

CAP LTER SURVEY200 FIELD PROTOCOL
VERSION 2015.1
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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 the nail if present (desert sites only)). 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 the Trimble GPS to identify the plot corners and mid-points - mark these with flags or cones.

Divide tasks among crew members.

General plot information

ODK form: s200_GPI

- Note the plot ID (for example, 'V12')
- Note plot (see parcel instructions below for parcels)
- Crew members: check all that are present, and note additional crew members not included in the list (add a new 'AdditionalCrew' group)
- Inclination
 - Identify the steepest section of the plot.
 - One person stands at top while another person stands some distance downhill.
 - Person at top uses clinometer to measure angle (in degrees) down to eye level of the other person
- Exposure: note predominant aspect of the plot (if there is any slope)
- Provide a brief description of the plot. Limit description to ~20 words and use keywords, such as desert, creosote flat, residential neighborhood, strip mall parking lot, etc.
- Quantify land use of the plot (only of the plot; add 'landuses_sampling_event' group)
 - 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 supplied codes (e.g., 1B1 for institutional (schools, churches, etc) sites).
- Note the use of buildings on the plot
- Record heights of buildings if present (add 'Plot structures' group)
 - Record the slope (in degrees) to the highest point and bottom of the structure from a known distance.
- Note surrounding transportation infrastructure that best reflects conditions at the plot
- Note current weather
- Note if it has rained and what evidence if so
- Note landscape practices (skip for desert plots)

- 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, hand watering, or not irrigated
- Estimate % of pervious area irrigated.
- Veg types present: soil / trees / shrubs / succulents / herbaceous groundcover / other groundcover
- Visible human activity (NA in private back yards): excluding conditions in private back yards, note signs of human activity within the plot corresponding to the checklist.
- Evaluation of surrounding neighborhood: excluding outlying desert areas, note general characteristics of the surrounding neighborhood.
- Note whether the plot center nail was located and whether one was left

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
- Be sure that crew members nor the vehicle are in the field of view for plot center photos.
- Where plot center is inaccessible, note location where photos were taken in the ‘notes concerning plot photos’ field
- Camera height should be ~1.5 m or ~5 ft (always have a crew member of approximately this height take photos)
- Note photo numbers in the form

Synoptic Plot Photos

- At the photographer’s discretion, take photos with the tablet to capture the ‘essence’ of the plot. These are most often taken from outside plot boundary looking toward plot center (and other angles as appropriate) but not necessarily.
- Describe each photo in the description box.

Vegetation

ODK forms: s200_trees_plot, s200_shrub_survey, s200_shrub_count, s200_hedges_survey, s200_annuals

Trees and saguaros

ODK form: s200_trees_plot

- Note the plot ID (for example, ‘V12’)
- ALL trees (including all palms) and saguaros in the plot are counted, measured, photographed, and their position recorded
- Add a ‘Tree Data’ group for each tree in the plot
- Note the ID of the tree if this information is known, knowable only by examining previous data sheets or from past Trimble files - you are unlikely to have this information

- Note the tree taxon. Select ‘other’ if the identity is not known. Record a new taxon or provide notes about the tree’s identity if relevant.
- Take a photo of the tree
- Record the GPS position of the tree
- Note if a voucher was collected
- If a voucher was collected, provide information about the voucher in ‘voucher details’ - in most cases, this will simply be the tree number but provide additional information if relevant. Collect a small sample. Collect specimens that have flowers, fruits, and roots when possible. Write “perennial” on herbarium envelope.
- Note the shape and class of each tree (NA in desert plots)
- Note if the tree is also in a parcel (urban sites only)
- Note the tree shape
- Note the tree class (NA in desert plots)
- Estimate the health of the canopy based on the condition of the leaves (% dead or senesced)
- Estimate the % of the canopy that is absent from a perfect circle or oval
- Measure stem diameter as Diameter at Breast Height (DBH 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 diameter at, preferably, ground height (DGH, diameter at ground height, where trunk emerges from ground), or, less desirable, at some other height. Note the measuring height (inches) and diameter on data sheet. For trees where multiple trunks are measured, sum the values and report only the total number, note also the number of stems/trunks measured.
- Tree height: where possible, measure height of the tree and the bottom of the canopy directly with a measuring tape. Otherwise, from a known (and measured) distance where you can see the top and base of the tree, use a clinometer to record the angle (degree, left-side scale of clinometer) to the top of the tree, and angle to base of the tree (where the trunk emerges from the ground).
- Canopy dimensions. Record the length of the living canopy along the N-S axis and E-W axes using a measuring tape. Measure the height to the bottom of the canopy above the ground. This is best addressed by using a meter tape but can be done with the clinometer if necessary. If using a clinometer, record the angle to the bottom of the canopy from a known distance.
- Record the position of the tree in the plot relative to plot center if GPS is not available.
- Add another ‘Tree Data’ group for additional trees

Shrubs, perennial groundcover, and cacti other than saguaros:

ODK forms: s200_shrub_survey, s200_shrub_count, s200_hedges_survey

shrub count

ODK forms: s200_shrub_count

ALL shrubs and cacti in the plot are counted by species, segregated by quadrant (to aid counting). Note that this does not include saguaros, which are treated like trees.

- Note the plot ID (for example, ‘V12’)
- Note plot (see parcel instructions below for parcels)

- Note the shrub taxon. Select ‘other’ if the identity is not know. Record a new taxon or provide notes about the plant’s identity if relevant.
- Take a photo of the plant if relevant. Pictures of each plant are not required here, but take photos if the ID is questionable or if there is something unique about the plant(s) or setting that would be useful to document with a photograph.
- Note if a voucher was collected
- If a voucher was collected, provide information about the voucher in ‘voucher details’ - in most cases, this will simply be the shrub number but provide additional information if relevant. Collect a small sample. Collect specimens that have flowers, fruits, and roots when possible. Write “perennial” on herbarium envelope.
- Quantify the number of this type of shrub in each quadrant of the plot. Note that the quadrant distinction is not overly important and is primarily added to aid counting in plots with high densities of shrubs, so focus on getting an accurate estimate of the number of shrubs and less about their exact location.

shrub survey

ODK forms: s200_shrub_survey

The details of at least 5 representative individuals of each shrub and cacti species (at least 1 from each quadrant when possible) are recorded in the s200_shrub_survey form. As with the shrub count, this does not include saguaros, which are addressed with the trees.

- Note the plot ID (for example, ‘V12’)
- Add a ‘Survey data for taxon’ group for each taxon in the plot
- Note the plant taxon. Select ‘other’ if the identity is not know. Record a new taxon or provide notes about the plant’s identity if relevant.
- Take a photo of the plant if relevant. Pictures of each plant are not required here, but take photos if the ID is questionable or if there is something unique about the plant(s) or setting that would be useful to document with a photograph.
- Note if a voucher was collected
- If a voucher was collected, provide information about the voucher in ‘voucher details’ - in most cases, this will simply be the shrub number but provide additional information if relevant. Collect a small sample. Collect specimens that have flowers, fruits, and roots when possible. Write “perennial” on herbarium envelope.
- Add a ‘Survey of plants of a given taxon’ group
- Note the shape and class of the plant (NA in desert plots)
- Plant dimensions: where possible, measure height of the plant directly with a measuring tape. Otherwise, from a known (and measured) distance where you can see the top and base of the plant, use a clinometer to record the angle (degree, left-side scale of clinometer) to the top of the plant, and angle to base of the plant (where the plant emerges from the ground).
- Canopy dimensions. Record the length of the living canopy along the N-S axis and E-W axes using a measuring tape.
- For each additional plant of this taxon, add a ‘Survey of plants of a given taxon’ group
- Add another ‘Survey data for taxon’ group for additional taxa.

Hedges (urban plots only)

ODK forms: s200_hedges_survey

A hedge versus a shrub 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).

- Note the plot ID (for example, 'V12')
- Add a 'Survey data for taxon' group for each taxon in the plot
- Note the plant taxon. Select 'other' if the identity is not know. Record a new taxon or provide notes about the plant's identity if relevant.
- Take a photo of the plant if relevant. Pictures of each plant are not required here, but take photos if the ID is questionable or if there is something unique about the plant(s) or setting that would be useful to document with a photograph.
- Note if a voucher was collected
- If a voucher was collected, provide information about the voucher in 'voucher details' - in most cases, this will simply be the hedge number but provide additional information if relevant. Collect a small sample. Collect specimens that have flowers, fruits, and roots when possible. Write "perennial" on herbarium envelope.
- Add a 'Survey of hedges of a given taxon' group
- Note the shape and class of the hedge
- Plant dimensions: where possible, measure height of the plant directly with a measuring tape. Otherwise, from a known (and measured) distance where you can see the top and base of the plant, use a clinometer to record the angle (degree, left-side scale of clinometer) to the top of the plant, and angle to base of the plant (where the plant emerges from the ground).
- Canopy dimensions: record the length (long axis) and width (short axis) of the living canopy of the hedge using a measuring tape.
- For each additional plant of this taxon, add a 'Survey of hedges of a given taxon' group
- To continue with additional species, add another 'Survey data for taxon' group

Annuals:

ODK forms: s200_annuals

Treat grasses and herbs as annuals

- Note the plot ID (for example, 'V12')
- Estimate the percent cover of annuals in the plot by the linear extent of annuals in contact with virtual lines that bisect the plot. Measure cover in 0.25 m increments, and include only coverage that is at least 0.25 m in length.
- Add a 'Survey data for taxon' group for each taxon in the plot
- Note the plant taxon. Select 'other' if the identity is not know. Record a new taxon or provide notes about the plant's identity if relevant.

- Note if the identify of the sample is known (with certainty)
- Note if a voucher was collected
- If a voucher was collected, provide information about the voucher in ‘voucher details’ - in most cases, this will simply be the shrub number but provide additional information if relevant. Whenever possible, collect specimens that have flowers, fruits, and roots - flowers are always a priority!
- Take a picture of every annual by adding an ‘annuals photos’ group. For annuals, you can take multiple photos of each plant if desired. Be sure to have at least one photo that features the plant and the herbarium voucher labeled with as much information as possible (site ID, sample number, 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).
- 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.
- continue to add a ‘Survey data for taxon’ group for each taxon in the plot
- 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 survey200 Herbarium cabinet.

Soil sampling

ODK form: s200_GPI

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 10 m in each cardinal direction, shifted 1.0 m clockwise; and 1.0 m east of plot center for the single 2” core
- At desert sites, rocky conditions may prevent sampling at preferred locations - 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.
- Record the location where cores were collected. Ideally, the location of each position should be recorded with the tablet. As a backup, the location can be described in the soil core location description boxes (see next step).
- 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 ~1 m east of plot center IF there is 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, ~10 m North, South, East and West of plot center and 1 m 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. In fact, it may not be possible to collect surface soil samples at sites where thick turf or impervious substrates are predominant. As much as possible, surface-soil samples should be collected in conjunction with the 1” soil cores but it is not essential that they overlap if one or the other type of sample is not feasible. It is not necessary to record the GPS location of surface soil samples.

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 a depth of 2 cm
- 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)

ODK form: s200_GPI

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 of 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.

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
- note the taxa of each plant from which a sample was collected

Before leaving the site:

- Confer with team members that all data were collected and all relevant data forms were addressed
- 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 the software WILL change the name/number of the photo causing quite a problem
- There is a folder on the shared drive for each tablet (Alpha, Bravo, Charlie). Within each of those folders, create a folder with the first letter of the tablet (a, b, or c) and the date as *mmdd* (e.g., tablet Bravo for the day March 8, 2015 would have the folder name b0308). Copy the ODK folder in the tablet to the folder on the shared drive that was just created.
- 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 study plot – if not accessible, survey the parcel that is most accessible. Data are to be collected for both the front and back yards if accessible.

General parcel information

ODK form: s200_GPI

- Note the plot ID (for example, 'V12')
- Note parcel
- Note the parcel address
- Quantify land use of the plot (only of the plot; add 'landuses_sampling_event' group)
 - 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 institutional (schools, churches, etc) sites).
- Note the use of buildings on the plot
- Record heights of buildings if present (add 'Plot structures' group)
 - Record the slope (in degrees) to the highest point and bottom of the structure from a known distance.
- Note surrounding transportation infrastructure that best reflects conditions at the parcel
- Note landscape practices
 - 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, hand watering, or not irrigated
 - Estimate % of pervious area irrigated.
 - Veg types present: soil / trees / shrubs / succulents / herbaceous groundcover / other groundcover
- **Synoptic Plot Photos**
 - Take synoptic photos of the parcel to capture the essence of the plot
 - Describe each photo in the description box.
- Note the type of residence
- Note approximate perceived social class of the neighborhood

Yard characteristics & features

- For front and rear yards separately, note the qualities as prompted by the form
 - yard upkeep
 - yard orderliness
 - yard features

- watering regimes
- yard landscape type
- amount of grass and characteristics (if present)
- weeds
- pruning
- detailed assessment of grass (if present)
- Add another ‘front or back yard’ group as access allows

Vegetation

ODK forms: s200_trees_parcel, s200_shrub_count

Trees and saguaros

ODK form: s200_trees_parcel

- Note the plot ID (for example, ‘V12’)
- ALL trees (including all palms) and saguaros in the yard(s) are counted, measured, photographed, and their position recorded
- Note front or back yard assessment
- Add a ‘Tree Data’ group for each tree in the plot
- Note the ID of the tree if this information is known, knowable only by examining previous data sheets or from past Trimble files - you are unlikely to have this information
- Note the tree taxon. Select ‘other’ if the identity is not know. Record a new taxon or provide notes about the tree’s identity if relevant.
- Take a photo of the tree
- Record the GPS position of the tree
- Note if a voucher was collected
- If a voucher was collected, provide information about the voucher in ‘voucher details’ - in most cases, this will simply be the hedge number but provide additional information if relevant. Collect a small sample. Collect specimens that have flowers, fruits, and roots when possible. Write “perennial” on herbarium envelope.
- Note the shape and class of each tree
- Note if the tree is also in a plot
- Note the tree shape
- Note the tree class
- Estimate the health of the canopy based on the condition of the leaves (% dead or senesced)
- Estimate the % of the canopy that is absent from a perfect circle or oval
- Measure stem diameter as Diameter at Breast Height (DBH 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 diameter at, preferably, ground height (DGH, diameter at ground height, where trunk emerges from ground), or, less desirable, at some other height. Note the measuring height (inches) and diameter on data sheet. For trees where multiple trunks are measured, sum the circumferences and report only the total number, note also the number of stems measured.

- Tree height: where possible, measure height of the tree and the bottom of the canopy directly with a measuring tape. Otherwise, from a known (and measured) distance where you can see the top and base of the tree, use a clinometer to record the angle (degree, left-side scale of clinometer) to the top of the tree, and angle to base of the tree (where the trunk emerges from the ground).
- Canopy dimensions: record the length of the living canopy along the N-S axis and E-W axes using a measuring tape. Measure the height to the bottom of the canopy above the ground. This is best addressed by using a meter tape but can be done with the clinometer if necessary. If using a clinometer, record the angle to the bottom of the canopy from a known distance.

A special note about trees in the parcel, unlike the s200_shrub_count and s200_GPI forms that allow you to address both the front and back yards in a single instance, a new form/instance must be created for each the front and back yards when surveying trees.

Shrubs and cacti other than saguaros (*shrub count*):

ODK forms: s200_shrub_count

ALL shrubs and cacti in the yard(s) are counted by species, segregated by yard position (front, rear). Note that this does not include saguaros, which are treated like trees.

- Note the plot ID (for example, ‘V12’)
- Note parcel
- Add a new ‘front or back yard’
- Note the yard position (front, rear)
- Add a ‘Survey data for taxon’ group for each taxon
- Note the shrub taxon. Select ‘other’ if the identity is not know. Record a new taxon or provide notes about the plant’s identity if relevant.
- note if the plant is a hedge
- Take a photo of the plant if relevant. Pictures of each plant are not required here, but take photos if the ID is questionable or if there is something unique about the plant(s) or setting that would be useful to document with a photograph.
- Note if a voucher was collected
- If a voucher was collected, provide information about the voucher in ‘voucher details’ - in most cases, this will simply be the shrub number but provide additional information if relevant. Collect a small sample. Collect specimens that have flowers, fruits, and roots when possible. Write “perennial” on herbarium envelope.
- Quantify the number of this type of plant in this particular yard (front, rear)
- Add a ‘Survey data for taxon’ group for each additional taxon
- Add another ‘front or back yard’ group note that you can end the survey and create a new form/instance of the ‘other’ yard if not convenient to measure at that time