Survey of California Vegetation Classification and Mapping Standards

March 6, 2024

Abstract

The Survey of California Vegetation (SCV) defines the process of vegetation classification and mapping as a series of integrated steps. The process begins with the collection of vegetation data in the field in a standardized format and following established protocols. The field data is then analyzed to produce a hierarchical classification of vegetation types that conforms to the United States National Vegetation Classification Standards (FGDC, 2008). A quantitative, rule-based key to each vegetation type is developed, and detailed descriptions are written for all vegetation types in the project area. The next step is the creation of a fine-scale digital vegetation map consisting of polygons based on aerial imagery; each polygon is coded with the vegetation type and an array of standardized attributes such as cover, structure, and disturbance level. Finally, the accuracy of the completed map is assessed through field surveys and scored following protocols that ensure impartiality. A summary of the standards for each of these steps is provided here. For more detail, please follow the links provided within.

Introduction

This document covers requirements for all steps in the integrated vegetation classification and mapping process. It is divided into three sections: Classification, Mapping, and Accuracy Assessment. An individual project may be limited to only one step (e.g., creation of a vegetation map based on an existing SCV-compliant classification), so only one section of this document may apply. A list of the deliverables for a complete vegetation mapping project, including an outline of the report content, is provided in the Vegetation Classification and Mapping Project Deliverables document.

There may be instances where some minor deviation from these standards is appropriate and/or necessary. If an instance arises that is not addressed by these standards, please contact California Department of Fish and Wildlife's (CDFW) Vegetation Classification and Mapping Program (VegCAMP) to discuss other possible options.

Please direct any questions or comments on these standards to the California Department of Fish and Wildlife's Vegetation Classification and Mapping Program.

Survey of California Vegetation Classification and Mapping Standards
Classification

Data Collection for Classification

The SCV process starts with the collection of plant and environmental data in the project area. Spatial information is captured using a GPS device with a minimum of 10 meter (m) accuracy. All other data may be recorded on standard paper forms or an electronic device. Data from the field surveys is transferred to a database, checked for quality and consistency, and prepared for use in the classification and mapping processes.

1. Sample Allocation

Sample collection sites are allocated such that multiple samples of each vegetation type are collected throughout the range of the type within the project area. Sample allocation should employ an analysis that balances three goals: a target number of samples is achieved based on workload predictions for the staff conducting the field surveys; the samples are distributed among the types so that both rare and common types are represented; and access to the collection sites is facilitated based on land ownership and proximity to roads or access trails. VegCAMP has employed several methods for sample allocation. These include Generalized Random Tessellation Stratified (GRTS) survey design (Stevens and Olsen, 2004) and a gradient-directed transect (gradsect) approach as described in Appendix B of the Yosemite National Park Vegetation Classification and Mapping Report (Keeler-Wolf et al., 2012). There is no standard for sample allocation.

In addition to providing the foundation for the hierarchical vegetation classification, the vegetation surveys document plant species locations for use in other applications, such as determining species ranges and abundances.

2. Field Sampling

   a. All vegetation data will be publicly available upon request and may be posted is online data portals, such as CDFW's Biogeographic Information and Observation System (BIOS) and other data-sharing utilities; no confidentiality agreements may be made with landowners.
   b. Permission to sample is required from all landowners, public and private. For CDFW-funded projects, written permission is required.
   c. Effort should be made to obtain access to as much of the study area as possible, including private lands, to ensure we are capturing all the vegetation types possible.
   d. The timing of data collection should coincide with phenology appropriate for the type of vegetation being surveyed, e.g., herbaceous vegetation must be sampled when the herbs are fully developed and flowering/fruiting to obtain reliable identification and accurate cover values.

e. Generally, for new vegetation types, at least 10 samples should be collected. Field surveys are taken using the "Combined Vegetation Rapid Assessment and Relevé Field Form" and following the "Protocol for Combined Vegetation Rapid Assessment and Relevé Sampling Field Form." Additional information may be collected based on specific project needs, such as evidence of Sudden Oak Death, etc.

f. All data collected in herbaceous vegetation follows the Relevé protocol. Data collected in shrublands and woodlands follows the Rapid Assessment protocol.

g. Each survey is assigned a unique identifier of eight alpha-numeric digits.

h. Field staff should be trained in vegetation sample design, plant identification, cover value estimation, and how to choose appropriate stands for sampling. They should also be familiar with vegetation classification concepts and with the US National Vegetation Classification Standards (USNVC). Training can be provided by the California Native Plant Society's (CNPS) Vegetation Program.

i. Keying should be done to match the Jepson E-Flora, but nomenclature and species codes must conform to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) PLANTS Database (USDA, NRCS, 2015) whenever possible.

j. All species are identified to the finest taxonomic level possible. All species with 1% cover or more in a plot, or with <1% cover, but occurring in multiple plots, should be identified to genus, species, and infraspecific level when possible.

k. Although not a requirement, voucher specimens should be taken and deposited in a recognized herbarium, particularly of plants outside their known range, new invasive species, or other unusual occurrences. Care must be exercised when collecting plants that may be rare. See the section on Voucher Collection in "Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities" on the CDFW website for more information. When a special status plant is located, data must be submitted to the California Natural Diversity Database (CNDDB).

l. Ground level photographs are taken in four cardinal directions at each sampling location. Additional photos can be taken when needed to characterize the stand.

3. Field Data Entry, Archiving, and Quality Checking Standards

a. Data from paper field forms is entered into the SCV-standard database framework (an Access database template can be obtained from VegCAMP).

b. If a digital recording device is used in the field to collect data that would otherwise go on the paper form, the data is structured so that it can be easily imported into the standard database.

    c. Archiving
       (1) Original paper data forms are stored so that they are accessible if any questions should arise concerning the surveys. Scanned copies are also made and archived with other project information.
       (2) Digital ground-level photos taken at each survey location are placed in a folder that is named with the unique identifier of the survey.
    d. Quality control
       (1) The geographic location of each survey is checked to be sure it is in the expected place, i.e., the sample point is on the property listed on the field form and is apparently in the sampled stand based on image interpretation. Field personnel are consulted when the location seems incorrect.
       (2) The values for all attribute fields are reviewed to be sure they lie within reasonable ranges for that attribute.
       (3) If data is entered from paper forms, it should meet a 99% accuracy rate for plant species and 95% for other fields, based on a random sample of the data.

Data Analysis for Classification

All plant species data collected for a project feed directly into a numerical analysis that clusters similar field samples together based on species composition and dominance. The groups formed and refined during this analysis are the basis of the hierarchical classification that defines the vegetation types used for the project.

4. Data Preparation Standards
    a. All botanical names in the dataset use standard nomenclature and have accompanying plant codes. The USDA NRCS PLANTS Database codes USDA, NRCS, 2015) are used as the standard, except in instances where a plant is recognized by The Jepson E-Flora, but not NRCS. In such cases, please contact VegCAMP for the proper plant code.
    b. Plant species that appear to be outside their known range are investigated and resolved.
    c. Data entry errors for plant names are checked by reviewing taxa with similar names and/or codes (e.g., ARDO3, *Artemisia douglasii* vs. ARDO4, *Arundo donax*).
    d. Subtle differences in the coding of infraspecific taxa are reviewed to ensure that one taxon was not entered in multiple formats [e.g., *Eriogonum fasciculatum* ssp. *foliolosum* (ERFAF5) versus *Eriogonum fasciculatum* var. *foliolosum* (ERFAF2)].

Note: At this point, the plant species data must be copied into a separate table, so that the detailed plot-related plant data will not be affected.

e. Taxa identified only to genus or family are reviewed and, in most cases, deleted from the dataset to reduce statistical noise.

f. Closely related taxa that occur in overlapping ecological settings may be merged into one taxon to reduce statistical noise.

g. Percent cover estimates for each taxon in the dataset are grouped into predetermined cover classes to normalize the dataset. Braun-Blanquet categories with 7 cover classes are the standard (1=<1%, 2=1-5%, 3=>5-15%, 4=>15-25%, 5=>25-50%, 6=>50-75%, 7=>75%), though occasionally presence-absence categories (0=absent, 1=present) are used. Alternatively, percent cover values can be standardized using General Relativization in PC-Ord. This process replaces absolute cover values with proportions of the total sum of cover values within a sample unit.

h. A table with 3 fields (survey ID, plant code, and cover class) for each field sample is generated.

i. Samples should not be spatially autocorrelated if the project has a good sampling methodology; however, samples included from other sources should be removed prior to analysis if they are spatially autocorrelated with samples from the project.

5. Data Analysis Standards
(Note: The following steps, a through h, are based on using PC-Ord software. If other software is used, similar program-specific steps should be taken.)

a. The data from the preceding step is imported into software suitable for analyzing ecological datasets and converted into a plot-by-species matrix.

b. Statistics that summarize alpha and beta diversity and the coefficient of variation (CV) for both plots and species are run on the plot-by-species matrix. These statistics measure data dispersion or variance in a dataset.

c. Outlier analyses are run on the plot-by-species matrix to flag outliers that are more than 3 standard deviations from the mean.

d. Taxa that occur in a small number of plots (i.e., less than 2, 3, 4, and 5 plots) are removed to generate additional plot-by-species matrices. The summary and outlier statistics mentioned in the previous two steps are repeated on these matrices.

e. A plot-by-species matrix with lower alpha and beta diversity and a lower CV for species (typically <200%) is selected. All species and plot outliers are removed from this matrix.

f. Agglomerative hierarchical cluster analysis that groups surveys together based on similar frequency and abundance is run on the selected matrix.

g. Indicator species analysis is run on the cluster diagram to show which species are indicators of each group when the cluster diagram is divided into 2 versus 3 versus 4 versus … 50, etc. groups. Two or three grouping levels that divide the cluster diagram into groups with the lowest average p-values

and highest number of significant indicators are selected to drive the vegetation classification process.

h. For large datasets, especially those with more than 500 samples, it is often recommended that the analysis steps above be run in stages. The initial stage involves analyzing all the samples in the full dataset together and using the cluster output to determine how to break the dataset into more manageable groups or subsets. Additional stages involve repeating the full analysis on each of the smaller subsets.

6. Vegetation Classification
The vegetation classification is developed based on the cluster groupings from the analyses described above. Ecologists use the frequencies and abundancies of the taxa that hold cluster groupings together ("indicator species") and information from existing classification reports to classify all surveys in the cluster analysis to the lowest level of the hierarchy possible (e.g., Alliance and/or Association). Finer-level cluster groupings guide classification of data to Association, while broader groupings guide classification to Alliance.

a. After the classification is established, surveys that were deleted from the analysis because they were flagged as outliers are reviewed and, if they share strong similarity with existing types, assigned final classification names.

b. The vegetation classification is provided to VegCAMP and/or the California Native Plant Society (CNPS) Vegetation Program for review, to ensure compliance with the Manual of California Vegetation (Sawyer et al., 2009) and the USNVC.

Vegetation Key, Map Classification, Descriptions, and Crosswalks

Four tools are developed from the hierarchical vegetation classification. The vegetation key is used by mappers to help choose vegetation types for the polygons they draw. The map classification is derived from the vegetation classification, with modifications dependent upon the resolution of the base imagery. Each map can have map classes at a variety of levels in the NVCS hierarchy from Macrogroup down to Association. Detailed descriptions of all vegetation types found in the project area are written. Crosswalks to other vegetation classification systems are provided so that the results of this project can be compared to other studies.

Examples of a vegetation classification, key, and crosswalks can be found in the "Classification of the Vegetation Alliances and Associations of the Northern Sierra Nevada Foothills, California Vol. 1." Examples of vegetation descriptions are found in these reports: "Classification of the Vegetation Alliances and Associations of the Northern Sierra Nevada Foothills, California Vol. 2" and "Classification of Modoc and Lassen Counties, California 2021."

7. Vegetation Key

a. Definitions of terms used in the key, such as absolute cover, dominance, stand, etc., are included at the beginning of the key.
b. The key is organized by layer (tree, shrub, herb, and sparse vegetation), and then by Alliance and Association.

8. Map Classification
   a. The map classification is based on the vegetation classification, but is restricted by what is discernable from the aerial imagery. For instance, if the vegetation classification includes an *Atriplex polycarpa* Alliance and an *Atriplex canescens* Alliance, but these two types cannot be distinguished from one another on the aerial imagery, an *Atriplex polycarpa-Atriplex canescens* Mapping Unit may be created in the mapping classification. Since these are non-standard classification units, careful consideration must be given to the naming of mapping units based on their relationships to the nested vegetation classification hierarchy. Ideally, they should nest within the same Group or Macrogroup, should be named by the dominant or characteristic species present, and be described in detail and documented with reconnaissance data. The hierarchy is in flux, and this documentation will allow the map to be updated in the future.
   b. Each vegetation type may be assigned a map code derived from the hierarchy of the types within the map classification.

9. Descriptions
   a. Descriptions of each Alliance and Association should have the following information:
      (1) A summary of the vegetation type, with a short description of the vegetation and the salient environmental characteristics
      (2) The distribution within the study area
      (3) A table of the means and ranges of cover values for each stratum
      (4) A summary of the environmental data
      (5) The number of samples used to describe the type and the sample identifiers
      (6) A discussion of the global distribution of the type, if known
      (7) Rarity status (if this is a newly described type, rarity would be estimated in consultation with VegCAMP)
      (8) "Stand tables" summarizing percent constancy and abundance (minimum, maximum, and average) values for each species in a type

10. Crosswalks
    a. A crosswalk of the final vegetation types to the US National Vegetation Classification Standard should be provided, organized according to the hierarchical structure of the USNVC.
    b. Crosswalks to other commonly used classifications, such as California Wildlife Habitat Relations (CWHR), are encouraged but not required.

Vegetation Mapping

Vegetation maps consist of geospatially registered polygons which are interpreted through analysis of aerial imagery using head's-up digitizing, image segmentation, or other techniques. Each map polygon is described with the vegetation type along with other attributes, such as strata cover values and environmental information, which allow the map geodatabase to be analyzed in multiple ways. For example, the conifer tree cover attribute allows one to query the map for all vegetation stands that have conifers, regardless of the vegetation type.

Vegetation mappers must have a good ecological knowledge of the vegetation types in the mapping area. This ecological knowledge is reinforced by the field reconnaissance surveys that are performed in order to match vegetation signatures on aerial photographs with actual vegetation types on the ground. The reconnaissance surveys may be augmented by Rapid Assessment and Relevé information compiled during the vegetation classification phase of the project. The vegetation key and descriptions of vegetation types that were developed during the classification phase are additional tools in the mapping process. Ancillary data that can assist the mappers includes datasets such as geology, soils, fire history, topography, or rare plant occurrence maps.

The standards presented here apply to areas being mapped for the first time. For projects that require remapping or update, please contact VegCAMP to discuss methodology.

These standards may change with greater availability of LiDAR or other remotely sensed data that will allow interpretation of greater detail.

11. Mapping Standards
    a. The base imagery for a mapping project should be consistent throughout the project area and ideally should be readily available to all agencies and the public. The base imagery must meet or exceed the National Agriculture Imagery Program (NAIP) resolution standards (1 m ground sample distance) and must match the spatial accuracy of the most recent NAIP product. The vegetation type attribution is at least to the Alliance level when possible; if the resolution of the imagery does not allow attribution to that level (as is the case with most herbaceous types), the Group or Macrogroup level is acceptable, depending upon the specific purpose of the map
    b. All vegetation cover is reported as absolute percent cover in a bird's-eye view. This equates to the cover of each layer that can be seen (i.e., that is not covered by a higher layer). Cover also takes porosity into account. This means that if conifer canopies cover 10 % of the stand, but are themselves only 50% opaque to the ground, then the cover estimate should be 5%.
    c. Cover values for woody vegetation are recorded in 1% increments.
    d. Cover values for herbaceous vegetation are recorded in the following cover classes: <2%, 2-9%, 10-40%, >40%.
    e. The minimum mapping unit (MMU) varies with the size of the project, but is not greater than 10 acres and is usually 1 or 2 acres; wetlands and other

special types are mapped at ¼ acre. The minimum width of polygons depends on the MMU, but is generally no less than 30 feet (10 meters) although narrower portions of stands may be included to preserve the continuity of linear stands such as riparian corridors. MMUs have varied between the desert and other parts of the state, and MMUs for wetlands have likewise varied. MMUs must be defined prior to mapping.

f. For project-level maps such as for environmental review or land management planning, the MMUs will likely be smaller; higher resolution imagery and the ability of ecologists to visit all or most of the stands on the ground can allow a higher resolution map. MMUs may also vary by lifeform, with even very small MMUs for sensitive herbaceous communities, for example, *Selaginella bigelovii* stands on a rock outcrop. They may also be smaller for types of concern such as invading Arundo donax stands that will need treatment, depending on the purpose of the map. MMUs will depend on the needs or requirements of the lead and trustee agencies and the needs for impact assessment and mitigation planning.

g. A consideration related to MMUs is the distances between isolated trees or shrubs from nearby related vegetation. If the distance is greater than the normal distribution within a stand then the isolated trees or shrubs should not be included in the nearby related stand but aggregated with the surrounding vegetation. For example, isolated *Quercus douglasii* trees surrounded by grassland should not be included in a nearby *Q. douglasii* stand if the distance between the isolated trees and the stand is greater than the normal spacing of the trees within the stand. They should be aggregated with the grassland as emergent trees.

h. Rules for aggregating stands/fragments that are below MMU
   (1) A below-MMU vegetation unit that is completely surrounded by another vegetation type is aggregated with the surrounding type.
   (2) Similar growth forms are combined when possible: tree-dominated types are aggregated with other tree-dominated types, shrub types with other shrub types, and herbaceous types with other herbaceous types.
   (3) If a below-MMU vegetation unit is the same growth form as two adjacent larger stands, and the adjacent stand types are very dissimilar in environment, the unit may be aggregated with the more environmentally similar type.
   (4) Whenever possible, wetland vegetation types are not aggregated with upland types, even if they are in the same growth form.

i. Rules for dividing polygons
   A polygon of a single vegetation map unit should be divided into smaller polygons based upon a change in cover class. Even though cover is attributed in 1% increments, the recommended cover classes to be used for dividing polygons of woody vegetation are the Braun-Blanquet categories

(1=<1%, 2=1-5%, 3=>5-15%, 4=>15-25%, 5=>25-50%, 6=>50-75%, 7=>75%). The cover classes used to determine divisions of herbaceous vegetation are: <2%, 2-9%, 10-40%, >40%. Classes used for breaks and MMU for breaks must be defined prior to mapping.

(1) Overstory cover break
  (a) Break a polygon on overstory cover if there is a change in cover class of the dominant/nominal layer. For example, if the vegetation is shrub-dominated, a change in cover class of the shrub layer is reason for a polygon division.
  (b) For projects with a 1-acre MMU, there is typically a 3-acre MMU for a break in the overstory cover, i.e., the resulting polygons must be at least 3 acres in size.

(2) Understory and emergent cover break
  (a) Break a polygon on understory cover or the emergent overstory cover if there is a change in cover class of the understory or emergent overstory layers. For example, if the vegetation is tree-dominated, a change in cover class of the shrub layer or a cover class break in the herbaceous layer as in (hi.) above is reason for a polygon division. Or, if the vegetation is shrub-dominated, a change in the cover class of the emergent tree layer (i.e. <1% to 1-5%) as in (i.) above is reason for a polygon division.
  (b) For projects with a 1-acre MMU, there is typically a 5-acre MMU for a cover class break in the understory or emergent overstory layers. Again, MMUs have varied between the desert and other parts of the state.

(3) Height and size class break for tree types, unless these have been modeled after mapping (see i.11 and i.12).
  (a) Break a polygon on tree height if there is a change in the height class or CWHR size class of the tree layer.
  (b) For projects with a 1-acre MMU, there is typically a 3-acre MMU for a break in tree height or size class.

j. Required mapping attributes for natural vegetation polygons include:
  (1) Vegetation type
  (2) Conifer cover
  (3) Hardwood cover
  (4) Total tree cover
  (5) Total shrub cover. Depending on the imagery used this may not be interpretable over a certain percent cover of overstory trees.
  (6) Total herb cover. Depending on the imagery used this may not be interpretable over a certain percent cover of overstory trees or shrubs.
  (7) Non-native species (exotics) cover (see mapping template geodatabase)
  (8) Roadedness

(9) Clearing (or anthropogenic alteration)

(10) Attribution method (MethodID): the polygon was attributed through image interpretation, based on a field survey, or based on a less-formal field reconnaissance

(11) Modal California Wildlife Habitat Relationship (CWHR) size class for trees (can be modeled based on field data). The classes are:

T1	<1" dbh
T2	1" to 6"
T3	>6" to 11"
T4	>11" to 24"
T5	> 24"
T6	Multilayer: Mature trees over younger trees
99	not applicable

(12) Modal Tree height (can be modeled based on field data). The classes are:

1	< ½ m
2	½ - 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
99	not applicable

(13) Other project-specific attributes (such as other disturbances like hydrological modification, sudden oak death, etc.)

k. Land use category for polygons that are not native vegetation. The minimum is Anderson Level I classes (Anderson, et al., 1976).

12. Geodatabase Quality Checking

   a. A topology check is done to eliminate gaps and overlaps.

   b. Acreage for all polygons is checked to identify slivers and polygons that are below the MMU. Polygons that are smaller than the MMU are reviewed to determine if they should be merged with adjacent polygons or kept as exceptions (e.g., polygons that are truncated by the project boundary).

   c. Attributes are checked to make sure there is a value for every attribute. "N/A" rather than a NULL value is used if an attribute does not apply to a specific polygon.

   d. Attributes are checked for obvious errors such as nonsensical cover values (e.g. is the total tree cover lower than the conifer cover and hardwood cover combined? Is there a shrub cover value for all shrub type polygons?).

e. If a notes field is used, it is checked to ensure that all information is relevant and useful. Any questions or notes that were used during the mapping process are removed. Abbreviations are changed to fully spell out the intended words.

13. Geodatabase Metadata

a. The following should be included in the vegetation map metadata:

(1) A summary describing the purpose of the mapping project, how the project boundary was determined, the mapping classification used and level of the hierarchy mapped.

(2) A description explaining why the dataset was made, who made it and for whom.

(3) The date and source of the base imagery and the field samples used in the mapping project. Also list imagery or other datasets used as ancillary information. Any dataset foundational to a segmentation-produced map, like Light Detection and Ranging (LiDAR) should be described including year of acquisition and quality (like Topographic Data Quality Levels (QL)) links to the metadata for those datasets included if available

(4) Contact information for an individual or organization that is knowledgeable about the dataset, including the name, telephone number and/or email.

(5) A full description of each field and its potential values. Note whether the value was directly interpreted or modeled (such as for tree height and size), and if modeled, how it was modeled. If an attribute is not required for a given vegetation or land use type, note that it may have the value "not applicable". Any abbreviations or coding used in the field should be explained.

(6) Minimum mapping unit for all mapping types and minimum polygon width, including MMUs for overstory and understory cover breaks and other attributes.

(7) How polygons on the mapping area's boundary were mapped (e.g., only up to the edge, with a buffer, or so the entire stand is mapped), attributed (e.g., is disturbance for the entire stand included, or just evaluated within the portion of the stand within the project boundary), and edge-mapped or seamed with an existing map.

(8) Any access or use constraints on the map. If there aren't any, put "None".

(9) A description of the Accuracy Assessment method and results.

(10) Citations and web addresses for project reports.

(11) Update frequency, if the map will be updated.

(12) The physical and/or digital location of any field datasets such as sample point locations, Relevé/Rapid Assessment field data forms, field photos, or herbarium specimens

Map Accuracy Assessment

An Accuracy Assessment (AA) analysis helps the map users determine how much confidence can be assigned to each of the mapped vegetation types and provides an understanding of the map's appropriateness for various applications.

Polygons are selected for assessment from the draft vegetation map and are presented to the field crew for survey. In order to prevent bias during the field surveys, the AA field map shows only the outlines of the polygons to be visited; vegetation type and map attributes are not shown. The field observations are then compared to the draft map attributes and each polygon is scored. To ensure the impartiality of the Accuracy Assessment process, members of the field survey team cannot have mapped the area they survey and scorers cannot have mapped or surveyed the area they score.

The mappers are given the results of the Accuracy Assessment, including scores and comments for specific polygons, so that both specific and systematic errors can be corrected prior to map finalization.

An example of the Accuracy Assessment process, including goodness-of-fit (also known as fuzzy logic) scoring, can be found in "Northern Sierra Nevada Foothills Project: Vegetation Mapping Report."

14. Accuracy Assessment Standards
    a. The Survey of California Vegetation requires 80% overall accuracy for vegetation maps.
    b. Every map must be verified. However, the formal Accuracy Assessment can be waived if at least 40% of all mapped polygons have been field surveyed, either before mapping or after completion of the draft map; or if types for all or most polygons are assigned in the field.
15. Sample Allocation
    Sample allocation should employ an analysis that balances four goals:
    a. Achieving a target number of samples based on workload predictions for the staff conducting the field surveys
    b. Distributing the samples among the vegetated mapping types so that both rare and common types are represented
    c. Facilitating access to vegetation polygons based on land ownership and proximity to roads or access trails
    d. Ensuring that previously surveyed polygons are not revisited
16. Accuracy Assessment Field Surveys
    VegCAMP does not have a standard field form for Accuracy Assessments, however, examples of two different formats for collecting data can be found in the appendices of these reports: "Northern Sierra Nevada Foothills Project: Vegetation Mapping Report" and "2013 California Desert Vegetation Map and Accuracy Assessment in Support of the Desert Renewable Energy Conservation Plan."

a. For a polygon to be assessed for accuracy, at least 10-20% of its area should be viewed. If this is not possible, the vegetation type and other attributes at the survey point should be recorded as information to the mapper. If less than 100% of the polygon can be viewed, field crews should note whether environmental features such as aspect, slope, and overall topography are consistent throughout the polygon, implying that the entire polygon is likely to be the same vegetation type.
b. The vegetation type is determined using the key and descriptions developed in section C: Vegetation Key, Map Classification, Descriptions, and Crosswalks. A list of dominant species and their corresponding percent cover estimates are recorded, along with values for other mapped attributes.
c. The spatial accuracy of the polygon is assessed and instructions are provided on how to redraw the lines if adjustments are necessary.
d. If the polygon contains more than one vegetation type, notes are provided as to how the polygon should be divided and a separate survey is taken for each type.
e. AA field data is entered into a database to facilitate scoring (an MS Access database template can be obtained from VegCAMP).

17. Scoring
a. Each field-assessed polygon is scored by comparing the vegetation type determined in the field survey to the type assigned by the mapper. A score of 0-5 is given based on a "goodness-of-fit" approach, where ecological and floristic similarities are considered.
b. Other information gathered in the field is provided to the mappers for reference, but does not contribute to the score.
c. After the map accuracy has been assessed, the mappers may update the map with the approval of CDFW or the contracting agency. If 80% accuracy is not attained for a particular vegetation type, polygons may be modified by:
    (1) aggregating to a less specific hierarchical unit (e.g., from Association to Alliance level; from Alliance to Group level);
    (2) keeping the vegetation type, but reporting that its accuracy is lower than typically acceptable, as long as the overall map accuracy is still 80%; and/or
    (3) making specific and systematic corrections to the polygon attributes or delineations based on the AA results.

Literature Cited

Anderson, James R., Ernest E. Hardy, John T. Roach, Richard E. Witmer. 1976. A Land Use and Land Cover Classification System For Use With Remote Sensor Data. U. S. Geological Survey Professional Paper 964. (https://archive.usgs.gov/archive/sites/landcover.usgs.gov/pdf/anderson.pdf, accessed January 2019)

Federal Geographic Data Committee (FGDC). 2008. National Vegetation Classification Standard, Version 2 FGDC-STD-005-2008. Vegetation Subcommittee, FGDC Secretariat, U.S. Geological Survey. Reston, VA. 55 pp. + Appendices.

Keeler-Wolf, Todd, Peggy E. Moore, Edward T. Reyes, John M. Menke, Deborah N. Johnson and Denise L. Karavidas. 2012. Yosemite National Park Vegetation Classification and Mapping Report. Natural Resource Technical Report NPS/YOSE/NRTR—2012/598. US Department of the Interior National Park Service, Fort Collins, CO.

Sawyer, J.O., T. Keeler-Wolf, and J.M. Evens. 2009. A Manual of California Vegetation, Second Edition. California Native Plant Society, Sacramento. 1300 pp.

Stevens, Don L. and Anthony R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99:262-278.

USDA, NRCS. 2015. The PLANTS Database (http://plants.usda.gov, 4 June 2015). National Plant Data Team, Greensboro, NC 27401-4901 USA.