SNAPSHOT: *by Billy Krimmel*[1]

Springtime Observations in Your Native Garden

Figure 1: Bush monkeyflower (*Mimulus aurantiacus*) flowers. The flower on the left has its stigma closed (and the bug *Closterocoris amoenus* inside), while the flower on the right has its stigma open. Poking the stigma with a small twig, pine needle, or toothpick will cause it to close.

Spring is an exciting time in the garden. Plants are growing in earnest, flowers are beginning to bloom, and birds and insects are buzzing around. In a native plant garden, one can be confident that many of the insect and bird species are also native and connected to broader ecological processes such as metapopulation dynamics, insect-plant coevolution, and habitat restoration (see box next page).

In this issue of *Grasslands*, we highlight some of the fascinating things that can be observed in your native garden. Native gardens are unique from conventional, non-native gardens — they share an evolutionary history with this fauna, which means that plant traits and animal traits can be interpreted within an evolutionary context. In this article, we will focus on a few that are fairly easy to observe in the spring.

Bush monkeyflower (*Mimulus aurantiacus*) is a beautiful native shrub that grows throughout much of the state, from the coast to the foothills, and Southern to Northern California. Along its range it exhibits wide variation in floral and leaf traits, resulting in a swath of cultivars that are commonly used in landscaping. Because it grows along such a wide range, it is adaptable to many different settings (i.e., sun, shade, soil type) and thus widely used in native landscaping.

Bush monkeyflower is pollinated primarily by hummingbirds. As it blooms in the spring, hummingbirds seek its nectar and often hang around native gardens where it is growing. And bush monkeyflower has a fascinating adaptation to being pollinated by hummingbirds: a touch-sensitive stigma (Figure 1) that helps it avoid self-pollination (see box next page) (Fetscher and Kohn 1999). The stigma is the part of the flower that receives pollen (compared with the anther, which produces and releases pollen). While some plants readily self-pollinate, many others (such as bush monkeyflower) have evolved means to avoid it.

Imagine a hummingbird carrying pollen from one bush monkeyflower flower to another. The hummingbird's beak and face are coated in this pollen as the hummingbird arrives to stick its face into another plant's flower. The stigma sits close to the entrance of the flower, wide open and bright white — take a look for yourself in your own garden! The nectar and pollen sit behind the stigma — this is the hummingbird's final destination, but it is forced to first bump into the stigma. As it does so, some of the pollen on its beak and face stick to the stigma, and upon contact it closes and clears the path for the hummingbird to access the nectar and pollen. As the hummingbird pulls its face out of the flower, the stigma is already closed, thus preventing the pollen from one flower from reaching the stigma from the same flower.

The mere touch by the hummingbird initiates the closure of the stigma, and one of the fun parts about this for the native gardener is that by merely touching the stigma with a finger or twig, the stigma will immediately begin to close. In a few minutes it will open up again, unless your finger or stick had pollen on it, in which case the stigma will remain closed as the flower initiates the fertilization process. Give it try in your garden or on your next hike!

There are many other interesting things to look for on bush monkeyflower. The plant bug *Closterocoris amoenus* (Hemiptera: Miridae) (inside a flower in Figure 1), can be found on plants in the wild and occasionally in gardens. During juvenile development, it resembles an ant (Figure 2), which is presumably a way to ward off predators. In Figure 2 it is feeding on the pupa of a gall midge (Diptera: Cecidomyiidae), which is a type of fly. To make matters more complicated, the fly feeds on a fungus that grows on developing flower buds of bush monkeyflower. These fly-managed fungal farms are called galls, and resemble normal flower buds except for being more rigid and lumpy. So, in Figure 2 we have a bug mimicking an ant feeding on what looks like a flower bud but is in fact a gall, inside of which is a fly growing and feeding on fungus. A lot is going on in this coevolved system! I encourage readers to do their own research on galls, gall midges, and other gall-forming insects (including wasps and aphids).

Another interesting plant-pollinator interaction to look (and listen) for in your garden involves buzz pollination. Buzz pollination has evolved in a range of plant and pollinator species and involves plants with tightly-held pollen that needs to be vibrated at a certain frequency in order to be released (e.g., Harder and Thomson 1989). It is common among many plants in the *Solanaceae* family, and a

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variety of solitary bees including many bumblebees (*Bombus* spp.). Other plants — including our native manzanitas — require buzz pollination. These bees, like all solitary bees, rely upon both nectar and pollen in order to feed their young; the pollen and nectar are combined into little nutritional balls that are placed alongside eggs in their nests, so that when the young bee larva hatch they immediately find provisions. These nests are typically made in the soil — look for small holes in bare dirt — the bees tend to be most active in the early morning and evening.

Figure 2 (inset): The plant bug *Closterocoris amoenus* feeds on the pupa of a gall midge (Diptera: Cecidomyiidae) on bush monkeyflower. Its mouth (referred to as a beak) penetrates into the center of the gall, where it sucks the flesh out the midge pupa.

When you are observing pollinators in your garden, keep an eye — and ear — out for bees that produce one pitch of buzzing when they fly, and another, higher-pitched buzz (a "middle C") when they interact with flowers. This special vibrating frequency serves to dislodge the pollen from the plant, allowing it to disperse among the bee's hairs. Subsequently the bee will groom the pollen from its hairs and put it into specialized structures on its legs, which are used to transport the pollen efficiently from foraging forays to their nests.

This process can be mimicked easily with a tuning fork, which makes for a fun backyard science experiment. Place a sheet of paper below a flower, then touch the flower with a tuning fork that is vibrating at a middle C frequency. Observe the amount of pollen released visually. Now try it on another flower with a tuning fork at a different frequency. For a more rigorous study, compare the weight of the pollen to get a more accurate measurement of any differences pollen quantity. You can also try this on some species that are not buzz-pollinated for an additional comparison. This is also a great way to pollinate your tomato plants by hand.

The bees that buzz-pollinate also tend to make small nests in the soil for their young. Their buzzing skills are used to compact the soil in small chambers as well, so make sure to keep an ear open as you observe them enter their nests in your garden! To encourage native buzz-pollinating bees to reproduce in your garden, plant some native species in the *Solanaceae* family and maintain some bare patches of soil.

References

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Important ecological processes related to your native garden

Metapopulation dynamics involve the dynamic consequences of migration, local extinction, and recolonization that result in regional persistence of species (Hanski 1998). In other words, a population of a particular species may persist over a broad range even as local populations become extinct until they are subsequently recolonized. This process is very important as it relates to creating robust populations of native species in urban areas — your native garden is part of a native garden metapopulation throughout your city, with each one adding resilience and robustness to the larger population.

Insect-plant coevolution describes the back-and-forth evolutionary process between plants and insects which share an evolutionary history and whose traits affect each other, resulting in each one affecting evolutionary selection on the other and each one shaping the other's evolutionary trajectory and resulting set of traits, including morphology and behavior. This framework and body of theory provides a way to ask why plants and insects interact in certain ways, and can only be applied to systems where the species evolved together — like the species in your native garden!

Habitat restoration is the practice of renewing and restoring ecosystems and habitats that have been degraded. As mentioned previously in this column, we (Americans) have converted more than half of our land in the continental United States into cities and suburbs that tend to have very few native species of plants. Planting a native garden means restoring a piece of this back to a functional habitat — with enough native gardens, we can restore our urban and suburban metapopulations.

Self pollination is when plants pollinate themselves with their own pollen. This can refer to the pollen within an individual flower pollinating that same flower, or to different flowers on an individual plant pollinating one another. Plants exhibit a wide range of adaptations to encourage or prevent self pollination, depending on their evolution and ecology.