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Chapter 1: **THE HONEY BEE**

INTRODUCTION

Meet *Apis mellifera*, the honey bee. The earliest *A. mellifera* pollinated Pliocene period plants 2.5 million years ago. By that time, native honey bees roamed Europe, Africa and Asia. The North American story of the honey bee is, however, much more recent; coinciding with the arrival of the pilgrims. The pilgrims brought colonies of honey bees to their colony in the New World.

Chapter 1 provides a broad overview of honey bee basics (i.e. taxonomy, anatomy, colony organization, communication, and hive production), expanded in later chapters.

SCIENTIFIC CLASSIFICATION

A fact we most all learn in elementary school is that the honey bee falls into the insect Class. Additional honey bee taxonomy is dictated by the physical characteristics (morphology) and behavior of the honey bee.

Table 1-1: Honey Bee Taxonomy illustrates the honey bee's scientific classifications, beginning with the most inclusive category, the animal Kingdom.

KINGDOM: ANIMALIA: Honey bees are animals, like humans, horses, pigs and dogs.

PHYLUM: ARTHROPODA: Surprisingly, Arthropoda includes lobsters and spiders. Bees and lobsters?

CLASS: INSECTA: Now this makes more sense. Insecta, one of the most populous classes of animals, also includes butterflies, dragonflies, staghorn beetles, fleas, lice, ants, and termites.

FAMILY: APIDAE: Contains a diversity of 15 tribe lineages. Includes honey bees, bumblebees, cuckoo bees, stingless bees, and carpenter bees.

TRIBE: APINI: Honey Bees.

GENUS: APIS: From Latin meaning 'Bee'.

SPECIES: MELLIFERA: From Latin meaning 'Honey Bearing'.

TABLE 1-1: HONEY BEE TAXONOMY

KINGDOM **Animalia**	-Animals.
PHYLUM **Arthropoda**	- A hardened outer skin (exoskeleton). - Body formed of several segments. - Jointed appendages.
CLASS **Insecta**	-Compound eyes. -Antennae. -Three-segmented bodies.
ORDER **Hymenoptera**	-Two pairs of membranous wings. -Chewing mouthparts. -Complete metamorphosis.
FAMILY **Apidae**	-Includes nearly 5,700 species of bees.
TRIBE **Apini**	-Chewing mouthpart lower lip has been modified to form a tongue.
GENUS ***Apis***	-Build a hive out of wax secretions from their bodies. -Produce and store honey.
SPECIES ***Mellifera***	-Specific name particular to the honey bee.
SUB-SPECIES	There are currently 26 recognized subspecies of *Apis mellifera*, with differences based on differences in morphology and molecular characteristics. Species will be covered in Chapter 2.

ANATOMY

The honey bee is an insect because it has three distinct body parts: head, thorax, and abdomen. It also has the requisite six legs, an exoskeleton, antennae and compound eyes.

Figure 1-1: Female Honey Bee illustrates physical characteristics of honey bees. The head features eyes, antennae, mandibles, and a very functional, yet tiny, brain. The thorax is the base for the legs and the wings. The abdomen contains the stinger, wax glands and reproductive organs.

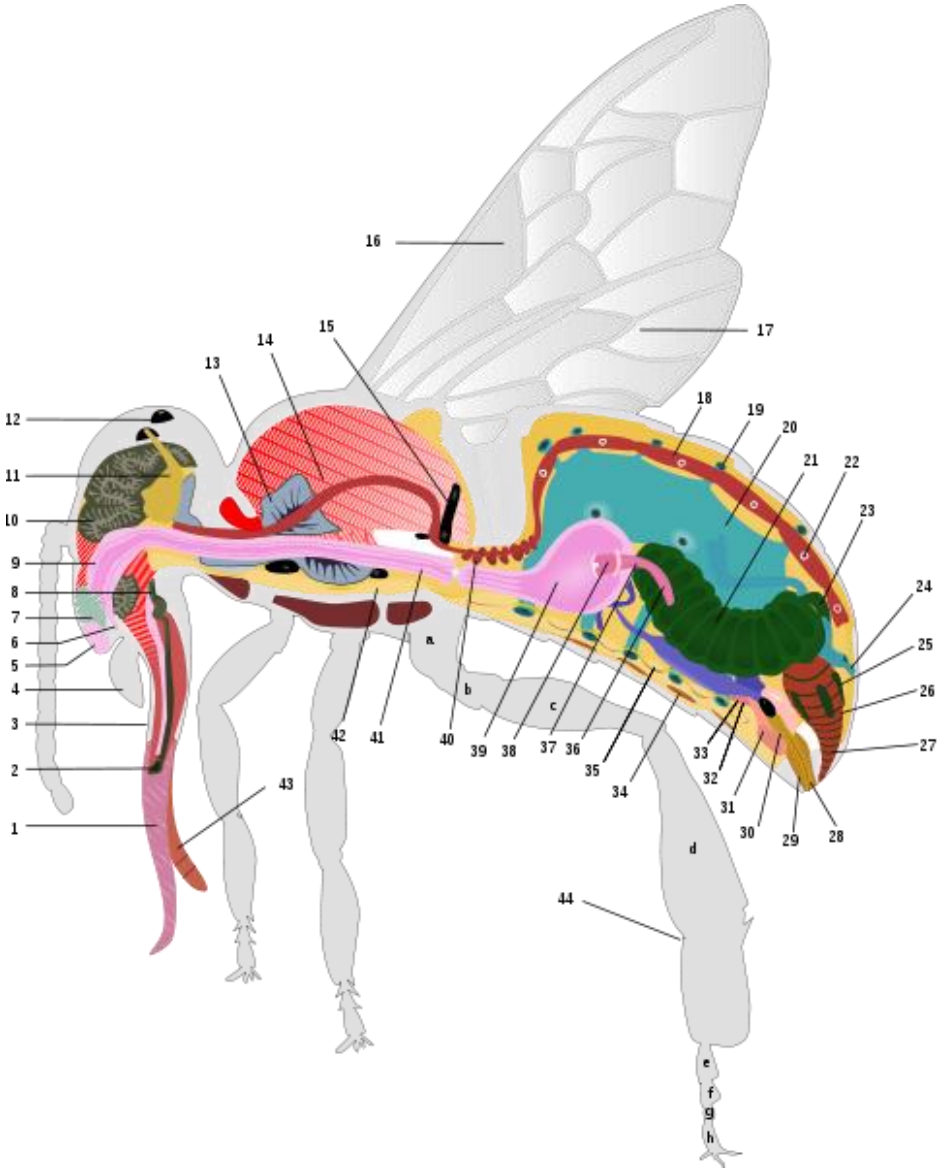

FIGURE 1-1: FEMALE HONEY BEE

KEY TO FIGURE 1-1

Special Glands

1	Glossae (tongue)	**14**	Chest Muscle	**27**	Anus	**40**	Heart Loop (Aorta)
2	Labial Palp	**15**	Flight Braces	**28**	Stinger	**41**	Esophagus
3	Maxillae	**16**	Forewing	**29**	Stinger Palp (Sheath)	**42**	Ventral Nerve Cord (ganglion)
4	Mandible	**17**	Hindwing	**30**	Sting Canal	**43**	Labium
5	Labrum	**18**	Heart	**31**	Venom Gland	**44**	Hind Leg
6	Food Canal (Mouth)	**19**	Opening of Spiracle	**32**	Oviduct	44a.	Coxa
7	Mandibular Gland	**20**	Air Sac	**33**	Venom Sac	44b.	Trochanter
8	Cardo	**21**	Ventriculus (Midgut)	**34**	Wax Gland	44c.	Femur
9	Pharynx	**22**	Heart Openings	**35**	Ventral Nerve Cord	44d.	Top: Tibia
10	Hypopharyngeal Gland	**23**	Small Intestine	**36**	Intestinal Valve	44d.	Lower: Basitarsus
11	Brain	**24**	Nasonov Gland	**37**	Proventriculus	44 e-h.	Tarsus 2-5
12	Ocellus (Simple Eye)	**25**	Rectal Pad	**38**	Stomach Entrance		
13	Salivary Gland	**26**	Rectum	**39**	Crop (Honey Stomach)		

Hypopharyngeal Gland (10) "Brood Food Gland"

The hypopharyngeal gland produces some of the compounds necessary to make royal jelly, used to feed the larvae. During the first three days of life, all eggs and larvae are drenched in royal jelly to stimulate development. Eggs/larvae that develop into queens are fed royal jelly throughout all stages of development; and royal jelly is even used to nourish adult queens.

Salivary Gland (13)

The salivary glands have several functions. Like the hypopharyngeal glands, the salivary glands produce some compounds necessary for producing royal jelly. The salivary glands produce liquid used to dissolve sugar, and produce compounds used to clean the body and contribute to the colony's chemical identity.

Nasonov Gland (24)

The Nasanov gland, which produces an attraction pheromone, is located on the abdomen. Worker bees release this pheromone or chemical odor to help other bees find the nest entrance, locate forage, form a swam, etc.

Wax Gland (34)

Wax glands convert the sugars found in honey into wax. Worker bees start to secrete wax about 12 days after emerging. About six days later, the gland degenerates and that bee will no longer produce wax. The queen is continually laying eggs to maintain colony size and to produce more new workers that produce wax.

EYESIGHT

Honey bees have compound eyes. Compound eyes have multifaceted surfaces, creating a prism-like view of the world. This view does little for attaining a fine focus; but is effective at sensing motion and slight movement.

Honey bees view their world through an ultraviolet filter. Ultraviolet sight is advantageous to the honey bee. Numerous plant species display ultraviolet markings that act as a beacon to the honey bee, encouraging them to "drink my nectar and, by the way, pollinate me."

THE COLONY

The FAMILY Apidae includes social and solitary bees (Mason bees). *Apis mellifera* are social; they live in large groups called colonies. Each honey bee has a role, typically based on age, and adheres to a rigid caste system in a complex matriarchal social order. They communicate by pheromone scent, by dancing, and by physical head butts.

WHO'S WHO IN THE COLONY

Figure 1-2 shows the three distinct castes of honey bees that constitute an entire colony: many workers (females), a solitary queen (female) and a significant number of drones (males). The queen, despite the lofty title, does not rule the colony. Workers make up most of the hive population and, therefore, have most of the control. It is the workers that lead the queen to most of her decisions. Table 1-2: Honey Bee Development and Lifespan Table 1-2: Honey Bee Development and Lifespan summarizes the lifecycle differences for workers, drones, and the queen.

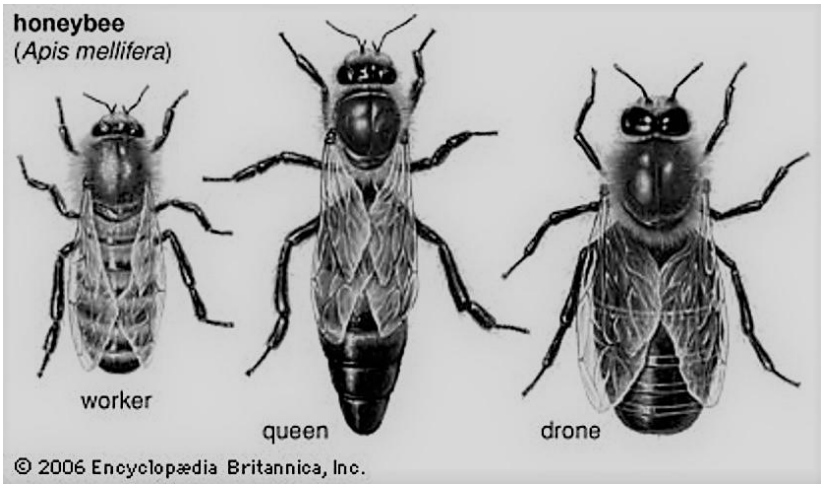

FIGURE 1-2: HONEY BEE CASTES

TABLE 1-2: HONEY BEE DEVELOPMENT AND LIFESPAN

	EGG	LARVA	WAX CAP SHAPE	PUPA	EMERGE ON:	Adult Life Span
QUEEN	3 days	4 days	Peanut shell	8-9 days	Day 16	2-5 years
WORKER	3 days	6 days	Concave	12 days	Day 21	15-38 days (summer) 140-320 days (winter)
DRONE	3 days	6 days	Convex	15-16 days	Day 24	8 weeks

Worker Bees

The workers are the true decision makers in the colony. They decide when to swarm, how much food to collect, and when a queen is past her prime (pheromones fading) and requires replacement (supersedure). If a newly hatched queen seems reluctant to make her mating flights, the workers also encourage her to leave the hive and search out drones with whom to mate.

Worker bees are the strength of the hive.

TABLE 1-3: WORKER BEE CHARACTERISTICS

NUMBER	Tens of thousands; 85% - 90% of summer colony population
GENDER	Female
SIZE	Smallest bees in the colony
ROLES	Hive duties are dependent upon age (may revert to previous roles in emergencies) • Nurse bee – cares for and feeds larvae; cleans cells of newly hatched bees • Housekeeping bee - cleans detritus & debris out of the hive • Mortuary bee - cleans dead bees from the hive • Comb-builder bee - Builds comb • HVAC bee - Keeps the hive warm or cool as needed; ensures ventilation • Meet & Greet bee - takes pollen, nectar or water from incoming field bees • Guard bee - patrols the hive entrance, repels foreigners • Field bee – forages: gathers pollen, nectar, water, and sap; pollinates flowers • Scout bee - searches for new homes prior to swarming

As field bees gather nectar and pollen from flowers, they become dusted in pollen. When they move within and between flowers, the pollen on their bodies is transferred from the flowers' stamens to their pistils, facilitating self-pollination and cross-pollination. If the bees are on a pollen-gathering mission, they pack the pollen into pollen baskets on their hind legs, to carry back to the hive where it is used as food for the developing brood.

Summer field bees, flying after nectar and pollen, wear out their wings and may only live for six weeks. Their wings in tatters, unable to return to the hive, workers find a warm sidewalk or wall to wait out their end.

Worker and drone eggs and larvae are fed straight royal jelly for the first three days. After that, they receive bee bread: a mixture of pollen, honey and bee saliva.

Queen Bee

The queen's main job is to lay eggs. She can lay up to 2,000 eggs each day. The eggs can be fertilized or non-fertilized. Fertilized eggs become workers, and non-fertilized eggs develop into drones. Nurse bees immediately tend to both worker and drone eggs.

FIGURE 1-3: QUEEN AND HER RETINUE, *ATTENDING TO HER MAJESTY* DENNIS ISIP

TABLE 1-4: QUEEN BEE CHARACTERISTICS

NUMBER	Only one
GENDER	The only sexually developed female; in some cultures, called the Mother
SIZE	Largest bee in the colony; abdomen protrudes well past her wings
MARKS	Often marked on her thorax with a painted, colored dot; one of five colors selected to designate birth year of the queen
ROLE	Reproduction: Lays up to 2,000 eggs per day (selects male/female egg based on cell size) • Mates only once over a period of days with up to 40 drones (avg. 12) • Mates in Drone Congregation Areas (DCA) - drone 'hang outs' • Her pheromones: o Keep the colony “queen right” o Regulate worker tasks, and encourage 'retinue' response in workers - grooming and feeding her • Only leaves the hive: o For her mating flights o With a swarm from a colony

Drones

A drone is a male bee. Unlike the female worker bees, drones do not have stingers. A drone's primary role is to mate with an unfertilized queen. Drones do not pollinate, gather nectar or pollen, defend the hive, or accomplish other work around the hive. They must beg food from the workers and are ousted from the hive in the fall. Drone characteristics are summarized in Table 1-5.

TABLE 1-5: DRONE CHARACTERISTICS

NUMBER	Thousands; 10% - 15% of peak summer colony population
GENDER	Male
SIZE	Smaller than the queen, larger than a worker
ROLES	Mate with queens

Drones in a hive do not usually mate with a virgin queen of the same hive. They drift from hive to hive. Mating between the drones and a virgin queen takes place away from the colony, in mid-air mating sites. These mating sites, called ‘drone congregation areas’, are specific locations where drones wait for the arrival of virgin queens.

Mating occurs in flight, which accounts for drones needing better vision, which is provided by their large eyes. Should a drone succeed in mating, he soon dies because the genitals and associated abdominal tissues are ripped from his body after mating.

SEASONS

The seasons and the weather dictate the honey bee's life. Colony composition and size is determined by health and the time of year (more to follow in chapters 7 (Spring), 8 (Summer), 9 (Fall) and 10 (Winter)).

Summer is when a colony reaches its apex, averaging 40,000 - 60,000 bees, including a queen, workers (females) and drones (males).

Fall finds the honey bees preparing for the coming winter months. The queen stops laying eggs. Almost all drones exit the hive, assisted by physical persuasion from the workers in the colony. The colony cannot afford to feed the drones through the winter months. Through winter, the colony clusters to warm themselves and the queen, and the population slowly shrinks.

Late winter finds the queen laying again, and the population grows in anticipation of the spring nectar flow and pollen collection.

COMMUNICATIONS

PHEROMONES

Worker bees come equipped with specialized glands. The pheromones released by these glands "talk" to other bees in the hive. Imagine 60,000 honey bees needing to send an emergency message to each other. Scent is the only practical solution. Over 30 different pheromones have been identified, each specific to its own message.

The queen also exudes a special pheromone. The worker bees rub against her and spread her scent, letting all the bees know that the queen is fine, or not. If the workers find her failing, they will take steps to replace her.

When workers sting, they leave a "ripe banana" scent. This precise scent informs honey bees that there is a threat to the hive. When beekeepers begin an apiary inspection, they often use smoke to help diminish, or mask, the effect of this honey bee alarm pheromone.

PHYSICAL MOVEMENT

Honey bees are master orienteers. Using the sun's position and visual landmarks, they follow a path to forage and then back home. Before any forager bee leaves the apiary area, she conducts an orientation flight, consisting of numerous spiral patterns over the hive. The orientation flight builds a solid memory of the hive and location for the bee.

All foragers complete orientation flights; thus, they share a map with their sisters. The famous "waggle dance" identifies the location of nectar, pollen and/or water sources. The waggle dance is familiar to many. As a bee dances, the speed, direction and positioning of her figure-eight movements transmit precise distances and directions to target sources, using the sun as a primary reference.

Honey bees also head butt each other to warn of imminent danger. The harder they butt, the closer the threat.

PRODUCTION

HONEY

Honey is a bee's source of carbohydrates. Field bees return to the hive with nectar, and transfer it to other bees in the hive, who mix the nectar with enzymes in their mouths, then place it in prepared cells to dry. When its moisture content falls to less than 18%, the honey is ripe and can be capped. A higher moisture content would allow the honey to ferment. Bees consume honey, then mix it with pollen and enzymes to produce bee bread for their young; and they store it for the winter.

POLLEN

Pollen is a bee's source of protein. Bees bringing pollen to the hive signals that brood is present. Bees pack pollen into prepared cells. It feeds the young (beebread) and is stored for the winter. Pollen makes a colorful mosaic on the frames; the color determined by the plant source.

PROPOLIS

A recipe for propolis includes resin from tree buds or sap, honey bee enzyme (bee saliva), and a little bit of beeswax. Highly antibacterial, bees use propolis to seal small gaps less than 3/8" between hive boxes, or between the top edges of frames. Propolis fills almost all spaces less than 3/8” in the hive.

WAX

Honey bees build comb using beeswax extruded from a worker's eight wax glands. The bees build incredibly exact, hexagonal cells to store honey and pollen, and to serve as a nursery for the young. They festoon (join legs together, making a living chain of bees) to build comb wherever they find more than a 3/8" space. Bee space focuses on order in the hive:

1. Space less than 3/8”, bees propolize
2. Space more than 3/8”, bees fill with comb

Bees consider 3/8" spacing ideal for moving about the hive. The concept of bee space allows the Langstroth-type hive to prosper (discussed further in Chapter 3).

FIGURE 1-4: EIGHT WAX GLANDS

HTTPS://APISCERA.COM/EN/BEESWAX/

QUICK REVIEW – CHAPTER 1

KEY POINTS

1. *Apis mellifera* is not native to North America.
2. *Apis mellifera* is an important pollinator.
3. The size of a colony varies by season and colony health.
4. Three castes of honey bees live in a colony: a queen, workers and drones.
5. *Apis mellifera* communicates through pheromones and body movements.

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Chapter 2: **SELECTING HONEY BEES**

HONEY BEE SPECIES

The honey bee is indigenous to Asia, Africa and Europe. The actual origin of the honey bee has puzzled beekeepers and scientists alike, until recently. A group of researchers studying the Apis genome declared that the honey bee seems to have originated in Southeast Asia, countering a long-held belief that they originated in Africa.

POPULAR SUBSPECIES FOR BEEKEEPERS

The first honey bee that the Pilgrims brought to the Americas was the European German Black bee, *Apis mellifera mellifera*. By default, as the only available bee, the black bee became the first favorite of colonial beekeepers. Eventually, other European and near-Eastern sub-species joined the Black Bee in the Americas, including Italians (*Apis mellifera ligustica*), Carniolan (*Apis mellifera carnica*) and Caucasian (*Apis mellifera caucasia*). Hybrid species include Primorsky Russians (a hybrid between Italian, Carniolan, Caucasian) and various other Carniolan-Italian combinations. These honey bees became American bees. Italians took over as favorite not long after.

SUBSPECIES – MAKING YOUR SELECTION

What influences a beekeeper's choice of honeybee? A beekeeper's goal should be the driving factor in choice of bee. Other considerations include cost, availability, temperament and the beekeeper's climate. Beekeeping goals, such as increased honey production, winter survivability, increased pollination, queen breeding and/or just for the pleasure of watching the bees work - these all help a beekeeper make the best choice.

With the invasion of *Varroa* mites, beekeepers eagerly sought 'hygienic' *Varroa* Sensitive Hygiene (VSH) hybrids (first bred by the ARS Lab, United States Department of Agriculture at Baton Rouge, 2000). Each sub-species, hybrid, or VSH hybrid embodies specific traits that the beekeeper considers when selecting for their apiary.

Africanized honey bees are extremely defensive (and therefore aggressive); and can be dangerous. They are not a problem for northern beekeepers; they do not range as far north as Washington State.

COLONY PERSONALITY

Each subspecies exhibits the personality quirks or behaviors of their subspecies, to some extent. Not all bees embody the same behavior to the same degree, however. These behavior traits are more like tendencies, or guidelines, not hard and fast rules. Moreover, beekeepers often claim that more variation may exist between two hives of Carniolans than between a hive of Italians and one of Carniolans.

Hive behaviors are genetic, but environments and the beekeeper contribute to these, as well. For example, if hives have regular visits from skunks, they'll tend to be aggressive, no matter which

book identifies them as docile. As in everything else, caveat emptor, let the buyer beware. The subspecies traits are summarized in Table 2-1.

TABLE 2-1: HONEYBEE SUBSPECIES AND THEIR TRAITS

	Italian	*Carniolan*	*Caucasian*	*Russian*
Origin	Apennine Peninsula in Italy	Southern Austrian Alps and Slovenia	High valleys of area between the Black and Caspian seas	Primorsky Krai region of Russia
Original Climate	Mediterranean	Temperate	High mountain valley	Siberian cold, long winters
Coloring	Light/yellow	Black/gray/brown	silver-gray to dark brown	dark brown to black
Gentleness	Relatively gentle/calm	Exceptionally gentle/docile	Calm on comb; Assertive if aroused	Very assertive
Honey Processing	Very good	Good	Low	OK
Propolizing	Little	Little	High	High
Excess Swarming	Moderate	High	Low	High
Spring Buildup	Good	Rapid	Slow	OK
Overwintering	Good in general; Poor in long/cold winters	Very good	Good	Very Good
Other Traits	1. Heavy Robbers 2. Tend to Drift 3. Most popular honeybee	1. Good comb builders 2. Low robbing 3. Hardiness	1. Tend to drift 2. Tendency to rob	1. Queen cells always present in summer 2. Expensive

OBTAINING BEES

BUYING BEES

In Washington, many beekeepers purchase their bees from migratory beekeepers following the spring California almond pollination. After weeks in the California almond groves, pollinating colonies are bursting at the seams. Migratory beekeepers split these heavy colonies and ship either packages or nucleus hives (nucs) north. The bees' arrival date is uncertain as it is highly dependent on California weather and queen mating. If it rains heavily in California, it can delay delivery in Washington.

Nucs

A nucleus hive looks like a deep, brood box cut in half. A nuc usually contains either four or five frames with drawn comb covered in bees (including a mated queen), brood, honey, and pollen. Because nucs are essentially an established hive, they cost more than a package of bees.

Nucs have a bottom board, body, and an outer cover. They are compact and easy to transport. The entrance must have a secure closure when transporting bees. During installation into a new hive, most bees will enter the new hive, but a few reluctant or stray bees may remain with the nuc. Placing it directly in front of the hive entrance allows strays to make their way to the entrance of their new home.

Packages

Packages of honey bees usually contain three to four pounds of bees, however three is most common. The bees come from a variety of hives that are "shook" through a funnel into the package. This method provides a wide cross-section of bees from a particular apiary in one new colony. The bees are loose inside the package and may cluster during transport. A three-pound package of bees includes workers, a caged queen and a feeding can full of sugar syrup Figure. Packages of bees tend to behave like a swarm.

FIGURE 2-2: NUCLEUS HIVE BOX

FIGURE 2-1: BEE PACKAGES

Queens

Queens can be ordered spring through fall from local beekeepers, or from as far away as Hawaii. Beekeepers may have a choice of reputable, local breeders recommended through beekeeping clubs or mentors to find healthy, viable queens or they can order from larger regional and national breeders from all over. Ensure you do plenty of research prior to ordering from a breeder. If a beekeeper orders outside their area, it is helpful to talk with others who may have ordered from that breeder. Check reviews and chat sites online to gauge the experience of others.

Queens ship in special cages designed to facilitate introduction of the new queen to a colony. She may travel unescorted or, if over a greater distance, may be accompanied by attendant workers that will clean and feed her. While acquiring a queen locally can be exciting, there is a lasting and certain charm in watching a nervous, mail-delivery person carry a package marked "LIVE QUEEN" to your door.

FIGURE 2-3: QUEENS IN CAGES

QUICK REVIEW – CHAPTER 2

KEY POINTS

1. Bee subspecies may differ in their behaviors.
2. Italians are among the most common subspecies selected by beekeepers.
3. Subspecies will produce different amounts of propolis.
4. Bees may be purchased from a variety of sources.
5. Africanized honeybees are extremely defensive, but do not live in Washington State.

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Chapter 3: **SELECTING EQUIPMENT**

Beginning beekeeping starts with having to make countless choices. You will be required to choose where and how your bees will live, select the type and size of hive to use, compare the merits of different foundations, find tools which suit your style, and purchase the all-important bee suit. In the beginning, this can be more than a bit overwhelming. Take advantage of your mentors; ask questions of experienced beekeepers.

HIVES, IN GENERAL

Bee colonies, whether in the wild or backyard, all need the same properties in their dwellings: a defensible entrance, room to expand, 3/8-inch bee space, protection from wind and cold, and protection from moisture.

Modern beehive design does little to mimic the characteristics of wild or feral bee dwellings; but it is conducive and convenient to beekeepers working and managing contained colonies.

HIVE TYPES

There are three primary beehives in use today: Langstroth, top-bar, and Warré. The Langstroth hive is the most widely used hive in the United States, and it's gaining popularity worldwide.

TABLE 3-1: HIVE TYPE COMPARISON

	Langstroth Hive	Top-Bar Hive	Warré Hive
History	Moveable frames perfected by Rev. L. L. Langstroth in 1852. First to incorporate critical 3/8" bee space. The most common hive type.	Long history of "top-bar" type hives (log hives). Evolution of hive development in Canada and Tanzania. Top-bar we know today was developed in the 1960s. Takes bee space into consideration.	Developed by a French monk, Emile Warré. He believed that everyone could keep bees if he developed the correct hive. Warré hive also known as the Ruche Populaire (People's hive).
Locating Equipment	Build, buy, in emergency situations, i.e. a swarm, can easily interchange with fellow beekeepers (beware of getting diseased or other undesirable equipment)	Build. No standard top-bar sizes of configuration. Difficult to borrow equipment from other top-bar beekeepers.	Build.
Mentoring	Easy to find a mentor through most beekeeping clubs. Lots of chatter on internet blog sites.	Moderately easy to find other top-bar keepers. Websites dedicated to top-bar hives. Lots of books and information.	Warré beekeepers are few and far between. Difficult to find mentoring.

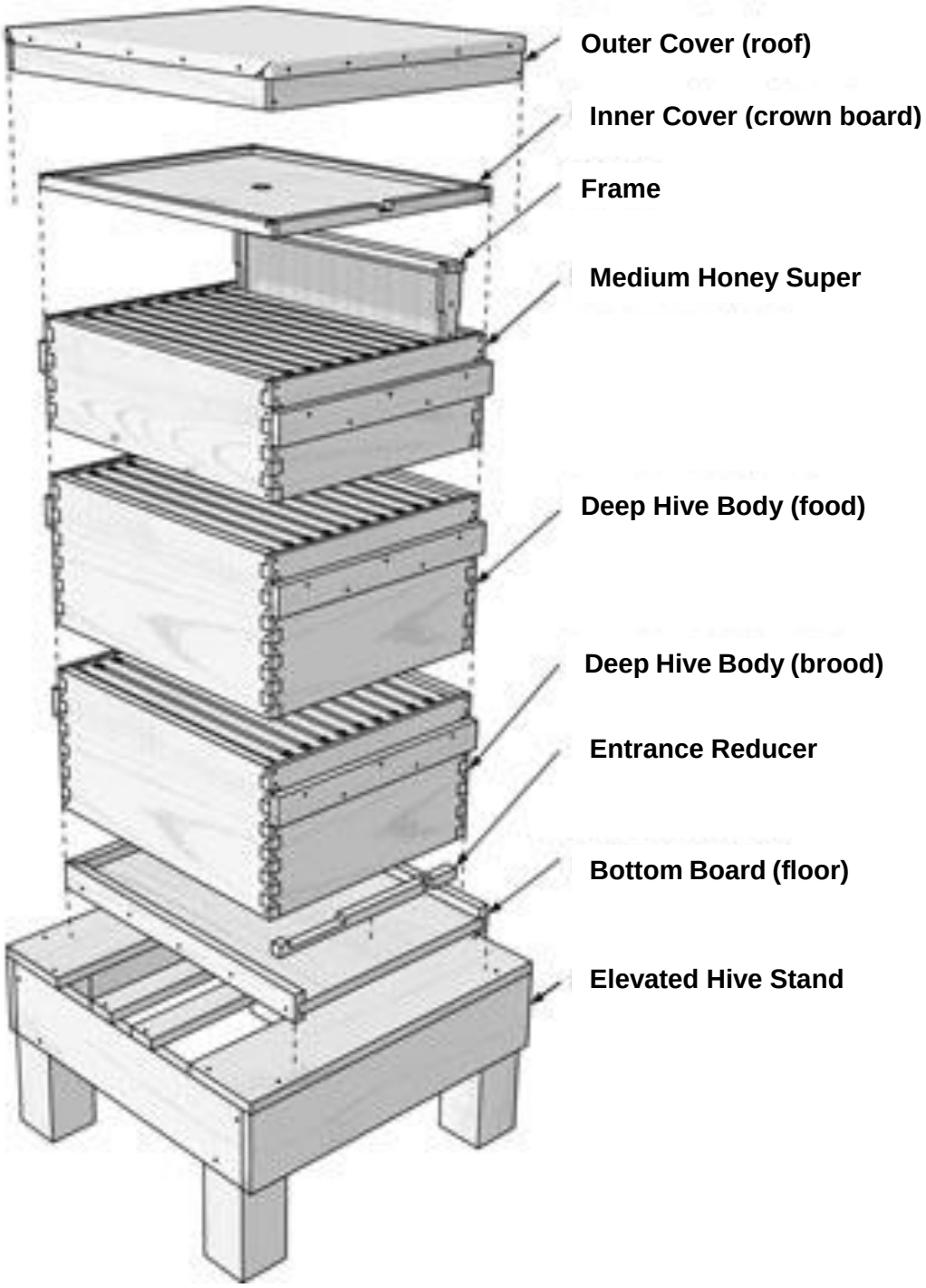


FIGURE 3-1: LANGSTROTH HIVE

COMMON PARTS IN MODERN HIVES

- **Outer Cover-** Keeps the hive dry and protects from wind. Types of covers include telescoping, migratory and cottage.

- **Inner Cover-** Sits under the outer cover. Can help control moisture, depending on its construction material. Inner covers are sometimes removed in summer to increase ventilation. Screened inner covers exist to increase ventilation as well.

- **Boxes-** come in several different styles/sizes depending upon the beehive design:
    - **Langstroth Hive**
        - *Shallow:* 19-13/16" x 16-1/4" x 5-3/4" (on average). Used to collect excess honey for the bees, or for personal extraction and consumption.
        - *Western:* 19-13/16" x16-1/4" x 6-5/8" (on average). Westerns or mediums used as both brood chambers and for honey supers. Easier to shift than deeps.
        - *Deep:* 19-13/16" x16- 1/4" x 9-9/16" (on average). Most often used as brood chambers.
    - **Top-bar Hive-** a single box with slanted or horizontal sides. There are no measurement standards for this type of hive.
    - **Warré-** 12” x 12” boxes with handles.

- **Frames and Foundation-** Langstroth hive frames hold foundation. Frames are specific to fit woodenware shallows, westerns, or deeps. Langstroth boxes come in two widths that accommodate either *eight* or *ten* frames. The frame and the plastic or wax foundation provide a base for the bees to build their comb. Foundation may be either pressed beeswax or plastic sheets that support comb built by bees. Artificial foundation helps stabilize the foundations during honey extraction. Warré and top-bar hives do not use any artificial foundation.

- **Bottom Board-** In Langstroth and Warré hives, the hive body is placed on a bottom board for support and protection. Bottom boards may be solid or screened. Screened bottom boards aid ventilation and are part of Integrated Pest Management (IPM). The space between the bottom board and first brood box becomes the entrance.

- **Entrance Reducer-** usually made from wood. Used to change the size of hive entrances based on season and need.

- **Landing Board-** Provides a handy place for bees to launch from and land during foraging, especially when the front entrance is congested.

- **Hive Stand-** May be wood, metal, or block. Raises hives off the ground to protect the bees from moisture and predators.

ADDITIONAL HIVE EQUIPMENT

Some other equipment that you may find useful:

- **Feeder-** (Langstroth hives) During nectar dearths and when bees are drawing out comb in deep boxes, beekeepers provide sugar syrup to help their bees. In the big scheme, these situations are brief. The feeder is a piece of equipment through which beekeepers can make the syrup available to their bees.

FIGURE 3-2: FRAME FEEDER

- **Slatted Box-** (Langstroth and Warré hives) This provides a place for foragers to rest during the night. The slatted rack is positioned on top of the bottom board and under the first brood box, providing an efficient platform for rest (otherwise the foragers must climb to the top of the hive to rest). Its use may help alleviate perceived overcrowding by the bees. In winter, it lifts the hive further off the ground, allowing the winter cluster to begin lower in the brood box. If a slatted box is not available, use a super with frames and foundation with undrawn comb.

- **Queen Excluder-** Excluders can be used during a honey flow to keep the queen from venturing into the super and laying eggs. These are available in both metal and plastic versions.

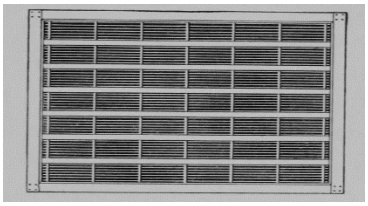


FIGURE 3-3: QUEEN EXCLUDER

- **Winter Mouse Guard-** These are usually metal; and are used in fall to keep mice from entering the cozy hive for winter.

- **Robbing Screen-** Robbing screens protect the colony's stores of honey during times of dearth, when other bees may feel the need to steal from the hives. They can also effectively stave off wasps in late summer.

PROTECTING WOODENWARE

Protecting the outside of wooden hive components helps extend the lifespan of the hives. Only treat the outside surfaces of the hive, never the inside. Normal outdoor paints work well, with a base coat and two or three coats of paint over the top. Visit your local hardware store to find marked-down paint, or "oops paint". Another common, albeit labor-intensive method is to dip the lid, bottom board, and hive bodies in boiled linseed oil, mixed with 5-10% beeswax or paraffin oil.

FIGURE 3-4: PAINTED HIVE BOXES

TOOLS OF THE TRADE

There are few physical necessities for tending a hive of domestic honeybees. Several key pieces of equipment will enhance your beekeeping experience: A few well-placed tools can make the interactions with your bees simpler, smoother, more fun and a whole lot safer.

***SMOKER*:** From the time humans started raiding beehives, they have used smoke. Whether it calms or confuses, it works. Honey bees rely heavily on scent and the smoke covers any alarm pheromone the bees may emit. A belief that smoke signals a forest fire to the bees. It surmises that the bees, in preparation to flee, gorge themselves with honey and become more docile.

FIGURE 3-5: SMOKER

Cool smoke is critical, as is keeping your smoker lit. Beekeepers tend to have their own preferences for fuel - burlap, pine needles, newspaper, pellets or cotton. For cool smoke, green grass or leaves can be added to the smoker. The smoker is a tool, just like your hive tool.

It is not a weapon to wield about, nor is excessive use required. One or two puffs go a long way.

HIVE TOOL: Hive tools are specialized metal implements that help beekeepers separate stacked hive boxes; and pull frames from the boxes. Hive tools can be very personal tools to a beekeeper. Most often beekeepers adopt the tool that was used to teach them. There are some key points to consider regarding hive tools:

- Have two on-hand. You will inevitably lose one.
- Paint the end of the tool with florescent paint. This will help you find it when you drop it or put it down somewhere.
- To prevent loss, try not to set it down. Keep it in hand or in your back pocket.

FIGURE 3-6: HIVE TOOL

***BEE BRUSH*:** A soft brush is useful to gently brush bees aside. It is especially useful during honey harvest to help get the bees off the frames. Some beekeepers use feathers. Check the feathers to make sure they are free of pests.

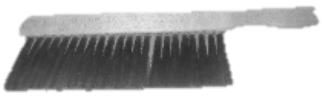


FIGURE 3-7: BEE BRUSH

WHAT TO WEAR

TO GLOVE OR NOT TO GLOVE

Wearing or not wearing gloves is a personal choice. If you are more comfortable wearing gloves, then do so. You are most likely to keep beekeeping if you are comfortable around the bees. If, on the other hand, you choose to not wear gloves, do not berate or belittle those who do. It is a personal choice.

Choosing Gloves

If you are afraid of being stung on your hands, there are many different types of bee gloves with longer sleeves to tuck beneath or over your suit. Most are sting resistant, meaning a bee might be able to sting through the glove; and others are sting proof, which means a stinger cannot penetrate your gloves. But, as you would imagine, the gloves that are sting proof are not the easiest gloves to work a hive with. Beekeeping gloves are usually cow leather or goat leather. Cow leather is thicker than goat leather and will have more protection from stings; but have less range of motion. Nitrile gloves are an inexpensive choice which allow increased dexterity and sensitivity. Nitrile gloves do not breathe like leather gloves do. One drawback is that the sweat has nowhere to go and it pools up inside your gloves.

FIGURE 3-8: COWHIDE GLOVES

Working Toward Gloveless

If your goal is to eventually work your hives without gloves, you can transition yourself by switching your glove type. Start with leather gloves, which will give the most protection while you are a new beekeeping and still learning how to handle your bees. Once you feel you have a sense of how to keep your bees calm while you inspect them, you can switch to nitrile. This will provide moderate protection and give you peace of mind while you work toward taking off your gloves completely. Eventually, you can begin testing the waters by starting out your hive inspection with gloves on and then taking them off part way through. This will allow you to judge the temperament of your hive before removing the gloves. Remember, a colony's behavior can change from day-to-day. Just because they were gentle during your last inspection, doesn't mean they will be for the next.

FACE PROTECTION

It is important to wear a veil attached to a suit or hat. While beekeepers debate the merits of gloves, most will wear a veil to protect delicate tissues located around the eyes, ears, nose and mouth. Stings on the nose, lips or ears are extremely painful.

FIGURE 3-9: VEIL

BODY PROTECTION

A bee suit is the ultimate, but not foolproof, protection to wear against bee stings. You may choose a jacket, or a full suit that covers from the ankles to the top of the head. Always ensure everything is zipped and all Velcro closed. If you do not have a suit, wear heavy denim pants and a heavier, long sleeve shirt. Tuck in or duct tape the ankles and wrists for added protection.

FIGURE 3-10: AN ARRAY OF PROTECTION

QUICK REVIEW – CHAPTER 3

KEY POINTS

1. Hive selection is tied to your overall goals in beekeeping.
2. The Langstroth hive is the most commonly used hive configuration in North America.
3. Several tools are essential: a smoker to calm the bees, a hive tool to open boxes and pull frames, and a bee brush to gently brush bees from hive components.
4. Protective wear is a personal choice. It is advisable for beekeepers to fully cover their body; and wear a veil to protect their face and ears.
5. To wear or not to wear gloves is a favorite beekeeper debate.

REFERENCES

Kim Flottum, Backyard Beekeeper - Revised and Updated, 3rd Edition: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden (Beverly, Massachusetts: Quarry Books, 2014).

Chapter 4: **THE APIARY**

You have your hives, suit, and gloves. You bought a smoker and you practiced keeping it lit with pine needles, newspaper or burlap. You bought two, 8-frame Langstroth hives, unassembled, now built and painted. The bees arrive in 2 weeks.

Someone at beekeeping class asks the innocent question:

"So, where are you going to put your hives?"

You quickly answer that you have a plan and you are

"putting them in the front yard, facing the street so everyone

can enjoy their activity!"

“Nope, you can’t do that. It is illegal in Spokane.” You freeze

and think, “now what?”

FIRST YEAR BEEKEEPERS:

Remember to register your new hives!

EXPERINCED BEEKEEPERS:

Remember to register your hives!

No need to panic. Just follow some simple rules of thumb that apply to beekeepers and to bees.

BEEKEEPER NEEDS

ORDINANCE

First and foremost, new and old beekeepers must know, understand, and follow the beekeeping statutes and regulation governing their area. No use in having the perfect site for your bees if it's illegal.

JURISDICTION

City, county, unincorporated county, or rural areas vary regarding their ordinances. Your apiary may be under the jurisdiction of the city or county government; or be under the auspices of the county Department of Health. Check it out early in your beekeeping journey. It’s best to have no surprises.

Beekeeping statutes may regulate the number of hives, number of hives per lot size, setbacks, perimeter restriction, and apiary barriers (fences). For example, ordinances for Spokane are shown in Figure 4-1. Some jurisdictions enforce laws through inspections, while others may follow nuisance ordinances. Nuisance ordinances are only enforced if a complaint is made by someone who feels they are adversely affected by your apiary.

WA – State Laws and Rules

RCW 15.60 - Apiaries

RCW 15.62 - Honey Bee Commission

WAC 16-600 - Honey

WAC 16-602 - Apiaries

Title 17C Land Use Standards
Chapter 17C.310 Animal Keeping
Section 17C.310.130 Beekeeping

A. Where Permitted.
Beekeeping is allowed as an accessory use on any lot occupied by a single-family residence that is in the RA, RSF, RTF, RMF and RHD zones. Beekeeping for educational or research purposes by an institution such as college, high school or agricultural extension office is allowed as a Type II conditional use permit in all zones, subject to the requirements of subsection (B)(1) through (5) below.

B. Standards Applicable to Beekeeping. Beekeeping is subject to the following standards:

1. Location, Density and Maintenance of Colonies.
    a. The number of colonies is limited to one colony per four thousand three hundred fifty square feet of lot area, up to a maximum of eight colonies; and
    b. Colonies shall be setback a minimum of twenty-five feet of any property line, except that a colony may be situated within ten feet of a side lot line or rear lot line provided the following provisions are met:
        i. The beehives are isolated from public access by a security fence as required under SMC 17C.110.230(F); and
        ii. The beekeeper establishes and maintains a flyway barrier at least six feet in height consisting of a solid wall, solid fencing material, dense vegetation or combination thereof that is parallel to the property line and extends ten feet beyond the colony in each direction so that all bees are forced to fly at an elevation of at least six feet above ground level over the property lines in the vicinity of the colony; or
        iii. The colony is situated ten feet or more above the grade of the nearest adjoining property line.
2. Colonies shall be maintained in movable-frame hives with adequate space and management techniques to prevent overcrowding and swarming.
3. In any instance in which a colony exhibits aggressive or swarming behavior, the beekeeper must ensure that the colony is re-queened. Aggressive behavior is any instance in which unusual aggressive characteristics such as stinging or attacking without provocation occurs.
4. Every beekeeper shall maintain an adequate supply of water for bees located close to each colony.
5. Registrations and Training.
    a. All colonies shall be registered with the director of the state department of agriculture pursuant to RCW 15.60.021 no later than April 1st of each year.
    b. The beekeeper shall have completed the requirements for apprenticeship level of the Washington State Beekeeper's Association master beekeeper certification program.

Date Passed: Monday, September 24, 2007
Effective Date: Saturday, November 10, 2007
ORD C34109 Section 4

FIGURE 4-1: EXAMPLE OF AN URBAN ORDINANCE - CITY OF SPOKANE

Beekeeping statutes may regulate the number of hives, number of hives per lot size, setbacks, perimeter restriction, and apiary barriers (fences). Some jurisdictions enforce laws through inspections, while others may follow nuisance ordinances. Nuisance ordinances are only enforced if a complaint is made by someone who feels they are adversely affected by your apiary.

NEIGHBORS

If you live on acreage, you likely have fewer neighbors compared to someone living in an urban setting. No matter where you live, it is always a good idea to start educating your neighbors as early as possible. You'll want to try and dispel any misconceptions or fears neighbors have of bees. Start by answering questions, explaining the progress of your hives, or inviting them to help you paint your boxes. Discuss your neighbor's ponds, or fountains, or even hummingbird feeders that could potentially become honey bee hotspots; and be sure to warn them about cleansing flights.

Promise your neighbors honey (at least in the second year), and they'll likely help you. Neighbors might keep an eye out for swarms - even protect them from passers-by. Ask them to suit up, if they'd like, and help with the bees. When your neighbors become concerned about your bees and about honey bee survival, we all win. They become new ambassadors for the honey bee.

PERMISSION

If the site you seek is not your own yard or pasture, ensure that you have permission, preferably written, to place the hives on the property.

HIVE MARKINGS

While legally required if you place your hives on other than your own property, marking your hives with your name and contact information has become necessary for many smaller beekeepers due to theft. You might also want to place your state registration number on your hives.

FIGURE 4-2: MARKED HIVES

SITE ACCESSIBILITY

A significant deterrent to beekeeping is having an apiary or hives located in an inaccessible area. All factors being equal, if you and your tools are unable to access your site easily, or are unable to easily move frames and equipment, you will be less inclined or motivated to visit and inspect your hives as often as needed. Your hives will then fail to thrive. You might feel frustrated and unsuccessful, possibly giving up on beekeeping altogether.

Beekeeping, especially in the first year, requires a great deal of dedication. Help make yourself successful by making it fun and easy. If your hives are on acreage, it's helpful to have a road leading to the hives. Make sure that you are neither having to carry your gear up a steep hill, nor down a steep slope.

HONEY BEE NEEDS

As with any other question of real estate, the answer is, "location, location, location." The listed factors help make and keep your bees healthier and be more productive pollinators and honey masters.

SUNSHINE

Sunshine equates to warmth. The earlier the hive warms, the earlier the bees will get to work. Optimum placement of hives is with the entrances facing south or southeast to take advantage of the warming sun.

SHADE IN HOT CLIMATES

Heat is critical to getting bees motivated and moving in the morning. Too much heat, however, can prove detrimental. This is especially true in the eastern part of Washington where summer temperatures can soar into the triple digits. Beware that the fine shade trees that rescue your hives from the summer sun may become deadly water drippers later, introducing moisture into the hive in autumn and winter.

WATER

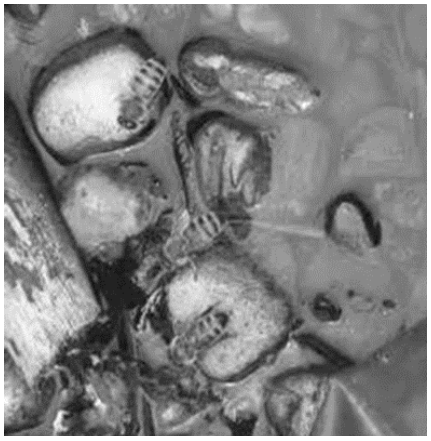


FIGURE 4-3: POND WITH LANDING PLACES

Water is essential to all living things. Providing a nearby water source for your bees will help keep them in your yard or at least in the vicinity (and out of your neighbor's yard). A safe pond is a great alternative.

You may have noticed that, given a choice, bees will most often head for what we consider "dirty" water. Dirty water is full of minerals and salts that the bees prefer. When you place your water source, remember the minerals and salts. Place a couple of rusty nails and copper into your water source and, perhaps, a small amount of salt. Bees do not mind moving water, such as in a fountain, if they have pebbles or rocks to land on and drink from. Often, no matter

what you do, the bees prefer to visit the neighbor's hot tub (it's the chemical salts) or neglected metal birdbath (minerals leeching from the birdbath). If this happens, use a small amount of lemongrass oil on your fountain for a couple of days. The bees will find it and use it. The scent of chlorine attracts bees. Switch to bromine if you or your neighbors have a pool or hot tub.

Once your bees consistently visit your source, remember to keep the water flowing. Bees will just as easily abandon a depleted source as adopt a rich one.

Additional water sources may be a Boardman Feeder placed at the front entrance of hives (beware the water does heat up) or even a chicken feeder with pebbles.

PROTECTION

Protection from Predators

Hives need protections from two-, four-, six- and eight-legged predators. Skunks, bears, wasps, hornets, spiders, and people are all actual or potential predators of the hives; and will be discussed in Chapter 6. In an urban or suburban environment, the best protection from two-legged predators is fencing. You never want your apiary labeled an "attractive nuisance," tempting people to mess with your hives. While your neighbors may be aware, not everyone is respectful.

Both urban and rural settings may deal with skunks (hives can be raised), less so bears (electric fencing can be installed). However, wasps and hornets are, importunely, too pervasive and deadly for a weak colony. Begin your hunt for wasps and hornets early, in some areas as early as February and March. Traps laden with wasp/hornet pheromones in the spring months can catch their queens, and potentially destroy thousands of future hive marauders. Share wasp and hornet traps with your neighbors - a win-win situation for everyone.

Protection from Prevailing Weather

Know which direction the prevailing winds hit your potential site. Provide a windbreak from frosty winter winds and guard against autumn and winter rains blowing directly into the hive. While you may not need to insulate your hives for winter, you will need to ensure that they stay as dry and warm as possible. Place your hives to take advantage of natural terrain and trees.

Protection from Damp and Cold-Air Sinks

As a camper, you know not to place your tent at the bottom of a hillside. Water drains downhill; therefore, the bottom of a hill hosts more wet and damp areas than the top; and should be avoided when configuring your apiary. Avoid wild areas with many birch trees. These trees and several other similar trees love to keep their roots wet and thrive in damp locations. Your bees, however, will not fare quite as well. Excessive moisture kills bees.

DAMPNESS IS THE NUMBER ONE ENEMY OF BEES!

DAMP LEADS TO DISEASE;

DISEASE LEADS TO WEAKENED HIVES.

Avoid cold-air sinks. These occur when moving air crosses an obstacle, like a hill. The warm air moves on, allowing the colder air to sink into low spots. The same effect occurs if you have a fence without openings - warm air passes over the fence and the cold air is deposited on the other side. A fence with openings allows air to pass by without creating a cold-air sink. Avoid placing hives in low areas in your selected environment.

FORAGE

Planting your yard with favorite bee forage is wonderful. Note that it is very important to know the type of forage surrounding your apiary for a mile or two. Is there forage to support all the bees in the area? Is there a variety of forage that is plentiful at least three seasons of the year? Promote and support your neighbors', city and county efforts in planting forage for bees and other pollinators.

HIVE ARRANGEMENT

In addition to finding the perfect site, with all the listed critical factors, all your work could go to waste if you do not pay attention to how your hives are arranged on your well-prepared, apiary site.

It's good to maintain space between hives. Placing hives too close hinders efficient management. There is nothing worse than bending over and knocking down the adjacent hive.

Avoid placing your hives in a straight-line unless you are conducting experiments on bee drift. Bees tend to drift to the right. After a time, you'll notice that your far-right hives are incredibly full and strong, while your far-left hives seem to have dwindled. Should this occur, exchange the far-right hives with the far-lefts until you regain a balance.

FIGURE 4-4: BEES VISITING FLOWERS (ETC.USF.EDU)

Decorating Hives

Paint your hives distinct colors. Pay special attention to the hive entrance or landing boards which do not change position when you rotate your brood boxes. Bees come to depend on such marks. Be creative and have fun with your painting and make the hives your own.

Moving Hives

Inevitably, the time arrives that you realize you need to move a hive. You want to move hives with the least amount of stress to the bees and to the beekeeper. Most beekeepers feel that a three-foot move or a three-mile move works best, to avoid confusing the foragers. Some beekeepers think this rule is more opinion than reality. But it is your hive to move; the choice is yours to make.

Location Move

Night-moved bees are calmer, and all the foragers will be home, so you won't leave bees behind at the old location. Screen or close all openings so bees can't exit the hive. You want to insure they have some ventilation. Secure hive bodies so they don't separate and allow bees to escape. Carefully load your bees and move to the new location. Move approximately one- to three- miles (or more) from the original site.

Move To a New Site in Your Yard or Apiary

If you are moving hives in your apiary, just move them a couple of inches to three feet each night until the hives are where you want them. Don't split or open a hive to move it. Try not to make much noise or move a hive roughly.

Bees might temporarily be a bit confused but with incremental moves you should be able to bring the bees along to the new site.

Quick Review – Chapter 4

Key Points

1. Where you keep your hive(s) will help determine their health and their productivity.
2. Depending upon where you live, exposure to sun and shade are important components to successful beekeeping.
3. Water is a major need for bees.
4. It is important to know the beekeeping ordinances for your area.
5. Understand the importance of when and how to move hives.

References

Lorenzo Langstroth, *Langstroth on the Hive and the Honey Bee: A Bee Keeper's Manual*.

Chapter 5: **PESTS, PARASITES & PATHOGENS**

State bee inspectors used to visit beekeepers. If inspectors found diseased or infested colonies, they could order all bees and equipment destroyed or treatment to begin.

Without a state bee inspector, beekeepers in Washington must rely on the professional and moral character of all beekeepers. The beekeeping community depends on all practitioners to have some sense of community and responsibility tied to beekeeping: including not having sick bees foraging in areas used by other beekeepers.

There are critical economic consequences as well. A package of bees may cost upwards of $150. Most beekeepers cannot afford to continually replace their bees. If one person's bees become ill because you failed to quarantine your sick colonies, who is responsible?

HOW TO IDENTIFY A SICK COLONY

Brood: Struggling and dying brood may be the strongest indicator of overall colony health.

Behavior: Honey bee behavior is also a strong indicator of colony and honey bee health. Bees are at their best:

- when they are foraging for nectar and bringing in pollen,
- when they consistently and thoroughly clean comb cells and the hive,
- when the queen's laying pattern is strong,
- when no dead bees litter the front of the hive,
- when no bees wander aimlessly on the ground in front of the hive, and
- when the bees are formed intact, e.g. no missing limbs, deformed wings, etc.

Population shift: When colony strength suddenly dwindles and you cannot blame a swarm, it's time to make a thorough inspection of the hive (avoid in temps below 45-50 degrees F). In some cases, when the colony population suddenly declines, it is too late to effectively intervene. Careful inspection of the brood and regular mite monitoring can help prevent the sudden dwindling of populations. Don't manage your colony in denial - act sooner, rather than later.

Visible signs: Visible signs of sick or diseased bees could include dysentery, which shouldn't be confused with typical signs of winter cleansing flights. Rather, look for thick and heavy streaks across the hive face and horizontal surfaces.

Smell: Odor is another good indicator. The warm honey-smell of a summer apiary is not easily forgotten. Neither is the sour, rotten, musty smell of an infected hive. Most dreaded is the sour smell associated with American Foul Brood (AFB). Any foreign smell is worth investigating.

THE PERFECT STORM – COLONY COLLAPSE DISORDER

Colony Collapse Disorder (CCD) is not a specific disease, pest, or environmental factor. Rather, it is the result of a combination of complex factors, compounded, to bring about the loss of millions of bees and millions of dollars. The excerpt below is from the USDA Agricultural Research Service (https://www.ars.usda.gov/oc/br/ccd/index/):

> "One problem plaguing honey bees since 2006 has been Colony Collapse Disorder(CCD), which is a syndrome specifically defined as a dead colony with no adult bees and with no dead bee bodies but with a live queen, and usually honey and immature bees, still present. CCD is not a general term that covers all managed honey bee colonies that are lost due to any reason. No scientific cause for CCD has been proven. Most research has pointed to a complex of factors being involved in the cause of CCD, and possibly not all of the same factors or the same factors in the same order are involved in all CCD incidents.
>
> But CCD is far from the only major threat to the health of honey bees and the economic stability of commercial beekeeping in the United States. In fact, the number of managed colonies that beekeepers have reported losing specifically from CCD has been waning since 2010. But the beekeeping industry continues to report losing a high percentage of their colonies each year to other causes.
>
> Major factors threatening honey bee health can be divided into four general areas: parasites and pests, pathogens, poor nutrition, and sub lethal exposure to pesticides. These factors tend to overlap and interact with one another, which complicates issues. In addition, there are other issues that have impacts on honey bee health such as the narrow genetic base of honey bees in the United States.
>
> The Agricultural Research Service (ARS), USDA's in-house scientific research agency, is striving to enhance overall honey bee health and improve bee management practices by studying honey bee diseases and parasites and how best to control them, as well as basic honey bee biology and genetics. ARS scientists also are working on projects as diverse as studying the biological interaction of simultaneous exposure to sub lethal amounts of pesticides and infection by Nosema fungi to long-term storage of honey bee semen to preserve genetic resources. In addition, ARS researchers are cooperating with other Federal agencies and State departments of agriculture, universities, and private companies in a variety of projects to improve honey bee health."

PARASITES AND PATHOGENS FOUND IN WASHINGTON

It is the responsibility of every beekeeper to be able to recognize symptoms of disease and to know how to sample colonies for mites and other bee pests. It is very important to maintain healthy bee colonies for pollination and honey production. Knowledge of which pests, parasites and pathogens are prevalent in our area is a helpful beginning.

TABLE 5-1: PESTS, PARASITES & PATHOGENS FOUND IN EASTERN WASHINGTON

Pests & Parasites	Fungal Diseases	Bacterial Diseases	Viral Diseases
Varroa Mites	Chalk Brood	American Foul Brood	Deformed Wing
Tracheal Mites	Nosema (a & c)	European Foul Brood	*Varroa* Destructor-1
Wax Moth			

VARROA MITES

Varroa destructor originated in Korea*. A. cerana,* the Southern and Southeast Asian honey bee; regularly grooms itself, causing the *Varroa* mites to drop off. *A. cerana* has evolved additional traits that make it possible for it to co-exist with *Varroa* mites*.* Unfortunately, the European honey bee *A. mellifera,* has no defenses against the mite, leaving it extremely vulnerable*.*

Varroa mites are found on both adult bees and brood **Error! Reference source not found.**. They reproduce in brood cells by living off their host. *Varroa* mites prefer drone brood due to the scent drone larva produce. Drones have a longer incubation period (24 days vs. 21 for workers) which results in more mites emerging from the drone cells. Adult, female mites crawl into brood cells containing ready-to-cap larvae (5- or 8-day old larva), and lay eggs in the brood comb to be incubated. The young mites feed on the hemolymph (blood), or the fat bodies (as new evidence suggests), of the larvae and pupae. Mite behavior weakens bees and makes them more susceptible to viruses and disease which are carried by the mites.

Relatively speaking, *Varroa* mites and *A. mellifera* have co-existed for only a brief period. The western honey bee and the *Varroa* mite have yet to develop a host/parasite balance (moving from parasitic to mutualism). Mutualism is a beneficial relationship between two species.

Varroa mites cause millions of dollars in honey bee losses each year, since its introduction to the U.S. (and most of the world). The *Varroa* mite acts as a viral vector (carrier of disease) for most honey bee viruses. In less than a few months, a heavily infested colony may be brought to its knees. The mite also serves as a factor, coupled with pesticides and a loss of habitat/forage, in the "perfect storm" scenario of colony collapse disorder.

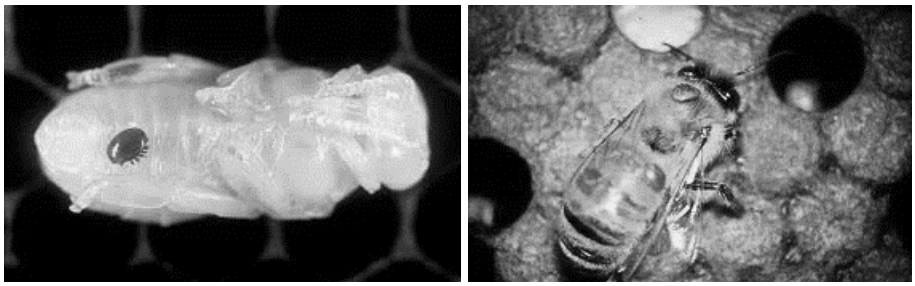


FIGURE 5-1:*VARROA* MITE ON PUPA AND ADULT

Varroa mite populations peak in the fall, usually a few weeks after the queen ramps down, decreasing her prolific egg-laying as the fall and winter seasons approach. This endangers the production of fall bees needed to sustain the hive through the winter months.

SAMPLING AND MONITORING INFESTATION LEVELS

Because of the difficulty of gauging the degree of *Varroa* mite infestation during normal colony inspections, the vigilant beekeeper must sample colonies for mites in a timely manner to determine what needs to be done to keep the mite population at a tolerable level.

“Mite load” refers to the number of mites in a hive relative to the number of bees. Generally, mite load is expressed as mites/100 bees, or percentage of mites. The higher the load, the higher the potential for complete disaster.

To establish mite load, several mite-math calculations have evolved - some more accurate and reliable than others. Because we can't possibly count each individual mite in a hive (sesame-seed-sized, brown/orange bits), there are several ways to estimate a count.

ALCOHOL WASH METHOD

This method for detecting and quantifying *Varroa* mite from honey bee colonies require the beekeeper to obtain a sample of live bees so that the mites can be collected directly from the bodies of the bees. In this way, the beekeeper can estimate the level of infestation for the entire colony.

Equipment Needed:

- A mason jar with a marking at the 1/2-cup level. Some mason jars come with embossed measurements, or you can draw a line with a marker.
- A solid lid to seal the jar when shaking the mites from the bees.
- A mason jar ring fitted with a round disk of #8 hardware cloth to filter the mites from the bees. This lid must fit on your mason jar.
- 70% isopropyl alcohol.
- A container for counting mites. It should be white or at least very light colored so the mites can be seen.

Testing Steps:

1. Collect half a cup of worker bees (approximately 300 bees) from the brood chamber of the colony. Make sure the queen is not one of the 300!
2. Place the bees inside a well-sealed container and add 70% isopropyl alcohol. Ensure the alcohol completely covers the honey bees in the container, approximately 2 cm above the surface of the bees.
3. Vigorously shake the sample in the container for two minutes to dislodge the mites from the bodies of the worker bees.

4. Pour the mixture of dead bees, mites and alcohol through the mesh wire screen over a receiving container or pan to filter out the honey bees from the smaller *Varroa* mites. The container or pan should be light colored or clear so the mites can be easily seen.
5. Count the mites in the container or pan. Divide by three to obtain the percentage of infestation. For example, if you have three *Varroa* mites in a sample of 300 bees then 3/300 = 1/100 or 1% infestation.
6. Dispose of the dead bees and rinse the container with water to remove the mites between samples.

The isopropyl alcohol method gives an accurate result for two reasons: 1) it better separates the mites from the bees, and 2) it allows an actual count of the mites in the sample, instead of an estimate.

POWDERED SUGAR SHAKE

This method for detecting and quantifying *Varroa* mites from honey bee colonies also requires the beekeeper to obtain a sample of live bees so that the mites can be collected directly from the bodies of the bees. The powdered sugar shake does not kill bees.

Equipment Needed:

- A mason jar with a marking at the half-cup level. Some mason jars come with embossed measurements, or you can draw a line with a marker.
- A mason jar ring fitted with a round disk of #8 hardware cloth. This lid must fit on your mason jar.
- Confectioner's sugar (powdered sugar or icing sugar).
- A spoon.
- A container for counting mites. It should be white or at least very light colored so the mites can be seen.
- A small amount of water.
- Note: University of Minnesota Bee Squad developed a field test kit which is convenient and easy to use; and you never have to worry about forgetting a part of the test kit. In 2019, the kit retailed for $20.

Testing Steps:

1. Collect half a cup of worker bees (approximately 300 bees) from the brood chamber of the colony. Make sure the queen is not one of the 300!
2. Quickly screw on the modified lid.
3. Pour the rest of the bees back in the hive.
4. Spoon some confectioners' sugar onto the mesh screen and work it through with your fingers.
5. Shake the bees in the jar for about a minute to completely coat both bees and mites, using as much sugar as necessary.

6. Let the jar sit for about 5 minutes. ***This is important because the sugar needs to warm to cause the mites to release***.
7. Invert the jar and shake it into your light-colored dish. Keep shaking until mites and sugar stop falling out.
8. Pour the bees back into the hive. The sugar-coated honey bees are easily added back to the hive and the sugar consumed.
9. Add a small amount of water to your dish of mites. This dissolves the sugar and makes the mites easier to see.
10. Count the mites in the container or pan. Divide by three to obtain the percentage of infestation. For example, if you have three *Varroa* mites in a sample of 300 bees then 3/300 = 1/100 or 1% infestation.

STICKY BOARD METHOD

A sticky board is just a piece of thin wood, a metal insert tray, or corrugated plastic that is covered with a sticky substance—usually pan spray or petroleum jelly—and placed below a screened bottom board. A grid-patterned disposable paper can be used on top of the tray to make it easier to count the mites.

Some of the phoretic mites (those that are on the adult bees) drop off the bees and stick to the board. The board can be left in place for one day, and then the mites are counted to determine the "24-hour mite drop". The test can be run for several days to obtain an average drop over a longer period, because mite drops can vary from day to day.

A sticky board is most effective as a post-treatment, monitoring device, as opposed to being a diagnostic tool to establish mite load.

Insert the sticky board under the screened bottom-board. Wait the requisite number of days; and then count the varroa (sesame-seed-sized, brown/orange bits) on the grid, and divide by the days the sticky board was in position. A grid-patterned disposable paper can be used on top of the tray to make it easier to count the mites.

VARROA MITE TREATMENTS: CHEMICAL CONTROL

Treatments suit every need. Whichever treatment you select, remember that *Varroa* mites can build up a resistance to the medication, necessitating a switch of medications in spring and fall.

Some beekeepers use essential and natural oils to threaten *Varroa* mites. There are varying reports of success with these treatments, but few scientific studies to validate effectiveness. *Use of these non-tested/not-approved treatments may violate state/federal laws.*

Commercially available mite treatments abound - some less intrusive; some more toxic. It is up to the beekeeper to decide how the bees will tolerate the medication chosen based on conditions in the hive, and the weather.

Nearly all treatments should be completed at least 2 weeks before the honey flow. Frames with honey, left in the hive during treatment, can absorb the mite medication, making it unfit for human

consumption. Whichever treatment you choose, read and follow the directions closely and complete the full cycle of the prescribed medication as recommended. Pay special attention to the temperature. Some medications are ineffective in colder temperatures.

NOTE: Some of the compounds used for mite treatment can be harmful to the beekeeper if used improperly. Keep a close eye on the behavior of each colony after medicating. After a week, inspect and confirm that the hive is still queen right. You may see a break in the queen's laying cycle after some medications are used.

THE GREAT CONTROVERSY

The time for eloquently and profoundly debating the pros and cons of *Varroa* mite treat vs. no-treat has swept past us. Beekeepers are backed into a corner and the only viable debate left is chemical treatment vs. non-chemical treatment for the control of *Varroa* mites.

In truth, few, if any, beekeepers want to watch their colonies dwindle and die a prolonged and miserable death. Still, some beekeepers begrudge any treatment citing "survival of the fittest" in the hope of developing more robust bee stock. If you choose not to treat (chemical or chemical-free), you put all hives within a one- to three-mile radius at risk.

In 2018, Sentinel Apiary Program conducted a test that revealed rapid increases in *Varroa* mite populations that cannot be explained by normal mite reproduction, indicating an outside source of mites. This study illustrated the extent to which *Varroa* mites from highly infested/crashing colonies can spread to nearby apiaries across the landscape. The arrows in Figure 5-2 show the distance and direction traveled by bees from crashing colonies, likely transferring mites to neighboring apiaries.

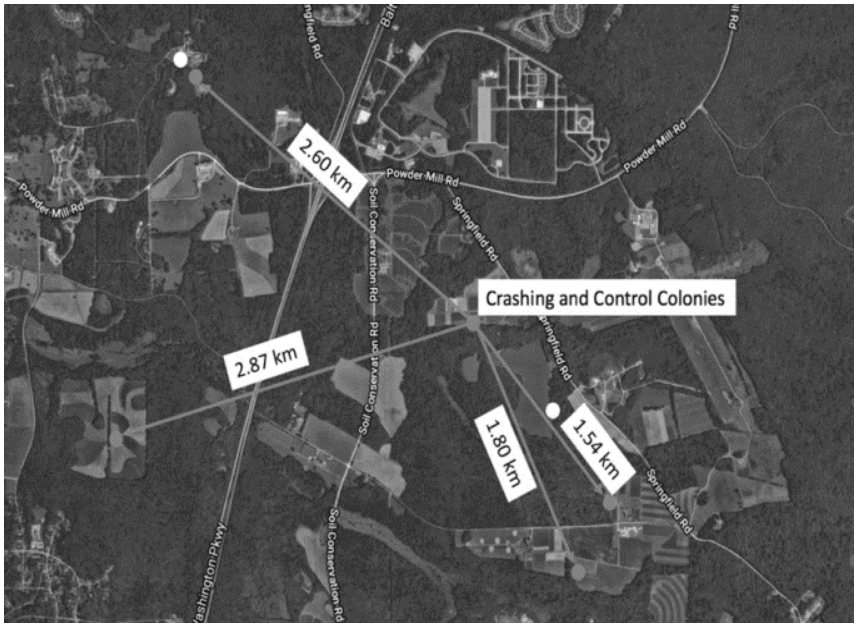


FIGURE 5-2: INTER-APIARY *VARROA* MITE TRANSMISSION (HTTPS://BEEINFORMED.ORG)

TRACHEAL MITES

The honey bee tracheal mite, *Acarapis woodii*, causes a disease known as acariosis. Tracheal mites are an internal parasite and only found in adult bees. The mites clog the bee's breathing tubes and shortens its life.

The parasite was first described in 1921 in bees in Great Britain. This discovery and concern over the potential impact that this mite would have on beekeeping in the United States led to the enactment of the Honeybee Act of 1922, which restricted the importation of honey bees from countries where this mite was known to exist.

SAMPLING AND MONITORING INFESTATION LEVELS

Determining the presence of tracheal mites is difficult since no single symptom is associated with presence of the mite. Bees may have disjointed wings and wander near the entrance of the hive. Bees may have distended bellies. However, these are also symptoms found in other diseases.

Presence of tracheal mites cannot be confirmed without dissecting a bee and visualizing its trachea.

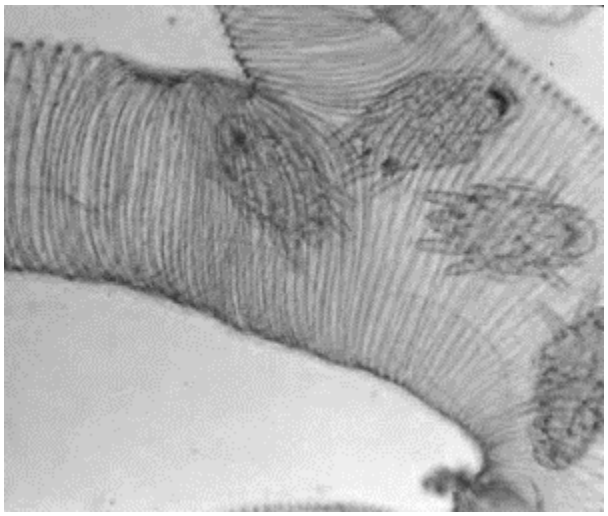


FIGURE 5-3: TRACHEAL MITES

TREATMENTS

Treatment for tracheal mites includes menthol crystals, formic acid and grease patties. Menthol is placed in the hive on the top of the hive bars when the temperature is less than 80°F. This allows the menthol vapor to waft through the hive. When the temperature is greater than 80°F, place the menthol on the bottom of the hive. Grease patties include grease, sugar, and may have wintergreen oil or other essential oils.

VIRUSES

The European honey bee plays a vital role in the global economy and food supply by assisting in the pollination of many of the world's food crops and by producing honey, beeswax, pollen,

propolis, royal jelly and other hive products. However, honey bees are subject to infection by a wide variety of pathogens.

So far, honey bees have been reported to be attacked by at least 22 viruses. Viruses of the honey bee typically infect the larval or pupal stage, but the symptoms are often most obvious in adult bees. Virus transmission within a colony is worsened by crowded conditions and the routine transfer of nectar, pollen, and bee bread between colony members via mouth-to-mouth feeding (trophallaxis). Many viruses are also transmitted by *Varroa* mites. The mites, when feeding on the hemolymph, transfer the viruses directly into the open circulatory system, which reaches every cell in the bee's body.

TABLE 5-2: ADULT VIRAL BEE DISEASES

1.	Acute bee paralysis virus	13.	Slow bee paralysis virus
2.	Kashmir bee virus	14.	Chronic bee paralysis virus
3.	Israeli acute paralysis virus	15.	Satellite virus
4.	Black Queen Cell Virus	16.	Cloudy wing virus
5.	Aphid lethal paralysis virus	17.	Bee virus X
6.	Big Sioux River virus	18.	Bee virus Y
7.	Deformed Wing Virus	19.	Lake Sinai virus-1
8.	Kakugo virus	20.	Lake Sinai virus-2
9.	*Varroa destructor* virus-1	21.	Arkansas bee virus
10.	Egypt bee virus	22.	Apis mellifera filamentous virus
11.	Sacbrood virus		
12.	Thai sacbrood virus		

Viruses pose a serious threat to the health and well-being of honey bees. Over the past decades, considerable progress has been made in our understanding of honey bee viral infections.

BACTERIAL DISEASES

Bacterial diseases are summarized below in Table 5-3.

TABLE 5-3: COMPARATIVE SYMPTOMS OF VARIOUS BROOD DISEASES OF HONEY BEES

Symptom	American Foulbrood (AFB)	European Foulbrood (EFB)	Sacbrood	Chalkbrood
Appearance of brood comb	Sealed brood. Discolored, sunken or punctured cappings.	Unsealed brood. Some sealed brood in advanced cases with discolored, sunken or punctured cappings.	Sealed brood. Scattered cells with punctured cappings.	Sealed and unsealed brood.
Age of dead brood	***Usually older, sealed larvae or young pupae.***	***Usually young, unsealed larvae***; occasionally older sealed larvae. Typically, in coiled stage.	Usually older sealed larvae; occasionally young unsealed larvae. Upright in cells.	Usually older larvae. Upright in cells.
Color of dead brood	Dull white, becoming light brown, coffee brown to dark brown, or almost black.	Dull white, becoming yellowish white to brown, dark brown, or almost black.	Grayish or straw-colored, becoming brown, grayish black, or black. Head-end darker.	***Chalk white*.** Sometimes mottled with black spots.
Consistency of dead brood	***Soft, becoming sticky to ropy.***	Watery; rarely sticky or ropy. ***Granular.***	***Watery and granular; tough skin forms a sac.***	Watery to paste-like.
Odor of dead brood	Slight to pronounced odor.	Slightly sour to penetratingly sour.	None to slightly sour.	Slight, non-objectionable.
Scale characteristics	Uniformly lies flat on lower side of cell wall. ***Fine threadlike tongue of dead pupae may be present*.** Head lies flat. Brittle. Black.	Usually twisted in cell. Does not adhere tightly to cell wall. Rubbery. Black.	Head prominently curled toward center of cell. Does not adhere tightly to cell wall. Rough texture. Brittle. Black.	***Does not adhere to cell wall*.** Brittle, chalky, white, mottled, or even black.

Bold italics indicates the most useful field characteristics.

United States Department of Agriculture (USDA) Bulletin 690

EUROPEAN FOULBROOD

European foulbrood (EFB) can devastate weak colonies; but is known to spontaneously resolve with a honey flow. Colonies under stress can develop EFB quickly. The classic treatment is to re-queen and/or break the brood cycle.

EFB kills larvae before worker bees cap the cells. Frames can look spotty with a range of dead and decaying larvae laid open. The smell is foul, but different from American foul brood.

EFB TREATMENTS

If desired and called for, beekeepers can treat EFB with Terramycin antibiotic. NOTE: Terramycin is no longer available over the counter; and must be obtained from a veterinarian.

AMERICAN FOULBROOD

American foulbrood (AFB) is a destructive disease, one of the most harmful beekeepers faced before being overtaken by the appearance of the *Varroa* mite.

The smell of AFB is the first indication of infection that a beekeeper may notice. Open a hive and the smell can be overwhelming. In addition to smell, sunken brood cells appear; some with pin-sized holes in the caps. The overall brood pattern is spotty (adults remove sick larvae from cells). A toothpick test can help verify AFB. Insert a toothpick into one of the cells, then swirl and pull out slowly. AFB, if present, attaches to the toothpick and causes a "ropey'' attachment as the toothpick is extracted from infected cells.

FIGURE 5-4: AMERICAN FOULBROOD INFECTION

Field Test for AFB: Holst milk test

The Holst milk test (Holst 1946) is a simple test based on the high-level of proteolytic enzymes produced by sporulation *P. larvae*. The test is conducted by suspending a suspect scale or a smear of a diseased larva in a tube containing 3-to 4-mL of one-percent powdered skim milk in water. The tube is then incubated at 37°C (98.6°F). If AFB is present, the suspension should clear in 10 to 20 minutes. It should be noted that this test is not always reliable. The only definitive answer comes from a lab diagnosis.

AFB Treatments

AFB spores last over 40 years in the environment, and place neighboring hives at risk.

If AFB is suspected, isolate the hive and the colony from your other hives.

Once discovered, a beekeeper's only choice is to destroy all the woodenware - frames and boxes - by burning. Burning everything is the age-old response to AFB. Additional post-infection treatments include irradiation for truckloads of infected hive woodenware, or freezing equipment in an attempt to eradicate the spores. You may be able to save the bees by shaking them onto foundation frames (not drawn comb frames) in new equipment. Immediately feed syrup to help clean out the bees' guts.

Prophylactic treatments of Terramycin have become difficult with the elimination of over-the-counter access to treatments.

DIAGNOSTIC ASSISTANCE FOR BEE DISEASES

You may need information quickly to enable swift treatment before you lose a hive.

Ask Questions. Research. Do field tests. Washington State does not employee a state bee inspector. States that do are able to provide a direct resource for beekeepers that may be able to identify a disease outbreak quickly due to their unique skillset. With no state inspector to call on when you need information fast, what are your options?

1. Ask a more experienced beekeeper to inspect your hives. Ask two more to assist and give their opinion, too.
2. Research online, comparing pictures and descriptions.
3. Field test: Acquire commercially available, single-use tests for American Foulbrood and European Foulbrood Diseases.
4. For serious matters, contact the WSU Bee Program at beediagnosis.fd@wsu.edu.

WASHINGTON STATE UNIVERSITY BEE LAB

What if you're not sure your bees are sick? What if treatment depends on a correct diagnosis?

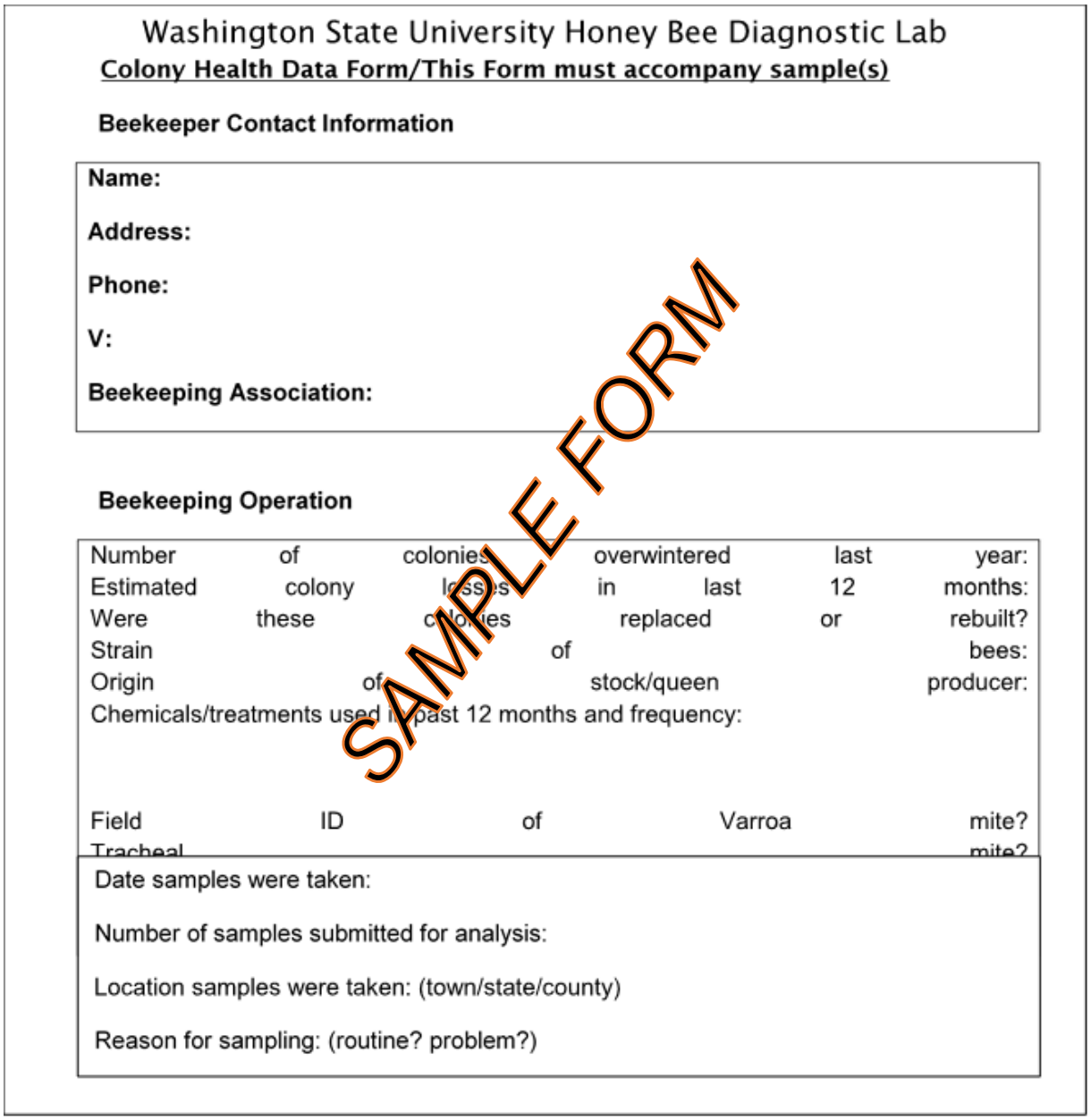
As part of the research effort on honey bee colony health in the Pacific Northwest, a Diagnostic Laboratory was set up at WSU in 2008 to evaluate submitted samples for the presence and prevalence of parasites and pathogens.

The lab is currently accepting samples from Pacific Northwest beekeepers, for analysis to determine the presence of Nosema, *Varroa* mites, and tracheal mites. However; the turnaround time might be longer than you can wait to treat your bees if they are sick.

Beekeepers are asked to use the protocol outlined in documents found at http://bees.wsu.edu/diagnostic-lab/ for collecting and submitting samples. This website also provides the registration form to be completed when submitting samples (Figure 5-5).

Recommended number of samples to be submitted:

1-10 colonies	11-25 colonies	More than 25 colonies
1 sample	2 samples	Please contact the Lab



Washington State University Honey Bee Diagnostic Lab

Colony Health Data Form/This Form must accompany sample(s)

Beekeeper Contact Information

Name:

Address:

Phone:

V:

Beekeeping Association:

Beekeeping Operation

Number of colonies overwintered last year:
Estimated colony losses in last 12 months:
Were these colonies replaced or rebuilt?
Strain of bees:
Origin of stock/queen producer:
Chemicals/treatments used in past 12 months and frequency:

Field ID of Varroa mite?
Tracheal mite?

Date samples were taken:

Number of samples submitted for analysis:

Location samples were taken: (town/state/county)

Reason for sampling: (routine? problem?)

FIGURE 5-5: SAMPLE COLONY HEALTH DATA FORM

QUICK REVIEW – CHAPTER 5

KEY POINTS

1. Colony Collapse Disorder is not a disease. It is the result of a combination of adverse factors affecting honey bees.
2. Disease prevention is always better than treatment.
3. Prophylactic treatment means you treat whether disease symptoms are visible or not.
4. American foulbrood is a devastating disease that requires that the hives be burned to eradicate disease spores.
5. *Varroa destructor* is one of the most prevalent and harmful threats facing honey bees. Many forms of management and treatment exist for *Varroa* mites.
6. Because you cannot see tracheal mites (*Acarapis woodi*), you must become familiar with infected bee behavior, and treat.

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WSU Honey Bee Diagnostic Lab <http://bees.wsu.edu/diagnostic-lab/>

Chapter 6: **PESTS: THE TWO-, FOUR- AND SIX-LEGGED VARIETIES**

Anything or anyone that causes illness or disrupts honey bee behavior is a pest. In Chapter 5, parasites, pathogens and eight-legged pests (mites) were discussed. This chapter discusses the two-, four-, and eight-legged pests.

What are acceptable pest levels? Bee pests abound. Many are merely annoying, but a few are deadly. While ants and earwigs might be tolerated (won't harm a strong colony), other pests are considered “zero tolerance”. A beekeeper chooses levels of pest acceptance and determines how much is too much.

TWO-LEGGED PESTS

HUMANS

As far as beekeeping goes, humans are the most obnoxious pests. We're terrible, not because we are foraging for food or searching for a warm place to protect our young, rather because we have want of money or goods and will sacrifice whatever gets in our way.

Immediately after the first person laid claim to the first honey tree, beekeepers started battling thieves. Honey, and to a lesser degree, wax, were precious and prized throughout history. Held in high esteem, honey paid both taxes and rents, from Mecca to Egypt to medieval England. While honey is not accepted by the IRS, individuals still steal honey, hives and queens.

Sophisticated "bee rustlers" take entire pallets of hives and erase all markings from former owners. In 2016, 20 artificially inseminated WSU queens were stolen (along with 4-5 frames/ hive) from an almond orchard during pollination season.

The small-time beekeeper may not worry about theft; but should be worried about vandalism. Hives located in fields out of direct sight, offer vandals opportunities to practice loathsome crafts, such as tipping, or total destruction. In addition to vandals, some two-legged pests antagonize bees by throwing rocks or large sticks, creating hostile colonies, making them difficult to work. The best defense against vandals is to make your hives blend with the environment. Tall fences work well to deter interlopers; locked gates are also a great deterrent. Informing neighbors to keep an eye out is also helpful.

Pesticides

Delivered by humans, pesticides are a prominent part of the honey bee environment, both in the hive and in the larger environment. Pesticides have been known to cause large-scale bee deaths since the early 1900s, many through direct poisoning during aerial sprays.

Pesticides deadly to both larvae and adult bees, proliferate in urban, suburban and rural localities. The use of honey bee-toxic pesticides; especially when nectar bearing trees and plants are in bloom, is forbidden in most agricultural areas. Bees may encounter pesticides when foraging, or the poisons may drift from a neighbor's yards to engulf hives.

Pesticide kills are sudden, as well as devastating, to colonies and beekeepers, alike. Beekeepers often discover a kill when mounds of dead bees are piled around the outside of a hive. More insidious is pesticide residue that remains in wax comb, where it continues to severely impact larvae, including immunosuppression.

Who is to blame? It's not always obvious. Identifying perpetrators of pesticide kills is sometimes only circumstantial. Therefore; state, city, county and commercial sprayers must stay vigilant.

to the presence of hives and bees. In some areas, commercial sprayers are responsible and liable for pesticide drift. Communication is the best defense/practice against pesticide exposure. Talk to your neighbors or nearby farms. Most people are aware of the importance of bees and are willing to work together to reduce exposure risk.

A defensive practice is to net your hive during times of heavy spraying.

BIRDS

While most birds in the Northwest co-exist happily with the honey bee, the Western Taninger, is an exception. The Western Taninger migrates across western Washington in early spring. He enjoys catching honey bees in mid-air. Taningers may stop in an apiary during migration and feed for two or three days, then move on. The Taninger's feeding does not decimate a colony unless the colony is already weakened, following a hard winter or disease. If the colony is weak, the birds could bring the colony's numbers down to a critical level.

FOUR-LEGGED PESTS

BEARS

Once a bear knows where hives are and has tasted the goods, it's almost impossible to stop the marauding beast. Bears will knock over hives; and destroy comb, frames and woodenware in search of tasty, protein-rich brood (the honey is a bonus).

The first, best defense is to not place your hives in known bear territory. However, with spreading suburbs and housing, many of us now live in what was natural habitat for the bear. Second, using an electric fence can help. Tap power from your home if the apiary is close; otherwise, you may want to invest in a battery- or solar-powered, electrified fences.

SKUNKS

Skunks typically come at night, knock on the front or side of the hive and eat the guard bees as they emerge. You can surmise a skunk has prowled your colonies if you find scratch marks on the front or side of the hives, skunk feces around the apiary (with bee parts in it), and nervous or agitated colonies.

Two practical skunk deterrents:

1. Raise your hives up to 12- to 18-inches off the ground. At that height, a skunk must rise up on its hind legs and expose its belly, which is susceptible to stings;
2. Install a skunk board. A skunk board is a piece of plywood the width of the hive entrance with nails or screws imbedded (think bed-of-nails). The board is placed in front of the hive (best to tack it down) with the sharps up to prevent skunks and other small animals from walking up to the hive entrances.

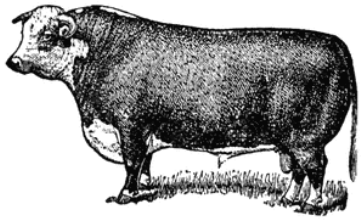
MICE

To a mouse, a winter spent in a dry and warm hive, (once the bees have clustered), is absolute bliss. Mice will wreck a hive by chewing on wax, wood and comb. They also defecate in the hive, bringing disease-carrying pathogens into contact with bees.

Some hive bottom boards are designed with entrances heights that are too small to admit mice. If your hive entrance is large enough for mice to fit through; install either purchased mouse guards or hardware cloth in the entrance. Reduce the entrance height to 5/16". This space is too small for a mouse to enter the hive and does not hinder the bees.

Be warned, if you install the mouse guards too late, you might just trap the mouse in the hive. More than one beekeeper has found the remains of a mummified or propolized mouse in the back of the hive (the bees like keeping everything tidy). Keep your apiary free of excess brush and beekeeping equipment. Don't provide a reason for mice to visit.

COWS



A cow seems to be a benign creature; but cows needing a back-scratch view tall hives as irresistible scratching posts. Cows will sidle up against a hive and scratch their back and sides. Next thing you know, the hive boxes are laid out on the ground like dominoes. Be cautious of seemingly placid cows. If you do find your hives in contention with cows, consider purchasing metal straps to bind the hive.

SIX-LEGGED PESTS

ANTS

Ants are not just troublesome to find in your hives; but can be a true menace. Ants can invade a hive in search of sugar syrup, honey, and in some cases, brood. A weak hive may spend all its time fighting ants instead of building a healthy colony.

In contrast, a small proportion of beekeepers claim a harmonious ant and bee co-existence. Ants are another case of how much you are willing to tolerate, given the interaction of ants and bees in a given hive.

To deal with ants, you must first deal with the landscape. Keep the grass or plants around the hives cut short. Ants will seize any advantage, such as a blade of grass to cross/jump/bridge a barrier and get into the hives. Think about planting mint around your hives - ants hate mint. Hive stands are also key ant deterrents. Place the legs of the hive stand in tuna fish cans of oil or diatomaceous earth. Finally, some beekeepers claim that sprinkling cinnamon or foot powder around the hives will keep the ants in check. Monitor for ant activity whenever you visit the apiary. Catch a potential infestation early.

WASPS AND HORNETS

In a honey bee's world, there is no place for wasps or hornets. NONE AT ALL. Most wasps and hornets destroy colonies.

A hive boiling with bees at the end of August can be ravaged by yellow jackets and become suddenly too weak to make it through winter. The marauders are patient, making stealthy attacks on the hive, probing for weaknesses. Once they invade, they can destroy the hive in a matter of days, or worse, leave a disheartened handful that will surely perish in winter.

The best defense is offense, when it comes to wasps. In early spring, wasp queens wake from dormancy and scout for a suitable nesting space. Catch these queens early (with rotten meat, canned cat food or with pheromone lures) and you'll potentially destroy thousands of summer wasps. Place robbing screens on hive entrances to discourage wasp forays into the hive.

Wasp/hornet traps come in various sizes and shapes. Homemade traps abound including the *Drown them in Soap and Water* traps, and the *Take the Poison Back to the Hive* combos. There is also the *Kill the Colony Where It Lives* method. Check online for tips and tricks.

To discourage wasps and hornets from your yard, clear dead bees from in front of hives, keep outside food in covered containers, and make sure the garbage can lid is on and secured tight. Ask the neighbors to be vigilant and place traps, as well.

Note: Do not mistake the non-aggressive paper wasps and solitary mud daubers to be aggressors or dangerous to your bees. These wasps are considered beneficial. They prey on other insects that humans may find disagreeable.

SMALL HIVE BEETLES (SHB)

Aethina tumida or the small hive beetle: Before our climate started to warm, we did not give much thought to the small hive beetle in the Pacific Northwest. It was a problem found only in the south. Unfortunately, the first SHB was spotted in Washington State in 2008. A serious outbreak hit out neighbors to the north, British Colombia, in 2017.

The SHB has yet to decimate hives in Washington, as it has in southern states, but it may just be a matter of time. Normally, at least in eastern Washington, our cold winters cause the SHB pupae to die in the soil.

FIGURE 6-1: SMALL HIVE BEETLE AND LARVAE

Adult SHB spend their lives in the sandy soil surrounding a hive - their only trips into the hive being to lay eggs. SHB burrow into hive, lay their eggs and then the damage begins. The SHB larval stage gorges on pollen, comb and honey. They have the potential to ruin both comb and frames. Control SHB by ground drenching the soil around the hive to destroy the adults.

WAX MOTH

Wax moth larvae cause extensive damage in the hive by chewing through woodenware and comb. The larvae spin spidery cocoons and make the hive uninhabitable for bees. Never store wax combs in dark, dank spaces as that is a sure way to attract wax moths to your equipment. Wax moth prevention is simple. Place all wax comb in the freezer for two days (to kill any lingering wax moth eggs and larvae on frames) and store your frames in a sealed, plastic garbage bag.

It may also make sense to protect your stored equipment by placing wax moth crystals in and around the storage area. Ensure you use the correct crystals. Common mothballs are dangerous.

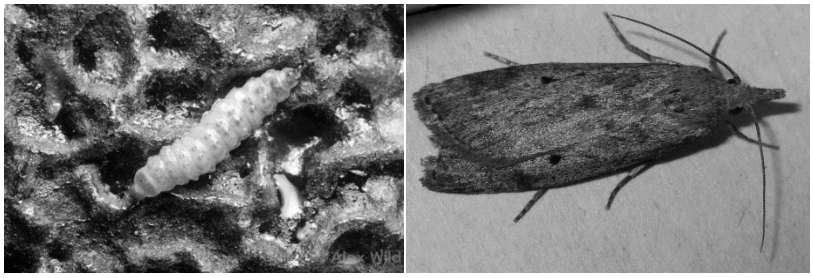


FIGURE 6-2: WAX MOTH LARVAE AND ADULT WAX MOTH

QUICK REVIEW – CHAPTER 6

KEY POINTS

1. Humans are a long-standing pest as far as honeybees are concerned.
2. Sudden pesticide kills are most often identified by layers of dead bees in front of the hive.
3. Elevating hives forces a skunk to expose its underside to capture bees, leaving it vulnerable to bee stings.
4. Elevating the hive can also aid in protecting from crawling insect pests.

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Black and white predator illustrations from <https://etc.usf.edu/clipart/>

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Minimizing Risks to Bees - Xerces Society.

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Chapter 7: **SPRING**

The Mason Bees are out and about, the forsythia just starting to bloom. The yard seems less muddy than last week and the bees are starting to take things seriously.

APIARY START-UP

In the apiary, bees do not magically come to life on the first day of spring. It happens slowly and methodically. Beginning in late winter, the colony prepares for spring and summer. Taking their time little by little, warm-day fair-weather flights become longer. The queen starts to lay more, and the workers begin bringing in early pollen.

If you have been feeding your colonies, do not slack off in the feeding. Once there is protein in the hive, the queen starts laying, with protein and carbohydrates essential to young brood. Now is the time to build up the over-wintered colonies, and if you are lucky, split them before the nectar flows in summer.

OVER-WINTERED BEES

The last eggs the queen lays in fall are the bees that tend the queen all winter. The queen shuts down her egg production in the fall as it gets colder, and the bees cluster in the winter. Honey bees do not hibernate, rather they cluster (like a ball of bees), with the queen in the middle. With all the bees emitting CO_2, the mass becomes hypoxic. The center of the cluster might measure only 15% oxygen which, in turn, lowers the bees' metabolism.

The bees on the outside of the cluster barely move, but their sisters inside constantly rotate to the outside of the cluster, giving every bee a chance at the warmth. The queen in the middle of the cluster enjoys a toasty 74° F when the hive is brood-free. Later, when she begins laying and brood is present, the temperature is increased to 92° F. The cluster must stay in close contact with the stores of honey or they could starve.

Do not make a full inspection until daytime temperatures approach 55° to 60° F. Before the weather warms up, you can knock on the outside of the hive and listen for buzzing. If you're using a telescoping top, you can also lift the lid and check for bees through the inner cover. You can monitor for cleansing flights outside of the hive on warm, sunny days. If you use a screened bottom board with its tray slid in for overwintering, an active/live hive will show signs of life by dropping debris onto the tray beneath the cluster. Check in February to see if the hive has enough honey to last through March. If the hive is too lightweight, feed honey bank food frames or candy.

Make your first, full post-winter inspection on a sunny and clear, day with as little wind as possible. The first inspection includes cleaning - perhaps a great deal of cleaning. Check and clean the front entrance and bottom board.

Look for the calling cards of hive health:

1. Is there brood?
2. How are the pollen stores?
3. How are the honey stores?
4. How full are the frames?

Depending on the size of the over-wintered colony, you may need to take the hive down to just one box, by removing empty honey frames and moving all other frames to the bottom. In this manner, the remaining bees will have less space to heat, and will find it easier to stay warm.

During early-season inspections, even if the number of bees requires two boxes, you might find all the bees in the top box and little to no bees or brood in the bottom deep box. In that case, it's helpful to reverse the colony. Moving the top box to the bottom board and the bottom box to the top, provides space for the bees to grow. Colonies tend to expand up through the equipment.

FEEDING

If warm weather creeps in too early, the bees will break cluster before nectar and pollen are available outside. If their honey stores are already eaten, the beekeeper needs to step in and feed from the honey bank, or feed sugar, candy, or fondant. Few things are more disheartening than getting your bees through a rough winter, only to lose them in the early spring.

Sugar syrup can be fed after temperatures warm, but not during cold periods (less than approximately 55°). Spring syrup is made with equal parts sugar* and water (1:1 syrup).

***To make syrup for the bees, only use only refined white sugar (beet or cane). Other types of sugar (brown, raw, organic, etc.) contain solids that are hard for the bees to digest and may cause dysentery.**

You might feel inclined to throw on pollen patties; however, beware that once you place pollen the queen will start ramping up egg production. You don't want the hive raising too many new bees if the weather is still unpredictable.

FEEDERS

Start a lively discussion at your bee club. Ask someone about which type of syrup feeders are best. Opinions, however, will likely differ.

FRAME FEEDERS: In-hive frame feeders are feeders placed next to the frames in a brood box. Some feeders have covers and include ladders or plastic trellis for bees to climb up and down while feeding. They come in 3-, 2- and 1-gallon capacities. They also come in deep and medium sizes.

TOP FEEDERS: Top feeders are placed on top of the brood boxes, hence the name. They have one or two troughs covered with wire that the bees use to climb to the food source.

GRAVITY FEEDERS: Gravity feeders are either large cans or jars with small holes in the lid (an example is the can of syrup that you receive with a package of bees). Turn it over and the bees draw the syrup out of the bottom. The vacuum created keeps the syrup from draining out. Boardman front entrance feeders are a type of gravity-feeder. Free-standing feeders may be placed near the hives or on top.

FRONT ENTRANCE FEEDERS: Boardman feeders are generally set into the front entrance of the hive. Sugar syrup or water can be fed to the bees from an inverted Mason jar topped with a lid that has had small holes punched into it. Some companies have started to produce larger plastic versions of the front entrance feeders. Front feeders could encourage robbing by yellow jackets, especially in the late summer. Boardman feeders are also free-standing, and can be used on top of the hive, or adjacent to it.

Check your feeders every couple of days. The bees can go through a great deal of syrup in a relatively brief period.

With the wide variety of bee feeders in the market, you can never run short of a choice. Bee feeders are essential for the survival of the bees when times are hard; however, you should remove them when they are not needed.

NEW BEES

New spring bees come in nucs and packages. Few things are as exciting, especially for the first-year beekeeper, as getting new bees. For Washington beekeepers, the spring bees are brought north after pollinating the almond orchards in California. The workers and the queen are introduced to each other right before shipping. Because of this, the queen may need a slower introduction, allowing the workers to accept her as their own.

PACKAGES: Packages come in 2-, 3-, and 4-pound options. Inside the box of wood and screen is a cluster of worker bees, a current-year queen in a cage, and a gravity feeder.

The quality of queens in packages varies. It's best to know your supplier; or trust your middleperson who makes the distribution. Picking up bees can be fun, and a great opportunity for some last-minute shopping. Look for a healthy, tight cluster on the queen. If there are lots of bees flying at your pick-up site, a large group of bees clinging to the outside of a package is a good sign that the queen has some strong pheromones.

NUCS: Nucs are mini starter-colonies. The term “nuc” stands for nucleus. You receive 3, 4, or 5 frames of varying amounts of bees, brood and a queen. The vented entrance is closed during transit to prevent wandering. Once the bees are on site, open the front entrance to allow them to scout and forage.

Receiving a nuc comes with an increased risk of inheriting someone else’s mites or disease problem. Practice an ounce of prevention and dispose of any combs that appears old or dark and almost black. You must treat nucs for mites early in the spring.

HIVING

Have your hives set-up and ready to go before you pick up your bees. Also, make sure that you have all the equipment that you need BEFORE you open your nuc or package.

The process of getting your bees from "container A" into "box B" is one of the most highly anticipated aspects of beekeeping for beginners. The hiving process can be so quick that you are done before you have time to think about it. It is a satisfying feeling to hive your first colony.

NUCS

Nucs are the easiest to hive.

1. Carefully move frames from nuc box to new hive.
2. Check that you have the queen.
3. Lay the nuc at the front of the hive to allow stragglers to find their way into the hive.

PACKAGES

Packages provide the beekeeper with an installation choice: shake or no-shake.

Shake Method

1. Prepare the hive by removing the outer and inner covers of the brood box. Remove five frames.
5. Give the package a light thump to dislodge the cluster around the queen cage. Remove the feeder can from the package. Slide the queen cage from the package; and place a cover over the opening to prevent the bees from flying out.
2. Ensure that the queen is active. Prepare her cage by removing the cork and quickly replacing it with a mini marshmallow. It's best to wait for her to be facing away from the cork before removing it. Be gentle. You can place her in a bee suit pocket to keep her safe and warm.
3. Take the package of bees and remove the cover. Shake the bees into the empty area in the deep. Place the almost empty package box on its side in front of the hive, with the opening faced toward the hive.
4. Replace all but one or two of the frames. Securely hang the queen cage between two frames on the side of the hive away from the feeder, with the screen facing forward (so the screen-side is exposed for feeding and ventilation). Push the frames together; and finish by adding the final frames to the box.
5. Fill the frame feeder half-full of warm 1:1 syrup mixture. Using a covered feeder with ladders avoids drowning bees; and reduces the chance they'll build burr comb in the feeder.
6. Replace the inner and outer covers.
7. Lay the package in front of the hive to catch the stragglers.
8. Check the queen cage in two or three days to make sure she is released. If not, release her yourself.
9. Feed warm syrup every three to four days, or as needed to keep syrup in the feeder. The bees need it to produce large amounts of beeswax.

No-shake Method

Follow steps 1 and 2 above. Deviate on step 3 by placing the package in the open space in the brood box, then remove the syrup can. Eliminate step 3 as there is no need to shake. Continue with steps 4 (minus replacing frames) thru 8. You can remove the package box and replace with frames the next day. If any bees remain in the package at that time, you may ultimately need to coax them out by shaking.

Feeding After Hiving

All new colonies need to be fed as soon as they are hived. Use the 1:1 syrup recipe: Mix one-part water to one-part sugar, using hot tap water to dissolve the sugar. It's best to feed warm syrup.

NOTE: Inner top feeders and inner gravity feeders require that a second hive box be placed around the feeder, between the first deep box and the lid.

MAINTAINING A BALANCE

If your beekeeping goal is a healthy hive that produces a surplus of honey, goes into fall with few mite issues, and tackles winter with large stores and strong bees, this is the time to make it happen. Beekeeping demands that you manage two seasons ahead. Always think about what impact your actions will have on the colony later down the line.

By the first nectar flow, look for seven to eight frames full of bees, and four to six frames of brood. They should already have 12 to 15 pounds of honey stores (about two deep or three medium frames full). The laying pattern should be even, not spotty. If the colonies appear weak, with only five or six frames of bees, consider combining with a stronger colony or boosting with brood and/or workers from a more robust hive.

Hive space is at a premium in the spring. The colony requires pollen, nectar and brood space, with additional area for the queen to keep laying. Never let the bees think they are running out of room. Always be ready to add the second deep and honey supers.

Frames: Frame manipulation has one cardinal rule - NEVER separate brood with an empty frame or from pollen and honey stores. (More on frame manipulation in Chapter 8 when we discuss swarms.)

COMBINING WEAK AND STRONG COLONIES

Keep the balance in your hives. If needed you can combine weak and strong colonies.

- Remove the queen from the weak colony.
- Open the strong colony and place a piece of newspaper across the top of the frames. Make sure it covers all the frames. Trim the sides if you can; otherwise it may wick rain. You can spray the paper with just a spritz or two of syrup, or leave it be. The bees know what to do. Slit the newspaper in three or four areas.
- Place the weak hive on top of the newspaper.

- Close the hive up as usual.

The newspaper method allows the weaker hive's bees to accustom themselves to the new queen's pheromones. By the time the bees from the weak hive make it through the newspaper (the bees will clean it out), they will have accepted the new queen.

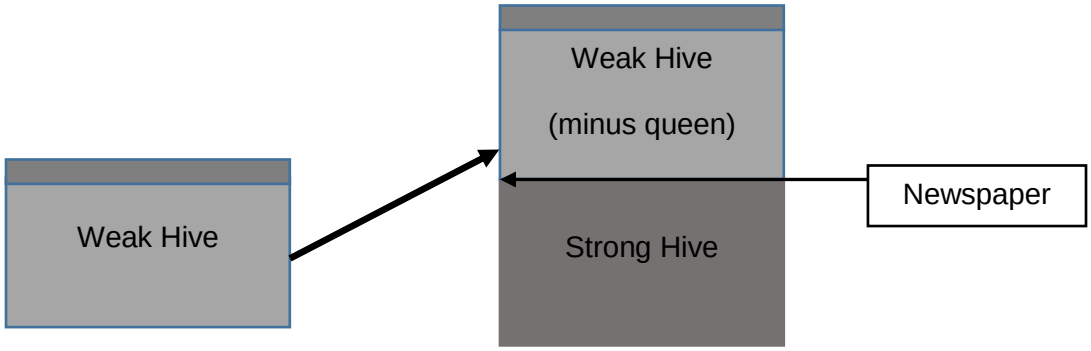


FIGURE 7-1: NEWSPAPER METHOD TO BALANCE HIVES

MANAGING A STRONG COLONY

What if you have the opposite problem? Let's say you have a super-strong colony and you have already provided them with a second brood box. Now the second deep is full. A congested brood nest may have the colony thinking "swarm". There are several techniques for providing space in the brood nest to reduce congestion, including:

- removing frames of brood and bees and adding them to a weaker hive, taking care not to inadvertently transfer the queen,
- splitting the strong hive into two weaker hives,
- manipulating frames within the existing hive, or
- switching the top and bottom boxes.

SPLITTING A HIVE

Split a strong colony by removing frames of brood and nurse bees; and placing them in a nuc or spare deep box, providing a new queen (or allowing the bees to raise a new queen on their own).

Afterwards, you may consider switching locations, i.e. placing the split with the new queen in the location of the original strong hive; and moving the original strong hive to a new location. Moving the old queen to a new location mimics swarming; and may reduce the hive's swarming impulse. With the new queen in the old location, that hive will benefit from field bees returning with pollen and nectar to their familiar location.

When the split becomes too "full" you need to add a second deep.

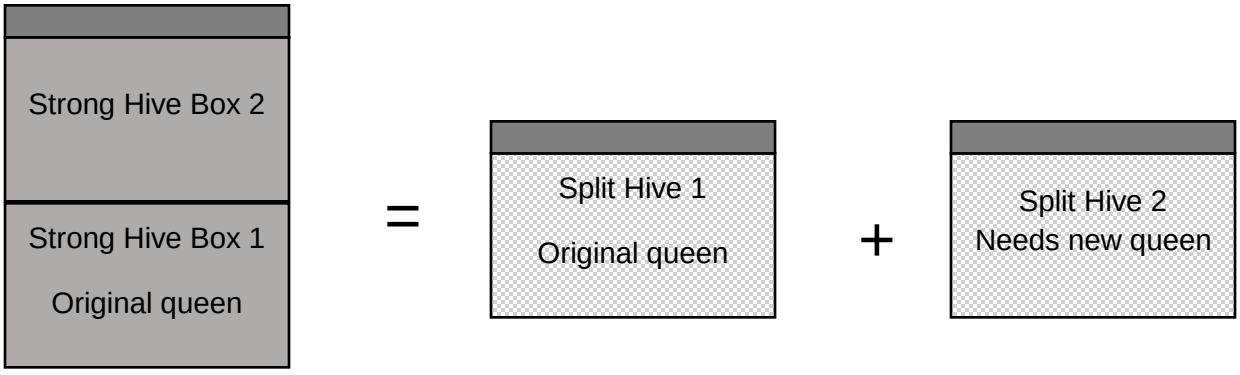


FIGURE 7-2: SPLIT HIVES

FRAME MANIPULATION

By managing frames and boxes within a hive, crowding (or perceived crowding) can be alleviated. Frame manipulation has one cardinal rule, never remove brood from pollen and honey stores. Below are several strategies for frame manipulation that reduce the hive's impulse to swarm:

- Place a foundation frame in the middle of the brood nest; and remove a less-important frame from the top box.
- Employ the Demaree method, developed in the late 1800's. Steps are well-documented on the internet. This method involves placing one or more empty supers and a queen excluder between the two deep boxes. The queen remains in the bottom with one or two frames of sealed brood, and empty, drawn comb. The foragers and most brood are placed in the top box, above the supers. This simulates a queen-less condition for the top half of the colony.
- Checkerboarding is done in the two supers directly above the brood nest, and does not affect the frames in the brood nest. By breaking up the honey stores at the top of the brood nest with alternating frames of empty, drawn comb, and frames full of honey, the bees' swarm impulse is reduced.

SWITCH TOP AND BOTTOM BOXES

As shown in Figure 7-3, swap the deep boxes, so the emptiest box is on top. Make sure that the queen and her brood are in the bottom brood box. The queen tends to climb upward and lays in the "new" space. Add honey supers as needed.

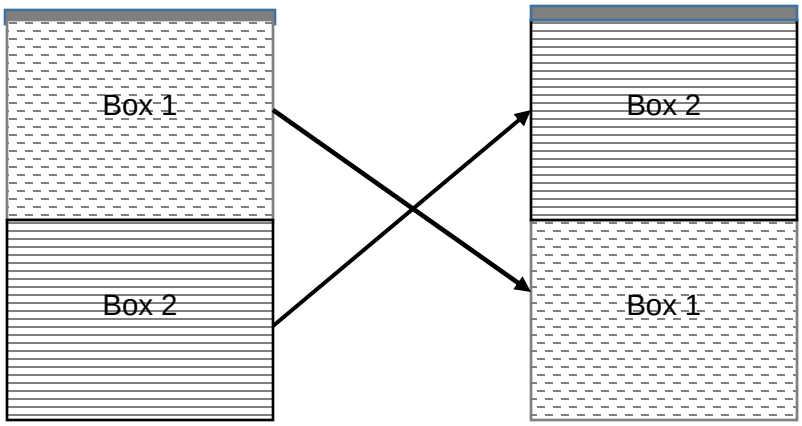


FIGURE 7-3: CONGESTED NEST BOX SWITCH

QUICK REVIEW – CHAPTER 7

KEY POINTS

1. Overwintered bees may have lived for over 3 months.
2. Supplemental feeding should be 1:1 sugar to water in the spring.
3. If you are medicating for mites, Nosema, etc., make sure the treatment is completed per instructions.
4. Some treatments may be used with honey supers on the hive (Formic acid or Hop Guard) while others require a waiting time. The label is the law.
5. New spring bees are usually purchased by the package or as a 'nuc" - a small 4- or 5-frame hive.
6. Always manage at least two seasons ahead.

REFERENCES

Kim Flottum, *Backyard Beekeeper - Revised and Updated, 3rd Edition: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden* (Beverly, Massachusetts: Quarry Books, 2014).

Two books by Ormond and Harry Aebi - They are still in print and available from several publishers including Prism and Rodale. These books contain practical advice and speak to why so many of us are beekeepers.

- *The Art and Adventure of Bee Keeping* (Santa Cruz: Unity Press, 1979).
- *Mastering the Art of Beekeeping Vol. 2* (Santa Cruz: Unity Press, 1979).

Chapter 8: **SUMMER**

Summer is the best time of year to sit in the apiary and watch the bees. The bees are at their most industrious peak and will often work long into the warm summer evenings. Summer also heralds a period of colony leave-taking - swarming or absconding. Hyper-vigilance of weather, availability of forage, bee behavior, and queen viability can predict whether your bees are likely to make it through the next two seasons, fall and winter.

> *"Bees do have a smell, you know, and if they don't, they should, for their feet are dusted with spices from a million flowers."*
>
> - Ray Bradbury, Dandelion Wine

INTEGRATED PEST MANAGEMENT (IPM)

Fundamental to healthy beekeeping practice are techniques referred to as Integrated Pest Management (IPM). IPM practices help keep bees strong and robust. IPM includes environmental, physical, mechanical, biological, chemical and genetic considerations. The theories applied by IPM to beekeeping are some of the same applied within the agriculture industry. IPM procedures should become second nature to the beekeeper.

INTEGRATED PEST MANAGEMENT

Successful *Varroa* control solutions are proactive. They control *Varroa* before the mites reach levels that threaten colony productivity and survival, rather than respond after the damage has occurred. IPM is a set of proactive, non-chemical and chemical methods that offers beekeepers the best whole-systems approach to controlling *Varroa*.

ENVIRONMENTAL CONTROLS

A first step in beekeeping is apiary site selection. An IPM environmental control consideration is selecting a site with sun and drainage. Controlling moisture protects a colony from a host of diseases which can weaken bees and make them prey for other pests.

Selecting a site with no standing puddles or depressions ensures the site has adequate drainage. Another control is not placing hives near the foot of a hill, where cold-air sinks can adversely affect the bees. More controls include protections from winter's prevailing winds and protection from rain gushing through the entrance. Making a solid site decision keeps bees healthy.

PHYSICAL/MECHANICAL CONTROLS

Physical IPM methods include:

1. Fences - keep out bears and other creatures (including humans).
2. Elevated Stands - keep skunks, etc. away.
3. Screened bottom boards - increase ventilation; mites that drop can't climb back up through the mesh.

4. Screened inner covers – improve ventilation.
5. Mouse entrance reducer - no mice in winter.
6. Robbing screens -- keep marauding bees and pirate hornets and wasps out.
7. Drone comb
    a. attracts the *Varroa* mite (longer incubation period) and,
    b. can be removed and frozen to kill all *Varroa* mites, and placed back in the hive.
8. Interruption of brood cycle.
9. Sanitation - cleaning tools, etc. when moving from hive to hive.
10. Keeping the apiary clean - not allowing mice or hornets to take advantage.

Biologic Controls

None have proven effective.

Chemical Controls

Chemical controls include the use of synthetic miticides, acids and approved essential oils. Key to IPM is treatment rotation from season to season to avoid *Varroa* mites building resistance to any one treatment.

It's obvious we cannot totally eradicate *Varroa* mites; therefore we must control the population growth.

Genetic Controls

Genetic IPM controls include obtaining genetically diverse stock such as hygienic VSH stock (Minnesota Hygienic or WSU), that have known *Varroa* mite resistance traits (cleaning, biting). Such stock can pass on their behaviors to their daughters, making the hive healthier.

Overall, checking on *Varroa* mite levels is crucial; check at least four times each year. Record your findings, treatments, weather, temperature, etc. Know your bees, but more importantly, learn about *Varroa* mite to better battle them.

Colony Behavior

Summer requires the highest amount of vigilance regarding bee behavior. It could signal a nectar flow, an imminent swarm, even a failing queen. Sudden aggressive behavior may signal an invasion of pests. Depressed behavior could mean a dead queen. Bearding could indicate an impending swarm or need for ventilation. These are all behaviors to watch for so you can respond accordingly.

QUEENS

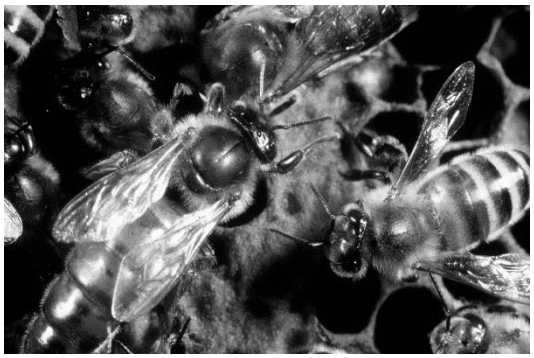


FIGURE 8-1: QUEEN BEE

The queen is the pheromone barometer of the hive. Although workers are recognized as the true decision makers, the queen's pheromones, or lack of quality pheromones, ultimately drive the workers to action.

Summer is when the queen you acquired or raised needs to show off her vitality and characteristics. The queen must have mated well to have sufficient supplies of quality sperm. The queen must come from robust and hearty stock, laying eggs in strong patterns across the frames. A younger queen may have stronger pheromones, but if you have a queen with queen daughters you've bred, which one are you to use? The known quality, or bet on the new bee?

Queens dictate the story of the honey harvest. Vigorous queens lay all spring, expanding the colony for expected nectar flows. If you are lucky, you'll have a hygienic queen. Her genetics help keep the *Varroa* mite count down and the nectar gathering strong. This can also be a horrible time, when a queen is failing and you're in denial, wanting to give her a couple of more days. When she ultimately fails, did your action delay getting a new queen and increase the chances of developing laying workers, who may never accept another queen?

This is the time of year you rely on your experience and that of others with similar goals.

SWARMS

> *'A SWARM IN MAY IS WORTH A LOAD OF HAY; A SWARM IN JUNE IS WORTH A SILVER SPOON; BUT A SWARM IN JULY IS NOT WORTH A FLY.*
>
> -English beekeeper proverb

FIGURE 8-2: BEE SWARM

Swarming is a natural behavior for *A. mellifera*. Swarming is one way a colony reproduces, passing on the queen's genes and behaviors to a new hive. Colonies often swarm during the spring build-up in May and June; but can throw swarms up through early fall. On a spring afternoon, usually between noon and 4 p.m., a colony's queen exits the hive, taking between 40% and 60% of the worker bees with her - but not before a replacement has been established for the bees left behind. Following their wild and awe-

inspiring flight, the swarming bees will settle, surrounding and protecting the queen, waiting for their scout bees to return with news of a new home.

How to Catch a Swarm

There are three ways to catch a swarm: 1) find one yourself, 2) catch one using a bait box, and 3) answer the call when someone reports that they need help with a swarm.

There are few guidelines governing swarm ownership with the first method where you are lucky and find a swarm yourself. However, if a swarm lands on private property, seek permission to avoid trespassing. You might want to carry your bee suit and swarm capture gear in your vehicle. You should always be prepared in case you spot a swarm.

The second method utilizes a bait box. A bait box is typically a deep with a few frames of drawn comb. By placing the box four to ten feet above the ground, you provide a good invitation to swarming bees. Don't fill your bait box with frames. Bees may find the offered living situation too crowded.

Finally, a third method, and maybe the easiest, involves joining your local bee club's swarm list. The list, coordinated by a club member, consists of beekeepers willing to collect swarms. When someone calls in a swarm, the swarm list coordinator calls club members near the swarm.

Beekeepers love swarms, as long as they're not originating from their own hives. Bees will swarm when conditions in the hive are poor, such as overcrowding, major mite infestation, lack of forage, etc. As a beginning beekeeper, you are constantly being told to inspect at least every 7 to 14 days. This is when that advice, and forced habit, pays dividends. Here are some signs that a swarm may be imminent:

- The hive has made queen swarm cells. Swarm cells are usually built along the bottom portion of the frame. Virgin queens emerge 16 days after their egg was laid.
- The bees are bearding on the front of the hive (not due to the hot weather).
- There is a sudden growth in the drone population.
- No new comb is evident.

While inspecting your hives, you find three or four occupied queen cells. What should you do? First, follow your goals. If honey production is the goal, you'll want to stop a swarm that will negatively affect your honey production. Transfer the frame with the queen cell(s) to a nuc, and have the bees raise a new queen there. You can also destroy all the queen cells but one (after making sure you still have a queen). Keep one cell in reserve as a backup queen in case the hive swarms. You might also place bait boxes to catch your own swarms. You can also add a deep for more room. You could also let them swarm. Often, they swarm no matter what you do.

If swarm behavior seems due to overcrowding, lack of ventilation, etc. take additional steps which could include: checkerboarding, alternating honey filled and empty frames above the brood (never in the brood-boxes), making a split (either acquiring or raising a new queen), increasing access to honey supers by adding a top entrance, adding an additional brood box or space for the foragers to hang out (e.g. a rec room). Again, they may swarm no matter what you do.

Another type of bee leave-taking is call absconding - when the entire colony leaves. This will be discussed more in Chapter 9.

SUPERSEDURE, EMERGENCY QUEENS, AND HOPELESSLY QUEENLESS

Do not confuse superseding and swarming. Superseding occurs when a queen is failing. Workers select the best eggs or young larvae and build queen cells around them, in order to replace their failing queen and save the hive. Supersedure cells are normally found mid-frame; whereas swarm cells are typically found at the bottom or very top of a frame. This is not a 100% rule; but is a fairly reliable guideline.

If you remove supersedure cells, the colony will likely start new ones; but at this point the remaining larvae may be too old to become good queens. If you remove a supersedure cell by mistake, be ready to get a new queen if the queen is lost or becomes a drone layer, laying only unfertilized eggs. Failing queens and laying workers only produce drones, causing the colony to fail.

When a queen dies suddenly, the hive will make an *emergency queen*. In this case, they react as in supersedure, except the situation will be dire. Since no more new eggs will be available, the workers need to work quickly, and successfully develop a new queen.

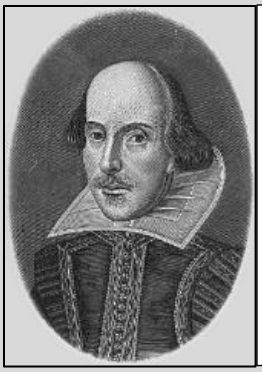
Occasionally when their queen fails or dies; a hive becomes *hopelessly queenless.* This happens when their early attempts to make a new, mated queen fail, and there are no more eggs or young larvae available. It's best to remedy this situation as soon as possible, either by introducing a new queen, or adding the remaining bees to another hive. The beekeeper needs to react *before* any worker bees become laying workers.

DEARTH

A dearth means that no nectar or pollen is being produced by plants, trees, etc. A dearth often occurs in early spring, and at the end of summer into early fall. Always remember that you are working toward building your hive's strength so it will make it through the next winter. Feed them, if necessary, so they have adequate stores for winter. It is difficult for them to make honey or add significant weight in late fall.

When feeding during a dearth, be shrewd and careful. Feed the bees as much as they need, but only use internal feeders. Do not leave the hive open for periods of time. While feeding, try not to spill any sugar syrup on or around the hive or apiary. When your bees are starving, so are all the neighboring wasps (including yellow jackets and hornets). They only need a little bit of incentive before they start robbing your hives.

Wasps will happily take down a colony in a matter of days. Have wasp traps up; and robbing screens in place. It is a tough time for the bees as they prep for the coming fall and winter.



He is not worthy of the honeycomb That shuns the hives because the bees have stings.

William Shakespeare, The Tragedy of Locrine (1595) III, II. 39

HONEY HARVEST

Before you begin - ensure that the bees have 60 to 80 pounds of honey for their winter stores.

Since the discovery of bees and, more importantly their honey, bees have reluctantly shared their bounty with humankind. Early man climbed cliff faces and monstrous trees, for just a taste of honey. They braved stings with just a smoking branch to shield them to keep the bees at bay.

Today harvest is somewhat easier; however, it still requires skill, a lot of patience, and a keen desire. Whether you extract using crush and strain, have a flow hive, or use an extractor (motorized or hand crank), the goal is the same - get the honey into the bottle.

Honey flows faster if you're working in a warm space.

Follow the process:

REMOVING THE FRAMES OF HONEY FROM THE HIVE

A few methods are available. Which one you choose depends on the number of hives and the amount of time you have for the harvest. These methods include:

- Use a bee escape, which allows the bees to exit the honey supers, but not to re-enter. Install the escape for about 24 hours before you harvest, and your supers should be clear of bees.
- Use a fume board. A fume board looks like a simple cover for the hive, but the inside is covered in felt. Drip the fume solution on the inner felt and place it on the hives. Bees will vacate in minutes.
- Use a bee vacuum or a low-power blower designed to be used with bees, to gently blow the bees out of the supers.
- Carefully lift each frame. Gently brush away the bees.

COLLECTING THE HONEY-LADEN FRAMES

Pull individual frames, brush off remaining bees, and place the frames in a covered bin or spare super box.

Alternatively, lift entire super boxes off and cover them while you continue to harvest. (You'll still have some bees in the boxes with this method, though, and maybe some surprise brood).

FIGURE 8-3: FRAMES OF HONEY READY FOR TRANSPORT

EXTRACTING THE HONEY

The sections below describe extraction room requirements, and several methods of honey extraction.

Harvesting Area

Bring the bee-less frames into your honey house or kitchen. Fundamentally, the honey harvest space should be warm; clean; have running water; and be screened against bees, hornets, wasps, mice, etc. Make sure that you cover any area you do not wish to wash. Honey, as you know, is sticky and will somehow end up on everything!

Comb Extraction

At this point; you can do comb extraction (of frames that use appropriate foundation). All you need to do is lay the individual honey frame onto a tray large enough to catch any drips, cut the comb from the frame, and then cut that honey-filled wax into chunks, packaging it in glass jars or other containers.

This way of harvesting honey is the speediest, as there's no uncapping of the honeycomb and the wax is eaten right along with the honey. Very gourmet in presentation, comb honey is a popular favorite.

FIGURE 8-4: HONEY COMB IN JAR

Gravity Extraction

You may also use gravity extraction at this point. For those who only have a few frames, it may not be cost effective to buy or rent an extractor (see Mechanical Extraction, below).

FIGURE 8-5: STRAINING CRUSHED COMB

Crush and Strain Method

1. Cut the comb from the frame; or cut and scrape the honeycomb from plastic, pre-formed foundation. Place the comb into a strainer.
2. Cut, crush or squeeze the honeycomb until every cell is opened, to allow the honey to drain out. A potato masher works well for this.
3. Let the mash strain into a catch container overnight.
4. Once the straining takes place and the left-behind comb is relatively dry - time and gravity are your friends here - you're ready to bottle the strained honey.

Mechanical Extraction

The easiest way to extract honey (if you have the right equipment), is to take nice full frames of honey, cut off their cappings with an uncapping knife (a special hot knife), and load them into an extractor that uses centrifugal force to spin the honey out.

Uncapping

Once in the harvest space (that has been set-up prior to your getting the frames), prepare to uncap the frames. Try and keep the frames warm as you go; warm honey flows more easily.

- Uncapping means removing the wax covering from cells filled with honey so that the honey can flow out of the cell.
- Uncapping should be done over a bin or container which will catch the wax caps and any residual honey (you will recover an amazing amount of honeys).
- You can uncap using:
    - a hot knife: an electrical knife that warms and easily slices through the wax. Use a slight sawing motion as you move the knife.
    - a scraper to simply scrape and uncap.
    - a plain knife that you can dip into hot water to do the same as above.

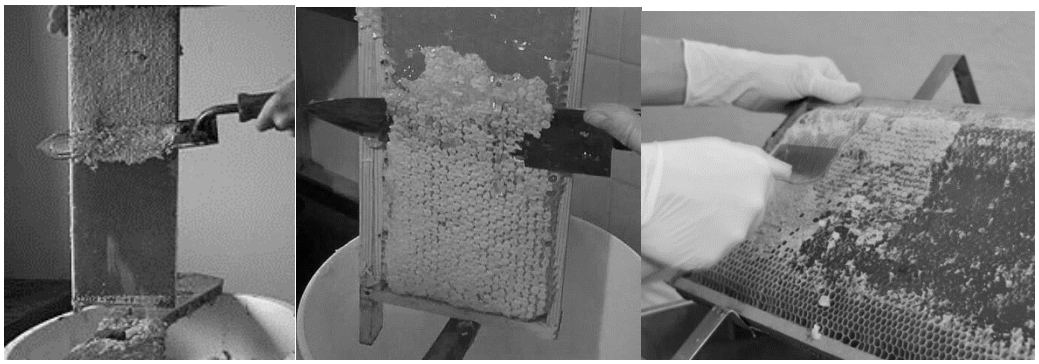


FIGURE 8-6: METHODS OF UNCAPPING COMB

Extracting

Extractors are basically large centrifuges. Extractors come in small and large sizes, depending on your operation and needs. They can be manually operated or motorized.

Extractors are fairly simple to use. While there are variations, the basic components consist of a drum/cylinder that is fitted with a framework into which you insert uncapped frames of honeycomb. Extractors are either radial or tangential. Radial extractors accept the frame and expose both sides of the uncapped honey to the centrifugal forces. On the other hand, tangential extractors take longer to finish extracting. Tangential extractors only expose one side of the frame at a time. The extractor must be stopped, and the frames turned to extract all the honey.

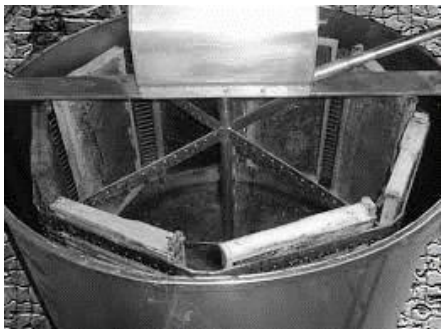


FIGURE 8-7: TANGENTIAL EXTRACTOR

Once your uncapped frames are inserted into the spinner inside the drum, you harness centrifugal force by means of turning a crank or flipping the "on" switch of an electric model. Out flies the honey (it's a beautiful thing), hitting the sides of the drum, and draining down to pool in the bottom.

Most commercially available extractors also have a spigot (honey gate) near the bottom that you open to drain the honey. Honey flows through the spigot, and into a strainer that has been placed over a catch bucket to catch bits of wax, wood, and bee bits. Catch buckets are food-grade buckets (5-gallon buckets work well). They are often fitted with a honey gate used during bottling.

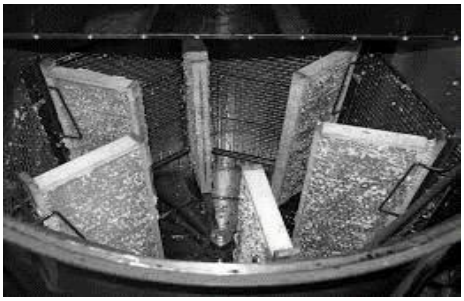


FIGURE 8-8: RADIAL EXTRACTOR

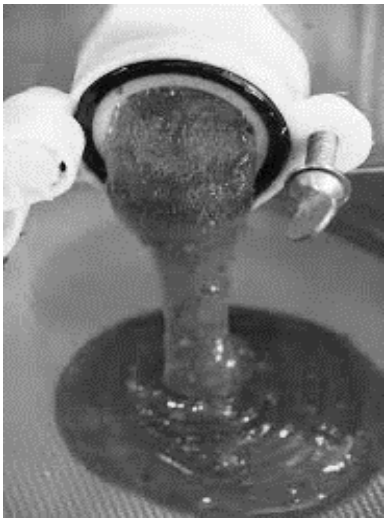


FIGURE 8-9: HONEY GATE

After the honey is extracted and bubbles have risen, you can place a piece of plastic wrap on top of the honey in the catch bucket. The plastic wrap adheres to the honey foam and makes it easier to remove if desired. Place a tight sealing lid on the bucket to keep out any additional moisture.

You can also strain the honey from the uncapping bin into 5-gallon buckets for bottling. It helps to wait several hours or overnight for the honey to drain from the cappings wax.

FIGURE 8-10: HONEY STRAINER

AFTER-EXTRACTION CLEAN-UP

After you have harvested all the honey from your frames, they may be placed back on the hives for the bees to clean.

When finished with extracting, you can set all used equipment (other than the extractor) on or by your hives so your bees can collect the honey that remains on the frames. In this manner, the frames will be cleaner in storage, and the bees will be able to make good use of their honey. Leave the frames with the bees for about a day, then store the equipment for later use (or replace some supers on the hives if summer is not over yet).

A disadvantage of setting the equipment in the bee yard for cleaning by your bees, is that it encourages robbing by wasps and other bees. For this reason, especially in late summer, it can be best to place the equipment directly on top of your hives.

After extracting, the extractor will have quite a bit of residual honey adhering to its sidewalls and floor. To clean:

1. Close the honey gate securely.
2. Tip the extractor up at a steep angle so the honey runs towards the gate.
3. Turn the heat up in the extraction room and leave it until the honey drains to the bottom.
4. Collect the honey that has gathered at the honey gate.
5. When the extractor will not be used again soon; you can also wipe and spray it with hot and cold water, as appropriate, to clean off residual wax and honey.

BOTTLING HONEY

Bottle your honey in a household room-temperature environment. The honey flows well when it is warm; but becomes stubborn and viscous when it cools.

Use clean jars with new lids.

Make sure you label the jars per Washington State code. As you prepare your labels, remember that honey weighs more than water. Honey is sold by weight, not fluid ounces Convert fluid ounces (volume), to net weight. For example, a pint canning jar holds 16 fluid ounces, but 23 to 24 ounces of honey, by weight. For pint jars, the label would read NET WT 23 OZ (652 g).

FIGURE 8-11: BOTTLED HONEY

Honey labels should also include the nectar source: such as Clover, Blueberry, or Fireweed Honey for varietals; or Wildflower Honey for non-varietal.

Refer to the Revised Code Washington (RCW) for the most up-to-date labeling information.

RCW 69.28.050 Containers to be labeled.

It shall be unlawful to deliver for shipment, ship, transport, sell, expose or offer for sale any containers or subcontainers of honey within this state unless they shall be conspicuously marked with the name and address of the producer or distributor, the net weight of the honey, the grade of the honey, and, if imported from any foreign country, the name of the country or territory from which the said honey was imported, or if a blend of honey, any part of which is foreign honey, the container must be labeled with the name of the country or territory where such honey was produced and the proportion of each foreign honey used in the blend.
[1939 c 199 § 32; RRS § 6163-32.]

QUICK REVIEW – CHAPTER 8

KEY POINTS

1. Understand honey bee behavior. Take steps to alleviate conditions that lead to swarming and colony collapse, such as over-crowding, disease, and queen failure.
2. Test and treat for *Varroa* mites to control disease.
3. Complete honey extraction at the right time. Leave enough honey for the bees to make it through winter.

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Chapter 9: **FALL**

You've extracted honey from the supers, entered it at the fair and done well. Now comes that strange weather period - not warm enough to be summer, hardly cold enough for winter. Flowers aren't blooming, so there's no nectar; but it's not cold enough for the bees to consider clustering.

Fall is not the time to rest. Winter is coming. You've worked through the spring and summer to keep your bees safe and healthy, and now is the time to tuck them in for the cold (and wet).

FIGURE 9-1: FALL FOLIAGE

HIVES IN FALL

Fall is time to enter the honey competition at the fair; and it's time to feed, medicate, and shelter your bees.

FAIR TIME

It's a great experience to enter your honey to be judged at the local county fair and state fair. Fairs provide the opportunity to compare your honey to others, and to improve your marketing and bottling skills. Originally, state fair competition rules helped local farmers market their honey by ensuring that the honey was bottled hygienically; and looked good enough to sell. Most fairs have additional competition for honey products (wax, comb, etc.), baking with honey, educational exhibits, body lotions and soaps, meads, and apiary gadgets.

Check out rules and dates for county and state fairs early. Understand the application deadlines, drop-off and pick-up schedules, and entry requirements. Some competitions require multiple entries and specific types of bottles. Every beekeeper should enter their extracted honey at least once in their lifetime. Figure 9-3 provides criteria used for judging extracted honey.

FIGURE 9-2: HARVESTED HONEY AT THE FAIR

Event	Extracted Honey
Show	
Entry No.	
Class	
Lot	

Sample:
Extracted Honey
Judges Score Card

POINTS	SCORE	ITEM	JUDGE'S REMARKS
20		Degree of density. All entries above 18.6% disqualified.	
10		Freedom from Crystals	
10		Absence of bubbles or foam	
20		Cleanliness (free of pollen granules, wax particles, dirt, bee parts, lint, etc.)	
10		Container's cleanliness and neatness	
10		Uniformity of entry and accuracy of filling	
20		Flavor & Aroma, downgraded for burnt or objectionable tastes	
100		Judging Team:	Award:

FIGURE 9-3: SAMPLE HONEY SHOW JUDGES SCORECARD

FEED

This is a time for vigilance. With the supers off, the weather mild, and bees still active, they will inevitably start consuming their winter stores. Unless you feed them, they could starve by Christmas. On the east side of Washington, hives need to enter winter with honey stores of 80 pounds for Carniolans, to 100 pounds for Italians. On the west side of the state, due to shorter winters, the guidelines are reduced to 60 pounds and 80 pounds for Carnis and Italians, respectively.

Feeding sugar syrup is great for the “morale” of the colony if there is a dearth of natural nectar. It also stimulates hygienic behavior, and thus helps with mite and disease problems. Generally, the sugar syrup used for fall feeding is a 2:1 sugar: water mixture. At this higher sugar concentration, it helps to heat the water so the sugar will mix in and dissolve more easily. Allow the mixture to cool if necessary, before feeding the bees.

PEST PREVENTION

Entrance reducers and mouse guards should go on in the latter half of summer - right when populations are beginning to decline and honey stores are growing. Smaller entrances will keep out yellow jackets and thieving neighbors in the fall, and mice looking for a warm place to live in the winter.

Mice will kill your hive if they nest over the winter in your hive. Take care of a potential mouse problem prior to winter. Take a flashlight when it's dark, remove your entrance reducer or mouse guard and make sure you cannot see a mouse nest on your bottom board. If you see a pile of grass in a corner, there is a mouse in your hive. If there is, find a friend to help you lift off the hive from the bottom board. If you are lucky, the mice will stay in their nest on the exposed bottom board and you can get rid of them and put the hive back down on the bottom board and reduce the entrance.

MAKE SURE HIVES ARE WATERTIGHT

If you're using screened bottom boards, be sure to close them up or swap them out for solid boards. If your equipment is old and falling to pieces, you might find corners missing and large cracks. Duct tape or metal tape can seal the gaps until you can replace your equipment in the spring. Broken bottom boards can allow mice to get in, so keep an eye out for drafty cracks.

MEDICATE

With the supers off, it is time to medicate for *Varroa* mites. You may be thinking, "I already medicated in the spring .... why now?" *Varroa* mite populations ebb and flow. The bee population ebbs and flows, too, but on slightly different schedules. To effectively and efficiently treat *Varroa* mites, you should understand the cycles of these dynamic populations.

In winter, both bee and *Varroa* mite populations are small. Bees are clustered, and the mites, without any brood to breed on, remain on the bees (phoretic stage), or are almost non-existent. Spring arrives and the bee population surges, peaking in June. Simultaneously, but more slowly, the mites breed in the brood. Mite populations peak in late summer/ early fall. The bee population contracts as the queen slows her laying; and the drones are 'asked' to leave the hive. Vulnerable in their reduced numbers, the bees are tired, there could be a dearth, there could be harassing hornets and wasps. These stressors leave bees susceptible to the viruses carried by mites.

Beekeepers should treat at least twice each year: once in the spring (March-May), just prior to the first big nectar flow (June), and once in the fall (August, September), right after the supers are harvested, when mite populations are at their peak. While many *Varroa* mite treatments fail to penetrate brood cells to kill the mites, fall treatments are more effective because there is less sealed brood to shelter the mites.

Mite Treatments

The most effective treatment depends on the season and the *Varroa* mite life cycle. Keep in mind, it is recommended that you should use a different treatment in the fall than that used in the spring. This ensures maximum treatment effectiveness.

Prepping for Winter and Planning for Spring

Fall maintenance and care helps prepare the bees for a hard winter and sets them up for a successful start in the spring.

- Address any moisture problems now, do not wait for winter. For example, moisture boards, quilts with cedar or other absorbent materials can be used to remedy problem areas.
- Remove any partially filled supers and remove the queen excluder if used.
- Combine weak hives.
- You may want to replace old queens with new, ensuring a vigorous queen for the spring.
- Provide both top and bottom entrances.
- Consider additional protection from winds and rains (wind breaks, wraps).
- Clean the apiary, do not leave a foothold for vermin.
- Place your mouse guards.
- If you are using solid bottom boards, tip them slightly to the front to allow moisture to run out.

Quick Review Chapter 9

Key Points

1. State and county fair honey show guidelines/rules were developed for farmers to learn to market their honey to the public.
2. Fall feeding is sugar syrup, 2:1 sugar to water.
3. Rotate your *Varroa* mite treatments from the one season to another.
4. Attach mouse entrance guards, if needed.
5. Do not try to winter a weak hive; either combine it with a strong one, or let it go.

References

"A Guide to Effective *Varroa* Sampling & Control", *The Honey Bee Health Coalition Tools for* Varroa *Management* (2015) <https://honeybeehealthcoalition.org/*Varroa*/> accessed June 25, 2019 – has been updated in 2018.

Roger A. and Mary Lou Morse, *Honey Shows: Guidelines for exhibitors, superintendents and judges*. (Kalamazoo, Michigan: Wicwas Press, 2015).

Roger A. Morse was a professor of apiculture at Cornell and a beekeeper for over 50 years. He researched and consulted in more than 60 countries. Author of other books and scientific articles, Morse died in 2000.

Chapter 10: **WINTER**

CLUSTERS

In winter, bees gather in a cluster, with the queen and any brood in the middle. Heat is produced by the bees flexing their wing muscles, keeping the cluster core at an average 72°F when there is no brood, to 94°F when brood is present. When the outside temperatures are moderate, the cluster is loosely formed; if temperatures plummet, the cluster tightens closer together. Bees continually move from the outside of the cluster to the inside.

As winter progresses, the cluster moves upward in the hive, maintaining contact with stored honey. Figure 10-1 shows an infrared picture of a clustered colony, distinguished by its glow, indicating heat.

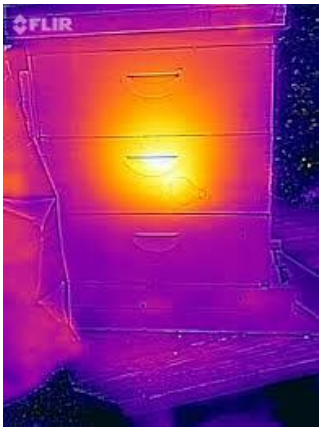

FIGURE 10-1: CLUSTER HEAT SHOWN BY FLIR

WINTER CARE

All you can do is keep a watchful eye at a distance; and try to help your bees if you see a problem while it is cold. Bees have been around for a long time, so though winter is a difficult time for them, they've clearly toughed it out before. Not to mention, winter bees are completely different from the bees you see during the spring.

FEEDING

The first step in winter feeding is taking care in late summer and fall to feed the colony, if necessary, to ensure they have adequate stores. Bees do not get out of the hive much during the winter. There isn't any food for them anyway. Ideally, if the temperature stays around 30-40°F, bees consume the least amount of food. The colder it gets, the more food they consume to generate heat.

You should not lift frames out of the hive when temperatures are below 60°F degrees. If you do, you can damage developing brood. You can lift the top off briefly, though, to take a 30-second peek at food supplies. Keep food on top of the winter cluster all winter long. This does not guarantee that your bees will make it, but at least they will not die from starvation.

Winter feeding may consist of candy boards or sugar/fondant placed on the top bars of the topmost hive. (Bees cannot take liquid feed when the temperatures are less than 55°F.) The candy boards and sugar/fondant may have already been placed earlier in winter; but may require a re-fill. Once you start feeding, do not stop, you are the bees' only source of food. If the weather remains cold, you may check on your bees by rapping on the side of the hive and listening for a buzz.

A stethoscope may be a handy tool to hear the bees, as well. Bees fail to live through winter if:

- they enter the season weak or with too few to make an adequate cluster,
- they starve due to lack of stores,
- they are weakened by *Varroa*, hornet attacks, less-than-robust queen, etc., or
- they get wet due to hive moisture problems.

Address these issues in the fall before they develop. Winter is often too late to take any meaningful action. Ensure that any honey left in the hive is fully ripened or the bees may exhibit signs of Nosema on their cleansing flights, or worse, defecate in the hive.

STABILITY

Make sure your hive is stable on its stand throughout the winter. As the ground freezes and thaws, your stand or blocks can shift; and your hive may topple over. Also, if you broke the propolis seal on your top cover, a harsh winter storm could blow the top off. Regularly check your hive for any shifting and keep it stable all winter. Keep a rock or weight on top to help stabilize the hive.

WIND BREAK

If your hives are in a particularly windy location, a wind buffer will go a long way for temperature regulation and preventing the hives from being knocked over. With a wind break, the fierce winter winds hitting the hive are reduced. Place your wind break a few feet back from the hives to maximize weather protection. You may have a natural wind break such as a grove of trees.

Stacked hay bales make an excellent temporary wall; but do not place them right next to the hives. They hold water; and result in too much moisture around the hives.

WINTER COVER

We live in an area where we get lots of snow and constant cold temperatures. In eastern Washington, it might be wise to invest in a hive cover; or wrap the hive in black plastic. Covers are simply slid onto your hives. Black plastic is cut to fit; and stapled in place. Either option helps keep your hives drier and a little warmer. Be sure covers are secured so they stay in place and do not block entrances. Covers should be installed in late October or November.

Keep a rock, cinder block, or other weight on top to help stabilize the hive and keep the wind from blowing the covers off.

KEEP IT CLEAR – GOOD VENTILATION

Good ventilation is key to hive survival. In most areas of central and eastern Washington, bee hives need to have a top entrance. Remember: bees seldom die due to low temperatures; they die due to moisture in the hives caused by poor ventilation.

The front entrance of your hive may become blocked by dead bees. The entrance and bottom board should be cleared out periodically to provide proper ventilation and allow bees to exit for cleansing flights when weather permits.

WINTER CHORES

Winter means cleaning and sharpening your hive tools (yes, they should be sharpened) and conducting maintenance on any equipment.

Winter is also the perfect time for planning next year's goals and for reading research. Every book, new or old, can provide a least one piece of beekeeping lore or skill that will enhance your beekeeping knowledge.

QUICK REVIEW CHAPTER 10

KEY POINTS

1. Moisture is more dangerous to bees than cold.
2. During temperate winters, check-on and feed the bees if necessary. The mild temperatures will keep. them active; and eating their winter stores fast.
3. The temperature inside a bee cluster ranges from 72° - 94°F.
4. Clear front entrances periodically.
5. Do not try to winter a weak hive; either combine it with a strong one, or let it go.
6. In most areas of Washington State, a top entrance is vital to hive survival.

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Chapter 11: SAVING THE BEES - RESOURCES

WHAT TO DO

INDIVIDUALS

1. Plant for bees.
2. Do not use pesticides. Minimize herbicide use, especially when flowers are in bloom. (Dandelion flowers are good for the bees.)
3. Educate you family and neighbors about the importance of bees.
4. Take a beekeeping class.

BEEKEEPING CLUBS

1. Educate the public about bees, honey, pesticides, and forage.
2. Get involved with queen breeding programs.
3. Plant for bees.
4. Support community efforts that support forage and habitat for bees and other pollinators.
5. Help new beekeepers get started and involved.
6. Speak to schools and 4-H groups.

BEEKEEPING RESOURCES

STATE BEEKEEPING ASSOCIATIONS

Washington, Oregon, Idaho, Montana

COUNTY LEVEL BEEKEEPING ASSOCIATIONS

Pierce, King, Thurston, Lewis, Benton, Chelan, Yakima, Spokane

COLLEGE/UNIVERSITY EXTENSION PROGRAMS

Washington State University
http://bees.wsu.edu/

Oregon State University
https://agsci.oregonstate.edu/residential-beekeeping-oregon/resources-beekeepers

UNIVERSITIES WITH LARGE HONEY BEE RESEARCH PROGRAMS:

Washington State University
Cornell
Oregon State University
University of California, Davis
University of Minnesota

NATIONAL ORGANIZATIONS:

USDA Agricultural Research Service (ARS) Bee Research Labs (BRL)

https://www.ars.usda.gov/research/programs/

Pollinator Partnership Honey Bee Health Improvement Project supports the United States, Canada, and Mexico's attempts to assuage the depletion of honeybees in the Western Hemisphere.

The Center for Honeybee Research in Asheville, North Carolina conducts research looking at the effects of pests on modern agriculture and promotes educational opportunities on the importance of bees in the environment.

Friends of Honeybees promotes local consumer action to support bee-friendly agricultural practices. Through their Buzz for Bees campaign, Friends of Honeybees advocate for financially supporting, locally sourced, and positively farmed products that will aid beekeepers practicing sustainable techniques.

Save the Bees campaign started a petition to protect bees and ban the use of bee killing pesticides. The campaign's goal is one million actions for bees-supporters can sign the petition, order seeds and beehive instructions; or sign up to volunteer.

Save the Honeybee Foundation works to promote sustainable farming practices and educational opportunities for beekeepers and citizens in Oregon and the Pacific Northwest.

The Honeybee Conservancy https://thehoneybeeconservancy.org/

American Beekeeping Federation

- Promoting the use of honey through a very active honey queen program, which includes selecting a honey queen annually and sending her on promotional tours throughout the country.
- Publishing an informative newsletter every 2 months.
- Sponsoring a national honey show each year.
- Holding an annual convention to transact business and to present an educational and informative program featuring topics of interest and importance to beekeepers.
- Representing all parts of the bee industry in Congress.
- Recent efforts have been made to obtain import controls, price support, and a continuation of the indemnification program.

American Honey Producers Association

- A well-funded bee research program.
- A smooth-working program of indemnity for losses caused by pesticides.
- A well-funded honey research program.
- Honey price support and loans.
- A commemorative stamp.
- Protection from imports.

American Bee Breeders Association

This national association of queen and package bee producers was founded in 1948.

Western Apicultural Society

It is designed to serve hobbyist and sideline beekeepers and is patterned after the Eastern Apiculture Society.

Bee Industries Association

The BIA is a national organization of bee supply and equipment manufacturers.

Honey Industry Council of America (HICA)

Of the nine council members, four are elected by the American Beekeeping Federation, two each by the National Packers and Dealers Association and the Bee Industries Association, and one by the American Bee Breeders Association.

National Honey Packers and Dealers Association

The association holds a short annual meeting during the American Beekeeping Federation Convention.

INTERNATIONAL ASSOCIATIONS

Apimondia

International federation of beekeepers' associations consists of more than 50 national associations from most of the major countries of the world. Included are such diverse nations as the United States, Russia, Israel, Egypt, and Zambia.

International Bee Research Association (IBRA)

This research association collects and abstracts all available scientific literature on apiculture throughout the world. IBRA publishes Bee World, a quarterly journal for beekeepers; Apicultural Abstracts, a compilation of scientific literature abstracts; and the Journal of Apicultural Research, an outlet for original bee research papers. The association also publishes books and pamphlets about bee culture.

ADDITIONAL ONLINE RESOURCES

http://eor-cpwebvarnish.newscyclecloud.com/Research/20160922/researchers-travel-world-to-breed-a-better-honeybee

https://www.npr.org/sections/thesalt/2015/10/09/446928755/could-a-mushroom-save-the-honeybee

Chapter 12: **BEE FORAGE**

The forage sources for honey bees are an important consideration for beekeepers. For bees, their forage consists of nectar and pollen from blooming plants within flight range. Nectar contains sugars that are the primary source of energy for the bees' wing muscles and for heat for honey bee colonies for winter. Pollen provides the protein and trace minerals that are mostly fed to the brood in order to replace bees lost in the normal course of life cycle and colony activity. The main nectar source and main pollen source differ widely with the latitude, region, season and type of vegetation.

As a rule of thumb, the foraging area around a beehive extends for two miles (3.2 km), although bees have been observed foraging twice and three times this distance from the hive. The minimum temperature for active honeybee foraging is approximately 55 °F (13 °C). Full foraging activity is not achieved until the temperature rises to 66 °F (19 °C). There are small differences in the races of the Western honey bees at what temperature they will start foraging.

STATE OF WASHINGTON REGIONAL GUIDE

Our state has mixed designations depending upon your physical location. Washington can be: Intermountain Semi-desert – Mountain, Northern Rocky Mountain Forest – Steppe, Okanogan Range or Highlands, Pacific Lowland Mixed Forest, etc.

Not sure about which bioregion you live or work in? Go to https://pollinator.org/guides and click on **Find Your Ecoregion Locator** for help.

WSU MASTER GARDENERS

The purpose of the WSU Extension Master Gardener Program is to train volunteers to be effective community educators in horticulture and environmental stewardship by providing science-based information generated from research at WSU and at other university systems.

They do this through staffing plant problem clinics, maintaining demonstration gardens, providing educational and community outreach through teaching and mentoring adults and youth in a variety of settings and platforms, and by continuing their own education.

Find your local Master Gardeners at http://mastergardener.wsu.edu/program/county/ for information on planting and caring for pollinator plants which will grow well in your location.

XERCES SOCIETY

The Xerces Society is a science-based conservation organization, working with diverse partners including scientists, land managers, educators, policymakers, farmers, and citizens. By using applied research, engaging in advocacy, providing educational resources, and addressing policy implications, the society endeavors to make meaningful long-term conservation a reality.

Xerces website, https://xerces.org/mission/, contains information on planting for pollinators.

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GLOSSARY

A

Abscond — The action of bees leaving the hive suddenly with few or no remainders. This should not be confused with swarming; it is often due to problems such as poor ventilation, high temperatures, mite problems, pests or other intolerable problems.

Acarine — A label for infestation of bees by tracheal mites.

Acarapis woodii — A mite, called the tracheal mite, which infests the honey bee's breathing or tracheal system; sometimes called Acarine disease, this refers to bees that are heavily infested with the tracheal mite.

Adulterated honey — Any product labeled "Honey" or "Pure Honey" that contains ingredients other than honey, that are not listed on the label.

Alarm pheromone — A chemical (iso-pentyl acetate) substance released near the worker bee's sting, which alerts other bees to danger; has a slight banana scent.

American foulbrood (AFB) — A brood disease of honey bees caused by the spore-forming bacterium, Bacillus larvae, and characterized by a ropy or gummy condition of affected larvae. It is the most widespread and destructive of the brood diseases; afflicting queen, drone, and worker larvae alike. It is highly contagious and has a long life span.

Anaphylactic shock — Constriction of the muscles surrounding the bronchial tubes of a human, caused by hypersensitivity to venom and resulting in sudden death unless immediate medical attention is received.

Antenna — One of two long-segmented sensory filaments located on the head of the bee, which enable bees to smell and taste.

Anther — From the Greek anthros (flower), referring to the·pollen-bearing portion on top of the stamen or male part of a flower.

Apiary — The area or location where bees and hives are kept, sometimes referred to as a beeyard.

Apiculture — The science, study and art of keeping bees.

Apiphobia — The acute fear of bees or anything related to bees.

Apis mellifera — The scientific name of the European bee that is kept for its honey and wax in most parts of the world has developed into several races differing in size, color, disposition, and productivity. Subspecies include: *apis mellifera ligustica* (Italian), *a. m. caucasia* (Caucasian), *a. m. carnica* (Carniolan), *a. m. intermissa* (African), and others.

Apistan A miticide used to control *Varroa* mites.

Apitherapy A division of therapy that uses bees and bee products for therapeutic and medical purposes.

B

Bacillus larvae The bacterium that causes American foulbrood (AFB).

Bearding Bees accumulating at the front of the hive, in a beard-like shape. Bees do this to make room inside the hive for added ventilation on a hot and humid day.

Bee bread A mixture of pollen and honey which have been collected by honey bees and stored within a cell of the comb. This is a high protein feed for both developing larva and bees.

Bee glue See Propolis.

Bee escape A device constructed to permit bees to pass one way, but prevent their return; used to clear bees from supers, or for other uses.

Bee Go Benzaldehyde: A colorless nontoxic liquid aldehyde C6H5CHO that has an odor like that of bitter almond oil, which occurs in many essential oils; usually made from toluene; used to drive bees out of honey supers.

Bee space 3/8 inch (9.5mm). The critical space large enough to accommodate a bee, but small enough to prevent bees from filling it with propolis or burr comb. The bee space is commonly thought of as a void greater than 1/4 inch and smaller than 3/8 inch. The bee space may vary depending on the size of the specific bee or race.

Beehive A container used by a beekeeper for the purpose of keeping a colony of bees. It is commonly a form of box or crate, but may be a skep, hollowed log, clay pot, etc. Typically but not necessarily, the combs are removable (frames, top bars) to assist management. Unmanaged bees live in a nest.

Beekeeper A person who keeps bees.

Beeswax	A substance that is secreted by bees by special glands on the underside of the abdomen, deposited as thin scales, and used after mastication and mixture with the secretion of the salivary glands for constructing the honeycomb. After the bee forms it into comb, beeswax is glossy and hard but plastic when warm, insoluble in water but partly soluble in boiling alcohol and in ether, and miscible with oils and fats. Beeswax is a mixture consisting of the palmitate of myricyl alcohol and other higher esters, free cerotic acid, and hydrocarbons. Its melting point is from 143.6- to 147.2 degrees F. This is the primary building material used by bees, and the main structure of comb.
Boardman feeder	A wooden or plastic device that fits into the entrance of a bee hive and holds a canning jar that can be filled with syrup or water.
Bottom board	The floor of a beehive that all the other components sit on.
Bottom supering	The act of placing honey supers under all the existing supers, directly on top of the brood box. The theory is the bees will work it better when it's directly above the brood chamber; as opposed to *top* supering, which would be simply putting the honey supers on top of the existing supers.
Brace comb	The sections of seemingly random comb that connect hive parts together. Brace comb is a form of burr comb.
Brood	A general term to refer to immature bees that not yet emerged from their cells. Brood can be in the form of eggs, larvae, or pupae of different ages.
Brood chamber	Section of the hive where brood is being raised and where the queen would normally be laying eggs. May include one or more hive bodies and the combs within.
Brood nest	See Brood chamber.
Brood food	A highly nutritious glandular secretion from the worker bee that is used to feed both brood and the queen.
Build up	The natural seasonal increase of bee population within a colony that coincides with the start of the main nectar flow.
Burr comb	Any section of comb that is not a part of the main comb piece within the frame or hanging from the top bar.

C

Capped brood — Immature bees whose cells have been sealed over with a wax cover by other worker bees. Inside, the non-feeding larvae are isolated, and spin cocoons prior to pupating.

Capping — 1. A thin layer of wax that covers cells containing honey.
2. The thin air permeable layer of wax that covers the cell of bee brood.

Caste — A name for the existence of different classifications of bees of a specific family. Includes queen, drone and worker.

Carniolan bees — A darkish race of honey bee *Apis mellifera camica* named for Camiola, Austria but originating in the Balkan region. They are gentle, do not propolize (too much), and are winter hardy.

Caucasian bees — A dark race of honey bee *Apis mellifera caucasia*, originating in the Caucasus mountains; gentle but tend to propolize excessively.

Cell — A single hexagonal prismatic chamber that makes up comb. Cells are used to store honey, pollen, nectar and developing brood.

Cell cup — See Queen cup.

Chalk brood — A disease affecting bee larvae, caused by a fungus *Ascosphaera apis.* Larvae eventually tum into hard, chalky white "mummies".

Chemicals — Chemicals used in and around honeybees can be divided into two categories; Hard Chemicals and Soft Chemicals. Hard Chemicals are those that will leave residuals in the hives absorbed into the bee's wax. These residuals are transferred to the pollen, honey, eggs, larvae, and adult bees. These residuals remain in the hive until the contaminated wax is removed. Soft Chemicals are those that leave no residuals in a hive.

Chilled brood — Bee larvae and pupae that have died from exposure to cold. This typically occurs in spring when the colony is expanding rapidly and on cold nights there aren't enough bees to keep the brood warm.

Chimney effect — The tendency for bees to fill only the center frames of honey supers; sometimes happens when bees are given too much room too fast.

Chronic paralysis virus aka CPV — Symptoms: bees trembling, unable to fly, hair loss, with distended abdomens. One variety called the hairless black syndrome, is recognized by hairless, black shiny bees crawling at the hive entrance.

Chunk honey	Honey in the comb, but not in sections, frequently cut and packed into jars then filled with liquid honey.
Clarifying	Removing visible foreign material from honey or wax to increase its purity.
Cleansing flight	The flight made by a bee to cleanse its digestive tract after a long period of confinement.
Clipping	The practice of taking part of one or both wings off of a queen both for discouraging or slowing swarming and for identification of the queen.
Cloak board	A device to divide a colony into a queenless cell starter and reunite it as a queen right cell finisher without having to open the hive.
Cluster	1. A mass of bees, often referring to a swarm or collection. 2. The huddling action taken by the bees within a colony during cold weather.
Cocoon	A thin silk covering secreted by larval honey bees in their cells in preparation for pupation.
Colony	The aggregate of worker bees, drones, queen, and developing brood living together as a family unit in a hive or other dwelling.
Colony collapse disorder	Also known as CCD. A recently named problem where most of the bees in most of the hives in an apiary disappear leaving a queen, brood and only a few bees in the hive with plenty of stores.
Comb	A double-sided configuration of hexagonal cells made of beeswax, in which eggs are laid, and honey and pollen are stored.
Comb, drawn	Wax foundation with the cell walls drawn out by the bees, completing the comb.
Comb foundation	A commercially made structure consisting of thin sheets of beeswax with the cell bases of worker cells embossed on both sides in the same manner as they are produced naturally by honey bees.
Comb honey	Honey in the wax combs, usually produced and sold as a separate unit, such as within a wood-framed section 4-1/2" square, or a plastic round ring.
Creamed honey	Honey that has undergone controlled granulation to produce a finely textured candied or crystallized honey which spreads easily at room temperature. The honey may have been pasteurized. This usually involves adding fine "seed" crystals and keeping at 57° F (14°C) for two weeks. Then, the honey can be stored at room-temperature.

Crush and strain Simple technique to extract honey, in which combs are gathered in a straining device (kitchen strainer, bucket with holes in the bottom, etc.) which allows honey to drain into a container below.

Cut-comb honey Comb honey cut into various sizes, the edges drained, and the pieces wrapped or packed individually.

D

Dearth A period of time when there is no available forage for bees, due to weather conditions (rain, drought) or time of year.

Deep Bee box typically 9 5/8" high. Typically used as bottom, brood boxes; but can also be used to hold honey frames.

Deformed wing virus A virus spread by the *Varroa* mite that causes crumpled, deformed-looking wings on fuzzy newly emerged bees.

Dextrose Also known as glucose (grape sugar), it is a simple sugar (or monosaccharide) and is one of the two main sugars (three trace) found in honey; forms most of the solid phase in granulated honey.

Diastase A starch-digesting enzyme in honey adversely affected by heat; measured in some countries to test quality and heating history of stored honey.

Disease resistance The ability-of an organism to avoid a particular disease; primarily due to genetic immunity or avoidance behavior.

Dividing Separating a colony, to form two or more units.

Division board feeder A wooden or plastic compartment which is hung in a hive like a frame and contains sugar syrup to feed bees.

Dorsal-ventral abdominal vibrations dance A bee dance used to recruit foragers. Also used on queen cells about to emerge, and possibly other times.

Double screen A wooden frame, 1/2 to 3/4 inch thick, with two layers of wire screen to separate two colonies within the same hive, one above the other. An entrance is cut on the upper side and faced to the rear of the hive for the upper colony.

Drawn comb Combs which contain completed cells.

Drifting The movement of bees that have lost their location and enter other hives; common when hives are placed in long, straight rows where returning foragers from the center hives tend to drift to the row ends.

Drone	The male honey bee which comes from an unfertilized egg (and is therefore haploid) laid by a queen or less commonly, a laying worker.
Drone brood or drone comb	Brood which matures into drones, reared in cells larger than worker brood.
Drone congregating area (DCA)	A specific area to which drones fly waiting for virgin queens to pass by. It is not known how or when they are formed, but drones return to the same spots year after year.
Drone layers	A drone laying queen or laying workers.
Drone laying queen	A queen that can lay only unfertilized eggs, due to age, improper or no mating, disease or injury.
Drone mother hive	A hive which is encouraged to raise a lot of drones to improve the drone genetics of mated queens. The selection is based on hive characteristics such as hygienic traits, low propolis use, high honey production and low swarming tendencies.
Dwindling	Any rapid decline in the population of the hive. The rapid dying off of old bees in the spring; sometimes called spring dwindling or disappearing disease.
Dysentery	An abnormal condition of adult bees characterized by severe diarrhea (as evidenced by brown or yellow streaks on the front of the hive or on top of the frames) and usually caused by long confinement (from either cold or beekeeper manipulation), starvation, low-quality food, or nosema infection.

E

Eggs	The first phase in the bee life cycle, usually laid by the queen (but sometimes by a laying worker), is the cylindrical egg 1/16in (1.6 mm) long. It is enclosed with a flexible shell or chorion. It resembles a small grain of rice.
Eight frame	Boxes that were made to take eight frames. Usually between 13 3/4" and 14" wide depending on the manufacturer.
Emergency queen cell	When the queen is removed for whatever reason, the hive will turn worker egg/larva into queen cells if there are larvae young enough to do so. This must be done within six days of the last laid fertilized egg (three days as egg plus first three days of newly hatched larva fed only royal jelly).
Entrance reducer	A device used to limit in and out traffic to a hive.

European foulbrood (EFB)	An infectious disease which only affects the brood of honey bees, and is caused by the bacteria *Streptococcus pluton.*
Extraction	Removal of honey from comb. Typically refers to use of an extractor, but also includes non-mechanical methods such as crush and strain.
Extractor	A centrifugal device in which frames can be drained of honey.

F

Feral bees	Term is used to describe honey bees that are not managed by a beekeeper.
Feral hive	Term used to describe a situated colony of feral bees not managed by a beekeeper, aka *nest*.
Fermentation	The process of yeast utilizing sugar as a food, and producing alcohol as a byproduct. Honey typically does not have enough moisture for fermentation to occur. Fermented honey is toxic to honey bees.
Fertile queen	A fertile queen is one that has mated with drones, and has a supply of spermatozoa in her spermatheca.
Fertilized	Usually refers to eggs laid by a queen bee. They are fertilized with sperm stored in the queen's spermatheca, in the process of being laid.
Field bees	Worker bees which are usually 21 or more days old and work outside to collect nectar, pollen, water, and propolis; also called foragers.
Forage	Natural food source of bees (nectar and pollen) from wild and cultivated flowers.
Foulbrood	Generic term to describe bacterial disease that effect only brood and no adult bees. See American foulbrood and European foulbrood.
Foundation	A thin sheet of wax or plastic that is embossed to be used as a guide for comb creation by the bees.
Frame	Four pieces of wood forming a rectangle, designed to hold honey comb, consisting of a top bar, two end bars, and a bottom bar (one or two pieces); usually spaced a bee-space (3/8") apart in the hive boxes.

	The segment of the hive that bees used to store pollen, nectar and honey.
Fructose	Fruit sugar, also called levulose (left-handed sugar), a monosaccharide commonly found in honey that is slow to granulate. Along with glucose, it is one of the two primary sugars which comprise honey.
Fumagillin	Bicyclohexyl-ammonium fumagillin, whose trade name is Fumadil-B (Abbot Labs), is a whitish soluble antibiotic powder discovered in 1952. It is mixed with sugar syrup and fed to bees to control Nosema disease.
Fume board	A rectangular frame, the size of a super, covered with an absorbent material such as burlap, on which is placed a chemical repellent to drive the bees out of supers for honey removal.

G

Glucose	Also known as dextrose, it is a simple sugar (or monosaccharide). Along with fructose, it is one of the two main sugars found in honey. Forms most of the solid phase in granulated honey.
Grafting	Removing a worker larva from its cell, and placing it in an artificial queen cup in order to have it reared into a queen.
Granulate	The process by which honey, a super-saturated solution (more solids than liquid) will become solid or crystallized; speed of granulation depends of the kinds of sugars in the honey, the crystal seeds (such as pollen or sugar crystals), and the temperature. Optimum temperature for granulation is 57° F (14° C).
Guard bee	Worker bees about three weeks old, which have their maximum amount of alarm pheromone and venom; they challenge all incoming bees and other intruders.
Guarding	The action of a bee which detects invaders and examines entering bees.

H

Hive	Home site for an individual colony of honey bees.
Hive body	A segment of the hive that creates a chamber for the building of comb and storage of collected resources. Usually referring to the boxes being used for brood.
Hive stand	A structure serving as a base support for a beehive; it helps in extending the life of the bottom board by keeping it off damp ground. Hive stands may be built from treated lumber, cedar, bricks, concrete blocks etc.

Hive tool A metal device used to open hives, pry frames apart, and scrape wax and propolis from the hive parts.

Honey A sweet, viscous material produced by bees from the nectar of flowers, composed largely of a mixture of sugars dissolved in about 17 percent water. It contains small amounts of mineral matter, vitamins, proteins, and enzymes.

Honey bound A condition where the brood nest of a hive is being backfilled with honey. This is a normal condition that is used by the workers to shut down the queen's brood production. It usually happens just before swarming and in the fall to prepare for winter.

Honey dew A sweet liquid excreted by aphids, leaf hoppers, and some scale insects that is collected by bees, especially in the absence of a good source of nectar. Can be toxic for bees and may cause diarrhea.

Honey flow A period of time when an abundance of nectar is available to be collected and converted into honey.

Honey house A building used for extracting honey and storing equipment.

Honey stomach A specially designed organ in the abdomen of the honey bee used for carrying nectar, honey, or water.

Honey supers Refers to boxes of frames used for excess honey production. From the Latin *supra* for "above" as a designation for any box above the brood nest.

Hopelessly queenless A hive that has gone queenless; and no longer contains any eggs/larvae young enough to use to make an emergency queen cell.

Hot (temperment) Bees that are overly defensive or outright aggressive.

I

Israeli acute paralysis virus (IAPV) The virus which has been blamed for CCD. First discovered in Israel where it was quite devastating to colonies.

Increase To add to the number of colonies, usually by dividing those on hand. See Split.

Infertile Incapable of producing a fertilized egg, as a laying worker or drone laying queen. Unfertilized eggs develop into drones.

Inner cover An insulating cover fitting on top of the top super but underneath the outer cover, with an oblong hole in the center.

Instramental insemination or AI or AII	The introduction of drone spermatozoa into the spermatheca of a virgin queen by means of special instruments.
Invertase	An enzyme in honey, which splits the sucrose molecule (a disaccharide) into its two components: dextrose and levulose (monosaccharides). This is produced by the bees and put into the nectar to convert it in the process of making honey.
Italian bees	A common race of bees, *Apis mellifera ligustica*, with brown and yellow bands, from Italy, usually gentle and productive, but tends to rob.

J

K

KTBH	A Kenya top bar hive. This type of hive has sloping sides.
Kashmir bee virus	A widespread disease of bees, spread more quickly by *Varroa* mites, found everywhere there are bees.

L

Langstroth	Modem hive management originated in the writings of L.L. Langstroth, minister (1810-95), who recognized the significance of bee space and box sizes of standardized dimensions. Efforts to improve on the original have led to size variations between and within countries, but the principles of bee space remain the same.
Langstroth hive	The basic hive design of L.L. Langstroth. In modem terms, any hive that takes frames that have a 19" top bar and fit into a box 19 7/8" long. Widths vary from five frame nucs to eight frame boxes to ten frame boxes and from Dadant deeps, Langstroth deeps, Mediums, Shallows and Extra Shallow; but all would still be Langstroths.
Larva	The second stage of development in the life cycle of the bee, starting the 4th day from when the egg is laid until it's capped on about the 9th or 10th day.
Laying worker	An unfertilized, non-queen female bee that is capable of laying drone eggs. This is often the result of a hive remaining queenless for a period of time.

Levulose Also called fructose (fruit sugar), a monosaccharide commonly found in honey that is slow to granulate.

M

Malnourished hive A colony of bees that is lacking the proper nutritional requirements to produce brood.

Mandibles The jaws of an insect; used by bees to form the honey comb and scrape pollen, in fighting, and picking up hive debris.

Marked queen A queen bee that has been marked with a spot of paint or had a disk adhered to her abdomen.

Mating flight The flight taken by a virgin queen while she mates in the air with several drones.

Mating Nuc A small nuc for the purpose of getting queens mated. Used in queen rearing. These vary from two frames of the standard size used by that beekeeper for brood, to the mini-mating nucs sold for that purpose with smaller than normal frames.

Medium A box that is 6 5/8" in depth, with frames are 6 1/4" in depth. AKA Illinois, Western or 3/4 depth.

Melissococcus pluton New name for the bacterium that causes European foulbrood. The old name was *Streptococcus pluton*.

Migratory cover An outer cover used without an inner cover, that does not telescope over the sides of the hive; used by commercial beekeepers who frequently move hives. This allows hives to be packed tightly against one another, because the cover does not protrude over the sides.

Miticide A chemical or biological agent which is applied to a colony to control parasitic mites.

Moisture content In honey, the percentage of water should be no more than 18.6 percent. Any percentage higher than that will allow honey to ferment.

Movable frame A frame constructed in such a way to preserve the bee space, so it can be easily removed. When in place, it remains unattached to its surroundings.

N

Nasonov A pheromone given off by a gland under the tip of the abdomen of workers that serves primarily as an orientation pheromone. It is

	essential to swarming behavior. Nasonoving is set off by disturbance of the colony.
Nectar	A liquid rich in sugars, manufactured by plants and secreted by nectary glands in or near flowers; the raw material for honey.
Nectar flow	The mass gathering of nectar from flowers by bees.
Newspaper method	A technique to gradually introduce two different colonies and form one hive, by providing a temporary newspaper barrier.
Nosema	An illness that affects the digestive tract in bees. A widespread adult bee disease caused by a one-celled spore-forming organism which infects the bee gut lining.
Nuc	See Nucleus hive.
Nucleus hive	A small colony of bees housed within a small hive box or container.
Nurse bees	Young, hive-bound bees, usually three to ten days old, which feed and take care of developing brood.

O

Observation hive	A hive made largely of glass or clear plastic to permit observation of bees at work.

P

Package bees	A quantity of adult bees (two to five pounds), with or without a queen, contained in a screened shipping cage.
Parasitic mite myndrome	Aka bee parasitic mite syndrome. A set of symptoms that are caused by a major infestation of *Varroa* mites. Symptoms include the presence of *Varroa* mites, the presence of various brood diseases with symptoms similar to that of foulbroods and sac brood but with no predominant pathogen, AFB-like symptoms, spotty brood pattern, increased superseding of queens, bees crawling on the ground, and a low adult bee population.
Paralysis	Aka acute paralysis virus (APV). A viral disease of adult bees which affects their ability to use legs or wings normally.
Pheromone	A chemical scent produced to establish a basic form of communication, or to stimulate a response.

Phoretic In the context of *Varroa* mites it refers to the state where they are on the adult bees, instead of in the cell - developing or reproducing on larvae.

Piping A series of sounds made by a queen, frequently before she emerges from her cell. When the queen is still in the cell it sounds sort of like a quack quack quack. When the queen has emerged it sounds more like zoot zoot zoot.

Pollen The dust-like male reproductive cells (gametophytes) of flowers, formed in the anthers, and important as a protein source for bees. Pollen is essential for bees to rear brood.

Pollen basket An anatomical structure on the bees' legs where pollen and propolis is carried.

Pollen substitute A food material which is used to substitute wholly for pollen in the bees' diet; usually contains all or part of soy flour, brewer's yeast, wheat, powdered sugar, or other ingredients. Research has shown that bees raised on substitute are shorter lived than bees raised on real pollen.

Proboscis The mouthparts of the bee that form the sucking tube or tongue.

Propolis Plant resins collected, mixed with enzymes from bee saliva and used to fill in small spaces inside the hive, and to coat and sterilize everything in the hive. It has antimicrobial properties. Often referred to as bee glue.

Pupa A brood bee in its final stage of metamorphosis.

Q

Queen The fertile female bee that, once mated, should be capable of producing male and female offspring. Recognized by other bees by her special pheromones (odors).

Queen cell A cell in which a queen is reared, having an inside diameter of about 1/3", hanging downward an inch or more in length.

Queen cup A cup-shaped cell hanging vertically from the comb, but containing no egg; also made artificially of wax or plastic to raise queens.

Queen excluder A device made of metal, wood, or plastic, having openings of 0.163 to 0.164 inch, which permits workers to pass but excludes queens and drones. Used to confine the queen to a specific part of the hive, usually the brood nest.

Queen right — A term used to describe a hive or colony of bees that has a producing queen.

Queen mandibular pheromone — Aka queen substance (QMP)
A pheromone produced by the queen and fed to her attendants who share it with the rest of the colony that gives the colony the sense of being queen right. Chemically QMP is very diverse with at least 17 major components and other minor ones. Newly emerged queens produce very little of this. By the sixth day they are producing enough to attract drones for mating. A laying queen makes twice that amount. QMP is responsible for inhibition of rearing replacement queens, attraction of drones for mating, stabilizing and organizing a swarm around the queen, attracting a retinue of attendants, stimulating foraging and brood rearing, and the general morale of the colony. Lack of it also seems to attract robber bees.

Queenless — Having no queen: A queenless hive will have no queen that can be found, little open brood and no unhatched eggs. A queenless hive must start queen cells within six days of the last egg laid by a killed or otherwise lost queen, or the hive will become hopelessly queenless.

R

Raw honey — Honey that has not been finely filtered or heated.

Requeen — To replace an existing queen by removing her and introducing a new queen.

Retinue — Worker bees that are attending the queen.

Reversing — The act of exchanging upper and lower hive boxes of the same colony, usually for the purpose of nest expansion. The box full of brood and the queen is placed below the emptier box, to allow the queen to move up into extra laying space above.

Robbing — Stealing of nectar or honey, by bees from other colonies. Happens more often during a nectar dearth.

Royal jelly — A highly nutritious, milky white secretion of the hypopharyngeal gland of nurse bees; produced by worker bees to feed to the youngest larva and to the queen throughout the larva stage and then throughout her mature life.

S

Sac brood — A brood disease of bees caused by a filterable virus which interferes with the molting process. The dead larva resembles a bag of fluid.

Screened bottom board	A bottom board with screen (usually #8 hardware cloth) for the bottom to allow ventilation and to allow *Varroa* mites to fall through.
Scout bee	Worker bees searching for a new source of pollen, nectar, propolis, water, or a new home for a swarm of bees.
Secondary swarm	A smaller swarm which may occur after the primary swarm has occurred.
Shallow	A box that is 5 11/16" or 5 3/4" deep with frames that are 5 1/2" deep.
Skep	A beehive without moveable combs, usually made of twisted straw in the form of a basket. Its use is illegal in all the states in the U.S as the combs cannot be inspected.
Slum gum	The refuse from melted combs and cappings after the wax has been rendered or removed; usually contains cocoons, pollen, bee bodies and dirt.
Small hive beetle (SHB)	A recently imported pest whose larvae will destroy comb and ferment honey.
Smoker	A device in which materials are slowly burned to produce smoke (not flames) which is used to subdue bees. It is important to use a material that produces a cool smoke so as not to harm the bees.
Solar wax melter	A glass-covered insulated box used to melt wax from combs and cappings using the heat of the sun.
Spermatheca	A small sac connected with the oviduct (vagina) of the queen bee in, which is stored the spermatozoa received in mating with drones.
Spiracles	Openings into the respiratory system on a bee that can be closed at will. These are on the sides of the bee. They are considerably smaller than the trachea they protect. The first thoracic spiracle is the one that is infiltrated 'by the tracheal mites as it is the largest. If you throw bees in water they will shut their spiracles completely to prevent drowning. When closed the spiracles are air tight.
Split	To divide a colony for the purpose of increasing the number of hives.
Stinger	An organ belonging exclusively to female insects developed from egg laying mechanisms, used to defend the colony; modified into a piercing shaft through which venom is injected. Honey bees have a barbed stinger which stays embedded in the recipient of a sting. After stinging, the bee will soon die.
Sucrose	Principal sugar found in nectar.
Sugar syrup	Feed for bees containing sucrose or table (cane or beet) sugar, and hot water in various ratios. Usually 1:1 in the spring and 2:1 in the fall.

Super Any hive body, or smaller box, used for the storage of surplus honey which the beekeeper will harvest. Normally it is placed over or above the brood chamber.

Supering The act and process of adding super boxes to the top of a hive, to allow collection of excess, harvestable honey.

Supercedure Rearing a new queen to replace the mother queen in the same hive. Shortly after the daughter queen begins to lay eggs, the mother queen often disappears.

Surplus honey Any extra honey removed by the beekeeper, over and above what the bees require for their own use, such as winter food stores.

Swarm A group of bees that leaves a mother colony to establish a new colony - a natural method of propagation of honey bee colonies.

Swarm Cells Queen cells usually found on the bottom of the combs before swarming.

T

TBH The top bar hive is a method to manage bees with removable combs which rely on top bars rather than frames for the combs. There is usually no allowance for bee space around the tops of the bars, so the bars represent a continuous cover. There are no standard dimensions as there are for Langstroth hives. See also KTBH.

Telescopic cover A hive cover with a rim that wraps around the hive boxes on all sides, and provides better protection from the elements than a migratory cover does. Usually used with an inner cover under it, to aid in removal.

Terramycin Called oxytet in Canada and other locations. It is an antibiotic that can be used as a preventative for AFB and a cure for EFB diseases. Now requires a prescription from a veterinarian.

Thorax The central region of an insect to which the wings and legs are attached.

Top supering The act of placing honey supers on TOP of the top super of a colony in expectation of a honey flow, as opposed to putting it under all the other supers, and directly on top of the brood box - which would be BOTTOM supering.

Tracheal mites A mite that infests the trachea of the honey bee. Resistance to tracheal mites is easily bred for.

Trophallaxis The transfer of food or pheromones among members of the colony through mouth-to-mouth feeding. It is used to keep a cluster of bees

alive as the edges of the cluster collect food and share it through the cluster. It is also used for communication as pheromones are shared. One very important one is QMP (Queen Mandibular Pheromone) which is shared by trophallaxis throughout the hive to let the hive know they are queen right.

U

Uncapping To shave off the cappings of sealed honey prior to extraction.

Uncapping knife A knife used to uncap the sealed honey prior to extraction. Hot water, steam or electricity can heat the knive.

V

Varroa destructor Used to be called *Varroa jacobsoni*. An external mite parasite on honeybees.

Veil A protective netting that covers the face and neck; and allows ventilation, easy movement and good vision while protecting from guard bees.

Virgin queen An unmated queen.

Vitellogenin In the context of bees, this is a protein that is in the fat bodies of bees that results in greater longevity. There is a much higher amount in winter bees as opposed to summer bees. There is a feedback loop in the colony where vitellogenin and juvenile hormone mutually suppress each other. This causes bees raised in the fall or leading up to swarming to have higher levels of vitellogenin and therefore longer lives than at other times.

W

Wax glands The eight glands located on the last four visible, ventral abdominal segments of young worker bees. They secrete beeswax flakes.

Wax moth Larvae of the moth *Galleria mellonella*, which can seriously damage brood and empty combs.

Western A "medium" box that is 6 5/8" in depth and the frames are 6 1/4" in depth.

Winter cluster A tightly packed cluster of bees that forms to maintain warmth during the colder winter months.

Winter hardiness The ability of some strains of honey bees to survive long winters by frugal use of stored honey.

Worker	Infertile female bee whose reproductive organs are only partially developed. Responsible for carrying out all the routine duties of the colony.
Worker comb	Comb measuring about five cells to the inch, in which workers are reared, and honey and pollen are stored.

X

Y

Z