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I have written 3 articles about the various pieces of equipment that are used commonly while beekeeping. In the articles, I discussed the Langstroth hive (February 2014), personal protective equipment (March 2014), the hive tool, and smoker (April 2014). I am concluding this four-part series on beekeeping equipment by discussing miscellaneous items that I find quite useful to own as a beekeeper and have with me every time I visit an apiary.

I hope I convinced you in my earlier articles that beekeeping really is an art, one that is practiced by thousands of individuals but mastered by none. Because of this, I find that bee management is 10% truth and about 90% opinion, the latter being held by the artist (beekeeper) who has his or her own way of doing things. This is relevant to a discussion of “miscellaneous beekeeping equipment” because I will discuss items that I find indispensable, but that other beekeepers might find trivial. I am not foolish enough to demand that you do things my way. After all, the beauty of art is that the outcome is “right” to the creator, regardless of the opinion of others. Likewise, time will teach you what equipment is useful to you and this will vary based on (1) who your mentor(s) is (are) (i.e. how you learned to do things), (2) what style of beekeeping you employ, and (3) your particular goals as a beekeeper. That said, I have developed a list of tools I find useful and I believe you should at least consider owning, if not having with you every time you work bees.

perpendicular to the hive body. The bars run parallel to one another and are spaced at such a distance to accommodate a frame. The purpose of the frame holder is... (you guessed it)...to hold frames while working a colony. As you know, it is easier to work a colony when one of the frames is removed from the box in which one is working. Most beekeepers, myself included, usually just rest one end (side) of the frame on the ground and the other end against the hive or hive stand. This is ok but it requires you to bend down when manipulating that frame. Work bees long enough and you will real-

ize that you have to be as nice as possible to your back; therefore, you will try to find ways to keep from bending over! Furthermore, grass, leaves, dirt, etc. stick to the part of the frame contacting the ground. This is a nuisance to remove when you are ready to return the frame to the hive. Finally, bees often crawl off a frame resting on the ground and go under the hive, crawl into the stacked supers, etc. The queen can do this as well if she is on the frame. Consequently, I prefer to put any frame I remove from the colony on the frame holder. My frame holder can accommodate 5 frames.



Figure 1: A frame holder mounted on the outside of a deep brood chamber. The holder can accommodate the three standard sizes of frames beekeepers use (deep, medium and shallow). Frames holders are useful because they provide a place to put frames removed from the colony while inspecting the hive. Here, the frame holder is shown without a frame (A) and with a frame (B).

1) The frame holder (or frame rest – Figure 1) – The frame holder is a metal device that attaches to the outside wall of a hive body and has two metal bars that project

2) 9-frame spacer (Figure 2) – Standard Langstroth supers and hive bodies are made to accommodate 10-frames. Bees can store more honey in a 10-frame super that contains only 9 frames. This is because the bees will “pull out” the wax (make longer cells) on 9 frames spaced to fill a 10-frame hive. Of course, it is easy to violate bee space in a super that contains only 9 frames. So, I like to have a 9-frame spacer which I use to help me space the frames correctly once I have finished working a super. The 9-frame spacer is pushed down on the frames from above, thus distancing the frames correctly from one another. Incidentally, I like the 9-frame spacer that is held and used manually rather than the one that is attached permanently inside the hive body or super on the ledge that holds the frames. While the latter certainly works, I find that they can get in the way while I work the colony. I will note that I even use 9 frames in my hive bodies (brood supers). I like the extra management space that having 9 frames creates. Of course, a 9-frame spacer is not necessary if you use 10 frames in all hive boxes. Some people even use 8 frames in a 10-frame super; consequently, 8-frame spacers are available for purchase.



Figure 2: A 9-frame spacer. This tool looks like a giant comb. When forced onto frames from above, it spaces the frames out correctly so the bee space is maintained. This tool is needed only if the beekeeper uses 9 frame equipment.

3) Ratchet straps (Figure 3) – I find ratchet straps to be indispensable in beekeeping. While many beekeepers never plan to move their hives, I find that all hives become migratory at some point in their existence. Perhaps you live in a subdivision and have no intention of moving your bees to an alternative nectar flow or to pollinate a crop. However, you never know when you may have to move your bees and having ratchet straps handy makes moving bees easier. Moving bees is true work (I will write an article on this topic in the future). Hives are heavy and cumbersome. A hive is composed of multiple boxes, a bottom board, a lid, etc. These have a tendency to slip past one another while a hive is in transit. Shifting supers is not good because it opens gaps in the hive through which bees can escape. Supers, hive bodies, bottom boards, lids, etc. will NOT shift if a ratchet strap is secured around the colony height-wise. Ratchet straps also can be used to secure hives while the colonies

are in transit, hold equipment together, etc. They are cheap and available at nearly every hardware store. They are worth owning.



Figure 3: A ratchet strap secured around a hive. The strap holds all of the hive parts together so that the hive can be lifted and moved with little risk of hive slippage (i.e. coming apart).

4) Boardman entrance feeder (Figure 4) – There are a million ways to feed bees. This will be the subject of a future article in my column. There are a lot of feeder styles as well. Though I prefer to provide the food to bees from above their cluster, I find a Boardman entrance feeder to be quite helpful, first as a quick way to feed bees and second as a good way to give the bees water in an area where streams, rivers, lakes etc. are not abundant. As noted, I feel that putting feeders above the bee cluster is the best way to deliver food to a colony. However this either requires one to purchase bulky hive top feeders or use migratory lids that accommodate feeder jars. I use telescoping covers (see my column in February 2014) and I do not want to cut holes in them to accommodate feeder jars. So, I find Boardman entrance feeders to be a cheap, easy alternative to feeding colonies. They are composed of 3 parts, the stand that slides into the entrance of the colony, the jar lid that contains perforations and which fits into the circular hole in the top of the feeder, and the jar. The jar can be any type of “small mouth” glass jar. I would not use a jar any smaller than a



Figure 4: A Boardman entrance feeder. The entrance feeder is made of wood (the walls) and metal (the top, back, and bottom). The feeder is slid, horizontal opening forward, into the hive entrance. The round opening at the top of the feeder accommodates a glass feeder jar that has a perforated lid. Bees enter the feeder and drink the sugar water or water from the perforations in the jar lid.

quart in size, though I much prefer the half gallon jars that you can purchase from your local beekeeping equipment distributor. I especially like Boardman entrance feeders because I have to provide water to my colonies year-round because there are no local water sources my bees can access. I give my bees water using the entrance feeder to keep them out of my neighbor’s horses’ water troughs.

5) Entrance reducer (Figure 5) – One of the things that I like about beekeeping is that, for the most part, we name items appropriately descriptive. The item I am describing next exemplifies this. The entrance reducer is a tool, usually made of wood, which is used to reduce the entrance of a colony. Colony entrances occasionally need to be reduced. In my experience, the entrance to a colony is usually much larger than feral bees would choose for themselves if looking for a home in a tree, a wall, the ground, etc. Big entrances can be hard for the bees to protect from other bees and pests and the entrances can be drafty. A lot of beekeepers will reduce the colony entrance during winter, thus, supposedly, helping the bees to keep the nest warm. Of course, you can use anything to reduce the nest entrance. I have used grass clippings, old clothes (t-shirts, socks, and underwear are my old clothes of choice), blocks of wood, etc. But why not use something made especially for the job? Most entrance reducers supplied by manufacturers have two sizes of notches cut in the reducer, thereby accommodating two sizes of reduced entrances.



Figure 5: An entrance reducer on a nuc colony. When placed on the hive entrance, the entrance reducer restricts the size of the nest opening. Most reducers come with two opening sizes.

6) Small fingernail scissors (Figure 6) – I clip one forewing (front wing) of all of my



Figure 6: Small, fingernail scissors. These scissors can be used to clip queens’ wings.

queens. This is part of what I do to control swarming in my colonies. I always have a little pair of fingernail scissors on hand while working a colony in the event that I need to clip a queen's wing. I prefer to use fingernail scissors because they are sharp and small, thus being able to slide under the queen's wing easily and make a clean cut.

7) Metal smoker pail (Figure 7) – Lit smokers are a fire hazard. I always put my lit smoker into a metal pail immediately after use. Metal pails can be purchased at almost any hardware store. Keeping lit smokers in a pail keeps them from contacting flammable material easily.



Figure 7: Metal smoker pail. I always place my smoker into a metal pail to reduce the risk of fire when the smoker is not in use.

8) Smoker fuel carrier (Figure 8) – I carry my smoker fuel in a plastic bucket. However, I know people who use large garbage bags rated for outdoor use or 5 gallon buckets as smoker fuel carriers. Both work equally well. The main point is to use a carrier that is waterproof. This is a good argument for using a 5 gallon bucket with a lid.



Figure 8: Smoker fuel carrier. Smoker fuel should be kept dry and handy. It should have its own container.



Figure 9: Queen cages. These are useful when queen management is necessary.

9) Queen cages (Figure 9) – Queen cages are small cages in which one can place a queen. Queen cages are usually made of plastic or wood. I find it useful to have a few on hand in the event that I need to confine the queen while manipulating a colony, hiving a swarm, etc.

10) Tack hammer and frame nails (Figure 10) – Tack hammers are small hammers that are used to drive small nails. They are extremely useful when repairing a frame, and beekeepers repair lots of frames. I suggest taking a tack hammer and frame nails with you when you work bees. Frames can come apart while the hive is being worked. A hammer and nails are quite useful when broken frames are encountered. Many equipment providers also sell frame top bar repair lugs. The frame top bar's end lugs (both ends of the frame top bar that rest on the hive body, thus suspending the frame) break easily, especially if the frame is old. There have been many times I have been out working bees and needed to repair the top bar of a frame. I suspect you will encounter the same issue in your beekeeping endeavor.



Figure 10: Tack hammer and nails. These are handy to have in the field when frame repairs are needed (and they often are). I recommend that you carry a small container of frame nails and a few frame repair end bars so that broken frames can be fixed when encountered.

11) Matches/lighter – Matches or lighters are necessary to light a smoker. I do like the fancy lighters that are available today. However, I find that they often are not very rugged and usually quit working before they run out of fuel. Even when I elect to use a lighter, I always have matches on hand as a backup. You should store the matches in a waterproof container. You can often find small, waterproof match holders in camp-



Figure 11: A bee brush. Bee brushes are useful for removing all of the bees from a frame.

ing supply stores or departments at the large chain stores.

12) Bee brush (Figure 11) – A bee brush is a soft-bristled brush that is used to remove bees from a frame. I no longer use mine that much, but it is very helpful at times. Bee brushes are usually used to remove bees from frames when the honey is ready to be extracted from the frame.

13) A work box or pail – Most of the items I have mentioned thus far need to accompany you every time you visit your apiary. As such, it is useful to have a single storage container that is easily transportable and in which you can place the mentioned items. I use another metal pail for this purpose. Such a pail can be taken to the apiary and can accommodate most of the small items I have mentioned.

14) A gallon jug of water – I like to have water on hand while working bees for three primary reasons. First, most bee management occurs during the warmer months of the year. Beekeeping is hot. So, I like to have water on hand for hydration purposes. Second, working bee colonies is sticky. Honey, wax, and propolis can get on your hands, feet, suit etc. It is always nice to have some water with which one can wash their hands, tools, and clothes. Finally, improper use of a smoker can lead to a fire, even when being extra diligent. Having water on hand is added fire insurance.

15) A sample collection kit – There are times when beekeepers see things in their colonies that they need help identifying. It is always a good idea to have a small, sample collection kit in the event that something needs to be preserved for future consideration. A sample collection kit could include (1) metal tweezers, (2) a small glass jar (8 oz), half filled with alcohol [ethanol (drinking alcohol) is best but isopropyl alcohol (rubbing alcohol) will work], (3) a second small jar (8 oz) that is empty, (4) a small knife, (5) a small spoon, (6) a flashlight, and (7) a magnifying glass. All living samples (eggs, larvae, pupae, adults, bee pests) should be collected into the alcohol jar while other samples (honey, wax, pollen, etc.) can be collected into the empty glass jar. Such a kit can be used to collect samples that are believed to be diseased or for which a second opinion is needed to identify the condition.

16) An extra 5-frame nuc with bottom board, lid, and frames with foundation (Figure 12) – A "nuc" is a small colony that accommodates full-size frames. Nucs are usually named according to the number of frames accommodated by the boxes. Therefore, a 5-frame nuc holds 5 frames. I feel that having a spare, bee-less hive on hand allows one to hive swarms they discover while in the apiary, split a bulging colony, condense a weakening hive, etc. I know many-a-beekeeper who wishes he/she

had a bee-less hive on hand to use to solve unexpected colony problems. I recommend having a nuc rather than a full-size colony because nucs are smaller, cheaper, and easier to throw into the back of a vehicle.

I am certain that there are useful beekeeping items that could be added to this list. Likewise, I feel sure that there are items on this list that many people would find unnecessary. However, what I list here (apart from the nuc) collectively costs less than \$100 and I feel that they are useful additions to a beekeeper's toolbox. All of these items (and an extra hive tool) are worth having in your beekeeping toolbox. Of course, there are times



Figure 12. A 5-frame nuc. These are especially handy when one discovers in the field that a colony needs to be split, a swarm needs to be hived, or a weak, full-size colony needs to be condensed.

when a beekeeper will need an item that is not found on the list I provide. But, those times are the exception rather than the rule. The items I mention above are handy for the vast majority of problems that beekeepers encounter. At the end of the day, beekeeping is more enjoyable when you are prepared adequately for the common problems.

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Honey Bees 101: Honey Bees are Eusocial

There are over 20,000 bee species on the planet. Only 9 of those species are honey bees. The life history of bees ranges from solitary (live alone) to eusocial (live in colonies). There are three traits that identify sociality in insects (i.e. that make insects social). The absence of all three makes a bee solitary, while the presence of all three makes one social.

The 3 traits of sociality (social requirements):

- 1) **Cooperative brood care** – Multiple members of the same species rear non-offspring young.
- 2) **Reproductive division of labor** – Only one or a few individuals reproduce while the others rear young, forage, guard the nest, etc.
- 3) **Overlapping generations** – Multiple generations perform the job tasks in the nest.

The various combinations of these three traits result in the various life histories associated with the 20,000+ bee species. There are three levels of sociality, depending on what combination of the traits one has. Some levels can be subdivided further into multiple groups.

- 1) **Solitary** – None of the social requirements are met (i.e. they do not have cooperative brood care, reproductive division of labor, or overlapping generations). The females provision the nest and lay their eggs on the food within. They then leave the before their offspring emerges.
- 2) **Presocial** – 0 – to – 2 of the social requirements are met, but not all three.
 - A. **Subsocial** – None of the social requirements are met. This group is distinguished from the solitary bees by the behavior of the mother. The nest consists of one adult female and a number of immature offspring. The offspring are fed progressively by the adult, that leaves or dies just before or at about the time the young reach maturity (almost overlapping generations).
 - B. **Parasocial** – 0 – to – 2 of the social requirements are met, but not all three. However, members of the same generation do interact.
 1. **Communal** – None of the social requirements are met. Yet, multiple members of the same generation share a nest that contains many “cells”. The females from the same generation each make, provision, and lay eggs in their own “cell” of the single nest. This likely allows many bees to defend a common nest entrance.
 2. **Quasisocial** – One of the social requirements is met. Multiple reproducing members of the same generation share a nest. These members cooperate in brood care.
 3. **Semisocial** – Two of the social requirements are met. Multiple members of the same generation share a nest. The members cooperate in brood care and have a reproductive division of labor.
- 3) **Eusocial (or “truly” social)** – All 3 social requirements are met in nests shared by multiple members of the same generation. First, the members cooperate in brood care. Second, there is a reproductive division of labor (queens and workers). Third, overlapping generations contribute to nest labor. There are two levels of eusociality.
 - A. **Primitively eusocial colonies** – The female castes (queens and workers) are externally indistinguishable in structure, but usually differ in size (i.e. the queens look like larger versions of the workers). The castes can live alone. Swarming does not occur. Food is usually only stored in the brood cells. Bumble bees are a good example of primitively eusocial bees.
 - B. **High Eusocial colonies** – The female castes (queens and workers) are very different from one another behaviorally, physiologically, in size, and in external structure. The reproductives (queens) lack the morphology (body plan) and behaviors necessary to live alone. The colonies are long lived and large. They store considerable food resources. Honey bees are highly eusocial.

Sociality confers a significant benefit to bees. First, there are more members in the nest to raise the offspring, perform the various job tasks, etc. Second, social bee nests typically are well defended (as any beekeeper can attest). Third, social bees often can live in a variety of habitats and can take advantage of a suite of floral resources. Fourth, social bees may be better able to handle significant stressors such as pathogens, pesticide exposure, etc. since individual members of the nest are “expendable”. Therefore, the nest can “take a hit” and keep moving forward. Finally, humans likely rely heavily on social bees and the pollination services they provide. This favors social bees since humans have a vested interest in maintaining the health of social bee colonies and populations.