Plant Diversity Protocol for LTAR Observatories

**Number of plots:** We recommend a minimum of 3 plots per plant community at a given site, but plot number must be determined by site based on number of communities, available labor, and other constraints.

**SOP for Field Sampling**

**1. Plot Establishment**

Plant diversity sampling occurs in a square-shaped plot measuring 20m on a side and containing four 100m2 subplots (Figure 1). Each subplot contains nested subplots: a 1m2 subplot nested in a 10m2 subplot in each of two corners. For comparison of data across space and through time, it is important that the dimensions of these plots and subplots be consistent across plots and sites. This protocol assumes that plots will be marked by a center point and four corners. The permanent markers define the corners of the plot and should maintain comparability through time. If this is not the case, plots must be established during each sampling bout according to the Plot Establishment Protocol (RD[07]). While delineating subplots, please take care to avoid trampling the plot – particularly the 1m2 subplots.

1. Delineate the sides of the 100m2 subplot, the 10m2 nested subplot (3.16 m from the nearest permanent marker at the plot corners or center) with flags or appropriate markers, and the 1m2 nested subplot.

2. The 1m2 nested subplot is delineated with a rigid frame anchored at the corner by a permanent plot marker. The square, multi-scale plot (Figure 1) is used to record plant species composition and cover. The plot includes nested subplots at specific locations within the plot.

**B.2 General Data Collection**

The plot-based collection requires photography, observation of primarily abiotic elements – termed ‘variables’ – in 1-m2 nested subplots, and observations of vascular plant species at multiple spatial scales.

**1. Metadata.** Record plotID, boutNumber, the primary botanist (measuredBy), additional staff (recordedBy), and date (which should reflect the day the sampling was completed).

**2. 1m2 Nested Subplots.** Photograph nested subplots, record variable cover estimates, and identify and record cover and height of vascular plant species in the subplot.

a. **Photograph 1m2 nested subplot**. Take a plane-view picture of the nested 1m2 nested subplot such that the subplot frame fills the photograph while standing at the middle of the south edge outside the 1m2 nested subplot. If it is not possible to stand at the south edge, move to the west, north, east edge in that order. Photograph name should include: plot\_ID, Module, subplot number, and date in the following format: CPER\_001\_PlantDiversity\_31.1.1\_20130812

b. **Measure and record variables other than vascular plants**. Estimate and record the combined cover of abiotic (non-living) elements, non-vascular plant species, and overstory cover of species in each 1m2 nested subplot (Table 3). Cover of any one element shall not exceed 100 percent, but the total cover of multiple elements may be greater than 100 percent. Observations should reflect those variables that cover the surface of the subplot (e.g. the moss growing on a rock, but not that part of the rock under the moss, or the litter on top of the soil but not the soil under the litter).



Figure 1. The square, multi-scale plant diversity sampling plot.



**Figure 2. The 1 m2 subplots is calibrated with black and white marks to make estimates of plant species cover more accurate and repeatable.**

**c. Measure and record vascular plant species data**.

1) Record the presence of vascular plant species by entering Natural Resource Conservation Service (NRCS)/US Department of Agriculture (USDA) PLANTS database code in the taxonID field for each species. If entering data into a hand-held electric device, any part of the scientific name or NRCS code can be entered. If no species are found in the nested 1-m2 subplot, either click “No plant cover present” on the electronic device or record the same in the taxonIDRemarks field of the first line of the datasheet. Species-specific comments should be entered in the taxonIDRemarks field.

If an exact determination can’t be made:

• Describe uncertainty about the genus or species with the appropriate identification qualifiers and/or detailed notes.

• Group or “lump” taxonomically similar species by entering the accepted NRCS genus code followed by sp/spp (depending on number of species in each plot), or enter possible species in the taxonIDRemarks field.

• If a species cannot be identified in the field and the individual does not have parts needed for identification, enter the lowest taxonomic rank that can be determined (e.g. genus or species) followed by the sp. Suffix.

• If a species cannot be identified in the field, enter the lowest rank taxon code (e.g. genus), a name to track the species in morphospeciesID, and any comments in the morphospeciesIDRemarks.

2) Estimate the combined cover of all individuals of each species in the nested subplot. • Only estimate cover of plants, or portions of plant, with stems that originate within or have some part of the stem inside the subplot frame.

• Estimate cover to nearest 1%.

• Enter 0.5 for estimates of cover <1%.

• Enter the basal area for cover of trees greater > 3m in height.

• There will often be spatial overlap of plant species. Cover should be recorded as the total aerial coverage for each species; estimates should not exceed 100 percent for a single species, but total subplot cover may be greater than 100%.

Cover estimates can be made more repeatable across observer, plots, and sites with calibration:

• Familiarize yourself with what particular cover estimates (e.g., 1%, 10%, 15%, etc.) look like and use them as reference sizes. For example, if you know that 1% cover is about the same size as your fist, use your fist as a reference.

• Each 1m2 nested subplot frame is calibrated in 10cm sections to make cover estimates easier (Fig. 2).

• Visually group species together into a percent cover.

• Fine tune estimate by subtracting out any spaces or gaps.

**2. 10m2 Nested Subplots.** Record the identity of all species with stems in each 10m2 nested subplot as described for the 1m2 nested subplot. It is not necessary to record species already documented in those 1m2 nested subplots in each respective 10m2 nested subplot. However, it is acceptable to list species that were observed in the smaller, 1m2 nested subplot (it may be difficult to remember, especially given the repetitive nature of the plot) as these records can be cleaned when processed.

There is no specific time that should be spent looking for plant species during search efforts. The search is best thought of in terms of a species-accumulation curve. Initial searching is likely to result in more species. A general guideline: if new species are being found, keep searching. If after five to ten minutes of gently moving dominant species to look for small and locally rare individuals – even crawling if necessary – no new species are found, then spend another five minutes and move on.

**3. 100m2 Subplots.** Record the identity of all plant species with stems in each 100m2 subplot as described for the 1m2 nested subplot. It is not necessary to record species already documented in nested subplots in each respective 100m2 subplot. However, it is acceptable to list species that were observed in the smaller, 1m2 and 10m2 nested subplots (it may be difficult to remember, especially given the repetitive nature of the plot)as these records can be cleaned when processed.

As with searching the 10m2 nested subplot, there is no specific time that should be spent looking for plant species during search efforts. The search is best thought of in terms of a species-accumulation curve. Initial searching is likely to result in more species. A general guideline: if new species are being found, keep searching. If after ten minutes of gently moving dominant species to look for small and locally rare individuals – even crawling if necessary – while searching the entire subplot and no new species are found, then spend another ten to fifteen minutes and move on.

**APPENDIX A. Delineating a precise plot.**

The perimeter of the plot and subplots shall be delineated by tape measures and subplot frames as follows (Figure 3):

1. Record date and plot number.

Begin in the south-west corner of the plot (point 31), at most sites this permanent marker will be labeled with information about the plot.

Anchor a 50 m tape and extend it towards the south-east corner (point 33).

a. Walk on the south side of the tape to avoid trampling plants inside the 20 x 20 m plot.

b. While pulling the tape, insert pin flags into the ground touching the outside edge of the tape at 1 m, 3.16 m, 10 m, 16.84 m, and 19 m.

Anchor the tape at the 20 m at the south-east corner of the plot (point 33) and pull it towards the marker at the north-east corner (point 51) of the plot.

c. Walk on the east side of the tape to avoid trampling plants inside the 20 x 20 m plot.

d. While pulling the tape, insert pin flags into the ground touching the outside edge of the tape at 21 m, 23.16 m, 30 m, 36.84 m, and 39 m.

Return to the south-west corner (point 31) of the plot.

Anchor the second 50 m tape and extend it towards the north-west corner (point 49).

e. Walk on the west side of the tape to avoid trampling plants inside the 20 x 20 m plot.

f. While pulling the tape, insert pin flags into the ground touching the outside edge of the tape at 1 m, 3.16 m, 10 m, 16.84 m, and 19 m.

Anchor the tape at the 20 m at the north-west corner (point 49) of the plot and pull it towards the marker at the north-east corner (point 51) of the plot.

g. Walk on the north side of the tape to avoid trampling plants inside the 20 x 20 m plot.

h. While pulling the tape, insert pin flags into the ground touching the outside edge of the tape at, 21 m, 23.16 m, 30 m, 36.84 m, and 39 m.

Anchor a third tape at the center of the plot (point 41) and extend it south toward the flag that at 10m.

i. Insert pin flags into the ground at 1 m and 3.16 m.

Return to the center and extend the tape east toward the flag that at 30 m.

j. Insert pin flags into the ground at 1 m and 3.16 m.

Return to the center and extend the tape north toward the flag at 30 m.

k. Insert pin flags into the ground at 1 m and 3.16 m.

Return to the center and extend the tape west toward the flag at 10 m. Leave the tape in this place to facilitate sampling subplot x.

l. Insert pin flags into the ground at 1 m and 3.16 m.



Figure 3. The plot will have some permanent markers and will also require temporary flags that are placed each time the plot is measured.