ESP/ERS 30 -- The Global Ecosystem

FIELD TRIP Guide: Davis to Hope Valley

Sacramento Valley - Foothills - Sierra Nevada Slope and Crest

Introduction

This trip follows an eastward transect from Davis across the Sierra crest at Carson Pass.

A. Communities. The smaller units of ecological pattern within biomes are usually called communities, though if you use Walter you will see much more ornate terms used by our German colleagues. But we don't want complex terminology to get in our way. Too much books, too little nature! Since plants dominate the structure of communities, plants usually define communities.

A word of warning about plant communities. Plants species are actually wildly individualistic in following the physical, chemical, and competitive factors that affect that particular species. Communities, like biomes, are very rough abstractions we use to give us some concepts to help our feeble minds to impose order on chaos. Think of real plant communities as integrated multiethnic neighborhoods, not as tightly segregated ones with only some species admitted not others. Alternatively, think of the idealized plant communities as how plant geography look if it were done to make life easy for book writers. Patterns exist, but they are anything but neat. On any given day, they vex, trouble, and thrill the biogeographers. Never a dull field trip anyway.

1. Central Valley Grassland - now primarily agricultural fields,

2. Oak Savannah and Foothill Woodland,

3. Chaparral,

4. Yellow Pine Forest,

5. Red Fir and Lodgepole Pine Forests,

6. Subalpine Forest, and

7. Mountain Meadow.

B. Field Guides as an aid to observation

Our slogan "read nature like a book, not books about nature" slights somewhat the value of good field guides. This literature is ever-expanding and many titles are aimed at people with little formal preparation. And the dirty secret is that professional ecologists use the simple field guides to teach themselves new organisms or new places because nobody is

well trained in all the necessary areas. The high level treatments, such as the Jepson Manual of California Plants are hard to use unless you have a good deal of experience and dedication.

This guide should help you distinguish these communities, though you will find additional references such as Ornduff or Storer and Usinger to help you recognize characteristics of these communities. Storer and Usinger is a fair general guide for plant (and animal) identification in the Sierra. More specialized field guides such as Niehaus and Ripper for wildflowers and the Pacific Coast Tree Finder for woody things are more satisfactory because many species you will see will be absent from the more general guides. I encourage you to concentrate on the woody trees and shrubs unless you already know this part of the vegetation or have a strong interest in something else. The woody vegetation structures the whole community, there are relatively few species and they are relatively easy to identify. Work the Pacific Coast Tree Finder hard on this trip! Don't forget to take copious notes and photographs.

As you observe these communities and the changes that occur, use a comparative approach. Why are deciduous trees more common at some elevations than at others? Why can some habitats support tall vegetation while others are restricted to low-growing plants? Recall from class lectures how various environmental factors are supposed to influence plants. Can you see any of these ideas actually manifest in the real world?

C. Environmental Factors

On a mountain elevation gradient such as the one you will travel over, the main environmental changes are due to changes in temperature and precipitation. Temperature drops with elevation at the approximate rate of 3.5^{o}F per 1000 feet or 6.5^{o}C per 1000 meters. Carson Pass, the crest of this transect, is at 8,574 feet. Keep track of your elevation as you go along; city limit signs give elevation.

The moisture regime is complex. In a semi-arid environment like California, rainfall reaches a peak at middle elevations, ca 6,000 ft. Rainfall is lowest on the Valley floor (e.g. at Davis), and even the lower foothills receive much more rain than we do.

Thus, plant growth ends up being limited by aridity at low elevations and again on the Eastern Slope. At high elevations, growing seasons are sharply circumscribed by temperature due to the long cold season. It varies a lot from year to year depending upon the amount of snow that needs to melt. A complicating factor is soil depth and quality. The deep clay soils of the Valley hold more moisture than the increasingly thinner soils of the upland slopes. As a result of all these interacting factors, the Sierra mountain gradient is a good place to observe how cold and drought stress interact to shape vegetation. (Of course, particular sites can be quite confusing because of the multiplicity of factors. Form hypotheses about what is going on, but do not get too dogmatic.)

D. Geology

The core of the Sierras is composed of granite batholiths (big blobs of relatively light colored, originally molten, rock emplaced, without breaking the surface, from 210 to 80 million years ago). Some of the batholiths certainly supported volcanoes on their tops, but these have long ago since eroded away. The formerly molten magma masses subsequently slowly cooled deep below the surface and solidified into granite. Subsequently, the area was lifted out of the sea to form a low mountain range, which was itself, particularly in the northern part, covered with an extensive layer of volcanic deposits beginning about 30 million years ago. In the last 10 to 20 million years the main uplift of the Sierras began. During the last 2 million years, the higher elevations of the chain have been extensively eroded by glaciers. Patches of glacially-polished surface can be found on granite around Carson Pass.

The Sierras are a tilted block mountain. The mountains rise slowly as we head east, but drop sharply along the faults that mark the eastern boundary of the tilted block. This shape is apparent when you get the right vistas but is partly obscured by the fact that river systems and formerly glaciers have carved deep gorges in the elevated landscape. Mountains are being torn apart by erosion even as they are rising up. Hence we never see a textbook tilted block. Geologists have to solve hard puzzles to infer what has happened and is happening.

On this trip, you will see ancient sedimentary metamorphic rocks in road cuts, sediments that were partly melted and recrystalized as the batholiths were emplaced. These are much better exposed in the big road cuts along Highway 50 on the way home than along the smaller roads you'll take up the mountain. At lower elevations, large areas of the batholiths are covered by a more or less thick layer of these rocks. They are dark brownish and blackish rocks that sometimes preserve the layered structure of sedimentary rocks. They were originally jammed against the edge of the North American Plate as this plate scraped all sorts of light junk off the top of ancient subducting plates as they dived underneath the North American Plate. Until the theory of seafloor spreading became accepted 40 years ago, these rocks confused geologists no end. The disorder of the jumble is quite evident in road cuts. Nearly every cut is a little different from every other, quite unlike the granitic rocks exposed higher up that look very similar for miles in every direction. At the higher elevations on this trip, you can easily spot the U-shaped valleys and lake basins that result from glacial activity. Also on other trips, you may see the relatively young, soft marine sediments of the Great Valley Formation as they lap onto the base of the Sierra. These are better exposed in the Inner Coast Range, see Bodega Field Trip Guide.

E. Human Uses

None of the country you will see on this trip is real wilderness. The Valley floor has been very extensively modified for agriculture and human habitation. The lower elevations of the mountains are grazed as have most of the mountain meadows. The middle elevations were formerly heavily logged. Today, logging has almost ceased, partly due to

environmental concerns, and partly because most of the most valuable old growth stands have already been logged. Above about 5500 feet, tourism becomes the main land use. In general, you will notice that human uses are as patterned as the vegetation in response to the environment. Formerly mining was very important and the scars of this activity are visible elsewhere in the sierras but not conspicuously on this route.

The road right-of-way is often worth careful observation. It is often badly disturbed, and shows the effects of creating thin soils on steep slopes. Roadsides are often corridors for invasive weeds like Yellow Star Thistle. In some places, a more or less intact bit of an early community is fenced from grazing and so preserved. On older rights-of-way a rather substantially alien dominated community is often developing for pretty clear reasons. Other times the local dominants seem very intent upon reclaiming the open ground. In general, any sort of human disturbance is like a crude experiment. Sock Ma Nature riht on the nose and see what she does. How Ma N responds to such "experiments" is often enlightening. Pay attention to what is present in these strips along the road as you progress along the transect.

F. Route

The route is into Sacramento on I-80, then following signs to US Highway 50, on to the suburbs on the east side of Sacramento. At the Power Inn Road Exit from US 50. The route takes Hwy 16 towards Jackson, then up Hwy 49 to Plymouth, then on Fiddletown Road to Fiddletown. Past Fiddletown the route turns onto Shake Ridge Road and eventually reaches Highway 88. Hwy 88 crosses Carson Pass and drops down to the intersection with Highway 89 in Hope Valley. The return route takes Hwy 89 over Luther Pass to US 50 at Meyers. Then it is home via US 50, over Echo Summit, and down the canyon of the South Fork of the American River.

On the trip up the mountain you will have made some plant friends. On the return practice trying to recognize them at a distance and at highway speeds (drivers taking care not to dangerously distract themselves). The overall pattern of the vegetation is hard to see unless you can recognize the dominant plants at a distance with fair accuracy. Concentrate on the general form of the communities and how the various trees differ in height, limb structure, leaf color, and so forth. An experience naturalist can recognize most of the trees and larger shrubs at 65 mph. A few years back a new genus of shrub was discovered in up near Mt Shasta when a carload of botanists on a road trip saw something that didn't fit any pattern they knew. The got out and took a good look and found a new genus!

Best if someone volunteers to navigate and studies the maps in advance. The mileage guides below are approximate (auto odometers are not high precision instruments) and if you get lost you'll have to map read to get back on track. If you have a GPS or can borrow one that helps, but navigation sometimes poses interesting challenges even with all the tools and a good navigator. Navigation is a little like science. Good navigators have a workable hypothesis about where they are; bad navigators either have no clue or are sure they know where they are. Overconfident and underconfident navigators are

equally dangerous! Navigation is frequently a humbling experience. Everyone can help. It is said that expert hunter-gather trackers discuss the meaning of clues and actively debate multiple hypotheses as they track animals. If you get lost, you may find that your mates generate a number of hypotheses worth discussing! Navigation tends to be a team sport.

Check the weather forecast for this trip. It crosses the Sierra Crest over a rather high pass and a big spring storm might lead you to a bigger adventure than you bargained for.

Mileage

0.0. Zero your trip odometer as you enter the onramp for I-80 East toward Sacramento.

5.2 Vic Fazio Wildlife Area on your right as you climb onto the Causeway. Before the European invasion, the Central Valley rivers were lined by broad floodplains with wetlands of various kinds, gallery forests, Valley Oak Savannas thick with fish an game. Mexican and American farmers discovered that these areas had deep, youthful, silty loam soils of the highest production potential. The dikes went up to prevent floods, wetlands were drained and filled, land was leveled, and the farmers conquered almost all in a century of pioneering. Even the pioneers were often ambivalent about what they were doing and early conservationists like John Muir were scathing that nothing was being preserved. Now, at places like the Fazio, restorationists are trying to recreate some of what was lost. Just east of the restorationists' ponds, note the farm fields. Most of the Bypass is farmed. Rice is a common crop and you may see some of the lovely sinuous "checks" (= small levees) that enclose the paddies. These are rapidly disappearing because laser technology permits very fast and accurate land leveling that permits farmers to build easier-to-farm rectangular paddies rather than sinuous ones following the natural contour lines.

The raised causeway portion of I-80 on this leg crosses the Yolo Bypass. When the water in the Sacramento River threatens to flood Sacramento, this diked portion of the flood plain serves as an alternate river channel. Several of these are used along the Sacramento. Such a solution to flooding is temporary since the lower velocities of floodwaters in the bypass allow silt to drop out of suspension, gradually filling the bypass up. In the meantime, fresh silt makes lovely natural fertilizer.

Rivers in flood plains are almost living things. They build up natural levees because as the river spills out of its channel during floods, coarser sediments settle out as velocities drop as the flood spreads out. The river actually tends to raise itself up above the land on either side as this process continues flood after flood. A big river's flood plain is usually a little lower than the river itself! This situation is obviously unstable. Every once in awhile the river will abandon such raised beds and form a new channel in the low flood plain. The Yellow River in China carries a huge amount of sediment and builds itself a channel behind natural levees many meters above the flood plain. It is prone to catastrophic reorganizations every few centuries that kill millions in catastrophic floods. Also, rivers in flood plains have a very strong tendency to meander, cutting new channel on the

outsides of bends and depositing sediments on the insides. (To understand why this occurs, reflect on the fact that faster water carries more and coarser sediment than slower. How will water velocity differ on the inside and outside of a bend as the stream makes the turn?).

Humans like to make major modifications of the flood plain for farming, homes, and industry, which requires us to try to defend them from the river's natural tendencies to flood, meander, and find new courses. Some catastrophic event will come along someday to rearrange all that you see here. No matter what engineers try to do, there is an even out there in the future that will make them look puny. Sacramento has statistically poorer flood protection in parts than New Orleans did before Hurricane Katrina.

Soil science tells us why people end up living along rivers prone to flood, volcanoes that tend to erupt and maintains that tend to shake. These things make good youthful soils, whereas the soils in safe places tend o be old and bad. If you farm the good land, you gotta pay the price in the form of “natural” disasters!

9.1 Stay to left on I-80 and follow signs for US 50 toward South Lake Tahoe.

12.2 Cross the Sacramento River. The Sacramento here carries massive amounts of water, in summer supplied by Shasta and Oroville Dams (mainly), to the Delta. On the South side of the Delta, pumps lift the stored water into canals that head to the San Joaquin Valley and eventually, via another set of pumps at the south end of the San Joaquin, to Los Angeles. These projects have excited controversy since they were built in the 1960s. Mark Twain’s remark “whiskey’s for drinkin, water’s for fightin over” captures the complexities of water politics in the semi-arid and arid West in a nutshell.

NOTE: The following 3 turns come quickly so read ahead and be prepared.

18.2 Take Power Inn Road-Howe Avenue exit for Hwy. 16 in the direction of Jackson.

Turn right onto Power Inn Road (don't take the first right turn to Cal. State).

18.7 Turn left on Folsom Blvd. (Hwy. 16) (Electric Substation should pass on your right at the intersection.)

19.3 Turn right over railroad tracks onto Jackson Road (Hwy. 16)

You will continue on this straight, flat Hwy. 16 for more than 10 miles.

23.3 Look for Valley Oaks volunteering in abandoned fields. In the deep, fertile soils of the Valley floor, Valley Oaks will volunteer with abandon from acorns planted by Scrub Jays. The Jays hide acorns that they harvest from mother trees as much as a mile from the tree. They return and eat most of them but they forget a few, aiding the dispersal. Why would Jays disperse their acorn stores over such a wide area? Or, have the suburbs already claimed this spot? Suburban gardeners usually plant mainly exotic trees, but a

few old Valley Oaks and other native vegetation are often left. Valley oaks would rapidly reclaim the many of the suburbs in this area if left to their own devices. I hoe out dozens of Valley Oak seedlings every year from my Davis garden. The mother trees are hiding everywhere. You may have seen the old giant at the Oak Avenue and Russell Blvd intersection on the north edge of campus.

24.0 The route crosses off the deep youthful soils of the floor of the Valley onto a slightly higher gently rolling terrace. These higher terraces have experienced a few hundred thousand years of soil development and are much poorer for farmland than the lower, more youthful soils.

Agricultural fields and grazing are the primary land uses today of the Central Valley, urbanization aside. The deeper, younger soils are in row crops and orchards while the older more weathered high terrace soils are generally left for grazing. The Valley was originally vegetated with perennial bunch grasses. The bunchgrasses of the Valley Grasslands are now uncommon because of plowing and grazing (favoring annual grasses) and major alterations such as urban development and intensive farming. Now restricted to a few reserves, Tule Elk were once abundant grazers on the grassland. (UCD's Jepson Prairie Reserve, south of Dixon, preserves a bit of the bunch grass prairie, and is worth a visit in the spring.)

In spring, the green fields of the Valley Grassland became painted in whites and yellows (and other colors). On the higher terraces that have never been plowed, the show still goes on. Oddly, the non-grassy wildflowers have not been replaced be alien weeds to anywhere near the same extent as the perennial grasses have been replaced by Mediterranean annual grasses. In small depressions, a seasonal succession of wildflowers occurs as trapped water progressively dries up. The result is concentric rings of different flowers. These depressions are called “Vernal” Pools (vernal = spring). Since Vernal Pools are special habitats, many pool species are endemic (restricted to a specific locality, in this case growing only in such pools). As more and more grazing land in the Valley is sold and developed or converted to crops, many of these endemics are becoming endangered and rare. The new UC Merced got in a nasty fight with conservationists because it was plunked down in the middle of a vernal pool system.

Stop if you see a show and can pull over safely. Common spring grassland wildflowers are Tidy Tips, Goldfields, Lupine, Butter-and-Eggs (Johnny tuck, Orthocarpus), California Poppy, and Brodiaea. If you have the book by Niehaus & Ripper you might easily identify 20 or more species. Similar sites may be found over the next 10 miles. Here you may hear the Meadowlark sing and see Brewer's and Red-winged Blackbirds.

28.2 You cross an aqueduct & Sunrise Blvd.

30.5 Sloughhouse. Elevation 110 feet.

Driving through this area, notice the Gallery Forest of the large Valley Oaks, winter deciduous oaks. The long narrow rows (hence "gallery") of trees follow a water course.

Why is this riparian (riverside) community important to organisms that also utilize the adjacent farm fields?

Just out of Sloughhouse, notice the red soils of the higher terraces. Watch along the sides of the road and in road cuts ahead. Recall how soil color is a useful index of soil age.

35 Horse ranchette developments like this are often on poorer soils of old terraces. Why?

35.8 Pass Rancho Murieta. Elevation 160 feet.

36.5 Consumnes River.

37.7 This is the Blue Oak Savannah (except for the golf course). The Blue Oaks are winter deciduous. Though the leaves are soft in the spring, they become thick and rather sclerophyll-like as they mature. The ground cover in this habitat is often similar to the valley grassland, dominated by grasses with annual and bulb wildflowers. In other parts of California, other trees (e.g. Interior Live Oak, California Buckeye) may form the tree layer. This is an environment where the competition between trees and grass for water is especially fierce. Oak seedlings only survive to become trees in rare years. In most years the seedling mortality due to drought stress and herbivore damage kills 100% of seedlings. Can you see the evidence for this?

39.0 We are passing through an exposure of the Ione Formation here. The road cut at mile 39.9 is especially good. You may remember from the Sierra-to-the-Sea soils tour that the Ione Formation is a fossil oxisol (soil heavily weathered under tropical conditions.) The Ione formation is about 45 million years old. It outcrops here and there from Oroville to Fresno always at about this elevation. Look for red iron layers and white clay and sand layers in road cuts. The pitted appearance of the landscape in some places are the remains of clay pits dug to extract kaolin (china clay) and other valuable minerals from the Ione.

40.5 The first Gray Pines appear. Gray Pines are easy to recognize at a distance. The have a tall, scraggly open form with a thin gray-green canopy composed of very long needles.

41.7 A wide pullout here is a good place to stop and identify some of the plants of the Foothill Woodland Community. Trees and shrubs are now fairly dense. Blue Oak, Digger Pine, and Interior Live Oak are found throughout this zone. Shrubs such as Coffeeberry, Chamise, Toyon, Yerba Santa, and Poison Oak are also found here. Keep an eye out for bunch grasses. Although they no longer dominate they can still be found. Chaparral, with these shrubs and others such as the very common Manzanita and Ceanothus genera forming a dense bushland, is another important community in the Foothill Belt. Birds you may see in this community include Mockingbird, Crow, Yellow-billed Magpie, Acorn Woodpecker, Black Phoebe, Western Kingbird, Robin, and Starling.

The next 15 miles will take you through a mixture of Savannah and Woodland. See if your observations lead you to any hypotheses about what governs this mosaic. A classic

pattern is that denser woods are found on north or east facing slopes while grassland or savanna dominate south or west facing slopes. What is going on in this case?

42.5 The big oak trees growing on flats here are Valley Oaks. They have regular green, deciduous leaves. Blue Oaks occur on sloping ground with thin soils. Their leaves have that decided bluish tint that gives them away at a considerable distance. Why bluish leaves?

50.0 Hwy 16 merges with Hwy 49 here. Go straight, now headed toward Plymouth on Hwy 49.

51.7 Plymouth city limits. Elevation 1,086 feet. About 52.5 miles look for the right turn to Fiddletown on Fiddletown Road.

52.5 Pass a small vineyard. Grapes and wineries are becoming common in this region. Vineyardists looking for the highest quality grapes often plant vines on thin, poor soil where no other crops are grown. Low production concentrates the flavor elements in the few berries that are produced. A quality grape producer may settle for yields of ½ to 1/3 what he could achieve if he was selling to a jug wine producer. The quality producers are in pursuit of concentrated flavors their winemakers can turn into complex wines. This is a significant part of the reason that expensive wine is expensive.

55.0 Notice the scattered Western Yellow Pines appearing in the forest about here. Look for a tall, straight, single-trunked pine with thick tufts of rather long grass green needles and a platy light brown bark.

56.8 Notice some nondescript metamorphic rock in a road cut.

60.6 Fiddletown. Elevation 1,687 feet.An old mining town, not yet a tourist destination of note. Go straight through town still on Fiddletown Road.

61.5 Some nice Big-Leaf Maple growing in this riparian community. You might see deer or turkeys along this stretch of road.

63.3. Black Oaks begin to enter forest. They have large, coarsely toothy shiny green leaves and a quite dark bark. You may be able to separate Douglas Firs from Yellow Pines along here. Doug firs often have long thin twigs hanging down from their branches, looking something like the long fringes on the sleeves of mountain men’s buckskin shirts.

65.2 Look for signs of aggressive forest management here. Foresters have cut undergrowth and pruned the lower limbs out of the Western Yellow Pines. What are they trying to accomplish here?

66.0 Keep track of what is volunteering here along the roadsides.

66.7 Look for layered sedimentary rock in a road cut.

68.3 Here or at some similar safe spot pull off to the right and stop. Over the last few miles you have driven through the transition from the Foothill Woodland to the Yellow Pine Forest, represented by Western Yellow (Ponderosa) Pine, Incense Cedar and Black Oak. Try to identify all these common dominants. Get an overall impression so that you can recognize them at a distance. The ground is covered in some areas with Mountain Misery, a strong smelling plant with finely dissected leaves. In the early spring the Dogwood is in bloom, its large white flowers making bright clouds in the forest. The Ceanothus bushes in this area have finger size spikes of fragrant white or blue flowers. Look also for Manzanita and Douglas Fir. At this elevation, the bunch grasses are much more common than at lower elevations.

On the south-facing slopes, the Upper Foothill Woodland is represented by Canyon Live Oak, Interior Live Oak, and Gray Pine. Also note the extent of forest on the opposite slopes.

To the south note how the landscape is a gently sloping plain interrupted by deep canyons. This slope is part of an ancient level-eroded surface called a peneplain of the early Sierra. Subsequent large Sierran uplifts have allowed rivers, such as the Mokelumne (seen here) and the Stanislaus, to carve canyons into the peneplain.

68.8 Take left away from the direction of Volcano on Shake Ridge Road. Notice on this stretch how many homes are scattered in this fire-prone environment. This type of development makes firefighting harder and more expensive than it used to be because firefighters feel obliged to save every home they can. The modern human adaptation to Mediterranean California is still a work in process!

74.6 Turn left onto Hwy. 88.

77.9 Cook's Station. Elevation 5000 feet.

81.7 Pass Ham's Station.

82.0 El Dorado National Forest Sign. Immediately after the sign, take the paved road off to the right.

This road goes through a good example of Yellow Pine Forest. Most parts have been logged at one time or another. But this is near the precipitation maximum in the Sierra and summers are long and mild. The rate of conifer growth is very high here, and secondary forests get fairly big fairly quickly. Look for evidence of fire. The elevation here is about 5000 feet. There are several dirt roads off to the side you may wish to hike along. In any case, find a place to get out and take a walk through the forest. You should find Western Yellow Pine (3-needled), Incense Cedar (small shingled leaves), Sugar Pine (5-needled, cones a foot or more long), White Fir (flat sprays of single needles), and Black Oak (deciduous broadleaf with pointed lobes). In some sites, Douglas Fir (cones with 3-pointed bracts between the scales) are also common. Note the thin understory. Can you figure out what is limiting the growth of understory shrubs and small trees? You will

likely see Buckbrush (a rather spiny Ceanothus with small leaves and whitish bark), Manzanita, and bunchgrasses. Look on the ground for shed leaves and cones that you cannot reach in the canopy.

Take a moment to smell the bark of a Ponderosa Pine. You will not smell much; this is for future reference (see mile 115.3). If you have found a quiet spot, you may wish to sit and listen. Often in this forest, birds and mammals are more noticeable to the ear than to the eye.

You may come across a pile of torn apart pine cones, a "Chickaree Kitchen", the work of the Chickaree Squirrel.

Check out the apparent ages (sizes) of the Yellow Pines and other trees here and in similar forests. Often forests have some big old trees and some very young ones, or none at all. Seldom do you find all ages equally represented. Think about what this implies for the "recruitment" (= growth of vulnerable seedlings to a size where they have a good chance of becoming a mature tree) dynamics of the forest. Remember that weather varies a lot from year-to-year and over centuries and millennia for that matter. Consider that in the White Mountains east of the Sierras, Bristlecone Pines 3 or 4 thousand years old still form a thin forest without any significant recruitment over that entire period of time. The life of a tree is very different from a human life. Try to think like a tree would think if trees thought.

What biome does this community resemble? What are the similarities and differences in vegetation and climate?

82.5 Back to Hwy. 88.

83.6 Road cut with light and dark colored metamorphic rock, perhaps a quartzite.

85.8 Passing lane begins. Inside of a large left curve are large trees of a Red Fir Forest.

86.4 Turn into the picnic area on the right surrounded by the decaying split rail fence. This stop is in the Red Fir Forest of the Lodgepole Pine-Red Fir Belt. Get out and make some friends in the Red Fir Forest. These trees are predominantly Red Firs (with dark red bark) and White Firs (with grey bark, very light on the youngest wood), both with sprays of single needles. Some parts of this belt are pure stands of Red Fir, others nearly pure Lodgepole Pine. You'll see some familiar shrubs, such as Buckbrush. Willows where it is moist. Young Red Firs make prime Christmas trees. They are called "Silvertip Fir" in that trade. If you compare the needles of Red and White Firs you can see where Silvertip comes from.

89.5 6,800 ft. A nice vista turnout on the right with stone posts. Here is a good view of the Lodgepole Pine-Red Fir Forest up to the subalpine forests to timberline and the Sierra Crest (including Mokelumne Peak at 9332 feet). As you continue, note changes in forest

composition, with the increased importance of Lodgepole Pine until you're in the Lodgepole Pine Forest.

The light grey rock beside the road is granite, part of the great batholith complex of the Sierras described in the introduction. Across the road the granite is in layers caused by a process called exfoliation. As erosion removes a great weight rock from the top of a batholith, the rocks underneath can expand a bit and as they do so they crack into the layers you see.

The low bushy mats covering areas of the granite are Huckleberry Oak, a true oak that grows as low shrub rather than an impressive tree. We have several shrubby oaks in the California flora. .

90.9 7,000 ft of elevation

101.0 Silver Lake. High mountains have many alpine lakes beginning at about this elevation. Lakes, except very big ones, are fairly temporary. Many mountain meadows began like as lakes, but have filled with sediment to become grassy flats. Glacial action is a major producer of lakes. The Sierra was mantled in large glaciers during the last ice age, which ended only 11,500 years ago. Moving ice is full of rocky debris and so glaciers act like giant, slow belt sanders. Where rock is weaker, it grinds deeper, leaving shallow lakes. At their ends, melting glaciers dump debris in big piles called “moraines” that can for a dam. Also glaciers are so heavy that they depress the rock. When they melt, the rock springs slowly back, accompanied by a lot of small-scale faulting that sometimes creates depressions that hold water. Glacial cycles of growth and retreat in the last few million years first create and then wipe out tens of thousands of lakes in the High Sierra.

102.4 Dark volcanic rocks lie on top of the light granite in the mountains ahead. From roughly 25 million years ago until 4 million years ago a chain of young volcanoes covered the much older batholiths that make up the granite core of the Sierras with a mantle of volcanic ash and related rocks. The rapid erosion in the High Sierra has removed most of these deposits, but not all of them.

102.7 Cross over the Silver Lake Dam. Elevation 7200 feet. Many Sierra lakes have had their outlets “improved” like this. It is often easy to construct a small dam where an existing outlet stream has cut down a narrow notch over the 10,000 or so years since the glacier melted. Irrigation districts and power companies have built a large number of such projects to store water for irrigation and hydropower.

106.1 Carson Spur. 7990 ft. Turn out on the left. Carson Spur gives a wide view of the drainage of the South Fork of the American River. Note the strata of volcanic ash here. We are among the eroded remnants of the relatively recent volcanic events. Here you will see Red Fir, Lodgepole Pine, and the treeline species Whitebark Pine, related to Sugar Pine. Note the similarities of their cones. Also look for tiny gray sagebushes with three tiny teeth at the ends of their leaves. This looks remarkably like a scaled down Big

Sagbush that is a dominant over such large areas of the Intermountain West. Maybe the same species is straggling up here as a natural bonsai specimen?

107.7 Kirkwood Meadows. Elevation 7682 feet.

108.4 Caples Lake. View of Roundtop Peak (10,380 feet) to the southeast. Note the stands of Quaking Aspen with White Bark Pine.

111 Note the big grove of Aspen and the squat Western Junipers with their shaggy red bark.

113.2 Carson Pass. Elevation 8,574 feet. Park in the lot (on the right) near the tall granite Snowshoe Thompson Monument.

Here at its highest elevation, the highway intersects the Subalpine Forest of scattered and low stature trees. Some individuals have thick trunks despite their shortness, and are quite old. Trees common to this zone are Western Juniper, Whitebark Pine, Lodgepole Pine, and Mountain Hemlock.

There is a trail south from the parking lot. Explore this forest a little ways. What bird and mammal life do you see or hear? Look for evidence of glacial activity.

If you're planning a long hike (here or in any part of the High Sierra), be aware of changeable weather conditions, even during the summer, and carry a sweater or jacket and some food.

113.5 Take turnout on right, Red Lake Vista Point. The eastern slope drops rapidly. What changes do you note in the vegetation? We have long since passed the precipitation maximum in the Sierras back in the Yellow Pine Forest. The Sierras squeeze much of the moisture from the mid-latitude storms that pass over it in the winter. The extra precipitation that falls because mountains lift up and cool the storms in excesses of what would happen on flat ground is called “orographic” precipitation. In their lee, the mountains create a “rain shadow.” The Sierra’s and Cascades’ rain shadows create the large Temperate Desert to our east.

The granite here has big black crystals in it and is cut by quartz veins. The larger the crystals, the more slowly the batholith cooled. Here, this one must have cooled rather slowly.

115.3. Around here, you begin to see a big pine that looks much like the Western Yellow pine. Find a good specimen with a convenient, safe place to stop. Pull a flake of bark off the tree and smell it. This is the Western Yellow Pine’s close eastern relative the Jeffrey Pine. Look for Big Sagebush, Rabbitbrush, aspen and Lodgepole pines here. .

121.3 Hope Valley. Elevation 7300 feet. Meadows surrounded to by Lodgepole Pine Forest with large stands of Quaking Aspen. The road crosses the Carson River here. You

may see fisherfolk. The Carson is a much loved trout stream. If you stop here you can explore the meadow. What kind of grasses dominate? If you miss this opportunity another will come up shortly.

Mountain Meadow Community. Such meadows generally consist of perennial grasses, sedges, and many annual and perennial forbs (broad-leafed herbs). A jingle that will help you remember the differences between grasses, sedges, and rushes goes like this. Sedges have edges, and Rushes are round, grasses have nodes, and are easily found. Most common sedges have triangular stems whose edges can be felt as you roll the stem between your fingers. Rushes usually have round stems. Grasses are most common and have swollen joints along the stem where the leaves originate. Sometimes the best way to study a meadow is on your hands and knees. (Remember than a proper naturalist comes home sweaty, dirty and smelling of crushed plants, You can't do proper natural history in high heels and white gloves.) Do you observe any seasonal succession in the meadow plants (dried up vs. mature vs. sprouting species)? How does this community compare to the Valley Grassland? To Tundra?

Return Route

122. 3 turn left on Hwy. 89 North toward Luther Pass - South Lake Tahoe. Re-zero trip odometer here. Almost immediately you cross the Carson again and there is another opportunity to check out the meadow if you missed the last one.

1.1 Note the old cowboy cabins to the left. Mountain meadows are prime summer rangeland. All around the world there are systems of "transhumanant pastoralism" in which people move animals up and down mountains to take advantage of seasonal grazing opportunities. Formerly sheep were important in California and Nevada; now transhumant pastoralism is largely restricted to cattle in the American West. The big budget Western movie Open Range (2003) gives a good feeling for two different styles of Western pastoralism, one more transhumanent and one based on ranches and more limited seasonal movement. Nowadays the ranch based system is operated in conjunction with trucking cattle to seasonal pastures, mostly on Federally owned Forest Service or Bureau of Land Management lands. Purely transhumanent strategies disappeared in the Sierra around 1900. As Federal land management agencies have reacted to the environmental movement they have opened a rift with their rancher customers. In the Intermountain West public land politics are added to water politics as generators of hot-button issues.

2.6 Luther Pass. Jeffrey and Lodgepole Pines. Does the meadow along here look like it could be a former lake?

10.6 Meyers. Junction with Hwy 50. Left on 50.

12.5 Road traverses across the Sierra Fault, in other words across part of the steep east face of the tilted block that makes up the Sierra.

15.0 Echo Summit 7382 feet.

17.4 Good granite exposures.

21.0 Dropping into the canyon of the South Fork of the American River.

22.4 Notice big glacially eroded spur on the left. Western Yellow Pine Forest starts about here.

23.0 The small summer cabins here are on leases on Forest Service land. When the leases expired a few years ago there was some talk of not renewing them. Seems like they were renewed.

29.3 5,000 feet.

30.0 First Black Oaks come in about here.

35.6 Notice that the shape of the Canyon is a sharp V shape in cross section along here. U shaped valleys (famously, Yosemite Valley) are the signature of glacial erosion; V shaped valleys are the product of river erosion. Why this difference?

38.3 Along here, a hot fire burned a large area in 2001 or 2002. As of this date, a kind of chaparral with few trees occupies the burn. In cooler fires, more trees survive and the succession to forest is more rapid. Metamorphic rocks in the road cuts here. Look for gneiss, a rock with layers of light and dark crystals, sometimes in swirled patterns. This rock has the same composition as granite and if it completely melted becomes granite. Sedimentary rocks eroded from granite will tend to have the same chemical composition as the parent granite. When these sediments are heated and subject to great pressure in the subduction zone, they are transformed into gneiss and then into granite. Light rocks with lots of silica and little iron and other heavy minerals rise when they melt, to form granite batholiths. So the trench and the batholiths that rise from it are in essence recycling sediments eroded from granite back into granite. Such things geologists learn by paying close attention to road cuts!

56 Passing thru the Sierra apple growing district. The best apples grow in a climate with distinctly greater winter chill than the Central Valley floor.

56.8 3,000 feet

59.6 Gray Pines begin to appear and Western Yellow Pines begin to drop out of the woodland.

63 Placerville (Hangtown) An historic gold mining town. Old city center worth a visit if you have time. West of Placerville we are on a younger complex of metamorphic rocks.

70.2 Beginning about here and for the mile and a half serpentine occurs in the road cuts. Serpentine is our State Rock. It has a distinctive gray-green color and slick, shiny look to it. The term comes from its resemblance to the texture of the skin of serpents. It is formed deep in seafloor spreading zones at the boundary between the crust and the mantle. The heavy rocks of this zone have no business being at the surface of the earth, quite the opposite of granite and related silica rich rocks, which essentially float on top of such dense rocks. Serpentines and allied "ultramafic" rocks (rocks with lots of heavy minerals like iron and magnesium and relatively little light silicon) at the earth's surface are almost as paradoxical as a brick of gold floating on a lake.

Before the theory of seafloor spreading, these rocks bedeviled geologists. Now there is a story at least. In the trenches subducting slabs of heavy ocean crust are sinking beneath the light continents, with the ultramafic rocks right at the bottom of the slab. But the trenches often get jammed with light debris on top of the ocean crust that resists subduction, such as comprise many of the of the dull metamorphic rocks we've seen in road cut on this trip. Then the subduction zone jumps back 30 or 40 miles. Forces in the new subduction zone then tip a block of crust up against the margin of the continent until it is on its side with light rocks to the east (in our case) and heavy ones to the west. Like a ship thrown upon the beach in a violent storm, what once was vertical is now horizontal. California is like several of these wrecked ships smashed one against another, the superstructure of the younger one crushed against he heavy keel of the older wreck. In some exceptional circumstances the whole ship is preserved almost intact, as in the textbook Josephine complex in far northwestern California. In most cases the block is not rotated enough to expose the whole sequence and we see only smashed superstructure not the heavier hull of the block. Yet, bands of serpentine running from SE to NW mark the keels of the wrecks, but other ultramafic rocks that serpentine is normally associated with are missing. A couple of wrecks comprise the Sierras below the granite, a couple are buried under the Central Valley, and another series comprise most of the Coast Ranges.

Serpentine is thus doubly out of place. It shouldn't be at the surface, but if it is at the surface it should be part of a complex of other heavy ultramafic rocks. What appears to happen is that serpentine itself sometimes absorbs so much water that it becomes quite a bit lighter than the original ultramafic crust-mantle rocks that were its precursors. Serpentine has been altered by contact with water in hydrothermal systems along the volcanic spreading ridges in the middle of the oceans. Hot, high pressure water in the deep ocean drives into the fractured rock of the spreading zone, altering its physical and chemical properties. Wet serpentine can then separate itself from the heavy rocks of the unmodified lower crust and upper mantle in subduction zones and move upward something like the hot molten granite and basalt magmas that fuel volcanoes. The keel of the wrecked ship can squeeze up through the rest of the wreck and end up in our road cuts, thousands of feet above its unmodified ultramafic parents.

To confuse matters further, different geologists tell different stories. Even to speak about serpentine and its relatives you really ought to have a PhD in geology with a specialization in ultramafic tectonics. That doesn't mean that we simple naturalists can have some fun trying to figure out what the devil happened to make gold float on water!

Gold would float on water if we could make a gold foam full of air. Serpentine is heavy ultramafic rock foamed with water to make it light like granite.

76.7 Outer suburbs of Sacramento. Note how the Blue Oak savanna is increasingly gobbled up by urban development as you move west. You can see the occasional Blue Oak incorporated into the urban landscape. Unlike live oaks, they tolerate garden conditions well. Continue West on Hwy 50 and the Hwy 80 to Davis. Home soon now!

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a. Alt, D.D. and D.W. Hyndman. 2000. Roadside Geology of Northern and Central California. Mountain Press.

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