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## Denver Botanic Gardens Research and Conservation Field Work Metadata Dictionary

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## Abstract

Glossary of terms agreed upon and used by Denver Botanic Gardens Research and Conservation during the 2018 field season.

## Attachments



FieldWork\_MetadataDi...

298KB

## Introduction

This booklet serves as a reference dictionary for terms used while recording data in the field relating to specimens, biological assets, surveys, monitoring, location and site descriptions, etc.

Regular use and consultation of this booklet allows for researchers across projects to describe biodiversity consistently and informatively, as well as use the same terms when describing processes.

## General Terms

### Specimen/Voucher

An individual or part of an individual plant, fungus, or animal that represents the occurrence of its species at a specific time and location that is to be accessioned and deposited within a permanent museum collection.

### Biological Asset

An individual, lot of individuals, part of an individual, or sample of a plant, fungus, animal, soil, or otherwise biological material that is collected with the intention of being used for further research. Biological Assets are not to be deposited within a permanent museum collection. Examples include, but are not limited to, **plant tissue**, **fungal tissue**, **seeds**, and **soil samples**.

### Sampling

The taking of data or materials that represent a subset of a whole.

### Survey

A general examination and occasionally sampling of an area that may or may not be repeated at a future instance(s).

### Monitoring

The examination and sampling of a specific location, repeated at defined time intervals.

### Occurrence

The existence and documentation of a taxon at a specific time and location. The basis of an occurrence may be a specimen, biological asset, or observation.

### Plot

A defined and delimited polygonal area, within which sampling occurs.

### Transect

A delimited linear area of a defined length and width, along which sampling occurs.



## Field Work Cover Sheet

### Collector/Associated Collectors

Same as Darwin Core term recordedBy.

A list of names of people, groups, or organizations responsible for recording the original Occurrence. The primary collector or observer, especially one who applies a personal identifier (recordNumber), should be listed as collector.

### Date

Same as Darwin Core term eventDate.

The date-time or interval during which an event occurred. For occurrences, this is the date-time when the event was recorded. recommended best practice is using the format **YYYY-MM-DD**.

### Study Site Name

The assigned name of the general site where the study is taking place.

For example: Chatfield Farms, Highline Canal, Peterson Property, Gilpin County Library Fen, Cebolla Creek Middle.

### EO Site Number

The identifier for the Element Occurrence. An Element Occurrence (EO) is an area of land and/or water in which a species or ecological community is, or was, present. Eos are overseen by Nature Serve and Natural Heritage Programs.

### Land Ownership

#### Owner Type

The organization, institution, or type of affiliation describing the owner of the land or property where the study is taking place.

#### Owner Name

The title or name of the person, organization, institution, or governing jurisdiction/authority that owns the land or property where the study is taking place.

### Permit

The accepted name or title of the document that grants permission for researchers to access land and/or collect materials from the agreed and defined locations. Permit names and naming conventions can be found on the Research Drive (Q:) within the PermitInformation Folder.

### Location Information

#### Survey Site Name (Sub-Location)

The assigned name of the specific location where the study is taking place. This can and should refer to the specific **plot**, **transect**, or sub-location within a general study area. Examples include Transect 1, Plot 1, Mile



Marker 1.

### **State**

Same as Darwin Core term stateProvince.

The name of the next smaller administrative region than country (state, province, canton, department, region, etc.) in which the Location occurs.

### **County**

Same as Darwin Core term county.

The full, unabbreviated name of the next smaller administrative region than stateProvince (county, shire, department, etc.) in which the Location occurs.

### **Nearest Population Center, Town or Village**

The nearest named place where which people reside, that is accessible to the research group. (There may be a population center that is physically closer, but not accessible).

### **Latitude**

Same as Darwin Core term decimalLatitude.

The geographic latitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic center of a Location. Positive values are north of the Equator, negative values are south of it. Values lie between -90 and 90, inclusive.

### **Longitude**

Same as Darwin Core term decimalLongitude.

The geographic longitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic center of a Location. Positive values are east of the Greenwich Meridian, negative values are west of it. Values lie between -180 and 180, inclusive.

### **Datum**

Same as Darwin Core term geodeticDatum. **WGS84 preferred**

The ellipsoid, geodetic datum, or spatial reference system (SRS) upon which the geographic coordinates given in decimalLatitude and decimalLongitude as based. Examples include WGS84 and NAD83.

### **Slope**

The angle or estimated angle at which the surface of the site is relative to zero (flat/level). For example, 0° would be flat ground, 45° would be a steep hillside. See Figure 1.

## Aspect

The cardinal direction a slope is facing. If the recorder was lying flat on their back on the slope, the cardinal direction they would be facing.

Accepted values include N, S, E, W, NE, NW, SE, SW, NNE, ENE, NNW, WNW, SSE, ESE, SSW, WSW.

See Figure 2.

## Elevation

Same as Darwin Core term `minimumElevationinMeters`.

The lower limit of the range of elevation (altitude, usually above sea level), in meters. If elevation is recorded in feet, please denote "ft" or "feet".

## Directions (Locality)

Same as Darwin Core term `locality`.

The specific description of the place. This term may contain information modified from the original to correct perceived errors or standardize the description. One can include how they got there, if useful.

## Ecological Description

### Study and Survey Site Name

A concatenation and/or abbreviation, standardized in some cases, of the general Study Site Name and the specific Survey Site Name (Sub-Location). Examples include **DBG\_CF\_Transect1\_JCOS1**, **HLC01**, Cebolla Creek Mid-Plot 22.

**Habitat:** *Habitat descriptions modified from Colorado Natural Heritage Program*

### Eastern Plains and Foothills Region

The eastern plains form much of Colorado's landscape east of the Continental Divide, extending the length of Colorado from Wyoming to New Mexico and east to Nebraska and Kansas. Elevations on the plains rarely exceed 6,000 feet (1829 m). Foothills, which occur at the eastern edge of the Rocky Mountains, form a transition zone between the plains and the mountains, extending from 6,000 (1829 m) to about 8,000 feet (2438 m) in elevation.

### Grasslands (Eastern Plains and Foothills Region)

Graminoids (grasses, rushes, sedges) are the most common and obvious vegetation. Forbs and a few shrubs or trees may be present. The plains of Colorado are in the shortgrass zone, but fingers of mid-grass prairie extend into the short-grass prairie, and patches of tall grasses occur in riparian areas where conditions are sufficiently

moist year-round.

### **Short-grass prairie**

Short-grass prairie covers much of the eastern plains, occurring on drought-prone, mildly alkaline, medium and fine-textured soils. The character of the short-grass prairie is shaped by aridity; average annual precipitation is between 10 and 16 inches (25-40 cm). Mid grasses are able to survive during periods of moderate conditions, but are replaced by blue grama and buffalograss during and following events of stress such as drought or overgrazing. In the absence of such stress, mid-grasses such as needleandthread, sideoats grama, junegrass, and Sandberg bluegrass are common and even dominant, and the many associated forbs can turn the prairie into a colorful wildflower garden in wet summers. Western wheatgrass may form monotypic stands in swales and depressions on clay-rich soils. Few shrubs grow consistently in short-grass prairie because the soils are too dry and compacted to support them; yucca, cacti, fourwing saltbush and rabbitbrush are the most common woody plants on the prairie.

### **Mid-grass prairie**

Mid-grass prairie is found on the western edge of the plains near the foothills and also in pockets in southeastern Colorado on sandy or loamy soils. Here, with generally greater annual precipitation and less stress from drought or overgrazing, grasses of medium height are able to survive.

### **Tall-grass prairie**

Tall-grass prairie is extremely uncommon in Colorado, occurring only in very small pockets along the Front Range where natural and artificial subirrigation supplements soil moisture. It requires well-drained soils that stay moist; this is a difficult combination in the arid climate of eastern Colorado. Individual tall grass species can be found where localized environmental factors support their growth.

### **Foothills grassland**

Localized environmental conditions at the base of the foothills support grasslands at higher elevations than is typical of the eastern plains. Pockets of mid and tall-grass prairie species occur with foothills species on sites in the foothills where soils have a very high content of coarse rock fragments. Most commonly, foothills grasslands are composed of mid-grass species, and include occasional shrubs.

### **Shrublands (Eastern Plains and Foothills Region)**

Shrubs are the most common and obvious vegetation. Graminoids, forbs, or bare ground may cover the understory. There may be a few trees present.

### **Saline bottomland shrublands (Eastern Plains and Foothills Region)**

These communities occur on alkaline flats and slight depressions where periodic saturation has caused salts to accumulate as a white crust on the soil surface. Only a few specially adapted species of plants can tolerate these extremely alkaline soils.

### **Sand sagebrush prairie**

Sand sagebrush prairie occupies sandy soils of the plains, primarily in the northeastern and southeastern corners of the state but also in other isolated areas where sandy soils occur. The porous nature of sand allows deeper water infiltration, giving deep rooted shrubs the opportunity to grow more abundantly here. Taller bunch grasses

are common in this community, although they tend to drop out in heavily grazed areas.

### **Mixed foothills shrubland**

These mixed shrublands occur on canyon slopes and on hillsides in the foothills zone. In the northern counties, shrublands consist primarily of skunkbush sumac (*Rhus trilobata*), mountain mahogany (*Cercocarpus montanus*), currant (*Ribes cereum*), and in some places bitterbrush (*Purshia tridentata*). In the southern counties, the composition of the shrublands changes, and Gambel's oak (*Quercus gambelii*) becomes the dominant component.

### **Woodlands (Eastern Plains and Foothills Region)**

Woodlands (Eastern Plains and Foothills Region)

Trees are the most obvious vegetation but they are widely spaced. Canopy cover is usually less than 40%. Graminoids, forbs, or shrubs may be present in the understory. Woodlands occur in the foothills zone and where canyons on the plains create foothills-like conditions.

### **Pinon pine-juniper woodlands (Eastern Plains and Foothills)**

Piñon pine-juniper woodlands occur in draws, on escarpments and mesas, and on rocky hillsides. Annual precipitation ranges from 12 to 18 inches (30-46 cm). Trees tend to be short and widely spaced. Either piñon or juniper may dominate; generally, juniper is more abundant at the lower end of the elevational range.

### **Ponderosa pine woodland and savanna**

Ponderosa pine woodlands and savannas occur primarily on dry, fire-prone south-facing slopes and have grassy understories with few shrubs.

### **Wetlands (Eastern Plains and Foothills Region)**

#### **Marshes (Eastern Plains and Foothills Region)**

Marshes are dynamic wetlands that typically receive flows of water in the spring, sometimes resulting in flooding and relatively deep water, followed by dropping water levels later in the season

#### **Playas (Eastern Plains and Foothills Region)**

Ephemeral ponds, or playas, occur in wide, shallow depressions throughout the plains. During spring, water collects in these depressions forming small, shallow ponds. Later in the summer, the ponds usually dry, leaving a grassy swale of sedges, rushes and grasses.

#### **Meadows (Eastern Plains and Foothills Region)**

Wet meadows occur on the eastern plains where the water table is high enough to saturate the soil for some portion of the growing season. This can occur along reservoirs and playas where springs emerge, or in irrigated pastures.

### **Riparian communities (Eastern Plains and Foothills)**

Typically, riparian forests and shrubland communities of the plains occur along streams that meander and braid

through wide, flat main channels. Patches of cottonwoods typically form the canopy layer, with sandbar willow along the stream edge and grasses, such as switchgrass and prairie cordgrass, between cottonwood clumps. In the foothills or in canyons on the plains, streams tend to be narrower with swifter flowing water. Foothills riparian areas often have dense shrub layers composed of willows, currants, plums, chokecherries and hawthorn.

### **Cottonwood/willow shrublands and forests**

On the plains, woody vegetation, mostly plains cottonwood and sandbar willow, germinates on the bare sandbars formed by meandering streams. A variety of grasses and forbs grow underneath and in open areas around these trees and shrubs.

### **Rocky mountain region**

This region lies between the plains and foothills to the east and the plateaus, canyons and lowlands to the west. The southern Rocky Mountains of Colorado are a complex group of well-defined ranges which have been carved by glaciers and eroded by streams to form steep, rugged canyons and ridges. This section also describes the vegetation of the great intermountain basins or "parks" (North Park, Middle Park, South Park) and the San Luis Valley, which are geographically part of the mountain region, but which may also share climatic and floristic characteristics with the eastern and western regions of Colorado.

### **Grasslands (Rocky Mountain Region)**

Grasslands are a minor but important part of the Rocky Mountain region's vegetation. They occupy specialized habitats where the climate is too cold or dry and/or the soils are too shallow to support the growth of trees and shrubs. In general, grasslands are small, providing openings within the forested zone, but the entire floor of South Park is a montane grassland. Two major types of grasslands have been distinguished on the basis of elevation. Montane grasslands occur between approximately 8,000 and 10,000 feet (2438 3048 m) and subalpine grasslands occupy favorable habitats between approximately 10,000 feet and treeline.

### **Montane and subalpine grasslands**

Small mountain grasslands and meadows are interspersed between the various forest communities and occur primarily on flat or gently sloping terrain with shallow to deep fine-grained soils. Large expanses of grassland or meadow communities are concentrated in parts of North, Middle, and South parks, the Wet Mountain Valley, the perimeter of the San Luis Valley and parts of the upper Rio Grande Basin (Benedict 1991). These grasslands range from moist to dry depending on exposure, their proximity to the water table and soil characteristics.

### **Shrublands**

#### **Sagebrush shrublands**

Sagebrush shrublands are most extensive in western Colorado, but also cover certain areas of the Rocky Mountain region. Two major types may be distinguished on the basis of elevation and soils. Basin big sagebrush shrublands occur at lower elevations on deep soils of floodplains and arroyos; they occur throughout western and southern Colorado. This type is dominated by basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), a tall shrub up to seven feet (2 m) in height. Understory vegetation tends to be sparse but other shrub species are common associates. Mountain big sagebrush communities occur at higher elevations on convex sites and on shallower soils than basin big sagebrush communities. Mountain big sagebrush is the dominant plant species of this type, but it may be replaced by black sagebrush at lower elevations on rocky soils and it intermixes with basin

big sagebrush growing in similar size on many sites. Mountain big sagebrush communities may include a variety of shrubs and an abundance of wild flowers. It occurs at upper elevations adjacent to aspen, oak-serviceberry, and coniferous forest.

### **Woodland (Rocky Mountain Region)**

Open woodlands of limber and bristlecone pines occupy dry, rocky, wind-swept sites in the Rocky Mountain region.

#### **Limber and bristlecone pine woodlands**

Limber pine can be found on a variety of windy, exposed sites as low as Pawnee Buttes in northeastern Colorado, but they are generally found above 9,000 feet (2743 m). Limber pine is most common in northern Colorado; bristlecone pine is limited to southern and central Colorado.

#### **Ponderosa Pine woodlands**

These woodlands occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most common. *Pinus ponderosa* is the predominant conifer; *Pseudotsuga menziesii*, *Pinus edulis*, *Pinus contorta*, *Populus tremuloides*, and *Juniperus* spp. may be present in the tree canopy. The understory is usually shrubby, with *Artemisia nova*, *Artemisia tridentata*, *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Cercocarpus montanus*, *Purshia stansburiana*, *Purshia tridentata*, *Quercus gambelii*, *Symphoricarpos* spp., *Prunus virginiana*, *Amelanchier alnifolia*, and *Rosa* spp. common species. *Pseudoroegneria spicata*, *Pascopyrum smithii*, and species of *Hesperostipa*, *Achnatherum*, *Festuca*, *Muhlenbergia*, and *Bouteloua* are some of the common grasses.

### **Forests (Rocky Mountain Region)**

Trees are the most obvious vegetation. They are closely spaced, and canopy cover is greater than 40% percent. Graminoids, forbs or shrubs make up the understory.

#### **Douglas-fir forests**

Forests dominated by Douglas-fir are found from 6,000 to 9,500 feet (1829-2896 m) throughout Colorado. In the foothills, Douglas-fir forests are confined to rocky soils on cool north-facing slopes and in shaded canyons, but in the montane zone, they may be found on slopes of all aspects. In northern Colorado, Douglas-fir may occur in pure stands or share the canopy with a few ponderosa pines, Rocky Mountain juniper, or Engelmann spruce. In southern Colorado the forest is much more mixed; Douglas-fir, white fir, southwestern white pine, ponderosa pine, and Engelmann spruce may vie for dominance in these middle-elevation forests.

#### **Lodgepole pine forests**

In Colorado, lodgepole pine is an upper montane and subalpine species whose range overlaps that of Engelmann spruce and subalpine fir, except that lodgepole pine does not occur naturally west of the Sangre de Cristo Mountains and south of the Gunnison River (Crane 1982). In general, lodgepole pine replaces Engelmann spruce and subalpine fir after catastrophic fires on dry sites, where it forms dense stands. Few herbaceous plants and shrubs are able to tolerate the deep shade of these "doghair thickets".



## **Aspen forests**

Aspen forests are distributed on moist deep soils and scattered shallow soils in all mountain zones except the alpine. At lower elevations, aspen forests reach into the upper foothills zone along ravines where conditions are cool and moist; in the montane and subalpine, aspen may form large groves on slopes and narrow borders on valley bottoms.

## **Engelmann spruce-subalpine fir forests**

Forests of Engelmann spruce and subalpine fir form extensive stands in the subalpine zone (9300-11,400 feet/2835-3475 m) of the Rocky Mountain region and extend down into the montane zone in cool ravines. These fairly homogeneous expanses of forest are occasionally interrupted by stands of lodgepole pine (in northern Colorado) or aspen, grasslands, meadows or wetlands.

## **Alpine tundra**

Alpine tundra extends from treeline (approximately 11,400 feet/3475 m) to the mountain tops. The cold, extremely windy climate produces harsh growing conditions. As a result, plants are mostly small, low, perennial and adapted to a short growing season.

## **Alpine meadows**

Alpine meadows are common on level to gently rolling sites with fairly deep, well-drained, finetextured soils. Dry meadows (turfs) occur in areas where snow does not accumulate in the winter or melts early, typically on windward slopes and ridges. Meadows in more mesic areas are found on gentle slopes or in shallow basins.

## **Wetlands (Rocky Mountain Region)**

Most of the naturally-occurring wetlands in Colorado are found in the montane and subalpine zones. There are a number of reasons for this. First, it rains and snows more at higher elevations. Second, air temperatures are cooler at higher elevations, so there is less evaporation than on the plains. Third, most of the montane and subalpine zone was glaciated during the last ice age, and glaciers tend to turn narrow, V-shaped mountain valleys into broad, flat, U-shaped valleys more suitable for wetland development.

## **Marshes (Rocky Mountain Region)**

Marshes occur in a variety of situations in the Rocky Mountain region of the state. Natural lakes dot the higher portions of the mountains where snowmelt from the high peaks collects in basins. In the San Luis Valley, the perennially high water table creates numerous shallow ponds with ideal conditions for marsh development. In lower elevation areas, dams by humans and beavers create small and large bodies of water.

## **Playas (Rocky Mountain Region)**

Shallow playas, also called internal drainage basins or ephemeral ponds, are most extensive in the San Luis Valley. During spring, water collects in these depressions forming small, shallow ponds. Later in the summer, the

ponds usually dry, leaving a grassy swale of sedges, rushes, and grasses.

### **Meadows (Rocky Mountain Region)**

Wet meadows of sedge, arctic rush, tufted hairgrass and other grasses occur along streams and around ponds in the broad mountain valleys. Wild iris may dot the meadows especially in heavily grazed areas. These meadows form where the soils are saturated in the spring and early summer, but usually dry out later in the summer. Salt meadows occur in areas of high surface salinity where the water table is close to the surface and where evaporation exceeds precipitation. Salt meadows are common in lower and middle elevations in Colorado and are most extensive in South Park and in the playas of the San Luis Valley. Greasewood shrubs are present within the playas where they grow on low sand dunes on the playa bottom or in a band along the upper playa margins.

### **Fens (Rocky Mountain Region)**

Fens occur on organic soils nourished by both surface runoff and groundwater sources. They can be found in relatively flat, constantly wet mountain valleys. Peat accumulation in fens occurs slowly, at a rate of about eight inches every 1,000 years (Cooper and Jones 1993). Rich fens, fens on soils rich in calcium carbonate and other salts, are extremely rare in Colorado, but are most common in South Park.

### **Riparian communities (Rocky Mountain Region)**

Along mountain streams, discontinuous patches of forest intermix with shrub communities and herbaceous wetlands. Forests of narrowleaf cottonwood, river birch, mountain alder, and clumps of aspen occur along the banks of the Colorado streams. Along permanent streams in cooler canyons, blue spruce, Douglas-fir, and white fir (southern Colorado) anchor the banks. At higher elevations, Englemann spruce becomes the dominant tree.

### **Willow carrs**

A waterlogged, woody terrain. Willow carrs occur on organic soils along montane and subalpine streams, on broad floodplains inundated by beaver dams, around the edges of sedge-dominated fens, and around glacial lakes and on solifluction terraces in the alpine zone.

### **Riparian forests**

Riparian plant communities consist largely of deciduous forests on lower montane streams and rivers and evergreen forests of higher elevations.

### **Alpine riparian communities**

Herbaceous riparian communities occur in the tundra along the headwaters of streams.

### **Western Plateau and Canyon Region**

This region lies west of the Continental Divide and below 8,000 feet (2438 m). Like the Rocky Mountain region, it is geographically and vegetationally complex. The unifying theme in this region is the relatively flat-lying layers of sedimentary rocks forming extensive highlands. The Colorado River and its major tributaries (the San Juan, Dolores, White, Yampa and Gunnison rivers) have cut deep canyons into the layers of rock. The region shares floristic affinities with the Colorado Plateau, the San Juan Basin and the Uintah Basin regions of Arizona, Utah and New Mexico.

## Grasslands

### Grasslands (Western Plateau and Canyon Region)

Grasslands and meadows occur primarily on fine-grained or deep soils on moderate to low slopes or on steeply sloping sites, and may be small patches interspersed among shrubland, woodland or forest communities. These areas range from mesic to dry depending on soil characteristics and the availability of ground water.

### Shrublands (Western Plateau and Canyon Region)

In western Colorado, shrubland communities separate out by elevation and soil type. The “adobe badlands” so common at the lowest elevations near Grand Junction and in the northwestern and southwestern corners of the state support mat saltbush shrublands. Greasewood and fourwing saltbush shrublands occur in alkaline depressions with clayey soils and a high water table (“flats”) in the same areas. Deeper, coarser soils at middle elevations support sagebrush shrublands, and hillsides near lower treeline support mixed mountain shrubland communities

### Mat saltbrush shrublands

Mat saltbush shrubland usually occurs on the driest sites below 6,000 feet (1829 m), usually on soils derived from shales of the Mancos and Green River formations. The total vegetation cover often does not exceed 10 percent. Gardner’s and mat saltbush seem best adapted to these harsh growing conditions and therefore are the dominant species.

### Saline bottomland shrublands (Western Plateau and Canyon Region)

Saline bottomland shrubland usually occurs below 7,500 feet (2286 m); it is common on broad valley floors from Wyoming to the New Mexico border and west into Utah. On moist alkaline soils developed from stream deposits, greasewood forms pure stands. As alkalinity and depth of alluvium decrease, greasewood is found with shadscale and other saltbush species

### Sagebrush shrublands (Western Plateau and Canyon Regions)

Basin big sagebrush shrublands occur at lower elevations on deep soils of floodplains and arroyos; they are especially well developed in the Piceance Basin. This type is dominated by big sagebrush (*Artemisia tridentata*). Mountain sagebrush communities occur at higher elevations and on shallower soils than Basin big sagebrush communities. Mountain big sagebrush is the dominant plant species of this type, but it may be replaced by black sagebrush at lower elevations on rocky soils or by alkali sagebrush on heavy clay soils.

### Mixed mountain shrubland

Mixed mountain shrublands occur at elevations between the piñon pine-juniper woodland and upper montane coniferous forest communities. The shrubland consists of Gambel’s oak growing either in pure stands or with mountain mahogany, serviceberry and/or snowberry. The shrubs form a dense canopy restricting the understory to relatively few shade tolerant graminoids and forbs.

### **Woodlands (Western Plateau and Canyon Regions)**

Woodlands occur on rocky hillsides at middle elevations and often define lower treeline. They are characterized by having one or more species of small trees – Utah juniper, Rocky Mountain juniper or piñon pine – dominant in the topmost layer of vegetation. Because these trees require more moisture and deeper soils than shrubs or grasses do, woodland communities are restricted to rocky, mesic sites in draws and north-facing escarpments below 6,000 feet (1829 m), and dry slopes among ponderosa pine and Douglas-fir communities above 6,000 feet.

### **Pinon pine-juniper woodlands (Western Plateau and Canyon Region)**

Piñon pine-juniper woodland communities occur on shallow, rocky soils in warm, dry sites. They often occur on hillsides and mesa tops, and this community will invade sagebrush shrublands and Great Basin grasslands in the absence of fire. Gravelly substrates with high levels of calcium and alkaline salts provide the optimum growth medium

### **Ponderosa pine woodlands**

Pine woodlands are composed predominately of ponderosa pine. They typically consist of open stands on dry south-facing slopes with a shrub and herbaceous understory. These woodlands form the ecotone between the Rocky Mountain region and the Western Plateau and Canyon region, except in northwestern Colorado, where they are absent and replaced by pure stands of Douglas-fir and aspen. These communities are similar to the pine woodlands in the foothills east of the Rocky Mountain region.

### **Wetlands (Western Plateau and Canyon Region)**

The landforms of western Colorado are an interesting mosaic of mountains (Uinta, Park, Gore, Elk, Sawatch and San Juan Ranges), mesas (Battlement and Grand), plateaus (White River, Roan and Uncompahgre), and basins (Wyoming, Piceance and San Juan). Major river systems draining the region and sometimes forming large canyons and valleys, include the Yampa, White, Colorado, Gunnison, Dolores and Animas. Wetland and riparian communities are as varied as the terrain; many are extremely saline or alkaline

### **Marshes (Western Plateau and Canyon Regions)**

Freshwater marshes occur in water less than 1.5 feet (0.5 m) deep and on adjacent saturated soils. Typical associated plant species include softstem bulrush, broad-leaved cattail, spike-rush, Arctic rush and arrowhead. Alkaline and saline marshes are characterized by hardstem and three-square bulrush, narrow-leaved cattail and arctic rush, growing on periodically saturated soils. Submergent and floating aquatic plants occur where water is deeper than 1.5 feet (0.5 m), and are characterized by pondweeds, bladderwort, water milfoil and water crowfoot.

### **Meadows (Western Plateau and Canyon Regions)**

Wet meadows often surround marshes, occupying saturated to moist soils. Plant species present reflect the

degree of alkalinity or salinity. Where the sites are moderately to highly alkaline or saline, saltgrass, alkali sacaton, alkaligrass, alkali cordgrass, meadow foxtail, foxtail barley, three-square bulrush, sea-blite and arrowgrass are typically present. Moist to wet swales and seeps also support the characteristic plant species identified in the above discussion.

### **Riparian communities (Western Plateau and Canyon Regions)**

Typically, riparian forests and shrubland communities of lower elevations of the Western Plateau and Canyon region occur on low terraces and floodplains. In the foothills, streams tend to be narrower with swifter flowing water.

### **Cottonwood/willow forests**

Riparian plant communities consist largely of deciduous forests on lower river terraces and floodplains, dominated by Fremont cottonwood in the lower elevations and narrowleaf cottonwood along moderate-gradient streams above about 6,000 feet (1829 meters) elevation.

### **Disturbed Habitat**

#### **Roadside habitat**

Adjacent to road with management activities or other types of disturbance associated with roadsides.

#### **Built habitat**

Buildings and sealed surfaces, such as roads and parking lots

#### **Managed vegetation**

Residential, commercial, and other regularly maintained green spaces

#### **Ruderal Vegetation**

Empty lots, abandoned farmland, and other green space that is highly disturbed but not managed

### **Geology and Landform**

#### **Soils**

##### **Clay**

Particle size is very small (<0.002 mm); use feel test to determine if clay.

##### **Silt**

Particle size is medium (0.002-0.05 mm); use feel test to determine if silt.

##### **Sand**

Particle size is coarse (0.05-2 mm); use feel test to determine if sand.



### **Gravel/Pebbles**

Loose aggregation of rock fragments, with relatively large (~ 1 cm) and coarse fragments

### **Humus**

Broken down organic material, decomposed leaves and other plant material

### **Fine**

Squeeze a moistened ball of soil in the hand. Fine soils will form a sticky ball that changes shape and greatly resists breaking.

### **Medium**

Squeeze a moistened ball of soil in the hand. Medium textured soils will form a ball that stays together, but change shape easily or form a ball that may break under moderate to heavy pressure.

### **Coarse**

Squeeze a moistened ball of soil in the hand. Coarse textured soils will not form a ball or will form a ball that breaks with even the slightest pressure.

### **Terrain/physiography**

#### **Flat**

Land that does not slope in any direction.

#### **Hill**

A point or small area of high ground. When you are on a hilltop, the ground slopes down in all directions

#### **Ridge**

A line of high ground with height variations along its crest. The ridge is not simply a line of hills; all points of the ridge crest are higher than the ground on both sides of the ridge.

#### **Valley**

Reasonably level ground bordered on the sides by higher ground. A valley may or may not contain a stream course. Generally, has maneuver room within its confines. The course of the contour line crossing the stream always points upstream.

#### **Saddle**

A dip or low point along the crest of a ridge. Not necessarily the lower ground between two hilltops; it may break along an otherwise level ridge crest,

#### **Depression**

A low point or hole in the ground, surrounded on all sides by higher ground,

**Draw**

Similar to a valley, except that it normally is a less developed stream course in which there is generally no level ground and, therefore, little or no maneuver room. The ground slopes upward on each side and toward the head of the draw.

**Spur**

A usually short, continuously sloping line of higher ground, normally jutting out from the side of a ridge. a spur is often formed by two thoroughly parallel streams cutting draws down the side of a ridge.

**Cliff**

A vertical or near-vertical slope. A cliff may be shown on a map by contour lines being close together, touching, or by a ticked "carrying" contour line. The ticks always point toward lower ground.

**Site History****Site management practices**

Types of actions or activities that have shaped or changed the landscape. Examples include, but are not limited to, controlled burns, agriculture, irrigation, restoration, grazing.

**Disturbance history**

A brief description of any activity or disturbances that have shaped or changed the landscape. Examples include, but are not limited to, fire, flood, structure construction, road construction, ground clearing or bulldozing, logging, and fragmentation.

**Degree of fragmentation or human disturbance**

An estimation of how much area has been impacted by fragmentation or disturbance, or the degree to which disturbance has impacted the landscape.

**Condition and extent of surrounding landscape**

A summary of the overall condition or and status of the surrounding landscape.

**KHD Vouchers****#**

Collector number. Same as Darwin Core term recordNumber.

An identifier given to the Occurrence at the time it was recorded. Often serves as a link between field notes and an Occurrence record, such as a specimen collector's number.

**Identification/Remarks**

A field taxonomic identification and/or summary of identifying characteristics that will aid in the taxonomic identification of a specimen.



### **Flower Color**

The color of petals and/or sepals at the time of collection.

### **Height**

A measurement or estimation of the height of the plant, measured from the base to the tip of the highest point.

**Denote units. Centimeters preferred.**

### **Habit**

The general characteristic form, shape, or architecture in which a plant grows. Examples include, but are not limited to, tree, shrub, forb, grass, growing in clumps, rhizomatous, upright, low-lying, herbaceous, woody, rosette, epiphytic, caulescent. See appendix for list and definitions of plant habits.

### **Associated Taxa**

Same as Darwin Core term associatedTaxa.

A list of plant species names occurring in the same general area as the voucher. Scientific names only, no habitat or common names.

### **Tissue Sample**

Was a tissue sample taken from the plant being taken as a specimen. Denote if taken from a different or from multiple individuals.

### **Abundant >500**

More than 500 individuals of the same species occurring within the site or general area.

### **Common 101-500**

Between 101 and 500 individuals of the same species occurring within the site or general area.

### **Frequent 11-100**

Between 11 and 100 individuals of the same species occurring within the site or general area.

### **Occasional 6-10**

Between 6 and 10 individuals of the same species occurring within the site or general area.

### **Rare 1-5**

Between 1 and 5 individuals of the same species occurring within the site or general area.

### **DBG Vouchers**

### **Identification**

A field taxonomic identification of the specimen.



### **Plant Associate**

The type of plant or tree that the specimen was growing on, near or adjacent to at time of collection.

### **Substrate**

A characterization of the material that the specimen was growing on at the time of collection.

### **Habit**

A description of how individuals of the same species as the specimen are growing in relation to each other in the location of collection.

### **Remarks**

Same as Darwin Core term occurrenceRemarks.

Comments or notes about the specimen/occurrence.

### **Image #s**

A reference to the image if a photograph of the in-situ specimen or habit was taken. This should allow the image to be matched with the specimen.

## **Vegetation Monitoring**

### **Study Site Name**

The assigned name of the general site where the study is taking place.

For example: Chatfield Farms, Highline Canal, Peterson Property, Gilpin County Library Fen, Cebolla Creek Middle-.

### **Project**

The title of the overall project of which the data being collected is associated. Examples include deer Creek Riparian Vegetation Monitoring, Highline Canal Vegetation Monitoring.

### **Transect ID**

A concatenation and/or abbreviation, standardized in most cases, of the general Study Site Name and the specific Survey Site Name (Sub-Location). Examples include **DBG\_CF\_Transect1\_JCOS1, HLC01**

### **Transect Length (m)/# points**

The length in meters of the transect and the number of evenly distributed points to be surveyed along the transect.

### **Date**

Same as Darwin Core term eventDate.

The date-time or interval during which an event occurred. For occurrences, this is the date-time when the event was recorded. recommended best practice is using the format **YYYY-MM-DD**.

**Start Time/ End time**

The time of day that the survey of the transect begun and ended.

**Observers**

Same as Darwin Core term recordedBy.

A list of names of people, groups, or organizations responsible for making observation and recording the original occurrences.

**Photo**

A reference to the image of the overall transect. This should allow the image to be matched to the transect at the time/date of the survey. Image number should also be recorded in the Photography metadata notebook.

**Orientation**

The cardinal direction the transect is aimed with when at the origin of the transect. See Figure 3.

**Distance to Stream**

The distance in meters from the center line of the transect at the point of interest to the bank of the stream.

**Bank Height**

The distance in centimeters from the top of the bank to the bottom of the stream.

**Transect Point**

The point along the transect at the specified distance from the origin.

**Top Canopy/1<sup>st</sup> Hit**

The species or soil surface of the first stem, leaf, or plant base intercepted by the pin flag.

**Lower Canopy Layers/2<sup>nd</sup> Hits**

Additional species and or soil surfaces intercepted by the pin that are below the top canopy.

**Soil Surface**

The surface at which the pin flag rests.

Accepted values are litter, base soil, rock, or water.

**Soil moisture (%)**

The water content in the soil.



### **Canopy cover (# cells/96)**

Number of cells that intersect with canopy, measured by a densiometer.

### **Canopy Cover Species**

A list of taxa for each species that are included in the canopy cover.

### **Litter**

Herbaceous litter is detached dead stems and leaves that are part of a layer that comes in contact with the ground. Recorded at soil surface if the pin flag lands on it.

### **Bare Soil**

Soil that is visibly unprotected by litter, rock, standing dead vegetation, or water.

### **Rock**

The pin flag rests on a rock (>5mm or 1/4 inch diameter).

### **Water**

Standing water, where the pin is sitting in the water. This could be temporary (i.e., a puddle) or permanent (i.e., the transect crosses a stream).

### **Downed Woody Debris (DWD)**

Dead woody material in various stages of decomposition. Can either be coarse woody debris (CWD) or fine woody debris (FWD).

### **Coarse Woody Debris (CWD)**

CWD includes downed, dead tree and shrub boles, large limbs, and other woody pieces that are severed from their original source of growth and on the ground. (USFS, 2005). Must be greater than 3 inches in diameter.

### **Fine Woody Debris (FWD)**

FWD includes downed, dead branches, twigs, and small tree or shrub boles that are not attached to a living or standing dead source. FWD can be connected to a larger branch, as long as this branch is on the ground and not connected to a standing dead or live tree. (USFS, 2005). Must be less than 3 inches in diameter.

## **Seed Collections**

### **Species**

The taxonomic identification of the plant from which seeds are being collected.

### **Number Plant Seeds Collected From**

An accurate count of the number of plants from which seeds are collected and placed together.



### **Voucher #**

Collector number. Same as Darwin Core term recordNumber.

An identifier given to the Occurrence at the time it was recorded. Often serves as a link between field notes and an Occurrence record, such as a specimen collector's number.

### **Associated Taxa**

Same as Darwin Core term associatedTaxa.

A list of plant species names occurring in the same general area as the voucher. Scientific names only, no habitat or common names.

### **Tissue Sample**

Was a tissue sample taken from the plant being taken as a specimen. Denote if taken from a different or from multiple individuals.

### **Abundant >500**

More than 500 individuals of the same species occurring within the site or general area.

### **Common 101-500**

Between 101 and 500 individuals of the same species occurring within the site or general area.

### **Frequent 11-100**

Between 11 and 100 individuals of the same species occurring within the site or general area.

### **Occasional 6-10**

Between 6 and 10 individuals of the same species occurring within the site or general area.

### **Rare 1-5**

Between 1 and 5 individuals of the same species occurring within the site or general area.

## **Demographic Monitoring**

### **Date**

Same as Darwin Core term eventDate.

The date-time or interval during which an event occurred. For occurrences, this is the date-time when the event was recorded. recommended best practice is using the format **YYYY-MM-DD**.

### **Researchers**

Same as Darwin Core term recordedBy.

A list of names of people, groups, or organizations responsible for making observation and recording the original occurrences.

**Site Comments**

Any remarks about the site as a whole.

**Plot Comments**

Any remarks about the plot as a whole.

**General Comments**

Any general remarks.

**Tag ID**

The identifier for the tag within the Research Database. Not on the tag itself.

**Tag**

The number recorded on the tag that is associated with a plant of interest.

**Plot**

The identifier for the plot.

**Dist (m)**

The distance in meters from center of the pot (marked with rebar) to where the tag of interest is located.

**Dir**

The cardinal direction from center of the pot (marked with rebar) to where the tag of interest is located.

**Location**

Distance and direction from the plant of interest to where the associated tag is located.

**LnYY**

The length of the plant in centimeters, measured from base of plant (where meets the soil) to the tip of the longest shoot. Specific to Asmi

**Diameter X**

Diameter of plant at widest point.

**Diameter Y**

Diameter of plant at point perpendicular to DiameterX

**#rosettes**

The number of rosettes present on the plat at the time of observation.

**#infl**

The number of flowering stems.



### **#infl Br**

The number of flowering stems that have been browsed on by animals.

### **rust**

Does the plant being observed exhibit the existence of a rust fungal pathogen? 1=yes 0=no

### **Height**

The length in cm from the base of the plant (where the plant meets the soil) to the top of the plant at the highest point. For cacti, to the top of the ball of the fleshy part, do not measure the spines or flowers.

### **Width**

The width of the plant in centimeters at the widest point. For cacti, only measure the fleshy part of the cactus, not the spines.

### **Minis**

The number of plants surrounding (in the immediate vicinity) of the plant of interest that are less than ½ centimeter in diameter.

### **FIYY**

A binary indicator of reproductive statue (1) or not reproductive (0)

### **FrYY**

The number of fruits observed on the plant of interest at the time of observation. Numbers following "Fr" denote the year of the observation in the 21st century.

### **BrYY**

The occurrence of browsing on the plant of interest at the time of observation and if detectable the type of animal (mammal or insect) that was browsing. Numbers following "Br" denote the year of the observation in the 21st century. examples include insect, mammal. Binary (1 = yes, 0 = none)

### **CommentsYY**

Any additional remarks about the plant or tag. . Numbers following "Comments" denote the year of the observation in the 21st century.

## **Population Genetics**

### **Number Plant Seeds Collected From**

An accurate count of the total number of plants from which seeds are collected and kept separate.

### **Species**



The taxonomic identification of the plant from which seeds are being collected.

### **Voucher #**

Collector number. Same as Darwin Core term recordNumber.

An identifier given to the Occurrence at the time it was recorded. Often serves as a link between field notes and an Occurrence record, such as a specimen collector's number.

### **Associated Taxa**

Same as Darwin Core term associatedTaxa.

A list of plant species names occurring in the same general area as the voucher. Scientific names only, no habitat or common names.

### **Abundant >500**

More than 500 individuals of the same species occurring within the site or general area.

### **Common 101-500**

Between 101 and 500 individuals of the same species occurring within the site or general area.

### **Frequent 11-100**

Between 11 and 100 individuals of the same species occurring within the site or general area.

### **Occasional 6-10**

Between 6 and 10 individuals of the same species occurring within the site or general area.

### **Rare 1-5**

Between 1 and 5 individuals of the same species occurring within the site or general area.

### **Individual ID**

An identifier assigned to an individual plant by the recorder in the field. Typically, a combination of an abbreviation for the site and a sequential number. For example, YF01 for Yellow Fence site and the first plant sampled.

### **Collection Type**

Circle each type of sample taken from each plant.

**S= Seed T= Tissue H= Herbarium Voucher Specimen O= Other**

### **Number Collected**

An accurate count or estimation (to be update with an accurate count) of the number of samples taken for each collection type. For example, 250/1/1 would equal 250 seeds, 1 tissue sample, and 1 voucher specimen. Typically, only 1 voucher and tissue sample can be taken from an individual plant, so the default value for these type of collections is 1.

**Latitude**

Same as Darwin Core term decimalLatitude.

**Longitude**

Same as Darwin Core term decimalLongitude.

**Photography****Date**

Same as Darwin Core term eventDate.

The date-time or interval during which an event occurred. For occurrences, this is the date-time when the event was recorded. recommended best practice is using the format **YYYY-MM-DD**.

**Photographer**

Full name of the person taking the photographs.

**Study Site Name**

The assigned name of the general site where the study is taking place.

For example: Chatfield Farms, Highline Canal, Peterson Property, Gilpin County Library Fen, Cebolla Creek Middle.

**Survey Site Name (Sub-Location)**

The assigned name of the specific location where the study is taking place. This can and should refer to the specific **plot**, **transect**, or sub-location within a general study area. Examples include Transect 1, Plot 1, Mile Marker 1.

**Image #**

The number of the image file as recorded by the camera. This number is visible when viewing the image after it has been taken with the digital camera. See Field Photography Protocol for additional information.

**Identifier**

A number or otherwise that links the image to the subject of the image. Typically, a specimen collector number (recordNumber) or plant tag in the case of demographic monitoring. Leave blank for habitat or general images that do not contain a specific plant.

**Comments**

Other general comments about the image that are important or may help in linking the image with a, observation or specimen record.

## Appendix

### Plant habits: terms and definitions

[https://en.wikipedia.org/wiki/Glossary\\_of\\_plant\\_morphology#Plant\\_habit](https://en.wikipedia.org/wiki/Glossary_of_plant_morphology#Plant_habit)

An acaulescent species of *Streptocarpus* has only one leaf, and appears to have no stem

Acaulescent – the leaves and inflorescence rise from the ground, and appear to have no stem. They are also known as rosette forms, some of the many conditions that result from very short internodes (i.e. close distances between nodes on the plant stem. See also radical, where leaves arise apparently without stems.

Acid plant – plants with acid saps, normally due to the production of ammonium salts (malic and oxalic acid)

Acme – the time when the plant or population has its maximum vigor.

Actinomorphic – parts of plants that are radially symmetrical in arrangement.

Arborescent – growing into a tree-like habit, normally with a single woody stem.

Ascending – growing uprightly, in an upward direction.

Assurgent – growth ascending.

Branching – dividing into multiple smaller segments.

Caducous – falling away early.

Caulescent – with a well-developed stem above ground.

Cespitose – forming dense tufts, normally applied to small plants typically growing into mats, tufts, or clumps.

Creeping – growing along the ground and producing roots at intervals along the surface.

Deciduous – falling away after its function is completed.

Decumbent – growth starts off prostrate and the ends turn upright.

Deflexed – bending downward.

Determinate growth – Growing for a limited time, floral formation and leaves (see also Indeterminate).

Dimorphic – of two different forms.

Ecad – a plant assumed to be adapted to a specific habitat.

Ecotone – the boundary that separates two plant communities, generally of major rank – trees in woods and grasses in savanna for example.

Ectogenesis – variation in plants due to conditions outside of the plants.

Ectoparasite – a parasitic plant that has most of its mass outside of the host, the body and reproductive organs of the plant live outside of the host.

Epigeal – living on the surface of the ground. See also terms for seeds.

Epigeal – occurring on the ground.

Epigeic – plants with stolons on the ground.

Epigeous – on the ground. Used for leaf fungus that live on the surface of the leaf.

Epilithic – growing on the surface of rocks.

Epiphloedal – growing on the bark of trees.

Epiphloedic – an organism that grows on the bark of trees.

Epiphyllous – growing on the leaves. For example, *Helwingia japonica* has epiphyllous flowers (ones that form on the leaves).[5]

Epiphyte – growing on another organism but not parasitic. Not growing on the ground.

Epiphytic – having the nature of an epiphyte.

Equinoctial – a plants that has flowers that open and close at definite times during the day.

Erect – having an essentially upright vertical habit or position.

Escape – a plant originally under cultivation that has become wild, a garden plant growing in natural areas.

Evergreen – remaining green in the winter or during the normal dormancy period for other plants.

Eupotamous – living in rivers and streams.

Euryhaline – normally living in salt water but tolerant of variable salinity.

Eurythermous – tolerant of a wide range of temperatures.

Exclusive species – confined to specific location.

Exotic – not native to the area or region.

Exsiccatus – a dried plant, most often used for specimens in a herbarium.

Indeterminate growth – Inflorescence and leaves growing for an indeterminate time, until stopped by other factors such as frost (see also Determinate).

Lax – non upright, growth not strictly upright or hangs down from the point of origin.

Parasitic – using another plant as a source of nourishment.

Precocious – flowering before the leaves emerge.

Procumbent – growing prostrate or trailing, but not rooting at the nodes.

Prostrate – lying flat on the ground, stems or even flowers in some species.

Repent – creeping.

Rosette – cluster of leaves with very short internodes that are crowded together, normally on the surface of the soil but sometimes higher on the stem.

Rostellate – like a rosette (cf. rostellum).

Rosulate – arranged into a rosette.

Runner – an elongated, slender branch that roots at the nodes or tip.

Stolon – A branch that forms near the base of the plant, grows horizontally, and roots and produces new plants at the nodes or apex.

Stoloniferous – plants producing stolons.

Semi-erect – Not growing perfectly straight.

Suffrutescent – somewhat shrubby, or shrubby at the base.

Upright – Growing upward.

Virgate – wand-like, slender erect growing stem with many leaves or very short branches.

Woody – forming secondary growth laterally around the plant so as to form wood.

## Duration

Duration of individual plant lives are described using these terms:

Annual – plants that live, reproduce, and die in one growing season.

Biennial – plants that need two growing seasons to complete their life cycle, normally completing vegetative growth the first year and flowering the second year.

Herbs – see herbaceous.

Herbaceous – plants with shoot systems that die back to the ground each year – both annual and non-woody perennial plants.

Herbaceous perennial – non-woody plants that live for more than two years, with the shoot system dying back to soil level each year.

Woody perennial – true shrubs and trees, and some vines, with shoot systems that remain alive above the soil



level from one year to the next.

Monocarpic – plants that live for a number of years then, after flowering and seed setting, die.

## References

Darwin Core Terms: A quick reference guide. Biodiversity Information Standards, 2018. Web. <http://rs.tdwg.org/dwc/terms/index.htm> Accessed April 2018.

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Hufft, Rebecca A. Vegetation Monitoring Protocol for measuring and collecting ecological data. 2018.