California Rapid Assessment Method for Wetlands (CRAM)

Slope Wetland Photo Dictionary

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United States Environmental Protection Agency
California Wetland Monitoring Workgroup
SFEI Aquatic Science Center
San Francisco Estuary Institute & The Aquatic Science Center
CCWG Central Coast Wetlands Group

Table of Contents

INTRODUCTION

The California Rapid Assessment Method (CRAM) for wetlands is a scientifically defensible tool to measure the condition of wetlands. CRAM uses visual indicators, as well as other measurements to assess the overall health of wetlands. Many of the visual indicators are difficult to describe with text or conceptual diagrams. Therefore, this compilation of photographic examples is being provided to assist CRAM practitioners in correctly utilizing the method.

This photo dictionary is specific to Slope Wetlands, and is a companion to the Photo Dictionary (May 2013) compiled for Estuarine, Riverine, and Depressional Wetlands. The photographs illustrate features specific to Slope Wetlands, concepts helpful for correctly conducting a CRAM assessment in a Slope Wetland, and examples of a range of conditions of Slope Wetlands. These examples are not an exhaustive catalog of all potential features within or states of Slope Wetlands, but instead are intended to provide a variety of examples to assist practitioners while in the field.

Photos were provided by the San Francisco Estuary Institute (SFEI) and the Central Coast Wetlands Group (CCWG).

SLOPE WETLAND SUB-TYPES

Slope Wetlands are a broad category of groundwater-dominated wetlands inclusive of Channeled and Non-channeled wet meadows, Channeled and Non-channeled forested slopes, and Seeps and springs sub-types. In these wetlands groundwater may emerge into the root zone or across the ground surface seasonally or perennially, but mainly has unidirectional flow. The term "slope" refers to the uni-directional flow of ground and surface water within the wetland, rather than to a geomorphic feature (e.g. hillslope, toe-slope). Each of the five sub-types are described below.

Channeled Wet Meadows are those associated with fluvial channels. They often have a zone of woody riparian vegetation such as willow or alder species, which other meadows may not have. They also have more complex topography than Non-channeled Wet Meadows due to the variation in elevation from channels, floodplain benches, oxbows, natural levees, or other riverine features.

Non-channeled Wet Meadows do not contain a stream or river channel, and are dominated by groundwater throughflow or surface water sheet flow. They may have ditches or rills but not complete channels. They are usually dominated by graminoids and forbs, and have few or no woody species. The gradient can range from very flat to steep, depending on the landscape position of the meadow. They can include meadows, broad swales, wide riverine floodplains or terraces with <30% woody vegetation cover, and marine terraces, among others.

Forested Slope Wetlands (Channeled Forested Slope or Non-channeled Forested Slope) are those wetlands larger than 0.5 acres (0.2 ha) that form due to a seasonal or perennial emergence of groundwater into the root zone and in some cases onto the ground surface, and that support more than 30% cover of tall woody vegetation (e.g. Lodgepole pines, willows, oaks, or other tree species). They may or may not have a channel.

Seeps and Springs occur on hillsides or at the base of dunes, hills, alluvial fans, levees, etc. Springs are indicated by groundwater emerging and flowing across the ground surface and sometimes through indistinct or very small rivulets, runnels, and other features that are too small to be called a creek or riverine system. They often lack the features of riverine channels, such as a thalweg or floodplain. Seeps are similar to springs but lack a single-dominant origin of surface flow. Most of the flow is confined to the root zone and is not evident on the ground surface. Seeps and Springs may have, or may lack woody vegetation; no distinction is made in CRAM.

Channeled Wet Meadows






Non-channeled Wet Meadows






Forested Slope Wetlands (Channeled and Non-channeled)






Seeps and Springs






ESTABLISH THE ASSESSMENT AREA (AA)

For wet meadow and forested slope wetlands, the AA should at least encompass the gradient from the upland edge to the core, or lowest central elevation of the wetland. Seep and Springs slope wetlands should include from the source of groundwater seepage or emergence, downslope to the wetland boundary or to where a transition in wetland type occurs, inclusive of any overhanging riparian vegetation. The recommended AA size is 1 ha, however variations on this size recommendation allow for assessment of all slope wetland systems.

For small Slope wetlands of all types (1 ha or smaller), the AA should include the entire wetland and any directly overhanging riparian vegetation. For medium sized wetlands, the AA should ideally be a 1 ha rectangle with one edge oriented perpendicular to the overall wetland flow direction. The rectangle should extend from the upland edge to either the channel centerline, the topographic low point of the meadow or wetland, or all the way across the wetland to the opposite upland edge.

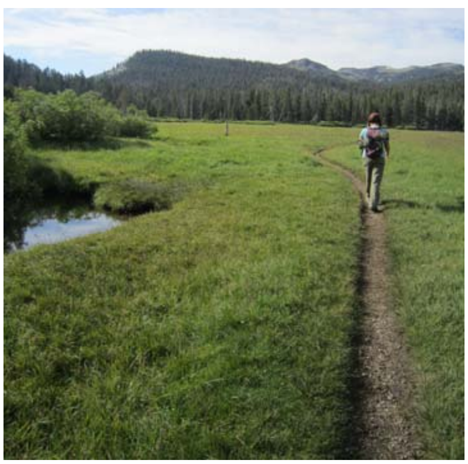
Below are two examples where the AA should extend from one upland edge, across to the opposite upland edge.

This example illustrates the concept of using the channel centerline as an AA boundary.

This example illustrates how overhanging riparian vegetation should be included within the AA.

Some features *should* be used to define Assessment Area boundaries, such as transitions between wetland types (left, transition from slope wetland to depressional wetland) or artificial berms, levees, dikes, dams, etc that direct or confine runoff (right, road berm).

Some features should *not* be used to define Assessment Area boundaries, such as at-grade trails (left) or fences that do not obstruct the movement of wildlife (right).



Assessment Area placement is dependent upon the purpose of the assessment, but should always follow the guidance set in the field book. Below are example AA boundaries: first row Channeled Wet Meadow Slope wetlands; second row Non-channeled Wet Meadow Slope wetlands; third row Forested Slope wetlands; forth row Seeps/Springs Slope wetlands.


Pacific Crest Trail
John Muir Trail
John Muir Trail
John Muir Trail
John Muir Trail
Pacific Crest Trail
Soda Springs


Morris Ranch Rd
Morris Ranch Rd

WATER SOURCE

Water Sources directly affect the extent, duration, and frequency of saturated or ponded conditions within an Assessment Area. Water Sources include direct inputs of water into the AA as well as any diversions of water from the AA. Diversions influence the water source because they affect the ability of the AA to function as a source of water for other habitats while also directly affecting the hydrology of the AA.

The following photos illustrate features to consider as negatively affecting Water Source.

Adjacent developments

Stormdrains

Irrigated agriculture

Sprinklers

Surface water diversion

Groundwater extraction

Dams

Paved roads

The following photos illustrate features that should *not* be considered as negatively affecting Water Source.

Beaver dams

Selective logging

HYDROPERIOD

Hydroperiod is the characteristic frequency and duration of inundation or saturation of a wetland during a typical year. This metric considers deviations from the natural hydrograph of the wetland, based upon a suite of visible indicators of change in the patterns of filling and drying in the wetland. The following photos show examples of *"less water",* or reduced extent and duration of innundation or saturation.


Pumps


Encroachment of upland vegetation


Stress or mortality of hydrophytes


Incision of fluvial channels

The following photos show examples of *“more water”*, or increased extent and duration of inundation or saturation.

Berms or levees keeping water in wetland

Pumps

Sprinklers

Flood irrigation

Formation of surface pannes/pools

Standing surface water


Diversions that move water into the wetland


Diversions that move water into the wetland

HYDROLOGIC CONNECTIVITY

Hydrologic Connectivity describes the ability of the wetland to slow the movement of surface runoff and shallow groundwater, and slowly release that water downstream. This metric assesses the degree to which the inflows of groundwater or surface runoff are likely to be retained and then released downstream in such ways that the outputs are filtered of particulate matter (although the outputs might be enriched with nutrients), downstream peak flows are reduced, and base flows in receiving channels are increased, extended downstream, and longer lasting.

Hydrologic Connectivity is assessed differently for Slope wetlands that have channels (Channeled Wet Meadows and Channeled Forested Slope wetlands). For Channeled wetlands, two sub-metrics are assessed: Bank Height Ratio, and Percent Dewatered. See the field book for guidance.

Bank Height Ratio

The Hydrologic Connectivity: Bank Height Ratio Sub-metric is scored by assessing the degree to which the lateral movement of floodwaters is restricted from flowing out onto the wetland surface due to incision of the channel. The sub-metric is assessed based on the bank height to bankfull depth ratio. Bank height is measured as the maximum height between the thalweg (the deepest point along the channel bed) and the top of the channel bank (the break in slope between the near vertical channel bank and the near horizontal wetland surface). The wetland surface is measured at the level of the primary horizontal wetland surface, and not at the height of any small inset floodplains that may be forming in an entrenched or incising system. Bankfull depth is measured as the height between the thalweg and the projected water surface at the level of bankfull flow.

A

B

C

D

Percent Dewatered

The following are examples of intact hydrologic connectivity, or in other words, Slope wetlands that are *not* showing indications of dewatering.

No channel incision

Vigor of hydrophytes

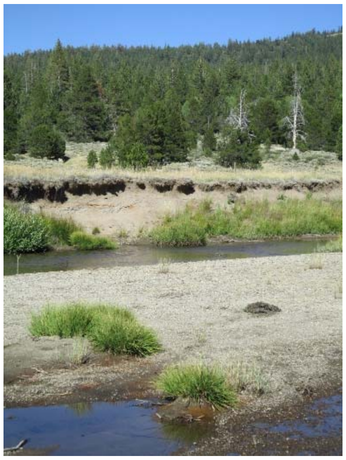
Low or no cover of upland plant species

Surface water present on wetland plain late into the summer season

Groundwater emerging

Moist peat soil

The following are examples of degraded hydrologic connectivity, or in other words, Slope wetlands that are dewatered.



Channel incision- low entrenchment ratios

Channel incision- undercut banks

Channel incision- hanging roots

Channel incision- scoured to bedrock or dense clay

Channel incision- active knickpoints

Channel incision- active headcutting

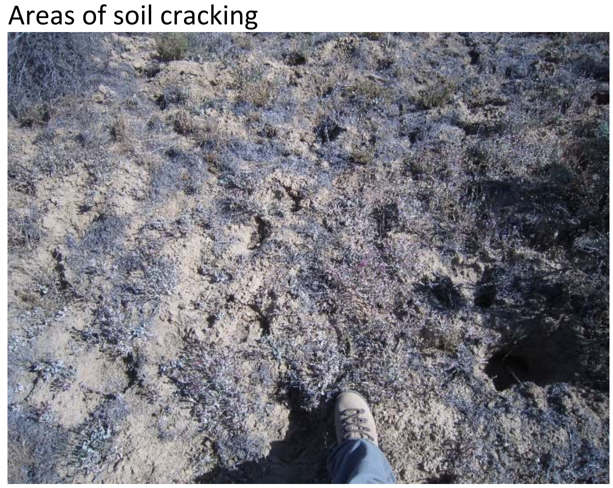
Stress or mortality of plants

Development of rills or gullies

Areas of bare soil

Areas of soil cracking

Decrease in vigor of hydrophytes



Changes in soil structure or moisture content

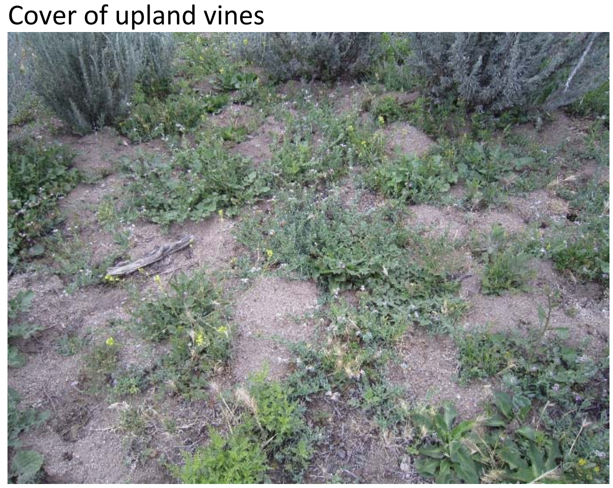
Cover of upland conifer species

Cover of upland deciduous trees

Cover of upland shrub species

Cover of upland vines

Cover of upland grasses



Cover of upland herbs/forbs

STRUCTURAL PATCH RICHNESS

Patch richness is the number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian species. Physical patches can be natural or unnatural. The minimum size for most patches to be counted is 3 m^2. Refer to the Patch Type definitions to determine if the feature in the field meets the definition.

Abundant wrack or organic debris

Active fluvial channel

Animal mounds and burrows, vole trails

Bank slumps or undercut banks


Beaver dams or lodges


Boulders or bedrock outcrop


Cutoff channels or oxbows


Filamentous macroalgae and algal mats


Gravel, cobble, or sand


Large woody debris

Moss

Non-vegetated flats or bare ground

Pannes or pools

Plant hummocks or tussocks

Sediment mounds around the bases of trees

Sediment splays


Soil cracks


Springs or upwelling groundwater


Standing snags


Submerged vegetation


Swales


Thatch


Variegated or crenulated upland edge


Variegated or crenulated upland edge

TOPOGRAPHIC COMPLEXITY

Topographic complexity refers to the variety of elevations within a wetland due to physical and biological materials and processes occurring within the AA. Topographic complexity is assessed by noting the overall variability in topographic features, physical patches, and vegetation roughness. For Slope wetlands, topographic complexity can be evaluated by observing the amount of macro- and micro-topographic relief and physical plant structure that affect moisture gradients or that influence the path of water movements along a transect across the AA. Note that in Slope wetlands, the macro- and micro-topographic features may be on the order of ≤ 1 m relief. In fens, the features may be on the order of centimeters.

For Slope wetlands, the practitioner must score two components: the physical topographic complexity, and the vegetation roughness.

Physical topographic complexity refers to the ground surface, and its macro topographic relief, micro topographic relief, and variety of slopes. Wetlands with greater physical topographic complexity will promote variable hydroperiods and associated moisture gradients that, in turn, promote ecological complexity by increasing the spatial and temporal variability in energy dissipation, surface water storage, groundwater recharge, particulate matter detention, cycling of elements and compounds, and habitat dynamics.

Vegetation roughness refers to the density and complexity of vegetation on the wetland surface, as it acts to slow the movement of surface water. Sites with greater vegetation roughness will have slower movement of surface water, as that water is forced to interact with the vegetation as it flows. Slower moving water has a greater likelihood of infiltrating, or allowing sediment or nutrients to be deposited or filtered by the wetland.

Physical Topographic Complexity

A: Abundant physical macro and micro topographic features

A: Abundant physical macro and micro topographic features


B: Moderate physical macro and micro topographic features


B: Moderate physical macro and micro topographic features


C: Minor physical macro and micro topographic features


C: Minor physical macro and micro topographic features

D: Lacking any physical macro and micro topographic features

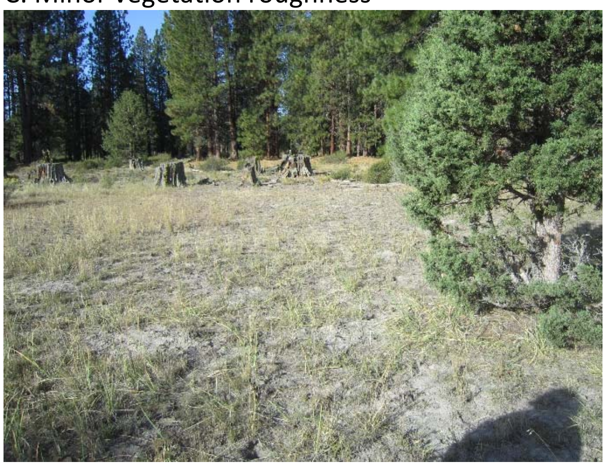
D: Lacking any physical macro and micro topographic features

Vegetation Roughness


A: Abundant vegetation roughness


B: Moderate vegetation roughness

C: Minor vegetation roughness



D: Lacking any vegetation roughness

HORIZONTAL INTERSPERSION

Horizontal Interspersion refers to the variety and interspersion of plant “zones,” or patches of monocultures or obvious multi-species association that are arrayed along gradients of elevation, moisture, or other environmental factors that seem to affect the plant community organization in a two-dimensional plan view. Interspersion is essentially a measure of the number of distinct plant zones or patches AND the amount of edge between them. Each zone must comprise 5% or more of the AA. It is important to note that the number of zones can be surprisingly high in some areas, and this metric cannot be scored by simply “counting” the number of zones. An "A" condition means BOTH more zones AND a greater degree of interspersion, and the departure from the "A" condition is proportional to BOTH the reduction in the numbers of zones AND their interspersion.

Plant “zones” are defined by a relatively unvarying combination of physiognomy and species composition. Think of each plant zone as a vegetation complex of relatively non-varying composition extending from the top of the tallest trees down through all of the vegetation to ground level.

For this metric, the practitioner is to define plant zones, sketch them within the AA, and then compare to the cartoons in the field book. The following photos illustrate varying degrees of interspersion.

A: High degree of interspersion

B: Moderate degree of interspersion

C: Low degree of interspersion

D: No interspersion

LIFE FORMS

The Plant Life Forms metric captures the number of different plant structure types that are present within the AA. Each plant life form provides unique functions for animal habitat as well as influencing hydrologic and physical processes. Wetlands with multiple life forms provide a greater diversity and complexity of biotic structure, which in turn provides the complexity of habitat for birds, mammals, amphibians and insects. Each life form must be present over at least 5% relative cover of the AA to be counted.


Bryophytes (mosses, liverworts, hornworts)


Coniferous Trees


Deciduous Broadleaf Trees


Evergreen Broadleaf Trees


Ferns


Grasses


Herbs/Forbs


Lichens or Fungi


Sedges/Rushes


Shrubs


Vines

STRESSORS

A stressor, as defined for the purposes of the CRAM, is an anthropogenic perturbation within a wetland or its environmental setting that is likely to negatively impact the condition and function of the CRAM Assessment Area (AA). A disturbance is a natural phenomenon that affects the AA. These photos highlight a selection of stressors observed in Slope wetlands.

Non-point source discharges

Dams

Engineered channel

Dike/levees


Ditches


Actively managed hydrology


Vegetation management


Trash


Mowing


Grazing


Excessive human visitation


Predation and habitat destruction by non-native vertebrates


Tree cutting/ sapling removal


Urban residential


Industrial/Commercial


Military training/air traffic


Intensive row crop agriculture


Ranching


Transportation corridor


Sports fields and urban parklands


Passive recreation


Active recreation