Evolutionary changes in human-altered environments can result from disruptions in key ecological interactions, such as plant-pollinator mutualisms. New Zealand’s remote oceanic island geography means that the evolution of the flora and fauna proceeded in isolation from other regions and therefore native plant-pollinator interactions are distinctive. Since human settlement profound changes in pollination systems have occurred. Today, naturalised exotic plant species comprise over 50% of New Zealand’s flora and many of these have become invasive weeds (Wilton and Breitwieser 2000). Since European settlement the originally low diversity of the native insect pollinator fauna (Lloyd 1985) has been supplemented by the naturalisation of agricultural introductions including the honey bee (*Apis mellifera*) and four bumble bee species (*Bombus* spp.) which have spread throughout New Zealand (Donovan 1980). Considering their shared origin and evolutionary background, we would expect exotic pollinators to prefer exotic plants and native pollinators to prefer native plants.

To determine the extent of the separation or crossover between exotic and native pollinators on exotic and native plants, we conducted a broad survey of flower visitors at 7 semi-natural sites throughout New Zealand from November to December 2005. We counted the number of insect visitors on flowers at individual plants along transects in mixed communities of native and exotic plants. Observations of day-active flower visitors were made for a minimum of 10 days at each site by making observations four times a day (9 am, 11 am, 1 pm and 3 pm). Counts were “snap-shot” or “near instantaneous” counts of the number of insects found in a 0.75 m² patch of flowers for each plant individual. By only counting the insects on a flower when first encountered, our focus was
the abundance of pollinators not their visiting rate or activity. The same
observers were maintained for each site. Flower visitors were assigned to easily
recognisable categories: honey bee, bumblebee, native bee, fly, beetle/bug, and
butterfly/moth during observations. Although birds were noted, the sampling
method did not encompass bird visits because they require a different method
(e.g., longer observation periods from farther away). For more information on
methods see http://www.landcareresearch.co.nz/research/biocons/pollination.

The proportions of each flower visitor category showed that exotic bees (Apis
mellifera and Bombus species) accounted for over a quarter of all observed
flower visitors, while native bees (Lasioglossum spp., Leioprotus spp. and
Hylaeus spp.) accounted for less than a quarter (Figure 1). Flies made up the
largest portion of the visitors but could not be identified to species during
observations and so were not separated into exotic and native counts. A
discriminant analysis on the combined data was conducted on 219 plant species
across all sites and plant individuals (Figure 2). The analysis of the profiles did
not reveal any overall separation of native endemic, native non-endemic, and
exotic naturalised plant species based on their flower visitor assemblages
(measured as proportions of the observed visitor categories).

Although the general survey does not support separation of exotic and native
plant-flower visitor associations at the overall community level, there are some
exotic plant species that are exclusively or predominantly visited by exotic
insects. These are potential “invasive mutualisms” if the plant species are
pollinator dependent and native pollinators are unable or unlikely to service them.
Such a mutualism means that by introducing certain exotic pollinators a positive
feedback loop is formed with the exotic plant that previously had no or few
pollinators and this promotes the spread of both plant and pollinator populations
(Goulson 2003). For example, species with closed flowers such as the flag
flowers of legumes are candidates for an “invasive mutualism” on islands without
large social bees such as New Zealand (Newstrom and Robertson 2005).
Furthermore, the crossover of exotic pollinators onto native plants means that they could displace native pollinators depending on population densities (Goulson 2003). On the other hand, exotic pollinators could provide valuable replacement or supplemental services for native plants that have lost their native pollinators such as birds and other vertebrates. These results contribute to the aims and goals of the International Pollinator Initiative of the Convention on Biological Diversity (CBD). New Zealand belongs to the recently formed regional branch, the Oceanic Pollinator Initiative (OPI). Since the island ecosystems of Oceania evolved in isolation from continental landmasses, they have unique and fragile plant-pollinator partnerships that are particularly vulnerable to climate change, land use intensification, habitat losses and invasion by alien species. The Oceania Pollinator Initiative (OPI) is a network of pollination ecologists and other researchers, policy makers, farmers, agronomists, beekeepers, conservationists and interested public to promote the conservation and sustainability of pollinators in natural and agricultural ecosystems in the region. OPI is aligned with four other continental size pollinator initiatives under the umbrella of the CBD International Pollinator Initiative, facilitated and coordinated by the Food and Agriculture Organisation (FAO). The OPI website is at www.oceaniapollinator.org.

References:


**Figure 1.** The percent abundance of each category of day-active insect visitors to flowers classified into easily recognisable pollinator “functional” groups at 7 semi-natural sites observed in 2005 in New Zealand. Exotic bees (honey bee and bumble bee) comprised approximately 35 % of the visitors whereas native bees comprised approximately 20 % of the visitors.
Figure 2.
Discriminant analysis based on flower visitor assemblages (measured as proportions of observed visitor categories) for plant species in three groups (native endemic, native non-endemic, and exotic naturalised) showed no separation. Data was combined for each of 219 plant species across all sites and plant individuals from 7 semi-natural and 2 cultivated sites in New Zealand.