

GUIDE TO HONEY BEE QUEEN BANKING



Oregon State
University



National Institute of Food and Agriculture
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Project *Apis m.*

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INTRODUCTION

A healthy and productive queen is an essential part of a successful colony. Access to and replacement of queens has become a key part of beekeepers' economics and management decisions, and this guide addresses the handling and storage of valuable, highly perishable honey bee queens. A beekeeper may need to store queens in reserve until they can be placed in colony settings. To safely hold queens, a beekeeper can use a special colony configuration called a 'queen bank.' Beekeepers can build a bank colony by removing the original queen, then placing individually caged queens in the bank by suspending the cages inside the bank colony in a removable frame. Worker bees will tend to each queen to keep them warm and fed, and the cages prevent queen aggression towards each other.



Photo by Sharah Yaddaw, Project Apis m.

Holding queens in a bank colony can serve beekeepers in many ways. The process of dividing colonies or assembling nucs in the spring can be lengthy, leaving a time gap between when the beekeeper acquires new queens and can introduce them in new colonies. Queen producers may need to store surplus queens for days or weeks after mating, to accommodate shipping preferences of customers. Beekeepers may also overwinter late-season queens in bank colonies to have queens available in the following year to replace failing queens in colonies prepared for almond pollination services or introduce the queens into newly divided colonies in early spring to offset winter colony losses.

Research findings support long-term queen banking, including overwintering bank colonies, as means to store queens without damaging them. Queens can be held in a bank colony for up to six months if the bank is properly established and maintained by the beekeeper (Wyborn 1991). Two key factors for a successful bank are to eliminate any free-roaming queens and ensure the bank has ample young worker bees. A free-roaming queen, by cage escape or otherwise, will put the banked queens at risk of aggression or abandonment by the workers. Bank colonies also need young workers regularly added to sustain a large worker population and facilitate proper queen care.

This guide will walk you through the step-by-step process of establishing and maintaining a queen bank.



SECTION 1: THE BASICS

Bank colonies can host many queens without death or injury with the proper equipment and management schedule. All banked queens must be confined in **queen cages** and managed in a **bank frame**.

EQUIPMENT

HOW TO USE QUEEN CAGES IN BANK COLONIES

Exposed

The cage mesh should always be exposed to the bank colony's workers to allow the workers to take care of the queen. Leave enough space between the cages in the bank frame and the neighboring frames. Some bank frames may not have a buffer space included in their design.

Sealed

Always seal the queen cage opening. This will be a cork, shipping bar, or plastic cap depending on the type of cage (see Table 1, pg. 5). Corks should be flush with the cage opening. Queen cages can also be banked with candy introduction tubes in the cage opening if the introduction tubes are flush with the bottom of the bank frame. Worker bees will chew through cork cage plugs and candy if they have access to it. This can be avoided by placing queen cages cork-side or candy-side down on the banking frame. Placing a layer of duct tape layer over the cork end will add more protection against chewing through corks should they become inadvertently exposed. Three-hole cages (see Table 1, pg. 5) corks on each end of the cage so the top-side cork must be covered with a layer of duct tape for long-term banking.



Figure 1. California mini cage with an unsealed cork (left) and sealed cork that is flush with cage opening (right). Bees can chew through the cork with access to edges, so always have cage cork flush with the cage opening for banking purposes.



Figure 2. Queen producers will often ship queens with candy installed in cages. Pushing the candy introduction tubes into the California mini cage opening so that it is flush with cage entrance is optional but not necessary for banking purposes (as shown with cage on right).

Grouped

Queen cages should be grouped together as closely as possible on the bank frame. This allows workers to easily cluster around queens in cool temperatures and reduces risk of small hive beetle damage. Do not place queens in the outer 3-4 inches of the bank frame when overwintering bank colonies.

No Attendants

Queen cage attendants will die in bank colonies. Always place attendants in queen cages immediately before use (see Cage attendants section, pg. 24)



Figure 3. Queens in California mini cages grouped together with candy introduction tubes flush with the bottom of a banking frame row. Pushing the candy introduction tubes into the cage is not necessary.

CHOOSING QUEEN CAGES

There are four commercially available queen cages in the U.S.: California mini, three-hole, JZs BZs, and hair roller queen cages (Fig. 4). Each cage type has a plug option to securely seal the queen inside the cage (see Cage plug supplies in table below).

Table 1. Specifications of four commercially available queen cages.

	<i>California mini</i>	<i>Three-hole</i>	<i>JZs BZs</i>	<i>Hair roller</i>
Material	Wooden cage with wire mesh	Wooden cage with push-in mesh or stapled mesh	Plastic	Plastic
Cage plug supplies	Cork	Cork	JZs BZs shipping bar is recommended to secure cages in bank frame	Candy Cup/Closure comes with plastic cap (sold separately)
Candy introduction supplies	Introduction tubes	Wax paper and waxed portion of wooden cage	JZs BZs Candy Cap (sold separately)	Candy Cup/Closure (sold separately)
Queen cell compatibility (See Appendix A, pg. 37)	Yes	Yes	No	Yes
Other features	<p>Small size allows more efficient spacing for banking and shipping.</p> <p>Small size allows more efficient spacing for banking and shipping.</p> <p>Offers tighter bee coverage in bank colonies.</p> <p>Limited space for cage attendants (see Cage attendants, pg. 24).</p>	<p>Spacious for 7+ cage attendants (see Cage attendants, pg. 24).</p>	<p>Plastic is infused with synthetic Queen Mandibular Pheromone</p> <p>Contains removable access bar to allow worker access (see pg. 32)</p> <p>Requires double bank frame to accommodate JZs BZs shipping bar (see Double bank frames section pg. 7)</p>	
Suppliers*	<p>BetterBee Beekeeping Supplies</p> <p>C. F. Koehnen & Sons Inc.</p> <p>Mann Lake Bee Supply</p>	<p>BetterBee Beekeeping Supplies</p> <p>C. F. Koehnen & Sons Inc.</p> <p>Dadant & Sons Inc.</p> <p>Mann Lake Bee Supply</p>	<p>BetterBee Beekeeping Supplies</p> <p>Blue Sky Bee Supply</p> <p>Dadant & Sons Inc.</p> <p>JZs BZs Honey Co.</p> <p>Mann Lake Bee Supply</p>	<p>BetterBee Beekeeping Supplies</p> <p>Blue Sky Bee Supply</p> <p>Mann Lake Bee Supply</p>

**See Resources (pg. 36) for contact information.*

Wooden v. plastic cages

Workers will seal openings in plastic cages and wire mesh of wooden cages with propolis over time. Some beekeepers experience more propolis on plastic cages with long term use.

Mesh options for three-hole cages

There are two types of three-hole cages: stapled mesh and push-in mesh. Stapled mesh lays flat on the wooden cage and the push-in mesh is slightly concave toward the wooden cage. See pg. 24 for more details that differentiate these two cage types.



Figure 4. (From left) California mini, three-hole, JZs BZs, and hair roller queen cages. Three-hole cage is pictured with candy in bottom third of the cage. Hair roller queen cage is pictured with Candy Cup/Closure attachment.

BANK FRAMES

Bank frames suspend queen cages inside the bank colony, keeping the queen secure and accessible for worker bee feeding. Bank frames must be handmade as they are not commercially available for purchase at this time. A variety of bank frame designs require minimal materials and equipment to build.

Bank frame designs described in this guide include:

1. Gated bank frame
2. Gateless bank frame
3. Single bank frame (2-tier and 3-tier)
4. Double bank frame

Queen cages can be pressed into the comb of a Langstroth frame instead of using a bank frame, see Appendix B for more details (pg. 38).

Gated bank frame

Bank frames will often have gates that functionally open and close to maneuver queen cages. As seen in Fig. 6, wooden gates can span across the entire bank frame without additional support whereas gates made from welding rods need a wooden centerpiece to function (Fig. 5).



Figures 5. A bank frame with an open gate (top row) and closed gate (bottom row). Partially taping queen cages is helpful for labeling information. The blue tape seen in this photo is used for labeling queens.
Credit: Megan Mahoney.



Figure 6. A bank frame with wooden gates secured by bent nails. See pg. 8 for design specifications.

Gateless bank frame

Gateless bank frames can have a tapered wooden piece (Fig. 7) or a lower front support (Fig. 8) for easy access to queen cages instead of gate closures.



Figure 7. Gateless bank frame with tapered wooden piece as front support for queen cages. Credit: Mikayla Wilson.



Figure 8. Gateless bank frame with low welding rod to secure queen cages. Credit: Arthur Kubogamell.

Single bank frame

We define different bank frame designs by their width, either double or single bank frames. Single bank frames occupy space equivalent to one Langstroth frame.

Tiers are the number of rows that can hold queen cages in a bank frame. A bank frame with 2 tiers can accommodate California mini, three-hole, and hair roller queen cages whereas 3-tier bank frames are limited only to California mini cages. The main advantage to a 3-tier bank frame is its increased queen cage capacity. A single 2-tier bank frame design can hold a maximum of 40 California mini queen cages whereas a single 3-tier can hold 60 California mini cages.

Double bank frame

Double bank frames can hold twice the number of queens as single bank frames, e.g. 80 California mini queen cages can fit in a double 2-tier frame. The increased width of double bank frames allows beekeepers to conveniently hold shipping trays of queens (Fig. 10). Wooden queen cages (California mini and three-hole cages) are placed back-to-back, and JZs BZs cages are fitted on a JZs BZs shipping bar before placement on bank frame. Double bank frames occupy more space than a Langstroth frame so care must be taken to keep the bee space (3/8th inch) between queen cages and the frames next to the queens.



Figure 9. A single bank frame placed in the center of a 10-frame box.



Figure 10. A double bank frame placed in the center of a 10-frame box.

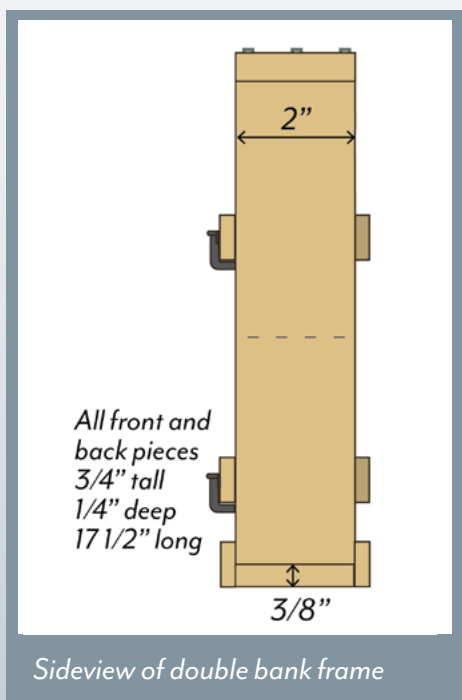
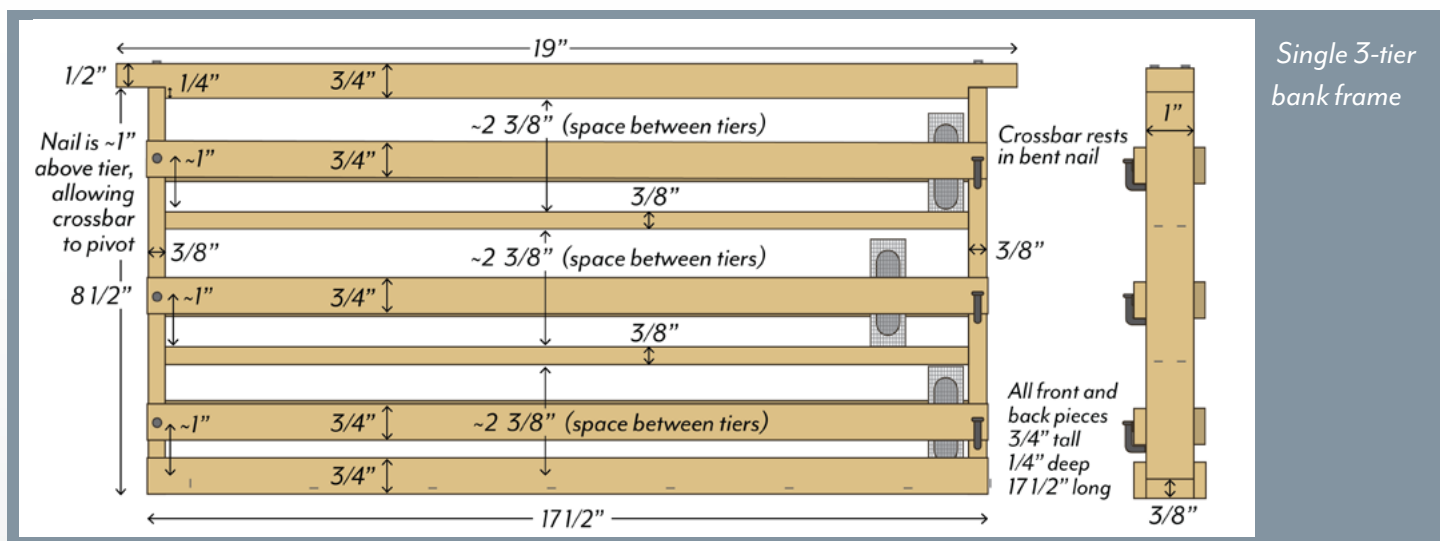
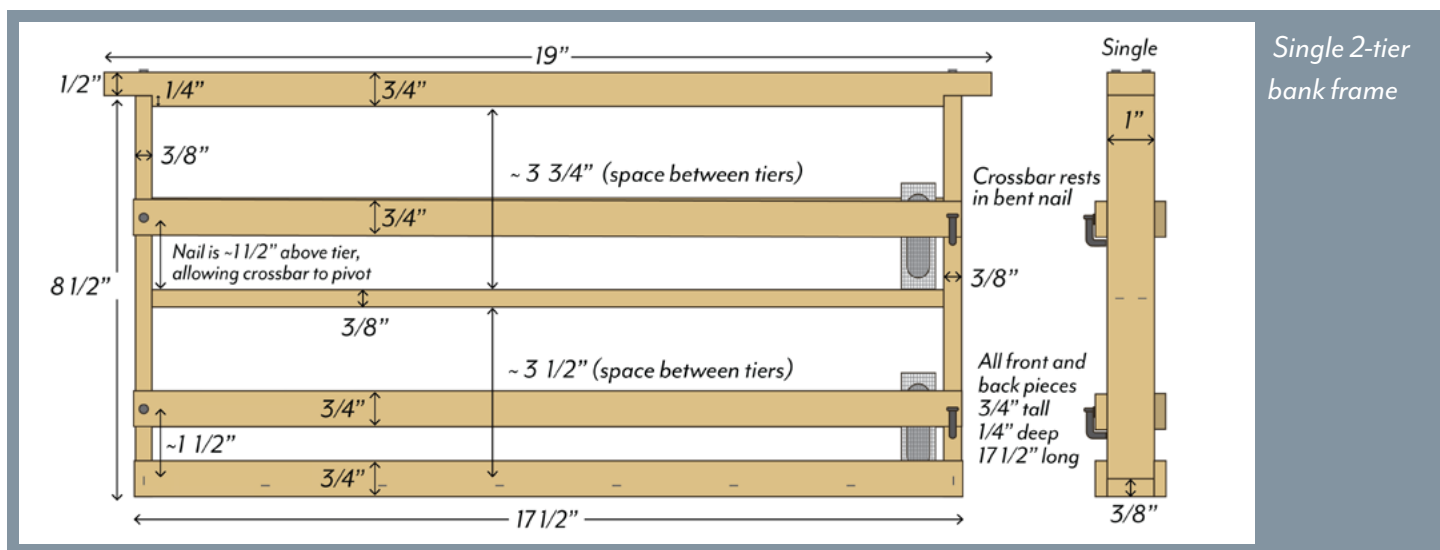


Table 2. Maximum capacity of queen cages for single and double bank frame designs. See pg. 5 for details on queen cage types.

Single bank frame	
2-tier	3-tier
<ul style="list-style-type: none"> 40 California mini 24 Three-hole 28 Hair roller 	<ul style="list-style-type: none"> 60-66 California mini
Double bank frame	
2-tier	3-tier
<ul style="list-style-type: none"> 80 California mini 48 Three-hole 56-88 JZs BZs 	<ul style="list-style-type: none"> 120-156 California mini 84-132 JZs BZs



Figure 12. 2-tiered double bank frame holding 2 shipping trays of 26 three-hole cages. Credit: Kona Queen Hawaii.



Figure 13. 84 JZs BZs queen cages in 3 orange JZs BZs shipping bars and stacked together in a double bank frame. Credit: David Thomas.



Figure 14. Empty double bank frames. Credit: David Thomas.



Figure 15. Cages may slightly overhang the bank frame in a 22-cage formation. Allow for extra space between the bank frame and neighboring brood frame to accommodate

Photo by Sharah Yaddaw, Project Apis m.





SECTION 2: ASSEMBLING THE BANK COLONY

The process for assembling a bank colony depends on seasonal conditions and the desired type of bank colony.

Types of bank colonies include:

- A. Field-season bank colony
 - 1. Queenless
 - a. Short-term
 - b. Long-term
 - 2. Queenright
- B. Winter-season bank colony
 - 1. Temperate winter
 - 2. Extended winter
 - 3. Indoor storage

Queen acceptance by bank colonies

The likelihood that a bank colony will accept queens depends on:

- ***Young workers:*** Increasing the population of young workers will increase odds of queen acceptance (see Supplying young worker bees, pg. 18).
- ***Lack of queen pheromone:*** Wait for the original queen's pheromone to dissipate before introducing new queen(s). There are two perspectives on how long this process takes: 24 hours or 30 minutes. See section on pg. 11 for more details.

Waiting period before queen introduction to bank colonies

Removing the colony’s original queen is standard practice when introducing new queen(s) into that colony. This applies to establishing bank colonies, cell builders, and requeening colonies. There are two perspectives on the waiting period between removing the original queen and introducing new queen(s)—waiting 15-30 minutes or 24 hours. Both perspectives rely on the assumption that the queen pheromone of the original queen must be completely absent before new queen introduction.

Perspective 1: Wait 15-30 minutes

Several studies found that queen pheromone rapidly dissipates from a colony after queen removal - specifically in 25-30 minutes or less (Juška and Seeley 1981, Naumann et al. 1991, Naumann et al. 1992). The Oregon State University Bee Lab establishes bank colonies with a 15-minute waiting period before queen introduction—a decision influenced by suggestions from beekeepers. Waiting 15 minutes has not resulted in poor queen survival in bank colonies thus far. Other professional beekeepers have also reported success by waiting for 15 minutes or less.

Perspective 2: Wait 24 hours

Winston et al. (1989), found that queen pheromone components were completely cleaned from glass slides by colonies of 8,000-10,000 workers in less than 24 hours. But waiting longer than 24 hours will simulate the production of queen cells from the colony’s remaining brood—risking an unwanted virgin queen in the colony (Pettis et al. 1995, Melathopoulos et al. 1996). Installing a synthetic queen pheromone strip, such as TempQueen, will extend the time the host colony can remain queenless.



Figure 16. TempQueen, a synthetic Queen Mandibular Pheromone strip, placed on a banking frame while awaiting queen arrival.

FIELD-SEASON BANK COLONY

Beekeepers use bank colonies during the field season to hold up to ~300 queens per bank. If queens need to be held in a bank colony for less than two weeks, assemble a bank as a queenless colony. Otherwise, long-term bank colonies can be built as a queenless or queenright bank unit.

Table 3. Pros and cons of queenless and queenright bank colonies:

	Queenless bank colony	Queenright bank colony
PROS	<ul style="list-style-type: none">Initial setup is less time-consuming than queenright bank colony setupLess risk of unwanted free-roaming queen	<ul style="list-style-type: none">Does not need donor colonies to maintain young bee population; bottom box (with laying queen) allows bank colony to produce its own brood needed in top boxDo not need to source a mated queen when discontinuing a bank colony
CONS	<ul style="list-style-type: none">Need donor colonies or other external source to routinely add young bees (long-term bank only)Difficult to requeen after banking is over	<ul style="list-style-type: none">Time-consuming setup processFaulty queen excluder poses risk of queen death in banked queensHigher risk of varied preferences in queen care. Reduced risk if laying queen is the same age as banked queens

QUEENLESS BANK COLONY

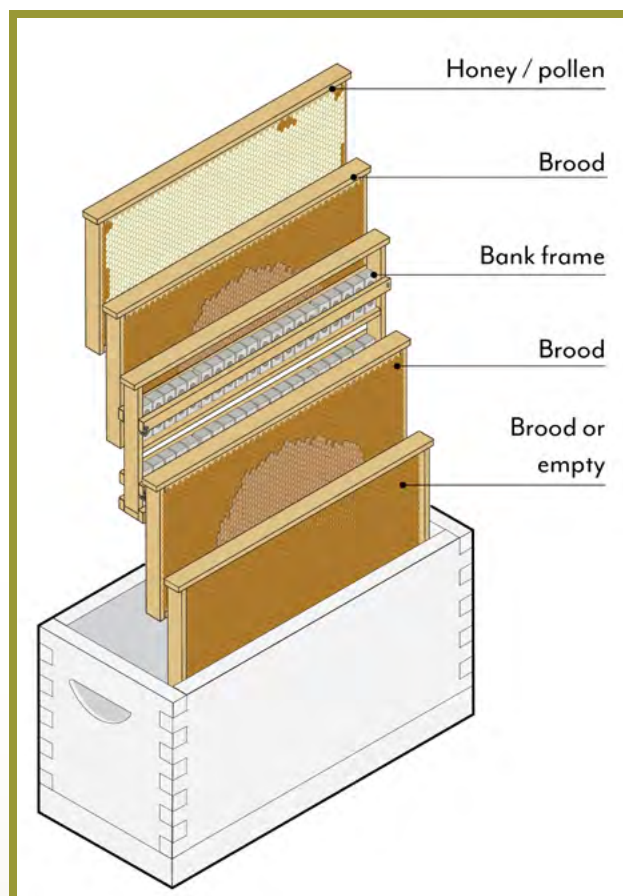
A queenless bank colony, by definition, does not include a free-roaming queen in any capacity. The steps involved in building a queenless bank colony differ slightly depending on how long the bank colony needs to be maintained, referred to as **short-term** and **long-term** bank colonies.

Short-term queenless bank colony

A short-term bank colony is an easy solution to temporarily hosting new queens. They do not need resources to sustain themselves beyond two weeks, eliminating the need to periodically supply young worker bees, perform *Varroa* mite management, or ensure heavy food stores. This allows short-term bank colonies to be in 5-frame nucs - offering quick and easy access and transport with banked queens.

Steps to build a short-term bank colony:

1. Choose/build a healthy colony
 - **5-frame nuc** with at least 2 brood frames or a **single-story colony** with 3-4 brood frames. All frames should be covered in bees.
 - Queenright
 - Low *Varroa* mite infestation (see Resources section for testing methods, pg. 36)
 - No signs of brood disease
 - Enough food stores for 2 weeks (1 frame of honey/ pollen)
2. Remove original queen, check all frames for secondary queen or virgin.
3. Leave colony queenless between 15 minutes to 24 hours (see Queen acceptance section, pg. 10).
4. Place bank frame of queens in the center of hive box.
5. Inspect every brood frame and remove any queen cells 7-10 days after removing the original queen from the colony (see Remove queen cells from brood frames, pg. 18).



Short-term colony setup.

Long-term queenless bank colony

A bank colony can last longer than two weeks by continually adding young workers every week (see Step 6).

Six steps to assemble a long-term bank colony:

1. Choose/build a healthy colony
 - Single-story colony with 3-4 brood frames and 5-7 lbs. of bees.
 - Queenright
 - Low *Varroa* mite infestation. Colony should have sample results of 0-1 *Varroa* mites per 100 bees (see Resources section for testing methods, pg. 36)

- No signs of brood disease
- Well-fed with 2-3 frames of honey/pollen

2. Remove original queen, check all frames for a secondary queen or virgin.

3. Leave colony queenless between 15 minutes to 24 hours (see Queen acceptance section, pg. 10).

4. Place bank frame(s) of queens in the center of hive box.

Note: If adding more than one bank frame, place one brood or empty frame between the bank frames.

5. Inspect every brood frame and remove any queen cells 7-10 days after removing the original queen from the colony (see Remove queen cells from brood frames, pg. 18).

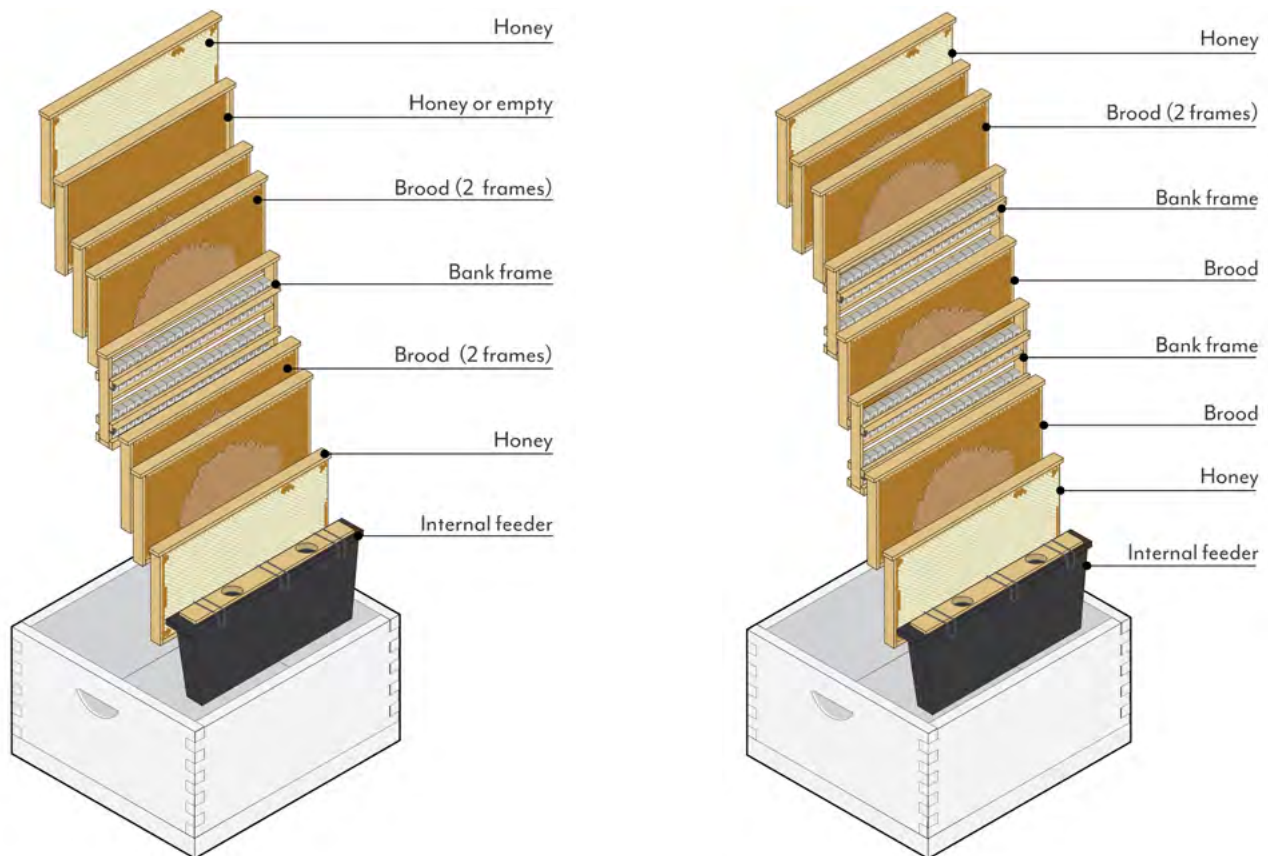
6. Add young bees to the bank colony (see Supplying young worker bees section, pg. 18).

- Placing 1-3 brood frames from donor colonies into bank colony every week. Step 5 and 6 can conveniently be done simultaneously.

OR

- Adding 2-4 lbs. of bulk bees to the bank colony every week.

Note: The single-story bank colony will grow to a double-story colony over time. Keep all brood frames in the bottom box and move bank frame(s) to the top box as a double-story bank colony.



Internal components of a long-term field season bank colony with one bank frame (left) and two bank frames (right).

QUEENRIGHT BANK COLONY

Queenright bank colonies have a laying queen present in the colony. The term, queenright, is a bit misleading for this bank colony setup because the laying queen cannot physically or pheromonally contact the caged queens.

Steps to assemble a queenright bank colony:

1. Find a medium box full of empty frames and queen excluder. Alternatively, find a double-screen.

2. Choose/build a healthy colony

- Double-story colony with at least 12 frames of bees
- Queenright
- Low *Varroa* mite infestation. Colony should have sample results of 0-1 *Varroa* mites per 100 bees (see Resources section for testing methods, pg. 36)
- No signs of brood disease
- Well-fed with 2-3 frames of honey/pollen

3. Find original queen and place in bottom box.

4. Place a queen excluder above the bottom box and a medium box above the queen excluder and below the top box.

Note: Alternatively, place a double-screen or divider board between the top and bottom box. No medium box is needed if using a double-screen.

6. Leave colony queenless between 15 minutes to 24 hours (see Queen acceptance section, pg. 10).

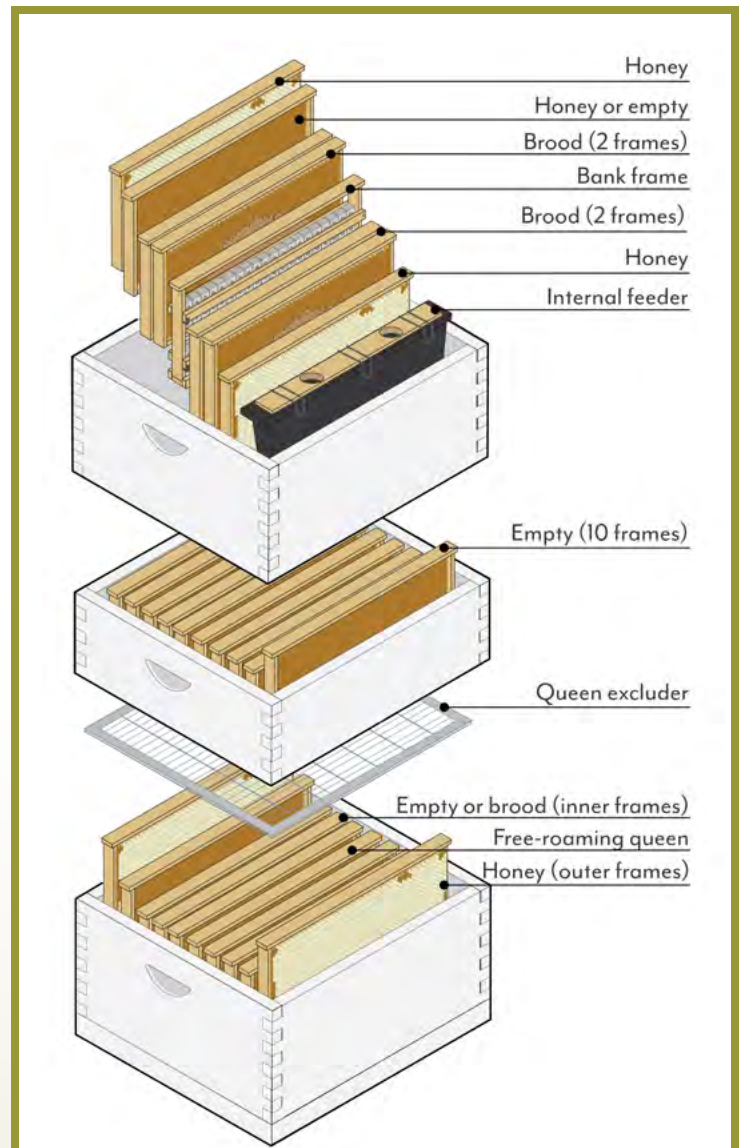
7. Place bank frame of queens in the center of top box.

Note: If adding more than one bank frame, place brood or empty comb between each bank frame.

8. After 7-10 days, inspect every brood frame in the top box and remove any queen cells (see Remove queen cells from brood frames, pg. 18).

9. Every week, move 1-3 brood frames from bottom box to top box and replace with empty frames. Inspect new brood frames (top box) 7-10 days later and remove any queen cells.

Note: Confirm that the bottom box is queenright when moving brood frames. The free roaming queen may die or move to the upper portion of the bank colony.



Internal components of a queenright field season bank colony with a free-roaming queen placed in the bottom deep box.

WINTER-SEASON BANK COLONY

Overwintering a bank colony can successfully supply queens in early spring. Specifications differ based on the type of winter climate. Controlled-environment indoor storage can also support bank colonies in the winter or summer months.

TEMPERATE WINTER

Overwintering bank colonies with average minimum and maximum temperatures of 35°F and 55°F between November and January.

Six steps on assembling a bank colony for winter:

1) Choose/build a healthy colony

- Double-story colony
- Large population of bees (14-20 frames of bees and 8 frames of brood)
- Queenright
- Low *Varroa* mite infestation. Colony should have sample results of 0-1 *Varroa* mites per 100 bees (see Resources section for testing methods, pg. 36)
- No signs of brood disease
- 50-60 lbs. stored honey, at least 5-6 deep frames full of honey

2) Remove original queen, check all frames for a secondary queen or virgin.

3) Leave colony queenless between 15 minutes to 24 hours (see Queen acceptance section, pg. 10).

4) Place caged queens in the centermost part of the bank frame. Then place bank frame of queens in center of the top box. If adding more than one bank frame, place one brood or empty frame between the bank frames.

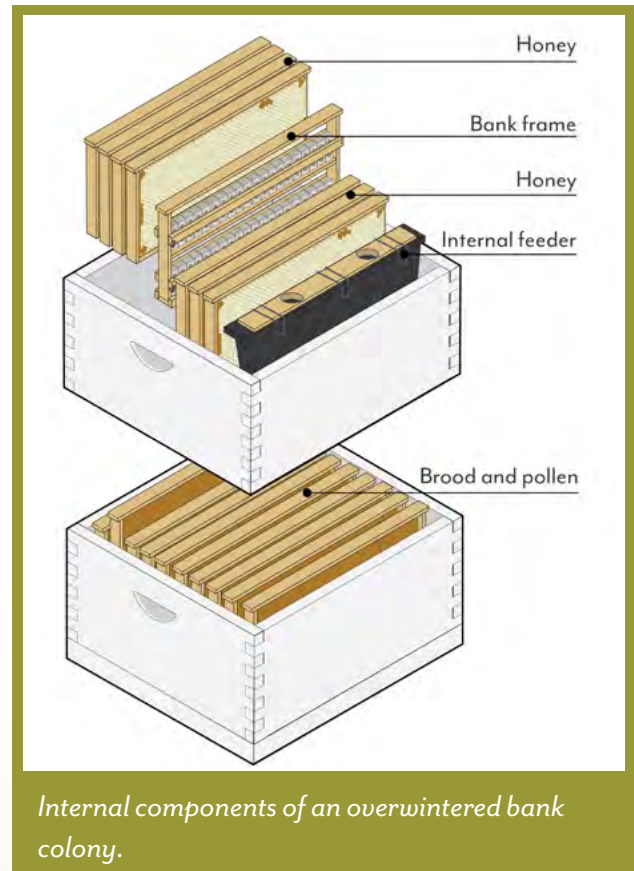
Note: Do not place queens within the outer 3-4 inches of the bank frame.

5) Inspect every brood frame and remove any queen cells 7-10 days after removing the original queen from colony (see Remove queen cells from brood frames, pg. 18).

6) After 21 days, apply the drizzle method of oxalic acid on bank colony. Apply the OA solution on every seam except the two seams that touch the bank frame (see *Varroa* mite management, pg. 20).

INCLEMENT WINTER

Building bank colonies for an inclement winter climate requires higher colony strength requirements than temperate winters. Beekeepers will combine two large colonies, totaling 15-20 frames of brood, in September. They will reduce the combined four-story colony to a double-story colony when the brood has emerged. Aside from colony strength, the six steps listed in the Temperate winter section are the same for building a bank for inclement winter (see above).



INDOOR STORAGE

Bank colonies can be overwintered inside a refrigerated storage unit with a humidity- and ventilation-controlled environment. Indoor storage units can effectively store bank colonies during the winter and during extreme heat or smoky periods in the summer.

General requirements for indoor storage units with bank colonies (Molitor 2019):

- 59.0-60.8°F
- 45-80% relative humidity
- Airflow of 20 watts/colony
- Ventilation rate of 0.5-9.0 cubic feet/minute

Consult the six steps in the Temperate winter section to build bank colonies for indoor storage (pg. 15). After establishing bank colonies, move them to indoor storage when the ambient temperature approach 59.0-60.8°F.



Photo by Sharah Yaddaw, Project Apis m.



SECTION 3: BANK COLONY MANAGEMENT

Banked queens are vulnerable to free-roaming queens and worker neglect if the bank colony is left unattended by the beekeeper. Proper bank management includes an effort to:

1. Minimize queen death
2. Supplying young worker bees
3. Feeding
4. Robbing
5. *Varroa* mite management
6. Insulation
7. Pest control

MINIMIZE QUEEN DEATH

Expect a few queens to die within the first 10 days of establishing a bank colony. Consult the Troubleshooting section (pgs. 28-29) if more than 10% of queens die within 2-4 weeks or if queens die in a distinct pattern, such as excessive death in one row on the bank frame. Caged queens can die because of a variety of reasons. Here are some strategies to minimize queen death.

Uniform queen age and reproductive status

Workers may neglect or act aggressively toward individual queens in a bank colony. Worker aggression may result in chewed queen tarsi or queen death.

Reduce preferential treatment of banked queens by workers by banking queens that are:

- **The same age:** workers are partial to older queens when mixed-aged queens are in the same bank colony. Place queens that range a few months in age in the same bank colony. This ruling will likely exclude the colony's original queen from the cohort of banked queens.
- **Are the same reproductive status:** Do not place mated queens and virgin queens in the same bank colony.

Queen cage placement on bank frame

If anticipating cold temperatures, consider placing queens away from exposed areas in the colony.

Best queen placement for cold temperatures...

- Centermost part of the bank frame
- Upper row(s) of a bank frame if using a single-story bank colony
- Top box of a double-story bank colony

Remove queen cells from brood frames

Workers will often create emergency queen cells from worker brood in bank colonies. These queen cells will be easily detected if brood frames are inspected 7-10 days after removing the original queen from colony or introducing a brood frame into existing bank colony. It is also easier to see queen cells after lightly shaking workers from each brood frame during inspection.

SUPPLYING YOUNG WORKER BEES

Young worker bees are most likely to care for queens. As bank colonies cannot produce their own worker bees, the beekeeper needs to supply them. This can be done by either adding brood frames or bulk bees to the bank colony weekly.

Add 2 brood frames weekly

Adding brood frames is a great way to introduce many young worker bees to a bank colony because it does not require special equipment. The downside of this method is the risk of workers producing emergency queen cells from the brood provided, which would be disastrous to the banked queens if unnoticed. This can be avoided by shaking bees from desired brood frames and placing them in another hive box that sits above a queen excluder. These brood frames in the top hive box can be removed after 12-24 hours.

Brood of any age can be introduced to bank colonies. Selecting brood of mixed ages allows a steadier supply of worker bees within a 1-2 week period. Alternatively, selecting mostly capped and/or emerging brood will minimize the likelihood of workers producing queen cells from this brood.

Add 2-4 lbs. of bulk bees weekly

Add bulk bees shaken from 2 or more frames to bank colonies every week (2-4 lbs. of bees). Shaking bulk bees from brood frames will increase the likelihood that they will be young—ideal for introducing in bank colonies. Adding bulk bees will require special equipment (e.g. shaker cage) to acquire young workers, but it is less time-consuming than adding brood frames—there is no need for a secondary inspection for queen cells with this method. A shaker cage will reduce the risk of accidentally introducing a queen while adding bulk bees because these bees must travel through an excluder with the shaker cage design.



Figure 18. Worker aggression toward one of the six banked queens (third queen from the right). These workers are tightly pressed on this queen's cage mesh.



Figure 17. Dead banked queens.

FEEDING

Bank colonies must have access to pollen and honey to feed their caged queens. They may require more pollen and honey stores than a typical colony when banking 30+ queens or when overwintering bank colonies with any number of queens.

Add additional pollen frames to bank colony during a pollen dearth period. Bank colonies can also benefit from feeding syrup unless it is during a time when robbing behavior is prevalent. If feeding with a top feeder, ensure the queens are not right below the syrup drip to avoid leakage mortalities.

Field season bank colonies should have at least 2 honey frames.

When kept at a steady 60.8°F, **overwintered bank colonies** lose about 48 lbs. from October to April. Place 5-6 deep frames of stored honey (50-60 lbs.) in the top box when building a bank colony for winter.

ROBBING

It takes about 30 minutes to build a bank colony. Having a colony open for a long time (e.g. 30 minutes) can intensify robbing during a nectar dearth. Robbing can reduce worker populations and should be avoided when building and maintaining bank colonies.

Robbing precautions

- Install entrance reducers on all colonies in the apiary or use robbing screens
- Seal alternative colony entrances
- Do not feed syrup before inspecting colonies
- Cover any bank colony with a thin sheet after inspection and remove after about 30 minutes
- Build or inspect bank colonies inside a bottomless screen tent
- Run a sprinkler in the center of an apiary immediately after colony inspection
- Remove hive lids from every colony in the apiary while working in select colonies
- Work queen banks early in the morning before foraging begins



Figure 19. Recently opened bank colonies covered with bedsheets to reduce robbing.



Figure 20. Inspecting a pallet of colonies inside a bottomless screen tent to reduce robbing.
Credit: Megan Mahoney.

VARROA MITE MANAGEMENT

Beekeepers should select bank colonies that have 0-1 *Varroa* mites per 100 bees with an alcohol wash or powdered sugar shake field test (see Resources, pg. 36). This is an important consideration when building a long-term bank colony. Colonies with high *Varroa* mite infestation have worker bees with lower lifespan and are at higher risk for sharp decline in worker population.

Beekeepers can further reduce the *Varroa* mite population of their queenless bank colonies by applying oxalic acid (drizzle method). An oxalic acid application is most effective when the colony is completely broodless. A winter-season bank colony will be broodless 21 days after establishment (see Resources, pg. 36). Apply the oxalic acid solution on every frame seam except the two seams that surround the bank frame or remove the bank frame from the colony during application.

INSULATION

Queens can be damaged or die by exposure to hot or cold temperatures. Beekeepers can insulate queens from extreme temperatures by...

- Insulating queen cages in the bank frame
- Insulating the colony

Insulating queen cages in the bank frame

Place the bank frame in the middle of the top box of a double-story bank colony to maximize heat exposure from bees. Adding wax comb in the empty space on bank frames can insulate the queen cages. Bees will naturally build comb in empty spaces inside the bank frame. Beekeepers can place cut comb into empty spaces in bank frames to speed up the process. Workers will seal this comb to the edges immediately and may even fill it with honey.



Figure 21. Workers will build wax comb around queen cages. Leave this comb to maximize insulation surrounding queen cages.



Figure 22. Wax comb placed inside bank frame in spaces unintended for queen cages.



Figure 23. 30 California mini cages surrounded by wax comb in bank frame.



Figure 24. Polystyrene (Styrofoam) hive equipment.

Insulating the colony

Polystyrene (Styrofoam) hive equipment can buffer bank colonies from extreme temperatures and protect clustering bees from excessive moisture during the winter. Several bee equipment suppliers sell polystyrene hive boxes, screened bottom boards, and lids separately (see Resources, pg. 36). Another option is to cut insulation board (2-inch thickness) to place directly above and below the bank colony.

Wrapping individual or palletized colonies with commercial wrap or tar paper can further insulate colonies from cold temperatures. See Resources for more information (pg. 36).



Photo by Sarah Yaddaw, Project Apis m.

PEST CONTROL

Wax Moth

Wax moth species, *Galleria mellonella* and *Achroia grisella*, can cause damage to used hive equipment. They will commonly feed on wax comb when stored in warm, unventilated spaces. Even a small amount of comb can attract them. The moths will lay eggs on used queen cages, JZs BZs plastic cell cups, and bank frames. Wax moth larvae will often chew into wood, leading to compromised equipment. Wax moth larvae may also kill queens by developing inside queen cells or queen cages. The best way to prevent wax moth infestation is to freeze (20°F) used queen production equipment, including queen cages and bank frames, when not in use. Wax moth can also enter queen cages in active bank colonies. Always inspect cage corks to confirm that they are flush with the cage entrance to prevent wax moth intrusion.



Figure 25. Wax moth larva damaging the inside of a reused California mini cage (left). Figure 26. Dead queen in queen cage with wax moth infestation (right)
Credit: Megan Mahoney.

Small hive beetle

Small hive beetle (*Aethina tumida*) can damage queen cages and kill inhabiting queens. They can infest queen cages inside bank colonies and shipping boxes. Keep small hive beetle infestation to a minimum by:

- Grouping queen cages together as closely as possible on the bank frame
- Transferring queens to new queen cages when ready to ship queens to customers
- Installing candy in queen cages at the last possible moment (see Candy section, pgs. 22-23)

SECTION 4: QUEEN INTRODUCTION AFTER BANKING

Beekeepers need to prepare queen cages for colony installation when ready to use banked queens. They also need to carefully introduce a laying queen into the bank colony when all banked queens are removed from the bank colony.

The following topics will be discussed in this section:

A. Queen cage modifications

1. Candy
2. Candy recipes
3. Cage attendants

B. Queen introduction in new colonies

C. Converting a bank colony to a queenright colony

QUEEN CAGE MODIFICATIONS

Prepare queens for colony installation with the following modifications:

- Add candy to queen cage opening
- Add cage attendants to queen cage if necessary

CANDY

The standard method for introducing queens in colonies is to use candy as a slow-release mechanism. Workers will chew through candy to release a caged queen in about 24-72 hours from installation. Candy placement depends on queen cage type.

For **California mini cages**, candy introduction tubes can be purchased or made with a tube-filling tool (see C. F. Koehnen & Sons Inc. in Resources, pg. 36). Store candy tubes sealed in plastic bag and refrigerated before use. Remove corks with forceps and push introduction tube into cage opening. If queen cages were banked with candy tubes, inspect candy and add more if necessary.



Figure 27. Premade candy introduction tubes for California mini cages.



Figure 28. Cork replaced with candy plug for colony installation



Figure 29. Queens that are ready for colony installation.
Credit: Lon Lloyd.

There are two types of **three-hole cages**: one with stapled mesh (Fig. 31) and push-in mesh (Fig. 32). Both are viable cages for banked queens, but the three-hole cage with the push-in mesh option offers an easier way to insert candy later and a quick release of dying attendants (see stings in Cage attendants, pgs. 24-25). One of the three holes has a wax layer for preserving the candy's moisture. Once candy is placed in the hole with wax, place a small piece of wax paper, often supplied with cage purchase, on top of candy dollop before installing cage mesh.

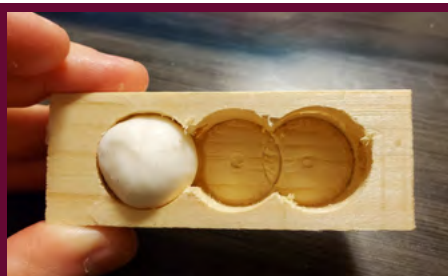


Figure 30. Candy placed in the waxed hole of three-hole cage.

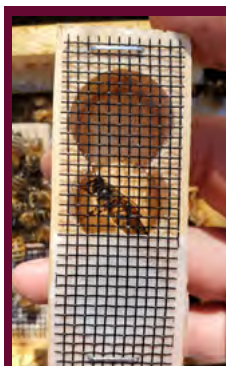


Figure 31.
Three-hole cage with stapled mesh.

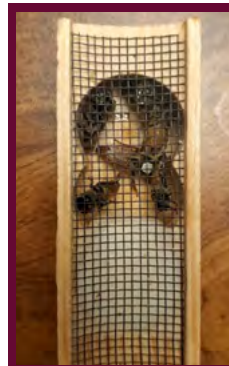


Figure 32.
Three-hole cage with push-in mesh (only available by C. F. Koehnen & Sons Inc).

Manually place candy in the long tube of JZs BZs cages and in the Candy Cup/Closure attachment for hair roller cages.

CANDY RECIPES

Recipe 1 Higher quality	Recipe 2 Lower quality
12 cups dry invert sugar (Drivert®) 1 cup liquid invert sugar (Nulomoline® or FreshVert®)	7.5 cups powdered sugar 1 cup corn syrup (Karo®)

Steps for both recipes:

1. Hand knead or mechanically mix dry and liquid sugar to form candy with a firm but malleable consistency.
2. If mechanically mixing candy, microwave liquid sugar for 30 seconds. Add dry sugar to a stand mixer, then slowly pour warmed liquid sugar while mixing.
3. Optional: cover candy with thin coating of dry sugar and rest overnight. Add more dry or liquid sugar to achieve desired consistency.
4. Optional: freeze candy for later use.



Figure 33.
JZs BZs cage filled with candy.
Credit: Katie Lee.

Candy Consistency

Candy should have a consistency resembling firm dough. Its firmness may change with storage or weather conditions prior to queen installation. Queens are at risk of being released too quickly or drowning in the candy if it is too soft. On the other hand, a queen may not be released in a timely manner if the candy is too firm. Always test candy before queen installation. See Step 3 in Candy Recipes (pg. 23) for details on correcting consistency issues. Taping over candy in 3-hole cages can help retain candy's moisture.

If there are any concerns regarding candy consistency, install queen cage with the candy facing downward and place one layer of thin masking tape around the exposed candy or refer to the Candy alternative section below.

Candy alternative

It can be difficult to maintain a desired consistency with candy. Alternatively, replace candy with a single layer of masking tape with two small holes pierced into the cage entrance to encourage chewing by workers.



Figure 34-35. One layer of masking tape around cage entrance with two small pin pricks. Credit: Megan Mahoney.

Cage attendants

In circumstances where bulk attendants are not allowed or not convenient, newly emerged workers can be caught and added to cages. This is best achieved by selecting worker attendants from open brood frames of a queenright colony and placing them inside the queen cage entrance individually. Add seven worker attendants per queen cage. More than seven attendants can be added to cages if there is concern of cool temperatures during shipment. Queens can be further insulated by shipping or transporting three-hole cages facing each other. Note: Three-hole cages can only face inward if they have push-in mesh cages (available by C. F. Koehnen & Sons Inc., pg. 36) Unlike the three-hole cages with flat stapled mesh, the push-in mesh option allows space between the bees from the two cages when facing inward. The attendants and queens would kill each other if the mesh were touching, as they would with the stapled mesh option.



Figure 36. Three-hole cages with seven worker attendants in each cage (stapled mesh cage option).



Figure 37-38. Three-hole cages with push-in mesh facing outward (left) and inward (right) for air shipping. Queens can be further insulated by shipping or transporting three-hole cages that are facing inward with push-in mesh cages (available by C. F. Koehnen & Sons Inc., pg. 36).

Circumstances for using cage attendants

- Air or ground shipping a small order of queens
- Shipping queens to Canada (required)
- Sending queens to North Carolina State University's Queen & Disease Clinic (see Resources, pg. 36)

Workers may sting your fingers during this transfer process and will die shortly thereafter. When air shipping, place queen cages upright with candy above the queen and workers to avoid dead workers blocking candy access. When introducing queens in colonies, place the queen cage at a 45-degree angle on comb with the cage mesh facing towards the bottom board and the hole angled downward. Alert queen producer if shipped queens arrive with all or mostly dead attendants.



Figure 39. Queen cage pushed into wax comb of a brood frame at a 45-degree angle on the frame. Credit: M. Mahoney.



Figure 40. Queen cage pushed into wax comb of a brood frame. Credit: M. Mahoney.

GROUND TRANSPORTATION OF BANKED QUEENS

Beekeepers need to transport banked queens to other apiary locations either in their bank colony or transfer banked queens into shipping boxes. Directly transport the bank colony to the desired location if it is a 5-frame nuc or single-story colony. Transfer caged queens and young worker bees into a shipping box or carton for transport if the bank colony is double- or triple-story.

Transporting a banked colony

- Cover the bank colony with a bee net or mesh laundry bag to prevent a stinging hazard to the public while in transit.
- Secure bank colony to the truck bed near the truck cab.
- Keep the bank colony out of direct sunlight for prolonged periods.

Transporting queens in shipping boxes

Shipping boxes can hold a small number of queens for daily use. Place cage attendants inside queen cages if transporting 1-10 queens (see Cage attendants, pgs. 24-25). Each individual cage should receive a droplet of water on cage mesh every 24 hours. If transporting more than 10 queens at a time, place queens inside shipping boxes or cartons with candy, water feeder, and bulk attendants.

Bulk attendants

Bulk attendants are worker bees that are loose within the shipping box. Collect attendants from brood frames of well-fed colonies.



Figure 41. Queens in a medium cardboard shipping box with candy, water, and bulk attendants.

Steps to add attendants to shipping box:

1. Mist bees with small amounts of water to reduce flight and enable easier maneuvering when weighing and transferring attendants.
2. Measure attendants by weight or volume.
3. Add attendants to the shipping box. Optional: measure attendants into a tall container, e.g. plastic deli container, before adding to the shipping box for easier measuring and handling.
4. Check attendant coverage of the queens before sealing the shipment. Add more attendants if there is partial coverage.

The amounts listed in Table 4 will allow attendants to properly cover queens in the shipping box. Queen producers should be mindful of forecasted temperatures during shipment and always check attendant coverage before sealing the shipment for delivery. Add more attendants if there is partial queen coverage or remove some attendants if preparing to ship queens in temperatures that exceed 100°F.

Table 4. Attendant quantities for shipping boxes (Frost 2016).

<i>Caged Queens</i>	<i>Attendants (ml)</i>	<i>Attendants (cups)</i>	<i>Attendants (grams)</i>
50	180	3/4	180
100	360	1.5	360

QUEEN INTRODUCTION IN NEW COLONIES

Colony preparation

Colonies should be well-fed, queenless, and large enough to adequately cluster around the brood nest and caged queen. Queen acceptance is higher with a smaller colony unit, such as a nuc or single-story colony. Younger bees more readily accept queens compared to old bees.

Queen installation

- Allow 15 minutes to 24 hours from removing the original queen before introducing the new queen into a new colony. See pg. 10 for details.
- Minimize the time between removing queens from the bank colony and installing them in new colonies.
- Push the queen cage into the comb of a frame with open brood with the candy aiming downward. Confirm queen cage mesh is exposed to workers (see Fig. 40).
- Place the queen cage near the upper edge of the cluster or brood nest.
- In temperatures that exceed 100°F, do not place the queen cage near the hive lid to prevent overheating.
- Do not revisit the colony for at least 3 days.

CONVERTING A QUEENLESS BANK INTO A QUEENRIGHT COLONY

Requeening a queenless bank colony after removing all banked queens can be difficult. Many of the workers are older and less accepting of a new queen.

Best approach

Introduce a queenright 5-frame nuc colony in the bank colony. Remove five frames from the bank colony and replace with a 5-frame nuc colony. Provide a physical barrier, like newspaper between the top and bottom box or caging the nuc's queen with candy.

Alternative approach

Add one frame of open brood from a donor colony. Press caged queen into the comb of an open brood frame following the Queen Installation steps (see above).

Photo by Sarah Yaddaw, Project *Apis m.*





SECTION 5: TROUBLESHOOTING

Beekeepers should inspect queens in bank colonies frequently. It is common to have the most queen death occur during the first week after queens were introduced in a bank colony. Common problems and their solutions are as follows:

<i>Problem</i>	<i>Observation(s)</i>	<i>Solution(s)</i>
An unexpected free-roaming queen near the caged queens	<ul style="list-style-type: none"> Many dead caged queens (50% or more) caused by worker abandonment of the queens Eggs seen in worker cells 	<ul style="list-style-type: none"> Remove the free-roaming queen Inspect queen cages for unsealed openings. <ol style="list-style-type: none"> Replace exposed or chewed corks or candy plugs. Adjust bank frame to secure queen cages. Inspect brood frames and remove any queen cells 7-10 days after introduction in bank colony. Shake all workers off of the brood frames before inspecting for queen cells. Queenright bank colonies: Inspect queen excluder for warped structure
Egg-laying workers in bank colony	<ul style="list-style-type: none"> Multiple eggs seen in worker and drone cells Higher presence of drone larvae and pupae, often in worker-sized cells 	<p>This is <i>not</i> a big concern. A possible, but unnecessary, solution includes adding young bees to bank colony—either by introducing brood frames or young bulk bees.</p>
Worker aggression toward caged queens	Caged queens with damaged tarsi	<ul style="list-style-type: none"> Place 1-2 layers of tape on half of the exposed mesh on every queen cage for additional protection. Replace chewed tape if aggression continues. Drizzle a scant dollop of honey on queen cages. Use California mini or three-hole queen cages instead of hair roller and JZs BZs cages. Smaller holes in wire mesh of wooden cages reduce exposure to workers.

Problem	Observation(s)	Solution(s)
Bank colony has high <i>Varroa</i> infestation	<ul style="list-style-type: none"> • Brood frames have symptoms of Parasitic Mite Syndrome • Sharp decline in adult worker population • Colony has sample results >1 <i>Varroa</i> mite per 100 bees 	<ul style="list-style-type: none"> • Treat bank colony with oxalic acid (drizzle method), pg. 20. • Transfer queens to a new bank colony with sample results of 0-1 <i>Varroa</i> mites per 100 bees.
Extreme ambient temperatures	<ul style="list-style-type: none"> • Dead queens in outermost queen cages on bank frame • All queens are dead 	<p>Cold ambient temperatures</p> <ul style="list-style-type: none"> • Do not place queens in the outer 3-4 inches of the bank frame when overwintering bank colonies. • Add young bees to bank colony—either by adding another hive box full of bees as the bottom box or combining two double-story colonies. • Replace screened bottom board with solid bottom board or seal screen with plasticore. • Transfer queens to a larger bank colony. <p>Hot ambient temperatures</p> <ul style="list-style-type: none"> • Remove some bees and brood from bank colony. • Move bank colony to cooler area, such as a refrigerated indoor storage facility
Queen lays eggs inside cage	Eggs in bottom of queen cage	This is <i>not</i> a big concern. The eggs will not be an obstruction when introducing queen in a new colony.



Figure 42. Combining two double-story colonies to build a bank colony with a large bee population to overwinter in extremely cold temperatures. Credit: A. Rousseau.



Figure 43. Banked queen laying eggs inside cage.

SECTION 6: FREQUENTLY ASKED QUESTIONS

Research on queen bank colonies spans the 1970s to present day, offering a breadth of knowledge that addresses critical questions on the sustainability and economic impact of bank colonies in a beekeeping operation. Several studies are referenced throughout this section, including two studies from Quebec (Rousseau and Giovenazzo 2021, Levesque et al. 2022) as well as some unpublished data from Oregon State University (OSU) and Washington State University (WSU). Margariet Wyborn's Master's Thesis (1991) is mentioned frequently in this section and serves as the most comprehensive evaluation of overwintering bank colonies. See References for details (pg. 35).

Does long-term banking affect:

- A. Queen survival? **Yes.**
- B. Queen weight? **Yes and no.**
- C. Queen reproductive quality? **No.**
- D. Performance of colonies headed by banked queens? **No.**

Overwintered Bank Colony Specifications in Research Studies:

Each study referenced in the section had different wintering conditions, specifications on hive equipment, colony strength, amount of stored honey, and queen stocking rate, and queen survival rates. Table 5 outlines these details on 5 individual studies.

Table 5. Details on location, winter conditions, bank colony establishment, queen stocking rate, and winter survival rates of five major research studies.

	Wyborn (1991)	Rousseau and Giovenazzo (2021)	Levesque et al. (2022)	WSU unpublished data (2020)	OSU unpublished data (2020-Present)
Location	British Columbia	Quebec	Quebec	Washington and California	Oregon
Winter description	Temperate 6 months (Sept.-March)	Inclement 7 months (Sept.-Oct. outdoors, Nov.-Apr. indoor storage held at 3 constant temps)	Inclement 7.5 months (Aug.- Sept. outdoors, Oct.-Apr. indoor storage held at 59°F)	Inclement 48 days in indoor storage held at 59.0°F (July-Aug.)	Temperate 4 months (Oct.-Jan.)
Hive configuration	Triple-story, 10-frame	Double-story, 10-frame	Double-story, 10-frame	Double-story, 10-frame	Double-story, 10-frame
Colony strength when first established	Combined large single- and double-story colony; includes 20 frames of brood	Combined two double-story colonies with 15-16 frames of brood	Combined two double-story colonies with 15-16 frames of brood	19-20 frames of bees, 5 frames of capped brood in bottom box, and 3 frames of capped brood in the top box	14-19 frames of bees
Stored honey	50 lbs.	Fed 8.5 gal. of 2:1 sucrose syrup	Fed 8.5 gal. of 2:1 sucrose syrup	4 frames in top box and 2-3 frames in bottom box (60-70 lbs.)	60 lbs.
Queen stocking rate	24 and 48	40	40, 80	50, 100, 200	20, 30, 60
Average queen survival rate(s) in overwintered bank colonies	60% in wooden cages with mesh	73% at 60.8°F in indoor storage 47% at 51.8°F in indoor storage 50% at 42.8°F in indoor storage	74% with 40 queens/bank 42% with 80 queens/bank	78% (combined average of all stocking rates)	66% with 20 queens/bank 80% with 30 queens/bank 72% with 60 queens/bank

DOES LONG-TERM BANKING AFFECT QUEEN SURVIVAL? YES.

Generally speaking, long-term queen banks can sustain high queen survival if properly maintained as evidenced by many beekeepers with experience managing bank colonies for 2-6 months (active field season). When considering overwintering bank colonies, **ambient temperatures** and **winter duration** can affect the chances of queen survival.

- Overwintering bank colonies at 60.8°F has a higher chance of queen survival compared to lower temperatures (42.8°F and 51.8°F) for 7 months (Rousseau and Giovenazzo 2021).
- Overwintering bank colonies had higher queen survival during the first 3 months (Sept.-Nov.) or a 7-month winter (Sept.-Apr.). Bank colonies were held at 42.8°F and 51.8°F (Rousseau and Giovenazzo 2021).
- Overwintering bank colonies at a constant 59.0°F had higher queen survival compared to bank colonies held in California summer heat (60-95°F daily temperatures; 48 days total) (WSU unpublished data).

Queen stocking rate may or may not impact the chances of survival in overwintered/dormant-season bank colonies. The duration and time of year may affect these survival rates (see Table 5).

- Bank colonies that overwintered in Quebec had significantly higher survival rates with 40 queens/bank than 80 queens/bank (Levesque et al. 2022).
- There was no difference in queen survival between bank colonies with 50, 100 and 200 queens that were held for 48 days (Jun.-Jul. at varying temperatures) (WSU unpublished data).
- There was no difference in queen survival between bank colonies with 30 and 60 queens during a 19-week winter (OSU unpublished data).

The **queen cage type** and **queen cage location** on the bank frame may affect queen survival when overwintering bank colonies.

- Queens held in cages made from queen-excluder material had lower survival rates than cages of material that completely excluded workers from the caged queen. However, some beekeepers have had success banking with worker access in JZs BZs queen cages. These JZs BZs cages have their access bar removed, allowing workers direct access to the queen (Wyborn 1991).
- Overwintered queens are more likely to die in outermost cages on the bank frame (Dietz et al. 1983, Wyborn 1991, Abd Al-Fattah et al. 2016).

There are **alternative ways to overwinter queens** aside from bank colonies. Most commonly, beekeepers will overwinter queens in 5-frame nucs. As seen in Wyborn's study, overwintering bank colonies results in lower queen survival rates versus overwintering queens in 5-frame nucs (British Columbia winters 1988-89). Beekeepers also overwintering queens in 4-way mating nucs colonies in temperate winter climates (British Columbia, California). There are pros and cons to all three techniques; beekeepers often base their decision on the amount of resources (bees, equipment, food inputs, etc.) they're willing to contribute and their desired queen availability in early spring.



Figure 44. JZs BZs queen cages with the access bar intact (top) and removed (bottom). Workers can travel inside the cage when the access bar is removed. Note: some beekeepers have reported success with this method, but this may not guarantee the highest possible survival rates.

DOES LONG-TERM BANKING AFFECT QUEEN WEIGHT? YES AND NO.

Queens may lose weight from being confined in bank colonies but will likely regain weight shortly after colony introduction.

Heavier queens have been demonstrated to be more fecund (Boch and Jamison 1960, Nelson and Gary 1983). Queens that are confined in cages will lose weight within days of confinement (Szabo 1975, Skowronek 2004). Similarly, several studies found that queens lose weight when overwintered in bank colonies under various conditions (Wyborn 1991, Rousseau and Giovenazzo 2021, Levesque et al. 2022, WSU unpublished data). Apart from Levesque et al. (2022), these studies weighed banked queens that were immediately removed from bank colonies without monitoring weight changes after queens initiate egg-laying in colonies. Levesque et al. (2022) found that banked queens regained a size and weight equivalent to queens that overwintered in 5-frame nucs 12 days after they were introduced into colonies. Thus, weight loss seen in confining queens in bank colonies appears to be temporary.

DOES LONG-TERM BANKING AFFECT QUEEN REPRODUCTIVE QUALITY? NO.

Many studies have evaluated effects of long-term banking on queens' sperm viability. Currently, there is very little evidence of adverse effects.

This includes no difference among queens' sperm viability that were overwintered in:

1. Bank colonies vs. 5-frame nucs (Wyborn 1991)
2. Bank colonies of different stocking rates
 - 40 and 80 queens per bank (Levesque et al. 2022)
 - 50, 100, and 200 queens per bank (WSU unpublished data)
 - 30 and 60 queens per bank (OSU unpublished data)
3. Bank colonies held at different temperatures
 - 42.8°F, 51.8°F, and 60.8°F for 7 months (Rousseau and Giovenazzo 2021)
 - 59.0°F vs. 60-95°F daily temperatures for 48 days (WSU unpublished data)

In 2020, a study on overwinter banks in Oregon found lower sperm viability in queens overwintered in banks vs. queens from fully established colonies. This phenomenon was noticed in one of the three beekeeping operations that were tested. This beekeeping operation had very low queen survival associated with five bank colonies (average 34% queen survival compared to 78-86% survival in two other operations). It is unclear what caused such low queen survival.

DOES LONG-TERM BANKING AFFECT PERFORMANCE OF COLONIES HEADED BY BANKED QUEENS? NO.

Queens that overwintered in bank colonies have comparable colony introduction success to other overwintering methods and early-season queens.

This includes no difference in colony introduction success with queens from:

- Bank colonies vs. 5-frame nucs (Wyborn 1991)
- Bank colonies held at different temperatures (42.8°F, 51.8°F, and 60.8°F) for 7 months had 79-94% queen introduction success rates (Rousseau and Giovenazzo 2021)
- Bank colonies with 40 and 80 queens per bank (Levesque et al. 2022)
- Bank colonies vs. early-season queens from Hawaii (OSU published data).

Banked queens had similar colony growth compared to queens from 5-frame nucs and early-season queens.

- There were no differences in a colony's amount of brood or adult bees with queens overwintered in 5-frame nucs and bank colonies in British Columbia, measurements were taken in June and August of 1989 and for a separate set of queens in 1990 (Wyborn 1991).
- After 11 months from establishment, colonies were evaluated with queens that overwintered in two locations in Oregon and early-spring queens from Hawaii. Colonies of all queen sources were viable for almond pollination (4 or more frames of bees), but colonies with overwintered banked queens from one of the beekeeping operations had more colonies with 8+ frames of bees than colonies with Hawaiian-sourced queens (OSU unpublished data).

Brood quality was the same for banked queens and early-season queens.

OSU ranked capped brood pattern quality of colonies with queens that overwintered in two locations in Oregon (2020-2021) and Hawaiian-sourced queens that were purchased in early spring of 2021. Colonies were evaluated in June, August, October of 2021, and February of 2022. They found no differences among all queen sources for every evaluation period.



*Figure 45. A solid capped brood pattern from a colony headed by a banked queen.
Credit: Carolyn Breece.*



Photo by Sharah Yaddaw, Project Apis m.

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RESOURCES:

Canadian review on overwintering queen banks and nucs

Bixby, M., M.M. Guarna, S.E. Hoover, and S.F. Pernal. 2019. Canadian Honey Bee Queen Breeders' Reference Guide. Canadian Association of Professional Apiculturists Publication. 55 pp. (See pgs. 40-44). <https://capabees.com/qbreederreference-guide032019/>

Queen Cage Suppliers

BetterBee Beekeeping Supplies
800-632-3379
www.betterbee.com

Blue Sky Bee Supply
877-529-9233
www.blueskybeesupply.com

C. F. Koehnen & Sons Inc.
530-891-5216
www.koehnen.com/products

Dadant & Sons Inc.
www.dadant.com

JZs BZs Honey Co.
Nick Irsfeld <jzsbzs@aol.com>
866-559-0525 Toll Free
831-469-9000 Direct/Int'l
www.jzsbzs.com

Mann Lake Ltd.
800-880-7694
<https://www.mannlakeltd.com/>

California mini tube-filling tool
C. F. Koehnen & Sons Inc.
530-891-5216
www.koehnen.com/products

TempQueen (synthetic queen pheromone strip)
BetterBee: Beekeeping Supplies and Education
www.betterbee.com

Varroa mite testing

Honey Bee Health Coalition How-To Video
youtu.be/IgPfT9FQxLc

Oxalic acid miticide application (drizzle method)

Honey Bee Health Coalition How-To Video
https://youtu.be/65g78v_p-MY

Insulation

Polystyrene (Styrofoam) hive equipment
BetterBee: Beekeeping Supplies and Education
www.betterbee.com

Dadant & Sons Inc.
www.dadant.com

Winter wrapping colonies

Reuter, G.S.; Spivak, M. (n.d.). Wrapping Honey Bee Colony for a Northern Winter with Tar Paper. Fact sheet #163. University of Minnesota. <https://drive.google.com/file/d/1CB376vTBumE1qI-LkMaRT-N8ZZmwCQ-ha/view?usp=sharing>

North Carolina State University's Queen & Disease Clinic

<https://www.ncsuapiculture.net/queen-and-disease-clinic>

APPENDIX A: BANKING QUEEN CELLS

Banking queen cells is an ideal practice for emerging virgin queens for purchase or insemination. Queens can eclose (emerge) directly into a queen cage while readily attended by worker bees. The cage entrance hole of California mini queen cages can fit queen cells. Three-hole cages can also hold cells but need a larger entrance hole drilled to fit the cell. A queen can chew through her cell's side wall, so make sure the JZs BZs plastic queen cell cup is flush with the cage's wood entrance.

Working with hair roller cages will require the additional purchase of a Candy Cup/Closure attachment. Placing queen cages in a bank frame is a great way to hold queen cells upright and can either be hosted by a bank colony or incubator. Set incubator temperature to 90-95°F with 55% humidity. Newly emerged queens are often monitored in an incubator and fed honey through the mesh until attendant workers are added or the queen is put into a bank colony to assist with feeding.



Figure 46. Queen cells fitted in the entrance of three-hole queen cages. Credit: Megan Mahoney.



Figure 47. Queen cells emerging inside California mini cages. Credit: Megan Mahoney.



Figure 49. Queen cells fitted inside Candy Cup/Closure attachment for hair roller cages. Credit: Megan Mahoney.



Figure 48. Hair roller queen cage with Candy Cup/Closure attachment. Queen cell is placed in the candy cup component of the cage (top piece).

APPENDIX B: BANK FRAME ALTERNATIVE

A Langstroth frame can serve as an alternative to the constructed bank frames described in Bank frames (pg. 6). Caged queens can fit inside a Langstroth frame by cutting out a piece of comb and plastic foundation that fits the desired number of queen cages. Place aluminum foil around the group of queen cages before placing into frame for easy maneuvering.



Figure 50-51. Cutting space in a wooden Langstroth frame with plastic foundation to fit queen cages for banking purposes. Credit: A. Rousseau.



Figure 52. Langstroth frame holding 40 California mini cages of queens (back-to-back) wrapped in aluminum foil. Credit: A. Rousseau.



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