Protocols for Monitoring Vegetation: Herbaceous Plants

Objective and Purpose

Plants, both woody and herbaceous, account for approximately 98% of the earth's biomass (Larsen, 2016). Aside from producing the oxygen we breathe everyday, plants are the foundation of the world's food web and provide invaluable ecosystem services. Recent studies have shown that plant biodiversity is linked to increased ecosystem productivity (Reich et al. 2012). As urbanization and climate change continue to threaten local plant populations, maintaining plant biodiversity has become a priority for many cities. By monitoring long-term trends in plant biodiversity as a part of the Urban Biodiversity Inventory Framework, we will be able to better understand and mitigate the impacts of urbanization and climate change to local ecosystems.

Protocol Consistency

Standardizing sampling protocols for the Urban Biodiversity Inventory Framework is a critical requirement of designing surveys that are replicable and producing results that are spatially and chronologically comparable (Larsen, 2016). This is especially important for long-term monitoring efforts that aim to measure changes over time. While a standardized approach among all cities using the Urban Biodiversity Inventory Framework is preferable, each city may identify a methodology best suited for their species of interest and resources at hand. It is important to record and report the methodology used and remain consistent in protocols unless modifications are essential to its improvement. It is equally important that site conditions are kept as similar across sites as possible to reduce the impacts of confounding factors. All methodology will be improved with the use of non-biased approaches to data collection, appropriate sampling efforts and accurate reporting of data. When collecting data on long-lived plants (e.g. perennial plants and trees), the use of permanent plots is preferred since there is a high correlation between sampling unit values between two time periods (Elzinga et al.,1998). The methodology below follows the assumption that the observers are properly trained, using methods to limit bias, and following designated protocol to ensure consistency among sites and years of sampling efforts.

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Track 2
Presence/Absence

Data to be Entered into UBIF Database

- City
- Data Collector(s)
- Date
- Location name
- Ecosystem/habitat of interest
- Taxonomic group
- Species
- GPS coordinates of each quadrat (Lat/Long in decimal degree format)
- Reference or city site
- Target species presence or absence

Additional Required Information to Record (see Data Collection Sheet)

- Number and size of quadrats

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Sampling Protocols:

Adapted from protocols described in Clark and Perry (2009) and Roberts-Pichette and Gillespie (1999).

Establishing Quadrats:

- Using systematic sampling methods, select permanent quadrat locations within each reference and city site. Each quadrat must contain the target species during the initial quadrat selection process.
  - We recommend a total of at least 10 quadrats spread out over 10 urban sites (one quadrat per city site) and at least 10 quadrats spread out over one reference site. The number of quadrats can be adjusted based on site conditions and available resources.
  - The recommended quadrat size is 1 m x 1 m. However, quadrat size can be increased or decreased to better fit target species, so long as the quadrat size is kept constant across all sites.
- Permanently mark quadrats at the four corners using durable markers that can withstand normal weathering, such as star pickets or fence droppers.

Collecting Presence/Absence Data:

- If target species is a flowering plant, sampling should occur when it is flowering for ease of identification (varies by species, but typically ranges from spring through mid-summer).
- To visualize the border of the quadrat, wrap and tie a string around the four permanent stakes. Portable quadrat frames are another option, which can be made to size using wood or PVC pipe.
- Each quadrat will be marked as “present” if the target species is present within the quadrat or “absent” if the target species is absent from the quadrat.
  - To be considered present, at least one individual of the target species must be rooted within the quadrat.

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Track 3
Relative Abundance

Note: Track 3 data can be collected from the same sites and quadrats surveyed in Track 2. If Track 2 is not used, refer to Track 2: "Establishing Quadrats" for information on quadrat establishment within city and reference sites.

Data to be Entered into UBIF Database

- City
- Data Collector(s)
- Date
- Location name
- Ecosystem/habitat of interest
- Taxonomic group
- Species
- GPS coordinates (Lat/Long in decimal degree format)
- Reference or city site
- Relative abundance (%) of target species

Additional Required Information to Record (see Data Collection Sheet)

- Number and size of quadrats
- Chosen method of percent cover estimates (basal vs. aerial)
- Percent cover estimates for target species, non-target species and bare ground

Optional Information to Record (see Data Collection Sheet)

- Non-target species information including but not limited to:
  - List of plant species present
  - Individual estimates of percent cover for each non-target species

Urban Biodiversity Inventory Framework

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Sampling Protocol:

Protocols adapted from those described in Caratti (2006), Elzinga et al. (1998), Eyre et al. (2011) and Natural Resources Research Institute (2011).

Collecting Relative Abundance Data

- Within each quadrat, estimate percent cover of the target species. Percent cover is estimated as the proportion of ground covered from view by any part of a plant belonging to the target species when looking down at the quadrat from a bird's-eye view. Use Figure 1 as a guide to estimating percent cover.
  - Depending on the characteristics of the target species, it may be more appropriate to estimate basal cover instead of aerial cover (Figure 2). This must be determined prior to the first data collection occurance so that all percent cover estimates are collected using the same methods.
    - If using the aerial method to estimate percent cover, an individual of the target species does not need to be rooted within the quadrat to be included in the estimate of percent cover.
    - If using the basal method to estimate percent cover, an individual of the target species must be rooted within the quadrat to be included in the estimate of percent cover.
- Using the same methods for estimating percent cover of the target species (described above), estimate percent cover of all non-target species and percent cover of bare ground within the quadrat.
  - Each quadrat will have three estimated values of percent cover: percent cover of the target species, percent cover of non-target species and percent cover of bare ground.
  - The three estimates of percent cover must add up to 100%
- Percent cover of one plant can change significantly over the course of a year, so it is important that data collection be completed at the same time each year.

Calculating Relative Abundance

- After each trap deployment period, counts will be summed for target species and non-target species for each transect.
- Relative abundance (%) for each transect will be calculated as the proportion of the individuals counted that belong to the target species.

$$\text{Relative Abundance (\%)} = \frac{\text{Number of target species}}{\text{Number of target species + Number of non-target}} \times 100$$

Figures

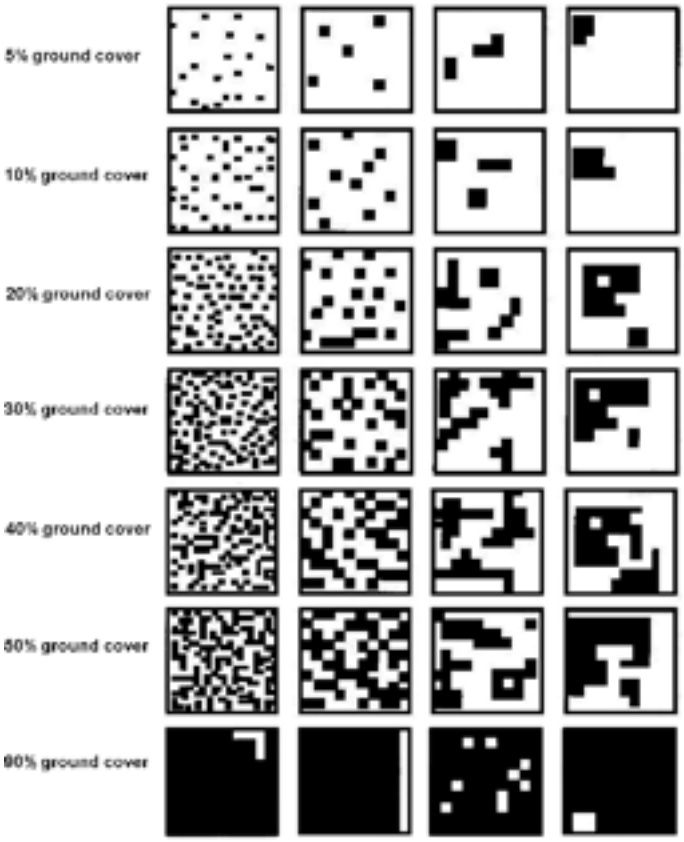

Figure 1. Estimate percent cover of a plant species as the proportion of ground covered by any part of a plant when looking down at the quadrat from a bird's-eye view. Image from Eyre et al. (2011).

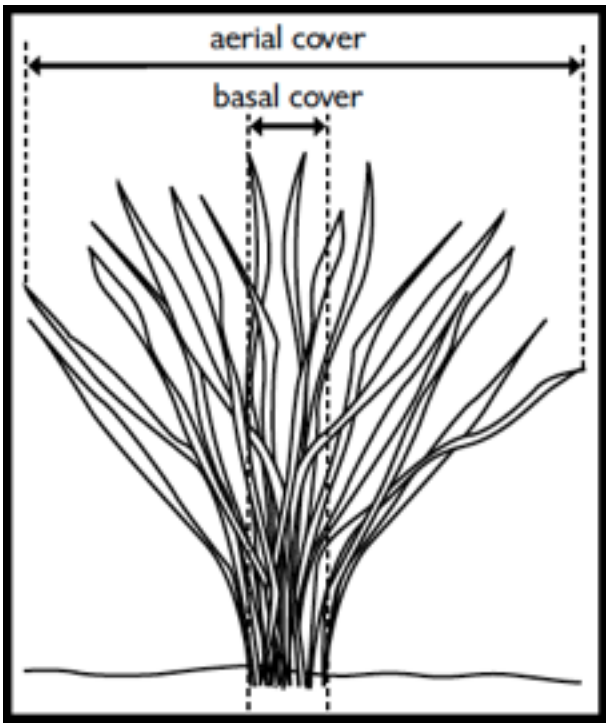

Figure 2. Depending on the characteristics of plant species present, it may be more appropriate to estimate percent cover using either aerial cover or basal cover. Image from Elzinga et al. (1998).

Citations and Additional Resources

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Eyre, T.J., A.L. Kelly, V.J. Neldner, B.A. Wilson, D.J. Ferguson, M.J. Laidlaw, A.J. Franks. 2011. BioCondition: a condition assessment framework for terrestrial biodiversity in Queensland. Assessment Manual. Version 2.1. Department of Environmental and Resource Management (DERM), Biodiversity and Ecosystem Sciences, Brisbane.

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