Hazard Tree Evaluation Using Survey123

By James T Blodgett, Kelly S Burns, and Bradley M Lalande
Plant Pathologists, Rocky Mountain Region

USDA Forest Service, Rocky Mountain Region
State, Private, and Tribal Forestry
Forest Health Protection

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INTRODUCTION

The HT_EvaluationForm_*** is an electronic form for the inspection of trees in developed forest sites that can be run on any smartphone, tablet, or computer using the Survey123 App or computer program by ESRI. This electronic form can be used instead of the Rocky Mountain Region's paper Hazard Tree Evaluation form found on the R2 hazard tree website. The "***" in HT_EvaluationForm_*** represents a 3-letter abbreviation for each R2 National Forest.

This Survey123 App is a simple form-centric application for collecting hazard tree survey data online or offline. A survey is composed of two items in ArcGIS Online (AGOL). One is the Form item, which represents the questions and settings in your survey. Another is the Feature Service item, which stores the survey data. Please keep in mind that both items are required for your survey to function. The following steps should be done in order to successfully complete hazard tree evaluations:

- **Obtain an AGOL account**: USDA Forest Service employees can request a Forest Service AGOL account by clicking on this link and filling in the information: FS Catalog Item - Employee Service Portal (usda.gov). Others can obtain an account by following the instructions on this website: https://www.arcgis.com/home/signin.html.
- **Download the Survey123 App or access application online**. Users can download the free App for phones and tablets at iTunes or Google Play (**Figure 1**) or https://www.esri.com/en-us/arcgis/products/survey123/resources (**Figure 2**).

Request to be Added to a R2 Hazard Tree Group

Each R2 National Forest has an AGOL hazard tree group. To request access to a Forest R2 hazard tree group, contact your group owner to be added to the group. Group owner information is located on the R2 Hazard Tree Management Website. Users must belong to a group in order to use the Hazard Tree Evaluation e-form.

Group member – Members of a *R2 Hazard Tree* Forest group should only include people who collect data for the Forest and/or use/manage the data. They should be people who work on the Forest where the data is being collected, and they should understand the data being collected/managed. The tasks of group members are to collect data according to R2's *Hazard Tree Management* Technical Report R2-73, and/or manage the data. All group members should attend *R2 Hazard Tree Management* training to understand the proper methods.

Group owner/manager – Owners and managers should work on the Forest and be able to work with all district group members (ideally someone in the Supervisor's Office). They should understand AGOL enough to manage the data. Preferably owners and managers should attend *R2 Hazard Tree Management* training to understand the data and data fields. The main duties of group owners and group managers are to add or remove group members and ensure data is backed up to the T: drive. The preferred method of backing up collected data is to export the feature layer to a file geodatabase

in AGOL and then download the geodatabase to the T: drive. They can help manage the data and assist group members with questions.

- **Once added to a group, download the appropriate Hazard Tree Evaluation form to your device**. There is a form for each R2 National Forest. After you belong to a R2 hazard tree group, the survey form is available to download. Open the Survey123 App, sign in using your AGOL username and password, click on the dropdown menu in the upper right corner, select “Download Surveys,” then click on “HT_EvaluationForm_***” (**Figure 3**). The “Training” form is for practicing while the “Forest” from is for real data.
- **Start collecting data**. After installing Survey123 and downloading the form, open the Survey123 App and you will see the “My Surveys” page. You can start collecting data by clicking on “HT_EvaluationForm_***” icon.

- **Submitting report**. Reports can be submitted directly from the e-form or can be entered from the paper form into a phone or computer using the Survey123 App or Windows/Mac program, respectively. Once submitted, data can be modified or copied to assist in entry of other trees.

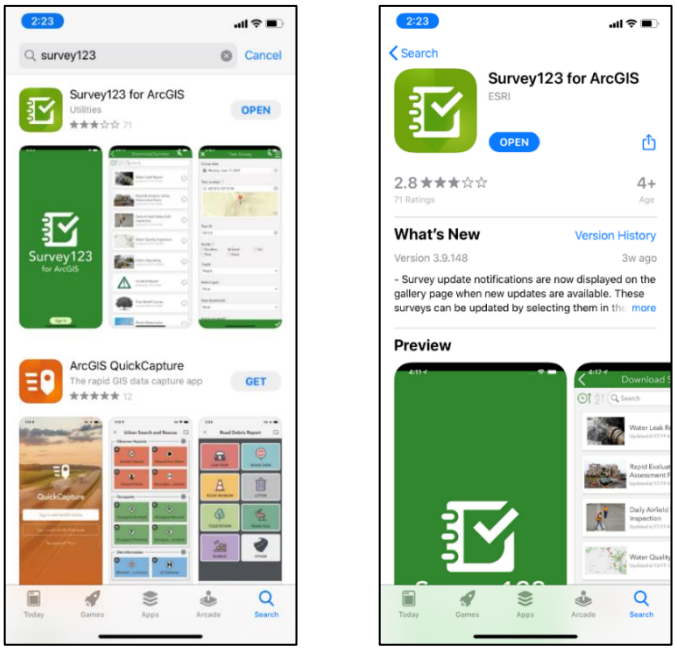

Figure 1*. Download Survey123 app via iTunes or Google* Play on phone or tablet or by downloading Survey123 deskto*p app.*

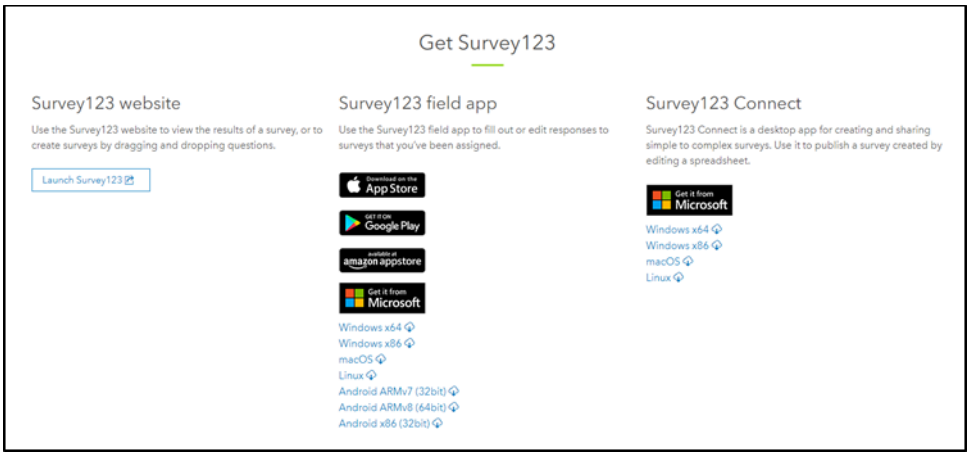

***Figure 2**. Online access to Survey123 website, field app, and Connect desktop application.*

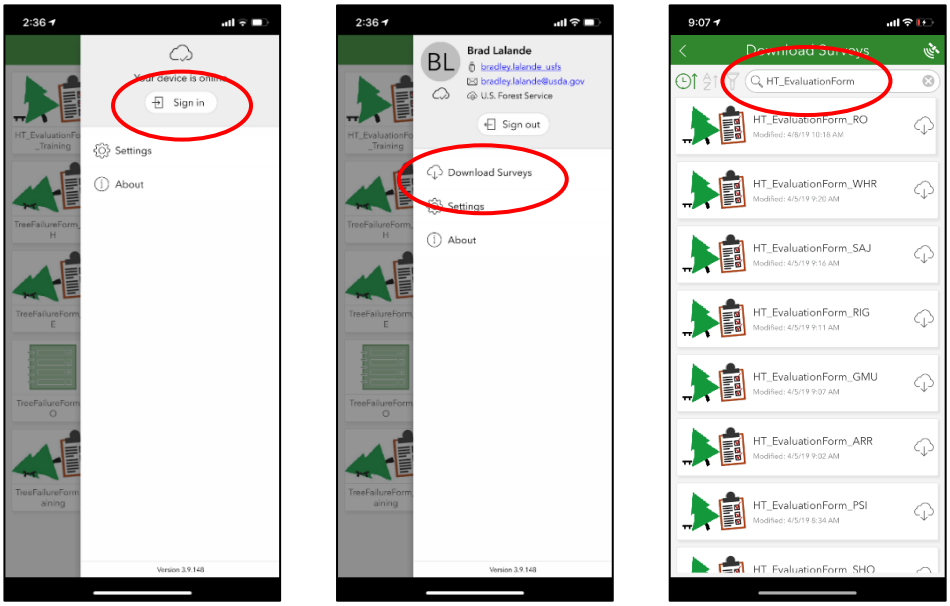

***Figure 3**. Before collecting data, log into your AGOL account using the three horizontal bars in upper right corner. Log in using USFS credentials. After logging in, select upper right figure indicating your account (the circle with your initials). Then choose "Download Surveys" to find R2 survey forms. Search "HT_EvaluationForm" to locate your specific forest and download relevant forest's HT Evaluation Form.*

Entering Data

To start collecting data, click on the "HT_EvaluationForm_***" icon, then click the "Collect" bar on the bottom of the screen (**Figure 4**). The form is set up in the same order as the paper form except "GPS point" and options for photographs are included. Fields with an asterisk (*) are required.

Collecting GPS Coordinates

The first variable you will see on your screen is “GPS point.” A GPS coordinate for each survey (*i.e.*, tree) will automatically be generated if you have the device’s GPS signal turned on (you can also fine-tune the point by pressing on the map image and dragging the pin to the appropriate location). Survey123 will average your location until 3 m or better accuracy is achieved (**Figure 4**) or you save the survey. Alternatively, you can digitize your location on the fly by pressing on “Press to capture location using a map,” then navigating the pinpoint to the tree’s location on the map. You must have a GPS signal to do this. Background imagery can be changed by selecting the top dropdown menu icon on the right (**Figure 4**) and then selecting the preferred background. Imagery can only be modified if you have pre-loaded a map or you have data service. In most cases, data will not be available, therefore modifying the map will not be an option. When you are satisfied with your location using either method, click on the check mark (√) on the bottom right.

Survey results are stored in a spatial database, so every tree surveyed must have a location. If your device does not report its location or you do not digitize it on the fly (*i.e.*, you do not have data service or use a pre-loaded map), a default location is used (lat. 0, long. 0, which is a point in the Atlantic Ocean west of Africa). If you do not have GPS, stem-mapping can be done using azimuth and distance from a reference point.

Offline maps can be added to phones/tablets for use in *Survey123* when Wi-Fi and data service is not available. Tile packages have been created for each Ranger District in the region. Maps can be accessed either through AGOL (click on the “Content” tab on the top of the screen, then click on “My Organization,” and type “FSTopo tile packages, *YOUR* ranger district” in the search line, or by downloading them from the Forest Service’s T: drive: T:\FS\Reference\GeoTool\agency\TilePackages\R02.

Maps can also be created with ArcMap or using Tile Package Kreator.

- **ArcMap** - https://desktop.arcgis.com/en/arcmap/latest/map/working-with-arcmap/how-to-create-a-tile-package.htm
- **Tile Package Kreator** - https://geonet.esri.com/groups/survey123/blog/2017/01/31/taking-your-maps-offline-with-tile-package-creator

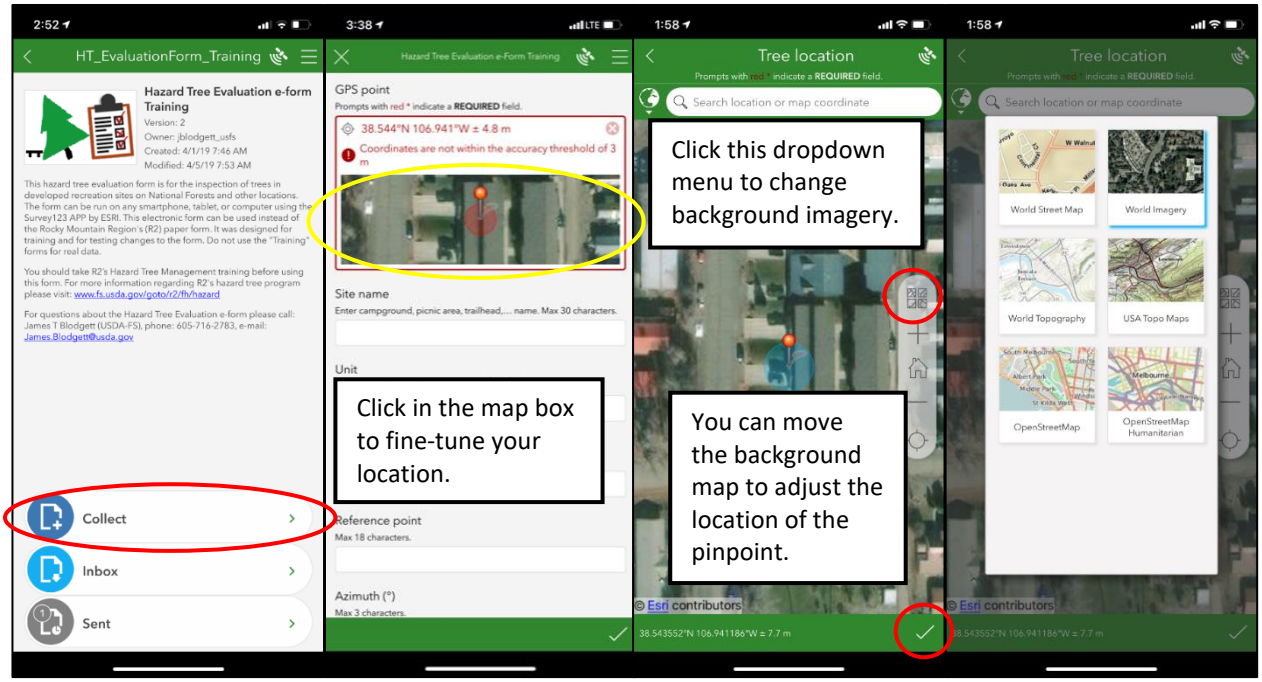

Figure 4*. To begin entering data, click "Collect" tab. Then proceed through all steps to submit a HT Evaluation Form. Coordinates are auto-generated if the device's location service is turned on. Otherwise, a point can be fine-tuned or generated on the fly by manually adjusting the location of the pinpoint. The dropdown menu can be used to change the background imagery.*

Inputting Hazard Tree Data

Using the e-form, if you leave fields marked with an asterisk blank or enter inappropriate information (*e.g.*, text for diameter), the report will be rejected when you submit it. Data is entered using drop-down menus (*e.g.*, tree species) or manually entering numbers (*e.g.*, tree number, DBH (in), etc.). Fields with circles indicate a single entry to document the target, tree's defect(s), and hazard rating.

Components of Evaluating Tree Hazard

Evaluation of tree hazard is based on two factors:

- ***Potential for loss (target potential)****.* This factor includes the potential for a tree or its parts to hit a person or valuable property, based on the level of exposure to a potential hazard.
- ***Potential for failure (defect potential)****.* "Failure" refers to mechanical failure of a tree, resulting in the tree or its parts failing. Structural defects in the tree increase the potential for failure.
- ***Calculating hazard rating***: Hazard rating is calculated by multiplying the target potential by the value of the worst defect. Six hazard rating outcomes are possible, ranging from 0 to 6 in order of increasing severity; there is no 5. If a tree could hit a developed area where people or property are typically stationary and

has a severe defect, such as root disease, it would get the highest hazard rating (target of 2; worst defect is 3; hazard rating is 2 x 3 = 6). If a tree has a severe defect but would hit a major trail or road in a developed site, the tree would get a moderate hazard rating (target of 1; worst defect is 3; hazard rating is 1 x 3 = 3). Trees that could potentially hit something of value, but have no defects get a hazard rating of 0 (**Figure 5**).

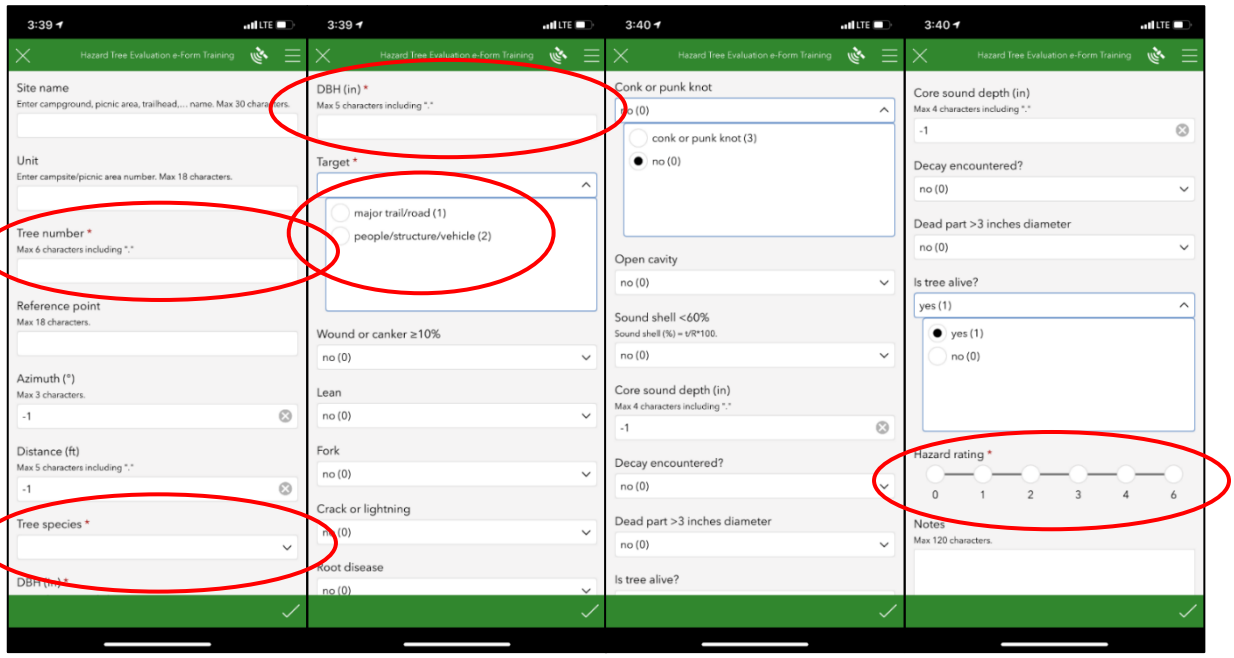

***Figure 5**. After collecting GPS data, input tree data to identify the potential for hazard of each tree. Images highlight required data.*

- For more information regarding all fields and attributes, a summary is provided in **Table 1**. Refer to *Hazard Tree Management* (http://www.fs.usda.gov/goto/r2/fh/hazard) for a complete description of the fields and their attributes as well as guidelines for conducting hazard tree evaluations.

Collecting Photos

The Survey123 App also allows you to capture photos of defects, trees, or other pertinent features (**Figure 6**). Photos can be captured using the camera on your device (select the camera icon by scrolling to the bottom of the form) or they can be uploaded (select the file folder icon and navigate to the location where the photo is stored). If you take the photo within the App, photo will not exist elsewhere, therefore taking a photo using your phone camera and uploading into the App is preferred.

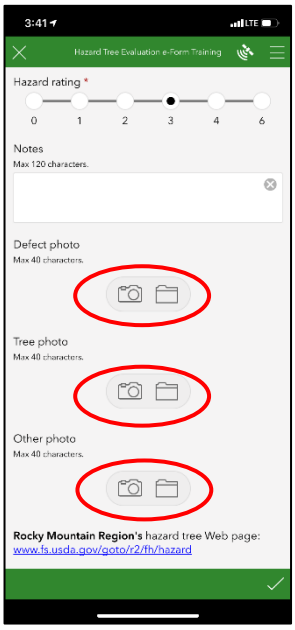

***Figure 6**. Collect photos using the device's camera or by uploading from a file.*

Saving Data

Once all the data has been entered, you can click the check mark on the bottom right of the screen. You will have the option to "Send Now," "Continue the Survey," or "Save this survey in the Outbox" (**Figure 7**). You must be online to send data. If you are online and click "Send Now" the record will automatically be stored on the cloud. If you are offline, you can click "Save this survey in the Outbox" which will store the data for later submission. Once you are back online, you can click on "outbox," then click "send surveys" at the bottom of the screen to save all your surveys to the cloud.

Once a survey is sent it can still be edited on your device (click "Sent" on the main page and then click on the survey you want to edit; **Figure 8**).

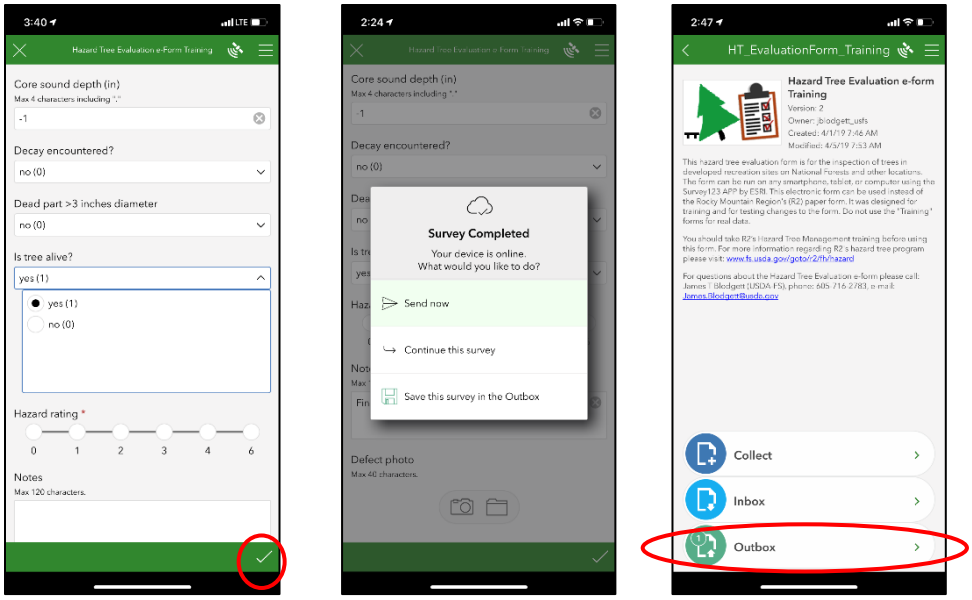

Figure 7. *Saving data by clicking check mark in bottom right of screen. Three options will display: send now, continue, or save data. If data is saved in the Outbox, you should submit the survey(s) when online.*

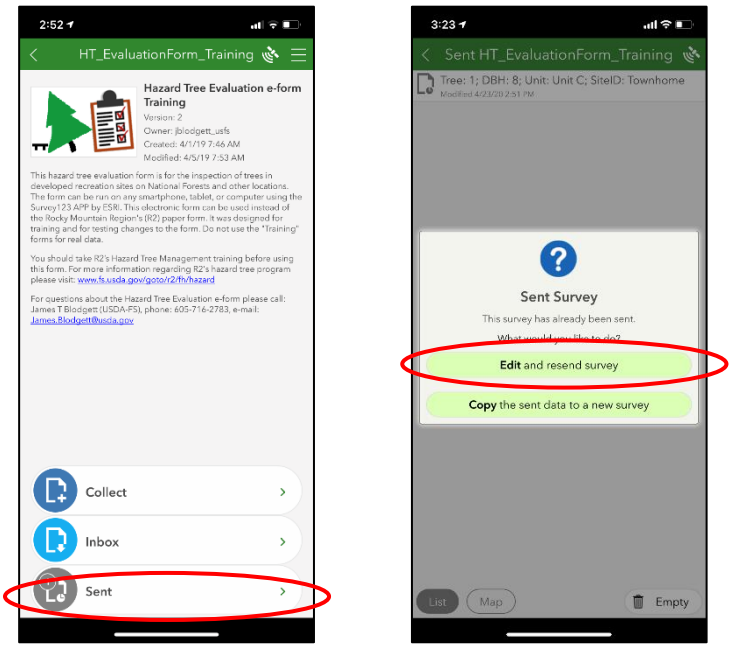

Figure 8. *Sent surveys can be edited on your device and resent.*

Downloading Data

Open Survey123 online (https://survey123.arcgis.com) and sign into your AGOL account.

If you don't see your form, type "HT_EvaluationForm_***" in the search box in the upper right corner (**Figure 9**).

Click on the data tab (little gray box with horizontal lines below HT_EvaluationForm_***) for the appropriate form.

Survey123 will download all surveys in the database unless otherwise specified. To reduce the number of surveys downloaded, or focus on your survey only, select the categories within "Filter" or choose specific dates to minimize your search (**Figure 10**). Select the output format you want by selecting the drop down "CSV" (csv, shapefile, or file geodatabase; **Figure 10**). To allow for photos to be accessed, select file geodatabase.

Output will automatically be downloaded to a designated location: *e.g.*, C:\Users\username\Downloads\S123_***_CSV\HT_EvaluationForm_***_0.csv (**Figure 11**). Double click on the file to open in Excel. Alternatively, open Excel, select "file" then "open," navigate to the folder where the file is stored.

Edit as necessary making sure to remove any duplicate surveys.

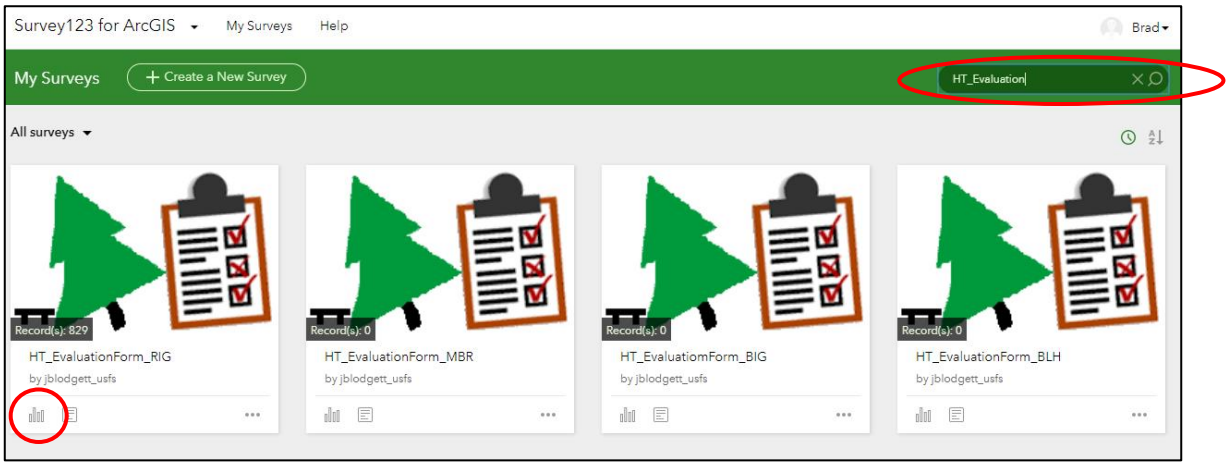

Figure 9*. Type "HT_EvaluationForm_***" in the search box to navigate to the appropriate form. Click the data icon (little gray box with horizontal lines below HT_EvaluationForm_***) to view and download data.*

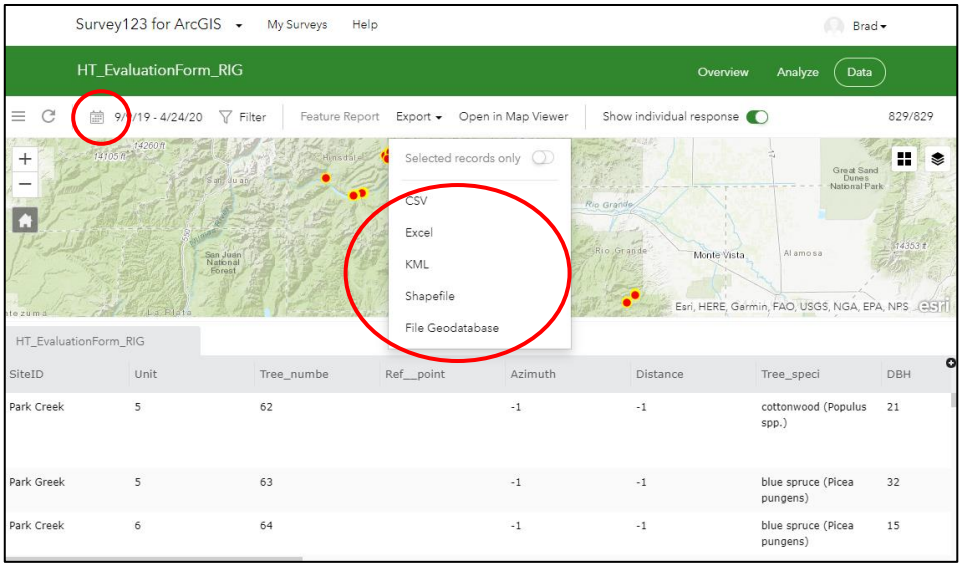

***Figure 10**. Under the data tab you can select the dates of the survey and the output format. Data will automatically be downloaded to your "download" folder.*

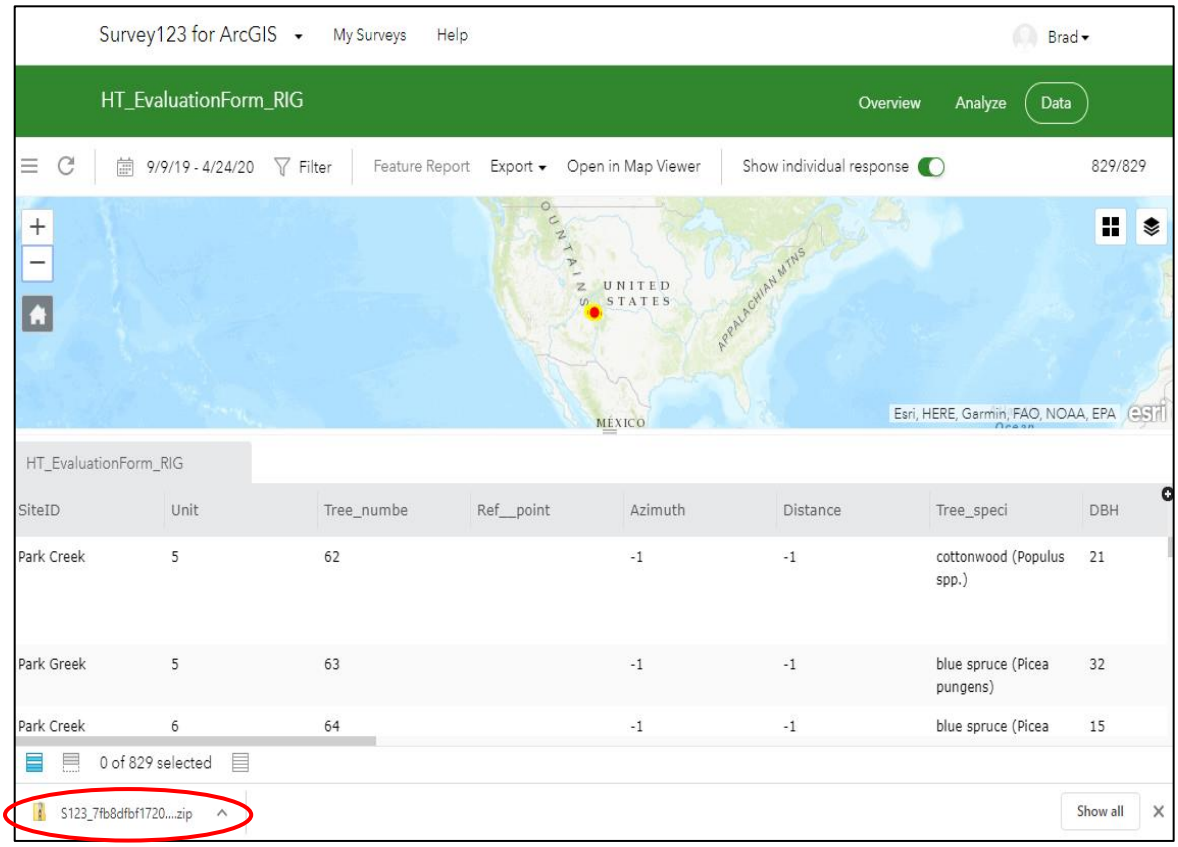

***Figure 11**. The file is stored with a cryptic filename. You may choose to open the file after it downloads (or "show in the folder") and then copy and paste the file to a more appropriate location and rename.*

Report Templates

Single-tree and summary reports can be generated using ArcGIS Survey123 Report Templates. You can use these basic instructions to get started.

1) Open ArcGIS Survey123 in your web browser: https://survey123.arcgis.com/surveys

2) Log-in

3) If testing the forms, look for *HT_EvaluationForm_Training.* If using real data, look for *HT_EvaluationForm__****. The *** represents a three-letter abbreviation for each R2 National Forest.

4) Select "Data" icon, box with lines figure (**Figure 12**). This will open the associated map and data page.

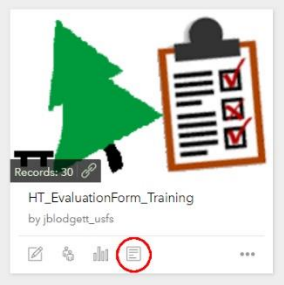

Figure 12. Select the "Data" icon.

5) Select a tree (*i.e.*, points) for a single tree report. It will make a single tree report for all trees selected if more than one tree is selected. Select several trees (*e.g.*, several trees at a site) for a summary report for a site.

6) Click on "Report" (**Figure 13**) and fill in the information/select the options you want. HT_EvaluationForm currently has three report options; make your choice from the dropdown menu.

- *HT_Evaluation_Tree_Report* generates a single tree report.
- *HT_Evaluation_Summary_Report* generates a summary report for all trees selected.
- *HT_Evaluation_Summary_byDefects_Report* generates a summary report for all trees selected and provides tree defect information.

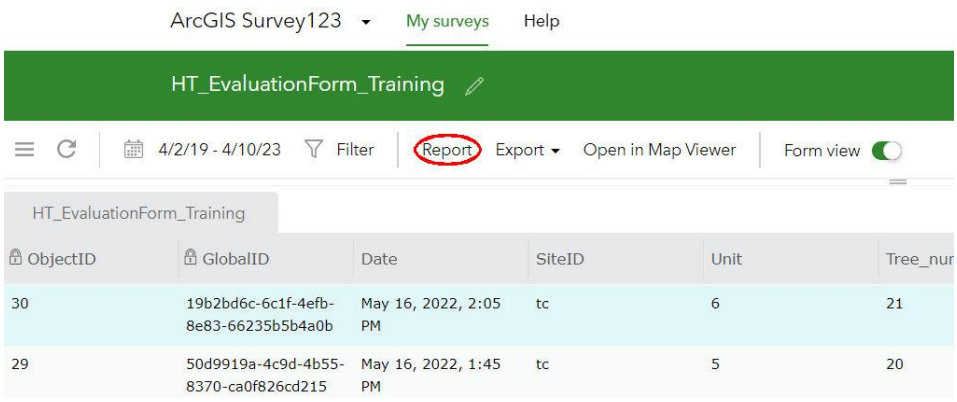

Figure 13. Select "report."

If you are using the *Training* version of the form, thus only testing reports, creating a draft version, or can use a draft version please use "Preview sample report" (**Figure 14**). Otherwise, there is a charge to the USDA-FS.

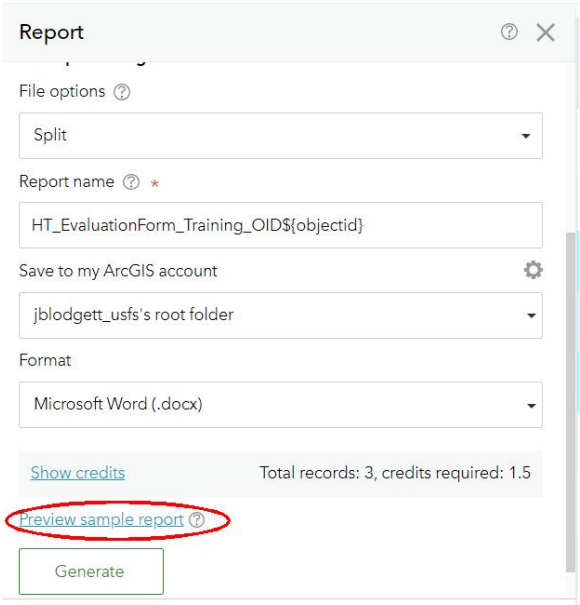

Figure 14. Please use the "Preview" option if possible.

7) Click the box: "Generate" to make a final report (there is a charge). This will allow you to download the Survey123 report in MS Word format where you can edit/format. You can also save the report in an AGOL Group folder for later downloads. These reports can be added in a Forest report, aid in tree management/removal, etc.

Table 1. Description of fields. Fields with an asterisk (*) are required in order to close the survey.

Survey123 field name	Export field name	Option/Type/Example	Type
Hidden[1]	ObjectID	na	na
Hidden[1]	GlobalID	na	na
GPS point[2]	x and y	na	na
***Date**[1]	Date	3/27/2017 10:57:13 AM	date and time
SiteID	SiteID	text, 30	text
Unit	Unit	text, 18	text
***Tree number**	Tree_numbe	0-9,999.9	number, 1 decimal
Reference point	Ref_point	text, 18	text
Azimuth	Azimuth	0-360, default -1[3]	number, 0 decimals
Distance	Distance	0-199.9, default -1	number, 1 decimal
***Tree species**	Tree_speci	PSME	code
Enter genus and species if not in list	Othr_speci	text, 36	text
***DBH**	DBH	5-99.9	number, 1 decimal
***Target**	Target	1, 2	code
Wound or canker ≥10%	Wound_cank	0-3, default 0	code
Lean	Lean	0, 1, 3, default 0	code
Fork	Fork	0-2, default 0	code
Crack or lightning	Crack_ligh	0, 1, 3, default 0	code
Root disease	Root_disea	0, 3, default 0	code
Roots exposed	Exposed_ro	0-3, default 0	code
Conk or punk knot	Conk_punk_	0, 3, default 0	code
Open cavity	Open_cavit	0-3, default 0	code
Sound shell	Sound_shel	0, 2, 3, default 0	code
Core sound depth	Core	0-49.9, default -1	number, 1 decimal
Decay encountered?	Decay_enco	0, 1, default 0	code
Dead part >3 inches	Dead_part_	0-3, default 0	code
Is tree alive?	Live_	0, 1, default 1	code
Hazard rating	Hazard_rat	0-6, no 5	code
Management/Mitigation	Mgt	default NA	code
Notes	Notes	text, 120	text
Defect photo[2]	na	na	na
Tree photo[2]	na	na	na
Other photo[2]	na	na	na
Hidden[1]	CreationDate	na	na
Hidden[1]	Creator	na	na
Hidden[1]	EditDate	na	na
Hidden[1]	Editor	na	na
Hidden[4]	x	longitude	number (-), and decimal
Hidden[4]	y	latitude	number (+), and decimal

[1] Auto-generated by the Survey123 App.

[2] These are not exported to a .csv file.

[3] A value of -1 represents no value since 0 could be a real value.

[4] Survey123 auto-generates "x" (longitude) and "y" (latitude) fields based on the location your device reports, the location you mapped on the fly, or a default (x=0; y=0) if GPS is not receiving or is off. Note, the device must have a strong GPS signal to generate accurate x/y values.