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Open Vegetation Survey 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 3x3m square plots, with each plot containing nine 1x1m 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.

EXTERNAL LINK

http://www.caboscience.org/

ATTACHMENTS

BC_vasc.pptx
mb_classification_areas.pdf
MB trees-fert plots.pdf
Goud_EM_MSc thesis_Table 3.docx
CABO_species_list_per_site_2019.xlsx

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.

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

MATERIALS TEXT

CAT S41 fieldwork cellphone -

Plot prioritization list -

Loop stake -
About 40 cm long

Plant press and newspaper -

Laser Geo
Haglöf Sweden -

24 rigid PVC pipes (top of frame), ¾'', 1 m long -
To be used as the frame horizontal structure, labelled with the subplot number they belong to.

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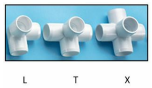
16 rigid PVC pipes (legs), ¾'', appropriate height -

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

16 PVC connectors for the intersections, ¾'' -

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



Tape Measure -

3 Stake wire flags -

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

2 Step Steel Step Ladders (2) -

CGOP site only.

3 m long Telescopic Aluminum Scaffold Plank -

CGOP site only.

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Mavic Air
Drone
DJI -

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

Identification guides -
See Open Vegetation Survey Protocol → Guidelines → Site Specific Information.

3 Square canopy cover negative templates -
1% = 10 x 10 cm
5% = 22,4 x 22,4 cm
10% = 31,6 x 31,6 cm

Trimble Catalyst GPS, NTRIP precision subscription -

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Wood pannel for take-off and landing

- -

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 STARTING

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.

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- 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.

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- 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.

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).

CAT S41 fieldwork cellphone -

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

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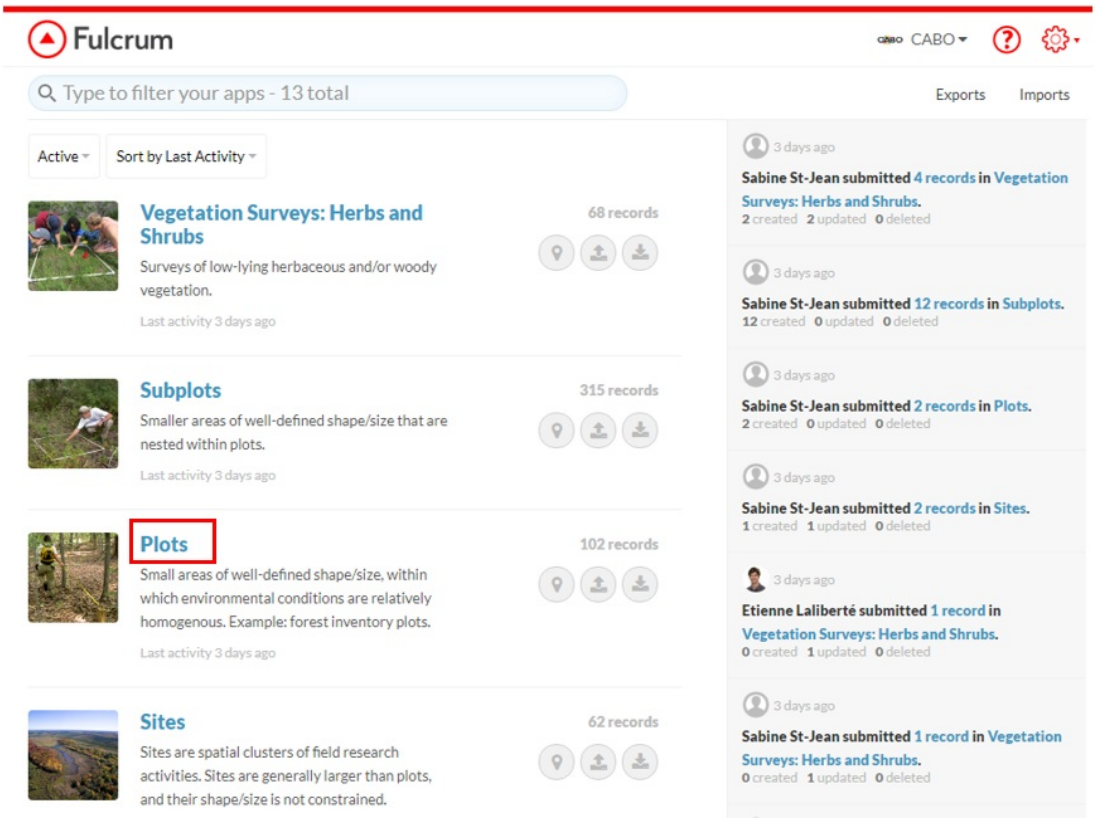

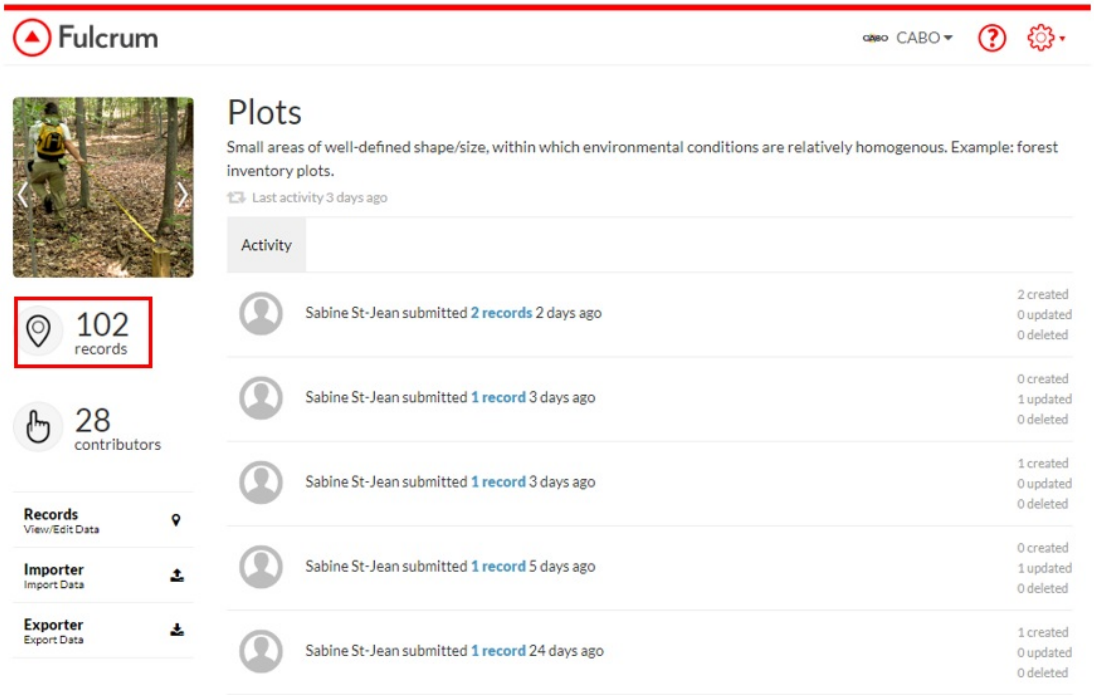

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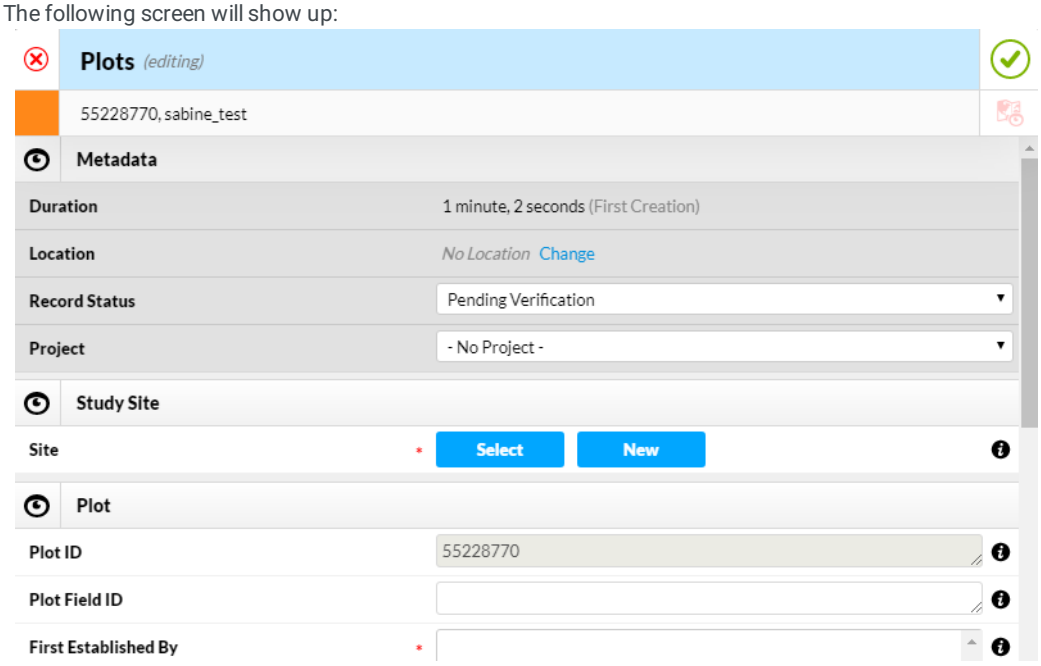
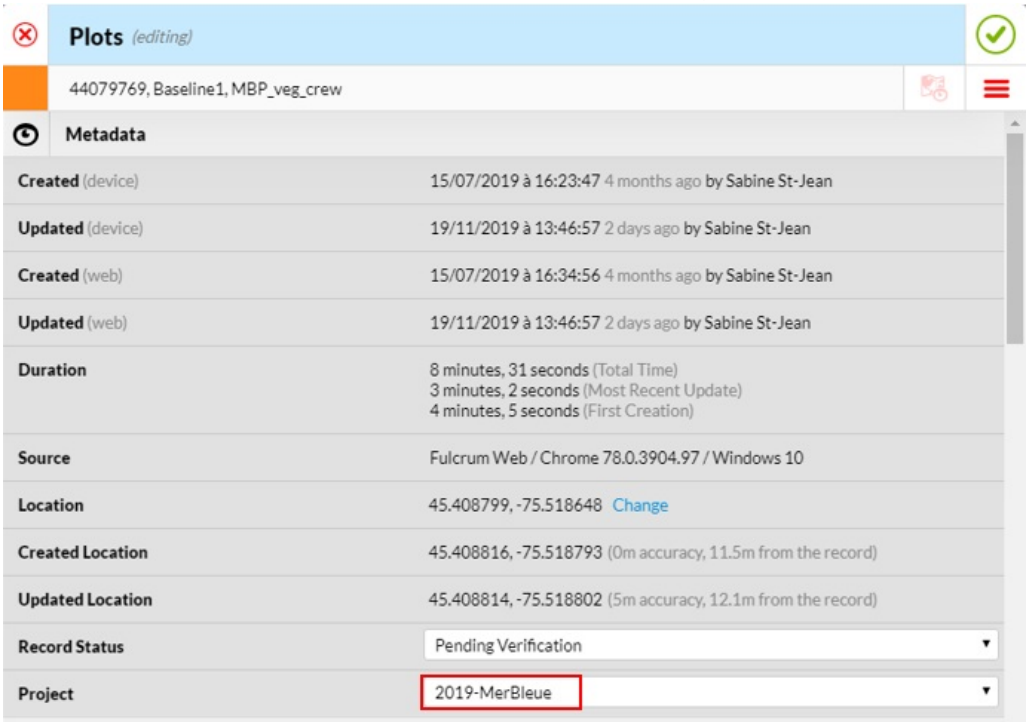
2.2 Create a new record by selecting the + symbol in a circle.

The following screen will show up:

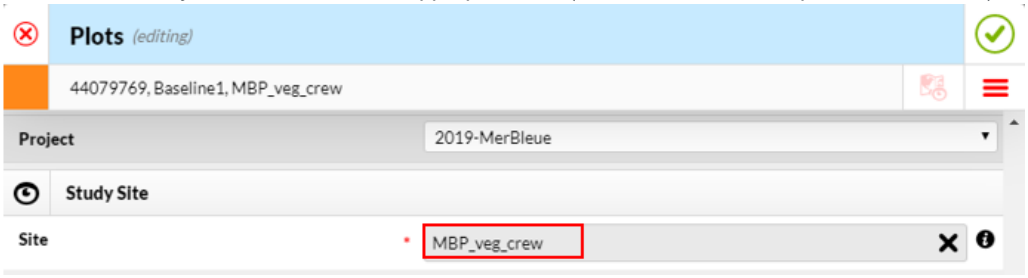


Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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).



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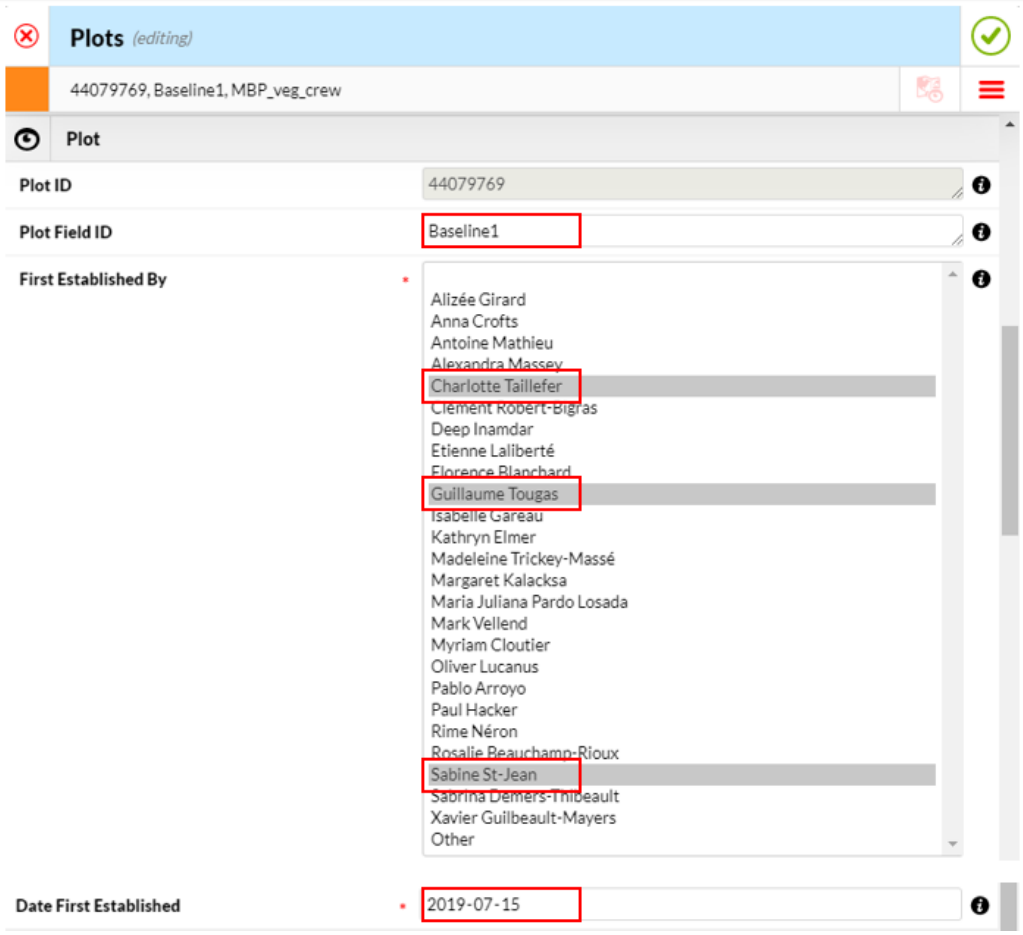
2.5 Under Plots → Plot, assign the plot a Plot Field ID, and indicate the names of the team members (one or more) creating the plot as well as the date of plot creation.

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



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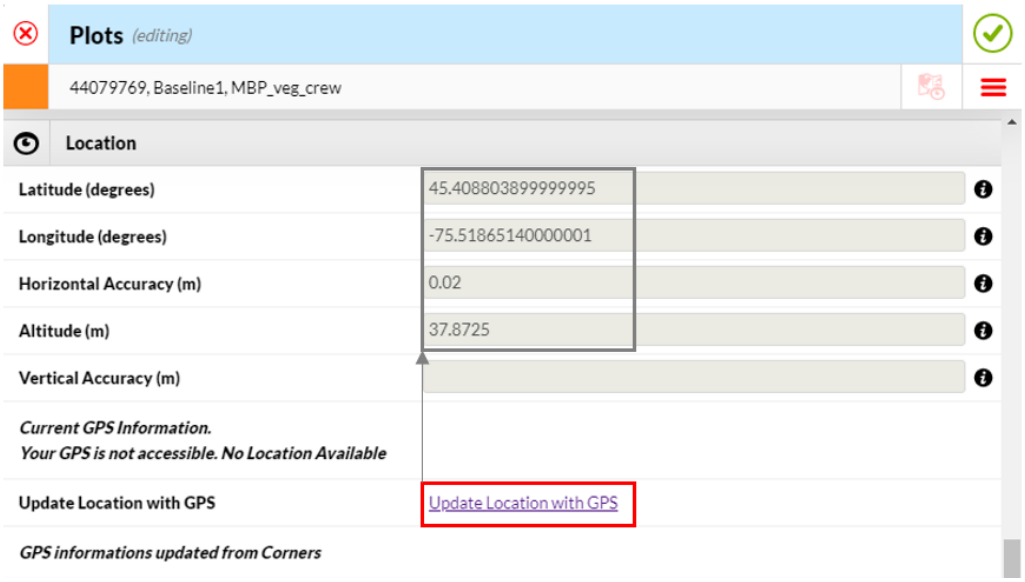
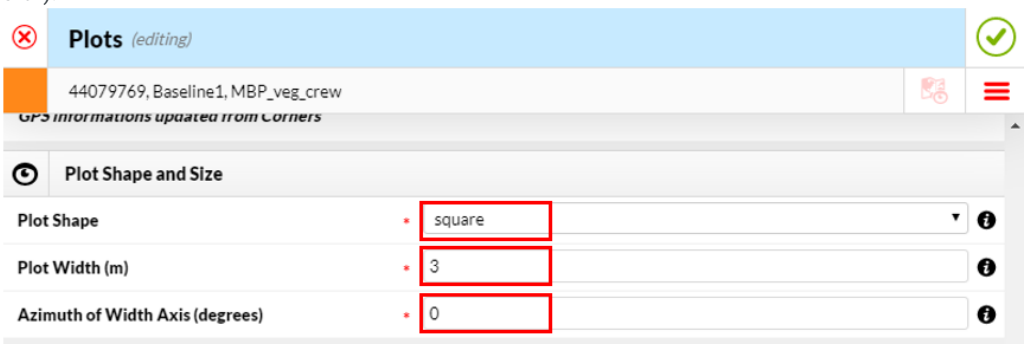
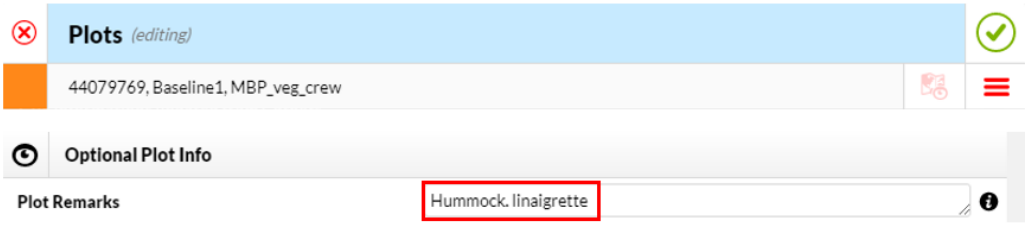
2.6 Under Plots → Location, georeference the plot location approximately by clicking on Update Location with GPS using a fieldwork cellphone - coordinates will automatically be imported to the Latitude and Longitude fields.



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.



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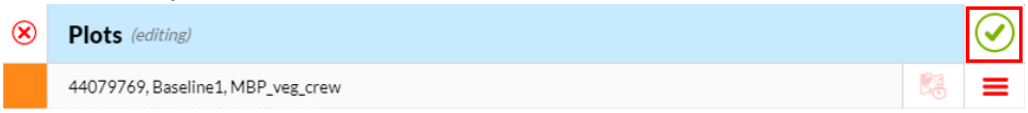
2.9 Save the data entry.



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).

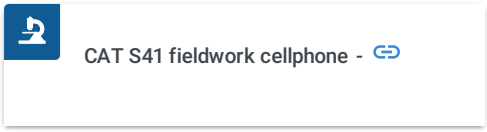
Most sites will require more than one CASI/SASI flight. Each flight is defined by a polygon on the map. Communication between the veg crew and the drone crew is necessary in order to be outside a given polygon while it is being imaged. An effective solution is to survey all the plots in one polygon at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



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

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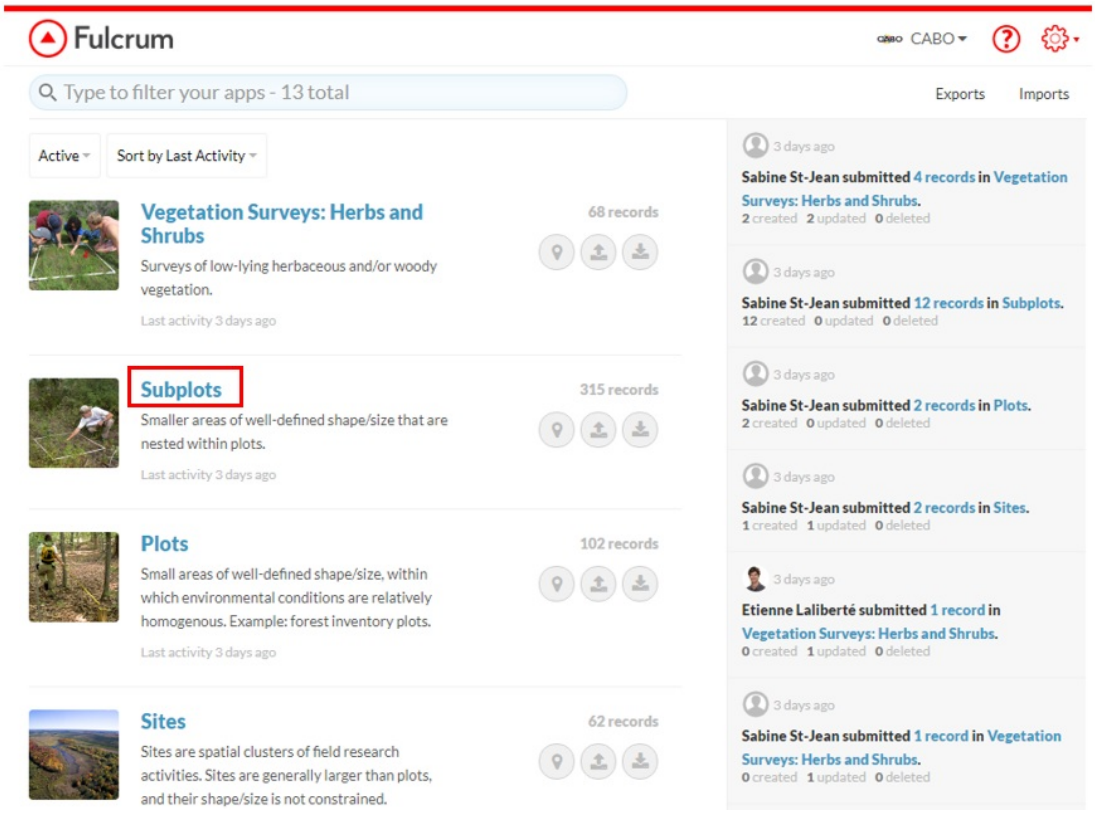

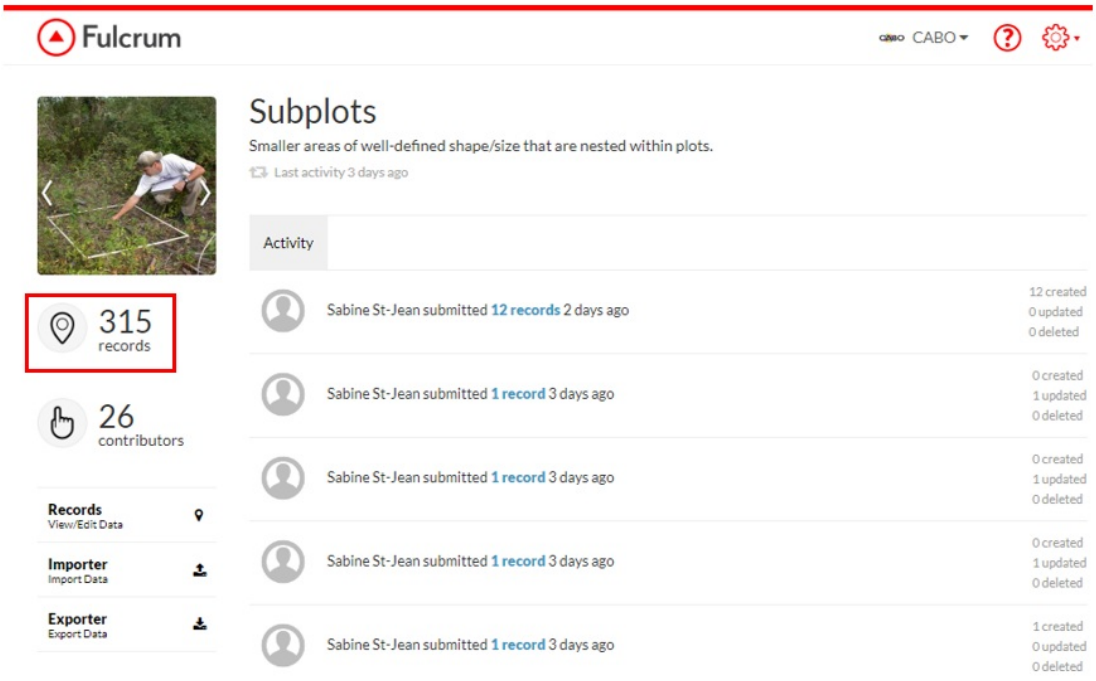

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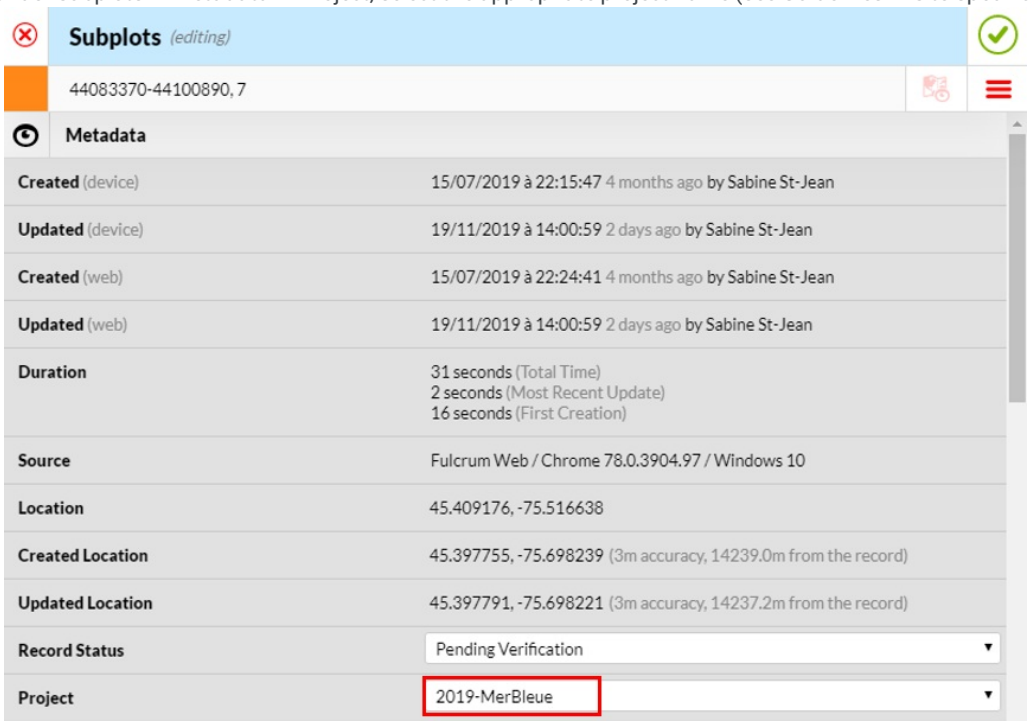
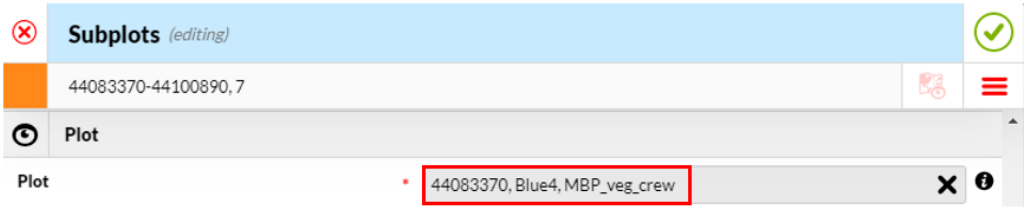
4.2 Create a new record under Subplots.

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.



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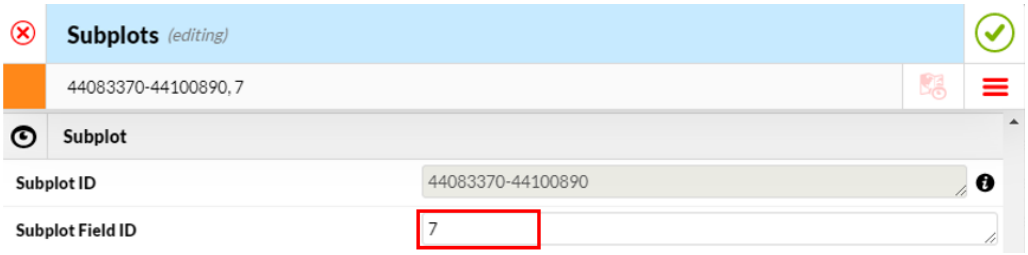
4.5 Under Subplots → Subplot → Subplot Field ID, enter a value between 1 and 9, according to the following image.

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.



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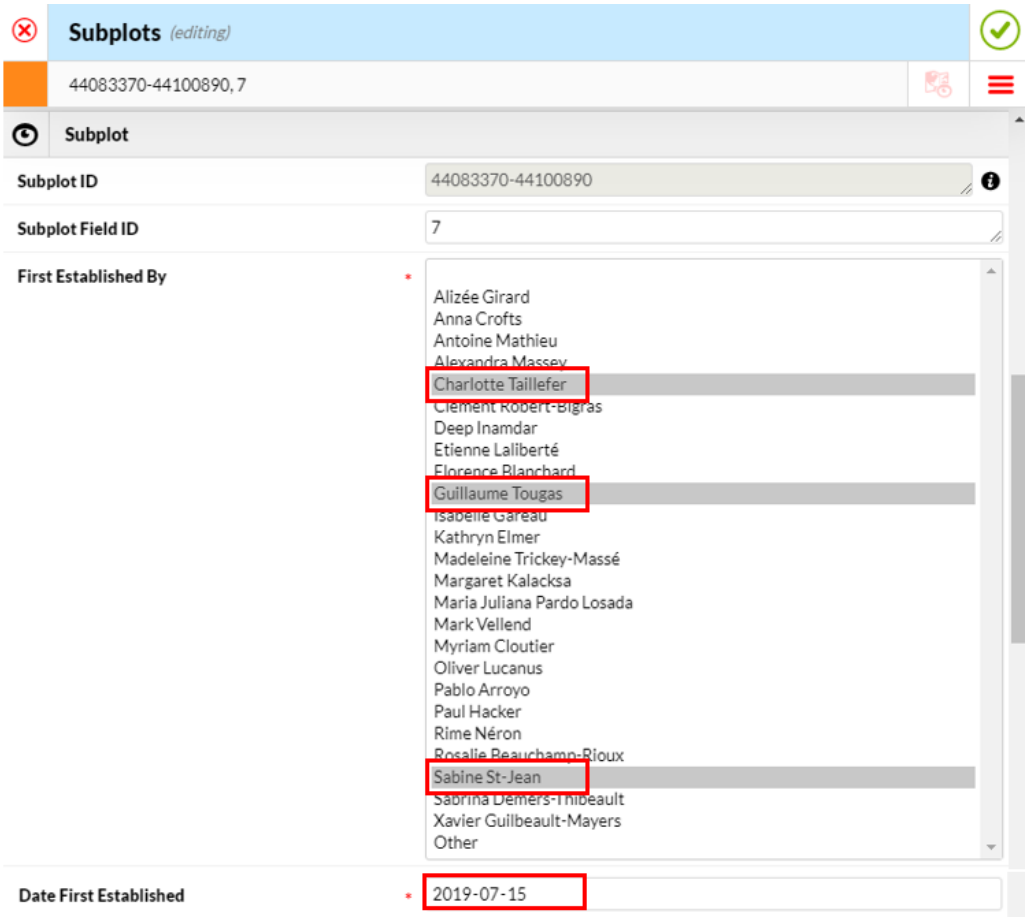
4.6 Under Subplots → Subplot, indicate the names of the team members (one or more) doing the subplot setup as well as the date of the subplot setup.

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



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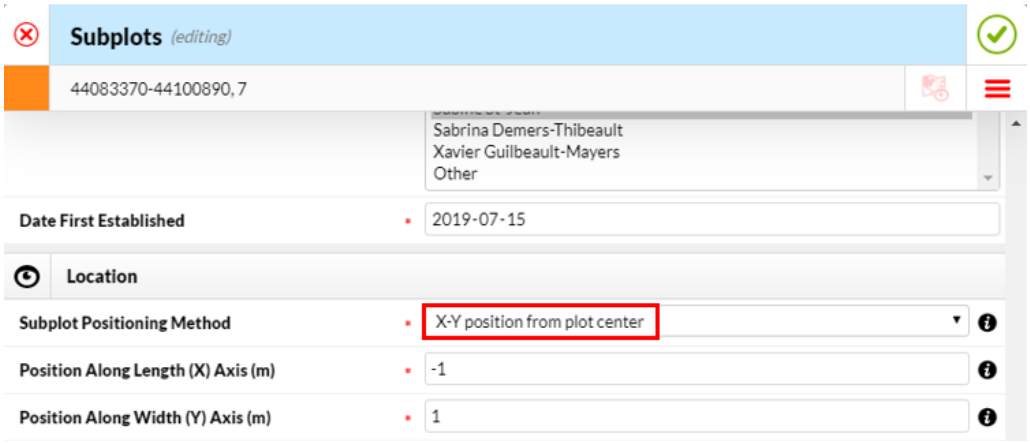
4.7 Under Subplots → Location, select the Subplot Positioning Method : X-Y position from plot center.

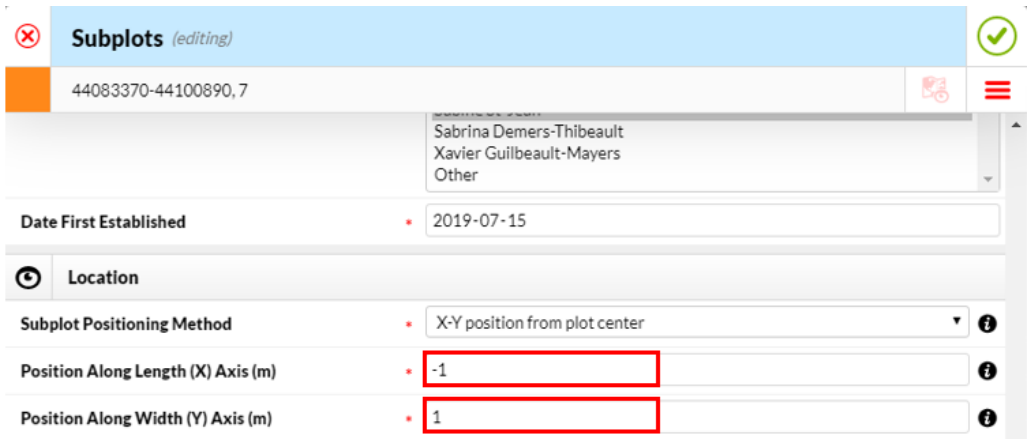
As positioning method "X-Y from plot center" is selected, there is no need to accurately georeference the subplots.



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

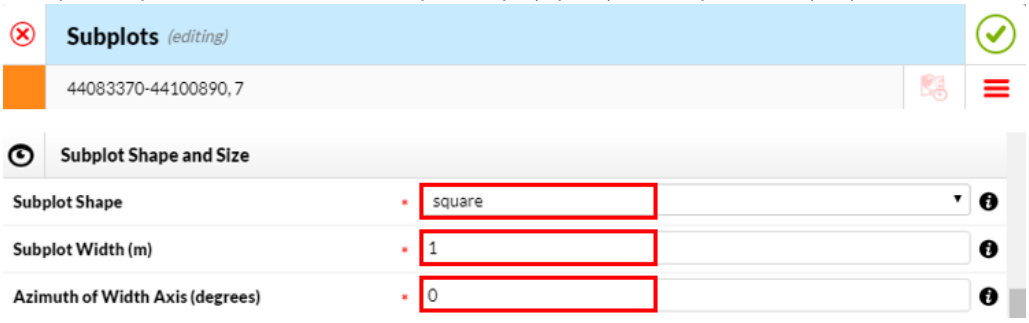
4.8 Under Subplots → Location, indicate the values for the Position Along Length (X) Axis (m) and the Position Along Width (Y) Axis (m): -1, 0 or 1 (according to the image from step 4.5).

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.

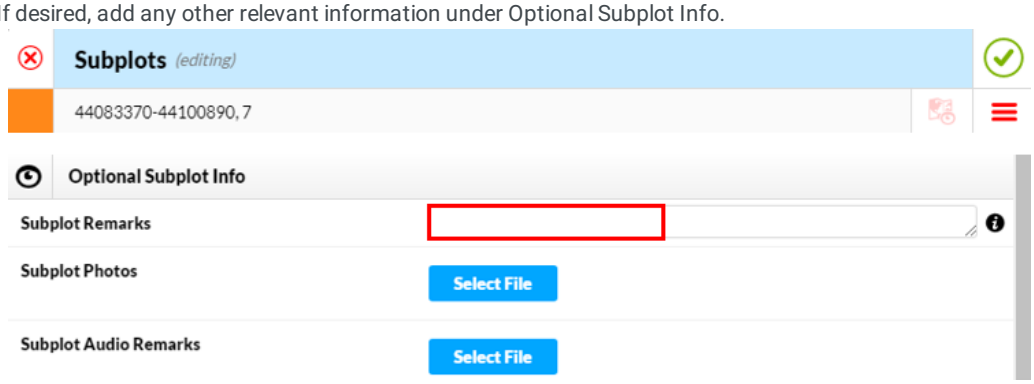


Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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°).

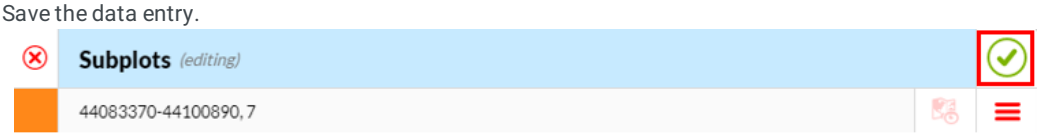


4.10 If desired, add any other relevant information under Optional Subplot Info.

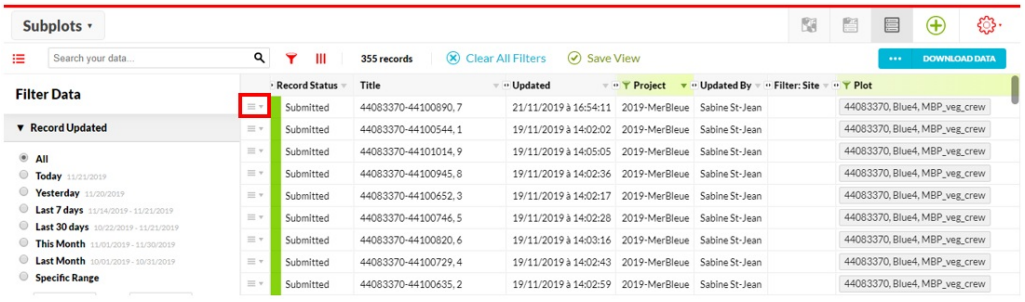


This optional field has not been used in the 2019 vegetation surveys.

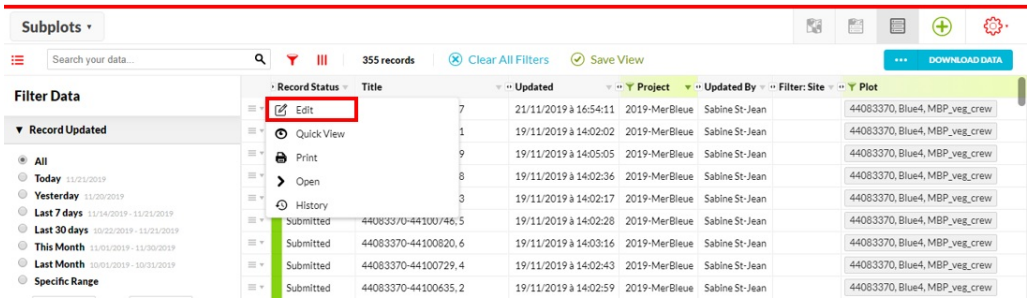
4.11 Save the data entry.

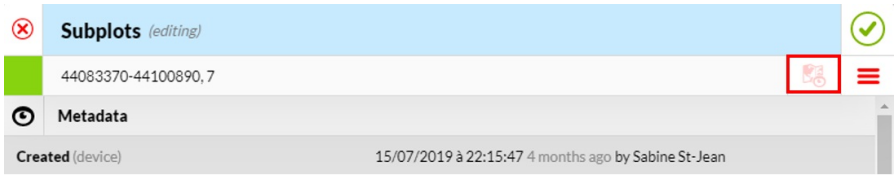


4.12 The subplots will automatically be placed on the map, in reference to the plot center. Verify that all the subplots (9 for each plot) appear on the map.

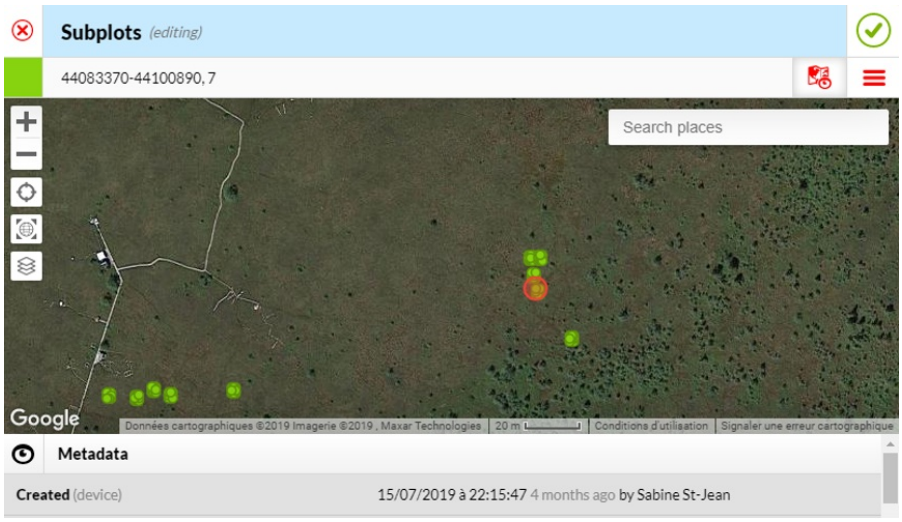


Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan





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

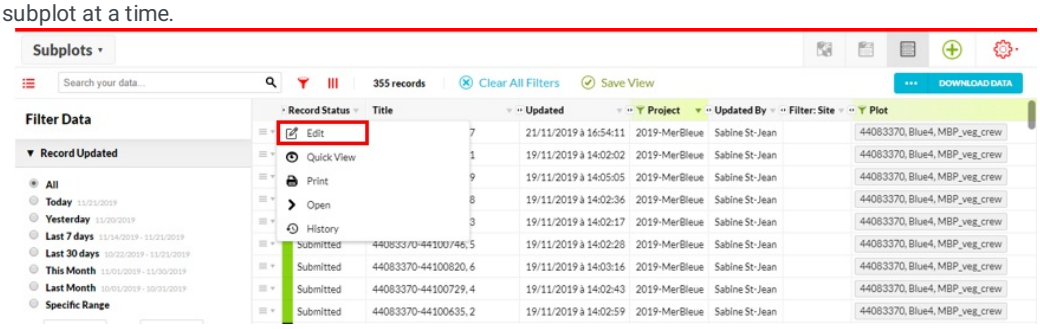


By zooming in, the 9 subplots will become visible.

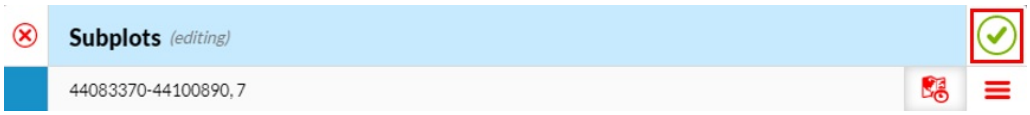
Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.

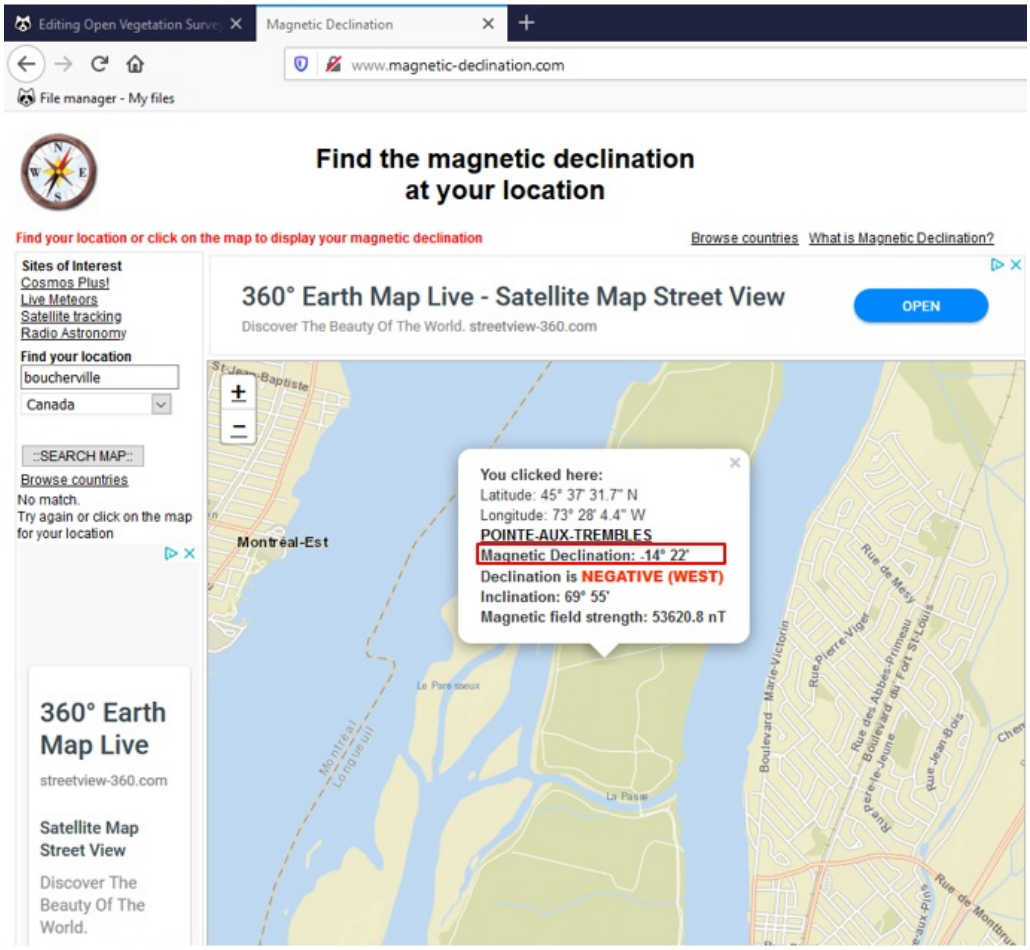


Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan



Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.



Laser Geo -

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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 3x3m area (i.e.: there are no drastic changes in vegetation within the plot).

Plot prioritization list -

CAT S41 fieldwork cellphone -

Plant press and newspaper -

Laser Geo

Haglöf Sweden -

Loop stake -

About 40 cm long

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.

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.

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

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.

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.

24 rigid PVC pipes (top of frame), ¾'', 1 m long -
To be used as the frame horizontal structure, labelled with the subplot number they belong to.

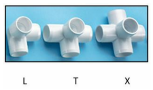
16 rigid PVC pipes (legs), ¾'', appropriate height
To be used as the legs, according to the vegetation height.
Heights:
- 0,37 m: this height allows for the scaffold to be placed over the grid (see the Vegetation Survey part of this protocol).
- 1 m
- 1,5 m

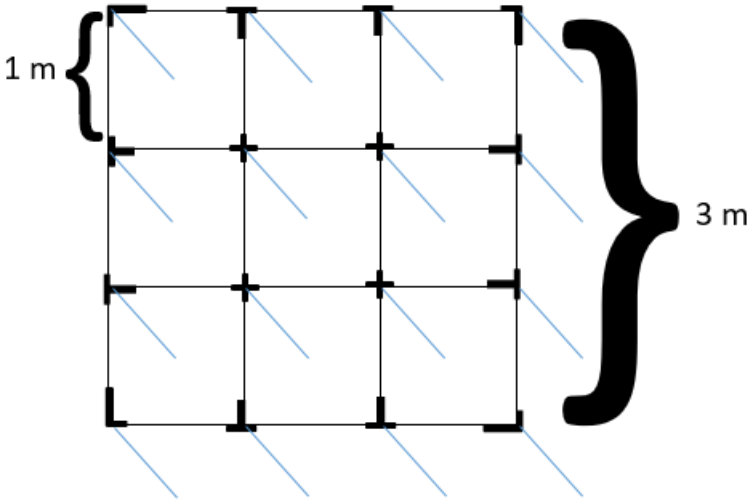
-

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

16 PVC connectors for the intersections, ¾'' -

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





Layout of the grid.
Figure legend:

16 PVC connectors for the intersections:

T 8 side pieces: T-shaped with a leg junction

L 4 corner pieces: L-shaped with a leg junction

\+ 4 middle pieces: X-shaped with a leg junction

16 rigid PVC pipes (legs) of the appropriate height

24 rigid PVC pipes (top of the grid), 1 m long

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).

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

8 Align the PVC grid.

Laser Geo

Haglöf Sweden -

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.

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

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.

Tape Measure -

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

10 Install stake wire flags on the 3 unmarked corners.

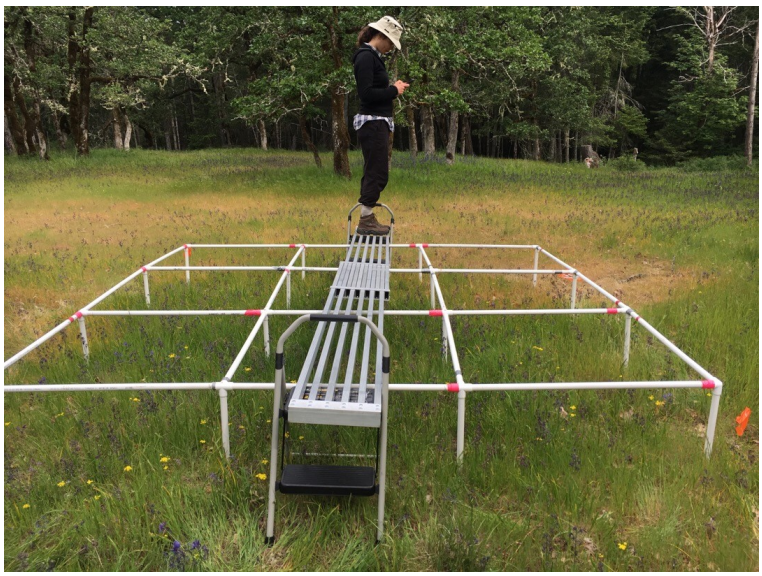
3 Stake wire flags -

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

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.

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.

2 Step Steel Step Ladders (2) -
CGOP site only.

3 m long Telescopic Aluminum Scaffold Plank -
CGOP site only.

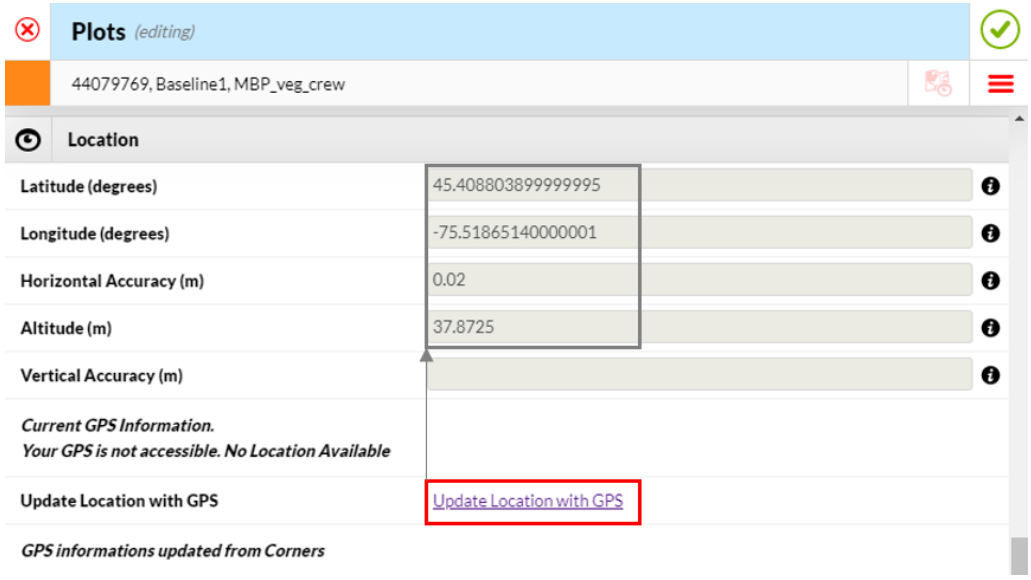
12 Update the approximate location of the plot center.

CAT S41 fieldwork cellphone -

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

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.

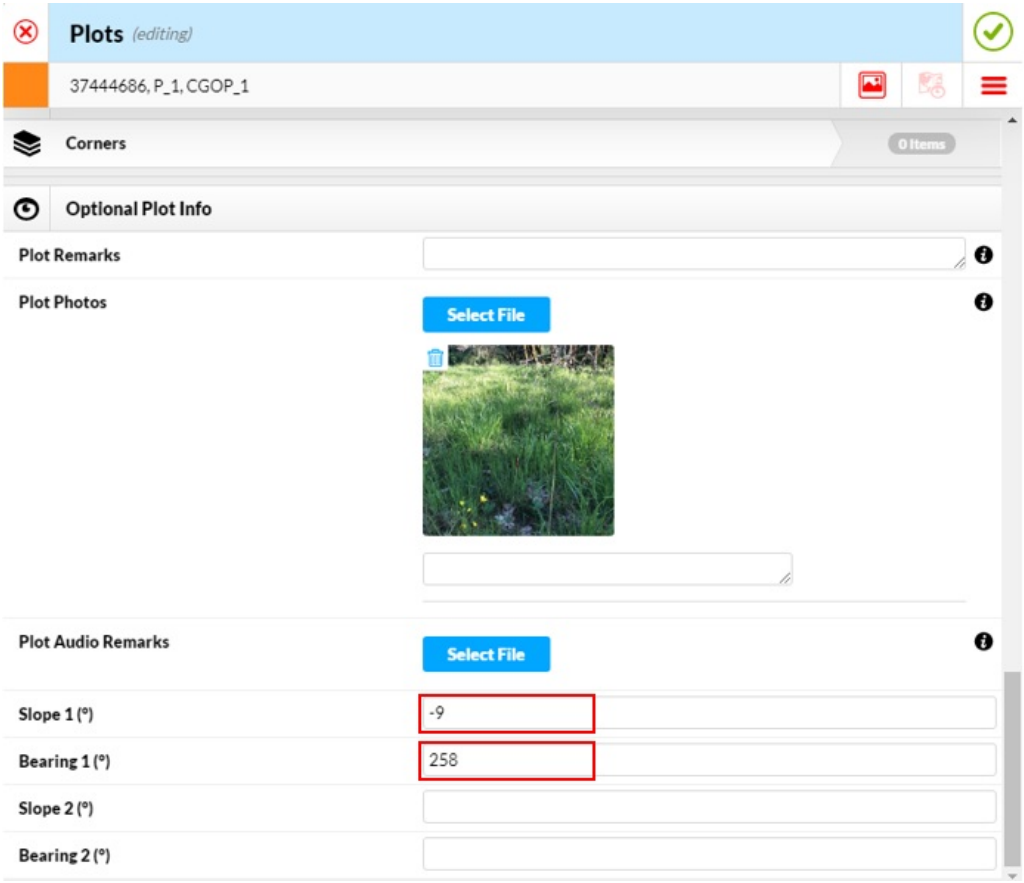
Laser Geo

Haglöf Sweden -

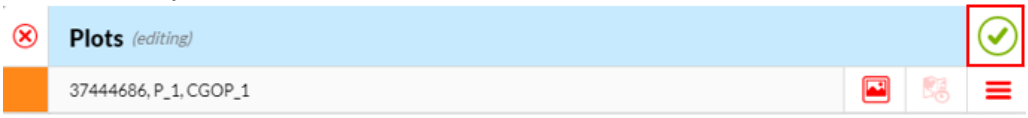
CAT S41 fieldwork cellphone -

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.



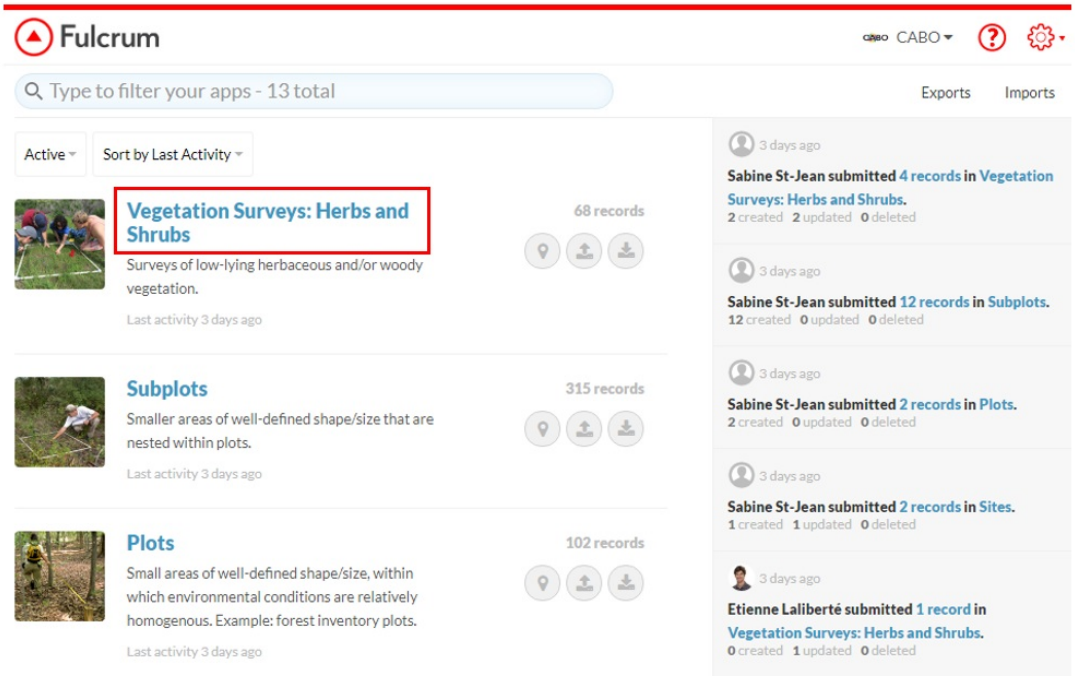
Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

Vegetation Survey: Creation

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

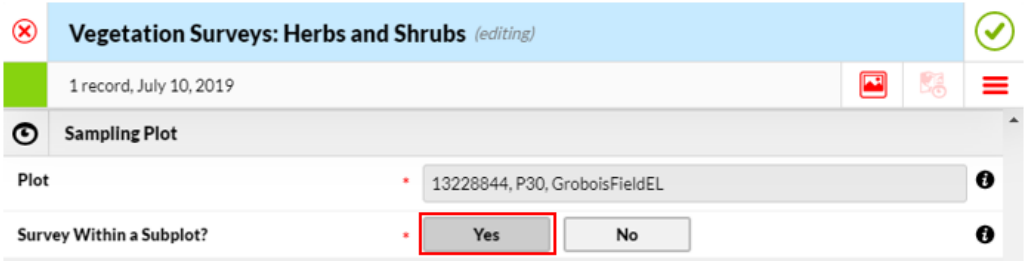
CAT S41 fieldwork cellphone -

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.

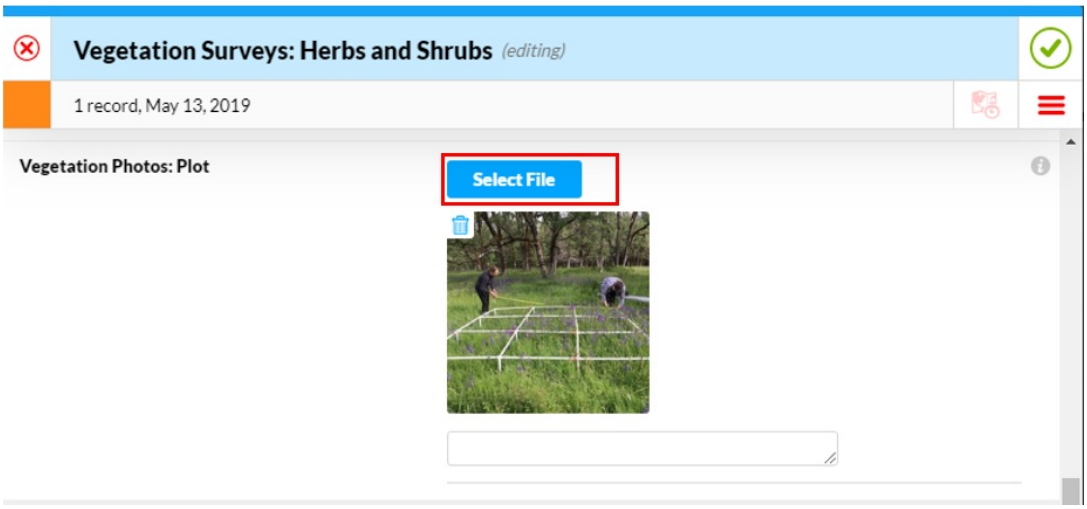
14.3 Under Vegetation Surveys: Herbs and Shrubs → Sampling Plot → Survey within a subplot?, answer Yes.



Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.



Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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

Mavic Air
Drone
DJI -

CAT S41 fieldwork cellphone -

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

Wood pannel for take-off and landing
-
- -

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

17 List all of the species occurring in the plot.

Identification guides -
See Open Vegetation Survey Protocol → Guidelines → Site Specific Information.

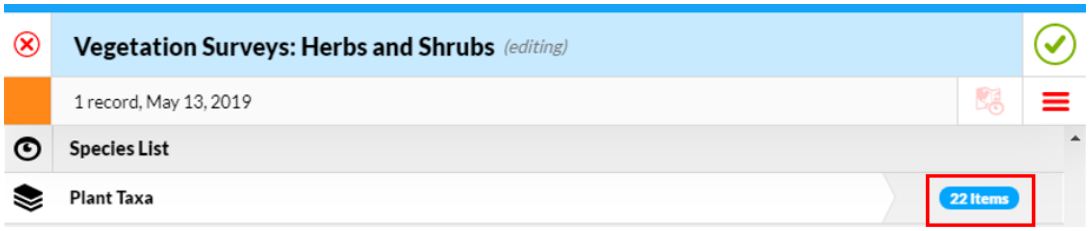
2 Step Steel Step Ladders (2) -
CGOP site only.

3 m long Telescopic Aluminum Scaffold Plank -
CGOP site only.

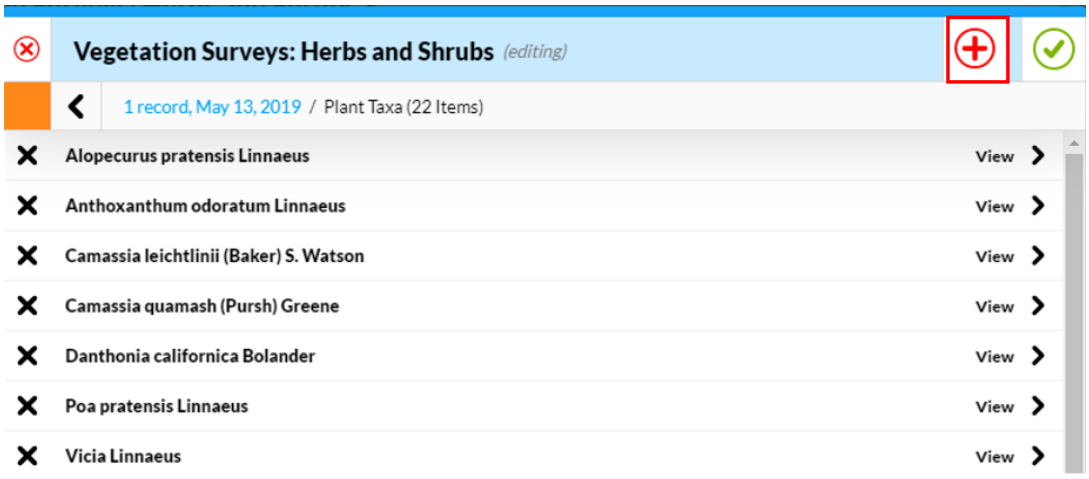
This step is done by the entire vegetation survey team, with everyone identifying and calling out species to one person who records them in *Fulcrum*. Uncertain identifications are discussed among team members.

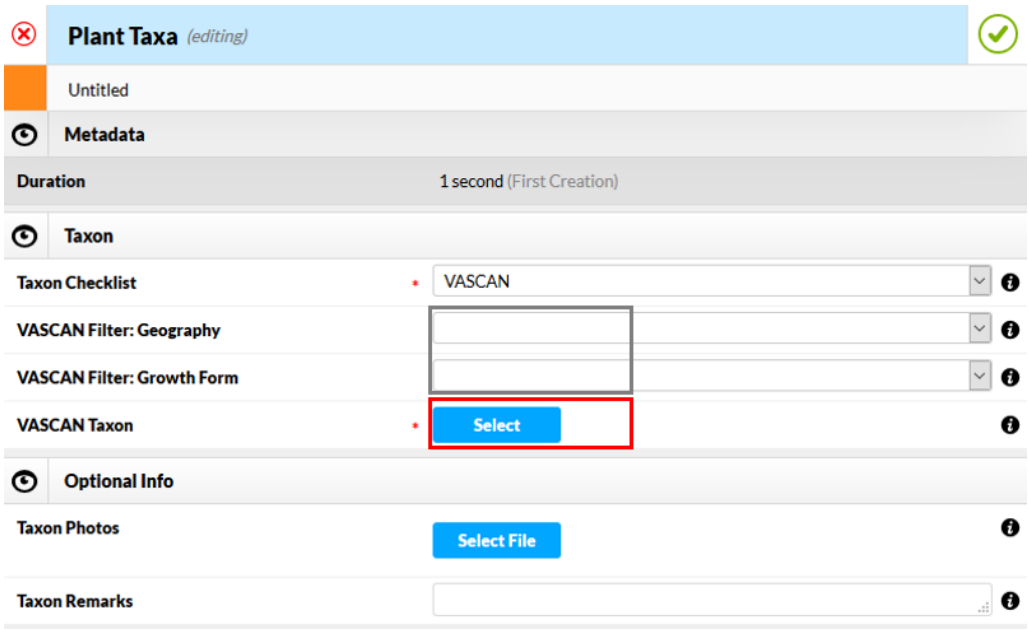
17.1 Under Vegetation Surveys: Herbs and Shrubs → Species List → Plant Taxa, create the species list by selecting species present in the plot one by one from the provided VASCAN list.

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



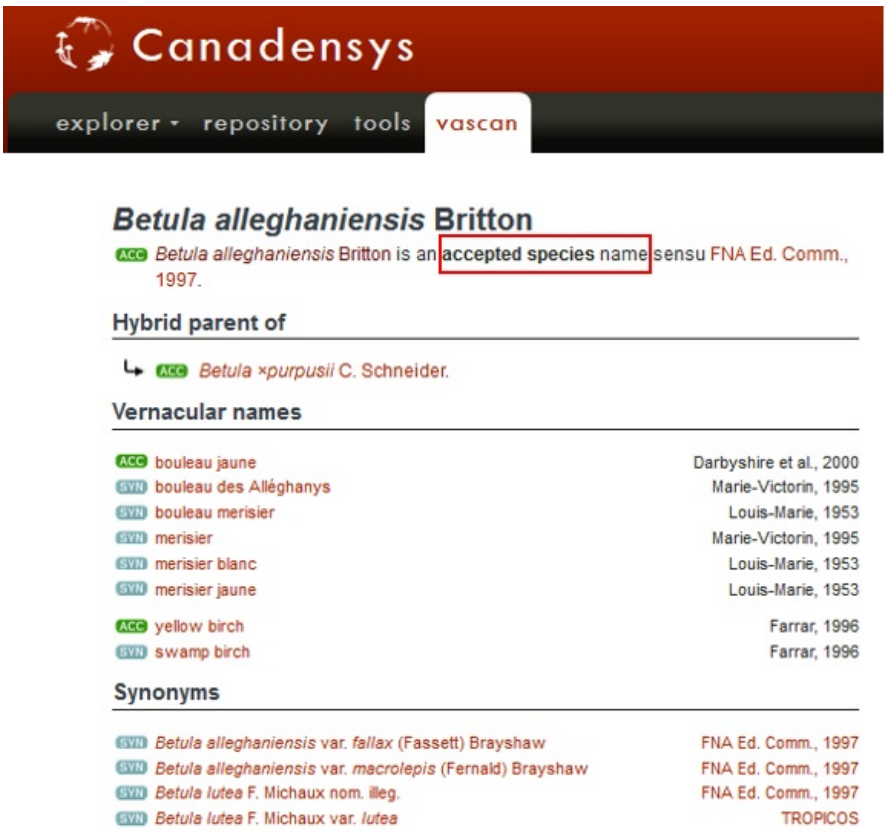
Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan





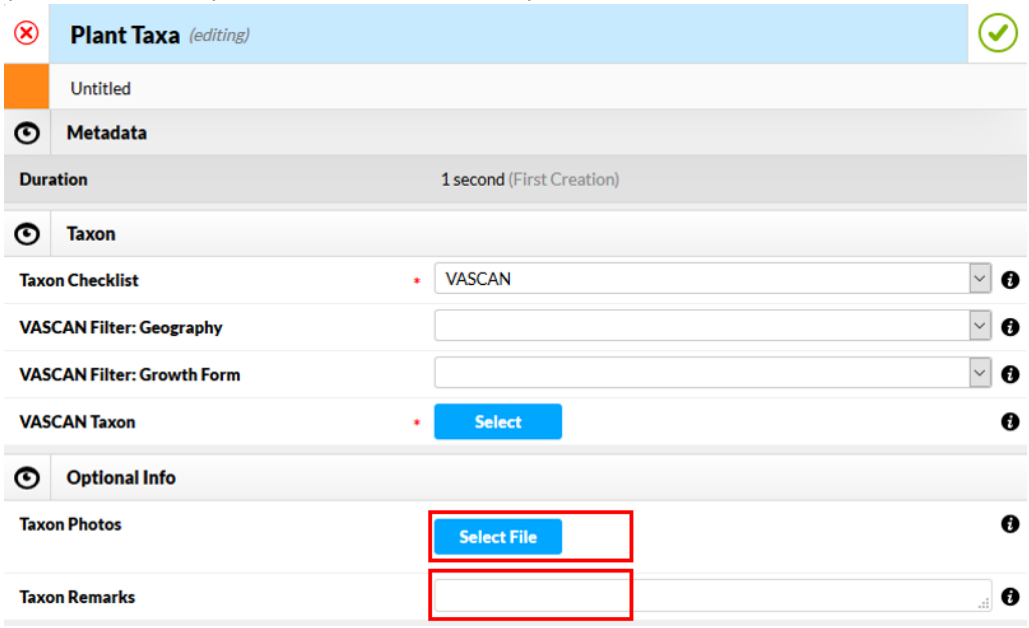
Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.



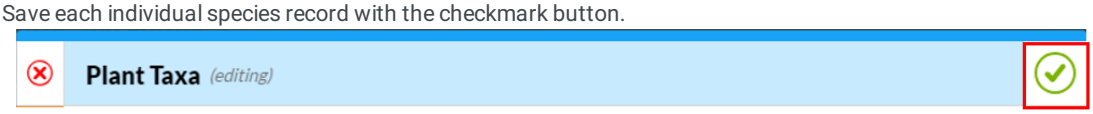
Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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



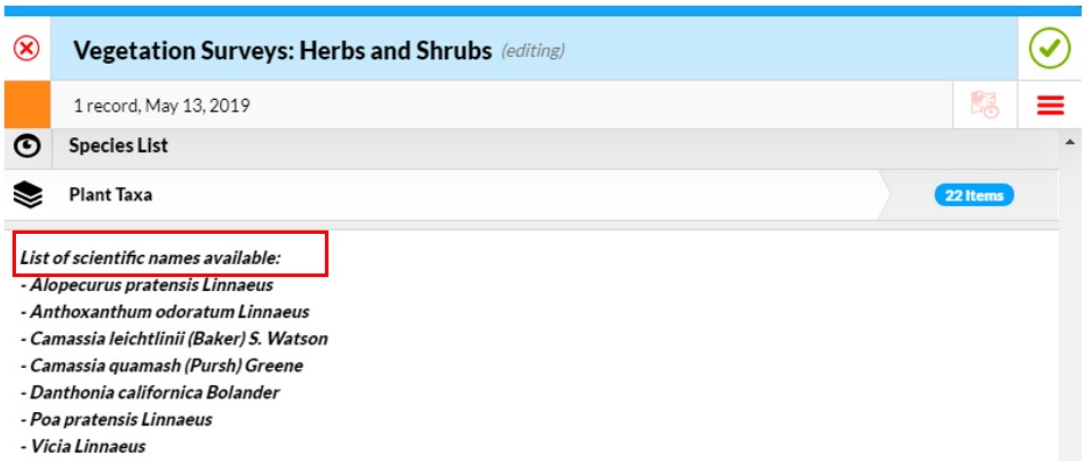
Photos and remarks are especially useful for specimens for which you are unsure of the identification. For these, also collect a herbarium specimen (step 21). Temporarily name that species with a taxon that does not occur in your field site. When you have the required resources to proceed to the identification,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

17.3 Save each individual species record with the checkmark button.

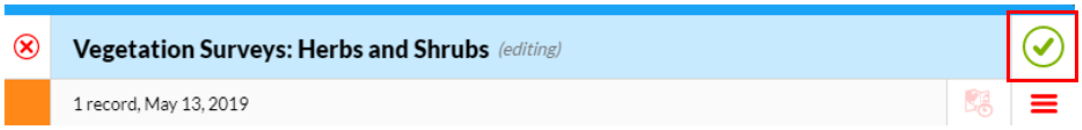


Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.



Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

17.6

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

Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.

3 Square canopy cover negative templates -
1% = 10 x 10 cm
5% = 22,4 x 22,4 cm
10% = 31,6 x 31,6 cm

Identification guides -
See Open Vegetation Survey Protocol → Guidelines → Site Specific Information.

2 Step Steel Step Ladders (2) -
CGOP site only.

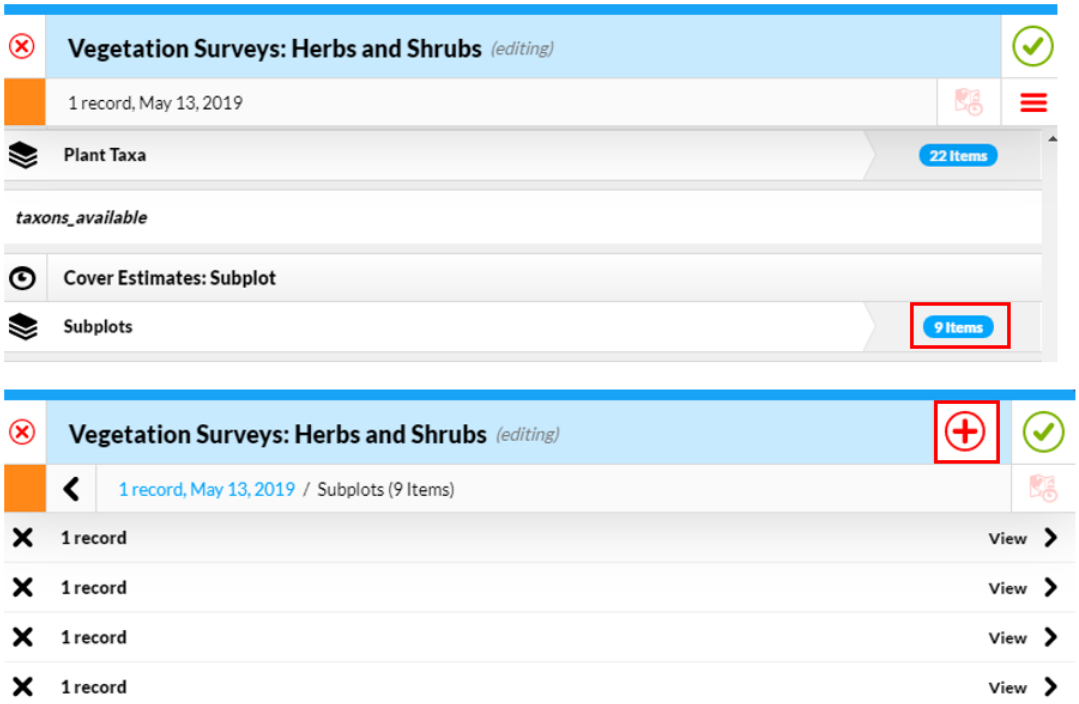
3 m long Telescopic Aluminum Scaffold Plank -
CGOP site only.

CAT S41 fieldwork cellphone -

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.

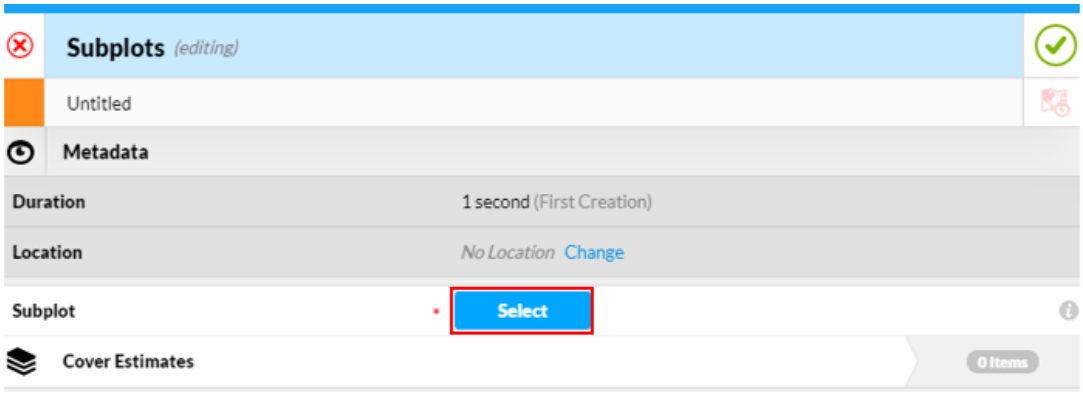
Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

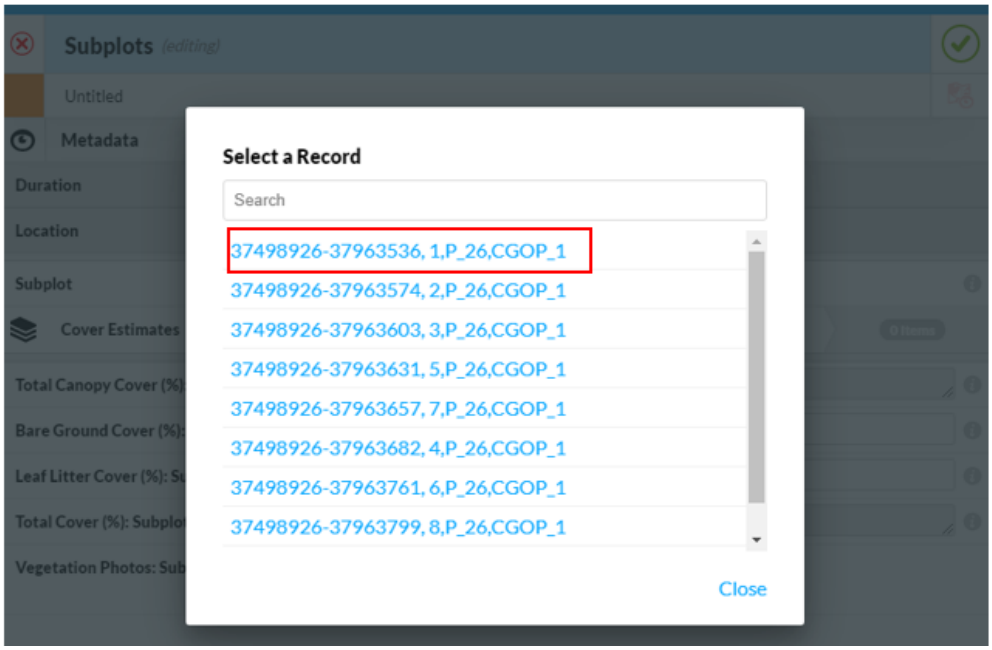
18.1 Under Vegetation Surveys: Herbs and Shrubs → Cover Estimates: Subplot, create a new subplot entry by clicking on the items and the plus buttons.



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.

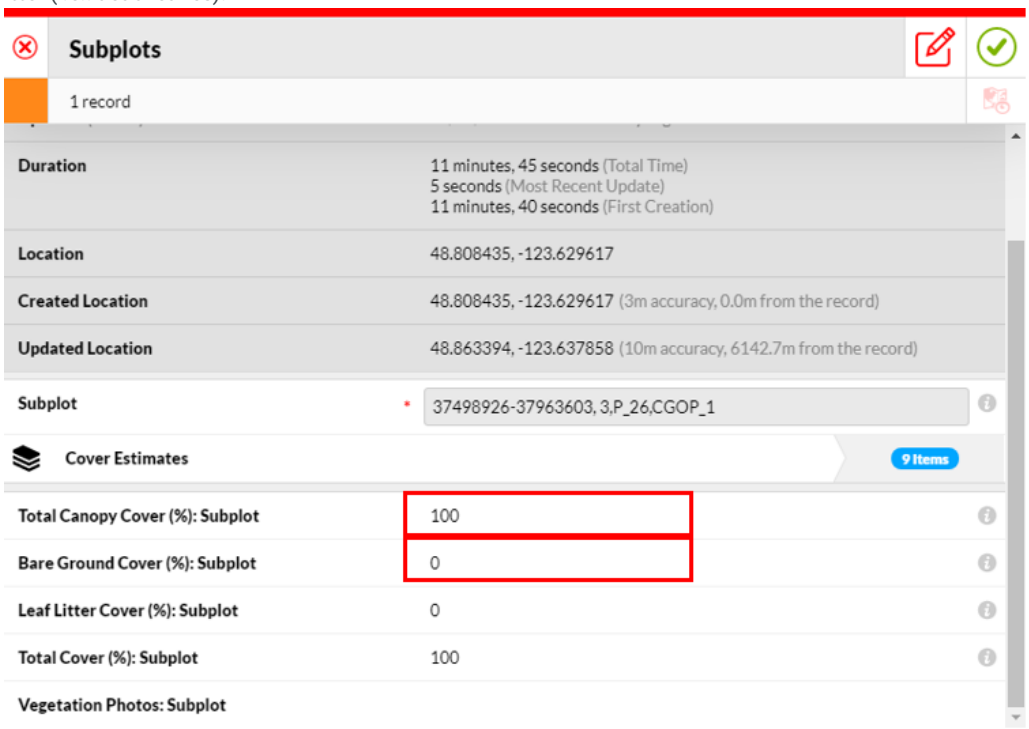
Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan





Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

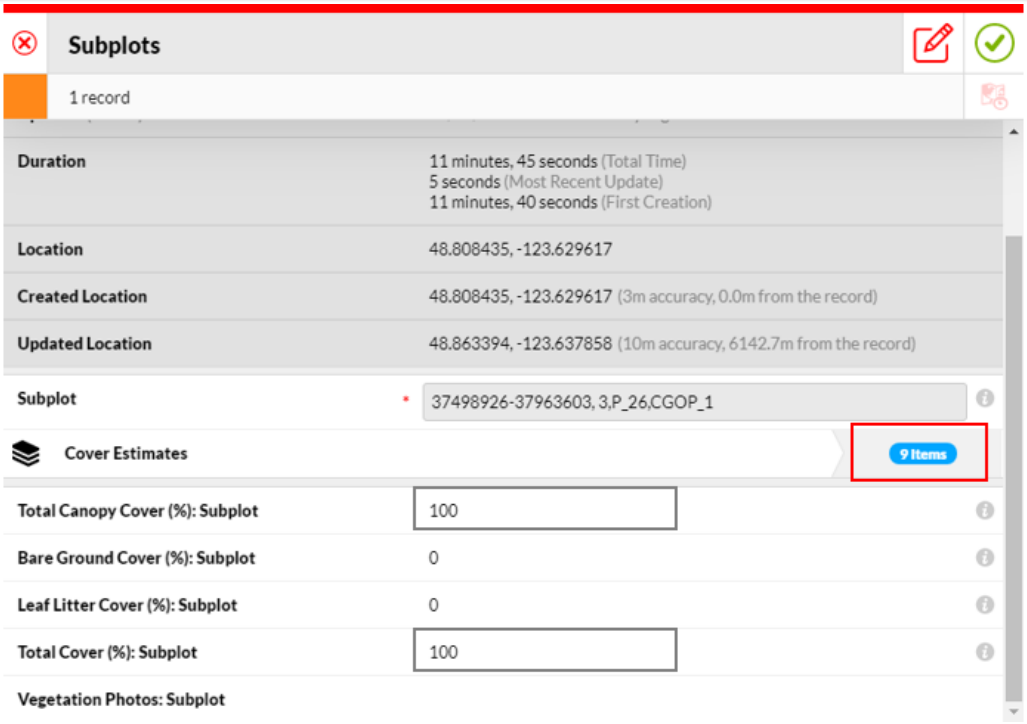
18.3 If NOT taking small drone pictures:
Under Vegetation Surveys: Herbs and Shrubs → Cover Estimates: Subplot → Subplots → Record [# from 1 to 9] → Cover Estimates, enter directly the Cover Estimates for the Bare Ground (i.e.: ground (soil or rocks) with no vegetation on it) and Leaf Litter (i.e.: dead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



Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

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.

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.

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):

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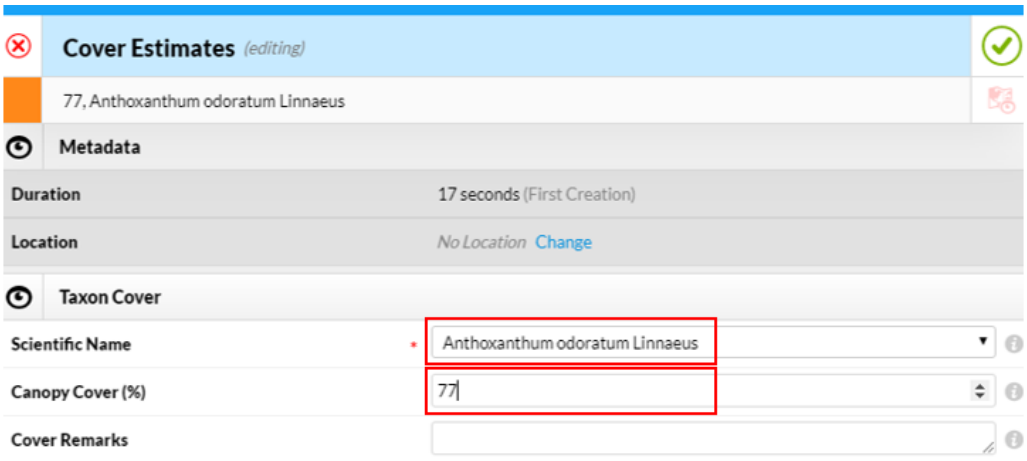
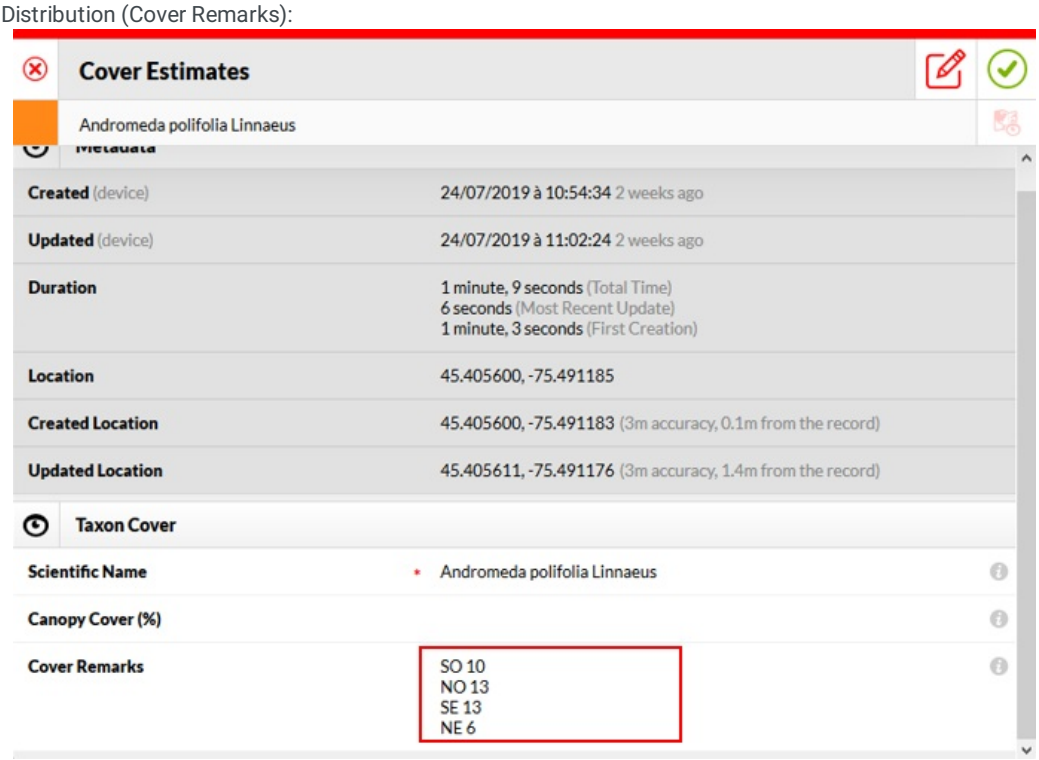


NOTES ON CANOPY COVER:
In order to best approximate what will be viewed by the airborne surveys:

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%.

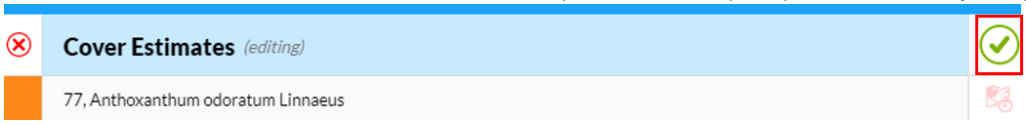
- Distribution (Cover Remarks):



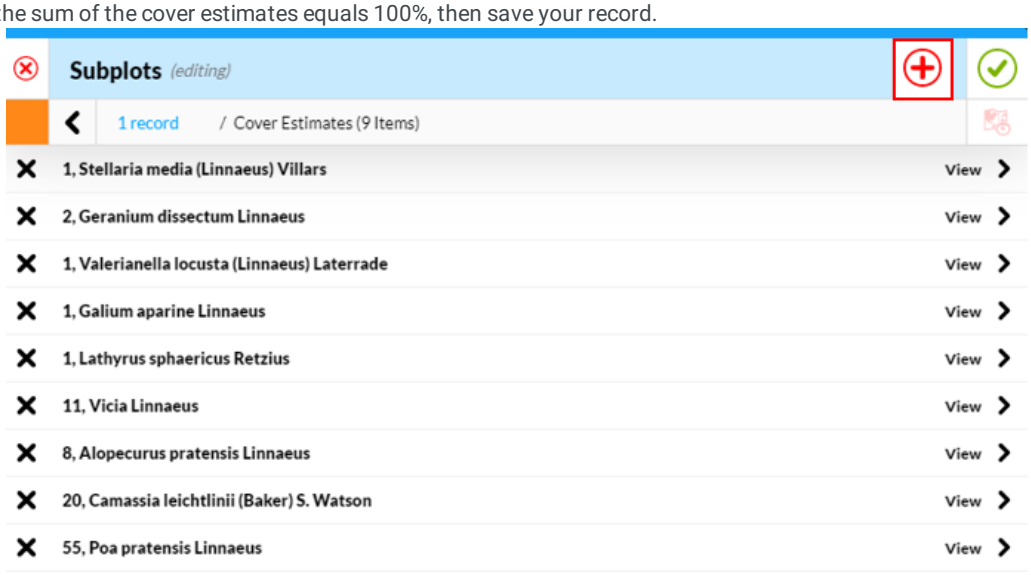
Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan

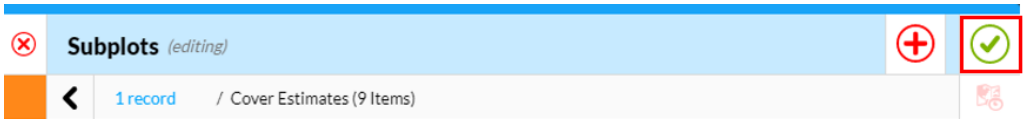
NOTES ON COVER REMARKS:
Divide each subplot in areas identified with direction acronyms (S = south, N = north, O or W = west, E = east, C = center) and add the number of individuals for a given species.

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

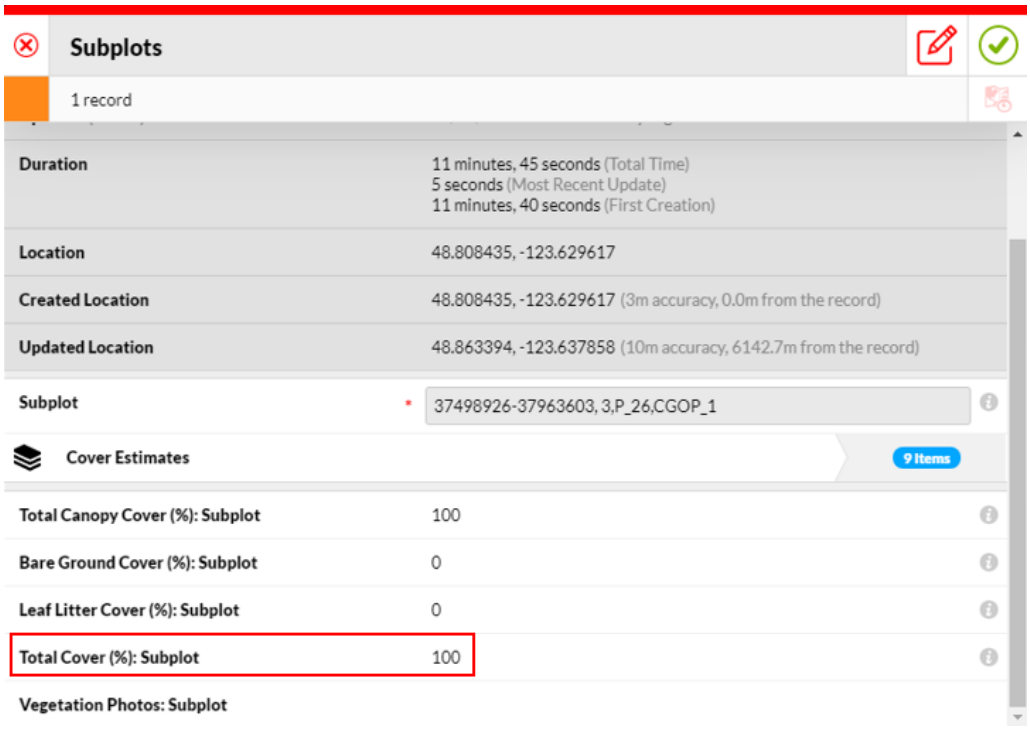


18.8 Keep adding species until the *Fulcrum* record is complete for the subplot and, if entering Abundance values (Canopy Cover), the sum of the cover estimates equals 100%, then save your record.



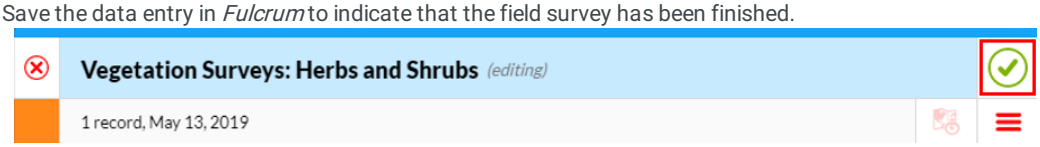


Citation: Sabine St-Jean, Mark Vellend (04/02/2020). Open Vegetation Survey Protocol. https://dx.doi.org/10.17504/protocols.io.3ebgjan



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.



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Precise Georeferencing

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

Trimble Catalyst GPS, NTRIP precision subscription

-

CAT S41 fieldwork cellphone -

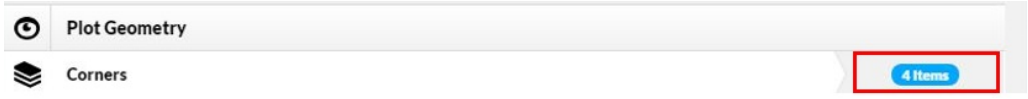
Each surveyed plot has to be precisely georeferenced OR marked with stakes before moving the grid to the following plot.

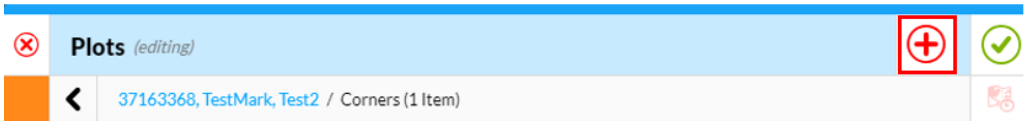
- If the Trimble GPS is available continuously, the precise georeferencing of the 4 corners can be done right away, and the plot stakes don't have to be installed.
- If the Trimble GPS is only available at a specific time, the plot corners are marked with stakes as indicated in steps 5 to 9. The precise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





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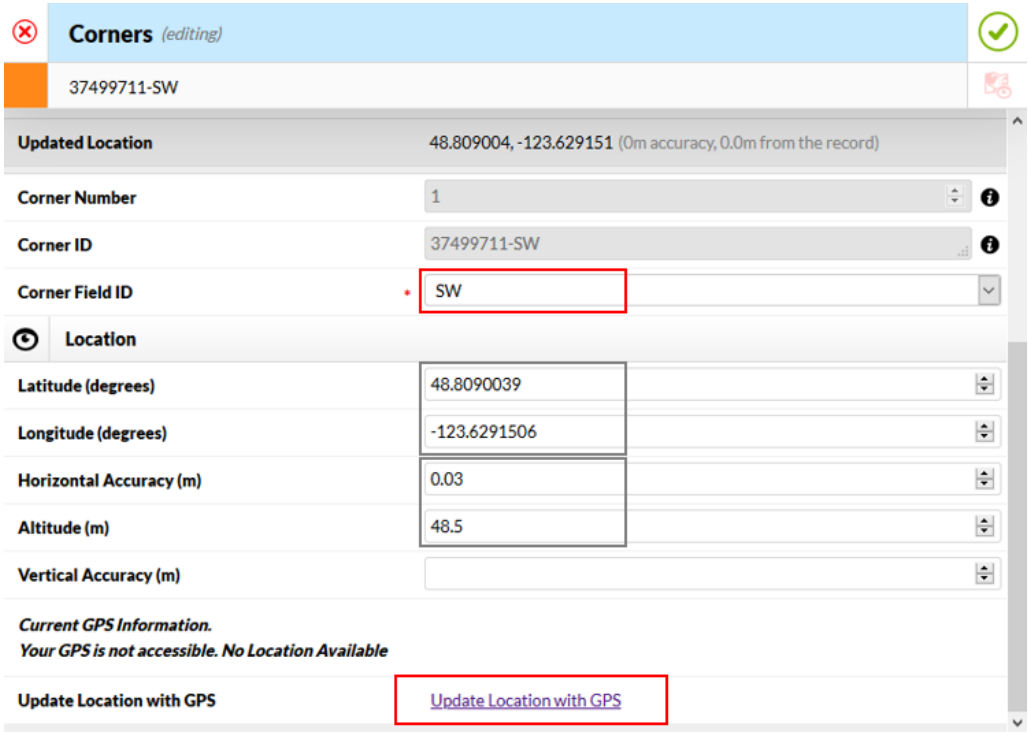
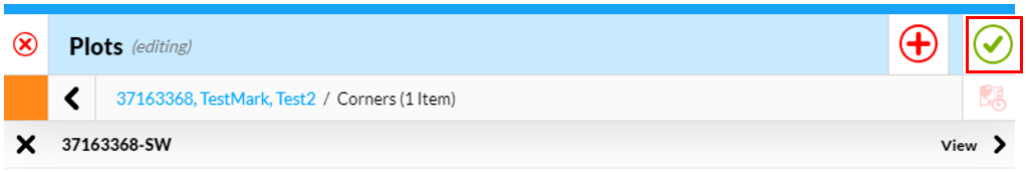
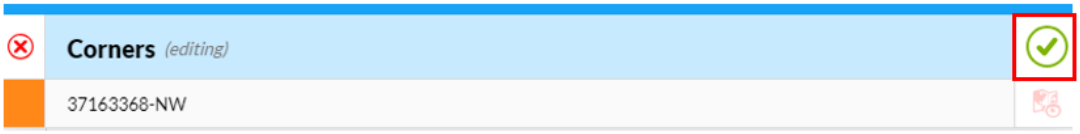


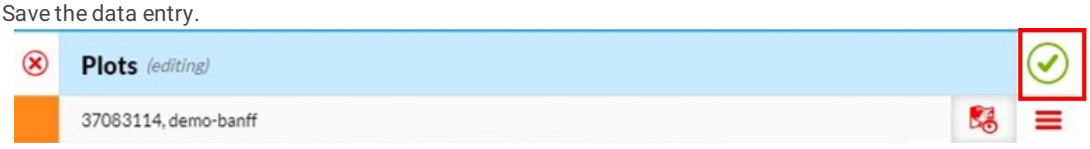


19.4 Repeat step 19.3 for each corner, turning clockwise.



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.

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Next Plot

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

Herbarium Specimens

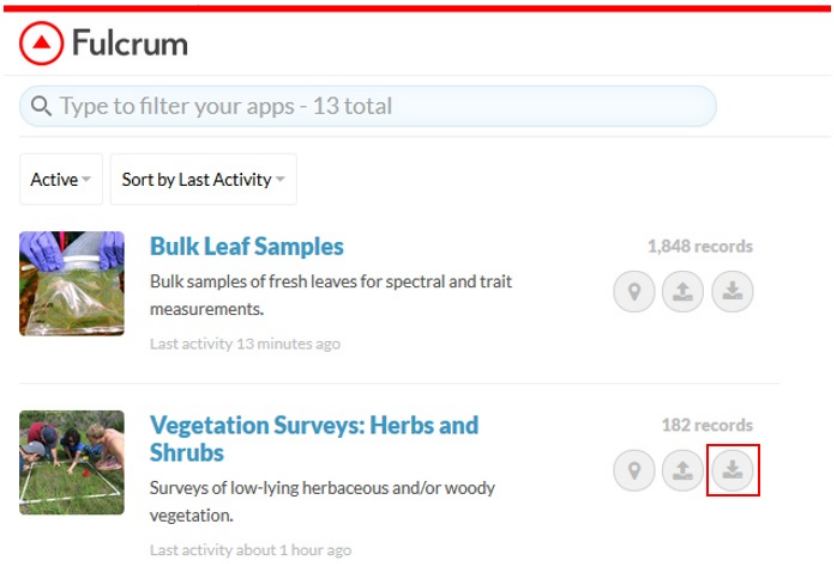
21 Refer yourself to the Herbarium Specimens protocol to collect herbarium specimens for 1) the species identified in the vegetation surveys, and 2) unknown plants.

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.



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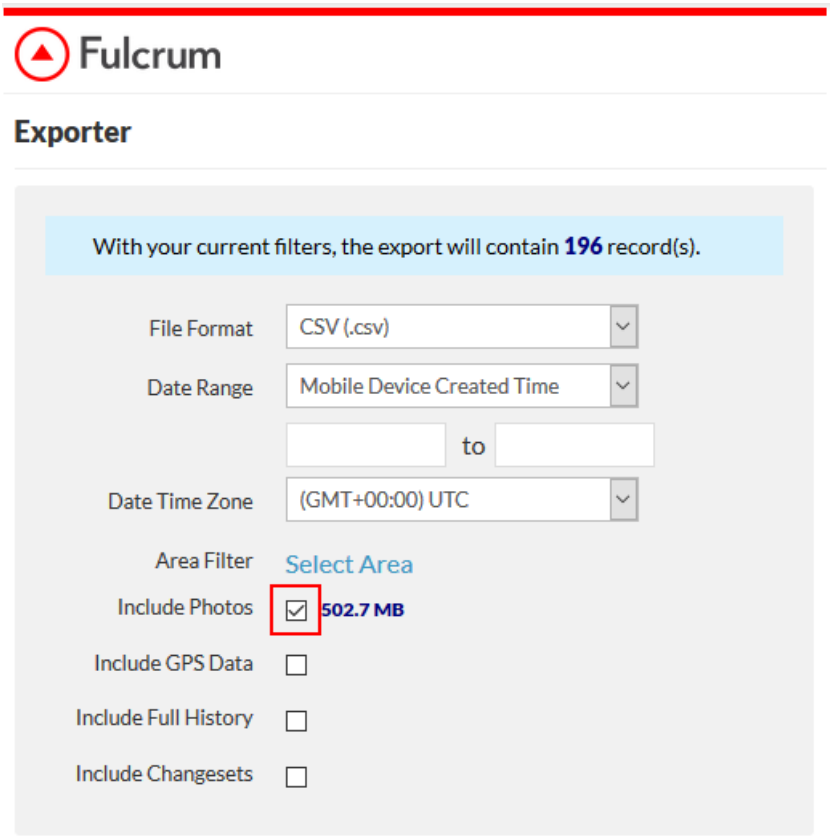

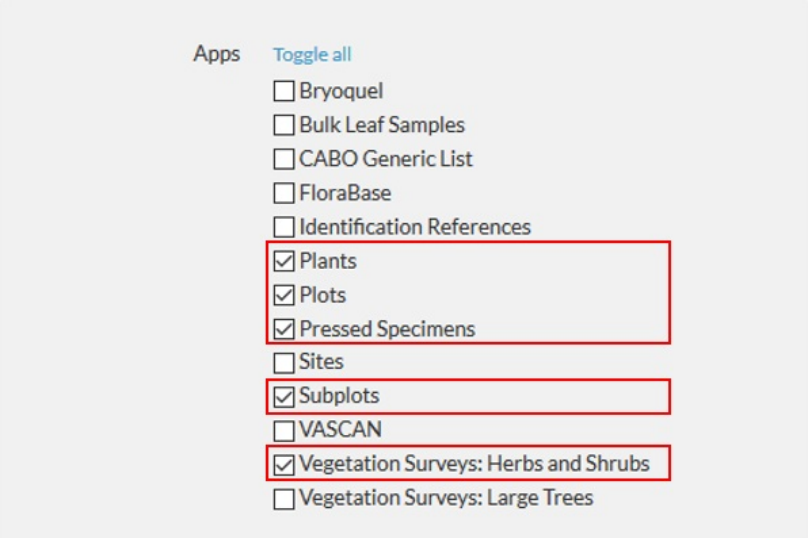

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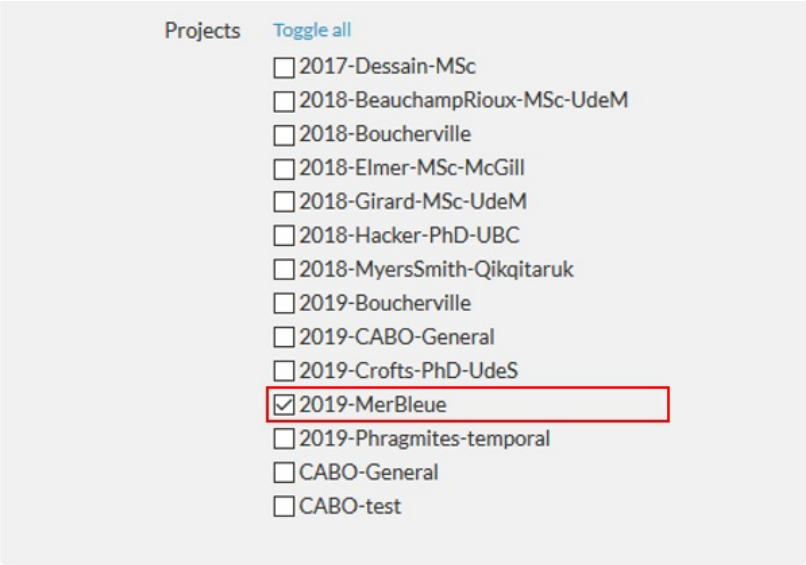

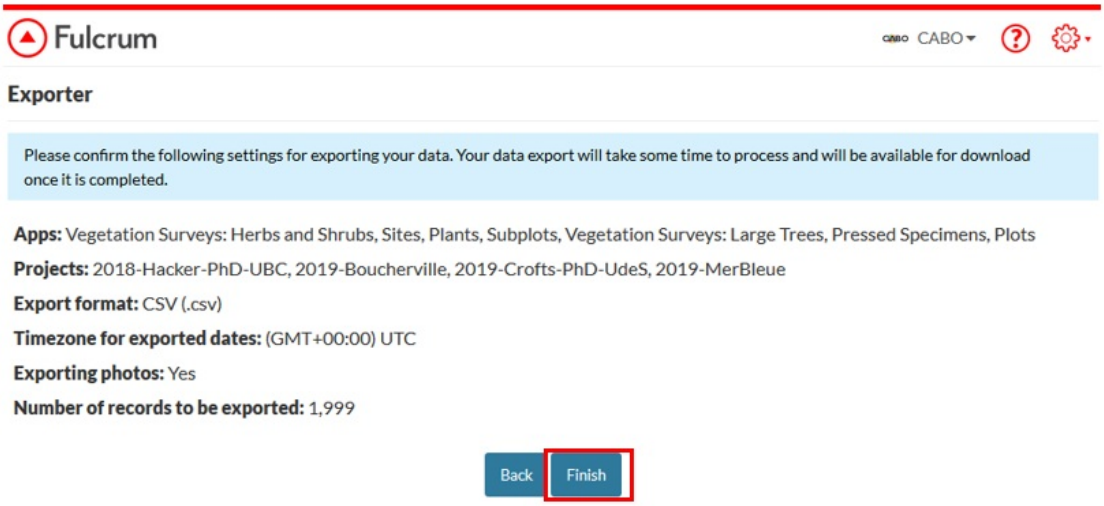

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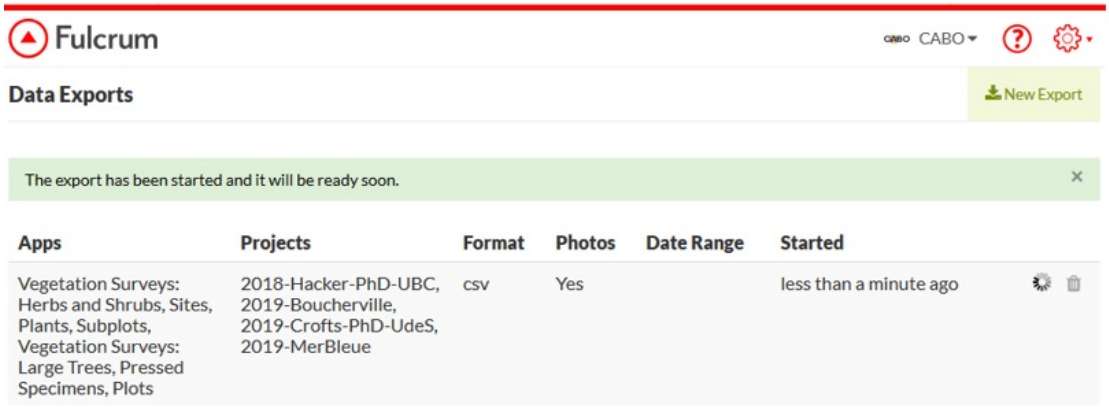

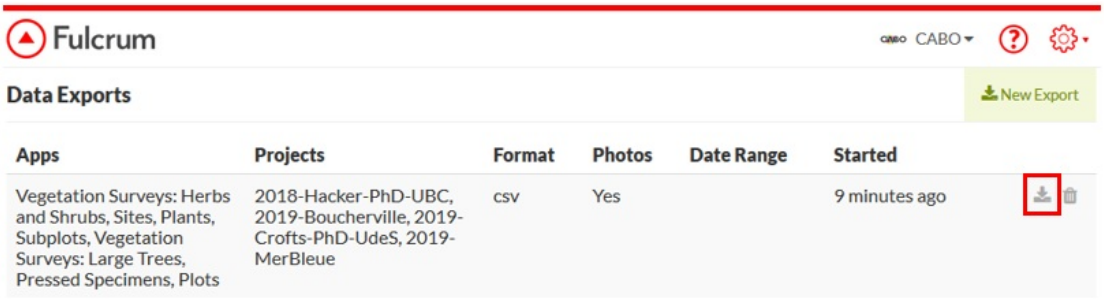

Finalization

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

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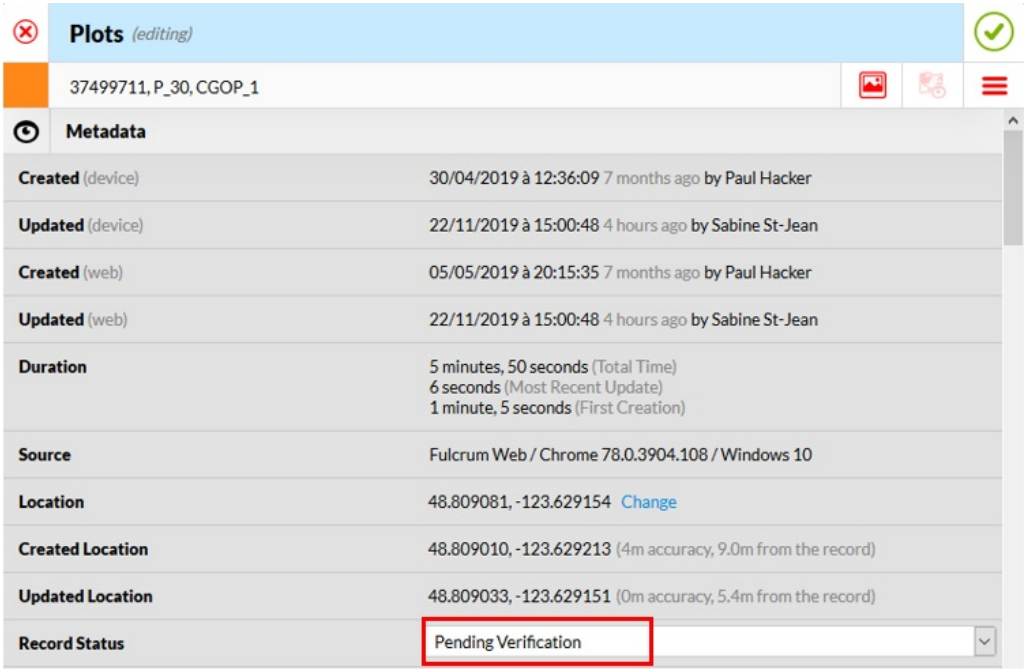
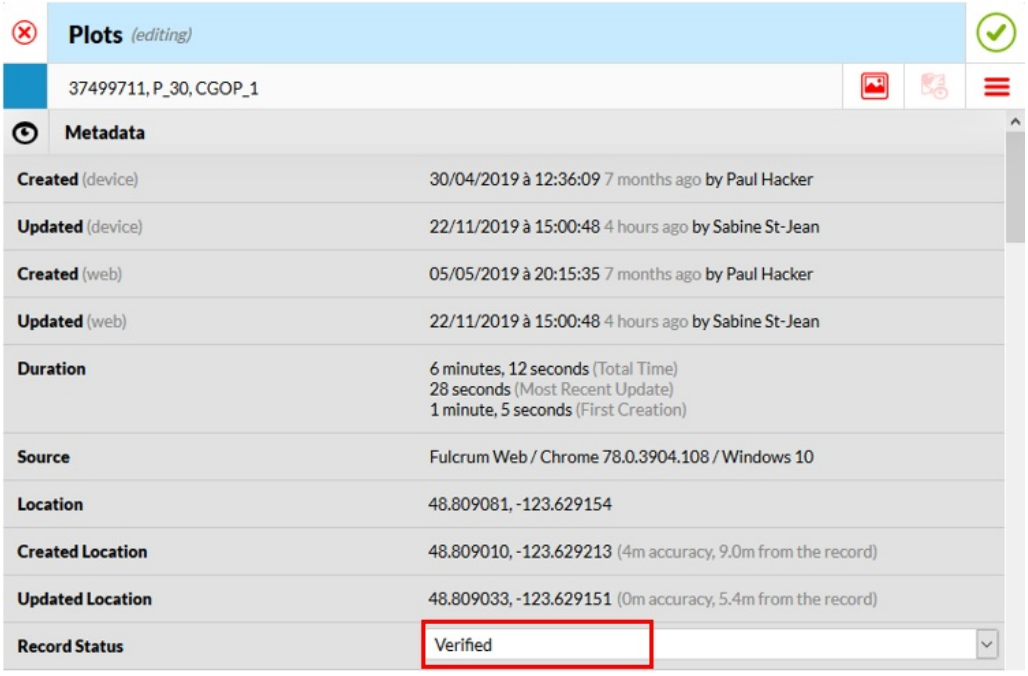
to Verified.





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.

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