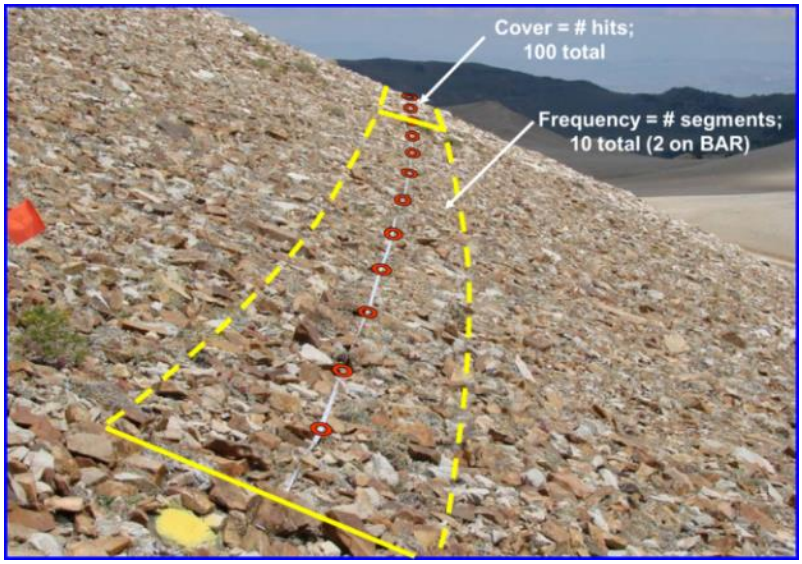
Downslope Surveys, WMRC GLORIA (**GL**obal **O**bservation **R**esearch **I**nitiative in **A**lpine Environments):
History, Strategy, Field Methods
Jim Bishop, revised July 2016

Overview and brief history

It was decided early in the California GLORIA project that it was worthwhile to survey from the summits downslope into the treeline woodland, to sample over the entire alpine zone. Any given species' elevational-profile could be analyzed, even mathematically through cross correlation functions, to show elevation shifts in the entire pattern of plant distribution. In addition, such surveys would indicate which plant populations were in position to move upslope and onto the summits sampled by the GLORIA protocol, and would also support other studies of plant distribution such as for the upper limit of shrubs.

In 2006 several plots were tried on the slopes below Patriarch Grove South, using various sampling protocols. Initially, we proposed using the 10mX10m plots as were used on the GLORIA summits, spaced at 25-meter elevation intervals down the slope below the summit. We chose instead a 1mX100m belt transect along the elevation contour. There would be 100 point samples taken along the transect. That would match the GLORIA 10mX10m area and sample density already in use on most California GLORIA summits. The 100 points would not adequately sample the many low-cover plants (often less than 1% areal cover). So in addition to the point samples, all of the species occurring in each 10m segment along the belt transect would be recorded, and that would give a measure of their presence. (Note: One exception is the first Barcroft downslope survey, 2011, in which the species occurrence was noted in two 50-meter segments of each transect.)

Downslope transects were established in 2007 and 2008 on generally SE-trending slopes below White Mountain (WMT), Barcroft (BAR), Sheep Mountain East (SME), and Patriarch Grove South (PGS). The transect ranges overlap vertically and provide a survey covering the entire elevation range from 4300m to 3300m, extending into the Bristlecone-Limber Pine woodland. Figure below outlines one belt-transect segment, with sample points, using the original protocol.



Current downslope project

In 2011 two of the downslope surveys were repeated, BAR and SME. In 2012 the other two, WMT and PGS, were repeated. In July 2013 a downslope survey was done on Campito Mountain, CPT.

Since the first downslope surveys were done, the international GLORIA program has adopted the "California Method" of 10mX10m summit survey plots. The new international protocol for those plots increases the number of sample points from 100 to 400 points (taken on a ½-meter grid). The current downslope surveys increase the belt-transect sample points to 400 to match the GLORIA protocol, and to increase the resolution of plant-species cover and general cover types. The present 10-segment, 400-point belt transect matches the summit 10mX10m plots exactly in area, segmentation, and sample-point grid. Figure on the last page shows the transect layout convention. The downslope survey protocol has been included as a supplement to the international summit protocols.

Survey protocol, as of 2011

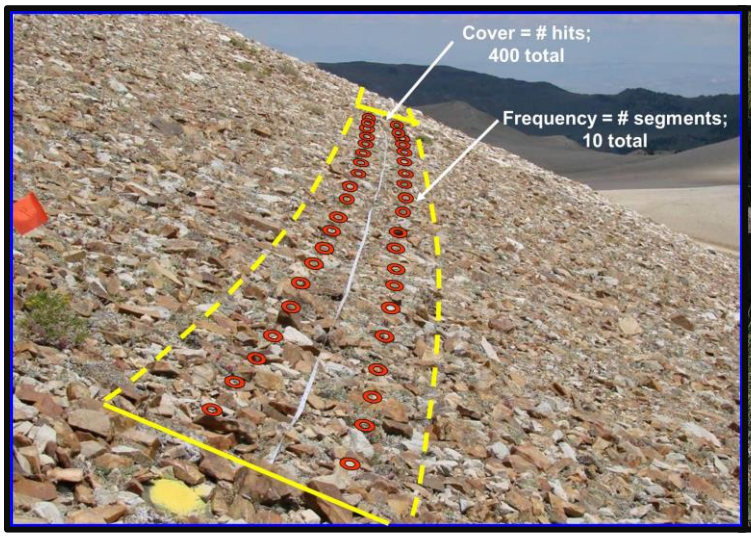
From the origin (center) point a tape is extended along-contour 50 meters each direction, defining the centerline of the belt transect. The 1-meter belt straddles the tape, ½-meter on each side. The belt is divided into ten 10-meter-long segments.

Four hundred (400) sample points are taken on each transect. The points lie ¼ meter to either side of the tape, at each ½-meter along the tape. Each 10-meter segment will have a total of 40 sample points. That distribution exactly matches the sample-point distribution of the GLORIA summit 10mX10m plots. Figure below left illustrates the placement of sample points in one 10-meter segment, right figure the indicator stick.

The sample-point distribution provides 400 points uniformly distributed over the 100 sq-meter area of the belt transect. Each point will be positioned by its place along the tape and distance from the tape, which will preclude observer bias in selection of the sample-point target. Those are the objectives of the point-sampling protocol: uniform distribution of sample points, and unbiased placement of each point.

Each transect segment is photographed, showing the end-point flags and the tape position. Those photographs will allow the tape in future surveys to be placed very close to the same transect line. It also allows correlation of micro-habitat type with plant occurrence.

As a practical matter, the downslope resurveys will not achieve replication of placement better than of order centimeters, maybe of order a decimeter. But that imprecision does not impair the basic standard of uniformly sampling with 400 unbiased points…they will effectively survey the same plot with the same method.



Classifying the point sample

If the point falls within the canopy-outline of a vascular plant, count it as a hit on that species. If dead material is still attached to the plant, the hit is on the plant. Detached dead material is “litter”. For gramminoids it is not always so obvious what is the canopy outline. The guideline used in our early GLORIA surveys was to imagine a soft net dropped over the plant—it will drape from the highest and outermost parts of the plant, and will sag gently inward in between those parts. If your point falls within the outline of the imaginary net, it is a hit on that plant. It is subjective, but the idea is to represent the ecological “presence” of the plant—and that presence involves the crown, the roots, the influence of the plant in limiting the space of nearby plants. As long as we are consistent, we’ll have a basis for observing change over time.

Rock or scree? That question generates discussion every year. At one time “rock” meant only “bedrock”. But that is often an impossible judgment to make just by looking (even for a geologist). Most recently we concluded that the distinction was meaningful only if it reflected the ecological influence of the rock/scree. A small rock can be displaced by a growing plant, and there are adjacent spaces amongst scree into which a plant can come up. A rock so large, whether it is bedrock or just a large boulder, that it is immovable and offers no substrate for a plant has a different ecological influence. In effect those areas are unavailable to contribute to plant cover, and their measure sets a limit on the potential cover by plants. So we view “rocks” as those that offer no potential for plant establishment over the area that they cover—in effect area removed from potential plant habitat. If the rock would essentially prevent colonization by plants, and would not be significantly overgrown by a plant canopy in that setting, think of it as “rock”. Scree is smaller rocks, those among which plants could become established and grow. The other convention is that small rocks “smaller than a garbanzo bean” are considered to be “bare ground”.

Field process

We assume a 3-person field team (or more) in the following suggested regimen. All of it can be done with fewer, or with more, people. And experience will allow fine-tuning that improves the team's efficiency.

1. From the transect origin extend the 50-meter tape to the left (looking uphill) along the contour (see diagram last page). For a flat land surface, that line has a constant direction, but for a realistic curved land surface that is a curved line. The tendency is for a person to keep walking more-or-less perpendicular to the fall-line they started from, and to slip down (usually) or up as the land curves. It may be helpful for a second person to watch the tape person with a clinometer, or against the horizon, and indicate to go up or down to stay on contour. Walking back along the tape mark the 10-meter points with pin flags, and paint spot at the transect ends (or a person coming behind can do that).
2. Meanwhile, the other team members can begin identifying plants in the transect. When the tape is laid walk out the transect, listing every plant in each 10-meter segment. With 3 or more folks a person can walk on either side of the tape calling the new species they see, and a third person can record the species. Most of the species will be listed on the form already. You make a check mark in the small box at the left end of the cell for that segment. Any new species is added to the list as need be. The recorder, or a 4th person, can make sure the plant lookers do not go beyond the end of the segment before starting the species search over again for the new segment..
3. At the end of the transect, return segment-by-segment and record the point samples. Place the T-marker astride the tape at ½-meter intervals, and read the two points indicated on either side. There will be 40 samples per segment. The recorder can keep track of which segment is being read. If there are enough folks, one person can place the T-marker while a plant person on either side of the transect calls the point. Note: You can begin at the beginning of each segment, and your last pair of points will be ½ meter before the end of that segment.
4. Photos are taken of the origin, each end point, and each segment looking along the transect in the direction from the left end toward the right end. Pick up the tape and the pin flags. Repeat the process for the right half of the transect. It helps to use two tapes and have the right half laid out already.

Recorder duties

1. Complete the information at the top of the form, including start/stop times.
2. Notice the segment you are beginning with and make sure you are marking in the appropriate column. For example, as you work out from the origin on the left half, you'll be marking segments 5, 4, 3, 2, 1, from the center of the form leftward. And as you work out from the origin on the right half you'll be marking segments 6, 7, 8, 9, 10 from the center rightward. Working inward from the far end of a transect will be the opposite order of segments.
3. Record each species occurring in a given segment with a mark at the left end of the space for that segment. Don't make a big mark that extends into the rest of the box…you'll need that space for point counts.
4. In recording point counts, use a small square of 4 dots to record 1, 2, 3, 4; then 4 lines connecting them in a square to record 5,6,7,8; and finally 2 diagonal lines to record 9, 10.
5. Each time a point hits a plant and the species is recorded as a hit, you also record a hit for "vascular plant" for that segment on the top section of the form. If you don't have time as you go along you can go back after and add up the vascular plant hits from the species list for that segment and record that number in the "vascular plant" section.
6. The blank row in the upper section can be used for something such as overstory trees, which we record as a hit in addition to whatever might lie below the tree canopy (that becomes necessary down in the woodland).
7. If the number of species exceeds 36 you can use the "Comments" section for another 2 species, by extending the column lines down. If need be you can attach a second form.
8. Use "Comments" to record such things as a placeholder name given a plant species that is not identifiable in the field, or how an interpretation of what to call something in the point counts was made.
9. Tally the "hits" and number of "segments" in the indicated spaces for each row and column. Reconcile the total numbers before you leave the transect (for example, if you end up with 398 total points, attribute a couple of additional points to the category with the highest subtotal). Check your arithmetic.

Note: There will be duplicate forms for each transect (with plant lists) and some blank forms. That will allow some flexibility for dual recorders or double-teaming both transect halves if team size allows it. Separate left/right forms will be compiled later onto one form.

Downsloope survey Country _____ Target Region _____ Series Name ______ Aspect ___
Transect #____ Lat________________________ Long________________________+ Elev ______
Date ________Time: from ______ to _______ Observers ______________________________________

Left — Transect segment (as you face into the hillside) — Right

Cover type	1	2	3	4	5	6	7	8	9	10	HitSeg
Bare ground											/
Litter											/
Rock											/
Scree											/
Vascular plant											/
											/
Total Hits for Column											

Extra row for overstory, etc.

Total = 40 hits

Total number of hits for this cover type

Total number of segments for this cover type

Total = 400 hits

Plant species											Hit Seg
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Record presence of this species in this segment with a checkmark

Record hits on point samples for this species in this segment in this box

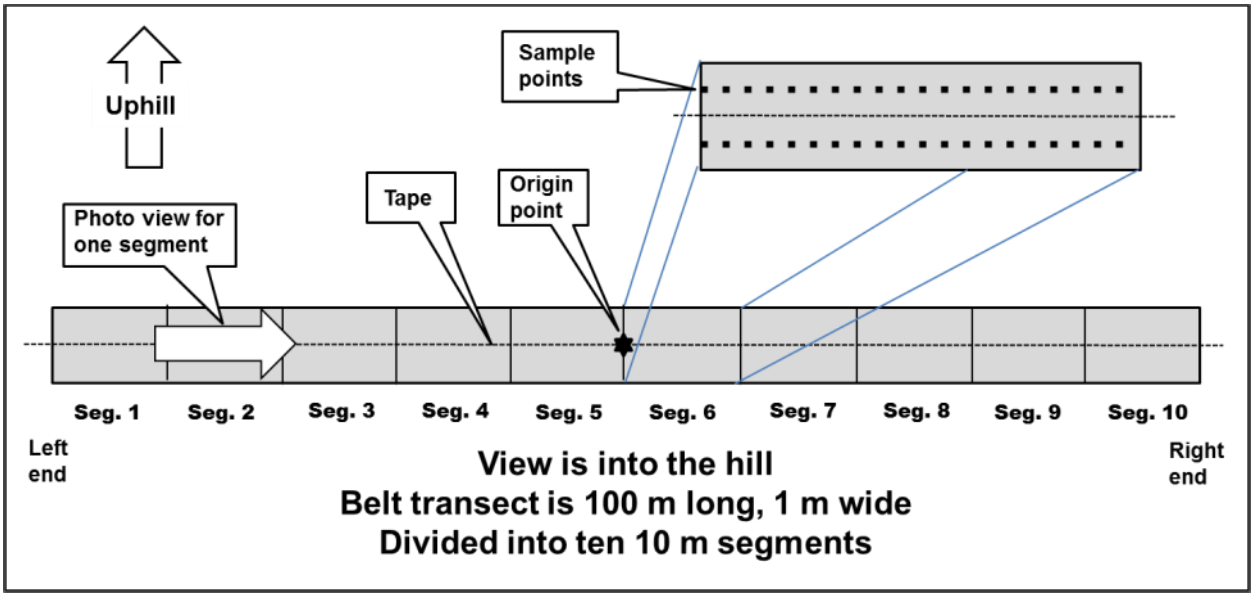
Total number of hits for this species

Total number of segments in which this species was seen

Origin or center of transect on this form

Comments:____
____

“Hits” (aka “cover”) is the # of points scored for that item: “Seg” (aka “frequency”) refers to the # of segments it occurs in.


Uphill
Sample points
Tape
Origin point
Photo view for one segment
Seg. 1
Seg. 2
Seg. 3
Seg. 4
Seg. 5
Seg. 6
Seg. 7
Seg. 8
Seg. 9
Seg. 10
Left end
Right end
View is into the hill
Belt transect is 100 m long, 1 m wide
Divided into ten 10 m segments