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Canopy Trees Survey Protocol - Forests of Southern Québec V.1

In 1 collection

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Protocol status: In development
We are still developing and optimizing this protocol

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Last Modified: April 02, 2020

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Keywords: Canadian Airborne Biodiversity Observatory, canopy tree survey, surveys of canopy tree, based canopy tree survey, canopy trees survey protocol, forests of southern québec, canadian airborne biodiversity observatory, vegetation survey, canopy tree, forested site, tree species, large trees app in fulcrum, selected tree, canopy area, large trees app, forest, tree, southern québec, québec, plants app in fulcrum, crown dominance class, species composition, elevation

Abstract

Here, we describe the standardized protocol used by the **Canadian Airborne Biodiversity Observatory** (CABO) to conduct ground-based surveys of canopy trees at forested sites: Parc national du Mont-Mégantic and Mont-Saint-Bruno, Québec. Ground-based canopy tree surveys were conducted in circular sample plots of 15 m radius, with plots distributed across gradients of interest (e.g., species composition, elevation, slope orientation, and logging history), and recorded in the *Plots* app in *Fulcrum*. For each sample plot, precise GPS coordinates of plot centres were taken, as well as slope angle and aspect. Within each sample plot, all trees that met the selection criteria were identified to species and geolocated relative to the plot center using the **Postex system** (**Haglöf Sweden AB, Långsele, SE**). In addition, height, diameter at breast height (DBH), canopy area, and crown dominance class were estimated for all selected trees. All data were entered into the *Vegetation Surveys: Large Trees* app in *Fulcrum.* In Parc national du Mont-Mégantic, for any tree species that had fewer than 10 individuals assigned as 'Dominant' or 'Co-dominant' (crown dominance classes), across all sample plots, additional individuals found outside sample plots were geolocated and measured to bring the sample size to 10 (data recorded in the *Plants* app in *Fulcrum*). The ground-based canopy tree surveys were conducted in order to be paired with remotely-sensed aerial hyperspectral imagery.

Attachments

Megantic_map_rare_tr... 165KB
Identification PICEA... 106KB
Sample_notice_park_r... 0B
Spruce.pdf 357KB
MtMegMap_01.pdf 1.4MB
MtMegMap_02.pdf 893KB
MtMegMap_03.pdf 2.7MB
Leaf Collection Park... 646KB
Quick ID Guide (inco... 19.2MB
CABO_species_list_pe... 37KB

Guidelines

OVERVIEW OF OBJECTIVES AND GENERAL METHODOLOGY

Ground-based forest surveys for CABO serve two main goals:

(1) **Permitting calibration/validation for identifying tree species from airborne sensor data**.

- This requires mapped locations of the crowns of multiple individuals of as many tree species as possible.
- Individuals should occur in a variety of conditions relevant to the signal received on the airborne sensor (e.g., aspect, slope) and should represent different crown sizes.

(2) **Permitting field-based tests – and validation of airborne-based tests – of how forest tree diversity and composition varies according to predictor variables of interest (e.g., elevation and logging history)**.

- This requires plot-based sampling in which each species present is quantified with respect to aspects of abundance (# stems > threshold DBH; location of those stems; individual DBH measurements, etc.).
- Fulfilling objective 2 contributes towards fulfilling objective 1, but probably not to the point that one sampling scheme completely fulfills both objectives. Specifically, rare species at the site level (e.g., across Mont-Mégantic) are unlikely to be represented by many individuals in a set of plots chosen to cover gradients of interest.

Materials

STEP MATERIALS

Equipment

new equipment

NAME

CAT S41 fieldwork cellphone

BRAND

-

SKU

https://www.catphones.com/en-us/cat-s41-smartphone/

LINK

Equipment

new equipment

NAME

3 16m long visible string

BRAND

-

SKU

Equipment

new equipment

NAME

Rebar

BRAND

-

SKU

https://www.homedepot.ca/product/peak-products-10mm-rebar-3m-10feet-black-steel/1000762764?eid=PS_GOOGLE_In-Store%20%7C%20DSA%20%7C%20All%20Pages_All%20Pages_b_DYNAMIC%20SEARCH%20ADS_dsa-19959388920&gclid=EAIaIQobChMI2OzUkpmF5AIVwf_jBx3RTwnzEAAYASAAEgKpev

LINK

30 pieces of 90 cm

SPECIFICATIONS

Equipment

new equipment

NAME

Rebar Safety Cap

BRAND

-

SKU

https://www.homedepot.com/p/3-8-Rebar-Safety-Cap-14980/202322846

LINK

Orange

SPECIFICATIONS

Equipment

new equipment

NAME

Laser Geo

BRAND

-

SKU

http://www.haglofcg.com/index.php/en/products/instruments/height/554-laser-geo

LINK

Equipment

new equipment

NAME

Trimble Catalyst GPS, NTRIP precision subscription

BRAND

-

SKU

Equipment

Duct Tape

NAME

-

BRAND

-

SKU

-

LINK

Equipment

Transect Tape

NAME

-

BRAND

-

SKU

-

LINK

Equipment

SYSTEM 2 DP Postex with DP II Caliper and L5 Laser Art no 15-103-1041

NAME

-

BRAND

-

SKU

http://www.haglofsweden.com/index.php/en/products/instruments/calipers/496-dp-postex

LINK

Troubleshooting

Safety warnings

Especially at Mont-Mégantic, terrain in places is steep and rocky, with high tree density. Field workers need to travel with care, and should not work alone, especially in more remote and steep-sloped sites.

Before start

The *Fulcrum* apps that will be used during this protocol – *Plots*, *Vegetation Survey: Large Trees*, and *Plants* – require the selection of a project and a site.

SITE SPECIFIC INFORMATION

Parc national du Mont-Mégantic

- Project: “2019-Crofts-PhD-UdeS”.
- Site: “MtMeg-1”.
- Address: For plots in the Mont-Saint-Joseph area, park at 4491 Chemin de la Montagne, Val-Racine, QC G0Y 1E1. For plots in the Franceville area, park in the Franceville parking lot.
- Project Leaders: Anna Crofts and Mark Vellend.
- Local crew for 2019: Anna Crofts, Sabine St-Jean, Guillaume Tougas, Charlotte Taillefer, Florence Normand-Boisseau and Juliette Frappier-Lecomte.
- Park contacts: Camille-Antoine Ouimet, Head of Conservation, Maintenance and Infrastructures (ouimet.camilleantoine@sepaq.com) and Mélina Dubois-Verret, Partnership Consultant (duboisverret.melina@sepaq.com).
- Notice: The park patrol officers need to be notified via email on the same day or before of details about the upcoming tree surveys (where, when, how many people; see the attached "Sample_notice_park_rangers.txt" file under the "Abstract" tab of this protocol). A research permit has to be carried by each team during the surveys.
- Number of plots: 30 in 2019.
- Site gradients of interest: species composition, elevation, slope orientation, and logging history.
- Conservation value: high, but trampling is only a problem in the wet areas.
- Magnetic declination: about -15° 21' (West).

/!\ Magnetic declination changes with time, and has to be verified shortly before fieldwork on http://www.magnetic-declination.com/

- Plant ID resources:

- Arbres et plantes forestières du Québec et des Maritimes, Michel Leboeuf, Éditions Michel Quintin, 2016.

Parc national du Mont-Saint-Bruno

- Project: “2019-MontSaintBruno”.
- Site: “MSB_forest_crew”.
- Address: Parc national du Mont-Saint-Bruno, Rang des Vingt Cinq Est, Saint-Bruno-de-Montarville, QC J3V 4P6.
- Project Leaders: Étienne Laliberté and Mark Vellend.
- Local crew for 2019: Sabine St-Jean, Anna Crofts and Éloïse Lessard.
- Park contact: Nathalie Rivard, Head of Conservation and Research (rivard.nathalie@sepaq.com).
- Notice: Prior to the inventories, the dates and times when the crew will enter and leave the park need to be communicated to Nathalie Rivard. A research permit delivered by the park authorities has to be carried all at times. A special authorization to drive the research vehicles inside the park is needed and has to be shown on the car dashboard or windows.

- Number of plots: 8 in 2019.
- Site gradient/target: The goals of this site are 1) to extend the altitudinal gradient at Mont-Mégantic and to sample tree species that are rare or absent from Mont-Mégantic, and 2) to maximize diversity among plots. Data from these two forested sites will be combined for analysis.
- Conservation value: high.
- Magnetic declination: about -14° 26' (West).

/!\ Magnetic declination changes with time, and has to be verified shortly before fieldwork on http://www.magnetic-declination.com/

- Plant ID resources:

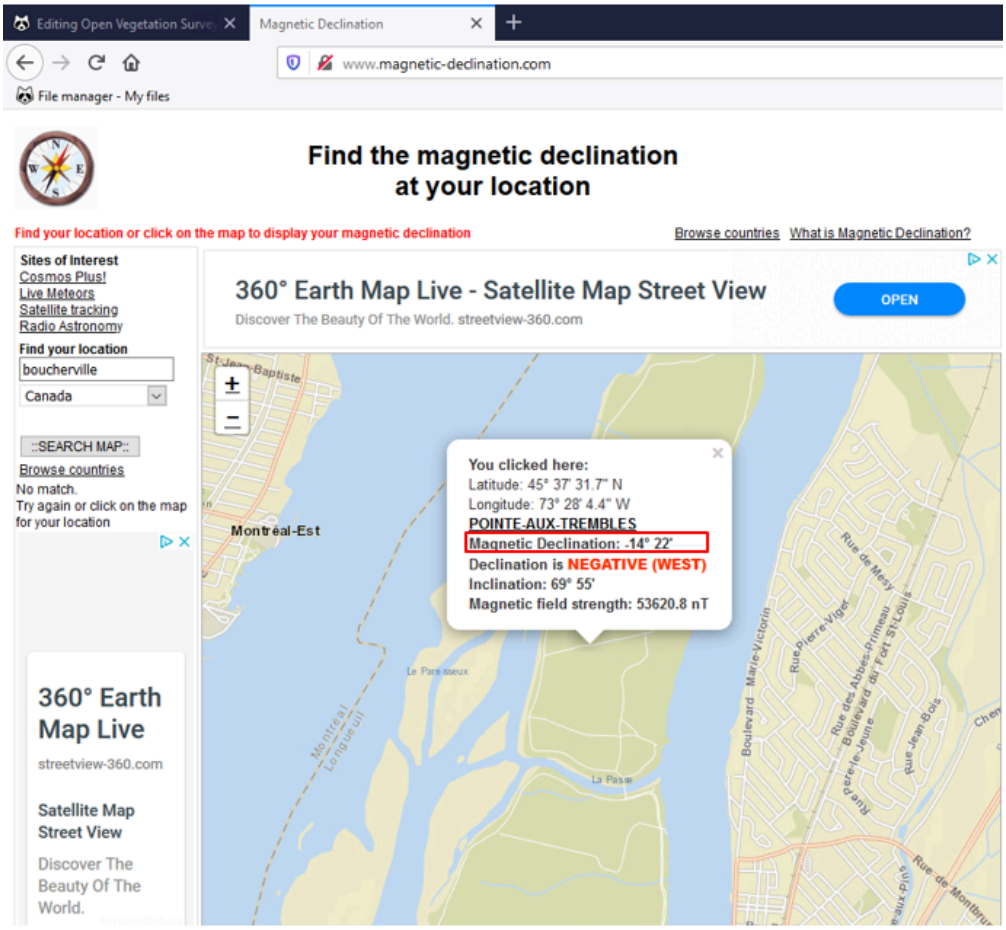
- Arbres et plantes forestières du Québec et des Maritimes, Michel Leboeuf, Éditions Michel Quintin, 2016.

Fieldwork Preparation

1 Undergo site reconnaissance. Select plot locations as follows:

- To fulfill the needs of locality-specific research questions, plots should span the gradients of interest (e.g., elevation and logging history), with relatively even coverage at different positions along the gradients. The aim is to maximize statistical power in tests of the basic form: community.property ~ X1 + X2...Xn, in which X1...Xn are plot-level variables that might explain variation in community properties across the gradients of interest.
- To fulfill CABO-wide needs for the calibration of sensor data, plots (or individual trees) should be sampled to ensure that each tree species is represented by at least 10 individuals considered Dominant or Co-dominant (see “Crown Class” distinctions below).
- The aim is to have a minimum of 30 plots per site.

2 To measure true north (vs magnetic north), the Laser Geo needs to be setup with the local magnetic declination.
Find the updated magnetic declination of your field site by locating it on http://www.magnetic-declination.com/. This has to be done shortly before fieldwork, as magnetic declination changes with time.
Enter this value in the Laser Geo under Settings → Magnetic declination.



Equipment

new equipment	NAME
Laser Geo	BRAND
-	SKU
http://www.haglofcg.com/index.php/en/products/instruments/height/554-laser-geo	LINK

Plot Creation and Measurements

3 Establish the plot in the field by permanently marking the plot center with rebar (90 cm long) topped with an orange safety cap. Be sure the rebar is inserted into the ground deeply enough to be sturdy. Label the cap with the plot number and mark the rebar with a piece of duct-tape labeled with: CABO - Plot number - Initials of the people establishing the plot - Date.

Equipment

new equipment

NAME

CAT S41 fieldwork cellphone

BRAND

-

SKU

https://www.catphones.com/en-us/cat-s41-smartphone/

LINK

Equipment

new equipment

Rebar

-

https://www.homedepot.ca/product/peak-products-10mm-rebar-3m-10feet-black-stee
eid=PS_GOOGLE_In-
Store%20%7C%20DSA%20%7C%20All%20Pages_All%20Pages_b_DYNAMIC%20SE
19959388920&gclid=EAIaIQobChMI2OzUkpmF5AIVwf_jBx3RTwnzEAAYASAAEgKpev

30 pieces of 90 cm

Equipment

new equipment — NAME

Rebar Safety Cap — BRAND

- — SKU

https://www.homedepot.com/p/3-8-Rebar-Safety-Cap-14980/202322846 — LINK

Orange — SPECIFICATIONS

Equipment

Duct Tape — NAME

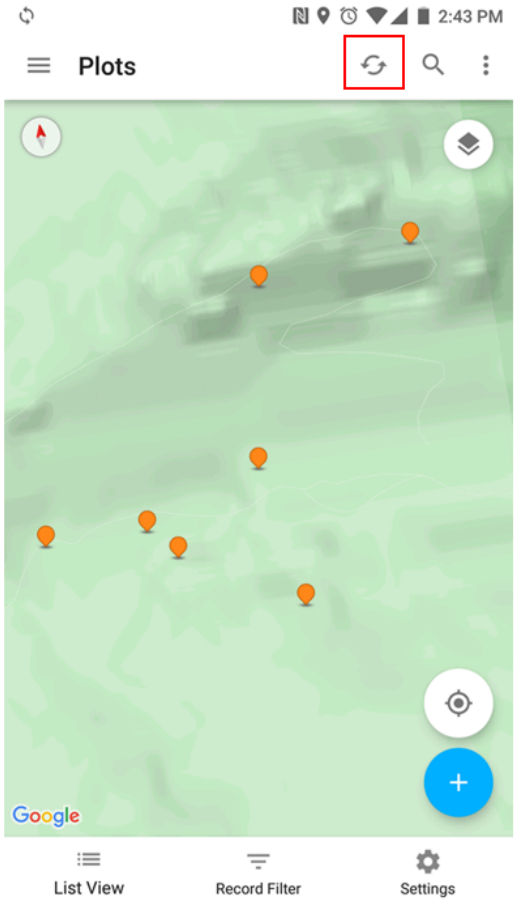
- — BRAND

- — SKU

4 Establish the plot in *Fulcrum*.

Note

Lots of areas of Parc national du Mont-Mégantic are not covered by cellular reception. Plots can be created in *Fulcrum* offline but be sure to sync as soon as possible once back in service.
Synch by opening the *Fulcrum* app on your phone and clicking on the 2 circular arrows icon.

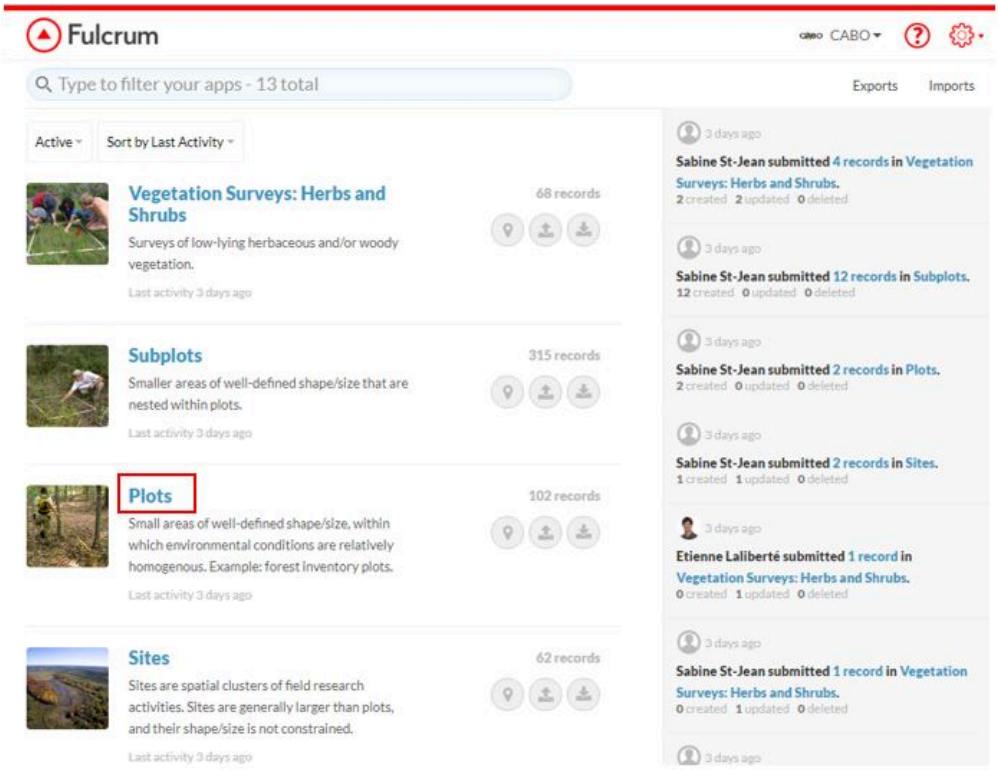


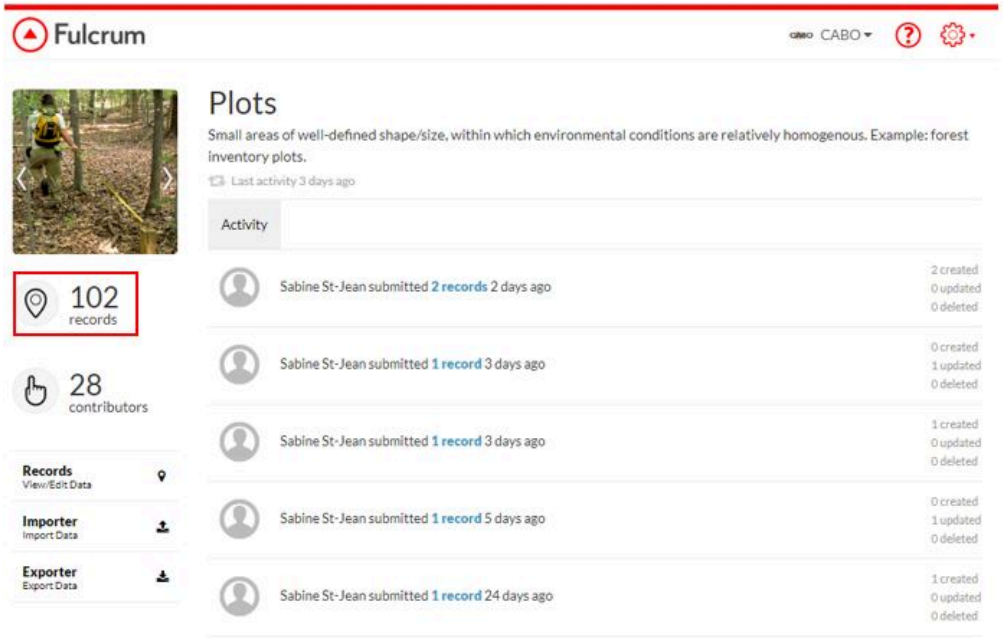
The two circular arrows will turn while synchronizing, and stop turning once the synchronization is complete.

Equipment

new equipment	NAME
CAT S41 fieldwork cellphone	BRAND
-	SKU
https://www.catphones.com/en-us/cat-s41-smartphone/	LINK

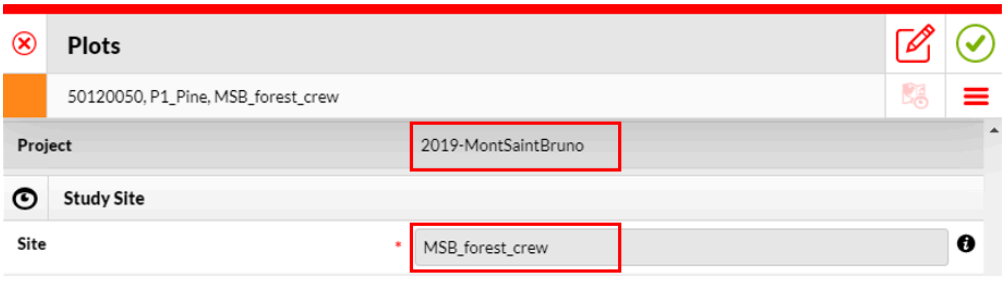
4.1 From the *Fulcrum* main menu, go to the *Plots* app and then access the Records.





4.2 Create a new record.

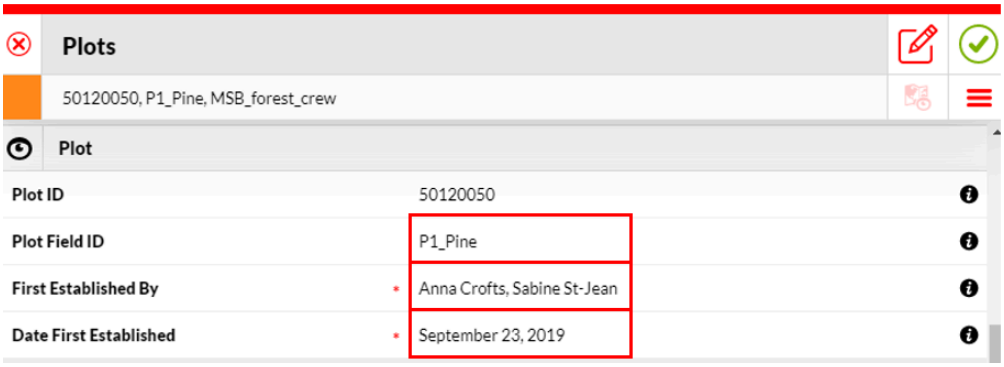
4.3 Under Plots → Metadata and Plots → Study Site, respectively select the appropriate Project and Site (see Site Specific Information).



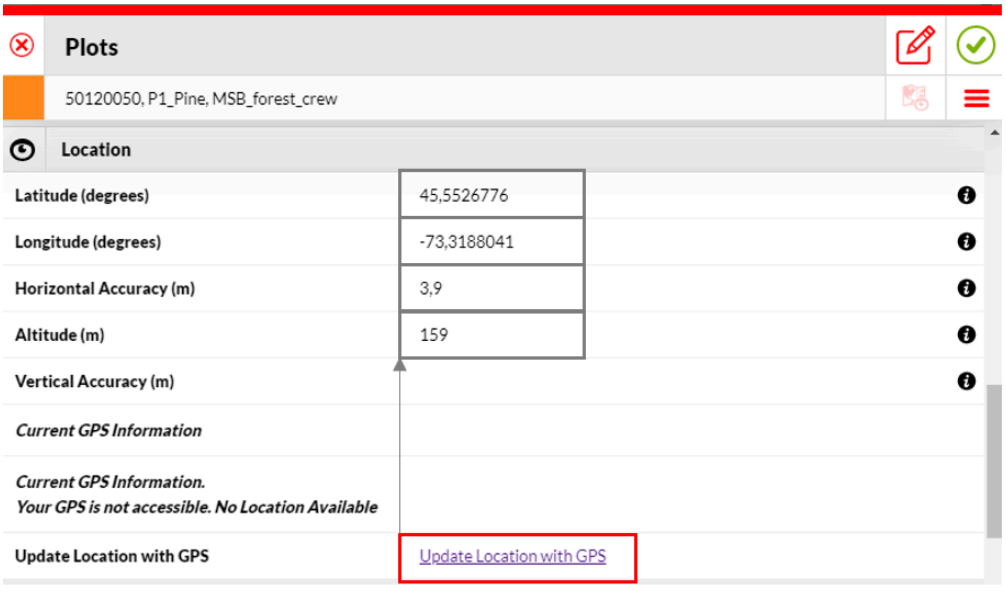
4.4 Under Plots → Plot, assign the plot a Plot Field ID, and indicate the names of the team members (one or more) creating the plot as well as the date of plot creation.

Note

The default entries are the name of the person logged into *Fulcrum* and the current date.



4.5 Under Plots → Location, georeference the plot location approximately by clicking Update Location with GPS on your field cellphone (connected to the Trimble GPS or not) – coordinates will automatically be imported to the Latitude and Longitude fields.

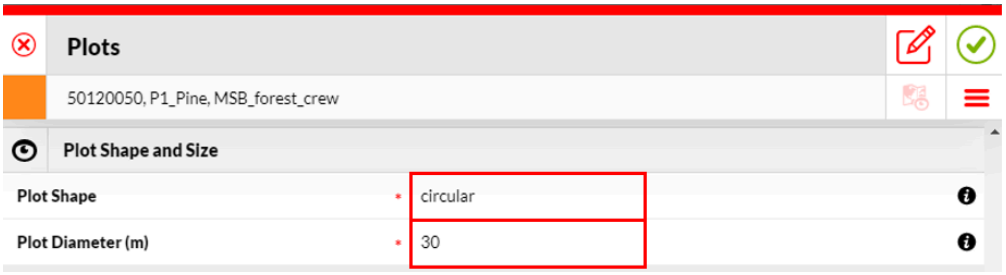


Note

During the growing season, under a closed canopy, GPS precision will be ~ 1 to 5 m, using the Trimble GPS or your field cellphone. This is okay when establishing plots but in the autumn once the leaves have dropped, plots will need to be revisited and location updated to obtain < 1 m, ideally < 30 cm, precision.

In 2019, the Trimble GPS was used when first establishing the plots, but the field cellphone would have resulted in an equivalent precision (> 1 m), because of the closed canopy. All plots have been or are to be revisited after leaf fall in the autumn or winter 2019-2020 to obtain more precise coordinates (< 1 m).

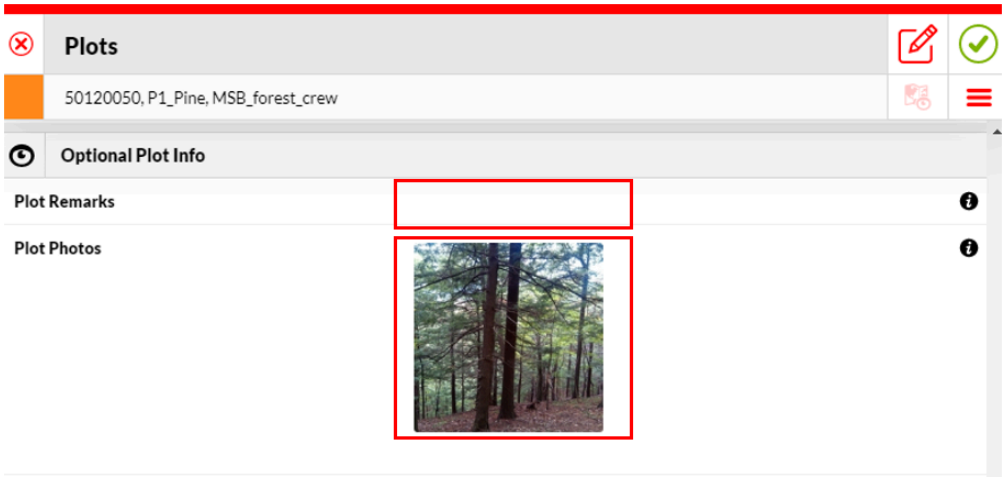
4.6 Under Plots → Plot Shape and Size, enter the Plot Shape (Circular), and Plot Diameter (30 m).



Note

The area of standard forest inventory plots is approximately 400m^2; this contains too few canopy trees for CABOs goals (i.e., community composition of canopy trees). The Postex system (see below and the **Postex System User Guide**) has a range of up to 30 to 40 m, however due to the forest density across Mont-Mégantic such range is not possible. A plot diameter of 30 m (15 m Postex range as radius) results in a plot area of approximately 707m^2; an area that is more likely to capture canopy tree community properties than standard forest inventory plots and still allows for use of the Postex system.

4.7 Under Plots → Optional Plot Info, take a photo of the plot (Plot Photos) and, if needed, add Plot Remarks (i.e., the reason why the plot was selected, e.g., contains a given rare species).



5 Take plot-level measurements (e.g., slope and aspect).

Equipment

Transect Tape	NAME
-	BRAND
-	SKU

Equipment

new equipment	NAME
Laser Geo	BRAND
-	SKU
http://www.haglofcg.com/index.php/en/products/instruments/height/554-laser-geo	LINK

5.1 Using the Angle and Compass functions of the Laser Geo, measure slope angle and aspect along two vectors per plot:

1) parallel to the steepest slope (shown in red in the figure below), and

2) any other secant vector (shown in white), crossing the first one.

Take the slope angle and aspect measurements between two researchers who are standing along the vectors 7.5 m apart. The angle is in the direction from the higher position to the lower position along the slope.

Figure showing an example of the two slope vectors. The steepest one is illustrated in red, and the secant one in white.

Note

For the slope angle measurements, the researcher using the Laser Geo should aim at the point equivalent to their eye-level on the other researcher.

Note

For Compass measurements, AZ (azimuth) denotes bearing (i.e., compass degrees).

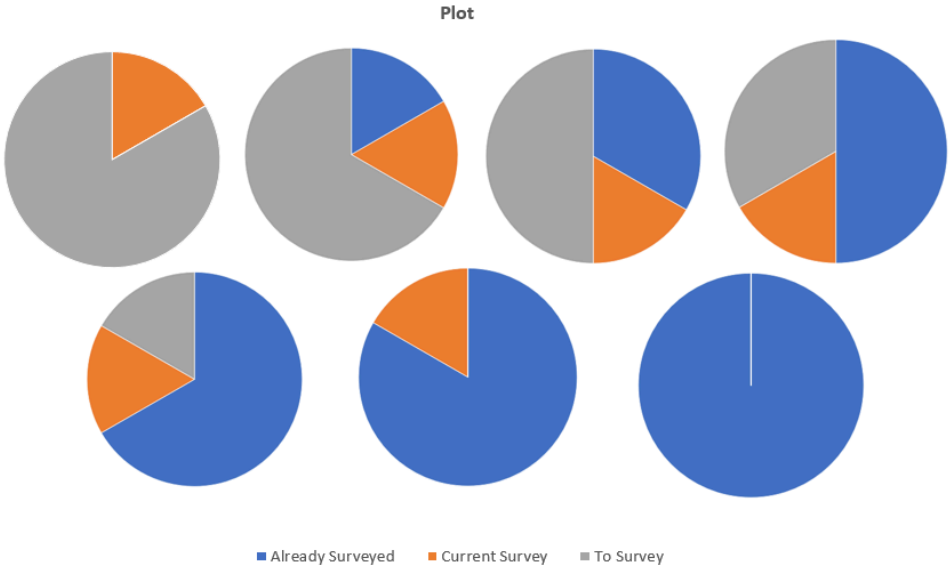
5.2 Under Plots → Optional Plot Info, save the slope angles (Slope 1 and Slope 2) and aspects (Bearing 1 and Bearing 2).

5.3 Save the newly created plot and its associated plot-level data.

6 Divide the plot in sampling sections to help keep track of your progression within the survey plot.

Equipment

new equipment	NAME
3 16m long visible string	BRAND
-	SKU

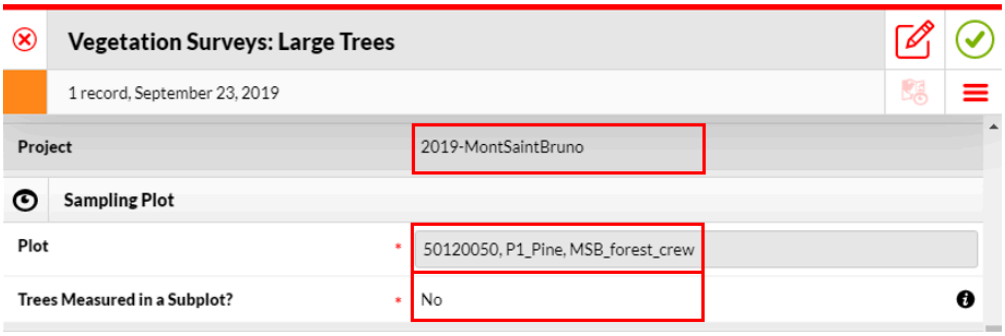


Three 16m long visible strings (shown as the white lines in this figure) are installed - starting from the plot center and going towards its edges - in order to create different sampling sections: 1) what has already been surveyed (shown in blue), 2) what is currently surveyed (shown in orange), and 3) what is left to survey (shown in grey). When a section is completed, move to the adjacent one. Once two adjacent sections are completed, remove the string separating them in order to combine them. Use the free string to delineate the new adjacent area to survey.
To avoid forgetting trees, survey each section going from the plot center to its edges, moving from one delineating string to the other in a regular zigzag pattern.

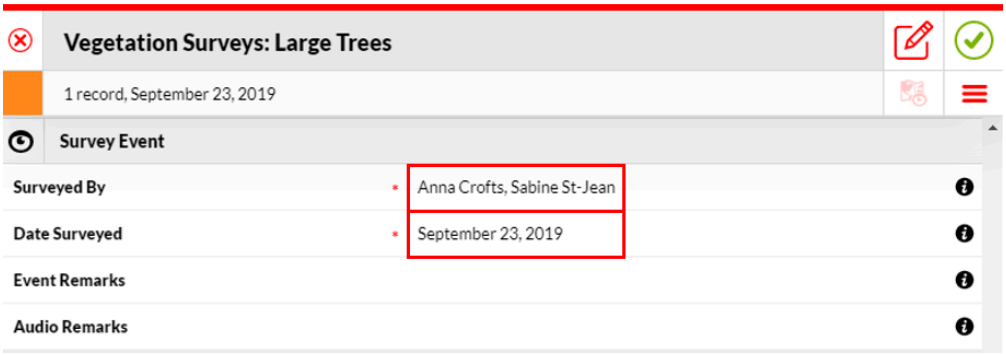
Creation of the Vegetation Surveys Records

7 From the *Fulcrum* main menu, go to the *Vegetation Surveys: Large Trees* app and create a new record.

7.1 Under Vegetation Surveys: Large Trees → Metadata, select the current Project (see Site Specific Information).
Under Vegetation Surveys: Large Trees → Sampling Plot, select the current Plot (as created in step 4), and answer "No" to Trees Measured in a Subplot?



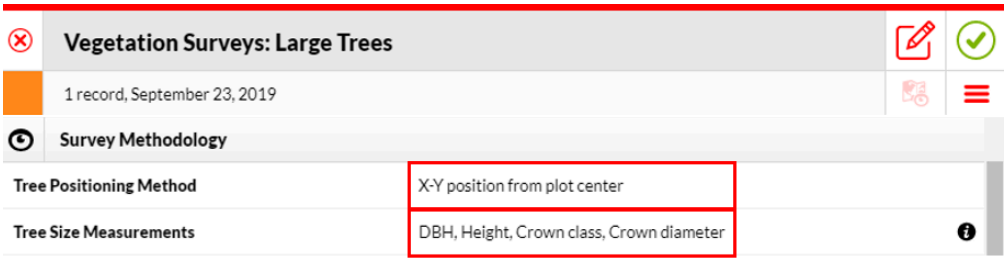
7.2 Under Vegetation Surveys: Large Trees → Survey Event, indicate the names of the team members (one or more) doing the vegetation survey as well as the date of the survey.



Note

The default entries are the name of the person logged into *Fulcrum* and the current date.

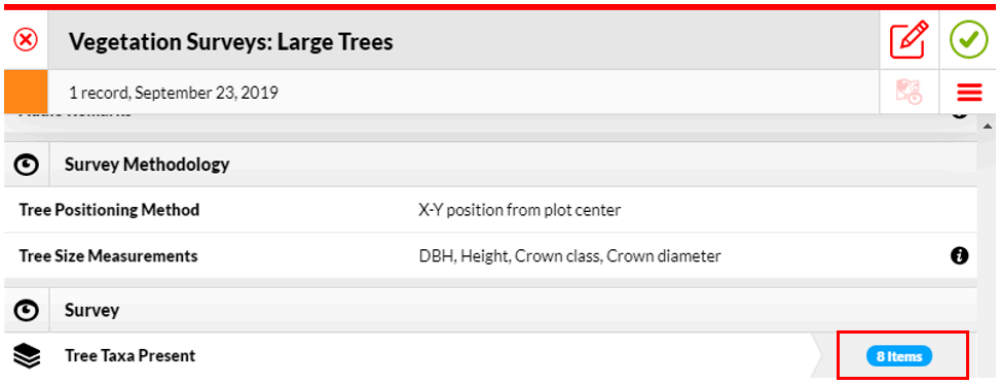
7.3 Under Vegetation Surveys: Large Trees → Survey Methodology, answer "X-Y position from plot center" to Tree Positioning Method.
For Tree Size Measurements, select the fields "DBH", "Height", "Crown class", and "Crown diameter".

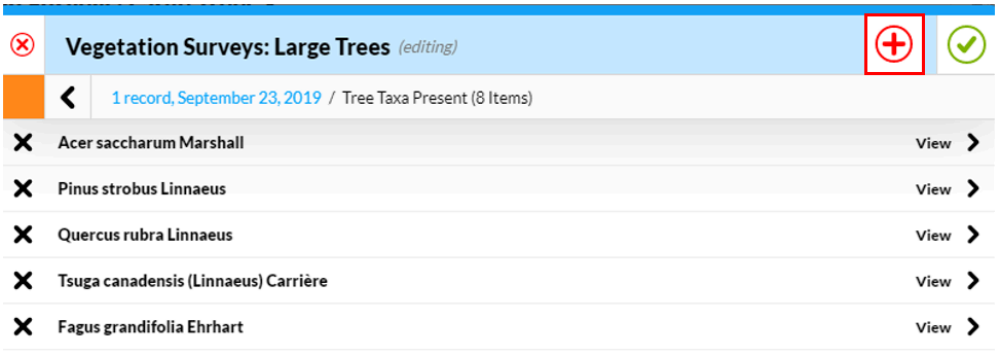


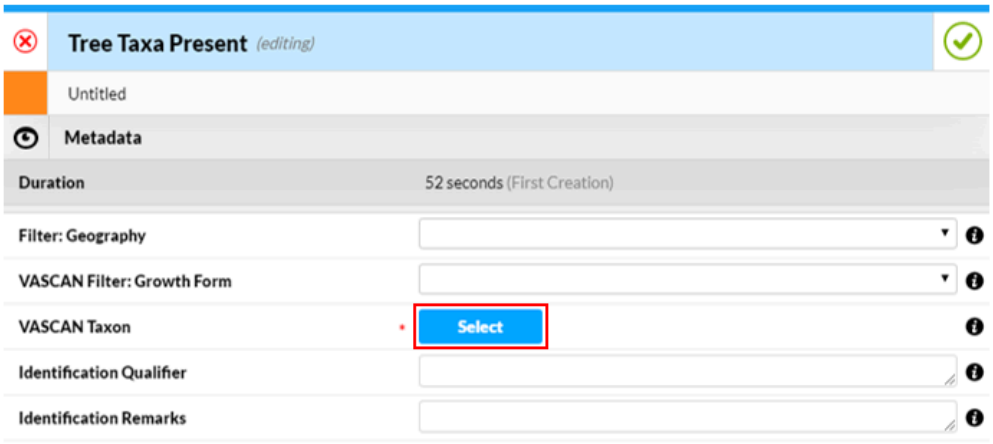
7.4 Under Vegetation Surveys: Large Trees → Survey → Tree Taxa Present, select "Items", then (+), then "Select", and enter the Latin names of all tree species present in the plots. Species are entered one at a time, once one is entered you are returned to the (+) step. This process selects the species you are entering from the built-in complete VASCAN species list, thus avoiding mistakes in the name of species.

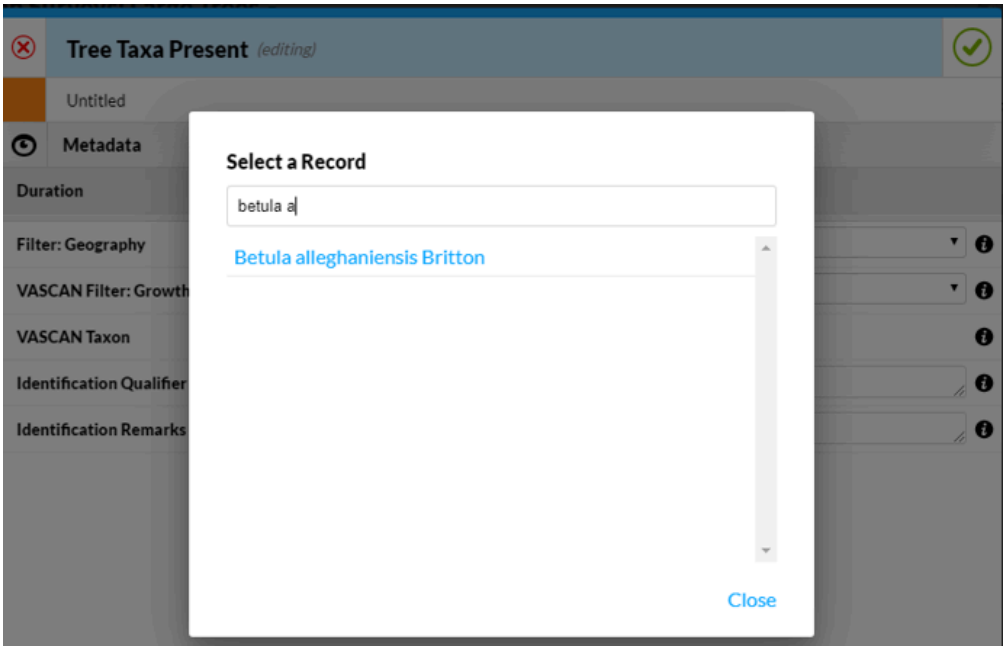
Note

If you find additional species when sampling, return to the the Vegetation Surveys: Large Trees → Survey → Tree Taxa Present and enter new species as instructed above. Before continuing with the survey be sure to save the changes if you have internet access.




Vegetation Surveys: Large Trees (editing)
1 record, September 23, 2019 / Tree Taxa Present (8 Items)
Acer saccharum Marshall View
Pinus strobus Linnaeus View
Quercus rubra Linnaeus View
Tsuga canadensis (Linnaeus) Carrière View
Fagus grandifolia Ehrhart View


Tree Taxa Present (editing)
Untitled
Metadata
Duration 52 seconds (First Creation)
Filter: Geography
VASCAN Filter: Growth Form
VASCAN Taxon
Select
Identification Qualifier
Identification Remarks


Tree Taxa Present (editing)
Untitled
Metadata
Duration
Filter: Geography
VASCAN Filter: Growth
VASCAN Taxon
Identification Qualifier
Identification Remarks
Select a Record
betula a
Betula alleghaniensis Britton
Close

Note

In some cases, the Latin names in VASCAN and in field guides might differ for a given species. VASCAN is to be considered more up to date. If you run into a species identified from a field guide that doesn't seem to be in the VASCAN drop-down list, use an internet connection to look up synonyms on the VASCAN website and obtain the accepted species name.

Postex Setup

8 Setup the Postex system, please refer to the **Postex System User Guide**.

Equipment

SYSTEM 2 DP Postex with DP II Caliper and L5 Laser Art no 15-103-1041

NAME

-

BRAND

-

SKU

http://www.haglofsweden.com/index.php/en/products/instruments/calipers/496-dp-postex

LINK

Equipment

new equipment

NAME

Laser Geo

BRAND

-

SKU

http://www.haglofcg.com/index.php/en/products/instruments/height/554-laser-geo

LINK

Equipment

Transect tape

NAME

-

BRAND

-

SKU

Survey Trees within each Plot

9 Survey all trees within each plot that meet the following selection criteria:
i) All trees with a crown canopy class of "intermediate", "co-dominant", or "dominant" (see step 9.6 for canopy class designations)
ii) Trees in the crown canopy class "suppressed" if DBH ≥ 9 cm.

For every tree that meets the selection criteria, identify it to species, measure DBH, position in the plot, height and canopy area, and assign a canopy class (see steps 9.1 to 9.9 for details).

Equipment

new equipment

NAME

Laser Geo

BRAND

-

SKU

http://www.haglofcg.com/index.php/en/products/instruments/height/554-laser-geo

LINK

Equipment

new equipment

NAME

CAT S41 fieldwork cellphone

BRAND

-

SKU

https://www.catphones.com/en-us/cat-s41-smartphone/

LINK

Equipment

new equipment
NAME

Trimble Catalyst GPS, NTRIP precision subscription
BRAND

-
SKU

Equipment

System 2 DP Postex with DP II Caliper and L5 Laser Art no 15-103-1041
NAME

Haglof Sweden
BRAND

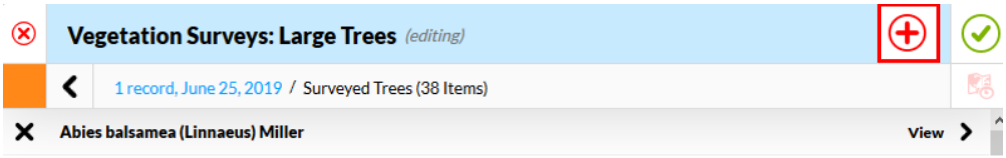
-
SKU

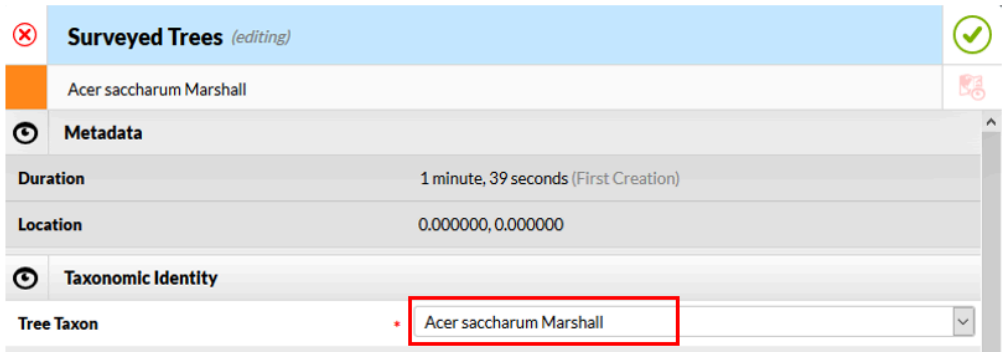
http://www.haglofsweden.com/index.php/en/products/instruments/calipers/496-dp-postex
LINK

9.1 Under Vegetation Surveys: Large trees → Surveyed trees, select (+) to begin a new entry. Identify individual to species and record it under Taxonomic Identity → Tree Taxon –only the taxa entered in step 7.4 will be available to choose from.

Note

- If needed, add "Identification Remarks" in the appropriate entry box in *Fulcrum*. This optional field has not been used in the 2019 surveys.
- If there is any ambiguity in species, make a note of this in the “Identification Qualifier” entry box in *Fulcrum*.
- All VASCAN recognised tree hybrids are available.

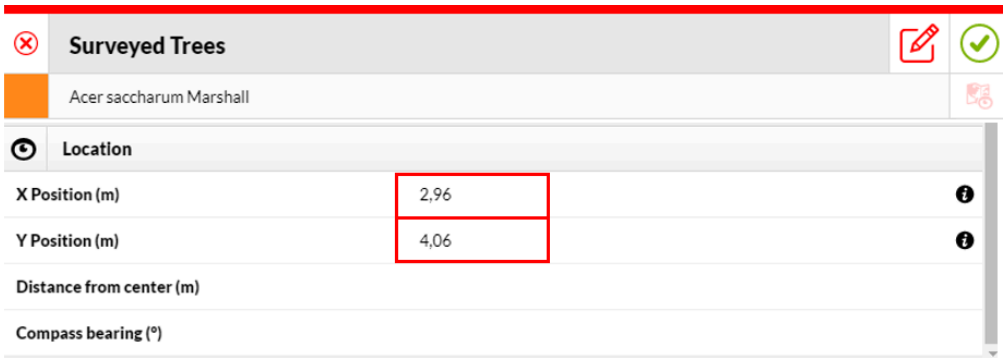




9.2 Measure the tree's DBH, to the nearest millimeter, using the Postex system's SmartScale caliper and DP II handheld device. Record DBH under Vegetation Surveys: Large trees → Surveyed trees → Size Measurement(s) → DBH (cm). If an individual has more than one DBH, use the additional DBH field(s).

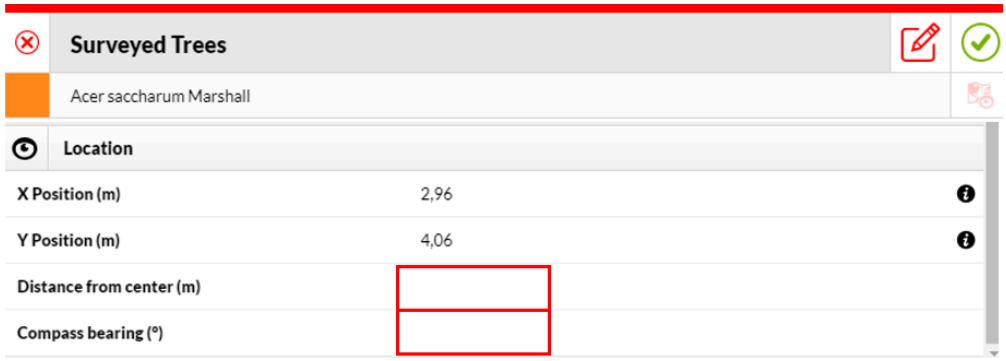
Diameter at breast height (DBH) is measured 1,30 m above the highest level of the ground around the tree, according to the "Normes d'inventaire forestier (2016)". We consider a tree to have multiple DBHs if different trunks are attached to the same base.

9.3 Estimate the tree's position in the plot, using the Postex system. Record the coordinates (the X and Y values, which are relative to the plot center) under Vegetation Surveys: Large trees → Surveyed trees → Location –there is no need to record the 3 distance measurements (d1, d2, and d3).



As the plot center's X-Y coordinates are (0, 0), X and Y Position values will each be negative for one half of the plot.

9.4 If the Postex system is unable to take a distance measurement (e.g., tree density is too high), use the Laser Geo to measure Distance from center and Compass bearing. To do so, aim the Laser Geo from the DBH of tree* towards the center of the Postex tripod and use the DME function to measure distance from center (m) and Compass function to get the compass bearing (°). Record these these values under Vegetation Surveys: Large trees → Surveyed trees → Location.
*In the middle of the trunk laterally, with the Laser Geo resting on the side of the tree to be able to aim. In 2019, we did not take into account the radius of the tree as, in dense forests where the Postex system was unable to work, most trees had a small DBH (< 20 cm).



9.5 Estimate the tree's Height, to the nearest 10 cm, using the Height 3P function of the Laser Geo. Record height under Vegetation Surveys: Large trees → Surveyed trees → Size Measurement(s) → Height (m).

Note

Height 3P calculates height using:
1) distance to tree (at eye-level),
2) angle to tree base, and
3) angle to tree top.
Because of the two angle measurements, this function does not require researcher to be on level ground.
To obtain correct measurements, the observer has to be about 10 m away from the tree trunk.

9.6 Assign the tree a Crown Class of "Dominant", "Co-dominant", "Intermediate", or "Suppressed" (as defined below). Record the assigned crown class under Vegetation Surveys: Large trees → Surveyed trees → Size Measurement(s) → Crown Class.

Note

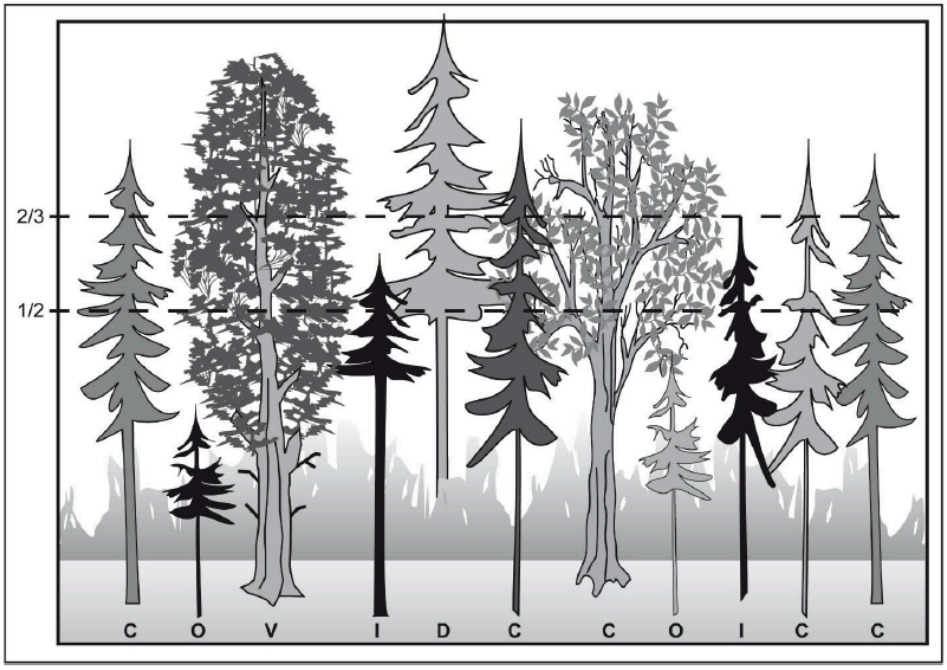
Crown class should be determined based on trees immediately surrounding* the individual measured (not at a per plot level).
*The immediate neighbours being all the trees (from all crown classes) whose canopy has a common edge with the canopy of the tree of interest.

	Crown class	Code	Description
	Dominant	D	Trees with crowns that extend above the general level of the trees

			immediately around the measured trees. They are somewhat taller than the co-dominant trees, and have well-developed crowns, which may be somewhat crowded on the sides, receiving full light from above and partly from the side.
	Co-dominant	C	Trees with crowns forming the general level of the trees immediately around the measured trees. The crown is generally smaller than those of the dominant trees and is usually more crowded on the sides, receiving full light from above and little from the sides.
	Intermediate	I	Trees with crowns below, but extending into, the general level of the crown canopy (may include trees, shrubs, or other obstructions) immediately around the measured trees. The crowns are usually small and quite crowded on the sides, receiving little direct light from above but none from the sides.
	Suppressed	S	Trees with crowns entirely below the general level of the crown canopy (may include trees, shrubs or other obstructions) around the measured trees, receiving no direct light either from above or from the sides.

Text taken directly from Table 12.1 from “Canada’s National Forest Inventory Ground Sampling Guidelines”, Version 5.0 (2008).
The original classifications (in "Normes de stratification écoforestière", 2015) included two additional categories (Veteran and NA) not relevant for CABO.

Schéma 12
Étagement d'un peuplement



Vétéran : Arbre survivant d'un peuplement disparu (peuplement précédent), dont l'âge est nettement supérieur à celui du peuplement actuel. Il cohabite avec les codominants et les dominants de ce peuplement ou il surplombe un jeune peuplement issu d'une perturbation d'origine naturelle ou humaine.

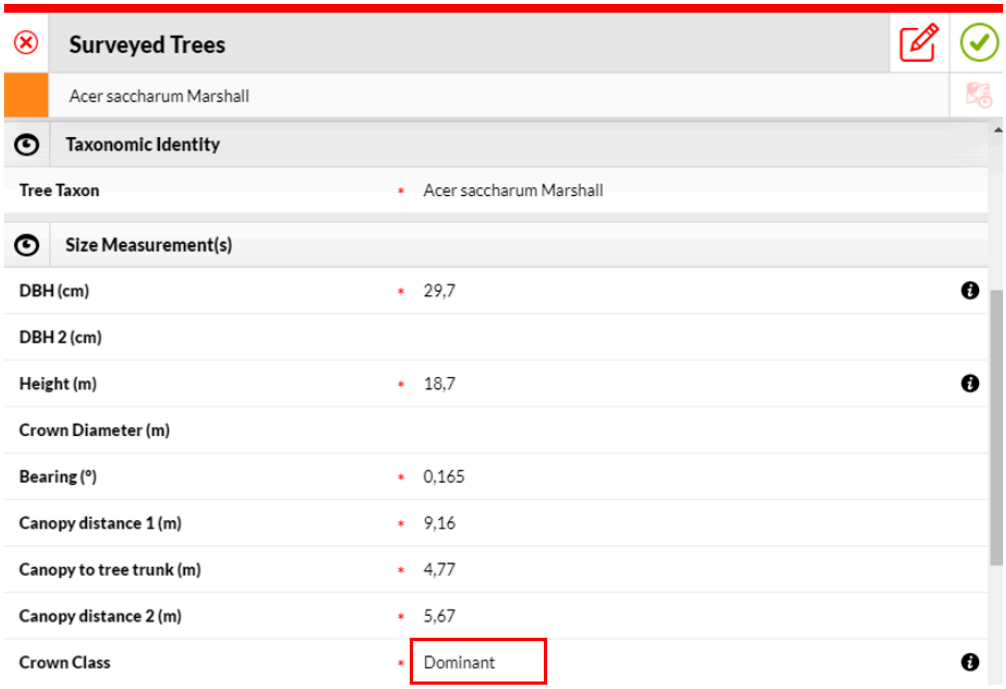
Dominant : Arbre dont la hauteur dépasse **visiblement** l'espace occupé par les codominants. Sa cime s'étend par-dessus l'étage général du couvert principal. Généralement, ils sont peu nombreux.

Codominant : Arbre dont la cime occupe l'espace où se situe généralement la majorité des cimes de tiges formant un peuplement, soit approximativement supérieur au 2/3 de la hauteur des arbres dominants. Leur cime contribue à former l'étage général du couvert du peuplement.

Intermédiaire : Arbre qui occupe l'espace médian de la majorité des hauteurs de tiges d'un peuplement, soit approximativement entre la 1/2 et les 2/3 de la hauteur des arbres dominants. Leur cime s'étend dans la partie inférieure du couvert.

Opprimé : Arbre qui occupe l'espace sous-jacent de la majorité des tiges d'un peuplement, soit approximativement plus bas que la 1/2 de la hauteur des arbres dominants. Leur cime est entièrement au-dessous de l'étage général du couvert.

Taken from Table 12 in "Normes de stratification écoforestière", (2015).
Vétéran (V): not used by CABO. The age of a tree and how it relates to stand history is not relevant to what is seen in airborne imagery, so such trees can be assessed according to the criteria for other designations.
Dominant (D): Dominant.
Codominant (C): Co-dominant.
Intermédiaire (I): Intermediate.
Opprimé (O): Suppressed.



9.7 Measure the tree's approximate crown dimensions (Bearing, Canopy distance 1 and 2, Canopy to tree trunk) using the the Compass and DME functions of the Laser Geo. Later calculations will assume an oval shape for tree crowns, in which case the necessary measurements involve the length and width and the position of the tree bole.

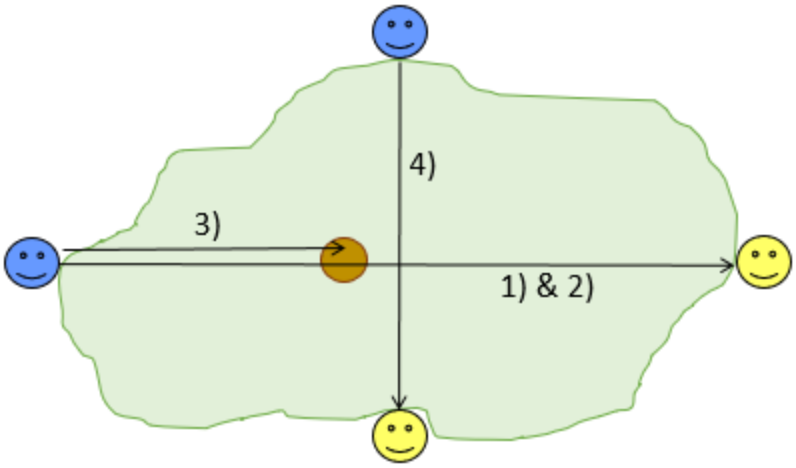
1) Bearing (°): the compass bearing of the longest part of the canopy (compass function).

2) Canopy distance 1 (m): the length of the longest dimension of the canopy (DME function).

3) Canopy to tree trunk (m): the distance to tree trunk of the longest side of the canopy (DME function), measured by the researcher with the Laser Geo standing at the same point than during measurements 1) and 2).

4) Canopy distance 2 (m): the length of the perpendicular side of the canopy (DME function).

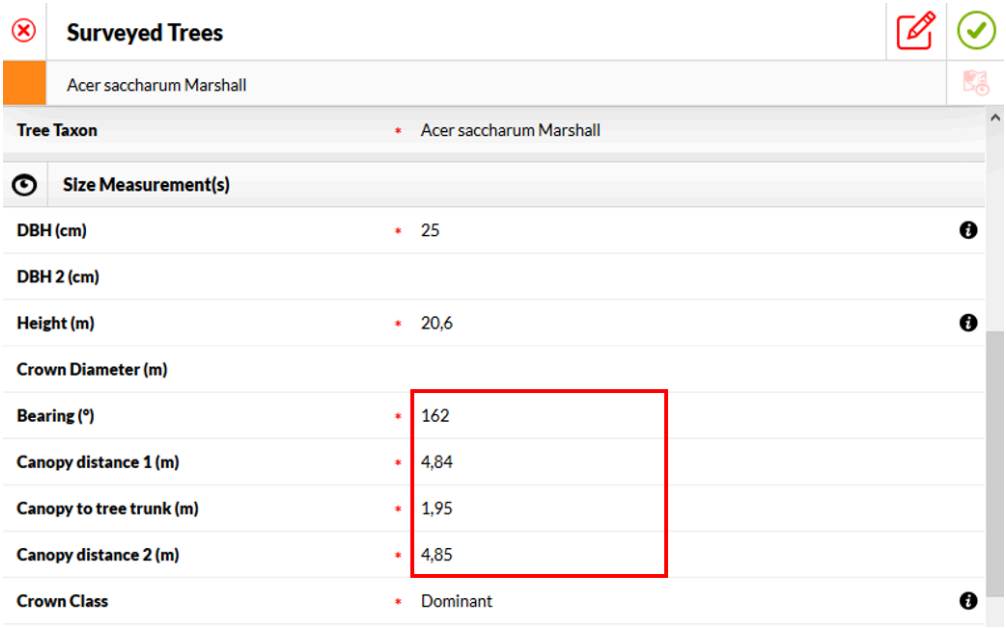
Record these values under Vegetation Surveys: Large trees → Surveyed trees → Size Measurement(s).



Brown circle: tree trunk.
Green ovalish shape: projection of the tree canopy.
Blue smiley face: researcher holding the Laser Geo.
Yellow smiley face: researcher at whom the Laser Geo is aimed.
Arrows: pointing in the direction in which the Laser Geo has to be aimed*.
*For measurement no 4), the position of the two researchers can be inverted.

Note

For bearing, there are always two possibilities (e.g., 90 or 270 degrees). We assumed that the position of the two researchers (more upslope or downslope) did not make a difference, as long as the researcher holding the Laser Geo (illustrated by a blue smiley face) does not move from measurements 1) to 3).



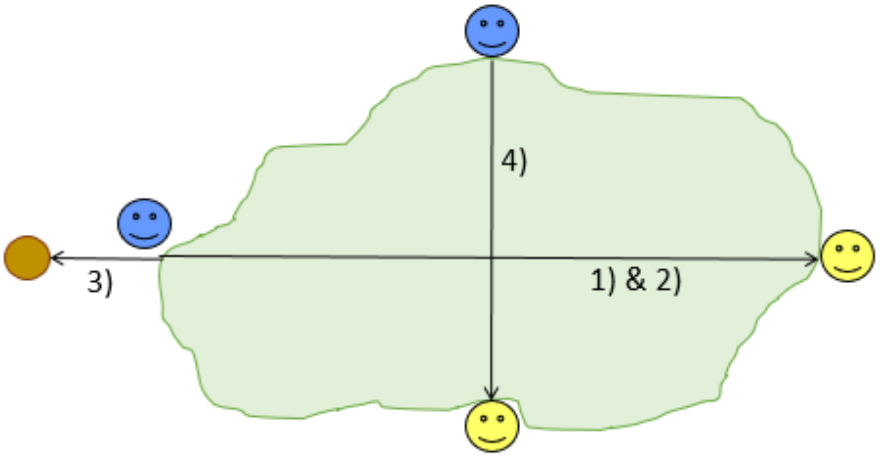
9.8 In the case where the tree is leaning or bent to the point that the trunk at breast height is not even underneath the crown, canopy dimension measurements are done as described above, except the distance from the edge to the tree trunk (see measurement 3 below) is entered as a negative number.

1) Bearing (°): the compass bearing of the longest part of the canopy (compass function).

2) Canopy distance 1 (m): the length of the longest dimension of the canopy (DME function).

3) Canopy to tree trunk (m): the distance to tree trunk of the longest side of the canopy (DME function), measured by the researcher with the Laser Geo standing at the same point than during measurements 1) and 2).

4) Canopy distance 2 (m): the length of the perpendicular side of the canopy (DME function).



Brown circle: tree trunk.
Green ovalish shape: projection of the tree canopy.
Blue smiley face: researcher holding the Laser Geo.
Yellow smiley face: researcher at whom the Laser Geo is aimed.
Arrows: pointing the direction in which the Laser Geo has to be aimed*.
*For measurement no 4), the position of the two researchers can be inverted.

9.9 Save your record.

9.10 Repeat steps 9.1-9.9 for every tree in the plot that meets the selection criteria.

Next Plot

10 Survey the next plot by following steps 3 to 9 over again.

Tree Mapping for Leaf Collection (Megantic Only)

11

Safety information

The following step applies to the larger leaf spectra effort. It represents what the leaf spectra crew asked the veg crew to do prior to their arrival at the Megantic site, in order to save time, as the veg crew has easier access to this site and is familiar with it.

During site reconnaissance (walking between plots), pay attention to: 1) individuals of rare tree species (see attached Species List per Site and step 12), and 2) trees that meet the Leaf Spectra selection criteria. Create and save individuals in the Plant app in *Fulcrum*.

Note

Leaf Spectra Selection Criteria:
- Leaves exposed to direct sunlight for at least 6 hrs a day.
- Tree height that allows for leaf collection (target leaves located at ____ m at most).
- Within 30 mins, ideally 15 mins, from parking spots for the Leaf Spectra van.
- If possible, sample individuals of the same species across the park (i.e., in both sectors and across the altitudinal gradient).
- Goal: 10 individual trees per species, for the common species; and 5 individual trees per species, for rare species (see attached Species List).

Details to know to assist the Leaf Spectra Crew during leaf collection:
- The Leaf Spectra van, once settled, won't move for the rest of the day.
- Once harvested from the tree, the leaves must remain attached to the branch during transportation to the Leaf Spectra van.
- If leaf collection occurs before aerial imagery, do not collect leaves inside the plots.

Equipment

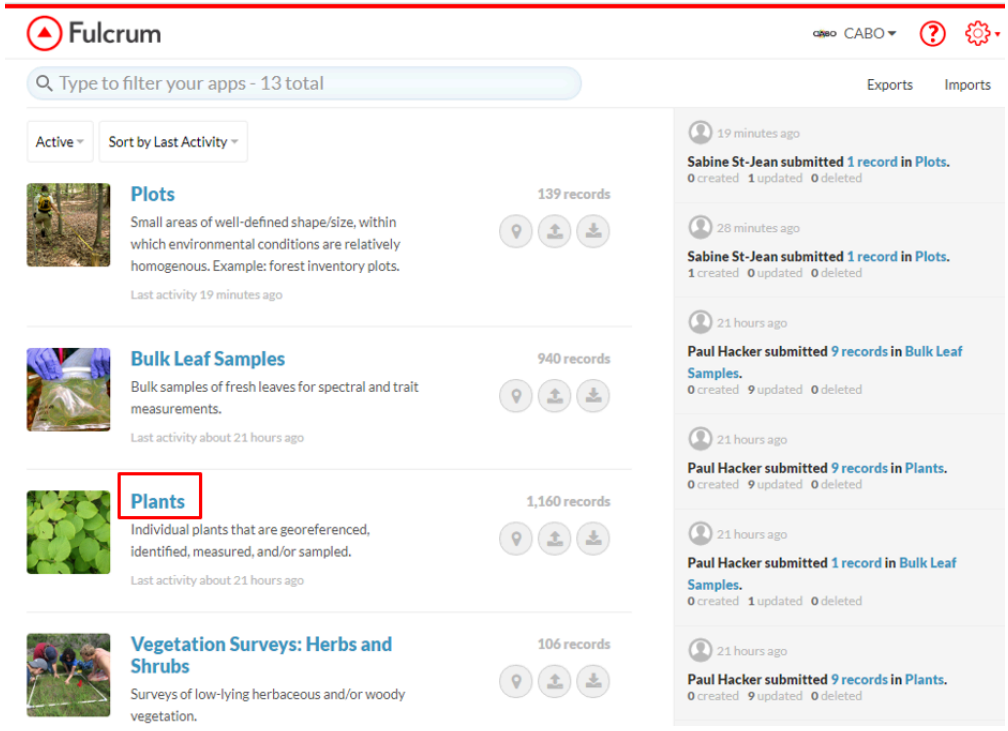
new equipment NAME

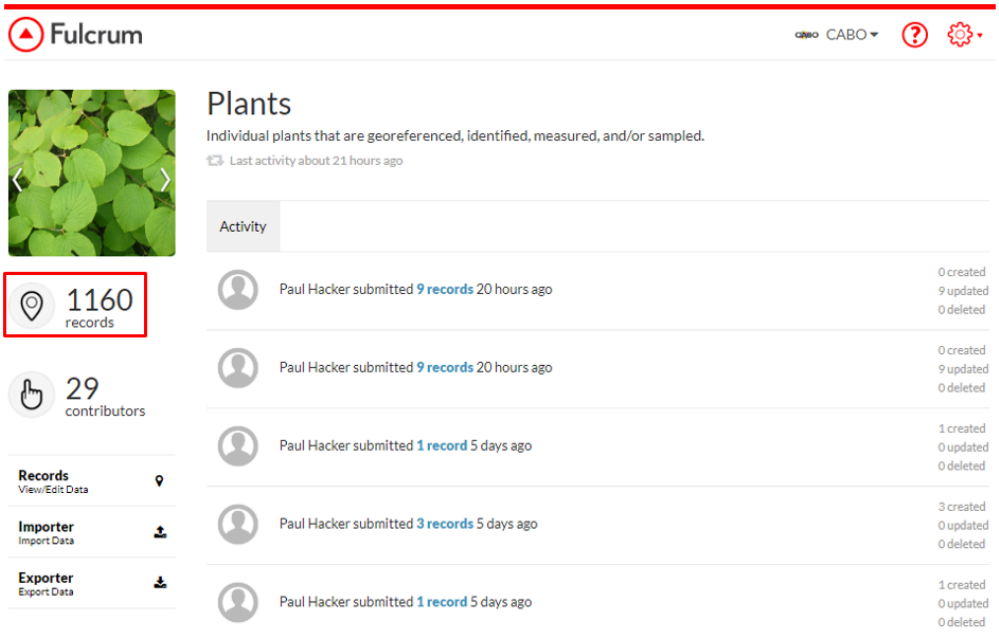
Trimble Catalyst GPS, NTRIP precision subscription BRAND

- SKU

Equipment	
new equipment	NAME
CAT S41 fieldwork cellphone	BRAND
-	SKU
https://www.catphones.com/en-us/cat-s41-smartphone/	LINK

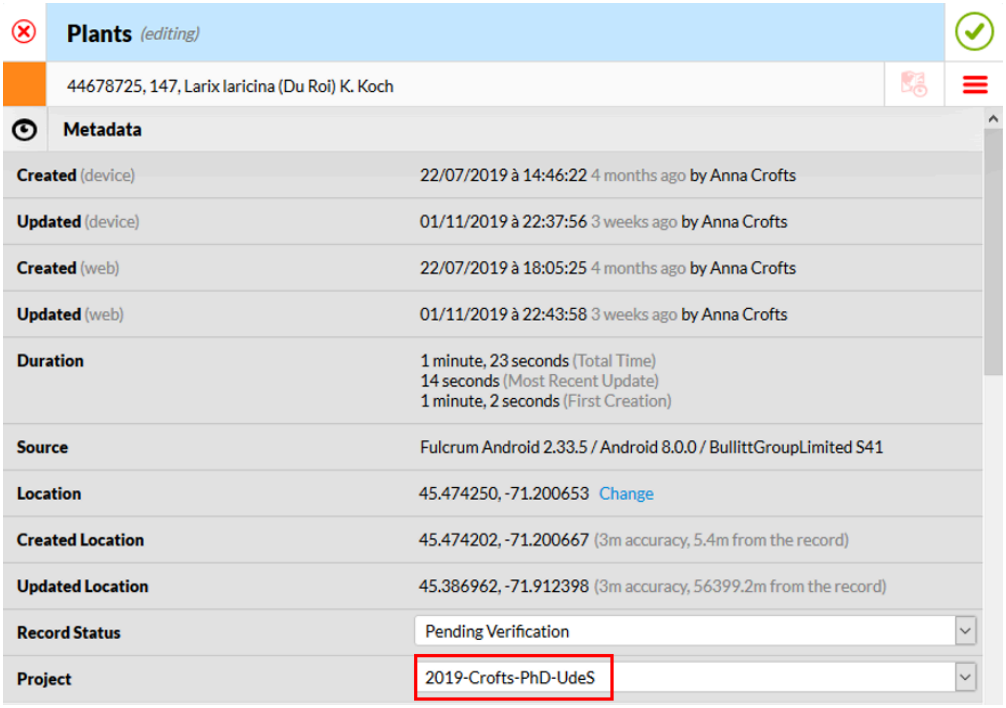
11.1 From the *Fulcrum* main menu, go to the Plants app.



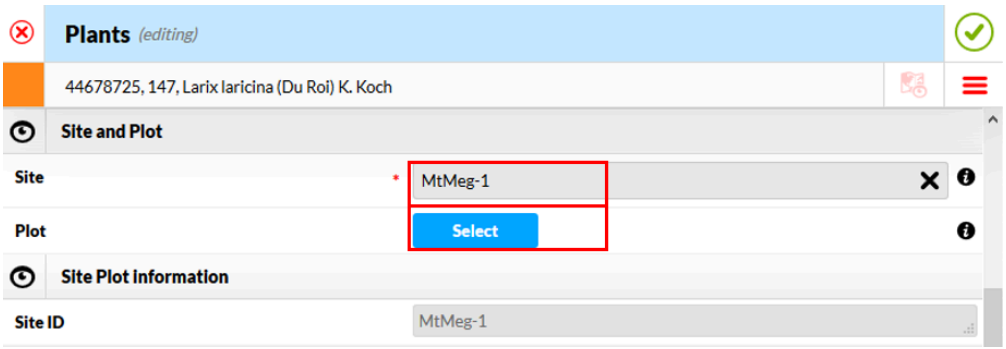


11.2 Create a new record.

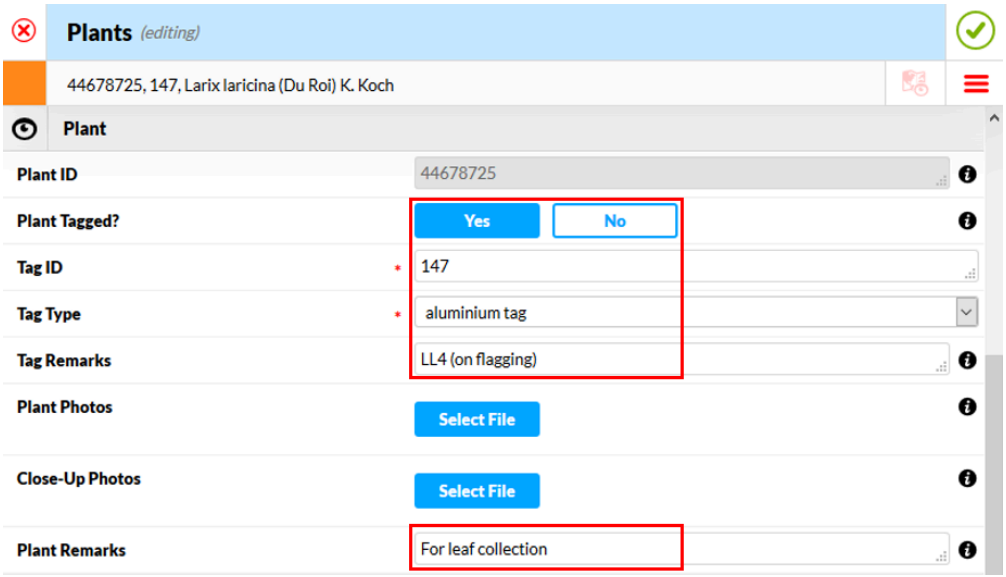
11.3 Under Plants → Metadata → Project, select the appropriate project name (see Site Specific Info).



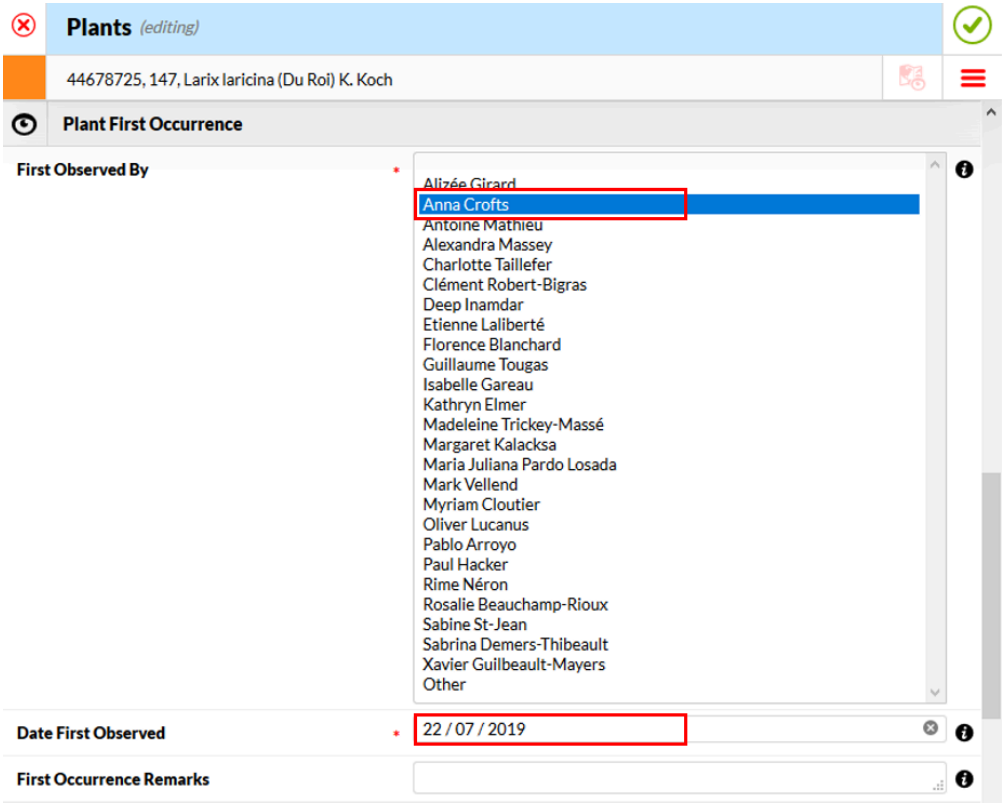
11.4 Under Plants → Site and Plot, select the appropriate Site (see Site Specific Info) and leave the Plot field blank.



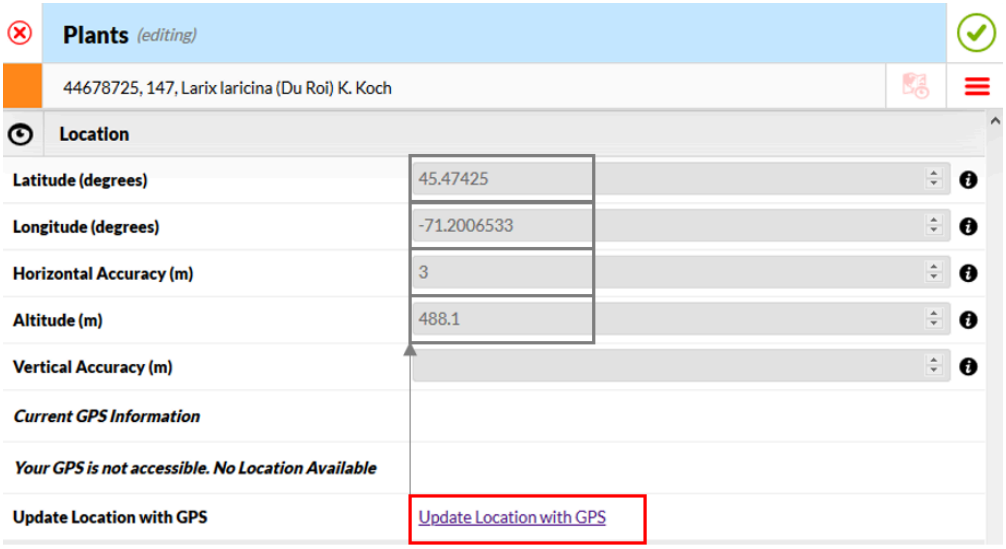
11.5 Permanently tag the tree using aluminium tree tags numbered 1-200 –place tag on the far side of tree, so it cannot be seen from the trail. Under Plants → Plant, answer "Yes" to Plant Tagged?, record the tag number next to Tag ID, and answer "aluminium tag" to Tag Type. Add any other relevant info next to Tag Remarks and Plant Remarks.



11.6 Under Plants → Plant First Occurence, indicate the names of the team members (one or more) who first observed the plant as well as the date of the first observation of the plant.

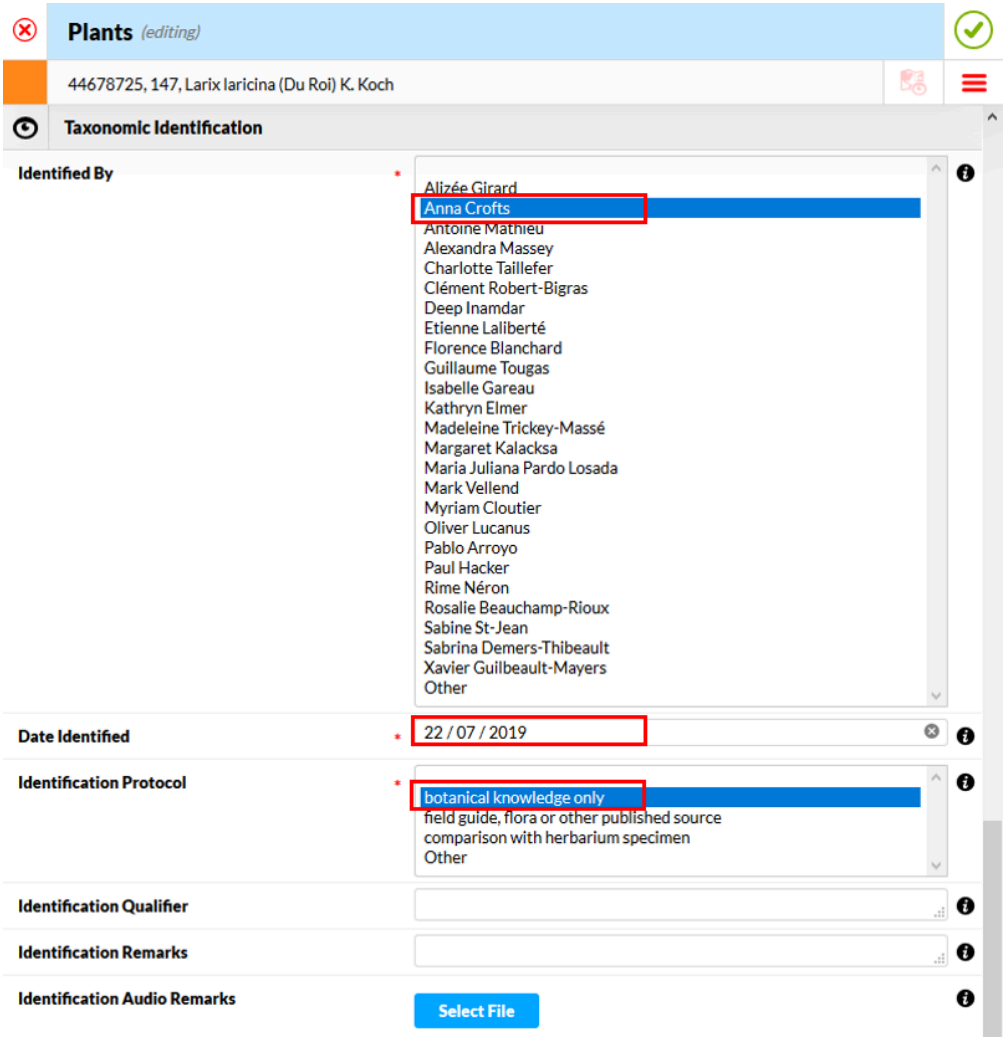


11.7 Under Plants → Location, precisely georeference the tree location by clicking Update location with GPS on your field cellphone connected to the Trimble GPS –coordinates will automatically be imported to the Latitude and Longitude fields.

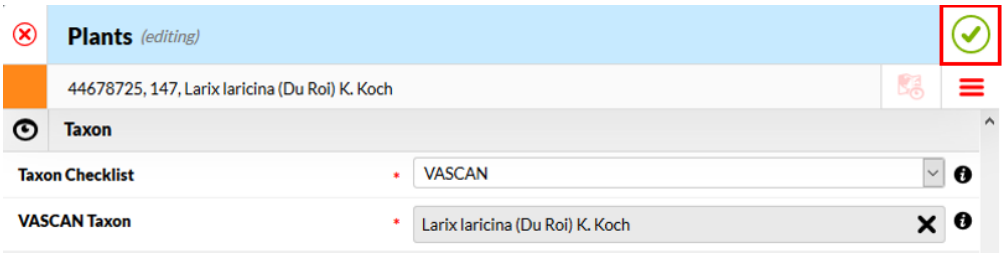


11.8 Under Plants → Taxon, select the name of the plant species from the VASCAN Taxon list.

11.9 Under Plants → Taxonomic Identification, indicate the team members (one or more) the tree was Identified By, enter the Date Identified, and indicate the Identification Protocol.



11.10 Save your record.



Rare Trees Survey outside Plots (Megantic Only)

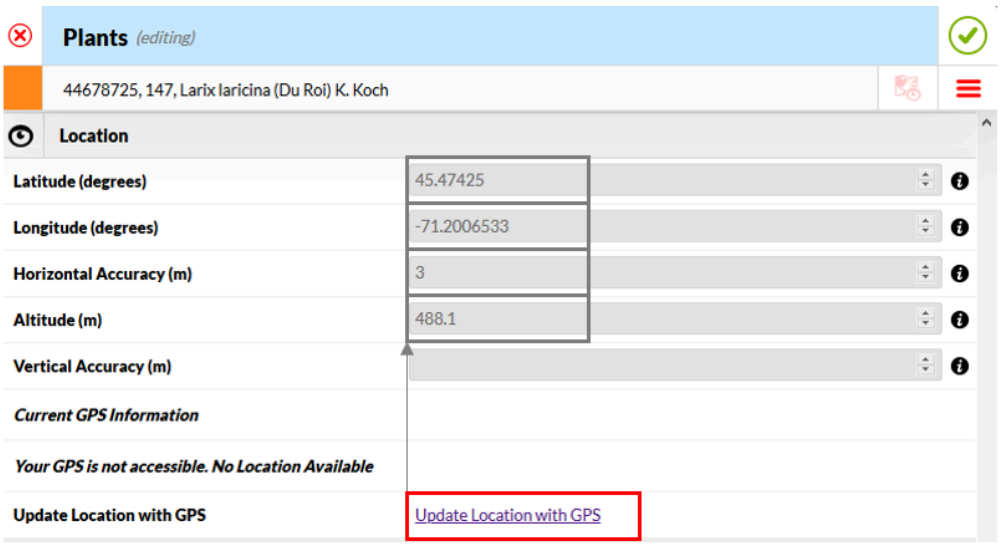
12 Survey additional rare trees as needed to ensure that all tree species observed across a given site are represented by at least 10 Dominant or Co-dominant individuals, in order to

fulfill CABO-wide needs for the calibration of sensor data mentioned at step 1.

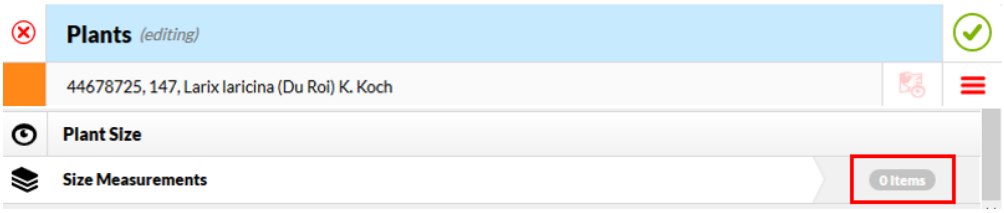
12.1 Identify the tree species represented by <10 Dominant or Co-dominant individuals across the set of plots at the given site.

12.2 For these species, find individual trees ≥ 9 cm DBH outside the plots to bring the sample size up to at least 10. If possible, use the trees recorded at step 11. If not, create Plant records for the selected trees by following the directions from step 11.

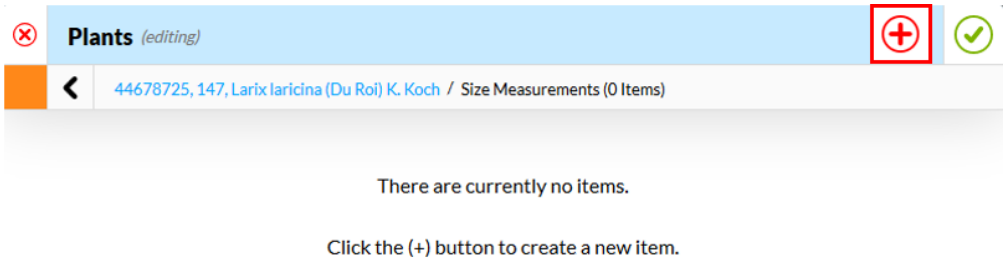
12.3 Georeference these trees under Plants → Location.



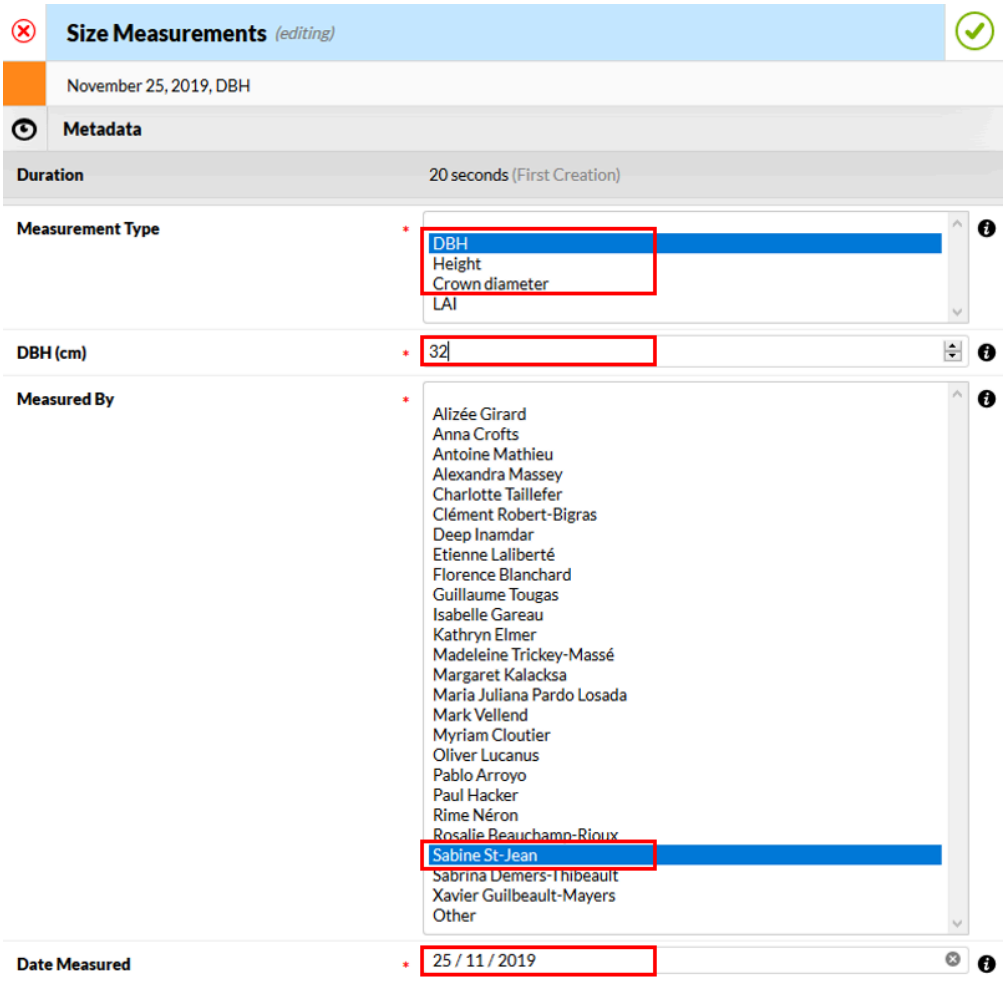
12.4 Record species identification, DBH, height, and crown dimensions in Plants → Plant Size → Size Measurements.



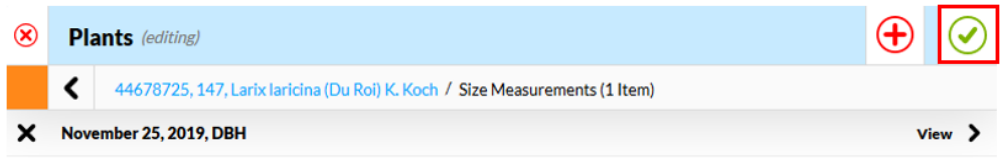
By clicking on the Items button, the following screen will show up.



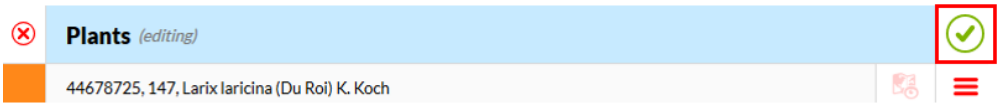
Create one new item per measurement.



Save your size measurements.



12.5 Save your record.

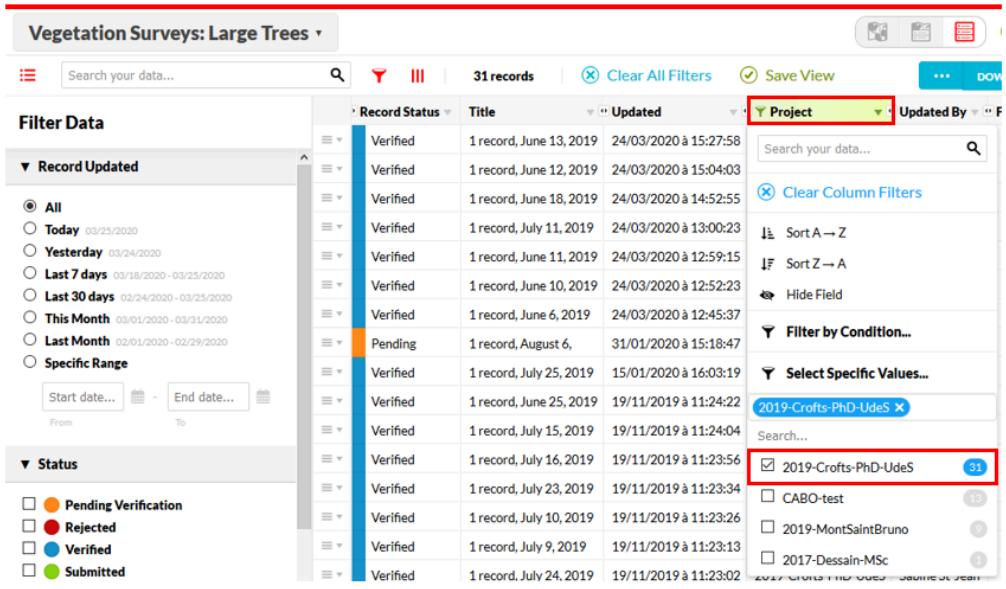


Coordinates Conversion

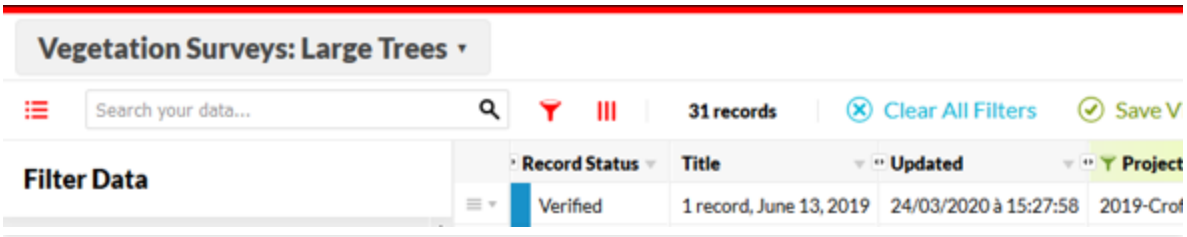
13 Once the field season is over, calculate the X-Y coordinates of the trees which had their coordinates taken using the Laser Geo (see step 9.4).

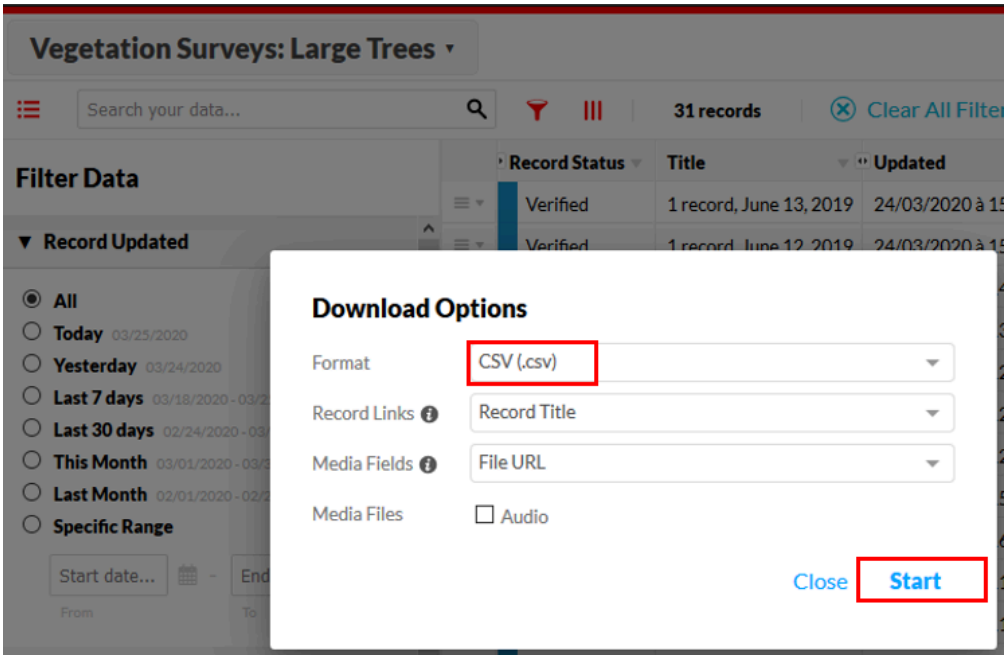
13.1 In *Fulcrum* → Vegetation Surveys: Large Trees, export your data of interest in .csv.

- Select the appropriate project or site.

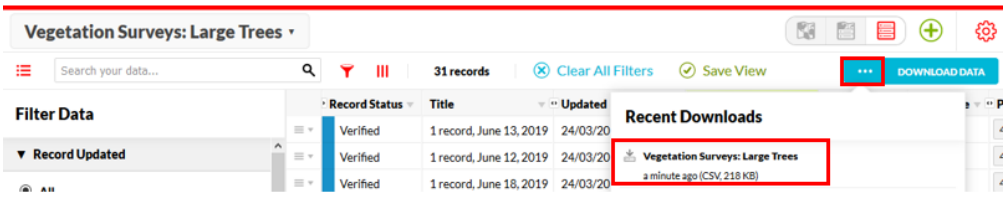


- Click on "Download data". Indicate the "CSV (.csv)" fomat, then click "Start".

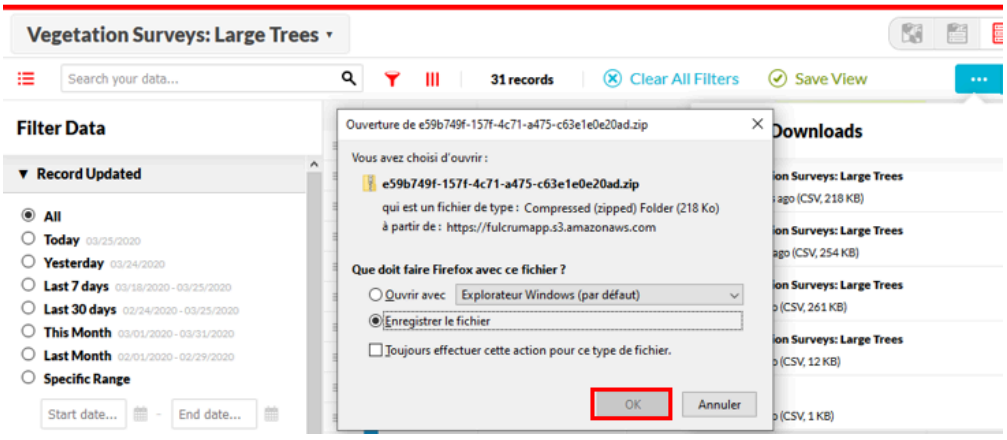




- Click on the "..." icon –a drop-down menu will appear. Click on the name of the file you just created.

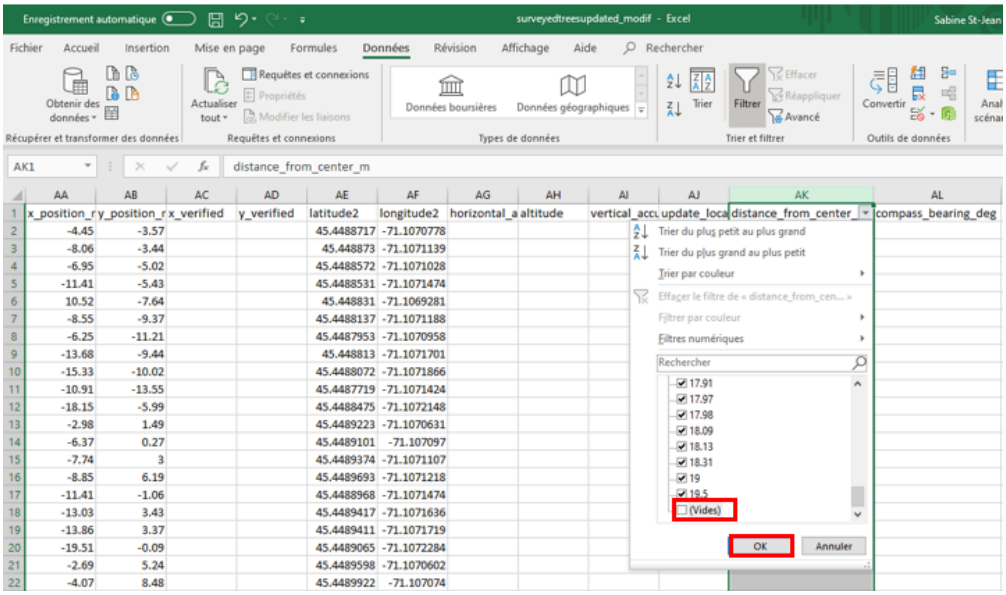


- A download window will appear. Click on "OK".



- Extract your compressed file, then open the "vegetation_surveys_large_trees_surveyed_trees.csv" file using Excel.

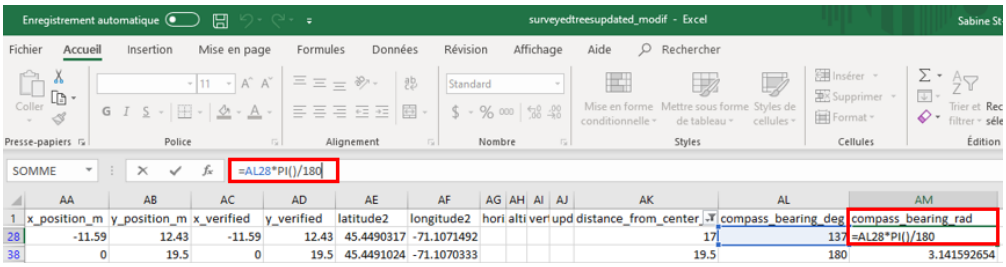
13.2 In Excel, filter the distance_from_center_m column to remove (untick) the "Empty" values, then click "OK".



13.3 In Excel, create a new column titled compass_bearing_rad_, with its cells containing the formula "=AL28*PI()/180" to convert degrees to radian.

Where AL28 is the name of the adjacent cell containing the compass_bearing_deg* value for a given tree.

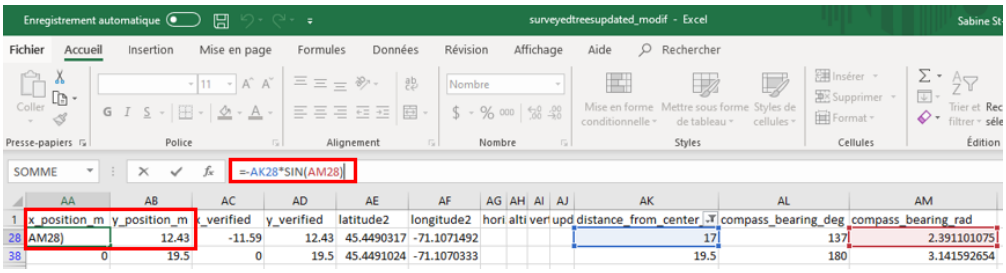
*This has been measured from the tree to the plot center, with North = 0°, East = 90° and so forth.



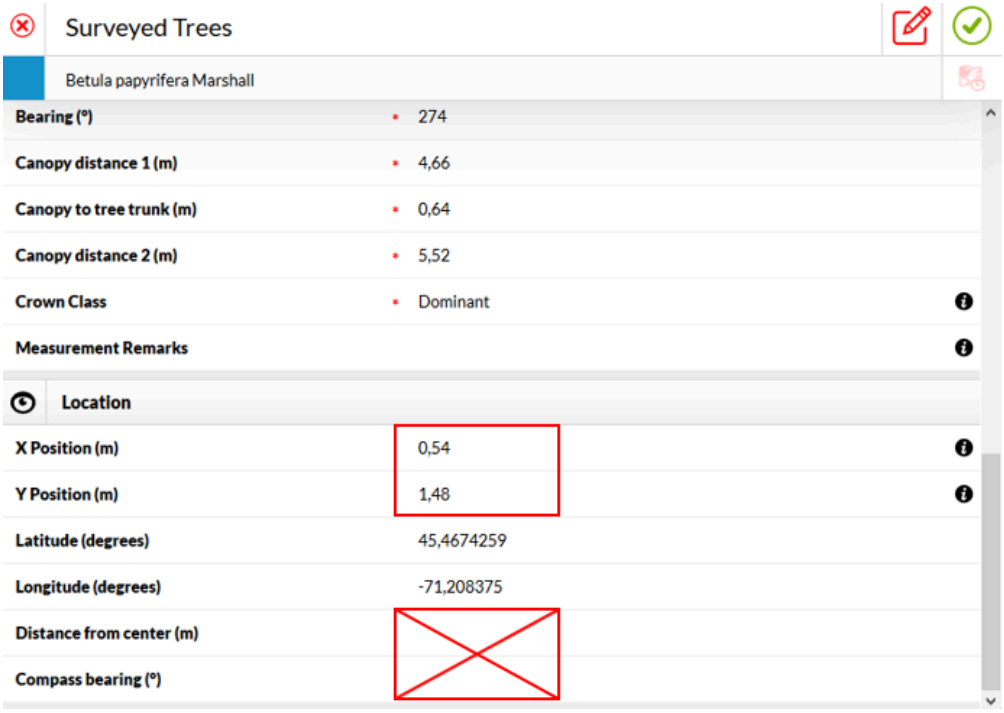
13.4 In Excel, caclulate X-Y coordinates of these trees using the following formulas:

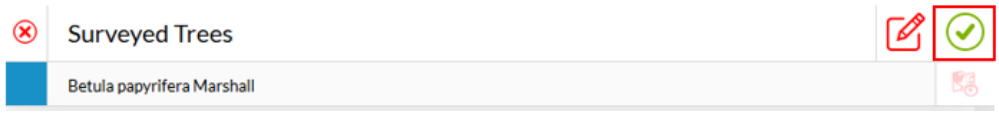
x = - L * sinΘ
y = - L * cosΘ

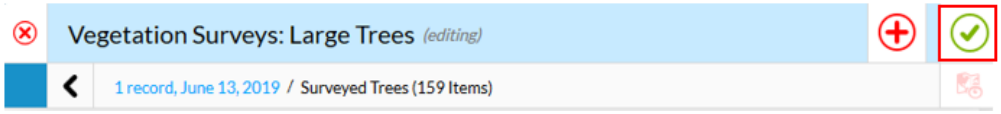
with:
x = x_position_m
y = y_position_m
L = Distance_from_center_m
Θ = Compass_bearing_rad

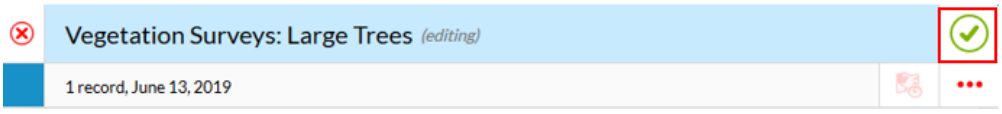


13.5 In *Fulcrum* → Vegetation Surveys: Large Trees → Survey → Surveyed Trees → [Record] → Location, edit the appropriate trees by adding their X-Y coordinates. Then, to avoid confusion, remove their Distance from center (m) and Compass bearing (°). Do so one Vegetation Survey at a time, saving your record when you're done.


Surveyed Trees
Betula papyrifera Marshall
Bearing (°) 274
Canopy distance 1 (m) 4,66
Canopy to tree trunk (m) 0,64
Canopy distance 2 (m) 5,52
Crown Class Dominant
Measurement Remarks
Location
X Position (m) 0,54
Y Position (m) 1,48
Latitude (degrees) 45,4674259
Longitude (degrees) -71,208375
Distance from center (m)
Compass bearing (°)


Surveyed Trees
Betula papyrifera Marshall


Vegetation Surveys: Large Trees (editing)
1 record, June 13, 2019 / Surveyed Trees (159 Items)


Vegetation Surveys: Large Trees (editing)
1 record, June 13, 2019