1969

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Recommended Citation

Thorne, Robert F. and Lathrop, Earl W. (1969) "A Vernal Marsh on the Santa Rosa Plateau of Riverside County, California," *Aliso: A Journal of Systematic and Floristic Botany*: Vol. 7: Iss. 1, Article 6.
Available at: <https://scholarship.claremont.edu/aliso/vol7/iss1/6>

A VERNAL MARSH ON THE SANTA ROSA PLATEAU OF RIVERSIDE COUNTY, CALIFORNIA

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INTRODUCTION

Vernal pools and marshes were, even in the early years of this century, rather few in southern California as compared with their relative abundance in the Central Valley to the north. Today with rapidly expanding population pressures, most of the known vernal pools and marshes have disappeared, generally to be replaced by housing developments, golf courses, and military bases. The authors, therefore, thought it desirable to call the attention of the botanical public to one large vernal marsh on the Rancho California on the Santa Rosa Plateau of the Santa Ana Mountains in Riverside County. The Rancho California is ultimately to be subdivided, and this vernal marsh, now in pasture, may well go the unfortunate way of its San Bernardino and San Diego neighbors.

The vernal marsh to be described is located approximately 5 miles west of Murrieta where it occupies a shallow basin, about 30 acres in area, on top of the lava-capped Mesa de Colorado at an approximate elevation of 2050 feet. This marsh is shown in the aerial photographs in Figs. 1 and 2, in the former as a dark patch of shallow water in the center of the lower half of the picture. A smaller marsh, about 7 acres, to the north of the large one on the mesa was not noticed in time to be investigated, but we plan to study it this spring. The Mesa de Colorado is located less than a mile west of the ranch headquarters and is indicated on the vegetation map (Fig. 2) of our flora of the Santa Rosa Plateau (Lathrop and Thorne, 1968) published in the previous issue of this journal. Its crest lies at 2075 feet.

The marsh was visited briefly in 1966 and 1967 by one or both of the authors in connection with the floristic survey of the flora of the plateau mentioned above. During 1968 several visits were made to the marsh, including two intensive investigation and collecting trips. The first trip was made April 18 with Dr. Sherwin Carlquist of the Rancho Santa Ana Botanic Garden and Mr. Oscar Clarke of the University of California at Riverside. The second trip was May 8 with Profs. P. A. Munz and R. K. Benjamin of the Rancho Santa Ana Botanic Garden.

The shallow basin of the marsh was well filled with water, to a maximum depth of perhaps three feet, on April 18, but the water level was markedly

lowered by May 8. By that date few spots in the marsh were more than a foot in depth. In later visits the junior author found the marsh to be largely desiccated by the middle of June. Fig. 3 shows the marsh with the water level rather low. It was photographed in late May from the east side of the marsh looking toward the line of Engelmann oaks (*Quercus engelmannii* Greene) on the western crest of Mesa de Colorado. Fig. 4 is a close-up of the aquatic vegetation still well supplied with water, whereas Fig. 5 illustrates the desiccated rocky margin of the marsh with the basaltic bedrock abundantly exposed. As discussed in our florula, the mean annual precipitation recorded in the area at the Tenaja Guard Station, Trabuco District, Cleveland National Forest, for the period 1960–1966 was 16.61 inches, with about ninety percent of the precipitation falling from December to April.

According to Mr. Charles Gerhart and Mr. Jerry Snow, who generously contributed the information on the soils of Mesa de Colorado, the soils of the vernal marsh and adjacent grassland of the mesa top belong to the Murrieta series. This series consists of fine-textured, reddish brown lateritic soil developed on mesas capped by hard, basic, olivine basalt, of undulating lava-flow origin. They occur on nearly level to strongly sloping mesas under grassland vegetation. The soils are usually moderately well drained and moderately fertile but with slow permeability and runoff and very low water-holding capacity. The surface soil, or A horizon, averages from 5 to 8 inches in thickness, and is a medium acid (pH 5.6), reddish brown to dark red, stony clay loam, of moderately fine angular blocky structure, sticky and plastic. The subsoil, or B horizon, is medium acid (pH 6.0), dark red to dark reddish gray clay, ranging in thickness from 11 to 20 inches and of a coarse prismatic structure, very sticky and very plastic. The parent rock, R horizon, mostly 12–30 inches below the surface and many feet thick, is hard olivine basalt, gray mottled with red and yellow and with many gas-bubble cavities, or granitic basalt. For further information on the Murrieta series one should consult the USDA Soil Survey cited in the references.

By late summer the soil has certainly reached the permanent wilting point (more than 15 atmospheres), and is hard, baked, and deeply fissured. There is little trace, other than fruits, seeds, or spores, of the ephemeral aquatics. The marsh has become a desiccated mud flat with a sparse covering of badly trodden and heavily grazed spike-rushes (*Eleocharis* spp.). The basaltic boulders outcropping at the margin (Fig. 5) and here and there throughout the shallow basin are then very conspicuous.

VEGETATION

The dominant plants in the vernal marsh are two abundant spike-rushes, *Eleocharis macrostachya* Britt. in Small and *E. montevidensis* Kunth var.

Fig. 1. Aerial view, taken with permission from USDA Soil Survey Aerial Photograph AXM5F141, of the Mesa de Colorado and the two vernal marshes, the larger one described in this paper shown in the lower half of the figure. The trees on the rim and slopes of the mesa to left (west) and right (east) are mostly *Quercus engelmannii*, Engelmann oak.

parishii (Britt.) V. Grant, especially the former. Although these are normally perennials from stout rhizomes, one wonders how the underground stems survive the extreme desiccation of most of the year. The tiny *E. acicularis* (L.) R. & S., also presumed to be perennial, is quite inconspicuous and mostly submersed near the rocky margin of the marsh. Several other perennials, mostly sparsely distributed about the margins of the marsh, including *Eryngium aristulatum* Jeps. var. *parishii* (Coul. & Rose) Mathias and Const., *Lythrum hyssopifolium* L., and *Sida leprosa* (Ort.) K. Schum. var. *hederacea* K. Schum., mature much later than the rest of the aquatic vegetation, flowering usually rather late in the summer. Possibly the two quillworts, *Isoetes howellii* Engelm. and *I. orcuttii* A. A. Eat. (Figs. 6 and 7), survive desiccation by their corms, and *Marsilea mucronata* A. Br. by its slender, long-creeping rhizomes.

The majority of the vascular plants in the marsh, however, are ephemeral aquatics that presumably survive the long period of desiccation as fruits, seeds, and spores. With the quillworts and *Marsilea* mentioned above they form a fascinating assemblage. The submersed and floating-leaved species found were *Callitriche marginata* Torr. and its var. *longipedunculata* (Morong) Jeps., *Crassula aquatica* (L.) Berger, *Elatine californica* A. Gray (Fig. 8), *Ē. chilensis* Gay (Fig. 8), *Anagallis minima* (L.) E. H. L. Krause, *Ranunculus aquatilis* L. var. *capillaceus* (Thuill.) DC., and *Potamogeton pusillus* L. More or less emersed were *Downingia cuspidata* (Greene) Greene ex Jeps. ssp. *cuspidata*, the only really showy-flowered plant in the marsh, *Plagiobothrys undulatus* (Piper) Jtn., and *Lilaea scilloides* (Poir.) Haum.

On the shallow, muddy margin of the marsh in April, and thus subject to early desiccation, were many semi-aquatics, including *Blennosperma nanum* (Hook.) ssp. *nanum*, *Cotula coronopifolia* L., *Filago gallica* L., *Gnaphalium palustre* L., *Psilocarphus brevissimus* Nutt. var. *brevissimus*, *Crassula aquatica*, *C. erecta* (H. & A.) Berger, *Trifolium amplexens* T. & G. var. *truncatum* (Greene) Jeps., *Plantago bigelovii* A. Gray ssp. *californica* (Greene) Bassett, *Anagallis minima*, *Mimulus guttatus* Fisch. ex DC., *Veronica peregrina* L. ssp. *xalapensis* (H.B.K.) Pennell, *Juncus bufonius* L., *J. sphaerocarpus* Nees in Funk, *Lilaea scilloides*, *Alopecurus howellii* Vasey, and several fescues, *Festuca dertonensis* (All.) Asch., *F. megalura* Nutt., and *F. myuros* L.

In the vernal moist grassland near the margins of the marsh was a relatively rich and more showy flora. The more conspicuous members of this community should be listed since they certainly owe their presence on the mesa to the vernal moisture. They include, more or less in order of abundance and conspicuousness of flowers: *Plagiobothrys nothofulvus* (A. Gray) A. Gray, *Ranunculus californicus* Benth., *Orthocarpus densiflorus* Benth. and var. *gracilis* (Benth.) Keck, *Calandrinia ciliata* (R. & P.) DC.

Fig. 2. Aerial photograph of the vernal marshes of Mesa de Colorado from the southwest. The larger marsh is approximately 30 acres and the smaller 7 acres. The photograph was taken late in March 1968, with the marshes at maximum water level, by Earl W. Lathrop.

Fig. 3. View across the large vernal marsh from east to west. The abundant emerged sedge is *Eleocharis macrostachya*, spike-rush. The oaks on the western rim of the mesa are Engelmann oaks. Photograph taken in late May 1938 by Earl W. Lathrop.

var. *menziesii* (Hook.) Macbr., *Brodiaea filifolia* S. Wats., *Muilla maritima* (Torr.) S. Wats., *Sisyrinchium bellum* S. Wats., *Lasthenia chrysostoma* (F. & M.) Greene, *Calycadenia tenella* (Nutt.) T. & G., *Trifolium variegatum* Nutt., *Plantago erecta* Morris, *Deschampsia danthonioides* (Torr.) Munro ex Benth. var. *gracilis* (Vasey) Munz, *Geranium carolinianum* L., plus such abundant introduced weeds as *Erodium cicutarium* (L.) L'Her., *E. obtusiplicatum* (M., W., & W.) J. T. Howell, *Cerastium glomeratum* Thuill., *Sisymbrium officinale* (L.) Scop., *Lamarckia aurea* (L.) Moench., *Hordeum glaucum* Steud., and *Bromus mollis* L.

Since negative data are sometimes rather significant, it is worthwhile to consider some of the aquatic or semi-aquatic species that because of distribution and habitat could be expected but were not found. Some of these species have indeed been found in smaller vernal pools or in other aquatic or moist habitats elsewhere on the Santa Rosa Plateau, as *Azolla filiculoides* Lam., *Evax acaulis* (Kell.) Greene, *Plagiobothrys acanthocarpus* (Piper) Jtn., *Elatine brachysperma* A. Gray, *Ludwigia peploides* (H.B.K.) Raven, *Samolus parviflorus* Raf., *Anemopsis californica* Hook., *Lemna* spp., *Brodiaea orcuttii* (Greene) Baker, *Potamogeton* spp., *Typha* spp., and *Zanichellia palustris* L. Still unreported from the plateau, however, are *Pilularia americana* A. Br., *Ophioglossum californicum* Prantl, *Lepidium latipes* Hook., *Bergia texana* (Hook.) Seub., *Elatine rubella* Rydb., *Pogogyne abramsii* J. T. Howell, *Ammania coccinea* Rottb., *Rotala ramosior* (L.) Koehne, *Myosurus minimus* L., *Limosella acaulis* Ses. & Moç., *Crypsis aculeata* Ait., *Orcuttia californica* Vasey, and *Phalaris lemmonii* Vasey. Since these species are known from vernal pools in adjacent areas of Riverside and San Diego Counties, some of them will possibly be found in the small vernal marshes and pools yet to be investigated on Mesa de Colorado and other parts of the plateau.

ADDITIONS AND CORRECTIONS TO THE FLORA OF THE SANTA ROSA PLATEAU

The additional field work on the plateau, especially involving the Mesa de Colorado marsh, has added a number of species or lesser taxa to the plateau flora. In the following list they are preceded by a double asterisk. Two species not collected during the earlier floristic survey have been re-discovered on the plateau. These are preceded by a single asterisk. A number of corrections are made to bring up to date the names used in our florula (Lathrop and Thorne, 1968). All species are listed in the order in which they did or should occur in the florula. The numbers listed are those of the senior author unless otherwise specified. The first set of specimens are represented in the herbarium of the Rancho Santa Ana Botanic Garden and a second set at Loma Linda University.

Fig. 4. Aquatic vegetation in the shallow water of the vernal marsh. The emersed plant is *Eleocharis macrostachya*, spike-rush, and the floating leaves are the floating rosettes of *Callitriche marginata longipedunculata*. Photograph taken in late May 1938 by Earl W. Lathrop.

Fig. 5. The desiccated eastern margin of the vernal marsh is heavily supplied with outcropping boulders of basaltic lava. The flowers among the spike-rushes are those of *Downingia cuspidata cuspidata*. Photograph taken in late May 1938 by Earl W. Lathrop.

- ***ISOETES ORCUTTII* A. A. Eat. (Figs. 6 and 7, right) was collected in shallow water of the vernal marsh on Mesa de Colorado, elev. ca. 2050 feet (37567); and shallow, cold, clear water of a small stream near the junction of the Tenaja Road and the road to the ranch headquarters, elev. ca. 2000 feet (37419, 37592); in both locations with *Isoetes howellii* (37568, 37420), *Marsilea mucronata* (37566, 37424), *Lilaea scilloides* (37450, 37569, 37595), *Ranunculus aquatilis capillaceus* (37562, 37423), and *Eleocharis montevidensis parishii* (37454, 37600). *Marsilea mucronata* A. Br. is the correct name for *M. vestita* auth., not Hook. & Grev.
- CIRSIIUM TIOGANUM* (Congd.) Petr. is the correct name for our common acaulescent thistle. *C. foliosum* (Hook.) DC. and *C. drummondii* T. & G. are boreal species which apparently do not reach California.
- ***ERIGERON FOLIOSUS* Nutt. (incl. var. *FOLIOSUS* and var. *STENOPHYLLUS* (Nutt.) A. Gray) is common in grassy openings in oak woodland and chaparral. It was inadvertently omitted from the flora.
- ***CALLITRICHE HETEROPHYLLA* Pursh var. *BOLANDERI* (Hegelm.) Fassett (Fig. 9) was abundant in shallow, cold, clear water of the small stream (37421, 37594, Lathrop 6164), with *Potamogeton foliosus* Raf. (37593), *Nasturtium officinale* R. Br. (37596), plus those species listed with *Isoetes orcuttii* above. Like the preceding species, it was omitted from the flora by accident.
- ***CALLITRICHE MARGINATA* Torr. var. *LONGIPEDUNCULATA* (Morong) Japs. was abundant in the vernal marsh on Mesa de Colorado (37451, 37562) where the var. *marginata* had been collected at a later date a previous year. I suspect that these two taxa, which need thorough investigation, are probably growth forms of one taxon, the former with floating leaves being found in somewhat deeper water, and the latter usually barely submersed or exposed on wet mud.
- ***ELATINE CALIFORNICA* A. Gray (Fig. 8, right) was locally abundant on bottom mud in shallow water at the west end of the vernal marsh on Mesa de Colorado (37452, 37560), where associated especially with *E. chilensis* (Fig. 8, left), *Callitriche marginata longipedunculata*, *Crassula aquatica*, *Isoetes* spp., *Marsilea mucronata*, and *Ranunculus aquatilis capillaceus*.
- ***TRIFOLIUM AMPLECTENS* T. & G. var. *TRUNCATUM* (Greene) Jeps. was inadvertently omitted from our flora. It is frequent in moist, grassy places, as about the vernal marsh on Mesa de Colorado (37438).
- SIDA LEPROSA* (Ort.) K. Schum var. *hederacea* (Dougl.) K. Schum. is recommended for *S. hederacea* (Dougl.) Torr.
- FRAXINUS VELUTINA* Torr. var. *CORIACEA* (S. Wats.) Rehder should be listed from stream margins, rather than in chaparral: along stream with *Platanus racemosa* Nutt., in Los Alamos Canyon, 12 miles NW of Murrieta, Lathrop 6799.
- ***PLANTAGO BIGELOVII* A. Gray ssp. *CALIFORNICA* (Greene) Bassett was found only with careful search (belly-botanizing) on the desiccated, open, muddy margin of the vernal marsh on Mesa de Colorado (37445, Lathrop 6801), where it was associated with similar tiny ephemerals such as *Blennosperm nanum nanum*, *Psilocarphus brevissimus brevissimus*, *Crassula aquatica*, *C. erecta*, *Plantago erecta*, *Anagallis minima*, *Veronica peregrina xalapensis*, *Juncus bufonius*, and *J. sphaerocarpus*. A collection (37575) made at a later date was more depauperate and matched the description of *P. bigelovii* ssp. *bigelovii*.
- LINANTHUS PYGMAEUS* (Brand) J. T. Howell ssp. *CONTINENTALIS* Raven is the correct subspecific epithet for the mainland material of this species. The typical subspecies is found on Guadalupe and San Clemente Islands.
- ERIOGONUM NUDUM* Dougl. ex Benth. var. *PAUCIFLORUM* S. Wats. is apparently the correct identification and name for the sterile material listed as *E. nudum saxatile* in the flora. That combination was a *lapsus* and had never been made by Reveal.
- RUMEX CRISPUS* L., rather than the misspelled *R. crispus* in the flora.
- ***ANAGALLIS MINIMA* (L.) E. H. L. Krause (*Centunculus minimus* L.) was a rare and tiny annual at the desiccated margin of the vernal marsh on Mesa de Colorado (37453, 37576), associated with those species listed above with *Plantago bigelovii californica*.

Fig. 6. Two plants of the robust *Isoetes howellii*, left, and two of the more delicate *I. orcuttii*, right, were removed from the water of the vernal marsh and photographed by Prof. Sherwin Carlquist against a boulder. The former species has a 2-lobed corm, the latter a 3-lobed corm, but these are not evident here.

Fig. 7. A close-up view of the bases of one plant each of *Isoetes howellii*, left, and *I. orcuttii*, right. The partial velum over the sporangium in the sporophyll of *I. howellii* is readily evident. The velum over the sporangium of *I. orcuttii* is complete. Photograph by Prof. Carlquist.

Fig. 8. One plant of *Elatine chilensis*, left, and one of *E. californica*, right, have been removed from the water of the vernal marsh and photographed by Prof. Carlquist. The sessile capsules are visible in some of the leaf axils.

Fig. 9. A plant of *Callitriche heterophylla bolanderi*, from a small vernal stream on the Santa Rosa Plateau, has been removed from the water and photographed by Prof. Carlquist. Both floating rosette leaves, right, and submersed leaves are shown, and the sessile mericarps are visible in some of the leaf axils.

- **SAXIFRAGA CALIFORNICA* Greene was collected from a mossy bank of a granite outcrop bordering a riparian habitat 12 miles NW of Murrieta in Los Alamos Canyon, *Lathrop* 6798. It was collected previously on the plateau in 1916.
- KECKIELLA CORDIFOLIA* (Benth.) Straw is the proper combination for this taxon under the segregate genus *Keckiella*. The generic name is feminine, not masculine.
- **ORTHOCARPUS DENSIFLORUS* Benth. (and var. *GRACILIS* (Benth.) Keck) were found in some abundance on the vernal moist grasslands surrounding the vernal marsh on Mesa de Colorado (37431, 37582). P. A. Munz had collected it in 1941 on the north end of the plateau.
- ***VERONICA PEREGRINA* L. ssp. *XALAPENSIS* (H.B.K.) Pennell was very rare on the margin of the vernal marsh on Mesa de Colorado (37447, *Lathrop* 6800), associated with the species listed above with *Plantago bigelovii californica*.
- ELEOCHARIS MACROSTACHYA* Britt. in Small (Figs. 3 and 4) is the correct name and authority for the husky perennial spike-rush usually misidentified as *E. palustris* or *E. mamillata* by California authors. Both *E. palustris* (L.) R. & S. and *E. mamillata* Lindb. f. are reportedly restricted to the Old World.
- ***JUNCUS SPHAEROCARPUS* Nees in Funk was rare on the desiccated margin of the vernal marsh on Mesa de Colorado (37448, *Lathrop* 6802), where associated with the much more common *J. bufonius* and the species listed above with *Plantago bigelovii californica*.
- BRODIAEA CORONARIA* (Salisb.) Engler var. *KERNENSIS* Hoov. is to be transferred to subspecific rank under *Brodiaea terrestris* Kell. by Theodore Niehaus. The combination is presumably in press.
- **POTAMOGETON PUSILLUS* L. was found in considerable abundance but mostly sterile in the shallow water of the marsh on Mesa de Colorado (37564). Dr. E. C. Ogden kindly determined it in duplicate for us.
- SCHEUCHZERIAACEAE* was published somewhat later than *JUNCAGINACEAE*. The latter name thus must be used for the combined family that includes *Lilaea scilloides*.

ACKNOWLEDGMENTS

The authors wish to express their gratitude to various persons who have supplied assistance, information, and materials for this paper. Mr. Oscar Clarke and Profs. P. A. Munz and Sherwin Carlquist have assisted with the field work. Prof. Carlquist also supplied us with several excellent photographs of aquatic plants. Mr. Charles Gerhart and Mr. Jerry Snow contributed the information on the soils of Mesa de Colorado. James L. Reveal, T. F. Niehaus, and E. C. Ogden have supplied determinations respectively for *Eriogonum*, *Brodiaea*, and *Potamogeton*. As with the earlier survey, the management of the Rancho California has been most generous with permission to collect on their land.

SUMMARY

A large, shallow vernal marsh, about 30 acres in area, located at 2050 feet in a shallow basin on top of the lava-capped Mesa de Colorado on the Rancho California on the Santa Rosa Plateau of Riverside County is described as to location, soils, seasonal aspects, and vegetation. Eleven species and subspecies are added to the known flora of the Santa Rosa Plateau and various corrections in names are given to supplement the earlier

published florula. With these additions and corrections, the known flora of the Plateau, some 45,000 acres in area, consists of 17 pteridophyte species (in 14 genera of 10 families), 1 conifer, 350 dicots (in 210 genera of 61 families), and 101 monocots (in 48 genera of 11 families) for a total of 469 species in 273 genera of 83 families. Seventy-three of the species are introduced and 396 are apparently indigenous to the Plateau.

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