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*A look at bee biology and how it affects colony management*

# Changing The Way We Train New Beekeepers

**The Bee Nest & How It Affects Colony Design**

My October to December travel blitz was momentarily interrupted by a phone call from neighbors near the Farm to help gather up a bee tree in a nearby town. The tree, at a horse farm, had already been cut down and the caller wanted to know IF I wanted it. I had just been at meetings in Michigan and Texas, with a bonus side trip to Palmer, Alaska to meet the new granddaughter. In a day I was set to drive to Connecticut for the fourth SNEBA meeting. I really did not want to take a day to help move and split open a bee tree and move the bees into frames on a questionably warmish day in mid November. So I passed.

Later I got a report that the comb extraction went well, and the queen was located and safely transported to a new regular home. The combs were fitted with light cord so they would stay in place in their new home in wood frames. It all seemed pretty logical and straightforward (See photos by Kathy King and Craig Fuller). I was given orders to stop by to see a strange new bee that was surrounded by lots of worker bees. On my drive out East I stopped and saw a worker bee denuded of body hairs and missing its sting. The beekeepers had found a robber bee and she had stung one of them. I guess that is how some beekeepers like to learn.

*Did the sting come out?*

*Yes. It came out into his hand.*

*Then it was a worker bee.*

I wish all mysteries were this easy to solve.

**Natural vs. Beekeeper-Provided Nest Sites**

Since I drove the 800+ miles from Kalamazoo to Hamden, I had some time to reflect on the nature of the bee nest, and how beekeepers have been forcing bees into structures over the millennia that the bees may or may not want to occupy. Most of the time the bees are pretty flexible and adapt to the human-provided space. Sometimes the bees rebel and depart the nest, especially if there is no brood or riches of food present.

*Craig Fuller holding a frame with a comb fragment from the bee tree.* Kathy King photo.

*Removing a comb from the nest.* Kathy King and Craig Fuller photo.

The maple tree this colony occupied provided a cylindrical nest space and long and narrow combs. While there is some parallel nature to these combs, they often have a twist or flex due to the bee's community comb building in a free form space. The bees work to fit the comb surfaces together, often amazingly so. But when the combs were carefully cut out from the bee tree they seem to be rotated ninety degrees to fit into the open frame. This is not an act of evil manipulation, but an attempt to fit the natural comb into an artificial space. This gives me pause for thought, since I constantly wonder if the bee space we provide is the best shape for bees.

We know that the different races of *Apis mellifera* L. have been selected for different nesting sites. As glaciers retreated in Europe and Asia following periodic ice ages, European species developed characteristics for adaptations for nest sites. The most common evolutionary sites for northern European races were hollowed areas in deciduous and coniferous trees, as well as some rock outcroppings, cave-like features caused by wind and water erosion. But colonies in Africa were selected to find nests in different types of nesting opportunities, as well as adapt to local climate needs. Many of these races have developed different survival strategies, and develop in different sized nests.

**North American Races**

In Central America, Mexico and the southern United States we have experienced (and still continue to experience) the interaction between classical managed European races and the invading African bees. During my visit to Texas, just before the trip to Connecticut, I visited an apiary with a range of bee nests in structures that ordinarily do not 'fit' European races. While the beekeeper did not consider them to be African, I suspect that there is an African influence on these colonies, since they occupied smaller spaces, such as birdhouses and water meters.

On the internet I found a useful summary of the nesting differences in Florida publication ENY-147 by M.K. O'Malley, J.D. Ellis and C.M. Zettel Nalen called Differences Between European and African Honey Bees. They are located at the Entomology & Nematology Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611. The Internet link is http://edis.ifas.ufl.edu/in784.

I have lifted Table 3 from this document to summarize the differences between European Honey Bees and African Honey Bees. One must remember that hybrid (Africanized) bees will often be intermediate between these characteristics.

| European Honey | African Honey Bee |
| --- | --- |
| Nests in large cavities, around 10 gallons in size | Nests in smaller cavities, 1 to 5 gallons in size |
| Typically nest in dry, above ground cavities | Will nest in underground cavities with a high moisture content |
| Nests in protected locations, rarely exposing the nest | Will nest in exposed locations, (e.g. hanging from a tree branch) |
| Due to larger colony size, nests are often easier to detect | Due to smaller colony size, nests often go undetected until disturbed |

It is impressive that the European races require such a large nest site as compared with the African races. But when we consider the reproductive strategies of the two groups, we quickly understand why this difference has evolved. European bees seem to optimize swarming at one or two swarms per season (the year 2009 may be remembered as a year when most colonies swarmed repeatedly, reflecting the periods of confinement and conditions suitable for more swarms). Compare that with the practice of African bees of swarming 10 times each season. This, of course, reflects the way the colonies utilize the honey and pollen resources as they enter the colony. African bees convert a larger percentage of the food income into brood, while the European bees convert a larger percentage into food storage necessary for survival during the Winter or dearth period. If a Michigan colony swarmed 10 times each season it would deplete both its bee population and food reserves so severely that the colony would certainly not survive the Winter. In fact, very few of the swarms would survive either, since they are smaller in size and would require greater effort to gather the reserves to survive the Winter. Even with good conditions, perhaps only one colony in five or six survives to reach its first anniversary. This helps us understand how this selection occurs so rapidly, and how often colonies in our apiaries are not as productive as we want them to be because of late swarming, small swarms, and poor foraging conditions.

When Dr. Tom Seeley gave European bees a choice between nesting cavities of different volumes, he found that swarms preferred the 40-liter size over two other sizes. This, of course, reflects their evolutionary heritage. There is clearly an optimal size for the natural bee nest, and it is a function of the size of the swarm and its evolutionary heritage. Seeley summarized this work in his books *Honeybee Ecology* (Princeton University Press, 1985) and The Wisdom of the Hive (Cornell) which of which I recommend you add to your collection. In that book, he describes the idealized nest site for European bees in the New York and New England regions:

1. A nest volume of 15 to 80 liters,
2. A South-facing entrance,
3. An entrance smaller than 75 $cm^2$,
4. An entrance near the floor level,
5. A nest entrance several meters above the ground,
6. Is located between 100 to 400 meters from the parent colony,
7. And has a set of pre-existing combs built by the previous colony occupant.

The reuse of nest sites fascinated me. Clearly, there is an advantage to the new swarm that finds a legacy nest from a previous swarm. Since these swarms are most likely within 400 meters of the parent colony, it is likely that the honey comb was left behind by a swarm from the same parent site, so the practice of nesting nearby the parent hive can have some subtle selective advantages when one considers the high mortality of new swarms. If a colony produces a swarm that invests all of its resources into comb building and cannot store enough food to survive the Winter, then in a future year the empty comb will attract a 'sister' swarm from the same colony to occupy the nest that does not need to put as many resources into comb building but instead can focus on food storage. Tom Seeley has told me how isolated these nests are in the wild (completely different distribution than beekeeper-managed colonies) and even wax moths have difficulty finding empty nests due to their Northern isolation. Thus the empty combs may persist for years waiting for a future swarm to select that nest site.

**Is our Langstroth-type hive still a good fit?**

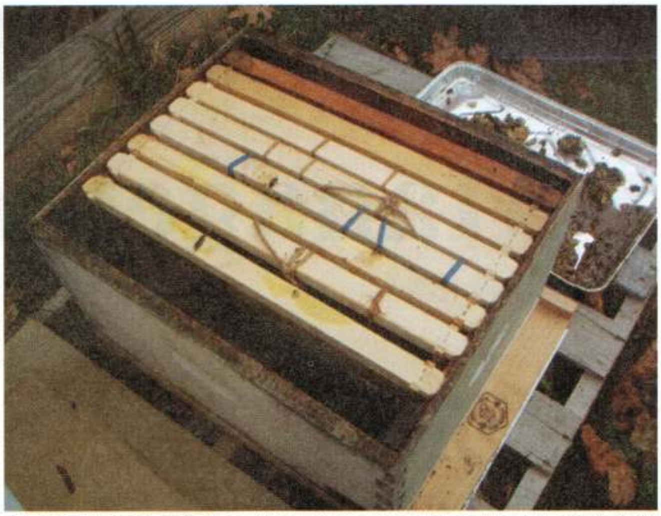
The debate over frame sizes and hive designs ended about a century ago with the acceptance of the standard Langstroth deep, medium (Illinois) and shallow frames in 10-frame equipment. Equipment was based on standard wood dimensions of the time, dimensions that have since changed and are now less efficient for the manufacturer.

Many other beekeepers have made the same comment about ten frame equipment as I have observed: bees don't use the outside combs unless the colony becomes amazingly strong and/or the beekeeper moves the frames and puts honey on the outside wall to optimize equipment use. This year it was extremely common to find new colonies, started on foundation, building a comb chimney very reminiscent of that nest in a bee tree. It was four to six frames wide and went up into as many boxes as we provided. It was if the bees were fitting and building comb and designing a tree-based nest in spite of our best efforts to provide them adequate room for expansion outwards.

These chimney-like comb-building patterns are adapted for the way bees survive during the Winter – they move up as they consume stores. Heat from the cluster moves up, warms the comb and honey, and provides the bees with an unrestricted and logical flow on the combs. That there are breaks provided by different frames allows the bees to communicate between the sides of the combs, and better regulate temperature.

Most experienced Northern beekeepers have found colonies dead in the Spring that still had full frames of honey on the *outside* of the of the cluster where they could not break to reach the needed food. As a result many beekeepers place a full box of honey on top of the hive in hopes that the bees will have plenty of food to survive the Winter. But the colonies I see that do best are the ones with top insulation that allows the bees to move up and then out, over the tops of the frames, as the cluster eats its way through the honey. A moisture-catching insulation, made from human-made insulation materials or a book of straw or a box of dry leaves, will often provide the natural moisture take-up that a bee tree likely provides that colony in the woods.

I keep asking bee scientists this question: How has the *Varroa* mite changed other habits or behaviors of honey bees now that we have had a quarter century of bee and mite interaction? Do colonies swarm more to create a break in the brood nest? Are over-wintering clusters larger, smaller or the same as in the past? Are



*Combs tied into frames, the bees were added back and the colony fed and closed up. While November is not the ideal time to remove bees from trees, there was a period of mild weather that persisted into December that allowed these bees to take down food.* Kathy King and Craig Fuller photo.

bees reselecting for old evolutionary habits that beekeepers had worked to reduce over the past century or so? I clearly do not have answers to any of these questions, but it reminds me that bees are constantly changing and adapting to their environment, be it *Varroa* mites or climate change (consider their historical dance with the glaciers in Europe and Asia!).

There may be good reason to again look at different box sizes and frame sizes. I would like to see how seven- and eight-frame colonies with depths greater than the current deep frame dimension will do in a multi-year, side-by-side comparison. I would also like to see how reinforced natural comb could be utilized in both top-bar colonies so the bees are able to move up on the combs and survive Northern Winters.

It may be time to go through an experimental phase of beekeeping similar to that following Langstroth's discovery (or adaptation) of the bee space. Top bar frames had existed in other parts of the world for centuries when Langstroth 'discovered' the bee space. European and American beekeepers were not aware of their use. It may be time to develop a hybrid colony that incorporates both Langstroth and Top-bar features.

Now, with African bees moving into more and more of the United States, we also need to look at the optimum nest size that minimizes swarming and promotes honey production by pure African and African-European hybrids.

Tinkerers, get out of the chair and into the wood shop! BC

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*It is in print.* Queen Rearing Essentials *by Dr. Connor is arriving at your local bee supply companies or can be ordered directly from the Wicwas Press website:* **www.wicwas.com**. *Also join Dr. Connor at the fourth Serious Sideliner Symposium at the Orlando meeting of the American Beekeeping Federation, being held this month.*