**DRAFT**

**Analysis Methods for Prairie Vegetation Monitoring Data**

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**Analysis Methods for Objective 1**

Detect change in the extent of physiognomic cover types in American Camp (AC) at San Juan Island National Historical Park (SJINHP) over years 2007-2015.

**Metric 1.1 (M1.1): Percent Cover H Herbaceous**

**Metric Type:** Landscape Structure.

**Denominator:** For a given transect, the sum of the straightened lengths, in meters, of herbaceous H, shrub S, tree T, developed D, and unvegetated U physiognomic cover types, allowing for possible temporal variation in transect start and end points.

**Numerator:** The length of the straightened transect, in meters, restricted to the physiognomic cover type herbaceous H.

**Metric Calculation**

**Example Calculation:** Utilizing Table 1 of recorded 2015 physiognomic cover types in transect 1-14, calculate the value of Metric 1.1 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, UTME, and UTMN in the WEST-derived shapefiles.

**Metric 1.2 (M1.2): Percent Cover S Shrub**

**Metric Type:** Landscape Structure.

**Denominator:** For a given transect, the sum of the straightened lengths, in meters, of herbaceous H, shrub S, tree T, developed D, and unvegetated U physiognomic cover types, allowing for possible temporal variation in transect start and end points.

**Numerator:** The length of the straightened transect, in meters, restricted to the physiognomic cover type shrub S.

**Metric Calculation**

**Example Calculation:** Utilizing Table 1 of recorded 2015 physiognomic cover types in transect 1-14, calculate the value of Metric 1.2 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, UTME, and UTMN in the WEST-derived shapefiles.

**Metric 1.3 (M1.3): Percent Cover T Tree**

**Metric Type:** Landscape Structure.

**Denominator:** For a given transect, the sum of the straightened lengths, in meters, of herbaceous H, shrub S, tree T, developed D, and unvegetated U physiognomic cover types, allowing for possible temporal variation in transect start and end points.

**Numerator:** The length of the straightened transect, in meters, restricted to the physiognomic cover type tree T.

**Metric Calculation**

**Example Calculation:** Utilizing Table 1 of recorded 2015 physiognomic cover types in transect 1-14, calculate the value of Metric 1.3 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, UTME, and UTMN in the WEST-derived shapefiles.

**Metric 1.4 (M1.4): Percent Cover D Developed**

**Metric Type:** Landscape Structure.

**Denominator:** For a given transect, the sum of the straightened lengths, in meters, of herbaceous H, shrub S, tree T, developed D, and unvegetated U physiognomic cover types, allowing for possible temporal variation in transect start and end points.

**Numerator:** The length of the straightened transect, in meters, restricted to the physiognomic cover type developed D.

**Metric Calculation**

**Example Calculation:** Utilizing Table 1 of recorded 2015 physiognomic cover types in transect 1-14, calculate the value of Metric 1.4 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, UTME, and UTMN in the WEST-derived shapefiles.

**Metric 1.5 (M1.5): Percent Cover U Unvegetated**

**Metric Type:** Landscape Structure.

**Denominator:** For a given transect, the sum of the straightened lengths, in meters, of herbaceous H, shrub S, tree T, developed D, and unvegetated U physiognomic cover types, allowing for possible temporal variation in transect start and end points.

**Numerator:** The length of the straightened transect, in meters, restricted to the physiognomic cover type unvegetated U.

**Metric Calculation**

**Example Calculation:** Utilizing Table 1 of recorded 2015 physiognomic cover types in transect 1-14, calculate the value of Metric 1.5 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, UTME, and UTMN in the WEST-derived shapefiles.

**Analysis Methods for Objective 2**

Detect change in the extent of exotic origin of plant species in American Camp (AC) at San Juan Island National Historical Park (SJINHP) over years 2007-2015.

**Metric 2.1 (M2.1): Percent Origin Exotic E of Cover-type H Herbaceous**

**Metric Type:** Vegetation Community Structure.

**Denominator:** For a given transect, the straightened length, in meters, of the herbaceous H physiognomic cover type.

**Numerator:** The length of the straightened transect, in meters, restricted to the exotic origin type E.

**Metric Calculation**

**Example Calculation**

Utilizing Table 2 of recorded 2015 physiognomic cover types and origins in transect 1-14, calculate the value of Metric 2.1 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. The origin in the NPS database is Origin. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, Origin, UTME, and UTMN in the WEST-derived shapefiles.

**Metric 2.2 (M2.2): Percent Origin Exotic E of Cover-type S Shrub**

**Metric Type:** Vegetation Community Structure.

**Denominator:** For a given transect, the straightened length, in meters, of the shrub S physiognomic cover type.

**Numerator:** The length of the straightened transect, in meters, restricted to the exotic origin type E.

**Metric Calculation:**

**Example Calculation**

Utilizing Table 2 of recorded 2015 physiognomic cover types and origins in transect 1-14, calculate the value of Metric 2.2 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. The origin in the NPS database is Origin. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, Origin, UTME, and UTMN in the WEST-derived shapefiles.

**Metric 2.3 (M2.3): Percent Origin Exotic E of Cover-type T Tree**

**Metric Type:** Vegetation Community Structure.

**Denominator:** For a given transect, the straightened length, in meters, of the tree T physiognomic cover type.

**Numerator:** The length of the straightened transect, in meters, restricted to the exotic origin type E.

**Metric Calculation:**

**Example Calculation:** Utilizing Table 2 of recorded 2015 physiognomic cover types and origins in transect 1-14, calculate the value of Metric 2.3 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. The origin in the NPS database is Origin. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, Origin, UTME, and UTMN in the WEST-derived shapefiles.

**Metric 2.4 (M2.4): Percent Origin Exotic E of Total Park Cover**

**Metric Type:** Vegetation Community Structure.

**Denominator:** For a given transect, the straightened length, in meters, of the sum of the lengths of all park physiognomic vegetation cover types, i.e., cover-type H herbaceous, cover-type S shrub, and cover-type T tree.

**Numerator:** The length of the straightened transect, in meters, restricted to the exotic origin type E, over all park physiognomic vegetation cover types, i.e., cover-type H herbaceous, cover-type S shrub, and cover-type T tree.

**Metric Calculation:**

**Example Calculation:** Utilizing Table 2 of recorded 2015 physiognomic cover types and origins in transect 1-14, calculate the value of Metric 2.4 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. The origin in the NPS database is Origin. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, Origin, UTME, and UTMN in the WEST-derived shapefiles.

**Metric 3.1 (M3.1): Percent of High-Quality Native Herbaceous**

**Metric Type:** Quality of Native Herbaceous Communities

**Denominator:** For a given transect, the straightened length sum, in meters, of the herbaceous H cover type of native N origin.

**Numerator:** The straightened length sum, in meters, of the herbaceous H cover type of native N origin with recorded exotic cover class 0-10%.

**Metric Calculation:**

**Example Calculation:** Utilizing Table 3 of recorded 2015 cover classes in transect 1-14, calculate the value of Metric 3.1 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. The origin is Origin. The cover class is CoverClass. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, Origin, CoverClass, UTME, and UTMN in the WEST-derived shapefiles.

**Metric 3.2 (M3.2): Percent of Medium-Quality Native Herbaceous**

**Metric Type:** Quality of Native Herbaceous Communities

**Denominator:** For a given transect, the straightened length sum, in meters, of the herbaceous H cover type of native N origin.

**Numerator:** The straightened length sum, in meters, of the herbaceous H cover type of native N origin with recorded exotic cover class 11-49%.

**Metric Calculation:**

**Example Calculation:** Utilizing Table 3 of recorded 2015 cover classes in transect 1-14, calculate the value of Metric 3.1 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. The origin is Origin. The cover class is CoverClass. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, Origin, CoverClass, UTME, and UTMN in the WEST-derived shapefiles.

**Metric 3.3 (M3.3): Percent of Low-Quality Native Herbaceous**

**Metric Type:** Quality of Native Herbaceous Communities

**Denominator:** For a given transect, the straightened length sum, in meters, of the herbaceous H cover type of native N origin.

**Numerator:** The straightened length sum, in meters, of the herbaceous H cover type of native N origin with recorded exotic cover class 50-100%.

**Metric Calculation:**

**Example Calculation:** Utilizing Table 3 of recorded 2015 cover classes in transect 1-14, calculate the value of Metric 3.3 as

**Database Considerations**

The physiognomic cover type in the NPS database is VegType. The origin is Origin. The cover class is CoverClass. Straightened transect lengths utilized in the calculation of metrics derive from UTM-10N eastings and northings (UTME and UTMN, respectively) collected at the time of data collection.

These variables correspond to VegType, Origin, CoverClass, UTME, and UTMN in the WEST-derived shapefiles.

**Models**

Three separate linear statistical mixed models [Piepho and Ogutu, 2002] were considered in modeling percent cover of each of the three physiognomic cover types over all transects *i* and years *j*. Each of the logit and arc-sine transformations aid in model-fitting when proportionality data are either less than 20% or greater than 80%. The arc-sine transformation has the added benefit of helping to stabilize variance.

1. Untransformed:

2. Logit:

3. Arc-Sine:

**Model Parameters of Interest**

1. : The overall American Camp linear temporal estimate of trend of percent cover of trees T, years2007-2015. For the Untransformed Model, estimate interprets as the average one-year percent change in the T Tree cover-type, over the whole of American Camp.

2. : The individual *i*th transect linear temporal prediction of trend of percent cover of trees T,over 2007-2015. For the Untransformed Model, prediction interprets as the average one-year percent change in the tree cover-type, for the individual *i*th transect.

3. : The variability in linear deviations of percent cover of trees T, over individual transects as a whole, 2007-2015. The value of will probably be relatively high, given that some transects are dominated by one physiognomic cover-type, while others have a prevalence of something different.

4. : The variability in linear deviations of percent cover of trees T, over individual time points as a whole, 2007-2015. The value of will hopefully be relatively low, assuming consistency of year-to-year weather patterns and data collection.

5. : The variability in slope deviations of percent cover of trees T, over individual transects as a whole, 2007-2015. The value of will hopefully be relatively low, assuming a lack of spatial variability, the relatively small sampling frame, and a consistent lack of disturbance throughout the park.

6. : The residual variability of individual observations. These provide assistance with assessing the quality of model fit.

**Example Data**

In year 2015, transect 1-14 recorded the following straightened physiognomic cover types and origins.

**Table 1: Observed Physiognomic Cover Types for Transect 1-14 in Year 2015.**

|  |  |
| --- | --- |
| **Cover Type** | **Total Transect**  **Length m (%)** |
| H Herbaceous | 257.99 (33.0) |
| S Shrubs | 24.19 (3.1) |
| T Trees | 305.54 (39.2) |
| D Developed | 9.59 (1.2) |
| U Unvegetated | 182.91 (23.4) |

**Table 2: Observed Origins for Transect 1-14 in Year 2015.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Cover Type** | **Exotic E Origin**  **Length m (%)** | **Native N Origin**  **Length m (%)** | **Total Cover**  **Type Length m** |
| H Herbaceous | 223.96 (86.8) | 34.03 (13.2) | 257.99 |
| S Shrubs | 17.88 (73.9) | 6.31 (26.1) | 24.19 |
| T Trees | 0.00 (0.0) | 305.54 (100.0) | 305.54 |

**Table 3: Observed Cover Classes for Transect 1-14 in Year 2015 for Native Herbaceous Total Length of 34.03 m.**

|  |  |
| --- | --- |
| **Cover Class** | **Native Herbaceous Length m (%)** |
| 0-10% | 28.21 (82.9) |
| 11-49% | 5.82 (17.1) |
| 50-100% | 0.00 (0.0) |

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