Vegetation Transects and Survey Plot Standard Operating Procedures

USGS Western Ecological Research Center SFBE

Soil Salinity and Survey Plot methods adapted from a modified version of:
Carlisle, B., M. Carullo, J. Smith, C. Wigand, R. McKinney, M. Charpentier, D. Fillis, , and M. Stolt 2006. Rapid method for assessing estuarine (salt) marshes in New England version 1.4 – October 2006.
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Purpose/Objective:
Vegetation monitoring will indicate the presence and potential source populations for restored areas. Vegetation sampling, paired with aerial photography, habitat digitization, and bathymetric data will provide a project-scale temporal and spatial understanding of estuarine processes after restoration actions. Vegetation surveys use a combination of point intercepts, quadrats, and circular habitat and land use plots to best characterize community composition and structure across a gradient. Vegetative composition, height, and percent cover of plant species will be collected in order to assess changes in vegetation through time. In addition, pore-water salinity and soil texture samples will be collected (see Soil Characteristics section on Sediment page). Elevation can also be measured along permanent transects and/or at vegetation quadrats.

Office Preparation
New vegetation transects and survey plots can be determined and established in the field, but office preparation prior to going out will help field work to be more efficient.

1.Using aerial photos in ESRI ArcGIS or GoogleEarth, identify the location of the new transect.

2. Determine and record UTM coordinates at the start and end of 50 meter transect. Create point shapefile in ArcGIS and add points for the start and end of the transect. If you are establishing a transect perpendicular to a channel, ensure that the starting point of the transect is on the edge of the channel (preferably at a channel cross section edge marker) and runs perpendicular to and away from the channel's edge.

3. Use the Buffer tool in ArcGIS to create a 50 m buffer circle (100 m diameter) around the point marking the 50 m end of the transect. This is your habitat survey plot.

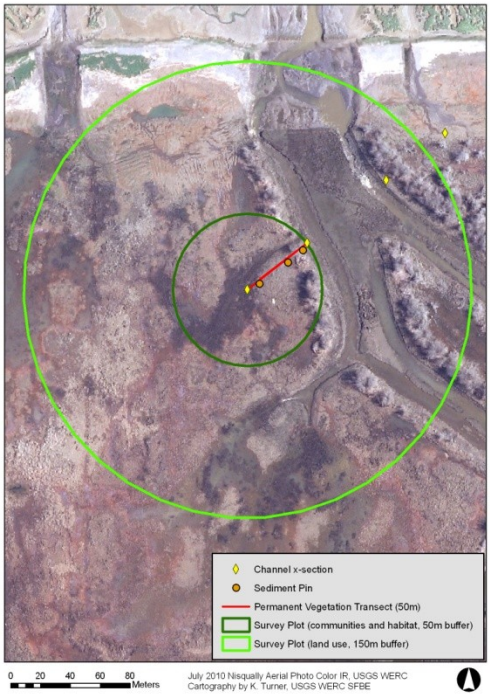


Figure 1. Vegetation monitoring transect, habitat survey plot, and land use survey plot. Nisqually NWR, WA.

4. Use the Buffer tool to create a 150 m land use buffer circle (300 m diameter) around the point marking the 50 m end of the transect.

5. Print a map with the aerial photograph overlain with the transect end points, labeled UTM coordinates and 50 meter buffer circle. It is not necessary to include the 150 m land use buffer circle as this analysis will be done using ArcGIS in the office.

Equipment Needed:
Compass
GPS unit
.25 m^2 quadrant
Tape measure 50+ m
Veg stick (round pole with centimeter increments written on it)
Map of veg transects
Transect locations/UTMs
Sharpie
Data sheets (Table 4)
Clipboard
Pencils
Plant list
Digital camera
Binoculars

Soil Salinity
Hand-held refractometer
Trowel or small shovel
Eye dropper
Filter paper (cut-up coffee filters can be used)
Plastic squeeze bottle with freshwater to rinse and calibrate refractometer

Field Methods:
1. Vegetation surveys are done annually during peak growing season.

2. Vegetation transects are sampled for both permanent and circle plot vegetation surveys (Figure 1). Each transect starts along a channel's edge at the channel cross section marker. The transect stretches 50 meters perpendicular to and away from the channel. Three different vegetation surveys are conducted along this transect, a permanent transect along the first 50 m, a community and habitat survey in a 100 m diameter survey plot, and a land use survey in a 150 m diameter survey plot (to be done in office). Detailed instructions for the all surveys are given below along with the order of operations to complete both surveys efficiently.

3. Transects are numbered based on their project, and when applicable, hydrologic unit and the location along that unit (i.e. North, Middle, or South).

4. The beginning of each transect is marked with a PVC pole labeled with a wooden stake and/ or short PVC. This is also the channel cross-section marker and will be located on the channel's edge at channel bankfull.

5. Each transect has a compass bearing that should be used to ensure that the tape measure is laid perpendicular to the channel. From the starting point, the person that is stretching out the tape should use the compass bearing to sight a spot on the horizon and stay on this bearing until reaching 50 meters. To avoid trampling vegetation, walk to the left side of the transect. At 50 meters pull the tape taut and lay it down or attach it to a temporary wooden stake.

Alternatively, using a GPS, one person could navigate to and stand at the 50 m end of the transect and the second person could stretch tape out from the beginning of the transect to them.

6. Walk back to the start of the transect and join your field partner. You will work together to complete the 50 m permanent vegetation transect. Use the Vegetation Sampling form (Table 1) to record data. Two different types of observations will be taken along the permanent transect; point intercept and quadrats. Walk along the left side of the tape and measure on the right side of the tape.

7. Point intercept data is recorded at 1m intervals starting at 0m and ending at 50 m. Place the vegetation stick so it intercepts the tape measure on the right side and hits the ground. Record the tallest species hit by the vegetation stick and the height of this species. Round the height up to the nearest cm. If a plant, such as a tree, is taller than the vegetation stick, estimate the height and write in the notes that an estimate of height was made. Note: In tidal marshes with multi-layered canopies, heights can be recorded for all species encountered.

8. Species are recorded as 4 letter codes. Include "non-species" such as; bare ground, litter, mudflat, etc (Table 2). Note that for any of these "non-species" that are recorded, no height measurement is needed.

9. Any species that are not identifiable by the observers should be collected as a voucher specimen for further identification purposes and given a number for the survey, until they are properly identified. DO NOT collect plants within the quadrat or along the transect, rather find the same unidentifiable plant nearby to collect. Collect all parts of the plants including roots, place in a baggie and label a temporary code, the date, and the transect it was collected. However, do not collect plants that are growing sparsely in case they have low populations. If you come across this type of plant, use the digital camera to take a close-up picture and record any notes or observations on the plant's growth form, habitat, and characteristics.

10. Quadrat data is collected at 0, 19.5, and 39.5 meters. Set the .25 m^2 quadrat on the right side of the tape measure. The right edge of the quadrat should be lined up with the sampling location along the tape (i.e. 0, 19.5 or 39.5). The species name, absolute percent cover, rooted stem count, and the maximum height for each species in these quadrants is recorded. Record all species found in the quadrants as well as non-species.

- Photo-plots: Take a photograph of the quadrat from directly overhead filling the frame with the quadrat. Place a sign in the photo, but outside of the quadrat labeled with the Site, Quadrat #, and Date. Record the photograph number.
- If standing water is present, measure the deepest water depth within the quadrant (record under WD), but do not include standing water in the percent cover.
- To estimate percent cover, first record the four letter code for all species and non-species present. Include all plant material intercepting the quadrant area, not just plants rooted in the quadrant. Make ocular estimates of the percent cover for each species etc. When percent cover for all species, etc. are estimated, sum these estimates. If the sum is less than 100%, reconsider estimates. However, due to different canopy layers, total percent cover can exceed 100%. Use the Percent Cover guide (Appendix A) to help with estimates.
- Height is measured from the substrate to the top of the tallest individual of each species in the quadrant. Record to the nearest cm.
- Stem counts (densities) are done by counting the rooted stems of individual plants inside the quadrant. This measurement is used to report the density of individuals per square meter for each species. If plant foliage is present in the quadrant, but the plant is rooted outside of the quadrant, record 0 as stem count. Stem density is most often used for woody species where the stems are easily discernable. In salt marsh habitats, the stems can be difficult to discern. When counting stems in the salt marsh habitat it is best to try and locate the base of each plant and count each base as one individual stem. When this is not possible without damaging the plants, then estimations in the field based on the individual circumstances must be made. **In these circumstances, make sure to write down your method for counting in the notes.**

- There are many grass species that may be growing so densely in the quadrant that only a sample of the stems need to be counted and a total count can be estimated, based on the relative size of the sample compared with the total percent cover of that species.

11. Soil salinity is measured in conjunction with salt marsh vegetation quadrats in all marsh units. Salinity data can aid understanding some of the fundamental causes of vegetation change. Soil salinity is measured adjacent to vegetation quadrats. These measurements are taken using substrate extracted water and a refractometer.

- Sampling should coincide with vegetation quadrat sampling.
- Calibrate (zero) hand-held salinity refractometer with fresh water (tap water is okay) before EACH field day.
- At a location near the vegetation quadrat a small shovel is used to create a pooling of water to sample from. This is done by pushing the shovel into the ground and wiggling it back a forth a few times.
- If the water is not pooling around the shovel then a handful of substrate can be extracted and the water squeezed out into the coffee filter. (Multiple handfuls of substrate can be used in order to gather enough water to filter through the filter.)
- The extracted water should pass through the filter paper and onto the glass plate of the refractometer. If there is not enough water to go through the coffee filter then a few drops can be tested without filtration, which is better than no reading at all. (The drops can be placed straight onto the refractometer, the reading line will be fuzzy and a best estimate will have to be made)
- Be sure to record if the water was collected from the pooled or hand squeezed method, if filtration was or was not successful, and record "dry" if no water can be extracted.
- Read and record the soil water salinity (ppt) on the data sheet.
- Clean-up. Discard (never re-use) the filter paper. Rinse refractometer with freshwater.

12. Once you have reached the end of the permanent transect at 50 m you will complete the 100 m diameter survey plot for generalized community and habitat classifications. The area of interest is a 100m diameter circle plot around the Survey Point. The Survey Point is the 50m point at the end of the permanent transect.

13. Create the 100m diameter of the circle plot by walking out an additional 50 meters along the compass bearing from the end of the vegetation transect to the other side of the Survey Plot. Examine the interior of the 100m Survey Plot as a team. Each person examines one half of the plot by walking the perimeter and scanning (you can use binoculars) as well as using an aerial photo with the 100 meter circle plot placed on it. Try to get a good view of this circle plot while minimizing the disturbance of the vegetation. After examining the plot the team will meet up and discuss what was found on each half, and calculate the cover classes of the entire 100 meter plot.

Look for the following plant communities and open water features (community types associated with low and high marsh will vary by region):

- *Jaumea carnosa* or *Carex sp.*-dominated ("Low Marsh")
- *Deschampsia caespitosa*-dominated ("High Marsh")
- Salt Marsh Terrestrial Border
- Brackish Terrestrial Border
- Invasives
- Pannes, Pools,Creeks and Mudflats

- Open Water
- Upland

14. Using the Percent Cover guide (Appendix A) 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.

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

15. Leave the Land Use table for the 100-m buffer around the Survey Plot blank, this data will be determined in the office using GIS and the protocols below.

100-m buffer around Survey Plot
These data are intended to characterize the land use, so that the condition data collected at the Survey Plot is tied more closely to land use disturbances. Land use in the buffer zone of the Survey Plot 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 ¼ acre lots
- Residential - High: smaller than or equal to ¼ 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 Percent Cover guide (Appendix A) 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, 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

Data Entry and Analysis:

1. Enter data in Excel database (see downloadable Channel Cross Section Database Template)

2. It is also helpful to take note of ideal surveying conditions (i.e. best time/tide to survey vegetation). You can also use the date and time of the previous survey to determine tide height suitable for taking measurements.

3. Vegetation collected from permanent transect and survey plots is primarily intended to track changes over time (Figure. 3), although the data can be used in numerous analyses such as:
    - Mean height by species
    - Mean stem density by species
    - Change in invasive species cover over time
    - Pore-water salinity ranges by species
    - Elevation range by species
    - Correlation or regression analyses (i.e. pore-water soil salinity and species richness, These data can also be used in numerous analyses as shown in the following slides.

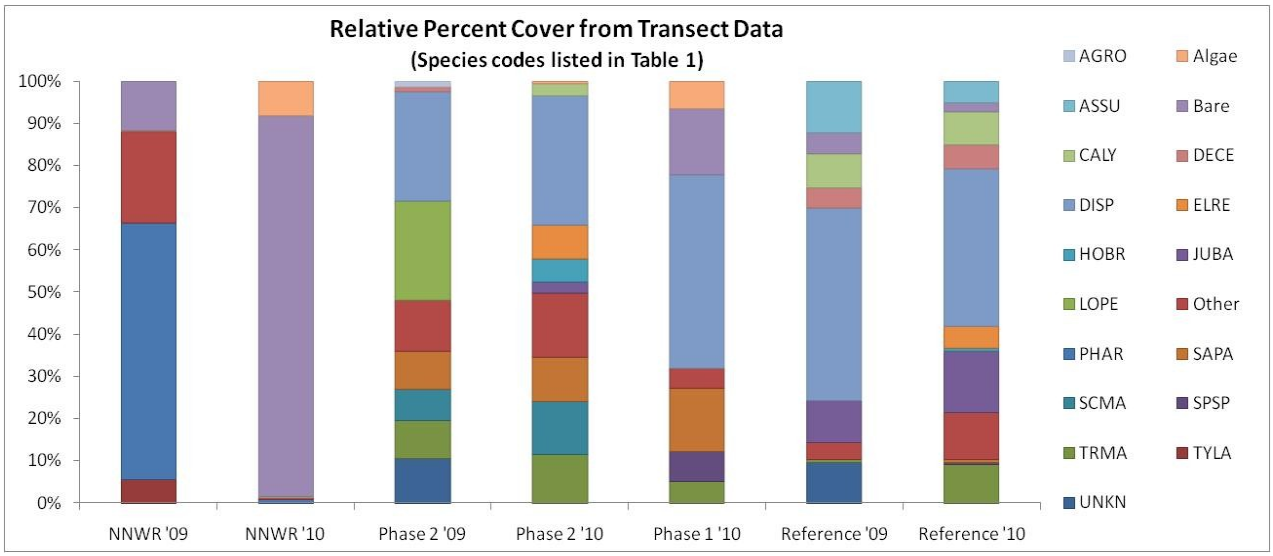


Figure 2. Relative percent cover along permanent vegetation transects in 2009 and 2010. Sites are listed in order of year dike was removed; NNWR (2009), Phase 2 (2006), Phase 1 (2002), and Reference (never diked). "UNKN" includes 6 different possible species, and "Bare" includes bare ground and other non-species. "Other is comprised of species with <5% relative cover at each site and survey year.

Table 1. Codes for non-species

Other Codes		**Height and Stem Density**
ALGB	Brown Algae	N/A
ALGG	Green Algae	N/A
BARE	Bare ground	N/A
SEDWR	Sediment Wrack – sediment layer that is covering DOM, LI, or WR. Note this is different than BARE.	N/A
DOM	Dead & standing plant material	N/A
LI	Litter - dead & **not** standing plant material	N/A
WR	Wrack – living or dead plant material that floated in with tide	N/A
MF	Mudflat	N/A
OPWA	Open Water	N/A
UNKN	Unknown	N/A

Vegetation Sampling Form - Permanent Transects / Quads

Date ___/___/___ time ___:____ Obs _____ Site_____ Transect

UTM (transect) _____/_____ Compass Reading

Point	Spp	Height (cm)
0.0*		
1.0		
2.0		
3.0		
4.0		
5.0		
6.0		
7.0		
8.0		
9.0		
10.0		
11.0		
12.0		

Point	Spp	Height (cm)
13.0		
14.0		
15.0		
16.0		
17.0		
18.0		
19.0		
20.0*		
21.0		
22.0		
23.0		
24.0		
25.0		

Point	Spp	Height (cm)
26.0		
27.0		
28.0		
29.0		
30.0		
31.0		
32.0		
33.0		
34.0		
35.0		
36.0		
37.0		
38.0		

Point	Spp	Height (cm)
39.0		
40.0*		
41.0		
42.0		
43.0		
44.0		
45.0		
46.0		
47.0		
48.0		
49.0		
50.0		

***remember quad**

Quad 1 **0.0 m WD** **Soil Salinity ppt _____** **Comments**

Species	%	Ht.	Dens	Species	%	Ht	Dens

Quad 2 **19.5 m WD** **Soil Salinity ppt _____** **Comments**

Species	%	Ht.	Dens	Species	%	Ht	Dens

Quad 3 **39.5m WD** **Soil Salinity ppt _____** **Comments**

Species	%	Ht.	Dens	Species	%	Ht	Dens

Comments, diagrams, etc.:

Survey Plot– Communities and Habitats

Site:_____Transect_____ Date:_____ Time:_____ Tide:_____ Obs:_____Center GPS Coordinates (50m): Northing_____Easting_____

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
<u>*Jaumea carnosa or Carex sp.* dominated ("low marsh")</u> Regularly flooded by daily tides; Highly saline conditions are dominated by *Jaumea carnosa* and *Salicornia virginica* Brackish conditions are dominated by *Carex sp.*, *Triglochin maritimum* and *Scirpus sp.* Common species include *Distichlis spicata*, *Plantago maritima*, *Spergularia sp*. and *Atriplex patula*.		
<u>*Deschampsia caespitosa* dominated ("high marsh")</u> Above mean higher high water; and inundated less than daily; Dominated by *Deschampsia caespitosa*, and *Hordeum brachyantherum* Common species include *Distichlis spicata*, *Grindelia integrifolia*, *Potentilla anserina ssp. pacifica*, and *Atriplex patula*		
<u>Salt marsh terrestrial border</u> 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 channel edges) Dominated by *Aster subspicatus*		
<u>Brackish terrestrial border</u> Rarely flooded by tides, but often tidal influenced fresh/brackish Not halophytic but tolerant of maritime conditions (spray and infrequent pulses) Includes areas heavily influenced by freshwater sources. Dominated by *Typha Latifolia, Salix sp*. and *Populus sp.* Could include *Spiraea douglasii* and *Physocarpus capitatus*		
<u>Invasives</u> Invasives such as *Phalaris arundinacea, Cotula coronopifolia, Lotus corniculatus, Circium sp,* and *Ranunculus sp.* Colonization and spread often result of disturbance		
<u>Pannes, Pools, Creeks, and Mudflats</u> Channels, creeks, ditches, pannes, pools and mudflats		n/a
<u>Open Water</u> Larger areas of water: bays, rivers, ponds		n/a
<u>Upland</u> Non-wetland areas of upland that fall into the 100m diameter circle; includes land uses of all types (e.g. natural and developed) Dominated by Conifers such as *Pseudotsuga menziesii* & *Thuja plicata*		n/a

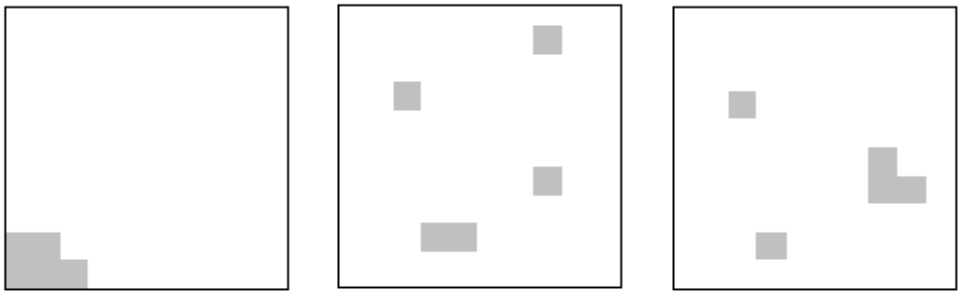
100m Buffer around Survey Plot – to be completed in office

Land Use Type	Cover Class	Land Use Type	Cover Class
Natural condition		Residential – Low	
Modified natural		Residential – High	
Maintained open		Urban	
Disturbed open		Marina	
Agricultural			

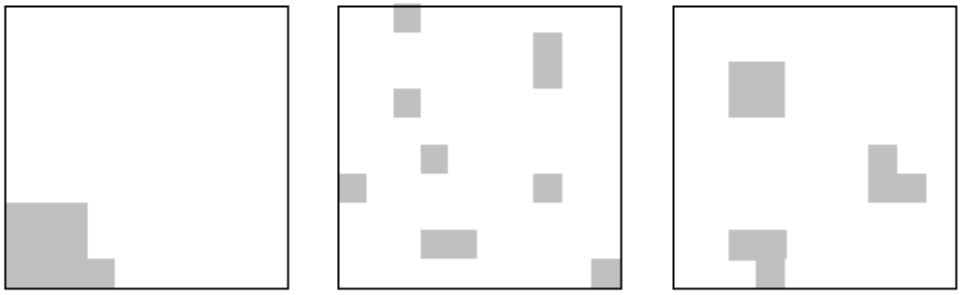
Appendix A. Percent Cover Guide

Vegetation cover estimates should be conducted by the same person for each sampling event to maintain a consistent sampling protocol and minimize sampling bias and errors. Otherwise, each person should be trained for estimating plant cover for greater consistency amongst observers.

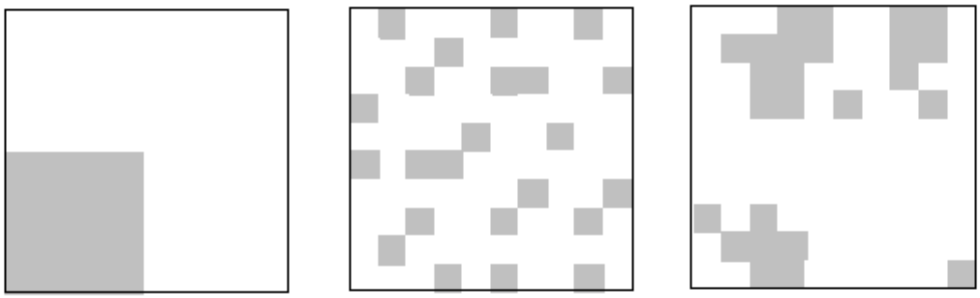
1% to 5%: These are all 5% cover



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

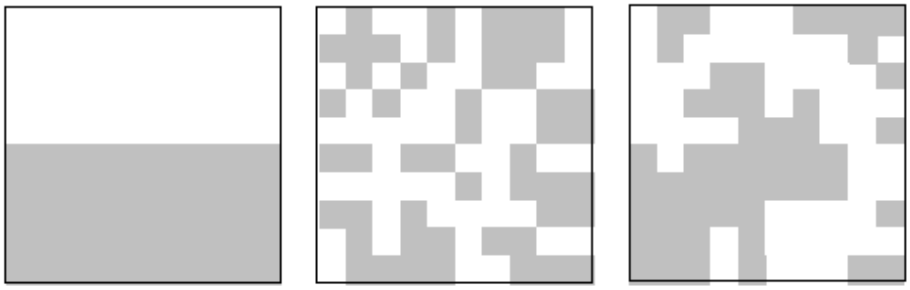


11% to 25%: These are all 25% cover

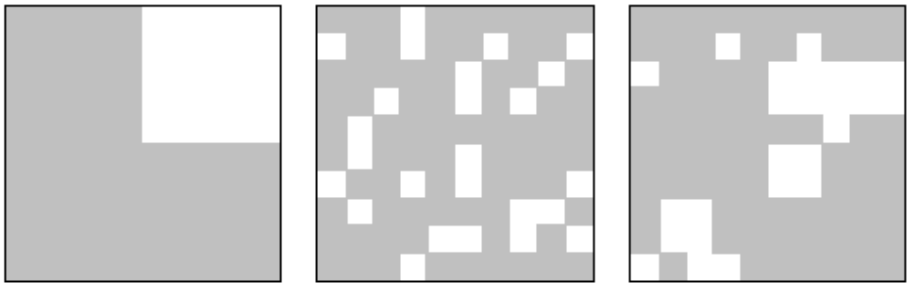


Appendix A cont.

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



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



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