Canadian Association of Professional Apiculturists

STATEMENT ON HONEY BEE WINTERING LOSSES IN CANADA FOR 2023

Prepared by CAPA National Survey Committee and Provincial Apiarists (in alphabetical order): Gabrielle Claing (co-chair), Sabrina Ellsworth, Julie Ferland (chair), Maria Janser, Melanie Kempers, Paul Kozak, Chris Maund, Cameron Menzies, Derek Micholson, Nuria Morfin, Samantha Muirhead, Medhat Nasr, Steve Pernal, Jason Sproule, Paul van Westendorp and Geoff Wilson

SUMMARY

The Canadian Association of Professional Apiculturists (CAPA) and Provincial Apiarists coordinated the annual honey bee wintering loss report for 2022-2023. As in previous years, the survey consisted of harmonized questions based on the national beekeeping industry, with Provincial Apiarists collecting survey data across all provinces. Respondents collectively wintered 370,722 honey bee colonies across Canada, representing 48% of all colonies operated in the country during 2022-2023. The national winter loss, including non-viable bee colonies, was 32.2% with provincial losses ranging from 11.7% to 46.2%. The national colony loss reported in 2023 is higher than the average of annual losses reported between 2007-2022 (27.0%). The higher-than-normal winter loss in 2021-2022 resulted in 52 548 or 6.4% fewer colonies operated by beekeepers during 2022-2023 than the previous year. Despite these recent losses, Statistics Canada reports that the total national colony count increased by 30% from 2007 to 2022, through the hard work and expense of beekeepers replacing dead or weak colonies.

Each province ranked the top four suspected causes of colony losses as reported by respondents. The reported causes were fairly consistent this year. In 2022-23, impacts from varroa and associated viruses, weak colonies in the fall, starvation and weather/climate were the most cited factors for winter loss across the country.

Beekeepers also responded to questions about the management of four serious parasites and pathogens to beekeeping: *Varroa destructor*, *Nosema* spp., American Foulbrood (*Paenibacillus larvae)* and European Foulbrood *(Melissococcus plutonius)*. Beekeepers in most provinces reported that they monitored for varroa mites, however a large proportion of beekeepers in some provinces neglected to do so, depending upon the time of the year. The most reported varroa treatments were: amitraz, formic or oxalic acid treatments in early season; formic or oxalic acid in mid-season; and oxalic acid, formic acid or amitraz at the end of the season. Canadian beekeepers treated their colonies to manage the risk of nosemosis, as well as American foulbrood and European foulbrood. Across the country, registered antibiotics were the most commonly used treatments, with methods and timing of applications varying among provinces.

Provincial Apiarists, technology-transfer personnel, and researchers have been working with beekeepers across Canada to encourage them to monitor for honey bee pests, especially varroa mites, brood diseases, and nosema, and to adopt recommended integrated pest management practices to keep these pests under control. CAPA members continue to collaborate through working groups encompassing diverse stakeholders to educate, develop and improve management options for beekeepers to keep healthy bees, and manage winter losses in Canada.

Disclaimer and Credits: Survey data were supplied by Provincial Apiarists (listed in Appendix A). Data were then compiled, further analyzed and an initial draft of this report written by Geoff Wilson, Gabrielle Claing, Julie Ferland, Medhat Nasr and Maria Janser, with subsequent review by the CAPA National Survey Committee.

INTRODUCTION

For over a decade, many countries, including Canada, have surveyed beekeepers and reported overwintering mortality rates of honey bee colonies and management practices used for varroa mites, nosema, American foulbrood and more recently, European foulbrood. The Canadian Association of Professional Apiculturists (CAPA) has worked with the Provincial Apiarists on surveying beekeepers for winter losses of honey bee colonies and possible causes of bee mortality in Canada since 2007. The objective of this national report is to consolidate provincial honey bee data across the country based on information collected through harmonized survey questions. The possible causes of winter loss, as reported by beekeepers, and information on pest surveillance and control are collated herein. The survey responses aid in identifying gaps in current management systems, developing strategies to mitigate colony losses, and provide guidance for improving bee health, biosecurity practices, and industry sustainability.

METHODOLOGY

In 2023, the Provincial Apiarists and the CAPA National Survey Committee members reviewed the questions used in the 2022 survey and made necessary revisions. Examples of these revisions include the addition of new treatments or strategies for beekeepers to manage pests and diseases as they are developed over the years, and adjustments to the questions regarding foulbrood and use of antibiotics. The result was an updated harmonized set of questions that was used in the 2023 survey (Appendix B). These questions took into account the large diversity of beekeeping industry profiles, management practices and seasonal activities within each province. Some provinces also included supplementary regional questions in their provincial questionnaire. The results of these regional questions are not included in this report but are discussed in the text. Further questions about results from a specific province may be accessed by contacting the Provincial Apiarist of the province in question (Appendix A).

Beekeepers that owned and operated a specified minimum number of colonies (Table 1) were included in the survey. The survey reported data from full-sized producing honey bee colonies that were wintered in Canada, but not nucleus colonies. Thus, the information gathered provides a valid assessment of honey bee losses and commercial management practices.

The common definitions of a honey bee colony and a commercially viable honey bee colony in spring were standardized as follows:

- Honey Bee Colony: A full-sized honey bee colony either in a single or double brood chamber, not including nucleus colonies (splits).
- Viable Honey Bee Colony in Spring: A honey bee colony that survived winter, with a minimum of 4 frames with 75% of the comb area covered with bees on both sides on May 1st (British Columbia), May 15th (New Brunswick, Nova Scotia, Ontario, Prince-Edward-Island and Quebec) or May 21st (Alberta, Manitoba, Saskatchewan and Newfoundland and Labrador).

The colony loss and management questionnaire was provided to producers using various methods of delivery including mail, email, online and a telephone survey; the method of delivery varied by jurisdiction (Table 1). In each province, data were collected, summarized and analyzed by the Provincial Apiarist. All reported provincial results were then analyzed and summarized at the national level. The national percent winter loss was calculated as follows:

$$Percentage\ Winter\ Loss = \left(\frac{Sum\ of\ the\ estimated\ total\ colony\ losses\ per\ province\ in\ spring\ 2023}{Sum\ of\ total\ colonies\ in\ operation\ in\ each\ province\ for\ 2022}\right) x\ 100$$

RESULTS

Response rates and global mortality

Throughout Canada, a total of 520 beekeepers responded to the 2023 survey. These respondents represented 40% of all the surveyed beekeepers. Respondents operated 48% of all registered colonies that were operated in all provinces in the 2022 season. The rate of participation and number of colonies continues to represent a substantial proportion of the commercial beekeeping industry in Canada.

The survey delivery methods, size of beekeeping operations and response rate of beekeepers for each province are presented in **Table 1**. It is important to note that the total number of colonies operated in a province reported by this survey may vary slightly from Statistics Canada's official numbers. In some provinces, the data collection periods for the provincial database and the Statistics Canada report are at different times of year.

Survey results showed that the national level of wintering loss, including non-viable colonies, was 32.2% with individual provinces ranging from 11.7% to 46.2%. The overall winter loss for 2022-2023 was 13.3% lower than the 2021-2022 loss at 45.5% which was the highest winter loss rate for this survey in the history of this survey. The level of winter loss varied from province to province, and among beekeeping operations within each province. In general, all provinces reported lower mortality in 2022-2023 than the previous year, the exception being Nova Scotia and New Brunswick who reported slightly higher mortalities compared to the previous year. Prince Edward Island and Alberta reported the highest winter losses in 2023 (46.2% and 39.0%, respectively), with weak colonies in the fall and varroa and associated viruses, respectively, cited as the most frequent causes of colony mortality in those provinces. The lowest reported winter loss in 2023 was by Newfoundland and Labrador (11.7%), where varroa mites have not been reported.

[Note: Ontario had one result (a high loss from one large commercial beekeeper) that had a major impact on the overall final winterloss for Ontario. Without this one response Ontario's winterloss statistic would be 16.7%. However, based on the established methodology the final winterloss statistic is 35.7% for Ontario.]

For detailed information about the winter losses in each province, please contact the office of the Provincial Apiarist directly (see contact information in **Appendix A**).

Table 1. Survey parameters and honey bee colony mortality (2022-2023) by province

Province	Total number of colonies operated in 2022	Estimated number of colonies lost based on the estimated provincial winter loss	Type of data collection	Number of beekeepers targeted by survey	Number of respondents (% of participation)	Minimal size of beekeeping operations targeted by survey (# of colonies)	Number of respondents' colonies that were wintered in fall 2022	Number of respondents' colonies that were alive and viable in spring 2023	Percentage of surveyed colonies as a proportion of the total number of colonies in the province	Provincial Winter Loss including Non-viable Colonies
Newfoundland and Labrador	473	55	Email	70	25 (36%)	1	223	197	47%	11.7%
Prince Edward Island	6 000	2 772	Email	50	24 (48%)	1	4 702	2 529	78%	46.2%
Nova Scotia	28 670	4 473	Online	46	20 (43%)	50	18 349	15 479	64%	15.6%
New Brunswick	13 406	3 244	Email, telephone	29	21 (72%)	50	10 328	7 833	77%	24.2%
Quebec	57 892	9 436	Online	129	77 (60%)	50	34 016	28 461	59%	16.3%
Ontario	102 562	36 615	Online, telephone	208	74 (36%)	50	35 304	22 690	34%	35.7%
Manitoba	103 841	31 152	Email, online	173	67 (39%)	50	49 599	34 718	48%	30.0%
Saskatchewan	102 000	29 376	Online	124	64 (52%)	50	31 879	22 686	31%	28.8%
Alberta	286 534	111 748	Online	169	78 (46%)	100	171 342	104 529	60%	39.0%
British Columbia	64 000	17 408	Online	312	70 (22%)	20	14 980	10 899	23%	27.2%
Canada	765 378	246 279		1 310	520 (40%)		370 722	250 021	48%	32.2%[1]

[1] This number is the total loss calculated over all colonies in Canada.

Overwintering methods

Overall, 72% of the colonies owned by respondents were wintered outdoors in fall 2022, with remaining colonies (28%) wintered indoors (**Table 2**). The highest percentage of colonies wintered indoors was in Nova Scotia (65%) and Manitoba (60%), followed by Quebec (58%) and Ontario (49%), whereas Prince Edward Island had no colonies wintered indoors.

Table 2. Overwintering method by province as cited by the respondents of the 2022-2023 winter loss survey

Province	Outdoors		Indoors	
	Number of colonies	Percent (%)	Number of colonies	Percent (%)
NFL	213	96	10	4
PEI	4 702	100	0	0
NS	6 373	35	11 976	65
NB	5 674	55	4 654	45
QC	14 134	42	19 882	58
ON	17 988	51	17 316	49
MB	19 965	40	29 634	60
SK	30 166	95	1 713	5
AB	153 134	89	18 208	11
BC	14 653	98	237	2
Canada	267 002	72	103 630	28

Nationally, the mortality rate was the same, 32.5%, for colonies wintered outdoors or indoors. The mortality rates for each province are presented in **Table 3.**

Table 3. Indoor and outdoor wintering mortality as cited by the respondents of the 2022-2023 winter loss survey

Province	Outdoors			Indoors		
	Total number of colonies in fall 2022	Total number of viable colonies in spring 2023	Percent of losses of colonies (%)	Total number of colonies in fall 2022	Total number of viable colonies in spring 2023	Percent losses of colonies (%)
NFL	213	191	10	10	4	60
PEI	4 702	2 529	46	0	0	
NS	6 373	5 295	17	11 976	10 184	15
NB	5 674	4 466	21	4 654	3 367	28
QC	14 134	11 184	21	19 882	17 277	13
ON	17 988	14 976	17	17 316	7 714	55
MB	19 965	14 804	26	29 634	19 914	33
SK	30 166	21 818	28	1 713	868	49
AB	153 134	94 143	39	18 208	10 386	43
BC	14 653	10 697	27	237	216	9
Canada	267 002	180 103	32.5	103 630	69 930	32.5

Contributing factors as cited by beekeepers

Beekeepers were asked to rank possible contributing factors to colony mortality. These responses are summarized in **Table 4**. When all causes in the top 4 are compiled regardless of their ranks, impacts from varroa and associated viruses, weak colonies in the fall, starvation and weather/climate were considered the most important factors for winter loss across the country in 2023.

Varroa and associated viruses was reported as one of the top four contributing factors to winter colony loss in eight provinces. While varroa mites and their impact on honey bee health are still a serious issue for Canadian beekeepers, survey results indicate that many beekeepers are monitoring and treating for varroa using multiple treatments per year. Unfortunately, some individual producers monitored and treated for varroa too late, by then, varroa levels were already at levels where damage to the colony had occurred. This results in wintering bees being less healthy from the impacts of varroa and associated viruses. Monitoring varroa mite levels is becoming increasingly important especially as environmental factors such as climate and weather can impact colony growth as well as the efficacy of miticides used by beekeepers. Moreover, the emergence of resistance to Apivar® impacts the efficacy of this product. With less efficacy, the ability of mite populations to rebound back to damaging levels is increased. In addition, reinfestation of varroa mites from neighbouring beekeeping operations may also occur after a treatment has been applied. Therefore, monitoring varroa levels frequently, before and after treatment, testing for Apivar® resistance, selecting suitable effective treatments and verifying treatment efficacy are all necessary elements of an effective management strategy for this economically important pest.

Weak colonies in the fall were also among the top four reported contributing factors to winter losses in eight provinces. While there can be many causes for weak colonies (e.g., lack of nutrition and late establishment of colonies), poor queens can result in weakened colonies prior to winter, leading to an insufficient number of bees to survive. Poor queens were also commonly reported as a top four contributing factor to winter losses. If a queen becomes infertile or dies during the winter, the colony will also perish as there is no opportunity for the beekeeper to replace the queen or for the colony to naturally re-queen itself. Poor and failing queens may be the result of many factors including: inadequate rearing conditions, poor mating weather, reduced sperm viability, queen age, diseases or exposure to pesticides within the hive or from the environment (Amiri et al., 2017; Pettis et al., 2004; Pettis et al., 2016; Williams et al., 2015).

Unpredictable weather during the late summer of 2022, and winter and early spring of 2023 was most commonly cited as the first cause of winter losses across Canada. In the prairie provinces (Manitoba, Saskatchewan and Alberta), dry weather during the summer resulted in an early end to the honey and pollen flows possibly resulting in lack of nutrition for the development of wintering bees. During the winter, cold temperatures across the country had the potential to negatively affect wintering colonies. Additionally, colony build-up was hindered by a cold spring in some regions that caused surviving colonies to dwindle, greatly increasing the number of non-viable colonies.

Starvation was reported as a cause of winter mortality by beekeepers in some regions in Canada. Starvation can result from the inability of bees in weak colonies to store enough food during the fall, the inability of bees to move to resources within the hive during winter, the rapid consumption of stored food because of early brood production or insufficient feed provided by the beekeeper in the fall or spring. During 2022-23, starvation may also have been associated with increased consumption of stored honey or sugar syrup during the extended cold weather in the spring of 2023 in some areas.

Some beekeepers reported that they did not know why their colonies perished, although this answer was not identified among the top four causes for losses among most provinces. Inability to identify a possible cause for colony mortality may be associated with lack of applying best management practices including monitoring for pests, diseases and other general colony health parameters during the season, or a multitude of underlying problems that cannot be identified without the assistance from specialists.

Table 4. Top four ranked possible causes of honey bee colony mortality by province, as cited by beekeepers who responded to the 2022-2023 winter loss survey

Province	Ranked 1st the most	Ranked 2nd the most	Ranked 3rd the most	Ranked 4th the most
NL[a]	Weather/Climate	Weak colonies in the fall	Starvation	Poor queens
PEI	Weak colonies in the fall	Varroa and associated viruses	Weather/Climate	Starvation
NS	Weak colonies in the fall	Starvation	Weather/climate	Don't know
NB	Weather/Climate	Starvation	Don't know	Varroa and associated viruses
QC	Varroa and associated viruses	Poor Queens	Weak colonies in the fall	Starvation
ON	Varroa and associated viruses	Starvation	Weak colonies in the fall	Other
MB	Poor queens	Starvation	Weak colonies in the fall	Varroa and associated viruses
SK	Weather/Climate	Poor queens	Weak colonies in the fall	Varroa and associated viruses
AB	Varroa and associated viruses	Poor queens	Weather/climate	Nosema
BC	Weather/Climate	Weak colonies in the fall	Varroa and associated viruses	Poor queens

[a] Varroa mites have not been reported in Newfoundland and Labrador.

Reported top causes of winter loss for operations exceeding 25% mortality are presented in **Table 5**. Poor queens, impacts from varroa and associated viruses, weather/climate, and weak colonies in the fall were equally cited as the top contributor to winter loss in operations with greater than 25% loss. Overall, there was more variability in reported causes of winter loss among provinces for these operations, than those reported in **Table 4**.

Table 5. Top four ranked possible causes of bee colony mortality by province, as cited by beekeepers who reported greater than 25% losses in the 2022-2023 winter loss survey

Province	Ranked 1st the most	Ranked 2nd the most	Ranked 3rd the most	Ranked 4th the most
NL[a]	Weather	Starvation	Weak colonies in the fall	Poor queens
PEI	Weak colonies in the fall	Varroa and associated Viruses	Weather/Climate	Starvation
NS	Other (shrews)	Poor queens	Weak colonies in the fall	Don't know
NB	Weather/Climate	Starvation	Don't know	Poor queens
QC	Varroa and associated viruses	Other	Don't know	Weak colonies in the fall
ON	Poor queens	Weather	Starvation	Varroa and associated viruses
MB	Poor queens	Nosema	Varroa and associated viruses	Weak colonies in the fall
SK	Weather/climate	Varroa and associated viruses	Poor queens	Weak colonies in the fall
AB	Varroa and associated viruses	Weather/climate	Poor queens	Nosema
BC	Don't know	Don't know	Don't know	Don't know

[a] Varroa mites have not been reported in Newfoundland and Labrador.

Integrated Pest Management

Integrated Pest Management (IPM) has become widely used to maintain healthy honey bees. To successfully manage bee health, beekeepers must identify and monitor pests and diseases to take timely action in accordance with approved methods. This survey focused on asking beekeepers questions about their management of four serious threats that may impact bee health, survivorship and productivity (**Appendix B**).

Varroa monitoring

The varroa mite continues to be considered by beekeepers and apicultural specialists as one of the main causes of honey bee colony mortality.

During the 2022 beekeeping season, a large proportion of surveyed beekeepers monitored varroa mite infestations at least once a year, with some monitoring more than three times per year (**Table 6**). Alcohol washes, sugar shakes or ether rolls using 300 bees per colony was the preferred method of detection in all provinces except Quebec, where beekeepers favoured the use of sticky boards. The frequency of use for the alcohol wash technique ranged from 48% in Québec to 82% in Manitoba. The frequency of use for the sticky board method ranged from 3% in Saskatchewan to 67% in Quebec. Some beekeepers used both sticky boards and alcohol wash methods to evaluate levels of mites.

Table 6. Varroa monitoring methods as cited by the respondents of the 2022-2023 winter loss survey					
Province	**Beekeepers screening for varroa mites (%)**				
	Technique		**Frequency**		
	Mite fall/sticky boards	**Alcohol wash (or sugar shake/Ether roll)**	**Once a year**	**Twice a year**	**Three times a year**
NL[a]	NA[b]	NA	NA	NA	NA
PEI	6	59	12	18	29
NS	20	55	20	20	25
NB	38	62	76	43	29
QC	67	48	14	19	39
ON	15	81	14	21	49
MB	16	82	84	70	33
SK	3	73	76	52	26
AB	32	79	18	37	40
BC	23	77	ND[c]	ND	ND

[a] Varroa mites have not been reported in Newfoundland and Labrador.

[b] NA: not applicable.

[c] ND: no data.

Table 7. Percentage of Beekeepers monitoring for varroa mites according to the time of year as cited by the respondents of the 2022-2023 winter loss survey			
Province	**Beginning of beekeeping season**	**Mid beekeeping season**	**End of beekeeping season**
NL[a]	NA[b]	NA	NA
PEI	49	53	35
NS	25	60	40
NB	19	52	43
QC	59	57	51
ON	75	49	78
MB	78	45	81
SK	47	28	63
AB	76	45	91
BC	82	23	37

[a] Varroa mites have not been reported in Newfoundland and Labrador.

[b] NA: not applicable.

The timing of sampling is important. Sampling prior to treatment windows can inform beekeepers as to whether treatments are needed, while sampling after treatments determines whether applications were efficacious. The percentage of beekeepers that always sampled before treatment varied from 25% in Nova Scotia to 64% in Alberta, while beekeepers that never sampled before treatment varied from 13% in Quebec to 36% in Prince Edward Island (**Table 8**). The percentage of beekeepers that always tested after treatment applications varied from 20% in Nova Scotia to 55% in Alberta, while beekeepers that never tested post treatment varied from 14% in Alberta to 58% in Prince Edward Island (**Table 8**).

Table 8. Beekeepers monitoring before and after treatment (%) as cited by the respondents of the 2022-2023 winter loss survey						
Province	**Always before treatment**	**Sometimes before treatment**	**Never before treatment**	**Always after treatment**	**Sometimes after treatment**	**Never after treatment**
NL[a]	NA[b]	NA	NA	NA	NA	NA
PEI	29	35	36	24	18	58
NS	25	40	35	20	30	50
NB	29	43	28	24	33	43
QC	50	37	13	24	27	49
ON	NA	NA	NA	NA	NA	NA
MB	43	37	20	31	40	29
SK	44	30	26	39	27	34
AB	64	22	14	55	31	14
BC	ND	ND	ND	ND	ND	ND

[a] Varroa mites have not been reported in Newfoundland and Labrador.

[b] NA: not applicable.

[c] ND: no data.

These results demonstrate that many Canadian beekeepers recognize the value of monitoring for varroa. Nevertheless, the desired goal is to have **all beekeepers regularly monitor** for varroa populations throughout the beekeeping season, particularly prior to treatment application windows, as well as after treatment to verify efficacy. Such sampling will ensure optimal timing of treatments and selection of the most effective treatment options for varroa control. While education and extension programs delivered to Canadian beekeepers have facilitated the adoption of recommended practices for managing varroa, ongoing innovation and improvement must continue.

Varroa control

In Canada, there are a variety of registered miticides available to beekeepers for mite control. Beekeepers are encouraged to use the most effective miticide that suits their region, season and operation. Beekeepers are also encouraged to rotate miticides to prevent the development of resistance to these products. In the current survey of bee winter losses, beekeepers were asked “what chemical treatment was used for varroa control during the 2022 season”. Beekeeper’s responses are summarized in **Table 9**. Rankings were compiled per treatment, but also per active ingredient. Since multiple commercially available treatments may use the same active ingredient, rankings may differ between treatment and active ingredient.

Table 9: Varroa control methods and compounds used at the beginning of the season as cited by the respondents of the 2022-2023 winter loss survey

Province	% of Beekeepers who treated	Main treatment methods[a]	Main active ingredients
NL[b]	NA[c]	NA	NA
PEI	65	Apivar (amitraz), Formic Pro (formic acid), 65% Formic acid - 40mL multiple applications	Amitraz, Formic acid
NS	85	Apivar (amitraz), Apistan (fluvalinate), Oxalic acid - sublimation	Amitraz, Flumethrin, Oxalic acid
NB	43	Formic Pro (formic acid), Apivar (amitraz), Oxalic acid - sublimation	Formic acid, Amitraz, Oxalic acid
QC	99	65% Formic acid - 40mL multiple applications, Apivar (amitraz), tie between : Oxalic acid - sublimation and OA drip)	Formic acid, Oxalic acid, Amitraz
ON	84	Apivar (amitraz), Oxalic acid - sublimation, Formic Pro (formic acid)	Formic acid, Amitraz, Oxalic acid
MB	97	Apivar (amitraz), Oxalic acid - sublimation, Oxalic acid - drip	Amitraz, Oxalic acid, Formic acid
SK	97	Apivar (amitraz), Oxalic acid - sublimation, Apistan (fluvalinate)	Amitraz, Oxalic acid, Fluvalinate
AB	87	Apivar (amitraz), Oxalic acid - sublimation, 65% Formic acid - 40mL multiple applications	Amitraz, Oxalic acid, Formic acid
BC	48	Oxalic acid - sublimation, 65% Formic acid - 40mL multiple applications, Apivar (amitraz)	Oxalic acid, Formic acid, Amitraz

[a] Treatments and active ingredients listed from most used to least used.
[b] There are not any reports of the varroa mite from Newfoundland and Labrador.
[c] NA: not applicable.

In the spring of 2022, the percentage of beekeepers who treated with chemical methods ranged from 43% to 99% in provinces where the mite is present. New Brunswick had the lowest percentage of beekeepers (respondents) who treated for varroa in the spring (43%)(fall treatments are more common in this province, see Table 11.) For Canadian beekeepers who did treat in the spring, the main miticide used for spring varroa control was Apivar® (active ingredient: amitraz). The second most common treatment was formic acid in various forms, followed by oxalic acid (Table 9). However, in Ontario, formic acid as an active ingredient (when all forms of treatments are added together) was more widely used than amitraz or oxalic acid in the Spring. From 11% to 48% of beekeepers have started to use an in-season treatment for varroa control. The number of products that can be used while honey supers are in place are limited to ensure honey quality, the primary control products are FormicPro, other formic acid applications and oxalic acid (**Table 10**). In fall of 2022, most Canadian beekeepers (71% to 99% depending on province) treated their colonies for varroa.

Table 10: Varroa treatment methods and compounds used mid season (honeyflow) as cited by the respondents of the 2022-2023 winter loss survey			
Province	**% of Beekeepers who treated**	**Main treatment methods[a]**	**Main active ingredients**
NL[b]	NA[c]	NA	NA
PEI	35	65% Formic acid - 40mL multiple applications, Formic pro (formic acid), Apivar (amitraz)	Formic acid, Formic acid, Amitraz
NS	20	Formic pro (formic acid), 65% Formic acid - 40L multiple applications	Formic acid
NB	33	Oxalic acid - sublimation, Apivar (amitraz), Formic Pro (formic acid)	Oxalic acid, Amitraz, Formic acid
QC	46	65% Formic acid - 40mL multiple applications, Formic Pro (formic acid), Oxalic acid - drip	Formic acid, Oxalic acid
ON	48	Formic Pro (formic acid), Other, MAQS (formic acid)	Formic acid, Oxalic acid
MB	15	65% Formic acid - 40mL multiple applications, Formic Pro (formic acid), Apivar (amitraz)	Formic acid, Amitraz, Oxalic acid
SK	11	Formic Pro (formic acid), 65% Formic acid - 40mL multiple applications	Formic acid
AB	21	Other, 65% Formic acid - 40mL multiple applications, Oxalic acid - sublimation	Oxalic acid, Formic acid
BC	ND[d]	ND	Formic acid, Amitraz, Oxalic acid

[a] Treatments and active ingredients listed from most used to least used.
[b] Varroa mites have not been reported in Newfoundland and Labrador.
[c] NA: not applicable.
[d] ND: no data.

The main miticides used at this time of the year were oxalic acid, formic acid and Apivar® (**Table 11**). It was noted that some beekeepers used Apivar® twice in the same year in 2022, once in spring and again in fall. In some provinces, a greater number of beekeepers have started to combine Apivar® with formic or oxalic acid during the fall for keeping control of mite populations.

Few beekeepers used Apistan® (a synthetic miticide with the active ingredient tau-fluvalinate) or Checkmite+® (a synthetic miticide with the active ingredient coumaphos). Beekeepers may be wary of these products because of previously reported resistance to these active ingredients in Canada. Bayvarol® (a synthetic miticide with the active ingredient flumethrin) was also rarely used; there have been concerns and reports from beekeepers about the limitations in the efficacy of this product, which have been confirmed by research projects in Canadian provinces (Currie et al., 2010; Morfin et al., 2022; Olmstead et al., 2019). Thymovar® (a miticide with the active ingredient thymol) was also reported used in some provinces.

Table 11: Varroa control methods and compounds used at the end of the season as cited by the respondents of the 2022-2023 winter loss survey			
Province	**% of Beekeepers who treated**	**Main treatment methods[a]**	**Main active ingredients**
NL[b]	NA[c]	NA	NA
PEI	71	Oxalic acid - sublimation, Apivar (amitraz), Oxalic acid - drip	Oxalic acid, Amitraz, Formic acid
NS	75	Oxalic acid - sublimation, Formic Pro (formic acid), Oxalic acid (drip)	Oxalic acid, Formic acid, Oxalic acid
NB	95	Apivar (amitraz), Oxalic acid - sublimation), Bayvarol (flumethrin)	Amitraz, Oxalic acid, Flumethrin
QC	73	65% Formic acid - 40mL multiple applications, Oxalic acid - sublimation, Thymovar (thymol)	Formic acid, Oxalic acid, Thymol (w/or w/o other essential oils)
ON	99	Oxalic acid - sublimation, Apivar (amitraz), Formic Pro (formic acid)	Oxalic acid, Amitraz, Formic acid
MB	99	Oxalic acid - sublimation, Apivar (amitraz), Thymovar (thymol)	Oxalic acid, Formic acid, Amitraz
SK	76	Oxalic acid - sublimation, Apivar (amitraz), 65% Formic acid 40mL multiple treatments	Oxalic acid, Amitraz, Formic acid
AB	97	Oxalic acid - sublimation, 65% Formic acid - 40mL multiple treatments, Apivar (amitraz)	Oxalic acid, Formic acid, Amitraz
BC	ND[d]	Oxalic acid - sublimation, Apivar (amitraz), Formic Pro (formic acid)	Oxalic acid, Amitraz, Formic acid

[a] Treatments and active ingredients listed from most used to least used.

[b] Varroa mites have not been reported in Newfoundland and Labrador.

[c] NA: not applicable.

[d] ND: no data.

Figure 1 summarizes miticide application according to the season throughout Canada. Although almost every beekeeper treats at the end of the season in most provinces, and many do at the beginning of the season, treatments during honey flow are scarce. However, in some provinces where honey flows occur late into the season, such as Ontario or Quebec, it is necessary to suppress mite levels before the end of the season. Treatments applied mid-season must be labelled for use during honeyflow or be applied only on colonies that are not producing honey to be collected (i.e.: nuclei). Some beekeepers who only receive revenue from pollination do not produce surplus honey.

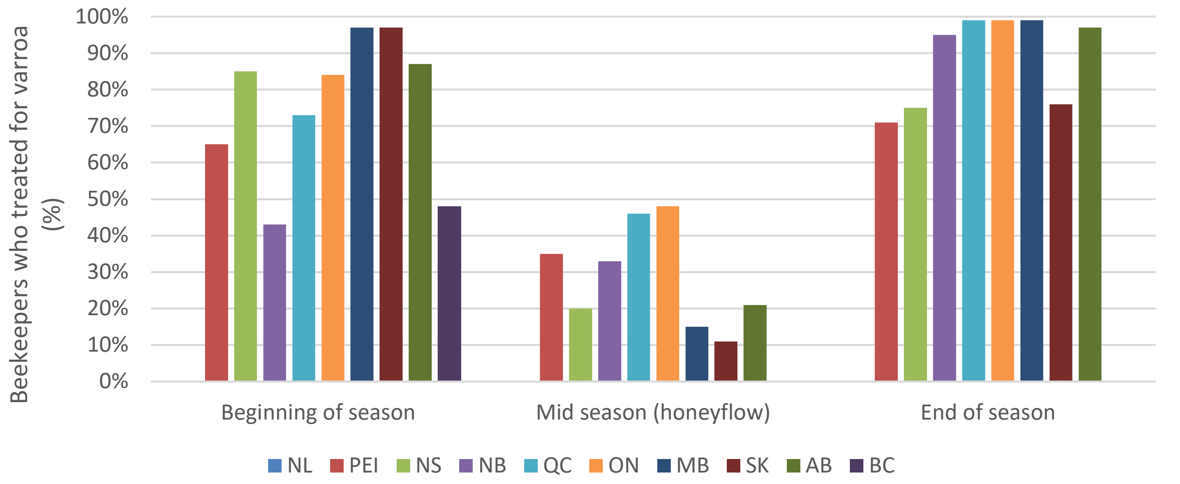

Figure 1. Percentages of beekeepers treating for varroa throughout the season as cited by the respondents of the 2022-2023 winter loss survey

Once again, these surveys show that Apivar® is one of the most used miticides for treating varroa in Canada. Because of the repeated use of Apivar®, it is only a matter of time before the development of resistance to this miticide. Findings of decreased efficacy have been documented in some provinces. It is becoming increasingly important that beekeepers become aware of the principles associated with resistance development and the importance of monitoring the efficacy of all treatments, in particular Apivar®. This will help to mitigate abrupt and widespread failures of treatments before mites cause irreparable damage to bees. Beekeepers are also encouraged to incorporate resistance management practices such as using appropriate thresholds for treatment, following label instructions, never leaving treatments in the hive beyond the appropriate treatment period or reusing chemical strips, and alternating miticides with different modes of action in their varroa treatment programs. In addition, having a wide suite of legally registered treatments with different functional activities and methods of application available to beekeepers is critical for maintaining a sustainable successful integrated varroa management strategy in Canada.

Nosemosis management practices

Nosema is a fungal parasite that infects honey bees. *Nosema ceranae* has gradually replaced *Nosema apis* to become the most frequently found nosema species in Canada (Copley et al., 2012; Emsen et al., 2016). The role of *N. ceranae* affecting honey bee colony survival during winter may vary by climatic region and bee populations in Canada. Several studies from central Canada have demonstrated that *N. ceranae* did not impact winter mortality, however the parasite was found to potentially impact the development of honey bee colonies in early spring (Emsen *et al*., 2016; Emsen *et al*., 2020; Guzman *et al*., 2010). Recently, a study from the Canadian Prairies (Punko 2021; Punko *et al*., 2021) has found that Nosema can increase colony mortality. The impact of Nosema was not cited by Canadian beekeepers in this survey as a possible cause of colony mortality during the 2022-2023 winter loss survey, apart from Manitoba and Alberta operations reporting greater than 25% losses.

Table 12. Antibiotic (fumagillin) and alternative treatments usage (% of beekeepers) for nosemosis as cited by the respondents of the 2022-2023 winter loss survey						
Province	**Beginning of season**			**End of season**		
	Fumagillin	**Other product**	**Main alternative products**	**Fumagillin**	**Other product**	**Main alternative products**
NL	0	0	NA[c]	0	0	NA
PEI	0	0	NA	0	0	NA
NS	0	0	NA	25	5	Hive Alive
NB	11	0	None	24	0	None
QC	0	37	Commercial nutritional supplement, Apple cider vinegar	0	40	Apple cider vinegar, Commercial nutritional supplement
ON	5	3	ND[d]	5	0	NA
MB	25	7	Honey Bee Healthy, Tie between: Nosi-Vet, Complete Bee, Probiotic	21	13	Honey Bee Healthy, Nosi-Vet, Tie between: Hive Alive, Super DFM, Wormwood solution, Probiotic
SK	27	13	ND	30	9	ND
AB	38	3	Pro Health, Bee Optimum, Bee Vital	60	3	Pro Health, Bee Optimum, Bee Vital
BC	13	18	ND	21	0	NA

[c] NA: not applicable.

[d] ND: no data.

In the survey, beekeepers reported the use of fumagillin for the treatment of nosemosis in spring and/or in fall of 2022 (**Table 12**). The percentage of beekeepers that reported using this antibiotic varied widely from province to province. Beekeepers were also asked to report all alternative treatments that they used during the spring or the fall to control nosemosis. Fumagilin-B® is the only product registered by Health Canada for nosema treatment. Any other products mentioned by beekeepers are not currently registered for the treatment of this disease, though some are marketed and used as general promoters of honey bee health. It is also worth noting that there are some regions of Canada where Fumagilin-B® is not used by most beekeepers. This may be due to the recent research in Canada clarifying the regional impacts of nosema on winterloss (Desai & Currie, 2016). Overall, nosemosis is still an issue impacting bee health and further research is required to understand its role in colony population build up, honey production and colony loss throughout Canada.

American and European foulbrood management practices

American foulbrood (AFB) is a bacterial disease of brood caused by *Paenibacillus larvae*. AFB is considered endemic in Canada. It is also of great concern to beekeepers as active infections may result in large-scale loss of honey bees and equipment and can spread within regions if proper steps are not taken to eliminate infective honey bee colonies and equipment. In recent years, some beekeepers have reported an increasing impact of and difficulty controlling European foulbrood (EFB) in their operation, a bacterial brood disease caused by *Melissococcus plutonius*. Oxytetracycline, although typically used as a treatment for AFB, has started to be used to treat signs of EFB outbreaks. Oxytetracycline, tylosin and lincomycin are antibiotics registered for treating AFB in Canada. Oxytetracycline is the only labeled treatment for EFB. The pattern of use for these antibiotics, as reported by beekeepers, is presented in **Table 13 and 14**.

Table 13. Antibiotic treatments for American foulbrood (oxytetracycline, tylosin and lincomycin) at the beginning of the season as cited by the respondents of the 2022-2023 winter loss survey

Province	Use of foulbrood treatments (% of respondents) at the beginning of season			
	Oxytetracycline*	Tylosin*	Lincomycin*	No Treatment
NL	0	0	0	100
PEI	6	0	0	94
NS	15	0	0	85
NB	62	0	0	38
QC	7	0	0	93
ON	56	0	0	38
MB	36	0	0	64
SK	30	0	0	70
AB	36	1	0	63
BC	7	1	0	92

*These categories are not mutually exclusive, therefore the total may be greater than 100.

Table 14. Antibiotic treatments for American foulbrood (oxytetracycline, tylosin and lincomycin) at the end of the season as cited by the respondents of the 2022-2023 winter loss survey

Province	Use of foulbrood treatments (% of respondents) at the end of season			
	Oxytetracycline*	Tylosin*	Lincomycin*	No Treatment
NL	0	0	0	100
PEI	12	0	0	88
NS	10	0	0	90
NB	19	0	0	81
QC	0	0	0	100
ON	58	0	0	44
MB	27	3	0	70
SK	37	5	0	58
AB	29	6	0	65
BC	7	3	0	90

*These categories are not mutually exclusive, therefore the total may be greater than 100.

Oxytetracycline was more frequently used by beekeepers in spring and fall than other treatments. Provincial recommendations on antibiotic use (e.g., metaphylactic vs therapeutic) vary. Beekeepers using antibiotics in the presence of signs of disease ranged from 0 to 100% for both AFB and EFB depending on the province (**Table 15**).

Table 15. Beekeepers who treated and saw signs of foulbrood

Province	Use of foulbrood treatments (% of respondents)		
	Treated and saw signs of AFB in 2022	Treated and saw signs of EFB in 2022	Treated and were unsure if they saw foulbrood in 2022
NL	ND[a]	ND	ND
PEI	50	100	0
NS	0	20	5
NB	0	0	0
QC	27	80	0
ON	0	3	1
MB	1	3	4
SK	0	16	0
AB	100	91	33
BC	ND	ND	ND

[a] ND: no data.

Honey Bee Winter Loss and Population in Canada Since 2007

Reported winter loss has been variable from year to year in Canada since the beginning of these annual surveys in 2007. This year, the reported winter mortality averaged 32.2%. This is higher than the long-term suggested baseline/ threshold for winter losses of 15%. In fact, since the beginning of this survey in 2007, this suggested acceptable level of loss has never been attained. As can be seen in **Figure 2**, national winter losses were highest in 2022, 2008 and 2009 which ranged from 45.5% to 33.9%. From 2007 to 2023, national winter losses ranged from 15.3% to 45.5%, averaging 27%. In spite of these loses, between 2007 and 2021 Statistics Canada reports showed that total number of colonies in Canada increased by 30%.

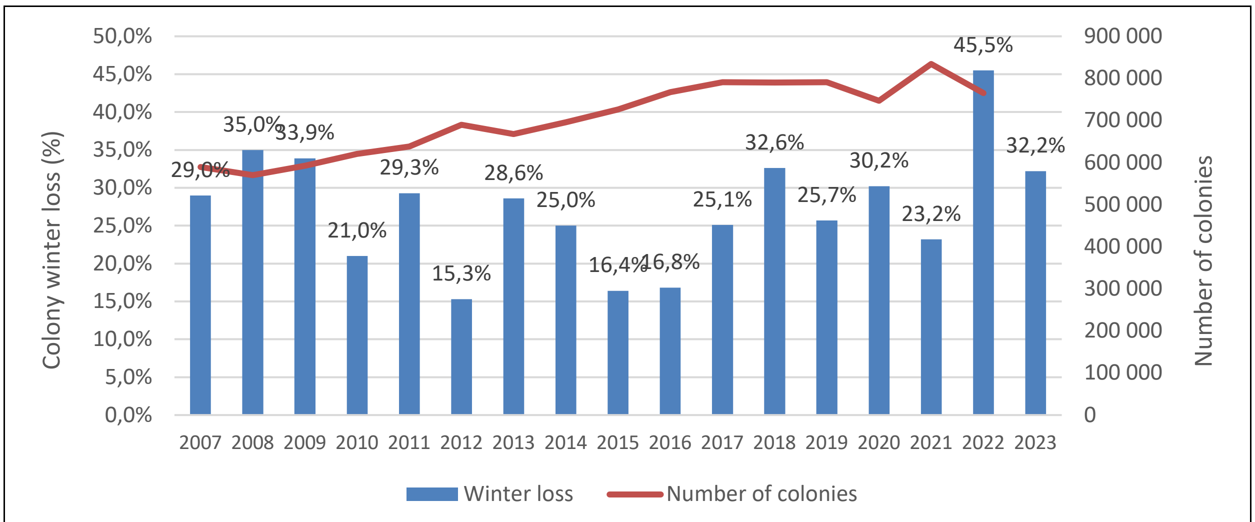

Figure 2. Summary of bee colony numbers and bee losses in Canada from 2007-2023 (based on data as reported by Stats Canada). *Note that the number of colonies as reported by Stats Canada is not available for the current year.*

Beekeepers must be vigilant and practice integrated pest management (IPM) for serious pests endemic to the honey bee population in Canada (e.g. varroa mites). A changing climate must be considered due to impacts on bee growth, varroa population development, treatment type and frequency of application. Beekeepers must also consider nutrition, and pesticide exposure within hives and from the environment as well as the added challenge of the economics of beekeeping which include variable honey prices and increasing costs of production. Individual beekeepers experiencing high winter losses face considerable expenses replacing dead colonies. These increased expenses greatly affect profitability and productivity and can put some beekeeping operations at risk of insolvency. Moreover, this survey and report do not take into account mid-season losses of honey bee colonies or queens that beekeepers may be experiencing throughout the beekeeping season. Nevertheless, the Canadian beekeeping industry has been resilient and able to grow, as proven by the overall increase in the number of bee colonies since 2007 (Figure 2) despite the difficulties faced every winter. While provincial estimates demonstrate regional trends in winter loss, within each province the results vary among regions and beekeeping operations. While there are operations that have been highly successful, there is a real risk of losing large proportions of colonies in Canada, and continued vigilance is required to maintain bee health and profitable beekeeping operations.

Although responses to this annual survey provide evidence that many beekeepers are using recommended practices for monitoring and managing honey bee pests and diseases, there are always opportunities for improvements. As such, the detailed management data from beekeepers summarised in this report has been used by some apiary and extension programs to focus on education, training, and communication efforts to beekeepers on improvement of management for honey bee pests. Up till now the focus has been for an open-ended approach to have beekeepers access training and education based on their own needs and determination. Further strategies may be considered to ensure that larger proportions of beekeepers are truly participating and using education and training resources.

It would appear that stress caused by parasites in combination with other stressors warrant further study to provide alternative management practices for maintaining honey bee health. At this time, beekeepers have a limited number of products to control varroa, and all of these options have their limitations. New options are important to mitigate the risk of developing resistance. Currently, the only product registered for the treatment of nosema is fumagillin. If resistance develops to the primary treatment for varroa (e.g., Apivar®) or to nosema (i.e. fumagillin), beekeepers could experience even greater and likely extreme difficulties keeping their bees alive. Ultimately, beekeepers will need more effective and additional options (miticides, antibiotics and non-chemical management options) in their “tool box” if they are to continue effective integrated pest management (IPM) strategies to maintain healthy bees.

Further Work

CAPA members continue to work closely with industry stakeholders and provincial working groups to address bee health and industry economics. Members of CAPA and Provincial Apiarists have also been involved in conducting surveillance programs at the provincial levels and across the country to monitor the status of bee health including emerging pests. CAPA members, the Provincial Apiarists, and Technology Transfer Programs are involved in conducting outreach and extension programs to promote IPM and biosecurity practices to beekeepers. Researchers within CAPA are active in evaluating alternative control options for varroa mites and nosema and developing genetic stocks more tolerant to pests which will enhance IPM practices and address honey bee health sustainability.

For more information about this report, please contact:

Dr. Julie Ferland, Chair of the CAPA National Survey Committee
Julie.Ferland2@mapaq.gouv.qc.ca Tel : 418 380-2100 Ext. 2067

Dr. Ernesto Guzman, President of Canadian Association of Professional Apiculturists (CAPA)
eguzman@uoguelph.ca Tel: 519 824-4120 Ext. 53609

REFERENCES

Copley, T. R., H. Chen, P. Giovenazzo, E. Houle, and S. H. Jabaji (2012). Prevalence and seasonality of Nosema species in Québec honey bees. *The Canadian Entomologist*, **144**(4), 577-588.

Currie, R. W., S. F. Pernal and E. Guzmán-Novoa (2010). Honey bee colony losses in Canada. *Journal of Apicultural Research*, **49**(1), 104-106. DOI: 10.3896/IBRA.1.49.1.18

Desai, S. D., and R. W. Currie (2016). Effects of wintering environment and parasite–pathogen interactions on honey bee colony loss in north temperate regions. *PloS one*, **11**(7), e0159615.

Emsen, B., E. Guzman-Novoa, M. M. Hamiduzzaman, L. Eccles, B. Lacey, R. A. Ruiz-Pérez and M. Nasr (2016). Higher prevalence and levels of *Nosema ceranae* than *Nosema apis* infections in Canadian honey bee colonies. *Parasitology Research,* **115**(1), 175-181.

Emsen, B., A. De la Mora, B. Lacey, L. Eccles, P. G. Kelly, C. A. Medina-Flores, T. Petukhova, N. Morfin and E. Guzman-Novoa (2020). Seasonality of *Nosema ceranae* infections and their relationship with honey bee populations, food stores, and survivorship in a North American region. *Veterinary Sciences,* **7**(3), 131.

Emsen, B., E. Guzman-Novoa, M. M. Hamiduzzaman, L. Eccles, B. Lacey, R. A. Ruiz-Pérez and M. Nasr (2016). Higher prevalence and levels of Nosema ceranae than Nosema apis infections in Canadian honey bee colonies. *Parasitology research*, **115**, 175-181.

Guzmán-Novoa, E., L. Eccles, Y. Calvete, J. McGowan, P. Kelly and A. Correa-Benítez (2010). *Varroa destructor* is the main culprit for the death and reduced populations of overwintered honey bee (*Apis mellifera*) colonies in Ontario, Canada. *Apidologie*, **41**(4), 443-450.

Morfin N, D. Rawn, T. Petukhova, P. Kozak, L. Eccles, J. Chaput, T. Pasma, and E. Guzman-Novoa (2022). Surveillance of synthetic acaricide efficacy against *Varroa destructor* in Ontario, Canada. *The Canadian Entomologist,* **154**, e17.

Olmstead, S., C. Menzies, R. McCallum, K. Glasgow and C. Cutler (2019). Apivar® and Bayvarol® suppress varroa mites in honey bee colonies in Canadian Maritime Provinces. *Journal of the Acadian Entomological Society,* **15**, 46–49.

Pettis, J. S., A. M. Collins, R. Wilbanks and M. F. Feldlaufer (2004). Effects of coumaphos on queen rearing in the honey bee, *Apis mellifera*. *Apidologie*, **35**(6), 605-610. DOI: 10.1051/apido:2004056

Punko, R. N. (2021). Nosema epidemiology and control in honey bees (*Apis mellifera*) under Canadian Prairie conditions. M. Sc., *University of Manitoba*. http://hdl.handle.net/1993/35487

Punko, R. N., R. W. Currie, M. E. Nasr, S. E. Hoover (2021). Epidemiology of Nosema spp. and the effect of indoor and outdoor wintering on honey bee colony population and survival in the Canadian Prairies. *PLoS ONE,* **16**(10), e0258801. DOI: 10.1371/journal.pone.0258801

Pettis, J. S., N. Rice, K. Joselow, D. vanEngelsdorp and V. Chaimanee (2016). Colony Failure Linked to Low Sperm Viability in Honey Bee (Apis mellifera) Queens and an Exploration of Potential Causative Factors. *PLoS ONE*, **11**(2), e0147220. DOI: 10.1371/journal.pone.0147220

Amiri, E., M. K. Strand, O. Rueppell and D. R. Tarpy (2017). Queen Quality and the Impact of Honey Bee Diseases on Queen Health: Potential for Interactions between Two Major Threats to Colony Health. *Insects,* **8**(2), 48. DOI: 10.3390/insects8020048

Williams, G., A. Troxler, G. Retschnig, K. Roth, O. Yañez, D. Shutler, P. Neumann and L. Gauthier (2015). Neonicotinoid pesticides severely affect honey bee queens. *Scientific Reports,* **5**, 14621. DOI: 10.1038/srep14621

APPENDIX A: LIST OF CANADA'S PROVINCIAL APIARISTS

NEWFOUNDLAND AND LABRADOR
Paige Marchant
Provincial Apiarist
Dept. of Fisheries, Forestry and Agriculture
P.O. Box 2006, 192 Wheelers Road
Corner Brook, Newfoundland and Labrador A2H 6J8
(709)637-2662
provincialapiarist@gov.nl.ca

NOVA SCOTIA
Jason Sproule
Provincial Apiarist / Provincial Minor Use Coordinator
Nova Scotia Department of Agriculture
P.O. Box 890 Harlow Building
Truro, NS, B2N 5G6
902-890-1565
Jason.Sproule@novascotia.ca

QUÉBEC
Julie Ferland, DMV
Responsable provinciale en apiculture
Direction de la santé animale
Ministère de l'Agriculture, des Pêcheries et de l'Alimentation
200, chemin Sainte-Foy, 11e étage
Québec (Québec) G1R 4X6
418 380-2100, poste 2067
Julie.Ferland2@mapaq.gouv.qc.ca

MANITOBA
Derek Micholson M.Sc. P.Ag.
Provincial Apiarist
Manitoba Agriculture
Ag. Services Complex Bldg. 204-545 University Cres.
Winnipeg, MB, R3T 5S6
204-791-0124
Derek.Micholson@gov.mb.ca

ALBERTA
Samantha Muirhead
Provincial Apiculturist
Alberta Agriculture and Forestry
Crop Diversification Centre North
17505 Fort Road NW
Edmonton, AB, T5Y 6H3
780-415-2309
Sam.Muirhead@gov.ab.ca

PRINCE EDWARD ISLAND
Cameron Menzies
Provincial Apiarist/
Berry Crop Development Officer
PEI Department of Agriculture and Fisheries
Jones Building, 5th Floor
11 Kent Street, Charlottetown PE, C1A 7N8
902 314-0816
crmenzies@gov.pe.ca

NEW BRUNSWICK
Chris Maund M.Sc. P. Ag.
Integrated Pest Management Specialist (Entomologist) and Provincial Apiarist
New Brunswick Department of Agriculture, Aquaculture and Fisheries
Crop Sector Development
Hugh John Flemming Complex
1350 Regent Street, P.O. Box 6000
Fredericton, NB, E3B 5H1
506-453-3477
chris.maund@gnb.ca

ONTARIO
Paul Kozak M.Sc.
Provincial Apiarist
Ministry of Agriculture, Food and Rural Affairs
Animal Health and Welfare Branch
1 Stone Road West, 5th Floor NW
Guelph, ON, N1G 4Y2
519-820-0821
Paul.Kozak@ontario.ca

SASKATCHEWAN
Geoff Wilson M.Sc. P.Ag.
Provincial Specialist, Apiculture
Saskatchewan Ministry of Agriculture
800 Central Ave, Box 3003
Prince Albert, SK, S6V 6G1
306-980-6198
Geoff.Wilson@gov.sk.ca

BRITISH COLUMBIA
Paul van Westendorp
Provincial Apiarist
BC Ministry of Agriculture
1767 Angus Campbell Road
Abbotsford, B.C., V3G 2M3
604-556-3129
Paul.vanWestendorp@gov.bc.ca

APPENDIX B: 2023 WINTER LOSS SURVEY CORE QUESTIONS

The followings are the core questions that will be used in 2023 by each provincial apiarist for reporting the colony winter losses at the national level. As it has been since 2007, the objective is to estimate the winter kills with a simple and standardized method while taking into account the large diversity of situations around the country. This is a survey so these questions are to be answered by the beekeepers.

1. How many full sized colonies[1] were put into winter in fall 2022?

Outdoor wintering	Indoor wintering	Total

2. How many full sized colonies[1] survived the 2022/2023 winter and were considered viable[2] on May 1st (British Columbia), May 15th (Ontario, Quebec and Maritimes) or May 21st (Alberta, Manitoba, Newfoundland and Saskatchewan)?

Outdoor wintering	Indoor wintering	Total

[1] Does not include nucleus colonies

[2] Viable: A viable colony, in a standard 10-frame hive, is defined has having 4 frames or more being 75% bee-covered on both sides.

NB: You must not include in this data new colonies created by division or purchased in spring 2022. You must however include overwintered colonies that would have been sold before May 1st (British Columbia), May 15th (Ontario, Quebec and Maritimes) or May 21st (Alberta, Manitoba, Newfoundland and Saskatchewan).

3. Which method of treatment did you use for **varroa control** in **2022**? *(Choose all that apply)*

Treatment	Beginning of beekeeping season	Mid beekeeping season (honey flow)	End of beekeeping season (late flow or no supers)
Apistan (Fluvalinate)			
CheckMite+ (Coumaphos)			
Apivar (Amitraz)			
Bayvarol (Flumethrin)			
Thymovar (Thymol)			
ApiLifeVar (Thymol)			
65% formic acid – 40 mL multiple applications			
65% formic acid – 250 mL single application (Mite Wipe)			
MAQS (formic acid)			

Formic Pro (formic acid)			
Oxalic acid – drip			
Oxalic acid – sublimation			
Hopguard II (Hop compounds)			
Other *(please specify)* ______________________			
None			

4. Which monitoring methods did you use for **varroa monitoring** in 2022?

Monitoring method	Beginning of beekeeping season	Mid beekeeping season (honey flow)	End of beekeeping season (late flow or no supers)
Mite fall/sticky board			
Alcohol wash			
Sugar shake			
CO2 roll			
Other			
None			

5. Did you monitor for varroa **before and after treatment**? *(Choose all that apply)*

	Before treatment	After treatment
Always		
Sometimes		
No		

6. Which method of treatment did you use for **nosema** control in 2022? *(Choose all that apply)*

Treatment	Beginning of beekeeping season	End of beekeeping season
Fumagillin		
Other (*please specify*) __________________		
None		

7. Did you apply the following **antibiotics** 2022? *(Choose all that apply)*

Treatment	Beginning of beekeeping season	End of beekeeping season
Oxytetracycline		
Tylosin		
Lincomycin		
None		

8. Did you see signs of American or European **foulbrood** in your colonies in 2022? *(Choose all that apply)*

o AFB
o EFB
o Unsure
o No

9. To what do you attribute the main cause of death of your colonies? (Please check every suspected cause and rank the causes according to their relative importance.)

Cause of death	Rank (1 = the most important)
Don't know	
Starvation	
Poor queens	
Varroa and associated viruses	
Nosema	
Weather/climate	
Weak colonies in the fall	
Other (*Please specify*) ________________________	
Other (*Please specify*) ________________________	
Other (*Please specify*) ________________________	