

Salmonberry in a Changing Climate: Threats and Opportunities



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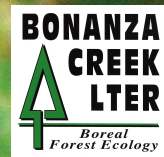


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WELCOME!

In late summer, berry picking is on the to-do list of many Alaskans. Alaska's wild berries provide delicious and highly nutritional food, and for communities not connected to the road system they are a crucial source of fruit. For Alaska Native peoples, berries are an important part of the culture, reflected in stories and recipes. Berry picking is a traditional and recreational activity for rural and urban Alaskans alike. But all across the state people have observed changes in the timing and predictability of fruiting for many berry species, and wonder if a changing climate is having an influence. A shifting climate has led to many changes that could influence berry species, including rising temperatures, longer growing seasons, shorter

snow-covered seasons, and altered precipitation patterns. It can also lead to changes in the pollinators that our berry plants depend on, and in the populations of the animals and microbes that consume or protect the plants. The effects of those changes are complicated, and the overall impact can be positive or negative.

In the "Berries in Alaska's Changing Environment" series, we examine what we know about the impacts of climate change on our berry species based on scientific research and observations by community members across the state. We identify potential threats to the growth, health, and fruit production of each species. We also look at opportunities: ways that Alaskans may be able

to preserve or even expand the availability of fruits. And third, we identify gaps in our knowledge that limit our current abilities to predict what will happen with our berry species. We hope this information will inspire berry lovers to find ways to take advantage of opportunities, protect what we have, and adapt when that is not possible.

The series will briefly discuss human use, and then look at growth, flowering, pollination, fruits and seeds, mutualists (like fungi that help plants obtain nutrients), herbivores, and pathogens, and highlight threats and opportunities for each aspect of the plant life cycle under a changing climate.

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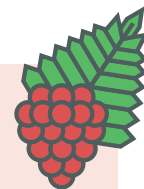
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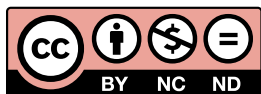
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MORE INFORMATION:

For more information and to download copies of this booklet visit the Alaska Berry Futures website at <https://casc.alaska.edu/changingberries>.



Suggested citation: Parkinson, Lindsey V; Mulder, Christa PH; Putman, Molly; Spellman, Katie L. (2024). Salmonberry in a Changing Climate: Threats and Opportunities. Berries in Alaska's Changing Environment Series: *Rubus spectabilis*. Institute of Arctic Biology and International Arctic Research Center, University of Alaska Fairbanks, Fairbanks, Alaska, USA.



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SALMONBERRY

Salmonberry (scientific name: *Rubus spectabilis*, in the Rosaceae family) is sometimes called high bush salmonberry in northern and interior Alaska to distinguish it from its low growing cousin, *R. chamaemorus*, which is also known as salmonberry in some regions. Salmonberry is known by many indigenous names across Alaska, including *alagnaq* (Alutiiq/Sugpiaq, Yup'ik)^{1,2}; *halagna-x* (Unangam Tunuu)³; *nikotł* (Upper Kuskokwim)⁴; *nkaał* (Ahtna)⁵; *nkułkegh* (Dena'ina)⁶; *was'x'aan tléiGu* (Lingít)⁷; *sk'aw* (Haida)⁸; and *Gga'koacksh* (Shm'algyack).⁹

It is a popular berry to harvest in south central and southeast Alaska and along the coast of North America from central California to the Aleutians.

Though salmonberry has a rich history of observational study and indigenous knowledge, it is not as well-studied in the Western science tradition as other subsistence berry species in Alaska. It is difficult to definitively say how *any* plant will respond to climate change but this is especially true for salmonberries. This knowledge gap is beginning to be filled. Researchers with the US Forest Service, the Sitka Sound Science Center, and others are currently investigating salmonberry in Alaska.¹⁰ This resource is a first step in summarizing available information, but there is much more to uncover!

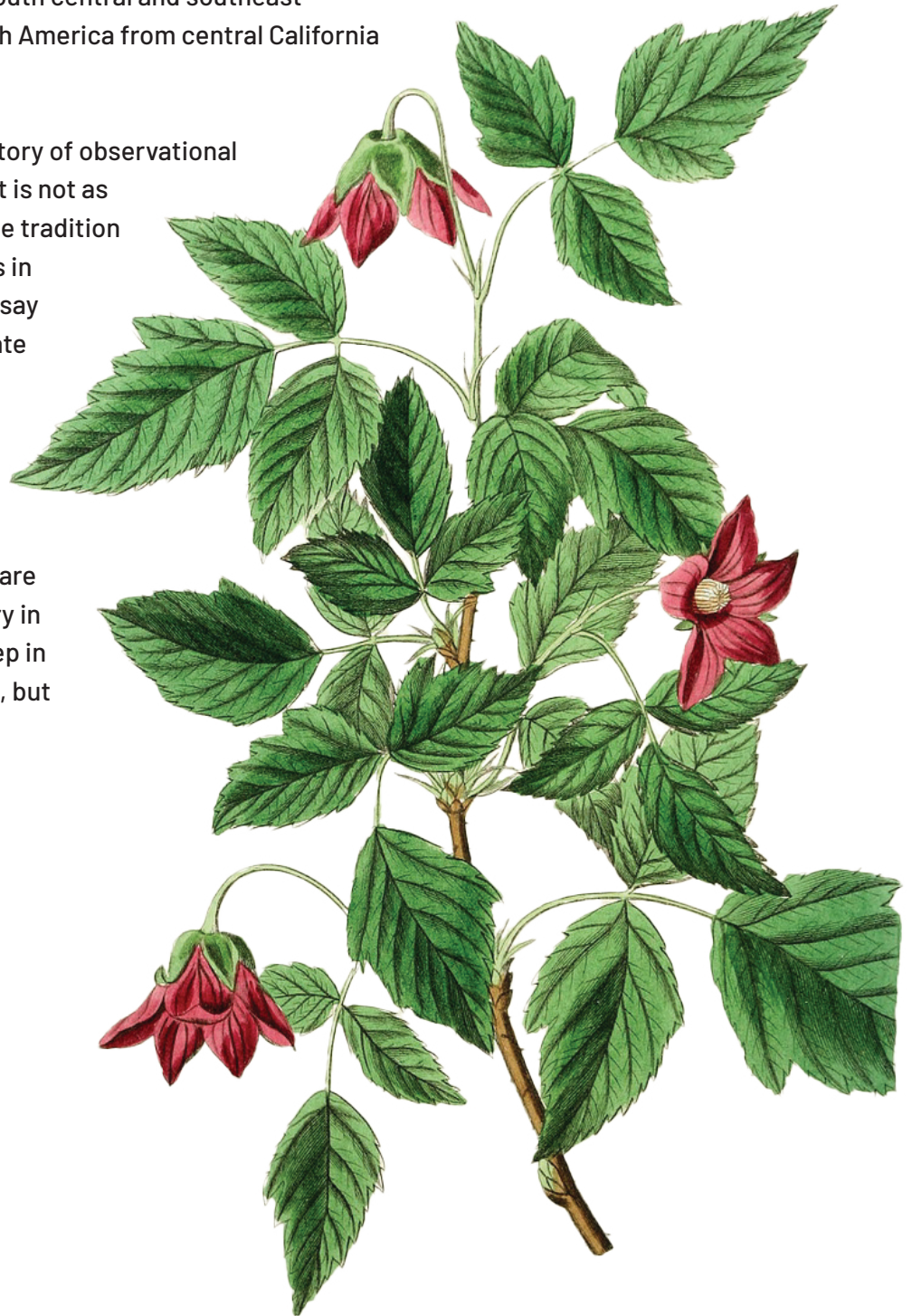


Figure 1. Botanical illustration of salmonberry from 1831. Image credit: J. Ridgway



HUMAN USE

Young salmonberry shoots are gathered in the spring to eat fresh or steamed, and the fruits are commonly picked in summer and fall across south central and southeast Alaska.^{6,11} The berries are mostly eaten fresh but are also added to baked goods and jams.^{12,13}

Traditionally, other parts of the plants were also used as materials, tools, or medicine. Leaves could line baskets, wipe fish, and cover cooking pits while the stems and branches could spread salmon and string clams for smoking.¹⁴

Powdered bark was historically used by some Indigenous communities to help with skin conditions.^{12,14}

Fresh salmonberries have high levels of antioxidants. Vitamin A is especially high.¹⁵

Salmonberries are closely related to domestic raspberries. They have been used as a source of genetic variation to help breed resistance to plant diseases, insects, and nematodes that

can cause extensive damage to raspberries.^{16–18}

Salmonberries are one of many plants that together made up part of a traditional forest gardening practice in Southeast Alaska, western Canada, and the Pacific northwest.¹⁹ Forest gardening is a form of light land management to encourage subsistence species to grow together: trees that bear fruits and nuts, berry plants in the understory, and a diverse array of herbs for food and medicine growing near the ground.^{19–21}

Photo credit: Alaska Native Plant Society

Photo credit: Caroline Dowd, Sandy Beach Recreation Site, Alaska (Flickr, public domain)

“ [I] grew up eating salmonberry flowers on the Kenai Peninsula. We'd pull off the petals (sometimes we'd eat them) then the frilly bits (didn't eat these) and under there would often be little black bugs we'd have to blow away before we could suck the nectar out [...] We didn't eat a whole lot and we'd space them out since every flower is a berry you're not getting later. ”

- u/WilderGiant,
Kenai Peninsula²²

CLIMATE IMPACTS ON HUMAN USE

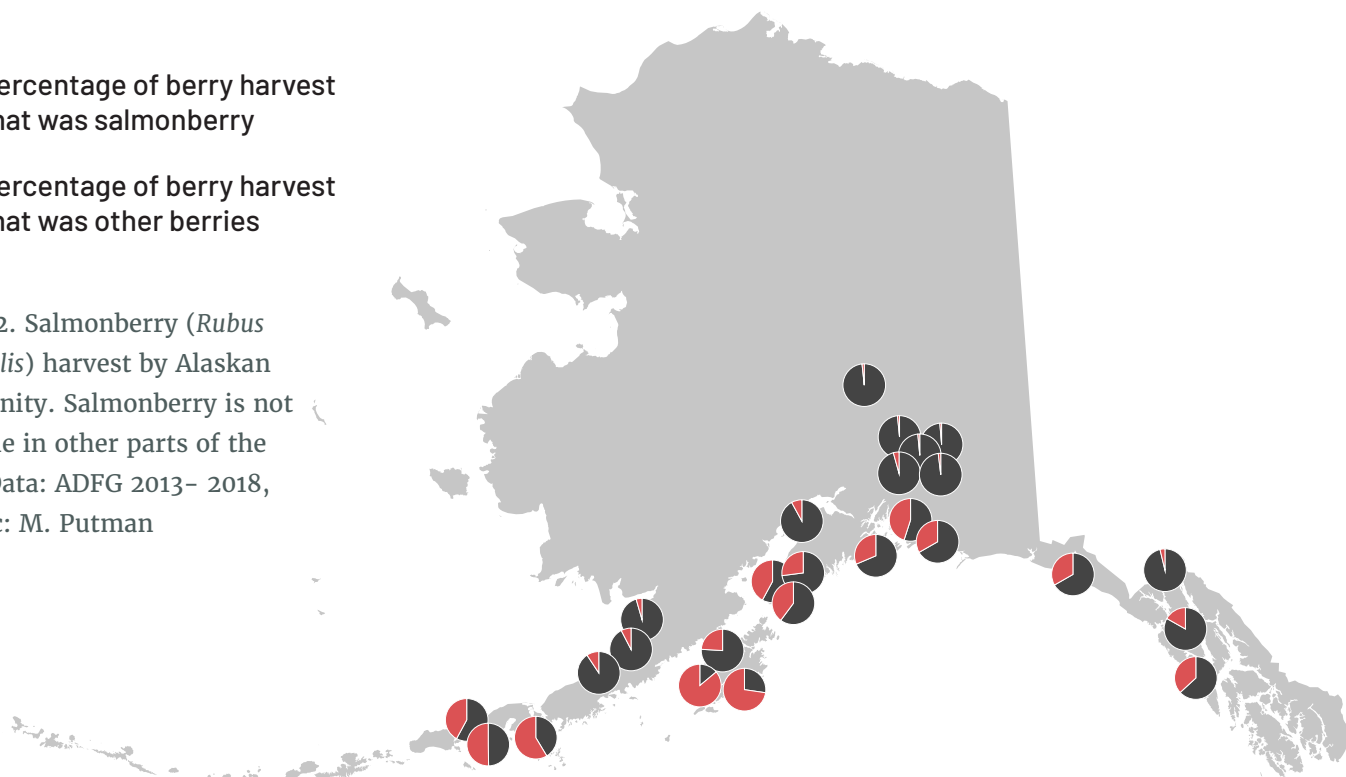
Relationships between plants and animals are built into the words of many indigenous languages. The names for the Swainson's thrush (*Hylocichla ustulata*) in several indigenous languages in British Columbia, Canada and the Haida language in Alaska all translate to “salmonberry bird.” The thrush arrives in the spring at the time the salmonberry flowers, and the song of the thrush is said to cause salmonberries to ripen.²³ These and other relationships that were traditionally used to know when and where to harvest may be disrupted by climate change.

Many berry species in Alaska have been changing the timing of flowering or the berry abundance becoming more variable. Changes in timing and abundance of salmonberry have not been well studied.

Photo credit: Alaska region
USFWS (Flickr, public domain)

- Percentage of berry harvest that was salmonberry
- Percentage of berry harvest that was other berries

Figure 2. Salmonberry (*Rubus spectabilis*) harvest by Alaskan community. Salmonberry is not available in other parts of the state. Data: ADFG 2013– 2018, Graphic: M. Putman



GROWTH

Salmonberry is a **deciduous** shrub that can grow to 3 – 13 feet (1 – 4 meters) tall and 30 feet (9 meters) wide.^{24,25} The plant grows rapidly: stems may add 12 – 24 inches (0.3 – 0.6 meters) per year. The underground biomass, which comprises about 30 – 40% of the plant's total biomass²⁶, is a mix of **rhizomes** (belowground stems) and roots. The rhizomes grow roughly horizontally underground, and many of the stems we see emerge from buds on these rhizomes. There are more buds on salmonberry rhizomes the farther away from a stem the rhizome gets. All the stems connected by an underground rhizome are genetically identical clones.²⁷ One particularly large clone measured in Oregon covered 377 square feet (35 m²).²⁸

Salmonberry has golden or yellowish-brown straight or arching stems (known as "canes") that, like many other closely-related species, often form thickets (Figure 3). Stems are woody and covered with fine prickles, especially on new growth.^{24,25} Stems can survive at least ten years.²⁹ As the stems get older, the bark takes on a shredded appearance (Figure 4).²⁵ Salmonberry grows well in nutrient-rich soil, most often **riparian** (riverside) areas and in moist or wet sites in woody areas,



Figure 3. Youth in Nanwalek with highbush cranberry (*Viburnum edule*, left) and salmonberry (right). The buds on the salmonberry are just starting to open. Photo credit: Katie Spellman.

such as roadsides, logged, or burned areas.³⁰

The leaves are formed from three leaflets, each 3 – 8.5 inches (7 – 22 centimeters) long. The leaves are smooth to slightly hairy on top, while the underside is paler and fuzzier.^{24,25} One trick used to recognize the plant is to look for the rough butterfly shape formed by the two lower leaflets. Leaves are dropped around October, and the plant is dormant during the winter.

Salmonberry is more shade-tolerant than other closely related plants such as prickly rose (*Rosa acicularis*) and cloudberry (*Rubus chamaemorus*).³² It not only grows quickly in logged forests and other disturbed areas, but it can also hold its own when competing with young trees of species like

Douglas fir, western hemlock, and Sitka spruce.^{33,34} It is so good at holding back trees that it is considered a "weed" in Canadian tree plantations!³⁴

One reason salmonberry acts like a weed is that its stems sprout mainly from the buds found on rhizomes, stumps, and root crowns.³⁵ So even if only a small portion of the rhizomes are intact after a disturbance (< 5%), the salmonberry plant can grow back.²⁷ And, again unlike many other berry species in Alaska, salmonberry actually thrives in alder thickets, growing larger and producing more shoots than in evergreen forests or along rivers.²⁶ This may have to do with the extra nitrogen available in alder forests due to nitrogen-harvesting bacteria that live in the alder's roots.

THREATS TO GROWTH FROM CLIMATE CHANGE

Drought: While salmonberries can grow extremely fast, they have one weakness: young salmonberry seedlings grow poorly under drought conditions.³⁶ Many regions in south and southeast Alaska may see more precipitation in the future, and climate models for southeast Alaska suggest losses of climatically suitable habitat will be really small (< 5% ; K. Baer, unpubl. data). However, in some other parts of the state longer growing seasons and higher summer temperatures are expected to increase evaporation from the soil and transpiration from leaves of plants.^{37,38} On the Kenai peninsula, the combination of lower annual precipitation and higher evapotranspiration under warmer temperatures has already reduced water availability to plants by about half since the mid-1960s.³⁹ June water availability is projected to decrease by another 10% over the next 75 years.³⁷ The drying trends are likely to continue and increase³⁸, and could make it difficult for young plants to survive.

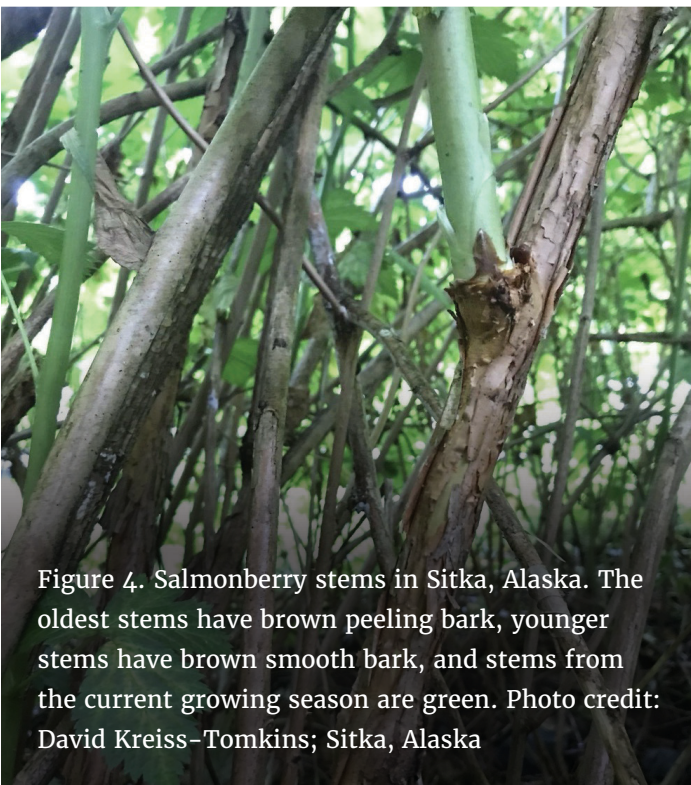
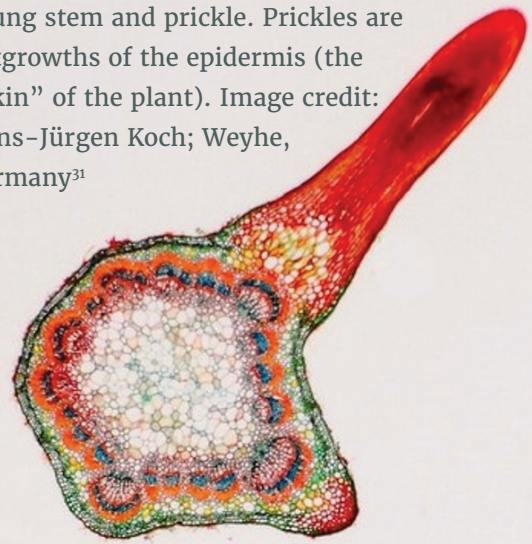


Figure 4. Salmonberry stems in Sitka, Alaska. The oldest stems have brown peeling bark, younger stems have brown smooth bark, and stems from the current growing season are green. Photo credit: David Kreiss-Tomkins; Sitka, Alaska

Figure 5. Cross section of a salmonberry young stem and prickles. Prickles are outgrowths of the epidermis (the “skin” of the plant). Image credit: Hans-Jürgen Koch; Weyhe, Germany³¹



OPPORTUNITIES FOR GROWTH FROM CLIMATE CHANGE

Low severity fire: Salmonberry can rapidly invade burned and other types of disturbed areas, provided that the rhizomes or seed banks are not badly damaged.¹⁶ Indigenous groups in the western US and Canada have long used managed burns as a way to increase the abundance of subsistence resources including salmonberry.³⁵ The optimal burning cycle used to maintain berry abundance was every 3–5 years.⁴⁰ The probability of fire is likely increasing in the south central and western coastal regions of Alaska.⁴¹ Combined with other climate changes this could support salmonberry expansion into new areas.

Warmer temperatures: Salmonberry bushes are limited by minimum temperatures in winter and by growing season length, so they are found primarily in areas near the coast, where the ocean influence provides for warm winters and cool, wet summers.^{16,42} As winter temperatures become less severe and the growing season lengthens, we may see salmonberry shrubs expanding their distribution northward and up into higher elevation areas, provided there is enough precipitation.



FLOWERS



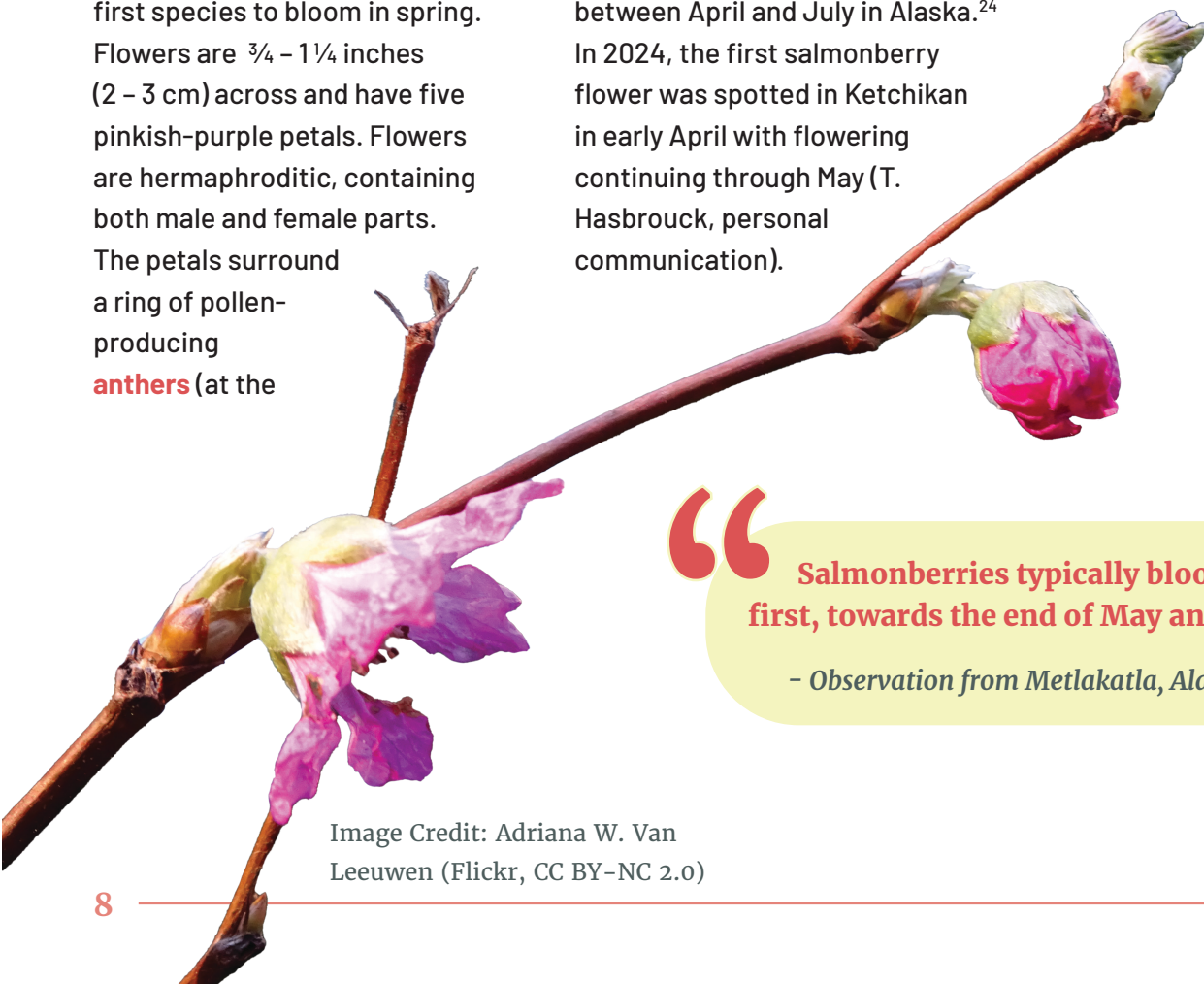
Figure 6 Salmonberry flower. Image credit: Peter Stevens (Flickr, CC BY 2.0)

Salmonberry flowers grow from branches that are at least one growing season old.⁴³ Flower buds are initiated in the summer of the year before they open, and bud scales protect the fragile bud during the winter. In southeast Alaska salmonberry is one of the first species to bloom in spring. Flowers are $\frac{3}{4}$ – $1\frac{1}{4}$ inches (2 – 3 cm) across and have five pinkish-purple petals. Flowers are hermaphroditic, containing both male and female parts. The petals surround a ring of pollen-producing **anthers** (at the

tips of the stamens, the male part of the flower) and a core of pollen-collecting **stigmas** (the tips of the carpels, the female parts) (Figure 6). Each carpel can, if fertilized, make a single seed (Figure 8, 10)

Salmonberry plants flower between April and July in Alaska.²⁴ In 2024, the first salmonberry flower was spotted in Ketchikan in early April with flowering continuing through May (T. Hasbrouck, personal communication).

Peak flowering in Sitka in 2023 was May 13–19.¹⁰ The flowers on each bush don't open all at once; instead, flowering is spread out over the spring season, with flowers opening either singly or in clusters of 2 or 3 at a time.



“ Salmonberries typically bloom first, towards the end of May and into June ”
– Observation from Metlakatla, Alaska⁴⁴

Image Credit: Adriana W. Van Leeuwen (Flickr, CC BY-NC 2.0)

POLLINATION

The flowers open earlier than other species, even before the leaves come out on deciduous shrubs such as alder.¹⁰ Each **carpel** (female component) has a sticky platform at the top called the stigma that traps pollen when the flower is visited by birds or insects. At the base of the carpel is an ovary. If the stigma catches pollen, then the ovary may get fertilized and make a seed (Figure 7). In salmonberries, each pollinated ovary can grow into one ball of the salmonberry fruit (called a drupelet).

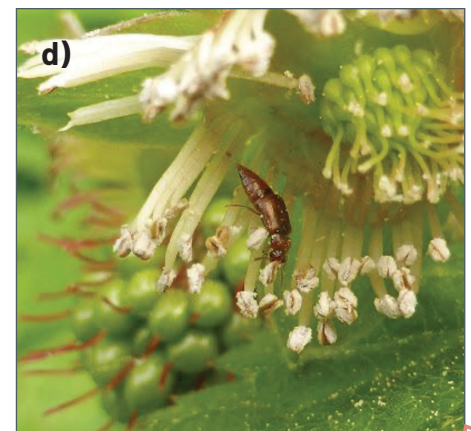
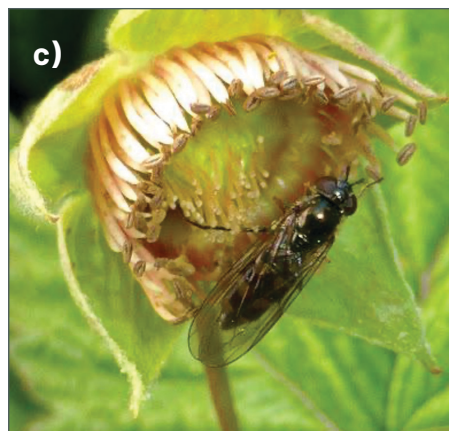
The flowers cannot fertilize themselves even though they

have both male and female parts;⁴⁵ they need pollen from a genetically different salmonberry plant for fertilization and fruit production.⁴⁶ Salmonberries don't need specialist pollinators to move pollen from the male part of the flower on one plant to the female part of the flower on another; their nectar (the main reward²⁹) and pollen are easy to access.³²

Salmonberry flowers are visited by a wide range of bumblebees (*Bombus* species) including the Sitka bumblebee (*B. sitkensis*), black-tailed bumblebee (*B. melanopygus*), and fuzzy-

horned bumblebee (*B. mixtus*). Salmonberry flowers can be an early source of food for queen bees shortly after winter (R. Armstrong, personal communication). Other pollinators include syrphid flies (family Syrphidae, also known as hoverflies, flowerflies, or bumbleflies)⁴⁷, hummingbirds (family Trochilidae),⁴⁸ and beetles.^{16,25,32} Rove beetles (family Staphylinidae) have been observed moving around in blossoms, covered in pollen (Figure 7d).³² Despite all these pollinators, not all flowers become fruits (Figure 9).

Figure 7. Pollinators on flowers in four stages. a) Bristleside fly (*Parasyrphus*) visiting a young flower with immature anthers (no pollen being released yet). The carpels (female parts) are clustered together tightly in the center. b) Bristleside fly visiting a slightly older flower with anthers just starting to release pollen. The carpels are visible in the center. c) and d) Variable dusky-face fly (*Melanostoma mellinum*, c) and a rove beetle (family Staphylinidae, d) visiting old flowers. These flowers have lost their petals but the anthers are still releasing pollen. Expanding ovaries (green balls that will become the berry) can be seen in the center, showing that fertilization has already occurred. Photo credits: Masumi Palhof; Kodiak, AK.



“

Hornets were frequently all over those [salmonberry] bushes - I have a phobia of them, always despised them - one day I saw a hornet snatch up a pest caterpillar.....and realized they were useful. I began watching them instead of planning their demise. Not only did hornets hunt for pests - when unsuccessful they would climb around the flowers, going from one to another. Not sure if they were looking for smaller prey or eating pollen, but they were definitely doing a very fine job of pollinating.

- Kevin; Kodiak, Alaska⁴⁹

”

THREATS TO POLLINATION FROM CLIMATE CHANGE

Timing of flowering. In other parts of its range, salmonberry flowering seems to be aligned with the arrival of rufous hummingbirds (*Selasphorus rufus*), which may be an important pollinator.⁴⁸ We don't know which pollinators, if any, are critically important to salmonberry plants in Alaska. The Metlakatla Indian Community Climate Change Adaptation Plan notes that salmonberries are flowering earlier; this may lead to mismatches between when flowers are open and pollinators are active.⁴⁴

Increased rain is expected across most regions of the state during the flowering and growing seasons⁵⁰ which impacts pollinator movement.

Competition:

“

An increase in non-native plant species have had noticeable effects on the reproductive characteristics of local berry vegetation. The non-native plants have changed the pattern of pollination, frequently decreasing the quality of it.

”

- Observation from Metlakatla, Alaska⁴⁴

OPPORTUNITIES FOR INCREASING POLLINATION

Less wind. Wind patterns are changing across Alaska⁵¹ and the alignment of the windy season and the flowering period will have a strong impact on pollination of flowers and the possibility of them making fruit. Much of southeast Alaska is predicted to stay about the same or become less windy during the pollination period.⁵¹



Black-tailed bumblebee (*Bombus melanogypus*). Photo credit: Masumi Palhof; Kodiak, Alaska

FRUITS AND SEEDS

Bradley Davis (Flickr, CC BY-ND 2.0)

A salmonberry is an aggregate fruit, which is many small fruits stuck together. Each little ball (drupelet) is the result of a pollen grain fertilizing a single ovule. All these fertilized ovules together form what we think of as a fruit (Figure 8). If the flower does not receive enough pollen, the plant will not make a fruit, even if it could make a really small one.

Salmonberries ripen approximately 30–36 days after pollination, from early July near Ketchikan to August around Kodiak and in the mountains.²⁴ In 2023, peak fruiting in Sitka was from July 29 to August 7. The fruits may stay on the plant as late as October in southeast Alaska.⁵² They are $\frac{1}{2}$ – $\frac{3}{4}$ inches (1.5 – 2 cm) long and resemble large, shiny raspberries that range in color from yellow to orange-red to black-red.

Both the red and the orange color variations are found throughout the salmonberry range but in the

southern end of the salmonberry's range (northern California, Oregon) orange is more common while red is more common in the north (Alaska).⁴³ Studies have found that although both red and yellow-orange morphs have similar physical qualities, birds generally favor eating the red fruits.⁵³ Meanwhile, the orange berries last longer on the vine

and lose less water when in the sun, which means they last a little longer on the plant. Because each end of the color range has an advantage (more seed spread by birds vs. longer time on the plant), the range of colors can persist.⁵⁴ Factors such as soil type (which affects germination), along with other unstudied factors also likely contribute to the range of colors.



Figure 8. Developing salmonberry fruit. When the carpel gets fertilized it swells to form a drupelet, each of which contains a single seed. Image credit: Brew Brooks (Flickr, CC BY-SA 2.0)



In **riparian** areas, one Alaskan study found the number of fruits per salmonberry shrub increased with increasing salmon density.⁵⁵ The salmon bring nutrients from the ocean into Alaska's forests when they spawn, which helps plants along the river grow and produce more fruits!

There are an average of 40 seeds per fruit in southeastern Alaska.⁴³ Many plant species need some way to break the seed coat before they can start the growing process. For some species it is fire or freezing, for others it's the damage from the digestive juices of an animal's gut. Salmonberry seeds may be helped along when eaten by some animals but must at a minimum go through a cool period before they can germinate. Then they can be triggered to start growing by increases in light and temperature.¹⁶ The seeds can wait for up to 100 years for the right conditions, which often comes in the form of some sort of forest disturbance.¹⁶



Figure 9. Images from repeat photography for monitoring salmonberry development in Sitka, Alaska. Notice that only a subset of the flowers developed into fruits. Photos courtesy of K. Baer, USDA Forest Service and Sitka Sound Science Center

OPPORTUNITIES FOR GREATER FRUIT PRODUCTION

Multiple fruitings: Master Gardener Genelle Winter of Metlakatla, Alaska, has observed salmonberries fruiting more than once in a growing season when the weather warms early in the spring.⁴⁴ Salmonberry differs from many other berry species in Alaska in this respect.

SEED DISPERSAL AND GERMINATION

Salmonberry seeds are dispersed primarily by songbirds^{56,57}, small mammals, and larger mammals like coyotes³⁵ and bears^{24,57} that eat the fruit and deposit the seed in their feces. Grizzly bears can deposit 50,000 to 100,000 salmonberry seeds in a single pile of feces!⁵³ Dispersal of seeds by animals has three advantages. First, passage through the gut usually increases seed germination. Second, seeds are more likely to end up in areas where plants grow well, like open areas. Third, seedlings need a lot of nutrients, especially phosphorus⁵⁸, to grow, and animals deposit nutrient-rich urine and feces along with the seeds. Salmonberry seeds in bear feces that contain animal material like bones and fur grow larger than the seedlings in feces of primarily vegetation!⁵⁹ The long fruiting time increases the

chance that the seeds will be dispersed by animals.³²

But not all animals that consume the fruit have positive effects. Some, including martens (*Martes americana*) and banana slugs (*Ariolimax columbianus*), may kill some seeds.^{53,60,61} Interestingly, a study on banana slugs found that seeds from red fruits were more negatively affected by the slug's digestive system than seeds from the yellow/orange salmonberries.⁶¹

Salmonberry seeds can also be dispersed by gravity when ripe fruits drop from the plant,^{16,43} and can then be moved elsewhere in the soil by burrowing animals¹⁶ or lost through predation — mostly by rodents.⁶²

Soil type can also affect seedling success. In Oregon, more salmonberry seedlings grew on

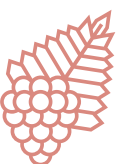


A robin with a salmonberry. Image credit: Lynette Elliott (Flickr, CC BY-NC 2.0)

sites with mineral soil than on soil in which the organic layers were undisturbed. Seedling emergence and survival were greater in thinned forest stands than in full clearcuts or unthinned stands.⁶³



Figure 10. Salmonberry seeds. Photo credit: Julia Scher, USDA⁶⁴



PLANT FUNGAL ASSOCIATES

The majority of the world's plants have relationships with **mycorrhizae**, a group of fungi that connect to plant roots and help the plant obtain water and nutrients. Plants in the genus *Rubus*, including salmonberry and cloudberry, often do not form these relationships. However, one study from 1974 looking at potted

salmonberry shrubs found that it formed connections with two species of arbuscular mycorrhizae when the spores were added to the soil.⁶⁵ It is unknown whether this occurs in plants in the wild.

"Arbuscular" comes from the Latin word *arbuscula*, meaning "little tree." The mycorrhizae

form small, tree-like structures *within* the plant's root cells, which are crucial for the **symbiotic** relationship between the plant and the fungus: the fungus gets carbohydrates from the plant while the plant gets water and nutrients from the fungus.

HERBIVORES AND PATHOGENS

A study of fungal **pathogens** on salmonberry leaves from Vancouver Island, Canada found over 300 species. Of those, 76 caused leaf necrosis (dead spots on the leaves) though only 19 caused serious damage.³⁴ Another study found that most leaf spot symptoms in British Columbia were from *Phomopsis* species.¹⁶ *Botrytis cinerea*, a gray mold, infects salmonberry fruits more than blueberry fruits (*Vaccinium* spp.), in southeast Alaska.⁶⁶

Observations from western Washington reported remarkably little insect damage even during an outbreak of tent caterpillars that destroyed the leaves of nearby alder (*Alnus* spp.).³²

Leaves, twigs, and stems are eaten by browsers such as deer, elk, and rabbits.^{67,68} The dense



Porcupine munching on salmonberry stalks. Photo credit: Ryan McFarland; Ketchikan, Alaska (Flickr, CC BY 2.0)

thickets provide excellent escape habitats for birds and small mammals, and nesting sites for songbirds.³⁵ Salmonberry shoots may make up about a quarter of

spring and summer diets of black and grizzly bears in coastal British Columbia, Canada.⁶⁹

Salmonberry shrubs are tough. The plants grow back quickly, sometimes even stronger than before, after browse, disturbance, and even low- to medium-severity fires. The shrub can outcompete many other plants, and even in the shade it still can grow well. While increasing drought is a potential concern it is impossible to predict with our current knowledge exactly how salmonberry shrubs will respond to all the expected changes across southern and southeast Alaska. The potential for more fruit production under an extended growing season also bodes well for future productivity. Of the berry species discussed in this series, this one is the most likely to benefit from our changing climate in Alaska.

BUILDING RESILIENCE TO CHANGES IN SALMONBERRIES

Food forests may be an excellent way to provide salmonberries to communities. **Forest gardening** is a traditional form of light land management to encourage subsistence species to grow together: trees that bear fruits and nuts, berry plants in the understory, and a diverse array of herbs for food and medicine growing near the ground.¹⁹⁻²¹ Even forest gardens that have not been actively managed for over 150 years still have higher diversity and density of culturally important food sources than nearby unmanaged forestlands.¹⁹

Protect salmon. Salmonberry shrubs that grow along healthy salmon streams produce more berries than the shrubs along streams with fewer salmon due to the nutrients the salmon bring to shore in their bodies.⁵⁵ Salmonberry seedlings also grow larger in bear manure containing animal remains than in potting soil or even manure containing vegetation.⁵⁹ Bone meal fertilization or traditional practices of burying unusable portions of animal carcasses, crushed oyster shells, or seaweed can help berry patches.^{59,70,71}

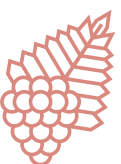
Pruning the branches after picking the berries can stimulate new growth and fruit production the next growing season.³⁵ Pruning can mend damaged shrubs, promote growth and health, increase flowering, and increase yields of berry bushes.²¹



“ See, a lot of people think we never touched the wild . . . berries. But we did. We cultivated it. We pruned it . . . *qw’alhem* [salmonberries], it’s done, after you pick it, *tl’exwiyy* [“breaking the tops off”] they called that. My grandma tell me that if you let it grow this high [two meters or so], then it doesn’t produce much berries. ”

– Kwaxsistalla Wathl’tthla (Chief Adam Dick of the Kwakwaka’wakw); British Columbia, Canada.
Personal communication to Nancy Turner⁷¹

Photo Credit: Ann Beeman; Ketchikan, Alaska
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KEY KNOWLEDGE GAPS

Alaskan plants may be different. Much of what we know about salmonberry plants comes from research in the contiguous United States or British Columbia, Canada. Little work has been done on the plants in Alaska. Southeast and south central Alaska comprise the northernmost range of the species and the plants may interact differently with their environment when compared to more southern populations.

There is more to learn underground. Most observations and experimental studies focus on the aboveground portion of the plant but 30 – 40% of the mass of a salmonberry plant is underground. There has only been one study on salmonberry **mycorrhizal relationships** and that one used potted plants from northwestern US. We have no idea what sort of relationships salmonberry shrubs might have with the fungal communities of Alaskan soils.

The **net impact** of increased temperatures and growing season length (likely positive for growth and range expansion) and increased drought (detrimental to seedling establishment and growth) is difficult to predict. The first models of salmonberry plants in Alaska are currently being undertaken.

GLOSSARY

Carpel - female part of a flower; contains stigma (pollen collector), ovary (fruit or seed to be), and style (piece connecting stigma and ovary)

Deciduous - an adjective for plants that have leaves that last for one season only

Herbivore - an animal that eats primarily plants

Mycorrhizae - Beneficial fungi that grow into and around many plant roots

Pathogens - bacteria, fungi, or viruses that cause disease

Rhizome - plant stem that grows underground, the roots grow off of it

Riparian zone - the land area around a river or stream

Symbiotic - a mutually beneficial relationship between two organisms

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Funding Acknowledgement: This report is part of the Alaska Berry Futures project of the Institute of Arctic Biology and International Arctic Research Center at the University of Alaska Fairbanks. Major funding is provided by the US Geologic Survey through the Alaska Climate Adaptation Science Center (G17ACOO213) and additional support is provided by NSF Arctic Harvest- Public Participation in Scientific Research project (Award 1713156) and the Bonanza Creek Long Term Ecological Research program (NSF Award DEB-163476 and USDA USFS award RJVA-PNW-01-JV-1161952-231)