ENVIRONMENT

~Challenge Project Winner~

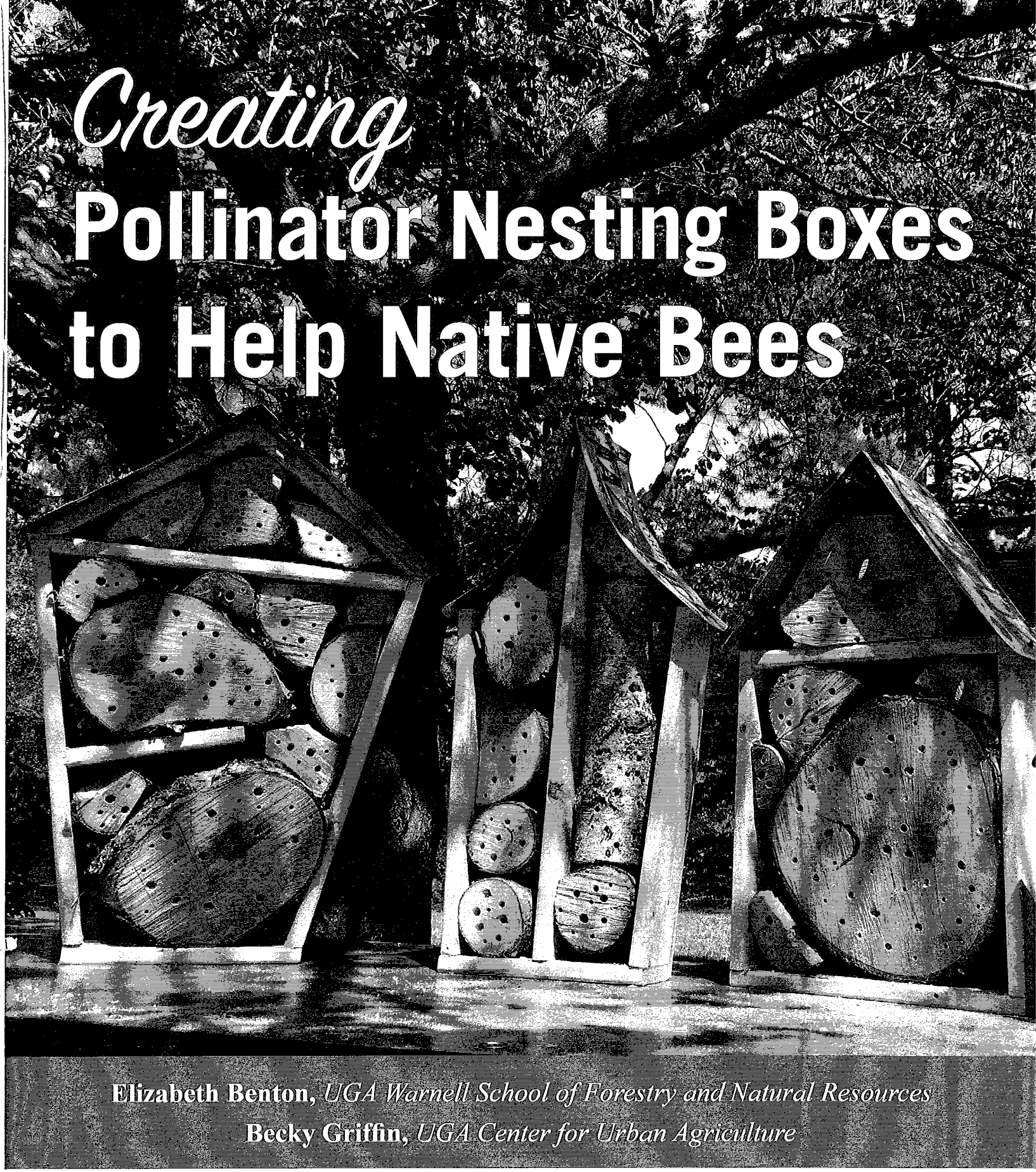
KITTEN FLOWER POTS *(GFWC Marietta Woman's Club 16 M, 419 Hrs, $25 Spent, $6 In-Kind)* The Marietta Woman's Club utilized 23 pieces of recycled plastic to create kitten-themed flower pots. Each plastic bottle was cut into the kitten design. Then bottles were spray painted. A cat's face was drawn on the painted pot. Bows were tied and glued around the neck of the bottle. Flowers were planted in the completed pots and donated to a local nursing home.

~Most Creative/Outstanding Project Winner~

1. **SUPER POLLINATORS** *(GFWC Hartwell Woman's Club, 24 M, 40 Hrs, $58 Spent, $25 In-kind)* The Hartwell Woman's Club decided on a bee project after watching a PBS show called, "Growing a Greener World", which had a segment on the Mason Bee Revolution. Members contacted the Hart County Botanical Garden to see if they would be willing to let us put a Bee Hut there, where there are already lots of plants for the bees to get pollen. The administrators there welcomed the project to their Sun Perennial Garden. The Club ordered a bee-starter kit (cost = $58) which included the Bee Hut, 50 bee tubes, 100 Leafcutter bee cocoons for Summer and 10 Mason bee cocoons for Spring 2021. The cardboard tubes are where the Bees lay their eggs. A stand was built for the bee hut to sit on (cost of $25, donated in-kind), and then it was installed in the garden before the bees arrived. The Leafcutter bees arrived in a small bag in a cardboard box. Members placed the Leafcutter bees in the hut on August 28th and went back a week later to be sure they had emerged from their cocoons. Pictures and a short video were taken to document the event.

2. **DETECTIVE SEYMORE GREEN PUPPET SHOW** *(GFWC Service Guild of Covington, 4 M, 20 Hrs, $500 In–kind)* Four members of the Service Guild of Covington practiced and performed with KCNB's puppet team to help perform the Detective Seymore Green & Buster Clean the Bases puppet show at First Presbyterian Church of Covington for Girl Scout Troop 18012 and their families and friends. The show educated nearly thirty children about the importance of litter prevention and water pollution prevention using fun characters, a story, and songs.
3. **RECYCLING CLUB** *(GFWC Marietta Woman's Club, 16 M, 36 Hrs)* The Marietta Woman's Club organized a recycling club of sixteen students from all of the fifth-grade classes at a local elementary school. Members of the Club collected and donated 250 plastic groceries bags and taught students to crochet these bags into mats for the homeless. Due to COVID-19, the project was incomplete.
4. **INTERNATIONAL WORLD PEACE ROSE GARDEN** *(GFWC Atlanta Woman's Club, 38 M, 40 Hrs, $2140 Donated, $444 In-kind)* IWPRG is a catalyst for peace around the world. The nonprofit was established to create beautiful rose gardens for peace on public lands. There are ten gardens and the MLK Jr. Historical Park is one of those sacred grounds. The "I Have A Dream" rose garden was established in 1992. Atlanta Woman's Club has partnered with this organization since 2015 to maintain the garden and to support an annual celebration honoring the student winners of the messages of peace poems that line the border of the rose garden.

5. **SPECIAL NEEDS GARDEN THERAPY** *(GFWC Lawrenceville Woman's Club, 5 M, 3 Hrs, $78.95 Donated, $125 In-kind*) The Lawrenceville Woman's Club partnered with a local garden club for grant money for a garden therapy project. A member wrote a grant application for $125, requiring matching funds. The project was for the Young Adults Learning Life Skills (YALLS) students. Grant money was used to purchase soil, tools, and seeds/plants to maintain four raised bed gardens. The Club furnished a cash contribution. We renewed a 2-year subscription to National Wildlife Federation's Ranger Rick magazine for elementary school age children.
6. **RAGS IN BAGS** *(GFWC Brunswick Woman's Club, 6 M, 14 Hrs, $50 Donated, $500 In-kind)* Rags in Bags is an ongoing donation program instituted by the Brunswick Woman's Club for the benefit of "furry friends "at the Humane Society of South Coastal Georgia, a no-kill facility in Brunswick, Georgia. Members bring bags with used hand/bath towels, wash cloths and dish towels rather than discarding them. These rags are used for cleanup days, operating room, mothers and newborns and creature comfort.
7. **AUDUBON AND BIRDS** *(GFWC Dunwoody Woman's Club, 109 M, 68 Hrs, $150 Donated, $452 In-kind)* Dunwoody Woman's Club partnered with GA Audubon in a project to educate members and contribute to their mission of "building places where birds and people thrive." Six members toured GA Audubon with a director talking about birds, their migrations, their habitat needs, foods and uses of feeders. To finalize the project, ten members met to create bird feeders made of gelatin, flour and bird seed. The feeders were hung in member's yards and at local parks. Directions were shared with those attending.
8. **FOR CLEAN WATER** *(GFWC Augusta Woman's Club, 32 M, 23 Hrs, $1230 Donated)* Augusta Woman's Club sponsored a Veteran's For Clean Water sampling site. VFCW take water samples at twenty-one local swimming spots. The water is tested for E. coli and the results are posted in the "SWIM GUIDE" so the public can check on the safety of the water before they swim. "Swim Guide" was introduced to the club, & downloaded on members phones. The Club purchased Water DO (Dissolved Oxygen) monitors for water sampling.
9. **BUDDY BENCHES** *(GFWC Morrow Civic Woman's Club, 15 M, 22 Hrs)* Members of the Morrow Civic Woman's Club partnered with the local ATT Pioneer Southside Council. Members collected over 17,000 plastic lids which were melted down and used to form recycled plastic "buddy" benches. These benches were placed in elementary schools where young children could sit when they need support from others.
10. **COMMUNITY GARDENS** *(GFWC LaFayette Woman's Club, 3 M, 200 Hrs, $100 Donated, $250 In-kind)* The LaFayette Woman's Club worked in gardens throughout the City of LaFayette. The most memorable day was when a local business, The Roper Corporation, helped prep the gardens for the upcoming winter months. The volunteers also spent time planting spring bulbs. The workday was successful in so many ways. One of the most significant parts of the day was meeting future engineers from all over the United States. This was a collaborative effort by the Club and the number two employee in our county. Over 150 pounds of produce from these gardens were collected and distributed to area food pantries in 2020!



Creating Pollinator Nesting Boxes to Help Native Bees

Elizabeth Benton, *UGA Warnell School of Forestry and Natural Resources*
Becky Griffin, *UGA Center for Urban Agriculture*

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& Natural Resources
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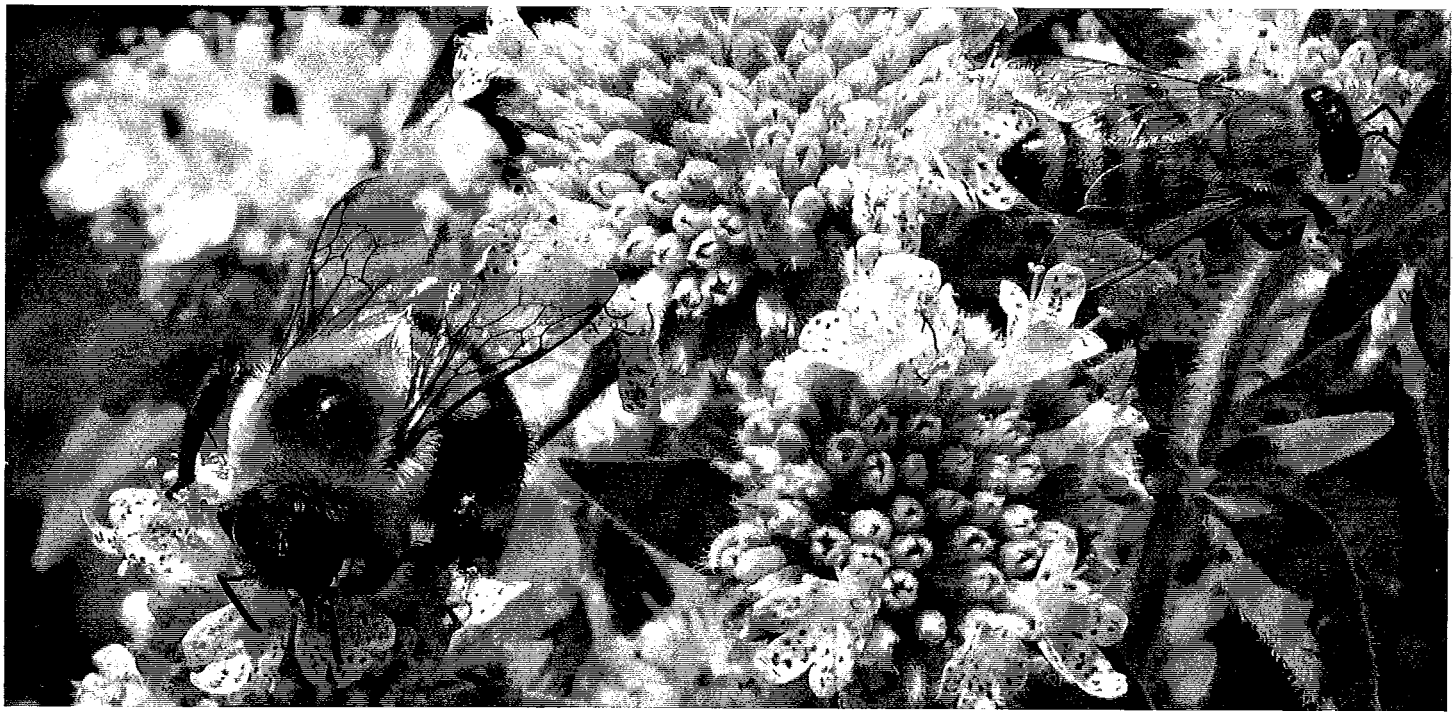
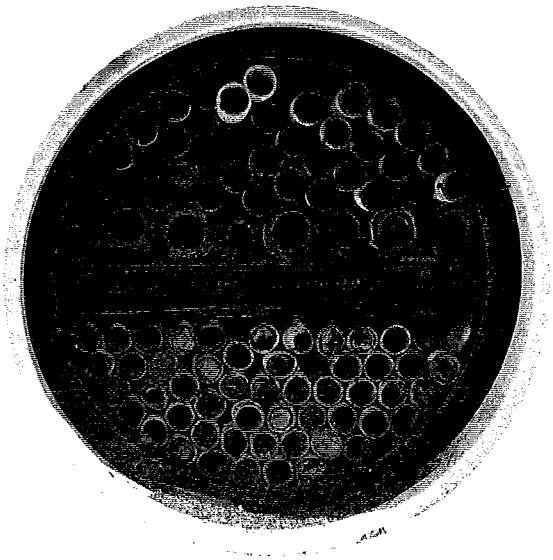
Native pollinators are animals from North America that pollinate crops and many other plants. Pollination is necessary for seed production in many plants. Pollinators include mason bees, carpenter bees, bumble bees, sweat bees, wasps, hover flies, butterflies, hummingbirds, and many more. Most of the focus on pollinators revolves around honey bees, which are native to Europe, Africa, and the Middle East, but not North America, but native bees are very important pollinators. Many native bees are solitary—an individual bee lives alone, rather than nesting in colonies or hives as honey bees do. Also, if left undisturbed, native bees will not sting.



Bumble bee and honey bee on mountain mint
Photo: Bodie Pennisi, University of Georgia



Mason bee paper tubes
Photo: Josh Fuder, University of Georgia

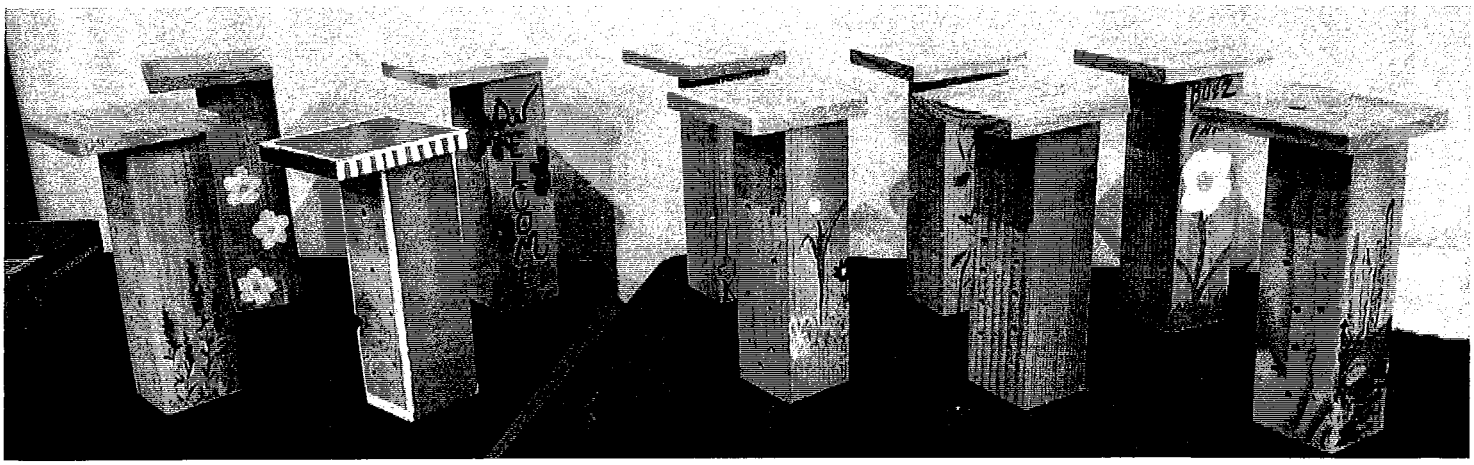
Planting pollinator-friendly flowers in your yard is a great first step for improving the quality of pollinator habitats. Adding nesting sites and nesting materials is another important measure in creating sustainable habitats, especially for native bees. Many native bees lay their eggs in aboveground cavities. They make nests in abandoned beetle tunnels in dead logs, hollow stems, and similar locations. Unfortunately, dead wood and debris that would be useful for nesting is often quickly removed from yards. While flowers may be present, the bees are left with few locations and materials for laying their eggs.

Urbanization is a direct cause of pollinator declines (Hennig and Ghazoul 2012). Neighborhoods have developed in areas that were once forests and other natural habitats. Natural landscapes have both the floral and nesting resources needed for native bees, but in most landscaped yards, the grass is mowed short, flowering "weeds" are killed with herbicides, many landscape bushes do not bloom, and debris is quickly removed to maintain a neat and manicured appearance.

If you want to help pollinators while maintaining a neat yard, there is good news. Many of the resources that pollinators need, including nesting locations, can be attractive additions to your landscape. In Europe, nesting boxes can host over 15% of native bee species (Fortel et al. 2016). When bees have access to a diversity of nesting materials, their numbers are positively affected, so providing nesting resources in your landscape is very beneficial to bees (Potts et al. 2003).

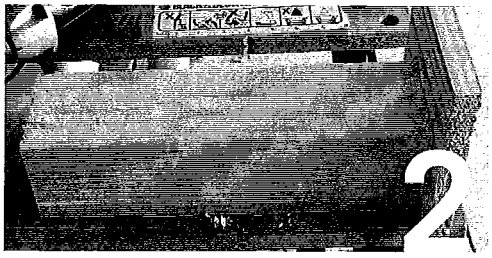
Bees can use different nesting substrates. Aboveground nesting bees use materials like hollow twigs, dead wood, and paper-based bee tubes. These materials can all be incorporated into nesting boxes, or "bee hotels." Nesting box design can be as simple as several paper-based bee tubes secured into a bundle or one piece of untreated lumber with holes drilled into the surface. Designs can also be creative, using a multilayered structure with numerous types of nesting materials. Creating a variety of cavity sizes will attract different types of pollinators based on their body sizes. The sides of the nesting box that do not contain holes can even be painted to add an attractive splash of color to your yard. Making nesting boxes can be a fun activity for the whole family.

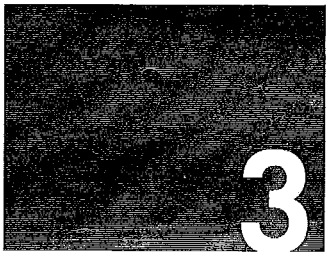
Materials for bee nesting boxes include tree trunk slices and untreated lumber, with license plates acting as roofs
Photo: Elizabeth Benton, University of Georgia

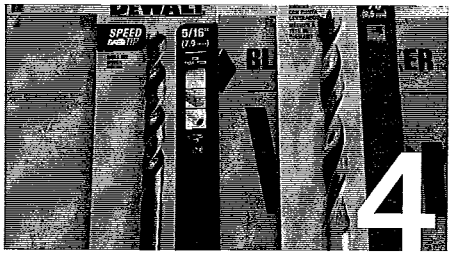


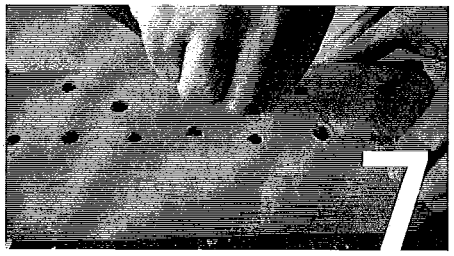
Simple "bee hotels," constructed from basic carpentry materials
Photo: Becky Griffin, University of Georgia

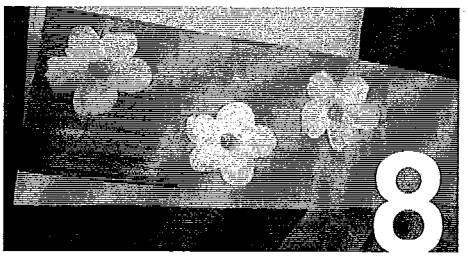
BUILDING A BEE HOTEL











1. Cut untreated wood to the desired size.

2. Add a roof to the structure. A roof will help to protect the nesting sites from rain.

3. Attach the roof to the structure with a few nails.

4. Select the appropriate drill bit size, from 5/16 to 3/8 of an inch. Holes can be drilled in various sizes.

5. Check the depth of the holes, which should be about the length of most drill bits.

6. Begin drilling the holes. The number of holes depends on the size of the nesting box, but a dozen should suffice for a small nesting box.

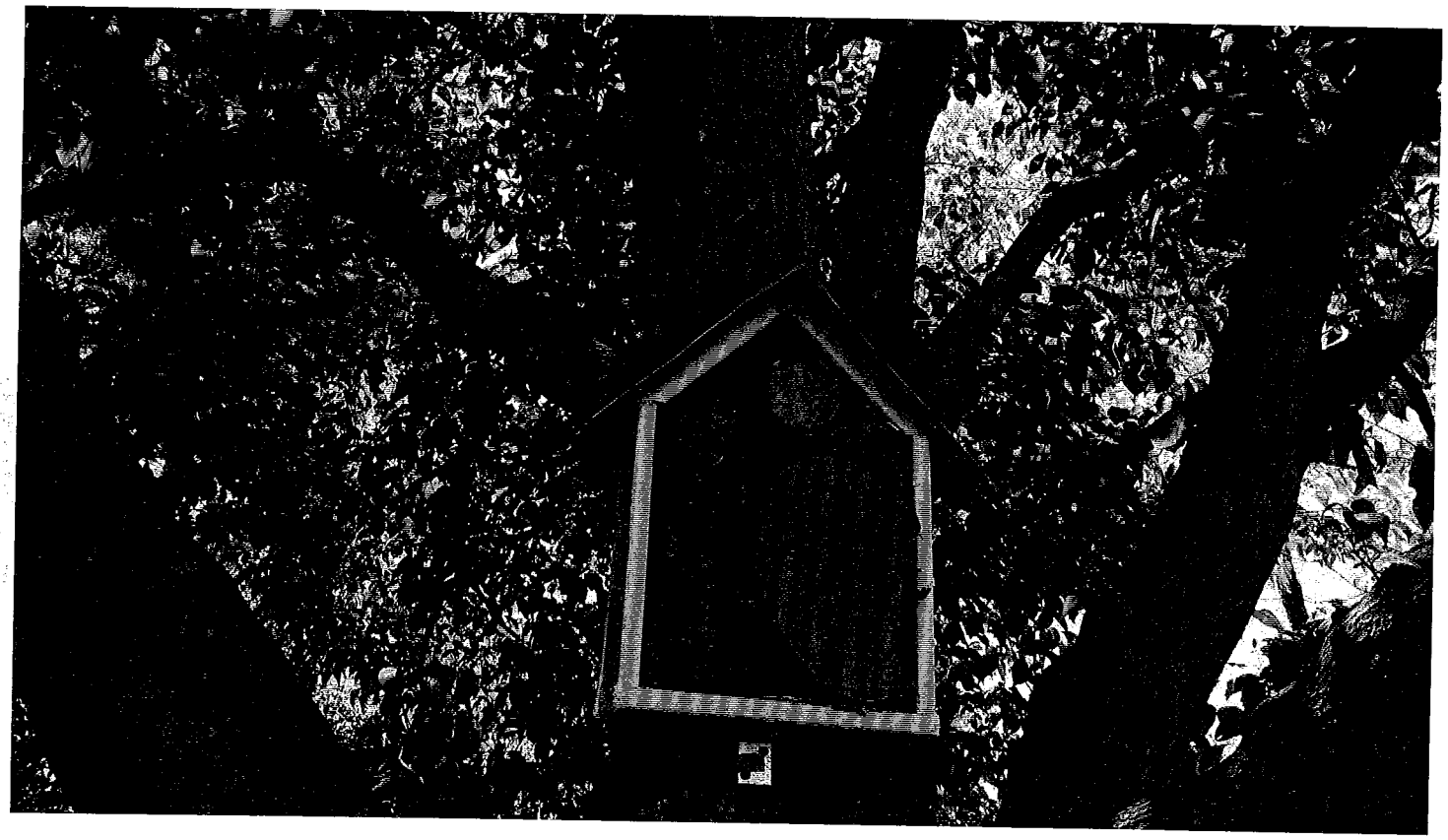
7. Gently sand the nesting holes. Splinters can remain after drilling, but removing splinters will make the nesting box more appealing for bees.

8. As desired, paint the sides that do not have holes.

9. The nesting box is ready to be placed in your yard.

Installing a Bee Hotel

Place bee nesting boxes in the yard during early spring so that they will be available for the first bees of the season to lay eggs. February should be appropriate for most places. Be sure that the boxes are installed at least 3 feet above the ground in a location protected from wind and rain. It is best to install the nesting boxes facing south. Secure the top and bottom of the boxes to a surface like a tree or fence. If the bottom of the box is not secured, it will blow around in the wind. Place multiple nesting boxes throughout your yard to give bees plenty of nesting locations. The bees that use nesting boxes have one generation each year, so do not remove the nesting boxes during the winter. Leave them out and bees will exit the holes in the spring.



Nesting boxes require some maintenance. Pollinators have pesky pathogens and parasites that harm them. Once a box has been in use for a couple of years, the wood will begin to degrade and the pathogens and parasites that find the box can become a problem. Depending on your design, plan to replace nesting boxes or the wood bolts in the boxes every two years.

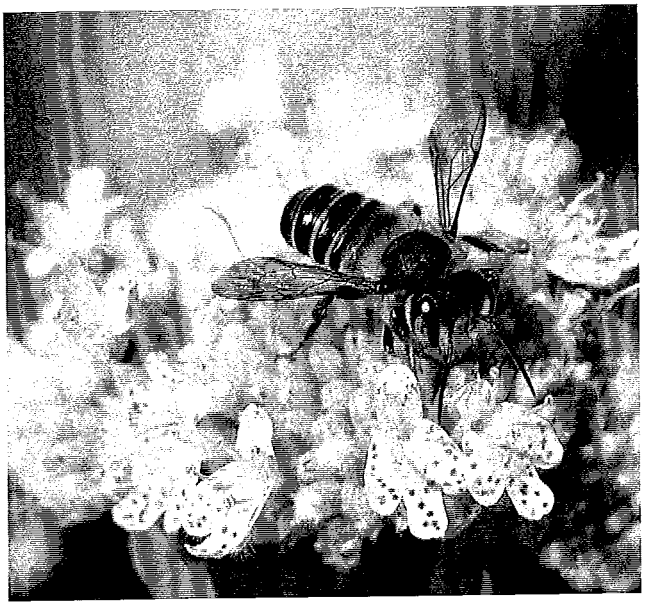
Once your nesting boxes are installed, it is time to relax and enjoy your pollinator visitors. Keep your eyes open for leafcutter bees and mason bees that will use the holes that you drilled in the wood. Carpenter bees may show up as well, but they will drill their own holes into the wood nesting boxes.

Leafcutter bees

(family: Megachilidae, *Megachile* spp.) —

Females emerge in the spring and summer and begin making their nests. A single egg is laid in each cell, or hole, in the nest. The female stocks the hole with pieces of leaves and pollen to feed developing larvae. The larva is nearly finished developing in the fall and will overwinter as a mature larva. The next spring, leafcutter bees emerge as adults and begin looking for new nesting sites.

Leafcutter bees are about 0.25 to 0.5 inches long and have black bodies with light or dark hairs. They carry pollen on hairs on the underside of their abdomen. Leafcutter bees have large mouthparts to cut the leaves, but they generally do not bite or sting unless disturbed.



Leafcutter bee on mountain mint
Photo: Bodie Pennisi, University of Georgia

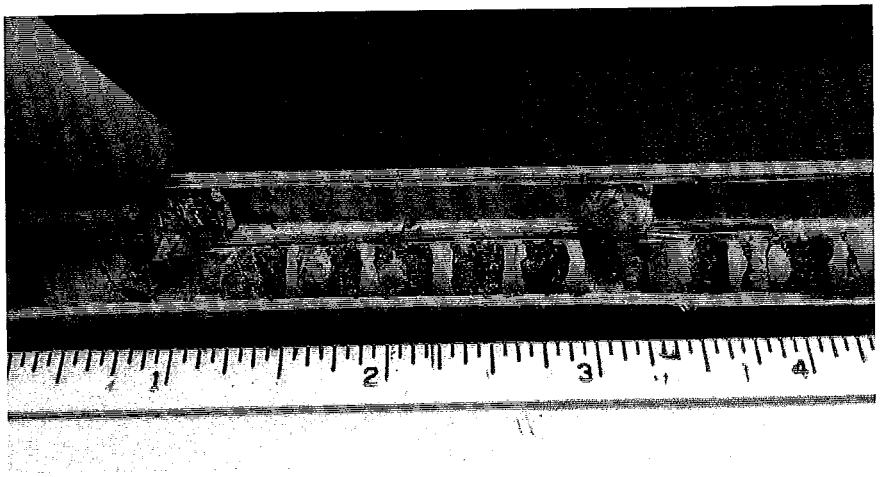
Mason bees

(family: Megachilidae, *Osmia* spp.) —

Mason bees received their name because they often use mud during nest construction. In the spring, male mason bees emerge first and wait for females to emerge so that they can mate. Shortly after mating, the males die. Females search for an appropriate nesting site and begin preparing the nest. A cavity or hole will have multiple cells, each of which has a single egg. The cells, between four and 10, are stocked with pollen and nectar to feed each larva once it hatches. The female divides the cells in the cavity with plugs of mud. Unfertilized male eggs are laid toward the front of the cavity, and fertilized female eggs are laid toward the back of the cavity. A female may produce approximately five nests, and larvae develop during the year. About a month after hatching, the larva has eaten its food and begins to spin a cocoon to continue development. Adults emerge the next spring.

Mason bees are about 0.25 to 0.5 inches long. Some have dark bodies covered with pale hairs, while others are a metallic greenish-blue with less hair.

Mason bee
Photo: Ted Kropiewnicki



Mason bee nest cells
Photo: Josh Fuder, University of Georgia

Large carpenter bees

(family: Apidae, *Xylocopa* spp.) —

Homeowners often consider large carpenter bees to be pests because they bore holes in the wood in siding, decks, and fences. Carpenter bees emerge later in the spring, and a female will begin to dig her tunnel once she has mated. Cells are stocked with pollen and nectar to feed developing larvae and wood chips are used to separate cells. Each cavity has about six to eight cells. Larvae finish development during the late summer. Adults emerge and then hibernate, usually in abandoned nesting sites, until the next year. Large carpenter bees will not use holes that are drilled into a nesting box, but they may use the nesting box to bore their own holes.

Large carpenter bees have a black body with either light or dark hairs. The back legs have special hairs for carrying pollen. They are relatively large bees, 0.75 inches long or larger. Large carpenter bees are often mistaken for bumble bees because they are similar in size and appearance. They can be easily identified, however. Bumble bees have a hairy abdomen, while large carpenter bees have a glossy abdomen.

Carpenter bee on ice plant
Photo: Bodie Pennisi, University of Georgia

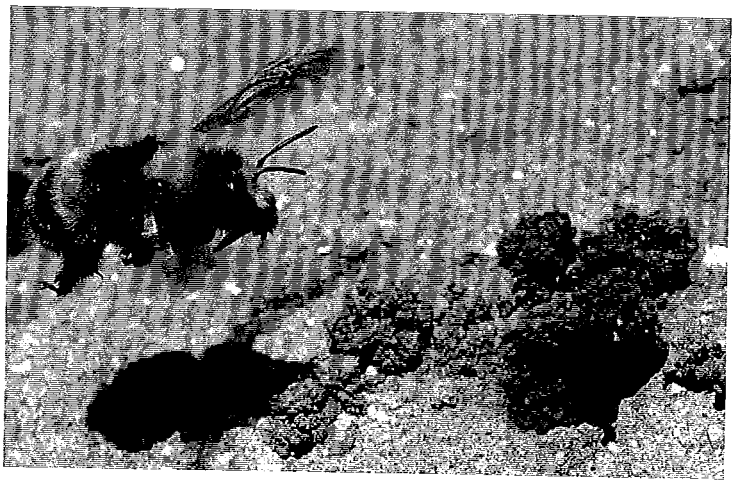
Small carpenter bees

(family: Apidae, *Ceratina* spp.) —

Small carpenter bees are metallic blue to green in color and typically nest in plant stems, but they may also use nesting boxes to lay their eggs.

To ensure that your lawn is also attractive to ground-nesting bees, leave a few dry, sandy areas of lawn, bare of vegetation, so that these pollinators have a place to construct their nests.

You can also help to create a pollinator-friendly landscape by planting pollinator-friendly trees, providing lots of flowers, and setting up bird baths or shallow dishes of fresh water.



Female digger bee approaching her nest
Photo: Kathy Keatley Garvey, UC Davis

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Circular 1125 (WSFNR-17-48) **December 2017**

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Selecting Trees and Shrubs as Resources for Pollinators

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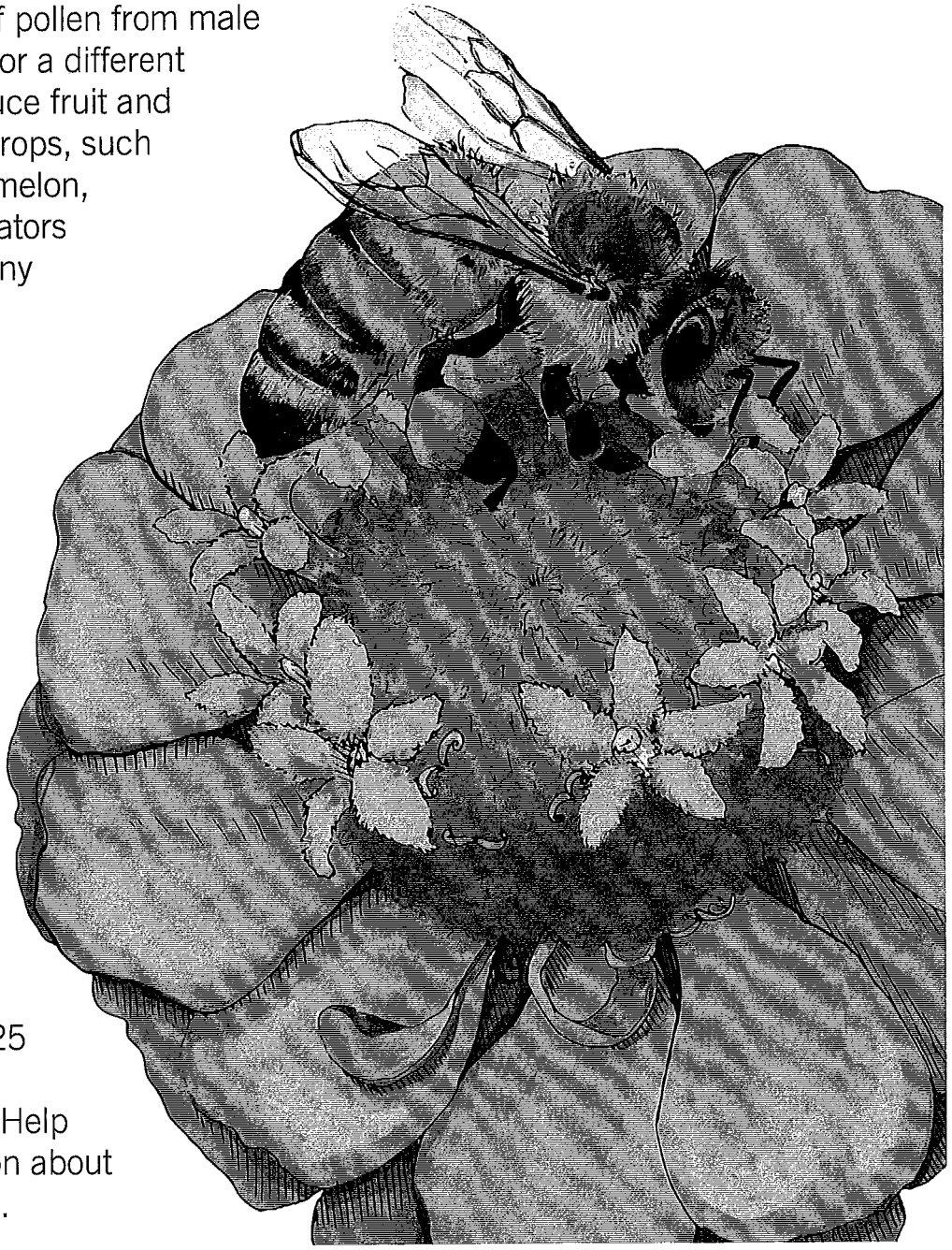
We can positively affect pollinator populations in our region by providing plants that help sustain them. Pollinators face the increasing challenges of habitat loss, parasite and disease pressure, and the unintended consequences of pesticide misuse. Bee forage plants can bloom season-long with careful plant selection appropriate to the region. A combination of herbaceous perennial and annual plants, trees, and shrubs can provide valuable resources to bees and other pollinators. Even grasses can be used by bees as a pollen source, while crape myrtles can provide a later season resource for pollinators. **Anyone—from individual home gardeners to commercial and agricultural property managers—can promote pollinator health by selecting and planting appropriate plants.** This guide provides options for selecting flowering woody plants that are attractive to bees and butterflies and sometimes have additional wildlife benefits. For recommendations of additional plants for pollinator friendly landscapes, refer to University of Georgia Extension Bulletin 1456, "Eco-Friendly Garden: Attracting Pollinators, Beneficial Insects, and Other Natural Predators."

Pollination, or the transfer of pollen from male to female parts of the same or a different flower, is necessary to produce fruit and seed in many horticultural crops, such as tomatoes, squash, watermelon, apples, and peaches. Pollinators include honey bees and many native bees, such as sweat bees, mason bees, digger bees, leaf cutter bees, carpenter bees, and bumble bees. Certain flies, butterflies, moths, beetles, wasps, and even hummingbirds also serve as pollinators.



We can support pollinator populations by providing floral resources, nesting areas, moisture sources, and open areas where butterflies can bask in the sun and ground-dwelling bees can nest. Refer to UGA Extension Circular 1125 (WSFNR-17-48), "Creating Pollinator Nesting Boxes to Help Native Bees," for information about creating native bee habitats.

Georgia's Pollinators

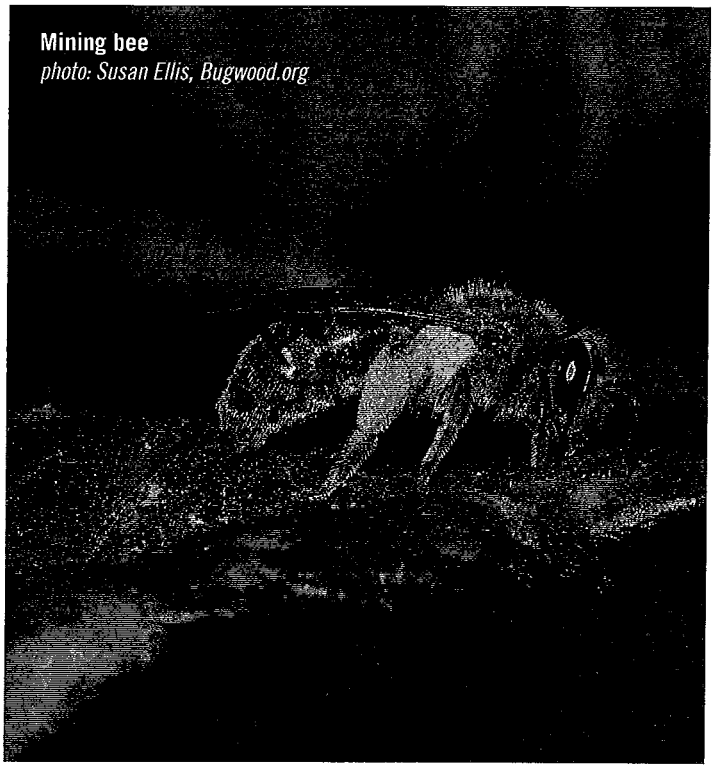
BEES

Colletidae
(cellophane, masked, plasterer or polyester bees)

Plasterer bees are solitary and nest in the ground. They line their subterranean burrows with a thin, shiny material that they produce. Other members of the family (yellow-faced or masked bees) nest in hollow plant stems or the old burrows of other bees. Bees in this family are small to medium in size, between 6 and 15 millimeters. They have heart-shaped faces, a moderately hairy head and thorax, and banded abdomen. Although solitary, these bees can be highly aggregated and are often seen nesting on bare ground slopes. Spring forage includes red maple, willow, and American plum. Bees in this family are among the native bees that collect pollen from blueberries.

Common genera:
Colletes (cellophane, plasterer, or polyester bees)
Hylaeus (masked or yellow-faced bees)

Yellow-faced bee
photo: David Cappaert, Bugwood.org



Mining bee
photo: Susan Ellis, Bugwood.org

Andrenidae
(mining bees)

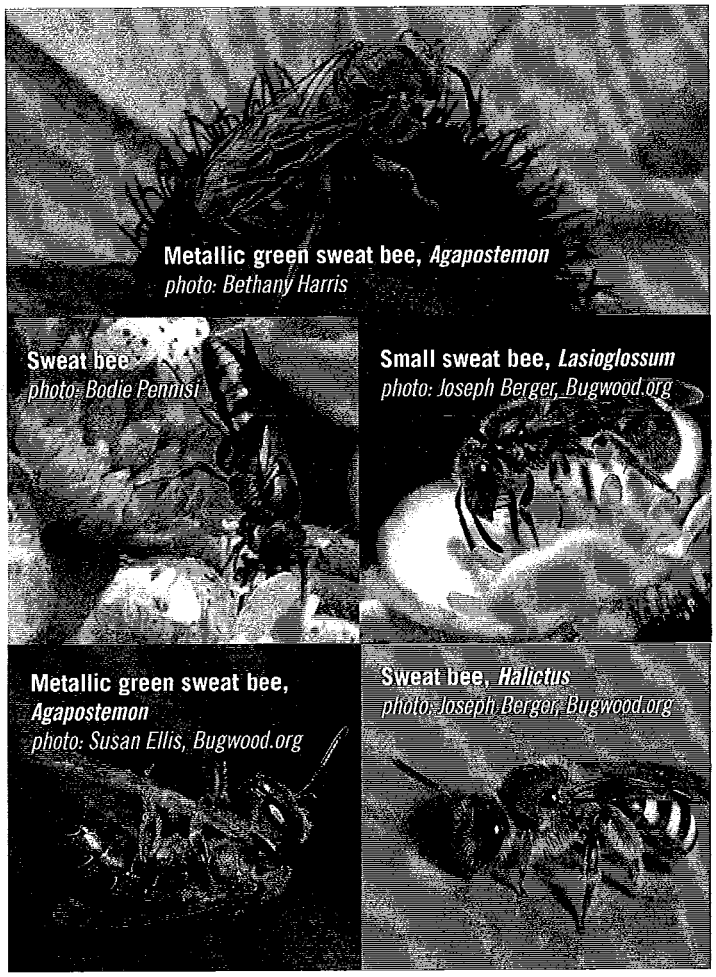
Mining bees are solitary bees that nest in the ground in a wide variety of settings. They range in size from small to large, 5 to 18 millimeters. The mining bee's head and thorax are covered with yellow, white, or gray hairs. Spring forage includes American plum, dogwood, hawthorn, red maple and willow. Bees in this family can be important pollinators of fruit trees and berries.

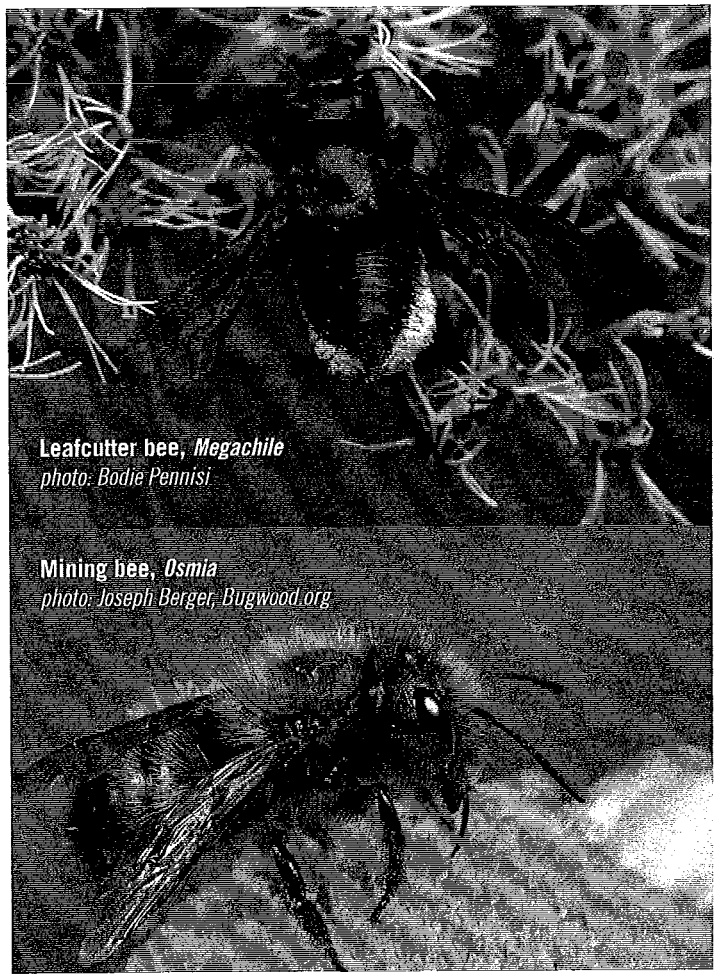
Common genera:
Andrena (mining bees)
Calliopsis (mining bees)

Halictidae
(sweat bees)

Bees in the family Halictidae are generalist foragers that include the metallic green sweat bees that are often seen on plants in the aster family. These bees visit a wide variety of herbaceous annual and perennial flowers, as well as serviceberry, dogwood, and American plum. They include solitary, communal and primitively social species. Many bees in this family are ground-nesting, and some nest in rotting wood.

Common genera:
Agapostemon (metallic green sweat bees)
Augochlora (metallic green sweat bees)
Halictus (sweat bees)
Lasioglossum (small sweat bees)





Megachilidae
(leafcutter and mason bees)

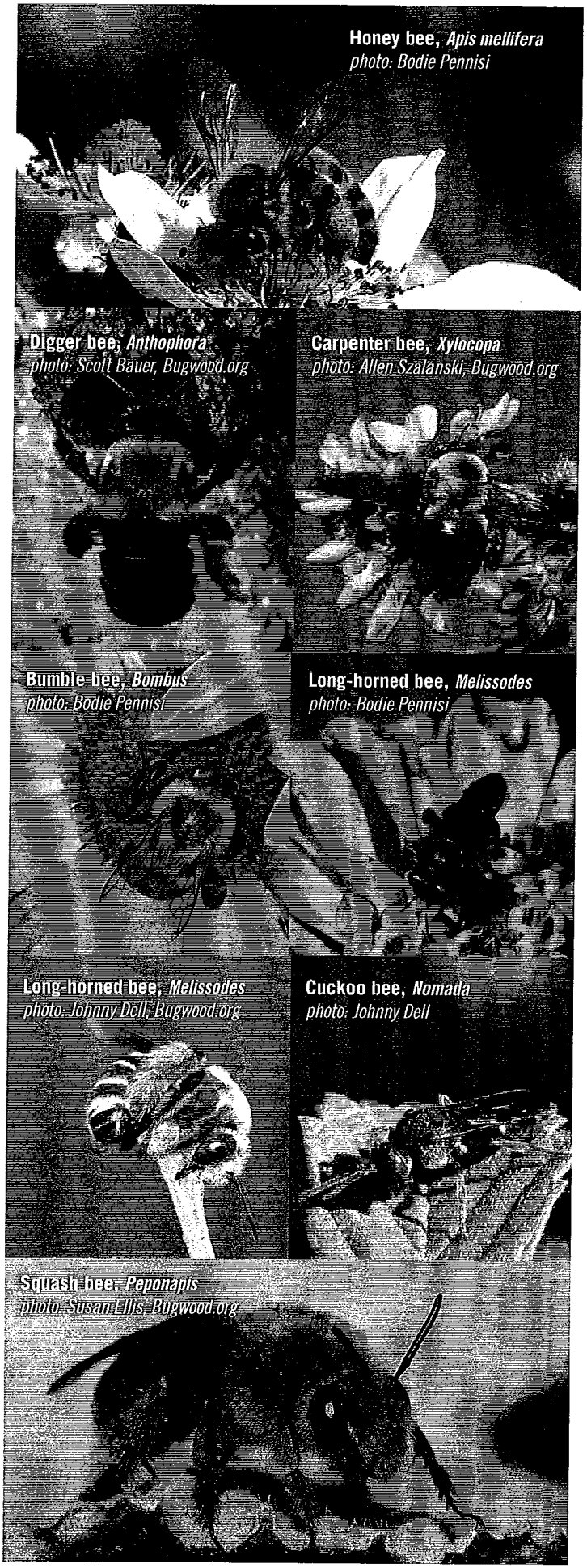
Megachilidae are small to large (5 to 21 mm) robust bees that carry pollen on the underside of the abdomen rather than on their legs. This is a diverse bee family with over 600 species in the United States and Canada. They have diverse nesting habits, making homes in cavities above or below ground, holes in dead trees, cavities in rocks, and in plant stems. Leafcutter bees use pieces of leaves or petals to construct divisions or chambers within nests.

Common genera:
Osmia (mason bees)
Megachile (leafcutter bees)
Hoplitis (mason bees)

Apidae
(cuckoo, carpenter, digger, bumble, and honey bees)

Bees in the Apidae family are large and of diverse shapes, sizes, and colors. This family is likely the most well-recognized bee group. As the honey bee is in the Apidae family, it is the most economically important bee family. These are generally bigger bees, although the largest bee in the world belongs to the Megachilidae family. While the majority of Apidae nest in the ground, some are twig and cavity nesters. Many genera are very hairy and all are long-tongued bees.

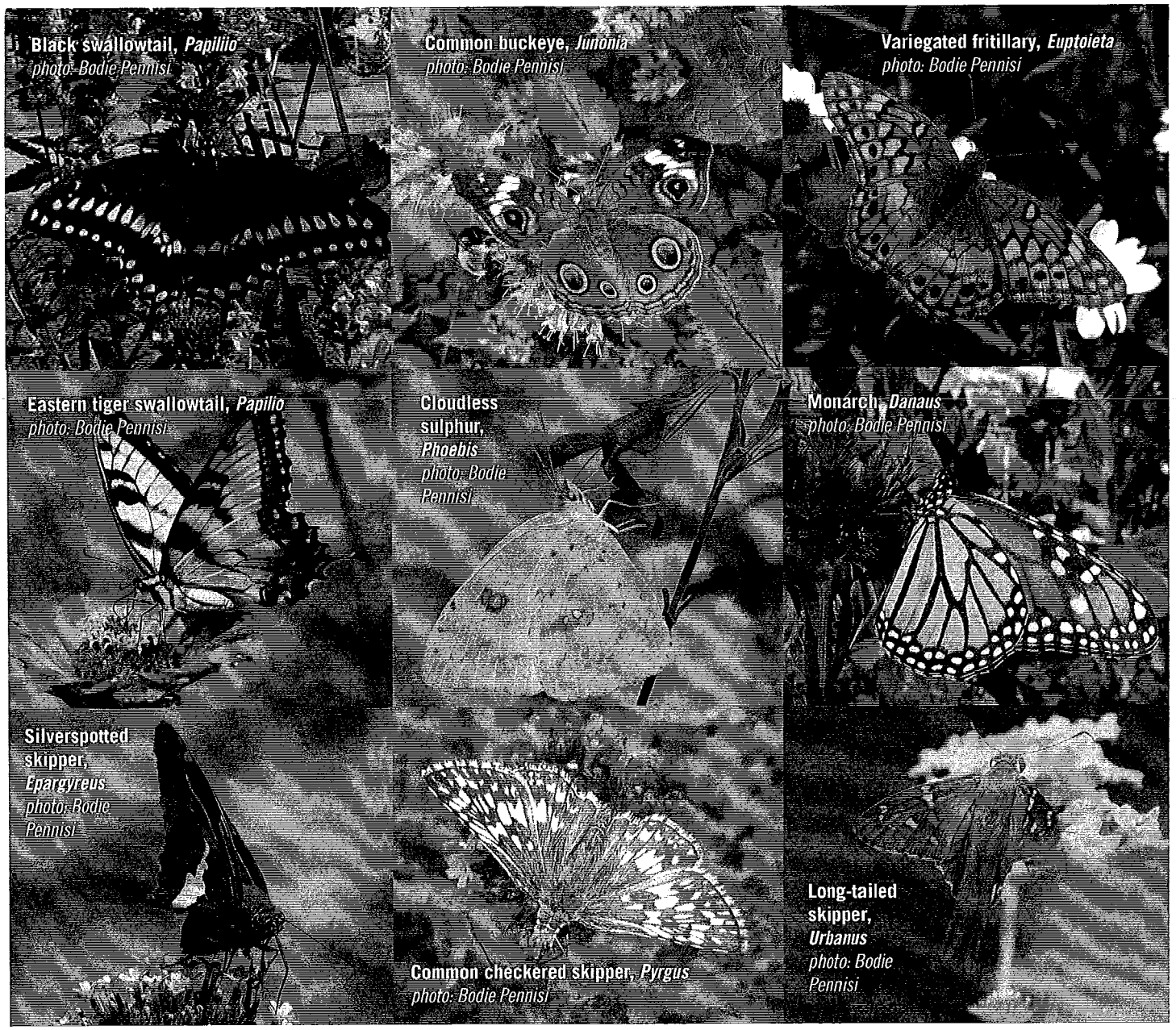
Common genera:
Apis mellifera (honey bees)
Anthophora (digger bees)
Xylocopa (carpenter bees)
Bombus (bumble bees)
Melissodes (long-horned bees)
Ceratina (small carpenter bees)
Peponapis (squash bees)
Nomada (cuckoo bees)



OTHER POLLINATORS

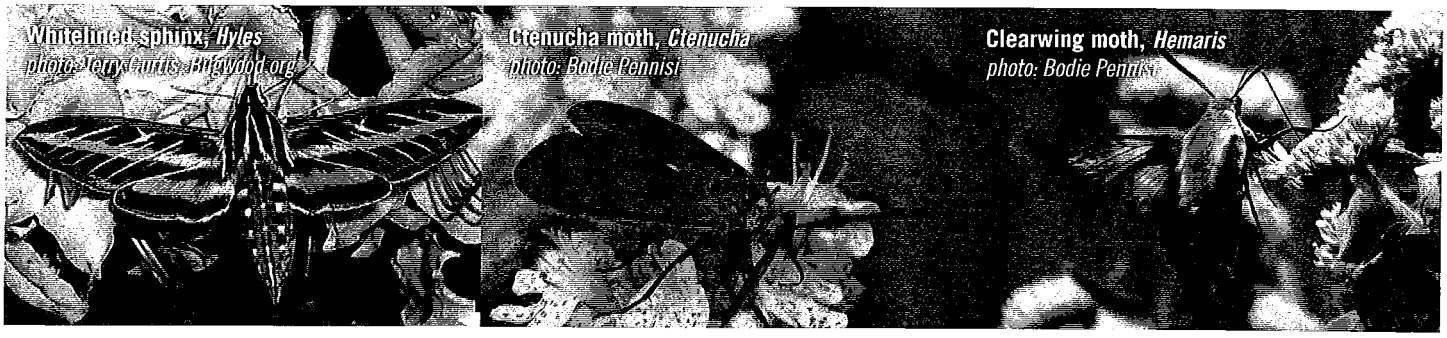
Butterflies

A diverse group of butterflies can serve as pollinators and are often present at the edges of woods, where a variety of trees, shrubs, and herbaceous flowering plants support their activity. Common members of the order Lepidoptera that might be encountered include brush-footed, swallowtail, skipper, white, sulphur, and milkweed butterflies. Butterfly antennae are simple (straight) with a swelling or club at the end. Adding moisture sources, basking areas like flat rocks, and larval host plants can help provide resources that butterflies require. Butterflies are typically day-flying.



Moths

Moths can be distinguished from butterflies by their antennae, which may be simple or feathered but do not have a swelling or club at the end. Moths can be day-active but are often active at night when they are attracted to flowers that open in the evening.

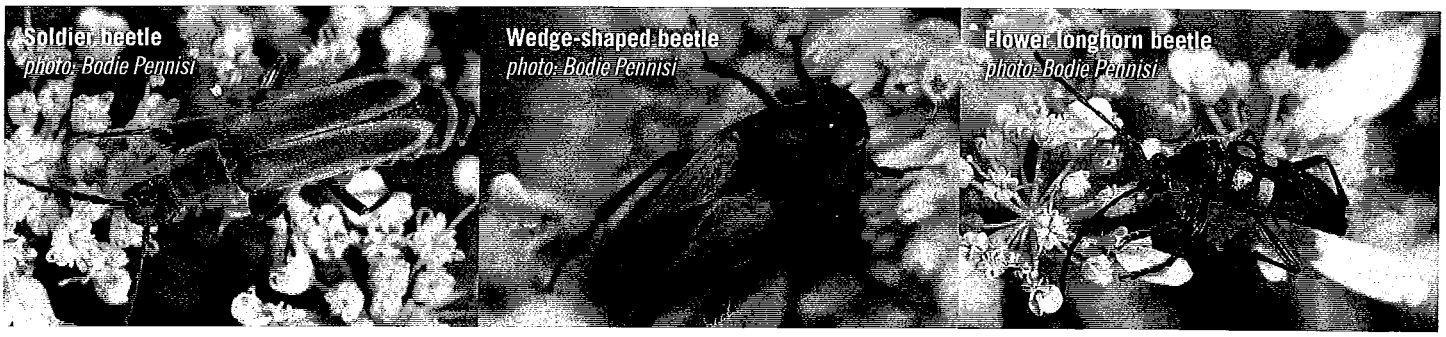


Flies

Flies are generalists, visiting many types of flowers. Flies can be economically important as pollinators of ornamental flowers. They often pollinate small flowers in shaded areas and moist habitats.

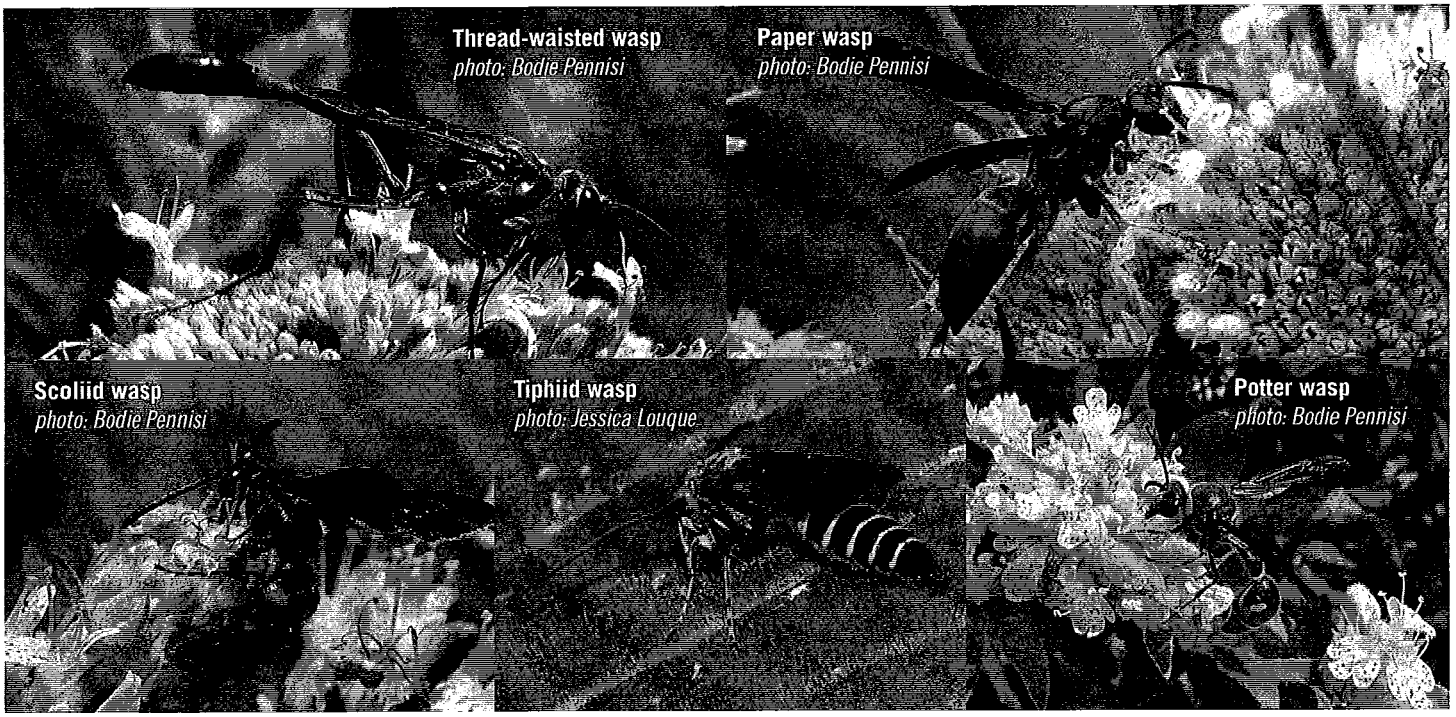
Beetles

Numerous beetles are associated with flowers and can serve a role as incidental pollinators. Plants that are known to be beetle pollinated include sweetshrub, pawpaw, and magnolia.



Wasps

Paper wasps, potter wasps, scoliid and tiphiid wasps, and other parasitoids of insect pests visit flowers regularly. Besides pollination, many wasps provide ecosystem services as predators or parasitoids of plant-eating insect pests.



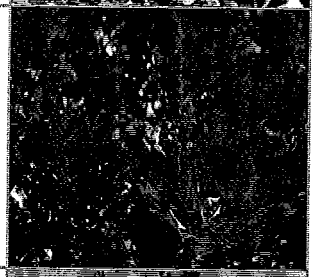
Hummingbirds

Hummingbirds are our key bird pollinators. They transfer pollen when they seek nectar, insects, and spiders on flowers that they visit. Pollen is transferred by hummingbirds on their beaks and feathers. They can access nectar from tubular flowers with their long beaks and tongues. Hummingbirds can see the color red, where bees cannot.

Pollinator-Friendly TREES AND SHRUBS

Abelia x grandiflora | **glossy abelia**
- Grows from 3 to 12 feet
- Variable leaf and flower color, some with attractive fall coloration
- Highly attractive to bees and butterflies
- Relatively pest-free and tolerant of soil conditions
- Requires full sun

Acer barbatum | **southern sugar maple**
- Grows from 50 to 75 feet
- Brilliant fall foliage
- Requires sun or partial shade with moist, well-drained soils
- Valuable for bees and birds



Acer rubrum | **red maple**
- Grows from 50 to 100 feet
- Colorful fall foliage and red flowers in early spring
- Growing conditions include full sun or partial shade and moist soils
- Larval food plant for caterpillars of many showy moths, for example rosy maple moth, and cecropia moth
- Good resource for bees and birds.
- Common bees attracted: *Andrena*, *Lasioglossum*, *Osmia*, and *Colletes*

Aesculus parviflora | **bottlebrush buckeye**
- Grows from 6 to 12 feet
- Mound-shaped with striking white flower spires and attractive gold fall foliage
- Growing conditions include partial shade and moist, well-drained soils
- Attractive to hummingbirds, butterflies, and bees
- Seeds and foliage are poisonous to humans
- Common bees attracted: *Bombus*, *Anthophora*, *Osmia*

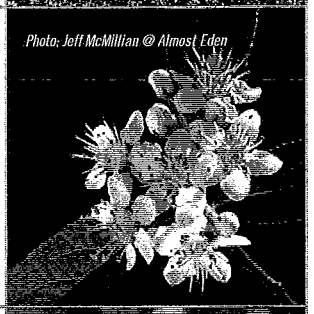
Aesculus pavia | **red buckeye**
- Grows from 10 to 40 feet
- Very showy red (or red and yellow) flower clusters can be nearly a foot long
- This spring bloomer can shed its shiny, bright green leaves by summer's end
- Grows well in part shade and moist, but not soggy, soils
- Attracts hummingbirds and bees
- Seeds and shoots are poisonous to humans

Amelanchier sp. | **serviceberry**

- Grows from 15 to 20 feet
- Drooping clusters of white flowers and red/purple berries
- Sun or part shade
- Does well on moist, well-drained, acidic soils
- Beneficial to bees and birds
- Common bees attracted: *Andrena* and *Lasioglossum*

Aronia arbutifolia | **red chokecherry**

- Grows from 6 to 10 feet
- Best in full sun to part shade and tolerates many soil types
- White flowers, dark red fall foliage, and dark fruit
- Common bees attracted: *Andrena*, *Lasioglossum* and *Bombus*



Baccharis halimifolia | **groundsel bush**

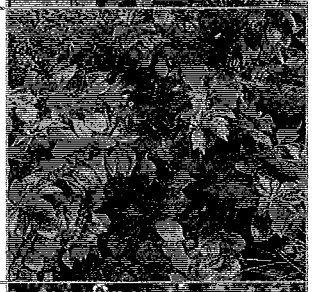
- Grows from 8 to 12 feet
- Evergreen to semi-evergreen with irregular form
- Flowers are not distinct, but the seeds look like tiny, white paintbrushes and are showy
- It is adaptable to wide range of conditions, from full sun to partial shade
- Spreads easily via seeds and suckers
- Provides late season nectar and pollen

Bignonia capreolata | **crossvine**

- Woody evergreen to semi-evergreen vine with showy, orange-red flowers
- Adaptable to many conditions provided in full sun to partial shade
- Good hummingbird plant

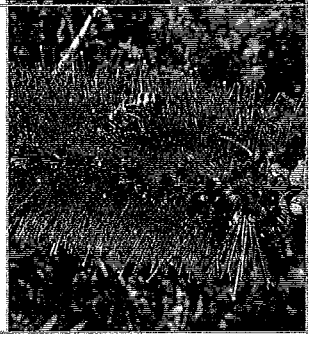
Callicarpa americana | **American beautyberry**

- Grows from 6 to 8 feet
- White and lavender flowers attract bees and butterflies while clusters of shiny purple (or white) berries attract birds
- Partial shade and moist soils are most suitable growing conditions



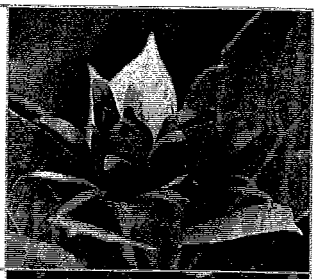
Callistemon citrinus | **red bottlebrush**

- Grows from 10 to 15 feet
- Showy red flowers are attractive to hummingbirds
- Requires full sun and tolerates variable soil conditions
- Drought-tolerant
- Cold hardy in zones 10 and 9



Calycanthus floridus | **sweetshrub**

- Grows from 6 to 12 feet
- Glossy dark green, fragrant leaves
- Part shade and moist soils most favorable
- Dark red flowers are pollinated by beetles

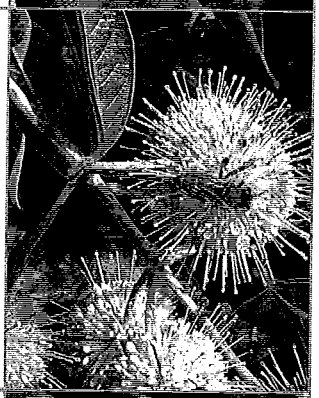


Catalpa bignonioides | **catalpa**

- Grows from 25 to 40 feet
- Large heart-shaped leaves, clusters of ruffled flowers, brown seed pods
- Wet to moist soils are most suitable
- Often host to the catalpa sphynx caterpillar
- Common bees attracted: *Bombus* and *Xylocopa*

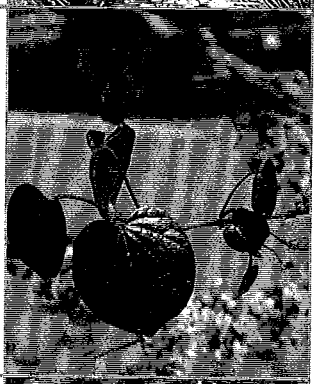
Cephalanthus occidentalis | **buttonbush**

- Grows from 6 to 12 feet
- Glossy dark green leaves and no particular fall color
- Dense, spherical clusters of flowers visited by bees, hummingbirds, hummingbird moths and butterflies
- Suited to wet soils with seeds utilized by water birds
- Common bees attracted: *Bombus*, *Ceratina*, *Hylaeus*, *Agapostemon*, *Melissodes* and *Xylocopa*



Cercis canadensis | **eastern redbud**

- Grows from 15 to 30 feet
- Tree with heart-shaped shiny leaves and showy, pink flowers
- Does well in moist, well drained soils and partial shade
- Leaf cutting bees, Megachile spp., utilize the leaves in nest construction, taking circular bites out of leaf margins
- Common bees attracted: *Andrena*, *Lasioglossum*, *Osmia*, *Xylocopa*, *Bombus* and *Colletes*

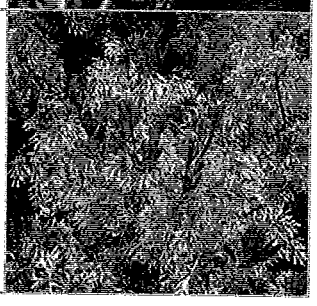


Chaenomeles speciosa | **flowering quince**

- Grows from 4 to 6 feet
- Early blooming and attractive to bees
- Average to moist, well-drained soil
- Full sun to partial shade

Chionanthus virginicus | **fringe tree**

- Grows from 15 to 30 feet
- Showy pendulous clusters of white flowers are pollinated by bees
- Dark, grape-like fruit attractive to wildlife
- Partial shade and moist soils for optimal growth



Prunus americana | **American plum**

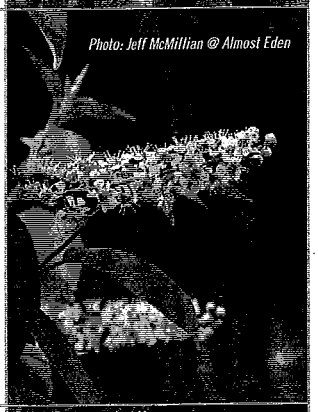
- Grows from 36 to 72 feet
- White flowers
- Medium water use
- Tolerates a wide range of light conditions
- Best in well-drained loams
- Supports honey bees, bumble bees and other native bee groups
- Common bees attracted: *Andrena*, *Lasioglossum*, *Osmia*, and *Colletes*

Prunus caroliniana | **Carolina cherry laurel**

- Grows from 15 to 30 feet
- Shiny, evergreen leaves and showy clusters of white flowers
- Does well in sun or partial shade on moist, well-drained, loose soils
- Attractive to bees and birds

Prunus serotina | **black cherry**

- Grows to 36 to 72 feet or taller
- Pendulous white flowers and yellow fall foliage
- Depending on variety, tolerates numerous soil moisture and pH conditions
- Valuable for wildlife and bees
- Larval host for numerous butterflies and moths
- Common bees attracted: *Andrena*, *Lasioglossum*, *Bombus*, *Osmia*, and *Nomada*

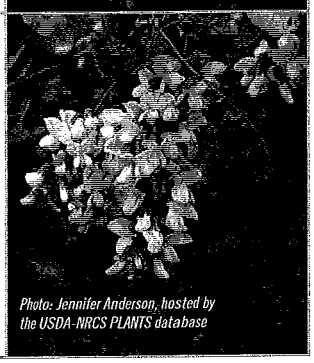


Rhus typhina | **sumac**

- Grows from 15 to 30 feet
- Bright red berries and colorful fall foliage
- Tolerates dry, even rocky, soils, variable light
- Serves as food for many bird species andju supports bees as a nesting and nectar source for native bees
- Common bees attracted: *Andrena*, *Lasioglossum*, *Bombus*, and *Agapostemon*

Robinia pseudoacacia | **black locust**

- Grows from 30 to 50 feet
- Fragrant, white clusters of flowers
- Tolerates variable soil moisture and full sun
- Highly attractive to birds, butterflies, hummingbirds, and bees
- Thorns and sprouting reduce desirability



Salix discolor | **pussy willow**

- Grows from 12 to 20 feet
- Attractive, fuzzy flower spikes
- Damp soils and full sun
- Larval food source for mourning cloak and viceroy butterflies
- Attractive to bees and butterflies
- Common bees attracted: *Andrena*, *Lasioglossum*, *Colletes*, *Bombus*, *Osmia*, *Ceratina* and *Nomada*

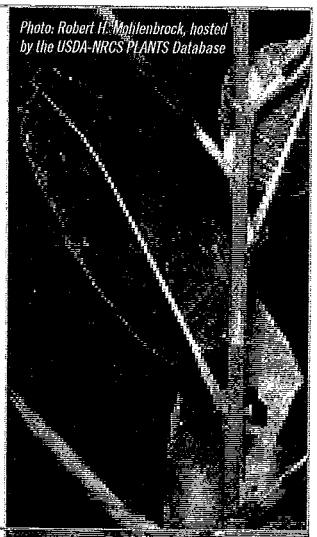


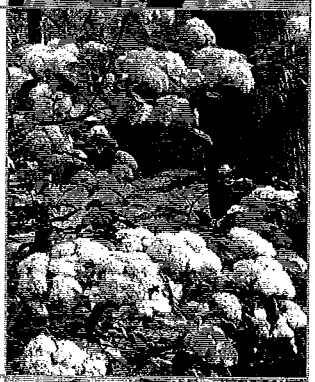
Photo: Robert H. Mohlenbrock, hosted by the USDA-NRCS PLANTS Database

Vaccinium corymbosum | **highbush blueberry**

- Grows from 6 to 12 feet
- Colorful in the fall, yellow, red and purplish hues
- Acidic soils of varying moisture levels are tolerated
- High value for bees, birds and other wildlife
- Prune after fruiting to encourage new growth and flowers
- Common bees attracted: *Andrena*, *Colletes*, and *Osmia*

Viburnum spp. | **viburnum**

- Medium to tall bushes with white flowers
- Some species, such as the arrowwood viburnum, prefer moist, sandy loam soils and full sun to partial shade
- Other species, such as mapleleaf viburnum, prefer dense shade
- Blackhaw Viburnum is adaptable to many conditions with sun to partial shade
- Attractive to bees, butterflies and fruit attractive to birds
- Common bees attracted: *Andrena* and *Lasioglossum*

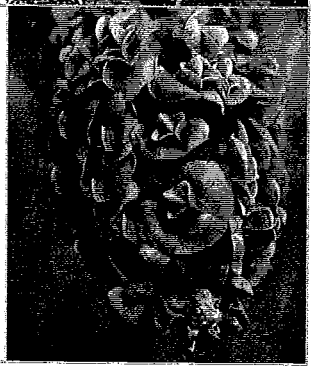


Vitex agnus-castus | **chaste tree**

- Grows from 8 to 10 feet
- Fragrant showy flower spires
- Adaptable to soil conditions in full sun
- Highly attractive to bees and butterflies

Wisteria frutescens | **American wisteria**

- Woody vine with clusters of pea-shaped, lavender blooms in early spring
- Prefers moist, fertile soil in full sun
- This native vine is not as aggressive as the invasive Japanese and Chinese wisterias and is a much better choice



Botanical Name	Common Name	Growth Habit	Native/ Non-native	Flower Color	Bloom Time								
					FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
Abelia x grandiflora	glossy abelia	shrub	non-native	white/pink			X	X	X	X	X		
Acer barbatum	southern sugar maple	small tree	native	yellow	X								
Acer rubrum	red maple	tall tree	native	yellow									
Aesculus parviflora	bottlebrush buckeye	shrub	native	white				X	X	X			
Aesculus pavia	red buckeye	shrub	native	red		X	X	X					
Aesculus sylvatica	painted buckeye	shrub	native	yellow/ green/pink		X	X	X					
Amelanchier spp.	serviceberry	small tree	native	white	X	X							
Aronia arbutifolia	red chokecherry	shrub	native	white				X					
Baccharis halimifolia	groundsel bush	shrub	native	white							X	X	X
Bignonia capreolata	crossvine	woody vine	native	orange/red			X	X	X				
Callicarpa americana	American beautyberry	shrub	native	lavender				X	X	X			
Callistemon citrinus	red bottlebrush	small tree	non-native	red					X	X			
Calycanthus floridus	sweet shrub	shrub	native	red				X	X				
Catalpa bignonioides	catalpa	medium tree	native	white				X	X				
Cephalanthus occidentalis	buttonbush	shrub	native	white					X	X	X		
Cercis canadensis	eastern redbud	medium tree	native	pink	X	X							
Chaenomeles speciosa	flowering quince	small tree	non-native	pink/white/ rose red		X	X	X					
Chionanthus virginicus	fringe tree	medium tree	native	white			X	X					
Clethra alnifolia	clethra	shrub	native	white/pink						X	X		
Cladrastis kentuckea	American yellowwood	tall tree	native	white			X	X					
Cornus florida	dogwood	medium tree	native	white		X	X						
Crataegus spp.	hawthorn	small tree	native	white		X	X						
Diospyros virginiana	persimmon	medium tree	native	white/ green/ yellow				X	X				
Edgeworthia chrysantha	paperbush	shrub	non-native	white/gold	X	X	X						
Euonymus americanus	strawberry bush	shrub	native	green/white				X	X				
Halesia tetraptera	silverbell	shrub	native	white			X	X					
Hamamelis virginiana	witch hazel	small tree	native	yellow								X	X

Botanical Name	Common Name	Growth Habit	Native/ Non-native	Flower Color	Bloom Time								
					FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
Hydrangea macrophylla	lacecap hydrangea	shrub	non-native	white/blue/ pink					X	X	X		
Hydrangea quercifolia	oakleaf hydrangea	shrub	native	white				X	X				
Ilex decidua	possumhaw	shrub	native	white		X	X	X					
Ilex opaca	American holly	small tree	native	white		X	X	X	X				
Ilex verticillata	winterberry	shrub	native	white					X	X			
Ilex vomitoria	yaupon holly	small tree	native	white			X	X					
Itea virginica	sweetspire	shrub	native	white				X	X				
Koelreuteria paniculata	golden raintree	medium tree	non-native	yellow					X	X			
Lagerstroemia spp.	crape myrtle	tree size varies	non-native	white/pink/ purple/ red					X	X			
Liriodendron tulipifera	tulip tree	tall tree	native	white/yellow			X	X					
Lonicera sempervirens	coral honeysuckle	Vine ground cover	native	red/yellow		X	X	X	X				
Malus angustifolia	southern crabapple	small tree	native	white	X	X							
Nyssa sylvatica	tupelo	tall tree	native	white			X						
Prunus americana	American plum	medium tree	native	white									
Osmanthus americanus	wild olive	shrub	native	white/ orange								X	X
Oxydendrum arboreum	sourwood	tall tree	native	white					X	X			
Physocarpus opulifolius	ninebark	shrub	native	white				X	X				
Prunus serotina	black cherry	medium tree	native	white	X	X							
Prunus caroliniana	Carolina cherry laurel	medium tree	native	white/pink	X	X							
Rhus typhina	sumac	medium tree	native	yellow					X	X			
Robinia pseudoacacia	black locust	tall tree	native	white			X						
Salix discolor	pussy willow	shrub	native	white/yellow	X	X							
Vaccinium spp.	highbush blueberry	shrub	native	white/pink			X	X					
Viburnum spp.	viburnums	shrub	native and non-native species	white				X	X	X			
Vitex agnus-castus	chaste tree	medium tree	non-native	white/pink/ purple					X	X			
Wisteria frutescens	American wisteria	Woody vine	native	lavender		X	X						

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The *Eco-Friendly* Garden:

Attracting Pollinators, Beneficial Insects, and Other Natural Predators

Bethany Harris, Kris Braman,
Bodie Pennisi, and Maria Putzke

Introduction

Why attract insects to your landscape? Although insects supply valuable services to landscapes and ecosystems, they are often perceived negatively. In actuality, insect pollinators are necessary for crop production **and** for the viability of wild plant species. Insects also help in the regulation of pests that destroy agricultural crops and in decomposition, helping to aerate the soil. These ecological services are referred to as **arthropod-mediated ecosystem services (AMES)**. Because insects are so necessary and beneficial to the landscape, the use of plant species that support these insects is important.

Recent studies in ecology (the interactions between organisms, their environment, and each other) have found that the way people choose to landscape in urban areas can affect the biodiversity of that area. **Biodiversity** is the variety among and within plant and animal species. Higher biodiversity in a landscape makes for a healthier ecological environment. With the use of native ornamental plants, gardeners and landscapers can help improve their local environment.

"Habitat management" refers to the use of insect-attracting plant species in order to intentionally draw insects to garden areas and urban landscapes. These plants provide a refuge for the insects during winter as well as nectar and pollen resources. Landscape arrangement directly affects beneficial insect populations, those insects that can provide ecological benefits such as biodiversity and natural pest control. This concept of habitat management can lead to potential increases in pollinating and other beneficial insect populations. An increase in these populations in landscapes will contribute to improved pollination of plants and biological pest control and reduce the need for pesticides. A pollinator-friendly and ecologically sustainable garden is both beautiful **and** able to attract and sustain beneficial insects.

What Kinds of Insects are Common Visitors in a Garden?

Three types of insects are commonly found in an ornamental garden. There are pollinators (Figure 1), plant-eating insects, and beneficial insects. Pollinators aid in the pollination of plant species by carrying pollen from one plant to another or within one plant. This process guarantees that the plant will produce fruit and seeds. Spiders also are considered beneficial (because they feed on many plant-feeding insects); however, they are not considered insects by entomologists; one difference being that the true insects have six legs while spiders have eight. For our purposes, we will include spiders in the 'beneficial insect' group. Beneficial insects are, simply put, 'good bugs' that eat 'bad bugs.' They are those insects that naturally prey on pests found in gardens and ornamental landscapes.

Figure 1. Bees are an important pollinator species that contribute greatly to the world's food production. However, evidence suggests that pollinator insect populations are declining worldwide.

What Were the Research Goals?

We studied habitat management in order to provide detailed information on the attractiveness of a wide selection of ornamental floral resources to pollinators, natural enemies, and plant-eating insects, as well as to determine the effects of various plant attributes on insect visitations.

Our overarching goal is to foster biodiversity in residential and commercial landscapes. We studied which plants and plant attributes are best able to attract ecologically important insects most often. By increasing the use of such plants, we can begin to improve ecological health and increase biodiversity in the landscape. A garden that provides suitable foraging sites with adequate and diversified nectar sources (such as shrubs, trees, and flowers) can increase viable populations of insects that will in turn help the garden to thrive. Just as important is understanding the relationships that bring about biodiversity, for example, flowers attract not only butterflies but also plant-feeding insects, which in turn attract natural predators who feed on them (Figure 2).

Figure 2. The plant whirling butterfly *(Gaura)* is highly attractive to pollinators and also aphids. The ladybug is a natural predator who feeds on the aphids.

Attracting insects to landscapes through the use of native and flowering plants can lead to increases in agricultural production and limitations of pesticide inputs.

How Was the Research Done?

The research was conducted at the University of Georgia campus in Griffin, Georgia. The Butterfly and Conservation Garden was established in the fall of 2012 and contains approximately 70, mostly perennial species, many of which are native plant species (Figures 3A, 3B, 4A, 4B, and 4C; Table 1).

Figure 3A. The Butterfly and Conservation Garden in October 2012 at installation.

Figure 3B. The Butterfly and Conservation Garden in July 2013.

Figure 4A.
A variety of foliar textures and colors were mixed with flowering plants to ensure not only that plants are attractive to insects but provide aesthetic appeal as well. *Hibiscus* 'Mahagony Splendor' and *Curcuma* 'Emperor' bold foliage complement the yellow flowers of tri-leafed coneflower, *Lantana* 'Mozelle,' and the pink blossoms of Eupatorium 'Gateway.'

Figure 4B.
Colocasia 'Black Stem' (center) and butterfly ginger's (top left) upright habit provide height and bold foliage complementing the flowers of salvia 'Mystic Spires' and smooth aster 'Bluebird' as well as the fine-textured foliage of blue star (photo taken in October 2014, when foliage was starting to turn yellow).

Figure 4C.
Shrubs planted included top left: naturalized senna (*Senna* x *floribunda*), bottom left: native buttonbush, top right: non-native glossy abelia 'Raspberry Profusion,' and bottom right: variegated hidden ginger (*Curcuma* 'Emperor').

Table 1. Complete list of perennial plants trialed at the gardens.

Abelia 'Raspberry Profusion'	*Foeniculum vulgare*
Achillea 'Sunny Seduction,' 'Coronation Gold'	*Gaura lindheimeri* 'Passionate Blush'
Agastache 'Acapulco,' 'Black Adder' †'Raspberry Nectar'	*Hedichium coronarium*
Amsonia hubrichtii	*Hedichium coccineum*
Asclepias incarnata	*Heliopsis scabra* 'Summer Sun'
Asclepias physocarpa	*Hibiscus* 'Mahogony Splendor'*
Asclepias tuberosa 'Hello Yellow'	*Lantana camara* 'Mozelle,' 'Miss Huff'
Aster dumosus 'Wood's Pink'	*Lonicera sempervirens* 'Major Wheeler'
Aster laevis 'Bluebird'	*Lysimachia* 'Firecracker'
Aster tataricum 'Jindai'	*Melissa officinalis*
Astilbe 'Visions in Pink'	*Monarda didyma* 'Raspberry Wine'
Belamcanda chinensis	*Nepeta x faassenii* 'Walker's Low'
Buddleia 'White Profusion'	*Passiflora incarnata*
Caryopteris x clandonensis 'First Choice'	*Petroselinum crispum*
Cassia x floribunda	*Petunia x hybrida* 'Fuseables'
*Celosia spicata**	*Phlox paniculata* 'Robert Poore'
Ceratostigma plumbaginoides	*Rudbeckia triloba*
Cephalanthus occidentalis	*Rudbeckia* 'Indian Summer,' 'Goldstrum'
Clethra alnifolia 'Hummingbird'	*Ruellia brittoniana* 'Purple Showers,' 'Katie White'
Colocasia 'Black Stem,' 'Pink China'	*Salvia microphylla* 'Hot Lips'
Coreopsis 'Big Bang Cosmic Eye,' 'Red Shift'	*Salvia x hybrida* 'Wendy's Wish'
Coreopsis auriculata 'Snowberry'	*Salvia leucantha* 'Santa Barbara'
Curcuma petiolata 'Emperor"	*Salvia* 'Mystic Spires'
Dendranthema 'Cambodian Queen'	*Senna x floribunda*
Dianthus 'Coconut Surprise,' 'Cheddar Pink'	*Solenostemon scutellarioides* 'Fuseables'
Dicliptera suberecta	*Stachys byzantina*
Digitalis purpurea 'Alba,' 'Excelsior Hybrid'	*Thunbergia alata*
Echinacea purpurea 'Magnus'	*Verbena bonariensis*
Eupatorium rugosum 'Chocolate'	*Verbena canadensis* 'Taylortown Red'
Eupatorium purpureum 'Gateway'	*Zinnia linearis* 'Starbright' *

**annual species*

† *In Georgia, some Agastache hybrids are more suitable when grown as annuals and replanted each year.*

The plants used in the garden were selected based on their attractiveness to pollinators and beneficial insects, their horticultural attributes, current availability in the trade, and their adaptability to a Southeastern growing environment. Pollinator-friendly garden plants can provide not only nectar and pollen, but also food — in the form of foliage for immature butterflies. For example, fennel, parsley, lemon balm, and passion flower were incorporated in the planting to serve as food source for the larval stages of various insect species. No pesticides were used for pest control throughout the study.

Our study focused primarily on pollinators visiting the garden, which included bees, wasps, flies, butterflies, moths, and beetles. Other considerations included: interesting foliage, extended blooming (spring to fall for seasonal interest), and low-maintenance (Figures 4A, 4B, and 4C; Table 1). Most of the plants we used require full-sun growing conditions, while a few species are better adapted to some shade. In addition to different color blooms, an aesthetically pleasing landscape incorporates a variety of the following:

- blossom size – many small flowers on an inflorescence to few large ones
- foliar textures – fine to coarse
- foliar colors – chartreuse to purple
- plant height – groundcovers to bushes

In order to assess the many insects that visited the garden, we used several methods. Insect activity, abundance, and diversity were evaluated through visual observations and sweep net (sampling of the plants through an aerial net), color pan, and sticky card trappings (Figure 5). The color pan trapping involved the use of colored plastic cups and bowls filled with soapy solutions, which served as traps for the insects. The sticky card trapping was used to monitor flying insect species that might not have been observed through the other methods. Yellow sticky trap cards were placed on utility posts at heights of 2 feet and 4 feet.

Figure 5. Insects were captured with an aerial net (left), sticky cards (right), and color pan traps (center).

What Were the Results?

Insect Types

We observed the following groups of insects: pollinators, beneficial insects (including spider species), and plant-feeding insects throughout the trial. Common pollinator species included: bumble bee (two species) (Figure 6), honey bee, carpenter bee (one species), small bee (13 species), paper and potter wasps, thread-waisted wasps, mud daubers, syrphid flies, other flies, and long-legged flies (Figure 7). The two types of pollinators seen in larger numbers were bees and flies, followed by wasps (Figure 8).

Figure 6. Left to right: small bee, bumble bee, and other bees (two on the right).

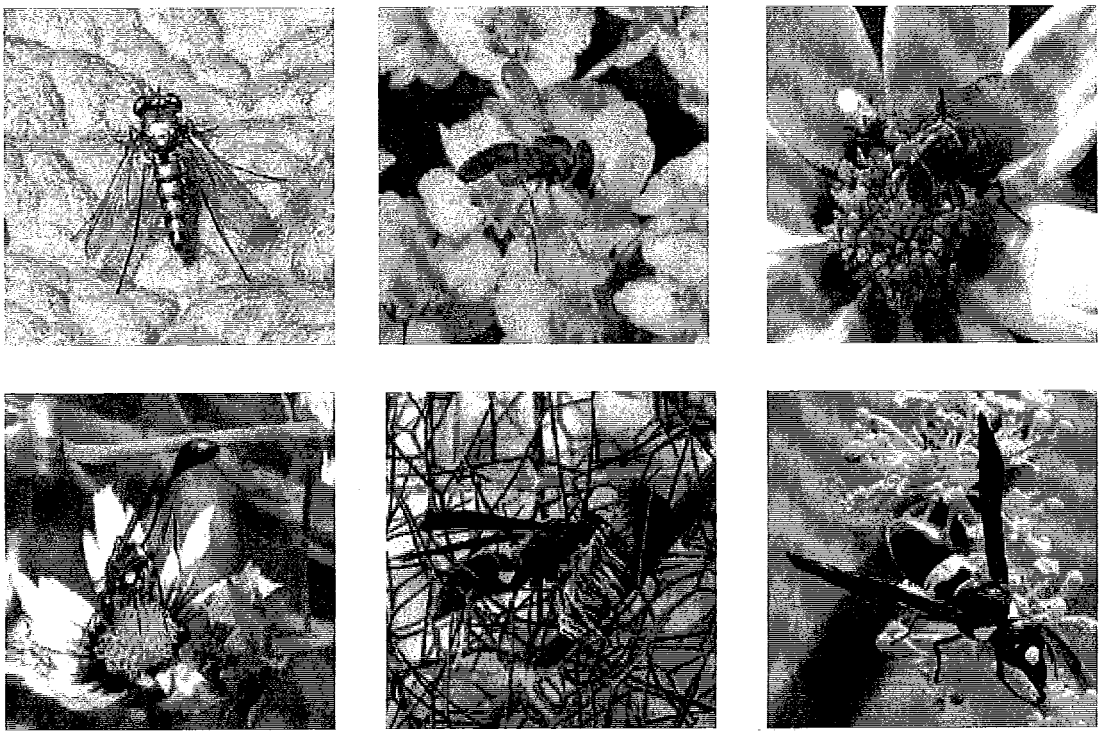

Figure 7. Top row: long-legged fly, syrphid fly and other fly. Bottom row: wasps.

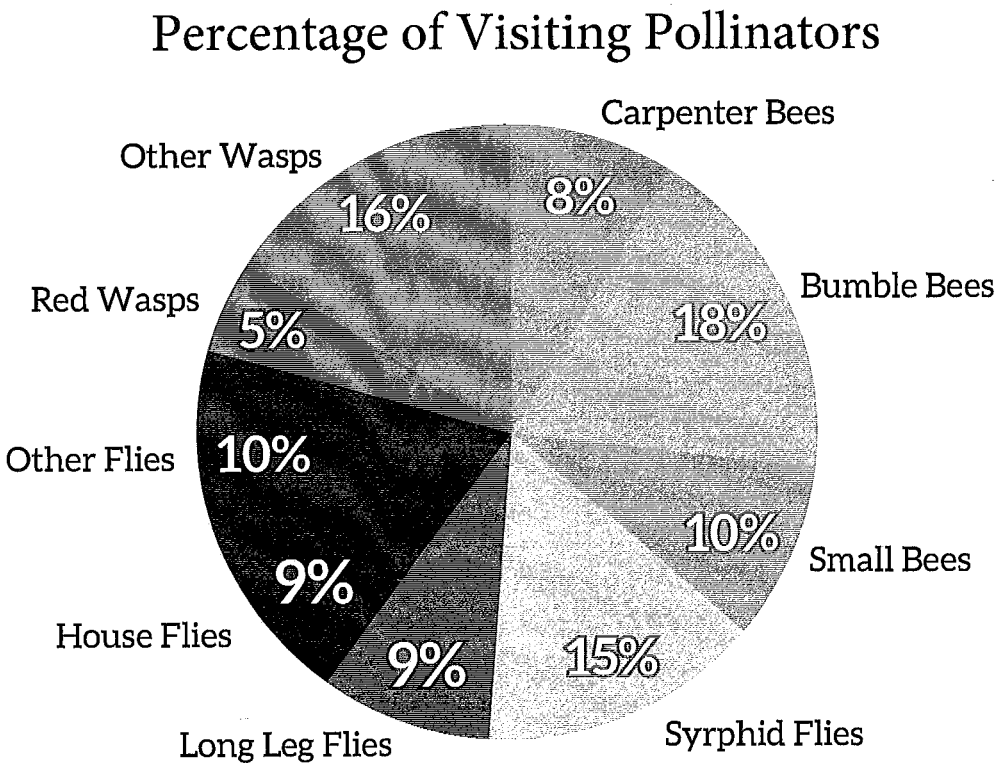

Figure 8. Insects as a percentage of the total amount of visiting pollinators; the two most common types of pollinator visitors were bees and flies, followed by different species of wasps.

Common lepidopteran species (butterflies and moths) that visited the garden included various skipper butterflies, Eastern swallowtail butterflies, sulphur butterflies, cabbage white butterflies, variegated and Gulf fritillary butterflies, common buckeye butterflies, American/painted lady butterflies, Eastern blue butterflies, and hummingbird moths (Figures 9A, 9B, and 9C). The most common types of butterfly visitors were skippers, followed by American/painted ladies and swallowtails (Figure 10).

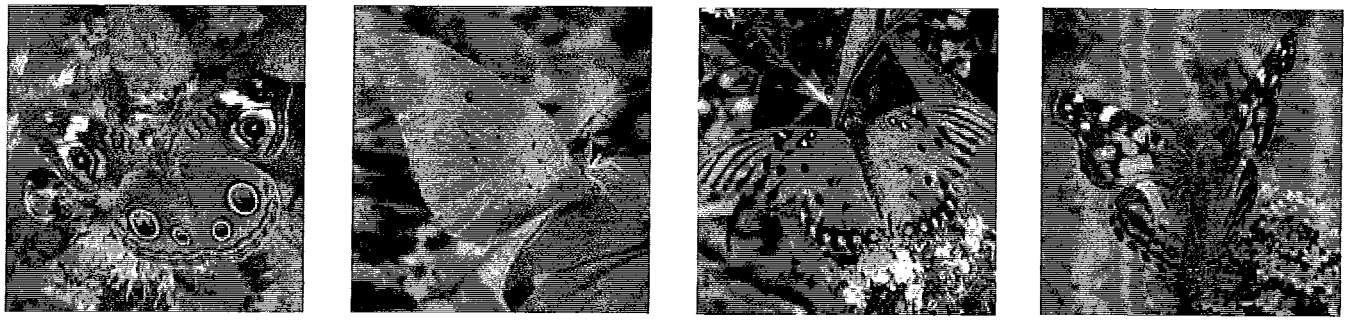

Figure 9A. From left to right: common buckeye, sulphur, fritillary, American/painted lady.

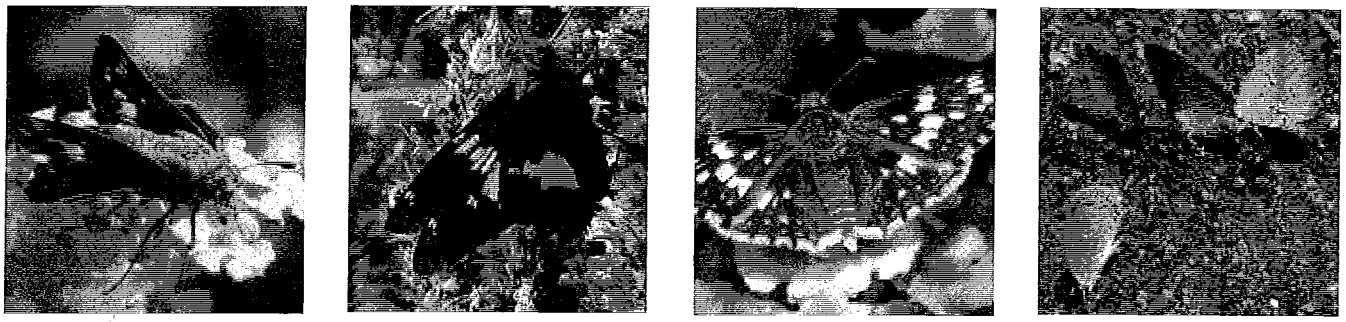

Figure 9B. From left to right: fiery skipper, silver-spotted skipper, checkered skipper, Eastern blue butterfly.

Figure 9C. From left to right: Eastern swallowtail, hummingbird moth, tiger swallowtail.

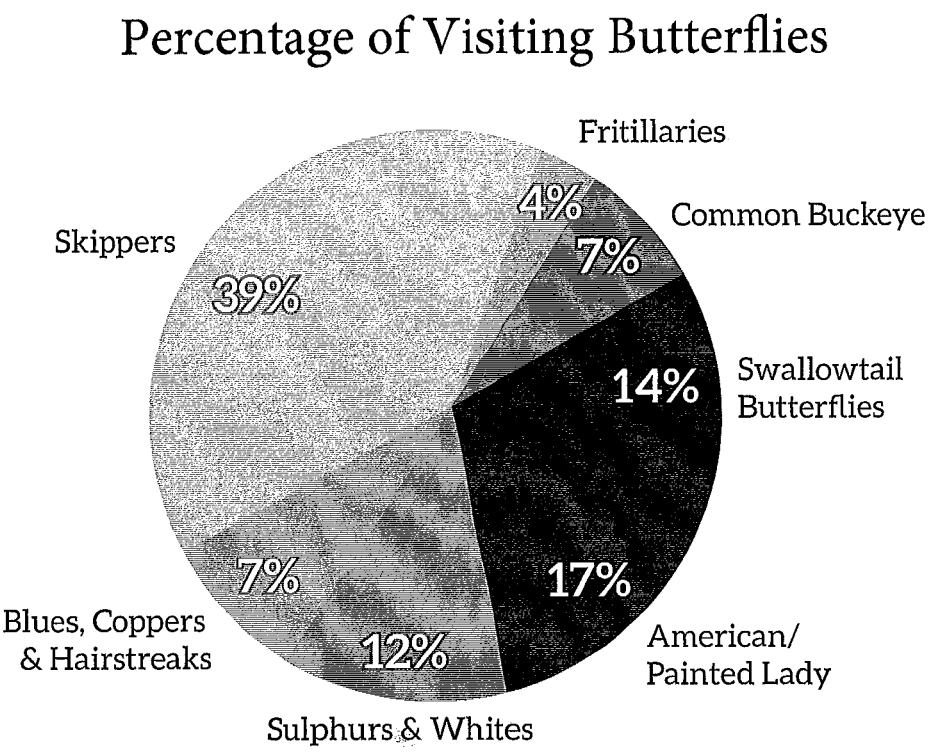

Figure 10. Percentage of visiting butterflies; most common were Skipper Butterflies, followed by American/Painted Lady, Swallowtails, and Common Buckeye.

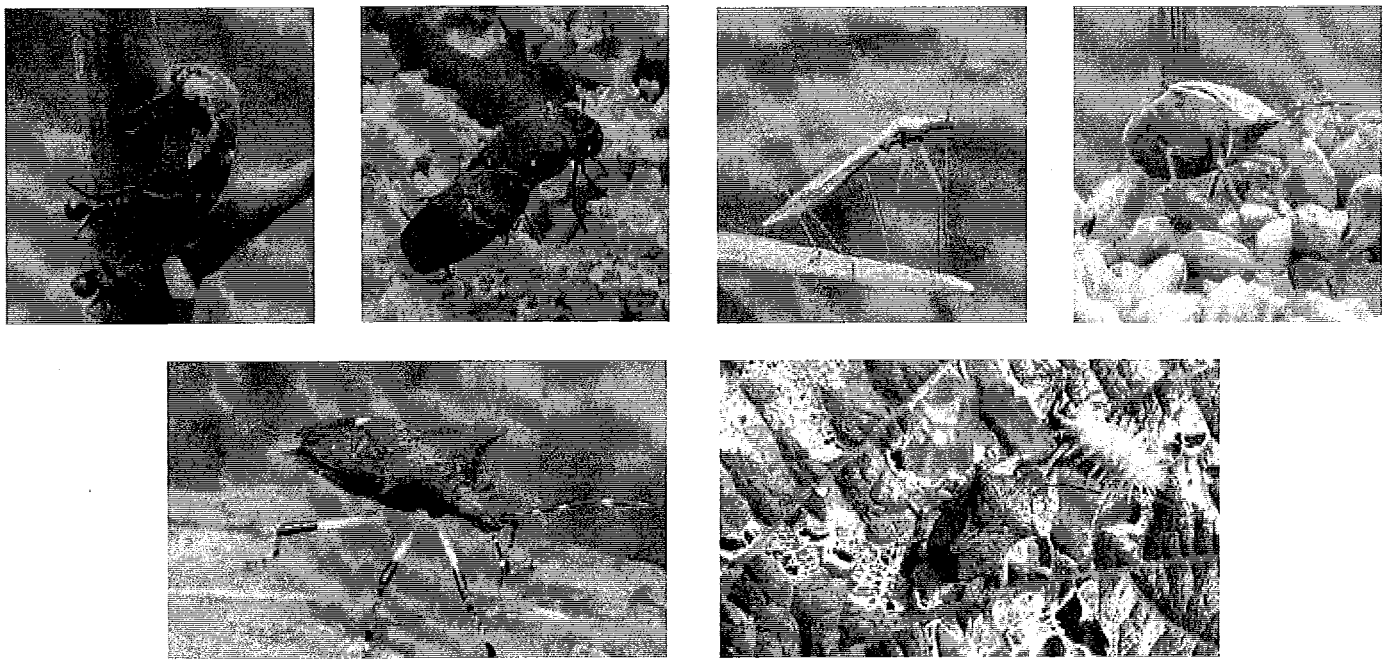

Figure 11. Top row: plant-feeding insects. From left to right: buffalo treehopper, tumbling flower beetle, green stink bug, stilt bug. Bottom row: predaceous stink bugs. From left to right: black stink bug, *Proxys punctulatus* (Palisot), and brown spined-soldier stink bug, *Podisus maculiventris* (Say). The pointy shoulders of the predaceous stink bugs can be one of the distinguishing features between 'good' stink bugs (i.e., those that eat pests), and 'bad' stink bugs (i.e., those that eat plants). The other distinguishing feature is the mouth parts, slender in the herbaceous type and thicker in the predaceous type.

In addition to pollinators, other visitors to the garden included plant-feeding insects, such as leafhoppers/treehoppers, stink bugs, flea and leaf beetles, tumbling flower beetles, and stilt bugs (although some species of stilt bugs can also be predators feeding on aphids) (Figure 11). Leafhoppers/treehoppers and stink bugs feed on plant sap, while the insects listed feed on pollen and other flower parts. The following species of leafhoppers were observed: buffalo treehopper, glassy-winged sharpshooter, and red-banded leafhopper. These insects were often seen by March or April and visited the garden throughout the summer and early fall. Stink-bug species fall into two categories — predaceous stink bug and plant-feeding stink bug. Predaceous stink bugs feed on beetle larvae, caterpillars, and other insects. Plant-feeding stink bugs feed on plant sap.

We also observed spider predators, such as green lynx spiders, white-banded crab spiders, wolf spiders, daddy long-legs spiders, golden silk spiders, and orb-weaver spiders (Figure 12).

Both beneficial insects/spiders and plant-feeding insects were seen in approximately equal numbers (Figure 13).

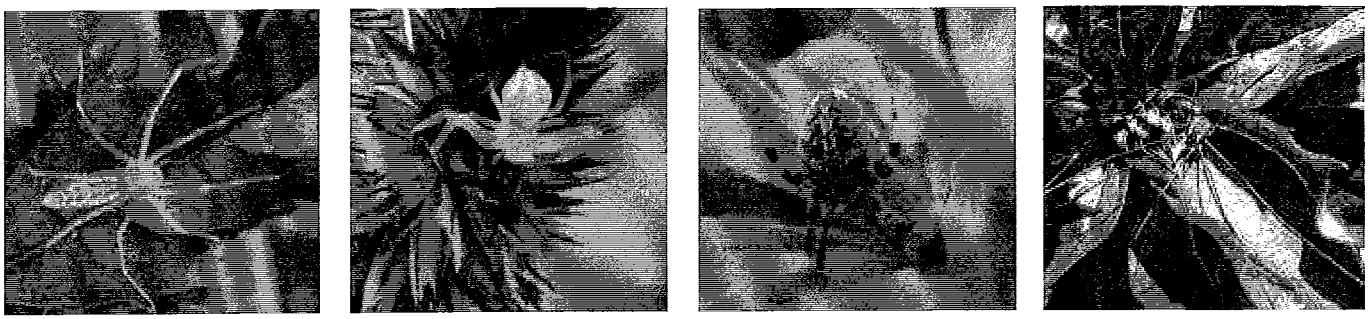

Figure 12. Spiders species encountered in the garden. From left to right: green lynx spider, white-banded crab spider, wolf spider, daddy long-legs spider.

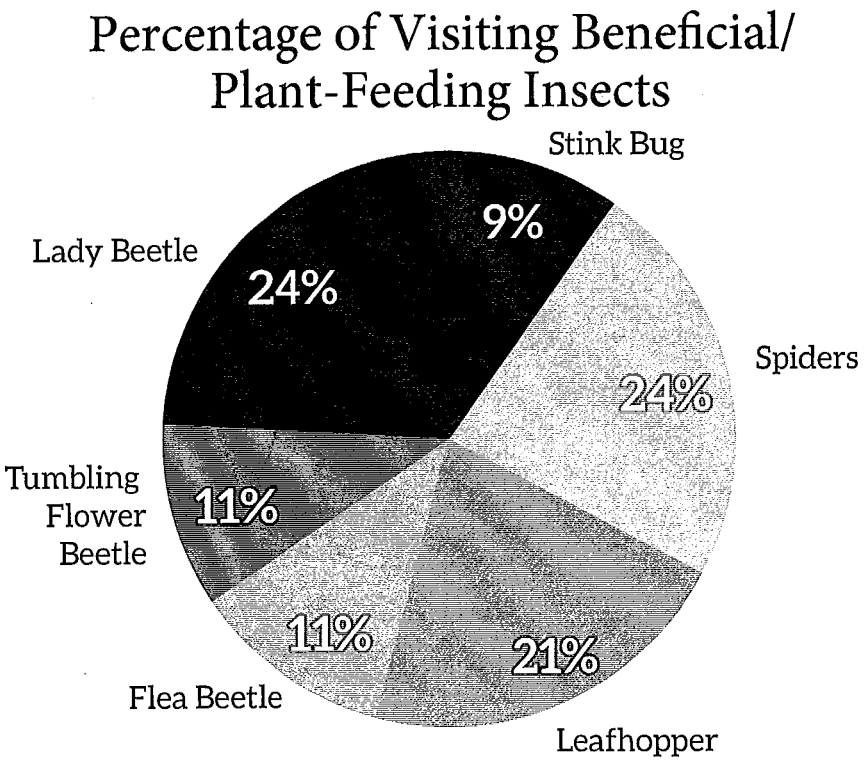

Figure 13. Types of beneficial/plant-feeding insects observed in the garden by percentage of total visiting beneficial/plant-feeding insects.

Some plant-feeding insects can be tolerated because they will help keep the presence of natural enemies of insects in the garden. If we eliminate all pests, the natural enemies will leave the area in search of food. To have a successful habitat management site, it is crucial to increase pest suppression by providing adequate resources for the natural enemies of those pests. One way of achieving this is by choosing the appropriate plants for the managed area. Some criteria used to determine which plants to choose for habitat management of insects included:

- attractiveness to natural enemies
- rich production of pollen and nectar
- seed accessibility
- availability of floral resources

Choose plants with sweet, pungent, highly fragrant flowers; red, purple, orange, yellow, or pink flower colors; and simple, open flowers. Native annual and perennial plants are preferred because they adapt locally, increase native plant diversity of the region, minimize recurring costs, and help with habitat permanency. Often, native plants have reduced water, nutrient, and sometimes pest control requirements because of their adaptation to the local climate.

If you want to have a large and viable population of active butterflies, your garden must provide more than just a source of nectar. Suitable habitat for over-wintering, storm protection, and overnight staging must also be provided. In order to attract butterflies all summer, you not only need nectar producing plants, but also larval food plants and a shallow pool of water (e.g., flat rocks that can hold water). You must also include salt sources, resting areas, and roaming areas in your garden. Many grasses and wildflowers native to Georgia provide suitable food for larvae. Establishing a pesticide-free habitat through the use of natural enemies of pests in place of chemical pesticides will also help you increase the population of active butterflies in your landscape.

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Bulletin 1456 **May 2016**

TESTING FOR WATER QUALITY

UGA extension

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When you pour yourself a glass of water to drink, it may appear clean, taste good, and you may expect it to be safe. However, many sources of water we assume are safe may contain dissolved minerals, organic compounds or even live organisms at harmful concentrations. Contaminated water used for drinking and cooking may affect your health. Also, high concentrations of certain minerals in your water can result in quality issues such as unpleasant taste and odors or staining of bathroom fixtures and/or laundry.

In 2009, the U.S. Geological Survey (USGS) released a report on test results of private well water from 30 of the nation's 62 principal aquifers across the United States. Important findings were:

- one of every five private wells contained one or more contaminants at concentrations exceeding the U.S. Environmental Protection Agency's (EPA) human health benchmarks
- approximately half of all wells had at least one problem
- a third of all wells had microbial contamination

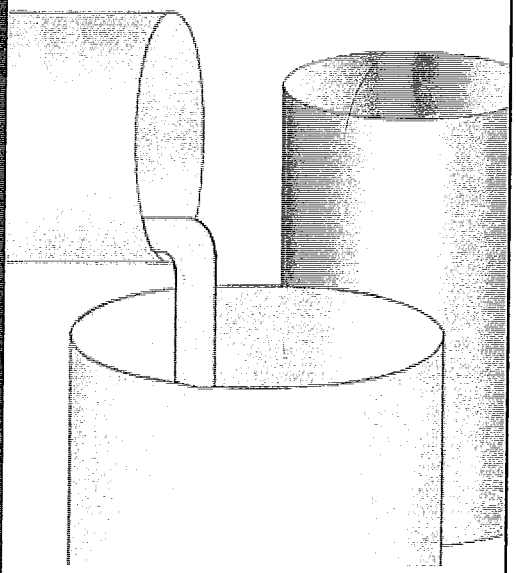
The quality and safety of drinking water is of great concern to many Americans today because of an increased interest in health and environmental quality. This new focus on water quality has led many Americans to consider testing their water. This publication is intended to help you understand water testing and to identify the tests needed.

WATER TESTING FOR PUBLIC WATER SUPPLIES

A Public Water System (PWS) is one that has at least 15 service connections or serves at least 25 people per day for at least 60 days of the year. If you receive drinking water from a PWS, the source of drinking water is either a surface water reservoir, a public well that pumps groundwater, or both. A system of pipes distributes the water to you and your neighbors. When your home is on a PWS, there are fewer concerns about water quality and safety because they are routinely tested and treated (if needed) for potential contaminants according to the EPA "Safe Drinking Water Act (SDWA)-1974."

The Environmental Protection Division (EPD) of Georgia ensures that all public water systems in the state continuously meet SDWA standards. Occasionally, problems such as spills, floods or treatment malfunctions do prevent the PWS from meeting water quality standards. Consumers are notified immediately of such violations and advised if any corrective actions (such as boiling water) are required. In 1996, Congress amended the SDWA, requiring PWSs to begin providing annual drinking water quality reports to customers beginning in 1999. The report is referred to as Consumer Confidence Report (CCR). If you have not received your CCR, you may request it by contacting your water utility company.

The CCR is usually based on the source water at the treatment plant. It is possible that water meets SDWA standards when it leaves the public water treatment plant but does not meet those standards by the time it reaches your kitchen or bathroom sink. For example, water can pick up lead from lead solder found in homes with plumbing installed before 1987 or from lead pipes found in very old homes. You may want to test your household water even if it comes from a PWS if there is a possibility of in-house contamination due to your home's plumbing, connections or treatment system.



HOUSEHOLD WATER QUALITY SERIES 2

WATER TESTING FOR PRIVATE WATER SUPPLIES

Government agencies do not monitor or regulate water quality in private wells, and water testing is not required by any federal or state regulation. If you are one of the 1.7 million Georgians with a private well, you are responsible for the quality and safety of your well water. Testing your well water quality is important to your health. Properly constructed and maintained water wells can provide many years of trouble-free service. However, surface contaminants may enter the well if it is not properly constructed and maintained, and the well may eventually deteriorate or become damaged as it gets older. In addition, some groundwater naturally contains one or more chemical substances at levels above the EPA's health-based standards, called the Maximum Contaminant Levels (MCLs). The taste, odor and appearance of your drinking water can give you an indication of its quality, but it does not indicate if the water is really safe or unsafe to drink. Contaminated water can taste and smell fine, whereas unpleasant-tasting or -smelling water can be safe to drink or use. Many of the most serious problems can only be detected through laboratory testing of the water.

TYPES OF WATER QUALITY TESTS

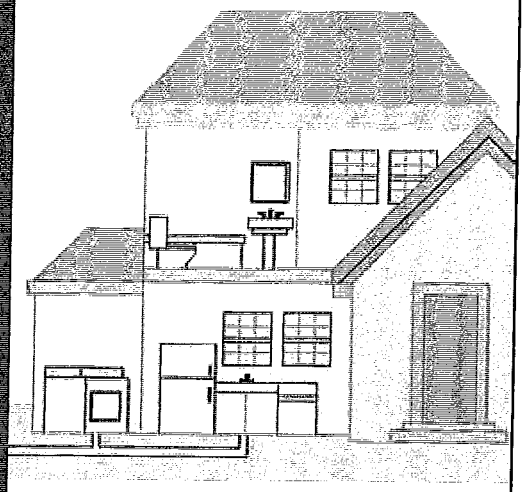
In general, water testing can be classified as bacterio¬logical, mineral/inorganic and organic chemicals tests.

- **Bacteriological tests** generally check for indicator bacteria (for example, total coliform, fecal coliform or *Escherichia coli*) and can indicate the presence or absence of disease-causing bacteria. However, there are many types of bacteriological tests that cover a variety of bacteria. These tests are costly and are conducted only if they are absolutely essential.
- **Mineral tests** can determine if the mineral content of your water is high enough to affect either health or the aesthetic and cleaning capacities of your water. A mineral test may include calcium, magnesium, manganese, iron, copper, zinc and some others. An abundance of these minerals can cause hard water, plumbing and laundry stains, or bad odors.
- **Organic chemicals** tests are generally performed only if there is reason to believe a specific contaminant has infiltrated the water system (such as pesticides entering the water supply). Industrial and petroleum contamination can also be found through organic chemical testing.
- **Other tests** may be conducted on radiological contaminants (radium and radon) or heavy metals (such as arsenic, mercury, lead or cadmium) based on the suspected natural and anthropogenic (man-made) sources of such contaminants.

WHEN SHOULD I TEST MY WELL WATER?

After construction of a new well or when an unused old well is brought back to service, make sure that the water is safe to drink. Consult a drinking water specialist at a water testing laboratory, local health department or your local county Extension agent to get information about the local contaminants of concern. Water quality remains fairly stable if the well is properly constructed and maintained. Even if your current water supply is clean and safe to drink, regular testing is important because it establishes a record of water quality that may help solve future problems. It is also necessary to regularly check the well for potential mechanical problems (improper well construction and/or poor soil filtration), especially in late winter or early spring after a heavy rainstorm. Test the water once each year for total coliform bacteria, nitrates, total dissolved solids and pH levels. If you suspect other contaminants, you should test for those as well.

In contrast, the quality of water in defective wells may change suddenly and remain unnoticed as the water may look, smell and taste the same. More frequent testing and corrective actions may be required.



During home sale transactions, some lending institutions require drinking water testing for lead, nitrate and bacteria before mortgage approval. Contact both the lending institution and the local health department for information on required tests.

After a new well is drilled or an existing well is opened for pump repair/replacement or any other maintenance, test your water for coliform bacteria to ensure that surface water is not entering the well. Take the sample only after shock chlorination and substantial flushing of the water system.

You should also consider testing your water if:

- your well does not meet construction codes, including deteriorated/damaged wellcap, well casing or curbing (concrete slab)
- family members or guests consuming the well water complain of gastrointestinal ailments
- anytime a pregnant woman, woman anticipating pregnancy or infant under the age of six months uses well water for drinking
- you are concerned about the presence of lead pipes or soldering in your home
- your water or pipes show signs of deterioration (e.g., water with a strange color, odor, taste or consistency, or pipes that are corroded or leaking)
- your water stains plumbing fixtures and laundry.
- you notice a water quality change after a heavy rain or an unexplained change in a previously trouble-free well (e.g., funny taste, cloudy appearance, etc.)
- you spill fertilizers, pesticides, oil, gasoline or other toxic substances on the ground within 500 feet of the well or in the well
- you have experienced some problems near your well (e.g., the area around the wellhead has been flooded or submerged, there have been land disturbances or new waste disposal sites nearby)
- you notice a substantial development in your area with land uses that handle hazardous chemicals
- you hear about new contamination problems in your area
- your neighbors find toxic chemicals in their well water
- you installed a new treatment system or replaced the main component of the existing one (filter media or cartridge)
- you detected that back-siphoning has occurred due to vacuum break failure or any other reason
- your water or well system has been contaminated or is suspected to have been contaminated by human or animal waste
- you discovered that your (or your neighbor's) septic system absorption field is within 100 feet of your well
- you detected that your heating oil tank or underground fuel tank near the well has leaked

WHICH TESTS SHOULD I REQUEST FOR MY WELL WATER AND HOW OFTEN?

No single test provides information on all possible contaminants, but water quality can be determined by the right test(s). Some contaminants, called ***primary contaminants***, can be a health risk if present in concentrations above the primary MCL (Maximum Contaminant Level). These include microorganisms such as bacteria, viruses or protozoa; inorganic chemicals such as arsenic, lead or nitrate; and organic chemicals such as insecticides, herbicides, fuel and solvents. Some contaminants, while not a health risk, can affect acceptability of water for domestic use if their concentrations exceed the secondary MCL. Given the long list of potential water contaminants, it may be cost prohibitive and in most cases unnecessary to test for all of them. **Table 1** lists the water tests appropriate for some common situations; **Table 2** summarizes some common water quality concerns, their causes and relevant water testing; and **Table 3** includes some unique situations and required water testing. These tables are just guidelines and do not replace the need for an expert opinion from a water specialist. Consult an expert if you suspect any contaminant that could present an immediate or long-term health risk. Your local county Extension agent,

a professional from the local health department or a water specialist from your testing laboratory can help.

Table 1. Generally recommended water tests for private wells in Georgia.

Testing Objective	Type of Test	Testing Frequency	Geographical Regions
Minimum Testing Recommendations			
Well Maintenance	**Bacteria**	Annual	All geographical regions
	Nitrates (Total Nitrate and Nitrate+Nitrite)	Annual	
	Turbidity and Color	Annual	
	Comprehensive Water Chemistry: Basic Water Chemistry (see below) plus Alkalinity, Soluble Salts (or Total Dissolved Solids), Nitrate, Chloride, Fluoride and Sulfate	Initially and then every 3 years	
	Basic Water Chemistry: pH, Hardness, Aluminum Calcium, Chromium, Copper, Iron, Magnesium, Manganese and Zinc	Annually after initial comprehensive water chemistry	
Additional Testing Recommendations			
Verification of Potential Contamination	**Lead and Copper**	At least once and then yearly follow-up for: 1) houses with plumbing that pre dates the 1987 plumbing codes with copper piping with lead solders 2) very old houses in which there are lead pipes 3) houses with brass and/or chrome fixtures (brass contains 3-8% lead; chrome fixtures contains lead)	All geographical regions
	Arsenic	At least once and then a yearly follow-up	Southern Coastal Plain region below the "Fall Line" on the Georgia map
	Uranium	At least once and then a yearly follow-up	Piedmont-Blue Ridge regions above the "Fall Line" on the Georgia map
	Volatile and Semi-volatile Organic Compounds, Pesticides, Petroleum Hydrocarbons and Other Organics	Not required on a regular interval; recommended only when contamination is suspected.	All geographical regions

Table 2.
Water quality concerns, common signs, causes and recommended test(s).

Concerns	Common Signs	Causes	Recommended Tests
Appearance	Reddish-brown or yellowish	Dissolved organic matter or iron	Iron and Tannin
	Frothy or foamy	Detergents	Detergents or Total Anionic Surfactants
	Cloudy	Suspended sediments	Turbidity and Total Suspended Solids
	Slimy brown precipitate	Dissolved iron with iron-bacteria	pH, Iron and Bacteria
	Black flakes or particles	Dissolved manganese	pH and Manganese
Stains on bathroom fixtures or clothing	Red or Brown	Dissolved iron	pH and Iron
	Yellow	Dissolved iron, hydrogen sulfide, hard water	pH, Hardness, Iron and Hydrogen Sulfide
	Black	Dissolved manganese, hydrogen sulfides	pH, Manganese and Hydrogen Sulfide
	Green or blue	Corrosive water, dissolved copper	pH, Hardness, Alkalinity, Saturation Index and Copper
Abnormal odor or taste	Bitter	Dissolved nitrate or sulfate	Nitrate and Sulfate
	Rotten egg	Hydrogen sulfide	Hydrogen Sulfide
	Soapy	Detergents, surfactants	Detergents and Total Anionic Surfactants
	Metallic	Dissolved metals like iron, manganese zinc, copper, lead	pH, Iron, Manganese, Zinc, Copper and Lead
	Salty	Excessive soluble salts	Total Dissolved Solids, Chloride, Sodium and Electrical Conductivity
	Septic, musty, earthy	• Decaying organic matter in the drain • Pollution of well water from surface drainage • Bacteria in the drain and/or well	Bacteria, pH
	Gasoline, kerosene, oil	Contamination by petroleum hydrocarbons, oil and grease	Petroleum Hydrocarbons, Oil and Grease
	Fruity	Fuel spill, leaking underground fuel storage tank, road runoff, ponding near well	Volatile Organic Compounds

Other	Corrosion of plumbing materials	Corrosive water	pH, Hardness, Alkalinity, Saturation Index, Lead, Copper, Iron, Manganese, Sulfate, Chloride and Electrical Conductivity
	White deposits on bathroom fixtures and pots or soap scum	Hard water	pH, Hardness, Alkalinity, Sulfate and Electrical Conductivity (or Total Dissolved Solids)
	Tarnished silverware	Hydrogen sulfide gas	pH and Hydrogen Sulfide
	Gastrointestinal illness (e.g., stomach ache, nausea, diarrhea)	Bacterial contamination, presence of excess nitrate, sulfate and manganese	Bacteria, Nitrate, Sulfate, Manganese, Detergents
	Discoloration and/or mottling of children's teeth	Excessive fluoride	Fluoride

Table 3. Situation-specific water test recommendations.

Situation	Test(s) to be Considered
Water supply for infant less than 6 months, pregnant or nursing woman, or elderly person with a genetically impaired enzyme system	Nitrate
Water supply used for children under 12 with developing teeth buds	Fluoride
Lead pipe or lead solder in plumbing (older home)	Lead, Copper, Zinc, pH, Hardness, Alkalinity
Close to old fuel storage tanks	Petroleum Hydrocarbons, Volatile Organic Compounds
Close to gas and oil drilling	Chloride, Total Dissolved Solids, Sodium, Barium, Lead, pH, Electrical Conductivity, Volatile Organic Compounds
Close to confined livestock area	Nitrate, Coliform Bacteria
Close to a chemical/pesticide spill or sprayer loading/rinsing area	Specific Chemical or Pesticide
Close to a landfill or dump site	Volatile Organic Compounds, Heavy Metals, Synthetic Organic Compounds
Septic system failure	Coliform Bacteria, Nitrate, Detergents, Total Dissolved Solids, Chloride, Sodium, Sulfates
Well located within an area of intensive agricultural use	Coliform Bacteria, Nitrate, Pesticide Scan, pH, Total Dissolved Solids
• Well near the coast or a salt storage pile • High blood pressure in the family • Water softener in place	Sodium, Chloride, Total Dissolved Solids

Adapted from "Water Quality Series: Drinking Water Testing," Oklahoma Cooperative Extension Service AGCE-878.

HOW SHOULD I TAKE A WATER SAMPLE FOR TESTING?

- Samples collected from the wellhead would allow evaluation of source water properties and designing any treatment system that may be necessary.
- Samples collected from a kitchen faucet would reflect the source water properties plus any potential contamination from the well owner's water supply system. For example, sampling at the wellhead for lead is not necessary, but sampling from the faucet for lead would indicate if lead solder was used in the plumbing. Also, it can indicate the efficiency of an existing treatment system.

WHERE SHOULD I TEST MY WELL WATER?

To have your water tested, call your local county Extension office or county health department or check with your municipal water supplier to find a suitable laboratory near you. These offices or your water testing laboratory can provide you the necessary information about sampling procedure, type of container, any preservative(s) necessary and shipping method.

HOW ARE THE WATER TEST RESULTS INTERPRETED?

Some contaminants are reported in parts per million (ppm) or milligrams per liter (mg/L); others in parts per billion (ppb) or micrograms per liter (µg/L). Bacteria in water are generally reported as Most Probable Number (MPN) or Colony Forming Units (CFU) per 100 mL. The presence of a contaminant is not always an indication of a health hazard or a serious nuisance. The level at which it is found is most important. Interpretation of the test results requires knowledge of the MCLs established under the SDWA. The concentration of a contaminant above its MCL merits attention and action to reduce it below the MCL. The primary MCLs have been set at concentrations that provide a wide margin of protection from harmful health effects for most people over a lifetime of drinking. Even though primary MCLs are enforceable standards for PWSs only, private well owners may choose to follow these standards to protect themselves from the potential health risk of drinking contaminated water. As an example, **Table 4** cites the MCLs for some selected contaminants.

Table 4. EPA drinking water standard for some selected primary and secondary contaminants.

Contaminants	MCL
A. Primary Contaminants	
• Arsenic	10 ppb
• Lead	15 ppb
•Total Coliform	0 MPN/100 mL
• *E. coli*	0 MPN/100 mL
B. Secondary Contaminants	
• Aluminum	0.2 ppm
• Iron	0.3 ppm
• Manganese	0.05 ppm
• Sulfate	250 ppm

Contact your local county Cooperative Extension office, local health department, or Georgia EPD for a complete list of drinking water standards. You can also find it online at **http://www.epa.gov**. Testing through UGA's water testing laboratory will provide details on any concerns as well as treatment options.

WHAT SHOULD I DO IF MY TEST RESULTS INDICATE A PROBLEM IN MY WELL WATER?

If your water test report shows any primary contaminant with a concentration above the MCL, you are at a risk of adverse health effects. In such a case, there are five basic alternatives:

- If possible, locate and eliminate the source(s) of contamination
- Install an appropriate treatment system
- Install a new well with expert guidance
- Connect with a public water system (if available)
- Use bottled water

Besides primary contaminants, certain nuisance contaminants, such as hydrogen sulfide or sodium, when found at high levels, may indicate the need for an alternative water source or a home treatment system. Refer to the other water publications in this series for more information about specific problem contaminants.

Sources:

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Skipton, S., B. Dvorak and W. Woldt. 2005. G89-907 Drinking Water: Testing for Quality. University of Nebraska – Lincoln Extension.

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cooperating.

Circular 858-2 / Revised July 2013

scape is more than just
a landscape that has been
, properly installed and
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ensure year-round beauty.

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simply changing watering
, adding mulch or relocat-
re suitable location can
more *waterSmart*.

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it more prone to insects
cally, plants are often over-
eriods of limited rainfall.

only wastes water, it also
hood that fertilizers and
ll run off into storm drains
y back to our streams,

e *waterSmart* by following
elines for outdoor water

For additional information on saving water in the landscape, see **www.conservewatergeorgia.net** or call your local county Cooperative Extension office at **1-800-ASK-UGA1**.

Prepared by:
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The University of Georgia
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With support from:

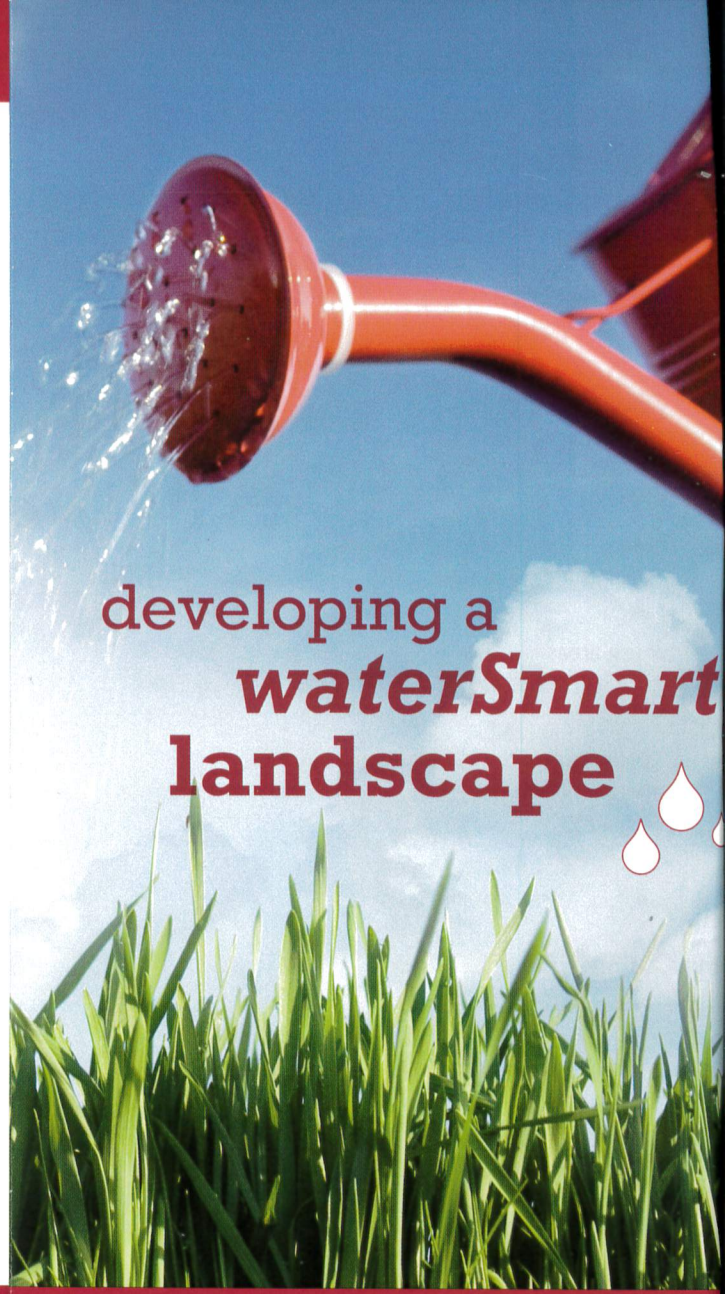
waterSmart
SAVE WATER • SAVE TIME • SAVE MONEY!
www.ConserveWaterGeorgia.net

Georgia WaterWise Council
www.gwwc.org
A SECTION OF THE GEORGIA ASSOCIATION OF WATER PROFESSIONALS

Do your part...and be *waterSmart*.
And remember...the water we save today
is an investment in our future!

Circular 930 **November 2008**

Printed on Recycled Paper



developing a *waterSmart* landscape

THE UNIVERSITY OF GEORGIA
COOPERATIVE EXTENSIO
Colleges of Agricultural and Environmental Sciences & Family and Consumer S

Begin with a *waterSmart* Design

A *waterSmart* landscape is designed to be functional and water-efficient. Try to preserve and incorporate existing vegetation into the design — it generally doesn't require supplemental irrigation if left undisturbed.

Group plants by their water-use: high, moderate or low. Generally, highly visible areas get the most water, while less visible areas get little or no supplemental water.

High water-use areas — Small, highly visible areas (such as home entrances) where plants are watered regularly to maintain optimum growth and quality.

Moderate water-use areas — Areas where plants are watered during establishment and when they show signs of moisture stress (pale green foliage, wilting or leaf scorching).

Low water-use areas — Areas where plants are watered only by natural rainfall after establishment.

Ideally, at least 60% of a *waterSmart* landscape includes low water-use areas. No more than 10% includes high water-use areas and no more than 30% includes moderate water-use areas.

Examine the Soil, Sunlight and Slope

An individual landscape may have many soil types. Evaluate the soil for:

- structure and texture
- drainage
- fertility

To determine soil fertility, take a sample to your local county extension office for testing. The results will tell you if your soil needs lime and what kind of fertilizer will provide the best growth.

Most soils benefit from compost, which improves:

- soil structure and texture, making it easier for roots to grow.
- the soil's water- and nutrient-holding capacity.
- soil fertility and the ability of roots to absorb nutrients.

Note how much sunlight each part of the landscape receives each day.

- Some plants do better in full sun while others need more shade.
- Plants in shady locations generally need less water than those in the sun.

During landscape construction:

- slope beds away from buildings.
- introduce shallow depressions to retain moisture.
- install drought-tolerant plants at higher elevations and moisture-loving plants at lower elevations where the site drains naturally.

Keep Irrigated Turfgrass Areas Small

Turfgrass usually occupies the largest area of a landscape and receives the highest amount of supplemental irrigation. To save water, keep irrigated turfgrass areas small.

There are many different types of turfgrasses, and they vary greatly in their ability to withstand periods of limited rainfall and drought. Bermudagrass, for instance, can survive long periods without water if it is installed and managed properly. For a list of recommended turfgrasses and management guidelines, contact your local Cooperative Extension agent.

Put the Right Plant in the Right Place

When selecting plants, consider:

- sun exposure
- light intensity
- typical wind conditions
- average summer and winter temperatures
- drainage patterns

Whether a plant is native to the area or an exotic import, if it's adapted to the soil, the climate and local site conditions, it will thrive. Contact your local county extension agent for information on landscape plants for Georgia.

Remember, plants don't save water... *waterSmart* people do!

When Irrigating, Mak

Never install an irrigation system Consider using low-volume irriga to water ornamental trees, shrub uses 30% to 50% less water tha evaporation. Watering in the eve reduce evaporation losses.

Mulch, Mulch, Mulch

Mulches:

- help retain water and minim
- help prevent weeds that com
- add organic matter and ben
- moderate soil temperatures.
- reduce erosion.
- lessen the spread of soil-bor

The best mulches are organic an shredded hardwood mulch, and water conservation, maintain a ornamental plants.

Start Grasscycling

Lawnmower clippings provide a at the soil surface and hold moi Research has shown that as mu the nitrogen applied as fertilize clippings are added back to the effective "grasscycling" is mow so the clippings remain small a into organic matter quickly.

Maintain the Water C

A low-maintenance, *waterSma*

- less water and fertilizer
- less routine pruning
- fewer pesticides
- less frequent fertilization

Watering, fertilizing and prunin additional irrigation and wilts e less fertilizer and fertilizing less nutrient runoff into rivers, lakes

rowing
mmunity
ban gardens

benefits of community gardens

Growing food in urban and suburban areas has many health, social and environmental benefits. Community gardens are often the focal point of schools, churches, communities, homeless shelters, senior centers or any place where people can enjoy a food garden's many benefits.

provision of fresh food
self-reliance
sense of community
crime prevention
increase in property values
good exercise
valuable skills
enhanced environment
stress reduction

garden resources

UGA extension

UGA Extension agents live locally and can provide community garden information through direct contact, in workshops, classes and seminars.

Georgia Master Gardener Extension volunteers are often available to help start community gardens or provide guidance. You can find Master Gardeners by calling your county Extension office at **1-800-ASK-UGA1**.

For a listing of county Extension offices visit:
extension.uga.edu/about/county/

UGA Extension publications are available online or for sale in printed format and offer practical, research-based information on topics related to community gardening.

Whether you are just starting, need help with specific growing issues or want to improve your gardening skills, you can take advantage of these valuable resources.

Find publications referenced in this brochure at:
extension.uga.edu/publications/
Search: **community gardens**

steps for success

1 cultivate people

Community gardening begins with cultivating people and relationships. Your garden should have several committed gardeners and dedicated leaders. Establishing garden rules is the essential first step. Deciding issues such as whether dogs will be allowed in the garden and how pesticides will be used, will help prevent problems down the road.

UGA Extension publication: **How to Start a Community Garden: Getting People Involved** (Bulletin 1399)

2 select a suitable site

Not all land, particularly in cities, works well for community gardens. The plot should be generally flat and receive at least six to eight hours of sun a day. If nearby buildings or trees shade the beds, you may want to find another lot. Check out the past uses of the land to see if there are any potential issues of contamination.

UGA Extension publication: **Siting a Garden** (Circular 1027-2)

3 assess the soil

Healthy plants start with healthy soil. It is important to test the soil for nutrients before you plant. Land in urban areas may be contaminated from previous land uses, which could include gas stations with buried tanks, chemical plants, or automobile and bus service garages. Your local UGA Extension office has soil sample bags and instructions on how to take soil samples and submit them for analysis. The results will tell you if the land is suitable for growing food and how to amend the soil. If the land is contaminated, find another location for the garden.

For more information visit:
aesl.caes.uga.edu/soiltest123/Georgia.htm

learn how to grow food

Growing vegetables and fruits requires know-how. Find out what grows best in your soil and climate, when to plant, how to plant and how to fertilize. Use cultivars that grow successfully in your area. Learn how to manage pests naturally. Experience helps you learn to outwit certain pests, manage diseases and gain confidence.

To learn the details of food gardening, work closely with your UGA Extension office. Extension has many publications on growing vegetables in general, or growing specific fruits or vegetables. Classes are offered as well, both in person and online. Consider subscribing to the community gardening blog to learn some gardening tips:
blog.extension.uga.edu/communitygardening

UGA Extension publications: **Vegetable Gardening in Georgia** (Circular 963)
Vegtable Garden Calendar (Circular 943)

after the harvest

Learn about food safety. Improper food handling can make you sick. UGA Extension offers nutrition and cooking classes particularly in areas where access to fresh food is limited. Use UGA Extension publications that teach safe food preservation techniques.

UGA Extension publication: **So Easy to Preserve** (Bulletin 989)

4 locate a water source

All plants need water, so having a nearby source is essential. An adjacent building or home may be willing to let you use its hose to water the garden, but this may not be a long term solution. Hooking up to the city system may be expensive and decisions will need to be made on how the water bills will be paid. Maybe a digging well is the answer but that can also be costly.

Rain barrels and cisterns can collect water from nearby roofs and are a popular option. Consider enrolling in a class on creating rain barrels. Master Gardener Extension volunteers are knowledgeable about water sourcing and can help you.

UGA Extension publication: **Sources of Water for the Garden** (Circular 1027-11)

5 become a compost connoisseur

You will need to renew the soil each year with compost, so make a place for it in your garden.
Learn how to turn garden debris and kitchen waste into compost, or "black gold." Extension offices often conduct classes in composting.

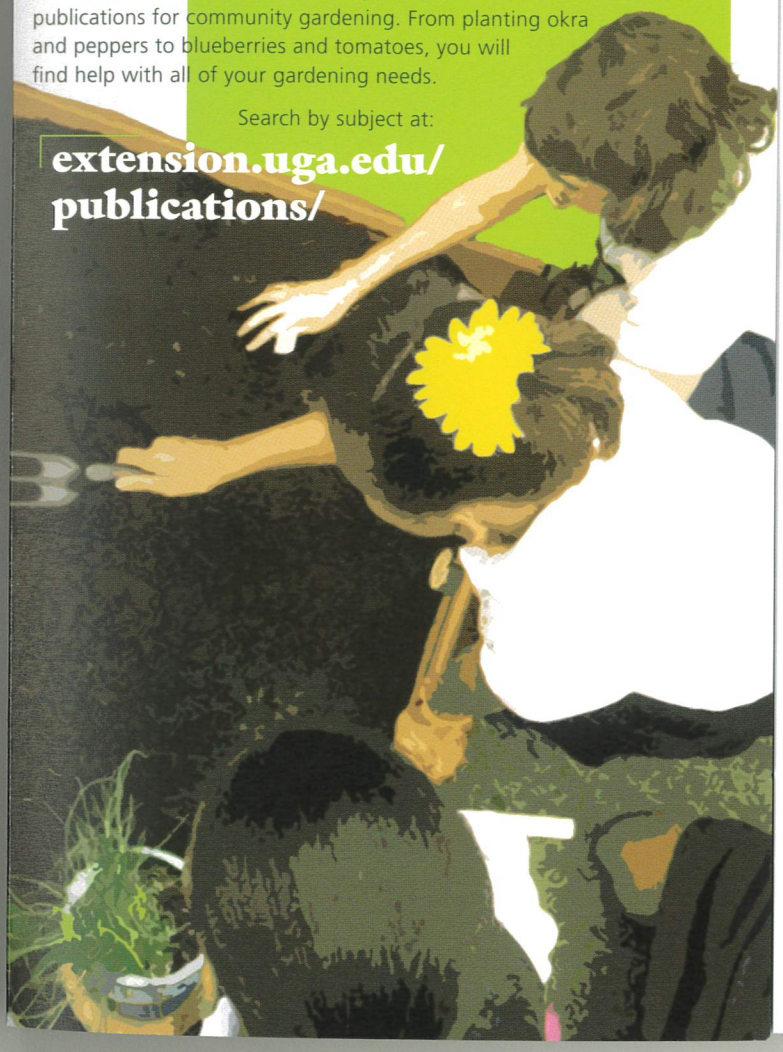
UGA Extension publication: **Composting and Mulching** (Circular 816)

dig deeper

UGA Extension offers hundreds of practical, research-based publications for community gardening. From planting okra and peppers to blueberries and tomatoes, you will find help with all of your gardening needs.

Search by subject at:

extension.uga.edu/publications/



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