Crop Pollinators

New Zealand relies on insects to pollinate crops worth at least NZ$2B annually to the New Zealand economy. These include crops grown for seed (e.g. carrot, radish, onion), fruits and vegetables (e.g. kiwifruit, avocado, tomato, squash, blueberries) as well as important pasture species (clovers).

Honey bees are often placed in crop fields to facilitate pollination. However, a combination of unmanaged bumblebee, native bee (Figure 1) and fly pollination can often exceed the contribution made by honey bees within pak choi (Chinese cabbage) and carrot fields. Pollinator activity can vary at different times of the day, with species responding differently to climatic conditions (activity windows). Climate change will affect pollinator activity windows by altering foraging periods and behaviour. By 2090, key crop growing regions such as Canterbury, Tasman, Hawke's Bay, Gisborne, Bay of Plenty and Northland are expected to have more than 20 extra days above 25°C than in 1990, but receive more extreme weather events (Canterbury twice as many drought days, other regions increased summer storms and heavy rainfall events). Surveys conducted in flowering pak choi and onion seed fields across New Zealand examined the abundance, diversity and behaviour of pollinators. The data were matched with climatic data collected at or near the time at which observations were made, using within-field recordings or data collected from nearby meteorological stations (within 10 km of fields).

Examples of pollinators responding differently to climate

Honey Bee

Figure 2 Honey bee (*Apis mellifera*)

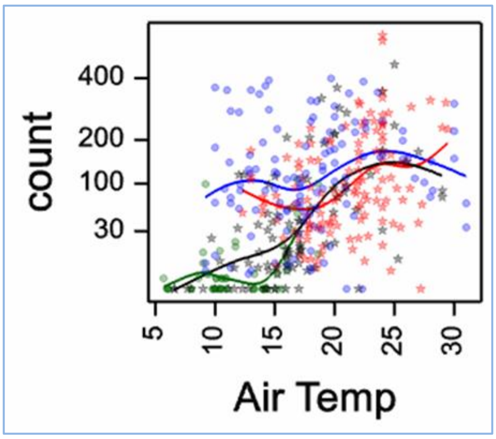

Figure 3 Counts of honey bees in onion, and pak choi seed fields (each point represents one field observation time) versus temperature (ºC). The lines are smoothed trend lines of total counts within fields (black – onion between 0600 and 0900 h, and 1600 and 2100 h; red – onion between 1000 and 1500 h; green – pak choi between 0600 and 0900 h, and 1600 and 2100 h; blue – pak choi between 1000 and 1500 h).

Honey bees were most abundant when conditions were sunny and temperatures exceeded 25oC. Honey bees are adept at foraging at high ambient temperatures but when temperatures fall below 20oC they find it increasingly difficult to maintain adequate body heat for flight. Increased temperatures brought about by climate change should extend their activity windows both during the day, and in the number of days suitable for foraging. However, increased storm activity and heavy rainfall events predicted for many regions in New Zealand may lead to increased unpredictability of their foraging times. This could particularly affect their pollination of crops with short flowering periods (e.g. some brassicas flower for just 2 – 3 weeks).

Bumblebees

Figure 4 Bumblebee (*Bombus terrestris*) visiting a flowering onion umbel.

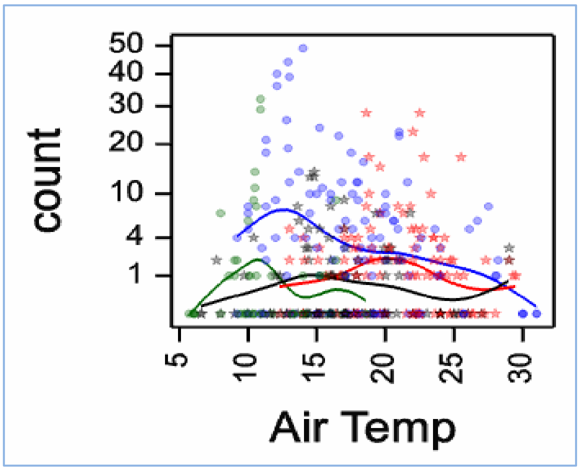

Figure 5 Counts of short-tongued bumblebees in onion and pak choi seed fields (each point represents one field observation time) versus temperature (ºC). The lines are smoothed trend lines of total counts within fields (black – onion between 0600 and 0900 h and 1600 and 2100 h; red – onion between 1000 and 1500 h; green – pak choi between 0600 and 0900 h and 1600 and 2100 h; blue – pak choi between 1000 and 1500 h).

The relative abundance of short-tongued bumblebees (*Bombus terrestris*) on crop flowers showed the opposite trend to honey bees for the same climate variables. Their larger body mass helps to maintain body heat when foraging in cooler temperatures, but they are less efficient at regulating their temperature at higher temperatures than honey bees. The increased temperatures brought about by climate change are likely to reduce the window of activity of bumblebees, both during the day, and in the number of days suitable for foraging. However, compared with honey bees, they will be more tolerant to increased storm activity.

Flies

Figure 6 Green soldier fly (*Odontomyia* sp.) visiting a flowering onion umbel.

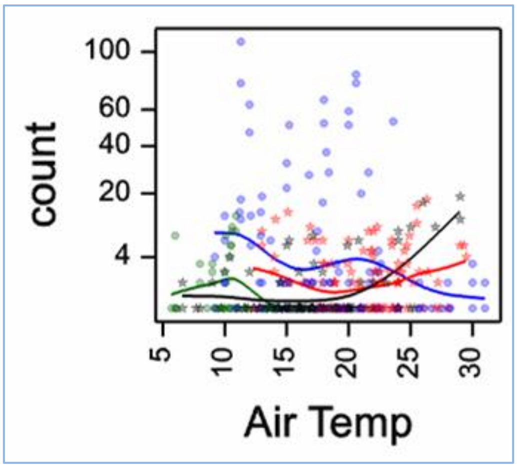

Figure 7 Counts of green soldier flies in onion and pak choi seed fields (each point represents one field observation time) versus temperature (ºC). The lines are smoothed trend lines of total counts within fields (black – onion between 0600 and 0900 h and 1600 and 2100 h; red – onion between 1000 and 1500 h; green – pak choi between 0600 and 0900 h and 1600 and 2100 h; blue – pak choi between 1000 and 1500 h).

Different fly pollinators showed different responses to climate. Some species such as New Zealand orange hoverflies (*Melanostoma fasciatum*) were more abundant at temperatures below 20oC, while others [e.g. blow fly specials (*Calliphona spp.*), drone flies (*Eristalis tenax*) and green soldier flies (*Odontomyia spp*.] foraged across a wide range of climatic conditions. Many fly species can fly at lower body temperatures than bees. They also tend to shelter closer to crops, allowing them to begin foraging quickly when climatic conditions become suitable. They are often dominant pollinators in cooler moister habitats. Flies capable of foraging under wide climatic conditions are likely to be among the most resilient pollinators as the climate changes.

Maintaining crop pollination services with changing climate

Climate change will have impacts on the activity windows of different pollinating species, thereby influencing their importance as crop pollinators, but climate change is also likely to alter:

- Pollinator lifecycles, distributions and their interactions with pests and diseases
- The timing and supply of nectar and pollen by crop plants
- The crop species grown and their locations.

These topics require further evaluation to assess the impact of climate change on the production of insect pollinated crops in New Zealand more accurately. Despite this, a key strategy should be to build pollinator species diversity to ensure pollinator activity is maximized under changeable and highly variable climatic conditions. This requires a focus on practical management solutions targeting a range of species already identified as key pollinators.

Figure 1 Native bee (*Leioproctus vestitus*) visiting a white clover floret.