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PILULARIA AMERICANA ON THE SANTA ROSA PLATEAU,
RIVERSIDE COUNTY, CALIFORNIA

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PILULARIA AMERICANA A. BR. (MARSILEACEAE)

Pilularia americana A. Br., the American Pillwort, is an inconspicuous and
highly specialized aquatic fern that is little collected. The slender, creep­
ing, branched rhizomes are rooted in mud or fine sand and bear at the nodes
a few erect, filiform leaves (2-6(-10) cm) and often a small, globose sporocar­
p (ca. 2-2.5 mm) (Fig. 1-3). Unlike their cousins in the genera Marsilea
and Regnellidium with four and two leaflets respectively, pillworts lack
leaflets though the delicate, thread-like leaves do retain the same circinate
vernation. It is easy to overlook the plants or to mistake them for immature
plants of Eleocharis acicularis (L.) R. & S. or seedlings of Juncus or other
monocots or Isoetes with which they are frequently associated. The known
distribution of our American species is highly disjunct both within the
United States and between the United States and Chile. It is almost always
an inhabitant of temporary, shallow bodies of water such as vernal pools,
hog-wallows, wet depressions, fluctuating reservoirs, and ditches. It is known
from shallow pools and wet depressions on granite in several counties of
north central Georgia (McVaugh and Pyron, 1951; Duncan and Blake,
1965); reservoir margins in Arkansas (where collected first in 1819 near
Fort Smith); a shallow creek in the Llano Uplift region of central Texas
(LaMotte, 1940); a mudflat in Quanah Parker Lake of the Wichita Mts.
Wildlife Refuge, Comanche County, Oklahoma (Correll, 1967); small sand
hill ponds of Reno County, south central Kansas, and Cherry County, north
central Nebraska (McGregor, 1950, 1967); vernal pools from Crook Coun­
ty, central Oregon, to the Kearny Mesa area in San Diego, California; and
from Valparaiso and Valdivia Provinces in central and south-central Chile
(Munoz Pizarro, 1959). It surely will be found in other areas, very likely,
for example, in northern Baja California, Mexico. Its disjunct range is due
presumably to long-distance dispersal of sporocarps by water birds, as in
the related and often associated Marsilea mucronata A. Br. (Malone and
Proctor, 1965).

In our survey of the large vernal marsh on the Mesa de Colorado, Santa
Rosa Plateau, Santa Ana Mountains, Riverside County, southern California,
the authors and their colleagues had sought Pilularia without success
(Thorne and Lathrop, 1969). An exceptionally wet winter in 1969, however,
by filling all the depressions on the Mesa de Colorado, gave us hope of finding additional species expected on the Mesa but not previously found.
there. Indeed, on the first trip to the Mesa on May 12, 1969, *Pilularia americana* was found in abundance at the western margin of the large vernal marsh as well as on the margins of smaller vernal pools farther north on the Mesa (see Fig. 1 and 2, Thorne and Lathrop, 1969). The pillwort in places actually formed dense turfs on the wet, muddy margins and in the shallow water at the edge of the marshes. It is possible that we would have overlooked a few, scattered pillworts previously, but it is not probable that we would have missed them had they been in such abundance as in May 1969.

The variation in abundance in vernal pool species from year to year is one of the more fascinating phenomena of this unusual habitat. In reference to the rain pools in Tulare County, California, Tom Howell (1968) wrote, “The different years produce fantastically different growths in the Pixley area. When I first went there in May 1965, I found one bit of *Pilularia* the size of two bits; then in 1966 there was a pillwort explosion and it was one of the commonest of plants. In 1966 I laboriously collected a few plants of *Elatine*; in 1967 there were sheets of it.” We must conclude that the Mesa de Colorado experienced a pillwort “explosion” in the spring of 1969.


Fig. 1–6.—Fig. 1. Plants of *Pilularia americana* in situ on wet mud at the west margin of the large vernal marsh on Mesa de Colorado. Note crozier at lower right. The filiform fronds are mostly less than 6 cm tall, averaging perhaps 4 cm.—Fig. 2. Turf of *Pilularia americana* with surface mud removed to show buried sporocarps rising from nodes of horizontal, branching rhizomes.—Fig. 3. Plants of *Pilularia americana* removed and washed to show the small sporocarps, each 2.0–2.5 mm in diameter.—Fig. 4. Plants of *Navarretia prostrata* in desiccated and cracked mud of small vernal pool on Mesa de Colorado. Corollas whitish to pale lavender in color and plants ca. 1 cm tall, mostly forming prostrate rosettes to 10 or 15 cm across.—Fig. 5. Small, fruiting plants of *Myosurus minimus* var. *apus* removed from dried mud on vernal pool on Mesa de Colorado. Fruiting spikes ca. 3–4 cm tall.—Fig. 6. Tiny plants of *Orcuttia californica* var. *californica* in desiccated and cracked mud of small vernal pool on Mesa de Colorado. Plants ca. 3 cm tall. (All photographs by Prof. Sherwin Carlquist.)
In view of the major disjunction in range of Pilularia americana between the United States and Chile, it is pertinent here to mention that the following species just listed and a few other aquatics from adjacent areas on the Santa Rosa Plateau also are found in Chile: Azolla filiculoides Lam., Psilocarpus brevissimus, Elatine chilensis, Lythrum hyssopifolium, Anagallis minima, Veronica peregrina, Carex praegracilis W. Boott, Juncus bufonius, Lilaea scilloides, and Zannichellia palustris L. In grassland and oak woodland plant communities immediately adjoining the aquatic habitats on the plateau are other species showing the same kind of amphitropical distribution: Sanicula crassicaulis Poepp. ex DC., Madia gracilis (Sm.) Keck, Pectocarya linearis (R. & P.) DC. var. ferocula I. M. Johnst., Crassula erecta (H. & A.) Berger, Lotus subpinnatus Lag., Oenothera dentata Cav., Microstera gracilis (Hook.) Greene, Calandrinia ciliata (R. & P.) DC., Linaria canadensis (L.) Dum-Cours. var. texana (Scheele) Penn., Festuca megalura Nutt., and Muhlenbergia asperifolia (Nees & Mey.) Parodi (Raven, 1963). Raven (1963) has also listed a number of vicariad pairs, some perhaps really conspecific, which include species found in or adjacent to our vernal marshes. The Chilean representatives are herewith listed, in each case immediately followed in parentheses by the California representative: Blennosperma chilense Less. (B. nanum (Hook.) Blake), Amsinckia hispida (R. & P.) I. M. Johnst. (A. menziesii (Lehm.) Nels. & Macbr.) Lupinus microcarpus Sims (L. densiflorus Benth.), Linanthus pusillus (Benth.) Greene (L. pygmaeus (Brand) J. T. Howell), Myosurus patagonicus Speg. (M. minimus), and Deschampsia monandra Parodi (D. danthonioides).

Pilularia americana was also collected May 17, 1969, by Dr. James Henrikson, No. 3290a, on Kearny Mesa, 1.5 miles N of Miramar along Hwy. 395, San Diego County, in vernal pools under sub-divisional death sentence. Examination of herbarium specimens from POM, RSA, and SD gave us the following additional localities for Pilularia in southern California, with latest collector and date in parentheses: ORANGE County: Costa Mesa (H. H. Tracy, Mar. 31, 1935); RIVERSIDE: mud flat, S of Lake Elsinore (P. A. Munz and F. W. Peirson, Apr. 29, 1922); SAN BERNARDINO: desiccating pools on clay mesa (Red Hill near Upland, I. M. Johnston, Apr. 8, 1917); SAN DIEGO: filling pools on mesas near San Diego (H. H. Tracy, Apr. 6, 1922); 1 mile N of San Marcos (F. F. Gander, May 11, 1937); vernal pools on mesa NE of Murray Dam (F. F. Gander, Apr. 20, 1937); 2 miles N of Poway Junction along Hwy. 395 (F. F. Gander, May 11, 1937); Radio Road, Chollas Heights (F. F. Gander, Apr. 27, 1937); clay depressions, Ramona (T. S. Brandegee, May 25, 1903); VENTURA: Mirror Lake, Ojai Valley (H. M. Pollard, June 15, 1955). We have examined herbarium material of Pilularia americana also from the following more northern counties of California: Colusa, Contra Costa, Fresno, Lake, Madera, Marin, Mendocino, Merced, Modoc, Monterey, Placer, Sacramento, San Joaquin, Solano, and Tulare, in almost all cases from mud, adobe, or other fine-grained heavy soil in vernal pools, ditches, or lake and reservoir margins. It has also been reported in
California from Santa Barbara, Santa Cruz, and Siskiyou Counties, and it surely is present in other counties as well.

ADDITIONS TO THE FLORA OF THE SANTA ROSA PLATEAU

The heavy precipitation in the winter of 1969 filled all the vernal marshes and pools and other depressions on the Mesa de Colorado. As was anticipated, careful investigation of these vernally moist habitats turned up a number of interesting species not previously found in the large marsh. These plus a few other species found during further exploration on other parts of the plateau are listed below with some of their associated plants. The species are arranged in the order in which they should occur in our flora (Lathrop and Thorne, 1968). The numbers given are those of the senior author unless otherwise specified. Dates are not listed since all collections were made on May 12, May 19, or June 6, 1969. The first set of specimens will be filed in the herbarium of the Rancho Santa Ana Botanic Garden and a second set at Loma Linda University. The many duplicates will be distributed widely.

**PILULARIA AMERICANA** A. Br. (Fig. 1–3) was collected on wet mud and in shallow water at the N margin of the large vernal marsh on the S end of Mesa de Colorado, elev. ca. 2050 ft, Rancho California, Santa Rosa Plateau (37919, 37966, 39321); and on the desiccated margin of a small vernal marsh, ca. 7 acres, N of the large marsh (Lathrop 7034). The associated species are listed above.


**DOWNINGIA CUSPIDATA** (Greene) Greene ex Jeps. ssp. **CUSPIDATA** is one of the most abundant species in the vernal marshes on Mesa de Colorado. Normally the corollas are lavender to bright blue with a yellow spot in a white area on the lower lip but a few plants with all white corollas were collected (39314b, Lathrop 7100).

**SAGINA OCCIDENTALIS** S. Wats. is apparently rare for only one plant was found on the grassy bank of a small stream 8 miles W of Murrieta on truck trail between Tenaja Road and Los Alamos Canyon (39337).

**SPERGULARIA BOCCONI** (Scheele) Foucaud was found only along the road to the ranch headquarters E of Mesa de Colorado, elev. ca. 2000 ft (Lathrop 7076). It is a naturalized weed from Europe.


**GARRYA VEATCHII** Kell. is apparently a rare shrub in the chaparral for it was found only on dry slopes near a small stream (39331, Lathrop 7111), with *Rhhus trilobata* *malacophylla* and the other plants listed above with that species.

**MECONELLA DENTICULATA** Greene was collected once on a grassy bank at the edge of chaparral in Los Alamos Canyon near junction with San Mateo Canyon, 12 miles NW of Murrieta (Lathrop 7021).

**NAVARRETTA PROSTRATA** (A. Gray) Greene (Fig. 4) was found on the desiccated margin or bed of small vernal marshes N of the large marsh on Mesa de Colorado (37929,

**Myosurus minimus** L. var. *apus* Greene (Fig. 5) was collected only on the desiccated margins of small vernal marshes N of the large marsh on Mesa de Colorado (37949, Lathrop 7061), where associated especially with *Pilularia americana*, *Psilocarphus brevissimus brevissimus*, *Navarretia prostrata* (37981), *Deschampsia danthonioides gracilis* (37950), and *Phalaris caroliniana* Walt. (37951, 37983).

**Veronica americana** (Raf.) Schw. was found only in a small stream 8 miles W of Murrieta on truck trail between Tenaja Road and Los Alamos Canyon (39339), mixed with *V. comosa* Richt., and associated with such other aquatics as *Anemopsis californica* Hook. (39340), *Callitriche heterophylla* Pursh var. *bolanderi* (Hegelm.) Fern. (39341), *Eleocharis montevidensis* Kunth var. *parishii* (Britt.) V. Grant (39345), *Lilaea scilloides* (39346), *Lemma gibba* L. (39344), *Potamogeton foliosus* Raf. (39343), and *Zannichellia palustris* L. (39342, Lathrop 7078).

**Veronica comosa** Richt. (39338) was collected with *V. americana* and the species listed immediately above.

**Calochortus albus** Doug. ex Benth. was found in rocky soil in a shaded grassy area under oak woodland ca. 2 miles beyond turn-off to ranch headquarters, elev. ca. 2000 ft (37984, Lathrop 7053).

**Orcuttia californica** Vasey var. *californica* (Fig. 6) is a rare vernal marsh grass known previously from only six stations in Baja California and Los Angeles, Riverside, and San Diego Counties of southern California (Moran, 1969). It was scattered over the desiccated and cracked muddy bottom of a small vernal marsh NW of the large vernal marsh on Mesa de Colorado (37971, Lathrop 7123), where it was associated chiefly with *Isoetes howellii* (37974), *Eryngium aristulatum* Jeps. var. *parishii* (C. & R.) Mathias & Const. (37975), *Psilocarphus brevissimus brevissimus* (37973), *Plagiobothrys undulatus* (37972), *Downingia cuspidata cuspidata*, and *Navarretia prostrata*.

**Phalaris caroliniana** Walt. was found only on the desiccated margins of a small vernal marsh N of the large marsh, Mesa de Colorado (37951, 37983), where associated especially with *Phalaris minor* Retz. (Lathrop 7066), *Deschampsia danthonioides gracilis*, *Lolium temulentum* L. (37982), and other grasses.

**ACKNOWLEDGMENTS**

We are grateful to several persons who have helped us. As with our earlier survey efforts on the Santa Rosa Plateau, the management of the Rancho California has been most generous with permission for us to collect on its land. Prof. Sherwin Carlquist has kindly supplied us with the excellent photographs of vernal marsh plants used in this paper. Dr. Reid Moran has sent us on loan the material of *Pilularia* from the Herbarium of the San Diego Natural History Museum.

**SUMMARY**

*Pilularia americana*, American pillwort, is added to the vernal marsh flora of the Santa Rosa Plateau of Riverside County, California. Its disjunct geographic and ecological distribution, annual fluctuations, and common vernal marsh associates are listed or discussed. Thirteen other species are also added to the known flora of the Santa Rosa Plateau and are listed with their associated species. With these additions, the flora of the Plateau, some 45,000
acres, consists of at least 18 pteridophyte species (in 15 genera of 10 families), 1 conifer, 360 dicots (in 215 genera of 62 families), and 104 monocots (in 49 genera of 11 families) for a total of 483 species in 280 genera of 84 families. Seventy-four of the species are believed to be introduced and 409 indigenous to the Plateau.

REFERENCES CITED


Moran, R. 1969. Orcutt grass is where it is (but why?) Environ. Southwest, August, 1969: 3-5.

