TREES FOR BEES CORNER

WHAT'S THE USE OF POLLEN?

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Pollen and nectar are critical to bee health and beekeepers' livelihoods. The more you nourish bees, the more they flourish into super-strong colonies with powerful foragers that can maximise honey harvesting and pollination services.

This year we saw that having a diversity of pollen and nectar sources in apiary sites spreads the risk in years when flowering is poor. For instance, some beekeepers were able to harvest excellent tāwari honey in spite of this year's poor flowering in other plants, particularly mānuka and clover.

A diversity and abundance of pollen sources improves bee health and reproduction, while substantial abundance of a valued nectar source can lead to high purity for a monofloral honey. This means that a comprehensive understanding of what the bees are foraging on each month is one of the most valuable types of information a beekeeper can gain about an apiary site. Pollen Profiles for apiary sites provide important evidence by showing the relative proportions of different pollen types that bees bring into the hive, either in their bee pollen pellet loads or in the nectar they store.

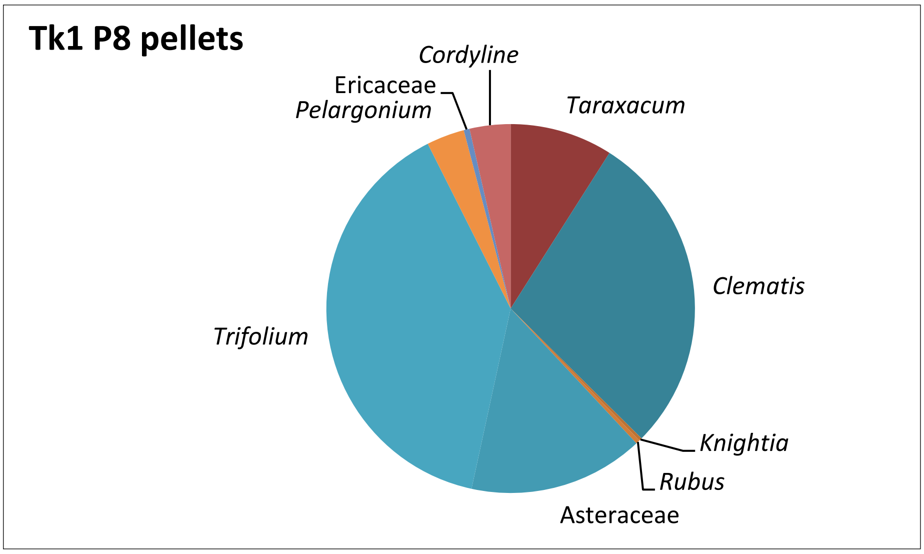

Figure 1. Pollen Profile for pollen pellets taken from 24 hour pollen trap for Hive TK1 at Naati Beez Site at East Cape, sampled on November 27, 2015

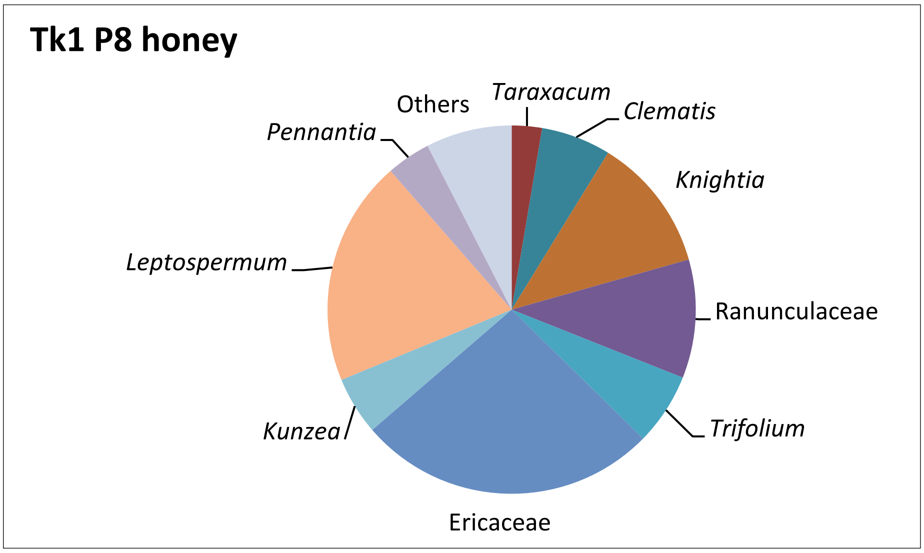

Figure 2: Pollen Profile for fresh nectar/honey taken from frames in Hive TK1 at Naati Beez Site at East Cape, sampled on November 27, 2015

New protocol being developed

Trees for Bees has been developing a new protocol for producing Pollen Profiles for apiary sites. The profiles help determine what pollen and nectar sources are available at the site and what the bees prefer. The results of Pollen Profile analyses can be used to generate a list of year-round preferred bee plants that are adapted to the locality and climate of the apiary site. As deficit periods are discovered, the gaps can be filled in with preferred bee plants that are best suited to the area. The quantity and quality of floral resources at a site can be optimised by planting more of the best candidate plant species from the local list.

We modelled our work on the pioneering study in New Zealand by Harris and Filmer (1948). They used pollen profile analyses to detect which plants the bees are foraging on for both pollen and nectar. They sampled pollen from hive pollen traps and frame honey to calculate the percentage of pollen types in each. Based on these pollen profiles, they interpreted which pollen and nectar sources the bees were using within the foraging range of the apiary.

We explored the Harris and Filmer methods in our pilot study with Naati Beez. This project was described in a poster at the Apiculture NZ 2016 conference (Raine et al., 2016) and later articles in *The New Zealand BeeKeeper*

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Figure 3. Xun Li, GNS Pollen Lab, processing pollen by the acetolysis method which requires a chemical fume hood that handles the acid fumes.

(Newstrom-Lloyd, 2016 August, 2016 September). The Naati Beez team sampled pollen and honey every two weeks from spring through autumn. The pollen and honey samples from the pollen hive traps (over a 24-hour period) and frame honey (when present) were sent for processing and identification by Dr Ian Raine and Dr Xun Li, experienced honey palynologists at the GNS Pollen Lab. From the pollen content data, Ian produced Pollen Profiles. An illustration of the profiles is given for the bee pollen pellets (Figure 1), and also for the honey samples (Figure 2) taken from the November 27th period at the East Cape site.

In our new MPI Sustainable Farming Fund Grant 2016 to 2019, we are collaborating with Ian and Xun again to improve our protocols for the Pollen Profile methods by testing them at several more sites in the North Island.

The initial interpretation of a Pollen Profile requires an understanding of pollen characteristics as well as floral morphology. For example, we know which plant species have pollen that is under-represented versus over-represented in honey, and why (see Bryant, 2001; Moar, 1985; Sawyer, 1988). We also know which plants have abundant nectar versus those with minimal nectar or no nectar. For example, pollen from a no-nectar plant in the honey indicates a wind-blown pollen that has either landed in a different flower's nectar before the bee collected it, or has been blown directly into the hive or fallen off bees while grooming. On the other hand, pollen in the bee pellets from a wind-pollinated species indicates the bees are foraging on that species for pollen, a result that seems to be a contradiction to some people because they assume wind-pollinated plants are not visited by bees. It is important to support the interpretation by observations on the way the bees fit into the flower to see how easily the pollen can be dislodged into the nectar, as demonstrated in our analysis of the mānuka flower (Newstrom-Lloyd, 2017).

When constructing Pollen Profiles for a new apiary site, it is often a good idea to use acetolysis methods to prepare pollen for identification (see Figure 3). Acetolysis is the process of clearing the pollen grains so that the skeletal features show up more obviously for pollen identification (Figure 5). This process requires a fume hood in a lab and is most useful when identifying unknown pollen. However, the acetolysis process is not needed when the pollen is already familiar from previous work at the apiary site or beekeepers' expert knowledge. In these instances, a simple staining method can often suffice (Figure 6). Beekeepers can learn to recognise pollen and pollen pellets at the local level for their apiaries, particularly if they have already observed which species are flowering within foraging range.

To support Pollen Profile analyses, the GNS Pollen Lab has a wide-ranging reference collection with pollen images for many plant species used by bees. The collection includes photos of pollen in both the acetolysed and non-acetolysed (simply stained only) formats. The images are produced using a high-powered compound microscope specifically designed for publication level photography (Figure 4). Some good examples of this type of work can be seen in the poster describing the recent research by Xun Li showing that mānuka and kānuka pollen are different and can be distinguished based on several characters (Li et al, 2015). This research was based on samples covering most of the geographic and taxonomic range of species and types of mānuka and kānuka in New Zealand in collaboration with Dr Peter de Lange.

New resources for beekeepers being produced

To help create and interpret Pollen Profiles for pollen pellets and honey collected by bees, the Trees for Bees team is producing several new resources for online and workshop delivery. Our goal is to make the methods available for do-it-yourself analyses by beekeepers. The two main resources under development are an illustrated online GNS Pollen Atlas for bee plants in New Zealand and an illustrated Trees for Bees Flower catalogue. The illustrations and information will help beekeepers verify their evidence about which pollen and nectar sources their bees are foraging on in their apiary sites.

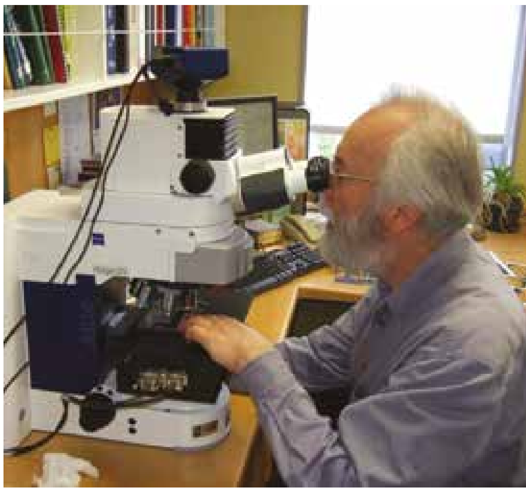

Figure 4. Ian Raine, GNS Pollen Lab, using a compound microscope designed to show pollen grains on the computer screen and in the microscope as well as take high resolution photographs.

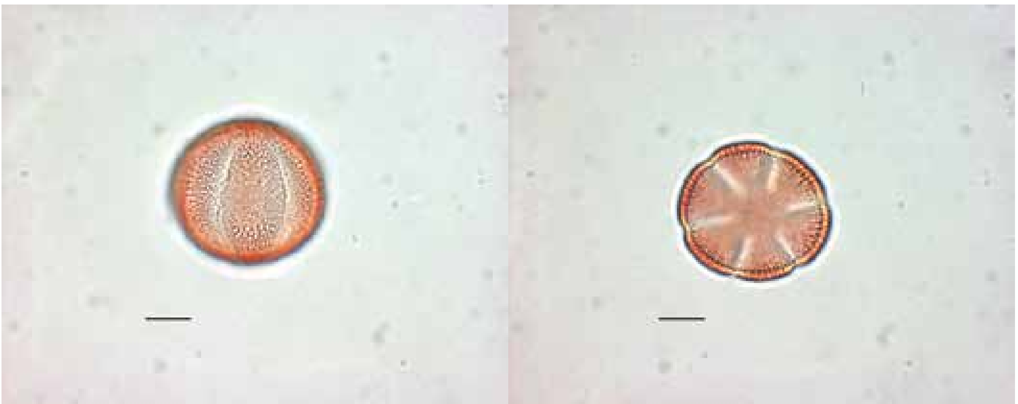

Figure 5. Acetolysed pollen grains of thyme (Thymus officinalis) *with equatorial view on the left and polar view on the right. Scale bar = 10 microns. The detailed features are clear and distinct.*

Figure 6. Non-acetolysed pollen grains of thyme (Thymus officinalis) *with equatorial view on the left and polar view on the right. Scale bar = 10 microns. The detailed features are not very clear or distinct compared to the acetolysed pollen in Figure 5.*

The Pollen Profile methods can be used for many other purposes too, such as investigating the presence of toxic plants in an area such as karaka or tutu, indicating the potential for a monofloral honey, determining what plants the bees were foraging on in the event of a pesticide poisoning, etc. The methods can be adapted at the local level to address many different questions about pollen and nectar foraging by bees.

Trees for Bees will be presenting a workshop on "The Power of Pollen Profiles" with Linda Newstrom-Lloyd, Xun Li and Ian Raine at the upcoming ApiNZ Conference in July 2017 in Rotorua. We will demonstrate the Pollen Profile procedures and techniques and illustrate how to interpret pollen and nectar resources from Pollen Profiles.

Glossary of Plant Names in Pollen Profile Figures

Apiaceae – Celery plant family
Asteraceae – Daisy plant family
Clematis – Clematis
Cordyline – Cabbage Tree
Coriaria – Tutu plant
Ericaceae – Heather family
Hoheria – Lacebark species
Knightia – Rewarewa
Kunzea – Kānuka
Leptospermum – Mānuka
Lotus – Birdsfoot trefoil
Metrosideros – Pōhutukawa
Pennantia – Kaikomako
Plantago – Plantain
Ranunculaceae – Buttercup family
Ranunculus – Buttercup species
Rosaceae – Rose family
Rubus – Raspberry, Blackberry or Bush lawyer
Taraxacum – Dandelion
Trifolium – Clover

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