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Open Vegetation Survey Protocol

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

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Abstract

Here we describe the standardised protocol used by the **Canadian Airborne Biodiversity Observatory** (CABO) to survey open vegetation (i.e., vegetation without tree cover) at the Cowichan Garry Oak Preserve (British Columbia), Mer Bleue Bog (Ontario) and Parc national des Îles-de-Boucherville (Québec) sites. Surveys were conducted in 3×3m square plots, with each plot containing nine 1×1m subplots. Plot locations were selected in order to capture a range of environmental conditions of interest (e.g., distance from forest, soil types, or microtopography). All data were entered via the *Fulcrum* application, using the *Plots*, *Subplots*, and *Vegetation Surveys: Herbs and Shrubs* apps. For each plot, we first verified plot orientation (two edges of the square north-south, two east-west), measured geographic coordinates of the plot center and corners, and estimated slope angle and aspect. All plant species within the plot were identified. For each subplot, we made visual estimates of percent cover of all plant species present, as well as leaf litter and bare ground. If a drone was available, percent cover estimates were not made in the field; rather, overhead photographs taken with the drone were first annotated and later analyzed quantitatively using virtual point frames to obtain data on the abundance and distribution of plant species within the plots. The ground-based plant surveys were conducted in order to be paired with remotely-sensed aerial hyperspectral imagery.

Attachments

FILE BC_vasc.pptx 27MB

PDF mb_classification_ar... 1.9MB

PDF MB trees-fert plots.... 10KB

DOCX Goud_EM_MSc thesis_T... 106KB

XLSX CABO_species_list_pe... 37KB

Guidelines

OVERVIEW OF OBJECTIVES AND GENERAL METHODOLOGY

Vegetation plots for CABO serve two main goals:

(1) **Permitting field-based tests – and validation of airborne-based tests – of how plant diversity and composition vary according to predictor variables of interest (e.g., distance from forest, soil type)**

This requires plot-based surveys in which each species present is quantified with respect to aspects of abundance (percent cover, location), and plot coordinates estimated with high precision.

(2) **Permitting calibration/validation for identifying plant species from airborne imagery**

This requires providing mapped locations of multiple individuals (or occurrences where individuals are difficult to distinguish) of as many plant species as possible. Individuals should occur in a variety of conditions relevant to the signal received on the airborne sensors (e.g., aspect, slope) and should represent different abundances. Individuals outside of vegetation plots, from which leaves were collected for spectra and trait measurements, have also been mapped (see Etienne Laliberté's "Measuring spectral reflectance and transmittance [...]" 2 protocols, for small and big leaves) and so also contribute to this goal.

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

Plot prioritization list

BRAND

-

SKU

Equipment

new equipment

NAME

Loop stake

BRAND

-

SKU

https://bosmereusa.com/Product.asp?_Brand=All&_Group=Outlet-Store&_pcode=E461

LINK

About 40 cm long

SPECIFICATIONS

Equipment

new equipment

NAME

Plant press and newspaper

BRAND

-

SKU

Equipment

Laser Geo

NAME

Haglöf Sweden

BRAND

-

SKU

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

LINK

Equipment

new equipment

NAME

24 rigid PVC pipes (top of frame), ¾'', 1 m long

BRAND

-

SKU

To be used as the frame horizontal structure, labelled with the subplot number they belong to.

SPECIFICATIONS

Equipment

new equipment

NAME

16 rigid PVC pipes (legs), ¾'', appropriate height

BRAND

-

SKU

To be used as the legs, according to the vegetation height.
Heights:
- 0,37 m: this height allows for the scaffold to be placed over the grid (see the Vegetation Survey part of this protocol).
- 1 m
- 1,5 m

SPECIFICATIONS

Equipment

new equipment

NAME

16 PVC connectors for the intersections, ¾''

BRAND

-

SKU

http://www.leevalley.com/us/garden/page.aspx?cat=2,2030&p=67332

LINK

4 corner pieces: L-shaped with a leg junction
8 side pieces: T-shaped with a leg junction
4 middle pieces: X-shaped with a leg junction

SPECIFICATIONS

Equipment

new equipment

NAME

Tape Measure

BRAND

-

SKU

Equipment

new equipment

NAME

3 Stake wire flags

BRAND

-

SKU

https://www.homedepot.com/p/Empire-3-5-in-x-2-5-in-Pink-Stake-Flags-100-Pack-78-003/301387971

LINK

About 50 cm long, 3.5'' x 2.5'' pink or orange vinyl flags on wire stakes

SPECIFICATIONS

Equipment

new equipment

NAME

2 Step Steel Step Ladders (2)

BRAND

-

SKU

https://www.homehardware.ca/en/2-step-steel-step-ladder/p/5435581#ccode=1525535417245

LINK

CGOP site only.

SPECIFICATIONS

Equipment

new equipment	NAME
3 m long Telescopic Aluminum Scaffold Plank	BRAND
-	SKU
https://www.homehardware.ca/en/6-9-telescoping-aluminum-scaffold-plank/p/5435115#ccode=1525535417245	LINK
CGOP site only.	SPECIFICATIONS

Equipment

Mavic Air	NAME
Drone	TYPE
DJI	BRAND
-	SKU
https://store.dji.com/product/mavic-air?vid=38961	LINK

Equipment

Go 4

NAME

App

TYPE

DJI

BRAND

-

SKU

The application used to connect your cellphone to the drone controller. Your cellphone then becomes the screen interface to control the drone.

SPECIFICATIONS

Equipment

new equipment

NAME

Identification guides

BRAND

-

SKU

See Open Vegetation Survey Protocol → Guidelines → Site Specific Information.

SPECIFICATIONS

Equipment

new equipment

NAME

3 Square canopy cover negative templates

BRAND

-

SKU

1% = 10 × 10 cm
5% = 22,4 × 22,4 cm
10% = 31,6 × 31,6 cm

SPECIFICATIONS

Equipment

new equipment

NAME

Trimble Catalyst GPS, NTRIP precision subscription

BRAND

-

SKU

Equipment

Wood pannel for take-off and landing

NAME

-

BRAND

-

SKU

Safety warnings

Open vegetation can be very sensitive to disturbance via trampling by researchers. Existing trails should be followed to the maximum extent possible, with trampling minimized, especially in the vicinity of survey plots, by using long strides and minimal steps. Researchers should never step inside a plot, in order to keep the vegetation intact for the inventories and airborne surveys.
Ticks have been spotted near these study sites, and mosquitoes and flies are abundant at the Mer Bleue Bog. Wearing long sleeves and pants and bringing bug spray are recommended.

Before start

In advance of the vegetation crew arriving, the local project leader may have identified the locations where vegetation surveys would be conducted, marking each plot in the field and defining each plot in *Fulcrum*. Also in advance of arriving on site, the vegetation crew familiarized themselves with the common species locally, using lists provided by local employees, websites and guidebooks.

For the first field day, the vegetation crew, with location guidance from the local crew, conducted site reconnaissance, learning how to identify all species in the field.

For the remainder of the time at a given field site (typically about two weeks), the vegetation crew implemented the protocol described in this document in as many plots as possible, except when aerial imagery was being collected. The vegetation crew coordinated with the local crew as necessary, for example to occasionally confirm plant identifications, but otherwise worked largely independently.

In the *Fulcrum* apps mentioned this protocol ("Vegetation Surveys: Herbs and Shrubs", "Plots", and "Subplots"), data entry requires the selection of a Project and a Site.

Plot prioritization

Plot locations were selected following a priority list aiming to cover as wide a range of environmental conditions as possible, with higher priority given to plots meeting the following criteria:

- Within (vs outside*) the airborne imagery polygons;
- Within the flight polygons that had already been imaged (vs not imaged yet);
- Relatively more accessible (vs less accessible) in order maximize the total number of plots surveyed and to gain experience prior to surveying more remote plots.

*This situation is not desired and only happenned at the CGOP site because of last minute changes in the flight polygons.

Site Specific Information

Cowichan Garry Oak Preserve (CGOP):

- Project (in *Fulcrum*): "2018-Hacker-PhD-UBC".
- Site (in *Fulcrum*): "CGOP-1".
- Address: 1241 Maple Bay Road, Duncan, BC, V9L 5R9. Please park on Maple Bay Road and walk down to the end of Aitken Road.
- Project Leader: Paul Hacker, PhD Candidate, University of British Columbia.
- Local crew: Paul Hacker, PhD Candidate, UBC, and Irvin Banman, Site Manager, CGOP.
- Park contact: Irvin Banman, Site Manager, CGOP.
- Number of plots: 30.

- Site gradient: spatial relationship to roads, agricultural land use change and an encroaching Coastal Douglas-fir forest.
- Conservation value: very high. Nature Conservancy of Canada volunteers and employees work hard every season on planting indigenous species and controlling invasive ones. Trampling has a big impact. Efforts are to be made seriously to avoid disrupting the site.
- Magnetic declination: approximately +16°1' (East).

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

- Plant ID ressources:

- **E-Flora BC website**.
- Plants of Coastal British Columbia (Revised Edition, 2016). Jim Pojar, Andy MacKinnon. 2005. Lone Pine Publishing.
- Wildflowers of the Pacific Northwest. Mark Turner & Phyllis Gustafson, 2006. Timber Press, Inc.
- Flora of the Pacific Northwest, An Illustrated Manual (Second Edition). C. Leo Hitchcock, Arthur Cronquist, 2018. University of Washington Press in association with Burke Museum of Natural History and Culture.

Mer Bleue Bog:

- Project: “2019-MerBleue”.
- Site: “MBP-veg-crew”.
- Address: Dewberry Trail, Dolman Ridge Road, Orléans, ON. Park at the end of the road. There is a locked chain in the middle of Dolman Ridge Road. Contact Étienne Laliberté or Margaret Kalacska to know the locker number.
- Project Leader: Margaret Kalacska, Prof., UMcGill.
- Local crew: Tim Moore, Prof., UMcGill, et al.
- Number of plots: 34.
- 2019 plot distribution (in reference to the "MB classification areas" PDF)

- Baseline: 5
- Lagg: 5
- Blue dome ("blue" in *Fulcrum*): 7
- Tree dominated ("treed" in *Fulcrum*): 7
- Dry: 2
- Wet: 2
- Hollow: 2
- Fertilization ("fert" in *Fulcrum*): 4 (for 4 treatments: all N variations, in reference to the "MB trees-fert plots" PDF)

- Site gradient: microtopography (hummocks to hollows, including lawns and mixes of hummocks and hollows).
- Conservation value: high. Walking in snowshoes or on the boardwalks is mandatory to protect the vegetation.
- Magnetic declination: about -13° 16 (West)

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

- Plant ID ressources:

- **Wetland Plants of Ontario**. Steven Newmaster, Alan Harris, Linda Kershaw. 1997. Lone Pine Publishing.
- **Plantes des milieux humides et de bord de mer du Québec et des Maritimes**. Martine Lapointe. 2014. Éditions Michel Quintin. Note: can also be useful for grasses and sedges.

- **Les sphaignes de l'Est du Canada - Clé d'identification visuelle et cartes de répartition**. Gilles Ayotte, Line Rochefort. 2019. Éditions JFD.

Parc national des Îles-de-Boucherville:

- Project: "2019-Boucherville".
- Site: "GrosboisFieldEL".
- Project Leader: Étienne Laliberté, Prof., UdeM.
- Park contact: Nathalie Rivard, Head of Conservation and Research.
- Local crew: Sabrina Demers-Thibault, lab technician at UdeM, et al.
- 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 (which is normally closed to cars) is needed and has to be shown on the car dashboard or windows.
- Number of plots: 30.
- Site gradient: botanical diversity, i.e. from monospecific plots of different species (all raspberries, all phragmites, all typha) to diverse plots.
- Conservation value: low. The site is invaded with Phragmites. Hence, if the vegetation surveys are done afer the airborne imagery, trampling is not as much of an issue. Still, follow the existing pathways as much as possible, especially before the imagery.
- Magnetic declination: about -14° 24 (West).

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

- Plant ID ressources:

- **Fleurs des champs du Québec et des Maritimes**. Sylvain Parent. 2011. Éditions Michel Quintin.
- **Arbres et plantes forestières du Québec et des Maritimes**. 2016. Éditions Michel Quintin. Note: for trees and shrubs.
- **Guide d'identification des mauvaises herbes du Québec**. MAPAQ - CPVQ. Note: for grasses.
- **Flore Laurentienne**. Frère Marie Victorin. 1995. Les presses de l'Université de Montréal. Note: to confirm identifications.
- **Plantes des milieux humides et de bord de mer du Québec et des Maritimes**. Martine Lapointe. 2014. Éditions Michel Quintin. Note: can also be useful for grasses and sedges.
- **Plantes sauvages des villes et des champs**, volumes 1 et 2. Fleurbec.

Fieldwork Preparation

1 Confirm with the local project leader (see Guidelines → Site Specific Information) that the plots have been marked in the field and created in *Fulcrum*. If the plots have already been created in *Fulcrum*, skip to step 3. If not, go to step 2.

2 In *Fulcrum*, enter contextual data for the plots.

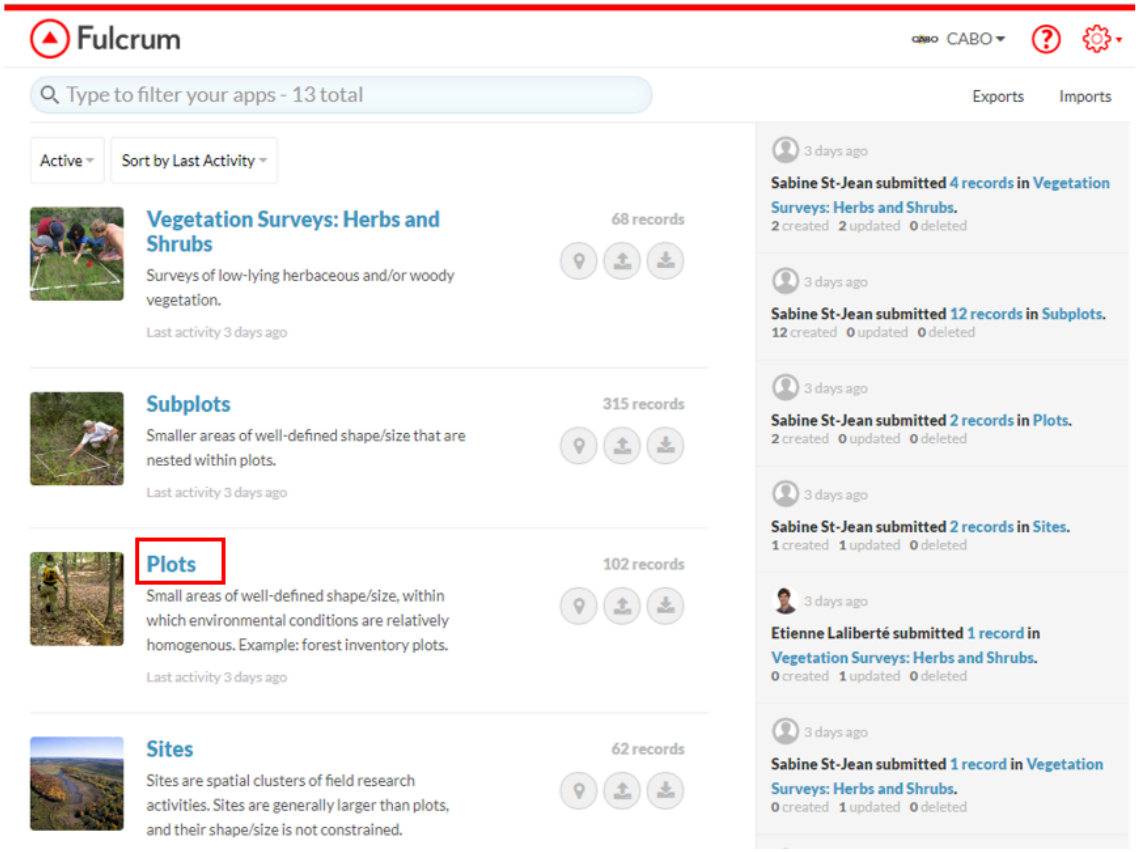
Note

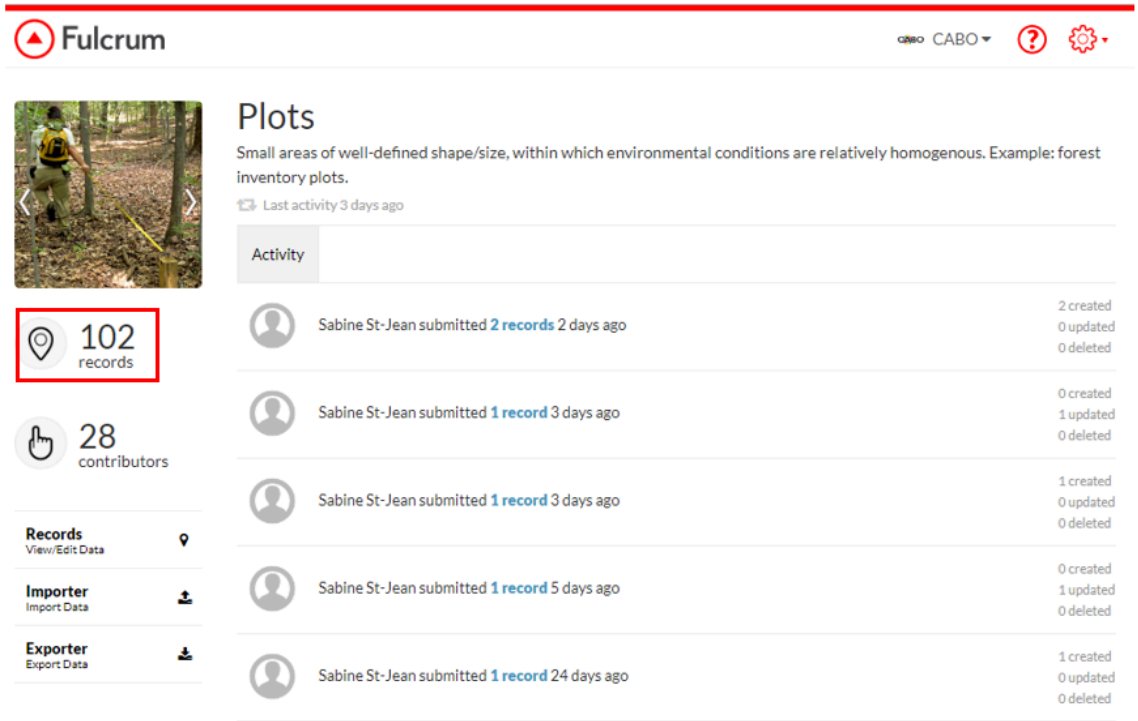
When selecting locations for the plots, the goal is to maximize herbaceous diversity. Trees are to be avoided. Shrubs can be included, especially if they are typical within the studied ecosystem. The plots have to be spread evenly through the site gradient (for ex.: distance from a forest, soil type, or microtopography).

Equipment

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

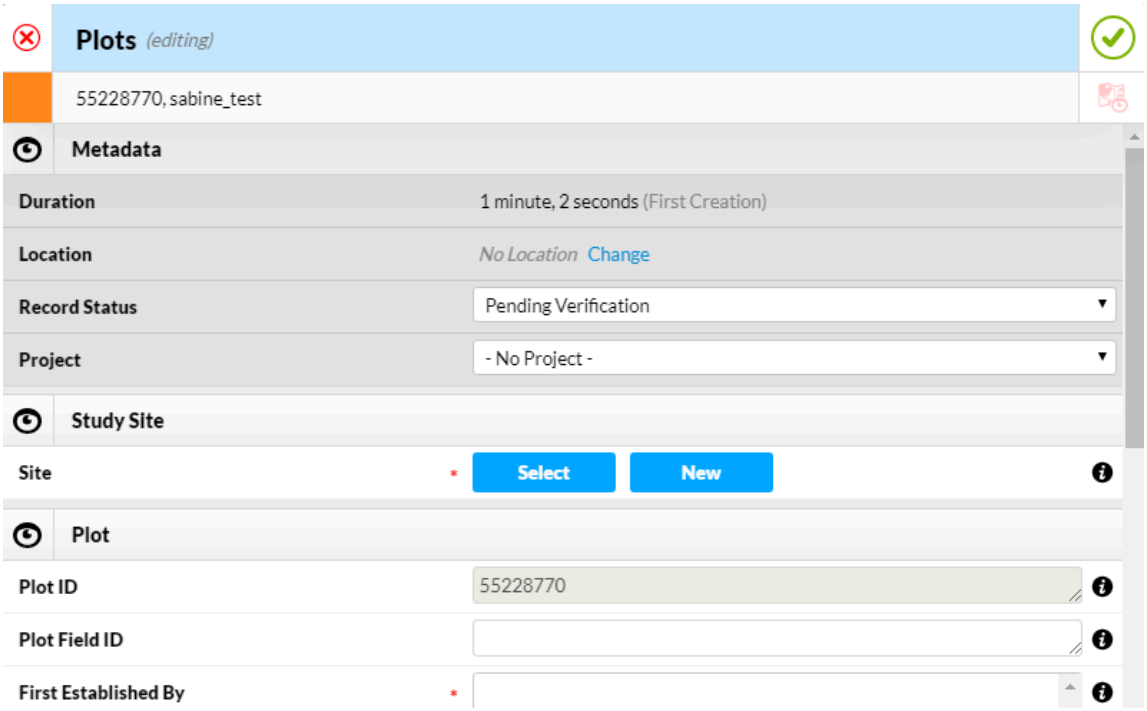
2.1 From the *Fulcrum* main menu, select the Plots app and then within Plots select the list of records


Fulcrum
CABO
Type to filter your apps - 13 total
Exports
Imports
Active
Sort by Last Activity
Vegetation Surveys: Herbs and Shrubs
Surveys of low-lying herbaceous and/or woody vegetation.
Last activity 3 days ago
68 records
Subplots
Smaller areas of well-defined shape/size that are nested within plots.
Last activity 3 days ago
315 records
Plots
Small areas of well-defined shape/size, within which environmental conditions are relatively homogenous. Example: forest inventory plots.
Last activity 3 days ago
102 records
Sites
Sites are spatial clusters of field research activities. Sites are generally larger than plots, and their shape/size is not constrained.
62 records
3 days ago
Sabine St-Jean submitted 4 records in Vegetation Surveys: Herbs and Shrubs.
2 created 2 updated 0 deleted
3 days ago
Sabine St-Jean submitted 12 records in Subplots.
12 created 0 updated 0 deleted
3 days ago
Sabine St-Jean submitted 2 records in Plots.
2 created 0 updated 0 deleted
3 days ago
Sabine St-Jean submitted 2 records in Sites.
1 created 1 updated 0 deleted
3 days ago
Etienne Laliberté submitted 1 record in Vegetation Surveys: Herbs and Shrubs.
0 created 1 updated 0 deleted
3 days ago
Sabine St-Jean submitted 1 record in Vegetation Surveys: Herbs and Shrubs.
0 created 1 updated 0 deleted

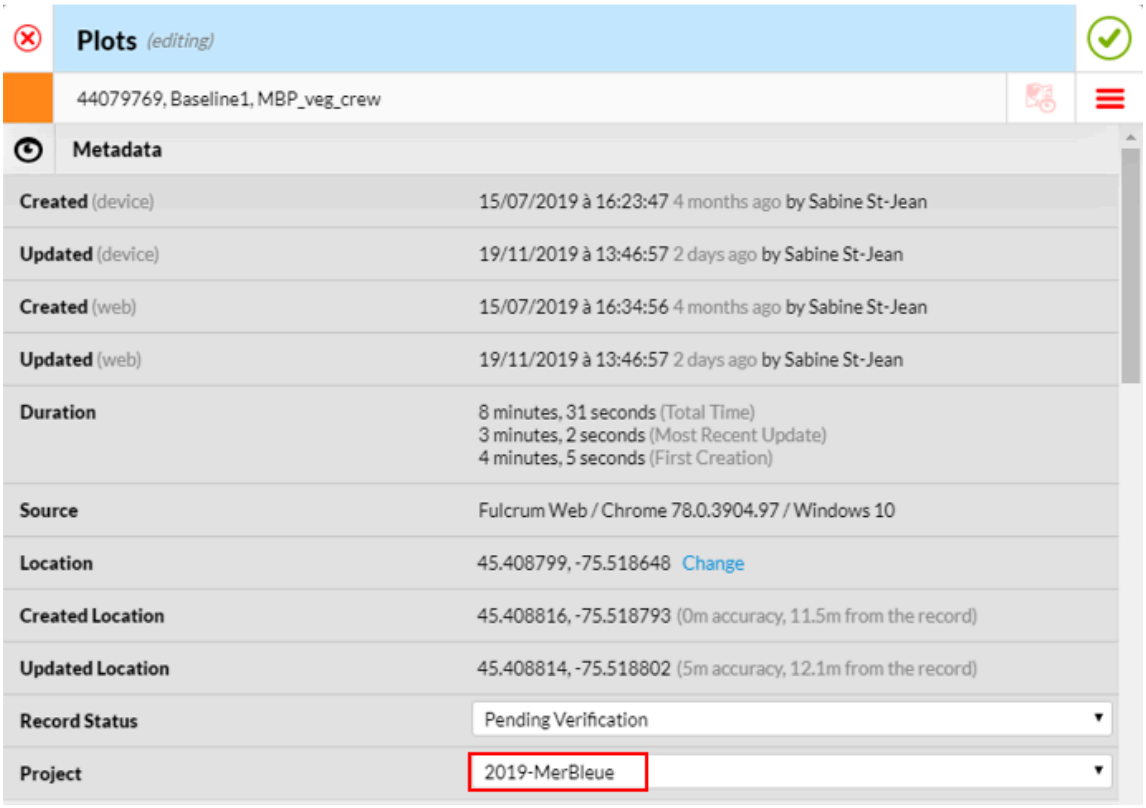

Fulcrum
CABO
Plots
Small areas of well-defined shape/size, within which environmental conditions are relatively homogenous. Example: forest inventory plots.
Last activity 3 days ago
102 records
28 contributors
Records
View/Edit Data
Importer
Import Data
Exporter
Export Data
Activity
Sabine St-Jean submitted 2 records 2 days ago
2 created 0 updated 0 deleted
Sabine St-Jean submitted 1 record 3 days ago
0 created 1 updated 0 deleted
Sabine St-Jean submitted 1 record 3 days ago
1 created 0 updated 0 deleted
Sabine St-Jean submitted 1 record 5 days ago
0 created 1 updated 0 deleted
Sabine St-Jean submitted 1 record 24 days ago
1 created 0 updated 0 deleted

2.2 Create a new record by selecting the + symbol in a circle.

The following screen will show up:



2.3 Under Plots → Metadata → Project, select the appropriate project name (see Guidelines → Site Specific Information).

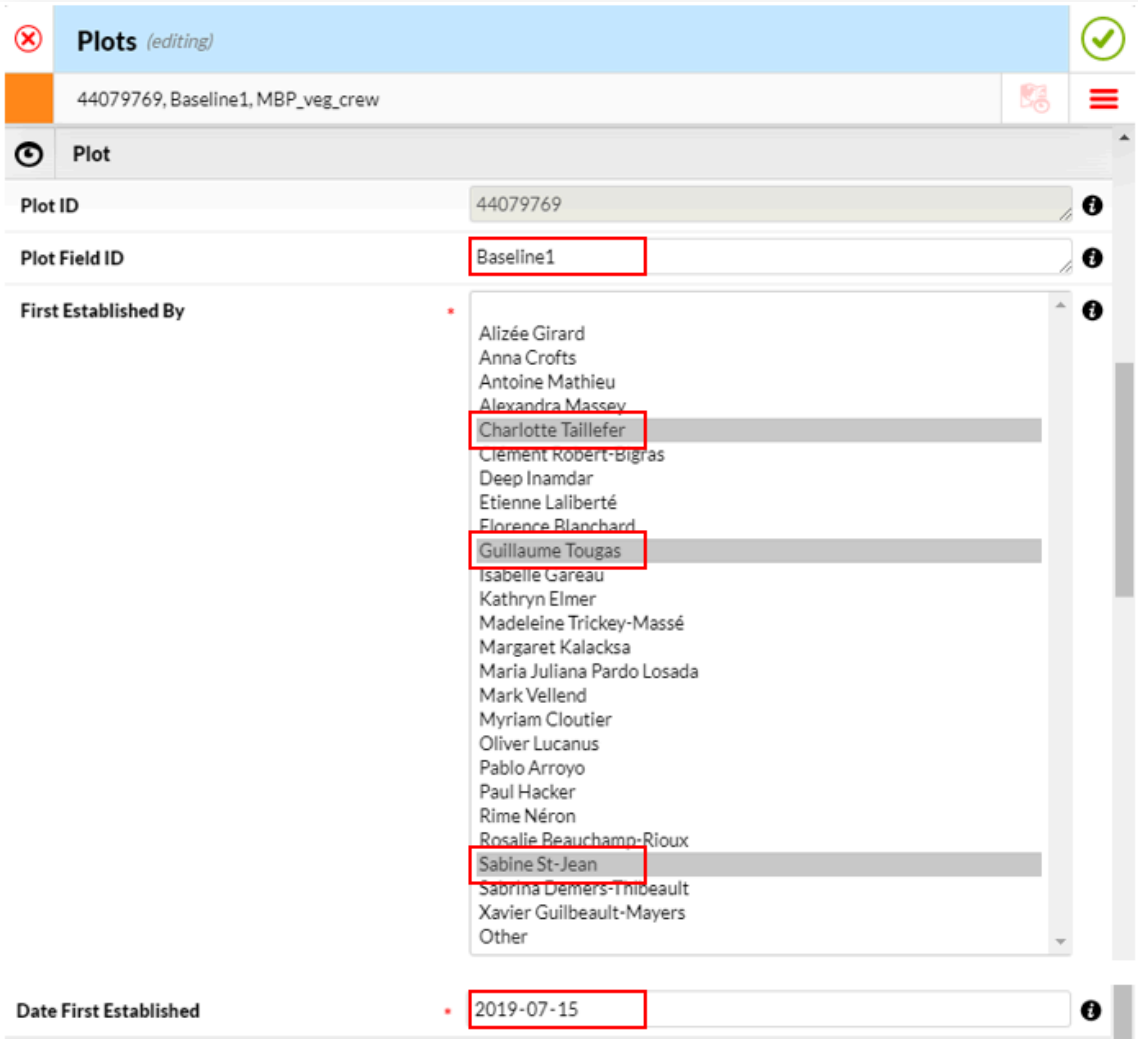


2.4 Under Plots → Study site → Site, select the appropriate site (see Guidelines → Site Specific Information).

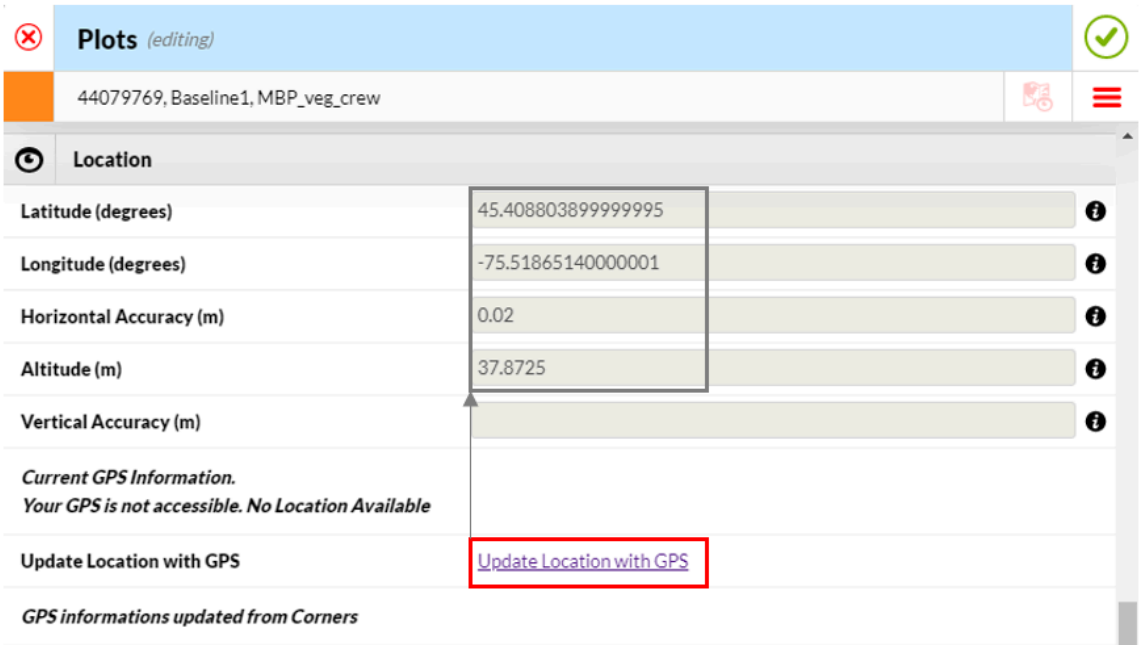
2.5 Under Plots → Plot, assign the plot a Plot Field ID, and indicate the names of the team members (one or more) creating the plot as well as the date of plot creation.

Note

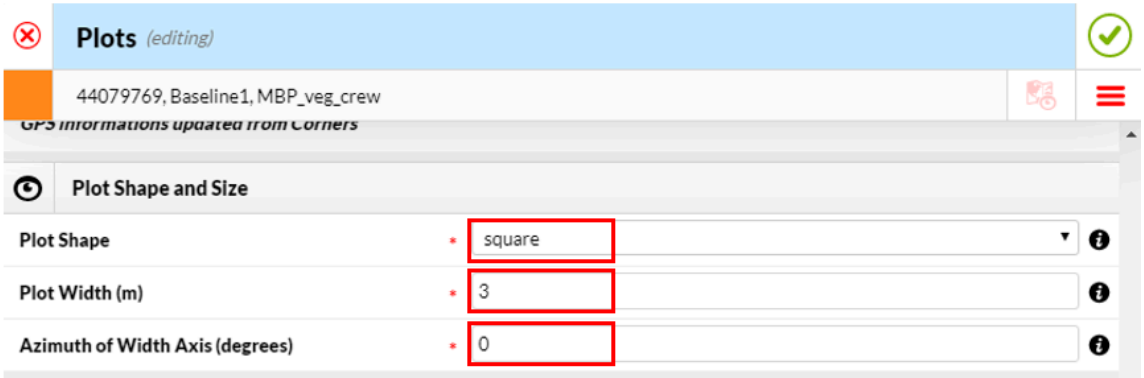
The default entries are the name of the person logged into *Fulcrum* and the current date.



2.6 Under Plots → Location, georeference the plot location approximately by clicking on Update Location with GPS using a fieldwork cellphone - coordinates will automatically be imported to the Latitude and Longitude fields.

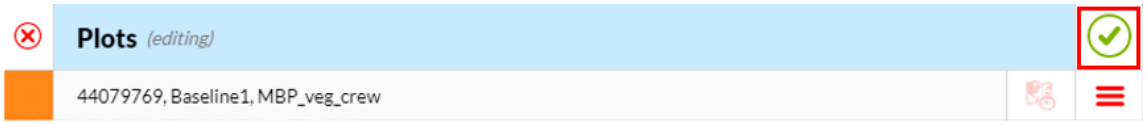


2.7 Under Plots → Plot shape and Size, enter the Plot shape (Square), the Width (3 m) and the Azimuth of width axis (0° = true north).



2.8 Add any other relevant information under Optional Plot Info.

2.9 Save the data entry.

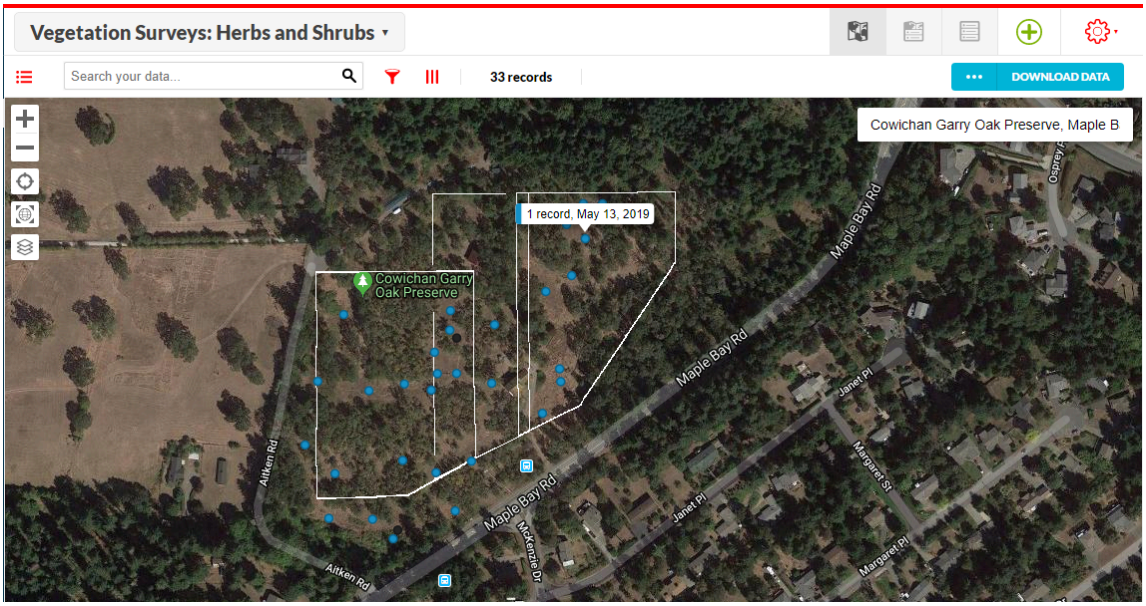


3 Create a plot prioritization list.

3.1 Given some degree of uncertainty at the outset with respect to how many plots can be surveyed in the allotted time, the plots must be done in accordance to the local prioritization criteria (see step 2).

Most sites will require more than one CASI/SASI flight. Each flight is defined by a polygon on the map. Communication between the veg crew and the drone crew is necessary in order to be outside a given polygon while it is being imaged. An effective solution is to survey all the plots in one polygon at a time to avoid being in the way during the imagery.

If some plots have been placed outside the flight polygons (not ideal, would happen only if a miscommunication occured), these are the last plots to be done.



The 3 flight polygons (outlined in white) that were used to cover the Cowichan Garry Oak Preserve site (B. C.) in May 2019.

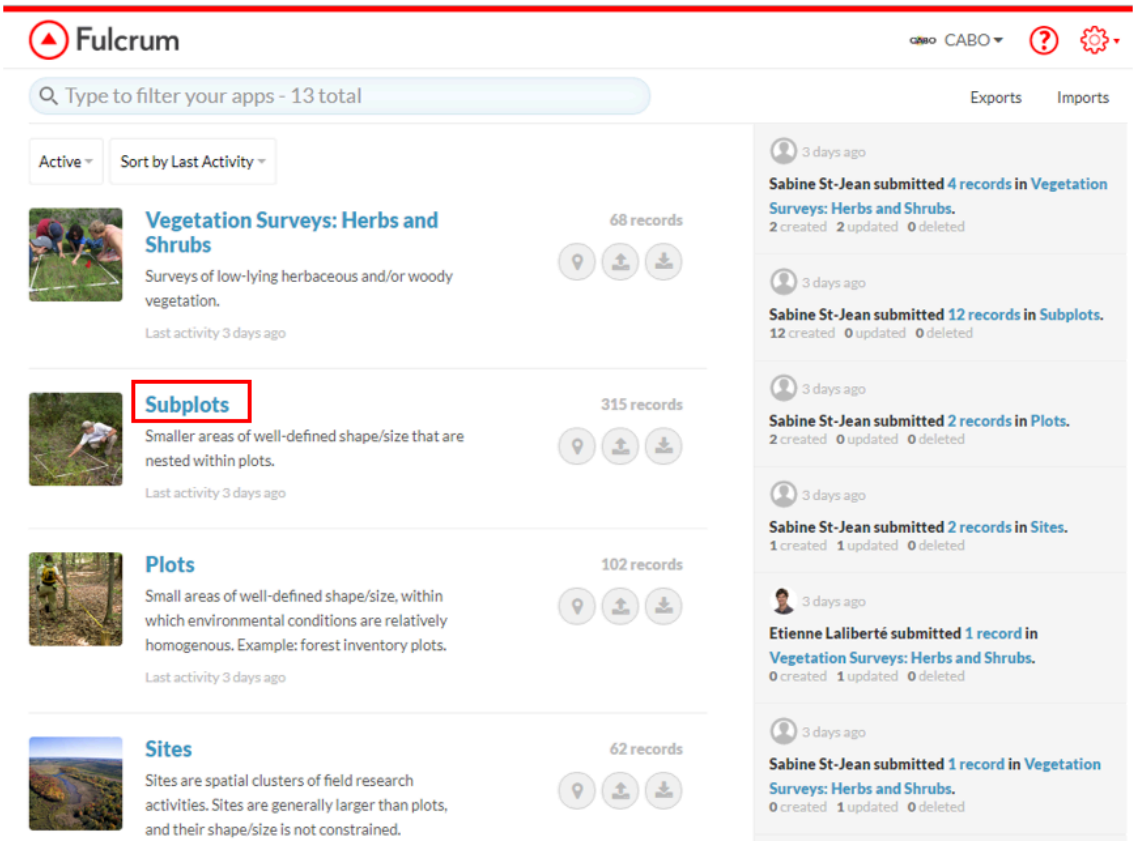
3.2 Validate that priority list with the local crew.

4 Enter contextual data for all the subplots.

Equipment

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

4.1 In the *Fulcrum* main menu, select the Subplots app.


Fulcrum
CABO
Type to filter your apps - 13 total
Exports
Imports
Active
Sort by Last Activity
Vegetation Surveys: Herbs and Shrubs
Surveys of low-lying herbaceous and/or woody vegetation.
Last activity 3 days ago
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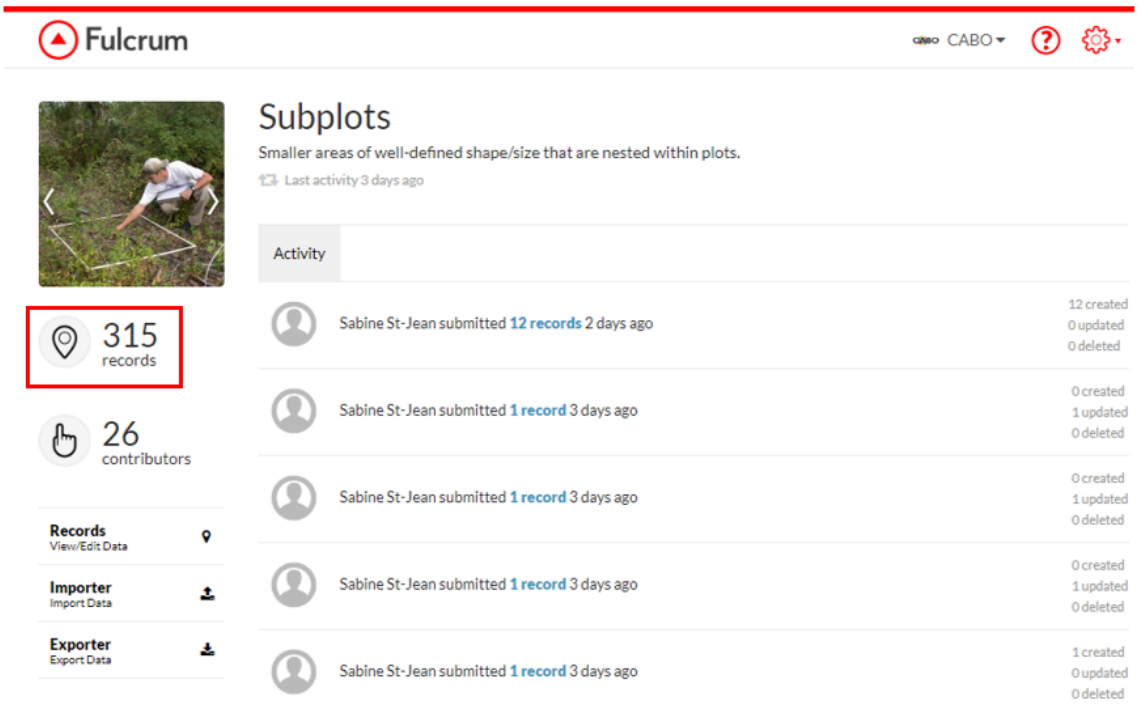
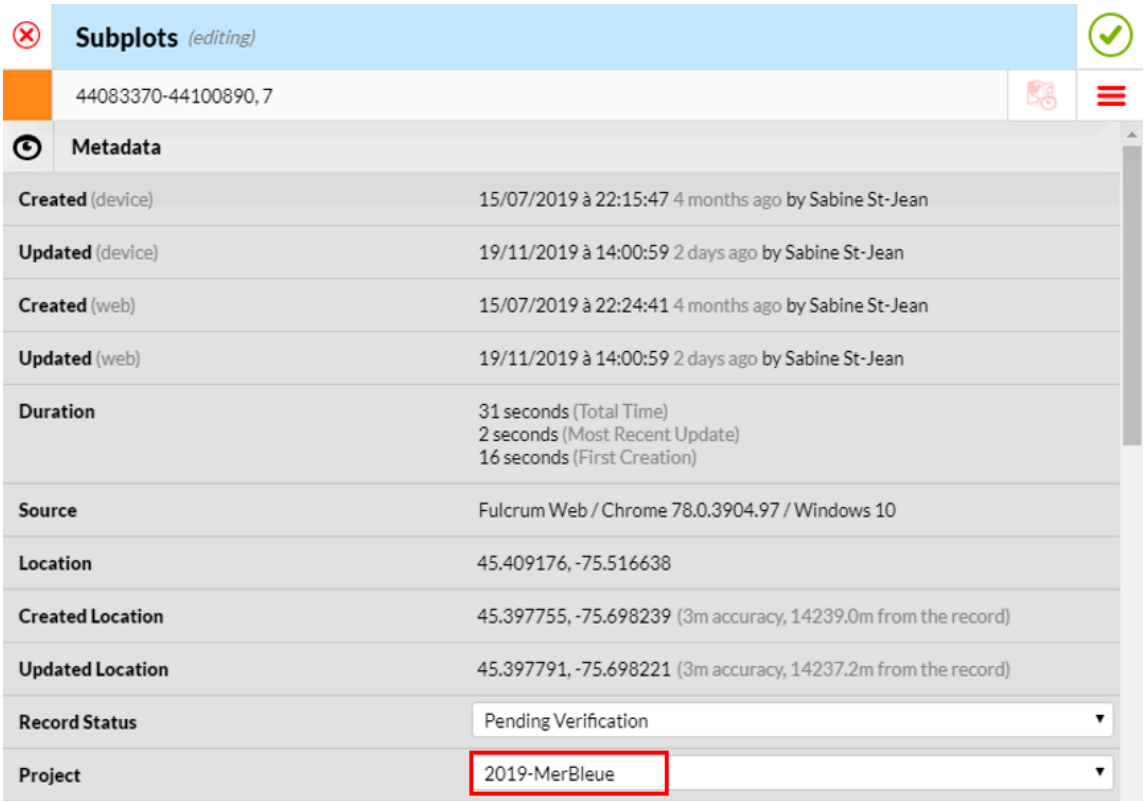
Sabine St-Jean submitted 2 records in Sites.
1 created 1 updated 0 deleted
3 days ago
Etienne Laliberté submitted 1 record in Vegetation Surveys: Herbs and Shrubs.
0 created 1 updated 0 deleted
3 days ago
Sabine St-Jean submitted 1 record in Vegetation Surveys: Herbs and Shrubs.
0 created 1 updated 0 deleted

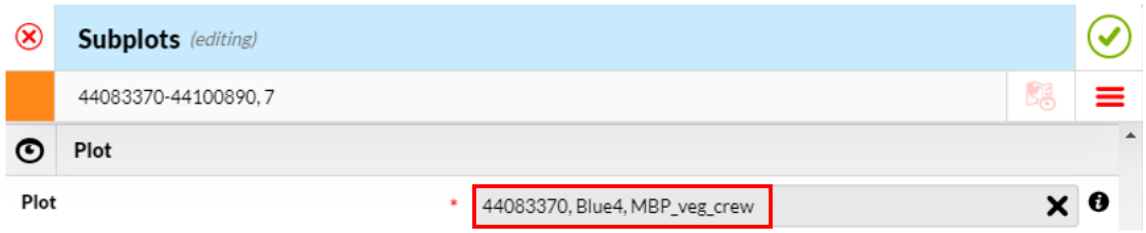


4.2 Create a new record under Subplots.

4.3 Under Subplots → Metadata → Project, select the appropriate project name (see Guidelines → Site Specific Infos).



4.4 Under Subplots → Plot → Plot, select the appropriate plot.



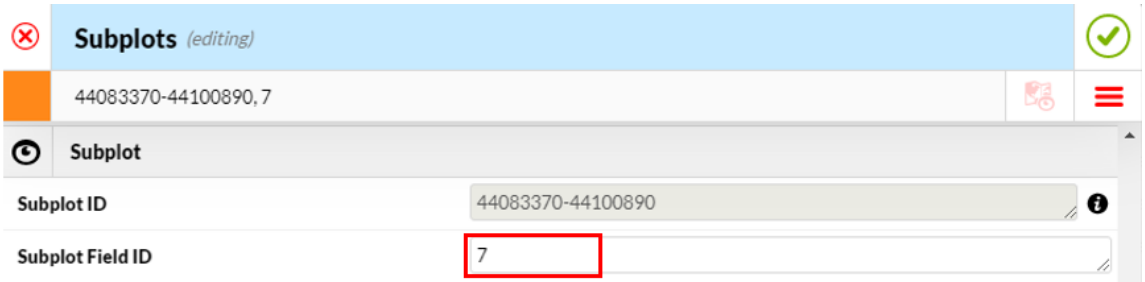
4.5 Under Subplots → Subplot → Subplot Field ID, enter a value between 1 and 9, according to the following image.

7 (-1, 1)	8 (0, 1)	9 (1, 1)
6 (-1, 0)	5 (0, 0)	4 (1, 0)
1 (-1, -1)	2 (0, -1)	3 (1, -1)

Representation of the positioning of the subplots within the plot, with the subplot field IDs (numbers from 1 to 9) and the (x, y) coordinates of every subplot (-1 to 1, -1 to 1) (to be used during step 4.8).

The numbers in parenthesis are used in accordance with the X-Y position from plot center subplot positioning method. The plot is virtually positioned on a plane, with the west-east axis being the x axis, and the north-south axis being the y axis. The numbers in parenthesis are the (x, y) coordinates of the subplot. The center of the plot (subplot 5) is defined as (0, 0).

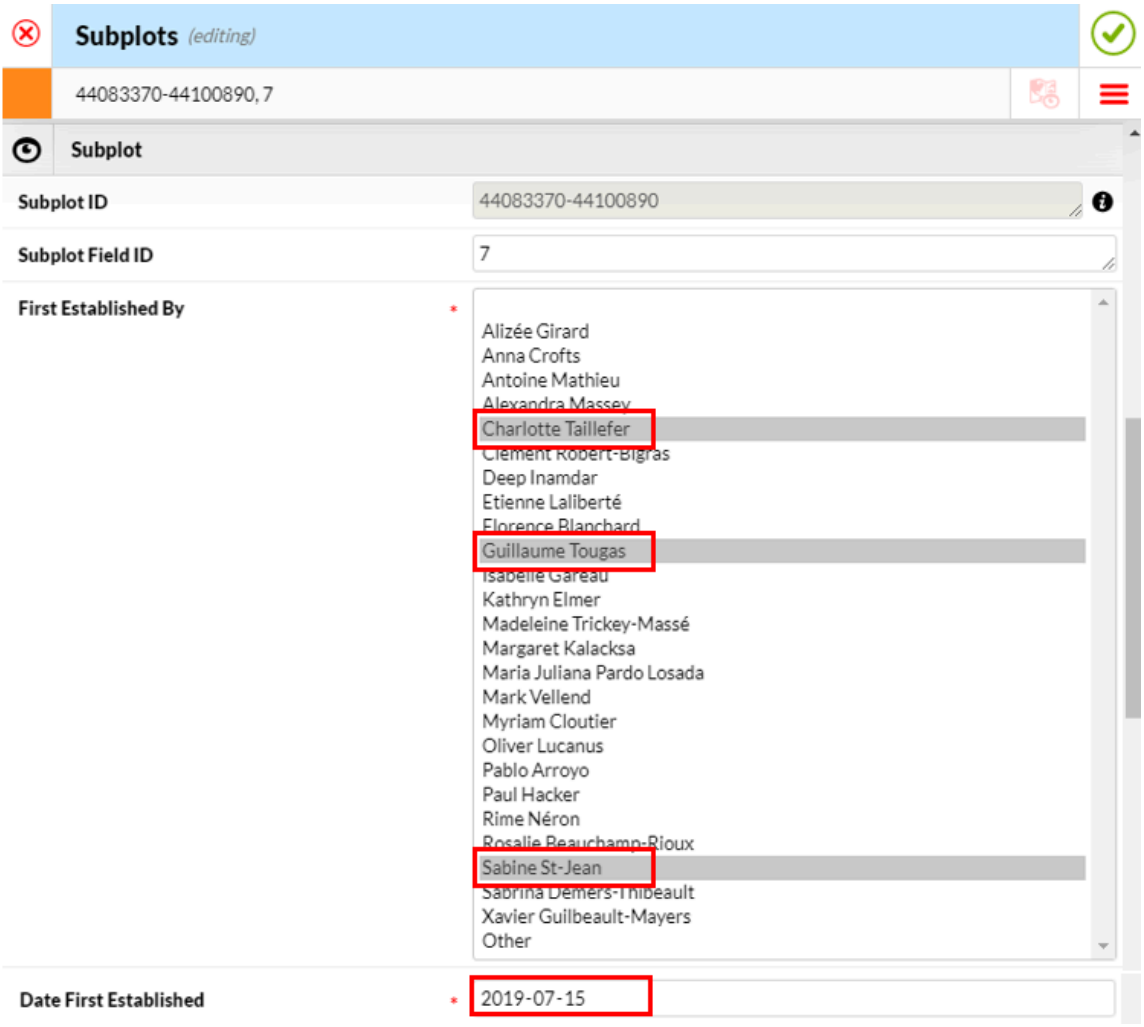
The numbers from 1 to 9 are the subplot field IDs. The layout of the subplot field IDs has been used consistently since 2018. It was first established by Etienne Laliberté (PI) in order to allow more ease of motion when taking the small drone pictures.



4.6 Under Subplots → Subplot, indicate the names of the team members (one or more) doing the subplot setup as well as the date of the subplot setup.

Note

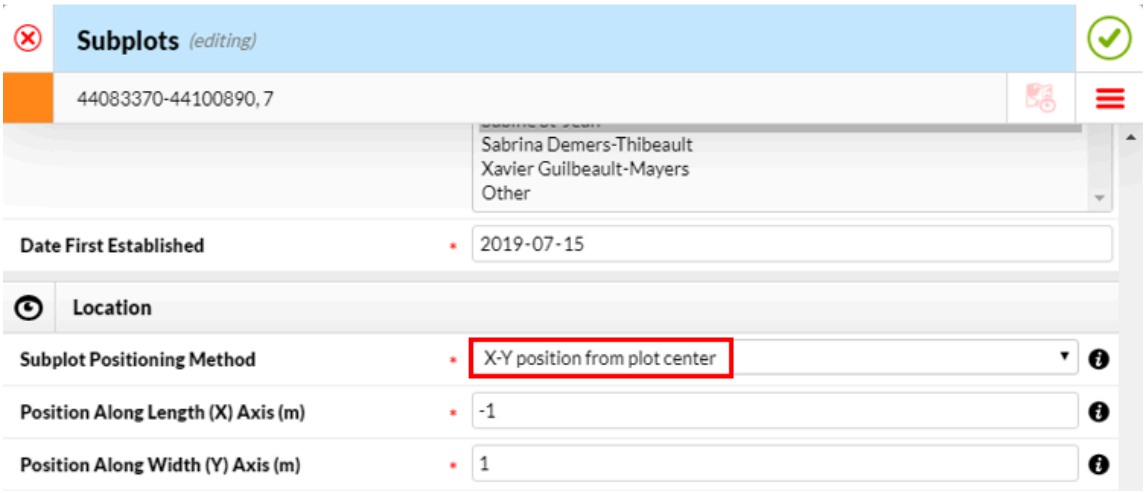
The default entries are the name of the person logged into *Fulcrum* and the current date.



4.7 Under Subplots → Location, select the Subplot Positioning Method : X-Y position from plot center.

Note

As positioning method "X-Y from plot center" is selected, there is no need to accurately georeference the subplots.

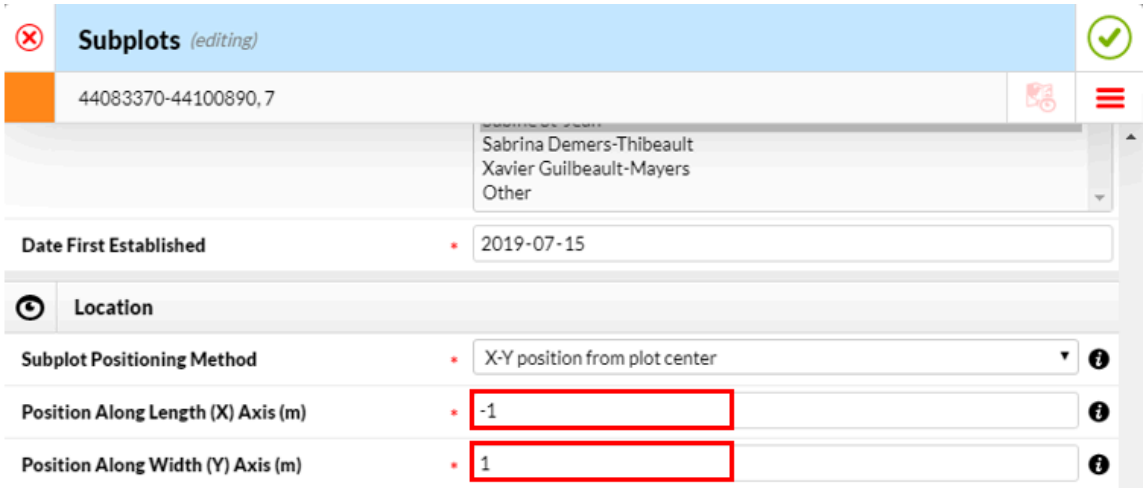


The positioning method X-Y position from plot center is described at step 4.5.

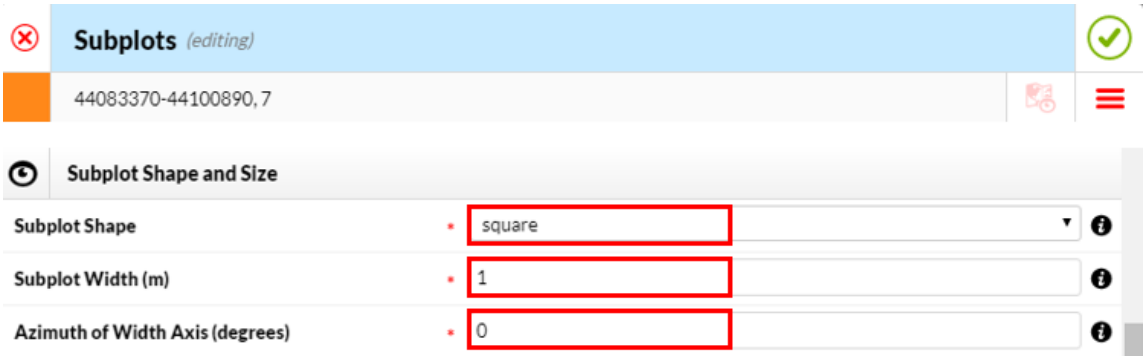
4.8 Under Subplots → Location, indicate the values for the Position Along Length (X) Axis (m) and the Position Along Width (Y) Axis (m): -1, 0 or 1 (according to the image from step 4.5).

Note

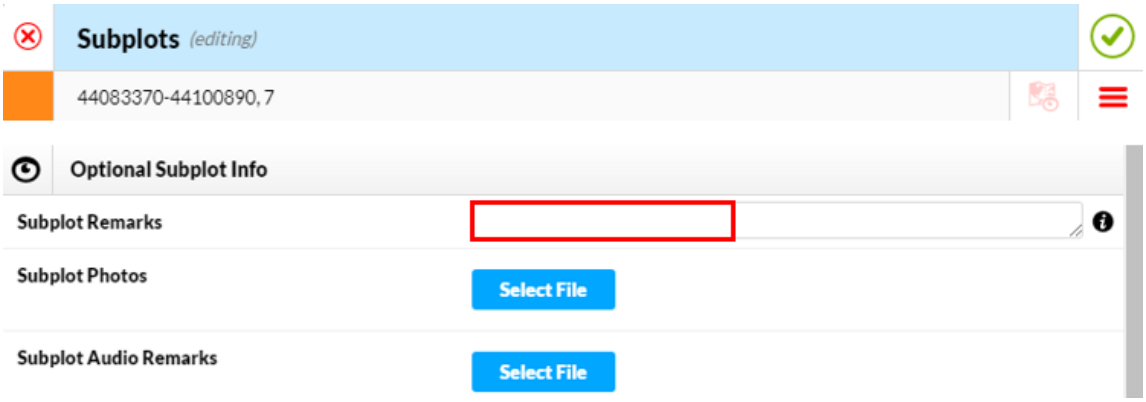
Étienne Laliberté (PI) prefers not to use default values here to allow for more flexibility when positioning the subplots. As of November 20, 2019, there are no default values available.



4.9 Under Subplots → Subplot Shape and Size, indicate the Subplot Shape (square), the Subplot Width (1 m) and the Azimuth of Width Axis (0°).

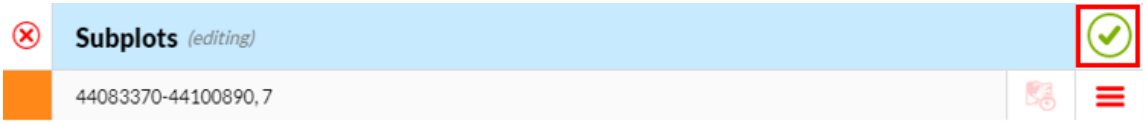


4.10 If desired, add any other relevant information under Optional Subplot Info.

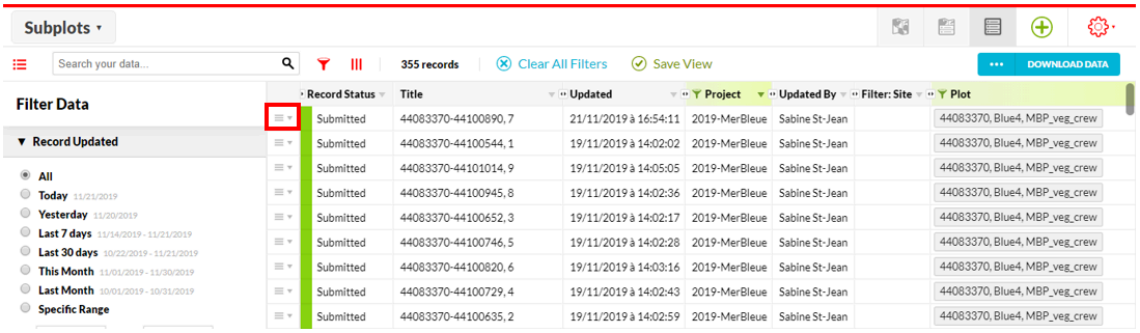


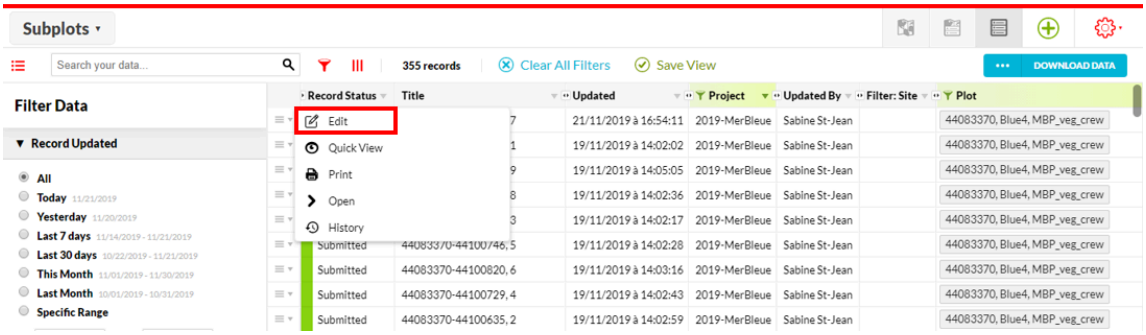
This optional field has not been used in the 2019 vegetation surveys.

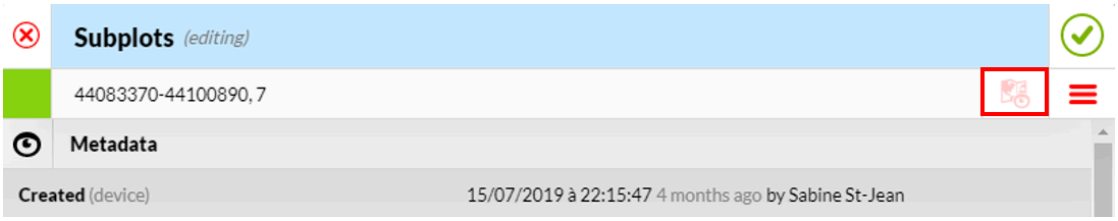
4.11 Save the data entry.



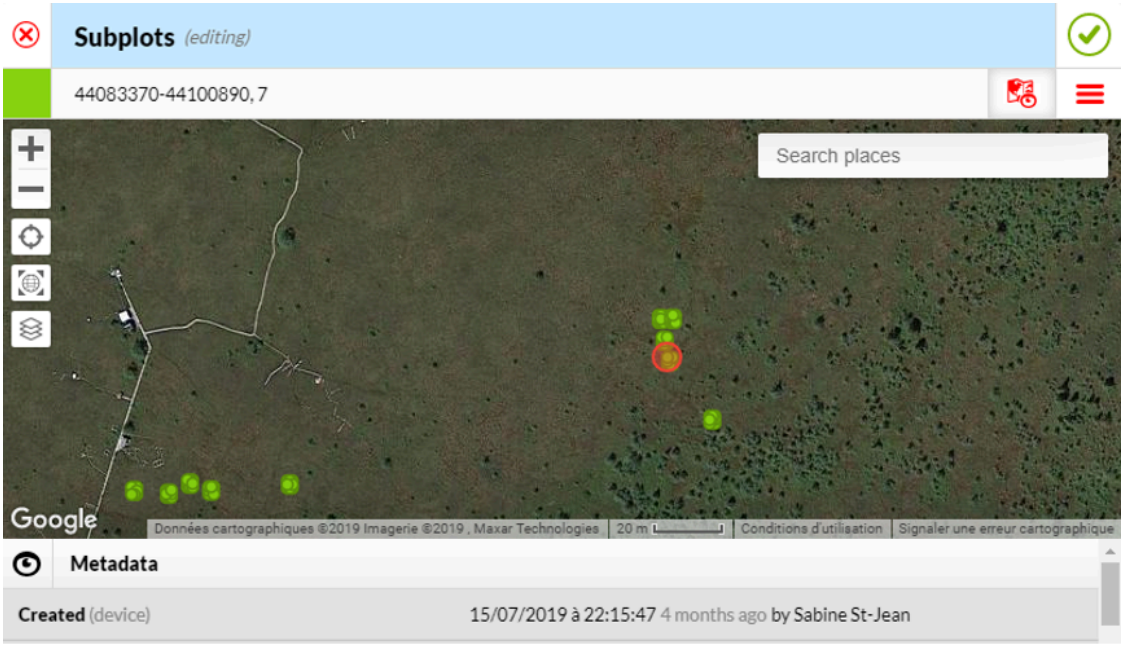
4.12 The subplots will automatically be placed on the map, in reference to the plot center. Verify that all the subplots (9 for each plot) appear on the map.







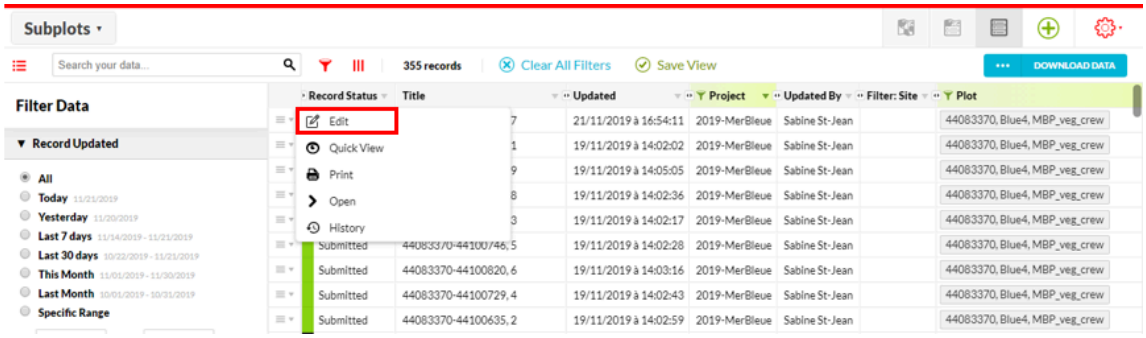
When clicking on the map icon, the following view will appear.



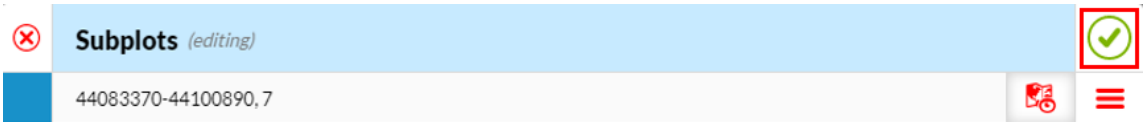
By zooming in, the 9 subplots will become visible.

If a subplot is missing, refer yourself to the configuration shown at step 4.5 to go back to the missing subplot record and check its (x, y) coordinates that need to be corrected.

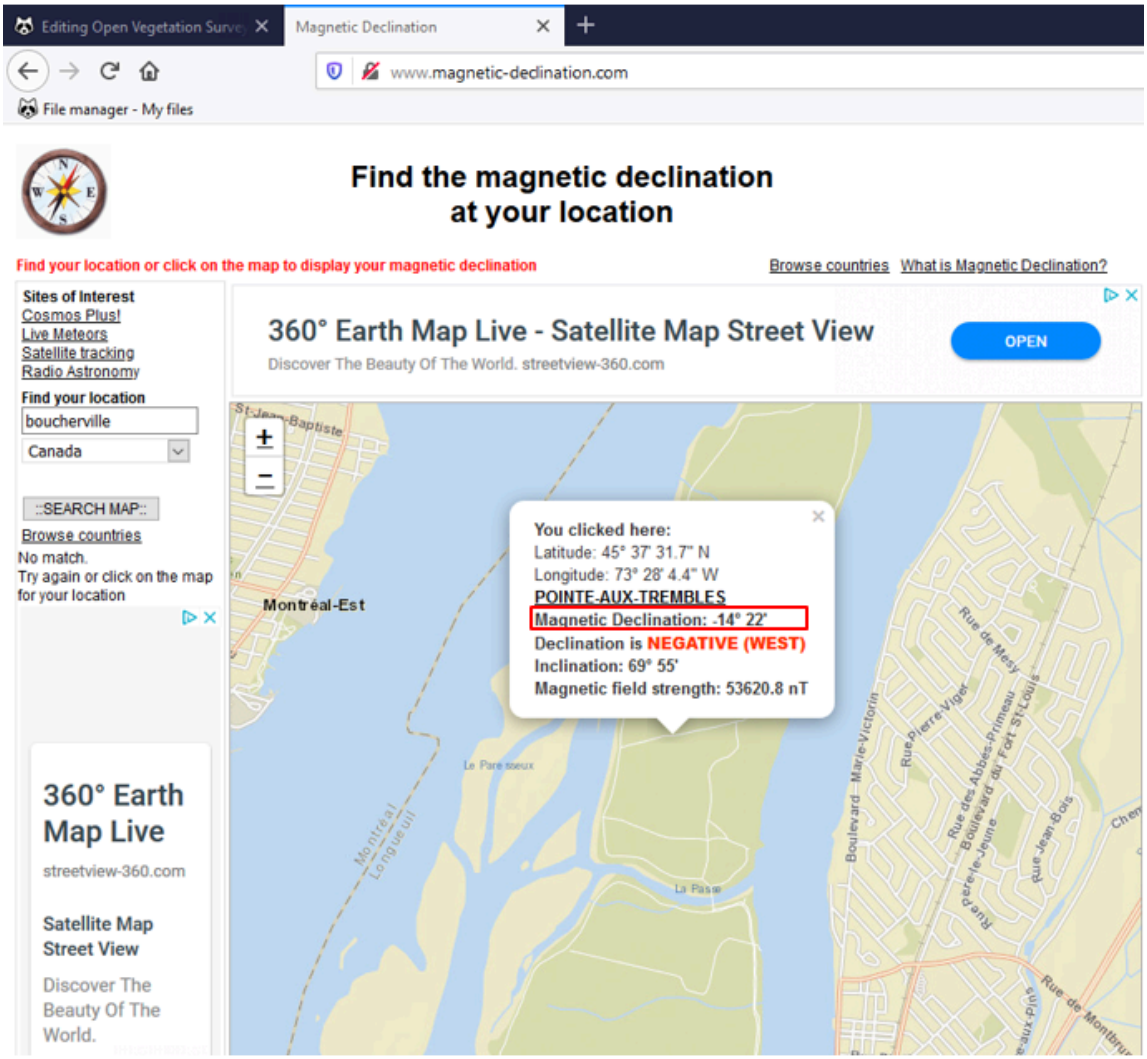
4.13 Update the Record Status of every correct subplot record by following the Menu icon → Edit → Record Status. In the drop-down list next to Record Status, change it from Pending verification to Verified and save that change. This has to be done one subplot at a time.


Subplots
Search your data...
355 records
Clear All Filters
Save View
DOWNLOAD DATA
Filter Data
Record Updated
All
Today
Yesterday
Last 7 days
Last 30 days
This Month
Last Month
Specific Range
Record Status
Title
Updated
Project
Updated By
Filter: Site
Plot
Edit
Quick View
Print
Open
History
Submitted
44083370-44100820, 6
44083370-44100729, 4
44083370-44100635, 2
19/11/2019 à 14:03:16
19/11/2019 à 14:02:43
19/11/2019 à 14:02:59
2019-MerBleue
Sabine St-Jean
44083370, Blue4, MBP_veg_crew

Subplots (editing)
44083370-44100890, 7
Search places
Google
Données cartographiques ©2019 Imagerie ©2019 , Maxar Technologies
50 m
Conditions d'utilisation
Signaler une erreur cartographique
Location
45.409176, -75.516638
Created Location
45.397755, -75.698239 (3m accuracy, 14239.0m from the record)
Updated Location
45.397791, -75.698221 (3m accuracy, 14237.2m from the record)
Record Status
Pending Verification
Project
2019-MerBleue



5 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 Installation

6 Begin setting up the highest-priority plot for the vegetation survey. Ensure that the central part of the plot is representative of the larger 3×3m area (i.e.: there are no drastic changes in vegetation within the plot).

Equipment

new equipment NAME

Plot prioritization list BRAND

- SKU

Equipment

new equipment NAME

CAT S41 fieldwork cellphone BRAND

- SKU

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

Equipment

new equipment

NAME

Plant press and newspaper

BRAND

-

SKU

Equipment

Laser Geo

NAME

Haglöf Sweden

BRAND

-

SKU

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

LINK

Equipment

new equipment

NAME

Loop stake

BRAND

-

SKU

https://bosmereusa.com/Product.asp?_Brand=All&_Group=Outlet-Store&_pcode=E461

LINK

About 40 cm long

SPECIFICATIONS

Note

If precise GPS coordinates of the 4 corners are recorded before moving to the next plot (see step 19), the plot stakes don't have to be installed.

6.1 Write the Plot field ID on a piece of flagging tape and tie it to a loop stake, without positioning it.

6.2 Use the COMPASS function of the Laser Geo to visualize a 0° – true north alignment. Position the loop stake as the southwest corner of the plot. Make sure the representative portion of the plot is about 1.5 meters northeast from where you position the loop stake.

Note

When using the Laser Geo, temporarily move the loop stake aside as it causes magnetic interference with the compass function of the Laser Geo.

Note

NOTES ON USING THE LASER GEO:
- The buttons are facing up;
- Place yourself in a sitting position, with your eye in the hole (objective) of the Laser Geo;
- Aim by maintaining a pressure on the orange button;
- Look at the value that appears on the side screen.

7 Assemble the PVC grid.

Note

Avoid disturbance to the plot at all costs, and to the neighbouring area as much as possible.

Once the grid is assembled, it can be carried from plot to plot by a minimum of 2 people. This avoids disassembling and reassembling it multiple times, thus saving a lot of time.

Equipment

new equipment

NAME

24 rigid PVC pipes (top of frame), ¾'', 1 m long

BRAND

-

SKU

To be used as the frame horizontal structure, labelled with the subplot number they belong to.

SPECIFICATIONS

Equipment

new equipment

NAME

16 rigid PVC pipes (legs), ¾'', appropriate height

BRAND

-

SKU

To be used as the legs, according to the vegetation height.
Heights:
- 0,37 m: this height allows for the scaffold to be placed over the grid (see the Vegetation Survey part of this protocol).
- 1 m
- 1,5 m

SPECIFICATIONS

Equipment

new equipment

NAME

16 PVC connectors for the intersections, ¾''

BRAND

-

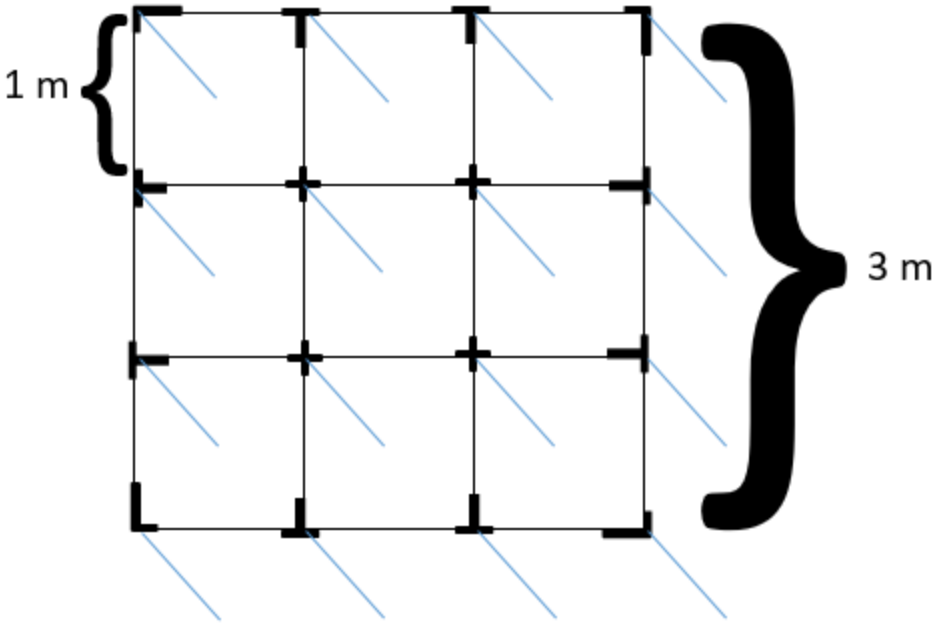
SKU

http://www.leevalley.com/us/garden/page.aspx?cat=2,2030&p=67332

LINK

4 corner pieces: L-shaped with a leg junction
8 side pieces: T-shaped with a leg junction
4 middle pieces: X-shaped with a leg junction

SPECIFICATIONS



Layout of the grid.
Figure legend:

7.1 First, set up the top of the grid, using the 24 rigid PVC pipes (top of frame) of 1 m long and the 16 PVC connectors for the intersections.

7.2 Then, add the legs of the appropriate height (16 PVC pipes).

8 Align the PVC grid.

Equipment

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

8.1 Have the Laser Geo rest directly on the southwest corner of the PVC grid (the one marked with the loop stake). Use the COMPASS function of the Laser Geo to align the PVC grid. The grid should already be close to perfectly aligned so that only minor adjustments are needed.

Note

Temporarily move the loop stake aside as it causes magnetic interference with the compass function of the Laser Geo.

Note

If precise GPS coordinates of the 4 corners are recorded before moving to the next plot (see step 19), the plot stakes don't have to be installed.

8.2 First, from the southwest corner, face north and turn the frame so that it has a 0° (± 2°) – true north alignment.

8.3 From the same corner, face east and ensure a 90° (± 2°).

9 Verify that adjacent plot corners are 3.00 ± 0.01 meters apart, using the tape measure to measure* to length of one side of the grid at a time.
*: From one inner corner to another, to avoid couting the width of the frame in the measurement.

Equipment

new equipment

NAME

Tape Measure

BRAND

-

SKU

10 Install stake wire flags on the 3 unmarked corners.

Equipment

new equipment

NAME

3 Stake wire flags

BRAND

-

SKU

https://www.homedepot.com/p/Empire-3-5-in-x-2-5-in-Pink-Stake-Flags-100-Pack-78-003/301387971

LINK

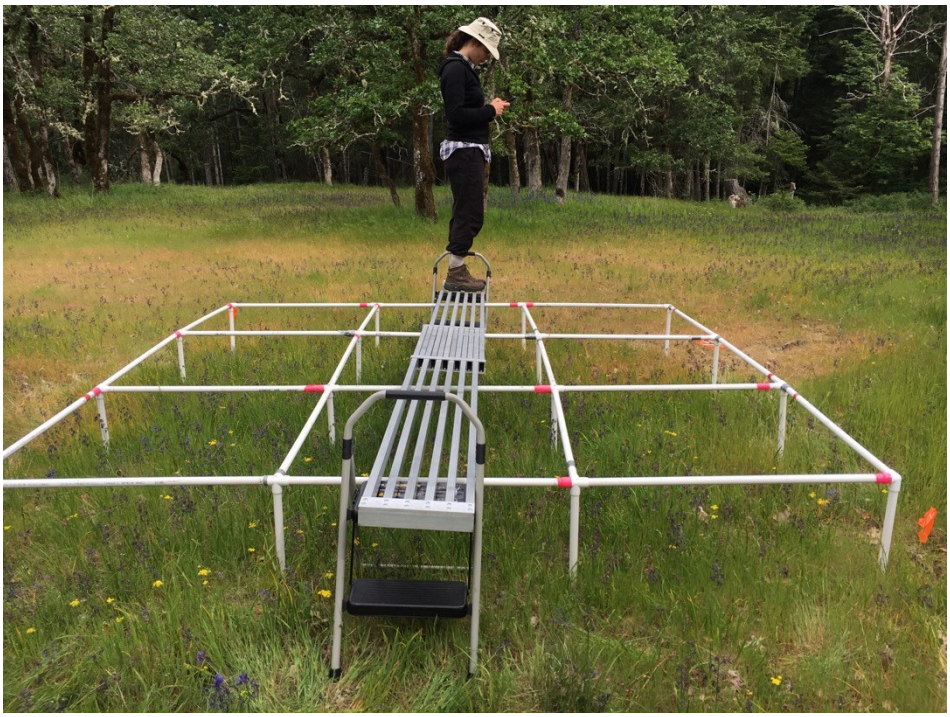
About 50 cm long, 3.5'' x 2.5'' pink or orange vinyl flags on wire stakes

SPECIFICATIONS

Note

If precise GPS coordinates of the 4 corners are recorded before moving to the next plot (see step 19), the plot stakes don't have to be installed.

11 Install the scaffold on top of the grid, across its middle row, having it rest on a 2 step steel ladder on each side.



Such placement allows 6 subplots to be surveyed without having to move the scaffold. The scaffold will later be moved (step 16.9) in order to survey the 3 underlying subplots.

Equipment

new equipment

NAME

2 Step Steel Step Ladders (2)

BRAND

-

SKU

https://www.homehardware.ca/en/2-step-steel-step-ladder/p/5435581#ccode=1525535417245

LINK

CGOP site only.

SPECIFICATIONS

Equipment

new equipment

NAME

3 m long Telescopic Aluminum Scaffold Plank

BRAND

-

SKU

https://www.homehardware.ca/en/6-9-telescoping-aluminum-scaffold-plank/p/5435115#ccode=1525535417245

LINK

CGOP site only.

SPECIFICATIONS

12 Update the approximate location of the plot center.

Equipment

new equipment

NAME

CAT S41 fieldwork cellphone

BRAND

-

SKU

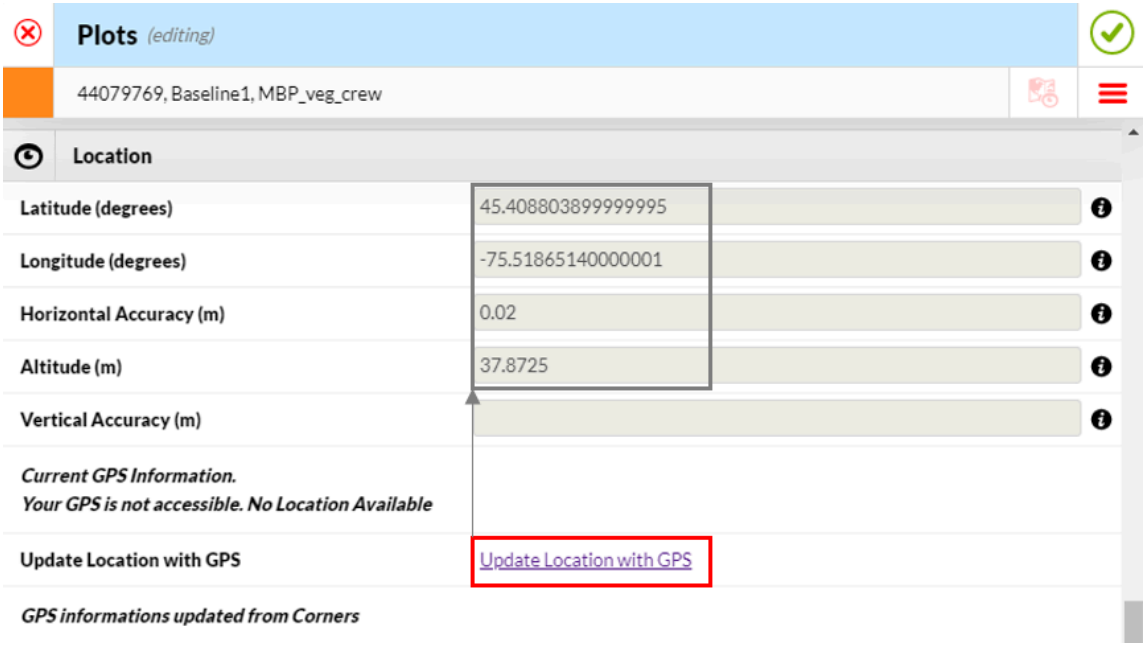
https://www.catphones.com/en-us/cat-s41-smartphone/

LINK

Note

If no scaffold is used, simply extend your arm towards the center of the plot.

12.1 Under Plots → Location, click on Update Location with GPS on a fieldwork cellphone. This will automatically generate numbers in the Latitude and Longitude fields.



13 Record the slope of the plot.

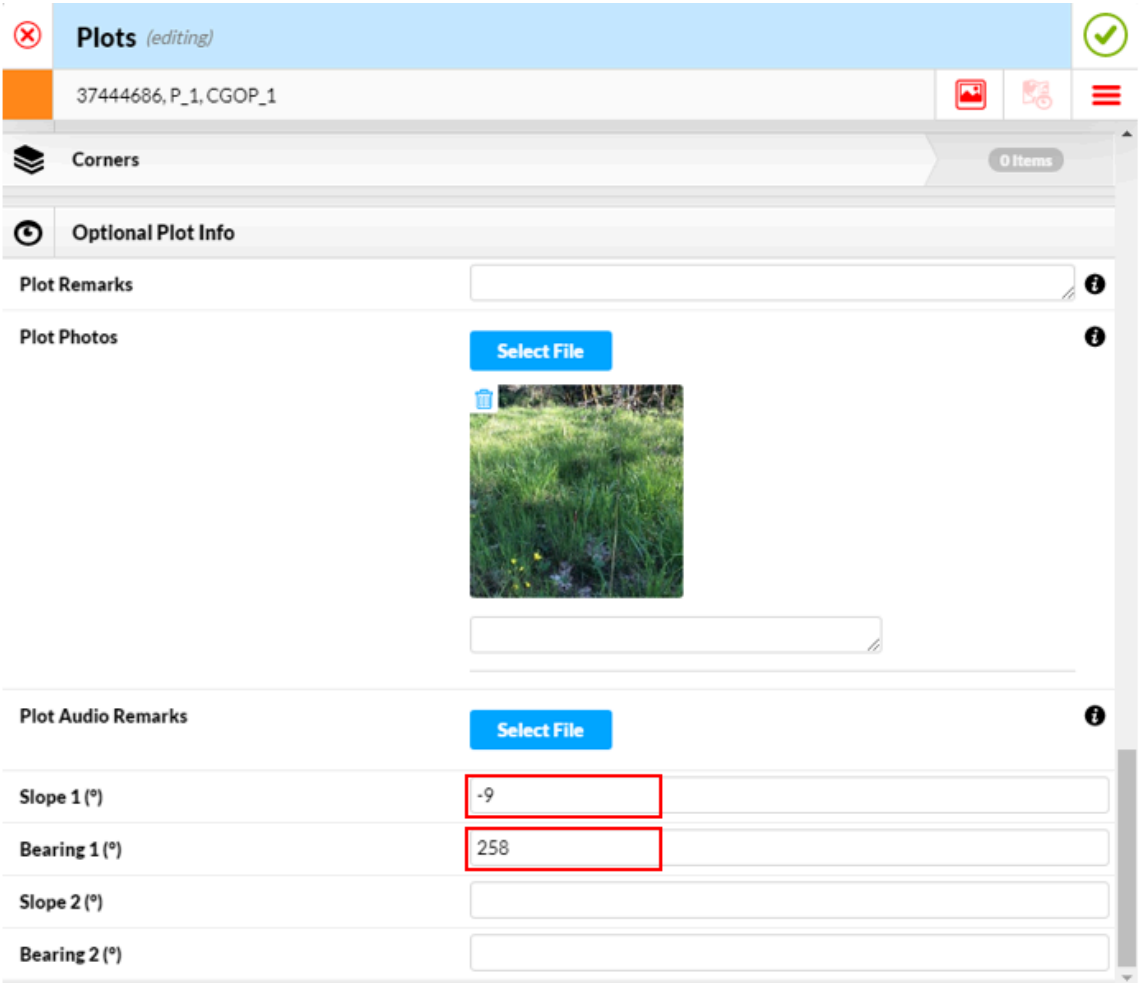
Equipment

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

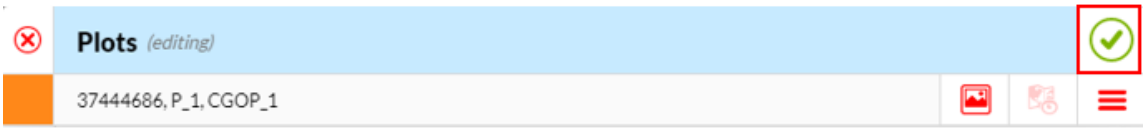
Equipment

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

13.1 Laying the Laser Geo on the frame of the grid, facing the direction of the steepest slope, measure to the nearest degree the inclination (ANGLE → DEG) and orientation (COMPASS) of the slope* under the plot and enter those values under Plots → Optional Plot Info → Slope 1 (inclination) and Bearing 1 (orientation).
*Ignore Slope 2 and Bearing 2. Open vegetation plots are normally not that inclined (vs forest plots), so one slope is sufficient to characterize them.



13.2 Save the data entry.



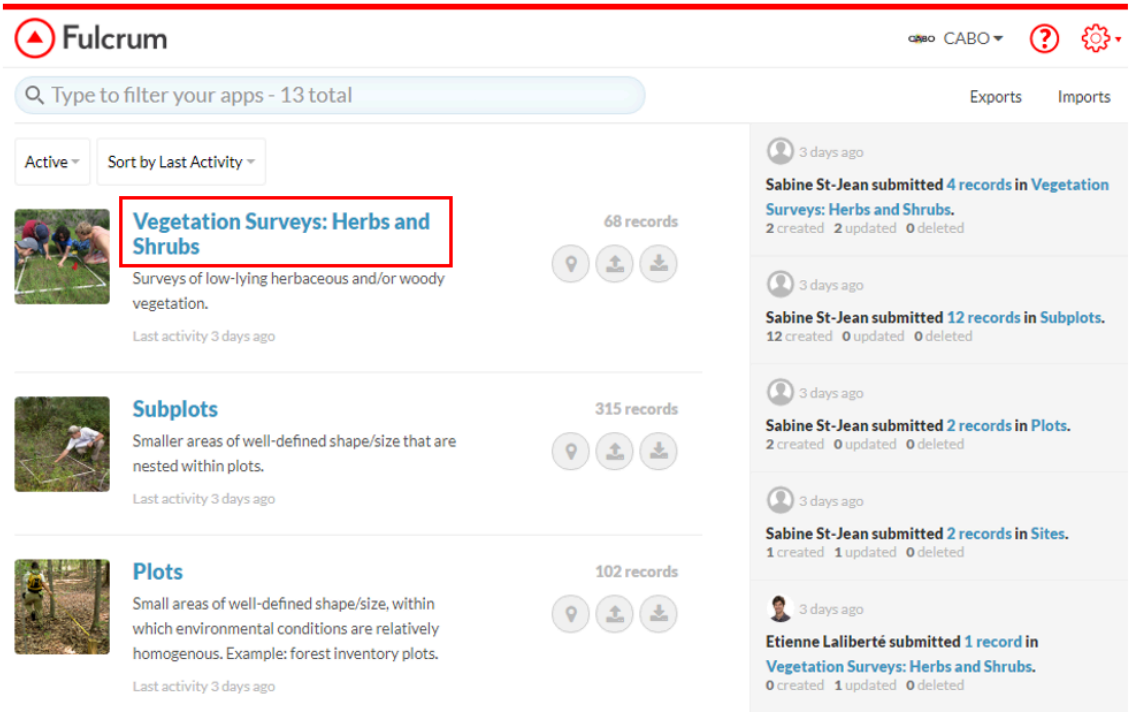
Vegetation Survey: Creation

14 Enter the contextual information for the vegetation survey in *Fulcrum* → Vegetation Surveys: Herbs and Shrubs.

Equipment

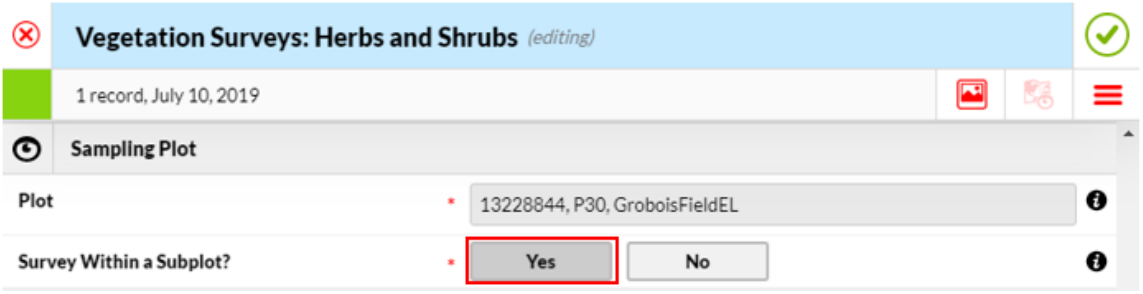
NAME	BRAND	SKU	LINK
new equipment	CAT S41 fieldwork cellphone	-	https://www.catphones.com/en-us/cat-s41-smartphone/

14.1 From the *Fulcrum* main menu, select the Vegetation Surveys: Herbs and Shrubs app. The basic sequence of things in *Fulcrum* is similar to creating a new plot (record creation, project selection, names of the team members, date of the inventory).



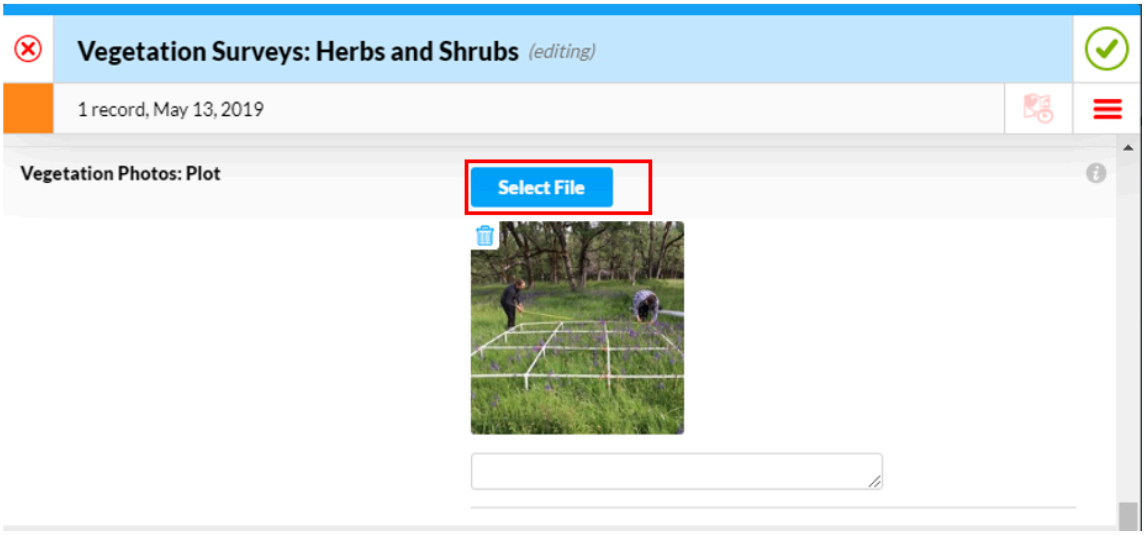
14.2 Under Vegetation Surveys: Herbs and Shrubs → Sampling Plot → Plot, select the appropriate plot.

14.3 Under Vegetation Surveys: Herbs and Shrubs → Sampling Plot → Survey within a subplot?, answer Yes.



Photos

15 If NO small drone photos are taken:
With your field cellphone, take a photo of the whole plot (from the south side of the PVC grid, from eye-level when standing, so that the whole plot is visible) and import it in *Fulcrum* under Vegetation Surveys: Herbs and Shrubs → Survey Event → Vegetation Photos: Plot, then save your record.



16 Refer yourself to the Small Drone Photos - Open Vegetation Protocol to take pictures of the plots and subplots.

Equipment

Mavic Air	NAME
Drone	TYPE
DJI	BRAND
-	SKU
https://store.dji.com/product/mavic-air?vid=38961	LINK

Equipment

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

Equipment

Go 4	NAME
App	TYPE
DJI	BRAND
-	SKU
The application used to connect your cellphone to the drone controller. Your cellphone then becomes the screen interface to control the drone.	SPECIFICATIONS

Equipment

Wood pannel for take-off and landing	NAME
-	TYPE
-	BRAND
-	SKU

Vegetation Surveys: Plots

17 List all of the species occurring in the plot.

Equipment

new equipment

NAME

Identification guides

BRAND

-

SKU

See Open Vegetation Survey Protocol → Guidelines → Site Specific Information.

SPECIFICATIONS

Equipment

new equipment

NAME

2 Step Steel Step Ladders (2)

BRAND

-

SKU

https://www.homehardware.ca/en/2-step-steel-step-ladder/p/5435581#ccode=1525535417245

LINK

CGOP site only.

SPECIFICATIONS

Equipment

new equipment	NAME
3 m long Telescopic Aluminum Scaffold Plank	BRAND
-	SKU
https://www.homehardware.ca/en/6-9-telescoping-aluminum-scaffold-plank/p/5435115#ccode=1525535417245	LINK
CGOP site only.	SPECIFICATIONS

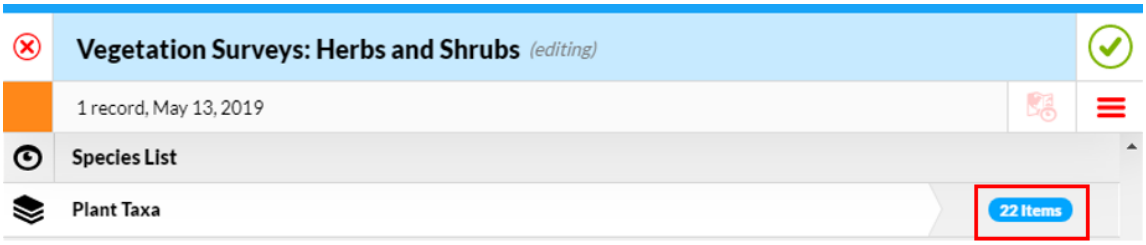
Note

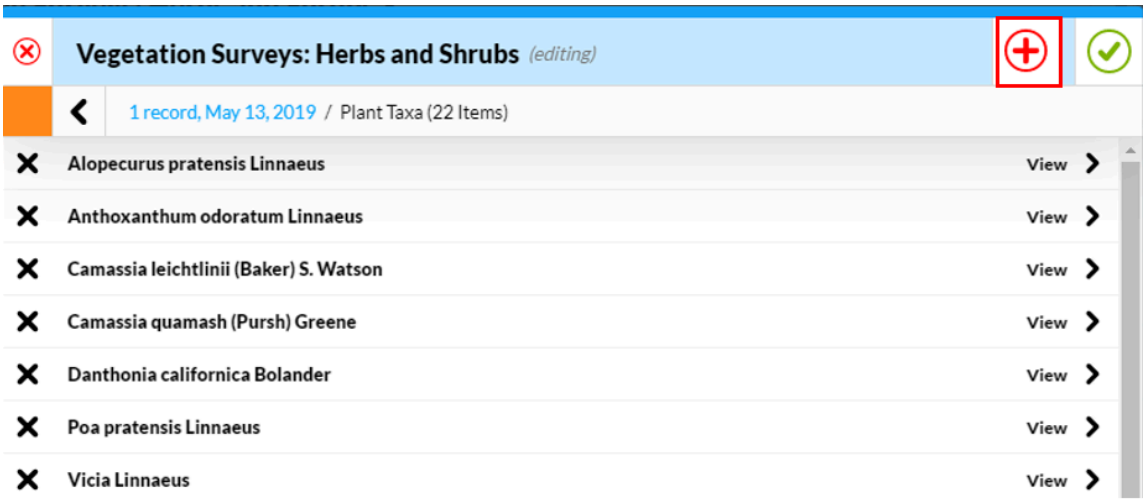
This step is done by the entire vegetation survey team, with everyone identifying and calling out species to one person who records them in *Fulcrum*. Uncertain identifications are discussed among team members.

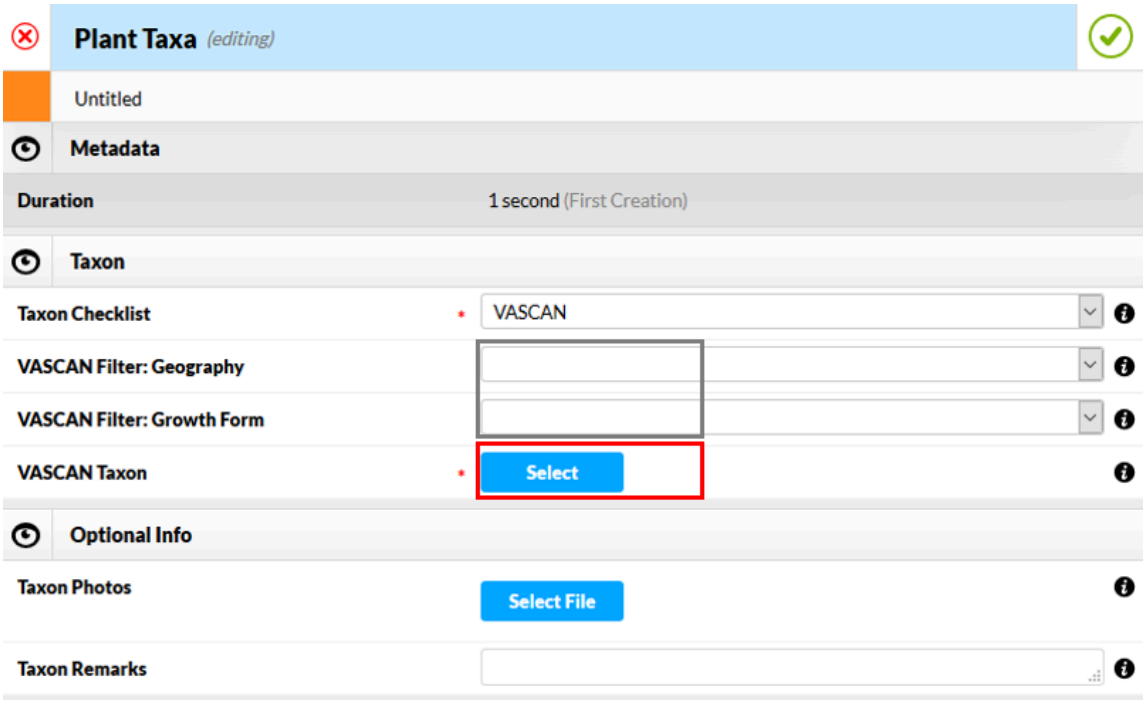
17.1 Under Vegetation Surveys: Herbs and Shrubs → Species List → Plant Taxa, create the species list by selecting species present in the plot one by one from the provided VASCAN list.

Note

The VASCAN list contains the Latin names only. Geography and growth form filters are optional.

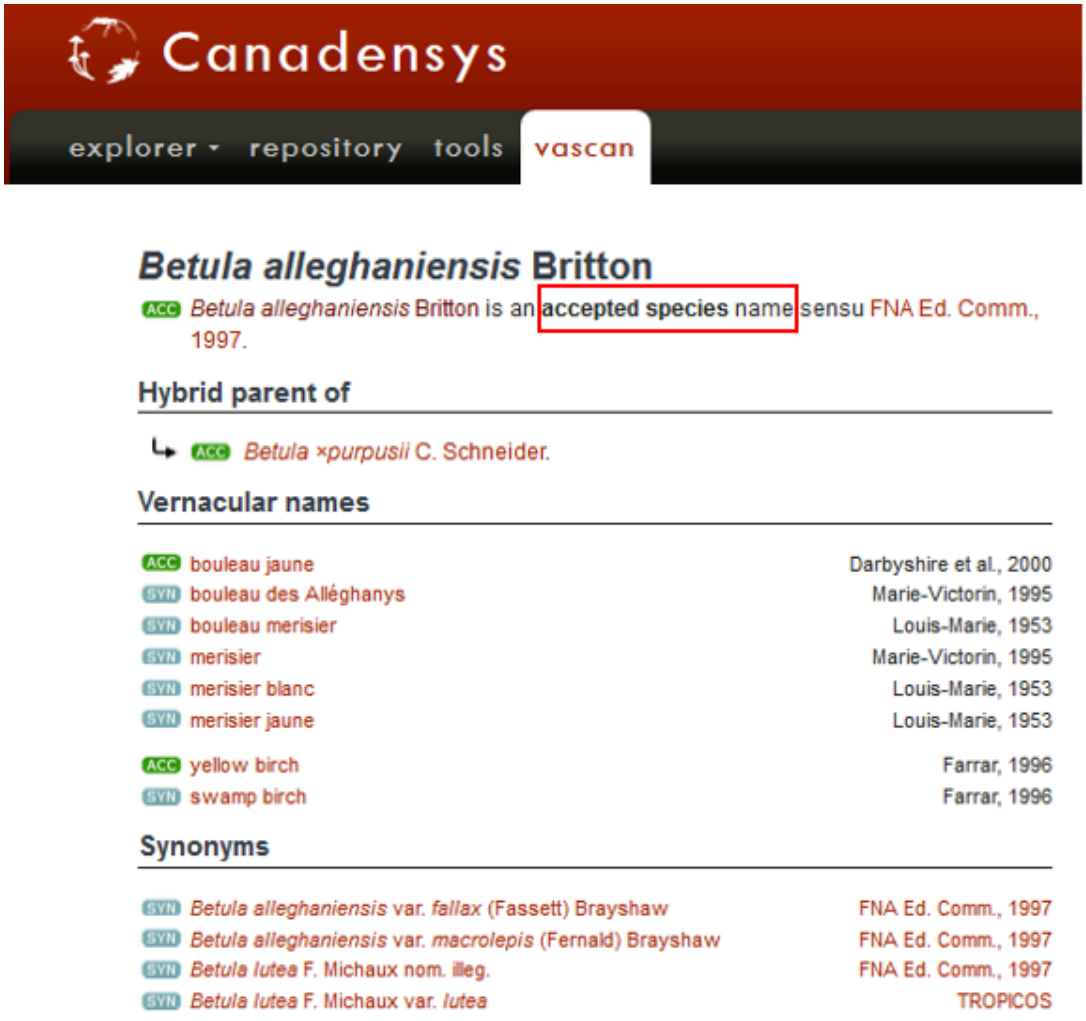



Vegetation Surveys: Herbs and Shrubs (editing)
1 record, May 13, 2019 / Plant Taxa (22 Items)
Alopecurus pratensis Linnaeus View
Anthoxanthum odoratum Linnaeus View
Camassia leichtlinii (Baker) S. Watson View
Camassia quamash (Pursh) Greene View
Danthonia californica Bolander View
Poa pratensis Linnaeus View
Vicia Linnaeus View

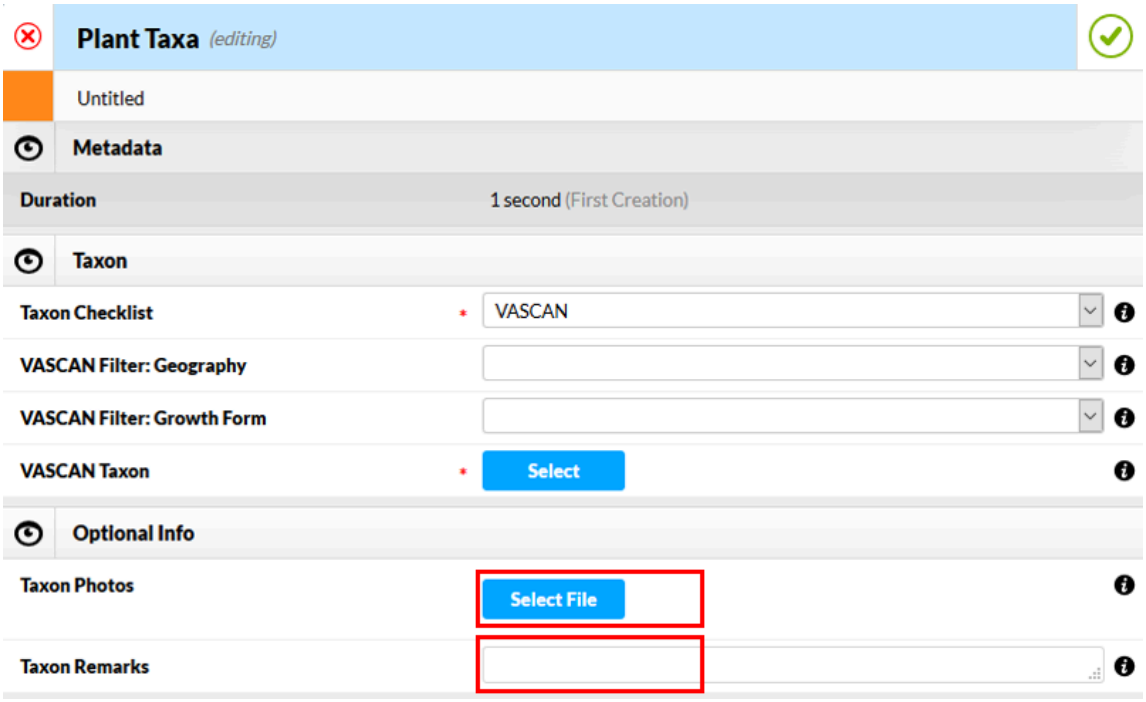

Plant Taxa (editing)
Untitled
Metadata
Duration 1 second (First Creation)
Taxon
Taxon Checklist VASCAN
VASCAN Filter: Geography
VASCAN Filter: Growth Form
VASCAN Taxon Select
Optional Info
Taxon Photos Select File
Taxon Remarks

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.



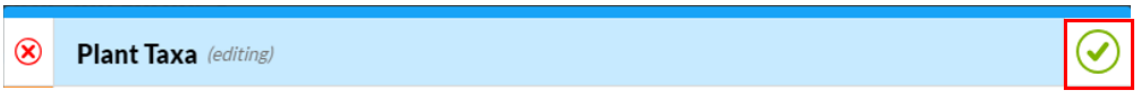
17.2 Optional info, such as photos, can be added for each species.



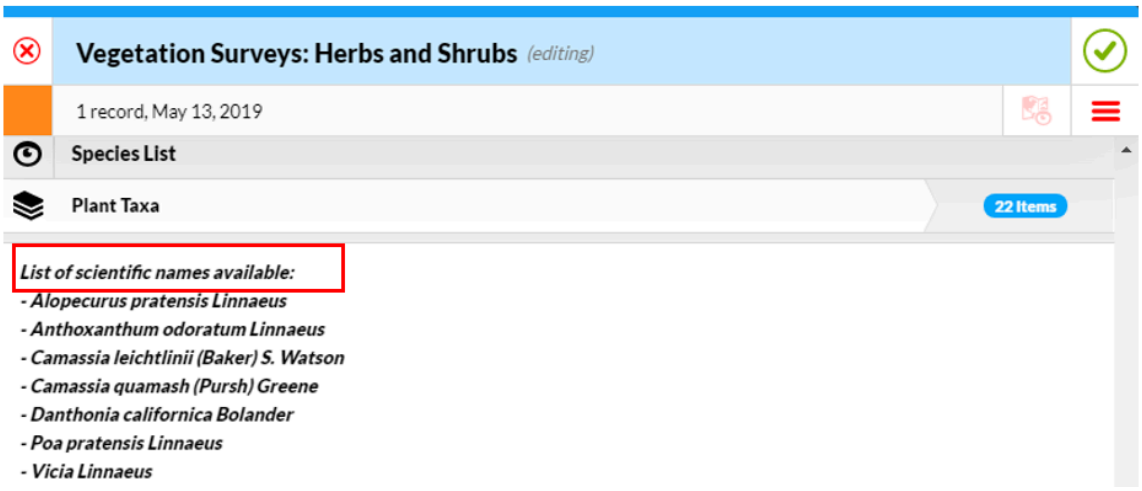
Note

Photos and remarks are especially useful for specimens for which you are unsure of the identification. For these, also collect a herbarium specimen (step 21). Temporarily name that species with a taxon that does not occur in your field site. When you have the required resources to proceed to the identification, update its name in *Fulcrum*.

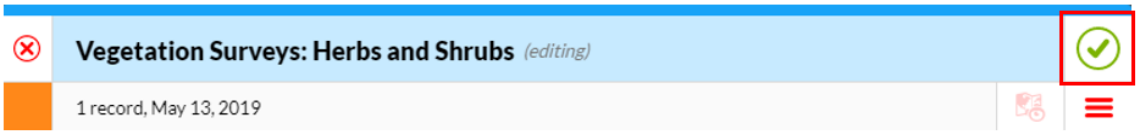
17.3 Save each individual species record with the checkmark button.



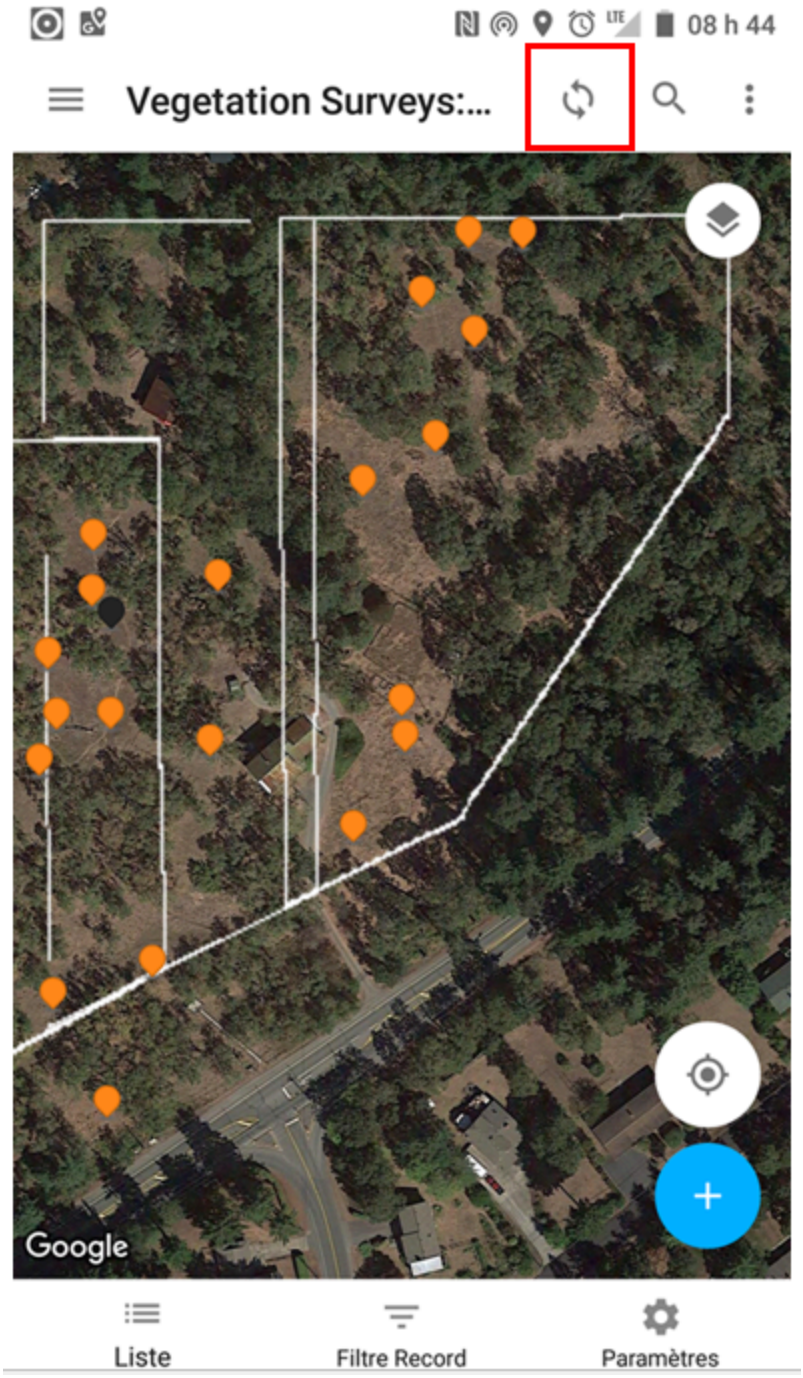
17.4 As species are selected, the List of scientific names for species present the plot is automatically created and updated under Vegetation Surveys: Herbs and Shrubs → Species List → Plant Taxa.



17.5 Save your edits.



17.6 Synchronize your *Fulcrum* app at the end of this process.



Vegetation Surveys: Subplots

18 For each subplot, create a list of all the species present. If no small drone images are taken, also record a visual estimate of percent cover (to the closest 1%). If small drone images are taken, enter a description of the distribution of every plant species (see 17.6

for guidelines) under Cover Remarks. The latter option is preferred as it provides spatial distribution information.

Equipment

new equipment	NAME
3 Square canopy cover negative templates	BRAND
-	SKU
1% = 10 × 10 cm 5% = 22,4 × 22,4 cm 10% = 31,6 × 31,6 cm	SPECIFICATIONS

Equipment

new equipment	NAME
Identification guides	BRAND
-	SKU
See Open Vegetation Survey Protocol → Guidelines → Site Specific Information.	SPECIFICATIONS

Equipment

new equipment

NAME

2 Step Steel Step Ladders (2)

BRAND

-

SKU

https://www.homehardware.ca/en/2-step-steel-step-ladder/p/5435581#ccode=1525535417245

LINK

CGOP site only.

SPECIFICATIONS

Equipment

new equipment

NAME

3 m long Telescopic Aluminum Scaffold Plank

BRAND

-

SKU

https://www.homehardware.ca/en/6-9-telescoping-aluminum-scaffold-plank/p/5435115#ccode=1525535417245

LINK

CGOP site only.

SPECIFICATIONS

Equipment

new equipment NAME

CAT S41 fieldwork cellphone BRAND

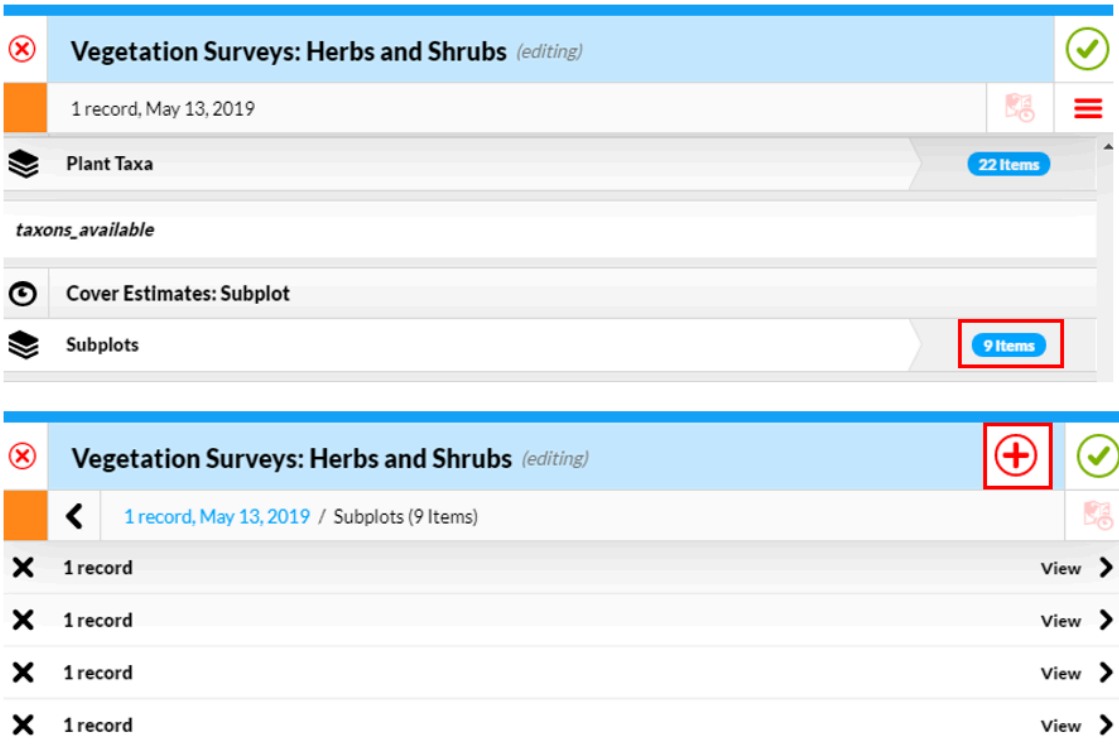
- SKU

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

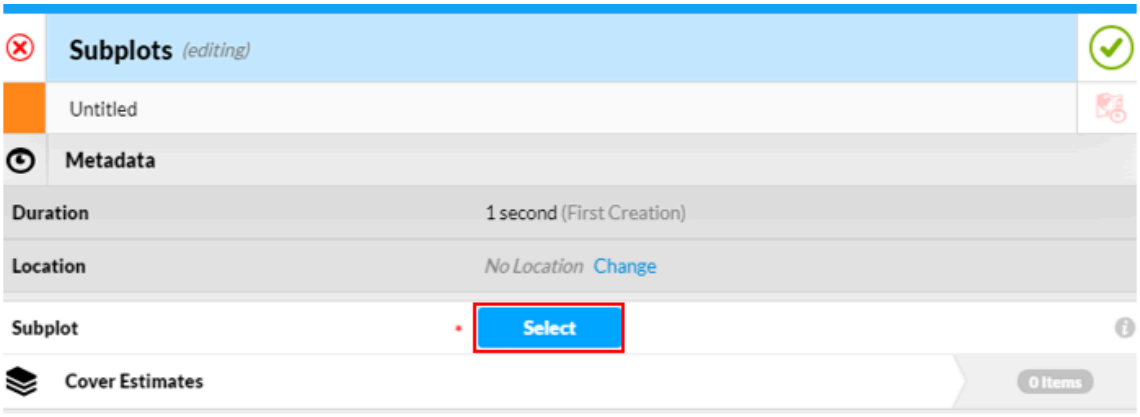
Note

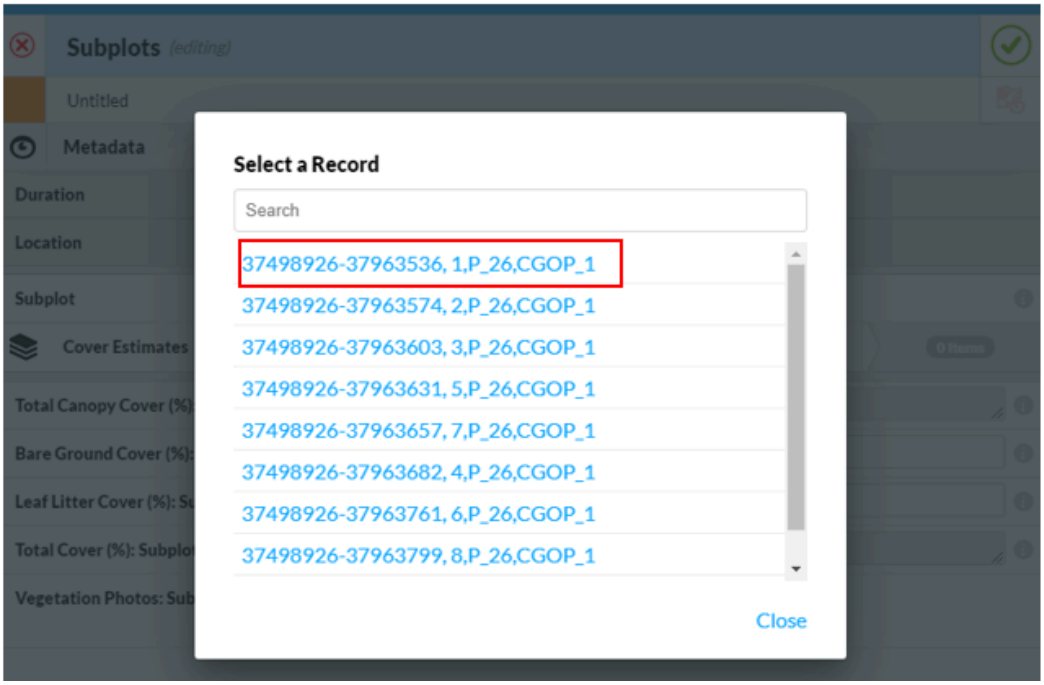
For the first plot(s), the technician and interns work together, one subplot at a time to confirm species identification and canopy cover estimates. As they gain confidence, they work separately on 3 subplots at a time, with verification as needed.

18.1 Under Vegetation Surveys: Herbs and Shrubs → Cover Estimates: Subplot, create a new subplot entry by clicking on the items and the plus buttons.

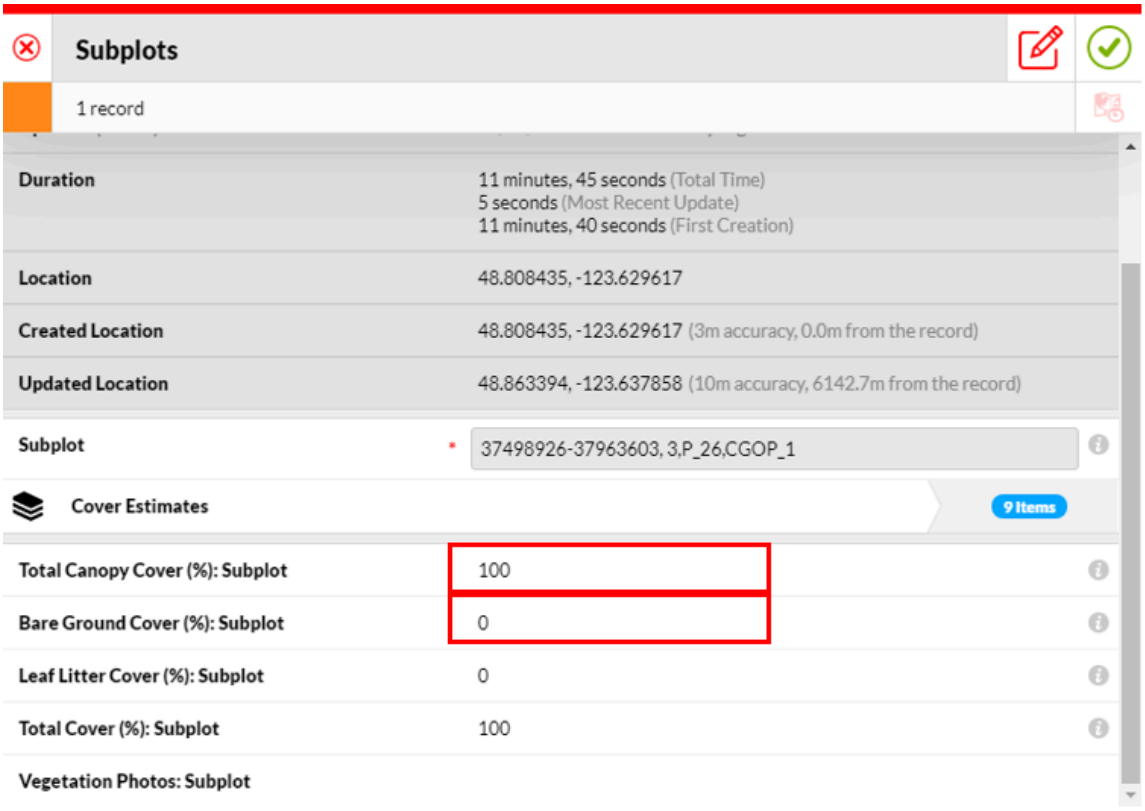


18.2 Under Vegetation Surveys: Herbs and Shrubs → Cover Estimates: Subplot → Subplots → Metadata, select the subplot number [# from 1 to 9] for which a record will be created.





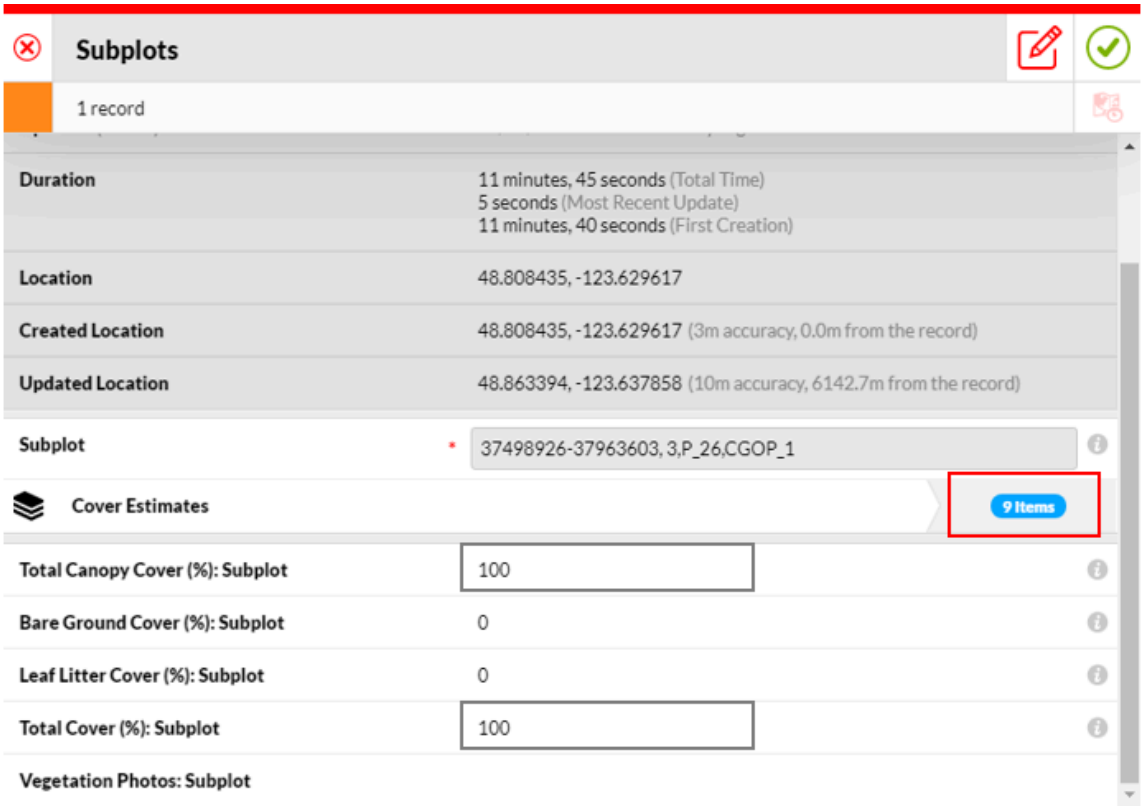
18.3 If NOT taking small drone pictures:
Under Vegetation Surveys: Herbs and Shrubs → Cover Estimates: Subplot → Subplots → Record [# from 1 to 9] → Cover Estimates, enter directly the Cover Estimates for the Bare Ground (i.e.: ground (soil or rocks) with no vegetation on it) and Leaf Litter (i.e.: dead leaves).



18.4 Under Vegetation Surveys: Herbs and Shrubs → Cover Estimates: Subplot → Subplots → Record [# from 1 to 9] → Cover Estimates, enter each plant species observed inside the subplot by clicking on the items and then the plus buttons.

Note

The Total Canopy Cover (%): Subplot and Total Cover (%): Subplot fields will automatically be updated.



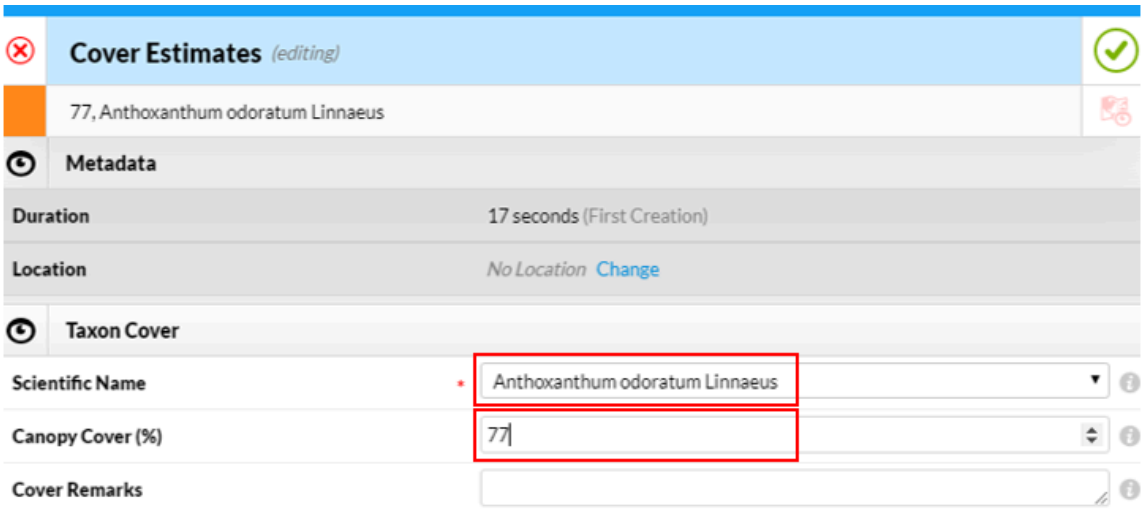
18.5 If finding species while looking closely that were not noticed at first, add the missed species to the plot species list (see Step 17), and it will now appear in the subplot species choice list. Synchronize your *Fulcrum* app after adding new species to the plot list to make them visible for the other users.

Note

The list of species for each subplot can only be done from the total species list created for the plot.

18.6 Under Vegetation Surveys: Herbs and Shrubs → Cover Estimates: Subplot → Subplots → Record [# from 1 to 9] → Cover Estimates, list every occurring species within the subplot by selecting its scientific name. Also enter abundance (if not using a small drone) or distribution (if using a small drone) data as follows:

- Abundance (Canopy Cover):

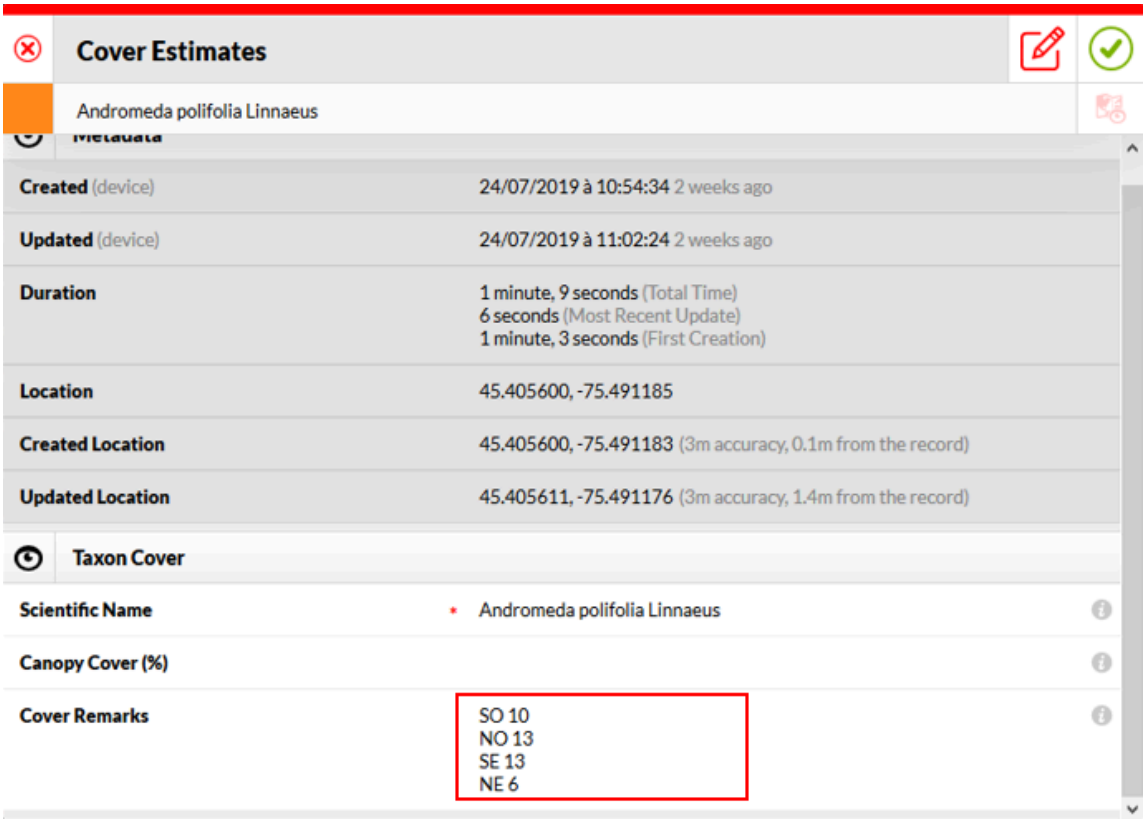


Note

NOTES ON CANOPY COVER:
In order to best approximate what will be viewed by the airborne surveys:

Record an estimate of cover within the subplot, even if the plant is rooted outside the subplot.
Similarly, do not measure cover that is outside the subplot, even if the plant is rooted within the subplot.
If the leaves of two species overlap, only consider the species on top.
The sum of all cover estimates must be 100%.

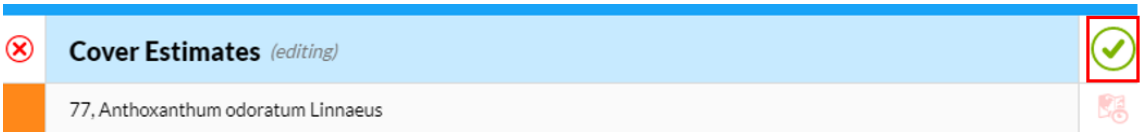
Distribution (Cover Remarks):



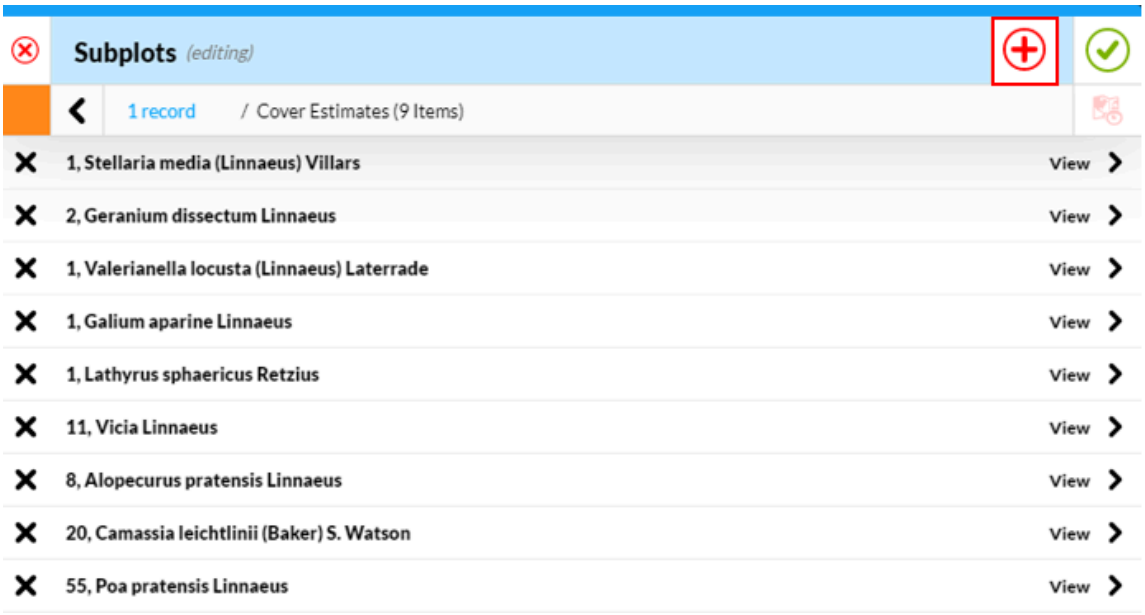
Note

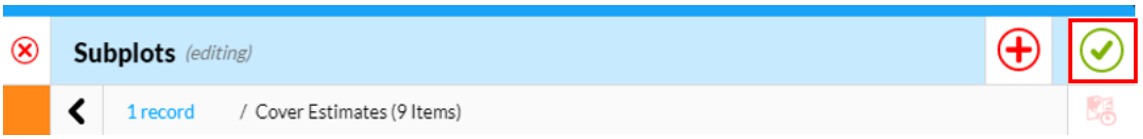
NOTES ON COVER REMARKS:
Divide each subplot in areas identified with direction acronyms (S = south, N = north, O or W = west, E = east, C = center) and add the number of individuals for a given species.

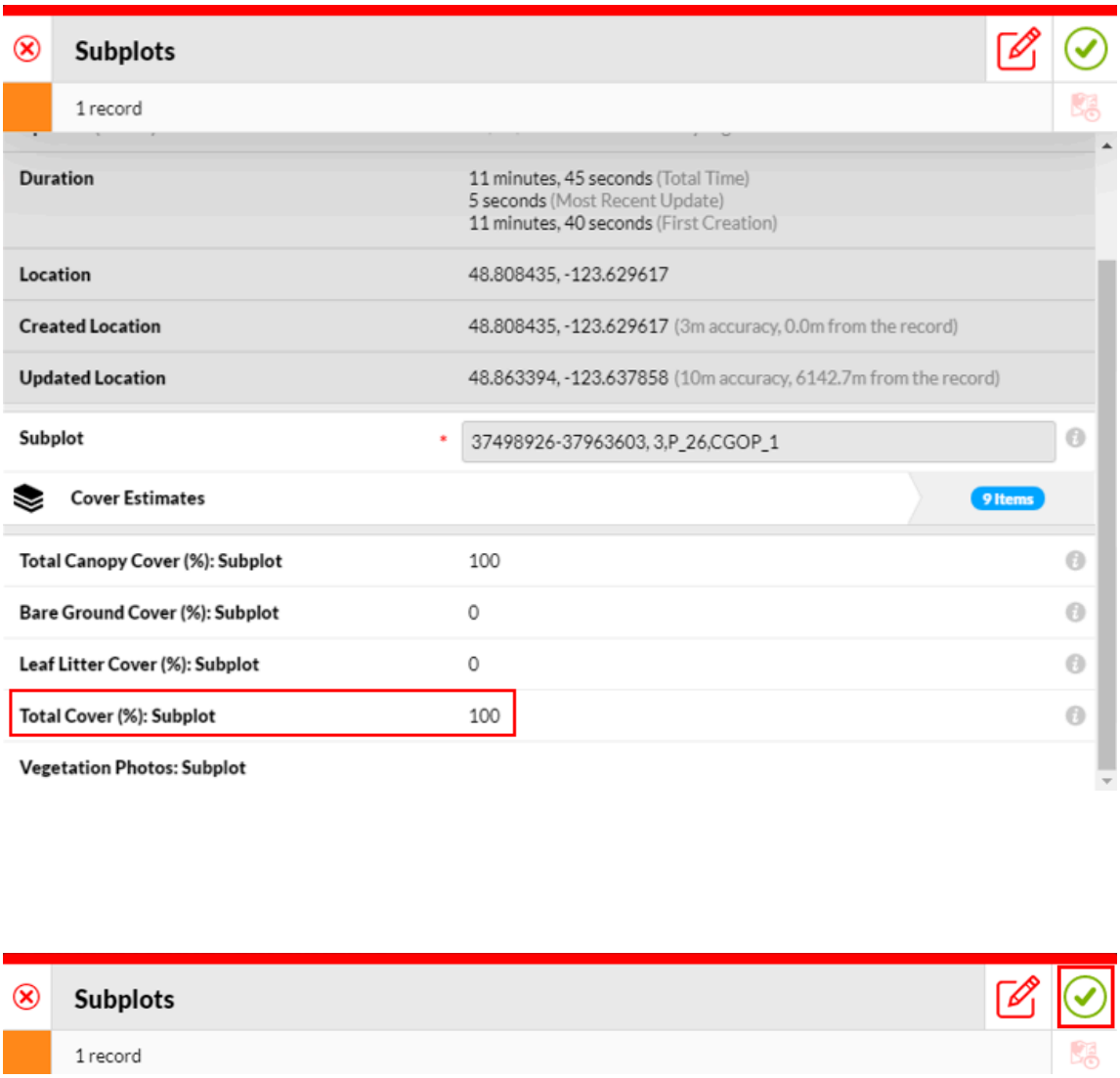
18.7 Click on the checkmark button after the addition of each species to the subplot species list to save your update.



18.8 Keep adding species until the *Fulcrum* record is complete for the subplot and, if entering Abundance values (Canopy Cover), the sum of the cover estimates equals 100%, then save your record.

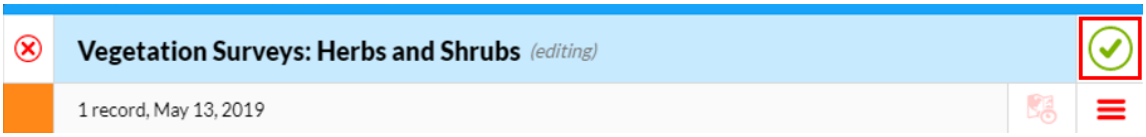

Subplots (editing)
1 record / Cover Estimates (9 Items)
1, Stellaria media (Linnaeus) Villars View
2, Geranium dissectum Linnaeus View
1, Valerianella locusta (Linnaeus) Laterrade View
1, Galium aparine Linnaeus View
1, Lathyrus sphaericus Retzius View
11, Vicia Linnaeus View
8, Alopecurus pratensis Linnaeus View
20, Camassia leichtlinii (Baker) S. Watson View
55, Poa pratensis Linnaeus View


Subplots (editing)
1 record / Cover Estimates (9 Items)



18.9 Repeat this process until all 9 subplots have been surveyed and saved into *Fulcrum*. When the vegetation survey of the 6 subplots visible from the scaffold is done, move the scaffold (along with the steel ladders) to an exterior row of subplots, in order to survey the 3 subplots previously hidden under the scaffold.
If no scaffold is available, walk around the plot to survey the different subplots, while being careful not to trample. To survey the central subplot (no 5), the survey from outside the plot is completed by observing the small drone picture from subplot 5.

18.10 Save the data entry in *Fulcrum* to indicate that the field survey has been finished.



Precise Georeferencing

19 Refer yourself to the Trimble GPS Protocol to precisely georeference the 4 corners of each surveyed plot.

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

Note

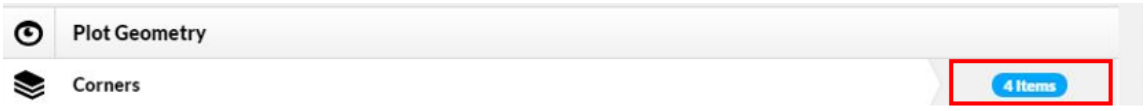
Each surveyed plot has to be precisely georeferenced OR marked with stakes before moving the grid to the following plot.

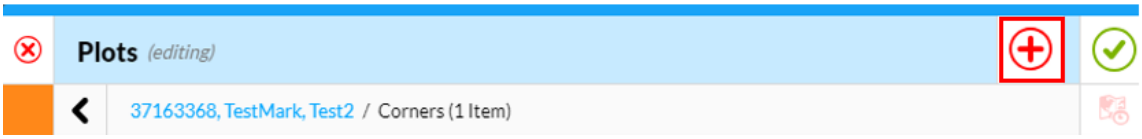
- If the Trimble GPS is available continuously, the precise georeferencing of the 4 corners can be done right away, and the plot stakes don't have to be installed.
- If the Trimble GPS is only available at a specific time, the plot corners are marked with stakes as indicated in steps 5 to 9. The precise coordinates of all surveyed plots are taken at once when the Trimble GPS is available.

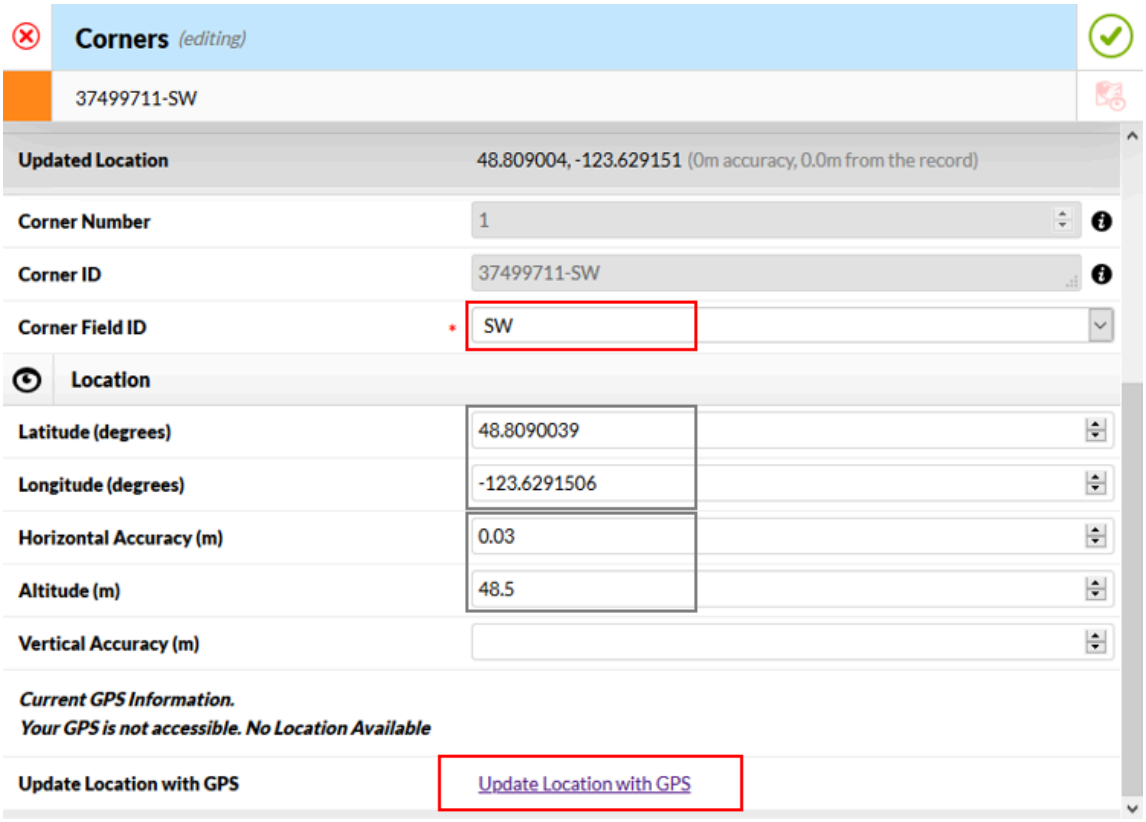
19.1 Connect the Trimble GPS to a field cellphone.

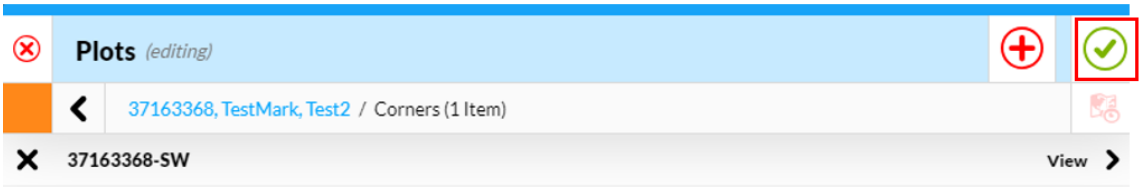
19.2 Place yourself on the southwest corner of the plot.

19.3 Under Plots → Plot Geometry, select the appropriate corner field ID and click on Update Location with GPS and wait for the horizontal accuracy to be ≤ 3 cm to save your record. This will automatically update the Location fields.

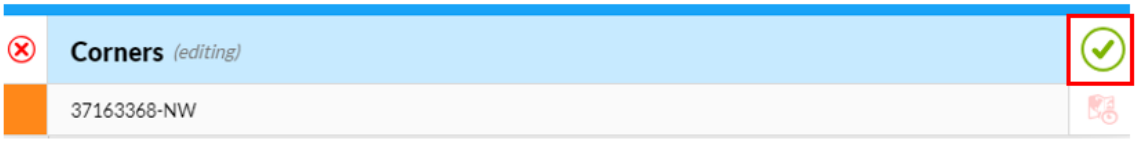








19.4 Repeat step 19.3 for each corner, turning clockwise.



I.e. Georeference plot corners in the following order: SW, NW, NE, SE.

19.5 Save the data entry.

19.6 Once the precise georeferencing of the 4 corners is done, the plot stakes (if present) need to be removed before the airborne surveys of the polygon they are within.

Next Plot

20 In accordance with the plot prioritization list, survey the next plot by following Steps 6 to 19 over again.

Herbarium Specimens

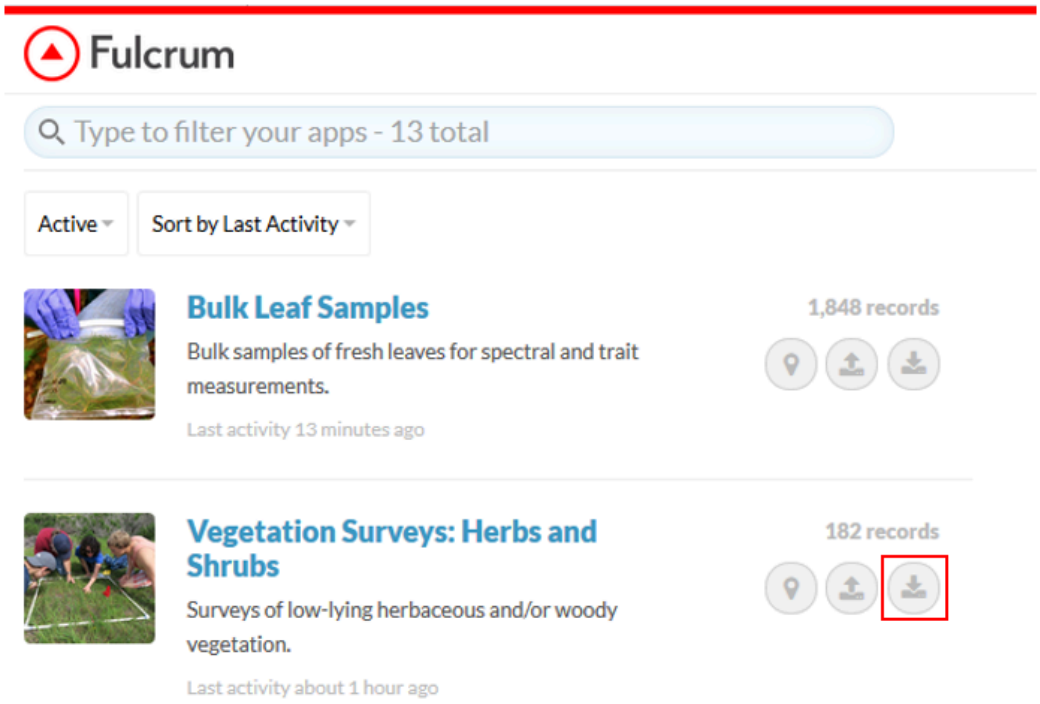
21 Refer yourself to the Herbarium Specimens protocol to collect herbarium specimens for 1) the species identified in the vegetation surveys, and 2) unknown plants.

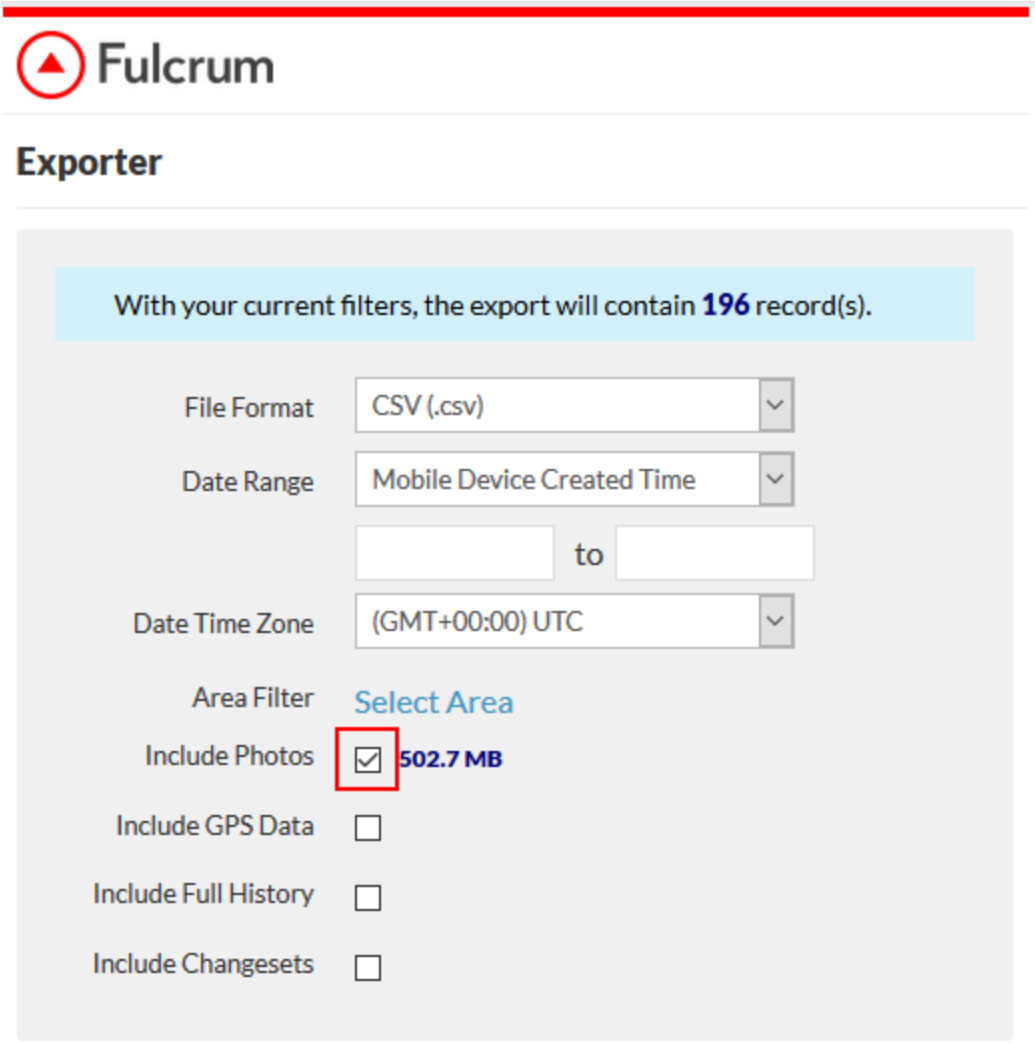
Maintenance of equipment and records: To do every evening during a fieldwork episode

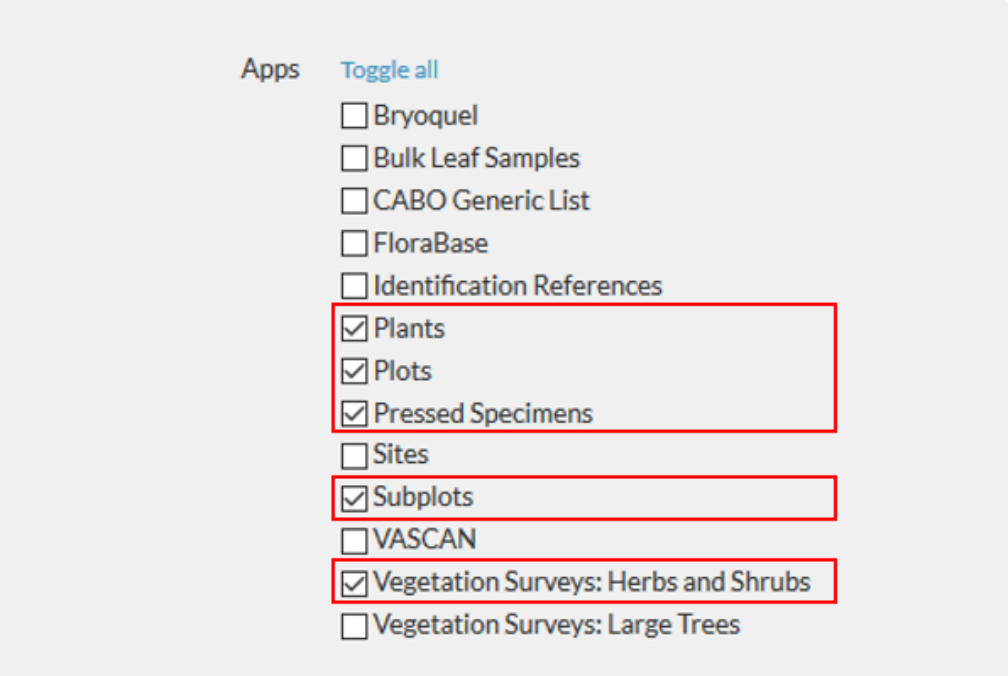
22 Plug in to charge all electronic devices (Laser Geo, Trimble battery, Drone and controller batteries, and field cellphones).

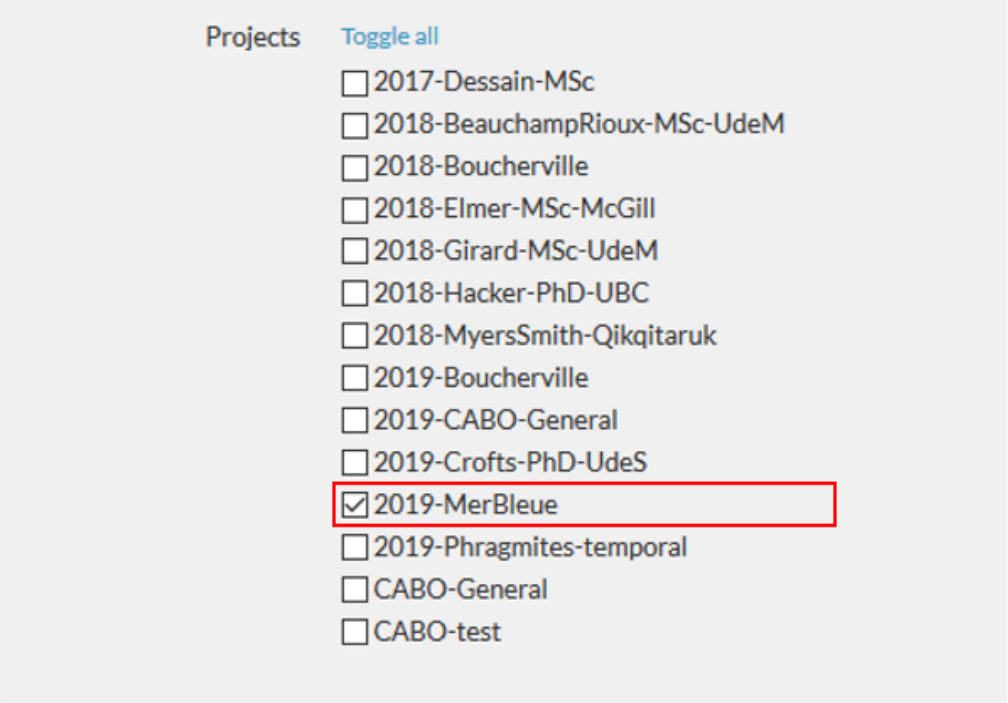
23 From the plots prioritization list, maintain a list of the plots done, classified by day.

24 In *Fulcrum*, export in .csv format the data from the appropriate project for Plots, Subplots, Vegetation Surveys, Plants, and Pressed Specimens (including photos) to your computer in order to create a local backup.

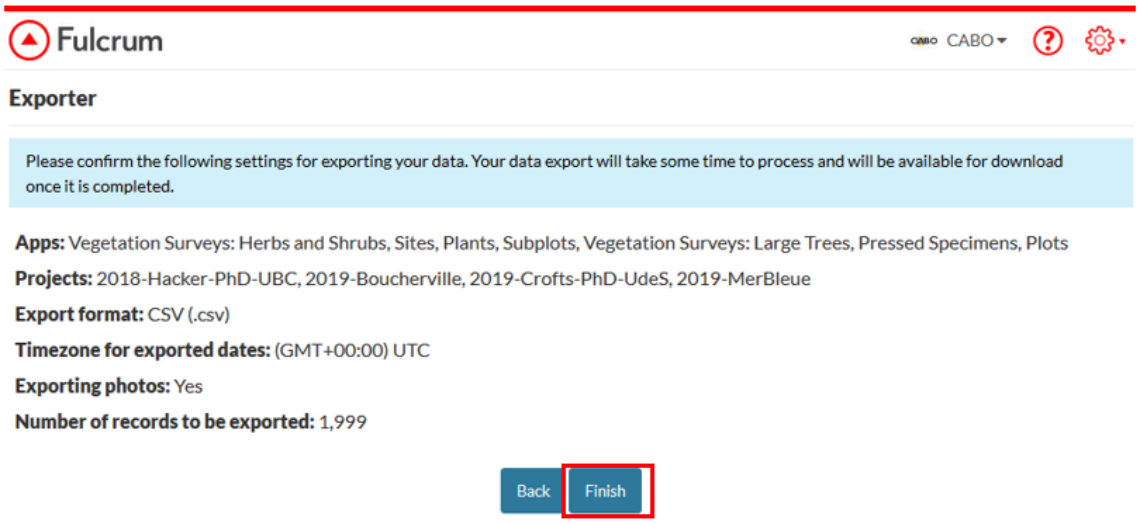

Fulcrum
Type to filter your apps - 13 total
Active
Sort by Last Activity
Bulk Leaf Samples
Bulk samples of fresh leaves for spectral and trait measurements.
Last activity 13 minutes ago
1,848 records
Vegetation Surveys: Herbs and Shrubs
Surveys of low-lying herbaceous and/or woody vegetation.
Last activity about 1 hour ago
182 records

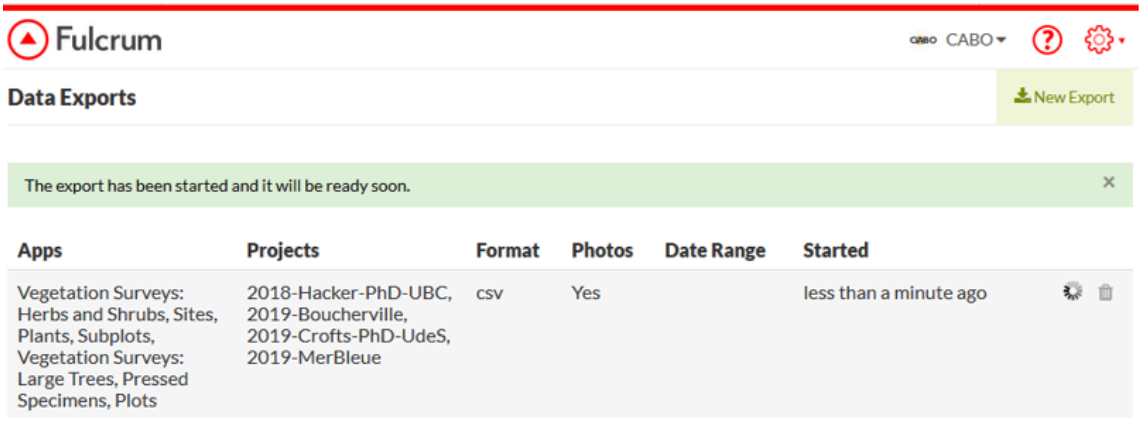

Fulcrum
Exporter
With your current filters, the export will contain 196 record(s).
File Format
CSV (.csv)
Date Range
Mobile Device Created Time
to
Date Time Zone
(GMT+00:00) UTC
Area Filter
Select Area
Include Photos
502.7 MB
Include GPS Data
Include Full History
Include Changesets

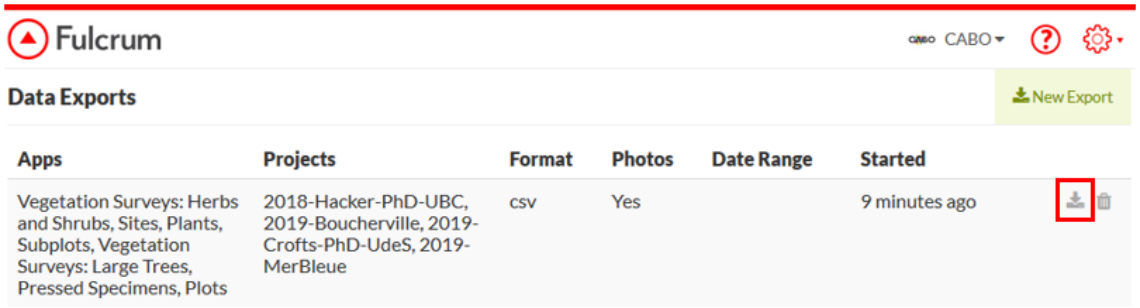

Apps
Toggle all
Bryoquel
Bulk Leaf Samples
CABO Generic List
FloraBase
Identification References
Plants
Plots
Pressed Specimens
Sites
Subplots
VASCAN
Vegetation Surveys: Herbs and Shrubs
Vegetation Surveys: Large Trees


Projects
Toggle all
2017-Dessain-MSc
2018-BeauchampRioux-MSc-UdeM
2018-Boucherville
2018-Elmer-MSc-McGill
2018-Girard-MSc-UdeM
2018-Hacker-PhD-UBC
2018-MyersSmith-Qikqitaruk
2019-Boucherville
2019-CABO-General
2019-Crofts-PhD-UdeS
2019-MerBleue
2019-Phragmites-temporal
CABO-General
CABO-test

Cancel
Next


Fulcrum
CABO
Exporter
Please confirm the following settings for exporting your data. Your data export will take some time to process and will be available for download once it is completed.
Apps: Vegetation Surveys: Herbs and Shrubs, Sites, Plants, Subplots, Vegetation Surveys: Large Trees, Pressed Specimens, Plots
Projects: 2018-Hacker-PhD-UBC, 2019-Boucherville, 2019-Crofts-PhD-UdeS, 2019-MerBleue
Export format: CSV (.csv)
Timezone for exported dates: (GMT+00:00) UTC
Exporting photos: Yes
Number of records to be exported: 1,999
Back
Finish

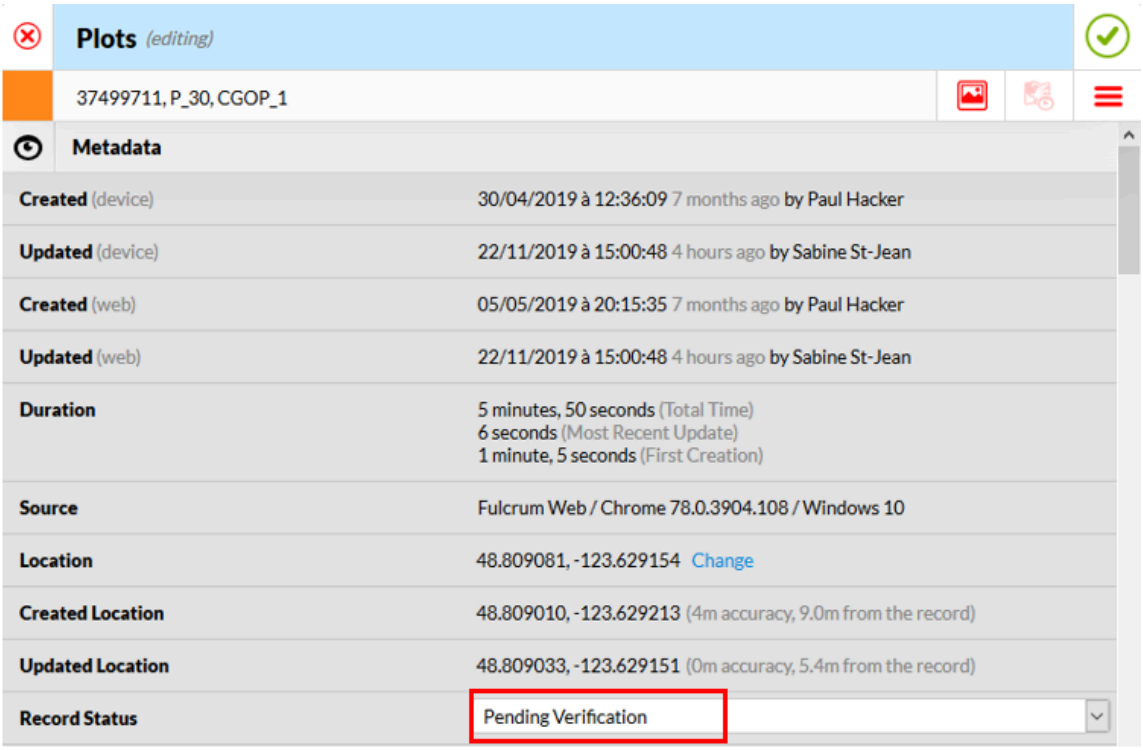

Fulcrum
CABO
Data Exports
New Export
The export has been started and it will be ready soon.
Apps
Projects
Format
Photos
Date Range
Started
Vegetation Surveys: Herbs and Shrubs, Sites, Plants, Subplots, Vegetation Surveys: Large Trees, Pressed Specimens, Plots
2018-Hacker-PhD-UBC, 2019-Boucherville, 2019-Crofts-PhD-UdeS, 2019-MerBleue
csv
Yes
less than a minute ago


Fulcrum
CABO
Data Exports
New Export
Apps
Projects
Format
Photos
Date Range
Started
Vegetation Surveys: Herbs and Shrubs, Sites, Plants, Subplots, Vegetation Surveys: Large Trees, Pressed Specimens, Plots
2018-Hacker-PhD-UBC, 2019-Boucherville, 2019-Crofts-PhD-UdeS, 2019-MerBleue
csv
Yes
9 minutes ago

Finalization

25 Identify any unknown plant and make the appropriate edits in the *Fulcrum* database.

26 When all the necessary information has been entered, change the Plots and Vegetation Surveys status from Pending Verification to Verified.



27 Refer yourself to the Post Processing: Abundance and Distribution of Species in Open Vegetation Plots protocol to process the small drone pictures in order to obtain abundance and distribution data.