Methods Areas for action		Wild living bee colonies	Species-appropriate beekeeping	Naturalistic beekeeping	Extensive honey production	Intensive honey production
Habitat / Hive	**Total volume**[1]	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 ringed honey super (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 [4, 11 , 12]	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 [11]	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
	Varroa treatments	X	not allowed	not necessary with good hive design and compliance with minimum distances between the bee colonies; possibly essential oils or lactic acid during the brood breaks (post-swarm)	complete brood removal, possibly essential oils, lactic acid, oxalic acid for nuclei from brood removal	formic acid, oxalic acid, synthetic acaricides, drone culling
	Colony density [3, 8]	0.2 to 1 bee colonies / km2	as much distance between the colonies as possible		apiary with minimal distance between colonies and overcrowding stress	swiss apiary, apiaries with hives lined up in rows, factory farming
Impacts	**Natural Selection**	maximum	very high	medium	low	nonexistent
	Biocenosis [6,7]	abundant, balanced		variable abundance and stability depending on the quality of the hive	partially present, unstable	greatly reduced / severely impaired by interventions / one-sided parasitic
	External immune system ("propolis envelope") [4, 5, 9, 10]	propolisation results in an optimally functioning external immune system with nest scent and heat retention and an antibiotic water cycle		propolisation results in a functioning external immune system, usually with nest scent and heat retention and an antibiotic water cycle	mostly reduced propolisation due to selection criteria and non-species-appropriate hive / the external immune system does not function adequately	
	Internal immune system [4, 5, 10, 11]	minimal stress on the energy-intensive internal immune system at the individual and colony level		depending on the quality of the hive, different loads on the energy-intensive internal immune system at the individual and colony level	high pressure on the energy-intensive internal immune system at the individual and colony level	
	Habitat climate [4, 11, 12]	optimal cavity climate in terms of temperature, humidity and nest scent retention; no mold formation in the honey storage combs		largely optimized climate in terms of temperature, humidity and nest scent and heat retention; no mold formation in the honey storage combs	Inadequate insulation keeps the hive climate in a "pessimum" with regard to temperature and humidity *; due to removable combs, the process of nest scent and heat generation must be constantly restarted; formation of condensation and mold	
	Life expectancy at individual and colony level [4]	optimal cavity climate, the nest scent and heat retention is built up and maintained by the cluster; the colony’s effort can be directed towards other core behaviors such as grooming and washboarding	largely optimal cavity climate. Because of minimal interventions, the nest scent and heat retention only needs to be built up once a year by the colony; minimal energy is wasted in compensation; the bees effort can be directed towards other core behaviors such as grooming and washboarding	due to largely optimized insulation, fixed comb and optimized interventions by the beekeeper, the nest scent and heat retention only needs to be rebuilt by the colony a few times a year; energy must be spent compensating for the interventions; nonetheless, energy capacity remains for key behaviors such as grooming and washboarding	insufficient insulation, excessively large hive volumes and beekeeping manipulations must be compensated for; repeated attempts to build up the nest scent and heat retention cost enormous amounts of energy and result in a shorter life expectancy	
Effort and output	**Care effort**	X	negligible	low	medium	high
	Benefit & harvest	acclimated bee colonies, natural gene pool	acclimated bee colonies, swarms, eventually small amounts of very high quality honey [13]	depending on the quality of the hive, very high-quality honey [13], swarms, partially acclimated bee colonies	honey, nucleus colonies, package bees, partially delayed natural swarms, possibly other bee products	

1Loftus JC, Smith ML, Seeley TD (2016) How Honey Bee Colonies Survive in the Wild: Testing the Importance of Small Nests and Frequent Swarming. PLoS ONE 11 (3): e0150362. doi: 10.1371 / journal.pone.0150362.

2WermelingerA (2013) Contemporary and targeted beekeeping methods. https://freethebees.ch/wp-content/uploads/2013/03/2013_03_29-Zeitgemaesse-und-zielgerigte-Imkermlösungen_v11.pdf 05/24/20/ 18:15

3SeeleyTD (2015), Crowding honeybee colonies in apiaries can increase their vulnerability to the deadly ectoparasite *Varroa destructor*. Apidologie (2015) 46: 716-727. DOI: 10.1007 / s13592-015-0361-2.

4 Evolution of beekeeping - species protection for honey bees. Torben Schiffer, Ulmer Verlag, 2020 ISBN 978-3-8186-0924-5.

5 The lives of bees - The untold story of honey bees in the wild. Thomas D. Seeley, Princeton University Press, 2019, ISBN 978-0-691-16676-6.

6 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

7http: //freethebees.ch/wp-content/uploads/2017/11/FourSimpleSteps_Michael_Bush-klein.pdf 06.06.18 / 17.35: “More than 30 other insect species, more than 170 arachnid species (including the book scorpion), more than 8000 microorganisms (Fungi, bacteria, viruses) ”.

8Kohl PL, Rutschmann B (2018), The neglected bee trees: European beech forests as a home for feral honey bee colonies. PeerJ 6: e4602; DOI 10.7717 / peerj.4602

9BorbaRS, Spivak M (2017) Propolis envelope in *Apis mellifera* colonies supports honey bees against the pathogen, *Paenibacillus* larvae.Scientific REPOrtS | 7 : 11429 | DOI: 10.1038 / s41598-017-11689-w

[10Ehrler] S, Moritz RFA (2016) Pharmacophagy and pharmacophory: mechanisms of self-medication and disease prevention in the honeybee colony (*Apis mellifera*). Apidology 47: 389-411. DOI: 10.1007 / s13592-015-0400-z

[11MitchellD] (2015) Ratios of colony mass to thermal conductance of tree and man-made nest enclosures of *Apis mellifera*: implications for survival, clustering, humidity regulation and Varroa destructor Int J Biometeorol, published online: 03 September 2015

12 Thür J (1946) Beekeeping. Natural, simple and sure of success. Friedrich Stock's Nachf. Karl Stropek book shop and antiquarian bookshop, Vienna. 1. Part The law of nest scent and heat retention, the basis for health, prosperity and yield. P. 5-12.

[13] Heaf D (2016) Bee guided pharmacognosy? BBKA News Incorporating the British Bee Journal July 2016

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