Dealing with Varroa: natural selection or artificial selection?

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With a modest knowledge of honey bee biology and behaviour any beekeeper would be able to intuit some of the basic conditions that are favourable to colony health. Nevertheless, there is scope for discussion among beekeepers regarding these conditions, not to mention heated arguments as to what is essential etc. Given that 'sound science' is respected by most people as a source of guidance, beekeepers turning to a more natural way of keeping their bees have looked to the science of apiology, in particular in peer reviewed papers, for justifications of the various aspects of their beekeeping. I did this in a small way in my book *The Bee-friendly Beekeeper*.[1] The citations I used for that publication in 2009 are compiled into a document together with abstracts and have been updated over the years as more papers relevant to apicentric beekeeping were published. Eventually that compilation was made into a searchable resource on the web site of the Natural Beekeeping Trust.[2] But it was not until very recently that apiologists addressed directly what a more natural way of keeping bees would look like. They turned to Charles Darwin and natural selection for inspiration. The resulting publications were warmly welcomed by natural beekeepers including myself. The first of these papers to appear was that of Peter Neumann and Tjeerd Blacquière (*The Darwin Cure for Apiculture*, 2016)[3] followed by a more thorough treatment of the subject by Tom Seeley (*Darwinian Beekeeping*, 2017).[4]

My switch to no treatments

These papers cover a wide range of beekeeping issues and should provide food for thought by all beekeepers regardless of their approach. But here, I focus on a very small though no less controversial part of the material raised in the papers, namely what we should do about Varroa, particularly in the long term. One does not have to have a purely materialistic conception of evolution to accept that any organism has to adapt to the conditions in which it finds itself, or become extinct, albeit sometimes only in a particular locality or localities. When I started beekeeping in 2003, it was put to me that we don't want to eradicate the mite completely from our colonies because its presence is needed for the bee and mite to co-adapt in the long term. I was therefore advised to use the so-called 'soft' acaricides such as organic acids or essential oils. However, it struck me as unlikely that any real co-adaptation would occur if I intervened against the mite with chemicals, i.e. effectively shielding the bee from the ravages of the mite. In doing so I would be suppressing natural selection, the only process that would drive the bee towards healthy survival in a mite infested environment. Therefore, in 2007 when I started my switch towards beekeeping more apicentrically with the Warré hive, foundationless comb, no frames, queen excluder or swarm control, I used no Varroa treatments whatsoever, neither chemical nor biotechnical.

I was encouraged to take this risky step by several scientific reports of colonies, feral and managed, surviving Varroa without treatment in places as far apart as New York State, Sweden and France etc.[5] It also seemed highly probable to me that somewhere in the at least 65 million years of bee evolution and the millions of years of wasp evolution before that,[6] these insects had acquired effective ways of dealing with ectoparasites and brood parasites. Also, the idea of medicating bees until eternity did not appeal. Furthermore, mite resistance to acaricides was already starting in the UK when I took up beekeeping and it has since grown far worse. Whereas once two treatments a year were sufficient, now up to seven are being used yet winter losses are over 30%.[7]

Although I had some startlingly heavy losses in the early years, survival has improved and the average winter loss over all years of untreated Warrés is 18%. This is very close to the 16% winter loss rate for established ferals surviving with Varroa recently reported by Tom Seeley (2017) for the area round Ithaca, NY, USA.[8] My average colony age at the time of writing is 38 months, all colonies having been through one winter. The oldest colony is 84 months old. All the colonies were started by running in swarms. I can determine colony age because there has been no artificial requeening of any kind and I can rule out

usurpation of dwindling colonies by swarms because my colonies are closely monitored. My longest surviving colony on that basis lasted 9 years. Of course, natural requeening occurred several times within that period.

The 5-year Gwynedd winter loss survey

This record is of course deeply anecdotal, and an 18% winter loss is not anything to write home about considering that losses before Varroa arrived were reportedly below 10%. However, somewhat less anecdotal is the 5-year survey of beekeepers' winter losses in my locality, the county of Gwynedd, conducted by Clive and Shân Hudson which is published in more detail elsewhere.[9] To summarise: over the period 2010 to 2015 up to 77 survey responders per year reported on 477 treated colonies with a 19% winter loss rate and 1096 untreated colonies with a 13% loss rate. Dorian Pritchard carried out statistical analysis of the result and found that the lower loss rate for untreated colonies was significantly different at $p<0.05$ compared with the treated colonies.[10] When I started my no-treatment experiment in 2007 I knew of no beekeepers in my local beekeepers' association who were not treating. But when this survey got underway in 2010 it came as a surprise to hear that most beekeepers here were not treating. The reason for the low and tolerable loss rate is still unknown. It certainly has nothing to do with hive type as that was factored into the survey. Could the fact that most people in this small geographical area are not treating be something to do with it?

Mite bombers

A valid criticism of not treating for Varroa is that bees drift to other colonies in the vicinity carrying mites with them and this is especially so when colonies eventually collapse.[11] Such bees could be drifting to colonies of treaters even up to 1.5 km away.[12] The catch phrase 'mite bomb' has been coined for such colonies, very likely reflecting the irritation of assiduous treaters at the perceived threat to their colonies. However, we should keep in mind that the term is more appropriately applied to colonies that have not co-adapted to Varroa, i.e. colonies that have not gained some resistance to the mite. For example, these could comprise bees that have been bought in from a supplier who treats for Varroa and then subjected to a no-treatment regime. A very different picture might emerge if we were able to obtain data for the spread of phoretic mites into the environment from colonies surviving in the long term untreated. We might call such colonies *mite bombers*.[13] Looking at the broader picture we can get some idea of the relative mite flows into the surroundings from treaters and non-treaters.

High losses among treaters

In the USA, the Bee Informed Partnership publishes on the internet annual survey statistics on beekeeping practices and colony losses.[14] Using data for all states/operations/years, treaters lost 33% of colonies, non-treaters 42%. In purely percentage terms it means there is only a 9% difference in the potential bee traffic, the 'blame' lying more heavily on the side of non-treaters. But when you look at colony numbers a different picture emerges. Still considering all data, 2,710,692 colonies were treated and 293,608 were not treated. This means that 894,528 treated colonies failed, and 123,315 untreated colonies, i.e. over seven times more treated colonies potentially sent mites into the surroundings than untreated colonies. To assess absolute levels of mite flows we would need to know average phoretic mite counts in failing colonies or for bees drifting from them, data that may be hard to come by. But we can be pretty sure that treaters do not have zero mite levels in their failing colonies as no acaricides are 100% effective. If their mite levels were as low as one seventh those of non-treaters the mite flow on bees drifting from failed colonies would be about balanced between treaters and non-treaters.

Holistic breeding

As suppressing with repeated doses of chemicals the emergence of the bee's natural measures against brood parasites and ectoparasites does not find many takers in natural bee husbandry, is there another option? To judge by the Gotland experiment, at first sight a so-called hard Bond ('Live and Let Die') approach requires a lot of colonies.[15] In that case, one hundred and fifty colonies were reduced to only seven in four years. Such

a scale is very likely beyond the resources of hobby and sideline beekeepers. Those risking very few colonies could rapidly lose them all and be without bees for some time. Nevertheless, very many beekeepers take that risk. Tom Seeley in his Darwinian beekeeping article[4] supports not treating but cautions in bold type those who do not treat to do it carefully and diligently by killing, long before they can collapse, colonies whose mite populations are skyrocketing. His reasons are both biological and social. Horizontal transfer of mites from collapsing colonies to other colonies can in the long run select for mite virulence, and the influx of mites to not yet resistant colonies, including those of neighbours, can overwhelm them. But in my locality where no treatment is the norm and has no dire consequences, I know of no beekeeper who is doing these pre-emptive killings. Such killings would be *artificial* selection, not *natural* selection. Artificial selection cancels out natural selection, therefore such killings would be a total departure from Darwinian beekeeping. One cannot have it both ways. Furthermore, if one is following another of Tom Seeley's insightful colony health promoting suggestions for Darwinian beekeeping, namely allowing swarming, then killing a colony that may swarm and go on to survive with a new queen with even only slightly better Varroa resistance would be short-circuiting the very evolution that the non-treater desires.

Whereas artificial selective breeding is a justifiable approach in husbandry generally, it is questionable whether it is a sustainable approach with the honey bee, an essentially wild creature. Focusing on individual desirable traits that appeal to the beekeeper such as Varroa resistance (e.g. Varroa sensitive hygiene), docility, honey productivity etc. may displace traits for long term survival from the mix of traits that more holistic breeding by natural selection delivers. In short, in not knowing the direction in which natural selection is heading, killing colonies could be throwing away good genetics.

Understanding through association

We turn now to the social problem of bees with phoretic mites invading neighbouring colonies. In my locality I have heard of no complaints from the treaters, who are in a minority. However in other places there are strong objections to the presence of untreated colonies and persons unknown have gone as far as destroying them.[16] The only solution I can see to such a social problem is for beekeepers who wish not to treat to work through their local associations to present the arguments in favour of not treating. This would be material for an article on its own, but it suffices here to list some of them:

- no poisoning the colony, especially queens, with acaricides
- no acaricide residues in wax, honey, propolis
- saving of much labour
- only about a 10% average loss reduction compared with not treating (USA)
- natural mite defence measures allowed to develop
- all honey bees in the locality heading evolutionarily the same way, so potential for receiving favourable genetics from local drones.

Furthermore, as treaters tend to be more common amongst commercial beekeepers it would be worth mentioning the stories of commercial beekeepers who have successfully taken the no-treatment route, e.g. Kirk Webster and John Kefuss.[16, 17] And having mentioned Kefuss it is worth noting in passing that in evolving his resistant bees he harnessed the mite pressure on his bees by reinfestation from bees drifting from chemically treated colonies as little as 1 km away. But if no consensus can be reached at the local association level then the non-treaters could form their own local associations and through the sharing of very local information place their colonies where there is least risk of friction with the treaters. An example of this is Hampshire Natural Beekeepers.[18]

Saving colonies or preserving the species?

Finally, there exists the point of view that when a creature is in your care you should do all you can to protect it from disease and suffering. You would treat your dog for fleas, so why not your bees for mites? Merely saying that a dog is fully domesticated but a colony of bees is a wild organism and therefore does not deserve the same consideration does not cut any ice with those who put forward the aforementioned point of view. Proponents of it might cite in their favour the story of Androcles and the Lion. The lion was a wild

creature treated compassionately by Androcles. But in animal ethics there is a hierarchy of moral value that is reflected in the law. Dogs are placed much higher than bees. This leaves what we do to bees open to an individual's moral preferences. Those who wish to medicate bees solely because they are in their care could be asked the following question: are they interested in saving individual colonies or saving the species? If the latter then Darwinian beekeeping, in its strictest sense, is for them. The alternative title of Darwin's famous book is *The preservation of favoured races in the struggle for life*. We favour the honey bee and should help it's struggle for life through all the bee-friendly measures that I and other apicentric beekeepers are proposing. That really would be an evolutionary approach to apiculture.

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