Search ...

WNPS Main Menu

Botanical Rambles

Welcome to the Washington Native Plant Society Blog

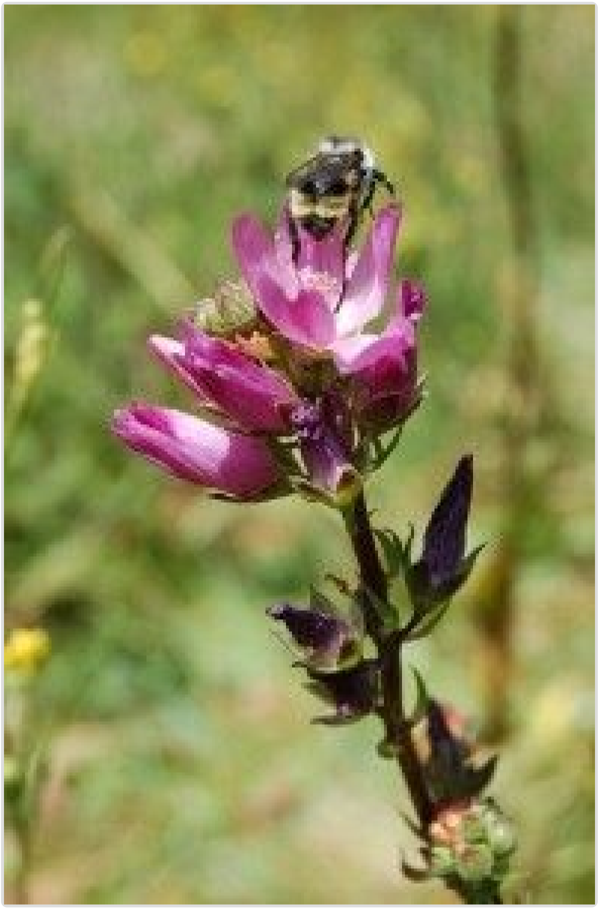
Font size: + − | Print

Coevolution and Pollination

PNW Plants, Conservation, Native Landscaping, Research & Inventory, Wildlife & Critters

Joe Arnett Friday, August 01 2014 22577 Hits

The coevolution of flowering plants and their animal pollinators presents one of nature's most striking examples of adaption and specialization. It also demonstrates how the interaction between two groups of organisms can be a font of biological diversity.



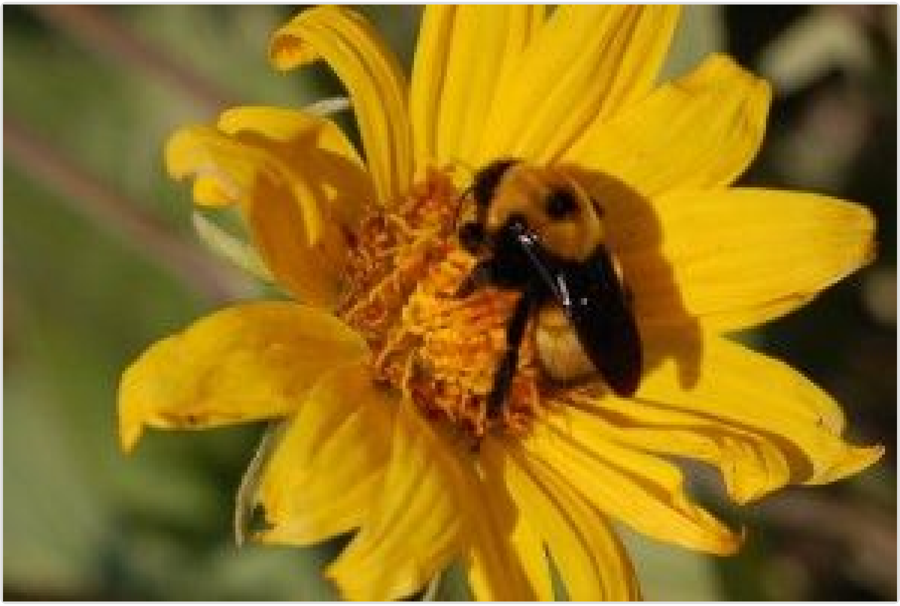
Sidalcea oregana var. calva, photo by Joe Arnett

Flowering plants are adapting to their pollinators, which are in turn adapting to the plants. Each of the participating organisms thus presents an evolutionary "moving target". The relationship between these distantly related taxa is symbiotic in the broad sense that characterizes life and that gives rise to the high degree of complexity and diversity that we perceive in nature.

If the rule in nature is "whatever works," our observations are that many things work, and that what works keeps changing. Our understanding is that each species evolves to its own benefit; in coevolution, these two self-interests collide, and remarkable things happen.

Bees

For an



Foraging bee. Photo by Joe Arnett

example, bees appear to be especially adept at perceiving bilateral symmetry and the colors blue and yellow, and at manipulating flower parts. So plants being pollinated by bees are subject to a strong selective pressure favoring bilateral symmetry and those colors.

In turn, the flowers exert pressure on the bees, favoring hairiness, body shape, and behavior that effectively transfer pollen. The resulting specialization can favor a trend toward an exclusive relationship, which may be to the benefit of each participant.

The plant gains the constancy of the bee, which majors on the particular species and facilitates pollination of widely spaced, specialized flowers. The bee gains exclusive access to the nectar. The specialization may contribute to developing isolation, often a component of speciation.

Star orchid (Angraecum sesquipedale) with pollinating long-tongued moth (Xanthopan morganii praedicta)

A long spur

Coevolution can be complex, involving the interactions of numerous characteristics, or in some cases, it can be simpler, such as when the back and forth pressure favoring longer floral tubes and longer insect tongues or bird beaks can lead to extremes of each. Hummingbird beaks and the long-tubular flowers on some of the plants they pollinate are often used as examples.

Charles Darwin described an interesting case of pollinator-flowering plant coevolution in Madagascar: the star orchid, *Angraecum sesquipedale*, has foot-long spurs, with the nectary at the tip. In 1862, when Darwin examined this orchid, he predicted that a long-tongued moth would be found that pollinated it; no moth with that extreme length of tongue was known at the time.

Then, in 1903, he was proven correct when a long-tongued moth, *Xanthopan morganii praedicta* was discovered. It was so-named because its occurrence had been predicted.

Wind and water

Among vascular plants, the largest share of diversity, by far, is found among the flowering plants, the most recent plant phylum to evolve. The Washington Flora Checklist (http://biology.burkemuseum.org/herbarium/waflora/checklist.php) reports 3,668 taxa (species, subspecies, and varieties) in Washington State.

A handful (30) of these are conifers, and a few more (86) are spore producing plants like ferns and horsetails. The rest are essentially all flowering plants.

Some of these flowering plants, like the grasses (345), sedges (197), and rushes (63), are pollinated by the wind, though these families are believed to have been derived from insect-pollinated ancestors. A few species are pollinated by hummingbirds, and a few (like willows) appear to utilize both insects and the wind. But the broad majority of flowering plants are dependent on insects.

Since plants are rooted in place, they cannot go traveling in search of each other for the purpose of fertilization, and so plants through the eons have succeeded only as alternative strategies have developed.

The more ancestral plants, such as ferns and their closer relatives, rely on water: sperm cells have to swim through water to receptive egg cells. Swimming worked, and still does, but it imposes a serious spatial restriction. A centimeter or so is a long swim for a single flagellated cell.

The conifers took a great leap forward when the ability arose to achieve transport of sperm cells within pollen grains, which could be disseminated by the wind. The wind can transport pollen miles rather than centimeters.

Wind pollination has its own set of limitations too, though. The pollen receptacle of a conifer is a small target, and the wind blows were it will. Wind pollination only works well when large volumes of pollen are produced, and when the plants grow in fairly dense concentrations.

That abominable mystery

Then, sometime around 160 million years ago, in what Darwin referred to as that "abominable mystery," flowering plants appeared, though they did not achieve dominance in the plant world until about the time the dinosaurs became extinct.

Transport of pollen was no longer limited by the capriciousness of the wind, but was conducted by living organisms, probably initially beetles. Unlike the wind, animals can concentrate on a single species and travel long distances between members of sparsely distributed individuals. And crucial, in my view, is that animals are also adapting, as are the flowers they pollinate.

Instead of just evolution of one organism, we encounter coevolution, where two different organisms are each evolving in response to each other. The result has indeed been an explosion of biodiversity, both in flowering plants and in the animals that pollinate them.

Pollinators and flower types

The table below presents some of the general characteristics of the most common pollinators in Washington State and the plant characteristics that have coevolved with them. These are generalizations, and you will see many exceptions if you look. But I hope that these typical relationships will increase your perception of the interactions between the plants and animals around you.

Pollinator	Pollinator characteristics	Typical flower types	Example plants
	Long bills,	Red or	

Hummingbirds	highly developed ability to perceive red, high metabolic needs, ability to hover.	reddish flowers, long broad tubes, often pendent or horizontal, large nectar rewards.	Honeysuckle, currants, salmonberry, columbine.
Bees, including bumblebees, honey bees, and solitary bees	Perception of bilateral symmetry, blue and yellow colors and ultraviolet light; dexterity at manipulating plant parts, ability to strongly vibrate by buzzing, need for both nectar and pollen.	Flowers with bilateral symmetry, often in shades of blue or yellow, nectar guides in the ultraviolet spectrum, flowers that require dexterity to open, sometimes bell-shaped flowers.	Lupines, clovers, orchids, penstemons, ericads (buzz pollination).
Butterflies	High nectar needs, require sunlight for	Bright colors, often tubular flowers,	Phlox, milkweed, sunflower family.

	flying, long tongues	nectar rewards.	
Moths	Often fly at night, sensitive to fragrance, ability to hover.	White or pale flowers which may open at night and close during the day, releasing fragrances, pendant or horizontal flowers	Catchfly, stickseed, wild tobacco.
Flies, including mosquitoes	Attracted to odors (sometimes unpleasant to humans), generalists.	Generally open accessible flowers, often releasing odors flies find attractive.	Many composites, sandworts, mustards, lomatiums.

Reprinted, with permission, from *Douglasia*, Volume 38, No. 2 Summer 2014. Washington Native Plant Society (www.wnps.org)

Tags: #Plant adaptations, #Pollination, #Butterflies, #birds, #Douglasia

Principles of Kick-bu... | Visit Kruckeberg Bot...

ABOUT THE AUTHOR

Joe Arnett

Author's recent posts

More posts from author

Pollination: A Sampler	Friday, September 05 2014
Coevolution and Pollination	Friday, August 01 2014
Birds, Bees, and the Alternation of Generations	Tuesday, July 08 2014

RELATED POSTS

Back to School

Events

Shout Outs for 2016

Events

Anticipating the David Douglas Exhibit

Events

Watch Out— Don’t Miss these Opportunities

WNPS Opportunities

Plant Adaptations and Fire

PNW Plants

Go Hawks! Hawkweeds, that is.

PNW Plants

Subscribe to eNews & Blog

Stay up-to-date with a monthly email from WNPS showcasing new blog articles, important announcements, and monthly events across the state.

Name

E-mail

SUBSCRIBE

Search Blog by Date

Mar 2020

MON	TUE	WED	THU	FRI	SAT	SUN
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Search Blog by Category

- PNW Plants
- Native Landscaping

- Conservation
- WNPS Opportunities
- Members
- Events
- Field Trips & Destinations
- Books, Publications & Resources
- Stewardship
- Research & Inventory
- Education
- Educational Grants
- Invasive Species
- Chapters
- Salal Garden
- Art & Botanical Illustration
- WNPS Products
- Wildlife & Critters
- Editorial
- Uncategorized