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Swarms

THE BIOLOGY AND CONTROL OF SWARMS IN NORTHERN STATES

Meghan Milbrath | Michigan State University | January 1, 2018

Why do we care about swarms?

Happiness is a big booming hive in the spring. A strong colony coming out of winter means that you did your job as a beekeeper – you kept varroa under control and ensured that your colony had sufficient food to raise a hearty generation of winter bees. Good job! But before you go and pat yourself on the back - make sure that you don't go and mess it all up by letting that colony swarm! I talk to many beekeepers in the north who are so focused on getting their first (and second and third) colony through the winter that they don't have a plan for how to manage their overwintered hives in the spring. These big hives quickly get away from them, and they almost all swarm.

So what? Swarming is natural, so it can't be bad, right?

Swarming itself is not bad, but if the process is uncontrolled, it can have negative consequences for us and our bees. It is like everything else – just because something is natural doesn't mean we have to let the whole thing run willy-nilly. Any beekeeper in the north can tell you that willy-nilly is not a great management strategy - we have too little time to get our hives ready to face old man winter. When we manage the swarm process, we give our bees a better chance of success.

Why do bees leave the hive?

There are three times when part of the colony will leave the hive: absconsion, a crowded swarm, and a reproductive swarm. We can identify which of these situations is occurring by considering the time of year and the condition of the parent hive.

The sad side of swarms

It is risky for the parent hive. New queens have only a 75%-90% chance of coming back from a mating flight. Thus for 10%-25% of the hives that swarm, the colony dies. Additionally, a colony disturbed by swarming cannot always right themselves in time. In the north, there is only a short window to get enough food and to raise a sufficient population of bees for winter.

It is bad for the swarming bees. Many beekeepers think swarms just repopulate the feral population, and live long and happy lives. Unfortunately, most swarms do not survive the first winter – survival is really low, around 15%. Those are terrible odds at health and survival, and I don't want to do that to animals. Remember, those bees aren't native to your area; they are only living there because you bought them for your own benefit. If you are going to bring bees into your area, the least you should do is give them a shot at a long and healthy life.

It is bad for your other bees. The high death rates of unmanaged colonies are usually from the varroa mite. For every swarm you let escape, you create an unmanaged colony in the neighborhood of the hives you are trying to care for. Mites grow unchecked in unmanaged hives, and when these colonies collapse, you have basically just 'mite-bombed' yourself.

It is bad for your neighbors. Honey bees are cavity dwellers, and a swarm will look for a cavity in which to build its new home. Ideally, they will look for an old hollow tree, but most people in the United States do not live in an area with old hollow trees- the only cavities may be your neighbors' soffits, floorboards, or siding. It can cost your neighbor thousands of dollars in repairs and removal. Swarming can turn your beekeeping hobby into a public nuisance.

It is bad for your wallet. When you lose a swarm, not only do you lose a lot of expensive-to-replace bees, but you also lose their production. Swarms generally contain a lot of bees of wax-building age, and you miss out on the value of the comb they would've drawn. In the north, swarms often occur at the beginning of the nectar flow, and you lose your workers when there is honey to be made. By the time that the colony gets queen right, we are often in a dearth, so you'll have lots of hungry mouths to feed, but no food. An early swarm may mean a summer of work with no reward – a practice hard to sustain.

ABSCONSION

My bees are so dumb! They swarmed in September! Or I can't believe my luck, I caught a swarm so late in the season! – do you think they will make it if I feed them really well? If it is late in the season, it isn't likely a swarm. Usually those bees are absconding, which means the entire colony is trying to leave, they aren't interested in splitting into a new colony.

For a colony to *swarm* it has to go through a full swarming process, which I'll describe below. In a situation where the colony absconds, the conditions in the hive are too poor to support proper colony growth. The most common cause of absconding is when colonies are overrun with varroa – the workers are trying to raise brood, but most of the brood are dying due to varroa-associated viruses. All this dying brood signals to the bees that the conditions aren't good and it is time to abandon the hive. We also see absconding ~~in~~ from over-crowded nucs and overheated hives. The bees just can't live in those conditions, and they hedge their bets in a new location.

But I still see bees, and I even see queen cells! The bees will generally abscond in the middle of the day. Young bees that can't fly are left behind, and the foragers who are out working will return to a relatively abandoned hive. These poor old and young bees will try to make emergency queen cells. Beekeepers will see these cells and ~~see~~ that there are bees in the hive, and are often fooled into thinking that a swarm or supercedure is happening. These post-absconscion colonies rarely recover in good health – they have a poor queen that is raised in stressful conditions, and are missing the bulk of the workers that make up the heart of a functioning colony.

CROWDED SWARMS

Crowded swarms can happen at any time of the season. They very frequently occur to second-year beekeepers, who are unfamiliar with how much faster a colony will expand when they have drawn comb – it is so much faster than a nuc or package on foundation. Colonies that are getting established and drawing out wax grow very slowly, and don't store much honey – they are turning all the nectar into valuable drawn comb. If they were lucky, the first-year beekeeper added a honey super maybe in June, and maybe another in July. The following year, the pace of a strong over-wintered colony catches them off guard - they don't realize that a strong colony on a good basswood flow can fill a super in less than a week! They also don't yet know their honey flows well, and when to expect the rush of food. An experienced beekeeper will put on two supers in anticipation of a good honey flow (that they know is coming because they know their local blooms). A first-few-year beekeeper will often peek in the hive to see if it is crowded, observe that the top super is only about 50% full, and not add a super ... only to have the flowers turn on the flow the next week, and their bees swarm into the trees. Yes, the beekeeping learning curve is steep, and often expensive.



Photo by Rusty Burlew, who has a good blog post on this topic—<https://honeybeesuite.com/did-they-abscond-or-die-from-varroa/>

Crowded swarms are 100% beekeeper error. It means that you didn't provide your bees with enough space to account for the incoming nectar. The bees always want to put nectar above the brood nest, but if there is no drawn comb above the brood nest, then they have no choice but to put the nectar in the brood nest, leaving no room for eggs, initiating a swarm. It will take experience to judge if you have the right amount of space – you will need to know your main honey flows and estimate the strength of a colony. This is one of the arts of beekeeping. A rule of thumb is that there is little danger of over-supersing a **strong** colony **early in the season**. If you overestimate space, you can always remove boxes later. Just make sure you don't over-super a **weak** colony – they won't be able to protect all the extra space from pests.



An overly crowded hive – shown by the honey stored in the burr comb. This is a lovely sight in October, when you know there is no more honey coming in, but it is not good in a colony midseason. It is a sign of overcrowding in a growing colony. This beekeeper may have missed out on a lot of honey, a lot of brood, and is risking losing the colony to a swarm. Photo by Andria, CC BY-ND 2.0, <https://flic.kr/p/9wsoF>

BEARDING

The first really hot day of summer means two things: 1) I will be hitting the lake, and 2) Facebook will be filled with photos of hives that are bearding, with the caption "What is going on? Is my hive about to swarm?"

Bearding is when bees hang out the front of the hive entrance – making the colony look like it has a beard.

Bearding has nothing to do with swarming.

When bees beard, it means it is too hot inside the hive.

The brood nest needs to be kept around 92°F. Brood doesn't develop well if it gets too hot, so bees loosen the cluster and fan air to control the temperature. Sometimes the cluster loosens all the way out the door! Some hang out on the front porch because if they were all inside, they would cook the brood. You may see bearding all day, or only at night when the foragers are home. What do I do about bearding? Nothing, it's too hot out - I am at the lake!



Photo by Rusty Burlew, <https://honeybeesuite.com/let-your-bees-beard/>

¹ In full disclosure I'll be jumping in the lake between bee yards, and not really hanging out at the lake. Anyone who knows me knows that summer is for working bees!

REPRODUCTIVE SWARMS

Now to the good stuff! When we see absconding and crowded swarms it usually means you had management issues (i.e. you messed up), so they aren't the same joyful experience as good, old-fashioned, springtime reproductive swarms.

A reproductive swarm is literally the *whole point* of a bee colony. The goal of all animals, like honey bees, is to grow enough to reproduce. A colony builds up over the summer to get enough food to make it through the winter so they can SWARM in the spring – making a new colony.

Reproductive swarms are an essential part of a colony's life cycle. This *essential* property is what makes it so hard to stop swarming once it has begun. You'll never succeed in stopping biology - you don't manage your sheep herd by trying to shove lambs back into ewes! Yet, many beekeepers are frantically cutting queen cells, and climbing trees in a panic to capture with hives determined to swarm. **Good beekeepers work *with* biology, and follow the cues to recognize which colonies are likely to swarm, identify the conditions that promote swarming, and take steps to manage the process- before swarms occur on their own.** It's a much calmer and happier approach to beekeeping that is safer for you and your bees. The rest of this document is dedicated to reproductive swarm biology with the intent of helping you to have better confidence and control come next swarm season.

WHICH COLONIES ARE LIKELY TO SWARM?

The first step in controlling swarms is to identify which colonies will need to be managed for swarming. Not all colonies are likely to swarm in spring. The characteristics of a colony most likely to swarm include:

- 1) The queen is old, meaning she has gone through a spring build-up already.
- 2) They are being fed in the spring (stimulative feeding),
- 3) They have a large cluster size.

1) Old queens

The main trigger to the swarming process is a drop in pheromones, prompting bees to create queen cells. Young queens will have a stronger queen scent (pheromone), which inhibits the creation of queen cells. Old queens have less overall queen scent, lowering the threshold to start swarming. If a colony with an old queen is too small to swarm in spring, it will generally re-queen itself right after swarm season through supercedure (I get a million calls for “missing” queens right after swarm season). Regardless of how the diminished queen scent from an old queen plays out, there's typically a queen event right in the middle of honey making time, which is risky for the colony and results in loss of production.

You can lower the chance of a swarm or a midsummer re-queening by going into winter with a young queen. **Re-queening in late summer/fall with young queens is a key part of getting control of swarm behavior.** You don't even have to kill the old queens (it is okay to admit that you are sentimental about your queens) – you can put them in nucs, or use them elsewhere, or keep them for an emergency. Ideally, you will make a nuc from each hive in late summer with the old queen, and will give the big hive a young queen. That way your main hive will be less likely to swarm, and you have a backup for winter. At minimum, mark your queens and take good notes so you know what colonies are more likely to swarm.



Marking queens is helpful to track the age of the queen and identify which colonies are likely to swarm. Photo and queen by Meghan Milbrath

2) Stimulative feeding

Every spring I'm asked "When should I start giving my bees pollen patties?" Anyone who knows me, knows I hate the S-word [*should*]. There is no "should" in beekeeping. At least not in relation to a calendar, so I can't tell you when you should put in pollen patties, or if you should at all.

In the spring, colonies do need protein because it is an important time of brood rearing. Most colonies in my area, however, have sufficient pollen stores, and will be able to bring in enough fresh pollen naturally as we usually have enough nice days for foraging on early spring trees. Some people want to add pollen substitute as insurance, regardless, thinking that there are no negative consequences, and they'll 'just do it to be safe'.



Honey bees munching on pollen substitute. Photo by Meghan Milbrath

Adding pollen patties isn't necessarily a bad idea, but it isn't without risk--the pollen substitute that you feed could trigger your colonies to raise too much brood. If they raise too much, they may build up to swarm too quickly, or the brood nest may get too large, and the developing bees can get chilled when the temperature invariably dips on a cold spring night. Colonies respond differently to stimulative feeding; there appears to be a genetic aspect: some will go crazy with growth if you put food in the hive, and some won't change their growth at all. So 'should' you put in pollen in the spring? Only if you think that they don't have enough incoming pollen or enough stored in the hive. And if you do feed, make sure you watch for explosive growth, and adjust your swarm management accordingly.

3) Large cluster size

A large cluster size is the most important driver of spring swarming. Even if you have an ancient queen, and you have been feeding the colony buffets of pollen substitute and 1:1 syrup, if the colony is too small, it will not swarm.



Here are two of my hives from last spring. The one on the right is huge and is likely to swarm; the one on the left doesn't have enough bees to swarm. It is good to mark which colonies need swarm control early in the season so you can plan. Of course, the big colony could always starve, and the small one could grow large enough to swarm if the weather and food was right. Photos by Meghan Milbrath

WHEN DO WE EXPECT TO SEE REPRODUCTIVE SWARMS?

Like everything in beekeeping, the answer to this question is “it depends.” The timing of swarming depends on when the colony gets big enough, which depends on the incoming food, which depends on the temperatures. In “Principles of Nectar Management,” Walt Wright indicates that swarm season is from apple blossom to hardwood greening. He is in Tennessee. In Michigan, the average bloom time for apples from 1980 to 2012 was May 6². That seems about right for the start of swarm season for me. The earliest that I have ever caught a swarm in Michigan is April 31st. Here is another place to take good notes – write down when you start hearing about swarms every year.

A few words of warning on guessing the timing of swarm season

- The timing will change every single year. If there is an early warm up that allows colonies to raise brood earlier, they will swarm earlier. A cool spring will push them later.
- If you feed pollen or 1:1 sugar water in the spring, it may push the colony towards swarming earlier.
- Like everything with bees, it is hyper-local. You can ask your nearby beekeeping friends, but the best way to know is to watch your own hives.
- ***Remember, that swarm control happens before swarming. Don't wait until May 1, or apple blossom, or whatever your cues are to start checking. All of the management techniques discussed in this document are to be performed **before** the swarm leaves – before you hear reports of swarms.***



Honey bee on an apple blossom. Photo by Zachary Huang, www.beetography.com

UNDERSTANDING CUES FOR THE SWARMING PROCESS

Bees give us tons of cues to tell us they are going to swarm. If a beekeeper is surprised by swarms it is usually because they didn't know what to look for. The signs were all there, the beekeeper just missed their significance. This is a situation where we need to learn to ‘speak bee’ to perceive the world from your bees’ perspective. The biggest trigger for swarming is

Lowered pheromones.

Bees can sense when pheromone levels change in the hive, but as weak humans, ~~we~~ are terrible at pheromone sensing. While can't use our antennae to sense lowered pheromones, we can see three conditions that indicate that the bees will be experiencing them:

- 1) The queen is old (discussed previously)
- 2) Backfilling in the brood nest and
- 3) Full frames of brood.

When brood/queen pheromones are low enough, it triggers queen cell production. We can't sense pheromones, but we can visualize signs indicating drop in pheromone levels.

² 2013 Bloom dates for southwest Michigan tree fruit crops, Mark Longstroth, Michigan State University Extension. https://www.canr.msu.edu/news/2013_bloom_dates_for_southwest_michigan_tree_fruit_crops

2) Backfilling in the brood nest

In a normally functioning hive, the queen will lay eggs in the brood nest, filling each newly vacated cell with an egg. As the queen lays, her glands leave a scent on the eggs, and as the larvae grow, they release their own brood scent. This combination of queen scent and brood scent is key for bees; these pheromones indicate that the hive is healthy and has space for normal function- empty cells for incoming nectar above the brood nest, and room for new eggs within the brood nest. If there is no room above the brood nest (because the cluster is at the top of the hive after winter, or because there aren't sufficient supers on the hive), the bees will begin to backfill – put nectar in the cells where young bees have recently emerged. During a strong honey flow, a big colony will have thousands of workers returning with nectar who need to unload. Because there are so many loaded workers, they will race the queen to the newly emptied cells in the brood nest. They usually win: the queen won't get to lay an egg in that cell, and soon the whole part of the hive that should be reserved for brood rearing is full of nectar.

The brood nest area should be filled with eggs and developing bees, all giving off pheromones. When it is backfilled with nectar, the colony scent drops considerably – lowered pheromone levels. If you remember one thing to look for, let it be this: **Backfilling is the first sign that a colony is fixing to swarm.** Once you see backfilling, you know that you have a large population, and there is food coming in. At this point, you can begin to do some of the swarm management options discussed at the end of this document.



Backfilling in the brood nest. Some beekeeper (me) didn't put supers on quickly enough, and the workers filled the brood nest with nectar before the queen could lay in them. The center of this frame should have eggs in it, but instead is full of nectar. You can see all the fresh nectar on this frame, indicating ~~that~~ there is a pretty good honey flow on. Photo by Sarah B. Scott

BACKFILLING IN CROWDED HIVES



*Backfilling. It's not just for reproductive swarms! Backfilling is the trigger for crowded swarms too. It is the first sign that the hive is literally too crowded. They have nowhere to put all the incoming nectar. Midsummer I often get calls from beekeepers who think that they need a new queen because they don't see any eggs or young larvae in their hive. Further questioning usually indicates that their queen is probably fine, but has nowhere to lay. They don't see eggs– **BECAUSE THEIR BROOD NEST IS BACKFILLED**. Where the heck to you expect a new queen to lay? I never suggest re-queening at this point, because there is no way to know what is going on until the nectar gets cleared out of the brood nest. Either the old queen is in there, and the girl just needs some space, or they have already left and there is a virgin in there (who also will need some space). The first step in this situation is to get some supers on the hive, stat!*

- *Don't underestimate the number of supers – you have to accommodate all the nectar in the brood nest currently, plus account for incoming nectar. It will likely take at least two supers to clear out the excess nectar from a big hive that is nectar-bound and hasn't already swarmed.*
- *Don't forget that it takes time to move all that nectar. A full brood nest of nectar is thousands of little mouthfuls and trips up to the supers. You may have to add drawn comb to the brood nest to give the queen immediate room to lay.*
- *You really need drawn comb at this point. If you only have foundation, it is pretty hard to remedy (especially if your colony already swarmed, because you'll have lost the wax-building bees.) If you only have foundation, you can maximize the speed in which they draw it out by moving new frames directly above and next to the brood nest (and next year vow to get supers on there earlier).*

Photo Rusty Burlew, <http://www.honeybeesuite.com/backfilling-the-sign-of-the-swarm/>

3) Full Frames of Brood

After backfilling, the second visual indication that a colony will likely swarm is full frames of brood. Our northern colonies start raising a small patch of brood pretty early in the season, when it is still really cold out. The size of this early brood nest is limited by warmth – the more bees you have, and/ or the warmer the outside temperature, the larger the brood nest can be. At some point in the season, it will be warm enough/ the colony will be big enough to cover and keep warm full frames of brood. Colonies often swarm after these full frames hatch out.

Full frames of capped brood are a strong signal to the bees that it is getting to be time to go: the large amount of capped brood scent indicates that the colony has reached a sufficient size--big enough to split, and big enough for both resulting colonies to stand a chance at survival. Full frames of brood also mean that it is likely warm enough for survival – there should be food out at this point, and it won't be consistently cold.



*Full frames of capped brood. Photo by Randy Oliver,
www.scientificbeekeeping.com*

The frames of brood themselves have a lot of brood pheromone, but it changes when they emerge as adults. As the bees in these frames emerge the hive will experience **lowered brood and lowered queen pheromones**. Brood pheromone is lowered because you will have thousands of brood become adults, and their scent will change (and their cells will likely get backfilled). Queen pheromone is lowered through a dilution effect. Workers touch the queen to pick up her scent, and they pass it among themselves. When you have more workers, you have more bees passing around the scent, and each bee suddenly experiences less.

The emerging of full frames of brood also causes a generational shift, changing the balance of the work in the hive. After emergence, workers usually play the role of nurse bee, then wax-builder / house bee, then forager. When thousands of new workers emerge at once, ready to take on their role as nurses, the current cohort of nurses graduates to wax-making house bees – perfect for the colony that needs to set up a new place to live! The nurse bees often can't fly yet, so they stay with the parent hive, but these house bees will fill up their bellies, and go with the new swarm, ready to build a new home³. Anyone who has caught a natural swarm can tell you that these are the absolute best for drawing out new wax. It makes sense when you think about all of the newly commissioned house bees that are relieved of nursing duty, and ready to build!

³. There are some neat swarm control methods that take advantage of the fact that these newly commissioned wax bees can fly but can't orient to the hive, including the Taranov method.

THE SWARM

In spring, the weather is warming up, allowing the brood nest to expand, and driving more plants to bloom and produce nectar. The bees bring in nectar and soon start to fill space in the brood nest. This loss of space prevents the queen from laying, she slims down, and the amount of brood pheromone drops. As more adult bees hatch, there is less queen pheromone for every bee – this drop in pheromone is the bees' way to know that the colony is big enough to swarm.

Once the queen pheromone is low enough, the colony will initiate the swarming process by drawing out queen cells. The first thing you might see is a little 'frosting' on the existing queen cups as the bees touch up the queen cups by adding bits of bright white new wax. These cups are used to create cells – and soon you'll see open cells with a larva each, floating in royal jelly. It is common for a large colony to produce dozens of cells. They are often found along the bottoms of frames, but they can be wherever they want to be – including along the tops of frames, on the sides, and in the brood nest, in areas where you would see supercedure cells.



Filled queen cells at the bottom of a frame – indicating that this colony is well on the way to swarming. A quick way to check for these cells is to open the boxes of the brood nest like a clamshell, and peek under the bottom of the top box. Photo by Randy Oliver, www.scientificbeekeeping.com

Note the bright white new wax on the queen cups in the above photo. This "frosting" indicates that the colony is putting attention into these cups, and is likely thinking about swarming. Note that this is on a frame of fully capped brood. You'll see these frosted cups at the same time that you'll see full frames of capped brood – just before a swarm. Photo by Richardoyouk, <https://flic.kr/p/54qQfm>, CC BY NC-ND 2.0

The swarm can leave **any time after the queen cells are capped**. On a nice day, the bees will fill their bellies with food and will take off, taking the queen with them. If there is a string of bad weather, and the swarm can't leave before the virgins are ready to hatch, the bees will keep the virgins from emerging, as otherwise they would kill the waiting-to-swarm queen. Nearby workers will allow the virgin to cut a hole in the cell, and will feed her when she extends her proboscis through that hole. But, they'll hold the lid in place on the cell, trapping her until the weather turns nice, and the old queen can escape safely with the swarm. One of the most amazing things I have experienced in beekeeping is opening a hive in this state – when I moved boxes to open the hive, I disrupted the workers' ability to keep in the virgins, and they all emerged at once. I caged over 20 virgins from that hive!

Once nice weather hits and the swarm has left the hive, they will gather together in a nearby location. To find out what happens next, I suggest Dr. Tom Seeley's Honeybee Democracy, a book that describes how swarms identify potential hive sites and chose the location of their new home. His book not only explains this process, but also reminds you how amazing bees are.



A queen cell that has been cut – the virgin is ready to emerge. Photo by Larry Connor

Don't cut queen cells!!!

I just hate that many old books and beekeeping resources still recommend cutting down queen cells. Why would you do that?! Please don't ~~cut queen cells~~. First, you likely won't find every last one of them, and you only need to miss one for the colony to still swarm. Secondly, these cells are perfectly good queen cells – why kill them? At least make up some nucs. Third, once the cells are capped, the colony may already have swarmed. If you cut the cells, you may eliminate the colony's chance of survival. Finally, you have done NOTHING to eliminate the triggers for swarming. You still likely have a backfilled brood nest, and low pheromone levels! You haven't slowed the urge to swarm at all, and at best pushed it back a few days.



Perfectly lovely swarm queen cells on a frame. Make a nuc with this frame! Even if you don't want more hives, I can guarantee that someone in your club would love your local queen. Photo by Keith McDuffee, CC BY 2.0 <https://flic.kr/p/bCp02Y>

Swarm Control

Swarm prevention has to start before the colonies swarm (duh). Therefore, we need to perform our management strategies when we see the first signs that a colony is headed towards swarming (backfilling and full frames of capped brood)—don't wait until you see queen cells. When I see backfilling starting in a few hives, I'll start swarm control on all of the big hives that are likely to swarm. My focus in swarm control is to always ensure that queens have space to lay. There are about 12 million different ways beekeepers have figured out how to do this, and I'll discuss a few I have used.

There is no “right” way to perform swarm control. You need to find the balance where you give the queen space to lay, but you aren't so aggressive in your manipulations that you hurt your bees. Many beekeepers perform swarm control on a nice warm day, and forget that the cluster will shrink at night when it is cold. If you open up the brood nest too much, you could leave brood exposed when the weather invariably cools. In Michigan, we often get a few *really* nice days in spring. You know, when everyone decides to go jogging and do yard work, and start digging in their bees. The weather always gets cold again, and beekeepers who do splits too early stress their bees, putting them at risk from stress-related diseases like European Foulbrood or Chalkbrood. As a rule of thumb, use less aggressive methods early in the season, when there is chance of cool weather.

You can use a mix of techniques. The main way to manage swarming is to follow what the bees are already wanting to do – split into two or more colonies. Splits are effective, and usually have to only be performed once to keep swarms under control. However, there are some times when a beekeeper may not want to perform a split, like when there is concern about cold weather in the forecast. There are ways to control swarming that don't involve splitting, but they generally require much more work, and they may not be sufficient to control swarming through the entire reproductive swarm period. You can use multiple swarm management techniques on the same hive to account for your needs. A great way to handle the ups and downs of springs in the north is to first perform a management technique to give more room above the brood nest, and later (once it is warm enough) perform a split.

In Michigan and other cold areas, we will often get nectar and pollen coming in well before it is safe enough to do any dramatic manipulations. Bees naturally want to put nectar above the brood nest, but because the bees are at the top of the hive after winter, they will have no space above the brood nest and will start to backfill almost immediately. In the early season, we need to make sure the queen has space to lay, but we have to do so in a way that won't be too disruptive to the brood nest. There are two ways that we can give the bees more space above the brood nest without moving brood frames – reversals, and early supering.

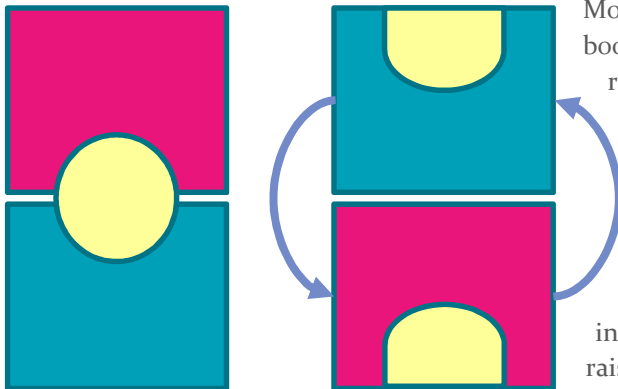
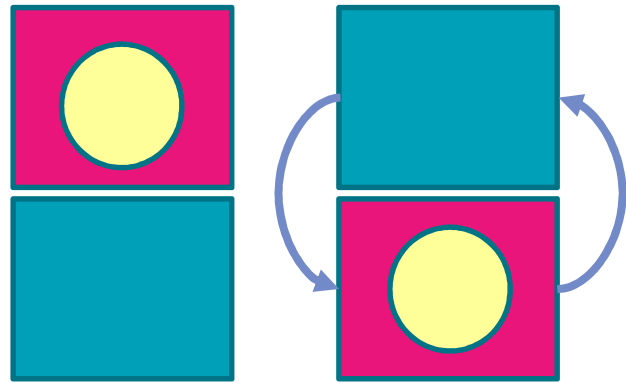


Look at that backfilling! This colony needs some swarm control!
Photo by Stephen Repasky from *The Hidden Signs of Swarming*,
<https://www.beeculture.com/whats-happening-hive/>

REVERSALS

A hive reversal is just that: you take the top box and move it to the bottom. In the text books, the spring cluster is in the top deep, and the bottom deep is empty, so when you switch their locations, the cluster has room above.

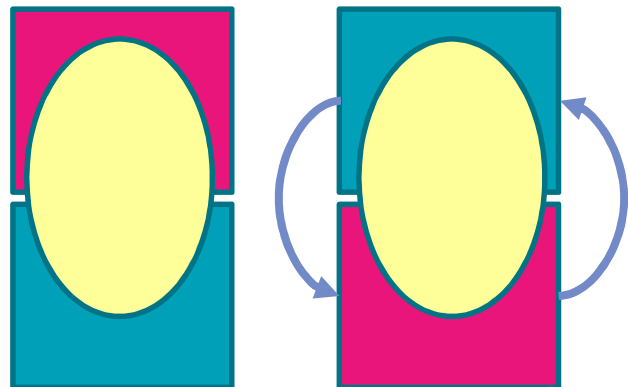
The figure to the right shows a textbook reversal. When you rotate the boxes, you move the cluster (yellow) to the bottom, giving them room on top. When the hive is set up this way, reversals are a perfectly fine technique to use. It also allows you to cull any old frames from the lower box that you may not have looked at for a few years.



Most of the time, the bees do not read the text book, so reversals don't work, or wouldn't be recommended. For example, many times the cluster extends across the gap between the boxes. If you reverse in this context, you would really set the hive back by breaking apart the brood nest. It could cause the brood to become chilled, or if the cluster is small enough, you could completely split it into two, and the part without the queen could raise emergency queen cells, and a virgin would kill the queen.

Another time when reversals don't work is when the colony is too big, which is often the case with the colonies that are likely to swarm. The brood nest is in the top box, but it is also in the bottom box (and maybe in a third box). A reversal just isn't worth it, because the little space you may gain is filled in quickly. You just do extra work and harass the bees for little gain.

Do I use reversals? I do, sometimes, but really not as a measure of swarm control. I reverse colonies that came through winter small—maybe only five frames. I don't want to give these colonies supers yet, because it is too much work for them to guard, so a reversal allows them some room to grow, without overwhelming. Even in these cases I don't always do a reversal, if the cluster isn't set up perfectly, or it just doesn't seem worth it.



My opinion on reversals: you can do them if the colony is set up perfectly and you happen to be out there already, but they don't buy you enough time to make the harassment worth it, so I wouldn't make a trip to the yard to reverse all your hives. If you are out supering, as discussed in the next section, and you come across a small hive that is set up perfectly, then go ahead and reverse it.

EARLY SUPERING

In Michigan we always get a spring warm up in mid-April. Right after tax day we get nice weather, and beekeepers all over the state just can't restrain themselves, and start digging in hives. They start splitting, checking brood, moving things around, and calling me with questions. I joke I'm going to change my voicemail during the warm-up to just say "quit digging in your hives, it is too early!" Without fail, after our two days of lovely weather, Michigan is going to be Michigan, and we'll get a few more weeks of winter – more snow and more cold.

Beekeepers who have made splits often return to unmated queens and chilled brood. I understand the urge to split—I also want to get out and work with my bees; I also miss them. However, I have learned the hard way that you can really set them back if you move brood frames too early. Now that I am older and wiser, and have stopped making mistakes, all I do in early spring is put two supers (or usually one deep) of drawn comb on every hive that is on the bigger side. This does a few things—it gives the bees space above the brood nest, it gets equipment out of my garage, and it allows me to go do some beekeeping without messing everything up.



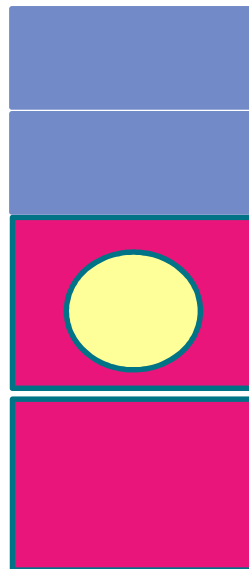
It is nice to get your equipment out of storage and on bees as early as possible. Not only does it get it out of your way, but it also protects the comb from mice and other pests. Photo by Meghan Milbrath

My opinion on early supering is that everyone should do it. I don't see a downside to putting on boxes of drawn comb onto big hives in the spring. I'll be back out to the bee yard to make splits soon, so I can remove them or make corrections then.

Spring management is all about finding the balance between a warm brood nest and space for incoming food. If the colonies are starving, and I am feeding them, then I don't put supers on (they won't be storing food if they need to eat it). I watch closely to see when food could be coming in—paying attention to blooms, days with foraging weather, and bees bringing in pollen.



Photo by Julie Falk, CC -ND BY 2.0
<https://flic.kr/p/26xtt>

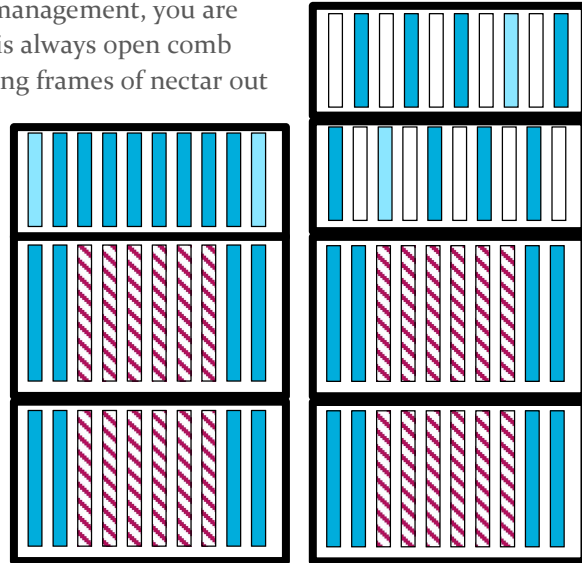


Configuration of the early spring hive. The colony was overwintered in two deep boxes (pink). The cluster (yellow circle) is in the top box after winter (or often both if it is larger). Before it is warm enough to even inspect the brood nest, I'll add two supers (purple), or one deep. This provides bees space above the brood nest for incoming nectar. Usually I use a deep so the queen can move up if she wants, and it makes my splits easier later. This only works with drawn comb.

NECTAR MANAGEMENT

Nectar management refers to multiple techniques that focus on moving frames so the queen always has room to lay. The goal is to keep the space directly above and around the brood nest open; this is where bees will preferentially put food, and solid food above the brood nest signals to the bees that they are crowded. If the frames above the brood nest are always open, then the bees won't feel the need to backfill. When you practice nectar management, you are either removing or rearranging frames so there is always open comb above the brood nest. This can be done by pulling frames of nectar out and moving them up and to the outside of the hive, or by "checkerboarding," where the frames above the brood nest are arranged like a checkerboard—alternating full frames of nectar and open comb.⁴

The left hive is crowded—with a solid row of nectar (blue) above the brood nest (pink stripes). The right hive has been given space by checkerboarding; full and empty frames are alternated so that the bees feel like they have space above the brood nest.



Considerations for nectar management

- Swarm control through nectar management is a LOT of work. A big colony on a strong nectar flow can fill frames in a matter of days, so you may need to move / add frames above the brood nest multiple times a week. It may be too much work to completely stop swarming in areas with a strong flow, but you can do it to buy time before making a split.
- You can end up with really big monster colonies, because you are constantly expanding the brood nest. This is fine if you are going to split later, or you need the workers for an early honey flow, but this may not be what you want—you'll have to do more work to manage varroa populations, and your colony may run out of food if you have a dearth.

You may see recommendations to checkerboard *within* the brood nest, where you alternate brood frames with empty comb. This is a little different than true nectar management, but it will push back swarming, because you'll still be giving the queen room to lay. Basically, you can keep the bees so confused through the entire reproductive swarm season that they never have time to initiate a swarm, because they are always filling in / fixing up after you. **Be very careful when moving brood frames in spring**—be sure that you don't expand too much if you anticipate a drop in temperature, and never move brood frames if the colony is small.

My opinion on nectar management: it can work if you have the time to check your hives all the time. It is too much work for me, and I end up splitting big colonies anyway.

⁴ For more information on nectar management, read the articles of Walter Wright. He wrote "Principles of Nectar Management," and a few others that outline his experience using this technique. As you read his work, keep in mind that the timing will be different in the north.

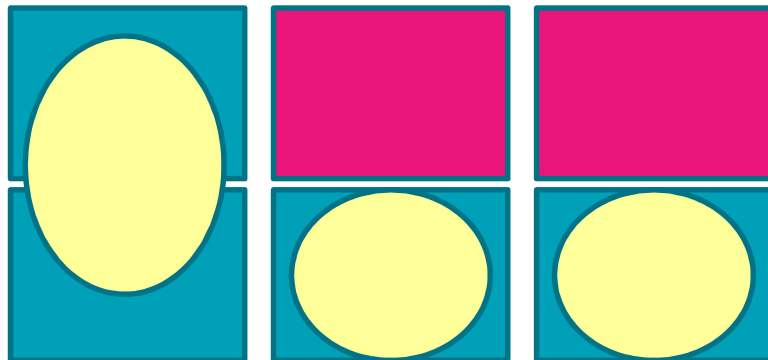
SPLITS

Splitting is the most effective form of swarm control, because you are doing what the colonies want to do anyway. Their goal is to come out of winter strong enough to reproduce: taking one hive and making two. When you split, you get the same outcome as a reproductive swarm, but it is managed better for the sake of you and your bees (and your neighbors.) There are about as many ways to make splits as there are beekeepers, because everyone has their own climates, needs, and time constraints. I'll outline a few methods below, but you should work with others and experiment to find a splitting method you like.

Walk-Away or Dirty Splits

The easiest form of splits is called a “walk-away” or “dirty” split. This method is simple because you don't have to find the queen. When you do a walk-away split, you just need to make sure that both of the resulting hives have the goods to make a new queen. Ensure that both hives have plenty of bees and each has some eggs and young larvae. One hive will have the queen, and she will keep laying, and the other hive will raise a new queen.

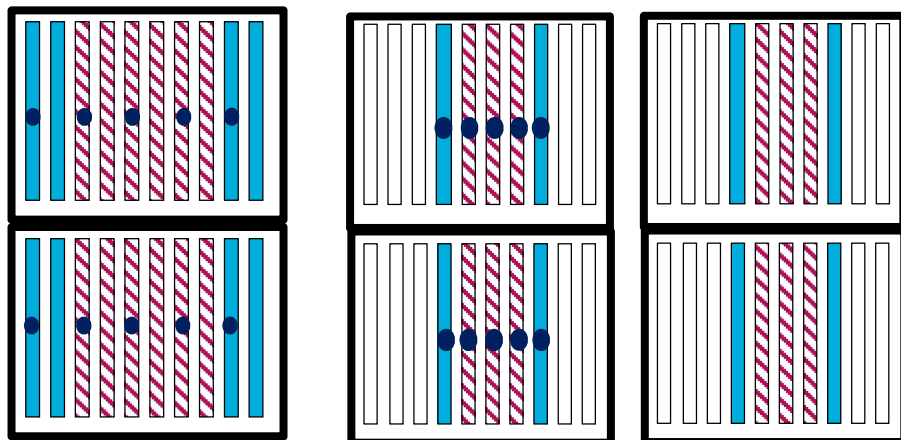
*The leftmost hive is the original hive. It is split into two new hives (middle and right), where each box from the original hive becomes the bottom box for a new hive, and a new box is added on top. You don't need to find the queen, you just have to make sure that each hive **could** make a queen if it needed to—that each hive has eggs.*



A second way to make a walk-away split is to number the frames, and put odd frames in one box and even frames in another. Push these frames to the middle, adding empty frames to the outside.

Walk-away splits are sometimes called dirty splits, because it isn't a very elegant way to split: you'll get uneven hives, and you have little control of where the queen is. However, these are fine techniques for new beekeepers who are nervous about hive manipulations. It is better to do a dirty split and sell the resulting hive to your neighbor than to lose your lovely queen to the trees or behind your neighbor's siding!

The leftmost hive is the original hive. All the odd frames go into one hive (middle), and even frames to another (right)—keeping all the bees with the frames they are on. The old frames are pushed together, and the boxes filled with empty comb.



THREE COMMON QUESTIONS ABOUT SPLITS

When do I know that my hive is ready to split?

The splitting sweet spot is smack at the start of swarm season, sooner than you spot swarm cells. If you go too early, you'll chill the brood, and your virgins won't have any drones to mate with. If you wait too long, your bees will make the split without you. I first look for backfilling and signs that the colony can cover a lot of brood. One way to tell if there are enough bees to split is if they festoon across the gap when you pull a frame out of the brood nest. Festooning means that there are enough bees to cover both sides of the frame. If you have open queen cells, you can still split, just keep in mind that the bees may still want to swarm in the hive with the original queen, so it is good to do a type of split that removes the queen. If you have capped swarm cells, it is likely that the swarm has left, so take advantage of those beautiful cells, and make some splits!



Bees festooning. Photo by Maja Dumat, CC BY 2.0 <https://flic.kr/p/7Z4meh>

Can I leave the new hive(s) in the same location as the original hive?

What if I only have one bee yard? Do I have to move the new hive two miles? You're fine. You don't have to have a second bee yard or move the hives to make a successful split. You can put the resulting hives right in the same location, or add a split right near the parent hive. Just keep in mind that bees that have oriented on the original hive will go back to that location—so you may have bees leave the hive in the new location and go back to the hive in the old location. That is fine, just account for it by moving more nurse bees to the hive in the new spot.

How do I know that my split worked?

If you do a type of split where you allow the bees to make a new queen, you want to make sure that you give the new queen time to develop before you go digging in there. A very common mistake is to open the hive too early and disrupt the process. When you open a hive with a cell or virgin there are too many ways to mess up things. A virgin is flighty, and the bees don't really like her. If you disrupt the bees too much while there is a virgin in the hive, you can push her to fly away or the bees can take out their anger on her and injure her (or worse!) You can damage queen cells by chilling them if the frame is out for too long, or by tipping the frame or bumping the cell. To prevent mucking it up, write down the day you made the split, and figure out the queen math to determine when you would expect to see brood. Don't open the hive until that date. Don't even peek. Write a stern reminder note on top of the hive if necessary. Nothing good comes from peeking in the hive early. Most of the time when there is a problem, it is because the queen didn't come back from a mating flight. If that happens, just combine the hive back with the original hive. By this time, reproductive swarm season will be over, and you can move on with life.

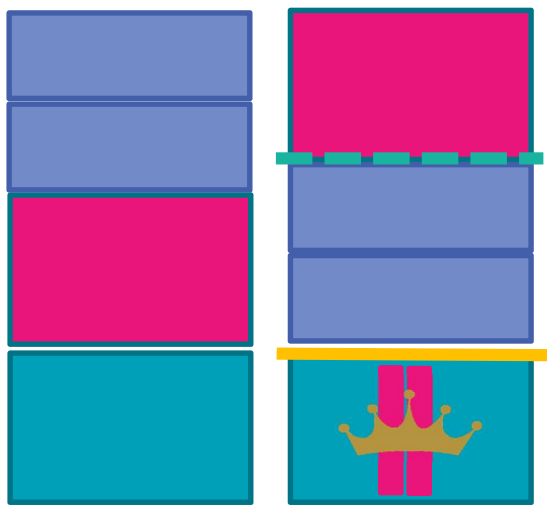


A young queen. Give her the best chance of success by letting her develop in peace! North Worrel, CC BY 2.0, <https://flic.kr/p/JdMtLe>

SPLITTING IN THE SAME HIVE: USING A DOUBLE-SCREEN/ SNELLGROVE BOARD

Some splitting techniques allow you to create the split in the same hive. Using a physical barrier and some distance, the brood are moved away from the queen, and the bees are separated into two clusters within the same column of boxes. Techniques that keep the split in the same hive have a great advantage for those of us in northern climates in that they reduce the chance of chilled brood.

The general set-up for an in-hive split is that the old queen is in the bottom box, with just a few frames of brood, and plenty of open comb to lay (if you take all the brood, the bees will just leave her, so you want to leave enough so there are some nurse bees to take care of her). Usually you add a queen excluder next, to confine her to the bottom box, and some boxes with drawn comb to provide space for nectar above her brood nest, and to provide distance to prevent bees in the top from receiving her pheromone. The brood frames from the original hive are added on the top.



A typical in-hive split. The hive on the left was overwintered in the two deeps (blue and pink). Two honey supers were added early in the season (purple). When the split is made (right hive), the queen is moved to the bottom box, and given plenty of room to lay. She is confined by a queen excluder (yellow line), and boxes are provided to give the bees room for nectar. The green dashed line represents an optional double-screen or Snellgrove board, which cuts off the bees from the lower hive.

Once you get the hive into this position, you have a few options, depending on what you want in the end: two separate hives, one really big recombined hive, or a 2-queen system.

- 1) If you want two separate hives, you can remove the top box and place it in a new location, and provide it with a queen cell or mated queen (or if it is large enough, allow it to raise a queen). I'll describe this process in detail later.
- 2) If you want to recombine the hive, you can use a Snellgrove board. A Snellgrove board is a modification to the double-screen that has a series of entrances that are opened and closed systematically to reunite the hive after the threat of reproductive swarming is passed. I don't really use this method, so I won't cover it, but there are plenty of other resources that provide detailed steps.
- 3) If you want a 2-queen system, which is great for making honey, you can use a double-screen, and allow the bees to raise their own queen (or give them a queen cell), and then switch the double-screen for a queen excluder once the queen has come back and is mated. If the queen doesn't get mated, you can just recombine.



A Snellgrove board. This technique requires frequent visits to the hive, so it is really best for beekeepers who only have/want a few hives that are easily accessible.

Finding the queen

You can find the queen by taking out all the frames and just looking for her, but this process sometimes takes forever, which is pretty disruptive to the bees. Since we want the queen to be in the bottom box, we don't actually have to find the queen, we just need to make sure that she ends up in the bottom box. To do this, remove all the hive boxes from the bottom board, and set up a new bottom box just the way you want it. Usually I put two frames of brood in the middle, some empty drawn comb, and two frames of food on the outside. Set a completely empty box (no frames or anything) on top of this box—this will act like a funnel. Take all the rest of the frames and shake the bees into the funnel into the bottom box.



There is a queen in here—do you see her? How about on a hot day, when you are sick of looking for queens? Photo and queen by Meghan Milbrath

Here is how I set up the bottom box which is in the original location. There are two frames of brood in the middle (pink stripes), and food frames on the outside (yellow dots). Fill in the rest of the box with drawn comb. Now the queen will have plenty of room to lay, and you have removed the risk of backfilling.

Remember that the whole point is to make sure the queen is in the bottom box, not to just shake bees. You don't have to shake every last bee into the box. If you shake all but a few bees off a frame, you should be able to tell that the queen isn't there. Likewise, if you find the queen at any point, you can just put her below, and stop the process. There is no need to keep shaking bees!

Once all the bees are in the bottom box, you can remove the empty funnel box, add a queen excluder, and restack the rest of the hive boxes in the order that you want. The top boxes are set up with the final product in mind—arrange the frames so the new split is ready to go. Set up each box with the brood in the middle (2-4 frames), some food on the outside, and a little space. If you want a bigger split, maybe you'll just make up one extra box to take. If you want more splits, and you have the bees, you can take a couple per hive. The bees will settle and rearrange themselves to cover the brood in the new arrangement.

One of the biggest reasons that I like doing the in-hive split is that you can set up the original hive on one day, and then think about what to do next. After you have the hive in this arrangement, you have put an immediate stop to the swarming process: the queen has plenty of room to lay, and the bees have plenty of space to add nectar. The next thing you need to worry about is the creation of emergency queen cells in the upper boxes. You need to choose what to do before you have virgins emerging and killing your queen down below (virgins can squeeze through a queen excluder). As I mentioned above, you can recombine the hive with a Snellgrove board, you can add a queen, and run it as a 2-queen system, or you can remove the splits. I generally just remove the splits, because I want to have more hives (Always. It is kind of a problem.)

A PERFECTLY FINE METHOD OF SWARM CONTROL

Below I'll outline the method that I have used the last few years for managing swarms. It may or may not be a good method for you (or who knows, it may not be a good method for me, either). I'm writing this in 2018; two years ago I tried this method on a few hives and liked it, so last spring I tried it on all my hives, and was pretty happy with it. The procedure is detailed later in this document.

The basic process:

- 1) Put extra boxes of drawn comb on the big hives early—during the first spring warm up, when I know that food is coming in.
- 2) Unwrap and start digging in there once I see dandelions, and the weather is warmer. If hives are ready to split, I'll start this day. If not, I'll inspect, and keep checking for early signs of swarming.
- 3) When I see backfilling etc. I'll make an in-hive split on a really nice day.
- 4) I'll move the splits from the top of the hives when I need to and add a queen cell the following day.

The reasons I like this method:

There are a few reasons why I split within the same hive.

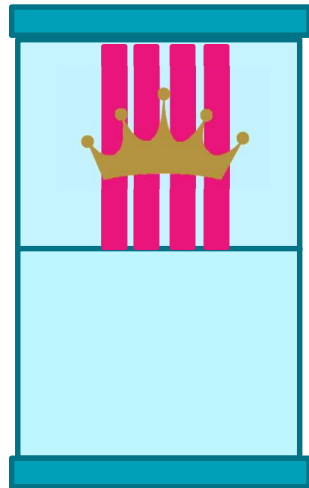
- First, during the splitting process, it can get crazy, with bees flying everywhere. With this method, the bees are calm and inside the hive when I want to move them.
- We have limited nice days in the spring. We often get warm followed by cold followed by cold followed by warm—you get the idea. I want the weather to be nice when I'm digging in the hive, but I don't care what it is like when I'm just moving hives. By separating the digging from the moving, I don't 'waste' nice weather driving around.
- As mentioned before, if we get a cold night, keeping the split within the same hive will allow for a little more protection for the brood. The bees can choose themselves how they should separate between the two clusters to keep the brood warm.
- The best part is that it allows me to take a step back, plan, and gather equipment. I'll make all my splits, and then note how many splits will be coming from that yard. At the end of the day I can go home have a beer, and figure out where I want to move the splits, what I need for hive stands, how many bottom boards to load into the truck, and how many queen cells I'll need. I don't have to make decisions in the yard when I'm hot and trying to get everything done.



A new yard made from splits of overwintered hives. Photo by Meghan Milbrath

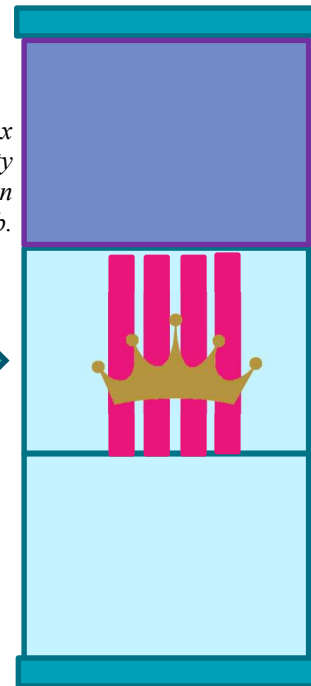
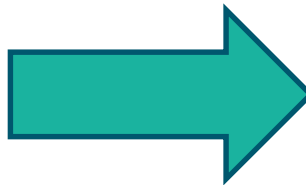
PROCEDURE: STEP BY STEP SPRING SWARM CONTROL

- 1) Add drawn comb to all the large hives once they start to bring in food (can be weeks in advance).



Here is the original hive as it is in early spring. The cluster is up top, and there is a small brood nest.

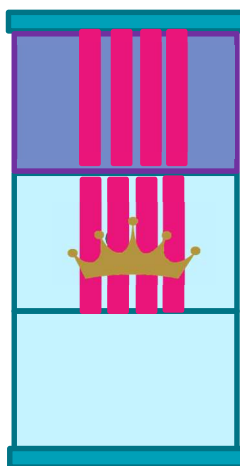
This is a box of empty drawn comb.



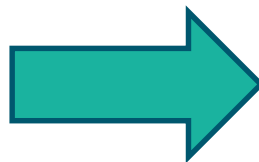
- 2) Create the in-hive split when you start to see signs that the colony is fixing to swarm (on a nice day if you have it).

You'll need the following equipment on the day that you will be restructuring the hive:

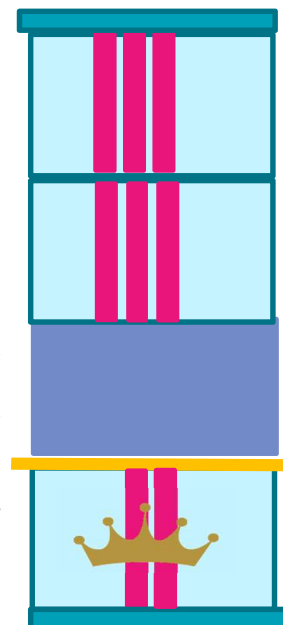
- A queen excluder for each hive that you will split
- An extra empty box (with no frames, for use as a funnel for shaking bees)
- Extra boxes with frames. You can use some honey frames from deadouts and mix in some foundation, but you really want drawn comb.



By this time, the brood box will have expanded. I am showing eight frames of brood, but it may be more or less at the time you make your split.



Here is the hive in the final arrangement. The original queen is in the bottom box, under a queen excluder (yellow). There is a box of drawn comb above her (purple). These two boxes will make up the hive that stays in the original location. The rest of the brood is brought up to the top boxes to start two new hives. In this case, two splits will be removed, but in other cases, you may have only enough bees to make one split from the hive.





Splits ready to move to a new location; parent hives are in the back. Photo by Meghan Milbrath

3) Move your splits to a new location

Another great thing about the in-hive split is that you can set up the original hive on one day, and then move the splits on a different day. If you move the bees at night, or on a cool rainy day (as shown in the photo above), you'll bring a lot more bees with you. If you move them on a sunny day, when the foragers are out, you'll leave a lot more bees at the original location. Neither way is right, you just have to choose what you want. One reason that I like moving them on a rainy day, is it allows me to get more work done—I can be out even when the weather is horrible, as it often is in Michigan—but I don't have to worry that I'm damaging my bees or chilling brood.

After I leave the yard on split day, I'll write down how many splits I'll plan on taking from that yard, and I'll load my truck with that many bottom boards, lids, and ratchet straps. One the day I'm moving the bees, I'll set the bottom boards on the ground next to the hives, and pull the split off, give it a cover, and recover the original hive as swiftly as I can. I'll drive the bees to the new location and leave them alone.

4) Add queens to the splits

I usually add queens the day after I move the splits. You can use mated queens or queen cells. I am generally using cells, because that is what I can get locally at that time. The split is opened, and I'll add in the cell between the frames of brood. I'll write down the date that I need to come back and check the queens, and if they didn't work (the queens didn't get mated), I'll just combine them with another hive.

That's it!

Best of luck to you and your bees this coming swarm season.