

## Sea Bluff Bluegrass (*Poa unilateralis*)

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It is as if someone had urged, “Go west, young bluegrass, go west!” and it did. Sea bluff bluegrass teeters on the western edge of the North American continent, clinging to ledges of cliffs and headlands, misted by saltspray. Some populations have left the continent altogether and grow on rocky islands along the coast, inhabited mainly by seabirds.

Also known as ocean bluff bluegrass, the most northern populations grow on a series of bluffs along a 3-mile stretch of the southern Washington coast in Pacific County (Camp and Gamon 2011). This rare grass is now reported from five counties on the Oregon coast: Clatsop, Tillamook and Lincoln in the north and Coos and Curry in the south, separated by a gap in the central coast characterized by long stretches of sand (lacking suitable habitat). In California, where it is known as San Francisco bluegrass, populations extend south along the coast from Humboldt County as far as San Luis Obispo County ([http://www.calflora.org/cgi-bin/species\\_query.cgi?where-calrecnum=6699](http://www.calflora.org/cgi-bin/species_query.cgi?where-calrecnum=6699)).

Roché first became interested in *Poa unilateralis* (ssp. *unilateralis* and ssp. *pachypholis*) when working on photographs for a field guide to grasses in Oregon and Washington. Floras gave the habitat as “fairly common on dunes and along ocean-facing

cliffs,” “sea cliffs and bluffs, weathered sandstones to heavy clays, in open ground and meadows in saltspray zone,” or “growing on grassy bluffs and cliffs near the Pacific Coast of North America” (Hitchcock *et al.* 1977, Soreng 1991, Soreng 2007). After the second year of looking unsuccessfully for this bluegrass, Roché realized that she needed to consult someone who knew this coastal grass. As it happened, Kathleen Sayce had written an article for *Kalmiopsis* about the flora of the north coast of Oregon (Sayce 2010), and she had already surveyed for sea bluff bluegrass in Pacific County for Washington State Parks (Sayce and Eid 2004). Possessing an overabundance of botanical curiosity, Sayce continued surveying into northern Oregon. The closest Roché has come to finding sea bluff bluegrass occurred when Sayce showed it to her with a spotting scope on an NPSO hike to the Neahkanie sea cliffs in June 2014.

While looking at Oregon Flora Project Atlas maps, Roché came upon the names of Dave and Diane Bilderback, botanists in Bandon who have surveyed this species on the south coast for the US Fish and Wildlife Service (Bilderback and Bilderback 2010, 2014). Like Sayce, they had become proficient at surveying with a spotting scope or high powered binoculars, but they also had access



Sea bluff bluegrass (*Poa unilateralis*) clings to small ledges in basalt cliffs along the coast of Oregon and southern Washington. Photo by Kathleen Sayce.



to a boat from the USFWS to visit the islands. *Poa unilateralis* had to be one of the least accessible grasses Roché had (not) encountered in Oregon. Clearly, among the threats to its existence, over-collecting by botanists did not rank very highly. Both Sayce and Roché found this rare grass intriguing, so they agreed to pool their efforts to see what they could discover about it.

### A peek up into the bluegrass family tree

The genus *Poa* is so large that its taxa have been grouped into subgenera, sections, and subsections. Within this hierarchy, *Poa unilateralis* is in the subgenus *Poa*, section *Secundae*, subsection *Halophytæ*, for which the type is *Poa unilateralis* (Soreng 1991). It is closely related to two taxa in its halophytic (salt-loving) subsection, *P. stenantha* and *P. napensis*, and is relatively closely related to the widespread Oregon species *Poa secunda*. Defining characters for subsection *Halophytæ* include the following: halophytic plants; intravaginal branching, long-cells of firm leaves producing a single oblique papilla per cell, the papillae tending to overarch the stomata (as in *Puccinellia*); spikelets more or less compressed; lemmas keeled; rachilla internodes 1 mm or less in length (Soreng 1991). Members of this group also share characteristics with the genus *Puccinellia*: open sheaths, cespitose habit and papillae on the leaves. Stebbins (1950) first suggested a hybrid origin with *Puccinellia* for section *Secundae* (including the *Halophytæ*). Soreng (1991) explained that these taxa couple ancestral non-*Poa*-like characters with the advanced *Poa* chloroplast type. For example, *P. unilateralis* (and *pachypholis*) have papillae on epidermal long cells similar to those in *Puccinellia*.

Evidently, somebody's mother up the line had sex with a saltgrass! Thus, most likely, sea bluff bluegrass didn't migrate west. One of its widespread *Poa secunda* ancestors mated with a *Puccinellia* and acquired a "taste for saltspray," or more accurately, a tolerance of salt spray, which is not generally conducive to plant growth. Perhaps one of those descendants found refuge on the rock bluffs along the ocean where competition for resources was less intense than in the surrounding coastal shrublands and tall grass/forb meadows.

### Type specimens and taxonomy

M.E. Jones first collected this *Poa* at San Francisco in May 1882 and Scribner (1893) used it as the type specimen for a new species he called *Poa unilateralis*, in reference to its inflorescence with branches directed toward one side. C.V. Piper collected a similar grass from ocean cliffs at Ilwaco, Pacific County, Washington, on June 22, 1904, and named it *Poa pachypholis* (Piper 1905). (*Pachy* = thick, *pholis* = scale).

The two species were differentiated primarily on the basis of pubescence on the lemmas, with glabrous lemmas in *P. unilateralis* and pubescent ones in *P. pachypholis*. The leaves of *P. pachypholis* were described as narrow and firm, with frequent cork-cell/silica-body pairs. In contrast, leaves of *P. unilateralis* lacked the cork-cell/silica-body pairs and were described as narrow to broad, lax or firm (but not narrow and firm; if narrow, then lax). Panicles in *P. pachypholis* were typically less congested than *P. unilateralis* (Soreng 1991).

Upon further review of specimens, Soreng found that the lemma pubescence character was not so clearcut. He discovered that nearly all plants of *P. unilateralis* have at least some pubescence on the lower lemmas of any given spikelet, sometimes even on the upper

lemmas. Based on the other characteristics (leaves and panicles), some Oregon *pachypholis* specimens were indistinguishable from *P. unilateralis*. Both species have "puccinellioid" papillae on the leaf-blade epidermis and are hexaploid with chromosome numbers of  $2n=6x=42$  (Soreng 1991). Thus, Soreng reclassified the pubescent



Inflorescence of *Poa unilateralis* ssp. *unilateralis* from Bandon. Specimen collected by Dave and Diane Bilderback, photographed by Cindy Roché and Robert Korfhage.



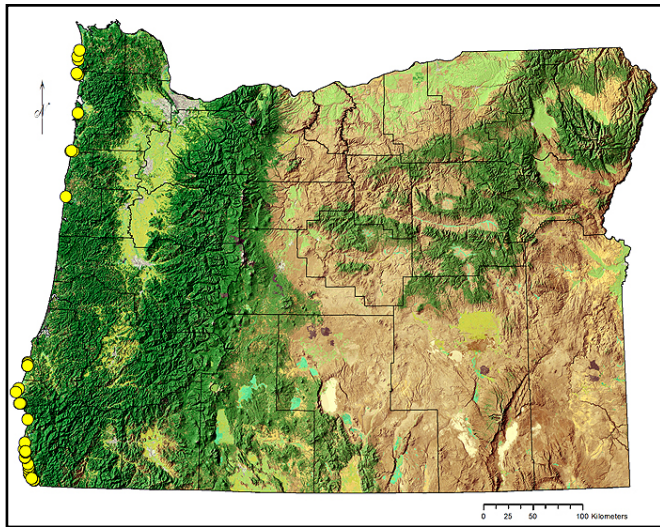
Floret of *Poa unilateralis* ssp. *unilateralis* from Bandon. Note the villous pubescence along the lemma and marginal veins in the lower third of the lemma. Photo by Cindy Roché and Robert Korfhage.



Spikelet of *Poa unilateralis* ssp. *unilateralis* from Bandon. Photo by Cindy Roché and Robert Korfhage.

1 The exception to this chromosome number is one population in California, which is duodecaploid,  $2n=12x=84$ .





Distribution of sea bluff bluegrass in Oregon. Map courtesy of the Oregon Flora Project Atlas, with survey data from Kathleen Sayce and Dave and Diane Bilderback.

lemma form (*pachypholis*) as a subspecies of *P. unilateralis*. The key characters are pubescence on the lemmas and the relative widths of cauline and innovation leaf blades. In *ssp. pachypholis*, keels and marginal veins are villous for more than 1/3 of the lemma and cauline leaf blades are similar to the innovation blades; in *ssp. unilateralis*, lemmas are glabrous or pubescent for less than 1/3 the length and cauline blades are wider and thicker than the innovation blades (Soreng 2007). Of the two subspecies, *pachypholis* is the rarer, limited to one county in Washington and some populations along the northern coast of Oregon. Specimens of sea bluff bluegrass from northern Oregon tend to be more variable than those from other locations, bearing characteristics of both subspecies, or even tending toward *Poa stenantha* (Soreng, pers. comm.).

### Physical appearance

In Washington and the north coast populations, sea bluff bluegrass has a mop-headed appearance, in which the inflorescences are not upright, but project stiffly out at angles from 20 to 70 degrees. When actively growing, its color is a distinctive light bluish-grayish-green. The slightly flat and wide leaves distinctly contrast with *Festuca rubra*, which often grows in association with it and has narrower leaves, is more upright in growth habit, and tends to a more yellowish-green or bright green leaf color.

Among the southern Oregon populations (*ssp. unilateralis*), leaves are also light bluish-gray-green, and the culm nodes, the basal sheaths of the culms and inflorescence are reddish purple prior to anthesis. The position of the inflorescences is distinctive: they stand at about a 60 degree angle; they are not upright, not horizontal. The stiff appearance of the reproductive culms is one of the characteristics that the Bilderbacks use for field recognition of the plant.



Habit of *Poa unilateralis* *ssp. pachypholis*. Note the sprawling habit with horizontal inflorescences and distinctive light bluish-grayish-green foliage. Photo by Kathleen Sayce.

### Habitat

Over its range, sea bluff bluegrass is reported as growing on sea cliffs and bluffs, on weathered sandstones to heavy clays, in open ground and meadows in the saltspray zone (Soreng 1991). Reports of inland populations in California ([http://www.calflora.org/cgi-bin/species\\_query.cgi?where-taxon=Poa+unilateralis](http://www.calflora.org/cgi-bin/species_query.cgi?where-taxon=Poa+unilateralis)) are undoubtedly other species (Soreng, pers. comm.). Until the recent surveys by Sayce and the Bilderbacks, populations in Oregon were not well documented.

In Washington, this coastal plant is known only from rock crevices and small ledges on steep basalt sea cliffs, at elevations ranging from 10 to 100 feet above sea level. Associated species include Oregon stonecrop (*Sedum oregonum*) and red fescue (*Festuca rubra*). The northern-most populations begin on the Cape Disappointment headlands, where this bluegrass persists on sea cliffs from the lighthouse north to O'Donnell Rock, a seastack that is now surrounded by sand in Beard's Hollow. Nancy Eid helped Sayce survey for sea bluff bluegrass in 2004, and they found hundreds of plants in more than ten populations, from the Cape Disappointment Lighthouse cliffs on the Columbia River north to O'Donnell Rock. These populations are always below the cliff tops, which are often densely covered with Sitka spruce forest and its associated shrubs or with meadows dominated by Pacific reedgrass (*Calamagrostis nutkaensis*), a large bunchgrass that grows in very dense stands, often with salal (*Gaultheria shallon*). Fescue-sedum meadows form a narrow band immediately below either spruce forest or reedgrass meadows; below that band sea bluff bluegrass grows on the rock ledges.

In 2004, Sayce and Eid found two populations that are now more than 2,000 feet from the ocean due to sand accretion on the north side of the mouth of the Columbia River. These were found on McKenzie Head and Middle Head, between North Head and



Cape Disappointment lighthouses, and well east of the current beach. They have been separated from direct salt spray since the 1950s. Likewise, O'Donnell Rock's population is also more than 500 feet from the beach and has been out of reach of salt spray since the 1960s.

South of the Columbia River, if a rock is high enough above the ocean to have a meadow on top of it, sea bluff bluegrass probably grows on it: on both ends of Tillamook Head, Haystack Rock in Cannon Beach, and south to Neahkahnie Mountain. On sea cliffs, it is found only below the *Festuca-Sedum* meadows. Lichens, mosses and the occasional mist maiden (*Romanzoffia traceyi*) or monkey flower (*Mimulus guttatus*) are its main companions. On the north coast of Oregon and south coast of Washington, populations are consistently located on north to northeast-facing cliffs, or on west-

facing cliffs that are well shaded by nearby outcrops. The base rock is basalt, either Miocene or Eocene, or very hard sedimentary rocks (sandstone). This grass has not been seen on other rock types or on soft sedimentary formations.

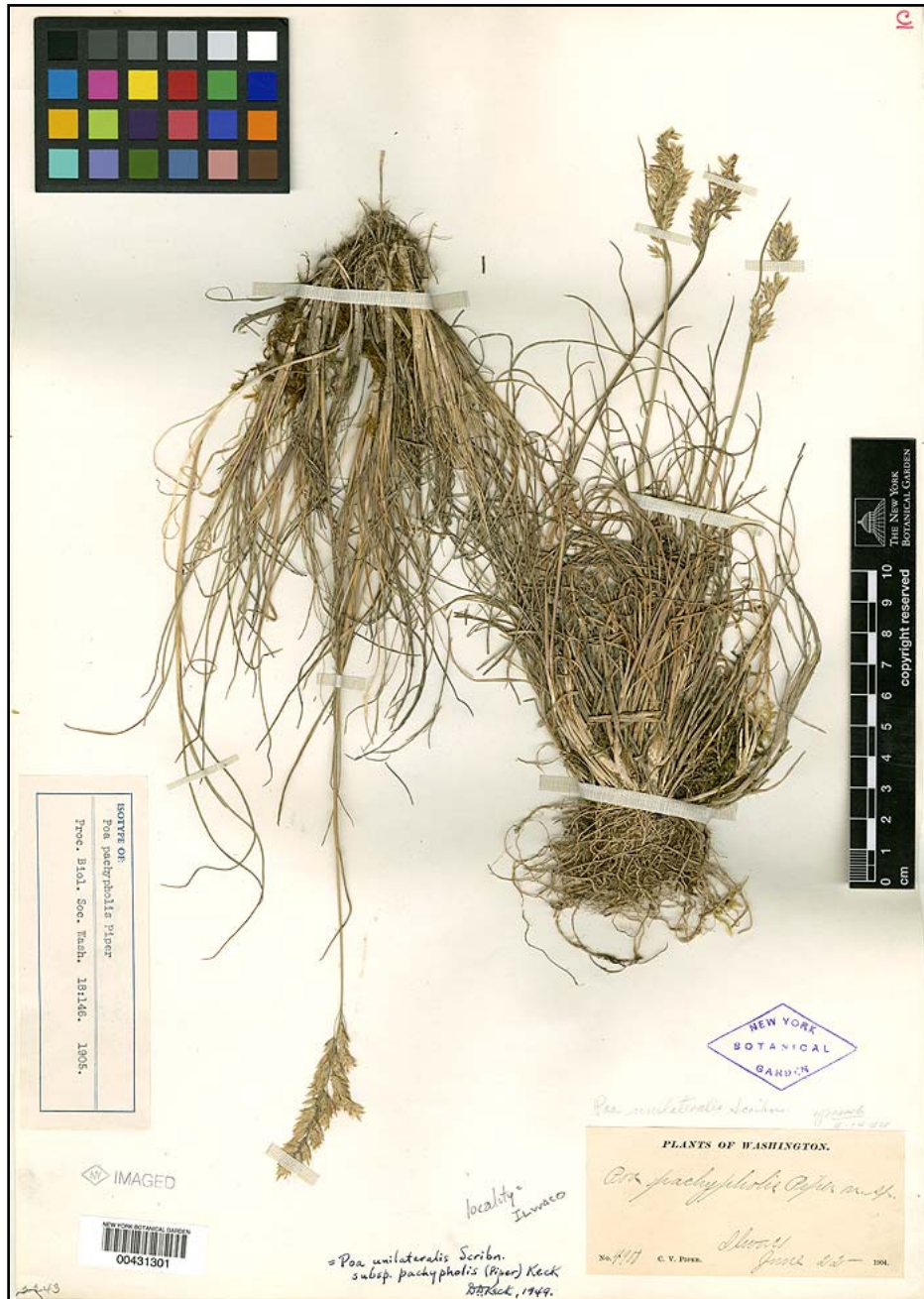
Along the rocky south coast of Oregon, plants more closely fit the description of *P. unilateralis* ssp. *unilateralis*. Rittenhouse (1996) included *Poa unilateralis* in a list of species found in coastal headlands, bluffs and prairies of the south coast of Oregon, but he did not specify whether it grew only on the sea bluff habitats or was also found on the coastal headlands and prairies. Curiously, his list did not include the common associate of sea bluff bluegrass, *Festuca rubra*.

Bilderback and Bilderback (2010, 2014) completed two distribution surveys along the Oregon coast from Florence to the California line. They found 64 populations of sea bluff bluegrass in Coos and Curry counties, none of which were north of Bandon. Most plants were restricted to north- and east-facing ledges and pockets of soil on the rocky, vertical faces of headlands, spires, rocks and islands. No populations were found growing in grassy headlands or coastal prairies, on south-facing rocky slopes, or farther than 300 feet from the ocean. In the 2010 survey of seven islands of the Oregon Islands National Wildlife Refuge, they recorded sea bluff bluegrass on the east side of four islands, usually growing in a stonecrop/herb association. Common associates included *Dudleya farinosa*, *Armeria maritima*, *Spergularia rubra*, *Sedum spathulifolium*, *Fragaria chiloensis*, and *Erigeron glauca* (Bilderback and Bilderback 2010). The survey completed in 2012 brought the total number of populations to 30 on islands and rocks within the Oregon Islands National Wildlife Refuge. An additional 34 populations grew on rocks within Oregon State Parks, on rocks surrounded by public beaches or on rocks adjacent to the beach.

### Phenology and reproductive biology

Historic comments in floras indicated that sea bluff bluegrass flowers in late spring or early summer, although photoperiod and seasonal temperatures may influence its phenology. Seasonal temperatures are strongly influenced by El Niño-Southern Oscillation events, which typically bring warm weather that promotes early flowering, and by La Niña events, which bring colder than normal weather that delays flowering.

At Cape Disappointment, sea bluff bluegrass greens up in fall and goes



Isotype of *Poa pachypholis* collected by CV Piper June 22, 1904, from Ilwaco, Pacific County, Washington. Courtesy of the C.V. Starr Virtual Herbarium of the New York Botanical Garden. (<http://sciweb.nybg.org/science2/vii2.asp>)

dormant in winter, then greens up again in spring. Flowering occurs from April to June, depending on the warmth of the winter to spring season. Seeds are shed as the plants go dormant for summer.

When Sayce and Eid first surveyed for it at Cape Disappointment in 2004, State Park staff told them that it flowered in June-July, but that year they found it flowering in early May.

On the south coast, inflorescences appear in April followed by anthesis during May. Seeds mature in June, although the leaves are still green. By July the inflorescences are dry and only a few leaves remain green. By August plants are in summer dormancy. They begin to grow again after autumn rains, often becoming noticeably green by November and growing over the winter.

### Rare status

In Washington, *Poa unilateralis* ssp. *pachypholis* has a status of Threatened. In Oregon, the Oregon Biodiversity Information Center (ORBIC 2015) assigns *Poa unilateralis* ssp. *pachypholis* a Heritage Rank of G4T2<sup>2</sup> S1<sup>3</sup> and places it on ORBIC List 1<sup>4</sup>. *Poa unilateralis* ssp. *unilateralis* has a Heritage Rank of G4T4 S4<sup>5</sup> and is on ORBIC List 4<sup>6</sup>.

The Bilderbacks' distribution surveys did not evaluate the total number of *Poa unilateralis* plants, only the number of sites<sup>7</sup>. However, they were able to share some anecdotal information about population size. They considered all the plants growing scattered on various ledges of a particular rock as a population. At Fish Rock, there were about 36 plants, which they classed as a medium-sized population. Two groups on Cathedral Rock comprised at least 50 plants each. In their estimation, the 200 plants ranging over an area 700 feet across at Cape Blanco was a large population. On Pirate Rock, there were fewer than 15 estimated plants, scattered over an area about 100 feet in diameter. Some rock faces with only a few suitable ledges may support as few as two or three plants. On the north coast of Oregon and south coast of Washington, populations comprise ten to two hundred individuals or more.

Throughout its range in Washington and Oregon, populations of sea bluff bluegrass are geographically isolated from each other. The two closest populations in southern Oregon are on Cathedral Rock, about 80 feet apart. All other populations are 100 feet or more from their nearest neighboring population. On the north coast of Oregon, suitable rocky outcrops with the right orientation are also separated

2 The letters G and T refer to Global and Trinomial (subspecies) rank. The ranking is a 1-5 scale with 1 being critically imperiled and 5 being secure. When determining species rank many factors are taken into account, including the number of known occurrences, threats, inherent sensitivity, area occupied, and other biological and anthropogenic factors.

3 State List 1 = critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences.

4 ORBIC List 1 contains taxa that are threatened with extinction or presumed to be extinct throughout their entire range. These are the taxa most at risk and should be the highest priority for conservation action.

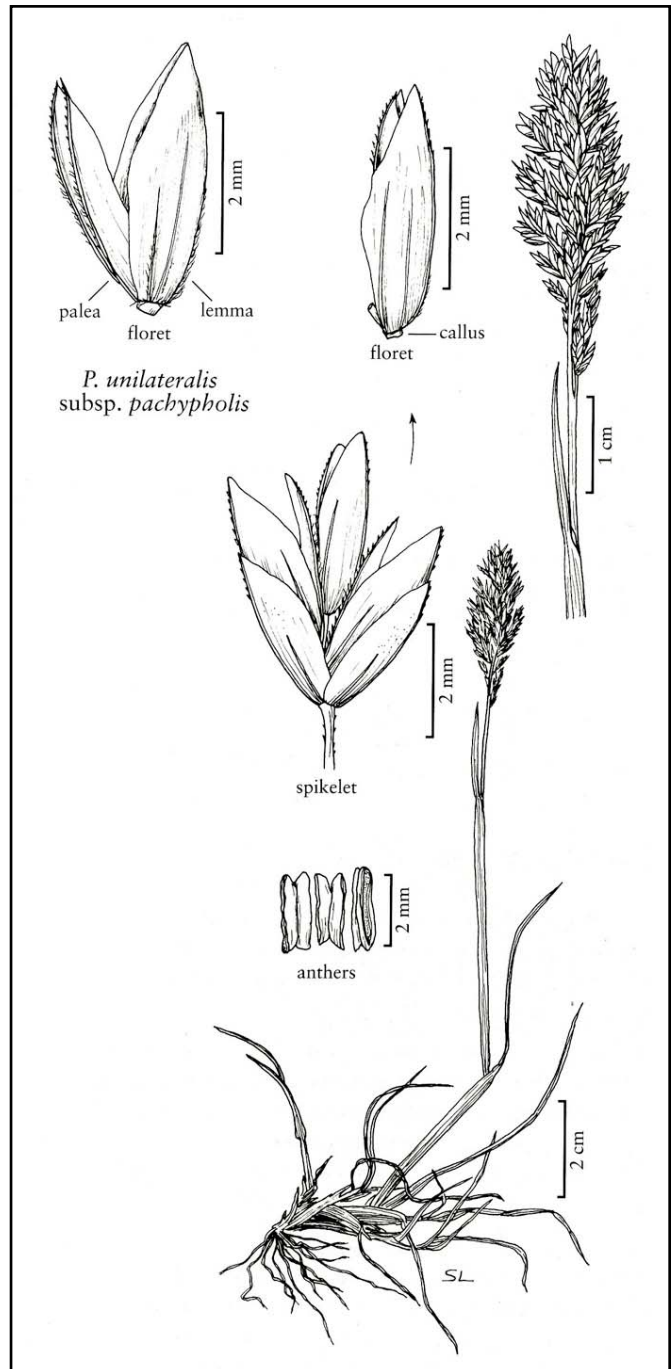
5 State List 4 = not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences.

6 ORBIC List 4 contains taxa that are of conservation concern but currently do not meet the criteria for begin considered threatened or endangered. This includes taxa which are very rare but are currently secure, as well as taxa which are declining in numbers or habitat but are still too abundant to be proposed as threatened or endangered. While these taxa currently may not need the same active management attention as threatened or endangered taxa, they do require continued monitoring.

7 Total numbers of plants and population sizes are critical information for evaluating the status of a rare taxon and for preparing a management or recovery plan.

by large distances: the north end of Tillamook Head is 22 miles from Cape Disappointment Lighthouse; from Tillamook Head south to the sea cliffs below Neahkahnie Mountain is 16 miles, and there are several populations in this section, where outcrops and orientation are suitable. The largest is probably at Cape Falcon.

Nothing is known about the life span of individual plants, effective dispersal distance for pollen, pollen viability, the mating system of the species, and the population fecundity. However, a preliminary assessment of some of the accessible populations reveals a skewed population age structure, dominated by larger, older reproductive plants, with no apparent seedlings and young plants anywhere in Oregon.



Line drawing of *Poa unilateralis* and both subspecies by Sandy Long, as it appeared in Flora of North America Vol. 24, p. 597. Illustration copyrighted by Utah State University.



## Threats

Even though nearly all of the current distribution of sea bluff bluegrass in Washington and Oregon occurs on rocks, islands and cliffs within the Lewis and Clark National Historical Park (National Park Service), Oregon Islands National Wildlife Refuge (US Fish and Wildlife Service), Oregon State Parks or other state lands, its future cannot be considered secure.

In fact, ssp. *pachypholis* is considered imperiled by the Washington Natural Heritage Program. Identified threats in Washington include competition with other plants (particularly non-native invaders), and in some locations, recreational rock climbing (Camp and Gamon 2011) and also fishing at Cape Disappointment State Park. Fishermen climb down over the rocks, especially near North Head Lighthouse. The greatest threat over the entire range of this species is loss of habitat. Since the species is limited to such a narrow range of conditions along the coastline – shallow soil on bluffs or crevices in rock ledges on protected aspects (north and east) in the salt spray zone – it would be particularly vulnerable to changes in sea level and rainfall patterns associated with climate change.

Most of the populations are inaccessible to humans, except for rock climbers. However, all but the hardiest vegetation on the tops of sea bluffs that are easily reached by walkers has been eliminated by trampling on many sites. Thus, we suspect that the grass was formerly more common on grassy headlands and meadows (as indicated in early habitat descriptions). We doubt that M.E. Jones in 1882 or C.V. Piper in 1905 rappelled off a sheer basalt cliff to collect their specimens.

In addition to trampling of fragile sites, humans and other vectors continue to disperse seeds of invasive plant species. Non-native species are now found in virtually every coastal habitat, including



Habit of *Poa unilateralis* ssp. *unilateralis* at Crook Point Headland, Curry County, Oregon. Note the upright leaves and compact panicle. Photo by Diane Bilderback on 15 May 2009.

the offshore islands and seastacks, where weeds may be introduced by waterfowl. Invaders include ice plant (*Carpobrotus chilensis*), velvetgrass (*Holcus lanatus*), wall barley (*Hordeum murinum*), riggut brome (*Bromus diandrus*), hedgehog dogtailgrass (*Cynosurus echinatus*), and various bentgrasses (*Agrostis* spp.). Trailplant (*Solidago sessilis*), a recent Patagonian arrival at Cape Disappointment (Wise and Kagan 2012), has made its way north and south along the coasts of Oregon and Washington. Normally found on hard-packed trails, it has been carried out onto sea cliffs by birds, fishermen and other visitors and seems at home there as well. Probably the most severe threat is from introduced clonal grasses, which displace *Poa unilateralis* from ledges of sea cliffs.



Sea bluff bluegrass grows on the face of Cape Falcon and other stunningly inaccessible habitats along the Pacific Coast. Photo by Kathleen Sayce.



## Acknowledgements

The authors thank Dave and Diane Bilderback, local field authorities for sea bluff bluegrass along the southern Oregon coast, for sharing their survey information and knowledge of the species. Also, Robert Soreng, *Poa* expert at the National Museum of Natural History, Smithsonian Institution, helped us tremendously with the taxonomy and origin of this rare bluegrass. Nancy Eid helped Sayce survey populations at Cape Disappointment, Tillamook Head, Ecola State Park, and Cape Falcon. Christina Stanley assisted with the survey at Haystack Rock in Cannon Beach. Thanks also to Dick Brainerd of the Carex Working Group for reviewing the manuscript, Kareen Sturgeon for calling our attention to an accessible population at the beach south of Cascade Head and Stephen Meyers for an updated Atlas Project map.

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Kathleen Sayce was born in Ilwaco, Washington (same as the type specimen of *Poa pachypholis*). She earned her BS in botany from Fairhaven College at Western Washington University, where she was also interested in marine ecology, scientific illustration and geology. She completed her MS in 1978 at Washington State University, and also worked with lichens and bryophytes at WSU and University of Idaho. Previous experiences with grasses include

studying the ecology of smooth cordgrass in Willapa Bay and coastal dune prairies. She was Science Officer for ShoreBank Pacific in Ilwaco 1998-2011. She lives on Willapa Bay north of Nahcotta, Washington, and in her spare time, hikes, botanizes new locations and grows native plants (geophytes and Pacifica iris are favorites). An example of her determined curiosity in mapping this sea bluff bluegrass in Oregon is when surveying Haystack Rock at Cannon Beach, she took her \$1,000-spotting scope into the surf at low tide to get a good angle for viewing the north face of the seastack!



Cindy Roché also attended Washington State University (BS 1978, MS 1987) and University of Idaho (PhD 1996). She began working with grasses as a Range Conservationist with the US Forest Service, and then illustrated them for a Range Plants laboratory manual. She came to Oregon in 1998 and joined the Native Plant Society of Oregon. She volunteered to help edit *Kalmiopsis* in 2000 and met Linda Ann Vorobik who promptly enlisted her to ink grass

illustrations for the *Flora of North America*. Currently, Cindy and her husband Bob Korfhage are collaborating with the Carex Working Group (Barbara Wilson, Nick Otting and Dick Brainerd) to produce a *Field Guide to Grasses of Oregon and Washington*. Photographing grasses in the field have taken them far and wide in Oregon, to many unforgettably beautiful places.