

## 1. Are bee populations declining, and, if so, what types of bees are affected?

**Kelsey Graham:** As with most things, the answer isn't a universal yes or no. Some species are certainly declining, while others are doing well. For instance, the rusty-patched bumble bee (*Bombus affinis*) used to be incredibly common throughout the northeast, but has now all but disappeared across most of the region. It is now the first bee species within the continental US to be provided protection under the Endangered Species Act. In contrast, the common eastern bumble bee (*Bombus impatiens*) has shown no evidence of decline, and is perhaps even increasing in abundance. So just within the same genus we have very different responses over time.

**Rachael E. Bonoan:** Yes, bee populations are declining. Pretty much all bees are being affected but the ones that may be hit the hardest are the solitary bees. Solitary bees are wild bees (they're not managed like honey bees and some bumble bees), most are stingless, and as their name suggests, they live alone. Since these bees live on their own, there is no buffer. Honey bees live in colonies of up to thousands—if one bee gets sick, injured, etc., there are other bees at home to pick up the slack. This is not the case for solitary bees. Wild bumble bees may also be hit hard—although they do live in colonies, they live in small colonies (not much more than about a hundred individuals) so they don't have as robust a buffer as honey bees.

**Dalton Ludwick:** Some bee species are in decline. Solitary and eusocial bees are being impacted. Honey bee (*Apis mellifera*) populations have held relatively stable over the past two decades. Of concern is the percentage of hives surviving each winter. Depending on the state, nearly half of honey bee hives die each winter. Unfortunately, much of the literature focuses on honey bee populations instead of other species which are more difficult to monitor.

**Jerry Hayes:** Managed honey bee colonies in the US have increased the last decade or so because of the demand for pollinators as pollinator dependent agriculture has increased. And because of the awareness of honey bee health issues the growth in 'hobby' backyard beekeeping has zoomed in those who are 50 years old to death who the kids are grown, they sold the SUV and they read the Mother Earth news in 1972. They now want to save the world and honey bees are it. "Other" bees (approx 4,000 species in north America) are struggling and some are increasing range and numbers, and it's all tied to climate change and growth of urban and suburban populations taking away or providing flower resources depending on the bee species.

**Rea Manderino:** Native bee populations are declining, but numbers are difficult to pin down. Researchers examining these questions have used museum collection numbers as a rough proxy for past numbers, but these methods are difficult to standardize. Long term survey work is always in demand, but rarely implemented, so much of our numbers come from the last decade or short-term assessments. A good chunk of attention has focused on bumblebees (*Bombus* sp.) in particular, but carpenter bees, sweat bees, and other non-bees (such as ants) are also vital hymenopteran pollinators.

**Manu Saunders:** European honey bees are the most recognised species of pollinator, and they're easy to manage as a semi-domesticated species - which is why they tend to get all the attention. But the Euro honey bee species is not at all representative of all the pollinators. Honey bee species are not endangered anywhere in the world (although the commercially managed lifestyle many of them have can have health risks for individuals). They're also not the best or most efficient pollinator for many crops and wild plants and are an exotic/invasive species in most parts of the world. There are over 20,000 other species of bee in the world, plus thousands of other insect pollinators (fly, butterfly, beetle, wasp etc.), not to mention the bats, birds and mammals that are important pollinators for some plants in some parts of the world. Some of these wild pollinator species are threatened, but for most of them we know very little about their ecology. But thousands of wild pollinators are at

risk of declines - it is hard to confirm rates of declines, because very little funding is available for the necessary research on wild pollinator species.

**Val Giddings:** According to FAO data globally, and USDA data nationally, domesticated *Apis mellifera* populations are not declining. Losses during winters seem to be increasing, but beekeepers have adapted to this and produced replacement queens at higher levels to compensate. (Note, however, that losses over the winter last year led to an 8% reduction in colony numbers in a January to January comparison; <https://www.usda.gov/media/press-releases/2016/05/12/usda-releases-results-new-survey-honey-bee-colony-health>). Everybody familiar with their situation agrees, however, that they honey bees increasing challenges from pests, parasites, and diseases. Just as with *mellifera*, the popular media is filled with alarms about plummeting populations and shrinking biodiversity and negative pesticide impacts on wild bees. But while we have a pretty good handle on what's going on with *mellifera*, and we know what does, and more importantly, does not threaten their health (i.e., on the list of threats to honeybees, neonics don't even emerge from background noise as a contender) our understanding of the situation with wild bees is lacking. It does appear that they do provide valuable pollination services, and there are lots and lots of them. But we have no robust baseline data on species or population numbers for anyplace in North America, nor anywhere in the world that I know of. So anybody who says we have to do X, Y, or Z to save wild bees is running on a lot of speculation over very little data, and should be regarded with serious skepticism.

**Maj Rundlof:** There are support that some groups of pollinators are in decline, for example some bumble bee species in Sweden and Denmark in Northern Europe and here in California. There are also many bee species listed as threatened on the European Red lists. For other pollinators we lack information to assess their threat status. To be able to assess the trends in bee populations, it is important to conduct monitoring of bee populations – something that we rarely do today.

## 2. What factors are causing the decline or are generally a threat to pollinators?

**Kelsey Graham:** Habitat degradation is a major component of bee decline. Bees depend on flowers for food, if flowers aren't as abundant, the community can't support as many bees. To support a diverse bee community, there needs to be a diverse floral community. These must go hand in hand to ensure pollinator abundance. Additionally, safe nesting habitat needs to be provided to allow the next generation to succeed. Providing habitat for bees is also one of the easier ways we can support the local pollinator community. Finding solutions to bee diseases, or the impact of pesticides (which are also real problems associated with bee decline) are not likely to be solved quickly (though a lot of work is going into these issues). But providing safe forage for bees is something that can happen now. It just takes prioritizing bees for both their intrinsic and extrinsic value.

**Rachael E. Bonoan:** There is likely an interaction of multiple factors causing pollinator decline but there are a few main factors that many scientists agree on: habitat loss, invasive species, pesticides, and lack of food.

**Dalton Ludwick:** Habitat loss and habitat disruption is a major concern for insect pollinators. Many insect species that act as pollinators require a plant or other insects during their larval life stages. If the larval hosts feed on plants and those plants are removed, then the pollinators are indirectly impacted.

**Jerry Hayes:** For managed honey bees it is introduced pest, parasites and diseases. "Other" bees (approx 4,000 species in north America) are struggling and some are increasing range and

numbers, and it's all tied to climate change and growth of urban and suburban populations taking away or providing flower resources depending on the bee species.

**Rea Manderino:** Habitat loss is a major driver of bee decline, as it is for most species loss. If bees cannot find suitable nesting conditions, their hives and nests will fail. They rely on wild pastures, woodlots, forests, and areas generally left undisturbed by human interaction.

**Manu Saunders:** thousands of wild pollinator species are at risk of declines from intensive agriculture practices, including monocropping, pesticide use, habitat loss etc. An equally important threat is lack of information - many of these insect species are still unknown to science, or very little is known of their ecology.

**Val Giddings:** Agreement among beekeepers and scientists is very wide that the major threats are Varroa destructor, followed a number of viral, bacterial and fungal diseases. Some data suggest pesticide exposure can reduce honeybees immune competence, but there is wide agreement that if this is a plausible mechanism it pales into insignificance compared to the other listed threats. See <https://www.usda.gov/sites/default/files/documents/ReportHoneyBeeHealth.pdf>

**Maj Rundlof:** The current threats to pollinators are habitat destruction, land use change, land management intensity, pesticide use, pollinator management, pathogens, invasive alien species and climate change (as identified in the pollinator and pollination assessment by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services). It is hard to name only one or the worst threat, since they often work together to threaten pollinators.

### 3. What can be done to improve pollinator health?

**Kelsey Graham:** Again, pollinator plantings can make a huge difference. Non-profits such as the Xerces Society and Pollinator Partnership have some wonderful programs working with utilities and department of transportation to plant wildflowers in utility rights-of-way and along roadsides. Xerces and the USDA-NRCS are also working with farmers and land owners to create high quality pollinator habitat. This can be particularly beneficial for farmers who depend on pollination services for their crops.

**Rachael E. Bonoan:** To improve pollinator health, the general public can plant more native, pollinator-friendly flowers, cut their lawn less often (weedy dandelions and clovers are pollinator food), and be aware of the chemicals they are using to treat their gardens/lawns. The general public can also help pollinators by supporting their local farmers!

**Dalton Ludwick:** If an individual is interested in improving pollinator health, then they could plant a variety of flowers that bloom throughout the year, diversify their property, and plant more native plants. Also, when possible, don't spray pesticides unless necessary (i.e. immediate danger to health, economic loss, etc.).

**Jerry Hayes:** Reduced pests, parasite and disease pressure safely and sanely for managed honey bees. For 'others' how does one mitigate climate change and habitat....I don't know.

**Rea Manderino:** Being rid of the great American lawn is one way, especially in the more rural areas. Allowing lawns to return to woodlots and pastures would go a long way to helping provide needed habitat, and that is for all pollinators. Flies, moths, and other non-bee Hymenoptera are major pollinators, and native trees, bushes, and forbs are major habitat/host plants for these insects in their larval stages. Pollinators are often (probably exclusively, but I dare not say so; entomology is rife with exceptions to every rule) only actively pollinating in their adult stages; it is easy to forget that their caterpillar and maggot stages also require food! Even

growing gardens, native or non-native, are better than lawns, as the native plants would provide better host plants for native insects and more familiar nectar sources for adult pollinators.

**Manu Saunders:** There are three simple ways we can help all pollinators:

- reduce vegetation clearing: areas of unmanaged vegetation are important habitat for pollinators and other beneficial insect species. In particular, things like dead wood, leaf litter and unmown lawns, which we consider unsightly, are essential for some pollinator species to survive.
- reduce chemical use: pesticides can kill or affect the health of good insects, not just pests, and herbicides can reduce the availability of important ground-level floral resources for pollinators
- promote floral diversity: different flowers provide different types of food & nutrients for pollinators. Most pollinator species have home ranges of a few hundred metres, so if we want them to hang around and breed more generations, we need to provide multiple types of flowers for them to feed on in parks, gardens and on farms.

**Val Giddings:** Plant more high nectar flowering plants with variable bloom times. If some way could be found to reduce the transmission of diseases and parasites among colonies trucked to CA to provide almond pollination that would be perhaps the biggest single bit of help. Also, breeding improved hygiene bees to combat *Varroa* more effectively.

**Maj Rundlof:** We can work against the current threats, by for example considering pollinator conservation in the management of land. Policymaker can keep pollinators and other biodiversity in mind when making decisions, farmers can allow some flowering weeds on less productive land and garden owners can chose to plant native, pollinator friendly plants that bloom throughout the season and produce flowers with nectar and pollen. An increasing threat is our commercialization and management of pollinators, which bring new challenges in managing pathogens and spread of invasive alien species.

#### 4. Is planting the seeds distributed by cheerios

<http://www.cheerios.com/bringbackthebees>) a good way to contribute to pollinator health? If so, why? If not, what are the potential downsides?

**Kelsey Graham:** This is tricky to answer. Homeowners providing flowers for bees can certainly help the bee communities, particularly in residential and urban landscapes. Backyard beekeeping (with honey bees) is becoming increasingly popular. But we need to provide them with enough floral resources for them to be successful, and not compete with native bees (honey bees are exotic). So, this means planting a lot of flowers, with ranging bloom times so that bees are covered throughout the foraging season (spring through fall). However, providing the RIGHT flowers for your region is also essential. North America has many diverse ecosystems, and many species are unique to regions. Therefore, you must provide flowers native to your local plant community to provide the best resources for your local bees, and to avoid the potentially devastating consequences of introducing exotic invasive plants. I encourage everyone who ordered seeds from Cheerios to check the seed mixture, and compare it to your local plant community. Check the [Lady Bird Johnson Wildflower Center](#), or the [Missouri Botanical Garden Plant Finder](#) to see if the seed is local to your region. If it's not native, and particularly if it's invasive to your region, do not plant it. Native seed mixes can be purchased for relatively low cost, and will be much better for your local community. You can also check out the pollinator plant recommendations for your region available through the [Xerces Society](#).

However, I must also add that General Mills has done a lot for supporting pollinators. They have provided a [multi-million dollar grant](#) to protecting pollinators, and their campaign to spread pollinator protection awareness has been very successful. So, while I caution planting the free seeds provided through their bring back the bees campaign, I think they are generally doing a good job to support pollinator conservation.

**Rachael E. Bonoan:** Planting seeds is a great way to contribute to pollinator health but, planting the seeds distributed by Cheerios is not. To contribute to pollinator health, you should plant seeds

that are native to YOUR area. That is not what Cheerios is doing—they are distributing the same seeds to everyone, no matter their geographic location. To find out which plants are NATIVE to your area AND good for pollinators, you can check out the Pollinator Partnership's app, [BeeSmart](#) or download one of their [free planting guides](#).

**Dalton Ludwick:** The idea behind the initiative is great. However, in practice, planting of non-native plants is not a great way to improve native pollinator health. If Cheerios was to replace the non-native plants with native species, then the effort would be much better. Planting non-native plants could prove fruitless or worse. Non-native plants could displace native plants or may not be pollinated by the native pollinators.

**Jerry Hayes:** Will it help....maybe a little. If you look at Bayer's Feed A Bee and initiatives by Haagen Das and Syngenta and many others over the years the awareness is there and since the key factor is this relationship between flowering entomophilous plants and 'bees' how can a 'finger be put in the dike' is the question.

**Rea Manderino:** Nectar is not in short supply. Trees and crops can provide nectar, in addition to familiar flowers. Promoting pollinator health doesn't necessarily come down to providing more nectar. The Cheerios campaign is a Feel-Good promotion that gives people the chance to feel like they are making a difference, but in reality, may cause further harm. Some of the seeds are native to the United States, but many are the familiar flowers of gardens that are native to Europe. These are popular nectar sources that may be invasive or competitive in certain ecosystems, but not in all. What is particularly troubling about this seed campaign is that it distributes the same mix of seeds across the United States, across vastly different ecosystems! What may be unable to spread in New England may be very aggressive in California. What may be a minimally attractive nectar source in Georgia may be a massive draw in Kansas, leaving native nectar sources unpollinated. Every ecosystem varies in its permeability to different invasions and in what ways those non-natives will integrate into the local ecology. Because so many systems are already dealing with non-native abundance, native forbs are often already in decline and their associated insects with them. Planting non-native seeds doesn't help the situation, but planting natives does. These seed mixes also promote the idea that North America is a homogeneous ecosystem, with certain superior plants that will fit everywhere. Silver bullets don't exist in ecology. There is no universally perfect seed mix, nor would we want one. Pollinator-friendly plants do not look the same everywhere; the meadows of Oregon should look vastly different than the meadows of Virginia because they are very different environments! Diversity is strength in ecology.

**Manu Saunders:** Planting flower seeds can help, but it's not the final answer. Each pollinator species has different life cycles, nest sites and food resources - and there are a few hundred different species in any one local area. So it's important to complement flower plantings with other helpful actions (see answer to Q3).

**Val Giddings:** This is, in principle, a great idea. But only if the seeds distributed are carefully selected, of high desirability to bees, and clean and free of commingling or contamination with noxious weed seeds. Otherwise this could be very unhelpful.

**Maj Rundlof:** Pollinators need nectar and/or pollen to survive, so planting plants that provide this would contribute to more food for pollinators. My recommendation is to plant species that are native to the region, since pollinators in the region would be adapted and used to these plants. I would also suggest to plant species that vary in the shape, color and flowering period, to create resources for a variety of different pollinator species. I'm not very familiar with all the plant species that were used in the Cheerios seed mix, but I know that at least Baby blue eyes and California poppy are used in flower mixes in research projects here at UC Davis to support pollinators.