Section 8 - Reports and Analysis Exercises

Before starting these exercises you need to have a copy of the FFI-Lite training dataset: *FFI_Training_Data_10514.SDF.* The training dataset is included in the zip file if you download the complete set of self-paced materials or it can be downloaded individually from *Software and Instructions and Training Data* tab on the *Manuals and Software* page on the FFI FRAMES website: *www.frames.gov/ffi*.

The exercises are designed to give you a brief overview of the summary reports and analysis reports in FFI and FFI-Lite. They aren't meant to be a complete description of all the reports and analysis functionality but to make you generally familiar with what's available.

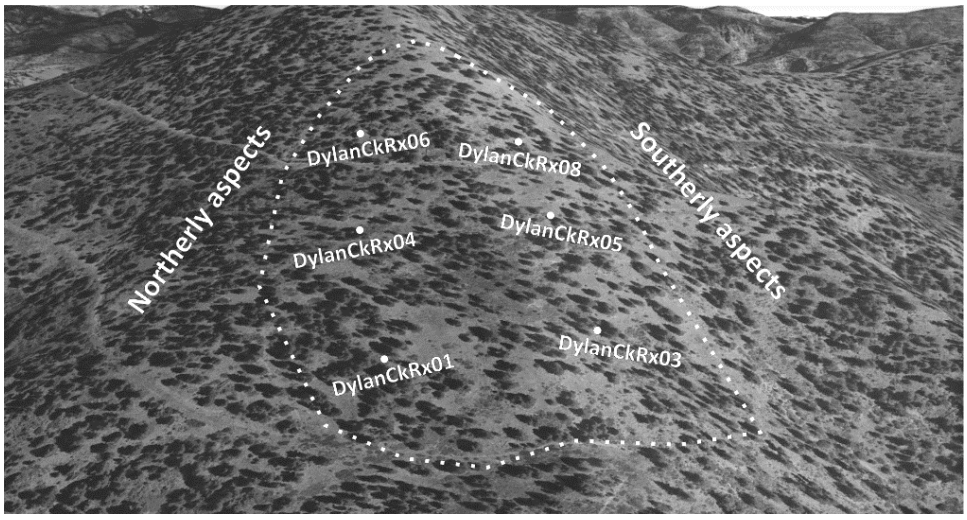
In these exercises you will:

1) Setup for Reports and Analysis
2) Create Summary Reports
3) Create Analysis Reports
3) Use the Analysis Reports to view species specific reports
4) Use the Confidence Intervals (CI) in lieu of One-sample t-tests
5) Stratify data using the UV fields on the Macroplot form
6) Create a Macro Plot CSV Report
7) Create a Sample Event CSV Report

The DylanCkRx project in the *FFI_Training_Data_10514* database includes data for six macro plots that have been measured three times:

2001/10/15 = Pretreatment measurements
2002/10/07 = First remeasurement (first year after prescribed fire)
2003/09/05 = Second remeasurement (second year after prescribed fire)

The project area is bisected by a ridge that separates the unit so about half the area has southerly aspects and half has northerly aspects. There are three plots on each aspect.



Reports and Analysis Exercise

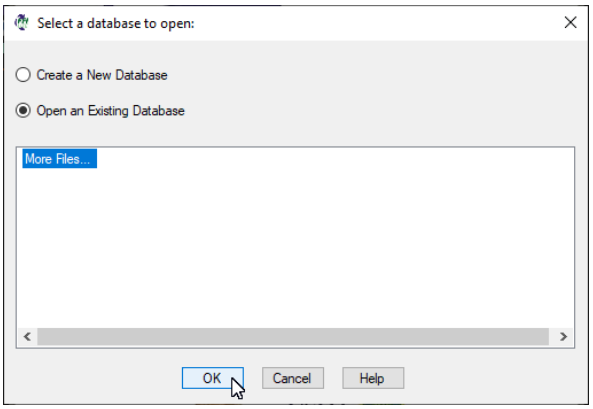
A prescribed fire was applied to the site after the pretreatment data was collected, then the macro plots were monitored again one year and two years posttreatment. Some objectives of the fire where to:

a) Kill less than 10% of the trees sampled using the Trees-Individual method (the mature trees) one year after the prescribed fire
b) Increase live crown base height of the mature trees one year after the prescribed fire.
c) Reduce the biomass of fine woody debris (FWD) one year after the prescribed fire.
d) Maintain the cover of beargrass (XETE) two years after the prescribed fire.
e) Maintain 11 tons/acre of duff one year after the prescribed fire.

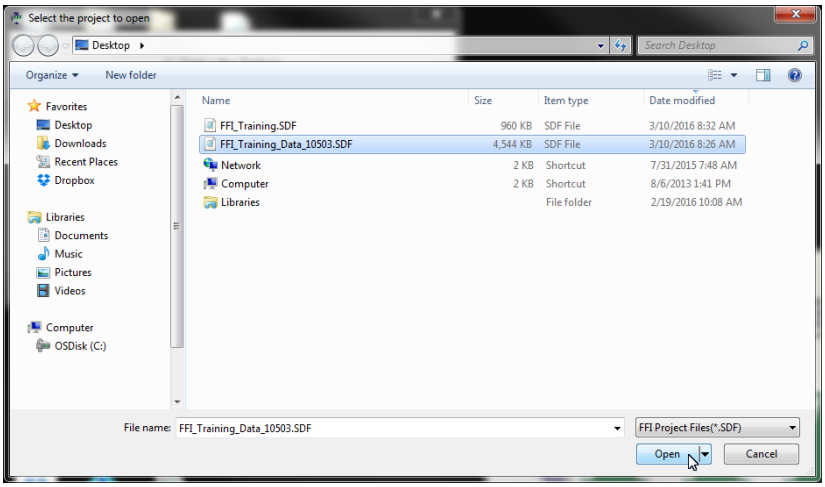
You will use the FFI **Reports and Analysis** to see if these objectives were met.

Exercise 1: Setup for Reports and Analysis

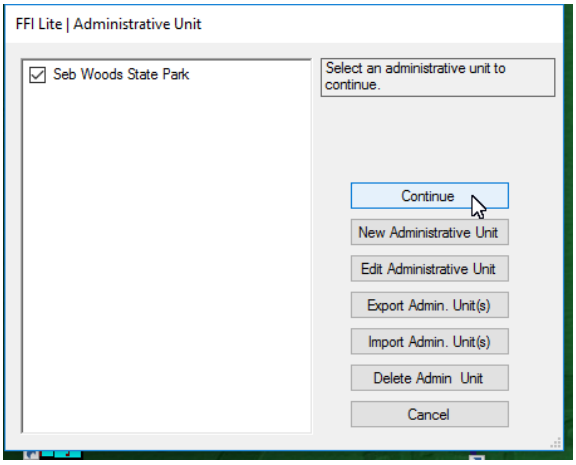
1.1 Double click the **FFI-Lite** icon and log into the *FFI_Lite_Training_Data_10514*. Select the radio button to **Open an Existing Database**. If the training database isn't displayed, click **More Files…**, then click **OK.**



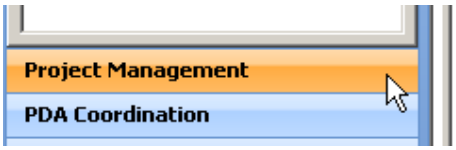
1.2 Navigate to the folder where you saved database. Click **Open**.



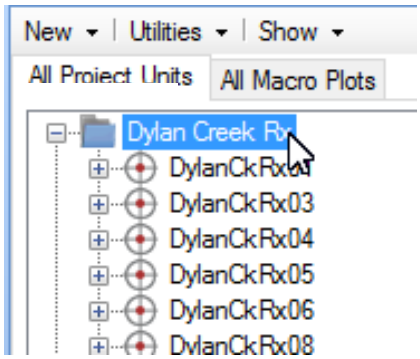
1.3 Check the box for the *Seb Woods State Park* administrative unit and click **Continue**.



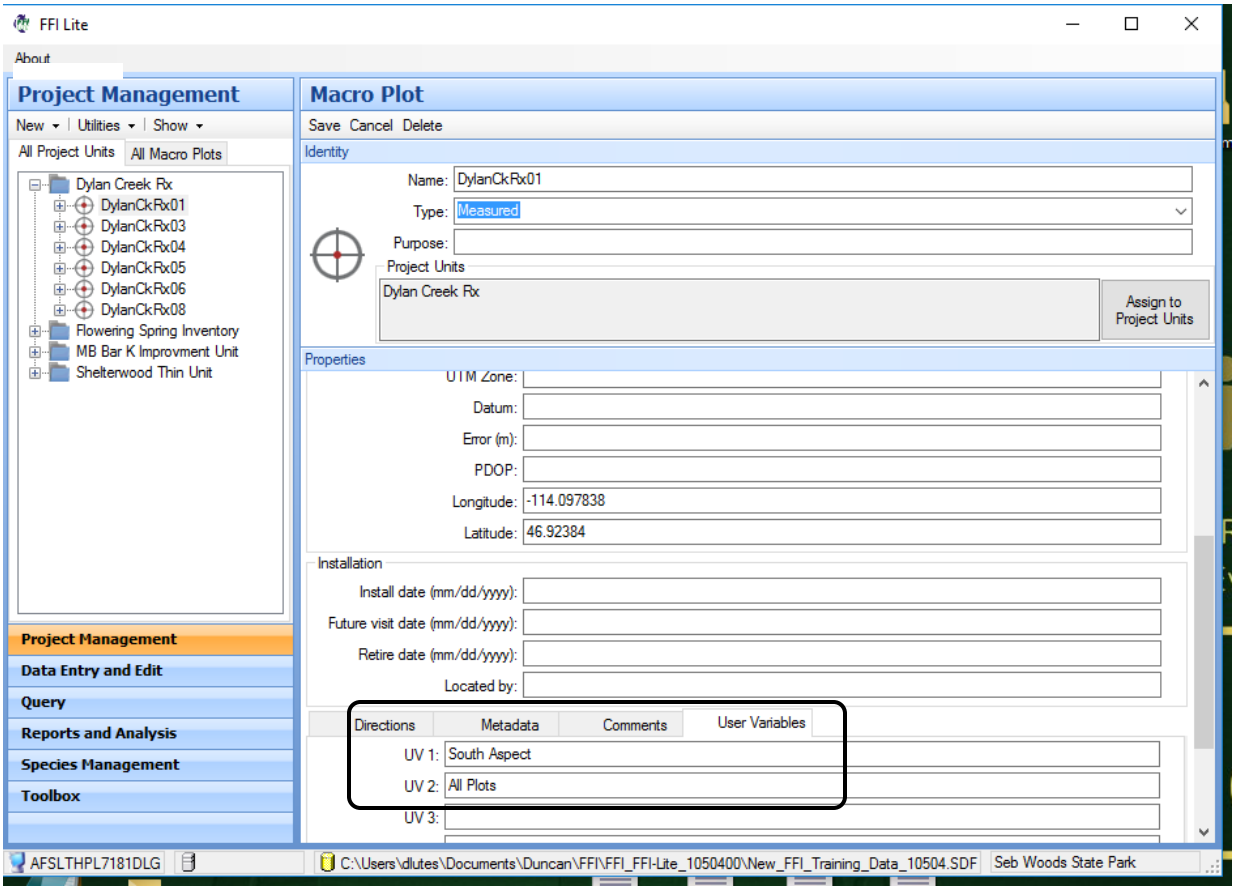
1.4 Click **Project Management** in the left pane.



1.5 Click on the *Dylan Creek Rx* project name in the left pane. Click the '+' sign next to the *Dylan Creek Rx* folder to make the macro plot names visible.

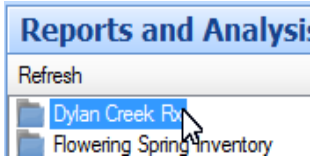


1.6 For each macro plot, click the macro plot name in the left pane, then scroll to the bottom on the right side and click on the **User Variables** tab. Make sure that an aspect is entered in *UV1* and All Plots is entered in the *UV2* field for each macro plot. You will use the UV fields to stratify macro plots when running the reports (i.e., get an average for all macro plots in each stratum for each sample event).

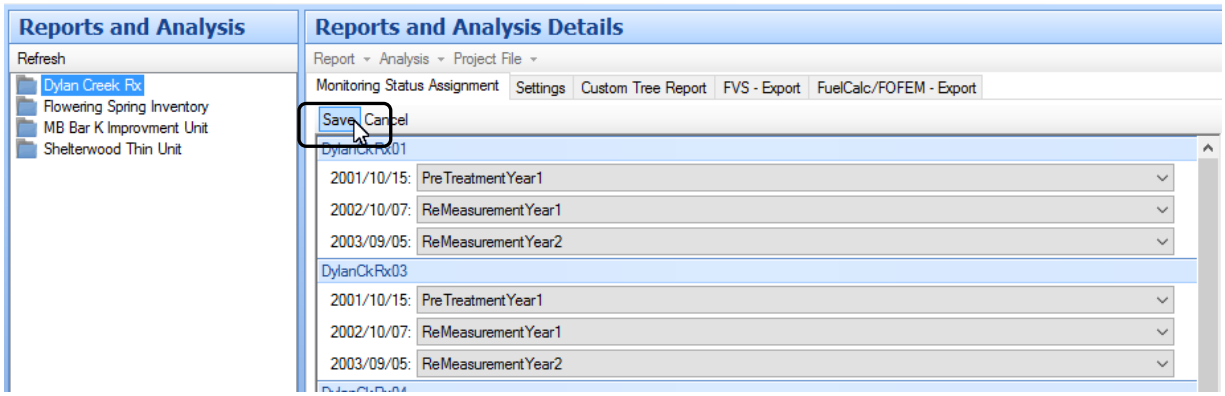


1.7 Click on **Reports and Analysis** in the left pane.

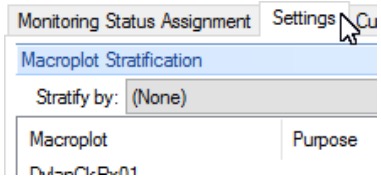
1.8 Click on the *Dylan Creek Rx* project folder in the left pane.

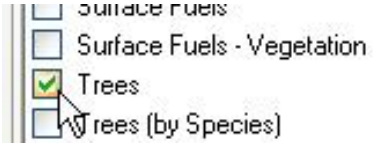


1.9 Monitoring statuses can also be assigned on this screen. For this exercise you should see the first sample event date is set to *PreTreatmentYear1*, the second date set to *ReMeasureYear1* and the third date set to *ReMeasureYear2*. Setting Monitoring Status identifies the sampling order for the analysis program. If you make changes to the monitoring statuses, be sure to click **Save** when done or you will have to reset all your monitoring status assignments next time you return to **Reports and Analysis**.

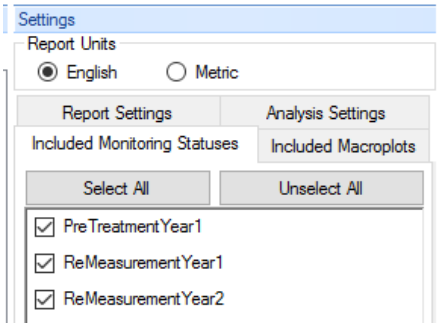


1.10 Click on the **Settings** tab and on the **Report Settings** tab on the right side, select *Trees*.

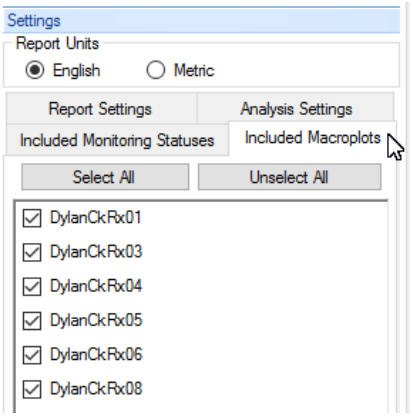




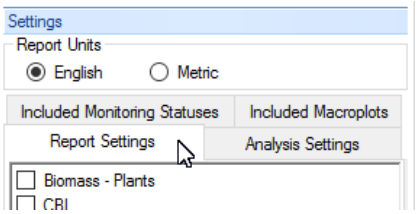
1.11 Click on the **Included Monitoring Statuses** tab and make sure all three are checked.



1.12 Click on the **Included Macroplots** tab and make sure all macro plots are selected.



1.13 Click on the **Report Settings** tab. This tab must be selected to create a report.

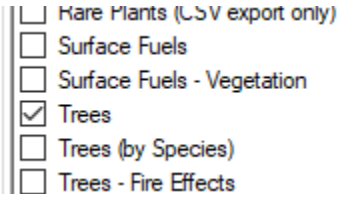


Exercise 2: Create Summary Reports

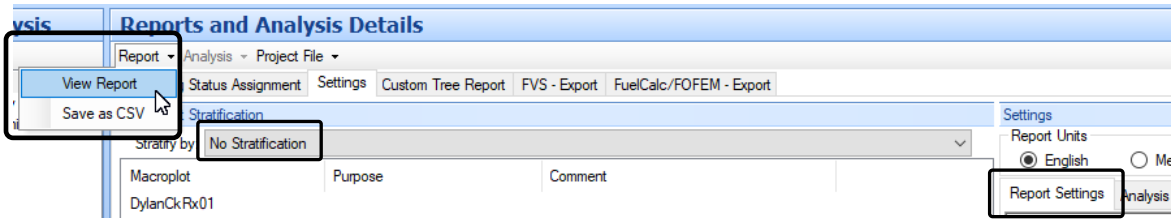
Tree Density

The summary reports in FFI present attribute values summarized to the macro plot level or by stratum. In Exercise 2 you will create three reports using the *Trees* protocol: 1) an unstratified report, 2) a summary that averages tree data across all six plots in the project by stratifying on *UV2* and 3) a report that averages tree data for the three plots in each stratum by stratifying on *UV1*.

2.1 Under the **Report Settings** tab, check the box for the *Trees* protocol.



2.2 The first report you create will not be stratified. Make sure the **Report Settings** tab in the right pane is selected and *No Stratification* is selected in the **Stratify by** dropdown. At the top of the page click **Report** > **View Report** to see the tree summary report.



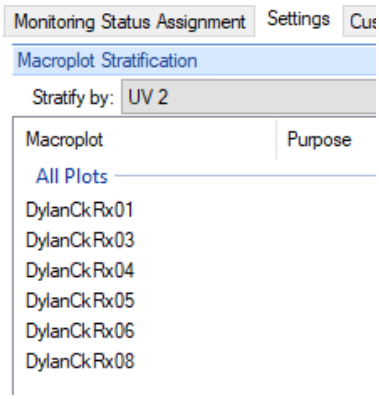
2.3 The screen shot below include just the top portion of the report. The macro plot and monitoring status names are on the left. There is a row in the report of each macro plot and monitoring status. The attributes in the report (e.g., basal area and average height) are calculated at the plot level.

Trees Summary

Macroplot	Monitoring Status	Trees (per acre)	Basal Area (sq. ft. / acre)	Avg. Live Crown Base Height (ft.)	Avg. Height (ft.)	QMD (in.)	Saplings (per acre)	Seedlings (per acre)	Total Trees (per acre)	Snags (per acre)
		Individual Trees								
DylanCkRx01	PreTreatmentYear1	50.0	27.4	27.2	63.0	10.0	60.0	600.0	710.0	10.0
DylanCkRx01	ReMeasurementYear1	30.0	24.4	51.7	72.7	12.2	60.0	600.0	690.0	30.0
DylanCkRx01	ReMeasurementYear2	30.0	24.4	51.7	72.7	12.2	60.0	900.0	990.0	30.0
DylanCkRx03	PreTreatmentYear1	50.0	69.2	26.4	66.6	15.9	60.0	600.0	710.0	10.0
DylanCkRx03	ReMeasurementYear1	40.0	67.4	34.8	78.0	17.6	60.0	600.0	700.0	20.0
DylanCkRx03	ReMeasurementYear2	30.0	63.9	38.0	89.0	19.8	60.0	900.0	990.0	30.0

2.4 Close the report by clicking the X in the upper right of the report window.

2.5 Now create a stratified report that averages the macro plot attributes for all six plots. In the middle pane, select *UV2* in the **Stratify by** dropdown. Notice the plot list below the dropdown now shows all six macro plots under *All Plots*. (The *All Plots* assignment was stored in *UV2* at the macro plot level (**1.6)**.)



2.6 At the top of the page click **Report** > **View Report** to see the new tree summary report. You will see on the left side that the data has been summarized to *All Plots* for each monitoring status. That means all the data for the six macro plots you selected in **1.12** have been grouped together and the values under each heading represent the average of all six macro plots in the stratum.

NOTE: You could have also created this report by selecting All Selected Macroplots *in the* ***Stratify by*** *dropdown list.*

Trees Strata Summary

Strata	Monitoring Status	Trees (per acre)	Basal Area (sq. ft. / acre)	Avg. Live Crown Base Height (ft.)	Avg. Height (ft.)	QMD (in.)	Saplings (per acre)	Seedlings (per acre)	Total Trees (per acre)	Snags (per acre)
		Individual Trees								
All Plots	PreTreatmentYear1	48.5	39.2	24.9	64.8	12.2	58.5	514.3	621.3	10.0
All Plots	ReMeasurementYear1	38.5	34.5	35.3	69.5	12.8	58.5	514.3	611.3	20.1
All Plots	ReMeasurementYear2	33.5	32.1	37.1	73.5	13.3	58.5	694.8	786.8	25.1

Seedling and sapling density includes live and dead trees.

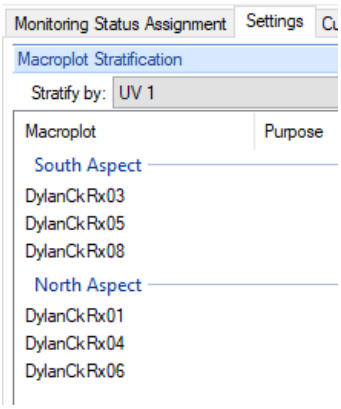
Use the information on the summary report and answer these questions:

Question 1: Tree records entered in the *Trees - Individuals* method are summarized in the column labeled *Trees (per acre).* Did the treatment appear to be successful in the objective of killing less than 10% of the total number of *Individual Trees* one year after the fire?

Question 2: Looking at this report can you tell how many seedlings the fire killed?

2.7 Close the report.

2.8 Create the third report that stratifies the plot by aspect as entered in *UV1*. Select *UV1* in the **Strata by** dropdown. Below the **Strata by** field you will see there are three plots in each stratum.



2.9 Click **Report>View Report** to see the new summary.

Trees Strata Summary

Strata	Monitoring Status	Trees (per acre)	Basal Area (sq. ft. / acre)	Avg. Live Crown Base Height (ft.)	Avg. Height (ft.)	QMD (in.)	Saplings (per acre)	Seedlings (per acre)	Total Trees (per acre)	Snags (per acre)
		Individual Trees								
North Aspect	PreTreatmentYear1	50.2	40.7	24.6	67.4	12.2	56.9	480.9	588.0	10.0
North Aspect	ReMeasurementYear1	33.5	31.9	37.6	72.9	13.2	56.9	480.9	571.2	26.8
North Aspect	ReMeasurementYear2	30.1	28.7	38.9	75.3	13.2	56.9	634.9	721.9	30.1
South Aspect	PreTreatmentYear1	46.8	37.6	25.2	62.2	12.1	60.2	547.6	654.7	10.0
South Aspect	ReMeasurementYear1	43.5	37.0	33.1	66.0	12.5	60.2	547.6	651.3	13.4
South Aspect	ReMeasurementYear2	36.8	35.4	35.3	71.7	13.3	60.2	754.7	851.8	20.0

Seedling and sapling density includes live and dead trees.

***Question 3*:** Two years after the fire, was mortality (trees per acre) of *Individual Trees* greater on plots with North Aspects or South Aspects?

***Question 4*:** When looking at the two aspects individually, did the prescribed fire treatment meet the tree mortality objective in Question 1: Kill less than 10% of overstory trees at the first remeasurement?

2.10 Close the report.

The next question asks about tree species response to the prescribed fire. The table below includes the symbol, common name, scientific name and general fire resistance for species in the report. It is just provided for those not familiar with the tree symbols seen in the report.

Symbol	Common Name	Scientific Name	Mature Tree Fire Resistance
ABLA	subalpine fir	Abies lasiocarpa	Low
LAOC	western larch	Larix occidentalis	High
PICO	lodgepole pine	Pinus contorta	Low
PIPO	ponderosa pine	Pinus ponderosa	High
PSME	Douglas-fir	Pseudotsuga menziesii	Moderate

2.11 The previous reports didn't have any species information in them, but it might be good to know how the prescribed fire impacted tree mortality of the individual species. For example, if the treatment was meant to selectively impact certain species. Under **Report Settings** tab on the right side of the screen, uncheck *Trees* and check the *Trees (by Species)* report. Set **Stratify by** to *UV2* and click **Report > View Report** to see the next summary.

Trees by Species Strata Summary

Strata	Monitoring Status	Species	Trees (per acre)	Basal Area (sq. ft. / acre)	Avg. Live Crown Base Height (ft.)	Avg. Height (ft.)	QMD (in)	Saplings (per acre)	Seedlings (per acre)	Total Trees (per acre)	Snags (per acre)
			Individual Trees								
All Plots	PreTreatmentYear1	ABLA	1.7	2.0	35.0	88.0	14.9			1.7	0.0
All Plots	PreTreatmentYear1	LAOC	8.4	7.1	28.0	68.8	12.5	3.3	30.2	41.9	1.7
All Plots	PreTreatmentYear1	PICO	5.0	1.2	23.3	48.3	6.7	6.7		11.7	3.4
All Plots	PreTreatmentYear1	PIPO	11.7	15.8	26.5	69.8	15.7	15.0	106.7	133.5	1.7
All Plots	PreTreatmentYear1	PSME	21.8	13.0	22.0	62.9	10.5	33.5	377.4	432.6	3.4
All Plots	ReMeasurementYear1	LAOC	8.4	7.1	31.7	68.8	12.5	3.3	30.2	41.9	1.7
All Plots	ReMeasurementYear1	PICO	1.7	0.7	35.0	48.0	8.9	6.7	33.3	41.7	6.7
All Plots	ReMeasurementYear1	PIPO	10.0	15.5	32.6	77.9	16.8	15.0	106.7	131.8	3.3
All Plots	ReMeasurementYear1	PSME	18.4	11.2	36.9	65.3	10.6	33.5	344.0	395.9	8.4
All Plots	ReMeasurementYear2	LAOC	8.4	7.2	32.4	69.6	12.5	3.3	60.3	72.0	1.7
All Plots	ReMeasurementYear2	PICO	1.7	0.7	35.0	48.0	8.9	6.7	50.0	58.4	6.7
All Plots	ReMeasurementYear2	PIPO	10.0	15.5	31.9	78.4	16.8	15.0	106.7	131.8	3.3
All Plots	ReMeasurementYear2	PSME	13.4	8.7	43.3	72.8	10.9	33.5	477.8	524.6	13.4

Seedling and sapling density includes live and dead trees.

Question 5: By the second remeasurement, what two species listed under *Individual Trees* had the smallest decrease in tree density and what two species had the greatest decrease in tree density?

2.12 Close the report.

NOTE: When summarizing monitoring data in written reports or in person, consider qualifying your assessments to acknowledge data limitations. For example, you might comment, "Using the data collected in this project, it appears the mortality of trees species _____ was less than 10% at the first and second remeasurement. Our observations when walking through the treatment area during sample visits support (or do not support) the information collected on the six sample plots".

Exercise 3: Create Analysis Reports

The parametric analysis reports in FFI use an *F-Test* and *Dunnett's multiple comparison procedure with a control* to identify significant differences in report attributes. First, the F-test is used to note if there are any significant differences in the attribute means. If significant differences are noted with the F-test then FFI uses the Dunnett's procedure to determine which means significantly differ. In FFI the 'control' attribute used for the Dunnett's procedure is always the top-most monitoring status selected on the Included Monitoring Statuses tab (**1.9**). The statistical tests are made by comparing each subsequent monitoring status to the control. The p-value for each comparison is presented at the bottom of the report.

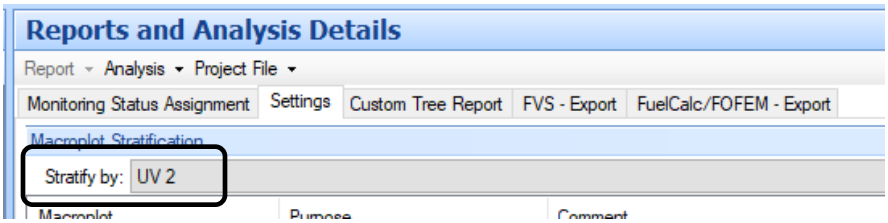
See the notes at the end of the exercises for more information about the statistical testing in FFI.

When data are not normally distributed, non-parametric equivalents of the F-test and Dunnett's procedure are also available. FFI uses *Friedman's chi-square*, *non-parametric multiple comparisons based on Friedman's Rank Sums* and a *distribution free confidence interval* for the non-parametric comparisons.

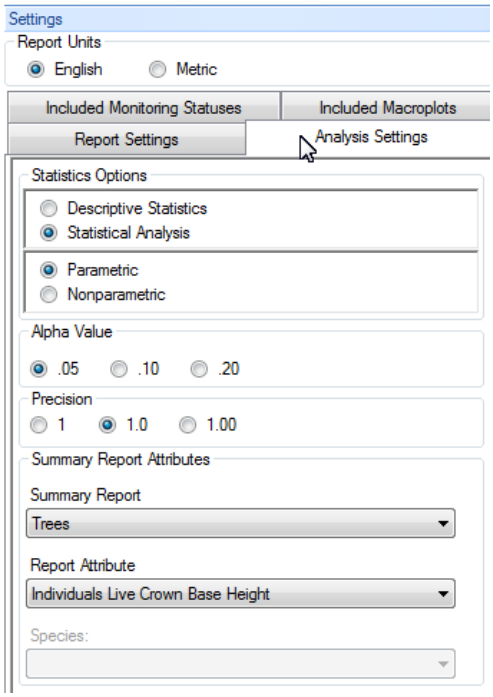
A minimum of four macro plots are required for parametric or non-parametric comparisons. Dunnett's comparison and Friedman's Rank Sums require data for each sample event. Any sample events with missing data cannot be included in a test.

Mature Live Crown Base Height

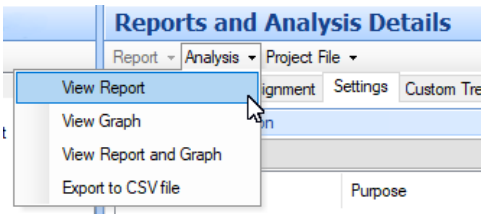
3.1 On the **Settings** tab set **Stratify by** to *UV 2*.



3.2 Click the **Analysis Settings** tab on the right.
Select: *Statistical Analysis*, *Parametric*, Alpha=*0.05*, Precision=*1.0*,
Summary Report = *Trees*, Report Attribute = *Individuals Live Crown Base Height*.



3.2 Click **Analysis** > **View Report**.



One-Way Analysis of Variance

Project Unit_____Dylan Creek Rx
Summary Report_____Trees
Report Attribute_____Individuals Live Crown Base Height
Units_____Feet

Strata: All Plots

	PreTreatmentYear1	ReMeasurementYear1			ReMeasurementYear2		
Plot	Attr	Attr	Diff	%Diff	Attr	Diff	%Diff
DylanCkRx01	27.2	51.7	24.5	90.0	51.7	24.5	90.0
DylanCkRx03	26.4	34.8	8.4	31.6	38.0	11.6	43.9
DylanCkRx04	21.0	28.3	7.3	34.5	31.0	10.0	47.6
DylanCkRx05	19.2	32.0	12.8	66.7	35.0	15.8	82.3
DylanCkRx06	25.6	32.8	7.2	28.2	33.9	8.3	32.5
DylanCkRx08	29.9	32.4	2.5	8.2	32.8	2.9	9.6
Mean	24.9	35.3	10.4	41.9	37.1	12.2	48.9
SDev	4.0	8.3			7.5		
N	6.0	6.0			6.0		
CI-Lower	20.7	26.6			29.2		
CI-Upper	29.1	44.0			45.0		

Dunnett's multiple comparison test

F-Value = 5.51 Prob = 0.0161 Alpha =.05 (Settings Dialog Box)

PreTreatmentYear1 to ReMeasurementYear1: p <= .01
PreTreatmentYear1 to ReMeasurementYear2: p <= .01

Each analysis report includes a header that lists the Project being analyzed (*Dylan Creek Rx*), the Summary Report being examined (*Trees*), the Report Attribute (*Mature Live Crown Base Height*) and the Units of the attribute (*Feet*).

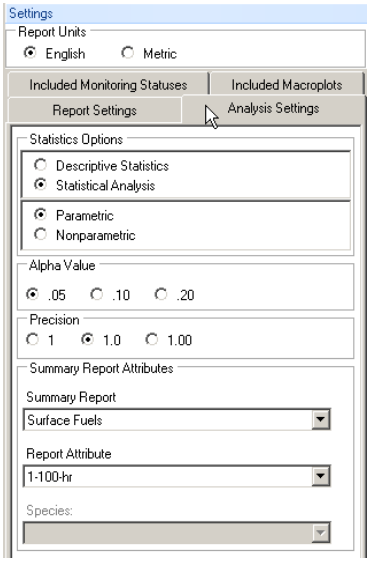
Average Mature Live Crown Base Height (MLCBH) is calculated by averaging the *Live Crown Base Height* for every tree in the Trees-Individual protocol, across all macro plots in the stratum, for each monitoring status. The result is shown in the row labeled 'Mean' in the analysis table. The values in the *Attr* columns of the *Mean* row are the values tested statistically (highlighted in yellow in the screen shot above).

Near the bottom of the analysis report the F-value calculated for this analysis is 5.51. The probability of this F-value is 0.0161. When the probability of the F-value (*Prob*) is less than the *Alpha* value (which you set in **3.1**: .05) it indicates the F-test is significant and there likely are statistically significant differences in the attribute means. When the F-test is significant, FFI uses the Dunnett's comparison to identify which means are significantly different. These comparisons are at the bottom of the report. In the example, the mean MLCBH for PreTreatment1 (24.9 ft) is tested against ReMeasurement1 (35.3 ft) and then the mean MLCBH for PreTreatment1 (24.9 ft) is tested against ReMeasurement2 (37.1 ft). The attribute means are considered significantly different if the p-value for the Dunnett's procedure is less than the significance level you choose (usually 0.01 or 0.05).

***Question 6*)** Was there any significant difference in Live Crown Base Height one year after the fire treatment at the 0.05 significance level?

3.3 **Close** the report
Biomass of Fine Woody Debris (FWD)

3.4 If not already selected, click on the **Analysis Settings** tab on the right.
Select: *Statistical Analysis*, *Parametric*, Alpha=*0.05*, Precision=*1.0*, Summary Report = *Surface Fuels*, Report Attribute = *1-100 hr*



3.5 Click **Analysis** > **View report**

One-Way Analysis of Variance

Project Unit_____Dylan Creek Rx
Summary Report_____Surface Fuels
Report Attribute_____1-100-hr
Units_____Tons per Acre

Strata: All Plots

	PreTreatmentYear1	ReMeasurementYear1			ReMeasurementYear2		
Plot	Attr	Attr	Diff	%Diff	Attr	Diff	%Diff
DylanCkRx01	14.2	6.0	-8.2	-57.6	8.2	-6.1	-42.6
DylanCkRx03	2.4	1.4	-1.0	-42.7	1.5	-0.8	-34.4
DylanCkRx04	8.1	1.4	-6.8	-83.0	2.2	-5.9	-72.6
DylanCkRx05	4.0	2.0	-1.9	-49.2	2.9	-1.1	-27.1
DylanCkRx06	3.8	1.4	-2.4	-63.2	1.6	-2.2	-58.4
DylanCkRx08	5.5	2.2	-3.2	-59.0	3.5	-2.0	-36.1
Mean	6.3	2.4	-3.9	-62.0	3.3	-3.0	-47.6
SDev	4.3	1.8			2.5		
N	6.0	6.0			6.0		
CI-Lower	1.8	0.5			0.7		
CI-Upper	10.9	4.3			5.9		

Dunnett's multiple comparison test

F-Value = 2.67 Prob = 0.1016 Alpha =.05 (Settings Dialog Box)

Question 7: Did the treatment meet the objective of reducing FWD (1-100hr) biomass one year after the prescribed fire?

3.6 **Close** the report.

Exercise 4: Use the Analysis Reports to view species specific reports

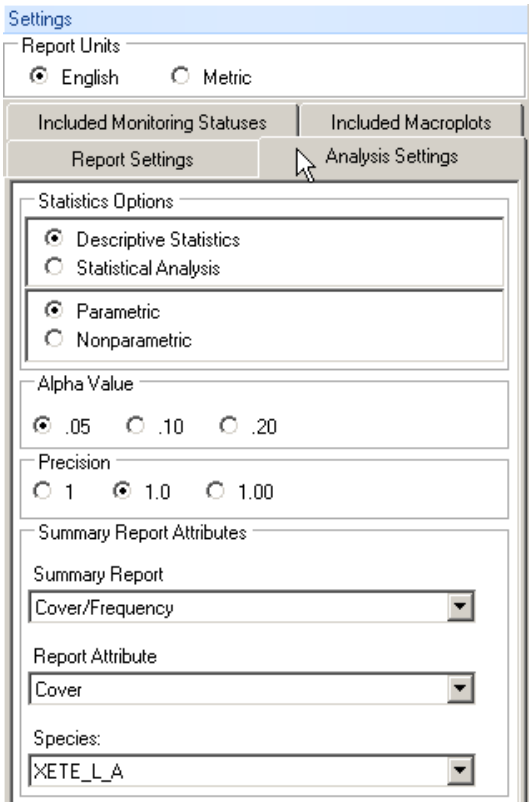
Cover of beargrass (XETE)

4.1 On the **Report Settings** tab uncheck *Trees* and check *Cover/Frequency*, stratify by *UV2* and click **Report** > **View Report** to view the Cover/Frequency summary.

You'll see it is difficult to compare the cover of XETE across monitoring visits because of all the species in the Cover/Frequency Report. By using the Analysis Reports you can view average cover for individual species more easily.

4.2 **Close** the report.

4.3 Click the **Analysis Settings** tab.
Select: *Descriptive statistics*, *Parametric*, Precision = *1.0*
Select Summary Report = *Cover/Frequency*, Report Attribute = *Cover*, Species = *XETE_L_A* (L=live and A=aerial cover). (When using descriptive statistics Alpha value is not used.)



4.4 Click **Analysis** > **View report**

Descriptive Statistics - Parametric

Project Unit_____Dylan Creek Rx
Summary Report_____Cover/Frequency
Report Attribute_____Cover
Units_____Percent
Species_____XETE_L_A

	PreTreatmentYear1	ReMeasurementYear1			ReMeasurementYear2		
Plot	Attr	Attr	Diff	%Diff	Attr	Diff	%Diff
DylanCkRx01	10.8	4.4	-6.4	-59.3	7.3	-3.5	-32.2
DylanCkRx03	1.2	0.0	-1.2	-100.0	0.8	-0.4	-33.3
DylanCkRx04	20.8	1.6	-19.2	-92.3	17.2	-3.6	-17.3
DylanCkRx05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DylanCkRx06	5.2	3.6	-1.6	-30.8	5.6	0.4	7.7
DylanCkRx08	1.6	0.0	-1.6	-100.0	0.0	-1.6	-100.0
Mean	6.6	1.6	-5.0	-75.8	5.2	-1.4	-21.9
SDev	8.0	2.0			6.7		
N	6.0	6.0			6.0		
CI-Lower	-1.8	-0.5			-1.8		
CI-Upper	15.0	3.7			12.1		

The report header shows that the percent cover of XETE_L_A is the attribute being reported.

NOTE: If the cover or frequency of a species or item is collected with a protocol at one sample event then the FFI analysis assumes zero cover and/or frequency for all other sample events where the species or item was not observed using the same protocol. In this example, live XETE was not observed at any sample event for plot DylanCkRx05 but it was observed on other plots and sample events so 0% cover is included in the calculation of average cover and standard deviation.

Question 8: Was the objective of maintaining XETE cover by the second remeasurement successful?

Question 9: Is there enough data to get statistical inference of XETE cover using the FFI analysis tools?

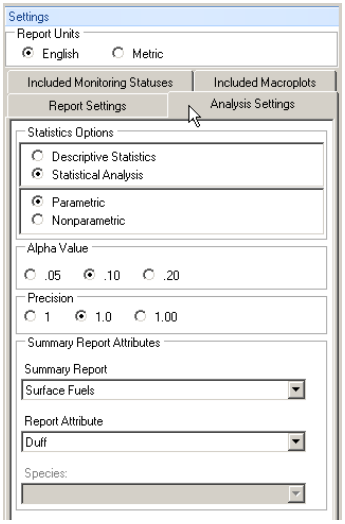
4.5 **Close** the report.

Exercise 5: Use the Confidence Intervals (CI) in lieu of One-sample t-tests

In some cases, a treatment will be applied in the hope an attribute will meet some target value. The FFI confidence intervals in the analysis reports can be used to make these inferences.

Biomass of Duff

5.1 If not already selected, click on the **Analysis Settings** tab.
Select: *Statistical Analysis*, *Parametric*, Alpha = *0.10*, Precision = *1.0,*
Summary Report = *Surface Fuels*, Report Attribute = *Duff*.



5.2 Click **Analysis** > **View Report**

One-Way Analysis of Variance

Project Unit_____Dylan Creek Rx
Summary Report_____Surface Fuels
Report Attribute_____Duff
Units_____Tons per Acre

Strata: All Plots

	PreTreatmentYear1	ReMeasurementYear1			ReMeasurementYear2		
Plot	Attr	Attr	Diff	%Diff	Attr	Diff	%Diff
DylanCkRx01	20.0	12.5	-7.5	-37.5	12.7	-7.2	-36.3
DylanCkRx03	8.5	6.9	-1.5	-18.2	7.9	-0.6	-7.4
DylanCkRx04	20.0	14.7	-5.2	-26.3	15.2	-4.7	-23.8
DylanCkRx05	11.5	10.9	-0.6	-5.4	10.8	-0.7	-6.3
DylanCkRx06	11.1	9.3	-1.8	-15.9	9.7	-1.4	-12.4
DylanCkRx08	18.4	8.6	-9.8	-53.3	11.7	-6.7	-36.5
Mean	14.9	10.5	-4.4	-29.6	11.3	-3.6	-24.0
SDev	5.1	2.8			2.5		
N	6.0	6.0			6.0		
CI-Lower	10.7	8.2			9.2		
CI-Upper	19.1	12.8			13.4		

One-Way ANOVA

F-Value = 2.44 Prob = 0.1210 Alpha =.10 (Settings Dialog Box)

The FFI analysis report includes two confidence interval values for each sample event: CI-Upper and CI-Lower. For any particular monitoring status, when a target value is greater than CI-Lower and less than CI-Upper it can be interpreted that the population mean is equal to the target value with a level of significance equal to 1-alpha*. For example, at the ReMeasurementYear2 visit, the target of 11 tons/acre of duff was met at the 0.10 significance level because that value lies within the 90% confidence interval - it is greater than 9.2 (CI-Lower) and less than 13.4 (CI-Upper).

Question 10: Did the treatment meet the objective of maintaining 11.0 tons/per acre of duff at ReMeasurementYear1?

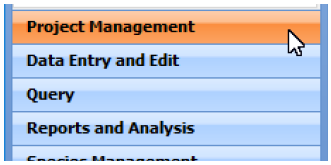
**The technical definition of a confidence interval states: if a large number of samples were taken and confidence intervals were constructed for each then theoretically about 90% of the intervals would include the population mean.*

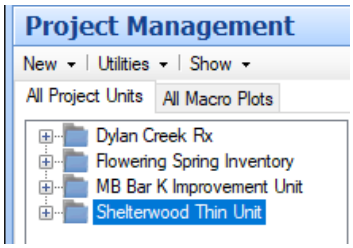
NOTE: Sometimes the target values used in objectives are a percentage of the mean of a sampled attribute. For example, an objective might be to maintain at least 75% of the pretreatment mean duff load. Using the data from the six plots in the exercise the the objective would be to maintain 14.9 X .75 = ***11.2*** *tons/acre of duff. However, the pretreatment mean of the six plots has its own variability as seen in the standard deviation and confidence levels. Further statistical testing will help when making statistical assessments using a percentage of an attribute mean but, for most monitoring, it is likely sufficient to calculate the target based on the mean then assess the significance of the change keeping in mind the uncertainty of the pretreatment mean.*

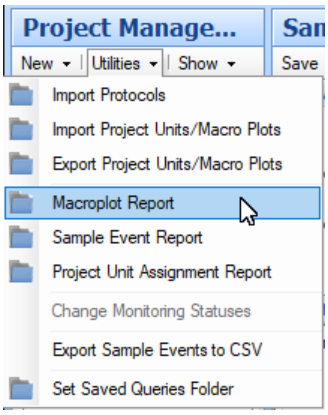
Exercise 6: Create a Macro Plot CSV report.

There are times when it is helpful to be able to view a report that includes all the data entered on the **Macro Plot** screen in **Project Management** for all macro plots in the currently selected Administrative Unit. Among other things, this report is often used to see what monitoring statuses are assigned to sample events, location information (UTM or lat-long) or what values are assigned to the stratification user variables.

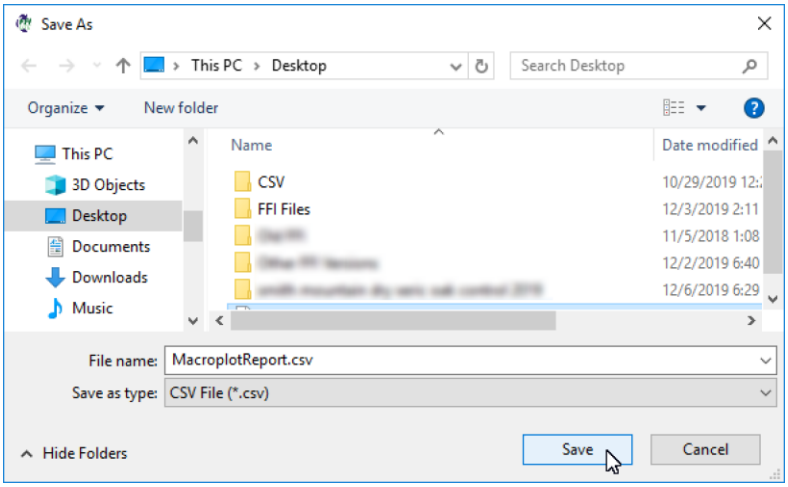
6.1 Click on **Project Management** at the lower left of the FFI window and select **Utilities>Macroplot Report**.



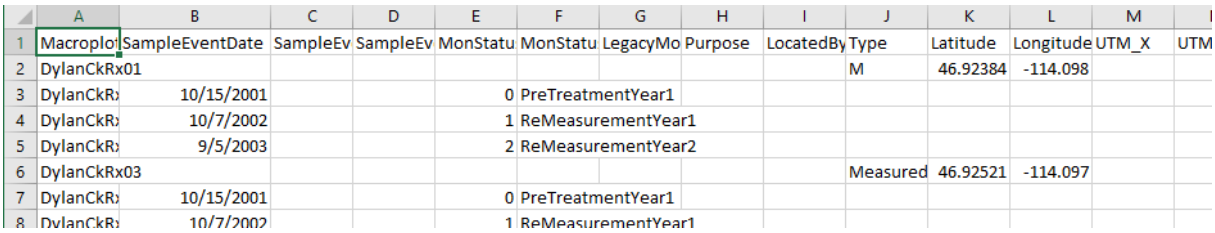




6.2 The file will be saved as *MacroplotReport.csv* by default. You can change the file name if needed. For this exercise save the CSV file to your Desktop. Click **Save**.

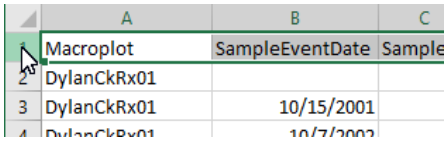


6.3 Click the *MacroplotReport.csv* icon on your desktop to open it (typically it will open in Excel). The sheet will have a row for the information entered on the Macro Plot page in **Project Management** followed by rows showing each sample event and associated monitoring status information. Some fields have been hidden in the screenshot below.

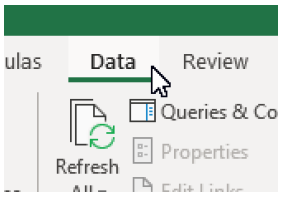


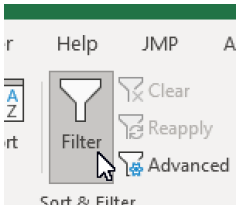
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Macroplot	SampleEventDate	SampleEv	SampleEv	MonStatu	MonStatu	LegacyMo	Purpose	LocatedBy	Type	Latitude	Longitude	UTM_X
2	DylanCkRx01									M	46.92384	-114.098	
3	DylanCkRx	10/15/2001			0	PreTreatmentYear1							
4	DylanCkRx	10/7/2002			1	ReMeasurementYear1							
5	DylanCkRx	9/5/2003			2	ReMeasurementYear2							
6	DylanCkRx03									Measured	46.92521	-114.097	
7	DylanCkRx	10/15/2001			0	PreTreatmentYear1							
8	DylanCkRx	10/7/2002			1	ReMeasurementYear1							

6.4 Take advantage of Excel's features, especially the Filter feature, to view the data you need to see. Click the gray area for row "1" on the left side of the Excel data grid to highlight the entire row. Then select **Data** in the Excel menu bar and click **Filter.**

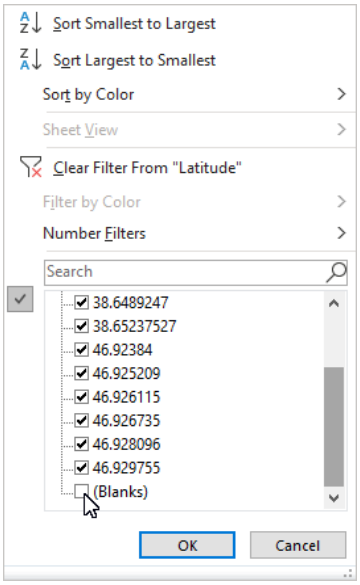


	A	B	C
1	Macroplot	SampleEventDate	Sample
2	DylanCkRx01		
3	DylanCkRx01	10/15/2001	





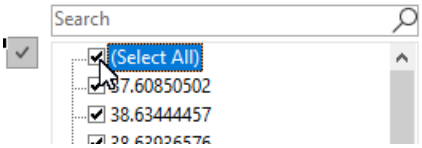
6.5 The **Filte**r feature adds a dropdown option for each column. Use the checkbox(es) to hide or view the information you want to see. For this example, to see all the plots that have a *Latitude* value entered, click the dropdown for *Latitude*, uncheck the box for *(Blanks)* and click **OK**.



6.6 All the sample events with a Latitude value are displayed in the grid.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Macroplot	Sam	Sa	Sar	Mc	Mor	Lega	Pur	Loc	Type	Latitude	Longitu	UTM_
2	DylanCkRx01									M	46.92384	-114.098	
6	DylanCkRx03									Measured	46.925209	-114.097	
10	DylanCkRx04									M	46.926735	-114.098	
14	DylanCkRx05									M	46.928096	-114.1	
18	DylanCkRx06									M	46.926115	-114.101	
22	DylanCkRx08									M	46.929755	-114.099	
26	FSJ077									M	37.608505	112.849	

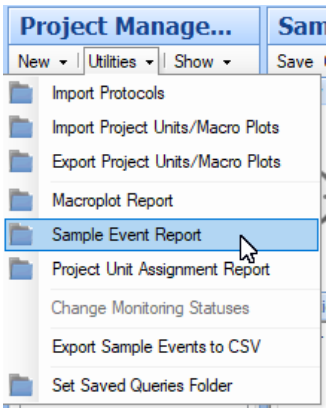
To filter different fields, first undo the current selection by clicking the box for *(Select All)* in the Filter dropdown for the Latitude column.



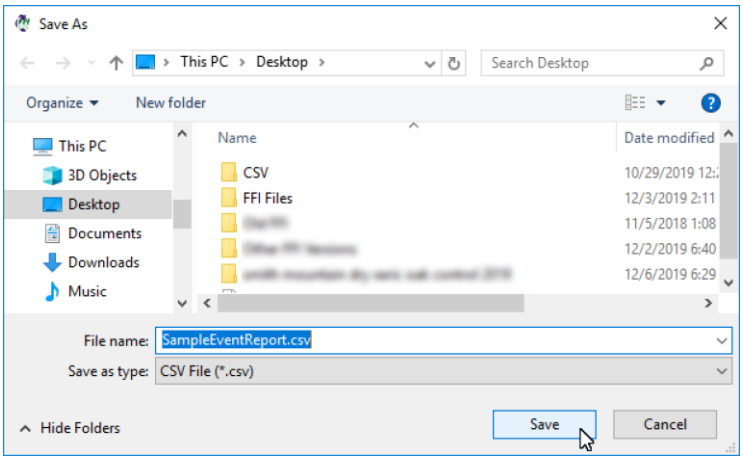
When working with real data, if you want to save the view you have created, you will need to save the file as an Excel spreadsheet (XLSX file). For this exercise there is no need to save the file you've just created. Click the *X* at the upper right of Excel to close Excel.

Exercise 7: Create a Sample Event CSV Report

7.1 The **Sample Event Report** provides a list of protocols assigned to each sample event in the currently selected Administrative Unit. This report is often used to review whether data has been entered in protocols (i.e., check if *Visited* = *Y* for protocols). To create a Macro Plot report, click the **Project Management** navigation bar and the select **Utilities>Sample Event Report**.



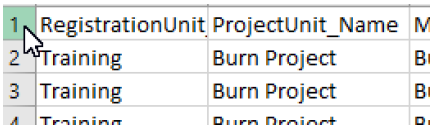
7.2 The file will be saved as *SampleEventReport.csv* by default. You can change the file name if needed. For this exercise save the CSV file to your Desktop. Click **Save**.

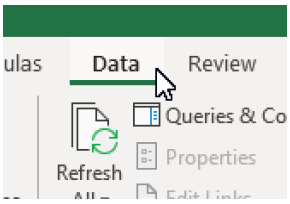


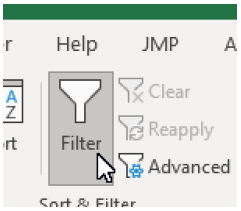
7.3 Click the *SampleEventReport.csv* icon on your desktop to open it. The sheet will have a row for each protocol assigned to each sample event.

	RegistrationUnit	ProjectUnit_Name	MacroPlot_Name	Multi_PU	SampleEvent_Date	MonitoringStatu	Protocols	Visited
2	Training	Burn Project	BurnPlot001	Y	12/4/2019 9:56	PreBurn	Surface Fuels	Y
3	Training	Burn Project	BurnPlot001	Y	12/4/2019 9:56	PreBurn	Surface Fuels - Piles	Y
4	Training	Burn Project	BurnPlot001	Y	12/4/2019 9:56	PreBurn	Surface Fuels - Vegetation	Y
5	Training	Burn Project	BurnPlot001	Y	12/4/2019 9:56	PreBurn	Biomass - Fuels	Y
6	Training	Burn Project	BurnPlot002	Y	12/4/2019 9:56	PreBurn	Rare Plant Species	Y

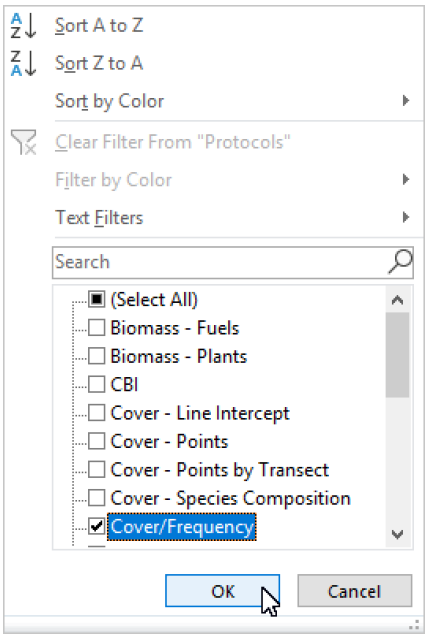
7.4 Use the Excel Filter feature to see if the data has been entered for all instances of the *Cover/Frequency* protocol in the Administrative Unit: click the gray area for row "1" to highlight the entire row, select **Data** in the Excel menu bar and click **Filter.**







7.5 Click the dropdown for *Protocols*, click the check in the (*Select All)* box to uncheck all boxes and then click the box for *Cover/Frequency* to check it. Click **OK**.



7.6 All the sample events assigned the *Cover/Frequency* protocol are displayed on the sheet – one row for each project unit the macro plot was assigned to. *Visited = Y* for all sample events so at least some data has been entered in the protocol for all sample events.

NOTE: When protocols are copied from a previous visit all the header data like Plot Area and Number of Transects (the sample attributes) get copied to the new sample event, which will set Visited to Y even though no data records (method attributes) have been entered.

	A	B	C	D	E	F	G	H	I
1	Registra	Proje	MacroPlot_Nam	Multi_F	SampleEver	SampleE	MonitoringStatus_Nam	Protocols	Visite
12	Seb Woods	Dylan C	DylanCkRx01	N	10/15/2001		PreTreatmentYear1	Cover/Frequency	Y
27	Seb Woods	Dylan C	DylanCkRx01	N	10/7/2002		ReMeasurementYear1	Cover/Frequency	Y
40	Seb Woods	Dylan C	DylanCkRx01	N	9/5/2003		ReMeasurementYear2	Cover/Frequency	Y
50	Seb Woods	Dylan C	DylanCkRx03	N	10/15/2001		PreTreatmentYear1	Cover/Frequency	Y
61	Seb Woods	Dylan C	DylanCkRx03	N	10/7/2002		ReMeasurementYear1	Cover/Frequency	Y

7.7 Experiment with filtering the Sample Event Report. For example, use filtering to show all the plots assigned to the *Shelterwood Thin Unit*. When done, click the *X* at the upper right of Excel to close Excel.

More information about the statistical tests in FFI and testing re-sampled macro plots

The statistical tests In FFI assume macro plots are randomly distributed in the treatment at *every* sampling visit but in most cases, monitoring is done with plots permanently established at the first sampling visit, then crews return to the same locations for re-sampling. When re-sampling permanently established plots the samples are not independent (an assumption of the statistical test used in FFI) so a paired t-test is a more powerful test because it takes advantage of data dependence to aid in determining significance. When means are tested with the F-Test and Dunnett's Comparison Procedure in FFI the tests will be more conservative than when using the paired test (i.e., less prone to find a significant difference when there really is one).

We can demonstrate using the Training Dataset. The tests use the 1-100 hour Surface Fuels and compare the F-Test results from FFI (the same data we used in Exercise **3.5**) with a paired t-test from a statistics package.

F-Test Results from FFI:

This test compares the means at the pretreatment visit (P1) and first remeasurement (R1) to see if they are equal.

H_0: P1 = R1
H_1: P1 <> R1
If *p(F)* > alpha, then no evidence that P1<>R1
0.1016 > 0.05; indicating the biomass of 1-100 hour fuel load is not significantly different between PretreatmentYear1 and RemeasurementYear1. Conclusion: Fail to reject Ho at the 95% significance level.

Project Unit_____FOREST
Summary Report_____Surface Fuels
Report Attribute_____1-100-hr
Units_____Tons per Acre

Plot	PreTreatmentYear1 Attr	ReMeasurementYear1 Attr	Diff
TESTFOREST1	14.2	6.0	-8.2
TESTFOREST3	2.4	1.4	-1.0
TESTFOREST4	8.1	1.4	-6.8
TESTFOREST5	4.0	2.0	-1.9
TESTFOREST6	3.8	1.4	-2.4
TESTFOREST8	5.5	2.2	-3.2
Mean	6.3	2.4	-3.9

F-Value = 2.67 Prob = **0.1016** Alpha **= 0.05** (Settings Dialog Box)

Paired t-Test Results from JMP

This test is used to see if the difference of the means at the pretreatment visit (P1) and first remeasurement (R1) is equal to 0.

H_0: P1 – R1= 0
H_1: P1 – R1 <> 0
If *p(t)* < alpha, then there is evidence that P1 – R1 <> 0
0.0200 < 0.05 indicating the difference of 1-100 hour fuel between PretreatmentYear1 and RemeasurementYear1 is significantly different than 0. Because the mean is negative, we can assume there is a significant reduction in 1-100 hour fuels after treatment. Conclusion: Reject Ho at the 95% significance level. Another way to consider the result is: there is a 2% (i.e. *p(t)* * 100) chance of finding as large or larger difference given that the null hypothesis is true.

	PreTreatmentYear1	ReMeasurementYear1	
Plot	Attr	Attr	Diff
TESTFOREST1	14.2	6.0	-8.2
TESTFOREST3	2.4	1.4	-1.0
TESTFOREST4	8.1	1.4	-6.8
TESTFOREST5	4.0	2.0	-1.9
TESTFOREST6	3.8	1.4	-2.4
TESTFOREST8	5.5	2.2	-3.2
Mean			-3.9

t-Value = 3.37 Prob = **0.0200** Alpha = **0.05**

No significant difference was noted in the Dunnett's test used by FFI but there was a difference noted when using the paired t-test. When using a pared t-test and comparing more than two pairs of data a Bonferroni Adjustment may be made to guard against Type I error.

Reports and Analysis Exercise Answers

1) Did the treatment appear to be successful in the objective of killing less than 10% of the total number of *Individual Trees* one year after the fire?

No. There were 48.5 trees when sampled before the treatment so 10% would be about 5 trees per acre (TPA), thus the density of the mature trees should remain more than 43.5 TPA. At both remeasurement periods the tree density was lower than that: 38.5 and 33.5 TPA, respectively.

2) Looking at this report can you tell how many seedlings the fire killed?

No. The report lists only the total (live and dead combined) seedling and sapling density. However, the Trees – Seedlings, Saplings *report shows live and dead seedling and sapling density.*

3) Two years after the fire, was mortality (trees per acre) of *Individual Trees* greater on plots with North Aspects or South Aspects?

North. The tree density of Individual Trees *decreased from 50.2 to 30.1 or 20.1 trees per acre (40%) on the northerly aspect plots and decreased from 46.8 to 43.5 or 10 trees per acre (21%) on the southerly aspect plots.*

4) When looking at the two aspects individually, did the prescribed fire treatment meet the tree mortality objective in Question 1: Kill less than 10% of overstory trees at the <u>first</u> remeasurement?

Yes, on the plots with southerly aspects Individual Tree *density decreased 3.3/46.8*100=7%. Note that by the second remeasurement the density of* Individual Trees *on the southerly aspect plots decreased by 10 trees per acre or 17%, which might make one consider not using the first remeasurement when it is important to account for delayed mortality. Mortality of* Individual Trees *on the northerly aspect plots was 33% at the first remeasurement.*

5) By the second remeasurement, what two species listed under *Individual Trees* had the smallest decrease in tree density and what two species had the greatest decrease in tree density?

There was no mortality of western larch (LAOC) and only 1.7 TPA reduction in ponderosa pine (PIPO) so those two species had the least mortality. Measured in absolute terms, the two species with greatest mortality were Douglas-fir (PSME) and lodgepole pine (PICO): 8.4 TPA killed (39%) and 3.3 TPA (66%), respectively. By percentage, the two species with greatest mortality were PICO and subalpine fir (ABLA): PICO 66% and ABLA 100%.

6) Was there any significant difference in Live Crown Base Height after the fire treatment at the 0.05 significance level?

Yes. The probability of the F-value is less than the alpha value (0.0161 vs. 0.05). The Dunnett's comparison then notes a significant increase in LCBH at both remeasurements. Pretreatment1 vs. Remeasurement1 the LCBH increased from 24.9 feet to 35.3 feet (prob <0.01) and Pretreatment1 vs. Remeasurement2 the LCBH increased from 24.9 feet to 37.1 feet (prob <0.01).

7) Did the treatment meet the general goal of reducing FWD (1-100hr) biomass one year after the prescribed fire?

No. The probability of the F-value is greater than the alpha value (0.1016 vs. 0.05). Note that the FWD load on the sample plots was reduced by more than half at the first remeasurement but the variability of the data was so high that there was little certainty the reduction wasn't sampled by chance. This is often a problem with biological data in general and small samples in particular. If

considering practical vs. statistically significant differences, a fire manager may say reduction by more than half is good enough – especially if a walk through confirms the same general consumption across the unit that was seen on the sampled plots; however, a statistician would say there is no significant reduction on FWD looking at the results of this test. Note the FWD load on DylanCrRx01 is substantially higher than the other plots, which increases the variability of the sample. An important question is why is the FWD load on that plot higher? If it is because of some unusual situation – maybe branches fell from a tree, locally increasing the FWD loading – there may be a reason to remove the sample plot from the analysis and try the test again. Removing plots is not something that should be done carelessly because: 1) the data may be a valid sample (even if the values are inconvenient) and 2) removing a sample changes the degrees of freedom used to make a test, which, other things remaining constant, makes finding significant differences less likely. If DylanCrRx01 is removed from the analysis and another test is made with alpha = 0.5, the reduction in FWD is significant.

8) Was the general goal of maintaining XETE cover successful by the second remeasurement?

Yes. Live beargrass (XETE) cover was 6.6% pretreatment and 5.2% at the second remeasurement. Cover is difficult to sample, and most samplers are happy to be within ±10% of the actual cover when sampling in the field. The objective was assessed using descriptive statistics' rather than 'statistical analysis' because the ±10% precision of the cover estimates is relatively broad. However, a statistical test can still be done – try it and see if your answer is the same after doing a statistical test.

9) Is there enough data to get statistical inference of XETE cover using the FFI analysis tools?

Yes. FFI needs at least four macro plots with the attribute of interest sampled at every sample event in order to provide statistical analysis. If a statistical test that does not meet these qualifications is attempted in FFI the report will show the descriptive statistics and a note will be added to the report indicating that statistical analysis could not be completed because of insufficient data. In the training dataset there are six macro plots with XETE cover sampled at each sample event. Note that sampling 0% cover is a valid sample and not the same as not sampling for cover at all. FFI uses the "Visited" field on the protocol to see if sampling for that protocol was attempted. If Visited = Yes and a species was not encountered on one plot but was encountered on another plot included on the report then FFI assumes cover was zero on the plot where it was not encountered. For example, no XETE cover data was entered on DylanCkRx001 *or* DylanCkRx003 *but it was sampled on the other plots so cover for the two plots was assumed to be 0%.*

10) Was the general goal of maintaining 11.0 tons/per acre of duff after the fire treatment met at the time of the second remeasurement?

Yes. When testing to see if a target was met you can use the limits of the confidence interval. In the FFI report the duff load at the second remeasurement was 11.3 tons per acre so the questions is, is that statistically the same as 11.0 tons/ per acre. Because target value (11.0) is between the upper and lower limits of the confidence interval (13.4 and 9.2, respectively) the goal was achieved. This same approach could be used to answer Question 1 where the target value is 48.5 – 4.85 = 43.6 TPA.