Blue Flower of Tribal Legend: "Skye blue petals resemble lakes of fine clear water"

Molly L. Sultany, Susan R. Kephart, Department of Biology,
and H. Peter Eilers, Department of Earth Science,
Willamette University, Salem, OR 97301

Today wild camas still creates a "blue skye" near Weippe prairie, in populations now fragmented by human occupation and land use (*C. quamash* subsp. *quamash* in flower and fruit). Photos courtesy of James Reveal.

First in importance as a wild food, camas
grow in the wet mountain meadows, bloom
blue in the early hot season.
Do not pass over the camas root in silence.
–From a contemporary poem by Gloria Bird (2002)

When camas flowers in mountain meadows and in the open prairies of the Willamette, Umpqua, and Rogue valleys, it creates a spectacular sky blue display that reminds us of its rich history of use by native people. Historically and today, one cannot "pass over" the early spring flowers without proclaiming their beauty, nor dig the bulbs "in silence," as harvesting them "gently" from the earth is "an all day job hard on the back" (Bird 2002). Once plentiful, common camas (*Camassia quamash*) and great camas (*C. leichtlinii*) supplied native Northwest peoples with a staple food and valuable trade commodity. Cultivation and trading expanded its natural geographic range, while burning sustained traditional harvest grounds in oak savannas and prairies. Today, where these habitats have been degraded or lost, camas populations have disappeared. Although some grassland restoration efforts are reintroducing *Camassia* as a foundation species, additional research and greater public awareness are needed to foster more widespread restoration. The cultural uses, botanical traits, and geography of two abundant camas species create an intriguing story and justification for future conservation efforts.

Historical Roots

Make a pit for baking.
This earth oven will hold them
The way mothers hold the child within. (Bird 2002)

According to archeological evidence, ancient camas ovens and charred bulbs in the Willamette Valley date back 7,750 years (Aikens 1993). Ovens unearthed near Eugene measure six feet in diameter and include baking stones and the remains of cooked camas. Camas bulbs were steamed in an earthen pit, with heated stones underneath, and vegetation such as grand fir (*Abies grandis*), ash (*Fraxinus*), willow (*Salix*), kelp blades, skunk cabbage (*Lysichiton americanum*) and sword fern (*Polystichum munitum*) layered over the camas. Tribal members formed a channel to pour water into the pit, creating steam that slow-cooked the bulbs for 24 to 36 hours, until they became soft and sweet (Turner and Kuhnlein 1983).

Ancient legends and the presence of camas at feasts and potlatches underscore its cultural value. In the legend from several tribes along the Columbia River, "*How Coyote Helped the People,*" coyote planted berries, camas and other roots, teaching people how to survive (Clark 1953). Similarly, in a Wasco legend, "*The Origin of the Root Festival*," fox brings roots and bulbs down to the earth with these instructions, "When you begin to dig the roots in the spring, you will sing and dance and give thanks to the Great Spirit." An Okanogan legend tells the story of Blue Flower, a young Kalispel girl, who prevents two quarreling suitors of a rival Okanogan tribe from acquiring her basket of bulbs: "She wanted no camas to grow in the valley of the Okanogan people" (Clark 1953). Camas was so important to native people that wars were fought over it in the 1870s. Tribes on reservations without food clashed with settlers who were feeding large hog herds on camas prairies set aside, under US government treaty, for traditional use by native people (Smith 1978).

Camas also played a pivotal role in the Lewis and Clark expedition. In the fall of 1805, after a difficult journey across the Bitterroot Mountains (now the Montana-Idaho border), the expedition party survived on camas bulbs shared by the Nez Perce. On their return trip east in the spring of 1806, Lewis and Clark again camped with the Nez Perce, collecting the type specimen of *Camassia* from "Quawmash flats," (Weippe Prairie in present Clearwater County, Idaho) (Gould 1942). Both Lewis and Clark wrote about camas in their journals, documenting details of morphology, preparation, and dietary importance. Lewis marveled at the magnificent blue color: "the quawmash is now in blume and from the colour of its bloom at a short distance it resembles lakes of fine clear water."

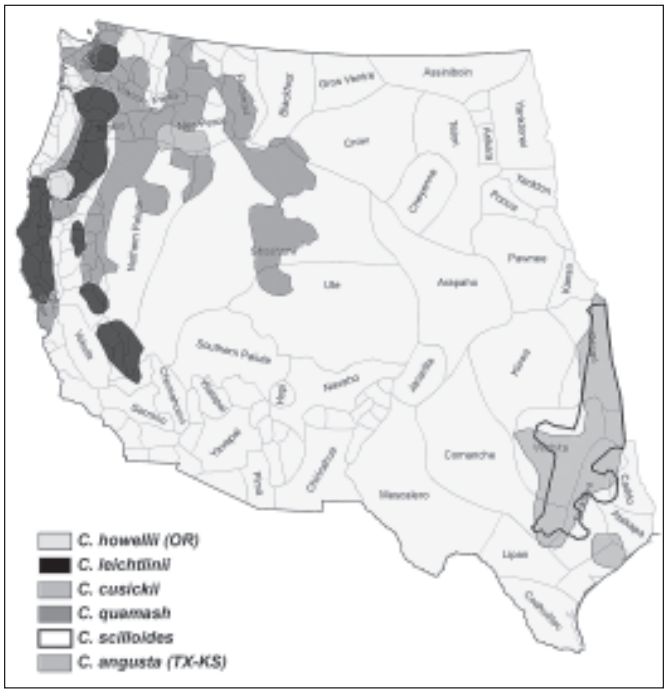
What's in a Name?

The English word "camas" originated from the Nez Perce word "*qém'es,*" (as documented by Lewis and Clark) along with "*quamash*," "*quawmash,*" and "*pas-shi-co root*" (Hartley 2001). Many other western Indigenous dialects include words for "camas" whose meanings reflect habitat, flavor, or the onion-like form. For example, the Shoshoni of the Snake River, Idaho, called "camas" "*pa-siko*," meaning "water sedge-lily" (Hartley 2001). In 1803-1805, the English blacksmith John Jewitt recorded words

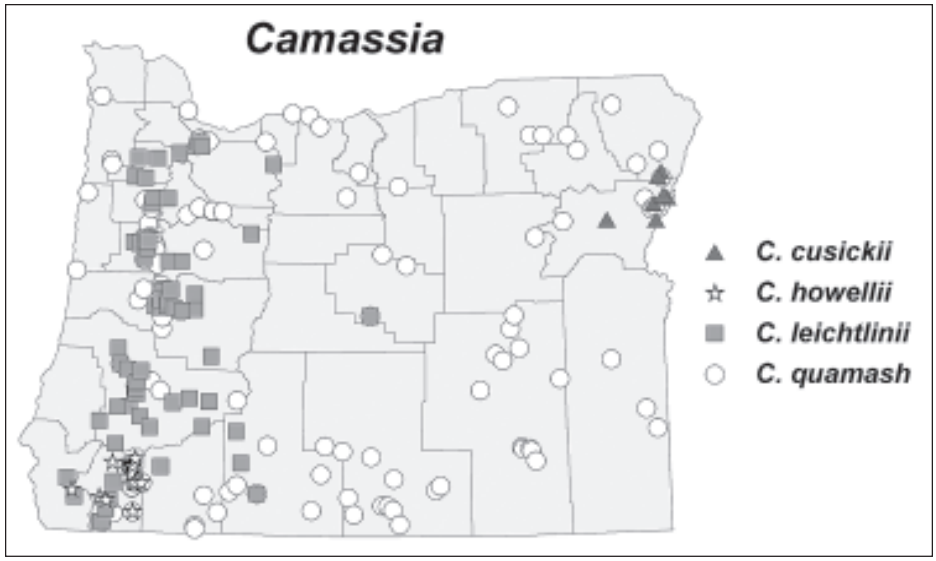
Wild camas bulbs have a characteristic black tunic surrounding the white, onion like, fleshy leaves. Photo by James Reveal.

of his Nuu-chah-Nulth captors that sounded similar to "camas," including "*cha-mass*" for fruit and "*cha-mas-sish,*" for sweet taste (Hartley 2001). Other common names for *C. quamash* include "Siwash onion" and "swamp sego." Common names are notoriously problematic in plants, however, and "camas" is no exception as it sometimes refers to plants of *Lomatium* in the carrot family.

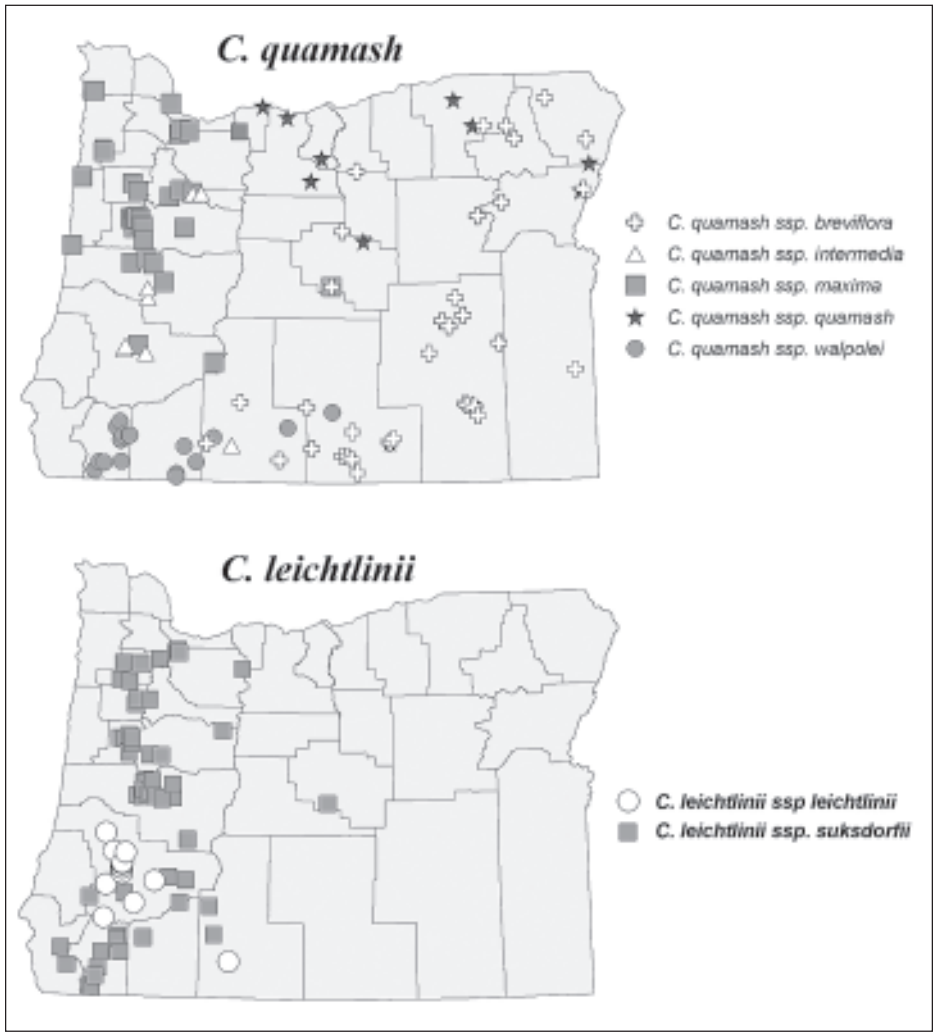
Traditionally, botanists classified *Camassia* in the Liliaceae with garden plants *Scilla* and *Hyacinthus,* close to the soap plant *Chlorogalum* (Gould 1942). In recent DNA analyses, *Camassia* and *Chlorogalum* remain well supported as sister taxa but are now classified in the Agave family with *Yucca* and *Agave* (Pfosser and Speta 1999). These lineages of Agavaceae *sensu stricto* also include species that share similar chromosome numbers (2n or n = 30) and a bimodality in size, with three to five large as well as



Many western and midwestern tribes lived within range of the six North American *Camassia* species (see page 31 for detail of tribes in Oregon). Tribes encountered the greatest diversity of these species in the Oregon territory. Map based on W. Beck and Y. Haase, 1989, *Historical Atlas of the American West.*



The geographic distribution of the four western species of *Camassia* span the entire state of Oregon, with a "hot-spot" of diversity in southwestern Oregon, likely reflecting the varied topography and geologic landscapes of this complex region. Maps were created using updated files obtained from the Oregon Flora Project at OSC.



In Oregon, *C. leichtlinii* is largely limited to the western slopes and valleys whereas *C. quamash* occurs from the western coast to the eastern plains. At least five subspecies of common camas occur with regularity in Oregon. Oregon Flora Project Database at OSC.

numerous small chromosomes (Bogler and Simpson 1996).

Several morphological features of *Camassia* species differ from those of their close relatives: chestnut brown bulbs partially covered by a coarser black tunic; keeled basal leaves; racemes of typically blue to purple flowers with six tepals; and dry, capsular fruits with shiny black seeds (Ranker and Hogan 2002; Kozloff 2005). *Camassia* exhibits high variability in seed number per locule with up to twelve seeds compared to one to two seeds per locule in *Chlorogalum* (Gould 1942).

Distinguishing among *Camassia* species

Of six North American species of *Camassia*, four (*C. cusickii, C. howellii, C. quamash,* and *C. leichtlinii*) occur in western North America. Among the four camas species in Oregon, two are abundant and widespread and two are restricted to small geographic regions. *Camassia cusickii* occurs in northeastern Oregon (see related article on Wm. Cusick by Rhoda Love) and *Camassia howellii* is limited to southwestern Oregon. The two abundant species, *C. quamash* and *C. leichtlinii* range from British Columbia south to California and share similar habitats. Native people likely did not differentiate between them when harvesting bulbs (Turner and Kuhnlein 1983), although differences in flowering times may have influenced harvest dates, and bulb size or flavor may have prompted preferential trading or gathering of one species over another (Beckwith 2004). *Camassia quamash* is the most widespread and variable, with eight subspecies (Ranker and Hogan 2002). It reaches its greatest diversity in Oregon; at least five subspecies occur in 29 of the 36 counties. A sixth subspecies, *utahensis*, is known from only two herbarium specimens in the Oregon Flora Project Database 2006.

Camassia species differ in bulb form and clustering, flowering time, plant size, and floral traits, including symmetry, number of tepal veins, curvature of the fruiting pedicel, and withering pattern of tepals (Ranker and Hogan 2002). In bilaterally symmetric

C. quamash ssp. *quamash*, as W. Clark notes so precisely in 1806: "the corolla consists of five long oval obtusely pointed Skye blue or water coloured petals…five of them are placed near each other pointing upwards while one stands horizon[tally], or pointing downwards." Each tepal withers separately, and the pedicels often curve inward, placing the fruits close to the stem (Ranker and Hogan 2002; Kozloff 2005). In contrast, *C. leichtlinii* flowers are consistently radially symmetric, with tepals that wither together around the ovary. Great camas plants are taller than common camas, and also have larger bulbs, leaves, and flowers (Gould 1942; Ranker and Hogan 2002). Where great camas grows with *C. quamash* ssp. *maxima,* common camas flowers two to three weeks earlier (mid-April at low elevations). Reproductive barriers exist between these two species, and protein studies show that they also differ genetically (Uyeda and Kephart 2006).

Camas Habitat: White Oak Savannas to Wet Prairies

Camassia quamash and *C. leichtlinii* occur together in seeps, wet prairies, and along streams and riverbanks west of the Cascade Range in Oregon. White oak savanna provides important habitat from southwestern British Columbia to northern California, including along Oregon's coast and western interior valleys. A feature of the Willamette Valley for at least 6,000 years (Boyd 1999), this ecosystem is characterized by a mild climate, abundant herbaceous vegetation, and mollisols (soils rich in organic matter that develop under grasslands). Where *C. quamash* and *C. leichtlinii* grow in sympatry, common camas usually occurs in full sun whereas great camas prevails in partial to full shade, beneath oaks or with ash and cottonwood along streams. Recent studies at Willamette University demonstrated that these species differed in germination and survival under varied temperatures and water levels, but both species thrive in basaltic soils that are winter-wet and summer-dry. Sandy or silty loams are ideal, but plants also grow in well-drained, gravelly, alkaline soils to heavier clays and silts (Stevens *et al*. 2001). Bulbs tolerate shallow soils as well as deeper soils limited by anoxia, shallow water tables, or impenetrable layers (Russell 2001).

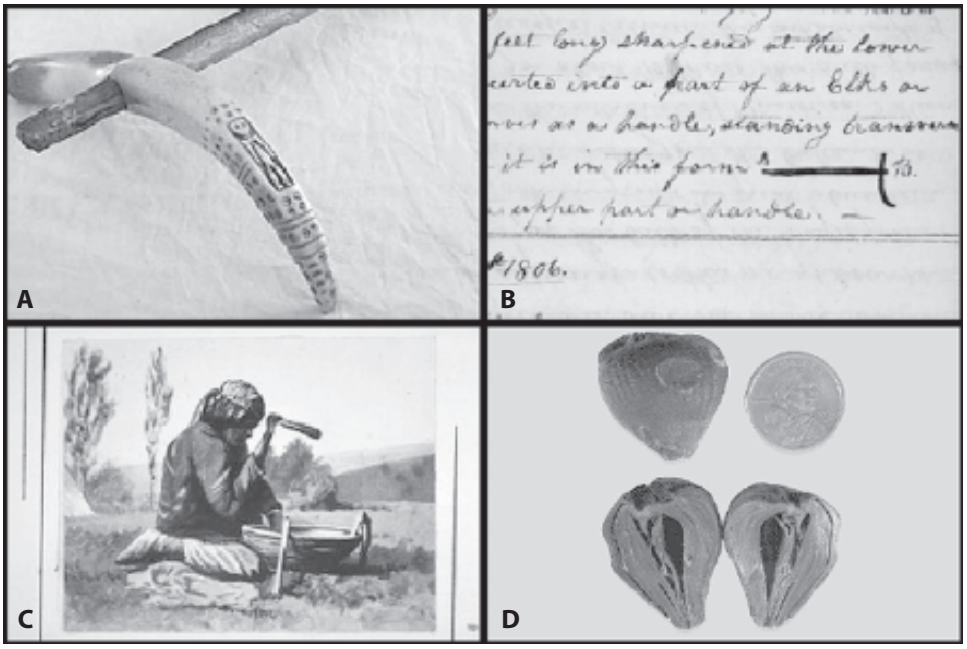
Ethnobotany

Camas are a small white onion
when removed from the earth.
When prepared for food
they turn black and sweet… (Bird 2002)

Camas held cultural, food, and medicinal value for diverse Oregon tribes including the Chinook, Kalapuyans, Klamath, Modoc, Nez Perce, Northern Paiute, Columbia River Sahaptins, and Takelma. Bulb digging and berry picking were important rites of passage for girls of the mid-Columbia region whose first basket of bulbs or fruits culminated in a tribal celebration recognizing her transition to adulthood (Hunn *et al.*1990). At wedding feasts native people traded cornhusk bags filled with bulbs or roots including camas, biscuit-root (*Lomatium caruifolium*) and bitterroot (*Lewisia rediviva*) (Van Allen Murphy 1958).

Distribution of Pacific Northwest Tribes in Oregon in the mid-1850s when Euro-American settlement curtailed traditional burning. Map based on W. Long, S. Allen, A. Buckley, and J. Meacham, 2001, *Atlas of Oregon*.

Native people consumed and stored large quantities of both species of camas. The bulbs were dipped in whale oil and eaten with meat or fish or dried and made into cakes for winter use (Turner and Kuhnlein 1983). *Camassia quamash* formed the basis for "bread," gravy, soup, and a sweet beverage (Moerman 1998). Dried camas cakes, the most valuable form, ranged in size from delicate finger foods to loaves of about 10 lbs (Juntunen *et al.* 2005). Camas provided protein as well as carbohydrates to the diet; biochemical analysis suggested that at 7% protein, camas bulbs were a slightly better source than acorns (2.9-6.3%) (Anderson 2005). Cooking greatly improves the texture, nutritive value and flavor of camas. After eating raw camas (white, slimy, glutinous), members of the Lewis and Clark expedition likened them to the taste of soap, but as Gloria Bird noted, *"better to have roots than complain and have no food."* Raw bulbs contain inulin, a complex, and largely indigestible sugar. Steaming in earth ovens converts inulin to fructose, a sweet, simple sugar. Konlande and Robson (1972) reported that raw camas bulbs contain only 0.5%



Photographs of digging sticks used for bulb extraction A) by the tribes of the Plateau cultures (Oregon Historical Museum 2002); B) in the time of Lewis & Clark (American Philosophical Society 2005). C) Nez Perce woman pounding camas (Gay 1889-1892). D) pit-baked camas bulbs. Photo by J. Agee.

reducing sugar compared to 43% in cooked bulbs. Various authors liken the consistency of cooked camas to roasted onions, the color to molasses, the flavor to fig or baked pear, the odor to vanilla, and the taste to maple sugar or sweet chestnut.

Common camas had several medicinal uses. The Blackfoot tribes of Montana and Alberta made a tea from its leaves to initiate labor, control postpartum bleeding, and expel the placenta (Moerman 1998; Foster and Hobbs 2002). The Nez Perce prepared a cough medicine by boiling camas bulbs and adding honey to the resulting juice.

The Oregon Camas Harvest

Oregon tribes harvested camas in prairies north of the John Day River, in the Grande Ronde Valley, and along the Umpqua River (Farmer and Holmes 1973). In southwestern Oregon, the slopes of the Table Rocks near Medford in Jackson County were a source of *C. leichtlinii*. Camas bulbs were second only to acorns in importance to the Takelmas of the upper Rogue River (Reyes 1994).

For most western tribes the camas harvest was a seasonal and communal activity with specific gender-related roles (Gilman and Ronda 2003). Seasonal camas harvests occurred during or after flowering, but often lasted many weeks, or months, as is documented for the Nez Perce (Stevens *et al*. 2001). Kalapuyans of the Willamette Valley harvested camas shoots or bulbs nearly continuously from March to June, before the late summer berry crops ripened. As with roots and berries, women and children assumed the role of harvesting camas bulbs; men collected firewood and branches and helped cook the camas in earthen pits (Van Allen Murphy 1958; Suttles 2005). Extracting camas from the ground without breaking the bulbs required skill and considerable effort. The fire-hardened digging stick was a sharp piece of wood with an elk or deer antler for a handle. Crafted by a woman (or by her husband), it was bequeathed to family members after her death (Gilman and Ronda 2003).

Annual camas harvests provided opportunities for intertribal trade and socialization at potlatches and feasts. For this reason, women collected camas in larger quantities than they needed for their own families or tribal unit. Nez Perce women typically gathered 50 to 60 pounds a day, with records as high as 80 to 90 pounds (Gilman and Ronda 2003). After harvest, Kalapuyans boiled young camas shoots for immediate consumption, cooked and sun-dried the bulbs, or ground them with mortar and pestle into flour to make porridge, cakes, or bread for the feasts. First food feasts celebrating plant foods were more common than those giving thanks for animal foods (Hunn *et al.*1990), and a poem by Gloria Bird (2002) reflects the cultural importance of camas.

Remember, granddaughter,
the dried camas will keep
a long time. Always thank
it for giving itself to you.

Intertribal Trade

"I am going to put bitterroot and camas and other roots in different parts of the country." (fox in Yakima legend, Clark 1953)

Although camas was abundant in the Pacific Northwest, its restricted distribution in some areas and the familial ownership of certain meadows fostered an extensive trade network in the northern Great Basin region (Statham 1982). Nez Perce tribes in northeastern Oregon and nearby Washington and Idaho traded camas to the Warm Springs, Umatilla, Cayuse, Walla Walla, Nespelem, Yakama, Crowes, and Flathead (Stevens *et al*. 2001). Camas trade was associated with special occasions: weddings, funerals, and the annual harvest. Kalapuyans gave camas to coastal tribes in exchange for delicacies such as dried salmon, clubs made from whalebone, and items decorated with shells. This trade may have expanded the natural range of camas. Lewis noted (11 June 1806): "in the Columbian Vally and near the coast [camas] is to be found in small quantities and inferior in size to that found in [Weippe Prairie]…" Tribes without large populations of camas probably transplanted bulbs to their areas; e.g., the Tillamook near the northern coast of Oregon (Lepofsky *et al*. 2005). Alternatively, coastal camas populations could represent natural refugia, for example, common camas in peat bogs at Bamfield, on Vancouver Island (N. Turner, pers. comm.).

Camas cultivation dates back thousands of years

Native people modified the natural habitat of camas by tilling, fertilizing (with ash and seaweed), weeding, and periodically

burning meadows; they also selectively gathered large bulbs while replanting small bulbs for future harvest (Anderson 2005; Turner and Peacock 2005). When the harvest occurred after fruiting, populations were sustained by camas seeds that fell into freshly dug ground.

Present day habitats and geographic variation in native camas were undoubtedly shaped by transplanting, intentional burning, selective harvesting, inter-tribal trade, and tribes being forced to live on small reservations. Of these practices, the consequences of burning the landscape were likely the most profound. Charcoal in lakebed cores in the Willamette Valley indicate that landscape-wide fires created a mosaic of open prairies and oak savannas (favorable camas habitat) more than 2700 years ago (Boyd 1999; Lepofsky *et al*. 2005). In response to a cooling trend three to four thousand years ago that favored coniferous vegetation, tribes along the Pacific coast began burning the prairies. When traditional burning ended, the once-thriving camas populations declined, and shrubs and conifers reinvaded the prairies (Wray and Anderson 2003).

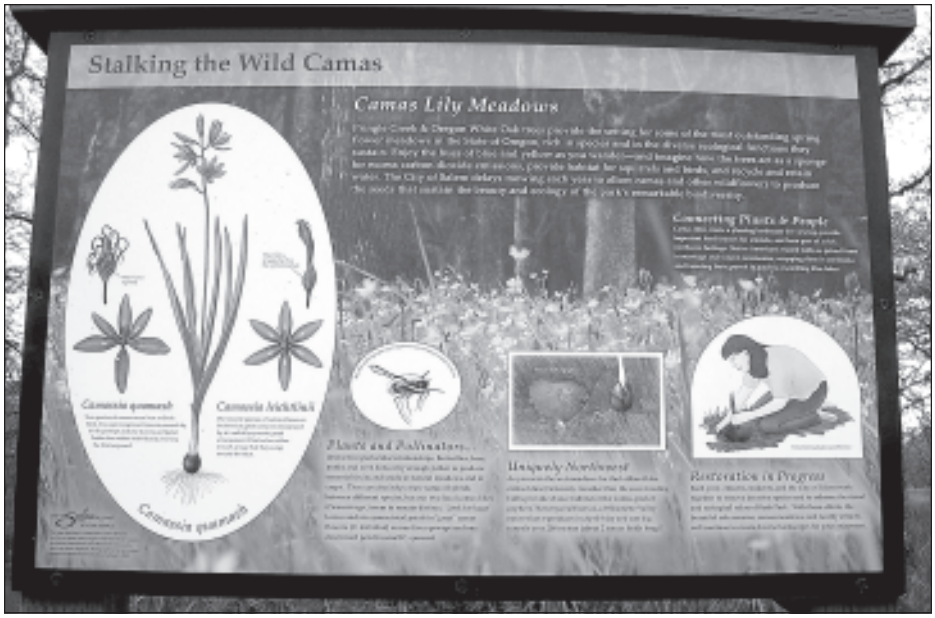
In Oregon, Kalapuya tribes regularly set fires during late summer and early fall to maintain oak savanna communities in the Willamette Valley (Boyd 1999). At Huckleberry Mountain, just west of Crater Lake (Douglas County), burning maintained not only berry patches and seasonal campsites, but also camas and other early successional plants and animals used by Klamath tribes (Deur 2002). *Camassia*, entering a period of dormancy during summer, survived summer and fall burns, and benefited from reductions in woody plant cover.

Conservation: Protecting and Restoring Camas Prairies

In the last two centuries, humans have drained wetlands and meadows for agriculture, controlled floods in riparian corridors, and converted prairies and oak savannas to crops, livestock pastures, and urban development. Camas prairies once sustained by native tribes have disappeared or currently risk extinction (Turner and Kuhnlein 1983; Wilson 1998). Federal and state statutes provide some protection for wetlands, which support camas, but 29% of native wetlands in Oregon are "imperiled," including Willamette Valley wet prairie (Morlan 2000). Fortunately, the adaptability of camas to a variety of environments and the relative ease with which it can be propagated facilitates restoration of degraded habitats. From seed, *Camassia* may flower within four years; bulb reintroductions in mitigated wetlands in Salem, Oregon, produced new seedlings within two years. Experimental camas populations in British Columbia remained stable under four years of weeding, size-based bulb harvesting, and burning, except in one population under xeric conditions (Beckwith 2004). In the San Juan Islands, the response to experimental burning was complex, as *C. leichtlinii* increased in abundance in burn plots over control plots in only two of three years (Dunwiddie 2006). We still have much to learn about habitat requirements of both camas species and their responses to restoration techniques. Detailed field research, including experimental trials, provides information for active resource management, both for preserving healthy camas populations and augmenting habitat restoration efforts. An understanding of the cultural history of camas may also lend insights that will improve future conservation practices.

Earthwatch Institute staff and volunteers remove invasive Scot's broom (*Cytisus scoparius*) from mesic prairie sites that support the growth of wild camas. Photo by Susan Kephart.

Among the diversity of seeds, fruits, bulbs, and shoots harvested by the earliest inhabitants of Oregon, camas was integral to diet, commerce, and ceremonial practices (Garibaldi and Turner 2004). Protecting healthy camas populations and their associated ecosystems (prairies, riparian corridors, and white oak savannas) should be a conservation priority. Future generations should be



Education and restoration efforts are critical to maintaining existing populations and to restoring existing habitat. Illustrations contributed by Andrea Foust Carlson with the support of Salem Public Works Watershed Grants Program. Photo by Susan Kephart.

able to gaze across these extraordinary blue landscapes and contemplate the traditional ecological practices that preserved camas and sustained native tribes.

Acknowledgements

We extend special thanks to Nancy Turner for many helpful comments. Ed Alverson, Brenda Beckwith, Rebecca Dobkins, Barbara Lane, Rhoda Love, Katie Mitchell, Frank Lang, and Cindy Roché also provided information or comments that improved this paper.

References

Aikens CM. 1993. Archaeology of Oregon. Portland (OR): US Department of the Interior, Bureau of Land Management.

Anderson MK. 2005. Tending the Wild: Native American Knowledge and the Management of California's Natural Resources. Berkeley (CA): University of California Press.

Beckwith B. 2004. The queen root of this clime: ethnoecological investigations of the blue camas (*C. leichtlinii* (Baker) Wats., *C. quamash* (Pursh) Greene; Lilicaeae) and its landscapes on Southern Vancouver Island, BC. (PhD thesis, University of Victoria)

Bird G. 2002. The roots. Frontiers: A Journal of Women Studies 23:22-23.

Bogler D, Simpson B. 1996. Phylogeny of Agavaceae based on ITS rDNA sequence variation. American Journal of Botany 83: 1225-1235.

Boyd R., ed. 1999. Indians, Fire and the Land in the Pacific Northwest. Corvallis (OR): Oregon State University Press.

Clark E. 1953. Indian Legends of the Pacific Northwest. Berkeley and Los Angeles (CA): University of California Press.

Deur D. 2002. Huckleberry mountain traditional-use study. Final report to National Park Service and USDA Forest Service, Rogue River National Forest, Oregon.

Deciphering a Diversity of Wild Camas

The distributions of *Camassia* span a wide altitudinal and latitudinal range in Oregon. According to the Oregon Flora Project database (2006), *C. leichtlinii* is widespread west of the Cascade Mountains, unlike common camas, *C. quamash,* which grows throughout Oregon. Among subspecies of *C. quamash*, subsp. *maxima* is prevalent in the western valleys and hills while subsp. *breviflora* dominates eastern Oregon sites, growing as high as 7,500 feet on Steens Mountain. The extensive, often confusing, subspecific variability of *C. quamash* merits closer morphological and molecular study, as is evident from the complex keys and descriptions in both Flora of North America (Ranker and Hogan 2002) and in Gould's classic 1942 revision. Until phylogeographic analyses are complete, field enthusiasts will need to rely on combinations of simple traits to accurately identify camas, as noted below. Geography definitely helps!

Northeast Oregon Here visitors may encounter either the sometimes gargantuan *C. cusickii*, or several subspecies of common camas (*C. quamash* subsp. *breviflora*, *quamash*, and possibly *utahensis*, in order of prevalence). In Cusick's camas, the base of each plant typically bears multiple clusters with 10 or more wide leaves (≥ 2 cm), compared to the single clusters of fewer, narrower leaves of common camas. Flowers of all of these taxa are variably irregular to zygomorphic in symmetry, but subsp. *quamash* has violet to brown anthers and separate tepal withering whereas subsp. *breviflora* (with bright yellow anthers) and *utahensis* (dull yellow to violent anthers) have connivent tepals that wither together after flowering.

Southeast Oregon: Except for the occasional "drifter" from southwest Oregon, field seekers of camas will likely only encounter *C. quamash* subsp. *breviflora* (described above) in Malheur, Harney, and Lake counties.

Northwest Oregon (Lane county northward): In this region, the blue-flowered common camas, *C. quamash* and great camas, *C. leichtlinii* subsp. *suksdorfii* overlap extensively. These species are readily distinguished by the smaller stature and flower size, bilateral symmetry, and separate tepal withering of the two subspecies of *C. quamash* found in this region, *maxima* and *intermedia.* These two subspecies are similar and their traits warrant additional study, but current taxonomic treatments use the pale tepal color, bright yellow anthers, and strongly incurving fruits of the less common *C. quamash* subsp. *intermedia* to differentiate it from subsp. *maxima* whose flowers vary in coloration, but are often deep blue to purple, have duller colored anthers, and are borne on pedicels with fruits that are appressed or spreading relative to the axis of the flowering stalk.

Southwest Oregon: This region hosts spectacular diversity, with all species of camas present except *C. cusickii*. Two species, *C. leichtlinii* and *C. howellii,* exhibit radial symmetry as well as connivent tepals that may become deciduous as the capsular fruits mature. After observing these plants in the wild, however, it is clear that the species are quite distinct. In sympatric populations, Howell's camas flowers later in the season, and its axes are adorned with numerous and delicate quarter-sized flowers whose ovaries mature into shiny, nearly globose capsules, in contrast to the larger flowers and dullish, more elongate fruits of great camas. The corolla of the second subspecies of great camas in this region, *C. leichtlinii* subsp. *leichtlinii* (Douglas County) is creamy white.

Four subspecies of *C. quamash* occur in southwestern Oregon. Subspecies *breviflora* is easily separated from *C. leichtlinii* and *C. howellii* by its typically zygomorphic corolla. Two additional bilaterally symmetric subspecies of *C. quamash* described already for northwest Oregon (*intermedia, maxima)* also occur here but, unlike subsp. *breviflora*, show the usual separate tepal withering of *C. quamash*. However, flowers of the narrowly distributed *C. quamash* subsp. *walpolei* are radially symmetric and might be confused with *C. leichtlinii* or *C. howellii* except in fruit as subsp. *walpolei* has both separately withering tepals and strongly appressed fruits.

Dunwiddie P. 2002. Management and restoration of grasslands on Yellow Island, San Juan Islands, Washington. The Nature Conservancy. http://conserveonline.org/docs/2002/04/ Accessed 2006 March 15.

Farmer J, Karnes D, Babich G, Porterfield T, Holmes K. 1973. An Historical Atlas of Early Oregon. Portland (OR): Historical Cartographic Publications.

Foster S, Hobbs C. 2002. A Field Guide to Western Medicinal Plants and Herbs. Boston (MA): Houghton Mifflin.

Garibaldi A, Turner N. 2004. Cultural keystone species: implications for ecological conservation and restoration. Ecology and Society 9 (3): 1. [online] http://ww.ecologyandsociety.org/vol9/iss3/art1/

Gilman C, Ronda J. 2003. Lewis and Clark: Across the Divide. Washington D.C., Smithsonian Books.

Gould F. 1942. A systematic treatment of the genus *Camassia* Lindl. American Midland Naturalist 28: 712-742.

Hartley A. 2001. The inland etymology of camas. October Newsletter, Society for the Study of Indigenous Languages of the Americas.

Hunn E, with Selam J. & family. 1990. Nch'I-Wana "The Big River" Mid-Columbian Indians and their Land. Seattle (WA): University of Washington Press.

Juntunen JR., Dasch MD., Rogers AB. 2005. The World of the Kalapuya. Philomath (OR): Benton County Historical Society and Museum.

Konlande J, Robson J. 1972. The nutritive value of cooked camas as consumed by Flathead Indians. Ecology of Food and Nutrition 2:193-195.

Kozloff E. 2005. Plants of Western Oregon, Washington, and British Columbia. Timber Press.

Lepofsky D, Hallett D, Lertzman K, Mathewes R, McHalsie A, Washbrook K. 2005. Documenting precontact management on the Northwest coast. *In* Deur D, Turner N (eds.) Keeping It Living: Traditions of Plant Use and Cultivation on the Northwest Coast of North America. Seattle (WA): University of Washington Press.

Lewis M, Clark W. 1905. Thwaites R. (Ed.) Original Journals of the Lewis and Clark Expedition 1804-1806. Vol. 5. Dodd, Mead, & Company.

Lofflin D, Kephart S. 2005. Outbreeding, seedling establishment, and maladaptation in natural and reintroduced populations of rare and common *Silene douglasii* (Caryophyllaceae). American Journal of Botany 92: 1691-1700.

Moerman DE. 1998. Native American Ethnobotany. Timber Press.

Morlan J. 2000. Summary of current status and health of Oregon's freshwater wetlands. Oregon State of the Environment Report 2000. Oregon Progress Board.

Pfosser M. Speta F. 1999. Phylogenetics of Hyacinthaceae based on plastid DNA sequences. Annals of the Missouri Botanical Garden 86: 852-875.

Ranker TA., Hogan T. 2002. Flora of North America, Vol. 26. Oxford University Press.

Reyes C. 1994. The Table Rocks of Jackson County: Islands in the Sky. Independent Printing Company.

Russell L. 2001. Bulbs of the Northwest. *In* McGary, J. (Ed.), Bulbs of North America. Timber Press.

Smith H. 1978. Camas: The Plant That Caused Wars. Smith, Smith, & Smith Publishing.

Stevens M, Darris DC, Lambert SM. 2001. Ethnobotany, culture, management and use of common camas. Native Plants Journal 2: 47-52.

Statham D. 1982. Camas and the northern Shoshoni, a biogeographic and socioeconomic analysis. Archeological Reports No. 10. Boise State University, 1-6; 44-56.

Suttles W. 2005. Coast Salish Resource Management. *In* Deur D, Turner N (eds.) Keeping It Living: Traditions of Plant Use and Cultivation on the Northwest Coast of North America. Seattle (WA): University of Washington Press.

Turner NJ, Kuhnlein H. 1983 Camas (*Camassia* sp.) and riceroot (*Fritillaria* sp.). Two liliaceous "root" foods of the Northwest Coast Indians. Ecol. Food Nutri. 13: 199-219.

Turner, NJ, Peacock S. 2005. Solving the perennial paradox: ethnobotanical evidence for plant resource management on the Northwest coast. *In* Deur D, Turner N (eds) Keeping It Living: Traditions of Plant Use and Cultivation on the Northwest Coast of North America. Seattle (WA): University of Washington Press.

Uyeda J, Kephart SR. 2006. Detecting species boundaries and hybridization in *Camassia* (Agavaceae) using allozymes. Systematic Botany 31(4): 642-655.

Van Allen Murphy E. 1958. Indian Uses of Native Plants. Mendocino County Historical Society: 14-15.

Wray J, Anderson M. 2003. Restoring Indian-set fires to prairie ecosystems on the Olympic Peninsula. Ecological Restoration 21: 296-301.

Wilson M. 1998. Wetland prairie. Part I. U.S. Fish and Wildlife Service Willamette Basin Recovery Plan. Portland, OR.

Molly L. Sultany is an undergraduate student pursuing a biology major at Willamette University in Salem, Oregon. Her interest in botanical sciences developed under the guidance of Professor Susan Kephart, who introduced Molly to *Camassia* research. In her hometown of Portland, Oregon, Molly is an avid volunteer in the education department at the Audubon Society of Portland. She plans to obtain a masters degree in teaching and become a science educator. Her passion for the environment is reflected by her love of camping, kayaking, and bird watching.

Dr. Susan R. Kephart is a Professor of Biology at Willamette University. Her research focuses on the reproductive biology, species boundaries, and patterns of hybridization in the genera *Asclepias, Camassia,* and *Silene*. She is actively working with undergraduate students, Earthwatch volunteers, and other professionals to restore native species to human altered landscapes that were historically present in prairies and wetlands. She and her husband Jim enjoy canoeing, hiking in coastal and montane areas, and anything that involves chocolate labs.

Dr. Peter Eilers is Professor of Geography and Environmental Studies at Willamette University. As a biogeographer, his research has focused on salt and freshwater wetlands with an emphasis on computer mapping and geographic information systems. He lives in Corvallis with his wife Kay and a samoyed named Sol.
