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APIS MELLIFERA IN NATURE. MY BELATED APPROACH TO THE NATURAL HISTORY OF THE HONEY BEE

Apis mellifera *in natura. Il mio approccio tardivo alla storia naturale dell'ape*

Once upon a time… since I was a child, I have been suffering from a severe form of Biophilia. Over the years my Biophilia has degenerated into a chronic form of Entomophilia: entomology. The immoderate passion for insects very soon led me to another syndrome: beekeeping. For many years, however, entomology and beekeeping were two completely separate worlds and *Apis mellifera* was the only insect for which I had no scientific interest. My conviction was that we know everything about the domestic honeybees! Everything went smoothly until, in November 2014, I had the mystical experience of meeting, in Würzburg, Jürgen Tautz, one of the major scholars of honey bee biology and author of the famous and wonderful text The buzz about bees (Tautz, 2008). During the meeting I was attending in Würzburg, Tautz presented some of his research and I realized, as he later confirmed to me in an exciting chat, that he uses top bar hives for his studies on the biology and ethology of the western honey bee. I had always considered the top bar hives to be hippies or hipster (updating this concept), so I naively asked him: WHY YOU DO IT? Tautz made me understand, with extreme kindness and with a lovely turn of words, that if you want to study the natural history of the lion, you do not go to the zoo but to the savannah. I felt like Saint Paul on the road to Damascus, unhorsed from my comfortable horse that is to say my solid beekeeping convictions. I too had my dazzling conversion on the way home from Wurzburg. So, does *Apis mellifera* have a natural history? Feverishly fumbling on the internet, thanks to the Wi-Fi of the train homeward, I discovered that there is also a natural beekeeping. I went back to being an

entomologist with honey bees too. After years of studying taxonomy, phylogeny, biology, ethology, bioacoustics and biogeography of various groups of insects, I had to retrace the same path on the insect that more than all the others I had absolutely handy in the last thirty years: *Apis mellifera*. I realized that fortunately the beekeeping course which I had been waiting for at the University of Padua (held by Professor Luigi Masutti) and which had unleashed in me the passion for this wonderful art, had actually been a course in apidology, and that the first texts on which I had studied were those masterpieces of Von FRISCH (1954), LINDAUER (1961) and FREE (1977). In a short time the references to the honey bee that I had read in the texts of Charles R. Darwin (DARWIN, 1859, 1868) and of many other entomologists and naturalists also surfaced. Since the beginning I had been put on the right path which, alas, I had lost immediately. So, I didn't have to sail in the dark, I had my good stars to refer to. In March 2015, after a winter spent in exciting readings on natural beekeeping and on the natural history of *Apis mellifera* (SEELEY, 2010 *above all*), and thanks to the lucky and a fruitful meeting with Marco Valentini, I populated my first two top bar hives. Thanks to the daily experience with these hives, shared with a group of friends within the Bees for Biodiversity project, jointly conducted by the Edmund Mach Foundation and the World Biodiversity Association, what I was studying and deepening on books, found a direct response in my new approach to my managed hives. This tumultuous learning process pushed me to communicate this personal cognitive journey and for this reason in 2016 I started writing a book, published in Italian the following year (FONTANA, 2017). This first Italian edition was followed by an updated edition in English (FONTANA, 2019) and a final (I swear) further expanded Italian edition two years later (FONTANA, 2021).

One of my first reflections on the biology of the honey bee was related to its evolutionary path and its subdivision into subspecies (RUTTNER, 1988). *Apis mellifera* evolved its ultimate taxonomic structure during climatic fluctuations and the subdivision into subspecies could be strategic above all being suitable for a more rapid adaptation to local changing conditions. Another bug on which I have deeply questioned is whether or not the honey bee must be considered a domesticated animal: *cum sint neque mansueti generis neque feri* (Pliny the Elder, Naturalis Historia, book XI-4). Some centuries later, Charles Robert Darwin (1809-1882) argued that these are precisely the biological peculiarities of *Apis mellifera* colonies that have prevented the domestication process: *Bees have been domesticated from an ancient period; if indeed their state can be considered one of domestication, for they search for their own food, with the exception of a little generally given to them during the winter. Their habitation is a hive instead of a hole in a tree… This remarkable uniformity in the hive-bee, wherever kept, may probably be accounted for by the great*

difficulty, or rather impossibility, of bringing selection into play by pairing particular queens and drones, for these insects unite only during flight (DARWIN, 1868). From the advent of beekeeping, many thousands of years ago, to today the honey bees have not been domesticated. In fact, unlike what happened for most of the really domesticated animals, that man has spread widely from well-defined centers of origin, in the case of bees were the apicultural techniques to be widespread, while the bees managed place by place have been for millennia those locals. This assertion was indirectly demonstrated by Ruttner who in the 80s practically found a subspecific structure still very well defined (RUTTNER, 1988).

From these considerations, shared by the most authoritative Italian apidologists, the need was immediately born to protect not only the honey bee but its complex and fragile genetic structure. The declaration of San Michele all'Adige (12 June 2018) clearly stated that: Apis mellifera*, despite being managed by beekeepers for many millennia, cannot be considered a domesticated animal and, as a pollinating insect, plays an irreplaceable role for the conservation of biodiversity and therefore in maintaining the natural balance itself, without counting the impact on agricultural production… The protection of the subspecies of* Apis mellifera *is a duty for the conservation of biodiversity and a resource for beekeeping* (FONTANA *et al.*, 2018).

The awareness of the wildness of the western honey bee (SEELEY, 2010, 2016, 2019; ALBOUY, 2016, 2019), led me to consider the colonies of *Apis mellifera* in the wild too. Did the wild colonies of western honey bee really disappear after the advent of *Varroa destructor*? And those we still find today are really all derived from swarms "escaped" from the colonies managed by beekeepers? To answer these questions Edmund Mach Foundation created a mobile app, BeeWild, to survey and monitor over time *Apis mellifera* wild colonies through a typical citizen science action. The experience with the top bar hives, the bibliographic insights for the writing of my book, the team work done for the San Michele all'Adige declaration and the first data deriving from the BeeWild app convinced me that the approach we have towards *Apis mellifera* is at the point of a proper Copernican revolution. There are many new questions about the biology of *Apis mellifera* that have emerged in recent years and finding an answer to them, however fascinating, is not easy.

One of the first problems is where does our biological knowledge about honey bees come from? Since ancient times knowledge on the biology of honey bees has concerned less and less the natural aspects, especially starting from the development of beekeeping based on the mobile honeycomb, the use of the wax foundation and the "pathological" control of swarming. Only in recent years researchers started to investigate the biology of *Apis mellifera* in its naturalness and we are all indebted for this to Thomas Dyer SEELEY

(2010, 2016, 2019), to Vincent ALBOUY (2016, 2019) and to a few other precursors. There are many aspects that a honey bee biology based on managed colonies has not clearly defined up to date. We know for example that a colony of honey bees normally forages within a radius of 1.5-3 km, in an area of 7-28 km^2, but its foragers can reach up to 13-14 km to collect pollen, exploring an area of about 500 km^2. At the same time, we know that to nest, a honey bee swarm needs a cavity with a volume of 20-40 liters. But such cavities are not uniformly distributed over the territory and so nesting sites have almost no direct connection with food sources. In reality the honey bee colony is a society of commuters and the nesting sites and the foraging sites normally do not coincide. After that, many colonies, as revealed by the first BeeWild app data, can be concentrated in sites with many available cavities, constituting natural apiaries. A still very open field of study is that relating to the honeycomb of bees. Natural combs are not a mistake of bees (as beekeepers accustomed to wax foundations often think) and for bees, secreting wax and building their honeycombs naturally is not a condemnation but a metabolic requirement. The natural honeycomb is composed of a variable number of cells of three types which are intended to contain worker (the smallest) or drone (the largest) brood and for the storage of honey (intermediate in size but longer and more inclined). The natural honeycomb is a non-living structure that determines the composition of the colony and its chances of survival and by this point of view it cannot be considered a simple inert support. We do not know, in natural colonies, what it is the "right" amount of brood and the "better" populousness of colonies as well the role of drones and the sufficient amount of honey stocks. What do we know about swarming that is generally considered by beekeepers as a seasonal hive disease? And what about multiple swarms (in Italy the natural multiple swarming is called *swarming fever*), about the merging of secondary swarms, about the reunion of small swarms with already established colonies? We still know very little about the song of the mother (queen) bees and even about which kind of mother bees produce it and why. What about the natural life span of the mother bee? And how long is the life span of a honey bee colony? According to SEELEY (2010), natural colonies that have been established for at least one year have a 75% chance of surviving to next spring while swarms have only the 25%. But how do we calculate the longevity of a colony of honey bees? If we consider that the colony, from a genetic point of view, is the one that leaves the cavity with the primary swarm accompanying the "old" mother bee, could we assume that on average a colony lives less than 2 years? We don't know yet how wild colonies overcome the varroa problem and why they don't collapse from the natural abundance of drones. Is their survival a matter of single colonies or is the surviving of a number of colonies within the local commu-

nity the most relevant point? Another open research field is that related to the subspecies identity. In Europe, the definition of subspecies has hitherto been largely based on honey bees managed by beekeepers while the study of wild colonies could bring new insights.

There are many other aspects that need to be investigated especially on the wild colonies of *Apis mellifera*, like:

- The "true" genetic identity of local populations
- The density of the colonies in the different environmental situations
- The relationship between these colonies and the other Apoidea
- The communities of organisms supported by honey bee colonies
- Western honey bee beyond from its original areas
- The real ecological role towards the local flora
- The sensitivity of these colonies to human action

For these and many other reasons, today it is urgent to assign clear protection to the wild colonies of honey bees, both because they are organisms with their own biological identity and dignity but also, selfishly, because these are precisely these colonies that will be able to save beekeeping.

All these biological aspects messily listed so far, upset and in part give new light to the scientific knowledge and to the daily observations of beekeepers and give rise to other reflections, perhaps a little philosophical: can we distinguish different "ranks" within the natural history of *Apis mellifera*? First of all, we can consider the individual one. For example, the mother bee works for the colony but also for herself. Her drones are destined to spread her own DNA while swarming the mother bee submits herself to the necessity of multiplication of the colony and of the diffusion in the environment of the species. Even worker bees, when they merge the small swarm they are a part (a cell?) with another swarm or colony, risking to perish their sister mother bee, seem to "seek" a greater chance of making "sense" of their individual existence rather than spending itself for the conservation of her own "familiar" group. There is the superorganism rank and about it we know many things: the subdivision into castes, the social sting, the swarming etc. Probably there is a third rank that could be the community of colonies living in natural or artificial apiaries or very close to each other. This is a very open field, but we still know something about behaviors like fertilization arenas and swarms and colony merging. What is then often forgotten, when we speak not of honey bees but of beekeeping, is the species rank. *Apis mellifera* has undoubtedly its strategies, its adaptations and its threats. We must always remember that beekeeping cannot be protected in any way if the honey bee species is not safeguarded in its intimate and marvelous complexity.

It is really exciting to realize that we do not yet know many things about the natural history of the western honey bees and I think that this partly

explains the irresistible fascination which arouses in *Homo sapiens* since the dawn of time. Let me dedicate to her the verses of this powerful and sweet song, that its author would not have imagined, despite that "honey", could also be referred to *Apis mellifera*:

I am woman, I am fearless
I am sexy, I'm divine
I'm unbeatable, I'm creative
Honey, you can get in line
I am feminine, I am masculine
I am anything I want
I can teach you, I can love you
if you got it goin' on

(I am woman, Emmy MELI, 2021)

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A wild colony of honey bees nesting since some years in a natural cavity in the lava rock on the island of Pantelleria (Sicily, Italy). April 2021, photo by the author.