

CAP LTER SURVEY200 FIELD PROTOCOL
VERSION 2010
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This protocol was based initially on the UFORE FOREST SURVEY devised by Dave Nowak (BES), and has been updated with input from CAP LTER PIs and field experience.

Arriving at the site, first steps:

Upon arriving at a site, use the Trimble GPS to locate the plot center (locate nail if present). Create a new folder in the GPS for the site, and record the location of the plot center; if present, always use the center nail as plot center and record this location as plot center in the GPS.

Use a compass (corrected for declination) to identify the cardinal directions, and stretch graduated, 15-m ropes in each of these directions – you will often have to needle the ropes through or over vegetation, over walls, under cars, etc. If there are too many obstructions for the ropes (quite common at urban sites) use the Trimble GPS to identify the plot corners and edges in lieu of delineating the plot with ropes.

Begin completing a plot data sheet (and parcel data sheet if relevant) for the site, and divide tasks among crew members.

General plot information (1st and 2nd pages of plot data sheet packet):

- Date, crew members (not just initials), Plot ID
 - Incline and Exposure:
 - Identify the steepest section of the plot.
 - One person stands at top and another person goes a known distance downhill.
 - Person at top uses clinometer to measure angle (in degrees) down to eye level on other person.
 - Person at top also records direction (degrees) of slope using compass
- Short description of plot – 20 word limit (key words only)
- Land use:
 - Percent of the plot area that is in the land use using the LTER land use categories 1 through 6. This will often be 100% (e.g., desert sites) but some plots will cover multiple categories (e.g. 60% residential, 40% street). Make sure percentages sum to 100%. Identify categories using outline codes (e.g., 1B1 for xxxx sites).
- Record street address of every house on plot where applicable
- Height of (new or previously un-surveyed) buildings.
 - Record the slope (%) to the highest point and bottom of the structure from a known distance. Be sure to compensate (by estimation) additional horizontal distance from a measurable point (e.g., wall) and horizontal distance to highest point of the structure (e.g., recessed chimney).
- Note surrounding transportation infrastructure that best reflects conditions at the plot.
- Note current weather and any evidence of rain
- Note landscape practices (urban plots only)
- Does the landscape have a natural or manicured appearance?

- Is the landscape maintained professionally?
- Are plants in the landscape healthy and vigorous?
- Are there any symptoms or signs of abiotic or biotic injury?
- Watering regimes: drip or trickle, overhead spray, flood, or hand watering
- Estimate % of pervious area irrigated.
- Veg types present: soil / trees / shrubs / succulents / herbaceous groundcover / other groundcover [these categories are extremely vague; this needs to be dropped from future surveys or more instruction provided]
- Visible human activity (na in private back yards): excluding conditions in private back yards, note signs of human activity within the plot corresponding to checklist categories.
- Evaluation of surrounding neighborhood: excluding outlying desert areas, note general characteristics of the surrounding neighborhood.

Photographs

Photos taken at plot center (to be taken with digital SLR fitted with 28mm lens)

- Photographer should stand at plot center, and take one photo in each cardinal direction.
- Where plot center is inaccessible, note location where photos were taken on data sheet.
- Use photos from previous survey to match camera angle and position, particularly when not taken from plot center.
- Camera height should be 1.5m (use tripod or have a crew member of this height take photos).
- Note photo numbers and photographer on data sheet. Be sure crew members are not in the field of view for plot center photos.

Synoptic Plot Photos

- Take synoptic photos from outside plot boundary looking toward plot center (and other angles as appropriate) to capture the 'essence' of the plot.
- Record photo numbers, a description of the photo (e.g., location and direction), and photographer on data sheet

Vegetation

Trees

- ALL trees in the plot are counted, measured, and their position (by GPS or grid location) noted.
- If recording tree location by GPS, each tree will have a unique GPS ID, beginning with the number '1' and increasing incrementally (the location of saguaros is recorded also so, if GPS'd, the ID of these plants will be included in the sequence of plant IDs).
- If recording the location of trees (or saguaros) by grid location (i.e., position on ropes), a GPS ID is not necessary.
- In 2010, we did NOT match plant IDs to plant IDs of previous surveys, this proved nearly impossible.
- We treated palms inconsistently in 2010, addressing these plants as both trees and shrubs; this distinction needs to be made in advance of the next survey (suggest treating them as trees).
- Note the shape and class of each tree (na in desert plots)

- Measure stem diameter as DBH (diameter at breast height, 54") of all stems at breast height. If this is not feasible (e.g., many small stems that would yield a poor estimate of girth), record the trunk height at, preferably, DGH (diameter at ground height, where trunk emerges from ground), or, less desirable, at some other height. Note the measuring height and diameter on data sheet.
- Tree height. Where possible, measure height of the tree and the bottom of the canopy directly with a measuring tape. Else, use a clinometer to record slope/angle (%; left-side scale of clinometer) of tree height, base of the tree (where the trunk emerges from the ground), and the height of the bottom of the canopy from a known distance.
- Canopy dimensions. Record the length of the living canopy along the N-S axis and E-W axes using a measuring tape.
- Take a photograph of the tree if needed for identification or tree health (see below), and record photo # on the data sheet.

Tree health

- For each tree on the plot, excluding seedlings and palms, complete a tree health inventory sheet. The tree ID on the tree health inventory must correspond to the plant ID on the vegetation data sheet. Take a photo of every tree, and note the picture number on the tree health inventory and vegetation data sheet.
- Instructions for assessing tree health exceed the scope of a protocol; training by Dr. Martin or Stutz is required for this aspect of the survey.

Shrubs and perennial groundcover:

- ALL shrubs in the plot are counted by species, segregated by quadrant (to aid counting), and recorded on the *Individual shrub count* sheet.
- The size and characteristics (i.e., shape and class (na in desert plots)) of at least 5 individuals of each shrub species (at least 1 from each quadrat when possible) are recorded on the *Shrubs and perennial groundcover* datasheet.
- In 2010, save for the first few sites of the survey, we did NOT note the location (by GPS or grid location) of shrubs.
- Plant height and extent. Use a measuring tape to record the height, and extent (length of the living canopy along the N-S axis and E-W axes). For particularly tall shrubs, use a clinometer to record slope/angle (%; left-side scale of clinometer) of plant height and to the base of the plant (where the stem/trunk emerges from the ground) from a known distance.
- Unknown plants (including those for which there is even a shadow of a doubt):
 - Photograph the live, uncollected specimen, and note photo number anywhere the unique specimen is referenced on a data sheet and on herbarium envelope.
 - Collect a small sample (adhering to protocol for collecting annuals (see below) as much as possible), and write "perennial" on herbarium envelope.

Hedges (urban plots only):

- Hedge versus shrub(s) is an arbitrary distinction to be made by the crew on site. Typically, we consider a shrub or shrubs(s) a hedge if it or, most often, they are positioned and manicured to create a distinct border, and if the growth of the plants is dense.

- The taxon, size, and shape of ALL hedges is recorded in the *Hedges* box of the vegetation data sheets. The number of hedges at each site should correspond to the number of entries on this sheet (i.e., there is not a separate hedge count sheet as there is for shrubs.)
- In 2010, save for the first few sites of the survey, we did NOT note the location (by GPS or grid location) of hedges.
- Plant height and extent. Use a measuring tape to record the height, and extent (length of the living canopy along the N-S axis and E-W axes). For particularly tall hedges (rarely, if ever, encountered), use a clinometer to record slope/angle (% , left-side scale of clinometer) of plant height and to the base of the plant (where the stem/trunk emerges from the ground) from a known distance.
- Unknown plants:
 - Photograph the live, uncollected specimen, and note photo number on the datasheet anywhere the unique specimen is referenced on a data sheet and on herbarium envelope.
 - Collect a small sample (adhering to protocol for collecting annuals (see below) as much as possible), and write “perennial” on herbarium envelope.

Cacti and succulents:

Saguaros

- ALL saguaros in the plot are counted, measured, and their position (by GPS or grid location) noted.
- If recording saguaro location by GPS, each plant will have a unique GPS ID, beginning with the number ‘1’ and increasing incrementally (the location of trees is recorded also so, if GPS’d, the ID of these plants will be included in the sequence of plant IDs).
- If recording the location of saguaros by grid location (i.e., position on ropes), a plant ID is not necessary.
- In 2010, we did NOT match plant IDs to plant IDs of previous surveys, this proved nearly impossible.
- Note class (na in desert plots)
- Measure trunk diameter as DBH (diameter at breast height, 54”).
- Saguaro height. Where possible, measure height of the saguaro directly with a measuring tape. Else, use a clinometer to record slope/angle (% , left-side scale of clinometer) of saguaro height and base (where the trunk emerges from the ground) from a known distance.
- Canopy dimensions. Record the length of the living canopy along the N-S axis and E-W axes using a measuring tape.

All other cacti and succulents:

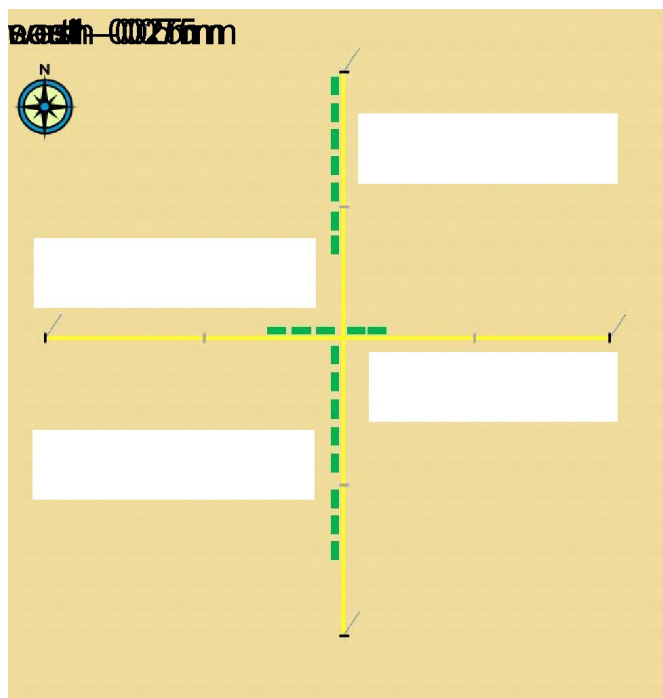
- ALL cacti in the plot are counted by species. If there are numerous cacti, the number of individuals may be segregated by quadrant and recorded on the *Individual shrub count* as per shrubs, else all individuals should be recorded in the *Cacti and succulents* box of the vegetation datasheet.
- The taxon, class, and size of at least 5 individuals of each species (at least 1 from each quadrat when possible) are recorded on the *Cacti and succulents* box of the vegetation datasheet.
- In 2010, save for the first few sites of the survey, we did NOT note the location (by GPS or grid location) of cacti except saguaros.

- Cacti height and extent. Use a measuring tape to record the height, and extent (length of the living canopy along the N-S axis and E-W axes). For particularly tall cacti, use a clinometer to record slope/angle (%) of plant height and to the base of the plant (where the stem/trunk emerges from the ground) from a known distance.
- Unknown cacti:
 - Photograph the live, uncollected specimen, and note photo number on the datasheet anywhere the unique specimen is referenced on a data sheet.

Annuals:

Annuals - cover

Estimate the % cover of annuals in the plot by the linear extent of annuals in contact with plot ropes. Measure cover in 0.25-m increments, and include only coverage that is at least 0.25m in length. For example, annual cover for the 1st meter in each cardinal direction would be estimated as follows in the diagram below where annual plant cover is noted by green bars:



At urban sites, note separately the total length of turf and annual coverage.

Annuals - diversity

- Collect a specimen of every annual species on the plot. Whenever possible, collect specimens that have flowers, fruits, and roots - flowers are always a priority!
- Each plant is listed on the data sheet, and given a unique number starting at '1' for each plot (i.e., numbers are not conserved across sites).
- Photograph each plant with a herbarium voucher labeled with as much information as possible (site ID, sample # corresponding to the annuals data sheet, sampling date, photo number, and

taxon if known) included in the backdrop (use a piece of blank, white paper as a background for the specimen and voucher packet). Note that it is important that the photo number written on the voucher packet is included in the photo.

- After photographing the specimen and voucher packet, place the specimen in the voucher packet and bundle packets for that site. When placing the specimen into the voucher packet, flatten leaves and spread them out as much as possible.
- Voucher packets are pressed in the lab the day they are collected. When a press is full, place it in the air-dryer in the Herbarium for ≥ 1 week, then move the press to the Herbarium freezer for ≥ 2 days. After this time, remove the packets from the press and place them in the survey 200 Herbarium cabinet.
- Treat grasses and herbs as annuals

Soil sampling

Soil cores - overview

- The goal is to collect four 1" soil cores for chemical analyses at multiple depths, and one 2" soil core for analyses of soil physical properties at each site.
- The preferred sampling locations for each of the 1" cores is 10m in each cardinal direction, shifted 0.5m clockwise; and 0.5m east of plot center for the single 2" core.
- At desert sites, rocky conditions may prevent sampling at preferred locations, and a suitable location near to the preferred spot should be located.
- The preferred sampling locations at urban sites are rarely accessible, and, as at desert sites, a suitable location near to the preferred location should be identified (note this system breaks down considerably given the habitat of many urban sites (e.g., houses, driveways, etc); in those instances, collect samples wherever possible striving to capture best the diversity of soil conditions at the site). Further, it may not be possible to collect 4 1"-cores at urban sites due to extensive irrigation, limited access to the plot (e.g., access to only one of several yards), etc. In those situations, collect as many 1" cores as possible, again striving to cover the diversity of soil types and cover at the site. At some locations, it may not be possible to collect any 1" cores due to the aforementioned conditions.
- In all cases, note the location where cores were collected using the grid system (i.e., position on ropes) or by GPS – if by GPS, note 'GPS'd' on the data sheet, and provide a sample description (e.g., 'AB11 soil north') for each entry in the GPS unit (be sure you are collecting GPS data in the appropriate site folder).
- Provide a brief description of the conditions where each soil was collected (e.g., gravel area of side yard, turf area of playground).

Soil cores – detailed instruction

- 2" soil core
 - carefully take an intact core 0.5m east of plot center IF no danger of hitting irrigation/power lines or the nearest location to plot center with representative ground cover
 - if the core is incomplete, remove the soil and collect another sample
 - Avoid pushing/compacting the sample when removing from corer
 - Place a red cap on top of the core sleeve, and a blue cap on the bottom of the core sleeve

- Label core sleeve with the plot ID and date
- 1” soil cores
 - collect 4 samples, 10m North, South, East and West of plot center and 0.5m clockwise from transect, or the nearest feasible location to these positions
 - Do not sample where there may be irrigation/power lines
 - if the core is incomplete, remove the soil and collect another sample
 - Avoid pushing/compacting the sample when removing from corer
 - Place a red cap on top of the core sleeve, and a blue cap on the bottom of the core sleeve

Surface soil – overview

A total of four surface soil (2-cm depth) samples are to be collected, one corresponding to each of the 1” soil core locations. Sweep aside gravel and loose vegetation before collecting sample, but do not collect samples from thick turf – it may not be possible to collect surface soil samples at sites where thick turf is predominant. Surface-soil samples should be collected in conjunction with the 1” soil cores. As such, if only 3 1”-soil cores were collected, only 3 surface-soil samples would be collected. An exception to this rule are sites where no 1”-cores were collected (e.g., due to extensive irrigation, limited plot access, etc.), in which case 4 surface soil samples should be collected (if possible).

Surface soil – detailed instruction

- Collect a single surface soil sample as near as possible to where 1” soil cores were collected (n = 4).
- Sweep aside gravel or loose vegetation, and place the copper coupling on soil where sample is to be taken. Sample soil that does not have vegetation cover (i.e. in a site where grass is growing near core location, move to nearest place without grass to sample surface soil).
- Hammer the copper ring into soil to 2 cm depth
- Collect soil to depth corresponding to the bottom of ring using a spoon, and place soil in Ziploc bag
- Label Ziploc bag with plot ID, date, and location.

Arthropods (sweep-net samples)

Arthropods – overview

Collect a sample of vegetation-dwelling insects from three different plants (preferably each a different species) at each site. At least one insect sample should reflect the dominant plant species at each site. The second and third samples should reflect other dominant plants at the site (including one or more ground sweeps if the site is dominated by turf or weeds), and preferred plants as follows:

Bougainvillea spp. (in mesic and xeric residential neighborhoods)

Citrus spp. (in mesic yards and in orchards, i.e. agriculture)

Encelia farinosa (in desert sites and xeric yards)

Larrea tridentata (in desert sites and xeric yards)

Nerium oleander (commercial sites, mesic yards, xeric yards)

Cupressus spp. (commercial sites, mesic yards)

Olea spp. (commercial sites, mesic yards)

Prosopis spp. (agriculture, desert, mesic, xeric)

Conduct ground sweeps at sites where only turf or weeds are present. In the absence of any vegetation, collect samples from off plot at a location that is representative of the plot (note this on the datasheet).

Sweep-net samples – detailed instructions

- select plant (see above)
- envelop one branch of selected plant with the sweep net
- shake the branch vigorously ten times
- remove the net from the branch (or vice versa) quickly, and choke the top of the net so flying insects cannot escape
- hold the net vertically and shake it such that the insects fall to the closed-end of the net (you can also open the net and wave it rapidly several times – this works particularly well for manipulating flying insects to the tip of the net).
- place an open insect jar over white paper
- hold the net vertically, and slowly move your choke-hold on the net toward the tip as you shake continuously.
- when your choke-hold on the net is very near the tip, grab the tip of the net (while maintaining your choke-hold), and slowly invert the tip of the net into an open sample jar and shake, flick, and prod all contents into the jar
- shake anything that falls on the white paper into the jar
- add completed sample tag (filled out using pencil (not pen!)) to the jar, and close tightly

Before leaving the site:

- Be sure that the plot, parcel (if necessary), and tree health (if necessary) data sheets are complete, including the side ID and date on every page, and stored in the site folder
- Be sure insect jars are stowed upright
- Be sure soil samples are collected from the backpacks and transferred to a storage container
- Be sure to collect all plant voucher packets, and that they are bundled by site

At the lab:

- Create a new folder (identified by site ID) for each site visited that day on the designated shared drive.
- Upload all photos and the GPS file for each site into the respective aforementioned folder. When uploading photos, be sure to copy and paste directly from the camera (by way of a file browser) to the desired location as opposed to using camera-provided software as these program will often change the name/number of the photo.
- Add voucher packets to a plant press. When a press is full, place it in the air-dryer in the Herbarium for ≥ 1 week, then move the press to the Herbarium freezer for ≥ 2 days. After this time, remove the packets from the press and place them in the survey 200 Herbarium cabinet.
- Place all soil samples at the designated location in the walk-in lab cooler

Parcel survey

At all residential sites, survey characteristics of the parcel that most overlaps with the 30x30m survey plot – if not accessible, survey the parcel that is most accessible.

Address the following details as per the plot – typically, these details will overlap completely with plot details but be careful that the assessment reflects the parcel if they differ from the plot characteristics. Note the address of the parcel surveyed.

- General plot information
- Short description of parcel – 20 word limit (key words only)
- Height of (new or previously un-surveyed) buildings.
- Note surrounding transportation infrastructure that best reflects conditions at the parcel.
- Note current weather and any evidence of rain
- Note landscape practices
- Visible human activity
- Evaluation of surrounding neighborhood

Synoptic parcel photos

- Take synoptic photos of the parcel to capture the essence of the plot.
- Record photo numbers, a description of the photo (e.g., location and direction), and photographer on data sheet

Vegetation

Address vegetation (trees & shrubs) in the front- and back-yards separately.

Trees

- ALL trees in the front yard are counted and measured, and in the back yard if accessible
- Note shape and class
- Canopy dimensions. Record the length of the living canopy along the N-S axis and E-W axes using a measuring tape.
- Take a photograph of the tree if needed for identification and record photo # on the data sheet.
- We did not measure stem/trunk diameter or tree height during the 2010 survey but it may be prudent to add these measurements to future surveys to estimate biomass

Shrubs and perennial groundcover:

- ALL shrubs in the front yard are counted, and in the back yard if accessible
- Unknown plants:
 - Photograph the live, uncollected specimen, and note photo number on the datasheet anywhere the unique specimen is referenced on a data sheet and on herbarium envelope.
 - Collect a small sample (adhering to protocol for collecting annuals (see below) as much as possible), and write “perennial” on herbarium envelope.

Residential parcel characteristics, and Front- and Back-yard characteristics

Complete self-explanatory survey sheet of yard characteristics for both the front- and back- (if accessible) yards.