Beekeeping (R)evolution – a Species Protection Program

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I learnt conventional beekeeping from my grandfather in 2006, while studying Biology at the University of Hamburg.

My first awakening happened when I treated my hives against *varroa* and then found hundreds of antennae on the mesh bottoms. This was the bees' response to the recommended treatment: self-mutilation.

It is this experience which spurred my search for better ways of keeping bees.

Through my experience with pseudoscorpions I was led to examine and research the climatic conditions of modern hives.

I was fortunately asked by Prof. J. Tautz to research the differences of climatic conditions in tree cavities and modern beehives and their effects on bee health. We have been able to establish impressive data that led us to conclude that the majority of bee hives in common use fail to offer the bees an environment that is appropriate to the needs of the species, with concomitant effects on the bees' health. I am much encouraged by my finding many wild bee colonies in Germany, and these have become my passion. I believe they have much to teach us. All we need to do is to cultivate an honest and open attitude to learn from them and apply this learning in all ways we can. We can already conclude that most of the bees' problems in our time are man-made.

In the last few years I have very often found myself standing in the fire of criticism because I am very critical and straightforward about my findings of how the methods of modern beekeeping affect the bee's biology. However, I am not doing this research in order to please someone! I am doing it because I want to help preserve the ecosystem of which we are a part, for future generations, and, of course, especially for my four-year-old daughter, who already identifies herself as a bee researcher to others, probably the youngest one ever...

It is apparent to me that modern beekeeping will eventually send the species of honeybees into its demise, if no counter-movement should arise. Not because beekeepers are vicious or ill-minded, but because the majority do not understand the effects of their manipulations as a whole.

Romy and I at the research institute in Aura an der Saale. A tree cavity simulation "the Schiffer-Tree" is placed on a weighing machine in order to monitor the overall weight changes and storage usage during the wintertime. Romy is offering flowers to the swarm that was placed inside, knowing they do not have any storage. They weighed 900 gm and grew to 5.9 KG of weight within 4 weeks. They can be monitored live on YouTube: https://www.youtube.com/watch?v=k5ui7wej8gA / https://www.youtube.com/watch?v=-mUqA6yJU8U

A century ago, man-made breeding, selection and beekeeping did not cause a threat to the species of honeybees because only a small fraction of the genetic pool was lying in human hands most of it was subject to natural selection. Nowadays tables have turned, and the main part of the 45 million years old, system-relevant key species, (which is literally carrying our ecosystem on its wings) is subordinate to the mercy of beekeepers that are either seeking to use honeybees for their own benefit or are somehow caught in the trap of modern beekeeping with all its side effects.

Altogether, it took me more than a decade of research to finally see a clear picture of the misery that bees are commonly forced to endure in our husbandries. Even though most beekeepers have the best intentions or idealistic reasons to keep bees, they are mainly blind to anything that wasn't taught to them, which easily leads to misinterpretations and questionable actions.

Scientists at work!

Top: Romy (4y) discovered one of the swarms that moved into a tree cavity only a stone´s throw away from our house and showed it to me (scientific research has become very convenient these days, for the first bee trees that were reported to me, I drove several hundred miles).

Bottom: Romy shortly after her third birthday offering some plants to a swarm that was just put into a skep.

Modern beekeeping is based on manipulation

In modern beekeeping everything is geared to easy interventions and prevention or suppression of "unwanted" bee behavior. It starts with the hives, nor-

mally un-insulated, thin-walled boxes with frames. The frames alone shackle the natural behavior of bees significantly in multiple ways. They are interrupting their communication, which is based on vibration; they prevent bees from building their combs freely, which would allow them to improve the climate by preventing heat loss within an unsuitable housing; frames cause a vast heat loss due to the bee space. The warm air heated by the bees streams away and spreads into the whole, normally voluminous, structure and gets lost through the relatively thin walls. In comparison, in tree cavities every gap in-between the combs forms a closed room where the preheated air gets trapped and is well-insulated by rather thick walls. On frames in boxes bees are forced to increase their metabolism incisively. Despite their extra effort they are not able to establish a stable climate in such housings, like they are able to do in species-appropriate geometries (structures). This is causing many negative side effects, including the loss of the sterile atmosphere that is found in tree cavities.

There is a huge amount of historic literature that describes very convincingly the fact that diseases and epidemics were spreading widely when beekeeping incorporated the frames and boxes which have become the status quo in our time. Nevertheless, the obvious negative effects have been ignored for the benefits of an easier manipulation. Today frames are extremely common and mostly unquestioned. Historical literature pertinent to the topic seems to have been forgotten. One text that I would like to point out is "Nestduftwärmebindung" written by Johann Thür in 1946. I highly recommend this literature to everyone. He described the antibiotic atmosphere in natural conditions, which could also be found in skeps. An English translation can be found here: www.naturalbeekeepingtrust.org/nest-scent-warmth.

I stumbled upon these astonishing coincidences when I was using a high definition endoscope for doing research on bees in an oak tree cavity, located in a massive trunk, during wintertime. Now, I already knew from measurements that tree cavities in oak trees get extraordinarily humid, which is caused by the morphology of the wood of oak trees. However, I could hardly believe how moist it really was. The footage shows vast amounts of water, not only on the inner walls of the cavity but also on the blossom-white storage combs and, strikingly, on the bees themselves.

Astonishingly, there was absolutely no indication of pathogens like the mould which is spreading widely in our boxes when condensation takes place, even though we had the best conditions that one could imagine for mould to spread. Further research on that matter confirmed Thür's observations and disclosed some features that no one has ever looked at before, like the water-cycle in tree cavities. By digesting honey, bees produce a lot of water. This water condenses on the propolis layer of the cavity and dissolves some antibiotic ingredients out of it. Bees eventually re-collect this water and literally drink their own medicine. Moreover, even the atmosphere itself showed sterilizing features which could be proved by placing mould-infected culture mediums directly into the cavity with the result that no pathogens were spreading on them. The thoroughly propolis-coated walls of the cavity are apparently dissolving antibiotic substances into the air. This effect seems to function efficiently at a temperature that is higher than 10 degrees. Underneath this temperature mould starts spreading slowly, which is one of the reasons why we cannot find this antibiotic system in our boxes. Those geometries always have cold areas, like the corners. Another reason is that our boxes are too smooth and therefore not being propolized by bees. In conclusion, the antibiotic system that has kept the bees healthy for millions of years cannot be found in modern hives.

Johann Thür also commented that diseases like Nosema and AFB were spreading significantly with the introduction of frame hives. Taking all the gained information into account, it seems very plausible that the common diseases of modern beekeeping are nothing but a side effect of the established husbandry, perhaps more appropriately called 'management' system. Additionally, there is not a single case of such epidemic outbreaks known that originated in bees living in trees or comparable natural conditions like skeps.

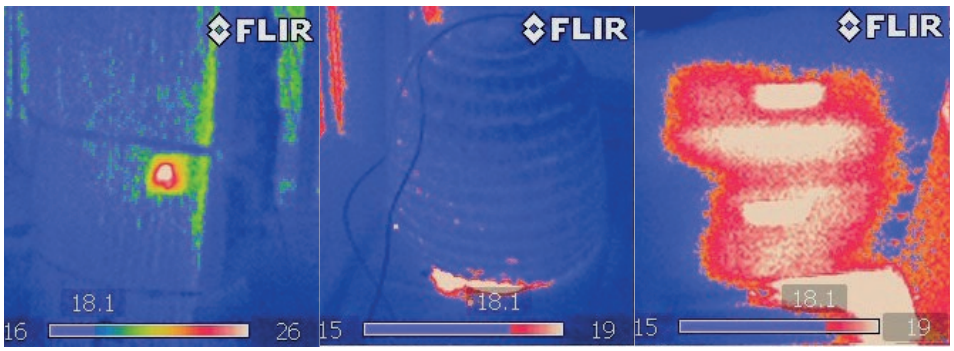
The storage combs in the oak tree cavity in February show a lot of free water directly on the combs, however even after several months they look as if they had been built the other day. Samples of these combs proved they were absolutely sterile.

One of the bees is carrying fluid water on its back. Thomas Seeley mentioned that bees get really thirsty in the wintertime and therefore are forced to fly out and collect water even directly on the snow. This, however, causes a huge threat to the bees as they can be chilled and die.

Apparently this is not the case in oak tree cavities.

A lot of condensed water could also be found on the walls of the cavity, directly on the propolis layer. Samples of this water proved to be highly antibiotic. Bees are recollecting this water which is a fission product of sugar digestion. They practically drink their own medicine. Before our research on this matter we believed that such moist conditions are always hostile to the bees because of the fact that mold starts spreading regularly on the storage combs at a humidity of appriox. 80%. However, the footage proved that this biological certainty is reversed in natural conditions and the amount of water is basically a benefit to the colony.

Two Petri dishes were set up, each containing the same medium, and inoculated with comb mold. The left one was left untreated whereas the right one had been wetted with a thin layer of condensed water that had been in contact with propolis for only 15 minutes. After 24 hours in the incubator both samples showed a significant difference, proving that water dissolves antibiotic substances out of the propolis.



Thermal pictures: A solid oak trunk, middle: a straw skep, right: An ordinary wooden beehive. These pictures were taken in June 2019. The heat loss on the surface of the ordinary hive is obvious. All the glowing areas must be balanced by nectar foragers. The skep and trunk only gloom at the entrance (the bees in the skep have their entrance at the bottom). The energy efficiency of the trunk and skep allows millions of hours of natural behavior. Meanwhile the box colony must fly in order to cope with the heat loss.

Roughening the inner surface of beehives will trigger the bees to propolize it, as they do it in the cavities. Open wooden fibers are provoking this behavior. I highly recommend this to everyone who is keeping bees in boxes.

Notice: The corners are filled with wooden triangle boarders in order to diminish the cold bridges and condensation that normally takes place in the corners.

Warré box: Francois Godet

Ironically, there are breeders today who are trying to breed bees that propolize less, because it is so sticky on their fingers, which is comparable to a total de-immunisation and a very good example of human short sightedness.

Beekeepers are normally very happy when they are standing in front of their hives and the bees are flying in great numbers because it seemingly indicates that they are strong and diligent. However when those boxes are standing next to tree cavities or other hives more closely orientated by bees' natural lifestyle, it is strikingly obvious that only the colony inside the box flies even when it is cold outside and/or raining whereas the others stay inside. A closer look with the thermal camera solves the riddle. The energy loss of the box in the form of heat is immense, which forces the bees to fly out literally under any circumstances in order to collect the fuel for their temperature replace with: warmth maintenance – nectar! In conclusion, those bees are showing nothing but compensatory behavior, based on an imposed emergency situation.

It is plausible that the increased metabolism resulting from the heat loss and excessive volumes of modern frame hives diminishes the lifespan of such hives' inhabitants, especially regarding the apparently higher activity of the nectar foragers, which must be counterbalanced by an expanded breeding activity. As a result even the queen ages faster whereas the *Varroa* mite population increases vastly. This problem is exacerbated further by adding volume (usually in the form of supers placed on top) and hindering swarming which is - much to the bees' detriment - very common in modern beekeeping.

Both features show a significant impact on the bees' behavior and the infestation rate with *Varroa* mites. The amount of brood in an ordinary hive alone could easily fill the type of tree cavity that bees would much prefer leaving no space for storing food! The Massive brood nests desired by beekeepers favour equally massive amounts of *varroa* mites.

By adding volume, we literally enslave our bees in their strongest instinct. The strongest instinct of honeybees is to have storage, which is realized in a fully stored attic. As long as the attic isn't filled, the colony will fly eagerly for the desired intake – just like a swarm. Meanwhile other important natural behaviors, such as grooming and washboarding, are deferred.

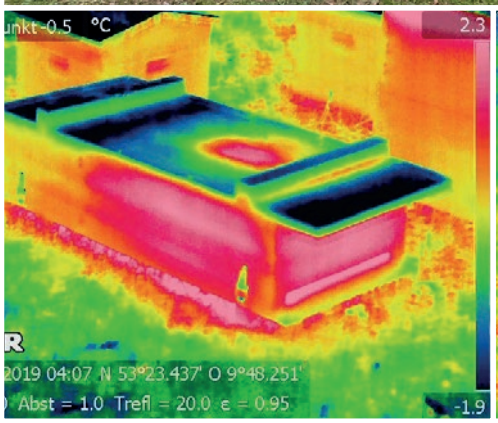
The numbers of *Varroa* mites we are raising in such modes of management that do not deserve the name 'husbandry' could never be matched under natural conditions. Ironically the main part of the brood is only balancing the heat loss from the box itself.

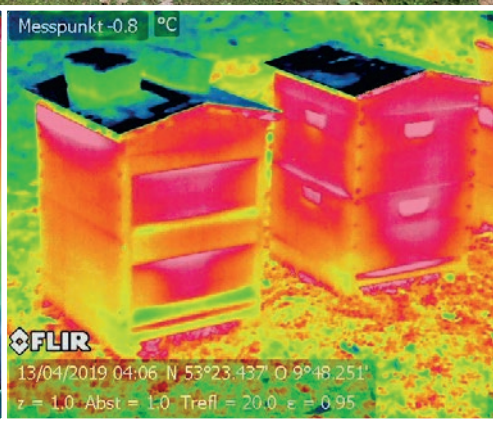
A tree cavity that bees would prefer has a volume of 20 to 40 liters, which is the volume of a single box of an ordinary hive. If we end up with a bee colony in four of those boxes we are dealing with a volume of 160 liters, sometimes more. All that space needs to be filled with combs, brood and storage, whereas the structure itself loses vast amounts of energy at the same time. This can only be achieved by a bee colony that is manipulated for breeding and intake but neglects other vital behaviors which can be readily observed in species-appropriate housings.

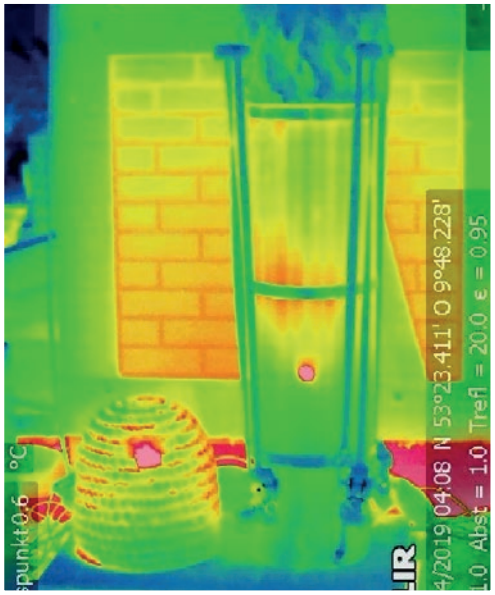
This becomes even clearer when one exemplarily calculates the labor time with set parameters in comparison.

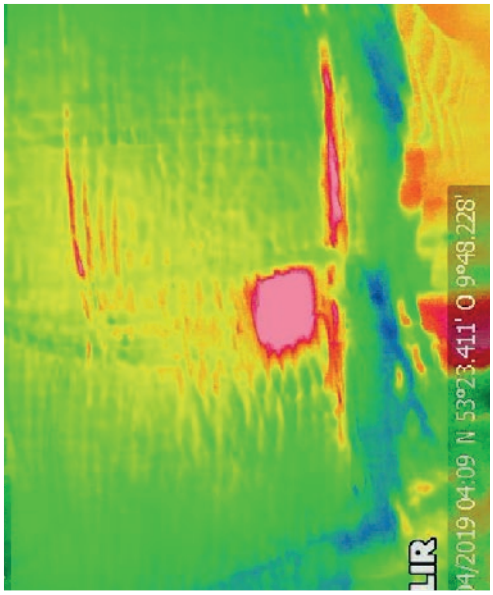
This calculation is just an example and highly variable based on multiple factors. It is meant to clarify that ordinary hives are wasting millions of hours of working capacity due to the energy loss, whereas bees in natural conditions are using this time for natural behavior – a key factor for their independent survival ability.

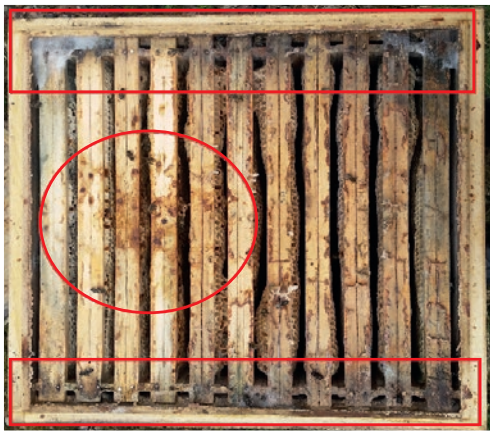
On average, a managed bee colony in a Zander hive needs about 300 kg of honey (approx. 600kg of nectar) for themselves every year (1). This impressive amount











Research on energy loss

A: A test stand at my house shows all the different hives that are in the test. The “real” bee colony in the solid oak trunk is serving as a calibration hive for the other shaped hives that are fitted with artificial computerized heat systems. These systems allow the gaining of data on the structural energy diffusion and problematic condensation areas, by excluding natural variables that bees would create.

B: The Bienenkiste – this type of hive shows the highest loss of energy in comparison to all of the others, even the way more voluminous hives. The huge energy loss takes up millions of hours of working capacity of the colony. Chilled brood and vast amounts of mold are a very common picture in this housing. Ironically, this hive is promoted as “species appropriate” by Mellifera, a huge beekeeping organization in Germany and sold in DIY warhouses in a cheap plywood design.

C: Two ordinary relatively thin walled wooden beehives show their massive energy loss and relatively cold corners that will regularly cause condensation and mouldy storage combs in the wintertime.

D: A straw skep with an upper entrance hole and a Schiffer-Tree cavity simulation compared to the solid oak trunk (F). All these structures show a very low energy loss by having the same temperature inside.

G: An ordinary box hive with the typical condensation patches in the corners after the wintertime.

H: A bee colony has lost its fight against the hostile, mouldy conditions. Excrements show that there has been infection amongst the bees.

of honey is needed to maintain the brood temperature, build combs, dehydrate the nectar by heat and ventilation, and so forth. About 20kg is needed to survive the wintertime. Therefore the intake and processing of nectar is permanently taking up the main part of the bee colonies' overall working capacity. 100.000-200.000 short-living nectar foragers (in total) are needed to do the job. Massive amounts of brood are produced and vast amounts of *Varroa* mites are generated as a side effect.

If one only calculates the flying hours of the nectar foragers it easily adds up to 20 million hours a year, only for the intake (depending on the parameters - space nectar processing and beekeepers harvest excluded).

In contrast, a tree cavity normally requires only a fraction of that energy. A bee colony in a nature-orientated or species-appropriate form of housing has an intake that is approximately ten times smaller. This means that such a bee colony would only need about 30-50kg of honey a year, including only about 2 kg of storage for six months of wintertime.

In conclusion, the nectar foragers of a bee colony in a natural form of housing fly about 16.3 - 18 million hours less within a year in comparison to a bee colony in a box (based on the same parameters in this calculation). Taking into account that a tree colony is normally about four times smaller due to the given volume, it still means that they would fly about 4.5 million hours less than bees in a box with the same volume. This is the price bees pay for the species-inappropriate housing and frames that we impose on them.

The energy loss of modern hives is causing multiple side effects, such as collapsing colonies in the first brood phase after wintertime because they are incapable of coping with another cool weather period. Chilled brood, starvation of colonies in the nectar gap in the middle of summer, robbing of weaker colonies, massive *varroa* infestations - especially when bees are hindered from swarming, deprived of their natural behaviors such as grooming, mould spreading on the storage combs, infection with mould spores and higher death rates during the wintertime: these are some of the disastrous results of modern bee management, not to mention the effects of mass beekeeping on the honeybees' solitary conspecifics – the solitary wild bees.

Bees Deaths in Winter, February 19th, 2019

Top left: Approximately 150 dead bees in front of the massive oak trunk.

Top right: The straw skep shows as well that only a few bees have perished.

Bottom left: The ordinary box hive shows a massive loss of bee lives. The size of the colony was comparable to the one in the trunk.

Every managed honeybee colony kept in an ordinary hive uses about half a ton of nectar more than their relatives living in natural conditions (see calculation) – in one summer!Tellingly many solitary bees are already highly endangered and significantly decreasing in numbers whereever we place our unsuitable hives en masse (2), and this is due to the vastly increased competition for nectar sources.

Parameters of the calculation

Each bee can store about 40 milligrams of nectar in its honey sac, which is also delivering the energy for the flight. Assuming that they come back to the hive with 30 milligrams of nectar, about 10 million flights are needed for the intake of 300kg of nectar. Because of the fact that at least half of it is water that is being fermented by the bees, they would have to carry about 600kg of nectar in total, in order to generate 300kg of honey, which then takes about 20 million flights in average. When we calculate lowly that each flight takes about an hour, it means that bees in such an ordinary hive would have to fly 20million hours a year only to maintain their brood temperature and to ensure their survival (excluding the labor time that is being used to process the nectar to honey and the beekeepers harvest).

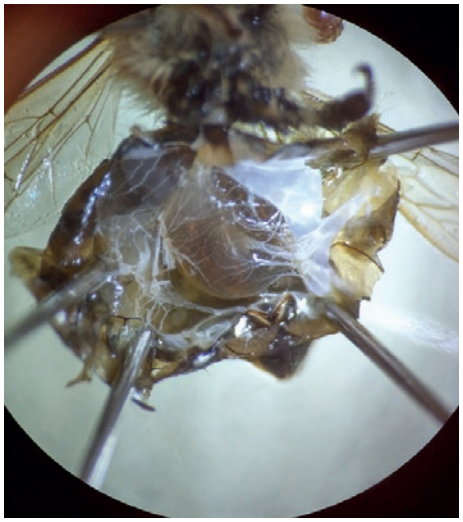
We can see that the bees' vastly increased metabolism caused by the significant energy losses of ordinary frame hives is taking its toll. This is also reflected in the death rate during the wintertime.

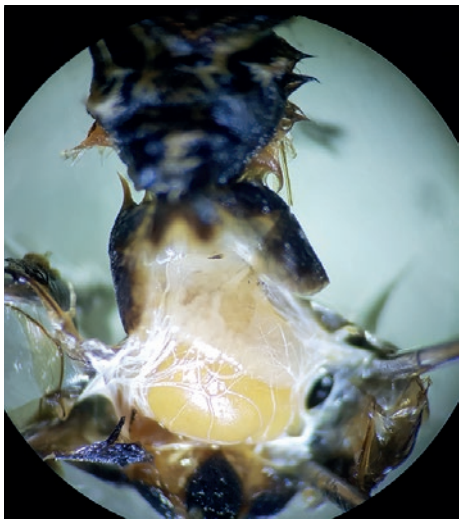
We literally burn their lives for the heat loss of the inappropriate housing "in a box". Additionally, every kilo of sugar that is digested by the bees produces about 0,7kg of water which then condenses in the corners and fuels mould spread on the honeycombs which is then infecting the bees, causing many colonies to collapse during the wintertime.

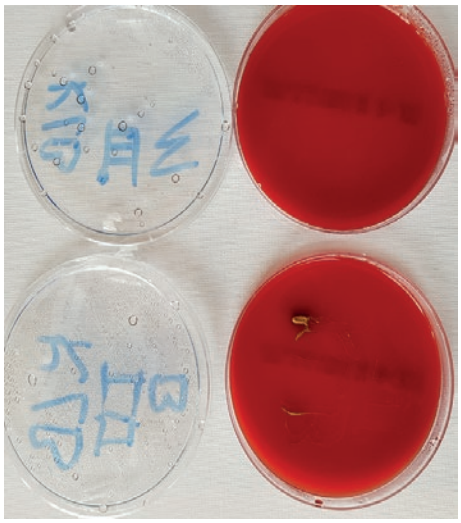
Another issue is that genetic manipulations are very common today. We appear to be in complete ignorance of the fact that every feature we desire and breed into bees costs something in return. Strikingly, all the criteria that define a "good bee" in modern beekeeping diminish the independent survival ability of the species itself. Moreover, modern beekeeping has eliminated natural selection - the only force that is capable of generating viable bees based on the process of survival of the fittest.

Learning from the Bees

Given what we know I consider that it is absolutely incumbent upon us to pay heed to the principles that allow bees to survive without any human interference. They can, so much is obvious, despite this crucial fact being persistently denied by the leading organizations that define modern beekeeping today. The best evidence







The effect of comb mold on bees

Upper left: Dissected winter bee from a Bienenkiste; the intestines are grayish in color and highly infected with mold spores (smear test upper right picture). Strikingly, all of the 20 bees that we dissected were infected.

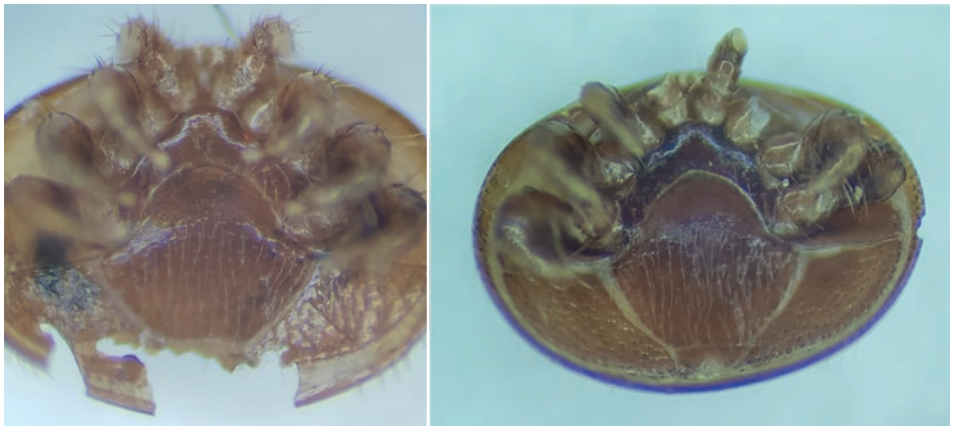
Below left: A dissected winter bee of a tree cavity; the intestines show brilliant colors. The smear test (below right) shows no infection whatsoever.

is provided by the many wild living and healthy colonies observed and frequently monitored throughout Great Britain and other countries. Despite the fact that many bee research institutes and scientists (in Germany) claim that they are bound to die, these rebellious bees in many parts of the world are clearly choosing not to fulfil their predicted destiny. It is clear to me that even most scientists and research institutes (Tom Seeley being in my view the laudable exception) have lost the ability to think 'outside of the box' as scientific research is normally done on bees living in boxes, in totally unnatural conditions. This is absolutely comparable to scientific research on "natural" behavior of animals living in a zoo, or in mass animal farming; I call it "zoo-research". There is absolutely no chance of learning anything about the "natural" behavior of a bee colony that is sliced into frames, living in a box and managed by a beekeeper. If we really want to learn something from the bees, we have to monitor them in natural conditions, undisturbed and in their perfect habitat; the tree cavity. Today, one thing is absolutely certain; only natural, species-appropriate conditions will allow bees to unfold their natural behavior and abilities which are genetically predisposed!

Effective grooming behavior

It is commonly known that bees show dynamic behavior based on the conditions they are faced with. As an example, scientific research has confirmed that taking away the capped brood for *Varroa* treatment in July will not lead to smaller colonies at the end of the summer. The colonies are replacing the missing brood by an increased breeding phase. The black bee is known for controlling its energy efficiency by adjusting the amount of brood to the changes of nectar supply in nature. Moreover, it is common knowledge that bees of artificial swarms, formed by a beekeeper, will reactivate their wax glands or even head glands for creating jelly for the brood, even though their glands had previously

Bees in tree cavity simulations often come out in the afternoon (not caused by heat). A close observation revealed most of them are just chilling whereas many of them are grooming each other (see bees in the middle).



Thoroughly groomed *Varroa* mites with fatal bite marks inflicted by the bees.

dried out. The overall behavior of bees is highly adaptive. Therefore it is no wonder that we were able to stumble upon another extremely interesting behavior that turned out to be dynamic; the grooming activity.

During the summer of 2018 I collected about 2000 samples of bee litter from 100 colonies in different hives. We could find effective grooming behavior, where up to 70% of the mites were killed by bees. However, only three out of 100 hives showed that behavior initially.

Interestingly, effective grooming behavior could only be determined in colonies that were not managed. Additionally they were kept in relatively tiny, single-room boxes for swarming. The main part of the other managed colonies had a grooming rate of only between 5-10%.

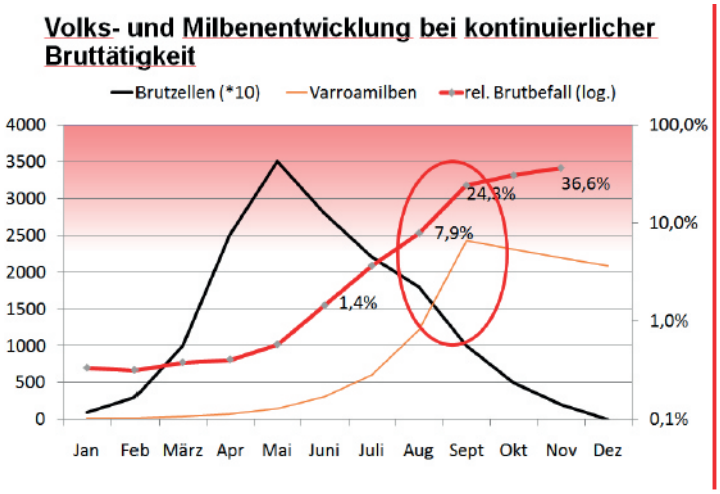
In conclusion, not all the colonies that were living in these more nature-orientated conditions showed an effective grooming behavior but all the colonies that were showing it were living in more natural conditions, which means they were not disturbed or manipulated by harvesting honey or adding space. Moreover, this behavior proved to be dynamic. When one of the effective colonies was given additional space, the grooming rate dropped dramatically from about 70% to less than 15% within a week.

Typically, grooming activity can be observed easily in nature-orientated housings. Thomas Seeley confirmed to me that the grooming rate in tree cavities would be somewhere between 40 and 60% which is also much higher than what we have observed in managed boxes.

This behavior appears to be mostly related and subordinate to nectar intake. If the attic isn't filled, there seems to be almost no time for bees to take care of themselves.

However, about ten years ago I had a colony in an ordinary hive which wasn't growing very well and I considered it to be "just lazy". A closer look revealed that they were spending a lot of time grooming each other despite being in a box. Sadly, those colonies are normally perceived as unproductive, and queen replacement is chosen as the quick fix. We really need to change our thinking.

A few different bee hives are placed directly in front of my bed. The last thing I look at before I fall asleep and the first glance I take in the morning are at those colonies. Hereby I initially realized many differences in behavior based on the structures bees are living in, throughout the years. Sensors placed in these hives provide further information. When I am lying in my bed and looking out of the windows, quite often with my daughter cuddling up on me, we are both thoroughly observing bees and doing research.



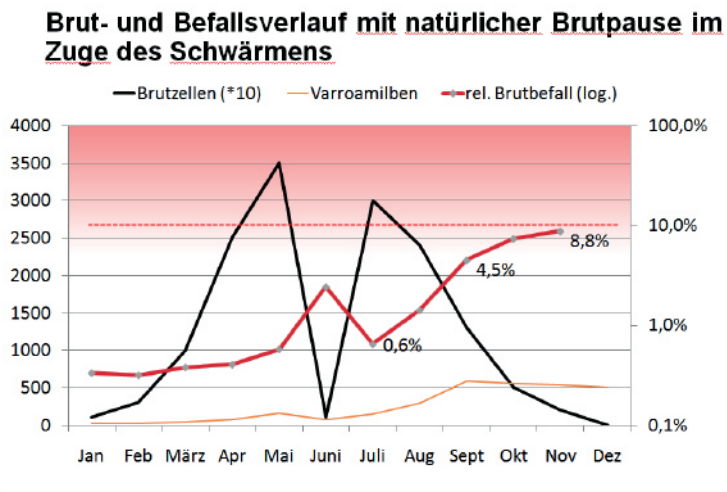
Bee colony and *Varroa* development without swarming

Black line: Bee brood development

Red line: Percentage of brood infestation

When bees are hindered swarming, the relative brood infestation will literally go through the roof by the end of the summer.

Graphic: used with allowance of Dr Ralph Buechler, Bee Research institute Kirchhain



Bee colony and *Varroa* development with swarming

Black line: Bee brood development

Red line: Percentage of brood infestation

When bees are swarming, the relative brood infestation will come to a halt for about 2 months, hindering the *Varroa* infestation to reach fatal levels.

Bee colony development in natural conditions

The behavior of a bee colony is highly dependent on its housing. A tree cavity has a set volume which is rather tiny compared to the modern hives. Starting in the spring time, the bees will normally develop a relatively huge brood field which is soon being displaced downwards by the first nectar intake (there is no beekeeper adding space) and finally is also decreased for even more intake. When this happens, natural behavior such as grooming and washboarding is being triggered and can be widely observed. Meanwhile the nectar forager activity is also being noticeably reduced. Additionally, in this phase many bees are hatching that do not need to nurture the offspring. As a result those bees are not worn out by the debilitating activity of generating jelly for the brood which results in a much longer lifespan of about 6 months3. During the next phase drones are generated and swarms will occur. All these incidents make perfectly sense regarding the overall energy consumption, which is reduced by the decreasing brood field as well as the outgoing swarm (fewer mouths are feeding on the stores). A significant reduction of *Varroa* development is a natural side effect of these conditions.

When comparing the activity of my skeps and my ordinary box hives, the differences in behavior are strikingly obvious. Whereas the bees in the boxes are seemingly doing nothing but flying, even in bad or cold weather, the skep bees are busy with thorough washboarding and other vital behaviors like cleaning the hive of wax moths, taking out infected larvae.

Apparently they are busy with vital behavior which they have time for because they have secure stores and because of the low energy consumption of the structure. Interestingly, when swarms out of ordinary boxes are placed into tree cavity simulations, they soon alter their behavior. This shows us that the information was genetically existing all the time but it was just not triggered by the conditions in the box.

Mite reduction due to swarms

Many beekeepers appear unaware of the vast amount of *varroa* mite reduction achieved by swarming. This is due to the fact that a swarm carries away about 20% of the *varroa* mites. Now, it does not make sense for *Varroa* to generate eggs when they cannot be laid. That is why the following brood pause is causing the *varroa* mites to change physically and become infertile, like winter mites. Moreover, all the *Varroa* are forced to survive by clinging on to the bees, which are very active. This leads to a mite reduction of 1-1.5% a day on the grounds that bees are flying out and not returning, they are biting or shaking the mites off or sometimes even natural death occurs. Furthermore, even though the mites will re-enter the brood after approximately 4 weeks, they are still infertile. It takes about 4 weeks extra for them to become fertile again. Therefore the brood pause for the bees is only about 4 weeks whereas for *Varroa* it is 2 months. As a result we have an overall mite reduction of up to 70% in the mother colony, by the end of July or beginning of August (two months after the swarm left. (3 & 4) Even in ordinary hives the reduction by swarming is so immense that in most cases no *Varroa* treatment is needed.

The tree cavity, a perfect habitat

In mid 2015 I was hired by Prof Jürgen Tautz and commissioned to do research on bees living in natural conditions. My scientific research assignment reads as follows; Comparison of the climatic conditions of tree cavities and man-made hives and its possible effects on bee health. I am still wondering today that I was given this assignment after the thousands of years that humans have been keeping bees. How is that comprehensible, that we know more about the needs of any other creatures like exotic snakes, spiders and reptiles that we keep in terrariums, whereas at the same time we seem to know almost nothing about the natural demands and requirements of the most important creature, regarding its role in the ecosystem?

One needs to understand that climatic conditions define ecological habitats, which means that all species became adapted to certain climatic conditions over millions of years of evolution.

Therefore every species has its specific requirements which are defined in a range between optimum and pessimum. The optimum means basically the perfect conditions for a species to live and spread, whereas the pessimum characterizes the worst conditions that would just allow survival. The climatic conditions are therefore one of the most important selective factors for living creatures.

It is nothing but common sense that a tree cavity provides totally different climatic conditions in comparison to lightweight wooden or, even worse, plastic boxes. This is also clearly shown in the climatic measurement data. This particular research revealed that bees are commonly held in pessimum conditions in modern beekeeping; sometimes even worse.

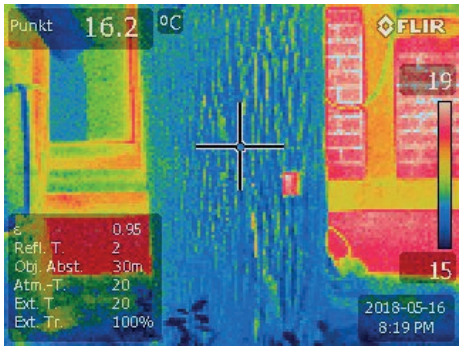
Even well-insulated Styrofoam hives are regularly showing a colder and much more unstable climate within, compared to tree cavities. At the same time they are extremely moist. It is literally like living in a plastic bag. There is an easy experiment to exemplify these conditions. If one places a transparent plastic bag over one's hand, it will soon lead to condensation on the inside. This effect is dynamic too. The colder it is outside the faster the condensation takes place on the inside. Because of the missing sterile atmosphere in plastic boxes, comb mould starts spreading unhindered with the already-described side effects.

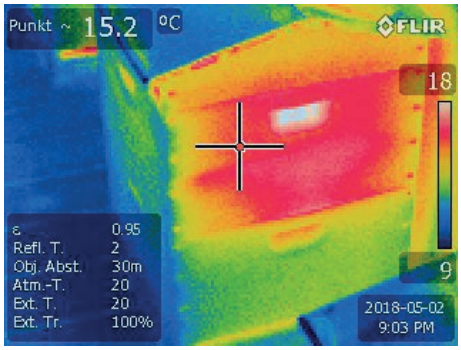
There is a growing number of beekeepers who are aware of the fact that bees need protection against heat loss, resulting in more and more hives to be insulated. This insulation, however, is mostly done by using lightweight material, which is effective in preserving the heat but still does not provide climate stability regarding the outer temperatures, like a tree cavity does.

The mass of a tree with its solid walls does not only insulate but also accumulates the temperature, which leads to a remarkable climate stability, unseen in modern hives. It is comparable to a big lake that doesn't change its temperature quickly when the weather changes. This stability saves the lives of many bee colonies because those living in such stable conditions are not triggered by the first few days of warm weather outside to start producing brood.

The unstable conditions are causing many weaker colonies to collapse every year. Because the inner temperature is extremely related to the outer temperature in modern hives, bees usually start breeding during the first warm days. These are often followed by another cold period resulting in chilled brood and an exhausted colony that gave its last strength in order to generate offspring.

Moreover, beekeepers are normally placing their bees directly on the ground,





Top: Comparison of the profile of a tree cavity and an ordinary box hive.

Bottom: Thermal pictures of those structures occupied by bees. Notice: The trunk is standing in front of my "low energy house" which is showing much more heat diffusion by having about 15 degrees less in the inside.

The box is showing a vast temperature diffusion. All that glowing mass must be put right by the colony, eventually resulting into a total different behavior. The corners are typically cold, causing condensation and mold at the inside.

Colors: blue (cold surface); green (moderate heat loss); yellow (huge heat loss); red (vast heat loss); white (most heat loss).

somewhere in a garden or in a field. Direct sunlight, wind and rain will increase the already huge instability of the inner climate even further. The bees have evolved for 45 million years by living in the forests. Now every woodland has its own micro climate. In such an environment, it never gets as hot, dry, windy or sunny as somewhere else. In conclusion the remarkably stable climatic conditions of a tree cavity are significantly enhanced by the stable climatic conditions of the environment, a fact that is being ignored by most beekeepers.

Another typical example for exceeded pessimum conditions caused by modern hives are bees that are starving to death on filled storage combs, during the wintertime. Mainly this is caused by frames and heat loss. The storage combs are literally freezing and almost reaching outer temperatures in most modern hive structures. As a result bees have to use vast amounts of energy to preheat the stores before they can feed on them. Sometimes they seem to be incapable of preheating the next frame and are therefore starving to death by sitting directly on their frozen storage, conditions one would usually never find in tree cavities.

Furthermore, many colonies collapse because of the increased metabolism based on the heat loss of modern geometries and volumes. The bees get worn out quickly which is also reflected in the death fall in such hives. Additionally, vast amounts of storage use are generating vast amounts of water and condensation which almost automatically leads to mould spreading on the honeycombs. The bees get infected and not rarely collapse because of the infection.

Living in a voluminous, thin-walled box in comparison to a rather small cylindrical and massive-walled tree cavity can be compared to surviving the wintertime in a tent outside rather than in a solid block house built out of massive wooden trunks.

We know that very well from ourselves. Despite the fact that we have become mostly independent of the outer weather by using clothes and heating in our houses and even in our cars, most of us still get ill regularly, when the temperatures drop in the wintertime. The climate has a huge effect on every living creature.

Moreover, because of the missing propolization and sterile atmosphere many pathogens are spreading, causing additional problems.

If that was not enough, by harvesting all the honey and replacing it with sugar water we undermine the immune system and cell renewal of the bees. No cells can be replaced by the bees metabolism if the ingredients that are necessary to actually build cells, like proteins, minerals, vitamins, are absent from the nutrition – a factor that is solely caused by the beekeeper and fuels the problem of the non species appropriate housing.

Now imagine one would be forced to survive about six months in such conditions by feeding on mouldering sugar water, without any vital ingredients. To me it is absolutely astonishing that bees can manage even that. A rather indirect factor that nevertheless is also connected to the housing and husbandry is the treatment of *varroa* mites with acids or neurotoxins, where bees are sometimes fatally affected.

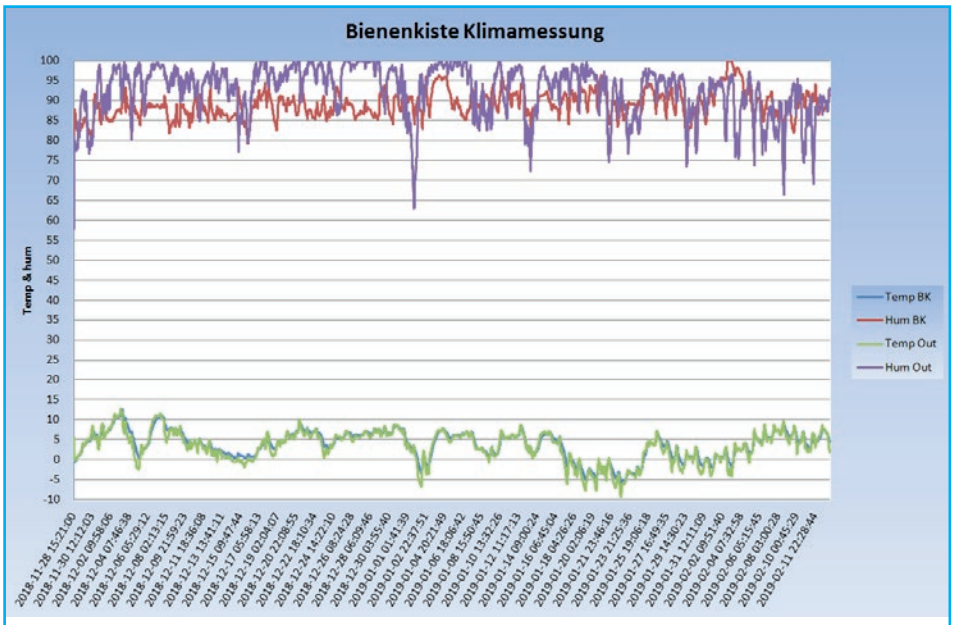
These are just a few examples of exceeded pessimum situations we are enforcing on our bees by modern beekeeping standards.

Special features of a tree cavity

From the collected data, we can already conclude that the more the geometry of a hive differs from the rather cylindrical form of a tree cavity the less stable the climate is within.

The Bienenkiste: A very flat box with a large surface. Therefore the temperature loss is immense and cannot be balanced by the bees shown in the following diagram:

As shown in the diagram overleaf the bees are able to establish stable climatic conditions, unmatched by manmade hives.



Climatic measurements of a bee colony inside a "Bienenkiste"

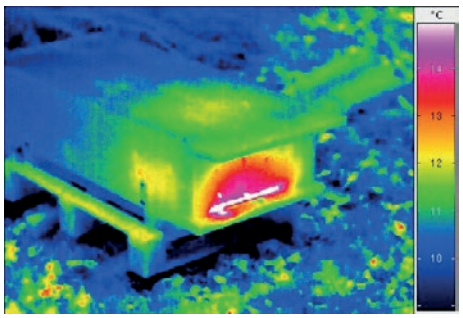
This structure is rather flat, the combs are directed to the huge entrance gap and there is an empty storage room that cannot be disconnected at the back. It therefore stays cold during the wintertime. This is causing vast amounts of mold and heat loss reflected in this diagram:

Blue line: Temperature inside the Bienenkiste during the wintertime (average temperature 3.6 degrees Celsius) Notice the minus degrees at the lowest peaks causing the storage combs to freeze. The blue line is almost invisible because it is congruent and overlapped by the temperature line that shows the outside conditions. In such a box bees are obviously incapable in of establishing a stable temperature.

Green line: Temperature outside, (average temperature 3.07 degrees Celsius).

Purple line: Outer humidity (average 93.42 percent).

Red line: Humidity inside of the Bienenkiste (average 89,02 percent) (Mold starts regularly spreading at a humidity of approximately 80%.



Top: a bee colony in a Bienenkiste equipped with climatic sensors.

Bottom: A thermal picture of a bee colony in a Bienenkiste during the wintertime. Notice the vast heat loss due to the long, shallow and large shape of the hive, as well as the empty space at the back. Condensation and mold starts right there.

This stability is based on:

- The location, far away from the ground, which is always humid and consists out of destruents (decomposers) like bacteria and mould.
- The geometry; thick walls, a small diameter and volume and a cylindrical shape are insulating and concentrating the warm air produced by the bees. The combs and some layers of the wood are preheated and storing the warm energy, basically functioning like a radiation system. As a result, quick changes like dropping temperatures have almost no effect on the stability inside the cavity.

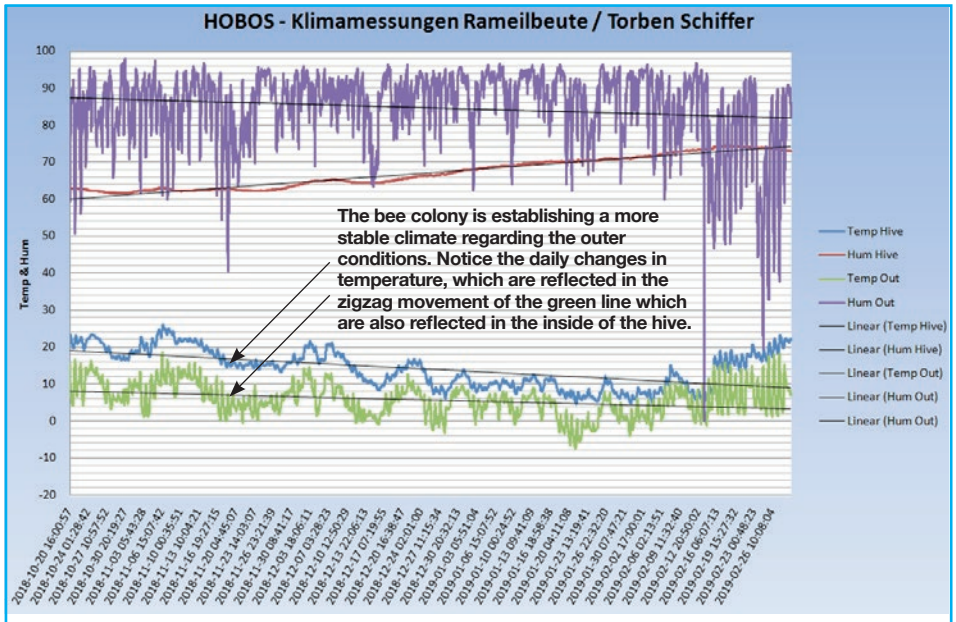
  In contradiction: In modern hives storage combs are regularly reaching minus degrees during the wintertime, leading to conditions that one would find in a cool bag filled with ice packs.
- The open fibers of the wood, especially at the bottom and the top, are stabilizing the climate even further due to absorbing and releasing humidity.
- The overall wood mass is accumulating the environmental conditions which are resulting in a very stable climate, comparable to a lake.

The tree cavities with all their special features have been the natural habitat of honeybees for about 45 million years. They have evolved in these structures. The cavities provide an almost perfect shelter from outer conditions and enable the bees to follow their natural biology and behavior. A sterile atmosphere as well as an antibiotic water cycle based on the thorough propolization of the cavity and heat, has kept the bees resilient towards pathogens. This is indicating that epidemics and illnesses in modern beekeeping are the negative side effects of a non species appropriate husbandry. The amount of energy that is being needed for survival is many times smaller than in modern hives, resulting in millions of hours that bees in modern geometries are forced to work additionally. Therefore mainly compensatory behavior can be observed in modern beekeeping and many bee colonies collapse especially during the wintertime, which is caused by exceeded pessimum conditions.

Another subject that is being almost totally ignored by modern beekeeping is that bees in natural conditions are living in a community of hundreds of species. This micro fauna has proved to be highly beneficial to the bees. There are mites feeding on the remains of the pollen that has fallen down; predatory mites feeding on the pollen mites and wax moths feeding on other organic material. However there are also pseudo scorpions that are feeding on all of the tiny creatures forming this complex ecosystem, including *Varroa* mites. By doing that they have proved to be very efficient in reducing the *varroa* mite population without causing any harm to the bees (5) comparable to the fish in which clean the reefs of the oceans. Ironically, the whole micro fauna which globally surrounds bee colonies in natural conditions, even today, has been wiped out by modern

Stefan Rameil, a heating engineer has built single room hives for three decades. He is a passionate Demeter beekeeper and insulates his hives thoroughly. This one has an insulation of about 8cm of sheep wool and a volume of approximately 75L.

https://www.demeter-nrw.de/hoefe/imkerei-rameil.php



Blue line: Temperature inside the hive; average value 14.1 degrees Celsius

Green line: Temperature outside; average value 5.74 degrees Celsius

Purple Line: Humidity outside; average value 84.6%

Red Line: Humidity inside; average value 67,2% (no comb mold possible)

The Rameil hive shows clearly the advantage of insulation. The bee colony is able to generate a rather independent inner climate, regarding the outer conditions. Notice: The decreasing values of the blue line are showing the declining colony (dying winter bees). The sudden increasing Temperature on the 15th of February shows the beginning of the brood phase. The inner relative humidity (red line) is increasing because of the declining temperature. This effect is reversed at the beginning of the brood phase.

Even though the inner climate is much more stable than in a hive that is not insulated, we still have a congruency of the outer and the inner temperature. Every rise and drop in degrees is also reflected in the inside, which indicates that the colony is still unable to generate a linear climate, like usually seen in tree cavities.

hives and the chemicals that are being used to fight *Varroa*.

In conclusion, modern beekeeping has evolved into a form of mass animal farming, including a total disregard of the natural lifestyle and needs of the bees or their surrounding micro fauna. We even fall at the lowest hurdle, which is providing natural conditions for one of the most important species in our world! We blithely ignore their natural requirements and their biology. Additionally we have practically abolished natural selection, the only force that is able to generate bees that are showing all the facets that define independent survivability.

Moreover, we are widely interfering with their genetics in order to create bees that are only showing a behavior that meets human requirements.

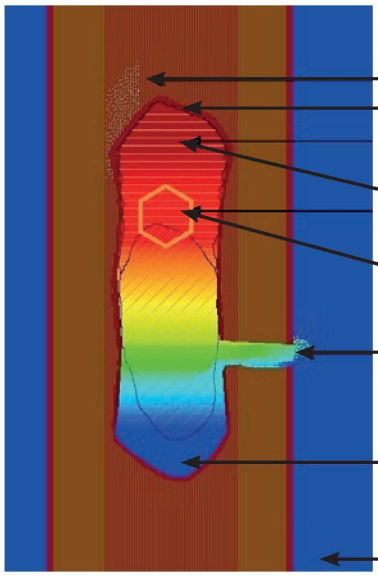
Fighting symptoms like *Varroa*, Nosema, AFB and other diseases seems to be the spirit of the age, which means that most beekeepers do not realize that they are mainly fighting the symptoms of their own totally unnatural beekeeping system that is not husbandry but management by questionable criteria. It is clear that today's beekeeping has mostly lost its connection to the true nature of the species, which in the absence of an effective counter-movement inspired by learning from the bees will lead eventually to the bees' demise.

Remarkably, the majority of today's beginner beekeepers are idealists. When asked, they overwhelmingly reply that their most important motivation is to protect the species and do something good for Mother Nature. Ironically, they end up learning a husbandry system that is based on manipulation and exploitation and get caught in the trap of treating the side effects of such a style of management. Even many experienced beekeepers are uneasy with the methods of treatment and manipulation but do not see any alternatives.

This is why I founded the Beekeeping (R)evolution

The Beekeeping (R)evolution is a species protection program for honeybees which is following the goal of providing the long-time-gone counterbalance to modern beekeeping. It means protecting the bees nature, biology and spirit against human manipulations and interventions and giving them not only the right to live undisturbed but also to die.

How a tree cavity works regarding climatic conditions



Open wooden fibers of the wood are absorbing and releasing moisture, based on the atmospheric humidity. The whole trunk is basically functioning like a huge reservoir for humidity and temperature. Therefore the conditions are very stable, unseen in modern hives.

The propolis coating dissolves antibiotic substances into the atmosphere which sterilizes pathogens. Condensation directly on the propolis proofed to be antibiotic too. By recollecting this water, bees drink their own medicine.

The warm air, produced by the bees is concentrated on a rather small diameter and preheats the storage combs (warm air drifts upwards). Every gap is forming a closed room. The massive walls are preventing heat loss but also accumulate the outer temperature which results in a very stable climate, almost independent from the outer weather.

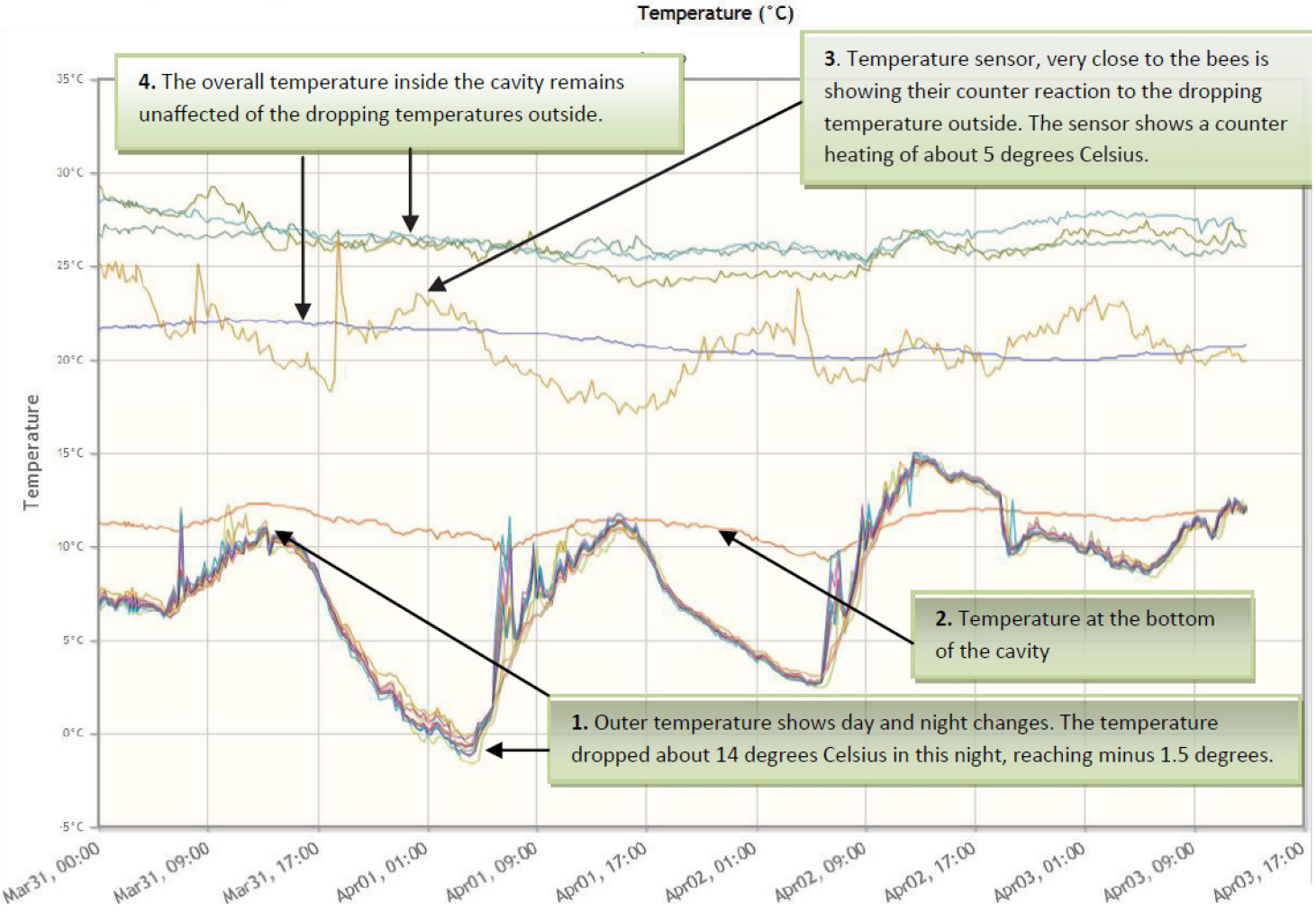
The colony is feeding on its storage combs. The heat produced by the bees is well contained. Storage use is only about 2 kg in 6 months of wintertime.

Co2 exhaled by the bees, is heavier than oxygen. It sinks to the ground and is exchanged with fresh air at the relatively small entrance whole, due to diffusion and moderate air movement. Only a very small amount of heat is being lost.

Coldest part of the cavity in the wintertime. During the summertime a huge micro fauna is feeding on the bee`s organic waste.

Outer weather conditions are memorized by the whole trunk. As a result short weather changes show almost no effect on the conditions of the cavity.

A closer look; how bees regulate the inner climate in a tree cavity in freezing conditions



Keeping bees in species appropriate conditions is of the utmost importance, it means protecting and preserving the species by granting them the right of "natural selection" instead of "box selection" or even worse, "human selection".

Now, I know that there are many programs where bees are being left untreated for natural selection, by living in totally unnatural conditions; - in a box and on frames! The box itself is practically a significant selective factor, due to the facts already described. As a result the losses will be much higher than necessary.

It is comparable to stopping treatment with antibiotics in a mass farming industry. Many of these animals would die just because of the environment they are faced with.

The Beekeeping (R)evolution is the first program that is focused on fighting the cause and not the symptoms of *Varroa* and other epidemics by providing natural conditions for honeybees, before letting them

A book scorpion feeding on Varroa mites. They can feed on up to 9 mites a day. These beneficial symbionts depend on natural climatic conditions as well as a huge variety of tiny species as prey animals for the nymph generations. They have surrounded honeybees for millions of years and were wiped out by modern beekeeping. Strikingly the extinction of the micro fauna in beekeeping was not even realized; nor from the beekeepers or the bee research institutes.

go through the process of the survival of the fittest.

In this spirit, I will, starting in 2020 in Germany offer courses in species-appropriate beekeeping according to my findings and my state of knowledge so far. We call for a much broader diversity of beekeeping education to meet the aspirations of bee guardians and protectors who honestly place the nature of honeybees and their specific requirements into the center of their actions.

To this end we are presently working on defining species-appropriate beekeeping together with Prof. Jürgen Tautz. Interestingly, so far, it has not been possible, because of the lack of data on bees in their natural habitats to really define species-appropriate beekeeping even though I wish to acknowledge the efforts made by, for example, biodynamic beekeepers in Germany in creating the first "Demeter Standards of Beekeeping" in the eighties of the last century. This gap has now been filled and we are about to publish a truly historic definition. It will be a clear dissociation from modern beekeeping methods. It is far beyond doing beekeeping in ordinary boxes, where basic natural requirements of honeybees are completely ignored.

Notwithstanding the many lobbyists in the queen breeding, trading and pharmaceutical industries that influence and direct modern beekeeping and are greatly opposed - possibly outraged - by this new movement - the numbers of those wishing to do right by the bees are growing fast, and together we are determined to guard our beloved bees! There is a growing community of people who really want to save the species and who do not care about "beekeeping standards" or money. For such people it is meaningless to learn how to manipulate the bees' behavior by gross interventions. To observe bees, to learn from them, to help preserve them for future generations, one has no need whatsoever to learn the craftsmanship of manipulation and exploitation.

Thus all the background science within this article will prepare readers for part two in the next issue which will describe the development, manufacture (and maybe plans) for the hive.

1 The Buzz about Bees: Biology of a Superorganism, Jürgen Tautz 2009
https://schleswig-holstein.nabu.de/tiere-und-pflanzen/insekten/wespen/19172.html
2: https://schleswig-holstein.nabu.de/tiere-und-pflanzen/insekten/wespen/19172.html
3 Bee research institute Kirchhain, Dr. Ralph Büchler – Bienenpodcast: https://www.bienenpodcast.at/bg039/
4 Bee research institute Kirchhain, Dr. Ralph Büchler – Bienenpodcast: https://www.bienenpodcast.at/bg039/
5 https://www.researchgate.net/publication/324562005_Bucherskorpione_als_Varroabekampfer

A solid piece of a trunk as bottom and lid serves as a reservoir for humidity and temperature, like in a tree cavity.

Solid walls, roughened from the inside, trigger propolization, allow insulation and temperature accumulation.

The set volume of the closed tube (about 30L) allows natural behavior and biology and protects the bees against human manipulation. The small inner diameter and height ensures an extremely low energy consumption.

A round entrance hole ensures a natural arrival and departure of the bees. It can be well defended and looses only little heat.

Space for the micro fauna below the entrance hole provides habitat for pseudo scorpions and organic waste of the bees. This is initially being filled with brittle, dry wood and bark