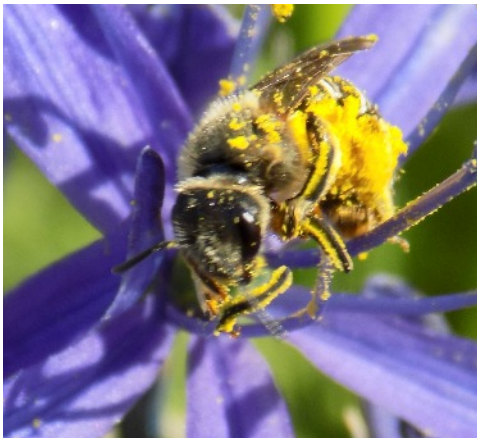
GARDEN FRIENDS



Pollinator patches

"If you feed them they will come." That's pretty good advice for gardens in the San Juan Islands, where we still have a diverse community of native bees and flower flies. Most island gardens are within a few hundred yards of scruffy"wild" hedgerows, woodland and wetlands, as well as other gardens and small farms. Wild pollinators do not have far to travel to new floral opportunities.

If you already have flowering vegetables and ornamentals around your home, wild pollinators will find them. Is there any purpose to planting "pollinator patches" to feed wild bees and flower flies? Here are several key factors to consider:

1. A diversity of flowers attracts a diversity of wild bee species. Adding a sprinkling of different flower types and colors to your garden, wherever there is a little bit of space between the peas, pumpkins or pear trees, will attract more pollinator species to visit your garden and nest within it, or nearby. As with vegetables and fruits, diversity is a hedge against unexpected weather conditions. Prioritize flowers that are accessible, not folded or narrow, and colors that bees can see (blues, purples, pinks, yellows, whites with yellow anthers).

2. Native pollinators benefit the most from extra food on the shoulder seasons: early spring and late summer. Our native wildflowers mainly bloom in late spring when the rains end, before the summer drought. Climate change is compressing that native-bloom window; bees have to work harder and compete for resources over a shorter period of time. Adding ornamentals that help extend the flowering window help native bees fully provision their nests and ensure the survival of the next bee generation.

3. Due to our changing climate and the need for shoulder-season support for bees, pollinator patches must be able to withstand late spring chilly rains and freezes as well as lengthier summer droughts. Shrubs tend to be hardier, once established, than herbaceous plants, and many continue to flower for weeks. Bulbs offer good toleration of spring chill; but many varieties have been selected to sacrifice the stamen for additional large petals. "Bomb"-type peonies are one example. These flowers are beautiful but produce no pollen, and as such are of no value to nesting female bees.

4. Does a pollinator patch draw bees away from your vegetables and other garden crops? Over a period of several years, native bees will nest near good pollen resources and their population and visits will increase to a level determined by all of the flowers available over the season. Think of a pollinator patch as a way of persuading bees to nest nearby, rather than simply visiting when your garden blooms peak.

Top picks for feeding native pollinators in the San Juan Islands include both native and non-native ("exotic") plants. Non-native plants (exotics) are not a problem in a garden setting and they can augment the flowering season as well as overall diversity of flower types and colors. Problems only arise if you introduce plants that spread readily on their own, requiring intensive management to contain, and difficult to remove. They should be avoided in island gardens. Some of the exotics that we recommend may spread within a garden but are not "invasive" in adjacent natural areas.

Be conscious, however, that bees do love two of the islands' most irrepressibly invasive shrubs, one of them native ("Nootka rose," *Rosa nutkana*), and the other introduced a century ago (Himalayan blackberry, *Rubus bifrons*). They have simple, wide, and relatively flat flowers with large masses of anthers that facilitate "buzz pollination" by bumblebees and some of our area's solitary native bees. We do not recommend using these hard-to-contain shrubs in a pollinator patch or hedgerow; however, if they already occupy some part of a garden or the surrounding landscape, avoid removing them all at once; it can have a catastrophic effect on wild bees nesting in the vicinity. Replace invasive bee-feeding plants gradually with manageable plants.

Here, then, are our suggestions for island gardens and farms:

For **early flowering native hedgerow shrubs**, we suggest the flowering currants (*Ribes sanguineum*), which are available in both the original red-flowered form as well as commercial white-flowered varieties. Fragrant flowers appeal not only to bees but also hummingbirds.

Our suggestion for an **early flowering native herbaceous perennial**, Oregon Sunshine (*Eriophyllum lanatum*), also called "Woolly Sunflower", is in the Aster family and has attractive bright yellow composite flowers that appeal to flower flies and early-emerging wild native bees such as Miners (Andrenidae) and bumblebees.

Other early-flowering native wildflowers include Camas (*Camassia spp*) and Chocolate Lilies (*Fritillaria affinis*), which can be seen interspersed in the islands' relic coastal meadows, such as American Camp. Camas in the islands is a traditional Native American staple food plant and genetically distinct in the islands where it was widely cultivated in coastal and wetland gardens. It grows in winter and flowers early. Showy purplish-blue flowers with golden anthers, Camas is a favorite of Miner bees (Andrenidae), bumblebees, our emerald green *Agapostemon texana* "sweat bees" (Halictidae), and other early-emerging bees and flower flies. To protect the genetic integrity of wild-growing island Camas, only plant seeds or bulbs collected from the islands. Our research garden can help: email ***info@kwiaht.org*** for resources.

Cosmos, Marigolds, and Zinnias are **midsummer- to late-summer exotic perennials** in the Aster family with flat yellow to red composite flowers that attract late season bees such as Carpenter bees (*Ceratina*) and "Fairy bees" (*Lasioglossum*), as well as flower flies. They make colorful small flower patches among vegetables. Be sure to buy and sow single-flowered varieties, however; the double-flowered varieties often lack pollen!

Late flowering hedgerows should include exotic shrubs in the Mint family (Lamiaceae) such as Rosemary, which is extremely hardy in our climate, Catmint (*Nepeta*), and Oregano, which bees adore but does require some management to prevent them from taking over garden beds.

Long-season hedgerow shrubs include two natives, *Ceanothus* ("wild lilac") and Snowberry (*Symphoricarpos albus*) that both wild bees and domestic honeybees enjoy in late summer; and the exotic barberries, which are also thorny and thus deer-resistant. All require a modest level of management to prevent them from becoming tall, gangly, and spreading gradually from the root mass. They are worth the extra effort. And the barberries produce small dry red sour fruits that birds savor, and are used in Persian cuisine.

Native bees also thrive on troublesome garden weeds such as Hairy Cat's Ear and Dandelion (both exotic Asteraceae) and non-native thistles. Until you have established some more manageable kinds of "bee food" in your garden, you may want to delay beheading or digging out these weeds each summer until the flowers have closed to form seed. In some disturbed landscapes of the islands, weeds have become the only late-summer source of pollen for native bees and flower flies!

Fairy bee on Oregon Sunshine

GARDEN FRIENDS

Bumblebees!

Although barely ten percent of the wild native bee species today in the San Juan Islands, bumblebees are probably the best known and most easily recognized. They are also arguably the most important wild bees in the islands due to their size, hardiness, cleverness, and what ecologists describe as "fidelity". Let's take a closer look at these keystone wild pollinators.

Emerging in spring, conspicuously large bumblebee queens emerge from hibernation, feed voraciously on early wildflowers, and build subterranean nests composed of hollow wax balls that resemble bunches of grapes. The queen's first eggs hatch into a cohort of smallish female workers that follow the queen by day and learn from her where to find dense patches of pollen-rich flowers, which they work over as a group. If floral resources are plentiful, additional generations of workers may be hatched; then finally, a cohort of male bees that mate to produce queens for the following year.

Bumblebees' ability to warm up by "shivering" enables them to beat most other wild bees to early spring flowers, and they are often seen feeding earlier than other bees on cool, foggy summer days. Bumblebees have an effective flight range of about a mile, so they can forage widely, and hop from island to island, a feat not attempted by other Salish Sea bees.

Bumblebees are "generalists," feeding on almost every kind of flower, but they are also "faithful". They search out dense patches of pollen-rich flowers and then work them persistently for days, meticulously cross-pollinating every individual flower in the patch. Bumblebees are reliable couriers. Pollen is delivered immediately to the correct floral addresses. Few bee species can match this degree of efficiency. What's more, bumblebees are cargo planes compared other bees, lifting nearly half of their own weight in pollen.

Bumblebees are also clever. Recent experiments have demonstrated that they learn quickly to move small objects such as ping pong balls to obtain a nectar reward, and learn by observing other bumblebees. They are also unusually dexterous for bees, opening many complexly folded flowers such as legumes that stump other bees. Plant an exotic flower species in your garden and bumblebees will usually be first to discover how to collect its pollen and nectar.

Most other pollinators buzz off when a bumblebee approaches—not because bumblebees are aggressive (occasionally they will gently shove each other off flowers) but due to their sheer size and ability to "buzz pollinate" and monopolize flowers. Domestic honeybees are the exception; they *are* aggressive and travel in gangs. Planting legumes, and arranging ornamentals in small clusters generally favors bumblebees.

The best way of keeping bumblebees in your garden is to leave a brushy area with some big rocks beneath which bumblebees will happily nest. Rock terraces are also good bumblebee habitat. Be sure to leave the nesting area undisturbed year-round, and (of course) never spray any pesticides around nests or flowers!

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GARDEN FRIENDS

Little black bees

Is that a tiny black ant in one of your garden flowers?

Ants sometimes do pilfer some nectar from flowers, often taking advantage of their powerful mandibles to chew a hole in the base of the flower near its stem, rather than taking the trouble to climb inside. But it's much more likely that a closer look will reveal that the visitor is a very small, mostly black bee. You can tell because it has wings and is busily combing, chewing and packing pollen grains.

In the islands these tiny bees, ranging from an eighth of an inch to three eights of an inch, mainly belong to three genera: Perdita ("fairy bees"), Ceratina ("small carpenter bees"), and Lasioglossum, a branch of "sweat bees". None of them are conspicuously fuzzy like bumblebees or domestic honeybees, but if you use a magnifier you will see that they do have very fine, short, sparsely distributed hairs to catch pollen.

Perditas are easy to identify. They have a bright yellow face; the rest of the body is dark, and the abdomen may be faintly banded gray and black. There are hundreds of Perdita species in North America but only one has been confidently identified in the islands, *P. nevadensis*. Fairy bees nest by tunneling into well-drained soils, and are limited in their choice of flowers. in our region they tend to focus on Polygonaceae including sorrels, knotweeds, dock, and smartweed, many of which are weeds!

The Ceratinas are much more widespread and common in the San Juan Islands, in part because they nest in "cane fruits" such as blackberries. The stems of these shrubby plants are not woody but filled with soft spongey material. Female Ceratinas chew a hole into the cane and excavate a tunnel-like nest in the soft interior. If you want Ceratinas in your garden, include patches or hedgerows of cane fruits and leave some old canes each summer for Ceratina nests. Ceratinas are cosmopolitan in their floral choices: more than 50 species West Coast plants including asters, sunflowers, penstemons, daisies, Oregon grape, currants, catmints, sage, plums, cherries, hawthorns, and blackberries. In the islands you are most likely to see the species *Ceratina acantha*; its whole tiny body is shiny metallic and dark, slightly blueish or greenish. Here is a weird fact about *C. acantha*: some populations can produce workers from unfertilized eggs!

The Lasioglossums are a large, diverse group of 1,700 species worldwide and at least 22 species identified in the San Juan and Gulf Islands. They range greatly in size, from tiny black shiny bees easily confused with Ceratinas, to bees in the half-inch or larger range. Our local species are dark except for somewhat lighter bands of fine hair on the apical border of each abdominal segment. Like all sweat bees they have a very finely fuzzy face. Like Ceratinas, they visit a diversity of flowers in our area including thistles, gumweed, dandelion, snowberry, evening primrose, strawberries, *Potentilla*, native roses, wild and weedy mustards, harebells, penstemons, blueberries, and clovers. Fertilized females overwinter in shallow ground tunnel- nests. The most common species in the islands, *L. albipenne*, is barely a quarter of an inch long, and is often seen in composite flowers (*photo above*).

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GARDEN FRIENDS

"Miners" in the garden

Watch closely, and you may see a fuzzy, wasp-like bee disappear down a small hole half-hidden beneath the herbaceous greenery in your garden. You have discovered the secret nest of a "miner" bee, a species of the hugely diverse bee family Andrenidae ("waspy" bees, from classical Greek) that dig solitary ground nests, and waterproof them with waxy secretions that are brushed on like an oily varnish.

Andrenids are important wild pollinators that tend to dig their nests within a few hundred feet of their floral resources—right below the flowers, if soil conditions permit. A pollinator-friendly garden plan should include patches of pollen-rich perennials in well-drained loams that are left undisturbed and pesticide-free all year for "miners" to nest. They are some of the first bees to emerge in spring, and can remain active to midsummer.

Andrenids are one of the oldest living bee lineages, having appeared at least 32 million years ago, and they have grown vastly diverse, globally and regionally. Of several thousand known species, about 70 are found around the Salish Sea, and about half of these regionally established species have been confirmed thus far in the San Juan Islands.

Miner bees share few characteristics that can easily be seen without dissection or a microscope. They all have rather round faces that are wider than they are long, and their heads are relatively thin and flat in profile. They have little tufts of facial hair between each eye and the corresponding antenna. There are dense bristly hairs on the hind legs used for packing pollen. And most species also have a dense patch of velvety hair on the upper (dorsal) side of their thorax that looks like a fuzzy back-pack. The back-pack is like a Velcro patch–for rubbing pollen off the anthers of flowers, of course!

The fuzzy back-pack is a useful starting-point for identifying common island species of miner bees such as the otherwise black *Andrena vicina* or *Andrena nivalis* as well as species with brightly white- or reddish brown-banded abdomens such as *Andrena sola*. The back-pack itself is usually pale gray, but can also be reddish as in *Andrena rufosignata* and *Andrena prunorum* in our area.

The diversity of miner bees is an adaptation to many different host-plant preferences. We have a single species, *Andrena astragali*, that is completely dependent on Death Camas, and can easily be spotted on this wildflower at American Camp in late spring. It has a light brown pack-pack and banded abdomen. But another common species in the San Juan Islands, *Andrena vicina*, has much wider tastes. It visits clovers, serviceberry, blackberries, blueberries, blackcaps, native crabapple, native roses and honeysuckles, dogwoods, rhododendrons, as well as garden squash and orchard apples, plums and cherries, among others. This is typical of most miner bees in our area, which makes them a good wild bee to invite into your garden.

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GARDEN FRIENDS

Mason bee hotels

A growing number of islanders buy mason bees to ensure pollinator services in their gardens and orchards. This can harm wild native bee populations. It is also uneconomical, since it simply replaces native mason bees that can be attracted to your garden by offering them good nesting habitat.

The Megachilid bee genus *Osmia*—the mason bees—is highly diverse and distributed globally. Thus far 26 wild native *Osmia* species have been documented in the San Juan and Gulf Islands alone. While some bee vendors in the Salish Sea region use "bee hotels" to attract and rear locally-adapted species for sale, most of the mason bees sold online and by garden store chains are the cosmopolitan species *Osmia lignaria*, the Blue Orchard Bee, native to much of western North America. *Osmia cornifrons*, native to Japan, was introduced by USDA in the 1970s for use in the eastern states. *Osmia californica*, a Great Basin native, is also sometimes sold here.

Why are mason bees so popular? Small, chunky, shiny, metallic, and sparsely fuzzy, they are solitary like most wild bees and do not form hives. Claims that they are more efficient pollinators than honeybees, or wild bees such as bumblebees, are unsubstantiated. The simple fact is that they are very easy to cultivate, making them marketable. In nature, mason bees nest in tunnels already drilled into old snags and stumps by beetle larvae or sapsuckers. A block of wood with deep drill-holes, a frame filled with cardboard tubes or a bunch of empty bamboo segments will attract female mason bees and become a "bee hotel". Mason bees are not social, but they tolerate the close company of other bees. At the end of summer, bee hotels can be left in the garden to provide a new generation of mason bees the following spring.

It helps that, like most solitary bees, mason bees forage close to their nests. Mounting a bee hotel inside the garden is a simple way to increase mason bee activity—whether or not the bee hotel already has its tubes or tunnels filled with larval bees. But there are downsides.

USDA monitors diseases and parasites of domestic honeybees (*Apis mellifera*), but not the growing mason bee pollinator-services industry. Imported tubes of mason bees can be infested with pollen mites; or the larvae of the kleptoparasite (nest-stealing) "cuckoo bee" *Stelis montana*; or the eggs of parasitic wasps.

Importing bees to the islands can devastate our wild native bees. You may be introducing invasive species of *Osmia* from other parts of North America, or introducing new parasites and pathogens. To put it frankly, importing bees from outside the Salish Sea has a high likelihood of displacing bees that already live here.

Instead, make your garden as attractive as possible for wild native bees to nest, thrive, and stick around!

Bee hotels can be useful to ensure that mason bees can find nests close to your garden. But beware: many of the kleptoparasitic bees and wasps that prey on pollinators will also move into your bee hotel. And if it is used for more than a year, your bee hotel can become infected with mites and pathogens that kill bees. You can reduce this risk by sticking with small bee hotels (say, fewer than 12 nest holes) and by cleaning your bee hotel every spring, once bees have emerged, with hot water and some plain unscented alcohol.

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GARDEN FRIENDS

What about Honeybees?

We love local artisanal honey; who doesn't? But honeybees cannot replace wild native bees as pollinators In the San Juan Islands' unique coastal and montane wildflower meadows, from American Camp and Iceberg Point to the summit of Mount Constitution.

Honeybees all belong to the genus *Apis*, which has just eight species worldwide. All of them share characteristics that make them attractive to humans and other omnivorous mammals: they form large communities that build waxen hives where they store concentrated flower nectar–honey–to feed their offspring. Just two species, *Apis mellifera* and *Apis cerana*, were domesticated historically, then spread worldwide as a source of human food.

Modern honeybees have their ancestral roots in southern Africa, the Middle East and southeast Asia, the same as humans. Rock art suggests that people raided the hives of wild honeybees for millennia, like bears and apes, but learned to build and manage artificial hives on Neolithic farms at least 4,600 years ago. Widespread sharing and cross-breeding of honeybees made them genetically distinct from their wild ancestors. Europeans brought honeybees with them to the "new world" in the 16th and 17th centuries, and later to Australia, where domestic bees that escaped and formed feral colonies added another layer of ecological complexity.

Beekeeping today still relies almost exclusively on more than 40 modern domestic subspecies of *Apis mellifera*. In the United States and Canada, honeybees traveled across the continent with European settlers, producing an ever-growing, increasingly diverse honey crop. In the 1910s, beekeepers began renting their hives to farms and orchards to boost pollination rates, which unquestionably had been depressed by plowing, pesticides and other disturbances of wild native bee species. A further change in bee culture has emerged since the 1990s, moreover: establishing hives with the express purpose of "helping the pollinators" generally, even in places such as the San Juan Islands where wild native bees are still abundant and quite capable of providing pollination services at no cost to farmers and gardeners. "Hobbyist" beekeepers are more likely to neglect hives, not feed them in winter, or fail to recognize and deal with *Varroa* mites or contagious diseases that result in "colony collapse".

Recent research in Germany, British Columbia, and Australia has shown that honeybees can compete with, and displace wild native bee species in landscapes composed of wild lands, small farms and gardens–as distinguished from, say, large-scale croplands with miles and miles of wheat, corn, or beans. Honeybees also become reservoirs of pathogens and parasites that can jump from domestic hives to wild bees that feed on the same flowers. Well managed honeybee hives can co-exist with wild native bees, however, because of differences in behavior.

Remember the excuse given by the Bug in the dark science-fiction comedy, *Men in Black*: "I have a million mouths to feed back home." That describes the ecology of honeybees. Each bee must maximize its daily delivery of pollen and nectar to the hive. To do this, they target large, relatively uniform patches of flowers. It's usually not worth their precious daylight flight time to visit small patches of diverse flowers, only some of which are in bloom. In a diverse landscape, wild native bees focus on small gardens and patchy wildflower meadows. And raising bees for bees' sake can reduce food supply and increase disease risk for honeybees and native bees alike!

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GARDEN FRIENDS

More cool bees!

The San Juan Islands are home to more than 150 species of wild native bees representing 15 families. Most are solitary—that is, each female bee builds her own nest, while male bees simply hang out among the flowers, waiting for potential mates to pass by. And most solitary bee species dig underground tunnels with tiny chambers and a small pellet of nectar and pollen for each egg. Bee families differ in how tunnel nests are waterproofed, however. Miner bees (Andrenidae) brush their nest walls with a waxy secretion. Wool-carder bees (Anthidium) gather plant hairs to knit sock-like nest walls. Here are three other kinds of solitary bees that have clever and amazing ways of keeping their eggs and larvae warm and dry.

The "cellophane bees" (Colletidae) line their underground nests with polyester secreted by a gland at the base of females' ovipositer (the "stinger"), repurposed through evolution from a venom sac. It's really the same kind of plastic used to make clothing! Cellophane bees like to nest together in a bank of soft, sandy soil, creating communities of dozens of bees. They do not have a division of labor like domestic honeybees or coordinate their activity, but simply by creating a lot of bee traffic around the colony, make it hard for a predator, parasitic wasp or cuckoo-bee to sneak into nests undetected. Cellophane bees love our native shrubs such as oceanspray, as well as native wildflowers in the aster-daisy family, wild mustards, and wild and garden onions. Our native species in the islands is *Colletes fulgidus*. It has a banded abdomen and velvety light brown hairs—on its face and thorax

"Leafcutter" bees are a tribe of the Megachilidae, the vast bee family that also includes wool-carder bees and mason bees. In the islands, you are most likely to see *Megachile periherta*, a relatively large, chunky bee with a banded abdomen, one of six leafcutter species recorded here. When it is foraging, a leafcutter has a distinctly yellow to orange patch of pollen on the underside of its abdomen—that is where she stores pollen for transportation to her nest. But you may get a real treat and see a leafcutter flying unsteadily, a small round piece of a green leaf in her mandibles. Leafcutters chew neat round pieces from leaves and use them to tile their nests, which may be underground or in beetle boreholes in snags or stumps. They will often colonize bee hotels intended for mason bees. We often see Leafcutters in garden flowers.

Perhaps most unusual of all are so-called "digger" bees (Anthophora). Distant relatives of bumblebees (as well as Eurasian honeybees), diggers form colonies of thousands of solitary females in sandy coastal bluffs along our shorelines. Like cellophane bees, they benefit from dense bee traffic but do not coordinate their efforts. Each female excavates a horizontal tunnel in the bluff, and when she has provisioned it with pollen and nectar, and laid her eggs, she seals it with a conspicuous clay plug. To make the clay, diggers sip water from tide pools and springs, often briefly forming large masses of bees. Diggers are mimics of bumblebees, but the distal end of their black abdomen is hairless, and their heads a bit square. They are also important, albeit rarely recognized pollinators—usually mistaken for bumblebees in gardens.

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GARDEN FRIENDS

Save your Shrews!

If you do not live with a cat, you may not know whether there are shrews around your home. If you do live with a cat, she has probably brought you some shrews, and you may want to take steps to exclude her from your garden to protect the shrews that remain!

The common shrew of the San Juan Islands and the Salish Sea is the Masked Shrew, *Sorex cinereus*. A tiny mammal just 3-4 inches long (tail included) with a life span of barely a year, shrews are largely beneficial; they eat a wide range of garden pests and generally do not disturb vegetables or ornamentals.

Shrews have very high metabolic rates and must eat continually, day and night, at least every few hours. In one day, a shrew may consume three times its body weight in larval and adult insects, worms, snails, and any other small animals it can subdue. At least one study found that shrews target caterpillars and other plump, calorie-rich insect larvae found on the soil surface or just beneath it.

Male and female shrews are solitary and have separate territories. Nests are opportunistic, often under rocks or in burrows left by other animals. There can be as many as 15-20 shrews per acre in gardens and uncultivated wetlands, where shrews can find large concentrations of small invertebrates.

Although they are small, quiet, and fast, shrews are easy prey for birds, larger mammals—and yes, house cats. Most young shrews become prey within a few months, during their first summer. Those that survive may have a litter of a half-dozen pink hairless shrewlets the following spring. Our relatively mild maritime weather makes it possible for at least some moths, beetles, and snails to remain active through the winter, improving the odds of survival for over-wintering shrews. Elsewhere in our latitude, shrews often have to draw down their stored body fat (astonishingly, including fatty myelin in their brains) to survive until spring.

Rock piles and rock terraces provide good nesting habitat for shrews around a garden. Shrews thrive if a garden has "scruffy edges" or hedgerows that enable them to leave their nests and travel hidden beneath leaf litter and shrub cover. That's also where snails and beetles are most likely to hide.

Of course, garden pesticides and herbicides should be avoided; you don't want to poison the animals that shrews eat. And if you have a problem with rats or other garden marauders, use selective rat traps (with covers that only rats can or will enter) or live traps (such as Havahart). Unprotected spring traps or poisoned bait kill non-target native rodents and birds, as well as native predators and scavengers–including Bald Eagles–that may feed on dead and dying poisoned rodents!

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GARDEN FRIENDS

Old trees

Many birds nest in the hollows of dead trees (or "snags"), and in cavities formed by decay of branch scars. In our area this includes owls and woodpeckers, also songbirds such as chickadees, nuthatches, and wrens, and wood ducks, among others. At least two of our larger bat species prefer tree cavity roosts: the Hoary Bat, which is the largest insectivorous bat of North America, and the more commonly seen Silver-Haired Bat. Both are voracious predators of moths, including cutworm and budworm moths that attack garden shrubs and fruit trees. On San Juan Island, Northern Flying Squirrels also rely on tree cavities. They indispensable for the natural dispersal of acorns and oak trees.

For rodent control by owls and moth control by bats, then, it is advantageous to have cavity-forming trees nearby. Unfortunately, there is a widespread but erroneous belief in the islands that cavity-nesting wildlife depend on Garry oaks. While oaks (like most long-lived deciduous trees) often form tree cavities, most of the large, occupied tree cavities we have encountered in the islands are in very old orchard trees, mainly apples, which frequently lose limbs to weather, fungal rot and pruning as they age. Of course, for a moth-eating bat, nesting in an orchard is paradise; surrounded by fruits that attract moths and other pests that are tasty to bats. Insectivorous birds such as nuthatches also benefit from nesting in fruit tree cavities for the same reason. For the orchardist or gardener, this should be welcomed.

Unfortunately, there has been a growing tendency for homeowners to neglect or remove old fruit trees, replacing them with lawns, or with young trees. It's important to recognize, at the outset, that well-tended apple and pear trees can live and produce fruit for centuries, as they do in hundreds of ancient orchards in Europe. Proper pruning and drainage can be considerably more cost-effective than digging out the old trees and planting new ones. This is certainly true from a pest-management perspective. Young trees will take several decades to reach the stage of producing cavities for bats or birds. Meanwhile, young trees are more vulnerable to many pests that birds and bats can help control.

Bees take advantage of old beetle boreholes and sapsucker "sapwells," which are most common in older deciduous trees, including old orchard trees. Indeed, a majority of sapwells we observe in field studies are in older apple trees, which appear to be unharmed by the drilling. On the contrary, sapwells are frequently taken over by wild native solitary bees as nests. Native island bees that preempt sapwells as well as small beetle boreholes in living trees and snags include some two dozen species of mason bees (*Osmia spp*) and leafcutters. Why buy mason bees when your old orchard trees attract and house the islands' own native mason bees naturally?

When native solitary bees occupy an old orchard, it means that all of the pollinators needed to keep trees fruitful, are already right there living in the trees. From a contemporary climate-change viewpoint, bees in trees means that pollinator services are much less affected by wet, stormy weather that can limit bees' flight range in the spring when Eurasian fruit trees such as apples, pears, plums and cherries bloom. Thus, one way to make your garden or farm more climate-resilient—as well as better managed for insect pests and small rodents—is to lavish care on old trees, especially the apples that remain from the islands' great passion for commercial orcharding in the 1880s to 1920s.

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GARDEN FRIENDS

Beneficial bats

Bats are the most abundant and diverse mammals in the San Juan Islands today. Nine bat species share the islands with us (there are 15 bat species in all of Washington State) and on a calm summer night, thousands of bats can be seen and heard flying over wetlands and lakes where insects swarm.

Bats are beneficial for islanders and island gardens. The smaller bat species consume vast quantities of insects such as mosquitoes and black flies, while larger bats target moths and beetles, including the adult stage of garden and orchard pests such as cutworms, armyworms and fruit worms, including the "coddling moths" that can damage apples, pears, plums, cherries, and peaches. Many of these destructive garden and orchard pests were introduced to North America by early European settlers, and came to western Washington when orchards were planted here more than a century ago with trees sourced from the East Coast. But regardless of their exotic origin, orchard pests like coddling moths taste delicious to our native bats that have feasted on them ever since.

Destructive European orchard moths mainly fly in late spring and summer as fruits form and ripen. This is also when Northwest bats are raising their pups and have the greatest need for lots of fatty, calorie-rich food. Moths are especially high on bats' menu because they are proportionally fattier than other insects. Moths feed voraciously as caterpillars, growing quickly but storing as much energy as possible as fat. Once they pupate and emerge as flying adults, most moths stop eating and simply live off their remaining body fat. They are wholly devoted to mating. Even the day-flying moths in our area that continue to drink some flower nectar, such as the large "hummingbird moths," have fat-stuffed bodies. Perfect bat food.

What makes moths particularly attractive to Northwest bats, however, is that fact that many moth species actually emerge and fly in winter, even when temperatures drop down to the twenties (Fahrenheit). This winter emergence begins in November, typically our stormiest and often coldest month. These wintertime moths are generally medium sized, pale colored and inconspicuous, and mainly belong to the Noctuidae. Conifers are often their larval hosts, of course; there isn't much deciduous growth to eat in winter! Lucky for Salish Sea region gardeners, moths fly as often as several nights per week. While they are not nearly as abundant as summer-emerging moths, they suffice to keep our bats sporadically active until spring.

Since moths are relatively scarce and patchy in winter, however, island bats disperse from October or November through March or April, and only congregate in "maternity roosts" to birth and nurse pups when insects begin to swarm again in large numbers. Look for bats 15 minutes to an hour after sunset in May through September, especially against a moonlit sky. Better yet, purchase an ultrasound microphone (such as Echo Meter Touch) to turn your smart phone into a bat detector! And don't panic if bats fly close to you (to sniff you, like dogs and cats); they are skillful flyers, and our islands' bats are very unlikely to carry diseases affecting people.

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GARDEN FRIENDS

Bat homes

Large, healthy maternity roosts ("colonies") are indispensable to bat reproduction and abundance. A mouse-eared (*Myotis*) bat roost can have hundreds of female bats, most 50-150 and rarely fewer than 25. Mother bats rely on large roosts to guarantee warmth, and to share pup-rearing. While mothers are away from the roost feeding, their aunties snuggle pups and keep them warm and safe. When they learn to fly, pups will learn where to hunt from their grandmothers and other female relatives.

Mother bats, who can live and grow wiser for more than 20 years, are particular about where they congregate to give birth, nurse and fledge their pups. With the exception of Hoary Bats, which tend to give birth to twins, our island bats have only one pup each year. Like most mammals, pups are born with very little hair, and cling to their mothers for warmth and milk for at least a month before they begin flying on their own. Given a choice, mother bats will gather in the dry attic, crawlspace, unused chimney or walls of an occupied—and therefore heated—house, rather than a "natural" roost such as a tree cavity. Only two of the islands' nine bat species routinely choose tree cavities as maternity roosts—two of our larger bats, Hoary Bats and Silver-Haired Bats. All of the others are most likely to be found roosting in houses, or well-maintained barns that are heated, or warmed by the sun or livestock, typically in a south-facing space that also gets warmed by the sun. Ideal maternity habitat has daytime temperatures over 90 degrees and is sufficiently insulated to hold much of that heat through the summer night.

Compared to a warm attic or barn roof, a bat box from an online seller or hardware store is typically small, thin-walled, drafty, and cold. Mounting it on a tree or freestanding post leaves it draftier and colder, also exposed to depredations by owls and, if less than 8-10 feet above the ground, cats and rats, the main predators of island bats and their pups. If occupied by bats at all, rather than spiders or paper wasps, these boxes may attract a few transient males, but they will not attract mother bats and consequently not affect the survival of bat populations in the neighborhood.

From a conservation perspective, the best approach focuses on protecting existing maternity roosts. This may mean leaving a bat colony undisturbed in an attic or crawlspace. For the safety of the bats and well as the human occupants of the home or barn, any gaps in ceilings or walls that make it possible for bats to enter rooms—"human space"—should be sealed with expanding foam insulation, wood and/or plaster. An opening large enough to insert two or three fingers is large enough for a curious, clumsy, naïve pup to drop through, where it will panic, get injured in a scuffle with people or hide and die of thirst.

Additional accommodations can be made to minimize conflicts between humans and bats sharing a home. In winter, when mother bats and their pups have dispersed, for example, canvas drop cloths can be laid out on an attic floor to capture "guano" that can be used as garden fertilizer, while making it easy to keep the attic relatively clean. Canvas, or tacking down plastic sheeting (such as pool liner) is especially useful if bats are roosting above exposed joists and insulation.

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GARDEN FRIENDS

Living with bats

While bats a valuable garden and orchard allies, conflicts can occur if bats are "invited" into your home unwittingly, and where they cannot live safely alongside people. Instead of waiting for evidence that bats have moved in, such as scatters of fecal pellets on decks or roof tiles, we recommend checking your home for potential bat entry-points proactively, sealing any gaps that you find, and replace these "invitations" with a properly designed and well-located bat box attached to a sun-warmed outer wall. If bats are in the neighborhood, they will be most beneficial if you take steps to manage where they choose to roost.

A "bat gap" in the outer shell of a building need only be about a half-inch wide (and 2-3 inches long) for a bat to squeeze through. Some gaps are created when openings intended for ventilation, or exhaust from appliances, heating systems and fireplaces are left unscreened, or screens have been pulled off (typically by birds or rodents—bats lack the muscles or teeth required) and not replaced. Vents for attics and hollow roofs are high up, and often difficult to see from ground level, but are most likely to be compromised and admit bats or other wildlife.

When a stick-built home settles over time, joints and seams in the outer wall can separate, leaving gaps that offer entry to walls and attics. Look carefully around any exposed beam ends, trusses, along the seam between the roof and wall, and beneath the eaves along the edges of soffits and fascia. The edge of roofs above the gutters you may find buckled roof tiles—or crenulations in corrugated metal sheet roofs—that afford a number of micro-hotels for bats. We recommend sealing all of these potential bat gaps when bats are least likely to be hiding inside, which is to say between October and April. Look inside with a flashlight if possible. Then fill with expanding foam insulation, or cover with a piece of hardware cloth, or a wooden lathe in the case of a long narrow slit or seam.

Then offer bats a warm home on the outside of your home. Look at the south-facing side of your home, which ordinarily will be warmest. If there is a roofed deck, or a projecting roof above first- or second-story rooms, consider building a "bat ledge" as described below. It's the simplest kind of bat house that makes use of space beneath, and protected by existing eaves. Alternatively, a properly large, well-insulated bat box can be mounted directly to an exterior wall. Think of it as a miniature attic built just for bats! It must be at least two cubic feet inside if it is to accommodate a maternity colony, all raw unfinished unpainted wood on the inside, at least an inch thick, with a watertight roof. We recommend a sloping metal roof, as well as dark paint on the outside of the box to maximize insolation—solar heating. A height of at least 8 feet above the ground is idea for bats to feel safe entering and leaving.

Have bats moved into your box or ledge? Bat fecal pellets ("guano") are small, black and hard when fresh, and sparkling under a magnifier; they are composed of chewed-up insect exoskeleton. Rodents leave soft, and when fresh rather greenish pellets composed largely of digested plant material. Birds have completely different digestion. They "poop" white-to-gray goop that is most liquid and leaves white streaks on walls and decks. If you find white streaks from the fascia or vents beneath eaves, they are birds—probably one of our native swallow species—not rodents or bats!

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