Managing Forests for Pollinators

Deserae Emmett, M.S. Graduate Research Assistant, Department of Agronomy, Horticulture and Plant Science, South Dakota State University
John Ball, Professor, SDSU Extension Forestry Specialist and South Dakota Department of Agriculture and Natural Resources Forest Health Specialist
Amanda Bachmann, SDSU Extension Urban Entomology Field Specialist

July 2025

Pollinators are insects and animals that transfer pollen from one flower to another. While bats and birds are pollinators for some plants, more than 98 percent of pollinators are insects. The pollination service provided by insects is essential for the development of seeds and fruit in our flowering plants (Figure 1).

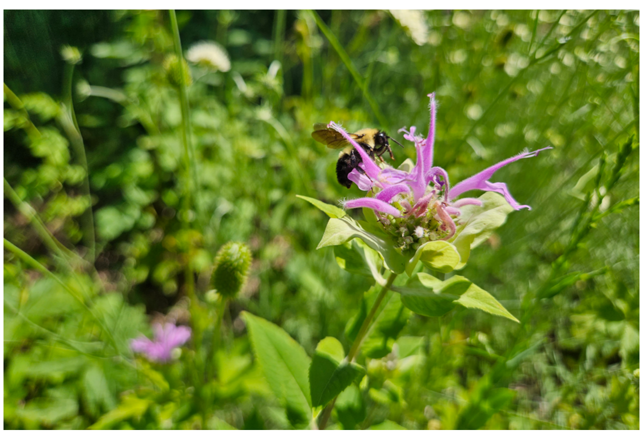

Figure 1. Flowers such as Bergamot *(Monarda)* provide pollen and nectar for many pollinators.

There is a national concern about declining pollinator populations. While much of the focus is on a managed species, the European honeybee, there is growing awareness that our native insect pollinators are declining due to habitat loss and other causes. These native insects provide an important pollination service in agricultural and urban ecosystems. Many of these pollinators reside in forests adjacent to agricultural, natural, and urban areas.

The Black Hills encompass more than a million acres of ponderosa pine forests. These forests provide clean water for drinking and irrigation, recreation opportunities, habitat for fish and wildlife, and forest products, among others. One forest product often forgotten is pollination service.

Insect pollinators residing in forests are essential for the reproduction of many of our forbs and flowering shrubs that live on the forest floor. These insects can also migrate from nearby forests to pollinate plants in gardens, orchards, and fields (Figure 2).

Figure 2. Woody flowering shrubs such as snowberry *(Symphoricarpos)* also are important food sources for pollinators.

Pollinators also provide other benefits to forest ecosystems beyond pollination services. Some ichneumon wasps are parasitoids, living on or in an insect host, killing it as the wasp larvae develop. But the adult ichneumon wasp feed on flower pollen and nectar. Many insect pollinators are also an important food source for birds, amphibians, and other wildlife.

Changes in forest canopy from logging or wildfire may correlate with native pollinator populations. Recent research conducted in the southeastern United States concluded that denser forests have contributed to the decline in pollinator populations. As the canopy cover increases, less sunlight penetrates through the tree foliage to the ground. This more shaded environment results in a decline in the density and composition of grasses, forbs and shrubs that inhabit the ground beneath the trees. This reduces pollen sources which in turn results in a decline in the number and species of pollinators.

Our survey looked at insect pollinators in the ponderosa pine forests of the Black Hills. The survey investigated the number of insect families residing in the ponderosa pine forest that serve as pollinators. The survey also looked at the difference in pollinator populations among managed and unmanaged mature ponderosa pine stands. Managed pine stands were classified as either low-density stocking or high-density stocking.

Stocking is determined in part by basal area. Basal area is the cross-sectional area of a tree trunk at 4.5 feet above the ground. This is measured on an acre basis as basal area per acre (BA/A). Mature pine forests in the Black Hills may range from stands with a low-density stocking of 40 to 50 BA/A to dense stands of more than 160 BA/A.

Managed pine stands in the Black Hills usually range from low density (40 to 50 BA/A) to high density (80-100 BA/A). Unmanaged stands were higher density. A stand of 18-inch diameter pines at 45 BA/A has about twenty-five trees per acre. The same stand at 85 BA/A has about double the number of trees.

What was found in the survey

The Black Hills supports many pollinator insect families. There were more than forty-five families recorded during the survey (Table 1). These insects are in four orders: Coleoptera (beetles), Diptera (flies), Hymenoptera (ants, bees and wasps), and Lepidoptera (butterflies, moths and skippers). The family listing means that species were recovered from pan traps, sweep nets or other collection means. A family listing does not mean that all species in that family serve as pollinators (Figure 3).

Figure 3. Lepidoptera, Hymenoptera, Coleoptera and Diptera (left to right) are the insect orders with the most pollinators.

Hymenopteran insects are considered the most important pollinators. Many of these pollinators are found in the family Apidae, the bumble bees and honeybees, along with Megachilidae, the leafcutter bees. Wasps, also known as yellowjackets or hornets, may feed on pollen and nectar and serve as pollinators. They are not as effective pollinators as bees as they lack the pollen-trapping hairs found on bees.

While Lepidopteran larvae (caterpillars) feed on plant material, many Lepidopteran insects are also pollinators as adults. The families Hesperidae, Lycaenidae, and Nymphalidae contain many pollinators. While numerous Lepidopteran insects feed on flower nectar as adults, many others do not feed as adults or may gather nectar from only a few plants so are ineffective pollinators.

Most Dipteran insects are eat other insects or feed on the blood of mammals. But some adult flies feed on nectar, so they serve as pollinators. A Dipteran family that includes many pollinators is Syrphidae, the flower flies. The syrphids also mimic the looks of bees with a similar black and yellow striped pattern. This deters predators who avoid bees.

While they are not the most common pollinators, many Coleopteran insects do provide this ecological service. They are considered less efficient pollinators as they do not visit flowers as often and more often feed on flower parts rather than gather pollen and nectar. Jewel beetles (Buprestidae), click beetles (Elateridae), leaf beetles (Chrysomelidae), rove beetles (Staphylinidae) and long-horned beetles (Cerambycidae) all feed on flowers and transfer pollen.

There was also a difference in the number of families found within the managed and unmanaged stands. Managed stands allowed more sunlight to penetrate the forest floor which increases the abundance of forbs to support pollinators. The most insect families were found in the low-density managed stands with the least in the unmanaged stands. This was not consistent across all insect orders as the hymenopteran insects were found in both managed and unmanaged stands

Managing forest habitat for pollinators

There are benefits to thinning ponderosa pine forests. These include reduced risk to wildfire and bark beetle outbreaks. Thinning also creates a more sunlit environment for grasses and forbs (Figure 4). Grasses, while wind pollinated, are still beneficial to pollinators by providing shelter and a food source for some larvae. But forb production is the key to improving pollinator habitat.

Figure 4. An open forest creates a more sunlit environment for pollinator-friendly plants.

Creating very open stands, however, will favor grasses over forbs. Over 50% canopy openings - where the pine crowns and sky are about equal proportion when looking up - is when grasses begin to outcompete forbs. The more horizontal leaf arrangement of many forbs allows them to survive with lower light intensities. This means that a uniform stocking level is not necessary for increasing forb production and too low of stocking may reduce pollinator habitat. A mosaic of stocking levels from 40 to 80 BA/A can provide microhabitats to support an array of forbs.

The increase in sunlight can improve the habitat for nonnative plants as well as the native vegetation. Canada thistle *(Cirsium arvense)* and hound's tongue *(Cynoglossum officinale)*, two common nonnative forbs in the Black Hills can quickly colonize any openings. Many exotic forbs are also utilized by pollinators. Careful, and targeted, herbicide may be necessary to manage these and other nonnative species.

Small meadows and marshes on forest lands are also important to pollinators. These small gaps in the forest canopy are excellent habitat for pollinators. The greater light intensity and moisture creates an abundance of forbs, such as Richardson's geranium *(Geranium richardsonii)* that provide the pollen and nectar for the pollinators (Figure 5).

Figure 5. Richardson's geranium *(Geranium richardsonii)* is a common forb is forest drainages and stream margins.

Slash – woody debris after harvesting operations – can also provide beneficial habitat for pollinators (Figure 6). Tunnel nesters such as carpenter bees (Hymenoptera: Apidae) and mason bees (Hymenoptera: Megachilidae) tunnel into decaying wood debris to construct nests. Bumble bees (Hymenoptera: Apidae) do not carve their own cavities but take advantage of ones created as the wood decays or carved by others.

Figure 6. Slash from thinning operations scattered on the ground provides habitat for some pollinators.

Some pollinators overwinter as adults and require shelter to survive the cold. The mourning cloak butterfly (Lepidoptera: Nymphalidae) is one of the first butterflies to fly in the spring. It spends the winter hiding in wood cavities or beneath log piles. Coarse woody debris on the forest floor provides habitat for this insect and many others.

Opening the pine canopies in stands through forest management practices allows the forest understory to flourish. These stands will see an increase in understory growth that is vital to pollinator food sources and habitat. An increase in pollinator activity provides pollination services to plants in the understory that are essential food for foraging animals. Managing forest canopy densities provides both food and habitat for pollinators that service the understory allowing for stability and overall health of the forest ecosystem.

Acknowledgement

We appreciate the financial support for this project by Neiman Enterprises, Inc, Hulett, WY

P-00348

Table 1. Pollinator families collected by order and forest management

Order and families	Common name	Low density managed stands	High density managed stands	Unmanaged stands
Coleoptera				
Buprestidae	Jewel beetles	–	–	X
Cantharidae	Soldier beetles	X	–	–
Chrysomelidae	Leaf beetles	X	X	X
Curculionidae	Weevils	X	X	–
Elateridae	Click beetles	X	X	X
Mordellidae	Tumbling flower beetles	X	–	–
Scarabaeidae	Scarab beetles	X	–	–
Staphylinidae	Rove beetles	X	X	X
Diptera				
Anthomyiidae	Root-maggot flies	X	X	–
Bombyliidae	Bee flies	X	–	–
Calliphoridae	Blow flies	X	X	X
Ceratopogonidae	Biting midges	–	–	X
Chironomidae	Midges	–	–	X
Drosophilidae	Fruit flies	X	X	–
Empididae	Dance flies	–	X	–
Lauxaniidae	Rocksitter flies	X	–	X
Muscidae	Stable flies	X	X	–
Pipunculidae	Big-headed flies	X	X	–
Sciaridae	Fungus Gnats	X	–	X
Simuliidae	Black flies, Buffalo gnats	X	–	–
Syrphidae	Flower flies	X	X	X
Tachinidae	Tachinid flies	X	X	X
Xylophagidae	Awl-flies		X	–
Hymenoptera				
Andrenidae	Mining bees	X	X	X
Apidae	Bumble bees and honeybees	X	X	X
Colletidae	Plasterer bees	X	X	X
Halictidae	Sweat bees	X	X	X
Ichneumonidae	Ichneumon wasps	X	X	–
Megachilidae	Leafcutter bees	X	X	X
Melittidae	Melittid bees	X	X	–
Vespidae	Vespid wasps	X	X	X
Lepidoptera				
Erebidae	Underwings, Tiger moths, and Tussock moths	X	X	X
Hesperidae	Skippers	X	X	X
Lycaenidae	Gossamer-winged butterflies	X	X	X
Nymphalidae	Brush-footed butterflies	X	X	X
Papilionidae	Swallowtail butterflies	X	–	–
Pieridae	White, yellow and sulphur butterflies	X	X	X
Pyralidae	Grass moths	X	–	–
Sphingidae	Sphinx moths	X	X	–
Tortricidae	Tortrix moths	X	–	–
Low density (40-50 BA/A, High density (80-100 BA/A), Unmanaged (>90 BA/A)				