The Vegetation of Suisun Marsh, Solano County, California: Permanent Plot Resample Study 1999, 2006, 2012

Prepared by

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Introduction

In 1999 the DFG Vegetation Classification and Mapping program identified 198 vegetation sampling plot locations within the Suisun Marsh to be surveyed in order to create a vegetation classification to support the Suisun Marsh triennial vegetation map, as well as to establish baseline vegetation data that can be monitored over time (Keeler-Wolf and Vaghti, 2000). Since then, some portion of the established plots has been resampled every 6 years. In 2006, 98 out of the 198 plots were resampled and compared to the 1999 plot data to determine changes. The documents reporting those findings can be obtained from the California Department of Fish and Wildlife document library (http://www.dfg.ca.gov/biogeodata/vegcamp/veg_classification_reports_maps.asp).

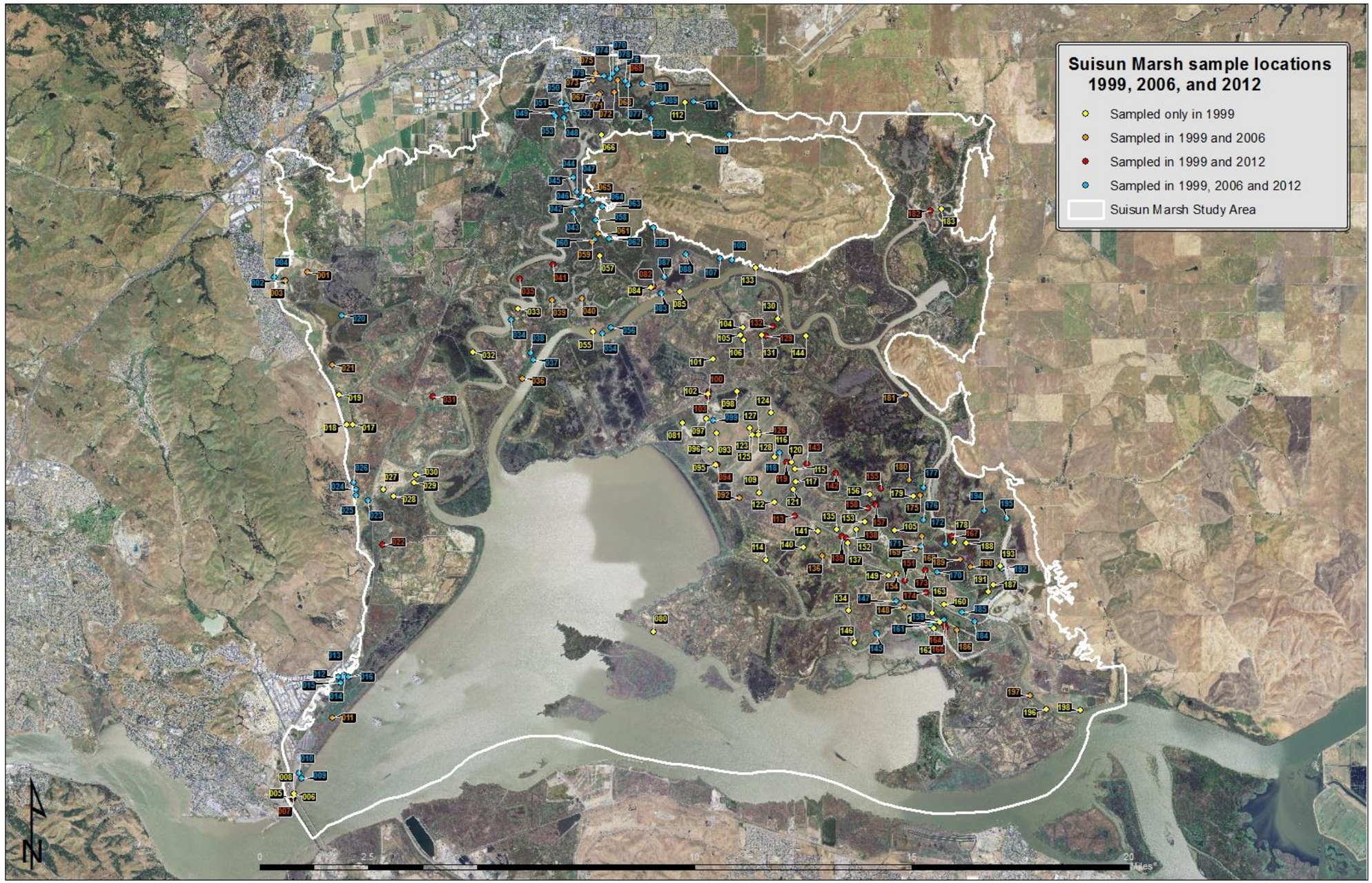
The purpose of this report is to document the methods and findings from the 2012 resampling of 98 of the original 198 vegetation sampling plots within Suisun Marsh and to show the trends of changes in the vegetation from 1999 to 2012 within those plots.

Methods

Plots sampled

Of the original 198 plots from 1999, 98 were resampled in 2012. Sixty-nine of those plots were also sampled in 2006, while 29 were previously only sampled in 1999 (Figure 1: The location of the 198 Suisun Marsh vegetation sampling plots). Plots were chosen for resampling based on a combination of accessibility, distribution across the marsh, number of times sampled prior to 2012, and previous vegetation type. While most of the plots resampled were located on public lands (92 plots), 6 plots were on private lands and had not been resampled since 1999.

Figure 1: The location of the 198 Suisun Marsh vegetation sampling plots.



Timing

All 98 plots were sampled within a three month span between July and September of 2012. Plots were usually sampled by crews of 2 and typically took between two and four hours to relocate, set up, and resample. It took 624 person hours to resample the 98 plots in 2012 (see figure below), which averages to about 3 hours per plot per crew. To maximize the field season and to aid in the 2012 vegetation remap, an additional 9 crew days (144 hours) were spent collecting reconnaissance data, totaling 768 person hours required to complete the field work for this project.

Month	Person Hours		**Total**
	Plot Resample	Reconnaissance	
July	496		**496**
August	80	144	**224**
September	48		**48**
Total	**624**	**144**	**768**

Plot relocation methods

Survey locations were navigated to using the original 1999 Global Positioning System (GPS) points and further refined using plot descriptions and field photos from 1999 and 2006. In 1999 the position from which the GPS point was taken within the plot was not specified nor was the orientation of the square and rectangular plots. In 2006, for the 98 plots that were resampled this was somewhat mitigated for by stating which corner the GPS point was taken from (usually the SW corner) and by describing the orientation of the rectangular plots (e.g. the long side is oriented north-south). However, in 2012, there were still some difficulties relocating the 69 plots that were previously sampled in 2006 and, of course, even more difficulties in relocating the 29 plots that had not been sampled since 1999.

Since 2006 our protocol now includes several standards that make plot relocation much easier. 1) The GPS point is always taken from the southwest corner of the plot. If for some reason this is not possible, the location of the point must be explicitly recorded on the datasheet. 2) From the SW corner (= the GPS point location), looking towards the plot, the bearing of the axis to the left is recorded. 3) If the plot is a rectangle, the recorder shall indicate whether the left side of the plot is the long or short side of the rectangle. These three pieces of data provide the exact location of the point as well as the orientation of the plot.

Plot sampling methods

As in 1999 and 2006, a modified California Native Plant Society/Department of Fish and Game relevé vegetation sampling field form and protocol was used. This is a plot-based sampling protocol adapted specifically for the Suisun Marsh vegetation sampling effort. Due to improvements in our understanding of vegetation sampling, monitoring, and relocation of plots some slight changes were made to the form and protocol since 2006.

The original 1999 plots were located based on stand homogeneity and were thought to represent the larger stand of a particular type. However, with the combination of management-induced changes such

as varying flooding, mechanical manipulation (disking, ditching, etc.), burning, or seeding of certain desirable species, the original stands may have changed internally, which could lead to the location of the plots currently not within homogeneous patches of vegetation. However, with resampling, even if the stand boundaries had shifted from the original sample, the plot location was kept the same, and additional notes were taken describing the types of shifts.

Estimates of percent cover were required for all species greater than or equal to 1 percent cover; if less than 1 percent cover, cover was noted as "less than 1 percent." Additional estimates for total vegetation cover, and total tree, shrub and herb covers are included (this differs from the 1999 and 2006 protocol that collected cover estimates for tall, medium, and low vegetation). A separate entry for non-native cover was noted to help with assessing impacts of invasive species.

As with plant species, the percent cover for open water, bedrock, cobble, stone, gravel, bare ground (or "fines") and litter were also estimated for each plot.

Appendix A contains a sample field form and the full sampling protocol used in 2012 and Appendix B contains a sample field form and sampling protocol used in 1999 and 2006.

Results and Discussion

Vegetation Types Changes (Table 1)

The 98 plots that were sampled in 2012 represent 40 vegetation associations within 25 vegetation alliances. The same plots in 1999 encompassed 51 vegetation associations within 30 vegetation alliances. This reduction in vegetation types is likely due a simplification in the vegetation classification since 1999 as a result of our increasing knowledge of the vegetation. Between 1999 and 2012 30.6% (30 plots) of the 98 plots maintained the same alliance and association and 51% (50 plots) remained the same at the alliance level.

Of the 98 plots that were sampled in 2012, 6 of them are now heterogeneous plots consisting of two or more vegetation types, two plots are not keyable due a species composition that does not typically repeat and one plot is now an unpaved parking lot. Plots that are characterized by *Salicornia pacifica* have increased from 16 plots in 1999 to 26 plots in 2012.

Of the 69 plots that were sampled all three years, 27.5% (19 plots) remained the same vegetation type at the alliance and association level and 47.8% (33 plots) stayed stable at the alliance level all three years. Between 2006 and 2012, 46.4% (32 plots) of the 69 plots remained stable at the alliance and association level and 59.4% (41 plots) remained within the same alliance. Those plots that are characterized by *Phragmites australis* increased from 1 plot in 1999 to 2 plots in 2006 to 6 plots in 2012.

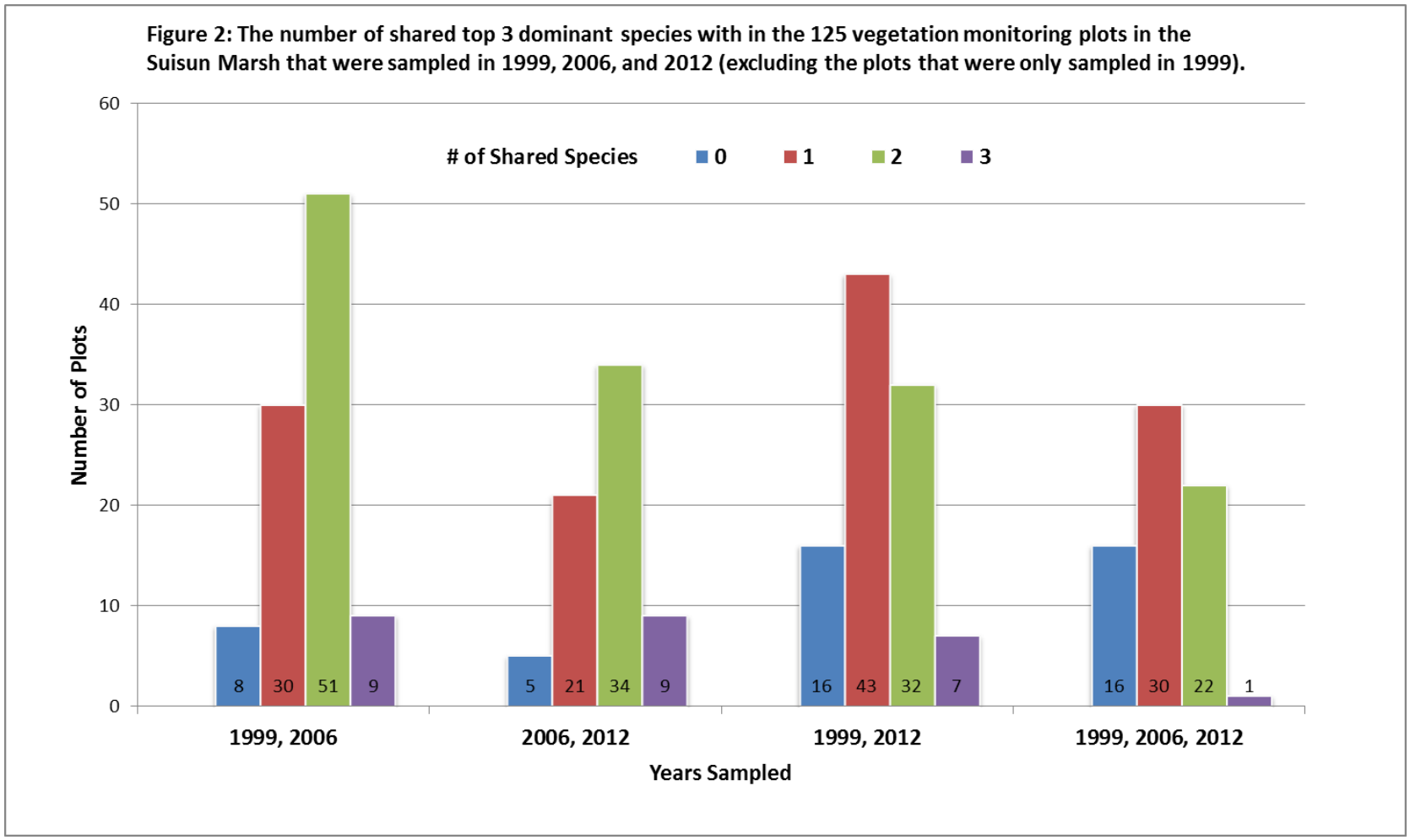
Species Dominance Changes (Figure 2 and Table 2)

While analysis of the keyed vegetation type is useful in determining major shifts in vegetation, it is also useful to look at shifts in species dominance over time in order to tease out minor shifts in species composition that can lead to big shifts in the future. Of the 69 plots that were sampled all three years, only one (plot 024) shared the same top three species, 16 plots had no overlap in dominant species, 30

plots had 1 shared dominant species, and 22 plots had 2 shared dominant species (Figure 2 and Table 2). Plot 037 shows an alarming progression of *Phragmites australis*[1] invasion from 1999 to 2012, where it was not even a component of the species composition in 1999 and then in 2006 it was already the most abundant species (27% relative cover), and in 2012 it had more than doubled in cover since 2006 to 83.3% relative cover (Table 2). Plot 090 shows a similar trend with *Phragmites australis* increasing from to 0% in 1999, to 6.9% relative cover in 2006, and to 14.9% relative cover in 2012 (Table 2).

[1] Although the native genotype of *Phragmites australis* is present in the marsh, is it not common; instead, a non-native genotype, which is more vigorous and grows in much denser stands, is now the prevalent genotype in Suisun Marsh.

Figure 2: Shared dominant species



Use of Wetland Indicator Species to Identify Trends (Table 3, Table 4, and Table 5)

One of the predicted long range values of the vegetation monitoring beyond tracking the extent and quality of habitat for the listed species covered under the Suisun Marsh Triennial Vegetation Survey is the tracking of the changes and specific impacts of expected sea level rise. If the predictions of higher mean sea level are correct, we should eventually be able to see some effects in the trends of vegetation shift over time since the first plots were established in 1999.

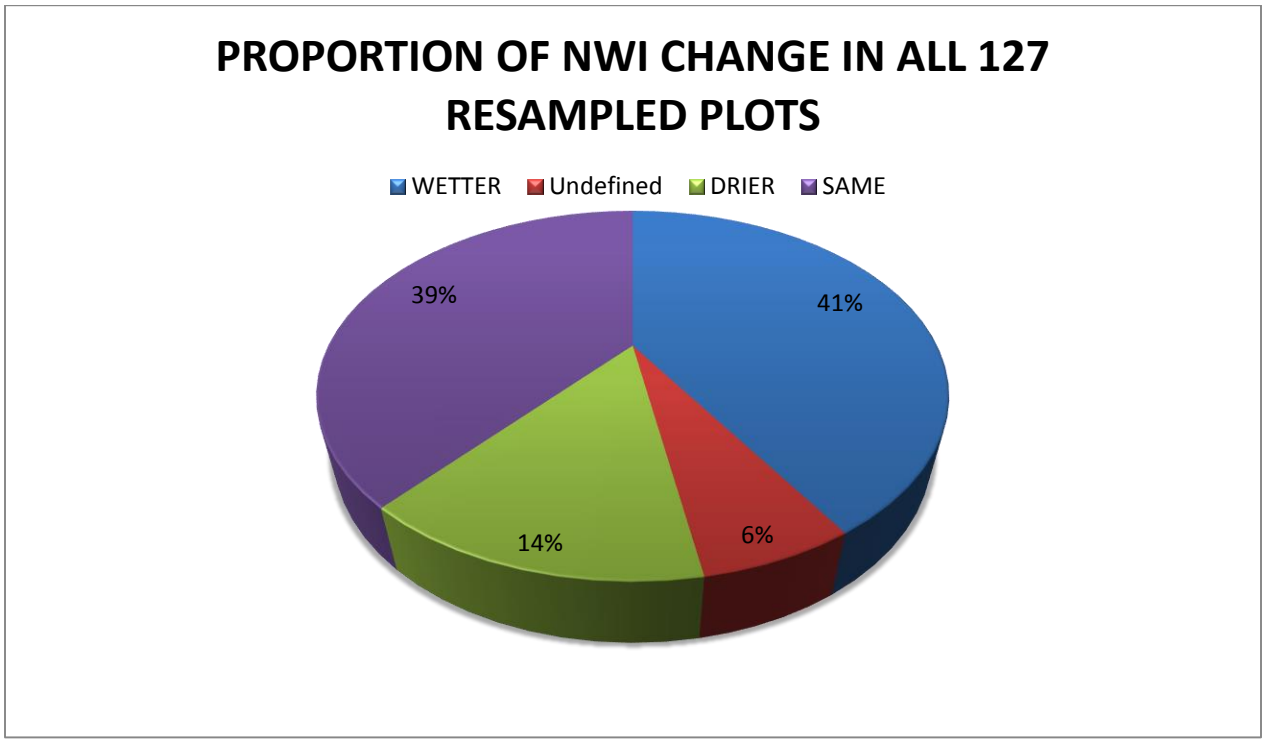
Field data should reflect this predicted trend more accurately and precisely than mapping using vegetation labels. This is because the field re-samples collect data on continuous % cover of all species located in the sample plot, as opposed to type and generalized cover class estimate by stratum as is recorded in each mapping polygon. The relative cover of different species indicative of different ranges and types of moisture tolerance should shift in a directional way. For example, in portions of the upper marsh near its inland edge, dryland species would be expected from the early sample dates to be shifting to proportionally more obligate wetland species as sea level rises over time.

National Wetland Indicator Status is standardized by a review panel of wetland ecologists who apply a scale of wetland staturation to all vascular plant species in each of the 10 separate USFWS National Regions. Standardized criteria are applied to each species based on their estimated proportion of the time each would be expected in wetlands (Table 3).

Each of the 104 species identified in the 125 resampled monitoring plots was assigned its wetland indicator status code for California. A color code shows its relative “wetness” to relative “dryness” (blue-wet, to orange-dry upland , see Table 4). If we use the same relative cover of the top 3 species per plot as depicted in Table 2, but code each of the species by its National Wetland Indicator status, it may be possible to display changes in wetland species dominance over the 3 sample years (‘99, ‘06, and ’12).

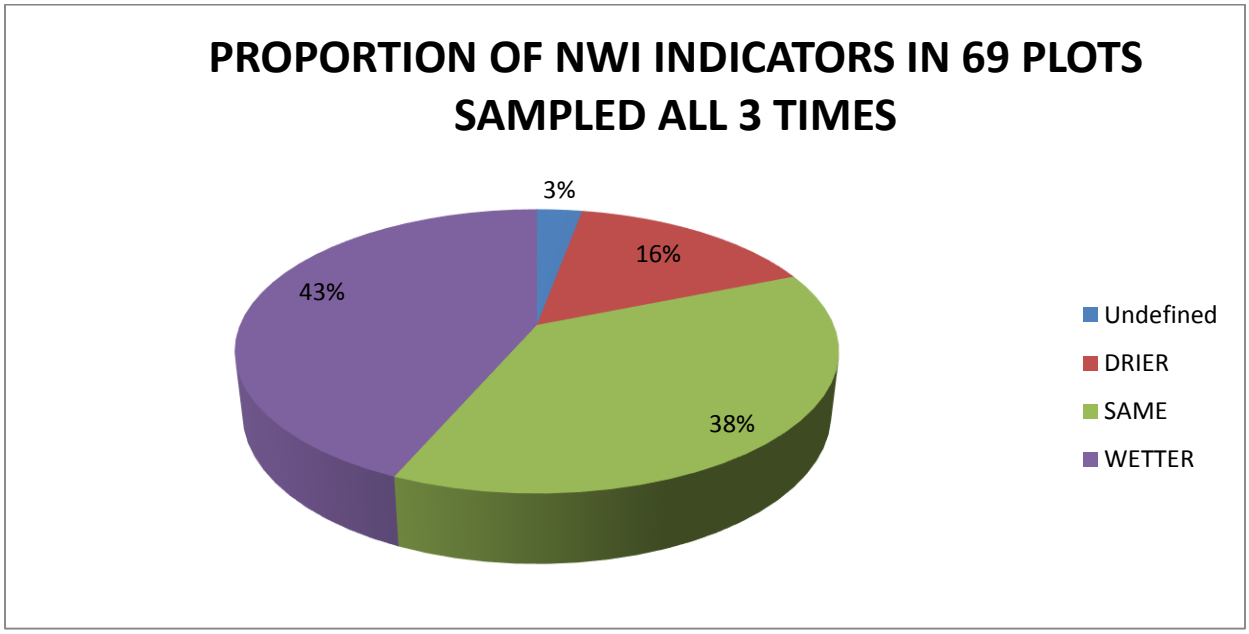
Of the 127 plots resampled at least once, the largest percentage of them changed to become relatively wetter, as indicated by the higher proportion of wetland obligate or facultative species in the top 4 categories in Table 2 (OBL, FAW, and FAC) (Figure 3).

Figure 3: A pie chart showing the percentage the 127 plots that were resampled at least once that have become drier, wetter or stayed the same since 1999.



The most reliable trend analysis can be done with the plots sampled in all three years. When only the 69 plots that were sampled all three times are displayed, the trend toward higher representation of wetter plots (indicated by the proportion of species more restricted to wetlands) is even more pronounced (Figure 4).

Figure 4: Pie chart showing the proportion of the 69 Suisun Marsh plots that were sampled all three years (1999, 2006, and 2012) that have become drier, wetter or stayed the same since 1999.



In this case only about 16% trended drier, while almost 50% trended toward greater representation of wetland species.

Some preliminary GIS exploratory analysis was undertaken to investigate possible trends explaining the apparent increase in wetland species. Due to the complex relationship between sea level shift and management of water regimes throughout much of the marsh, trends remain difficult to ascertain. This is understandable for several reasons:

- The expert-driven ranking of NWI values of the plant taxa may or may not accurately reflect the local plant species true tolerance of different moisture conditions
- The flooding regimes in various parts of the marsh, including interval, depth, and duration of flooding, are strongly controlled by individual management objectives
- The variations in true tidal regime and in ambient rainfall patterns over the past 13 years inject sufficient uncertainty as to make recognition of trends difficult.

Based on the three intervals measured so far, it remains to be seen if the trend toward wetter vs. drier or static conditions goes beyond managed conditions. The most likely direct effects will be first seen by focusing on unmanaged tidal marsh plots, and potentially intensifying the revisitation of more of these plots, over the long term.

Non-Native Species Comparison (Table 6 and Table 7)

Table 6: Relative non-native cover

Of the 69 plots that were sampled all three years, 30 plots showed an increase in relative exotic cover from 1999 to 2012 (averaging a 19% increase in relative cover), 4 of which showed a relative increase of more than 50% cover. On the other hand, 4 of the 29 plots showed a decrease of 50% or more relative exotic cover. 10 of the 69 plots showed only a minimal (<1%) change in relative exotic cover. Since 1999 the mean relative non-native cover over the 69 plots had remained relatively stable decreasing by 2.2%.

Table 7: A summary of the non-native species

Of the 51 dominant non-native species (top three exotics per plot) that were present in the 69 plots that were sampled all three years, 23 of the species increased in the number of plots that they occurred in, while 16 species decreased in plot occurrences and 12 species occurred in the same number of plots. *Phragmites australis* showed the greatest increase in the number of plot occurrences, increasing from 3 plots in 1999 to 13 in 2012 with an average relative cover increasing by more than 8% relative cover over the 69 plots. *Atriplex prostrata*, *Lepidium latifolium*, and *Phragmites australis* were the most ubiquitous non-native species across the 69 plots, occurring in 31, 15, and 13 plots respectively in 2012. From 1999 to 2012, 16 of the 51 non-native species increased in average relative cover, 23 decreased, and 12 of the species had a less than 1% increase or decrease in average relative cover. *Taeniatherum caput-medusae, Elytrigia pontica,* and *Salsola soda* showed the greatest increase in average relative cover over the 69 plots, while *Rubus armeniacus, Agrostis avenacea* and *Conium maculatum* showed the greatest decrease in average relative cover.

Tables

Table 1: Vegetation Type Comparison

The keyed vegetation type for each of the Suisun Marsh vegetation monitoring plots for each sampling year. The table excludes the plots that were only sampled in 1999. The plots that are highlighted in yellow remained the same at the alliance and association level all 3 years. The plots highlighted in orange remained the same only at the alliance level all three years. Plots highlighted in light green are plots sampled in 1999 and only resampled in 2012 where the type stayed the same at the alliance and association level. Plots highlighted in dark green are plots sampled in 1999 and only resampled in 2012 where the type changed at the association level but stayed the same at the alliance level. Blue text indicates that the vegetation has shifted to a wetter type and orange texts indicates that the vegetation has shifted to a drier type.

	1999		2006		2012	
PlotID	**Alliance**	**Association**	**Alliance**	**Association**	**Alliance**	**Association**
001	Schoenoplectus californicus	Schoenoplectus californicus-Typha angustifolia	Schoenoplectus acutus	Schoenoplectus acutus-Typha angustifolia	N/A	
002	Bolboschoenus maritimus	Bolboschoenus maritimus-Salicornia pacifica	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia)-Distichlis spicata
003	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia)-Distichlis spicata	N/A	
004	Salix gooddingii	Salix gooddingii	Salix gooddingii	Salix gooddingii	Salix gooddingii	Salix gooddingii
007	Spartina foliosa	Spartina foliosa	N/A		Schoenoplectus californicus	Schoenoplectus californicus
009	Schoenoplectus californicus	Schoenoplectus californicus	Schoenoplectus californicus	Schoenoplectus californicus	Schoenoplectus californicus	Schoenoplectus californicus
010	Phragmites australis	Phragmites australis	Phragmites australis	Phragmites australis	Phragmites australis	Phragmites australis
011	Phragmites australis	Phragmites australis	Open Water	Open Water	N/A	
012	Salix laevigata	Salix laevigata-Salix lasiolepis	Salix laevigata	Salix laevigata-Salix lasiolepis	Salix laevigata	Salix laevigata
013	Centaurea (solstitialis, melitensis)	Centaurea solstitialis	Centaurea (solstitialis, melitensis)	Centaurea solstitialis	Leymus triticoides	Leymus triticoides

PlotID	1999		2006		2012	
	Alliance	**Association**	**Alliance**	**Association**	**Alliance**	**Association**
014	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)
015	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	Phragmites australis	Phragmites australis
016	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Annual Grasses (Polypogon, Hordeum, Lolium)	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata
020	Bolboschoenus maritimus	Bolboschoenus maritimus	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	Multiple Types	Multiple Types
021	Bolboschoenus maritimus	Bolboschoenus maritimus-Salicornia pacifica	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	N/A	
022	Bolboschoenus maritimus	Bolboschoenus maritimus-Salicornia pacifica	N/A		Bolboschoenus maritimus	Bolboschoenus maritimus
023	Atriplex prostrata-Cotula coronopifolia	Atriplex prostrata-Distichlis spicata	Schoenoplectus americanus	Schoenoplectus americanus-Distichlis spicata (provisional)	Phragmites australis	Phragmites australis
024	Distichlis spicata	Distichlis spicata-Atriplex prostrata	Distichlis spicata	Distichlis spicata-Salicornia pacifica	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata
025	Festuca perennis	Festuca perennis	Festuca perennis	Festuca perennis	Parking Lot	Parking Lot
026	Distichlis spicata	Distichlis spicata-Cotula coronopifolia	Distichlis spicata	Distichlis spicata-Salicornia pacifica	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata
031	Bolboschoenus maritimus	Bolboschoenus maritimus-Salicornia pacifica	N/A		Bolboschoenus maritimus	Bolboschoenus maritimus
034	Rubus armeniacus	Rubus armeniacus	Rubus armeniacus	Rubus armeniacus	Rubus armeniacus	Rubus armeniacus

PlotID	1999		2006		2012	
	Alliance	**Association**	**Alliance**	**Association**	**Alliance**	**Association**
035	Atriplex prostrata-Cotula coronopifolia	Atriplex prostrata-Distichlis spicata	N/A		Bolboschoenus maritimus	Bolboschoenus maritimus-Salicornia pacifica
036	Persicaria lapathifolia-Xanthium strumarium	Alliance Only	Distichlis spicata	Distichlis spicata-Annual Grasses	N/A	
037	Atriplex prostrata-Cotula coronopifolia	Cotula coronopifolia	Atriplex prostrata-Cotula coronopifolia	Cotula coronopifolia	Phragmites australis	Phragmites australis
038	Atriplex prostrata-Cotula coronopifolia	Atriplex prostrata-Bolboschoenus maritimus	Bolboschoenus maritimus	Bolboschoenus maritimus-Salicornia pacifica	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Bolboschoenus maritimus
039	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Atriplex prostrata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Sesuvium verrucosum	N/A	
040	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Sesuvium verrucosum	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Sesuvium verrucosum	N/A	
041	Juncus arcticus (var. balticus, mexicanus)	Juncus arcticus var. balticus-Lepidium latifolium	N/A		Juncus arcticus (var. balticus, mexicanus)	Juncus arcticus var. balticus-Lepidium latifolium
042	Distichlis spicata	Distichlis spicata-Juncus balticus-Triglochin maritima	Sarcocornia pacifica (Salicornia depressa)	Salicornia pacifica-Distichlis spicata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica
043	Distichlis spicata	Distichlis spicata-Juncus arcticus var. balticus (J. arcticus var. mexicanus)	Distichlis spicata	Distichlis spicata-Juncus balticus-Triglochin maritima	Distichlis spicata	Distichlis spicata-Juncus balticus-Triglochin maritima
044	Rubus armeniacus	Rubus armeniacus	Rubus armeniacus	Rubus armeniacus	Rubus armeniacus	Rubus armeniacus
045	Schoenoplectus acutus	Schoenoplectus acutus-Typha angustifolia	Schoenoplectus acutus	Schoenoplectus acutus-Typha angustifolia	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia,

PlotID	1999		2006		2012	
	Alliance	**Association**	**Alliance**	**Association**	**Alliance**	**Association**
						domingensis)
046	Distichlis spicata	Distichlis spicata-Juncus balticus-Triglochin maritima	Distichlis spicata	Distichlis spicata-Juncus balticus-Triglochin maritima	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata
047	Distichlis spicata	Distichlis spicata-Juncus balticus-Triglochin maritima	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata
048	Schoenoplectus americanus	Schoenoplectus americanus-Potentilla anserina	Schoenoplectus americanus	Schoenoplectus americanus-Potentilla anserina	Schoenoplectus americanus	Schoenoplectus americanus-Potentilla anserina
049	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)-Schoenoplectus americanus	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)-Schoenoplectus americanus
050	Sesuvium verrucosum	Sesuvium verrucosum	Sesuvium verrucosum	Sesuvium verrucosum	Sesuvium verrucosum	Sesuvium verrucosum
051	Schoenoplectus californicus	Schoenoplectus californicus	Schoenoplectus acutus	Schoenoplectus acutus	Schoenoplectus californicus	Schoenoplectus californicus
052	Baccharis pilularis	Baccharis pilularis/Annual Grasses-herb	Baccharis pilularis	Baccharis pilularis/Annual Grasses-herb	Baccharis pilularis	Baccharis pilularis/Annual Grasses-herb
053	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata
054	Rosa californica	Rosa californica-Baccharis pilularis	Rosa californica	Rosa californica-Baccharis pilularis	Rosa californica	Rosa californica-Baccharis pilularis
056	Distichlis spicata	Distichlis spicata-Annual Grasses	Distichlis spicata	Distichlis spicata-Annual Grasses	Frankenia salina	Frankenia salina-Distichlis spicata

PlotID	1999		2006		2012	
	Alliance	**Association**	**Alliance**	**Association**	**Alliance**	**Association**
058	Bromus (diandrus, hordeaceus)-Brachypodium distachyon	Alliance Only	Distichlis spicata	Distichlis spicata-Annual Grasses	Distichlis spicata	Distichlis spicata-Annual Grasses
059	Distichlis spicata	Distichlis spicata-Salicornia pacifica	Distichlis spicata	Distichlis spicata-Salicornia pacifica	N/A	
060	Lepidium latifolium	Lepidium latifolium-Distichlis spicata	Lepidium latifolium	Lepidium latifolium-Distichlis spicata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Distichlis spicata
061	Distichlis spicata	Distichlis spicata-Annual Grasses	Distichlis spicata	Distichlis spicata-Sarcocornia pacifica	N/A	
062	Leymus triticoides	Leymus triticoides	Leymus triticoides	Leymus triticoides	Leymus triticoides	Leymus triticoides
063	Schoenoplectus americanus	Schoenoplectus americanus	Schoenoplectus americanus	Schoenoplectus americanus-Lepidium latifolium	Schoenoplectus americanus	Schoenoplectus americanus-Lepidium latifolium
064	Distichlis spicata	Distichlis spicata-Juncus balticus-Triglochin maritima	Distichlis spicata	Distichlis spicata-Juncus balticus-Triglochin maritima	Distichlis spicata	Distichlis spicata-Juncus balticus-Triglochin maritima
065	Leymus triticoides	Leymus triticoides	Leymus triticoides	Leymus triticoides	N/A	
067	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	N/A	
068	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Annual Grasses (Polypogon, Hordeum, Lolium)	Distichlis spicata	Distichlis spicata-Annual Grasses	N/A	
069	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Annual Grasses (Polypogon, Hordeum, Lolium)	N/A		Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica
070	Festuca perennis	Festuca perennis	Festuca perennis	Festuca perennis	Festuca perennis	Festuca perennis

PlotID	1999		2006		2012	
	Alliance	Association	Alliance	Association	Alliance	Association
071	Distichlis spicata	Distichlis spicata-Juncus arcticus var. balticus (J. arcticus var. mexicanus)	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	N/A	
072	Schoenoplectus americanus	Schoenoplectus americanus	Schoenoplectus americanus	Schoenoplectus americanus	N/A	
073	Distichlis spicata	Distichlis spicata-Juncus arcticus var. balticus (J. arcticus var. mexicanus)	Schoenoplectus americanus	Schoenoplectus americanus	N/A	
074	Frankenia salina	Frankenia salina	Frankenia salina	Frankenia salina	Frankenia salina	Frankenia salina
075	Frankenia salina	Frankenia salina-Distichlis spicata	Distichlis spicata	Distichlis spicata-Atriplex prostrata	N/A	
076	Festuca perennis	Festuca perennis	Lotus corniculatus (Provisional)	Alliance Only	Multiple Types	Multiple Types
077	Festuca perennis	Festuca perennis	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica
078	Grindelia (stricta)	Alliance Only	Lepidium latifolium	Alliance Only	Not keyable	Not keyable
079	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Annual Grasses (Polypogon, Hordeum, Lolium)	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica
082	Stuckenia (pectinata)-Potamogeton spp.	Stuckenia pectinata	N/A		Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)
083	Schoenoplectus americanus	Schoenoplectus americanus-Distichlis spicata (provisional)	Distichlis spicata	Distichlis spicata-Cotula coronopifolia	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata
086	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata
087	Schoenoplectus acutus	Schoenoplectus acutus-Apocynum cannabinum	Schoenoplectus acutus	Schoenoplectus acutus-Apocynum cannabinum	Schoenoplectus californicus	Schoenoplectus californicus-Schoenoplectus

PlotID	1999		2006		2012	
	Alliance	Association	Alliance	Association	Alliance	Association
						acutus/Rosa californica
088	Schoenoplectus americanus	Schoenoplectus americanus	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)	Multiple Types	Multiple Types
089	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Annual Grasses (Polypogon, Hordeum, Lolium)	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Annual Grasses (Polypogon, Hordeum, Lolium)	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica
090	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Atriplex prostrata	Distichlis spicata	Distichlis spicata	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)-Phragmites australis
091	Festuca perennis	Festuca perennis	Festuca perennis	Festuca perennis	Festuca perennis	Festuca perennis
092	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Atriplex prostrata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	N/A	
094	Atriplex lentiformis	Atriplex lentiformis	N/A		Atriplex lentiformis	Atriplex lentiformis
099	Lepidium latifolium	Lepidium latifolium-Distichlis spicata	Lepidium latifolium	Lepidium latifolium-Distichlis spicata	Lepidium latifolium	Lepidium latifolium-Distichlis spicata
100	Frankenia salina	Frankenia salina	N/A		Frankenia salina	Frankenia salina
103	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Atriplex prostrata	N/A		Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica
107	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata
108	Leymus triticoides	Leymus triticoides	Leymus triticoides	Leymus triticoides	Leymus triticoides	Leymus triticoides

PlotID	1999		2006		2012	
	Alliance	**Association**	**Alliance**	**Association**	**Alliance**	**Association**
110	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica
111	Distichlis spicata	Distichlis spicata-Salicornia pacifica	Distichlis spicata	Distichlis spicata-Salicornia pacifica	Distichlis spicata	Distichlis spicata-Juncus balticus-Triglochin maritima
113	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Crypsis schoenoides	N/A		Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica
118	Atriplex lentiformis	Atriplex lentiformis	Atriplex lentiformis	Atriplex lentiformis	Atriplex lentiformis	Atriplex lentiformis
119	Elytrigia pontica	Alliance Only	N/A		Elytrigia pontica	Alliance Only
126	Lotus corniculatus (Provisional)	Alliance Only	N/A		Elytrigia pontica	Alliance Only
129	Sesuvium verrucosum	Sesuvium verrucosum	N/A		Unvegetated	Unvegetated
132	Atriplex prostrata-Cotula coronopifolia	Cotula coronopifolia	N/A		Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica- Cotula coronopifolia
136	Distichlis spicata	Distichlis spicata-Annual Grasses	Distichlis spicata	Distichlis spicata-Annual Grasses	N/A	
138	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Atriplex prostrata	N/A		Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica
139	Conium maculatum-Foeniculum vulgare	Foeniculum vulgare	N/A		Conium maculatum-Foeniculum vulgare	Foeniculum vulgare
142	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	N/A		Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica
143	Festuca perennis	Festuca perennis	N/A		Lepidium latifolium	Lepidium latifolium-Distichlis

PlotID	1999		2006		2012	
	Alliance	Association	Alliance	Association	Alliance	Association
						spicata
145	Schoenoplectus californicus	Schoenoplectus californicus	Schoenoplectus californicus	Schoenoplectus californicus	Schoenoplectus acutus	Schoenoplectus acutus
147	Festuca perennis	Festuca perennis	Distichlis spicata	Distichlis spicata-Annual Grasses	Multiple Types	Multiple Types
148	Festuca perennis	Festuca perennis	Festuca perennis	Festuca perennis	N/A	
151	Atriplex prostrata-Cotula coronopifolia	Atriplex prostrata-Annual Grasses	N/A		Distichlis spicata	Distichlis spicata-Annual Grasses
154	Atriplex prostrata-Cotula coronopifolia	Atriplex prostrata-Distichlis spicata	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Disitchlis spicata	N/A	
155	Centaurea (solstitialis, melitensis)	Centaurea solstitialis	N/A		Atriplex prostrata-Cotula coronopifolia	Atriplex prostrata-Annual Grasses
157	Bolboschoenus maritimus	Bolboschoenus maritimus-Salicornia pacifica	N/A		Bolboschoenus maritimus	Bolboschoenus maritimus-Salicornia pacifica
158	Stuckenia (pectinata)-Potamogeton spp.	Stuckenia pectinata	N/A		Stuckenia (pectinata)-Potamogeton spp.	Stuckenia pectinata
159	Atriplex prostrata-Cotula coronopifolia	Atriplex prostrata	Atriplex prostrata-Cotula coronopifolia	Atriplex prostrata	Phragmites australis	Phragmites australis
161	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)/Echinochloa crus-galli	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)/Echinochloa crus-galli	Schoenoplectus acutus	Schoenoplectus acutus-Typha angustifolia
164	Persicaria lapathifolia-Xanthium strumarium	Alliance Only	N/A		Not keyable	Not keyable

PlotID	1999		2006		2012	
	Alliance	**Association**	**Alliance**	**Association**	**Alliance**	**Association**
166	Sesuvium verrucosum	Sesuvium verrucosum-Cotula coronopifolia	N/A		Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica- Cotula coronopifolia
167	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Sesuvium verrucosum	N/A		Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Sesuvium verrucosum
168	Persicaria lapathifolia-Xanthium strumarium	Alliance Only	Typha (angustifolia, latifolia, domingensis)	Typha (angustifolia, latifolia, domingensis)-Phragmites australis	N/A	
169	Distichlis spicata	Distichlis spicata	Distichlis spicata	Distichlis spicata-Annual Grasses	N/A	
170	Bolboschoenus maritimus	Bolboschoenus maritimus-Sesuvium verrucosum	Phragmites australis	Phragmites australis	Phragmites australis	Phragmites australis
171	Frankenia salina	Frankenia salina	Festuca perennis	Festuca perennis	Frankenia salina	Frankenia salina
172	Sesuvium verrucosum	Sesuvium verrucosum	Sesuvium verrucosum	Sesuvium verrucosum	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica- Sesuvium verrucosum
173	Atriplex prostrata-Cotula coronopifolia	Cotula coronopifolia	N/A		Distichlis spicata	Distichlis spicata-Annual Grasses
174	Persicaria lapathifolia-Xanthium strumarium	Alliance Only	N/A		Multiple Types	Multiple Types
175	Phragmites australis	Phragmites australis	Persicaria lapathifolia-Xanthium strumarium	Alliance Only	N/A	
176	Juncus arcticus (var. balticus, mexicanus)	Juncus arcticus var. balticus-Conium maculatum	Juncus arcticus (var. balticus, mexicanus)	Juncus arcticus var. balticus-Conium maculatum	Distichlis spicata	Distichlis spicata-Annual Grasses

PlotID	1999		2006		2012	
	Alliance	**Association**	**Alliance**	**Association**	**Alliance**	**Association**
177	Juncus arcticus (var. balticus, mexicanus)	Juncus arcticus var. balticus-Conium maculatum	Juncus arcticus (var. balticus, mexicanus)	Juncus arcticus var. balticus-Conium maculatum	Juncus arcticus (var. balticus, mexicanus)	Juncus arcticus var. balticus
180	Bare Ground	Bare Ground	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	N/A	
181	Rosa californica	Rosa californica-Baccharis pilularis	Rosa californica	Rosa californica-Baccharis pilularis	N/A	
182	Sesuvium verrucosum	Sesuvium verrucosum	N/A		Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica- Sesuvium verrucosum
184	Schoenoplectus acutus	Schoenoplectus acutus	Schoenoplectus acutus	Schoenoplectus acutus-Typha angustifolia	Schoenoplectus acutus	Schoenoplectus acutus-Typha angustifolia
185	Atriplex prostrata-Cotula coronopifolia	Atriplex prostrata	Elytrigia pontica	Alliance Only	Elytrigia pontica	Alliance Only
186	Persicaria lapathifolia-Xanthium strumarium	Alliance Only	Persicaria lapathifolia-Xanthium strumarium	Alliance Only	N/A	
189	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica-Sesuvium verrucosum	Sarcocornia pacifica (Salicornia depressa)	Sarcocornia pacifica	N/A	
190	Bare Ground	Bare Ground	Open Water	Open Water	N/A	
192	Frankenia salina	Frankenia salina	Frankenia salina	Frankenia salina-Distichlis spicata	Frankenia salina	Frankenia salina-Distichlis spicata
194	Juncus arcticus (var. balticus, mexicanus)	Juncus arcticus var. balticus	Bromus (diandrus, hordeaceus)-Brachypodium distachyon	Polypogon monspeliensis (provisional)	Juncus arcticus (var. balticus, mexicanus)	Juncus arcticus var. balticus-Conium maculatum
195	Rosa californica	Rosa californica	Rosa californica	Rosa californica	Multiple Types	Multiple Types
197	Schoenoplectus acutus	Schoenoplectus acutus-Typha angustifolia	Schoenoplectus acutus	Schoenoplectus acutus-Typha angustifolia	N/A	

Table 2: Top 3 most abundant species by relative percent cover ((Species cover / Total Cover)*100) for the 125 Suisun Marsh plots that were sampled in 1999, 2006, and 2012. N/A means the plot was not sampled in that year. Not all plots contained three species and, therefore, three species are not always listed. The table excludes plots that were only sampled in 1999.

	1999		2006		2012	
PlotID	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
001	Typha angustifolia L.	29.1	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	54.2	N/A	
	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	10.4	Schoenoplectus californicus (C.A. Mey.) Palla	23.2		
	Schoenoplectus californicus (C.A. Mey.) Palla	59.3	Typha angustifolia L.	12.4		
002	Salicornia virginica L.	3.3	Typha angustifolia L.	96.2	Distichlis spicata (L.) Greene	50.5
	Scirpus maritimus L.	93.1	Bolboschoenus maritimus (L.) Palla	3.5	Typha angustifolia L.	36.4
	Typha angustifolia L.	2.2	Distichlis spicata (L.) Greene	0.3	Typha angustifolia L.	10.1
003	Atriplex triangularis Willd.	0.2	Typha angustifolia L.	71.4	N/A	
	Typha angustifolia L.	99.8	Bolboschoenus maritimus (L.) Palla	11.4		
			Distichlis spicata (L.) Greene	17.1		
004	Leymus triticoides (Buckley) Pilg.	28.2	Salix gooddingii C.R. Ball	25.8	Salix gooddingii C.R. Ball	16.3
	Salix lasiolepis Benth.	11.0	Salix lasiolepis Benth.	10.3	Salix lasiolepis Benth.	24.9
	Salix laevigata Bebb	39.1	Leymus triticoides (Buckley) Pilg.	41.3	Elymus triticoides Buckley	43.0
007	Schoenoplectus californicus (C.A. Mey.) Palla	0.2	N/A		Schoenoplectus californicus (C.A. Mey.) Palla	83.3
	Spartina foliosa Trin.	99.8			Spartina foliosa Trin.	15.6
					Algae	1.0
009	Schoenoplectus californicus (C.A. Mey.) Palla	70.0	Schoenoplectus californicus (C.A. Mey.) Palla	88.9	Schoenoplectus californicus (C.A. Mey.) Palla	85.0
	Spartina foliosa Trin.	30.0	Spartina foliosa Trin.	11.1	Spartina foliosa Trin.	15.0

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
010	Lepidium latifolium L.	0.2	Phragmites australis (Cav.) Trin. ex Steud.	99.8	Phragmites australis (Cav.) Trin. ex Steud.	100.0
	Phragmites australis (Cav.) Trin. ex Steud.	99.8	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	0.2		
012	Cynodon dactylon (L.) Pers.	11.6	Salix laevigata Bebb	49.5	Salix laevigata Bebb	27.0
	Salix laevigata Bebb	57.2	Salix lasiolepis Benth.	36.0	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	25.5
	Salix lasiolepis Benth.	14.3	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	5.4	Phragmites australis (Cav.) Trin. ex Steud.	18.0
013	Distichlis spicata (L.) Greene	16.1	Centaurea solstitialis L.	27.4	Bromus diandrus Roth	50.5
	Bromus hordeaceus L.	9.6	Lolium multiflorum Lam.	10.0	Leymus triticoides (Buckley) Pilg.	29.8
	Centaurea solstitialis L.	58.7	Vulpia myuros (L.) C.C. Gmel.	37.3	Lolium multiflorum Lam.	9.2
014	Distichlis spicata (L.) Greene	6.6	Typha latifolia L.	89.8	Typha latifolia L.	85.7
	Salicornia virginica L.	87.3	Salicornia virginica L.	6.0	Typha L.	14.3
	Scirpus maritimus L.	3.3	Bolboschoenus maritimus (L.) Palla	3.0	N/A	
015	Frankenia salina (Molina) I.M. Johnst.	4.2	Salicornia virginica L.	83.5	Phragmites australis (Cav.) Trin. ex Steud.	54.8
	Polypogon monspeliensis (L.) Desf.	1.0	Distichlis spicata (L.) Greene	10.3	Distichlis spicata (L.) Greene	27.4
	Salicornia virginica L.	94.6	Frankenia salina (Molina) I.M. Johnst.	3.9	Salicornia pacifica Standl.	13.7
016	Distichlis spicata (L.) Greene	2.1	Salicornia virginica L.	85.5	Salicornia pacifica Standl.	47.2
	Polypogon monspeliensis (L.) Desf.	6.4	Distichlis spicata (L.) Greene	5.7	Distichlis spicata (L.) Greene	45.1
	Salicornia virginica L.	90.0	Atriplex triangularis Willd.	2.8	Phragmites australis (Cav.) Trin. ex Steud.	2.1

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
020	Bolboschoenus maritimus (L.) Palla	86.4	Salicornia virginica L.	92.5	Typha latifolia L.	17.4
	Typha angustifolia L.	7.4	Typha angustifolia L.	0.7	Typha angustifolia L.	17.4
	Typha latifolia L.	4.9	Bolboschoenus maritimus (L.) Palla	6.8	Bolboschoenus maritimus (L.) Palla	17.4
021	Cotula coronopifolia L.	0.2	Salicornia virginica L.	94.3	N/A	
	Salicornia virginica L.	24.9	Sesuvium verrucosum Raf.	4.7		
	Scirpus maritimus L.	74.7	Atriplex triangularis Willd.	0.3		
022	Salicornia virginica L.	12.5	N/A		Bolboschoenus maritimus (L.) Palla	76.3
	Scirpus maritimus L.	44.6			Salicornia pacifica Standl.	11.5
	Sesuvium verrucosum Raf.	42.0			Sesuvium verrucosum Raf.	7.6
023	Distichlis spicata (L.) Greene	35.4	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	26.5	Phragmites australis (Cav.) Trin. ex Steud.	84.2
	Aster subulatus Michx.	12.5	Distichlis spicata (L.) Greene	31.0	Atriplex prostrata Bouchér ex DC.	6.1
	Atriplex triangularis Willd.	36.5	Phragmites australis (Cav.) Trin. ex Steud.	22.1	Salicornia pacifica Standl.	3.1
024	Atriplex triangularis Willd.	5.1	Distichlis spicata (L.) Greene	51.7	Salicornia pacifica Standl.	79.5
	Distichlis spicata (L.) Greene	87.9	Salicornia virginica L.	23.0	Distichlis spicata (L.) Greene	16.6
	Salicornia virginica L.	3.0	Atriplex triangularis Willd.	23.0	Atriplex prostrata Bouchér ex DC.	1.7
025	Lolium multiflorum Lam.	71.3	Lolium multiflorum Lam.	65.5	Centaurea solstitialis L.	31.2
	Vicia sativa L.	5.5	Lepidium latifolium L.	7.6	Brassica nigra (L.) W.D.J. Koch	6.3
	Vulpia myuros (L.) C.C. Gmel.	12.7	Bromus diandrus Roth	10.9	Asteraceae L.	6.3
026	Cotula coronopifolia L.	16.4	Distichlis spicata (L.) Greene	69.9	Salicornia pacifica Standl.	88.2
	Distichlis spicata (L.) Greene	30.7	Salicornia virginica L.	29.1	Distichlis spicata (L.) Greene	8.5
	Polypogon monspeliensis (L.) Desf.	15.4	Atriplex triangularis Willd.	0.2	Atriplex prostrata Bouchér ex DC.	2.8

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
031	Echinochloa crus-galli (L.) P. Beauv.	0.8	N/A		Bolboschoenus maritimus (L.) Palla	25.7
	Salicornia virginica L.	28.4			Bolboschoenus maritimus (L.) Palla	63.4
	Scirpus maritimus L.	70.6			Atriplex prostrata Bouchér ex DC.	5.1
034	Bromus diandrus Roth	0.2	Rubus discolor Weihe & Nees	84.5	Rubus armeniacus Focke	68.5
	Distichlis spicata (L.) Greene	0.2	Raphanus sativus L.	9.9	Raphanus sativus L.	7.0
	Rubus discolor Weihe & Nees	99.4	Carduus pycnocephalus L.	1.0	Anthriscus caucalis M. Bieb.	7.0
035	Atriplex triangularis Willd.	35.5	N/A		Atriplex prostrata Bouchér ex DC.	13.3
	Helenium bolanderi A. Gray	22.1			Bolboschoenus maritimus (L.) Palla	33.3
	Polypogon monspeliensis (L.) Desf.	12.6			Salicornia pacifica Standl.	17.8
036	Cotula coronopifolia L.	7.9	Sonchus oleraceus L.	23.0	N/A	
	Polygonum argyrocoleon Steud. ex Kunze	45.5	Polypogon monspeliensis (L.) Desf.	10.8		
	Rumex conglomeratus Murray	13.1	Distichlis spicata (L.) Greene	35.2		
037	Chenopodium album L.	12.4	Phragmites australis (Cav.) Trin. ex Steud.	27.0	Phragmites australis (Cav.) Trin. ex Steud.	83.3
	Cotula coronopifolia L.	27.9	Polypogon monspeliensis (L.) Desf.	22.9	Atriplex prostrata Bouchér ex DC.	7.8
	Rumex conglomeratus Murray	29.8	Cotula coronopifolia L.	21.3	Salicornia pacifica Standl.	6.7
038	Atriplex triangularis Willd.	70.9	Atriplex triangularis Willd.	13.2	Rumex dentatus L.	2.6
	Cuscuta salina Engelm. var. major Yunck.	2.6	Polypogon monspeliensis (L.) Desf.	29.0	Salicornia pacifica Standl.	87.2
	Scirpus maritimus L.	21.6	Bolboschoenus maritimus (L.) Palla	42.2	Bolboschoenus maritimus (L.) Palla	7.7
039	Cotula coronopifolia L.	4.3	Salicornia virginica L.	31.0	N/A	
	Salicornia virginica L.	82.4	Atriplex triangularis Willd.	14.5		
	Atriplex triangularis Willd.	8.7	Sesuvium verrucosum Raf.	31.0		

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
040	Salicornia virginica L.	92.1	Salicornia virginica L.	83.3	N/A	
	Sesuvium verrucosum Raf.	7.9	Sesuvium verrucosum Raf.	16.7		
041	Atriplex triangularis Willd.	2.7	N/A		Lepidium latifolium L.	43.4
	Juncus balticus Willd.	47.4			Conium maculatum L.	10.8
	Lepidium latifolium L.	43.8			Juncus L.	20.3
042	Distichlis spicata (L.) Greene	32.4	Glaux maritima L.	20.0	Grindelia stricta DC.	12.0
	Glaux maritima L.	27.0	Grindelia stricta DC.	16.0	Salicornia pacifica Standl.	41.2
	Grindelia stricta DC.	14.2	Salicornia virginica L.	36.0	Glaux maritima L.	17.2
043	Distichlis spicata (L.) Greene	54.6	Distichlis spicata (L.) Greene	19.8	Grindelia stricta DC.	37.1
	Potentilla anserina L.	8.5	Grindelia stricta DC.	15.8	Juncus balticus Willd.	18.5
	Juncus balticus Willd.	28.4	Juncus balticus Willd.	33.2	Salicornia pacifica Standl.	15.5
044	Lepidium latifolium L.	0.2	Bromus diandrus Roth	0.2	Rubus armeniacus Focke	80.3
	Rubus discolor Weihe & Nees	99.4	Distichlis spicata (L.) Greene	7.3	Distichlis spicata (L.) Greene	16.1
	Typha angustifolia L.	0.2	Rubus discolor Weihe & Nees	91.7	Conium maculatum L.	0.5
045	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	41.6	Distichlis spicata (L.) Greene	0.2	Typha angustifolia L.	85.5
	Schoenoplectus californicus (C.A. Mey.) Palla	1.0	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	26.2	Conium maculatum L.	0.3
	Typha angustifolia L.	57.2	Typha angustifolia L.	73.4	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	13.2
046	Distichlis spicata (L.) Greene	52.9	Distichlis spicata (L.) Greene	34.2	Distichlis spicata (L.) Greene	17.9
	Jaumea carnosa (Less.) A. Gray	6.6	Jaumea carnosa (Less.) A. Gray	12.8	Juncus balticus Willd.	9.9
	Triglochin maritimum L., orth. var.	24.8	Salicornia virginica L.	25.6	Salicornia pacifica Standl.	43.7
047	Distichlis spicata (L.) Greene	24.6	Distichlis spicata (L.) Greene	14.6	Grindelia stricta DC.	13.4
	Glaux maritima L.	19.1	Juncus balticus Willd.	13.9	Salicornia pacifica Standl.	50.2
	Juncus balticus Willd.	25.9	Salicornia virginica L.	46.2	Glaux maritima L.	8.4

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
048	Calystegia sepium (L.) R. Br.	33.6	Calystegia sepium (L.) R. Br.	17.8	Oenanthe sarmentosa C. Presl ex DC.	18.1
	Euthamia occidentalis Nutt.	18.3	Euthamia occidentalis Nutt.	14.8	Calystegia sepium (L.) R. Br.	30.9
	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	46.4	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	38.5	Euthamia occidentalis Nutt.	22.3
049	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	6.1	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	17.1	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	79.2
	Schoenoplectus californicus (C.A. Mey.) Palla	1.0	Typha angustifolia L.	47.0	Typha angustifolia L.	14.8
	Typha angustifolia L.	92.9	Typha latifolia L.	11.1	Eleocharis acicularis (L.) Roem. & Schult.	3.3
050	Scirpus maritimus L.	0.2	Digitaria sanguinalis (L.) Scop.	21.7	Sesuvium verrucosum Raf.	54.2
	Sesuvium verrucosum Raf.	98.8	Scirpus maritimus L.	23.5	Salicornia pacifica Standl.	18.1
	Atriplex triangularis Willd.	1.0	Sesuvium verrucosum Raf.	54.2	Bolboschoenus maritimus (L.) Palla	24.1
051	Schoenoplectus californicus (C.A. Mey.) Palla	100.0	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	99.0	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	5.2
			Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	1.0	Schoenoplectus californicus (C.A. Mey.) Palla	88.0
					Typha angustifolia L.	5.2
052	Hordeum marinum Huds.	39.6	Hordeum marinum Huds.	21.9	Baccharis pilularis DC.	57.3
	Baccharis pilularis DC.	35.7	Avena barbata Pott ex Link	21.9	Bromus diandrus Roth	19.9
	Bromus diandrus Roth	9.1	Baccharis pilularis DC.	25.8	Avena barbata Pott ex Link	17.5
053	Salicornia virginica L.	69.3	Cotula coronopifolia L.	2.1	Salicornia pacifica Standl.	93.4
	Atriplex triangularis Willd.	6.3	Distichlis spicata (L.) Greene	21.4	Distichlis spicata (L.) Greene	4.9
	Distichlis spicata (L.) Greene	21.0	Salicornia virginica L.	74.9	Bolboschoenus maritimus (L.) Palla	0.3

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
054	Baccharis pilularis DC.	8.6	Baccharis pilularis DC.	20.1	Rosa californica Cham. & Schltdl.	67.7
	Rosa californica Cham. & Schltdl.	78.4	Lolium multiflorum Lam.	5.6	Baccharis pilularis DC.	7.5
	Schoenoplectus californicus (C.A. Mey.) Palla	5.7	Rosa californica Cham. & Schltdl.	56.3	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	15.0
056	Distichlis spicata (L.) Greene	63.5	Distichlis spicata (L.) Greene	46.9	Bromus diandrus Roth	25.9
	Frankenia salina (Molina) I.M. Johnst.	10.5	Frankenia salina (Molina) I.M. Johnst.	18.8	Distichlis spicata (L.) Greene	11.3
	Lactuca serriola L.	20.2	Bromus diandrus Roth	23.5	Frankenia salina (Molina) I.M. Johnst.	51.8
058	Bromus diandrus Roth	24.4	Distichlis spicata (L.) Greene	28.8	Bromus diandrus Roth	29.9
	Bromus hordeaceus L.	28.5	Bromus diandrus Roth	53.2	Distichlis spicata (L.) Greene	41.9
	Hordeum marinum Huds.	31.6	Lactuca serriola L.	5.5	Centaurea solstitialis L.	18.0
059	Cuscuta salina Engelm. var. major Yunck.	9.5	Distichlis spicata (L.) Greene	46.2	N/A	
	Distichlis spicata (L.) Greene	62.0	Salicornia virginica L.	42.0		
	Salicornia virginica L.	14.6	Triglochin maritimum L., orth. var.	5.0		
060	Atriplex triangularis Willd.	5.7	Distichlis spicata (L.) Greene	17.4	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	13.3
	Distichlis spicata (L.) Greene	17.2	Lepidium latifolium L.	52.1	Salicornia pacifica Standl.	59.8
	Lepidium latifolium L.	59.3	Salicornia virginica L.	13.0	Distichlis spicata (L.) Greene	10.6
061	Distichlis spicata (L.) Greene	48.5	Distichlis spicata (L.) Greene	44.4	N/A	
	Jaumea carnosa (Less.) A. Gray	9.9	Lotus corniculatus L.	17.1		
	Lotus corniculatus L.	27.7	Salicornia virginica L.	21.4		
062	Bromus hordeaceus L.	1.0	Bromus hordeaceus L.	7.0	Elymus triticoides Buckley	63.6
	Lepidium latifolium L.	1.0	Lactuca serriola L.	15.1	Bromus diandrus Roth	13.6
	Leymus triticoides (Buckley) Pilg.	96.9	Leymus triticoides (Buckley) Pilg.	54.3	Lactuca serriola L.	9.1

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
063	Frankenia salina (Molina) I.M. Johnst.	2.0	Juncus balticus Willd.	12.6	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	38.7
	Atriplex triangularis Willd.	3.0	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	57.1	Lepidium latifolium L.	23.5
	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	89.4	Typha latifolia L.	9.1	Juncus balticus Willd.	16.6
064	Distichlis spicata (L.) Greene	49.3	Distichlis spicata (L.) Greene	28.1	Salicornia pacifica Standl.	40.5
	Juncus balticus Willd.	13.8	Jaumea carnosa (Less.) A. Gray	24.1	Juncus balticus Willd.	11.8
	Triglochin maritimum L., orth. var.	24.2	Salicornia virginica L.	20.1	Distichlis spicata (L.) Greene	16.9
065	Distichlis spicata (L.) Greene	18.2	Distichlis spicata (L.) Greene	25.6	N/A	
	Bromus hordeaceus L.	5.8	Bromus hordeaceus L.	7.2		
	Leymus triticoides (Buckley) Pilg.	70.4	Leymus triticoides (Buckley) Pilg.	54.2		
067	Atriplex triangularis Willd.	8.8	Atriplex triangularis Willd.	0.2	N/A	
	Juncus balticus Willd.	17.7	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	2.3		
	Typha latifolia L.	70.7	Typha latifolia L.	97.0		
068	Frankenia salina (Molina) I.M. Johnst.	15.8	Distichlis spicata (L.) Greene	46.0	N/A	
	Lolium multiflorum Lam.	27.9	Lepidium latifolium L.	19.3		
	Salicornia virginica L.	44.7	Lolium multiflorum Lam.	13.8		
069	Polypogon monspeliensis (L.) Desf.	1.0	N/A		Salicornia pacifica Standl.	98.3
	Salicornia virginica L.	96.0			Hordeum murinum L.	0.3
	Lolium multiflorum Lam.	2.0			Atriplex prostrata Bouchér ex DC.	0.3

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
070	Atriplex triangularis Willd.	10.0	Frankenia salina (Molina) I.M. Johnst.	16.3	Salsola soda L.	51.4
	Frankenia salina (Molina) I.M. Johnst.	12.9	Hordeum marinum Huds.	20.3	Bromus hordeaceus L.	9.3
	Lolium multiflorum Lam.	67.7	Lolium multiflorum Lam.	52.8	Lolium multiflorum Lam.	23.4
071	Distichlis spicata (L.) Greene	71.1	Atriplex triangularis Willd.	2.6	N/A	
	Juncus balticus Willd.	10.0	Distichlis spicata (L.) Greene	0.3		
	Typha L.	7.0	Typha latifolia L.	96.9		
072	Atriplex triangularis Willd.	7.9	Atriplex triangularis Willd.	0.3	N/A	
	Salicornia virginica L.	1.1	Salicornia virginica L.	2.6		
	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	90.5	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	96.9		
073	Distichlis spicata (L.) Greene	60.6	Atriplex triangularis Willd.	17.4	N/A	
	Juncus balticus Willd.	16.2	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	48.4		
	Sonchus oleraceus L.	7.1	Typha latifolia L.	17.4		
074	Frankenia salina (Molina) I.M. Johnst.	41.8	Frankenia salina (Molina) I.M. Johnst.	35.8	N/A	28.3
	Lolium multiflorum Lam.	20.9	Hordeum marinum Huds.	3.6	Salsola soda L.	28.3
	Rumex crispus L.	26.2	Lolium multiflorum Lam.	53.8	Frankenia salina (Molina) I.M. Johnst.	28.3
075	Atriplex triangularis Willd.	9.0	Atriplex triangularis Willd.	26.8	N/A	
	Distichlis spicata (L.) Greene	44.8	Distichlis spicata (L.) Greene	32.2		
	Frankenia salina (Molina) I.M. Johnst.	45.7	Frankenia salina (Molina) I.M. Johnst.	16.1		
076	Distichlis spicata (L.) Greene	4.7	Lotus corniculatus L.	42.7	Atriplex prostrata Bouchér ex DC.	24.3
	Lolium multiflorum Lam.	18.6	Lepidium latifolium L.	19.0	Distichlis spicata (L.) Greene	35.7
	Rumex crispus L.	66.1	Lolium multiflorum Lam.	11.4	Lotus corniculatus L.	25.7

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
077	Frankenia salina (Molina) I.M. Johnst.	11.7	Frankenia salina (Molina) I.M. Johnst.	16.8	Salicornia pacifica Standl.	74.1
	Hordeum marinum Huds.	43.8	Salicornia virginica L.	75.5	Frankenia salina (Molina) I.M. Johnst.	11.9
	Lolium multiflorum Lam.	43.8	Lolium multiflorum Lam.	3.4	Distichlis spicata (L.) Greene	11.9
078	Lotus corniculatus L.	5.6	Frankenia salina (Molina) I.M. Johnst.	20.4	Euthamia occidentalis Nutt.	9.9
	Grindelia stricta DC. var. angustifolia (A. Gray) M.A. Lane	72.0	Grindelia stricta DC.	23.7	Lotus corniculatus L.	11.9
	Lolium multiflorum Lam.	9.3	Lepidium latifolium L.	47.5	Jaumea carnosa (Less.) A. Gray	49.4
079	Hordeum marinum Huds.	0.2	Atriplex triangularis Willd.	0.3	Salicornia pacifica Standl.	27.7
	Polypogon monspeliensis (L.) Desf.	1.1	Salicornia virginica L.	98.0	Salsola soda L.	3.0
	Salicornia virginica L.	98.7	Polypogon monspeliensis (L.) Desf.	1.4	Algae	69.2
082	Potamogeton pectinatus L.	100.0	N/A		Typha angustifolia L.	35.7
					Bolboschoenus maritimus (L.) Palla	21.4
					Typha angustifolia L.	25.0
083	Distichlis spicata (L.) Greene	51.3	Cotula coronopifolia L.	15.0	Salicornia pacifica Standl.	51.9
	Juncus balticus Willd.	5.1	Distichlis spicata (L.) Greene	52.9	Lotus corniculatus L.	10.8
	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	35.9	Salicornia virginica L.	17.6	Distichlis spicata (L.) Greene	13.0
086	Distichlis spicata (L.) Greene	15.0	Distichlis spicata (L.) Greene	17.9	Salicornia pacifica Standl.	43.0
	Polypogon monspeliensis (L.) Desf.	11.2	Picris echioides L.	8.9	Distichlis spicata (L.) Greene	28.3
	Salicornia virginica L.	50.5	Salicornia virginica L.	57.2	Epilobium ciliatum Raf.	7.9

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
087	Apocynum cannabinum L.	29.6	Apocynum cannabinum L.	12.6	Rosa californica Cham. & Schltdl.	50.0
	Rosa californica Cham. & Schltdl.	15.2	Rosa californica Cham. & Schltdl.	25.1	Schoenoplectus californicus (C.A. Mey.) Palla	30.0
	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	16.9	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	37.7	Raphanus sativus L.	6.0
088	Polypogon monspeliensis (L.) Desf.	7.3	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	2.2	Rumex violascens Rech. f.	36.8
	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	54.9	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	4.3	Sonchus oleraceus L.	16.5
	Typha angustifolia L.	32.1	Typha latifolia L.	91.8	Atriplex prostrata Bouchér ex DC.	12.9
089	Polypogon monspeliensis (L.) Desf.	15.9	Lolium multiflorum Lam.	7.5	Salicornia pacifica Standl.	95.0
	Rumex crispus L.	10.6	Poaceae	19.4	Atriplex prostrata Bouchér ex DC.	1.3
	Salicornia virginica L.	63.4	Salicornia virginica L.	72.0	Distichlis spicata (L.) Greene	2.5
090	Atriplex triangularis Willd.	7.3	Distichlis spicata (L.) Greene	88.2	Phragmites australis (Cav.) Trin. ex Steud.	14.9
	Frankenia salina (Molina) I.M. Johnst.	1.0	Lepidium latifolium L.	3.9	Typha latifolia L.	19.8
	Salicornia virginica L.	88.5	Phragmites australis (Cav.) Trin. ex Steud.	6.9	Distichlis spicata (L.) Greene	54.5
091	Bromus hordeaceus L.	8.8	Frankenia salina (Molina) I.M. Johnst.	16.5	Lolium multiflorum Lam.	42.6
	Hordeum marinum Huds. ssp. gussonianum (Parl.) Thell.	4.4	Hordeum marinum Huds.	10.3	Bromus hordeaceus L.	42.6
	Lolium multiflorum Lam.	82.2	Lolium multiflorum Lam.	70.2	Frankenia salina (Molina) I.M. Johnst.	5.3

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
092	Atriplex triangularis Willd.	13.6	Polypogon monspeliensis (L.) Desf.	2.2	N/A	
	Salicornia virginica L.	82.8	Rumex dentatus L.	3.3		
	Rumex pulcher L.	1.9	Salicornia virginica L.	93.8		
094	Atriplex lentiformis (Torr.) S. Watson	60.1	N/A		Atriplex lentiformis (Torr.) S. Watson	57.4
	Atriplex triangularis Willd.	13.7			Lepidium latifolium L.	4.8
	Bromus diandrus Roth	23.2			Bromus diandrus Roth	35.1
099	Distichlis spicata (L.) Greene	37.7	Distichlis spicata (L.) Greene	40.1	Lepidium latifolium L.	19.1
	Lepidium latifolium L.	53.4	Lepidium latifolium L.	40.1	Salicornia pacifica Standl.	25.5
	Salicornia virginica L.	2.7	Polypogon monspeliensis (L.) Desf.	4.0	Distichlis spicata (L.) Greene	38.2
100	Frankenia salina (Molina) I.M. Johnst.	53.2	N/A		Frankenia salina (Molina) I.M. Johnst.	51.6
	Hordeum marinum Huds.	2.1			Lolium multiflorum Lam.	43.7
	Lolium multiflorum Lam.	42.6			Asteraceae L.	0.8
103	Atriplex triangularis Willd.	6.6	N/A		Salicornia pacifica Standl.	96.8
	Cotula coronopifolia L.	4.7			Atriplex prostrata Bouchér ex DC.	0.5
	Salicornia virginica L.	88.7			Cotula coronopifolia L.	2.3
107	Distichlis spicata (L.) Greene	15.8	Distichlis spicata (L.) Greene	8.1	Distichlis spicata (L.) Greene	26.8
	Salicornia virginica L.	77.5	Limonium californicum (Boiss.) A. Heller	1.6	Salicornia pacifica Standl.	60.2
	Atriplex triangularis Willd.	3.2	Salicornia virginica L.	87.1	Phragmites australis (Cav.) Trin. ex Steud.	11.2
108	Bromus diandrus Roth	31.2	Taeniatherum caput-medusae (L.) Nevski	16.0	Elymus triticoides Buckley	34.1
	Bromus hordeaceus L.	14.6	Bromus diandrus Roth	13.3	Taeniatherum caput-medusae (L.) Nevski	51.1
	Leymus triticoides (Buckley) Pilg.	43.9	Leymus triticoides (Buckley) Pilg.	53.3	Bromus diandrus Roth	4.9

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
110	Cuscuta salina Engelm. var. major Yunck.	6.1	Cuscuta salina Engelm.	6.9	Salicornia pacifica Standl.	72.6
	Distichlis spicata (L.) Greene	2.0	Hainardia cylindrica (Willd.) Greuter	2.3	Distichlis spicata (L.) Greene	12.6
	Salicornia virginica L.	90.4	Salicornia virginica L.	86.2	Cuscuta L.	11.0
111	Cordylanthus mollis A. Gray ssp. mollis	11.5	Distichlis spicata (L.) Greene	45.7	Distichlis spicata (L.) Greene	18.5
	Distichlis spicata (L.) Greene	61.8	Salicornia virginica L.	45.7	Salicornia pacifica Standl.	64.0
	Salicornia virginica L.	17.7	Triglochin maritimum L., orth. var.	2.8	Lotus corniculatus L.	7.4
113	Crypsis schoenoides (L.) Lam.	26.5	N/A		Salicornia pacifica Standl.	94.5
	Salicornia virginica L.	66.4			Salicornia pacifica Standl.	5.2
	Scirpus maritimus L.	6.6			Cotula coronopifolia L.	0.3
118	Atriplex lentiformis (Torr.) S. Watson	27.9	Hordeum marinum Huds.	4.4	Atriplex lentiformis (Torr.) S. Watson	81.6
	Atriplex triangularis Willd.	29.9	Atriplex lentiformis (Torr.) S. Watson	48.5	Bromus diandrus Roth	2.3
	Conium maculatum L.	24.9	Conium maculatum L.	32.4	Elytrigia pontica (Podp.) Holub	7.0
119	Atriplex triangularis Willd.	0.2	N/A		Elytrigia pontica (Podp.) Holub	90.9
	Hordeum marinum Huds.	18.5			Brassica nigra (L.) W.D.J. Koch	5.7
	Elytrigia pontica (Podp.) Holub	80.6			Frankenia salina (Molina) I.M. Johnst.	2.8
126	Lotus corniculatus L.	88.8	N/A		Lepidium latifolium L.	28.4
	Lepidium latifolium L.	3.1			Elytrigia pontica (Podp.) Holub	67.4
	Picris echioides L.	5.1			Frankenia salina (Molina) I.M. Johnst.	3.5
129	Chenopodium album L.	0.3	N/A		Salicornia pacifica Standl.	47.6
	Sesuvium verrucosum Raf.	99.7			Bolboschoenus maritimus (L.) Palla	26.2
					Cotula coronopifolia L.	26.2

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
132	Cotula coronopifolia L.	99.6	N/A		Salicornia pacifica Standl.	50.9
	Polypogon monspeliensis (L.) Desf.	0.2			Cotula coronopifolia L.	18.8
	Sesuvium verrucosum Raf.	0.2			Polypogon monspeliensis (L.) Desf.	16.1
136	Distichlis spicata (L.) Greene	74.4	Distichlis spicata (L.) Greene	20.1	N/A	
	Lotus corniculatus L.	5.9	Frankenia salina (Molina) I.M. Johnst.	9.1		
	Lolium multiflorum Lam.	7.8	Lolium multiflorum Lam.	66.6		
138	Atriplex triangularis Willd.	0.2	N/A		Salicornia pacifica Standl.	93.6
	Frankenia salina (Molina) I.M. Johnst.	1.0			Polypogon monspeliensis (L.) Desf.	2.3
	Salicornia virginica L.	98.8			Cotula coronopifolia L.	2.3
139	Bromus diandrus Roth	4.3	N/A		Foeniculum vulgare Mill.	86.2
	Distichlis spicata (L.) Greene	13.0			Distichlis spicata (L.) Greene	2.5
	Foeniculum vulgare Mill.	82.3			Carduus pycnocephalus L.	2.5
142	Atriplex triangularis Willd.	0.2	N/A		Salicornia pacifica Standl.	97.8
	Salicornia virginica L.	99.3			Distichlis spicata (L.) Greene	1.4
	Aster subulatus Michx.	0.2			Bolboschoenus maritimus (L.) Palla	0.3
143	Distichlis spicata (L.) Greene	6.3	N/A		Lepidium latifolium L.	61.2
	Lolium multiflorum Lam.	62.6			Distichlis spicata (L.) Greene	30.6
	Lepidium latifolium L.	17.7			Frankenia salina (Molina) I.M. Johnst.	7.7
145	Distichlis spicata (L.) Greene	0.2	Agrostis avenacea J.F. Gmel.	0.2	Phragmites australis (Cav.) Trin. ex Steud.	2.2
	Atriplex triangularis Willd.	1.0	Distichlis spicata (L.) Greene	6.9	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	20.0
	Schoenoplectus californicus (C.A. Mey.) Palla	98.2	Schoenoplectus californicus (C.A. Mey.) Palla	91.2	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	73.4

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
147	Agrostis avenacea J.F. Gmel.	26.8	Distichlis spicata (L.) Greene	38.7	Salicornia pacifica Standl.	42.5
	Lolium multiflorum Lam.	33.7	Lolium multiflorum Lam.	15.5	Distichlis spicata (L.) Greene	32.6
	Xanthium strumarium L.	18.4	Polypogon monspeliensis (L.) Desf.	23.2	Distichlis spicata (L.) Greene	14.2
148	Aster subulatus Michx.	1.0	Distichlis spicata (L.) Greene	1.0	N/A	
	Atriplex triangularis Willd.	2.0	Bromus diandrus Roth	1.9		
	Lolium multiflorum Lam.	95.6	Lolium multiflorum Lam.	94.4		
151	Atriplex triangularis Willd.	33.2	N/A		Distichlis spicata (L.) Greene	70.1
	Lolium multiflorum Lam.	23.9			Bromus diandrus Roth	5.2
	Sonchus oleraceus L.	13.5			Lolium perenne L.	6.5
154	Distichlis spicata (L.) Greene	22.3	Distichlis spicata (L.) Greene	22.2	N/A	
	Atriplex triangularis Willd.	41.5	Salicornia virginica L.	37.0		
	Scirpus maritimus L.	13.4	Polypogon monspeliensis (L.) Desf.	22.2		
155	Centaurea solstitialis L.	54.4	N/A		Atriplex prostrata Bouchér ex DC.	36.3
	Lactuca serriola L.	4.6			Polypogon monspeliensis (L.) Desf.	24.8
	Raphanus sativus L.	39.8			Frankenia salina (Molina) I.M. Johnst.	8.3
157	Cotula coronopifolia L.	7.7	N/A		Salicornia pacifica Standl.	53.4
	Salicornia virginica L.	21.9			Distichlis spicata (L.) Greene	3.1
	Scirpus maritimus L.	65.7			Bolboschoenus maritimus (L.) Palla	37.7
158	Lemna gibba L.	1.5	N/A		Bolboschoenus maritimus (L.) Palla	2.6
	Potamogeton pectinatus L.	97.0			Potamogeton pectinatus L.	97.1
	Typha angustifolia L.	1.5			Algae	0.3

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
159	Atriplex triangularis Willd.	96.0	Atriplex triangularis Willd.	41.7	Lepidium latifolium L.	1.2
	Phragmites australis (Cav.) Trin. ex Steud.	1.0	Phragmites australis (Cav.) Trin. ex Steud.	35.7	Atriplex prostrata Bouchér ex DC.	0.2
	Polypogon monspeliensis (L.) Desf.	1.0	Polygonum L.	6.0	Phragmites australis (Cav.) Trin. ex Steud.	98.1
161	Echinochloa crus-galli (L.) P. Beauv.	23.4	Atriplex triangularis Willd.	14.1	Typha L.	59.8
	Persicaria lapathifolia (L.) Gray	23.4	Typha angustifolia L.	26.5	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	12.0
	Typha angustifolia L.	39.1	Xanthium strumarium L.	35.3	Typha L.	10.8
164	Polypogon monspeliensis (L.) Desf.	24.5	N/A		Picris echioides L.	18.8
	Aster subulatus Michx.	28.1			Sonchus oleraceus L.	14.1
	Persicaria lapathifolia (L.) Gray	29.9			Rumex L.	33.0
166	Cotula coronopifolia L.	24.2	N/A		Salicornia pacifica Standl.	42.0
	Bolboschoenus maritimus (L.) Palla	6.6			Cotula coronopifolia L.	55.0
	Sesuvium verrucosum Raf.	66.1			Atriplex prostrata Bouchér ex DC.	0.6
167	Cotula coronopifolia L.	1.1	N/A		Sesuvium verrucosum Raf.	46.5
	Sesuvium verrucosum Raf.	15.3			Salicornia pacifica Standl.	51.1
	Salicornia virginica L.	81.9			Cotula coronopifolia L.	0.5
168	Lotus corniculatus L.	8.5	Juncus balticus Willd.	3.7	N/A	
	Polypogon monspeliensis (L.) Desf.	44.4	Phragmites australis (Cav.) Trin. ex Steud.	62.3		
	Xanthium strumarium L.	30.7	Typha angustifolia L.	31.2		
169	Atriplex triangularis Willd.	1.0	Distichlis spicata (L.) Greene	19.0	N/A	
	Distichlis spicata (L.) Greene	93.6	Lolium multiflorum Lam.	48.5		
	Frankenia salina (Molina) I.M. Johnst.	1.0	Bromus diandrus Roth	28.5		

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
170	Sesuvium verrucosum Raf.	13.4	Phragmites australis (Cav.) Trin. ex Steud.	36.4	Phragmites australis (Cav.) Trin. ex Steud.	66.9
	Polygonum argyrocoleon Steud. ex Kunze	7.8	Rumex conglomeratus Murray	25.5	Salsola australis R. Br.	13.9
	Bolboschoenus maritimus (L.) Palla	70.5	Scirpus maritimus L.	21.8	Salicornia pacifica Standl.	13.9
171	Frankenia salina (Molina) I.M. Johnst.	73.1	Bromus diandrus Roth	58.7	Frankenia salina (Molina) I.M. Johnst.	69.2
	Juncus balticus Willd.	0.9	Frankenia salina (Molina) I.M. Johnst.	3.1	Lolium multiflorum Lam.	17.9
	Lolium multiflorum Lam.	24.1	Lolium multiflorum Lam.	36.7	Bromus diandrus Roth	10.3
172	Scirpus maritimus L.	1.0	Sesuvium verrucosum Raf.	75.8	Salicornia pacifica Standl.	35.8
	Sesuvium verrucosum Raf.	99.0	Persicaria lapathifolia (L.) Gray	15.2	Cotula coronopifolia L.	15.9
			Rumex conglomeratus Murray	4.3	Phragmites australis (Cav.) Trin. ex Steud.	15.9
173	Atriplex triangularis Willd.	0.2	N/A		Distichlis spicata (L.) Greene	79.8
	Cotula coronopifolia L.	98.8			Lotus corniculatus L.	9.7
	Aster subulatus Michx.	0.2			Atriplex prostrata Bouchér ex DC.	5.8
174	Echinochloa crus-galli (L.) P. Beauv.	11.8	N/A		Phragmites australis (Cav.) Trin. ex Steud.	48.0
	Persicaria lapathifolia (L.) Gray	88.2			Typha angustifolia L.	45.9
					Xanthium strumarium L.	4.2
175	Phragmites australis (Cav.) Trin. ex Steud.	29.1	Phragmites australis (Cav.) Trin. ex Steud.	9.2	N/A	
	Persicaria lapathifolia (L.) Gray	26.2	Persicaria lapathifolia (L.) Gray	12.3		
	Xanthium strumarium L.	36.8	Xanthium strumarium L.	71.6		

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
176	Centaurea solstitialis L.	9.6	Centaurea solstitialis L.	5.0	Distichlis spicata (L.) Greene	13.4
	Conium maculatum L.	39.5	Conium maculatum L.	42.3	Juncus arcticus Willd.	13.4
	Juncus balticus Willd.	40.7	Juncus balticus Willd.	40.3	Bromus diandrus Roth	36.3
177	Conium maculatum L.	33.5	Conium maculatum L.	41.0	Juncus arcticus Willd.	88.7
	Juncus balticus Willd.	55.8	Juncus balticus Willd.	54.1	Rosa californica Cham. & Schltdl.	4.4
	Raphanus sativus L.	4.9	Sonchus oleraceus L.	1.5	Asteraceae L.	3.0
180	Salicornia virginica L.	50.0	Salicornia virginica L.	100.0	N/A	
	Sesuvium verrucosum Raf.	50.0				
181	Baccharis pilularis DC.	67.9	Baccharis pilularis DC.	51.9	N/A	
	Euthamia occidentalis Nutt.	4.5	Calystegia sepium (L.) R. Br.	1.7		
	Rosa californica Cham. & Schltdl.	22.6	Rosa californica Cham. & Schltdl.	43.3		
182	Sesuvium verrucosum Raf.	28.4	N/A		Bolboschoenus maritimus (L.) Palla	21.4
	Atriplex triangularis Willd.	1.1			Salicornia pacifica Standl.	28.6
	Chenopodium album L.	70.0			Cotula coronopifolia L.	14.3
184	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	15.7	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	34.4	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	16.3
	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	65.4	Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	17.2	Typha angustifolia L.	12.5
	Typha angustifolia L.	9.2	Typha angustifolia L.	45.9	Schoenoplectus (Rchb.) Palla	57.6
185	Atriplex triangularis Willd.	97.8	Brassica nigra (L.) W.D.J. Koch	3.1	Conium maculatum L.	1.3
	Cirsium vulgare (Savi) Ten.	0.2	Conium maculatum L.	3.1	Brassica nigra (L.) W.D.J. Koch	0.3
	Elytrigia pontica (Podp.) Holub	1.1	Elytrigia pontica (Podp.) Holub	92.6	Elytrigia pontica (Podp.) Holub	98.3

PlotID	1999		2006		2012	
	Species Name	Relative Species Cover	Species Name	Relative Species Cover	Species Name	Relative Species Cover
186	Cotula coronopifolia L.	7.3	Cotula coronopifolia L.	25.4	N/A	
	Polypogon monspeliensis (L.) Desf.	5.2	Salicornia virginica L.	10.2		
	Xanthium strumarium L.	83.9	Xanthium strumarium L.	51.8		
189	Cotula coronopifolia L.	2.5	Atriplex triangularis Willd.	0.3	N/A	
	Sesuvium verrucosum Raf.	15.0	Salicornia virginica L.	96.7		
	Salicornia virginica L.	82.5	Scirpus maritimus L.	1.5		
192	Agrostis avenacea J.F. Gmel.	24.3	Distichlis spicata (L.) Greene	18.0	Frankenia salina (Molina) I.M. Johnst.	58.8
	Distichlis spicata (L.) Greene	4.9	Frankenia salina (Molina) I.M. Johnst.	33.8	Bromus diandrus Roth	24.5
	Frankenia salina (Molina) I.M. Johnst.	64.0	Bromus diandrus Roth	22.5	Distichlis spicata (L.) Greene	9.8
194	Frankenia salina (Molina) I.M. Johnst.	1.0	Cotula coronopifolia L.	3.3	Salicornia pacifica Standl.	5.2
	Salicornia virginica L.	11.4	Polypogon monspeliensis (L.) Desf.	92.6	Juncus arcticus Willd.	28.5
	Juncus balticus Willd.	87.5	Rumex conglomeratus Murray	1.1	Polypogon monspeliensis (L.) Desf.	62.2
195	Frankenia salina (Molina) I.M. Johnst.	7.4	Frankenia salina (Molina) I.M. Johnst.	11.9	Agrostis avenacea J.F. Gmel.	1.7
	Lepidium latifolium L.	4.2	Poa L.	36.8	Frankenia salina (Molina) I.M. Johnst.	20.3
	Rosa californica Cham. & Schltdl.	80.3	Rosa californica Cham. & Schltdl.	48.7	Rosa californica Cham. & Schltdl.	76.0
197	Euthamia occidentalis Nutt.	17.3	Rubus discolor Weihe & Nees	13.9	N/A	
	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	20.2	Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	37.0		
	Typha angustifolia L.	20.2	Typha angustifolia L.	27.7		

Table 3: Indicator rank and definition for wetland species. Further explanation may be found at the NRCS Plants Database website: http://plants.usda.gov/wetland.html

NWI Code	NWI Status	NWI Explanation
OBL	Obligate Wetland	Almost always is a hydrophyte, rarely in uplands
FACW	Facultative Wetland	Usually is a hydrophyte but occasionally found in uplands
FAC	Facultative	Commonly occurs as either a hydrophyte or non-hydrophyte
FACU	Facultative Upland	Occasionally is a hydrophyte but usually occurs in uplands
UPL	Obligate Upland	Rarely is a hydrophyte, almost always in uplands

Table 4: List of wetland indicator value for all species listed in the 127 resampled plots. Color coding matches definitions from Table 3.

Species name	Indicator Code
Agrostis avenacea	FACW
Algae	OBL
Anthriscus caucalis	UPL
Apocynum cannabinum	FAC
Argentina anserina	OBL
Atriplex lentiformis	FAC
Atriplex prostrata	FAC
Avena barbata	UPL
Baccharis pilularis	FAC
Bolboschoenus maritimus	OBL
Brassica nigra	UPL
Bromus diandrus	UPL
Bromus hordeaceus	FACU
Calystegia sepium	FAC
Carduus pycnocephalus	UPL
Centaurea solstitialis	UPL
Chenopodium album	FACU
Cirsium vulgare	FACU
Conium maculatum	FAC
Cordylanthus mollis ssp. mollis	OBL
Cotula coronopifolia	OBL
Crypsis schoenoides	FACW
Cuscuta salina	?
Cuscuta salina var. major	?
Cynodon dactylon	FACU

Species name	Indicator Code
Digitaria sanguinalis	FACU
Distichlis spicata	FACW
Echinochloa crus-galli	FAC
Eleocharis acicularis	OBL
Elytrigia pontica	UPL
Epilobium ciliatum	FACW
Euthamia occidentalis	FACW
Foeniculum vulgare	FACU
Frankenia salina	FACW
Glaux maritima	OBL
Grindelia stricta	FACW
Grindelia stricta var. angustifolia	FACW
Hainardia cylindrica	FACW
Helenium bolanderi	FACW
Hordeum marinum	FAC
Hordeum marinum ssp. gussonianum	FAC
Hordeum murinum	FAC
Jaumea carnosa	OBL
Juncus	FACW
Juncus arcticus	FACW
Juncus balticus	FACW
Lactuca serriola	FACU
Lemna gibba	OBL
Lepidium latifolium	FAC
Leymus triticoides	FAC
Limonium californicum	OBL
Lolium multiflorum	FAC
Lolium perenne	FAC
Lotus corniculatus	FAC
Oenanthe sarmentosa	OBL
Persicaria lapathifolia	FACW
Phragmites australis	FACW
Picris echioides	FAC
Polygonum argyrocoleon	FAC
Polypogon monspeliensis	FACW
Potamogeton pectinatus	OBL
Raphanus sativus	FACU
Rosa californica	FAC
Rubus armeniacus	FACU
Rumex conglomeratus	FACW

Species name	Indicator Code
Rumex crispus	FAC
Rumex dentatus	OBL
Rumex pulcher	FAC
Rumex violascens	FACW
Salicornia pacifica	OBL
Salix gooddingii	FACW
Salix laevigata	FACW
Salix lasiolepis	FACW
Salsola australis	FACU
Salsola soda	FACW
Schoenoplectus	OBL
Schoenoplectus acutus	OBL
Schoenoplectus americanus	OBL
Schoenoplectus californicus	OBL
Sesuvium verrucosum	FACW
Sonchus oleraceus	UPL
Spartina foliosa	OBL
Symphyotrichum subulatum	OBL
Taeniatherum caput-medusae	?
Triglochin maritimum	OBL
Typha	OBL
Typha angustifolia	OBL
Typha latifolia	OBL
Vicia sativa	UPL
Vulpia myuros	FACU
Xanthium strumarium	FAC

Table 5: Top 3 species per plot showing the color coding as defined in the PLANTS wetland indicator status website. Table displays up to 3 of the highest relative cover species as coded with their wetland status. Additional columns show their trend code as determined by the relative proportion of change of indicator species from beginning to end of time series (based on total relative cover of wettest indicators). Each resampled plot can be scored as W (Wetter; trending toward higher relative cover of wetland species), S (Stable or same; no discernible trend in wetland species proportions), or D (Drier; trend to relative dominance by drier indicator species than when first sampled)

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
001	Schoenoplectus californicus	59.3	Schoenoplectus acutus	54.2			
	Typha angustifolia	29.1	Schoenoplectus californicus	23.2	N/A		
	Schoenoplectus acutus	10.4	Typha angustifolia	12.4			S
002	Bolboschoenus maritimus	93.1	Typha angustifolia	96.2	Distichlis spicata	50.5	
	Salicornia pacifica	3.3	Bolboschoenus maritimus	3.5	Typha angustifolia	36.4	
	Typha angustifolia	2.2	Distichlis spicata	0.3	Typha angustifolia	10.1	D
003	Typha angustifolia	99.8	Typha angustifolia	71.4			
	Atriplex prostrata	0.2	Distichlis spicata	17.1	N/A		
			Bolboschoenus maritimus	11.4			S
004	Salix laevigata	39.1	Leymus triticoides	41.3	Elymus triticoides	43.0	
	Leymus triticoides	28.2	Salix gooddingii	25.8	Salix lasiolepis	24.9	
	Salix lasiolepis	11.0	Salix lasiolepis	10.3	Salix gooddingii	16.3	S
007	Spartina foliosa	99.8			Schoenoplectus californicus	83.3	
	Schoenoplectus californicus	0.2	N/A		Spartina foliosa	15.6	
					Algae	1.0	S
009	Schoenoplectus californicus	70.0	Schoenoplectus californicus	88.9	Schoenoplectus californicus	85.0	
	Spartina foliosa	30.0	Spartina foliosa	11.1	Spartina foliosa	15.0	S
010	Phragmites australis	99.8	Phragmites australis	99.8	Phragmites australis	100.0	
	Lepidium latifolium	0.2	Schoenoplectus acutus	0.2			S

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
011	Phragmites australis	100.0	Water	100			W
012	Salix laevigata	57.2	Salix laevigata	49.5	Salix laevigata	27.0	
	Salix lasiolepis	14.3	Salix lasiolepis	36.0	Schoenoplectus americanus	25.5	
	Cynodon dactylon	11.6	Schoenoplectus americanus	5.4	Phragmites australis	18.0	W
013	Centaurea solstitialis	58.7	Vulpia myuros	37.3	Bromus diandrus	50.5	
	Distichlis spicata	16.1	Centaurea solstitialis	27.4	Leymus triticoides	29.8	
	Bromus hordeaceus	9.6	Lolium multiflorum	10.0	Lolium multiflorum	9.2	D
014	Salicornia pacifica	87.3	Typha latifolia	89.8	Typha latifolia	85.7	
	Distichlis spicata	6.6	Salicornia pacifica	6.0	Typha	14.3	
	Bolboschoenus maritimus	3.3	Bolboschoenus maritimus	3.0			W
015	Salicornia pacifica	94.6	Salicornia pacifica	83.5	Phragmites australis	54.8	
	Frankenia salina	4.2	Distichlis spicata	10.3	Distichlis spicata	27.4	
	Polypogon monspeliensis	1.0	Frankenia salina	3.9	Salicornia pacifica	13.7	D
016	Salicornia pacifica	90.0	Salicornia pacifica	85.5	Salicornia pacifica	47.2	
	Polypogon monspeliensis	6.4	Distichlis spicata	5.7	Distichlis spicata	45.1	
	Distichlis spicata	2.1	Atriplex prostrata	2.8	Phragmites australis	2.1	D
020	Bolboschoenus maritimus	86.4	Salicornia pacifica	92.5	Bolboschoenus maritimus	17.4	
	Typha angustifolia	7.4	Bolboschoenus maritimus	6.8	Typha angustifolia	17.4	
	Typha latifolia	4.9	Typha angustifolia	0.7	Typha latifolia	17.4	S
021	Bolboschoenus maritimus	74.7	Salicornia pacifica	94.3			
	Salicornia pacifica	24.9	Sesuvium verrucosum	4.7	N/A		
	Cotula coronopifolia	0.2	Atriplex prostrata	0.3			D
022	Bolboschoenus maritimus	44.6	N/A		Bolboschoenus maritimus	76.3	W

PlotID	1999		2006		2012		
	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
	Sesuvium verrucosum	42.0			Salicornia pacifica	11.5	
	Salicornia pacifica	12.5			Sesuvium verrucosum	7.6	
023	Atriplex prostrata	36.5	Distichlis spicata	31.0	Phragmites australis	84.2	
	Distichlis spicata	35.4	Schoenoplectus americanus	26.5	Atriplex prostrata	6.1	
	Aster subulatus	12.5	Phragmites australis	22.1	Salicornia pacifica	3.1	?
024	Distichlis spicata	87.9	Distichlis spicata	51.7	Salicornia pacifica	79.5	
	Atriplex prostrata	5.1	Atriplex prostrata	23.0	Distichlis spicata	16.6	
	Salicornia pacifica	3.0	Salicornia pacifica	23.0	Atriplex prostrata	1.7	W
025	Lolium multiflorum	71.3	Lolium multiflorum	65.5	Centaurea solstitialis	31.2	
	Vulpia myuros	12.7	Bromus diandrus	10.9	Asteraceae	6.3	
	Vicia sativa	5.5	Lepidium latifolium	7.6	Brassica nigra	6.3	?
026	Distichlis spicata	30.7	Distichlis spicata	69.9	Salicornia pacifica	88.2	
	Cotula coronopifolia	16.4	Salicornia pacifica	29.1	Distichlis spicata	8.5	
	Polypogon monspeliensis	15.4	Atriplex prostrata	0.2	Atriplex prostrata	2.8	W
031	Bolboschoenus maritimus	70.6	N/A		Bolboschoenus maritimus	63.4	
	Salicornia pacifica	28.4			Bolboschoenus maritimus	25.7	
	Echinochloa crus-galli	0.8			Atriplex prostrata	5.1	S
034	Rubus armeniacus	99.4	Rubus armeniacus	84.5	Rubus armeniacus	68.5	
	Bromus diandrus	0.2	Raphanus sativus	9.9	Anthriscus caucalis	7.0	
	Distichlis spicata	0.2	Carduus pycnocephalus	1.0	Raphanus sativus	7.0	S
035	Atriplex prostrata	35.5	N/A		Bolboschoenus maritimus	33.3	
	Helenium bolanderi	22.1			Salicornia pacifica	17.8	
	Polypogon monspeliensis	12.6			Atriplex prostrata	13.3	?

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
036	Polygonum argyrocoleon	45.5	Distichlis spicata	35.2			
	Rumex conglomeratus	13.1	Sonchus oleraceus	23.0	N/A		
	Cotula coronopifolia	7.9	Polypogon monspeliensis	10.8			?
037	Rumex conglomeratus	29.8	Phragmites australis	27.0	Phragmites australis	83.3	
	Cotula coronopifolia	27.9	Polypogon monspeliensis	22.9	Atriplex prostrata	7.8	
	Chenopodium album	12.4	Cotula coronopifolia	21.3	Salicornia pacifica	6.7	W?
038	Atriplex prostrata	70.9	Bolboschoenus maritimus	42.2	Salicornia pacifica	87.2	
	Bolboschoenus maritimus	21.6	Polypogon monspeliensis	29.0	Bolboschoenus maritimus	7.7	
	Cuscuta salina var. major	2.6	Atriplex prostrata	13.2	Rumex dentatus	2.6	W
039	Salicornia pacifica	82.4	Salicornia pacifica	31.0			
	Atriplex prostrata	8.7	Sesuvium verrucosum	31.0	N/A		
	Cotula coronopifolia	4.3	Atriplex prostrata	14.5			D
040	Salicornia pacifica	92.1	Salicornia pacifica	83.3			
	Sesuvium verrucosum	7.9	Sesuvium verrucosum	16.7	N/A		S
041	Juncus balticus	47.4			Lepidium latifolium	43.4	
	Lepidium latifolium	43.8	N/A		Juncus	20.3	
	Atriplex prostrata	2.7			Conium maculatum	10.8	?
042	Distichlis spicata	32.4	Salicornia pacifica	36.0	Salicornia pacifica	41.2	
	Glaux maritima	27.0	Glaux maritima	20.0	Glaux maritima	17.2	
	Grindelia stricta	14.2	Grindelia stricta	16.0	Grindelia stricta	12.0	W
043	Distichlis spicata	54.6	Juncus balticus	33.2	Grindelia stricta	37.1	
	Juncus balticus	28.4	Distichlis spicata	19.8	Juncus balticus	18.5	
	Potentilla anserina	8.5	Grindelia stricta	15.8	Salicornia pacifica	15.5	W?

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
044	Rubus armeniacus	99.4	Rubus armeniacus	91.7	Rubus armeniacus	80.3	
	Lepidium latifolium	0.2	Distichlis spicata	7.3	Distichlis spicata	16.1	
	Typha angustifolia	0.2	Bromus diandrus	0.2	Conium maculatum	0.5	W
045	Typha angustifolia	57.2	Typha angustifolia	73.4	Typha angustifolia	85.5	
	Schoenoplectus acutus	41.6	Schoenoplectus acutus	26.2	Schoenoplectus acutus	13.2	
	Schoenoplectus californicus	1.0	Distichlis spicata	0.2	Conium maculatum	0.3	S
046	Distichlis spicata	52.9	Distichlis spicata	34.2	Salicornia pacifica	43.7	
	Triglochin maritimum	24.8	Salicornia pacifica	25.6	Distichlis spicata	17.9	
	Jaumea carnosa	6.6	Jaumea carnosa	12.8	Juncus balticus	9.9	W
047	Juncus balticus	25.9	Salicornia pacifica	46.2	Salicornia pacifica	50.2	
	Distichlis spicata	24.6	Distichlis spicata	14.6	Grindelia stricta	13.4	
	Glaux maritima	19.1	Juncus balticus	13.9	Glaux maritima	8.4	W
048	Schoenoplectus americanus	46.4	Schoenoplectus americanus	38.5	Calystegia sepium	30.9	
	Calystegia sepium	33.6	Calystegia sepium	17.8	Euthamia occidentalis	22.3	
	Euthamia occidentalis	18.3	Euthamia occidentalis	14.8	Oenanthe sarmentosa	18.1	S
049	Typha angustifolia	92.9	Typha angustifolia	47.0	Schoenoplectus americanus	79.2	
	Schoenoplectus americanus	6.1	Schoenoplectus americanus	17.1	Typha angustifolia	14.8	
	Schoenoplectus californicus	1.0	Typha latifolia	11.1	Eleocharis acicularis	3.3	S
050	Sesuvium verrucosum	98.8	Sesuvium verrucosum	54.2	Sesuvium verrucosum	54.2	
	Atriplex prostrata	1.0	Bolboschoenus maritimus	23.5	Bolboschoenus maritimus	24.1	
	Bolboschoenus maritimus	0.2	Digitaria sanguinalis	21.7	Salicornia pacifica	18.1	W

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
051	Schoenoplectus californicus	100.0	Schoenoplectus acutus	99.0	Schoenoplectus californicus	88.0	
			Schoenoplectus americanus	1.0	Schoenoplectus americanus	5.2	
					Typha angustifolia	5.2	S
052	Hordeum marinum	39.6	Baccharis pilularis	25.8	Baccharis pilularis	57.3	
	Baccharis pilularis	35.7	Avena barbata	21.9	Bromus diandrus	19.9	
	Bromus diandrus	9.1	Hordeum marinum	21.9	Avena barbata	17.5	D?
053	Salicornia pacifica	69.3	Salicornia pacifica	74.9	Salicornia pacifica	93.4	
	Distichlis spicata	21.0	Distichlis spicata	21.4	Distichlis spicata	4.9	
	Atriplex prostrata	6.3	Cotula coronopifolia	2.1	Bolboschoenus maritimus	0.3	W
054	Rosa californica	78.4	Rosa californica	56.3	Rosa californica	67.7	
	Baccharis pilularis	8.6	Baccharis pilularis	20.1	Schoenoplectus acutus	15.0	
	Schoenoplectus californicus	5.7	Lolium multiflorum	5.6	Baccharis pilularis	7.5	S?
056	Distichlis spicata	63.5	Distichlis spicata	46.9	Frankenia salina	51.8	
	Lactuca serriola	20.2	Bromus diandrus	23.5	Bromus diandrus	25.9	
	Frankenia salina	10.5	Frankenia salina	18.8	Distichlis spicata	11.3	D?
058	Hordeum marinum	31.6	Bromus diandrus	53.2	Distichlis spicata	41.9	
	Bromus hordeaceus	28.5	Distichlis spicata	28.8	Bromus diandrus	29.9	
	Bromus diandrus	24.4	Lactuca serriola	5.5	Centaurea solstitialis	18.0	W
059	Distichlis spicata	62.0	Distichlis spicata	46.2			
	Salicornia pacifica	14.6	Salicornia pacifica	42.0	N/A		
	Cuscuta salina var. major	9.5	Triglochin maritimum	5.0			W
060	Lepidium latifolium	59.3	Lepidium latifolium	52.1	Salicornia pacifica	59.8	
	Distichlis spicata	17.2	Distichlis spicata	17.4	Schoenoplectus americanus	13.3	W

PlotID	1999		2006		2012		
	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
	Atriplex prostrata	5.7	Salicornia pacifica	13.0	Distichlis spicata	10.6	
061	Distichlis spicata	48.5	Distichlis spicata	44.4			
	Lotus corniculatus	27.7	Salicornia pacifica	21.4	N/A		
	Jaumea carnosa	9.9	Lotus corniculatus	17.1			W
062	Leymus triticoides	96.9	Leymus triticoides	54.3	Elymus triticoides	63.6	
	Bromus hordeaceus	1.0	Lactuca serriola	15.1	Bromus diandrus	13.6	
	Lepidium latifolium	1.0	Bromus hordeaceus	7.0	Lactuca serriola	9.1	D?
063	Schoenoplectus americanus	89.4	Schoenoplectus americanus	57.1	Schoenoplectus americanus	38.7	
	Atriplex prostrata	3.0	Juncus balticus	12.6	Lepidium latifolium	23.5	
	Frankenia salina	2.0	Typha latifolia	9.1	Juncus balticus	16.6	S?
064	Distichlis spicata	49.3	Distichlis spicata	28.1	Salicornia pacifica	40.5	
	Triglochin maritimum	24.2	Jaumea carnosa	24.1	Distichlis spicata	16.9	
	Juncus balticus	13.8	Salicornia pacifica	20.1	Juncus balticus	11.8	W
065	Leymus triticoides	70.4	Leymus triticoides	54.2			
	Distichlis spicata	18.2	Distichlis spicata	25.6	N/A		
	Bromus hordeaceus	5.8	Bromus hordeaceus	7.2			S
067	Typha latifolia	70.7	Typha latifolia	97.0			
	Juncus balticus	17.7	Schoenoplectus americanus	2.3	N/A		
	Atriplex prostrata	8.8	Atriplex prostrata	0.2			W
068	Salicornia pacifica	44.7	Distichlis spicata	46.0			
	Lolium multiflorum	27.9	Lepidium latifolium	19.3	N/A		
	Frankenia salina	15.8	Lolium multiflorum	13.8			D

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
069	Salicornia pacifica	96.0	N/A		Salicornia pacifica	98.3	
	Lolium multiflorum	2.0			Atriplex prostrata	0.3	
	Polypogon monspeliensis	1.0			Hordeum murinum	0.3	S
070	Lolium multiflorum	67.7	Lolium multiflorum	52.8	Salsola soda	51.4	
	Frankenia salina	12.9	Hordeum marinum	20.3	Lolium multiflorum	23.4	
	Atriplex prostrata	10.0	Frankenia salina	16.3	Bromus hordeaceus	9.3	W
071	Distichlis spicata	71.1	Typha latifolia	96.9	N/A		
	Juncus balticus	10.0	Atriplex prostrata	2.6			
	Typha	7.0	Distichlis spicata	0.3			W
072	Schoenoplectus americanus	90.5	Schoenoplectus americanus	96.9	N/A		
	Atriplex prostrata	7.9	Salicornia pacifica	2.6			
	Salicornia pacifica	1.1	Atriplex prostrata	0.3			S
073	Distichlis spicata	60.6	Schoenoplectus americanus	48.4	N/A		
	Juncus balticus	16.2	Atriplex prostrata	17.4			
	Sonchus oleraceus	7.1	Typha latifolia	17.4			W
074	Frankenia salina	41.8	Lolium multiflorum	53.8	Bromus hordeaceus	28.3	
	Rumex crispus	26.2	Frankenia salina	35.8	Frankenia salina	28.3	
	Lolium multiflorum	20.9	Hordeum marinum	3.6	Salsola soda	28.3	W
075	Frankenia salina	45.7	Distichlis spicata	32.2	N/A		
	Distichlis spicata	44.8	Atriplex prostrata	26.8			
	Atriplex prostrata	9.0	Frankenia salina	16.1			?

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
076	Rumex crispus	66.1	Lotus corniculatus	42.7	Distichlis spicata	35.7	
	Lolium multiflorum	18.6	Lepidium latifolium	19.0	Lotus corniculatus	25.7	
	Distichlis spicata	4.7	Lolium multiflorum	11.4	Atriplex prostrata	24.3	W
077	Hordeum marinum	43.8	Salicornia pacifica	75.5	Salicornia pacifica	74.1	
	Lolium multiflorum	43.8	Frankenia salina	16.8	Distichlis spicata	11.9	
	Frankenia salina	11.7	Lolium multiflorum	3.4	Frankenia salina	11.9	W
078	Grindelia stricta var. angustifolia	72.0	Lepidium latifolium	47.5	Jaumea carnosa	49.4	
	Lolium multiflorum	9.3	Grindelia stricta	23.7	Lotus corniculatus	11.9	
	Lotus corniculatus	5.6	Frankenia salina	20.4	Euthamia occidentalis	9.9	W
079	Salicornia pacifica	98.7	Salicornia pacifica	98.0	Algae	69.2	
	Polypogon monspeliensis	1.1	Polypogon monspeliensis	1.4	Salicornia pacifica	27.7	
	Hordeum marinum	0.2	Atriplex prostrata	0.3	Salsola soda	3.0	S
082	Potamogeton pectinatus	100.0	N/A		Typha angustifolia	35.7	
					Typha angustifolia	25.0	
					Bolboschoenus maritimus	21.4	S
083	Distichlis spicata	51.3	Distichlis spicata	52.9	Salicornia pacifica	51.9	
	Schoenoplectus americanus	35.9	Salicornia pacifica	17.6	Distichlis spicata	13.0	
	Juncus balticus	5.1	Cotula coronopifolia	15.0	Lotus corniculatus	10.8	W
086	Salicornia pacifica	50.5	Salicornia pacifica	57.2	Salicornia pacifica	43.0	
	Distichlis spicata	15.0	Distichlis spicata	17.9	Distichlis spicata	28.3	
	Polypogon monspeliensis	11.2	Picris echioides	8.9	Epilobium ciliatum	7.9	S
087	Apocynum cannabinum	29.6	Schoenoplectus acutus	37.7	Rosa californica	50.0	
	Schoenoplectus acutus	16.9	Rosa californica	25.1	Schoenoplectus californicus	30.0	
	Rosa californica	15.2	Apocynum cannabinum	12.6	Raphanus sativus	6.0	S?

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
088	Schoenoplectus americanus	54.9	Typha latifolia	91.8	Rumex violascens	36.8	
	Typha angustifolia	32.1	Schoenoplectus americanus	4.3	Sonchus oleraceus	16.5	
	Polypogon monspeliensis	7.3	Schoenoplectus acutus	2.2	Atriplex prostrata	12.9	D
089	Salicornia pacifica	63.4	Salicornia pacifica	72.0	Salicornia pacifica	95.0	
	Polypogon monspeliensis	15.9	Poaceae	19.4	Distichlis spicata	2.5	
	Rumex crispus	10.6	Lolium multiflorum	7.5	Atriplex prostrata	1.3	W
090	Salicornia pacifica	88.5	Distichlis spicata	88.2	Distichlis spicata	54.5	
	Atriplex prostrata	7.3	Phragmites australis	6.9	Typha latifolia	19.8	
	Frankenia salina	1.0	Lepidium latifolium	3.9	Phragmites australis	14.9	S?
091	Lolium multiflorum	82.2	Lolium multiflorum	70.2	Bromus hordeaceus	42.6	
	Bromus hordeaceus	8.8	Frankenia salina	16.5	Lolium multiflorum	42.6	
	Hordeum marinum ssp. gussonianum	4.4	Hordeum marinum	10.3	Frankenia salina	5.3	W
092	Salicornia pacifica	82.8	Salicornia pacifica	93.8	N/A		
	Atriplex prostrata	13.6	Rumex dentatus	3.3			
	Rumex pulcher	1.9	Polypogon monspeliensis	2.2			W
094	Atriplex lentiformis	60.1	N/A		Atriplex lentiformis	57.4	
	Bromus diandrus	23.2			Bromus diandrus	35.1	
	Atriplex prostrata	13.7			Lepidium latifolium	4.8	S
099	Lepidium latifolium	53.4	Distichlis spicata	40.1	Distichlis spicata	38.2	
	Distichlis spicata	37.7	Lepidium latifolium	40.1	Salicornia pacifica	25.5	
	Salicornia pacifica	2.7	Polypogon monspeliensis	4.0	Lepidium latifolium	19.1	W

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
100	Frankenia salina	53.2	N/A		Frankenia salina	51.6	
	Lolium multiflorum	42.6			Lolium multiflorum	43.7	
	Hordeum marinum	2.1			Asteraceae	0.8	S
103	Salicornia pacifica	88.7	N/A		Salicornia pacifica	96.8	
	Atriplex prostrata	6.6			Cotula coronopifolia	2.3	
	Cotula coronopifolia	4.7			Atriplex prostrata	0.5	W
107	Salicornia pacifica	77.5	Salicornia pacifica	87.1	Salicornia pacifica	60.2	
	Distichlis spicata	15.8	Distichlis spicata	8.1	Distichlis spicata	26.8	
	Atriplex prostrata	3.2	Limonium californicum	1.6	Phragmites australis	11.2	W?
108	Leymus triticoides	43.9	Leymus triticoides	53.3	Taeniatherum caput-medusae	51.1	
	Bromus diandrus	31.2	Taeniatherum caput-medusae	16.0	Elymus triticoides	34.1	
	Bromus hordeaceus	14.6	Bromus diandrus	13.3	Bromus diandrus	4.9	S
110	Salicornia pacifica	90.4	Salicornia pacifica	86.2	Salicornia pacifica	72.6	
	Cuscuta salina var. major	6.1	Cuscuta salina	6.9	Distichlis spicata	12.6	
	Distichlis spicata	2.0	Hainardia cylindrica	2.3	Cuscuta	11.0	S
111	Distichlis spicata	61.8	Distichlis spicata	45.7	Salicornia pacifica	64.0	
	Salicornia pacifica	17.7	Salicornia pacifica	45.7	Distichlis spicata	18.5	
	Cordylanthus mollis ssp. mollis	11.5	Triglochin maritimum	2.8	Lotus corniculatus	7.4	D?
113	Salicornia pacifica	66.4	N/A		Salicornia pacifica	94.5	
	Crypsis schoenoides	26.5			Salicornia pacifica	5.2	
	Bolboschoenus maritimus	6.6			Cotula coronopifolia	0.3	W
118	Atriplex prostrata	29.9	Atriplex lentiformis	48.5	Atriplex lentiformis	81.6	
	Atriplex lentiformis	27.9	Conium maculatum	32.4	Elytrigia pontica	7.0	D

PlotID	1999		2006		2012		
	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
	Conium maculatum	24.9	Hordeum marinum	4.4	Bromus diandrus	2.3	
119	Elytrigia pontica	80.6	N/A		Elytrigia pontica	90.9	
	Hordeum marinum	18.5			Brassica nigra	5.7	
	Atriplex prostrata	0.2			Frankenia salina	2.8	D?
126	Lotus corniculatus	88.8	N/A		Elytrigia pontica	67.4	
	Picris echioides	5.1			Lepidium latifolium	28.4	
	Lepidium latifolium	3.1			Frankenia salina	3.5	S?
129	Sesuvium verrucosum	99.7	N/A		Salicornia pacifica	47.6	
	Chenopodium album	0.3			Bolboschoenus maritimus	26.2	
					Cotula coronopifolia	26.2	W
132	Cotula coronopifolia	99.6	N/A		Salicornia pacifica	50.9	
	Polypogon monspeliensis	0.2			Cotula coronopifolia	18.8	
	Sesuvium verrucosum	0.2			Polypogon monspeliensis	16.1	S?
136	Distichlis spicata	74.4	Lolium multiflorum	66.6	N/A		
	Lolium multiflorum	7.8	Distichlis spicata	20.1			
	Lotus corniculatus	5.9	Frankenia salina	9.1			S?
138	Salicornia pacifica	98.8	N/A		Salicornia pacifica	93.6	
	Frankenia salina	1.0			Cotula coronopifolia	2.3	
	Atriplex prostrata	0.2			Polypogon monspeliensis	2.3	S
139	Foeniculum vulgare	82.3	N/A		Foeniculum vulgare	86.2	
	Distichlis spicata	13.0			Carduus pycnocephalus	2.5	
	Bromus diandrus	4.3			Distichlis spicata	2.5	S

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
142	Salicornia pacifica	99.3	N/A		Salicornia pacifica	97.8	
	Aster subulatus	0.2			Distichlis spicata	1.4	
	Atriplex prostrata	0.2			Bolboschoenus maritimus	0.3	S
143	Lolium multiflorum	62.6	N/A		Lepidium latifolium	61.2	
	Lepidium latifolium	17.7			Distichlis spicata	30.6	
	Distichlis spicata	6.3			Frankenia salina	7.7	W
145	Schoenoplectus californicus	98.2	Schoenoplectus californicus	91.2	Schoenoplectus acutus	73.4	
	Atriplex prostrata	1.0	Distichlis spicata	6.9	Schoenoplectus acutus	20.0	
	Distichlis spicata	0.2	Agrostis avenacea	0.2	Phragmites australis	2.2	S
147	Lolium multiflorum	33.7	Distichlis spicata	38.7	Salicornia pacifica	42.5	
	Agrostis avenacea	26.8	Polypogon monspeliensis	23.2	Distichlis spicata	32.6	
	Xanthium strumarium	18.4	Lolium multiflorum	15.5	Distichlis spicata	14.2	W
148	Lolium multiflorum	95.6	Lolium multiflorum	94.4	N/A		
	Atriplex prostrata	2.0	Bromus diandrus	1.9			
	Aster subulatus	1.0	Distichlis spicata	1.0			S
151	Atriplex prostrata	33.2	N/A		Distichlis spicata	70.1	
	Lolium multiflorum	23.9			Lolium perenne	6.5	
	Sonchus oleraceus	13.5			Bromus diandrus	5.2	W
154	Atriplex prostrata	41.5	Salicornia pacifica	37.0	N/A		
	Distichlis spicata	22.3	Distichlis spicata	22.2			
	Bolboschoenus maritimus	13.4	Polypogon monspeliensis	22.2			W
155	Centaurea solstitialis	54.4	N/A		Atriplex prostrata	36.3	
	Raphanus sativus	39.8			Polypogon monspeliensis	24.8	
	Lactuca serriola	4.6			Frankenia salina	8.3	W

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
157	Bolboschoenus maritimus	65.7	N/A		Salicornia pacifica	53.4	
	Salicornia pacifica	21.9			Bolboschoenus maritimus	37.7	
	Cotula coronopifolia	7.7			Distichlis spicata	3.1	S
158	Potamogeton pectinatus	97.0	N/A		Potamogeton pectinatus	97.1	
	Lemna gibba	1.5			Bolboschoenus maritimus	2.6	
	Typha angustifolia	1.5			Algae	0.3	S
159	Atriplex prostrata	96.0	Atriplex prostrata	41.7	Phragmites australis	98.1	
	Phragmites australis	1.0	Phragmites australis	35.7	Lepidium latifolium	1.2	
	Polypogon monspeliensis	1.0	Polygonum	6.0	Atriplex prostrata	0.2	S
161	Typha angustifolia	39.1	Xanthium strumarium	35.3	Typha	59.8	
	Echinochloa crus-galli	23.4	Typha angustifolia	26.5	Schoenoplectus acutus	12.0	
	Persicaria lapathifolia	23.4	Atriplex prostrata	14.1	Typha	10.8	W
164	Persicaria lapathifolia	29.9	N/A		Rumex	33.0	
	Aster subulatus	28.1			Picris echioides	18.8	
	Polypogon monspeliensis	24.5			Sonchus oleraceus	14.1	?
166	Sesuvium verrucosum	66.1	N/A		Cotula coronopifolia	55.0	
	Cotula coronopifolia	24.2			Salicornia pacifica	42.0	
	Bolboschoenus maritimus	6.6			Atriplex prostrata	0.6	S
167	Salicornia pacifica	81.9	N/A		Salicornia pacifica	51.1	
	Sesuvium verrucosum	15.3			Sesuvium verrucosum	46.5	
	Cotula coronopifolia	1.1			Cotula coronopifolia	0.5	S
168	Polypogon monspeliensis	44.4	Phragmites australis	62.3	N/A		
	Xanthium strumarium	30.7	Typha angustifolia	31.2			
	Lotus corniculatus	8.5	Juncus balticus	3.7			W

PlotID	1999		2006		2012		
	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
169	Distichlis spicata	93.6	Lolium multiflorum	48.5			
	Atriplex prostrata	1.0	Bromus diandrus	28.5	N/A		
	Frankenia salina	1.0	Distichlis spicata	19.0			D
170	Bolboschoenus maritimus	70.5	Phragmites australis	36.4	Phragmites australis	66.9	
	Sesuvium verrucosum	13.4	Rumex conglomeratus	25.5	Salicornia pacifica	13.9	
	Polygonum argyrocoleon	7.8	Bolboschoenus maritimus	21.8	Salsola australis	13.9	S
171	Frankenia salina	73.1	Bromus diandrus	58.7	Frankenia salina	69.2	
	Lolium multiflorum	24.1	Lolium multiflorum	36.7	Lolium multiflorum	17.9	
	Juncus balticus	0.9	Frankenia salina	3.1	Bromus diandrus	10.3	S?
172	Sesuvium verrucosum	99.0	Sesuvium verrucosum	75.8	Salicornia pacifica	35.8	
	Bolboschoenus maritimus	1.0	Persicaria lapathifolia	15.2	Cotula coronopifolia	15.9	
			Rumex conglomeratus	4.3	Phragmites australis	15.9	W
173	Cotula coronopifolia	98.8			Distichlis spicata	79.8	
	Aster subulatus	0.2	N/A		Lotus corniculatus	9.7	
	Atriplex prostrata	0.2			Atriplex prostrata	5.8	D
174	Persicaria lapathifolia	88.2			Phragmites australis	48.0	
	Echinochloa crus-galli	11.8	N/A		Typha angustifolia	45.9	
					Xanthium strumarium	4.2	W
175	Xanthium strumarium	36.8	Xanthium strumarium	71.6			
	Phragmites australis	29.1	Persicaria lapathifolia	12.3	N/A		
	Persicaria lapathifolia	26.2	Phragmites australis	9.2			D
176	Juncus balticus	40.7	Conium maculatum	42.3	Bromus diandrus	36.3	
	Conium maculatum	39.5	Juncus balticus	40.3	Distichlis spicata	13.4	
	Centaurea solstitialis	9.6	Centaurea solstitialis	5.0	Juncus arcticus	13.4	S

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
177	Juncus balticus	55.8	Juncus balticus	54.1	Juncus arcticus	88.7	
	Conium maculatum	33.5	Conium maculatum	41.0	Rosa californica	4.4	
	Raphanus sativus	4.9	Sonchus oleraceus	1.5	Asteraceae	3.0	W
180	Salicornia pacifica	50.0	Salicornia pacifica	100.0	N/A		
	Sesuvium verrucosum	50.0					W
181	Baccharis pilularis	67.9	Baccharis pilularis	51.9	N/A		
	Rosa californica	22.6	Rosa californica	43.3			
	Euthamia occidentalis	4.5	Calystegia sepium	1.7			S
182	Chenopodium album	70.0	N/A		Salicornia pacifica	28.6	
	Sesuvium verrucosum	28.4			Bolboschoenus maritimus	21.4	
	Atriplex prostrata	1.1			Cotula coronopifolia	14.3	W
184	Schoenoplectus acutus	65.4	Typha angustifolia	45.9	Schoenoplectus	57.6	
	Schoenoplectus americanus	15.7	Schoenoplectus acutus	34.4	Schoenoplectus acutus	16.3	
	Typha angustifolia	9.2	Schoenoplectus americanus	17.2	Typha angustifolia	12.5	S
185	Atriplex prostrata	97.8	Elytrigia pontica	92.6	Elytrigia pontica	98.3	
	Elytrigia pontica	1.1	Brassica nigra	3.1	Conium maculatum	1.3	
	Cirsium vulgare	0.2	Conium maculatum	3.1	Brassica nigra	0.3	D
186	Xanthium strumarium	83.9	Xanthium strumarium	51.8	N/A		
	Cotula coronopifolia	7.3	Cotula coronopifolia	25.4			
	Polypogon monspeliensis	5.2	Salicornia pacifica	10.2			W
189	Salicornia pacifica	82.5	Salicornia pacifica	96.7	N/A		
	Sesuvium verrucosum	15.0	Bolboschoenus maritimus	1.5			
	Cotula coronopifolia	2.5	Atriplex prostrata	0.3			W

	1999		2006		2012		
PlotID	Species	Relative Cover	Species	Relative Cover	Species	Relative Cover	trend code: S=same, W=wetter, D=drier
190	Echinochloa crus-galli	62.5	Water	100	N/A		W
	Atriplex prostrata	12.5					
	Cotula coronopifolia	12.5					
192	Frankenia salina	64.0	Frankenia salina	33.8	Frankenia salina	58.8	S
	Agrostis avenacea	24.3	Bromus diandrus	22.5	Bromus diandrus	24.5	
	Distichlis spicata	4.9	Distichlis spicata	18.0	Distichlis spicata	9.8	
194	Juncus balticus	87.5	Polypogon monspeliensis	92.6	Polypogon monspeliensis	62.2	S
	Salicornia pacifica	11.4	Cotula coronopifolia	3.3	Juncus arcticus	28.5	
	Frankenia salina	1.0	Rumex conglomeratus	1.1	Salicornia pacifica	5.2	
195	Rosa californica	80.3	Rosa californica	48.7	Rosa californica	76.0	S
	Frankenia salina	7.4	Poa	36.8	Frankenia salina	20.3	
	Lepidium latifolium	4.2	Frankenia salina	11.9	Agrostis avenacea	1.7	
197	Schoenoplectus acutus	20.2	Schoenoplectus acutus	37.0	N/A		?
	Typha angustifolia	20.2	Typha angustifolia	27.7			
	Euthamia occidentalis	17.3	Rubus armeniacus	13.9			

Table 6: Relative non-native species cover ((Non-Native Cover / Total Cover)*100) for the 69 Suisun Marsh plots that were sampled in all three sampling years (1999, 2006, and 2012). Grey highlighted plots indicate an increase in relative non-native cover, green highlighted plots indicate a decrease in relative non-native cover, and plots that are not highlighted show a <1% change in relative non-native cover.

PlotID	Relative Non-Native Cover (%)			
	1999	2006	2012	Δ 1999-2012
002	0.2		2.0	1.8
004	9.8	6.8	9.6	-0.2
009	0.0	0.0	0.0	0.0
010	100.0	99.8	100.0	0.0
012	13.8	6.3	39.3	25.6
013	71.7	90.3	63.3	-8.4
014	2.6	0.6	0.0	-2.6
015	1.0	2.1	56.2	55.1
016	7.8	5.7	3.4	-4.4
020	0.0	0.0	14.9	14.9
023	51.0	26.8	94.8	43.8
024	7.9	24.4	4.0	-3.9
025	99.8	99.6	75.0	-24.8
026	40.4	0.5	2.8	-37.5
034	99.8	100.0	93.6	-6.2
037	98.9	82.3	93.1	-5.8
038	74.9	44.3	4.6	-70.3
042	4.0	4.3	3.8	-0.3
043	1.7	1.1	9.6	7.9
044	99.6	92.2	81.2	-18.4
045	0.2	0.2	1.0	0.8
046	3.3	0.5	1.2	-2.1
047	12.3	1.7	3.7	-8.6
048	0.1	3.6	0.0	-0.1
049	0.0	0.0	0.9	0.9
050	1.0	21.7	2.4	1.4
052	63.5	69.0	41.7	-21.8
053	6.7	3.4	0.7	-6.1
054	3.1	13.7	6.0	3.0
056	25.3	34.1	36.9	11.6
058	85.9	69.6	53.9	-32.1
060	65.2	52.6	5.6	-59.6
062	2.7	37.0	30.0	27.3
063	6.7	9.6	27.3	20.6

PlotID	Relative Non-Native Cover (%)			
	1999	2006	2012	Δ 1999-2012
064	0.2	0.2	3.4	3.2
070	87.1	79.7	99.1	12.0
074	58.2	63.3	71.7	13.6
076	89.0	86.7	62.0	-27.0
077	87.9	6.0	2.1	-85.9
078	24.5	50.9	31.2	6.7
079	1.3	2.0	3.2	1.8
083	6.2	28.0	32.9	26.7
086	24.1	13.4	7.8	-16.3
087	2.0	13.4	16.0	14.0
088	7.5	1.1	61.8	54.3
089	36.6	8.2	2.0	-34.5
090	9.6	10.8	21.0	11.4
091	97.8	83.1	90.3	-7.5
099	55.3	47.9	31.8	-23.5
107	4.7	1.0	11.8	7.1
108	56.1	46.4	65.7	9.6
110	1.2	4.4	2.8	1.6
111	1.2	2.6	8.6	7.4
118	71.5	49.7	17.5	-54.0
145	1.2	1.2	5.0	3.8
147	73.7	44.3	4.8	-68.8
159	99.2	84.5	100.0	0.8
161	25.5	20.8	1.7	-23.8
170	15.2	67.6	83.0	67.8
171	25.3	96.4	29.5	4.2
172	0.0	7.6	33.4	33.4
176	58.6	59.1	73.2	14.6
177	43.7	44.7	3.6	-40.1
184	0.3	0.2	0.0	-0.3
185	100.0	100.0	100.0	0.0
186	14.9	30.7	0.0	-14.9
192	30.5	39.2	26.5	-4.0
194	0.0	98.3	64.5	64.5
195	12.3	2.6	3.7	-8.5
Mean Total	33.09010983	33.32451556	30.92999674	-2.160113091

Table 7: A summary of the non-native species that were the top three most abundant within each of the 69 Suisun Marsh vegetation monitoring plots that were sampled all three sampling years (1999, 2006, 2012). The yellow highlighted species are considered non-native species of concern.

	# of Plots where the Species is one of the Top 3 most abundant				Minimum Relative Cover Of Species				Maximum Relative Cover of Species				Average Relative Cover of Species where dominant			
Species Name	1999	2006	2012	Δ 1999-2012	1999	2006	2012	Δ 1999-2012	1999	2006	2012	Δ 1999-2012	1999	2006	2012	Δ 1999-2012
Agrostis avenacea	2	1	1	-1	24	0.02	2	-22	27	0.02	2	-25	25.5	0.02	2.0	-23.5
Agrostis viridis		1		0		4		0		4		0		4.0		0.0
Anthriscus caucalis			1	1			7	7			7	7			7.0	7.0
Apium graveolens	3	8	2	-1	0.02	0.02	0.02	0	6	3	0.02	-5.98	2.7	1.0	0.2	-2.5
Asparagus officinalis		1		0		0.02		0		0.02		0		0.02		0.0
Atriplex prostrata	34	28	31	-3	0.02	0.02	0.02	0	98	42	24	-74	12.1	3.9	2.8	-9.3
Avena barbata		1	2	2		22	2	2		22	17	17		22.0	9.5	9.5
Brassica nigra		1	2	2		3	0.02	0.02		3	6	6		3.0	3.0	3.0
Bromus diandrus	10	12	12	2	0.02	0.02	2	1.98	31	59	50	19	7.5	16.5	18.8	11.3
Bromus hordeaceus	6	4	6	0	1	0.02	0.02	-0.98	29	13	43	14	11.2	5.3	14.7	3.5
Carduus pycnocephalus	1	1	1	0	5	1	5	0	5	1	5	0	5.0	1.0	5.0	0.0
Centaurea solstitialis	3	5	5	2	0.02	2	0.02	0	59	27	31	-28	23.0	8.0	13.0	-10.0
Chenopodium album	1	1	1	0	12	0.02	1	-11	12	0.02	1	-11	12.0	0.02	1.0	-11.0
Cirsium vulgare	5	1	1	-4	0.02	0.02	0.02	0	7	0.02	0	-7	1.8	0.02	0.02	-1.8
Conium maculatum	3	6	9	6	25	0.02	0.02	-25	39	42	4	-35	32.3	20.0	1.7	-30.7
Cotula coronopifolia	7	10	5	-2	0.02	0.02	0.02	0	28	21	16	-12	7.7	4.5	3.4	-4.3
Crypsis schoenoides			1	1			1	1			1	1			1.0	1.0
Cynodon dactylon	1	2	2	1	12	2	3	-9	12	3	4	-8	12.0	2.5	3.5	-8.5
Digitaria sanguinalis		1		0		22		0		22		0		22.0		0.0
Echinochloa crus-galli	2			-2	5			-5	23			-23	14.0			-14.0
Elytrigia pontica	1	1	2	1	1	93	7	6	1	93	98	97	1.0	93.0	52.5	51.5

Species Name	# of Plots where the Species is one of the Top 3 most abundant				Minimum Relative Cover Of Species				Maximum Relative Cover of Species				Average Relative Cover of Species where dominant			
	1999	2006	2012	Δ 1999-2012	1999	2006	2012	Δ 1999-2012	1999	2006	2012	Δ 1999-2012	1999	2006	2012	Δ 1999-2012
Foeniculum vulgare	2	2	1	-1	1	3	0.02	-0.98	2	4	0.02	-1.98	1.5	3.5	0.02	-1.5
Hainardia cylindrica		1		0		2		0		2		0		2.0		0.0
Hordeum marinum	5	5	2	-3	0.02	4	0.02	0	44	22	1	-43	23.6	12.0	0.5	-23.1
Hordeum marinum ssp. gussonianum	2			-2	4			-4	5			-5	4.5			-4.5
Hordeum murinum			2	2			0.02	0.02			1	1			0.5	0.5
Hordeum murinum ssp. leporinum		1		0		1		0		1		0		1.0		0.0
Hypochaeris radicata	1		1	0	6		2	-4	6		2	-4	6.0		2.0	-4.0
Lactuca serriola	7	6	3	-4	0.02	0.02	1	0.98	20	15	9	-11	4.0	5.3	4.3	0.3
Lepidium latifolium	11	13	15	4	0.02	0.02	0.02	0	59	52	23	-36	11.3	13.8	4.9	-6.3
Lolium multiflorum	13	13	6	-7	0.02	0.02	0.02	0	82	70	43	-39	29.3	25.8	17.3	-12.0
Lotus corniculatus	2	8	8	6	0.02	0.02	0.02	0	6	43	26	20	3.0	6.4	8.4	5.4
Malva neglecta		1		0		1		0		1		0		1.0		0.0
Paspalum dilatatum		1		0		1		0		1		0		1.0		0.0
Phragmites australis	3	8	13	10	1	0.02	2	1	100	100	100	0	34.3	28.6	42.8	8.5
Picris echioides	3	3	5	2	1	1	0.02	-0.98	6	9	5	-1	3.0	4.3	1.6	-1.4
Polygonum argyrocoleon	1		2	1	8		1	-7	8		1	-7	8.0		1.0	-7.0
Polypogon monspeliensis	18	12	12	-6	0.02	0.02	0.02	0	16	93	62	46	4.8	15.6	7.7	2.8
Raphanus sativus	1	5	4	3	5	1	0.02	-4.98	5	10	7	2	5.0	4.8	5.0	0.0
Rubus armeniacus	2	3	3	1	99	1	17	-82	99	92	80	-19	99.0	59.0	55.3	-43.7
Rumex conglomeratus	2	4		-2	1	1		-1	30	25		-30	15.5	7.8		-15.5
Rumex crispus	6	3	3	-3	0.02	0.02	0.02	0	66	3	6	-60	17.5	1.7	2.0	-15.5
Rumex dentatus			1	1			3	3			3	3			3.0	3.0

Species Name	# of Plots where the Species is one of the Top 3 most abundant				Minimum Relative Cover Of Species				Maximum Relative Cover of Species				Average Relative Cover of Species where dominant			
	1999	2006	2012	Δ 1999-2012	1999	2006	2012	Δ 1999-2012	1999	2006	2012	Δ 1999-2012	1999	2006	2012	Δ 1999-2012
Salsola australis			1	1			14	14			14	14			14.0	14.0
Salsola soda			3	3			3	3			51	51			27.3	27.3
Sonchus oleraceus	3	1	5	2	0.02	2	0.02	0	0.02	2	17	16.98	0.02	2.0	4.6	4.6
Taeniatherum caput-medusae		1	1	1		16	51	51		16	51	51		16.0	51.0	51.0
Torilis arvensis			1	1			2	2			2	2			2.0	2.0
Vicia sativa	1			-1	6			-6	6			-6	6.0			-6.0
Vulpia bromoides		1		0		4		0		4		0		4.0		0.0
Vulpia myuros	1	1		-1	13	37		-13	13	37		-13	13.0	37.0		-13.0

Photo Comparison

Suisun 015. From left to right, 1999, 2006, and 2012. 1999 and 2006 are facing 300°, 2012 is facing west, 270°. With over 50% of the total plot covered in standing water in 2012, the general trend for this plot is longer inundation leading to less *Salicornia pacifica* and other short wetland herbs, lower total vegetation cover, and invasion of *Phragmites australis*. *Phragmites australis* is of particular concern because it is more tolerant of prolonged inundation and will easily thrive in open water where the low wetland herbs can not.

Suisun 022. From left to right, 1999 from southeast corner facing 256°, 2006 from southwest corner facing 256°. This site has maintained a similar species composition from 1999 to 2012 although the total vegetation cover is decreasing due to prolonged inundation.

Suisun 023. From left to right, 1999, 2006, and 2012. From southwest corner: 1999 facing 86°, 2006 and 2012 facing east, 90°. This plot has changed vegetation types every sampling year. In 1999 it was codominated by *Atriplex prostrata* and *Distichlis spicata* (with no *Phragmites australis* cover). In 2006 it was codominated by *Schoenoplectus americanus* and *Distichlis spicata* (with 20% *Phragmites australis*). In 2012 this plot was strongly dominated by *Phragmites australis*. Overall this plot is transitioning from shorter, dryer wetland herbs and weeds to tall wetland herbs that tolerate and thrive in areas with longer inundation. This is another example of *Phragmites australis* invasion.

Suisun 024. From left to right, 1999, 2006, and 2012. All from northeast corner, facing 222°. The *Salicornia pacifica* is slowly increasing in this plot, from 3% cover in 1999, 20% cover in 2006, to 48% cover in 2012, indicating more consistent soil moisture. Yet again another example of higher moisture content.

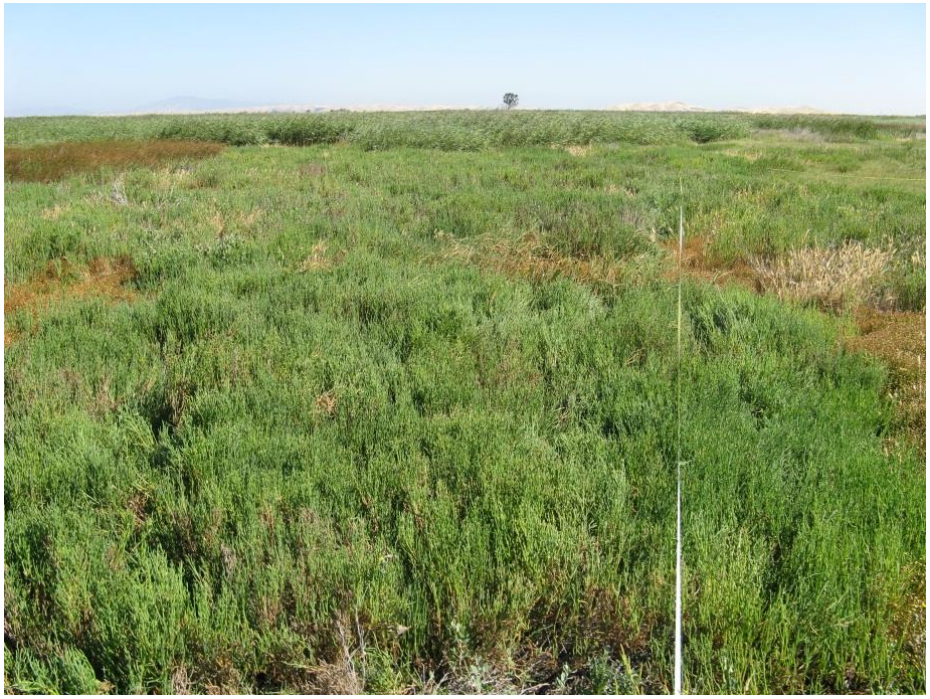
Suisun 050. From left to right, 1999, 2006, and 2012. All from southwest corner facing 26°. This plot is shifting dominance from *Sesuvium verrucosum* to *Bolboschoenus maritimus,* indicating longer inundation intervals.

Suisun 063. From left to right, 1999, 2006, and 2012. All from southwest corner facing 26°. This plot has remained the same at the alliance level from 1999 to 2012 (*Schoenoplectus americanus* Alliance), however at the association level it has shifted from pure *Schoenoplectus americanus* in 1999 to *Schoenoplectus americanus* with increasing *Lepidium latifolium* in 2006 to 2012.

Suisun 070. From left to right, 1999, 2006, and 2012. 1999 from 9m west of the north corner on the north side facing 180°, 2006 and 2012 from southwest corner facing south, 180°. This plot has remained a *Lolium multiflorum* alliance with a decreasing component of *Frankenia salina.* As of 2012 the plot was dominated by *Salsola soda,* which is a new weed for Suisun Marsh and should be considered a non-native species of concern, showing up recently in several areas.

Suisun 077. From left to right, 1999, 2006, and 2012. 1999 from west corner facing 110°, 2006 and 2012 from southwest corner facing 110°. The vegetation in this plot has shifted from dry upland vegetation in 1999 (*Lolium multiflorum* Alliance) to moister *Salicornia pacifica* in 2006 and 2012.

Suisun 099. From left to right, 1999, 2006, and 2012. 1999 from east corner facing 340°, 2006 and 2012 from southwest corner facing 340°. Despite evidence of manipulation (tilling?) in 2012, this plot has remained a *Lepidium latifolium-Distichlis spicata* Association all three sampling years (although total vegetation cover has decreased drastically).



Suisun 147. From left to right, 1999, 2006, and 2012. All from southeast corner facing 348°. The vegetation in this plot is transitioning to a higher native component. In 1999 the plot was dominated by annual grasses and *Xanthium strumarium , in* 2006 *Distichlis spicata* was dominant although *Xanthium strumarium* was still present at 15%, and in 2012 *Distichlis spicata* and *Salicornia pacifica* were clearly dominant and increasing and *Xanthium strumarium* had decreased to only 2% cover within the plot. This increase cover of *Salicornia pacifica*, is indicative of a general increase in moisture in recent years.

Suisun 174. From left to right, 1999 and 2012. 1999 from south side facing 340°, 2012 from northwest corner facing north, 360°. A clear shift in species composition is likely due to increased inundation allowing tall wetland species like *Typha angustifolia* and *Phragmites australis* to increase.

Suisun 185. From left to right, 1999, 2006, and 2012. 1999 from east corner facing 296°, 2006 and 2012 from southeast corner facing 296°. Plot obviously heavily managed; dominated by *Atriplex prostrata* in 1999 and quickly type changed to *Elytrigia pontica* in 2006 and has remained as such since.

Literature Cited

Boul, R., T. Keeler-Wolf, D. Hickson. 2007. The Vegetation of Suisun Marsh, Solano County, California: First Permanent Plot Resample Study. 1999 vs. 2006. California Department of Fish and Game, Biogeographic Data Branch. Sacramento, CA.

Keeler-Wolf, T. and M. Vaghti. 2000. Vegetation Mapping of Suisun Marsh, Solano County, California. Report to the California Department of Water Resources. California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch. Sacramento, CA.

Appendices

Appendix A: The California Native Plant Society/CA Department of Fish and Game Relevé vegetation sampling field form and protocol, adapted for the 2012 Suisun Marsh vegetation sampling.

(Revised July 9, 2012) **Project Code: SUMA12**

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	**Date:**	**Name(s) of surveyors (circle recorder):**

GPS Waypoint and photos to be taken at the SW corner of the plot, unless otherwise dictated by prior surveys.

GPS wypt #: _____ Datum: _____ or NAD83. Bearing, left axis at wypt_____ (degrees) of Long / Short side

UTME ___ ___ ___ ___ ___ ___ **UTMN** ___ ___ ___ ___ ___ ___ ___ **Zone: 10 / 11** (circle one) **Error: ±_____ ft / m / pdop**

Camera Name/Photograph #'s:

Stand Size (acres): <1, 1-5, >5 | Plot Size (m^2): 10 / 100 / 400 / 1000 | Plot Shape ___ x___ ft / m or Circle Radius____ft / m

Exposure, Actual °: _____ NE NW SE SW Flat Variable All | Steepness, Actual °: _____ 0° 1-5° 5-25° > 25

Topography: Macro: top upper mid lower bottom | Micro: convex flat concave undulating

Geology code: _____ Soil Texture code: _____ | Upland or **Wetland/Riparian** (circle one)

% Surface cover: (Incl. outcrops) (>60cm diam) (25-60cm) (7.5-25cm) (2mm-7.5cm) (Incl sand, mud)

H20:____ BA Stems:____ Litter: ____ Bedrock:____ Boulder:____ Stone:____ Cobble:____ Gravel:____ Fines:____ =100%

% Current year bioturbation _____ Past bioturbation present? Yes / No | % Hoof punch _____

Fire evidence: Yes / No (circle one) If yes, describe in Site history section, including date of fire, if known.

Plot location & orientation:

Site history *(include observations of fire scars, insect/disease damage, grazing/browsing, human disturbance):*

Vegetation and species distribution *(Vegetation and/or species of note that have patchy or continuous distribution):*

Additional Comments, unusual species:

Disturbance code / Intensity (L,M,H): _____/____ _____/____ _____/____ _____/____ _____/____ **"Other"** _____ / ____

II. HABITAT AND VEGETATION DESCRIPTION

Tree DBH : T1 (<1" dbh), **T2** (1-6" dbh), **T3** (6-11" dbh), **T4** (11-24" dbh), **T5** (>24" dbh), **T6** multi-layered (T3 or T4 layer under T5, >60% cover)

Shrub: S1 seedling (<3 yr. old), **S2** young (<1% dead), **S3** mature (1-25% dead), **S4** decadent (>25%)

% Cover- Non-Vasc cover: _____ Living Vasc. Veg:_____ Dead Standing Veg:_____ Non-Native Veg:_____

% Cover - Conifer / Hardwood tree: _____/_____ Shrub: _____ Herbaceous <1/2m: _____ Herbaceous >1/2m: _____

Height Class - Conifer / Hardwood tree: _____/_____ Shrub: _____ Herbaceous <1/2m: 01 Herbaceous >1/2m: _____

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: _____

Field-assessed association name (optional): _____

Adjacent alliances/direction: _____/_____, _____/_____	☐
Confidence in alliance identification: L M H Explain: _____	☐
Phenology (E,P,L): Herb____ Shrub____ Tree____ Other identification or mapping information:	☐

CNPS/CDFG Relevé Field Form - Suisun

RELEVE SPECIES SHEET (Revised 7/2/2012)

Page _______ of Polygon/Stand #: ____________

Stratum categories: T=Tree, S=Shrub, H1=Herb(<0.5m), H2=Herb(>0.5m), E=SEedling, A=SApling, and N=Non-vascular

% Cover Intervals for reference: r = trace, <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%

Strata	Vascular plant name or lichen/bryophyte	% Cover	Collection	Final species determination (or DBH)

CALIFORNIA NATIVE PLANT SOCIETY / DEPARTMENT OF FISH AND GAME
PROTOCOL FOR RELEVÉ SAMPLING FIELD FORM FOR SUISUN MARSH RESAMPLING

(June 26, 2012)

Introduction

This protocol describes the methodology for the relevé vegetation sampling techniques as recorded in the CDFG Suisun Marsh Relevé Field Form (dated June 21, 2012). This is a plot-based sampling protocol adapted specifically for the Suisun Marsh vegetation sampling effort that started in 1999 and is repeated every 6 years. The original project and sampling effort is detailed in Keeler-Wolf and Vaghti (2000).

Defining a stand of vegetation:

A stand is the basic physical unit of vegetation in a landscape. It has no set size. Some vegetation stands are very small, such as alpine meadow or tundra types, and some may be several square kilometers in size, such as desert or forest types. A stand is defined by two main unifying characteristics:

1) It has compositional integrity. Throughout the site, the combination of species is similar. The stand is differentiated from adjacent stands by a discernable boundary that may be abrupt or indistinct.

It has structural integrity. It has a similar history or environmental setting that affords relatively similar horizontal and vertical spacing of plant species. For example, a hillside forest originally dominated by the same species that burned on the upper part of the slopes, but not the lower, would be divided into two stands. Likewise, sparse woodland occupying a slope with very shallow rocky soils would be considered a different stand from an adjacent slope with deeper, moister soil and a denser woodland or forest of the same species.

The structural and compositional features of a stand are often combined into a term called homogeneity. For an area of vegetated ground to meet the requirements of a stand, it must be homogeneous (uniform in structure and composition throughout).

Sampling a plot within in a stand:

Because many stands are large, it may be difficult to summarize the species composition, cover, and structure of an entire stand. We are also usually trying to capture the most information as efficiently as possible. Thus, we are typically forced to select a representative portion to sample.

The original 1999 plots were located based on stand homogeneity and were thought to represent the larger stand of a particular type. However, with the combination of management-induced changes such as flooding regime, mechanical manipulation (disking, ditching, etc.), burning, or seeding of certain desirable species, the original stands may have changed internally, which could lead to the location of the plots currently not within homogeneous patches of vegetation. Even if the stand boundaries have shifted from the original sample, the location should still be kept the same, and additional notes should be taken describing the types of shifts.

Plot Size

Plot size depends on the type of plant community being sampled. For this project, shrub and herb communities are sampled with 400 sq. m plots.

Plot Shape

In this project, even though stands may have changed due to environmental or management changes, the same plot shape and configuration will be used as was used for the plot in the 1999 sampling effort.

As background, a relevé has no fixed shape, though plot shape should reflect the character of the stand. If the stand is about the same size as a relevé, the plot boundaries may be similar to that of the entire stand. If we are sampling streamside riparian or other linear communities, our plot dimensions should not go beyond the community's natural ecological boundaries. Thus, a relatively long, narrow plot capturing the vegetation within the stand, but not outside it would be appropriate. Species present along the edges of the plot that are clearly part of the adjacent stand should be excluded.

If we are sampling broad homogeneous stands, we would most likely choose a shape such as a circle (which has the advantage of the edges being equidistant to the center point) or a square (which can be quickly laid out using perpendicular tapes).

Definitions of fields in the protocol

LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #: All will start with SUMA (for Suisun Marsh) followed by the two digit abbreviation for the year (e.g. 12 for 2012) and end with the retained survey number (e.g., 178). e.g. SUMA12178

Date: Date of the sampling.

Name(s) of surveyors: The full names of each person assisting should be provided for the first field form for the day. On successive forms, initials of each person assisting can be recorded. Please note: The person recording the data on the form should circle their name/initials.

GPS waypoint #: The waypoint number stored in a Global Positioning System (GPS) unit when marking a waypoint for the sample location. Stored points should be downloaded in the office to serve as a check on the written points and to enter into a GIS. This will always be a unique number. If possible follow this format: GPS name yr mo dy time (e.g. GPS1207021042).

Unless otherwise stated in the field form from previous years, take the GPS point from the southwest corner of the plot or in the center of a circular plot.

GPS name: The name/number assigned to each GPS unit.

Datum: (NAD 83) The standard GPS datum used is NAD 83. If you are using a different datum, note it here.

Bearing, left axis at SW pt (note in degrees) of Long or Short side: For square or rectangular plots: from the SW corner (= the GPS point location), looking towards the plot, record the bearing of the axis to your left. If the plot is a rectangle, indicate whether the left side of the plot is the long

or short side of the rectangle by circling "long" or "short" side (no need to circle anything for circular or square plots.

UTM coordinates: Easting (UTME) and northing (UTMN) location coordinates using the Universal Transverse Mercator (UTM) grid. Record in writing the information from the GPS unit.

UTM zone: Universal Transverse Mercator zone. Suisun Marsh is in Zone 10.

Error: ± The accuracy of the GPS location, when taking the UTM field reading. Please record the error units by circling feet (ft), meters (m), or positional dilution of precision (pdop). If your GPS does not determine error, insert N/A in this field.

Elevation: Recorded from the GPS unit. Please circle feet (ft) or meters (m).

Photograph #s: Write the name or initials of the camera or its owner, JPG number, and direction of photos. *Take four photos in the main cardinal directions (N, E, S, W) clockwise from the north, from the GPS location.* Also try to replicate, as close as possible, each photo from previous survey.

Stand Size: Estimate the size of the entire stand in which the sample is taken. As a measure, one acre is about 4000 square meters (approximately 64 x 64 m), or 208 feet by 208 feet. One acre is similar in size to a football field.

Plot Size: Circle the size of the plot. Refer to previous sample datasheet to replicate size.

Plot Shape: Record the length and width of the plot and circle measurement units (i.e., ft or m). If it is a circular plot, enter radius (or just put a check mark in the space). Refer to previous sample datasheet to replicate shape.

Exposure: (Enter actual º and circle general category): With your back to the general uphill direction of the slope (i.e., by facing downhill of the slope), read degrees of the compass for the aspect or the direction you are standing, using degrees from north, adjusted for declination. Average the reading over the entire stand, even if you are sampling a relevé plot, since your plot is representative of the stand. If estimating the exposure, write "N/A" for the actual degrees, and circle the general category chosen. "Variable" may be selected if the same, homogenous stand of vegetation occurs across a varied range of slope exposures. Select "all" if stand is on top of a knoll that slopes in all directions or if the same, homogenous stand of vegetation occurs across all ranges of slope. Most plots in Suisun will not have an exposure, so write "N/A" for the actual degrees (not 0º), and circle "Flat".

Steepness: (Enter actual º and circle general category): Read degree slope from a compass or clinometer. If estimating, write "N/A" for the actual degrees, and circle the general category chosen. Make sure to average the reading across the entire stand even if you are sampling in a relevé plot. Most plots in Suisun will not have an exposure, so write "0º" for the actual degrees, and circle "0º".

Topography: First assess the broad (**Macro**) topographic feature or general position of the stand in the surrounding watershed, that is, the stand is at the top, upper (1/3 of slope), middle (1/3 of slope), lower (1/3 of slope), or bottom. **Circle *all* of the positions that apply for macrotopography.**

Then assess the local (**Micro**) topographic features or the lay of the area (*e.g.*, surface is flat or concave). **Circle only *one* of the microtopographic descriptors**.

Geology: Geological parent material of site. If exact type is unknown, use a more general category (*e.g.,* igneous, metamorphic, sedimentary). *See code list for types.*

Soil Texture: Record soil texture that is characteristic of the site (*e.g.,* coarse loamy sand, sandy clay loam). *See soil texture key and code list for types.*

Upland or Wetland/Riparian (circle one): Indicate if the stand is in an upland or a wetland. There are only two options. Wetland and riparian are one category. Note that a site need not be officially delineated as a wetland to qualify as such in this context (*e.g.,* seasonally wet meadow).

% Surface cover (abiotic substrates). It is helpful to imagine "mowing off" all of the live vegetation at the base of the plants and removing it – you will be estimating what is left covering the surface. **The total should sum to 100%.** Note that non-vascular cover (lichens, mosses, cryptobiotic crusts) is not estimated in this section.

% Water: Estimate the percent surface cover of running or standing water, ignoring the substrate below the water.

% BA Stems: Percent surface cover of the plant basal area, *i.e.*, the basal area of stems at the ground surface. Note that for most vegetation types BA is 1-3% cover.

% Litter: Percent surface cover of litter, duff, or wood on the ground (cow pies are litter).

% Bedrock: Percent surface cover of bedrock.

% Boulders: Percent surface cover of rocks > 60 cm in diameter.

% Stone: Percent surface cover of rocks 25-60 cm in diameter.

% Cobble: Percent surface cover of rocks 7.5 to 25 cm in diameter.

% Gravel: Percent surface cover of rocks 2 mm to 7.5 cm in diameter.

% Fines: Percent surface cover of bare ground and fine sediment (e.g. dirt) < 2 mm in diameter.

% Current year bioturbation: Estimate the percent of the sample or stand exhibiting soil disturbance by fossorial organisms (any organism that lives underground). Do not include disturbance by ungulates. Note that this is a separate estimation from surface cover.

Past bioturbation present? Circle Yes if there is evidence of bioturbation from previous years.

% Hoof punch: Note the percent of the sample or stand surface that has been punched down by hooves (cattle or native grazers) in wet soil.

Fire Evidence: Circle Yes if there is visible evidence of fire, and note the type of evidence in the "Site history, stand age and comments section," for example, "charred dead stems of *Quercus berberidifolia* extending 2 feet above resprouting shrubs." If you are certain of the year of the fire, put this in the Site history section.

Site history, stand age, and comments:

Plot location & orientation: Describe in as much detail as possible how the survey point was accessed (what roads, trails, distance walked, boat ride if taken) and the location and orientation of the plot. To the best of your ability, place the plot in the exact location as in previous years (see old datasheets and photos for orientation and placement). If previous data does not indicate the location from which the GPS point was taken, you can assume it was taken from the SW corner of the plot.

Site history: Briefly describe the stand age/seral stage, disturbance history, nature and extent of land use, and other site environmental and vegetation factors. Examples of disturbance history: fire, landslides, avalanching, drought, flood, animal burrowing, or pest outbreak. Also, try to estimate year or frequency of disturbance. Examples of land use: grazing, mowing, discing or mining. Examples of other site factors: exposed rocks, soil with fine-textured sediments, high litter/duff build-up, multi-storied vegetation structure, or other stand dynamics.

Vegetation and species distribution: Describe the distribution of the vegetation and species within the plot. Is the vegetation patchy or continuous? Is there one large patch of Phragmites that's in the NE quadrant of the plot? Is there more than one vegetation type within the plot?

Additional Comments: Use this space for listing species that are locally or regionally rare, endangered, or atypical (*e.g.*, range extension or range limit) within the stand. This field will be useful to the Program for obtaining data on regionally or locally significant populations of plants. Also include comments about unusual animal species, logistical planning issues for the next resampling effort of this plot, etc.

Disturbance code / Intensity (L,M,H): List codes for potential or existing impacts on the stability of the plant community. Characterize each impact each as **L** (=Light), **M** (=Moderate), or **H** (=Heavy). For invasive exotics, divide the total exotic cover (e.g. 25% Bromus diandrus + 8% Bromus madritensis + 5% Centaurea melitensis = 38% total exotics) by the total % cover of all the layers when added up (e.g. 15% tree + 5% low tree + 25% shrub + 40% herbs = 85% total) and multiply by 100 to get the % relative cover of exotics (e.g. 38% total exotics/85% total cover = 45% relative exotic cover). L = 0-33% *relative* cover of exotics; M =34-66% relative cover, and H = > 66% relative cover. You will also be estimating "% Non-Native Veg Cover" further down on the datasheet. *See code list for impacts.*

II. HABITAT AND VEGETATION DESCRIPTION

California Wildlife-Habitat Relationships (CWHR)

For CWHR, identify the size/height class of the stand using the following tree, shrub, and/or herbaceous categories. These categories are based on functional life forms.

Tree DBH: Circle one of the tree size classes provided when the tree canopy closure exceeds 10 percent of the total cover, or if young tree density indicates imminent tree dominance. Size class is based on the average diameter at breast height (dbh) of each trunk (standard breast height is 4.5ft or 137cm). When marking the main size class, make sure to estimate the mean diameter of all trees over the entire stand, and weight the mean if there are some larger tree dbh's. The "**T6 multi-layered**" dbh size class does not occur in Suisun Marsh.

Shrub: Circle one of the shrub size classes provided when shrub canopy closure exceeds 10 percent by recording which class is predominant in the survey. Shrub size class is based on the average amount of crown decadence (dead standing vegetation on live shrubs when looking across the crowns of the shrubs).

Overall Cover of Vegetation

Provide an estimate of cover for the following categories below (based on functional life forms). Record a specific number for the total aerial cover or "bird's-eye view" looking from above for each category, estimating cover for the living plants only. Litter/duff should not be included in these estimates. The porosity of the vegetation should be taken into consideration when estimating percent cover (how much of the sky can you see when you are standing under the canopy of a tree, or how much light passes through the canopy of the shrub layer?).

To come up with a specific number estimate for percent cover, first use generalized cover classes as reference aids such as the CWHR cover classes (<2%, 2-9%, 10-24%, 25-39%, 40-59%, 60-100%) or the modified Braun-Blanquet cover-abundance scale (<1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%). While keeping these intervals in mind, you can then refine your estimate to a specific percentage for each category below.

% NonVasc cover: The total cover of all lichens, bryophytes (mosses, liverworts, hornworts), and cryptogrammic crust on substrate surfaces including downed logs, rocks and soil, but not on standing or inclined trees or vertical rock surfaces.

% Vasc Veg cover: The total cover of all vascular vegetation taking into consideration the porosity, or the holes, in the vegetation. This is an estimate of the absolute vegetation cover, disregarding overlap of the various tree, shrub, and/or herbaceous layers and species.

% Non-Native Veg Ccover: The total cover of all vascular non-natives taking into consideration the porosity, or the holes, in the vegetation. This is an estimate of the absolute vegetation cover, disregarding overlap of the various tree, shrub, and/or herbaceous layers and species

% Cover by Layer

% Conifer Tree /Hardwood Tree: The total foliar cover (considering porosity) of all live tree species, disregarding overlap of individual trees. Estimate conifer and hardwood covers separately.

Please note: These cover values should not include the coverage of regenerating tree species (i.e., tree seedlings and saplings).

%Shrub: The total foliar cover (considering porosity) of all live shrub species disregarding overlap of individual shrubs.

%Herbaceous <1/2 m: The total cover (considering porosity) of all herbaceous species less than ½ meter in height, disregarding overlap of individual herbs.

%Herbaceous >1/2 m: The total cover (considering porosity) of all herbaceous species greater than ½ meter in height, disregarding overlap of individual herbs

Height Class by Layer

Modal height for conifer tree /hardwood tree, shrub, and herbaceous categories: Provide an estimate of height for each category listed. Record an average height value per each category by estimating the mean height for each group. Please use the following height intervals to record a height class: 01 =< 1/2m, 02=1/2-1m, 03 = 1-2 m, 04 = 2-5 m, 05 = 5-10 m, 06 = 10-15 m,

07 = 15-20 m, 08 = 20-35 m, 09 = 35-50 m, 10 => 50m.

Species List and Coverage

List all species, including nonnative species, present in the plot, using the relevé species sheet (page 2 of survey form)

In the strata column for each species, use the following codes:

T = Tree. A woody perennial plant that has a single trunk.

S = Shrub. A perennial, woody plant, that is multi-branched and doesn't die back to the ground every year.

H1 = Herb that are <1/2 meter in height. An annual or perennial that dies down to ground level every year.

H2 = Herb that are >1/2 meter in height. An annual or perennial that dies down to ground level every year.

E = SEedling. A tree species clearly of a very young age that is < 1" dbh.

A = SApling. 1" - <6" dbh and young in age, OR small trees that are < 1"diameter at breast height, are clearly of appreciable age, and kept short by repeated browsing, burning, or other disturbance.

N = Non-vascular. Includes moss, lichen, liverworts, hornworts, cryptogammic crust, and algae.

Be consistent and don't break up a single species into two separate strata. The only time it would be appropriate to do so is when one or more tree species are regenerating, in which case the Seedling and/or Sapling strata should be recorded for that species. These may be noted on the same line, e.g.:

Strata	**Species**	**%Cover**	C
T/E/A	Quercus douglasii	40/<1/<1	

Use Jepson Manual nomenclature. Write out the genus and species of the plant. Do not abbreviate. When uncertain of an identification (which you intend to confirm later) use parentheses to indicate what part of the determination needs to be confirmed. For example, you could write out *Brassica* (*nigra*) if you are sure it is a *Brassica* but you need further clarification on the specific epithet.

Provide the % absolute aerial cover for each species listed. When estimating, it is often helpful to think of coverage in terms of the following cover intervals at first:

<1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%.

Keeping these classes in mind, then refine your estimate to a specific percentage. All species percent covers may total over 100% because of overlap.

Record the <1% cover in two categories: r = trace (i.e., rare in plot, or solitary individuals) and <1% (few individuals at < 1% cover, but common in the plot).

Include the percent cover of snags (standing dead) of trees and shrubs. Note their species, if known, in the "Stand history, stand age and comments" section.

All non-native species should be included in the species list.

If a species collection is made, it should be indicated in the collection column with a "C" (for collected). If the species is later keyed out, cross out the species name or description and write the keyed species name in pen on the data sheet. Do not erase what was written in the field, because this information can be used if specimens get mixed up later. If the specimen is then thrown out, the "C" in the collection column should crossed out. If the specimen is kept but is still not confidently identified, add a "U" to the "C" in the collection column (CU = collected and unconfirmed). In this case the unconfirmed species epithet should be put in parentheses [e.g., *Hordeum (murinum)*]. If the specimen is kept and is confidently identified, add a "C" to the existing "C" in the collection column (CC = Collected and confirmed).

INTERPRETATION OF STAND

Field-assessed vegetation alliance name: Name of alliance or habitat following the Suisun classification system or the Manual of California Vegetation (Sawyer J.O., Keeler-Wolf T., and Evens, J. 2009). Please use scientific nomenclature, *e.g., Quercus agrifolia* forest. An alliance is based on the dominant or diagnostic species of the stand, and is usually of the uppermost and/or dominant height stratum. A dominant species covers the greatest area. A diagnostic species is consistently found in some vegetation types but not others.

Please note: The field-assessed alliance name may not exist in the present classification, in which case you can provide a new alliance name in this field. If this is the case, also make sure to state that it is not in the MCV or Suisun classification under the explanation for "Confidence in alliance identification."

Field-assessed association name (optional): Name of the species in the alliance and additional dominant/diagnostic species from any strata. In following naming conventions, species in differing strata are separated with a slash, and species in the uppermost stratum are listed first (*e.g., Quercus douglasii/Toxicodendron diversilobum*). Species in the same stratum are separated with a dash (*e.g., Quercus lobata-Quercus douglasii).*

Please note: The field-assessed association name may not exist in the present classification, in which you can provide a new association name in this field.

Adjacent Alliances/direction: Identify other vegetation types that are directly adjacent to the stand being assessed by noting the dominant species (or known type). Also note the distance away in meters from the GPS waypoint and the direction in degrees aspect that the adjacent alliance is found (e.g., *Salicornia virginica* / 50m, 360° N *Cressa truxillensis* /100m, 110°).

Confidence in Identification: (L, M, H) With respect to the "field-assessed alliance name", note whether you have L (=Low), M (=Moderate), or H (=High) confidence in the interpretation of this alliance name.

Explain: Please elaborate if your "Confidence in Identification" is low or moderate. Low confidence can occur from such things as a poor view of the stand, an unusual mix of species that does not meet the criteria of any described alliance, or a low confidence in your ability to identify species that are significant members of the stand.

Phenology: Indicate early (E), peak (P) or late (L) phenology for each of the strata.

Other identification problems or mapping issues: Discuss any further problems with the identification of the assessment or issues that may be of interest to mappers. Note if this sample represents a type that is likely too small to map. If it does, how much of the likely mapping unit would be comprised of this type. For example: "this sample represents the top of kangaroo rat precincts in this general area, which are surrounded by vegetation represented by CARR000x; this type makes up 10% of the mapping unit."

Appendix B: California Native Plant Society Relevé vegetation sampling field form and protocol used for the 1999 and 2006 Suisun Marsh vegetation sampling

(Revised 4/4/05)

Page_____ of Relevé # _____

See code list for italicized fields

	FOR OFFICE USE ONLY
Polygon #_____ or Relevé # _____	Permanent Number:
Date _____/ _____/ _____ MM DD YYYY Airphoto #	Community Name: Community Number: Occurrence Number:
County	Source Code:
USGS Quad. 7.5' or 15' (Circle one)	Quad Code: Quad Name: Map Index Number:
CNPS Chapter	Update: Yes No (Circle one)

Landowner

Contact Person

Address

City	Zip	Phone number

Observers

Relevé plot shape (square, rectangle, triangle, circle, entire stand) _____

Relevé plot size (length and width of rectangle, or circle-*diameter*) _____ _____ (m.)

NOTE: Forest/woodland plots should be 1000m² if upland or 400m² if riparian. All shrub plots should be 400m². Herb plots should be 100 or 10m²*. *Please consult with CNPS Vegetation Ecologist on herb plots. For circle radiuses: 5.64m (100m²), 11.28m (400m²), 17.84m (1000m²)

Study Plot Revisit? Yes or No (Circle one) Photo Interpreter Community Code for Polygon _____

Other polygons of same type? Yes or No Is plot representative of whole polygon? Yes or No (Circle one) If not, why not? _____

GPS File # _____ GPS name (or points in file) _____ Start Time _____:_____(am or pm) GPS Datum (from GPS setup) (e.g. WGS 84, NAD 27) _____

File type: Point or Polygon (circle one) Releve: UTMN ___ ___ ___ ___ ___ ___ ___UTME ___ ___ ___ ___ ___ ___ Error ±_____ ft/m UTM Zone _____

Transect: Start UTME ___ ___ ___ ___ ___ ___UTMN ___ ___ ___ ___ ___ ___ ___ End: UTME ___ ___ ___ ___ ___ ___ UTMN___ ___ ___ ___ ___ ___ ___

Elevation (ft.)_____ Slope (°) _____Aspect (°) _____ Topography: *Macro* _____ *Micro* _____

VEGETATION DESCRIPTION

Dominant Layer ___ 0-0.5 m, ___ 0.5-5 m, ___>5 m Preliminary Alliance Name _____

Stand Size ____<1 acre, ____1-5 acres, ____ >5 acres *Dominant Vegetation Group* _____ *(use codes from code list)*

Structure: Ground _____ Shrub _____ Tree _____ (1. Continuous 2. Intermittent 3. Open) Phenology: Ground _____Shrub _____Tree _____ (Early, Peak, Late)

Wetland Community Type _____ (Wetland or Upland)

If Community Type = Wetland (see Artificial Keys to Cowardin Systems and Names)

Cowardin System _____ Subsystem _____Class _____

Distance to water (m): Vertical _____ Horizontal _____ Channel form (if riverine) _____ (Straight, Meandering, Braided)

Adjacent Alliance Location (e.g., North, South, East, or West of stand)	Description (up to 4 species by layer)

Photographs – *Note position and direction of photo(s) relative to plot*

CALIFORNIA NATIVE PLANT SOCIETY RELEVÉ FIELD FORM

Page_____ of Relevé # _____

STAND AND ENVIRONMENTAL DESCRIPTION

Trend code _____
1. Increasing 2. Stable 3. Decreasing
4. Fluctuating 5. Unknown

Site Impact codes _____ _____ _____ _____ _____ _____ _____ _____
(List codes in order, with most significant first)

Site Intensity _____ _____ _____ _____ _____ _____ _____ _____
1. Light 2. Moderate 3. Heavy (List beneath each impact code)

Site Location and Plot Description – Describing where the plot is located and what the main vegetation and environmental features are

Site History – Including observations of fire scars, insect/disease damage, grazing/browsing, human disturbance

Sensitive Species – List species observed and GPS UTM's; Estimate size and extent of local populations

Unknown Specimens – List code, identification notes (e.g. Genus, condition of specimen) of unknowns

Additional Comments – Including animal observations, anthropological observations, abiotic features

Surface Coarse Fragments and Soils Information (see cover class intervals-**below** ⇓)

Type:	Fines	Gravel	Cobble	Stone	Boulders	Bedrock	Litter	Water	Living stems	Other (Specify):
Descriptor:	Including sand, mud	2mm-7.5 cm diameter	7.5-25 cm diam	25-60cm diam.	>60cm diam.	Including outcrops	Organic matter covering ground	Standing or running water	At ground surface	
Cover class (see below):										
% Cover*:										

*note all surface fragments, non-vegetation, living stems, etc., should add up to 100%

% Bioturbation _____ ***Soil Texture*** _____ ***Parent Material*** _____

Cover Class Intervals: 1 (<1%), 2 (1-5%), 3a (>5-15%), 3b (>15-25%), 4 (>25-50%), 5 (>50-75%), 6 (>75%)

Height Classes for Vegetation Strata & Cover Estimates (see cover class intervals - **above** ⇑)

Layer name:	Cryptogam Layer	0-25 cm	25-50 cm	0.5-1 m	1-2 m	2-5 m	5-10 m	10-20 m	20-30 m	>30 m.
Main										

species:										
Cover class:										

CALIFORNIA PLANT COMMUNITIES RELEVÉ FIELD FORM (PART 2)

SPECIES SHEET (Revised 5/17/01)

Page_____ of Relevé # _____

Cover Class Intervals: 1 (<1%), 2 (1-5%), 3a (>5-15%), 3b (>15-25%), 4 (>25-50%), 5 (>50-75%), 6 (>75%)

L=Low herbs and subshrubs (<0.5 m.), M=Medium height (0.5 m.-5.0 m.), T=Tall height (>5.0 m.)

L	M	T	Vascular plant name or moss/lichen cryptogamic crust cover	Final species determination or Tree dbh	Cover Class	%

Total Vegetation Cover (Class): _____ Total Tall_____ Total Medium _____ Total Low _____ Total Non-Native _____

CALIFORNIA NATIVE PLANT SOCIETY RELEVÉ PROTOCOL

CNPS VEGETATION COMMITTEE
October 20, 2000 (Revised 3/30/05)

Introduction

In *A Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995), CNPS published a Vegetation Sampling Protocol that was developed as a simple quantitative sampling technique applicable to many vegetation types in California. Investigators use an ocular estimation technique called a relevé to classify and map large areas in a limited amount of time.

The relevé method of sampling vegetation was developed in Europe and was largely standardized by the Swiss ecologist Josias Braun-Blanquet. He helped classify much of Europe's vegetation, founded and directed a synecology center in France, and was editor of *Vegetatio* for many years. The relevé was, and is, a method used by many European ecologists, and others around the world. These ecologists refer to themselves as phytosociologists. The use of relevé in the United States has not been extensive with the exception of the US Forest Service.

The relevé is particularly useful when observers are trying to quickly classify the range of diversity of plant cover over large units of land. In general, it is faster than the point intercept technique. One would use this method when developing a classification that could be used to map of a large area of vegetation, for example. This method may also be more useful than the line intercept method when one is trying to validate the accuracy of mapping efforts.
The relevé is generally considered a "semiquantitative" method. It relies on ocular estimates of plant cover rather than on counts of the "hits" of a particular species along a transect line or on precise measurements of cover/biomass by planimetric or weighing techniques.

Selecting a stand to sample:

A stand is the basic physical unit of vegetation in a landscape. It has no set size. Some vegetation stands are very small, such as alpine meadow or tundra types, and some may be several square kilometers in size, such as desert or forest types. A stand is defined by two main unifying characteristics:

1) It has <u>compositional</u> integrity. Throughout the site the combination of species is similar. The stand is differentiated from adjacent stands by a discernable boundary that may be abrupt or indistinct, and
2) It has <u>structural</u> integrity. It has a similar history or environmental setting that affords relatively similar horizontal and vertical spacing of plant species throughout.
   For example, a hillside forest originally dominated by the same species that burned on the upper part of the slopes, but not the lower, would be divided into two stands. Likewise, a sparse woodland occupying a slope with very shallow rocky soils would be considered a different stand from an adjacent slope with deeper, moister soil and a denser woodland or forest of the same species.

The structural and compositional features of a stand are often combined into a term called homogeneity. For an area of vegetated ground to meet the requirements of a stand it must be homogeneous.

Stands to be sampled may be selected by assessment prior to a site visit (e.g. delineated from aerial photos or satellite images), or may be selected on site (during reconnaissance to determine extent and boundaries, location of other similar stands, etc.). Depending on the project goals, you may want to select just one or a few representative stands for sampling (e.g., for developing a classification for a vegetation mapping project), or you may want to sample all of them (e.g., to define a rare vegetation type and/or compare site quality between the few remaining stands).

Selecting a plot to sample within in a stand:

Because most stands are large, it is difficult to summarize the species composition, cover, and structure of an entire stand. We are also usually trying to capture the most information with the least amount of effort. Thus, we are typically forced to select a representative portion to sample.

When sampling a vegetation stand, the main point to remember is to select a sample that, in as many ways possible, is representative of that stand. This means that you are not randomly selecting a plot; on the contrary, you are actively using your own best judgement to find a representative example of the stand.

Selecting a plot requires that you see enough of the stand you are sampling to feel comfortable in choosing a representative plot location. Take a brief walk through the stand and look for variations in species composition and in stand structure. In many cases in hilly or mountainous terrain look for a vantage point from which you can get a representative view of the whole stand. Variations in vegetation that are repeated throughout the stand should be included in your plot. Once you assess the variation within the stand, attempt to find an area that captures the stand's common species composition and structural condition to sample.

Plot Size

All releves of the same type of vegetation to be analyzed in a study need to be the same size. It wouldn't be fair, for example, to compare a 100 m2 plot with a 1000 m2 plot as the difference in number of species may be due to the size of the plot, not a difference in the stands.

A minimal area to sample is defined by species/area relationships; as the sampler identifies species present in an area of homogeneous vegetation, the number will increase quickly as more area is surveyed. Plot shape and size are somewhat dependent on the type of vegetation under study. Therefore general guidelines for plot sizes of tree-, shrub-, and herb-dominated upland, and fine-scale herbaceous communities have been established. Sufficient work has been done in temperate vegetation to be confident the following conventions will capture species richness:

Alpine meadow and montane wet meadow: 100 sq. m
Herbaceous communities: 10 sq. m plot, 100 sq. m plot or 400 sq. m plot (Consult with CNPS, and use one consistent size)
Shrublands: 400 sq. m plot

Forest and woodland communities: 1000 sq. m plot
Open desert vegetation: 1000 sq. m plot

Plot Shape

A relevé has no fixed shape, plot shape should reflect the character of the stand. If the stand is about the same size as a relevé, you need to sample the entire stand. If we are sampling a desert wash, streamside riparian, or other linear community our plot dimensions should not go beyond the community's natural ecological boundaries. Thus, a relatively long, narrow plot capturing the vegetation within the stand, but not outside it would be appropriate. Species present along the edges of the plot that are clearly part of the adjacent stand should be excluded.

If we are sampling broad homogeneous stands, we would most likely choose a shape such as a circle (which has the advantage of the edges being equidistant to the center point) or a square (which can be quickly laid out using perpendicular tapes). If we are trying to capture a minor bit of variety in the understory of a forest, for example a bracken fern patch within a ponderosa pine stand, we would want both bracken and non-bracken understory. Thus, a rectangular shape would be appropriate.

GENERAL PLOT INFORMATION

The following items appear on each data sheet and are to be collected for all plots. Where indicated, refer to attached code sheet.

Polygon or Relevé number: Assigned either in the field or in the office prior to sampling.

Date: Date of sampling.

County: County in which located.

USGS Quad: The name of the USGS map the relevé is located on; note series (15' or 7.5').

CNPS Chapter: CNPS chapter, or other organization or agency if source is other than CNPS chapter.

Landowner: Name of landowner or agency acronym if known. Otherwise, list as private.

Contact Person: Name, address, and phone number of individual responsible for data collection.

Observers: Names of individuals assisting. Circle name of recorder.

Plot shape: indicate the sample shape as: square, rectangle, circle, or the entire stand.

Plot size: length of rectangle edges, circle radius, or size of entire stand.

NOTE: See page 2 for standard plot sizes.

Study Plot Revisit: If the relevé plot is being revisited for repeated sampling, please circle "Yes".

Photo interpreter community code: If the sample is in area for which delineation and photo interpretation has already been done, the code which the photointerpreters applied to the polygon. If the sample site has not been photointerpreted, leave blank.

Other polygons of same type (yes or no, if applicable), if yes, mark on map: Other areas within view that appear to have similar vegetation composition. Again, this is most relevant to areas that have been delineated as polygons on aerial photographs as part of a vegetation-mapping project. If one is not working from aerial photographs, draw the areas as on a topographic map.

Is plot representative of whole polygon? (yes or no, if applicable), if no explain: Detail what other vegetation types occur in the polygon, and what the dominant vegetation type is if there is more than one type.

Global Positioning System Readings: Due to the recent availability of very accurate and relatively low cost GPS units, we highly recommend obtaining and using these as a standard piece of sampling equipment. Now that the military intentional imprecision (known as "selective availability") has been "turned off" (as of July 2000), it is typical for all commercial GPS units these units to be accurate to within 5 m of the actual location. Also note that the GPS units can be set to read in UTM or Latitude and Longitude coordinates and can be easily translated. Thus, the following fields for Latitude, Longitude, and legal description are now optional. In order for all positional data to be comparable within the CNPS vegetation dataset, we request using UTM coordinates set for the NAD 83 projection (see your GPS users manual for instructions for setting coordinates and projections).

Caveat: Although GPS units are valuable tools, they may not function properly due to the occasionally poor alignment of satellites or due to the complexity of certain types of terrain, or vegetation. We thus also recommend that you carry topographic maps and are aware of how to note your position on them in the event of a non-responsive or inaccurate GPS.

UTMN and UTME: Northing and easting coordinates using the Universal Transverse Mercator (UTM) grid as delineated on the USGS topographic map, or using a Global Positioning System.

UTM zone: Universal Transverse Mercator zone. Zone 10S for California west of the 120^{th} longitude; zone 11S for California east of 120^{th} longitude.

Legal Description: Township/Range/Section/Quarter Section/Quarter-Quarter section/Meridian: Legal map location of the site; this is useful for determining ownership of the property. California Meridians are Humboldt, Mt. Diablo, or San Bernardino. (This is optional, see above discussion of GPS units)

Latitude and Longitude: Degrees north latitude and east longitude. This is optional (see above)

Elevation: Recorded in feet or meters. Please indicate units.

Slope: Degrees, read from clinometer or compass, or estimated; averaged over relevé

Aspect: Degrees from true north (adjust declination), read from a compass or estimated; averaged over relevé.

Macrotopography: Characterize the large-scale topographic position of the relevé. This is the general position of the sample along major topographic features of the area. *See attached code list.*

Microtopography: Characterize the local relief of the relevé. Choose the shape that mimics the lay of the ground along minor topographic features of the area actually within the sample. *See attached code list.*

VEGETATION DESCRIPTION

Dominant layer: Indicate whether the community is dominated by the Low layer (L), Mid-layer (M), or Tall (T) layer.

Preliminary Alliance name: Name of series, stand, or habitat according to CNPS classification (per Sawyer and Keeler-Wolf 1995); if the type is not defined by the CNPS classification, note this in the space.

Adjacent alliance: Adjacent vegetation series, stands or habitats according to CNPS classification; list in order of most extensive to least extensive.

Structure: Characterize the structure of each layer.

> Continuous = greater than 2/3 (67%) cover; crowns touching
> Intermittent = between 1/3 and 2/3 cover (33% to 66 %); interlocking or touching crowns interrupted by openings.
> Open = less than 1/3 (33%) cover; crowns not touching or infrequently touching.

Phenology: Based on the vegetative condition of he principal species, characterize the phenology of each layer as early (E), peak (P), or late (L).

WETLAND COMMUNITY TYPES

Community type: Indicate if the sample is in a wetland or an upland; note that a site need not be officially delineated as a wetland to qualify as such in this context.

Dominant vegetation form: This is a four letter code which relates the vegetation of the plot to the higher levels of the NBS/NPS National Vegetation Classification System hierarchy. *See attached code list.*

Cowardin class: See "Artificial Keys to Cowardin Systems and Names" (attached). If the plot is located in a wetland, record the proper Cowardin system name. Systems are described in detail in Cowardin et al. 1979. Classification of wetlands and deepwater habitats of the United States. US Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Marine: habitats exposed to the waves and currents of the open ocean (subtidal and intertidal habitats).

Estuarine: includes deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land (i.e. estuaries and lagoons).

Riverine: includes all wetlands and deepwater habitats contained within a channel, excluding any wetland dominated by trees, shrubs, persistent emergent plants, emergent mosses, or lichens. Channels that contain oceanic-derived salts greater than 0.5% are also excluded.

Lacustrine: Includes wetlands and deepwater habitats with all of the following characteristics: 1) situated in a topographic depression or a dammed river channel; 2) lacking trees or shrubs, persistent emergents, emergent mosses or lichens with greater than 30% aerial coverage; and total area exceeds 8 ha (20 acres). Similar areas less than 8 ha are included in the lacustrine system if an active wave-formed or bedrock shoreline feature makes up all or part of the low tide boundary, of if the water in the deepest part of the basin exceeds 2 m (6.6 feet) at low tide. Oceanic derived salinity is always less than 0.5%.

Palustrine: Includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity derived from oceanic salts is less than 0.5%. Also included are areas lacking vegetation, but with all of the following four characteristics: 1) areas less than 8 ha (20 acres); active wave-formed or bedrock shoreline features lacking; 3) water depth in the deepest part of the basin less than 2 m (6.6 feet) at low water; and 4) salinity due to ocean-derived salts less than 0.5%.

Vertical distance from high water mark of active stream channel: If the plot is in or near a wetland community, record to the nearest meter or foot the estimated vertical distance from the middle of the plot to the average water line of the channel, basin, or other body of water.

Horizontal distance from high water mark of active stream channel: If the plot is in or near a wetland community, record to the nearest meter or foot the estimated horizontal distance from the middle of the plot to the average water line of the channel, basin, or other body of water.

Stream channel form: If the plot is located in or near a community along a stream, river, or dry wash, record the channel form of the waterway. The channel form is considered S (single channeled) if it consists of predominately a single primary channel, M (meandering) if it is a meandering channel, and B (braided) if it consists of multiple channels interwoven or braided.

Photographs: Describe the number of color photographs taken at the relevé, and the camera's view direction from compass bearings. It is helpful to take a photograph of the relevé from the intersection of the tapes (if tapes were used to define the plot), and another from inside the relevé. Additional photos of the stand may also be helpful. If using a digital camera or scanning in the image into a computer, relevé numbers and compass directions can be recorded digitally. If using a 35mm camera, please note the roll number, frame number, compass direction, and the initials of the person whose camera is being used. (e.g. Roll 5, #1, to the NW, SS)

STAND AND ENVIRONMENTAL INFORMATION

Vegetation trend: Based on the regenerating species and relationship to surrounding vegetation, characterize the stand as either increasing (expanding), stable, decreasing, fluctuating, or unknown.

Impacts: Enter codes for potential or existing impacts on the stability of the plant community. Characterize each as either 1. Light, 2. Moderate, of 3. Heavy. *See attached code list.*

Site location and plot description: A concise, but careful description that makes locating and/or revisiting the vegetation stand and plots possible; give landmarks and directions. Used in conjunction with the GPS position recorded earlier, this should enable precise re-location of the plot. Indicate where the GPS reading was taken within the plot. In general, the location of the GPS reading should be on the Northwestern corner of the plot, if the plot is rectangular (or square), or in the center if the plot is circular. It is also helpful to briefly describe the topography, aspect, and vegetation structure of the site. If you can't take the GPS reading at the Northwest corner (an obstacle in the way) then note where the GPS point was taken. If you can't get a GPS reading, then spend extra time marking the plot location as precise as possible on a topo map.

Site history: Briefly describe the history of the stand, including type and year of disturbance (e.g. fire, landslides or avalanching, drought, flood, or pest outbreak). Also note the nature and extent of land use such as grazing, timber harvest, or mining.

Unknown plant specimens: List the numbers of any unknown plant specimens, noting any information such as family or genus (if known), important characters, and whether or not there is adequate material for identification. Do not take samples of plants of which there are only a few individuals or which you think may be rare. Document these plants with photographs.

Additional comments: Feel free to note any additional observations of the site, or deviations from the standard sampling protocol. If additional data were recorded, e.g. if tree diameters were measured, please indicate so here.

COARSE FRAGMENTS AND SOIL INFORMATION

Coarse fragments, litter: Estimate the cover class of each size at or near the ground surface averaged over the plot. Always remember to estimate what you actually see on the surface as

opposed to what you think is hiding under, organic litter, big rocks, etc. However, rocks, organic litter, or fine material visible under the canopy of shrubs or trees should be included in the cover estimate.

One way to consider this is to assume that all of the components of coarse fragments plus the basal cross-section of living plant stems and trunks (at ground level) will add up to 100%. Thus, estimate the cover value of each of the items in the box on the form for coarse fragments (including the basal area of plant stems) so that they will add up to 100%. Remember that the basal area of plant stems is usually minimal (e.g., if there were 10 trees, each 1 m in diameter at ground level on a 1000 square meter plot, they would cover less than 1% {0.79%} of the plot).

These data are asked for because certain categories of coarse fragments of rock and other materials have been shown to correlate with certain vegetation types and are thus likely influencing the type of vegetation that is growing in a given area. These estimates should be made quickly with the main point to keep in mind being a rough estimate of the relative proportions of different coarse fragments on the plot.

Fines: Fine mineral fragments including sand, silt, soil, "dirt" < 2 mm in diameter

Gravel: rounded and angular fragments 0.2-7.5 cm (0.08 -3 in.) diameter

Cobble: rounded and angular fragments >7.5-25 cm (3 -10 in.) in diameter

Stone: rounded and angular coarse fragments >25 cm-60 cm (10 -24 in.) in diameter

Boulder: rounded and angular coarse fragments >60 cm (>24 in.) in diameter

Bedrock: continuous, exposed, non-transported rock

Litter: extent of undecomposed litter on surface of plot (this includes all organic matter, e.g. fallen logs, branches, and twigs down to needles and leaves).

Living stems: basal area of living stems of the plants at ground surface

% Bioturbation: Estimate percent cover of ground disturbance by animals (e.g., small mammal burrowing trails, cow hoof marks) across the entire plot surface.

Soil texture: Record the texture of the upper soil horizon, below the organic layer if one is present. *See attached key and code list*.

Parent Material: Geological parent material of site. *See attached code list*.

National Vegetation Classification height Classes for Vegetation Strata

The relevé method just described calls for estimates of plant cover for each taxon. It is strongly floristically oriented. Another way of considering the relationships between plants in vegetation is by evaluating structure, or physiognomy. The underlying thinking is that life forms within a stand of vegetation occur in response to similar ecological pressures (TNC 1998). Estimation of cover within predetermined height classes is one way to describe the structure of vegetation. Structure of a stand of vegetation also is used in modeling wildlife use of the vegetation (WHR).

For information gathered using this CNPS protocol to be comparable with the wealth of information being gathered by the National Park Service and the Biological Resources Division (BRD) of the USGS it is also necessary for CNPS to estimate vegetation cover according to pre-defined vegetation strata. The following height classes are defined by the USGS/NPS:

High Tree	>30 m
Medium High Tree	20-30 m
Medium Low Tree	10-20 m
Low Tree	5-10 m
High Shrub	2-5 m
High Herb/ Medium Shrub	1-2 m
Low Shrub	0.5-1 m
Medium Herb	25-50 cm
Low Herb	0-25 cm
Moss/Lichen	

Cover in these vegetation strata is estimated using the same cover classes as were used for cover of individual taxa. Again, estimation of percentages is optional. Please note that although these strata have names in the national classification, they don't necessarily have to be populated by the type of species that are their namesake (e.g., tall herbaceous species may be diagnostic of the tall shrub category in the case of a giant reed stand). For this reason we have simply listed the strata by their height classes and have opted not to name them.

We have also requested that you list the diagnostic species for each layer. In this case the diagnostic species is the single species that seems to best characterize that layer it may be the only species found in a given layer, it may be as common as other species in that layer but is more restricted to that single layer, or it may be less common than other species in that layer, but so representative of that layer that it can't be ignored. The cover of the diagnostic species in that layer does not have to be re-estimated as it is estimated in the individual species tally already.

VEGETATION DATA

Assessment of Layers

This first step is described in the CNPS point-intercept transect protocol. Estimates the maximum height for the low and mid layers and the minimum height for the tall layer are recorded. These estimates are made after a quick assessment of the vegetation and its structure. The estimates need not be overly precise and will vary among vegetation types. A caveat: if several relevés are being sampled within the same vegetation type, it is important to be consistent when assigning layers. Some types will have more than three layers (e.g. two tree layers of different maximum height); this should be indicated in the relevé description. However, data are recorded for only three layers (low, mid, and tall). The layer a species occupies will often be determined by growth form, but exceptions do occur. For example, with trees young seedlings may occupy the low layer, saplings the mid layer, and mature individuals the tall layer for some taxa, for example.

Species List

The collection of vegetation data continues with making a comprehensive species list of all vascular plants within the relevé. This list is achieved by meandering through the plot to see all microhabitats. During list development, observers document each taxon present in each layer in which it occurs separately, recording it on a different line of the data form and noting which layer is represented. This is important for data entry because each layer of each represented taxon will be entered separately. Each individual plant is recorded in only one layer, the layer in which the tallest portion of the individual is found. One should reach a point at which new taxa are added to the list only very slowly, or sporadically. When one has reached that point, the list is probably done.

The following sections explain how to perform the actual relevé, the Estimation of Cover Values. The sections prefaced by bold-faced titles explain the technique, and the sections with regular font titles refer to the steps needed to complete the accompanying Field Form.

DBH – see separate field form (optional)

<u>DBH if >10 cm</u>:

The diameter at breast height (dbh) is important in certain studies. It may be recorded next to each tree species name. First indicate the species name by code and then record the number of sprouts/trunks in clonal trees. You should measure the tree dbh of every tree trunk/sprout that has diameter > or = 10 cm at breast height in the plot, and each measurement should be in centimeters (cm) using a dbh tape measure. For trunks that may be fused below breast height and branched at breast height, each trunk at breast height gets a separate measurement.

Also indicate if each tree/clone is in the overstory or understory. Trees in the overstory are generally at canopy level. Trees in the understory are entirely below the general level of the canopy.

If snags are encountered in plot, record the dbh and denote it as dead by circling its dbh measurement. If you are unable to identify the snag to species, put the four letter code "SNAG" in the species column.

Depending on the density of trees in each plot, you can record dbh of trees for every tree trunk in the plot, or you can sub-sample the trunks to estimate dbh for every tree species in relatively dense plots. For woodland/forest plots, sub-sampling is appropriate for half the plot if there are at least 50 trees/resprouts present (e.g., 200 m^2 sub-sample in riparian and 500 m^2 sub-sample in upland).

When sub-sampling, make sure to denote this as a sub-sample (note on the data form) and record the sub-sample of dbh's for each tree species in the appropriate row on the Field Form. Once the data are post-processed and entered into a database, then you will need to record each sub-sampled dbh reading three additional times to come up with a full sample of dbh readings. For example, with a sub-sampled tree dbh of 15 cm, this value of 15 should be entered four times (not just once) when it is entered in the database.

Lifeform and size class: If dbh <15.2 cm, counts should be made for conifers and hardwoods in two different size classes. Count seedlings ($\leq$ 2.54 cm) and saplings (> 2.54 but < 15.2 cm). First estimate if there are more than 50 seedlings in one half (50% subsample) of the plot. If so, then do counts of seedlings and saplings in five sub-plots of 2x2 m squares. If the plot shape is a circle, place one square in the center of the plot, and four other squares 10 m to the N, S, E, and W of the plot center. If there are less than 50 seedlings in the 50% subsample plot, then record counts for that subsample instead.

Estimating Cover:

There are many ways to estimate cover. Many people who have been in the cover estimation "business" for a long time can do so quickly and confidently without any props and devices. However, to a novice, it may seem incomprehensible and foolhardy to stand in a meadow of 50 different species of plants and systematically be able to list by cover value each one without actually "measuring" them in some way.

Of course, our minds make thousands of estimates of various types every week. We trust that estimating plant cover can be done by anyone with an open mind and an "eye for nature." It's just another technique to learn.

It is very helpful to work initially with other people who know and are learning the technique. In such a group setting, typically a set of justifications for each person's estimate is made and a "meeting of the minds" is reached. This consensus approach and the concomitant calibration of each person's internal scales is a very important part of the training for any cover estimate project.

An underlying point to remember is that estimates must provide some level of reliable values that are within acceptable bounds of accuracy. If we require an accuracy level that is beyond the

realm of possibility, we will soon reject the method for one more quantitative and repeatable. As with any scientific measurement, the requirement for accuracy in the vegetation data is closely related to the accuracy of the information needed to provide a useful summary of it. Put into more immediate perspective - **to allow useful and repeatable analysis of vegetation data, one does not need to estimate down to the exact percent value the cover of a given plant species in a given stand**.

This point relates to two facts: there is inherent variability of species cover in any environment. For example, you would not expect to always have 23% *Pinus ponderosa*, 14% *Calocedrus decurrens*, and 11% *Pinus lambertiana* over an understory of 40% *Chamaebatia foliosa*, 3% *Clarkia unguiculata*, and 5% *Galium bolanderi* to define the Ponderosa pine-Incense cedar/mountain misery/bolander bedstraw plant community. Anyone who has looked at plant composition with a discerning eye can see that plants don't space themselves in an environment by such precise rules. Thus, we can safely estimate the representation of species in a stand by relatively broad cover classes (such as <1%, 1-5 %, 5-25%, etc.) rather than precise percentages.

The data analysis we commonly use to classify vegetation into different associations and series (TWINSPAN and various cluster analysis programs, for example) is likewise forgiving. When analyzed by quantitative mutivariate statistics information on species cover responds to coarse differences in cover and presence and absence of species, but not to subtle percentage point differences. This has been proven time and again through quantitative analysis of vegetation classification. Many of the world's plant ecologists estimate cover rather than measure it precisely. Some of the seminal works in vegetation ecology have been based on cover estimates taken by discerning eyes.

With this as a preamble, below we offer some suggestions on estimating cover that have proven helpful. These are simply "tricks" to facilitate estimation, some work better for different situations. You may come up with other methods of estimation that may seem more intuitive, and are equally reliable in certain settings. All values on the relevé protocol that require a cover class estimate, including coarse fragment and vegetation layer information, may rely on these techniques. Just make the appropriate substitutions (using the coarse fragment example substitute, bedrock, stone, cobbles, gravel, and litter for vegetation).

Method 1: The invisible point-intercept transect:

This method works well in relatively low, open vegetation types such as grasslands and scrubs where you can see over the major stand components. For those who have worked with the original CNPS line intercept methodology it's like counting hits along an imaginary line at regular intervals of the 50 m tape. Here's how it goes:

> Envision an imaginary transect line starting from your vantage point and running for 50 m (or however many meters you wish, as long as you are still ending up within the same stand of vegetation you're sampling - never keep counting outside of your homogeneous stand). Now "walk" your eye along this tape for 50 m and visually "take a point" every 0.5 m. Don't worry about precision, just try to "walk" your eye along the line and stop every 0.5 m or at any other regular interval until you reach its end and mentally tally what

species you hit. Once you come up with a number of hits for each major species in one imaginary transect, take another transect in another direction and estimate the number of hits on that one. Do this several times (usually 3-4 is enough if you are in a homogeneous stand), then average your results.

This can go quickly in simple environments and in environments where the major species are easily discernable (chaparral, bunch-grassland, coastal scrub, desert scrub). Your average number of hits need not be a total of 100 as in the original transect method, but could be 50 along a 25 m imaginary line (in which case you would multiply by two to get your estimated cover), or 25 along a 12.5 m line (multiply average by 4), etc.

Method 2: Subdivision of sample plot into quadrants:

Many plots, whether they are square, circular, or rectangular, may be "quartered" and have each quadrant's plant cover estimated separately. If the plot is a given even number of square meters (such as 100, 400, or 1000 m^2) then you know that a quarter of that amount is also an easily measurable number. If you can estimate the average size of the plants in each of the quarters (e.g, small pinyon pines may be 5 m^2 (2.2m x 2.2m), creosote bush may be $2m^2$ (or 1.41 m x 1.41 m), burrobush may be $0.5m^2$) then you simply count the number of plants in each size class and multiply by their estimated size for the cover in a given quadrant. Then you average the 4 quadrants together for your average cover value.

This method works well in vegetation with open-to-dense cover of low species such as grasses or low shrubs, in open woodlands, and desert scrubs.

Method 3; "Squash" all plants into a continuous cover in one corner of the plot :

Another way to estimate how much of the plot is covered by a particular species is to mentally group (or "march", or "squash") all members of that species into a corner of the plot and estimate the area they cover. Then calculate that area as a percentage of the total plot area. This technique works well in herb and shrub dominated plots but is not very useful in areas with trees.

Method 4: How to estimate tree cover:

Cover estimates of tall trees is one of the most difficult tasks for a beginning relevé sampler. However it is possible to do this with consistency and reliability using the following guidelines.

1. Have regular sized and shaped plots that you can easily subdivide.
2. Estimate average crown spread of each tree species separately by pacing the crown diameter of representative examples of trees of each species and then roughly calculating the crown area of each representative species.
3. Add together the estimated crown area of each individual of each species of tree on the plot for your total cover.

Method 5: The process of elimination technique:

This method is generally good for estimating cover on sparsely vegetated areas where bare ground, rocks, or cobbles cover more area than vegetation. In such a situation it would be advisable to first estimate how much of the ground is not covered by plants and then subdivide the portion that is covered by plants into rough percentages proportional to the different plant species present. For example, in a desert scrub the total plot not covered by plants may be estimated at 80%. Of the 20% covered by plants, half is desert sunflower (10% cover), a quarter is California buckwheat (5% cover), an eighth brittlebush (2.5% cover), and the rest divided up between 10 species of herbs and small shrubs (all less than 1% cover).

Any of these techniques may be used in combination with one another for a system of checks and balances, or in stands that have characteristics lending themselves for a different technique for each layer of vegetation.

In a relevé, cover estimates, using the techniques described above, are made for each taxon as it is recorded on the species list. Estimates are made for each layer in which the taxon was recorded. For example, if individuals of coast live oak (CLO) occur in the tall, the mid, and the low layer, an estimate is made for Tall CLO, for mid CLO, and for low CLO.

In a traditional relevé, cover is estimated in "cover classes," not percentages, because of the variability of plant populations over time and from one point to another, even within a small stand. This protocol uses the following 6 cover classes:

Cover Class 1: the taxon in that layer covers < 1 % of the plot area
Cover Class 2: the taxon in that layer covers 1 % - 5 % of the plot area
Cover Class 3a: the taxon in that layer covers >5 - 15 % of the plot area
Cover Class 3b: the taxon in that layer covers >15 - 25 % of the plot area
Cover Class 4: the taxon in that layer covers >25 - 50 % of the plot area
Cover Class 5: the taxon in that layer covers >50 - 75 % of the plot area
Cover Class 6: the taxon in that layer covers > 75% of the plot area

Percentages (optional)

This CNPS protocol also encourages observers to estimate percentages if they feel confident in their estimation abilities. This optional step allows the data to be compared more easily to data collected using different methods, such as a line or point intercept. It also instills confidence in the cover estimate of borderline species that are close calls between two cover classes (e.g., a cover class 2 at 5% as opposed to a cover class 3 at 6%). It is particularly useful for calculating cover by the process of elimination techniques and for estimating total vegetation cover (see below) and coarse fragment cover.

Total Vegetation Cover by Layer

In addition to cover of individual taxa described above, total cover is also estimated for each vegetation layer (e.g. tall, medium, low). This is done using the same cover classes as described

above but combines all taxa of a given category. They can be calculated from the species percent cover estimates, but please make sure to disregard overlap of species within each layer. These estimates should be absolute aerial cover, or the "bird's eye view" of the vegetation cover, in which each category cannot be over 100%.

Caveats

Please consult with the members of the vegetation committee for advice and feedback on proposed vegetation surveys prior on initiating projects.

Notes on the Order and Division of Labor for Data Collection: As with every procedure there are always more and less efficient ways to collect the information requested. Although we respect each field crews' option to choose in what order they collect the data, we suggest the following general rules:

- Work with teams of two for each plot collected.
- Both team members can determine the plot shape and size and lay out the tapes and mark the edges for the plot boundary (see below).
- The two person teams can also divide up tasks of data collection with one member collecting location, environmental (slope, aspect, geology, soil texture, etc.) and plot description information while the other begins the species list. Thus, two clipboards are useful and data sheets that are at first separated (not stapled).
- Following the making of the initial species list and collection of location and environmental data both team members convene to do the estimation of plant cover by species followed by the estimation of total vegetation cover and cover by layer.
- Following that process, the estimation of cover by the up to 10 height strata classes and the listing of the diagnostic species for each is done collaboratively.
- This is followed by the estimation of the coarse fragment information, again done collaboratively.

For egalitarian and familiarization purposes we suggest that the roles be switched regularly between the team members and that if multiple teams are being used in a larger project, that each team member switches frequently between teams, building all-important calibration, and camaraderie among the whole group.

Suggestions for Laying out Plots: If you are laying out a circular plot, work with two or more people. One person stands at the center of the plot and holds the tape case while the other walks the end of the tape out to the appointed distance (radium 5.6 for 100 m^2 circle, radius 11.3 m for a 400 m^2 circle, and radius 17.6 m for a 1000m^2 circle). The walker then fixes the tape end with a pin flag and walks back to the center where he/she instructs the center person to walk in the opposite direction of the already laid out tape radius, stretching the rest of the tape to an equal length (another 11.3 or 17.6 m) to the opposite edge of the plot, where he/she affixes it with another pin flag. This process is again repeated with another tape laid out perpendicular to the first so that an "+ " shape is created . The margins of the circle can be further delineated by

measuring to the center of the circle with an optical tape measure (rangefinder) and marking mid points between the four ends of the crossed tapes.

When laying out square or rectangular plots work with two or more people per team. If doing a rectangle, determine the long axis of the plot first and have one person be stationed at the zero m end of the tape while the other person walks the unrolling tape case out to the appropriate length. The stationary end person can guide the walker, keeping them moving in a straight line. Once that tape is laid out and the far end staked, the team lays out another tape perpendicular to the first, either at one end, using the same type of process. This establishes the width of the rectangle (or square). Using an optical rangefinder and pin-flags, or colored flagging the team can further mark additional points along the other parallel long axis and short axis of the plot (every 5 m for shorter plots or every 10 m for longer plots is suggested) so that the entire plot boundary can be easily visualized.

References:

Barbour M.G., J.H. Burk, and W.D. Pitts 1987. Terrestrial Plant Ecology, Second Edition. Benjamin/Cummings Publishing Co. Menlo Park, CA. 634 pages.

Sawyer and Keeler-Wolf. 1995. Manual of California Vegetation. California Native Plant Society, Sacramento, CA. 471 pages

The Nature Conservancy and Environmental Systems Research Institute. 1994. Final Draft, Standardized National Vegetation Classification System. Prepared for United States Department of the Interior, National Biological Survey, and National Park Service. Arlington, VA. Complete document available at the following website:
http||:biology.usgs.gov/npsveg/fieldmethods.html

Suggested Equipment:
Equipment List: Prices as of May 2000, toll free orders from Forestry Suppliers (1-800-647-5368) (item numbers in parentheses)

Chaining pins, surveyor steel (#39167)	$21.50
Fiberglass tapes 2 - 165'/50 m (#39972)	$42.90
Logbook cover 8 ½ " x 12" (#53200)	$23.95
Perforated flagging (#57960)	$1.95
UTM Coordinate Grid (#45019)	$16.95
Rangefinder, 10-75m (#38973)	$51.60
Silva Compass w/ clinometer (#37036)	$43.90
Garmin GPS 12XL (#39095, #39111)	$244.90

CALIFORNIA NATIVE PLANT SOCIETY RELEVÉ FIELD FORM CODE LIST (revised 3/30/05)

MACRO TOPOGRAPHY

00 Bench
01 Ridge top (interfluve)
02 Upper 1/3 of slope
03 Middle 1/3 of slope
04 Lower 1/3 of slope (lowslope)
05 Toeslope (alluvial fan/bajada)
06 Bottom/plain
07 Basin/wetland
08 Draw
09 Other
10 Terrace (former shoreline or floodplain)
11 Entire slope
12 Wash (channel bed)
13 Badland (complex of draws & interfluves)
14 Mesa/plateau
15 Dune/sandfield
16 Pediment
17 Backslope (cliff)

MICRO TOPOGRAPHY

01 Convex or rounded
02 Linear or even
03 Concave or depression
04 Undulating pattern
05 Hummock or Swale pattern
06 Mounded
07 Other

SITE IMPACTS

01 Development
02 ORV activity
03 Agriculture
04 Grazing
05 Competition from exotics
06 Logging
07 Insufficient population/stand size
08 Altered flood/tidal regime
09 Mining
10 Hybridization
11 Groundwater pumping
12 Dam/inundation
13 Other
14 Surface water diversion
15 Road/trail construction/maint.
16 Biocides
17 Pollution
18 Unknown
19 Vandalism/dumping/litter
20 Foot traffic/trampling
21 Improper burning regime
22 Over collecting/poaching
23 Erosion/runoff
24 Altered thermal regime
25 Landfill
26 Degrading water quality
27 Wood cutting
28 Military operations
29 Recreational use (non ORV)
30 Nest parasitism
31 Non-native predators
32 Rip-rap, bank protection
33 Channelization (human caused)
34 Feral pigs
35 Burros
36 Rills
37 Phytogenic mounding
38 Sudden oak death syndrome (SODS)

PARENT MATERIAL

IGTU	Igneous (type unknown)
VOLC	General volcanic extrusives
RHYO	Rhyolite
ANDE	Andesite
BASA	Basalt
ASHT	Ash (of any origin)
OBSI	Obsidian
PUMI	Pumice
PYFL	Pyroclastic flow
VOFL	Volcanic flow
VOMU	Volcanic mud
INTR	General igneous intrusives
GRAN	Granitic (generic)
MONZ	Monzonite
QUDI	Quartz diorite
DIOR	Diorite
GABB	Gabbro
DIAB	Diabase
PERI	Peridotite
METU	Metamorphic (type unknown)
GNBG	Gneiss/biotite gneiss
SERP	Serpentine
SCHI	Schist
SESC	Semi-schist
PHYL	Phyllite
SLAT	Slate
HORN	Hornfels
BLUE	Blue schist
MARB	Marble
SETU	Sedimentary (type unknown)
BREC	Breccia (non-volcanic)
CONG	Conglomerate
FANG	Fanglomerate
SAND	Sandstone
SHAL	Shale
SILT	Siltstone
CACO	Calcareous conglomerate
CASA	Calcareous sandstone
CASH	Calcareous shale
CASI	Calcareous siltstone
DOLO	Dolomite
LIME	Limestone
CALU	Calcareous (origin unknown)
CHER	Chert
FRME	Franciscan melange
GREE	Greenstone
ULTU	Ultramafic (type unknown)
MIIG	Mixed igneous
MIME	Mixed metamorphic
MISE	Mixed sedimentary
MIRT	Mix of two or more rock types
GLTI	Glacial till, mixed origin, moraine
LALA	Large landslide (unconsolidated)
DUNE	Sand dunes
LOSS	Loess
CLAL	Clayey alluvium
GRAL	Gravelly alluvium
MIAL	Mixed alluvium
SAAL	Sandy alluvium (most alluvial fans and washes)
SIAL	Silty alluvium
OTHE	Other than on list

SOIL TEXTURE

COSA	Coarse sand
MESN	Medium sand
FISN	Fine sand
COLS	Coarse, loamy sand
MELS	Medium to very fine, loamy sand
MCSL	Moderately coarse, sandy loam
MESA	Medium to very fine, sandy loam
MELO	Medium loam
MESL	Medium silt loam
MESI	Medium silt
MFCL	Moderately fine clay loam
MFSA	Moderately fine sandy clay loam
MFSL	Moderately fine silty clay loam
FISA	Fine sandy clay
FISC	Fine silty clay
FICL	Fine clay
SAND	Sand (class unknown)
LOAM	Loam (class unknown)
CLAY	Clay (class unknown)
UNKN	Unknown
PEAT	Peat
MUCK	Muck

DOMINANT VEGETATION GROUP

Trees:

TBSE	Temperate broad-leaved seasonal evergreen forest
TNLE	Temperate or subpolar needle-leafed evergreen forest
CDF	Cold-deciduous forest
MNDF	Mixed needle-leafed evergreen-cold deciduous. forest
TBEW	Temperate broad-leaved evergreen woodland
TNEW	Temperate or subpolar needle-leaved evergreen woodland
EXEW	Extremely xeromorphic evergreen woodland
CDW	Cold-deciduous woodland
EXDW	Extremely xeromorphic deciduous woodland
MBED	Mixed broad-leaved evergreen-cold deciduous woodland
MNDW	Mixed needle-leafed evergreen-cold deciduous woodland

Shrubs:

TBES	Temperate broad-leaved evergreen shrubland
NLES	Needle-leafed evergreen shrubland
MIES	Microphyllus evergreen shrubland
EXDS	Extremely xeromorphic deciduous shrubland
CDS	Cold-deciduous shrubland
MEDS	Mixed evergreen-deciduous shrubland
XMED	Extremely xeromorphic mixed evergreen-deciduous shrubland

Dwarf Shrubland:

NMED	Needle-leafed or microphyllous evergreen dwarf shrubland
XEDS	Extremely xeromorphic evergreen dwarf shrubland
DDDS	Drought-deciduous dwarf shrubland
MEDD	Mixed evergreen cold-deciduous dwarf shrubland

Herbaceous:

TSPG	Temperate or subpolar grassland
TGST	Temperate or subpolar grassland with sparse tree
TGSS	Temperate or subpolar grassland with sparse shrublayer
TGSD	Temperate or subpolar grassland with sparse dwarf shrub layer
TFV	Temperate or subpolar forb vegetation
THRV	Temperate or subpolar hydromorphic rooted vegetation
TAGF	Temperate or subpolar annual grassland or forb vegetation

***Sparse Vegetation*:**

SVSD	Sparsely vegetated sand dunes
SVCS	Sparsely vegetated consolidated substrates

Simplified Key to Soil Texture
(Adapted from Brewer and McCann 1982)

Place about three teaspoons of soil in the palm of your hand. Take out any particles ≥ 3 mm in size.

A. Does soil remain in ball when squeezed in your hand palm?

Yes, soil does remain in a ball when squeezed..... **B**

No, soil does not remain in a ball when squeezed..... **sand**

SAND Sand (class unknown)
Very coarse texture……COSA Coarse sand
Moderately coarse texture…… MESN Medium sand
Moderately fine texture…….. FISN Fine sand

B. Add a small amount of water until the soil feels like putty. Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger. Does soil make a ribbon?

Yes, soil makes a ribbon; though it may be very short.....**C**

No, soil does not make a ribbon.....**loamy sand**

Very gritty with coarse particles….....COLS Coarse, loamy sand
Moderately to slightly gritty with medium to fine particles.....MELS Medium to very fine, loamy sand

C. Does ribbon extends more than one inch?

Yes, soil extends > 1 inch.....**D**

No, soil does not extend > 1 inch.....Add excess water

Soil feels gritty……..…….…..**loam or sandy loam**

LOAM Loam (class unknown)
Very gritty with coarse particles….....MCSL Moderately coarse, sandy loam
Moderately gritty with medium to fine particles.....MESA Medium to very fine, sandy loam
Slightly gritty .....MELO Medium loam

Soil feels smooth.....**silt loam**

MESIL medium silt loam

D. Does soil extend more than 2 inches?

Yes, ribbon extends more than 2 inches, and does not crack if bent into a ring.....**E**

No, soil breaks when 1–2 inches long; cracks if bent into a ring……...Add excess water

Soil feels gritty….....**sandy clay loam or clay loam**
Very gritty……..……...MFSA Moderately fine sandy clay loam
Slightly gritty……MFCL Moderately fine clay loam

Soil feels smooth.....……...**silty clay loam or silt**
Moderately fine texture……...MFSL Moderately fine silty clay loam
Very fine texture…….. MESI Medium silt

E. Soil makes a ribbon 2+ inches long; does not crack when bent into a ring.....Add excess water

Soil feels gritty.....**sandy clay or clay**

CLAY Clay (class unknown)
Very gritty…… FISA Fine sandy clay
Slightly gritty…….. FICL Fine clay

Soil feels smooth.....…….....**silty clay**

FISC Fine silty clay

UNKN = UNKNOWN PEAT = PEAT MUCK = MUCK

Artificial Key to the Systems and Classes

Key to the Systems

1. Water regime influenced by oceanic tides, and salinity due to ocean-derived salts 0.5% or greater.
    2. Semi-enclosed by land, but with open, partly obstructed or sporadic access to the ocean. Halinity wide-ranging because of evaporation or mixing of seawater with runoff from land . . . . . ESTUARINE
    2'. Little or no obstruction to open ocean present. Halinity usually euhaline; little mixing of water with runoff from land 3
        3. Emergents, trees, or shrubs present . . . . . ESTUARINE
        3'. Emergents, trees, or shrubs absent. . . . . MARINE
1'. Water regime not influenced by ocean tides, or if influenced by oceanic tides, salinity less than 0.5%
    4. Persistent emergents, trees, shrubs, or emergent mosses cover 30% or more of the area . . . . . .PALUSTRINE
    4'. Persistent emergents, trees, shrubs, or emergent mosses cover less than 30% of substrate but nonpersistent emergents may be widespread during some seasons of year 5
        5. Situated in a channel; water, when present, usually flowing . . . . . RIVERINE
        5'. Situated in a basin, catchment, or on level or sloping ground; water usually not flowing. 6
            6. Area 8 ha (20 acres) or greater . . . . . .LACUSTRINE
            6'. Area less than 8 ha 7
                7. Wave-formed or bedrock shoreline feature present or water depth 2 m (6.6 feet) or more . . . . . LACUSTRINE
                7'. No wave-formed or bedrock shoreline feature present and water > 2 m deep . . . . . PALUSTRINE

Key to the Classes

1. During the growing season of most years, aerial cover by vegetation is less than 30%.
    2. Substrate a ridge or mound formed by colonization of sedentary invertebrates (corals, oysters, tube worms) . . . . . REEF
    2'. Substrate of rock or various-sized sediments often occupied by invertebrates but not formed by colonization of sedentary invertebrates 3
        3. Water regime subtidal, permanently flooded, intermittently exposed, or semipermanently flooded. Substrate usually not soil 4
            4. Substrate of bedrock, boulders, or stones occurring singly or in combination covers 75% or more of the area . . . . . ROCK BOTTOM
            4'. Substrate of organic material, mud, sand, gravel, or cobbles with less than 75% areal cover of stones, boulders, or bedrock. . . . . UNCONSOLIDATED BOTTOM
        3'. Water regime irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded. Substrate often a soil 5
            5. Contained within a channel that does not have permanent flowing water (i.e., Intermittent Subsystem of Riverine System or Intertidal Subsystem of Estuarine System) . . . . . STREAMBED
            5'. Contained in a channel with perennial water or not contained in a channel 6
                6. Substrate of bedrock, boulders, or stones occurring singly or in combination covers 75% or more of the area . . . . . .ROCKY SHORE
                6'. Substrate of organic material, mud, sand, gravel, or cobbles; with less than 75% of the cover consisting of stones, boulders, or bedrock. . . . . UNCONSOLIDATED SHORE
1'. During the growing season of most years, percentage of area covered by vegetation 30% or greater.
    7. Vegetation composed of pioneering annuals or seedling perennials, often not hydrophytes, occurring only at time of substrate exposure 8
        8. Contained within a channel that does not have permanent flowing water. . . . . STREAMBED (VEGETATED)
        8'. Contained within a channel with permanent water, or not contained in a channel . . . . . UNCONSOLIDATED SHORE (VEGETATED)
    7'. Vegetation composed of algae, bryophytes, lichens, or vascular plants that are usually hydrophytic perennials 9
        9. Vegetation composed predominantly of nonvascular species 10
            10. Vegetation macrophytic algae, mosses, or lichens growing in water or the splash zone of shores . . . . . AQUATIC BED
            10'. Vegetation mosses or lichens usually growing on organic soils and always outside the splash zone of shores . . . . . .MOSS-LICHEN WETLAND
        9'. Vegetation composed predominantly of vascular species 11
            11. Vegetation herbaceous 12
                12. Vegetation emergents. . . . . .EMERGENT WETLAND
                12'. Vegetation submergent, floating-leaved, or floating. . . . . .AQUATIC BED
            11'. Vegetation trees or shrubs 13
                13. Dominants less than 6 m (20 feet) tall . . . . . .SCRUB-SHRUB WETLAND
                13'. Dominants 6 m tall or taller . . . . . .FORESTED WETLAND