The birds and the bees

Six—Many Loranthaceae mistletoes, including Peraxilla in New Zealand, have "exposure" flowers which cannot open themselves; birds pop the buds open and pollinate them. However, a reduction in bird density has decreased visitation rates in some areas and depressed seed production in these plants. Here we report that tiny native solitary bees (Hylecta sp.) can successfully prise open Peraxilla tetrapetala buds, which is, to our knowledge, the first documented case of an invertebrate opening an explosive, bird-pollinated flower. The bee is inefficient at pollen transfer, but still doubles the number of seeds ripened per flower. This example is an extreme case of ecological replacement of vertebrates by an invertebrate in a depauperate island fauna.

Peraxilla flowers are relatively large (27–42 mm); ripe buds open only with considerable force, from a beak or a human hand, for example. The main pollinators are honeyeaters: tui (Prosthemadera novaeseelandiae, mass 120 g) and bellbirds (Anthornis melanura, mass 30 g). Exotic, explosive flowers worldwide are usually bird-opened, exclusively so in the Loranthaceae. Insect-tripped explosive flowers occur in several families, such as Cytisus scoparius (Fabaceae), but there are no previous reports of any explosive flower that can be opened by both birds and insects.

We have observed native solitary bees (Hyleus sp.; Hymenoptera, Colletidae) opening flowers of P. tetrapetala at two sites, Craigieburn and Lake Ohau. The small bees (body length 7 mm) are dwarfed by mistletoe buds (see figure), yet at Lake Ohau bees successfully opened about one bud in four by attacking the tip of the bud with their mandibles. This takes considerable effort and time (20–40 seconds), whereas tui open buds in 0.23 ± 0.06 seconds. As Hyleus weigh only 0.01 g (1/3,000 of the bellbird mass) it is remarkable that they can open buds at all. Insect-explosive flowers like Cytisus scoparius are much more restrictive; bumblebees trip them easily, whereas slightly lighter honeybees have difficulty.

Peraxilla stigmas are well placed to collect pollen from an approaching bird, but Hyleus are pollen harvesters and are so small that they often do not touch the stigma, reducing pollination effectiveness. Our experiments on plants in the absence of birds show that bees cannot open P. colensoi flower buds, even though they visit flowers frequently. P. colensoi buds require more force to open than P. tetrapetala, and may be beyond the strength of these bees.

In contrast, bees open many P. tetrapetala buds inside our experimental wire-mesh bird-exlosures; significantly more of these opened flowers ripen a seed (see table). A few unopened buds set seeds by self-pollination in both Peraxilla species, but by opening P. tetrapetala buds Hyleus doubles the fruit-set. As Hyleus cannot readily contact the stigma, it could improve the fruit-set partially by giving other invertebrates access to open flowers. Introduced wasps (Vespula spp.) and honeybees (Apis mellifera) were present at all sites that we studied, but did not open Peraxilla flowers. These flowers are opened only by native animals (whether birds or insects).

New Zealand generally has unspecialized pollination syndromes and a depauperate fauna (there are no land mammals). This could explain why the only invertebrate known to open bird-adapted explosive flowers is found in New Zealand. Elsewhere, changes in pollinator availability in isolated populations may promote speciation via pollination syndrome shifts, like the one recently analysed genetically in Mimulus. The tiny Hyleus is an unlikely substitute for birds on larger flowers like P. tetrapetala, yet we have found that in the absence of birds it can double seed production. Because habitat clearance and introduced mammalian predators in New Zealand have lowered both bird and mistletoe densities, this small pollinator helps provide important conservation benefits.

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