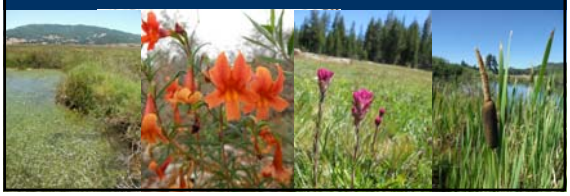
California Rapid Assessment Method for Wetlands

Biotic Structure Attribute



Biotic Elements in Wetland Ecosystems

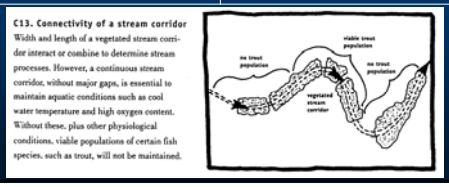
- Tangible structure (e.g., plant and animal tissues)
- Ecological structure (e.g., populations of producers, consumers, and decomposers)
- Ecological processes
- CRAM:
  - Condenses these biological and ecological elements to representative vegetation characteristics
  - Represents established ecological patterns in a simplified manner
  - Maintains link to ecological patterns

The Biotic Structure Attribute Measures Complexity

- Ecologically complex wetlands have more species and more individuals
- In CRAM, wetlands with complex structures score higher
- Biotic Structure metrics that emphasize complexity:
  - Greater plant species richness
  - Greater horizontal "zone" complexity
  - Greater vegetation layering
- Direct measurements of biological diversity are Level 3 studies and are not addressed by CRAM

Biotic Aspects in the Buffer and Landscape Context Attribute

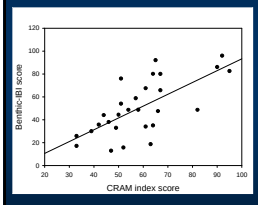
Function	CRAM Metric
Riparian connectivity for wildlife and fisheries movement and conservation	Stream Corridor Continuity
Buffer functions are important for wildlife and habitat protection	Buffer



Biotic Aspects in Hydrology and Physical Structure Attributes

Function	CRAM Attribute
• Instream conditions: important for fish and amphibians	Hydrology Attribute considers aggradation, degradation, and fluvial process indicators
• Hydromodification: correlated with invasions by exotic species	Hydrology Attribute considers channel stability and connectivity to floodplain
• Microhabitat elements: important for many invertebrates and some vertebrates	Physical Structure Attribute tallies soil cracks, snags, undercut banks, other microhabitats, etc.

Biotic Structure Attribute Reflects Ecological Patterns

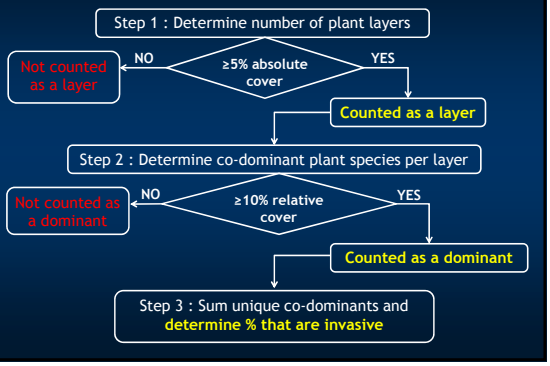


- CRAM/IBI Correlations
  - *CRAM Index ($P<0.0001$, $R^2 = 0.471$)*
  - *CRAM Biotic ($P<0.0001$, $R^2 = 0.434$)*
- CRAM Biotic Structure/Species Richness of Riparian Associated Birds
  - *CRAM Biotic ($P = 0.037$, Spearman's $\rho = 0.328$)*
- CRAM Biotic Structure/Species Richness of All Birds
  - *CRAM Biotic ($P = 0.029$, Spearman's $\rho = 0.342$)*

Metric 1: Plant Community

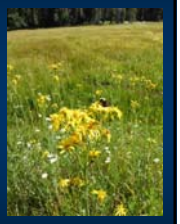
- Diversity of vegetation in the AA:
  - ***Plant layer diversity***: More vegetation layers = increased richness and higher productivity
  - ***Number of dominant plant species***: Diverse communities are more biologically productive and provide more habitat niches
  - ***Percentage of the dominant species that are invasive***: Dominance by invasive species reduces ecological functions

Determining Plant Community Submetrics



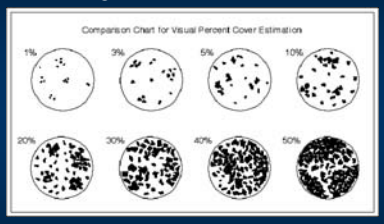
Measuring Species Richness

- Why the 10% threshold for plant dominance?
- More species = better condition
- The 10% threshold for dominance identifies a count of the number of species
- Sub-metric can then be scored numerically



Estimating Percent Cover: Key CRAM Skill

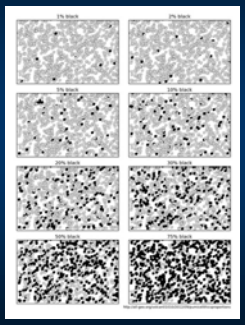
- Percent coverage can be difficult to estimate



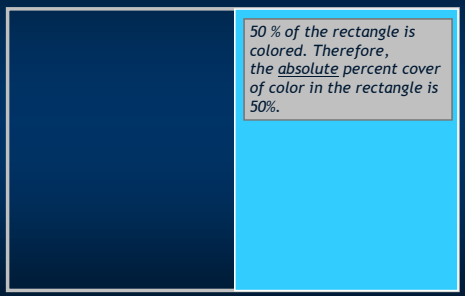
- You can "calibrate your eye" using a graphic
- A layer must cover 5% of the area that is suitable for the layer (i.e. absolute coverage)

Estimating Relative Percent Cover

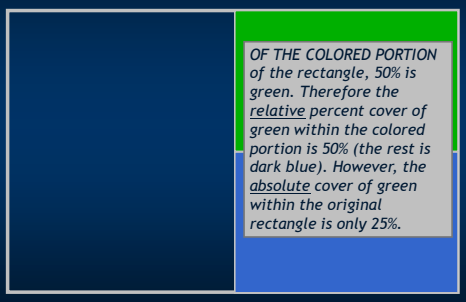
- A plant species must cover 10% of the area covered by a layer to be included as a co-dominant species (i.e. Relative cover)



Absolute vs. Relative Percent Cover



Absolute vs. Relative Percent Cover



Defining Plant Layers

- Each CRAM field book has height thresholds to define plant layers for the wetland type
- Layer heights are based on typical vegetation communities for the wetland type

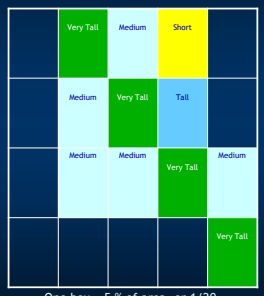
Wetland Type	Plant Layers				
	Aquatic	Semi-aquatic and Riparian			
	Floating	Short	Medium	Tall	Very Tall
Non-confined Riverine	On Water Surface	<0.5 m	0.5 – 1.5 m	1.5 – 3.0 m	> 3.0 m
Confined Riverine	NA	<0.5 m	0.5 – 1.5 m	1.5 – 3.0 m	> 3.0 m

Considerations for Defining Plant Layers and Co-Dominant Species

- A layer is present if it covers at least 5% of the area that is suitable for that layer
- Floating layer doesn't occur in terrestrial portions of AA, other layers don't occur in open water portions of AA, etc.
- A species can exist in >1 layer, but an individual can exist only in one layer
  - Each plant is counted in the tallest layer it occupies
  - Species can be in multiple layers, but each species is only counted once
  - Vines are counted in the tallest layer of vegetation the vine reaches
- Dead vegetation contributes to the absolute cover requirement for defining a layer, but dead species are not counted as co-dominants

Submetric 1: Number of Plant Layers

≥ 5% Absolute cover, in aggregate, within AA

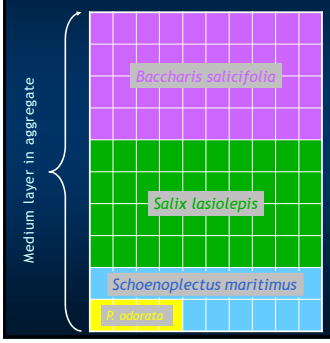


- Very Tall Layer (>3m)
  - (20%)
- Tall Layer (1.5-3m)
  - (5%)
- Medium Layer (0.5-1.5m)
  - (25%) *next slide ->*
- Short (<0.5m)
  - (5%)

- Therefore, this AA has 4 layers

Submetric 2: Number of Co-Dominant Plant Species

≥ 10% relative cover, in aggregate, within layer



Relative cover within layer ≥ 10%?

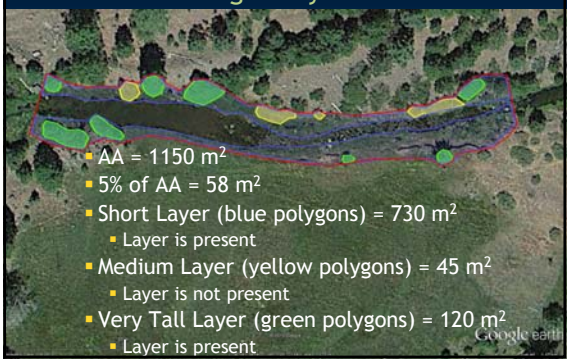
- *Baccharis salicifolia*
  40/100 = 40% Yes
- *Salix lasiolepis*
  40/100 = 40% Yes
- *Schoenoplectus maritimus*
  16/100 = 16% Yes
- *Pluchea odorata*
  4/100 = 4% No

- Therefore, the medium layer has 3 dominants

Use a Quantitative Approach to Metric Scoring

- Plant layer presence can be estimated using area
  - Example: AA is 3000 m^2, minimum area for layer to be present is 5%
    - 3000 X 0.05 = 150 m^2
- Dominant species ≥ 10% coverage in a layer
  - Example: A Layer covers 2/3 of the AA and the minimum area for species to be dominant is 10% of the layer
    - 2/3 X 3000 = 2000 m^2
    - 2000 X 0.10 = 200 m^2

Plant Community Example: Determining if Layer is Present



- AA = 1150 m^2
- 5% of AA = 58 m^2
- Short Layer (blue polygons) = 730 m^2
  - Layer is present
- Medium Layer (yellow polygons) = 45 m^2
  - Layer is not present
- Very Tall Layer (green polygons) = 120 m^2
  - Layer is present

Plant Community Special Notes

- Invasive status is determined by listing on the Cal-IPC Invasive Plant Inventory (any level)
- Local invasive species can be defined by regional experts

Ratings for the Plant Community Metric

Rating	Number of Plant Layers Present	Number of Co-dominant Species	Percent Invasion
Non-confined Riverine Wetlands			
A	4 – 5	≥ 12	0 – 15%
B	3	9 – 11	16 – 30%
C	2	6 – 8	31 – 45%
D	0-1	0 – 5	46 – 100%
Confined Riverine Wetlands			
A	4	≥ 11	0 – 15%
B	3	8 – 10	16 – 30%
C	2	5 – 7	31 – 45%
D	0-1	0 – 4	46 – 100%

- Scoring tables exist for each module
- Thresholds are based on typical plant communities for each wetland type

Metric 2: Horizontal Interspersion

- Horizontal distribution of different habitat conditions
- Different vegetation associations represent different habitat types
- Greater horizontal zonation provides increased habitat values for wildlife
- Higher scores for more zones, greater interspersion of zones, and consistent distribution of zones
- An "A" condition means BOTH more plant zones AND a greater degree of interspersion among zones, and the departure from the "A" condition is proportional to BOTH the reduction in the numbers of zones AND their interspersion

Scoring Horizontal Interspersion

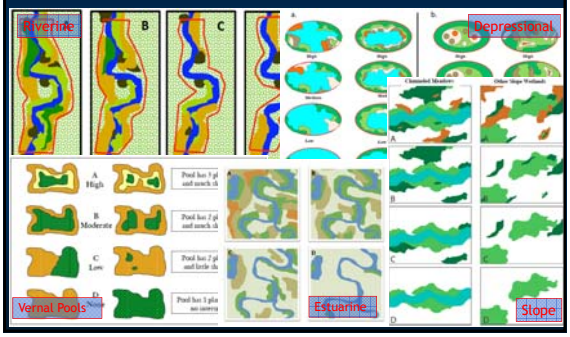
- Wetlands with short vegetation:
  - Plant zones viewed as a two-dimensional plan view of vegetation types
- Wetlands with taller vegetation and layering:
  - Each zone can be a combination of overlapping species in multiple layers
- Combination of aerial image interpretation and field observations

Scoring Criteria for the Horizontal Interspersion Submetric

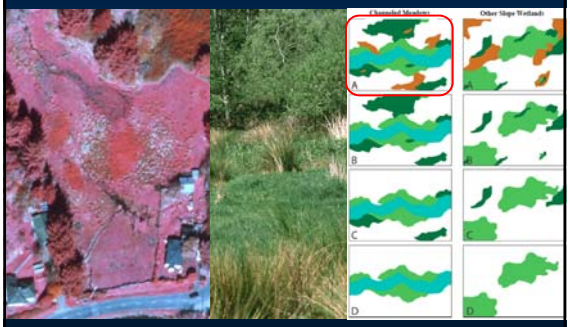
Rating	Alternative States
A	AA has a high degree of plan-view interspersion.
B	AA has a moderate degree of plan-view interspersion.
C	AA has a low degree of plan-view interspersion.
D	AA has minimal plan-view interspersion.

Scoring is based on a worksheet field sketch and interpretation of a graphic figure from the appropriate field book

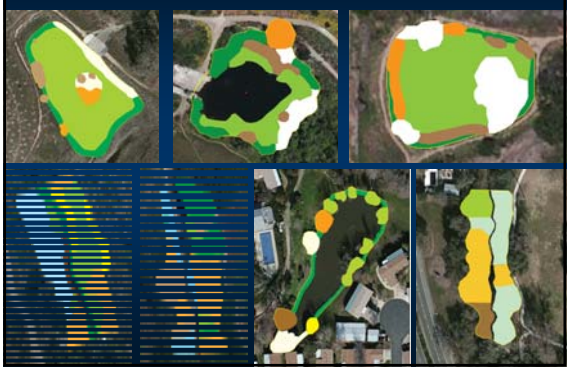
CRAM Interspersion Diagrams
Different Diagrams for Different Modules



Example: Scoring Interspersion



Example: Interspersion Field Sketches

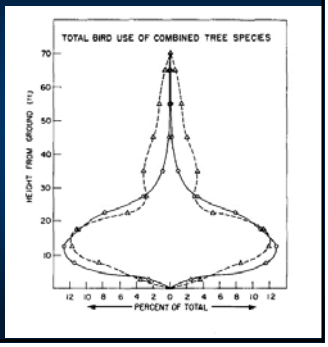


Metric 3: Vertical Biotic Structure

- Vertical diversity of habitat
- **Same** vegetation layers as the Plant Community metric
- Wetlands that lack vertical structure and vegetation layers (e.g., vernal pools) do not include either this metric or the "layers" sub-metric
- Compare the observed conditions with alternative conditions illustrated in the field book

Ecological Functions of Vertical Structure

- Ecological relationship between wildlife use and vertical layering
- Particularly for riparian areas
- Vertical structure = habitat for foraging, nesting, etc
- Bird use parallels vegetation structure



Solid line: percent of foliage volume in each height class.
Dashed line: summed bird use.
Data from R.P. Balda, study in SE Arizona
The Condor 71:399-412.

Functions of Vertical Structure

- Overlapping vegetation layers provide:
  - vertical gradients in light and temperature
  - greater species diversity and richness of invertebrates, fish, amphibians, mammals, and birds
  - rainfall interception, reduced evaporation from soils, and enhanced filtration of floodwaters

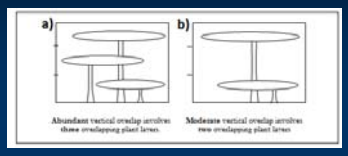
Entrained Vegetation Functions

- Ground nesting birds require vegetation cover at nest sites
- Plant canopies entrap coarse plant litter that is lifted into the canopies by rising water (tides or floods)
- This "entrained" material is left hanging in the plant cover, providing shelter for birds and small mammals

Dense Canopy Functions

- Rainfall interception
- Reduced evaporation from soils
- Enhanced filtration of flood waters

Vertical Biotic Structure in Wetlands with Woody Riparian Vegetation

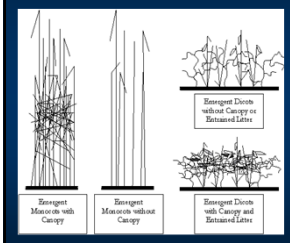


- For wetland types with well-developed vertical woody vegetation structure
- 3-D concept: vertical layering measured over a proportion of the AA in horizontal plan view
- Higher scores = higher vertical density of layers and higher cover of these layers over the AA

Vertical Biotic Structure Scoring Using Overlap

Rating	Alternative States
A	More than 50% of the vegetated area of the AA supports **abundant** overlap of 3 plant layers.
B	More than 50% of the vegetated area of the AA supports at least **moderate** overlap of 2 plant layers.
C	25%-50% of the vegetated area of the AA supports at least **moderate** overlap of 2 plant layers.
D	Less than 25% of the vegetated area of the AA supports **moderate** overlap of 2 plant layers **OR** AA is sparsely vegetated overall.

Vertical Biotic Structure in Emergent Wetlands with Herbaceous Vegetation

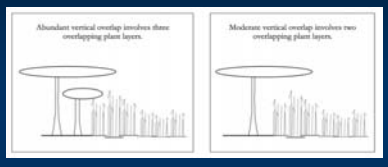


- Values and functions of entrained litter in herbaceous wetlands
- Estuarine and depressional wetlands
- Proportion of AA with entrained litter

Vertical Biotic Structure Scoring Using Entrainment

Rating	Alternative States
A	Most of the vegetated plain of the AA has a dense canopy of living vegetation or entrained litter or detritus forming a "ceiling" of cover above the wetland surface that shades the surface and can provide abundant cover for wildlife.
B	Less than half (25-50%) of the vegetated plain of the AA has a dense canopy of vegetation or entrained litter or detritus as described in "A" above; OR Most of the vegetated plain has a sparse canopy of vegetation or entrained litter or detritus.
C	25-50% of the vegetated plain of the AA has a sparse canopy of vegetation or entrained litter or detritus.
D	Most of the AA (>75%) lacks a canopy of living vegetation or entrained litter or detritus.

Vertical Biotic Structure in Emergent Wetlands with Woody Riparian Elements



- Many wetlands have both marshy emergent layers and woody "riparian" vegetation
- Higher scores = higher vertical density of layers and higher cover of these layers over the AA