = 85	
		Loss (%)	Δ (25–24)	Loss (%)	Δ (25–24)	Loss (%)	Δ (25–24)	Loss (%)	Δ (25–24)	Loss (%)	Δ (25–24)	Loss (%)	Δ (25–24)
Queen failure	Cool	0.3 (0.3–0.4)	-0.9	0.6 (0.5–0.7)	-1.3	0.0 (0.0–0.0)	+0.0	0.0 (0.0–0.1)	+0.0			0.0 (0.0–0.1)	+0.0
	Overall	1.1 (1.0–1.1)	-0.3	1.6 (1.4–1.7)	+0.0	0.0 (0.0–0.0)	+0.0	0.0 (0.0–0.0)	-0.0	0.1 (0.1–0.2)	-0.0	0.1 (0.1–0.2)	+0.1
	Warm	3.9 (3.8–4.0)	-0.3	4.7 (4.4–5.0)		2.0 (1.8–2.3)		10.3 (9.6–11.0)		3.3 (3.0–3.7)	+3.3	3.0 (2.6–3.3)	
	Cool	3.3 (3.2–3.5)	-4.2	3.3 (3.0–3.6)		1.1 (0.9–1.3)		3.3 (2.9–3.7)				2.3 (2.1–2.6)	
	Overall	3.6 (3.5–3.7)	-2.1	4.0 (3.8–4.2)		1.6 (1.4–1.7)		7.1 (6.7–7.5)		3.3 (3.0–3.7)	+3.3	2.6 (2.4–2.9)	
Other	Warm	3.3 (3.2–3.4)	-0.3	1.0 (0.9–1.2)	-4.1	1.4 (1.2–1.6)	-0.2	0.1 (0.0–0.1)	-1.2	3.0 (2.7–3.4)	-1.6	2.2 (2.0–2.5)	-1.1
	Cool	1.8 (1.7–1.9)	+0.2	1.4 (1.3–1.6)	-3.3	8.8 (8.2–9.3)	+6.1	0.1 (0.0–0.1)	-7.5			0.5 (0.4–0.7)	-1.9
	Overall	2.6 (2.5–2.6)	-0.0	1.2 (1.1–1.4)	-3.7	4.8 (4.5–5.1)	+2.7	0.1 (0.0–0.1)	-4.2	3.0 (2.7–3.4)	-1.6	1.4 (1.2–1.6)	-1.5

Note: Changes in percent losses across years are based on small sample sizes and should be taken as indicative only. ACT and NT data were removed because there were fewer than 10 respondents.

## The economic burden of management

The transition to varroa management has imposed a structural shift in the operating costs for commercial beekeepers in NSW (Table 5A). While these increases were not statistically significant, they represent trends in the data that should be monitored.

- **Financial costs:** The direct material cost per hive fell from \$22.18 in 2024 to \$19.19 in 2025. This likely reflects a shift toward lower-cost organic acid treatments or generic formulations, or lower varroa burdens from less re-infestation in 2024.
- **Labour costs:** Conversely, the labour input increased. Commercial beekeepers spent an average of 27.1 minutes per hive on varroa management in 2025, up from 22.0 minutes in 2024.

With the caveat that these data are not statistically significant, if true, this substitution of labour for treatment costs is noteworthy; the extra **5.1 minutes per hive** equates to about **85 extra workhours** (over two weeks of full-time labour) for a typical 1,000-hive operation.

**Table 5A. Treatment costs and labour (Commercial); values are mean  $\pm$ 95% CI (costs in AUD).**

Year	Respondents	Cost per colony	Minutes per colony	Colonies treated	Cost per operation	Regulation compliance cost
2024	36	22.18 (15.33–29.02)	22.0 (14.9–29.1)	60,982	57,082 (0–155,560)	Not asked in 2024
2025	83	19.19 (15.43–22.96)	27.1 (12.8–41.5)	60,963	19,590 (7,391–31,789)	90,362 (50,488–130,236)

**Table 5B. Treatment costs and labour (Amateur); values are mean  $\pm$ 95% CI (costs in AUD).**

Year	Respondents	Cost per colony	Minutes per colony	Colonies treated	Cost per operation
2024	211	34.66 (30.35–38.97)	34.7 (30.4–39.0)	1,224	210 (160–259)
2025	206	38.87 (34.51–43.22)	39.6 (32.7–46.4)	1,542	317 (171–462)

Beyond direct treatment costs, the regulatory environment has imposed significant indirect financial burdens. Among respondents in varroa-affected areas, 39.6% reported incurring costs associated with compliance (e.g., health certificates, honey testing), and 30.0% reported a loss of income due to movement restrictions (Table 6). These hidden costs are substantial. For example, the average cost of regulation compliance for commercial operators was estimated at \$90,362, a figure that often exceeds the direct costs of mite management (Table 5A).

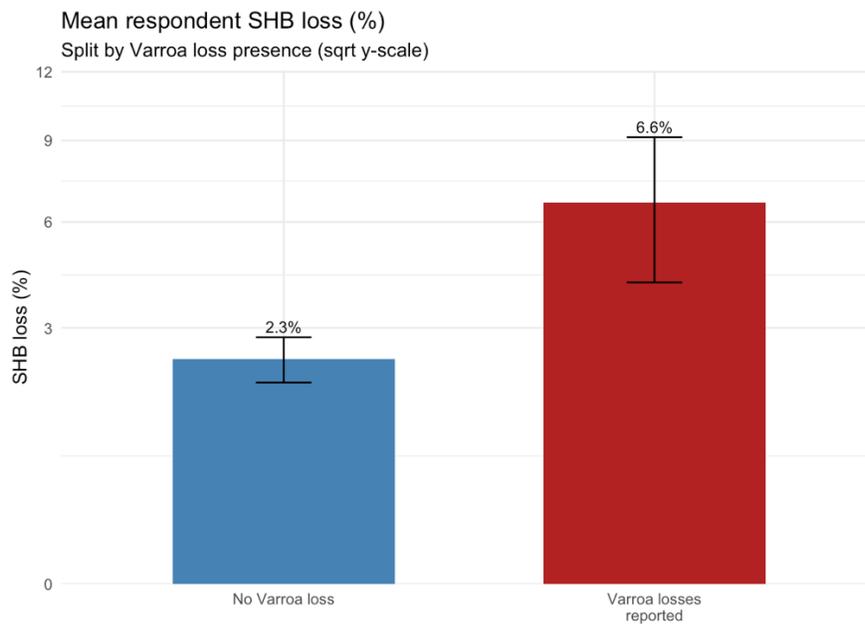
**Table 6. Reported impacts from varroa regulations (2025 varroa-affected respondents).**

<b>Varroa impact</b>	<b>Response #</b>	<b>%</b>
Queen shortages	40	18.4%
Loss of income due to colony/queen/bee movement restrictions	65	30.0%
Costs associated with training (yourself or your staff) to meet varroa regulations	11	5.1%
Costs associated with compliance with varroa regulations, e.g. health certificates, honey testing (not counting surveillance costs)	86	39.6%
Other	103	47.5%

Percentages are within 2025 among respondents in varroa-affected areas; respondents may select multiple impacts (n=217). All summary of 71 open responses: higher compliance or treatment costs, extra monitoring work (alcohol washes/testing), colony or queen losses, and movement restrictions.

## Potential pest interaction: varroa and small hive beetle (SHB)

The survey uncovered statistical evidence of a synergistic interaction between varroa and small hive beetle (*Aethina tumida*). Beekeepers who reported losses due to varroa also reported significantly higher losses due to SHB (6.6%) than those who did not report varroa losses (2.3%). This suggests that mite infestation may compromise the colony's ability to police beetle populations or other causes of colony loss (Figure 1). The magnitude of varroa and SHB was also significantly correlated (Spearman  $r = 0.17$ ;  $p = 1.9e-19$ ). While this pattern is consistent with a synergistic interaction, whereby varroa weakens the colony's ability to police beetle populations, the survey cannot rule out confounding geographic variables. The current varroa red zones are largely coastal or humid regions where SHB pressure is naturally higher. Consequently, while the 'double threat' is real for these beekeepers, experimental research is required to confirm whether a biological synergy exists.



**Figure 1. SHB losses were higher for varroa-affected beekeepers.**

## Effects on feral bees and honey yields

Interestingly, varroa presence did not appear to be the primary driver of perceived honey yield reductions in the 2025 season. About 41% of beekeepers in varroa zones reported lower honey yields, which was actually lower than the 46% of beekeepers in varroa-free zones who reported the same. This unexpected resilience in yield may be driven by a shift in ecological competition. A significantly higher proportion of respondents in varroa-present areas reported a decline in feral colonies (34.0%) compared to those in varroa-free zones (10.2%). The rapid disappearance of the unmanaged feral population, which historically competes for floral resources, might provide a 'resource release' for managed hives, thereby buffering the productivity losses typically associated with varroa infestation. Yet, this release has thus far failed to materialise (Appendix IV, Tables S1 and S2).

# Beekeeper experiences with varroa treatments

## Efficacy vs. adverse effects

Commercial beekeepers evaluated the success and safety of various control methods (Table 7, Table 8). Respondents were asked to give a qualitative evaluation of success from 1 to 4, corresponding to 'Not at all', 'Partly', 'Mostly' and 'Completely'. The data were analysed on a linear scale, with higher values indicating more successful treatment.

- **Synthetic chemicals:** Synthetic miticides remained the most reliable tools. Apitraz (amitraz) had the highest success score (3.30/4.0), followed closely by Bayvarol (flumethrin) (3.25/4.0).
- **Organic chemicals:** Organic miticide revealed higher risks. Formic Pro (formic acid) was associated with severe adverse effects; 87.5% of users reported issues, including 25.4% colony death and 22.5% queen death. This high mortality is likely linked to the difficulty of using temperature-sensitive fumigants during the Australian warm season. Oxalic acid was the most popular organic miticide and showed good success (2.9/4.0) though 37.7% of beekeepers reported some adverse effects. Thymol and essential oils were not commonly used (<10 respondents).

**Table 7. Self-reported varroa treatment success.**

(Likert 0–4 scale. Higher values indicate greater efficacy.)

Treatment	Respondents	Success score (mean, 95% CI)
Api-Bioxal	7	2.57 (1.52–3.62)
Apiguard	34	2.56 (2.14–2.98)
Apistan	9	2.56 (1.61–3.51)
Apitraz	10	3.30 (2.82–3.78)
Apivar	51	3.00 (2.65–3.35)
Bayvarol	179	3.25 (3.10–3.40)
Did not treat	17	0.71 (-0.04–1.45)
Drone uncapping	70	1.86 (1.61–2.11)
Essential oils	9	1.78 (0.94–2.62)
Formic acid	10	2.20 (1.26–3.14)
Formic Pro	65	2.48 (2.14–2.81)
Other	23	2.83 (2.31–3.34)
Oxalic acid	112	2.87 (2.70–3.04)
Queen caging	12	1.92 (1.13–2.70)
Thymol	5	2.20 (1.16–3.24)

**Table 8. Respondents reporting specific adverse effects, by treatment in 2025. Multiple adverse effects could be reported by a single respondent.**

Treatment	Respondents	No adverse effects	Colony death	Loss of brood	Loss of workers	Queen death	Reduced queen acceptance or performance
Api-Bioxal	9	44.4%	11.1%	0.0%	22.2%	22.2%	11.1%
Apiguard	35	57.1%	11.4%	11.4%	14.3%	5.7%	11.4%
Apistan	9	44.4%	44.4%	33.3%	33.3%	33.3%	44.4%
Apitraz	10	80.0%	10.0%	10.0%	20.0%	10.0%	20.0%
Apivar	54	63.0%	9.3%	13.0%	9.3%	7.4%	18.5%
Bayvarol	183	69.9%	4.4%	10.9%	9.3%	6.0%	9.8%
Did not treat	29	24.1%	31.0%	10.3%	10.3%	10.3%	10.3%
Drone uncapping	75	78.7%	0.0%	9.3%	4.0%	0.0%	2.7%
Essential oils	11	72.7%	0.0%	0.0%	0.0%	9.1%	9.1%
Formic acid	11	27.3%	0.0%	18.2%	18.2%	36.4%	0.0%
Formic Pro	71	21.1%	25.4%	29.6%	39.4%	22.5%	19.7%
Other	24	54.2%	8.3%	16.7%	8.3%	0.0%	0.0%
Oxalic acid	113	62.8%	3.5%	8.8%	5.3%	8.8%	15.9%
Queen caging	12	33.3%	8.3%	50.0%	33.3%	0.0%	8.3%
Thymol	5	80.0%	20.0%	0.0%	0.0%	0.0%	0.0%

## Chemical rotation practices

Sustainable management of varroa relies on the rotation of chemical classes to delay resistance. Survey data indicate that this message has not yet fully penetrated the industry. Alarming, 45% of respondents reported using only a single class of hard acaricide (primarily amitraz) without rotation during the 2024–25 season. This reliance on a single chemical mode of action places the Australian industry at high risk of rapid resistance development, mirroring trends in New Zealand and the USA.

## Varroa monitoring methods

The 2025 survey data reveal distinct differences in monitoring practices between commercial and amateur beekeepers, though the industry as a whole is converging on best practice methods (Table 9).

The alcohol (or detergent) wash has established itself as the primary monitoring tool for the Australian industry. It was the most common method in all cohorts, used by 73.1% of all respondents. Adoption is particularly high in the commercial sector: 83.3% of commercial beekeepers use this method compared to 69.9% of amateur beekeepers (Table 9).

#### Secondary and visual methods

Commercial beekeepers were significantly more likely to use drone brood inspection (uncapping) as a supplementary monitoring tool (69.2%) than amateurs (47.6%). This indicates that commercial operators are frequently using a multimodal approach to detection.

Conversely, amateur beekeepers were more likely to rely on less sensitive or non-lethal monitoring techniques. Visual inspection of adult bees was used by 32.1% of amateurs compared to only 19.2% of commercial operators. Similarly, amateurs reported higher usage rates for sticky boards (20.7% vs. 9.6%) and sugar shakes (17.9% vs. 4.5%) (Table 9).

The use of CO<sub>2</sub> injection for monitoring remains a minority practice but is twice as prevalent in the commercial sector (14.1%) than among amateurs (7.0%).

**Table 9. Varroa monitoring methods, by operation size, 2025.**

Method	Amateur	Commercial	Overall
Alcohol/detergent wash	69.9% (n=351)	83.3% (n=130)	73.1% (n=481)
Visual inspection of drone brood/De-capping brood	47.6% (n=239)	69.2% (n=108)	52.7% (n=347)
Visual inspection of adult bees	32.1% (n=161)	19.2% (n=30)	29.0% (n=191)
Sticky board (or other collection tray below the hive)	20.7% (n=104)	9.6% (n=15)	18.1% (n=119)
Sugar shake/roll	17.9% (n=90)	4.5% (n=7)	14.7% (n=97)
CO <sub>2</sub>	7.0% (n=35)	14.1% (n=22)	8.7% (n=57)
Other (specified)	3.6% (n=18)	5.1% (n=8)	4.0% (n=26)
Sent sample to a lab	1.0% (n=5)	0.6% (n=1)	0.9% (n=6)

Note: Counts reflect unique respondents selecting each method; percentages are within operation size. Respondents could choose multiple monitoring methods.

# Discussion

## Overall losses

These first two National Colony Loss Surveys suggest that annual overall colony loss rates in Australia (6.8% in 2024; 10.5% in 2025) are comparable to most other countries that carry out such surveys (Gray et al. 2023). In both years, losses were higher in the warm season than in the cool season (7.4% vs. 6.1% in 2024; 12.7% vs. 8.1% in 2025). This effect was also observed in individual states and when amateur and commercial beekeepers were considered separately. Thus, an early conclusion that may be drawn from the first two years of data is that the hot, dry summers throughout most of Australia are more difficult for beekeepers to manage than our relatively mild winters. This highlights the unique challenges of Australian apiculture; in the vast majority of beekeeping nations, colony loss surveys focus on winter losses (Gray et al. 2023).

In all states, queen failure generally caused most colony losses in 2025. In the 2024 survey, queen failure was not included as an option; 'reasons not listed' was one of the most commonly chosen reasons for colony death. Thus, we can tentatively conclude that the omission of queen failure from the 2024 response options largely explains the high number of respondents choosing 'reasons not listed' and thus captures important data about queen failure that was missing in the 2024 survey.

In both years, suspected starvation, robbing and SHB were the primary drivers of colony losses (note: queen failure was introduced as a cause in 2025 and is a dominant cause of mortality). Varroa-attributed losses, as expected, are currently concentrated in NSW. Varroa was second only to queen failure as a reason for colony losses in NSW. We expand on the implications of this for the industry below.

## A tale of two industries: the varroa divide

While overall national loss percentages are comparable to those reported in international surveys, the NSW data provide a clear forecast of the severe biological and economic challenges that will almost certainly confront the rest of the country as varroa inevitably spreads.

Varroa killed 2.6% of all colonies in NSW in 2025, an increase of 1.2% from 2024. Additionally, overall losses were higher in areas where varroa was present in both years. For amateur beekeepers, overall losses were nearly three times greater in areas with varroa. The difference was much smaller for commercial beekeepers, but the overall effect was still observed. This shows that colonies are weakened by varroa, and thus become more likely to succumb to other causes of colony losses. The smaller effect for commercial beekeepers is likely because they manage many more hives, so there is a smaller impact on overall percentages if an individual hive is lost.

Furthermore, we noted an interaction between varroa and SHB in both years of the survey. Beekeepers who reported losses due to varroa also reported loss rates of 6.6% to SHB, compared to 2.6% for beekeepers who did not have losses due to varroa. To our knowledge, this effect has not been reported in any other beekeeping country where both pests are present. This finding is particularly relevant for the eastern states, where SHB is already one of the most significant pests of honey bees. The climatic and geographic structure of varroa and SHB presence is not random. While SHB losses were higher in Varroa infested areas (Figure 1), so the extent to which these trends are causal is uncertain. More research is needed to determine the true extent of this interaction and the possible ramifications for beekeeping operations in these areas.

In summary, the higher losses directly attributed to varroa in NSW, the higher overall loss rates in varroa-affected areas, as well as the significant financial and labour costs of management, illustrate the seismic shift that is underway in the industry. It should be noted that the losses are still relatively small and could indicate the success of T2M education campaigns.

### The true cost of varroa

The first two years of the survey reveal some interesting potential trends about the economic impacts of varroa. In 2024 and 2025, costs of treating for varroa were higher for amateur beekeepers than commercial beekeepers, in terms of dollar value per treatment/regulation cost and time spent per hive, with more beekeepers affected. For amateur beekeepers, these costs increased in the second year of the survey. However, for commercial beekeepers the dollar value of treatments per hive was lower in 2025, while the time spent per hive was higher. This indicates that commercial beekeepers are spending more time treating per hive to save money on treatments.

While this decrease in treatment costs may, at first glance, appear to be an encouraging sign, it does not capture the full spectrum of economic disruption and does not, on its own, suggest that varroa is becoming cheaper to manage. Rather, commercial beekeepers appear to be investing their time to cut financial treatment costs, and this extra time will affect beekeeper businesses in other ways. Commercial beekeepers spent an extra 5.1 minutes per hive treating for varroa in 2025 than in 2024, which equates to 85 hours, or more than two full working weeks, for a 1,000 hive operation. This represents a significant opportunity cost, diverting time and resources from other value-adding activities, such as honey harvesting, queen rearing, or preparing colonies for pollination contracts.

Furthermore, this quantified economic impact excludes the indirect costs of replacing queens in failed or weakened colonies, the greater need for supplemental feeding to support colonies under parasitic stress, and the lower productivity in terms of smaller honey yields and potentially less effective pollination services from smaller, weaker hives. The true economic burden of varroa is a systemic one that will affect every facet of a beekeeping operation's profitability.

## Implications for national biosecurity and industry sustainability

### Optimising treatment strategies and industry resilience

The survey's findings on treatment efficacy highlight the critical role of synthetic miticides, such as Bayvarol and Apitraz, which provided robust protection during a period of overwhelming reinfestation pressure. Additionally, the prevalence of these treatments reflects the support of government agencies, which supplied these chemical tools during initial detection rounds in QLD, VIC and SA. To ensure the longevity of these effective controls, the industry is building upon the substantial investment made by the Transition to Management (T2M) program into Integrated Pest Management (IPM) education. By continuing to adopt IPM principles, such as monitoring, threshold-based treatments, and chemical rotation, beekeepers are actively securing the long-term biosecurity of the sector (Jack and Ellis 2021; Rosenkranz, Aumeier and Ziegelmann 2010).

### National biosecurity and the value of the managed sector

The spread of varroa also signals a fundamental shift in the national pollination landscape that underscores the vital importance of the managed honey bee industry. While varroa is expected to affect the feral honey bee population (Australian Government 2023; Holmes et al. 2024), this transition places commercial beekeepers at the forefront of Australian agriculture. As the 'free' pollination services historically provided by feral colonies recede (Stahlmann-Brown et al. 2022), the managed sector is positioned to become the primary guarantor of pollination security. This shift highlights the increasing economic value of professional beekeeping and the industry's essential role in sustaining agricultural productivity.

Based on our results, it is too early to tell if this fall has begun in NSW. While 34% of NSW respondents indicated that they observed a decrease in the feral population, a similar percentage (23%) indicated they had not observed a change, and the majority of respondents (54%) were unsure. It will take time for a decline in the feral population to become noticeable, so it will be interesting to see if more beekeepers report declines in future surveys.

## Knowledge gaps and future research priorities

### Other factors of mortality

While the survey presents a number of patterns, the underlying reasons require further study. For example, suspected starvation is a major driver of honey bee losses in many regions (ranging from 0.3% in Queensland to 4.6% in South Australia) (Table 4). This level of loss due to starvation is comparable to, for example, New Zealand (Stahlmann-Brown et al. 2022.; Stahlmann-Brown and Robertson 2024). Understanding regional and climactic variability in food availability and how they interact with varroa will be a key priority in coming years.

## Monitoring mite load

Our 2025 survey data reveal that alcohol/detergent washes were the most commonly used monitoring method—adopted by 73.1% of all respondents and 83.3% of commercial operators (Table 9). Understanding the relative effectiveness of different monitoring methods is essential for evidence-based recommendations.

Peer-reviewed evidence highlights the following:

- Alcohol wash generally provides more consistent and higher mite recovery rates (>90%) than sugar shake, which is more variable and humidity dependent (Jack and Ellis 2021).
- Sugar shake, while non-lethal, tends to underestimate mite levels, especially under humid conditions, potentially delaying treatment (Jack and Ellis 2021).
- Sticky boards, though convenient, can substantially under- or overestimate infestation, with high day-to-day variability and poor correlation to actual infestation when brood is present (Rosenkranz et al. 2010).
- Alcohol wash remains the gold standard for accuracy, despite its drawback of killing sampled bees (Jack and Ellis 2021).

The dominance of alcohol wash in our survey aligns with its well-documented high accuracy and reproducibility. However, education is needed on the limitations of sugar shakes and sticky boards. While preferred by some beekeepers because they are less lethal to bees, they may be less accurate.

## Monitoring methods: comparative effectiveness

Because only two surveys have been carried out, it is too early to determine whether the reported effects represent overall trends. More data are needed, particularly as varroa continues to spread. However, the fact that overall losses are higher in areas with varroa indicates that there may be interactions between varroa and other factors that contribute to colony losses. Thus, these inaugural surveys are more valuable for the questions they raise than for answers they may provide, as they provide early indications of where research should be focused. For example, the data suggesting a synergistic interaction between varroa and SHB is a novel and alarming finding. If varroa-weakened colonies are indeed more susceptible to collapse from SHB, the combined impact in warm, humid regions could be far greater than the sum of their individual effects. These two areas may represent priorities for targeted research to equip the industry with the knowledge it needs to manage these complex interacting threats.

# Recommendations for a resilient national beekeeping industry

Based on the findings of the 2024 and 2025 Australian National Colony Loss Surveys, the following recommendations are proposed to enhance the resilience, profitability, and sustainability of the industry as it adapts to managing *Varroa destructor*.

## For beekeepers (commercial and amateur)

### 1. Implement rigorous monitoring.

Adopt regular varroa monitoring (e.g., alcohol wash, soapy water wash, wax strip uncapping) as a standard and non-negotiable component of hive management. Treatment decisions should be based on established economic thresholds, not on a fixed calendar schedule, to ensure that treatments are applied only when necessary (Jack and Ellis 2021).

### 2. Adopt integrated pest management (IPM).

Build upon the comprehensive IPM education delivered during the Transition to Management (T2M) phase to support beekeepers in navigating long-term resistance management. While the recent reliance on robust synthetic treatments was a necessary response to overwhelming reinfestation pressures, the industry's focus must now proactively target the strategic rotation of chemical modes of action. Using established extension networks to guide this transition, i.e. ensuring beekeepers have the confidence to alternate between synthetics and organics as conditions allow, will be critical to slowing the selection of resistant mites and preserving effective tools. Because evolution of pesticide-resistant alleles is potentially irreversible, much greater adherence to rotations is needed than self-reported by respondents. Continued education will be necessary.

### 3. Enhance record-keeping.

Improve apiary records to more accurately diagnose causes of colony loss. Specifically, beekeepers should track queen age, performance (e.g., brood pattern), and supersedure events to better understand the contribution of queen health to overall colony mortality.

## For industry bodies (AHBIC, state associations)

### 1. Develop and disseminate best management practices (BMPs).

Lead the development of state-specific varroa management BMPs that account for regional differences in climate, floral resources, and the prevalence of other stressors, such as SHB.

### 2. Launch targeted extension and education campaigns.

Use the findings of this report to create and deliver educational materials focused on key management priorities. For example, the ANU media team helped to produce infographics designed to convey the key survey results in a form that can

be easily interpreted by target audiences (Appendix III). These infographics can be readily modified and updated as new survey data becomes available. Campaigns should emphasise the critical importance of treatment rotation, the high risk of adverse effects associated with some organic treatments (particularly Formic Pro), and the necessity of monitoring before and after treatment to verify efficacy. Education and dissemination of community knowledge acquired by T2M and through this survey is the most urgent and effective action associations can take, particularly targeting varroa-free areas. The developing landscape will require continuous adaptation and re-education, which strategies must account for.

### **3. Advocate for the survey to be continued and refined.**

Formally recommend to the survey administrators and funding bodies that future iterations of the National Colony Loss Survey include 'queen problems' as a specific, selectable category for the cause of colony loss to close this critical knowledge gap.

Improvements to survey should be based on feedback. Critically, the colony loss survey increases in value over time, monitoring changes as they occur. This is particularly true in Australia, most of which has not yet been affected by varroa. Addressing mechanisms for continued survey delivery will be essential to capture these dynamics and to generate value from the current work.

## **For researchers and funding bodies (AgriFutures Australia)**

### **1. Prioritise research on queen health.**

Direct funding toward research that unpacks the broad category of queen health issues. Reported queen failures may often stem from complex external factors rather than biological viability alone. Future studies should examine the extent to which logistical constraints, such as border closures disrupting access to replacement stock, and variations in beekeeper practical skills, contribute to perceived queen failure. Additionally, queen failure may be a symptom of other problems, such as disease. By broadening the scope beyond genetics and performance, the industry can identify whether losses are driven by stock quality or by the operational context in which queens are managed.

### **2. Fund research into pest synergies.**

Support targeted research to validate and quantify the suspected synergistic interaction between *Varroa destructor* and SHB. This research is critical for developing integrated management strategies in regions where both pests are prevalent.

### **3. Establish longitudinal monitoring of acaricide resistance.**

Fund and support the establishment of a long-term monitoring program to track the efficacy of registered miticides over time. This program will serve as an early warning system for the emergence of resistance in Australian varroa populations, enabling the industry to adapt its management recommendations proactively.

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## Appendix I: 2024 Australian Colony Loss Survey Questionnaire

The full text of the survey questionnaire is provided below for methodological transparency.

### BLOCK 1: Consent

Welcome to the 2024 Australian Colony Loss Survey! Thank you for participating in the 2024 Australian Colony Loss Survey. The Australian Colony Loss Survey will provide vital information regarding the impacts of varroa, what treatments are working and what it is costing the average beekeeper to manage. Your participation is crucial to our understanding of the most important issues affecting Australian beekeepers and will inform policies to ensure the future of the Australian beekeeping industry. This survey is for every beekeeping operation, large or small. Whether you lost 0% or 100% of your hives, please complete the survey. The project is funded by the Commonwealth Department of Agriculture, Fisheries and Forestry National Varroa Transition to Management Program and is managed by AgriFutures Australia. It is being undertaken by a consortium of researchers and Australian honey bee industry representatives. Your participation makes it possible to identify trends in Australian beekeeping and to understand better the impact varroa is having. Bringing together the experience of beekeepers, this survey will also show what countermeasures are working across Australia.

Before you begin, here are a few important notes related to your privacy: \* Your participation is voluntary and you can stop the survey at any time. \* Following Australian law, neither the researchers nor AgriFutures will share your data with anyone else. \* The data you enter are anonymous. \* If you choose to provide contact details, which is optional, we will use your them for future surveys, which will allow us to track changes over time across Australia. You will be able to opt-out and have your contact details deleted at any time. Your contact details will not be associated with your responses for the purposes of data analysis or reporting.

A few notes about how the survey works: \* This 2024 Australian Colony Loss Survey takes about 7 minutes for small operators and ~15 minutes for commercial beekeepers. \* The questions are easy to answer but may require you to look up some of your records. \* We recommend using a computer, but the survey also works on mobile devices (for best results, we suggest turning your phone sideways). \* We thank you for your patience and appreciate your contribution to making this project possible.

The ethical aspects of this research have been approved by the ANU Human Research Ethics Committee (Protocol 2024/1189). Click YES to begin the survey, then NEXT (scroll down if needed) to continue. \* YES, take me to the survey \* NO, I don't want to do the survey this year.

## BLOCK 2: Number of colonies

Did you have any bee colonies under your management at any one time between 1 September 2023 and 31 August 2024? A 'colony' is a queenright unit of bees, including queenright nucs, splits and captured swarms and feral colonies. Do not include mating nucs. \* yes \* no

## BLOCK 3: 0 colonies

Thanks for participating in this survey! It is designed to record the experiences of beekeepers who actively managed colonies between 1 September 2023 and 31 August 2024. Since you didn't manage any colonies during this time, your survey will be quite short.

Why did you have no colonies between 1 September 2023 and 31 August 2024 (inclusive)? Please select the best answer from the list below. \* I am a new beekeeper. \* I am an experienced beekeeper. I didn't have colonies over the last year, but I plan to return to beekeeping in the future. \* I am an experienced beekeeper. I didn't have colonies over the last year, and I am not currently planning to return to beekeeping in the future. \* I am an experienced beekeeper. All of my hives were euthanised during the varroa incursion response, and I have not yet been able to replace them. \* Other (please describe)

## BLOCK 4: Location

The 2024 Australian Colony Loss Survey begins with questions about the 2023-24 production season (i.e., between 1 September 2023 and 31 March 2024), especially colony losses and varroa. Most questions cover the entire period, but some focus on seasons. They are defined as: warm season/summer (1 September 2023 – 31 March 2024) and cool season/winter (1 April – 31 August 2024).

In which region(s) were your apiary sites located during the 2023-24 production season? Select all that apply. \* ACT \* New South Wales \* Northern Territory \* Queensland \* South Australia \* Tasmania \* Victoria \* Western Australia

What methods did you use to monitor your colonies for varroa? Select all that apply. \* Alcohol wash \* Soapy water wash \* Sticky board (or other collection tray below the hive) \* Sugar shake / roll \* Visual inspection of adult bees \* Visual inspection of drone brood / uncapping brood \* Sent sample to a lab \* Other (please describe) \* None of the above

Were you affected by the varroa epidemic? Check all that apply. \* Queen shortages \* Loss of income due to colony movement restrictions \* Research, training and compliance costs (not counting surveillance costs) \* Other

## BLOCK 5: Varroa

Were you in the New South Wales red zone before varroa eradication was stopped in September 2023? \* Yes \* No

Did you see any issues with deformed wings or other developmental abnormalities in any of your colonies in New South Wales? \* None \* Limited \* Extensive \* Unsure

Did you see any issues with spotty brood patterns in any of your colonies in New South Wales? \* None \* Limited \* Extensive \* Unsure

What methods did you use to treat varroa. Tick all that apply \* Did not treat \* Api-Bioxal® \* Apiguard® \* Apistan® \* Apivar® \* Apitraz® \* Bayvarol® \* Formic Pro® \* Queen caging (forced brood break) \* Formic acid - vapourisation \* Thymol - vapourisation \* Oxalic acid - strips \* Oxalic acid - dribbling \* Plant essential oils e.g. oregano oil, eucalyptus oil, etc. \* Drone uncapping \* Other treatment

## BLOCK 6: Warm season colony losses

The questions below will focus on warm season losses (1 September 2023 – 31 March 2024). Enter whole numbers only.

How many colonies did you have in [state where respondent kept bees] during the warm season?

How many of the colonies that were dead upon inspection at the end of the warm season for each of the following reasons? \* Foulbrood (EFB or AFB) \* Robbing by other bees \* Suspected starvation \* Suspected varroa and related issues \* Suspected nosema and other diseases \* Small hive beetle \* Other reasons not listed above \* Reasons that you are unsure

## BLOCK 7: Cool season colony losses

The questions below will focus on cool season losses (1 April 2024 – 31 August 2024). Enter whole numbers only.

How many colonies did you have in [state where respondent kept bees] during the cool season?

How many of the colonies that were dead upon inspection at the end of the cool season for each of the following reasons? \* Foulbrood (EFB or AFB) \* Robbing by other bees \* Suspected starvation \* Suspected varroa and related issues \* Suspected nosema and other diseases \* Small hive beetle \* Other reasons not listed above \* Reasons that you are unsure

## BLOCK 8: Demographics

This part of the survey focuses on who you are as a beekeeper.

Approximately how many years of beekeeping experience do you have?

Which of the following best describes your role in this beekeeping operation? \* Owner \* Paid employee \* Unpaid helper \* Other (please describe)

## BLOCK 9: Qualitative

Would you like to provide your contact details so that we can send you the results of this survey and get in touch with you about future surveys? Your contact information will **NOT** be linked to your responses, which will be kept anonymous. *Leave blank if you prefer not to answer.*

- Name \_\_\_\_\_
- Email address \_\_\_\_\_
- Phone number \_\_\_\_\_

*Thank you for completing the 2024 Australian Colony Loss Survey. If you have any comments about the survey, please enter them in box below. **Press NEXT to submit your survey.***

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END OF BLOCK 9

**END OF SURVEY**

## Appendix II: 2025 Australian Colony Loss Survey Questionnaire

### BLOCK 1: Consent

#### **Welcome to the 2025 Australian Colony Loss Survey!**

Thank you for participating in the 2025 Australian Colony Loss Survey. Your participation is crucial to our understanding of the most important issues affecting Australian beekeepers and will inform policies to ensure the future of the Australian beekeeping industry. The Australian Colony Loss Survey will also provide vital information regarding the impacts of varroa, what treatments are working and what it is costing the average beekeeper to manage.

This survey is for **every beekeeping operation**, large or small. Whether you lost 0% or 100% of your hives, please complete the survey. The project is funded by the Commonwealth Department of Agriculture, Fisheries and Forestry National Varroa Transition to Management Program and is managed by AgriFutures Australia. It is being undertaken by a consortium of researchers and Australian honey bee industry representatives. Your participation makes it possible to identify trends in Australian beekeeping and to understand better the impact varroa is having. Bringing together the experience of beekeepers, this survey will also show what countermeasures are working across Australia.

Before you begin, here are a few important notes related to your privacy:

- Your participation is **voluntary** and you can stop the survey at any time.
- Following Australian law, neither the researchers nor AgriFutures will share your data with anyone else.
- The data you enter are **anonymous**.
- If you choose to provide contact details, which is optional, we will use your them for future surveys, which will allow us to track changes over time across Australia. **You will be able to opt-out** and have your contact details deleted at any time. Your contact details will not be associated with your responses for the purposes of data analysis or reporting.

A few notes about how the survey works:

- This 2025 Australian Colony Loss Survey takes about 7 minutes for small operators and ~15 minutes for commercial beekeepers. The questions are easy to answer but may require you to look up some of your records.
- We recommend using a computer, but the survey also works on mobile devices (for best results, we suggest turning your phone sideways).

We thank you for your patience and appreciate your contribution to making this project possible. The ethical aspects of this research have been approved by the ANU Human Research Ethics Committee (**Protocol 2024/1189**).

Click **YES** to begin the survey, then **NEXT** (scroll down if needed) to continue

- YES, take me to the survey**
- NO, I don't want to do the survey this year

*Skip to: End of Survey if answer = 'NO, I don't want to do the survey this year.'*

END OF BLOCK 1

## BLOCK 2: Number of colonies

Did you have any bee colonies under your management at any one time between 1 September 2024 and 31 August 2025?

*A 'colony' is a queenright unit of bees, including queenright nucs, splits and captured swarms and feral colonies. Do not include mating nucs.*

- yes
- no

*Answer 'yes' = Skip to Block 4*

*Answer 'no' = Proceed to Block 3*

END OF BLOCK 2

## BLOCK 3: 0 colonies

*Thanks for participating in this survey! It is designed to record the experiences of beekeepers who actively managed colonies between 1 September 2024 and 31 August 2025. Since you didn't manage any colonies during this time, your survey will be quite short.*

Why did you have no colonies between 1 September 2024 and 31 August 2025 (inclusive)?

*Please select the best answer from the list below.*

- I am a new beekeeper.
- I am an experienced beekeeper. I didn't have colonies over the last year, but I plan to return to beekeeping in the future.
- I am an experienced beekeeper. I didn't have colonies over the last year, and I am not currently planning to return to beekeeping in the future.
  - Other (please describe)

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**[CONDITIONAL: Displays if answer = 'I am a new beekeeper']**

Approximately how many years of **beekeeping experience** do you have? Please round to the nearest number.

*(Respondents indicate number through sliding scale, or may select 'Prefer not to answer'.)*

Proceed to BLOCK 8

END OF BLOCK 3

## BLOCK 4: Location

*The 2025 Australian Colony Loss Survey begins with questions about the 2024-25 production season (i.e., between 1 September 2024 and 31 March 2025), especially **colony losses** and **varroa**. Most questions cover the entire period, but some focus on seasons. They are defined as: *warm season/summer (1 September 2024 – 31 March 2025)* and *cool season/winter (1 April – 31 August 2025)*.*

In which **region(s)** were your apiary sites located during the 2024-25 production season? Select all that apply. *Later, we will ask you separately about colony losses in each state to account for geographic differences.*

- ACT**
- New South Wales**
- Northern Territory**
- Queensland**
- South Australia**
- Tasmania**
- Victoria**
- Western Australia**

Was varroa detected in your area?

- Yes
- No

If yes, how long has varroa been present?

Did you notice a change in honey yields where you operate?

- Yes, honey yields increased compared with the previous season
- Yes, honey yields decreased compared with the previous season
- No, honey yields were similar the previous season
- Prefer not to answer

In your opinion, has the number of feral colonies changed where you operate?

- Yes, there are fewer feral colonies than there were before the 2024-25 season
- Yes, there are more feral colonies than there were before the 2024-25 season
- No, the number of feral colonies is similar to before the 2024-25 season
- Unsure

**[UNCONDITIONAL: all respondents receive below questions]**

What **methods** did you use for monitoring AND/OR surveillance of varroa? *Select all that apply.*

- Alcohol wash
- Soapy water wash
- Sticky board (or other collection tray below the hive)
- Sticky board in conjunction with miticide strip
- Sugar shake/roll
- Visual inspection of adult bees
- Visual inspection of drone brood/uncapping brood
- Sent sample to a lab
- Other (please describe) \_\_\_\_\_
- None of the above

Were you affected by regulations associated with varroa? *Check all that apply.*

***If you were in an area where varroa was detected, you will be asked about treatment costs subsequently, so don't list them here.***

- Queen shortages
- Loss of income due to colony/queen/bee movement restrictions
- Costs associated with training (yourself or your staff) to meet varroa regulations
- Costs associated with compliance with varroa regulations e.g. Health certificates, honey testing, etc. (not counting surveillance costs)
  - Other

If you selected 'Other' please specify how varroa regulations affected you:

---

Please estimate the financial cost of varroa regulations on your operation for the 2024-25 production season (to the nearest dollar value):

---

END OF BLOCK 4

## BLOCK 5: Varroa

***[CONDITIONAL: respondents see this Block if varroa is present in their area]***

Did you see **any issues with deformed wings or other developmental abnormalities** in any of your colonies?

- None
- Limited
- Extensive
- Unsure

Did you see **any issues with spotty brood patterns** in any of your colonies?

- None
- Limited
- Extensive
- Unsure

At what mite count threshold do you treat for varroa?

***[Respondents select value between 0 and 100 from sliding scale]***

What **methods** did you use to treat varroa. *Tick all that apply*

- Did not treat
- Api-Bioxal®
- Apiguard®
- Apistan®
- Apivar®
- Apitraz®
- Bayvarol®
- Formic Pro®
- Queen caging (forced brood break)
- Formic acid - generic
- Thymol - generic
- Oxalic acid – generic Plant essential oils e.g. oregano oil, eucalyptus oil, etc.
- Drone uncapping
- Other treatment

If you selected 'Other treatment' please specify what treatment(s) you used:

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In what season did you use each treatment during the 2024-25 production season??

Please tick all that apply

	Spring	Summer	Autumn	Winter
Did not treat ()				
Api-Bioxal® ()				
Apiguard® ()				
Apistan® ()				
Apivar® ()				
Apitraz® ()				
Bayvarol® ()				
Formic Pro® ()				
Queen caging (forced brood break) ()				
Formic acid - vapourisation ()				
Thymol - vapourisation ()				
Oxalic acid - strips ()				
Oxalic acid - dribbling ()				
Plant essential oils e.g. oregano oil, eucalyptus oil, etc. ()				
Drone uncapping ()				
Other treatment ()				

If you selected 'Other treatment' please specify in which season the treatment was used.

Please tick all that apply:

	Spring	Summer	Autumn	Winter
<i>Insert treatment name</i>				
<i>Insert treatment name</i>				
<i>Insert treatment name</i>				
<i>Insert treatment name</i>				

How successful was the treatment?

**[Respondents use sliding scale to choose one answer for each treatment they selected]**

	Not at all	Partly	Mostly	Completely
Did not treat ()				
Api-Bioxal® ()				
Apiguard® ()				
Apistan® ()				
Apivar® ()				
Apitraz® ()				
Bayvarol® ()				
Formic Pro® ()				
Queen caging (forced brood break) ()				
Formic acid - vapourisation ()				
Thymol - vapourisation ()				
Oxalic acid - strips ()				
Oxalic acid - dribbling ()				
Plant essential oils e.g. oregano oil, eucalyptus oil, etc. ()				
Drone uncapping ()				
Other treatment ()				

If you selected 'Other treatment' please rate each treatment you used according to the above:

	Not at all	Partly	Mostly	Completely
<i>Insert treatment name</i>				
<i>Insert treatment name</i>				
<i>Insert treatment name</i>				
<i>Insert treatment name</i>				

Were there any adverse effects?



Drone uncapping	<input type="checkbox"/>					
Other treatment	<input type="checkbox"/>					

If you selected 'Other treatment' please specify what treatment was used and whether you noted any of the above adverse effects:

---

How many colonies did you treat for varroa?  
 \_\_\_\_\_

On average, how much did it cost per colony to treat for varroa (excluding labour costs)?

\$ value per colony: ***[Respondents select value between 0 and 100 from sliding scale]***

On average, how many minutes of labour per colony did you spend on varroa treatment?  
 Minutes per colony: \_\_\_\_\_

END OF BLOCK 5

**BLOCK 6: Warm season colony losses**

The questions below will focus on warm season losses (1 September 2024 – 31 March 2025). Enter whole numbers only. If you do not have an exact figure, please estimate. Please include any colonies that were intentionally lost. For example, if a colony was lost to starvation because it was too expensive to provide supplemental sugar, please include this loss under 'suspected starvation'.

How many colonies did you have in ***[state where respondent kept bees]*** during the warm season? *If your colonies spent time in other states, please include colonies that spent most of the time in ***[state where respondent kept bees]****

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How many of the **colonies that were dead upon inspection at the end of the warm season** for each of the following reasons?

American Foulbrood: \_\_\_\_\_

European Foulbrood : \_\_\_\_\_

Robbing by other bees : \_\_\_\_\_

Suspected starvation : \_\_\_\_\_

Suspected varroa and related issues : \_\_\_\_\_

Suspected nosema and other diseases : \_\_\_\_\_

Small hive beetle : \_\_\_\_\_

Queen failure: \_\_\_\_\_

Other reasons not listed above : \_\_\_\_\_

Reasons that you are unsure : \_\_\_\_\_

Total : \_\_\_\_\_

If you selected 'Other reasons not listed above' please indicate what these reasons were and how many colonies were lost to each:

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END OF BLOCK 6

## BLOCK 7: Cool season colony losses

The questions below will focus on cool season losses (1 April 2025 – 31 August 2025). Enter whole numbers only. If you do not have an exact figure, please estimate. Please include any colonies that were intentionally lost. For example, if a colony was lost to starvation because it was too expensive to provide supplemental sugar, please include this loss under 'suspected starvation'.

How many colonies did you have in **[state where respondent kept bees]** during the cool season? *If your colonies spent time in other states, please include colonies that spent most of the time in [state where respondent kept bees]*

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How many of the **colonies that were dead upon inspection at the end of the cool season** for each of the following reasons?

American foulbrood : \_\_\_\_\_  
European foulbrood: \_\_\_\_\_  
Robbing by other bees : \_\_\_\_\_  
Suspected starvation : \_\_\_\_\_  
Suspected varroa and related issues : \_\_\_\_\_  
Suspected nosema and other diseases : \_\_\_\_\_  
Small hive beetle : \_\_\_\_\_  
Queen failure: \_\_\_\_\_  
Other reasons not listed above : \_\_\_\_\_  
Reasons that you are unsure : \_\_\_\_\_  
Total : \_\_\_\_\_

If you selected 'Other reasons not listed above' please indicate what these reasons were and how many colonies were lost to each:

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END OF BLOCK 7

## BLOCK 8: Demographics

*This part of the survey focuses on who you are as a beekeeper. If you don't want to answer these questions, please select 'prefer not to answer'.*

Approximately how many years of **beekeeping experience** do you have? Please round to the nearest number.

***[Respondents select answer from dropdown menu – '1 year' to 'more than 60 years']***

Which of the following best describes your **role** in this beekeeping operation?

- Owner
- Paid employee
- Unpaid helper
- Other (please describe)

END OF BLOCK 8

## BLOCK 9: Qualitative

Would you like to provide your contact details so that we can send you the results of this survey and get in touch with you about future surveys? Your contact information will **NOT** be linked to your responses, which will be kept anonymous. *Leave blank if you prefer not to answer.*

- Name \_\_\_\_\_
- Email address \_\_\_\_\_
- Phone number \_\_\_\_\_

*Thank you for completing the 2025 Australian Colony Loss Survey. If you have any comments about the survey, please enter them in box below. **Press NEXT to submit your survey.***

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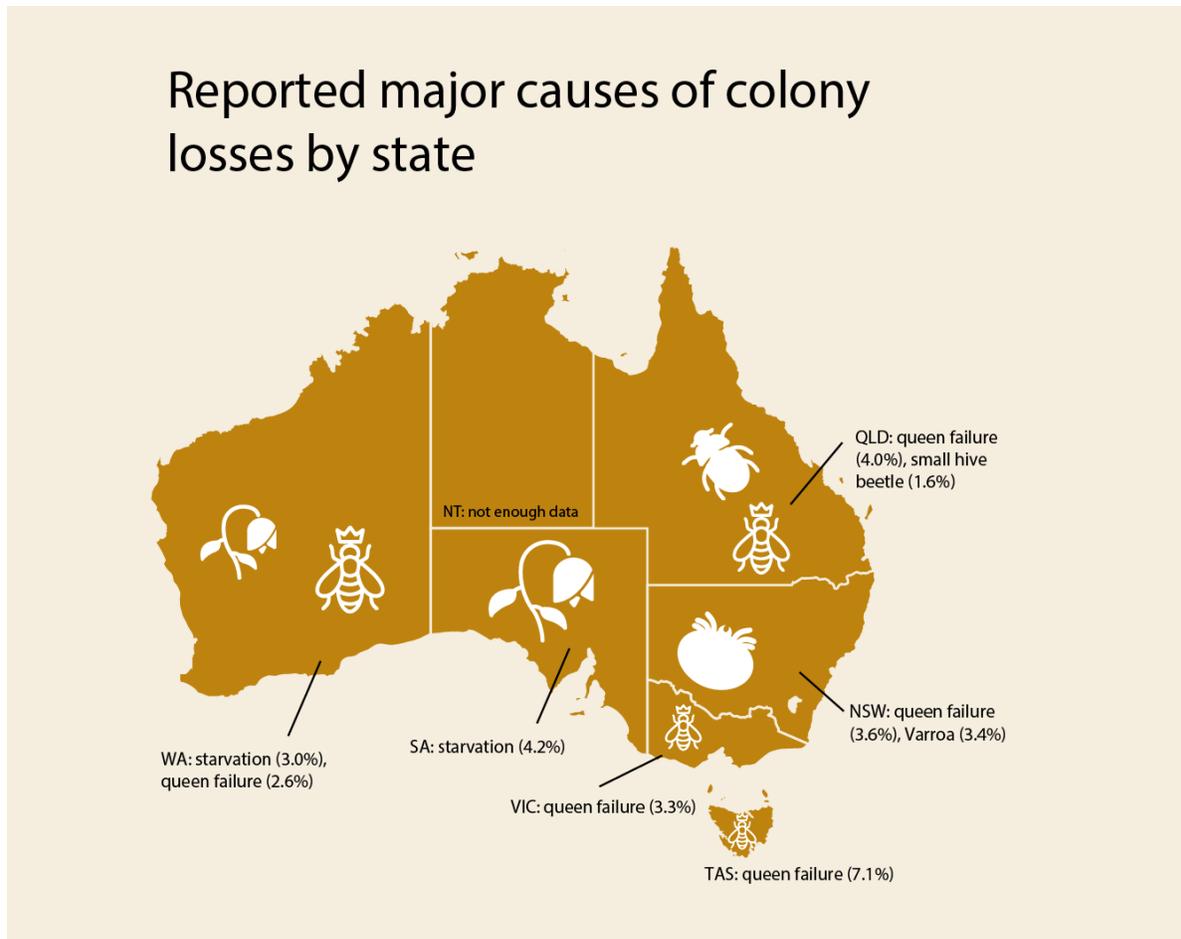
END OF BLOCK 9

**END OF SURVEY**

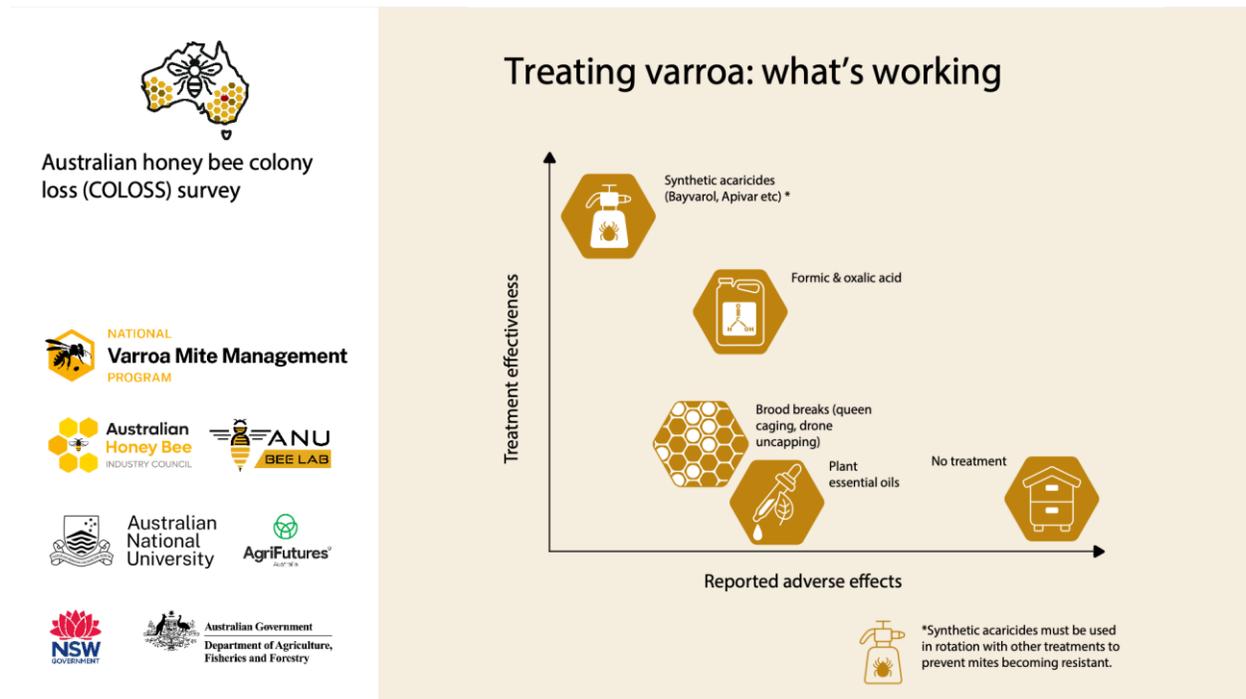
## Appendix III: Infographics based on survey data

Infographics created by ANU media team to help communicate key findings to target audiences.

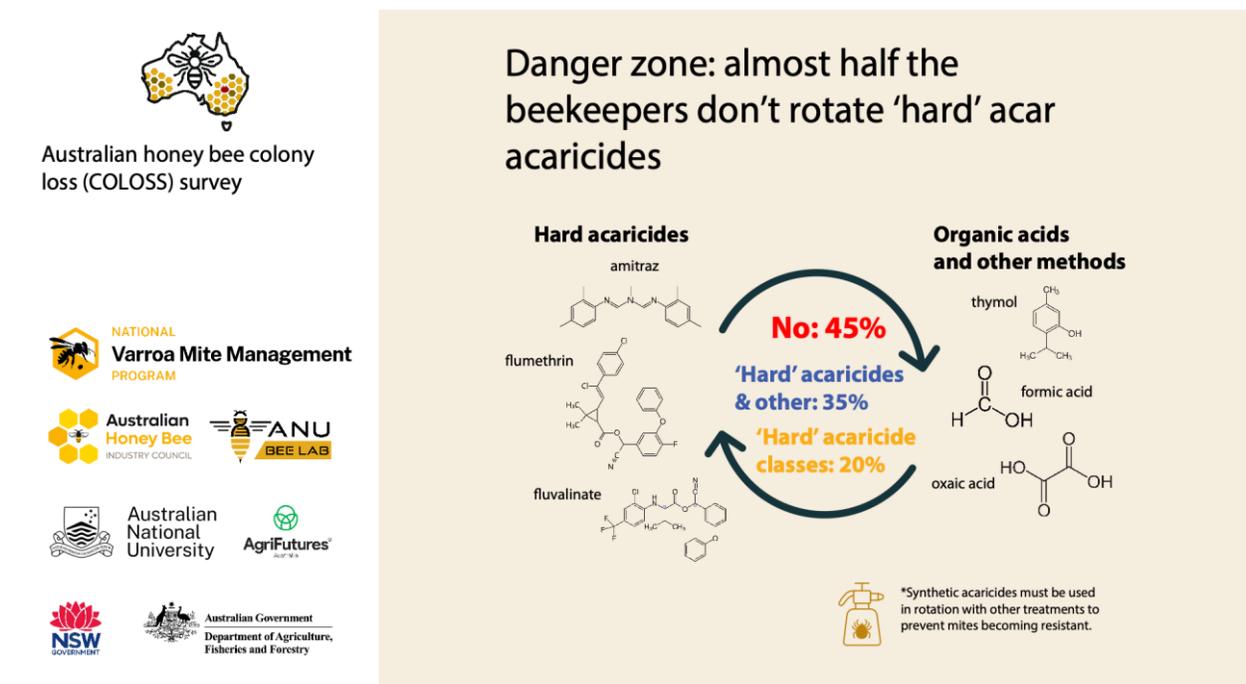
Infographic 1: Reported primary causes of colony losses by state.



Infographic 2: Treating varroa: Efficacy and adverse effects.



Infographic 3: Rotation.



## Appendix IV: Supplementary results tables (2024–25)

**Table S1. Perceived honey yield changes, by varroa status, 2025.**

Year	Varroa status	Higher honey yields	Lower honey yields	No change	Respondents
2024	With varroa	11.3%	39.9%	48.8%	248
	Without varroa	17.0%	40.6%	42.5%	106
2025	With varroa	11.2%	41.3%	47.6%	286
	Without varroa	11.4%	45.8%	42.9%	378

Note: Percentages are within varroa groups by year and exclude respondents who skipped the question or selected 'Prefer not to answer'.

**Table S2. Perceived feral colony changes, by varroa status, 2024–25.**

Year	Varroa status	Fewer feral colonies	More feral colonies	No change	Unsure	Respondents
2024	With varroa	24.9%	3.4%	15.3%	56.3%	261
	Without varroa	8.1%	1.8%	39.6%	50.5%	111
2025	With varroa	34.0%	1.7%	20.8%	43.6%	303
	Without varroa	10.2%	3.1%	43.0%	43.8%	393

Note: Percentages are within varroa groups by year and exclude respondents who skipped the question or selected 'Prefer not to answer'.

**Table S3. Colony-weighted percent losses (95% CI), by year, state, and season.**

Year	State	Season	Loss % (colony-weighted, 95% CI)	N respondents	Total colonies
2024	ACT	Warm	48.2% (38.6–57.9)	9	110
		Cool	47.6% (37.6–57.6)	9	103
2025		Warm	2.4% (0.1–12.6)	6	42
		Cool	11.9% (4.0–25.6)	6	42
2024	NSW	Warm	10.5% (10.2–10.8)	373	49,318
		Cool	7.6% (7.4–7.9)	373	45,070
2025		Warm	14.0% (13.7–14.2)	271	80,300
		Cool	9.2% (9.0–9.4)	255	77,346

Year	State	Season	Loss % (colony-weighted, 95% CI)	N respondents	Total colonies
2024	NT	Warm	0.0% (0.0–10.0)	1	35
		Cool	0.0% (0.0–7.4)	1	48
2025		Warm	0.0% (0.0–70.8)	1	3
		Cool	33.3% (0.8–90.6)	1	3
2024	QLD	Warm	8.9% (8.4–9.4)	93	10,880
		Cool	12.0% (11.5–12.6)	93	12,217
2025		Warm	10.2% (9.8–10.7)	160	16,525
		Cool	6.1% (5.7–6.4)	159	15,744
2024	SA	Warm	2.6% (2.3–2.9)	128	13,581
		Cool	4.8% (4.4–5.2)	128	13,546
2025		Warm	11.1% (10.6–11.7)	55	13,290
		Cool	14.9% (14.3–15.6)	49	12,080
2024	TAS	Warm	3.7% (3.4–4.0)	94	15,306
		Cool	8.2% (7.8–8.7)	94	14,272
2025		Warm	17.6% (16.7–18.4)	70	8,158
		Cool	4.1% (3.7–4.6)	61	6,919
2024	VIC	Warm	6.8% (6.5–7.1)	285	26,965
		Cool	0.5% (0.4–0.6)	285	27,314
2025		Warm	9.0% (8.5–9.6)	111	11,112
		Cool	0.2% (0.1–0.3)	97	11,451
2024	WA	Warm	4.2% (3.8–4.6)	35	10,498
		Cool	6.1% (5.7–6.6)	35	10,352
2025		Warm	8.8% (8.3–9.3)	85	11,184
		Cool	6.9% (6.4–7.3)	81	10,997

**Table S4. National colony-weighted percent losses (95% CI), by year, season, and varroa status.**

Year	Season	Loss % with varroa	Loss % without varroa
2024	Warm	12.1% (11.7–12.4)	7.1% (6.9–7.4)
2024	Cool	6.9% (6.6–7.2)	5.5% (5.3–5.8)
2024	Overall	9.5% (9.3–9.8)	6.4% (6.2–6.5)
2025	Warm	13.4% (13.2–13.7)	10.7% (10.4–11.0)
2025	Cool	7.9% (7.7–8.1)	8.7% (8.5–9.0)
2025	Overall	10.7% (10.5–10.8)	9.7% (9.5–9.9)

**Table S5. Amateur colony-weighted percent losses (95% CI), by season, year, and varroa status.**

Year	Season	Loss % with varroa	Loss % without varroa
2024	Warm	23.9% (21.6–26.3)	9.7% (7.4–12.5)
2024	Cool	18.7% (16.5–21.0)	5.7% (3.8–8.1)
2024	Overall	21.4% (19.8–23.0)	7.8% (6.3–9.6)
2025	Warm	27.6% (25.3–30.0)	10.7% (9.5–12.1)
2025	Cool	14.3% (12.3–16.4)	6.0% (5.0–7.1)
2025	Overall	21.5% (19.9–23.1)	8.5% (7.7–9.4)

**Table S6. Commercial colony-weighted percent losses (95% CI), by season, year, and varroa status.**

Year	Season	Loss % with varroa	Loss % without varroa
2024	Warm	11.5% (11.1–11.9)	7.1% (6.8–7.4)
2024	Cool	6.4% (6.1–6.7)	5.5% (5.3–5.8)
2024	Overall	9.0% (8.7–9.2)	6.3% (6.2–6.5)
2025	Warm	13.2% (13.0–13.4)	10.7% (10.4–11.0)
2025	Cool	7.8% (7.7–8.0)	8.9% (8.6–9.2)
2025	Overall	10.5% (10.4–10.7)	9.8% (9.6–10.0)

**Table S7. Respondent-average percent losses (Amateur <50).**

Year	State	Season	Loss % (respondent-average, 95% CI)	N respondents
2024	ACT	Warm	0.0 (0.0–0.0)%	7
		Cool	21.7 (-13.2–56.5)%	7
2025		Warm	5.0 (-8.9–18.9)%	5
		Cool	7.5 (-6.4–21.4)%	5
2024	NSW	Warm	19.1 (15.3–22.9)%	297
		Cool	15.5 (11.7–19.2)%	297
2025		Warm	28.7 (22.9–34.5)%	184
		Cool	17.1 (11.8–22.5)%	171
2025	NT	Warm	0.0%	1
		Cool	33.3%	1
2024	QLD	Warm	6.0 (1.6–10.3)%	62
		Cool	2.5 (-1.0–6.1)%	62
2025		Warm	10.0 (5.9–14.2)%	123
		Cool	9.3 (4.4–14.3)%	123
2024	SA	Warm	10.5 (5.7–15.3)%	105
		Cool	10.5 (5.2–15.9)%	105
2025		Warm	14.7 (4.8–24.6)%	29
		Cool	17.3 (4.7–29.9)%	23
2024	TAS	Warm	5.4 (1.9–8.9)%	81
		Cool	6.6 (2.3–10.8)%	81
2025		Warm	4.5 (1.2–7.7)%	60
		Cool	8.3 (2.0–14.6)%	51
2024	VIC	Warm	6.5 (4.1–8.9)%	242
		Cool	1.4 (0.1–2.8)%	242
2025		Warm	11.3 (5.7–16.9)%	87
		Cool	2.1 (-0.9–5.0)%	75
2024	WA	Warm	13.3 (-5.1–31.7)%	12
		Cool	18.5 (-2.8–39.8)%	12
2025		Warm	14.2 (6.3–22.1)%	47

Year	State	Season	Loss % (respondent-average, 95% CI)	N respondents
		Cool	7.2 (0.8–13.7)%	46

**Table S8. Respondent-average percent losses (Commercial ≥50).**

Year	State	Season	Loss % (respondent-average, 95% CI)	N respondents
2024	ACT	Warm	65.0 (-379.7–509.7)%	2
		Cool	65.0 (-379.7–509.7)%	2
2025		Warm	0.0%	1
		Cool	10.5%	1
2024	NSW	Warm	18.4 (12.3–24.5)%	76
		Cool	14.2 (7.9–20.4)%	76
2025		Warm	19.2 (14.2–24.3)%	87
		Cool	14.6 (9.6–19.7)%	84
2024	NT	Warm	0.0%	1
		Cool	0.0%	1
2025	QLD	Warm	6.9 (4.3–9.4)%	31
		Cool	4.3 (1.2–7.5)%	31
		Warm	10.1 (7.0–13.1)%	37
		Cool	5.1 (2.7–7.4)%	36
2024	SA	Warm	3.3 (1.3–5.3)%	23
		Cool	3.9 (2.1–5.7)%	23
2025		Warm	15.6 (6.4–24.8)%	26
		Cool	12.4 (7.8–17.1)%	26
2024	TAS	Warm	3.2 (1.7–4.8)%	13
		Cool	4.7 (1.5–7.8)%	13
2025		Warm	7.8 (3.3–12.2)%	10
		Cool	6.3 (2.8–9.8)%	10
2024	VIC	Warm	8.6 (2.9–14.2)%	43
		Cool	1.2 (-0.1–2.5)%	43
2025		Warm	8.0 (4.6–11.4)%	24
		Cool	0.2 (-0.1–0.6)%	22
2024	WA	Warm	6.1 (2.9–9.3)%	23

Year	State	Season	Loss % (respondent-average, 95% CI)	N respondents
2025		Cool	10.8 (1.8–19.7)%	23
		Warm	10.8 (7.2–14.3)%	38
		Cool	7.9 (5.0–10.7)%	35

**Table S9. Reported developmental abnormalities and spotty brood, With varroa, 2024–2025.**

Observation	Year	No issues	Extensive issues	Some issues	Unsure	Respondents
Abnormalities	2024	84.0%	1.9%	13.4%	—	262
	2025	85.1%	1.6%	9.7%	2.6%	308
Spotty brood	2024	61.5%	5.0%	32.1%	—	262
	2025	52.9%	4.2%	36.4%	5.8%	308

Note: Each row summarises With varroa respondents; percentages are within question and year, with respondent counts on the right.



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