# CAPS Ecological Settings Variables – November 2011

This appendix lists the ecological settings variables. These 23 spatial variables are meant to represent the important ecological attributes of each point in the landscape. They were selected for their ecological importance, subject to data availability. These variables are used in the Similarity, Connectedness, and Aquatic Connectedness metrics. See Appendix G for their grid names, weights, and parameterization.

| Biophysical attribute | Biophysical variable | Description |
|---|---|---|
| Temperature | Growing season degree-days | Degree-days is a heuristic tool for predicting vegetation growth; calculated by taking the sum of daily temperatures above a threshold (10°C). Temperatures above an upper threshold of 30°C are excluded.<br><br>*Units & range*: 0-n °days<br>*Source*: PRISM |
| | Minimum winter temperature | The minimum temperature (°C) reached in the winter sets the northern range limit for many plants and animals.<br><br>*Units & range*: °C, unbounded<br>*Source*: PRISM |
| Solar energy | Incident solar radiation | Solar radiation is a principal determinant of plant growth; calculated based on slope, aspect, and topographical shading.<br><br>*Units & range*: arbitrary, unbounded<br>*Source*: modeled from DEM and lat/long |
| Chemical & physical substrate | Soil pH | Soil pH measures acidity, which affects nutrient uptake by plants.<br><br>*Units & range*: 0-14 pH<br>*Source:* NRCS soils |
| | Soil depth | Soil depth (cm) affects communities primarily because shallow soils (usually on steep slopes or ridgetops) limit deep-rooted plants.<br><br>*Units & range*: 0-n cm<br>*Source:* NRCS soils |

| Biophysical attribute | Biophysical variable | Description |
| --- | --- | --- |
| | Soil texture | Soil texture, ranging from organic soils through clay to gravelly sand affects plants and many soil-dwelling invertebrates and some vertebrates. *Units & range*: ordinal, 1 (organic) through 6 (coarse textured) *Source:* NRCS soils |
| | Water salinity | Salinity measures the salt content of water in aquatic settings and is an important determinant of the ecological community. *Units & range*: in three broad classes: fresh, brackish, and saltwater *Source*: from photo-interpretation (saltwater from DEP wetlands, brackish from DEP) |
| | Substrate mobility | Substrate mobility measures the *realized* mobility of the physical substrate, due to both substrate composition (i.e., sand) and exposure to forces (wind and water) that transport material, and is an important attribute of certain dynamic systems (e.g., coastal dune systems). *Units & range*: an index of mobility, ranging from 1 = stable to 10 = highly mobile *Source*: landcover |
| | $CaCO_3$ content | Calcium content of the soil and water influences buffering capacity (and hence susceptibility to acidification) among other things; calculated based on the composition of the soil and underlying bedrock. *Units & range*: % calcareous at cell (terrestrial) or % calcareous for the watershed (aquatic) *Source*: TNC's lithology (near surface bedrock) |

| Biophysical attribute | Biophysical variable | Description |
|---|---|---|
| Physical disturbance | Wind exposure | Wind exposure measures the exposure to sustained high winds, which can be an important determinant of plant community development under extreme conditions (e.g., Krumholtz vegetation on mountaintops); calculated based on the mean sustained wind speeds at 30 m above ground level using a 200 m resolution model developed for wind energy purposes.<br><br>*Units & range*: meters per second<br>*Source*: MassGIS wind speed data |
| | Wave exposure | Wave exposure measures direct exposure to ocean waves, which can influence physical substrate stability and hence plant community development.<br><br>*Units & range*: index from none (no wave exposure) to maximum wave exposure (e.g., open ocean)<br>*Source*: derived from custom GIS model that measures the average distance to land from a set of radial vectors emanating outward from the focal cell, scaled by the MassGIS wind power grid |
| | Steep slopes | Steep slopes measures the propensity for gravity-induced physical disturbance (e.g., talus slopes).<br><br>*Units & range*: percent slope (0-infinite)<br>*Source*: derived from DEM |
| Moisture | Wetness | Soil moisture (in a gradient from xeric to hydric).<br><br>*Units & range*: arbitrary<br>*Source*: Topographic wetness index, using FD8 algorithm, from DEM |

| Biophysical attribute | Biophysical variable | Description |
|---|---|---|
| Hydrology | Flow gradient | Gradient (percent slope) of a stream determines water velocity, often approximated by categories such as pool, riffle, run, cascade.<br><br>*Units & range*: % slope, unbounded; 0 = flat<br>*Source*: from DEM and MassGIS stream centerlines |
| | Flow volume (watershed size) | Flow volume measures the absolute size of a stream or river. This value is often approximated by stream order.<br><br>*Units & range*: arbitrary; 0 for non-flowing systems<br>*Source*: log-scaled FD8 flow accumulation, from DEM |
| | Tidal regime | In coastal areas, degree of tidal influence.<br><br>*Units & range*: ranges from 0 for upland/inland areas beyond the reach of storm surges to 1 for areas with daily tides.<br>*Source*: modeled from 5 m DEM, NOAA tide range data, and DEP wetlands |
| Vegetation | Vegetative structure | Coarse vegetative structure, from unvegetated through shrubland through closed canopy forest.<br><br>*Units & range*: 1 to 10, ordinal<br>*Source*: land use |
| Development | Developed | Indicator of development.<br><br>*Units & range*: 0 = undeveloped; 1 = developed<br>*Source*: land use |
| | Hard development | Indicator of mostly impervious development.<br><br>*Units & range*: 0 = undeveloped or mostly pervious development (e.g. orchards, cemeteries); 1 = developed<br>*Source*: land use |

| Biophysical attribute | Biophysical variable | Description |
|---|---|---|
| | Traffic rate | Traffic is based on a model of the probability of an animal crossing a road being hit given the traffic rate (see Gibbs and Shriver 2002, Conservation Biology 16:1647-1652).<br><br>*Units & range*: 0-1<br>*Source*: MassDOT roads layer |
| | Impervious | Percent impervious surface.<br><br>*Units & ranges*: 0-100%<br>*Source*: MassGIS impervious layer, upscaled to 30 m |
| | Terrestrial barriers | Barriers to terrestrial organisms.<br><br>*Units & ranges*: 0 to 5, expert-assigned<br>*Source*: MassDOT roads, MassGIS trains |
| | Aquatic barriers | Barriers to aquatic organisms.<br><br>*Units & ranges*: 0-1, values for dams, culverts, and bridges<br>*Source*: MassDOT roads, MassGIS trains, MassGIS stream centerlines, Stream Continuity Project |