

# California Rapid Assessment Method for Wetlands (CRAM)

## Photo Dictionary



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Central Coast Wetlands Group  
at Moss Landing Marine Labs





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## Introduction

The California Rapid Assessment Method (CRAM) is a 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 CRAM tool. There are photographic examples for many indicators and also for specific narratives that are used to score some metrics (e.g. buffer condition). Some examples are specific to a single wetland type and some are universal across wetland types. These examples are not an exhaustive catalog of all potential states of wetlands, however they do present a range of conditions at various wetland types. The wetland types included in this photo dictionary are Estuarine, Riverine, and Depressional wetlands.



*Photos were provided by the Central Coast Wetlands Group (CCWG), San Francisco Estuary Institute (SFEI), Southern California Coastal Water Research Project (SCCWRP), and Roberts Environmental and Conservation Planning LLC.*

## Buffer

Definition: The buffer is a zone of transition between the immediate margins of a wetland and its surrounding environment that is likely to help protect the wetland from anthropogenic stress and natural disturbance. For the purposes of CRAM, the buffer is an area adjoining the AA that is in a natural or semi-natural state and currently not dedicated to anthropogenic uses that would severely detract from its ability to entrap contaminants, discourage visitation into the AA by people and non-native predators, or otherwise protect the AA from anthropogenic stress and natural disturbance.

## Examples of Land Covers Included in Buffers



*Roads not hazardous to wildlife*



*At grade bike and foot trails*



*Vegetated levees*



*Open rangeland*



*Natural upland habitat*



*Horse trails*



*Railroads with infrequent use*



*Swales and ditches*



*Nature or wildland parks*



*Fences that do not interfere with the movement of wildlife*

## Examples of Land Covers Excluded from Buffers



*Parking lots*



*Intensive agriculture (row crops, orchards and vineyards)*



*Sounds walls or other concrete walls*



*Golf course*

CRAM Photo Dictionary



*Horse paddocks, feedlots, turkey ranches, etc*



*Active railroads with frequent use*



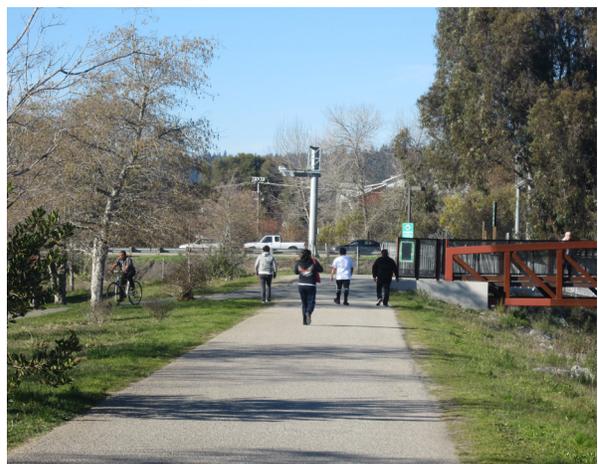
*Residential areas*



*Lawn*



*Paved roads (2 lanes or larger)*



*Pedestrian/bike paths with heavy use*



*Commercial developments*



*Sports fields*



*Urbanized parks with active recreation*



*Fences that interfere with the movements of wildlife*

## Examples of Varying Buffer Condition

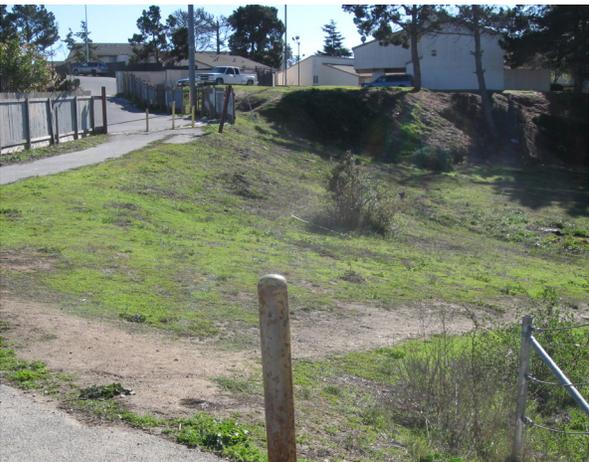
**A**



**B**



C



D



# Channel Stability

## *(Riverine)*

Definition: Channel stability is assessed as the degree of channel aggradation (i.e., net accumulation of sediment on the channel bed causing it to rise over time), or degradation (i.e., net loss of sediment from the bed causing it to be lower over time). The degree of channel stability can be assessed based on field indicators.

## Indicators of Equilibrium



*Perennial vegetation is abundant and well established along the bankfull but not below it*



*Larger bed material supports abundant mosses or periphyton*



*Well defined bankfull*



*Channel contains embedded woody debris*



*Leaf litter, thatch, or wrack in pools*



*Channel bars consist of well sorted bed material*



*There is little or no active undercutting or burial of riparian vegetation*



*Regular spacing between channel pools*



*No densely vegetated mid channel bars*

## Indicators of Aggradation



*Perennial vegetation encroaching into channel*



*Partially buried living tree trunks or shrubs along banks*



*Planar bed*



*Sediment choked culverts*



*Active floodplain with fresh splays of coarse sediment*

*Note: 'Avulsion channels' is not pictured due to the inability to accurately represent the indicator using a photo.*

## Indicators of Degradation



*Deeply undercut banks with exposed roots*



*Abundant banks slides or slumps*



*Lower banks are uniformly scoured*



*Riparian vegetation is declining in stature or falling into channel*



photo: Sean Mundell

*Historic floodplain has been abandoned*



*Channel bed is scoured to clay or bedrock*



*Knickpoints*

*Note: 'Channels have coalesced' is not pictured due to the inability to accurately represent the indicator using a photo.*

## Hydroperiod *(Depressional and Estuarine)*

Hydroperiod is the characteristic frequency and duration of inundation or saturation of a wetland during a typical year.

**Estuarine Definition:** The natural hydroperiod for estuarine wetlands is governed by the tides, and includes predictable variations in inundation regimes over days, weeks, months, and seasons. A change in the hydroperiod of an estuarine wetland (i.e., a change in the tidal prism) can be inferred from changes in channel morphology, drainage network density, and the relative abundance of plants indicative of either high or low marsh. A preponderance of shrink-swell cracks or dried pannes on the wetland plain is indicative of decreased hydroperiod. In addition, inadequate tidal flushing may be indicated by algal blooms or by encroachment of freshwater vegetation. Dikes, levees, ponds, or ditches are indicators of an altered hydroperiod resulting from management for flood control, salt production, waterfowl hunting, mosquito control, etc.

**Depressional Definition:** Depressional wetlands typically have daily variations in water height that are governed by diurnal increases in evapotranspiration and seasonal cycles that are governed by rainfall, runoff, and specialized management practices. This metric evaluates recent changes (within the last 5 years) in the hydroperiod, flow regime, or sediment regime of a wetland and the degree to which these changes affect the structure and composition of the wetland plant community. Common field indicators of an altered hydroperiod for depressional wetlands include pumps, spring boxes, ditches, hoses and pipes, and encroachment of terrestrial vegetation.

## Indicators of Altered Hydroperiod: Direct Engineering Evidence



*Pumps*



*Ditching*



*Active water control structures at the outlet or inlet*



*Hoses and pipes*



*Upstream impoundments and diversions*



*Levees and water control structures*

## Hydrologic Connectivity *(Depressional and Estuarine)*

Depressional Definition: Hydrologic Connectivity describes the ability of water to flow into or out of the wetland, to inundate its adjacent upland transition zones, allowing the system to accommodate rising flood waters without dramatic changes in water level, which can result in stress to wetland plants and animals. Additionally, the presence of this transition zone between the wetland and the upland provides varied saturation zones and their associated habitats and increases complexity. This metric is scored by assessing the degree to which the lateral movements of rising waters are restricted by features such as very steep banks, levees, concrete walls, rip-rap, or road grades in the AA, its encompassing wetland and the associated upland transition zone.

Estuarine Definition: Hydrologic Connectivity describes the ability of water to flow into or out of the wetland, or to accommodate rising flood waters without dramatic changes in water level, which can result in stress to wetland plants and animals. This metric is scored by assessing the degree to which the lateral movement of rising tides or flood waters is restricted by unnatural features such as levees, dikes, sea walls, or road grades in the AA, its encompassing wetland and the associated upland transition zone.



*Levees*



*Dikes and walls*



*Rip rap*



*Road grades*

## Structural Patch Richness

Definition: Patch richness is the number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian species. This metric is different from topographic complexity in that it addresses the number of different patch types, whereas topographic complexity evaluates the spatial arrangement and interspersion of the types. Physical patches can be natural or unnatural.

**ABUNDANT WRACK or ORGANIC DEBRIS  
IN CHANNEL OR ALONG SHORELINE**  
*(Depressional, Estuarine, Riverine)*

Definition: Wrack is an accumulation of natural or unnatural floating debris along the high water line of a wetland. The organic debris must be free of its original growth position. Senesced plant material that is still attached to the parent plant does not count (for example, last year's cattail or bulrush growth).



*Depressional*



*Estuarine*



*Estuarine*



*Riverine*

## ANIMAL MOUNDS AND BURROWS *(Depressional, Estuarine)*

Definition: Many vertebrates make mounds or holes as a consequence of their foraging, denning, predation, or other behaviors. The resulting soil disturbance helps to redistribute soil nutrients and influences plant species composition and abundance. To be considered a patch type there should be evidence that a population of burrowing animals has occupied the Assessment Area. A single burrow or mound does not constitute a patch.



*Depressional*



*Estuarine*



*Estuarine*



*Depressional*

## BANK SLUMPS OR UNDERCUT BANKS (*Depressional, Estuarine, Riverine*)

Definition: A bank slump is a portion of a depressional bank that has broken free from the rest of the bank but has not eroded away. Undercuts are areas along the bank or shoreline of a wetland that have been excavated by waves or flowing water.



*Riverine*



*Riverine*



*Estuarine*



*Depressional*

## COBBLES AND BOULDERS *(Depressional, Riverine)*

Definition: Cobbles and boulders are rocks of different size categories. The middle axis of a cobble ranges from about 6 cm to about 25 cm. A boulder is any rock having a middle axis greater than 25 cm. Submerged cobbles and boulders provide habitat for aquatic macroinvertebrates and small fish. Exposed cobbles and boulders provide roosting habitat for birds and shelter for amphibians. They contribute to patterns of shade and light and air movement near the ground surface that affect local soil moisture gradients, deposition of seeds and debris, and overall substrate complexity. Cobbles and boulders contribute to oxygenation of flowing water.



*Riverine*



*Depressional*



*Riverine*



*Riverine*

## CONCENTRIC OR PARALLEL HIGH WATER MARKS *(Depressional)*

Definition: Repeated variation in water level in a wetland can cause concentric zones in soil moisture, topographic slope, and chemistry that translate into visible zones of different vegetation types, greatly increasing overall ecological diversity. The variation in water level might be natural (e.g., seasonal) or anthropogenic.



*Depressional*



*Depressional*



*Depressional*

## DEBRIS JAMS (*Estuarine, Riverine*)

Definition: A debris jam is an accumulation of drift wood and other flotsam across a channel that partially or completely obstructs surface water flow.



*Estuarine*



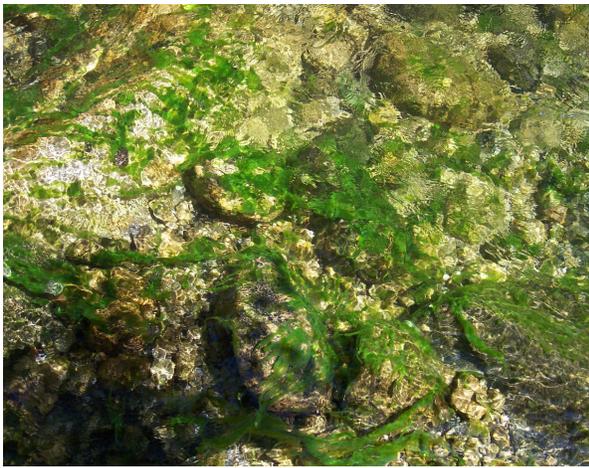
*Riverine*



*Riverine*

## FILAMENTOUS MACROALGAE AND ALGAL MATS (*Depressional, Estuarine, Riverine*)

Definition: Macroalgae occurs on benthic sediments and on the water surface. Macroalgae are important primary producers, representing the base of the food web in some wetlands. Algal mats can provide abundant habitat for macro-invertebrates, amphibians, and small fishes.



*Riverine*



*Depressional*



*Estuarine*



*Estuarine*

## LARGE WOODY DEBRIS *(Depressional, Estuarine, Riverine)*

Definition: Large woody debris (LWD) provides important services and is an indicator of dynamic hydrology and ecology. It provides basking habitat for turtles or perching habitat for birds, which use wood perches preferentially over rock substrates. LWD can be a source of food for invertebrates, and it increases overall topographic heterogeneity. It can provide structure to create scour pools or eddies with dynamic hydrology. It can be a refuge to hide from predators in a low-relief landscape. In an depressional or estuarine system LWD is defined as any woody fragment greater than 10 cm diameter and 1 meter long. In a riverine system LWD is defined as a single piece of woody material, greater than 30 cm in diameter and greater than 3 m long.



*Estuarine*



*Estuarine*



*Riverine*



*Depressional*

## NON-VEGETATED FLATS (*Depressional, Estuarine*)

Definition: A flat is a non-vegetated area of silt, clay, sand, shell hash, gravel, or cobble at least 10 m wide and at least 30 m long that adjoins the wetland foreshore and is a potential resting and feeding area for fishes, shorebirds, wading birds, and other waterbirds. Flats can be similar to large bars (see definitions of point bars and in-channel bars below), except that they lack the convex profile of bars and their compositional material is not as obviously sorted by size or texture.



*Depressional*



*Depressional*



*Estuarine*



*Estuarine*

OPEN WATER  
*(Depressional)*

Definition: Areas of deeper water depths within depressional wetlands that are more than 10 meters wide and do not support emergent vegetation. Open water habitat typically supports submerged macrophytes and provides important foraging habitat for waterfowl and other wildlife species.



*Depressional*



*Depressional*

PANNES OR POOLS ON FLOODPLAIN  
(*Estuarine, Riverine*)

Definition: A panne is a shallow topographic basin lacking vegetation but existing on a well-vegetated wetland plain. Pannes fill with water at least seasonally due to overland flow. They commonly serve as foraging sites for waterbirds and as breeding sites for amphibians.



*Estuarine*



*Estuarine*



*Riverine*



*Riverine*

## PLANT HUMMOCKS OR SEDIMENT MOUNDS *(Depressional, Estuarine, Riverine)*

Definition: Hummocks are mounds created by plants along the banks and floodplains of wetland systems created by the collection of sediment and biotic material around wetland plants. Hummocks are typically less than 1m high. Sediment mounds are similar to hummocks but lack plant cover. They are depositional features formed from repeated flood flows depositing sediment on the floodplain.



*Depressional*



*Estuarine*



*Riverine*



*Riverine*

## POINT BARS AND IN-CHANNEL BARS (*Estuarine, Riverine*)

Definition: Bars are sedimentary features within intertidal channels. They are patches of transient bedload sediment that form along the inside of meander bends or in the middle of straight channel reaches. They sometimes support vegetation. They are convex in profile and their surface material varies in size from small on top to larger along their lower margins. They can consist of any mixture of silt, sand, gravel, cobble, and boulders.



*Riverine*



*Estuarine*



*Estuarine*



*Riverine*

## POOLS OR DEPRESSIONS IN CHANNEL (*Estuarine, Riverine*)

**Estuarine Definition:** Pools are areas along tidal channels that are much deeper than the average depths of their channels and that tend to retain water longer than other areas of the channel during periods of low or no surface flow.

**Riverine Definition:** Pools are areas along fluvial channels that are much deeper than the average depths of their channels and that tend to retain water longer than other areas of the channel during periods of low or no surface flow.



*Riverine*



*Riverine*



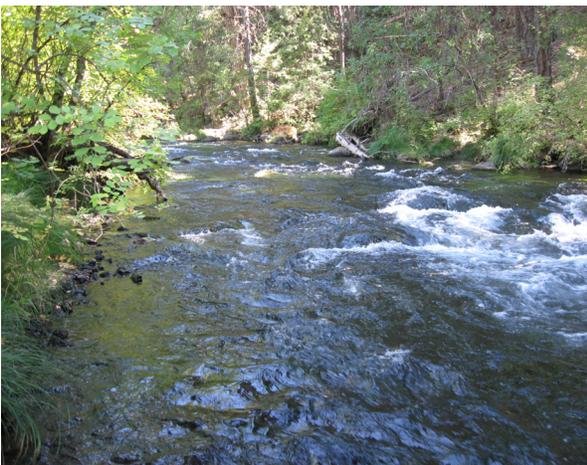
*Estuarine*

## RIFFLES OR RAPIDS *(Riverine)*

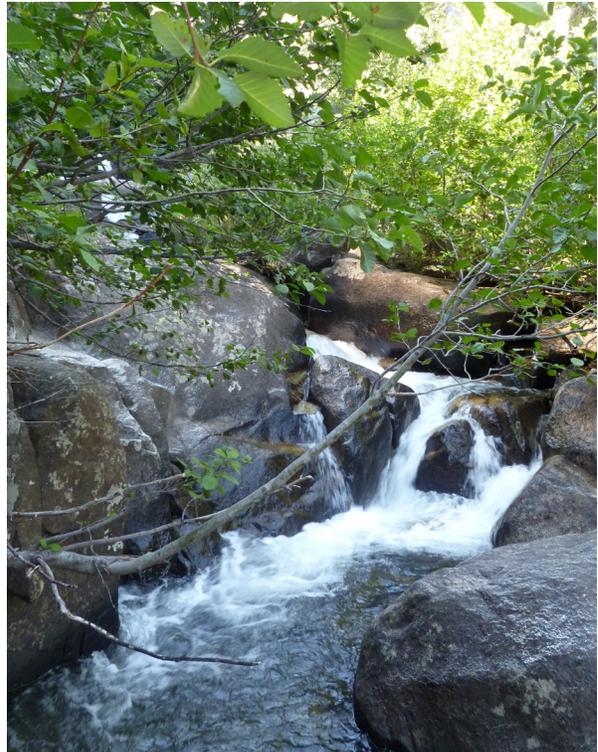
Definition: Riffles and rapids are areas of relatively rapid flow, standing waves and surface turbulence in fluvial channels. A steeper reach with coarse material (gravel or cobble) in a dry channel indicates presence. Riffles and rapids add oxygen to flowing water and provide habitat for fish and aquatic invertebrates.



*Riverine*



*Riverine*



*Riverine*

## SECONDARY CHANNELS ON FLOODPLAIN OR ALONG SHORELINE (*Estuarine, Riverine*)

**Estuarine Definition:** Channels confine estuarine flow. A channel consists of a bed and its opposing banks, plus its floodplain. Estuarine wetlands can have a primary channel, and one or more secondary channels of varying sizes that convey tidal flows.

**Riverine Definition:** Channels confine riverine flow. A channel consists of a bed and its opposing banks, plus its floodplain. Riverine wetlands can have a primary channel that conveys most flow, and one or more secondary channels of varying sizes that convey flood flows. The systems of diverging and converging channels that characterize braided and anastomosing fluvial systems usually consist of one or more main channels plus secondary channels. Tributary channels that originate in the wetland and that only convey flow between the wetland and the primary channel are also regarded as secondary channels.



*Riverine*



*Estuarine*



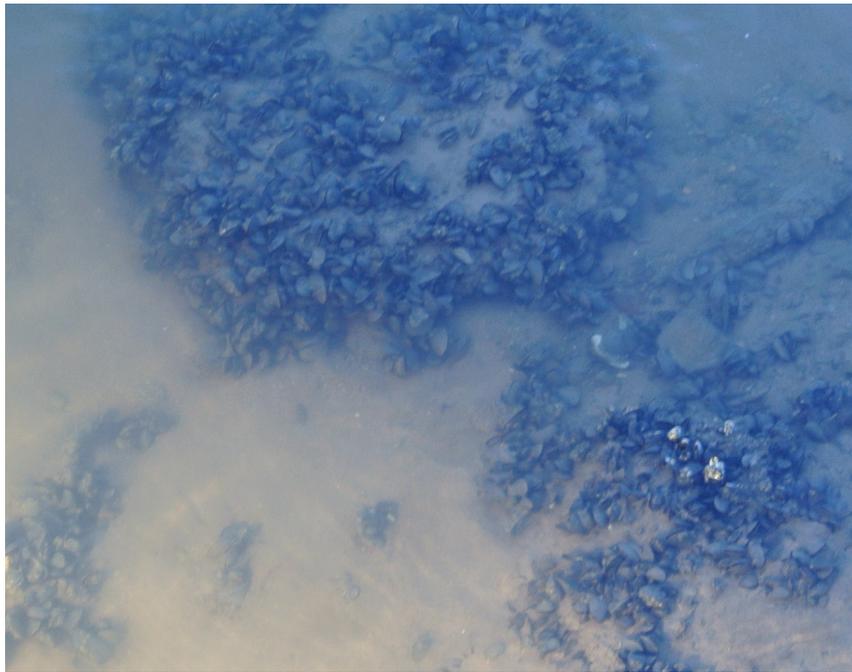
*Riverine*



*Estuarine*

## SHELLFISH BEDS (living) (*Estuarine*)

Definition: Oysters, clams and mussels are common bivalves that create beds on the banks and bottoms of wetland systems. Shellfish beds influence the condition of their environment by affecting flow velocities, providing substrates for plant and animal life, and playing particularly important roles in the uptake and cycling of nutrients and other water-borne materials.



*Estuarine*

## SOIL CRACKS *(Depressional, Estuarine)*

Definition: Repeated wetting and drying of fine grain soil that typifies some wetlands can cause the soil to crack and form deep fissures that increase the mobility of heavy metals, promote oxidation and subsidence, while also providing habitat for amphibians and macroinvertebrates. Cracks must be a minimum of 1 inch deep to qualify.



*Estuarine*



*Estuarine*



*Depressional*



*Depressional*

## STANDING SNAGS (*Depressional, Estuarine, Riverine*)

Definition: Tall, woody vegetation, such as trees and tall shrubs, can take many years to fall to the ground after dying. These standing “snags” they provide habitat for many species of birds and small mammals. Any standing, dead woody vegetation that is at least 3 m tall with at least a 10 cm diameter is considered a snag.



*Riverine*



*Depressional*



*Estuarine*

## SUBMERGED VEGETATION (*Depressional, Estuarine, Riverine*)

Definition: Submerged vegetation consists of aquatic macrophytes such as *Zostera marina* (eelgrass), and *Elodea canadensis* (common elodea) that are rooted in the sub-aqueous substrate but do not usually grow high enough in the overlying water column to intercept the water surface. Submerged vegetation can strongly influence nutrient cycling while providing food and shelter for fish and other organisms.



*Riverine*



*Riverine*



*Estuarine*



*Depressional*

## SWALES ON FLOODPLAIN OR ALONG SHORELINE *(Depressional, Riverine)*

Definition: Swales are broad, elongated, vegetated, shallow depressions that can sometimes help to convey flood flows to and from vegetated marsh plains or floodplains. But, they lack obvious banks, regularly spaced deeps and shallows, or other characteristics of channels. Swales can entrap water after flood flows recede. They can act as localized recharge zones and they can sometimes receive emergent groundwater.



*Riverine*



*Depressional*



*Riverine*



*Depressional*

## VARIAGATED, CONVOLUTED, OR CRENULATED FORESHORE *(Depressional, Riverine)*

Definition: As viewed from above, the foreshore of a wetland can be mostly straight, broadly curving (i.e., arcuate), or variegated (e.g., meandering). In plan view, a variegated shoreline resembles a meandering pathway. Variegated shorelines provide greater contact between water and land. This can be viewed on a scale smaller than the whole AA (2-3 m). Large boulders and fallen trees along the shoreline can contribute to variegation.



*Depressional*



*Depressional*



*Riverine*



*Riverine*

VEGETATED ISLANDS  
(Exposed at high water stage)  
*(Depressional, Riverine)*

Definition: An island is an area of land above the usual high water level and, at least at times, surrounded by water. Islands differ from hummocks and other mounds by being large enough to support trees or large shrubs.



*Riverine*



*Depressional*

## WOODY VEGETATION IN WATER *(Depressional)*

Definition: Live trees or woody vegetation in water provide important foraging and bird nesting habitat, as well as allocthonous contributions of carbon to the wetland as the base of the food web. This does not include riparian woody vegetation at the edge of the wetland but rather trees or large shrubs that are within the wetland.



*Depressional*



*Depressional*

## Topographic Complexity

Definition: Topographic complexity refers to the micro- and macro-topographic relief and variety of elevations within a wetland due to physical and abiotic features and elevation gradients that affect moisture gradients or that influence the path of flowing water. The following indicate the range of topographic features that occur in different types of wetlands.

Depressional: pools, islands, mounds or hummocks, variegated shorelines, soil cracks, partially buried debris, animal tracks, cobbles and boulders

Estuarine: channels large and small, ditches, islands, bars, pannes, potholes, natural and unnatural levees or dikes, shellfish beds, sediment mounds, bank slumps, first-order tidal channels, soil cracks, partially buried debris, plant hummocks, burrows, animal tracks

Riverine: pools, runs, glides, pits, ponds, sediment mounds, bars, debris jams, cobble, boulders, slump blocks, tree-fall holes, plant hummocks

## Depressional: Examples of Topographic Features



*Pools*



*Islands*



*Mounds or hummocks*



*Variegated shoreline*



*Soil cracks*



*Partially buried debris*



*livestock tracks*



*Cobbles and boulders*



*Bench*

## Estuarine: Examples of Topographic Features



*Channels large and small*



*Ditches*



*Islands*



*Bars*



*Pannes*



*Animal burrows*



*Natural and unnatural levees*



*Shellfish beds*



*Animal tracks*



*Bank slumps*



*First order tidal channels*



*Soil cracks*



*Partially buried debris*



*Plant hummocks*

## Riverine: Examples of Topographic Features



*Pools*



*Runs*



*Glides*



*Pits*



*Sediment mounds*



*Debris jams*



*Cobble*



*Boulders*



*Slump blocks*



*Tree fall holes*



*Plant hummocks*



*Benches*



*Bars*

## Horizontal Interspersion and Zonation

Definition: Horizontal interspersion refers to the variety and interspersion of plant “zones.” Plant zones are obvious multi-species associations (in some cases zones may be plant monocultures that remain relatively constant in makeup throughout the AA and which 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. In all cases, the plant “zones” are defined by a relatively unvarying combination of physiognomy and species composition. Think of each plant zone as extending from the top of the tallest plants down through all of the vegetation to ground level. A zone may include groups of species of multiple heights, and this metric is not based on the layers established in the Plant Community Submetric A.

# Examples of Varying Horizontal Interspersion

**A**



**B**



C



D



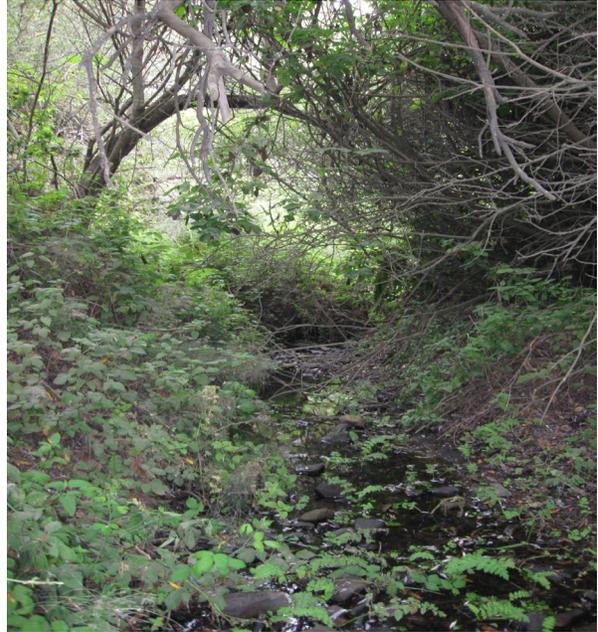
## Vertical Biotic Structure

**Estuarine Definition:** The vertical component of biotic structure consists of the interspersions and complexity of plant layers. For estuarine wetlands this metric is assessed as the amount of living vegetation, entrained litter, or detritus across the marsh plain and the amount of space beneath it.

**Riverine and Depressional Definition:** The vertical component of biotic structure assesses the degree of overlap among plant layers. The same plant layers used to assess the Plant Community Composition Metrics are used to assess Vertical Biotic Structure. To be counted in CRAM, a layer must cover at least 5% of the portion of the AA that is suitable for the layer.

## Examples of Varying Vertical Biotic Structure: Overlap

***Abundant Overlap***



***Moderate Overlap***



***No Overlap***



***Sparsely Vegetated***



## Examples of Varying Vertical Biotic Structure: Entrainment

*Dense canopy with high ceiling over 10-20cm*



*Dense canopy with low ceiling*



*Sparse canopy*



# Plant Identification

The CRAM photo dictionary does not provide its own set of plant identification photos. However it does provide a list of various resources and websites to assist CRAM practitioners in the identification of species.



*Monoptilon bellidiforme*



*Carex* sp.

## Plant Identification Resources

**Botanical Image Database**

<http://pages.unibas.ch/botimage/fame.htm>

**Calflora**

<http://www.calflora.org/>

**California Academy of Sciences Botany**

<http://research.calacademy.org/botany/collections>

**California Native Plant Society**

<http://www.cnps.org/>

**CalPhotos**

<http://calphotos.berkeley.edu/flora/>

**Consortium of California Herbaria**

<http://ucjeps.berkeley.edu/consortium/>

**Efloras**

<http://www.efloras.org/>

**Global Invasives Species Database**

<http://www.issg.org/database/welcome/>  
(for invasive plants)



*Lilium* sp.



*Eleocharis* sp.

**Invasive Plant Council**

<http://www.cal-ipc.org/>  
(for invasive plants)

**Jepson Interchange**

<http://ucjeps.berkeley.edu/interchange.html>  
[http://ucjeps.berkeley.edu/interchange/old\\_index.html](http://ucjeps.berkeley.edu/interchange/old_index.html)  
(using this older version of their interface you can generate a list of plants by county or floristic bioregion)

**North Americas Plant Atlas**

<http://www.bonap.org/>

**SEINet**

<http://swbiodiversity.org/seinet/index.php>

**USDA Plants Database**

<http://plants.usda.gov/java/>



*Fouquieria splendens*