CROSSOSOMA

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SOME INTERESTING FLORISTIC FINDS IN THE COYOTE MOUNTAIN AND VOLCANIC HILLS AREA (SAN DIEGO CO. AND IMPERIAL CO.)

by

Erik G. Jonsson, Calif. Native Plant Soc. (descriptive part), and Duffie Clemons, San Diego Natural History Museum, Botany Dept. (herbarium catalog).

Introduction. For many years we have been collecting and cataloging plants from the Colorado desert in San Diego and Imperial Counties. We have discovered a number of interesting plants in the Coyote Mountain and Volcanic Hills area near the county line 12 miles north of the Mexican border. We have chosen to group these plants into three categories: 1. Plants that require abnormally wet years, 2. Plants that have primary and secondary populations in washes, and 3. other interesting discoveries. The following is not only a description of how we found the plants, but it is also an attempt to stimulate interest among other botanists to search for rare and unusual plants in the desert especially during wet years.

1. Plants requiring abnormally wet years.

In our deserts there occur plants that are relicts from the ice age. After the ice age, conditions were much more humid and could support vegetation demanding much more moisture than our present desert plants. As the climate got drier some of these plants died out or moved out of the area. Others adapted to the new environment. For some, the adaptation consisted of producing seeds that would remain viable for many years so that the plants could sprout, flower and go to seed only during years of abnormally high rainfall. We

Might call these "relict years." Not only would the seeds have to remain viable for a long time, but they also would need such a triggering device for sprouting that it would occur only after a period of very high rainfall.

When such a "relict year" occurs, as it did in 1983, every able-bodied botanist ought to leave all normal work aside and go out in the desert and see what is going on. Not only is it a delight to walk around in Mother Nature's incomparable rock garden under those conditions, but the chances of finding new locations for rare plants are high. It is also a good time to find species new to science in the desert. After all, if Mitchel Beauchamp was able to find a new Baccharis in Encinitas in the middle of the well populated coast area of San Diego county, there ought to be some unknown species hiding in some isolated canyon in the desert waiting for a very wet year and an inquisitive botanist to set eyes on it.

As a good example of a plant waiting for a "relict year" in our desert take Gilia filiformis that was found in a small tributary canyon to North Mortero Wash in the Volcanic Hills area. As luck would have it, I was bending down to look at some white-flowered Nemacladus when I was surprised to find a yellow one. Of course, we do not have any yellow Nemacladus in our desert so it had to be something else. The three-parted stigma pointed to a Gilia and a drawing in Jaeger of Gilia filiformis seemed to fit. After all, there are not too many yellow Gilias and the stem was so filiform that the flowers seemed to be hanging in mid-air without any support. The only thing that did not fit was that it was supposed to grow only in the Mojave desert.

After Duffie Clemons confirmed my identification in the herbarium, we set out to look for more locations. Some people call the Desert Stars, Monoptilon bellioides, "belly plants," but these stand out a mile compared to Gilia filiformis. The only way to make reasonably sure that they do not grow where one is looking is to go down on hands and knees and really scan the ground. That way we found that they seem to be restricted to slopes, mostly northfacing, covered with volcanic gravel. Nearly all the time they were associated with

Linanthus jonesii. We have been back to the area several times since but have found no sign of the plants. It will probably take a tremendous soaking to bring them out.

Another plant that we were interested in was Phacelia neglecta. I had found it first in 1979 on the U. S. side of the border by Signal Mountain. I went back in 1983 when I was scouting out the area for a possible field trip with the California Native Plant Society. With more luck than skill I managed to find it again, in spite of the fact that it was early in the season. The plant consisted only of two tiny leaves with a little white flower in between, all hugging the ground. It was small enough to be hidden by a dime. In fact, after changing film to take a picture of the little beauty, I had to look for five minutes before I spotted it again!

Later we ran into the Phacelia on desert pavement, just south of the mouth of Painted Gorge (on the east end of Coyote Mountain). This was getting close to San Diego County, and since there was no record of it from that area I was eagerly looking around for it during my vacation that spring, all of which I spent in the desert. The way I found the first location was just plain luck. Carrizo Creek was flooded that year and the shortest way to bypass it was to go by Ocotillo Wells and Westmorland. On my way southeast one afternoon I stopped in Ocotillo Wells to avoid a sandstorm ahead. During a hike in the roaring wind, I found some plants usually associated with Phacelia neglecta, so I decided to look around a little more the next morning, a Monday when the ORV's would be out of the way. Some 600 meters north of the Los Puertecitos Historical Marker everything started to fall into place. There were ridges of desert pavement sticking up out of the generally sandy area and plenty of Chorizanthe corrugata and Chorizanthe rigida, Langloisia schottii and Oligomeris linifolia, which usually go with the plant. And then on a ridge there it was, perhaps 50 lush specimens. Since it was in the middle of the ORV-area I checked to see how many were affected by that activity and was happy to find that only a few had been flattened by a tire. Luckily for the plant, the ORV's stay in the sand as much as possible and avoid desert pavement.

Some days later I found a second location for Phacelia neglecta in the main wash between Coyote Mountain and Hwy S-2 also on desert pavement. I made a little cairn so as to recognize the place and have revisited it several times in later years but have found no trace of the little plants.

Cynanchum utahense seems to be another of those plants that demand more rainfall than normal. I have found it in three locations in San Diego County, all just south of Coyote Mountain. One of these is two miles east of Sweeney Pass, in a small canyon 200 meters N.E. of where Hwy S-2 crosses from section 34 into section 3. This population is especially interesting for two reasons. First, the population there was the biggest I have ever seen, some 100 plants, and second, it flourished in September 1983 after abundant summer rains. Both Munz (Flora of Southern California) and Wiggins (Flora of Baja California) state that it flowers from April to June, (i.e., it is a lateblooming winter annual). September may not be a pleasant time to be in the desert, for it can be extremely hot. This could be the reason why its appearance as a summer annual has been overlooked. Another reason is of course that abundant summer rains are very rare in our area. This large and lush September population could mean that it is predominantly a summer annual and the rare and tiny winter annual populations that have been found before are exceptions to the rule.

Lastly, Duffie Clemons and I found Phacelia pachyphylla in a tiny side canyon at the mouth of Painted Gorge on the east side of Coyote Mountain. In spite of looking intensely for it during that spring, no other population was found. Because the plant is fairly easy to spot, it seems that is quite rare in the area.

2. Primary and secondary populations of desert plants.

When one finds an isolated specimen of a plant species in a canyon or in a wash, chances are that the source of the seed was a mother population somewhere upstream. So, just as a prospector, after finding a placer deposit of gold in a streambed, would look for the mother lode in the area above, a botanist, who finds a "placer specimen" in a wash, can do the same thing to find the "mother population" in its usual habitat higher up.

In March 1983 I found a white Eriophyllum in the big wash south of Coyote Moutain in Sect. 17 a little east of the county line. I thought it was the fairly common Eriophyllum wallacei var. rubellum, but when I looked at the pappus I realized it was Eriophyllum lanosum, known in San Diego County only from Vallecitos. I looked around but no other specimen was to be seen. "If there is one, there must be more," Reid Moran always told me. But where was another? A few days later I got the answer. Hiking up a sidecanyon to Lava Flow Wash, I noted a few specimens growing in the sand in the upper part of the canyon, and higher up where the canyon widened to a large bowl I found the "mother lode," thousands of specimens growing like a garden ground-cover. The distance from the "mother lode" to the "placer deposit" I had first found was five miles. Abundant rains that winter must have flooded the canyon and carried the seeds all the way down to the main wash.

A similar thing happened with Linanthus aureus var. decorus. I found a single specimen at the mouth of North Mortero Wash and later we found the "mother lode" three miles upstream.

Eucnide rupestris shows a similar tendency both in the old well-known location in Painted Gorge and also in the new location we found in Indian Gorge. The mother populations are on steep talus slopes where the species designation rupestris fits well. A specimen growing in the sand just at the junction of the Indian Gorge and Torote Canyon indicated that there were more populations higher up in one or both of those canyons.

One might have expected the plants in the secondary populations to be smaller and less lush than those in the mother populations, but the opposite was true. The logical reason was that each plant in the dense mother populations had much less water and nutrients available than the isolated ones growing in the washes. Many botanists concentrate their excursions to washes, where most of the desert roads are, and avoid the rocky upper areas. It is possible that the habitat for some plants listed as sandy washes, are based on "placer deposits." The primary habitat might be in canyon slopes higher up.

3. Other interesting finds.

Riverside County was held to be the southern limit for Lepidium fremontii, the perennial peppergrass that is so common in the Mojave desert. We found it first in the Imperial Co. part of Coyote mountain, in Painted Gorge and in a canyon running north, only one mile east of the county line. This made us suspect it would also be in San Diego Co. So, in April 1986 we went looking for it in a canyon on the northern side of Coyote mountain, two miles west of the county line, and there it was! The populations were small; only one or two plants were found in each location.

Psorothamnus polydenius (Dalea polyadenia) is supposed to occur in the Mojave Desert from the Twentynine Palms region to Inyo and Mono Cos. at an elevation of 2500-6000 ft. It was therefore a surprise to us when on a California Native Plant Society fieldtrip we found a large population of it below a 1300 ft. elevation in a little canyon in the saddle of Coyote Mountain, two miles east of the county line. It is interesting that other hikes down that canyon when the shrub was not in bloom had failed to reveal it. This goes to show that one trip is not enough where shrubs are concerned!

Pilostyles thurberi, the tiny parasite on Psorathamnus emoryi was not recorded for San Diego County. Wayne Armstrong found it first in San Diego Co. on the slopes below the Carrizo Badlands Overlook, and lately Duffie Clemons and I have found it in so many locations that it is becoming routine. It grows both on the north and south lower slopes of Coyote Mtn.

Plagiobothrys jonesii is somewhat of a misfit in its genus. It is bristly as a Cryptantha and has nutlets resembling those of Amsinckia tesselata. During the wet spring of 1983 we found it in several locations in the Volcanic Hills area. We also noted it in the spring of 1984 in the canyon draining the northern part of the inner pasture, which had been flooded some time earlier. That is the last we have seen of it. Perhaps it is one of those that appear in our area only after abnormally wet winters. Heretofore it was believed to occur only in the Mojave.

In conclusion, we hope this little presentation has convinced you that there is still a lot to discover in our local desert, especially after a wet winter. During those unusual "relict years" it is a good idea to leave other projects aside and go exploring. It might be a long time before such favorable conditions occur again. The following table is a complete catalog of the species mentioned in this account.

A Catalog of Some Interesting Floristic Finds in the Coyote Mountain-Volcanic Hills Area, San Diego and Imperial Counties

Cyanachum utahense (Engelm.) Woods — Utah deboltia
Range:
Abrams: Mojave & Colorado Deserts, CA to NV, southern UT, & AZ
CNPS Special Publication 1, 3rd ed, 1984:67; List 2 (Rare & endangered in CA but more common elsewhere). RED 111+. IMP, RIV, SBD, SDG, AZ, NV
Munz: Both deserts to AZ, UT
Beauchamp: San Felipe; Blair Valley; SE of Dolomite Mine below Coyote Mtn.
Collections (IMP & SDG):
J. Dice 227, 28 Jan 1979 (SD 105419); Blair Valley
D. F. Howe 532, 5 Jun 1937 (SD 113033), Earthquake Valley
Erik Jonsson 306, 14 Apr 1982 (SD 111529), nr Dolomite Mine
E.J. 438, 5 Apr 1983 (SD 115565), nr Coyote Wells, IMP
E.J. 789, 18 Sep 1983 (SD 115675), Sweeney Pass quad.

Eriophyllum lanosum (Gray) Gray — Woolly frocks
Range:
Abrams: Eastern SBD to e. IMP, south to central BCfa, east to southern NV, s. UT, and AZ.
Beauchamp: Vallecito Stage Station; SW of Lava Flow Wash; Volcanic Hills
Jaeger: Eastern Mojave Desert to AZ, UT, BCfa.
Munz: Eastern Mojave & Colorado Deserts to UT, AZ, BCfa
Collections (IMP & SDG):
Gander 4176.30, 17 Apr 1935 (SD 11220), Vallecito Station.
E.J. 462, 13 Apr 1983 (SD 115589), Sweeney Pass quad
E.J. 945, 18 Mar 1985 (SD 118117), North Mortero Wash, Carrizo Mtn quad.

Eucnide rupestris (Baill.) Thompson & Ernst — Rock nettle
Range:
Beauchamp: Indian Gorge; Mountain Palm Springs
Munz: Painted Gorge, IMP: to SW AZ & MX on islands & shore of Gulf.
Herbarium, SD: BCfa sur & norte; AZ, Tiburon Id & San Esteban Id, Sonora.
Collection (SDG only):
E.J. & Duffie Clemons 806, 18 Mar 1984 (SD 115685)(BSCA), nr mouth of Indian Gorge, Sweeney Pass quad.

Gilia filiformis Parry ex Gray — Threadstem gilia
Range:
Abrams: Mojave Desert from INY & SBD, east to UT & AZ
Beauchamp: Sweeney Pass; SW of Lava Flow Wash
Herbarium, SD: Clark Co, NV
Jaeger: Mojave Desrt to UT
Munz: Mojave Desert to UT, AZ
Collections (SDG only):
E.J. 446, 6 Apr 1983 (SD 115573), Sweeney Pass quad
E.J. 464, 13 Apr 1983 (SD 115591), Carrizo Mtn quad

Lepidium fremontii Wats. Fremont peppergrass
Range:
Abrams: Mojave Desert CA to UT, south to BCfa Norte & AZ
Herbarium, SD: INY, KRN, RIV, SBD, NV
Munz: INY to north RIV to UT, AZ
Collections (IMP & SDG):
E.J. & D.C. 421, 26 Mar 1983 (SD 115548), Painted Gorge, IMP
E.J. & D.C. 1446, 12 Apr 1986 (SD 119046) (BSCA), east slope Coyote Mts, SDG
H.V. Witham 1762, 12 Dec 1972 (SD 83103), Painted Gorge, IMP

Linanthus aureus (Nutt.) Greene var. decorus (Gray) Jeps.
Range:
Abrams: Mojave Desert
Beauchamp: Dos Cabezos, Volcanic Hills
Herbarium, SD: SBD
Collections:
R.M. Beauchamp & R.C. Pierce 1798, 13 Mar 1971 (SD 85436), nr Dos Cabezos Sta.
E.J. & D.C. 478, 15 Apr 1983 (SD 115605), Sweeney Pass quad

Phacelia neglecta Jones
Abrams: Mojave & Colorado Deserts, CA to adjacent NV & AZ
Beauchamp: Ocotillo Wells; Valley south of Coyote Mtn
Herbarium, SD: SBD
Munz: Deserts, SBD to IMP; NV, AZ
Collections:
E.J. 434, 2 Apr 1983 (SD 115561), Coyote Wells, IMP
E.J. & D.C. 416, 22 Mar 1983 (SD 115544), nr Painted Gorge Road, IMP
E.J. 463, 11 Apr 1983 (SD 115590), Shell Reef quad, SDG

Phacelia pachyphylla Gray Thick-leaved phacelia
Range:
Abrams: Mojave & Colorado Deserts, CA
Herbarium, SD: INY, SBD
Jaeger: Both deserts to BCfa & AZ
Munz: Deserts, KRN to IMP: north BCfa
Collection: (IMP):
E.J. & D.C. 415, 22 Mar 1983 (SD 115543), Painted Gorge quad, IMP

Pilostyles thurberi Gray Thurber pilostyles
Range:
Abrams: Southern Colorado Desert
Beauchamp: Coyote Creek below Borrego Valley; Fonts Point Wash; below Carrizo Overlook; ±4.5 miles west of IMP Co. line on S-2
CNPS Spcl Pub 1, 3rd ed, 1984:76; List 2. RED 111+. IMP, RIV, SDG, AZ, BCfa, NV+
Herbarium, SD: BCfa, Sonora
Jaeger: East of Yuma, IMP
Munz: IMP to AZ
Collections:
W.P. Armstrong s.n. 24 Dec 1977 (SD 99508), slope below Carrizo Badlands overlook.
J. Dice 211, 12 Jun 1979 (SD 105420), Carrizo overlook above Cyn Sin Nombre
E.J. & D.C. 902, 28 Jan 1985 (SD 118358), Davies Valley IMP
E.J. & D.C. 1233, 2 Nov 1985 (SD 118581), Fonts Point Wash
E.J. & D.C. 1440, 12 Apr 1986 (SD 119062), Carrizo Badlands, east slope Coyote Mts.
E.J. 1451, 6 Apr 1986 (SD 119050), Carrizo Mtn quad
P.H. Raven 17381, 19 Apr 1962 (SD 51854), nr Kane Springs, IMP
R.F. Thorne & R.K. Benjamin 31824, 23 May 1963 (S 60399), south of San Felipe Creek, west of Salton Sea, Hwy 99, IMP

Plagiobothrys jonesii Gray Jones popcorn flower
Range:
Abrams: INY south to Whipple Mts, SBD
Beauchamp: SW of Lava Flow Wash
Herbarium, SD: SBD; White Mts, CA: AZ; Isla Angel de la Guarda
Jaeger: Mountains of east & north Mojave; to AZ
Munz: Whipple Mts; SBD to White Mts, Argus Mts; to AZ
Collections (SDG):
E.J. 449, 6 Apr 1983 (SD 115576), Sweeney Pass quad
E.J. & D.C. 829, 7 Apr 1984 (SD 115692), east slope Tierra Blanca Mts, SDG

Psorothamnus polydenius (Torr.) Rydby. Nevada indigo-bush
= Dalea polyadenia
Range:
Abrams: INY to NV
Barneby: Daleae Imagines. NYBG 27:49. 1977. INY, MNO, SBD; NV, UT
Herbarium, SD: MNO, SBD
Munz: Mojave Desert from 29 Palms to INY & MNO
Collection:
D.C. & E.J. 1565, 19 Oct 1986 (SD 120058), west slope, Coyote Mts, IMP

Abbreviations:

States:

AZ	Arizona
CA	California
NV	Nevada
UT	Utah

Counties (CA):

IMP	Imperial
INY	Inyo
KRN	Kern
MNO	Mono
SBD	San Bernardino
SDG	San Diego

Herbaria:

SD	San Diego Natural History Museum
BSCA	Anza-Borrego Desert State Park

Geographic:

ID	Island
Mtn	Mountain
Mts	Mountains
nr	near
quad	quadrangle

Miscellaneous:

BCfa	Baja California
CNPS	Calif. Native Plant Society
MX	Mexico
NYBG	New York Botanical Garden
RED	Rarity-Endangerment-Distribution
s.n.	Sine numero (not numbered)
+	In this state and others

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Wiggins, Ira L. 1980. Flora of Baja California. Stanford Univ. Press.

ANNOUNCEMENTS

AUDUBON SOCIETY'S WESTERN REGIONAL CONFERENCE. From March 26-29, 1988, the Audubon Society is sponsoring its 1988 Western Regional Conference entitled Defining the Common Ground. This conference, held at Asilomar, California, will be designed around a series of workshops to discuss conservation issues such as urban wetlands and status of national wildlife refuges. A number of interesting fieldtrips also will be offered. Registration fees are $30 for adults and $10 for children. Housing is also available for an additional charge. For more details contact Audubon at (916) 481-5332.

UNTIMELY DEATH OF DAVID GAINES. David Gaines, who founded the MONO LAKE COMMITTEE 10 years ago, died in a head-on collision on Monday, January 11, 1988. The collision, involving three cars, occurred in a blinding snowstorm on Highway 395 near Mammoth Lakes. David Gaines is best known for his tireless energy in attempting to secure protection for Mono Lake. His campaign was successful in gaining congressional approval for a 57,000 acre National Forest Scenic Area surrounding the lake. He was also instrumental in convincing the Bureau of Land Management that they should designate the lake as an area of critical environmental concern. All environmentalists will miss David Gaines.

NATIVE PLANT SALE. The Southern California Botanists will again have its spring plant sale of native and water-conserving exotic plants on Sunday, March 20, 1988, from 8 AM - 2 PM, at the visitor parking lot area at Rancho Santa Ana Botanic Garden. Plants for the sale will be provided by Mockingbird Nursery (Riverside), Tree of Life Nursery (San Juan Capistrano) & Wildwood Nursery (La Verne). Note: volunteers will be needed to assist in the plant sale set-up and take-down -- any S.C.B. member who participates will receive a 10% discount on plant materials purchased at the sale! For further information, call Geoff Smith at: (714) 526-6963 or (714) 929-5248.

SCB Board of Directors. The next meeting will be held at Alan Romspert's house on Thursday, February 4, at 7:30 PM. Please mark your calendars.

February 13 (Saturday). Fungus Foray. Starr Ranch. Walt Wright will lead this foray potentially held at Starr Ranch. We will look for mushrooms and examine the oak woodlands and grasslands at the Ranch. Take I-5 South to Ortega Hwy (74) and go east. We will meet at the Caspers Parking lot at 9:00 a.m. (immediately west of the entrance). If you have a high clearance vehicle, please bring it along. Be prepared to pay up to $10.00 in entrance fees. For details, contact Dave Bramlet at (714)549-0647.

February 21 (Sunday). Laguna Beach. Fred Roberts will lead this trip to examine some of the unique plants including Verbisina dissita, Laguna Beach dudleya, multi-stemmed dudleya and western dichondra found along the coast near Laguna Beach. To reach the meeting site take I-405 S to 133 (Laguna Beach Freeway) and go south on PCH to Aliso Beach (just south of the Aliso Golf Course) and go right on Aliso Way. We will meet at 9:00 a.m. in the parking lot. For details, contact Dave Bramlet at (714)549-0647.

February 27 (Saturday). Thousand Palms Reserve. Katie Barrows will take us on this tour of a California fan palm oasis. The reserve is run by the Nature Conservancy. To reach the reserve take the I-10 to Rawan Road and go East 6 miles to Palm Cyn. Rd. Then go left to the Thousand Palms Reserve entrance. Meet at 9:00 a.m. For details, contact Dave Bramlet at (714)549-0647.

March 5 (Saturday). Camp Pendelton. The purpose of this trip is to examine the native grasslands and oak woodlands in the eastern part of the base. To reach the base take the San Diego Freeway (405) south to Vandergrift Road and turn left (west) to the main gate. We will meet at 8:30 AM. This trip is still tentative based on getting permission from Camp Pendelton. To verify that you would like to attend and to make certain that the trip is still on please call Dave Bramlet at (714) 549-0647.

March 12-13 (Saturday-Sunday). Guadalupe Canyon, Baja California. This trip led by Bob Thorne will visit the spectacular palm oases and surrounding environs of famous Guadalupe Canyon. Meet on Saturday morning at 9:00 AM at the junction of Mexico 2 and the dirt road that runs south on the west side of Laguna Salada. See AAA map of Baja California. Bring camping gear, pesos, Mexican auto insurance, water, and a birth certificate or passport. For more information call Dave Bramlet at (714) 549-0647.

March 19 (Saturday). Santa River. Walt Wright will lead this trip to view the remaining vegetation along the Santa Ana River in San Bernardino County. Meeting time will be 9:00 AM. For details on the exact starting point for the trip contact Dave Bramlet at (714) 549-0647.

Charter Boat Trip to Guadalupe and Cedros Islands of Coastal Baja California, Mexico March 26 through April 1, 1988. Several botanists, ornithologists and naturalists have expressed an interest in a charter boat trip to Guadalupe, Cedros and San Martin Islands during the Easter break of 1988. The primary purpose of the trip is the observation of the unique flora and fauna of these islands and surrounding waters. Much of the time will be spent hiking and exploring the interesting biology and geology of the islands. There will also be abundant marine mammal and sea bird observations in route and on the islands. Plans are to have prominent botanists from Mexico and the U. S. on the trip and persons knowledgeable of marine mammals, birds and island biogeography.

This is a non-profit cooperative charter that will cost approximately $950 per person for the 7 day trip. All meals and lodging on the vessel are included. Departure from San Diego will be Saturday, March 26 and return on Friday, April 1. Plans are to spend 3 days in the vicinity of Guadalupe Island with onshore hikes to visit the Monterey Pine and Guadalupe Cypress forest and other botanical and wildlife interests. Hopefully we will be able to gain permission to spend one night on the island in the cypress forest found at the higher elevations. A day will be spent on Cedros Island and a half day on San Martin if time is available.

More information is available by contacting Margie Stinson at (619)726-2228, Thomas Oberbauer at (619)225-8397; work 565-3041) or writing to Biological Adventures, Fisherman's Landing, 2838 Garrison, San Diego, CA 92106. Make checks payable to Pacific Sportfishers. The trip is sure to be fun and educational. Don't miss out.

TENTATIVE DATES FOR FUTURE EVENTS.

April 10 Pines to Palms Highway

May 15 Spring Mountains, Nevada

SOUTHERN CALIFORNIA BOTANISTS

GRANTS AVAILABLE

SCB announces its annual program of grants to support student research in field botany, e.g., floristics, taxonomy, ecology. Both graduates and undergraduates are encouraged to apply. The amount of an award varies but cannot exceed $200.00. A limited number of proposals can be funded. Grants may cover expendable items (gasoline, film, etc.) not otherwise available to the student.

Proposals containing the following information will be considered:

1. Title page.
2. Description of proposed research, primary objectives, and relationship of the research to the student's goals (two page limit).
3. Timetable for research: anticipated commencement and completion dates.
4. Budget, with justifications, and statement regarding availability of funds from other sources.
5. Brief resume stating current position, education, affiliations, qualifications and anticipated position and address at completion of research.
6. A letter of recommendation from a faculty member (may be sent separately to the Student Research Grants Committee).

Three copies of the proposal should be submitted before **May 1, 1988**

to: Student Research Grants Committee
Southern California Botanists
Department of Biological Science
California State University
Fullerton, California 92634

SCB will publish the results of the research in its journal, *Crossosoma*. Awardees will provide SCB a formal report of the research completed, in a format suitable for publication, by not later than one year following receipt of the grant.

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SOUTHERN CALIFORNIA BOTANISTS

Rancho Santa Ana Botanic Garden
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Claremont, CA 91711

The purpose of the SOUTHERN CALIFORNIA BOTANISTS is the etudy, preservation and conservation of the native plante of California; and the education of the public to the value of the native flora and its habitats. It is a non-profit association formed in 1927.

Membership benefits include:

Various field trips throughout the etate led by competent field botaniste and biologists.

A yearly plant eale leaturing native California species.

An annual symposium on various aspects of the California vegetation.

The SCB Journal, CROSSOSOMA.

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SCB COMING EVENTS (DETAILS WITHIN)

February 13	Fungus Foray to Starr Ranch
February 21	Laguna Beach
February 27	Thousand Palms Oasis
March 5	Camp Pendleton
March 12, 13	Guadalupe Canyon, Baja California
March 19	Santa Ana River
March 20	Annual Plant Sale

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REGIONAL BIOGEOGRAPHY OF DISJUNCT PLANT SPECIES IN THE SANTA ANA RIVER CANYON AREA

by

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Introduction

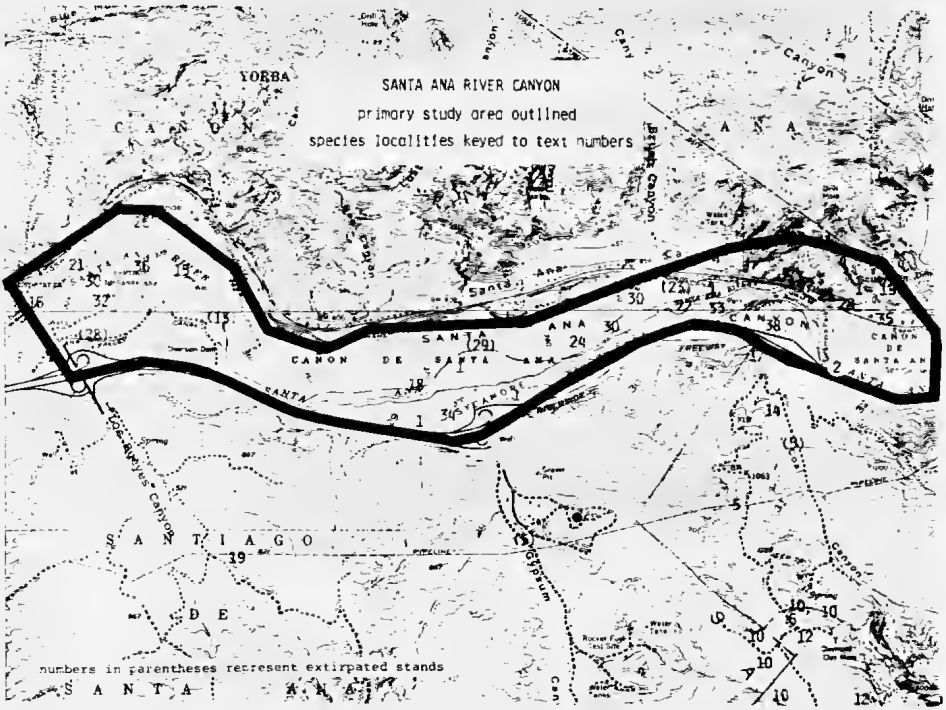
Extending west from Prado Dam, Riverside County to the vicinity of Imperial Highway, Orange County, Santa Ana Canyon lies at the geographical boundary of four biogeographic regions, the greater Los Angeles Basin coastal plain, the San Jose-Puente Chino Hills upland, the Santa Ana Mountains, and the interior cismontane Chino-San Jacinto Basin complex. In addition, the Santa Ana River plays a role in downstream dispersal of montane species originating from the Santa Ana, San Bernardino San Jacinto and San Gabriel Ranges, and desert flora probably transported into the watershed via San Timoteo Wash.

Some of the more interesting examples of disjunct or outlier plant populations along or near the river are discussed below. Certain of these, never common, have presumably been extirpated by development. Several river-dispersed or range-edge taxa occur in the Canyon but outside of the study area. The river is of interest not only for its dispersal role but its function (by carving down Santa Ana Canyon) as a partial barrier between the Chino Hills and Santa Ana Mountains.

Description of Study Area

The primary area of study for this paper extends from the Orange-Riverside-San Bernardino County boundary within the Green River Golf Course, west to Weir Canyon Road, Orange County, and from the Riverside Freeway north to the slopes of the Chino Hills. Approximately 1085 acres of Santa Ana River floodplain, Pleistocene-age river terrace and mountain slopeland are located within the primary study area. By reference to previous studies and surveys, additional range edge and disjunct species populations outside the primary study area are included in this paper. Some of the other locales discussed are the upstream and downstream reaches of the present or preexisting Santa Ana River floodplain between Prado Dam and the City of Anaheim, and the northern Santa Ana Mountains, including Pleasants Peak, Black Star Canyon, Coal Canyon and Gypsum Canyon.

The location of each plant species discussed in text is depicted by number on the study area map.



Methods

This paper is adapted from Section 2.1.2 of Santa Ana River Canyon, Orange County, Resource Management Plan, prepared for Orange County Environmental Management Agency Parks and Recreation and Public Works by the author, S.A. Loe, wildlife biologist and L.R. Hays, ornithologist, on October 21, 1987. Field surveys were conducted in the primary study area from July, 1986 to February, 1987. 86 hours were expended by the author on the walkover reconnaissances devoted to the inventory of plant species and qualitative analyses and mapping of plant communities. The identification of certain special interest taxa was confirmed by Fred M. Roberts, Jr., Museum of Systematic biology, University of California, Irvine, where voucher specimens from the study are housed.

Information about species of interest which occur outside of the primary study area is contained in the following studies: Lathrop and Thorne, 1978; Marsh and Abbott, 1972; Marsh, 1979a, 1979b, 1982.

Unpublished field reconnaissance data of Fred M. Roberts, Jr., John W. Johnson, Gordon A. Marsh and the author have also been utilized in discussion of species outside the primary study area.

Southern Disjuncts or Range-Edge Species

A number of these reach their southernmost distribution in the Santa Ana Canyon area. Some have been slowed by the presence of the Canyon from establishing footholds in the Santa Ana Range south and several are still fairly restricted to the Canyon slopes, though they have successfully dispersed across the river.

Southern Range Edge Species

1. Southern California black walnut (Juglans californica)

The distribution of southern California black walnut extends from the Santa Ynez Mountains southeast to the northern Santa Ana Mountains. Major populations are located in the Santa Monica Mountains, the San Jose Hills and the Puente-Chino Hills. The species is quite common in mixed riparian and southern oak woodland in Santa Ana Canyon but is of very sparing distribution southward. Gray squirrels appear to play an important role in the dispersal of the species in the local area.

2. Purple sage (Salvia leucophylla)

The range of purple sage extends from San Luis Obispo and Kern County south to the northern Santa Ana Mountains. The coastal sage scrub species is

quite common in the Santa Monica Range. Locally, there are populations in the Chino Hills and the northern Santa Anas, in Black Star and Santiago Canyon. One locality was found near the Riverside Freeway in Santa Ana Canyon. Orange County populations of the species may be relict stands remaining from a more extensive Pleistocene Epoch distribution.

3. Sticky monkeyflower (Diplacus longiflorus longiflorus).

Except for isolated populations (as at Starr Ranch), the Orange County coastal cismontane distribution of this species appears to be restricted to the Santa Ana Canyon region, supplanted southward by orange bush monkeyflower (D. aurantiacus). D. longiflorus populations in San Diego County may have become established via an interior cismontane dispersal route through the Temescal Valley hills and inner slopes of the Santa Ana Mountains. Fred Roberts Jr. suggests that D. aurantiacus is coastally oriented while D. longiflorus is adapted to the more extreme interior habitats.

The ecological and taxonomic relationships of the two species are areas requiring additional research.

Southern Disjuncts

These are assumed to occur in the Santa Ana Canyon region in relict population, isolated stands remaining from a more continuous and extensive distribution during the Pleistocene Epoch.

4. Nevin's brickellia (Brickellia nevinii)

Nevin's brickellia is a white-leaved stiffly branched subshrub of xeric, near vertical cobblestone outcrops originally thought to occur in a range from the Santa Monica and San Gabriel Mountains north to Santa Barbara and Kern County. Recently, the author discovered the species in upper Williams Canyon in the northern Santa Ana Range. Fred Roberts, Jr. and Gordon Marsh later found a second population in upper Black Star Canyon and a third in upper Santiago Canyon. During the ongoing study, a population was tentatively identified high on a headwall within a Chino Hills canyon on the west side of Scully Hill.

This plant is on the CA Native Plant Society list of restricted-distribution listed species.

5. Braunton's rattleweed (Astragalus brauntonii)

This rattleweed is a Federal candidate for threatened/endangered listing. It occurs in a disjunct population on Silverado Formation substrate between Coal and Gypsum Canyon. Washdown individuals have been recorded in

both canyons. The purple-flowered species is a fire follower. Its main distribution is within highly localized areas of the Santa Monica Mountains, with outlier populations in the Simi Hills and the San Gabriel Range east to Monrovia (Spenger, 1986).

6. Yellow dicentra (Dicentra ochroleuca)

This graceful, pale yellow wildflower ranges south from the Santa Ynez Mountains to the northern and interior Santa Ana Range. Its type locality is the Santa Monicas and it is also rather sparingly distributed through the lower elevations of the San Gabriel Range. A population occurs in the higher watershed of Santa Ana Canyon in the divide area between Gypsum and Coal Canyon.

The following southern disjuncts have range centers far to the north.

7. Knobcone pine (Pinus attenuata)

This is a characteristic closed cone pine of serpentine soils in the Siskiyou Range, southern Oregon and the Klamath Moutains of northwestern California. It extends south through the inner Coastal ranges north of San Francisco, and then discontinuously along the Monterey-Big Sur coastline southward. There are isolated populations in the Sierra Nevada, also on depauperate soils.

In southern California is a disjunct distribution within the San Bernardino Range and a small disjunct population on Pleasants Peak in the northern Santa Ana Mountains. The southernmost stand, 150 miles disjunct from the Pleasants Peak population is located near Ensenada, Baja California.

The Pleasants Peak population, near but not in Santa Ana Canyon, grows on hypothermically altered volcanic soil. A rare endemic, Santiago Peak phacelia (Phacelia suaveolens keckii) and a disjunct shrub, warty-leaved ceanothus (Ceanothus papillosus roweanus) grow in the unusual association.

8. Rough-leaved aster (Aster radulinus)

The previously known range of this perennial wildflower extended from Vancouver B.C. south to San Luis Obispo County and Santa Cruz Island. Recently, Fred Roberts, Jr. discovered a population in upper Mabey Canyon in the northern Santa Ana Mountains of Orange County (Roberts, pers. comm. 2-10-87).

9. Warty-leaved ceanothus (Ceanothus papillosus var. roweanus)

This is a striking deep-blue flowered California lilac with aromatic, viscid leaves. It occurs with knobcone pine on Pleasants Peak, and in a stand in upper Holy Jim Canyon. Otherwise, it ranges from San Benito and Monterey Counties to Santa Barbara County (with outliers south into Ventura County).

Northern Disjuncts or Range-Edge Species

10. Tecate Cypress (Cupressus guadalupensis forbesii)

There are four populations of this taxon in southern California, all relict. Three are restricted to southern San Diego County and the fourth is in the Santa Ana Canyon watershed on the ridge between Coal and Gypsum Canyon. The species also occurs in northern Baja California in scattered localities. Within the State, all populations are threatened (particularly by overly frequent fires); the one in the periphery of the study area is also threatened by development. The species, along with its local associate, Braunton's rattleweed are in the process of being nominated for State threatened/endangered listing. The Tecate cypress biotic association contains several rare floral and faunal components and is in Orange County a unique habitat type in need of protection.

A Tecate cypress washdown individual was reported by Marsh and Abbott, 1972, in the study area, but was not relocated during the ongoing study.

11. Orange bush monkeyflower (Diplacus aurantiacus)

See discussion, sticky monkeyflower.

12. Dense reed grass (Calamagrostis densa)

Of relatively frequent occurrence on gabbro substrate in San Diego County mountains, this species is known from only two relict populations in the Santa Ana Range, one at Hidden Ranch in Black Star Canyon and the second within the Tecate cypress biotic association on the Coal-Gypsum divide, peripheral to the primary study area.

Dense reed grass is a CNPS restricted-distribution species.

Interior-origin Disjuncts and Range Edge Species

These are assumed to be dispersed to the study area and its vicinity by the Santa Ana River. It can also be argued that several of the southern outlier species discussed above may have been river-dispersed.

13. Indian hemp (Apocynum cannabinum)

This is an attractive understory herb of climax gallery forest floors and other moist habitats. A rather cosmopolitan species in the United States, it is sparingly distributed in southern California. Populations previously discovered in the Santa Ana Canyon Narrows may be dispersed from out of the San Bernardino Mountain portion of the watercourse, where Richard Zembal reports the herb to be abundant in areas. Rancho Santa Ana Botanical Garden records indicate that the herb occurred all through Santa Ana Canyon in the past. Last records for it in and near the study area were at Green River Meadows, now a housing tract, and SAVI Business Park, where the gallery forest was destroyed during site development.

14. Great Basin sagebrush (Artemisia tridentata)

A widespread montane and transmontane valley species typical of coarse soils with snow as a water source, Great Basin sagebrush occurs here near the mouth of Coal Canyon, peripheral to the primary study area. The author recently discovered a second cismontane population of about 1/2 acre extent, in the extreme southern Orange County within the Cristianitos Canyon watershed.

15. Broom baccharis (Baccharis sarothroides)

This is a shrub of sandy washes and bajadas which has desert affinity. Previously unknown from Orange County, the population of the species discovered in Horseshoe Bend in the study area is now one of two recently documented. (The other, discovered by W. Walton Wright in south Laguna arrived here via cismontane dispersal from coastal San Diego County which contains Colorado Desert outpost populations).

16. Sweetbush (Bebbia juncea)

A desert subshrub with slender green stems but few to no leaves, sweetbush is quite common in coastal sage scrub and certain alluvial scrub habitats in the study area.

17. Rabbitbrush (Chrysothamnus nauseosus)

A single, sterile individual of this montane and transmontane Great Basin scrub plant grows on the slopeland above the Riverside Freeway on the west side of the mouth of Coal Canyon. Additional localities of the species in the study area region are Maple Springs Truck Trail, Santa Ana Mountains and upper Borrego Canyon, Loma Ridge.

18. Coulter's conyza (or horseweed) (Conyza coulteri)

This forb is quite rare in Orange County though it has been taken on the coast in at least two localities (Crystal Cove State Park and Huntington Beach Central Park). However, it is quite common in moist shallow drainages in the interior cismontane regions, especially in the Temescal/San Jacinto Valley area. One individual was identified on site at the edge of the abandoned orange grove north of the Featherly Park Wilderness.

19. Brittlebush (Encelia farinosa)

This white-leaved, showy yellow-flowered shrub is widespread in stony soil at the desert edge and in the interior cismontane inland sage scrub-vegetated habitats as around Lake Mathews.

In the study area, it is found on dry south-facing cliffsides of the Chino Hills. The westernmost known natural population in Orange County is or was in "Los Bueyes" Canyon immediately southwest of the study area. The species is now widely dispersed in the County because of its use in highway-edge hydromulch mixtures. Once more or less isolated from its close relative, California encelia, the two now grow side by side in many locales and hybrids are being produced which may profoundly affect the genetic makeup and survival characteristics of the latter species population.

20. Desert dandelion (Malacothrix glabrata)

Desert dandelion is a widespread desert wildflower. John W. Johnson[1] described seeing, many years ago, desert dandelion and pencil cactus (Opuntia ramossisima) in the sandy riverwash alluvium of vacant lots in what is now the city of Anaheim. Both are now assumed to be extinct in the County.

21. Arrow-weed (Pluchea sericea)

This pink-flowered shrub grows about desert springs and watercourses. Arrow-weed is found in two widely separated localities on the north side of the Santa Ana River. The first is at the foot of the Chino Hills along the railroad tracks in the east portion. The second is at the foot of the Pleistocene terrace which was the site of the Rancho Santa Ana entry station, in the northwest part of Horseshoe Bend.

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1 Longtime resident and naturalist in Orange County, Johnson spent an illustrious career as a biology teacher in the Newport Mesa School District.

22. Spreading yellow-cress (Rorippa sinuata)

This is a higher montane species primarily of the San Bernardino Mountains which was found in at least one locality along the River in the study area (the old road crossing in the Featherly Park/Green River Golf Course reach).

23. Beavertail cactus (Opuntia basilaris)

This desert species was found during the G. Marsh - K. Abbott 1972 survey of the river south of the Anaheim Union Canal gatekeeper's house in an area which was subsequently planted to orange trees. The cactus could not be relocated during the present survey. O. b. ramosa was recently discovered by the author in Hot Springs Canyon in the southern Santa Ana Mountains, Orange County.

24. Pierce's prickly pear (Opuntia littoralis piercei)

This variety of the coastal prickly pear typically occurs in the higher elevation areas of the San Bernardino Mountains. Colonies of cacti tentatively identified as being of this taxon are infrequent in the east part of the study area in the alluvial scrub association, growing on sand bars within recently abraided alluvial flats. Variety confirmation by a cactus specialist is needed. However, high river and side channel flow blocked recent attempts to collect samples for verification.

25. Pencil Cactus (Opuntia ramossima)

See discussion above.

26. Winged pigweed (Cycloloma atriplicifolium)

This interior cismontane ruderal is sparingly established in abraided alluvial openings north of the River in the Horseshoe Bend reach.

27. Desert stillingia (Stillingia linearifolia)

One population of this desert herb was found at the foot of the Chino Hills along the railroad tracks. John Thomas Howell collected it in the Canyon many years ago but it had not been reported again since his early botanical explorations until now. This is the only known locality of the species in Orange County.

28. Wild licorice (Glycyrrhiza lepidota)

This is an aromatic-rooted shrub of moist places in the Mojave Desert. It was discovered on a spoils bank at the foot of the Chino Hills along the railroad tracks in the east part of the study area, near the easterly arrowweed stand. The species occurred along the Santa Ana Valley Irrigation Canal in Horseshoe Bend before this historic waterway was removed during construction of SAVI Business Park.

29. Water Gentian (Eustoma exaltatum)

While the range of this wildflower extends along the southern tier of the United States to Florida, in California the blue to white blossoming herb is restricted to moist places in the Colorado Desert and along the Santa Ana River channel. Marsh and Abbott found it in the Horseshoe Bend Reach. During the ongoing study it was located farther east, on the bank of a borrow site pond north of the river. This habitat has apparently been recently destroyed by grading of the Gypsum Canyon Road extension to La Palma Avenue.

30. Sticky yerba santa (Eriodictyon trichocalyx)

Three populations of this San Bernardino Mountains alluvial scrub subshrub were found in the study area. The easternmost was in an orange grove just west of Brush Canyon north of the river. The second was on an old levee east of Featherly Park. The third was growing on a 1969 era levee in Horseshoe Bend. A fourth population exists or existed east of the study area along the Green River Golf Course east boundary fence.

31. Santa Ana River woolly-star (Eriastrum densifolium sanctorum)

Once thought to be endemic to Santa Ana Canyon, this brilliant blue-flowered subshrub of the alluvial scrub community has apparently been extirpated in Orange County. The last stand grew on a terrace between Imperial Highway and Esperanza Station (Weir Canyon Road) which was developed as a mobile home park in the 1970's. Richard Zembal is of the opinion that there is no remaining suitable habitat for the species here. Suitable habitat must be high enough to escape flood inundation, i.e., a terrace, where substrate is sandy, not cobbly. Most old terrace habitat is now developed. The formation of new terraces is now prevented by Prado Dam, which captures sand in Prado Basin upstream.

Fortunately, several populations have been recently discovered in the upper reaches of the Santa Ana River and in Cajon-Lytle Creek Wash. These are probably the endemic stands, and Orange County populations were washdowns. Santa Ana River woolly-star is Federally listed as endangered.

32. Thurber's buckwheat (Eriogonum thurberi)

This pink-flowered desert herb was found on sandy flats between the river and the SAVI Ranch terrace in 1979. The locale was subsequently disturbed, but the spring flowering annual may still persist there. Marsh and Abbott had found the species north of the river about 9 years earlier.

33. Coyote tobacco (Nicotiana attenuata)

This is an interior cismontane and desert species discovered in a single locality in the eastern portion of the study area.

34. Interior saltgrass (Distichlis spicata stricta)

The saltgrass observed in several locales in the study area as in springy places on the Chino Hills slopes and within the "sandspit" loop of Featherly Park is assumed to be the interior stricta variant rather than the nominate Distichlis spicata of the coastal salt marshes. This species is found around desert oases and in moist places in the interior cismontane area.

Coastal Range-Edge Species

35. Wall-rocket (Diplotaxis tenuifolia)

A small population of this adventive subshrub of the mustard family is found on either side of the railroad tracks as they pass by Green River Golf Course just inside the Orange County line. A native of Europe, this species is sparingly introduced about seaports in California. It appears that the A.T. and S.F. Railroad has inadvertently aided in its inland transport.

36. "Short-spined" coastal prickly pear (Opuntia littoralis austrocalifornica)

This low-growing rather glaucous and sparsely-spined variant of coastal prickly pear cactus is found in open alluvium in the Horseshoe Bend reach of the study area. O. littoralis and its variants O. l. vaseyi and O. l. piercei as well as O. l. austrocalifornica appears to occupy most appropriate habitat niches within the river floodplain. O. "occidentalis" hybrid prickly pears are restricted to upland slopes in coastal sage scrub, and are relatively rare on the floodplain.

37.Brewer's saltbush (Atriplex lentiformis ssp. breweri)

This whitish-leaved shrub is a frequent component of coastal bluff scrub, especially in small canyon drainages flowing out toward the beach. An inland outpost was found on the eastern margin of the Brush Canyon bajada and west of Brush Canyon south of the new housing tract (Villa del Rio). Brush Canyon drains into the Santa Ana River from the north, and is located in the eastern portion of the primary study area.

38. Davidson's saltbush or bract-scale (Atriplex serenana davidsonii)

Populations of this herbaceous chenopod have been found at Coal Canyon Stables and east of the study area in Green River Meadows. Both sites had been substantially disturbed by horses.

Summary

The Santa Ana River is an ancient feature of the southern California landscape. The present day watersheds, largest in southern California, encompasses an estimated 2450 square miles. It includes an area extending from the west slopes of the San Jacinto Mountain, north slopes of the Palomar range and east slopes of the Santa Ana Mountains north to Pigeon Pass and the San Timoteo Badlands, the high southern slopes of the San Bernardino and eastern San Gabriel Ranges and west to the 670 square mile Chino Basin and the south slope of the Puente-Chino Hills.

Within the study area, the Santa Ana Canyon lies on the common boundary of two major landforms, the Chino/Puente Hills and the Santa Ana Mountains. So pronounced is the division created by the Canyon that, for a few upland plant species, regional dispersal across the chasm is blocked. Thus, on a minor scale, the Canyon is a biogeographic as well as landform boundary.

The setting is thus an ideal area to search for and find unusual relict, range edge and "washdown" flora species, 37 of which are described above.

Still unanswered issues, fruit for further research are the locations (or hypothetical locations) of preexisting "bridge" populations between now disjunct and relict localities of species in the Canyon area and northern Santa Ana Mountains and more northern present-day localities which are considered main centers of distribution. Were these "bridge" populations concentrated solely in the major mountain chains? Or did such lesser landforms as the San Jose and Puente-Chino Hills raising above the often marshy alluvial basins also function as habitats for now disjunct upland species such as Brickellia nevinii, Salvia leucophylla, Dicentra ochroleuca, and Astragalus brauntonii? The location of preexisting links between now-separated populations of plants north and south of the Los Angeles Basin is a perplexing and interesting mystery awaiting research.

The author gratefully acknowledges the careful review of the draft of this paper and the constructive suggestions made by Allan Schoenherr, Goeff Smith and Jack Burk.

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ANNOUNCEMENTS

Mona Myatt Memorial. As you probably know, former SCB President, Mona Myatt passed away February 10. Mona was ill with cancer. Her loss is deeply felt, both as a person and a scientist. A group of people working with Mona's husband, Mike Meyer, have established a memorial fund for her. Because the flowering plants of the desert were dear to Mona, the fund will be used to further the understanding and protection of the botanical resources of the desert. Depending upon the level of support, they plan to make a contribution in her name to the Nature Conservancy and/or establish an annual memorial prize for the best paper on desert plant biology. If you would like to contribute to this fund, please make your contribution payable to "Natural History Museum Foundation," and send it to:

John Palmer (phone 818-302-9750)
Environmental Affairs G01, Room 497
Southern California Edison
P.O. Box 800
Rosemead, CA 91770

The Museum will provide you with a written acknowledgement for tax records, and you will be informed of the exact use made of the fund. Your support would be greatly appreciated.

Santa Monica Mountains Wildflowers. The Santa Monica Mountains Chapter of CNPS is sponsoring a wildflower show on April 9 and 10, from 10:00 a.m. to 5:00 p.m. at the L.A. Co. Museum of Natural History, 900 Exposition Blvd. For details, call Margaret Huffman at (213) 459-4279. They also have a series of wildflower walks at the Santa Monica Mountains National Recreation Area. These Saturday walks are led by a CNPS naturalist. They usually run from 8:45 a.m. to 2:00 p.m. For details call (818) 348-5910 or (213) 479-1942.

Nature Trips Sponsored By The American Cetacean Society. Easter Wildflowers on Anacapa Island. Saturday, April 2, 8:30 a.m. to 4:30 p.m. Steve Junak, Botanist at the Santa Barbara Botanic Gardens, offers his expertise on Channel Islands flora and history in this day hike on Anacapa Island. Boat leaves from Ventura and takes one hour to travel to the island, which will be in brilliant bloom. Cost: $35/$30 members. Bring a picnic lunch.
Catalina Safari. Saturday, April 16 or 23, 9:00 a.m. to 5:30 p.m. Naturalist-guided bus tour of the interior of Catalina Island. Package includes roundtrip passage on the Catalina Express. Cost: $55/$48 members. Bring a picnic lunch. For further information phone 548-8500. Reservations for these trips are made upon payment only. Send a check payable to "ACS/LA" to Sue Lafferty, 3706 Weymouth, San Pedro, CA 90731.
Santa Fe Dam Nature Center. The County of Los Angeles Dept. of Parks and Recreation has re-opened the Santa Fe Dam Nature Center. The Center will open to the public on weekends. Open hours will include Saturday and Sundays, 9:00 a.m. to 5:00 p.m. It is located in the midst of the last remaining Alluvial Scrub plant community left in Southern California. For millennia, the great San Gabriel River has deposited its riches of alluvium from the towering San Gabriel mountain range, creating a striking desert-like landscape. In spring, a profusion of spiky yucca plants sends up a fragrant forest of 15-foot high creamy white flowering stalks amidst bright-flowered cacti and many native shrubs and wildflowers. This unique environment provides a home for two endangered species, the black-tailed gnatcatcher and the coast horned lizard, as well as many other species. A self-guided nature trail provides opportunity to stroll, enjoy the sweeping views and solitude, and observe the birds and other wildlife as you experience a glimpse of California as it used to be.

Wilderness Fair. The Wilderness Institute is sponsoring the 4th Annual Wilderness Fair on Saturday, April 9, 1988, at Calamigos Ranch in Agoura Hills. The goal of The Wilderness Fair is to provide an opportunity for the general public of the greater Los Angeles area, including the disabled population, to enjoy participatory outdoor activities, such as an adventure ropes course and nature hikes, live entertainment, and the opportunity to learn about local outdoor organizations and to purchase artwork by local artisans. If you have any questions, call Bonnie Berry, event coordinator, at (818) 887-7831.

Green Scene. The Fullerton Arboretum on the CSUF campus is having a plant sale April 23, 24 (Saturday and Sunday). All kinds of plants are for sale. Take Yorba Linda Blvd. west from the 57 Freeway. Turn left at the first signal.

Undergraduate Research Conference. Occidental College and Santa Clara University are co-hosting this conference to provide a means of recognizing undergraduate research. The conference will be held at Occidental College on Saturday, April 30. For information contact Dr. John C. Hafner, Dept. of Biology, Occidental College, L.A. 90041. (213) 259-2673.

Southern California Academy of Sciences Annual Meeting. A $100.00 award for best student paper in botany or plant ecology will be awarded by SCB. This year's annual meeting will be held at CSU Northridge on May 6, 7. Topics of interest to botanists include ecology of southern California kelp beds, desert biology, and the use of microfossils in paleoecologic reconstructions of southern California.

Botanizing Across Oregon. The Oregon Chapter of The Nature Conservancy, on July 24 to 30, 1988, will take a botany field trip across Oregon that will include the newly established Columbia River Gorge Scenic Area, the Cascade mountains, central Oregon's high desert, immense Malheur National Wildlife Refuge and spectacular Steens Mountain in southeastern Oregon. Although the emphasis of this expedition is botany, they will also enjoy excellent birding, varied geology, and other natural history topics. Accommodations will include three nights at the historic Frenchglen Hotel, situated at the base of Steens and adjacent to Malheur Refuge. Travel will be by van, and space is limited to nine participants. For details write: Oregon Botany Expedition, The Nature Conservancy, 1205 NW 25th Avenue, Portland, Oregon 97210.

FIELD TRIPS

April 10 (Sunday). 8:00 a.m. to dusk. Pines to Palms Trip. Geoff Smith will lead this trip to examine desert, chaparral and mountain habitats. Meet at the S. E. corner of the Ramona Expressway and 215 south of Riverside. Caravan from Hemet through the San Jacinto Mountains on Hwy 74 with stops at plant communities discussed in Geoff's Crossosoma article (April, 1986). Bring a sack lunch and comfortable walking shoes. For further information contact Geoff at (714) 526-6963 (evenings); (714) 929-5248 (evenings) or (714) 992-7380.

April 16, 17 (Saturday-Sunday). Ash Meadows, Nevada. This is a trip for four-wheel drive vehicles (limit 15). David Magney will lead this trip to examine Federally listed plants in this desert valley, just east of Death Valley. Write for details to David Magney, 509 Palomar Rd., Ojai, CA. 93023-1737 or call (805) 646-7420 (H), or (805) 686-4415 (W).

April 16, 17 (Saturday-Sunday). Short Canyon, eastern Sierra Nevada. This trip will be led by the Bristlecone Chapter of CNPS. Meet at 9:30 a.m. at Brady's, on Highway 395 north of the junction with Highway 14. Call Dave Bramlet for details. (714) 549-0674.

April 23 (Saturday). Johnson Valley. Dave Bramlet will lead this trip to view King Clone, the 11,700 year-old ring of creosote bushes. Also, the Mojave should be nearing the end of its bloom at this time. Meet at 9:00 a.m. at the junction of Highway 247 and Bessemer Rd. Take I-15 north to Victorville and go east on Highway 18 to Highway 247. Take Highway 247 east to Bessemer Rd. Call Dave for details at (714) 549-0674.

April 30 (Saturday). Maple Springs, and maybe Bald Peak; Santa Ana Mountains. These areas burned during the Silverado Canyon fire last year. The regrowth includes plants known as fire followers, such as Turricula parryi (poodle-dog bush) and Papaver californicum (fire poppy). From the Newport Freeway (55) take the Chapman Ave. exit east, following Chapman to Santiago Canyon Rd. (S18). Turn right on Santiago, and follow it to Silverado Canyon Rd. Go to the end of Silverado Canyon Rd, where it is blocked by a gate. We will meet there at 10:00 a.m. Leader: Karlin Marsh, (714) 649-2027.

May 7 (Saturday). Rubidoux Nature Center. Oscar Clarke will lead this field trip to examine riparian vegetation along the Santa Ana River. Meet at 9:00 a.m. To reach the Nature Center take the Pomona Freeway (60) east to Valley Way. Go south to Mission. Take Mission east to Riverview Dr, then go west to Peralta Place and south just past Riverview to the Rubidoux Nature Center.

May 14 (Saturday). Big Bear and Baldwin Lake Pebble Plains. Potential trip to view one of California's greatest centers of endemic plants. Call Dave Bramlet if you are interested. (714) 549-0674.

May 21 (Saturday). Tetracoccus Ridge, Panamint Mountains. The Bristlecone Chapter of CNPS will lead this trip. Call Dave Bramlet for details. (714) 549-0674.

TENTATIVE FUTURE TRIPS

Spring Mountains, Nevada (May or June)

Vernal Pools, San Diego County (April)

Palomar Mountain (June)

If you are interested, send SASE to Dave Bramlet, 1691 Mesa Dr. A-2, Santa Ana, CA. 92707.

Amateur and Professional Botanists. The journal of the Southern California Botanists, CROSSOSOMA, provides an ideal means by which you can publish things of botanical interest to southern Californians. If you have a favorite field trip, gardening hints, or some preliminary data that you'd like to have in print submit your manuscript to:

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GRANTS AVAILABLE

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1. Title page.
2. Description of proposed research, primary objectives, and relationship of the research to the student's goals (two page limit).
3. Timetable for research, anticipated commencement and completion dates.
4. Budget, with justifications, and statement regarding availability of funds from other sources.
5. Brief resume stating current position, education, affiliations, qualifications and anticipated position and address at completion of research.
6. A letter of recommendation from a faculty member (may be sent separately to the Student Research Grants Committee).

Three copies of the proposal should be submitted before **May 1, 1988**

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SCB COMING EVENTS (DETAILS WITHIN)

April 10	Pines to Palms Highway
April 16, 17	Ash Meadows, Nevada
April 16, 17	Short Canyon, Eastern Sierra Nevada
April 23	King Clone, Johnson Valley
April 30	Maple Springs, Santa Ana Mountains
May 7	Rubidoux Nature Center
May 14	Big Bear and Baldwin Lakes
May 21	Tetracoccus Ridge, Panamint Mountains

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CROSSOSOMA

SOUTHERN CALIFORNIA BOTANISTS
Rancho Santa Ana Botanic Garden, Claremont, CA 91711

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RECENT ECOLOGICAL INVESTIGATIONS AND PRESENT STATUS OF THE ENDANGERED SANTA ANA RIVER WOOLY-STAR, ERIASTRUM DENSIFOLIUM SSP. SANCTORUM (MILLIKEN) MASON

by
John Wheeler

Department of Biological Sciences
California State University, Fullerton
Fullerton, California 92634

INTRODUCTION

Eriastrum densifolium ssp. sanctorum (E.d.s.) is a member of the phlox family, Polemoniaceae. The plant is a short-lived perennial sub-shrub found only in the floodplain of the Santa Ana River in San Bernardino County. Terminal bracteate heads produce clusters of showy tubular flowers that attract hummingbirds, swallowtail butterflies, skippers, blue butterflies and many species of bees and flies. E.d.s. is a primary source of seasonal color, forming an attractive profusion of blue when aggregations of plants flower in late May, June, and July.

The restricted range and potential vulnerability of E.d.s. was first reported by Zembal and Kramer (1984). Historically, E.d.s. probably occurred along approximately 60 miles of the Santa Ana River, but the plant is now restricted to about eight linear miles of floodplain. The habitat is located from near the mouth of the Santa Ana River canyon, at the foot of the San Bernardino Mountains, and extending west to the floodplain in the vicinity of Norton Air Force Base in San Bernardino County.

In addition to a restricted geographical range, Zembal and Kramer (1984) recognized that E.d.s. was apparently confined to

certain flood-mediated habitats within the floodplain such as sand terraces and washes. Areas downstream from the present range are no longer suitable E.d.s. habitats due to development, river channeling, and flood control activities (Zembal and Kramer, 1984; Walt Wright, personal communication).

In 1984, Zembal and Kramer strongly recommended the protection of remaining E.d.s. habitat and a study of E.d.s. autecology. In October 1987, E.d.s. was listed as endangered by the Federal Government. The following report summarizes the ecological behaviors and habitat requirements of the Santa Ana River Wooly-star, Eriastrum densifolium sanctorum, as they are currently understood based on recent investigations (Burk et al, 1987). The status of remaining habitat in terms of human mediated disturbance is also discussed. This research is ongoing and will provide guidelines for mitigation of the effects of Seven Oaks Dam, a Corps of Engineers flood control project currently under construction in the Santa Ana River canyon upstream from all verified E.d.s. habitat. E.d.s. habitat is ephemeral with respect to successional time. Rejuvenation of habitat is therefore threatened by the control of periodic flooding.

METHODS

Habitat analysis: In June 1987, we mapped the distribution of E.d.s. in the Santa Ana Wash (Burk et al, 1987). In late June and early July, five large subpopulations were selected for intensive sampling. We intentionally chose widely separated sites so that variability of habitat throughout the floodplain could be investigated. These five sites were each paired with a nearby site that did not support E.d.s., resulting in five pairs of sites. The pairing of sites was possible because of the aggregated nature of E.d.s. dispersion. The five sites supporting E.d.s. were named 1A-5A; each paired site without E.d.s. was named 1B-5B.

At each site a 100 meter east/west axis was established. Five points along this axis where randomly selected. Northward from each point, a 30-meter line transect was used to record cover based on intercept length of perennial plant species, combined annuals, dead shrubs, and rock (Burk et al, 1987). Of the five randomly placed lines at each site, the center and end lines were utilized to collect surface (0-10 cm depth) and subsurface (15-25 cm depth) soil samples and data on ambient and surface insolation. The soil samples were analysed to provide values for surface and subsurface pH, salinity, micro-organics, and texture. Soil texture was classified as large gravels (1.25-10 cm), small gravels (0.2-1.25 cm), sand (0.05-2 mm), silt (0.002-0.05 mm), and clay (< 0.002 mm). Soil texture was analysed using the standard Bouyoucos hydrometer method as outlined by Cox (1985).

The line intercept and site data were organized for two separate multivariate DRA (detrended reciprocal averaging) analyses (Pimentel and Smith, 1986). To clarify whether E.d.s. habitat differed from adjacent paired sites in terms of constituent species, a species response matrix (excluding E.d.s.) vs. sample sites was analysed. A second matrix of environmental characteristics (substrate and insolation) vs. sample sites was then analysed to identify differences, if any, in environmental conditions between habitats supporting E.d.s. and adjacent unpopulated habitats.

Seedling survivorship: On 6 and 7 November 1987, initial sets of individual seedlings were permanently marked for the purpose monitoring suvivorship at the five E.d.s. study sites. Permanent plots (0.25 m^2) were systematically positioned within 1.0 meter and generally southwest of the base of reproductive E.d.s. adults. Preliminary seed dispersal measurements conducted in late September and October 1987 indicated that most seeds disperse within 1.0 meter of the mother plant; moreover, preliminary measures of seedling density taken on 28 October similarly indicated maximium densities within one meter and generally southwest of the mother plant.

Rain data are those recorded by the nearby Redlands Daily Facts newspaper. Measurements obtained from a raingauge I installed on 29 November 1987 at a central location within the floodplain coincide well with measurements of precipitation taken on the newspaper premises from 29 November 1987 to 11 April 1988.

From 15 November through 9 December 1987, I placed supplemental plots at four of the five sites. No supplemental plots were established at site 3A because this site seems to represent habitat that is modified regularly by seasonally active, minor washes. Seasonal disturbance would have regularly reversed any local successional processes on the 3A site. The other sites (1A, 2A, 4A, and 5A) represent terrace habitats that have apparently been modified only during flood years. These terrace sites are similar in that successional processes would not have been reversed since the initial formation of the terrace.

It was not possible to mark all seedlings of the initial cohort at each site on one day. Seedlings marked later than 6-7 November but before 10 December 1987, were considered to be members of the initial cohort based on: 1) limited precipitation during this period (only 23 mm spread over 5 separate dates) and 2) the absence of subsequent recruitment during this period in plots established on 6-7 November. All seedlings marked between 6 November and 10 December were therefore assumed to be members of the cohort that germinated in response to 104 mm of precipitation recorded from 12 October to 5 November 1987 (spread over 12 separate dates).

A total of 125 permanent 0.25 m^2 plots were placed in the field between 6 November and 9 December 1987. At sites 1A, 2A, 4A, and 5A respectively, 31, 26, 31, and 31 plots were established. These plots have been monitored regularly from time of placement to the present in order to follow seedling survivorship and recruitment over time.

Adult mortality: Dead E.d.s individuals were collected at each of the five study sites. The root crown was sectioned and the cut surface polished to allow descrimination of growth rings.

RESULTS

Habitat and vegetation analyses: With a single exception, DRA analyses (Fig. 1 and 2) showed that habitats supporting E.d.s. differed from adjacent habitats without E.d.s., both in species composition and environmental characteristics. Sites 1A-5A (those supporting E.d.s.) are relatively open. Surface insolation is higher, and clays and silts form a lower percentage of the soil composition. The percentage of sand in the soil is higher at the A sites. Salinity and percent micro-organics are lower in habitats supporting E.d.s. The analysis suggests that Croton californica, Heterotheca fastigiata ssp. villosa (formerly Chrysopsis fastigiata), Ericameria pinifolia (formerly Haplopappus pinifolius), Eriodictyon trichocaylx and Lepidospartum squamatum are species with distributions and habitat requirements that are similar to E.d.s. In contrast, species occurring on B sites such as Adenostoma fasciculatum, Artemisia californica, Brickellia californica, Prunus illicifolia, Rhamnus crocea, Rhus ovata, and Solanum xanti were never found on E.d.s. sites.

The exception was site 5B, which was more closely related to the A sites than to B sites, based on either associated species or physical characteristics. See discussion for an explanation of this anomaly.

Except for site 5B, the A sites are distinctly segregated from B sites (Fig. 1 and 2). In addition, A sites form a spectrum with respect to the B group of sites. Two of our A sites (2A and 4A) plotted relatively close to the grouping of B sites; this indicates that habitats in 2A and 4A exhibit characteristics that relate them to the B group. Two other sites (1A and 5A) plot away from the B group; habitats at 1A and 5A are relatively less similar to habitats on B sites. One site (3A) plots in an intermediate position.

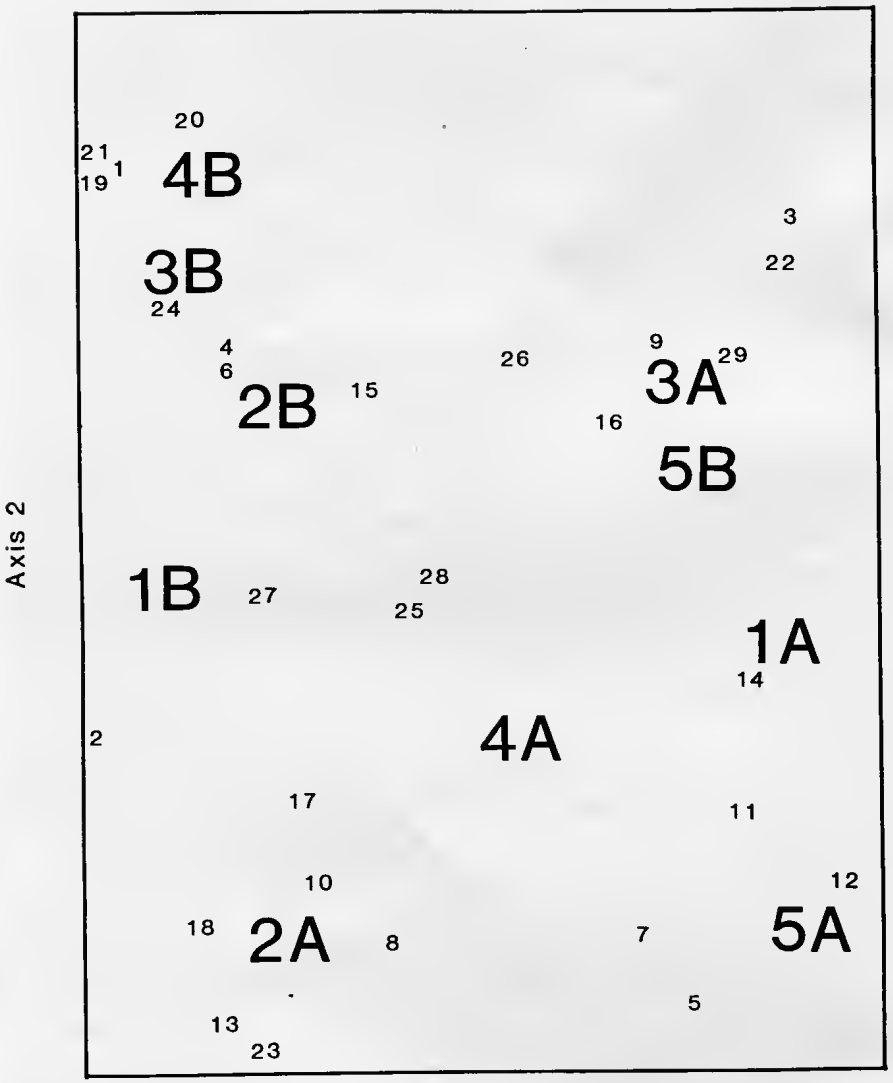

Figure 1. Ordination diagrams showing results of DRA analysis of the species vs. samples data matrix. I have superimposed the species ordination onto the samples (sites) ordination. The proximity of sites and species on the graph implies positive association in nature. The placement of site labels on the figure represents the geometric center of the coordinates of transects per site. Numbers 1-29 represent species codes (see Table 1). E.d.s was not included in the data; its location on the figure was approximated from separate DRA runs where it was included.

Table 1. Summary of cover by species at all sites (% of total cover), at A sites plus site 5B (group 1), and at B sites (group 2). Where a species occurred in both groups, Mann-Whitney U tests were used to determine significance. ns = not significant, ** = significant (P < .01)

Species	Species code	Total cover	Cover Group 1	Cover Group 2	
Adenostoma fasciculatum	1	1.57	0.00	3.94	
Artemisia californica	2	0.22	0.00	0.55	
Bebbia juncea	3	0.08	0.13	0.00	
Brickellia californica	4	0.07	0.00	0.19	
Croton californicus	5	1.90	2.74	0.66	ns
Encelia farinosa	6	0.42	0.13	0.85	ns
Eriastrum densifolium	7	0.83	1.66	0.00	
Eriodictyon trichocalyx	8	5.16	8.19	0.62	ns
Eriogonum fasciculatum	9	10.87	10.60	11.28	ns
Gutierrezia bracteata	10	0.60	0.56	0.66	ns
Ericameria pinifolia	11	0.07	0.12	0.00	
Heterotheca fastigiata	12	1.71	2.86	0.00	
Juniperus californica	13	0.32	0.13	0.62	ns
Lepidospartum squamatum	14	4.03	4.97	2.62	ns
Lotus scoparius	15	0.67	0.43	1.02	ns
Melica frutescens	16	0.01	0.02	0.00	
Opuntia littoralis	17	0.54	0.34	0.83	ns
Opuntia parryi	18	0.54	0.08	1.24	ns
Prunus ilicifolia	19	0.33	0.00	0.84	
Rhamnus crocea	20	0.01	0.00	0.04	
Rhus ovata	21	0.05	0.00	0.14	
Salvia apiana	22	0.22	0.37	0.00	
Senecio douglasii	23	0.26	0.22	0.32	ns
Solanum xanti	24	0.15	0.00	0.39	
Stephanomeria pauciflora	25	0.09	0.13	0.04	ns
Yucca whipplei	26	0.89	0.88	0.90	ns
Annual plants	27	38.67	19.07	68.08	**
Dead shrubs	28	4.41	3.65	5.55	ns
Cryptogams	29	0.05	0.09	0.00	

Table 2. Statistical comparison of environmental factors in plots contained in Group 1 (A sites plus 5B) and Group 2 (B sites excluding 5B). ns = not significant, * = significant (P = < .05), ** = significant (P = < .01) as determined by Mann-Whitney U Two Sample Test.

Factor	Code	Group 1	Group 2	
Ambient light	1	85.5	88.7	ns
Reflected light	2	48.2	30.0	*
Rock > 10 cm	3	5.6	6.2	ns
Bare ground	4	30.6	4.6	**
Surface sand	5	97.1	77.9	**
Subsurface sand	6	98.1	87.3	**
Surface silt	7	2.3	20.3	**
Subsurface silt	8	1.3	11.6	**
Surface clay	9	0.7	1.9	**
Subsurface clay	10	0.6	1.2	*
Surface particles <2mm	11	91.0	94.3	ns
Subsurface particles <2mm	12	88.1	85.2	ns
Surface gravel 0.2 - 1.25 cm	13	4.5	2.6	ns
Subsurface gravel 0.2 - 1.25 cm	14	6.5	3.7	ns
Surface gravel 1.25 - 10cm	15	3.9	3.2	ns
Subsurface gravel 1.25 - 10cm	16	5.4	9.8	ns
Surface salinity (% of max)	17	52.9	68.4	*
Subsurface salinty (% of max)	18	47.6	53.9	ns
Surface micro-organics	19	0.5	1.9	**
Subsurface micro-organics	20	0.3	0.9	**

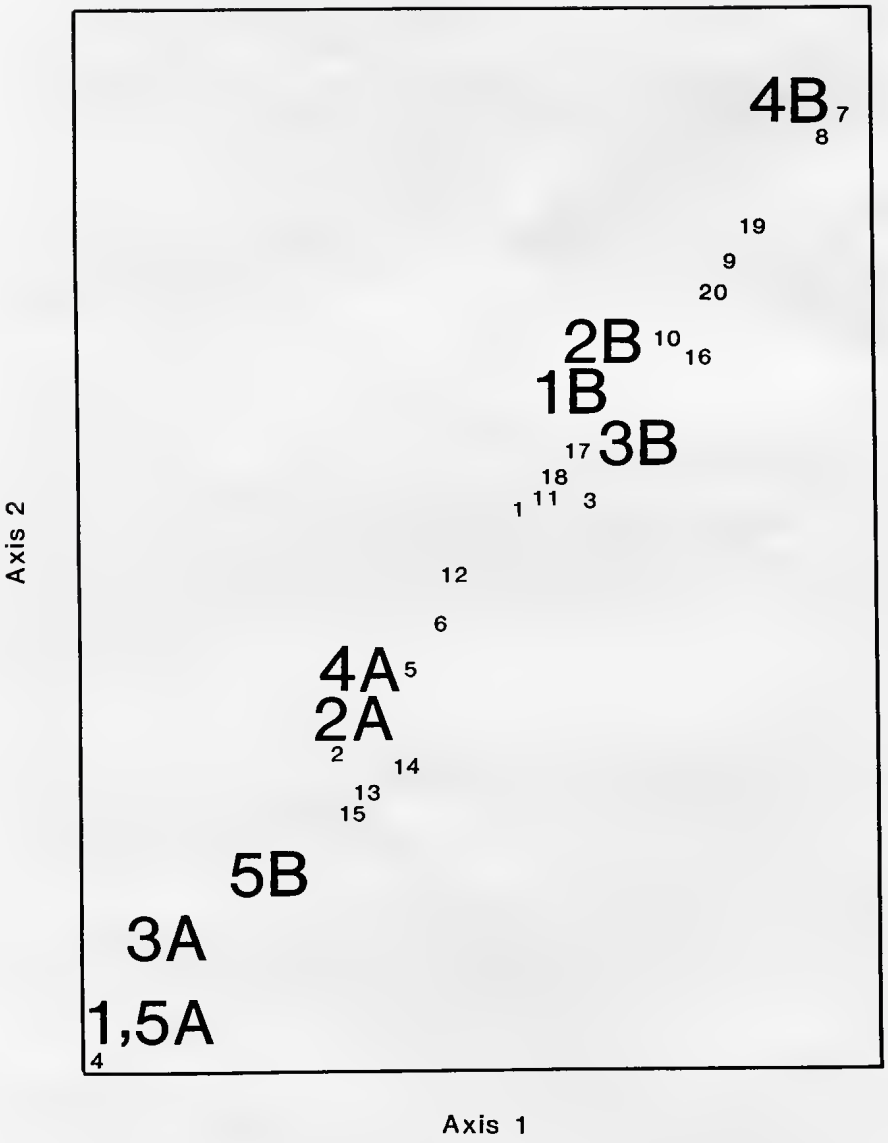

Figure 2. Ordination diagrams showing results of DRA analysis of the environmental factors vs. samples data matrix. I have superimposed the factors ordination onto the samples (sites) ordination. The proximity of sites and environmental factors on the graph implies a positive association in nature. Numbers 1-20 represent codes for environmental factors listed in Table 2.

Adult mortality: Growth ring counts are summarized in Table 1. On the average, E.d.s. individuals live for five years. Observations in the field suggest that plants are reproductive by their second year. An area known to have been disked in October 1984 supports fully grown and even senescent individuals.

Table 3. Summary of growth ring analysis at the five Eriastrum densifolium sanctorum study sites. Numbers represent age at death for all plants on each site for which root crowns remained in place.

	Site				
	1A	2A	3A	4A	5A
N	24	26	29	39	35
Mean	5.00	4.96	5.03	4.62	4.71
Maximum	7.00	8.00	10.00	9.00	7.00
Std. dev.	1.00	1.22	1.79	1.27	1.03

Seedling survivorship: The first rainfall after E.d.s. seed dispersal, in the Fall of 1987, occurred on 12 October (13.2 mm) followed on 23 October 1987 (the largest storm in October) by 27.4 mm of precipitation. Seedlings were first noticed on 26 October. Preliminary seedling densities were measured on 28 October. Prior to 10 December 1987, a final sample size of 453, 310, 387, and 514 seedlings were individualy marked at sites 1A, 2A, 4A, and 5A respectively.

E.d.s. seedling survival through 11 April 1988 is summarized in Figure 3. The four survivorship curves document the survivorship of individual seedlings on each site. Survivorship has been lowest on site 2A; only 7.6% of the initial cohort remain alive. Survivorship has been highest on site 1A where 77.8% of the initial cohort remain alive. At site 5A, 48.3% of the initial cohort remain alive; at 4A, 29.0% are living. Herbivores are probably not the cause of mortality because I found > 80% of the dehydrated remains of dead seedlings in the field.

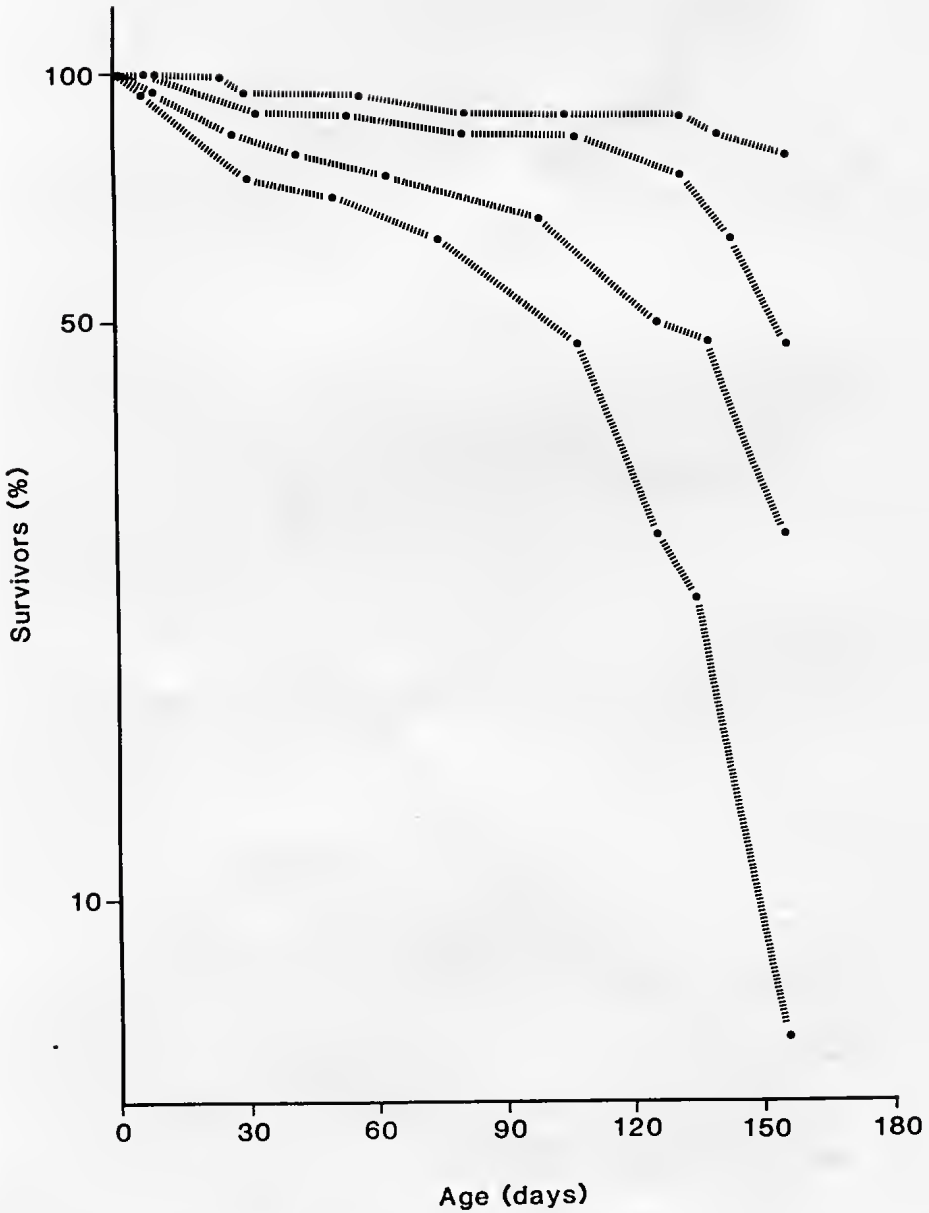

Figure 3. Eriastrum densifolium sanctorum seedling survival through 11 April 1988. The four survivorship curves document the survivorship of individual seedlings on sites 1A, 2A, 4A, and 5A. N = 453, 310, 387, and 514 respectively. The vertical axis is on log scale.

DISCUSSION

Southern California represents a main center of endemism for the family, Polemoniaceae; of 54 species in cismontane Southern California, 35 are endemic (from Munz, 1974). The genus Eriastrum contains one perennial woody species: E. densifolium. Perennial woody tissue is thought to indicate a primitive state, whereas the annual habit is considered to be a derived state. E. densifolium, therefore, is considered to be the most primitive extant species in the genus (Grant, 1959).

Craig (1934) and Mason (1945) recognized five subspecies of E. densifolium. E. d. densifolium (typica) occurs in coastal areas from Santa Barbara County northward to the Monterey area. E. d. mohavensis, E. d. austromontanum, and E. d. elongatum occupy transmontane, montane, and cismontane habitats respectively from central California to lower California. Eriastrum densifolium sanctorum (E.d.s.) is an exceptional local subspecies apparently restricted to the Santa Ana River drainage in San Bernardino County. E.d.s. is easily distinquished from the other subspecies because of its large stature (25-75 cm to rarely 100 cm) and large corolla (25-32 mm). E.d.s. is also the only subspecies that is conspicuously lanate throughout. The California Flora (Munz and Keck, 1959) recognizes the above five subspecies; however, E. d. elongatum was somehow omitted in the Flora of Southern California (Munz, 1974).

The verified present range of E.d.s. is about eight miles of floodplain mentioned above. Additional E.d.s. populations have been reported in association with the Lytle Creek and Cajon Washes to the west (Zembal and Kramer, 1984; Krantz, 1985). However, two lines of evidence suggest that individuals in these populations clearly differ from the pure E.d.s. type. In July 1987, I visited Eriastrum densifolium populations in the Lytle Creek Wash. With respect to floral size (16-22 mm), branching pattern, stature, and pubescence they resemble E. d. elongatum or perhaps an intermediate between E. d. elongatum and

sanctorum. In addition, Craig (1934) documented the occurrence of E. d. elongatum in the Cajon Wash one mile above Devore and at Highland Blvd. He mentioned no E.d.s. associated with the Cajon Wash. Craig then recorded intermediates (E. d. elongatum X E. d. sanctorum) near the cities of Colton and San Bernardino. These localities are associated with the Lytle Creek drainage.

Eriastrum densifolium individuals associated with Lytle Creek Wash appear to form a hybrid swarm that is in need of taxonomic resolution. They are variable, but clearly different from E.d.s. Craig's (1934) historical records indicate that plants in the Cajon Wash (Devore area) may also differ. If these populations are, in fact, taxonomically separate or genetically diluted then the known range of pure E.d.s. is restricted to the single population north of Redlands.

Within its range, E.d.s. is confined to flood-mediated habitats. Taken together, sites supporting E.d.s. exhibit species compositions, surface light levels, and substrate characteristics that indicate these habitats were established by sand deposition during flooding and are young in successional time. In contrast, sites without E.d.s. exhibit the characteristics of older successional habitats.

One pair of sites that does not show the above trend is 5A and 5B. Site 5B resembles A sites in both species composition (except E.d.s.) and physical factors. Sites 5A and 5B are located downstream of all other sites in a relatively homogeneous portion of the floodplain south of Norton Air Force Base. We suspect that E.d.s. is not found in site 5B because of dispersal limitations rather than elimination in successional time. Smooth E.d.s. seeds exhibit no features that would facilitate either wind or animal dispersal.

E.d.s. individuals produce abundant viable seed. Seeds stored in the lab for 7-8 months are > 90% viable. Our field work suggests that essentially all seeds germinate with the first rain(s) of the season and that no scarification is required.

Seedling survivorship at each site generally correlates with relative successional age of the terrace. Cohorts of seedlings on A sites that are most similar to the B group in both multivariate analyses, exhibit low survivorship, whereas cohorts on A sites that are less related to the B group exhibit higher survivorship.

In the DRA analyses, annuals are associated with the B sites. Conditions on relatively older successional sites favor the establishment and reproduction of certain annual species. Alien species such as Schismus barbatus, Erodium cicutarium, and Bromus rubens are ubiquitous at all sites. Relative cover of annuals probably accounts for some of the differences in seedling survival on A sites. At sites with high cover of annuals, they conceivably could monopolize soil moisture and/or light during the establishment phase of E.d.s. seedlings. The fact that I was usually able to find the dehydrated remains of dead seedlings corroborates this idea, barring mortality due to pathogens.

Habitat characteristics and seedling survival both indicate that E.d.s. habitat naturally deteriorates in successional time. In this respect, appropriate habitat is ephemeral. Habitat analyses show that E.d.s. is confined to open, well lighted areas with abundant washed sand. In addition, E.d.s. habitats themselves form a spectrum of successional states. In other words, some areas that support E.d.s. are older and relatively deteriorated; seedling mortality is higher in these areas.

E.d.s. colonizes freshly deposited terraces and reproduces by seed until the habitat reaches a point in successional time where seedlings can no longer establish. For adult plants, the average age at death is five years; maximum age appears to be about ten years. In the absence of flooding, E.d.s. stands eventually decline as establishment decreases and adults became senescent. Under normal conditions, however, periodic flooding would tend to renew E.d.s. habitats and prevent local extirpation events.

Seven Oaks Dam will prevent the periodic flooding upon which E.d.s. depends for rejuvenation of its habitat. Eventually, artificial manipulation will be necessary to arrest succession in existing E.d.s. habitats.

Germination, seed bank, and competition analyses are underway to help resolve this complicated problem. Preliminary analysis of lab work and field observations indicates that E.d.s. seeds are present in the soil for less than one year. E.d.s. seeds require leaching and therefore probably contain water soluble inhibitors. The lack of a permanent seed bank is indicated for two reasons: 1) > 95% of the seeds germinate in the lab under constant drip within 24 hours and 2) no recruitment was observed at site 1A on 22 April 1988 despite heavy rains (a total of 57 mm) in the prior week. No recruitment on 22 April suggests that in the field all viable seeds had either reached the leaching threshold and germinated or had been removed by animals. No seeds were found in soils collected prior to dispersal of the 1987 seed crop. Interestingly, transient seedbanks are often associated with rare taxa (Fiedler,1987).

In the short term, it is imperative that remaining E.d.s. habitat be protected from human disturbance. A recent publication by the California Native Plant Society featured an article that placed E.d.s. in a top-twelve priority list of California's most endangered plants (York, 1987). At present, existing E.d.s. habitats are heavily used and regularly disturbed. Habitat protection is essential so that ongoing autecological studies can continue and maximum numbers of individuals saved for a source of seed.

Reclamation of disturbed areas and future mitigation strategies will most certainly require large numbers of seeds. Habitat integrity is even more critical in view of the short life span of adults. Seeds for future use will come from the seedlings of today, not the adults, because adults will soon become senescent. For this reason, seed collection should be a careful and conservative process. Liberal harvest of seeds on a yearly basis would reduce recruitment in existing stands.

Based on modern distribution, large tracts of optimum habitat already have been removed by sand and gravel interests west of Orange Street. Suboptimal (older) habitats east of Orange Street are currently being mined. Plans are underway to reclaim exhausted pits. Reclamation of pits involves modification of the pit walls until substrate reaches the angle of repose. E.d.s. seeds can then be introduced to these surfaces.

Illegal unrestrained off-road vehicle use is also alarming, especially in open (optimum) habitats west of Orange Street. Part of the off-road vehicle problem stems from the confusing diversity of land juristiction and law enforcement on the floodplain. Ownership should be consolidated to facilitate management and protection of remnant E.d.s. habitats.

SUMMARY

Eriastrum densifolium sanctorum, the Santa Ana River Wooly-star, is restricted in geographical range to about eight miles of floodplain habitat. Moreover, recent visits and historical records suggest that populations reported in the Lytle Creek and Cajon washes are phenotypically different from E.d.s. If true, then E.d.s. exists as a single relatively continuous population in the main Santa Ana River floodplain in San Bernardino County.

In addition to its restricted range, E.d.s. is further confined to flood-mediated habitats within the floodplain. Flood deposited sand terraces are the most important habitat.

The sand terraces are not static; E.d.s. habitats deteriorate as normal successional processes modify the environment. Multivatiate analyses involving measures of perennial plant species, combined annuals, dead shrubs, rock, insolation, and substrate indicate that E.d.s. habitats are relatively young in successonal time when compared to adjacent habitats without E.d.s. Moreover, when E.d.s. sites are considered in isolation, they form a spectrum of successional states.

Studies of seedling success on sites with different successional (flooding) histories, show that seedling survivorship decreases as habitats age. If E.d.s. habitats succeed to climax, seedling establishment would undoubtedly cease. Encroachment by annuals, especially alien species, also seems to hasten habitat deterioration.

Normally, periodic flooding would tend to recycle E.d.s. habitat. However, Seven Oaks Dam will stop the flooding upon which E.d.s. depends for rejuvenation of habitat. If flooding is stopped, artificial habitat manipulation will be essential to simulate the effect of flooding and prevent extinction of the plant. Protection of existing stands is urgently needed to preserve the integrety of remaining habitat, and retain existing individuals for an immediate source of seed.

ACKNOWLEDGEMENTS

I am very grateful to Dr. Jack H. Burk for advice and support in my studies and with this article. I similarly thank Dr. C. Eugene Jones for his support and Dr. Allan Schoenherr for helpful editorial comments. Sandra DeSimone was a great help to us last summer, in the field, in the lab, and with the multivariate analyses.

Thanks are due to Richard Zembal and Karla Kramer for first noticing E.d.s., publicizing its status, and initiating the research. Tim Krantz has also invested personal time in the study of this vulnerable plant.

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ANNOUNCEMENTS

Biogeography of Southern California. The Southern California Botanists are sponsoring their fourteenth annual symposium to be held on October 29, 1988. Mark your calendars now. Among the speakers will be Dr. Robert Thorne of Rancho Santa Ana Botanic Garden who will speak on the history of southwestern deserts and Dr. Richard Minnich of the University of California, Riverside who will discuss the influence of fire on the distribution of native southern California vegetation.

SCB Board of Directors Looks for Volunteers. Due to an untimely sequence of events, the SCB Board of Directors has experienced a depletion of its ranks. If you would like to be a participant in the planning of SCB events, ie. symposia, field trips, or social gatherings, please contact Geoff Smith at (714) 526-6963. The Board of Directors meets once a month, usually on the first Thursday of the month.

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Dr. Jon E. Keeley, Editor
Department of Biology
Occidental College
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FIELD TRIPS

May 28, 29, 30, Saturday thru Monday (Memorial Weekend). Granite Mountain Tamarisk Eradication. Budweiser Spring and Budweiser Wash have a recent invasion of tamarisk that should be susceptible to hand-pulling. The area's elevation of about 4000 ft. should make temperatures tolerable for work in the morning and evening. Camp near Granite Cove in the University of California's Granite Mountains Reserve. Arrive there at any time on Saturday; then work on Sunday and depart Sunday evening or Monday. For details contact Bill Neill, 4900 Glenview, Anaheim, CA 92807, H: (714) 779-2099; W: (714) 528-7201 x2423.

June 4 (Saturday). Mazourka Canyon, Inyo Mountains. The Bristlecone Chapter of CNPS will lead this outing. Meet at 9:00 AM at the "rock" service station, corner of Mazourka Rd. and Hwy 395 just south of Independence. Beautiful desert canyon full of wildflowers. Prepare for the desert; lots of water, etc. Contact: Mark Bagley, P.O. Box 1431, Bishop, CA 93514, (619) 873-5326.

June 4, 5 (Saturday, Sunday). The Nature Conservancy's Big Bear Valley Preserve. Tim Krantz will lead this joint field trip of the San Diego Chapter and the San Gabriel Mountains Chapter to the Big Bear Valley Preserve. The pebble plains of Baldwin lake (near Big Bear Lake) have a unique and highly endemic flora consisting of more than a dozen rare plants. Meet at the preserve entrance at 1D:DD AM. The entrance is at the Nature Conservancy sign by an old building on the north side of North Short drive (Hwy 18) at the north end of Baldwin Lake. This will be a weekend field trip. Camping sites and Motels are nearby. The Preserve requests a $5.DO donation from each participant. If you plan to attend, call or write: Harry Spilman, 715 Prospect #G, South Pasadena CA, 91D3D, (818) 799-9486.

June 11 (Saturday). Ventura River Mouth. This trip led by the Channel Islands Chapter of CNPS will meet at 9:DD AM at parking lot of Ventura River bridge east end of Main St., Ventura. Explore wetlands vegetation of the Ventura River mouth. Discuss wetlands vegetation types, invasive exotics, and management problems. Easy walking. Ends about 2 PM. Leader: David Magney, Dames & Moore, 175 Cremora Dr., Suite A-E, Goleta, CA 93117. (8D5) 685-4415 or (8D5) 646-742D.

June 19 (Sunday). Newport Back Bay. Dave Bramlet will lead this popular trip to see salt marsh vegetation at one of California's few remaining estuaries. Interesting plants include salt marsh bird's beak, Cordylanthus maritimus, and Yerba Mansa, Anemopsis californica. Meet at 9:DD AM at the intersection of San Joaquin Road and Back Bay Drive. For details call Dave at (714) 855-D222.

June 25, 26 (Saturday, Sunday). San Gabriel Mountains Field Trip. Meet at 9:15 AM Saturday, Angeles Crest Highway at the entrance to Charlton Flats picnic area. Exact itinerary will be decided later. If conditions are favorable we may camp overnight at Chilao and visit a different area Sunday. Contact Geoff Burleigh, (81B) 361-1D15.

July 16, 17 (Saturday, Sunday). Sagehen Creek & Research Station. Sacramento Valley Chapter of CNPS will lead this trip. Meet Saturday 10:3D AM in front of ranger station, Tahoe NF on Hwy 89 near Truckee. See east-side Sierran montaine & subalpine vegetation that includes 2 or 3 rare species. Camping at Sagehen Creek, Tahoe NF. Leader: G.L. Stebbins, (916) 753-2665.

SCB COMING EVENTS (DETAILS WITHIN)

May 28-30	Granite Mountain Tamarisk Eradication
June 4	Mazourka Canyon, Inyo Mountains
June 4,5	Big Bear Valley Reserve
June 11	Ventura River Mouth
June 19	Newport Back Bay
June 25, 26	San Gabriel Mountains
July 16, 17	Sagehen Creek

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Managing Editor: Allan Schoenherr

WATER CONSERVATION IN TWO SPECIES OF DODECATHEON (PRIMULACEAE) IN THE COTTONWOOD BASIN, SOUTHERN SIERRA NEVADA.

Sherry Schmidt
Mount San Antonio College
Department of Biology

INTRODUCTION

Alpine sites in the Sierra Nevada exhibit a large degree of variability in soil moisture due to differences in snow distribution and topography. Klikoff (1965a,b) proposed that microsite variability in soil moisture is a primary factor that contributes to a sharp local patterning of alpine vegetation. This is exemplified by sharp variations in vegetation within a few meters, between wet meadows dominated by herbaceous species, and dry slope regions dominated by conifers and woody perennials.

Although the Sierra Nevada receives heavy winter snowfall it is characterized by high atmospheric aridity and high solar radiation during the summer months. Summer aridity is unique to the Sierra Nevada when compared to

other North American mountain ranges. This is reflected by the proportion of annual plants found in alpine regions. Went (1953) reported that 40-80 annual species may be found above 3,000 e in the Sierra Nevada. According to Chabot and Billings (1972), only a single annual species, Koenigia islandia, is listed for North Aeerican alpine areas outside the Sierra Nevada.

Alpine plants have evolved numerous adaptations to cope with aridity. A number of investigators have noted that vegetation tends to become more xeromorphic with increasing elevation. Physiological adaptations to reduce transpirational water loss have also been noted. For example, Mooney et al. (1965) reported that dry site alpine plants in the Sierra Nevada had lower transpiration rates than species inhabiting wet sites. Ehleringer and Miller (1975) and Oberbauer and Billings (1981) found that plants inhabiting dry sites had higher leaf resistance values than wet site species.

Shooting stars (Dodecatheon spp.) are small herbaceous perennials characteristic of wet localities and alpine meadows. Two species of shooting star, Dodecatheon jeffreyi and Dodecatheon redolens, co-occur in the southern Sierra Nevada but occupy different microenvironments. Dodecatheon jeffreyi, a wet meadow species, is found in abundance in saturated soils. Dodecatheon redolens inhabits drier sites along streae margins and within the meadow-forest ecotone. Apparent differences in habitat preference between these two speoies may be related to differences in their geographical history and associated water-related adaptations. The occurrence of D. redolens in drier eicrohabitats suggests that it has evolved a more efficient eeans of restricting water loss than D. jeffreyi. Dodecatheon jeffreyi, a widespread western cordilleran species, is found throughout the Sierra Nevada, Cascade, and Rocky Mountain ranges. Dodecatheon redolens, an endemic western species, is restricted to isolated locations in the Great Basin Ranges

and southern Sierra Nevada. This study considers the degree to which measured differences in transpiration and leaf resistance are related to the variation in microhabitat distribution of D. jeffreyi and D. redolens and how these water relation parameters may be related to the phytogeographic history of each species.

MATERIALS AND METHODS

The study site was located in the Cottonwood Basin of the Sierra Nevada, Inyo County, California (Figure 1).

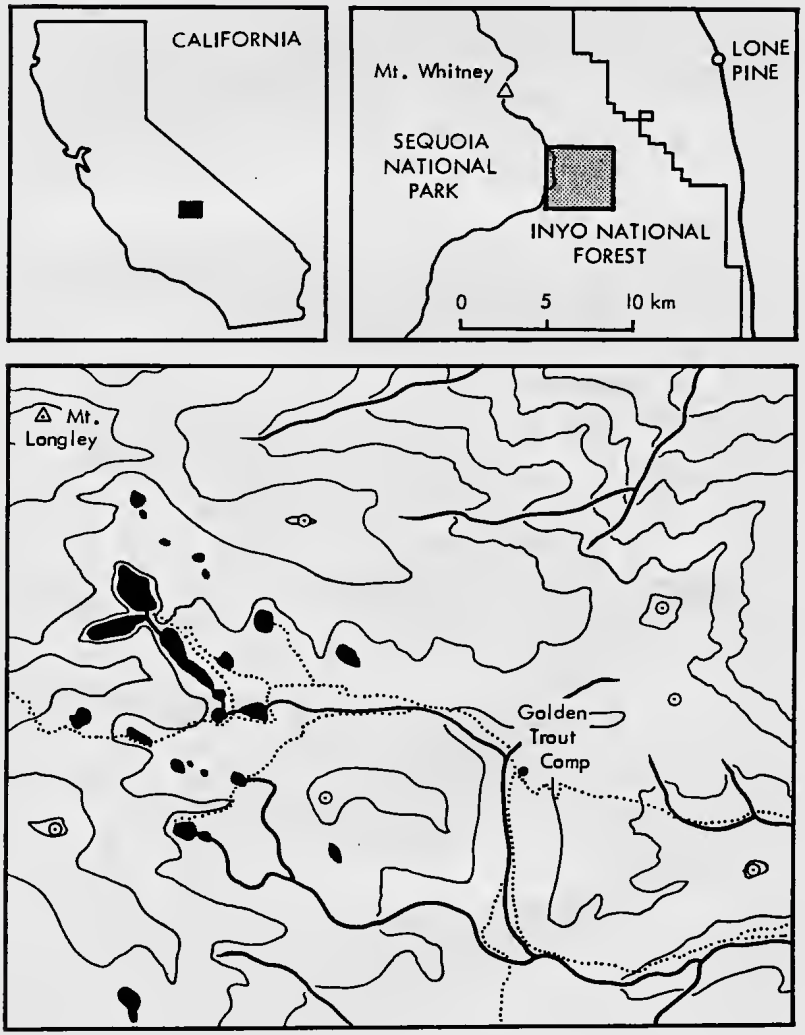

Figure 1: Location of the study area in California.

Transpiration and stomatal resistance were measured to determine differences in water conserving ability between the two species. Measurements of soil moisture, soil texture, elevation, and slope were obtained at sites where either species was present in abundance to determine factors that might influence local distribution patterns (Figure 2).

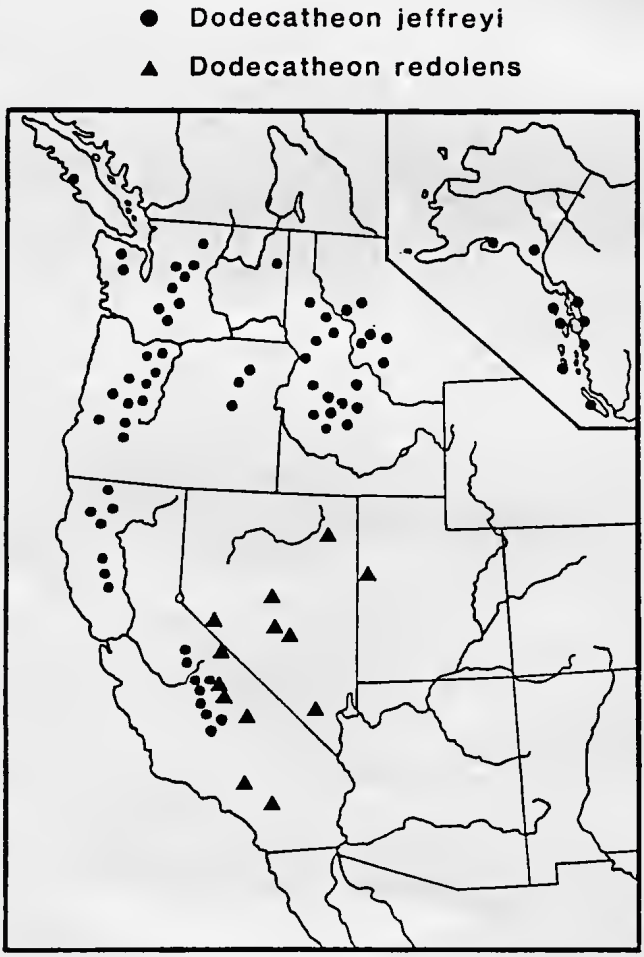

Figure 2: Distribution map of Dodecatheon jeffreyi and Dodecatheon redolens.

Physiological measurements were conducted on plants obtained from a meadow along Cottonwood Creek (3,175 m) where both species were present and growing in close proximity. This ensured that the plants had been exposed to similar environmental conditions throughout their development. Twenty plants were transplanted into 4-liter plastic pots and transported to the study site (3,385 m). Soil was at field capacity during all physiological measurements.

Five plants of each species were used for all measurements. Transpiration and leaf resistance were measured on 14 July, 2 August, and 25 August 1982 at 3,385 m. Plants were transported to 2,985 m on 26 August 1982 to determine if elevation affected either transpiration or leaf resistance. The plants were allowed to acclimate overnight before measurements were taken.

Transpiration rates were obtained by the phytometer method. Pots were placed in plastic bags with only the shoots exposed. Pots were weighed to the nearest 0.1 g at two-hour intervals from 0700 h until dusk (1800-1900h) on a triple beam balance. Leaf surface areas were measured within three days after transpiration rates were obtained.

Leaf resistance measurements were juxtaposed with transpiration measurements. Resistance values were measured at two-hour intervals with a Li-Cor diffusive resistance meter by the method described by Morrow and Slatyer (1971). Plants were placed in full sunlight since both species are generally found in open areas.

In order to quantify elevational changes in species abundance microhabitat data were obtained during July and August 1983 at 21 locations ranging from 3,070 m to 3,555 m. The 3,070 m site was the lowest elevation where *D. jeffreyi* occurred in dense patches. The 3,555 m site was above timberline and was the highest elevation where *D. redolens* was observed (Table 1).

Table 1. Elevation, aspect, percent slope, end species present at each location where measurements were obteined.

Location	Elevation (m)	Aspect	Percent Slope	Species	Measurements Obtained
Cottonwood Creek	3070	--	--	*D. jeffreyi*	Density
Golden Trout Camp	3135	South	3°	*D. jeffreyi*	Dansity Soil Moisture Soil Texture
Cottonwood Creek	3140	North East (45°)	4°	*D. jeffreyi* *D. redolens*	Dansity
Cottonwood Creek	3175	South (170°)	7°	*D. radolans*	Density Soil Moisture Soil Textura
			4°	*D. jeffreyi*	Density Soil Moisture Soil Texture
One mila North of Golden Trout Camp	3230	South (180°)	5°	*D. redoians*	Density
Cottonwood Creak	3195	East (90°)	3°	*D. jeffreyi* *D. redolens**	Density
Cottonwood Creak	3245	South (176°)	8°	*D. jeffreyi* *D. redolens**	Denaity Soil Mositure Soil Texture
Muir Laka Outlet	3395	South East (127°)	7°	*D. radolens*	Density Soil Mositure Soil Texture
Upper Cottonwood Basin	3480	South West (225°)	18°	*D. redolens*	Soil Mositurs Soil Textura
Sixth Lake	3555	South (190°)	4°	*D. redolens*	Density Soil Moistura Soil Taxture

**D. radolens* observed in isolated areas but no dansity measurements obtained.

RESULTS

Dodecatheon jeffreyi had significantly higher transpiration rates than *D. redolens* (Figure 3). *Dodecatheon jeffreyi* also showed a greater fluctuation in transpiration between measurement intervals. Although both species achieved their maximum observed transpiration rates between 1300 h and 1400 h, *D. jeffreyi* exhibited higher maximum transpiration rates than *D. redolens*. There was also greater variability in the data obtained from *D. jeffreyi* than those from *D. redolens*.

There were significant differences in leaf resistences between D. jeffreyi and D. redolens. D. redolens had higher average leaf resistance values than D. jeffreyi. Rainfall during the first two weeks of August was correlated with changes in leaf resistance. Leaf resistance values obteined on 25 August indicate that stomates were open for all measurements prior to 1300 h. Resistance increased by 1900 h for both species reflecting early stomatal closure. Measured transpiration rates followed a pattern similar to that observed earlier in the season. Thus water loss did not appear to be excessive even though resistance was low.

Trenspiration and leef resistances were measured 27 August after transporting the plants from 3,385 m to 2,985 m and ellowing them to acclimate overnight. Observed leaf resistance values were low for both species. Stomates epperently remained open during the entire period meesurements were teken (0900 h - 1300 h). Observed transpiration rates increased in both species as the dey progressed. Dodecatheon jeffreyi exhibited a higher observed trenspiretion rete than D. redolens et the lower elevation (Figure 3).

Soil moisture estimates were obtained during July and August 1983. Soil moisture differed significently between sites. As expected, based on the 1982 data, D. redolens inhabited sites with drier soils than D. jeffreyi. Also, the driest soils were found et the upper elevations except for the 3,480 m site where there was seepege from an underground spring. All sites inhabited by D. jeffreyi were cheracterized by standing weter except the 3,245 m site. Soil moisture velues obtained for a specific site at different detes did not differ significantly.

Density was significently different between sites. D. jeffreyi reeched the highest density at Golden Trout Camp (3,135 m) where there were 43 individuals m^{-2}.

Dodecatheon redolens showed a trend of increasing density with an increase in elevation (r = .966) as shown in table 3. The 3,245 m site was the highest elevation where D. jeffreyi was found in abundance. Scattered individuals of D. jeffreyi were observed as high as 3,385 m.

There is a possibility that some of the data included in this report could have been obtained from D. jefferyi x D. redolens hybrids. A few intermediate morphotypes were observed near Golden Trout Camp. Furthermore, D. alpinum may also occur in the area. This species is nearly indistinguishable from D. jeffreyi, but the Cottonwood Lakes Basin is considered to be out of its known range.

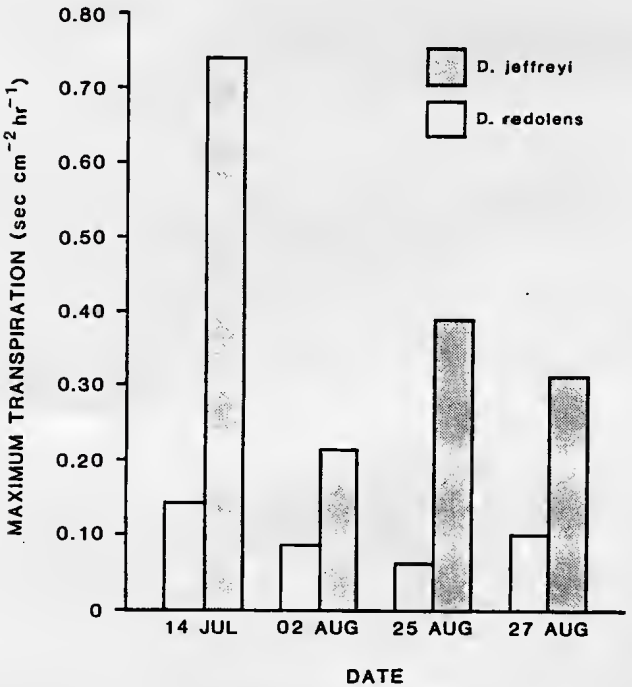

Figure 3: Maximum and minimum observed transpiration rates of Dodecatheon jeffreyi and Dodecatheon redolens on 14 July, 2 August, 25 August, and 27 August 1982. Values for 14 July, 2 August, and 25 August were obtained at 3,385 m. The 27 August values were obtained after transporting the plants to a lower elevation (2,985 m).

DISCUSSION

Variation in soil moisture is a prime factor contributing to the distribution of Sierran alpine plant species. Differences in microhabitat preference between D. jeffreyi and D. redolens are correlated with differences in soil moisture and water conservation ability. The difference in water conservation ability between these species is reflected in their respective transpiration rates and leaf stomatal resistancee. Dodecatheon redolens, which occupies drier sites, has a greater water conservation ability as indicated by higher leaf resistances and lower transpiration rates. Dodecatheon jeffreyi, which occupies sites where water is readily available, exhibits higher transpiration rates and lower leaf resistances. These observations are in agreement with studies by Mooney et al. (1965) and Ehleringer and Miller (1975), who demonstrated that water expenditures in alpine species are correlated with the water supply of their habitat.

In addition to species differences in transpiration and leaf stomatal resistance, seasonal differences within each species were observed. Fluctuations in the daily course of leaf resistance throughout the season appear to be related to rainfall. The low leaf resistance during wet periods do not result in significant increases in transpirational water loss. This finding supports Kramer's (1959) statement that there is little increase in transpiration over a wide range of stomatal apertures if evaporative rates are low.

Although significant differences in transpiration and leaf resistance occur between D. redolens and D. jeffreyi, some similarities were noted. Neither species reached levels of water stress sufficient to cause stomatal closure at midday and both species responded to variation in elevation in the same manner. The lack of a midday

reduction in transpiration conflicts with findings reported by Mooney et al. (1965) and Ehleringer and Miller (1975). The absence of a midday reduction might be due to a difference in experimental method since soil was at field capacity during all physiological measurements. Stomatal closure to reduce transpiration at midday, in absence of severe water stress, would decrease the diffusion of CO_2 into the leaf and could limit productivity. Productivity is an important limiting factor for species with short growing seasons such as those that inhabit desert and alpine regions.

The increase in transpiration rates for both species, when transported to a lower elevation, indicates that elevation may be a factor that influences the distribution of D. jeffreyi and D. redolens through its effect on transpiration. This observation supports the results of an earlier study by Mooney et al. (1965). These data imply that elevation can be a factor that influences plant drought adaptations. Billings and Mooney (1968) note that plants tend to become more xeromorphic with an increase in elevation. However, factors that limit the lower distributions of alpine plants are rarely considered. The effect of elevation on transpiration appears to be an important factor that limits the lower distributions of alpine plants. This may be due the relationship between leaf size and its effect on water loss. Differences in leaf size have been reported to have significant influences on transpiration by Smith and Geller (1980). The dry site high elevation species, D. redolens, has larger leaves than D. jeffreyi. In high elevation perennials, large leaf sizes could act to increase the leaf temperatures early in the summer when temperature is a factor limiting growth. However, at lower elevations where temperatures are higher, a large leaf size could lead to substantial increases in transpiration due to high leaf temperatures.

The evolution of different physiological and morphological adaptations may be related to the proposed biogeographic origins of D. jeffreyi and D. redolens. Dodecatheon jeffreyi is a western cordilleran species that apparently evolved in more mesic regions than the endemic western D. redolens. Dodecatheon redolens is restricted to the more arid regions of the Sierra Nevada and occurs in the Great Basin ranges. Since D. redolens exhibits a greater degree of stomatal control over water loss than D. jeffreyi, D. redolens can inhabit drier sites. It appears that the difference in elevational distribution between the two species is related to drought adaptations. Aridity increases directly with elevation and Dodecatheon redolens occupies higher sites. However, the large leaf size of D. redolens may exclude this species from lower elevations where D. jeffreyi is abundant, due to the effect of leaf temperature on transpiration. To clarify the relationship between phytogeography and drought adaptions, future studies should compare water-related physiology in a number of species with different biogeographic origins.

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ANNOUNCEMENTS

California Riparian Systems. This three-day conference from September 22 to 24 at U. C. Davis is a follow-up to the 1981 conference. The theme of this conference is riparian restoration. There is a variety of sponsors and cosponsors for this conference that includes more than 120 speakers and panelists. There are several enrollment options. The fee for all three days is $80; Saturday only costs $30. You may enroll by phone if you use MasterCard or Visa. Call (800) 752-0881. To enroll by mail, contact University Extension, U. C. Davis, CA 95616.

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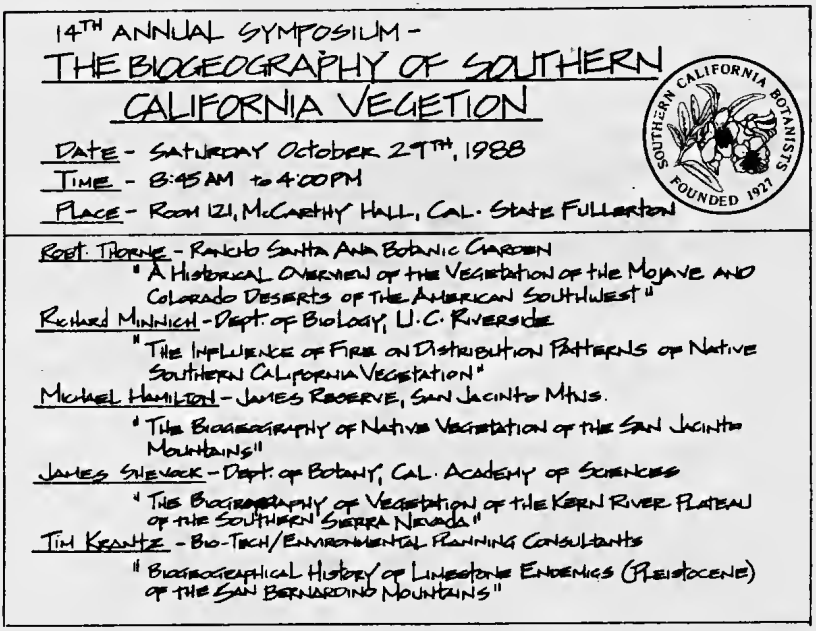
Biogeography of Southern California. The Southern California Botanists are sponsoring their fourteenth annual symposium to be held on October 29, 1988. Mark your calendars now.



Society for Ecological Restoration and Management. This new society is soliciting charter members. It has been organized in response to the growing interest in ecological restoration as a technique for environmental conservation. This is an interdisciplinary organization designed to promote research and facilitate communication about restoration technologies. Dues are $25/year, Contact the society at the University of Wisconsin Arboretum, 1207 Seminole Highway, Madison, Wisconsin 53711.

Proceedings of the Second Native Plant Revegetation Symposium. Proceedings of this symposium held on April 15-18, 1988, are now available from the Native Plant Revegetation Society. Send $15 to NPRS, 3808 Rosecrans St., No. 373, San Diego, CA 92110.

FIELD TRIPS

July 30 (Saturday). White Mountains. This trip hosted by the Channel Islands Chapter of CNPS will visit the bristlecone pines of the White Mountains, the oldest living things. Alpine and subalpine flora will also be observed. Contact Ron Wilkinson, (805) 643-5007.

August 7 (Sunday). Mount Baldy. Meet at 9:30 AM at the foot of the Mt. Baldy Ski Lift. Ride up the ski lift (fee charged) and explore the montane flora with Orlando Mistretta. From I-10 take the Indian Hill exit to Claremont (north). Go about 10 miles to Foothill Blvd., then east to Mills Avenue. Go north all the way to the end. For information call Dave Bramlet at (714) 549-0647.

August 13-14 (Saturday-Sunday). Rock Creek Basin, Sierra Nevada. The Bristlecone Chapter of CNPS will lead this trip to the beautiful basin north of Bishop. Meet at 9:00 AM on Rock Creek Road and Hiway 395 near Tom's Place. Mark Bagely will lead this trip to examine alpine, subalpine, and riparian vegetation. For information call him at (619) 873-5326.

August 13-14 (Saturday-Sunday). Ash Meadows, Nevada. The Channel Islands Chapter of CNPS is hosting this trip to see summer-blooming wildflowers in the desert. Bob Love, who lives in Ash Meadows will lead the group. Prepare for summer in the desert. For information call Dave Magney (805) 646-7420.

September 3-5 (Saturday-Monday). Clark Mountain, eastern Mojave. The Channel Islands Chapter of CNPS will host this Labor Day trip to the white fir forest on Clark Mountain in the eastern Mojave. For details call Ron Wilkinson (805) 643-5007.

Amateur and Professional Botanists. The journal of the Southern California Botanists, CROSSOSOMA, provides an ideal means by which you can publish things of botanical interest to southern Californians. If you have a favorite field trip, gardening hints, or some preliminary data that you'd like to have in print submit your manuscript to:

Dr. Allan Schoenherr
Division of Biological Sciences, Fullerton College
321 E. Chapman Avenue
Fullerton, CA 92634

SOUTHERN CALIFORNIA BOTANISTS

Rancho Santa Ana Botanic Garden
1500 North College Avenue
Claremont, CA 91711

The purpose of the SOUTHERN CALIFORNIA BOTANISTS is the study, preservation and conservation of the native plants of California; and the education of the public to the value of the native flora and its habitats. It is a non-profit association formed in 1927.

Membership benefits include:

Various field trips throughout the state led by competent field botanists and biologists.

A yearly plant sale featuring native California species.

An annual symposium on various aspects of the California vegetation.

The SCB Journal, CROSSOSOMA.

Discounts on botanical and natural history books.

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/____/	Group or organization	$15.00	/____/	Renewal

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Make check payable to: SOUTHERN CALIFORNIA BOTANISTS.
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CROSSOSOMA (ISSN 0891-9100) is published bimonthly (February, April, June, August, October, and December) by Southern California Botanists, a California non-profit corporation. Back issues of CROSSOSOMA are available for $2.00 an issue (plus 25¢ postage) or $8.00 a volume (plus $1.00 postage). Send a check with your request to Alan P. Romspert, Treasurer, at the above address. Manuscripts submitted for publication should be addressed to Dr. Allan A. Schoenherr, Editor of CROSSOSOMA, Division of Biological Sciences, Fullerton College, Fullerton, CA 92634.

SCB COMING EVENTS (DETAILS WITHIN)

July 30	White Mountains, Bristlecone Pines.
August 7	Mount Baldy, San Gabriel Mountains.
August 13-14	Rock Creek Basin, Sierra Nevada.
August 13-14	Ash Meadows, Nevada
September 3-5	Clark Mountain, eastern Mojave.
October 29	Symposium, Biogeography of Southern California

SOUTHERN CALIFORNIA BOTANISTS
Rancho Santa Ana Botanic Garden
1500 North College Avenue
Claremont, CA 91711

CROSSOSOMA

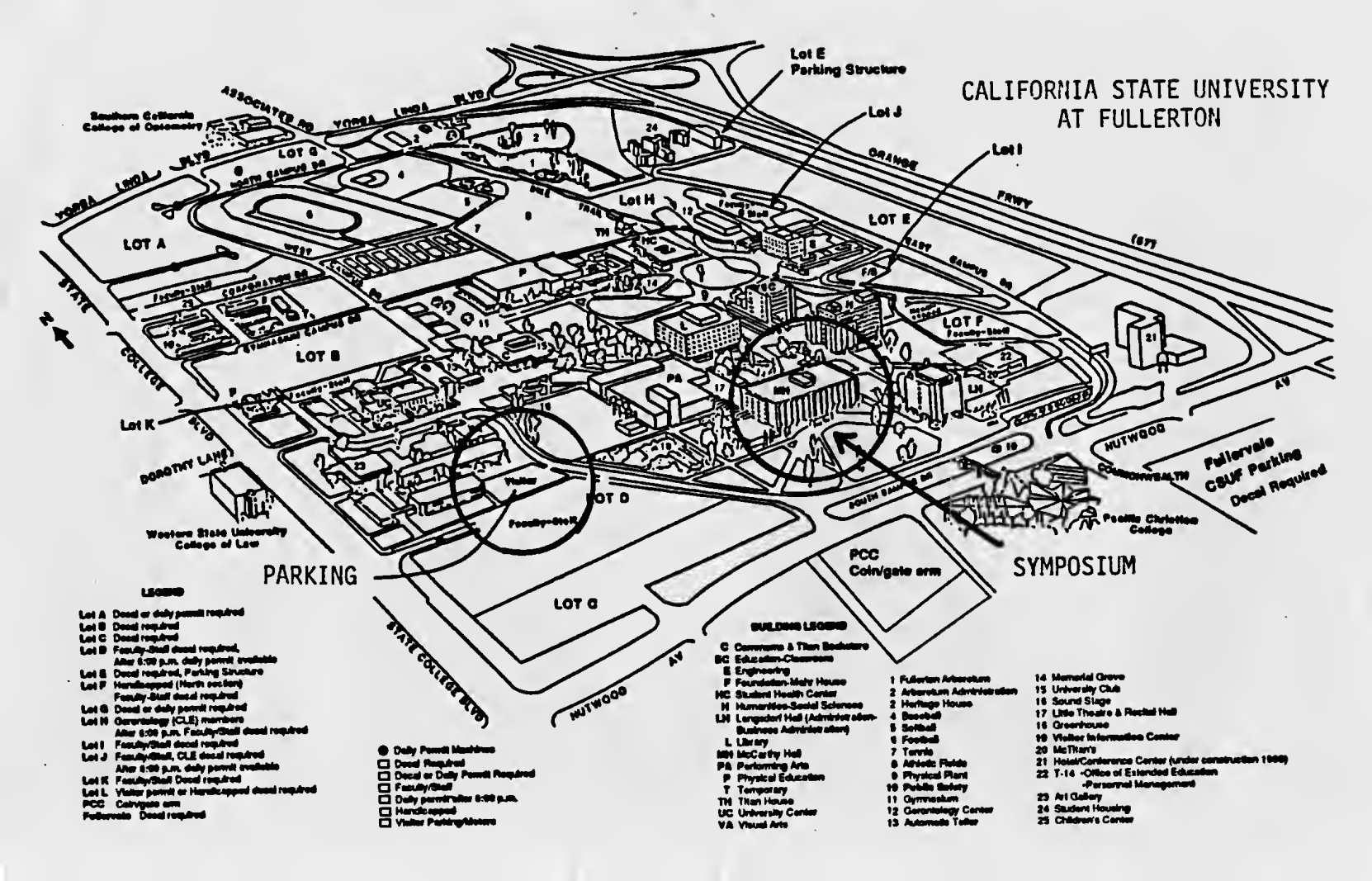
SOUTHERN CALIFORNIA BOTANISTS
Rancho Santa Ana Botanic Garden, Claremont, CA 91711

CROSSOSOMA Vol. 14, No. 5 PROGRAM ISSUE October, 1988
Managing Editor: Allan Schoenherr

14th Annual Symposium
on the Topic of

The Biogeography of Southern California Vegetation

Date Time: Place:	Saturday October 29, 1988 8:45 am to 4:00 pm Cal State University Fullerton Room 121 McCarthy Hall
Admission:	$7.00 for Current S C B Members $10.00 for Non-Members $15.00 for S C B Membership and Admission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Lot G Decal or daily permit required
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Daily permit after 6:00 p.m.
Handicapped
Visitor Parking/Metered
BUILDING LEGEND
C Commons & Titan Bookstore
EC Education-Classroom
E Engineering
F Foundation-Mahr House
HC Student Health Center
H Humanities-Social Sciences
LH Langsdorf Hall (Administration-Business Administration)
L Library
MH McCarthy Hall
PA Performing Arts
P Physical Education
T Temporary
TH Titan House
UC University Center
VA Visual Arts
1 Fullerton Arboretum
2 Arboretum Administration
3 Heritage House
4 Baseball
5 Softball
6 Football
7 Tennis
8 Athletic Fields
9 Physical Plant
10 Public Safety
11 Gymnasium
12 Gerontology Center
13 Automatic Teller
14 Memorial Grove
15 University Club
16 Sound Stage
17 Little Theatre & Recital Hall
18 Greenhouse
19 Visitor Information Center
20 McTitan's
21 Hotel/Conference Center (under construction 1988)
22 T-14 -Office of Extended Education
-Personnel Management
23 Art Gallery
24 Student Housing
25 Children's Center

BIOGEOGRAPHY OF SOUTHERN

CALIFORNIA VEGETATION

Saturday, October 29th, 1988
California State University at Fullerton
Room 121, McCarthy Hall

The natural landscape of California is a fascinating environment to experience. Few geographic regions in the world of comparable size have such a wide diversity of geologic landforms, climates, and complex vegetation patterns. This rich mosaic of native plant distribution is largely a result of dramatic geologic events and climatic changes that have occured within the region, particularly during the past 60 million years (Cenozoic). Mountain-building, sea-level fluctuations, movement of crustal plates and regional changes in climate thru geologic time have resulted in a vast array of rock types, soild, and terrain which provide the substrate for plant distribution. This symposium presents a series of speakers who will give accounts of how current biogeographic patterns of native plant distribution in Southern California have been influenced by the past geologic and climatic events. You are invited to hear these insights into our region's amazing past!

Geoff Smith, SCB President

PROGRAM SCHEDULE

8:00 Registration, coffee

9:00 Introduction, Geoff Smith, SCB President

9:10 Dr. Robert F. Thorne, Rancho Santa Ana Botanic Garden.
A Historical Overview of the Vegetation of the Mojave and Colorado Deserts of the American Southwest.

The Mojave and Colorado Deserts of the American Southwest are geologically recent in origin, resulting primarily from the rain-shadow caused by the Late Pliocene-Pleistocene elevation of the Sierra Nevada, Transverse, and Peninsular ranges. Their age thus is perhaps two to three million years. The present vegetation is even more recent, largely Holocene in origin, and still evolving. During the last, Wisconsin, glacial episode the California deserts were well supplied with huge, deep lakes and large streams and an

open woodland, possibly grassy, supporting numerous large mammals, now mostly extinct. The desert flora, however, is in large part more ancient, having been assembled since early Paleogene time from many sources. Most of the perennials are probably former members of the Madro-Tertiary Geoflora that dominated southern California and adjacent areas during the Tertiary. They are species of dry habitats preadapted to long periods of drought, hot, dry summers, and cool, wet winters and thus able to populate and adapt to the varied desert habitats when they became available. They survived cool, pluvial, glacial periods by migration southward or to lower elevations. Some elements of the American southwestern desert flora are derived from Mexico, South America, central Asia, and a few possibly from North Africa and the Mediterranean region by overland immigration or long distance dispersal. In some instances this was aided by changing ocean size due to continental movement, glacial sea-level lowering, and to changes in oceanic-current patterns. Some desert plants, at least some of the ephemerals, may well be of very recent, even Holocene, origin in our arid Southwest.

10:00 Tim Krantz, Big Bear Valley Preserve, Big Bear Lake.
Biogeography of Endemic Plant Communities of the San Bernardino Mountains.

The San Bernardino Mountains of southern California exhibit one of the highest numbers of endemic species in California for an area of its size. Comprising approximately 864 square miles, the San Bernardinos include 21 strictly endemic and at least another 14 near-endemic taxa.

These are largely distributed among four different plant communities: pebble plains and associated subalpine meadows, Mt. San Gorgonio alpine zone, and limestone endemics. With the exception of three or four of the endemic taxa, all of them are confined to these general communities.

Perhaps the best indicators of a flora's geological history and origins are its endemic plants. This is certainly the case

with the flora of the San Bernardino Mountains and its biogeography. The limestone endemics tell a tale of ancient coral seas and of monumental and, at times, catastrophic upheaval. The pebble plains describe periods of huge lakes that left deep clay deposits, followed by the inexorable upheaval and fragmentation that takes place with mountain building, interspersed with the advances and retreats of Ice Ages and deserts.

Mt. San Gorgonio itself, representing the highest peak in southern California at 11,500 feet and rising, hosts a highly discrete alpine community at its summit. Gnarled and wind-pruned lodgepole and limber pines virtually crawl up the last 200 meters as they give way to a unique and interesting alpine flora including several strict endemics found only on the summit and a number of other species found nowhere else in southern California.

The discussion will include principles of island biogeography, archipelago configuration, isolation mechanisms, and the effects of habitat fragmentation as exemplified by the rare plant communities described.

10:50 Break

11:00 Dr. Michael P. Hamilton, University of California James San Jacinto Mountains Reserve, Idyllwild.

1,000 Year Old Lodgepole Pine: The Old-growth Forests of the San Jacinto Mountains.

Lodgepole pine (Pinus contorta) is distributed from the central Yukon to Baja California and east to South Dakota. It grows over a wider range of climate, from sea level to over 4,000 meters in elevation, than any other type of pine. The southern California lodgepoles (Pinus contorta ssp. murrayana) occur at high elevations in the San Gabriel, San Bernardino, and San Jacinto Mountains. This is the mountain subspecies that occurs northward through the Sierra Nevada and Cascades. Studies of old-growth lodgepole stands in the San Jacinto Mountains, near the southern limit of distribution, may reveal factors relating to ancient distribution patterns.

This presentation reports an investigation of an old-growth lodgepole pine forest growing at 3,050 m in the San Jacinto Mountains. Height, diameter, and condition of all trees in a 1 ha. plot located in a dry, well drained area, were measured and their relative position located on a stand map. Similar data were collected for all standing snags and stumps and for down snags, branches, and tops. Increment cores were taken from 65 trees representing the range of diameters present, and ages were determined using a dendrochronological sequence developed for the areas. Soil samples were taken and standard nutrient analyses were conducted. Similar data were collected in a 1/10 ha plot located in a nearby, moist area.

The dry site study area was dominated by an open stand of large lodgepole pines with very low density (400 trees/ha). Stand averages for diameter, height, and age were 33 cm, 7.4 m, and 250 years old, with maxima exceeding 90 cm, 15 m, and 1,000 years old. The frequency distribution of diameters at 1.3 cm was bimodal with maxima at 0-5 cm (5-70 years old) and 40-45 cm (250-390 years old). Despite heavy cone crops, stand replacement was proceeding very slowly as "seedlings" (heights 0.50 m) were few in number (41/ha), were as old as 55 years, and were primarily growing in crevices in surface rocks.

In contrast, the moist-site study area was dominated by a dense stand of lodgepoles (3240 trees/ha). Trees in this stand were smaller and younger than those in the dry site. The frequency distribution of diameters at 1.3 m was strongly skewed to smaller sizes with most trees being in the 0-5 cm diameter class (35-80 years old). "Seedlings" (heights 0.50 m) were quite abundant (260/ha).

Stand dynamics appeared to be dictated by the severity of the environment, especially the occurrence of wind storms, lightning fires, and drought. The standard climatic analysis of the dendrochronological sequence indicated that midwinter precipitation (ie. snowpack) and early growing season air temperature were the controlling variables for diameter growth. Interestingly,

growth rates after 1955 were better than those predicted by known climatic variables suggesting the possibility of anthropogenic causes. Soil analyses indicated a surprisingly good nutrient balance despite the low levels of organic nitrogen due to the slow rates of decomposition. Stand regeneration and tree growth appeared to be primarily controlled by site water balance. Plans for specifically examining this subject will be discussed.

12:00 Lunch

1:40 Dr. Richard A. Minnich, Geography Program, Department of Earth Sciences, University of California Riverside.

The Influence of Fire on Distribution Patterns of Native Southern California Vegetation

The interested student of California vegetation is easily impressed by how climatic differences produced by the large altitudinal relief of its mountain ranges and distance from the Pacific ocean, as well as the influences of soils and geomorphology, affect the patterning of plant communities within the State. Seldom, however, are plant distributions looked at in terms of recurrent fire, as a dependent variable upon these environmental factors. In California's mediterranean climatic region, the potential for fire is so great that more mortality and reproduction of woody vegetation is probably accomplished through burning than any other process. Many communities persist over time because taxa respond flexibly to disturbances through such adaptations as sprouting, fire-resistant bark, seed scarification, fruit serotiny, and long-distance seed dispersal. At the scale of plant communities, fires influence the floristic composition and physiognomy of ecosystems.

Plant communities have been associated with model "fire regimes" which describe general fire recurrence intervals, fire size and behavior, vegetation damage, and postfire succession. This approach does not take into consideration the selective influence of fire on distributions because the impacts of fire are not homogeneous within ecosystems, but occur in gradients

corresponding with changes in the physical environment. Key variables influencing fire gradients include terrain, exposure to the ambient wind field, vegetal productivity, and stratification of fuels. Geographic relationships between fire and vegetation can be elusive because site fire pattern is subject to the vagaries of ignitions, weather, and previous fire history; individual taxa must be adapted to considerable temporal and spatial fluctuation in the pattern of disturbances. The constraints of climate, terrain, and vegetation exert an inertia, however, such that the pattern of burning and concomitant biotic distributions occur in mean states that reflect site conditions. Ecological research has shown that woody perennial taxa in California have wide-ranging adaptive modes and establishment efficiences after burns. Thus, in view of interactions between vegetal physiognomy, species adaptations and fire pattern, it follows that gradients in fire regime influence ecosystem biogeography.

In this presentation, I will survey several major ecosystems in southern California, including grassland-coastal sage scrub, chaparral, mixed evergreen forest, mixed conifer forest, pinyon woodland, and creosote bush scrub. Fire pattern and postfire succession of each are evaluated in relation to environmental gradients. The discussion will not be restricted to the contemporary scene. California wildlands have been influenced by a long history of fire suppression management which has modified fire regimes and vegetation throughout the state, and plant distributions were originally shaped by uncontrolled fire. In many examples, I will address accounts of vegetation and fire in southern California written before fire control in the late 19th century. Data are also shown for adjacent northern Baja California, Mexico, where fire control is still not effectively practiced.

2:30 James R. Shevock, Regional Botanist, Pacific Southwest Region, USDA Forest Service, San Francisco.

Biogeography of Vegetation of the Kern River Plateau of the Southern Sierra Nevada.

The vegetation and flora of the southern Sierra Nevada contains the greatest diversity of plant communities and number of native species for any physiographic province in California. The position of the southern Sierra in relation to other physiographic provinces including the San Joaquin Valley, Transverse Ranges, Mojave Desert, and the Great Basin affect the distribution and arrangement of plant communities for this area. Other factors influencing the distribution and range of vegetative types and communities include geology and soils, elevation and aspect, annual precipitation and climate. Elevation ranges from 800 to 14,000 feet in the southern Sierra and annual precipitation from 8 to 50 inches. It is estimated that over 60% of the state's flora occurs in the Southern Sierra Nevada.

3:20 Closing remarks

ANNOUNCEMENTS

CALIFORNIA OAK WOODLAND SYMPOSIUM

A symposium on hardwood range and oak woodland communities entitled: "California Oak Woodlands: Attitudes and Responsibilities" is to be held in Sacramento on January 22-24, 1989. There will be 2 days of panel discussions by various groups on land use issues, management concerns, and conservation alternatives. Panelists will include small and large land owners, conservation group members, policy maker, planners, developers, architects and natural resource management agencies. The symposium will be preceded by a field trip on Sunday, January 22, to look at residential development in oak woodland areas. Poster session will also be held to provide information on programs, activities, or other materials related to hardwood range and other oak woodlands. CNPS is one of the many co-sponsors of this symposium. More detailed information will be provided in the next Bulletin and brochures will be available shortly from: Oak Symposium Coordinators, c/o Department of Forestry and Fire Protection, Room 1516-20, P.O. Box 944246, Sacramento, CA 94244-2460.

UPPER NEWPORT BAY NEEDS YOUR HELP

Upper Newport Bay has survived threats from development and from siltation. Now the reserve faces another threat - the destruction of native plant communities by the invasion of several species of weedy exotic plants which have escaped from cultivation. The most important and potentially damaging species are pampas grass, castor bean and ice plant. These aggressive weeds are rapidly displacing native species along the shores of the bay itself, as well as in the surrounding riparian and coastal sage scrub communities.

We must act soon to protect the fragile plant communities which are becoming increasingly rare in Southern California, and which provide food and shelter for the bay's wildlife. The Department of Fish and Game can use the help of teams of volunteers in a program of weed control.

Volunteers are needed for the physical work of removing weeds and for mapping and photographic documentation of progress of the work. Donations and the loan of equipment will also be appreciated.

If you can join a team to start this important work, please notify:

Greg Gerstenberg
615 S. Grand Avenue
Orange, CA 92666

WETLANDS

November 4-6. There will be a symposium on wetland management and the operation of nature centers at the Chula Vista Interpretive Center in San Diego. Anyone interested in this symposium should contact Dave Bramlet, (714) 549-0647.

NON-NATIVE TREE REMOVAL ON THE MOJAVE RIVER FLOODPLAIN

Camp Cady Wildlife Park, October 22-23. Tamarisk, native to Eurasia, is invading a woodland of cottonwood and mesquite on the Mojave River floodplain. Removal of these trees is sponsored by the Desert Protective Council on a wildlife reserve of the California Fish & Game Department. Call Bill Neill, (714) 779-2099. Angeles Chapter Wildlife Chair, Sierra Club, for more information.

Non-native tree-removal without harming native vegetation is labor intensive. You can contribute by helping to clear and pile the cuttings. You should wear lightweight protective clothing, work gloves, and sunglasses.

FIELD TRIPS

October 8 (Saturday). Cahuilla Mountain. Steve Boyd, Riverside/San Bernardino Chapter (CNPS) will lead this trip to a Coulter pine, black oak woodland. Meet at the intersection of Florida Avenue, (Hwy 74) and Fairview Avenue, which is about 6 miles east of Hemet (Thomas Guide 57, D3). Call Harry Spilman, (818) 799-9486, for details.

October 15 (Saturday). Cactus Field Trip. Geoff Smith will lead this trip. Meet at Dana Point Harbor, at corner of Del Obispo Street and Ensenada Place. Hours: 8:30 AM - 4:30 PM (approx.). Bring lunch. We shall encounter most of the taxonomic segregates of the highly complex populations of native prickly pear cactus (Opuntia), from coastal habitats to interior valley locations. Route is from Dana Harbor to Capistrano, over Ortega Hwy (Hwy 74) to the Temecula region of southern Riverside Co. Of major interest is examining the possible influence that the introduced mission cactus may have played on present Opuntia populations.

Amateur and Professional Botanists. The journal of the Southern California Botanists, CROSSOSOMA, provides an ideal means by which you can publish things of botanical interest to southern Californians. If you have a favorite field trip, gardening hints, or some preliminary data that you'd like to have in print submit your manuscript to:

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SCB COMING EVENTS (DETAILS WITHIN)

October 8	Cahuilla Mountain
October 15	Ortega Highway Cactus Trip
October 29	Symposium, Biogeography of Southern Califurnia

SOUTHERN CALIFORNIA BOTANISTS
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CROSSOSOMA Vol. 14, No. 6 December, 1988
Managing Editor: Allan Schoenherr

ALKALOIDS IN TWO SPECIES OF CHOLLA, OPUNTIA ACANTHOCARPA AND OPUNTIA ECHINOCARPA

Frits Zeylemaker
Natural History Museum, 900 Exposition Boulevard,
Los Angeles, CA 90007

Abstract

The alkaloids dimethoxyphenethylamine, tyramine, and hordenine were found in chollas from Morongo Valley and Yucca Valley. However, presence or absence of the chemicals varied at each locality indicating the possible influence of environmental factors such as soil or sunlight differences.

Introduction

Plants produce a variety of chemicals that are not recognizable by external morphological features. The function of these chemicals varies. Some of them function in photosynthesis or metabolism. Others are produced to discourage herbivory. Nevertheless, the presence or absence of these chemicals may aid in the identification of species. The presence of flavenoids in prickly-pear cacti has been used for taxomic purposes (Walkington, 1965), and the presence of the flavenoid mearnsitrin has been detected in some varieties of Acacia mearnsii where there is no external difference from other varieties (Zeylemaker, 1969).

Alkaloids also have been detected in cacti. The presence in peyote of the hallucinogenic drug mescaline is a well known example. Several species of Opuntia also contain alkaloids, as demonstrated by the work of J.L. McLaughlin and his students (Meyer, et. al., 1980). The purpose of this paper is to report

on the presence of alkaloids in two species of cholla.

Methods

In October 1983 specimens of Opuntia acanthocarpa Engelm. & Bigelow were collected from Morongo Valley and Opuntia echinocarpa Engelm. & Bigelow from three different locations in Yucca Valley of the Mojave desert.

Five Opuntia acanthocarpa plants and seven Opuntia echinocarpa plants from different locations were tested. Plants were separately labeled and screened for alkaloids using a method developed by J.L. McLaughlin (Meyer, Bryan N. et al. 1980). Young stem joints were dried and twenty to thirty grams ground with chloroform and two ml conc. ammonium hydroxide in a blender for 10 minutes and filtered. The extract was condensed by rotary evaporator and extracted with 80 ml 1n hydrochloric acid. The acidic solution was shaken with 100 ml chloroform and 100 ml ether. These extracts were discarded. The remaining watery solution, however, was adjusted to pH 9.5 with sodium hydroxide and the basic solution extracted again with 100 ml chloroform and 100 ml ether. The combined extracts were condensed in a rotary evaporator and used for thin layer chromatography. The solvent used was ethylacetate-methanol-conc. ammonium hydroxide (17:2:1) on silica gel GF 250,$CaSO_4$ plates.

The markers used were hordenine, tyramine and 3,4-dimethylphenethylamine HCl. The plates were viewed under UV and sprayed with fluoram 0.02% in acetone and dansyl Chl in 0.05% in acetone. Provisional identification was obtained by cochromatography.

Results and discussion

The samples of Opuntia acanthocarpa collected in Morongo Valley (8320, 8321, 8322 and 8324) contained dimethoxyphenethylamine and tyramine (Table I). For unknown reasons, one sample (8323) contained none of the alkaloids mentioned. The populations of Opuntia echinocarpa sampled from Yucca Valley were variable (Table I).

TABLE I

Presence (+) or absence (-) of alkaloids in Opuntia acanthocarpa, collected in Morongo Valley (M) and Opuntia echinocarpa, from Yucca Valley. Localities: La Contenta Rd (C), Rancho Nogusta (R), and Aberdeen Rd (A).

plant #	locality	dimethoxyphenethylamine	hordenine	tyramine
8320	M	+	-	+
8321	M	+	-	+
8322	M	+	-	+
8324	M	+	-	+
8323	M	-	-	-
8325	C	+	+	+
8327	C	+	+	+
8328	R	+	+	+
8332	A	+	+	+
8333	A	+	+	+
8335	A	+	+	-
8326	C	+	-	+
8330	R	+	-	+
8331	A	+	-	+
8334	A	+	-	+
8329	R	+	-	-

It was not possible to identify all alkaloids in the plants. The occurence of dimethoxyphenethylamine was confirmed by Dr. J.L. McLaughlin and his students (Ma, et al, 1986) in Opuntia echinocarpa (8327 and 8328). [Specimens are preserved in the herbarium of the Museum of Natural History of the Los Angeles county respectively under # 122209, 122210 and 122212.] The occurrence of mescaline in Opuntia basilaris has been reported by Ma et al., 1986 in a quantity (0.01%) which is insufficient to cause hallucinations in humans.

Conclusion

The presence of alkaloids such as dimethoxyphenethylamine are widely distributed in both Opuntia acanthocarpa from Morongo Valley and Opuntia echinocarpa from Yucca Valley. Hordenine was only found in Opuntia echinocarpa, but its presence or absence varied at every locality. Individual Opuntia plants of the same species may differ considerably in their content of alkaloids.

ACKNOWLEDGMENTS

Thanks are due to the Natural History Museum of Los Angeles Co. and expecially to Dr. Ron R. Reynolds for the use of their facilities. I thank Dr. Jerry McLaughlin for the pure samples used as markers in the TLC.

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Walkington, D.L. 1965. Morphological and chemical evidence for hybridization in some species of Opuntia occurring in southern California. Doctoral Dissertation. Claremont Graduate School. Claremont, CA.

Zeylemaker, F.C.J. 1969. Distribution of Mearnsitrin in Acacia populations. Phytochemistry 8:435-436.

VASCULAR PLANTS OF LAS ISLAS DE TODOS SANTOS, NW BAJA CALIFORNIA, MEXICO

Robert F. Thorne and Steven A. Junak

Rancho Santa Ana Botanic Garden, Claremont, CA 91711 and Santa Barbara Botanic Garden, Santa Barbara, CA 93105

This list of the vascular plants collected or observed on the Todos Santos Islands in Todos Santos Bay, is based in part upon collections and observations made by Robert F. Thorne and associates on a Southern California Botanists boat trip out of Ensenada to the South Island on March 8, 1980, and by Steven A. Junak and Ralph N. Philbrick on trips to the islands in April 1978 and April 1985. Stephen A. Junak made additional collections in March 1987. The use of earlier collections made by Ralph N. Philbrick and Michael R. Benedict is greatly appreciated. Additional species not seen on these trips are included from a list of "Plants of the Todos Santos Islands, Baja California," published by Reid Moran in 1950 in Leaflets of Western Botany 6: 53-56 and from a later informal list also apparently generated by Dr. Moran. A preceding * denotes species believed to be introduced on the islands. Vouchers are mostly filed at RSA, SBBG, SD, and MEXU.

The two islets comprising Las Islas de Todos Santos have a combined area of 1.2 sq km. They are located about 6 km from the tip of the Punta Banda peninsula on the mainland at lat 31 deg 48 min N and long 116 deg 48 min W. The larger of the two islets, Isla Todos Santos del Sur, reaches a maximum elevation of about 100 m and has a diverse topography with a main peak and several hills and swales. The vegetation on the larger islet is an interesting mixture of coastal sage scrub, maritime desert scrub, and grassland. The smaller islet, Isla Todos Santos del Norte, is a relatively flat tableland with limited topographic diversity and a maximum elevation of about 20 m. The vegetative cover on the north islet is primarily disturbed grassland and coastal sage scrub.

Aizoaceae
Carpobrotus aequilaterus (Haw.) N. E. Br.
*Mesembryanthemum crystallinum L.
*Mesembryanthemum nodiflorum L.
Alliaceae
Dichelostemma pulchellum (Salisb.) Heller
Anacardiaceae
Malosma laurina (Nutt. in T. & G.) Nutt. ex Abrams
(Rhus laurina Nutt.)
Rhus integrifolia (Nutt. in T. & G.)Brewer & S. Wats.
Apiaceae
Apiastrum angustifolium Nutt. in T. & G.
Daucus pusillus Michx.
Asteraceae
Amblyopappus pusillus Hook. & Arn.
Ambrosia chenopodiifolia (Benth.) Payne
Artemisia californica Less.
*Centaurea melitensis L.
*Chrysanthemum coronarium L.
Coreopsis maritima (Kell.) Hall
Encelia californica Nutt.
Filago californica Nutt.
Gnaphalium beneolens A. Davids.
Gnaphalium bicolor Bioletti
Hazardia berberidis (A. Gray) Greene
Hemizonia fasciculata (DC.) T. & G.
Hemizonia greeneana Rose ssp. peninsularis Moran
*Hypochoeris glabra L.
Isocoma veneta (H.B.K.) Greene ssp. oxyphylla (Greene) ined.
Lasthenia californica DC. ex Lindl. [L. chrysostoma
Fisch. & Mey.) Ornduff]
Malacothrix similis Davis & Raven
Microseris lindleyi (DC.) A. Gray [M. linearifolia
(Nutt.) Sch.Bip.]
Perityle emoryi Torr.
Rafinesquia californica Nutt.
*Sonchus oleraceus L.
*Sonchus tenerrimus L.
Stephanomeria diegensis Gottlieb
Verbesina dissita A. Gray
Viguiera laciniata A. Gray
Boraginaceae
Amsinckia intermedia F. & M.
Cryptantha clevelandii Greene var. clevelandii
Cryptantha intermedia (A. Gray) Greene
Brassicaceae
*Cakile maritima Scop. ssp. maritima
Caulanthus lasiophyllus (Hook. & Arn.) Pays.
[Thelypodium lasiophyllum (Hook. & Arn.) Greene]
Descurainia pinnata (Walt.) Britt. ssp. menziesii (DC.) Detling
*Sisymbrium irio L.
*Sisymbrium orientale L.
Lepidium nitidum Nutt. var. nitidum
Lepidium oblongum Small
Cactaceae
Bergerocactus emoryi (Engelm.) Britt. & Rose
Mammillaria dioica K. Bdg.
*Opuntia ficus-indica (L.) Mill.
Opuntia littoralis (Engelm.) Ckll. ssp. littoralis
Opuntia oricola Philbrick
Opuntia prolifera Engelm.
Caryophyllaceae
Polycarpon depressum Nutt. in T. & G.
Silene antirrhina L.
*Silene gallica L.
Chenopodiaceae
Aphanisma blitoides Nutt. ex Moq. in DC.
Atriplex californica Moq. in DC.
Atriplex julacea S. Wats.
*Atriplex semibaccata R. Br.
Chenopodium californicum (S. Wats.) S. Wats.
*Chenopodium murale L.
*Salsola australis R. Br. (S. kali L. var. tenuifolia Tausch)

Convolvulaceae
  Calystegia macrostegia (Greene) Brummitt ssp. longiloba
    (Abrams) Brummitt
  Calystegia macrostegia ssp. macrostegia
  Dichondra occidentalis House
Crassulaceae
  Crassula connata (R. & P.) Berger in Engler & Prantl
    var. connata (Tillaea erecta Hook. & Arn.)
  Dudleya anomala (A. Davids.) Moran
  Dudleya attenuata (S. Wats.) Britt. & Rose
    ssp. orcuttii (Rose) Moran
  Dudleya brittonii Johansen
  Dudleya Xsemiteres (Rose) Moran
Cucurbitaceae
  Marah macrocarpus (Greene) Greene
Euphorbiaceae
  Euphorbia crenulata Engelm.
  Euphorbia misera Benth.
Fabaceae
  Astragalus trichopodus (Nutt.) A. Gray ssp. leucopsis
    (T. & G.) Thorne (A. leucopsis T. & G.)
  Lotus scoparius (Nutt. in T. & G.) Ottley ssp. watsonii
    (V. & R.) ined. (L. watsonii (V. & R.) Greene]
  Lotus strigosus (Nutt. in T. & G.) Greene var. strigosus
  Lupinus truncatus Nutt. ex Hook. & Arn.
  Trifolium gracilentum T. & G.
  Trifolium tridentatum Lindl.
  Vicia ludoviciana Nutt. (V. exigua Nutt. in T. & G.)
Frankeniaceae
  Frankenia salina (Mol.) Jtn. (F. grandifolia Cham. & Schlecht.)
Geraniaceae
 *Erodium cicutarium (L.) L'Her. ex Ait.
 *Erodium moschatum (L.) L'Her.
 *Pelargonium zonale (L.) Ait.
Grossulariaceae
  Ribes viburnifolium A. Gray
Hydrophyllaceae
  Eucrypta chrysanthemifolia (Benth.) Greene
  Phacelia cicutaria Greene ssp. hispida (A. Gray)
    Beauchamp ex Thorne
  Phacelia distans Benth.
  Phacelia hirtuosa A. Gray
  Phacia ixodes Kell.
  Pholistoma racemosum (Nutt.) Const.
Lamiaceae
 *Marrubium vulgare L.
Malvaceae
  Eremalche exilis (A. Gray) Greene
 *Lavatera assurgentiflora Kell.
 *Malva parviflora L.
Nyctaginaceae
  Mirabilis californica A. Gray var. californica
Orchidaceae
  Piperia unalascensis (Spreng.) Rydb.
    [Habenaria unalascensis (Spreng.) S. Wats.]
Papaveraceae
  Eschscholzia californica Cham. var. peninsularis (Greene) Munz
  Eschscholzia ramosa Greene
Poaceae
 *Avena barbata Brot.
 *Avena fatua L.
  Bromus arizonicus (Shear) Stebb.
 *Bromus diandrus Roth.
 *Bromus mollis L.
 *Bromus rubens L.
  Elymus condensatus Presl
 *Hordeum murinum L. ssp. glaucum (Steud.) Tzvel.
 *Hordeum murinum L. ssp. leporinum (Link) Arcang.
 *Lamarckia aurea (L.) Moench.
  Melica imperfecta Trin.
  Muhlenbergia microsperma (DC.) Kunth
 *Phalaris minor Retz

Poa secunda Presl [P. scabrella (Thurb.)Benth. ex Vasey]
*Polypogon monspeliensis (L.) Desf.
Stipa diegoensis Swall.
Vulpia myuros (L.) K. C. Gmel. var. hirsuta Hack.
(Festuca megalura Nutt.)
Vulpia octoflora (Walt.) Rydb. (Festuca octoflora Walt.)
Polemoniaceae
Gilia sp.
Polygonaceae
Eriogonum fasciculatum Benth. ssp. fasciculatum
Eriogonum grande Greene ssp. testudinum (Reveal) ined.
Pterostegia drymarioides F. & M.
Polypodiaceae
Polypodium californicum Kaulf.
Portulacaceae
Calandrinia ciliata (R. & P.) DC. var. menziesii (Hook.) Macbr.
Calandrinia maritima Nutt.
Claytonia perfoliata Donn. var. perfoliata
Ranunculaceae
Clematis pauciflora Nutt. in T. & G.
Delphinium parryi A. Gray ssp. maritimum (A. Davids.) ined.
Resedaceae
Oligomeris linifolia (Vahl) Macbr.
Rosaceae
Heteromeles arbutifolia (Ait.) M. Roem.
Scrophulariaceae
Antirrhinum nuttallianum Benth. in DC.
Linaria canadensis (L.) Dum.-Cours. var. texana (Scheele) Penn.
Castilleja jepsonii Bacig. & Heckard
Orthocarpus purpurascens Benth. var. purpurascens
Solanaceae
Lycium brevipes Benth. var. brevipes
Lycium californicum Nutt. ex A. Gray
*Lycopersicon esculentum Mill.
Nicotiana clevelandii A. Gray
Physalis greenei Vasey & Rose
*Solanum americanum Mill.
Solanum palmeri Vasey & Rose
Urticaceae
Hesperocnide tenella Torr. (Urtica urens of Wigg.)
Parietaria hespera Hinton ssp. hespera (Parietaria floridana auct.)
Zosteraceae
Phyllospadix torreyi S. Wats.

Updated 27 May 1988

ANNOUNCEMENTS

Operation Phoenix is a partnership of individuals and organizations that have been formed to work together toward resource recovery on fire damaged land. The opportunities are basically two-fold; man power to complete the tasks, and financial support to provide materials and supplies.

Volunteer work will involve tree planting, tree plantation maintenance, stream rehabilitation and other projects. Of 700,000 acres burned during the summer fire siege of 1987, approximately 250,000 acres of devastated forest will nee helping hands to heal the land. The local work to be done includes one area in Trabuco and the Cleveland National Forest.

The U.S. Forest Service, the California Department of Forestry and

Fire Protection, and the BLM are agencies involved in this project. If you are interested in helping in any way, call Gus and Frieda Kinoshita, at 974-1639, and they will forward additional information to you.

CALIFORNIA OAK WOODLAND SYMPOSIUM

A symposium on hardwood range and oak woodland communities entitled: "California Oak Woodlands: Attitudes and Responsibilities" is to be held in Sacramento on January 22-24, 1989. There will be 2 days of panel discussions by various groups on land use issues, management concerns, and conservation alternatives. Panelists will include small and large land owners, conservation group members, policy maker, planners, developers, architects and natural resource management agencies. The symposium will be preceded by a field trip on Sunday, January 22, to look at residential development in oak woodland areas. Poster session will also be held to provide information on programs, activities, or other materials related to hardwood range and other oak woodlands. CNPS is one of the many co-sponsors of this symposium. More detailed information will be provided in the next Bulletin and brochures will be available shortly from: Oak Symposium Coordinators, c/o Department of Forestry and Fire Protection, Room 1516-20, P.O. Box 944246, Sacramento, CA 94244-2460.

Planning and Conservation League, Annual Symposium. January 28, 29 at Sacramento State University. The Planning and Conservation League is a membership organization that represents to the state legislature organizations such as CNPS, Audubon Society, Wilderness Society, and the Laguna Greenbelt. PCL is devoted to the passage of sound environmental legislation in California. For information on this symposium write to PCL, 909 12th St., Suite 203, Sacramento, CA 95814.

Trailbuilding in southern California. Each weekend the Sierra Club (and associated environmental groups) sponsors volunteer trail building. You can take part by helping for a day, a weekend or becoming a regular. Call the Sierra Club Trails Coordinator for the Mountain Range in which you want to work. Sierra Club membership is not required. Santa Monica Mountains, call Ron Webster, (213) 451-1231; San Gabriel Mountains (Angeles N.F.), call Charles Jones, (818) 352-9611; Santa Ana Mountains, call Ken Croker, (714) 546-7016.

Bibliographies on Chaparral and the Fire Ecology of other Mediterranean Systems, 2nd Edition, by Jon E. Keeley. This publication may be obtained free of charge by writing to the Water Resources Center, University of California, Rubidoux Hall, Riverside, CA 92521; or call (714) 787-4327.

Desert Ecology: A Research Symposium, Robert G. Zahary, Editor. This volume is a collection of papers presented at the 1986 Symposium on Desert Ecology sponsored by the Southern California Academy of Sciences and the Southern California Desert Studies Consortium. Of botanical interest are papers on southern California desert communities, post-pollination changes in floral morphology, symbiotic microorganisms in roots of desert plants, and the influence of cactus morphology on the interception of light. Copies may be ordered by calling Margaret Barber at (213) 744-3304. The price is approximately $26.00.

California Oak Heritage Conservation Conference, Peter Bowler and Stacy Brown, Editors. This volume is a series of papers from a 1983 symposium at the University of California, Irvine. It stresses practical, nontechnical information on management, natural history, ecology, and preservation of native southern California oaks. To order a copy, send a check or money order for $10.00 to Sea and Sage Audubon Society, P.O. Box 25, Santa Ana, CA 92702.

CNPS Inventory of Rare and Endangered Vascular Plants, 4th Edition. This volume is now for sale at $19.95 (add $2.95 tax and shipping for first copy, $1.95 tax and shipping for each additional copy). Order from Calif. Native Plant Society, 909 12th St. Suite 116, Sacramento, CA 95814.

Plant Biology of Eastern California. This volume from the Mary DeDecker Symposium is now available at $15.00 per copy (includes postage and handling). Order from White Mountain Research Station, 6713 Geology Bldg., University of California, Los Angeles, CA 90024-1567.

Common Riparian Plants of California and Common Wetland Plants of Coastal California. These Field Guides written and designed for use by professionals and lay people, use photocopies of actual plants, presented life-size. Prices: Riparian Plants, $18.00 + $1.50 shipping; Wetland Plants, $12.00 + $1.00. Order from: Pickleweed Press, 212 Del Casa, Mill Valley, CA 94941.

December 10 (Saturday) 10:00 AM to dusk. Mycological Foray, El Cariso Campground. This LA Mycological Society field trip will look for a variety of fungi in tha Santa Ana Mountains. Meet at the entrance to the El Cariso campground on the Ortega Highway. To reach the meeting take the San Diego freeway (5) south to the Ortega Highway (74). Go east on 74 to the El Cariso Guard Station and go turn left to the campground entrance. Call the LA Mycological Society at (213) 292-1900 for details.

January 14 (Saturday) 10:00 AM to dusk. Mycologial foray, Stunt Cyn. The Mycological Society will conduct this field trip to the Santa Monica Mountains to look for mushrooms and other fungi. Call the LA Mycologial Society at (213) 292-1900 for details.

January 22 (Sunday) 9:00 AM to 3:00 PM. Torrey Pines State Park. Dave Bramlet will lead this trip to examine the relictual Torrey pine. Other interesting species include: Shaw's agave, western dichondra, warty-stem ceanothus, and mission manzanita. To reach the park take the San Diego freeway (5) south to Carmel Valley Rd. (past Del Mar) and go right (west). Continue west to North Torrey Pines Rd and turn left (south) and go south to the park entrance. We will meet at 9:00 AM at the upper parking lot, near the visitors center. Please remember that the Park rules do not allow pets or food within the park. For details call Dave Bramlet at (714) 549-0647.

February 11 (Saturday) 9:30AM to dusk. Fungus foray, Rancho Mission Viejo. Walt Wright will lead this field trip to look at plants (vascular) and fungi in the oak woodlands found on the Rancho Mission Viejo. Take the San Diego freeway (5) south, to the Ortega Highway (74) and go east about 5 miles. We will meet at the large yellow gates on the south side of Ortega Hwy. (Cristianitos Rd.), which is about 1/4 mi. before (west) the entrance of Caspers Park. For additional information call the LA Mycological Society at (213) 292-1900.

February 11 (Saturday) Tentative Desert Field Trip

Dave Charlton may lead a field trip in the Mojave desert for the Riverside Chapter of CNPS. For additional information send an SASE to Dave Charlton 427 Canoe Cove Dr., Diamond Bar CA 91765.

February 12 (Sunday) 10:00 AM to 5:00 PM. Mycologial Faire.

The LA Mycological society will hold a series of demonstrations, displays and lectures on common fungi of southern California at the Orange County Natural History Museum. To reach the Museum take the San Diego Freeway (405) to Jamboree and turn right (south). Continue south to Eastbluff Dr. Turn left on Eastbluff, go past Corona del Mar high school to Vista del Oro. Turn right and look for the Museum on the left (2627 Vista del Oro). For additional information call the LA Mycological Society at (213) 292-1900.

February 25, 26 (Saturday and Sunday) Fungus forays and Faire.

The LA Mycological Society will hold a number of forays in Los Angeles and potentially Orange Counties to look for mushrooms and other fungi. A faire to display these fungi with lectures and demonstrations will be held on Sunday at the LA Arboretum. For details contact the LA Mycological Society at (213) 292-1900.

March 5 (Sunday) 9:30AM to 3:00PM. Moro Canyon, Crystal Cove State Park. Fred Roberts will lead this trip to examine coastal sage scrub, oak woodland and riparian vegetation in the Sycamore Mills. To reach the park take the San Diego Freeway (405) to McArthur and go right (south). Continue on McArthur to the Pacific Coast Highway (PCH) and turn left (southeast). Continue south on PCH to the sign for the Moro Cyn parking lot and visitors center. Turn left and drive to the visitors center where we will meet.

April 1 and 2 (Saturday and Sunday). Anza-Borrego Desert Weekend.

Erik Jonsson will lead this trip to look for desert wildflowers in the park. It is too early to determine the exact areas we will visit but we will dry camp somewhere within the park. Be prepared

for hot weather and bring along plenty of water. Must have containers for two quarts of water on Sat. afternoon, boots and camping gear. We will meet at 10:00 AM on Sat. at Scissors Crossing- junction of SR-78 and S-2 (San Diego County). Trip will end about noon on Sunday. If you plan to attend, call or write: Dave Bramlet, 1691 Mesa Dr. No. A-2, Santa Ana CA 92707, (714) 549-0647.

TENTATIVE TRIPS

March 12	Telegraph Cyn., Chino Hills State Park
April 15-16	Cactus Trip, Dana Pt. to Hemet
April 30	Harford Springs Park, Riverside County.

Comments on the Fall Symposium. The Board of Directors thanks all SCB members and other interested persons for their attendance and support of this year's highly successful symposium. We wish to acknowledge in particular the excellent, well-organized presentations of the five speakers: Robert Thorne, Tim Krantz, Mike Hamilton, Richard Minnich and Jim Shevock.

Several individuals donated extra energies and time to ensure the success of the symposium and should be singled out for their contributions: Al Romspert (speakers luncheon, registration and membership), Linda Harris and Sherry Schmidt (registration), Diana Cosand (audio-visual setup and registration), Allan Schoenherr (photo display and audio-visual operation), Laura Kopase, Dave Charlton and Dave Bramlet (advance publicity), and Terry Daubert (tables for registration and refreshments setup).

The Board appreciates the symposium co-sponsorship and participation by the Cal State Fullerton Biology Club, and also wishes to thank the Biology Dept. faculty at CSUF for allowing the symposium to be held at McCarthy Hall - an excellent facility! I personally enjoyed being the 'Moderator' for this event at my alma mater, and am looking forward to having the 1989 Symposium at CSUF!

Geoff Smith, SCB President

MEMBERSHIP-TREASURER'S REPORT

As in past SCB symposia this year's symposium again had an agenda of excellent subjects presented by knowledgable speakers. What sets this year's symposium apart from those of the past eight years is the financial outcome. The combination of a most welcome attendance, the free use of the lecture hall, and the ability to provide our own refreshments allowed us to post a profit this year. We wish to thank the CSUF Biology Club for co-sponsoring this year's symposium and arranging for the food sales permit. Thanks also to SCB Director Diana Cosand for her efforts in reserving the lecture room and audio visual equipment.

We had an attendance of approximately 140 people during the day's activities. As the room held only 120 seats this turnout far exceeded our expectations. Not everyone was able to stay for all the talks; this allowed seating for most people during the course of the symposium. Twenty-five new members joined and fourty-four current members renewed their memberships for the coming year.

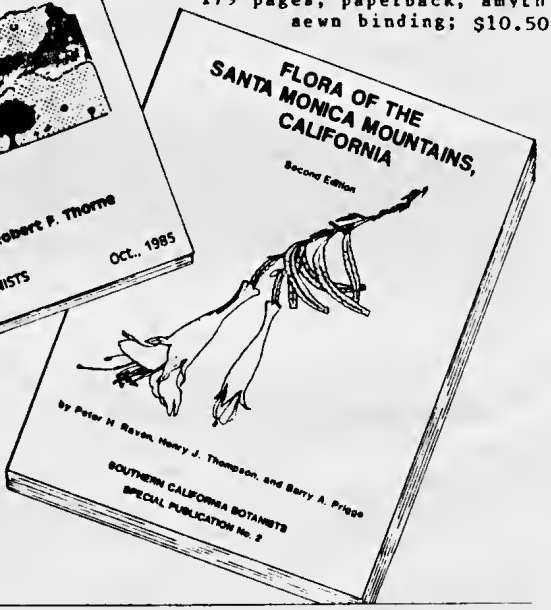
Receipts for symposium attendance totaled nine hundred fourty-two dollars ($942.00). Our expenses for advertisement, refreshments, speaker honorariums and lunches was four hundred thirty-seven dollars ($437.00). The profit of five hundred and five dollars ($505.00) will allow for more student grants in 1989.

Thanks go out to members (both old and new) who attended this year's SCB symposium making it the huge success that it was. We hope to see and visit with you again next year. To those members that were unable to attend we hope to see you at the next symposium and at future SCB functions during the coming new year.

Alan P. Romspert

SCB Membership-Treasurer

Two revised floras from the Southern California Botanists



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SCB COMING EVENTS (DETAILS WITHIN)

December 10	Fungus Foray, El Cariso Campground
January 14	Fungus Foray, Stunt Cyn.
January 22	Torrey Pines State Park
February 11	Fungus Foray, R. Mission Viejo
February 11	Desert Field Trip (Tentative)
February 12	Fungus Faire, Nat. Hist. Mus.
February 25	Fungus Foray and Faire
March 5	Moro Canyon
April 1&2	Ana-Borrego State Park

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