COLONY DECISION MAKING #1

And A Look At Observation Hive Behavior #2

Walt Wright

I have been challenged on more than one occasion for talking or writing like bees have the capacity for "thinking." The PhD Entomologist will often pointedly remind me that insects don't think, they only respond to stimuli. In this segment of the series, I'll offer a few examples of colony judgments, and let you make up your own mind on the question.

Nectar management (Feb '02 *Bee Culture*) is based on personal observations over several years. The technique is an effective swarm prevention measure that also increases honey production. The underlying principles of honey bee survival strategy led to experimentation with the technique. Those concepts of colony judgments and resultant internal colony operational changes fall on deaf ears. Virtually no one is willing to seriously consider that those concepts are valid. The literature is no help. Although the build up operations are different than Fall closeout of brood rearing, there is no reference to colony objectives or internal operational changes. I contend that between the two major operational changes at the beginning and end of the growing season there are several other more subtle changes. Some of those mid-season changes are prompted by colony consensus decisions.

To get started, here are a couple examples of drastic operational changes that are described in the literature. The first is suspending brood rearing when honey stores fall below a minimum reserve. This trait is evidence of colony decision-making and its stark effect on colony internal operations. In a nectar dearth, when honey stores fall below a level of adequate reserve (colony judgment) the colony stops rearing brood. Larvae of all ages turn yellow, and then brownish as they starve. When nectar is again available in the field, the colony will pick up where they left off in brood rearing. In the meantime, they will wait it out with their minimum reserve.

We lead off with the above description because it is remarkable in several respects. First it implies that the colony continually assesses the honey on hand from the standpoint of a comfortable reserve. Second, there is definitely a consensus opinion that the colony needs to go on short rations to conserve stores. Third, the change in internal operations is sudden and total. The whole colony, perhaps 40,000 bees, endorses the operational change. At least all the nurse bees are relieved of their duties. It stands to reason that nectar scouts still go to the field to check for a break in the dearth.

In addition to the circumstances described above, consider the absconding swarm. The European races do not abscond as readily as tropical races, but they still have absconding in their inventory of survival tactics. When available forage does not meet their needs, the consensus decides to abscond. There is some prep time before leaving the area. Queen laying must be stopped while she trims down for fight. When she is able to travel cross-country, they leave capped brood and stores behind. The stores left behind may look like enough to the beekeeper, but the colony makes the judgment on criteria that only they know.

The experts know about these decisions and their effects. Still they resist any discussion or serious consideration of the possibility that other operational changes during the season could be the result of colony decision-making. They don't want to talk about operational changes at all. Colony decision-making may not be deductive logic as we know it. It may be genetically programmed response or instinct. Whatever the process, honey bee colonies do make judgments on circumstance, and collectively take action to react to the circumstance.

Let's take a quick look at the other half of the entomologist's position – that "bees only react to stimuli." When a colony is expanding the brood nest during the build up, they expand into liquid feed. It can be diluted honey, nectar, or a combination of the two. The colony decides how much expansion will be included in this step and draws an imaginary arc on the comb filled with liquid feed. The cells below the imaginary arc are used to feed the colony. When all the feed is consumed, the cells are prepared for eggs, and the brood nest takes a jump to the cells above the arc, which are still filled with feed. What started as an imaginary line is now the dome at the top of the brood. All this description of the process is included just to ask a simple question of the entomologist. What is the difference in stimulus of cells on either side of the imaginary line? Most have a common cell sidewall.

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The size and position of this brood nest increase could possibly be controlled by pheromones, but it is difficult to imagine how that would work.

The introduction to this series (March, '03) included a general description of the colony's ability to regulate stores and population in balance, in consonance with overall cavity volume. An accomplished mathematician would have some trouble with the calculations involved in making that come out right. Do we add a few more cells of Winter pollen at the expense of brood, or is more foraging bee power more important?

The scientists have convinced me that immediate needs can be conveyed by pheromones. For example: The nurse bees need more pollen to feed the young. Pheromones can do that. But long-range planning, like preparing the Winter brood nest, takes more than pheromones. Instinct or colony decisions based on instincts are required.

The solitary honey bee in the field may be an insect, but the colony is something more. When speaking of colony actions, I use the word consensus. That word implies opinion or majority judgment. In most of the above, assessment of the situation, a decision, and then corrective action is involved. Does that sound a lot like thinking? The honey bee colony makes judgments on a regular basis – all day, every day. If it's not thinking, it is something very close to it.

Earlier in this series we described what we see happening in the beehive through the swarm season. To protect survival of the parent colony, internal operations change with progress toward the objective. Assessments and decisions by the colony affect timing of operational changes.

#2 ↓ In this segment, we will attempt to make a case for the observation hive not being representative of the over-Wintered colony. Observation hives provide visual access to the activities in a functional bee colony. They are at once educational and interesting. Even the casual passerby is often intrigued by the prospect of seeing a colony at work from a safe vantage point.

A substantial part of literature data is derived from close range observation. Information such as development times of mature bees from egg to emergence as adults is valid data that can be acquired without colony intrusion. However, the intent of this article is not to extol the virtues of the observation hive, but to provide an introduction to its limitations.

The observation hive is reported to be difficult to Winter. Without speculating on why this is true, it is assumed that the typical observation hive is populated in the Spring. Whether it is populated with bees on foundation and an unrelated queen, or a frame of brood and adhering bees and an unrelated queen, the situation is the same. The mini starter is faced with becoming established as a functional colony. This is the same prospect facing a natural swarm or a purchased packaged starter. What is not recognized in the literature is that establishment of a colony in a new location induces a separate mode of internal operations.

The differences in status between the over-Wintered, established colony and the starter are obvious to the most casual observer. The established colony has a cavity completely furnished with functional comb, that in large measure is filled with stores to support population build up to reproduction strength. The starter has an empty cavity and fewer bees. Additionally, they have less remaining seasonal forage time since the early season forage sources have already passed. Because of the starter's handicaps, the beginning colony is highly motivated. They are faced with a literal "do or die" situation. Most natural swarms perish, but its not from lack of dedication to establishment requirements. One indication of the starter's higher motivation is their reckless foraging in marginal flying weather. The starter will forage vigorously when the established colony is content to wait for conditions to improve.

The starter package or natural swarm has multiple top priorities. Comb building is most important because they can make no progress without comb. Rearing brood for replacement bees is no less important because the starting population is dying off and will be essentially depleted in a few weeks. In parallel with those two activities, they must forage for feed and build a reserve of stores for the time when forage availability terminates in the field. In addition to accumulation of stores, the foraging bees must provide the wax makers with an ever increasing supply of nectar used as the raw material for wax. The list of top priorities is the basic reason that the target reproductive swarm issue season is just before woodland peak forage availability.

The natural swarm is prepared for establishment when they leave the colony. Swarm preparation activities are tailored to produce a reproductive swarm that has a chance at survival. Large numbers of wax makers are generated prior to swarm issue to provide the swarm with comb builders. We might mention that the swarm can be building comb nearly a month before the parent colony has wax making capability. If the swarm issues on schedule, it will depart about three weeks prior to the white wax of the main flow. Think about that for a minute. Does your favorite reference source tell you why that is true? It has to do with changes in colony internal operations in the Spring season.

The natural swarm also has a higher percentage of young bees in its make up. The brood nest reduction of the swarm prep period has the fringe benefit of freeing up bees of nurse bee age. They are the youngest of the adult bees, and more of them are available to populate the swarm. Loss of bees to die off is not as severe for the natural swarm as for the purchased package. The package shipped from the deep south has wax makers, but in diluted numbers. The bees' development schedule is more advanced the further south we go, and the wax makers of the package were developed for the main flow. We strayed from the subject of this article to describe the swarm's preparedness to survive establishment in a new location. My intent was to show that establishment is a separate mode of internal colony operations that is unique to establishment.

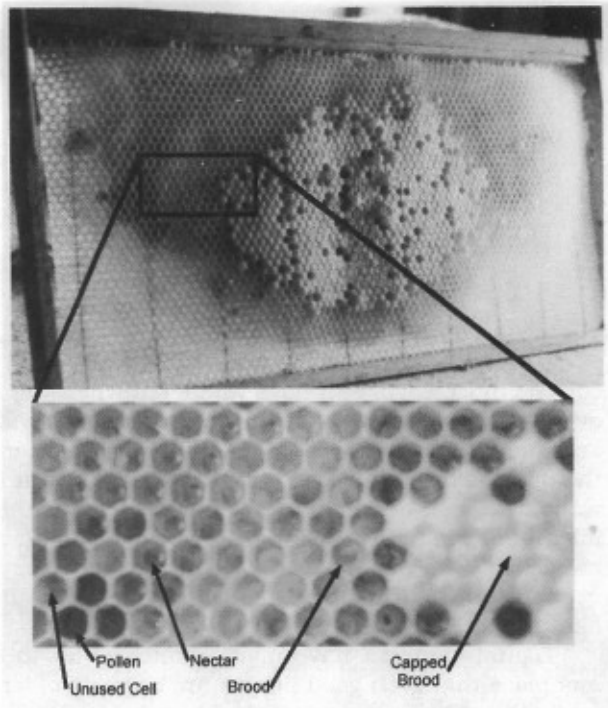
The multiple top priorities and the limited time to get them done impart a sense of urgency to the

starter. The higher motivation level has already been mentioned. They also have techniques for accomplishing the requirements in parallel. For example, they will place an egg for brood rearing in a cell that has barely started being built. They have three days before hatching to get the cell walls built a little deeper, and five more days before capping the larva. They will build the cell around the developing larva, and when the larva is mature enough to cap, the cell will be finished and ready. The same approach is used for storage cells. Within an hour of moving in that new location, foragers can be bringing pollen to feed brood. Cells for storage have just gotten started. The colony will build sidewalls for the storage cells as they are being filled. In this way, the three major requirements of establishment are in progress at the same time. Comb building, brood rearing, and stores accumulation are in high gear in parallel. We see this mode of operation as peculiar to establishment of the starter colony.

The photo shows the fifth frame being developed by a package colony. Lower edge and corners are still unimproved foundation. What is not seen in the picture is the arc of capped honey at the top of all frames as the colony expanded across. The accumulation of honey reserve has not started at the top of this frame as of photo time. There is some feed nectar in shallow cells to the left of the larvae cells.

The angle shot shows the progression of cell depth of cells in use. The three cells of dark pollen at the lower left of the box are likely the charcoal-colored pollen of wild blackberry. It may not be obvious in the photo, but those cells are perhaps an eighth inch deep and the nectar cells above about the same. The cells get deeper as you cross the cells of larval brood toward the capped brood. The older larvae adjacent to the capped brood have been fed some of that dark pollen and the cells look a little murky in the photo. If you look closely at those cells in the angle photo, you can see that they are not up to the depth of the cappings.

The newly-stocked observation hive will be operating in the establishment mode as described above. The activities of the bees in that mode will not reflect the activities in the over Wintered colony. The established colony, with residence cavity filled with functional comb, can concentrate on activities that produce the reproductive swarm. You could watch the activities in an observation hive around the clock for the whole Spring season, and not be any smarter about the activities related to reproductive swarming. It's not necessary for the established colony to operate in the hurry-up offense (football jargon) of establishment. They can take a more leisurely tempo and still accomplish reproduction in a timely manner.



In addition to the hurry-up offense, the starter has other operational differences. A couple should be mentioned that can be applied by the beekeeper. The following items may be expanded when that subject is discussed in detail:

The natural swarm builds downward. Starting at the top of the cavity, comb is constructed in the down and outward directions. Downward growth affects pollen storage. Pollen is difficult to move. To avoid blocking growth with pollen, it is often maintained during establishment at the top of the brood. During expansion of comb in the down and out direction, new comb at the sides and bottom can be filled with nectar pending brood next expansion. The nectar can be consumed or moved readily to expand the brood volume. This variation in establishment stores location can carry over into the second season, where stores are essentially upside-down from the established overwintered colony normal location.

A second operational difference of establishment is the tendency to supersede. The natural swarm leaves the parent colony with the old queen. As long as she performs according to expectations, she is used for the early establishment brood rearing. But when establishment is assured, supersedure is automatic. Other starters beside natural swarms may also invoke the supersedure insurance measure.

I offer these comparisons to provide a possible reason for the literature omission of any reference to internal operations of the overwintered colony. If your only exposure to internal operations is an observation hive, and the activities do not change significantly in the observation hive with season advancement, your lack of understanding is excusable. And if you only see one mode of operation, there is little reason to suspect that other modes exist.

For those PhDs who find it easier to ridicule what I see happening in the hive than to contest it from a position of strength, the following advice applies: Get in the beeyard and see for yourself. On a late Winter day, when the overnight temperatures are in the 20s, and the overwintered colony has a three-hour workday, they are busily working toward generating the reproductive swarm. To issue the swarm approaching the peak of forage availability, they must accomplish the up-front work during the frosty morning period of late Winter.

The observation hive has a different set of priorities. BC

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