

SMART Field Sensors Guide



Version 1.8



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Background

Field sensors have become an increasingly important element in protected area management over the last decade, particularly camera traps and acoustic devices. Static and silent field sensors, carefully positioned, can provide important information on movement of key wildlife or human intruders, or evidence of illegal activity (sounds of chainsaws, vehicles, or gunshots), complementing observations by patrol teams.

SMART's Field Sensors Plugin was designed to support this process, incorporating data from field sensors into the SMART database where it can be queried and analysed with patrol data to give decision makers the most accurate picture of the ground. It is not designed as a mass storage platform, however, as such users will need a plan to store their data separately¹. Users should be aware that the aim of this tool is to allow Conservation Areas to incorporate field sensor data into SMART, to assist the decision-making process and use of adaptive management.

Field sensors are only as good as how they are deployed and managed: batteries run out, units break, and some localities are better than others. Field Sensors Plugin was designed to assist managers with keeping track of the status of their units and refine their understanding of deployment conditions necessary for the unit to work optimally.

Purpose of this handbook

This handbook introduces readers to SMART's Field Sensors Plugin, with the primary audience being data managers, analysts and managers of field sensors. It explains the concepts and structure of the plugin and provides a thorough explanation of its functionality. How you decide to configure and implement Field Sensors will depend on your information requirements, however we provide examples in the guide for potential use case scenarios and what you might want to consider when building your data model.

Acknowledgements

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Particular thanks to staff from ZSL Thailand and Rimba, Malaysia, for piloting the first version of Field Sensors Plugin and providing valuable feedback.

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Photo Credits:

Cover Image: © ZSL Thailand/ Department of National Parks, Wildlife and Plant Conservation (DNP) Thailand. Activities funded by Panthera and USFWS RTCF.

Page 3: Rangers deploy a camera trap to monitor wildlife and illegal activity, Khao Yai National Park. © Anthony Lynam/WCS

Back cover: Serval © Ryan Scott/Panthera

¹ Various options for storing camera-trap data are available e.g. Young et al. 2018. Software to facilitate and streamline camera trap data management: A review <https://doi.org/10.1002/ece3.4464>

Chapter 1: Introduction

1-1: What are Field Sensors?

Field Sensors¹ have become an increasingly important tool for ecological monitoring and law enforcement work within conservation areas. They can provide staff with critical information about the environment, activities and occurrences which may be used to develop informed responses. This plugin was developed to enhance the use of field sensors by fulfilling the following objectives:

- Provide tools for the management and maintenance of field sensors.
- Allow the cataloguing and management of imagery derived from these sensors.
- Integrate with other observations within a SMART database (patrols, surveys, independent incidents) for querying and visualizing data.

The outcome of these objectives can result in an increased situational awareness about the user's environment.

1-2: Capabilities and Limitations

Capabilities provided by Field Sensors in comparison to third party software include:

- Ability to incorporate both patrol and sensor data together when aggregating data for analysis
- Patrol and sensor data are stored in one convenient location
- Simple and fast navigation to sensor data
- Ability to visualize live sensor deployments to aid in management

NOTE: At this time, only image files from cameras can be imported and used in SMART. Future versions of the Field Sensors Plugin aim to allow a wider variety of file types to be included.



¹'Field Sensors' can be defined to include camera traps, acoustic monitoring devices, geofences and other technologies used to remotely capture information from the field, which may be manually or automatically transferred to data management personnel. For the purposes of this training manual however, 'Field Sensors' refer primarily to the wide variety of camera traps available for use in conservation areas.

Chapter 2: Getting Started

2-1: Installing Field Sensors

Open your Conservation Area and navigate to **File** ☐ **Install New Plugins....** In the **Work with** field, select **Local Update Site** and search for **SMART Field Sensors (Cameras etc) Plug-in** (the exact name may change in future updates) in the space below (Fig. 2.1). Tick the box next to the name and then press **Next**. Proceed through the following menus until Field Sensors has been installed. A restart may be required before you can use it.

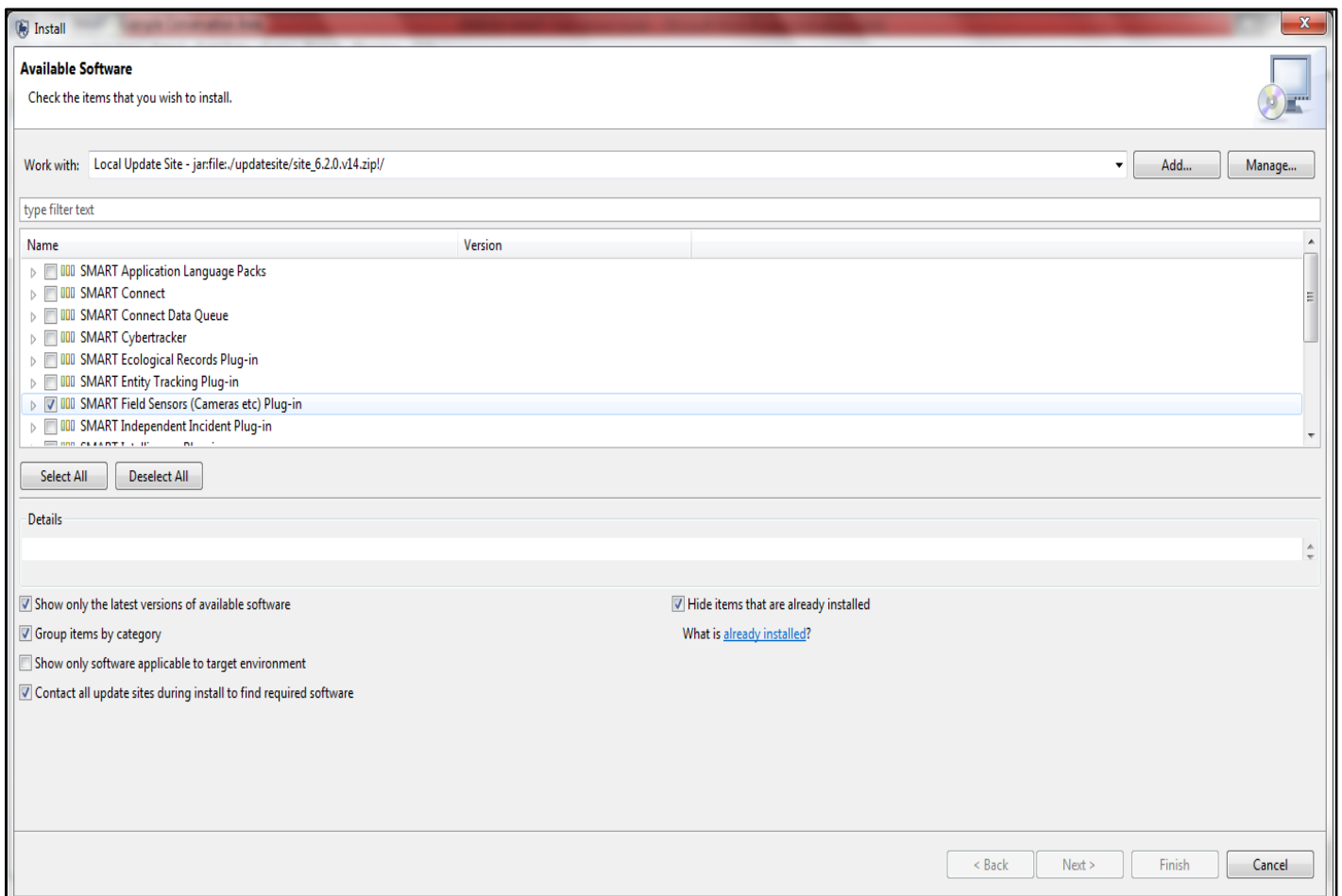



Figure 2.1: Location for Field Sensors installation.

2-2: Terms and Definitions

Below is a list of terms used within this guide, whose definitions are not explicitly stated throughout its content:

- **Active:** Refers to the status of a station/location, i.e. when a functioning sensor is deployed within it. Also refers to the status of field sensors, when they are deployed and functioning at a location.
- **Inactive:** Refers to the status of a station/location, when a functioning sensor is not deployed within it. Also refers to the status of field sensors, when they are: 1. not deployed or 2. deployed but not functioning.
- **Independent Incident:** A cluster of activity from one or more assets (i.e. multiple triggers/images), which meet user defined criteria, in terms of their spatial and temporal characteristics, so as to be considered as part of a single 'incident'.

2-3: Navigation

This document uses specific terminology for navigating the user interface of the Field Sensors plugin. Figure 2.2 identifies what the terminology refers to. The central hub for working in Field Sensors is called the **Field Sensor Perspective** and is accessed by pressing , located on the main toolbar, to **open the field sensor perspective**.

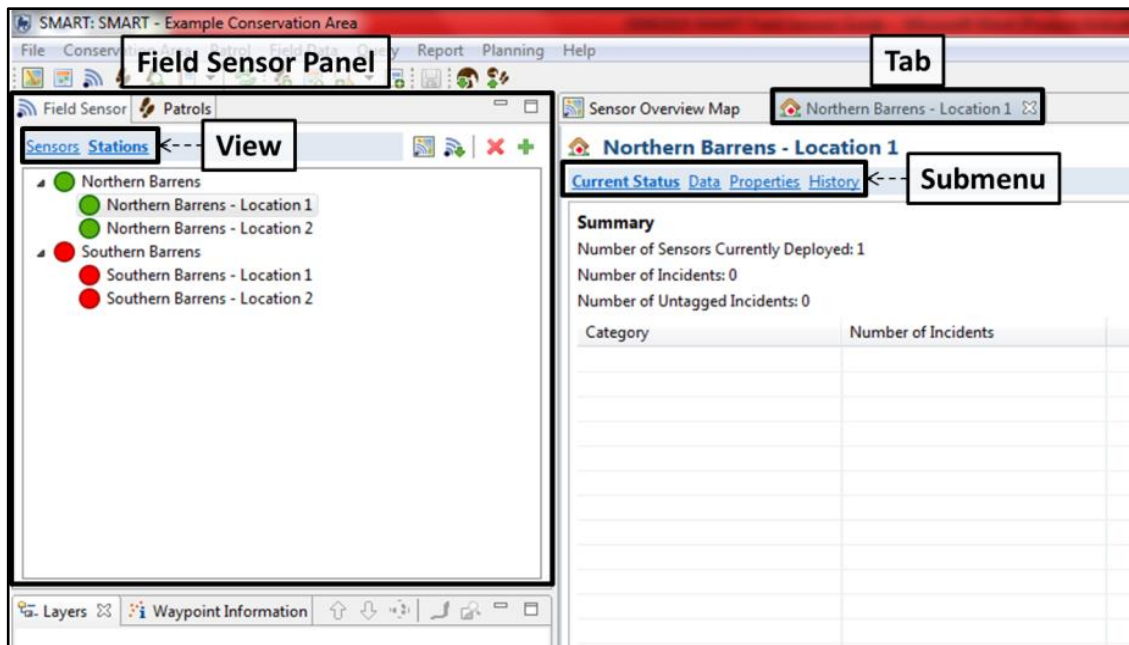


Figure 2.2: Field Sensor perspective layout.



Field sensors can be used to gather information remotely for a variety of needs, such as ecological monitoring or law enforcement. Here a camera trap has been used to monitor illegal entries into a protected area. © Wildlife Protection Solutions

Chapter 3: Data Model Structure

3-1: Organization

All sensor-related data in Field Sensors is organized within four categories (Figure 3.1). Each category reflects a real-world element critical to the monitoring process, and are defined in this guide as follows:

- **Sensor:** Individual data collection asset. Categories of different types of sensors identify their capabilities (camera trap, acoustic monitor). Sensor is interchangeable with the term “asset”.
- **Station:** A targeted area of interest. The scale of the station is user-defined and will generally reflect the size of relevance of the target area. Stations are represented by coordinates for a central point, with a buffer of user-defined width.
- **Location:** The specific point, in coordinates, where a sensor is deployed. Locations also have a defined buffer, defining the area of sensor coverage. Several locations may be present within one station. Location is interchangeable with the term “unit location”.
- **Deployment:** A set period of time during which a sensor is deployed at a location within a station, whether active or inactive.

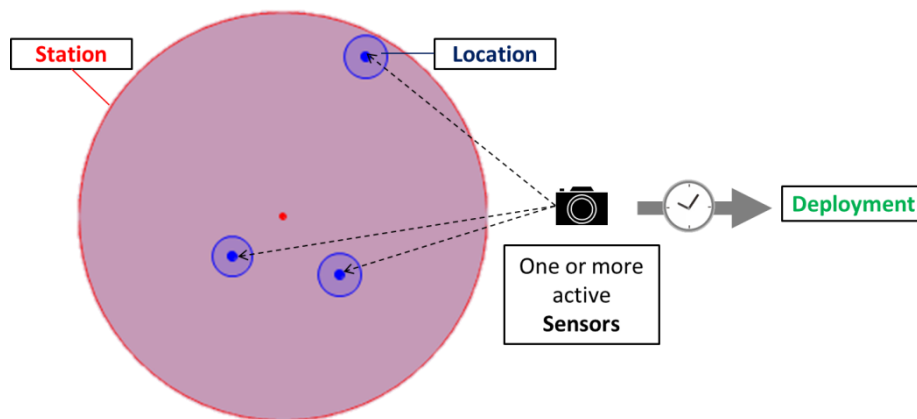


Figure 3.1: Visual representation of database structure.

3-2: Attributes

Field Sensors data model attributes can be customized to capture structured and unstructured data about the characteristics of a real-world sensor, station, location, or deployment. The attributes are independent from the core data model for your Conservation Area. Attributes within Field Sensors are managed centrally, and once created, can be applied to Sensors, Stations, Locations, and Deployments as appropriate. Attributes can be accessed from **Field Data** ☐ **Field Sensors** ☐ **Field Sensor Attributes...** (Figure 3.2).

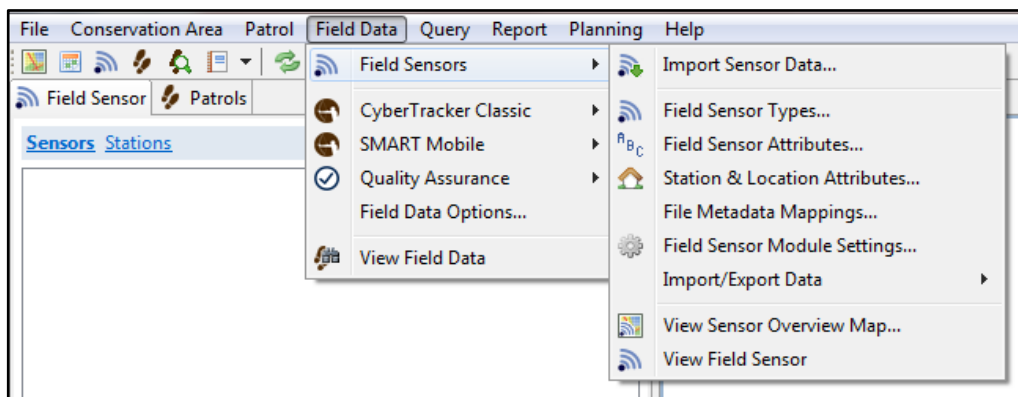


Figure 3.2: Attribute menu access.

To add a new attribute manually, click **Add**. The next window (Figure 3.3), allows users to enter a name for the attribute (the key is automatically generated by the system based on user inputted name) and define its data type. One of six data types must be selected:

- **Numeric:** Accepts positive or negative number values, up to fifteen significant digits. Larger values can be entered but are displayed using scientific notation (i.e. 3.23145E11 instead of 323145000000).
- **Text:** Accepts all character inputs (letters, numbers and symbols within the language selection for the attribute up to a maximum limit of 1024 characters).
- **Boolean:** Accepts a Boolean value, 'Yes' or 'No'. Boolean attribute fields can also be turned on or off using a checkbox if the user is unable to choose one of the two options.
- **List:** Accepts a single selection from a list of values which have been set in the data model. The user is not able to turn list fields off with a checkbox, so it is important that lists contain all values such as 'Other' or 'Unknown'.
- **Date:** Accepts a date value in the format YYYY-MM-DD. The value can be input manually or selected from a calendar picker by the user. Date fields can also be turned on or off using a checkbox if the user does not have this information.
- **Position:** Accepts location coordinates based on the coordinate reference system in use by the SMART Conservation Area. Coordinates can be either geographic or projected and can be entered manually or selected from the map.

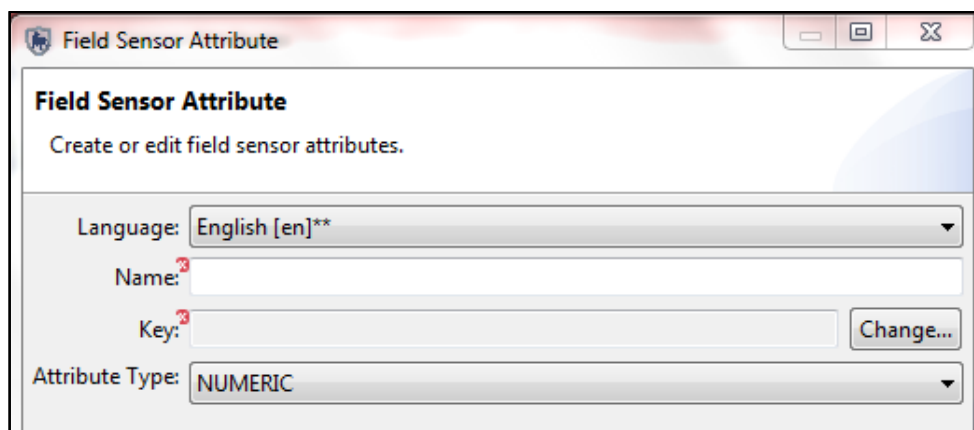


Figure 3.3: New attribute creation.

Once an attribute has been created, it is visible in the **Field Sensor Attributes...** menu. Attributes in this space can be edited and deleted by highlighting an attribute and pressing **Edit** or **Delete** respectively.

All attributes that are created are termed **User Defined Attributes**. These attributes can be edited or deleted at any time. Examples of **User Defined Attributes** used in protected areas can be found in the [Appendix](#) at the end of this guide.

NOTE: be aware that deleting an attribute will also delete any data stored within that attribute.

System Defined Attributes, as with the rest of the SMART platform, cannot be edited or deleted, as they are used for specific functions within the plugin. An example of a system defined attribute, is the name of an individual sensor (Sensor ID). Other attributes, such as **Total Time in Field** and **Total Incidents**, are automatically generated and cannot be defined by the user. Field Sensors will automatically create these attributes when a deployment is entered. As their names suggest, **Total Time in Field** counts how long a sensor was deployed (including live sensors) and **Total Incidents** counts incident groupings of imported sensor imagery. They also differ from other attributes with regards to how they can be viewed. Both can be viewed in the **Deployments** submenu of a **Sensor Information Tab**, under **Summary**. **Total Time in Field** can additionally be viewed in the **Field Sensors** submenu of a **Station Information Tab**.

The following sections (3-3, 3-4, 3-5, and 3-6) outline the steps for adding attributes to specific sensor types, stations, locations, and deployments.

3-3: Sensors

Users must create a **Sensor Type** before individual sensors can be entered into the database. A sensor type represents a template for a group of sensor units that share a common set of characteristics. For example, a newer and older version of the same brand of camera will likely have performance differences. By entering both sensor types into Field Sensors, their data can easily be separated for analytical purposes. In addition to ease of separation, sensor types provide control over the application of specific attributes.

Camera models are the most common way to distinguish sensor types, different types of categorization can be used (different software, modifications, etc.). To create a sensor type, go to **Field Data** ▢ **Field Sensors** ▢ **Field Sensor Types...** (Figure 3.4). The next window is very similar to the attributes menu. To add a new sensor type manually, press **Add**.

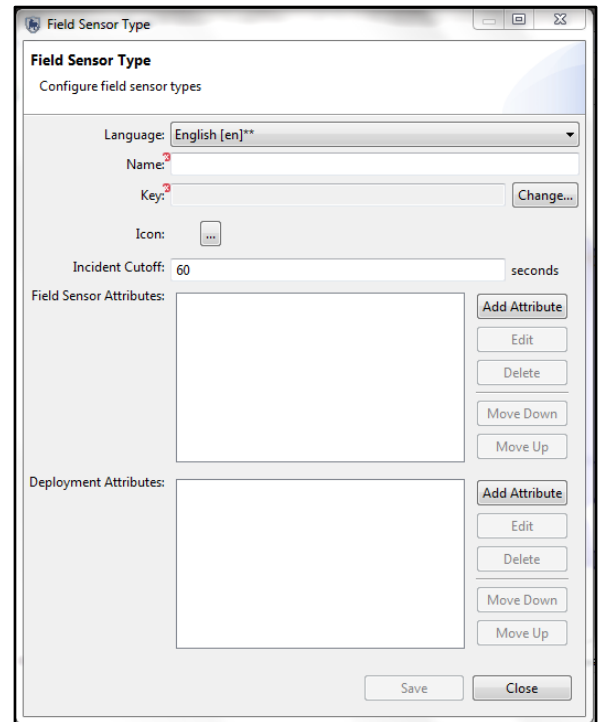


Figure 3.4: New sensor type creation.

- **Name** represents the sensor model or other categorization used.
- A custom **Icon** can be used (from any location on the device).
- **Incident Cutoff** relates to automatic grouping of imported imagery (see section 5-1).
- The two bottom boxes show the attributes that apply to either the field sensor or deployment categories. In order to add an attribute to either box follow the steps:
 - Press **Add Attribute** to show all existing attributes. Check the attributes you want added to the category and press **OK** (this will need to be done individually for each sensor type).
 - You also have the option of creating new attributes here by pressing **Create New Attribute**. This will create an attribute that will appear in the same pool as all others (not specific to the category you are creating it for) but will be assigned to the category you are working from.

All information related to **Field Sensor Type** can be edited after it is created.

*NOTE: changes to the **Incident Cutoff** will not automatically update any existing imagery data groupings. Changing the data model of a sensor type, by changing or removing attributes, can also lead to the loss of existing data.*

To create a new sensor unit, navigate to the Field Sensor panel (default position is on the left side of the screen). Ensure you are in the **Sensors** view, and press **+ create a new sensor** on the top right (Figure 3.5).

You will be prompted to enter a **Sensor ID** and to select a **Field Sensor Type**. The **Sensor ID** should be a unique identifier that can be found on the physical sensor itself (e.g. a serial number or asset register number). All field sensor types you have created will appear in the field sensor type box and only one can be selected. You cannot change the sensor type of a given sensor once it has been created.

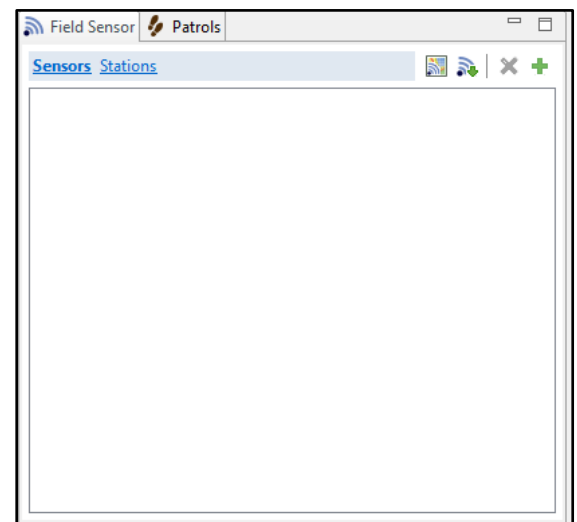


Figure 3.5: Sensor creation.

After creating a sensor, you will notice the new information in the field sensor panel. In the example shown below, we have created two sensor types and one sensor of each type (Figure 3.6).

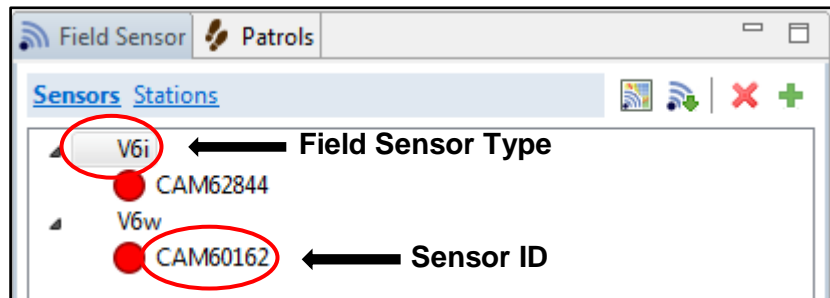


Figure 3.6: Newly created sensors.

Should you need to remove a sensor, select it from the list of sensors and press **✖ delete the selected station and all related data** and enter conservation area login and password when prompted

NOTE: this will remove all associated data with no way of recovery.

Additionally, there is a second method of deletion. Double click the name of the sensor to open the sensor information tab. Within the tab, select the **Properties** submenu. Press **Retire Sensor** on the top right of this menu to functionally delete the sensor (Figure 3.7). You will be prompted to optionally write a comment on why the sensor is being retired. The difference between the first deletion method and retiring a sensor, is that a retired sensor can still be observed in the database and its past data **will not** be deleted. Retired sensors can optionally be displayed in the field sensors panel by right clicking in the white space beside the list of sensors and selecting **Show Retired Field Sensors** (Fig. 3.8). Retired field sensors can be activated again if needed.

NOTE: a retired field sensor still retains the sensor's unique ID, so if a retired sensor became fixed and ready for use again you should reactivate the retired field sensor instead of creating a new one.

In general, it is good practice to ensure sensors are only retired when they are no longer available (lost, stolen, damaged beyond repair, etc.).

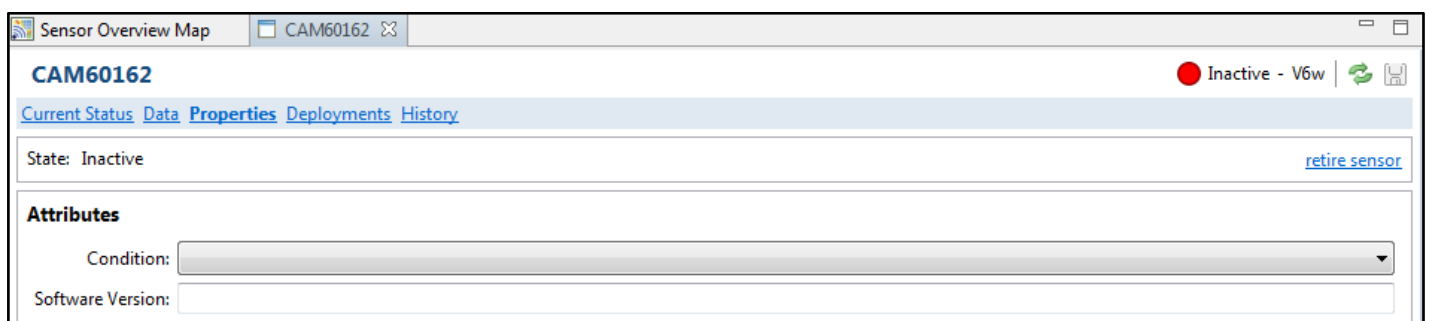


Figure 3.7: Location of the 'retire sensor' function.

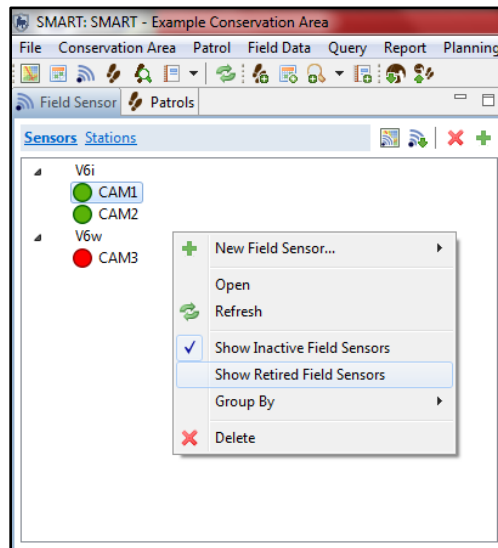





Figure 3.8: Location of show retired field sensors.

Double clicking on a sensor will open the sensor's information tab. In the tab are five submenus: **Current Status**, **Data**, **Properties**, **Deployments**, and **History**.

- **Current Status:** Summary information of a currently deployed sensor. This section will be blank for inactive sensors. Includes a map showing the sensor location (unit location) in **blue** relative to the station it is within in **red**.
- **Data:** Imagery data organized by incident, specific to the sensor in view. Ability to modify incident information and stamp model data to incidents (see section 5-3).
- **Properties:** List of associated attributes with the ability to change their values. Additionally, location of retire sensor function. If any changes are not saved by pressing  **save changes** on the top right, you will be asked if you want to save your changes when exiting the tab.
- **Deployments:** Summary information of past deployments, including the automatic **Total Time in Field**. Ability to add, edit, and delete deployments associated with the sensor.
- **History:** Log of any comments/observations made. Press  **create a new history record** to create a new history record. Records are text based and serve as a location to store information that does not have a specific location in attributes.

3-4: Stations

To create a new station, access the **Stations** view within the field sensor panel and press  **create a new station** at the top right. You will then be prompted to enter a station **ID** and **Position** (Figure 3.9).

The station ID should represent a unique identifier for the station. Position consists of X and Y coordinates, which can either be entered manually or by clicking on **map...** on the right. If you click on **map...**

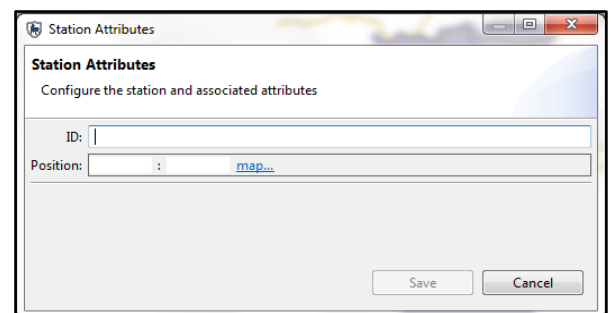



Figure 3.9: Station creation

you will be shown the default Conservation Area map. By hovering your cursor over the map, the coordinates will update accordingly (enlarge the window to allow enough space to show all coordinate digits). To select the stations coordinates, press  **click on a map to add new point** and then simply click the position of choice on the map. The selected position will be marked with a red star. To complete the selection, press **OK**.

Although we apply a point position for a station, the definition of station describes it as an area. The point acts as the centroid of a buffered circular area whose radius is also user-defined. To define the station buffer radius, navigate to **Field Data** ▢ **Field Sensors** ▢ **Field Sensor Module Settings...** In this window, users are able to define the buffer radius for both stations and locations in metres

NOTE: these values apply to ALL stations and locations.

Once the station has been created, its information will appear in the field sensor panel under the station view (Figure 3.10). The process for deleting a station if necessary is the same as deleting sensors, except without the option of retiring. To delete a station, press **✖ delete the selected station and all related data** while having highlighted the station and enter conservation area login and password when prompted

NOTE: that this will remove all associated data with no way of recovery.

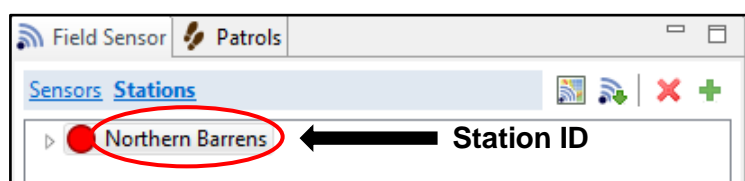


Figure 3.10: Newly created station.

To add attributes to stations, navigate to **Field Data** ▢ **Field Sensors** ▢ **Station and Location Attributes...**

Double clicking a station will open the station information tab. In the tab are five submenus: **Current Status**, **Data**, **Unit Locations**, **Properties**, **Field Sensors**.

- **Current Status:** Summary information of an active (sensor currently deployed) station. This section will be blank for stations without any active sensors. Includes a map showing the sensor location (unit location) in **blue** relative to the station it is within in **red**.
- **Data:** Image data organized by incident specific to the station in view. Ability to modify incident information and stamp model data to incidents (see section 5-3).
- **Unit Locations:** List of locations and their status (active or inactive). Also includes the same map as described in the **Current Status** submenu.
- **Properties:** List of associated attributes with the ability to change their values. At the top of this section is **Position** which displays the station's coordinates. You can change the stations' coordinates either by manually deleting and re-entering values or by pressing **map...** (the coordinates of a station should not be changed once it contains data, as this may conflict with geospatial metadata related to the sensor data). If you click on **map...** you will be shown the default Conservation Area map. By hovering your cursor over the map, the coordinates will update accordingly (enlarge the window to allow enough space to show all coordinate digits). To select the stations coordinates, press **⊕ click on a map to add new point** and then simply click the position of choice on the map. The selected position will be marked with a red star (Figure 3.11). To complete the selection, press **OK**. If any changes are not saved by pressing **💾 save changes** on the top right, you will be asked if you want to save your changes when exiting the tab.

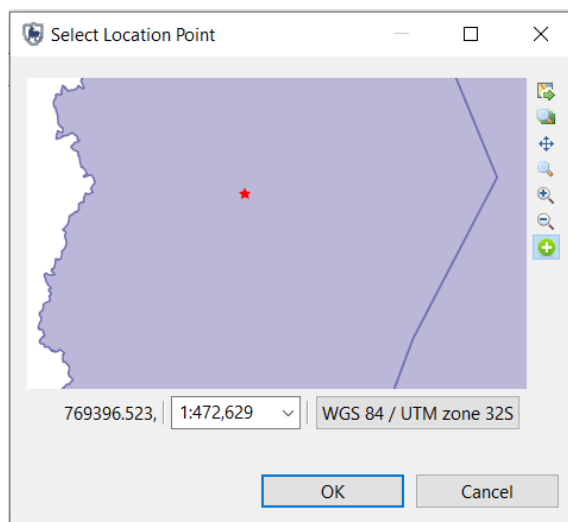


Figure 3.11: Changing a station's position on the map

- **Field Sensors:** List of all past and active deployments in the station with some summary information.

3-5: Locations

Locations can only be created in association with an existing station. There are four methods to create locations, two of which take place while adding data in the form of a deployment or imagery. The other two are the standard methods which do not require any additional data to be entered and will be discussed here:

- Open the information tab of the station for which you would like to add a new location. Navigate to the **Unit Locations** submenu. This submenu displays information on all active and inactive locations (shown in the status column) with their unique ID shown in the Location column. To create a new location, right click anywhere in the blank area of the spreadsheet and press **Add** (Figure 3.12). A window will open displaying default values for **ID** and **position** for the new location (Figure 3.14). The default ID is the name of the station followed by “- Location X” where X is the number of stations that have been created. It is not necessary to include the name of the station in the location ID since it is contained within the station already but may be helpful for quick recognition of its association. The default position is the same as the station. This can be edited using the same procedure as described in the stations section.

OR...

- Right click on an existing station in the field sensor perspective and select **New ▢ Unit Location** (Figure 3.13). The remaining steps of the procedure are the same as described above.

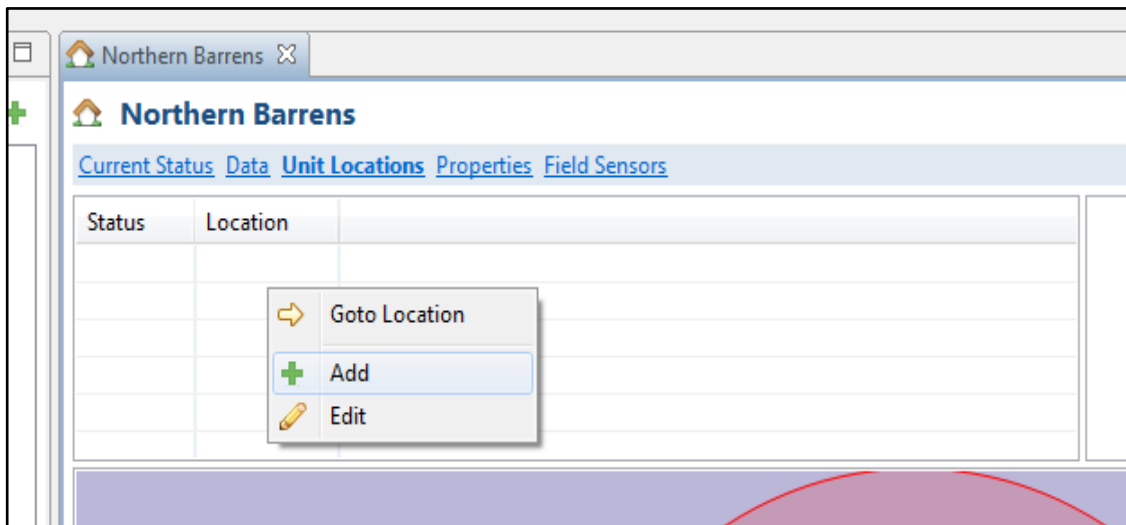


Figure 3.12: Location creation in the Unit Locations submenu of a station tab.

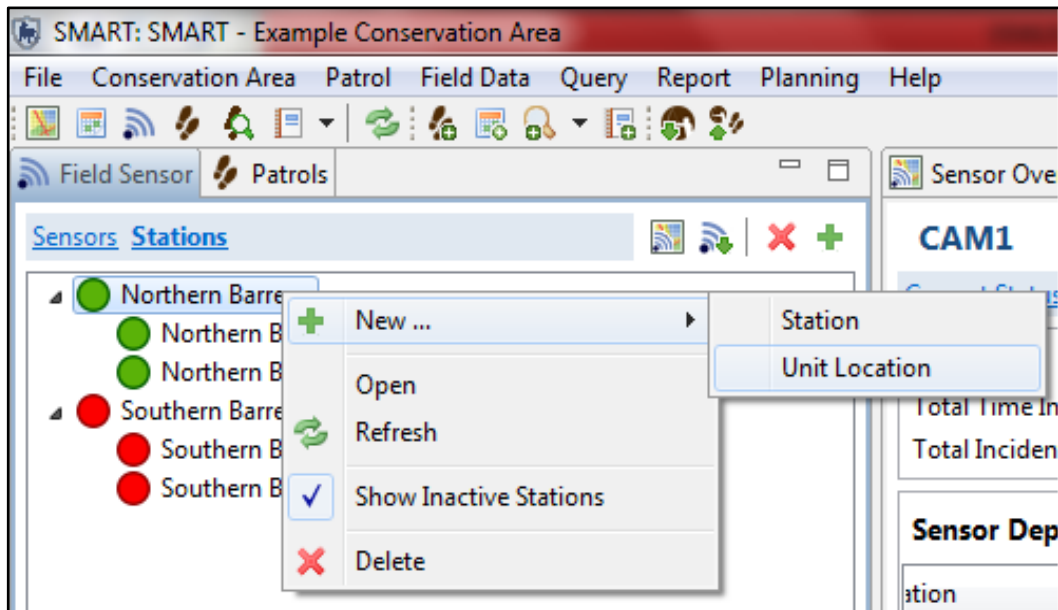


Figure 3.13: Location creation in the Stations view of the field sensor panel.

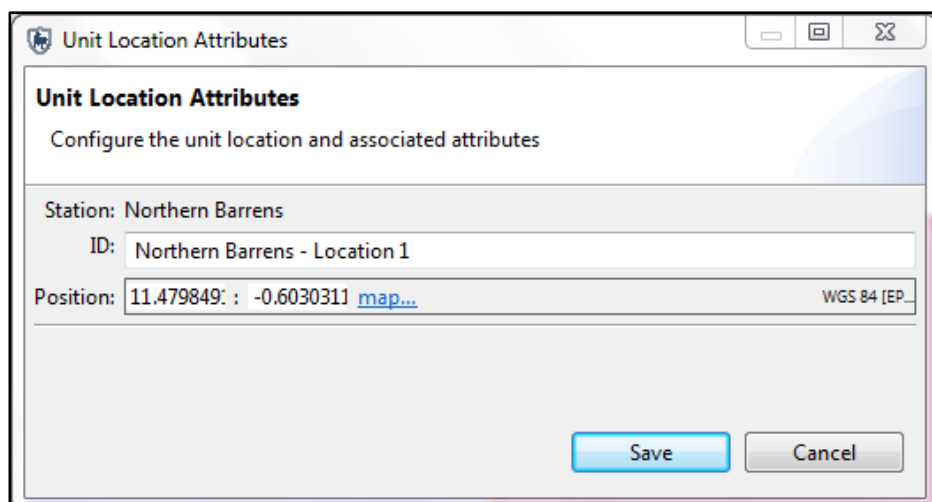


Figure 3.14: Location ID and position.

To manage attributes for locations, navigate to **Field Data** ▢ **Field Sensors** ▢ **Station and Location Attributes....**

Newly created locations are visible by expanding the station they belong to within the **Stations** view of the field sensor panel. Locations can be deleted by right clicking them in either the field sensor panel or in the Unit Locations submenu within the stations tab by selecting **Delete** (ID and Position can also be edited in the Unit Locations submenu).

NOTE: any associated data, including imagery, will be deleted.

Double clicking a location will open the location information tab. In the tab are four submenus: **Current Status**, **Data**, **Properties**, **History**:

- **Current Status:** Summary information of an active (camera currently deployed) location. This section will be blank for locations without any active cameras. Includes a map showing the sensor location (unit location) in **blue** relative to the station it is within in **red**.

- **Data:** Image data organized by incident specific to the location in view. Ability to modify incident information and stamp model data to incidents (see section 5-3).
- **Properties:** List of associated attributes with the ability to change their values. At the top of this section is **Position** which displays the locations coordinates. You can change the location's coordinates either by manually deleting and re-entering values or by pressing **map...** (the coordinates of a location should not be changed once it contains data, as this may conflict with geospatial metadata related to the sensor data). If you click on **map...** you will be shown the default Conservation Area map. By hovering your cursor over the map, the coordinates will update accordingly (enlarge the window to allow enough space to show all coordinate digits). To select the locations coordinates, press the press **+ click on a map to add new point** and then simply click the position of choice on the map. The selected position will be marked with a red star. To complete the selection, press **OK**. If any changes are not saved by pressing **save changes** on the top right, you will be asked if you want to save your changes when exiting the tab.
- **History:** Log of any comments/observations made. Press **+ create a new history record** to create a new history record. Records are text based and serve as a location to store information that does not have a specific location in attributes.

3-6: Deployments

Deployments bring together all data elements previously discussed. It is necessary for at least one sensor, station, and unit location to exist before a deployment can be created. There are two methods for creating deployments:

- Open the sensor information tab of the sensor you are creating a deployment for. Navigate to the **Deployments** submenu and press **+ create a new sensor deployment** on the top right to open the **Sensor Deployment Record** window (Figure 3.15). You will be prompted to enter a station, location, start date, and end date. If the sensor is currently deployed, you can leave end date unchecked. Once the values have been entered press **OK** to finalize the deployment. The newly created deployment will appear in the **Sensor Deployments** table with summary information, including the automatically produced **Total Time** attribute.

OR...

- Importing images to a location that does not have an existing deployment coinciding with the date range of the images will automatically create a new deployment. This deployment will assume a start date equal to the date and time of the earliest image and will also be assumed to have been active until the current date.

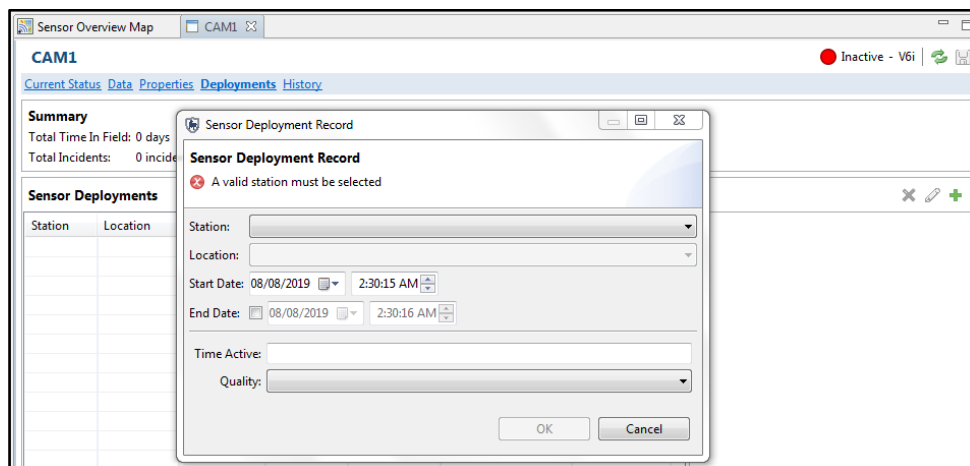







Figure 3.15: Deployment creation.

The first method is recommended, as it is unusual for the start time of a deployment to coincide with the first image. Whichever method is used it is likely that future editing will be required. To edit deployment information, highlight a deployment record in the **Sensor Deployments** table within the **Deployments** submenu and press  **edit selected deployments** on the top right. This will open the same **Sensor Deployment Record** window where values can be changed.

This is also the location where deployment attribute values are entered. To delete a deployment, highlight a deployment and press  **delete selected deployments** next to the edit symbol

NOTE: any associated data, including imagery, will be lost once deleted.

Once a deployment has been created for a sensor that is currently active, the circle symbols in the field sensors panel will update. Below is a list of all symbol variants and their meaning:

-  : Sensor, station, or location is currently active.
-  : Sensor, station, or location is currently inactive.
-  : Sensor has been retired.

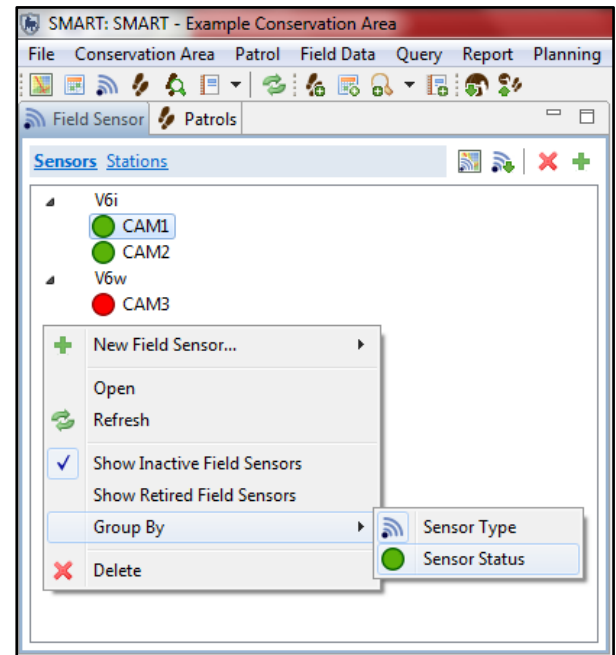



Figure 3.16: Sensor grouping in the field sensor panel.

You can also rearrange the order of elements in the field sensors panel by their status by right clicking in the open area and pressing **Group By**  **Sensor Status** (Figure 3.16). Returning to the default organisation is accomplished in the same menu but instead pressing **Sensor Type**.

3-7: Customization through Attributes

The definitions previously outlined for the structure of categories in Field Sensors, describe the functionality of the plugin and can be thought of as good practice for organizing a large database. Some elements of the data model however, can be customized to support additional use cases if required. The underlying structure that governs how each category (sensor, station, location, deployment) interact in Field Sensors is not customizable, but the attributes that can be associated with each are. How a category is utilized is ultimately dependent on the attributes associated to it, and in that regard, users are partially able to customize how they interact with data stored in Field Sensors (Figure 3.17).

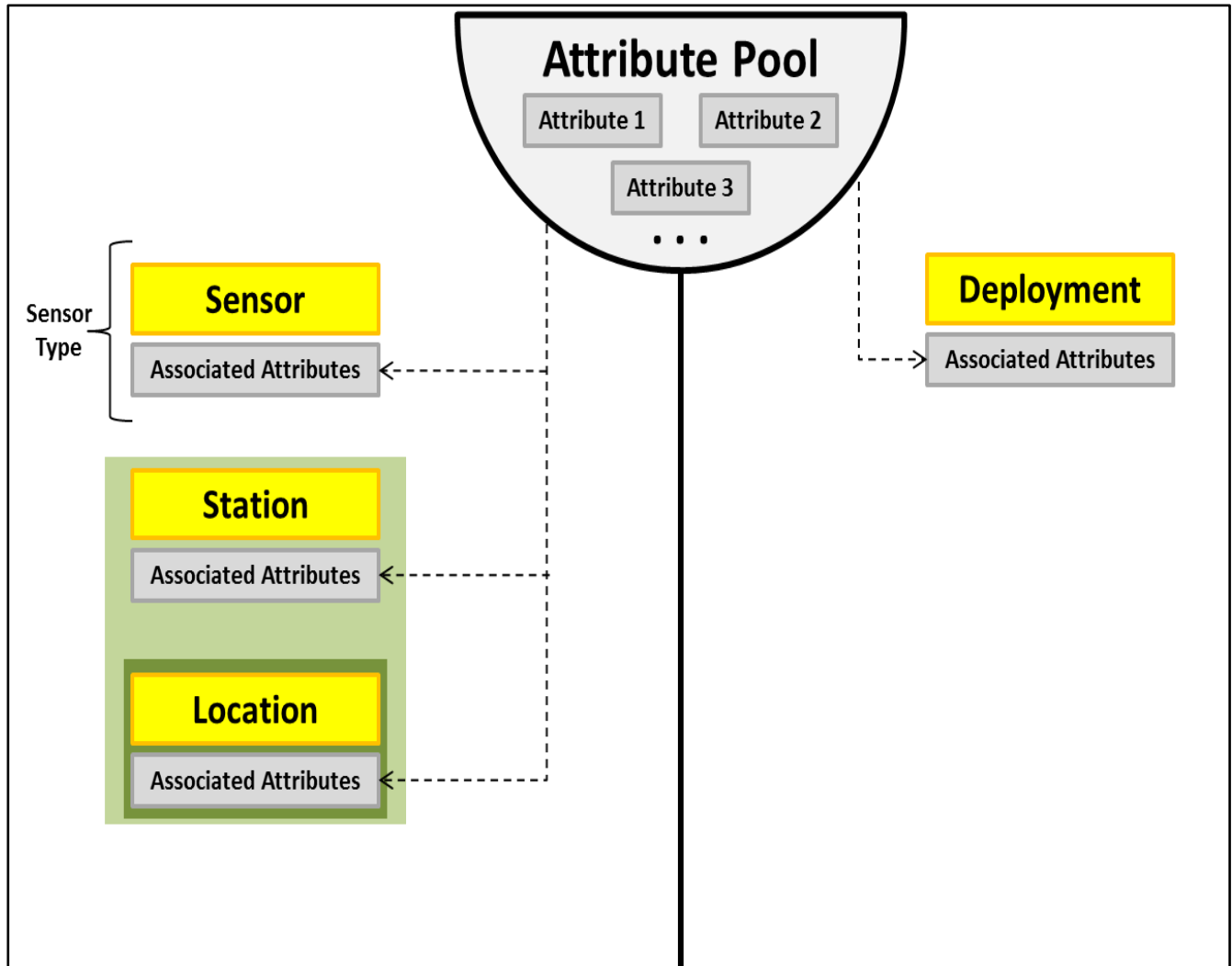



Figure 3.17: Representation of attribute allocation to Field Sensor categories.

Chapter 4: Managing Sensor Deployments

Maintaining awareness of where your field sensors are, and their condition is paramount to any successful operation. Field Sensors dynamically displays key information for device and deployment management. The following sections will cover this functionality.

4-1: Sensor Overview Map

The sensor overview map is a visual representation of sensor, station, and location information. To open the map, press  **view overview map** located in the field sensors panel. The sensor overview map will open as a new tab displaying default Conservation Area map (Figure 4.1).

All of the general map management and viewing tools that exist for the default map panel are located on the top right of the tab. Coordinates display, scale options, and current projection are located on the bottom right of the tab.

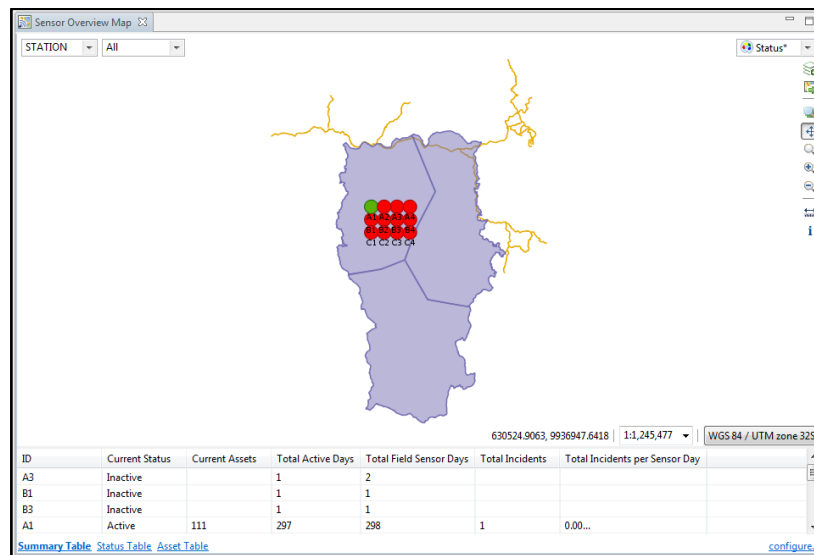





Figure 4.1: Default Field Sensors map.

On the top left of the tab are the drop-down menu options for displaying sensor information. In the first menu, you have the option to select **STATION** or **LOCATION** to display either stations or locations respectively. Only stations/locations will be displayed that have had at least one deployment on record, represented by either the active  icon if a sensor is currently deployed in the station/location or the inactive  icon if there is not.

You can control what stations/locations are displayed based on time of deployment by using the second dropdown menu. There are six pre-set time period options to select from as well as a **Custom...** option that will allow you to filter stations and location by date. Note that the colours of the icons will not change in response to new time ranges selected, i.e. a station/location that was active during the specified time frame will still be represented by  if it is inactive at the present time.

4-2: Summary, Status, and Asset Tables

Located at the bottom of the sensor overview map are the summary, status, and asset tables. Each table provides different information on current and past deployments for the purpose of quick recall and visualization in a management setting

NOTE: the size of the table can be extended by clicking the top of the table and dragging upwards. Data contained in these tables cannot be exported.

incidents that include the hunting threat within a station or location. Multiple attributes can be selected. When another attribute is entered, <AND|OR> will appear between attribute formulas in the definition box. Instructions are provided in the bottom of the window for how to structure a formula with multiple attributes

NOTE: in formulas 'VALUE' must be replaced with a text or numbers matching the desired observation value to be referenced.

The **Combined Column** takes the values of two or more specified categories and computes a new value via addition, subtraction, multiplication or division (numeric type attributes only). The default numerical categories as well as custom user made categories will be displayed in the Columns box. Double click a category to populate the Definition box (same as in category column procedure). Double click another category to add to the definition box. Basic mathematical operators, < + | - | * | / >, will appear between categories. Instructions are provided in the bottom of the window for how to structure a formula with multiple categories.

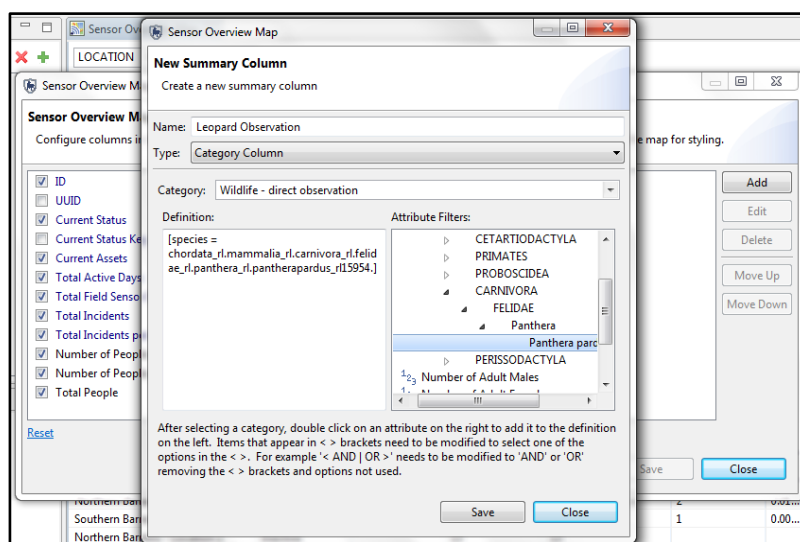


Figure 4.3: Example formula for checking stations/locations that have detected leopards.

NOTE: when a formula is satisfied in an incident, the resulting value is always one per instance. Therefore, users are unable to sum the actual numerical value of a category whose values can be greater than 1.

Once all data fields have been entered, press **Save** and then press **Save** again. The newly created category will appear in the configuration menu and can be turned on and off like the default categories. User created categories can be edited and deleted by pressing **Edit** or **Delete** respectively while highlighted in the configuration menu.

Status Table

The status table displays the days for which a station/location was active (Figure 4.4). Columns are dates and the rows are station/location IDs depending on which is selected. Values will either be filled in green or orange to indicate that the station/location was active or inactive respectively on that date. The time range displayed in this table will match the time range selected in the sensor overview map.



The asset table is focused on status information related to individual sensors (Figure 4.5). Much of the information in this table overlaps with what is shown in the field sensor panel. The six default columns in this table are:

- **Status:** Indication if sensor is active.
- **ID:** Name of sensor.
- **Type:** Sensor type.
- **Start Date:** Date when sensor was deployed of the current active deployment.
- **End Date:** Date when sensor was removed from deployment.
- **Total Time:** Days and hours sensor has been active for the current deployment.

Following the default columns are columns for user-created deployment attributes and sensor attributes. The sensor attributes are designated with “(asset)” written after their name. The values displayed reflect the user defined names.

Figure 4.5: *Example asset table.*




An image of a black bear caught on camera trap in Canada. Note the sensor's data stamp which includes the camera model, time, date and moon phase. © James Slade/Global Wildlife Conservation

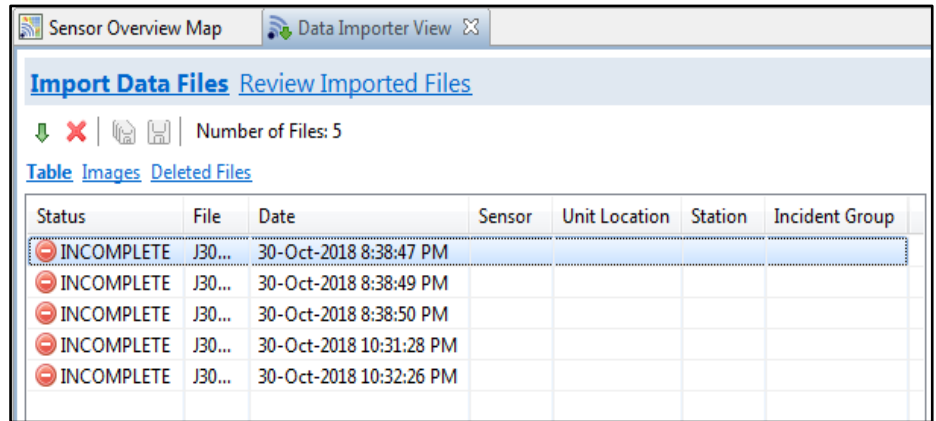
Chapter 5: Sensor Imagery Data

After sensors, stations, and locations have been created, users can begin importing sensor imagery. Sensor data cannot exist in Field Sensors without an associated sensor, station, location, and deployment. The deleting of any one of these categories associated with image data, will result in the permanent loss of that data. This chapter will cover image data import, management, analysis, and export in Field Sensors.

5-1: Image Import Procedure

Navigate to **Field Data** □ **Field Sensors** □ **Import Sensor Data...** or press  **import field sensor data** in the field sensor perspective. This will open the **Data Importer View**. To begin importing images, press  **select files to import** on the top left.

You will be prompted to navigate to the file location where the images to be imported are stored. To import multiple images at the same time, the images must be contained in the same folder (images cannot be aggregated from multiple folders for import). Highlight all images for import and then press **OK**. The table in the Data Importer View will now be populated with a line of information for each image imported (Figure 5.1).



Status	File	Date	Sensor	Unit Location	Station	Incident Group
INCOMPLETE	J30...	30-Oct-2018 8:38:47 PM				
INCOMPLETE	J30...	30-Oct-2018 8:38:49 PM				
INCOMPLETE	J30...	30-Oct-2018 8:38:50 PM				
INCOMPLETE	J30...	30-Oct-2018 10:31:28 PM				
INCOMPLETE	J30...	30-Oct-2018 10:32:26 PM				

Figure 5.1: Data importer view with data.

Images can immediately be viewed by pressing **Images** to open the images submenu. The status column will show “INCOMPLETE” for all images until **Sensor**, **Station**, and **Unit Location** columns have been populated. To enter these values, select one or more lines and then right click anywhere in the selection. Hover over **Set Sensor...** and then press **Other Sensor...** to open a list of existing sensors to choose from (Figure 5.2). All of the lines that are highlighted will be populated with the same value.

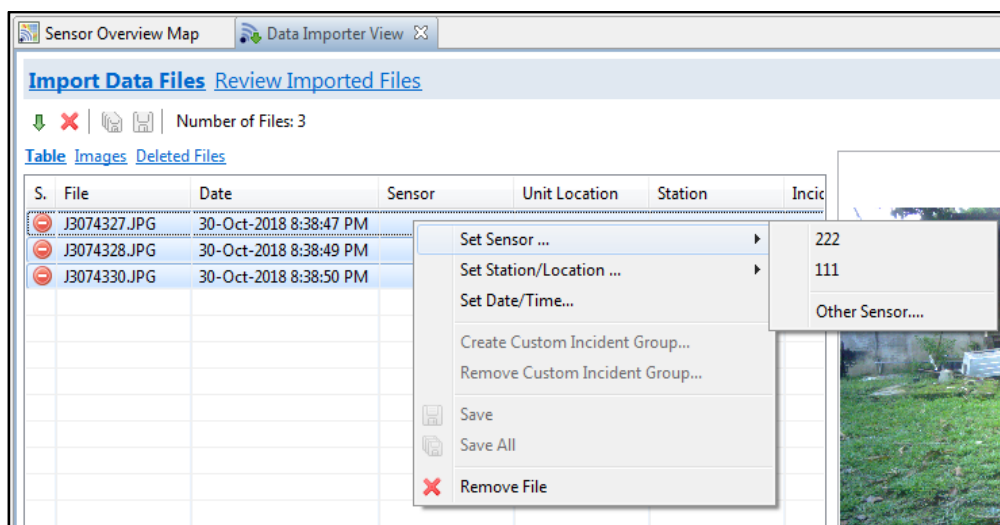


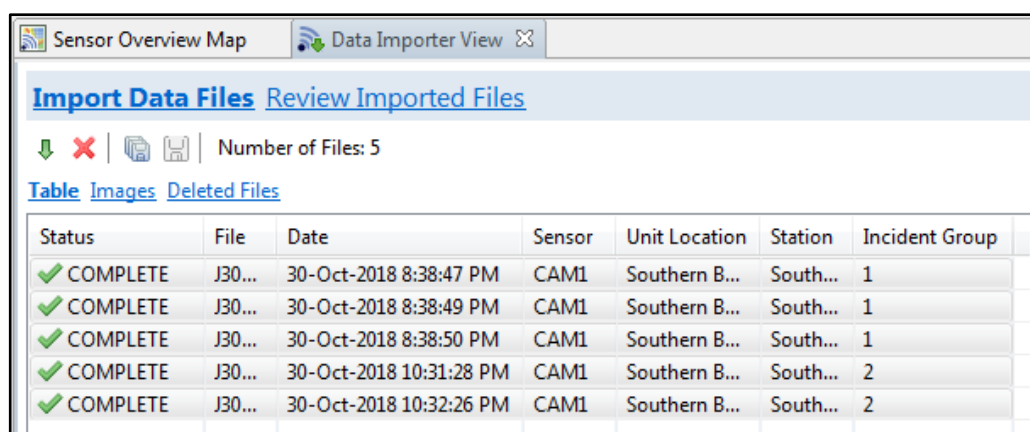
Figure 5.2: Inputting selected images information.

Any recently selected sensors will be listed. Select **Other Sensor...** if the desired sensor is not listed. Hover over **Set Station/Location...** and then press **Other Location...** to open a list of existing stations and locations to choose from. You can also create new stations and unit locations from this menu by selecting

<**Create New Station**> in the station dropdown menu or <**Create New Unit Location**> in the unit location dropdown menu. Once both sensor and station/location information have been set, status will show “COMPLETE” (Figure 5.3). **Incident Group** will also be automatically updated. The groupings are based on two criteria:

- **Incident Cutoff:** Time threshold for which multiple images being uploaded at once from the same sensor (or multiple sensors) are identified as an ‘independent incident’ and assigned a common **Incident Group**. Field Sensors will check the date and times of imported images and assign incident groups for groups of images falling within the incident cutoff, starting from the earliest image. This setting can be modified in the **Field Sensor Types...** window (see section 3-3). Any changes made to incident cutoff will not retroactively change image groupings already entered into the SMART database.
- **Station:** Images belonging to the same station, whether they come from the same or multiple sensors, can be assigned to common incident groupings. Images coming from different stations cannot be grouped together.

*NOTE: Incident groupings are only assigned during import and cannot be produced retroactively. If users desire images from within the same station to be grouped together, it is imperative that their imagery be imported **AT THE SAME TIME**.*



The screenshot shows a window titled "Data Importer View" with a tab "Import Data Files" selected. Below the tab are icons for import, delete, and save, and a label "Number of Files: 5". A table with columns "Status", "File", "Date", "Sensor", "Unit Location", "Station", and "Incident Group" is displayed. The table contains five rows of data, all with a status of "COMPLETE".

Status	File	Date	Sensor	Unit Location	Station	Incident Group
✓ COMPLETE	J30...	30-Oct-2018 8:38:47 PM	CAM1	Southern B...	South...	1
✓ COMPLETE	J30...	30-Oct-2018 8:38:49 PM	CAM1	Southern B...	South...	1
✓ COMPLETE	J30...	30-Oct-2018 8:38:50 PM	CAM1	Southern B...	South...	1
✓ COMPLETE	J30...	30-Oct-2018 10:31:28 PM	CAM1	Southern B...	South...	2
✓ COMPLETE	J30...	30-Oct-2018 10:32:26 PM	CAM1	Southern B...	South...	2



Figure 5.3: Imported sensor imagery after station, unit location, and sensor has been specified.

If you are importing multiple photos from different locations into the same table, they will appear in the same sequence as they were imported. This means that if images occurring at a later date are imported before images from an earlier date, they will appear first in the table. However, this will not matter once they are saved to the database as they will be rearranged automatically (but Incident Group will still occur in the same order as they appeared on the table if it is a concern). After images are saved to the database, the incident grouping number can be edited, but they won't automatically move the group entered.


Before images are saved to the database, date/time can be edited, and new incident groupings can be specified. To edit date and time, select one or more images, right click, and press **Set Date/Time...** (a warning message will pop up and ask if you would like to continue; press **Yes**). You will then be prompted to enter a new date and time.

NOTE: if the new date/time exceeds the incident cut off threshold or falls within the limits of another group, the incident grouping will change.


To create a new incident grouping, select one or more images, right click, and press **Create Custom Incident Group...** A new incident group will be created with a value of one greater than the highest incident value in the table. There will also be an “*” next to the grouping number to indicate that it is a user defined grouping. To remove a custom grouping, select the image/s, right click, and press **Remove Custom Incident Group...**

To save the imported images to the database, press  **save all files to the database** (or save only selected images by pressing  **save selected files to the database**). The first will save all of the images in the table, and the second will save only those that are highlighted.

*NOTE: highlighting a single image belonging to an **Incident Group** will also save the other images in the same group to the database.*

You may also remove selected images from the table by pressing  **remove file from import list**. If an image was mistakenly removed you can return it by pressing **Deleted Files** to open the deleted files submenu, locate and right click the image and press **Restore**.

5-2: Reviewing Saved Images

Open the **Data Importer View** and then press **Review Imported Files** (Figure 5.4). Images will only appear here once they have been saved to the database in the previous step. Saved images are organized by station/location and incident grouping. Information in the grey title bands from left to right are: date and time of the start of the incident, duration of the incident in brackets, station ID, location ID, and sensor ID. Image size and the number displayed per page can be changed by pressing  **Configure data table settings** on the top right. You can also double click an image to enlarge it.

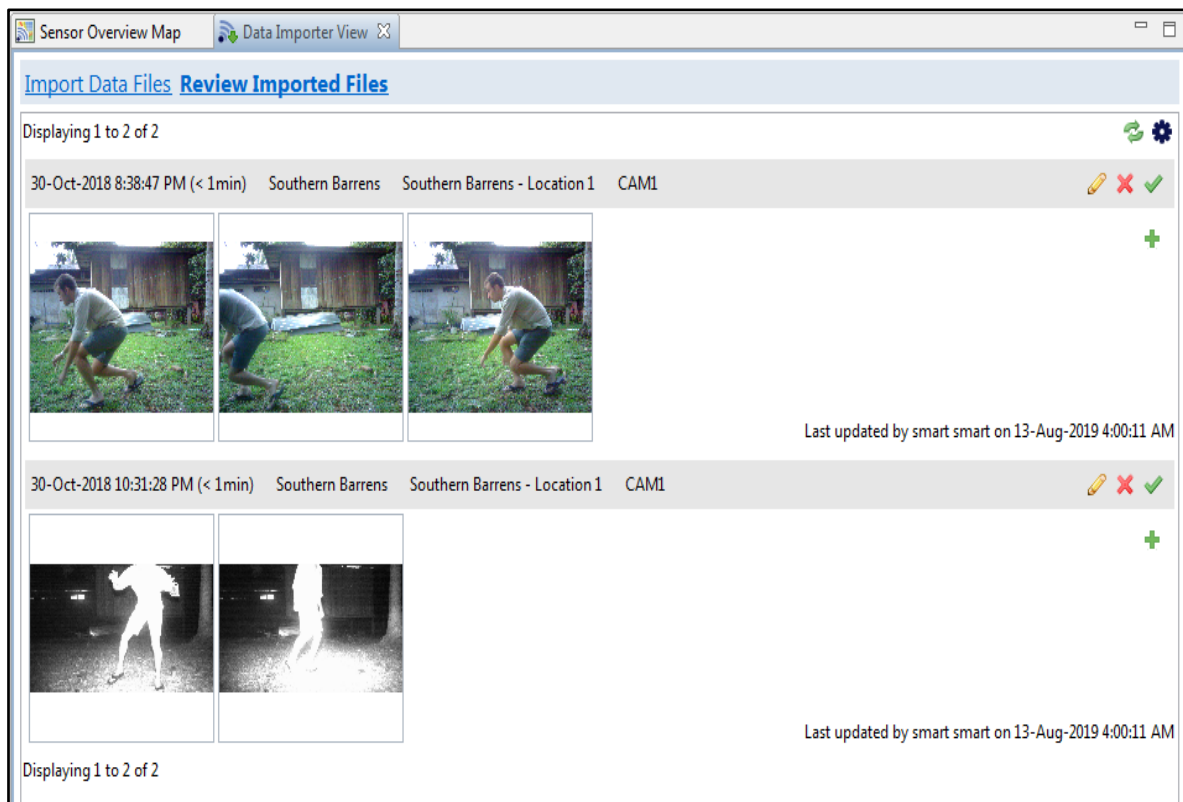


Figure 5.4: Review of newly imported sensor imagery.

Right clicking images offers several options (Figure 5.5).

- **Extract as New Incident...** will open the **Waypoint Attributes** window where you can specify the new incidents' date, time, duration, as well as add any comments (multiple images can be selected at once).
- **Remove Attachment...** will remove selected images from the database without deleting the entire incident

*NOTE: if there is only one image in an incident then this function will not work. Instead, press **✗ delete incident** on the right side of the grey title band to delete an incident entirely.*

- **Import Attachment...** allows you to add one or more images to an incident. After selecting the desired image(s) you will be prompted to select the **Sensor ID** that the image(s) belong(s) to. You can even select a different **Sensor ID** than that of the existing images in the incident.

*NOTE: newly imported attachments will not show until **↻ reload table** is pressed. Adding attachments to an incident will not automatically update the duration and, if editing is required, will need to be edited (see next paragraph). You will also not be able to select the order in which the image appears in the sequence.*

- **Properties** will display a multitude of information and metadata of the image.

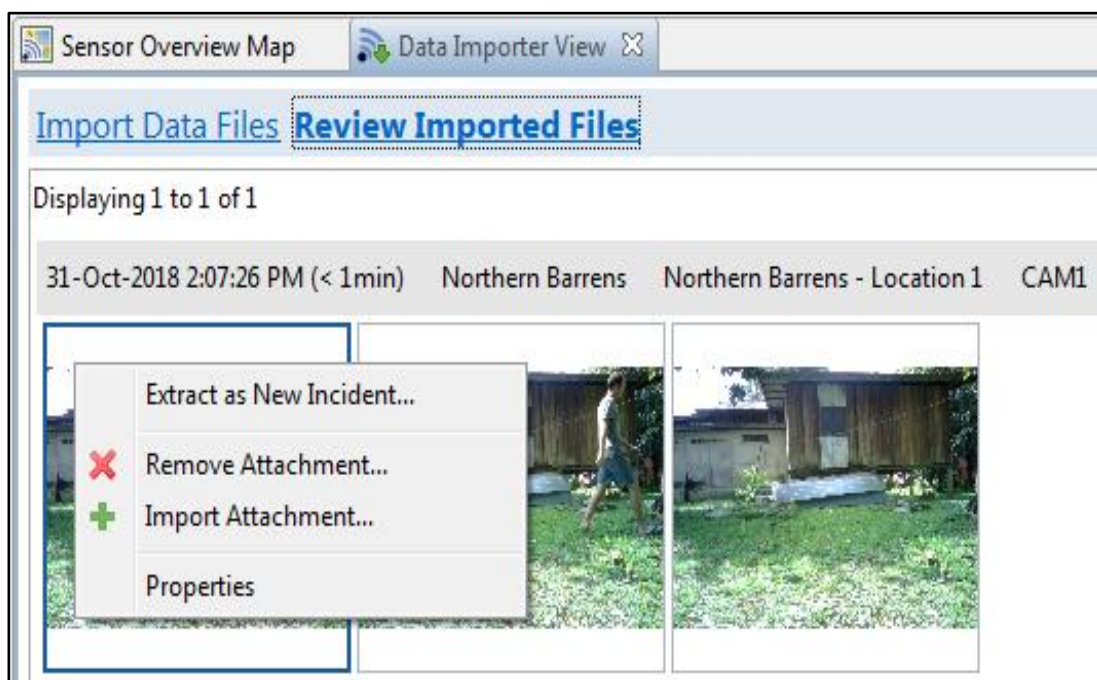


Figure 5.5: Editing options for newly imported sensor imagery.

Incident information can be edited by pressing **✎ modify waypoint date/time or ID** in the grey title band. This will open the same **Waypoint Attributes** window as discussed previously, but with the addition of being able to edit the **Incident Grouping ID**.

When you are satisfied with the saved images you can clear them from the **Review Imported Files** interface by pressing **✓ mark as verified** in the grey title band to validate them. A message will appear in place of the validated images noting their validation. Similarly, deleted incidents will leave a message in place noting their deletion (Figure 5.6).

Pressing **↻ reload table** will remove these logs. Validation only removes images from the **Review Imported Files** interface and has no other effect. Since all images can be accessed elsewhere from within Field Sensors, validating images essentially is just a function to clean up the workspace as more images become added to the database.

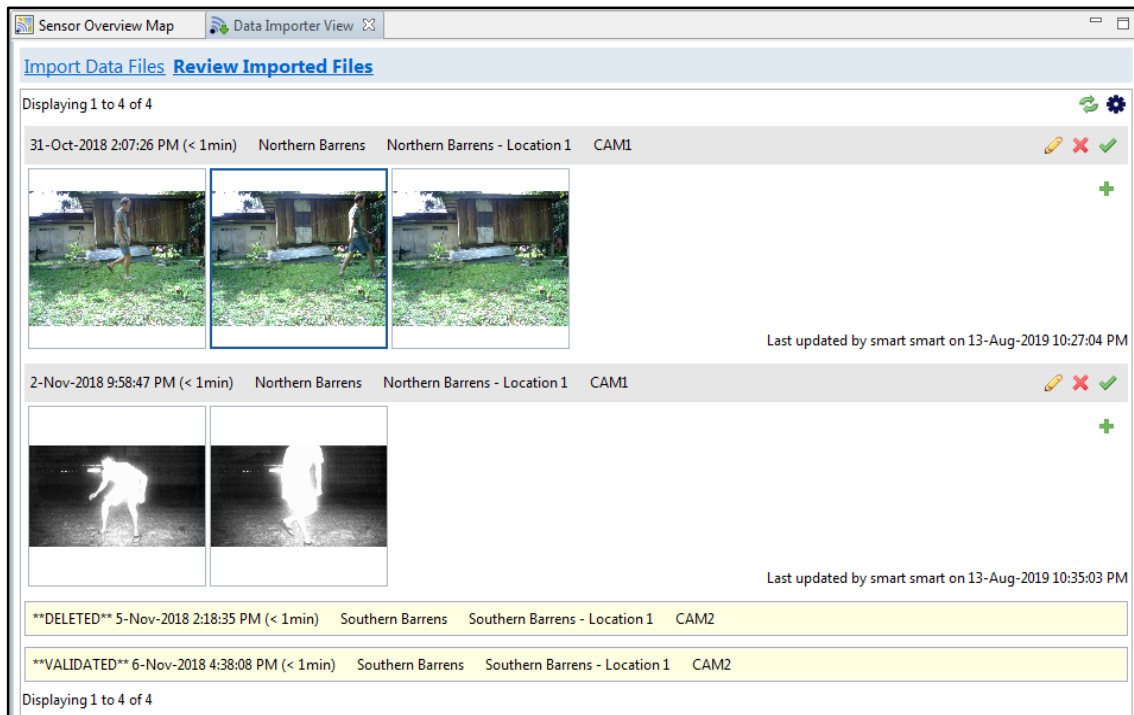


Figure 5.6: Validation and deletion messages in place of removed images.

The remaining function that has not been mentioned, **+ add a new observation**, will be discussed in section 5-3.

5-3: Imagery Data Viewing and Stamping

In the previous section, we began viewing organized images in the **Review Imported Images** interface. Saved images can also be viewed in the data submenus in either of the **Sensor**, **Station**, or **Location** Information Tabs. The tab chosen for image viewing will ultimately depend on the user's needs, but it is recommended that the **Review Imported Files** interface be used for adding observations as standard procedure. Only mark as verified after the necessary observations have been created, to avoid unprocessed images being saved to the database.

NOTE: as new image files are added to the database, this interface will become cluttered and difficult to manage. Ensure older images are verified and removed regularly.

Any incident in the database can be "stamped" with information from the core SMART data model. To begin stamping incidents with observations, press **+ add a new observation**. This will open the **Waypoint Observations** window where you can specify the nature of the observation (Figure 5.7).

Expand the data model categories until you find the desired category and highlight it. The upper right box will display the attributes used by the core SMART data model. When all of the relevant attributes have been entered, press **Create Observation**. The upper right box will now reset, and the new observation will be listed in the bottom box. Multiple observations can be made for a single incident.

Observations can be edited by pressing **modify selected observation** on a highlighted observation. The upper right box will populate with the attributes that were previously entered for that observation. After making changes, press **Update Observation** to apply them.

To delete an observation, press **delete selected observation** on a highlighted observation. Press **Save** to finalize any changes and to return to the data submenu. While **enable edit mode** is active, both **modify selected observation** and **delete selected observation** will be visible next to each observation in the data submenu. You will now see observations listed on the right side of their respective incidents.

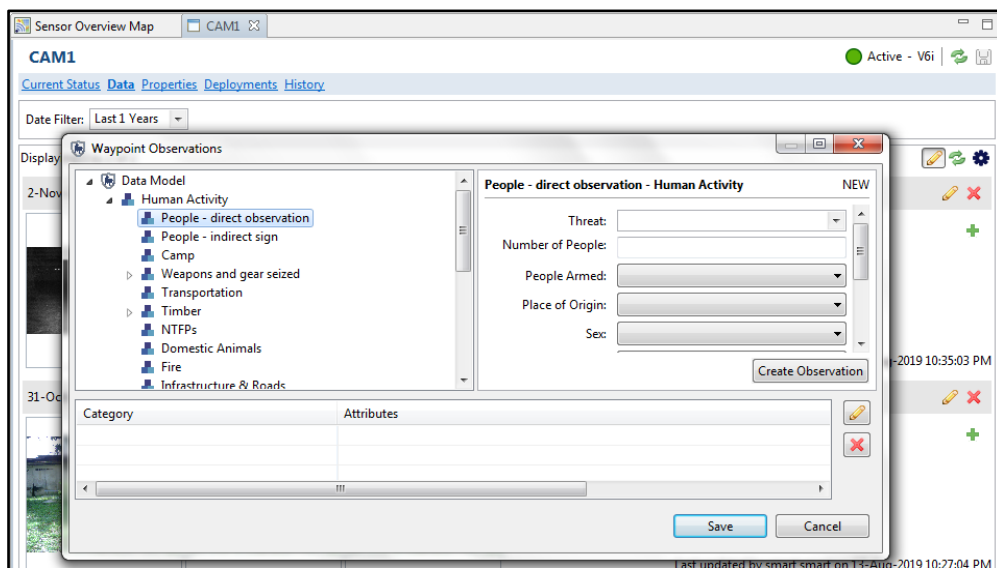










Figure 5.7: Stamping imported sensor imagery with core SMART attributes.

When reviewing imagery in the **sensor**, **station**, or **location** information tabs, images are organized similar to the **Review Imported Files** interface, with similar functionality ( **reload table**,  **Configure data table settings**). Only images associated with the particular category will appear. For example, viewing images within a station tab will only display images that were collected from deployments from that station. The same applies to sensors and locations. The most recent incidents are displayed first. At the top of this page is the **Date Filter**, which allows you to choose from five different options for displaying images in relation to how long ago they were taken relative to the current date. The only addition is the  **enable edit mode** button. When pressed, each incident will now display three buttons for editing. The two buttons in the grey title band,  **modify waypoint date/time or id** and  **delete incident** operate the same as in the review imported images area. To add core model data observations, press  **add a new observation**.

Where sites are using the SMART Triggers plugin, observations should only be created once all of the relevant Waypoint attributes have been populated to ensure that this information is included in any records automatically created in SMART Profiles. A quick way to check values for waypoint attributes is to perform a Field Sensors incident query and review the values in each column (see section 7-1).

5-4: EXIF/XMP

EXIF and XMP metadata, associated with image files, can be used to streamline the image import and data stamping process. User-defined mappings, made between image metadata and SMART data models (both the core data model and the data model for Field Sensors), can be used to automate data entry tasks.

To create metadata mappings, navigate to **Field Data**  **Field Sensors**  **File Metadata Mappings...** to open the **File Metadata Mappings** window. This area is the central hub for metadata mapping configuration and management. All existing mappings are displayed in the table. To configure a new mapping, press **Add** to open the **Sensor Metadata Mapping** window. Several data fields require specification:

- **Metadata Type:** Select which type of metadata (EXIF or XMP) will be used for mapping.

If EXIF is selected...


- **EXIF Tag (Hex):** Tag (name) of the metadata field whose value will be extracted. This can be entered manually or by pressing **Select Tag From File ...** to open file explorer. Navigate to and open a representative image file to open a list of EXIF metadata tags and their associated values. Highlight the desired tag and press save. EXIF Tag (Hex) will now display a number that represents the chosen tag.

- **EXIF Tag (Name):** The name of the chosen tag that will automatically update when an EXIF Tag is selected.

If XMP is selected...

- **XMP Path:** Tag (name) of the metadata field whose value will be extracted. This can be entered manually or by pressing **Select Path from File ...** to open file explorer. Navigate to and open a representative image file to open a list of XMP metadata tags and their associated values. Highlight the desired tag and press save.
- **map tag to field:** Select if metadata is to be mapped to Field Sensors specific attributes. Open the list to specify the type of attribute that the metadata will be mapped to:
 - **ASSET_ID:** Sensor ID
 - **STATION_ID:** Station ID
 - **LOCATION_ID:** Unit Location ID
 - **WAYPOINT_COMMENT:** Waypoint comment

Once the desired field has been selected, press **Save** to create the mapping.

- **Map to data model:** Select if metadata is to be mapped to an observation attribute within the SMART core data model. Press **Add** to populate the Data Model Mapping column with a placeholder element. Highlight the **Select Data Model Element** placeholder and press  (appears only when selected) to open a list of SMART data model categories. Navigate to and double click the desired category. It will now be listed under the Data Model Mapping column (Tag will still be blank) (Figure 5.8). Depending on what category is being mapped to, specifying the Tag Value may or may not be required. For example, if the user is interested in mapping numerical data, such as the SMART attribute “Number of People” within the “People - direct observation” category, users only need to specify the data model element. The value of the XMP path in the image will be applied to the attribute automatically. This method also applies to text data.

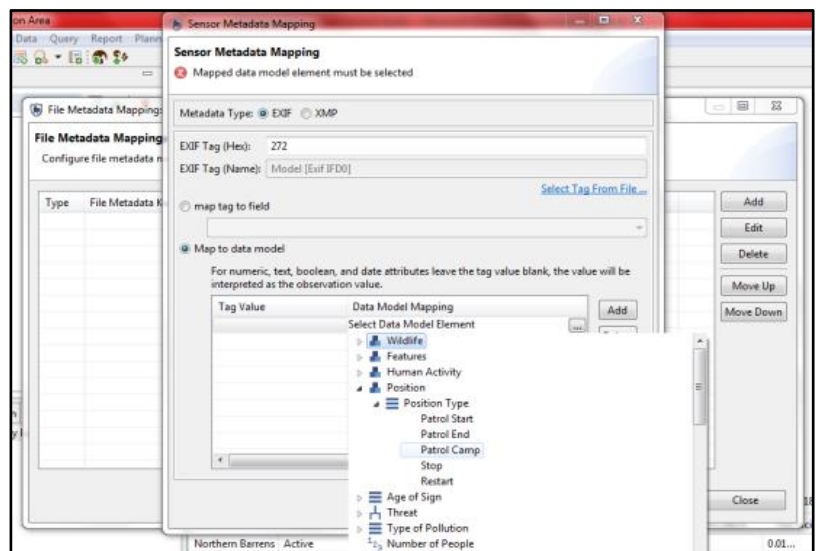


Figure 5.8: Example metadata mapping where EXIF type metadata is being mapped to a SMART data model element.

For a tree data type attribute, such as “Threat” users need to specify the exact threat mapping in Select Data Model Element and must also specify the Tag Value. When the same tag value is found in the specified XMP path, Field Sensors will create the observation. To enter a tag value, double click an empty cell in the Tag Value column for which a data model element mapping exists and enter the value manually. To enter all of the metadata values stored in one or multiple images at the same time, press **Add All Values found in Files...**, then select one or more images whose metadata values will be scanned and press **Open**. The table will then populate with all metadata values found with a placeholder element for each.

NOTE: users should ensure that the data type of the SMART attribute is compatible with the metadata to be mapped first. Mappings must be managed to ensure that they correspond to the current import. When a mapping is no longer needed it should be deleted immediately.

After all fields have been entered press **Save**. The new metadata mapping is now listed in the file metadata mappings window. Mappings can be edited or deleted by highlighting them and pressing **Edit** or **Delete** respectively

NOTE: for tags to map to fields correctly, the spelling must match exactly. Data model Boolean and list attributes must be mapped to the attribute value's key rather than the name.



Images such as this elephant caught on a camera trap, can be mapped to elements within the user's SMART data model.


© ZSL Thailand/ Department of National Parks, Wildlife and Plant Conservation (DNP) Thailand. Activities funded by Panthera and USFWS RTCF.

Chapter 6: Data Management

Field Sensors supports the export and subsequent import of data model elements akin to the SMART patrol database. This chapter will cover all of the data stored within Field Sensors that can be exported, as well as what can be imported, to facilitate data management tasks.

6-1: Data Model Elements Export/Import via XML


Navigate to **Field Data** ☐ **Field Sensors** ☐ **Import/Export Data** ☐ **Export Model Data...** to open the **Export Field Sensor Model** window (Fig. 6.1).

In the **Export To** section, specify whether you would like to export the data as an XML file, or export directly to another SMART conservation area that exists on the same device. If exporting as a file, press  and navigate to the desired directory for saving. If exporting directly to another conservation area, select the name of the desired conservation area from the dropdown menu.

The next step is to decide what elements will be exported, starting with attributes. The **Attributes** section lists all user defined attributes and are all selected by default. Checking/unchecking a box will select/deselect an attribute (or press **All** or **None** to apply to all). Only selected attributes will be included in the export. The next two sections, **Field Sensor Types** and **File Metadata Mappings**, function in the same manner.

The **Configuration** section lists three options:

- **Include Field Sensor Module Settings:** Select if you want station and location buffer values to be exported.
- **Include Station Attributes:** Select if you want the currently assigned station attributes to be exported (and re-assigned upon import).
- **Include Location Attributes:** Select if you want the currently assigned location attributes to be exported (and re-assigned upon import).

To import data model elements that were previously exported in XML format, navigate to **Field Data** ☐ **Field Sensors** ☐ **Import/Export Data** ☐ **Import Model Data...** to open the **Import Field Sensor Model** window, select **Model Elements from XMP File** and then press **Next**. Press  and navigate to and select a previously exported XML file and then press **Finish**. A window will open notifying you of successful import as well as of any elements that did not import (due to a conflict with existing data model elements).

The import step for model data that was exported directly to another SMART Conservation Area is integrated in the same process. Once the Conservation Area and data elements have been selected, press **OK** for the export and sequential import to execute simultaneously.

6-2: Imagery Export/Import

There are two methods of exporting Field Sensors imagery:

- Export the entire Conservation Area and import it to another SMART client. This will of course include all model elements in addition to the entire SMART database, and thus will require a significant amount of time to complete as your database grows in size.
- Export of images related to a queried observation (see section 7-2).

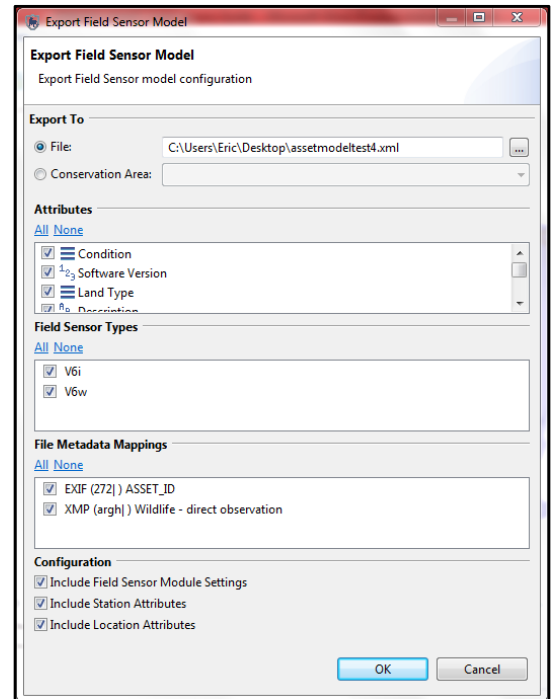


Figure 6.1: Exporting Field Sensors' data model elements.

6-3: Data Model Elements Import via CSV

Field Sensors supports data import from CSV files. This is particularly useful for migrating sensor data being managed on a different system to SMART. Navigate to **Field Data** □ **Field Sensors** □ **Import/Export Data** □ **Import Model Data...** to open the **Import Field Sensor Data** window (Figure 6.2). Separate options are listed for import of sensors, stations, and locations from CSV. Because the import procedure for all three categories is the same (apart from a few unique data fields which will be listed) the following directions apply to all categories.

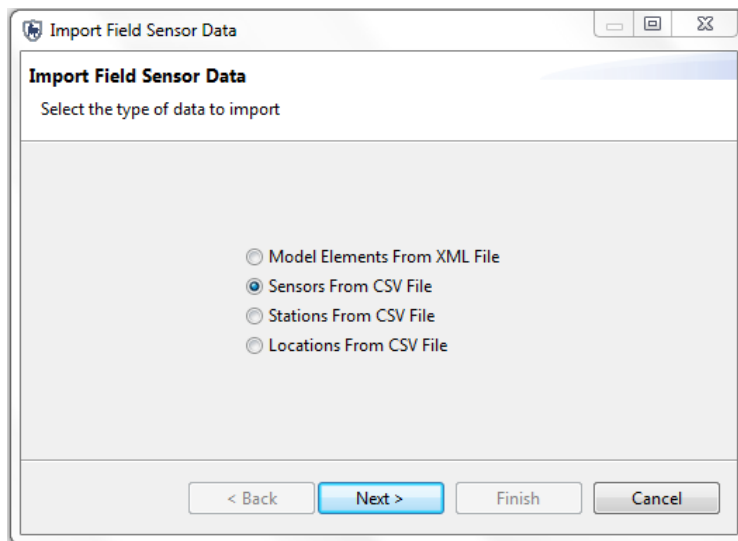



Figure 6.2: CSV import options as well as XML import option.

The structure of the CSV containing the data for import is very simple. The first row should list attribute category headings including headings for sensor type, sensor ID, station ID, and location ID. The exact spelling of column headings does not need to match the spelling in Field Sensors as they are mapped manually. Every row below the headings represents an individual database object and the attributes for that object are to be filled out accordingly.

Select any of the import from CSV categories and press **Next** to open the **Import (“Sensors”; “Stations”; “Locations”) from CSV** window (Figure 6.3).

- Select the CSV **File** for import by pressing  and navigating to the saved location.
- **Delimiter** is the character used to separate values in the CSV. The most common characters are listed in the dropdown menu where comma (,) is selected by default. If you are unsure about which delimiter your CSV file uses, right click the file and select properties. The delimiter used will be shown next to “Type of file”.
- When the **Skip First Line** box is selected, the first line of the CSV will not be imported (used when the file has column headings).
- **Date Format** lists several formats commonly used in excel. Date formats in the CSV must match the selected date format in Field Sensors. Not all formats are recognized in Field Sensors and you may be required to change the format used in CSV.

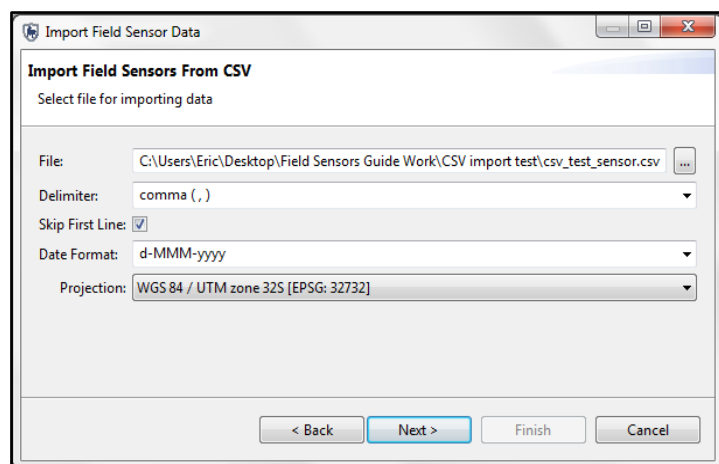


Figure 6.3: CSV import window (select file)

NOTE: the date format option will only be visible if a date data type attribute is present for the category in use.

- The projection for coordinate values contained in the CSV should be selected in **Projection**. This will allow the coordinates to be automatically converted to the project's projection when imported.

*NOTE: the desired projection will only be available for selection if it is already in the list of projections in the Conservation Area. If you need to add a projection to the list, navigate to **Conservation Area** ☐ **Manage Projections...***

Once all data fields have been completed, press **Next**. You will be prompted to enter both system defined and user defined attributes, however only system defined attributes are necessary for data import to proceed (indicated by asterisks) (Figure 6.4). Only those user attributes that are already defined in the Field Sensors data model will be available for data mapping. System defined attributes are unique for each category as follows:

- Sensor system attributes
 - **Field Sensor Type:** Designation for a group of sensor units that all share the same characteristics
 - **Field Sensor ID:** Unique identifier of the sensor unit.
- Station system attributes
 - **Station ID:** Unique identifier.
 - **Station Position:** Coordinate position.
 - **X:** Horizontal axis coordinate value.
 - **Y:** Vertical axis coordinate value.
- Location system attributes
 - **Location ID:** Unique identifier.
 - **Station ID:** Unique identifier (same value as attribute of the same name in station system attributes).
 - **Location Position:**
 - **X:** Horizontal axis coordinate value.
 - **Y:** Vertical axis coordinate value.

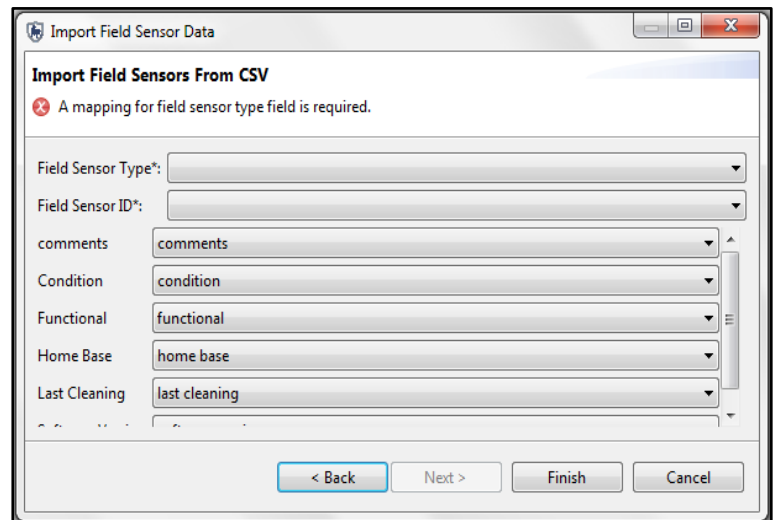


Figure 6.4: CSV import window (map fields)

Once all system attributes have been mapped, press **Finish**. Successful imports will be identified in a new window which will also indicate the number of sensors, stations, or locations that were imported. Unsuccessful imports will also be identified in a new window. The specific attributes that were unable to be imported will be identified.

NOTE: Boolean data types will always import into SMART with a value of 0 (or no) with the field unchecked (inactive) regardless of the value in the CSV. Coordinate data also does not import properly because the option to select X and Y coordinates separately is not given for user defined attribute import (only one column selection).

Chapter 7: Searching the Database

7-1: Query

Like patrol data, information contained in the Field Sensors plugin can be queried. To access the Field Sensors specific query, navigate to **Query** ▢ **New Query** ▢ **Field Sensor Queries** ▢ and choose either of **New Field Sensor Observation Query...**, **New Field Sensor Incident Query...**, or **New Field Sensor Summary Query...** depending on the type of information you require. Observation, incident and summary distinctions are the same as in normal SMART queries.

For observation and incident queries, the added Field Sensors functionality can be found in the **Field Sensor Filters** heading in the query filter tab (Figure 7.1). For summary queries, the equivalent functionality is found in the **Field Sensor Group By** heading in the query filter tab (Figure 7.2).

To query across both sensor and patrol data, navigate to **Query** ▢ **New Query** ▢ **All Data Queries** and select one of the four query types (Figure 7.3).

Filtering by user, and most system defined attributes, is currently not available in Field Sensors.

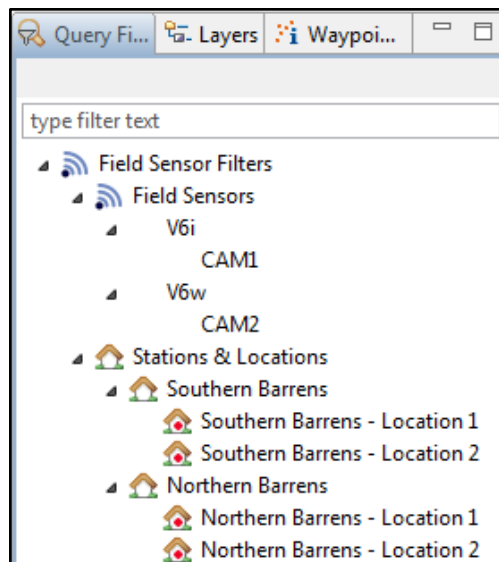


Figure 7.1: Observation and incident query Field Sensor filters.

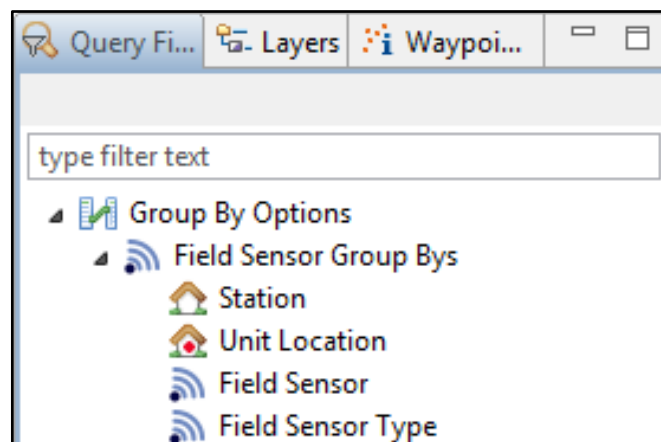


Figure 7.2: Summary query Field Sensor filters.

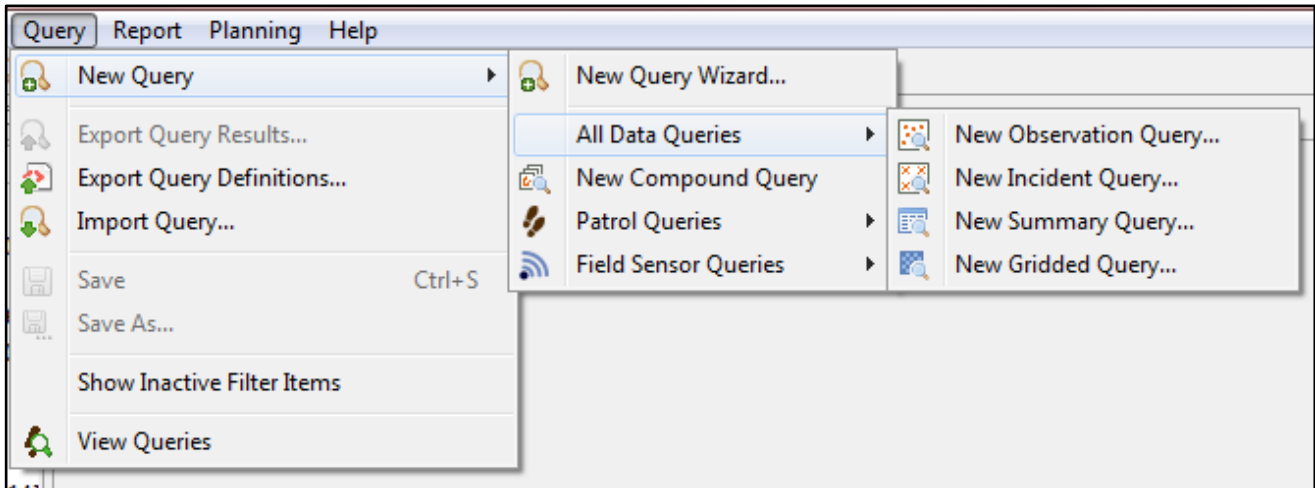


Figure 7.3: All data query types to query for patrol data and sensor data together.

7-2: Export Target Imagery

The query tool can be utilized to target broad groups or specific imagery based on core SMART data model elements or Field Sensors filters. Perform an observation or incident query and navigate to the **Attachments** panel of the results. All imagery associated with the results will be listed. To export the imagery, select one or more images, right click, select **Export Selected Attachments** and select the desired directory (Figure 7.4).

NOTE: to query for all images in the Field Sensors database regardless of observations or attributes, simply execute a query without entering any filters.

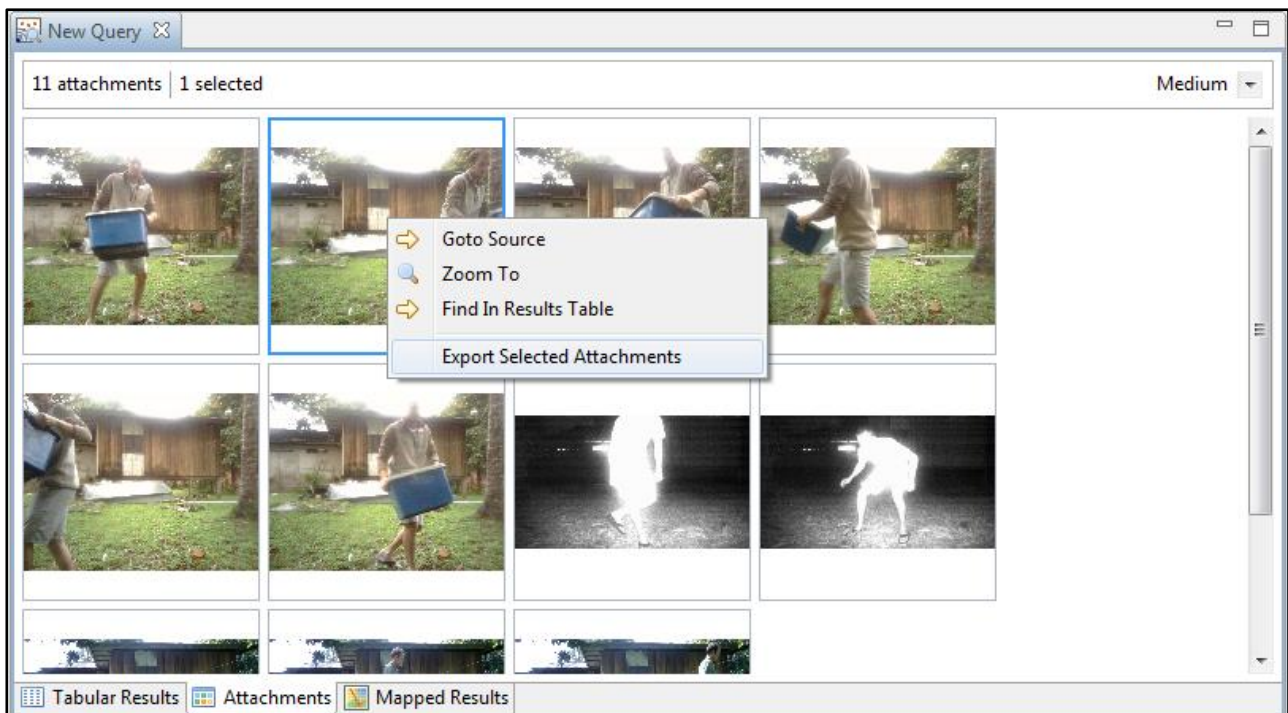


Figure 7.4: Export imagery via query.

Chapter 8: Interoperability with Other SMART Plugins

8-1: Triggers and Profiles

The SMART Triggers plugin allows for the automatic creation of entities and records in SMART Profiles based on the values of observation attributes created in SMART Field Sensors, patrols, independent incidents, and surveys. The plugin allows users to establish specific criteria to filter observations and define an action when any newly entered data meets the criteria.

The Field Sensors plugin represents one potential observation source. When creating a new filter in SMART Triggers, select the **Field Sensor** option for the **Observation Source** to ensure that observations associated with independent incidents are considered by the user defined filters (Figure 8.2).

*NOTE: selecting **All Sources** will include **Field Sensor**.*

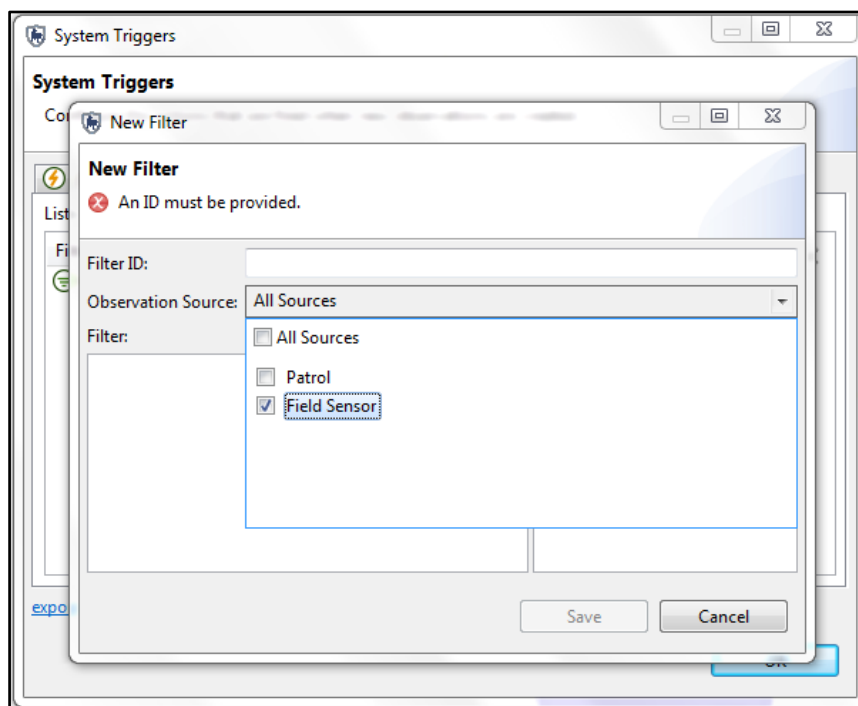


Figure 8.1: *Field Sensors observation filter in Triggers.*

Images represent a rich source of unstructured data that is an important input to the creation of a multi-source fusion repository in SMART Profiles. Using SMART Triggers ensures that geospatial, attribute, and image data is automatically transferred into Profiles, eliminating redundant data entry and reducing the potential for human error, while creating a link in the database between the data in Profiles and Field Sensors.

Additional information about the use of Triggers and Profiles is beyond the scope of this guide however and can be found in the SMART Profiles Training Manual.

Where automated processes are used to increase interoperability between SMART plugins, users must consider how changes in one plugin may impact the broader task of data management across the entire SMART Platform.

Appendix. Examples of Attributes used in Field Sensors

Here we included a few examples of **User Defined Attributes** to give users an idea of attributes commonly used with the Field Sensors plugin. Additional explanations of key terms and concepts can be found in the [SMART Training Manual Glossary](#).

Field Sensor Attributes

Battery Type (LIST)
 Firmware version (LIST)
 Status (LIST)
 Serial Number (TEXT, NUMERIC)
 SD card size (NUMERIC, LIST)

Deployment Attributes

Objective (TEXT)
 Time of deployment/pickup (NUMERIC)
 Cycle: 24hr/Day only/Night only (LIST, NUMERIC)
 Power level: Low/Med/High (LIST)
 Battery life factors (TEXT, LIST)
 Battery drained (BOOLEAN)
 Damaged (BOOLEAN)
 Damage details (TEXT, LIST)
 Compromised (BOOLEAN, LIST)
 Compromised details (TEXT, LIST)
 Transmission issues (BOOLEAN, TEXT, LIST)
 Camera interference (BOOLEAN)
 Interference details (TEXT, LIST)

Station & Location Attributes

Location (TEXT, LIST, POSITION)
 Position: Ground/Tree (TEXT, LIST)
 Trail position: On trail/Off trail (TEXT, LIST, BOOLEAN)
 Slope (NUMERIC)
 Distance from nearest village (NUMERIC)
 Distance from forest edge (NUMERIC)
 Distance from nearest ranger station (NUMERIC)
 Distance from nearest water body (NUMERIC)
 GSM signal (LIST, BOOLEAN)
 Data signal (LIST, BOOLEAN)
 Direction (LIST)
 Camera bearing (NUMERIC)
 Exposure environment (TEXT, LIST)
 Location ruined (BOOLEAN)

