Vegetation Classification of Alliances and Associations in Marin County, California

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CALIFORNIA NATIVE PLANT SOCIETY

Photos on Cover:
Top Left: *Bolboschoenus maritimus* Alliance at Santa Venetia marsh (photo by Brittany Burnett)
Top Right: *Arctostaphylos montana* Association in the foreground and *Hesperocyparis sargentii* in the distance on Carson Ridge (photo by Julie Evens)
Bottom: *Sequoia sempervirens* Alliance (photo by MMWD staff)

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Abstract

This report describes approximately 110 alliances and 280 associations that occur in Marin County, California, comprising the most comprehensive local vegetation classification to date. The vegetation types were defined using a standardized classification approach consistent with the Survey of California Vegetation (SCV) and the United States National Vegetation Classification (USNVC) system. This floristic classification forms the basis for an integrated, countywide vegetation map supported through a collaboration by Golden Gate National Parks Conservancy, National Park Service, Tukman Geospatial LLC, and other partners of the Marin Countywide Vegetation Map and Landscape Database Project. Vegetation ecologists from the California Native Plant Society analyzed species data from 6,407 field surveys collected between 1992 and 2019. The data included 255 new surveys collected in 2018 and 2019 through funding provided specifically for this classification effort. Additional surveys were compiled for the analysis from previous sampling efforts in Marin (2,966) and from adjacent counties (3,186) to provide a broader, regional understanding. A total of 26 tree-overstory, 29 shrubland, 53 herbaceous and 2 sparsely vegetated alliances are described, with 79 tree-overstory, 72 shrubland, 127 herbaceous and 3 sparsely vegetated associations.

The report results include summary tables of county-wide classification results including a count of surveys by alliance. Appendices include a floristic key of vegetation types, a table of vegetation types nested within the USNVC hierarchy, and descriptions of each vegetation alliance and association. The descriptions contain stand tables which summarize structural and species cover data for each type; stand tables serve as a reference for the county-wide expression of vegetation, as well as plant palettes for future restoration efforts.

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Introduction

Marin County encompasses more than half a million acres of diverse plant community assemblages representing a varied set of habitats including redwood groves, Douglas-fir forests, oak woodlands, willow and alder riparian stringers, chaparral, coastal and dune scrub, freshwater and brackish marshes, and tidal marshes. The county is bounded by the Pacific Ocean to the west, with San Pablo and San Francisco Bay to the east, encompassing a topographically and geologically diverse environment. Figure 1 illustrates the county boundary with fourteen watershed units used to divide the county into regions (CalWater 2004).

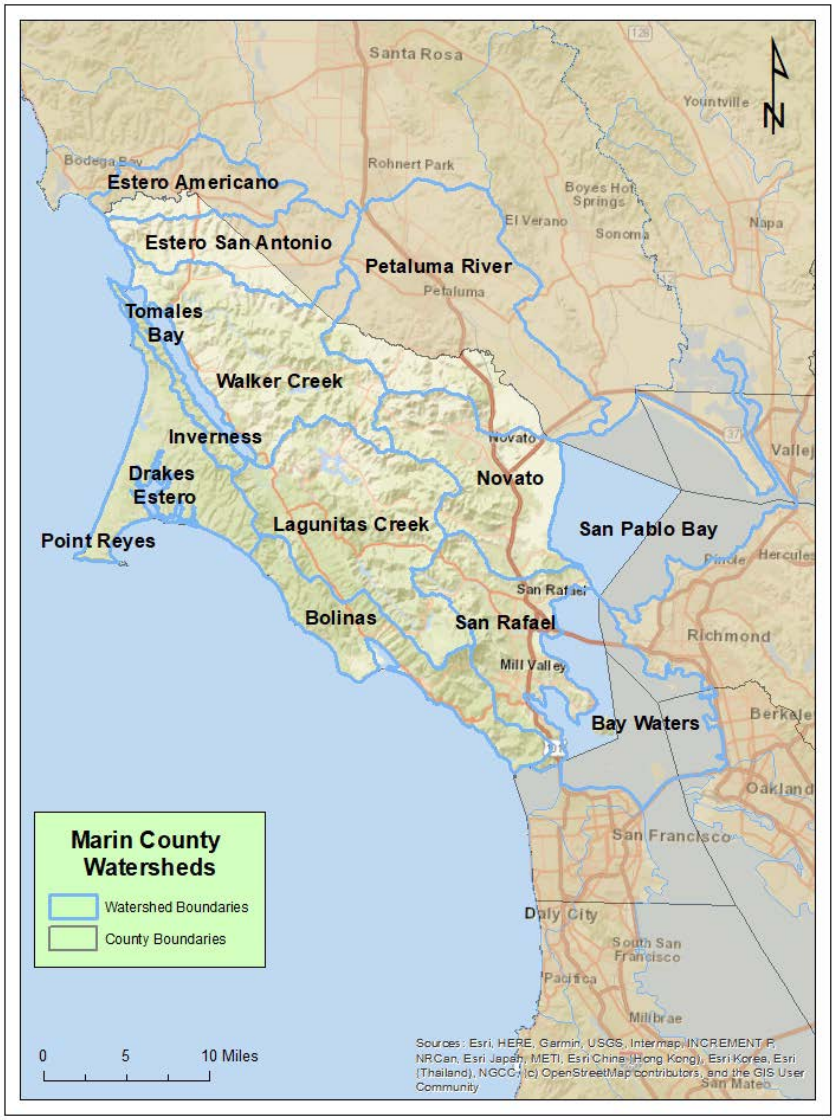

Figure 1. Fourteen watershed units as defined by CalWater (2004) in Marin County. These units divide the county into regions and are noted as sample locations in the vegetation descriptions.

From the narrow sandy beaches of the coastline to the complex estuaries of Bolinas Lagoon and Drakes Estero, vegetation patterns are on display where plant species sort out according to inundation, salinity, and overall ecological setting. The Point Reyes peninsula and Tomales Bay provide the most extensive dunes of the county, supporting a rich mix of low annuals, perennials, and shrubs forming linear patterns of dune mat and coastal scrub communities, depending on proximity to the coast, soil texture and other factors. Long ridges point toward the San Francisco Bay with Mount Tamalpais rising as the highest point in the county. Numerous local creeks and tributaries cut deep canyons and long valleys, while the San Andreas Fault bisects the county, contributing to the diversity of geologic substrates. A dizzying mix of sedimentary shales and sandstones, igneous intrusions of chert, and metamorphosed serpentine are common on the eastern side of the fault, while west of the fault line granite and recent marine sand deposits are found (Howell 1970). Frequent landslides due to steep terrain, moderate rainfall, and loamy soils allow for rocky bluffs and outcrops supporting patches of sparse specialized vegetation.

The typical Mediterranean climate of warm dry summers and cool rainy winters is moderated by the Pacific Ocean and fog. Rainfall averages vary across the county (45 – 114 cm, or 18 – 45 inches) with a strong difference between the humid coastal belt of redwood and Douglas-fir forests and the drier inland portions of grasslands, oak savannah / woodlands, and rocky chaparral. The intersection of varying climate, topography, geologic substrate, and soil formation help to create the stunning diversity of types described in this document (Howell 1970).

In 2018, a collaborative group of agencies and partners formed the Marin Countywide Vegetation Map and Landscape Database Project initiated by the Tamalpais Lands Collaborative (One Tam) to map the county's topography, physical and biotic features, and diverse plant communities. The foundation for the map is the standard vegetation classification approach supported by the California Native Plant Society Vegetation Program (CNPS) and the California Department of Fish and Wildlife's (CDFW) Vegetation Classification and Mapping Program (VegCAMP). This report summarizes the methods and results of the classification effort completed by CNPS and vetted by VegCAMP and NatureServe ecologists, to describe the vegetation types found across Marin County.

CNPS uses an integrated set of steps for classification compliant with *A Manual of California Vegetation* (CNPS 2020) and the United States National Vegetation Classification System (FGDC 2008). A floristic key and descriptions of the vegetation for Marin County are included herein, as well as a table showing the hierarchical relationship of the full local classification to the United States National Vegetation

Classification (USNVC). The USNVC hierarchy is composed of eight levels, organized into three upper, three middle, and two lower levels as shown below in Table 1.

Table 1. The levels of the USNVC hierarchy for natural vegetation.

Level	Example
Upper	
Level 1 - Formation Class	Forest & Woodland
Level 2 - Formation Subclass	Temperate & Boreal Forest & Woodland
Level 3 - Formation	Cool Temperate Forest & Woodland
Middle	
Level 4 - Division	Vancouverian Forest & Woodland
Level 5 - Macrogroup	Vancouverian Coastal Rainforest
Level 6 - Group	Californian Coastal Redwood Forest
Lower	
Level 7 - Alliance	*Sequoia sempervirens* Forest & Woodland Alliance
Level 8 - Association	*Sequoia sempervirens* – *Notholithocarpus densiflorus* / *Vaccinium ovatum* Association

The Marin County classification defines vegetation at the two finest levels, alliance and association. The alliance is defined by plant species composition, habitat conditions, physiognomy, and diagnostic species; at least one of the diagnostic species is typically found in the uppermost or dominant stratum (Jennings et al. 2009). The association is the most detailed classification level and reflects more specific characteristics of vegetation such as finer-level differences in species composition, topography, soils, substrate, climate, hydrology, and disturbance regime (FGDC 2008). Associations often recognize two or more diagnostic species found in different vegetation layers (Sawyer et al. 2009).

While this document represents the most comprehensive vegetation classification of Marin County to date, further refinement of types is expected with additional site-specific data collection and analyses from the greater Bay Area region as well as future changes to vegetation due to disturbance (e.g., fire, drought, and climate change), and natural successional shifts that occur across the landscape over time.

Methods

Data Collection

CNPS, Golden Gate National Parks Conservancy (Parks Conservancy), and Tukman Geospatial LLC initially compiled available vegetation datasets from previous sampling, classification, and mapping efforts. CNPS, CDFW, and the mapping team drafted a preliminary list of classification and mapping units, and many agency partners assisted in refining this preliminary list. Then we identified specific vegetation types that needed further representation in classification surveys, and agency partners helped identify locations and provide land access for sampling. Parks Conservancy project manager (Danny Franco) additionally coordinated land access, which assisted in spatially expanding the sampling effort on public and private lands.

Parks Conservancy field staff (namely, Brittany Burnett and Sam Abercrombie) and field coordinator (Shelly Benson) sampled vegetation across the summer-fall of 2018 and spring-summer of 2019. They focused on types that were either underrepresented in past efforts or relatively uncommon in Marin County. Staff were guided by a preliminary sample allocation by Tukman Geospatial LLC, though they also opportunistically sampled priority vegetation types during peak plant phenology with oversight from the field coordinator, especially for herbaceous types sampled in 2019.

Parks Conservancy staff and contractors used the CNPS-CDFW Combined Vegetation Rapid Assessment and Relevé protocol for sampling (see https://www.cnps.org/plant-science/field-protocols-guidelines for copies of the field form and protocol) after being trained by CNPS staff. Protocols comply with state and national standards as defined by the Survey of California Vegetation (SCV; VegCAMP 2020) and the US National Vegetation Classification (USNVC 2019) and are dependent on the recognition of a *stand* as the basic physical unit of vegetation in a landscape. A stand has both compositional and structural integrity. Compositional integrity is defined as similarity in species composition and relative cover; structural integrity refers to general regularity in the horizontal and vertical spacing of plant species as a result of topography, soils, geology, climate, slope, exposure, and site or disturbance history. A stand has no set size and may represent patterns as small as zones within a vernal pool, or quite expansive patches, such as a Douglas-fir forest occupying several hundred acres.

The survey data included the date of sampling, GPS location, environmental characteristics of the sampled stands, vegetation layer information, site history, and the field-assessed vegetation type. Additionally, four digital photos were taken in the cardinal directions at the GPS point for each survey location, using digital cameras having a minimum of 8-megapixel resolution. Complete species lists were recorded for

plot-based relevé surveys, while the most dominant and/or characteristic species were recorded for stand-based Rapid Assessment (RA) surveys. Percent cover estimates were recorded for all species listed in relevés and RAs. All data were recorded on paper field forms; spatial information and a subset of the data included on the forms were captured on GPS-enabled devices running ESRI's Collector application. Spatial data were stored in a geodatabase feature class. Survey data from field forms and field devices were entered into a standardized Microsoft Access database and were quality-controlled for accuracy.

Analysis and Classification

Vegetation RA and relevé data were analyzed by CNPS in 2019 for tree and shrub types and in 2020 for herbaceous types. Prior to analysis, scientific names of all taxa were first converted to standard alpha-numeric codes used by the PLANTS Database (USDA NRCS 2020). A prefix of "2" was applied to codes for taxa recognized by the Jepson eFlora (Jepson Flora Project 2020) or A Manual of California Vegetation (CNPS 2020), but not the PLANTS Database. General life forms, such as moss and lichen, also have codes beginning with the number 2 (e.g., 2MOSS). Abundance (cover) values for all taxa were converted to seven different classes using the following modified Braun-Blanquet (1932) cover categories: 1=<1%, 2=1–5%, 3=>5–15%, 4=>15–25%, 5=>25–50%, 6=>50–75%, 7=>75%. The data were then screened for outliers using the Sorensen (Bray-Curtis) Distance Measure, and taxa that occur in a small number of plots (i.e., less than 6 plots) were removed to generate additional plot-by-species matrices with lower coefficients of variation for species (typically <200%) and to minimize chaining.

CNPS analyzed the species cover data using PC-Ord and R software (McCune and Mefford 2006, R Core Team 2013). The cluster analysis used the Sorensen Distance Measure and Flexible Beta Linkage method at -0.25 (McCune and Grace 2002). Using this method of agglomerative clustering, surveys were grouped together based on similarities in species composition and abundance (McCune and Mefford 1997). For both the woody and herbaceous analyses, CNPS conducted an initial cluster analysis including all surveys in the available dataset. The initial cluster analysis was performed to partition the dataset into manageable subsets. Outlier and cluster analyses were conducted on each subset and indicator species analysis (ISA) was used to select cluster group levels for classification analysis. ISA produced indicator values for each species across different cluster group levels (ranging from 2 to 46), testing for statistical significance using a quantitative/binary response with 4999 randomizations (Dufrêne and Legendre 1997). The cluster group levels that had relatively high numbers of

significant indicators and relatively low overall mean p-values were chosen for the final evaluation of the community classification (McCune and Grace 2002).

During the classification process, samples were partitioned into groups based on cluster membership. Membership rules for assigning samples to Alliance and an Association (if possible) were defined primarily by species constancy and abundance; however, pre-existing classifications and floras were consulted to define analogous/similar types. Each sample was evaluated for consistency within a group, and samples that were misclassified in the cluster analysis were reclassified based on the membership rules. The resulting floristic classification is compliant with *A Manual of California Vegetation* (CNPS 2020) and the USNVC (FGDC 2008, USNVC 2019). The most specific vegetation type, the association, is defined by a group of samples that have similar dominant and/or characteristic species in the overstory as well as other important or indicator species, whereby these species are distinctive for a particular environmental setting. A set of similar associations is grouped hierarchically to the next higher level in the classification, the alliance. These are grouped sequentially into the group, macrogroup, division, and upwards through the formation, sub-class, and class levels.

A summary of the analysis and classification process is provided in the following steps:

1. Import a plot-by-species matrix into PC-Ord with percent cover values of plants converted into Braun-Blanquet cover classes
2. Run summary statistics on the complete dataset and remove taxa occurring in < 2, 3, etc. surveys. Determine the coefficient of variation (CV), and species and plot outliers for each output. Use an output with a CV less than 200%, if possible
3. Decide on an output from step 2 and remove plot and species outliers greater than 3 standard deviations from the mean, using Sorensen Distance Measure
4. Run cluster analysis on the chosen output to determine the arrangement of samples based on species abundance and presence
5. Based on cluster group results in step 4, break the dataset up into smaller units for subsequent analyses
6. Repeat steps 1–4 for each subset of data generated from step 5
7. Run indicator species analysis (ISA) at each cluster group level, from 2 groups up to the maximum number possible (all groups must have at least 2 samples)
8. Use ISA to settle on the final representative grouping variable for each cluster analysis for preliminary labeling

9. Determine preliminary alliance and association names for each of the samples based on cluster membership, species constancy, abundance, and existing classifications
10. Develop decision and membership rules for each association and alliance by summarizing species cover, species constancy, and diagnostic species for the type for the keys and descriptions
11. Use the decision and membership rules to assign final alliance and association names to all samples included in the analysis and all outlier samples removed from the dataset.

Following the analysis of field data and development of the classification and key, CNPS engaged peer reviewers including state ecologists at VegCAMP (including Rachelle Boul and Todd Keeler-Wolf) and national ecologists at NatureServe (Patrick McIntyre). This process has involved two parallel efforts: 1) evaluate the existing alliance and association units to determine types for addition or revision in both the state and national classification systems, and 2) apply the upper levels of the recently revised USNVC hierarchy to ensure conformity in our state classification (per USNVC 2019). While working to apply the most current version of the 8-level USNVC hierarchy, we also are making recommendations on revisions and refinements for the upper levels of the hierarchy as well as the lower levels (Faber-Langendoen et al. 2018). This dynamic process is on-going since it includes various peer reviewers (including other western regional ecologists from the Washington Heritage Program), whereby updates and improvement still may occur in the future. In the meantime, the California state classification may have slight differences in the alliance and association names as compared to the USNVC (or in their concepts), and we are working towards aligning these state and national efforts.

Upon conferring alliance and association units, CNPS has written detailed local vegetation descriptions for Marin County. CNPS office staff (namely, Kendra Sikes, Savannah Vu, Kelsey Guest, and Julie Evens) wrote and edited the descriptions. The descriptions are divided into four sections based on general lifeform (dominance by trees, shrubs, herbs, and sparsely vegetated); they are organized alphabetically by alliance within each section followed by their respective association descriptions. Alliance descriptions begin with a statewide and a local narrative, including vegetation lifeform summary information and membership rules. Next, a summary of the environmental setting is provided including elevation, aspect, slope, macro topography, ground surface cover, soil texture, geology and county distribution by watershed (see watershed map Figure 1). Site impacts are noted, along with a list of associations found in Marin County. Finally, classification comments are provided along with data

references, global and state rarity ranks, and sample size. References for datasets in the descriptions may not be included in the Reference section of this report. All references are available for review using the bibliography available through *A Manual of California Vegetation* Online (CNPS 2020).

Each alliance and association description includes a stand table that summarizes species composition by type and lists constancy and cover estimate values (average, minimum and maximum) for all taxa occurring in at least 20% of stands. The definitions and conventions used to develop the descriptions and the keys are available as a comprehensive glossary in Appendix A. For vegetation types with a low sample size from Marin County (<5), related surveys from surrounding counties are included in the alliance and association descriptions and Survey IDs are noted.

Results

Data Compilation

A total of 255 stands of vegetation were sampled in the summer-fall of 2018 and spring-summer of 2019 through funding provided specifically for this classification effort, including 84 rapid assessment (RA) and 171 relevé surveys (Figure 2). Additional surveys that were compiled for the analysis from previous sampling and classification efforts in Marin County (2,966) and from adjacent coastal counties (3,186) provided a broader, regional understanding of vegetation types with overlapping floristic and ecological characteristics (Figure 3).

The compiled data were collected between 1992 and 2019 from the Marin Municipal Water District (Evens and Kentner 2006), Marin County Open Space District (Buck and Evens 2010), Point Reyes National Seashore and Golden Gate National Recreation Area (Schirokauer et al. 2003), Sonoma County Vegetation Mapping Program (Klein et al. 2015) and many others (see Table 2). CNPS reviewed the quality and accuracy of the data and archived it with newly collected data into a standardized Microsoft Access database. Data will be publicly available through CDFW's Biogeographic Information and Observation System (BIOS) and other data-sharing utilities upon project completion.

Species names were entered in the survey database as they were recorded in the field, yet the PLANTS Database (USDA NRCS 2020) was used as the standard for nomenclature (both botanical names and accompanying codes) for this classification effort. Taxa that could not be found in the PLANTS Database were assigned codes based on the Jepson eFlora (Jepson Flora Project 2020).

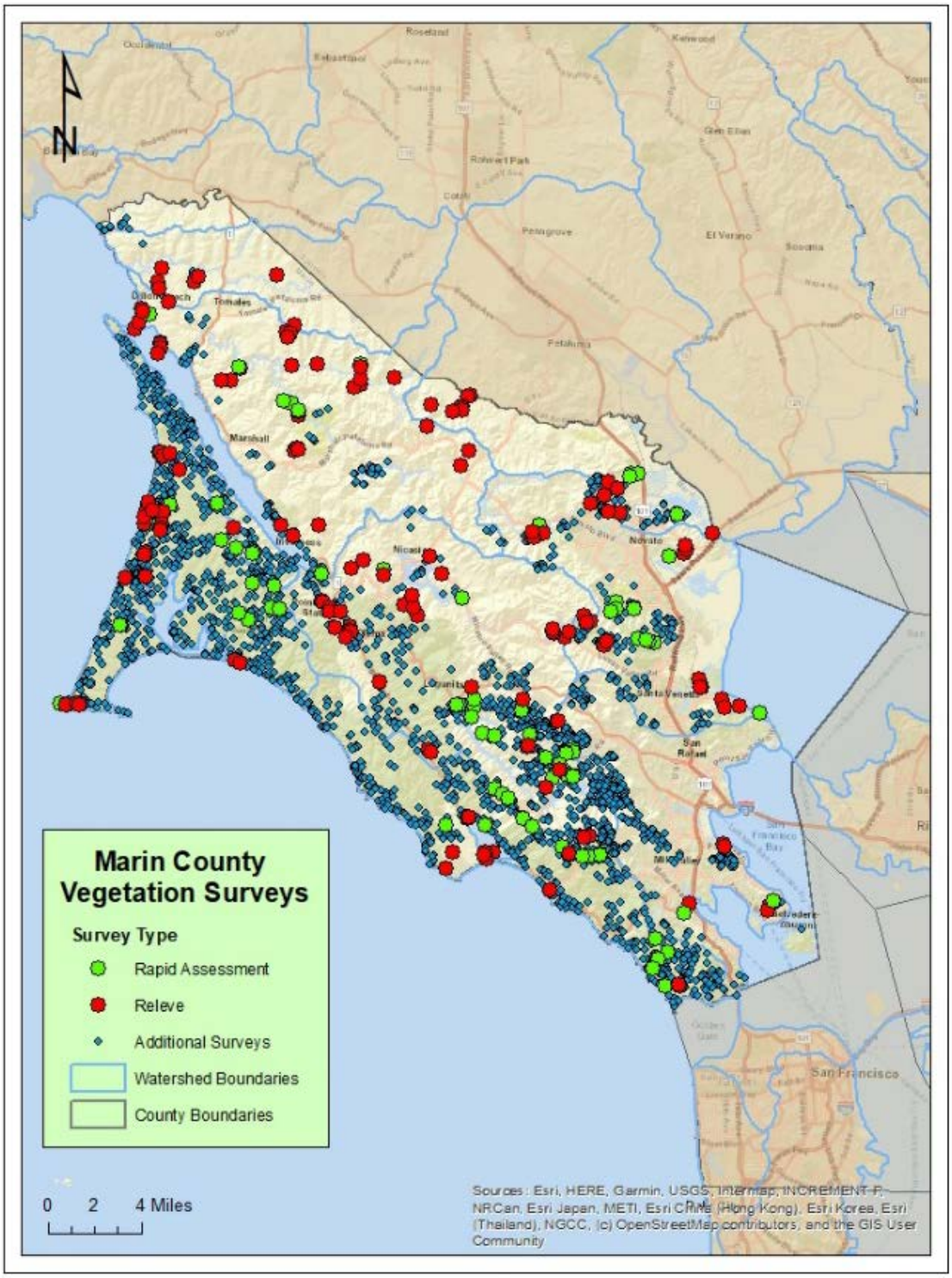

Figure 2. Locations of rapid assessment and relevé survey points in Marin County. The red and green points show surveys collected in 2018 and 2019 specifically for this project. The smaller blue points show surveys compiled from other projects in Marin County and included in the classification.

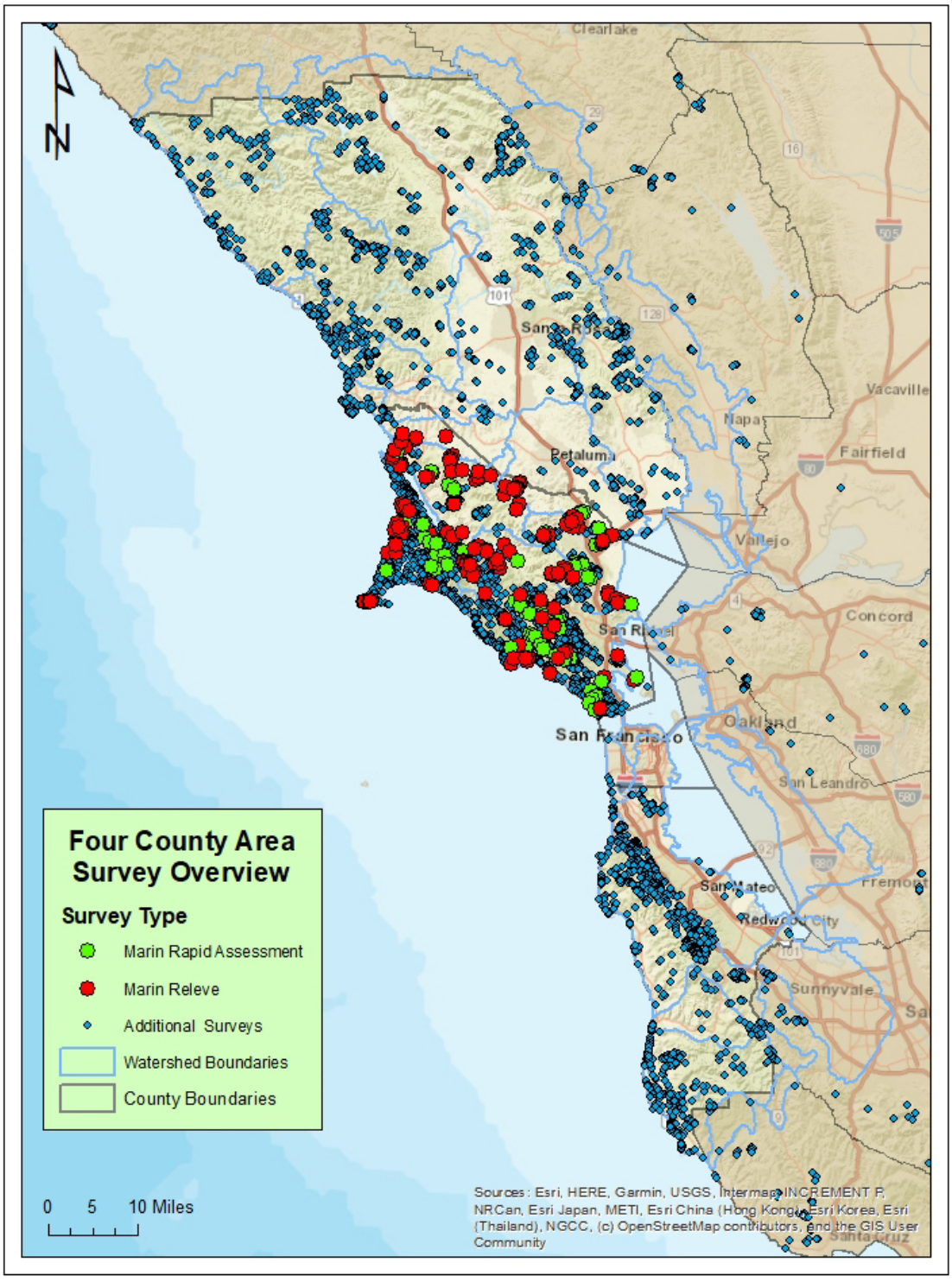

Figure 3. Locations of survey points in four Bay Area counties. The red and green points show surveys collected in Marin County during 2018 and 2019 for this project. The smaller blue points show surveys included in the classification analyses from other projects in adjacent coastal counties.

Table 2. Compilation of vegetation classification samples by focal area and entity within Marin County.

Focus/Location of sampling	Entity	Type of survey	# of samples
Marin County	Golden Gate National Parks Conservancy / D. Franco	Rapid assessments, Relevés	255
Marin County	Marin Co. Open Space District / M. Martin	Relevés, Accuracy Assessments	430
Marin County	Marin Municipal Water District/J. Klein & A. Williams	Rapid assessments, Relevés, Monitoring	520
Marin Grasslands	OneTam	Relevés	40
Marin County	NPS San Francisco Bay Area Network/E. Wrubel	Nested permanent plots, Transects	161
Point Reyes	National Park Service	Rapid assessments, Relevés, Accuracy Assessment, Transects	1498
Tennessee Valley	National Park Service	Wetland delineation	42
Bay Area Hyperspectral Vegetation Mapping	Sonoma State Univ./M. Clark	Plot-based rapid assessments	44
Coastal Prairie	Sonoma State Univ./C. Luke & UC Davis/A. Solomeschsch	Relevés using cover classes	186
Maritime chaparral	UC Santa Cruz/B. Hall & San Francisco State/M. Vasey	Relevés	8
Rare Plant Communities	CNPS & CA Dept. Fish & Wildlife	Line Intercept	6
Rangeland Management	Point Blue Conservation Science	Transects	9
Northern Coastal Scrub	San Francisco State/E. Wrubel	Rapid assessments, Relevés	22
		Total	**3221**

Classification

Vegetation RA and relevé data were analyzed by CNPS in 2019 for tree and shrub types and in 2020 for herbaceous types. An additional 3,186 surveys from neighboring counties were included to provide a broader, regional understanding of vegetation types with overlapping floristic and ecological characteristics (Figure 3). The dataset was partitioned into five subsets during analysis that broadly corresponded to patterns of redwoods, other trees, chaparral, other shrub/herbs, and saline/riparian. Cluster and

Indicator Species Analyses were conducted on each of the five subsets to select appropriate cluster grouping variables for community classification. Both broad- and fine-scale cluster grouping variables were selected for each subset based on the presence of relatively high numbers of significant indicators and low average p-values.

After CNPS produced a draft classification, VegCAMP and NatureServe ecologists reviewed it and provided feedback for additional refinement. The floristic vegetation classification resulted in approximately 110 alliances and 280 associations within Marin County: 26 tree-overstory, 29 shrubland, 53 herbaceous/grassland and 2 sparsely vegetated alliances (Table 3); and 79 tree-overstory, 72 shrubland, 127 herbaceous/grassland and 3 sparsely vegetated associations (Appendix B, Table 4). Of the types classified, 20 alliances and 39 associations are considered “Semi-Natural” or “Ruderal” because they are dominated and characterized by non-native plants that are reproducing and maintaining populations in the wild.

The attributes of sampled vegetation, including species composition, structure, and cover, were used to develop a floristic key to vegetation types of Marin County (Appendix C) and the descriptions (Appendix D). The field key is organized by vegetation layer (e.g., tree-overstory, shrubland, herbaceous), USNVC hierarchical level (e.g., Group, Alliance, and Association), and environmental setting (e.g., riparian / wetland, upland). The field key provides users the ability to assess vegetation types while in the field. Field testing of the vegetation key was performed in collaboration with the mapping team during field reconnaissance in June 2019. Both the field key and descriptions contain membership rules for each alliance in the classification. Upon establishing these membership rules, all outliers or other surveys removed from the initial analysis were subsequently classified to alliance and association. While 6,407 surveys were included in the comprehensive vegetation classification analysis, only those located in Marin County (3,221 surveys) are included in the descriptions, unless otherwise noted in the classification comments (when sample size was low). Eighteen surveys were excluded from the final descriptions because they were classified above alliance level, to the group or macrogroup level.

Additionally, Table 5 in Appendix B represents the classification list of alliances and associations in Marin County nested within the USNVC hierarchy. The classification names for each field survey are located in a survey database. The survey data will be publicly available upon project completion through CDFW’s Biogeographic Information and Observation System (BIOS).

Table 3. Alliance list with sample size for surveys collected in Marin County, California. An asterisk (*) denotes alliances that are likely present or known to be present but do not have classification surveys in the County.

Lifeform	Alliance Name	n
Forest And Woodland	*Acer macrophyllum – Alnus rubra* Alliance	85
	Acer negundo Alliance	1
	Aesculus californica Alliance	6
	Alnus rhombifolia Alliance	3
	Arbutus menziesii Alliance	40
	Eucalyptus spp. *– Ailanthus altissima – Robinia pseudoacacia* Semi-Natural Alliance	2
	Fraxinus latifolia Alliance*	0
	Hesperocyparis (sargentii, macnabiana) Alliance	22
	Hesperocyparis macrocarpa – Pinus radiata Semi-Natural Alliance	15
	Notholithocarpus densiflorus Alliance	17
	Pinus muricata – Pinus radiata Alliance	62
	Platanus racemosa – Quercus agrifolia Alliance	1
	Pseudotsuga menziesii – (Notholithocarpus densiflorus – Arbutus menziesii) Alliance	155
	Quercus (agrifolia, douglasii, garryana, kelloggii, lobata, wislizeni) Alliance	2
	Quercus agrifolia Alliance	88
	Quercus chrysolepis (tree) Alliance	12
	Quercus douglasii Alliance	8
	Quercus garryana (tree) Alliance	8
	Quercus kelloggii Alliance	18
	Quercus lobata Alliance	15
	Quercus lobata Riparian Alliance	5
	Quercus wislizeni – Quercus parvula (tree) Alliance	9
	Salix gooddingii – Salix laevigata Alliance	3
	Salix lucida ssp. *lasiandra* Alliance	6
	Sequoia sempervirens Alliance	119
	Umbellularia californica Alliance	189
Shrubland	*Acacia* spp. *– Grevillea* spp. *– Leptospermum laevigatum* Semi-Natural Alliance*	0
	Adenostoma fasciculatum Alliance	47
	Arctostaphylos (bakeri, montana) Alliance	29
	Arctostaphylos (canescens, manzanita, stanfordiana) Alliance	13
	Arctostaphylos (nummularia, sensitiva) – Chrysolepis chrysophylla Alliance	44
	Arctostaphylos glandulosa Alliance	62
	Artemisia californica – (Salvia leucophylla) Alliance	41
	Baccharis pilularis Alliance	418
	Ceanothus cuneatus Alliance	8

Lifeform	Alliance Name	n
	Ceanothus thyrsiflorus Alliance	41
	Cornus sericea Alliance*	0
	Corylus cornuta var. *californica* Alliance	18
	Cytisus scoparius – Genista monspessulana – Cotoneaster spp. Semi-Natural Alliance	25
	Diplacus aurantiacus Alliance	2
	Frangula californica – Rhododendron occidentale – Salix breweri Alliance	1
	Gaultheria shallon – Rubus (ursinus) Alliance	25
	Lotus scoparius – Lupinus albifrons – Eriodictyon spp. Alliance	3
	Lupinus arboreus Alliance	36
	Lupinus chamissonis – Ericameria ericoides Alliance	30
	Prunus ilicifolia – Heteromeles arbutifolia – Ceanothus spinosus	1
	Quercus durata Alliance	8
	Quercus wislizeni – Quercus chrysolepis (shrub) Alliance	23
	Rhododendron columbianum Alliance	3
	Rubus armeniacus - Sesbania punicea - Ficus carica Semi-Natural Alliance*	0
	Rubus spectabilis – Morella californica Alliance	32
	Salix exigua Alliance	2
	Salix lasiolepis Alliance	57
	Salix hookeriana – Salix sitchensis – Spiraea douglasii Alliance*	0
	Toxicodendron diversilobum Alliance	16
Herbaceous	*Abronia latifolia – Ambrosia chamissonis* Alliance	6
	Ammophila arenaria Semi-Natural Alliance	16
	Amsinckia (menziesii, tessellata) – Phacelia spp. Alliance	1
	Atriplex prostrata – Cotula coronopifolia Semi-Natural Alliance	1
	Avena spp. *– Bromus* spp. Semi-Natural Alliance	59
	Azolla (filiculoides, microphylla) Alliance	3
	Bolboschoenus maritimus Alliance	2
	Brassica nigra – Centaurea (solstitialis, melitensis) Semi-Natural Alliance	7
	Bromus carinatus – Elymus glaucus Alliance	52
	Cakile (edentula, maritima) Provisional Semi-Natural Alliance	1
	Calamagrostis nutkaensis Alliance	51
	Carex barbarae Alliance	3
	Carex nudata Alliance*	0
	Carex obnupta – Oenanthe sarmentosa – Scirpus microcarpus Alliance	75
	Ceratophyllum demersum Aquatic Provisional Alliance	1
	Conium maculatum – Foeniculum vulgare Semi-Natural Alliance	3
	Corethrogyne filaginifolia – Eriogonum (elongatum, nudum) Alliance*	0
	Cortaderia (jubata, selloana) Semi-Natural Alliance	1

Lifeform	Alliance Name	n
	Cynosurus echinatus – Arrhenatherum elatius Semi-Natural Alliance	2
	Deschampsia cespitosa – Festuca rubra Brackish Salt Marsh Alliance	1
	Deschampsia cespitosa – Hordeum brachyantherum – Danthonia californica Alliance	62
	Distichlis spicata Alliance	33
	Eichhornia crassipes – Ludwigia (hexapetala, peploides) Provisional Semi-Natural Alliance	2
	Eleocharis (acicularis, macrostachya) Alliance	6
	Eriophyllum staechadifolium – Erigeron glaucus – Eriogonum latifolium Alliance	22
	Eryngium aristulatum Alliance	1
	Eschscholzia (californica) – Lupinus (nanus) Alliance	10
	Festuca idahoensis – Danthonia californica Alliance	99
	Holcus lanatus – Anthoxanthum odoratum Semi-Natural Alliance	25
	Hydrocotyle (ranunculoides, umbellata) Alliance	2
	Juncus (effusus, patens) – Carex (pansa, praegracilis) Alliance	130
	Lasthenia californica – Plantago erecta – Vulpia microstachys Alliance	31
	Lasthenia glaberrima Alliance	2
	Lepidium latifolium – (Lactuca serriola) Semi-Natural Alliance	1
	Leymus cinereus – Leymus triticoides Alliance	2
	Leymus mollis Alliance	2
	Lolium perenne Semi-Natural Alliance	24
	Mesembryanthemum spp. *– Carpobrotus* spp. Semi-Natural Alliance	8
	Mimulus (guttatus) Alliance	1
	Nassella spp. *– Melica* spp. Alliance	120
	Nuphar lutea Alliance	2
	Phalaris aquatica – Phalaris arundinacea Semi-Natural Alliance	11
	Poa pratensis – Agrostis gigantea – Agrostis stolonifera Semi-Natural Alliance	6
	Polygonum lapathifolium – Xanthium strumarium Alliance	9
	Sarcocornia pacifica (Salicornia depressa) Alliance	76
	Schoenoplectus (acutus, californicus) Alliance	13
	Sedum spathulifolium Provisional Alliance	4
	Selaginella (bigelovii, wallacei) Alliance	2
	Sparganium (angustifolium) Alliance	4
	Spartina foliosa Alliance	5
	Trifolium variegatum Alliance	3
	Typha (angustifolia, domingensis, latifolia) Alliance	10
	Zostera (marina, pacifica) Pacific Aquatic Alliance*	0
Sparsely Vegetated	*Allium* spp. *– Streptanthus* spp. *– Hesperolinon* spp. Serpentinite Alliance	8
	Dudleya cymosa – Dudleya lanceolata / Lichen – Moss Alliance	6

Discussion

In the approximately 332,800 acres of land (or 1,300 km2) in Marin County, the diversity of vegetation types is superlative -- from tidal marshes and coastal freshwater marshes, to beach dune and dune scrub, to maritime and mesic chaparral, to oak woodland and tanoak forests, to Douglas-fir and redwood forests of many varieties. The fine-scale classification of vegetation has resulted in differentiating new alliances for the Manual of California Vegetation, including serpentine barrens (*Allium* spp. – *Streptanthus* spp. – *Hesperolinon* spp. Serpentine Alliance), coastal beach scrub (*Eriophyllum staechadifolium – Erigeron glaucus – Eriogonum latifolium* Alliance), coastal bluff scrub (*Gaultheria shallon – Rubus (ursinus)* Alliance), and non-native coastal conifer stands (*Hesperocyparis macrocarpa – Pinus radiata* Semi-Natural Alliance).

Upon conferring with the National Vegetation Classification, a few alliances from the Manual have been split at a finer-scale such differentiating riparian valley oak forest (*Quercus lobata* Riparian Alliance) from upland stands, while other alliances that are localized in the Greater Bay Area have been merged together into broader concepts across various habitats including maritime chaparral (*Arctostaphylos (nummularia, sensitiva) – Chrysolepis chrysophylla* Alliance) and xeric serpentine chaparral (*Arctostaphylos (bakeri, montana)* Alliance). Other more broadly distributed types from western North America have been combined together from previously separate alliances based on overlapping lowland and coastal plant assemblages, yet they are separated from similar montane assemblages, including wet meadow (e.g., *Deschampsia cespitosa – Hordeum brachyantherum – Danthonia californica* Alliance), moist meadow (e.g., *Festuca idahoensis – Danthonia californica* Alliance), and riparian scrub (e.g., *Frangula californica – Rhododendron occidentale – Salix breweri* Alliance). Additionally, ruderal or seral scrub types have been simplified into broader concepts (e.g., *Cytisus scoparius – Genista monspessulana – Cotoneaster* spp. Semi-Natural Alliance*, Lotus scoparius – Lupinus albifrons – Eriodictyon* spp. Alliance).

Additionally, a few types in the USNVC are being split and/or recognized at the Alliance level, pending either review by western regional ecologists or database management by NatureServe for acceptance nationally. This includes the *Arbutus menziesii* and *Notholithocarpus densiflorus* alliances being split and the *Umbellularia californica* Alliance being recognized. A summary of these changes from both the state and national systems are included in Appendix B, Table 5. Some decisions still pending review by Western Heritage ecologists include the broadening or merging of alliance concepts for coastal freshwater to brackish marshes and aquatic wetlands, in which we are still gathering input and analysis from California to Washington and east to Colorado. Other pending decisions include placement of some alliances in the USNVC hierarchy, including the placement of *Eleocharis (macrostachya, acicularis)* Alliance at the Group level. These and future revisions will be forthcoming in the Manual of

California Vegetation and the USNVC, and updates to state rarity ranking will also need to be addressed once fine-scale mapping and classification data are synthesized and evaluated.

The classification does recognize various ‘semi-natural’ or ‘ruderal’ types when invasive (non-native) or native weedy generalist plant species overwhelmingly dominate stands (e.g., >90% relative cover), and substantially replace the typical native diagnostic plants. Setting a high threshold minimizes the creation of new types until it is certain that a characteristic combination of species has been formed (Faber-Langendoen et al. 2018). This includes the *Ammophila arenaria, Mesembryanthemum* spp. – *Carpobrotus* spp., among various other herbaceous alliances. One expanded ruderal shrubland type is the *Cytisus scoparius – Genista monspessulana – Cotoneaster* spp*.* Alliance and a new type is the *Acacia* spp. – *Grevillea* spp. – *Leptospermum laevigatum* Alliance (which was primarily observed during mapping reconnaissance). Classifying and mapping these ruderal types can be important to identify and evaluate restoration actions, particularly for ruderal types that negatively impact the local ecosystems – i.e., when the impacts of non-native plant dominance change the natural ecological processes and/or increase threats (e.g., non-native herbs disrupting active dune assemblages, invasive shrubs increasing fuel loads and wildfire threats).

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Appendix A

Glossary

The following terms with their respective definitions have been established in developing the vegetation classification, keys, and descriptions.

- **Taxon** – Species names defined in the PLANTS Database (USDA NRCS 2020), except in two cases: When a more current name has been assigned in the Jepson eflora (Jepson Flora Project 2020), or for general vegetation terms such as moss and lichen.
- **Lifeform terms:**
  - **Tree** – Is a one-stemmed woody plant that normally grows to be greater than 5 meters tall. In some cases, trees may be multiple-stemmed (ramifying) after fire or other disturbance, but size of mature plants is typically greater than 5 m and undisturbed individuals of these species are usually single stemmed.
  - **Regenerating tree** – seedlings and saplings defined as follows:
    - *Seedlings* - trees clearly of a young age that have less than 1" diameter at breast height (dbh) or have not reached breast height. Applies only to trees propagating from seed; resprouts are not recorded here even if they meet the size requirements.
    - *Saplings* – trees with 1" – 6" dbh and young in age, OR small trees that are less than 1" dbh, are clearly of appreciable age, and are kept short by repeated browsing, burning, or other disturbance. Includes trees that are re-sprouting from roots or stumps following fire, logging or other disturbance. These re-sprouts may exhibit a shrubby form, with multiple small trunks, but are species that are generally considered trees. If a majority of the trunks are greater than 6" dbh, then the re-sprouts would be recorded under the "Tree" stratum.
  - **Understory tree** – trees that grow beneath the main canopy of a forest/woodland.
  - **Shrub** – Is normally a multi-stemmed woody plant that generally has several erect, spreading, or prostrate stems and that is usually between 0.2 meters and 5 meters tall, giving it a bushy appearance. Definitions are blurred at the low and the high ends of the height scales. At the tall end, shrubs may approach trees based on disturbance frequencies (e.g., old-growth re-sprouting species such as *Quercus wislizeni,* etc., may frequently attain "tree size"). At the low end, woody perennial herbs or sub-shrubs of various species are often difficult to categorize into a single life-form; usually sub-shrubs (per USDA-NRCS 2020) were categorized in the "shrub" category.
  - **Herb** – Is any vascular plant species that has no main woody stem-development, and includes grasses, forbs, and perennial species that die-back seasonally.

- **Cryptogam -** Is a nonvascular plant or plant-like organism without specialized water or fluid conducting vascular tissue (i.e., xylem and phloem). Includes mosses, lichens, liverworts, hornworts, and algae.
- **Cover** – The primary metric used to quantify the abundance of a particular species or a particular vegetation layer within a plot. It was measured by estimating the aerial extent of the living plants, or the "bird's-eye view" looking from above for each category. Various subcategories of cover for species and vegetation are defined as follows:
  - **Absolute cover** – Refers to the actual percentage of the ground (surface of the plot or stand) that is covered by a species or group of species. For example, *Pseudotsuga menziesii* covers between 5% and 10% of the stand. Absolute cover of all species or groups if added in a stand or plot may total greater or less than 100% because it is not a proportional number.
  - **Relative cover** – Refers to the amount of the surface of the plot or stand sampled that is covered by one species (or physiognomic group) as compared to (relative to) the amount of surface of the plot or stand covered by all species (in that group). Thus, 50% relative cover means that half of the total cover of all species or physiognomic groups is composed of the single species or group in question. Relative cover values are proportional numbers and, if added, total 100% for each stand (sample).
  - **Dense/Continuous cover** – Used to describe individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where there is greater than 66 percent absolute cover.
  - **Intermittent cover** – Used to describe individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where there is 33-66 percent absolute cover.
  - **Open cover** – Used to describe individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the cover is less than 33 percent absolute cover.
  - **Sparse cover** – Used to describe individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the *average* cover value is <2% absolute cover (though the range in cover could be <1-9% cover).
  - **Emergent** – A plant (or vegetation layer) is considered emergent if it includes plants that rises above a predominant vegetation layer, but that are sparse in cover. It is considered as a member of the next tallest layer, but typically has an absolute cover < 10%.
- **Constancy, Cover-Abundance, and Related Terms** – Used in the key, descriptions and the vegetation constancy tables for the species summarized within all stands of the alliance or association (codes from tables in parentheses):
  - **Constancy** (Con) – Number of occurrences divided by the number of samples X 100%
  - **Diagnostic** – A species or group of species whose relative constancy or abundance differentiates one vegetation type from another; the term can include character, constant, differential, and indicator species (Jennings et al. 2006).
  - **Dominant** (D) – Must be in at least 75% of the samples, with at least 50% relative cover in all samples.
  - **Co-dominant** (cD) – Must be in at least 75% of the samples, with at least 30% relative cover in all samples.

- **Characteristic** (Char) – Present in at least 75% of the samples for that vegetation type, with no restriction on cover.
- **Abundant** – Present in 50 to 75% of the samples, with at least 50% relative cover.
- **Usually/Often** (Often) – Present in 50 to 75% of the samples, with no restriction on cover.
- **Sometimes** – Present in 25 to 50% of the samples, with no restriction on cover.
- **Average** (Avg) **and Relative Cover** (RelCov) – Average cover for a taxon in a vegetation type is calculated as the sum of its 'absolute' cover values divided by the total sample size; relative cover is calculated as the comparative sum of cover values for one taxon compared to the sum of cover values of other taxa, in which proportional numbers are derived (see **Cover** section for more details).
- **Minimum** (Min) and **Maximum** (Max) – The minimum and maximum cover values that a taxon had from the surveys of a vegetation type. Values could be an absolute cover value (e.g., 1%) and/or a mid-point value of a cover class (e.g., 2.5% for a cover class of 1–5 %) depending on data available

- **Stand** – Is the basic physical unit of vegetation in a landscape. It has no set size. Some vegetation stands are very small such as wetland seeps, and some may be several square kilometers in size such as desert or forest types. A stand is defined by two main unifying characteristics:
  - 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 gradual.
  - It has *structural* integrity. It has a similar history or environmental setting, affording relatively similar horizontal and vertical spacing of plant species. For example, a hillside forest formerly dominated by the same species, but that has burned on the upper part of the slope and not the lower is divided into two stands. Likewise, a sparse woodland occupying a slope with shallow rocky soils is considered a different stand from an adjacent slope of a denser woodland/forest with deep moister soil and the same species.
- **Vegetation:**
  - **Woodland and forest vegetation**: In the National Vegetation Classification, a woodland is defined as a tree-dominated stand of vegetation with between 25 and 60 percent cover of trees and a forest is defined as a tree-dominated stand of vegetation with 60 percent or greater cover of trees.
  - **Shrubland vegetation**: Shrubs (including dwarf-shrubs) are evenly distributed throughout the stand, providing a consistent (even if sparse) structural component, and one or both of the following criteria are met: (1) Shrubs influence the distribution or population dynamics of other plant species; (2) Shrubs play an important role in ecological processes within the stand.
  - **Herbaceous vegetation**: Herbs are evenly distributed throughout the stand, providing a consistent (even if sparse) structural component, and play an important role in ecological processes within the stand, and the stand cannot be characterized as a tree or shrub stand.

- **Nonvascular vegetation**: Nonvascular organisms provide a consistent (even if sparse) structural component and play an important role in ecological processes within the stand.
- **Semi-natural/ruderal vegetation**: Stands characterized by naturalized non-native species. Examples include *Tamarix* spp., and *Brassica* spp. Note: the terminology for semi-natural versus ruderal plant communities is still under discussion with ESA Vegetation Panel and Hierarchy Review Working Group, and in the last 5 years the classification names have gone back and forth between these two terms.

- **US National Vegetation Classification (USNVC, or NVC) Hierarchy Levels:**
  - **Class** – A vegetation classification unit of high rank (1st level) defined by a broad combination of dominant general growth forms adapted to basic moisture, temperature, and/or substrate or aquatic conditions (FGDC 2008).
  - **Subclass –** A vegetation classification unit of high rank (2nd level) defined by a combination of general dominant and diagnostic growth forms that reflect global mega- or macroclimatic factors driven primarily by latitude and continental position, or that reflect overriding substrate or aquatic conditions (FGDC 2008).
  - **Formation –** A vegetation classification unit of high rank (3rd level) defined by a Combination of dominant and diagnostic growth forms that reflect global macroclimatic conditions as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions (FGDC 2008).
  - **Division –** A vegetation classification unit of intermediate rank (4^{th} level) defined by a combination of dominant and diagnostic growth forms and a broad set of diagnostic plant species that reflect biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes (FGDC 2008).
  - **Macrogroup** – A vegetation classification unit of intermediate rank (5^{th} level) defined by a moderate set of diagnostic plant species and diagnostic growth forms that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes (FGDC 2008).
  - **Group** – A vegetation classification unit of intermediate rank (6^{th} level) defined by combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms that reflect biogeographic differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes (FGDC 2008).
  - **Alliance** – A classification unit of vegetation of low rank (7^{th} level), containing one or more associations and defined by one or more diagnostic species, often of high cover, in the uppermost layer or the layer with the highest canopy cover. Alliances reflect physiognomy as well as regional to subregional climates, substrates, hydrology, and disturbance regimes (Jennings et al. 2006, FGDC 2008). The USNVC assigns Alliances a database code and scientific name.
  - **Association** – A vegetation classification unit of low rank (8^{th} level) defined by a diagnostic species, a characteristic range of species composition, physiognomy, and distinctive habitat conditions (Jennings et al. 2006). Associations reflect local topo-edaphic climates, substrates, hydrology, and disturbance regimes.
- **Other Classification Terms:**

- **Provisional Type –** A vegetation type that is not yet formally described, but expected to be an addition to the existing list of USNVC types for a project area. The type may be represented by plot samples (e.g., <10 samples), while it may or may not be particularly common or because it is localized in extent; however, it could be documented in additional location(s) outside of the study area.

- **Conservation Rank** – The California Department of Fish and Wildlife's Vegetation Classification and Mapping Program's Survey of California Vegetation (SCV) uses the state Heritage Program methodology per NatureServe for natural community conservation ranks as defined below (and see http://www.natureserve.org). "G" indicates the alliance's rarity and threat globally, and "S" indicates the alliance's rarity and threat in California:
  - **G1 and S1** – Critically Imperiled—At very high risk of extinction due to extreme rarity. Often 5 or fewer viable occurrences and/or up to 518 hectares.
  - **G2 and S2** – Imperiled—At high risk of extinction due to very restricted range, very few occurrences, steep declines, or other factors. Often 6–20 viable occurrences, and/or 518–2,590 hectares
  - **G3 and S3** – Vulnerable—At moderate risk of extinction due to a restricted range, relatively few populations, recent and widespread declines, or other factors. Often 21–100 viable occurrences and/or 2,590–12,950 hectares.
  - **G4 and S4** – Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors. Often greater than 100 viable occurrences and/or more than 12,950 hectares.
  - **G5 and S5** – Secure—Common; widespread and abundant.

    Notes:
    - If a vegetation type (i.e., alliance or association) is marked with a G1 through a G3 code, it is rare and threatened throughout its range. A type marked with a G5 and an S1 through an S3 code is secure through its range outside the state but is rare and threatened in California. A G4/S4 type may or may not be endemic to the state and is secure statewide.
    - Semi-natural alliances and associations are not ranked.

- **Abbreviations and Other Characters:**
  - **Parentheses ( )** – When parentheses are used around a species name within a vegetation type name, it indicates that the species is often present as an indicator of that association or alliance, but it does not meet a threshold of 75% or more constancy. The parentheses may be used around the full scientific name or only around the species epithet. An example is the *Pinus muricata – (Arbutus menziesii – Notholithocarpus densiflorus) / Vaccinium ovatum* Association. If parentheses are only around the species epithet, it means that the genus is consistently present but another species could also be present from that genus. An example is the *Artemisia californica / Nassella (pulchra)* Association, where the genus may be represented by one or more species found within the parentheses.
  - **NVC Alliance Code:** The assigned database code and scientific name for the Alliances in the USNVC.

- **Local Environmental Attributes –** Used in the alliance and association descriptions.
  - **Macrotopography** – broad topographic term to describe general position of a stand in the surrounding watershed (e.g., top, upper third, middle third, lower third, and/or bottom) followed by the number of surveys noted in parentheses within each position.
  - **% Surface cover:** The abiotic ground surface substrates of the plot/survey.
    - **Large rock** – percent cover of rocks on the ground with a diameter greater than 25 cm. Includes rocks that were recorded in the field as bedrock, boulder (>60 cm in diameter) and stone (>25 cm – 60 cm in diameter).
    - **Small rock** – percent cover of rocks on the ground with a diameter ranging from 2 mm to 25 cm. Includes rocks that were recorded in the field as gravel (2 mm – 7.5 cm in diameter) and cobble (>7.5 cm – 25 cm in diameter).
    - **Fines Cover** – percent (exposed) cover of fine sediment or soil particles with a diameter less than 2 mm; i.e., ground that is not covered by litter, small rock, or large rock.
    - **Litter Cover** – percent cover of litter, duff, and/or unattached wood on the ground.
  - **Marin County Watersheds** – List of county-wide distribution by watershed unit followed by the number of surveys noted in parentheses within each unit (CalWater 2004).
- **Site Impacts –** Used in the alliance and association descriptions to depict the degree of non-native plant cover and most frequent or abundant non-native plant species. Categories for the average non-native plant cover relative to native cover include low (≤20% relative cover), moderate (20-50% relative cover), and high (>50% relative cover).

Appendix B

Vegetation Classification Tables

Vegetation Classification for Marin County is organized within two tables, one including the Alliances and Associations, and the other with Alliances nested in the current USNVC hierarchy.

Table 4. Alliances and associations with surveys in Marin County (number of surveys in column Co), with number of surveys classified for that association in the greater Bay Area (in column All). Status column (Stat) includes the following abbreviations for association status: rev = revised definition, new = new type. An asterisk (*) denotes alliances that are likely present or are present but without classification surveys in the County.

Lifeform				
Alliance	**Association**	**Co**	**All**	**Stat**
Forest and Woodland				
Acer macrophyllum – Alnus rubra				
	Acer macrophyllum / (Rubus ursinus)	4	10	rev
	Alnus rubra / Rubus spectabilis – Sambucus racemosa	34	43	
	Alnus rubra / Salix lasiolepis – Rubus spp.	29	45	rev
	Umbellularia californica – Acer macrophyllum	13	24	rev
	Umbellularia californica / Rhododendron occidentale	5	7	rev
Acer negundo				
	Acer negundo / (Rubus ursinus)	1	10	rev
Aesculus californica				
	Aesculus californica – Umbellularia californica	4	10	rev
	Aesculus californica / Toxicodendron diversilobum / Moss	2	14	
Alnus rhombifolia				
	Alnus rhombifolia – Umbellularia californica – (Quercus chrysolepis)	3	8	rev
Arbutus menziesii				
	Arbutus menziesii – (Quercus agrifolia)	21	43	rev
	Arbutus menziesii – Umbellularia californica	19	29	
Eucalyptus* spp. – *Ailanthus altissima – Robinia pseudoacacia				
	*Acacia melanoxylon**	0	3	new
	Eucalyptus (globulus, camaldulensis)	2	12	
Fraxinus latifolia*				
	*Fraxinus latifolia**	0	6	
Hesperocyparis (sargentii, macnabiana)				
	Hesperocyparis sargentii	4	7	
	Hesperocyparis sargentii / Ceanothus jepsonii – Arctostaphylos spp.	17	34	rev
	Hesperocyparis sargentii / Rhododendron occidentale	1	6	rev
Hesperocyparis macrocarpa – Pinus radiata				**new**
	Hesperocyparis macrocarpa Ruderal	9	16	rev
	Pinus radiata plantations	6	15	
Notholithocarpus densiflorus				
	Notholithocarpus densiflorus – Arbutus menziesii	11	31	
	Notholithocarpus densiflorus – Quercus chrysolepis	2	3	
	Notholithocarpus densiflorus / Vaccinium ovatum	2	7	

Lifeform					
Alliance	**Association**		**Co**	**All**	**Stat**
	Pinus muricata – Pinus radiata				
		Pinus muricata	7	13	
		Pinus muricata – (Arbutus menziesii – Notholithocarpus densiflorus) / Vaccinium ovatum	27	34	rev
		Pinus muricata / Arctostaphylos glandulosa	5	5	
		Pinus muricata / Ceanothus thyrsiflorus – Baccharis pilularis	21	22	new
	Platanus racemosa – Quercus agrifolia				
		Quercus agrifolia / Salix lasiolepis	1	4	
	Pseudotsuga menziesii – (Notholithocarpus densiflorus – Arbutus menziesii)				
		Pseudotsuga menziesii – (Umbellularia californica) / Frangula californica	17	22	
		Pseudotsuga menziesii – Arbutus menziesii	5	16	
		Pseudotsuga menziesii – Chrysolepis chrysophylla – Notholithocarpus densiflorus	3	7	
		Pseudotsuga menziesii – Notholithocarpus densiflorus – Umbellularia californica / Toxicodendron diversilobum	10	14	
		Pseudotsuga menziesii – Notholithocarpus densiflorus / Vaccinium ovatum	1	6	rev
		Pseudotsuga menziesii – Quercus agrifolia	21	47	
		Pseudotsuga menziesii – Quercus chrysolepis	9	21	
		Pseudotsuga menziesii – Umbellularia californica / (Toxicodendron diversilobum)	28	55	rev
		Pseudotsuga menziesii – Umbellularia californica / Polystichum munitum	15	23	
		Pseudotsuga menziesii / (Toxicodendron diversilobum)	7	16	rev
		Pseudotsuga menziesii / Baccharis pilularis	35	48	
		Pseudotsuga menziesii / Corylus cornuta / Polystichum munitum	3	8	rev
	Quercus (agrifolia, douglasii, garryana, kelloggii, lobata, wislizeni)				
		Quercus agrifolia – Quercus garryana – Quercus kelloggii	2	15	
	Quercus agrifolia				
		Quercus agrifolia – Arbutus menziesii – Umbellularia californica	31	57	
		Quercus agrifolia – Arbutus menziesii / Corylus cornuta – Rubus spp.	4	6	
		Quercus agrifolia – Quercus kelloggii	1	4	
		Quercus agrifolia – Umbellularia californica / Heteromeles arbutifolia – Quercus berberidifolia	1	10	
		Quercus agrifolia / Adenostoma fasciculatum – (Salvia mellifera)	3	3	rev

Lifeform					
Alliance		**Association**	**Co**	**All**	**Stat**
		Quercus agrifolia / grass	20	41	
		Quercus agrifolia / Toxicodendron diversilobum	25	63	
	***Quercus chrysolepis* (tree)**				
		Quercus chrysolepis – Arbutus menziesii – Notholithocarpus densiflorus var. *densiflorus*	3	10	rev
		Quercus chrysolepis – Umbellularia californica	8	14	
		Quercus chrysolepis / Quercus (wislizeni, parvula)	1	3	
	Quercus douglasii				
		Quercus ×eplingii / Grass	8	13	
		*Quercus douglasii – Quercus agrifolia**	0	7	
	***Quercus garryana* (tree)**				
		Quercus garryana – Umbellularia californica – Quercus (agrifolia, kelloggii)	4	38	
		Quercus garryana / (Cynosurus echinatus – Festuca californica)	3	28	
	Quercus kelloggii				
		Quercus kelloggii – Arbutus menziesii – Quercus agrifolia	9	20	
		Quercus kelloggii – Pseudotsuga menziesii – Umbellularia californica	6	17	rev
	Quercus lobata				
		Quercus lobata – Quercus agrifolia / grass	13	21	
		Quercus lobata / grass	2	18	
	***Quercus lobata* Riparian**				**new**
		Quercus lobata – Fraxinus latifolia / Vitis californica	1	6	
		Quercus lobata – Salix lasiolepis	1	1	
		Quercus lobata / Rubus ursinus – Rosa californica	1	5	rev
	***Quercus wislizeni – Quercus parvula* (tree)**				
		Quercus (parvula, wislizeni) – Arbutus menziesii / Toxicodendron diversilobum	9	23	rev
	Salix gooddingii – Salix laevigata				
		Salix laevigata / (Cornus sericea – Ribes spp.*) / Scirpus microcarpus – Carex* spp.	2	5	rev
		Salix laevigata / Salix lasiolepis	1	7	
	Salix lucida* ssp. *lasiandra				
		Salix lucida ssp. *lasiandra*	6	21	
	Sequoia sempervirens				
		Sequoia sempervirens – Acer macrophyllum – Umbellularia californica	15	36	
		Sequoia sempervirens – Arbutus menziesii / Vaccinium ovatum	8	21	rev
		Sequoia sempervirens – Chrysolepis chrysophylla / Arctostaphylos glandulosa	6	9	

Lifeform					
Alliance		**Association**	**Co**	**All**	**Stat**
		Sequoia sempervirens – Notholithocarpus densiflorus / Vaccinium ovatum	33	78	
		Sequoia sempervirens – Pseudotsuga menziesii – Notholithocarpus densiflorus	8	47	rev
		Sequoia sempervirens – Pseudotsuga menziesii – Umbellularia californica	10	17	
		Sequoia sempervirens – Umbellularia californica	24	38	
		Sequoia sempervirens / (Pteridium aquilinum) – Woodwardia fimbriata	8	16	
		Sequoia sempervirens / Polystichum munitum	4	10	
	Umbellularia californica				
		Umbellularia californica	27	48	
		Umbellularia californica – Notholithocarpus densiflorus	12	14	
		Umbellularia californica – Quercus agrifolia / Toxicodendron diversilobum	87	131	rev
		Umbellularia californica – Quercus wislizeni	11	16	
		Umbellularia californica / Polystichum munitum	43	53	
Shrubland					
	Acacia* spp. – *Grevillea* spp. – *Leptospermum laevigatum*				**new**
		*Acacia (cyclops, dealbata)**	0	1	new
	Adenostoma fasciculatum				
		Adenostoma fasciculatum	15	28	
		Adenostoma fasciculatum – (Arctostaphylos glandulosa – Ceanothus jepsonii)	9	15	
		Adenostoma fasciculatum – Diplacus aurantiacus	23	35	
	Arctostaphylos (bakeri, montana)				**new**
		Arctostaphylos montana	24	27	
		Arctostaphylos montana – Adenostoma fasciculatum	5	7	
	Arctostaphylos (canescens, manzanita, stanfordiana)				
		Arctostaphylos canescens	2	9	
		Arctostaphylos canescens – Arctostaphylos glandulosa – Adenostoma fasciculatum	2	5	
		Arctostaphylos manzanita	9	24	
	Arctostaphylos (nummularia, sensitiva) – Chrysolepis chrysophylla				**new**
		Arctostaphylos sensitiva	22	39	
		Chrysolepis chrysophylla – Arctostaphylos glandulosa	7	8	
		Chrysolepis chrysophylla / Vaccinium ovatum	15	24	
	Arctostaphylos glandulosa				
		Arctostaphylos glandulosa	20	27	
		Arctostaphylos glandulosa – Adenostoma fasciculatum	21	28	
		Arctostaphylos glandulosa – Adenostoma fasciculatum – Quercus wislizeni	21	23	

Lifeform					
Alliance	**Association**		**Co**	**All**	**Stat**
	Artemisia californica – (Salvia leucophylla)				
		Artemisia californica	11	34	
		Artemisia californica – Diplacus aurantiacus	19	31	
		Artemisia californica / Nassella (pulchra)	11	16	
	Baccharis pilularis				
		Baccharis pilularis	23	32	
		Baccharis pilularis – (Frangula californica) – Rubus spp.	10	188	rev
		Baccharis pilularis – Artemisia californica	47	83	
		Baccharis pilularis – Ceanothus thyrsiflorus	9	18	
		Baccharis pilularis – Toxicodendron diversilobum	44	115	
		Baccharis pilularis / (Nassella pulchra – Elymus glaucus – Bromus carinatus)	67	88	
		Baccharis pilularis / Annual grass – herb	25	58	rev
		Baccharis pilularis / Carex obnupta – Juncus patens	36	47	
		Baccharis pilularis / Danthonia californica	29	60	
		Baccharis pilularis / Deschampsia cespitosa	13	20	
		Baccharis pilularis / Eriophyllum staechadifolium	2	28	
		Frangula californica ssp. *californica – Baccharis pilularis / Scrophularia californica*	14	32	rev
		Garrya elliptica	3	6	rev
	Ceanothus cuneatus				
		Ceanothus cuneatus	1	1	
		Ceanothus cuneatus – Adenostoma fasciculatum	5	18	
	Ceanothus thyrsiflorus				
		Ceanothus thyrsiflorus – (Rubus ursinus)	26	31	
		Ceanothus thyrsiflorus – Baccharis pilularis – Toxicodendron diversilobum	13	27	
		Ceanothus thyrsiflorus – Vaccinium ovatum – Rubus parviflorus	2	2	
	Cornus sericea*				
		*Cornus sericea / Salix (lasiolepis, exigua)**	0	7	
	Corylus cornuta* var. *californica				
		Corylus cornuta / Polystichum munitum	18	30	
	***Cytisus scoparius – Genista monspessulana – Cotoneaster* spp.**				
		Cotoneaster (lacteus, pannosus)	1	2	new
		Cytisus scoparius	1	1	rev
		Genista monspessulana	18	21	
		Ulex europaeus	5	7	rev
	Diplacus aurantiacus				
		Diplacus (aurantiacus, puniceus)	2	3	

Lifeform					
Alliance	**Association**		**Co**	**All**	**Stat**
	Frangula californica – Rhododendron occidentale – Salix breweri				
		Rhododendron occidentale – Frangula californica ssp. *tomentella*	1	8	
	Gaultheria shallon – Rubus (ursinus)				**new**
		Gaultheria shallon – Vaccinium ovatum / Pteridium aquilinum	3	6	rev
		Holodiscus discolor – Baccharis pilularis – Rubus ursinus	5	14	rev
		Rubus parviflorus	2	8	rev
		Rubus ursinus	15	40	
	***Lotus scoparius – Lupinus albifrons – Eriodictyon* spp.**				
		Eriodictyon californicum / herbaceous	1	8	
		Lupinus albifrons	2	10	
	Lupinus arboreus				
		Baccharis pilularis – Lupinus arboreus	5	8	rev
		Lupinus arboreus	30	45	
	Lupinus chamissonis – Ericameria ericoides				
		Ericameria ericoides	2	3	
		Lupinus chamissonis	4	6	
		Lupinus chamissonis – Ericameria ericoides	24	43	
	Quercus durata				
		Quercus durata – Adenostoma fasciculatum	4	19	
		Quercus durata – Arctostaphylos glandulosa	4	4	
		Quercus durata – Ceanothus jepsonii	2	14	
	***Quercus wislizeni – Quercus chrysolepis* (shrub)**				
		Quercus (parvula, wislizeni) – Arctostaphylos glandulosa	15	18	rev
		Quercus agrifolia – Quercus chrysolepis – Quercus parvula (shrub)	3	3	new
		Quercus parvula (shrub)	5	10	rev
	Rhododendron columbianum				
		Rhododendron columbianum – Gaultheria shallon / Carex obnupta	3	3	rev
	Rubus armeniacus – Sesbania punicea – Ficus carica*				
		*Rubus armeniacus**	0	4	
	Rubus spectabilis – Morella californica				
		Morella californica – Rubus spp.	13	27	
		Rubus spectabilis	15	25	
		Sambucus racemosa – (Rubus ursinus)	3	6	new
	Salix exigua				
		Salix exigua	2	7	
	Salix lasiolepis				
		Salix lasiolepis	8	18	
		Salix lasiolepis – Rubus spp.	41	87	rev

Lifeform					
Alliance		**Association**	**Co**	**All**	**Stat**
		Salix lasiolepis – Salix lucida	8	10	
	Salix hookeriana – Salix sitchensis – Spiraea douglasii *				
		*Salix sitchensis**	0	10	
	Toxicodendron diversilobum				
		Toxicodendron diversilobum – (Baccharis pilularis)	16	53	rev
Herbaceous					
	Abronia latifolia – Ambrosia chamissonis				
		Abronia latifolia – Calystegia soldanella – Lathyrus littoralis	3	5	
		Ambrosia chamissonis	3	10	
	Ammophila arenaria				
		Ammophila arenaria	6	12	
		Baccharis pilularis / Ammophila arenaria	10	13	rev
	Atriplex prostrata – Cotula coronopifolia				
		Cotula coronopifolia	1	1	
	***Avena* spp. – *Bromus* spp.**				
		Avena barbata – Avena fatua	24	42	
		Brachypodium distachyon	14	17	
		Briza maxima	4	6	
		Bromus diandrus	8	13	
		Bromus hordeaceus – Erodium botrys	6	12	
		Hypochaeris glabra – Vulpia bromoides	1	2	
	Azolla (filiculoides, microphylla)				
		Azolla (filiculoides, microphylla)	**3**	**4**	
	Bidens cernua – Euthamia occidentalis – Ludwigia palustris				
		Bidens frondosa	1	2	rev
	Bolboschoenus maritimus				
		Bolboschoenus maritimus – Sarcocornia pacifica	1	3	
	Brassica nigra – Centaurea (solstitialis, melitensis)				
		Brassica nigra	1	2	
		Carduus pycnocephalus – Silybum marianum	1	3	new
		*Carthamus lanatus**	0	0	new
		Raphanus sativus	5	8	
	Bromus carinatus – Elymus glaucus				
		Bromus carinatus	27	59	
		Elymus glaucus	1	23	
		Pteridium aquilinum – Grass	16	37	
		Thermopsis californica – Bromus carinatus – Annual Brome	7	7	
	Cakile (edentula, maritima)				
		Cakile (edentula, maritima)	1	2	
	Calamagrostis nutkaensis				
		Calamagrostis nutkaensis	3	7	

Lifeform					
Alliance		**Association**	**Co**	**All**	**Stat**
		Calamagrostis nutkaensis – Carex (obnupta) – Juncus (patens)	33	39	
		Calamagrostis nutkaensis / Baccharis pilularis	15	33	
	Carex barbarae				
		Carex barbarae	3	4	
	Carex nudata*				
		*Carex nudata**	0	4	
	Carex obnupta – Oenanthe sarmentosa – Scirpus				
		Argentina egedii – (Juncus lescurii)	6	10	rev
		Carex obnupta	26	41	
		Carex obnupta– Argentina egedii	4	4	new
		Carex obnupta – Juncus patens	15	16	
		Juncus lescurii	5	14	
		Scirpus microcarpus Pacific Coast	11	19	rev
		Oenanthe sarmentosa	4	6	
	Ceratophyllum demersum Aquatic				
		Ceratophyllum demersum Western	1	2	
	Conium maculatum – Foeniculum vulgare				
		Conium maculatum	1	1	
		Dipsacus (fullonum, sativus)	2	3	new
	Corethrogyne filaginifolia – Eriogonum (elongatum, nudum)*				
		*Eriogonum nudum**	0	2	
	Cortaderia (jubata, selloana)				
		Cortaderia (jubata, selloana)	1	2	
	Cynosurus echinatus – Arrhenatherum elatius				
		Cynosurus echinatus – (Danthonia pilosa – Nassella manicata)	2	14	
	***Deschampsia cespitosa – Festuca rubra* Brackish Salt Marsh**				
		Festuca rubra – (Argentina egedii) Salt Marsh	1	1	new
	Deschampsia cespitosa – Hordeum brachyantherum – Danthonia californica				
		Deschampsia cespitosa – Danthonia californica	21	43	
		Deschampsia cespitosa – Eryngium armatum	13	30	rev
		Deschampsia cespitosa – Horkelia marinensis	5	7	rev
		Deschampsia cespitosa – Iris douglasiana	12	35	new
		Deschampsia (cespitosa, holciformis)	4	7	rev
		Hordeum brachyantherum Lowland	6	18	rev
	Distichlis spicata				
		Distichlis spicata – annual grasses	1	1	
		Distichlis spicata – Frankenia salina – Jaumea carnosa	20	24	
		Distichlis spicata – (Sarcocornia pacifica)	8	10	rev
	Eichhornia crassipes – Ludwigia (hexapetala, peploides)				
		Ludwigia (hexapetala, peploides)	2	6	

Lifeform				
Alliance	**Association**	**Co**	**All**	**Stat**
Eleocharis (acicularis, macrostachya)				
	Eleocharis macrostachya	5	13	
Eriophyllum staechadifolium – Erigeron glaucus – Eriogonum latifolium				**new**
	Artemisia pycnocephala	13	23	
	Erigeron glaucus – Fragaria chiloensis	3	31	new
	Eriophyllum staechadifolium – Eriogonum latifolium	6	30	new
Eschscholzia (californica) – Lupinus (nanus)				
	Bromus hordeaceus – Lupinus nanus – Trifolium spp.	6	10	
	Eschscholzia californica	1	10	
	Lupinus bicolor	3	3	
Festuca idahoensis – Danthonia californica				
	Danthonia californica – Nassella pulchra	39	90	
	Danthonia californica Coastal	10	35	rev
	Festuca californica	6	11	
	Festuca idahoensis – (Danthonia californica – Koeleria macrantha)	27	65	rev
	Festuca idahoensis – Nassella pulchra	9	21	new
	Festuca idahoensis Ultramafic	2	6	
	Festuca rubra	2	2	rev
	Heterotheca sessiliflora – Danthonia californica	3	6	rev
	Perideridia kelloggii – Danthonia californica	1	6	new
Grindelia (stricta)				
	Grindelia stricta	6	16	rev
Holcus lanatus – Anthoxanthum odoratum				
	Holcus lanatus	23	34	
	Holcus lanatus – Anthoxanthum odoratum	2	15	
Hydrocotyle (ranunculoides, umbellata)				
	Hydrocotyle ranunculoides	2	2	
Juncus (effusus, patens) – Carex (pansa, praegracilis)				
	Carex amplifolia – Carex gynodynama	1	1	new
	Carex densa	4	4	
	Carex pansa	1	1	
	Carex praegracilis Coastal	7	10	rev
	Carex serratodens	3	10	
	Carex tumulicola	4	9	new
	Juncus covillei	3	1	new
	Juncus effusus	43	55	
	Juncus patens	13	16	
	Juncus patens – Holcus lanatus	13	17	
	Juncus patens – Juncus occidentalis	6	13	
	Juncus phaeocephalus	24	37	
Lasthenia californica – Plantago erecta – Vulpia				

Lifeform					
Alliance		**Association**	**Co**	**All**	**Stat**
		Hemizonia congesta – Lolium perenne	11	31	
		Lasthenia californica – Plantago erecta – Hesperevax sparsiflora	3	30	
		Lotus humistratus – Plantago erecta – Lomatium spp.	1	4	
		Plantago erecta – Lolium perenne Lichen-rocky	4	8	
		Vulpia microstachys – Plantago erecta – Calycadenia (truncata, multiglandulosa)	8	19	
	Lasthenia glaberrima				
		Lasthenia glaberrima – Pleuropogon californicus	1	3	
	Lepidium latifolium – (Lactuca serriola)				
		Lepidium latifolium	1	2	
	Leymus cinereus – Leymus triticoides				
		Leymus triticoides	1	5	
	Leymus mollis				
		Leymus mollis – Abronia latifolia – (Cakile sp.*)*	2	11	
	Lolium perenne				
		Lolium perenne	17	44	
		Lolium perenne – Hordeum marinum – Ranunculus californicus	4	4	
		Lolium perenne – Lotus corniculatus	1	6	
	***Mesembryanthemum* spp. – *Carpobrotus* spp.**				
		Carpobrotus (edulis)	8	14	
	Mimulus (guttatus)				
		Mimulus guttatus	1	5	
	***Nassella* spp. – *Melica* spp.**				
		Elymus multisetus – (Eschscholzia californica – Plantago erecta)	2	27	rev
		Melica californica	30	46	
		Melica torreyana	15	22	rev
		Nassella pulchra	3	4	
		Nassella pulchra – Avena spp. *– Bromus* spp.	20	84	
		Nassella pulchra – Hemizonia congesta	19	40	
		Nassella pulchra – Lolium perenne – (Trifolium spp.*)*	8	17	
		Nassella pulchra – Lolium perenne – Plantago erecta Serpentine	21	55	
	Nuphar lutea				
		Nuphar lutea ssp. *polysepala*	2	5	
	Phalaris aquatica – Phalaris arundinacea				
		Phalaris aquatica	10	16	
		Phalaris aquatica – Avena barbata	1	1	
	Poa pratensis – Agrostis gigantea – Agrostis stolonifera				
		Festuca arundinacea	6	7	
	Polygonum lapathifolium – Xanthium strumarium				

Lifeform					
Alliance		**Association**	**Co**	**All**	**Stat**
		Alisma (triviale)	3	4	new
		Polygonum (amphibium, lapathifolium)	2	4	
		Xanthium strumarium	2	4	
	Sarcocornia pacifica (Salicornia depressa)				
		Sarcocornia pacifica – Cotula coronopifolia	1	2	
		Sarcocornia pacifica – Jaumea carnosa – Distichlis spicata	52	66	
		Sarcocornia pacifica Tidal	17	37	
		*Triglochin maritima**	0	0	new
	Schoenoplectus (acutus, californicus)				
		Schoenoplectus acutus	3	10	
		Schoenoplectus californicus	10	18	
	Sedum spathulifolium				
		Sedum spathulifolium – Polypodium californicum / Lichen – Moss	4	6	rev
	Selaginella (bigelovii, wallacei)				
		Selaginella wallacei / Lichen – Moss	2	2	new
	Sparganium (angustifolium)				
		Sparganium eurycarpum	4	5	rev
	Spartina foliosa				
		Spartina foliosa	5	7	
	Trifolium variegatum				
		Trifolium variegatum	3	3	
	Typha (angustifolia, domingensis, latifolia)				
		Typha (latifolia, angustifolia)	5	10	
		Typha domingensis	1	2	
	Zostera (marina, pacifica)* Pacific Aquatic				**new**
		*Zostera marina**	0	0	new
Sparsely Vegetated					
	***Allium* spp. – *Streptanthus* spp. – *Hesperolinon* spp. Serpentinite**				**new**
		Allium falcifolium – Eriogonum luteolum – Streptanthus (batrachopus, morrisonii)	2	2	new
		Streptanthus glandulosus – Dudleya abramsii / Lichen – Moss	4	12	new
	***Dudleya cymosa – Dudleya lanceolata* / Lichen – Moss**				
		Dudleya farinosa / Lichen – Moss	6	6	new

Table 5. Vegetation classification at the Alliance level organized within the current USNVC hierarchy for Marin County. Two status columns for the National Vegetation Classification (NVC) and for the Manual of California Vegetation (MCV) indicate whether the alliance is newly added based upon this project (new) with modifiers for whether the alliance was merged (-m) or split (-s) from existing Alliance concepts, or whether the alliances were expanded (expand) or otherwise revised (revise) from their existing concepts. An asterisk (*) denotes alliances that are likely present or are present but have not been sampled in the County.

Class & Subclass						
Formation	**Division**	**Macrogroup**	**Group**	**Alliance**	**NVC**	**MCV**
1. Forest & Woodland						
1.B. Temperate & Boreal Forest & Woodland						
1.B.1	Warm Temperate Forest & Woodland					
	1.B.1.Nc.	Californian Forest & Woodland				
		M009	Californian Forest & Woodland			
			G195	Californian Broadleaf Forest & Woodland		
				Aesculus californica		
				Quercus (agrifolia, douglasii, garryana, kelloggii, lobata, wislizeni)		
				Quercus agrifolia		
				Quercus chrysolepis (tree)		
				Quercus douglasii		
				Quercus kelloggii		
				Quercus lobata		
				Quercus wislizeni–Quercus parvula	expand	expand
				Umbellularia californica	new-s	
			G198	Californian Conifer Forest & Woodland		
				Hesperocyparis (sargentii, macnabiana)	new-s	new-m
				Pinus muricata – Pinus radiata		
		M513	Californian Ruderal Forest			
			G678	Californian Ruderal Forest		
				Eucalyptus spp. *– Ailanthus altissima – Robinia pseudoacacia*	expand	

Class & Subclass							
Formation	**Division**	**Macrogroup**	**Group**	**Alliance**	**NVC**	**MCV**
				Hesperocyparis macrocarpa – Pinus radiata	new	new
1.B.2	Cool Temperate Forest & Woodland					
	1.B.2.Nd	Vancouverian Forest & Woodland				
		M024	Vancouverian Coastal Rainforest			
			G235	Californian Coastal Redwood Forest		
				Sequoia sempervirens		
		M886	Southern Vancouverian Dry Foothill Forest & Woodland			
			G206	Cascadian Oregon White Oak - Conifer Forest & Woodland		
				Quercus garryana (tree)		
			G208	Californian Moist Coastal Mixed Evergreen Forest		
				Pseudotsuga menziesii – (Notholithocarpus densiflorus – Arbutus menziesii)		new-m
				Notholithocarpus densiflorus	new-s	
				Arbutus menziesii	new-s	
1.B.3.	Temperate Flooded and Swamp Forest					
	1.B.3.Nd	Western North American Interior Flooded Forest				
		M036	Interior Warm & Cool Desert Riparian Forest			
			G797	Western Interior Riparian Forest & Woodland		
				Acer negundo		
				Platanus racemosa – Quercus agrifolia		
				Quercus lobata Riparian		new-s
				Salix gooddingii – Salix laevigata		
		M298	Interior West Ruderal Flooded & Swamp Forest & Woodland			
			G510	Interior West Ruderal Riparian Forest & Scrub		
				*Rubus armeniacus - Sesbania punicea - Ficus carica**		
	1.B.3.Ng.	Vancouverian Flooded & Swamp Forest				
		M035	Vancouverian Flooded & Swamp Forest			
			G851	North-Central Pacific Lowland Riparian Forest		
				Acer macrophyllum – Alnus rubra		new-m
				Alnus rhombifolia		

Class & Subclass						
Formation	**Division**	**Macrogroup**	**Group**	**Alliance**	**NVC**	**MCV**
				*Fraxinus latifolia**		
				Salix lucida ssp. *lasiandra*		
2. Shrub & Herb Vegetation						
2.B. Temperate & Boreal Grassland & Shrubland						
2.B.1.	Mediterranean Scrub & Grassland					
	2.B.1.Na.	Californian Scrub & Grassland				
		M043	Californian Chaparral			
			G257	Californian Xeric Chaparral		
				Adenostoma fasciculatum		
				Arctostaphylos (bakeri, montana)	new	new-m
				Arctostaphylos (canescens, manzanita, stanfordiana)	new-s	
				Ceanothus cuneatus		
			G258	Californian Maritime Chaparral		
				Arctostaphylos (nummularia, sensitiva) – Chrysolepis chrysophylla		new-m
			G261	Californian Mesic & Pre-montane Chaparral		
				Arctostaphylos glandulosa	new-s	
				Prunus ilicifolia – Heteromeles arbutifolia – Ceanothus spinosus		
				Quercus durata		
				Quercus wislizeni – Quercus chrysolepis (shrub)	new-s	new-m
		M044	Californian Coastal Scrub			
			G264	Central & Southern Californian Coastal Sage Scrub		
				Artemisia californica – (Salvia leucophylla)	revise	
			G662	Californian North Coastal & Mesic Scrub		
				Baccharis pilularis		
				Ceanothus thyrsiflorus		
				Corylus cornuta var. *californica*		
				Toxicodendron diversilobum		
			G782	Californian Coastal-Foothill Seral Scrub		
				Diplacus aurantiacus	revise	

Class & Subclass							
Formation	**Division**	**Macrogroup**	**Group**		**Alliance**	**NVC**	**MCV**
					Lotus scoparius – Lupinus albifrons – Eriodictyon spp.	revise	new-m
		M045	Californian Annual & Perennial Grassland				
			G496	Californian Perennial Grassland			
					*Corethrogyne filaginifolia – Eriogonum (elongatum, nudum)**		
					Nassella spp. *– Melica* spp.	new-m	
			G766	Californian Annual Grassland & Forb Meadow			
					Amsinckia (menziesii, tessellata) – Phacelia spp.		
					Eschscholzia (californica) – Lupinus (nanus)		
					Lasthenia californica – Plantago erecta – Vulpia microstachys		
		M046	Californian Ruderal Grassland, Meadow & Scrub				
			G497	Californian Ruderal Grassland, Meadow & Scrub			
					Acacia spp. *– Grevillea* spp. *– Leptospermum laevigatum**	new	new
					Avena spp. *– Bromus* spp.		
					Brassica nigra – Centaurea (solstitialis, melitensis)	revise	
					Lolium perenne		
2.B.2.	Temperate Grassland & Shrubland						
	2.B.2.Nf.	Western North American Grassland & Shrubland					
		M493	Western North American Ruderal Grassland & Shrubland				
			G648	Southern Vancouverian Lowland Ruderal Grassland & Shrubland			
					Conium maculatum – Foeniculum vulgare	revise	
					Cortaderia (jubata, selloana)		
					Cynosurus echinatus – Arrhenatherum elatius	new	expand
					Cytisus scoparius – Genista monspessulana – Cotoneaster spp.	expand	expand
					Holcus lanatus – Anthoxanthum odoratum		
		M050	Southern Vancouverian Lowland Grassland & Shrubland				
			G488	Southern Vancouverian Shrub & Herbaceous Bald, Bluff & Prairie			

Class & Subclass						
Formation	**Division**	**Macrogroup**	**Group**	**Alliance**	**NVC**	**MCV**
				Bromus carinatus – Elymus glaucus		
				Calamagrostis nutkaensis		
				Festuca idahoensis – Danthonia californica		new-m
				Gaultheria shallon – Rubus (ursinus)	new	new
2.B.4.	Temperate to Polar Scrub & Herb Coastal Vegetation					
	2.B.4.Nb.	Pacific North American Coastal Scrub & Herb Vegetation				
		M059	Pacific Coastal Beach & Dune			
			G498	North Pacific Maritime Dune & Coastal Beach		
				Leymus mollis		
			G663	Californian Coastal Beach & Dune		
				Abronia latifolia – Ambrosia chamissonis		
				Eriophyllum staechadifolium – Erigeron glaucus – Eriogonum latifolium	new-s	new-s
				Lupinus arboreus		
				Lupinus chamissonis – Ericameria ericoides	new-s	
		M511	North Pacific Coastal Ruderal Grassland & Shrubland			
			G647	North Pacific Maritime Coastal Ruderal Dune		
				Ammophila arenaria		
				Cakile (edentula, maritima)	new	
				Mesembryanthemum – Carpobrotus spp.		
2.C. Shrub & Herb Wetland						
2.C.2.	Temperate to Polar Bog & Fen					
	2.C.2.Na.	North American Bog & Fen				
		M063	North Pacific Bog & Fen			
			G284	North Pacific Acidic Open Bog & Fen		
				Rhododendron columbianum		
2.C.4.	Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland					
	2.C.4.Nb.	Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland				
		M073	Vancouverian Lowland Marsh, Wet Meadow & Shrubland			
			G322	Vancouverian Wet Shrubland		
				*Cornus sericea**		

Class & Subclass						
Formation	**Division**	**Macrogroup**	**Group**	**Alliance**	**NVC**	**MCV**
				Frangula californica – Rhododendron occidentale – Salix breweri	new	new-m
				Rubus spectabilis – Morella californica	expand	new-m
				*Salix hookeriana – Salix sitchensis – Spiraea douglasii**		new-m
		M073	Vancouverian Lowland Marsh, Wet Meadow & Shrubland			
			G517	Vancouverian Freshwater Wet Meadow & Marsh		
				Deschampsia cespitosa – Hordeum brachyantherum – Danthonia californica	expand	new-m
				Carex barbarae	new	
				*Carex nudata**	new	
				Carex obnupta – Oenanthe sarmentosa – Scirpus microcarpus	new-m	new-m
				Juncus (effusus, patens) – Carex (pansa, praegracilis)	expand	new-m
				Mimulus (guttatus)	new-s	new-s
			G525	Temperate Pacific Freshwater Wet Mudflat		
				Bidens cernua – Euthamia occidentalis – Ludwigia palustris	expand	new
				Polygonum lapathifolium – Xanthium strumarium	new	
		M074	Western North American Vernal Pool			
			G530	Californian Vernal Pool		
				Eleocharis (acicularis, macrostachya)	revise	new-m
				Eryngium aristulatum		
				Lasthenia glaberrima		
				Trifolium variegatum		
		M301	Western North American Ruderal Marsh, Wet Meadow & Shrubland			
			G524	Western North American Ruderal Marsh, Wet Meadow & Shrubland		
				Atriplex prostrata – Cotula coronopifolia	new	
				Lepidium latifolium – (Lactuca serriola)		expand
				Phalaris aquatica – Phalaris arundinacea	expand	

Class & Subclass							
Formation	**Division**	**Macrogroup**	**Group**	**Alliance**		**NVC**	**MCV**
				Poa pratensis – Agrostis gigantea – Agrostis stolonifera			
		M888	Arid West Interior Freshwater Marsh				
			G531	Arid West Interior Freshwater Marsh			
				Schoenoplectus (acutus, californicus)			
				Typha (angustifolia, domingensis, latifolia)			
	2.C.4.Nc.	Southwestern North American Warm Desert Freshwater Marsh & Bosque					
		M076	Warm Desert Lowland Freshwater Marsh, Wet Meadow & Shrubland				
			G533	North American Warm Desert Riparian Low Bosque & Shrubland			
				Salix lasiolepis			
				Salix exigua			
2.C.5.	Salt Marsh						
	2.C.5.Nc.	Temperate and Boreal Pacific Coastal Salt Marsh					
		M081	North American Pacific Coastal Salt Marsh				
			G499	Temperate Pacific Salt Marsh			
				Bolboschoenus maritimus			
				Deschampsia cespitosa – Festuca rubra Brackish Salt Marsh			new
				Distichlis spicata			new-s
				Grindelia (stricta)			
				Sarcocornia pacifica (Salicornia depressa)			
				Spartina foliosa		new-s	
	2.C.5.Nd.	North American Western Interior Brackish Marsh, Playa & Shrubland					
		M082	Warm & Cool Desert Alkali-Saline Marsh, Playa & Shrubland				
			G538	North American Desert Alkaline-Saline Marsh & Playa			
				Leymus cinereus – Leymus triticoides			
5. Aquatic Vegetation							
5.A. Saltwater Aquatic Vegetation							
5.A.3.	Benthic Vascular Saltwater Vegetation						
	5.A.3.We.	Temperate Seagrass Aquatic Vegetation					
		M184	Temperate Pacific Seagrass Intertidal Vegetation				

Class & Subclass						
Formation	**Division**	**Macrogroup**	**Group**	**Alliance**	**NVC**	**MCV**
			G373	Temperate Pacific Seagrass Bed		
				Zostera (marina, pacifica) Pacific Aquatic*	expand	new
5.B. Freshwater Aquatic Vegetation						
5.B.2.	Temperate to Polar Freshwater Aquatic Vegetation					
	5.B.2.Na.	North American Freshwater Aquatic Vegetation				
		M109	Western North American Freshwater Aquatic Vegetation			
			G544	Western North American Temperate Freshwater Aquatic Vegetation		
				Azolla (filiculoides, microphylla)		
				Ceratophyllum demersum Aquatic		
				Hydrocotyle (ranunculoides, umbellata)		
				Nuphar lutea		
				Sparganium (angustifolium)		
		M401	North American Temperate Ruderal Aquatic Vegetation			
			GXXX	North American Temperate Ruderal Aquatic Vegetation	new	
				Eichhornia crassipes – Ludwigia (hexapetala, peploides)	new	
6. Open Rock Vegetation						
6.B. Temperate & Boreal Open Rock Vegetation						
6.B.1.	Temperate & Boreal Cliff, Scree & Other Rock Vegetation					
	6.B.1.Nb.	Western North American Temperate Cliff, Scree & Rock Vegetation				
		M887	Western North American Cliff, Scree & Rock Vegetation			
			G563	Californian Cliff, Scree & Rock Vegetation		
				Allium spp. – *Streptanthus* spp. – *Hesperolinon* spp. Serpentinite		new
				Dudleya cymosa – Dudleya lanceolata – Lichen/Moss		
				Sedum spathulifolium		
				Selaginella (bigelovii, wallacei)	expand	expand

Appendix C

Vegetation Field Key for Marin Vegetation

This key is for the vegetation types found in Marin County, based on the classification developed by analyzing vegetation field survey data collected for this and other relevant projects. The key is intended as a guide to field-based and image interpretation-based identification of vegetation. This key is not dichotomous; instead, it follows the hierarchy of the current United States National Vegetation Classification (USNVC), in which we are updating the state classification of *A Manual of California Vegetation* (MCV; Sawyer et al. 2009) to confirm to the revised USNVC (USNVC 2019). The USNVC hierarchy is promoted by the Federal Geographic Data Committee (FGDC), the Ecological Society of America's Vegetation Panel (FGDC 2008, Faber-Langendoen et al. 2012, 2014), and the California Department of Fish & Wildlife's Survey of California Vegetation (SCV). This key provides additions and revisions to both the USNVC and MCV, and future updates will be found online (USNVC 2019, CNPS 2020).

This key lists vegetation types starting with the current or recently updated version of the USNVC Macrogroup level and proceeding down to the Association level. The complete hierarchy for this classification is listed in the Appendix B, Vegetation Classification for Marin County, California.

Due to a high diversity of the vegetation types in the county, the key is complex. Follow the instructions in a section carefully and sequentially to arrive at the determined vegetation type. You will need to collect or refer to plant composition data that includes both species that are dominant and also those "indicator" or characteristic/diagnostic species, whose presence may cause a stand to key to a particular vegetation type. If it seems that a stand of vegetation could key to more than one type, review the descriptions (e.g., stand tables, environmental information) for each type to determine which one fits best. Note that this vegetation key may include types that are not accurately detectable in remotely sensed imagery.

Terms, Concepts, and Symbols used throughout the Key

Stand: The basic physical unit of plant communities in a landscape. It has no set size. Some vegetation stands are very small, such as certain wetland types, and some may be several square kilometers in size, such as certain forest types. A stand is defined by two main unifying characteristics:

1. It has compositional integrity. Throughout the stand, the combination of species is similar. The stand is differentiated from adjacent stands by a discernible boundary that may be abrupt or occur indistinctly along an ecological gradient.

2. 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, 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 compositional and structural features of a stand are often combined into a term called homogeneity. For an area to meet the definition of a stand, it must be homogeneous at the scale being considered.

United States National Vegetation Classification (*USNVC*)*:* A central organizing framework for how all vegetation in the United States is inventoried and studied, from broad scale formations (biomes) to fine-scale plant communities. The purpose of the USNVC is to produce uniform statistics about vegetation resources across the nation, based on vegetation data gathered at local, regional, or national levels. The latest classification standard was published in by the FGDC (2008).

The hierarchy units in the USNVC from highest to lowest (i.e., broadest to finest) are:

1. Formation Class
2. Formation Subclass
3. Formation
4. Division
5. Macrogroup
6. Group
7. Alliance
8. Association

Alliance: Plant communities based on dominant/diagnostic species of the uppermost or dominant stratum. Accepted alliances are part of the USNVC hierarchy. For the Marin County vegetation mapping effort, map classes are typically at the alliance level of the USNVC hierarchy (though sometimes at the Group or Macrogroup levels).

Association: The most botanically detailed or finest-scale plant community designation based on dominant species and multiple co-dominant or sub-dominant indicator species from any stratum. Associations are also part of the USNVC hierarchy. The Marin Co. map classes are not typically defined to the association level, but they are noted in the key below the Alliance to represent the variation within each alliance that has been identified during the project.

Asterisks (*) – Those types not currently known for the study area, but that have a high potential to occur, are sometimes included in the key with an * after the alliance or association name.

Botanical nomenclature: We use the PLANTS database (USDA NRCS 2020) as our standard for botanical names, including scientific names, so this information can be shared nationally with our USNVC partners. However, when a more current name has been assigned in *The Jepson Manual, second edition* (Jepson Flora Project 2020), we may substitute names by the TJM2 and a species code beginning with “2JM” is assigned. General vegetation types, such as moss and lichen, have codes beginning with the number 2 (e.g., 2MOSS).

Plant community nomenclature: Taxa separated by "–" are typically within the same stratum; taxa separated by "/" are in different strata.

Cover: The primary metric used to quantify the importance/abundance of a particular species or a particular vegetation layer within a stand. Cover is measured by estimating

the aerial extent of the living plants, or the bird's-eye view looking from above, for each category. Cover in this project uses the concept of "porosity" or foliar cover rather than "opacity" or crown cover. Thus, field crews are trained to estimate the amount of light versus shade produced by the canopy of a plant or a stratum by taking into account the amount of shade it casts excluding the openings it may have in the interstitial spaces (e.g., between leaves or branches). This is assumed to provide a more realistic estimate of the actual amount of shade cast by the individual or stratum which, in turn, relates to the actual amount of light available to individual species or strata beneath it. However, as a result, cover estimates can vary substantially between leaf-on versus leaf-off conditions. Stands dominated by deciduous species (e.g., *Aesculus californica, Toxicodendron diversilobum*) should be sampled during *leaf-on* since they will have substantially less cover when leaves are absent and may key to another type.

Absolute cover: The actual percentage of the surface area at a survey area covered by a species or physiognomic group (trees, shrubs, herbaceous), as in "tan oak covers 10% of the area being surveyed." Absolute cover of all species or physiognomic groups, when added together, may total greater than 100%, because this is not a proportional number and plants can overlap with each other. For example, a stand could have 25% tree cover in the upper layer, 40% shrub cover in the middle layer, and 50% herbaceous cover when surveyed on the ground. However, when aerial interpretation is being used, the maximum absolute value is 100% since lower levels of vegetation cannot be seen through the overstory on aerial photographs.

Relative cover: The percentage of surface area at a survey area covered by one species relative to other species within the same physiognomic stratum (tree, shrub, herbaceous) or by one stratum relative to the total vegetation cover in an area (or polygon). Thus, 50% relative cover of *Quercus douglasii* in the tree layer means that *Q*. *douglasii* comprises half the cover of all tree species within a stand, while 50% relative shrub cover means that shrubs make up half the cover of all vegetation within a stand. Relative cover values are proportional numbers that, when added together, total 100% for each species within a stratum or each stratum within a stand of vegetation.

Dominance: Dominance refers to the preponderance of vegetation cover in a stand of uniform composition and site history. It may refer to cover of an individual species as in "dominated by tan oak," or it may refer to dominance by a physiognomic group, as in "dominated by shrubs." When we use the term in the key, a species is dominant if it is in relatively high cover in each stand (e.g. relative cover exceeds 50% of a layer's total cover). See "dominance by layer," below, for further explanation.

Strongly dominant: A species in the dominant lifeform stratum has 60% *or* greater relative cover.

Co-dominant: Co-dominance refers to two or more species in a stand with similar cover. Specifically, each species has between 30% and 60% relative cover. For example, in a coastal scrub stand with 5% *Baccharis pilularis*, 4% *Frangula californica*, and 3% *Rubus ursinus* (total 13% shrub cover), technically only the *Baccharis* (5/13 = 39% relative cover) and the *Frangula* (4/13 = 31% relative cover) would be co-dominant because *Rubus* would only have 23% relative cover (3/13 = 23%).

Characteristic/Diagnostic species: Should be present in at least 80% of the stands of the type, with no restriction on cover. Relatively even spacing throughout the stand is important, particularly in vegetation with low total cover, since an even distribution of the diagnostic species is a much better indicator than overall cover. Characteristic species that are evenly distributed are better indicators of a type than species with higher cover and patchy distribution.

Dominance by layer/stratum: Tree, shrub, and herbaceous layers are considered physiognomically distinct. Alliances are usually named by the dominant and/or characteristic species of the *tallest characteristic layer* (see tree-characterized, shrub-characterized, and herb-characterized vegetation definitions below). Average covers within the dominant layer reflect the "modal" concept of the health/age/environment of a particular vegetation type. For example, a higher average cover of woody plants within a stand not recently affected by disturbance reflects a mode of general availability of water, nutrition, and equitable climate, while lower average cover under similar conditions would reflect lower availability of these things.

Woody plant: A vascular plant species that has a noticeably woody stem (e.g., shrubs and trees). It does not include herbaceous species with woody underground portions such as tubers, roots, or rhizomes.

Tree: A one-stemmed woody plant that normally grows to be greater than 5 meters tall. In some cases, trees may be multi-stemmed (ramified due to fire or other disturbance), but the height of mature plants typically exceeds 5 meters. If less than 5 meters tall, undisturbed individuals of these species are usually single stemmed. Certain species that sometimes resemble shrubs but may be trees in other areas (e.g., *Aesculus californica*) are, out of statewide tradition or by the USNVC, called trees. It behooves one to memorize which species are “traditionally” placed in one life-form or another. We use the accepted lifeforms in the USNVC or the PLANTS Database (USDA NRCS 2020) to do this.

Tree-characterized vegetation: Trees are evenly distributed throughout the stand. In the Mediterranean climate of the North Coast, tree-dominated alliances typically have >10% absolute tree cover, providing a consistent structural component.

Forest: In the USNVC, a forest is defined as a tree-dominated stand of vegetation with 60% or greater absolute cover of trees. Most forest alliances tend to have average cover of trees >60%, but individual stands under certain conditions may drop lower than 60%.

Woodland: In the USNVC, a woodland is defined as a tree-dominated stand of vegetation with between 25% and 60% absolute cover of trees. Most woodland alliances tend to have average cover of trees with 25-60%, but individual stands under certain conditions may drop higher or lower than this range.

Emergent: A plant (or vegetation layer) is considered emergent if it has low cover and rises above a layer with more cover in the stand. For example, individual *Pseudotsuga menziesii* trees may comprise an emergent tree layer of 2% cover over dense *Gaultheria shallon* and *Rubus parviflorus* in the shrub understory; the stand would be considered within the *Gaultheria shallon – Rubus* (*ursinus*) Shrubland Alliance because the total tree cover is <10% and the shrub cover is >10%. Medium to tall shrubs are not considered emergent over shorter shrubs, but short trees are considered emergent over tall shrubs.

Shrub: A multi-stemmed woody plant that is usually 0.2-5 meters tall. Definitions are blurred at the low and high ends of the height scales. At the tall end, shrubs may approach tree-size based on disturbance frequencies (e.g., old-growth re-sprouting chaparral species such as *Cercocarpus montanus*, *Fremontodendron californicum*, *Prunus ilicifolia*, and so forth, may frequently attain "tree size", but are still typically multi-stemmed and are considered shrubs in this key). At the short end, woody perennial herbs or sub-shrubs of various species are often difficult to categorize into a consistent life-form (e.g., *Eriogonum latifolium*, *Lupinus chamissonis*); in such instances, we refer to the PLANTS Database or “pick a lane” based on best available definitions.

Sub-shrub: A multi-stemmed plant with noticeably woody stems less than 0.5 meter tall. May be easily confused with a perennial herb or small shrub. We lump them into the “shrub” category in stand tables and descriptions of vegetation types.

Shrub-characterized vegetation: Shrubs, including sub-shrubs, are evenly distributed throughout the stand, providing a consistent (even if sparse) structural component; the stand cannot be characterized as a tree stand; and one or both of the following criteria are met: 1) shrubs influence the distribution or population dynamics of other plant species; 2) shrubs play an important role in ecological processes within the stand. Shrub alliances typically have at least 10% absolute shrub cover.

Herbaceous plant: Any species of plant that has no main woody stem development; includes grasses, forbs, and perennial species that die back each year.

Herb-characterized vegetation: Herbs are evenly distributed throughout the stand, providing a consistent (even if sparse) structural component, and playing an important role in ecological processes within the stand. The stand cannot be characterized as a tree or shrub stand.

Nonvascular vegetation: Nonvascular organisms characterize a stand, providing a consistent (even if sparse) structural component and playing an important role in ecological processes within the stand.

Class A. Vegetation dominated, co-dominated, or characterized by an even distribution of overstory trees. The tree canopy is generally greater than 10%, but may occasionally be less than 10% over a denser understory of shrubs and/or herbs **= Tree-Overstory (Woodland / Forest) Vegetation**

Class B. Vegetation dominated, co-dominated, or characterized by woody shrubs in the canopy. Shrubs usually have at least 10% cover. Tree species, if present, generally total less than 10% absolute cover. Herbaceous species may have higher cover than shrubs **= Shrubland Vegetation**

Class C. Vegetation dominated, co-dominated, or characterized by non-woody, herbaceous species in the canopy, including grasses, graminoids, and broad-leaved herbaceous species. Shrubs, if present, usually comprise less than 10% of the vegetation cover. Trees, if present, generally comprise less than 10% cover. Sometimes vegetation is sparse (<10%) or variable in herbaceous cover on rock outcrops, open sand, and other substrates, and will key here. **= Herbaceous & Sparse Vegetation**

Class A. Tree-Overstory (Woodland / Forest) Vegetation

Section I: Woodlands and forests dominated or characterized by needle or scale-leaved conifer trees. Includes *Hesperocyparis*, *Pinus*, *Pseudotsuga*, and *Sequoia*.

1. Temperate rainforest dominated or co-dominated by *Sequoia sempervirens*. Found in maritime climates with summertime fog.

Vancouverian Coastal Rainforest Macrogroup

Californian Coastal Redwood Forest Group

1a. *Sequoia sempervirens* dominates, co-dominates, or characterizes (rarely with as little as 5% cover) stands near streams, along all slopes and aspects, or on ridges. Associated trees include *Acer macrophyllum*, *Notholithocarpus densiflorus*, *Pseudotsuga menziesii*, *Torreya californica*, and *Umbellularia californica*, which are typically sub- to co-dominant but may occasionally exceed *Sequoia* in cover. *Vaccinium ovatum*, *Oxalis oregana*, and *Woodwardia fimbriata* may intermix in the understory.

***Sequoia sempervirens* Alliance**

Sequoia sempervirens – Acer macrophyllum – Umbellularia californica Association
Sequoia sempervirens – Alnus rubra / Rubus spectabilis Association*
Sequoia sempervirens – Arbutus menziesii / Vaccinium ovatum Association
Sequoia sempervirens – Chrysolepis chrysophylla / Arctostaphylos glandulosa Association
Sequoia sempervirens – Notholithocarpus densiflorus / Carex globosa – Iris douglasiana Association*
Sequoia sempervirens – Notholithocarpus densiflorus / Vaccinium ovatum Association
Sequoia sempervirens – Pseudotsuga menziesii – Notholithocarpus densiflorus Association

Sequoia sempervirens – Pseudotsuga menziesii – Umbellularia californica Association
Sequoia sempervirens – Umbellularia californica Association
Sequoia sempervirens / Oxalis oregana Association*
Sequoia sempervirens / (Pteridium aquilinum) – Woodwardia fimbriata Riparian Association
Sequoia sempervirens / Polystichum munitum Association

2. Cool-temperate coniferous forests and woodlands influenced by warm, relatively dry summers and cool rainy winters. Stands are dominated or co-dominated by *Pseudotsuga menziesii,* or *P*. *menziesii* in combination with *Notholithocarpus densiflorus* in the tree overstory.

Southern Vancouverian Dry Foothill Forest & Woodland Macrogroup

Southern Vancouverian Dry Douglas-fir - Madrone Forest & Woodland Group

2a. *Pseudotsuga menziesii* is dominant or co-dominant with *Arbutus menziesii*, *Notholithocarpus densiflorus, Quercus agrifolia*, *Q*. *chrysolepis*, or *Umbellularia californica* in the canopy. *Pseudotsuga* is typically dominant to co-dominant with *Notholithocarpus* but may occasionally be slightly sub-dominant. When *P*. *menziesii* co-dominates with hardwoods, key to *P*. *menziesii*, except when with *Quercus garryana* or *Q. kelloggii,* (see *Q*. *garryana* (step 4a4) or *Q. kelloggii* Alliance (step 5c4) below. Stands sampled in Marin County are typically within 5-10 km of the coast.

***Pseudotsuga menziesii – (Notholithocarpus densiflorus – Arbutus menziesii)* Alliance**
Pseudotsuga menziesii – Arbutus menziesii Association
Pseudotsuga menziesii – Chrysolepis chrysophylla – Notholithocarpus densiflorus Association *Pseudotsuga menziesii – Notholithocarpus densiflorus – Umbellularia californica / Toxicodendron diversilobum* Association
Pseudotsuga menziesii – Notholithocarpus densiflorus / Vaccinium ovatum Association
Pseudotsuga menziesii – Quercus agrifolia Association
Pseudotsuga menziesii – Quercus chrysolepis Association
Pseudotsuga menziesii – Umbellularia californica / (Toxicodendron diversilobum) Association
Pseudotsuga menziesii – (*Umbellularia californica) / Frangula californica* Association
Pseudotsuga menziesii – Umbellularia californica / Polystichum munitum Association
Pseudotsuga menziesii / (Toxicodendron diversilobum) Association
Pseudotsuga menziesii / Baccharis pilularis Association
Pseudotsuga menziesii / Corylus cornuta / Polystichum munitum Association

3. Closed cone or xerophyllic conifers, including *Hesperocyparis* spp., *Pinus attenuata, Pinus muricata*, or *Pinus radiata* is dominant or co-dominant in the overstory.

Californian Forest & Woodland Macrogroup

Californian Conifer Forest & Woodland Group

3a. *Hesperocyparis sargentii* dominates on slopes, ridges, or along stream benches and terraces of serpentine, volcanic, or other ultramafic substrates.

Adenostoma fasciculatum, *Arctostaphylos* spp., *Ceanothus jepsonii*, and *Quercus durata* are commonly found in stands.

***Hesperocyparis (sargentii, macnabiana)* Alliance**

3a1. *Hesperocyparis sargentii* dominates on slopes, ridges and terraces of serpentine, volcanic or other ultramafic substrates.

Hesperocyparis sargentii Association

3a2. *Hesperocyparis sargentii* dominates on ridges and upper slopes with *Arctostaphylos montana* and other shrubs such as *Ceanothus jepsonii* and *Adenostoma fasciculatum.*

Hesperocyparis sargentii / Ceanothus jepsonii – Arctostaphylos spp. Association

3a3. *Hesperocyparis sargentii* dominates or co-dominates with *Umbellularia californica* in the tree canopy along stream benches in a riparian setting. *Rhododendron occidentale* and *Salix* spp. may be present in the shrub canopy.

Hesperocyparis sargentii / Rhododendron occidentale Association

3b. *Pinus attenuata* dominates or co-dominates with *Quercus chrysolepis* in the tree overstory, often with moderately dense cover of shrubs such as *Arctostaphylos* spp. and *Vaccinium ovatum* in the understory. Stands are not likely in Marin Co. but are in surrounding counties.

Pinus attenuata* Alliance

Pinus attenuata / Arctostaphylos (crustacea) Association*

Pinus attenuata / Arctostaphylos (manzanita, canescens) Association*

3c. *Pinus muricata* is dominant or co-dominant in the tree overstory and/or regenerating tree layer. The understory may include moderate to dense cover of shrubs such as *Arctostaphylos* spp., *Baccharis pilularis, Gaultheria shallon*, *Toxicodendron diversilobum* and *Vaccinium ovatum*.

***Pinus muricata – Pinus radiata* Alliance**

Pinus muricata Provisional Association

Pinus muricata – (Arbutus menziesii – Notholithocarpus densiflorus) / Vaccinium ovatum Association

Pinus muricata / Arctostaphylos glandulosa Provisional Association

Pinus muricata / Ceanothus thyrsiflorus – Baccharis pilularis Association

3d. Stands dominated or co-dominated by planted or naturalized conifer species including *Hesperocyparis macrocarpa* and/or *Pinus radiata.*

Californian Ruderal Forest Macrogroup

Californian Ruderal Forest Group

***Hesperocyparis macrocarpa – Pinus radiata* Semi-Natural Alliance**

3d1. *Pinus radiata* dominates the conifer canopy. Planted stands of *Pinus radiata* are found along roadsides or on slopes where they were introduced (not native to Marin Co.).

Pinus radiata plantations Provisional Semi-Natural Association

3d2. Planted *Hesperocyparis macrocarpa* dominates in patches or along roads. In this region of California, stands are considered semi-natural since they are not naturally occurring.

Hesperocyparis macrocarpa Ruderal Provisional Semi-Natural Association

Section II. Woodlands, forests, and riparian vegetation characterized and/or dominated mainly by native and non-native broad-leaved evergreen and deciduous trees. Includes species of *Aesculus*, *Acer*, *Alnus*, *Arbutus*, *Fraxinus*, *Juglans*, *Notholithocarpus*, *Populus*, *Quercus*, *Salix*, and *Umbellularia*.

4. Vegetation dominated, co-dominated, or characterized by one or more of the following broadleaf trees: *Acer macrophyllum*, *Arbutus menziesii*, *Chrysolepis chrysophylla, Notholithocarpus densiflorus*, or *Quercus garryana*.

4a. Broadleaf trees such as *Arbutus menziesii*, *Chrysolepis chrysophylla, Notholithocarpus densiflorus*, or *Quercus garryana* dominate, co-dominate, or characterize moist, coastal, mixed evergreen forests and woodlands. Stands of *Quercus garryana* may also occur in more interior settings, where the winters are cooler and the summers are warmer.

4a1. *Arbutus menziesii* is either dominant with sub-dominant *Quercus agrifolia* or is dominant to co-dominant with *Quercus kelloggii* and/or *Umbellularia californica*. *Pseudotsuga menziesii*, *Heteromeles arbutifolia*, and *Toxicodendron diversilobum* are often present. If *Arbutus* is sub- to co-dominant with *Quercus agrifolia*, *Q*. *chrysolepis*, or *Notholithocarpus densiflorus*, key to the one of these alliances instead of *A*. *menziesii*.

Southern Vancouverian Dry Foothill Forest & Woodland Macrogroup

Southern Vancouverian Dry Douglas-fir - Madrone Forest & Woodland Group

***Arbutus menziesii* Alliance**

Arbutus menziesii – (*Quercus agrifolia*) Association
Arbutus menziesii – Umbellularia californica Association

4a2. *Notholithocarpus densiflorus* is strongly dominant in the tree canopy or co-occurs with sub-dominant to co-dominant *Arbutus menziesii* or *Umbellularia californica*.

***Notholithocarpus densiflorus* Alliance**

Notholithocarpus densiflorus – Arbutus menziesii Association
Notholithocarpus densiflorus – Quercus chrysolepis Association
Notholithocarpus densiflorus / Vaccinium ovatum Association

4a3. *Chrysolepis chrysophylla* is strongly dominant in dense, clonal stands occurring on upper slopes and ridges, often transitional between forest and chaparral. Stands occur along Mt. Tamalpais – Bolinas Ridge.

Californian Chaparral Macrogroup

Californian Maritime Chaparral Group

***Arctostaphylos* (*nummularia*, *sensitiva*) – *Chrysolepis chrysophylla* Alliance**

Chrysolepis chrysophylla – Arctostaphylos glandulosa Association
Chrysolepis chrysophylla / Vaccinium ovatum Association

4a4. *Quercus garryana* dominates or co-dominates with other broadleaf trees or *Pseudotsuga menziesii*. Stands are of two types: 1) relatively dense woodlands without a significant understory herb component or 2) open woodlands over moderate to dense native and non-native herbs (e.g., *Cynosurus echinatus* and *Festuca californica*). *Pseudotsuga menziesii*, *Umbellularia californica*, *Quercus agrifolia*, and/or *Q*. *kelloggii* commonly intermix, typically as sub-dominants. If two or more other species of *Quercus* are present and, collectively, they are co-dominant with *Q*. *garryana*, key to the *Quercus* (*agrifolia*, *douglasii*, *garryana*, *kelloggii*, *lobata*, *wislizeni*) Alliance (step 5c1).

Southern Vancouverian Dry Foothill Forest & Woodland Macrogroup

Cascadian Oregon White Oak - Conifer Forest & Woodland Group

***Quercus garryana* (tree) Alliance**

Quercus garryana – Umbellularia californica – Quercus (*agrifolia*, *kelloggii*) Association
Quercus garryana / (*Cynosurus echinatus – Festuca californica*) Association

4b. *Acer macrophyllum* dominates or co-dominates with *Umbellularia californica* in riparian stands, OR *Umbellularia californica* is dominant in riparian stands with *Acer macrophyllum* or *Pseudotsuga menziesii* characteristically present. An understory of riparian shrubs such as *Rhododendron occidentale* are sometimes present.

Vancouverian Flooded & Swamp Forest Macrogroup

Vancouverian Flooded & Swamp Forest Group

***Acer macrophyllum – Alnus rubra* Alliance**

Acer macrophyllum / (Rubus ursinus) Association
Umbellularia californica – Acer macrophyllum Association
Umbellularia californica / Rhododendron occidentale Association

5. Vegetation dominated or co-dominated by the following broadleaf, primarily upland tree species: *Aesculus californica*, *Quercus agrifolia*, *Q*. *chrysolepis*, *Q*. *douglasii*, *Q*. *kelloggii*, *Q*. *lobata*, *Q*. *parvula*, *Q*. *wislizeni*, and/or *Umbellularia californica*.

Californian Forest & Woodland Macrogroup

Californian Broadleaf Forest & Woodland Group

5a. *Aesculus californica* dominates in open to moderately dense woodlands. If *Umbellularia californica* is present, it is sub-dominant. A variety of herbs may be found in the understory.

***Aesculus californica* Alliance**

Aesculus californica – Umbellularia californica Association

Aesculus californica / *Toxicodendron diversilobum* / Moss Association

5b. *Umbellularia californica* is either dominant or co-dominant with *Quercus agrifolia* in open to dense woodlands. Found in a variety of settings, such as streamsides, valley bottoms, coastal bluffs, inland ridges, steep north-facing slopes, rocky outcrops and post-fire landscapes. If *U*. *californica* is co-dominant with *Arbutus*, *Acer*, *or Pinus sabiniana* on serpentine, or *Pseudotsuga menziesii*, *Quercus chrysolepis, Q. garryana*, *Q. lobata, Q*. *kelloggii*, or *Sequoia*, key to one of these other hardwood or conifer alliances instead. Purely riparian stands of *U. californica* when it is dominant or co-dominant with *Acer macrophyllum* should be keyed to the *Acer macrophyllum – Alnus rubra* Alliance.

***Umbellularia californica* Alliance**
Umbellularia californica Association
Umbellularia californica – Notholithocarpus densiflorus Association
Umbellularia californica – Quercus agrifolia / Toxicodendron diversilobum Association
Umbellularia californica – Quercus wislizeni Association
Umbellularia californica / Polystichum munitum Association

5c. One or more species of *Quercus* listed above (step 5), other than *Quercus garryana* (step 4a4), dominates or co-dominates in the tree overstory OR *Quercus garryana* co-dominates with two other oak species.

5c1. *Quercus agrifolia*, *Quercus garryana*, and/or *Quercus kelloggii* are present and these oak species typically co-dominate. Other oaks such as *Q*. *chrysolepis*, *Q*. *douglasii*, *Q*. *lobata* may also be present. This is a mixed type when multiple *Quercus* tree species intermix (at least three) and it is difficult to assign to an alliance defined by one oak species – also read key steps to individual oak alliances below.

***Quercus* (*agrifolia*, *douglasii*, *garryana*, *kelloggii*, *lobata*, *wislizeni*) Alliance**
Quercus agrifolia – Quercus garryana – Quercus kelloggii Association

5c2. *Quercus chrysolepis* is dominant or co-dominant with *Arbutus menziesii* or *Umbellularia californica* in the tree overstory. *Quercus wislizeni* is occasionally found as a sub-dominant tree.

***Quercus chrysolepis* (tree) Alliance**
Quercus chrysolepis – Arbutus menziesii – Notholithocarpus densiflorus var. *densiflorus* Association
Quercus chrysolepis – Umbellularia californica Association
Quercus chrysolepis / Quercus (wislizeni, parvula) Association

5c3. *Quercus douglasii* or *Quercus* ×*eplingii* (the hybrid between *Q*. *douglasii* and *Q*. *garryana*) dominates or co-dominates with *Quercus agrifolia* or *Arbutus menziesii* in the tree overstory. The understory herbaceous layer is often moderately dense to dense, with a mixture of native and non-native forbs and grasses.

***Quercus douglasii* Alliance**
Quercus × *eplingii* / Grass Provisional Association
Quercus douglasii – Quercus agrifolia Association
Quercus douglasii / Mixed herbaceous Association*

5c4. *Quercus kelloggii* or *Quercus* × *morehus* dominates or co-dominates with *Pseudotsuga menziesii*, *Q*. *agrifolia*, and/or *Umbellularia californica* in the tree overstory. *Arbutus menziesii* is often present as a sub-dominant species. Stands in Marin County are found inland, above maritime influence, often on northerly slopes.

***Quercus kelloggii* Alliance**
Quercus kelloggii – Arbutus menziesii – Quercus agrifolia Association
Quercus kelloggii – Pseudotsuga menziesii – Umbellularia californica Association

5c5. *Quercus lobata* dominates or co-dominates with *Fraxinus latifolia, Quercus agrifolia, Salix lasiolepis,* and/or *Umbellularia californica* in the tree overstory. Stands are typically found along valley bottoms and lower slopes on seasonally saturated soils that may flood intermittently. Common understory shrubs include *Rosa californica*, *Rubus* spp., and *Toxicodendron diversilobum*.

***Quercus lobata* Riparian Alliance**
Quercus lobata – Fraxinus latifolia / Vitis californica Association
Quercus lobata / Rubus ursinus – Rosa californica Association
Quercus lobata – Salix lasiolepis Association

5c6. *Quercus lobata* dominates or co-dominates with *Quercus agrifolia* and/or *Umbellularia californica* in the tree overstory in an upland habitat. Stands are typically found on slopes and summit valleys with an open grassy understory and *Toxicodendron diversilobum* is a common understory shrub.

***Quercus lobata* Alliance**
Quercus lobata – Quercus agrifolia / Grass Association
Quercus lobata / Grass Association

5c7. *Quercus agrifolia, Q. parvula, Q. wislizeni* or other *Quercus* spp. dominates and/or co-dominates as a shrub or regenerating tree, co-occurring with *Umbellularia*, *Adenostoma*, and a variety of other shrubs that prefer more mesic, northerly exposures. *Quercus parvula* and *Q. wislizeni* are not always morphologically distinct.

***Quercus wislizeni – Quercus chrysolepis* (shrub) Alliance**
Quercus agrifolia – Quercus chrysolepis – Quercus parvula (shrub) Provisional Association
Quercus parvula (shrub) Provisional Association
Quercus (parvula, wislizeni) – Arctostaphylos glandulosa Association

5c8. The tree form of *Quercus parvula* and/or *Q. wislizeni* dominates or co-dominates in the tree canopy, often with *Arbutus menziesii*, *Pseudotsuga menziesii*, and/or *Umbellularia californica*. If the oaks have a shrubby habit or are regenerating and intermixing with a variety of other shrub species, key to the *Quercus wislizeni – Quercus chrysolepis* (shrub) Alliance above and in step 9b.

***Quercus wislizeni – Quercus parvula* (tree) Alliance**
Quercus (*parvula*, *wislizeni) – Arbutus menziesii / Toxicodendron diversilobum* Association

5c9. *Quercus agrifolia* dominates or co-dominates with *Arbutus menziesii* in the tree canopy. If *Q*. *douglasii* (or hybrid *Q*. ×*eplingii*), *Q. kelloggii, Q*. *lobata*, or *Umbellularia californica* is co-dominant to dominant, key to one of these other alliances instead of *Q*. *agrifolia*. The understory herbaceous layer often contains a mixture of native and non-native herbs and/or shrubs.

***Quercus agrifolia* Alliance**
Quercus agrifolia – Arbutus menziesii – Umbellularia californica Association
Quercus agrifolia – Arbutus menziesii / Corylus cornuta – Rubus spp. Association
Quercus agrifolia – Quercus kelloggii Association
Quercus agrifolia – Umbellularia californica / Heteromeles arbutifolia – Quercus berberidifolia Association
Quercus agrifolia / Adenostoma fasciculatum – (Salvia mellifera) Association
Quercus agrifolia / Grass Association
Quercus agrifolia / *Toxicodendron diversilobum* Association

6. *Acer negundo*, *Juglans hindsii*, *Populus fremontii*, *Quercus agrifolia,* or *Salix laevigata* is dominant, co-dominant or characteristic in permanently moist or riparian settings, where sub-surface water is available all year. Nearby upland vegetation is often dominated by broadleaf evergreen or deciduous trees, as opposed to conifers.

Interior Warm & Cool Desert Riparian Forest Macrogroup

Western Interior Riparian Forest & Woodland Group

6a. *Acer negundo* dominates in the tree overstory, often along major streams and rivers, with other riparian plants such as *Fraxinus*, *Populus*, *Rubus*, and *Salix*. Stands are considered rare in the state and may be small and monospecific.

***Acer negundo* Alliance**
Acer negundo / (Rubus ursinus) Association

6b. *Salix laevigata* dominates along streams, rivers, ditches, floodplains, and lake edges. Associated trees and shrubs include *Alnus rhombifolia*, *Populus fremontii*, *Quercus agrifolia*, *Rubus*, *Salix*, and others.

***Salix gooddingii – Salix laevigata* Alliance**
Salix laevigata – (Cornus sericea – Ribes spp*.) / Scirpus microcarpus – Carex* spp. Association
Salix laevigata / Salix lasiolepis Association

6c. *Juglans hindsii* or hybrids dominate in stands along riparian corridors, floodplains, and terraces. Other riparian species may be present, including *Acer*, *Fraxinus*, and *Rubus*. Stands are not likely in Marin Co. but are in surrounding counties.

Juglans hindsii* and Hybrids Special Stands and Semi-Natural Alliance

6d. *Populus fremontii* dominates or co-dominates with *Acer negundo*, *Juglans*, and/or *Salix*, sometimes with *Populus* having as little as 5% absolute cover. If *Juglans hindsi*i is dominant, but Populus has at least 20% relative cover in the tree layer, key here. Stands are not likely in Marin Co. but are in surrounding counties.

Populus fremontii – Fraxinus velutina – Salix gooddingii* Alliance

6e. *Quercus agrifolia* dominates in a riparian setting, often with *Salix* spp. and *Toxicodendron diversilobum.*

***Platanus racemosa – Quercus agrifolia* Alliance**
Quercus agrifolia / Salix lasiolepis Association

7. *Alnus rhombifolia*, *Alnus rubra, Acer macrophyllum, Fraxinus latifolia*, *Quercus lobata,* and/or *Salix lucida* are dominant, co-dominant, or characteristic of broadleaf riparian tree vegetation. Stands are more likely to occur near cool temperate coniferous forests, unlike vegetation of the Southwestern North American Riparian, Flooded and Swamp Forest Macrogroup described above. Found along riparian corridors, incised canyons, seeps, stream banks, mid-channel bars, floodplains, and terraces

Vancouverian Flooded & Swamp Forest Macrogroup

North-Central Pacific Lowland Riparian Forest Group

7a. *Alnus rhombifolia* dominates or co-dominates with *Acer macrophyllum* or *Umbellularia californica* in the tree overstory. *Umbellularia californica* may be higher in cover, though stands for this type will often have other riparian trees along with *Alnus rhombifolia* to be classed here. If *Fraxinus latifolia* is co-dominant, key to the *Fraxinus latifolia* Alliance below. A variety of shrubs and herbs may be found in the understory, including *Rubus*, *Toxicodendron*, and numerous ferns. Careful identification of alder stands closer to the coast is necessary to differentiate from *A*. *rubra* stands.

***Alnus rhombifolia* Alliance**
Alnus rhombifolia – Acer macrophyllum Association*
Alnus rhombifolia – Umbellularia californica – (Quercus chrysolepis) Association

7b. *Alnus rubra* dominates in the tree canopy in riparian settings, typically within a few miles of the coast. The understory is often comprised of one-to-many species of *Rubus, Salix lasiolepis,* and *Sambucus racemosa*, which sometimes exceed *Alnus* in cover. If *Salix lucida* is co-dominant, key to that *Salix* alliance. *Alnus rubra* stands were encountered in riparian or swampy bottomlands but can also occur along rocky streambeds in similar settings to *A. rhombifolia* stands. Careful identification of the *Alnus* species is important closer to the coast.

***Acer macrophyllum – Alnus rubra* Alliance**
Alnus rubra / Rubus spectabilis – Sambucus racemosa Association
Alnus rubra / Salix lasiolepis – Rubus spp. Association

7c. *Acer macrophyllum* dominates or co-dominates with *Umbellularia californica* or, occasionally, *Fraxinus latifolia* in riparian or, occasionally, upland stands. *Pseudotsuga menziesii*, *Quercus agrifolia* and *Q*. *chrysolepis* may intermix. *Acer* stands can be found farther than 10 miles from the coast or in the interior part of the county, usually in low-lying, rocky, steep canyons.

***Acer macrophyllum – Alnus rubra* Alliance**
Acer macrophyllum Association

7d. *Salix lucida* ssp. *lasiandra* dominates in the overstory, sometimes with higher or similar cover by shrubs in the understory, such as *Rubus* spp. and *Salix*

lasiolepis. Sometimes *Alnus rubra* may be co-dominant with *S. lucida,* and adjacent stands may be dominated by *Alnus* spp., *Quercus agrifolia* or conifers.

***Salix lucida* ssp. *lasiandra* Alliance**
Salix lucida ssp. *lasiandra* Association

7e. *Fraxinus latifolia* dominates or co-dominates with *Alnus rhombifolia* or *Umbellularia californica* in the tree overstory. Stands not sampled but occur infrequently in Marin County.

Fraxinus latifolia* Alliance
Fraxinus latifolia Association*

7f. *Quercus lobata* dominates or co-dominates with *Fraxinus latifolia, Quercus agrifolia, Salix lasiolepis,* and/or *Umbellularia californica* in the tree overstory. Stands are typically found along valley bottoms and lower slopes on seasonally saturated soils that may flood intermittently. Common understory shrubs include *Rosa californica*, *Rubus* spp., and *Toxicodendron diversilobum*.

***Quercus lobata* Riparian Alliance**
Quercus lobata – Fraxinus latifolia / Vitis californica Association
Quercus lobata / Rubus ursinus – Rosa californica Association
Quercus lobata – Salix lasiolepis Association

8. A tree species of *Eucalyptus, Acacia melanoxylon,* or *Ailanthus altissima* dominates in planted or naturalized stands. Often found in groves, windbreaks, uplands, and along stream courses. Stands were observed but rarely sampled in Marin County. For shrubby species of *Acacia*, see the Naturalized Non-Native Mediterranean Scrub Group in Section II, 5d2.

Californian Ruderal Forest Macrogroup and Group

***Eucalyptus* spp. – *Ailanthus altissima – Robinia pseudoacacia* Semi-Natural Alliance**
Eucalyptus (globulus, camaldulensis) Semi-Natural Association
Ailanthus altissima Semi-Natural Association*
Acacia melanoxylon Provisional Semi-Natural Association*

Class B. Shrubland Vegetation

Section I. Riparian or moist hillside settings with vegetation dominated or co-dominated by shrubs and vines. Includes *Frangula californica* (including all subspecies), *Lonicera involucrata, Morella californica*, *Rhododendron occidentale*, *Rubus armeniacus*, *R. spectabilis*, *Salix breweri*, *S. exigua*, *S. lasiolepis*, *S. melanopsis*, *S. sitchensis,* and/or *Sambucus racemosa*. *Note: if *Rubus ursinus* or *R. parviflorus* dominates, key to the *Gaultheria shallon – Rubus* (*ursinus*) Alliance in Section II below (step 5b4).

1. Non-native shrub *Rubus armeniacus, Rosa eglanteria* or *Delairea odorata* is strongly dominant in riparian sites, mesic clearings, disturbed areas and stock ponds.

Interior West Ruderal Flooded & Swamp Forest & Woodland Macrogroup

Interior West Ruderal Riparian Forest & Scrub Group

Rubus armeniacus – Sesbania punicea – Ficus carica* Semi-Natural Alliance
Rubus armeniacus Semi-Natural Association*

2. *Lonicera involucrata, Morella californica*, *Rubus spectabilis, Salix sitchensis, Sambucus racemosa,* and/or *Rhododendron columbianum* dominate or co-dominate with other *Rubus* spp.

2a. Vegetation dominated or co-dominated by *Morella californica* and/or *Rubus spectabilis*. Stands may be small and are generally found close to the coast on moist or wet soils, ravines, and riparian areas.

Vancouverian Lowland Marsh, Wet Meadow & Shrubland Macrogroup

Vancouverian Wet Shrubland Group

***Rubus spectabilis – Morella californica* Alliance**
Morella californica – Rubus spp. Provisional Association
Rubus spectabilis Association

2b. *Sambucus racemosa* dominates in the shrub overstory, often preferring riparian streams, seeps along slopes, and moist post-fire slopes where there was past disturbance.

***Rubus spectabilis – Morella californica* Alliance**
Sambucus racemosa – (Rubus ursinus) Provisional Association

2c. *Salix sitchensis* dominates or co-dominates with *S. lasiolepis* along coastal or low elevation streams, lagoons. A variety of sub-dominant trees and shrubs may be present, including *Alnus*, *Morella,* and *Rubus*.

Salix hookeriana – Salix sitchensis – Spiraea douglasii* Alliance
Salix sitchensis Provisional Association*

2d. *Cornus sericea* is dominant in the shrub layer. Emergent riparian trees and shrubs such as *Rubus ursinus* and *Toxicodendron diversilobum* are often present.

Cornus sericea* Alliance
Cornus sericea – Salix (lasiolepis, exigua) Association*

2e. *Rhododendron columbianum* is dominant in the shrub layer. This is a rare type, typically in wetland seeps and fens along the coast, though one stand was

sampled in a small riparian channel. Other unsampled fen types in Marin County may include species such as *Carex utriculata, C. echinata, C. simulata, C. exsiccata,* and/or *C. pellita*.

North Pacific Bog & Fen Macrogroup

North Pacific Acidic Open Bog & Fen Group

***Rhododendron columbianum* Alliance**
Rhododendron columbianum – Gaultheria shallon / Carex obnupta Association

3. *Frangula californica*, *Rhododendron occidentale*, *Salix breweri*, *S. exigua*, *S. lasiolepis*, and/or *S. melanopsis*, dominant or co-dominant with *Baccharis pilularis* or *Rubus* spp.

3a. *Frangula californica* and/or *Rhododendron occidentale* dominate or co-dominate with *Rubus*. Stands are found along springs, seeps, and ravines in wetland and riparian settings, often on sedimentary and serpentine substrates that retain water much of the year. If *Frangula californica* is dominant in upland settings along with *Baccharis pilularis* or other upland plants, key to the *Baccharis* alliance (Section II.5b.)

Vancouverian Lowland Marsh, Wet Meadow & Shrubland Macrogroup

Vancouverian Wet Shrubland Group

***Frangula californica – Rhododendron occidentale – Salix breweri* Alliance**
Rhododendron occidentale – Frangula californica ssp. *tomentella* Provisional Association

3b. *Salix exigua* or *S. lasiolepis* dominates or co-dominates along streams banks and benches, rivers, or close to springs.

Southwestern North American Warm Desert Freshwater Marsh & Bosque Macrogroup

Warm Desert Lowland Freshwater Marsh, Wet Meadow & Shrubland Group

3b1. *Salix exigua* dominates along rivers and streams, or close to springs. They are often the first plants to colonize bars and cut banks, followed later by trees such as *Acer* and *Salix* spp.

***Salix exigua* Alliance**
Salix exigua Association

3b2. *Salix lasiolepis* dominates or co-dominates with *Rubus* along stream banks and benches, slope seeps, and drainage stringers. Emergent riparian trees are often present, such as *Acer*, *Alnus*, *Fraxinus*, *Salix,* and others.

***Salix lasiolepis* Alliance**
Salix lasiolepis Association
Salix lasiolepis – Rubus spp. Association
Salix lasiolepis – Salix lucida Association

Section II. Coastal scrub, dune/bluff, and disturbance-following vegetation dominated or co-dominated by drought-deciduous or seral (both deciduous and

evergreen) shrubs. Includes *Artemisia californica, Baccharis pilularis*, *Ceanothus thyrsiflorus*, *Corylus cornuta, Ericameria ericoides*, *Eriodictyon californicum*, *Eriogonum fasciculatum, Frangula californica, Garrya elliptica, Gaultheria shallon*, *Holodiscus discolor, Lupinus albifrons*, *L. arboreus*, *L. chamissonis*, *Rubus ursinus*, and *Toxicodendron diversilobum*. Resprouting, deep-rooted, sclerophyllous shrubs may at times be characteristic, but not dominant.

4. *Ericameria ericoides*, *Lupinus arboreus*, and/or *L. chamissonis* are dominant, co-dominant, or characteristic (sometimes with as little as 5% cover) in the shrub overstory on coastal dunes or bluffs. A variety of herbs, including many of the following non-natives, may be present with high cover in the understory: *Bromus diandrus*, *Carduus*, *Holcus*, *Rumex acetosella*, and *Vulpia bromoides*.

Pacific Coastal Beach & Dune Macrogroup

Californian Coastal Beach & Dune Group

4a. *Lupinus arboreus* dominates or co-dominates with *Baccharis pilularis* and/or *Rubus ursinus,* often with high cover of grasses including *Bromus diandrus, Holcus lanatus, Lolium perenne*, *Vulpia bromoides*, and other non-native herbaceous species.

***Lupinus arboreus* Alliance**
Lupinus arboreus Association
Baccharis pilularis – Lupinus arboreus Association

4b. *Ericameria ericoides* and/or *Lupinus chamissonis* dominate as individuals or in combination as co-dominants with *Baccharis pilularis* or *Lupinus arboreus*.

***Lupinus chamissonis – Ericameria ericoides* Alliance**
Ericameria ericoides Association
Lupinus chamissonis Association
Lupinus chamissonis – Ericameria ericoides Association

5. Shrublands dominated or co-dominated by native, disturbance-following, naturalized, or planted species including *Artemisia californica, Baccharis pilularis*, *Ceanothus thyrsiflorus*, *Cistus, Cytisus*, *Eriodictyon californicum*, *Eriogonum fasciculatum, Gaultheria shallon*, *Genista, Heterotheca sessiliflora*, *Lupinus albifrons*, *Rubus parviflorus, R. ursinus*, *Toxicodendron diversilobum,* and/or *Ulex europaeus.*

Californian Coastal Scrub Macrogroup

5a. *Diplacus aurantiacus, Eriodictyon californicum*, or *Lupinus albifrons* dominates in the overstory.

Californian Coastal-Foothill Seral Scrub Group

5a1. *Eriodictyon californicum, Lotus scoparius, Pickeringia montana,* or *Lupinus albifrons* dominates or co-dominates with other seral scrub, often in stands that are open and/or display recent evidence of fire or other disturbance such as road cuts. Other coastal scrub may be present at lower cover, including *Artemisia californica, Baccharis pilularis,* and *Toxicodendron diversilobum.* The understory may be composed of mixed native and non-native herbs, which sometimes have higher cover than the overstory shrubs.

***Lotus scoparius – Lupinus albifrons – Eriodictyon* spp. Alliance**
Eriodictyon californicum / Herbaceous Association
Lupinus albifrons Association

5a2. *Diplacus aurantiacus* dominates often on steep slopes and ridgetops. Other coastal scrub may be present at lower cover. If *D. aurantiacus* is co-dominant with *Adenostoma fasciculatum* or *Artemisia californica*, see those respective alliances.

***Diplacus aurantiacus* Alliance**
Diplacus (aurantiacus, puniceus) Association

5b. *Baccharis pilularis*, *Ceanothus incanus*, *C*. *thyrsiflorus*, *Corylus cornuta, Frangula californica, Garrya elliptica, Gaultheria shallon*, *Holodiscus discolor, Rubus parviflorus, R. ursinus*, and/or *Toxicodendron diversilobum* dominate or co-dominate as shrubs. Shrubs are typically evergreen or winter-deciduous, not sclerophyllous or drought-deciduous species. Found along cool, coastal strips or on sheltered inland draws and lower slopes, where species are tolerant of disturbance and trees tend to be excluded.

California North Coastal & Mesic Scrub Group

5b1. *Baccharis pilularis* dominates or co-dominates with *Frangula californica*, *Toxicodendron diversilobum*, or *Rubus* spp. in the shrub overstory. If *Calamagrostis nutkaensis* or *Carex obnupta* is co-dominant with *B*. *pilularis*, key to the *C*. *nutkaensis* Alliance (see Class C, step 9c3a). If stands have greater cover of *Artemisia californica, Ceanothus thyrsiflorus* or *Toxicodendron diversilobum* than *Baccharis pilularis,* key to those respective alliances. A variety of native and non-native forbs and grasses may intermix in the herbaceous layer, sometimes with higher cover than *Baccharis* – including *Avena*, *Bromus*, *Danthonia*, *Deschampsia*, *Elymus glaucus*, *Festuca*, *Hypochaeris*, *Nassella pulchra,* and others.

***Baccharis pilularis* Alliance**
Baccharis pilularis Association
Baccharis pilularis – Artemisia californica Association
Baccharis pilularis – Ceanothus thyrsiflorus Association
Baccharis pilularis – (Frangula californica) – Rubus spp. Association
Baccharis pilularis – Toxicodendron diversilobum Association
Baccharis pilularis / (Nassella pulchra – Elymus glaucus – Bromus carinatus) Association
Baccharis pilularis / Annual Grass – Herb Association
Baccharis pilularis / Carex obnupta – Juncus patens Provisional Association
Baccharis pilularis / Danthonia californica Association
Baccharis pilularis / Deschampsia cespitosa Association
Baccharis pilularis / Eriophyllum staechadifolium Association

5b2. *Frangula californica* dominates or co-dominates with *Baccharis pilularis, Morella californica, Oemleria cerasiformis,* and/or *Toxicodendron diversilobum* in the shrub overstory. Stands occur in upland coastal bluff on mesic slopes, related to stands of *Baccharis pilularis*. (also see Class B. **3a** above)…

***Baccharis pilularis* Alliance**

Frangula californica ssp. *californica – Baccharis pilularis / Scrophularia californica* Association

5b3. *Ceanothus thyrsiflorus* dominates in the overstory shrub layer, often with moderately dense cover. *Diplacus aurantiacus*, *Heteromeles*, *Pseudotsuga menziesii*, *Quercus wislizeni*, and other species may intermix as sub-dominants in the shrub and tree layers. If *Baccharis pilularis* is present, *Ceanothus thyrsiflorus* is greater in cover. Additionally, stands of *Ceanothus incanus* are included in the *C. thyrsiflorus* Alliance since they are more limited in distribution and are ecologically similar to *C. thyrsiflorus*.

***Ceanothus thyrsiflorus* Alliance**
*Ceanothus incanus**
Ceanothus thyrsiflorus – (*Rubus ursinus*) Association
Ceanothus thyrsiflorus – Baccharis pilularis – Toxicodendron diversilobum Association
Ceanothus thyrsiflorus – Vaccinium ovatum – Rubus parviflorus Association

5b4. *Gaultheria shallon, Rubus parviflorus,* and/or *R. ursinus* dominate or co-dominate with *Anthoxanthum odoratum*, *Baccharis pilularis, Holcus lanatus,* or *Toxicodendron diversilobum* on hillslopes, rock outcrops, coastal bluffs, or flats.

***Gaultheria shallon – Rubus* (*ursinus*) Alliance**
Gaultheria shallon – Vaccinium ovatum / Pteridium aquilinum Provisional Association
Holodiscus discolor – Baccharis pilularis – Rubus ursinus Association
Rubus parviflorus Association
Rubus ursinus Association

5b5. *Toxicodendron diversilobum* dominates, sometimes intermixing with sub-dominant *Baccharis pilularis* and *Rubus* spp. If *B. pilularis* is present and greater than 50% relative cover, key to the *Baccharis pilularis* Alliance (step 5b1). For this project, stands were encountered close to the coast, although they are likely to occur inland as well.

***Toxicodendron diversilobum* Alliance**
Toxicodendron diversilobum – (Baccharis pilularis) Association

5b6. *Corylus cornuta* dominates or co-dominates with *Baccharis pilularis* and other shrubs as a medium-tall scrub on steep concave slopes with northern to eastern exposures surrounded by *Pseudotsuga menziesii*. Other shrubs may include *Baccharis pilularis*, *Frangula californica*, *Rubus ursinus*, *Vaccinium ovatum,* and *Toxicodendron diversilobum*. Stands occur in the southern portion of Inverness Ridge.

***Corylus cornuta* var. *californica* Alliance**
Corylus cornuta / Polystichum munitum Association

5b7. *Garrya elliptica* dominates with other shrubs such as *Baccharis pilularis* and *Toxicodendron diversilobum* as well as herbaceous species such as *Polystichum munitum*. Emergent trees may be present at low cover, including *Umbellularia californica*.

***Baccharis pilularis* Alliance**

Garrya elliptica Provisional Association

5c. *Artemisia californica* dominates and may intermix with *Baccharis pilularis, Diplacus aurantiacus,* and/or *Toxicodendron diversilobum*. If *Baccharis pilularis* is present, *Artemisia californica* is greater in cover for this alliance.

Central & Southern Californian Coastal Sage Scrub Group

***Artemisia californica – (Salvia leucophylla)* Alliance**
Artemisia californica Association
Artemisia californica – Diplacus aurantiacus Association
Artemisia californica / Nassella (pulchra) Association

5d. *Albizia lophantha*, *Cistus, Cotoneaster, Cytisus scoparius, Eriogonum fasciculatum, Genista monspessulana, Grevillea, Helichrysum petiolare, Rosa rubiginosa, Ulex,* or other Mediterranean shrubs not native to Marin County dominates in naturalized or planted stands. May be found invading disturbed areas, grasslands, or forest openings.

5d1. *Cistus* spp., *Cotoneaster* spp., *Cytisus scoparius, Erica* spp., *Genista monspessulana, Ulex europaeus,* or other broom plants dominate in the shrub overstory. Fire promotes broom invasions in woodland settings; however, broom or other non-native Mediterranean scrub may invade coastal grasslands without fire.

Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group

***Cytisus scoparius – Genista monspessulana – Cotoneaster* spp. Semi-Natural Alliance**
Cotoneaster (lacteus, pannosus) Provisional Semi-Natural Association
Cytisus scoparius Provisional Semi-Natural Association
Genista monspessulana Semi-Natural Association
Ulex europaeus Provisional Semi-Natural Association

5d2. A non-native *Acacia, Albizia lophantha, Grevillea,* and/or *Leptospermum laevigatum* dominates or co-dominate together in the shrub or low tree canopy. If *Acacia melanoxylon* is dominant, key to the *Eucalyptus* spp. – *Ailanthus altissima – Robinia pseudoacacia* Semi-Natural Alliance. Stands are scattered in Marin Co. invading coastal bluffs as shrubs or multi-trunked small trees.

Californian Ruderal Grassland, Meadow & Scrub Group

Acacia* spp. – *Grevillea* spp. – *Leptospermum laevigatum* Semi-Natural Alliance
Acacia (cyclops, dealbata) Association*

5d3. *Helichrysum petiolare, Maytenus boaria, Rosa eglanteria, R. rubiginosa, Pittosporum,* or other non-native shrubs dominant in open to dense stands, where they are often invading coastal grasslands.

Californian Ruderal Grassland, Meadow & Scrub Group (key to group level only)

Section III. Shrub vegetation dominated by evergreen sclerophyll-leaved species, including many that have developed growth strategies driven by a Mediterranean climate. Most of the core diagnostic species are endemic to California, including

***Adenostoma*, *Arctostaphylos*, *Ceanothus cuneatus*, *C. oliganthus*, *Cercocarpus montanus*, *Chrysolepis chrysophylla, Quercus berberidifolia*, *Q. durata*, and shrubby *Q. wislizeni*.**

Californian Chaparral Macrogroup

6. *Arctostaphylos sensitiva, A. virgata, Chrysolepis chrysophylla* var. *minor* or *Vaccinium ovatum* dominates or co-dominates in maritime chaparral stands. *Pinus muricata* and *Pteridium aquilinum* are often present. Stands are often transitional between forest and chaparral.

Californian Maritime Chaparral Group

***Arctostaphylos* (*nummularia*, *sensitiva*) – *Chrysolepis chrysophylla* Alliance**
Arctostaphylos sensitiva Association
Chrysolepis chrysophylla – Arctostaphylos glandulosa Association
Chrysolepis chrysophylla / Vaccinium ovatum Association

7. *Cercocarpus montanus, Prunus ilicifolia, Prunus virginiana,* and/or *Quercus berberidifolia* dominate or co-dominate with *Adenostoma fasciculatum*. Stands are mostly found inland from the coastal fog belt and are often composed of large shrubs occupying mesic sites such as north-facing slopes, concavities, and toeslopes with well-drained soils.

Californian Mesic & Pre-Montane Chaparral Group

7a. *Cercocarpus montanus* dominates or co-dominates with *Adenostoma fasciculatum*. *Diplacus aurantiacus* and *Toxicodendron diversilobum* are often present. Stands are not likely in Marin Co. but are in surrounding counties.

Cercocarpus montanus* Alliance

7b. *Quercus berberidifolia* dominates or co-dominates with *Adenostoma fasciculatum, Cercocarpus montanus* and/or other chaparral shrubs. Stands are not likely in Marin Co. but are in surrounding counties.

Quercus berberidifolia* Alliance

7c. *Heteromeles arbutifolia, Prunus ilicifolia,* and/or *Prunus virginiana* dominates or co-dominates in the shrub layer with *Baccharis pilularis,* and/or *Toxicodendron diversilobum. Sanicula crassicaulis* and other herbs such as *Clinopodium douglasii* may be present to abundant in the understory.

***Prunus ilicifolia – Heteromeles arbutifolia – Ceanothus spinosus* Alliance**

8. *Arctostaphylos montana*, *Ceanothus jepsonii*, and/or *Quercus durata* dominate or co-dominate in shrub vegetation restricted to or adapted to ultramafic soils and substrates (e.g., serpentine, gabbro).

8a. *Arctostaphylos montana*, a serpentine endemic, dominates or co-dominates with *Adenostoma fasciculatum* and/or *Quercus durata* in the shrub overstory, often on upper slopes, flats and ridges. *Ceanothus jepsonii*, *Hesperocyparis sargentii*, *Heteromeles arbutifolia*, and *Calamagrostis ophitidis* are commonly present.

Californian Xeric Chaparral Group

***Arctostaphylos* (*bakeri*, *montana*) Alliance**

Arctostaphylos montana Association
Arctostaphylos montana – Adenostoma fasciculatum Association

8b. *Quercus durata* dominates or co-dominates with *Adenostoma fasciculatum, Arctostaphylos glandulosa* or *Ceanothus jepsonii* on ultramafic soils. *Ceanothus jepsonii* may occasionally exceed *Q. durata* in cover when present. *Heteromeles arbutifolia* and/or *Umbellularia californica* are often present in stands.

Californian Mesic & Pre-Montane Chaparral Group

***Quercus durata* Alliance**
Quercus durata – Adenostoma fasciculatum Provisional Association
Quercus durata – Arctostaphylos glandulosa Association
Quercus durata – Ceanothus jepsonii Association

9. *Ceanothus oliganthus, Quercus wislizeni* var. *frutescens, Q. parvula,* and/or *Arctostaphylos glandulosa* dominate or co-dominate in the shrub overstory. These shrublands are more frost tolerant and typically found at higher, cooler, or more mesic sites than the California Xeric Chaparral Group.

Californian Mesic & Pre-Montane Chaparral Group

9a. *Ceanothus oliganthus* dominates in shrublands that are often found in localized patches following fires. If *Quercus wislizeni* is co-dominant, key to the *Quercus wislizeni – Quercus chrysolepis* (shrub) Alliance directly below.

Ceanothus (oliganthus, tomentosus)* Alliance
Ceanothus oliganthus Association*

9b. *Quercus agrifolia, Q. parvula, Q. wislizeni* or other *Quercus* spp. dominate and/or co-dominate as shrubby regenerating trees or short trees, co-occurring with *Umbellularia*, *Adenostoma*, and a variety of other shrubs that prefer more mesic, northerly exposures. *Quercus parvula* and *Q. wislizeni* are not always morphologically distinct. When *Q. wislizeni* or *Q. parvula* dominates or co-dominates as an overstory tree, key to the *Quercus wislizeni – Quercus parvula* (tree) Alliance. *Umbellularia californica* is often emergent, while a variety of thick- and soft-leaved shrubs intermix as sub-dominants.

***Quercus wislizeni – Quercus chrysolepis* (shrub) Alliance**
Quercus agrifolia – Quercus chrysolepis – Quercus parvula (shrub) Provisional Association
Quercus parvula (shrub) Provisional Association
Quercus (parvula, wislizeni) – Arctostaphylos glandulosa Association

9c. *Arctostaphylos glandulosa* dominates or co-dominates with *Adenostoma fasciculatum* and/or *Quercus wislizeni* on convexities, outcrops, ridges, or slopes. Sometimes *Q. wislizeni* may be a tree, though often it is shrubby in stands sampled. Soils may be derived from sandstone, serpentine, or gabbro. Species commonly found as emergent trees or sub-dominant shrubs include *Arbutus menziesii*, *Arctostaphylos* spp., *Diplacus aurantiacus*, and *Heteromeles arbutifolia*.

***Arctostaphylos glandulosa* Alliance**[1]

[1] The *Arctostaphylos glandulosa* Alliance is placed in the Pre-Montane Chaparral Group of the USNVC. For this project, it is also related to the Xeric Chaparral Group because some stands occupy exposed

Arctostaphylos glandulosa Association
Arctostaphylos glandulosa – Adenostoma fasciculatum Association
Arctostaphylos glandulosa – Adenostoma fasciculatum – Quercus wislizeni Association

10. Sclerophyll (i.e., thick-leaved) shrublands dominated by one or more of the following taxa: *Adenostoma*, *Arctostaphylos canescens*, *A. glandulosa, A*. *manzanita*, or *Ceanothus cuneatus*. Most stands occur on well-drained soils along exposures that are in full sun much of the growing season, including upper slopes, spur ridges, and convexities.

Californian Xeric Chaparral Group

10a. *Arctostaphylos canescens* and/or *A*. *manzanita* dominate or co-dominate, sometimes with co-dominant *Adenostoma fasciculatum*. Found typically on volcanic, Franciscan, and greenstone substrates. One alliance is recognized for all three *Arctostaphylos* vegetation types, with associations specific to each species.

***Arctostaphylos* (*canescens*, *manzanita*, *stanfordiana*) Alliance**
Arctostaphylos canescens Provisional Association
Arctostaphylos canescens – Arctostaphylos glandulosa – Adenostoma fasciculatum Provisional Association
Arctostaphylos manzanita Association

10b. *Ceanothus cuneatus* dominates or co-dominates with *Adenostoma fasciculatum*, often on convexities with westerly exposures. A variety of shrubs may intermix, including *Arctostaphylos*, *Baccharis*, *Eriodictyon*, *Heteromeles*, *Quercus durata,* and others.

***Ceanothus cuneatus* Alliance**
Ceanothus cuneatus Association
Ceanothus cuneatus – Adenostoma fasciculatum Association

10c. *Adenostoma fasciculatum* dominates, often with sub-dominant shrubs such as *Arctostaphylos manzanita*, *A*. *glandulosa*, or *Diplacus aurantiacus*. If *A*. *fasciculatum* co-dominates with *Arctostaphylos* spp., *Ceanothus cuneatus*, *Cercocarpus montanus*, *Quercus berberidifolia,* or *Q*. *durata*, key to one of the latter alliances instead of *A*. *fasciculatum*.

***Adenostoma fasciculatum* Alliance**
Adenostoma fasciculatum Association
Adenostoma fasciculatum – (*Arctostaphylos glandulosa – Ceanothus jepsonii*) Association
Adenostoma fasciculatum – Diplacus aurantiacus Association

Class C. Herbaceous Vegetation

Section I. Vegetation of: a) freshwater wetland or riparian settings with water or wet ground present temporarily, seasonally, or throughout the growing season,

southerly-facing sites with shallow soils, yet the alliance is typically found in areas with higher moisture from fog and rain as compared to *Adenostoma fasciculatum* and related xeric chaparral alliances with shallow soils.

b) saline or alkaline lowlands where water accumulates in the winter, or c) tidal salt or brackish marshes with seasonal or ephemeral inundations. Includes herbaceous vegetation dominated, co-dominated, or characterized by: *Argentina* (=*Potentilla*), *Azolla, Bidens*, *Bolboschoenus*, *Carex*, *Ceratophyllum*, *Distichlis*, *Eleocharis macrostachya*, *Grindelia stricta*, *Hydrocotyle, Juncus arcticus*, *J. effusus*, *J. lescurii*, *J. patens*, *Lasthenia glaberrima*, *Lemna*, *Lepidium latifolium*, *Leymus triticoides*, *Ludwigia*, *Mimulus guttatus*, *Nuphar*, *Oenanthe*, *Persicaria*, *Pleuropogon*, *Sarcocornia* (=*Salicornia*), *Schoenoplectus*, *Scirpus*, *Sparganium, Spartina*, *Typha,* and/or *Xanthium*.

1. Freshwater stands dominated by aquatic, floating or submerged plants, including *Azolla, Ceratophyllum*, *Hydrocotyle, Lemna*, *Ludwigia*, *Nuphar* and/or *Sparganium*. Found along slow-moving streams, still ponds, lakes, or on ground surfaces after water levels have dropped.

Western North American Freshwater Aquatic Vegetation Macrogroup

1a. *Ludwigia hexapetala* or *L. peploides* dominates, creating mats in shallow water or over wet soil. Other aquatic plants such as *Azolla*, *Lemna*, *Myriophyllum aquaticum, Polygonum*, and *Sparganium* may be present.

North American Temperate Ruderal Aquatic Vegetation Group

***Eichhornia crassipes – Ludwigia* (*hexapetala*, *peploides*) Provisional Semi-Natural Alliance**

Ludwigia (*hexapetala*, *peploides*) Provisional Semi-Natural Association

1b. *Azolla filiculoides* or *Azolla mexicana* (=*A. microphylla*) dominates or characterizes stands on water or wet ground surfaces. If *Lemna* is co-dominant, key to this alliance.

Western North American Temperate Freshwater Aquatic Vegetation Group

***Azolla* (*filiculoides, microphylla*) Alliance**

Azolla (filiculoides, microphylla) Association

1c., *Ceratophyllum*, *Hydrocotyle, Lemna*, *Nuphar* or *Sparganium* dominates on or in water surfaces of streams, ponds or lakes.

Western North American Temperate Freshwater Aquatic Vegetation Group

1c1. *Ceratophyllum demersum* dominates. One stand was surveyed in Marin County along the southern shore of upper Abbott's Lagoon. Other stands are likely to occur in the county.

***Ceratophyllum demersum* Aquatic Provisional Alliance**

Ceratophyllum demersum Western Provisional Association

1c2. *Nuphar lutea* dominates on the water surface. Algae and a variety of hydrophytes may intermix, including *Alisma*, *Carex*, *Hippuris vulgaris*, *Lemna, Polygonum*, and *Oenanthe*.

***Nuphar lutea* Alliance**

Nuphar lutea ssp. *polysepala* Provisional Association

1c3. *Hydrocotyle ranunculoides* dominant on the water surface of coastal lagoons, ponds, freshwater lakes, and wet marshes growing with *Lemna* spp. and *Scirpus microcarpus*.

***Hydrocotyle (ranunculoides, umbellata)* Alliance**
Hydrocotyle ranunculoides Association

1c4. *Sparganium eurycarpum* is dominant in wetlands with other forbs including *Agrostis pallens, Oenanthe sarmentosa,* and *Rumex conglomeratus*.

***Sparganium (angustifolium)* Alliance**
Sparganium eurycarpum Provisional Association

2. Salt and brackish marshes dominated or co-dominated by *Atriplex prostrata*, *Bolboschoenus*, *Cotula coronopifolia, Distichlis spicata*, *Frankenia salina, Grindelia stricta, Jaumea carnosa, Lilaeopsis occidentalis*, *Sarcocornia* (=*Salicornia*), *Spartina, Triglochin* spp., or other plants. May appear as sparsely vegetated mudflats at low tide, or during restoration (as along San Pablo Bay). Additionally, Intertidal Temperate Pacific Seagrass Beds with *Zostera* spp. and Mudflats with trace amounts of cover by herbs are included here (see 2c to 2d).

2a. *Bolboschoenus maritimus*, *Distichlis spicata*, *Frankenia salina*, *Grindelia stricta, Jaumea carnosa, Sarcocornia* (=*Salicornia*), *Spartina* and/or *Triglochin* spp. dominant or co-dominant tidal salt to brackish marshes.

North American Pacific Coastal Salt Marsh Macrogroup

Temperate Pacific Salt Marsh Group

2a1. *Bolboschoenus maritimus* or *B. robustus* dominates or co-dominates with *Sarcocornia* (=*Salicornia*) *pacifica*.

***Bolboschoenus maritimus* Alliance**
Bolboschoenus maritimus Association*
Bolboschoenus maritimus – Sarcocornia pacifica Association

2a2. *Distichlis spicata* dominates or co-dominates with *Frankenia salina* and/or *Jaumea carnosa*. Non-native grasses including *Avena* spp. and *Bromus hordeaceus* may have high cover and *Sarcocornia pacifica* may be present as a sub-dominant.

***Distichlis spicata* Alliance**
Distichlis spicata – Annual Grasses Association
Distichlis spicata – Frankenia salina – Jaumea carnosa Association
Distichlis spicata – (Sarcocornia pacifica) Association

2a3. *Frankenia salina* is strongly dominant in tidal marsh settings with other salt tolerant plants such as *Limonium californicum* and *L. ramosissimum*. *Sarcocornia pacifica* or *Distichlis spicata* may be present as a sub-dominant.

***Sarcocornia pacifica* (*Salicornia depressa*) Alliance**
Frankenia salina – Limonium californicum – Monanthochloe littoralis – Sarcocornia pacifica Association*

2a4. *Sarcocornia pacifica* dominates or co-dominates with *Distichlis spicata, Frankenia salina, Jaumea carnosa*, *Triglochin* spp. including *Triglochin concinna*, and/or *Lepidium latifolium*. Stands found in coastal salt marshes, alkali flats, and

wetland mudflats. Sometimes, *Jaumea carnosa* is dominant with *S. pacifica* subdominant and keyed here.

***Sarcocornia pacifica* (*Salicornia depressa*) Alliance**
Sarcocornia pacifica – Cotula coronopifolia Association
Sarcocornia pacifica – Jaumea carnosa – Distichlis spicata Association
Sarcocornia pacifica Tidal Association

2a5. *Triglochin maritima* dominates or co-dominates with *Distichlis spicata, Sarcocornia pacifica, Jaumea carnosa,* or *Frankenia salina* in marshes of Tomales Bay.

***Sarcocornia pacifica (Salicornia depressa)* Alliance**
Triglochin maritima Association

2a6. *Festuca rubra* dominates in tidal marsh and dune overwash settings.
***Deschampsia cespitosa – Festuca rubra* Brackish Salt Marsh Alliance**
Festuca rubra – (Argentina egedii) Provisional Association

2a7. *Spartina foliosa* dominates on mudflats, banks, berms, and margins of bays and deltas.

***Spartina foliosa* Alliance**
Spartina foliosa Association

2a8. *Grindelia stricta* dominates or co-dominates with natives such as *Sarcocornia pacifica, Distichlis spicata,* and/or *Frankenia salina* or with non-native herbs such as *Polypogon monspeliensis, Rumex crispus,* and *Bromus diandrus*. Stands may be found on salt or alkaline marshes, tidal flats, or levees.

***Grindelia (stricta)* Provisional Alliance**
Grindelia stricta Provisional Association

2b. Non-native species such as *Cotula coronopifolia, Polypogon monspeliensis,* and/or *Atriplex prostrata* dominate in low-lying sloughs and other disturbed alkaline or saline wetlands.

Western North American Ruderal Marsh, Wet Meadow & Shrubland Macrogroup

Western North American Ruderal Marsh, Wet Meadow & Shrubland Group

***Atriplex prostrata – Cotula coronopifolia* Semi-Natural Alliance**
Cotula coronopifolia Semi-Natural Association

2c. *Zostera marina* and/or *Z. pacifica* dominate in sub-tidal and aquatic marine settings.

Temperate Seagrass Aquatic Vegetation Macrogroup

Temperate Pacific Seagrass Bed Group

Zostera* (*marina, pacifica*) Pacific Aquatic Alliance
Zostera marina Association

2d. Tidal mudflats or dry pond bottoms (sometimes in sites undergoing restoration) typically with trace amounts of cover by herbs.

Vancouverian Lowland Marsh, Wet Meadow & Shrubland Macrogroup

Temperate Pacific Freshwater Wet Mudflat Group

2d1. *Lilaeopsis occidentalis* dominates in coastal salt marsh settings. Stands are not likely in Marin Co. but may be in surrounding counties.

Lilaeopsis occidentalis* Provisional Alliance

2d2. Mudflats or dry pond bottoms (sometimes in sites undergoing restoration) with trace amounts of cover by *Agrostis avenacea, Sarcocornia pacifica, Sesuvium,* and others. Cover by plants is sparse and/or uneven.

Mudflat/Dry Pond Bottom Mapping Unit

3. Freshwater or brackish stands dominated by *Argentina*, *Carex pansa*, *C*. *obnupta*, *C*. *praegracilis*, *Juncus effusus*, *J*. *lescurii*, *J*. *patens*, *Oenanthe*, *Schoenoplectus*, *Scirpus microcarpus*, and/or *Typha,* where water is present throughout all or most of the growing season. Soils have high organic content and may be poorly aerated.

Arid West Interior Freshwater Marsh Macrogroup

3a. *Schoenoplectus* and/or *Typha* dominate in the herbaceous layer. Stands are found along streams, ditches, shores, bars, and channels of river mouth estuaries; around ponds and lakes; and in sloughs, swamps, and freshwater to brackish marshes.

Arid West Freshwater Marsh Group

3a1. *Schoenoplectus acutus* or *Schoenoplectus californicus* dominates or co-dominates with other herbs including *Typha* spp. Occurs in both freshwater and tidal marshes, along ponds and lagoons.

***Schoenoplectus* (*acutus, californicus*) Alliance**
Schoenoplectus acutus Association
Schoenoplectus californicus Association

3a2. *Typha latifolia, T*. *angustifolia*, and/or *T*. *domingensis* dominate in semi-permanently flooded freshwater or brackish marshes. If *Schoenoplectus acutus* or *S*. *californicus* is co-dominant, key to the appropriate *Schoenoplectus* Alliance.

***Typha* (*angustifolia*, *domingensis*, *latifolia*) Alliance**
Typha (latifolia, angustifolia) Association
Typha domingensis Association

3b. *Argentina egedii*, *Bolboschoenus maritimus*, *B. robustus, Carex nudata*, *C*. *obnupta*, *C*. *praegracilis*, *C*. *pansa*, *C. subbracteata, C. tumulicola, Distichlis spicata*, *Eleocharis macrostachya*, *Festuca rubra, Juncus covillei, J. effusus*, *J. hesperius, J*. *lescurii*, *J*. *patens*, *J*. *occidentalis*, *J*. *phaeocephalus*, *Oenanthe*, and/or *Scirpus microcarpus* dominate or co-dominate in mesic or wetland settings. *Holcus*, *Hypochaeris*, *Leontodon*, *Rumex* and *Vulpia bromoides* may intermix with similar cover. Stands may be found along seasonally flooded brackish marshes, coastal sand dunes, swales and plains, shallowly inundated woods, meadows, roadside ditches, mudflats, coastal swamps, lakeshores, marshes, and riverbanks.

Vancouverian Freshwater Wet Meadow & Marsh Group

3b1. *Carex praegracilis*, *C*. *pansa*, *C. subbracteata,* or *C*. *tumulicola* dominates or co-dominates with *Holcus lanatus* or *Lolium perenne*. Stands of *C*. *praegracilis* are not restricted to the coast and may be found interior in the county in moist meadows and hillside depressions.

***Juncus (effusus, patens) – Carex* (*pansa*, *praegracilis*) Alliance**
Carex pansa Provisional Association
Carex praegracilis Coastal Provisional Association
Carex tumulicola Provisional Association

3b2. *Carex obnupta* and/or *Scirpus microcarpus* dominates or co-dominates with other shrubs and herbs including *Argentina egedii, Baccharis pilularis, Juncus effusus, J. patens, Oenanthe sarmentosa,* and *Rubus ursinus* across a variety of freshwater and brackish settings near the coast.

***Carex obnupta – Oenanthe sarmentosa – Scirpus microcarpus* Alliance**
Carex obnupta Association
Carex obnupta – Juncus patens Association
Scirpus microcarpus Pacific Coast Association

3b3. *Juncus effusus*, *J*. *patens*, *J. covillei, J. hesperius, J*. *occidentalis*, and/or *J*. *phaeocephalus* dominate individually or in combination near the coast or farther inland. Co-dominant species may include *Carex densa*, *Holcus lanatus*, *Hypochaeris radicata*, *Juncus bufonius*, and *Vulpia bromoides*.

***Juncus* (*effusus*, *patens*) – *Carex* (*pansa*, *praegracilis*) Alliance**
Juncus covillei Provisional Association
Juncus effusus Association
Juncus patens Association
Juncus patens – Holcus lanatus Provisional Association
Juncus patens – Juncus occidentalis Provisional Association
Juncus phaeocephalus Association

3b4. *Juncus lescurii* dominates or co-dominates with *Argentina egedii*, *Carex obnupta,* or *Distichlis spicata* in slightly brackish marshes or freshwater marshes and meadows.

***Carex obnupta – Oenanthe sarmentosa – Scirpus microcarpus* Alliance**
Juncus lescurii Association

3b5. *Argentina egedii* (=*A*. *anserina* or *Potentilla anserina* ssp. *pacifica*) and/or *Festuca rubra* dominates or co-dominates with *Calamagrostis nutkaensis, Carex obnupta, Holcus lanatus*, *Juncus* spp., *Leontodon taraxacoides*, *Lotus corniculatus, Schoenoplectus californicus,* and *Trifolium wormskioldii* in freshwater to brackish marsh habitats.

***Carex obnupta – Oenanthe sarmentosa – Scirpus microcarpus* Alliance**
Argentina egedii – (Juncus lescurii) Association
Carex obnupta – Argentina egedii Provisional Association

3b6. *Oenanthe sarmentosa* dominates or co-dominates with *Argentina egedii* or other herbs in freshwater to slightly brackish marshes.

***Carex obnupta – Oenanthe sarmentosa – Scirpus microcarpus* Alliance**
Oenanthe sarmentosa Association

4. Wetland herbaceous vegetation dominated or characterized by *Alisma* spp., *Bidens frondosa*, *Bolboschoenus glaucus, Carex barbarae*, *C. densa, C*. *nudata*, *C*. *serratodens*, *Juncus arcticus*, *Grindelia* spp*., Lepidium latifolium*, *Leymus triticoides, Mimulus guttatus*, *Persicaria (=Polygonum) lapathifolia*, or *Xanthium strumarium*. Stands occupy settings where saturated soil or standing water throughout the growing season are key characteristics.

4a. Stands dominated or characterized by the species of *Carex*, *Juncus*, *Leymus*, or *Mimulus* mentioned above.

Vancouverian Lowland Marsh, Wet Meadow & Shrubland Macrogroup

Vancouverian Freshwater Wet Meadow & Marsh Group

4a1. *Carex barbarae* dominates in seasonally or intermittently saturated wetlands.

***Carex barbarae* Alliance**
Carex barbarae Association

4a2. *Carex serratodens* dominates or co-dominates with *Agoseris heterophylla*, *Juncus arcticus*, *J. occidentalis* or *Leymus triticoides*. Stands are often found on serpentine seeps and meadows.

***Juncus (effusus, patens) – Carex (pansa, praegracilis)* Alliance**
Carex serratodens Provisional Association

4a3. *Carex densa* dominates individually or in combination near the coast or farther inland in wet meadows. Co-dominant species may include *Holcus lanatus*, *Juncus* spp., *Mentha pulegium*, *Plantago lanceolatum,* and *Ranunculus californicus*.

***Juncus (effusus, patens) – Carex (pansa, praegracilis)* Alliance**
Carex densa Provisional Association

4a4. *Carex amplifolia* dominates in wet meadow areas with *Carex gynodynama* and *Juncus* spp.

***Juncus (effusus, patens) – Carex (pansa, praegracilis)* Alliance**
Carex amplifolia – Carex gynodynama Provisional Association

4a5. *Carex nudata* dominates with other herbs lower in cover including *Equisetum* spp. along rocky streams and streambanks. Stands occur in Sonoma and San Mateo Co., and may occur in small stands in Marin Co.

Carex nudata* Alliance
Carex nudata Association*

4a6. *Juncus arcticus* (var. *balticus* or *mexicanus*) dominates in freshwater, brackish, or alkaline settings. *Argentina egedii*, *Carex* spp., *Mentha pulegium* and other hydrophytes may intermix as sub-dominants.

Juncus arcticus* (var. *balticus*, *mexicanus*) Alliance
Juncus arcticus var. balticus – (var. mexicanus) Association*

4a7. *Leymus triticoides* dominates or co-dominates with *Lolium perenne* or other non-native grasses or forbs. Stands are found on poorly drained floodplains, valley bottoms, and brackish marsh margins.

***Leymus cinereus – Leymus triticoides* Alliance**
Leymus triticoides Association

4a8. *Mimulus guttatus* or another wetland *Mimulus* species dominates or co-dominates in the herbaceous layer with *Cirsium* and *Juncus* spp. or non-native grasses such as *Lolium perenne* and *Polypogon monspeliensis*. Stands are found in moist or saturated settings along streams, ephemeral cascades, ditches, fens, seeps, and springs often with high cover of moss.

***Mimulus* (*guttatus*) Alliance**
Mimulus guttatus Association

4b. Stands dominated or characterized by non-native, ruderal, or disturbance adapted taxa: *Alisma* spp., *Bolboschoenus glaucus, Lepidium*, *Euthamia, Bidens, Persicaria*, and/or *Xanthium*.

4b1. *Lepidium latifolium* dominates in the herbaceous layer along intermittently and seasonally flooded freshwater and brackish marshes and riparian corridors. In alkaline or saline settings, *Distichlis spicata* is commonly present.

Western North American Ruderal Marsh, Wet Meadow & Shrubland Group

***Lepidium latifolium – (Lactuca serriola)* Semi-Natural Alliance**
Lepidium latifolium Semi-Natural Association

4b2. *Persicaria* (= *Polygonum)* spp., *Alisma* spp., and/or *Xanthium strumarium* co-dominate or dominate in marshes and regularly disturbed vernally wet ponds, fields, and stream terraces.

Temperate Pacific Freshwater Wet Mudflat Group

***Polygonum lapathifolium – Xanthium strumarium* Alliance**
Alisma (triviale) Provisional Association
Polygonum (amphibium, lapathifolium) Association
Xanthium strumarium Association

4b3. *Euthamia occidentalis, Hoita orbicularis, Bidens* spp., and/or the native herb *Ludwigia palustris* dominates or co-dominates in wetlands with emergent shrubs such as *Rubus ursinus*. *Baccharis glutinosa* (= *B. douglasii)* is often present.

Temperate Pacific Freshwater Wet Mudflat Group

***Bidens cernua – Euthamia occidentalis – Ludwigia palustris* Provisional Alliance**
Bidens frondosa Provisional Association
Euthamia occidentalis Provisional Association*

4b1. Other non-native plants dominant in marsh settings, but without general repeated patterning in the data, yet may include *Bolboschoenus glaucus, Polypogon monspeliensis, Rumex crispus,* among others.

Western North American Ruderal Marsh, Wet Meadow & Shrubland Group

5. Herbaceous stands dominated or characterized by *Eleocharis macrostachya*, *E. acicularis, Eryngium aristulatum, Lasthenia glaberrima*, *L. fremontii, Limnanthes douglasii, Navarretia leucocephala, Pleuropogon californicus* or *Trifolium variegatum*. In the *Manual of California Vegetation* (Sawyer et al. 2009), these stands are recognized in a macrogroup associated with vernal pools, even though they do not always occur in vernal pool settings. Future versions of the hierarchy will likely split vernal pool and non–vernal pool stands into different alliances, groups, and macrogroups based on ecological and environmental differences. Few true vernal pool types occur in Marin County.

Western North American Vernal Pool Macrogroup

Californian Vernal Pool / Swale Bottomland Group

5a. *Eryngium aristulatum* or *Hemizonia congesta* is co-dominant in the herbaceous layer with other swale and vernal pool species.

***Eryngium aristulatum* Alliance**
Hemizonia congesta Association*

5b. *Pleuropogon californicus* and/or *Lasthenia glaberrima* are present, sometimes with high cover in the herbaceous layer along with *Limnanthes douglasii, Navarretia leucocephala*, *Eryngium aristulatum*, and/or *Isoetes howellii*. If *Eleocharis macrostachya* or *E. palustris* is present and co-dominant, key to this alliance instead of *Eleocharis*. Stands typically occur in vernal pools or vernally influenced marshes.

***Lasthenia glaberrima* Alliance**
Lasthenia glaberrima – Pleuropogon californicus Association

5c. *Eleocharis macrostachya* dominates in the herbaceous layer along lakeshores, streambeds, swales, vernal pools, pastures, ditches, and ponds. *Juncus phaeocephalus* and *J. patens* may also be present. If *Lasthenia glaberrima* or *Pleuropogon californicus* have high cover, key to the *L. glaberrima* Alliance above.

***Eleocharis* (*acicularis*, *macrostachya*) Alliance**
Eleocharis macrostachya Association

5d. *Malvella leprosa* characteristically present with *Eleocharis acicularis* and with salt tolerant species such as *Heliotropium curassavicum* and *Phyla nodiflora* in the herbaceous layer. One stand was sampled along the southeast bank of Stafford Lake in Marin County.

***Eleocharis* (*acicularis*, *macrostachya*) Alliance**

5e. *Trifolium variegatum* dominates or co-dominates in the herbaceous layer with a variety of other native and non-native herbs such as *Bromus* spp., *Juncus bufonius, Lolium perenne, Lotus* spp., *Plagiobothrys* spp., *Trifolium fucatum,* and others. Stands occur in vernally wet, shallow swales.

***Trifolium variegatum* Alliance**
Trifolium variegatum Association

5f. Other vernal pool, wet depression, and swale species are dominant or characteristically present including a variety of native and non-native herbs such

as *Bromus* spp., *Hordeum* spp., *Juncus* spp*., Limnanthes douglasii, Lolium perenne, Plagiobothrys* spp., *Trifolium* spp., and others. Stands occur in vernally wet swales and pools.

Californian Vernal Pool / Swale Bottomland Group

Section II. Vegetation dominated or characterized by herbaceous species that occupy dry, seasonally moist, and usually well-drained sites that range from interior dry ridges and cliffs to ocean bluffs, dunes, and terraces with cooling summer fog and salty breezes. Stands are not wet or inundated as in Section I above. This group includes native and non-native annual and perennial grasslands, seral herbaceous stands, dry cliff and canyon vegetation, and coastal dune/ bluff vegetation. Dominant, co-dominant, and characteristic taxa include: *Abronia*, *Agrostis gigantea*, *A. stolonifera*, *Allium falcifolium*, *Ambrosia*, *Ammophila*, *Anthoxanthum*, *Avena*, *Brachypodium*, *Brassica*, *Briza*, *Bromus*, *Calamagrostis*, *Carpobrotus*, *Centaurea*, *Cynosurus*, *Danthonia*, *Deschampsia*, *Dudleya, Elymus elymoides*, *E. glaucus*, *E. multisetus*, *E. luteolum*, *E. nudum*, *Erodium*, *Eryngium armatum*, *Eschscholzia*, *Festuca arundinacea*, *F. californica*, *F. idahoensis*, *Heterotheca*, *Holcus lanatus*, *Hordeum*, *Lasthenia californica*, *Leymus mollis*, *Lolium*, *Melica*, *Mesembryanthemum*, *Nassella*, *Phalaris*, *Plagiobothrys nothofulvus*, *Plantago erecta*, *Pteridium*, *Raphanus*, *Sedum, Selaginella, Streptanthus*, and/or *Vulpia* spp.

6. *Allium falcifolium*, *E. luteolum*, *E. nudum*, *Polypodium californicum, Sedum spathulifolium, Selaginella wallacei,* and/or *Streptanthus glandulosus* characterize or dominate stands on exposed rock or coastal headlands and cliffs; OR Lichen and/or moss is characteristic and dominant.

Western North American Cliff, Scree & Rock Vegetation Macrogroup

Californian Cliff, Scree & Rock Vegetation Group

6a. *Selaginella wallacei* or *S. bigelovii* dominates or characterizes small stands on rock outcrops, cliff faces, or skeletal soils over gently to steeply sloping, impervious substrates. Moss and lichen species often intermix.

***Selaginella (bigelovii, wallacei)* Alliance**
Selaginella wallacei / Lichen – Moss Provisional Association

6b. Sparsely vegetated herbaceous stands (generally less than 2% absolute cover) characterized by *Allium falcifolium*, *Claytonia exigua, Dudleya* spp*., Eriogonum luteolum*, *E. nudum*, *Plantago erecta, Streptanthus batrachopus,* and/or *S. glandulosus* growing on steep serpentine barrens with exposed gravel and bedrock.

***Allium* spp. – *Streptanthus* spp. – *Hesperolinon* spp. Serpentinite Alliance**
Allium falcifolium – Eriogonum luteolum – Streptanthus (batrachopus, morrisonii) Association
Streptanthus glandulosus – Dudleya abramsii / Lichen – Moss Association

6c. *Sedum spathulifolium* and/or *Polypodium* spp. dominate or co-dominate in small stands on steep north-facing rock outcrops and vertical cliff faces. Moss and lichen species often have high cover.

***Sedum spathulifolium* Provisional Alliance**
Sedum spathulifolium – Polypodium californicum / Lichen – Moss Provisional Association

6d. The native *Dudleya farinosa* or other *Dudleya* spp. is characteristic, dominant or co-dominant with herbs such as *Eriogonum latifolium, Vulpia bromoides*, and others. OR Lichen and/or moss is characteristic and dominant. Often on rocky coastal bluffs, cliffs, headlands, and bedrock outcrops.

***Dudleya cymosa – Dudleya lanceolata* / Lichen – Moss Alliance**
Dudleya farinosa / Lichen – Moss Provisional Association

7. *Corethrogyne filaginifolia* or *Eriogonum nudum* dominates or co-dominates with non-native herbs in upland stands including rocky sites and areas with recent disturbance.

Californian Annual & Perennial Grassland Macrogroup

Californian Perennial Grassland Group

7a. *Eriogonum nudum* or *Corethrogyne filaginifolia* co-dominates with *Bromus diandrus*, *Erodium botrys*, *Vulpia bromoides,* and others in herbaceous stands often occupying steep slopes and exposed rocky convexities. Stands occur in Sonoma and Contra Costa Co., and may occur as small stands in Marin Co.

Corethrogyne filaginifolia – Eriogonum* (*elongatum*, *nudum*) Alliance
Eriogonum nudum Association*

8. Native and non-native annual forb/grass vegetation AND native perennial grasslands growing within the California Mediterranean climate. Stands are generally often found in relatively drier sites than those in the Western North American Ruderal Marsh, Wet Meadow & Shrubland and Western North American Ruderal Grassland & Shrubland Macrogroups, which is more common near the coast (see step 9). Includes vegetation characterized by, but not limited to *Amsinckia*, *Avena*, *Brassica*, *Bromus*, *Centaurea*, *Cynosurus*, *Elymus glaucus*, *Eschscholzia*, *Lasthenia californica*, *Lolium*, *Lupinus, Melica*, *Nassella, Pennisetum*, *Plagiobothrys nothofulvus, Plantago erecta*, *Pteridium aquilinum*, and *Vulpia microstachys*.

Californian Annual & Perennial Grassland Macrogroup

8a. Herbaceous vegetation dominated, co-dominated or characterized by native annual forbs and grasses such as *Amsinckia, Eschscholzia*, *Lasthenia californica*, *Lupinus*, *Plagiobothrys*, *Plantago erecta*, and *Vulpia microstachys*. Commonly occurring taxa include *Avena*, *Bromus*, *Cryptantha*, *Geranium*, *Dichelostemma*, *Lolium*, and *Vulpia*. Stands are found on upland slopes, flats, and ridges.

Californian Annual Grassland & Forb Meadow Group

8a1. *Eschscholzia californica*, *Lupinus bicolor*, and/or *L. nanus* dominate or co-dominate with a variety of native and non-native forbs and grasses.

***Eschscholzia* (*californica*) – *Lupinus* (*nanus*) Alliance**
Bromus hordeaceus – Lupinus nanus – Trifolium spp. Association

Eschscholzia californica Association
Lupinus bicolor Provisional Association

8a2. *Plagiobothrys nothofulvus* dominates and intermixes with a variety of native and non-native forbs and grasses.

Plagiobothrys nothofulvus* Alliance
Plagiobothrys nothofulvus – Daucus pusillus – Trifolium microcephalum Provisional Association*

8a3. *Lasthenia californica, Calycadenia* spp., *Hemizonia congesta, Hesperevax sparsiflora, Lomatium, Lotus humistratus, Micropus californicus, Plantago erecta,* and/or *Vulpia microstachys* dominate individually or in combination as characteristic plants in the herbaceous layer*. Lasthenia californica, Plantago erecta,* and/or *Vulpia microstachys* are often present, sometimes with sparse cover.

***Lasthenia californica – Plantago erecta – Vulpia microstachys* Alliance**
Hemizonia congesta – Lolium perenne Association
Lasthenia californica – Plantago erecta – Hesperevax sparsiflora Association
Lotus humistratus – Plantago erecta – Lomatium spp. Provisional Association
Micropus californicus Provisional Association*
Plantago erecta – Lolium perenne lichen-rocky Association
Vulpia microstachys – Plantago erecta – Calycadenia (*truncata*, *multiglandulosa*) Association

8a4. *Amsinckia* spp. and/or *Phacelia* spp. dominate and characterize stands with a variety of native and non-native forbs and grasses.

***Amsinckia (menziesii, tessellata) – Phacelia* spp. Alliance**
Amsinckia spectabilis Provisional Association

8b. *Elymus elymoides*, *E. multisetus, Melica* spp., and/or *Nassella pulchra*, all native perennial grasses, are dominant or characteristic in stands, sometimes with equal or greater cover of non-native herbs.

Californian Perennial Grassland Group

8b1. *Elymus elymoides* or *E. multisetus* dominates or co-dominates in stands on serpentine soils, often on southerly exposures. Stands of *Elymus multisetus* with *Eschscholzia californica* and/or *Plantago erecta* were encountered most often in the sites visited for this project; *Dichelostemma capitatum*, *Eriogonum nudum*, *Lotus humistratus*, and *Minuartia douglasii* were also commonly present.

***Nassella* spp. – *Melica* spp. Alliance**
Elymus multisetus – (*Eschscholzia californica – Plantago erecta*) Association

8b2. *Melica californica, M. torreyana,* and/or *Nassella pulchra* are dominant, co-dominant or characteristic in stands. *Avena*, *Bromus*, *Hemizonia congesta*, *Lolium perenne*, *Plantago erecta, P. lanceolata.* and/or *Trifolium* spp. intermix as dominant, co-dominant or characteristic taxa in associations of this alliance. If *Danthonia californica* or *Festuca idahoensis* is co-dominant or characteristic with *Nassella pulchra,* then key to the *Festuca idahoensis – Danthonia* alliance.

***Nassella* spp. – *Melica* spp. Alliance**
Melica californica Association
Melica torreyana Association
Nassella pulchra Association
Nassella pulchra – Avena spp. *– Bromus* spp. Association
Nassella pulchra – Hemizonia congesta Association
Nassella pulchra – Lolium perenne – (Trifolium spp*.)* Association
Nassella pulchra – Lolium perenne – Plantago erecta Serpentine Association

8c. Herbaceous vegetation strongly dominated (typically >85% relative cover) by non-native grasses and forbs such as *Aegilops, Avena*, *Brachypodium*, *Brassica*, *Briza*, *Bromus*, *Carduus pycnocephalus, Centaurea*, *Cynosurus*, *Danthonia pilosa (Rytidosperma penicillatum)*, *Erodium*, *Lolium, Nassella manicata, Pennisetum,* and *Raphanus*. Native herbaceous species have insignificant cover in these stands, especially during the active growing season. Stands are found in foothills, rangelands, fallow fields, woodland openings, riparian areas, and disturbed settings.

Californian Ruderal Grassland, Meadow & Scrub Group

8c1. *Avena*, *Brachypodium*, *Briza*, *Bromus*, *Erodium* and/or *Hypochaeris* dominate individually or in combination. If *Elymus caput-medusae* is co-dominant with *Avena* and/or *Bromus* spp., those stands can also key here. If *Lolium perenne* is co-dominant key to that alliance.

***Avena* spp. – *Bromus* spp. Semi-Natural Alliance**
Avena barbata – Avena fatua Semi-Natural Association
Brachypodium distachyon Semi-Natural Association
Briza maxima Provisional Semi-Natural Association
Bromus diandrus. Semi-Natural Association
Bromus hordeaceus – Erodium botrys Semi-Natural Association
Hypochaeris glabra – Vulpia bromoides Semi-Natural Association

8c2. *Brassica nigra*, *Raphanus sativus, Carduus pycnocephalus, Carthamus lanatus, Centaurea solstitialis, Silybum marianum,* or another non-native forb dominates in the herbaceous layer, often in old or active agriculture lands, disturbed fields, and upland grazed areas.

***Brassica nigra – Centaurea* (*solstitialis*, *melitensis*) Semi-Natural Alliance**
Brassica nigra Semi-Natural Association
Carduus pycnocephalus – Silybum marianum Provisional Semi-Natural Association
Carthamus lanatus Provisional Semi-Natural Association*
Centaurea solstitialis Semi-Natural Association*
Raphanus sativus Semi-Natural Association

8c3. *Cynosurus echinatus*, *Danthonia pilosa (Rytidosperma penicillatum)*, and/or *Nassella manicata* dominate or co-dominate in the herbaceous layer. *Anagallis*, *Avena*, *Lolium*, *Plantago lanceolata*, *Rumex*, and *Vulpia bromoides* are often present.

***Cynosurus echinatus – Arrhenatherum elatius* Semi-Natural Alliance**
Cynosurus echinatus – (*Danthonia pilosa – Nassella manicata*) Provisional Semi-Natural Association

8c4. *Lolium perenne* dominates or co-dominates with *Avena* spp., *Bromus* spp., *Hordeum marinum*, *H. murinum*, *Medicago*, *Trifolium subterraneum, Elymus caput-medusae,* and other non-natives in the herbaceous layer. Native species are typically less than 10% relative cover. These invaded stands are often found on moist or poorly drained sites, on or off serpentine.

***Lolium perenne* Semi-Natural Alliance**
Lolium perenne Semi-Natural Association
Lolium perenne – Hordeum marinum – Ranunculus californicus Semi-Natural Association
Lolium perenne – Lotus corniculatus Semi-Natural Association

8c5. *Aegilops triuncialis* dominates or co-dominates with *Avena barbata*, *Bromus hordeaceus*, *Lolium perenne,* and other non-natives in herbaceous stands. Often found on dry grasslands with serpentinite parent material.

***Lolium perenne* Semi-Natural Alliance**
Aegilops triuncialis – Hemizonia congesta Provisional Semi-Natural Association*

9. Herbaceous vegetation dominated, co-dominated, or characterized by native or non-native perennial grasses and forbs. Stands are generally found in moister settings than those in the Californian Annual & Perennial Grassland Macrogroup (see step 8) and are often coastal. The grasses include: *Agrostis gigantea*, *A. stolonifera*, *Anthoxanthum*, *Calamagrostis nutkaensis*, *Cortaderia* spp*., Bromus carinatus, Danthonia californica*, *Deschampsia cespitosa*, *Elymus elymoides*, *E. multisetus*, *Festuca arundinacea*, *F. californica, F. idahoensis*, *Holcus lanatus*, *Hordeum brachyantherum, Iris douglasiana,* and/or *Phalaris aquatica*. Forbs include: *Conium maculatum, Dipsacus* spp*., Heterotheca sessiliflora, Pteridium aquilinum* and *Thermopsis californica.* Note: stands dominated by *Lolium perenne* key out in step 8 above.

9a. *Agrostis*, *Anthoxanthum*, *Cortaderia* spp., *Festuca arundinacea*, *Holcus*, and/or *Phalaris* are dominant, co-dominant, or characteristic in herbaceous stands.

Western North American Ruderal Marsh, Wet Meadow & Shrubland Macrogroup

Western North American Ruderal Marsh, Wet Meadow & Shrubland Group

9a1. Non-native, mesic to wet, disturbed pasturelands dominated or co-dominated by the following perennial grasses: *Agrostis gigantea*, *A. stolonifera*, *Festuca arundinacea*, and/or *Phalaris*. If native species are present and co-dominant, key to an alliance dominated or characterized by natives. Found in wet settings, including brackish marshes, meadows, stream terraces, wet pastures, agricultural wetlands, or tidal zones.

9a1a. *Agrostis gigantea*, *A. stolonifera*, and/or *Festuca arundinacea* dominate or co-dominate in the herbaceous layer. The stands encountered for this project were dominated by *F. arundinacea*, though stands dominated by *Agrostis* may be present in Marin County.

***Poa pratensis – Agrostis gigantea – Agrostis stolonifera* Semi-Natural Alliance**
Festuca arundinacea Provisional Semi-Natural Association

9a1c. *Phalaris aquatica* dominates in naturalized or planted stands. Other non-native herbs, such as *Avena barbata* and *Hypochaeris glabra* may be present with low cover.

Phalaris aquatica – Phalaris arundinacea **Semi-Natural Alliance**
Phalaris aquatica Provisional Semi-Natural Association
Phalaris aquatica – Avena barbata Provisional Semi-Natural Association

9a2. Non-native, slightly mesic, disturbed herblands dominated or co-dominated by the following perennial grasses and forbs: *Anthoxanthum*, *Cortaderia, Cynosurus, Nassella manicata,* and/or *Holcus,* and/or the following forbs: *Ageratina adenophora, Conium maculatum, Dipsacus fullonum, Dipsacus sativus, Echium candicans,* or *Foeniculum vulgare*. If native species are present and co-dominant, key to an alliance dominated or characterized by natives. Found in meadows, moist pastures, agricultural areas, coastal terraces, or coastal bluffs.

Western North American Ruderal Grassland & Shrubland Macrogroup

Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group

9a2a. *Holcus lanatus* and/or *Anthoxanthum odoratum* dominate individually or in combination. Other co-dominants may include *Briza maxima*, *Lolium perenne*, *Plantago lanceolata, Rumex acetosella*, and *Vulpia bromoides*.

Holcus lanatus – Anthoxanthum odoratum **Semi-Natural Alliance**
Holcus lanatus Semi-Natural Association
Holcus lanatus – Anthoxanthum odoratum Semi-Natural Association

9a2b. *Conium maculatum, Ageratina adenophora, Dipsacus fullonum, D. sativus,* or *Foeniculum vulgare* dominates herbaceous stands, though various other taxa are likely present.

Conium maculatum – Foeniculum vulgare **Semi-Natural Alliance**
Conium maculatum Semi-Natural Association
Foeniculum vulgare Semi-Natural Association*
Dipsacus (fullonum, sativus) Provisional Semi-Natural Association

9a2c. *Cortaderia jubata* or *Cortaderia selloana* dominates in naturalized stands, sometimes in dense clumps, or other non-native plants such as *Echium candicans* dominant or co-dominant with *Cortaderia jubata*.

Cortaderia (jubata, selloana) **Semi-Natural Alliance**
Cortaderia (jubata, selloana) Provisional Semi-Natural Association
Echium candicans Semi-Natural Association*

9a2d. *Cynosurus echinatus*, *Danthonia pilosa (Rytidosperma penicillatum)*, and/or *Nassella manicata* dominate or co-dominate in the herbaceous layer. *Anagallis*, *Avena*, *Lolium*, *Plantago lanceolata*, *Rumex*, and *Vulpia bromoides* are often present.

Cynosurus echinatus – Arrhenatherum elatius **Semi-Natural Alliance**
Cynosurus echinatus – (*Danthonia pilosa – Nassella manicata*) Provisional Semi-Natural Association

9b. Native, mesic to moist, primarily coastal grasslands dominated, co-dominated, or characterized by *Bromus carinatus*, *B. maritimus, Calamagrostis nutkaensis*,

Deschampsia cespitosa, *Danthonia californica*, *Elymus glaucus, Eryngium armatum, Festuca californica, F. idahoensis, Heterotheca sessiliflora, Hordeum brachyantherum, Iris douglasiana, Pteridium aquilinum* and/or *Thermopsis californica*. Other species such as *Baccharis pilularis*, *Briza maxima*, *Holcus lanatus*, *Nassella pulchra*, and/or *Vulpia bromoides* commonly intermix in stands. Found in a variety of settings, including dunes, bluffs, meadows, valley bottoms, alluvial slopes, terraces, meadows, and seasonally flooded areas with moderate salinity.

9b1. *Deschampsia cespitosa*, *Danthonia californica*, *Iris douglasiana,* and/or *Eryngium armatum* dominate or co-dominate individually or in combination (if *Holcus lanatus* has the highest cover, but these three species have at least 10% combined cover, key to *Deschampsia*). Settings range from coastal dunes and bluffs to inland plains (e.g., Santa Rosa Plain) to foothill meadows.

Vancouverian Lowland Marsh, Wet Meadow & Shrubland Macrogroup

Vancouverian Freshwater Wet Meadow & Marsh Group

***Deschampsia cespitosa – Hordeum brachyantherum – Danthonia californica* Alliance**

Deschampsia cespitosa – Danthonia californica Association
Deschampsia cespitosa – Eryngium armatum Association
Deschampsia cespitosa – Horkelia marinensis Association
Deschampsia cespitosa – Iris douglasiana Association
Deschampsia (cespitosa, holciformis) Association

9b2. *Hordeum brachyantherum* dominates or co-dominates with *Achillea millefolium, Holcus lanatus*, *Hordeum marinum, Lolium perenne*, and/or *Lotus corniculatus* in moist meadows, along stream terraces and coastal bluffs, and near seeps and springs.

Vancouverian Lowland Marsh, Wet Meadow & Shrubland Macrogroup

Vancouverian Freshwater Wet Meadow & Marsh Group

***Deschampsia cespitosa – Hordeum brachyantherum – Danthonia californica* Alliance**

Hordeum brachyantherum Lowland Association

9b3. *Calamagrostis nutkaensis* dominates or co-dominates with *Baccharis pilularis*. Other species such as *Carex obnupta, Heracleum maximum*, *Holcus lanatus*, *Juncus* spp., *Pteridium aquilinum,* and/or *Rubus ursinus* often intermix in stands.

Southern Vancouverian Lowland Grassland & Shrubland Macrogroup

Southern Vancouverian Shrub & Herbaceous Bald, Bluff & Prairie Group

***Calamagrostis nutkaensis* Alliance**

Calamagrostis nutkaensis Association
Calamagrostis nutkaensis – Carex (obnupta) – Juncus (patens) Association
Calamagrostis nutkaensis / *Baccharis pilularis* Association

9b4. *Festuca idahoensis, Festuca rubra, Heterotheca sessiliflora,* and/or *Danthonia californica* dominate or characterize stands. Occasionally, the larger *Festuca californica* may replace *F. idahoensis* in somewhat shadier or less exposed sites. *Bromus carinatus*, *Elymus glaucus*, *Nassella pulchra, Plantago erecta,* and a variety

of native and non-native forbs and grasses may intermix as sub-dominants. *Festuca*, *Danthonia* or *Perideridia kelloggii* and other native species share at least 10% relative cover in the herb layer, with other non-native grasses and forbs sometimes having higher cover (e.g., *Cynosurus echinatus*, *Hypochaeris radicata,* and *Vulpia bromoides*).

***Festuca idahoensis – Danthonia californica* Alliance**
Danthonia californica – Nassella pulchra Association
Danthonia californica Coastal Association
Festuca californica Association
Festuca idahoensis – (Danthonia californica – Koeleria macrantha) Association
Festuca idahoensis – Nassella pulchra Provisional Association
Festuca idahoensis Ultramafic Provisional Association
Festuca rubra Association
Heterotheca sessiliflora – Danthonia californica Provisional Association
Perideridia kelloggii – Danthonia californica Provisional Association

9b5. *Bromus carinatus, Bromus maritimus, Elymus glaucus, Pteridium aquilinum, and/or Thermopsis californica* dominate or co-dominate near meadows, in forested openings, and on elevated flats. *Achillea millefolium, Bromus hordeaceus, Geranium dissectum, Rumex acetosella*, and *Vulpia bromoides* are often present.

***Bromus carinatus – Elymus glaucus* Alliance**
Bromus carinatus Association
Elymus glaucus Association
Pteridium aquilinum – Grass Association
Thermopsis californica – Bromus carinatus – Annual Brome Association

10. Coastal dune, bluff, meadow, cliffs, and other vegetation dominated by herbaceous species such as *Abronia*, *Ambrosia*, *Ammophila*, *Artemisia pycnocephala, Carpobrotus*, *Dudleya, Erigeron glaucus, Eriogonum latifolium, Eriophyllum staechadifolium, Fragaria chiloensis, Leymus mollis*, and *Mesembryanthemum*; or Lichen and/or moss is dominant.

10a. Native species, including *Abronia latifolia*, *Ambrosia chamissonis*, *Artemisia pycnocephala*, *Lathyrus littoralis, Leymus mollis* and/or other herbs, are characteristic to dominant on dunes or bluffs. Plants are adapted to salt spray, wind and shifting sands and are thus capable of colonizing relatively unstable and sterile substrates.

Pacific Coastal Beach & Dune Macrogroup

10a1. *Leymus mollis* dominates or is characteristically present in the herbaceous layer. *Abronia*, *Ambrosia chamissonis, Artemisia pycnocephala*, *Cakile*, and other herbaceous species may be present as sub-dominants.

North Pacific Maritime Dune & Coastal Beach Group

***Leymus mollis* Alliance**
Leymus mollis – Abronia latifolia – (*Cakile* spp.) Association

10a2. *Abronia latifolia, Ambrosia chamissonis, Calystegia soldanella, Lathyrus littoralis,* and/or *Poa douglasii,* are characteristically present to dominant, with *Armeria maritima, Camissonia cheiranthifolia, Cardionema ramosissimum, Lupinus tidestromii,* or *Polygonum paronychia* sometimes to often occurring as

associated species. Non-native species such as *Cakile maritima*, *Carpobrotus* spp., and *Ammophila arenaria* may also be present.

Californian Coastal Beach & Dune Group

***Abronia latifolia – Ambrosia chamissonis* Alliance**
Ambrosia chamissonis Association
Abronia latifolia – Calystegia soldanella – Lathyrus littoralis Association

10a3. *Artemisia pycnocephala, Erigeron glaucus, Eriophyllum staechadifolium, Eriogonum latifolium,* and/or *Fragaria chiloensis* dominate or characterize sea bluffs, stabilized dunes, and exposed coastal terraces. Shrubs such as *Baccharis pilularis*, *Lupinus arboreus*, *L. versicolor*, and *Rubus ursinus* may be present at low cover. Other native forbs and grasses may be present including *Achillea millefolium, Angelica hendersonii, Bromus carinatus, Daucus pusillus* and/or *Dudleya* spp.

Californian Coastal Beach & Dune Group

***Eriophyllum staechadifolium – Erigeron glaucus – Eriogonum latifolium* Alliance**
Artemisia pycnocephala Association
Erigeron glaucus – Fragaria chiloensis Association
Eriophyllum staechadifolium – Eriogonum latifolium Association

10a4. *Ericameria ericoides, Lupinus chamissonis,* and/or other coastal bluff scrub are dominant or subdominant in the shrub layer, while psammophytic annuals such as noted in 10a.1 above are also often present.

***Lupinus chamissonis – Ericameria ericoides* Alliance**
Lupinus chamissonis – Ericameria ericoides Association

10b. Native *Dudleya farinosa* or other *Dudleya* spp. characteristic, dominant or co-dominant with herbs such as *Eriogonum latifolium, Vulpia bromoides*, and others; OR Lichen is characteristic and often dominant.

Western North American Cliff, Scree & Rock Vegetation Macrogroup

Californian Cliff, Scree & Rock Vegetation Group

***Dudleya cymosa – Dudleya lanceolata* / Lichen – Moss Alliance**
Dudleya farinosa / Lichen – Moss Provisional Association

10c. Non-natives, including *Ammophila*, *Cakile, Carpobrotus*, and/or *Mesembryanthemum* strongly dominate typically at >80% relative cover on dunes, bluffs, or disturbed lands. Emergent shrubs such as *Baccharis pilularis* or *Lupinus arboreus* may be present.

North Pacific Coastal Ruderal Grassland & Shrubland Macrogroup

North Pacific Maritime Coastal Ruderal Dune Group

10c1. *Ammophila arenaria* is strongly dominant in the herbaceous layer.

***Ammophila arenaria* Semi-Natural Alliance**
Ammophila arenaria Semi-Natural Association
Baccharis pilularis / *Ammophila arenaria* Association

10c2. *Carpobrotus* and/or *Mesembryanthemum* dominate on bluffs, dunes, or disturbed lands, often forming impenetrable mats that limit natives from establishing.

***Mesembryanthemum* spp. – *Carpobrotus* spp. Semi-Natural Alliance**
Carpobrotus (*edulis*) Semi-Natural Association

10c3. *Cakile edentula* and/or *C*. *maritima* are strongly dominant along active beaches at the debris line.

***Cakile (edentula, maritima)* Provisional Semi-Natural Alliance**
Cakile (edentula, maritima) Provisional Semi-Natural Association

Appendix D

Vegetation Descriptions

See separate electronic file for the local Alliance and Association descriptions for Marin County.