Protocol for assessing the wildlife habitat value for New England salt marshes.

The following protocol uses aerial photography and digital land cover data to assess the extent of the eight assessment components described in the Framework (McKinney and Wigand 2006). To arrive at the fraction of various habitat and vegetation types required in the protocol, first estimate their percent cover from aerial photos and field assessments (e.g., 28 % low marsh, 62 % high marsh); then convert percent cover to the fraction of that habitat type or vegetation by dividing by 100 (e.g., 0.28 fraction low marsh, 0.62 fraction high marsh).

1) SIZE CLASS: measure the area of the marsh unit in hectares.

2) MORPHOLOGY: categorize the marsh morphology as a salt meadow, meadow/fringe, wide fringe, marine fringe, or narrow fringe marsh by comparing aerial photography of the marsh to Figure 2 in the Framework.

3) HABITAT TYPE: identify all habitat types present and estimate their percent cover. For the habitat types low marsh, trees overhanging water, high marsh, wooded islands, and phragmites, measure the area of the marsh surface in hectares. Divide the area of the marsh surface by the area of the marsh unit to arrive at the percent marsh surface.

Shallow Open Water: 1) delineate the area within the cove that is shallow open water (< 60 cm) at mean low water; 2) divide the area of shallow open water by the area of the marsh unit to calculate the percent shallow open water in the marsh unit.

Tidal flats: 1) delineate the area within the cove that is tidal flat (exposed mud flat at mean low water, or the area between the marsh surface and shallow open

water at mean low water); 2) divide the area of tidal flat by the area of the marsh unit to calculate the percent tidal flat in the marsh unit.

Low marsh: 1) estimate the fraction of the marsh surface that is emergent vegetation (fraction emergent vegetation; note that by definition the marsh surface will consist of emergent vegetation, trees, shrubs, and vines); 2) estimate the fraction of emergent vegetation that is low marsh; 3) multiply the fraction emergent vegetation by the fraction emergent vegetation that is low marsh to calculate the fraction of low marsh; 4) multiply the percent marsh surface by the fraction of low marsh to calculate the percent low marsh in the marsh unit.

Trees overhanging water: 1) estimate the fraction of the marsh surface comprised of trees (fraction trees); 2) estimate the fraction of trees that overhang water; 3) multiply the fraction trees by the fraction of trees that overhang water to calculate the fraction trees overhanging water; 4) multiply the percent marsh surface by fraction trees overhanging water to calculate the percent trees overhanging water in the marsh unit.

High marsh: 1) estimate the fraction emergent vegetation that is high marsh; 2) multiply the fraction emergent vegetation by fraction emergent vegetation that is high marsh to calculate the fraction high marsh; 3) multiply the percent marsh surface by fraction high marsh to calculate the percent high marsh in the marsh unit.

Wooded islands: 1) estimate the fraction trees that comprise wooded islands; 2) multiply the fraction trees by fraction of trees that comprise wooded islands to

calculate the fraction wooded islands; 3) multiply the percent marsh surface by fraction wooded islands to calculate the percent wooded islands in the marsh unit.

Pools: 1) count the number of pools on the marsh surface; 2) divide the number of pools by the area of the marsh surface to calculate the density of pools.

Pannes: 1) count the number of pannes on the marsh surface; 2) divide the number of pannes by the area of the marsh surface to calculate the density of pannes.

Phragmites: 1) estimate the fraction emergent vegetation that is phragmites; 2) multiply the fraction emergent vegetation by fraction of emergent vegetation that is phragmites to calculate the fraction phragmites; 3) multiply the percent marsh surface by fraction phragmites to calculate the percent phragmites in the marsh unit.

Marsh-upland border: 1) measure the perimeter of the marsh unit in meters.

Width: measure the average width of the upland border in meters.

Length: 1) measure the length of the marsh perimeter in meters that is adjacent to upland (natural land, maintained open land, residential land; excluding open water and sandy or rocky areas that are surrounded by open water): this is the length of the marsh-upland border; 2) divide the length of the marsh-upland border by the perimeter of the marsh to calculate the percent of the marsh-upland border adjacent to upland.

Composition: 1) measure the length of the marsh-upland border that is composed of shrubs; 2) divide the length of the marsh-upland border that

is composed of shrubs by the length of the marsh-upland border to calculate marsh-upland border composition.

4) EXTENT OF ANTHROPOGENIC MODIFICATION: using the base image, categorize the degree of ditching and tidal restriction as little to no, moderate, or severe by comparing with Figures 3 and 4 in the Framework.

5) VEGETATION: identify vegetation species and measure their percent cover. As with the marsh habitat types, measure the area of the marsh surface in hectares, and divide the area of the marsh surface by the area of the marsh unit to arrive at the percent marsh surface. Also, measure the area of estuarine open water in hectares, and divide the area of estuarine open water by the area of the marsh unit to arrive at the percent estuarine open water.

Aquatic plants: 1) estimate the fraction of estuarine open water inhabited by aquatic plants, 2) multiply the fraction of estuarine open water inhabited by aquatic plants by the percent estuarine open water to calculate the percent aquatic plants in the marsh unit.

Emergent vegetation: estimate the percent of the marsh surface that is emergent vegetation (note that this will be 100 times the estimate of the fraction of the marsh surface that is emergent vegetation used to calculate several of the habitat types).

Shrubs: 1) estimate the fraction shrubs on the marsh surface, 2) multiply the fraction shrubs on the marsh surface by the percent marsh surface to calculate the percent shrubs in the marsh unit.

Trees: 1) estimate the fraction trees on the marsh surface (note that this will be the same estimate used to calculate the percent of the trees overhanging water and wooded island habitat types), 2) multiply fraction trees on the marsh surface by the percent marsh surface to calculate the percent trees in the marsh unit.

Vines: 1) estimate the fraction vines on the marsh surface, 2) multiply the percent vines on the marsh surface by the percent marsh surface to calculate the percent vines in the marsh unit.

6) VEGETATIVE HETEROGENEITY: note the presence or absence of the five vegetation/edge types in the marsh unit (see page 29 in the Framework) and classify the degree of heterogeneity from Figure 5 in the Framework. The five vegetation/edge types are:

1) emergents / shallow open water

2) emergents / tidal flats

3) emergents / shrubs

4) emergents / trees

5) shrubs / trees

7) SURROUNDING LAND COVER AND LAND USE: measure the area of four land use categories (open water, natural, maintained open, developed land) in a 152 m buffer around marsh unit and calculate the percent cover of each category.

8) CONNECTIVITY AND ASSOCIATED HABITATS: delineate all occurrences of seven associated habitats present within a 1 km buffer around the marsh unit (see Framework page 32).

Number: count the number of associated habitat types within the buffer.

Average size: measure the average size (in hectares) of all associated habitats within the buffer.

Percent of 1 km buffer: measure the percent of the 1 km buffer covered by associated habitats.

The seven associated habitat types are:

1) Sand or cobble beach

2) Coastal dunes or overwash

3) Other salt marsh wetland

4) Brackish wetland or pond

5) Freshwater wetland or pond

6) Upland meadow

7) Upland forest

Calculating numerical and relative ranking scores.

The following is an example of the calculations required to arrive at numerical scores and an overall relative ranking score for a hypothetical New England salt marsh using the assessment protocol described in Appendix 1.

1) SIZE CLASS: the area of the marsh unit is 5.9 hectares; this fits the Moderate/Low (5 – 25 ha) criteria under size class in Table 2, so this size is assigned a value of 2. The numerical score for this component is determined by multiplying the value by the weighting factor: 2 x 10 = 20.

2) MORPHOLOGY: the marsh morphology is meadow/fringe; value (from Table 2) is 4 (High / Moderate); numerical score is 4 x 10 = 40.

3) HABITAT TYPE: [percent marsh surface = (1.0 / 5.9 ha) x 100 = 16.9%]

Shallow Open Water: 1) area of shallow open water is 1.7 ha; 2) 1.7 ha equals 28.8 % shallow open water in the marsh unit; value (from Table 2) is 5 (High); numerical score is 5 x 7 = 35.

Tidal flats: 1) area of shallow open water is 2.4 ha; 2) 2.4 ha equals 40.7 % shallow open water in the marsh unit; value is 5 (High); numerical score is 5 x 8 = 40.

Low marsh: 1) the fraction emergent vegetation on the marsh surface is 0.88; 2) the fraction of emergent vegetation that is low marsh is 0.48; 3) the fraction low marsh is 0.88 x 0.48 = 0.42; 4) the percent low marsh in the marsh unit is 16.9 % x 0.42 = 7.2 %; value is 3 (Moderate); numerical score is 3 x 8 = 24.

Trees overhanging water: 1) the fraction trees on the marsh surface is 0.07; 2) the fraction of trees that overhang water is 0.02; 3) the fraction trees overhanging water is 0.07 x 0.02 = 0.001; 4) the percent trees overhanging water in the marsh unit is 16.9 % x 0.001 = 2.4 %; value is 1 (Low); numerical score is 1 x 5 = 5.

High marsh: 1) the fraction of emergent vegetation that is high marsh is 0.45; 2) the fraction high marsh is 0.88 x 0.45 = 0.40; 3) the percent high marsh in the marsh unit is 16.9 % x 0.40 = 6.7 %; value is 3 (Moderate); numerical score is 3 x 8 = 24.

Wooded islands: 1) the fraction of trees that comprise wooded islands is 0.05; 2) the fraction wooded islands is 0.07 x 0.05 = 0.004; 3) the percent trees overhanging water in the marsh unit is 16.9% x 0.004 = 0.6 %; value is 1 (Low); numerical score is 1 x 6 = 6.

Pools: 1) there are 3 pools on the marsh surface; 2) the density of pools is 3 / 1.0 ha = 3.0; value is 3 (Moderate); numerical score is 3 x 8 = 24.

Pannes: 1) there is 1 panne on the marsh surface; 2) the density of pannes is 1 / 1.0 ha = 1.0; value is 1 (Low); numerical score is 1 x 5 = 5.

Phragmites: 1) the fraction of emergent vegetation that is phragmites is 0.07; 2) the fraction phragmites is 0.88 x 0.07 = 0.06; 3) the percent phragmites in the marsh unit is 16.9 % x 0.06 = 1.0 %; value is 3 (Moderate); numerical score is 3 x 4 = 12.

Marsh-upland border: 1) the perimeter of the marsh unit is 1108 meters.

Width: the average width of the upland border is 1.5 meters; sub-value is 1 (Low).

Length: 1) the length of the marsh perimeter is 913 meters; 2) the percent of the marsh-upland border adjacent to upland is (913 / 1108) x 100 = 82.4%; sub-value is 3 (High).

Composition: 1) the length of the marsh-upland border that is composed of shrubs is 502 meters; 2) the marsh-upland border composition is 55.0 %; sub-value is 2 (Moderate).

Total value of marsh-upland border is 1 + 3 + 2 = 6; value is 3 (Moderate); numerical score is 3 x 8 = 24.

4) EXTENT OF ANTHROPOGENIC MODIFICATION: the degree of ditching is little to no; value is 5 (High); numerical score is 5 x 9 = 45. The degree of tidal restriction is little to no; value is 1 (High); numerical score is 5 x 7 = 35. Note that the criteria are reversed for

this component to reflect the inverse relationship between the extent of this characteristic and habitat quality.

5) VEGETATION: As calculated for the marsh habitat types, the percent marsh surface is 16.9 %. The area of estuarine open water is 4.9 ha; the percent estuarine open water is 4.9 / 5.9 ha = 83.1 %.

Aquatic plants: 1) the fraction of estuarine open water inhabited by aquatic plants is 0.08; 2) the percent aquatic plants in the marsh unit is 83.1 % x 0.08 = 6.6 %; value is 3 (Moderate); numerical score is 3 x 2 = 6.

Emergent vegetation: the percent of the marsh surface that is emergent vegetation is 88.0 %; value is 3 (Moderate); numerical score is 3 x 3 = 9.

Shrubs: 1) the fraction shrubs on the marsh surface is 0.05; 2) the percent shrubs in the marsh unit is 16.9 % x 0.05 = 0.8 %; value is 1 (Low); numerical score is 1 x 3 = 3.

Trees: 1) the fraction trees on the marsh surface is 0.07; 2) the percent shrubs in the marsh unit is 16.9 % x 0.07 = 1.2 %; value is 1 (Low); numerical score is 1 x 4 = 4.

Vines: 1) there are no vines on the marsh surface; 2) value is 0 (Absent); numerical score is 0.

6) VEGETATIVE HETEROGENEITY: 5 of the vegetation / edge types were present in the marsh unit; value is 5 (High); numerical score is 5 x 6 = 30.

7) SURROUNDING LAND COVER AND LAND USE: 1) 23.8 % of the land cover in a 152 m buffer around the marsh unit was open water; value is 1 (Low); numerical score is 1 x 6 = 6; 2) 57.1 % of the land cover in a 152 m buffer around the marsh unit was natural land;

value is 5 (High); numerical score is 5 x 9 = 45. For the remaining two categories, the criteria are reversed to reflect the inverse relationship between the extent of this characteristic and habitat quality. 3) 13.3 % of the land cover in a 152 m buffer around the marsh unit was maintained open land; value is 3 (Moderate); numerical score is 3 x 5 = 15; 4) 5.7 % of the land cover in a 152 m buffer around the marsh unit was developed land; value is 3 (Moderate); numerical score is 3 x 9 = 27.

8) CONNECTIVITY AND ASSOCIATED HABITATS:

Number: there were 5 associated habitat types within the buffer; sub-value is 3 (High).

Average size: the average size of associated habitats within the buffer was 5.5 ha; sub-value is 2 (Moderate).

Percent of 1 km buffer: 40.0 % of the 1 km buffer was covered by associated habitats; sub-value is 2 (Moderate).

Total value of connectivity and associated habitats is 3 + 2 + 2 = 7; value is 5 (High); numerical score is 5 x 9 = 45.

The relative ranking score of this marsh, calculated by adding the numerical scores for all of the components and categories, is 529.

Field assessment protocols.

A site visit will be useful to ground-truth the estimates for habitat type, vegetative structure, and vegetative heterogeneity in the marsh unit. Any combination of accepted field survey techniques can be used, ranging from visual estimates of the extent of habitat or vegetation types to more rigorous quantitative sampling techniques. Examples of

quantitative or semi-quantitative methods are provided by Bullock (1996) and include total counts, frame quadrats, transects, and point estimates. Below is a representative protocol, consisting of a combination of visual and point estimates, that can be used to ground-truth estimates for small to medium-sized (5 - 125 ha) marshes:

1) Low marsh, trees overhanging water, high marsh, wooded islands, and phragmites

a) For smaller marshes, visual estimates of the extent of habitat types are preferred:

i) Obtain map of marsh surface.

ii) Walk the perimeter of the marsh unit and note the extent of the following habitat types:

Low Marsh

Trees overhanging water

High Marsh

Wooded islands

Phragmites

iii) Estimate the percent cover for each of the above habitat types.

b) Visual estimates may not be practical for larger marshes, in which case point estimates of the extent of habitat types may be employed:

i) Obtain map of marsh surface.

ii) Using a GIS, generate 3 to 6 random points on the marsh surface. The number of points will vary according to marsh surface size:

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

iii) The area of interest is a 100m circle plot around each survey point.

iv) At the survey point, extend a field tape 50m in one direction. This will be the radius of the 100m circle plot.

v) Survey the entire 100 m 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.

vi) Look in the 100 m circle plot for the following habitat types:

Low Marsh

Trees overhanging water

High Marsh

Wooded islands

Phragmites

vii) Estimate the percent cover for each of the above communities.

Average the percent cover values for the 3 – 6 survey points.

3) Vegetative structure

a) For smaller marshes, visual estimates of the extent of vegetation are preferred. Vegetation extent can be estimated concurrently with habitat type:

i) While walking the perimeter of the marsh unit, note the extent of the following vegetation types:

Emergents

Shrubs

Trees

Vines

ii) Estimate the percent cover for each of the above vegetation types.

b) Visual estimates may not be practical for larger marshes, in which case point estimates, using the 100 m circle plot around the survey point generated to estimate habitat types, may be used to estimate the extent of vegetation:

i) Look in the 100 m circle plot for the following vegetation types:

Emergents

Shrubs

Trees

Vines

ii) Estimate the cover for each of the four vegetation life forms listed above. Average the percent cover values for the 3 – 6 survey points.

5) Vegetative heterogeneity

a) Using the data generated from visual or point estimates, note the presence or absence of the five vegetation/edge types in each 100m circle plot on the marsh surface (see page 29 in the Framework).

b) Calculate the total number of the five vegetation/edge types on the marsh surface from their occurrence in the survey points. For example, using point

estimates, if survey point #1 has emergent/open water and emergent/tidal flat, survey point #2 has only emergent/tidal flat, and survey point #3 has emergent/open water and emergent/shrub, the total number of vegetation/edge types on the marsh surface would be 3.