Botanical Bounty

An exploration of the diverse flora of the Salmon River Watershed

Salmon River Restoration Council

spring 2018

Milkweeds are favored by pollinators. It is the only plant monarch butterfly larvae will eat! Monarchs are in decline due to extensive agricultural use of Roundup® weed killer on corn and soy fields.
Showy milkweed (Asclepias speciosa) *and tiger swallowtails -- photo by Emily Ferrell.*

Cover: Siskiyou lewisia *along with sedums and penstemon -- by Bob Atwood, former AmeriCorps volunteer for SRRC*

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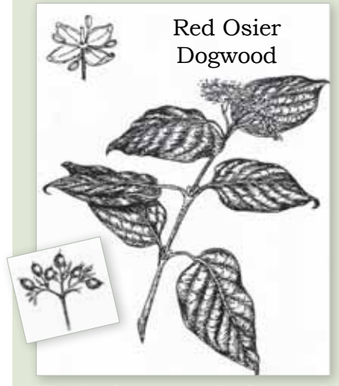
"The People made a chewing gum from the 'milk' of this plant that, especially at World Renewal gatherings, both the young and old would chew. ...When enough milk had been collected, it was heated and stirred until the liquid congealed."



"Red osier or creek dogwood (*Cornus sericea*) is "a shrub with reddish bark...The branches of this dogwood species were made into arrowshafts by the Karuk. Carved serviceberry (*Amelanchier alnifolia*) points were used with these shafts."

- from *Plants and the People: The Ethnobotany of the Karuk Tribe,* researched, compiled and illustrated by Barbara J. Davis and written by Michael Hendryx © Siskiyou County Museum

Engaging the Botanical World

A larkspur (Delphinium decorum) *growing on our thistle hunting grounds above Forks of Salmon -- by Emily Ferrell*

When it comes to plants, the Salmon River is a special place. Our watershed lies in the midst of a region renowned for the diversity of its flora. The Klamath Mountains are home to 3,540 different plants, including one of the highest conifer diversities in the world (see article, page 4). The steep, inaccessible, and relatively undeveloped nature of our mountainous home has led to its natural diversity remaining relatively intact through the past century and a half of rapid ecological change. That said, threats are not altogether lacking – invasive plants, and habitat loss and fragmentation due to mining, logging, fire suppression and high intensity wildfires are all serious concerns for plant life on the Salmon River.

For 25 years, SRRC has been working to protect and restore native plant communities in the Salmon River watershed. In 1994, after over a decade of the Salmon River and Mid Klamath communities fighting to prevent the aerial and hand spraying of herbicides for forest management (see article, page 10), the fledging SRRC perceived a new threat to human and ecological health from herbicides. There was an increasing interest from management agencies in controlling the ever spreading populations of noxious weeds. In an effort to prevent the use of the preferred chemical control methods, SRRC developed the Community Noxious Weeds Program (CNWP), which pioneered the use of community manpower to manually control noxious weeds (see article, page 11). That same year, SRRC also began collecting and propagating native grass seeds for USFS revegetation projects.

Scarlet fritillary (Fritillaria recurva) *-- by Karuna Greenberg*

Our Noxious Weeds and Native Plants Program expanded over the years, and now, two and a half decades later, the Salmon River Restoration Council (SRRC) and its partners are effectively managing 17 key species on over 550 sites, spread across the 751 square mile watershed, without the use of herbicides. Over the years of managing noxious weeds we have learned many valuable lessons. Top on this list is the need for education, prevention, and community involvement. The considerable success of the CNWP over the years is in large part due to the consistent and enthusiastic involvement of the Salmon River community. In fact, we have come to believe that ongoing success controlling invasive plants requires the active participation of a well-informed public. Invasive species will never be completely eliminated. We may be lucky enough to eradicate some detrimental species with persistent hard work, but there will always be new invaders on the horizon. Without community solutions, raising awareness of the local population and user groups, those invasives would eventually overrun our native plant communities.

Slender Iris (Iris tenuissima) *-- by Emily Ferrell*

Staghorn clarkia (Clarkia concinna) *taken during an SRRC Adopt-A-Highway clean-up -- by Karuna Greenberg*

Weeds have always been a priority for SRRC, but we are increasingly taking on other projects that protect and restore our native flora. Our Habitat Restoration Program is working to restore floodplains and create more robust riparian vegetation along the river (see article, page 14). Through the Western Klamath Restoration Partnership, our Fire, Fuels, and Forestry Program is getting more involved with landscape scale planning and implementation of projects that will be necessary to help restore the natural fire regimes that our native forest and meadow ecosystems depend upon. We are also venturing into native plant research, with a proposed project to monitor the health of the Boulder Peak population of whitebark pine (see article, page 6), and screen for rust resistance within the unique and isolated populations of the Klamath Mountains.

SRRC is committed to continuing our work to protect and restore the amazing biological diversity that helps make the Salmon River such a unique place. With the help of our agency partners, and the dedication of the local community, we can continue the good work that has gone into controlling weeds and improving habitat for so long, as well as branching out into projects that we have yet to address, such as restoring high mountain meadows, protecting native pollinators, and controlling new invasives. We look forward to working together to protect our native plants!

Salmon River Plant Biodiversity

Within the verdant folds of its steep mountains and narrow canyons, the Salmon River watershed holds an extraordinarily diverse assemblage of plants. This includes nearly half of the pine tree (*Pinus*) species and about two-thirds of the oak (*Quercus*) and gooseberry (*Ribes*) species found in California. It has one of the greatest diversities of *Ceanothus* in North America. Perhaps more famously, our forests are home to more species of coniferous trees than nearly any other forest on earth and is home to the largest incense cedar in the world. The Salmon River plant community is globally outstanding!

Just within the watershed, some plant species grow only in a handful of locations while others can be found virtually everywhere. A few endemic plants grow only here and a few other places nearby. New species and subspecies have been discovered in the Salmon watershed and, certainly, there are others still awaiting discovery.

We have three manzanita (Arctostaphylos) *species in the Salmon River watershed. This one is being pollinated by a drone fly (Criorhina sp.) -- photo by Emily Ferrell*

View of Thompson Peak with green manzanita (Actostaphylos patula) *in the foreground -- photo by Karuna Greenberg*

Geology To understand why the Salmon River watershed has such a diverse flora, we first need to look at the varied and complex geology of the encompassing Klamath Mountains since nearly all of our plants grow upon the rock and soil of these mountains. Starting around 200 million years ago, the Pangea supercontinent broke apart, freeing the North American tectonic plate to begin its journey out of the tropics and toward today's location. Simultaneously, the western edge of North America was colliding with different tectonic plates and smaller pieces of land were incrementally added onto the continent, piecing California together in an assemblage of *accreted terranes*, each having a unique geologic character. Continued tectonic collisions uplifted this new land, eventually forming the Klamath Mountains. Plumes of magma then melted into the core of the mountains, crystallizing into silvery granite. By this point, the Klamath Mountains were up to 14,000 feet high and composed of a complex swirl of wildly different rock types, including some—like serpentine—that are rarely found on the earth's surface. This geologic diversity has led to a highly varied substrate for plants to grow upon and is one cornerstone of today's botanical diversity.

Microclimates & Connectivity The Klamath Mountains have been eroding for the past 65 million years, but they continue to be defined by exceptionally rugged topography and prominent peaks. Located just 40 miles from the ocean, the Salmon River's mountains interact with Pacific and inland weather systems to create highly localized microclimates. In our current climatic regime, drier areas along the river get as little as 25 inches of rain per year while Crapo Mountain can get over 80 inches of rain. The wide range of elevations in the watershed and variations in aspect add further complexity to the microclimates. These gradients in elevation, aspect, and moisture are the second cornerstone of our watershed's exceptional botanical diversity. Overlaying this on top of the area's geologic and soil diversity creates a spectrum of unique habitats for a wide array of plants. In a further twist of complexity, the plant cover itself affects the microclimates in a feedback cycle.

Red larkspur (Delphinium nudicaule) *-- photo by Emily Ferrell*

Climate, of course, shifts over time and its changes over the past many thousands of years have strongly influenced our current assemblage of plants. As earlier climate regimes have wavered between cool and moist and warm and dry, plants from the Great Basin, Cascades, Sierra Nevada, Central Valley, and coastal areas have all gathered in our watershed and surrounding Klamath Mountains, making it a junction of major biotas. The physical connectivity of the Klamath Mountains to the Cascades and coastal ranges has been a critical element to the movement of species through time as climates have shifted. Owing to the diversity of soils and microclimates here, many plants were able to locate and occupy niches that suited their particular needs and remain here even as regional and global climates have continued to change. Some of these plants eventually evolved into new species or subspecies that are found nowhere else. These are referred to as neoendemics and include the Salmon Mountain wake robin (*Trillium ovatum* ssp. *Oettingeri*), Marble Mountain campion (*Silene marmorensis* ssp. *Kruckeberg*), Siskiyou phacelia (*Phacelia leonis*), and Copeland's speedwell (*Veronica copelandii*).

Glaciation Another key aspect to the biodiversity of the watershed lies in the fact that this area escaped the burden of continental glaciation during the Wisconsin glaciation, which occurred from 25,000 to 13,000 years ago. During this period, the Klamath Mountains served as a biologic refugia for plant species forced southward by the advance of glaciers across Canada and the Pacific Northwest. After the glaciers retreated, some of these species remained in the high elevations of the watershed where they can still be found. Some species that were once common across a wider range, such as the Brewer spruce and Sadler oak (*Quercus sadleriana*), no longer exist anywhere else. These are referred to as paleoendemics and, together with the neoendemics, they define a group of endemic plants that are totally unique to our area.

Disparate Populations The same processes that resulted in paleoendemics have also led to the formation of disparate populations of plant species that are still found in other locations. These include whitebark pine, subalpine fir, Pacific silver fir and Engelmann spruce. All of these trees occur in other areas but their Salmon River populations represent outliers that are distant from the other populations. While they remain the same species, there are often detectable differences between the populations here and elsewhere, indicating that they are subtly evolving and may eventually split off to form new subspecies or complex hybridizations. Humans may be behind at least one disparate population: the northernmost population of gray pine occurs near Forks of Salmon, and some botanists theorize that Native Americans brought it here for its bountiful pine nut crops.

Brewer spruce seen along the trail to Russian Lake during an SRRC guided conifer hike -- photo by Karuna Greenberg

Fire Regime The plant assemblages we see today in the Salmon River watershed came together about 3,000 to 4,000 years ago when the climate cooled and moistened compared to the previous several thousand years. Paleoecological records tell us that plant taxa respond individualistically to climate change: the ranges of some species expand while others contract in response to climate change, eventually altering the composition of the plant assemblage. In turn, this alters competitive interactions between species and affects the geographic distribution of fire-adapted and fire-intolerant species. In another feedback loop, the geographic distribution of these species affects the fire regime by altering the frequency, extent, and intensity of wildfires. Fire-adapted species, such as knobcone and lodgepole pine, need fire for reproduction and contribute to fuel loading by shedding needles and bark and by retaining dead branches as ladder fuels to ignite the canopy. Fire intolerant species, such as Brewer spruce and Pacific silver fir, effectively hide from fire by living only in cool, moist, north-facing slopes at higher elevations. The suppression of wildfires over the past 100 years has led to unnatural build-ups of fuel and this often increases the intensity of wildfires. Some of these fires are beginning to burn into the fire refugia used by fire-intolerant species. It remains to be seen whether this will affect the composition of local plant assemblages by burning out fire-intolerant species.

What's Missing The Salmon River watershed lies near the geographic center of the Klamath Mountains and much of what can be said about the watershed's biodiversity can also be said about the Klamath Mountain region as a whole. There are, however, some unique species found in the Klamath Mountains that are, oddly, unknown in the Salmon River watershed. Perhaps most notable is the Port Orford cedar which is endemic to the Klamath Mountains and occurs to the west and to the east of the Salmon River watershed, but seemingly skipped over our area. Perhaps there are a few lurking in a cool, damp area yet to be discovered within the watershed. The same may be true for the carnivorous California pitcher plant (*Darlingtonia californica*), which is known to occur just outside the watershed to the northwest, south, and to the east but nowhere within the watershed. Also seemingly missing from the watershed is the Alaska yellow cedar (*Cupressus nootkatensis*) which grows in isolated areas of the Siskiyou Mountains just across the Klamath River. It just goes to show, you can have amazing diversity but diversity itself is diverse and no one place has it all.

The Future As our region's climate continues to shift away from the cool and moist regime it has experienced for the past several thousand years, the non-vascular plants and fungi that are largely restricted to persistently cool and moist late-successional forests face the greatest challenges. These species cannot quickly relocate to areas that suit their particular needs and may end up the first among many species to be lost in our regional plant communities. Other plants may be able to find new niches within our mountains by moving up in elevation or shifting to cooler sides of ridges. The encroachment of fire into these areas, however, may foil their strategy. Regardless, our plant communities are shifting and moving even now, although this occurs at a rate that is not easily observable. Even as the story of the Salmon River watershed's plant diversity is not fully known, it is already changing, just as it always has. - *Scott Harding*

The 20 conifer species of the Salmon River watershed

1. Foxtail pine - *Pinus balfouriana*
2. Whitebark pine - *Pinus albicaulis*
3. Western white pine - *Pinus monticola*
4. Jeffrey pine - *Pinus jeffreyi*
5. Ponderosa pine - *Pinus ponderosa*
6. Lodgepole pine - *Pinus contorta*
7. Sugar pine - *Pinus lambertiana*
8. Knobcone pine - *Pinus attenuata*
9. Grey pine - *Pinus sabiniana*
10. Common juniper - *Juniperus communis*
11. Engelmann spruce - *Picea engelmannii*
12. Brewer spruce - *Picea breweriana*
13. Mountain hemlock - *Tsuga mertensiana*
14. Douglas-fir - *Pseudotsuga menziesii*
15. Pacific yew - *Taxus brevifolia*
16. Incense-cedar - *Calocedrus decurrens*
17. Pacific silver-fir - *Abies amabilis*
18. Subalpine fir - *Abies lasiocarpa*
19. Shasta fir - *Abies x shastensis*
20. White fir - *Abies concolor*

Native Conifer Spotlight: Whitebark Pine

Whitebark Pine is a long-lived and slow-growing five-needle pine which occurs in subalpine conifer forests throughout the west, but is rare in the Salmon Mountains. Because of where they grow, these tough trees endure harsh winds, deep snow, nutrient poor soil, and summer drought, which causes them to develop into beautiful sculptures reminiscent of the severe environments they persist in.

Left: An old whitebark pine bleached by the weather -- photo by Michael Kauffmann
Above: Whitebark pine on the left and common juniper sprawling on bedrock to the right in the Russian Wilderness -- photo by Karuna Greenberg
Below: Nutcracker -- photo by John C. Avise, Whitebark cones -- photo by K. Greenberg

Whitebark pine is different from other five-needle pines because the cones stay closed and the seeds are wingless. The trees therefore rely exclusively on Clark's Nutcrackers *(Nucifraga columbiana)* to get the seeds out of the cones and spread them as they cache the seeds throughout high elevation areas. Of course, some of the seeds are spread around by other animals which eat them, and the nutcrackers forget some of their caches, so it is those dropped and forgotten seeds that will develop into seedlings. The trees and birds mutually rely on each other, and the loss of one species will result in the loss of the other, both of which are keystone species. Keystone species provide a primary role in the balance of an ecosystem, the loss of which results in a cascade of changes throughout the system. This pine is a keystone species because the large, nutritious seeds are a primary food source for many creatures. They're often the first trees to come back after a disturbance such as wildfire, and thus create nurse sites for other vegetation to establish. They hold soil and steep slopes in place in rugged terrain; and they provide shade for the snowpack, helping it last longer into the spring.

Whitebark pine populations have shifted, primarily due to changes in climate, insect and pathogen distribution changes, altered fire return intervals, and increased fire severity and intensity. Stress during drought conditions caused by changes in climate have hindered these trees' ability to resist insect and pathogen attacks. White pine blister rust outbreaks (*Cronartium ribicola*; a non-native invasive pathogen) have further weakened drought-stressed trees and exacerbated native mountain pine beetle (*Dendroctonus ponderosae*) infestations, resulting in massive mortality. Most whitebark pine individuals are not resistant to rust outbreaks because they did not evolve with the pathogen and so are further weakened when trying to resist bark beetle attacks. On top of all of that, increased beetle infestations have been correlated with increased climatic warming. Many agencies are currently researching natural rust resistance and bark beetle treatments throughout the pine's range.

The great loss of these trees has led the US Fish and Wildlife Service to list whitebark pine as a *candidate species*. This means that there is sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act, but the development of protective regulations is precluded by higher priority listing activities. Until it is listed, federal and state agencies are applying special management criteria, primarily focused on avoiding disturbance to individual populations.

If you're interested in learning more about these unique and beautiful trees, we highly recommend *Conifer Country* by Michael Kauffmann. This excellent field guide focuses on our amazing conifer diversity (The Salmon Mountains have one of the greatest conifer diversities in the world!) and directs you to excellent hikes to visit these amazing trees. In coordination with the Klamath National Forest, SRRC is collecting occurrence data of this locally rare species. We have proposed a project to monitor the health of the Boulder Peak population, the largest whitebark pine stand in the Marble Mountain Wilderness Area and screen for rust resistance within the other unique and isolated whitebark pine populations of the Klamath Mountains.

- Melissa Van Scoyoc

The Karuk Herbaria:
Two Collections of Native Plant Specimens in Happy Camp & Orleans

Plants play a major role in Karuk culture. The aboriginal territory of the Karuk People is ecologically one of the most diverse bio-regions in the world. Our people have respectfully been living with these plants by eating them, making baskets and tools, making medicines, celebrating them in ceremonies, making fire with them, etc. since time immemorial. The plants from our area have not only taught us how to survive, but how to live and thrive in this world.

The way that we can learn more about the plants of this area is by using the Western science method of going out into the field, collecting the plant, writing down all the descriptive data about the plant, identifying the scientific name of the plant, mounting the plant and it's data onto thick mounting paper, and storing the final sample in a cabinet for safe keeping and further study.

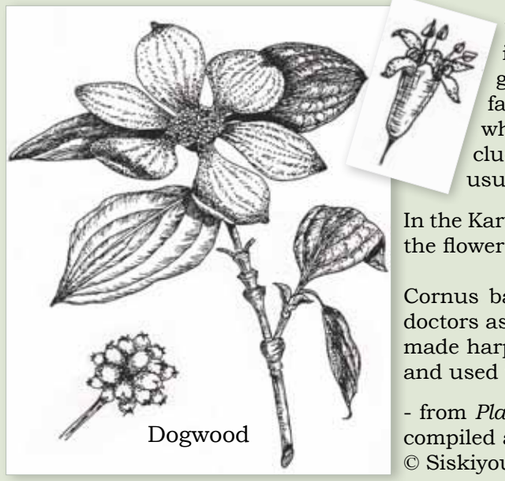
In the spring of 2015, Dr. Megan Mucioki from UC Berkeley & Jepson Herbaria started working with me as a co-collector for the Karuk Herbaria. The first plant that we collected was Pacific dogwood (uyáhaamah, *Cornus nuttallii*) from my brother's driveway. I know that this was not a coincidence, because we were cleaning eels. Karuk traditional ecological knowledge tells us that when the dogwood blooms, it means that the eels are running.

To date we've collected two collections of 134 species each for the Karuk Herbaria, mounted over 300 specimens, and we've taught over 200 people—young and old—how to collect, press and mount Native plant specimens. We made it into the high country to study and collect a couple of Alliums last year with a small group of interested young people and adults. The wild onions collected were; Siskiyou onion (*Allium siskiyouense*) and pink star onion (*Allium platycaule*).

Our legacy of Karuk ethnobotany will survive and continue for many generations of Karuk People to come. Yôotva, yôotva to Dr. Tom Carlson of UC Berkeley & Jepson Herbaria, and to the Klamath Basin AFRI Food Security Grant.

- Ben J. Saxon, Biological Technician for Department of Natural Resources

Photos of dogwood flowers above, and the page from the Karuk Herbaria containing the vanilla leaf plant -- by Ben Saxon



"In the fall, mountain dogwood foliage turns red. The flowers grow in two parts. The 1/2 to 1 inch center head is composed of tiny greenish-white blossoms which later develop into bright red berries favored by squirrels, birds, and other animals. 4 to 7 large creamy white petals (sometimes tinged with purple) surround this center cluster. These petals are actually appendages called bracts -- modified, usually reduced, leaf-like structures.

In the Karuk world, mountain dogwood was used as a good luck charm because the flower "looks to the ocean." It was also used in the sweat lodge.

Cornus bark contains tannin and cornine which was used by early frontier doctors as a quinine substitute for malaria. Tribes north of the Karuk territory made harpoons from the wood for salmon fishing. They also burned the twigs and used the charcoal for tattooing purposes."

- from *Plants and the People: The Ethnobotany of the Karuk Tribe,* researched, compiled and illustrated by Barbara J. Davis and written by Michael Hendryx

Without Us, Weeds Would Not Exist

Throughout history, as people roamed and invented uses for land, certain plants tagged along and got in the way. In response a new plant category, "weeds", was invented to indicate which plants were enemies of the people. Since non-native weeds began pouring into the west in the mid-1800s, the problem has increased enormously: on western public lands over 17 million acres are already infested and weeds are spreading at about 4,600 acres per day.[1] In order to protect the biodiversity and integrity of Salmon River ecosystems, let's explore the concepts, impacts, and societal issues surrounding our photosynthetic foes.

What makes a plant a weed? Historically, it's been all about us. Scholars first defined a "weed" in relation to human values (e.g., "useless, unwanted, undesirable"[2]), activities (e.g., "follows human disturbance"[3]), and behavior (e.g., "competitive and aggressive"[4]). Because many weedy plants injure or sicken animals, range communities embraced the term "noxious weeds." Congress adopted this term in the Federal Noxious Weed Act of 1974, which set up a legal system for battling "any plant or plant product that can directly or indirectly injure or cause damage to crops, livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the U.S., the public health, or the environment." Nowadays more people want to move environment to the top of the list and use the less human-centered term "invasive plants." No matter what you call them, however, all weedy plants possess a unique combination of traits that allows them to colonize wide swaths of land, displace native plants, and disrupt entire ecosystems.

Why so successful? In California, the most common plant is yellow starthistle—a weed! How did this happen? Upon arrival to a new land, a weedy plant is suddenly freed from all the environmental restrictions it evolved with, such as extreme cold, fire regime, diseases, hungry insects, and territorial neighbors. Now unconstrained, it rapidly colonizes with successful strategies at each life stage: reproduction (e.g., easy to fertilize, high seed production), dispersal (e.g., highly mobile seeds, sprout from fragments), germination (e.g., fast seedling growth) and neighbor interactions (e.g., poisonous, exploitative roots, tolerance to herbicides). Take the case of our old friend spotted knapweed: the bees love it, the wind carries its thousands of seeds, it rapidly grows tall and deep in drought conditions, and it produces toxins that poison all plants around it. This species' strategies allowed it to colonize seven million acres of the American West in one century.

Why so serious? What began as a few grasses introduced for the early settlers' livestock is now a big problem for Klamath ecosystems. In California, over 1,000 non-native plants encroach on native ecosystems and continue to arrive at an alarming rate.[5] The worst plants out-compete natives for water, nutrients, sunlight, and space. A study from Glacier National Park, for example, found that after 3 years spotted knapweed eradicated five rare and two uncommon plants from sample plots and sent six of twenty-one uncommon species to the rare list.[6] This is a serious loss because indigenous plants do not live in isolation—each one is a critical resource for other creatures that depend on them.

Weed infestations significantly impact wildlife by decimating food plants and physically altering the environment. Elk and deer eat everything else before nibbling noxious invasives like knapweed or spurge,[7] for example, and riverside weeds crowd out the nesting sites of ducks, terns, and other water fowl.[8] Weeds can also change soil and fire processes. Spotted knapweed's simple taproot cannot hold soil together like native plants do, inducing erosion and subsequent sedimentation that makes life harder for fish.[9] In fire-prone California landscapes, tall Scotch broom and Italian thistle increase the severity of fire by connecting ground fires to tree canopies.[10,11] In these ways, invasive species have contributed to the decline of 42% of the threatened and endangered species in the United States,[12] while altering the availability and aesthetics of the landscapes we need and love.

Left: Tom Holzem standing beside thistle taller than himself in Scott Valley, 2003 -- by Petey Brucker
Below: Local native flowers and pollinators, and Weeding on Thistle Hill -- photos by Emily Ferrell
Page 8: Starthistle thriving on the Salmon River -- photos by Emily Ferrell

The situation Modern weeds warfare focuses on killing plants that compete with commercial endeavors, like farming, grazing, timber production, and golf courses. And just like all wars the War on Pests is costly, both in terms of money and health. **Every year Americans spend over $10 billion to apply one billion pounds of more than 600 different pesticides.**[13] Meanwhile, exposure to pesticides poisons up to 20,000 farmworkers[14] per year and increases their cancer rates.[15] Just like bacteria to antibiotics, weedy plants rapidly become resistant to chemicals. And new weeds just keep coming. Ecologist C.L. Mohler described this cyclical "approach in which shifts in weed composition and development of herbicide resistance are attacked with newly developed herbicides and complex mixtures of existing materials. This approach guarantees a continuing market for new chemical technologies, but leaves the grower with a generally increasing bill for weed control."[16]

While farmers have been dealing with herbicide resistant weeds for decades, these "super weeds" are now everyone's problem. In the early 2000s Scotts and Monsanto developed a strain of Roundup®-resistant bentgrass, primarily for golf courses. In 2003, before it was approved for sale, the GMO grass escaped from test plots in Idaho into Oregon where it crossed with wild grasses, passing along its Roundup® resistance to hybrid generations. The engineered grass invaded further, threatening endangered species, habitats, and the livelihood of Oregon grass growers. Concern voiced by a coalition of farmers, seed dealers, environmentalists, scientists and regulators did little to sway the USDA, however, which deregulated the bentgrass in January 2017, thereby transferring the burden of control from the mega-rich corporations to underfunded agencies, people and community organizations like SRRC. It probably won't be long before we see this engineered grass cross over into the Klamath region.

The battle for wildness In the U.S., agencies recently started to focus more on weeds that threaten wildland ecosystems; in 2010 they applied 200 tons of herbicide across 1.2 million acres of federal and tribal land.[17] The Salmon River community's commitment to non-chemical methods allows us to manage things differently. Thankfully, many of the qualities that draw you to the Salmon River also discourage weeds from taking over: the remoteness, the lack of roads, and the large tracts of wilderness reduce the odds of foreign plants arriving here and finding sunny, disturbed earth to colonize.

Noxious weed crew and volunteers get amazing views of the river canyon and distant snowy peaks as a perk to going weeding above Forks of Salmon

Weeds also have the disadvantage of being tracked by a highly-trained crew of locals with over two decades of experience to guide them. Every year we search for weeds in places vulnerable to colonization or contact with people, such as river accesses, trailheads, parking areas, and fire camps. In order to know what to look for, we stay up-to-date on which weeds are making their way here and strategize with our partners at the Mid Klamath Watershed Council, USFS, and others. In addition to researching scientifically-validated eradication methods, we experiment and collect data on which non-chemical methods work best here. The insights gained after twenty-five years of digging, tarping, snipping, fires and floods give us the critical edge over each new weedy challenge. But these strategies do not compare to our greatest weapon: **community support**. Without the eyes, hands, and supportive spirit of community members, this program would not have been born and could not be maintained. Moving forward into this era of uncertain climate and political changes, our program's structure and strategies give us the adaptability, knowledge, and resources to keep up a solid defense against weeds.

- Emily Ferrell

1 (USDA, BLM, Partners Against Weeds Action Plan)
2 (Bailey and Bailey, 1941)
3 (Pritchard, 1960)
4 (Brenchley, 1920)
5 (Calif. State Parks, Silent Threats: Non-native Species Invading our Wildlands)
6 (Thompson, 1996)
7 (Blossey, Skinner, & Taylor, 2001)
8 (Lacey, Marlow, & Lane, 1989)
9,10 (Brooks, D'antonio, Richardson, Grace, Keeley, DiTomaso, Hobbs, Pellant, & Pyke, 2004)
11 (USDA, USFS, Non-native Invasive Plant Species - Problem and Solution)
12 (Pimentel and Greiner, 1997).
13 (US EPA, Office of Pesticide Programs, 1992)
14 (Zahm, & Blair, 1993)
15 (Wagner, Antunes, Irvine, Nelson, & Firn, 2017)
**Contact us for a list of full citations*

Remembering the Herbicide Wars

Clockwise from above: Aerial spraying on the Siuslaw National Forest in 1976 from an info pamphlet put out by the USDA on spray techniques

Salmon River Concerned Citizen Mahaj Seeger speaking to the US Forest Service and community members regarding the proposed spraying

River folk demonstrating against spraying, being confronted by USFS personnel at the USFS station in Forks of Salmon
Both photos on right by Jeff Buchin

It was the late 1970s. A wave of "back-to-the-landers" had fled the cities to settle in the forests of the Pacific Northwest, where timber was still a highly-profitable, relatively unregulated industry. The Vietnam War was ending, so the federal government found itself with a surplus of aircraft, pilots, and Agent Orange. At the same time, the United States Forest Service was increasing the industrialization of their management of public forest land. Their new methods included a system called the "conifer-release program." The program relied on aerially-sprayed herbicides to kill hardwoods and brush that competed with plantation trees, theoretically increasing conifer growth rates so they could be logged earlier.

Throughout the region, in communities adjacent to public land, concern was rising about the widespread use of herbicides. Information was difficult to find about what was being sprayed on their watersheds, so people had to find out the hard way. Mavis McCovey, a nurse at the Karuk Tribal Health Clinic at the time, noticed unusually high rates of health problems among people living around the Orleans area that correlated with the time period of heavy spraying. In her published memoir she recounts, "Between 1976 and 1978, we did not have a single baby carried successfully by anyone… By 1977 we had 3,000 bladder infections in a community of 650 to 900 people…24 women got pregnant…and all of them miscarried." Although repeatedly ignored and thwarted by multiple government agencies, McCovey persisted. Her writings were disseminated around the country, a documentary was made, and her voice alerted Salmon River locals to the dangers of the herbicides in use at the time.

Communities throughout the Pacific Northwest began to do their research and share knowledge with each other. They discovered that herbicide formulas included 2,4-D and 2,4,5-T, the main ingredients in Agent Orange, and had been linked to hormonal and endocrine disruptions in Vietnam veterans and their wives and children. Local community members in the Klamath and Salmon watersheds, most of whom obtained their drinking water out of surface creeks and springs, and many of whom were working in the woods planting trees, logging and fighting fire, believed both human and environmental health were at risk, and opposed the spraying. And so, the politically and culturally diverse community on the Salmon River joined efforts with other grass roots organizations to stop the use of herbicides, eventually forming the Salmon River Concerned Citizens (SRCC). They demonstrated with signs and chants. One group surrounded a spray helicopter and prevented it from taking off. Locals took spray cards—specially treated paper which changes color when in contact with herbicides—to prove that Agent Orange chemicals were drifting into water supplies. The remote community knew that they had to get their story out, so van loads of concerned citizens drove to the Bay Area to speak on the radio and meet with the Forest Service's Regional Forester.

In 1984, citizen groups won a court case that resulted in a moratorium on herbicide spraying in the Region until a new EIS on herbicide use was completed. The Final EIS was completed in 1988, permitting herbicide use when essential for meeting timber yield objectives. The Salmon River Concerned Citizens became the lead plaintiff in a court challenge of the Final EIS for herbicide use. Although the suit was unsuccessful, the decade of citizen protest and legal conflict resulted in the Klamath National Forest ceasing its aerial spraying program. In the more than 25 years since the original moratorium on herbicide use, KNF has never resumed aerial spraying. Although conflicts surrounding other methods of herbicide application ensued, the decade of protests and legal battles over aerial spraying created real change in forest management practices. It is rare that citizens can overcome their differences to successfully challenge powerful, institutionalized systems.

The story of the "Herbicide Wars" is worth remembering. It shows how small communities can create real and lasting change. *- Emily Ferrell*

How We Revolutionized Noxious Weeding

With the Herbicide Wars only a decade behind them, the Salmon River community united in vehement opposition when threats of herbicide use on invasive plants re-emerged in the early 1990s. While nobody wanted weeds to take over the watershed, the majority of residents believed that alternative treatments could safely manage weeds and provide long-term social benefits. Their unified strategies and hard work resulted in a community-based solution—the Cooperative Noxious Weeds Program (CNWP)—which is still the most extensive and successful manual eradication program in the region.

The CNWP was born in 1994, when SRRC co-founder Petey Brucker learned that the US Forest Service was planning to control several infestations of Scotch broom. He knew that the law required land managers to use "the most effective means," which usually meant herbicides, to battle noxious weeds. So, Petey summoned his neighbors to help eliminate the Scotch broom and document their efforts, thereby resurrecting the community's anti-herbicide movement in the form of organized manual weeds removal.

That same year locals started digging Marlahan mustard, a bright yellow blight that was spreading along the roadsides. Petey's clever strategies inspired an unprecedented amount of volunteerism. He reached out to educate people about weeds issues, then framed weeding as a game in which whoever pulled the most plants won. The empowered and innovative volunteers even forged their own digging tools—the now-iconic curved bars still used today—superior to anything they could buy. For three years it appeared that Petey's elegant tactic of "if there aren't any plants then they won't spray" was working. Until one plant changed the game.

In 1997, the discovery of large populations of spotted knapweed (*Centaurea maculosa*), a highly invasive Class A regulated weed, greatly increased the threat of herbicide use. By the time this pernicious weed was noticed it was carpeting the river bar at Kelly Gulch and had spread from this "mother population" during the 1997 flood to invade other river bars downstream. After it came to light that agencies had sprayed an upslope knapweed site with Tordon®, a chemical not registered for use in California, local residents and the Karuk Tribe united in strong opposition. Under heavy pressure, the USFS began working on an Environmental Assessment (EA) for knapweed treatment, which is required by law before taking any Federal action that may impact the environment, such as herbicide use.

Community volunteers and SRRC coordinators digging spotted knapweed on the river bars in 1998, 1999, and 2001

Using the CNWP, SRRC immediately organized an intensive effort to manually remove spotted knapweed. An unprecedented number of volunteers participated. "About forty of us would sit out there at Kelly's Bar and just dig, dig, dig. The Forest Service didn't know what to do!" Petey recalled. People united around the effort with unique spirit. One local reported that they "would sit around and sing songs about knapweed. We always talked about knapweed…Sometimes you'd get sick of it…but otherwise, it was kind of funny." The vast majority of river residents opposed the plan to apply herbicides. The Karuk Tribe passed a resolution against the use of herbicides in their ancestral territory, and the USFS received more public comments on their EA than any other contemporaneous action, including timber sales. These actions and the commitment of local volunteers worked to persuade the USFS Klamath National Forest Supervisor to include manual eradication as one of the alternatives in the EA.

Petey and the innovative weed digging bar invented by local weeders

After three years of public scoping, meetings, and field trips, the Forest Supervisor decided to let the community try the manual eradication alternative, stating that she could not ignore the success of manual treatments nor the flood of public sentiment. However, she approved the use of herbicides if manual efforts failed to meet four strict criteria for eradication: 1) 60% reduction in plants per year, 2) no more than one seeding plant per site at the end of the season, 3) and none at the end of four years, and 4) no spread. Refusing to be intimidated by these measures, locals took on the challenge with determination, ingenuity, and positive spirit.

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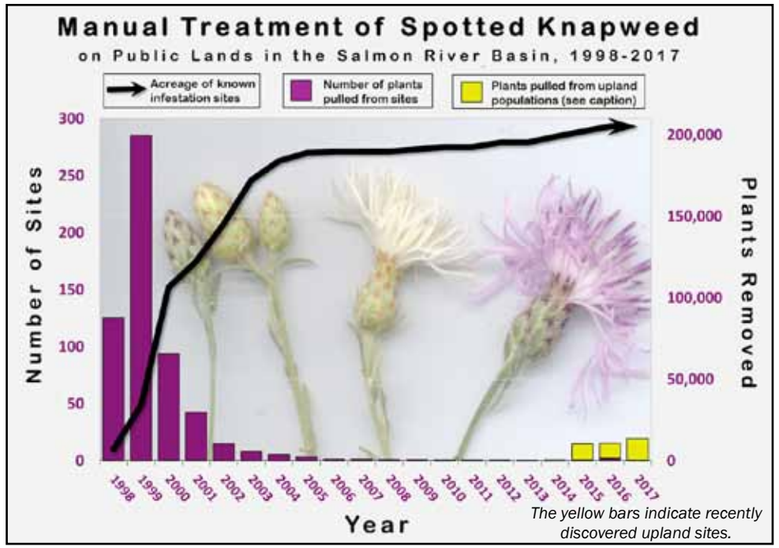
And all their hard work paid off. As volunteers consistently showed up to dig, knapweed steadily disappeared. Over the first 10 years, the notorious Kelly's Bar infestation fell from over 80,000 to a mere 40 plants, reflecting an overall reduction of 99% across all sites. Year after year the USFS's strict criteria were met, and as time went on and trust increased, enforcement of the criteria relaxed. The enormous amount of volunteerism was critical to this success. By 2004, 1500 volunteer days had been contributed in a community of only 250 people. By 2012, the CNWP had leveraged over $225,000 in grant funding and over $420,000 worth of volunteer support. As with all grant programs, weeds budgets were not stable from year to year, so the large volunteer base ensured the consistent work necessary to keep an invader like knapweed on the decline. Over the years, the relationship between SRRC and the USFS around weeds management evolved, moving from a place of distrust and antagonism to one of trust and cooperative management. The long term and steady commitment of SRRC and the Salmon River community was broadly recognized and it became a collaborative effort of shared value and outcomes.



The yellow bars indicate recently discovered upland sites.

The CNWP's unique story gained notoriety among the world of weeds management. The Siskiyou County Resource Advisory Committee (RAC) was the first to fund the CNWP because they liked that it was done by innovative, hard-working locals instead of big government. They even picked Petey, who served on the RAC, to represent them at the national RAC conference, where he was asked to be the keynote speaker. Petey accepted the opportunity to represent his community, beginning his speech by reaching back and wagging his long, silver ponytail at the crowd while suggesting that "First, you have to be willing to work with people you're not used to working with." Later, during a poster session at the California Exotic Pest Council's conference SRRC found itself sandwiched between the massive displays of Monsanto and Dow Chemical. Petey said, "I just had six or eight postcards and a tray of cookies. And people came to us, saying 'How are you succeeding?!' I told them, we in the Salmon River use our not so secret weapon—our hands! And we get rid of it." The CNWP offered a model that empowered other communities to effectively manage weeds and prevent the negative consequences associated with herbicide use.

Besides getting rid of weeds, benefits generated by a community-managed weeds program greatly exceed those from an externally-managed herbicide program. Participant's social, political, and ecological experiences were positively impacted by increased education, jobs, personal empowerment, and support of cultural traditions. One local noted that "factions of the community that normally probably wouldn't get together get together on a sensitive environmental issue like this.[1]" The work deepened people's sense of connection and attachment to place. Local Ryan Wiegel remembers how, "Petey would drop us off at Sawyers and say, 'Just walk until you can't, and climb out.' And we became addicted to that. It was so thrilling and exciting. I'll never have that privilege again in my life." *- Emily Ferrell*

1. Kari Noorgard "Tools in the Toolbox: Community Based Stewardship in the Management of Invasive Weeds," 2003

Knobcone Pine - "An unusual species in that the cones remain on the tree and closed from fifteen to 50 years. Since 3¼ to 6 inch cones may become embedded within the wood of the expanding trunk, knobcone has been called 'the tree that swallows its cones.' Unless thoroughly heated or touched by fire the cones will not open to drop their seeds.

When ripe, the cones of this pine species were gathered for the blackish seeds which were used as beads to decorate dresses. Seed extraction occurred right at a tree site if convenient, or latter within an encampment. First, a fire was built and allowed to die down. Cones were then placed in the coals and rolled from side to side until the scales slowly began to open. Finally, they were turned upside down and tapped to release the seeds.

Knobcone pine pitch was applied to open sores as a healing agent."

- from *Plants and the People: The Ethnobotany of the Karuk Tribe,* researched, compiled and illustrated by Barbara J. Davis and written by Michael Hendryx © Siskiyou County Museum

Invasive Plant Spotlight: Sulfur Cinquefoil


The invasive cinquefoil has a duller yellow flower and the hairs are stiff and shorter than the native Potentilla gracilis. *Right: Invasive sulfur cinquefoil leaves.*

Sulfur cinquefoil (*Potentilla recta*) is the first Class A invasive weed to invade the Salmon River since spotted knapweed! It has proven to be highly successful at spreading throughout the West including here on the Salmon River. Sulfur cinquefoil can adapt to almost any habitat in our area, from the river road to the sub-alpine mountains. Infestations often start along roads or trails--especially at trailheads--then rapidly spread into adjacent areas. Old logging landings and other disturbed sites can get thick patches of the weed. SRRC and our partners are working on a plan to control this new Class A weed without the use of herbicides.

How to identify: This perennial weed can be distinguished from our native cinquefoil at first glance by its stiff hairs on the stems and leaves. They stick straight out and when backlit create an easily-seen, glowing aura. The stiff, upright stems bear many marijuana-like leaves, each with five to seven toothed leaflets, pointing upward, along the entire length of the branched stem. Leaves may be more spread open in older plants and those growing in low light. Slender cinquefoil (*see below*) is a look-alike native. It has short, soft hairs that lie flat, so look for those stiff hairs!

By late May, sulfur cinquefoil begins to send up flower stalks, blooming from late June into early August. Pale yellow flowers have five heart-shaped petals that darken towards the center. This weed sets seed and dies back soon after flowering. Each flower produces dozens of tiny (about 1/32 inch long) seeds. The seeds have a net-like, raised pattern on the surface and a tiny wing around the edge of the seed. Slender cinquefoil seeds have a plain, smooth seed coat and no wing.

Slender cinquefoil - Native Look-alike


The native cinquefoil has short hairs that lie flat and brighter yellow flowers than the invasive sulfur cinquefoil – photo by Gary A. Monroe, hosted by the USDA-NRCS PLANTS Database

Slender cinquefoil (*Potentilla gracilis*) is a native perennial wildflower with clusters of golden yellow flowers. It is described as highly variable.

You will find the bloooms of slender cinquefoil in meadows, roadsides, subalpine meadows, and open forest from June through September.

The flower has five heart-shaped petals. The brown stems are few to many and covered with soft spreading hairs. The palmate leaves are 2 ½ to 12 inches wide, divided into five to nine lance-shaped, sharply toothed leaflets. The underside of the leaf is usually light green with silky hairs, while the upper surface is green with fewer hairs.

Slender cinquefoil serves as a nectar and pollen source for honey bees and, according to the Xerces Society for Invertebrate Conservation, is of special value to native bees, butterflies, and other beneficial insects.


The native species leaf is similar to the invasive's but has silky hairs on a brown stem – by Ben Legler

What you can do to prevent the spread of weeds:

Educate yourself on what weeds you might come across on the Salmon River and what steps you can take to slow them down. Contact us if you see something that you think might be a new weed. If you see weeds and have the time, destroy the seedheads and/or dig them up!

Try not to drive or walk through patches of weeds. Seeds will get picked up by your tires, or by your socks and shoes for you to take home. Check your sand or gravel sources or you might end up with a weed patch in your yard. Keep weeds on your property mown, whacked or dug to prevent the spread of seeds.

Come on out to a weed workday! The views are amazing and include wildflowers, birds and beautiful riverbar sites you have probably never been to!

Riparian Revegetation on the Salmon River

Historic hydraulic mining on the Salmon River -- photo from the Chico State University collection

Driving along the Salmon River and its forks, you may notice large river bars and terraces with few plants growing on them. At one time those areas would have had a dense and diverse riparian forest covering them. The plants were removed during historic mining and/or the 1964 flood and have yet to be recolonized. In floodplain areas, dynamic and powerful river flows scour those sites on a regular basis, washing soil, seeds and seedlings downstream. On higher terraces, mining washed away the soil or covered it in large cobbles (mine tailings) and plants just can't establish where there is no soil to grow.

Field trip to Red Bank on the North Fork Salmon River, a habitat restoration project site -- photo by Karuna Greenberg

Additionally, the there aren't enough large logs on the floodplains, either woven together in piles or jams, or scattered about. Large logs catch fine sediment and build soil, as well as create protected nurse sites for seedlings to establish. The loss of large wood in the river is due to historic mining and logging, as well as long-term fire suppression. Mining removed existing log-jams and large trees along the floodplains; later logging removed many large trees growing along waterways, especially in tributaries, that would have fallen down and eventually ended up in the river; and a century of fire suppression removed the primary cause of trees dying and falling into waterways for many years to come.

The loss of riparian forest along the river has effects that are felt throughout the watershed. For instance, in summer, areas lacking shade trees allow sunlight onto the river, directly heating up river temperatures and hurting fish. River bar areas and terraces farther from the water's edge get hot and indirectly transmit heat throughout the floodplain. This causes water just under the ground surface to heat up. That warmed groundwater only adds heat to the already warm waters of the Salmon River. The lack of shrubs and trees is also limiting fish rearing in the river. In winter and spring, when the river flows higher, flooded shrubs and trees provide slow water for juvenile fish to hide from the fast-flowing river. The flooded vegetation will have a lot of bugs for the juveniles to eat while they are hanging out waiting for the flooding to subside.

The SRRC has been working on several pilot projects for the last few years. These projects have multiple objectives, one of which is to improve native riparian forest. We can do that by enhancing the floodplain so that more water spreads out and feeds shrub and tree seedlings during hot summer months. We can also create nurse sites, which catch fine sediment and organic matter and provide protection for seedlings. Given the tough conditions our young plants will have on the river, hot, dry summers and winter/spring flooding, we are going to be doing quite a bit of experimenting to try to figure out the most successful, yet cost effective methods that work out here.

Cuttings of willows and cottonwoods can be planted right into the ground because they naturally produce high concentrations of the rooting hormone auxin. A foot or so of stem above ground will produce plenty of leaves for the plant to create food for growing roots. These plants can be cut into long poles, 6-12 feet long, and placed in riverbars to reach into the groundwater. Some native riparian tree, shrub, grass and forb species can be planted directly from pots or bare root. These types of seedlings have very short root systems and will likely require watering during summer months for several years following planting. Other grasses and forbs can be seeded directly into areas that have restored soil.

These are some of the native riparian and transition species that we would consider for direct planting:

Trees: white alder, bigleaf maple, black cottonwood, Pacific dogwood, Oregon ash, Douglas fir, incense cedar, sugar pine, ponderosa pine, and Pacific willow.

Shrubs: black elderberry, California hazel, cascara, currants, Indian plum, choke cherry, mock orange, ocean spray, Pacific ninebark, red osier dogwood, snowberry, western redbud, western serviceberry, willow (arroyo, sandbar, dusky, yellow, red, Pacific), and Wood's rose.

Graminoids (grasses): blue wildrye, California oatgrass, Drummond's rush, meadow barley, mountain brome, Pacific rush, slender rush, slender wheatgrass, starry broomsedge, tufted hairgrass, western inflated sedge, slender leaved sedge, smooth stemmed sedge.

Forbs: American bird's-foot trefoil, common madia, coyote mint, lupine (miniature, silverbush), milkweed (narrow-leaved, showy), seep monkeyflower, western bleeding heart, western columbine, and western yarrow.

Vines: California wild grape

If you are interested in these exciting projects, you can contact Mel Van Scoyoc at habitat@srrc.org.

- Melissa Van Scoyoc

"The twigs of this species were used for warp sticks in making twined baskets. Gathering took place in April and then again during August when twigs were large enough and could be easily peeled. The harvest was dried and tied in bundles to be used later.

Sandbar willow roots were also used in basketmaking. Gathering took place along river and stream banks in the fall when roots were exposed during low water conditions. The plant parts were then cleaned, scraped and dried for later use as basket overlay materials.

Present day Karuk Elders maintain that sandbar or gray narrow-leaf willow is the only willow that should be used in basket construction.

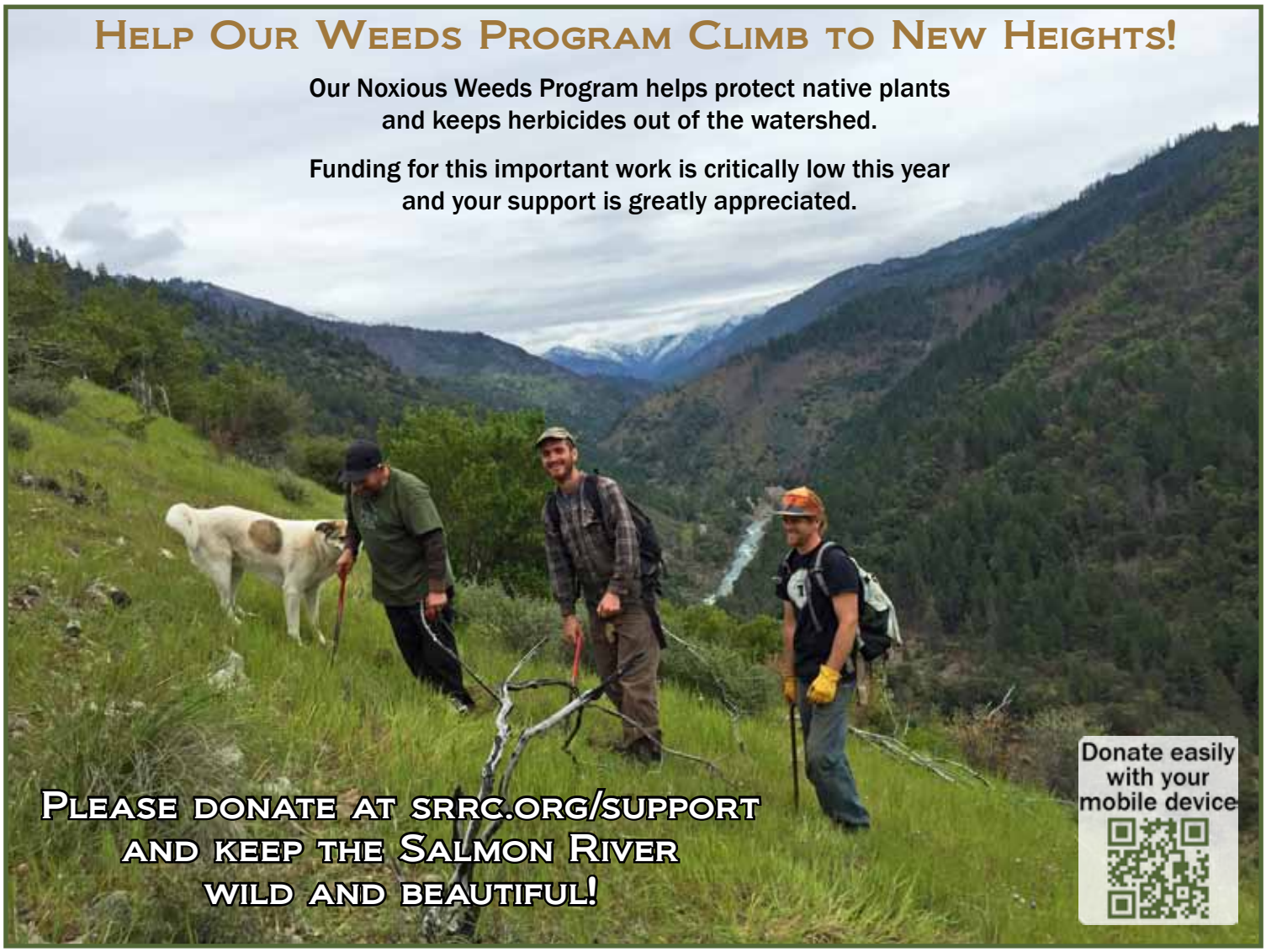
Other tribes and early settlers used willow bark to treat sore throats and as a poultice for headaches. The bark contains acetylsalicylic acid, the ingredient of aspirin."

- from *Plants and the People: The Ethnobotany of the Karuk Tribe,* researched, compiled and illustrated by Barbara J. Davis and written by Michael Hendryx © Siskiyou County Museum

Help Our Weeds Program Climb to New Heights!

Our Noxious Weeds Program helps protect native plants and keeps herbicides out of the watershed.

Funding for this important work is critically low this year and your support is greatly appreciated.



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