AFTON CANYON

Background Information

Desert Studies Center
March 1991
AFTON CANYON GEOLOGY

Prepared by Ken Schulte, BLM

INTRODUCTION:

During the California Desert Conservation Area (CDCA) planning process (1976 - 1980), Afton Canyon was nominated as an Area of Critical Environmental Concern to protect natural and scenic values in the area. The nomination noted that Afton Canyon is one of the few places where the Mojave River surfaces and sustains extensive riparian vegetation and diverse wildlife. It also noted that Afton Canyon contains outstanding scenic quality due to the unique vegetation and spectacular erosional strategical. Afton Canyon itself is a notable geologic feature, even without considering associated geology (Wachter, et al, 1976, p.244). BLM is preparing a report in support of a protective withdrawal petition for a total of 8,835.26 acres.

PRE-PLEISTOCENE HISTORY:

The basement complex, consisting of Mesozoic and pre-Mesozoic-age metamorphic and igneous rocks is overlain by Cenozoic-age volcanic and sedimentary deposits. The oldest rocks are in the central and eastern part of Afton Canyon. Marble, exposed at the downstream end of the canyon, is believed to be Paleozoic in age. An orthoquartizite unit in the metamorphic-igneous complex is tentatively correlated with the Triassic-Jurassic Aztec Sandstone on the basis of lithologic similarity and age constraints (Cameron et al, 1979, p. 397).

During and since the Mesozoic era, the region has undergone uplift and erosion which has exposed large areas of intrusive and metamorphic rocks. During the period of uplift and erosion, igneous activity continued with the intrusion of numerous dikes. Volcanism became particularly active during the Miocene epoch with extrusive and, in part, explosive phases. Pyroclastic rocks are exposed on the south side of Afton Canyon in Sections 20 through 24 and Sections 28 through 30. Erosion of the pre-Tertiary rocks continued during the Miocene epoch. Drainage was partly into internal basins with deposition of non-marine sediments (Collier & Danehy, p. 18). Faulting and folding were active during Tertiary time and have continued up to the present.

PLEISTOCENE LAKES

More than a century ago it was recognized that many of the valleys in the Great Basin states of Utah, Nevada, Oregon and California were completely enclosed and lacked outlets to the sea (Snyder, et al, 1964). Throughout many of these valleys the early investigators recognized land forms as having formed in a lake environment.

Manix Lake existed during the late Pleistocene, or Wisconsin stage, probably representing the pluvial period equivalent to
the Tioga stage of Sierra glaciation. Water that filled Manix Lake came from the north slope of the San Gabriel Mountains before complete capture by drainage through Cajon Pass, and from the San Bernardino Mountains, which formed the headwaters of the Mojave River in Manix time. If the present rainfall had been doubled during a pluvial (rainy) period, it would have represented little actual increase in the desert areas, which might have had 8 or 10 inches, but would have represented an increase to something like 50 inches in the mountains, enough to supply a good-sized perennial river and to keep a large desert lake filled. Overflow from Manix Lake filled the pluvial Lake Mohave which covered both the present Silver Lake and Soda Lake Basins, respectively north and south of Baker, and overflowed that lake into Death Valley to fill Lake Manly (Bassett, A.M., 1967, p. 2).

MANIX LAKE:

In late Pleistocene time, a large area encompassing Coyote Lake, Troy Lake and the Mohave River eastward to Afton Canyon, was covered by Manix Lake. Fossils have been found mainly in the upper lake clay facies of the Manix Beds of Buwalda (1914). These include bones, largely those of birds (some extinct, but most still living), mammals (including horse and camel), and locally abundant shells of clams and snails.

Blackwelder and Ellsworth (1936) examined exposures of lacustrine sediments in the Afton Canyon area, and inferred two moist epochs of extensive lakes. Radiometric dates and field evidence suggest that Manix Lake #1 rose to 1780 feet, formed the lower of two shorelines, deposited a thick section of sediments containing Rancholabrean fauna, and may have dried up prior to 47,000 years ago based on carbon 14 age-dating results from the Yale Radiocarbon Lab according to Jefferson (1982, p.11). Manix Lake #2 rose to 1800 feet, carved an upper shoreline in alluvium, buried the earlier lake beds, and was drained perhaps 19,000 years ago (Jefferson, 1982). Anodonta clam shells collected from the 1800-foot bench near Afton Canyon yielded an age of 20,050 years. A more recent date for the draining of Manix Lake is provided by Meek (1989) who proposes that Manix basin was intact at least until 14,230 years ago. A new age estimate on Anodonta found in situ on the highest shoreline indicates that the Manix basin was intact at least until 14,230 years ago, plus or minus 1,325.

The draining of Manix Lake was probably accompanied by erosion of its outlet near the Manix fault. Subsequent downcutting and erosion by the Mojave River has resulted in badlands geomorphology with excellent exposures of the lake and pre-lake sediments as well as the fanglomerate in Afton Canyon. Afton Canyon is described as the finest such water gap of the Mojave Region (Wachter, et al, p. 244). It is probable that the Manix fault was responsible for the zone of weakness that has been eroded to form Afton Canyon, and it is possible that a break along this zone may have taken place while Manix Lake existed, creating a new outlet for the lake which could have cut rapidly
into the shattered rock draining Manix Lake rather quickly (Bassett, 1967). On April 10, 1947 movement along the fault produced an earthquake of magnitude 6.2 centered near NE1/4 Section 4, T.10 N., R.4 E., eight miles west of the study area.

MANIX FAULT:

The most important structural feature of the area is the Manix fault zone which is well exposed in Afton Canyon. It is considered to be a major active fault in the east-central Mojave Desert (Bassett & Kupfer, p. 40). Geophysics and surface mapping indicate that the total length of the Manix fault zone is at least 22 1/2 miles with the western terminus at the Calico Mountains and trending eastward, disappearing beneath alluvial cover east of the Afton Canyon (Hamilton, 1982). The left-lateral Manix fault system terminates at the northwest trending right-lateral Calico fault, somewhat as the Garlock fault terminates at the San Andreas fault. Strike-slip movement is suggested by the braided or anastomosing tendency of the fault trace and the presence of high blocks on both sides of the fault (Bassett & Kupfer, p. 41). Left Lateral displacement is suggested by the direction of the fold axes in the Miocene rocks adjacent to the fault zone. The fault zone strikes slightly north of east. South of the canyon the fault separates thick gravel deposits on the north from brecciated slivers of Tertiary volcanic rocks on the south. In Afton Canyon, a zone of intensely fractured, sheared, and altered rock over 1,000 feet wide separates thick Tertiary sedimentary rocks on the south side of the canyon from basement granitic and metamorphic rocks on the north side. The Manix Fault Zone has been described in detail by Keaton (1977).

SPECIAL FEATURES

Beach Bar:

The Afton Road turnoff traverses a beach bar of Pleistocene Manix Lake in the S1/2 Section 1 (T.11 N., R.5 E.). Rounded pebbles can be found just west of the road edge. The bar trends northwest, and another bar in Sections 8 and 17 (T.11 N., R.6 E.) trends north-northwest. Both were formed along the eastern edge of the basin, due to wave action generated by winds from the west.

Palisades:

Vertical walls have been cut into the Pleistocene gravels of the Manix Formation and eroded into impressive palisades. These are especially prominent on the south side of the canyon in the south one half of Section 14 (T.11 N., R.6 E.). The Pleistocene gravels have been consolidated into "fanglomerate" derived from the Cady Mountains to the south. As this alluvial fan was being deposited where Afton Canyon exists today, lacustrine clays were being deposited to the west during the early phase of Lake Manix.
CAVE MOUNTAIN MINERALIZATION:

Both limestone and iron have been produced from deposits just downstream from Afton Canyon and along the south slope of Cave Mountain.

Limestone was mined from the Cave Canyon deposits about 500 to 1,000 feet east of the Afton Canyon ACEC (Area of Critical Environmental Concern). Technically, the limestone is actually marble and is part of the unit mapped by Southern Pacific geologists as "undifferentiated metamorphic-igneous complex". The marble is probably Mississippian in age based on fossils found in similar hills farther east (Bassett, p. 3). From 1906 to the early 1920's "limestone" for use as sugar rock was quarried from the Baxter and Ballardie deposits, then owned by D.F. and D.A. Baxter and A.W. Ballardie. Adjoining quarries were operated during part of the same period by Sugar Lime Rock Company of Los Angeles (Wright et al, p. 173). These old properties, together with adjoining land owned by the Southern Pacific Company, were acquired by California Portland Cement Company (CPC) in 1930. CPC is now owned by Calmat.

Iron mineralization occurs in or associated with shear zones as replacement bodies in either marble or the metamorphic-igneous complex rocks.

Iron ore (hematite and Magnetite) has been mined east of the Afton Canyon ACEC from the Cave Canyon iron deposits (SE1/4 Sec. 11 & SW1/4 Sec. 12, R.11 N., R.6 E.) owned by Calmat. CPC has mined the deposits intermittently since 1930 (Wright et al, p. 93) and used it as one of the essential ingredients for making Portland cement at Mojave and Colton. The iron oxide minerals, are used to form calcium aluminum ferrite, which helps to reduce kiln temperatures for production of clinker and to increase sulfate-resistance of the finished cement. Clinker refers to the temperature at which partial fusion occurs. Workings include several shafts, adits, and trenches. In 1957 (Gay, p.247) production was given as 50,000 tons every 2 years. In 1984 CPC produced 15,000 tons of which 5,000 tons were trucked to Mojave (Rains, 1985). In 1957 the reserves were estimated as 3,500,000 tons of 52-57 percent iron.

MAGNESITE OUTCROP:

Magnesite occurs in the "Cliffside deposit" in SW1/4 SE1/4 Section 21, T.11 N., R.6 E. The deposit is described by Collier and Danehy (1958 p. 13) as being about 14 feet thick, striking northeast, and dipping 45 degrees to the northwest. Wright et al (p. 159) described the deposit as 30 to 75 feet thick and cropping out for a horizontal distance of 400 to 500 feet (from southwest to northeast). The white carbonate bed was probably initially a lacustrine limestone that has been altered to dolomite and in part to magnesite, the commodity for which the
bed was mined (Bassett, 1967). Basalt, perhaps as a sill, according to Bassett, is associated with the magnesite bed, which is separated by a thin mudstone unit from the pre-Tertiary hornblende biotite schist upon which the Tertiary section was deposited nonconformably.

A few carloads of magnesite were shipped in 1917-1918 from the Cliffside deposit (Wright, p. 159). Ore was carried by a 1900-foot aerial tram across the river to the railroad, and shipped to International Magnesite Company, Chula Vista. Resources of 100,000 to 200,000 tons of ore lie above the canyon floor with 30 percent MgO content, but the silica and lime content are high and may present quality problems (Wright, p. 159). Seawater and natural brines are the principal raw materials used for U.S. magnesium compound production (Kramer, p. 104).

CRONESE LAKES:

Cronese Valley is occupied by two playa lakes known as West Cronese and East Cronese. The present environment in Cronese Valley seems to be duplicating, on a smaller scale, an identical environment that existed at a slightly higher elevation quite recently. Present playas sit on and in dissected older playa deposits; present sand dunes blow across eroded dune deposits now partly cemented; present playa lakeshores lie below older shorelines, and older fans are being dissected to yield modern fan deposits. A contributing factor to this situation is the whimsical nature of the Mojave River which can, in flood, drain northward from Afton Canyon into Cronese Valley or eastward into Mojave Sink. Cronese Valley has been flooded in historic times and certainly must have held varying amounts of water since the Pleistocene. Base level changes may be accounted for by such water level changes and erosional changes in basin outlets, but tectonic base level controls are also suggested (Watchter, et al, 1976, p. 271).

Although Mojave River flood water occasionally flows into East Cronese Lake, it only rarely overflows into West Cronese lake. Ground water underflow from the Mojave probably continues to move into East Cronese Valley throughout the year (Burnham, 1955, p. 10). The clays that floor West Cronese Lake have a high salt (surface) content and in other ways seem to be quite different from those flooring East Cronese Lake (Anctil, et al, 1957, p. 7). A well in Section 19, near the center of East Cronese Valley, penetrated 252 feet of sediment, mostly clay and silt. A 67-foot-thick zone of dark blue clay was logged, beginning at a depth of 91 feet. Possibly this clay is correlative in time with Lake Manix (Anctil, et al, 1957, p. 7).
REFERENCES:


, 1966, Geologic Map of the Newberry Mountains


Rains, John, 1985, personal communication with manager for California Portland Cement Co.


Sonoran Natural Region Study prepared for the National Park Service Science Center, Univ. Arizona, Dept. of Geosciences, p. 244.

ARCHAEOLOGICAL BACKGROUND

Prepared by

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AFTON CANYON: DSC Faculty Field Trip

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Prehistoric Background on Afton Canyon, the Sink of the Mohave and the Cronise Basin by Anne G. Duffield

This Faculty Field Trip, with visits to Afton Canyon, the Sink of the Mojave and the Cronise Basin, will not only explore some of the most interesting geological landscape and one of the richest riparian habitats in the Mojave Desert, this trip will also traverse an area with a long and diverse history of human use.

In 1972, archaeologists Warren and Crabtree proposed the following regional cultural chronology for this part of the desert:

Period I: Lake Mojave 6000 B.C. -- 5000 B.C.
Period II: Pinto 5000 B.C. -- 2000 B.C.
Period III: Gypsum 2000 B.C. -- A.D. 500
Period IV: Saratoga Springs A.D. 500 -- A.D. 1000
Period V: Shoshonean A.D. 1000 -- A.D. 1840

Archaeological evidence, primarily surface finds, representing all of these periods has been found within the general area of this tour. Systematic research was begun in the 1920s and data has slowly accumulated since. Highlights of the significant archaeological work to date will provide important background to the cultural chronology proposed above.

The first professional archaeologist to study this part of the Mojave was in many ways one of the best and most creative, namely Malcolm J. Rogers. All subsequent research of any merit in the area references Rogers' work, particularly his first paper, Report of An Archaeological Reconnaissance in the Mohave Sink Region, published by the San Diego Museum of Man in 1929. Beginning in April of 1926, Rogers surveyed the sink of the Mojave River (southwest of the Desert Studies Center) and also the Turquoise Mountains to the northeast near Halloran Summit off I-15, looking for archaeological remains. He found sufficient evidence, he believed, (primarily stone tools and pottery) to assert that this part of the Mojave Desert was occupied by
Puebloan people, specifically from the Basketmaker III period. In his later papers, Rogers elaborated on his chronology and included Basketmaker III at the end of his "Amargosa Industry", which he dated from A.D. 200 to A.D. 900 (Moratto 1984:353).

After documenting the prehistoric mining tools and other artifacts still present there, Rogers shifted his focus from the Turquoise Mountains to the Sink of the Mohave (as he spelled it) in search of supporting evidence for his theories.

"It was in the hope of finding a more definite Puebloan occupation of California that we removed our activities to the south end of the Mohave Sink; we were not disappointed. Here the ecology is, or has been, more favorable to such a culture... The two Cronise Lakes, situated just west of where the Mohave River enters the Mohave Sink, and into which the river sometimes empties, have had water in historic times; both are completely surrounded by Indian camps and villages. At East Cronise Lake, wavecut terraces on some of the older sites show that they have been partially covered by water since their abandonment (Rogers 1929:8, emphasis added).

Rogers followed these observations with a suggestion which has been challenged by many later archaeologists but has never been systematically tested. Solid evidence of prehistoric agriculture (or, more properly, horticulture) in the Southern California deserts remains elusive. Continuing,

If agriculture, such as corn culture, was ever practiced in the Mohave Desert, this locus has always seemed to me to have offered the most favorable environment. If the overflowing of the lower reaches of the Mohave River and its sinks was fairly periodical, corn-culture could have been conducted as it was by the Yuman peoples of the Colorado River. The only evidence that we could find indicative that corn was grown here is the great number of metates and manos present (op.cit).

During his survey of the East Cronise Lake basin in 1928, Rogers discovered "a site whose Puebloan attributes are sufficiently strong to identify it as a permanent village of these people" (op.cit. pg. 10). These attributes included house floors, chipped stone, broken metates, manos, pottery sherds and even two Mohave cremations, eroding out of a low saddle on the east side of the lake. Malcolm Rogers was certainly fortunate to have seen these resources when he did, and modern researchers are likewise fortunate that he had the skill to recognize them for what they were and the dedication and support to publish his findings. Certainly the slopes and sand dunes around East
Cronise are not covered with artifacts and cremations today.

Surveying during the same years as Malcolm Rogers, and sometimes in scholarly competition with him, Elizabeth C. Campbell, with her husband William, scoured the Mojave for traces of man around the former shorelines of what she recognized as Pleistocene lakes. Her 1937 report for the Southwest Museum entitled The Archaeology of Pleistocene Lake Mohave is still considered a classic. The Campbells' work established the "Lake Mohave point" as a diagnostic artifact type for the earliest period of occupation of the desert (Campbell 1937). The Campbells also recorded sites along the shore of East Cronise Lake in 1932 and 1935, though the results of these surveys have not been published (York 1990:1).

During the 1940s and 1950s, large numbers of archaeological sites were recorded along the Mojave River by Gerald Smith and Ruth D. Simpson, in cooperation with the San Bernardino Museum and the Archaeological Survey Association. Unfortunately, the data accumulated by these surveys has never been completely analyzed, though the resource potential is intact. As Director of the San Bernardino Museum, Gerald Smith carried out many surveys and several excavations along the Mojave River in the 1960s, some of which have been documented (Smith et al, 1957). The assertion by a Barstow resident that Dr. Smith excavated the deposits in the large cave in Afton Canyon years ago has not been verified (Casebier, personal communication, 1979).

What amounts to the first serious academic study to be undertaken in the area since the 1930s was conducted by Christopher Drover in 1979 for his PhD. in Anthropology from the University of California at Riverside. His dissertation, entitled The Late Prehistoric Human Ecology of the Northern Mohave Sink, San Bernardino County, California presented the results of his research and excavations in the Cronise Basin. Drover documented intensive prehistoric use of the area, as evidenced by dense archaeological deposits, numerous inhumations and cremations, and abundant "shell middens" composed of cemented charcoal and freshwater mussel shell. Drover maintained that most habitation in the basin had occurred in protohistoric times, between about A.D. 1450 and A.D. 1750.

Drover's study of the ethnographic literature relating to the Cronise and the Sink of the Mohave point up a significant feature of area's prehistory. The cultural provenience of this part of the desert should really be considered as a transition or overlap zone. Traditional use of the territory is disputed among the Mohave, the Chemehuevi and Vanyume groups. It appears the area was an ethnographic borderline which may have shifted into historic times.

Padre Francisco Garces, in his journey through Afton Canyon
in 1776, found people living there that were different linguistically from the Mohave or the Chemehuevi. He called them "Bene- me", later rendered by Kroeber as Vanyume and related by him to the Serano of the San Bernardino Mountains. The Vanyume were considered extinct by 1900 (Kroeber in Schneider 1988:2).

The Chemehuevi, a group of Numic speakers, apparently used the Cronise for collecting salt. Oral traditions gathered from 23 informants of the Colorado River Tribes in 1979 establish fairly frequent salt mining on both the East and West Cronise Lake playas (Laidlaw in Drover 1979:64). Drover comments that

This behavior is confirmed by the observable nature of the saline deposits in these two playas. [According to Laidlaw's informants,] salt mining forays consisted of 7-10 people who carried their own water in a tied-off mountain sheep bladder and made simple brush or stacked stone windbreaks. Occupation was only long enough to gather salt and leave after several days. Salt was traded to the Mojave for the use of riverine agricultural land. Salt mining journeys to the Cronise Valley continued until 1930. While such behavior might explain some of the Cronise archaeological sites, the shellfish middens and cemeteries reflect other settlement patterns (Drover 1979:64).

Again according to modern informants, the Mohave Indians also used the Sink of the Mohave.

Four separate and distinctively owned aboriginal trails lead into the Mohave Sink from the Colorado River. In the early spring and late fall for a 2-3 week period, the Mohave maintained trading camps in Afton Canyon and as far west as Cantil, California as recently as the 1920s. One Mohave informant mentioned springs in the Cronise Mountains the activity of which, coupled with the Mojave River determined the time of year for their visits. One Mohave trail leads through the Cronise Valley on a north-south axis and was traveled by parties intending to mine red pigment further north in the Owlshead Mountains (Laidlaw in Drover 1979:65).

The question of ethnographic provenience of this area has been pursued by two recent archaeological projects worth mentioning. One was a contract study directed by Andrew York of the firm of Dames & Moore in which three sites were excavated to permit the installation of a U.S. Sprint fiber optics cable across the Bureau of Land Management Cronise Basin Area of Critical Environmental Concern (ACEC). Testing in December of 1987 revealed subsurface archaeological deposits, leading to a
data recovery phase in April and May of 1988.

The results of York's excavations in the Cronise were somewhat surprising. Unlike the deposits at Drover's sites, no culturally modified shellfish or fish bones were found; nearly all of the bone fragments recovered were from small mammals. Where identifiable, the faunal remains included, in descending order of abundance, desert cottontail, jackrabbit, desert iguana, woodrat, bighorn sheep, mule deer, bobcat and snake. Five separate firepits were uncovered, from which eight charcoal samples were taken for radiocarbon dating. Five of the dates cluster convincingly around 270 B.P. (Before Present or A.D. 1680), with the remaining three at 760, 560 and 500 B.P. (A.D. 1190 - 1450). Ceramics found in the sites also fit into this late prehistoric date range, with the ceramic types determined to be of Patayan II period, ca. 1000-500 B.P. The authors conclude that their research supports Drover's contention of a Lower Colorado River influence in the area, though possibly as a result of Mohave trading or the diffusion of ceramic technology (York 1990).

The most recent archaeological project of an academic nature to be undertaken in our area of interest was conducted by Joan Schneider of the University of California, Riverside. In her paper entitled Human Adaptation at the Afton Canyon Site presented in 1988, Schneider asserts that no archaeological excavation had previously been carried out in Afton Canyon, although some 17 archaeological sites have been recorded there. Of the six described as occupation sites, she states that most have been destroyed by the periodic flooding of the Mojave River, or severely impacted by recent human activity.

The site excavated by Schneider is located on a terrace on the south side approximately 18 meters above the level of the Mojave River. 36 five meter square surface units were collected and 27 one by two meter test units were excavated by a volunteer crew during the spring of 1984. The faunal material recovered included big horn sheep, tortoise, rabbit and fresh water mussels, with parts of the large animals selectively brought to the site, "especially tongues!". She reports that "16 artiodactyl hyoid bones" were found to support this, meaning tongue bones.

In an interesting series of parallels to the Cronise Basin sites, there were likewise no fish remains found by Schneider in the Afton Canyon sites. Her ceramic types were also identified as originating in the Colorado River and Southwest culture areas, as were those in the Cronise. Also, 42 of the 43 beads found in the Cronise Basin were made of marine shell (York 1990:5) while Schneider reported that "shell beads from the Pacific Coast and the Gulf of California were recovered, as well as fragments of abalone shell" (op.cit.). Radiocarbon dates for the Afton Canyon site are older than those for the Cronise, placing that occupa-
tion along the river at around A.D. 1050.

Schneider concluded her paper with a new slant on the ethnic affiliation of the late prehistoric users of the Afton Canyon site.

From the lack of fish remains at the site, and the preponderance of tortoise remains, I believe that the prime occupants of the Afton Canyon site were not Mohave, because of the Mohave food taboo regarding the consumption of reptiles, as reported ethnographically (Laird 1976, Kroeber 1925). There is a complete absence of Desert Side-notched points and pottery associated with Numic groups. The specific indentification of the groups using the Afton Canyon site is problematic at this time and the distinct possibility remains that the site was used by several different contemporaneous groups (Schneider 1988:3).

In summary, the archaeological potential of this rich area of the Mojave Desert is only just beginning to be realized. Focusing on the persistent questions, future studies presumably will continue to fine-tune the cultural affiliation and chronology of the region, which is clearly considerably more complex than previously perceived. It may be that the Mojave River is the late-period north-south cultural boundary for the Mojave Desert, with prehistoric trade routed along its banks, foreshadowing the interstate highway a few miles to the north. Research needs to continue in these promising areas.
Bibliography

Campbell, Elizabeth W. C., et al
1937 The Archaeology of Pleistocene Lake Mohave. Southwest Museum Papers No. 11, Los Angeles.

Drover, Christopher
1979 The Late Prehistoric Human Ecology of the Northern Mohave Sink, San Bernardino County, California. Dissertation on file, UCR.

Moratto, Michael J.

Rogers, Malcolm J.

Schneider, Joan S.

Smith, G. A., W. C. Schuiling, L. Martin, R. J. Sayes and P. Jelson
1957 Newberry Cave, California. San Bernardino County Museum Association Scientific Series No. 1

York, Andrew
BIOLOGICAL BACKGROUND

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RESOURCE ECOLOGY
AFTON CANYON

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I'm presenting you this list of references to back up some of the things I want to show you on this Desert Studies weekend. Getting existing information on field sites is becoming more and more important to field biologists.

MAPS
Demos: USGS 7.5 Quads, Orthophotos, 1:100,000, Soil Map on Orthophotos, LORAN system (vs. GPS)
Soda Mountains California, 1:100,000 1978 Surface Management Status..Bureau of Land Management (Planimetric)
California: Index to topographic and other map coverage. Published and distributed by U. S. Geological Survey, National Mapping Program. Address: U. S. Dept. Agriculture, Soil Conservation Service (soil maps with orthophotos)

AERIAL PHOTOGRAPHS
Demos: NAPP stereo pairs, NAPP microfiche
Address: U. S. Geological Survey - Dept. of Interior, EROS Data Center, Sioux Falls, SD 57198.
Forms: NAPP/NHAP Order Form, Geographic Search for Aircraft Data Inquiry Form
Microfiche: NAPP/NHAP Mapline Plots... Los Angeles (N).. Trona

PHOTOGRAPHS (3-D, ETC)
Demos: Polaroid Cameras.. 3-D pictures, panoramic photos, self-trip systems

WILDLIFE HABITAT RELATIONSHIPS DATA BASE
Demos: Printout for S. Mojave Desert Hydrological Area
CALIFORNIA NATURAL DIVERSITY DATA BASE
Demos: Printout for area Quads, Overlay system
Calif. Dept. Fish and Game. 1990. RareFind: A database application for the use of the California Department of Fish and Game's Natural Diversity Data Base. Mimeo.

CALIFORNIA ENDANGERED SPECIES INFORMATION SYSTEM
Demos: Printout of a typical search.
Address: Peggy Cranston, U.S. Bureau of Land Management, California State Office, 2800 Cottage Way, Sacramento, Calif. 95825

BIRDS
Demos: Printout of breeding bird data for nearest route
Address: Sam Droege, Fish and Wildlife Service, Office of Migratory Bird Management, Laurel, Maryland 20708.

FLUORESCENT DYE TRACKING
Demo: live trapping on Friday night... u-v tracking on Sat.

IMPACTS

DESERT RIPARIAN

Fish and Wildlife Reference Service Newsletter. 5430 Grosvenor Lane, Suite 110, Bethesda, MD 20814


NOAA. 19--. Climatological Data: Annual Summary, California. U. S. Dept. Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service (day, month, year... temp. and rainfall data... Baker is nearest station?)


U. S. Bureau of Land Management. .... Habitat Management Series for Unique or Endangered Species. Denver Service Center... T-N.... various species.

U.S. Fish and Wildlife Service. ..... Habitat Suitability Index Models: ..... various species. Biological Services Program, FWS/OBS.... various

THE TAMARISK INVASION
OF
DEsert RIPARIAN AREAS

by William M. Neill
M. S., Geology

Educational Bulletin # 83-4
A publication of the
Education Foundation of the
Desert Protective Council, Inc.

Deciduous tamarisk in bloom, showing small
white-to-pink flowers and scaley, cedar-like leaf.

Water is the most precious of life-sustaining resources in the desert. Consequently, the perennial springs and streams of the desert — where fresh water can be obtained during the hot summer months — are the most productive of wildlife habitats. A rich variety of animal species — bighorn sheep, birds, rare fish and amphibians — depend for their survival on the constant flow of water at these scattered oases and on the plant and insect life that flourishes there.

Human occupancy of the desert has centered around the perennial water sources since prehistoric times, but in recent decades this impact has intensified greatly, as some have been expropriated by mining or cattle-grazing operations, others have been diverted to support agriculture, residential settlement, or transportation, and still others have been trampled by feral burros descended from those abandoned by prospectors. To this list of assaults must be added another threat to desert ecology, less obvious but equally damaging: It is the uncontrolled invasion of a foreign plant, Tamarix sp. called deciduous tamarisk or saltcedar, which was imported from the Mediterranean region a century ago. Tamarisk is a virulent pest in desert riparian areas because it aggressively displaces native trees and shrubs, it withdraws and transpires water from the ground at a high rate, and it is a poor source of food and shelter for desert wildlife.

EARLY HISTORY

Tamarisk seeds were first brought to North America in the 1800’s from southern Europe or the eastern Mediterranean region. Originally it was planted by immigrants to the southwest desert as an ornamental shrub or shade tree, or to create wind breaks, or to stabilize eroding stream banks. Soon, however, tamarisk escaped cultivation and dispersed widely along river courses owing to wind transport of its pollen-size seeds. Along the upper Gila River in Arizona, wild tamarisk growth was first noticeable after a flood in 1916; then, with rapid proliferation, the plant became common in the 1920’s, abundant in the 1930’s, and the dominant riparian tree species, replacing willow and cottonwood, in the 1940’s. The same rapidity of infestation was observed in central Utah and the Rio Grande and Pecos River valleys of New Mexico and Texas. By 1961, according to the only comprehensive inventory yet published, tamarisk occupied an estimated 1400 square miles of flood-plain land in the western United States.
As early as 1950, the tamarisk invasion had come to the attention of water-supply and flood-control authorities, primarily in Arizona and New Mexico, who were concerned about the wasteful loss of ground water through transpiration and the constriction of flood channels by dense tamarisk growth in the river valleys. The economic impact of the problem led to detailed investigations by government scientists, who contributed the following assessments:

Salt cedar ... probably was introduced from southern Europe over a hundred years ago, and in this relative short period has spread with alarming rapidity until it is now found to some extent in almost every drainage channel throughout the Southwest. In some areas ... this highly aggressive species has thrived at the expense of other vegetation so that the infested lands are nearly valueless for grazing or wildlife. Further, these jungle-like growths often have encroached into the stream channels to such extent that a flood problem is created. (Bowser 1952)

Sometime during the second decade of this century, saltcedar ... was introduced into the Gila River Valley. Conditions for the growth of this plant were ideal, and it spread rapidly throughout the bottom land wherever it could reach its roots to the water table. The number of cottonwoods and willows in the meantime declined, but because of destruction by man and because these plants could not compete with the saltcedar, which thrive and spread at the expense of nearly all the native plant life. (Gatwood, 1950)

Saltcedar is a very tenacious plant. Its ability to survive periodic cutting or burning and to regrow perhaps more luxuriously than before has been demonstrated. (Bowser, 1952)

Where conditions are favorable saltcedar grows as a dense jungle-like thicket that is difficult to penetrate (Gatwood, 1950)

Saltcedar is a highly water-consuming naturalizing shrub that has escaped from cultivation and spread rapidly from one stream valley to another. An aggressive plant, it has not only invaded but has entirely replaced the native vegetation in many areas... owing to the rapid spread of the plant, its high water consumption, and the potential flood hazard engendered by it, saltcedar is of concern to the residents of these regions. (Robinson, 1965)

Although many introduced plants grow along waterways in the Southwest, it is mainly saltcedar that has come to dominate extensive areas... Its rapid spread on the flood plain of the Gila River and elsewhere is largely the result of prolific seed production, effective seed dissemination, rapid growth, and early maturation. (Turner 1974)

**ATTRIBUTES**

Compared with the native trees and shrubs of desert riparian areas, tamarisk is impressively robust and competitive, yet has markedly inferior value as wildlife habitat. Consider these aspects of its botanical personality:

A single large tamarisk tree produces a half million seeds a year, which disperse widely by wind and germinate wherever the soil remains moist for several weeks. Seedlings mature rapidly and produce small, pink flowers often by the end of the first year. Under optimum conditions, a desert riparian area containing only a few tamarisk trees can be converted to an impenetrable thicket in less than a decade.

Tamarisk grows so rapidly, up to one foot per month, and so densely that native trees are crowded and shaded from direct sunlight and cannot thrive.

Tamarisk is reputed to have the highest

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Mature, multi-branched tamarisk tree about 15 feet high and 15 feet wide. Note figure on left for scale.
transpiration rate of all deep-rooted trees that tap the water table. Moreover, tamarisk is more resistant to drought, once seedlings are established, than most native riparian trees, so that at time of water stress the native trees die but tamarisk survives and thereafter consumes a greater fraction of the available ground-water supply.

Tamarisk can tolerate excessive salinity in water and in soil by its ability to exude salt crystals from openings in its scale-like leaves. The salt falls or is washed to the ground, where it kills emerging grasses and seedlings of other tree species. As a result, where it is well established in dense thickets, tamarisk is likely to be the only form of plant life. As noted by Van Hylckama (1980), "One rarely finds an intruder in a saltcedar thicket."

Tamarisk is not killed by fire, cutting at ground level, or application of herbicide to the foliage, unless the root system is killed, the root crown will resprout vigorously. Effective tamarisk removal requires (1) mechanical uprooting or (2) cutting at ground level and applying to the stump a systemic herbicide that is carried to the roots by vascular transport.

The seed of tamarisk is too small to be eaten by rodents or birds, and its thin, scalely leaf is unpalatable to native browsing animals and to leaf-eating insects. By contrast, the native mesquite tree produces large, nutritious seeds, rich in protein, that are a mainstay of rodents; mesquite and willow provide high-quality forage for desert bighorn sheep; and willow and cottonwood harbor a greater abundance of insect life than does tamarisk, so are more beneficial to many bird species.

CONTROL EFFORTS IN CALIFORNIA

On the California desert, tamarisk is well established along parts of the Colorado and Mojave Rivers and at places around and near the Salton Sea. At these localities, the growth is so dense and widespread and has so completely replaced native vegetation that efforts at control or eradication would be impossibly difficult and would follow, rather than prevent, the loss of natural habitat. Elsewhere, the problem is not so formidable. At many smaller, isolated water sources that are scattered about the desert, the infestation either is fairly recent or is restricted in size by limited water supply or inhospitable growing conditions. In these cases, control measures to preserve the indiginuous riparian vegetation are both feasible and potentially effective. The list of desert water sources that warrant such attention includes Amargosa Canyon, Big Morongo Canyon, Corn Spring, Darwin Falls, Piute Creek, Saline Valley and possibly San Sebastian Marsh.

One tamarisk removal project has already been completed, with dramatic success, at Eagle Borax Spring in Death Valley National Monument. Deciduous tamarisk probably was present at this large marsh, on the west side of the valley floor, in the 1940's or before, but due to grazing by horses it did not proliferate until the mid 1950's. It then spread and grew rapidly during the next decade, so that by the late 1960's, the surface water in the marsh had disappeared, the native grasses and reeds were being replaced by tamarisk, and mesquite trees adjacent to the marsh were slowly losing vigor owing to the competition for ground water. After burning the tamarisk cover in 1972 to restore the water level in the marsh, the Park Service began permanent removal by cutting with chain saws and applying systemic herbicide to the stumps. The program was continued intermittently by Park Service employees over the next 10 years and then completed in 1982 with volunteer assistance. With the tamarisk gone, the recovery of the marsh has been rapid and impressive: the surface water has returned, to be used by migratory birds; the grasses and reeds are flourishing; and the grove of mesquite trees is again healthy.

With the Death Valley achievement as a guide, Anza-Borrego Desert State Park and the U.S. Bureau of Land Management are separately initiating programs of tamarisk control at other important riparian areas of the California Desert. To a large
extent, at least on BLM land, these efforts will require weekend volunteer labor to be successful. Friends of the desert who can participate will be rewarded with immediate, tangible results to show for their labor and the satisfaction of helping to avert the eventual loss of these fragile, most important natural resources.

For further information, or to volunteer write —
Riparian
P.O. Box 193
Lucerne Valley, CA 92356

REFERENCES


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Heavy vegetation in middle distance is composed entirely of large tamarisk trees. Mojave River west of Afton Canyon.

CARRY PLENTY OF WATER

DESERT PROTECTIVE COUNCIL INC.

Educational Bulletin #83-4
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The East Mojave Desert

The East Mojave, in Southern California, is a masterpiece of nature, with splendid jagged peaks rising from the desert floor, the highest being Clark Mountain at 7,929 feet. There’s the drama of thirty-two volcanic cinder cones in Mojave Cinder Cones which give the appearance of a lunar landscape. Extensive joshua tree forests ascend into pinyon-juniper woodland and on two peaks, into small communities of white fir. Compare these to the Kelso Sand Dunes, sculpted by the sand and winds of the Devil’s Playground.

In all of the California Desert there is no finer grouping of different wildlife habitats. The East Mojave supports almost 300 species of animals. The Providence, Granite, and New York Mountains, Cima Dome, and the Kelso Dunes are the finest examples of their particular habitat types in California.

Also rich floristically with over 700 species of plants, the East Mojave is home to over 25 rare or endangered species. Many more plants and animals still need to be identified.

Unique cultural, historical, and archaeological resources abound in this 1½-million-acre area. Visitors can observe petroglyphs, pictographs, Indian sites, Indian trails, the Mojave Road, abandoned army forts and posts, abandoned mines, ghost towns, abandoned railroads, and the Kelso Depot, a magnificent two-story railroad depot built in 1924.

The natural and cultural resources of this region are breathtaking. This national treasurehouse must be protected and preserved for present and future generations or it will be lost. The East Mojave is truly the “Gem of the California Desert.”

A Brief History of the East Mojave

Human Occupation

The Mohave and Chemehuevi Indians were the first historic peoples known to inhabit the East Mojave.

European influence started with Father Francisco Garces’ expedition in 1775. He was guided by Mohaves across the Colorado River, over the Providence Mountains, to the Mojave River, on to Mission San Gabriel and back to Arizona.

During the Spanish and Mexican periods of California history, the Mohaves and Chemehuevis were basically independent of European influences.

In 1850 California became a state at which point administration of public lands of the East Mojave was assumed by the Government Land Office. In 1859 the Mohave Nation was defeated by the U.S. Army, which then built the Mojave Road and set up a series of military posts. In 1867 the Chemehuevis surrendered to the Army. Both Indian nations now have their own reservations along the Colorado River.

Railroads, Mines, and Cattle Grazing

The railroad between Needles and Barstow was completed in 1883 by Southern Pacific. By completing this line, the company acquired immense holdings of land in alternate sections along the tracks. Soon after, Santa Fe acquired control. In 1905, the railroad line now owned by Union Pacific was completed between Yermo and Las Vegas.

The first commercial mines in the East Mojave were the silver mines of the Macedonian Mining District. Activity lasted from 1863 to 1866. The Clark Mountain Mining District was active in the 1870s. The Bonanza King Silver Mine made the town of Providence active in the 1880s. The Vanderbilt gold mining area was active in the 1890s. The only present large-scale commercial mines in the East Mojave are the rare earth mines at Mountain Pass.

Cattle grazing has been prevalent in the region ever since the Rock Springs Land and Cattle Company was incorporated in 1894 and continued unregulated on the public lands until the Taylor Grazing Act of 1934.
Geographical Values

Fifteen mountain ranges, two dry lakes, nine valleys, one creek, innumerable washes, vulcanism, rhyolite plugs, piedmont, one sand dune system and other geologic phenomena are located within the area.

Some of the region’s most outstanding geographical features include the Providence Mountains, New York Mountains, Clark Mountain, Pioche Creek, Granite Mountains, Piute Range, Cima Dome, Mojave Cinder Cones, Woods Mountains, Devil’s Playground, Soda Dry Lake, Kelso Sand Dunes, Castle Peak, Pinto Valley, Table Mountain, Wildhorse Mesa, Pachalka Spring, Midhills, Kokoweef, Clipper Valley, Ivanpah Valley, Ivanpah Mountains, Watson Wash, Woods Wash, Fourth of July Canyon, and Hole in the Wall.

Geographically, this region is part of the Great Mojave Desert, of which the Western and Central portions have been urbanized and disturbed by the works of man. The East Mojave, however, is still near-pristine.

Scientists ask many questions about the East Mojave: What caused the formation of the Cima Dome? Were the Mojave Cinder Cones formed only 800 years ago? How large were the Pleistocene Lakes? Where does the Mojave River water go? What was the nature of the tropical forests in pre-Pleistocene times? When did the giant ground sloths become extinct? These questions have yet to be fully answered. The East Mojave is certainly a scientific treasurehouse.

Botanical Values

The East Mojave is especially rich in botanical resources. The four botanical zones of the Great Basin, Mojave Desert, Sonoran Desert, and California coastal zone intermingle their particular species of plants.

The region’s major trees include Joshua tree forests, pinyon-juniper forests, desert willow, and a few white firs. Cima Dome contains the world’s largest Joshua tree forest. Other major plants include Mohave yucca, Baccatia yucca, many species of cactus, sagebrush, creosote, fern, galleta grass, and innumerable species of wildflower. The spring wildflowers are especially beautiful. The Pioche Creek oasis is fascinating.

California coastal-zone plant communities are found in the New York Mountains and the Clark Mountains. Some of their outstanding plants include oak, manzanita, ceonothus, California lilac, silk tassel, and yerba santa. It is remarkable that these coastal species exist in the desert. Every means necessary must be undertaken to protect this outstanding resource.

The East Mojave is botanically rich with its over 700 species of vascular plants, of which 25 are listed as rare or endangered.

Wildlife Values

Supporting almost 300 species of wildlife, the East Mojave has some 47 species of mammals, 36 species of reptiles, and 206 species of birds. Many insect and other species have yet to be identified and cataloged.

Some of the mammals include bighorn sheep, mountain lion, coyotes, bobcats, porcupines, and bats. The non-native feral burros have caused extensive environmental damage here. Efforts at burro reduction must be increased to help eliminate this problem and to reduce competition among animals naturally found in this habitat.

Some of the outstanding birds include golden eagles, prairie falcons, doves, and quails. Excellent birding sites include Alton Canyon, Kelso Depot, and Piute Creek.

The second densest area of desert tortoise (Gopherus agassiz) in the world is in the Ivanpah Valley. In fact, reptiles of every description, including the Mojave fringe-toed lizard and the regal ring-necked snake, are found here. Several endemic insect species, found nowhere else, have been sighted on the Kelso Sand Dunes.

The Mojave Chub, an endangered Pleistocene fish, is protected at Soda Springs.

Cultural and Archaeological Values

The East Mojave, that treasurehouse of historical, archaeological, and educational resources, has many unique cultural resources.

The anthropological record suggests that the Mohaves inhabited the East Mojave from perhaps the tenth to the sixteenth century, while in the seventeenth century the Chemehuevi (Southern Piutes) apparently moved from the north and forced the Desert Mohaves to the Colorado River. Indian trails such as the Mojave Trail can still be traced.

Who made the petroglyphs and pictographs in this region and what are their meanings? Perhaps we will never know—unless they are protected from vandals.

Several outstanding Chemehuevi village sites exist, as do numerous Indian campsites. Such sites as Hokwaits, Kauyaiheits, and Timpaushawagotsits should be preserved. Restorations of these protected sites would make magnificent museums. Timpaushawagotsits in Wild Horse Canyon includes structures, artifacts, trails, and petroglyphs.

Nineteenth-century remains include the Mojave Road, Fort Piute, Camp Rock Spring, and the ghost towns of Providence, Vandebilt, Barnwell, and Hart. Twentieth-century construction has left buildings at the Kelso Depot and Zzyzx Springs.

The East Mojave is a cultural province all its own. It is a
cosmic blend of Native American, Spanish, Mexican, and American efforts, each with its own desert living experience. Nothing is sadder than for a civilization to lose touch with its past.

**Recreational Values**

Recreation in the East Mojave is for all people of all ages. There are hiking and riding trails, interpretive routes for vehicles, turn-outs to view the wildflowers, cacti, vistas and land forms. There are ghost towns, museums, old forts and petroglyphs to visit. There is opportunity for solitude, for wilderness and there’s clean air to breathe. Visitors are able to sample a bit of each within a few hours.

Popular open areas for off-highway vehicle play lie in close proximity.

**Educational Values**

The East Mojave is one of the most studied natural areas in California. Of California’s ten most popular university natural-study areas, five are located within the proposed park. Wildhorse Mesa, Kelso Sand Dunes, Granite Mountains, and Cima Dome are popular field-trip areas for colleges, high schools, and other institutions.

The University of California conducts research studies in the Granite Mountains and has proposed research study areas in the Mesquite Lake and Clark Mountain areas. The California Desert Studies Consortium, administered by the California State Colleges, maintains a research and educational facility at Soda Springs. This facility helps protect the Mojave Chub, an endangered Pleistocene fish, and the historic buildings of Zzyzx Springs. Tours of the relics of the Pleistocene era and explanation of the site’s cultural values are part of the interpretive program offered visitors to Soda Springs.

**Pleistocene Values**

There are many values from the Pleistocene era (over 11,000 years ago) which are found in the East Mojave. There is much to learn about the Pleistocene Ice Age. Dry Lake cultures of this desert area from the many clues in the plant, animal, and human pre-history found here.

To scientists, the East Mojave is a haven for paleontological data. Humans have been recorded as having lived at Soda Lake for at least 10,000 years. An example of pre-historic existence in this area is the Calico Early Man Site, near Barstow, where humans are thought to have lived some 200,000 years ago.

Plant remnants are also preserved in the East Mojave. The "King Clone Creosote," in the Johnson Valley, has been dated back some 12,000 years. (Creosote rings are theorized to be the oldest living things on earth.) The world’s largest Joshua tree forest at Cima Dome is also Pleistocene remnant.

During the Pleistocene, giant ground sloths ate Joshua tree blossoms. Bones of one of these creatures have been found at the entrance to Mitchell Caverns. Other animal finds include Pleistocene rhinoceros remains (found in the Hackberry Mountains) and the surviving Mojave Chub (the endangered species of fish still found only at Soda Springs). The paleontological traces do not stop with these examples but recede further into pre-history with footprints at Dinosaur Trackway in the Mescal Mountains.

**Wilderness Values**

Eleven marvelous examples of near-pristine wilderness exist within the East Mojave:

**Castle Peaks Wilderness** A magnificent collection of jagged peaks surrounded by a joshua tree forest, it is also an important golden eagle habitat.

**Cinder Cones Wilderness** Thirty-two volcanic calderas remain from eruptions, which occurred perhaps as recently as 1200 A.D. The Mojave Cinder Cones are a National Landmark.

**Clark Mountain Wilderness** Clark Mountain, at 7,929 feet, is the highest peak in the Mojave Desert; on its summit is a relict white-fir forest.

**Granite Mountain Wilderness** A bighorn sheep habitat exists among the 240 different species of plants.

**Kelso Dunes Wilderness** Golden sand dunes of 700-foot drifts make this the second highest dune system in North America, second only to Great Sand Dunes National Monument in Colorado.

**New York Mountains Wilderness** The 7,523-foot peak of New York Mountain boasts one relict white-fir forest and two needle-pinyon-pine forests. Ranging over the 288 species of plants are bighorn sheep, mule deer, and golden eagles.

**Piute Range Wilderness** Piute Creek, the only year-round, flowing creek in the East Mojave, has historic Fort Piute located above its banks. Other outstanding features of this wilderness include riparian habitat, the majestic Piute Gorge, and little disturbed portions of the Mojave Trail and Mojave Road.

**Providence Mountains Wilderness** The 345 plant species make this a botanical paradise. It is a bighorn sheep and golden eagle habitat and has extensive limestone cavern formations.

**South Providence Mountains Wilderness** South Providence Peak towers at 6,612-feet and continues the marvelous expanse of the Providence Chain.

**Table Mountain Wilderness** This juniper-studded mesa is only one of two true mesas in California; the other is nearby Wildhorse Mesa, which is part of the Providence Mountains Wilderness.

**Woods Mountains Wilderness** Outstanding geographical and archeological values are found in this remote desert mountain range. Of special interest are the petroglyphs.
National Landmarks

The National Park Service designates select portions of America’s lands and waters to become National Landmarks. The Eastern Mojave contains two of these: Cindercones and Mitchell Caverns.

Mitchell Caverns is under the jurisdiction of the California State Park System.

The Cindercones National Landmark consists of 25,600 acres. Thirty-two volcanic cindercones, intermixed with lava flows, are evidence of some of the most recent volcanic activity in Southern California. Yet, in spite of National Landmark status, the Bureau of Land Management (BLM) allows mining of some of these cindercones to continue.

Six other areas in the East Mojave have been studied for National Landmark status but have not been so designated: Afton Canyon, Central Providence Mountains, Cima Dome, Clark Mountains, Granite Mountains, Piedmont and Kelso Sand Dunes.

Vehicular Access and the Mojave Road

In 1859 the U.S. Army established the Mojave Road. This road connected Los Angeles with the Colorado River and was the Mojave Desert’s first wagon road. The Army had conflicts with the local Indians, and several forts and posts were established. From Camp Cady the Mojave Road went east through Afton Canyon to a redoubt at Soda Springs, past Soda Dry Lake to Marl Spring, and through the Cinder Cones and Cima Dome to Camp Rock Spring. The last California outpost was Fort Piute. This series of outposts should be restored because of their inherent cultural value. Vandals have destroyed most of the ruins. A Mojave National Park interpretive program would restore this forgotten era of Mojave Desert history.

The Mojave Road should be made into a hiking and horseback-riding trail. National park status would ensure the integrity and protection of the remains of this road and would allow visitors to relive some of the experiences of the frontiersmen. The Mojave Road was abandoned in 1883 when the Santa Fe Railroad was constructed; however, some of it remains in near-original condition.

Other Roads

Most of the region is largely unspoiled, yet is easily accessible by automobile. The main arteries to the Eastern Mojave are the four major routes which provide easy access to the area: The Las Vegas Freeway, completed in 1961; the Needles Freeway, completed in 1973; Highway 66, formerly the National Trails Highway, paved in 1920; and Highway 91 to Las Vegas, paved in 1931. Smaller access roads include Kelbaker Road, Essex Road, Black Canyon Road, Lanfair Road, Ivanpah Road, Kelso-Cima Road, Cima Road, Cedar Canyon Road, Wildhorse Canyon Road, and U.S. Highway 95.

The Future

The 1.4 million acres of public land in the East Mojave belong to you, to me and to our descendants. They are not “owned” by the Bureau of Land Management; the Bureau is only the custodian, the “Brinks Armed Guard” as it were. Ever present are the “thieves” who would rob us of our treasures.

The future of the East Mojave is in a state of flux. For example, the “East Mojave National Scenic Area” designation, bestowed by the Secretary of Interior in 1980, is not a permanent classification. Areas of Critical Environmental Concern (ACECs) are subject to annual amendments. Wilderness Areas have yet to be designated by Congress. Documented abuses of federal and state laws continue.

The ultimate fate of the East Mojave lies in the hands of Congress which has several choices such as: maintaining the status quo, mandating enforcement of both the spirit and the letter of the law or transferring the gem-like public lands to the National Park Service whose mission is to protect in perpetuity for the nation’s quality lands. Citizens for Mojave National Park, P.O. Box 106, Barstow, CA 92311, support this latter proposal.

The East Mojave is at the cross roads. Time is running out for the perpetuation of this near-natural, irreplaceable desert ecosystem.

CARRY PLENTY OF WATER

The Desert Protective Council, Inc.

Educational Bulletin 87-1
(permission is hereby granted to reproduce in whole or in part)
RIPARIAN AREAS
In The
Deserts Of California

By Kristin H. Berry

Educational Bulletin # 83-1
A publication of the
Education Foundation of the
Desert Protective Council, Inc.

Duane Winters

Danwín Falls, Inyo County. Danwín Falls is part of a
perennial stream which is managed as an area of
Critical Environmental Concern by the Bureau of Land
Management.

Riparian areas are some of the more important lands in the deserts of California and in lands throughout the world. We can define riparian areas as those lands adjacent to or associated with surface or subsurface waters. Riparian areas generally have high soil moisture content and support vegetation typically found in marshes, along stream banks, and adjacent to lakes and rivers. In the deserts of California, there are over 800 water sources and associated riparian systems. This number does not include guzzlers, drinkers, and big game tanks established for wildlife by the California Department of Fish and Game.

Desert water sources are in such forms as a sea (the Salton Sea), episodic lakes (dry lake beds that fill temporarily in winter with rain), rivers, perennial and ephemeral streams, ponds, marshes, seeps, and underground water courses or washes just to mention a few.

Riparian areas also can be described by the associated vegetation, which usually presents a lush contrast to the stark appearance of the adjacent lands. Numerous types of vegetation are found together with surface and subsurface waters, such as mixed cottonwoods and willows, palm oasis, mesquite woodlands, groves of saltcedar, seep willows, salt grass and rushes, and ironwood and paloverde washes.

Riparian systems have a number of important values, in addition to the water. The purpose of this bulletin is to acquaint the reader with some of the biological values, conservation problems, and management actions. Biological values are described first, followed by threats to riparian systems, and management activities of federal and State agencies.
RARE PLANTS

Several species of rare plants occur in riparian areas. Two of the more endangered species are the Soda Springs milk-vetch and the Amargosa Nitrophila. The Soda Springs milk-vetch is found in a few moist seeps at Big Sand Springs in the north end of Death Valley. It is a candidate for federal listing as an endangered species and is on the State-endangered species list. Feral burros are damaging the limited, delicate habitats. The Amargosa Nitrophila is a candidate for emergency listing as a federal endangered species and is also State-listed as endangered. This species is known only from the Carson Slough in the Amargosa Desert. It is a tiny, two- to three-inch plant with small, pink flowers. Another rare (but not endangered) species found with the Amargosa Nitrophila is Tecopa bird’s beak. It is more widespread in marshy areas of the Amargosa drainage.

The showiest of the rare plants is the alkali tulip. Its lavender or pink petals have darker lavender lines and rose spots. The alkali tulip is found in alkaline meadows of the Mojave Desert, such as at Cusherbury Springs on the desert side of the San Bernardino Mountains, and at Saratoga Springs in Death Valley National Monument. The riparian area at Cusherbury Springs may dry up in the near future; the land is privately owned and water is being diverted for a cement plant.

Red Rock Canyon State Recreation Area on the eastern slope of the Sierra Nevada is the site of a fifth rare plant, a candidate for listing as endangered. The Red Rock tarweed is found in a few washes. Motorized vehicles drive perilously close to the habitat. These five species are just a few of the rare plants that can be found near or on the edges of desert springs, seeps, rivers, and marshes.

FISH AND WILDLIFE

Of the 25 animal species listed by the State or federal government as rare, threatened, or endangered in the California deserts, eighteen are riparian species. Seven of the 18 species are endemic (found only in) limited areas of the desert: the Mohave chub, Cottonball Marsh pupfish, desert pupfish, black toad, desert slender salamander, Inyo Brown Towhee, and Amargosa vole. Almost all these animals have very restricted habitats — a few marshes or springs, a single canyon.

The fishes deserve special comment. Desert fishes have suffered more than other vertebrate groups dependent on water sources, not only in the California deserts but elsewhere in the Southwest. The Tecopa pupfish, a small, two-inch fish restricted to North and South Tecopa Hot Springs in the Amargosa drainage, was declared extinct by the Fish and Wildlife Service a few years ago. Loss of this species was probably due to habitat alteration (development of public baths at the hot springs) and

Alion Canyon on the Mojave River, San Bernardino County. The campground is being abused by visitors. The mesquite trees shown here are being illegally cut down for firewood by the visitors.

(Kristen Berry photo credit)
hybridization with another species of fish. The Mohave chub, once an inhabitant of the Mojave River, was almost extirpated when an exotic fish species was introduced to its habitat. Now the principal chub population exists in an artificial pond at Fort Soda, south of Baker in the central Mojave Desert. No natural populations remain.

Riparian areas also support abundant bird populations. Often the cottonwood groves, willow thickets, and palo verde and ironwood woodlands have several times the numbers and species of birds as the adjacent habitats of desert pavement and creosote scrub. Also of importance are the isolated springs, natural tanks, and seeps that provide water for desert and peninsular bighorn sheep, mule deer, upland game birds, and other animals.

THREATS TO RIPARIAN AREAS

Water and the associated riparian vegetation are precious resources in the desert. They have been sought relentlessly by technological man since the late 1800's and have been developed, modified, and in some cases, destroyed. Settlements and towns have grown up around such places as Tecopa Hot Springs and the Colorado and Mojave Rivers. Agricultural developments have drained many rich, natural, artesian flows (e.g. at Cantil and Harper Dry Lake and Marsh). In some cases, mining of the water table has caused the formation of deep fissures in the vicinity of wells. Settlers have planted noxious pests, such as the salt cedar.

Domestic livestock and feral burros exert pressure on riparian vegetation and associated surface water throughout much of the desert. Probably fewer than two dozen areas have been fenced to protect vegetation and water and exclude large grazing animals.

Mining for gold, silver, lead, and other hard-rock minerals has resulted in modifications to the water sources and to vegetation in still other areas. Recently miners burned riparian vegetation in Knight Canyon and at French Madam Spring in the Argus Range. Miners were responsible for bulldozing and damaging riparian vegetation at Linekil Spring, a public water reserve in Surprise Canyon, the Panamint Mountains, in spring of 1982. Linekil Spring has a limestone slope covered with maidenhair ferns and supports a relict population of tree frogs.

Recreationists seek out and camp at water sources, often cutting trees and collecting fallen trees and dead shrubs for firewood. Visitors frequently discard trash, shoot wildlife, release exotic animals, and drive off-road through fragile riparian vegetation. As human populations in southern California continue to grow, pressure on riparian areas and associated waters will accelerate.

Duane Winters

Sunflower Spring in the Old Woman Mountains, San Bernardino County. This area has been abused by overgrazing for decades; the vegetation has been altered considerably and little riparian growth remains.
MANAGEMENT OF RIPARIAN AREAS

Several federal and State agencies are concerned with protecting and managing riparian areas within their jurisdictions. The National Park Service manages riparian areas in Death Valley and Joshua Tree National Monuments. Efforts are underway by the Park Service in Death Valley to control the spread of the exotic salt cedar and tamarisk and feral burro populations. The Naval Weapons Center, China Lake, is also controlling burro populations in an effort to protect riparian and other resources. The Bureau of Land Management, by far the largest land-management agency in the California deserts, has established 22 special management areas called Areas of Critical Environmental Concern to conserve, protect, and manage riparian values in a few selected areas. Anza Borrego Desert State Park also has programs to protect peninsular bighorn sheep watering areas from over-use by park visitors during summer months.

Unfortunately, too few of the more than 800 water sources in the California deserts are receiving attention. Possibly half of the water sources are privately owned by ranchers or are on patented mining claims. Most in private ownership are exploited or managed for a single use — for livestock or mineral development, or to support agriculture and towns.

References.

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CARRY PLENTY OF WATER

Duane Winters

Amargosa River and Gorge in Inyo County. This area is managed by the Bureau of Land Management as an Area of Critical Environmental Concern. It is one of the few areas closed to offroad vehicles in the deserts of California.

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