What do we mean by locally adapted bees?

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There are widespread misconceptions about the meaning of the term **'locally adapted bee'** which need to be clarified. The honey bee (***Apis mellifera***) returned to Britain after the last Ice Age around 6,250 BC (ie. over 8 thousand years ago). Our native bee (***Apis mellifera mellifera***) belongs to a group of sub-species that is usually thought to have evolved on the Atlantic coast. Its common (non-scientific) name is very variable but the most widely used version is probably the Northern Dark bee but it is also referred to as the British Black bee or Welsh Black bee or simply the Black bee. It is thought to be most closely related to ***Apis mellifera intermissa*** (Western side of North Africa) and ***Apis mellifera ibirica*** (Spain and Portugal). The natural distribution of **Apis m.m.** starts north of the Pyrenees in France, spreading north into most of Western Europe including Scandinavia, Northern Germany and Northern Russia. Some authorities consider the origin of ***A m.m.*** to be Northern Russia but exactly how this can be reconciled with its Atlantic (genetic) affinities is not clear. No doubt DNA studies will shed further light on this matter in the near future.

Regardless of its true origins, this is the race of honey bee that invaded Britain when the climate and vegetation became suitable and progressively adapted to the changing post-glacial climate. This is the origin of the British native bee and, with the closing of the land-bridge with Europe, it would have continued to evolve in genetic isolation - that is until man came along and started to move bees around. In response to the widely different climatic regimes that occur in Britain, locally adapted strains would have developed. Similarly, over the rest of its wide geographical range in Europe, other strains of ***Apis m.m.*** have evolved in the 10-12 thousand years since the last glacial period and they differ from our own island version, ie. you can not import a true 'native' Black bee, only a near relative.

In Middle Europe the native sub-species is the Carniolan bee (***Apis mellifera carnica***) and in the Mediterranean regions the Italian bee (***Apis mellifera ligustica***) – again with many local variations. As the ice sheets withdrew they arrived by an entirely different route round the eastern end of the Mediterranean. These two races are on a different branch of the honey bee family to that of the Northern Dark bee. All these different sub-species or races of honey bee (and some others) have been repeatedly introduced to Britain over the years – bees of Greek origin are particularly popular at the present time. All the sub-species (and strains) are genetically compatible and can (and have) inter-breed with our native bee.

In the mid-19th century it became the fashion for Victorian beekeepers to import honey bees from other parts of Europe (particularly the Italian and Carniolan races) under the assumption that they had advantages (for beekeeping) compared with the native bee. Importation of non-native races accelerated in the early 20th century in response to Isle of Wight disease – a problem that the earlier importations may well have created. Some people claimed that the British Black bee became extinct at this time but, as with Mark Twain, their death was greatly exaggerated. Recent studies by BIBBA (and others) have shown the native Black bee, with more or less its original genotype, is alive and well in several parts of Britain, and this includes parts of Wales. Most Black bees have been exposed to other races and some degree of genetic introgression has occurred - such bees are usually referred to as '**near native bees'**.

It was the Northern Dark bee that the early colonists took with them to places like North America, Australia and New Zealand (where there are no native honey bees). Several centuries later it was replaced by what were considered to be 'better' races of bee (mostly Italian but some Carniolan). However, it is interesting to note, that in climatic conditions similar to their natural range (such as those found in South Island New Zealand and Tasmania) the Northern Dark bee has proved to be something of a survivor and has persisted as a background feral population and in some places is still the beekeepers choice. What is even more significant is that in these situations the Northern Dark bee seems to have resisted genetic introgression (remained fairly pure) despite being outnumbered by other races of bee in beekeepers' hives. On the contrary, the flow of genes seems to be from Northern Dark bee into the other races and not vice versa. In New Zealand this is welcomed by some beekeepers who find that 'mongrelized' bees are better foragers, but not by others who consider an increase in defensive behaviour (which often occurs) to be unacceptable. The process underlying this situation is simply natural selection; swarms of Italian bees that escape from beekeepers do not survive for long in the wild. In the absence of large scale queen rearing and for use in regular (beekeeper controlled) queen replacement, it seems likely that the Northern Darks bees would gradually re-establish itself in beekeepers' hives in some areas.

In Britain **locally adapted bees** have developed in places where natural selection is allowed to operate, without (genetic) interference from outside sources, over a number of years. There is no information to say how long this process takes but it seems unlikely that stability could be reached in less than 10 to 30 years. Each time bees from external sources are introduced to an area, through their drones and swarming, they create genetic ripples which may take some time to die-down. In order for locally adapted bees to become established in an area it requires the elimination (or serious reduction) of external genetic influences. In any given area the result of local adaptation may not be a pure Black bee (they are often mongrelized – but appearances can be deceptive) but **there is no rule that says the inclusion of some genes from other races can not be adaptive**. In this context 'adaptive' simply means they are genes that make them fitter (more likely to survive) in their locality. Some degree of genetic introgression may also be an advantage because species that evolve in genetic isolation can lose adaptability and find themselves at a disadvantage when conditions change - and this is exactly what may happen with climatic change.

The mechanism by which locally adapted bees are created is almost entirely through natural selection (survival of the fittest). The winter of 2012-13 was a severe test and the colonies that survived must be assumed to be those with greater fitness. Tightly controlled bee breeding is not a viable substitute for natural selection because it is difficult to know which characteristics are important - and rather arrogant to think we do know. In rigorous selective breeding there can only be loss of genes and no gain and in the long-term that can have serious implications – as has been discovered in North America. It is a basic misunderstanding of the biology of the honey bee to attempt to breed it using the type of model that has been successful with other domesticated animals. Herd animals, like sheep and cattle, have a totally different reproductive strategy in which a single dominant male fathers most of the offspring, often for a period of several years. In this system males born to the herd are usually driven out as they approach sexual maturity and disperse in search of a herd in which they can oust the (aging) dominant male. The result is a period of inbreeding followed by a sudden switch when a new male takes over and introduces new genes. This is very similar to the breeding system that farmers employ to run their stock, introducing a new ram or bull every few years. By contrast the reproductive strategy of the honey bee is one of extreme out-breeding in order to maintain the maximum amount of intra-colony genetic diversity. The honey bee is the most extreme

example of polyandry (mating with multiple males) known to science and this reproductive strategy is pursued at no small risk to colony survival. When a virgin queen goes out to mate the whole future of the colony depends on her safe return (there is no backup plan) so mating with numerous drones (10-20 is the normal target) from as many different sources as possible is clearly vital to the way in which a honey bee colony functions.

The current situation is that in most parts of west and mid-Wales (where there have not been large scale introductions of other races) the local bees are genetically fairly close to Black bees, ie. near-native. Further east (along the Wales-England border) there tends to be an increased influence from other races of bee. Some areas experience regular importations of other races and the genetic make-up of the local bee is extremely variable and unstable. In these circumstances it is impossible for a locally adapted bee to develop.

One of the motivations behind beekeepers wanting to purchase pure bred races of non-native bee is their low level of defensive behaviour, resulting in easier handing. The Northern Dark bee has a bad reputation in this respect but this is primarily because it is difficult to establish and maintain a reasonably pure race under conditions where there is a genetic background of other races. Beekeepers who buy other races to obtain good temperament are in fact purchasing a time-bomb. This is only a short-term solution because when subsequent generations of queens mate with local bees the result is often extreme aggressive behaviour. It is with what is called the F2 generation (but in genetic terms should be called the F1) of inter-racial crosses that the worst problems occur.

The above explanation should have made it clear that **locally adapted bees can not be bred but can only be bred from.** The only place you can breed from locally adapted is **locally** and this means that large scale or centralized breeding can not (by definition) be the best solution.

The WBKA aims to encourage its affiliated Beekeeping Associations (and their individual members) to become self-sufficient for new colonies and queens using **locally adapted** breeding stock. If this can be achieved it will reduce the market for imported queens and bees and this is the only practical way forward. This policy involves an important element of positive feedback because, as more areas become populated with locally adapted bees, the easier it will be to establish a population of near-native bees. The WBKA have produced a booklet on 'Simple Means of Making Increase' and will offer training to Association officers.

In conclusion I would draw your attention to the summary from an article written by Leslie Bailey from the IBRA publication Bee World in 1999 entitled '***The quest for a super-bee'***.

'Highly intensive selection of the honey bee for <u>any quality</u> (my underlining) **may decrease its resistance to its wide variety of enzootic pathogens by decreasing its genetic variability. Maintenance of naturally adapted regional strains by traditional means and management that least inhibits their essentially independent lifestyle may be more rewarding.'**

Les Bailey is an internationally renowned honey bee pathologist and made these comments primarily in relation to bee disease. There has been much research over intervening years on the importance of intra-colony genetic diversity which only serves to reinforce his opinions.