SHOSHONE
and
TECOPAH HOT SPRINGS

Background Information

Desert Studies Center
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Field Trip Guide
to
Shoshone and Tecopah Hot Springs

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Cover: China Ranch Way Station, circa 1920. From the Petroff Collection of the Mojave River Valley Museum
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Photo courtesy of Mojave River Valley Museum
HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

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Photos and map from Backdoor to California, courtesy of the author, Clifford Walker, and the Mojave River Valley Museum.
HISTORIC HIGHPOINTS OF THE MOJAVE DESERT

The Mojave Desert abounds with fading roads, old mines, crumbling buildings, empty railroad berms, broken fences, and vanished dreams. Because of the desert environment, many historic activities overlie prehistoric sites in order to take advantage of the infrequent watering places.

The ancient Mojave Trail, running from the Colorado River to the Pacific Ocean (through Mid Hills and Soda Springs), was also utilized in historic times. In 1776, Father Francisco Garces was the first European to travel this road when he crossed the Mojave Desert to break a trail from Arizona to the Mission San Gabriel. He was followed in later years by Mountain Man Jedediah Smith (the first American to travel overland to California), Kit Carson, and Lt. John C. Fremont, among others.

Beginning in 1853, army engineers surveyed the eastern Mojave Desert because many people were interested in the best route for a railroad. Lt. A. W. Whipple was instrumental in completing this work. An unusual sidelight during the late 1850’s was Edward Beale’s use of a camel train while he was working to improve the Mojave Trail into a wagon road.

By 1859, pack trains traveled from Los Angeles to Fort Mojave on the Colorado River by using the Mojave Road. They were joined one year later by the mail riders. A string of army forts and redoubts were built to protect travelers from an occasional Indian ambush along the road. One of these redoubts was built at Soda Springs. Pictographs near a spring along the Zzyzx Road commemorate this time. Messages such as "1859 G. H. , "Wagon Boss", and "Letty" can be seen. Historian Dennis Casebier discovered that George Hanson was a teamster on the old Mojave Trail and the wife of one of the officers at the redoubt was named Leticia. Camp Rock Springs, east of the Mid Hills Campground, is another U.S. Army outpost. Built in 1866, it was also part of the mail route. Because it is a source of water, the history and prehistory of this site also spans centuries.

Mining for turquoise, silver, salt, soda, quicksilver, and then gold began during the 1860s by the Americans, although Indians from the Southwest mined turquoise in the Mojave Desert hundreds of years earlier. Very rich silver mines were found in the New York, Clark, and Providence Mountains. The "boom" time for mining in this area was from 1900-1919 when copper, lead, and zinc were also in demand. In recent decades, the most important elements to mine have been talc, clay, and cinders as well as a revival in gold mining.
The Union Pacific railroad tracks were laid east/west in the early 1880s but it was not until after the turn of the century that the north/south area was serviced by the Tonapah and Tidewater Railroad. The latter ran from Ludlow, California to Gold Center, Nevada (on Soda Lake and into Death Valley), but fell into disuse as mining activities declined. The rails were finally donated to the war effort in 1943 and the cross-ties were used in constructing many buildings, ramps, and fences in the area. The historic Kelso Train Depot, built in 1924 when Kelso was a stop for steam-powered locomotives, has been saved from destruction. It is a large two-story, Spanish-style building.

The Mojave Desert has also been used as grazing land for vast herds of cattle and sheep. The remains of buildings used by ranchhands, farmers, and homesteaders were much more abundant in past decades. Vandalism takes as large a toll of historic as of prehistoric remains.

The most visible change around Soda Springs occurred when Curtis Howe Springer utilized the area as part of his health resort and spa facility between 1944 and 1974. Most of the buildings, pools, and plants date to this period.

Springer brought out derelicts from Skid Row in Los Angeles, both to rehabilitate them and to build his resort. The BLM took over Springer's facility in 1974 and a Consortium, composed of seven Southern California State Universities began a program of upgrading the buildings in 1977.
PREHISTORY OF THE MOJAVE DESERT AREA

Archaeological sites spanning at least 12,000 years have been found around Pleistocene lake beds. Terraces around the former lakes contain the large, crude tools used by big game hunters 12,000 years ago. Mojave and Pinto points, scrapers, grinding stones, split twig figures, pottery, and small triangular projectile points span the last 10,000 years.

The Mojave Trail, running from the Colorado River to the Pacific Ocean, was in use since ancient times. Obsidian and sea shells were two major trading items and Pacific Ocean shells have been found in sites in Arizona and New Mexico. A few pieces of Southwestern pottery have likewise been found in California.

Prior to European contact, it is not certain which people lived here. Tribal boundaries of desert peoples are indistinct at best. Both the Chemehuevi and the Vanyume have been mentioned in the area since contact times.

Linguistic research suggests that the Chemehuevi were fairly recent inhabitants of the Great Basin, and the only local tribe to migrate into California during historic times. They migrated because of Yuman warfare along the Colorado River (in 1867, war began between the Chemehuevi and Mojave because of the Mormons, who wanted Mojave women for wives). The Chemehuevi eventually moved as far south as Twenty-nine Palms, which had been Serrano territory. The Serrano moved because of a smallpox epidemic in 1830.

The Chemehuevi tribal area was one of the largest in California. It occupied the territory west of the Colorado River from the Kingston Range south of Death Valley, through the Providence Mountains to about the boundaries of Riverside and Imperial Counties. It is believed, however, that the population was very small, not exceeding 800.

Their main subsistence was small game, rabbits, rats, lizards, seeds, and other readily available foods. They were primarily basket makers with only an occasional piece of pottery. Their dwellings were little more than shelters against the sun and wind. Temporary shelters were domed-shaped structures made of sticks covered with brush. Some groups built semi-subterranean (one foot below ground level) shelters covered with an overlay of brush and grass and covered with earth.
The Vanyume disappeared so soon after contact so that very little is known about them. Their subsistence pattern would be nearly identical to the Chemehuevi because of the limited resources available in the area. Overall the Mojave Desert was sparsely inhabited, with small family groups moving in a round of hunting and gathering. Post-contact warfare between desert tribes has been noted but the pre-historic associations remain unknown.
CULTURE CHRONOLOGY FOR THE AMARGOSA-MOJAVE BASIN
(After Warren et al, 1980)

Pleistocene Period  Earlier than 10,000 BC to 8,000 BC.
Large bifaces, cores, flakes, scrapers
no projectile points. (Rogers' "Malpais"
or San Diegoito I period, associated
with cleared circles and intaglios.)

Lake Mojave Period  8,000 BC to 5,000 BC. (Warren and
Crabtree, 1986) and 6,000 to 4,000 BC
(Bettinger and
Taylor, 1974).
Sites associated with Pleistocene lake
shores. Fluted points similar to Clovis
and Folsom, leaf shaped points and
knives, crescents, Lake Mojave points,
concave scrapers.

Pinto Period  5,000 BC to 2,000 BC. Contains Pinto
Points, but both the points and the
period are poorly defined.

Gypsum Period  2,000 BC to AD 500. Humbolt, Elko, and
Gypsum Cave points, grinding stones
(manos and metates) become prevalent and
continue through later periods. Split
twig figures, pit houses and Basketmaker
III pottery appear in the east.
Turquoise mining occurs.

Saratoga Springs
Period  AD 500 to AD 1200. Rose Springs and
Eastgate points, Gray Ware Pottery.
Shoshonean Period

AD 1200 to historic time. Small, triangular arrow points replace the larger, stemmed points - Desert Side-notched and Cottonwood triangular points.

Local brown ware pottery ("Paiute brown ware") is introduced. Use of mortar/pestle, increase of bone and shell tools and ornaments, use of roasting pits

Mortuary customs shift from inhumation to cremation. Linguistics poorly understood (Numic speakers spread from Death Valley, however informants spoke Takic.)
ROCK ART

Pictographs (painted) and petroglyphs (pecked or abraded) are two forms of rock art found in the Mojave Desert. Desert varnish (chemical weathering phenomena which deposits a layer of brown patina on the surface of stone), made large rock surfaces an attractive medium for the creation of petroglyphs.

Petroglyphs in the Great Basin are divided into representational and abstract elements. The abstract category is further broken down into curvilinear and rectilinear. The following categories are found in the east Mojave Desert region.

**Anthropomorphs** - elements having a human-like form, often stick figures.

**Zoomorphs** - elements having an animal-like form i.e. deer, lizards, mountain sheep, scorpions.

**Curvilinear** - rounded figures such as circles, wavy lines, suns, bar-bells.

**Rectilinear** - straight lines or lines joined at angles such as squares, "F" or rake shapes, zig-zag lines.

There are also combinations of these elements such as a possible insect design which combines squares and wavy-lines in its make-up or meandering lines which change from zig-zag to wavy.

The pictographs found in this area are often associated with petroglyphs. They are usually curvilinear and rectilinear designs in red, white, black, or green colors.

Some rock art sites are associated with other archaeological remains such as tools or pottery, but not always. All of the rock art in this area of the Mojave Desert, however, is located near water sources (i.e. near springs, seasonal streams, washes) and trails. Petroglyphs seem to occur along the Mojave Trail wherever there is water.

Attempts to date rock art have met with limited success. It has been suggested that the styles change through time. The curvilinear style may be the earliest, followed by rectilinear.
Although these pictures have been studied for years, there are exceptions to most of the interpretations. Those along trails may be linked with big game hunting in some areas but not in the eastern Mojave Desert. Mountain sheep were the only large game in the area but they did not occur where many of the petroglyphs sites are which depict them. Some researchers believe glyphs in this area simply mark travel routes or indicate ownership of various resources.
SOME PLANTS USED BY DESERT INDIANS

Agave - "cabbages" and stalks roasted and eaten, blossoms boiled and dried. Fibers from leaves used for clothing, sandals, etc.

Brittle Bush - dry seeds gathered from July to August. Often parched with hot coals and ground into meal on metates.

California fan palm - dates were gathered from late June to early November. Eaten fresh or sun-dried and stored. Could be ground into meal.

California juniper - edible berries gathered in large quantities between June and August. Eaten fresh or dried in sun; ground into meal and made into mush or formed into cakes and stored.

Chia - seeds harvested from June until September. Hulled by rolling on a metate and applying pressure with a mano. Then dry seeds were winnowed in a flat basket. Seeds were parched in baskets with hot coals, then ground into meal.

Creosote Bush - edible flower buds harvested between May and June.

Desert Ironwood - seed pods collected from May to June. Roasted in an open fire and pounded into meal, formed into small cakes.

Jojoba - fruit gathered between May and July. The oily seeds were eaten fresh or ground into meal.

Mesquite - can be eaten as is, tree-dried, or made into a beverage or mush. June through August. Both pods and beans eaten.

Mormon Tea - hard, black seed collected in early summer and ground into meal and eaten as a mush.

Ocotillo - edible blossoms collected from March until mid-summer. Eaten fresh or soaked in water for a drink. Seed pods also collected and eaten.

Opuntia - Beavertail cactus - young fruit and buds collected between March and June. Ripe fruit eaten fresh and tender buds cooked or steamed with hot stones in a roasting pit.
Opuntia - Pencil cactus - fruit gathered between April and May. Eaten fresh or sun-dried and stored.

Saltbush - seeds harvested from June until September. Ground into flour and eaten as mush.

Screwbean - like Mesquite but pod is coiled rather than straight. Ripens several weeks earlier than Mesquite and are sweeter.

Yucca - green seed pods and edible flowers collected in early April and May. Seed pods were roasted in pit with hot coals.
CALIFORNIA DESERT INDIAN REFERENCES

Bean, Lowell J.

Bean, Lowell and Harry Lawton

Cameron, Constance

Chartkoff, Joseph and Kerry Kona Chartkoff

D'Azevedo, Warren L. Editor

Heizer, Robert F. Editor
1978 Handbook of North American Indians Volume 8 *California.* Smithsonian Institution, D.C.

Heizer, Robert F. and M. A. Whipple

Miller, Ronald and Peggy

Moratto, Michael J.
1984 *California Archaeology.* Academic Press, Inc.

Rogers, Malcolm J.

Strong, William Duncan

Books from the Copley Press
San Diego, CA

Ancient Hunters of the Far West
The Broken Stones
Anza Conquers the Desert

(Book(s) may be obtained from the publishers, museum gift shops, or Coyote Press, P.O. Box 3377, Salinas, CA 93912.)
MOJAVE DESERT HISTORIC REFERENCES

Casebier, Dennis G.


Walker, Clifford J.

Many interesting historic articles have appeared in *Westways* Magazine, *Desert* Magazine, and Bureau of Land Management Cultural resources Publications which cover various study areas of the desert.
BIOLOGICAL BACKGROUND

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Our route for this field trip will allow us to observe a variety of plants and animals. I have provided a list of plants, birds, reptiles, mammals and some invertebrates of the Mojave Desert that are commonly found in and around the Desert Studies Center. An article dealing with microhabitat types and how iguanid lizards in the Mojave desert, utilize some of these habitats is included. These lists are representative of the organisms we might see (dependent on weather conditions) at the Desert Studies Center and/or on the planned stops along Hwy 127 and the Old Spanish Trail. In addition, I have Field Guides to all the above groups for your use. Field Guides form the basic identification mechanism in biological field based instruction.

Field based instructional techniques that we will use during this field trip include observation, can trapping, noosing, road riding, and black lighting (Saturday night). These techniques will be discussed and demonstrated when and if the organisms are active.

At five locations, Desert Studies Center (Lake Tuendae),
Saratoga Spring, Shoshone Spring and possible at Salt Spring and China Ranch, we will have an opportunity to observe pupfish, minnows and mosquitofish. These are small fishes that occupy natural springs and/or river drainages. Because each location is isolated from other such sites a great majority of the time, genetic exchange is very low or nonexistent. The result is that each population is genetically unique and has been named.

- **Pupfish**  Genus *Cyprinodon*  Family Cyprinodontidae
- **Mosquitofish**  Genus *Gambusia*  Family Poeciliidae
- **Minnows**  Genus *Gila*  Family Cyprinidae
- **Shoshone Pupfish**  *Cyprinodon nevadensis shoshone*
- **Tecopah Pupfish**  EXTINCT  *Cyprinodon nevadensis calidae*
- **Saratoga Spring Pupfish**  *Cyprinodon nevadensis amargosae*
- **Western Mosquitofish**  *Gambusia affinis affinis*
- **Mojave Tui Chub**  *Gila bicolor mohavensis*

Two of the fish, Mojave Tui Chub and the pupfish, *C.n. amargosae* are found in Lake Tuendae at the Desert Studies Center. The Mojave Tui Chub is restricted to Lake Tuendae and Soda Spring (Desert Studies Center), in the China Lake Naval Weapons Range and one or two isolated man-made ponds.
REFERENCES

The following Field Guides to the organisms of the Mojave Desert can be purchased at The Nature Company stores and other fine book sellers.


PLANT LIST
SOJA SPRINGS, MOHAVE DESERT CALIFORNIA

+ - Common names from Edmund Jaeger's Desert Wild Flowers
* - Common names from LeRoy Abrams's Illustrated Flora of the Pacific States

ASTERACEAE Sunflower Family

*Ambrosia dumosa* =White Bur-Sage =Burrobush
*Aster exilis* =Slim Aster
*Aster intricatus* =Shrubby Alkali Aster
*Ballegu phacelioides* =Colorado Desert Marigold =Lax-Flower
*Ballegu pinnatiloba* =Monely Marigold
*Bobbin juncea* =Burrobush
*Brockella incana* =Woody Brockella or Brockelbush =Woody Brockella
*Chenactis carpophyllia* =Wobble Pincushion
*Chenactis fremontii* =Fremont Pincushion
*Chenactis pinnata* =Broad-Flowered Chenactis =Erata Pincushion
*Encelia farinosa* =Brittlebush or Incense
*Encelia ventricosa* =Bush Encelia =Rayless Encelia
*Eriophyllum angustissimum* =Woody Daisy =Yellow-Frocks
*Filago depresse* =Desert Filago
*Geosia campestris* =Desert Sunflower
*Haplopappus venosus* =Coastal Iscoma
*Helianthus ammophila jaegeri* =Common Sunflower =Annual Sunflower
*Hyptis semiculata* =Seminole Blazing Star =White Burrobush =Burrobush
*Machaeranthera aida* =Machaeranthera tortifolia =Mohave Aster
*Malacothrix coulteri* =Bunny-Seed
*Malacothrix glabra* =Desert Dandelion
*Nuttallia nuttallii* =Pineapple Weed
*Neorheinoltia bellidioides* =Mohave Desert Star
*Palafoxia arida* =Spanish Needle
*Perityle enosyi* =Squaw Rock-Daisy
*Pseudophyllium echinatum* =Desert-Pur or Pinyon-Cedar
*Plascoregion silvaticum* =Pinyon-Cedar
*Pluchea sericea* =Arrow-Seed
*Poastrum annuum* =Bunny Rosettes =Fen-Leaf
*Rafinesquia neomexicana* =Desert Chicory
*Senecio lasianthus* =Mohave Groundsel
*Stephanomeria purpurata* =Desert Phlox =Desert Pink
*Styloloma micropodium* =Woody Styloloma or Desert West-Straw =Desert West-Straw
**Cyperaceae** Sedge Family
- *Scirpus olneyi* - Olney’s Bulrush

**Euphorbiaceae** Spurge Family
- *Croton californicus* - California Croton
- *Croton desertorum* - Desert Croton
- *Euphorbia polycarpa hirsuta* - Small-Seed Euphorbia
- *Stillingia spinulosa* - Annual Stillingia
- *Stillingia greggii* - Broad-Leaved Stillingia

**Fabaceae** Pea Family
- *Astragalus lenticularis fremontii* - Nodding Bristlepod
- *Dalea mollis* - Downy Dalea
- *Lotus coldweltii* - Coldwater Lotus
- *Lupinus arizonicus* - Arizona Lupine
- *Lupinus brevicaulis* - Short-Stemmed Platycaulus
- *Parkinsonia aculeata* - Palo Verde
- *Prosopis glandulosa torreyana* - Mesquite
- *Prosopis pubescens* - Jutilllo or S. rev-bean

**Ceratophyllaceae** Waterweed Family
- *Erodium cicutarium* - Red-Stemmed Filaree
- *Erodium texanum* - Texas Filaree
- *Desert Barren’s-Bill*

**Hydrophyllaceae** Waterleaf Family
- *Nama desmanthus deminutum* - Purple Mat
- *Phacelia crenulata crenulata* - Heliotrope Phacelia
- *Mesquite Phacelia - Hatch-Leaved Phacelia*

**Juncaceae** Rush Family
- *Juncus cooperi* - Cooper’s Rush

**Liliaceae** Lily Family
- *Hesperocallis undulata* - Desert Lily

**Loasaceae** Loasa Family
- *Eucodile arenae* - Desert Rock-Mistle
- *Euphorbia albidifolia* - White-Stemmed Stick-Leaf
- *Euphorbia albida* - Small-Flowered Blazing Star
- *Petalonia thurberi thurberi* - Common Sandpaper Plant
- *Thurber Sandpaper Plant*

**Malvaceae** Mallow Family
- *Eremalche exilis* - White Mallow
- *Eremalche rotundifolia* - Desert Five-Spot
- *Eremalche rotundifolia* - Desert Five-Spot or Chinese Lantern
SCHIZANTHACEAE  Four-O’Clock Family
Abelia x villcana ‘willa’ = Desert Sand-Verbena = Hairy Sand-Verbena
Allionia incarnata = Allionia or Windmill = Windmill
Mirabilis bigelovii rotunda = Desert Four-O’Clock or Wishbone Bush = Wishbone Bush

BREViGRIUnACEAE  Evening-Primrose Family
Camissonia boothii intermedius = Booth’s Primrose
Camissonia brevipes brevipes = Desert Primrose = Yellow Cups
Camissonia brevipes pallida = Desert Primrose = Yellow Cups
Camissonia claviformis aurantiaca = ‘Lavender-Fruited’ Primrose = Brown-Yed Primrose
Camissonia claviformis lanceolata = ‘Lavender-Fruited’ Primrose = Brown-Yed Primrose
Camissonia claviformis x brevipes = ‘Lavender-Fruited’ Primrose = Brown-Yed Primrose
Camissonia refracta = ‘Refraeted Desert Primrose’ = Narrow-Leaved Primrose
Camissonia deltoidea = Large Desert Evening Primrose = Dome Primrose

BROMELIACEAE  Bromeliad Family
Orobanche cooperi = Cooper’s Bromegrass or Desert Broomrape = Broom-Weed Stranger

PAPYRUSACEAE  Poppy Family
Azteca azurea = Chinese or Broad-Winged Prickly Poppy = Prickly Poppy
Encholiria minuta = Pygmy Poppy = Little Gold Poppy
Encholiria parviflora

PLANTAGINACEAE  Plantain Family
Plantago insularis fasciculata = Island Plantain = Woolly Plantain

POACEAE  Grass Family
Aristida adscensionis = Six-Weeks Grass
Boeteliana aridicola = Needle Grama
Bouteloua barbata = Annual Grama
Bromus rubens = Stiff Grama = Grass
Bromus spicata stricta = Stiff Grass
Eriochloa pulchra = Narrow-Tailed Dropseed
Eriochloa rigidula = Calliandra
Eriochloa hymenoides = Indian Mountain-Rice
Panicum arvifluminum = Desert Grass
Panicum australis = Common Reed
Schizachyrium barbatum

POLYPODIACEAE  Sedge Family
Chloris viridula = Grass-Formed Grass = Small-Sedge
Eriophorum vaginatum = Small-Sedge = Bluegrass
Eriophorum anguste = Small-Sedge = Bluegrass
Eriophorum curtissianum = Small-Sedge = Bluegrass
Eriophorum cespitosum = Small-Sedge = Bluegrass

SOLANACEAE  Potato Family
Physalis alkekengi = Calliandra = Calliandra

TAMARICACEAE  Tamarisk Family
Tamarix ramosissima = Tamarisk ramosissima

TEPHRARIAE  Cat-Tail Family
Pyrrhosia floribunda = Narrow-Leaved Cat-Tail

VICIEACEAE  Mistletoe Family
Phoradendron californicum = California Mistletoe = Desert Mistletoe

ZITOPHYLLACEAE  Castor Family
Glechoma divaricata = Creosote Bush = Creosote Bush or Covillea
BORAGINACEAE  Borage Family

Anisocoma tesselata  Tesselated Borage  Tesselated Fiddle-Neck  Fiddle-Neck
Cynoglossum montanum  Gallbladder 
Cryptantha decipiens  White-Headed Forget-Me-Not
Cryptantha marginata  White-Rayed Forget-Me-Not

Caryophyllaceae  ~Flower Family

Caulanthus cooperi  Cooper's Caulanthus
Daucus carota  California Carrot

BRASSICACEAE  Mustard Family

Caulanthus cooperi  Cooper's Caulanthus
Daucus carota  California Carrot

BRASSICACEAE  Mustard Family

Capsella bursa-pastoris  Shepherd's Purse  Cress

CAPPARACEAE  Caper Family

Capsella bursa-pastoris  Shepherd's Purse  Cress

CARYOPHYLLACEAE  Chickweed Family

Carya illinoinensis  American Hickory

CHEMOPHORACEAE  Goosefoot Family

Capparidopsis species  Capparidopsis

CUCURBITACEAE  Cucumber Family

Cucumis pepo  Cucumber

CUCURBITACEAE  Cucumber Family

Cucurbita pepo  Winter Squash  Pumpkins  Cucurbit

CUCURBITACEAE  Cucumber Family

Cucurbita pepo  Winter Squash  Pumpkins  Cucurbit

CUCURBITACEAE  Cucumber Family

Cucurbita pepo  Winter Squash  Pumpkins  Cucurbit
FRINGILLIDAE/EMBERIZIDAE
Chipping Sparrow
Black-Chinned Sparrow
Harris' Sparrow
White-Crowned Sparrow
Golden-Crowned Sparrow
Lincoln’s Sparrow
Song Sparrow

PODICIPEDIDAE
Horned Grebe
Eared Grebe
Western Grebe
Plid-Billed Grebe

PELICANIDAE
White Pelican

PHALACROCORACIDAE
Double-Crested Cormorant

ARDEIDAE
Great Blue Heron
Green Heron
Little Blue Heron
Cattle Egret
Great Egret
Snowy Egret
Black Crowned Night Heron
American Bittern

THERIURGITHIDAE
White-Faced Ibis

ANATIDAE
Canada Goose
Ross' Goose
Mallard
Gadwall
Pintail
Green-Winged Teal
Blue-Winged Teal
Cinnamon Teal
European Widgeon
American Widgeon
Northern Shoveler
Wood Duck
Ring-Necked Duck
Canvasback
Lesser Scap
Buffaleader
Ruddy Duck
Hooded Nerganser
Common Nerganser

CATHARTIDAE
Turkey Vulture

ACCIPITRIDAE
Northern Goshawk
Red-Tailed Hawk
Cooper's Hawk
Sharp-Shinned Hawk
Swainson's Hawk
Rough-Legged Hawk
Ferruginous Hawk
Golden Eagle
Bald Eagle
Northern Harrier

PANDIONIDAE
Osprey

FALCONIDAE
Prairie Falcon
Pigeon Hawk
American Kestrel

PHASIANIDAE
Gambel's Quail
Chukar

RALLIDAE
Virginia Rail
Sora-Rail
Yellow Rail
Common Gallinule
American Coot

CHARADRIIDAE
Killdeer

SCOPIDAE
Common Snipe
Spotted Sandpiper
Solitary Sandpiper
Willet
Greater Yellowlegs
Lesser Yellowlegs
TROGLODYTIDAE
Bewick's Wren
Cactus Wren
Long-Billed Marsh Wren
Rock Wren

NIANIDAE
Northern Mockingbird
Cattlebird
Le Conte's Thrasher

TURDIDAE
American Robin
Swainson's Thrush
Western Bluebird
Townsend's Solitaire

SYLVIIDAE
Black-Tailed Gnatcatcher
Ruby-Crowned Kinglet

MOTACILLIDAE
Water Pipit

BOMBYCILLIDAE
Cedar Waxwing

PTILOGNATHIDAE
Phainopepla

LANIIDAE
Loggerhead Shrike

STURNIDAE
Starling

VIREONIDAE
Bell's Vireo
Grey Vireo
Solitary Vireo

PARNIDAE
Nashville Warbler
Lucy's Warbler
Yellow Warbler
Yellow-Rumped Warbler
Black-Throated Grey Warbler
MacGillivray's Warbler
Yellowthroat
Wilson's Warbler
American Redstart

PLICEIDAE
House Sparrow

ICTERIDAE
Bobolink
Western Meadow Lark
Yellow-Headed Blackbird
Red-Winged Blackbird
Hooded Oriole
Northern Oriole
 Brewer's Blackbird
Great-Tailed Grackle
Common Grackle
Brown-Headed Cowbird

THRAUPIDAE
Western Tanager
Hepatic Tanager

FRINGILLIDAE/EMBERIZIDAE
Rose-Breasted Grosbeak
Black-Headed Grosbeak
Indigo Bunting
Lazuli Bunting
 Cassin's Finch
House Finch
Lesser Goldfinch
Brown Towhee
Vesper Sparrow
Lark Sparrow
Black-Throated Sparrow
Sage Sparrow
Oregon Junco

SCOPIDAE (continued)
Pectoral Sandpiper
Least Sandpiper
Long-Billed Dowitcher
Semipalmated Sandpiper
Sanderling

RECURVIROSTRIDAE
American Avocet
Black-Necked Stilt

PHALAROPOIDAE
Wilson's Phalarope
Northern Phalarope

LAGIDAE
Herring Gull
Ring-Billed Gull
Forster's Tern
Black Tern

COLUMBIDAE
Hemipode Pigeon
Rock Dove
White-Winged Dove
Mourning Dove

CUCULIDAE
Road Runner

TITIDAE
Barn Owl

STRIIDAE
Great Horned Owl

CAPRIMULGIDAE
Common Poorwill
Lesser Nighthawk

APOIDAE
White-Throated Swift

TROCHILIDAE
Costa's Hummingbird
Broad-Tailed Hummingbird

ALCEDIIDAE
Belted Kingfisher

PICIDAE
Common Flicker
Yellow-Bellied Sapsucker
Ladder-Back Woodpecker

TYRANNIDAE
Eastern Kingbird
Western Kingbird
Cassin's Kingbird
Ash-Throated Flycatcher
Black Phoebe
Say's Phoebe
Tricol's Flycatcher
Gray Flycatcher
Western Wood Pewee
Olive-Sided Flycatcher
Vermillion Flycatcher

ALAUDIDAE
Horned Lark

HIRUNDINIDAE
Violet-Green Swallow
Tree Swallow
Bank Swallow
Rough-Winged Swallow
Barn Swallow
Cliff Swallow

CORVIDAE
Common Raven
Pinyon Jay

PARIDAE
Verdin
ORDER

FAMILY

Caninae (Common Name) (remarks)

INSECTIVORA

Soricidae

Sorex marriani (Marrian Shrew)

CHIROPTERA

Vespertilionidae

Antrozous pallidus (Pallid Bat)
Nycticeius fasciatus (California Myotis)
Nycticeius subulatus (Small-footed Myotis)
Nycticeius thysanodes (Fringed Myotis)
Nycticeius volans (Hairy-winged Myotis)
Nycticeius yumanensis (Yuma Myotis)
Nipletus fuscescens (Big Brown Bat)
Lasius cinereus (Roary Bat)
Pipistrellus hesperus (Western Pipistrelle)
Plecotus townsendi (Lump-nosed Bat)

Hyluridae

Tadarida brasiliensis (Brazilian Freetail Bat)

LAGOMORPHA

Leporidae

Lepus californicus (Blacktail Jackrabbit)
Cuniculus auduboni (Desert Cottontail)

RODENTIA

Sciuridae

Ammospermophilus leucurus (Whitetail Antelope Squirrel)

Heteromyidae

Dipodomys merriami (Merriam Kangaroo Rat)
Dipodomys deserti (Desert Kangaroo Rat)
Perognathus spinatus (Spiny Pocket Mouse)
Perognathus formosus (Long Tail Pocket Mouse)
Perognathus longimembria (Little Pocket Mouse)
Perognathus penicillatus (Desert Pocket Mouse)

Procideae

Buscidae lepida (Desert Woodrat)
Onychomys torridus (Southern Grasshopper Mouse)
Peromyscus maniculatus (Deer Mouse)
Peromyscus eremicus (Cactus Mouse)
Peromyscus ornatus (Canyon Mouse)
Neotomamys megalotis (Western Harvest Mouse)

Muridae

Mus musculus (House Mouse) ***

CARNIVORA

Canidae

Urocyon cinereoargenteus (Gray Fox)
Vulpes macrotis (Kit Fox)
Canis latrans (Coyote)

Procidae

Bassariscus astutus (Ringtail Cat)

Mustelidae

Nephele nesbiti (Striped Skunk)
Spilogale putorius (Spotted Skunk)
Taxidea taxus (Badger)

Felidae

Lynx rufus (Bobcat)
Felis concolor (Mountain Lion) **

PERISSODACTyla

Equidae

Equus asinus (Wild Burro) **
Equus caballus (Wild Horse, Mustang) **

Antilocapridae

Antilocapra americana (Pronghorn Antelope) **

ANTROPOIDIA

Cervidae

Odocoileus hemionus (Mule Deer) **

Bovidae

Ovis canadensis (Big-Horn Sheep) **

- Migratory
- ** No longer occur at the Desert Studies Center
- *** Introduced

Names based on: Ingles, Lloyd S. 1965, "Mammals of the Pacific States (California, Oregon, Was"
Some Common Invertebrates of the Mojave Desert

Class Chilopoda (centipedes)

Class Arachnida (arachnids)

Order Araneae (spiders)
   Desert Tarantula (Aphonopelma chalcodes)
   California Trapdoor Spider (Bothriocyrtum californicum)
   Desert Loxosceles (Loxosceles deserta)
   Orb Weavers (Araneus sp.)
   Elongate Long-jawed Orb Weaver (Tetragnatha elongata)
   Grass Spiders (Agelenopsis sp.)
   Burrowing Wolf Spiders (Geolycosa sp.)
   Thin-legged Wolf Spiders (Pardosa sp.)
   Jumping Lynx Spider (Oxyopes sp.)
   Flower Spider (Hismene vatica)
   Inconspicuous Crab Spiders (Philodromus sp.)
   Metaphid Jumping Spiders (Metaphidippus sp.)

Order Scorpionida (scorpions)
   Yellow Vaejovis Scorpion (Vaejovis flavus)
   Giant Hairy Scorpion (Hadrurus sp.)

Order Opiliones (daddy-long-legs)
   Brown Daddy-long-legs (Phalangium opilio)

Order Acarina (mites and ticks)

Order Uropygi (whipscorpions)
   Giant Vinegarone (Hastigoproctus giganteus)

Order Solpugida (sun spiders)
   Windscorpion (Eremobates sp.)

Class Insecta (insects)

Order Thysanoptera (silverfish)
   Sand Dune Silverfish (Leucocephisma arenaria)
   Rockhopper (Mesomachilis pedetontus)

Order Odonata (dragonflies and damselflies)
   Common Ruby Spot (Hetaerina americana)
   Bluet (Enallagma sp.)
   Vivid Dancer (Argia vivida)
   Big Red Skimmer (Libellula saturata)
   Pastel Skimmer (Sympetrum corruptum)
   Common Green Darner (Anax junius)
Order Blattodea (cockroaches)
Sand Roaches (*Armenivaga* sp.)
Hairy Desert Cockroach (*Eremobia xubdiaphana*)

Order Orthoptera (grasshoppers, katydids)
Red-Winged Grasshopper (*Dissosteteria pictipennis*)
Pallid-winged Grasshopper (*Trimeritropis pallidipennis*)
Creosote Bush Grasshopper (*Boettetix punctatus*)
Creosote Bush Katydid (*Insara covillae*)
Splendid Shield-backed Katydid (*Nepuda ovata*)
Brown-winged Shieldback (*Carnobates fuliginosus*)
Sand Treader (*Macrobaenetes* sp.)
Ant Cricket (*Myrmecophila cretonensis*)
California Mantid (*Stagmomantis californica*)
Minor Ground Mantid (*Litaneutria minor*)
Gray Walking Stick (*Pseudoxyem ne straminea*)

Order Dermaptera (earwigs)
Toothed Earwig (*Spongovostox spicidentatus*)

OrderIsoptera (termites)
Western Drywood Termite (*Kalotermes minor*)
Desert Dampwood Termite (*Paraneotermes simplicicornis*)

Order Embioptera (webspinners)
Black Webspinner (*Oligotoma nigra*)

Order Hemiptera (true bugs)
Green Stink Bug (*Chlorochroa* sp.)
Western Leaf-footed Bug (*Leptoglossus cyanea*)
Large Milkweed Bug (*Oncopeltus fasciatus*)
Pacific Ambush Bug (*Phymatida pacifica*)
Western Bloodsucking Cononose (*Triatoma protracta*)
Western Corsair (*Ragahu thoraci*)
Robust Assassin Bug (*Aphiomera* sp.)
Four-spurred Assassin Bug (*Zelus tetracentrus*)
Black Shore Bug (*Saadula* sp.)
Water Strider (*Gerris* sp.)
Toad Bug (*Gelastocoris occlusus*)
Single-banded Backswimmer (*Notonecta unifasciata*)
Western Creeping Water Bug (*Ambrosus occidentalis*)
Salt Marsh Water Boahten (*Tricoriza reticulata*)
Toe Biter (*Abedus indentatus*)
Little Toe Biter (*Belostoma fluineum*)
Desert Water Scorpion (*Ranatra brevicollis*)

Order Homoptera (leafhoppers, planthoppers and cicadas)
Annulate Spittle Bug (*Aphrophora annulata*)
Leafhoppers—Blue Sharpshooter (*Hordnia cirrillata*)
Three Cornered Alfalfa Leafhopper (*Spissistilus festinus*)
Cochinial Scale (*Dactylopius coccus*)
Desert Cicada (*Diceroprocta* sp.)
Order Thysanoptera (thrips)
   Western Flower Thrips (*Frankliniella occidentalis*)

Order Neuroptera (lacewings and antlions)
   Green Lacewing (*Chrysopa carnea*)
   Brown Lacewing (*Hemerobius* sp.)
   Brown Mantispid (*Plegra signata*)
   Antlions (*Brachynemurus, Myrmeleon*)
   Desert Scorpionfly (*Boreus notoperates*)

Order Diptera (true flies)
   Sagebrush Gall Midge (*Asplondylia artemisiae*)
   Cactus Fruit Midge (*Asplondylia opuntiae*)
   Punkies (*Culicoides* sp.)
   Mosquitos (*Culex* sp.)
   Common Midge (*Chironomus* sp.)
   Spotted Soldier Fly (*Stratiomyus maculosa*)
   Horse Fly (*Tabanus* sp.)
   Deer Fly (*Chrysops* sp.)
   Flower Loving Fly (*Apicera* sp.)
   Common Robber Flies (*Efferia, Machinus* and *Stenopogon*)
   Greater Bee Fly (*Bombylius major*)
   Cactus Fly (*Volucella mexicana*)
   Common Hover Flies (*Eupeodes, Syrphus, Scava*, *Allograpta* and *Metasyrphus*)
   Eye Gnat (*Hippelates* sp.)
   House Fly (*Musca domestica*)
   Green Bottle Fly (*Phaenicia sericata*)
   Black Blow Fly (*Phormia regina*)
   Common Blow Fly (*Eucalliphora lilaea*)
   Common Flesh Fly (*Sarcophaga* sp.)
   Caterpillar Destroyer (*Leptesia archippivora*)
   Rodent Bot Fly (*Cuterebra* sp.)

Order Lepidoptera (moths and butterflies)
   Yucca Moth (*Tegeticula* sp.)
   Creosote Bush Bagworm (*Thryidietyrpx meadi*)
   Diamond Back Moth (*Plutella xylostella*)
   Clearwing Moth (*Paranthrene* sp.)
   Carpenterworm (*Prionoxystus robiniae*)
   Pyralid moths - Several common genera (our most common desert moths)
   Fragile Gray (*Anacampedodes fragilaria*)
   Looper (*Eupithecia* sp.)
   Tent Caterpillar (*Malacosoma* sp.)
   Arizona Desert Miller (*Conocharis arizonae*)
   Palm Moth (*Litoprosopus coachella*)
   Mexican Tiger Moth (*Apantesia proxima*)
   Saltmarsh Caterpillar or Acrea Moth (*Estigmene acrea*)
   Painted Tiger Moth (*Arachnig picta*)
   Hera Moth (*Hemileuca hera*)
   White Lined Sphinx Moth (*Hyles lineata*)
   Common Checkered Skipper (*Pyrus communis*)
   Fiery Skipper (*Hylephila phyleus*)
Pigmy Blue (*Brephidium exile*)
Square Spotted Blue (*Pseudophilotes batooides*)
Monarch (*Danaus plexippus*)
Common Checkerspot (*Euphydryas chalcedona*)
Painted Lady (*Vanessa cardui*)
Sara Orange Tip (*Anthocaris sara*)
Southern Dogface (*Colias cesonia*)

Order Coleoptera (beetles)
Tiger Beetle (*Cicindela sp.*)
Bombardier Beetle (*Brachinus tschernikhi*)
Desert Carabid (*Pterostichus brunnea*)
Yellow Spotted Diving Beetle (*Thermonectus marmoratus*)
Whirligig Beetle (*Gyrinus sp.*)
Giant Black Water Beetle (*Hydrophilus triangularis*)
Scavenger Water Beetle (*Tropisternus sp.*)
Hairy Rove Beetle (*Staphylinus maxillocus*)
Sipophil Beetle (*Sipho ramosa*)
Common June Beetle (*Phyllophaga sp.*)
Ten Lined June Beetle (*Polyphaga decemlineata*)
Green Fruit Beetle (*Cotinus texana*)
Spotted Flower Buprestid (*Amaeodera sp.*)
Green Ostomatid (*Teneochila chloridea*)
Cactus Flower Beetle (*Carpophilus pallipes*)
Desert Spider Beetle (*Cysteodesma armatus*)
Stink Beetle (*Elyodes sp.*)
Ironclad Beetle (*Phloeodes diabolicus*)
Red Milkweed Beetle (*Tetraopes sp.*)
Yucca Weevil (*Sicyphorus yuccae*)

Order Hymenoptera (wasps and bees)
Common Braconid (*Apanocephala sp.*)
Common Ichneumonid (*Ophion sp.*)
Tiger Tiphid (*Myxinum sp.*)
Nocturnal Tiphid (*Brachycistis sp.*)
Velvet Ant (*Dasyvutilla sp.*)
Kingfisher Wasp (*Trilegus alcione*)
California Harvester Ant (*Pogonomyrmex californicus*)
Mexican Honey Ant (*Myrmecocystus mexicana*)
Tarantula Hawk (*Pepsis sp.*)
Common Eumenid Wasp (*Euodynerus annulatum*)
Paper Wasp (*Polistes sp.*)
Mud Dauber (*Sceliphron caementarium*)
Golden Digger Wasp (*Sphex ichneumonina*)
Thread-waisted Digger Wasp (*Aeneophila sp.*)
Sand Wasp (*Sembix sp.*)
Green Cricket Hunter (*Chlorion aerarium*)
Common Burrowing Bee (*Andrena sp.*)
Alkali Bee (*Nomia slanderi*)
Metallic Sweat Bee (*Agapostemon sp.*)
Semisocial Sweat Bee (*Halictus sp.*)
California Carpenter Bee (*Xylocopa californica*)
REFERENCE BOOKS

FIELD GUIDES
A Field Guide To the Insects of America North of Mexico by D.J. Borrow and R.E. White (Peterson Field Guide Series, Houghton Mifflin, 1970). $11.95

CHILDREN'S BOOKS
Bees and Honey by Oxford Scientific Films (G.P. Putnam's Sons, 1982). Intermediate
Busy Bugs by A. and F. Graham (Dodd Mead & Co., 1963). Primary and intermediate
The Butterfly Cycle by Oxford Scientific Films (G.P. Putnam's Sons, 1982). Primary and intermediate
Gypsy Moth Workbook by Dennis Ham (American Forestry Association, 1983). Primary and intermediate
Honey Bees by Jane Lecht (The National Geographic Society). Preschool and primary
Let's Look at Insects by H.E. Huntington (Doublaycs Co., Inc.). Intermediate and advanced
The Very Hungry Caterpillar by E. Carle (Collins & World, 1975). Preschool and primary

PICTURE CARDS AND COLORING BOOKS
Coloring Fun With Insects by Edwin W. King, 1982. Entomological Society of America, 4603 Calvert Rd., College Park, MD 20740. $2.50

SLIDE SETS
Arthropods: An Introduction to Insects and Their Relatives. Carolina Biological Supply Co., 2700 York Rd., Burlington, NC 27215. (57 slides, puzzles, work sheets, guide)
Insect Anatomy Up Close by R.W. Educational Images, Ltd., P.O. Box 367, Lyne Falls, NY 13358. (Write for catalog)
Insect Metamorphosis Up Close—the Monarch Butterfly by A. Warner and C. Belfink. Educational Images, Ltd., same address as above.

FILMSTRIPS
Insects: How They Help Us. National Geographic Society Education Services, 17th & M Streets NW, Washington, DC 20006. (15 min.) Primary and intermediate

FILMS

INSECT SUPPLIES
Carolina Biological Supply Co., 2700 York Rd., Burlington, NC 27215 or Box 187, Gladstone, OR 97027. (Insect collecting equipment, live insects: crickets, bees, butterflies, cockroaches, ladybugs, termites, dermestid beetles, etc.)
NASCO, 901 Jamarine Ave., Fort Atkinson, WI 53538 or 1534 Princeton Ave., Modesto, CA 95352. (Collecting supplies, "Giant Ant Farm")
WING Natural Science Establishment, Inc., 5100 West Henrietta Rd., Rochester, NY 14692. (Insect collecting equipment, live insects: crickets, cockroaches, termites, etc.)

WHERE TO GET MORE INFORMATION
- Beekeepers (check for local associations)
- County Cooperative Extension Service (look in the phone book under local government listings)
- Entomological Society of America, 4603 Calvert Rd., College Park, MD 20740
- Museums, State and Local Parks, Zoos, Nature Centers
- Pest Control Companies
- State Department of Agriculture, Forestry, or Natural Resources
- State University Departments of Entomology
- Xerces Society, Department of Zoology and Physiology, University of Wyoming, Laramie, WY 82071 (an insect conservation group)
- Young Entomologist Society, Michigan State University, Dept. of Entomology, East Lansing, MI 48824-1115
Amphibians and Squamates of the Soda Springs Area


Prepared by
William Presch
Department of Biological Science
California State University, Fullerton

ORDER
Family
Genus species (common name) (remarks)

ANURA
Bufonidae

Bufo punctatus (red spotted toad) (Granite and Providence Mts.)

Ranidae

Rana catesbeiana (bull frog) (introduced: Now extinct)

Hylidae

Hyla regilla (pacific tree frog) (introduced)

CHELONIA
Testudinidae

Xerobates (Gopherus) agassizii (desert tortoise)

SAURIA
Gekkonidae

Coleonyx variegatus (banded gecko)

Iguanidae

Dipsosaurus dorsalis (desert iguana)
Sauromalus obesus (chuckwalla)
Callisaurus draconoides (zebra-tailed lizard)
Uma scoparia (Mojave fringe-toed lizard)
Gambelia wislizenii (leopard lizard)
Crotaphytus collaris (collared lizard)
Sceloporus magister (desert spiny lizard)(To the west of station)
Urosaurus gracilus (long-tailed brush lizard)
Uta stansburiana (side-blotched lizard)
Phrynosoma platyrhinos (desert horned lizard)
Xantusiidae

Xantusia vigilis (desert night lizard)

Scincidae

Eumeces gilberti (Gilbert’s skink) (not at station but to east)

Teiidae

Cnemidophorus tigris (western whiptail lizard)

SERPENTES

Leptotyphlopidae

Leptotyphlops humilis (western blind snake)

Boidae

Lichanura trivirgata (rosy boa) (Not seen at station)

Colubridae

Phyllorhynchus decurtatus (spotted leaf-nose snake) (?)
Nasticophis flagellum (coachwhip)
Salvadora hexalepis (western patch-nosed snake)
Pituophis melanoleucus (gopher snake)
Arizona elegans (glossy snake)
Lampropeltis getulus (common kingsnake) (?)
Rhinechilus lecontei (long-nosed snake) (?)
Sonora semiannulata (western ground snake) (?)
Chionactis occipitalis (western shovel-nosed snake)
Tantilla planiceps (western black-headed snake) (questionable)
Hypsiglena torquata (night snake)
Trimorphodon biscutatus (Sonoran lyre snake) (?)

Crotalidae

Crotalus cerastes (sidewinder)
Crotalus mitchelli (speckled rattlesnake)
Crotalus scutulatus (Mojave rattlesnake)

(?) Soda Springs within the range of the species, but not reported from the area.
DESERT MICROHABITATS

Within the Mojave desert, there are a large number of different habitats varying with the season. These habitats may be large or small in extent, but each has only a narrow range of environmental conditions. The following are some examples of microhabitat types, and each may be further subdivided according to shade, moisture conditions, etc... because desert insects and arthropods generally specialize by moisture tolerance or other factors such as proximity to food. The following is a list of nineteen common microhabitats with characteristic insect examples.

1. On ground under stones or debris (webspinners, predaceous ground beetles, darkling ground beetles).
2. In or on desert dunes (burrowing bugs, ground beetles, weevils, larvae of moths).
3. In moist leaf litter (springtails, dipluran, many kinds of small beetles).
4. In freshwater ponds (diving beetles, backswimmers, water boatmen, naiads of damselflies and dragonflies).
5. On or under stones in streams (tiger beetles, caddisflies, and black flies).
6. On surface of pools and ponds (water striders, riffle bugs, whirligig beetles).
7. On sand or mud margins of streams or ponds (toad bugs, shore bugs, tiger beetles).
8. In galls of woody plants (larvae of gall wasps, gall gnats or small moths and parasitic wasps).
9. On or in leaves of living plants (aphids, whiteflies, lacebugs, caterpillars and fly larvae).
10. Visiting flowers (various beetles, hover flies, butterflies, bees).
11. Inside fruit or seed of flowering plants (larvae of moths, weevils, and fruit flies).
12. On recently felled branches or trunks (bark beetles, metallic wood borer beetles, longhorned beetles, parasitic wasps).
13. Under bark of old stumps or logs (ironclad beetles, carpenter ants, various fly larvae).
15. On recently killed vertebrate animal carcasses (blowflies, hister beetles, and carrion beetles).
17. On or in animal droppings, especially cow pats (dung flies, blow flies and scarab beetles).
18. On living animals or in their fur (horse flies, fleas and lice).
19. On human skin (head lice, crab lice).
Reptiles: Adaptations to Desert Ecosystems

By Robert C. Stebbins
Curator Emeritus of Herpetology
Museum of Vertebrate Zoology
University of California, Berkeley

There are few desert areas in the world that surpass the California desert in the variety and accessibility of reptiles for study and enjoyment. This richness results from a variety of physical, biotic and historic factors. Throughout the desert are many mountains and basins, some to below sea level. There are many playas and old stream beds with associated sand deposits—the legacy of a Pleistocene system of freshwater lakes and streams, many mountain-fed springs and seepages, varied soils, lava flows, rock outcrops, vast alluvial plains, and myriads of washes carrying intermittent water flow from upland areas. All combine to offer physical conditions for a great variety of habitats, and all are contained in an area about 450 miles long and averaging about 150 miles wide, within a day’s drive of surrounding urban areas.

Vertebrates found abroad in greatest numbers on warm days in the desert are usually reptiles. A number of physiological, structural and behavioral traits, characteristic of reptiles generally, have contributed to their survival in deserts. As ectotherms (organisms whose internal temperatures adjust to the ambient environment), reptiles can “sit out” unfavorable conditions of temperature, humidity and other factors, with minimal expenditure of energy, by retreating to a cool location where their body temperature and metabolism drop to lower levels. They can thus go for long periods without food—weeks, months, some species over a year—when they have adequate fat.

Desert reptiles have developed patterns of behavior that conserve energy and water. Some species are nocturnal, avoiding the heat and dryness of daytime. Examples are geckos and about half of the snakes including the Western Shovel-Nosed Snake and Sidewinder. Some diurnal species become more nocturnal during hot dry weather, and some species cease activity completely in summer and estivate. Reptiles have a bimodal yearly pattern, with surface activity in spring and early summer and in fall, many then going into hibernation.

CALIFORNIA DESERT REPTILES
SPECIES BY FAMILIES

Lizards
3 geckos
19 iguanids
2 xantusiids (night lizards)
1 skink (Gilbert’s Skink)
1 teiid (Western Whiptail)
2 anguid (alligator lizards)
1 anniellid (Calif. Legless Lizard)
1 helodermatid (Gila Monster)

Snakes
1 leptotyphlopids (Western Blind Snake)
1 boid (Rosy Boa)
13 colubrids
6 vipers (rattlesnakes)

Cheloniens
Desert Tortoise
Western Pond Turtle
(found along the Mojave River)

The Spiny Softshell Turtle probably has been introduced and the status of the Sonoran Mud Turtle is uncertain, hence these species have not been included.
during the winter months. Some alter their daily activity with seasonal progression. Many diurnal species arise late and retreat early during the cooler spring days but give way to a bimodal pattern in late spring and early summer. As days become warmer, they arise progressively earlier, cease activity during the heat of the day, and then emerge again in late afternoon as temperatures cool. These changes are related to energy and water conservation, without which these animals could not survive in the desert.

Most reptiles conserve water by excreting their urinary nitrogenous wastes chiefly as uric acid, a relatively insoluble non-toxic substance that requires little water for elimination. Some herbivorous species, such as the Chuckwalla and Desert Iguana, obtain large amounts of potassium or other salts in their plant foods, and expel much of the excess at high concentration via nasal salt glands, snorting the fluid from their nostrils. Much water is thereby conserved. The Flat-tailed Horned Lizard also uses this method to expel sodium excesses obtained from feeding on ants. The Chuckwalla stores water in lymph spaces under the skin along the sides of the body. Many arid-lands reptiles are tolerant of a considerable rise in electrolyte levels in their body fluids; thus, during times of drought they simply get saltier, expelling the excess salts when water again becomes available. These mechanisms for water conservation are made possible by the relatively impermeable skin of reptiles, which in arid-lands species is particularly resistant to water loss.

Most desert reptiles are small in size: lizards are usually under a foot in snout-to-vent length and snakes are generally under six feet. Consequently, they can find many places of refuge in the burrows of other animals, cracks in rocks or the ground, and other below-surface retreats where they escape unfavorable conditions. Some dig their own burrows. Subterranean retreats are crucial to reptiles' existence. They provide a place for daily rest, protection against inclement weather and predators, and sites for hibernation and estivation.

Reptiles also have a marked capacity to turn off reproduction when faced with austere conditions. It is now known that in drought years females of some species do not yolk up eggs. Some species have evolved a yolking cycle that extends over two (sometimes three) years in adjustment to availability of food and suitable conditions for activity under the extreme conditions in deserts.

Most of our desert reptiles lay whitish, unpigmented, soft-shelled eggs which are usually buried in the ground. (The Desert Tortoise and Leaf-toed Gecko lay eggs with brittle shells.) Eggs usually are laid in late spring or summer and hatch in the fall. Adults of many species have greatly decreased their surface activity by then and competition with the young is thus reduced. A few species bear live young, including the diminutive Desert Night Lizard, the California Legless Lizard (known from only a few isolated localities on the western fringe of the desert), the Rosy Boa and all rattlesnakes. The young are active promptly upon breaking free from the fetal membranes.

One of the mysteries of the desert is how reptile eggs, incubating in the surface layers of desert soil and unattended by adults, escape desiccation. Little information is available as very few nests...
have been found. Moist pockets of soil are more abundant in the desert than generally supposed—in wash bottoms, beneath hummocks by perennial plants, in the depths of burrows, and beneath insulating layers of sand—and female reptiles must be able to sense their location. Clutches discovered have not been at great depths. Most nests are probably within one foot of the surface where favorable temperatures for development occur. Some egg-eating desert reptiles are adapted to locate and dig out such nests. The Patch-nosed and Leaf-nosed Snakes have an enlarged scale on the tip of the snout that appears to fulfill this function.

One of the great delights in observing desert reptiles is their coloration. In diversity and brilliance, some of them have markings that rival those of birds. However, the brighter colors in lizards are often concealed until presented in a behavioral display and they may change in intensity with season and with transient color phase. Colors function in concealment and advertisement, both functions often occurring in the same species. In addition, the ability of most desert lizards to darken and lighten can affect the rate of heat gain and loss when they are thermoregulating. They can accelerate the absorption of radiant energy when dark and reflect it when pale.

Most reptiles have colors and patterns that harmonize with their habitat but this is nowhere more evident than in the open, brightly illuminated terrain of deserts where reptiles’ color patterns help to conceal them. This includes some of the conspicuously banded snakes whose bold patterns appear to function as disruption of their body outline nocturnally, making them less visible to owls, kit foxes and other night-time predators. At the same time, males of many diurnal lizards have bright belly markings and colorful throats, which become especially brilliant in the breeding season. Females many species also develop brood colors. These advertising colors are ordinarily seen until displayed, then they do not disrupt camouflage. In display, the lizard’s body is usually flattened from side to side and the throat lowered, bringing the colorfull into view—an action enhanced by bowing movements. The dorsoventrally flattened Fringe-toed Lizards, on the other hand, become even flatter and pull the belly skin up onto the dorsal surface of one side, exposing their ventral markings as they tilt their bodies toward the object of their display.

Seventy-three species of native reptiles occur in the southwestern region, the United States, including the Great Basin Desert. Of these, 53 species (representing 14 families) occur in the California desert: 30 lizards, 21 snakes and two chelonians (turtles and tortoises). See chart on page 13 for number of species by families.

Herpetologists who visit the California desert for the first time are invariably impressed by the remarkable variety of structure and life styles of the reptiles present within small geographic area. For example, within a radius of a mile from Palm Springs, one can find 1 species of desert lizards and 14 species of snakes. At the Flagg Run Lava Flow in the Mojave Desert (a less varied environment), there are 10 species of lizards, species of snakes and the Desert Tortoise.

The iguanids, all members of the same lizard family, display an impre
ative ecological segregation; thus, they can live in close association with little competition. In the Palm Springs area, for example, the following occur: (1) two closely related insectivorous runners, the Zebra-tailed Lizard and Coachella Valley Fringe-toed Lizard—the former primarily a wash and flat dweller and the latter restricted to fine, usually windblown sand; (2) two fairly large insectivorous climbers, the Desert Spiny Lizard and the Banded Rock Lizard—the former more variable in habitat requirements and often a tree climber, and the latter a strict rock dweller; (3) two small insectivores, the Long-tailed Brush Lizard and the Side-blotched Lizard—the former closely restricted to brush and trees, where it rests camouflaged on branches in wait for its prey, and the latter seldom climbing into vegetation; and (4) two ant-eaters, the Desert Horned Lizard and the Black-tailed Horned Lizard—the former occupying a variety of habitats and the latter largely restricted to fine sand.

The great range in form, coloration, and behavior of lizards reflects their differing habitats and lifestyles. The Chuckwalla and Banded Rock Lizard are adapted for life among rocks; both crawl over the rock surfaces with a sprawling gait, their limbs extending far laterally.

The Banded Rock Lizard has a pattern that matches the texture and coloration of rock surfaces; the Chuckwalla seeks refuge from predators in crevices and wedges itself in place by inflating its lungs. The Zebra-tail is a slim-legged, greyhound-like runner capable of 18 miles per hour. It carries its conspicuous banded tail curled over its back when it runs, offering to predators an expendable part that can be regrown. The Long-tailed Brush Lizard aligns itself with the branch or bark furrows upon which it rests, its long tail looking like a twig. Upon sensing danger it often closes its eyes, further adding to its bark-resembling appearance.

The Fringe-toed Lizard has elongate pointed scales on the sides of its toes that increase its footing on fine sand and aid in "sand-swimming" short distances beneath the surface to escape predators or unfavorable surface conditions. It has kitchen-sink-trap-like nasal passages that trap sand which may bypass the nasal valves; earflaps that cover the delicate eardrums when burrowing in sand; overlapping "vacuum-seal" eyelids that protect the eyes from sand; and a third eyelid mechanism that encapsulates sand that gets into the eye in a mucous film in the anterior eye corner and then expels it. Most of the skin is like velvet, the scales reduced to fine granules, which cut down friction when these lizards engage in sand-swimming.

The ant-eating habits of the horned lizards may explain their appearance. They may spend many minutes exposed near ant nests as they catch their small prey. Their stomachs are large and habits sedentary, resulting in a short-legged, squat body form. Their spiny bodies, crown-of-thorns and remarkable groundmatching camouflage help protect them while they stand, largely immobile and attentive on their prey.

Reptiles as a group play an important role in population regulation and in the process of natural selection in desert environments. Reptiles can be approached and examined up close. The only venomous species of concern in our local desert are the rattlesnakes—so have a look if you wish, but keep your distance! With all reptiles in the desert, I emphasize looking not taking. They should be left alone to play their part in the ecosystem.

Much remains to be learned about the distribution and habits of our California desert reptiles. Anyone willing to take the time, look closely and record accurately what is observed can contribute to the growing body of knowledge about these fascinating desert survivors.
GEOLOGICAL BACKGROUND

Prepared by

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INTRODUCTION: During this trip we will be travelling through a region which is unique in its geological diversity. Rocks along the route range in age from Precambrian to Holocene from all three rock families. During the trip we will pass near the lowest point in North America (Badwater in Death Valley at -282 feet below sealevel) and peaks which rival the highest point in the lower 48 states (Telescope Peak at 11,049 feet). One of the stops will allow us to view the area of intersection of two strike-slip faults of regional significance.

After leaving Baker will pass several ranges of hills. For the first several miles north of Baker the Soda Mountains are to our left (west) and the Hallowan Hills to the right. As we travel north along highway 127 we are travelling along the course of the Mojave River which heads in the San Bernardino Mountains. With sufficient rainfall the river will empty first into Soda Lake (the lake near which Desert Studies Center lies) and then into Silver Lake. With still more water (about 40 feet) Silver Lake will overflow at about the point where the power line crosses the highway north into Silurian Lake and then will follow Salt Creek past the Salt Creek Hills and join the Amargosa River (near the Harry Wade Monument) which then empties to the west and then north into Death Valley. A lake about 30 feet deep was present in Death Valley after the heavy floods of 1861. Similarly, after the disastrous floods of 1938 significant amounts of standing water was present at Badwater.

The Soda Mountains consist of varied rock types ranging from Precambrian to Tertiary. A large northwest striking fault crosses the range and separates two distinct assemblages with prominent volumes of Paleozoic sedimentary rocks to the southwest. Precambrian gneisses are restricted to the northeast side of the fault. Most of the rocks on both sides of the fault have been intruded by plutonic rocks of Mesozoic age. All have been cut by later high-angle faults. (Grose, 1959)
To the east the Halloran Hills are more subdued in their topographic appearance. They are composed mainly of Precambrian metamorphic rocks intruded by Mesozoic rocks. In the eastern part of the Halloran Hills volcanics of the Cima volcanic field overlie many of the older rocks (DeWitt, 1980). Additionally, regional Tertiary extension probably also caused the emplacement of rock bodies of various compositions along low-angle faults at various places in the area (Reynolds, 1989).

As we continue to travel north and pass the power lines near Silver Lake the Avawatz Mountains appear to the northwest and the Silurian Hills to the northeast. The north side of the Avawatz Mountains is formed by the Garlock fault, a large left-slip fault, which merges at the northeast corner of the range with the right-slip Death Valley fault zone. As the merged fault system "wraps" to the southeast around the east face of the range they may change from predominantly strike-slip character to reverse slip (Brady, 1982). The steepness of the east face of the Avawatz Mountains may reflect the presence of this reverse fault.

The Avawatz Mountains consist of mainly of Precambrian and Paleozoic metasedimentary rocks intruded by Mesozoic rocks. Some Tertiary sedimentary and volcanic rocks are also present (Troxel, 1982).

The Silurian Hills, as mapped by Kupfer (1960), consist of two structurally distinct rock masses separated by a thrust fault. The section below the fault is a nearly complete stratigraphic section ranging from older Precambrian gneiss, through the Pahrump Group (see accompanying stratigraphic section) and up through younger units with the uppermost being the Carrara Formation. Lying upon this assemblage is an allochthonous thrust mass composed mainly of, what Kupfer called, the Riggs Formation, consisting primarily of deformed and brecciated carbonate rocks.

From the highway with proper sun angle we may be able to see a portion of the thrust fault in the "middle island", one of three low hills lying slightly west of the main part of the Silurian Hills but still east of the lake. Dark, discolored rocks (Crystal Spring Formation) lie low on the hill with lighter colored rocks (Riggs Formation) exposed higher. The fault separates the two rock types. The old Tidewater-Tonapah railway grade runs just east of the three hills.
STOP 1

The Salt Spring Hills, site of the first gold discovery in the region, formed a barrier to the northward flow of Salt Creek (Ancestral Mojave River?) until geologically recent time. The presence of lake beds along the south flank of the hills represents deposition during the ponding of the river prior to drainage integration with the Amargosa River.

Rocks ranging in age from Precambrian to Tertiary make up the hills (Troxel, 1982). Oldest rocks are from the Kingston Peak Formation. A Mesozoic intrusive cuts the sedimentary section and forms the outcrops to the northeast near the highway. To the east of the intrusive rocks are large brecciated mass of carbonate rocks are exposed. These rocks appear to represent a large block, gravitationally emplaced. Troxel (1982) suggests the Kingston Range, 20 miles northeast, as their site of origin. Rocks interpreted to be of Tertiary age underlie the breccia mass.

STOP 2

Saratoga Spring lies at the southern end of the Ibex Hills and immediately north across the southern end of Death Valley from the Avawatz Mountains. From this location one can see the intersection of the Death Valley fault zone and the Garlock Fault (and Mule Spring fault).

At Saratoga Spring the most obvious geologic feature is the white talc debris on slopes below mines nearby. During the time of formation of the Pahrump Group are igneous sill of regional extent was inserted into the Crystal Spring Formation. Contact metamorphism of the carbonate rocks of the Crystal Spring Formation caused the formation of Talc-Mg3(Si4O10)(OH)2. In the Death Valley area the presence of these splashes of white indicates the presence of the Precambrian Crystal Spring Formation.

STOP 3

The Charlie Brown highway road cut offers a good view of the faulting geometry in the Death Valley area. Present in the road cut are volcanic rocks of Tertiary age which have been subjected to normal faulting. In this type of faulting extension of rocks must occur. The horizontal extent of the rocks before faulting is smaller than after. Similarly, the rocks in Death Valley have been extended making this small outcrop a good representation of the larger-scale processes operating the west. The black rock layer is a vitrophyre (glass with phenocrysts) caused by intense local welding of an ash flow tuff.
Stop 4

The Resting Spring range is named for the spring at its southern end. From a vantage point along highway 127 between Shoshone and the Tecopa turnoff we can view (if the sun is at an appropriate angle) several of the formations making up the stratigraphic section in this area. Refer again to the stratigraphic column included herein.

The top portion of the rocks of the range area composed of the dark grey Bonanza King Formation of middle Cambrian age. It is composed mainly of limestone and dolomite. The Bonanza King is middle Cambrian in age. Type section for this formation is in the Providence Mountains to the south near the town of Kelso.

Below these rocks are the red-brown rocks of the Carrara Formation. Type section for the Carrara is near the town of Beatty to the northeast. The Carrara is mainly shale and carbonate rock as we will see at the stop at Emigrant Pass later. The Carrara is early Cambrian in age.

Below the Carrara is the light-orange brown stripe of the Zabriskie Quartzite. Type section for the Zabriskie is near Emigrant Pass.

Below the Zabriskie is the Wood Canyon, barely visible at the base of the hills. Its type section is in the Spring Mountains. The Wood Canyon is made of many different rock types including sandstone, shale and limestone. The Precambrian-Cambrian boundary probably lies within the Wood Canyon.

Stop 5

At Emigrant Pass we will stop in an excellent exposure of the Carrara Formation. In this easily accessible site we can collect portions of Olenellid trilobites, index fossils for the lower Cambrian. The prominent ridge just to the left (west of the parking site a few tens of feet) is the Zabriskie. The massive cliffs above us are made of the Bonanza King.
List of References


Brady, R.H., 1982, Geology at the intersection of the Garici and Death Valley Fault zones, Northeastern Avawatz Mountains, California- a field guide: in Cooper, J.D. (comp), Geology of Selected areas in the San Bernardino Mountains, western Mojave Desert and southern Great Basin, California: Guidebook- Geological Society of America


HISTORICAL BACKGROUND

Prepared by

Mr. Clifford Walker
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Barstow, California
7:00 a.m. Leave for field trip. If you want some Restino Springs water, bring empty jug or jar. Have camera, jacket, hat and hiking shoes out of pack and ready to use.

You will leave ZZVXX and artificially-made Lake Tuendae and drive next to ancient Lake Mohave, another Ice Age lake. Off to your right, you will be looking where the ancient Mohave Indians traveled from their homeland on the Colorado River, north and south of Needles in the Mohave Valley. The Mohave traded as far west as San Luis Obispo and Santa Barbara and as far east as the Hopi villages. The Mohave led Father Garces across Soda Dry Lake in 1776 and guided Trapper Jedediah Smith across in 1826. In 1827, the Mohave ambushed Smith and killed half his party.

Quick Stop #1

At Baker, cars line up facing north on Hwv. 127, just north of the Greek restaurant. At the site of the Greek restaurant, "Death Valley Jack" Nickerson built an 8 by 10' building in the late 1920's, then sold it to Enos Failing, who built it up to multimillion dollar chain of restaurants, motels and service stations. At the northwest corner, "Dad" Fairbanks built a cafe, market and gas station and he and his descendants all contributed to the desert economy especially of Baker and Shoshone. Charles Brown was Senator Brown for years.

Mileage at Baker 00

To the left as you leave Baker you will see Baker International Airport--desert people tend toward the hyperbolic. Joyce Failing was a renown aviatrix who broke several air records. During World War II, she taught many young pilots how to fly. This became an Army Air Corps facility.

A few miles out of Baker, notice the old railroad bed of the Tonopah and Tidewater Railroad (1906-1927), started by Francis Marion Smith, the Borax King. Notice on the left across the lake, the original line went but flooded out so the railroad built it on the right above the old flood plain. Many of the tracks were salvaged for the war effort in WWII. The ties went for desert building, including the El Rancho Hotel in Barstow.

Slow down at Townsite of Silver Lake

Silver Lake 7.8 miles (from Baker) Depot of the T & T RR and wagon road to Las Vegas. During the early 1900's Silver Lake was the biggest town from Barstow to Shoshone and from Barstow to Vegas. The borax mill at Death Valley Junction closed around 1927 and moved to Boron, and the new Hwv. 91-466 opened between Barstow and Las Vegas. These two events helped cause the demise of Silver Lake and the birth of Baker. "Death Valley Jack" Nickerson and other famous people you have never heard of are buried here.

In 1908 the town of Greenwater in Death Valley was declining. When
"Tiger Lil" left, the miners knew the the town was doomed. She moved here to Silver Lake and operated a "hotel." (Lindenfelter 336, O'Conley 74-83)

To the right you see the Halloran Mountains where the Pre-Pueblo turquoise mines are. The mines (Walker 24-25) were developed perhaps by the Anasazi people. One mine was 30 feet long 12 feet wide and 12 feet deep; stone picks were found along with white on black pottery.

Beach Bar of Pleistocene Lake Mojave

6.8 miles Look across the dry Silver Lake and see the shoreline of the Ice Age Lake Mohave. The drainage went north, eventually into Death Valley, ancient Lake Manley.

Red Pass to the left, heading for Red Pass Lake and Bitter Springs where the Old Spanish Trail went and the Mormon Road followed it in 1849. Also to the left is the Avawatz Mountains (Uto-Aztecan word for mountain sheep). Silurian Lake to the right was part of the ancient drainage system of the Mojave River during the Ice Age.

Stop Salt Springs 29.6 miles

One of the springs on the Old Spanish Trail, first gold mining in Southern California (Walker 180-181), where gold was discovered by the Mormons under Jefferson Hunt in December 1849, ironically, as they were rushing to the gold area of California. This is a most historic spot from 1830 to 1905.

Leave Salt Springs and drive past the Wade Monument, in honor of the 49er Wade who left with his family after having enough of Death Valley, headed south until he hit the Old Spanish Trail.

Notice the U-shaped valley—the valley and drainage to the left starts Death Valley, the one to the right, where you can see Dumont Dunes, goes up the Amargosa River toward Tecopa, Shoshone and western Nevada. Off in the distance is a lone tree; that is where the Amargosa River crosses Hwv. 127—usually dry this time of year. Amargosa is the Spanish word for "bitter." The Amargosa travels over 250 miles and ends in Death Valley, 80 miles from its start.

Saratoga Springs—the bottom of Death Valley Permanent Indian village of Muta, where Uto-Aztecan language people lived for thousands of years. From this area, about 1200 A. D. started a migration out of the desert, northeast across Nevada to form the Shoshone of the Rockies and the plains, and the Ute of the Rockies, and later the Comanche of the Rockies who came into the southern plains (with the guns from the French and the horses from the Spanish) and became such a terror in western Oklahoma and in Texas.

Saratoga Springs is a most important place in the mining history of the area. Way stations, freighting stops, borax stop from Amargosa Borax Works to Daggett (1882-83) and 20 Mule Team route to Mojave (1884-88)—Saratoga was the hub.

Ibex Pass 2000—elevation To the left is the Ibex Spring, destined for bulldozing by the US Park Service—Saved by the Mojave River Valley Museum and now "adopted" by the Museum under the auspices of the Park Service.
Talc mining on hill to the north, see white spot. 41.9 miles

Drop down into the floor of the ancient Lake Tecopa, now drained by the Amargosa River. See greenish lake sediment from thousands of years of lake deposit during the Ice Age. Off in the distance, toward the east, you will soon see the V in the Nopah Range. That is Emigrant Pass, on the OLD, OLD road from Las Vegas. Nopah is the Uto-Aztecan word for "no water." Pahrump is the word for place of water, which is over the hill in Nevada. New Mexican traders and the trappers and the 49ers—all camped in the southern part of this valley.

The main Indian village is around Shoshone, called Yaga. Indians lived here until the 1940s and most moved to the Pahrump area.

**Shoshone Stop**

One of the last to leave Greenwater was Ralph Fairbanks who brought several of the buildings from Greenwater to start Shoshone next to one on the Indian villages. The heirs of Fairbanks still own most of the town. Brian Brown owns China Ranch. The museum is housed in one of the old Greenwater buildings.

**Doublin Canyon and Miners' condos Short Stop**

After the seeing the cut on the Charlie Brown Highway we head south down Amargosa Valley and below the lakebed of Ice Age Lake Tecopa.

Emigrant Pass and Resting Springs. Dr. Harry Godshall and his wife Jo have graciously welcomed us to rest (and use their bathroom facilities) at this most historic spot. Dr. Lincoln Godshall was a mining engineer who ran the Noonday and the Bunsite mine, mining lead for Pittsburg Paints, plus gold and silver.

We explore the wagon road and mule trail over the Nopah Range, see the wagon tracks as they head toward Las Vegas.

Head back toward Tecopa and to China Ranch, owned by Brian and Bonnie Brown. a beautiful ranch along the sweet water of Willow Creek. A one-mile hike takes us to an ancient Indian village where we can see 30+ house circles and an Indian trail.

5:00 p.m. Head for Desert Studies Center at Soda Springs, ZZVZX.

6:00 p.m. End of Field Trip.

Hope you had a good time and an educational experience, and can appreciate the heritage of the Mojave Desert.

**RULES:** No picking up artifacts. It's against the State and Federal antiquity laws. Find them, photograph them and turn in a site report to the closest agency.

Leave the desert cleaner than you found it. Don’t even leave a cigarette butt. Bring everything back, including your spouse.