Time for a new approach to crop pollination

Deborah K. Rich, Special to The Chronicle
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The parasitic mite that devastated **honey** bee colonies across the United States this spring served notice that we are overly reliant upon the **honey** bee for crop pollination. Beekeepers report the mite infested 40 to 60 percent of managed beehives. Unless we find alternate pollinators to cart around, or another means to pollinate our fields, we risk periodic crop failures due to lack of pollination. And not just of almonds (whose February bloom faced severe **honey** bee shortages), but of any of the more than 100 insect-pollinated crops grown in the United States as well.

The larger our crop fields, and the more intensively we farm, the more we need a bee that we can propagate off-site and truck to our fields on demand. Conventional "clear cut" agriculture relegates natural landscapes that support native bee populations to the far edges of productive regions, and any **bees** that might make the long trip out to the fields are subject to pesticide poisoning.

The **honey** bee is an obvious choice for managed pollination. We have a long association with **honey bees** and their **honey**, and we have learned, over hundreds of years of observation, their nesting preferences and how to transport their hives. Most importantly for large-scale agriculture, **honey bees** nest together and raise their young in colonies whose populations number in the tens of thousands. Other species nest alone or in much smaller colonies, which complicates efforts to house and transport them.

But the social tendencies of the **honey** bee, combined with the size and national scope of **honey** bee operations (beekeepers have consolidated, just as other agricultural suppliers have, and often ship beehives by the semi-truck load), nearly guarantees the rapid transmission of diseases and parasites when they appear.

Recognizing the very real threat of crop failure that our dependence upon a single species of bee poses, researchers are coaching pollinator understudies. The blue orchard bee (also known as the orchard mason bee) is proving a cooperative pollinator of some early blooming orchard crops, and the bumble bee is helping to pollinate hot-house tomatoes.

Still, it may be time -- while there still is time -- for another approach entirely. The United States is home to 4,000 bee species, of which 1, 500 are found in California, to say nothing of the many moth, fly, wasp and butterfly species that also assist with pollination. (Of the insect pollinators, the bee is the most important because only the bee actively gathers both pollen and nectar to transport to her nests; other insects gather pollen only incidentally while they seek out nectar, similar to the way our socks gather burrs while we pick flowers.) If we have pushed native **bees** out of our agricultural regions, not to mention our

inner cities, it could be that we can pull them back in.

Thanks to Claire Kremen's recent work in Yolo and Solano counties, we know that, when present, native bee populations are more than equal to the task of fully pollinating many crops. In a study that began in 1999, Kremen, an assistant professor of ecology and evolutionary biology at Princeton University, discovered that on organic farms within two kilometers of riparian forests or hillsides of chaparral and oak, native **bees** were so numerous as to even pollinate fields of watermelon. Watermelon provides a good measure of pollination services because it is entirely dependent upon insects for pollination and requires several insect visits to transfer enough pollen to set a marketable fruit.

Perhaps, then, the better approach to reducing our reliance on the **honey** bee for crop and ornamental plant pollination is to protect and, where necessary, recreate ecosystems that support a wide range of native bee species; to focus more on being general managers of diverse farm, park and garden landscapes, and less on micro-managing specific species.

Fortunately, we have reason to believe that even small patches of habitat within landscapes can greatly boost bee diversity and abundance. "**Bees**," wrote Kremen in the December 2002 Proceedings of the National Academy of Sciences, "can seek out patchy resources and persist within small fragments of habitat... ." And while it would be presumptuous to think that we've deciphered the subtle nuances in habitat preferences among different bee species, we do understand their basic needs.

All **bees** require pesticide-free nesting and overwintering sites (for most bee species, they are one and the same), and forage. The vast majority of our native **bees** are solitary nesters, meaning that each female builds and provides for her own nest.

More than two-thirds of the species nest in the ground, while most of the others nest in wood. A few seek out small spaces between rocks or beneath clumps of grass. The bumble bee, a social-nesting native bee, needs a modest cavity to nest in and often opts for abandoned rodent burrows.

Ground-nesting **bees** prefer patches of dry, sloped, bare or partially vegetated dirt. The Xerces Society, dedicated to the conservation of invertebrates, suggests that, "Some of the best places around farms for creating habitat for native pollinators are the worst places for growing crops. For example, areas with the poorest soils may provide some of the best sites for ground-nesting **bees**, because these animals often prefer to nest in well-drained, inorganic sand and silt."

Where farmers can leave field edges, fence rows, set-aside acres, road and canal berms, and utility easements uncultivated and unsprayed, they will greatly increase their chances of hosting native **bees**. "A lot of times **bees** will nest right along farm roads. So, if you know that and start to recognize that resource, then maybe you'll pull up your plow before coming all the way up to the road and keep that ground stable," says Mace Vaughan, conservation director for the Xerces Society.

If, along with the **bees**, invasive weeds move into uncultivated fringe areas and threaten to leap-frog into the crop, planting hedgerows of native trees, shrubs and grasses will help keep the weeds at bay while allowing strips of land to lie untended (after the hedgerows have been established). Mowing is another option for weed control. Mowing in the late fall or winter is less likely to disturb nesting **bees**. When mowing must be done earlier, waiting to mow until after the plants flower, but before they set seed, will allow **bees** time to forage.

When dense root mats or thatch blanket areas designated for bee

habitat, farmers must clear away some of the vegetation; the goal is to give the **bees** access to the soil while leaving some grass and shrubs in place to provide forage and to help prevent soil erosion. Bee-conscious gardeners will want to uncover soil at the back of sunny flowerbeds, pushing aside woodchips and compost, and they have justification to label persistent bare patches in the lawn "bee habitat."

Ideally, habitat areas will encompass slopes of varying degrees. The nesting preferences of bee species range from vertical banks to nearly flat ground.

Wood-nesting **bees** claim beetle tunnels in dead branches, or burrow into shrubs with soft-centered twigs, for example: elderberry, sumac and blackberry. Providing habitat for wood-nesters can be as simple as leaving stand dead or dying trees and planting shrubs with pithy stems.

Alternatively, farmers and gardeners can fabricate wood nests by drilling holes, ranging in size from 3/32 to 3/8 inch in diameter, in wooden blocks, chunks of firewood, stumps or even fallen logs. (Holes 1/4 inch or less in diameter should be drilled 3 to 5 inches deep, and holes larger than 1/4-inch diameter should be 5 to 6 inches deep). Mounting or hanging bundles of paper straws, bamboo and reed stems, or pithy twigs is another option for providing habitat for wood-nesting **bees**. Constructed nests should be cleaned out or replaced every other year to avoid parasites, fungi and diseases.

Flowering plants that offer **bees** nectar and pollen will likely already be present on the farm and in the garden, but several adjustments to the timing and diversity of blooms can help ensure that **bees** are present in large populations when the cash crops (or favored landscape plants) need them. In general, the more food that is available, and the closer it is to nesting sites,

the larger the bee populations. When female **bees** can find large clusters of flowering plants near to their nests, they can spend relatively more time provisioning the nests and laying eggs and less time commuting.

In temperate zones, having plants blooming nearly year-round is key to promoting bee abundance and diversity. The active periods of **bees**' lives vary, and one bee species or another will be foraging for nectar and pollen from at least February through November. Orchards often have difficulty sustaining bee populations year-round because, after their flush of blooms during the spring, they typically offer few foraging opportunities. Planting the avenues between orchard trees with a cover crop that blooms before or after the orchard - clover, thyme or short yarrow, for example -- will not only help ensure pollinators for the orchard, but for neighboring crops as well.

The bumble bee, the sweat bee and many other native **bees** important for crop pollination produce several generations. The presence of late winter and early spring blooms will facilitate the foraging and egg-laying of the first generation and help to ensure large pollinator populations on-site in the summer and fall.

Plant diversity is important too. Different **bees** seek out different bloom shapes and prefer one plant's pollen to another's. Many non-native plants can be excellent sources of nectar and pollen, but **bees** and plants have co-evolved together to achieve the most efficient pollen transfer. Planting forage plants native to the region (see accompanying list for suggestions for California) will likely best service native bee populations and accommodate their particular preferences and body types.

Gardeners can consider whether they can eschew grassy lawns in favor of swaths of clover, violets and chamomile. Where grass is a must-have, raising the mowing deck to allow any flowering

plants that have moved in to bloom will help eke a little forage out of the grassy swath. Open space that doesn't receive much foot traffic can be planted with low-growing herbs like oregano, thyme and marjoram: all three of which swarm with small **bees** when in flower.

If we are to sustain native bee populations on-site, we must reduce our use of chemical pesticides. Pesticides don't have to be sprayed directly on **bees** to kill them; because pesticides dissolve in nectar and settle on pollen, they also poison **bees** that arrive later to forage. Even when exposure isn't lethal, pesticides can affect the **bees**' ability to fly and navigate, or cause spasmodic movements and paralysis, all of which limit foraging and nest building.

The Xerces Society recommends creating buffer zones around crops, leaving, for example, the outermost 15 or 20 feet of a field unsprayed. Trying to spray when **bees** are less active, for example at night or in the winter months, will help to reduce direct kills.

And, since we apply pesticides every day in our parks, schools, office buildings and homes, it is not only farmers who will have to reconsider pesticide use.

For more information

The Xerces Society publishes both a short manual (Farming for **Bees**) and a handbook (Pollinator Conservation). Both offer guidelines for recognizing and providing native bee habitat. Contact them at (503) 232-6639, or www.xerces.org.

For an overview of pollinators and conservation issues, see: "The Forgotten Pollinators" by Stephen L. Buchmann and Gary Paul Nabhan. (Island Press, Washington D.C., 1996)

Knox Cellars supplies artificial nests for native **bees** and other native bee-related equipment. Contact them at (425) 898-8802, or www.knoxcellars.com.

Pinnacles National Monument near Monterey: a center of bee diversity

Towering rock spires draw the eye at the Pinnacles National Monument, 14 miles east of Soledad in Monterey County, but take note of the **bees** on your next visit as well. In the late 1990s, Olivia Messinger and Terry Griswold of the USDA Bee Biology and Systematics Laboratory conducted a survey and found that the 25-square-mile preserve hosts almost 400 bee species, perhaps the highest-known bee diversity per unit area of any place on earth.

For comparison, consider that Clark County, Nev., another center of bee diversity, with 598 species, encompasses approximately 7,910 square miles. The Mojave National Preserve, with 305 bee species, is spread over 2,500 square miles.

"Nearly 400 bee species are now known to reside in the monument, representing 52 genera and all six North American bee families. The **bees** at Pinnacles range in size from minuscule (mosquito-sized) to gargantuan (the size of one's thumb), and come in colors as varied as the plants they visit --

from coppery greens to steely blues, or glossy black," Messinger and Griswold wrote in a report published in Fremontia in 2002.

At least two of the species (Andrena annectans and Ceratina hurdi) appear to be endemic to the monument and surrounding areas.

Factors contributing to the diversity of **bees** at the Pinnacles

include the relatively open landscape, dry soils typical of temperate zones, and the presence of nearly 600 species of flowering plants.

For visitor information call (831) 389-4485, or visit www.usparks.com/pinnacles/park_info.html.

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