Canadian Association of Professional Apiculturists Statement on Honey Bee Wintering Losses in Canada (2015)

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Summary

The Canadian Association of Professional Apiculturists (CAPA) conducted the annual honey bee wintering loss survey for the winter of 2014/15 in Canada. A set of harmonized questions based on national beekeeping industry profiles was used in the survey. The Provincial Apiculturists collected survey data from beekeepers across Canada who own 362,949 honey colonies. This represents 52% of all colonies operated and wintered in Canada in 2014. The national average percentage of colony winter loss was 15.9%. Provincial averages ranged from 10.4-37.8%. Colony winter loss in Ontario was 37.8%, lower than the 58% loss reported in 2013/14. Overall, the reported national colony loss is the lowest since 2006/07 and represents a decrease of 36.4% from 2013/14 winter losses.

Respondents reported considerable variation in identifying and ranking the top 4 possible causes of colony losses. Answers included starvation, weak colonies, poor queens, *Nosema* and weather conditions.

Beekeepers responded to questions on management of *Varroa* mites, *Nosema* and American foulbrood. Over 67% of beekeepers monitored *Varroa* infestation, the majority using Apivar™, formic acid and oxalic acid for treatments. Despite monitoring *Nosema* infections less frequently, many beekeepers regularly used fumagillin to treat nosemosis. Across Canada, registered antibiotics are used to treat for American foulbrood however beekeepers in Quebec and British Columbia applied these products less frequently. CAPA continues to work with various stakeholders and is actively involved in the Bee Health Round Table to address risks and opportunities related to bee health.

Introduction

Over the last decade, many countries, including Canada, have reported on overwintering mortality of honey bee colonies. The Canadian Association of Professional Apiculturists (CAPA) has surveyed and reported the wintering losses of bee colonies and possible causes of bee mortality at the national level since 2007. The objective of this national report is to consolidate provincial losses for a national representation, present the possible main causes of winter losses, and to provide information pest surveillance and control. These results provide information needed to identify gaps in current management systems, to develop strategies to mitigate bee colonies losses and to improve bee health.

Methodology

In 2015, the provincial Apiculturists and CAPA National Survey Committee members agreed on a harmonized set of questions (Appendix I). These questions took into account the large diversity of beekeeping industry profiles and seasonal activities within each province. Some provinces included supplementary regional questions which are not covered in this report. Beekeepers that owned and operated 30 or more colonies in British Colombia and New Brunswick; 50 colonies or more in Manitoba, Ontario, Quebec, Nova Scotia and Prince Edward Island; 100 colonies or more in Saskatchewan; and 400 colonies or more in Alberta were considered sideliners or commercial beekeepers and were included in the survey. The survey covered all full-sized producing wintered colonies in Canada, but not nucleus colonies. Thus, the information gathered provides a valid assessment of bee losses and management practices across Canada.

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

- Honey Bee Colony: A full-sized honey bee colony either in a single or double brood chamber and does not include nucleus colonies.
- Viable Spring Honey Bee Colony: A viable honey bee colony that survived winter, in a standard 10-frame hive, with minimum 4 frames with 75% of the comb area covered with bees on both sides on May 1st (British Columbia), May 15th (Ontario, Quebec and Maritimes) or May 21st (Alberta, Saskatchewan and Manitoba).

The survey material was provided to producers using various methods of delivery. The questionnaire was sent by regular mail, email and in some jurisdictions the survey was administered online or by telephone (Table 1). In each province, data was tabulated and analyzed by the Provincial Apiculturists. The provincial results were then analyzed and summarised at the national level to determine average bee losses across Canada. The national percent of winter loss was calculated as follows:

$$Percentage\ Winter\ Loss = \left(\frac{Sum\ of\ the\ estimated\ total\ colony\ losses\ per\ province\ in\ spring\ 2015}{Sum\ of\ total\ colonies\ in\ operation\ in\ each\ province\ for\ 2014}\right)x100$$

Results

Throughout Canada, 443 beekeepers responded to 2015 survey. These beekeepers operated nearly 52% of all colonies that were wintered in 2014. The surveys' methods, operational size of surveyed beekeepers, and the level of participation within each province are presented in Table 1. Accounting for live colonies that were too weak to be considered commercially viable, the national level of wintering loss was 15.9% for the winter of 2014/15 (Table 1).

All provinces experienced low or equivalent losses in comparison with 2013/2014 results. The level of winter loss varied among provinces, within regions in each province, and from operation to operation. This years' loss is considered one of the lowest average losses in the last 8 years since the national survey commenced. It represents a 36.4% reduction over the previous years' winter losses (2013/2014). In 2014/15, the survey indicated that Ontario beekeepers suffered a 38% winter loss, a decrease of 20% compared to losses reported in 2013/2014. When Ontarios' results are removed from 2014-15 calculations, the national level of winter loss decreased from 15.9% to 12.4%. The prairie provinces benefited from favourable winter and spring conditions and reported an average of 11.1% winter losses in 2014/2015. Overall, the 2014/2015 winter loss in most of the provinces, except Ontario, were close to or better than what beekeepers reported as an annual acceptable long term loss.

For detailed information about winter losses in each province, please contact each province directly for a copy of its provincial report where available.

Table 1: Survey parameters and honey bee colony mortality by province

Province	Total number of colonies operated in the province in 2014	Estimated total number of colonies not surviving or unviable (using the provincial percent of winter loss)	Survey results					
			Type of data collection	No. of respondents	Size of surveyed beekeeping operations	No. of the respondents colonies that were wintered in fall 2014	Surveyed colonies as a proportion of total number of colonies per province (%)	Winter loss as calculated from responding beekeepers (%)
Prince Edward Island	9,584	1,687	Online survey	28	all registered beekeepers	9,584	100	17.6
Nova Scotia	22,050	3,330	Email	23	50 or more colonies	17,431	79.1	15.1
New Brunswick	12,331	2,811	Mail, email	23	30 or more colonies	5,540	44.9	22.8
Quebec	51,979	9,720	Mail	75	50 or more colonies	36,687	70.9	18.7
Ontario	96,000	36,288	Online survey, mail, phone calls	109	50 or more colonies	38,667	40.3	37.8
Manitoba	81,400	11,396	Email	58	50 or more colonies	37,425	46.0	14.0
Saskatchewan	95,000	9,880	Email	28	100 or more colonies	31,056	32.7	10.4
Alberta	283,000	29,998	Mail, email, phone calls	67	400 or more colonies	165,107	58.3	10.6
British Columbia	46,000	5,524	Online survey	32	30 or more colonies	21,452	46.6	12.0
Canada	**697,344**	**110,634**		**443**		**326949**	**Average :**	**15.9**

Contributing Factors as Cited by beekeepers

Beekeepers were asked to rank possible contributing factors to colony losses. These responses are summarized in Table 2. Beekeepers reported that last winter was very cold and long in the Eastern provinces but quite warm in the Western provinces. It is not surprising that the weather was considered a major factor for winter loss in the Eastern provinces. Starvation due to lack of enough stored feed, or the inability of colonies to move to new resources within the hive, was reported by many beekeepers as well. In some cases, especially in Western provinces, honey bees started producing brood early and depleted their stored food, resulting in a starvation. Weak colonies in the fall, which could not able survive the entire winter were also identified as a contributing factor to losses across Canada. In several provinces, particularly the Prairie Provinces and Quebec, poor queen quality was considered the number 1 factor contributing to reported winter losses. Poor queen quality due to weak colonies and queenless conditions impact the colonies' ability to survive the winter.

Table 2: Top four ranked possible main causes of honey bee colony mortality by province, as cited by beekeepers who responded to the 2014-15 winter loss survey.

Province	Possible causes of bee losses reported by beekeepers (ranked from high to low)			
	1st	2nd	3rd	4th
PEI	Don't know	Weather	Starvation	Weak colonies in fall
NS	Don't know	Starvation	Weather	Weak colonies in fall
NB	Weather	Starvation	Don't know	Weak colonies in fall
QC	Poor queens	Starvation	Weak colonies in fall	Don't know
ON	Starvation	Weak colonies in fall	Poor queens	Don't know
MB	Poor queens	Starvation	Don't know	Weak colonies in fall
SK	Poor queens	Starvation	Weak colonies in fall	------
AB	Poor queens	*Nosema*	Starvation	*Varroa*
BC	Weak colonies in fall	Poor queens	Starvation	Don't know

Moreover, several beekeepers in different provinces reported that they did no't know why their colonies died. If beekeepers are unable to identify a possible cause for the mortality of their colonies, it may be because of multiple underlying problems, or a lack of monitoring colony health status throughout the season.

Bee Pest Management Practices

In recent years, pest management has become an widespread practice by beekeepers to ensure keeping healthy honey bees. Lack of monitoring bee health status and determining levels of infestation by pests can be a serious problem as reported in previous years. Therefore, this survey focused on asking beekeepers questions about management of three identified serious pests and diseases that could impact bee health and productivity.

A. Varroa monitoring and control

Varroa mite infestation continues to be considered by beekeepers and bee specialists as one of the main cause of honey bee colony mortality. Although very few concerns regarding *Varroa* were cited by beekeepers in 2014/2015 survey, sustained monitoring and management of *Varroa* in honey bee colonies have been widely recognized as most important factors to keep healthy honey bee populations in Canada.

In 2014, over 67% of surveyed of beekeepers monitored *Varroa* mite infestations mainly using the alcohol wash or the sticky board methods (Table 3). Alcohol wash was the most preferred technique in all provinces, except Quebec and British Columbia. The proportion of beekeepers that monitored *Varroa* mites using the alcohol wash technique was 45% (range: 11%-89%). It is reported that 22% (range 0-50%) of surveyed beekeepers used the sticky board method to determine mite infestations. The percentage of beekeepers from Quebec and British Columbia used sticky boards was 50% and 47%, respectively. Ether-roll and icing sugar shake techniques for *Varrao* monitoring were also reported to be used by some beekeepers in Canada. In British Columbia, 16% of the beekeepers reported using the icing sugar shake for monitoring *Varroa* mites. These results demonstrate that beekeepers recognize the value of surveillance and monitoring of *Varroa* mites. The educational programs delivered to beekeepers in Canada have made a difference in the application of proper beekeeping management practices for *Varroa* mites. Implementing surveillance and monitoring programs for *Varroa* mites enables beekeepers to successfully adopt principles of Integrated Pest Management (IPM) to determine the right timing and select the best treatment options for *Varroa* mites.

Most beekeepers in Canada manage *Varroa* mites using a combination of non-chemical and chemical control measures. Non-chemical methods include using bee stocks with genetic traits that increase tolerance to *Varroa*, trapping *Varroa* using drone combs, trapping *Varroa* using screened bottom boards with sticky boards and the division of colonies (e.g. splits) to set back the *Varroa* population. There are a variety of registered chemical options available to beekeepers including synthetic miticides, organic acids and essential oils. The efficacy of these miticides can be affected by several factors including time of treatment, pattern of use, presence of brood, ambient temperatures, and resistance levels in *Varroa* mite populations. Therefore, beekeepers are encouraged to use the most effective miticide that fits their operation and rotate miticides to prevent the development of resistance.

Table 3: *Varroa* monitoring and chemical control methods as cited by the responders of the 2014-15 winter loss survey.

Province	Beekeepers Monitoring *Varroa* mites (%)		Beekeepers who treated Varroa and method of treatment* (%)			
			Spring		Summer/fall	
	sticky boards	alcohol wash	% of Beekeepers	Main chemical methods	% of Beekeepers	Main chemical methods
PEI	28	32	84	Apivar[1], Formic acid[2]	96	Oxalic acid, Formic acid
NS	48	43	43	Apivar, Apistan[3]	96	Apivar, Formic acid
NB	30	35	43	Apivar	91	Apivar, Thymovar[4], Oxalic acid
Qc	50	11	54	Formic acid, Oxalic acid	94	Formic acid, Oxalic acid, Thymovar
On	17	40	81	Formic acid Apivar	97	Apivar, Oxalic acid, Formic acid
Mb	18	52	71	Apivar, Formic acid, Thymovar	76	Apivar, Oxalic acid, Formic acid
Sk	11	71	90	Apivar, Apistan	50	Formic acid, Apistan, Apivar, Oxalic acid
Ab	0	89	84	Apivar, Formic acid, Oxalic acid	54	Formic acid, Apivar, Oxalic acid
BC	47	31	66	Apivar, Formic acid, Oxalic acid	88	Formic acid, Oxalic acid, Apivar

* Chemical treatment is in order from most to least commonly used chemical for Varroa treatment

In the 2014/2015 colony winter loss survey, beekeepers were asked which methods they used for the chemical treatment of *Varroa* in 2014. The response of beekeepers is summarized in Table 3. In the spring, the percentage of beekeepers that treated with chemical methods varied from 43% in Nova Scotia to 90% in Saskatchewan. Throughout Canada, the main

[1] The active ingredient in Apivar™ is amitraze.
[2] Formic acid is applied in various commercial registered methods.
[3] The active ingredient in Apistan™ is fluvalinate.
[4] The active ingredient in Thymovar™ is thymol.

chemical methods for spring *Varroa* control were Apivar™ (a synthetic miticide in which the active ingredient is amitraz) and formic acid (an organic acid). In fall of 2014, most Canadian beekeepers treated their colonies for *Varroa* with chemical methods, ranging from 50% in Saskatchewan to 97% in Ontario. The main chemical methods of treatment utilized at this time of the year were formic acid, Apivar™ and oxalic acid. Beekeepers who responded to the survey very rarely mentioned Apistan™ (active ingredient: fluvalinate) and Checkmite^{+}™ (active ingredient: coumaphos) due to the resistance of mites to these active ingredients. The resistance to fluvalinate and coumaphos (two synthetic miticides) have quickly developed during the last decade. Consequently, amitraz (Apivar™) is currently the most commonly used synthetic miticide for *Varroa* control.

These reports tend to show that amitraz (Apivar™) is the most commonly used miticide for treatment for *Varroa* in Canada. However, due to the repeated use of amitraz (Apivar™), it may only be a matter of time before we see the development of resistance to this miticide. Therefore, beekeepers' awareness of these principles and monitoring the efficacy of amitraz (Apivar™) after treatment are important to avoid any failure of treatment surprises. Beekeepers are also encouraged to incorporate alternation of miticides with different modes of action, as well as good biosecurity and food safety practices to successfully manage resistance development to applied miticides. This type of information is the focus of many extension and educational programs offered by various provincial apiculture programs which will keep the Canadian honey bee industry healthy and sustainable.

B. Nosema **management practices:**

Nosema is considered a serious pathogen across Canada that can impact colony survival. However, it was rarely cited as a possible cause of colony mortality during the 2014-15 winter loss survey.Alberta was the only province where beekeepers cited *Nosema* as the second possible cause of winter losses in 2014/2015. Despite beekeepers in some jurisdictions not reporting *Nosema* as a cause for colony loss, this does not preclude this pathogen as a factor in colony losses. The pathogen requires thorough examination of bees in laboratories to identify and quantify the *Nosema* spores. Moreover, there is lack of epidemiological, and treatment information on the newly dominant species, *Nosema ceranae,* as well as its impacts on bee health.

In the survey, beekeepers reported their use of fumagillin for the treatment of nosemosis either in spring or in fall of 2014 (Table 4). The percent of beekeepers reporting using this drug varied widely from province to province. Each province reported higher use in fall than the spring except British Columbia where it was the same between the seasons. Alberta also stood out because 100% of beekeepers that responded treated their hives with fumagillin in spring of 2014.

C. American foulbrood management practices

American foulbrood (AFB) is a bacterial disease of brood caused by *Paenibacillus larvae*. Although AFB is considered endemic in most countries, it is always of great concern to beekeepers and, consequently, it is regulated in every Canadian province. Antibiotics do not kill AFB spores but prevent the growth and multiplication of the vegetative form. Oxytetracycline, and more recently tylosin, are antibiotics currently registered for treating AFB in Canada. The pattern of use for these antibiotics, as reported by beekeepers who answered the 2014/2015 winter loss survey, is presented in Table 4. The percentage of beekeepers who applied oxytetracycline was 44% and 41% in spring and fall, respectively. It is not a surprise that tylosin is less frequently used by beekeepers than oxytetracycline for the control of AFB. This

Table 4: Antibiotic treatments for *Nosema* and American foulbrood as cited by the respondents of the 2014-15 Winter loss Survey.

	Beekeepers (%) who applied Fumagillin		Beekeepers (%) who applied treatments for American foulbrood			
	Spring	Fall	Spring Oxytetracycline treatment	Spring Tylosin treatment	Fall Oxytetracycline treatment	Fall Tylosin treatment
PEI	34	38	44	4	24	8
NS	39	70	87	0	52	0
NB	35	74	74	0	39	0
Qc	8	26	8	1	7	1
On	22	29	62	0	62	0
Mb	28	47	74	0	46	7
Sk	46	54	71	0	82	4
Ab	100	25	43	0	30	19
BC	53	53	19	3	28	6

antibiotic has been recently registered in Canada, and it is good practice to restrict its use to situations where oxytetracycline resistance is suspected or confirmed. Beekeepers from Quebec report a much lower level of use of antibiotic treatment for AFB. This reported low use of antibiotics may be related to the Province of Quebec's mandatory requirement for veterinary prescription for any antibiotic use in honey bees.

Further Work:

CAPA members continue to work closely with the Bee Health Round Table, scientists, regulators and stakeholders to address bee losses and bee health. Members of CAPA and provincial apiculturists have also been actively involved in conducting surveillance programs to monitor the status of bee health at the provincial levels and across the country. Researchers within CAPA are active in evaluating alternative control options for *Varroa* mites, developing methods of integrated pest management (IPM) for honey bees and breeding of genetic stocks more tolerant of diseases and mites.

Educational extension activities led by provincial apiculturists and technology transfer programs have been conducted across Canada to promote IPM practices to beekeepers. Best management practices that mphasize surveillance programs to monitor *Varroa* mites and *Nosema* spp, show proper use of treatment options, and discuss winter management are included.

Members of CAPA are currently pursuing research in: honey bee immunity, honey bee viruses, genetic expression of honey bee responses to disease, the impacts of neonicotinoid pesticides on the short and long-term health of honey bees, the biology of new and emerging bee pests, best management practices to promote the health of colonies, and nation-wide surveillance of honey bee pests and diseases. In cooperation with the Canadian Honey Council, CAPA members are also involved in pursuing the registration of alternative products for *Varroa* control in Canada.

Honey Bee Winter Loss in Canada since 2007

In Canada, winter loss shows a declining trend since 2010 (Fig 1). The winter losses were highest in 2007 to 2009 ranging from 29.0 – 35% (average 32.6%). From 2010 to 2015, losses ranged from 15.5 to 29.3% (average 23.8%). It should be noted that the reported winter loss in 2014/2015 was in most of the provinces within the acceptable long term targeted winter loss by beekeepers.

These reports of multi-year surveys provide evidence that beekeepers have been successfully addressing bee health issues. However, the challenge faced by most beekeepers is to maintain bee health and effective treatment of bee pests. At this time, beekeepers have access to few effective chemical products to control *Varroa* mite and *Nosema.* If resistance develops today to any of these products and alternative treatments are not available or are still under development, beekeepers will suffer serious consequences. Ultimately, beekeepers must consider an integrated approach to maintain healthy bees. This approach is not only limited to pest management, but it includes proper nutrition, large healthy bee populations throughout the year, and reducing exposure to pesticides.

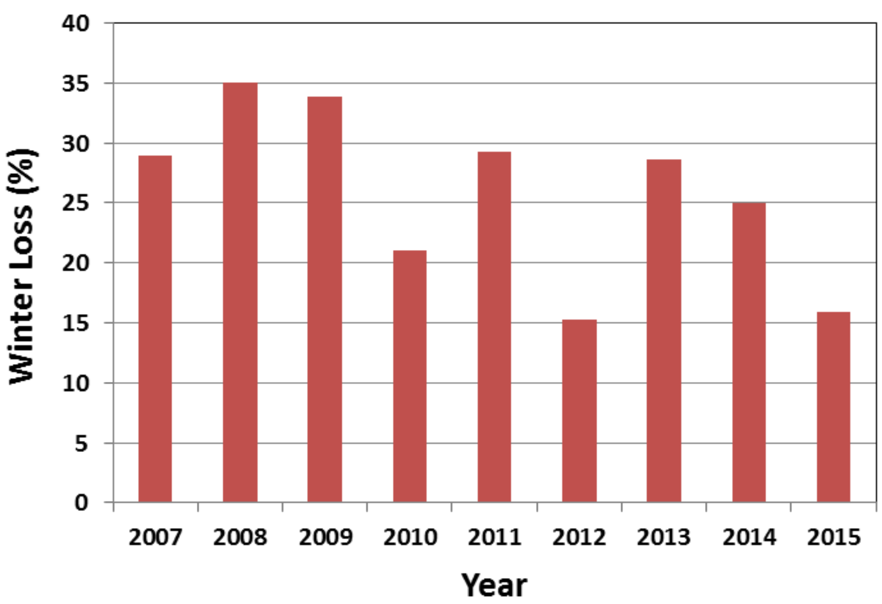

Fig 1. Honey bee colony loss (%) in Canada from 2007-2015.

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Appendix I: CAPA - 2015 Core Winter loss survey questions

The followings are the core questions that will be used in 2015 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[5] were put into winter in fall 2014?

   ____

2. How many full sized colonies[1] survived the 2014/2015 winter and were considered viable[6] on May 1st (British Columbia), May 15th (Ontario, Quebec and Maritimes) or May 21st (Alberta, Saskatchewan and Manitoba) ?

   ____

3. Which method of treatment did you use for varroa control in **spring 2014**? What percent of hives were treated ? *(Choose all that apply)*

	Treatment	**Percent of hives treated (%)**
☐	Apistan (fluvalinate)	
☐	CheckMite+ (coumaphos)	
☐	Apivar (amitraz)	
☐	Thymovar (thymol)	
☐	65% formic acid – 40 ml multiple application	
☐	65% formic acid – 250 ml single application	
☐	Mite Away Quick Strips (formic acid)	
☐	Oxalic acid	
☐	Other *(please specify)* ________________________	
☐	None	

[5] Does not include nucleus colonies

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

4. Which method of treatment did you use for varroa control in late **summer/fall 2014**? What percent of hives were treated? *(Choose all that apply)*

	Treatment	Percent of hives treated (%)
☐	Apistan (fluvalinate)	
☐	CheckMite+ (coumaphos)	
☐	Apivar (amitraz)	
☐	Thymovar (thymol)	
☐	65% formic acid – 40 ml multiple application	
☐	65% formic acid – 250 ml single application	
☐	Mite Away Quick Strips (formic acid)	
☐	Oxalic acid	
☐	Other *(please specify)* _________________________	
☐	None	

5. Have you monitored your colonies for Varroa during the 2014 season ?
   - O Yes – sticky board
   - O Yes – alcohol wash
   - O Yes – other (*please specify*) ______________________________
   - O No

6. Which method of treatment did you use for **nosema** control in **spring 2014**? What percent of hives were treated?

	Treatment	Percent of hives treated (%)
☐	Fumagillin	
☐	None	

7. Which method of treatment did you use for **nosema** control in **fall 2014**? What percent of hives were treated?

	Treatment	Percent of hives treated (%)
☐	Fumagillin	
☐	None	

8. Which method of treatment did you use for **American foulbrood** control in **spring** 2014? What percent of hives were treated? *(Choose all that apply)*

	Treatment	Percent of hives treated (%)
☐	Oxytetracycline	
☐	Tylosin	
☐	None	

9. Which method of treatment did you use for **American foulbrood** control in **fall 2014**? What percent of hives were treated ? *(Choose all that apply)*

	Treatment	Percent of hives treated (%)
☐	Oxytetracycline	
☐	Tylosin	
☐	None	

10. To what do you attribute the main cause of death of your colonies? (Please indicate percentage of wintered colonies that died from each factor.)

	Cause of death	Percent of wintered colonies that died from this factor (%)
☐	Don't know	
☐	Starvation	
☐	Poor queens	
☐	Ineffective Varroa control	
☐	Nosema	
☐	Weather	
☐	Weak colonies in the fall	
☐	Other (Please specify) ________________________	
☐	Other (Please specify) ________________________	
☐	Other (Please specify) ________________________	