

# Rings around the posies: Updates on the classification of vernal pool vegetation



Jennifer Buck-Diaz & Carol W. Witham  
Vernal Pools Conference, April 11, 2018





## Outline

Vegetation classification

History of VP classification

Fine-scale VP classification

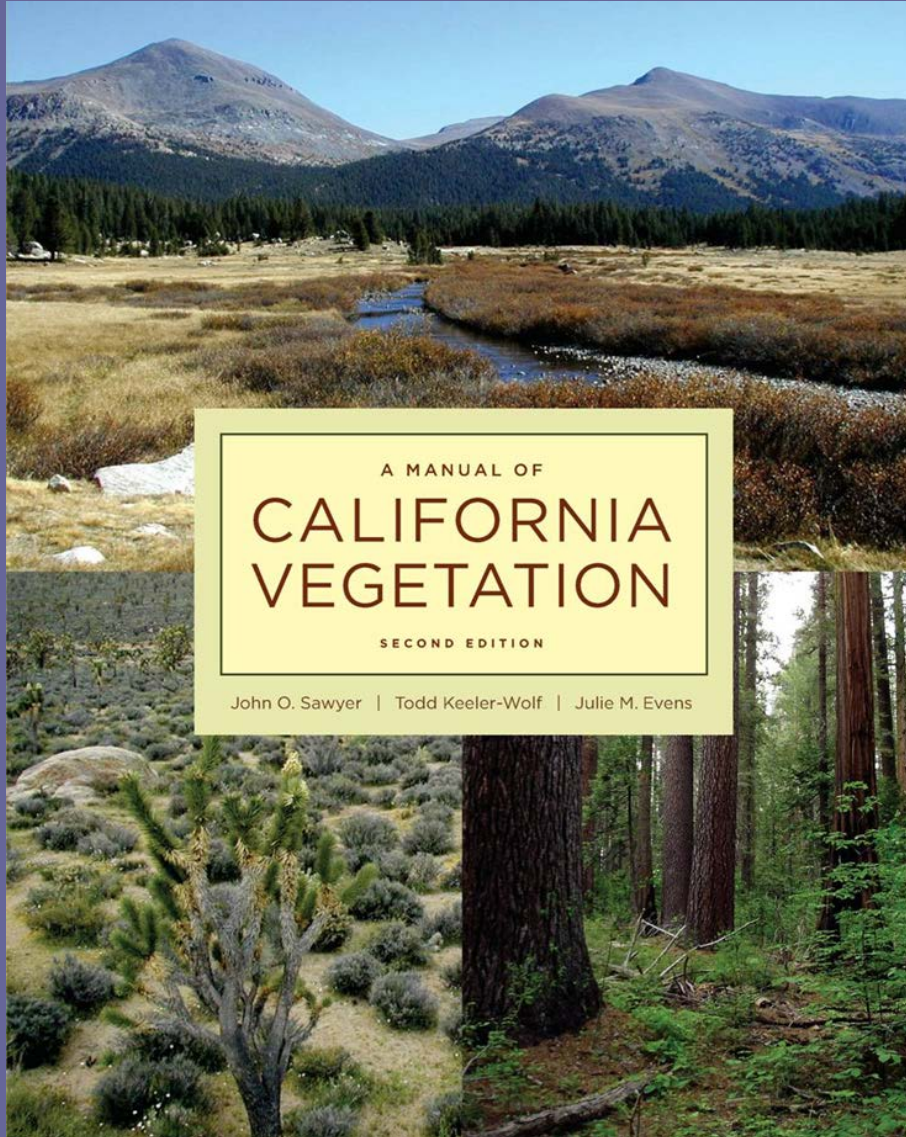
- Indicator species of VPs

Keying out VP vegetation

Applications and uses

Next steps

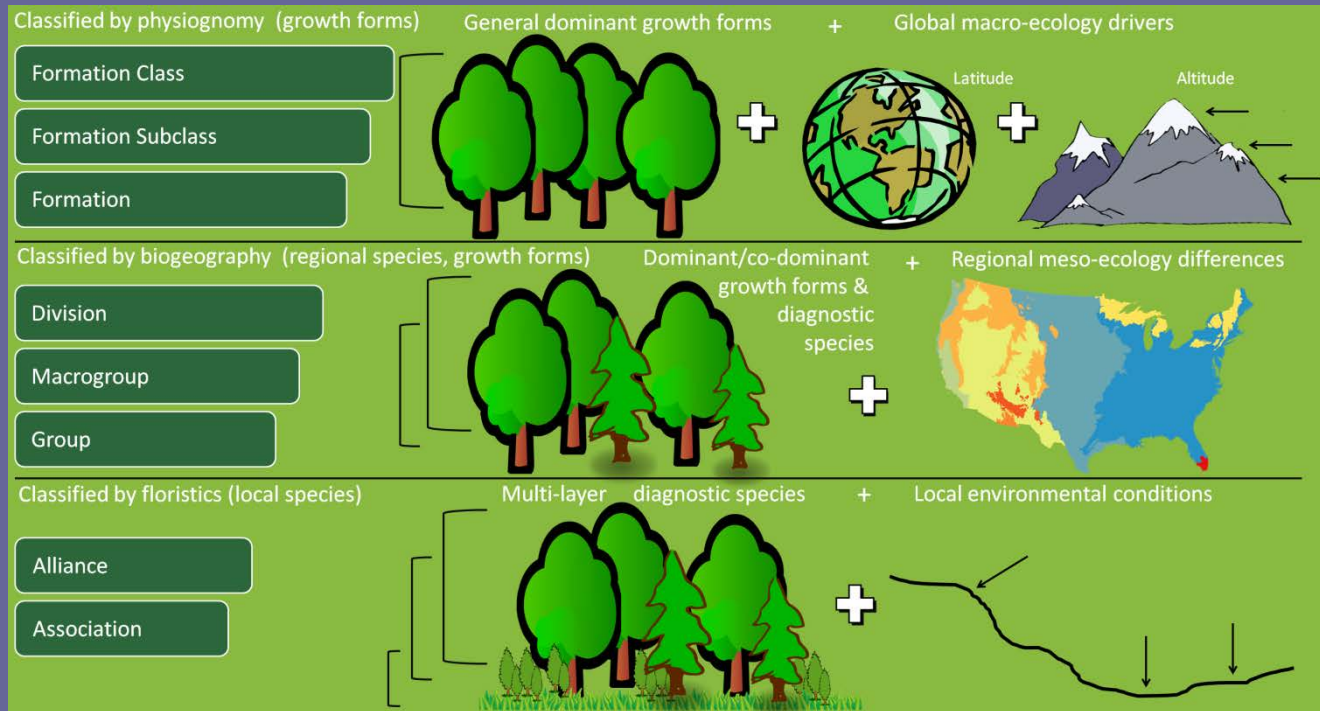
# MCV Classification



- Alliance  
The basic unit of floristic classification, usually named by the dominant and characteristic plant species in the uppermost layer of vegetation (canopy)
- Association  
The smallest fundamental unit of classification, typically includes species from other strata (understory)

John O. Sawyer, Todd Keeler-Wolf, Julie M. Evens. 2009.

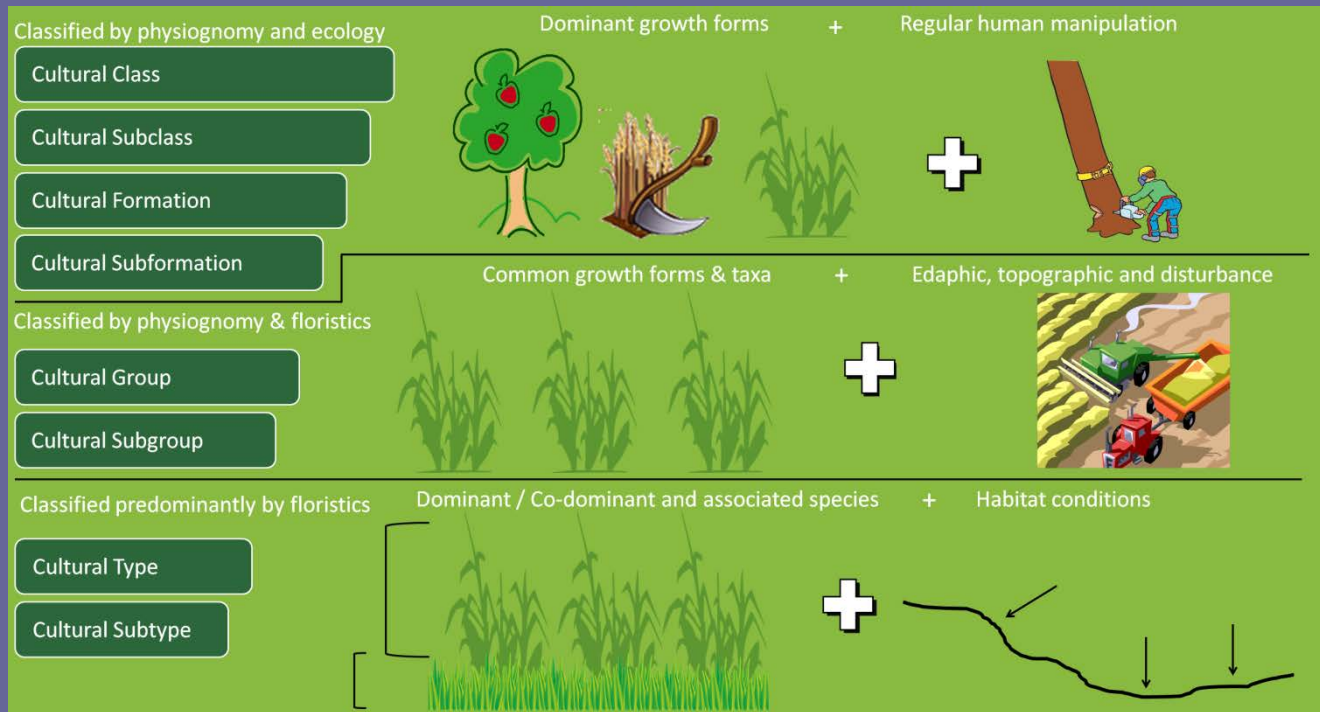
# What is vegetation classification?



*As with any taxonomy, vegetation classification is used to simplify communication and share information*

- At broad scales, vegetation types are based strongly on shared growth forms that dominate an area and reflect patterns of climate and substrate
- At fine scales, vegetation types are based on assemblages of plant species that co-occur in an area and are linked by their interactions with each other and their environment

# What is vegetation classification?



*Cultural  
vegetation  
classification*

- At broad scales, vegetation types are based strongly on shared economic use or value (i.e. harvestable timber)
- At fine scales, vegetation types are based on assemblages of plant species that co-occur (often based on annual crops)

# Are California's vernal pools unique?

- Abiotically -- **NO**
- Floristically -- **YES**



- The California Floristic Province is only region that has evolved an extensive flora endemic to vernal pools
- Over 100 species are completely restricted to CA vernal pools
- Has been challenging to classify CA vernal pools



A MANUAL of  
CALIFORNIA  
VEGETATION

John O. Sawyer and Todd Keeler-Wolf. 1995.  
California Native Plant Society.  
*Based on Robert F. Holland. 1986.  
California Department of Fish and Game.*

# Vernal pool series

- Northern basalt flow vernal pools
- Northern claypan vernal pools
- Northern hardpan vernal pools
- Northern volcanic ashflow vernal pools
- Northern volcanic mudflow vernal pools
- San Diego mesa vernal pools
- San Jacinto Valley vernal pools
- Santa Rosa Plateau vernal pools

# California Vernal Pool Assessment Preliminary Report

## 17 Vernal Pool Regions

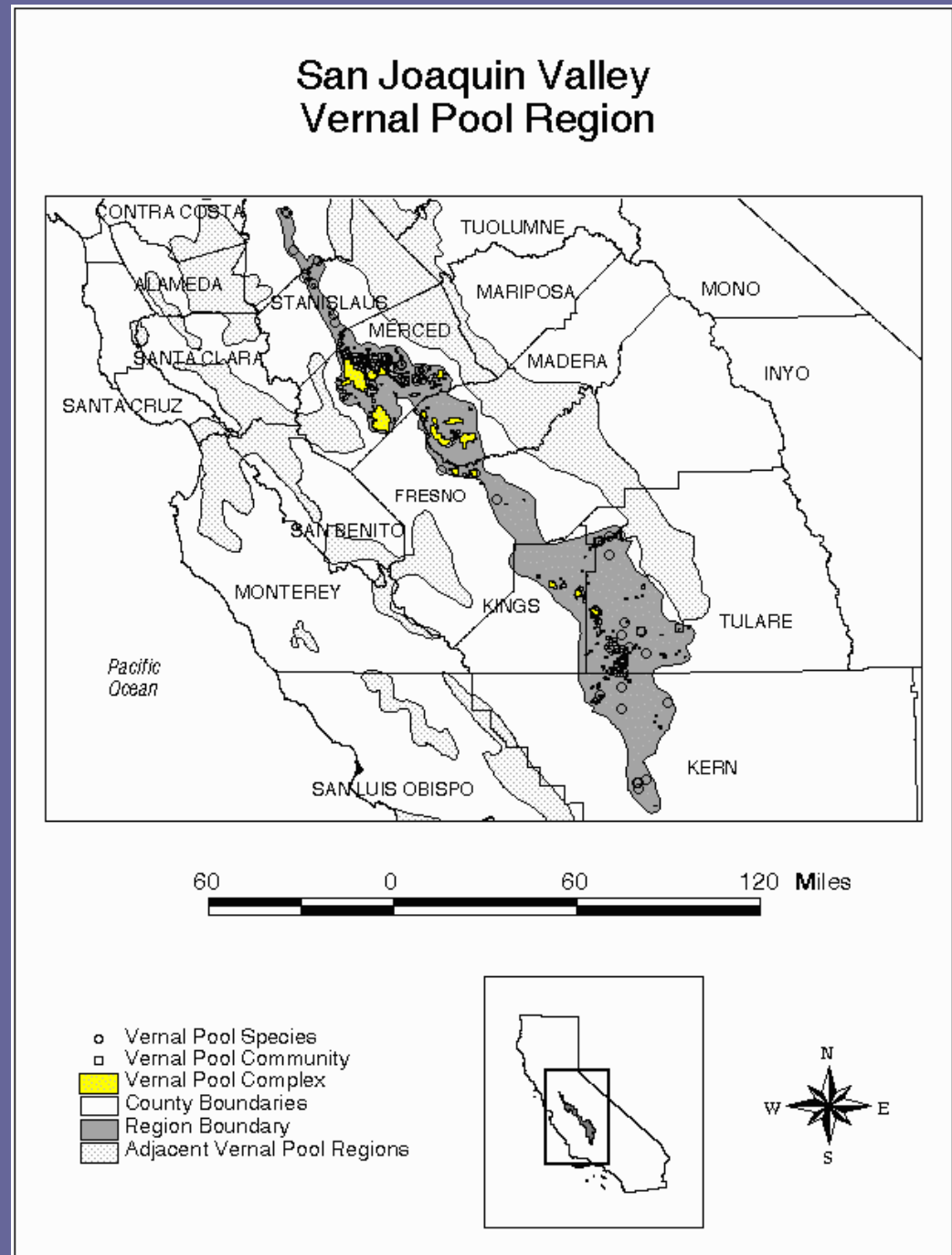
Todd Keeler-Wolf,  
Diane Elam,  
Kari Lewis, and  
Scott Flint. 1998.





# Each Region Treated in Detail

- Complexes
- Communities
- Species
  - Included a comprehensive list of taxa found in vernal pools





*Navarretia* (8 species)



*Lasthenia* (8 species)



*Psilocarphus* (4 species)

## Endemic vernal pool genera



*Plagiobothrys* (13 species)



*Limnanthes* (5 species)



*Pogogyne* (5+ species)



*D. concolor*



*D. bicornuta*



*D. pulchella*

## Speciation of the genus *Downingia*

(6 of the 13 species are shown here)



*D. cuspidata*



*D. ornatissima*



*D. pusilla*



*Navarretia myersii*

*Juncus leiospermus*  
ssp. *leiospermus*



© 1987 Dean Taylor



*Astragalus tener* var. *tener*

## Special-status Plants



© 1993 Dean Taylor

*Legenere limosa*



*Navarretia heterandra*



© 2002 Jaymee Marty


*Hesperervax caulescens*



Four different pools within one complex!



# Fine-scale classification of VP vegetation

- 
- 5+ years of field work
  - > 3,000 plots across CA
  - collected vegetation data and environmental variables



Tuscan



Phoenix Park

# Zonation of vegetation within vernal pools



Vina Plains



Thomes Creek

Vegetation type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Eryngium vaseyi	100	89	92	100	80	79	75	79	60	91	64	37	62	83	29	68
Plagiob stipitatus	100	56	82	64	72	74	66	36	100	13	73	48	43	25	.	43
Lasthenia fremontii	100	67	64	36	51	83	70	81	.	87	55	59	68	8	83	81
Psilocarphus brevissimus	80	72	75	43	54	69	80	52	.	70	18	19	60	.	100	88
Crassula aquatica	40	72	57	29	72	83	73	76	40	100	18	33	46	.	58	43
Deschampsia danthonioides	20	22	29	71	49	78	60	64	.	78	46	74	73	33	25	51
Callitriche marginata	80	72	21	7	35	47	43	41	.	61	18	11	62	25	13	5
Navarretia leucocephala	.	.	79	43	33	36	36	7	.	.	64	63	.	8	.	77
Juncus bufonius	.	.	21	.	33	64	47	21	60	74	36	44	19	42	.	14
Pogogyne ziziphoroides	.	11	14	.	23	52	43	38	80	87	46	96	.	.	17	1
Eleocharis acicula	20	.	25	14	51	53	27	5	.	.	.	.	54	8	8	18
Alopecurus saccatus	.	72	32	71	47	12	33	41	.	44	18	4	24	8	4	10
Pilularia americana	.	28	18	14	28	66	39	26	.	26	.	.	11	.	29	5
Isoetes orcuttii	20	28	14	.	30	50	33	21	.	65	9	11	22	.	.	.
Veronic peregri	.	17	.	.	5	.	22	17	80	22	27	11	.	.	63	30
Lasthenia glaberrima	100	100	100	100	100	5	8	21	.	13	.	4	16	.	33	1
Eleocharis palustris	40	50	79	100	81	38	8	33	.	22	.	.	5	17	54	36
Limnanth douglas s. ro	40	33	4	.	.	.	15	41	20	87	64	30	78	58	.	.
Trifolium depauperatum	.	.	7	.	14	2	17	17	60	57	100	30	14	8	.	.
Hemizonia fitchii	.	17	.	.	12	48	19	7	60	17	64	41	3	50	29	1
Lepidium nitidum	.	.	.	.	.	3	5	10	80	22	18	70	46	17	.	.
Plagiobothrys greenei	.	.	.	.	2	10	12	10	100	78	9	26	.	.	.	.
Blennosper nanum v. na	.	6	.	.	.	3	5	14	.	57	.	59	51	42	.	.
Cicendia quadrangulari	.	.	.	.	14	17	25	24	.	74	.	41	.	.	.	1
Hypochaeris glabra	.	6	7	.	14	12	39	52	100	100	18	82	35	33	.	.
Erodium botrys	.	28	7	.	28	17	40	64	60	96	18	44	11	25	.	.
Vulpia bromoides	.	6	4	.	16	3	19	43	20	83	18	11	35	.	8	1
Bromus hordeaceus	.	6	7	.	7	17	34	19	100	26	36	78	41	.	29	5
Plantago elongata	.	6	.	.	.	.	5	21	.	9	9	48	5	.	79	60
Downingia insignis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	67	56
Cressa truxillensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	38	77
Myosurus minimus	.	17	.	.	.	.	2	7	.	13	.	4	3	.	42	53
Polypogon monspeliensis	.	.	.	.	21	7	2	.	.	.	.	.	.	.	100	56
Crypsis schoenoides	.	.	.	.	.	.	0.9	.	.	.	.	.	.	.	79	55
Cotula coronopifolia	.	17	.	.	7	.	2	10	.	.	.	.	.	.	79	21

Table from Barbour et al. Madrono article 2003 -

CLASS: *Downingio bicornutae-Lastheniетеа fremontii*

← deep

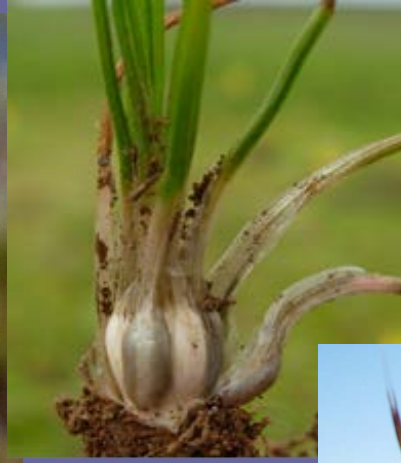
← shallow

ORDERS

← alkaline



# Diagnostic Species



## Vegetation of long-inundated pools

- *Lasthenia glaberrima* alliance
- *Eleocharis (acicularis, macrostachya)* alliance

## Vegetation in shallower pools

- *Lasthenia fremontii* – *Downingia (bicornuta)* alliance
- *Centromadia (pungens)* alliance
- *Deinandra fasciculata* alliance
- *Layia fremontii* – *Achyrrachaena mollis* alliance
- *Montia fontana* – *Sidalcea calycosa* alliance
- *Trifolium variegatum* alliance

## Vegetation of alkaline/saline pools

- *Cressa truxillensis* – *Distichlis spicata* alliance
- *Frankenia salina* alliance
- *Lasthenia fremontii* – *Distichlis spicata* alliance



# Great Valley

## Indicator species

- *Eryngium castrense*
- *Eryngium vaseyi vallicola*
- *Eryngium aristulatum aristulatum*
- *Downingia bicornuta picta*
- *Navarretia leucocephala leucocephala*
- *Plagiobothrys stipitatus micranthus*
- *Pogogyne zizyphoroides*
- *Pogogyne douglasii*
- *Centromadia fitchii*
- *Centromadia pungens*
- *Lasthenia fremontii*
- *Castilleja campestris*



# Modoc and Sierra Valley

## Indicator species

- *Eryngium alismifolium*
- *Plagiobothrys cusickii*
- *Plagiobothrys mollis*
- *Navarretia leucocephala minima*
- *Downingia bacigalupii*
- *Marsilea oligospora*
- *Porterella carnosula*
- *Muhlenbergia richardsonii*
- *Polygonum polygaloides*



# North and Central Coast

## Indicator species

- *Eryngium armatum*
- *Eryngium aristulatum aristulatum*
- *Eryngium vaseyi vaseyi*
- *Plagiobothrys bracteatus*
- *Plagiobothrys chorisianus hickmanii*
- *Navarretia leucocephala bakeri*
- *Navarretia leucocephala plieantha*
- *Navarretia leucocephala pauciflora*
- *Ranunculus pusillus*
- *Lasthenia conjugens*
- *Lasthenia burkei*
- *Blennosperma bakeri*



# Southern California

## Indicator species


- *Eryngium aristulatum parishii*
- *Navarretia fossalis*
- *Navarretia hamata leptantha*
- *Pogogyne abramsii*
- *Pogogyne nudiuscula*





## Conclusions of fine scale classification

- Vernal pool community types repeat across the landscape and some are localized to specific regions
- Listed plant species are tightly associated with certain communities
- ~ 50 communities (associations) in CA



# Keying out vernal pool vegetation

**IIA2a.ii.** *Downingia ornatissima* is characteristic with other herbs including *Alopecurus saccatus*, *Deschampsia danthonioides*, and *Plagiobothrys stipitatus*. Other species present may include natives *Lasthenia fremontii*, *Navarretia leucocephala*, *Eryngium castrense*, and *Blennosperma nanum*. Found in northeastern and northwestern Sacramento Valley regions on northern hardpan and volcanic mudflow vernal pools...

***Lasthenia fremontii* – *Downingia ornatissima* Herbaceous Association**

**IIA2a.iii.** *Downingia bicornuta* and/or *Downingia cuspidata* are present with characteristic species *Psilocarphus brevissimus*, *Deschampsia danthonioides*, and *Eryngium castrense*. *Gratiola ebracteata* and *Lasthenia fremontii* are either absent or insignificant. Found in the northeastern Sacramento Valley region in volcanic vernal pools including high terrace and mudflows...

***Downingia (bicornuta, cuspidata)* Herbaceous Association**

**IIA2a.iv.** *Downingia insignis* is characteristically present along with other vernal pool species such as *Lasthenia fremontii*, *Deschampsia danthonioides*, and *Eryngium vaseyi*. Stands are found in the northern Solano-Colusa vernal pool region

***Downingia insignis*–*Psilocarphus brevissimus* Herbaceous Association**

**IIA2a.v.** *Downingia ornatissima*, *D. cuspidata*, *D. bicornuta*, and *Lasthenia fremontii* are absent or insignificant in the herbaceous layer. *Eryngium vaseyi*, *E. castrense*, *Plagiobothrys stipitatus* var. *micranthus*, and *Psilocarphus brevissimus* are present and abundant with other vernal pool taxa. Found in vernal pools with deeper or longer inundation, hardpan pools, and volcanic mudflows in the northeastern and northwestern Sacramento Valley as well as central and northeastern San Joaquin Valley regions...

***Eryngium (vaseyi, castrense)* Herbaceous Association**

**IIA2a.vi.** *Lasthenia fremontii* is constant and conspicuous while species of *Downingia* are absent or insignificant. *Lolium perenne*, *Deschampsia danthonioides*, *Alopecurus saccatus*, *Achyrrachaena mollis*, and *Navarretia* spp. are characteristic...

***Lasthenia fremontii* Herbaceous Association (Provisional)**

**IIA2.b.** *Hemizonia congesta* ssp. *luzulifolia*, *Lasthenia glabrata*, *Lepidium latipes* var. *latipes*, *Lupinus bicolor*, *Medicago polymorpha*, and/or *Trifolium willdenovii* are characteristic species in the herbaceous layer. Other common non-native species include *Bromus hordeaceus*, *Lolium perenne* and *Medicago polymorpha*. See Barbour et al. 2007 for full alliance description...

***Hemizonia congesta* Herbaceous Association (Provisional)  
of the *Eryngium aristulatum* Herbaceous Alliance**

**IIA2.c.** *Montia fontana* and/or *Sidalcea calycosa* is characteristically present along with other vernal pool species such as *Lasthenia fremontii*, *Limnanthes alba*, *Plagiobothrys* spp., and *Trifolium* spp. ...

***Montia fontana* – *Sidalcea calycosa* Herbaceous Association  
of the *Montia fontana* – *Sidalcea calycosa* Herbaceous Alliance**

**IIA2.d.** *Cotula coronopifolia*, *Cressa truxillensis*, *Crypsis schoenoides*, *Distichlis spicata*, *Frankenia salina*, *Triphysaria* spp., and *Myosurus minimus* present along with diagnostic vernal pool plants including *Downingia insignis*, *D. pulchella*, *Lasthenia fremontii*, and *Psilocarphus brevissimus*. Found in alkaline or saline vernal pools...

***Lasthenia fremontii* – *Distichlis spicata* Herbaceous Alliance**

**IIA2d.i.** *Cressa truxillensis* is characteristically present and usually abundant, and *Downingia pulchella* is also present and often abundant...

***Downingia pulchella* – *Cressa truxillensis* Herbaceous Association**



# MCV Online

<http://vegetation.cnps.org/>

CNPS Alliance: Lasthenia x Jennifer

vegetation.cnps.org/alliance/416

Apps Bookmarks Inbox - j buck@cnps.c CNPS - California Nat Google Maps YubaNet.com | We D Calflora - Search for CalPhotos Jepson Interchange Welcome to the PLA USNVC Other bookmarks

**CNPS**  
*California Native Plant Society*  
A Manual of California Vegetation Online

## *Lasthenia fremontii* - *Downingia (bicornuta)* Herbaceous Alliance

Fremont's goldfields - *Downingia* vernal pools

### Characteristic Species

*Downingia* spp. and/or *Lasthenia fremontii* are characteristically present in the herbaceous layer with *Castilleja campestris*, *Cuscuta howelliana*, *Eryngium castrense*, *Eryngium vaseyi*, *Gratiola ebracteata*, *Lilaea scilloides*, *Limnanthes douglasii*, *Plagiobothrys stipitatus* var. *micranthus*, *Plagiobothrys undulatus*, *Psilocarpus brevissimus* var. *brevissimus* and *Ranunculus bonariensis* var. *trisepalus*. Other common species include *Briza minor*, *Bromus hordeaceus*, *Centromadia fitchii*, *Croton setigerus*, *Erodium* spp., *Hordeum* spp., *Hypochoeris glabra*, *Leontodon saxatilis*, *Lolium perenne* or *Lythrum hyssopifolia*.

### Vegetation Layers

Herbs < 60 cm; cover is intermittent to continuous.

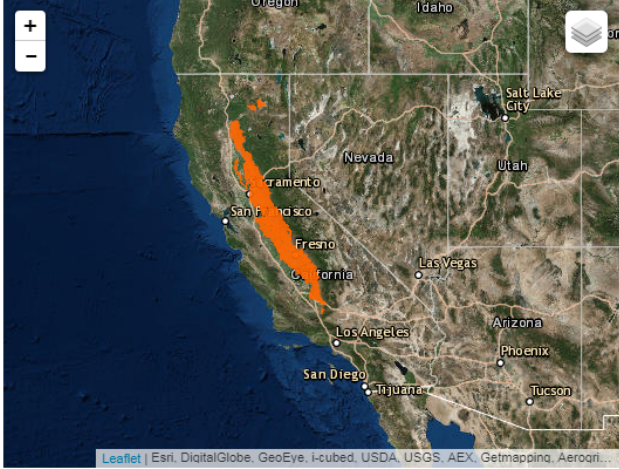
### Membership Rules

- Castilleja campestris* ssp. *campestris*, *Downingia bicornuta*, *Gratiola ebracteata*, *Lasthenia fremontii*, and/or *Ranunculus bonariensis* var. *trisepalus* present and abundant collectively or in part with upland species; or *Eryngium castrense*, *E. vaseyi*, *Plagiobothrys stipitatus* var. *micranthus*, and/or *Psilocarpus brevissimus* var. *brevissimus* present and abundant; or *Downingia cuspidata*, *D. bicornuta*, and/or *D. ornatissima* present in the herbaceous layer (Barbour et al. 2007).

### Habitats

Shallow vernal pool bottoms and edges, mostly hardpan pools on older geomorphic surfaces but also on

### USDA Ecological Section Map



The map shows the distribution of the alliance in California, highlighted in orange. The distribution is primarily in the northern and central parts of the state, including areas around Sacramento, San Francisco, Fresno, and San Diego. Major cities like Sacramento, San Francisco, Fresno, Los Angeles, San Diego, Las Vegas, Phoenix, and Tucson are labeled. The map also shows state boundaries for Oregon, Idaho, Nevada, Utah, and Arizona.

### Summary Information

- Primary Life Form:** Herb
- Elevation:** 15-710 m
- State Rarity:** S3

# MCV Online

<http://vegetation.cnps.org/>

CNPS Alliance: Lasthenia x Jennifer

vegetation.cnps.org/alliance/416

Apps Bookmarks Inbox - j buck@cnps.c CNPS - California Nat Google Maps YubaNet.com | We D Calflora - Search for CalPhotos Jepson Interchange Welcome to the PLA USNVC Other bookmarks

*brevissimus* var. *brevissimus* present and abundant; or *Downingia cuspidata*, *D. bicornuta*, and/or *D. ornatissima* present in the herbaceous layer (Barbour et al. 2007).

## Habitats

Shallow vernal pool bottoms and edges, mostly hardpan pools on older geomorphic surfaces but also on volcanic substrates. Soils have short periods of inundation. The USFWS Wetland Inventory (1996 national list) recognizes *Lasthenia fremontii*, *Downingia bicornuta*, and other *Downingia* as OBL plants.

## Other Habitat, Alliance and Community Groupings


<b>MCV (1995):</b>	Northern hardpan vernal pool habitat, Northern volcanic mudflow vernal pool habitat
<b>NVCS (2009):</b>	North Pacific hardpan vernal pool, Northern California volcanic vernal pool
<b>Calveg:</b>	Annual grasses and forbs, Vernal pool
<b>Holland:</b>	Northern hardpan vernal pool
<b>Munz:</b>	Valley grassland
<b>WHR:</b>	Annual grassland
<b>CDFW CA Code:</b>	42.007.00

## National Vegetation Classification Hierarchy

<b>Formation Class:</b>	Mesomorphic Shrub and Herb Vegetation (Shrubland and Grassland)
<b>Formation Subclass:</b>	Temperate and Boreal Shrubland and Grassland
<b>Formation:</b>	Temperate and Boreal Freshwater Marsh
<b>Division:</b>	Western North American Freshwater Marsh
<b>Macro Group:</b>	Western North America Vernal Pool
<b>Group:</b>	Californian mixed annual/perennial freshwater vernal pool / swale bottomland

## Summary Information

- **Primary Life Form:** Herb
- **Elevation:** 15-710 m
- **State Rarity:** S3
- **Global Rarity:** G3
- **Distribution:** CAN: BC. USA: CA, OR, WA (NatureServe)
- **Endemic to California:** No
- **Endemic to California Floristic Province and Deserts:** No
- **Date Added:** 2009/09/01



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## Related Links

# MCV Online

<http://vegetation.cnps.org/>

CNPS Alliance: Lasthenia x

vegetation.cnps.org/alliance/416

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**Macro Group:** Western North America Vernal Pool

**Group:** Californian mixed annual/perennial freshwater vernal pool / swale bottomland

**Remarks** [\(more\)](#)

**Life History Traits of the Principal Species** [\(more\)](#)

**Fire Characteristics** [\(more\)](#)

**Regional Status** [\(more\)](#)

**Management Considerations** [\(more\)](#)

**Associations** [\(hide\)](#)

- *Downingia bicornuta* [4]
- *Downingia (bicornuta, cuspidata)* [1], [3]
- *Eryngium (vaseyi, castrense)* [1], [3]
- *Lasthenia californica* - *Downingia bicornuta* [5]
- *Lasthenia fremontii* [3]
- *Lasthenia fremontii* - *Downingia bicornuta* [1], [2], [3]
- *Lasthenia fremontii* - *Downingia ornatissima* [1], [3]
- *Ranunculus bonariensis* - *Holocarpha virgata* [1]

**References** [\(more\)](#)

**Related Links**

- » [Feedback](#)
- » [How to read alliance descriptions](#)
- » [Full bibliography](#)

# Applications

- Conservation!
  - Identify and protect rare vernal pool vegetation
  - Configure preserves to include maximum vernal pool vegetation diversity
  - Monitor threats and climate change in vp vegetation



# Applications

- Regulatory ?
  - Community diversity
  - Selection of appropriate reference pools
  - Focus on diagnostic species instead of those that are dominant and widespread



# Applications

- Management ??
  - Monitor change over time
  - Potentially detect shifts due to climate change
  - Contribute to long-term and far-reaching data sets



# Next Steps...

- Publish results of regional vernal pool vegetation classifications (Coast Ranges, SoCal, Modoc)
- Identify and rank rare vernal pool vegetation associations
- Use vernal pool locations and vegetation to highlight Important Plant Areas (IPAs) for conservation planning
- Tie wildlife habitat relationships to vernal pool floristics

# Next Steps...

- Revise key to vernal pool vegetation types to make it more user friendly
- Continue education and outreach to broaden collection and use of vernal pool vegetation data
- Identify and publish recognized differences in vernal pool vegetation across the state
- Work on how to incorporate vernal communities in environmental review, regulation and mitigation



# Acknowledgements

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  - Department of Fish and Wildlife– Biogeographic Data Branch, Wildlife Conservation Board
  - Federal Agencies – BLM, BOR, DOD, EPA, NPS, USFS, USFWS, USGS
  - Other State Agencies – CDF, CalTrans, DWR, State Parks, UC
  - Other Agencies and Organizations – County Parks, City governments, Land conservancies, Packard Foundation, TNC

