Conservation Biology

Diversity

Questioning public perception, conservation policy, and recovery actions for honeybees in North America

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Pollinator declines have resulted in an increasing number of policies and actions to conserve bee populations in many parts of the world. In North America, there is strong public engagement but also growing controversies over how to address declines. The controversies are fueled by the complexity of scientific information on species, habitat types, and countries and by intense lobbying by nongovernmental organizations and the beekeeping, agrochemical, and farming industries. Policy and conservation initiatives often focus on the western honeybee (*Apis mellifera*), a domesticated species not native to North America. Although losses of managed honeybee colonies are recorded annually, we argue that North American honeybee losses are not a conservation problem; rather, they are a domesticated-animal-management problem. By focusing attention on honeybees, policies and funding priorities may undermine native bee conservation and have negative impacts ecologically and socially.

In North America, there are approximately 4000 native bee species (Michener 2007). A small portion of these (primarily bumblebees) are classified as at risk of extinction (e.g., IUCN 2016), but data that can be used to determine the status of the vast majority of species are lacking. In recent years, numerous pollinator conservation polices at federal (e.g., Bee Health Roundtable 2014), provincial (e.g., Ontario Ministry of Agriculture, Food and Rural Affairs 2016), state, and municipal levels have been created that focus primarily on honeybees. For example, honeybees, monarchs, and pollinator habitat are the 3 priorities of the U.S. Pollinator Partnership Action Plan (Pollinator Health Task Force 2016). Although the honeybee industry is subject to various stressors, including parasite outbreaks, exposure to insecticides, and declining nutrition (Ratnieks & Carreck 2010), honeybees are not at risk of extinction based on globally accepted International Union for Conservation of Nature Red List criteria and continue to be imported into North America in large numbers (e.g., Pernal (e.g., Pernal 2014). Honeybees are important pollinators in agricultural systems, where large areas planted in monoculture depend on an industrialized pollination system (Aizen & Harder 2009). However, growing evidence indicates wild bee communities can provide more effective pollination services in certain contexts (e.g., Spira 2001; Garibaldi et al. 2013), particularly under climate change (e.g., Rader et al. 2013).

The popularity of hobby and commercial beekeeping outside of intensive agricultural systems has increased dramatically (Moore & Kosut 2013). Of concern is that beekeepers are increasingly given access to natural areas (e.g., PPAP 2016), often without prior environmental impact assessments or ongoing monitoring of native bee communities. These initiatives are often portrayed as conservation initiatives aimed at saving bees, increasing wildflower pollination, and connecting people with nature. From a beekeeper's perspective, bringing hives into natural or urban areas can decrease exposure to agrochemicals and increase the diversity of nectar sources for honey production and nutrition (Lorenz & Stark 2015). However, these areas often have high native-bee diversity (e.g., Hendrix et al. 2010; Bates et al. 2011; Tonietto et al. 2011; Murray et al. 2012; Fortel et al. 2014) and do not have a dearth of pollinators (Wagenius & Lyon 2010; Williams & Winfree 2013).

Although honeybees have received significant positive press and public support, there are important yet often ignored reasons why increasing their numbers outside intensive agricultural systems should be avoided. Honeybees have large colonies and have become invasive

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in all regions outside of their Old World origin (Cane 2003; Moritz et al. 2005). Honeybees are prone to a number of diseases, which vary in prevalence. For example, Youngsteadt et al. (2015) found worker survival decreases significantly as urbanization and management increase, which suggests that strict regulation and training of beekeepers are needed. Laboratory studies show honeybee diseases can transfer to other species (Hoffmann et al. 2008; Graystock et al. 2016). Although there are many knowledge gaps surrounding the impacts of disease transfer on wild populations, increasing the number of hives in cities or natural areas could lead to spread of diseases into surrounding areas. Honeybees compete with wild bees for pollen and nectar (Kato et al. 1999; Dupont et al. 2003, Paini 2005; Watts et al. 2012; Hudewenz & Klein 2013). A typical apiary of 40 hives removes the equivalent of the larval mass pollen provisions of 4,000,000 solitary bees (Cane & Tepedino 2017). Honeybees can forage over large fragmented areas (2–3 km) and visit thousands of flowers (Beekman & Ratnieks 2000). Once a good food source is found, they recruit nestmates to maximize pollen and nectar foraging (Seeley et al. 1991). This has negative impacts on native bees. For example, Thomson (2004, 2006) documented declines in foraging activity of native bees with proximity to honeybee colonies, especially among species active at the end of the summer.

Honeybees may also have large impacts on native plant communities and natural ecosystems. For example, honeybees can help non-native plants outcompete native plants by enhancing seed set through pollination (Barthell et al. 2001). Spread of invasive plants can distract native bees from their native plant mutualisms, which can lead to further negative effects on biodiversity (Traveset & Richardson 2006). Honeybees can also damage flowers and steal nectar and pollen from flowers without pollinating them, which can affect native plant persistence over time (Rust 1979; Carmo et al. 2004; Hargreaves et al. 2009).

Cities have begun to set policies that regulate urban beekeeping (e.g., Edmonton, New York, San Francisco, Toronto) as a perceived responsible action to help pollinators. However, increasing honeybees in cities may have numerous social impacts in addition to the above-mentioned ecological impacts. In areas where human density is high, sting risk and anaphylactic reactions may increase. More nuanced is that encouraging urban beekeeping may further people's misunderstanding of the importance of native biodiversity and ecosystem integrity. The act of beekeeping under the auspice that one is saving the bees is akin to domesticating nature, whereby natural processes are lost in exchange for a human benefit (Kareiva et al. 2007). Redirecting public attention and policy away from domesticated honeybee management to evidence-based conservation of wild pollinators is critical for native plant communities and will increase the resilience of agricultural and natural ecosystems.

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