Self Guided Bryophyte Tour of the Regional Parks Botanic Garden

Draft to be finished Spring 2017

Kiamara Ludwig
Photos by John Game

Route map on back cover

Stop 1

Bed # 905 Garry Oak by the Visitor's Center.

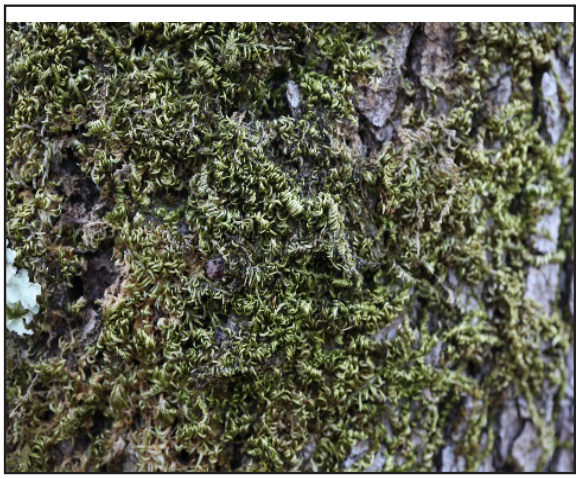
1. Homalothecium nuttallii

2. Dendroalsia abietina

3. Orthotrichum lyellii

As you stand looking at the Gary Oaks in Bed 905 you notice the trunk is covered in mosses and lichens. Lichens are combined life forms composed of algae and/or cyanobacteria living among filaments of fungi in a symbiotic relationship. The combined life form, the lichen has properties that are very different from the properties of its component organisms. The combiniation of algae, cyanobacteria and fungi form unique lichens. This tree also has a variety of mosses on it. Mosses are small flowerless green plants that lacks true roots, and reproduce by spores. They grow in low mats or rounded cushions.

Homalothecium nuttallii

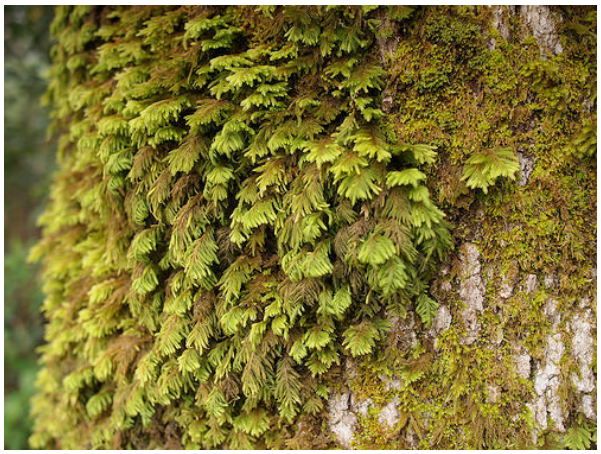


Dry

Wet

Dendroalsia abietina

Dry



Wet

The trees and flowering plants you see around you have roots, stems and leaves. The roots absorb water and nutrients from the soil which are then distributed throughout the plant. Mosses do not have roots. They obtain their nutrients directly through the leaf surface when hydrated. Most people distinguish mosses from other plants by calling them non–vascular plants because they cannot produce wood or become large plants. The true difference between bryophytes and other plants is lignin. Lignin is present in ALL vascular plants. It is not present in any bryophytes. Lignin is a class of complex organic polymers that form important structural elements. Lignins are particularly important in the formation of cell walls, especially in wood and bark, because they lend rigidity and do not rot easily. It is lignin that allows the oak to obtain it height and supports a vascular system that extends from the roots to the uppermost leaves. Mosses and lichens cause no harm to trees and actually assist in nutrient cycling.

STOP 2

Visitor Center Roof by Back Deck

Where do mosses grow?

Bryophytes are not restricted to moist shady places, but are found in all environments on earth except for marine ecosystems. They occur on all continents including Antarctica. Since bryophytes have no roots, they are not restricted to growing on soil. Many bryophytes are quite content to grow on rock surfaces and tree trunks. In addition, rock/soil/bark chemistry can influence which species become established. Some bryophytes are substrate specific such as the members of the genus *Grimmia* that prefers to grow on rock. *Homalothecium* from the first stop is not substrate specific and can grow on bark, soil or rock. Here we see it growing on our roof. We see it creeping along the beam of the lath house. You can also see it creeping along the concrete bases of many of our bridges. Look for mosses on older roofs, in mortar between bricks, in slow flowing streams and lakes. Where your imagination takes you there will be bryophytes.

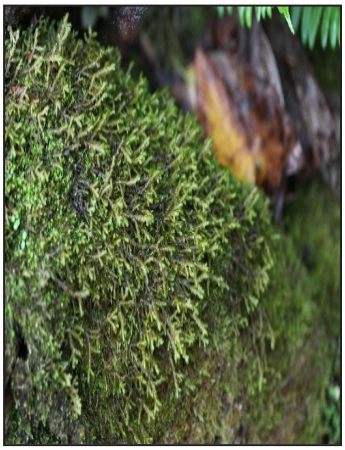
Stop Three

Bed # 925 At the end of the Serpentine Bed

The Plant Kingdom is split into 13 major divisions: Most people are familiar with just three. The flowering plants (*Magnoliophyta*); the cone bearing plants (*Coniferophyta*) and the ferns (*Pteridophyta*). The Plant Kingdom is split into 13 major divisions: Most people are familiar with just three. The flowering plants (*Magnoliophyta*); the cone bearing plants (*Coniferophyta*) and the ferns (*Pteridophyta*). This tour is concerned with *Bryophyta* or mosses. Originally grouped as a single division or phylum, the 24,000 bryophyte species are now grouped in three divisions: Mosses (*Bryophyta*), Liverworts (*Hepatophyta*), and Hornworts (*Anthocerotophyta)*. All reproduce by spore. We do have hornworts in the garden but they are ephemeral so are only occasionally seen. There are only 4 hornwort species known in Contra Costa County, 7 in the state. They are present in the spring in the Canyon Section at the base of the rock featured in stop #8 At this stop (#3) we have liverworts. Liverworts are divided into 2 types the thalloid and leafy. Here we can see both a thalloid and a leafy representative. The leafy liverwort is *Porella navicularis* and the thalloid is *Lunularia quadrata*.

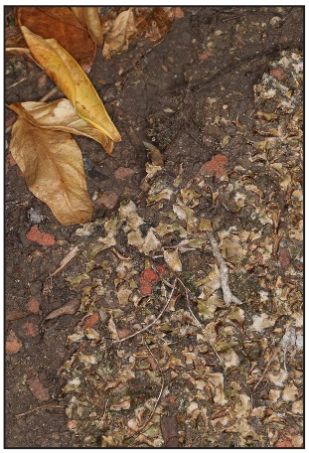
Leafy Liverwort
Porella navicularis

Dry

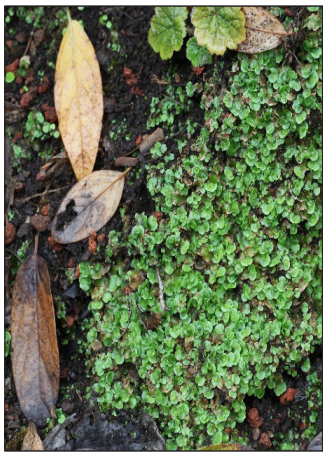


Wet

Thalloid Liverwort
Lunularia quadrata



Dry



Wet

Stop Four

Bed 655 Hansens's Spike Moss- *Selaginella hansonii-* *edge of north lawn*

Hansens's Spike Moss- *Selaginella* is not a true moss, despite the common name of Spike Moss that appears on the sign. As a member of the phyllum *Lycopodiophyta, Selaginella* is a tracheophyte or vascular plant having roots and water conducting tissues. It does reproduce by spore like ferns and *Bryophytes*. The most interesting feature shared in common between Selaginella and the surrounding mosses is **dessication tolerance.** Most people think that plants such as cactus are desiccation tolerant but they are not. They have evolved many complex morphological and physiological strategies to conserve water, however, if the plant cells totally dry out the plant dies.

Most bryophytes are able to be thoroughly dried out and then come back to life. The leaves of mosses are generally only one cell thick and are forced to follow the hydration of their environment, i.e., if the environment is wet they are wet. If the environment becomes dry the moss dries to be in equilibrium with its environment. This is referred to as poikilohydric. In contrast, most vascular plants are homeohydric, meaning vascular plants have the ability to restrict cellular water loss regardless of environmental conditions. Despite being in a dry environment for most days of the year a cactus's and other desert plant's cells are kept moist at all the time. There are approximately 130 species of vascular plants which are desiccation tolerant out of an estimated 400,000 species worldwide. Most of these 60 to 70 desiccation tolerant species are either *Lycophytes* or *Pteriphytes*. That leaves only approximately 60 species of angiosperms (flowering plants) that exhibit some degree of vegetative desiccation tolerance.

In Bryophytes **desiccation tolerance** is relatively common, especially in climates with a dry season. As the plant dries out it sequesters sugars into specialized cells that will function to repair damage occurred during drying. Bryophytes also have cellular compounds that protect the cell's integrity during the drying process. Mosses can remain dry until the water returns. Within minutes it begins using the sequestered sugars to repair damage to the cells and chloroplasts. Within hours it is growing plant again photosynthesizing to repalaces sugar stores and begin cell division. If the moss dries out before it can replace the sequestered sugars used for cellular repair the plant can ultimately die.

Stop 5. Staying at Hansen' Spike Moss.
Look directly right at the rock covered with mosses

Grimmia laevigata

Isothecium cristatum

While the inventory of bryophytes in California is still ongoing, there are currently 650 mosses, 150 liverworts, and 7 hornworts documented for the state of California. The mosses in California are especially diverse with nearly 50 percent of all of the mosses reported for North America also found within California. To date in the garden we have identified 54 species. What we are looking at here are *Grimmia laevigata* , *Didymodon vinealis* and *Isothecium cristatum*. Each represents a major division in the moss group: Pleurocarps and Acrocarps.

Acrocarps are usually unbranched and erect, forming mounded hummock like colonies. They are slower growing than Pleurocarps. The sporophytes of the Acrocarps emerge from the tips of the plant. It is pretty safe to say if you see a mounding moss it is an Acrocarp. Pleurocarpous mosses have a prostrate growth habit. They are freely branching to form colonies in a creeping fashion and are quicker to regenerate from broken fragments.

On the rock to the right of the *Selaginella hansenii* we have both Acrocarpous and Pleurocarpus mosses. The dark mounds with a silver sheen are *Grimmia laevigata*. It is an acrocarpous moss

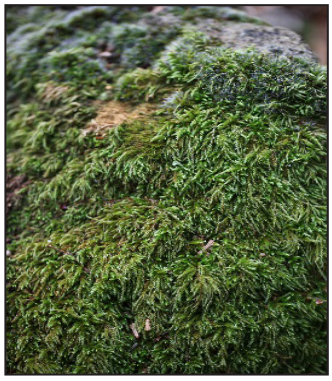
The creeping moss is *Isothecium cristatum*. It is a pleurocarpus moss.

Grimmia laevigata
Acrocarp

Dry

Wet

Isothecium cristatum
Pleurocarp



Dry

Wet

Stop 6 -Nurse Log in Rain Forest
Bed 501- north end of the bed

Healthy standing trees are a tribute to our natural environment. But even in their fallen state on the ground, trees perform nobly as re-generators of our forest environment. When one of these trees falls in the rain forest either from storms, age or intentional human intervention it usually begins a new life as a nurse log. Sometime after a tree dies, it will come crashing down, opening up an area of sunlight at the forest floor. After a few years, with a build up of fallen needles, mosses and fungus the fallen tree 's surface resembles soil (humus). When a seed from an adjecent plant lands here they have a perfect place to grow - rich organic soil with moss providing sustained moisture and nitrogen, a newly created patch of sunlight, and a platform to raise them above the undergrowth they would otherwise be competing with.Being perched on the top of a fallen tree brings another advantage. Nurse logs also act like giant sponges. They store the moisture throughout the year and release it during times of summer drought.

Leucolepis menziesii

Leucolepis menziesii, one of three dendroid mosses in California. This is the gardens first *Bryophyte* accession. It was collected Oct 4, 2016 by Joe Dahl near the Lake Earl Pine Barrens in Del Norte County . Because *Leucolepis menziessi* is in our Rain Forest Section as it does not dry out here.

Stop 7 On left hand side (NW corner) bridge as you enter the Canyon

If you look at the stumps of the cut down bay trees beneath the maple you will see *Bryolawtonia vancouveriensis*

Looking left we see 2 old stumps from a California Bay Laurel (Umbellularia californica). On the base of these stumps the moss Bryolawtonia vancouveriensis continues to grow. Bryolawtonia vancouveriensis is found almost exclusively growing on the bases of mature Umbellularia californica as its preferred substrate. . Whether or not it is bark chemistry or bark texture, mosses tend to restrict themselves to specific micro habitats. Moss species growing on or under trees are often specific about the species of trees they grow on; some prefer conifers while others select broadleaf trees. As mentioned before the genus Grimmia are only found on rocks. Looking across the creek and down into the canyon there are several unique habitats. California's largest moss, Fontinalis neomexicana can under ideal conditions become up to 2 ft long and prefers fast moving.clean watercourses. In California it is most often seen in the Sierra Nevada. Others mosses prefer only seasonally wet areas or are located just at the high water mark of streams. . Choice of substrate varies by species. Looking down the canyon we have rocks, acidic soils, seeps and water spray areas, streamsides, shaded places, humus soils, boggy areas, downed logs, tree trunk bases, tree trunks, and tree branches.

Wet

Dry

STOP 8

Bed # xxx

As you enter the Canyon along Wildcat Creek you will see a large rock on your right hand side.
Along with moss you should see, depending on the time of year the skeletons of the annual flowering plant *Romanzoffia californica* or the actual plant. The two main mosses on this rock are *Isothecium cristatum* and *Isothecium stoloniferum*. They actually grow side by side.

Romanzifia californica skeletons

in Spring in bloom

Isothecium stoloniferum

Isothecium cristatum

Moss mats and soil crusts sometimes act as nursery beds for certain vascular plants. They hold the soil surface together, preventing erosion, allowing for the buildup of organic matter, and holding onto moisture. They encourage the growth of nitrogen-fixing bacteria. In some cases, they even provide a spot for seeds to nestle in place while germination proceeds. Certain vascular plants are facilitated; others are discouraged. The effects depend on the details of the interaction and the background quality of the soil. For example, in certain arid systems soil crusts promote the growth of a variety of showy wildflower species and dampen the dominance of alien grasses.

STOP 9 -The lower bulb bed by the Glass House adjacent to BED 212

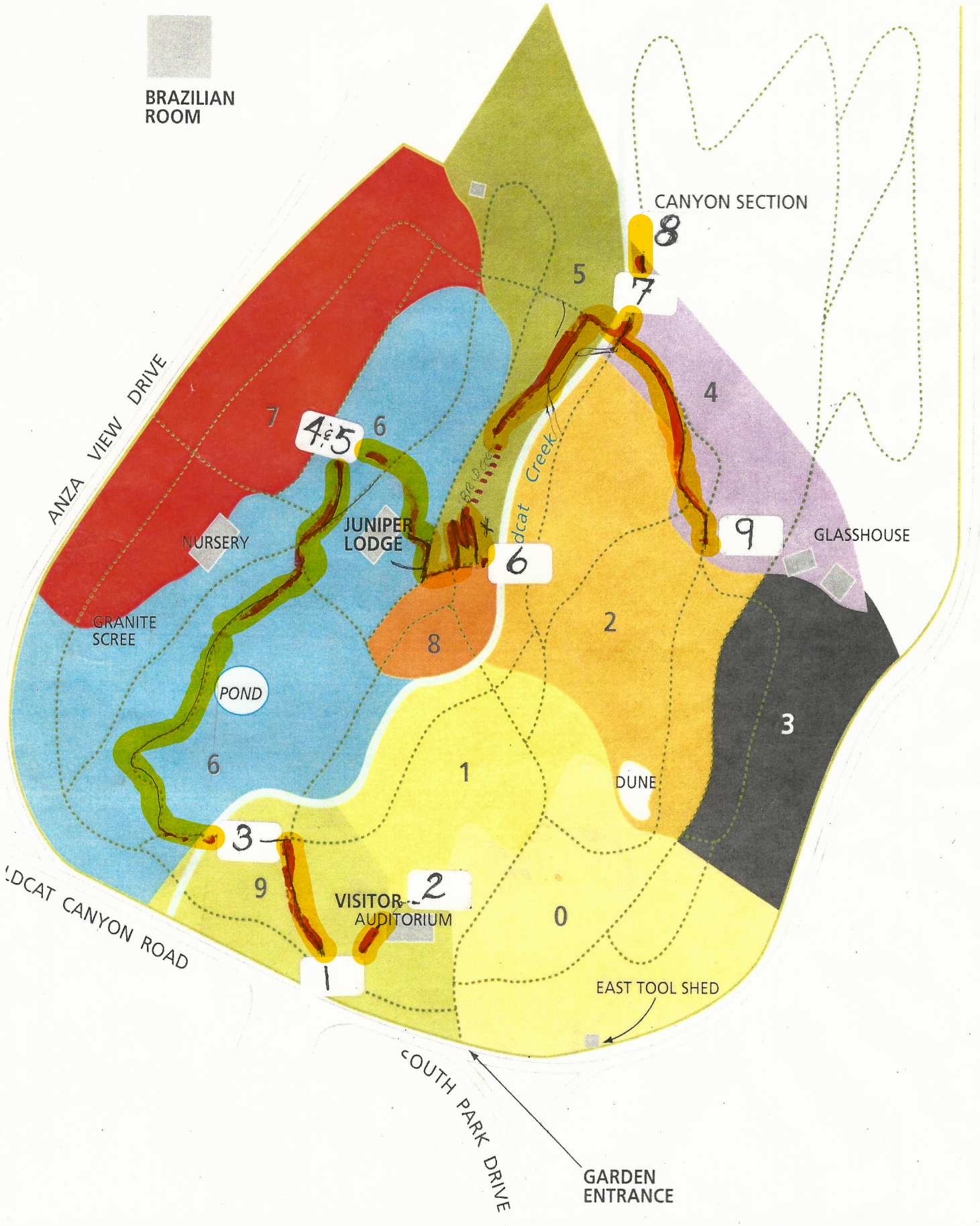
These small mosses living in the gravel perform an important function for the surrounding bulbs and annual flowers living in this nutrient poor soil. Vascular plants get their nutrients from underground via root hairs and partnerships with symbiotic fungi. *Bryophytes* and lichens obtain nutrients that are dissolved in water that then comes in contact with these compact organisms. Mosses, liverworts and lichens cover the earth and the trunks of trees in many plant communities, and they line the banks of streams. During summer drought, mineral nutrients build up as dust. When the rain comes, theses nutrients go into solution. Then byophytes and lichens actively absorb the nutrients, largely preventing ions such as nitrate and phosphate from being flushed down streams. As the rainy season continues the nutrients are slowly released back to the ecosystem where they seep into the soil and are captured by vascular plants.

Funaria species
Dry

Wet

Bryum species
Dry

Wet


BRAZILIAN ROOM
CANYON SECTION
8
7
5
4
ANZA VIEW DRIVE
7
4&5
6
Creek
NURSERY
JUNIPER LODGE
6
9
GLASSHOUSE
GRANITE SCREE
8
2
POND
3
6
1
DUNE
3
9
VISITOR
AUDITORIUM
2
0
1
EAST TOOL SHED
SOUTH PARK DRIVE
GARDEN ENTRANCE