

Accuracy Assessment of Los Peñasquitos Lagoon Vegetation Map

The Los Peñasquitos Lagoon vegetation map is based on extensive field surveys from mid-2013 to early 2015 and interpretation of aerial imagery and LIDAR elevation data. The accuracy assessment described here was performed in the autumn of 2016. A total of 58 plots from 19 categories were evaluated. The final map accuracy was 69% using a traditional error matrix, and 89% with a fuzzy logic scoring system.

Methods

GIS methods

We started by performing simple QA/QC tests on the existing map. We corrected topology errors and standardized the attribute table so that each hierarchical level of the Manual of California Vegetation (MCV) classification (Group, Alliance, and Association) was recorded in a separate field. Many polygons were below the suggested minimum mapping unit (MMU) of 0.1 hectares, so we manually merged adjacent polygons based on the extent of shared perimeter and mapping rules associated with each category. We retained salt panne, mudflat, and water polygons that were below the MMU due to the importance of these habitats. In addition, polygons that were enclosed by these habitat types (such as islands of *Salicornia pacifica* surrounded by water) were allowed as exceptions to the MMU rule, as were polygons on the perimeter of the mapped area. Polygons initially mapped as salt panne, mudflat, or water that were later changed to a different category based on examination in the field were also allowed as exceptions to the MMU rule.

We did an initial examination of the number of polygons from each alliance to determine how to allocate the sampling effort for the field-based accuracy assessment. The initial goal was to perform a field assessment of at least one polygon for each alliance with fewer than five total polygons, three field assessment polygons for alliances with five to 15 polygons, and five for alliances with greater than 15 polygons. We focused the accuracy assessment effort on marsh areas, and did not examine categories such as Upland, Developed, or Disturbed. Using targeted geographic regions of the mapping area, we selected polygons for field assessment randomly from the alliances of interest. Due to time limitations, both of the “mudflat” polygons and two of the “salt panne” polygons were assessed using geotagged photographs that were taken during other field work in October 2016. Although the map was produced at the association level, we allocated sampling polygons at the alliance level to reduce the complexity of sample selection.

After field work was complete, we merged adjacent polygons of the same association to improve map aesthetics. In a few cases, we left adjacent polygons of the same category because the relevé notes provided useful information about differences in polygons that would be lost if the polygon information was merged. We updated the final map with revised categories for all field-assessed polygons. We also updated polygons that were not explicitly part of the accuracy assessment effort but were shown in the field to be incorrectly classified.

Field methods

We conducted field work from October – November 2016 using an abbreviated form of the rapid assessment protocol developed by the California Native Plant Society (CNPS). In a full rapid assessment, extensive site information and cover estimates of up to 20 species are recorded. In the abbreviated form of this protocol, we estimated cover of up to six dominant species, although we often noted additional unusual or noteworthy species. We used polygon boundaries loaded onto the mobile phone app

“Collector” (produced by ESRI) to determine our location in the field and carried printed maps to take additional notes in the field. Our field maps showed only the polygon boundaries and did not have any information on the original mapped alliances.

When possible, we took geo-tagged photographs from the center of the polygons and walked the extent to assess species cover. Three polygons were assessed using only Google Street view photos, an additional five polygons were assessed only from adjacent roads or trails, and one polygon was assessed after walking through less than 20% of the polygon due to access issues.

We followed the membership rules listed in the Vegetation Classification Manual for Western San Diego County as closely as possible to assign alliances to the accuracy assessment polygons based on cover estimates. Two alliances were listed only in the Manual of California Vegetation (*Juncus (oxymeris, xiphioides)* Provisional Alliance and *Carpobrotus edulis* or Other Ice Plants Herbaceous Semi-Natural Stands).

It was impossible to adequately document cover of the annual grass *Festuca perennis* (formerly *Lolium perenne*) because the accuracy assessment effort took place in the autumn, when only dead stems from the previous year’s growth were visible. In an effort to remain consistent with the previous mapping rules, we classified stands with greater than 15% absolute cover of dead *Festuca perennis* present from the previous growing season as provisional *Festuca perennis* associations of the mapped alliance. The goal is that this might approximate the 30% threshold for live *Festuca perennis* listed in the Vegetation Mapping for TMDL Compliance document. Polygons with previous relevé data indicating *Festuca perennis* cover of 30% or greater consistently across the polygon were also classified as *Festuca perennis* associations. Only two polygons had such high *Festuca perennis* cover and low native vegetation cover documented to be considered “*Festuca perennis* semi-natural stands”. The associations listed as part of this project (*Baccharis salicifolia*/*Festuca perennis* Provisional Association, *Frankenia salina*-*Festuca perennis* Provisional Association, and *Salicornia pacifica*-*Festuca perennis* Provisional Association) are not yet recognized in the Vegetation Classification Manual for Western San Diego County or the Manual of California Vegetation.

Accuracy assessment scoring

Once the field polygons had been assigned final classifications, we performed the accuracy assessment in two ways. We produced a traditional error matrix to calculate the percent accuracy at the alliance level, group, and macrogroup level, and used a “fuzzy logic” system to score the association level accuracy. In the “fuzzy logic” system, we used scores from 0 – 5 to give higher weight to field polygons that were a closer match to the mapped category. The scores were mostly based on a comparison of the hierarchy level, although we also examined the cover of the diagnostic species as assessed in the field. If it seemed reasonable that the discrepancy in classification was due to sampling season (such as the seasonally flooded *Cressa truxillensis* Alliance, which was previously classified as Water), we scored the comparison as being correct. The scoring system is shown in Table 1.

Table 1: Fuzzy logic scoring system adapted from California Native Plant Society

Score	Description
0	Completely wrong life form, minimal ecological similarity
1	Same life-form (e.g, shrub, tree, or herb-grass)
2	Match at three levels up from lowest level classified, usually Macrogroup
3	Match at two levels up from lowest level classified, usually Group
4	Match at one level up from lowest level classified, usually Alliance, or diagnostic species cover within 20% of established threshold
5	Perfect match

Results

We examined a total of 58 polygons from 19 categories, representing 8% of the total polygons across the project area (Table 2). Although we originally intended to allocate field polygons using the thresholds specified earlier, the original mapped classification did not always match the field-assessed classification, resulting in a deviation from the original targeted number of samples. Due to time constraints, we were not able to complete all of the less abundant categories and instead focused our efforts on the more common categories. The full listing of mapping categories, including the hierarchy from macrogroup, group, alliance, and association, is provided in the Appendix.

The overall level of accuracy assessed using the traditional scoring system is 69% at the alliance level , 76% at the group level, and 81% at the macrogroup level (Tables 3-5). There was considerable confusion between *Salicornia pacifica* and *Frankenia salina* alliances. These two species occur in close proximity and visually similar in aerial imagery. Many of the field-assessed polygons had percent cover values of these species close to the threshold values for determining the classification. The process of estimating cover values is somewhat subjective, so some of the discrepancy in classification is likely to be due to inter-observer variation. One of the limitations of the traditional scoring system is that it treats all misclassifications as equal, even though some classifications are more ecologically similar than others. Some of these errors due to misclassification is reduced when comparing the group and macrogroup levels, but since the very similar *Salicornia pacifica* and *Frankenia salina* alliances are organized within different macrogroups, this confusion is still treated as an error at the macrogroup level.

The “fuzzy logic” approach produced an accuracy of 89% at the association level (Table 6). Many of the *Salicornia pacifica* and *Frankenia salina* alliances discrepancies were given high scores in this approach, better representing the reality that these two alliances are quite similar in the field.

There were initially 61 accuracy assessment plots, but three were later removed from the analysis. Polygon number 8 was removed because the initial mapping effort had observed high cover of non-native annual plants, but it was not possible to adequately document those plants during the most recent field assessment conducted in the fall. Polygon 53 was removed because the initial merging procedure resulted in a more heterogenous polygon than should have been assessed in the field, and it was not possible to later separate the percent cover values. Polygon 58 was removed because we were unable to walk through the majority of the polygon due to dense growth of *Rubus* sp., and it was not possible to view the polygon from other vantage points.

Table 2: Count of accuracy assessment polygons and total mapped polygons for each alliance. Mapping categories shown with an asterisk (*) are not formally recognized as alliances in the Manual of California Vegetation (either unvegetated categories or categories at the group rather than alliance level.)

Alliance	Accuracy assessment count	Total count
<i>Ambrosia chamissonis</i> - <i>Abronia maritima</i> Alliance	1	2
<i>Arthrocnemum subterminale</i> Alliance	1	10
<i>Arundo donax</i> Semi-Natural Stands	2	6
<i>Baccharis salicifolia</i> Alliance	3	22
Beach*	0	1
<i>Bolboschoenus maritimus</i> Alliance	0	3
<i>Carpobrotus edulis</i> or Other Ice Plants Semi-Natural Stands	1	2
Channel*	0	5
<i>Cressa truxillensis</i> ... Alliance (seasonal water)	1	4
Developed*	0	20
<i>Distichlis spicata</i> Alliance	0	5
Disturbed*	0	7
<i>Festuca perennis</i> Semi-Natural Stands	0	2
<i>Frankenia salina</i> Alliance	12	82
<i>Isocoma menziesii</i> Alliance	4	23
<i>Juncus (oxymeris, xiphioides)</i> Provisional Alliance	0	1
<i>Juncus acutus</i> Provisional Alliance	1	10
Mediterranean ... Grassland Semi-Natural Stands*	1	1
Mudflat*	2	52
Naturalized ... Riparian and Semi-Natural Stands*	0	7
<i>Platanus racemosa</i> Alliance	1	1
<i>Pluchea sericea</i> Alliance	1	2
<i>Salicornia pacifica (Salicornia depressa)</i> Alliance	5	144
<i>Salix gooddingii</i> Alliance	4	6
<i>Salix lasiolepis</i> Alliance	3	35
Salt panne*	6	69
<i>Schoenoplectus acutus</i> Alliance	0	1
<i>Schoenoplectus americanus</i> Alliance	1	6
<i>Schoenoplectus californicus</i> Alliance	0	4
<i>Typha (angustifolia, domingensis, latifolia)</i> Alliance	8	22
Upland*	0	76
Water*	0	71
Total	58	702

Table 3: Error matrix showing agreement between mapped and ground reference polygons at the alliance level. Mapping categories shown with an asterisk (*) are not formally recognized as alliances in the Manual of California Vegetation (either unvegetated categories or categories at the group rather than alliance level.)

		Ground reference polygons																						
		Ambrosia chamissonis- Arthrocnemum subterminale	Arundo donax Semi- Natural Stands	Baccharis salicifolia Alliance	Carpobrotus edulis ... Stands	Distichlis spicata Alliance	Eucalyptus Semi- Natural Alliance	Frankenia salina Alliance	Isocoma menziesii Alliance	Juncus acutus Provisional Alliance	Mediterranean ... Grassland Stands	Mudflat*	Platanus racemosa Alliance	Pluchea sericea Alliance	Salix gooddingii Alliance	Salix lasiolepis Alliance	Salt Panne*	Salicornia pacifica Alliance	Schoenoplectus americanus Alliance	Schoenoplectus californicus Alliance	Typha Alliance	Water* or Cressa truxillensis	Row sum	User's accuracy
Mapped polygons	Ambrosia chamissonis... Alliance	1																					1	100%
	Arthrocnemum subterminale		1					1															2	50%
	Arundo donax Semi-Natural			2																			2	100%
	Baccharis salicifolia Alliance				3										1								4	75%
	Carpobrotus edulis ... Stands					1																	1	100%
	Distichlis spicata Alliance										1												1	0%
	Eucalyptus Semi-Natural Alliance												1										1	0%
	Frankenia salina Alliance							6						1					3				9	67%
	Isocoma menziesii Alliance								4														4	100%
	Juncus acutus Provisional							1		1													2	50%
	Mediterranean ... Grassland																						0	0%
	Mudflat*												2										2	100%
	Platanus racemosa Alliance																						0	0%
	Pluchea sericea Alliance														1								1	100%
	Salix gooddingii Alliance															1							1	0%
	Salix lasiolepis Alliance															2	3						5	60%
	Salt Panne*																	6	1				7	86%
Salicornia pacifica Alliance							4											1				5	20%	
Schoenoplectus americanus																			1		1	2	50%	
Schoenoplectus californicus																					2	2	0%	
Typha Alliance																					5	5	100%	
Water* or Cressa truxillensis																						1	1	100%
Column sum		1	1	2	3	1	0	12	4	1	1	2	1	1	4	3	6	5	1	0	8	1	40	diagonal
Producer's accuracy		100%	100%	100%	100%	100%	0%	50%	100%	100%	0%	100%	0%	100%	25%	100%	100%	20%	100%	0%	63%	0%	58	total

Overall accuracy: 69%

Table 4: Error matrix showing agreement between mapped and ground reference polygons at the group level.

		Ground reference polygons																	
		Vancouverian/Pacific dune mat	Southwestern N. American introduced riparian scrub	California-Vancouverian semi-natural littoral scrub and herb	Introduced N. American Mediterranean woodland and forest	Southwestern N. American salt basin and high marsh group	Central and south coastal California seral scrub	Mediterranean California naturalized ... grassland	Mudflat*	Sonoran-Coloradan semi-desert wash woodland/scrub	Southwestern N. American riparian ... woodland	Southwestern N. American riparian/wash scrub	Salt Panne*	Temperate Pacific tidal salt and brackish meadow	Southwestern N. American alkali marsh/seep vegetation	Arid West freshwater emergent marsh	Water* or Californian mixed annual/perennial freshwater	Row sum	User's accuracy
Mapped polygons	Vancouverian/Pacific dune mat	1																1	100%
	Southwestern N. American introduced riparian scrub		2															2	100%
	California-Vancouverian semi-natural littoral scrub and herb			1														1	100%
	Introduced N. American Mediterranean woodland and forest									1								1	0%
	Southwestern N. American salt basin and high marsh group					10								3				13	77%
	Central and south coastal California seral scrub						4											4	100%
	Mediterranean California naturalized ... grassland																	0	0%
	Mudflat*								2									2	100%
	Sonoran-Coloradan semi-desert wash woodland/scrub									1								1	100%
	Southwestern N. American riparian ... woodland										1							1	0%
	Southwestern N. American riparian/wash scrub											3	6					9	67%
	Salt Panne*												6	1				7	86%
	Temperate Pacific tidal salt and brackish meadow					4		1						1				6	17%
	Southwestern N. American alkali marsh/seep vegetation														1	1		2	50%
	Arid West freshwater emergent marsh															7		7	100%
	Water* or Californian mixed annual/perennial freshwater vernal																1	1	100%
Column sum		1	2	1	0	14	4	1	2	1	5	6	6	5	1	8	1	44	diagonal
Producer's accuracy		100%	100%	100%	0%	71%	100%	0%	100%	100%	20%	100%	100%	20%	100%	0%	0%	58	total

Overall accuracy: 76%

Table 5: Error matrix showing agreement between mapped and ground reference polygons at the macrogroup level.

		Ground reference polygons														
		Vancouverian Coastal Dune and Bluff	Introduced North American Mediterranean Woodland and	Warm Semi-Desert/Mediterranean Alkali-Saline Wetland	California Coastal Scrub	California Annual and Perennial Grassland	Mudflat*	Madrean Warm Semi-Desert Wash Woodland/Scrub	Southwestern North American Riparian, Flooded and Swamp Forest	Salt Panne*	North American Pacific Coastal Salt Marsh	Western North American Freshwater Marsh	Water* or Western North America Vernal Pool	Row sum	User's accuracy	
Mapped polygons	Vancouverian Coastal Dune and Bluff	2												2	100%	
	Introduced North American Mediterranean Woodland and								1					1	0%	
	Warm Semi-Desert/Mediterranean Alkali-Saline Wetland			11							3	1		15	73%	
	California Coastal Scrub				4									4	100%	
	California Annual and Perennial Grassland													0	0%	
	Mudflat*						2							2	100%	
	Madrean Warm Semi-Desert Wash Woodland/Scrub							1						1	100%	
	Southwestern North American Riparian, Flooded and Swamp								12					12	100%	
	Salt Panne*									6	1			7	86%	
	North American Pacific Coastal Salt Marsh			4		1					1			6	17%	
	Western North American Freshwater Marsh											7		7	100%	
	Water* or Western North America Vernal Pool												1	1	100%	
	Column sum		2	0	15	4	1	2	1	13	6	5	8	1	47	diagonal
Producer's accuracy		100%	0%	73%	100%	0%	100%	100%	92%	100%	20%	0%	0%	58	total	

Overall accuracy: 81%

Table 6: Fuzzy logic scores for each accuracy assessment polygon. Numbers showed in grey were not considered as part of the final score due to issues encountered during the analysis.

Accuracy assessment			
ID	Original association	Ground reference association	Score
1	Frankenia salina-Festuca perennis Provisional Association	Frankenia salina Alliance*	5
2	Salicornia pacifica-Frankenia salina Association	Frankenia salina Alliance*	4
3	Frankenia salina Alliance*	Frankenia salina-Festuca perennis Provisional Association	5
4	Frankenia salina Alliance*	Salicornia pacifica-Frankenia salina Association	4
5	Baccharis salicifolia Association	Baccharis salicifolia Association	5
6	Frankenia salina-Festuca perennis Provisional Association	Salicornia pacifica-Festuca perennis Provisional Association	4
7	Salicornia pacifica-Frankenia salina Association	Frankenia salina Alliance*	1
8			
9	Salt Panne*	Salt panne*	5
10	Salt Panne*	Salt panne*	5
11	Frankenia salina Alliance*	Frankenia salina Alliance*	5
12	Salicornia pacifica-Frankenia salina Association	Frankenia salina Alliance*	4
13	Frankenia salina-Festuca perennis Provisional Association	Frankenia salina-Festuca perennis Provisional Association	5
14	Isocoma menziesii Provisional Association	Isocoma menziesii Provisional Association	5
15	Salicornia pacifica Association	Frankenia salina Alliance*	4
16	Salix gooddingii Association	Salix gooddingii Association	5
17	Schoenoplectus americanus Association	Schoenoplectus americanus Association	5
18	Frankenia salina Alliance*	Frankenia salina Alliance*	5
19	Isocoma menziesii/Distichlis spicata Association	Isocoma menziesii/Distichlis spicata Association	5
20	Salix lasiolepis Association	Salix lasiolepis Association	5
21	Salix lasiolepis Association	Salix lasiolepis Association	5
22	Salt Panne*	Salt panne*	5
23	Typha (angustifolia, domingensis, latifolia) Alliance*	Typha (angustifolia, domingensis, latifolia) Alliance*	5
24	Salix lasiolepis Association	Salix gooddingii Association	4
25	Water*	Cressa truxillensis Provisional Association (seasonal water)	5
26	Typha (angustifolia, domingensis, latifolia) Alliance*	Typha (angustifolia, domingensis, latifolia) Alliance*	5
27	Baccharis salicifolia Association	Salix gooddingii Association	4

Accuracy assessment			
ID	Original association	Ground reference association	Score
28	Isocoma menziesii Provisional Association	Isocoma menziesii Provisional Association	5
29	Isocoma menziesii/Distichlis spicata Association	Isocoma menziesii/Distichlis spicata Association	5
30	Schoenoplectus californicus Association	Typha (angustifolia, domingensis, latifolia) Alliance*	4
31	Typha (angustifolia, domingensis, latifolia) Alliance*	Typha (angustifolia, domingensis, latifolia) Alliance*	5
32	Salt Panne*	Salt panne*	5
33	Schoenoplectus americanus Association	Typha (angustifolia, domingensis, latifolia) Alliance*	4
34	Salicornia pacifica-Festuca perennis Provisional Association	Salicornia pacifica-Festuca perennis Provisional Association	5
35	Salt Panne*	Salicornia pacifica Association	4
36	Arthrocnemum subterminale Association	Arthrocnemum subterminale-Salicornia pacifica Association	5
37	Frankenia salina-Festuca perennis Provisional Association	Frankenia salina Alliance*	5
38	Baccharis salicifolia Association	Baccharis salicifolia/Festuca perennis Provisional Association	5
39	Baccharis salicifolia Association	Baccharis salicifolia/Festuca perennis Provisional Association	5
40	Salix lasiolepis Association	Salix gooddingii Association	2
41	Carpobrotus edulis or Other Ice Plants Semi-Natural Stands*	Carpobrotus edulis or Other Ice Plants Semi-Natural Stands*	5
42	Arundo donax Semi-Natural Stands	Arundo donax Semi-Natural Stands*	5
43	Arundo donax Semi-Natural Stands	Arundo donax Semi-Natural Stands*	5
44	Typha (angustifolia, domingensis, latifolia) Alliance*	Typha (angustifolia, domingensis, latifolia) Alliance*	5
45	Mudflat*	Mudflat*	5
46	Mudflat*	Mudflat*	5
47	Salt Panne*	Salt panne*	5
48	Salt Panne*	Salt panne*	5
49	Eucalyptus (globulus, camaldulensis) Semi-Natural Alliance*	Platanus racemosa-Populus fremontii... Association	1
50	Juncus acutus Provisional Association	Juncus acutus Provisional Association	5
51	Ambrosia chamissonis... Association	Ambrosia chamissonis-Abronia maritima... Association	5
52	Juncus acutus Provisional Association	Frankenia salina-Distichlis spicata Association	3
53			
54	Frankenia salina-Distichlis spicata Association	Salicornia pacifica-Frankenia salina Association	4
55	Arthrocnemum subterminale- Salicornia pacifica Association	Frankenia salina-Distichlis spicata Association	3
56	Pluchea sericea Association	Pluchea sericea Association	5

Accuracy assessment			
ID	Original association	Ground reference association	Score
57	Typha (angustifolia, domingensis, latifolia) Alliance*	Typha (angustifolia, domingensis, latifolia) Alliance*	5
58			
59	Salix lasiolepis Association	Salix lasiolepis Association	5
60	Distichlis spicata-Annual Grasses Association	Mediterranean ... Grassland Semi-Natural Stands*	1
61	Schoenoplectus californicus Association	Typha (angustifolia, domingensis, latifolia) Alliance*	4
Overall accuracy:			89%

Appendix: Classification Hierarchy

Macrogroup

Group

Alliance

Association

California Coastal Scrub

Central and south coastal California seral scrub

Isocoma menziesii Alliance

Isocoma menziesii Provisional Association

Isocoma menziesii/Distichlis spicata Association

California Annual and Perennial Grassland

Mediterranean California naturalized annual and perennial grassland

Festuca perennis Semi-Natural Stands

Festuca perennis Semi-Natural Stand Type

Madrean Warm Semi-Desert Wash Woodland/Scrub

Sonoran-Coloradan semi-desert wash woodland/scrub

Pluchea sericea Alliance

Pluchea sericea Association

Southwestern North American Riparian, Flooded and Swamp Forest

Southwestern North American introduced riparian scrub

Arundo donax Semi-Natural Stands

Southwestern North American riparian evergreen and deciduous woodland

Platanus racemosa Alliance

Platanus racemosa-Populus fremontii/Salix lasiolepis Association

Salix gooddingii Alliance

Salix gooddingii Association

Southwestern North American riparian/wash scrub

Baccharis salicifolia Alliance

Baccharis salicifolia Association

Baccharis salicifolia/Festuca perennis Provisional Association

Salix lasiolepis Alliance

Salix lasiolepis Association

North American Pacific Coastal Salt Marsh

Temperate Pacific tidal salt and brackish meadow

Bolboschoenus maritimus Alliance

Bolboschoenus maritimus Association

Distichlis spicata Alliance

Distichlis spicata-Annual Grasses Association

Salicornia pacifica (Salicornia depressa) Alliance

Salicornia pacifica Association

Salicornia pacifica-Festuca perennis Provisional Association

Salicornia pacifica-Frankenia salina Association

Salicornia pacifica-Jaumea carnosa Association

Salicornia pacifica-Jaumea carnosa-Frankenia salina

Warm Semi-Desert/Mediterranean Alkali-Saline Wetland

Southwestern North American salt basin and high marsh group

- Arthrocnemum subterminale Alliance

 - Arthrocnemum subterminale Association

 - Arthrocnemum subterminale-Salicornia pacifica Association

- Frankenia salina Alliance

 - Frankenia salina-Distichlis spicata Association

 - Frankenia salina-Festuca perennis Provisional Association

- Juncus acutus Provisional Alliance*

 - Juncus acutus Provisional Association

 - Juncus acutus-Jaumea carnosa Provisional Association

Southwestern North American alkali marsh/seep vegetation

- Schoenoplectus americanus Alliance

 - Schoenoplectus americanus Association

Western North America Vernal Pool

Californian mixed annual/perennial freshwater vernal pool / swale bottomland

- Cressa truxillensis-Distichlis spicata Alliance

 - Cressa truxillensis Provisional Association

Western North American Freshwater Marsh

Arid West freshwater emergent marsh

- Schoenoplectus acutus Alliance

 - Schoenoplectus acutus Association

- Schoenoplectus californicus Alliance

 - Schoenoplectus californicus Association

- Typha (angustifolia, domingensis, latifolia) Alliance

Western North America Wet Meadow and Low Shrub Carr

Naturalized warm-temperate riparian and wetland group

- Naturalized Warm-Temperate Riparian and Wetland Semi-Natural Stands

Californian warm temperate marsh/seep

- Juncus (oxymetris, xiphioides) Provisional Alliance

 - Juncus xiphioides Provisional Association

Vancouverian Coastal Dune and Bluff

California-Vancouverian semi-natural littoral scrub and herb vegetation

- Carpobrotus edulis or Other Ice Plants Herbaceous Semi-Natural Stands

Vancouverian/Pacific dune mat

- Ambrosia chamissonis-Abronia maritima Alliance

 - Ambrosia chamissonis-Abronia maritima-Cakile maritima Association

Other mapping units

- Beach

- Channel

- Developed

- Disturbed

- Mudflat

- Salt panne

- Upland

- Water