

SOP 1: Vegetation Monitoring in Salt Marshes using Rapid Assessment Method

Adapted from:

Rapid Method for Assessing Estuarine (Salt) Marshes in New England
Version 1.4 – October 2006

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Introduction

This protocol describes the methods used to sample salt marsh vegetation and associated cover types (e.g. water, bare ground, wrack or litter) using 100-m diameter Survey Plots. Within each plot, percent cover of marsh plant community types is recorded. In addition, occurrence of individual species along a transect bisecting the plot is recorded. Salt marsh vegetation is sampled once per year, near the end of the growing season. Survey Plots are positioned randomly throughout the marsh units.

Sampling Locations

1. *Survey Points* have been selected at random from among the avian monitoring points according to the following allocation:

Size of marsh study unit	Number of Survey Points
0 to 25 hectares	3
>25 to 75 hectares	4
> 75 to 125 hectares	5
> 125 hectares	6

2. Each Survey Point is buffered with two circles, one of 50m radius and another of 150m radius (see Figure 1). This creates the 100m diameter *Survey Plot* with the Survey Point at its center, and the 100m wide buffer around the survey plot (i.e. the “donut” surrounding the plot).

3. At each Survey Point, a 100m transect is established that bisects the Survey Plot, running from one side of the 50m radius circle to the other through the center Survey Point. The line

should be oriented so that it runs perpendicular to the bank of the nearest creek or water feature and the upland edge (see Figure 1).

Sampling Method

100m diameter Survey Plot

The area of interest is a 100m diameter circle plot around the Survey Point. Assess the generalized plant communities and habitat types in the plot and sample species present along a transect bisecting the plot.

1. Two GPS locations are provided for the Survey Plot: the center Survey Point and a Perimeter Point. Mark the Perimeter Point with a temporary visible marker (flagging on vegetation or a surveyor's flag). Create the 100m transect by extending the measuring tape along the compass bearing from the Perimeter Point, through center Survey Point, to the other side of the Survey Plot. Examine the interior of the 100m Survey Plot as you establish the transect. Mark the end of the transect.
2. Ten point-intercept locations will be used to survey the species present along the transect. To avoid backtracking, start measuring species at the end of the transect that is opposite the starting Perimeter Point.
 - a. Divide the transect length by 9 to get the transect interval. For 100m transects, survey locations will be at the following meters marks: 100, 89, 78, 67, 56, 45, 33, 22, 11, 0.
 - b. Place the bayonet vertically at the first point intercept location (which is the end of the transect).
 - c. Record any species that touches the bayonet on the Survey Plot data sheet – Plant Species (Data Sheet A). Record the species only once, even if it contacts the bayonet more than once.
 - d. At the next transect interval, repeat step c.
3. Establish the Survey Plot by extending the field tape 50m from the Survey Point in multiple directions and marking perimeter points.
4. Survey the entire 100m circle plot by walking the perimeter and using your binoculars to scan inside. Try to get a good view of this circle plot while minimizing the disturbance of the vegetation. Look for the following plant communities and open water features:
 - *Spartina alterniflora*-dominated (“Low Marsh”)
 - Perennial turf grasses (“High Marsh”)
 - Salt Marsh Terrestrial Border
 - Brackish Terrestrial Border
 - Invasives
 - Pannes, Pools and Creeks
 - Open Water
 - Upland

6. Using the cover class guide (Appendix) and the table below, estimate the cover for each of the above communities. Fill in the cover class and note dominant species on the Survey Plot data sheet- Plant Communities and Habitats (Data Sheet B).

Cover classes:

- +: Absent or Less than 1%
- 1: 1% to 5% cover
- 2: 6% to 10% cover
- 3: 11% to 25% cover
- 5: 51% to 75% cover
- 6: 76% to 100% cover

100-m buffer around Survey Plot

These data are intended to characterize the land use at the Survey Point, so that the condition data collected at the Survey Point is tied more closely to land use disturbances. Land use in the buffer zone of the Survey Point is classified into eight types:

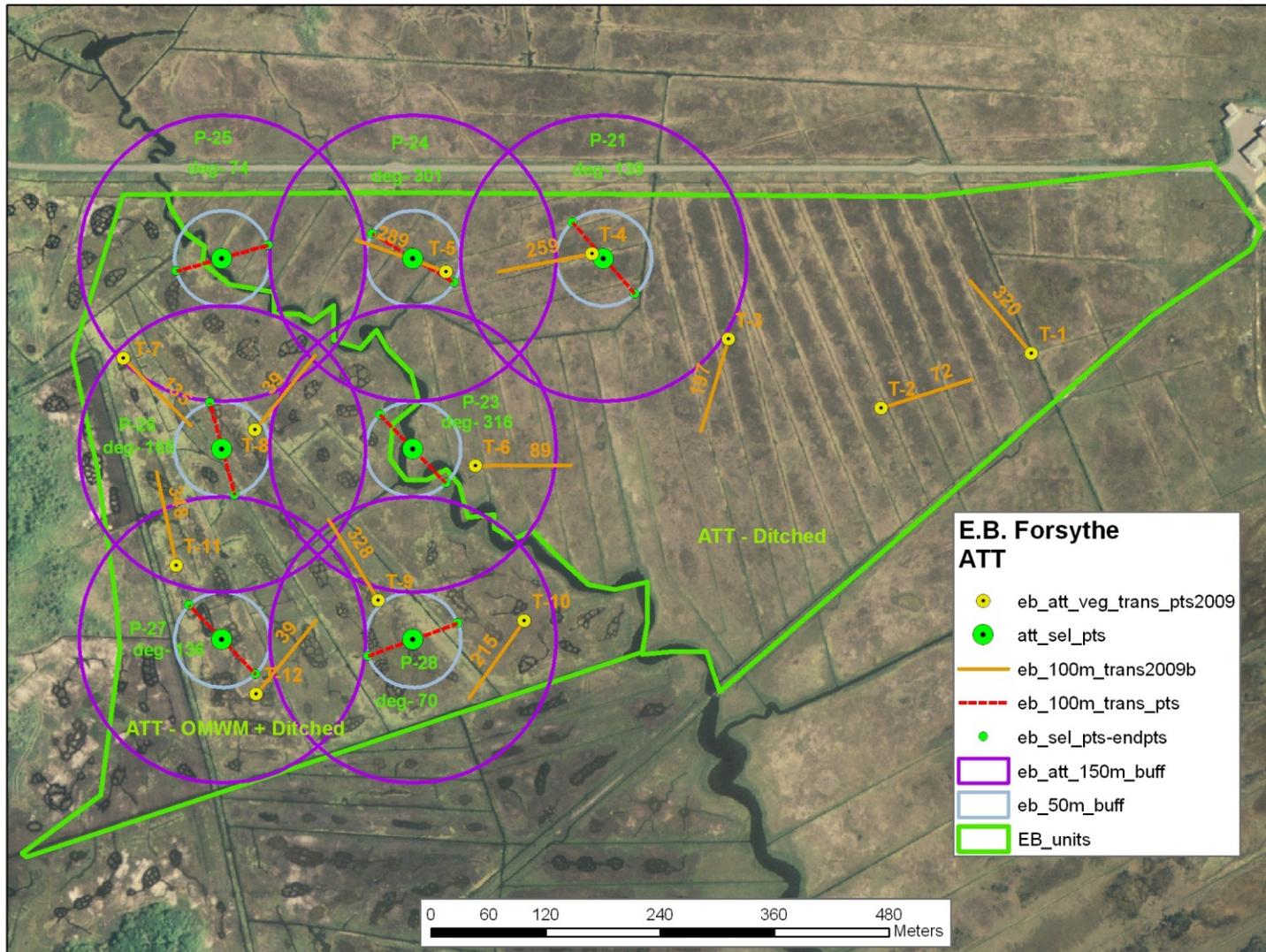
- Natural condition: Undisturbed natural area of buffer, including shrub, forest, meadow, wetlands, open water, etc.
- Modified natural condition: managed marsh (e.g. OMWM, impoundment, tidally restricted)
- Maintained open: Parks, golf courses, cemeteries, public green space, vacant undeveloped land, abandoned agriculture, power lines, areas of no vegetation, etc.
- Disturbed open: Sand, gravel, and rock mining; landfills; etc.
- Agricultural: Pasture, cropland, cranberry bogs, nurseries, etc.
- Residential - Low: greater than $\frac{1}{4}$ acre lots
- Residential - High: smaller than or equal to $\frac{1}{4}$ acre lots
- Urban: Urban areas including commercial buildings, industrial parks, apartments, shopping centers/malls, airports, roads and highways, freight, storage and stadiums.

Using the base map, look in a band approximately 100-m wide around the perimeter of the Survey Plot and examine the types of land uses present. Using the cover class guide (Appendix) and values below, estimate the cover for each of the above land use types. If your base map has land use data, make sure what you see in the field corresponds and if necessary, override the mapped land use types with current information. On the Survey Plot data sheet – Communities and Habitats (Data Sheet B), mark the cover class for the extent of each land use type present.

Cover classes:

- +: Absent or Less than 1%
- 1: 1% to 5% cover
- 2: 6% to 10% cover
- 3: 11% to 25% cover
- 4: 26% to 50% cover
- 5: 51% to 75% cover
- 6: 76% to 100% cover

Figure 1. Example of GIS set-up: salt marsh unit, Survey Plots, Land Use buffers, transects.



SOP 2: Vegetation Monitoring in Salt Marshes Using Square-Meter Quadrats

Adapted from:

M.J. James-Pirri and C.T. Roman. 2005. Monitoring Salt Marsh Vegetation (revision #1): A protocol for the National Park Service's Long-Term Monitoring Program, Northeast Coastal and Barrier Network.

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Date: May 2009

Introduction

This protocol describes the methods used to sample salt marsh vegetation and associated cover types (e.g. water, bare ground, wrack or litter) using 1m² quadrats. Within each quadrat, species composition is recorded and the percent cover is estimated for each cover class. In addition, height classes of species of concern (e.g. invasive species) are recorded. Salt marsh vegetation is sampled once per year, near the end of the growing season. Quadrats are positioned randomly along transects that are distributed throughout the marsh units.

Sampling Locations

There are often distinct zones of salt marsh vegetation encountered from tidal creeks toward the upland border of salt marshes. At creek banks, the marsh is flooded twice daily by tidal action, commonly called the low marsh. Here, *Spartina alterniflora* usually dominates. With a progression landward, elevation of the marsh surface is increased and the marsh is flooded less frequently. This zone is referred to as the high marsh. Typical plants of the high marsh include *S. patens*, *Distichlis spicata*, short form *S. alterniflora*, and *Juncus gerardii*. At the upland border, there is often a zone of species that is less tolerant of flooding and high soil salinities, including *Iva frutescens*, *Panicum virgatum*, and *Phragmites australis*. Because of this distinct gradient of elevation and frequency of tidal flooding, and corresponding responses of vegetation to this gradient, a sufficient number of samples must be taken to ensure adequate representation in all vegetation zones.

The marsh study unit has been divided into sections to distribute samples across the entire marsh. Transects, 100 m in length, were then allocated randomly within sections at a density of approximately 6 per 40 ha, by random selection of both the starting point and the direction. The systematic division of the area into sections with the random placement of transects within each section provides good interspersed samples within the sample area. In the field, quadrats are located randomly within 20-m intervals along each transect. This results in 6 quadrats along every 100-m transect. Random location of transects and quadrats reduces bias and supports the application of inferential parametric statistics.

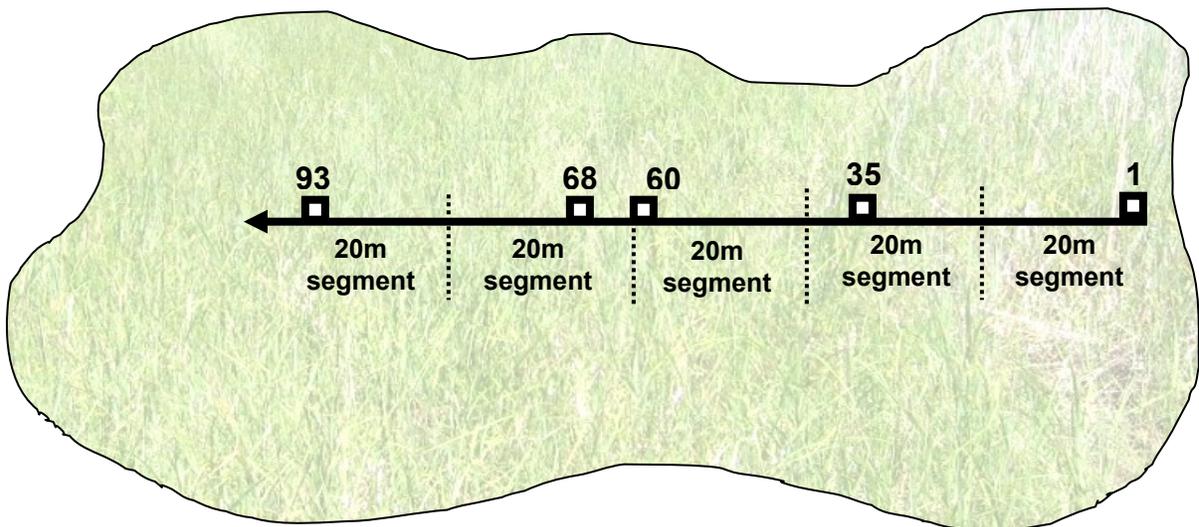
To avoid potential observer bias in transect placement, transect starting points (with GPS coordinates) and orientation will be established on aerial photographs before field sampling begins. Transects should begin several meters inside the marsh so that all samples are representative of the marsh itself, not the upland border. Exact starting points may need to be adjusted toward or away

from the marsh edge in the field. Set up transects in the field using the fiberglass reel tape. Before “walking out” the transect, choose a landmark at the far end and establish the direction using your compass. Follow this line as you walk with the reel tape, always staying to one side of the tape so as not to disturb the vegetation on the other side (where the quadrat sampling will occur). The compass is an invaluable tool in laying out straight transects, especially in wetlands with tall vegetation that blocks sight.

Quadrats are distributed along transects in the field at a density of 1 quadrat per 20-m transect interval, resulting in 6 quadrats along each 100-m transect. Use a random number table with numbers 1-20 to assign the location of each quadrat within each 20-m interval. For example, if the random numbers are 1, 15, 20, 8, 13, then samples would be located at 1m (0+1), 35m (20+15), 60m (40 + 20), 68m (60 + 8), and 93m (80+13) along the transect (Figure 2). The general segment length (in this case 10m) should be recorded on the data sheet as “sample/quadrat interval,” because it is the average distance between samples for that wetland.

Quadrats should be offset 1m to the right of the transect (when facing higher quadrat numbers) to prevent trampling of vegetation within the quadrat.

Figure 2. Example of quadrat placement along vegetation transect.



Constructing the quadrat frame

Quadrat frames are constructed of PVC. Cut thin-diameter PVC into four 1m segments. Attach a single elbow to one end of each 1m piece by roughening the end and the inside of the elbow with sandpaper. Then, clean the roughened surfaces and apply PVC glue. Affix one elbow to the end of each segment. At each sampling location, assemble the four pieces in the field to create the quadrat. Do not glue the 4 pieces of the quadrat frame into a square, because it will be difficult to transport in the field. One option is to thread 4 pieces onto elastic cord and tie off so that the quadrat stays together a bit better. However, this is not recommended in settings with very tall vegetation, because the quadrat pieces need to be detached from one another to surround those individuals.

Sampling Method

On the Square-Meter Quadrats data sheet (Data Sheet C), record percent-cover estimates for each species found *rooted* within the quadrat space, including standing dead vegetation identifiable to species. Also record percent cover of the following major categories:

- Water – permanent standing water in quadrats that are partly within a creek, ditch, marsh pool, or flooded panne
- Large macroalgae identified by species – generally includes rockweeds (*Fucus*, *Ascophyllum*); microalgae (e.g. diatom mats) and fine filamentous macroalgae are not included, this cover is included in Bare, below.
- Bare – includes mud, sand, microalgae mat, etc. These are areas that are not flooded with water and are devoid of living vascular plants or large macroalgae.
- Wrack/Litter – Wrack is material that has floated into the plot, generally dead plant material. Litter is dead plant material that is highly decomposed and may or may not be attached.
- Rock

In order to allow for the imprecision of visual percent-cover estimates, the following cover classes should be used:

+: Less than 1% (usually only 1 specimen in plot)

1: 1% to 5% cover

2: 6% to 10% cover

3: 11% to 25% cover

4: 26% to 50% cover

5: 51% to 75% cover

6: 76% to 100% cover

Estimate cover of species that lie only within the quadrat frame space. Note that it is possible for quadrats to have a total cover >100% for all species. Multiple observers (within or between marsh units) should calibrate their percent-cover estimates with each other to maintain consistency between different quadrats.

Height classes of species of interest such as the common reed (*Phragmites australis*) should be measured within vegetation quadrats where it occurs and recorded on the Plant Height data sheet (Data Sheet D). For example, *Phragmites* height will indicate the vigor of the species and its response to changes in hydrology. Height of *Phragmites* should only be done after the plants in the quadrat have produced a seed head (thus if you are sampling before this has occurred it will require returning to the quadrat for height measurements later in the season). Height is measured to the tallest portion of the plant, such as the leaves (when stretched out over head) or the top of the seed head.

- If there are 20 or fewer stems, classify all stems in the quadrat by height class. Record the number of stems falling into each height class.
- If there are more than 20 stems in the quadrat, divide the quadrat into quarters and randomly select one quarter section of the quadrat. Classify all stems within the randomly selected quarter by height class and record the number of stems falling into each class.

SOP 3: Soil Salinity Monitoring

Protocol adapted from:
M.J. James-Pirri and C.T. Roman. 2005. Monitoring Salt Marsh Vegetation (revision #1): A protocol for the National Park Service's Long-Term Monitoring Program, Northeast Coastal and Barrier Network.

Modified by:
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Date: May 2009

Introduction

Soil salinity will be measured in conjunction with salt marsh vegetation quadrats in all Intensive marsh units (IVS + IVSG units). Salinity data can aid understanding some of the fundamental causes of vegetation change. Soil salinity is measured using a soil probe adjacent to vegetation quadrats. In addition, at two refuges only, salinity will also be measured in conjunction with groundwater level in wells installed adjacent to vegetation plots. Together these measurements will provide an indicator of soil drainage or degree of soil saturation as well as salinity regime.

Materials for Soil Salinity Sampling

- Soil sipper (provided; consists of syringe, flexible plastic tubing, and rigid plastic tubing - (Fig. 1)
- PVC pipe or metal rod of similar diameter to the sipper for pre-drilling a hole if soil is firm
- Hand-held refractometer
- Filter paper (cut-up coffee filters can be used)
- Plastic squeeze bottle with freshwater to rinse and calibrate refractometer

Temporal Frequency of Soil Salinity Sampling

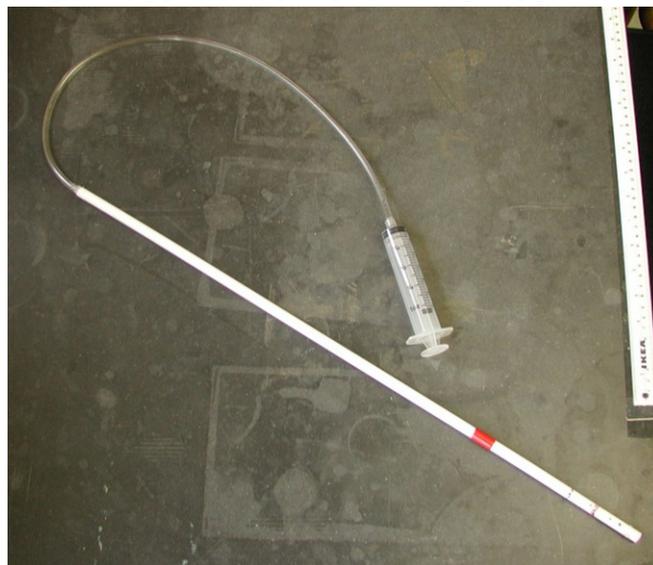
- In all Intensive units (IVS+IVSG units), soil salinity should be measured at the same time as vegetation quadrats are sampled. This sampling occurs once during the habitat monitoring period.
- In Intensive units receiving groundwater level sampling (IVSG units), soil salinity should *also* be measured at the same time as groundwater table level, within 2 hours of low tide when surface is drained of water. This sampling occurs at least twice throughout the July-August habitat monitoring period.

Sampling Soil Water Salinity in Association With Vegetation Quadrats – IVS and IVSG Units

- 1) Sampling should coincide with vegetation quadrat sampling.

- 2) Calibrate (zero) hand-held salinity refractometer with fresh water (tap water is okay) before EACH field day.
- 3) At a location near the vegetation quadrat well, carefully insert the soil salinity sipper (perforated end downward) 15cm into the sediment (tape can be used to mark 15cm). Sippers have a tendency to break if inserted too quickly into firm soil. If the soil is particularly firm, you will need pre-drill a hole into the soil using a piece of PVC or metal of similar diameter to the sipper.
- 4) Carefully withdraw the plunger on the plastic syringe to draw soil water into the syringe.
- 5) If no water is drawn up at 15cm, then insert the probe deeper (30cm, then 45cm) until soil water is drawn up into the syringe. If the sample is collected from deeper than 15 cm, record the depth that soil water was collected on the Square Meter Quadrat data sheet (Data Sheet C, same field as Salinity, e.g. ___/30). Record dry if no soil water was collected at 45cm.
- 6) Once several milliliters of water have been withdrawn into the syringe, detach it from the probe.
- 7) Place a piece of filter paper over the nozzle of the syringe. Depress the syringe plunger and let the water pass through the filter paper and onto the glass plate of the refractometer.
- 8) Read and record the soil water salinity (ppt) on the Square Meter Quadrat data sheet (Data Sheet C).
- 9) Clean-up. Discard (never re-use) the filter paper. Using water from a nearby creek, rinse silt and sediment from the probe by drawing up water into the syringe. Discard all the water in the syringe and probe before sampling the next station. Rinse refractometer with freshwater.
- 10) Check the probe frequently to make sure it is not clogged with fine sediment. The finer the sediment (*e.g.*, mud, clay) the more likely the probe is to get clogged.
- 11) It is possible to get hypersaline readings (above 30 ppt) during hot summer days, however be sure that the refractometer is calibrated prior to each sampling day.

Fig. 3. Sipper and syringe for sampling porewater.

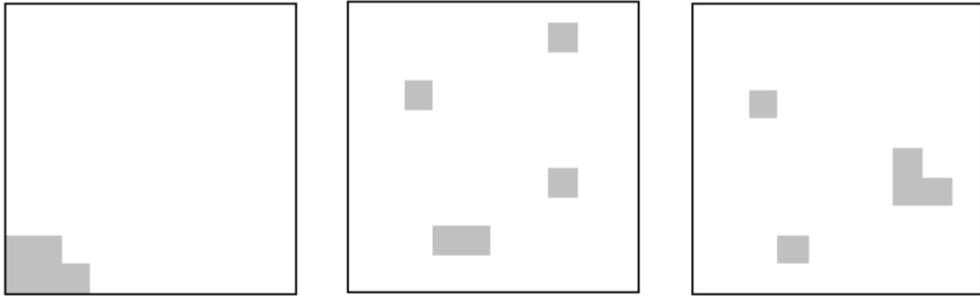


Sampling Soil Water Salinity in Association With Groundwater Wells – IVSG Units Only

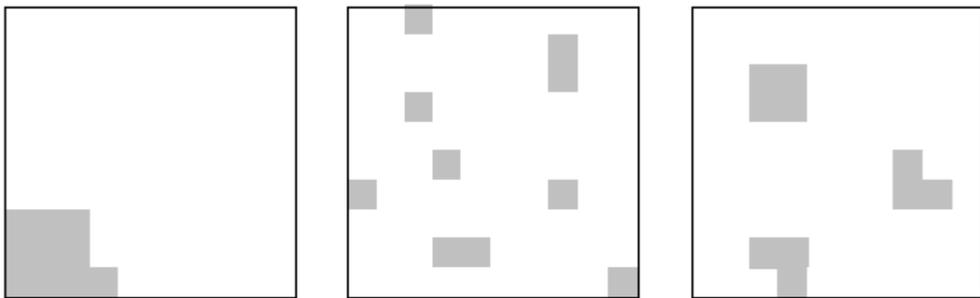
Sampling should coincide with groundwater well sampling and should always be measured within 2hrs of low tide. Follow the steps above for measuring soil water salinity. Samples should be taken adjacent to the groundwater well at the same time groundwater level is measured. Record this salinity data on the Soil Salinity and Groundwater Table Level data sheet (Data sheet E). Thus in IVSG units, soil salinity is measured in association with vegetation quadrats and separately in association with groundwater wells, and salinity measurements from each sampling are recorded in different places (with vegetation data on Data Sheet C as described in previous section, and with groundwater level data on Data Sheet E as described here).

Appendix

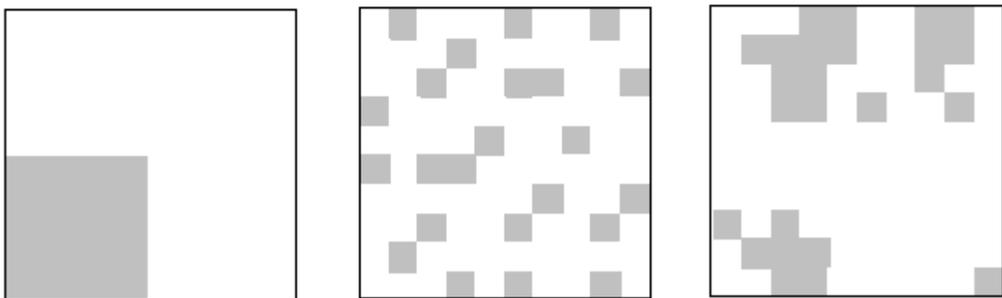
1% to 5%: These are all 5% cover



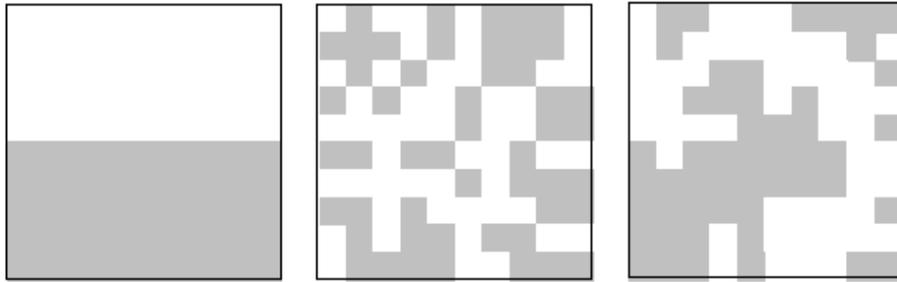
6% to 10%: These are all 10% cover



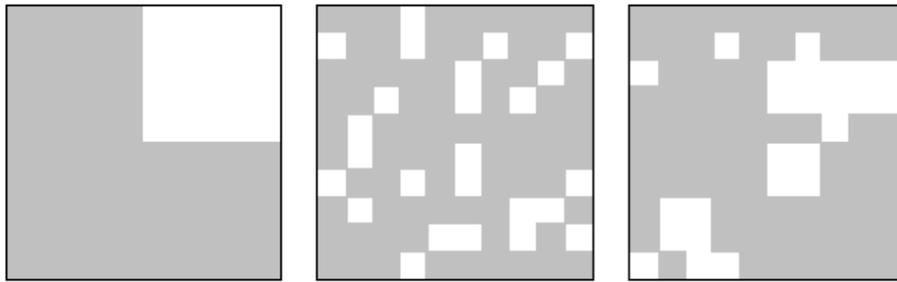
11% to 25%: These are all 25% cover



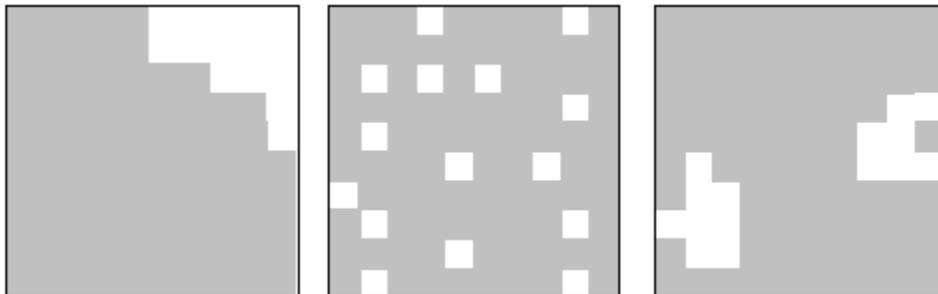
26% - 50% - These are all 50% cover



51% - 75% - These are all 75% cover



76% - 100% - These are all 85% cover



Survey Plot– Communities and Habitats

Marsh Study Unit Name: _____ **Survey Plot #** _____

Center GPS Coordinates: Lat. or Northing _____ **Long. or Easting** _____

Date: _____ **Time:** _____ **Tide:** _____ **Personnel:** _____

Cover classes: +(<1%) 1(1-5%) 2(6-10%) 3(11-25%) 4(26-50%) 5(51-75%) 6(76-100%)

Communities and Habitats in 100m Diam. Survey Plot	Cover class	Dominant species
<p style="text-align: center;"><u><i>S. alterniflora</i> dominated (“low marsh”)</u></p> <ul style="list-style-type: none"> • Regularly flooded by daily tides; • Strongly halophytic; • Dominated by tall form (75cm+) <i>S. alterniflora</i> 		
<p style="text-align: center;"><u>Perennial turf grasses (“high marsh”)</u></p> <ul style="list-style-type: none"> • Flooded by mean tide or greater; • Strongly to moderately halophytic; • Dominated by <i>S. patens</i>, <i>D. spicata</i>, <i>J. gerardii</i> • Includes areas of short form <i>S. alterniflora</i> as well as solitary forbs such as <i>L. nashii</i>, <i>A. tenuifolius</i> and <i>T. maritimum</i> 		
<p style="text-align: center;"><u>Salt marsh terrestrial border</u></p> <ul style="list-style-type: none"> • Infrequently flooded by spring and storm tides • Moderately halophytic; • Could include areas of higher elevation on marsh platform commonly islands or linear patches next to excavated ditches) • Most common: <i>I. frutescens</i>; <i>S. sempervirens</i>; <i>P. virgatum</i>; <i>A. pungens</i> 		
<p style="text-align: center;"><u>Brackish terrestrial border</u></p> <ul style="list-style-type: none"> • Rarely flooded by tides, but often tidal influenced fresh/brackish • Not halophytic but tolerant of maritime conditions (spray and infrequent pulses) • Could include fresher areas of high water table on marsh plain • Most common: <i>T. angustifolia</i>, <i>S. robustus</i>, <i>S. pectinata</i> • Could include native <i>P. australis</i> if properly identified 		
<p style="text-align: center;"><u>Invasives</u></p> <ul style="list-style-type: none"> • Invasives such as <i>P. australis</i> and <i>L. salicaria</i> • Colonization and spread often result of disturbance 		
<p style="text-align: center;"><u>Pannes, Pools and Creeks</u></p> <p>Channels, creeks, ditches, pannes and pools</p>		n/a
<p style="text-align: center;"><u>Open Water</u></p> <p>Larger areas of water: bays, rivers, ponds</p>		n/a
<p style="text-align: center;"><u>Upland</u></p> <p>Non-wetland areas of upland that fall into the 100m diameter circle; includes land uses of all types (e.g. natural and developed)</p>		n/a

Land Use Type in Surrounding 100m Donut	Cover Class
Natural condition	
Modified natural	
Maintained open	
Disturbed open	
Agricultural	
Residential – Low	
Residential – High	
Urban	
Marina	

