Native Pollinator Section for the NC Pollinator Protection Plan

Introduction to Native Pollinators

North Carolina depends on and provides a home to a huge diversity of native pollinators, including bees, flies, wasps, butterflies, beetles, moths, and hummingbirds. Native bees are especially important crop pollinators since their only food is pollen and nectar (other native pollinators eat insects or other parts of plants at some life stage) and they are "central place foragers" traveling as short a distance from their nest as possible to forage. Native pollinators, especially native bees, are vital for successful production of blueberry, apple, strawberry, blackberry, raspberry, squash, cucumber, cantaloupe, melon, persimmon, muscadine grape, and tomato, along with many other plants (Cane 1996; McGregor 1978;).

Like the European honey bee, native pollinators (such as bumble bees, mining bees, monarch butterflies, or ruby-throated hummingbirds) depend on flowering plants for nectar and/or pollen to survive. Unlike European honey bees, most native bees and other pollinators cannot be moved to better forage sites or given supplemental food if floral resources are scarce. Nor can they be moved to avoid pesticides or other disturbance. A few species are managed, such as the common eastern bumble bee (*Bombus impatiens*) and the blue orchard bee (*Osmia lignaria*), but their "management" involves rearing and releasing, or providing supplemental nesting materials, not colony management or relocation as for honey bees. One pollinator we can provide supplemental food for is the hummingbird, but hummingbirds need huge numbers of tiny insects to feed their young, which we can only provide through habitat stewardship. *Supporting our native pollinators entails protecting and enhancing food supplies and nesting habitat, which also benefits European honey bees.*

Pollinator Diversity in North Carolina

There are about 500 species of bees, 175 species of butterflies, and an unknown number of other insect pollinators in North Carolina, plus one bird, the ruby-throated hummingbird (Asher and Pickering 2014; Discoverlife.org). Of the bees, mostly native, about 17 are bumble bees (*Bombus* spp.), nearly 100 are mining bees (*Andrena* spp.), and 21 are mason (aka orchard) bees (*Osmia* spp.), groups tremendously important for spring flowering fruit crops such as apple and blueberry. Among mason bees, there is one managed native species, the blue orchard bee, *Osmia lignaria*, and two naturalized species, *Osmia cornifrons* and *Osmia taurus*, that were introduced to the US from Japan in 1977 by the USDA Agricultural Resource Service (Batra 1978). Also vital for North Carolina crops are some pollen specialist bees, the southeastern blueberry bee, *Habropoda laboriosa*, and three squash bees (cucurbit specialists), *Peponapis pruinosa, Xenoglossa strenua,* and *Xenoglossa kansensis* that are especially important for squash, cucumber, and pumpkin production. Another specialist, the hibiscus, rose mallow, or okra bee, *Ptilothrix bombiformis*, may be very important for okra and possibly cotton. Some leafcutter bees, *Megachile* spp., are specialists on wild peas and may also be effective in cultivated peas. In NC, there are about 37 *Megachil*e species. Many other native bee species are very important for crops, but only a few studies have specifically examined the importance of native bees in North Carolina crops or ecosystems. One NC study in blueberry found wild bee richness was as important as honey bee abundance in predicting blueberry pollination (Shelley et al 2014). An ecosystem study examined the effects of prescribed fire on floral visiting insects of the NC mountains (Campbell et al 2007). Based on crop research in Virginia and other Atlantic coast states, native bees likely provide the majority of pollination service for many specialty crops, especially where crop fields are relatively small (average farm in Virginia and North Carolina is about 170 acres, so field sizes are generally smaller than that) (Adamson et al 2011; Sampson and Cane 2000; Sarver 2007; Winfree et al 2008).

Though we know less about fly, beetle, wasp, ant, and other insect pollinators, some may be especially important for native plant pollination that helps sustain North Carolina's tourism industry—particularly spring ephemeral wildflowers and unusual carnivorous plant communities. Syrphid flies (aka flower or hover flies) are active in cooler wetter conditions than many bees. In Europe, syrphid flies are regularly included in crop pollination research. In the US, syrphid flies and a number of other predatory and parasitoid insects are generally monitored more for their roles reducing crop pest populations (conservation biological control). In North Carolina, where tourism benefits greatly from our tremendous spring wildflower display, some flies and beetles are important unsung heroes of pollination. *Like us, all pollinators need food, shelter, and protection from toxins. Understanding the diversity of pollinators in our natural landscapes will give land owners and land managers the opportunity to better support managed and unmanaged species.*

Rare, Threatened, and Endangered Pollinators
Pollinators with conservation priority in the NC Wildlife Action Plan include 7 bumble bees and 18 butterflies or moths (www.ncwildlife.org/plan). These bumble bees were very common and may have declined due to impacts of managed *Bombus impatiens* carrying diseases picked up in European rearing facilities (Cameron et al 2011). Factors associated with decline among these species parallel potential threats for other species: habitat fragmentation, pesticide use, pests and diseases, and genetic diversity.

Special Protection Considerations for Native Pollinators
This section highlights conservation needs with a focus on our most agriculturally important pollinators, native bees. Efforts to support bees usually benefit other insects, other wildlife, and watershed health and are vital to our well-being. Native pollinator decline is linked to habitat loss, degradation and fragmentation; diseases and parasites, including those introduced from managed pollinators; and pesticide exposure (Natural Research Council 2007).

Because native bees do not live in constructed hives and cannot be easily moved, understanding their nesting and foraging habits, and how their lifecycles differ from managed honey bees can help land managers avoid unnecessary negative impacts and improve agricultural production (Gill et al 2016).

Nest sites
Most native bees (about 70%) nest in the ground, about 30% nest in cavities, and nearly all are solitary (not colonial like honey bees). Those nesting in the ground may nest within crop fields, such as squash bees, some long-horned bees, and some sweat bees. Others nest where native soils are the right combination to ensure good drainage and structure—sandy enough so nests are not inundated during rains and clayey enough to prevent collapse. Bees nesting in cavities may utilize snags or brush piles, stems of pithy plants, or cavities we provide such as cut bamboo or drilled wood. Since a large chunk of the annual cycle of a bee's life may be growing, pupating, or waiting to emerge from individual nest cells, these nest sites need to be protected. This protection is balanced with methods to maintain floral diversity, including periodic site disturbance such as fire, clearing, or mowing, important for long term maintenance of the floral diversity that best supports insect diversity. Aim to never disturb more than one third of habitat areas at any given time to ensure undisturbed refuge from which pollinators may emerge to recolonize treated areas.

Bumble bees live in annual colonies, with mated queens overwintering individually underground or in cavities protected from wind, rain, and predators. When the queens emerge in spring, they make nests under lodged grasses, in brush piles, or any location that is protected from disturbance by predators and sheltered from rain. They often use abandoned mouse burrows that already include soft, dry nesting

materials and space for the annual colony to grow to as many as 400 bees, though more commonly between 50 and 200 bees.

Butterflies and other insects also nest in or on live or dead plants, in the ground, below leafy debris, or in brush piles or snags. Hummingbirds generally nest on the outer branches of trees where even snakes rarely tread due to the small size of those outer branches.

Best Management Practices to Support Native Bee Populations
Support bee health. All of these practices benefit wild and managed pollinators (Goulson et al 2015).

- Protect and enhance floral resources; maintain for diversity
- Reduce risks of spreading disease
- Reduce negative impacts of pesticides

Protect and Enhance Floral Resources
Enhancing floral diversity benefits all bees, but planting native species is especially important for native bee populations and the host of other beneficial insects (natural enemies of pests) that have co-evolved within native ecosystems. Many native bees are pollen specialists, including squash bees that are vital for cucurbits, hibiscus bees of unknown importance in cotton and okra, several blueberry specialists including the southeastern blueberry bee, and a host of sunflower specialists. Other eastern native plants with pollen specialist bees include various genera of asters, native thistles (*Cirsium*), goldenasters (*Chrysopsis*), wild potato vines (*Ipomoea*), primroses (*Oenothera*), ground cherries (*Physalis*), silkgrasses (*Pityopsis*), willows (*Salix*), fuzzy beans (*Strophostyles*), ironweeds (*Vernonia*), and violets (*Viola*).

Many butterfly caterpillars are host specific, dependent on particular host plants in order to thrive and reproduce. While not directly important for pollination of crops, they provide food for the diversity of wildlife that supports North Carolina's tremendous wildlife commerce with birders, hunters, naturalists, and other tourists who simply enjoy the natural diversity of the state.

Many Farm Bill Conservation Programs support enhancing wildlife habitat to support pollinators. In North Carolina, farm land and forest conservation practices that benefit pollinators include enhancing floral diversity in natural areas around farms and in adjacent forest land by reducing mowing in riparian corridors or around agricultural fields, or using thinning and prescribed fire to open forest canopies. In cultivated areas, farmers can enhance floral natural diversity with perennial wildflowers, shrubs, and trees planted in field borders, hedgerows, or as conservation cover. They can also enhance crop diversity or cover crop flowering to support pollinators and other beneficial insects. To learn more about opportunities to support pollinators with Farm Bill programs in North Carolina, visit www.nc.nrcs.usda.gov, http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=38006.wba, or http://plants.usda.gov/pollinators/nrcsdocuments.html. To learn more about plants for pollinators, visit https://growingsmallfarms.ces.ncsu.edu/growingsmallfarms-pollinatorconservation/.

Leaving areas unmown, brush piles, snags (dead trees or fallen logs) is also important for native bees. Unmown native bunch grasses are especially important for bumble bees. The grasses lodge over and create protection from predators and rain. Any areas that seem perfect for field mice are generally good for bumble bees, who seek out abandoned rodent burrows that have the added bonus of soft, warm fur. Reducing mowing around riparian areas can enhance summer forage for native and managed bees, while also protecting water resources. Though it is not as easy to create sites for ground-nesting bees,

farmers can scout for open areas where vegetation is thin, leave cliffs or soil banks unvegetated, and protect sites where they observe native solitary bees nesting from pesticides or other disturbance. In croplands, avoiding deep tillage can greatly reduce damage to nests, and no-till practices, particularly in combination with flowering cover crops, benefits ground-nesting species. Planting or preserving plants with pithy stems such as blackberry, black raspberry, sumac, and elderberry supports cavity-nesting bees. Cavities made by wood boring beetles and other insects in snags provide homes for some cavity-nesting bees. As these dead trees decay, they create homes for beneficial beetles (predators of crop pests). Adding clear mowed edges, fencing, or signage about pollinator habitat lets people know "messy" areas are intentional and this greatly enhances acceptance and appreciation (Forsyth 2005; Sauer 1998). Signs have the added benefit of creating awareness about bees and their habitat needs *and* creating opportunity for discussion. Signs can be especially engaging when children are the designers (see for example the North Carolina Zoo's poster competition http://www.nczoo.org/IMAGES/Education/Families,%20Scouts,%20Small%20Groups,%20Camps/Poster2015.jpg) .

Reduce Risks of Spreading Disease

In line with current regulation of honey bee movement across state lines and efforts to reduce spread of disease by promoting local honey bee queen and nuke production and sales, we need similar regulation and management of other managed bee species. This is vital not only to reduce the spread of diseases among managed species, but also to reduce the spread of disease to wild populations. Declines in bumble bee populations are linked to diseases from both managed bumble bees and honey bees (Sachman-Ruiz et al). Currently solitary species such as *Osmia lignaria* and *Megachile rotundata* (an introduced species from Eurasia*)* and colonies of bumble bees (*Bombus impatiens*) imported to North Carolina are not monitored or regulated, and these bees may also spread diseases to wild bees and managed honey bees (McMahon 2015). Although *Osmia lignaria* is native to North Carolina, a western species of *Osmia lignaria* is commonly reared and likely the more common import. Direct inquiries to the companies selling these bees produces no information about species origins or nativity. Many well-meaning citizens buy these bees without understanding that they are unregulated, may not be native, and could be carrying diseases that can spread and harm existing bee populations. While such commerce may not harm home owners, farmers may inadvertently harm the bee populations that support their crop production.

Pesticide Specific Concerns for Native Bees

While native bees face many of the same risks as managed honey bees, understanding how their biology and behavior differ from honey bees can help land managers protect these vitally important wild bee populations, as well.

The Pollinator Research Action Plan produced by the Pollinator Health Task Force and published by the White House in May 2015 calls for new research to measure impacts of pesticides on solitary species, recognizing important differences between honey bee colonies and solitary species (Pollinator Health 2015). Unlike honey bee colonies with thousands of workers, solitary bees do not have a buffer to protect the egg-laying female from risks. Nor are there separate females foraging and feeding larvae. If a female solitary bee dies, that ends reproduction—no sisters take over her work.

There is no buffer between pesticide residues and a solitary bee. With 70% of bee species nesting in the ground (solitary species and bumble bee colonies), some within agricultural fields, they are at greater risk from soil drenches, chemigation, or seed coatings (Rundlof 2015). Solitary bee brood cells are constructed from mud and plant materials, which, if carrying pesticide residues, may greatly reduce survival of developing larvae. Solitary bee larvae are also at higher risk from pesticide exposure than

honey bee larvae because they are typically fed directly on raw pollen and/or undiluted nectar (Michener 2007). Honey bee larvae are primarily fed a brood food secreted by adult workers, a glandular secretion that includes honey, and are only fed small amounts of pollen directly once they are four or five days old (Winston 1987).

Land managers can reduce negative impacts to native bees by using integrated pest management, reducing pesticide use, choosing the least toxic pesticides, and choosing application methods with the least impact on bees. For additional information on reducing potential negative impacts of pesticides on bees, see:

- How to Reduce Bee Poisoning from Pesticides (Reidl et al 2006)
- Agronomy Technical Note No. 9: Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators Using Integrated Pest Management and Other Conservation Practices (Vaughan et al 2014)

How Beekeepers Can Help Native Bees

The presence of honey bee colonies helps remind farmers to be cautious in their pesticide use. However, managed bees can be safeguarded on site or moved, while most native bees cannot. Honey bees can also be provided supplemental food, as needed. A honey bee queen killed or sterilized by pesticide exposure can be replaced, while solitary bees cannot. Beekeepers can help farmers understand how native bees benefit crop production and share precautions to protect bee health. Many farmers notice other bees, but do not know anything about native bee life cycles. Knowing that native bees are always present in farm landscapes may help farmers be more cautious, and therefore more protective of honey bees even when apiaries are not apparent. Raising awareness of native bee life cycles and habitat needs can greatly benefit honey bees if farmers reduce mowing, include more flowering plants in field borders, hedgerows, or cover crops, are more cautious in pesticide use, and avoid importing bees from outside the state.

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