Standard Operating Procedures (3.3): Vegetation Biomass

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Standard Operating Procedures:
Vegetation Biomass

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Protocol Suitability Evaluation

A habitat suitability table containing appropriate estuarine wetland habitat types (of those evaluated) to implement vegetation biomass protocols is displayed in Table 1. All vegetated habitats are appropriate for this survey type. A comparative assessment of cost, effort, and data quality are shown in Table 2. A matrix of additional detailed categorical evaluations of vegetation biomass protocols can be found in Appendix 3.3A.

Table 1. Appropriate habitat types for vegetation biomass survey protocols.

	Habitat Types					
Survey Protocol	**Tidal Channel**	**Mud/sand flat**	**Emergent salt marsh**	**Non-tidal salt marsh**	**Salt pan**	**'Degraded' / fill**
Vegetation Biomass			X	X	X	X

Table 2. Categorical assessment of cost/effort and data quality for vegetation biomass survey protocols.

	Evaluation Metric	**Vegetation Biomass**	**Notes**
Time / Effort	Office Preparation Time	10-30 minutes	----
	Equipment Construction Time (one time)	0-10 minutes	----
	Field Time (per transect)	10-30 minutes	Additional time may be necessary along transects with high biomass
	Laboratory Time (per transect)	30-60 minutes	Samples must be sorted, dried, and weighed
	Post-Survey Processing / QAQC Time	10-30 minutes	----
	Minimum Repetition (site-dependent)	Many Repetitions	----
	Relative Cost (equipment and supplies)	< $15	----
Survey / Data Quality	Accuracy (at a survey area level)	High	----
	Precision (at a survey area level)	Medium	----
	Qualitative-Quantitative Score	Quantitative	----
	Subjectivity-Objectivity Score	Objective	----

Resulting Data Types

The application of vegetation biomass survey protocols will yield quantitative data displayed in species-specific grams per square meter of above ground biomass. These data may be used in conjunction with vegetation cover survey data to extrapolate transect-level biomass per species or identify biomass trends over in relation to external stressors (e.g., low rainfall years, installation of tide gates). These data provide an additional layer of functional assessment when combined with other vegetation SOPs such as vegetation cover (SOP 3.2).

Objective

Long-term monitoring of vegetation is one of the most common methods of evaluating the health and functioning of a wetland system (Zedler 2001). Change in the relative amount of native and non-native plant species may affect the distributions of associated wildlife species. Many different approaches have been used to estimate plant species cover, especially for terrestrial vegetation (see review in Murray et al. 2006). However, vegetation cover alone is often not enough to accurately assess the health of a vegetation community, and aboveground biomass may be used as an indicator metric to quantify net primary productivity of the community (EPA 2002), particularly if harvested annually at the end of the primary growing season.

This method samples above ground vegetation tissue (as dry weight) within a defined area for use in conjunction with vegetation cover data to assess wetland vegetation communities and alliances. Biomass data should be collected during the vegetation cover surveys (SOP 3.2) to optimize time management. Specific protocols were developed by Dr. Sean Anderson at California State University, Channel Islands.

Additional below ground biomass can supplement data even further; however, these methods often require time-intensive collection, lengthy durations of an experiment, or more intensive permit conditions and potential impacts to the plant community.

Figure 1. Transect tape deployed from labeled PVC.

Equipment

Equipment and supplies needed for this survey include:

1. GPS and camera
2. Transect tape (30m)
3. 10cm x 10cm PVC quadrat
4. Various sized paper bags (large and 'lunch-sized')
5. Grass shears or clippers
6. Permanent ink pen to label bags with transect, date, and time of collection.

Field Preparation

Equipment described above should be collected prior to the field shift. Batteries for all electronic devices should be checked, charged, and/or replaced as needed. Relevant data sheets should be printed and attached to the clipboards. Avoid planning for field survey days that are subsequent to rain events, as samples will require more drying time and may be more likely to rot.

Field Methods

Transects surveyed for biomass should be the same as the vegetation cover surveys (see Vegetation Cover SOP 3.2 for details on assigning transects within wetland habitats). Biomass sampling can be

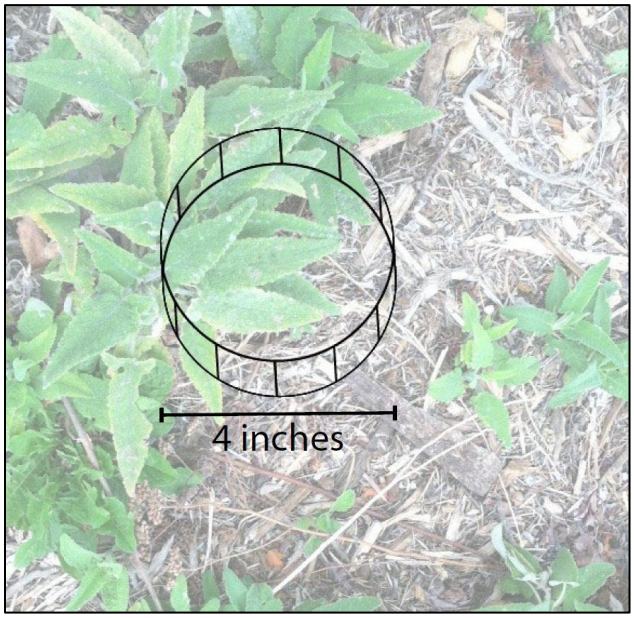

Figure 2: Cylindrical area representing where plant tissue should be collected.

disruptive or impact the vegetation community and is recommended at a frequency of annually (or bi-annually) near the end of the wetland growing season (late summer / early fall; Broome et al 1986; Collins et al 2010). *Note: new biomass quadrat locations must be surveyed each time to account for the impacts of the previous year's surveys*.

After sampling for vegetation cover using quadrats, survey for above ground biomass on a subset of these quadrats (3-5). All biomass within a 10 x 10 cm quadrat should be collected at each quadrat location (S. Anderson, pers. comm. 2010). *Note: special permits may be required for special status or sensitive plant species (and/or they may need to be avoided).* The 100 cm^2 quadrat should be placed in the center of the cover quadrat and all live plant material throughout the three-dimensional canopy to the ground should be collected from within this area. Visually, this resembles a rectangular prism within which all live plant material should be cut using the grass shears and collected. Harvested samples should be placed into an appropriately sized bag labeled with the transect/plot number, species, and date, and time. Plant material may be separated by species either in the field or laboratory, as preferred, as long as the bags are appropriately labeled.

Helpful hint: The outer diameter of a 4" PVC pipe also gives an area of approximately 100 cm^2 and can be used in lieu of the mini-quadrat (Figure 2).

Helpful hint: If the survey site is dominated by two or three species, it is usually faster to segregate plant tissue in the field as you snip the stems. Often laboratory-based sorting can be quite tedious and time-consuming when technicians are presented with numerous cut stems that lack leaves or other distinguishing characteristics.

Laboratory Methods

Wet harvested biomass needs to be dried (using a laboratory oven) immediately upon return to the laboratory to avoid rot. Dry vegetation can sit in a dry, well aerated room for up to one week before processing (or while other samples are drying). Excessively wet samples (e.g., plants from low elevation sites collected after a high tide) should generally be air dried until any visible moisture on the outer plant surfaces or paper bag is gone. This assures that the drying oven does not become overly "steamy" which can lengthen the drying time any potential cause problems with older oven models. It is generally recommended to attempt low tide vegetation collection in those habitats to reduce drying.

Plant biomass should be dried at 80° C for 24-48 hours and then immediately weighed to the nearest 0.1 gram. Note that samples should be weighed before cooling to avoid weight changes due to reabsorbed moisture from the air. Three control (empty) bags of each size should also be dried (and the weights averaged for each size) to calculate the empty bag weight. This weight should be subtracted from the total weight of the plant material plus the bag to determine actual plant weights. *Helpful hint: If you have very little vegetation material in the sample, it is more accurate to weight the plant tissue directly upon the balance without the bag, but care must be taken to clearly denote this on the data sheet to avoid calibration mistakes*.

Data Entry and QAQC Procedures

Data should be entered in the field using the appropriate data sheet (Appendix 3.3B). All required fields should be completed in full, and the data recorder should sign their name at the top of the document(s). Data should be transferred to the appropriate electronic database within three days, and the hard copies filed in labeled binders. Electronic copies of all data should be housed on an in-house dedicated server and backed up to a cloud-based or off-site server nightly. Hard copies should be saved for five years. Electronic copies should be saved indefinitely.

Quality Assurance and Quality Control (QAQC) procedures should be conducted on all data. QAQC procedures should be conducted by the QA Officer and include a thorough review of all entries, double checking of all formulas or macros, and a confirmation that all data sheets, Chain-of-Custody forms, and field notes are filed appropriately with electronic back-up copies available. QAQC should verify that the entered data match the hard copies of the field data sheets. Any discrepancies should be corrected, and the initial data entry technician notified.

Data Analyses

After data have been entered, corrections made, and QAQC procedure completed, data can be used in multiple analyses. Examples include averaging the above ground biomass estimates by species per transect or habitat type and displaying the resulting graphs or assessing the biomass in relation to the cover data to get a total biomass of each species in each transect.

Health and Safety Precautions

Not applicable.

References and Applicable Literature

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APPENDIX 3.3A

	Evaluation Metric	Vegetation Biomass	Notes
	Correlation to L2 CRAM	Attribute 4	----
Personnel Requirements	Specialty Equipment or Clothing Required	Few Specialty Items	Scissors, plastic bags
	Ease of Transport (amount or weight of supplies)	Few Items / Easy	----
	Ease of Implementation	Easy	May be more difficult in areas with high biomass
	Expertise / Skill Level	Some Technical Knowledge	No expertise is required for field implementation, but lab processing will require familiarity with species identifications. *In situ* field separation of species is easier than lab post-processing.
	Number of Personnel	2	----
	Training Requirements	None	----
	Seasonality of Survey Time	Fall	Peak growing season
	Suggested Frequency	Annual	Or biannual to reduce disturbance
Survey / Data Quality	Type of Output	Numerical	----
	Active or Passive Monitoring Style	Active	----
	Specialty Computer Software Required	No	----
	Availability of Online / External Resources	Some	----
Potential Limitations	Wetland Type Applicability	All	----
	Images or Multi-Media Required	Images Required	----
	Degree of Impact / Disturbance	High Disturbance	Taking vegetation cuttings and trampling
	Vegetation Height Limitation	Overhead (~2m)	Must be able to access the highest vegetation
	Appropriate for Tidal / Wet Habitats	Yes	----
	Tide Height	Low Tide Only	Tidal inundation may make it difficult to access or identify submerged vegetation
	Regional or Broad Implementation *	Infrequently Used	----
	Potential for Hazards / Risk	Low to No Risk	----
	Restrictions	Special Status Species	----

** based on monitoring literature review*

APPENDIX 3.3B

Vegetation Biomass Data Sheet

Date:		Staff:	
Survey Start Time:	**End Time:**	Uploaded:	Date:
Habitat:		QAQC:	Date:
Other Notes:			

Station Information		**Station Information**	
Transect:		Transect:	
Meter:		Meter:	
sp. collected (%):		sp. collected (%):	
Add'l sp. w/in 5 m:		Add'l sp. w/in 5 m:	
GPS Coordinates:	N 33.	GPS Coordinates:	N 33.
	W 118.		W 118.
Weight weight (g):		Weight weight (g):	
Dry weight (g):		Dry weight (g):	
Notes:		Notes:	
Station Information		**Station Information**	
Transect:		Transect:	
Meter:		Meter:	
sp. collected (%):		sp. collected (%):	
Add'l sp. w/in 5 m:		Add'l sp. w/in 5 m:	
GPS Coordinates:	N 33.	GPS Coordinates:	N 33.
	W 118.		W 118.
Weight weight (g):		Weight weight (g):	
Dry weight (g):		Dry weight (g):	
Notes:		Notes:	
Station Information		**Station Information**	
Transect:		Transect:	
Meter:		Meter:	
sp. collected (%):		sp. collected (%):	
Add'l sp. w/in 5 m:		Add'l sp. w/in 5 m:	
GPS Coordinates:	N 33.	GPS Coordinates:	N 33.
	W 118.		W 118.
Weight weight (g):		Weight weight (g):	
Dry weight (g):		Dry weight (g):	
Notes:		Notes:	
Station Information		**Station Information**	
Transect:		Transect:	
Meter:		Meter:	
sp. collected (%):		sp. collected (%):	
Add'l sp. w/in 5 m:		Add'l sp. w/in 5 m:	
GPS Coordinates:	N 33.	GPS Coordinates:	N 33.
	W 118.		W 118.
Weight weight (g):		Weight weight (g):	
Dry weight (g):		Dry weight (g):	
Notes:		Notes:	