TREES FOR BEES CORNER

ANNUAL VARIATION IN MĀNUKA HONEY YIELDS: WHAT DOES IT MEAN?

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This year (2016/2017) has been a difficult season for beekeepers in many regions. It comes at a time when there is unprecedented pressure on honey production and wintering sites and raises the question whether this season is a one-off occurrence, or whether it's part of a pattern.

Like farmers remembering the bad droughts they've been through, experienced beekeepers understand this year's low honey yield as part of the nature of beekeeping. Their past experiences have taught them how to manage their hives when nectar yield is poor, so that they can get through to next year. This article looks at the implications of variable seasons in terms of honey production and income, particularly for mānuka honey operations.

Examples of honey crop variability

The data presented here from two actual examples of honey yields from New Zealand apiaries demonstrates the point that beekeepers can expect considerable variability in the quantity and quality of honey yields over the years.

The examples in Figures 1 and 2 clearly illustrate long-term patterns of variability from apiary sites in two different regions of the North Island, not only in total honey production, but also in the floral composition and activity levels of the honey. Both apiary sites are in catchments containing mānuka scrub, native bush and clover pasture, and so could be considered typical of many sites on the margins of farmland and mānuka/native bush.

The level of total honey production at Site 1 (Figure 1) varies by as much as ±50 to 60% from the long-term average (22 years). It is also of interest to note that while Site 1 can produce 100% mānuka honey in a good season (five of 22 seasons), it can also produce no mānuka honey (six seasons). Furthermore, in only two of the years with average or better production has it been 100% mānuka; more typically, the higher-producing seasons are around 75% mānuka honey, with only one good mānuka season in the last five years of data.

At Site 2 (Figure 2), production has varied by +40% to -80% over nine seasons, with a noticeable drop in average activity in the mānuka honey since 2013. This is assumed to be due to dilution of the mānuka honey at that site, and there has been a noticeable increase in competition from other apiaries since 2013.

Figure 1: *Honey production and floral composition—site 1.*

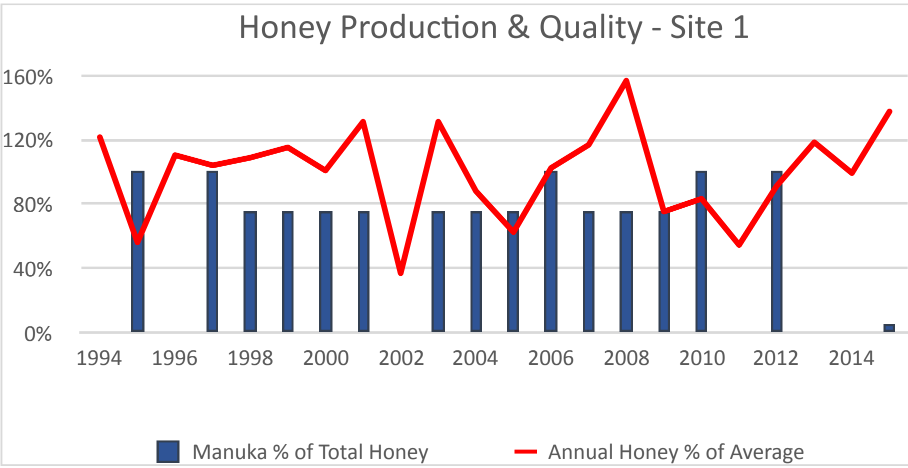
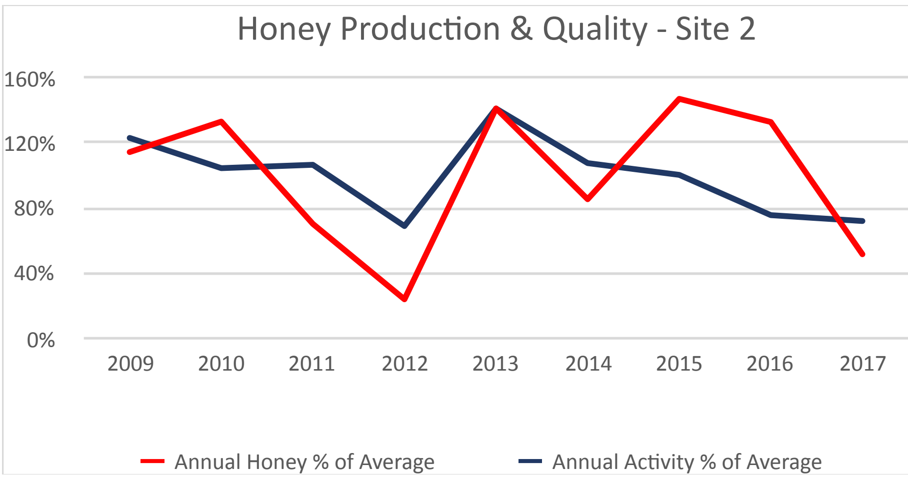


Figure 2: *Honey production and activity—site 2.*



While both of these apiary sites are capable of producing good mānuka honey, whether they do so is beyond the control of the beekeeper, as bees will feed on whatever gives them the best nectar/sugar return at the time. It is well known that the nectar flow, sugar concentration, floral composition, and activity are variable from year to year, so this needs to be factored into any business plan. The introduction of competing hives by other beekeepers is also largely beyond the control of the resident beekeeper.

How does this variability in honey production impact on apiary viability?

To understand this question in the current context of beekeeping, we use the level of variability shown in the two examples above to compare two different cases with different stocking rates of hives in a single catchment.

In the first case (Table 1), we look at a catchment that had traditionally supported 80 hives in a number of apiaries over the long term; that is, the carrying capacity of the catchment is around 80 hives. In the second case (Table 2), we compare the results for a new beekeeper who has decided to increase the number of hives to 240 in the same catchment in hopes of greater honey production.

For the traditional site in Table 1, we show the honey production and income in average, poor and good years for full-strength hives, where the variability in honey yield is ±50%. In an 'average' year the apiaries collect 12,000 kg of honey; the bees require about two thirds of the honey for colony maintenance; and the surplus is extracted by the beekeeper (4,000 kg, at 50 kg/hive).

The beekeeper leaves 15 kg/hive for winter colony maintenance, with the balance being sold (35 kg/hive). Honey price is set at $25/kg, assuming a high proportion of active mānuka. Minimal supplementary feeding is assumed, which is reflected in the average hive cost, noting that the cost of purchasing hives isn't included here. This results in a gross margin of $54,000 income from the 80 hives for an average year.

In an above-average year, with production up 50% and the same colony maintenance honey demand and the same costs as an average year, the gross margin increases to $204,000, as all the increase in production goes to the bottom line. In a below-average year the amount of honey collected is halved, hive costs increase as additional feeding is required, and two scenarios are considered in terms of honey production.

The first scenario is that all the honey collected is required for colony maintenance, which is insufficient for 80 full-strength hives and risks hive losses, there is no honey income and the gross margin is a loss of $24,000.

The second scenario is that the ratio of colony maintenance honey remains at two-thirds of total honey collected, in which case there is 2,000 kg of surplus honey (25 kg/hive of which 10 kg/hive is sold) and the gross margin is a loss of $4,000. Note that at 25 kg/hive surplus honey, this means that hives have weakened significantly (see Table 8.1, Matheson, 1984), and are likely to go into winter in poor condition. Furthermore, should the beekeeper feed sugar solution to try and maintain hive strength during the honey flow, this risks C4 contamination in the honey collected.

> "...nectar flow, sugar concentration, floral composition and activity are variable from year to year ..."

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Traditional Hives	Average	Above Avg	Below Average	
Number of Hives	**80**	**80**	**80**	**80**
Total honey collected (kg)	12,000	18,000	6,000	6,000
Colony maintenance honey (kg)	8,000	8,000	8,000	4,000
Colony surplus honey (kg)	4,000	10,000	-2,000	2,000
Surplus honey (kg/hive)	**50**	**125**	**-**	**25**
Winter store honey (kg/hive)	**15**	**15**	**-**	**15**
Honey for sale (kg/hive)	**35**	**110**	**-**	**10**
Apiary honey income ($25/kg)	$70,000	$220,000	$ -	$20,000
Income per hive	$875	$2,750	$ -	$250
Hive Costs - per hive	$200	$200	$300	$300
Hive Costs - apiary	$16,000	$16,000	$24,000	$24,000
Gross Margin	**$54,000**	**$204,000**	**-$24,000**	**-$4,000**

Table 1. *Production and income for 80 hives.*

Note that these scenarios all assume the same average honey price, but the price of honey will vary depending on export or domestic prices and the quality of the honey (monofloral or mixed), as well as the activity level if it is mānuka honey, and this can be very variable as shown in Figures 1 and 2.

The second case (Table 2) reflects the recent trend for some beekeepers to load additional hives onto mānuka sites in the expectation that this will result in a lift in production consistent with the increase in hive numbers. While an increase in hives might lift overall production, this is very rarely in direct proportion to hive numbers, and so once the carrying capacity of the foraging area is reached for that season the production per hive declines, costs increase, and profit declines. A larger amount of the maximum nectar available at the site is being consumed for colony maintenance because of the increased number of bees at the site. This is exacerbated where the apiary site is greatly overstocked, or where the foraging area is overstocked with too many other apiary sites located too close.

Table 2 shows the impact on income of increasing hive numbers from 80 to 240 in the same catchment which has historically had a carrying capacity of 80 hives, and for which long-term average production is known. As with Table 1, production and income is calculated for average, poor and good years, where the variability is ±50%.

Two scenarios are shown for each 'year', one where colony maintenance honey is at the level required for full-strength hives, and the other where the ratio of two-thirds of collected honey is used for colony maintenance. In all cases where colony maintenance honey requirements are as for full-strength hives, there is insufficient honey collected to both have a surplus and to meet colony maintenance requirements, which risks hive losses. Together with additional hive costs due to increased feeding requirements, this results in a loss of least $72,000.

Where the colony maintenance honey is two-thirds of total honey collected, there is a modest honey surplus in both average and above average years, but this still results in a loss as there is insufficient honey for sale to recover costs. Selling the winter store honey might reduce these losses, but it would need to be replaced with sugar solution at additional cost and would also compromises bee nutrition and health. Again, in these situations hive strength will be significantly reduced and the hives risk going into winter in poor condition.

Increased Hives	Average		Above Average		Below Average	
Number of Hives	**240**	**240**	**240**	**240**	**240**	**240**
Total honey collected (kg)	12,000	12,000	18,000	18,000	6,000	6,000
Colony maintenance honey (kg)	24,000	8,000	24,000	12,000	24,000	4,000
Colony surplus honey (kg)	-12,000	4,000	-6,000	6,000	-18,000	2,000
Surplus honey (kg/hive)	**-**	**16.7**	**-**	**25.0**	**-**	**8.3**
Winter store honey (kg/hive)	**-**	**15.0**	**-**	**15.0**	**-**	**15.0**
Honey for sale (kg/hive)	**-**	**1.7**	**-**	**10.0**	**-**	**-**
Apiary honey income ($25/kg)	$-	$10,000	$-	$60,000	$-	$-
Income per hive	$-	$42	$-	$250	$-	$-
Hive Costs – per hive	$300	$300	$300	$300	$300	$300
Hive Costs – total	$72,000	$72,000	$72,000	$72,000	$72,000	$72,000
Gross Margin	**-$72,000**	**-$62,000**	**-$72,000**	**-$12,000**	**-$72,000**	**-$72,000**

Table 2. *Production and income for 240 hives.*

Note that because of the carrying capacity of 80 hives for the catchment, the same level of honey collected for the apiary has been assumed as in Table 1, but the level of surplus honey per hive that the beekeeper can obtain is lower or non-existent, because of the increased number of colonies needing maintenance honey. This is a point often missed by novice beekeepers and non-beekeepers who are making decisions about hive numbers to be placed for a projected honey harvest. The increase in hive costs is due to additional inputs from feeding costs because carrying capacity of the catchment has been exceeded and the additional work required to manage the larger numbers of hives. Note again that hive purchase costs are not included.

Taken together, these costs for the increased number of hives results in significantly higher overall operational costs, and this then results in a net loss for all scenarios. Compared to the catchment running with the number of hives within carrying capacity, the profit is much less for each scenario.

Discussion

Beekeeping practices and economics are complex. The carrying capacity of an apiary site will be influenced by surrounding land use changes (including the presence of competing apiary sites within the foraging area), and by climatic variability, which drives flowering density and nectar flow as seen this year. This variability can only be estimated by looking at the long term, as shown in the examples in Figures 1 and 2.

Calculating expected yields and income based on these examples shows dramatic differences in the results, which illustrates a fundamental principle of beekeeping. The number of hives does not automatically correlate with honey production, and catchment areas will have a finite carrying capacity with limits on their production depending on climate, floral resource availability and quality, as well as the level of competition from other apiary sites within the foraging area.

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Determining the carrying capacity and the optimum number of hives that will give the highest returns is one of the skills required of a good beekeeper. Normally beekeepers proceed cautiously to determine the maximum honey production per hive that they can expect over the long term from an apiary site. Carrying capacity for the same vegetation will vary from region to region, making it difficult to predict. But when a beekeeper has experienced sustainable optimum production over a number of years, then it's a fair bet that it reflects the true carrying capacity of that area. When too many hives are placed on a site, the law of diminishing returns is in operation.

Those seeking to invest in honey production for mānuka or other monofloral honeys should take into consideration the reality of variable annual honey yields, variable nectar flows of one plant species compared to another, and the economic impacts of overstocking beyond the carrying capacity of an apiary site. This applies to the number of hives per apiary as well as the number of hives within the honey bee's foraging range, which is normally from three to five kilometres (2,830 to 7,850 hectares in area). The foraging range can be significantly further depending on floral resource availability and total load of hives within the foraging area.

The principle of diminishing returns and the reality of good years/bad years apply to farming bees for honey production in the same way that they apply to farming cows for dairy production. Long-term averages and the variability in yield from year to year are a significant component of managing expectations for economic returns. Similarly, the principles of carrying capacity and not overly relying on artificial feeding apply equally to beekeeping as they do to pastoral farming.

References

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