In the following article Jonathan Powell addresses the subject of bees as we hardly know them. Wild bees living in trees. Of course, all bees are wild. But a few hundred years of ever more refined honeybee "management" and environmental degradation have taken their toll on the creature. Deprived of nearly all ways of expressing their innate preferences and instincts, the bees are losing their resilience.

Contrary to what beekeeping orthodoxy – and this includes purveyors of 'treatments', bee saunas, bee gyms and any other such contraptions – would purport, wild bees exist in our country, and are faring well. Most of them live in trees, lovingly observed over years by warm-hearted beekeepers who feel happy for the bees to have 'escaped', others live in hives, lovingly observed by human beings, former beekeepers mostly, who have connected with them and feel enriched by their company. But just as there are not enough pure and unadulterated blossoms for the bees to feed on, there are not enough trees allowed to get old enough to develop natural cavities for bees to live in. Nor are there enough beekeepers allowing the species to propagate freely. That is our world now, and it is not bee-friendly. The resurgence of interest in the ancient craft of tree beekeeping, of creating new habitat, guarding what is left and allowing the honeybee to live in freedom, inspires hope. Heidi Herrmann

Learning from Wild Bees and Tree Beekeeping

By Jonathan Powell

What if there was a completely different approach to beekeeping? Where the beekeeper makes a hive that suits the bees, or they do not come. A system where the beekeeper is required to give up control and complexity, and evolution is once again determined by the bees and nature.

I would like to tell you why tree hives inspire me, particularly so in the context of the environmental challenges that bees face in the 21st century.

Besides describing the history, dimensions and methods of tree beekeeping I will make mention of the transformative effects my engagement with tree hives has had on me, as a beekeeper, as a human being. It would be a disservice to the bees and their message for me to remain silent on this. The bees show me that too often I take when I should wait to receive. I can jump to quick solutions and miss the longer paths to better understanding, but this understanding only comes when I am open to the idea that I might be wrong and ready to receive. Therefore, if what you read here simply gives you a little more intellectual knowledge about tree beekeeping, or furnishes you with more ideas for the next beekeeping experiment or bee gadget, I will have failed. We live in a world saturated with knowledge and technology but I fear it is lacking in wisdom. Having kept bees as a child in the 1970s, I have seen in the short space of 40 years the decline of forage, the drop in queen fertility, and the vitality of bees being eroded. This has deeply affected me and prepared the ground for my present commitment to a form of beekeeping which really does give me a sense of cautious optimism for the future of the bees.

The evolutionary path of the bee is a story of imperceptible change over millions of years, where bees slowly evolved to fit each locality – or devolved to end broken relationships with the environment. Then, in a mere 150 years, a blink in time, under the stewardship of a new master, "modern beekeeping" together with the pressures of modern agriculture, the old order that shaped bees was swept away. We have taken control, but are we smarter? The bees have always selected on the basis of survival of the fittest, whilst we select on simpler parameters like honey yield and temperament. Add to that swarm suppression, bee importation, artificial splits, prophylactic use of antibiotics, sugar feeding and migration, and what emerges that we have woven a tangled and confused evolutionary path that has no direction for bees and is alien to their genetic history.

What if there was a completely different approach to beekeeping? Where the beekeeper makes a hive that suits the bees or they do not come. Where the density of hives is set by the bees, and there is no intervention to stimulate the hive or save it from failure. A system where the beekeeper is required to give up control and complexity, and evolution is once again determined by the bees and nature. A hive that can last a hundred years or more and cost nothing. This is not the fantasy of a dreamy idealistic beekeeper, but an old Eastern European traditional form of beekeeping called tree beekeeping, where a hive cavity is formed inside a living tree.

HISTORY OF TREE BEEKEEPING

Whilst the history of tree beekeeping does not span the millions of years of the bees' history, it can claim to be one of the oldest forms of beekeeping and one that perhaps most closely respects bees' innate preferences. Tree beekeeping can trace its roots back over 1000 years to Eastern European monks who provided the first written account of tree beekeeping in 900 CE. A Russian tomb from the 5th century was found to contain a complete set of tree beekeeping tools, and a preserved tree hive was recovered from the Older river dating to around the 10th century. In 940 King Otto I allowed tree beekeeping within the Teltowsche Heide (Grunewald forest, Berlin), but the last Zeidler (German tree beekeeper) gave up in 1550.

In the seventeenth century tree beekeeping saw its maximum development in the Polish-Lithuanian Commonwealth. In the most developed regions tree beekeepers formed communities, called 'Fratrum Mellocidarum', and members would manage registered areas of the forest called a 'bartny bór', a basic unit area of forest with 60 tree hives. They were bound by oaths, with their own laws and later some political power. A wealthy tree beekeeper could own/

Making entrance hole © J Powell

Etrance and entrance plug © J Powell

Hive-entrance © Nick Adams

lease as many as 400 hives. Unusually for the time, these organisations allowed women to inherit tree hives after the death of their father or husband. It was an important branch of the economy; profits from wax and honey could be 30 times higher than from wood. Tree hives belonged to kings, princes and cities, and tree hive keepers had a right to an inheritable timeless lease of the tree hives. In return beekeepers would pay tax in the form of hive products, wax and honey, tending meadows and, later, money. Historically, there was another advantage to the tree and bee relationship, most notably in Poland where there was legal protection and severe punishments preventing the felling of trees containing hives, and protection of the hive from robbery.

From the mid 19th century the economies of wood and honey changed. Wood became more important to fuel war and industrial development. Legal bans on tree beekeeping were imposed by the rulers of Austria, Prussia and Russia to make way for the felling of the trees. However, even after some decline, the Polish census of 1827 recorded over 70,000 tree hives. In Belarus there are still more than 800-1000 log hives in trees, but only a few tree cavities with bees. In the Polish Bielowieza National Park there are still 112 tree hive cavities, made before an 1888 ban, when the forest was declared the Russian Tsar's private property. These hives are now abandoned, their entrances are closing and they have no bees. The last Bielowieza tree beekeeper, Filimon Waszkiewicz, died in 1967.

Gradually, for the convenience of beekeepers, tree hives migrated to log hives on platforms, then to logs on the ground, and then, with the start of modern beekeeping, to thin-walled hives with frames, the "filing cabinet" style hives we know today. With modern commercial beekeeping also came sugar, antibiotics, genetic dilution, migratory beekeeping and dense apiaries.

Germany 2015 - Bavarian Course

RENAISSANCE OF TREE BEEKEEPING

The tree hive tradition in Eastern Europe was all but lost by the 1930s.Then in 2002, Dr Hartmut Jungius and Dr Przemysław (Przemek) Nawrocki of the World Wide Fund for Nature (WWF) discovered during the establishment of woodland nature reserve of 22 000 hectares, that tree beekeeping was still being practiced in the Southern Urals of Bashkortostan in Russia. Over 700 hives can be found here, of which, in an average year, 30% are naturally populated by swarms and managed by the Bashkir.

Thanks to knowledge gathered from the Bashkir together with historical information from countries such as Germany and Poland, we know how traditional tree hives are constructed, and what lengthy preparations were made for a tree destined to become host to a hive.

The majority of tree hives are created in pine trees that are typically older than 150 years; larch is another common tree, and to a lesser extent oak, fir and spruce. First, the crown of the tree is removed so that the tree grows in girth. Traditionally, after a further 70 years, the third generation of tree beekeeper made the hive. Ideally the tree needs to be at least 80 cm in diameter. The family line then managed the hive for 200-300 years.

When all of this work is carried out correctly to the traditional design (the old tree beekeepers could rely on their instinctual nature wisdom for that) the tree is not harmed; indeed, it is believed that making the cavity invigorates the tree. Part of the longevity of trees with tree hives may have to do also with the fact that bees will line any cavity they inhabit, with the powerful substance of healing propolis. Tree beekeeping must be approached with the same respect and specialist skills that the Zeidler of old applied to the craft.

Understandably, the image of a chainsaw cutting a hole in a living tree arouses complex feelings in people. Let me re-assure you: cavities intended to serve as tree hives are only cut into trees of a large diameter and consequently the ratio of the cavity entrance width to the tree circumference is less than 7%. This is no problem for the tree. Detailed examination of mature trees will show that many have natural breaks in the trunk, such as woodpecker and squirrel holes

and broken limbs from wind damage, often enlarged into sizeable cavities by the action of rot or fungus growth. In the case of the cavities provided in trees for the purpose of hosting colonies of honeybees, nearly all the wood removed from the tree is so-called "heartwood". This wood is dead, indeed a tree can thrive with its heartwood completely decayed. The height of the hive, at least 4m above the ground, the depth into the tree of 35cm and the position relative to limbs are all carefully selected to ensure that the structural integrity of the tree is not compromised. Contrast this to the traditional bee hive or even your own home where the wood is from felled trees.

In this tree hive management system, the top one third is respected and always left undisturbed for raising brood and for winter stores. If there is any spare honey it is harvested from the bottom two thirds of the hive. Typically 10 -15kg is harvested in a normal year. The hives are opened just twice a year: once in spring to check if the hive is populated, and then in the autumn for the honey harvest. In this way the medicinal hive atmosphere, the integrity of brood nest scent and warmth, is guarded and maintained.

The hives are not treated for mites with acid washes or pesticides and yet remain healthy. Interestingly, many beekeepers in the West, often referred to as natural beekeepers, are similarly discovering that bees will slowly adjust to mites and diseases. They can only do so if they are left to manage themselves, i.e. rarely disturbed, their winter honey stores left intact, and overwintered on their own stores as opposed to sugar, which has been clearly shown to weaken bees' immunity[1].

Tree hives naturally populate at a density of three hives per one square kilometre; however this varies greatly depending on the weather. In good years almost all the Bashkir hives will fill with bees, but in very poor years only 10% may have bees. The low density of hives greatly reduces the problem of disease spread whilst matching forage level to bee density. By allowing the weather to test the bees, weak colonies fail and only strong colonies propagate their genetics. Tree hives being static allow bees to build long-term bonds with their local environment as well as other colonies. The role of the drones in such stable environments and the effect of long-lasting drone congregation areas remain unexplored.

CONSTRUCTION OF TREE HIVES

We can now look in detail at the construction and dimensions of a hive, but remember this is tree beekeeping and the dimensions are approximate. I like to use my hands and limbs to do the measurements, and if you see me hug a tree in the forest, I'm probably measuring it ... and giving it some love!

Construction of a tree hive starts with a slot that forms the 'human entrance' to the hive, at 4-5 m from the ground. The slot is typically 800-900 cm long and 12 cm wide. The internal diameter of the hive is around 35 cm and has a volume of approximately 80-90 litres. This leaves thick walls of at least 5 cm to insulate the hive. A cavity is normally left open for a year to let the wood season. When the hive is occupied, the bees will gradually cover the walls with protective propolis. A slot door of similar thickness to the walls and with insulating foliage completes the hive's human entrance. The bees' entrance is located one third of the way from the top of the hive, by forming a 8cm x 8cm hole that is positioned approximately 20 cm away from the human entrance.

A carving axe is used to create a long-tailed plug that fits inside the entrance hole leaving two vertical 1cm x 8cm slots either side of the plug. The tail of the plug goes into the cavity and marks the point above which the beekeeper must never disturb the colony. Honey may be harvested below the tail of the entrance plug. Inside the cavity two sets of two spales are arranged in a cross that fit above and below the entrance plug.

Each spale is approximately 1 cm x 0.8 cm x 40 cm and pointed at the ends. The length is adjusted to be a tight fit inside the cavity with the pointed ends digging into the side walls. Spales are not necessary if the hive is not harvested for honey.

The final internal components are eight thin hardwood spikes used to fix 8 cm x 8 cm bait comb to the top of the hive. I prefer to call it 'welcome comb', as we are not trapping the bees for collection, instead we are inviting them to stay. The welcome comb is arranged to encourage the bees to build comb parallel to the door, which simplifies inspection.

The final internal components are eight thin hardwood spikes used to fix 8 cm x 8 cm bait comb to the top of the hive. Personally I prefer to call it 'welcome comb', as we are not trapping the bees for collection, instead we are inviting them to stay. The welcome comb is arranged to encourage the bees to build comb at right angles to the door opening, which simplifies inspection.

The traditional tools for hollowing out the hive include: hand forged adze, round scorp and heavy duty chisel/lever. A carving axe is used to make the internal components and this also doubles as a hive tool. More recently, tree beekeepers use chainsaws to speed up the process of making the hive and working platform. The process takes one to two days.

The final stage is to add the tree beekeeper's family mark on the tree. In Bashkir this is called a tamga, and historically in Poland, a signum (more recently it is called 'ciosno' and 'znamie'). This is cut into the bark at the base of the tree. The mark shows ownership, and was once also used for tax collecting purposes.

Should you be interested to delve deeper into the subject and perhaps even contemplate preparing a tree for

Welcome comb © J Powell

hosting a bee colony, please visit the website of the Natural Beekeeping Trust and follow the link http://naturalbeekeepingtrust.org/ebook to preview the Field Guide to Tree Beekeeping available there.

COMPARISONS BETWEEN WILD COLONIES AND MANAGED COLONIES

But just how well do tree hives match the natural preferences of bees? What would bees do if we did nothing at all? Only when we know this can we judge if our interventions are supporting them or not. For more understanding, we therefore look to the bees in the wild and how they live.

The study of bees in the wild is difficult and there are very few large traditional non-commercial forests with very mature trees. Additionally, spotting a colony high in a tree in a forest is hard, and studying one is even harder. However, there are useful studies on bees in Arnot Forest (USA) by Prof Thomas Seeley[2] and others which provide some possible benchmarks.

In one of his lectures in Switzerland in 2015, Professor Seeley outlined differences between how wild bees live compared with those in a typical apiary, as shown in the table below. I have included a tree beekeeping hive column and additional parameters, though I appreciate that not all of the apiary traits are common to all beekeepers.

Clearly there are many differences between tree hives in the wild and their ground based apiary cousins, but do these affect the health and vitality of the bee?

Professor Seeley firmly believes that the attributes of natural tree hives have a measurable and significant positive effect on hive health. The Arnot Forest bees he studied had adapted to the deadly varroa mite, and no signs of foul brood diseases were found in forest studies spanning 33 years. In one of Seeley's studies, inspired by forest bees, he recommended apiary hives be spaced much wider: at 10m, to reduce transfer of disease.

But could more extensive tree beekeeping with its minimal inspection or the introduction of unmanaged tree hives be a problem for conventional apiaries?

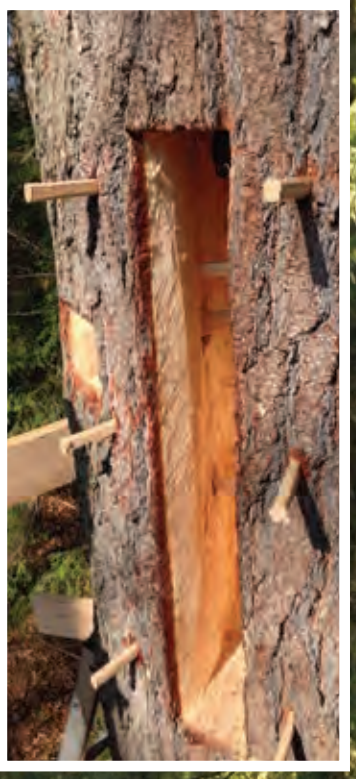
Catherine Thompson's 2014 paper on "Parasite Pressures on Feral Bees" touches on this concern. However it showed established feral bee colonies apparently able to tolerate high values of deformed wing virus (DWV) that would normally lead to colony mortality [feral is used to describe likely escaped swarms from apiaries, though I prefer the term "wild" and will use that from now on]. This tolerance may be related to the work of Gideon et al [2015][3] on DWV and 'superinfection exclusion', in which they highlight honeybees, varroa and DWV reaching a stable state by natural selection.

Papers by Miller 1935[4], Bailey 1958[5], and Goodwin 1994[6] all indicate that wild bees do better than managed colonies concerning disease, and the main threat to wild colonies are local dense populations of "managed" colonies. This may not be a surprise when we consider that horizontal transfer of pathogens, not seen in wild hives, is common in beekeeping. We also know that the microbiota of honey bees can be damaged for several decades by the use of antibiotics[7] . Furthermore, it is well established that the effects of sugar on the gut of bees compromises their immune system[1].

In the UK it is likely that many conventional apiaries already exist close to wild hives; in the Andover (Wiltshire, UK) locale alone there are reportedly over 80 wild bee sites, many with strong colonies continuously inhabiting their hives over many years.

So, there is a picture emerging of wild colonies retaining vitality through normal selective pressure. Concerns that

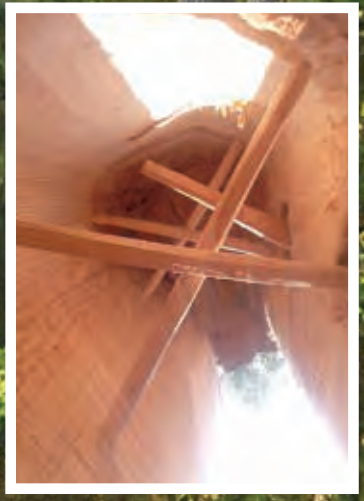
Natural tree hive	Tree Beekeeping Hive	Common Apiary
High off the ground 4-8m, where the humidity is lower, and it is warmer in winter	4m above the ground, where the humidity is lower and it is warmer in winter	Very close to the ground
Small nest (40 ltrs median volume)	Large nest (80 ltrs volume)	Large nest (70+ ltrs volume)
Small hive opening	Small hive opening	Large ive opening
Thick hive walls covered in propolis	Thick hive walls covered in propolis	Thin wooden floor and walls. Propolis removed and floor cleaned at least annually
Queens live long on small brood comb (1m2)	Queens live long on small brood comb	Queens often replaced by beekeeper (1-2 year cycle) on large brood comb (2 m2)
Hives well spaced (1-3 hives per km2)	Hives well space (1-3 hives per km2)	Hives closely packed together
Regular annual swarming	Regular annual swarming	Swarm prevention
Brood nest not restricted and follows the bee preference (17% drones)	Brood nest not restricted and follows the bee preference	Brood nests often culled to remove or restricted to reduce drones
No chemical or antibiotic treatments	No chemical or antibiotic treatments	Regular chemical treatments for mites and common diseases
No honey harvest	Limited honey harvest	Extensive honey harvest
No opening of hive	Hive opened twice a year: Spring check and September harvest	Regular opening of hive, sometimes weekly
Bees never fed sugar	Bees never fed sugar	Bees routinely fed sugar
Hive consists of empty cavity	Spales added to support comb during harvesting	Frames for easy honey removal and transfer of combs and brood (and pathogens!) between hives
No intervention to prevent loss	No intervention to prevent loss	Intervention to prevent loss
Natural comb managed by bees	Natural Comb managed by bees	Foundation comb (often contaminated), rotation of comb, supering, queen exclusion from supers (honey harvest areas)
Static position	Static position	Sometimes migratory
Key	**Same as Natural Tree Hive**	**Different to Natural Tree Hive**



Newly completed hive with wood pegs for securing door © J Powell

newly completed hive without insulating cover.©J Powell

Hive sealed ready for bees - with insulating cover ©J Powell



View up inside compleyted hive © J Powell

Honey and schnapps ©J Powell

Hive in Poland © Piotr

they may be potential pathogen reservoirs are not borne out by studies or anecdotal evidence. Furthermore, Gideon's and Seeley's research has shown that natural selective pressure uncompromised by treatments and alien inputs has been a positive to bee health and created an important genetic reservoir. This has worked well over millions of years, and rather than shun this natural wisdom, we would do well to embrace it by creating tree hives.

With the resilience of wild bees in mind, it is no wonder that tree beekeeping has caught the imagination of many beekeepers across Europe. The Natural Beekeeping Trust[8], Gaiabees[9] and Free The Bees[10] promote tree hives, and new organisations such as Bractwo Bartne[11] and Tree Beekeeping International[12] have formed to teach tree hive making and tree beekeeping skills. Additionally, tree beekeeping is being used to protect four different races of dark bees (Northern, Augustowska, Kampinoska and Asta) in Polish forests and, in Bashkortostan, tree beekeeping is bringing additional income to the local community. In Germany, habitat forestry initiatives are attempting to increase forest biodiversity by incorporating tree beekeeping.

I believe that tree hives, which draw closely from the innate preferences of the bees in the wild, can offer new directions to apiculture. Recent hive designs, such as those by Lazutin, Somerville and Haverson[13] , have mimicked the high insulating properties of tree hives. This is supported by the work of Mitchell[14]. Increasing numbers of beekeepers are rejecting treatment of bees, and the practice of leaving enough honey for overwintering bees and rejecting the use of sugar is becoming more common.

For me, a narrow focus on apiculture misses the full inspiration of trees and bees.

In recent weeks I was privileged to embark on a project to bring this craft to the UK for the first time. It had been something of a dream of mine ever since I was introduced to tree beekeeping by a group of Polish Zeidlers in Switzerland some years ago. Needless to say I got many requests from people wishing to establish a tree hive on their property, so strong is the allure of this ancient craft and many people's desire to let bees be bees. But finding the right place for creating a tree hive is as difficult as finding the right tree in our much depleted environment. I had to learn to wait, to let the desire to do something rest. After a long search I finally found a wonderful tree in one of the oldest organic farms in this country. I had an immediate sense that the "right" place might be beckoning. And so it was, I am happy to say. With tremendous support from the farm team I created, a few weeks ago, Britain's first tree hive on Pertwood Farm in Wiltshire, Pertwood is an exemplary mixed farm. It was greatly affirming to meet scout bees exploring the new cavity as I was applying the finishing touches. But I have no words to describe my feelings upon hearing, whilst at work in my office, that a huge swarm of bees had taken possession of the home prepared for them only 2 days earlier. There were tears of joy! Our human connection with bees is deep, and when they respond with resounding approval to something we have made for them, with love and conviction, it is a very momentous experience. An experience that has enriched me every day since their arrival. I told the wildlife expert at Pertwood that when you put bees and trees together something magical happens. He now understand this, and the bees and tree are both now in the hearts and minds of so many people.

Bees, as we all know today, have suffered from a catastrophic loss of quality non-toxic forage, variety of forage and habitat, and have been subjected to inordinate genetic damage and mechanical manipulation. To have any hope of regaining their vitality they need our support. It goes without saying that beekeeping as practised and taught today has no place in preserving what is left of the bees' integrity, let alone enhancing their vitality. Whereas the creation of tree hives, alongside the creation and nurturing of pure and varied sources of forage, strike me as an appropriate response to the needs of the bees today, especially so, if the hives are not harvested for honey. The bees need us to help restore the environments in which they unfold their existence, and they emphatically do not need our "help" with managing their hive life! My fear is that beekeepers will try and take from the wild bees and repeat exactly the same mistakes as the past (we have already seen failures in breeding from wild bees), but my hope is that we apply some humility, take a longer path to understanding and instead of taking, receive the wider message of the bees. We have a lot to learn.

Already many new extensive networks of tree hives are being established, including those in protected habitat forests, promising to provide new environments for bees, free from human intrusion and economic imperatives. These will be places to recover what has been largely lost. After more than a century of continuously taking from bees, there is a strong need to redress the balance. Interest in providing trees for bees is buoyant, and many new host trees have already been established by dedicated teams of bee guardians in Poland and Germany. The time is ripe for putting the needs of the bees first, and in that sense the revival of tree beekeeping provides a new direction. ■

***Jonathan Powell** is a Trustee of The Natural Beekeeping Trust and Founder Member of Tree Beekeeping International*
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Tree Beekeeping International supported courses for 2016
Details will appear on http://tree-beekeeping.org

Germany	Mellifera	July
	Essen	2010 König October
	Paderborn	August September
	Düsseldorf	June Lecture.
Belgium	October	
Poland	Augustow	July festival, April Course
France	Normandy	September

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