BUMBLE BEE PARASITES AND CONSERVATION IN THE PACIFIC NORTHWEST

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Bumble Bee Parasites and Conservation in the Pacific Northwest

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Introduction

Bumble bees, or bees in the genus *Bombus*, family Apidae, are charismatic insects known for their large, fuzzy bodies, colorful markings, and strong-yet-erratic flight patterns. Bumble bees provide important pollination services for wild and managed flowering species and, with certain crops, can be more efficient pollinators than honey bees. Bumble bees are used around the world for greenhouse pollination, as they can fly in the reduced UV conditions inside of greenhouses while honey bees struggle to orient themselves (Phillips 2019). The Pacific Northwest (PNW), comprised of Washington, Idaho, and Oregon, is home to almost 30 species of native bumble bee; 49 species exist in the US (Pehling and Glass 2017; PNW Bumble Bee Atlas 2023; Best et al. 2024). Four common species of bumble bee are shown in Figure 1. While some native bumble bee species may be common, bumble bees, like other native bees, are declining due to the combined effects of pesticides, habitat loss, pathogens, and parasites (Goulson et al. 2015).

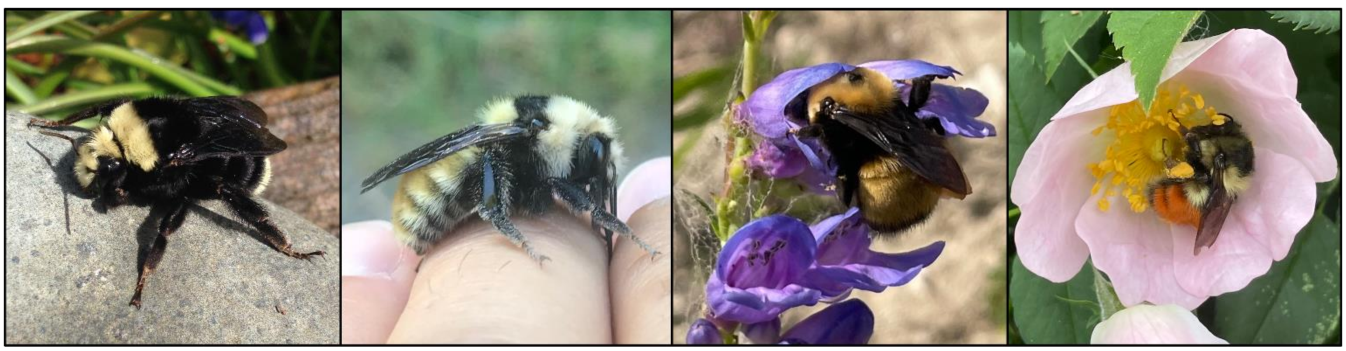

Figure 1. In order from left to right: yellow-faced bumble bee (*Bombus vosnesenskii*) foundress queen, white-shouldered bumble bee (*B. appositus*) worker on researcher's hand, Nevada bumble bee (*B. nevadensis*) worker in Penstemon, *B. huntii* worker on rose. Photos by M. Luppino.

Parasites of bumble bees are diverse. Much research has been done to determine the identities and effects of parasites of honey bees, but there is still mystery surrounding bumble bee parasites. Parasites are organisms that steal resources from their host, at a cost to the host. Some parasites live outside or on their host, as ectoparasites, or inside their host, as endoparasites. The most common bumble bee ectoparasites are mites. Most endoparasites are disease-causing microorganisms called pathogens, which include viruses, fungi, nematodes, and protozoa, though some mites can be endoparasites as well. Not all the animals, fungi, and bacteria living on or in bees are bad for them. Commensal relationships benefit one species but do not harm or benefit the other, while mutualistic relationships benefit both organisms. Some species of mites may engage in commensalism or mutualism by eating harmful fungi or nematodes which would otherwise harm the bumble bees or their food (Schwarz and Huck 1997). Bacteria in the guts of bumble bees help digest food. Some fungi, like yeasts, help break down pollen.

Harmful parasites and other stressors on bee populations can threaten bumble bee populations, but there is still a lot to learn about how these factors interact. Nonetheless, there are some ways to reduce these threats and help conserve the bees. This publication will help readers understand bumble bees, their parasites, and how to use this knowledge to help bumble bees.

Bumble Bee Biology

Bumble Bee Life Cycle

Knowing the bumble bee life cycle is important to understanding where and how parasites fit in. Like butterflies and beetles, bumble bees undergo complete metamorphosis, going through egg, larval, pupal, and adult stages. Similar to honey bees, bumble bees build nests, live communally, and use a caste system consisting of a single queen, dozens of sterile female workers, and a few males, called drones. Bumble bees exist in much smaller colonies than honey bees and produce smaller amounts of honey. While honey bee colonies often have tens of thousands of individuals, bumble bee colonies can range in size from a few dozen to several hundred individuals. A robust colony can be seen in Figure 2. The dark, open cells in this photo are used to store honey and pollen, while the light, closed cells contain developing bumble bee larvae and pupae.

Figure 2. *Bombus* queen (center) and her colony raised in captivity. Photo by E. Evans.

Figure 3 depicts an overview of the life cycle of bumble bees, along with the parasites and pathogens that affect them. Gynes, known as foundress queens or queens that have mated but have not started a colony of their own, overwinter buried slightly belowground or in leaf litter, as shown in Figure 3A. In early spring, the foundress queen gathers nectar and pollen and creates wax cells to lay eggs in (Figures 3B and 3C). A number of species nest underground, typically in old rodent dens, but other species are known to nest aboveground in preexisting cavities (Richards 1978). Once her nest is founded, mites disperse into the nest and begin their own lives (Figure 3C). She cares for her developing young (called brood), warms the nest, and gathers resources until her worker-caste daughters are old enough to take over these tasks, depicted in Figure 3D. All the while, the parasite and pathogen populations also grow and then disperse between nestmates, between different colonies, and between species (Figure 3E).

Once the workforce is of sufficient size, the queen remains inside the nest to lay eggs for the remainder of her life (Figure 3F). Bumble bees can be seen flying around and visiting flowers between early March and early October, depending on species (Koch et al. 2012). The colony reaches its peak size in late summer, with mites and pathogens reaching their maximum number shortly after (Figure 3G). New queens are reared from eggs which receive special care from workers, and drones are reared from unfertilized eggs the queen lays before she dies. The reproductive caste leaves the nest to mate once reaching maturity in early fall (Figure 3H) (Eickwort 1994; Schwarz and Huck 1997). The colony's old queen, the workers, and the drones all die in the fall, and the new foundress queens overwinter individually, along with the mites and infectious microorganisms that are adept at finding them (Figure 3A) (Eickwort 1994; Schwarz and Huck 1997). A more detailed explanation of bumble bee life cycles can be found in Washington Bumble Bees in Home Yards and Gardens (Pehling and Glass 2017) and The Bumble Bee Lifestyle (Cressman et al. 2021).

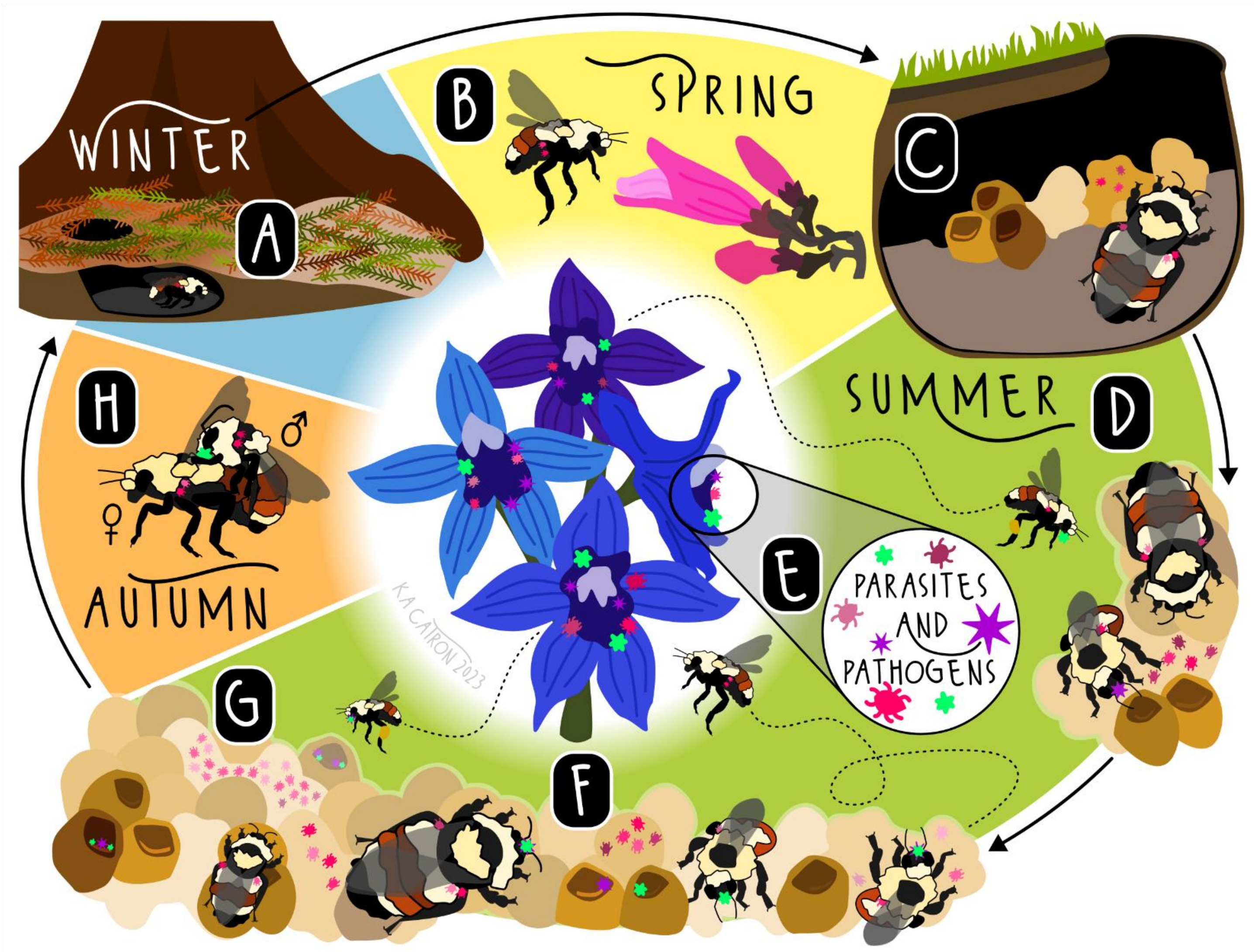

Figure 3. A generalized diagram of bee, mite, and pathogen life cycles. Image by K. Catron.

Flowers: Essential and Dangerous

Bumble bees depend on flowers for carbohydrate-rich nectar and protein-rich pollen. These resources are collected first by queens and then, after nest establishment, by workers throughout the season. Bumble bees' long, tongue-like proboscis is for lapping up nectar, and the corbicula, on their hind legs, are used as pollen baskets (Figure 4). Food is brought back to the hive for the brood. Nectar is used to make honey, which is a stable food that lasts during periods of inclement weather or nectar dearth.

Parasites take advantage of the bees' intimate relationship with flowers to disperse through the environment. A single flower may be visited by numerous bees in a single day. Imagine if humans stuck their faces into the same tray of food at a buffet to get what they needed every day—they might all get sick quickly. A bumble bee may rub its whole body on a flower's stamen, as shown in Figure 5, to collect the pollen that is gathered into its corbicula. Bees inadvertently leave parasites and pathogens on the flower for the next visitor (Schwarz and Huck 1997). Hence, commercial honey bee and bumble bee hives used for pollination in industrial agriculture can be sources of parasites and pathogens for wild bee populations (Singh et al. 2010; Fürst et al. 2014; Colla et al. 2006; Figueroa et al. 2023). Bumble bees can pick up parasites and pathogens from flowers and bring them back to the nest, where transmission rates increase.

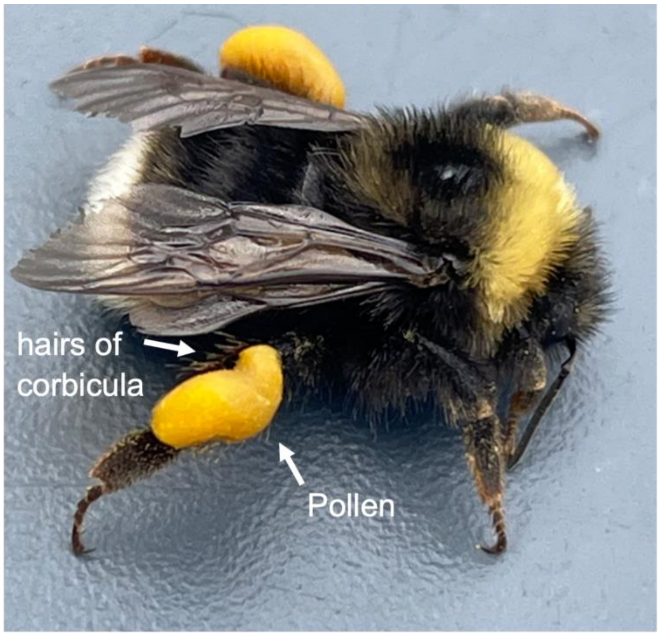

Figure 4. Western bumble bee, *Bombus occidentalis*, with pollen-filled corbicula. Photo by M. Luppino.

Figure 5. Yellow-faced bumble bee, *Bombus vosnesenskii*, in pumpkin blossom. Photo by M. Luppino.

External Parasites (Ectoparasites) of Bumble Bees

Mites

Mites, which resemble small spiders, can be herbivores, predators, decomposers, or parasites. Ectoparasitic mites (Figures 6 and 7) are common and can be seen on bumble bees, as they live outside of their hosts' bodies. Perhaps the most infamous bee mite in the world, varroa mite (*Varroa destructor*), is a parasitic mite that feeds on honey bee larvae and spreads viruses in honey bee colonies. While these mites are not yet known to affect bumble bees in the PNW, they have been seen using bumble bees as a means of dispersal in states like California (Garvey 2016). Including varroa, there are 91 species of mites known to associate with bumble bees globally, and there are probably many more species yet to be identified (Klimov et al. 2017). Currently, there is no known ectoparasite that negatively affects bumble bees to the same level varroa affects honey bees, but mites can be harmful, neutral, or beneficial to their bumble bee hosts, depending on species and circumstances.

Figure 6. Mites on first abdominal segment of bumble bee. Photo by M. Luppino.

Figure 7. *Bombus griseocollis* (brown-belted bumble bee) with close-up of mites between thorax and abdomen. Photo by M. Luppino.

Mite Biology

Ectoparasitic mites can harm bumble bees by feeding on pollen, honey, or the bee itself. However, some mites that live on bumble bees can be harmless or even beneficial (Schwarz and Huck 1997). Some other groups of bees have taken this beneficial relationship to an extreme by evolving specialized structures called acarinaria on their bodies that house mites.

The morphology and life cycles of bumble bee-associated mites are diverse, but there are some generalities. Figure 8 shows a representative image of the many life stages mites possess, though the species depicted is known only to parasitize the eggs of mason bees. Mites commonly have six life stages: egg, larva, protonymph, deutonymph, tritonymph, and adult (Koulianos and Schwarz 1999). Mite larvae have six legs and grow another two when molting into protonymphs, then they maintain eight legs throughout subsequent life stages.

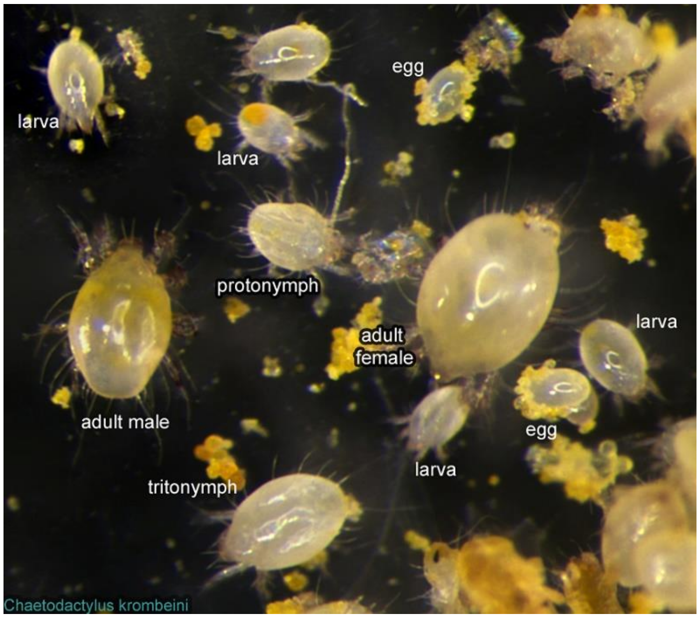

Figure 8. Cultured life stages (feeding stages only) of *Chaetodactylus krombeini* (Astigmata). Pollen grains visible. Photo by P. Klimov.

Mites use flowers to spread between bumble bee colonies or host species. The only time when bumble bee-parasitic mites are found outside the nest is when they are engaging in phoresy—that is, clinging to the bee—to disperse throughout the environment. Mites most commonly engage in phoresy during the deutonymph stage and prefer to latch onto queens or worker bees over males (Huck et al. 1998). Mites cling to a bee while inside the nest and dislodge when the bee visits a flower, then move onto a subsequent bee visitor to that flower (Haas et al. 2019; Schwarz and Huck 1997). In the bumble bee nest, ectoparasitic mites spend most of their lives there eating, defecating, molting (shedding their exoskeletons to grow), and mating.

Mites can have many generations in a single year but must overwinter on foundress queens at the end of the season (Eickwort 1994). After a foundress queen successfully begins her colony in the spring, the mites detach, molt into adults, and begin mating anew (Koulianos and Schwarz 1999).

While little has been done to study mites of bumble bees in the PNW, a few studies have found mites clinging to bumble bees' exoskeletons. The following mites are commonly observed.

Kuzinia

Mites in the genus *Kuzinia* (Figure 9), in the family Acaridae, have been found on many species of bumble bee in Oregon, California, and Illinois (Kissinger et al. 2011). *Kuzinia* mites are kleptoparasites, meaning they steal resources from their host. In a bumble bee colony, *Kuzinia* mites will feed on fungi but also honey and pollen. They often nibble on the cocoons of developing bees, exposing them to fungi and mold (Chmielewski 1971). While they do not directly hurt bees, *Kuzinia* are considered harmful.

The small size of *Kuzinia* may help them stay firmly attached to bees even during high wind or vigorous grooming. Males also have adanal suckers on the underside of the rear end of the main portion of their body to cling to female mites during mating or to bees during flight (Witaliński 1990; Chmielewski 1971). The arrow in Figure 9 shows a dark-colored structure with several light-colored circles; these are the adanal suckers.

Figure 9. *Kuzinia* sp. slide mounted. Photo by N. Olsen.

Pneumolaelaps

Mites in the genus *Pneumolaelaps* (Figure 10), in the family Laelapidae, are fast moving and cling to bees using their extra-long legs. This genus eats soil-dwelling Astigmata mites that feed on fungus in and around nests (Eickwort 1988; Coddington and Colwell 2001). Bumble bees work to suppress fungal growth by adding nectar mixed with bacteria-laced salivary excretions to the already antifungal waxy coating of pollen grains (Royce and Krantz 1989). *Pneumolaelaps* mites are considered harmful to colonies because they feed on honey, and pollen and its protective coatings, increasing fungal growth and leading to further loss of pollen provisions (Eickwort 1994; Royce and Krantz 1989).

Figure 10. *Pneumolaelaps* sp. slide mounted. Photo by N. Olsen.

Parasitellus

Mites in the genus *Parasitellus* (Figure 11), in the family Parasitidae, differ from the previously described groups because it is unclear whether this genus poses a significant threat to bumble bees. Adult females and deutonymphs may harm the colony by feeding on pollen stores, while males and mites during all other life stages remove parasitic microarthropod eggs from the nest by eating them (Richards 1976; Eickwort 1994). *Parasitellus* mites have been found in most bumble bee nests in Canada as well as on almost a third of foundress queens in Denmark (Revainera et al. 2020; Schousboe 1987). These extra-large mites use their increased size and strength, along with crab-like pincers for gripping, to their advantage during phoresy. They can survive on flowers for more than 24 hours while waiting for a new bumble bee host to visit (Schwarz and Huck 1997).

Figure 11. *Parasitellus* sp. slide mounted. Photo by N. Olsen.

Non-mite Kleptoparasites

Some species of bumble bees themselves can be parasites of other bumble bees. Cuckoo bumble bees are so named because a single queen will invade an already established colony of bumble bees and kill the founding queen. Cuckoo bumble bees only produce queens and drones as offspring, given that the workers of the dethroned queen unwittingly raise the brood of this imposter. Cuckoo bumble bees rely on the parasitized colony's workers to collect food for their young and hence they do not have pollen baskets like other bumble bees.

Figure 12 shows the indiscriminate cuckoo bee, which besides being a kleptoparasite, visits flowers and can offer some pollination benefits. Cuckoos have been in decline in recent years as their host's populations are dwindling. Many cuckoos have been recommended as additions to the International Union for Conservation of Nature's Red List of Threatened Species, a watch list for species at risk of going extinct, in 11 European countries (Kosior et al. 2007).

Some beetles and moths are associated with bumble bee nests, where they could be considered kleptoparasites or scavengers, but their occurrence is sporadic and their impact negligible (Evans et al. 2023).

Figure 12. Indiscriminate cuckoo bee, *Bombus insularis*, on dandelion flower. Photo by B.E. Reynolds.

Internal Parasites (Endoparasites) of Bumble Bees

Background

There is limited information on parasites that live inside PNW bumble bees. Much of the endoparasite research comes from studies of bumble bee species which have been mass reared in laboratories for commercial use to pollinate crops, especially in greenhouses. *Bombus terrestris* is commonly used in Europe and is not allowed for importation to North America, but *B. impatiens*, a species native to eastern North America, is commercially available in some parts of the PNW. However, as it is not native, it is highly regulated in the US.

Managed bumble bees are likely more resistant to pathogens than wild bees, as artificial selection for stronger bee populations allows for the buildup of pathogens (Graystock et al. 2016). Wild bees face an increasing risk of pathogen spillover from greenhouse operations, and it is suspected to contribute to the documented decline of wild bumble bees (Otterstatter and Thomson 2008). Managed bumble bee colonies are considered the greatest source of parasites for their wild counterparts (Goulson et al. 2008). Parasitic mites that live inside the tracheae, or breathing tubes, of bumble bees commonly used in greenhouses have been found around the US but not yet in the PNW (Evans et al. 2023). Additional work is needed to determine the threat of such endoparasites in the PNW.

Parasitoids

Parasitoids are insects that completely kill their host in the process of feeding on them. Adult parasitoids land on bees outside the nest and insert eggs into them. Bumble bee parasitoids include flies in the families Phoridae and Conopidae and small wasps in the families Braconidae and Eulophidae (Evans et al. 2023). Conopid flies are especially interesting. After conopid eggs hatch, the larvae modify their host's brain, which permanently alters the bee's behavior. This forces parasitized bees to dig their own graves so the flies can overwinter safely after eating the bees alive from the inside. Figure 13 shows a bumble bee with a Conopid larva inside. The larva chews a hole through the bee's abdomen so its resulting adult form can escape from the host carcass. They have been found to parasitize all bumble bee castes, parasitizing up to 25% of bees, and have been found elsewhere in the US in 13 species also native to the PNW (Malfi and Roulston 2014; Kissinger et al. 2011). In general, the prevalence and effects of bumble bee parasitoids have been sporadically studied, and their impact in the PNW is unknown.

Microorganisms and Viruses

There are more bacteria cells than human cells in the human body (Sender et al. 2016). Humans coexist with numerous microorganisms like bacteria, fungi, and viruses. Some are beneficial and others are harmful. Bumble bees are in the same situation. Like the probiotics in yogurt, a diversity of primarily bacterial gut microbiota obtained from flowers and nestmates aid with digestion, growth, and resistance to pathogens in bumble bees (Engel et al. 2016). However, as in humans, some microscopic organisms may also make bumble bees sick and can spread in numerous ways. One of the ways they may spread is through phoretic mites, which have been found to harbor bumble bee pathogens and may be able to transmit them between hosts (Revainera et al. 2020; Graystock et al. 2015).

Figure 13. Conopid fly larva visible inside deceased bumble bee. Photo by T. Roulston.

Fungi

Many of us think of mushrooms when we hear the word fungus, but fungi can also exist as a single-celled organism, some of which are pathogenic. The most well-known fungal pathogen of bumble bees, *Vairimorpha bombi* (previously named *Nosema bombi*), causes dysentery, or infectious diarrhea, as do *Nosema apis* and *N. ceranae*, the cause of nosema disease in honey bees. It is transmitted via infected feces while visiting flowers or cleaning the nest. The fungus colonizes the cells lining the bee digestive tract and urinary system, multiplying quickly inside the cell until it explodes. Figure 14 shows pictures of the fungi heavily infecting the Malpighian tubules, the functional equivalent of human kidneys.
Figure 14C shows a protozoan, *Apicystis bombi*, infecting the bee at the same time. *Nosema ceranae*, one of the most prevalent pathogens in honey bees,

has been detected in multiple bumble bee species in the Americas, Europe, and Asia (Graystock et al. 2013; Li et al. 2012; Arbulo et al. 2015; Plischuk et al. 2009). Studies have confirmed that bumble bees can genuinely be infected by *N. ceranae*, and not just act as asymptomatic carriers (Graystock et al. 2013; Fürst et al. 2014). Other reports of fungi attacking bumble bees are uncommon, and their prevalence in wild bumble bee populations is unknown (Figueroa et al. 2023).

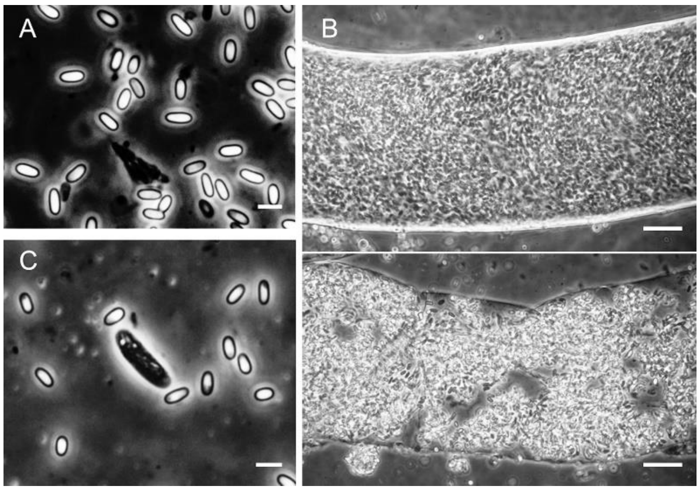

Figure 14. *Vairimorpha bombi* (= *Nosema bombi*) in Malpighian tubules of *Bombus terrestris*. Individual spores shown in A and C, with spores grouped tightly together in B. Photo by S. Plischuk.

Other well-known fungi are beneficial to bumble bees. Yeasts in nectar and the gut help bumble bees digest pollen (Pozo et al. 2020). Beneficial fungi increase bumble bee survival and help reduce the negative effects of fungicides applied to crops (Rutkowski et al. 2022).

Bacteria

In honey bees, foulbrood is caused by bacteria that pass through the digestive system and into the bees' hemolymph (insects equivalent of blood) and causes a full body infection that leads to death of larvae and pupae (Evans and Schwarz 2011). However, there are no known major bacterial diseases in bumble bees. Bacteria in bumble bees are more often thought to be harmless or beneficial.

Protozoa

Protozoa are single-celled organisms more closely related to animals than to bacteria. The species *Crithidia bombi*, shown in Figure 15, is one of the most well-studied bumble bee pathogens, though several other *Crithidia* species also infect bumble bees. In humans, protozoa cause diseases like sleeping sickness, Chagas, and leishmaniasis. In bumble bees, infection with *C. bombi* can impair workers' abilities to forage and survival of overwintering queens. This pathogen attacks bumble bees by anchoring its flagellum (a hair-like arm) to the bee gut. Researchers have found that a chemical in the nectar of heather flowers, callunene, causes *C. bombi* to lose their flagella, reducing their ability to infect their hosts (Koch et al. 2019). Beneficial fungi and bacteria in bumble bees can also increase resistance to *C. bombi* (Mockler et al. 2018; Pozo et al. 2020).

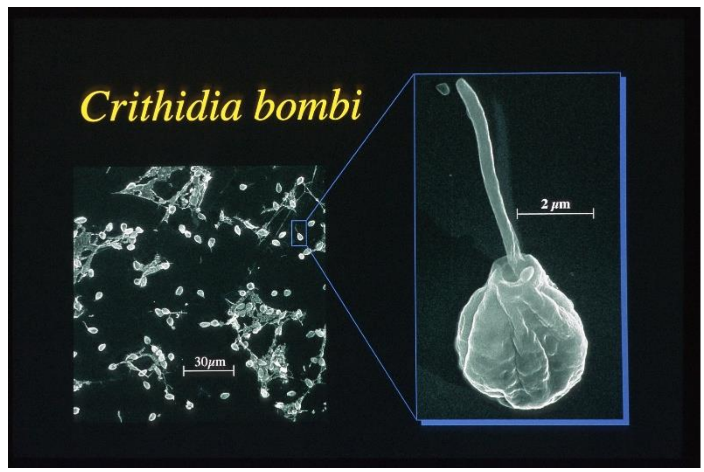

Figure 15. *Crithidia bombi*, with flagella visible. Photo by ETH Zurich, Experimental Ecology lab.

Viruses

All 60 viruses that have ever been detected in bumble bees were first discovered in honey bees (Figueroa et al. 2023). Like in honey bees, many of these viruses may have no apparent ill effects, or the severity of effects might vary, depending on other environmental stressors. Some of the most familiar honey bee viruses that also infect bumble bees include deformed wing virus, the AKI virus complex (acute bee paralysis virus, Kashmir bee virus, and Israeli acute paralysis virus), and sacbrood virus. Studies have shown that deformed wing virus can be transmitted between honey bees to bumble bees via shared floral resources and direct contact. Infected bumble bees exhibit reduced foraging efficiency, impaired wing development, and shorter lifespans (Fürst et al. 2014; Genersch et al. 2006). Bumble bees infected with viruses of the AKI complex exhibited the same symptoms as infected honey bees, including trembling, loss of motor control, and eventual death (Figueroa et al. 2023). The effect of sacbrood virus on bumble bees is unknown, though its prevalence in populations can be quite high (Dolezal et al. 2016).

How to Help Bumble Bees

Understanding Bumble Bee Stress

Parasites and pathogens combined with other stressors like pesticides, other toxicants, and poor diet, can have cumulative detrimental effects on bumble bees. Some evidence indicates that these factors can interact to worsen the survival and health of bees (Tosi et al. 2017). When bees are compromised by pathogens, parasites, or toxins, they have a harder time learning and surviving. Bees that do not have a robust diet are more likely to have parasites (Watkins de Jong et al. 2019). Insect populations are declining, and bumble bees, like other insects, are facing “death by a thousand cuts” from a combination of many factors (Wagner et al. 2021). Understanding these factors individually, and how they interact, could help lead to developing strategies to mitigate the problem.

Bumble bees do best in diverse ecosystems and have distinct habitat requirements: a place to rear young, a place to secure food, and a place to overwinter. These three habitat requirements may not exist in immediately adjacent spaces, but bumble bees can forage up to one mile in search of food (Osborne et al. 2008). In the context of an urban environment, a particular garden in a neighborhood can provide bumble bees with a reliable source of food, a yard a block away might have suitable habitat for rearing young, while a park a few blocks away might provide a safe overwintering site. A neighborhood can be a mosaic of opportunities for bumble bees, provided they are not overly exposed to pesticides or pollution.

A Place to Rear Young

While popular and important, bee hotels used to attract mason and leafcutter bees are not useful to bumble bees. Bumble bees are mostly cavity nesters and like living in the enclosed spaces of abandoned rodent dens, or even in large tufts of grass, depending on species. One study found that ground nesting species did best when vole dens were plentiful, with dens located about four inches underground (Rao and Skyrm 2013). Bumble bees are choosy about where they nest, and studies across the forests of Canada found that less than 15% of houses are used aboveground, with less than 5% of houses occupied belowground (Herndon 2020; Johnson et al. 2019). If a particular environment has scarce opportunities for nesting sites, bumble bee houses (Figure 16) or birdhouses (Figure 17) can be used to attract them, but they will require annual cleaning to prevent the buildup of pathogens and parasites, just like mason bee houses (Pehling and Glass 2017). For those curious, mason bee care information is available in Additional Resources.

Figure 16. Bumble bee houses mounted on stakes. Photo by M. Luppino.

Figure 17. Bumble bees fanning the entrance of their nest in a used birdhouse to cool it. Photo by M. Luppino.

It may take a few years before bumble bee nesting boxes are used, but you can still encourage bees to give them a try. Bumble bees can warm themselves, but they prefer well-insulated spaces to control the temperature of their young. Therefore, filling boxes with fluff, or allowing birds to nest in them, will inspire bumble bee usage. Burying bumble bee houses underground may encourage bees but burying them may also attract mice competitors. Understanding of bumble bee nesting preferences is still limited, especially in urban environments, but the Additional Resources section has more information about sizing, placement, and maintenance of bumble bee houses.

A Place to Secure Food

Perhaps the best thing anyone can do to help bumble bees is to plant flowers as a food source. Consult with your local university Extension office for a list of good flower species. Planting a greater diversity of flowers and ensuring flowers are available throughout the growing season will provide bees with food during their life cycles (Scheper et al. 2014; Goulson 2008). A greater availability of flowers may reduce mite and virus transmission by preventing bees from all visiting the same few flowers. Well-fed bumble bees have also been found to be less susceptible to mortality from *C. bombi* (Brown et al. 2000). Increased floral diversity and abundance not only helps bumble bees but also the more than 600 species of native bee in Washington State (WSDA 2023). Flowers can also help attract other native pollinators like beetles, flies, butterflies, wasps (see Figure 18), and even beneficial insects that will help control pests (James 2014).

While bumble bees are generalists and feed on a variety of flowers, their digestive systems have a harder time with foods that are not familiar (Scheper et al. 2014). Additionally, the shape of some non-native flowers makes accessing nectar or pollen difficult for native bumble bees. Suggestions for wildflower planting guides can be found in the Additional Resources section.

A Place to Overwinter

Little is known about overwintering preferences, as many species nest underground, but some species prefer burrowing almost two inches under fallen cypress tree needles for their overwintering sites (Williams et al. 2019). Leave a garden filled with plenty of twigs, hollow stems, leaves, and other organic debris at the end of the year that bumble bees may use as habitat.

Figure 18. Bumble bee and skipper butterfly on common teasel. Photo by M. Luppino.

Pesticides

Do not apply pesticides to bee-attractive plants while they are in flower. The United States Environmental Protection Agency (EPA) has previously required a “bee hazard” graphic to be displayed on pesticide labels for those moderately or highly toxic to bees (Durant et al. 2021; Code et al. 2016; O’Neal et al. 2018). However, warning information based on the EPA’s Pollinator Risk Assessment Guidance is now listed under the Environmental Hazards section of the pesticide label. This indicates persistence of residues on plants, effects from short- and long-term exposure, as well as lethal and sublethal effects. However, testing is often only required on honey bees as a surrogate for all bees, so actual susceptibility to pesticides may differ. To play it safe, the Xerces Society for Invertebrate Conservation suggests keeping bee-attractive flowers 40 feet away from most ground-based pesticide applications and 125 feet from crops treated with neonicotinoid pesticides. It is very difficult to study the effects on the larger population in the field, but laboratory studies have shown that pesticide exposure can increase the effects of parasites on bees (O'Neal et al. 2018). To learn more about keeping bees safe from pesticides, see the Additional Resources section.

How to Identify Parasites

If you have found a bee that seems to have mites, the Bee Mite ID website is an excellent resource for identifying harmful versus harmless mites on bees. You can also post a photo on iNaturalist.org or contact a university entomologist. Scientists are still learning about the parasites of bumble bees, and very few people have actively looked for bee parasites in the Pacific Northwest, so observations from the community can help.

Conclusion

Many groups of organisms are associated with bumble bees. Not all are harmful, but parasites of bumble bees can threaten their health. Although parasitism of bumble bees is understudied, recent studies have shown that bees are resilient, intelligent organisms capable of surviving in various environments. Bumble bees depend on diverse ecosystems to nest, eat, and survive the winter, as shown in Figure 19. Parasites are also an important part of maintaining biodiversity. A cuckoo bee may take advantage of other species, but they are bumble bees too, and their presence might indicate that a strong bumble bee population exists to support them. You can help protect bumble bees by providing safe nesting and overwintering sites and an abundance of flowers to reduce risk of parasite transmission.

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Figure 19. Ecosystem containing diverse wildflowers in bloom, and space to nest and overwinter, in Turnbull National Wildlife Refuge. Photo by M. Luppino.

Additional Resources

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