Note: This protocol is modified from the CANTTEX Field Manual – Part A (Bean and Henry 2003) available at http://www.eman-rese.ca/eman/ecotools/protocols/terrestrial/CANTTEX%20Manual%20A%20English.pdf. The Manual describes standardized methods for establishing a tundra ecosystem monitoring site.

4.0 Plant Community Composition

4.1 Introduction

Changes in plant community composition are one of the most important changes predicted to occur with climate change and are already being observed in some parts of the Arctic. An alteration in the composition of the plant cover in a given area will have effects at multiple scales. Ecological processes will be affected, such as nutrient cycling, animal forage quality and quantity, and larger scale climate patterns will be affected as well if, for example, the treeline were to shift northward.

Monitoring plant community composition is a very important and time consuming endeavour, but it only needs to be carried out once every 3-5 years. In the interests of standardization, CANTTEX established the summer of 2003 as a baseline year and encourages all CANTTEX and CiCAT sites to do a survey of plant community composition in their first year in operation, especially if they establish experimental plots. All CiCAT super sites should complete assessments of species composition and abundance in 2008. Point framing can take between 20 minutes and 2 hours per plot to complete depending on the density of vegetation and the detail with which data are being collected.

4.2 Point Framing

Point framing is a standard method for measuring the composition and abundance of low-stature vegetation such as the forbs, graminoids and dwarf shrubs that characterize arctic tundra. The method described here was designed for the ITEX program and is quantitative and objective. Although it is time consuming, point framing provides a thorough and reliable description of the vegetation cover at a given site. Point framing requires two people and takes between 20 minutes and two hours to complete for each plot depending on the density and diversity of the vegetation.

Point frames are preferably built out of aluminium tubing forming a 1.1 m X 1.1 m square (inside dimensions) but can also be constructed of plastic PVC tubing. Smaller frames can be used but the 1 m X 1 m is preferable. All frames should have 100 points. The frame is supported on adjustable legs so that it can be levelled over the area being sampled. Holes are drilled along each side of the frame at 10 cm intervals straight down through the tubing (Figure 3). String, wire, or nylon fishing line is passed through the hole on one side and across to the corresponding hole on the opposite side and drawn taut. Once this is done for each set of holes, the resulting paired grids have 100 intersections of strings at 10 cm intervals.

Equipment List for Point Framing:

Point-frame
Level
Ruler or tape-measure to record height of point-frame
Pin
Data sheets
Pencils and eraser
Voucher Envelopes
Field guide and hand lens to help identify plants

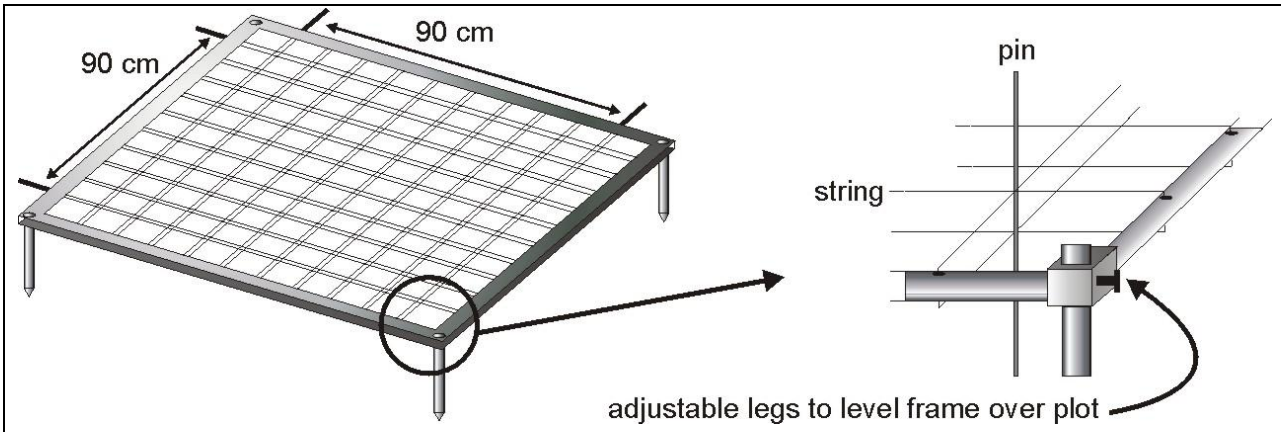


Figure 3. Design of point frame with inset showing position of pin at the intersection of two sets of strings.

The location of the plot should be clearly marked with a permanent metal leg hole or some other marker and details on the orientation of the plot (e.g. “marked leg hole is the southwest corner of the plot”) should be recorded so that the same patch can be re-surveyed in the future. The geographic coordinates of the plot will also help locate it in the future (see section 2.4). The point frame should be levelled so that the lower set of strings is just above the height of the tallest plant in the plot. The distance between the frame and the ground should be recorded for each of the corners to provide a sense of the microtopography at the site (see field data form – Fig. 4). Ideally, heights to the first plant and the ground should be recorded at each point.

At each of the intersections lower a pin (a surveying pin or knitting needle for example) straight down until it touches the ground (Fig. 3). You should not look at the pin as you lower it to avoid “aiming” it. Once the pin has been lowered one person identifies the species of each plant that comes into contact with the pin and another person records these on the data sheet (example provided in Fig. 3). If abbreviations or other codes are used to record the species, ensure that these are included with the data sheet so that there is no confusion when the data are being entered. A common method is to use the first three letters of the genus name and the first three letters of the species name (i.e. *Saxifraga oppositifolia* is recorded as ‘Sax opp’). If the plant material touched by the pin is dead and attached to a standing plant that is either dead or alive, the material is recorded as dead and should have a ‘d’ after the species designation in the data sheets. Any plant material that is not attached to a standing plant is referred to as ‘litter’. If species are encountered with which you are not familiar, find a specimen of the same plant species outside the plot, place it in an envelope, label it, and keep it for future identification. This is called a ***voucher specimen***. The last entry at each point should be the ground cover (i.e. rock, bare ground, litter, moss, lichen, standing water, etc.). The identification of mosses and lichens is difficult and should only be attempted by an experienced bryologist. However, a complete list of all plants should be produced. After all 100 points are completed, the plot should be examined visually and any plant species that are present but were not recorded in the sampling should be written on the bottom of the data sheet to be given a cover value of less than 1% when the data are entered.

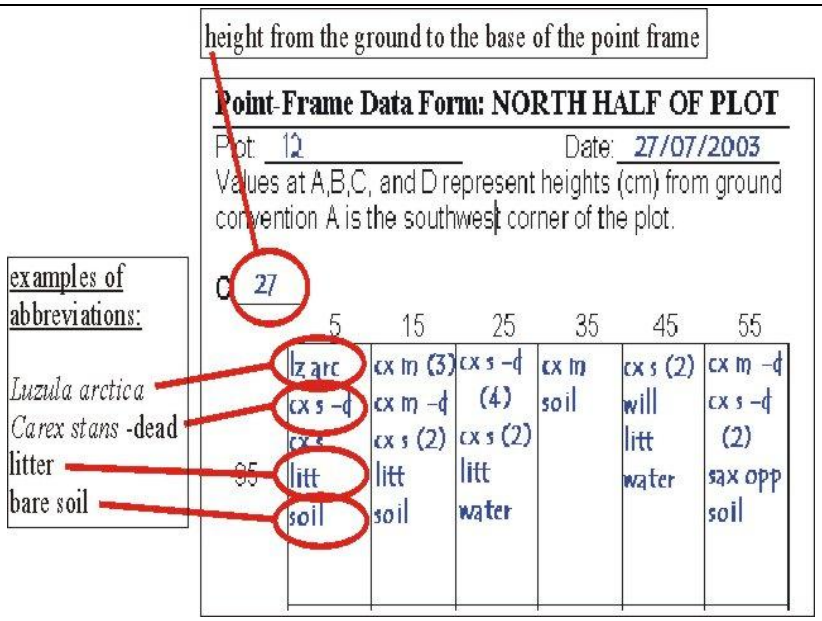


Figure 4. Sample field data form for point-framing. A complete blank version of the form is provided in Appendix A.

Note: Measurement of trees

In addition to the standard surveying of plots, the presence of sporadic trees or tree-islands (groups of small trees surrounded by tundra) where they are near sites should be noted and monitored. This is best done by marking the tree or tree-island in some way and measuring its size. For a single tree, measure its height and diameter at roughly 1.3 m above the ground and for a clump of trees measure the diameter of the island at its widest point and the height and basal diameter of the tallest tree. The height of the tree can be measured using a clinometer which measures angles by looking through an eyepiece at the top of the tree and reading the angle. The height is calculated by **h** = **d** (tan **θ**) + **e**, where **h** is the height of the tree, **d** is the distance you were from the tree when you measured the angle, **θ** is the angle read from the clinometer, and **e** is the height of your eyes above the ground.

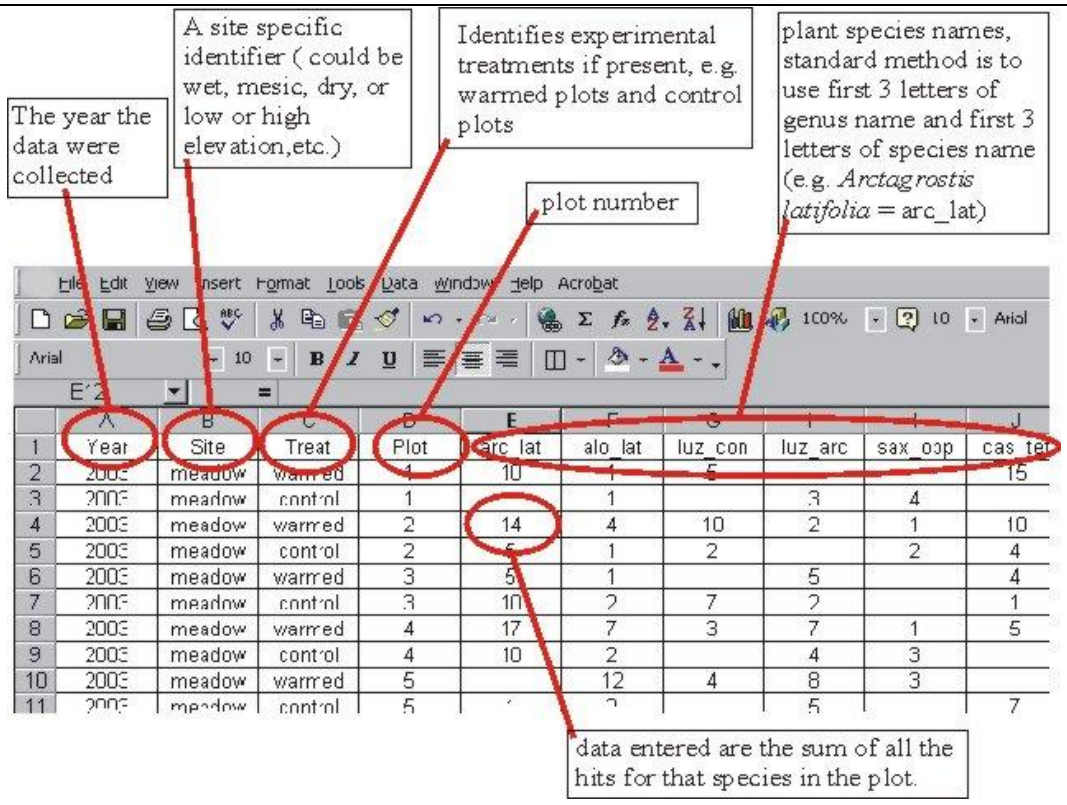
Be sure to mark the location of the tree-island on your site map as well as the geographic coordinates if you have access to a GPS. The status of cone production and the presence of new seedlings should be monitored. The development of new seedlings should also be noted and monitored. If possible, seedlings should be monitored for growth and survival.

4.3 Data Entry

A sample data sheet for point-framing is provided in Appendix A. Each cell in the table represents one of the intersection points of the strings on the ***quadrat***. Within the cell, list the plant species touched by the pin in order, ending with the ground cover (lichen, moss, rock, soil, etc.). If more detail is desired you can divide each species into different parts (leaves, flowers, stems). It is strongly recommended that you record all hits and plant parts as this gives a much more accurate description of the vegetation. In all cases, you should distinguish between live and dead parts of plants. Any dead material not attached to a live plant is called litter. Two data sheets are required per plot to record all 100 points (Appendix A).

Data entry is a repetitive task but is essential if the data are to be properly stored and analyzed. Many general data entry and storage issues are discussed in section 8. You are encouraged to get in touch with someone from CANTTEX (e.g. Greg Henry <ghenry@geog.ubc.ca>) if you have any questions or problems. Data entry will require you to set-up a digital database in a spreadsheet program. The database should contain plot summaries of the number of times each species was recorded during point framing (Fig. 5). Be sure to give the spreadsheet an appropriate file name and to save it often as you are entering the data. Once entered make sure to have the data backed-up in at least two places (e.g. a CD and your hard drive). If you use abbreviations for species names,

sites, or treatments make sure to have a key to explain the abbreviations to someone who is not familiar with them.



	A	B	C	D	E	F	G	H	I	J
1	Year	Site	Treat	Plot	arc_lat	alo_lat	luz_con	luz_arc	sax_oop	cas_tet
2	2003	meadow	warmed	1	10	1	5			15
3	2003	meadow	control	1		1		3	4	
4	2003	meadow	warmed	2	14	4	10	2	1	10
5	2003	meadow	control	2	5	1	2		2	4
6	2003	meadow	warmed	3	5	1		5		4
7	2003	meadow	control	3	10	2	7	2		1
8	2003	meadow	warmed	4	17	7	3	7	1	5
9	2003	meadow	control	4	10	2		4	3	
10	2003	meadow	warmed	5		12	4	8	3	
11	2003	meadow	control	5		2		5		7

Figure. 5 Example of the set-up for entering vegetation composition data gathered by point-framing.

Point-Frame Data Form: NORTH HALF OF PLOT

Plot: _____ Date:_____ Recorded by:_____.

Values at A,B,C, and D represent heights (cm) from ground surface to bottom of point-quadrat frame. By convention A is the southwest corner of the plot.

C _____ **D** _____.

	5	15	25	35	45	55	65	75	85	95	
95											95
85											85
75											75
65											65
55											55
	5	15	25	35	45	55	65	75	85	95	

A _____ **B** _____.

Comments:_____.

_____.

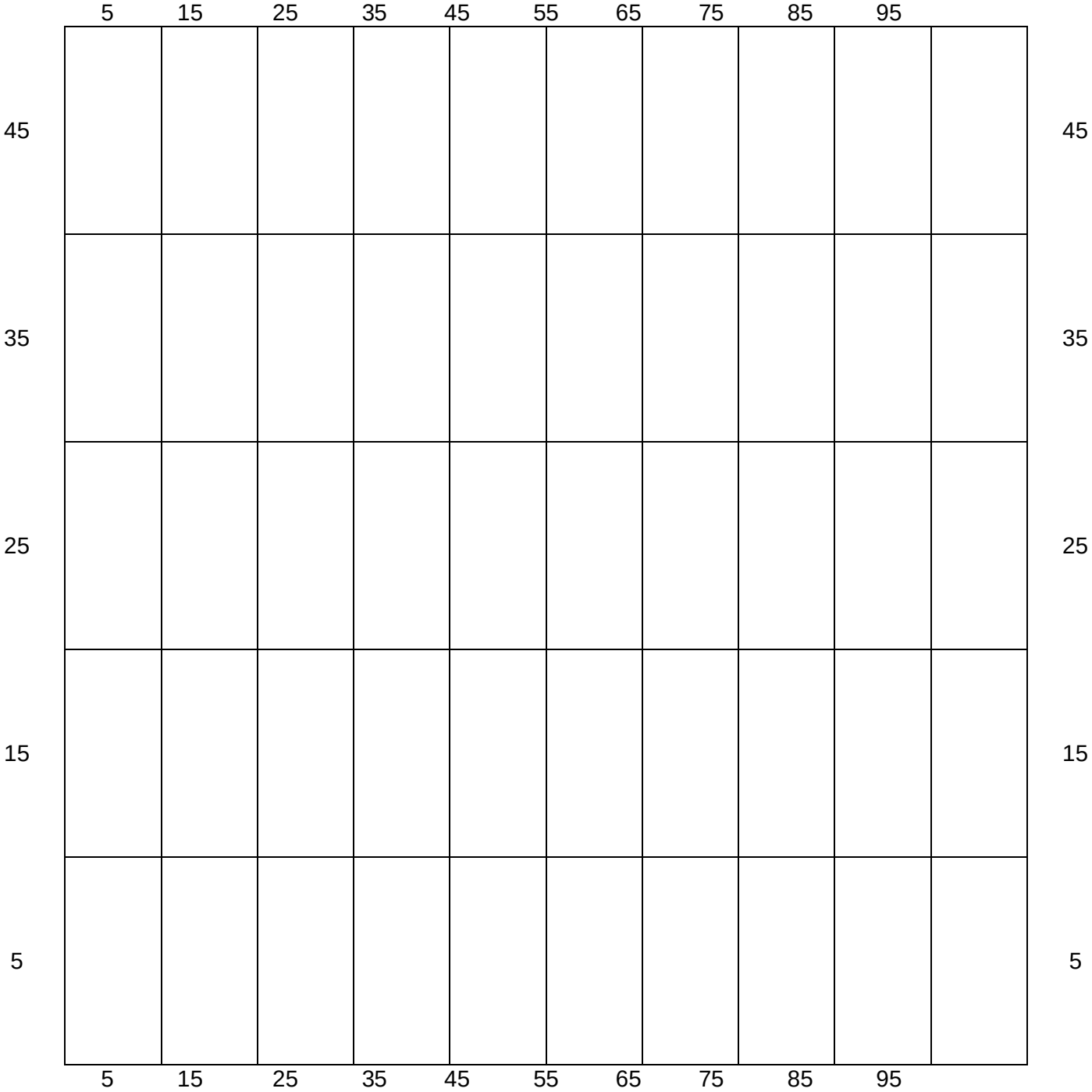
Computer data entry by:_____ Date: _____ Rekey?_____.

Point-Frame Data Form: SOUTH HALF OF PLOT

Plot: _____ Date:_____ Recorded by:_____.

Values at A,B,C, and D represent heights (cm) from ground surface to bottom of point-quadrat frame. By convention A is the southwest corner of the plot.

C _____ **D** _____.



A _____ **B** _____.

Comments:_____.

_____.

Computer data entry by:_____ Date: _____ Rekey?

Appendix C: Random Number Table

The random number table below can be used when selecting plot locations or plants to be monitored.

10	27	53	23	54	04	26	47
28	41	50	88	83	39	94	89
34	21	42	02	80	05	84	46
61	81	77	23	53	44	42	28
61	15	18	54	90	07	52	59
91	76	21	64	75	39	56	29
00	97	79	06	53	01	30	48
36	46	18	94	78	08	67	25
88	98	99	50	91	43	46	02
04	37	59	21	69	92	55	91
63	62	06	41	16	29	79	30
78	47	23	90	54	12	14	23
87	68	62	43	66	59	50	36
47	60	92	77	95	48	61	12
56	88	87	41	44	50	81	33
02	57	45	67	68	77	06	75
31	54	14	17	67	46	14	01
28	50	16	36	67	24	59	96
63	29	62	50	86	86	92	48
45	65	58	51	74	44	44	12
39	65	36	70	76	30	49	61
73	71	98	04	79	79	08	94
72	20	56	11	77	97	09	89
75	17	20	76	48	26	53	87
37	48	26	29	89	06	45	47
68	08	60	72	01	02	97	17
14	23	02	67	17	10	18	99
49	08	98	44	67	19	41	72
78	37	96	43	65	09	56	16
37	12	06	68	76	44	91	58
14	29	34	04	47	87	59	25
58	43	09	36	10	05	12	09
10	43	28	70	00	90	43	14
44	38	67	54	07	17	38	81
90	69	88	51	20	11	78	95
41	47	59	62	31	68	84	45
91	94	10	19	56	79	14	40
80	06	14	66	34	22	24	31
67	72	54	48	19	80	75	24
59	40	77	27	09	53	85	38
05	90	24	95	20	37	71	71
44	43	35	98	31	77	59	66
61	81	80	82	98	55	08	57
42	88	31	05	24	27	10	12
77	94	07	39	01	49	96	91
78	76	30	16	50	23	88	09
87	76	19	81	90	18	57	72
91	43	59	47	46	01	17	73
84	91	05	73	47	41	91	16
87	41	77	83	12	73	36	59