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Defensive Honey Bees: What are they and how should you react to them?

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A brief history of honey bees

Western honey bees (*Apis mellifera*) are a common feature of the American landscape and an indispensable part of commercial agriculture, yet these charismatic pollinators were not always part of this country's diverse bee fauna. Honey bees did not exist in the Americas prior to their introduction during European colonization. Since then, many different subspecies of honey bees were imported to the American continents from Eurasia and Africa, starting as early as the 1600s. *Apis mellifera* is a taxonomically diverse species, comprised of more than 30 subspecies historically grouped into 4-5 major biogeographic lineages: African (A), Western European (M), Eastern European (C), Western Asia (O) and those of the Arabian Peninsula (Y) [1]. Early introductions of honey bees stemmed largely from the European lineages with modest importations from Western Asia. The Italian and Carniolan honey bee were largely the subspecies of choice (*Apis mellifera ligustica* and *Apis mellifera carnica*) particularly preferred for their gentle natures and industrious honey producing capabilities. However, European honey bees had evolved in a temperate climate and were ill-suited to the tropical conditions of South America. To address this, honey bee research scientists sought to selectively breed a common African subspecies *Apis mellifera scutellata* with pre-existing European stock. A small number of *A. m. scutellata* queens were imported from South Africa to Sao Paulo, Brazil in 1956 to begin breeding. Researchers hoped to forge a honey bee that combined the tropical hardiness of *A. m. scutellata* with the honey production capabilities and gentle nature of the European subspecies in popular use. In an unanticipated accidental spillover event, hybridized honey bees escaped their research apiaries and settled into the surrounding areas, establishing robust populations by interbreeding with the medley of preexisting European honey bee subspecies. These honey bee hybrids, created by the mixture of African and European lineages, adapted remarkably well to the new habitat and set off on a geographic species range expansion that now extends from northern Argentina to northern California (U.S.A.) [2,3]. The heightened degree of territorial nest defense characteristic to *A. m. scutellata* honey bees and their hybrid forms spurred a large degree of public concern over the territorial expansion of this invasive insect. Such was the public tremor that the media and popular press dubbed it the "killer bee" following several human fatalities caused by mass stinging attacks. The *scutellata*-hybrid honey bee is now securely established across Central and South America and much of the southwestern United States.

What's in a name?

Most people think of them as "Africanized" bees, however this label is perhaps due for an update. Originally meant to highlight the African ancestry of the hybrid form, the term now faces greater scrutiny for its overgeneralization. Researchers have begun to move away from the blanket term of “Africanized” to one of greater phylogenetic specificity: “scutellata hybrid” [4]. More than a dozen subspecies of honey bees are native to the African continent, many of which differ vastly from *A. m. scutellata*, the African subspecies introduced to the American continents. Thus, the term “Africanized” is seen as frustratingly broad as there exists no single African honey bee. It is also impossible to stereotype all African honey bees as exceedingly aggressive as there exist several African honey bees subspecies well known for their gentle characters (e.g. the honey bees of the Ethiopian Highlands, *Apis mellifera monticola*) [1,5]. It is perhaps time to revisit the use of the term “Africanized” and employ the more specific term “scutellata hybrid” to describe this honey bee type.

Where are they?

In California, feral bees with significant ancestry from *A. m. scutellata* now extend up to the south of Sacramento [2-4]). However, the amount and frequency of significant *A. m. scutellata* ancestry varies. For instance, in San Diego and nearby regions of southern California, all unmanaged honey bees sampled have approximately 40% *A. m. scutellata* ancestry, with the remaining 60% of genes coming from other honey bee lineages [4,6,7]. Because unmanaged (feral) honey bee populations are large, queens from managed hives that mate locally may produce offspring that are *A. m. scutellata* hybrids, particularly in southern California. As you travel north, the percentage of genes coming from *A. m. scutellata* decreases until, near Davis and Sacramento, only a minority of honey bees have any *A. m. scutellata* genes, and, when they do, these genes make up only a small portion (10-15%) of their genomes [4]. As a rule of thumb for the current situation in California, unmanaged honey bees south of Bakersfield are highly likely to be *A. m. scutellata* hybrids while those north of Bakersfield are less likely. In South America, *A. m. scutellata* hybrids extend south into northern Argentina where their range appears to be limited by cold winters. It is unclear if *A. m. scutellata* hybrids will continue to advance north in California. Their rate of range expansion has clearly slowed, but warming temperatures may favor future range expansion.

What to do if you encounter defensive bees

Bees are usually more defensive when they are near their colonies, a natural behavior that one may inadvertently trigger when encountering a nest [8]. This can occur both with managed and feral colonies [9] and is not a trait exclusive to any bee species. It also applies to managed bees such as *Apis mellifera ligustica* [8]. However, it is true that feral bees, particularly those genetically admixed with *A. m. scutellata* can have heightened defensiveness [9], though not always [5]1.

In general, unless you are wearing full protective honey bee gear, one should avoid bee colonies. Because managed honey bees are usually kept in conspicuous boxes, they are easy to spot. However, feral bees can nest in cavities such as holes in the ground, in walls or attics, in hollow trees, within saguaro cactus cavities, or in water meter boxes and are therefore less conspicuous [10]. To avoid such colonies, it is best to listen for its steady buzz or watch for flight activity. Note that such signs decrease when it is colder and at night. Watching for these signs may also be difficult to do when engaging in a noisy activity or when walking or running. One strategy is to avoid climbing a tree or disturbing an object (kicking a log or rock) before first checking for bee activity. Wearing lighter-colored clothing may be somewhat helpful since bees orient towards dark objects. Wearing clothing that provides better coverage can also help. However, these measures will not provide much protection against a large colony when its defensive behavior is triggered. In some cases, highly defensive bees can sting when you are some distance from the colony [11]. Sometimes bees will approach if you have an odor associated with sweet food. However, if a bee is following you and seems particularly interested in dark areas on your person (often your hair), do not swat it or disturb, but try to move away. If a bee persists following you as you move away, this is unusual. Move rapidly away until you are no longer being followed.

If you observe strong defensive bee behavior, the best strategy is to run away. You may not know where the colony is, but this is not necessary. Move away from where you first noticed defensive bee behavior. Most serious incidents have occurred when people trapped themselves inside an enclosure into which bees could enter but people could not leave. In one well-reported Southern California incident, the victim simply lay on the ground [12]. Each bee sting marks you with alarm pheromone that attracts more bees and a stay-in-place strategy will result in more stings, which can easily penetrate light clothing. Running away works because a motivated individual can usually outrun the bees. In addition, moving rapidly away will reduce the number of stings that you receive. It is important to **not** cover your eyes when running since you are more likely to trip and fall if your vision is obscured. You should also not attempt to submerge yourself in a body of water since you will inevitably need to come up for air, and the bees can continue to follow as you swim [13]. The panic and anxiety of an attack can also harm one's ability to swim effectively.

Your first priority should be running away, not removing stings. If you have only received a few stings and are no longer being followed by bees, it is then safe to begin removing the stingers. Some recommend using tweezers or credit cards for removal, but this takes time, and the faster you remove the stingers, the less the inflammatory effect. When a bee stings you, it usually deposits a poison gland that continues pumping. Studies have shown that the size of the allergic reaction is correlated with how long the sting remains in you, so quick removal is best [14]. Just use your nails to scrape out the stingers. Defensive bees are often attracted to dark objects such as dark hair, so it will be difficult to find all the stings in hair. Please seek help.

If you are required to carry the medical device known as an EpiPen, you should use it when and as advised by your health care provider since it is a prescription device that carries its own risks. Incorrect or inappropriate use can have serious health consequences [15]. If you have any concerns after being stung, please immediately call 911 or contact your health care provider. Finally, if you were stung in an area with other humans or pets, you should warn them of what happened. In a neighborhood, people should stay indoors and make sure that windows and doors are secured to prevent bees from entering.

A silver lining?

Feral honey bees have existed in the United States since the first managed colonies swarmed. Because these feral honey bees are not treated for diseases or parasites, they have been subject to natural selection and are, in some ways, the ultimate survivors. Buffeted by pesticides, diseases, and parasites, they nonetheless survive. What can we learn from them? As noted, feral bees in southern California have a strong likelihood of possessing genes from *A. m. scutellata*. While studies in other US regions suggest that the such genes are not necessary to explain why feral honey bee colonies are abundant despite not receiving treatments, like managed colonies [16], this is a fascinating question that deserves further study.

Multiple factors, including climate change, poor nutrition, pesticides, parasites, and diseases contribute to pollinator stress [17,18], densely packed colonies, pesticide exposure [19], poor nutrition [20], and increasing pathogen pressure [21], managed honey bees continue to experience mounting stress that feral honey bees (including *A. m. scutellata* hybrids) also face. If so, how can explain the large number of feral honey bee colonies throughout southern California? As others have suggested [16], survival of the fittest (natural selection) likely has an important role since, by definition, only those colonies that resist these pressures will survive and propagate. Such natural selection generally benefits from increased genetic diversity. As reviewed above, feral honey bees in southern California are mixtures of several honey bee lineages and harbor increased levels of genetic variation relative to managed honey bees. Research in other parts of the US where *A. m. scutellata* genes are absent has shown that increased genetic diversity *per se* is important for disease resistance in both managed and feral honey bees [22]. However, in South Carolina [23], feral honey bees have somewhat lower genetic diversity than managed honey bees, suggesting that genetic diversity is important, but the exact genes under selection matter. For example, researchers have found that Pennsylvania feral honey bees have higher expression levels of some immune genes than managed honey bees [24], a pattern similar to what has been documented in South Carolina [23]. These differences are exciting because they suggest ways in which we can use these "survivor" bees to understand what behavioral and genetic traits can help honey bees deal with multiple stressors.

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