# A.B.C

# Winterization Guide for Beekeeping

Apiaries and Bees for Communities

www.backyardbees.ca

Written By Eliese Watson

## Forward

"Agriculture has been designed as a competition, who said that competition was a virtue? The disease of the moral culture of the mind is our inability to understand diversity."

- Dr. Vandana Shiva
  Calgary, 2011

I would first like to thank you for having a look through this guide! It is my honor to share what I have learned from the honeybees with you, they are the most excellent teachers in life. And although this guide is a practical guide to winterization of a honeybee colony, I would like to take a moment to thank the bees for coming to me and changing my life. It is through them that I have learned how to live the *hive mentality* in my daily life and work practices.

I started A.B.C- Apiaries and Bees for Communities in Calgary, AB Canada in 2010, and at the time, had no idea what I was doing. All I knew was that I *had* to work with bees. As A.B.C developed, I learned that there were so many people in my city, and others, seeking out honeybees for the purpose of reconnecting with nature in its purest form. As we came together, we came together as bees do: working together with all of our unique and diverse skills, working as a collective, learning and growing as a whole. This experience has made me realize the amazing lessons that bees are teaching all new beekeepers around the world: **Honeybees offer us a glimpse of a reality where altruism, collaboration, and living in harmony with nature are possible.**

The best part of the urban beekeeping revolution, in my opinion, is not that we are all uniting to *save* the honeybees. This idea, although beautiful, lacks depth. We are not the saviours of these little creatures, they are ours. They have survived about 100 million years of ice ages, geological calamities, seen mountains rise and fall, and humans rise from the earth. If anything, they are here to teach us something. I see it in the eyes of every person who goes inside a beehive for the first time. Remember the way the hive smelled the first time you stuck your nose in, the way you held your breath when you saw the queen for the first time**?** These are not just insects! Bees transcend any sort of reality that we have thought possible of success in this world, a competition free reality. Maybe this lesson is what will save us. If only we were to all open up to what they have to teach us, listen to their lessons, and grow and flourish as they have, maybe then the bees will again flourish. Maybe that is what it will take, and then the management of the bees will become less about their production and taking away, and more about living in harmony with bees and sharing with them in the fullest sense.

This short manual is a practical guide about hive health and winterization with some clues and ques to look for when you are attending to your honeybees in the fall. Some of the concepts may seem basic, but I feel that it is important to look at all factors of the complex honeybee network to understand the colonies needs and wants. That said, some of these concepts may be hard to get your head wrapped around, if so, do not worry. As said, the honeybees have 100 million years of evolution under their belt; they are complex and sophisticated organisms which have been studied by many throughout the ages, and still, our knowledge is miniscule. So take a breath and smile, the world is not as simple as it may seem, and isn't that a beautiful thing!

Your sister bee,
Eliese Watson
Founder, Apiaries and Bees for Communities (www.backyardbees.ca)
Director, The Community Pollinator Foundation (www.thepollinatorfoundation.org)
Creator, The Community Hive (www.thecommunityhive.org)

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## Assessing Your Beehive in the Fall: Things to look for

Whether you are a diligently observant beekeeper, a lovingly consistent bee inspector, or simply a bee-minder, there are very important things that you need to be looking for in the fall to ensure that your bees are well prepared for the winter season. By doing these things, you can increase the chances of survival of your beloved comrades, and get your fill in of their company before they disappear for the winter season. Remember, once they are wrapped, you won't be getting in to the beehive at least until April!

Here is a list of 'normal' behaviour things to look for in your beehive in the fall!

1. **Drone Culling**: Drones have a very important purpose in the lifecycles of honeybees. As the carriers of important genetic material, they are the conduits of genetic information that is vital to the diversification and resiliency of future colonies. Drones are created in the early summer months and are raised from unfertilized eggs laid by the Queen with the purpose of spreading her genetic code to other colonies. A queen and a colony will primarily lay drones when there is an abundance of surplus of nectar and pollen, and the health of the hive is at its highest. Because drones do not take part in pollination or in the nursing of young bees, they are a drain on the resources of the hive, and therefore will not be tolerated within the beehive for the fall, winter and spring months. The limited storage of pollen and honey are put to better use with the more efficient and hive supportive members of the colony: the female workers and the queen. *In the fall you will see drones being shoved and or dragged out of the hive and left for dead. This is a natural progression of the hives lifecycle.* These drones offer sustenance to other members of the habitat: wasps, birds, and small animals before the winter comes.

2. **Entrance Protection:** You should notice a stronger and more assertive group of guard bees at the entrance of the beehive in the fall. Why is this? This is because honeybee populations are still high in the early fall, but the amount of pollen and nectar available to forage on has decreased to very small amounts. The bees not only become more inquisitive for alternative sources of nourishment, but are also seeking out opportunities to ***Rob*** neighbouring communities. ***Robbing*** is a common concern for honeybees as they enter in to the fall. If the colony is weak in the fall and is incapable to protecting their entrance, they may fall victim of either another honeybee colony looting their stores, or of wasps coming in and stealing their young, nectar, and pollen. To solve this problem, many colonies may put up a visible blockade made of wax and or propolis to close off parts of the entrance and or show greater fervour in checking the bees entering the beehive.

3. **Brood Nest Size:** As the sunlight hours diminish in the fall, and the quantities of nectar and pollen coming in to the hive decrease, these factors become ques for the queen to decrease the quantity of eggs she lays. The decreased size of brood nest allows for the populations of the beehive to slowly diminish in to the fall and also increase the spacial access for pollen and honey storage in the brood nest locations without the necessity of building more wax or expanding the hive size. This is a very important part of fall because the colony must be at just the right size for the amount of honey stores available to the colony as well as large enough to keep the colony warm throughout the year. Too large may cause them to starve out, and too small may cause them to freeze to death. This is the important risk that the beehive is concerned about when entering the fall!

4. **Hygienic Behaviour:** In the spring and in the fall, the beehive will engage in fervour for cleaning the beehive. This is because the bees in the hive, throughout the winter, move slowly to maintain energy and are incapable of breaking cluster to tidy up the hive, making them particularly susceptible to disease and stress. So, by cleaning out the hive, the bees are taking preventative measures to ensure their hive is clear of fungi and viruses that may take over in the sensitive winter months. This is an inherent behaviour that bees have in these seasons. There is a lot of news about *hygienic bees*, that bees can be bred to be specifically better cleaners then generic honeybees. I would like you to have a read about **Epigenetics** at this link (http://www.time.com/time/magazine/article/0,9171,1952313,00.html). The story is about people in Sweden, but the importance of the story in regards to bees is that learned behaviours and environmental factors can be expressed within a few generations within genetic codes. It is all very interesting; but the real lesson is to trust that the bees are working in a higher and more sophisticated level then we currently understand.

5. **Clustering:** Honey bees will begin to cluster at temperatures below 18C in the fall. So this means that when you look in to your beehive at these times, your hive will look as though man of the bees have disappeared. This is because the bees in the hive have compressed in to a small ball

## Indicators of Honeybee Hive Health in the Fall

**Common Ailments**

**Varroa Mites:** The standard method of 'bee-care' is to treat for varroa mites and diseases in the fall to ensure that your hive will survive the winter season. It is important to understand that the mites do not kill the bees through their existence; they are instead a gateway parasite. This means that the punctures in the bees' exoskeleton allow for other diseases to take over because of the bees weakened immune system. In my personal opinion, you will not have a concern for varroa mite infestations if:

6. Your hive has swarmed and you allowed your colony to requeen naturally
7. You split your hive and you requeened naturally
8. You went queenless for a minimum of 3 weeks before inserting a mated queen
9. You have not seen any signs of mites on your honeybees

As you see in the video, nymph varroa need young larva to feed on in order to successfully reproduce. By allowing your hive to go queenless for a period of 21 days or longer, you have allowed your bees to reach maturity and offer a lull of time where there is no larva for the varroa to reproduce on. You also allow for a period of time for the nurse bees to focus on cleaning the beehive of any health concerns, increasing the epigenetic behaviours for hygienic activity. This allows for the bees to naturally catch up with varroa populations when the bee populations are the greatest and the hive health is at its most vibrant. In my opinion, this method of care will be like the concept of crop rotation after the destruction of soil health in the dirty 30's. Allowing the bees a chance to stop producing bees, and catch up with the internal health of the hive, will in the end, help increase the total health and survival rate of the colony.

**Chalk Brood:** Chalk brood is a fungal infection that takes hold in a beehive under stress. This means that if you see chalk brood within your hive, it is an early indicator of beehive poor or depleting health. Chalk brood can be identified easily by looking at the brood nest and observing uncapped brood which looks white and chalky. The fungus attacks the brood and causes the larva to harden inside the cell. You can observe the effects of chalk brood at the hive entrance as well, as the workers carry out the mummified larva out the front.

**Nosema:** There are two different types of nosema: *nosema apis* and *nosema ceranae.* Both types of nosema are a single celled protozoan that affects the digestive system of the honeybee. Unlike apis, *ceranae* protozoan act similar to fungi in that it can survive for long periods in a dormant state in both dry cold, and warm wet environments, and is harder on the health of the honeybees if contracted. Both nosema types are spread through fecal matter discharged throughout the hive, digested by the bees in an effort to clean it up, then shared through the transfer of nectar between bees as the residual protozoan remain in the bee gut. The spread of the protozoan through cleaning behaviour decreases the chances of drones and queen contraction. Nosema effects bees by decreasing worker bee's ability to digest proteins and decreases their lifespan. Queens can become infected with nosema and the disease can cause the queen to atrophy. Signs of the causes of nosema are queen supersedure, winter kills, reduced honey yields, and dwindling populations.

**Uncommon Ailments; but keep a keen look out**

**Foul Brood:** AFB, American Foul Brood, is a very unique and distinct bacterial infection that affects the bees in their brood stages. AFB is a spore forming bacteria which can remain in a beehive, active and inactive, for over 50 years. AFB was first found in the United States in the early '80s. Fear of the disease, and the tracheal mite, spreading the Canada was the main reason for the closure of the border of beekeeping equipment and bees in 1987. AFB is a very challenging disease to manage once the bacteria vegetates and releases its spores. Some colonies, during the honey flow, are able to clean up the bacteria and overcome the effects of the bacteria. Many are not, and the primary response to decrease chances of the beehives spores effecting the other hives in the area, due to the highly social behaviour of bees and the impacts of drift in bees during the honey flow, beekeepers will burn the whole hive, bleach/peroxide their equipment, and or treat with antibiotics.

How to identify AFB?

Beehive Scent: AFB, in its many stages of effect on the hives populations, will give the beehive the scent of rotting flesh. You are ***not*** able to identify AFB by looking at adult bees. The spores are carried by the bees, but only vegetate on the larval stages of bees causing the larva to completely decompose within the cell and settle in a gooey mass at the bottom part of the cell.

Holes in the capped cells: Have a look at your brood cells and see if there are punctures or the capping looks sunken in. The holes are created by the adult bees looking in to see what is happening to the larva below. And, with seeing the infected cell below, the adult bee will, earlier on in the infection, chew the capping off and clean the cell by ingesting the infected slurry of the dead larva and 'vomiting' it out once it leaves the hive. This is how the disease is transported to other bees, by the bees later sharing nectar from one another contaminated with the bacteria and eventually fed to the larva. In the later stages of the effects of AFB the bees will leave the infected cells capped after finding the dead larva because their numbers are too weak to clean out the cells.

Rope Test: European Foul Brood and American Foul Brood are very similar in that they are both spore forming bacteria and they affect the bees the same and smell the same. EFB, though, is a less invasive bacterium and rarely results in the need to burn the hive. How you tell the difference between the two is to do the ***rope test***. The rope test is very easily done. If the hive is infected with AFB you will be able to tell by using a tooth pick or pin by inserting it in to a diseased cell. When you pull the slurry out with the pin or toothpick, you will see the substance stretch out like glue. This is proof that you have AFB. If you

have all of the symptoms of Foul brood, but fail the rope test, it is likely that your hive in infected with EFB.

If you have identified AFB within your hive, it is recommended that you contact the Medhat Nasr, and he will send an inspector to come out and have a look at your hive. He will be able to take samples from the hive to identify the AFB as antibiotic resistant or not. He will then offer you advice to what chemical treatments and or doses you can use or he will recommend the burning of the beehive itself. It is very important that you review the chemicals recommended because many of these chemicals will have long term residual effects on your colony for years to come as well as some products rumoured to being recommended for the treatment of AFB through this past season are not approved for commercial use within a beehive or tested for that use. I guess the key to all of this is to always do what you feel is right, do your research, make some phone calls, and do what makes you feel like it's the right decision. You are beekeeper, and therefore will always be a student to the field!

It is my opinion that foul brood cells are residual in all colonies, and that it flares up within a beehive under duress. Therefore, the best preventative measure you can make is to observe the health of your colony throughout the year and be sensitive to early signs of beehive stress; hive behaviour during inspections, chalk brood fluctuations, varroa mite concentrations. Take these factors in to consideration with the weather, nectar flow, time of the year, and previous actions taken with the hive. For example, if you have a hive showing signs of chalk brood, but it is in late May, which was particularly wet (increasing the stress and outbreaks of chalk brood within colonies in general) but you decide to go through your plan to split the colony due to personal goals. It is likely that your splits will have a weak build up and the quantities of chalk brood in the queened colony will increase, as well as the susceptibility to other diseases and viruses. The ideal way to approach all decisions which will impact the colony such as splitting is to consider the beehive as a living single organism. If the immune system of the colony has signs of being low, it is important to not take actions which will put the colony at risk of becoming very ill.

## Overwintering Your Beehive

When preparing your beehives for winter wrapping, there are a lot of things to consider. Here are a few things to keep in mind as you prepare your plans.

**How wrapped is wrapped?:** Although at first thought you imagine that the bees need to be packed in tight like a well wrapped Christmas present, keep in mind that the bees are breathing organisms, and by-products of respiration are water and carbon dioxide. Without proper ventilation, the beehive can succumb to carbon dioxide poisoning or become chilled due to moisture build up.

**What is the most common causes of winter kill?:** There are, I am sure as in anything to do with bees, many beekeepers who will disagree with me, but through asking every beekeeper I meet, their answer has been most commonly **moisture build up issues.** Bees are fully capable of living in a moist environment throughout the winter so long as the moisture isn't excessive; such as drops or draining water falling on to the cluster. That is why it is important that the bees have proper ventilation through the top of the hive, not just the bottom. Excessive moisture build up can also cause mould to form in the early spring, causing the bees to live in a high degree of stress. Have a look at the picture below of mould pulled from a beehive that survived the winter season.

**Other issues with moisture build up:**
The bees may become ice bound in the winter. When this happens, it can look as though the beehive starved out in the winter, even though there can be a full super full of honey below the cluster. This is a challenging thing to prove, because by the time that you unwrap the bees, the ice has melted and fallen to the bottom of the hive, and therefore you cannot see the direct causes of why the bees didn't move down to eat the honey surplus. This can be caused by a poor winter location. Some locations are wetter and increase the chances of moisture build-up. Also, this may be caused by poor ventilation in the hive, causing the ice to build up instead of move out of the hive with air circulation. It is important that you have a lower and upper air access, even in the smallest amounts, to allow a small convection within the hive for moist air to leave the hive.

**Ideas and strategies to decrease moisture issues:**
Now, I have heard of many things being done to help maintain moisture in the past year, including maxi pads, external heating elements for the hive, indoor winterization, and the like. But the best way to ensure that your bees are going to enjoy a dryer winter season is to ensure that the hive is properly insulated on the roof. Heat rises in the hive and it is through this heat loss that the outside weather fluctuations can directly affect the internal climate of the colony. With the weather that we have here in Calgary and area, these fluctuations can be extreme; -30 one day, +10 the next. That is why it is important that you offer as much buffer space for the bees to regulate their hive temperature with as little work and stress as possible.

**Bill Staggs Method**: Bill, like many other beekeepers, really likes to use carpet directly on top of the top bars with the shag facing toward the hive. Carpet has a high fibre count and will insulate the hive, as well as absorb excess moisture when hive temperature fluctuations cause the ambient humidity to distillate. He then likes to place in Reflectix(TM) on top of the carpet. He then wraps his whole unit with a black plastic wrapped insulation folded in on the top over the Reflectix(TM), with the telescoping lid holding the wrapping down. The wrapping has holes in it where the entrances (with their reducers on) are at the bottom and the top of the beehive so that the bees can fly on sunny days to expel their wastes. (Bees won't poop in the hive over the winter to keep the hive clean and decrease the chances of disease) Bill does the three layered whammy! This is what I am going to be doing this fall with my bees, in both the langstroth's and the Top Bar Hives.

**Sam Comfort and Reflectix(TM):** Sam likes to put Reflectix(TM) directly over the top bars. Keep in mind that Sam lives in a more temperate climate to here, living in upstate New York. Reflectix(TM) can be bought through any hardware store and bought in a roll. He says that it helps keep the heat in the hive quite well.

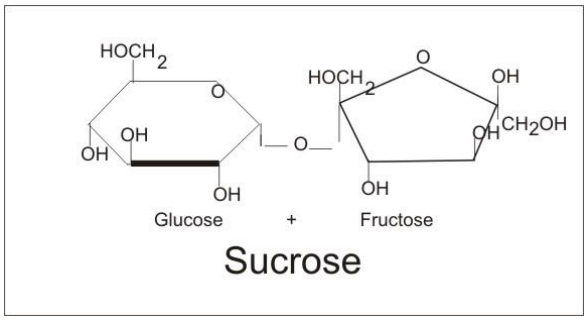
**Insulated Super**: There are a lot of beekeepers who will do an insulated top shallow or standard super as well. This is done by placing a feeder board over the top brood box in a langstroth beehive design, then placing a shallow super over the board, filling the box with household insulation, wool blankets, or leaves/organic matter (such is used in Japanese warre hives). Some beekeepers will use the feeder space throughout the fall and keep an over turned paint can over the feeder box to feed the bees in the early fall ensure the bees have enough for the winter. These internal feeders will decrease the robbing behaviour in a densely populated bee yard.

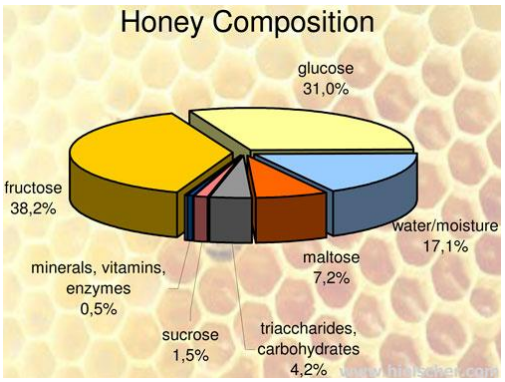
**TBH Winterization:** As with langstroth beehives, it is imperative that there is an adequate amount of roof insulation. I am going to winterize my hives similar to the way that Bill Stagg winterizes his colonies with the triple roof insulation and wrap. I have also drilled holes just under the rim of the lid which measures ½ inch at the front. This will allow bees to come and go as they please from the top on warmer days, and also allow for the moisture to flow out of the hive. I make sure that the lid overhangs the hole because I don't want excess moisture from the lid dripping in and freezing the hole shut.

## To Feed or Not to Feed, That is the Question!

If you are in a room of beekeepers and you want to see faces flush and arguments to ensue, ask about whether you should feed or not and the *right way* to do it! Keep in mind these are my opinions, the information that I have found and digested (pun intended) and that you should always practice what you are comfortable practicing! It is *your* relationship with *your* bees; not mine. So, here are some basic questions answered.

**What is feeding?:** Feeding is done by beekeepers to ensure that the beehive has enough food for the winter season. To be honest, it is something that has only come in to practice as beekeeping has increased as an industrial practice. Once honey has become a bulk commodity, it has become the beekeepers practice to harvest most/more honey then the hive can replace before the winter. Sugar on the market has always had a cheaper price per pound than honey, so it has been an economic incentive to harvest the honey and artificially feed the bees. And guess what? The bees don't even know the difference! Just kidding. Of course they do! So are you an evil do-er if you feed? Of course not, but there are some very important things to consider before you feed.




**Considerations to take before feeding:** In the image above, you can see the difference in the components of sugar vs. honey. Now, these images do not even take in to considerations the yeasts and living bacteria that exist in the raw honey stored in the hive which aids the bees in digestion and health. The .5% of minerals and enzymes in the honey, I feel, plays an integral role in the health of the colony throughout the year. So, although the bees do and can survive on artificial feed, there will be a long term effect on the bees if this is *all* they are eating. So, it is important that you leave enough honey for the bees to overwinter with or without feeding. They work all year to gather the food that they know they are going to need to survive the winter.

**When is it a good idea to feed?:** Many people will feed their bees when they come from a package overseas because the trip can cause the colony to be weak and lack the energy needed to forage for nectar and pollen sufficient to feed the bees and their young. Feeding also attributes to hive build up, meaning that there is food to go around, even if there isn't a nectar or pollen source. Commonly beekeepers will feed during times of dearth. This means bees are fed in the early spring, during prolonged rainy periods, and in the fall. Dearth feeding is commonly done in the beekeepers interest, and is not necessary to be done for the sake of the bees. Feeding during these times offers a larger population of mature foragers when the nectar flow comes on, ideally ensuring a larger honey crop in the fall or bees to split in the early parts of summer.

**What are the risks of feeding?:** The time of year is important when you are artificially feeding honeybees. Whether the product being stored in the comb comes from nectar or sugar, the form of the product must end off at 14%-21% moisture. This means that that excess moisture must be lost through evaporation before the product is considered *cured* or *ripened*. At which case the moisture content is also low enough to keep it from fermenting in the comb. For the proper ripening to occur, there needs to be an ambient temperature high enough to promote healthy evaporation as well as a long enough break in time from the feeding, capping, and fall cold daytime and night-time temperatures. As mentioned before in the previous topics of winterization, moisture can be a very important challenge for the bees throughout the winter. If the bees go in to winter with combs full of nectar with a moisture content over that of 21%, you run a risk of excess moisture build up throughout the winter as the evaporation process intermittently takes place throughout the winter months inside the hive without adequate external temperatures to encourage that moisture to go beyond the hive door. So, be sure not to feed too late in to the fall season or in the winter months.

**What role does pollen play in the spring/summer/fall?:** Pollen is a very important part of honeybee health. It is their only source of protein in the bee diet and is a primary component of bee bread or brood food.

- **Spring:** Pollen is an important part of honeybee development between 2 and 21days. Just as important, it is an indicator of the external environments progression through the seasons. Within the beehive, the bees live in relative darkness, and most of their understanding of what is growing outside the hive is strictly dependant on what the worker bees are bringing in. This goes for the queen too! So, if in the early parts of spring, the bees begin to bring in pollen, it is a trigger for the queen to start laying eggs. The environments production of pollen stands as a testament that summer is fast approaching and the food that will be available for the hive will soon be at their disposal. So, when beekeepers place pollen patties in the beehive, what they are doing is tricking the beehive in to thinking that outside the hive, there are flowers popping their heads out of the snow already. This causes for a longer season for the beekeeper and a stronger foraging work force when the nectar flow comes on in 2 months. This is the cause *spring build up*. There is a risk that the beekeeper takes on putting pollen patties in the hive in the spring, and it is the lack of knowledge of the honey store surplus available to the bees in the hive and the highly unreliable weather that is to come in the following months. It has happened where a beekeeper has put in pollen patties too early and the bees starved out because there weren't enough food stores to feed the growing and expanding hive population.
- **Summer:** As said before, pollen is integral to the development of young bees, and so pollen is needed throughout the summer months to be fed to the young. It is during the summer months though that the bees store surplus pollen in the hive to be saved for the fall and spring months to come. You can observe the development and growth of larval stage bees by watching the bees bringing in pollen at the entrance of your hive. A colony without brood will not bring in pollen.
- **Fall:** Pollen is very important to the development of healthy *winter bees*.

  "***Winter bees live a lot longer (100+ d) than summer bees (~30 d)*** The trigger colonies use to switch from summer to winter bee production is unknown, but a leading hypothesis is that it is simply the cessation of brood rearing in the fall. Nursing, after all, is hard work and the bees born into a nest with no nursing jobs have it easy and live longer. Although the verdict on the trigger is still out, it is clear that winter bees differ physically: "newly emerged bees that overwinter have significantly greater dry weight, protein, fat, triglycerides, glycogen and glucose content than bees that do not survive to winter" (http://www.capabees.com/main/files/pdf/winteringpdf.pdf)

## Winter Inspection Sheets

The following are general inspection sheets that can be used throughout the year to aid you in keeping track of the development and challenges facing your beehives throughout the year. I cannot stress enough how important it is to keep track, in one way or another, of how your hives are doing. You can have a diary, notebook, duct-tape on your hive with notes, or a binder with inspection sheets, it's all up to you. But by keeping track you can have an idea of what works and what doesn't. Especially after the long winter months, you can forget what you did the previous year, and miss out on the opportunity of rooting out what occurred and why, and learn from those experiences.

# Apiaries and Bees for Communities Inspection Report Card

| Apiaries and Bees for Communities<br>www.backyardbees.ca<br>403.244.4770 | Hive Name(s):<br>Inspected By:<br><br>Yard: | Equipment Inventory: |
|---|---|---|

Comments:

| Sun | Mon | Tue | Wed | Thu | Fri | Sat |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

| Inspected for | Date | Date | Date | Comments |
|---|---|---|---|---|
| Traffic @ Entrance: H/M/L | | | | OUTSIDE THE HIVE ASSESSMENT: |
| Bees brining in pollen? Y/N | | | | |
| Feeder in Place? Y/N | | | | |
| Signs of Dysentery? Y/N | | | | |
| # of Brood Boxes on? | | | | |
| # of Honey Supers on? | | | | |
| Queen Excluder on? | | | | |
| # Frames of Open Brood? | | | | INSIDE THE HIVE ASSESSMENT: |
| # Frames of CBrood/ % V | | | | |
| # Frames of CHoney % V? | | | | |
| See Eggs? | | | | |
| See Queen Cells? Age? | | | | |

# Apiaries and Bees for Communities Inspection Report Card

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**Apiaries and Bees for Communities**
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**403.244.4770**

Hive Name(s):
Inspected By:
Yard:

| Inspected for: | Date | Date | Date | Comments |
|---|---|---|---|---|
| See Small Larvae? | | | | INSIDE THE HIVE ASSESSMENT: |
| See the Queen? | | | | |
| See Drone Cells? | | | | |
| Did the Hive Swarm? | | | | |
| Total Frames of Bees: | | | | |
| Total Frames of Brood: | | | | |
| Total Frames of Honey: | | | | |
| Total Raw Foundation? | | | | |
| # of Bad Comb/burr/old wax? | | | | |
| Hive Scent Normal? | | | | DISEASE ASSEMENT |
| See Brood Disease? ID? | | | | |
| Deformed Wings on Bees? | | | | |
| See Mites on Bees? | | | | |
| Mite Drop Test? # in 24 hrs | | | | |
| Hive Re-queened? | | | | |
| Bottom Board Clean? | | | | |

## Is Your Hive Winter Ready?

Like any society, the concepts of what is evaluated as success are distinctive to the culture and the environment. It is challenging to set up a schematic of standards to gauge what will ensure a successful winter for your bees. I have seen strong colonies with lots of honey starve out by spring, while beside that hive have a small 5 frame nuc survive with surplus in the same yard. Wintering success has as much to do with the colonies ability to communicate, share, and manage populations and brood development. If a queen keeps a cluster too large, the outside bees can die from the cold because they are too far from the central heat. The bees may also exhaust too much moisture though eating and breathing, as well, eat the food stores too quickly. So, as much as it is about not taking too much and ensuring that there is food, in the end, it is up to the bees to survive. So, the information garnered below is a generalization based on research and years of experience from commercial beekeeping practices taking place here in Alberta and other provinces and states.

**Statistics and ratios to keep in mind**

Honey stores: 80-90lbs- 36-40kgs (each frame/bar = 6lbs)
Pollen Stores: 3-6 frames or bars
Varroa drop: 8 is the viable maximum for transport bees inter-provincially.
(sticky bottom board test in a 72 hour period/3)

See the attached publication from Beverlodge Honeybee Research Centre in Alberta Canada.

**Canadian Association of Professional Apiculturists**
**L'Association Canadienne des Professionels de l'Apiculture**

# The Biology and Management of Colonies in Winter

Adony Melathopoulos
Beaverlodge Research Farm, Box 29, Beaverlodge, AB T0H 0C0 melathopoulosa@agr.gc.ca

## The Biology of Wintering

In nature bees have two general methods for maintaining colony temperatures in winter: 1) selecting a protected and well-suited cavity (**Tab. 1**) and 2) clustering.

Clusters have a two-part structure (**Fig. 1**): 1) a ***dense outer mantle*** in which bees jam together, orienting their heads towards the center of the cluster and 2) a ***loose inner core*** where bees are free to move. The ***mantle insulates*** and, at its tightest, approaches the insulation of bird feathers or mammal fur (0.1 W/kg/ºC). Clusters move slowly from empty combs to ones full of honey. This movement is typically upwards and sideways, never downwards.

Before we go on, here are ***four critical temperatures*** you should know: 1) brood nest = **32-36ºC**, 2) minimum thorax temperature needed for flight = **27ºC**, 3) minimum temperature needed to pump flight muscles and warm up (analogous to mammal "shivering") = **18ºC** and 4) below which bees go into a "chill coma" = **6ºC**.

Bees ***begin clustering when temperatures fall below 18ºC***. Cluster size shrinks until -10ºC at which the cluster is tightest. The cluster shrinks 5-fold between 18ºC and -10ºC. Below -10ºC hive temperatures can only be maintained by increasing core heat production (**Fig. 2**). The ***core bees create this heat by "pumping" their flight muscles***. This process is ultimately fueled by honey which prompted WF Cheshire to write in 1888: "Each bee… is a tiny furnace carrying on a process in its tissues and fluids which is the exact chemical equivalent of oxidizing honey…".

***WORDS OF WISDOM - A hive's metabolic rate is lowest when temperatures are 5-10ºC. This is why beekeepers who winter bees indoors maintain their buildings at 5ºC: the bees use the least amount of honey at this temperature.***

***It is estimated that bees produce 0.68 kg of water per kg of honey they consume***. This water is important to the bees and they use it to dilute honey, feed brood and flush metabolic wastes from their bodies. Nonetheless, some of this water escapes as a vapour, which in itself is important as brood develops best at 40% relative humidity. ***A problem occurs, however, when outside temperatures drop***. Cold air does not hold as much water as warm air, so as warm moist air leaves the cluster, it condenses on the comb. Bees can cope with some moisture outside the cluster, but ***if the moisture accumulates and begins dripping back on the bees it saps them of heat***. This issue is significant when we consider the role of the upper entrance in your colonies.

Bees reduce their energy consumption through the winter by ***"turning their thermostat down"***. They accomplish this by shutting down brood production in late fall and early winter (**Fig. 3**), which is thought to be triggered by shortening day length. Free of maintaining incubation temperatures (remember: 32-36ºC), the core bees lower their heat production and, thus, minimize their consumption of honey. ***Brood rearing begins slowly again after the winter solstice***. The high metabolic cost of late-winter brood rearing translates into higher honey consumption rates at the end of winter. In one study, colonies ate honey at twice the rate in March (0.84 kg per week) compared to December (0.42 kg per week).

| Nest-site property | Frequency of occupation, given choice[a] |
|---|---|
| *Apis mellifera* | |
| Nest height from ground | 5 m > 1 m |
| Nest exposure/visibility | Visible > hidden |
| Distance from parent nest | No preference (?) |
| Entrance area | 12.5 cm² > 75 cm² |
| Entrance location | Bottom > top |
| Entrance direction | Southward > northward (?) |
| Cavity volume | 10 liters < 40 liters > 100 liters |
| Previous occupancy | Previously used > new |
| Nasanov pheromone | With pheromone > without pheromone |
| Cavity dryness | Damp sawdust = dry |
| Cavity soundness | Walls with holes = sound walls |

**Table 1.** Nest site "checklist" for bees scouting for a new home (Seeley and Morse 1978).

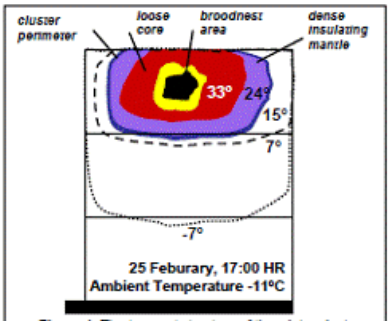


**Figure 1.** The two part structure of the winter cluster (Owen 1971, redrawn from Seeley).

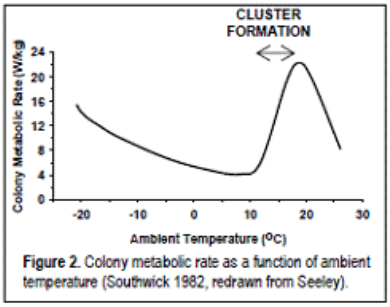


**Figure 2.** Colony metabolic rate as a function of ambient temperature (Southwick 1982, redrawn from Seeley).

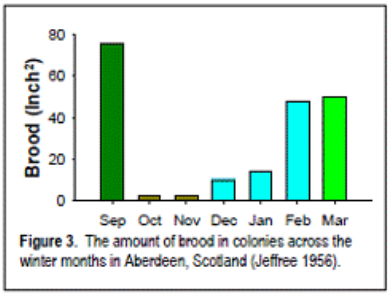


**Figure 3.** The amount of brood in colonies across the winter months in Aberdeen, Scotland (Jeffree 1956).

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🗣 ***"Bees do not freeze to death in winter – they starve" - Herman Rauchfuss, Sr. Make sure your bees have enough stored honey!***

**How much honey do bees consume (double brood nest)?**

| Location | Recommended Honey Stores |
|---|---|
| Saskatchewan | 80-90 lb (36-40 kg) |
| Wisconsin, New York State | 60-80 lb (27-36 kg) |
| Kentucky | 55-60 lb (24-27 kg) |
| California, N. Carolina | 30 lb (13 kg) |

Weights are for honey only. The equipment and bees weigh ~60lb, so that in Saskatchewan for example, a colony should weight 120-140 lb after feeding.

🗣 ***"Thirty pounds more honey than the average colony uses is cheap insurance, compared with the risk of losing the best colonies because they have even one pound too little" – CL Farrar***

How do colonies make it through a long Canadian prairie winter if they stop rearing brood? Shouldn't the colony gradually dwindle away? Although populations do shrink considerably from August to March, the colonies are able to maintain their numbers through the ***production of winter bees***. ***Winter bees live a lot longer (100+ d) than summer bees (~30 d)*** (Fig. 4). The trigger colonies use to switch from summer to winter bee production is unknown, but a leading hypothesis is that it is simply the cessation of brood rearing in the fall. Nursing, after all, is hard work and the bees born into a nest with no nursing jobs have it easy and live longer. Although the verdict on the trigger is still out, it is clear that winter bees differ physically: "newly emerged bees that overwinter have significantly greater dry weight, protein, fat, triglycerides, glycogen and glucose content than bees that do not survive to winter" (Matilla et al 2001).

How does a colony begin rearing brood in the middle of winter when there is no fresh pollen to collect? For one thing, ***bees can store a considerable amount of pollen in the comb before winter***. They appear to use this pollen to rear brood since colonies that store more pollen also have more bees in the spring (Fig 5): ***notice the 20,000 bee difference between colonies going into winter with a deficient or abundance of pollen.*** Bees also seem to be able to draw on stores of protein from their bodies in order to feed brood.

🗣 ***Bees should go into winter with 3 to 6 well-filled frames of pollen. In the last part of winter, Farrar (1936) says colonies can use up almost a frame of pollen a week. If colonies do not have much stored pollen, they will benefit from supplemental pollen up until natural pollen flows begin.***

There is ***genetically-based variation*** in the ability of bees to winter, although it is uncertain what specific traits are associated with this variation. The ***variation*** certainly ***runs along racial lines***. The ***German Black Bee*** of northern Europe (*A. mellifera mellifera*) has the best wintering ability of any other European race. Bees of this race, however, are hard to domesticate. Among domesticated races the high elevation ***Carniolan*** (*A. m. carnica*) and central European ***Caucasian*** (*A. m. caucasica*) bees are better at wintering than ***Italian Bees*** (*A. mellifera ligustica*).

🗣 ***Domestication has muddied most natural racial populations. Consequently, a bee that externally looks 'Italian' or 'Carniolan' may not winter like either race should. When purchasing queens you should always look past superficial***

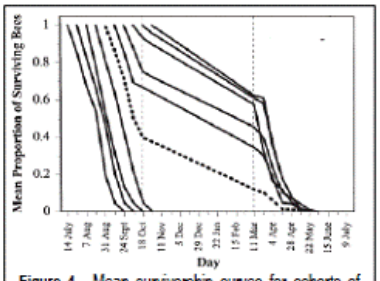


**Figure 4.** Mean survivorship curves for cohorts of bees introduced at 12-d intervals (from 14 July until fall brood rearing ceased). The graph shows a clear transition from ***short-lived summer bees*** and ***long-lived winter bees*** beginning with the cohort born on the 31 August (dotted curve). The data was collected by Harris in southern Manitoba and later analysed by Matilla et al. 2001.

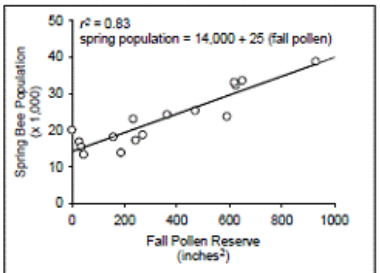


**Figure 5.** Relationship between stored pollen in a colony in the fall and the population of bees in the spring (late-March / early-spring). Data was collected over two years at Laramie, Wyoming. Farrar 1936.

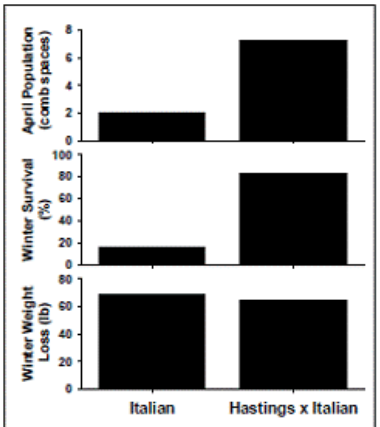


**Figure 6.** The amount of honey consumed (winter weight loss), the percentage of colonies surviving winter and spring adult populations between "Italian" commercial queens from California compared to hybrids of "Italians" crossed to "Hastings Carniolans". For all measures the hybrids were superior for wintering compared to the "Italians", suggesting the difference was genetic and dominantly inherited (from Szabo 1980)

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***resemblance, and instead, choose on the basis of proven performance under your conditions.***

There is also ***variation within races***. This variability is used by queen breeders to select for improvements on wintering. A notable example of this is the work of bee breeder Everett Hastings (Birch Hills, Saskatchewan). In the 1940s Hastings obtained the remnants of a Mountain Grey Caucasian stock originally imported from Russia to the US in the early 20th Century. Following years of selecting this stock under his harsh winter conditions, he began incorporating Carniolan genetics in 1963. This hybrid population was selected to be very winter hardy and extremely productive in prairie environments. Although his stock is no longer maintained, it has been incorporated into notable breeding populations worldwide, most notably the New World Carniolan population in Ohio. These bees ***use less honey to winter, have bigger spring populations and have a higher rate of winter survival*** than commercial "Italian" queens from California (**Fig 6**).

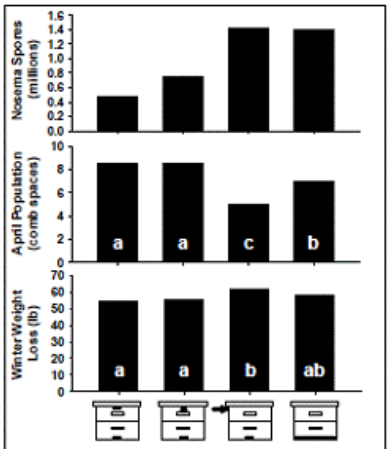


**Figure 7.** The amount of honey consumed (winter weight loss), spring adult populations and nosema levels among colonies with different types of entrances: 1) bottom and top entrances 1 x 1.5 cm each, 2) bottom (1 x 1.5 cm) and top (2.5 cm dia in middle of 2nd chamber), 3) bottom and side (1 x 1.5 cm each) and 4) fully open bottom entrance and no top (from Szabo 1982). Different letters mean averages were significantly different.

## Management of Colonies in Winter

In ***most regions of the USA and a few warm regions of Canada (eg southern BC and Ontario) winter management is a simple affair***: **1)** make sure colonies have ***enough honey and pollen***, **2)** use ***bee stock adapted to the area*** and **3)** provide a way ***for excess moisture to escape*** the colony. In ***colder areas, colonies benefit from more intensive management***. These regions include the rest of Canada, the Northwest states east of the Rocky Mountains, Midwest states north of Kansas and the Northeast states north of Pennsylvania.

***The best way to vent extra moisture from wintering colonies is with an upper entrance***. This entrance is **VERY IMPORTANT!** A study from northern Alberta, for example, demonstrated that either a 1 x 1.5 cm top entrance built into the inner cover or a 2.5 cm diameter hole in drilled into the middle of the upper brood box greatly increased colony strength, health and decreased the consumption of honey stores (**Fig. 7**).

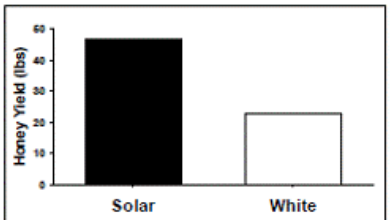


**Figure 8.** The amount of honey collected from colonies in Israel during the earliest honey flow (March) if they were painted white or enveloped in a black plastic tent (solar) (Wineman et al 2003).

In colder areas of N. America colonies benefit from some level of protection. There are ***two general designs for protecting colonies*** wintered outside. The first involves wrapping colonies in black-coloured, wind-proof sleeves (***solar wraps***). The black surfaces of solar wraps passively warm colonies on sunny winter days ***causing them to break their cluster at lower ambient temperatures than normal***. Although wraps were traditionally homemade from tar-paper or roofing felt, industrially produced waxed cardboard sleeves are now becoming more common. The second method involves wrapping the colonies with a layer of insulation (***insulated wraps***). These wraps help ***colonies retain heat when temperatures are extremely low***, but in turn prevent colonies from warming on sunny days.

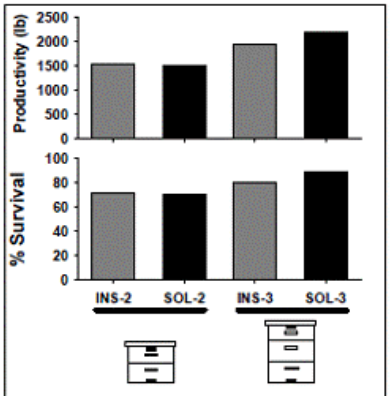


**Figure 9.** The percent survival and productivity of colonies wintered using four different methods: packs of four colonies wrapped together with insulated wraps, that were either 2 (INS-2) or 3 (INS-3) brood chambers in size or individual solar wrapped colonies in 2 (SOL-2) or 3 (SOL-3) brood chambers. Productivity = (The Number of Colonies Surviving Winter) x (Average Honey Production of Parent Colonies + Ave. Honey Production of Splits) (Sugden et al. 1988)

***The kind of wrap that you should use depends on where you live.*** Solar wraps increase colony productivity in some places with fairly mild winters. A study from Israel, for example, demonstrated that colonies that were enclosed in a black plastic tent achieved brood rearing temperatures a month earlier than colonies painted white, and as a consequence, were able to double their honey production during the first honey flow in March (**Fig. 8**). More traditional solar wraps also perform well in relatively colder climates. The best way to winter colonies in Minnesota, for example, is as triple brood nests with solar wraps (tar paper) rather than the insulated double brood nest 4-packs (**Fig. 9**). Solar wraps, however, are not used under the more extreme conditions found on the Canadian prairies. Although a number of studies in this region have concluded that ***insulated 4-Packs***

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(Fig. 10) are superior to solar wrapped double brood nest colonies, I am not aware of any comparisons of 4-Packs to solar wrapped triple brood nests. Potentially solar wrapped triples might work well on the prairies, particularly with the trend to warmer winters.

Honey bee colonies are also ***wintered indoors*** (Fig 11) in temperature controlled buildings. Indoor wintering is only practiced in the Canadian prairies, in Quebec and in the Maritime Provinces. Bees are typically moved indoors when daytime temperatures are below freezing (typically at the end of October on the prairies). ***Colonies stay indoors for 5 to 6 months***. Some beekeepers winter a few thousand colonies in a single building.

As I mentioned in the Wintering Biology section, colonies winter most efficiently at 5ºC. ***Keeping wintering buildings at 5ºC is tricky because: 1) colonies give off heat and 2) outdoor temperatures fluctuate.*** In the late fall the heat produced by the bees is greater than the amount required to keep the room temperature at 5ºC. ***The excess heat is removed by exhausting the warm storage air and replacing it with cool outdoor air***. This air is exhausted using thermostatically controlled fans. The ***exhausting also removes $CO_2$ and moisture***, both of which are harmful to bees at high levels. Exhaust fans are typically tied into a reticulating polyethylene duct system that ensures the air moves uniformly throughout the room (Fig. 12).

When the outdoor temperature is very cold the bees are able to generate only enough heat to keep the building at 5ºC. In this situation the exhaust fans remain closed. ***To prevent $CO_2$ and moisture from building up, a low level exhaust runs to ensure just enough fresh air is brought in***. It is a task to adjust the exhausting system so that it can keep the air fresh and temperature regulated (Fig 13). Consequently, I urge you to consult with your provincial apiculturalist before you begin construction. If temperatures fall lower still, ***backup heat*** is used to warm the building. In warmer climates, such as in Quebec, buildings are also equipped with ***refrigeration systems to cool buildings down*** when temperatures begin to rise in the spring.

**Figure 10.** The ***Peer 4-Pack*** from Saskatchewan consists of four double brood nest colonies pushed together and wrapped in black plastic that contains ***R-12*** batt insulation. The top of the pack contains ***R-20*** insulation batts, again in plastic to prevent the insulation from getting wet. The roof is made of a piece of plywood and upper entrances are fastened by wooden blocks.

**Figure 11.** An indoor wintering building pictured as colonies are being moved in. Notice the ***recirculating fans*** and ***return duct*** on the ceiling and one of the ***cold air intakes*** with ***light trap*** on the right wall. This building holds about 1,000 single brood nest colonies and is operated by Jack and Dorathee Cage.

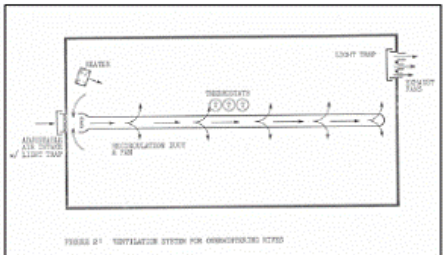

**Figure 12.** A simplified schematic of the ventilation, exhaust and heating systems used in indoor wintering buildings. ***Notice that all exhausts are equipped with light traps to ensure that no light enters the building.*** Although lights disturb indoor wintering bees ***beekeepers employ red lights, which are invisible to bees, for routine maintenance***. The recirculating fans and ducts ensure that air in the building is ***well mixed***. The ***heater*** is only used when outside temperatures are so low that the heat generated by the bees can no longer maintain the room temperature at 5ºC.

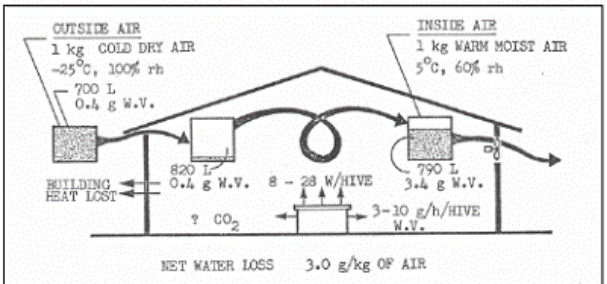


**Figure 13.** Winter ventilation for overwintering hives. **EXAMPLE.** ***Each colony in the building generates 3-10 g of water vapour per hour and 8-28 watts of heat***. Imagine if we brought 1 kg of outdoor air into the building. This air is at -25ºC and 100% relative humidity (RH), and thus, contains only 0.4 g of water vapour (remember cold air does not hold much water). When that 1 kg of outdoor air is brought into the 5ºC building (60% RH), it can now hold 3.4 g of water. Thus for each kg of 5ºC air (60% RH) exhausted there is a net loss of 3.0 g of water vapour. To move that 3.0 g/kg of water 0.25 L/s of air must be exhausted from our theoretical building. If we bring this amount of cold air into the building we will need to produce 13 W per hive to keep the building at 5ºC. We also loose 4 W of heat through the walls of the building, so now we need 13 + 4 = 17 W to keep the building at 5ºC. Let's say the colonies are only producing 12 W. We therefore need another 5W per hive from the heater. Phew! ***Save yourself the trouble and get an expert when planning a wintering building.***

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