# Acquisition of Imagery for Vegetation Mapping

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## Considerations

Scale: The decision on what scale (or resolution) you need (e.g., 1:500 or 1:24,000) requires that you understand the minimum size of vegetation units or other features that you want to be able to discern. The best approach for the uninitiated is to take some time inspecting existing imagery of the same area taken at different scales, looking for small patterns that you wish to be able to reliably identify. In general, we recommend using digital aerial photography with a base scale of at least 1:24,000 or larger for photo interpretation of vegetation alliances and associations.

Cost: For large areas, existing imagery is generally much less expensive than having your own flown. For small areas, imagery acquired with a drone is ideal.

Black and White, Color Infrared, or True Color: This choice is best decided by looking at some examples of an area you know with respect to what you are hoping to detect. True color works best for desert and other dry environments. CIR works well for mesic to wet environments and also in sparsely vegetated settings where it emphasizes individual shrubs. Black and white is cheaper (and your only choice for historical vegetation mapping), but subtleties are lost in distinguishing variants of life forms. Many photo interpreters find that it is a toss-up between true color and color-infrared as to the most useful product in well-vegetated parts of the state.

Time of Year: In California, generally the summer is the best time to have imagery flown. The months of June, July, and August usually mean lower shadow cover in land with sharp topography, and it is past the confusing "green-up" time of the spring when all vegetation looks surprisingly similar. Cloud cover is also generally low. There are exceptions: high montane areas may need to be flown later to reduce snow cover, and marshes and wetlands need to have full phenology of emergent wetland species, which doesn't usually occur until mid to late summer.

Age of Imagery: Older imagery may be suitable for some applications or vegetation types, but generally the more recent the imagery, the better, particularly for vegetation types that change rapidly or are subject to disturbances such as fire or flooding. A wide array of imagery may be available in government or the archives of private firms. However, depending on the part of the state and the type of vegetation, changes happen rapidly and you need to be able to depict the existing conditions. Again, you must think about the purpose of your mapping.

Orthorectification: Some imagery types, such as digital orthophoto quadrangles ("digital ortho quads" – DOQs, or quarter-quads - DOQQs) are *orthorectified*, that is, the distorting effects of relief displacement and imaging geometry have been removed so that the image has the same spatial qualities as a map. Imagery can also be simply *rectified*, that is, georeferenced but not corrected for relief displacement and imaging geometry. If your vegetation boundaries are drawn using imagery that has not been orthorectified, in most cases the boundaries will need to be rectified later to make a useful vegetation map. Don't be deceived by relatively cheap prices for imagery; most cheap new imagery is not orthorectified, and to do it yourself takes time and expertise. The orthorectification process is essential to develop accurate vegetation maps. If at all possible obtain orthorectified imagery if doing digital interpretation. The more accurate the orthorectification, the more it will cost.

Combining different types of imagery: You may want to use supplemental imagery to increase your ability to interpret your base orthorectified imagery, or to update it if there has been a disturbance to the mapping area. Bing, Google Earth and even Street View in Google Maps are useful. If your map may be used in legal proceedings, the map must reflect the conditions at the date of the imagery, or any changes based on supplemental imagery must be well-documented.

Government Sources

*National Aerial Photography Program (NAPP).* For fairly recent air photos, see the following for information on this program and on ordering: http://eros.usgs.gov/aerial-photography

*National Agriculture Imagery Program (NAIP)* acquires imagery during the agricultural growing seasons in the continental U.S.
http://www.fsa.usda.gov/programs-and-services/aerial-photography/imagery-programs/index

*USGS Digital Orthophoto Quadrangles (DOQs).* See the following for information on this imagery and on ordering: https://lta.cr.usgs.gov/DOQs

*USGS EarthExplorer.* This is the online catalog of existing government imagery including everything from de-classified experimental satellite imagery to very old black and white aerial photography. https://lpdaac.usgs.gov/data_access/usgs_earthexplorer

*USGS High Resolution Orthoimagery.* The USGS, along with the National Geospatial-Intelligence Agency (NGA), are acquiring high resolution orthoimagery for major metropolitan areas and state capitals of the United States. While primarily covering urban areas, there are sometimes non-urban areas of coverage included.
https://lta.cr.usgs.gov/high_res_ortho

*Cal-Atlas* has a variety of free downloadable data including NAIP true color imagery, USGS DOQ/DOQQ (mostly black and white with some color infrared) and High Resolution Orthoimagery, Landsat satellite imagery, as well as a broad library of other data including Digital Raster Graphics (DRGs - scanned topo maps), hydrography, ownership, and boundary layers, etc. http://www.atlas.ca.gov/download.html

*USDA Geospatial Data Gateway.* This site has free downloadable NAIP imagery as well as USGS DOQ/DOQQ mosaics and other miscellaneous data. http://datagateway.nrcs.usda.gov/

*USGS Seamless Data Distribution System (SDDS).* This site offers free data downloads including USGS DOQ and High Resolution Orthoimagery (primarily covering urban areas, although sometimes non-urban areas of coverage are included), Landsat satellite imagery, and various other products. http://nationalmap.gov/viewer.html

Private Sources

Private companies may have stock photos of your study area or can be hired to acquire air photos. In addition, a various open source imagery resources are available online through ESRI's ArcGIS Online, Google Earth, Bing, etc.

Historical Air Photos

*National Archives.* Historical air photos can be useful as an ancillary data source, or to determine change over time. http://www.archives.gov/research/search/

*Map and Imagery Laboratory at UC Santa Barbara* also has digital historical imagery, particularly for Southern California http://www.library.ucsb.edu/mil

*UC Berkeley's Earth Sciences & Map Library* http://www.lib.berkeley.edu/EART/air-catalog.html

See also *Whittier College's Fairchild Collection*

Existing Vegetation Maps/Projects

*California Department of Fish and Game.* DFG's IMAPS viewer, BIOS, includes vegetation maps from around the state, such as Western Riverside County and Anza Borrego State Park. Or see the VegCAMP data webpage: https://www.wildlife.ca.gov/Data/VegCAMP

*CalFire Fire and Resource Assessment Program (FRAP).* Datasets available include CALVEG, a relatively coarse-scale vegetation map largely of the forested portions of the state derived from Landsat imagery in 1977, and CA Land Cover Mapping & Monitoring Program (LCMMP) updates through 2002, produced in cooperation with the USFS Remote Sensing Lab. http://frap.fire.ca.gov/data/frapgisdata-subset.php and http://www.fs.usda.gov/main/r5/landmanagement/gis

*Multi-source Land Cover Data.* FRAP compiled the "best available" land cover data (including CALVEG and GAP) into this single data layer. Cross-walks were used to compile the various sources into the common California Wildlife Habitat Relationships (CWHR) system classification. http://frap.fire.ca.gov/data/frapgisdata-sw-fveg_download

*California Gap Analysis Project (GAP)*, Biogeography Lab, UC Santa Barbara and USGS-Biological Resources Division, produced a coarse-scale vegetation and land use map in 1998: http://www.biogeog.ucsb.edu/projects/gap/gap_home.html

GAP Analysis Program (GAP) (aka Re-GAP). GAP is conducted as regional- and state-level projects and is coordinated by the USGS. It is a cooperative effort among regional, state, and federal agencies, and private groups as well as the USGS for inventory, monitoring, research, and information transfer. http://gapanalysis.usgs.gov/data/

*USGS - NPS Vegetation Mapping Program.* Maps around the nation, including those from California: John Muir National Historic Site, Pinnacles National Park, Point Reyes National Seashore, Joshua Tree National Park, Yosemite National Park, and Sequoia & Kings Canyon National Parks, with others to follow. https://science.nature.nps.gov/im/inventory/veg/

*DataBasin*. Mapping tools and data presented as a science-based mapping and analysis platform that supports learning, research, and sustainable environmental stewardship. https://databasin.org/

Miscellaneous

*The California Coastal Records Project* has very high quality, although non-orthorectified photos of the immediate coast of California. It's good ancillary data if you're working right on the coast. http://www.californiacoastline.org/

*The California Historic Topographic Map Collection.* Chico State University supports this online collection, with digital maps throughout the state, including quite a few from the late 1800's. These may be useful for identifying old river alignments, pre-development topography, abandoned place names (ranches, railways, and roads), land grants and other features for the historical context of conservation planning. http://www.csuchico.edu/special-collections/collections/maps.shtml

*Wieslander Vegetation Type Map (VTM) project.* This project has digitized the VTM dataset, which was compiled in the 1920s and 30s and consists of photos, species inventories, plot maps, and vegetation maps covering most of California. A shapefile of the vegetation map is also available. http://vtm.berkeley.edu/

*National Wetland Inventory (NWI) Wetlands Mapper.* The Wetlands mapper is designed to deliver easy-to-use, map like views of America's Wetland resources. It integrates digital map data along with other resource information to produce current information on the status, extent, characteristics and functions of wetlands, riparian, and deepwater habitats. https://www.fws.gov/wetlands/data/mapper.HTML