"Just as each of us has one body with many members, and these members do not all have the same function, so in Christ we who are many form one body, and each member belongs to all the others."

— Romans 12:4-5 (NIV)

Every now and then, there will be a news story about a tractor-trailer truck loaded with honey bee hives that tips over on the interstate highway. Invariably, the headline will include some sophomoric journalistic cleverness such as, "The Buzz on the Street is from Millions of Bees Dumped on Highway!" I usually skip over these know-nothing articles but friends and family forward them to me anyway. What I'm waiting for is an informative article that says something like, "Truck Spills 400 Colonies onto Overpass." You and I know that 1) nobody actually has any idea how many individual bees are in a particular hive, let alone on the back of a truck, and 2) individual bees are essentially irrelevant: it is colonies that matter.

This second point (that colonies, not bees, are what matter) is a simple idea but one that we as beekeepers must understand and embrace if we are to be successful. There is no such thing as a single honey bee – honey bees cannot exist without the collective colony. The colony is the fundamental biological unit, not the individual bees. As such, the colony itself is an organism, or more properly, a super-organism.

Biology-online.org defines an organism as "An individual living thing that can react to stimuli, reproduce, grow, and maintain homeostasis." Don't these attributes apply to a honey bee colony? Let's look at each of these characteristics in turn.

React to stimuli

The colony's mechanisms for reacting and adapting to ever-changing situations are extremely complex. One example is how the colony initiates or suppresses foraging depending on the status of the colony. If resources (water, nectar, pollen or resin to make propolis) are needed, house bees will

How does a worker bee know when to forage for food? It is the colony that determines what the workers do, based on the needs of the colony, not the needs of each bee. Photo: Mark Powers

agitate idle forager bees to stimulate them to get back to work. Conversely, when resources are no longer needed, house bees are slow to service returning foragers. With no one willing to off-load their stores, foragers quit foraging. In this way, the colony, as a collective, gathers food when it is "hungry" and shifts to other activities when it is "full."

Another example of colony-level response to stimuli is the reaction to threats from other animals. A single bee with a single stinger may annoy an aggressor but won't often kill it. No worries: it is the colony that defends itself – it isn't left up to individual bees. A bee marks the aggressor with alarm pheromone and a united colony-level response is swift and decisive.

Perhaps the ultimate example of how the colony reacts to stimuli is demonstrated when it loses its queen. A complex array of pheromonal signals tell the colony exactly what the problem is and it quickly takes steps to remedy it. The individual bee has no inherent reason to care about the loss of the queen – its well-being will continue as before, with or without her. However, the collective colony will soon perish in her absence. The remedy is implemented by the colony as a cohesive functional unit, not by individual altruistic bees.

Reproduce

Bumble bee colonies reproduce when a

single mated queen emerges from her dormancy in the spring. She forages, makes wax cells, lays eggs and raises a few daughters (and sons). Then those daughters begin helping out with chores around the house, such as foraging and raising their baby siblings.

With honey bees, the queen is not physically capable of effectively foraging – she doesn't have the specialized body parts that workers have for that job. She cannot produce the wax that is essential for building comb. She can only do two things: 1) distribute pheromones that signal the status of the colony and 2) lay eggs. Note that those eggs do not represent "reproduction" of the colony. Instead, new worker and drone bees are analogous to new cells in the body.

Reproduction of the colony – the way that new colonies are created – is accomplished via swarming. This is essentially the same process as how new amoeba are created: the original amoeba splits in two. In biological terminology, individual bees are created via sexual reproduction but the colony, the only thing that really matters, reproduces asexually by fission. For a detailed step-by-step description of how swarming occurs, see April 2019's "Swarm Season is Here! Are You Ready?"

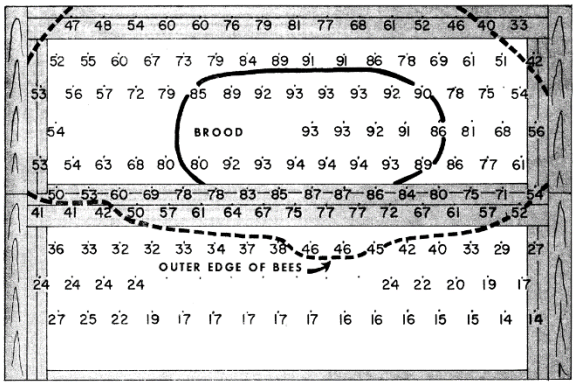
Grow

Biology-online.org defines growth as: 1) the gradual increase (e.g. in size or number) of an animal or vegetable body over time; and 2) the development of an organism, e.g. of a plant from a seed to full maturity. In the context of a honey bee colony, growth, both in size and to maturity, is demonstrated in what happens following a swarming event, or equivalently, when a new package is installed. The colony must build its infrastructure (the comb) and increase its population to a self-sustaining level. Typically a new colony's first year of existence is devoted to achieving this goal. In year two, the now-mature colony is ready to reproduce (swarm). Note that this type of growth and maturation has nothing to do with the life cycle of individual bees – it is fully a colony concept.

Maintain homeostasis

Biology-online says that homeostasis is "the tendency of an organism or a cell to regulate its internal conditions, usually by a system of feedback controls, so as to stabilize health and functioning, regardless of the outside changing conditions." A straightforward example of homeostasis is how the human body regulates its internal temperature so that it stays at 98.6° F. We call this being "warm-blooded" and it is a defining characteristic of mammals and birds. But guess what? Although individual honey bees, like all insects, are "cold-blooded", honey bee colonies are "warm-blooded." The colony maintains its central core, the brood nest, at a near-constant 95-ish° F. This temperature is mandatory for brood, particularly larvae, to develop properly.

How does the colony regulate temperature? When cooling is needed, bees collect water and smear it on the cell walls inside the hive. Other bees fan their wings to create air flow, causing evaporative cooling. Furthermore, bees will absorb heat while inside the hive, then travel to the outside to release it. This type of activity is responsible for what we call bearding, where large masses of bees are often seen on the face of the hive during the hot summer months.



A strong colony will maintain the temperature around the delicate brood at around 95° F, regardless of the ambient temperature. Note that the temperature outside the cluster is as low as 14° F; the temperature outside the hive was 7° F. Source: Charles D. Owens, The thermology of wintering honey bee colonies, ARS Technical Bulletin No. 1429, USDA, 1971

When the brood nest needs heat, certain bees vibrate their thorax muscles as if flying but without moving their wings. This generates heat, just as doing jumping jacks generates heat within a human. Some of these heater bees press against the surface of the sealed brood comb to transfer their heat to the comb and the brood inside. Other heater bees enter empty cells that are scattered throughout the brood nest, raise their body temperature as described, and transfer heat to the surrounding cells. A few strategically-placed empty cells are deliberately left in the brood nest for this very purpose.

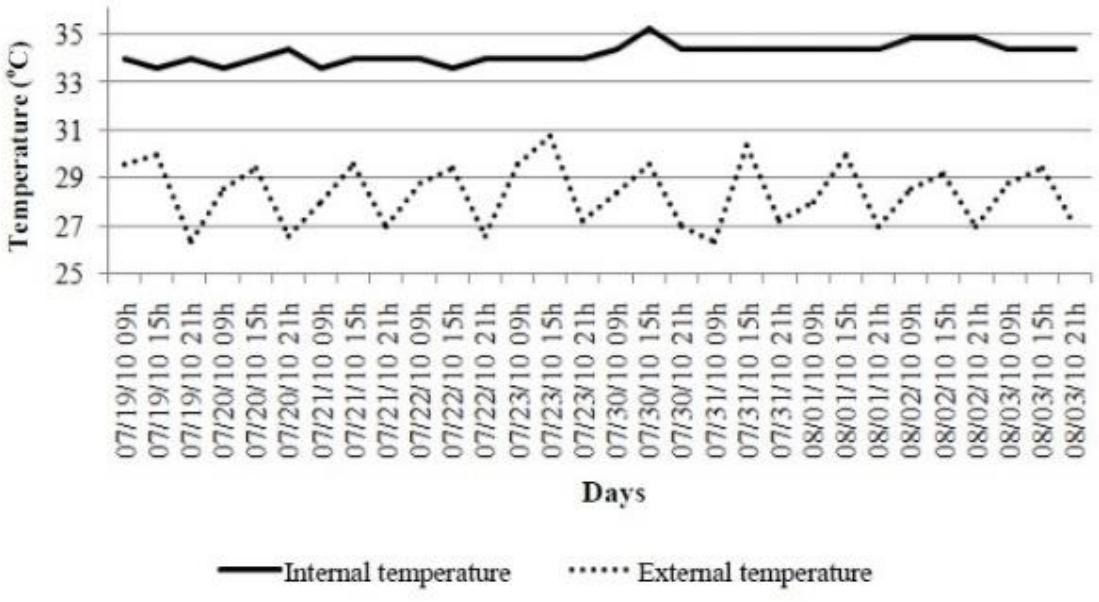
It isn't just temperature that is manipulated: humidity is as well. Inconsistent and incorrect humidity kills brood. The colony brings in water and fans it to maintain humidity at the necessary, fairly high level. It is interesting to note that the colony must remove tremendous amounts of moisture from the food storage area (honey must be dried) but at the same time it must pump up the moisture in the brood nest. The fact that it is able to do both simultaneously is amazing!

It's obvious

I hope I've been able to convince you that with respect to honey bees, the individual bee is essentially irrelevant. It is the colony that is the biological unit of interest. We should ponder the implications that this may have for how we care for our colonies. As one example, maybe we shouldn't agonize too much about sacrificing 300 bees in an alcohol-wash Varroa mite test.

With all of this in mind, shouldn't we change the name of our hobby from Beekeeping to Colony Keeping? At the very least, we should encourage journalists to quit reporting how many individual bees fall off of trucks!

Randall Austin is a NC Master Beekeeper who keeps a few honey bee hives in northern Orange County, NC. He can be reached at s.randall.austin@gmail.com.
Note: All previous articles are archived at https://baileybeesupply.com/educational_resources/



Summertime brood temperature is kept constant by a combination of heat generation, evaporative cooling and heat-shifting. Source: Daniel De F Brasil et al., "Internal Ambience of bee colonies submitted to strengthening management by adding broods", Eng. Agríc., Jaboticabal, v.34, n.5, p.902-909, Sept/Oct 2013