A Plea for Conscious Beekeeping through Diversification and Adjustment of Intensity

by André Wermelinger and Emanuel Hörler

There are more and more beekeepers who get into beekeeping because of their love of nature, and not primarily for maximizing honey yield. Despite this, their management practices are often as "intensive" as that of commercial beekeepers. Currently, there is no clear Europe-wide classification of hive management procedures. The non-profit organization FREETHEBEES has described various management methods and ranked them according to their production intensity. Using the following overview, beekeepers can now rank their own management practices, critically question and optimize their management style in order to achieve their goals.

In agriculture, we are familiar with extensively managed meadows and wildflower strips (so-called ecological compensation and biodiversity promotion areas (1) as well as different forms of livestock farming with varying degrees of intensity (2). The additional maintenance is subsidized through compensatory payments, and with livestock there are criteria for classifying species-appropriate management. These systems are highly structured, classified, and officially recognized (2, 3). The producer can know exactly what he/she is doing, and the consumer can know exactly what he/she is buying. Those who can offer sustainably produced products can take advantage of consumer appeal and charge higher prices. Contrary to this widely-supported and proven practice in agriculture, with its clearly defined terms, in modern beekeeping we simply speak of "good beekeeping practice".

What do the terms "extensive", "sustainable," and "species-appropriate" mean in beekeeping?

So far no criteria or categories have been developed according to which the intensity of beekeeping work can be classified, or if they have, they are unknown to the beekeeper. That is why the meaning of terms such as "naturalistic", "appropriate", "biological" are left to the individual beekeeper to define for him/herself. As a rule, beekeepers classify their style of beekeeping by which hive system they use. A Swiss hive beekeeper (Burki system) would be subjectively placed on the "intensive" end of the spectrum as a honey beekeeper, while a Warre beekeeper is usually seen to be closer to nature. In practice, however, one can also manage a Swiss hive less intensively, while a Warre hive can be set up for intensive management. The hive system, therefore, only allows limited conclusions to be drawn about the intensity of the beekeeper's work. The sole approach we know of for measuring the intensity of beekeeping practices comes from David Heaf (4).

Criteria which influence the intensity of beekeeping

Hive type/ habitat:

- total volume
- volume alterations throughout the season
- shape of cavity
- construction material/insulation
- comb construction

Management interventions:

- reproduction
- feeding
- Varroa mitigation
- density of local bee colonies

The style of hive and beekeeping methods influence the welfare of the colony indirectly via the following areas:

- natural selection
- biocenosis (flora and fauna in the hive)
- external and internal immune system
- hive climate
- life span performance at the individual and colony level

As reference points for the intensity of management, we have at one end of the spectrum a wild colony living in a tree cavity, and at the other end we have conventional beekeeping. Due to the interventions focused on maximum honey yields, this latter style is classified as **"intensive" beekeeping**, and from this the term **"extensive" beekeeping** is derived - also directed towards a honey crop, but aspiring to be more sustainable. With the starting point being the entirely free nature of a wild-living honeybee colony, FREETHEBEES suggests management styles that reflect **species-appropriate** as well as **naturalistic** beekeeping methodologies, which focus on the welfare of the colony, as opposed to honey harvest or even beekeeper convenience. Naturalistic colonies are managed rather restrictively: with an appropriate hive, and very favorable environmental conditions (optimal vegetation development, flower-rich surroundings) a small amount of honey may be harvested. However, the high colony losses through natural selection - as with wild-living colonies - can be avoided in naturalistic beekeeping, the most important intervention for this being targeted feeding to avoid starvation. Another feature of both species-appropriate and naturalistic beekeeping is the free and unhindered swarm impulse, which is guaranteed through the

	Area of action	Wild living bee colonies	Species-appropriate beekeeping	Naturalistic beekeeping	Extensive honey production	Intensive honey production
Habitat / Hive	Total volume[5]	small: 20 - 40l		small to medium: 20 - 60l	medium to large: 60 - 100l	very large: over 100l
	Volume modifications (honey super, brood chamber)	fixed volume, single cavity	fixed volume with possible cavity subdivision for intervention purposes	cavity subdivision possible by means of frames or rings; adding empty space below cluster (E. Warré); removal and immediate replacement of a constantly attached honey ring (T. Schiffer)	volume expansion through supering: honey supers placed on top (Swiss hive, Dadant) or sideways honeycomb expansion ("Einraumbeute"*, top bar hive); reduction and expansion of brood space	
	Habitat shape	natural cavities or cylindrical simulations of a tree cavity		cylindrical or angular approximations of a tree cavity	vast majority are square boxes	
	Construction material and insulation[18, 20, 37]	natural solid wood, tree-cavity-like insulation, moisture regulation through the corresponding exposed wood fiber ends at ceiling and floor		natural materials with stable climatic conditions similar to tree cavities, from thin-walled to well-insulated	natural materials, if possible, with a moisture-permeable lid, mostly thin-walled and poorly insulated	various materials, partly also synthetic, mostly vapor-impermeable lids, thin-walled and poorly insulated
	Inner surface	natural / roughened		brushed	smooth / roughened	smooth
	Comb construction[37]	natural comb / fixed comb		natural comb, if possible fixed	frames with natural comb at least in the brood nest; wax foundation may be used in the honey super	frames with wax or plastic foundation
	Reproduction	unaffected, completely natural swarming		natural swarms, minimal swarm intervention	delayed swarming; at best, post-swarms preempted by reproductive splits	swarm delay or prevention, nuclei, package bees, queen breeding
Management Conditions	Feeding	X	not allowed	with high insulation factor, not necessary due to the low total consumption and the minimal honey harvest, but generally permitted	allowed; especially when rearing young colonies, constant feeding in small quantities results in stocks well mixed with nectar	large amounts of sugar in a short time interval; sugar is pure energy- vitamins, minerals and secondary plant nutrients are missing

Table 1: Classification of operating modes according to intensity. The increasing intensity correlates with the amount of treatment and care required and with the honey yield for the beekeeper. The natural needs of the honeybee colony are increasingly restricted and its immune system weakened.

use of smaller hives and - particularly – hives with fixed volumes (5).

Wild-living Colonies

A wild colony living in a tree cavity inhabits a rather small, fixed-volume cavity. There is no division between broodnest and stores. There is no beekeeper to add honey supers or shrink the broodnest throughout the year. The colony swarms unhindered and regularly (5). The bees construct their own combs freely, without frames or foundation. There is no supplemental feeding or varroa management.

Depending on the nectar flow and quality of the habitat selected by the colony, it can become a challenge for a wild-living colony to collect enough stores for the winter. Colonies may swarm in the middle of a dearth, and the swarm find itself able to build up only slowly. The end of summer may arrive without enough stores to survive the winter. The mother colony can be weakened by departing swarms, and due to a scarce nectar supply, recover only slowly, also finding itself without enough stores for the coming winter. While harvesting surplus honey from a wild colony is possible in principle, typical nectar flows in our current environment make it in practice very unlikely.

Interesting and worth mentioning are reports from Bashkiyrian tree beekeepers in the Ural mountains, who harvest 25kg of honey out of their hollowed-out living trees, still leaving the colonies with enough of their own stores for overwintering. This is only possible when the flow is particularly strong and well-balanced throughout the entire season. These dream conditions are made possible by the extensive stands of Linden trees in the local forests (6). In Switzerland, we observe similarly balanced, dearthless flows occassionally in the Alpine foothills and – interestingly - also in cities (7).

Wild-living colonies are subject to natural selection, and thereby suffer relatively high rates of loss over the winter. In the wild, 85% of departing swarms do not survive the first winter (8), and observations in Switzerland show an even higher casualty rate (9). This can be explained by the poor quality and quantity of seasonal nectar flow in the region: after the fruit trees and bushes have blossomed in spring, nectar and pollen collectors are starved (10). Swarms - as well as their mother colonies - do indeed survive the summer, but they have so little winter stores that they often don't even make it through the fall. Varroa and brood diseases most likely play a minor role in this situation.

Figure 1: Crowded colonies - extremely high colony density promotes drifting and robbing and therefore increases transmission of parasites and bee diseases.

Only natural selection yields robust colonies that are adapted to local conditions. Widespread stable breeding successes are rarely observed (11); they are a "temporary phenomenon in terms of location and time" due to the reproductive biology of honeybees (12, 13).

Colonies kept in a species-appropriate manner

Tree hollows have become rare. Wild honeybees are thus best protected and encouraged through species-appropriate beekeeping, through which the natural habitat can be most faithfully simulated by offering a kind of artificial nesting tree cavity. There follow no interventions in the colony, which enables the natural and free swarming impulse. The fate of the colony is thereby completely subject to natural selection.

Naturalistic colonies

The beekeeper can keep bees naturalistically - similar to wild colonies. He/she allows free swarming, avoids adding honey supers, and does not alter the volume of the hive (e.g., by addition of frames with foundation, or expanding or shrinking the broodnest).

Adding empty space underneath (for example, a box or super of any modular hive system without frames and foundation) as Warré described in his method, has no relevant, negative influence on the swarm impulse (14). Honeybees typically swarm in spring, before they begin to expand the nest downwards. The eagerness to swarm and the following brood break is an important basis for colony hygiene, as well as mite control (5). Those who would like to additionally reduce the mite population may use well-tolerated agents during the brood break after swarming (15, 16).

In many areas, naturalistically-kept colonies rarely yield surplus honey. Exceptions are cities and the Alpine foothills, as well as seasons with meterologically favorable conditions for the nectar flow. Through an improved quality of habitat, the survival rate of naturalistic colonies increases, and - in optimal circumstances - small honey harvests are possible. To ensure survival of the colony, naturalistic beekeeping allows for feeding as necessary.

Colonies kept under species-appropriate as well as naturalistic conditions should be sited as far apart from each other as possible. This reduces colony drift and thus the spread of diseases and parasites (17). While tightly-grouped colonies are indeed convenient for the beekeeper, it is comparable to the overcrowding seen in factory farming.

The climate in the naturalistic hive is a matter of survival

Species-appropriate as well as naturalistic beekeeping is done with "hives" that most closely approximate the honeybee's natural habitat. This means a well-insulated, cylindrical hollow space that enables a uniformly warm, antiseptic nest climate (18, 19). These two characteristics distinguish our conventional hive systems from hollow, living trees.

The conclusions of Torben Schiffer show this convincingly (20): Warré's ingenious invention of the straw or sawdust "quilt box" placed on top of the hive enables a relatively low humidity, as measured in hollow trees. Warré's quilt box can be easily adapted to fit on top of any other style of hive, or to the rear as with the Swiss hive, in place of a window in the form of a straw or reed mat (21). A well-insulated hive reduces the total energy expenditure of the colony by a factor of as much as 12, in both summer and winter (22). The colony thus works less in the summer, and consumes fewer stores over the winter, which increases the chances for survival (20).

A stable, warm and moderately humid nest climate enables the development of a hive biocenosis which, in addition to honeybees, is made up of around 30 other

Fig. 2: Bees can be observed as they begin to close their nests with a “bee plug” on mild summer evenings. This “plug” fills only the entrance and does not reach into the cave (12). Often wax moths can be observed trying to enter the nest at this time of day. Does the bee plug serve - amongst other things -to ward off moths?

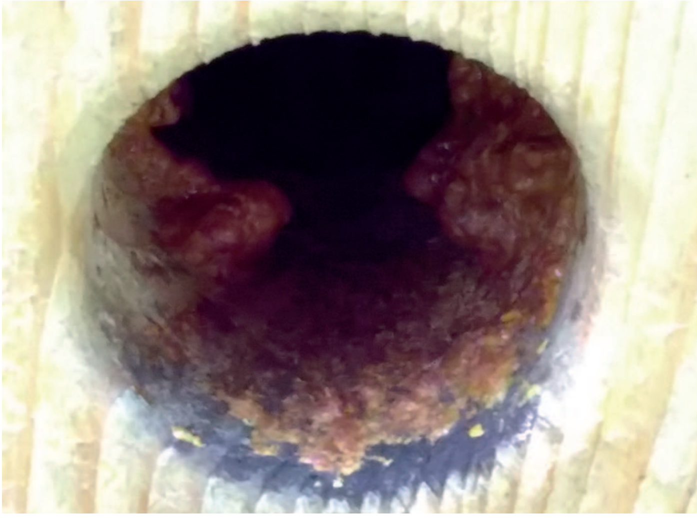

Fig. 3: Propolis stock and covered floor in the nest entrance. Propolis is an essential element for the health of our bees. A good propolisation of the cave entrance and the cave walls results in an optimally functioning external immune system with “Nestduftwärmebindung” and antibiotic water circulation.

insect species, 170 arachnid species - including mites - and 8,000 microorganisms (23). The arachnids also include the book scorpion (*Chelifer cancroides*), which actively hunts and eats Varroa mites, and lives symbiotically with the honeybee colony (20). However, it does not tolerate the damp climate of the Swiss hive or Dadant magazine hives, nor routine treatments with formic and oxalic acid. It is very likely that the other species that inhabit beehives do not survive conventional treatments. We do not know of any existing scientific study on the effects of a missing hive biocenosis on our bee colonies.

Beekeepers assume that parasites like Varroa, viruses like Deformed Wing Virus and bacteria such as *Melissococcus plutonius* (European Foulbrood) are the cause of honeybee problems. However, what influence an intact hive biocenosis* can have on the health of a honeybee colony should be scientifically studied and answered. Could Varroa, viral and bacterial infections actually be the symptoms of a weakened immune system?

Intensive versus extensive honey production

Beekeepers want to produce honey. Honey is, after all, the main incentive for keeping bees, and of course, honey is a product that consumers expect from the beekeeper.

However, it is worth questioning whether the current system of honey production is sustainable. As shown in the examples of wild, species-appropriate or naturalistic colonies, honey can only be harvested on rare occasions. When honey production is desired, certain interventions against the natural processes of the hive must be performed. The most important intervention for honey production is the addition of honey supers at the right moment. This forces the bees to collect and process large amounts of nectar into honey during the main flow, which only lasts for a short time. The delaying, or indeed prevention of swarming through honey supering is a side effect that the beekeeper knowingly accepts.

Extensive honey production, in contrast, optimizes the welfare of the colony through the avoidance of wax foundation sheets with their uniform worker cell size, particularly in the broodnest. The frame is provided with a wax starter strip, which is drawn out by the bees as natural comb. This allows the bees to build drone or worker cells at their own discretion. Instead of organic acids for Varroa management, which have strong and undesirable side effects, we recommend for extensive beekeeping the Büchler method of complete brood removal (24). Performed at the right time (depending on location and colony progress in mid-July), this chemical-free, once-yearly intervention can still result in harvests that are on par with any other well-known treatment method. Colony hygiene is improved by the brood break, just as with swarming. In addition, the comb in the broodnest is renewed. The colony goes into winter just as strong as a conventionally treated hive. The winter oxalic acid treatment is not needed. With a good nectar flow and skillful operation, honey yields can be achieved in extensive honey production (24, 25), and the bees can overwinter on their own stores without feeding sugar or a honey-sugar mixture (Table 1).

While the intensive honey production model taught in beekeeper courses everywhere may be the method of choice for commercial beekeepers, it is not sustainable. For most hobbyists, there is no need for intensive honey production. The need for diversification of beekeeping and production methods for a modern and responsible beekeeping practice is obvious.

Diversification of beekeeping

The economic value of all the insect pollination in Switzerland is estimated to be around 350 million Swiss francs (26). If we apply global estimates to Switzerland, about half of this is provided by honeybees (27) Therefore, the pollination provided by honeybees is economically much more important than the honey they produce. This portion of the pollination could be provided much more sustainably through a combination of extensive and naturalistic beekeeping (Table 1).

In practice, this would mean that 80% of an apiary’s colonies be managed for extensive honey production, producing the same amount of honey as before, but much more sustainably. The remaining 20% are managed naturalistically or species-appropriately, producing an “ecological and evolutionary compensation contribution” in favor of nature.

This compensation is important because the wild honeybee population necessary for natural selection has been massively reduced in the last 150 years, in particular due to habitat loss, lack of food and the influence of intensive honey production (12, 20, 28). The wild population is subject to natural selection, and ensures the bees’ ability to adapt to environmental changes. Without wild bees there will be no more locally-adapted colonies. The smaller the population of wild honeybee colonies, the more the evolution

Fig 4: Spring operations at the nest entrance: returning collector bees, guard bees, fanning and washboarding bees.References and Notes

of the species will be left to beekeepers, who cannot fulfil this responsibility if all colonies are managed for honey production.

At its most basic level, the more extensive the beekeeping, the greater the freedom of the honey bee colonies, the less potent the undesirable effects of the interventions, and the stronger the natural selection. The result of these processes are resilient and locally-adapted bee colonies. Reports from all over Europe show that treatment-free beekeeping is possible under naturalistic conditions (29, 30, 31, 32). The colony losses are of the same order of magnitude seen in treatment-intensive honey production. Data from Wales even show significantly lower losses if the colonies are not treated against Varroa (33, 34).

In addition to securing the proportion of pollination and domestic honey production through management styles that are as extensive as possible, the beekeeper's contribution to the balance of ecologicy and evolution is more necessary than ever. This can be made possible by diversifying the methods of operation by managing some of the colonies naturalistically or species-appropriately, and protecting and promoting the wild population.

Awareness of the intensity of one's management style

This classification of operating methods is intended to serve as a guide for assessing one's own degree of intensity. It enables structured and well-founded comparisons among beekeepers. If the factors that determine the intensity are recognized, they can be consciously changed, and the beekeeping method correspondingly developed in one direction or the other. This awareness only arises when there is the will to question, to distinguish, to classify one's management in terms of intensity and to try for oneself. What one has tested and experienced for oneself is worth more than a thousand theories read in texts.

Time is ripe to rethink "good beekeeping practice", to get out of mono-apiculture and to become aware of our responsibility to society and nature. What will the first step be in your apiary?

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Glossary

*Cavity biocenosis - a piece of the honeybee health puzzle. Biocenosis is a community of organisms of different species in a definable habitat (biotope, here the hive). Biocenosis and biotope together form the ecosystem (bee colony, honeycomb structure, "cavity", roommates). https://de.wikipedia.org/wiki/Bioz%C3% B6nose 13.05.18 / 18.32

**The pessimum denotes the least favorable environmental condition under which an organism can survive. The opposite is the optimum. https://de.wikipedia.org/wiki/Pessimum // 01.01.20 / 19.38

***"Einraumbeute" is a product name of Mellifera e. V. (www.mellifera.de)

André Wermelinger, Co-founder and managing director FREETHEBEES; andré.wermelinger@freethebees.ch.
Emanuel Hörler, Experience trail honeybees Rehetobel AR; former member of the scientific advisory board FREETHEBEES; info@biophil.ch.