

VEGETATION MAP AND CLASSIFICATION OF KNOXVILLE WILDLIFE AREA, NAPA COUNTY, CALIFORNIA



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ABSTRACT

The California Department of Fish and Wildlife (CDFW) Vegetation Classification and Mapping Program (VegCAMP) created a fine-scale vegetation classification and map of the southern addition to the CDFW Knoxville Wildlife Area , Napa County, California following State Vegetation Survey, Federal Geographic Data Committee (FGDC), and National Vegetation Classification (NVC) standards (Grossman et al 1998).

The vegetation classification was derived from data collected in the field during the periods November 18–20, 2013 and April 28–May 1, 2014. Vegetation polygons were drawn using heads-up “manual” digitizing using the 2011 Napa County 30-cm resolution color infrared (CIR) imagery as the base imagery. Supplemental imagery included National Agricultural Imagery Program (NAIP) true color and CIR 1-meter resolution data from 2009–2012, BING imagery, and current and historical imagery from Google Earth. The minimum mapping unit (MMU) is 1 acre, with the exception of wetland types, which have an MMU of $\frac{1}{2}$ acre. Ponds, riparian types, and the one vernal pool on the WA that were visible on the imagery were mapped regardless of size, and streams were generally mapped if > 10 meters wide (narrower portions may have been mapped to maintain the continuity of the streams). Mapping is to the NVC hierarchy association, alliance, or group level based on the ability of the photointerpreters to distinguish types based on all imagery available and on the field data.

Both the existing (northern) and new addition (southern) portions of the Knoxville WA were mapped in 2002 as part of the Napa County vegetation map (<https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=14660>). The 2014 map update was undertaken for two reasons: the 2002 map is at a coarse thematic resolution (alliance through macrogroup level), and vegetation in portions of the Wildlife Area has changed since the 2004 Rumsey Fire. We have produced an updated version of the 2002 map layer that uses the same spatial data, but adds a crosswalk to the current classification and the upper levels of the current hierarchy. This map layer is included in the download of the dataset from BIOS. The metadata report for the crosswalk can be found at

<https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=164825>.

PROJECT STAFF AND ACKNOWLEDGMENTS

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GIS and database support was provided by Rosie Yacoub and Aicha Ougzin; data entry was completed by Mary Jo Colletti. Classification was performed by Anne Klein and Todd Keeler-Wolf; mapping and attribution were completed by Rachelle Boul and Diana Hickson; the report was written by Rachelle Boul, Diana Hickson, and Anne Klein, and was edited by Mary Jo Colletti, Catherine Curley, and Rosie Yacoub

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PURPOSE

The purpose of the classification and vegetation map is to aid in the development of a management plan for CDFW's Knoxville Wildlife Area. The vegetation classification and mapping provide an inventory of habitat types, and a measure of the extent of each type on the property, for use in assessing the biological resources present and determining appropriate management strategies.

METHODS

FIELD SAMPLING METHODS

Relevé samples were collected from 22 vegetation stands and Rapid Assessment (RA) samples were collected from 46 vegetation stands from November 18–20, 2013 and April 28–May 1, 2014 following the Combined Relevé and Rapid Assessment Protocol (Appendix A) and using the form in Appendix B. Relevés were used for herbaceous vegetation and include the absolute cover of all species within a 100 square meter plot. Rapid Assessments were used for vegetation types characterized by tree or shrub cover of at least 10%; they include the absolute cover of 10–20 of the most common or characteristic species in the stand. Whereas the Relevé samples a discrete plot in a vegetation stand, the Rapid Assessment considers the entire stand, i.e. a “plotless” sample. Reconnaissance samples were collected for 122 stands of vegetation. A subset of the Relevé and Rapid Assessment data is collected during a Reconnaissance, as shown in the form in Appendix C.

Appendix D is a list of all plant species recorded during field data collection.

Sample point locations were collected with GPS-enabled data recording devices and are stored in a geodatabase maintained by VegCAMP. Relevé and Rapid Assessment data were entered into VegCAMP's MS Access database, which is available from VegCAMP. The Rapid Assessment and Relevé data include the date of sampling, GPS location, environmental characteristics (microtopography, substrate, soil texture, slope, aspect, ground surface characteristics, disturbance type and intensity), vegetation structure (tree, shrub, and herb covers and heights, total vegetation cover), cover by species, site history, and the Alliance and Association. Additionally, four digital photos were taken in the cardinal directions from each Relevé or Rapid Assessment location and are available from VegCAMP. These data and field photos can serve as a baseline for monitoring future vegetation change. The Reconnaissance

data provide observational notes on stand composition and environmental attributes at specific GPS locations in the landscape, and are sometimes associated with photos. The primary use of Reconnaissance data is to aid in mapping.

VEGETATION CLASSIFICATION METHODS

The classification is based largely on existing vegetation types described in the Manual of California Vegetation (Sawyer et al. 2009), but includes new provisional types which are supported by Buck-Diaz et al. 2012, Evens and Kentner 2006, and this project. The Relevé and RA data collected in 2013 and 2014 (68 surveys total) were used to create the vegetation and map classification for the Knoxville Wildlife Area. These data were analyzed using multivariate cluster analysis, performed by PC-ORD version 6 software. The cluster analysis was based on abundance (cover values) converted to seven different classes using the following modified Braun-Blanquette (1932) cover categories: 1 = <1%, 2 = 1–5%, 3 = >5–15%, 4 = >15–25%, 5 = >25–50%, 6 = >50–75%, 7 = >75%. For the analysis, VegCAMP used the Sorenson distance measure and flexible beta linkage method at -0.25 (McCune and Grace 2002). Floristic data collected in 103 reconnaissance samples were used to refine and validate the final classification for the map.

Naming conventions for vegetation types follow the National Vegetation Classification System (Grossman et al. 1998) and the Manual of California Vegetation, 2nd Edition (Sawyer et al. 2009). An association is defined by a group of samples that has similar dominant and characteristic species in the overstory, along with other important or indicator species, which are distinctive in a particular environmental setting. A set of similar associations is grouped hierarchically to the next higher level in the classification, the alliance. Alliances can be placed into groups, and then macrogroups, the next two levels up. For this map, vegetation was mapped to the association level if possible, but some polygons were mapped only to alliance.

Appendix E shows the Hierarchical Field and Mapping Key used to classify the vegetation types for this project.

DELINEATION RULES AND MAP ATTRIBUTES

The vegetation map was delineated according to the following rules:

Minimum Mapping Unit (MMU) and minimum width:

- 1 acre for typical vegetation types
- $\frac{1}{2}$ acre for special vegetation types (e.g., localized types)
- No MMU for cattle ponds
- 10 meter width for linear features

Polygon cover class breaks:

- 3 acre MMU for cover class break in the overstory vegetation cover (i.e., when the adjacent vegetation is of the same mapping unit, but the cover class is different)
- 5 acre MMU for cover class break in the understory vegetation cover

Delineation:

- All polygons were drawn at a scale of 1:800 to 1:3500

Imagery:

- Base: Napa County 2011 30 cm True Color and Color Infrared (CIR)
- Supplemental: National Agricultural Imagery Program (NAIP) 2012 (Summer) True color, CIR and NDVI
- Ancillary: Other NAIP years, ESRI Basemap Imagery, Google Earth, Bing

Each mapped polygon has the following attributes:

MapClassCode

The code assigned to the vegetation type of the polygon

MapClass

The vegetation type of the polygon. Note that the lowest level of the hierarchy that could reasonably be photointerpreted was used; in many cases, this was the association.

Heterogeneity

The measure of uniformity of the vegetation type, cover class, and size class within the polygon. A low heterogeneity is desirable.

- | | |
|----------|---------------------|
| Low | <5% heterogeneous |
| Moderate | 5–40% heterogeneous |
| High | >40% heterogeneous |

ConifCover

The cover of conifer trees in the polygon, using the cover density values below

HwdCover

The cover of hardwood trees in the polygon, using the cover density values below

TreeCover

The cover of all trees (conifer and hardwood) in the polygon, using the cover density values below

ShrubCover

The cover of all shrubs in the polygon, using the cover density values below

Cover density (total bird's-eye cover) is photointerpreted separately for conifer, hardwood, total tree and shrub layers of vegetation, and placed into the following cover classes:

- none visible
- trace-0.9%
- 1-9.9%
- 10-19.9%
- 20-29.9%
- 30-39.9%
- 40-49.9%
- 50-59.9%
- 60-69.9%
- 70-79.9%
- 80-89.9%
- 90-100%

<null> is used for water features (ponds and streams)

HerbCover

Herbaceous cover. In the absence of field data, herbaceous vegetation cannot be definitively determined, and is modeled by the photointerpreters based on signature, topography, and adjacent field data. The herbaceous values are for absolute cover, not bird's-eye cover. This means if you have 38% shrub and tree cover you do not need to mentally subtract that before estimating herb cover.

- 0%
- <2%
- 2-9%
- 10-39%
- 40-59%
- 60-100%
- can't determine

NonNative_Plants

The presence of non-native plants was determined from field observation and modeling based on ecological setting, since few of the non-natives are interpretable from the imagery. Herbaceous stands with a signature indicating a lot of thatch were called *Centaurea solstitialis* (yellow star-thistle), but may in fact be dominated by *Elymus (=Taeniatherum) caput-medusae* (medusahead).

- | | |
|-------------|------------------------------------------------------------|
| Not Visible | no visible non-native plants |
| Low | total non-native cover is <33% of total vegetation cover |
| Medium | total non-native cover is 33-66% of total vegetation cover |

High total non-native cover is >66% of total vegetation cover

Roads_Trails

- | | |
|-------------|--------------------------------------------------------------------------------------------------|
| Not Visible | there are no visible roads or trails in the polygon, i.e. the polygon is “whole” |
| Low | roads or trails bisect the polygon, so that from 2/3 to just below the entire polygon is “whole” |
| Medium | roads or trails bisect the polygon, so that 1/3–2/3 of the polygon is “whole” |
| High | roads or trails bisecting the polygon, so that <1/3 of the polygon is “whole” |

OtherImpact:

Impacts observable in the imagery as follows:

- OHV activity
- Disking/grading
- Development
- Erosion/runoff
- Ungulate Trails
- none

Level_OtherImpact

Subjective determination of the level of any impact recorded in the previous field

- Not Visible
- Low
- Medium
- High

Method of identification:

Method of determining the vegetation type

- Rapid assessment field data
- Relevé field data
- Field reconnaissance
- Photointerpretation
- Other information
- Pre-map reconnaissance
- Adjacent alliance to Rapid Assessment or Relevé

DB_ID

The database ID of the Rapid Assessment, Relevé, or Reconnaissance used to determine the vegetation type (if one were used)

Confidence

The level of confidence of the photointerpreter in correctly identifying the vegetation type and attribute values of the polygon

- Low
- Medium

High

Comments

Text field for additional information

UID

Unique identifier for each polygon

DBH

The diameter at breast height (DBH) of the trees within the polygon, using California Wildlife Habitat Relationships classes as follows:

- <1"
- 1–6"
- 6–11"
- 11–24"
- >24"

Multi-layered

Note that CWHR follows the forestry practice of the use of quadratic mean diameter, which assigns greater weight to larger trees.

FireEvidence

Yes	dead snags or other evidence of a recent fire are apparent on the imagery, or field data indicate evidence of fire.
No	no evidence is evident, but likely would be evident if the polygon had burned.
Unknown	the vegetation type would not show any photointerpretable indication of recent fire; i.e., herbaceous stands or stands of shrubs that don't leave dead standing stems and that resprout very quickly.

NVCS_name

Standardized name of the vegetation description used in the National Vegetation Classification System

NVCS_level

The level of the National Vegetation Classification System Hierarchy to which the vegetation type corresponds

NVCS_Macrogroup

The standardized name for the macrogroup within the National Vegetation Classification System

CalVeg_Name

A crosswalk to the Classification and Assessment with Landsat of Visible Ecological Groupings (CalVeg) vegetation system (USDA Forest Service). Note that there may be a one-to-many relationship between CalVeg and NVCS.

CalVeg_Code

The CalVeg code

CWHR_Type

A crosswalk to the California Wildlife Habitat Relationships system. Note that there is usually a one-to-many relationship between CWHR and NVCS.

CWHR_Code

The CWHR code.

Global_Rank

The global rarity rank of the plant community (only for polygons mapped to the Alliance level)

- G1 fewer than 6 viable occurrences and/or 2000 acres worldwide
- G2 6–20 viable occurrences and/or 2000–10,000 acres worldwide
- G3 21–100 viable occurrences and/or 10,000–50,000 acres worldwide
- G4 greater than 100 viable occurrences and/or greater than 50,000 acres worldwide
- G5 community demonstrably secure due to secure worldwide abundance

State_Rank

The state rarity rank of the plant community (only for polygons mapped to the Alliance level). The state rank will always be less than (more rare) or equal to the global rank.

- S1 fewer than 6 viable occurrences and/or 2000 acres statewide
- S2 6–20 viable occurrences and/or 2000–10,000 acres statewide
- S3 21–100 viable occurrences and/or 10,000–50,000 acres statewide
- S4 greater than 100 viable occurrences and/or greater than 50,000 acres statewide
- S5 community demonstrably secure due to secure statewide abundance

Rare

Rarity of the vegetation type

- Y alliances and associations with state rank S1–S3
- N not rare

CaCode

California Natural Community Code - unique code assigned to Alliances and Associations

FIELD VERIFICATION

Field verification has not yet been completed for this map, as of January 2019. Although some areas have burned since mapping was completed in 2014, the majority of the WA lands have not burned, preserving our objective to complete accuracy assessment for this map as time and funding allow.

NEW ALLIANCES AND ASSOCIATIONS

Since generating the map in 2014, some alliances and associations have changed, often expanded, and the current NVCS type does not exactly match the map class originally used. In each case below, the NVCS type is followed by the corresponding 2014 map class in parenthesis:

- “Allium spp. - Streptanthus spp. - Hesperolinon spp. Serpentinite Provisional Alliance” (“Allium falcifolium-Eriogonum spp.-Streptanthus spp. Provisional Semi-natural Stands”)
- “Ceanothus (oliganthus, tomentosus) Alliance” (“Ceanothus oliganthus Alliance”)
- “Leymus cinereus - Leymus triticoides Alliance” (“Leymus triticoides Alliance”)
- “Thermopsis californica - Bromus carinatus - Annual Brome Association” (“Thermopsis californica Provisional Association”)
- “Corethrodyne filaginifolia - Eriogonum (elongatum, nudum) Alliance” (“Eriogonum (elongatum, nudum) Provisional Alliance”)
- “Eschscholzia (californica) - Lupinus (nanus) Alliance” (“Eschscholzia (californica) Alliance”)
- “Nassella spp. - Melica spp.” (“Melica (californica, torreyana) Provisional Alliance”)
- “Nassella spp. - Melica spp.” (Nassella pulchra Alliance)

Additionally, the following name change of species occurred since 2014, resulting in a corresponding change in alliance name. The current NVCS name is followed in parenthesis by the map class utilized in the 2014 map:

- "Hesperocyparis sargentii Alliance" ("Callitropsis sargentii Alliance")

RARITY RANKINGS

The NVCS type “Nassella spp. - Melica spp. Alliance” has been assigned to two map classes utilized in 2014: “Melica (californica, torreyana) Provisional Alliance” and “Nassella pulchra Alliance”. The new expanded alliance is not rare, with global and state ranks of G4 and S4, respectively, yet all currently-known associations within this alliance are considered rare at this time (including those that would be closely analogous to the above original map classes). As such, please note that, while broadly taken together this type is not rare, each occurrence of this type delineated in the map would in fact be rare when individually assessed at a finer scale of classification.

Several associations within this map are assumed to be rare at this time, however their exact global and state rarity rankings are yet to be determined and vetted. Please consider these types to have state ranks of S3 or lower, as per our current understanding of their distribution and/or threat impacts:

- "Adenostoma fasciculatum - Heteromeles arbutifolia / Melica torreyana"
- "Ceanothus oliganthus - Adenostoma fasciculatum"
- "Quercus berberidifolia - Ceanothus oliganthus"
- "Quercus durata - Adenostoma fasciculatum"
- "Quercus lobata - Quercus wislizenii"
- "Umbellularia californica - Quercus wislizenii"

Rarity ranks are subject to change due to changing threats and trends and as ranking methodologies are further refined. At this time, ranks are updated using the NatureServe Conservation Status Assessments Rank Calculator Version 3.186 and the ranks for this map are current as of January 22, 2019. Please check CDFW's Natural Communities page for the most up-to-date rarity ranks (<https://www.wildlife.ca.gov/Data/VegCAMP/Natural-Communities>).

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Appendix A

CNPS and CDFW Combined Vegetation Rapid Assessment and Relevé Protocol

CDFW-CNPS Protocol for the Combined Vegetation Rapid Assessment and Relevé Field Form

(March 27, 2018)

Introduction

This protocol describes the methodology for both the Relevé and Rapid Assessment (RA) vegetation sampling techniques as recorded in the Combined Vegetation Rapid Assessment and Relevé Field Form. The same environmental data are collected for both techniques. However, the relevé sample is a plot demarcated with a measuring tape, and each species in the plot is recorded along with its cover. The rapid assessment sample is not based on a taped plot, but is based on a visually estimated, usually circular area within a representative portion of the entire stand, with up to 20 of the dominant or characteristic species and their cover values recorded.

In general, collect rapid assessments in woody vegetation and relevés in herbaceous vegetation. When working in an area that has not been sampled before, RAs in woody vegetation may list more than 20 species.

Defining a Stand

A stand is the basic physical unit of vegetation in a landscape. It has no set size. Some vegetation stands are very small, such as a portion of a vernal pool, and some may be several square kilometers in size, such as a forest type. All samples should be in stands that meet the minimum mapping unit of 1 acre for upland and 0.5 acre for special stands such as small wetlands, riparian and serpentine barrens.

A stand is defined by two main unifying characteristics:

- 1) It has compositional integrity. Throughout the site, the combination of species is similar. The stand is differentiated from adjacent stands by a discernable boundary that may be abrupt or indistinct.
- 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, sparse woodland occupying a slope with very shallow rocky soils would be considered a different stand from an adjacent slope with deeper, moister soil and a denser woodland or forest of the same species.

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

Selecting a bounded plot (Relevé) or representative area (Rapid Assessment) to sample within a stand

Stands to be sampled may be selected by evaluation prior to a site visit (e.g., from aerial photos) or they may be selected on site during reconnaissance to determine extent and boundaries, location of other similar stands, etc.

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

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

Selecting a relevé plot or RA area requires that you see enough of the stand you are sampling to feel comfortable in choosing a representative plot location. Take a brief walk through the stand and look for variations in species composition and in stand structure. In hilly or mountainous terrain, look for a vantage point from which you can get a representative view of the whole stand.

Variations in vegetation that are repeated throughout the stand should be included in your plot. Once you assess the variation within the stand, attempt to find an area that captures the stand's common species composition and structural condition to sample.

Tracking sampled vegetation types

For large projects, the number of samples should be tracked daily or weekly by field-assessed Alliance type so that samples are spread as evenly as possible over types and time is not wasted collecting excessive numbers of samples of certain types. When multiple teams are in the field in the same week, daily communication between teams about Alliances sampled can ensure even sampling. *Prior to selecting a stand to sample, determine if what you are going to sample is needed based on this Alliance tracking.*

Selecting plots to avoid spatial autocorrelation

When possible, do not sample adjacent stands. Do not take more than one sample of the same vegetation type within a sub-watershed. Exceptions can be made due to limited access to private lands. For example, samples from different formations, subclasses or classes (e.g., wetlands vs. uplands, lithomorphic vs. mesomorphic) may be sampled in the same sub-watershed, however, avoid sampling a grassland adjacent to an open woodland, even though they are technically different formations.

Plot Size

All relevés of the same type of vegetation need to be the same size if they are to be analyzed together. Plot shape and size are somewhat dependent on the type of vegetation under study. Therefore, general guidelines for plot sizes of tree, shrub, and herbaceous communities have been established. Sufficient work has been done in temperate vegetation to be confident the following conventions will capture species richness:

Herbaceous communities: 100 m² plot

Special herbaceous communities, such as vernal pools, fens: 10 m² plot

Shrublands and riparian forest/woodlands: 400 m² plot

Open desert and other shrublands with widely dispersed but regularly occurring woody species: 1000 m² plot

Upland Forest and woodland communities: 1000 m² plot

Plot Shape

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

Location of GPS Points

For Relevés, one corner will be considered the plot Identifier (ID point) and should be in the SW corner, if possible. If it is taken in another corner, this should be noted in the Site History section.

Definitions of fields in the Field Form

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Relevé or RA: Circle the appropriate survey type.

Database #: This is the unique ID number for Relevés and Rapid Assessments, in the form of *PPPPxxxx*, where *PPPP* is the 4-character project code and *xxxx* is a unique 4-digit number (e.g. CARR0001 for Carrizo sample #1). If this is a long-term plot, a character from A to Z can be added to the unique ID for each re-sampling survey; so the first re-sample for CARR0001 would be CARR0001A.

Base Points: For a projected RA (GPS within stand = No), a Base Point will be taken where the surveyors are standing and a separate point will be projected into the stand. The ID of the basepoint is *B_PPxxxx*, i.e. B_CARR0001.

Photo Points: Occasionally, stand photos will be taken from a vantage point outside the stand, or in a place other than the survey point. The ID for this point is *PPPPxxxx_P#*, i.e. the first Photo Point for CARR0001 will be CARR0001_P1.

Date: Date of the sampling.

UID: The ID number of a reference point that this survey describes.

Name of recorder: The full name of the recorder should be provided for the first field form for the day. On successive forms, initials can be recorded.

Other Surveyors: The full names of each person assisting should be provided for the first field form for the day. On successive forms, initials of each person assisting can be recorded.

Location Name: The name of the property or park, or the location within large holdings (like USFS or BLM properties).

GPS name: The name/number assigned to each GPS unit. This can be the serial number if another number is not assigned.

Bearing°, left axis at ID point of Long / Short side: Fill this in for Relevés only. For square or rectangular plots: from the ID Point, looking towards the plot, record the bearing of the axis to your left. If the plot is a rectangle, indicate whether the left side of the plot is the long or short side of the rectangle by circling "long" or "short" side (no need to circle anything for square plots). If there are no stand constraints, set up the plot with boundaries running in the cardinal directions and place the ID Point in the SW corner.

UTM coordinates: Easting (**UTME**) and northing (**UTMN**) location coordinates using the Universal Transverse Mercator (UTM) grid. Record the information from your GPS unit. These coordinates are always the base point of the survey. Soil samples and photos are taken from this point, and exposure, steepness, topography, etc. are measured here. If the GPS is not within the stand (i.e., the point is projected), these are the UTM coordinates of the base point.

For Relevé plots, take the waypoint in the southwest corner of the plot whenever possible or in the center of a circular plot.

Zone: Universal Transverse Mercator zone. Zone 10 is for California west of the 120th longitude; zone 11 is for California east of 120th longitude (the straight portion of California's eastern boundary).

NAD83: This is the default GPS datum. If you use a different one, cross this out and write in the correct datum.

GPS error: ft./ m./ PDOP: Circle the appropriate unit of measure and record the error reading from the GPS unit.

Decimal degrees: *Use this only if your GPS unit will not record UTM coordinates.* Latitude–Longitude reading in decimal degrees. Record the information from your GPS unit. These coordinates are always the base point of the survey. Soil samples and photos are taken from this point, and exposure, steepness, topography, etc. are measured here.

For Relevé plots, take the waypoint in the southwest corner of the plot whenever possible or in the center of a circular plot.

GPS within stand? Yes / No: Circle “Yes” to denote that the GPS waypoint was taken directly within or at the edge of the stand being assessed for a Rapid Assessment, or circle “No” if the waypoint was taken at a distance from the stand (such as with a binocular view of the stand). If the point is taken at the edge of the stand, note the direction to the stand.

If No, cite from GPS to stand: distance (m), bearing°, inclination°: From the base GPS point, measure the distance to the projected point using a range finder. Record the compass bearing from the base point to the projected point; record the inclination if the base and projected points are not at the same elevation.

and record Base point ID: This is the waypoint # of the base GPS point, where the surveyors were standing to record the distance survey.

and Projected UTMs: These are the coordinates of the projected point, the point being surveyed. They are generated in the field if the GPS units have the ability to calculate projected points. If the GPS unit does not have this capability, make a note to that effect and leave these fields blank.

Camera Name: Write the camera name.

Cardinal photos at ID point: Take four photos in the main cardinal directions (N, E, S, W) clockwise from the north, from the ID Point, and record the jpeg numbers here. Try to include the horizon in at least some of these photos. If this is a distance survey to a projected point, take the four cardinal photos at the base point and at least one photo of the stand. A digital camera with a minimum 10 megapixel resolution must be used.

Other photos: This may include cardinal photos at additional corners or other relevant photos. Notes regarding photo locations or subjects can go here.

Stand Size: Estimate the size of the entire stand in which the sample is taken. As a measure, one acre is about 4,000 square meters (approximately 64 x 64 m), or 208 feet by 208 feet. One acre is similar in size to a football field.

Plot Area (m²): If this is a Relevé, circle “100” for a 100m² plot, or record the plot size.

Plot Dimensions: Record the length and width of the Relevé plot in meters.

RA Radius: Enter the radius in meters of the visually estimated sample area for Rapid Assessments (should be a 20-meter radius at minimum). For a large stand, this limits the area covered by the RA. If you can see and assess the entire stand, the length and width should be recorded. If it is a long, narrow stand, note the width of the stand at your location. If your point is on the edge of the stand, record the radius into the stand, but note your location and the direction to which the RA Radius applies in the Site History section.

Exposure: (Enter Actual ° and circle general category): While facing in the general downhill direction, read degrees of the compass for the aspect or the direction you are standing, using degrees from north, adjusted for declination. Average the reading over the entire stand, even if you are sampling a Relevé plot, since your plot is representative of the stand. If estimating the exposure, write “N/A” for the actual degrees, and circle the general category chosen. “Variable” may be selected if the same, homogenous stand of vegetation occurs across a varied range of slope exposures.

Steepness: (Enter Actual ° and circle general category): Read degree slope from your compass. If estimating, write “N/A” for the actual degrees, and circle the general category chosen. Make sure to average the reading across the entire stand even if you are sampling in a Relevé plot.

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

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

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

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

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

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

H₂O:	Percent surface cover of running or standing water, ignoring the substrate below the water.
BA Stems:	Percent surface cover of the basal area of stems at the ground surface. For most vegetation types, BA is 1-3% cover.
Litter:	Percent surface cover of litter, duff, or wood on the ground.
Bedrock:	Percent surface cover of bedrock, including outcrops.
Boulder:	Percent surface cover of rocks >60 cm in the longest dimension.
Stone:	Percent surface cover of rocks >25–60 cm in the longest dimension.
Cobble:	Percent surface cover of rocks >7.5–25 cm in the longest dimension.
Gravel:	Percent surface cover of rocks 2 mm–7.5 cm in the longest dimension.
Fines:	Percent surface cover of bare ground and fine sediment <2 mm in the longest dimension (e.g., dirt, sand).

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

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

% Hoof punch: Note the percent of the plot surface that has been punched down by hooves (cattle or native grazers) in wet soil. Depressions must be >2 cm deep.

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

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

Disturbance code / Intensity (L,M,H): List codes for potential or existing impacts on the stability of the plant community. See code list for impacts and definitions of levels of disturbance.

Characterize each impact each as **L** (=Light), **M** (=Moderate), or **H** (=Heavy). Disturbance is evaluated on a stand basis.

II. HABITAT AND VEGETATION DESCRIPTION

California Wildlife Habitat Relationships (CWHR)

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

Tree DBH: Circle one of the tree size classes provided when the tree canopy closure exceeds 10% of the total cover, or if young tree density indicates imminent tree dominance. Size class is based on the average diameter at breast height (dbh) of each trunk (standard breast height is 4.5ft or 137cm). When marking the main size class, make sure to estimate the mean diameter of all trees over the entire stand, and weight the mean toward the larger tree dbh's. The "**T6 multi-layered**" dbh size class signifies a multi-layered tree canopy (with a size class T3 and/or T4 layer growing under a T5 layer and a distinct height separation between the classes) exceeding 60% total cover. Stands in the T6 class need also to contain at least 10% cover of size class 5 (>24" dbh) trees growing over a distinct layer with at least 10% combined cover of trees in size classes 3 (>6-11" dbh) or 4 (>11-24" dbh).

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

Herbaceous: Circle one of the herb height classes when herbaceous cover exceeds 2% by recording the predominant class in the survey. Note: *This height class is based on the average plant height at maturity, not necessarily at the time of observation.*

Desert Palm/Joshua Tree: Circle one of the palm or Joshua tree size classes by averaging all the stem-base diameters (i.e., mean diameter of all stem-base sizes). Diameter is measured at the plant's base above the bulge near the ground.

Desert Riparian Tree/Shrub: Circle one of the size classes by measuring mean stem height (whether tree and/or shrub stand).

III. INTERPRETATION OF STAND

Field-assessed vegetation Alliance name: Enter the name of the Alliance following the Manual of California Vegetation, 2nd Edition (Sawyer, Keeler-Wolf and Evens 2009). Please use scientific nomenclature, e.g., *Quercus agrifolia* forest. An Alliance is based on the dominant or diagnostic species of the stand, and usually reflects the uppermost and/or dominant height stratum. A dominant species covers the greatest area. A diagnostic species is consistently found in some vegetation types but not others.

The field-assessed Alliance name may not exist in the present classification, in which case you can provide a new Alliance name in this field. If this is the case, also make sure to state that it is not in the MCV under "Explain" below.

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

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

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

Confidence in Alliance identification: (L, M, H) With respect to the “Field-assessed Alliance name,” note whether you have L (=Low), M (=Moderate), or H (=High) confidence in the interpretation of this Alliance name.

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

Phenology: Indicate early (E), peak (P), or late (L) phenology for each of the strata. For herbs, this generally indicates if species are in flower and/or fruit and are therefore identifiable. For shrubs and trees, this attribute generally refers to cover, e.g., a tree that is fully leafed out will be considered peak (P) even if it is not in flower. Phenology is useful for cover estimation and species identification issues, and should be elaborated upon in the next field.

Other identification or mapping information: Discuss any further problems with the identification of the assessment or issues that may be of interest to mappers. Note if this sample represents a type that is likely too small to map.

IV. VEGETATION DESCRIPTION

Database #: Copy the database # from Page 1.

Overall Cover of Vegetation

Provide an estimate of cover for the life-form categories below. Record a specific number for the total aerial cover or “bird’s-eye view” looking from above for each category, estimating cover for the living plants only. Litter/duff should not be included in these estimates.

The *porosity* of the vegetation should be taken into consideration when estimating percent foliar cover for all categories below: consider how much of the sky you can see when you are standing under the canopy of a tree, or how much light passes through the canopy of the shrub layer to help you estimate foliar cover.

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

Total % Vasc Veg cover: The total cover of all vascular vegetation taking into consideration the porosity, or the holes, in the vegetation, and disregarding overlap¹ of the various tree, shrub, and/or herbaceous layers and species.

% Cover by Layer

Conifer Tree /Hardwood Tree: The total foliar cover (considering porosity) of all live tree species, disregarding overlap¹ of individual trees. Estimate conifer and hardwood covers separately. **Please note:** These cover values should not include the coverage of regenerating tree species (i.e., tree seedlings and saplings).

Regenerating Tree: The total foliar cover of seedlings and saplings, disregarding overlap¹ of individual recruits. See seedling and sapling definitions below.

Shrub: The total foliar cover (considering porosity) of all live shrub species disregarding overlap¹ of individual shrubs.

Herbaceous: The total cover (considering porosity) of all herbaceous species, disregarding overlap¹ of individual herbs.

¹ Porosity reduces the total cover of the canopy. Overlapping strata should not be included in the total cover percent; for instance, if a shrub is growing under a tree, only the cover of the tree will be added into the total; the cover of the shrub will be disregarded, except for the amount by which it fills in the porosity of the tree canopy.

Height Class by Layer

Modal height for conifer tree / hardwood tree, regenerating tree, shrub, and herbaceous categories. Record an average height value for each category by estimating the mean height for each group. Please use the following height intervals to record a height class: 1 = <1/2 m, 2 = 1/2-1 m, 3 = 1-2 m, 4 = 2-5 m, 5 = 5-10 m, 6 = 10-15 m, 7 = 15-20 m, 8 = 20-35 m, 9 = 35-50 m, 10 => 50 m.

Note: For the herbaceous layer height, this height class is based on the average plant height at the time of observation, as opposed to how this is recorded in the CWHR section (at maturity).

Species List and Coverage

For Rapid Assessments: List up to 20 species that are dominant or that are characteristically consistent within the assessment area. These species may or may not be abundant, but they should be constant representatives in the survey. When different layers of vegetation occur, make sure to list species from each stratum. As a general guide, make sure to list at least 1-2 of the most abundant species per stratum. There is a heavy line on the form under the 20th line to limit the RA section of the species list.

Note: If constant, diagnostic, or interesting species occur outside the assessment area but in the stand, list the species and estimated stand cover in the Site History section.

For Relevés: list all species present in the plot, using a second species list page if necessary.

** If using a second species list page, note "Continued" on the bottom of the first page and be sure to note the Database # on the second page.

For both sample types, provide the stratum:

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

A = SApling. 1" - <6" dbh and young in age, OR small trees that are <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 >6" dbh, then the re-sprouts would be recorded under the "Tree" stratum.

E = SEedling. A tree species clearly of a very young age that is <1" dbh or has not reached breast height. Applies only to trees propagating from seed; resprouts are not recorded here even if they meet the size requirements.

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

H = Herb. An annual or perennial that dies down to ground level every year.

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

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

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

In some cases, the stratum of a particular species might not be obvious. Some examples are *Juniperus californica*, which has the size and growth habit of a shrub, but it is considered a tree, and mistletoe, which is considered a shrub. It is useful to have a list of species with ambiguous strata for each project. Consult the MCV or contact VegCAMP if you are unsure.

C. If a species collection is made, it should be indicated in the collection column with a "C" (for collected). If the species is later keyed out, cross out the species name or description and write the keyed species name in pen on the data sheet. Do not erase what was written in the field, because

this information can be used if specimens get mixed up later. If the specimen is then thrown out, add a "T" to the "C" in the collection column (CT = thrown out after confirmation) or cross out the "C". If the specimen is kept but is still not confidently identified, add a "U" to the "C" in the collection column (CU = collected and unconfirmed). In this case the unconfirmed species epithet should be put in parentheses [e.g., *Hordeum (murinum)*]. If the specimen is kept and is confidently identified, add a "C" to the existing "C" in the collection column (CC = collected and confirmed). If the specimen is later deposited in an herbarium, add a "D" to the existing "C" in the collection column (CD = collected and deposited) and note the receiving herbarium.

Use Jepson Manual nomenclature. Write out the genus and species of the plant. Do not abbreviate except for dominant species that do not have ambiguous codes. If you aren't sure there aren't duplicate codes, don't use a code. When uncertain of an identification (which you intend to confirm later) use parentheses to indicate what part of the determination needs to be confirmed. For example, you could write out *Brassica (nigra)* if you are sure it is a *Brassica* but you need further clarification on the specific epithet.

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

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

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

Include the percent cover of snags (standing dead) of trees and shrubs. Use the code "SNAG." Note their species, if known, in the "Species" column (i.e. SNAG – *Quercus wislizeni*).

For Rapid Assessments, make sure that the major non-native species occurring in the stand also are listed in the space provided in the species list with their strata and % cover.

For Relevés, all non-native species should be included in the species list.

Also for Relevés, record the <1% cover in one of two categories: "r" for trace (i.e., rare in plot, or solitary individuals) and "+" for <1% but not rare or solitary individuals.

Unusual species: List species that are locally or regionally rare, endangered, or atypical (e.g., range extension or range limit) within the stand. This field will be useful to the Program for obtaining data on regionally or locally significant populations of plants.

Note: Field forms are generally filled out in pencil, so that changes may be made easily while working in the plot or stand. Once out of the stand, however, entries on the field form should not be erased, but should be crossed out and corrected in a different-colored ink.

Appendix B

Rapid Assessment and Relevé Form

Combined Vegetation Rapid Assessment and Relevé Field Form

(Revised March 27, 2018)

Combined Vegetation Rapid Assessment and Relevé Field Form

(Revised March 27, 2018)

SPECIES SHEET

Database #: _____

IV. VEGETATION DESCRIPTION

% NonVasc cover: _____ Total % Vasc Veg cover: _____

% Cover - Conifer tree / Hardwood tree: _____ / _____ **Regenerating Tree:** _____ **Shrub:** _____ **Herbaceous:** _____

Height Class - Conifer tree / Hardwood tree: _____ / _____ Regenerating Tree: _____ Shrub: _____ Herbaceous: _____

Height classes: 1=<1/2m, 2=1/2-1m, 3=1-2m, 4=2-5m, 5=5-10m, 6=10-15m, 7=15-20m, 8=20-35m, 9=35-50m, 10=>50m

Stratum categories: T=Tree, A = SApling, E = SEedling, S = Shrub, H = Herb, N = Non-vascular
% Cover Intervals for reference: r = trace, + = <1%, - 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%

Unusual species: _____

Appendix C

Reconnaissance Form

RECON FIELD FORM (March 30, 2017)

Appendix D

Plant Species in the Knoxville Wildlife Area

This is a list of all plant species recorded during field data collection. We use the USDA PLANTS database nomenclature.

Species Name	Stratum
<i>Achillea millefolium</i>	Herb
<i>Achyrrachaena mollis</i>	Herb
<i>Acmispon brachycarpus</i>	Herb
<i>Acmispon glaber</i>	Shrub
<i>Acmispon</i> sp.	Herb
<i>Acmispon wrangelianus</i>	Herb
<i>Adenostoma fasciculatum</i>	Shrub
<i>Adiantum jordanii</i>	Herb
<i>Adiantum</i> sp.	Herb
<i>Aesculus californica</i>	Tree
<i>Agoseris</i> sp.	Herb
<i>Allium serra</i>	Herb
<i>Amsinckia intermedia</i>	Herb
<i>Amsinckia</i> sp.	Herb
<i>Amsinckia menziesii</i>	Herb
<i>Anagallis arvensis</i>	Herb
<i>Ancistrocarphus filagineus</i>	Herb
<i>Andropogon glomeratus</i> var. <i>scabriglumis</i>	Herb
<i>Arctostaphylos</i> sp.	Shrub
<i>Arctostaphylos manzanita</i>	Shrub
<i>Arctostaphylos viscida</i>	Shrub
<i>Artemisia douglasiana</i>	Herb
<i>Aster foliaceus</i> var. <i>apricus</i>	Herb
<i>Astragalus gambelianus</i>	Herb
<i>Astragalus</i> sp.	Herb
<i>Athyrsanus pusillus</i>	Herb
<i>Avena barbata</i>	Herb
<i>Avena fatua</i>	Herb
<i>Avena</i> sp.	Herb
<i>Baccharis salicifolia</i>	Shrub
<i>Brachypodium distachyon</i>	Herb
<i>Brachypodium</i> sp.	Herb
<i>Briza minor</i>	Herb
<i>Brodiaea</i> sp.	Herb
<i>Bromus carinatus</i>	Herb
<i>Bromus carinatus</i> var. <i>carinatus</i>	Herb
<i>Bromus diandrus</i>	Herb

Species Name	Stratum
<i>Bromus hordeaceus</i>	Herb
<i>Bromus</i> sp.	Herb
<i>Bromus rubens</i>	Herb
<i>Calandrinia ciliata</i>	Herb
<i>Calandrinia maritima</i>	Herb
<i>Calochortus amabilis</i>	Herb
<i>Calochortus</i> sp.	Herb
<i>Calycanthus occidentalis</i>	Shrub
<i>Calystegia</i> sp.	Herb
<i>Capsella bursa-pastoris</i>	Herb
<i>Carduus pycnocephalus</i>	Herb
<i>Carex densa</i>	Herb
<i>Carex nudata</i>	Herb
<i>Carex praegracilis</i>	Herb
<i>Carex senta</i>	Herb
<i>Carex serratodens</i>	Herb
<i>Castilleja applegatei</i>	Herb
<i>Castilleja attenuata</i>	Herb
<i>Ceanothus cuneatus</i>	Shrub
<i>Ceanothus integerrimus</i> var. <i>macrothrysus</i>	Shrub
<i>Ceanothus jepsonii</i>	Shrub
<i>Ceanothus</i> sp.	Shrub
<i>Ceanothus oliganthus</i>	Shrub
<i>Centaurea melitensis</i>	Herb
<i>Centaurea solstitialis</i>	Herb
<i>Cerastium glomeratum</i>	Herb
<i>Cerastium viscosum</i>	Herb
<i>Cercis occidentalis</i>	Shrub
<i>Cercis occidentalis</i> var. <i>orbiculata</i>	Shrub
<i>Cercocarpus betuloides</i>	Shrub
<i>Cercocarpus</i> sp.	Shrub
<i>Cercocarpus montanus</i>	Shrub
<i>Chaenactis glabriuscula</i>	Herb
<i>Chlorogalum</i> sp.	Herb
<i>Chlorogalum pomeridianum</i>	Herb
<i>Chorizanthe membranacea</i>	Herb
<i>Chorizanthe</i> sp.	Herb
<i>Cirsium cymosum</i>	Herb
<i>Cirsium douglasii</i>	Herb
<i>Cirsium vulgare</i>	Herb

Species Name	Stratum
<i>Clarkia gracilis</i>	Herb
<i>Clarkia gracilis</i> ssp. <i>gracilis</i>	Herb
<i>Clarkia purpurea</i>	Herb
<i>Clarkia</i> sp.	Herb
<i>Claytonia perfoliata</i>	Herb
<i>Clematis</i> sp.	Shrub
<i>Collinsia parviflora</i>	Herb
<i>Collinsia sparsiflora</i>	Herb
<i>Convolvulus arvensis</i>	Herb
<i>Conyza canadensis</i>	Herb
<i>Croton setigerus</i>	Herb
<i>Crypsis schoenoides</i>	Herb
<i>Cryptantha</i> sp.	Herb
<i>Cynosurus echinatus</i>	Herb
<i>Cynosurus</i> sp.	Herb
<i>Cyperus eragrostis</i>	Herb
<i>Datisca glomerata</i>	Herb
<i>Daucus carota</i>	Herb
<i>Daucus pusillus</i>	Herb
<i>Delphinium hesperium</i> ssp. <i>hesperium</i>	Herb
<i>Delphinium hesperium</i> ssp. <i>pallescens</i>	Herb
<i>Delphinium variegatum</i>	Herb
<i>Deschampsia caespitosa</i> ssp. <i>Beringensis</i>	Herb
<i>Dichelostemma capitatum</i>	Herb
<i>Dichelostemma</i> sp.	Herb
<i>Dichelostemma pulchellum</i>	Herb
<i>Dichelostemma volubile</i>	Herb
<i>Distichlis spicata</i>	Herb
<i>Downingia</i> sp.	Herb
<i>Eleocharis macrostachya</i>	Herb
<i>Elymus caput-medusae</i>	Herb
<i>Elymus elymoides</i>	Herb
<i>Elymus glaucus</i>	Herb
<i>Elymus glaucus</i> ssp. <i>glaucus</i>	Herb
<i>Elymus multisetus</i>	Herb
<i>Elymus triticoides</i>	Herb
<i>Epilobium</i> sp.	Herb
<i>Eriodictyon</i> sp.	Shrub
<i>Eriodictyon californicum</i>	Shrub
<i>Eriogonum</i> sp.	Herb

Species Name	Stratum
<i>Eriogonum nudum</i>	Herb
<i>Eriophyllum lanatum</i>	Herb
<i>Erodium botrys</i>	Herb
<i>Erodium brachycarpum</i>	Herb
<i>Erodium cicutarium</i>	Herb
<i>Eryngium aristulatum</i> var. <i>aristulatum</i>	Herb
<i>Eryngium jepsonii</i>	Herb
<i>Eschscholzia caespitosa</i>	Herb
<i>Eschscholzia californica</i>	Herb
<i>Euphorbia serpyllifolia</i>	Herb
<i>Euphorbia spathulata</i>	Herb
<i>Eurybia radulina</i>	Herb
<i>Festuca bromoides</i>	Herb
<i>Festuca idahoensis</i>	Herb
<i>Festuca microstachys</i>	Herb
<i>Festuca myuros</i>	Herb
<i>Festuca perennis</i>	Herb
<i>Filago gallica</i>	Herb
<i>Frangula californica</i>	Shrub
<i>Galium andrewsii</i>	Herb
<i>Galium aparine</i>	Herb
<i>Galium californicum</i>	Herb
<i>Galium</i> sp.	Herb
<i>Galium parisiense</i>	Herb
<i>Galium porrigens</i>	Herb
<i>Garrya congdonii</i>	Shrub
<i>Garrya</i> sp.	Shrub
<i>Gastridium phleoides</i>	Herb
<i>Geranium californicum</i>	Herb
<i>Geranium carolinianum</i>	Herb
<i>Geranium dissectum</i>	Herb
<i>Geranium</i> sp.	Herb
<i>Geranium molle</i>	Herb
<i>Gilia clivorum</i>	Herb
<i>Gilia</i> sp.	Herb
<i>Gilia tricolor</i>	Herb
<i>Gnaphalium</i> sp.	Herb
<i>Grindelia camporum</i> var. <i>camporum</i>	Herb
<i>Grindelia</i> sp.	Herb
<i>Harmonia hallii</i>	Herb

Species Name	Stratum
<i>Helenium puberulum</i>	Herb
<i>Hemizonia congesta</i>	Herb
<i>Hemizonia congesta</i> ssp. <i>luzulifolia</i>	Herb
<i>Hesperevax</i> sp.	Herb
<i>Hesperevax sparsiflora</i>	Herb
<i>Hesperevax sparsiflora</i> var. <i>sparsiflora</i>	Herb
<i>Hesperocyparis sargentii</i>	Tree
<i>Heteromeles arbutifolia</i>	Shrub
<i>Holodiscus discolor</i>	Shrub
<i>Hordeum brachyantherum</i>	Herb
<i>Hordeum</i> sp.	Herb
<i>Hordeum leporinum</i>	Herb
<i>Hordeum murinum</i>	Herb
<i>Hypochaeris radicata</i>	Herb
<i>Iris macrosiphon</i>	Herb
<i>Isoetes howellii</i>	Herb
<i>Juglans</i> sp.	Tree
<i>Juncus arcticus</i>	Herb
<i>Juncus effusus</i>	Herb
<i>Juncus</i> sp.	Herb
<i>Juncus luciensis</i>	Herb
<i>Juncus mexicanus</i>	Herb
<i>Juncus oxymeris</i>	Herb
<i>Juncus patens</i>	Herb
<i>Juncus phaeocephalus</i>	Herb
<i>Keckiella</i> sp.	Shrub
<i>Koeleria macrantha</i>	Herb
<i>Lactuca</i> sp.	Herb
<i>Lactuca serriola</i>	Herb
<i>Lasthenia californica</i>	Herb
<i>Lasthenia californica</i> ssp. <i>californica</i>	Herb
<i>Lathyrus</i> sp.	Herb
<i>Lathyrus vestitus</i>	Herb
<i>Lepechinia calycina</i>	Shrub
<i>Lepechinia</i> sp.	Shrub
<i>Lepidium nitidum</i>	Herb
<i>Leptosiphon bicolor</i>	Herb
Lichen	Non-vascular
<i>Lolium</i> sp.	Herb
<i>Lomatium</i>	Herb

Species Name	Stratum
<i>Lomatium utriculatum</i>	Herb
<i>Lonicera hispidula</i>	Shrub
<i>Lupinus albifrons</i>	Shrub
<i>Lupinus bicolor</i>	Herb
<i>Lupinus</i> sp.	Herb
<i>Lupinus latifolius</i> ssp. <i>latifolius</i>	Herb
<i>Lupinus microcarpus</i> var. <i>densiflorus</i>	Herb
<i>Lupinus succulentus</i>	Herb
<i>Lythrum hyssopifolia</i>	Herb
<i>Madia exigua</i>	Herb
<i>Madia Molina</i>	Herb
<i>Malacothamnus fremontii</i>	Shrub
<i>Malacothrix</i> sp.	Herb
<i>Marah fabaceus</i>	Shrub
<i>Medicago hispida</i>	Herb
<i>Medicago</i> sp.	Herb
<i>Medicago polymorpha</i>	Herb
<i>Melica bulbosa</i>	Herb
<i>Melica californica</i>	Herb
<i>Melica</i> sp.	Herb
<i>Melica torreyana</i>	Herb
<i>Melilotus albus</i>	Herb
<i>Mentha piperita</i> ssp. <i>citrata</i>	Herb
<i>Micropus californicus</i>	Herb
<i>Micropus californicus</i> var. <i>californicus</i>	Herb
<i>Micropus</i> sp.	Herb
<i>Microseris douglasii</i> ssp. <i>douglasii</i>	Herb
<i>Microsteris gracilis</i>	Herb
<i>Mimulus aurantiacus</i>	Shrub
<i>Mimulus cardinalis</i>	Herb
<i>Minuartia douglasii</i>	Herb
<i>Monardella</i> sp.	Herb
<i>Monardella viridis</i>	Herb
Moss	Non-vascular
<i>Pellaea andromedifolia</i>	Herb
<i>Pentagramma triangularis</i>	Herb
<i>Pentagramma</i> sp.	Herb
<i>Perideridia kelloggii</i>	Herb
<i>Perideridia</i> sp.	Herb
<i>Phacelia californica</i>	Herb

Species Name	Stratum
<i>Phacelia distans</i>	Herb
<i>Phacelia</i> sp.	Herb
<i>Phalaris aquatica</i>	Herb
<i>Pinus sabiniana</i>	Tree
<i>Plagiobothrys</i> sp.	Herb
<i>Plagiobothrys nothofulvus</i>	Herb
<i>Plagiobothrys stipitatus</i> var. <i>micranthus</i>	Herb
<i>Plantago erecta</i>	Herb
<i>Plectritis</i> sp.	Herb
<i>Poa bulbosa</i>	Herb
<i>Poa secunda</i>	Herb
<i>Polypogon monspeliensis</i>	Herb
<i>Populus fremontii</i>	Tree
<i>Psilocarphus tenellus</i>	Herb
<i>Quercus xmoreha</i>	Tree
<i>Quercus agrifolia</i>	Tree
<i>Quercus berberidifolia</i>	Shrub
<i>Quercus douglasii</i>	Tree
<i>Quercus durata</i>	Shrub
<i>Quercus kelloggii</i>	Tree
<i>Quercus lobata</i>	Tree
<i>Quercus wislizeni</i>	Tree
<i>Quercus wislizeni</i> var. <i>frutescens</i>	Shrub
<i>Ranunculus aquatilis</i>	Herb
<i>Ranunculus californicus</i>	Herb
<i>Ranunculus</i> sp.	Herb
<i>Rhamnus ilicifolia</i>	Shrub
<i>Ribes</i> sp.	Shrub
<i>Ribes malvaceum</i>	Shrub
<i>Rigiopappus</i> sp.	Herb
<i>Rosa californica</i>	Shrub
<i>Rubus ursinus</i>	Shrub
<i>Rumex crispus</i>	Herb
<i>Salix breweri</i>	Shrub
<i>Salix exigua</i>	Shrub
<i>Salix laevigata</i>	Tree
<i>Salix lasiolepis</i>	Shrub
<i>Salvia columbariae</i>	Herb
<i>Sambucus</i> sp.	Shrub
<i>Sambucus nigra</i>	Shrub

Species Name	Stratum
<i>Sanicula bipinnata</i>	Herb
<i>Sanicula bipinnatifida</i>	Herb
<i>Sanicula crassicaulis</i>	Herb
<i>Sanicula graveolens</i>	Herb
<i>Scrophularia californica</i>	Herb
<i>Scutellaria</i> sp.	Herb
<i>Senecio vulgaris</i>	Herb
<i>Sisyrinchium bellum</i>	Herb
<i>Sisyrinchium</i> sp.	Herb
<i>Solidago californica</i>	Herb
<i>Sonchus oleraceus</i>	Herb
<i>Stachys ajugoides</i>	Herb
<i>Stachys albens</i>	Herb
<i>Stachys</i> sp.	Herb
<i>Stachys rigida</i>	Herb
<i>Stellaria media</i>	Herb
<i>Stipa</i> sp.	Herb
<i>Stipa pulchra</i>	Herb
<i>Streptanthus glandulosus</i>	Herb
<i>Streptanthus morrisonii</i>	Herb
<i>Symphoricarpos albus</i>	Shrub
<i>Symphoricarpos</i> sp.	Shrub
<i>Symphoricarpos mollis</i>	Shrub
<i>Symphoricarpos rivularis</i>	Shrub
<i>Sympyotrichum chilense</i>	Herb
<i>Thermopsis californica</i>	Herb
<i>Thermopsis californica</i> var. <i>californica</i>	Herb
<i>Thermopsis</i> sp.	Herb
<i>Thysanocarpus curvipes</i>	Herb
<i>Thysanocarpus</i>	Herb
<i>Torilis</i> sp.	Herb
<i>Torilis arvensis</i>	Herb
<i>Toxicodendron diversilobum</i>	Shrub
<i>Toxicoscordion fremontii</i>	Herb
<i>Toxicoscordion</i> sp.	Herb
<i>Toxicoscordion venenosum</i>	Herb
<i>Trifolium ciliolatum</i>	Herb
<i>Trifolium hirtum</i>	Herb
<i>Trifolium</i> sp.	Herb
<i>Trifolium microdon</i>	Herb

Species Name	Stratum
<i>Triteleia</i> sp.	Herb
<i>Triteleia laxa</i>	Herb
<i>Typha domingensis</i>	Herb
<i>Typha</i> sp.	Herb
<i>Umbellularia californica</i>	Tree
<i>Veronica</i> sp.	Herb
<i>Vicia americana</i>	Herb
<i>Vicia</i> sp.	Herb
<i>Vicia sativa</i>	Herb
<i>Vicia sativa</i> ssp. <i>sativa</i>	Herb
<i>Vicia tetrasperma</i>	Herb
<i>Vicia villosa</i>	Herb
<i>Vitis californica</i>	Shrub
<i>Vitis</i> sp.	Shrub
<i>Vulpia microstachys</i>	Herb
<i>Xanthium strumarium</i>	Herb
<i>Zigadenus fremontii</i>	Herb

Appendix E

Hierarchical Field and Mapping Key

Knoxville Wildlife Area

Key to Identification of All Stands of Vegetation Sampled or Encountered in the Field

This key is developed for the areas mapped in support of the Knoxville WA. It is intended for use as a guide to identification of field-based and image interpretation-based vegetation assessments.

Due to the diversity of the vegetation communities in the area, this is a complex key. You will need to collect or refer to plant composition data that includes not only those species that are dominant but also those "indicator," or characteristic/diagnostic species, whose presence may cause a stand to key to another vegetation type. If you are using this key for mapping rules please also note that some of the types are typically below the accurate detectability for mapping in this project.

Terms and Concepts 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 structural and compositional features of a stand are often combined into a term called homogeneity. For an area of vegetated ground to meet the requirements of a stand, it must be homogeneous at the scale being considered. The map has a variable Minimum Mapping Unit (MMU) size. For special types such as wetlands and riparian it is 1/2 acre (vernal pools are occasionally smaller) and for upland vegetation it is 1 acre.

Alliance: Plant communities based on dominant/diagnostic species of uppermost or dominant stratum. Part of the United States National Vegetation Classification (USNVC) hierarchy.

Association: The most botanically detailed plant community designation based on dominant species and multiple co- or subdominant indicator species from any strata. Part of the USNVC hierarchy.

Plant community nomenclature: Species separated by "-" are within the same stratum; species separated by "/" are in different strata. The number that precedes some plant community names is the Mapping Code used for labeling plant community polygons for the associated GIS-based plant community map.

Cover: The primary metric used to quantify the importance/abundance of a particular species or a particular vegetation layer within a stand. It 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 mapping project uses the concept of "porosity" or foliar cover rather than "opacity" or crown cover. Thus, field crews and aerial photo interpreters are trained to estimate the amount of 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.

Absolute cover: The actual percentage of the surface area of the survey that is covered by a species or physiognomic group (trees, shrubs, herbaceous), as in "creosote bush covers 10 percent of the survey." Absolute cover of all species or physiognomic groups, when added together, may total greater than 100 percent, because this is not a proportional number and plants can overlap each other. For example, a survey could have 25 percent tree cover, 40 percent shrub cover, and 50 percent herbaceous cover.

Relative cover: The percentage of the surface area of the survey that is covered by one species or physiognomic group (trees, shrubs, herbaceous) as compared or relative to the amount of surface of the survey covered by all species or groups. Thus, 50 percent relative cover means that half of the total proportion of cover of all species or physiognomic groups is composed of the single species or group in question. Relative cover values are a proportional number that, when added together, total 100 percent for each sample or stand. For example, a scrub oak-chamise vegetation survey with 15 percent cover scrub oak and 15 percent cover chamise estimated using absolute cover would translate to 50 percent relative cover of each species.

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 chamise," or it may refer to dominance by a physiognomic group, as in "dominated by shrubs" - see "dominance by layer," below.

Strongly dominant: 60 percent+ relative cover. A species in the dominant life form stratum has 60 percent or greater relative cover.

Co-dominant: Each species has 30 percent–60 percent relative cover. Co-dominance refers to two or more species in a stand with near equal cover. In general, co-dominance can occur among species that have between 30 and 60 percent relative cover each. To be co-dominant species should be in at least 70 percent of the stands of this type, with at least 30 percent relative cover in each stand. For example in a stand with 20% *Adenostoma fasciculatum*, 25% *Quercus berberidifolia*, and 15% *Ceanothus cuneatus* (total 60% shrub cover), the *Adenostoma* ($20/60 = 33\%$ relative cover) and the *Quercus* ($25/60 = 42\%$ relative cover) would be co-dominant while *Ceanothus cuneatus* would be sub-dominant with only 25% relative cover.

Consistent/Characteristic/Diagnostic species: Should be present in at least 80 percent of the stands of the type, with no restriction on cover.

Abundant species: Should be present in at least 50 percent of the samples, with an average of at least 50 percent relative cover in all samples.

Dominance by layer: Tree, shrub, and herbaceous layers are considered physiognomically distinct. A vegetation type is considered to belong to a certain physiognomic group if it is dominated by one layer. Layers are prioritized in order of height. The tallest layer, if it meets a criterion in the "characterized" definitions (see below) is said to dominate, and the type is usually named at the alliance level by the characteristic species of the tallest layer. Average covers within the dominant layer reflect the "modal" concept of the characteristics 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.

Diagnostic species: A species typically found in the dominant stratum of a vegetation type often lending its name to that association or alliance due to its constancy and reliable presence throughout most similar stands.

Sparse: Used to describe individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the cover is less than 10 percent absolute cover.

Woody plant: Is any species of plant that has noticeably woody stems. 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 multiple stemmed following ramifying after fire or other disturbance, but the size of mature plants is typically greater than 5 meters. Undisturbed individuals of these species are usually single stemmed.

Tree-characterized vegetation: Trees are evenly distributed throughout the stand and meet one or both of these criteria: (1) trees influence the distribution or population dynamics of other plant species; (2) trees play an important role in ecological processes within the stand.

Forest: In the USNVC, a forest is defined as a tree-dominated stand of vegetation with 60 percent or greater 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 percent.

Woodland: In the USNVC, woodland is defined as a tree-dominated stand of vegetation with between 25 percent and 60 percent cover of trees. The same notion of "modality" that applies to forest types also applies here and to the sparsely wooded category.

Emergent: A plant (or vegetation layer) is considered emergent if it has a low cover and rises above a layer with has most of the cover in the stand. For example, individual *Umbellularia californica* trees may comprise an emergent tree layer of 5 percent over a dense layer of *Ceanothus oliganthus* shrubs; the stand would be considered within the *Ceanothus oliganthus* Shrubland Alliance because the total tree cover is < 10% and the shrub cover is > 10%. Further, medium to tall shrubs are not considered emergent over shorter shrubs, but short trees are considered emergent over tall shrubs.

Shrub: Usually a multi-stemmed woody plant that is between 0.2 meter and 5 meters tall. Definitions are blurred at the low and high ends of the height scales. At the tall end, shrubs may approach trees based on disturbance

frequencies (e.g., old-growth resprouting chaparral species such as *Cercocarpus montanus*, *Fremontodendron californica*, *Prunus ilicifolia*, and so forth, may frequently attain "tree size"). At the short end, woody perennial herbs or subshrubs of various species are often difficult to categorize into a consistent life-form.

Sub-shrub: A multi-stemmed plant with noticeably woody stems less than 0.5 meter tall.

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.

Herbaceous plant: Any species of plant that has no main woody stem development and 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 play an important role in ecological processes within the stand, and the stand cannot be characterized as a tree or shrub stand.

Botanical nomenclature: We use the NRCS PLANTS database in vegetation mapping as our standard for botanical names.

All references to percent cover in the key are to absolute cover unless specified in a particular section as relative cover.

**Hierarchical Field and Mapping Key to the Vegetation of the Southern Unit of
Knoxville Wildlife Area, Napa Co.**

Section I: Woodlands and forests dominated or characterized by needle or scale-leaved conifer trees.

1. Vegetation dominated or characterized by *Callitropsis sargentii*.

Californian evergreen coniferous forest and woodland Group

Callitropsis sargentii dominates in an open to dense tree overstory, sometimes with understory shrubs meeting or exceeding *Callitropsis* in cover. *Salix breweri*, *Frangula* spp., and other riparian or wetland species may be in the understory.

***Callitropsis sargentii* Alliance**

Section II. Woodlands, forests, and riparian shrublands characterized mainly by native and non-native broad-leaved evergreen and deciduous trees, as well as riparian shrub species. Includes *Aesculus*, *Baccharis*, *Populus*, tree species of *Quercus* and *Salix*, *Tamarix*, and *Umbellularia*.

2. Woodland or forest stands characterized by *Aesculus*, a tree species of *Quercus*, or *Umbellularia*. The understory may be shrubby or herbaceous – if the former, shrubs are often of similar stature to re-sprouting trees due to recent fires.

Californian broadleaf forest and woodland Group

2a. *Aesculus californica* dominates in the tree overstory, sometimes with as little as 5% cover. In Knoxville, two sub-MMU stands were supported by reconnaissance surveys – there were no supporting RA data.

***Aesculus californica* Alliance**

2b. *Quercus agrifolia* is the dominant tree or is co-dominant with *Quercus wislizeni* in the tree overstory. Stands occur on lower slopes in ravines, or along riparian terraces and may intergrade with *Q. lobata* or *Q. wislizeni* stands. Understory shrubs may include *Ceanothus oliganthus*, *Frangula californica*, or *Heteromeles arbutifolia*.

***Quercus agrifolia* Alliance**

Quercus agrifolia/Ceanothus oliganthus Association

Quercus agrifolia/Frangula californica–Heteromeles arbutifolia Association

2c. *Quercus wislizeni* is the dominant species in the overstory or may be co-dominant with *Pinus sabiniana* or *Quercus douglasii*. In Knoxville, when shrubby resprouts of *Q. wislizeni* are no taller than common shrubs such as *Ceanothus oliganthus*, *Frangula californica*, and/or *Heteromeles*, stands still key to this tree alliance.

***Quercus wislizeni* tree Alliance**

Quercus wislizeni/Ceanothus oliganthus Provisional Association

Quercus wislizeni–Pinus sabiniana/annual grass–herb Association

Quercus wislizeni–*Pinus sabiniana*/*Arctostaphylos manzanita* Association
Quercus wislizeni–*Quercus douglasii*–*Aesculus californica* Association
Quercus wislizeni–*Quercus douglasii*–*Pinus sabiniana*/(grass) Association

2d. *Quercus douglasii* is the dominant tree or may be co-dominant with *Pinus sabiniana*. In Knoxville, the understory herbaceous layer is often comprised of a moderate to dense variety of native and non-native forbs and grasses.

***Quercus douglasii* Alliance**
Quercus douglasii/grass Association
Quercus douglasii–*Pinus sabiniana* Association

2e. *Quercus lobata* is the dominant tree or may be co-dominant with another tree species of *Quercus*. Stands occur in uplands (e.g., valleys, lower slopes) or in riparian settings.

***Quercus lobata* Alliance**
Quercus lobata–*Salix lasiolepis* Association
Quercus lobata–*Quercus wislizeni* Association

2f. *Umbellularia californica* is the dominant species in the overstory or may be co-dominant with *Quercus wislizeni*. Stands are found along lower slopes or in draws or ravines. In post-fire stands, *Umbellularia* resprouts are often shrubby with height similar to co-occurring shrubs or resprouting *Aesculus* or *Quercus wislizeni*. Mesic chaparral shrubs such as *Ceanothus oliganthus*, *Frangula*, *Heteromeles*, or *Quercus berberidifolia* can attain similar combined covers to the re-sprouting trees.

***Umbellularia californica* Alliance**
Umbellularia californica–*Quercus wislizeni* Association

3. Riparian vegetation dominated by *Populus*, *Salix laevigata* or by a shrub species of *Salix*, including *S. breweri* or *S. lasiolepis*.

Southwestern North American Riparian, Flooded and Swamp Forest Macrogroup

3a. Riparian vegetation dominated by trees.

Southwestern North American riparian evergreen and deciduous woodland Group

3a1. *Salix laevigata* dominates the tree overstory, though *Salix lasiolepis* may meet or exceed it in cover in the understory. If *S. lasiolepis* has >60% relative cover, key to the *S. lasiolepis* Alliance. If *Populus fremontii* is present, it must be sub-dominant with ≤5% absolute cover.

***Salix laevigata* Alliance**

3a2. *Populus fremontii* ≥5% absolute cover in the tree layer. One or two small stands may exist in the area, with or without co-dominant *Salix laevigata*. This type is not substantiated by survey data.

***Populus fremontii* Alliance**

3b. Riparian vegetation dominated by shrubs.

Southwestern North American riparian/wash scrub Group

3b1. *Salix breweri* dominates in the shrub overstory, often intermixing with other shrubs or herbaceous species in seeps and small stream channels on serpentine substrates. Emergent trees of *Callitropsis sargentii* occasionally occur in stands.

***Salix breweri* Alliance**

3b2. *Salix lasiolepis* dominates in the shrub overstory. If riparian tree species are present, they must be sub-dominant (generally < 10% absolute cover), with *S. lasiolepis* having >60% relative cover.

***Salix lasiolepis* Alliance**

***Salix lasiolepis* Association**

Section III. Shrub or grass vegetation dominated or characterized by Mediterranean warm temperate taxa, including shrubs of the genera *Adenostoma*, *Ceanothus cuneatus*, *C. oliganthus*, *Eriodictyon*, *Lupinus*, and *Quercus*; as well as grasses and forbs of the genera *Eriogonum*, *Eschscholzia*, *Lasthenia*, *Melica*, *Nassella (Stipa)*; and non-native herbs and grasses of the genera *Avena*, *Bromus*, and *Centaurea*. [Note: *Ceanothus integrifolius* keys out in section IV, step 7].

4. Shrublands dominated or characterized by evergreen, sclerophyllous chaparral species. Indicator taxa include *Adenostoma*, *Ceanothus*, *Eriodictyon*, *Heteromeles*, or a shrub species of *Quercus*. [Note: there is not enough evidence to support the existence of the *Heteromeles arbutifolia* Alliance in Knoxville. There were some reconnaissance surveys that showed dominance by *Heteromeles*, but these stands were sub-MMU and/or occurred with more diagnostic species. When *Heteromeles* intermixes with other shrubs (sometimes having the highest cover), key to the alliance of the other, most diagnostic shrub (e.g., *Adenostoma fasciculatum*, *Quercus berberidifolia*, or *Q. durata*)].

California Chaparral Macrogroup MG043

4a. *Quercus berberidifolia* is the dominant shrub or may be co-dominant with *Adenostoma fasciculatum*, *Ceanothus oliganthus*, or *Cercocarpus montanus*. Stands tend to occupy more mesic sites, such as north-facing slopes, concavities and toeslopes with well-drained soils.

Californian mesic chaparral Group

4a1. Stands with co-dominant *Quercus berberidifolia* and *Adenostoma fasciculatum* (both species have between 30% and 60% relative cover in the shrub overstory). Often found on upper to middle, north-facing and somewhat sheltered slopes.

***Quercus berberidifolia-Adenostoma fasciculatum* Alliance**

4a2. *Quercus berberidifolia* is the dominant shrub or is co-dominant with *Ceanothus oliganthus* or *Cercocarpus montanus*. Typically found on north-facing or otherwise lower, relatively sheltered slopes. Stands may grade into scrubby woodlands of *Quercus agrifolia*, *Q. wislizeni*, or *Umbellularia californica*.

in lower slope positions. *Aesculus californica* may be sub-dominant to *Q. berberidifolia* as an emergent tree.

***Quercus berberidifolia* Alliance**

Quercus berberidifolia/Aesculus californica Provisional Association

Quercus berberidifolia–Ceanothus oliganthus Association

Quercus berberidifolia–Cercocarpus montanus Association

4b. *Arctostaphylos viscida* is dominant, *Ceanothus oliganthus* is dominant, *Quercus durata* is dominant, or each of the three species may be co-dominant with *Adenostoma fasciculatum* in the shrub overstory. In general, stands are more frost-tolerant and found at higher, cooler, and more mesic sites than the Xeric or Mesic Chaparral Groups.

Californian pre-montane chaparral Group

4b1. *Arctostaphylos viscida* ssp. *pulchella* is the sole dominant shrub or is co-dominant with *Adenostoma fasciculatum* on serpentine, exposed, or south-facing slopes. No surveys were collected, but there were anecdotal observations in the northwest portion of the study area.

***Arctostaphylos viscida* Alliance**

4b2. *Ceanothus oliganthus* is the dominant shrub or may be co-dominant with *Adenostoma fasciculatum*. *Heteromeles arbutifolia* may also have relatively high cover.

***Ceanothus oliganthus* Shrubland Alliance**

Ceanothus oliganthus–Adenostoma fasciculatum Association

4b3. *Quercus durata* is the dominant shrub or may be co-dominant with *Adenostoma fasciculatum* or *Heteromeles arbutifolia*. Stands are often found on dry, rocky, or gravelly serpentine substrates, with serpentine-specialized shrubs such as *Arctostaphylos viscida* ssp. *pulchella* and *Ceanothus jepsonii*. Or they may occur along with broadly-tolerant chaparral shrubs such as *Adenostoma*, *Frangula californica*, and *Heteromeles*.

***Quercus durata* Alliance**

Quercus durata–Adenostoma fasciculatum Provisional Association

4c. *Adenostoma*, *Ceanothus cuneatus*, or *Eriodictyon* dominates in the shrub canopy, often on well-drained soils in full sun exposures, including upper slopes, spur-ridges and convexities.

Californian xeric chaparral Group

4c1. *Adenostoma fasciculatum* strongly dominates (usually with ≥60% relative shrub cover) or may be co-dominant with *Heteromeles arbutifolia*. Stands are usually on south-facing or otherwise well-drained, exposed slopes. If *Ceanothus cuneatus*, *C. oliganthus*, *Quercus berberidifolia*, or *Q. durata* intermixes as a co-dominant shrub, key to the appropriate *Ceanothus* or *Quercus* alliance instead of the *A. fasciculatum* Alliance.

***Adenostoma fasciculatum* Alliance**

Adenostoma fasciculatum Association
Adenostoma fasciculatum–Heteromeles arbutifolia/Melica torreyana Association

4c2. *Ceanothus cuneatus* is the dominant shrub or may be co-dominant with *Adenostoma fasciculatum*. If *C. integrifolius* is co-dominant, key to the *C. integrifolius* Alliance (see step 7 below). Usually on southerly-facing or otherwise relatively exposed upper slopes.

Ceanothus cuneatus Alliance
Ceanothus cuneatus–Adenostoma fasciculatum Association

4c3. Diffuse shrublands characterized by open to intermittent cover of *Eriodictyon californicum* over native and non-native annual and perennial herbs. If *Lupinus albifrons* intermixes as a co-dominant shrub, key to the *Lupinus* Alliance.

Eriodictyon californicum Alliance
Eriodictyon californicum/herbaceous Association

5. Upland shrublands where main shrubs are drought or winter deciduous (e.g., *Lupinus albifrons*) or herblands with perennial herbs/subshrubs with drought-deciduous leaves (e.g., *Eriogonum nudum*). Leaves tend to be lost in late spring, with new ones emerging after fall and winter rains. Stands are often more open than typical stands of chaparral and have a variety of forbs and grasses in the understory. Stands are generally small (<5 acres), and occupy steep or eroded transitional sites between grassland and sclerophyll-dominated shrublands.

California Coastal Scrub Macrogroup

5a1. Open, diffuse shrublands characterized by a sparse to intermittent shrub cover of *Lupinus albifrons*. *Eriodictyon californicum* may be co-dominant. Other, more thick-leaved and evergreen shrubs may be present, but with uneven or patchy distribution.

Lupinus albifrons Alliance

5a2. Sparse herblands with *Eriogonum nudum* present throughout the stand. Vegetation contains a variety of other native herbaceous annuals and/or perennials, but none usually with noticeably higher cover or being more diagnostic than *E. nudum*. Stands are generally rocky or gravelly, on or off serpentine substrate.

Eriogonum (elongatum, nudum) Provisional Alliance
Eriogonum nudum Provisional Association

6. True herblands, where the plants are not woody, even at the base. Stands are characterized by both native and non-native grasses and forbs. Shrubs, if present, not >10% absolute cover and/or not evenly distributed across a stand. Indicator genera include *Avena*, *Bromus*, *Centaurea*, *Eschscholzia*, *Lasthenia*, *Melica*, *Nassella* (*Stipa*), *Plantago* and *Vulpia*.

California Annual and Perennial Grassland Macrogroup

6a. Stands dominated or characterized by mostly annual grasses and forbs. Native herbs are characteristic and evenly distributed across the herbaceous layer, though non-native forbs and grasses may be dominant. Cover and composition vary year to year, but indicators usually present in sufficient amounts to differentiate from non-native stands. Diagnostic taxa include *Eschscholzia* spp., *Lasthenia* spp., *Plantago erecta* and *Vulpia microstachys*.

California annual forb/grass vegetation Group

6a1. *Eschscholzia californica* is seasonally dominant or co-dominant on upland slopes or flats with well-drained sandy to loamy soils. *Amsinckia*, *Avena*, *Bromus*, *Dichelostemma*, *Erodium cicutarium*, *Lupinus bicolor*, *Uropappus lindleyi* and a variety of other native and non-native taxa may be present.

Eschscholzia (californica) Alliance

Eschscholzia californica Association

6a2. *Lasthenia californica*, *Plantago erecta*, and/or *Vulpia microstachys* are characteristically present in herbaceous stands. A variety of native forbs including *Lupinus bicolor*, *Plagiobothrys* spp., and *Trifolium* spp. may be present.

Lasthenia californica–Plantago erecta–Vulpia microstachys Alliance

6b. Stands characterized by perennial, native grasses that are evenly distributed across a stand. Annual, non-native forbs and grasses may also be present and abundant. Diagnostic genera include *Nassella (Stipa)* and *Melica*.

California perennial grassland Group

6b1. *Melica californica* is characteristically present and evenly distributed in the herbaceous layer, usually with at least 10% relative cover. A variety of native and non-native taxa, such as *Achillea*, *Amsinckia*, *Athyranthus (Daucus) pusillus*, *Bromus*, *Galium*, *Trifolium*, *Triteleia*, and *Vicia* may intermix.

Melica (californica, torreyana) Provisional Alliance

Melica californica Provisional Association

6b2. *Nassella (Stipa) pulchra* is characteristically present and evenly distributed in the herbaceous layer, usually with at least 10% relative cover. A variety of native and non-native taxa, such as *Bromus*, *Centaurea*, *Delphinium*, *Erodium*, *Geranium*, *Micropus*, *Sisyrinchium*, and *Sonchus* may intermix.

Nassella pulchra Alliance

6c. Stands strongly dominated by non-natives and lacking evenly distributed, diagnostic native plants (usually <5% relative cover). Annual *Avena*, *Bromus*, *Brachypodium*, *Centaurea*, and *Taeniatherum* and other non-native herbaceous taxa are strongly dominant. Because very few surveys were collected in non-native stands for this project, most polygons will be mapped broadly at the Group Level.

Mediterranean California naturalized annual and perennial grassland Group

6c1. *Avena barbata* or *A. fatua* (usually *A. barbata* in Knoxville) is strongly dominant.

***Avena (barbata, fatua)* Semi-natural Stands**

6c2. *Bromus diandrus* or *B. hordeaceus* is strongly dominant in the herbaceous layer, often co-occurring with *Brachypodium distachyon*.

***Bromus (diandrus, hordeaceus)–Brachypodium distachyon* Semi-natural Stands**

6c3. *Centaurea solstitialis* is seasonally characteristic, often intermixing with other non-native herbs, which may exceed *Centaurea* in cover (e.g., *Bromus* and/or *Taeniatherum*).

***Centaurea (solstitialis, melitensis)* Semi-natural Stands**

Section IV. Vegetation not adapted to Mediterranean climates and, therefore, dominated or characterized primarily by native species. Stands are higher in the mountains or more strictly associated with cooler and moist to wet microsites. In Knoxville, shrub stands are dominated by *Ceanothus integerrimus*. Herbaceous stands are dominated or characterized by *Carex*, *Eleocharis*, *Eryngium*, *Juncus*, *Leymus*, *Thermopsis*, or *Typha*.

7. *Ceanothus integerrimus* is the dominant species or may be co-dominant with *C. cuneatus* in the shrub canopy. *C. integerrimus* has winter deciduous leaves (difficult to ascertain during growing season) and is the sole alliance member of the Western Cordilleran Montane Shrubland and Grassland Macrogroup in the study area. *Adenostoma*, *Arctostaphylos manzanita*, *Lepechinia*, and *Quercus wislizeni* may intermix.

Southern Vancouverian montane deciduous scrub Group

***Ceanothus integerrimus* Shrubland Alliance**

8. *Thermopsis californica* and/or *Bromus carinatus* (both are perennial species) are characteristically present and one or both may be dominant. Non-native annual grasses such as *Avena* or *Bromus* are often present and may intermix with a variety of native and introduced grasses and forbs. Currently, this vegetation is recognized at the association level. Further data collection is needed to determine the appropriate alliance name for this type.

Western dry upland perennial grassland Group

***Thermopsis californica* (Alliance unknown) Provisional Association**

9. Stands dominated or characterized by tall to short grasses, graminoids, or forbs and restricted to freshwater seeps, marshes, wet meadows, seasonal ponds or in regularly to episodically flooded bottomlands or depressions. Most stands are small, although some meet MMU requirements and have been mapped. Indicator taxa include *Carex*, *Eleocharis*, *Eryngium*, *Juncus*, *Leymus*, and *Typha*.

9a. *Typha* spp. (in Knoxville, likely *T. domingensis*) dominates in the tall herb layer.

Arid West freshwater emergent marsh Group

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

***Typha domingensis* Association**

9b. *Eleocharis macrostachya* or *Eryngium aristulatum* dominates or characterizes the herbaceous layer.

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

9b1. *Eleocharis macrostachya* is the sole dominant or may be co-dominant with *Juncus arcticus*. Stands may occur in wetland ponds or in vernal pools/swales with a variety of plants such as *Lolium*, *Micropus*, *Ranunculus*, and *Typha*.

***Eleocharis macrostachya* Alliance**
***Eleocharis macrostachya* Association**

9b2. Vernal pools dominated by *Eryngium aristulatum*. One stand was sampled in Knoxville when the pool still had standing water. Associated taxa may include other vernal pool taxa such as *Downingia*, *Isoetes*, *Juncus luciensis*, *Lythrum*, *Plagiobothrys*, and *Psilocarphus*.

***Eryngium aristulatum* Alliance**

9c. Vegetation dominated or characterized by *Carex barbara*, *C. senta*, *C. serratodens*, *Juncus arcticus*, *Juncus oxymeris*, *J. xiphiooides*, or *Leymus triticoides*.

Californian warm temperate marsh/seep Group

9c1. *Carex senta* (or possibly *C. barbara*, though no stands were sampled for this project), the loosely cespitose or rhizomatous sedge, dominates in the herb layer, often near seeps or swales. In the one survey collected at Knoxville, *Carex senta* had moderate cover surrounding a small sulphur spring, intermixing with *Mimulus cardinalis*, *Helenium puberulum*, *Stachys ajugoides*, and a variety of other herbs. This vegetation type falls out as an association under the *Carex barbara* Alliance – both species are ecologically similar and there currently is not enough data to support a separate *C. senta* Alliance.

***Carex barbara* Alliance**
***Carex senta* Provisional Association**

9c2. *Carex serratodens* is the sole dominant species or, in Knoxville, may be co-dominant with *Cirsium cymosum* or *Stachys* spp. along seeps, near streambanks, or in other wetland settings.

***Carex serratodens* Provisional Alliance**

9c3. *Juncus arcticus*, the dark brownish-green rhizomatous rush, is dominant, characteristic, or co-dominant with *Leymus triticoides* in the herbaceous layer, often along creeks or near seeps and springs.

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

9c4. An iris-leaved species of *Juncus* (e.g., *J. oxymeris*, *J. xiphiooides*) dominates near creeks or in other wetland settings.

***Juncus* (*oxymeris*, *xiphiooides*) Alliance**

9c5. *Leymus triticoides*, the pale green creeping grass, dominates or characterizes stands. Stands are usually too small to map and often occur adjacent to edges of wetlands or riparian areas. If *Juncus arcticus* is co-dominant and/or grows with more even distribution, key to *J. arcticus*.

***Leymus triticoides* Alliance**

Section V. Sparsely vegetated outcrops and other settings where vegetation is limited by the lithic nature of the substrate. Vegetation often largely absent and not uniformly distributed across a landscape surface, not composed of evenly-spaced trees or shrubs, or not characterized by herbaceous species most of the time. In the study area, stands are characterized by *Streptanthus*.

California Cliff, Scree, and Other Rock Vegetation Macrogroup

In Knoxville, one survey characterized by *Streptanthus morrisonii* with trace cover, was found on a northwest-facing serpentine barren. No other species were observed in the stand, which was adjacent to *Quercus durata* scrub.

Central California Coast Ranges cliff and canyon Group

***Allium falcifolium-Eriogonum* spp.-*Streptanthus* spp. Provisional Alliance**