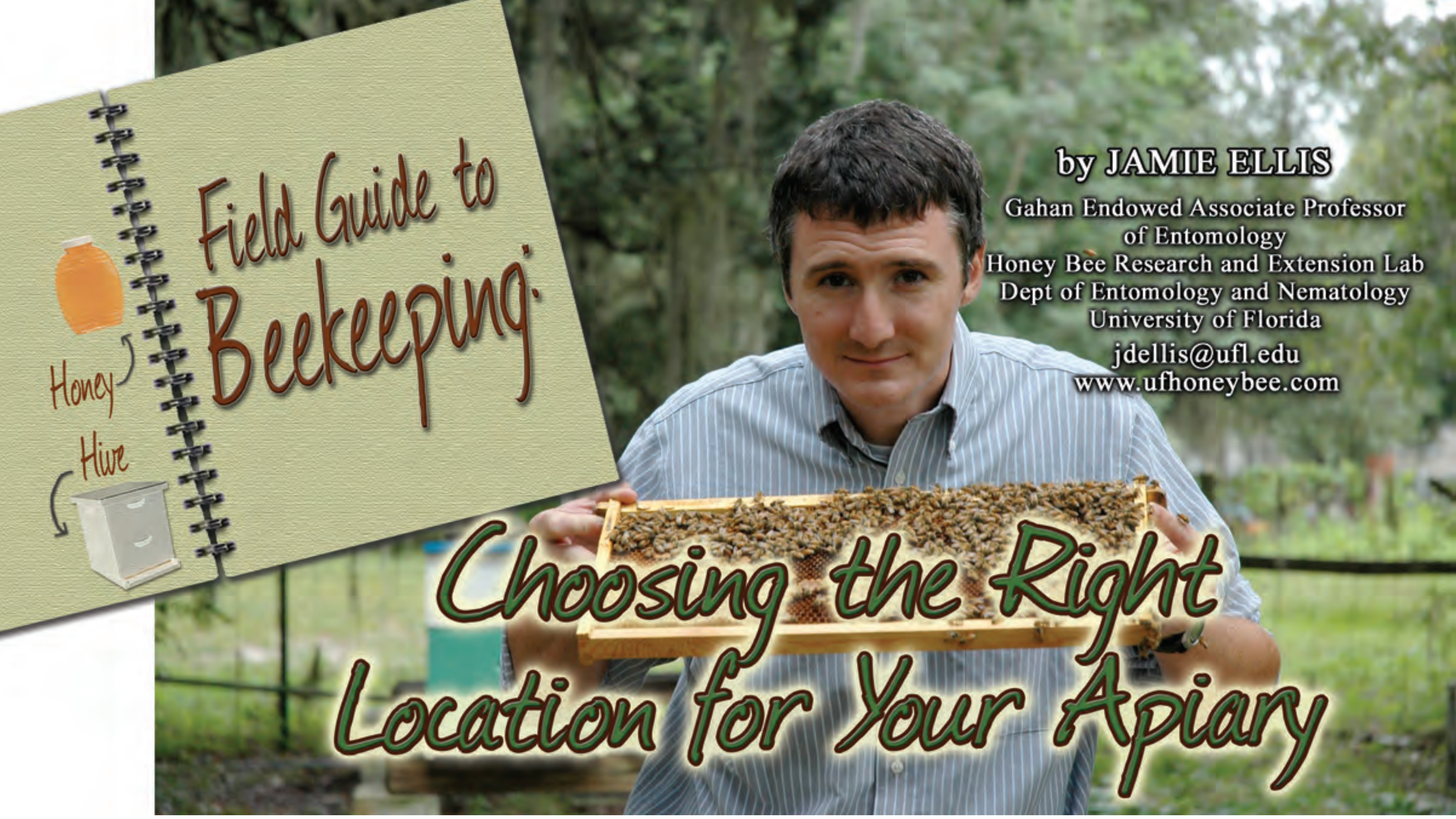

Field Guide to Beekeeping

Choosing the Right Location for Your Apiary

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An apiary is an assembly of one or more bee hives at a single location. I once believed that you could establish apiaries anywhere and that the bees would thrive and make honey by the bucket. Boy, was I wrong. I grew up in central Georgia and had only one apiary site during my early years. My grandfather was a dairy farmer and he was gracious enough to allow me to keep my bees on his farm. The site was great. I enjoyed many years of keeping bees and making honey. The apiary location was good for the bees, but it significantly skewed my view of beekeeping. When I began to teach about bees and beekeeping, I would scoff at people who would tell me that their bees were not making honey at the apiary site they chose. I always believed that they had this problem because they did not know how to keep bees. After all, bees make honey everywhere.

Then, I moved to High Springs, Florida. I was told, before moving to the area, that it was a difficult place to keep bees. Local beekeepers told me that bees survive just fine in the area, but that they do not make honey. Of course, since I knew everything, I believed the people just did not know what they were doing. I would keep bees in High Springs my way, and sit back and watch the honey come in by the gallon.

I failed to make any honey the first year I kept bees in High Springs. Surely, that was an anomaly, an unlucky twist of fate. Of course, it happened again the second year. I began to question my tactics. By the third year, I was convinced that one could not make palatable, surplus honey in the city I now call home. I had learned an important lesson. Not all apiary sites are created equal.

This article is about choosing the right apiary site to locate your bees. The characteristics beekeepers look for in apiaries vary by how they intend to use the apiary. For example, staging yards (apiaries where colonies are put temporarily for purposes other than pollinating crops and/or making honey) can just be large fields and relatively void of good forage for the bees. On the other hand, you have to put bees close to nectar-rich plants if you want to make honey. Regardless, all "good" apiary sites share common characteristics one must value in order to maximize colony production and beekeeper enjoyment of the craft. Just like in real estate, all that matters when choosing apiary sites is location, location, location.

Before discussing some "apiary essentials," I want to note that I realize that beekeepers, especially hobbyist beekeepers, often have little choice when picking a good apiary location. Sometimes, your only option is your only option. There is nowhere else to go. However, there are good pointers to remember even when your options are limited.

20 Characteristics of a Good Apiary Location

1) There must be copious, quality pollen and nectar sources nearby (Figure 1). Honey bees thrive when floral resources abound. However, a plant does not necessarily produce quality nectar and/or pollen just because it blooms. Have you ever had tulip honey? Even if a given plant produces a lot of nectar, there must be enough of the plants around in order for the bees to make honey. I often get the comment that "I have a citrus tree in my yard and I do not get any citrus honey": of course not. Bees have to forage from numerous citrus trees in order to make citrus honey. The same is true of whatever nectar source your bees are pursuing.

One also should be careful to believe the distance rule of foraging behavior. We have all read in books that bees will fly two to five miles from the nest in search of nectar and pollen. Though this is true, do not expect a crop of sourwood honey if there are five acres of sourwood four miles from your apiary. The best apiary sites are those located as close as possible to the quality forage resources.

Furthermore, a potential apiary site may yield honey, but it may not be palatable. For example, my bees make a super of wild cherry in February and one of Spanish needle in September. Neither honey is palatable to most humans. There is nothing else in my area the rest of the year except pine and oak trees (Figure 2). Neither are known to yield nectar that bees can use to make honey. My bees are able to sustain themselves on the cherry and Spanish needle honey, but they do not produce a marketable crop for me.

My advice here is simple: check with other beekeepers in your area to determine if the area has a history of providing major nectar flows and quality pollen. I find beekeeper advice quite valuable in these instances. At the end of the day, however, there is no substitute for giving the area a try. You really will not know if nectar and pollen resources abound if you do not place colonies there for some years. My rule of thumb is that I will give an area three years with five to ten hives before I consider it a resource desert.

(l) Figure 1: Saw palmetto (shown) and gallberry are important honey plants in north central Florida. They often grow in thick patches over a wide area. Though this location is a great place to produce honey, it may not be an ideal apiary site the rest of the year when palmetto and gallberry are not in bloom. After all, what else is there for the bees to collect? (r) Figure 2: A resource desert for honey bees. This forest looks lush and healthy, but that does not mean that it is a good place for bees to forage. A close inspection will show that it is composed principally of oak trees. Oak trees do not produce nectar or pollen that bees can use. This is not a suitable location for a potential apiary, especially if this type of plant life dominates the surrounding area (and it does in this case).

<u>2) There should be a source of clean water near the colonies.</u> Bees need water to survive. They are going to forage for water at the nearest quality source, which always seems to be exactly where you do not want them to forage. Consequently, a convenient source of water should be available to the bees at all times during the year so that the bees will not congregate at swimming pools, pet watering bowls (Figure 3), or other watering sources where they may contact humans, birds, or domestic pets. Some sources of water that beekeepers can provide include: (1) a tub of water with wood floats to prevent the bees from drowning, (2) a faucet in the apiary that is left to drip steadily, or (3) filling Boardman entrance feeders (quart jars with holes in the lids) with water and placing them in the colony entrance (Figure 4). If using tubs of water, the water should be changed periodically to avoid stagnation and mosquito breeding.

<u>3) Apiaries should be established away from where people or animals frequent.</u> Most people are scared of bees. Some are allergic to bees. Nothing will kill your beekeeping hobby quicker than neighbors who are upset at you for allowing your bees to drink water from their pool. Most beekeepers adopt the "out of sight, out of mind" policy with locating their hives at a suitable apiary site. For practical reasons, and to promote public safety and reduce beekeeping liability, one should not site apiaries in proximity to tethered or confined animals, students, the elderly, general public, drivers on public roadways, or visitors where animal/bee and people/bee interactions may have a higher likelihood of occurring.

<u>4) Apiaries should not be visible to vandals.</u> There are two reasons to "hide" apiaries from others. The first we addressed in point 3 when we noted that bees can be a public safety issue in some circumstances. The second reason is that bee colonies can be the target of vandals. Colonies and colony equipment are stolen regularly. It is a good idea to keep your colonies out of site.

<u>5) Apiaries must be easily accessible.</u> I have traveled all around the world and seen people keep bees in the hardest possible places to access. I have seen colonies on roofs, in narrow mountain passes, in the thickest imaginable bushes, etc. I take the completely opposite approach. Beekeepers should be able to get to their bees easily. The access road should be navigable and not be prone to flooding. Apiaries should not be located in bushes or on the edge of steep grades. Of course, one should not make it easy for others to find and access your apiary. Yet, you should be able to access your bees when needed. I feel that you should be able to drive a truck and trailer to your bees and have enough room to turn the vehicle around easily.

<u>6) It is a good idea to have a written agreement when locating apiaries on other peoples' property.</u> Beekeepers often need to locate apiaries on property owned by others. Commercial beekeepers do this all the time. Many hobby beekeepers I know, especially those living in subdivisions, also have to locate their bees on property they do not own. When this happens, I recommend that the beekeeper and landowner have a written agreement concerning the use of the apiary site. The agreement could stipulate how long the bees are allowed to stay, the site rental fee (if any), road maintenance, property owner pesticide use practices, etc. I know, a man's word was good enough in the good-old-days. Well, these are not the good-old-days. Have a written agreement.

<u>7) Avoid locating apiaries in low areas.</u>

Figure 3: Bees drinking water from my dogs' watering dish. My colonies are not located close to any rivers, lakes, ponds, streams or other sources of water. Consequently, my bees regularly visit my dogs' water dish to collect water. This could be bad if it happens to be your neighbor's dog's dish.

Figure 4: I use Boardman entrance feeders to deliver water to my bees. I note that this seems to limit the number of my bees that wander elsewhere for water.

Low areas are not ideal apiary sites for three reasons: (1) cool air sinks to low areas, (2) moist air tends to settle in low areas, and (3) low areas are at risk of flooding. Apiaries sites should be high and dry.

8) Bees located in full sun have to work hard to keep their colonies cool. I have heard all sorts of advice regarding sun, shade and apiaries. In general, the historic advice concerning sunlight is that bees need morning sun and afternoon shade. Their colonies should face south. I am not aware of any research available to support those statements. However, the anecdotal support for the statements seem to be that (1) morning sun "wakes the bees up and gets them moving earlier", (2) colonies need to be in the shade during the heat of the day and (3) colonies facing south get maximum sun exposure on their entrance as the sun moves along its southern elliptical orbit (I know, the sun is not moving – the earth is simply rotating). I am not sure if any of this is true or useful. Many beekeepers feel keeping bees in full sun reduces disease and pest pressures in colonies (see point 9). I have not seen convincing evidence for this supposition. What I do know is that bees living in colonies located in full sun have to work harder to keep their nest cool. When bees work harder, you lose honey. On the other hand, apiaries should not be located in full shade. Bees do seem to do better when their colonies get some daily sun. At the end of the day, "morning sun and afternoon shade" might just be the best advice after all . . .

9) The apiary site should not promote high disease and pest pressures. The science on this topic is in its infancy, but I feel that there are some locations that make it easier for bee pests and pathogens to weaken colonies. You hear this a lot with small hive beetles and chalkbrood, for example. Usually, local beekeepers have a good feel for the disease and pest pressure in an area. You would do well to vet any potential apiary site with a knowledgeable, local beekeeper.

10) Flying bees should be "encouraged" to fly above head level. Watch the entrance of a bee colony and you will notice that the flight activity at the nest entrance is reminiscent of the flight activity at Hartsfield Jackson International Airport in Atlanta. There are bees flying everywhere, in every direction. If you have ever flown, you will know that planes do not take off at a 90º angle. They climb gradually, even if it feels they are launching like a rocket.

Likewise, given no obstruction, a departing bee will leave the colony at a small angle, gradually gaining altitude as she distances herself from the nest. This is a significant problem for apiaries located close to tethered animals or places where people frequent since the bees, in their climb to cruising altitude, may encounter people or animals and respond negatively.

One can establish and maintain a flyway barrier to address this issue. The ideal barrier is at least 6 feet in height and consists of a solid wall, fence, dense vegetation or combination thereof and extends 10 or more feet beyond the colonies in each direction. A barrier will force the bees to fly at an elevation of at least 6 feet upon their exit from/approach to the hive. This flight path will minimize human/bee traffic interactions and will nearly eliminate those lovely encounters where you step into the air traffic of a busy hive, thus leading bees to get stuck in your hair.

Figure 5: This apiary is located in an area where bears are known to frequent. Consequently, the beekeeper built an electric fence around his apiary to keep bears from damaging/destroying the colonies.

11) Apiaries should be located away from areas that are treated regularly with pesticides. This can include some areas that are farmed heavily, but it may also include urban areas where property pest control, mosquito spraying, etc. are common.

12) Avoid locating apiaries in areas prone to frequent, high gusts of wind. Wind can cause significant damage to colonies during winter months. It also can wreak havoc on colonies during mating season, when queen bees are taking their mating flights. The latter is, in fact, one of the leading hypotheses for the development of thelytokous parthenogenesis in Cape honey bees (you will have to do your homework on this phenomenon to see what it is; alternatively, you can wait a few years for me to end up covering the topic in my column ☺ . Regardless, apiaries should be protected from strong wind.

13) Apiaries should not be established in a flood zone. Bees have four wings and six legs. They do not have any flippers. Consequently, bees cannot swim. Neither can their beehives. Beware of placing colonies in flood zones. Colony flooding can be a significant problem, especially if the target nectar plant of interest (tupelo, for example) resides in swampy areas that are prone to flooding.

14) Colonies should be protected from bears (Figure 5) and other vertebrate pests. People tend not to know that bears are present in an area until they keep bees. Bears WILL find your colonies if they live in your area. Apiaries sited in areas where bears are present must be protected. This usually is accomplished using an electric fence.

I include "other vertebrate pests" to note that skunks, opossums, birds, rodents, etc. can be a threat to colonies. People in other geographic regions have to contend with additional vertebrate threats. I did my PhD work in South Africa, where baboons were a threat to bees. One should know the given vertebrate threats associated with a potential

Figure 6: This nuc is almost overcome with grass and vines. Thick plant growth can restrict bee movement into and out of colonies. It likely impacts colony ventilation as well. Apiaries should be easy to maintain.

Figure 7: Colonies can be damaged significantly when trees and their limbs fall. I learned the hard way. I spent a lot of time cutting away limbs from a tree that fell and crushed my colonies (a). The hives survived (b), but it took considerable time to fix the problem. I should have known better than to put my colonies under a leaning, live oak tree!

apiary site and either take steps to protect the colonies from the threat or simply choose a different apiary site to locate their bees.

15) The apiary site should be easy to maintain. This simply means that the beekeeper should be able to mow the grass, weed around colonies, etc. without battling large rocks, thick underbrush, large trees, or steep inclines. Level apiaries are best. Colonies should not be allowed to be overtaken by tall grass or thick brush (Figure 6). Furthermore, keep in mind that trees and limbs eventually succumb to gravity, so beekeepers should be prepared to address these issues when the time comes (Figure 7).

16) Good apiary sites are free of colony debris. This is more a management issue rather than a quality of site issue. However, it is worth noting here. Any characteristic that makes it difficult for the beekeeper to keep a clean apiary should be viewed negatively. No bee comb or other materials should be left on the grounds of the apiary site. Upon their removal from the hive, all such materials should be disposed of promptly in a sealed container or placed within a building or other bee-proof enclosure.

17) Whenever possible, apiaries should not be sited in areas that are prone to high-risk, natural phenomenon. For example, how harsh are the winters (wind and cold)? Does the potential apiary site have fires frequently? How heavy is the rainfall? Is the apiary near a fault line? Is the site on the side of a mountain prone to mudslides or avalanches? Apiaries succumb to natural disasters just like the rest of us.

18) Beekeepers who have multiple apiary sites should optimize the distance between apiaries. This means that apiaries should be far enough apart to maximize colony foraging efficiency, but close enough together to make it economical for the beekeeper to visit multiple apiaries during one trip. Regarding the former, bees will fly 2-5 miles from their nest to gather nectar and pollen. Consequently, I recommend that beekeepers keep their apiary sites at least four miles apart to take advantage of a colony's natural foraging range. Colonies in apiaries spaced four miles apart work their local two mile radius energetically best and only overlap with the four mile flight radius of the nearest apiary when the bees fly 2-4 miles from the nest. I believe this maximizes foraging efficiency.

19) Apiary sites should meet all requirements set forth by local, regional and state laws. This is very important. Many beekeepers, usually unknowingly, establish apiaries in areas where bees cannot be kept legally. This may be in certain counties, cities, or municipalities that regulate the placement of apiaries. Sometimes, apiaries can only be established in areas zoned for agricultural use. It is important that beekeepers check local and state laws to determine the legal issues surrounding siting an apiary. One last word of caution: Do not assume that you can put an apiary in your backyard if there are no local or state laws prohibiting the keeping of bees in certain areas. People who live in subdivisions, especially those that are governed by home owners' associations, may be forced to keep bees elsewhere. The rules of a homeowners' association often trump other regulations/laws since the homeowners submitted willingly and voluntarily to the rules when they joined the association. Regardless, it is important that potential legal restrictions be known before establishing an apiary.

20) Aesthetics – go ahead, pick a pretty site for your apiary. If all or most of the other criteria for choosing an apiary are followed, then you might as well keep your colonies in an area where you enjoy visiting. For many beekeepers, the aesthetic qualities of an apiary site trump some of the other qualities I mentioned. For example, some beekeepers are willing to trade ease-of-access to a site for the beauty of the location. Beekeeping should be fun, so it is okay to want to place your bees in an area that is naturally beautiful.

Usually, time is the best determinant of the quality of an apiary site. The truth is that you will not know how good a site is until you locate colonies there. Even then, colonies may need to be on site for a few years before you get a good idea of the site's quality. You have probably noticed throughout the article that I often mention that you should network with local beekeepers to discuss where to place your bees. They often have first-hand knowledge of the quality of the potential site and its propensity to harbor disease, pests, bears, or other hazards. Remember, choosing the right apiary is about location, location, and location. I hope the 20 tips I discussed above will help you as you consider the options available to you for placing your bees.

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HONEY BEES 101: HAPLODIPLOIDY

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One of the key characteristics of the insect order Hymenoptera, the order to which bees, wasps and ants belong, is that its members have a haplodiploid reproductive system. In the simplest context, this means that males (drones) result from unfertilized eggs (a process called arrhenotoky) and females (queens and workers) result from fertilized eggs. As simple as it sounds, haplodiploidy is profoundly important in the world of hymenopteran insects.

Queen honey bees do not mate in the hive; otherwise, they would mate with their brothers. Within the first 10 days of their lives, queens leave the hive, fly to areas where drones congregate (you guessed it: "drone congregation areas"), and mate with around 15 - 20 drones. Queens do all of this in the course of one or maybe two mating flights, and then never mate again. Queens are able to store semen from each drone in a special organ in their bodies, the organ being named the "spermatheca". Armed with a lifetime supply of eggs and a 3 - 4 year supply of sperm, queen bees begin laying eggs around 10 days of age.

The interesting thing about queen bees is that they can control the sex of the egg. Remember, drones result from unfertilized eggs. So, the queen will lay an egg and withhold semen from it when she desires to produce a drone. On the other hand, the queen will release semen from her spermatheca when she wants to produce a female offspring. Queens only control the sex of the egg. Workers control whether a fertilized egg becomes a queen or another worker (more on that in a future Honey Bees 101).

Think about the implications of this genetically. Female honey bees are diploid, having been produced from an egg contributed by the mother and that was fertilized by a sperm contributed by her father. Female bees have two alleles (types of a given gene) for each gene, the allele contributed by the mother and the one given by the father. The female offspring can only inherit one of the two alleles that her mother possesses. Since drones are haploid, their female offspring ALWAYS inherit EVERY allele the father has. After all, he only has one copy of every gene that he can contribute.

Drones, being haploid, receive everything they have from their mother. Consequently, drones do not have fathers and cannot sire sons. They do, however, have grandfathers and can produce grandsons (there is some honey bee trivia for you). Since the queen has two alleles for each gene and the drone can only inherit one of those alleles, the drone is not a male "clone" of the queen. In fact, the drone only inherits half of the queen's alleles (one of two alleles for each gene the queen has).

Now, let us put all of this together. In haplodiploid reproduction, females are more related genetically to their full sisters (sisters that have the same mom and dad) than they are TO THEIR OWN OFFSPRING. I will show you how this happens. Consider a queen that mates with one drone and that produces two worker offspring. Half of the alleles that both workers possess come from the drone (their father). Since their father only has one set of alleles for each gene, the workers share identical alleles given by the father. The father gives the workers half of everything they have; so, two workers are at least 50% related genetically. Now, the queen has two alleles (again, types) for each gene. The workers can inherit only one of those types. Statistically, workers only share 50% of the alleles possessed by their mother and only half of their total allotment of alleles come from their moms (so they share half of 50% of their alleles = 25% shared alleles). Thus, workers that are full sisters share 100% of half of their alleles (those provided by the father) and 50% of the remaining half (those provided by the mom). <u>Consequently, workers that are full sisters share 75% of their DNA</u>. Contrast this with the genetic relationship between the queen and her offspring. A queen gives half of what she has to her offspring. She is only 50% genetically related to her offspring. Thus, full sisters in a haplodiploid system share, on average, 75% of their DNA while mothers only share 50% of their DNA with their offspring.

This is a complicated process to explain so let me give you an imaginary example to help walk you through the math. Let us pretend that one gene codes for the color of workers. That gene can come in many forms: A (brown), B (yellow), and C (red). A, B, and C are alleles of the color gene. The drone is haploid so he can only have one allele for color. We will say he has the C allele (or is red). The queen is diploid so she can have a combination of any of these alleles. For example, she could get A from her mom and B from her dad, B from her mom and B from her dad, and so on. For the sake of our example, let us say she has A from her mom and B from her dad, making her AB. Now, you have an AB mom mating with a C dad and producing two workers. Both workers MUST get C from their dad. That is all he has to give. Therefore, half of the sisters' alleles are 100% the same, i.e. the two workers completely share at least half of their DNA, that given by the father. Now, both workers have to inherit an allele from their mom. They could (1) both get A, (2) both get B, (3) or the first get A and the second B, (4) or the first get B and the second A. With these options, they both inherit the same alleles in two scenarios (1 and 2) and opposite alleles in the other two (3 and 4). Average this out over all genes and any two full sister workers statistically end up sharing about half of the alleles given to them by their mother. Since the mother contributes half of both workers' alleles and the workers only share half of those: 50% of 50% is 25%. The 25% shared from the mother added to the 50% shared from the father equals 75%. Again, full sisters in a haplodiploid system are more related than mothers are to their own offspring.

Among other things, some believe this relatedness contributed to the development of sociality in bees. Why else would females forfeit the right to produce children of their own in favor of raising their mother's offspring? After all, all life yearns to reproduce. Imagine, however, a scenario in which you are more related to your mother's offspring than you are to your own. Put succinctly, you would have a better chance of passing on your genes if you ensure your mother's reproductive success. This anomaly is a consequence of haplodiploidy.