TREES FOR BEES CORNER

BEES WITHOUT BORDERS: WHAT IS THE LIMIT?

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New Zealand has become the 'California' of the southern hemisphere in terms of hive numbers and hive density. Almond pollination drives the demand for millions of hives needed in California, while mānuka honey drives the demand for hundreds of thousands of hives in New Zealand.

California is supplied with beehives by migratory hives from Florida and other states where abundant floral resources are available in winter and early spring to sustain and build-up colonies. In contrast, New Zealand is a small, isolated oceanic island and cannot import migratory beehives. We are confined to only 263,310 km^2 of land—much of it unsuitable for beekeeping because it is too wet, too cold, too windy or too dry, according to beekeeper John Berry.

Looking at the 70-year trend, New Zealand's hive numbers have grown exponentially in the last five years to an unprecedented 700,000 managed colonies. Never before has New Zealand held this many domesticated hives. Never before have hive numbers increased so rapidly. Historically, feral hives with wild bees have never existed in such concentrated densities.

To ask if we are over the limit is to ask the most difficult question: what is the carrying capacity of the land? Even if we planted up every suitable square metre with the best mānuka cultivars (eco-sourced or not) along with the maximum number of Trees for Bees plants to provide support for autumn and spring forage, would we be able to meet the market expectations for mānuka honey production? Can New Zealand's apiculture industry cope with this rapid exponential increase? What is the limit to growth in this sector and equally important, what are the consequences to the pastoral, horticultural and arable sectors that require pollination services in the midst of more lucrative honey harvesting opportunities?

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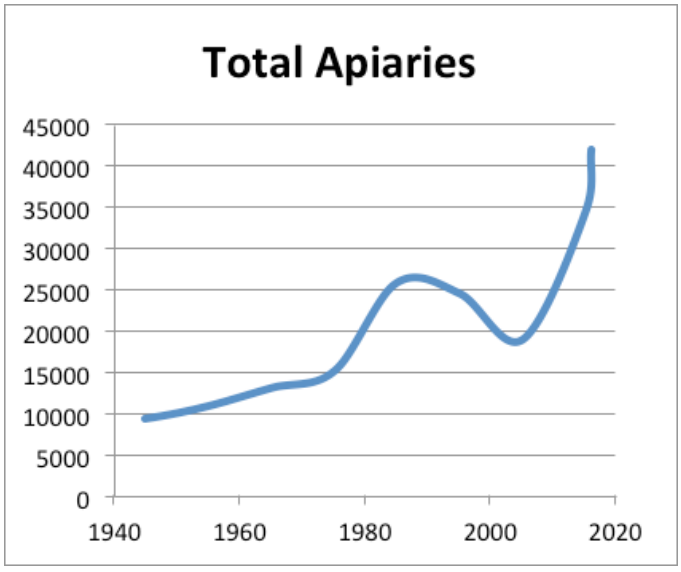
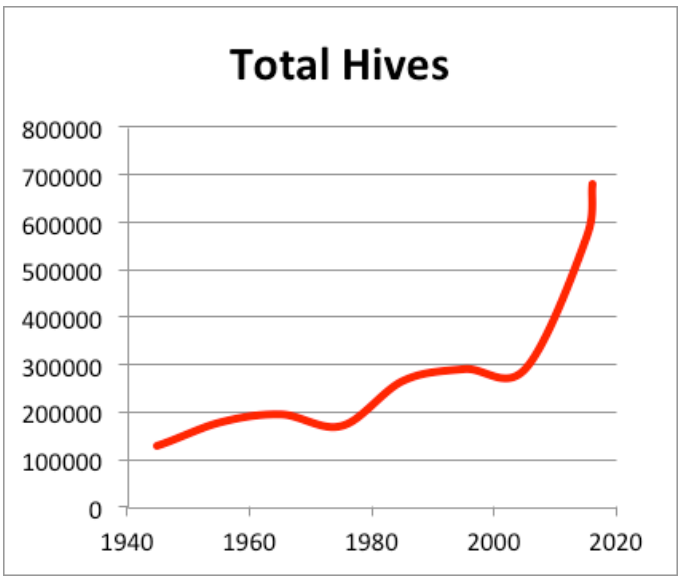
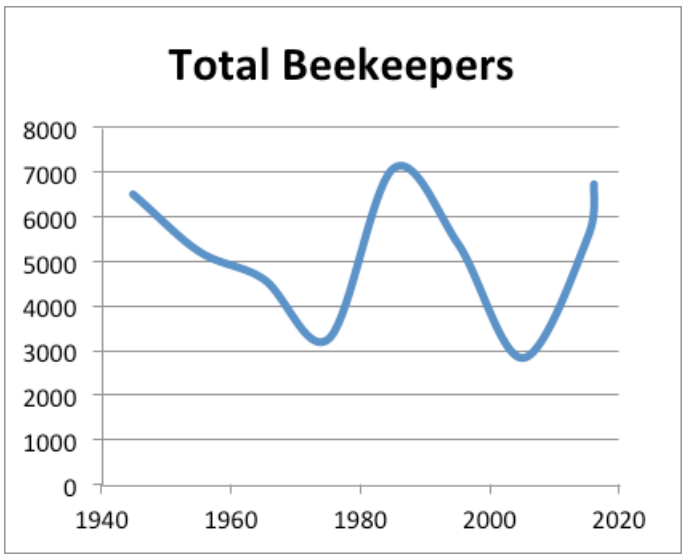
Figure 1. Number of hives, apiaries, and beekeepers over 70 years in New Zealand from 1945 to 2016. Data from Murray Reid, AsureQuality Limited.







International comparisons of hive density

To put this rapid rise in hive numbers in perspective, let's compare New Zealand's density of hives per land area in the context of population density to other major beekeeping countries and regions. For this viewpoint, we are looking at overall hive density for total land area, and not small scale estimates of actual hives/ha. For context, we are using the number of hives per capita, not the number of hives per beekeeper.

As shown in the table, the density of hives over the total land area in New Zealand is 2.658 hives/km^2 — similar to California with 3.538 hives/km^2. Looking at an island nation with comparable land area to New Zealand (but with more land available to beekeeping), the United Kingdom with 1.13 hives/km^2 has less than half the density of hives as New Zealand while the other countries listed have much less; for example, USA, Germany, and Canada. It is difficult to obtain accurate current beehive and beekeeper data for most countries; it may be that Italy and Turkey have similar hive densities per land area to New Zealand but they both have much smaller numbers of hives per beekeeper.

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New Zealand actually has the same number of hives as a country as large as Canada at 700,000. Even if we consider only a tenth of the land area of Canada to be available to beekeeping (a conservative estimate), the density of hives in New Zealand is three and half times greater than 10% of Canadian land area.

Country	Land area (sq km)*	Population**	Pop Density (per sq km)***	Number of Beehives****	Density Hives (per sq km) of land area	Beehives per capita
California	423,970	38,800,000	91.5	1,500,000	3.538	0.0387
New Zealand	263,310	4,595,700	17.5	700,000	2.658	0.1523
United Kingdom	241,930	65,138,232	269.2	274,000	1.134	0.0042
United States	9,147,420	321,418,820	35.1	2,740,000	0.299	0.0085
Germany	348,540	81,413,145	233.6	55,560	0.159	0.0007
Canada (at 10% land estimated to be available for apiculture)	909,351	35,851,774	n/a	700,000	0.759	n/a
Canada total land area	9,093,510	35,851,774	3.9	700,000	0.076	0.0195

* http://data.worldbank.org/indicator/AG.LND.TOTL.K2
** http://data.worldbank.org/indicator/SP.POP.TOTL
*** *http://data.worldbank.org/indicator/EN.POP.DNST*
**** *Beehive numbers were obtained from various internet sources for each country. Details available on request. California data comes from http://www.ipl.org/div/stateknow/popchart.html and other Internet sources. The number of hives for California includes the migratory hives in spring.*

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Understanding overstocking and diminishing returns

Taking the above facts into account, as a nation, has New Zealand exceeded the limit? Can our foraging resources sustain increasing hive numbers? How will we know if carrying capacity is reached?

Traditionally, beekeepers know by trial and error over a number of years just how many hives per apiary and how many apiaries per region will give them the best return for their investment. Customarily, this information is passed on when beekeeping operations are sold. Beekeepers gain skills in estimating the carrying capacity of new apiary sites by recognising familiar vegetation types. They are cautious to begin with and then increase stocking until they experience diminishing returns for the extra hives they add to the apiary. Experienced beekeepers know that too many hives create an unviable apiary because excess bees increases the cost of production and reduces honey yields and profits. Too many bees will use all of the available nectar for their own maintenance leaving nothing for producing honey. Using an analogy to dairy cows, why would a farmer put 1000 cows on land that can only carry 500 cows that produce equal or more milk on that same land area as the 1000 cows?

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The cost of production is one key to understanding overstocking. The health of the animal is the second key. Malnourished or starving animals succumb to disease and perform poorly. Purchasing protein supplements is expensive and can be risky in terms of biosecurity if it is imported. Artificial protein supplements are necessary when bees have no other option, but the problem is that overstocking leads to the use of excessive artificial supplements that soon become prolonged whole diet substitutes, which can easily lead to nutrient deficiencies (palm kernel for dairy cows, for example). This will lead to health issues in bees as much as in any other animal, especially since the nutrient requirements of honey bees are so poorly understood at this time. The rapid increase in the use of bee feed supplements beyond a normal level is the primary evidence that carrying capacity has been reached and exceeded in many regions.

Reduced honey yields and activity levels as well as competition for apiary sites, both for mānuka honey production and for overwintering hives, provides further evidence. Since honey bees were first brought into New Zealand in the early 1800s to improve the pollination of clover and crops, the number of beekeepers, apiaries and hives has grown slowly over the decades, with fluctuations depending on disease and pest problems (e.g., AFB, varroa), as well as the relative economic returns from honey and pollination contracts. This slow growth up to 2005 is shown in the graph above. Along with this increase, a trustworthy infrastructure evolved with workable best-practice guidelines that everyone followed, namely a three-kilometre separation distance between apiary sites and a best estimated number of hives for each apiary site, depending on the climate and floristic resources of the area. As beekeeping expanded, eventually this separation distance was reduced to two kilometres.

In the last few years, however, this separation distance and the reasoning behind it has increasingly been ignored. This practice has become widespread with novice beekeepers and landowners (albeit unwittingly) participating in apiary takeovers, border stacking, and overstocking without understanding the consequences to themselves or others.

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Although some of this behaviour is deliberate, some of it is innocent. Many landowners, novice beekeepers, financial investors, shareholders, bank managers, government policy makers, and enthusiastic start-up honey companies do not know or do not want to know what hive carrying capacity is or why separation distances are necessary. They do not understand that bees operate without borders. Bees do not observe any man-made boundaries, fenced or not, that is within bee foraging range. They fly anywhere within their foraging range. This range is from two to five kilometres, and even up to 12 kilometres if a rich nectar source is preferred at such a distance.

Furthermore, unsuspecting landowners do not know that overstocking leads to reduced honey yields and poor colony performance and survival. For instance, one landowner allowed 120 hives to be added to the farm in the middle of two traditional apiary sites, each with only 20 hives and a two-kilometre separation distance between them. These apiary sites were stable and at carrying capacity. They have been in the same place for well over 20 years. The landowner was paid to allow this overstocking and told the traditional beekeepers not to worry because the new beekeepers said they were going to feed the added hives with protein supplement and sugar solution. The landowner did not know that bees prefer natural pollen to protein supplement, or that the new beekeeper was 'muscling in' to get access to the natural pollen and nectar resources or else they would not have paid the farmer for access to the site.

And herein we find a part of the solution to this complex problem in today's beekeeping. It is not surprising to hear that landowners are starting to learn by bitter experience after contracting with beekeepers for promised honey yields or clover pollination that did not eventuate. Slowly the word is spreading among landowners. It is heartening to learn that landowners are starting to agree with traditional beekeepers that the consequence of overstocking is that everybody inevitably loses.

Moving forward

It is beyond the scope of this article to discuss the consequences of overstocking to pollination services and the wellbeing of native bees and other pollinators, because the most urgent first priority is to inform everyone that honey bees without borders have a limit. Experienced beekeepers honour and understand the two-kilometre limit very well. The more experienced beekeepers can estimate the limit with more accuracy to keep their cost of production at the right level.

Let us hope that educational material can be developed and distributed widely and that word of mouth can spread quickly to stop the wasteful and expensive practices of overstocking and dishonouring the two-kilometre separation distance rule, as well as ignoring the carrying capacity limits for the number of hives at each apiary. Let us hope that immediate and significant planting of additional floral resources, particularly for spring build-up and wintering sites, can be actioned to alleviate overstocking and competition. See www.treesforbeesnz.org for ideas and "how to" information.

And let us hope that plantations of superior eco-sourced or fully domesticated cultivars of mānuka can be planted up rapidly to meet the market demands the apiculture industry now face. The outrageous claims of honey returns in terms of both yield and price, and the simplistic approach to beekeeping by newcomers and those hungry for success needs to be countered by real information before more landowners and novice beekeepers are disappointed and in some cases, severely disadvantaged financially.

We are encouraged to learn that ApiNZ is developing a beekeeping Code of Practice, which will address many of these challenges; how this will be received and adopted by industry will be interesting to follow.

Trees for Bees Riparian Planting on James Callaghan's farm in Staveley, Canterbury, in the Ashburton District. All native plants used. Planted in 2014 with Angus McPherson, Farm Planting Adviser. Photo: Linda Newstrom-Lloyd.