COMMUNITY BASELINE MEASUREMENTS FOR ITEX STUDIES

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Measurement of species cover before and during ITEX manipulations is critical to the inter-pretation of the species data. Observed responses may be due as likely to changes in the biotic environment caused by shifts in species abundance and competitive regime as to changes in the abiotic environment. It is also important that the compositional data be based on a quantitative measure such as percentage cover rather than on a visual estimate or cover-abundance scale, as these may be too coarse to detect change. In particular, the Braun-Blanquet cover-abundance scale, which is very appropriate for relevés that conform to minimal sampling areas (in terms of complete community representation within the sample), is inappropriate for small-scale studies such as ITEX, which encompass much less than the minimal area required for the community.

The recommended standard method for ITEX plots is a fixed, square point frame, with 100 measurements spaced equidistantly within the frame. The frame size can vary slightly to fit your chamber configuration, but in most cases should range between 75 and 100 cm on a side. The distance between points is determined by the side length of the frame divided by 10, so that a 75 cm frame has points separated by 7.5 cm, and a 100 cm frame has points separated by 10 cm. Placing the points much closer than 7 cm will result in oversampling of a very small area and repeated sampling of the same individuals in many ecosystems (this will happen in any case, but as the size gets smaller it becomes more of a problem).

Construction details

(see Figure 1): The frame is constructed of 3-sided angular aluminum tubing, approximately 2 cm across and 2 mm in thickness. Four pieces cut to the length of the frame sides plus 2 x the width of the material (if you use material that is 2 cm across and wish to make a 1 m frame, the pieces should be 100 + (2x2) = 104 cm) are mitered 90 deg at the corners. Thus, the inside measure of the frame is the important dimension. Corners are stabilized using 90 deg angle braces on the outside, and also with cross braces across the bottom of the frame, approximately 15 cm out from the side (i.e., forming a triangle in the corner of the frame). Screws are used to attach braces to the frame. The four corners of the frame are assigned a letter code A, B, C, and D in the following manner: A in the lower left, B in the lower right, C in the upper left, and D in the upper right. Adhesive metric measuring tape is attached permanently to the top of each side of the frame, with the numbers running from A to B and C to D and from A to C and B to D. The tape is used to identify a coordinate system for recording and tracking data. Small (approx. 1-1.5 mm diameter) holes are drilled at appropriate sampling intervals through the center of each side of the frame. For a 100 cm frame, the first hole is drilled 5 cm from the left side, continuing every 10 cm. For a 70 cm frame, the first hole is drilled 3.5 cm from the left side, continuing every 7 cm. Holes should be drilled very cleanly in order to avoid ripping or tearing the string with rough edges. The frame can now be strung with nylon fishing line. We have found white line to be the easiest to see and work with. String each distance with a separate piece, otherwise breaks will result in having to restring the entire frame. String is drawn through both holes on one side of the frame, stretched across the center until taut, and then strung through both holes on the other side. This results in two parallel sets of strings running across the top and bottom of the frame. Four intersecting strings then define each sampling point within the frame. Attach a small bubble level to each side of the frame in the center.

Legs are made of solid aluminum rods approximately 1.5 cm diameter; length should be great enough to allow the frame to be placed level on the steepest slope likely to be encountered in your study. We have found 1 m long legs to work in almost any situation, but shorter (50 cm) legs are easier to use. Having two sets of legs, one long and one short, is the most flexible solution. Holes are drilled in each corner of the frame approximately 1 mm greater than the leg diameter. Legs are placed through the holes, with the pointed end down, and stabilized with rubber grommets that fit snugly around the legs (they should move up and down the legs only when minor force is exerted) placed on either side of the frame.

Permanent marking plates and leg holes are also part of the construction. Four leg holes and 3-4 permanent marking plates are needed for each plot. These will remain in the field. Leg holes and marking plates are both made of small, flat circles, of rustproof material, approximately 3 cm in diameter. These are available through forestry supply catalogs as marking tags. For the permanent marking plates, a cross, with a precise 90 deg angle, should be stamped on the center of the tag. Three to four small holes are drilled around the perimeter of the tag. These are used to fasten the tag to the ground using nails. The hole should be large enough to let the nails through easily, but smaller than the head of the nail. The leg holes are similarly drilled for nails, and a circle is drilled through their center such that the legs of the frame can fit easily through it.

Data sheets

Data sheets consist of a grid of 100 squares (or rectangles) arranged in a 10 x 10 matrix on the page. It is helpful to have a dashed line through the horizontal center of each

square. Each square is used to record the information from a single point, and are arranged spatially to match their arrangement on the frame. The X and Y axes of the matrix, on both top and bottom and left and right sides, should be labeled with the appropriate coordinates. For example, in a 100 cm square, X coordinates should begin on the left with 5, and continue with 15, 25, 35, etc., up to 95. Y coordinates begin at the bottom row and continue upward in a similar manner. Thus, the lower left square is defined as 5,5, corresponding to the string intersection at 5,5 on the frame. The letters A, B, C, and D are written on each corner of the data sheet corresponding to their position on the frame (A in lower left, B lower right, etc.), and a small line for recording is drawn next to each letter. The bottom of the data sheet should have a section entitled "Other species" and a place to record the names of species in the plot that were not encountered. There should also be a section for recording notes.

Set-up

Remove the chamber if present. Slip a leg hole marker over each leg, and place the frame on the ground with the "A" corner in the southwest. The legs may be driven gently into the substrate to help stabilize the frame. Adjust the frame so that it is above the canopy and not disturbing it, and roughly level by sliding the corners of the frame up and down on the rubber grommets (it should not be precise at this time). Nail the leg holes into the substrate. Now level the frame precisely and stabilize the corners. To do this, begin at the "A" corner (or anywhere, it doesn't matter), and firmly clamp the frame to the legs with a C-clamp around the rubber grommets holding the legs in place. Level the AB side precisely, and clamp the B corner down. Continue around each side in the same manner; the final side should be level with no further adjustment. If it is not, you will need to make a minor adjustments until all four sides are precisely level. The final set-up step is to place the permanent marking tags inside the plot. These tags will replace the underlying vegetation, and should be placed in a relatively flat, stable position, ideally at the four corner points of the frame, but at least three positions. At each of these points, place the tag on the ground, and line the cross on the tag up precisely with the intersection of the strings at that point. Nail the tag to the ground. Be careful not to bump or reposition the frame during this process or during the recording. It is very important that the tags be placed in a stable spot and that they be located precisely. Although only two tags are necessary to relocate the frame, the additional points provide additional security in the case of disturbance.

Recording

Before recording for each point, measure the distance from the ground surface to the bottom of the frame at corners A, B, C, and D, and record on the data sheet. For each point, record the following information: Site down to the first species encountered, and call it out. Measure the distance from the bottom string intersection to the point to the nearest 0.5 cm. The scribe should record the species code** and distance in the top half of the square for that point. Then gently move the point away, being careful to minimize disturbance to the canopy, until you can site the "ground" surface, which may actually be a moss or lichen carpet, a litter layer, bare soil, rock, or even a leaf or branch of a shrub. Again, call out the species and measure the distance from the bottom string intersection to the point. Record these values on the bottom half of the square. In many cases, there will be no "second" hit. In all cases, record an X for a permanent marker, but still measure the distance.

** species codes: 6 or 8 letter species codes can be used by combining the first letters of the genus with those of the species. However, it is critical to keep track of the codes as they are developed and to assure that they uniquely identify all of your species. D. Murray and V. Razzhivin have offered to make the Panarctic flora codes available to ITEX.

Unless otherwise noted, the assumption is that the species hit was live, and that the hit was on leaf or other green material (unless the species is a moss or lichen). If this is not the case, the following letter codes should be added to the data sheet immediately following the species code: d (dead - meaning that entire specimen is dead but still attached to the substrate), w (woody), sd (standing dead - meaning a non-green portion of a vascular plant, such as a brown leaf, attached to a living plant). In some cases more than two of these may be used, for example if a woody branch of a completely dead Dryas octopetala were encountered, it would be recorded as dryoct w d. If a leaf of the same plant were encountered, it would simply be dryoct d. Detached material, whether green or alive, should be recorded simply as litter, except in the case of certain lichen species that do not attach to the substrate.

The final point of information that should be recorded is a subjective determination of the repeatability of the sample, that is, does the caller think that if the sample were repeated in a year, and the plot very precisely relocated, that the same species (or lack of species, such as rock), would be recorded there? Determination of this subjective measure requires a combination of common sense and some knowledge of the species. For example, a hit that is firmly in a solid, single species Sphagnum mat, or a rock, will be very repeatable. Upper hits may occasionally be in this category, for example a large leafed species such as Rubus chamaemorus will likely regrow over the same position in future years. Similarly, a dense shrub cover will most likely be there again, although the hit will be on a new leaf. If the caller believes this to the case, he should say "good" after calling out the species name, and the scribe should circle the species code on the data sheet. This information is not used in any cover calculations but may prove invaluable in future years when sampling is repeated. A change of the "good" hits may be taken more seriously as a true indication of change at that point than the other hits.

Once all the points have been recorded, the caller and scribe should do a visual search of the plot for species present but not encountered. These are recorded as present at the bottom of the data sheet, and will be given a value of less than 1% cover.

The most common mistake that can occur in the recording phase, and one which wastes a lot of time, is for the scribe to record the data in the wrong location on the sheets. This may happen for many reasons, such as lack of clarity about starting a new point, the caller losing track of where he is and skipping to a new row or column, etc. We recommend beginning at the 5,5 coordinate and continuing across the first row, then moving up to 95,10, and back down the 10 row. The caller and scribe should always verify with each other when a new row is begun. If there is disagreement, then it can be straightened out before serious damage is done. Once the first half of the frame is done, the caller should move to the other side, and both parties should again verify the starting point and direction of movement across the frame. The scribe should be careful not to get confused by the fact that he will begin writing in the lower left corner of the data sheet, rather than the upper left, and that he may sometimes move right to left and other times left to right.

Take down and future use

The legs should be carefully removed from the hole markers in order to avoid disturbing the markers. The leg hole and permanent markers can be used to precisely relocate the plot in the future.

Calculation of cover values

Calculate an index of absolute cover for each species as the total number of hits on that species divided by (100 minus the number of permanent tags) times 100. This is not a true measure of absolute cover, since points intermediate between the top and bottom of the canopy are not included. Species present but not encountered can be assigned a value of <1% cover. Standing dead specimens should be included in the cover values, but dead specimens should be excluded.

Calculation of microtopography

Simplification: If time is a serious constraint, the following measures can be considered optional. Deleting any of these measures will necessarily result in a loss of information and in increased difficulty in interpretation of results, however there are always trade-offs to be made in time invested and information. At the very minimum, the critical information is relative cover for all experimental and control plots. The following deletions will still maintain that basic information.

1. The frame does not have to be precisely relocated each time. However, the information on change will be much more coarse.
2. Height is not necessary unless information on canopy structure is desired