PLANT ADAPTATIONS HABITAT

Desert—Southern California

- Agave shawii (Agavaceae , Shaw' s Agave) Bed 5
- Artemisia triden tata (Asteraceae, Great Basin Sagebrush) Bed 28
- Echinocereus engelmannii (Cactaceae, Hedgehog Cactus) Bed 30
- Ephedra spp. (Ephedraceae , Mormon Tea) Bed 3
- Eriogonum oval i folium (Polygonaceae) Bed 3
- Mimulus aurantiacus (Scrophulariaceae, Sticky Monkey flower) Bed 2
- Opuntia basilaris (Cactaceae, Beavertail Cactus) Bed 27
- Opuntia spp. (Cactaceae, Prickly Pear) Bed 6
- Salvia spathacea (Lamiaceae, Pitcher Sage) Bed 2
- Washingtonia filifera (Arecaceae, California Fan Palm) Bed 8
- Yucca schidigera (Liliaceae, Mojave Yucca) Bed 4

Valley—Foothi11

- Ceanothus purpureus (Rhamnaceae , Hollyleaf Ceanothus) Bed 119
- Deschampsia caespi tosa (Poaceae , Tufted Hairgrass) Bed 122 • Erysimum capi tatum angustatum (Brassicaceae , Antioch wallflower) Bed 121
- Festuca california (Poaceae, California Fescue) Bed 103
- F. idahoensis (Idaho Fescue)
- Heteromeles arbutåfolia (Rosaceae , Toyon) Bed 104
- Lupinus spp. (Fabaceae , Lupine) Bed 203
- Nasella spp. (Poaceae, Needlegrass) Bed 211
- Oenothera del toides howe11ii (Onagraceae, Antioch Dunes Evening Primrose) Bed 121, 122
- Quercus kelloggii (Fagaceae, Black Oak) Bed 112?
- Q. lobata (Valley Oak) Native Calif. Meadow Bed 211 • Rhamnus ilicifolia (Rhamnaceae, Coffeeberry) Bed 102? • R. tomentella crassifolia (Coffeeberry) Bed 106
- Salvia spa thacea (Lamiaceae, Pitcher Sage) Bed 103

rro

Sierran

- Arctostaphylos uva—ursi x pa tula (Ericaceae, Convict Lake Manzanita) Bed 612 • Artemisia arbuscula ssp. thermopola (As teraceae , Mountain Sagebrush) Bed 612
- Eriogonum sp. (Polygonaceae , Wild Buckwheat) Bed 632

PLANT ADAPTATIONS HABITAT

- E. prattenianun (Lava Buckwheat) Bed 633
- E. ursinum (Donner Buckwheat) Bed 633
- E. wrightii var. subscaposum (Wright's Buckwheat) Bed 612 • Lewisia congdonii (Portulacaceae, Congdon's Lewisia) Bed 646
- Populus tremuloides (Salicaceae, Quaking Aspen) Bed 622
- Hesperostipa coma ta (Poaceae , Needle and Thread) Bed 633

Sea Bluff

- Arctostaphylos uva—ursi (Ericaceae, Bearberry) Bed 805
- Artemisia pycnocephala (Asteraceae, Soft Sagebrush) Bed 806 • Calochortus elegans (Liliaceae, Cat' s Ear)
- Dudleya farinosa (Crassulaceae) Bed 813
- Eschscholzia californica (Papaveraceae, California Poppy) Bed 805
- Fragaria chiloensis (Rosaceae, Beach Strawberry) Bed 805
- Gaul theria shall on (Ericaceae, Sal al) Bed 812
- Juniperus communis var . sibirica (Cupressaceae, Dwarf Juniper) Bed 806
- Monardella villosa var. franciscana (Lamiaceae, Franciscan Coyote Mint) Bed 805
- Salvia mellifera (Lamiaceae, Black Sage) Bed 806
- Sedum spa thulifolium (Crassulaceae) Bed 805

Redwood

- Adiantum peda tum (Pteridaceae, 5—finger Fern) Bed 712
- Alnus sp. (Betulaceae, Alder) Bed 719 (?)
- Asarum caudatum (Aristolochiaceae, Wild Ginger) Bed 720 • Athyrium felix—femina var. si tchense (Dryopteridaceae, Lady Fern) Bed 726
- Dicentra formosa (Papaveraceae, Bleeding Heart) Bed 726 • Oxalis oregana (Oxalidaceae, Redwood Sorrel) Bed 709, 714
- Sequoia sempervirens (Taxodiaceae, Coast Redwood) Bed 709
- Trillium chloropetalum (Liliaceae, Common Trillium) Bed 726
- Vaccinium ova tum (Ericaceae, Huckleberry) Bed 711

rro

pacific Rain Forest

- Alnus sp. (Betulaceae, Alder) Bed 512?
- Asarum hartwegii (Aristolochiaceae, Hartweg' s Wild Ginger) Bed

PLANT ADAPTATIONS HABITAT

521

- Oxalis oregana (Oxalidaceae, Redwood Sorrel) Bed 508
- Polystichum muni tum x californicum (Aspidiaceae, Hybrid Sword Fern) Bed 501
- Rhododendron macrophyllum (Ericaceae, California Rose—bay) Bed 522
- Torreya californica (Taxaceae, California Nutmeg) Bed 519

Santa Lucia

- Adenostoma fasciculatum (Rosaceae, Chamise) Bed 219
- Arctostaphylos edmundsii parvi folia 'Bert Johnson' (Ericaceae, Bronzemat) Bed 226
- A. refugioensis (Ericaceae, Refugio Manzanita) Bed 203
- Malacothamnus niveus (Malvaceae, San Luis Obispo Bush Mallow) Bed 227
- Salvia leucophylla (Lamiaceae, Gray or Purple Sage) Bed 210

Channel Islands

- Adenos tema fasciculatum (Rosaceae, Chamise) Bed 309
- Artemisia californica (Asteraceae, Canyon Gray Sagebrush) Bed 312
- Ceanothus arboreus (Rhamnaceae, Tree Ceanothus) Bed 314
- Dudleya candelabrum (Crassulaceae, Candleholder Dudleya) Bed 308
- Eri ogon um arborescens (Polygonaceae , Santa Cruz Island Buckwheat) Bed
- E. gigan teum (Polygonaceae , St. Catherine's Lace) Bed 308

Francis can

- Arctostaphylos uva—ursi (Ericaceae, Bearberry) Bed 405
- A. imbricata (Ericaceae, Mountain Manzanita) Bed 405
- A. pacifica (Ericaceae, Pacific Manzani ta) Bed 402
- Ceanothus thyrsiflorus (Rhamnaceae, Blue Blossom) Bed 401
- Lupinus spp. (Fabaceae, Lupine) Bed 410
- Salvia spathacea (Lamiaceae, Hummingbird Sage) Bed 405 , 410
- Vaccinium ova tum (Ericaceae, Huckleberry) Bed 402

To

Index IIIC

PLANT ADAPTATIONS HABITAT

Shasta —Klamath

- Acer circinatum (Aceraceae, Vine Maple) Bed 911
- Artemisia cana (Asteraceae, Hoary Sagebrush) Bed 902
- Eriogonum siskiyouense (Polygonaceae, Siskiyou Buckwheat) Bed 902
- Nevi us ia cliftonii (Rosaceae, Shasta Snow—Wreath) Bed 902
- Pi cea breweriana (Pinaceae, Weeping or Brewer Spruce) Bed 920

Desert Section Plant Adaptations February 2000 Irene Winston

1. Succulency

a) fleshy leaves, eg., Agave shawii, (Liliaceae), Shaw's agave (bed 5)

Check the thickness at the base of the leaves. How can fleshy leaves help a plant growing in an arid region? (By storing water when it is available.)

b) fleshy stems: paddle-like stems, eg., Opuntia basilaris var.brachyclada, (Cactaceae), (bed 6) (Fleshy leaves store water when it is available.)

2. UV Radiation adaptation

a) hairiness, eg., Eliogonum ovalifolium, (Polygonaceae), Cushenberry buckwheat (bed 3)

With a hand lens examine the leaf surface. (Long white hairs reflect incoming radiation, reducing leaf temperature, and thereby reducing the amount of water lost through transpiration.)

b) farinosity, eg., Dudleya pulverulenta. (Crassulaceae), (bed 3). Rub your fingers over a leaf surface. What do you see on your fingers? How can this white powder help a plant? (The white powder reflects the UV radiation, reducing the leaf temperature and thereby reducing the water loss.)

3. Reduced leaf surface, eg., Opuntia basilaris var. brachyclada, (Cactaceae), (bed 6).
Leaves are reduced to spines.
How do reduced leaf surfaces help a plant growing in an arid area? (Smaller leaf surface from which water can transpire.)

4. Prostrateness, eg., Eriogonum ovalifolim var. vineum. (Polygonaceae) (bed 3)

What advantage does a plant growing close to the ground have in a dry windy environment? (Low stunted growth form offers wind protection and some shading and therefore reduces water loss.)

Plant Adaptations in the Valley & Foothills Regions Feb 2000 Irene Winston

I) Adaptations to summer drought:

1) deep roots to absorb water at depth

2) leaf structure to reduce transpiration

Shrubs and trees: deep root systems, small, evergreen, leathery (sclerophyllous) leaves, vertically oriented, with thick cuticles (All characteristics which reduce water loss.)

eg., Rhamnus tomentella crassifolia, (Rhamnaceae), coffeebeny, (bed # 106), R. ilicifolia, coffeeberry, (bed # 102), eg., Heteromeles arbutifolia, (Rosaceae), toyon, (bed # 104), Quercus lobata, (Fagaceae), valley oak, (bed # 211 - Native California Meadow)

3) growth rate either fast to produce seed in 1 growing season or slow to allow for initial establishment of deep roots Grasses

a) annual grasses: - fast growth after rains with seeds produced at the end of the growing season (no examples of annual grasses in this section)

b) perennial bunch grasses- slower growth with establishment of deep root systems first, then seed production after a few years' growth eg., Nasella spp., needlegrass, (bed # 211, eg., Festuca idahoensis (Poaceae), Idaho fescue, Festuca californica, (Poaceae), California fescue, (bed #103), Deschampsia caespitosa. (Poaceae), tufted hairgrass (bed # 122)

Il) Adaptations to poor soils - Symbiosis

1) symbiotic relationship with nitrogen-fixing bacteria, eg., Lupinus spp., lupine (found in bed # 203), Ceanothus purpureus, (Rhamnaceae), hollyleaf ceanothus, (bed # 119) (The nitrogen-fixing bacteria convert nitrogen compounds into a chemical form that the plant can use.)

2) symbiotic relationships with mycolThizae.eg., Ouercus lobata, (Fagaceae), bed # 211 + Q. kelloggii, black oak, bed # 112?, near the bridge) [The mycorrhizal "roots" allow the plants access to more water and dissolved minerals than they could absorb on their own.]

Ill) Adaptation to fire regimes:

1) seed fire scarification - (Some seeds require fire softening of their outer coats before germination can occur.), eg., Ceanothus purpureus. (Rhamnaceae), (bed # 119)

IV) Adaptation to reduce competition for scarce resources: Allelopathy - chemical inhibition, ie., production of volatile compounds, allelochemicals, which leach into the soil and inhibit seed germination, (interference not competition), eg., Salvia spathacea. (Lamiaceae), pitcher sage, (bed # 103)

Endangered species preservation in the RPBG:

The current Antioch Dunes Preserve in Contra Costa County is a remnant of what was once a unique ecosystem that was destroyed by the removal of sand for construction and glass making purposes. With the reduction of the habitat, the populations of the endemic plants and their pollinators plummeted.

eg., Antioch Dunes Evening Primrose, Oenotheria deltoides howellii,(Onagraceae), (bed # 121,122), eg., Antioch wallflower, Erysimum capitatum angustatum, (Brassicaceae), (bed # 121) . eg., hawk moth which is the pollinator for these plants

As the flowers, the food supply, for the hawk moth dwindled, so did the hawk moth population. And as fewer flowers were pollinated, fewer seeds were produced, thereby contributing to a further reduction in the plants' populations.

These three species, among others, are on the endangered list. The RPBG acts to preserve populations of endangered plants so that their seeds can be banked and reintroduced into the wild.

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February 2000 Irene Winston

Plant Adaptations Sierran Section

1. Adaptations to winter drought:
    a) Deep roots to absorb water at depth when water is not available at upper soil levels due to freezing temperatures
    b) deciduousness - loss of leaves eliminates possiblility of water being lost through leaf transpirationthereby reserving water in the plant eg., Populus tremuloides, (Salicaeae), quaking aspen, in lawn between # 621 and bed # 622

2. Adaptation to high winds:

Prostrateness or low growth form for wind protection; lower growth habit allow for reduced transpiration, reserving water in the plant eg., Arctostaphylos uva-ursi x patula. (Ericaceae), Convict Lake manzanita, bed# 612, eg., Eriogonum wrightii var. subscaposum, (Polygonaceae), Wright's buckwheat bed#612, eg., Eriogonum prattenianum,(Polygonaceae), lava buckwheat, bed # 633

3. Adaptations to high ultraviolet radiation
    a) anthocyanin presence (especially in wintertime when cold or frosty, anthocyanins protect against chlorophyll destruction by UV light and raise the temperature of the leaves) eg., Eriogonum ursinum. (Polygonaceae), Donner buckwheat, bed # 633
    b) bluish/green or silvery colored leaves (reflect light thereby reducing water loss) eg., Stipa comata, (Hesperostipa comata), (Poaceae), needle and thread, bed # 633 eg., Eriogonum dumosa, (Polygonaceae), wild buckwheat, bed # 632 eg., Artemisia arbuscula SSP. thermopoda, (Asteraceae), mountain sagebrush bed#612
    c) hairiness (Light colored hairs reflect light which reduces leaf temperature which in turn reduces water loss.) eg., Artemisia arbuscula,(Asteraceae), dwarf sage, bed # 633 eg., Eriogonum prattenianum,(Polygonaceae), lava buckwheat, bed # 633
    d) farinosity (The white powder reflects light, leading to a reduction in leaf temperature, and thereby a reduction in water loss.) eg., Dudleya spp., (Crassulaceae), bed # 646

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Sea Bluff

1. Adaptations to the stress of strong day-time wind due to high land-sea temperature and pressure gradient
   a) light colored flowers, (In response to difficulty for day-time insect pollinatorer because of high winds, pollination occurs at dawn or dusk when winds are lighter

   Light colored flowers are easier to be seen at dawn and dusk.) eg., Eschscholzia caljfomiga, (Papaveraceae), California poppy, bed # 805

   b) prostration - wind shade, eg., Juniperus communis var. sibirica,(Cupressaceae). dwarf juniper, bed # 806 (Low profile and compact overlapping branches provide shade from strong ultraviolet radiation and protection from the wind.)

   c) succulency - water storage, eg., Sedum spathulifolium, (Crassulaceae), bed # 805 (Succulency allows for water storage for dry times.)
   d) hairiness - eg., Artemisia pycnocephala, (Asteraceae), soft sagebrush, bed # 806 (Because light colored hair reflects radiation, the leaves do not heat up as much and therefore do not lose as much water through transpiration. The hairs, in addition, allow for increased humdity to build up right at the leaf surface also reducing reducing water loss.)

2. Adaptations to the stress of high atmospheric salt loads of the shoreline marine environment which can cause desiccation year-round:
   a) prostration - wind shade; eg., Artemisia pcynocephala. (Asteraceae), soft sagebrush, low form, bed # 806 (see 1 b above)
   b) succulency - eg., Dudleya farinosa, (Crassulaceae), bed # 813 (see 1 c above)
   c) hairiness on leaves, eg., Saly_ianellitera, (Lamiaceae), black sage, bed # 806 (no label yet, plant just to right of bed # 806 sign) (see 1 d above)

3. Adaptations to high UV Radiation stress due to salt haze and broken fog which can destroy chlorophyll:
   a) hairiness on leaves, eg., Monardella villosa var. franciscana, (Lamiaceae), Franciscan coyote mint, bed # 805 (see 1 d above)
   b) farinosity, white powder on leaves, eg., Dudleya farinosa. (Crassulaceae), bed # 813 (The white powder reflects radiation and lowers the leaf temperature thereby reducing the water loss from the plant.)
   c) prostration (light shade), eg., Juniperus communis var. sibirica,(Cupressaceae), dwarfjuniper, bed # 806 (see 1 b above)
   d) anthocyanins (in stems), eg., Gaultheria shallon (Ericaceae), salal, bed # 812, Fragaria chiloensis, (Rosaceae), beach strawberry, bed # 805 (Anthocyanins protect against chlorophyll destruction by UV radiation.)

4. Adaptations to summer drought stress which can cause desiccation:
   a) fog-drip structures ("hairs", eg., Calochortus elegans, (T ,iliaceae), cat's ear, bed #? (Fog condenses on the fog-drip structures, "hairs," which funnel the water down to the roots. The sea bluff area is a highly desiccating environment due to the salt spray and high UV light conditions.)

b) leathery leaves, eg. Arctostaphylos uva-ursi,manzanita, (Ericaceae), bed # 805, eg., Gaultheria shallon, (Ericaceae), salal, bed # 813 (The leathery leaves reduce the water loss from the plant.)

5. Adaptation to long growing season (nonstressj due to highly maritime condition:
   a) perennialism in normally annual species, eg., Eschscholzia californica (Papaveracea) California poppy, bed # 805 (Since there is a long growing season, there is no need for the plants to rush to produce seed in one year, ie., be an annual. Inland, where the growing season is short, Eschscholzia californica is an annual.)

Redwood Section Adaptations

1. Adaptations to reduced light in lower shaded understory:
   a) Dark green leaves, eg., Asarum caudatum. (Aristolochiaceae), wild ginger, bed # 720 (Darker leaves have more chlorophyll which allows photosynthesis to proceed maximally under reduced light conditions.)
   b) leaves held horizontally, eg., Oxalis oregana, (Oxalidaceae), redwood sorrel, bed # 709,714 (A horizontal leaf position allows for maximum capture of light in the reduced light environment.)

2. Adaptation to summer drought (fog drip of approximately 12" or 30 cm):
   a) highly dissected leaves, eg., Sequoia sempevirens, (Taxodiaceae), coast redwood, bed # 709; eg., Athyrium felix femina var. sitchense, (Dryopteridaceae), lady-fern, bed #726 (The increased leaf surface allows more fog to condense on it and increases the fog drip to the roots.)

3. Adaptation to poor nutrient acidic soil caused by high moisture and cool temperature soil leaching:
   a) symbiotic associations with fungi, mycorrhizae, eg., members of the Ericaceae, Rhododendron occidentale, bed # 718; Vaccinium ovatum huckleberry, bed # 711. (Fungal "roots" allow for plants' greater absorption of water and minerals.)
   b) symbiotic association with nitrogen-fixing baceria, eg., Alnus spp. (Betulaceae), bed # 719 (Nitrogen- fixing bacteria supply nitrogen compounds in a form that the plants can use.)

4. Redwood, Sequoia sempervirens, (Taxodiaceae), adaptation to fire:
   a) resistance to fire, due to thick bark, and large amount of water in the wood and almost nonflammable pitch, ego, redwood, bed # 709 (Non-living thick bark protects inner living tissues.)
   b) enhanced seedling establishment because other competiting seeds do not survive fires, redwood, bed # 709 (Other seeds are burned by fire and do not survive, leaving the fire-resistant redwood seeds with a competitive edge to germinate after a fire.)

5. Redwood, Sequoia sempervirens, adaptation to disturbances of fire, flooding, and siltation: a) ability to sprout new stems and adventitious roots from dormant buds (burls) around base and along trunks after damage if tree is cut or blown down, redwood, bed # 717 (The redwood has a competitive edge over other plants that do not have this form of regeneration.)

6. Adaptation for seed dispersal:
   a) seeds with oil-beaning attachments that resemble dead insect parts. Scavenger ants carry these off, feed on them, and discard the seeds, eg., Dicentra-fQrmQS@, .

(Papaveraceae), bleeding heart, bed # 726; eg., Trillium chloropetalum, (Liliaceae), trillium, bed # 726 (The ants distribute the seeds away from the immediate area thereby cutting down the competition for resources in the immediate vicinity of the parent plants, ensuring better germination and survival rates for the seeds.)

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Keator, Glenn, Docent Notes

Plant Adaptations

Pacific Rain Forest Section February 2000 Irene Winston

1. Adaptations to reduced light in lower shaded understory:
   a) dark green leaves, eg., Asarum hartwegii. (Aristolochiaceae), Hafiweg's wild ginger, bed # 521 (More chlorophyll allows for maximum photosynthetic rate in the reduced light environment.)
   b) leaves held horizontally, eg., Oxalis oregana, (Oxalidaceae), redwood sorrel, bed # 508 (Horizontally held leaves can capture as much light as possible for photosynthesis.)
   c) dissected leaves, eg., Polystichum munitum x californicum, (Aspidiaceae), hybrid sword fern, bed # 501 (Dissected leaves provide greater leaf surface area for light and fog drip.)

2. Adaptation to poor nutrient, acid soil caused by high rainfall, acid leaf drop from conifers and ericads, and fog dlip:
   a) symbiotic associations with fungi, mycorrhizae, eg., Rhododendron macrophyllum (Ericaceae), California rose-bay, bed # 522 (Mycorrhizal associations allow for greater absorption of water and dissolved minerals for the plant.)
   b) symbiotic association with nitrogen-fixing bacteria, eg., Alnus spp. (Betulaceae), alder, bed # 512 (?) and in between 2 bridges over Wildcat Creek between Pacific Rain Forest Section and Franciscan Section. (Nitrogen-fixing bacteria provide essential nitrogen compounds in a form that the plant can use in its metabolic reactions.)

3. Adaptation to disturbances of cutting or blowing down:
   a) Stump sprouting, eg. Torreya californica, (Taxaceae), California nutmeg, bed # 519

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Santa Lucia Section

The Santa Lucia section of the Garden encompasses the central coast and Coast Range Mountains of Santa Cruz, San Benito, Monterey, San Luis Obispo, and Santa Barbara counties. Much of this area receives little or no summer rainfall. In the coastal areas, summer moisture may be available in the form of fog. Winter rainfall amounts tend to be greater at the coast than inland. However, the thin, rocky soils of the central coast area do not hold water well. Much of the inland areas of the Santa Lucia section of the state are vegetated by chaparral. Plants in these areas are adapted to wet, mild winters and long, hot, dry summers. Soils in chaparral communities are shallow and have low water-holding capacities. All of the plants we'll look at in this section of the garden are evergreen. Vital energy is conserved when plants do not shed and then regrow all of their leaves at once every year.

Adaptations to drying coastal conditions (intense sunlight, wind, shallow soil):

Arctostaphylos edmundsii parvifolia 'Bert Johnson' - Bronzemat - Ericaceae Bed 226

An especially compact growth habit as well as densely-clustered and very small leaves enable this plant to tolerate the desiccating effects of coastal wind and sun.

Adaptations to heat and aridity:

Malacothamnus niveus - San Luis Obispo bush mallow - Malvaceae Bed 227

This rare shrub's leaves are covered with a dense mat of wooly white hairs (the leaves undemeath are green) that reflect away the heat of the sun and trap moisture before it evaporates from the leaves. The new stems of the plant are also covered with these white hairs. The small size of the leaves helps reduce the plant's exposure to the sun.

Salvia leucophylla - gray or purple sage - Lamiaceae Bed 210

This plant's adaptations to a hot, dry environment include those that reduce evaporation of water from the leaves (dense white hairs on both sides of small leaves) and one that reduces competition for scarce water by other plants (a substance released from the plant's leaves prevents germination of other plants' seeds underneath it. This phenomenon is called allelopathy). In addition, the fragrant (to us) substance in the leaves discourages insects and other animals from eating them, as they find the substance distasteful.

to heat, aridity, and fire:

Adenostoma fasciculatum - chamise - Rosaceae Bed 219

Chamise is well-adapted to the hot, dry chaparral environment in which it grows. Its leaves are sparse, very short, and very narrow, which reduces evaporation of water from their exposed surfaces. Chamise also contains allelopathic substances that inhibit the germination of other species beneath it, thereby reducing competition for scarce water. Chamise burns readily in the fires that frequently sweep through chaparral communities due to its resinous wood, numerous woody stems, and standing dead branches. However, it recovers quickly from fire by regrowing from a thick, woody underground structure called a lignotuber. Lignotubers are insulated from fire and extreme temperatures by the surrounding soil.

Arctostaphylos refugioensis - Refugio manzanita - Ericaceae Bed 203

The leaves of this manzanita have no petioles (leaf stalks); their bases are cupped around the stems to which they are attached. This gives the leaves a more-or-less vertical and overlapping orientation, which reduces their exposure to the heat and drying effects of the sun. The leaves of this manzanita are sclerophyllous, that is, thick, hard, stiff, and covered with a waxy coating that reduces evaporation. The seeds of this and many other manzanitas have very hard, thick coats that resist water penetration and therefore do not germinate easily. However, when exposed to the high temperatures of fire, the seed coats crack, allowing water to penetrate. In this way, the manzanitas may regrow in an area after being destroyed by fire.

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Channel Islands Plant Adaptations February 2000 Irene Winston

I. For plants situated on the sea bluffs and exposed to high winds, high ultraviolet radiation, and desiccating sea sprays of a marine environment:

a) prostration, ("dwarfing effect") eg., <u>Adenostoma fasciculatum,</u> (Rosaceae), chamise, bed # 309 (The low profile and compact form offer some sheltering from winds which cause more plant water loss, and some extra shading from UV radiation which causes chlorophyll damage.)

b) gray leaves, eg., <u>Artemisia califomica</u> (Asteraceae), "canyon gray" sagebrush, bed # 312 (Light colored hairs reflect UV radiation thereby preventing chlorophyll damage.)

c) succulence, <u>Dudleya candelabrum</u>, (Crassulaceae), candleholder dudleya, bed # 308, on rock and at base of rock (Succulence allows for water storage; water is then stored in the plant, available during dry or desiccating times.)

Il. For plants situated in less exposed areas:

a) larger than usual sized plants (common on islands), eg., Eriogonum arborescens, Santa Cruz Island buckwheat, (Polygonaceae), bed # 301, eg., Eriogonum giganteum, (Polygonaceae), St. Catherine's lace, bed # 308, eg., Ceanothus arboreus tree ceanothus, (Rhamnaceae), true tree with extra large leaves, bed # 314 (In a less exposed, more inland location, plants are able to translate energy into more growth because there is a reduction in the stresses that occur in the desiccating, exposed, marine environment. There is also more water available on these islands than on the mainland.)

Ill. Adaptation to reduction in herbivory:

a) leaves with smooth margined leaves, ie., no prickles on leaves, eg., Prunus ilicifolia lyonii. island cherry, bed # 305 (no label, large tree, east towards fence) (Reduction in herbivory means plants can grow larger without the attendant loss of reserves caused by browers.)

Bibliography

Keator, Glenn, "RPBG Docent Notes"
- "Some Special Plants from the Channel Islands"

Franciscan Section Plant Adapatations February 2000 Irene Winston

I. Adaptations to reduce transpiration in wind-swept environments or drier environments:

a) prostration, eg., Arctostaphylos uva-ursi, (Ericaceae), bearberry, bed # 405 (The low and compact growth habit offers some sheltering from winds which cause more plant water loss, and some extra shading from UV radiation which causes chlorophyll damage.)
b) sclerophyllous leaves, eg., Arctostaphylos imbricata. (Ericaceae), San Bruno Mtn. manzanita, bed # 405 (Water loss through transpiration is reduced because of the leathery leaves with thick cuticles and waxy surfaces and stomates often only on lower surfaces.)
c) vertically positioned leaves, eg., A. pacifica, Pacific manzanita, (rare and endangered), bed # 402 (Vertically positioned leaves do not receive as much radiation as horizontally positioned leaves, keeping leaf surfaces cooler, and thereby cutting down on water loss.)
d) lighter colored leaves, eg. Arctostaphylos imbHcata, (Elicaceae), San Bruno Mtn. manzanita, bed # 405 (Because lighter colored leaf surfaces reflect more radiation keeping the leaf surfaces cooler, there is less water loss.)
e) hairiness, eg., A. imbricata, bed # 405 (The light colored hairs reflect radiation thereby keeping leaf surface temperature lower which, in tum, reduces water loss.)

Il. Adaptations for living in nutrient-poor soils:

a) symbiotic association with nitrogen-fixing bacteria, eg., Ceanothus thyrsiflorus, (Rhamnaceae), bed # 401, and Lupinus spp. (Fabaceae), lupine, (no label), bed # 410 between stair pathway and winter drainage (In soils in which N salts are in low concentrations, the bacteria supply the plant with N compounds necessary for its metabolism.)
b) symbiotic association with mycorrhizae, eg., Vaccinium ovatum (Ericaceae), huckleberry, bed # 402 (The mycorrhizae provide access to more soil water and dissolved minerals.)

Ill. Adaptation to reduce herbivory:

a) volatile compounds released when plant leaves are broken, eg., Salvia spathaceae. (Lamiaceae), hummingbird sage, beds # 405 and 410 (no labels, see map) (Reduction in herbivory reduces the loss of manufactured food which can then be used for other plant metabolic processes.)

IV. Adaptation to reduce competition:

a) alleopathy, eg., Salvia spathacea, beds # 405 and 410, (no labels, see map) (Cuts down on plant competition allowing for more favorable conditions for water and mineral absorption, and light access for photosynthetic activity.)

Bibliography

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Plant Adaptations Tour
Shasta-Cascade Section

The Shasta-Cascade section of the Garden includes many different plant habitats. It encompasses the Klamath Mountains, the Cascade Range, and the Modoc Plateau, which share a northern latitude but are otherwise different in many ways.

The Klamath Mountains lie in the northwest corner of California and the southwest corner of Oregon. The Klamath Mountains region actually includes five more-or-less contiguous mountain ranges: the Siskiyou, Salmon, Marble, and Scott Mountains and the Trinity Alps. The Klamaths are a range of mountains formed by folding and are among the oldest geological features in California. The highest peaks in the Klamath Mountains exceed 9000 feet elevation. The western slopes receive very heavy precipitation; here may be found some of the wettest and most heavily forested areas in the state. Plant communities in these areas, which include mixed evergreen and montane coniferous forests, contain a very rich diversity of species. Due to the rain shadows cast by the high western peaks, the eastern parts of these mountains are hotter and drier and are vegetated by oak and juniper woodlands in their lower elevations.

The Cascade Range is a chain of volcanoes that reaches from southern British Columbia into northern California, east of the Klamath Mountains. The tallest of these volcanoes is Mt. Shasta, at over 14,000 feet elevation. Unlike the Klamath Range, which is a broad, contiguous range of mountains, the Cascades are comprised of high peaks that rise as isolated cones above a plateau of volcanic deposits. Vegetation in the Cascade Range is mainly similar to that in the northern Sierra Nevada. However, due to the rain shadow cast by the Klamath Mountains, the lower elevations of the Cascades are vegetated by oak and juniper woodlands and chaparral.

The Modoc Plateau lies east of the Cascade Range. It is a comparatively flat plateau ranging from 3000 to over 6000 feet elevation, with many small volcanic cones and higher mountain ridges (in the Warner Mountains) of 8000 to almost 10,000 feet. The Modoc Plateau is covered by extensive volcanic deposits. Because this area is in the rain shadows of the Klamath Mountains, the Cascade Range, and the northern Sie1Ta Nevada, much of its vegetation is desert scrub and desert woodland. Montane coniferous forests may be found at the higher elevations.

KLAMATH MOUNTAINS PLANTS

Adaptation to heavy snow accumulation:

Picea breweriana - weeping or Brewer spruce - Pinaceae Bed
920
Pliant, drooping branches shed heavy snow and flexible stems bend under the weight of an accumulating snowpack, reducing limb breakage.

Adaptations to high elevation in a northerly latitude (drought and cold):

Eriogonum siskiyouense - Siskiyou buckwheat - Polygonaceae Bed 902

Although evergreen, this plant's low, mounding growth habit and small leaves in dense rosettes allow it to conserve water in a cold, dry winter environment (water which falls as snow is unavailable in winter) and a warm, dry summer environment (due to lack of summer precipitation).

The leaves of this buckwheat turn red in cold weather when chlorophyll is destroyed and underlying accessory pigments become visible.

CASCADE RANGE PLANTS

Adaptations to high elevation in a northerly latitude, i.e., cold winters with little available water due to snowpack:

Neviusia cliftonii - Shasta snow-wreath - Rosaceae
Bed 902

Acer circinatum - vine maple - Aceraceae
Bed 911

Deciduousness allows these two plants to conserve water in a cold, dry winter environment (water which falls as snow is unavailable in winter).

Adaptation to low light levels:

Acer circinatum - vine maple - Aceraceae
Bed 911

This small tree usually grows in the understory of coniferous forests. Its relatively large, flat, deep green leaves (due to a high density of chloroplasts) allow it to collect and use the decreased intensity of available light.

When grown in a sunnier location, this tree's leaves tend to be smaller and lighter green.

MODOC PLATEAU PLANTS

Adaptations to drought:

Artemisia cana - hoary sagebrush - Asteraceae

Bed 902 (there are also a few unlabeled Artemisia tridentata - Great Basin sagebrush plants several feet to the left of the hoary sagebrushes)

Sagebrushes are common in high desert areas such as the Modoc plateau. Their gray leaves, which are actually green but are covered with a dense mat of fine, white hairs, reflect away the heat of sunlight and trap moisture next to the leaf surface before it evaporates. The small size of sagebrush leaves and their vertical orientation reduce théir exposure to the sun.

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