SWM SUSTAINABLE WILDLIFE MANAGEMENT PROGRAMME

Preparing a sample design for point transects with DISTANCE 7.3 and GIS software

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KEY WORDS

Distance sampling, point transects, camera trapping, methodology, density, wildlife abundance, terrestrial species

SUSTAINABLE WILDLIFE MANAGEMENT PROGRAMME (SWM)

Millions of people depend on wild meat for food and income. Wild meat is an important source of protein, fat and micronutrients, particularly for indigenous peoples and rural communities in tropical and subtropical regions of Latin America, Africa, and Asia. The demand for wild meat is growing, especially in urban areas. If hunting for wild meat is not managed at sustainable levels, then wildlife populations will decline and rural communities will suffer increased food insecurity. Recent studies have shown that overhunting for food is now threatening hundreds of wildlife species with extinction.

Between 2018 and 2024, the Sustainable Wildlife Management (SWM) Programme will improve the conservation and sustainable use of wildlife in forest, savannah, and wetland environments. Field projects are being implemented in 13 countries and aim to:

- improve how wildlife hunting is regulated
- increase the supply of sustainably produced meat products and farmed fish
- strengthen the management capacities of indigenous and rural communities
- and reduce demand for wild meat, particularly in towns and cities

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For further information: www.swm-programme.info

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ABSTRACT

Distance sampling at point transects has long been used to estimate animal density, particularly in rugged terrain and frequently of birds across the world. The point transect method relies on a human observer recording the distances to all birds seen around each of a series of points during a specified time interval. The point transects are ideally arranged systematically with a random starting point across the area of interest. Once the data have been collected the Distance software is used to estimate density and abundance cross the area of interest.

Since 2017, camera traps have been used in a similar way, with important differences as follows:

- cameras are active 24 hours a day, so the number of observations (photographs of animals passing in front of the lens) per unit time, is much higher than when an observer spends a limited amount of time at each point;
- observations are available for both day and night time;
- cameras are less likely, if well managed, to attract the attention of wildlife, or to be avoided by wildlife, than a human observer, thus fulfilling one of the key assumptions of Distance sampling (animals should not move in response to the "observer");
- cameras do not have a 360-degree vision angle, so this must be take into account when estimating animal density;
- animals are not "available" 24 hours a day – some are semi-arboreal, many are either diurnal or nocturnal, and so this must also be taken into account during the analysis.

This document, which is available in both English and French versions, outlines the steps to take when designing a survey for point transects that use camera traps. The number of points and the length of time that they are deployed will depend on the effort required for a target coefficient of variation (CV), and on the number of cameras available. It is advised that at least 50 points are set per survey stratum. For example, if 1,000 trap-days are required for estimation of density of a given species, that can be 1,000 camera traps for one 24-hour period, or 100 camera traps for ten 24-hour periods, or 50 camera traps for twenty 24-hour periods. In this document, we assume that we have 50 camera traps, and an area within which we will set the traps. We describe how to design the survey so that the 50 cameras are placed systematically, with a random start, using a combination of GIS and the Distance software. The results are a shapefile of the locations of the points, and a set of x and y coordinates (in excel format) that can be uploaded to a GPS and /or SMART.

CONTENTS

1. PREAMBLE

This document shows how to design a sampling plan for point transects. Point transects are often used in rugged terrain or to estimate bird density, with each point being visited by an observer who records birds from that point during a short set time interval. Since 2017, they have also been used to estimate the density of terrestrial animals of all kinds, where a camera trap replaces the human observer.

The basis of a point transect sampling design is that all points are located within a predefined study area. This area can be subdivided into one or more strata. The most practical way to place cameras is to use the survey design feature of the Distance software to generate a design with geographical coordinates associated with each point transects. We describe here how to do this, using a real example.

With GIS software and the Distance software, it is now easy to make a sampling plan. Simply project the boundaries of the study area in UTM, and import the file to Distance.

2. PREPARATION OF SHAPEFILES USING GIS SOFTWARE

Use a GIS manual, such as the ArcGIS 10.4 user guide, or the QGIS user guide, for information on how to prepare stratum boundaries for a study area. In this version of the Guide we have used ArcGIS but we can also prepare a QGIS one for people familiar with that tool (which is available free online).

2.1 Projection in UTM

If your shapefile is projected in decimal degrees, you need to convert it to a UTM projection.

Click on the « Arc Toolbox », icon, and select « Data Management Tools » and then « Projections and Transformations » and then « Project ». With this tool you can create a new shapefile with the UTM projection appropriate to your area.
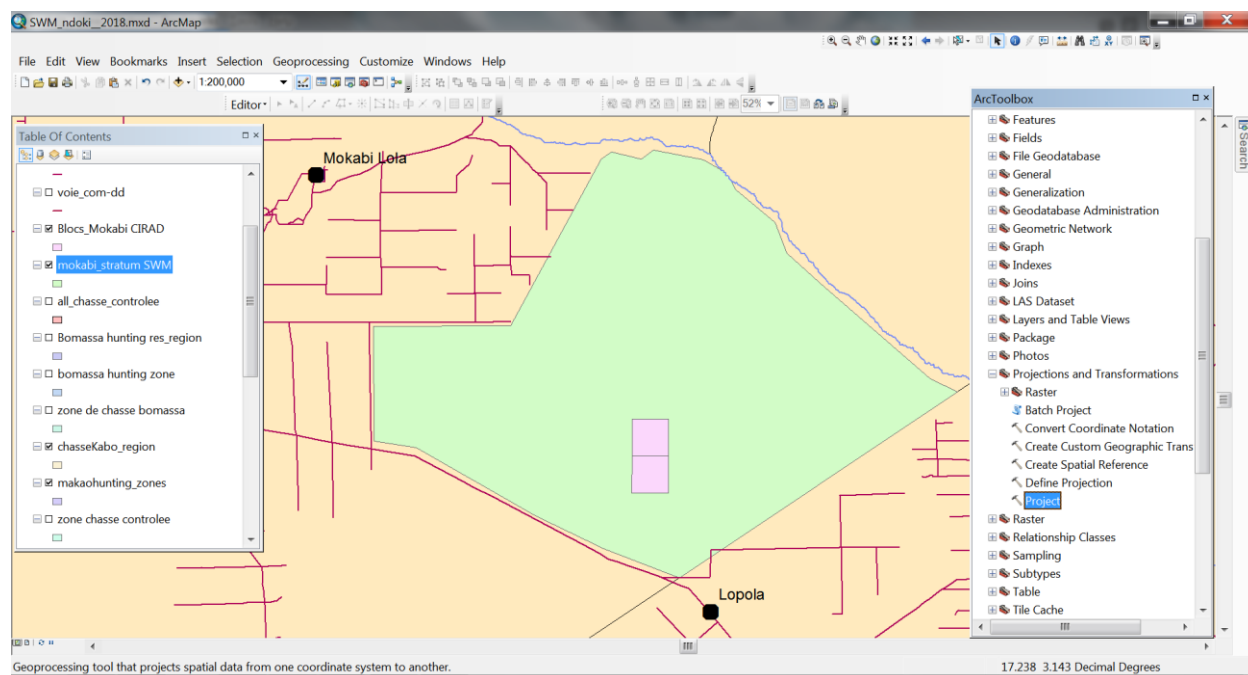
Drag and drop the layer that you want to reproject into the first field of the dialog box that opens "**Input Dataset**". In the second field, navigate to where you want the resulting shapefile to be created, and give it the same name as the original file, except ending the file with the appropriate projection (in this example, mokabi_stratum_SWM_UTM33N.shp). In the third field of the dialog box, choose the projection

that you need: in this case, an area in the north of the Republic of Congo, it's WGS 1984 UTM Zone 33N. Click OK to convert the file.
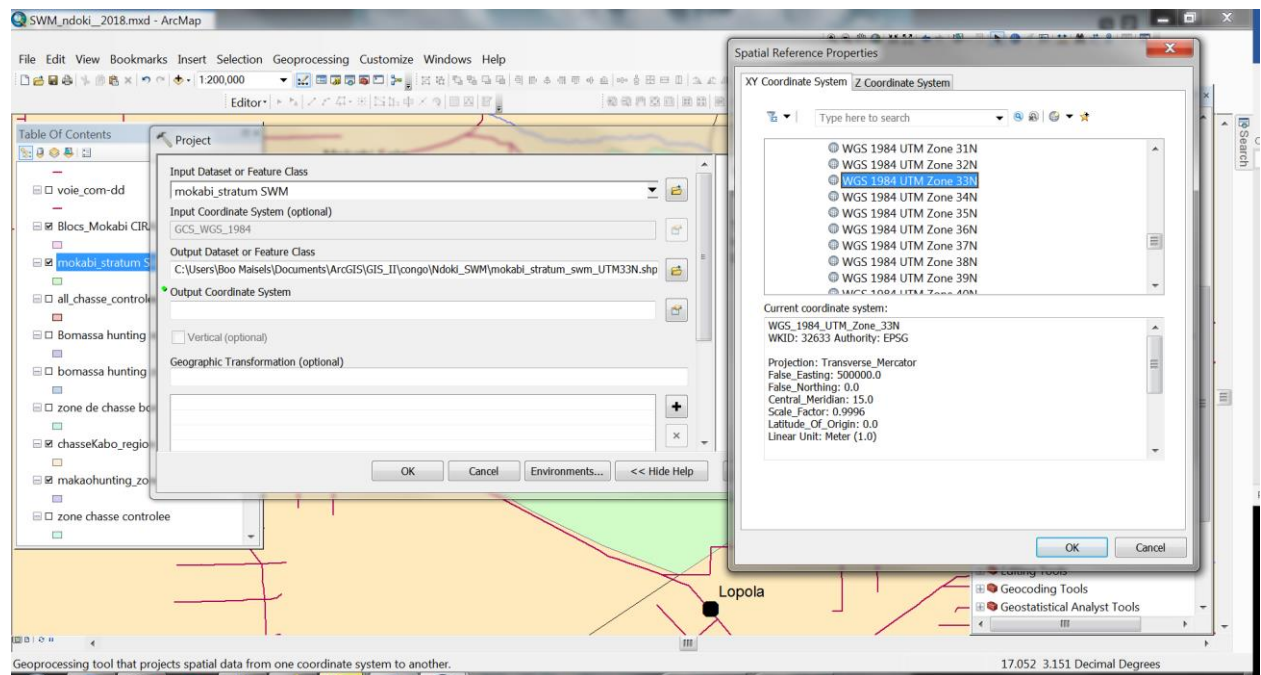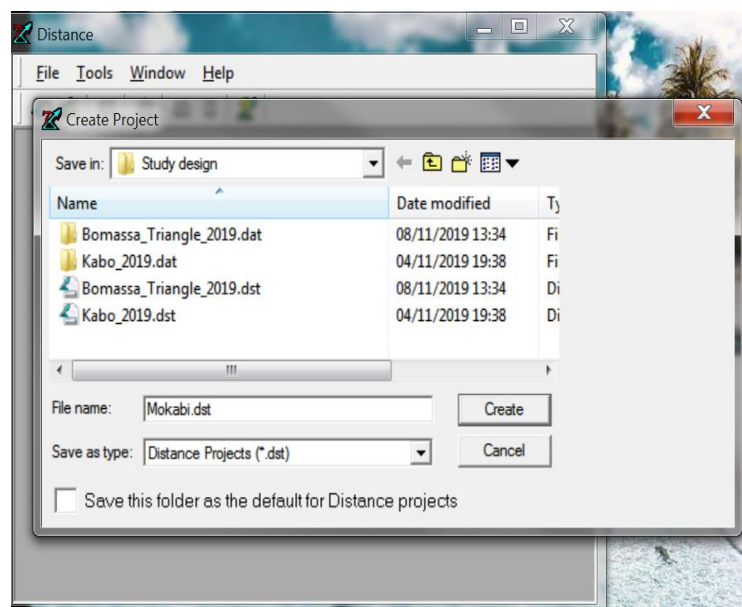

3. CREATING A SURVEY DESIGN IN DISTANCE 7.3

3.1 Creating a new project

Make sure you have the most recent version of Distance. It is available, free of charge, here:
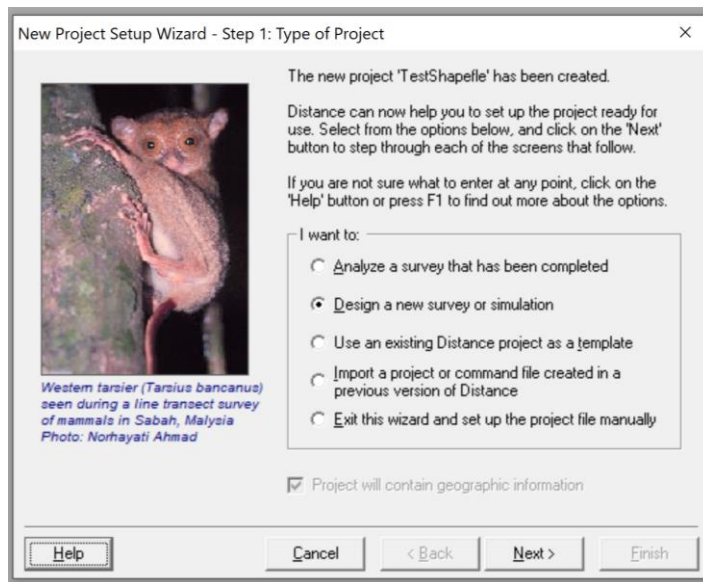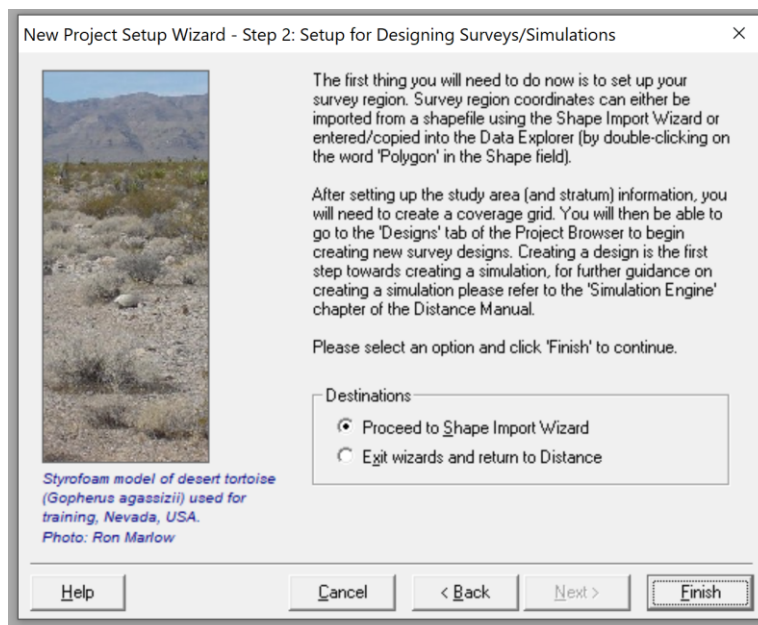
http://distancesampling.org/Distance/index.html

Install the software, then open it.

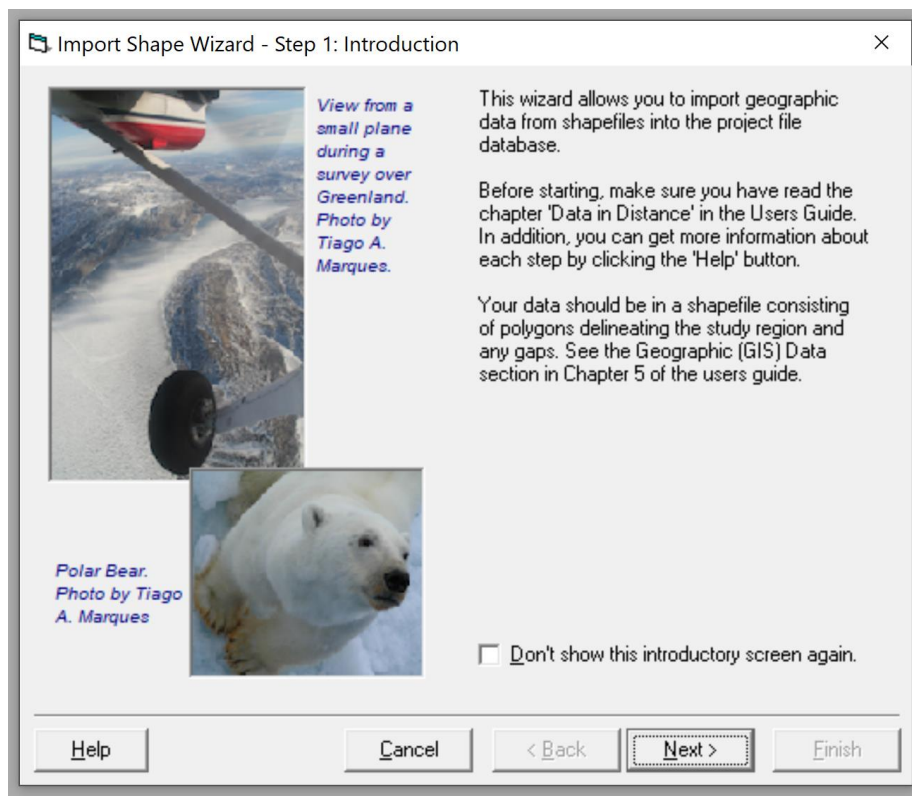Create a new project in the correct folder (where your design will be stored in Windows Explorer).

Select "Design a new survey or simulation"…Next…

New Project Setup Wizard - Step 1: Type of Project

The new project 'TestShapefle' has been created.

Distance can now help you to set up the project ready for use. Select from the options below, and click on the 'Next' button to step through each of the screens that follow.

If you are not sure what to enter at any point, click on the 'Help' button or press F1 to find out more about the options.

I want to:

○ Analyze a survey that has been completed

● Design a new survey or simulation

○ Use an existing Distance project as a template

○ Import a project or command file created in a previous version of Distance

○ Exit this wizard and set up the project file manually

☑ Project will contain geographic information

Western tarsier (Tarsius bancanus) seen during a line transect survey of mammals in Sabah, Malaysia Photo: Norhayati Ahmad

You get a screen of information, read it and then ensure that the "Proceed to Shape Import Wizard" is selected before clicking on "Finish" …

New Project Setup Wizard - Step 2: Setup for Designing Surveys/Simulations

The first thing you will need to do now is to set up your survey region. Survey region coordinates can either be imported from a shapefile using the Shape Import Wizard or entered/copied into the Data Explorer (by double-clicking on the word 'Polygon' in the Shape field).

After setting up the study area (and stratum) information, you will need to create a coverage grid. You will then be able to go to the 'Designs' tab of the Project Browser to begin creating new survey designs. Creating a design is the first step towards creating a simulation, for further guidance on creating a simulation please refer to the 'Simulation Engine' chapter of the Distance Manual.

Please select an option and click 'Finish' to continue.

Destinations

● Proceed to Shape Import Wizard

○ Exit wizards and return to Distance

Styrofoam model of desert tortoise (Gopherus agassizii) used for training, Nevada, USA. Photo: Ron Marlow

The first time you do this you will see an introductory screen with information about importing a shapefile into Distance.

Now the software asks you to import the study area. Navigate to where you stored it, and click on the appropriate shapefile.
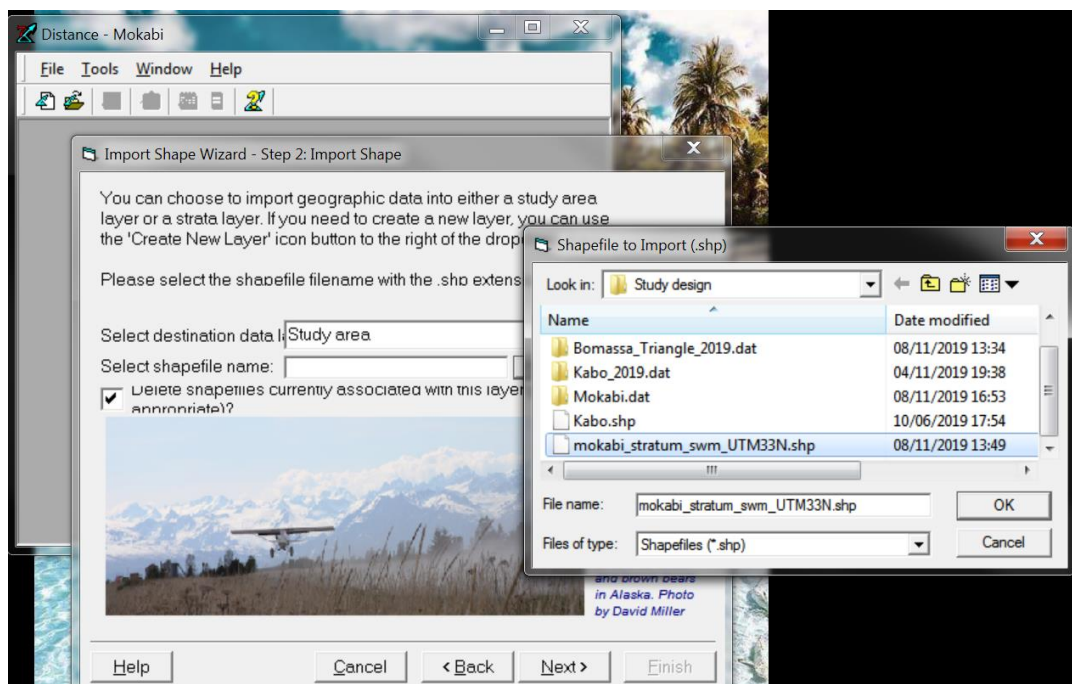
On the « File », « Project Properties », menu check that the default coordinate system is set to WGS 1984, with a « Transverse Mercator » projection, and that the shapefile units are in meters.

In the third step: Coordinate System, look at "Coordinate System Properties", make sure that the coordinate system is what you assigned to your shapefile: in this case WGS 1984 UTM Zone 33N:
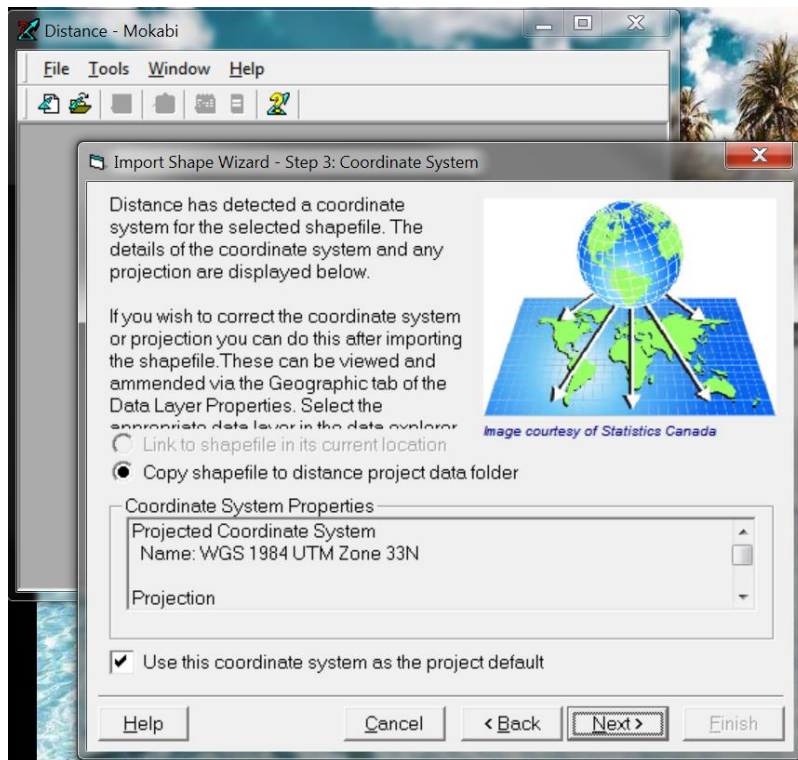
with the projection *of map data* set to "Transverse Mercator", and the *map* unit*s* in meters.
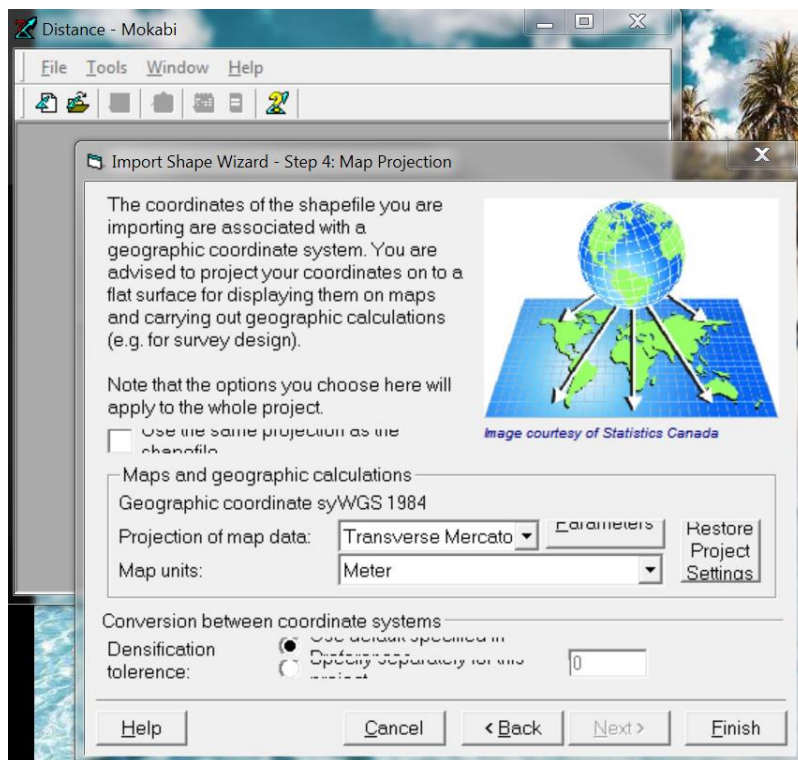
Then click **Finish**.

You'll then see this dialog box which will ask you if you want to create a coverage grid. Say yes!
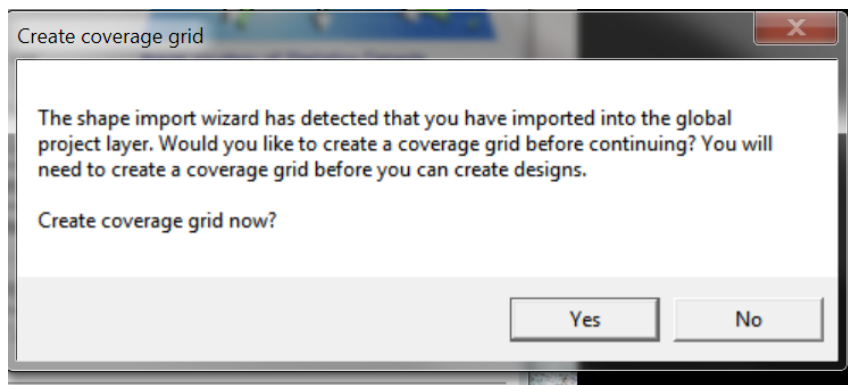
Distance will now ask you to create a new layer, which you'll call "Grid" (make sure that's what it says in the "Layer name" box), and make sure the other two boxes say Study area and Coverage (see below). Click on "Properties" and choose the option "**Distance between grid points**". In our example, we have entered 2000 meters between the points. Then click on OK (twice).
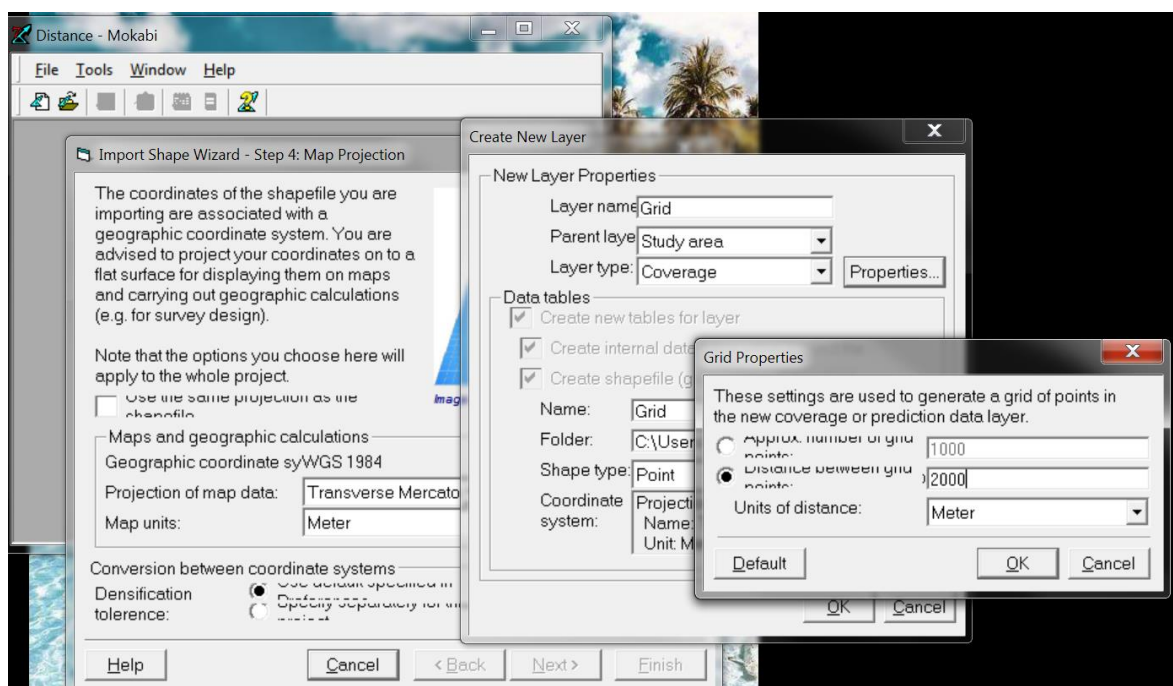
The next box tells you how many points you'll have in your grid (in this case 109). If you think it's enough, carry on by clicking on "Yes".
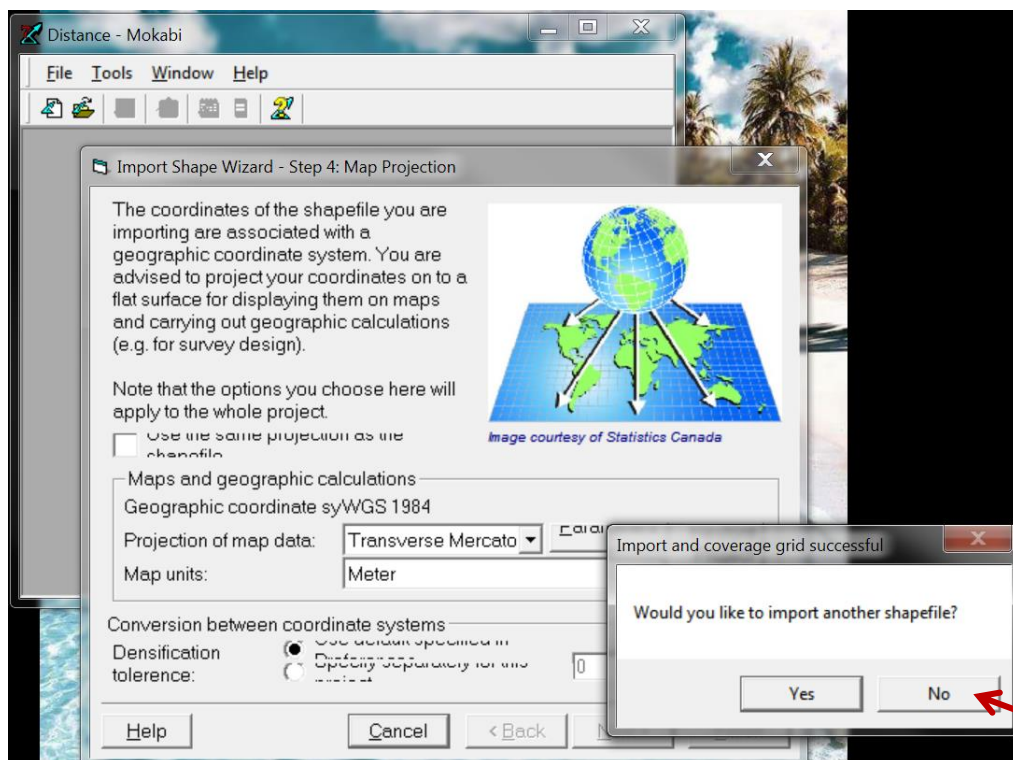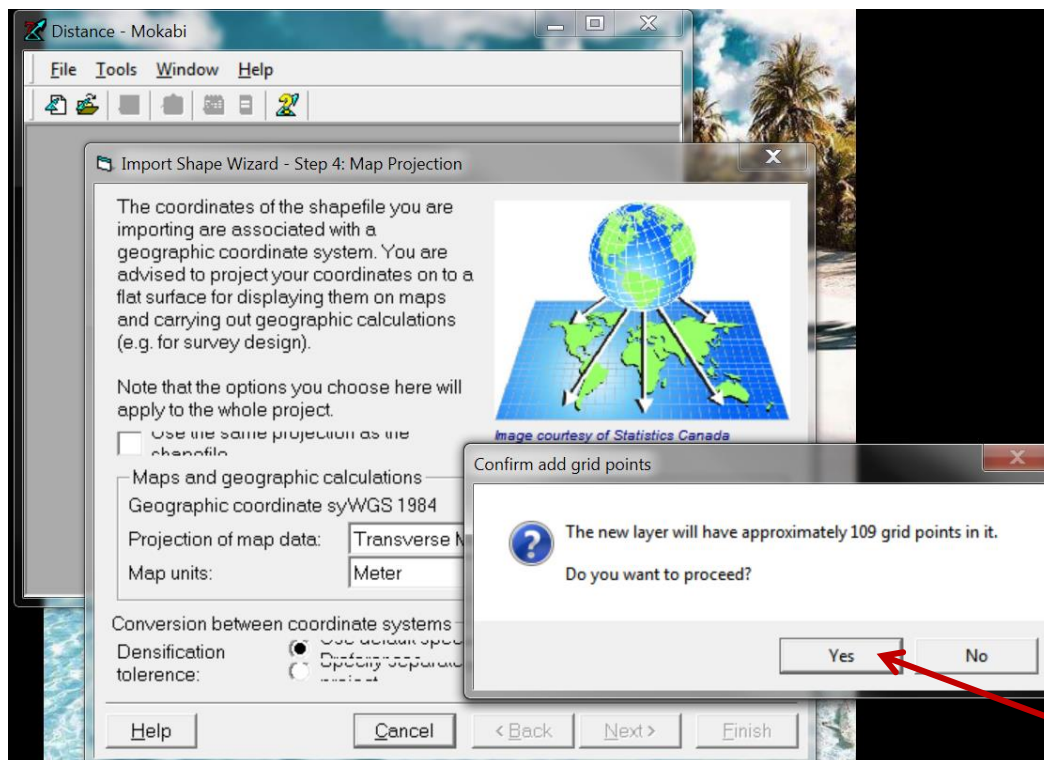
You'll be asked if you want to import another shapefile. If in addition to the shapefile you just imported that defines your study area, for example, if you want to generate a design within two or more strata, then say « Yes » and go through the same procedure. In our example we have just one stratum, so we click "No".

The next window shows the structure of your project: you have the Study area at the top (which is the shapefile you imported) and the Grid you just created just below it.
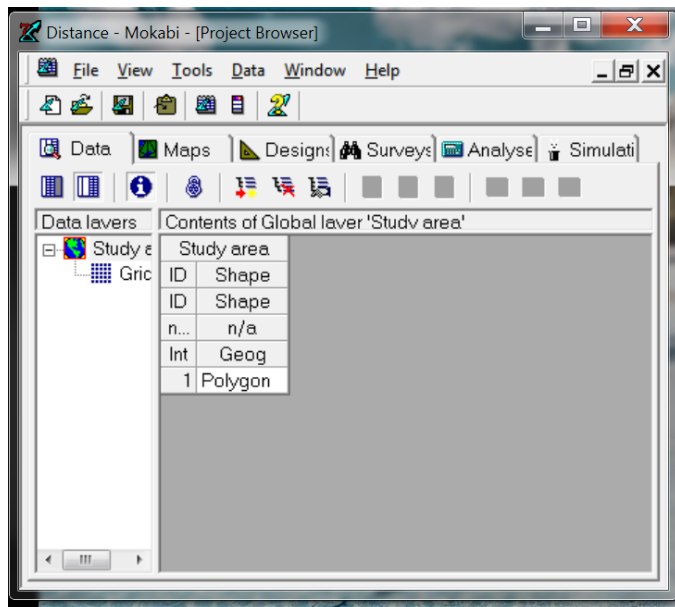
It's a good idea to check that these are correctly imported. You can do that by visualising them in the Map tab. Click on the Map tab, and create a New Map.
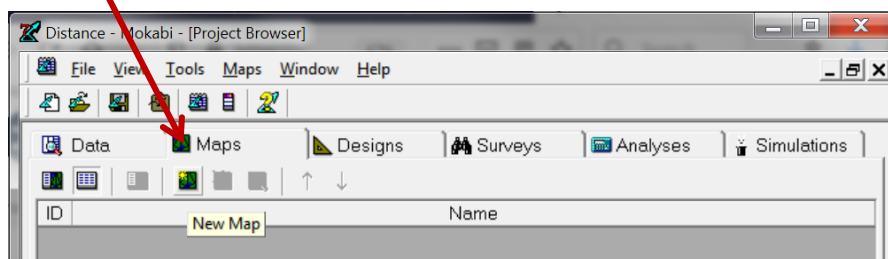
Open it with the button that looks like a magnifying glass…
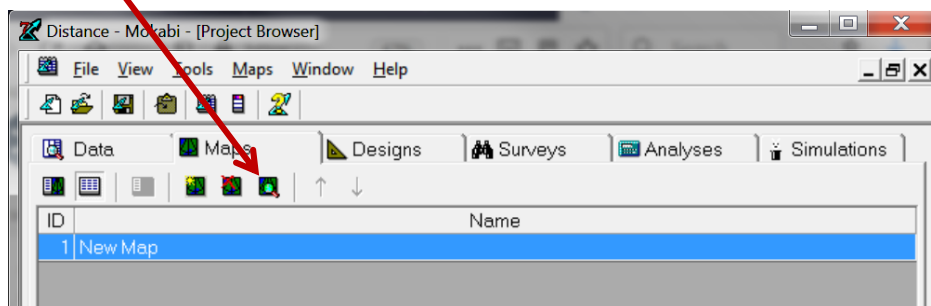
…and add both the study area and the grid, one by one, using the "**Add layer to map**" button..
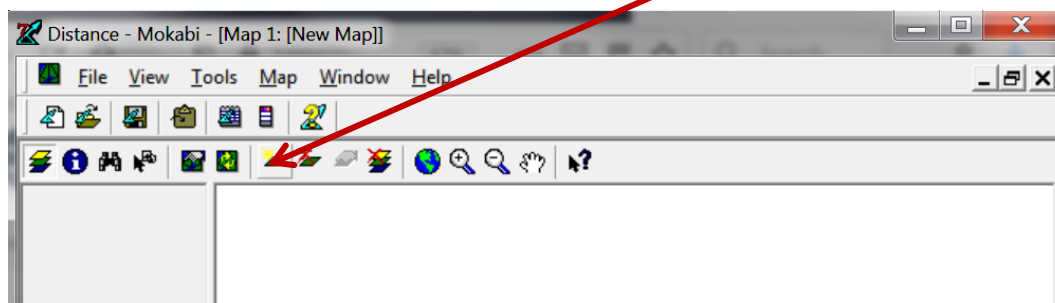
The first layer by default here was Grid, and clicking on it added it to the Map.
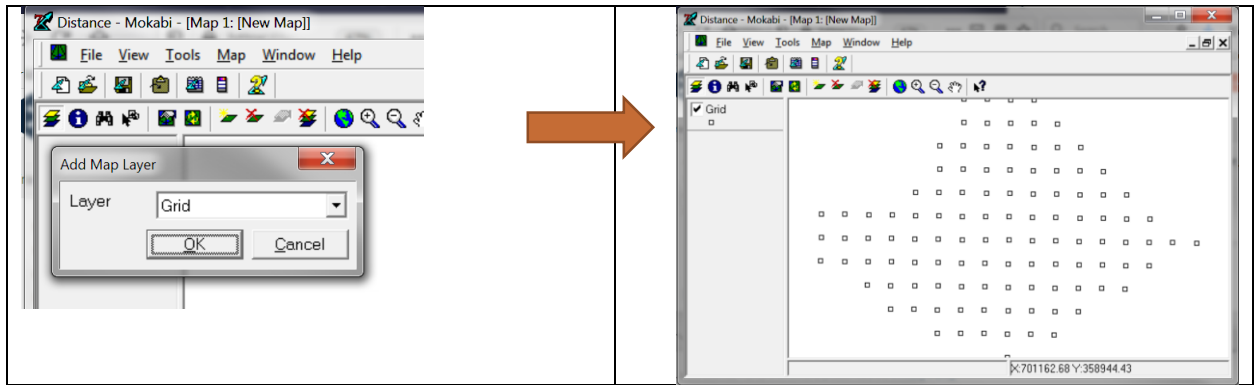
Add New Layer again and use the scroll arrow to choose Study area. Add it...and it will appear on the Map. It will overlay Grid, but just like in any GIS software, you can push it to underlay the Grid.
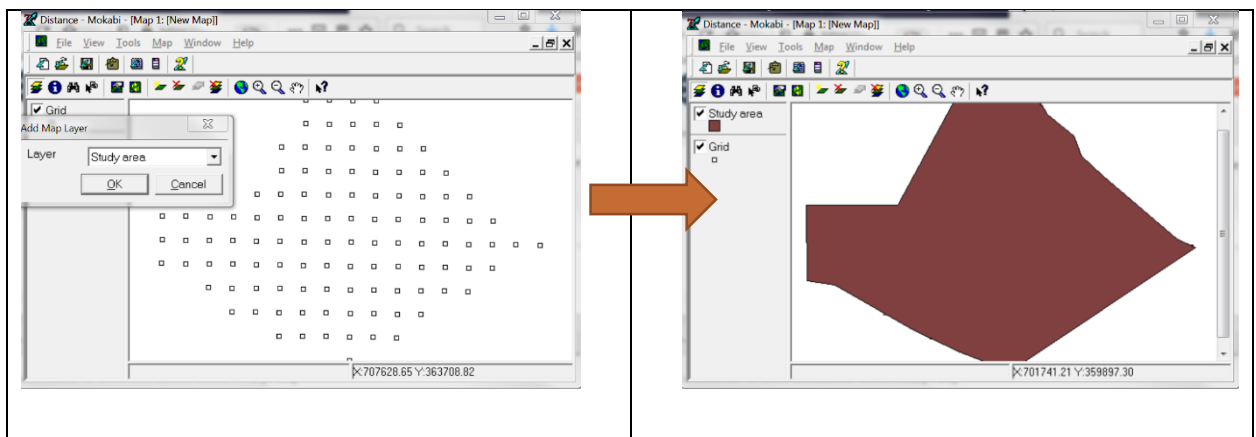
If it all lines up nicely, we can close the Map and create a new design for our point transects.
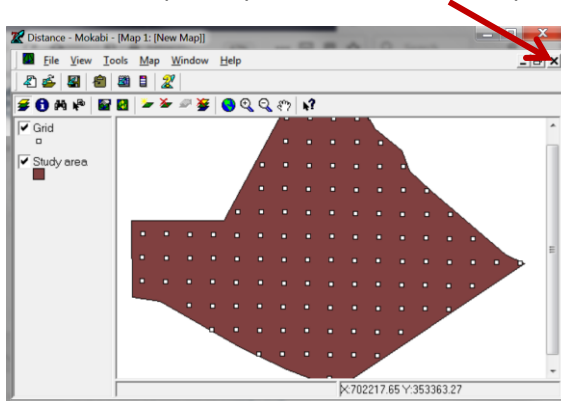
3.2 Create and evaluate a design

We can create our first design. Go to the Design tab, and click on the small yellow triangle ("New Design").
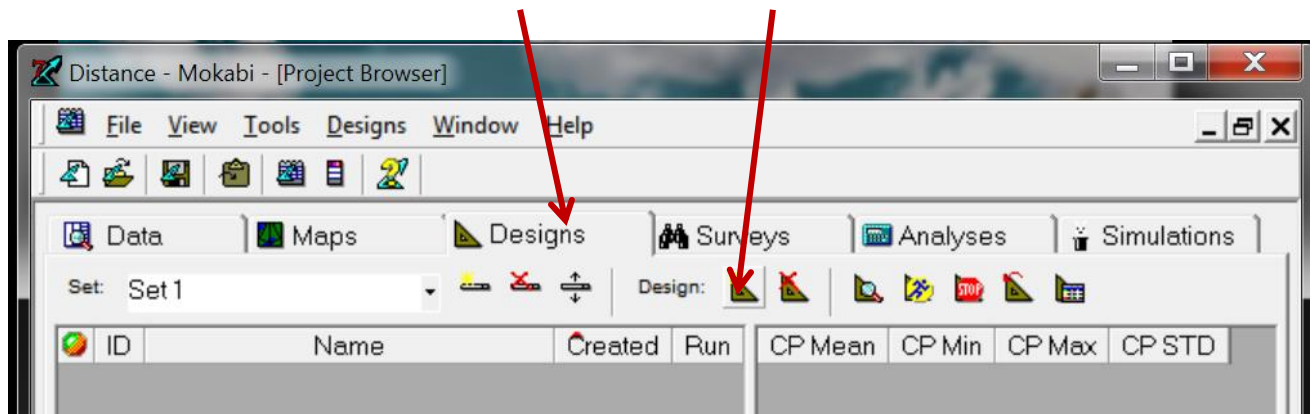
Open it (click on the grey ball on the left).
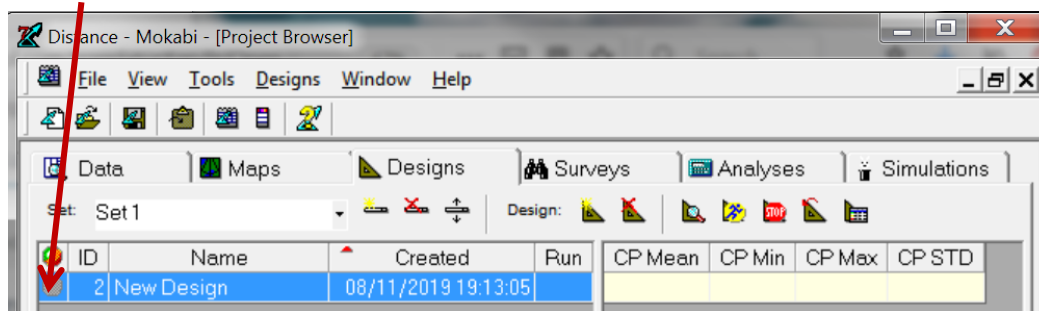
Make sure that the first box is set to "Point" and the second to "Systematic grid sampling", then click on "Properties".
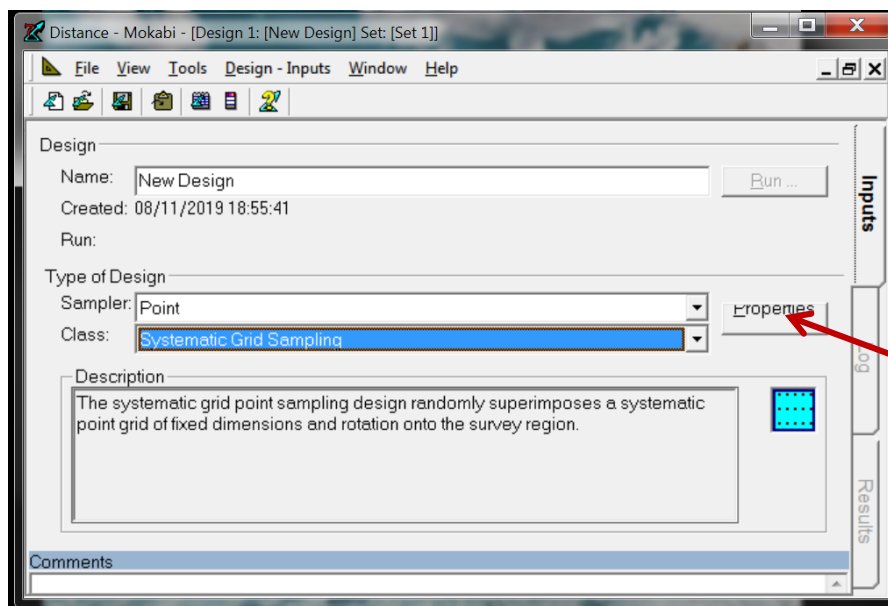
This is where you tell Distance how far apart the cameras will be placed, or alternatively how many cameras you want to set up. In the latter case, Distance calculates the spacing between the cameras for you, depending on the shape and size of the polygon. Click on the "**Effort Allocation**" tab, "**Point Spacing**" and select Kilometers. In our example, we have 50 cameras, so we enter 50 in the "**Effort**" column Distance will indicate that the cameras will be 2,986 kilometres apart (almost 3 km).

If there were two strata, there would be two lines, not one (so there would be the id 1 line and then another one – id 2 – below it). You can have different numbers of cameras in each stratum.
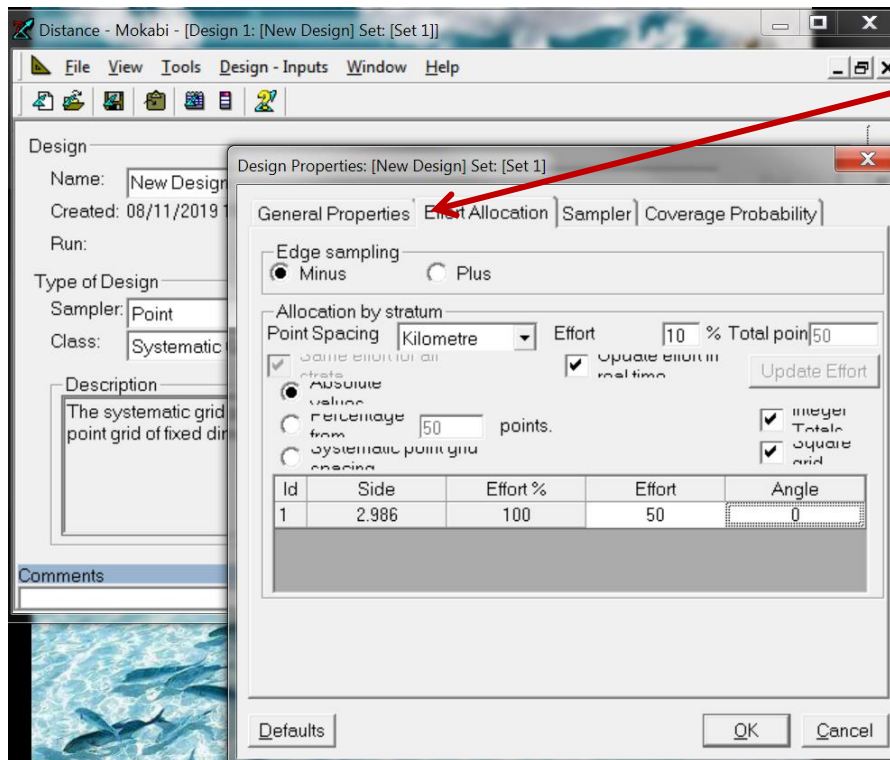
Then click on "Run" and on the second button (Create new survey) to examine the first possibility of your new sampling plan.
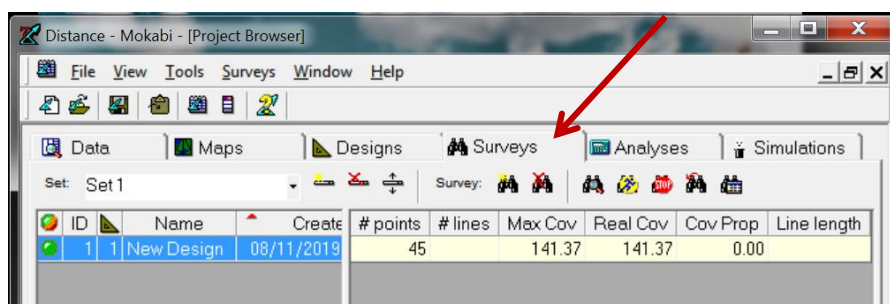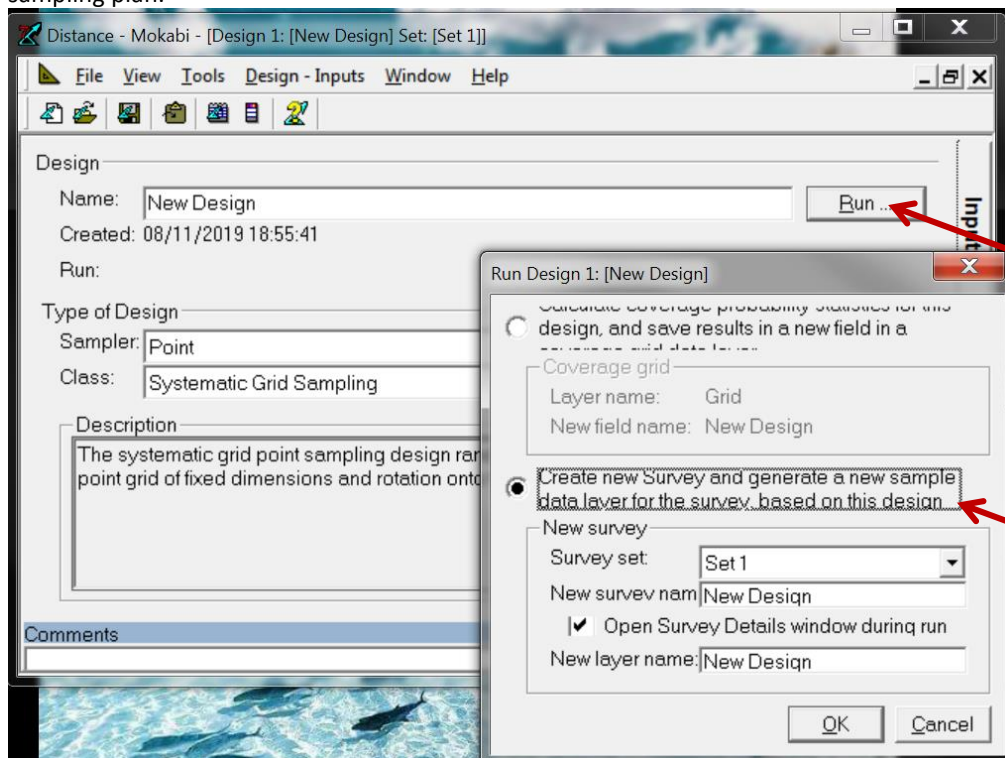
Now look at the new sampling plan (you can access it in the "Surveys" tab if it is closed)
If the operation has been executed successfully, the last tab on the right will be green.
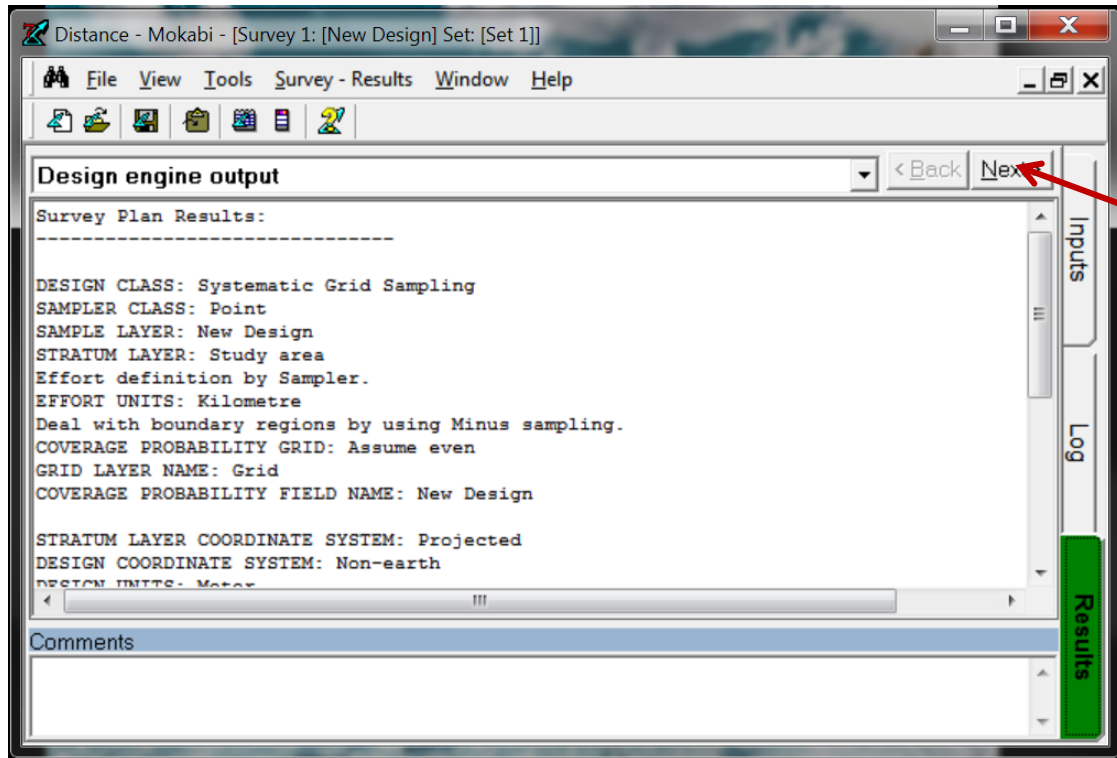
Click on Next and you will see the camera locations.
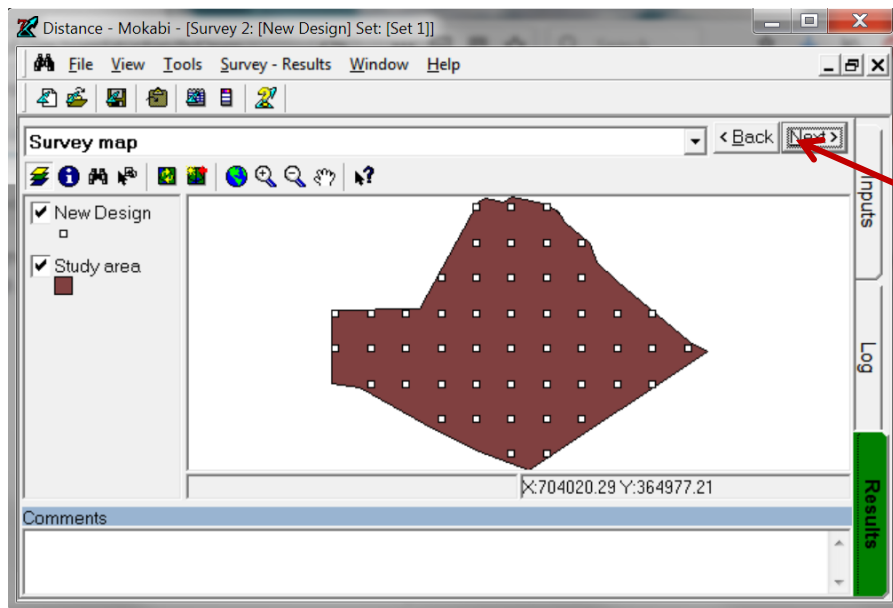
Click Next again and you will see the geographical coordinates of each camera point.
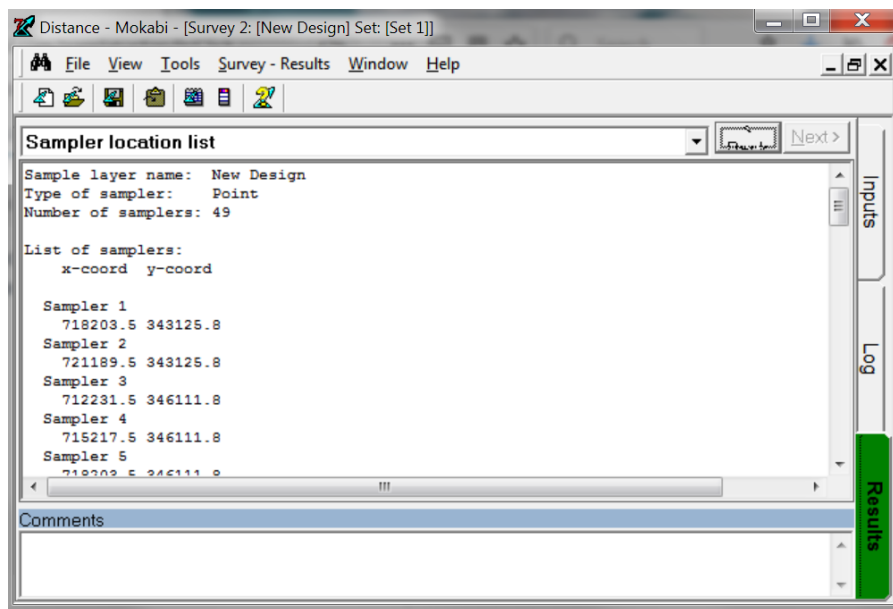
These points have been saved as a shapefile, called New_Desi.shp and are located in the Project Distance folder that ends with .dat (in this case, in Mokabi.dat). You can use this shape file directly in your GIS when creating maps for teams to follow, or for any other purpose when you want to illustrate the location of the points.
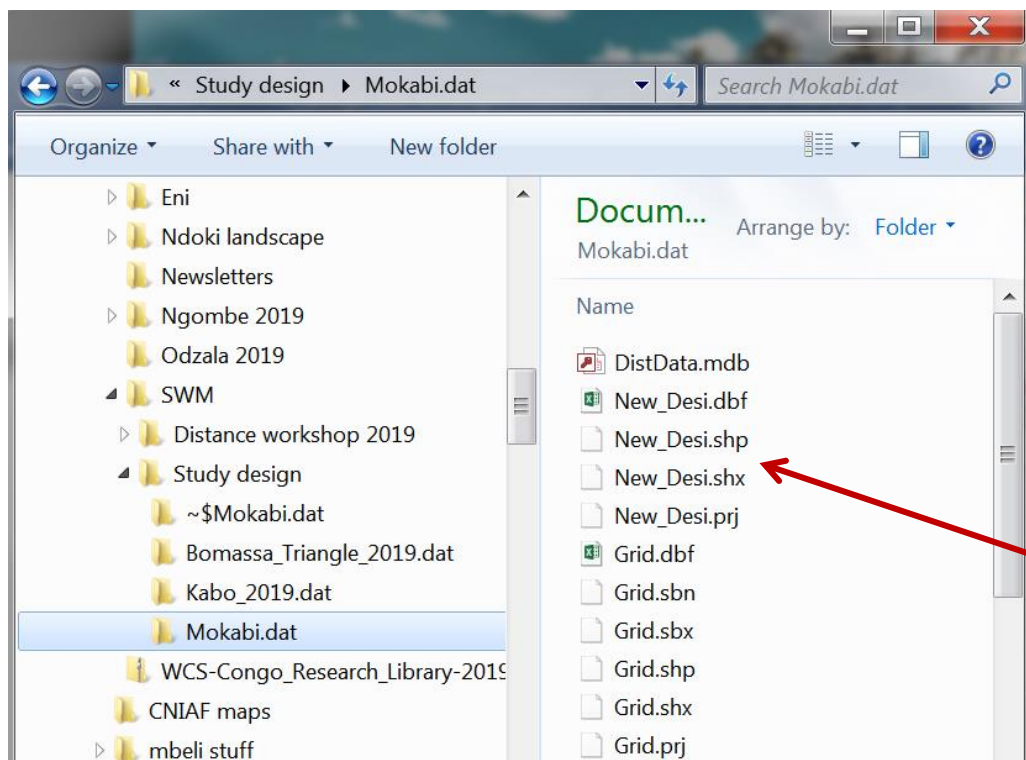
When you are satisfied with your final drawing, you can copy the corresponding shape file from the.dat folder, paste it into the final survey design folder, and rename it (in our case we could call it Mokabi_finaldesign.shp).

3.3 Preparation of the transect start and end coordinates

In the window with the transect coordinates, click on the "Copy Results to Clipboard" icon to copy all the transect start and endpoints.
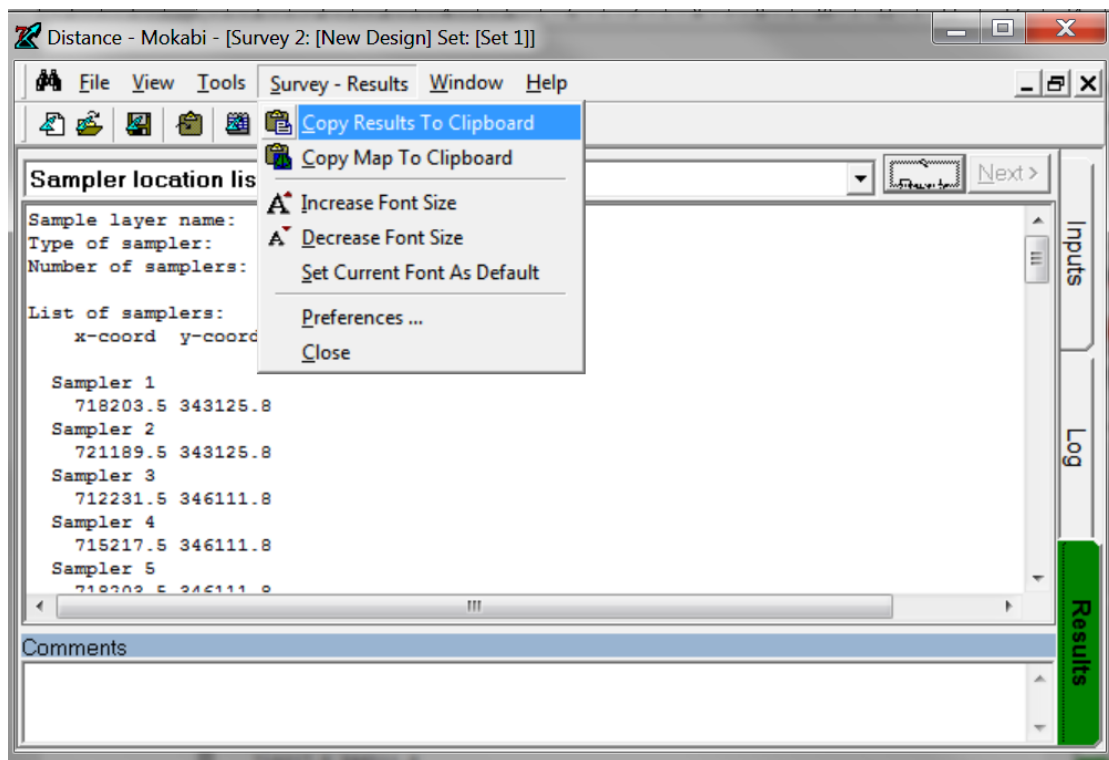
Paste these values into an Excel file:
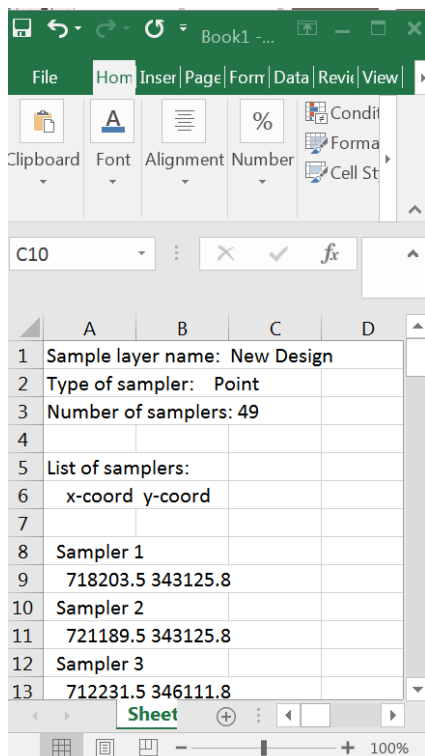
If you increase the width of column A, you will see that all the information is in that column. We need it to be divided into three columns: Transect (this is the unique identifier of each point transect); x-coord and y-coord. We will therefore divide the single column into three columns using Excel's "Text to columns" tool:
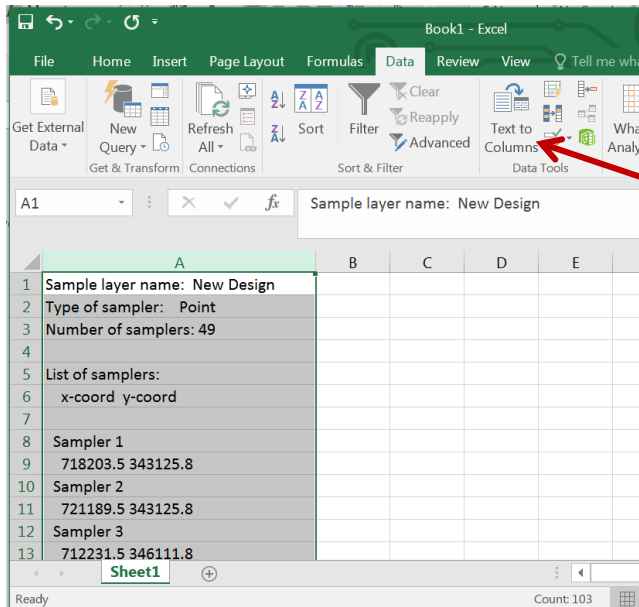
In the dialog box that appears, make sure the "Delimited" button is selected, then click Next.
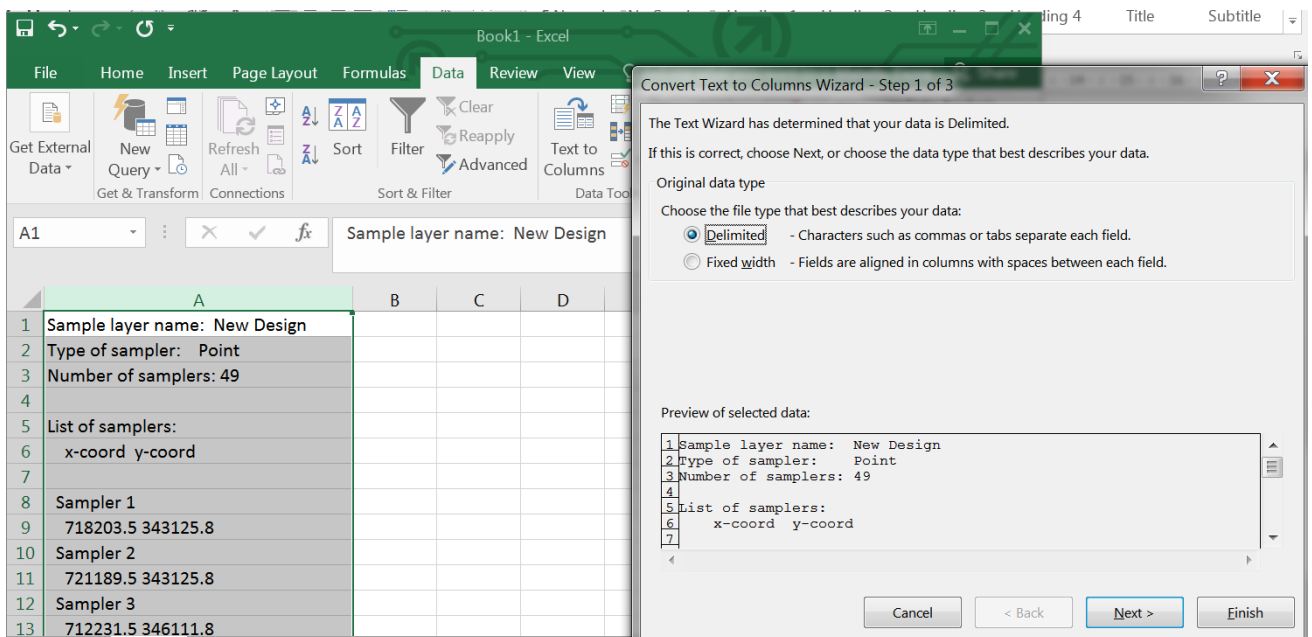
In the dialog box, choose "Space" as the delimiter. And then *"Next"…*
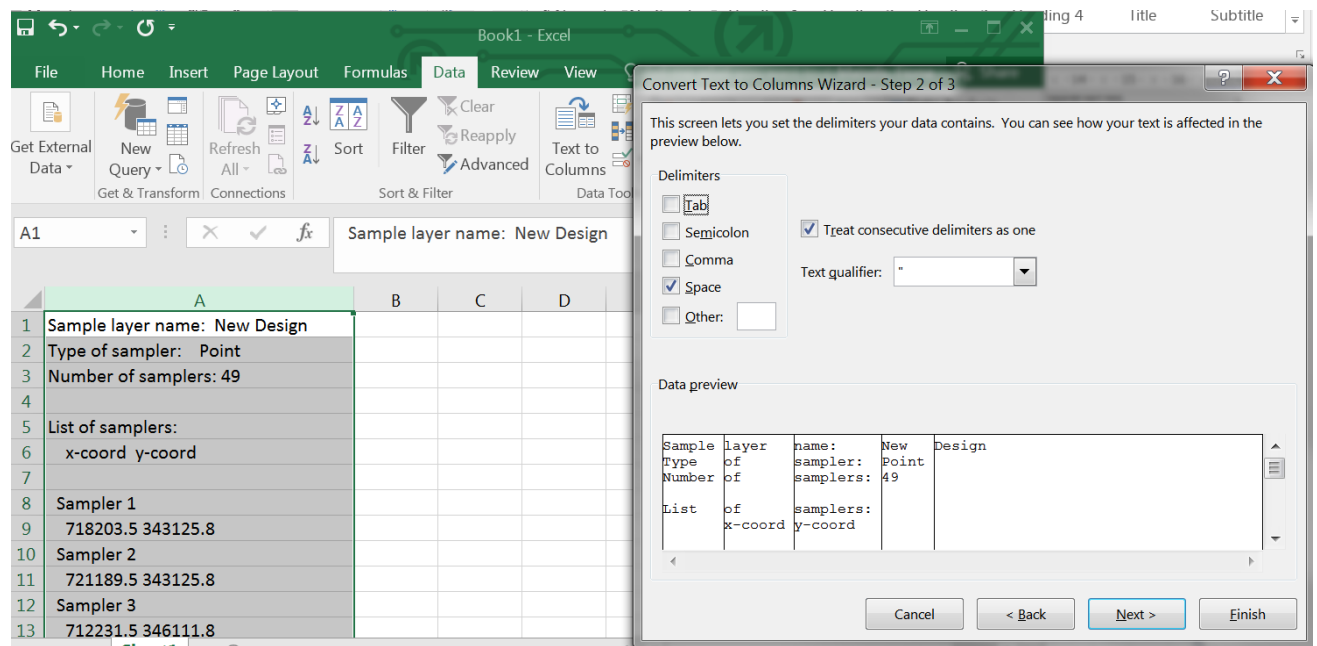
..and then « Finish ».
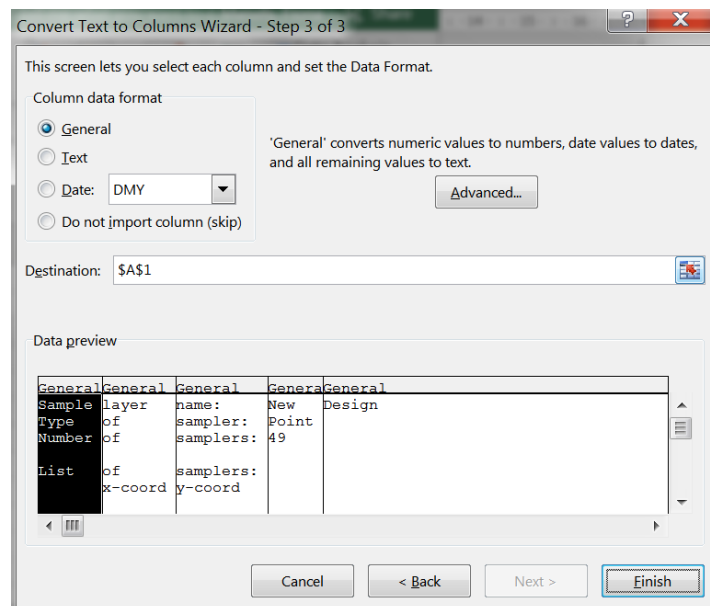
You now have a file like this one: "Sampler" is the unique ID of each point transect (1, 2, 3, etc.). For the moment, this unique identifier is in the same column as the y coordinate, so we have to do a little Excel manipulation to get them into their own column.
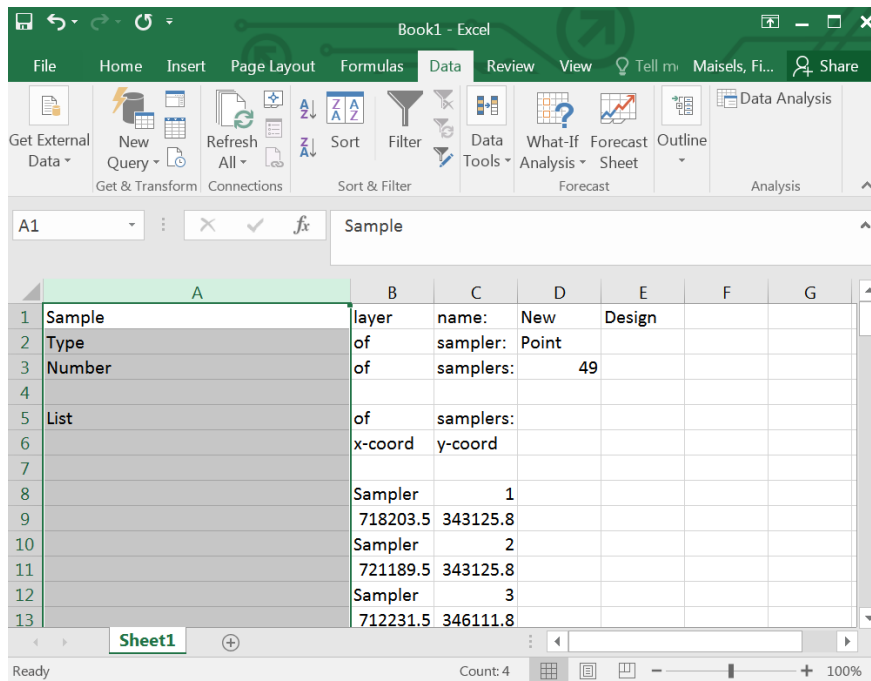
Scroll down to the bottom of the excel file...
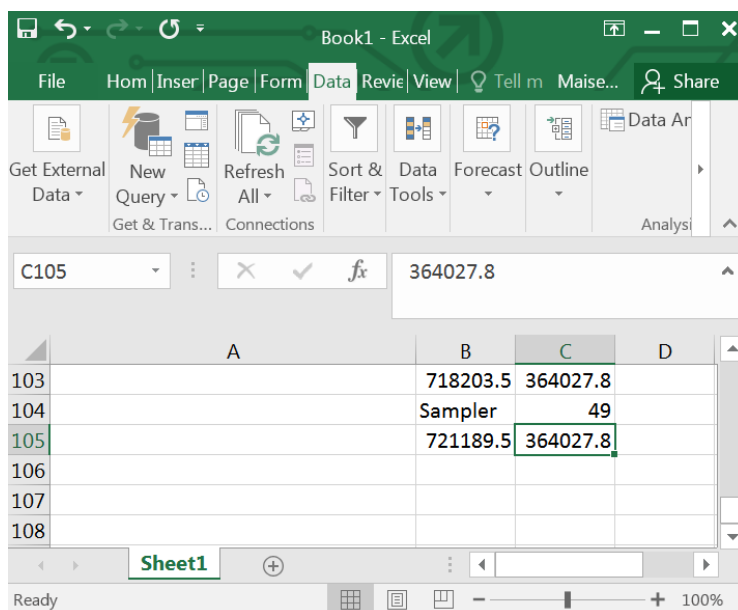
Select the columns with the x and the y coordinates … and (in the Data tab) activate "Filter".
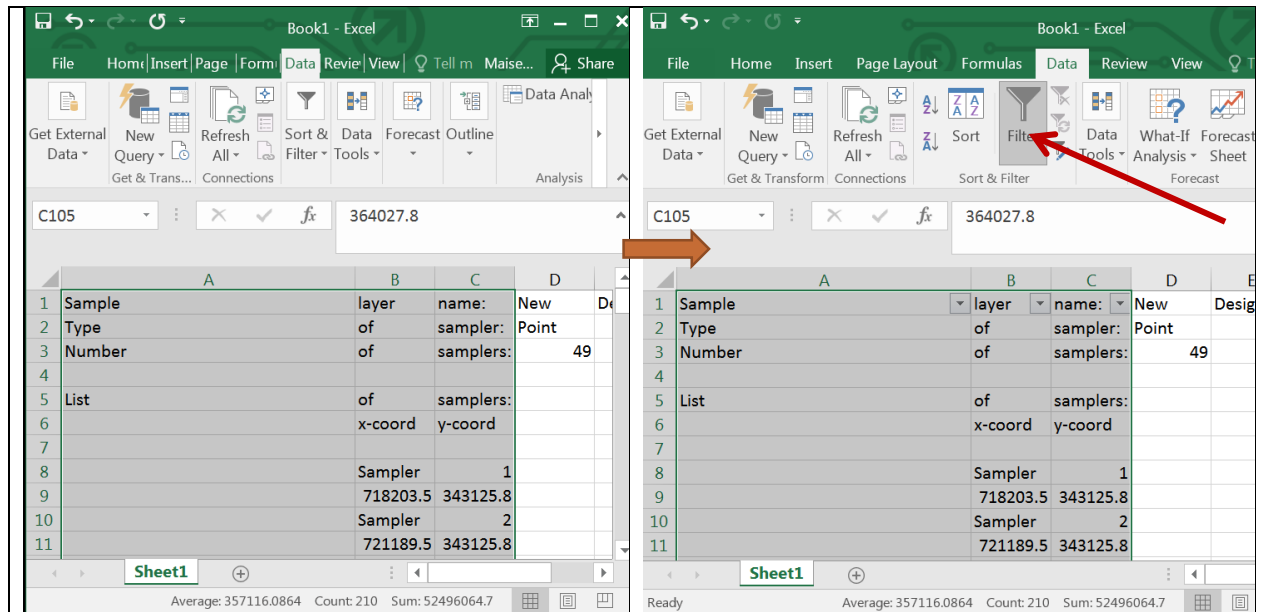
In the column that contains the unique identification number of each point transect (column C, here), use the filter to select the empty lines….
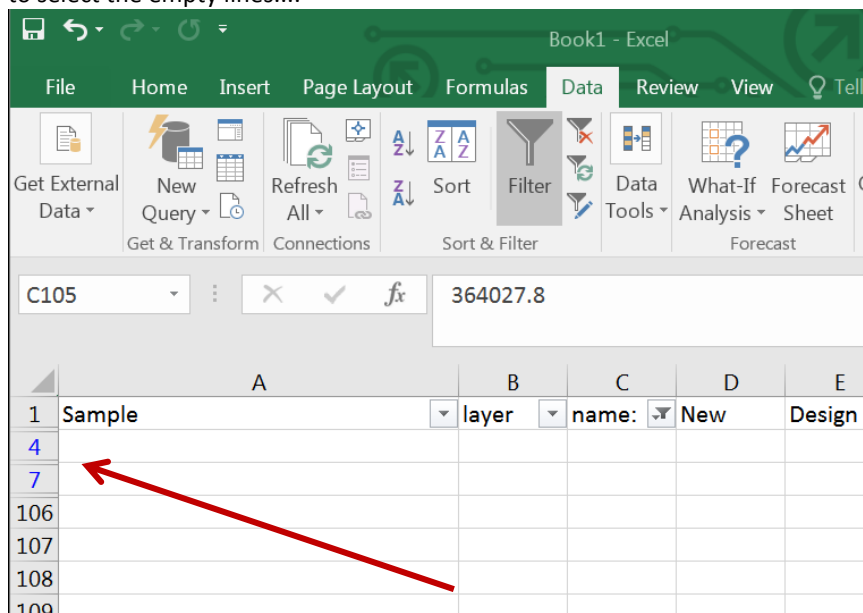
Delete them…
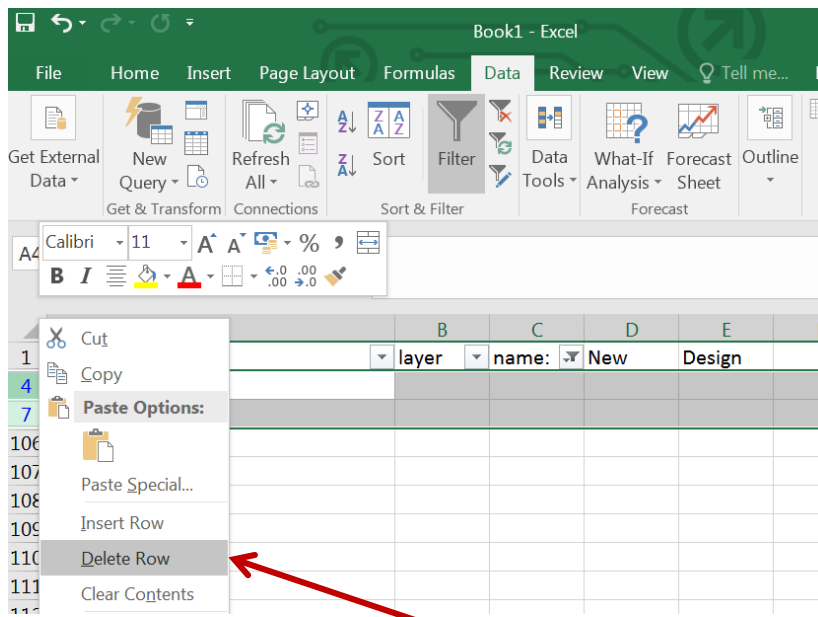
Clear the filter….
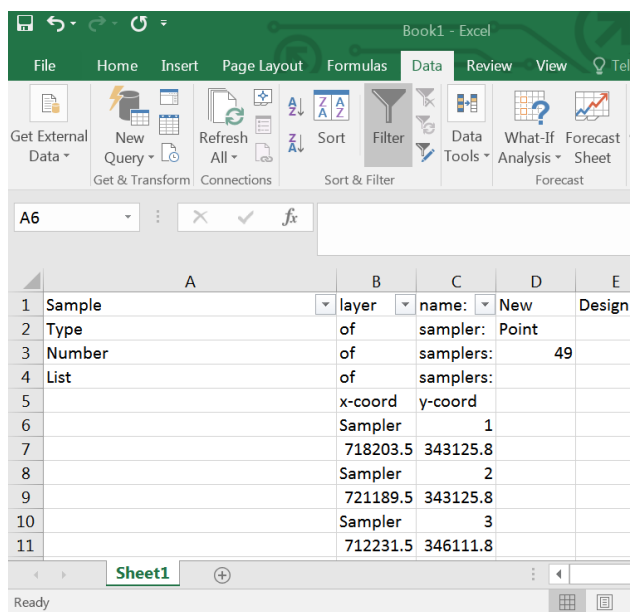
Manually delete the first four lines, so that the only remaining headers are the x-coordinate and the y-coordinate... Then name the first column "Transect". This is where the unique ID will finally be located.

Activate the filter again, and filter the x-coordinate column again... and select the cells containing the word "Sampler". Then, in the Transect column, copy the IDs from column C (keep the filter while you do this) using a formula...(see example below)

...and then copy this formula all the way to the bottom of the Transect column.
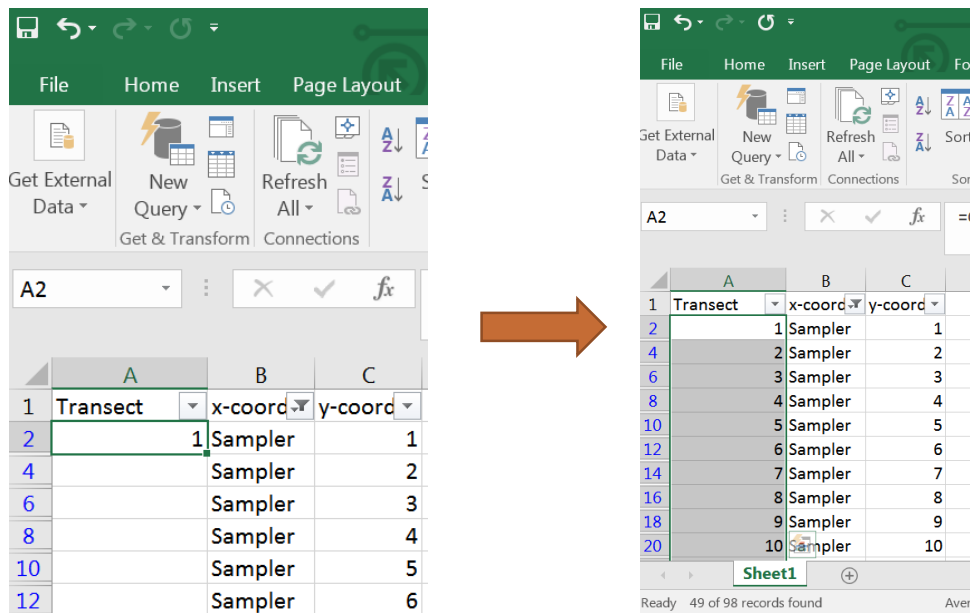
Disable the filter, and select the Transect column. Copy the contents of the entire column (remember *that it contains formulas, which we will convert into numbers*).

Then - in the same column - click on "Paste Special" and choose "Values". This is the choice indicated here (Paste Values, then the first option with 123). This copies the column on*to* itself, but without the formulas.
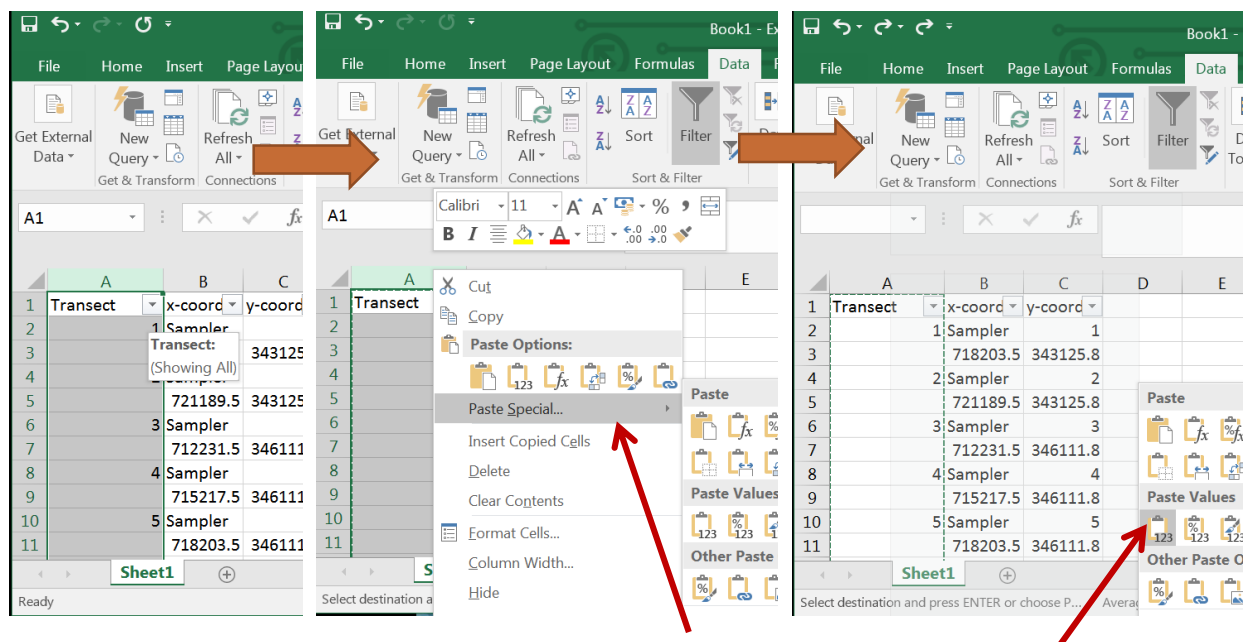
Now we can shift all the numbers in the Transect column down one place, so that each Transect ID is on the same line as its x and y coordinates.

To do this, we go to the first identification number in the transect column, right-click and choose "Insert", then choose "Shift cells down". The entire column of numbers will be moved down one cell.
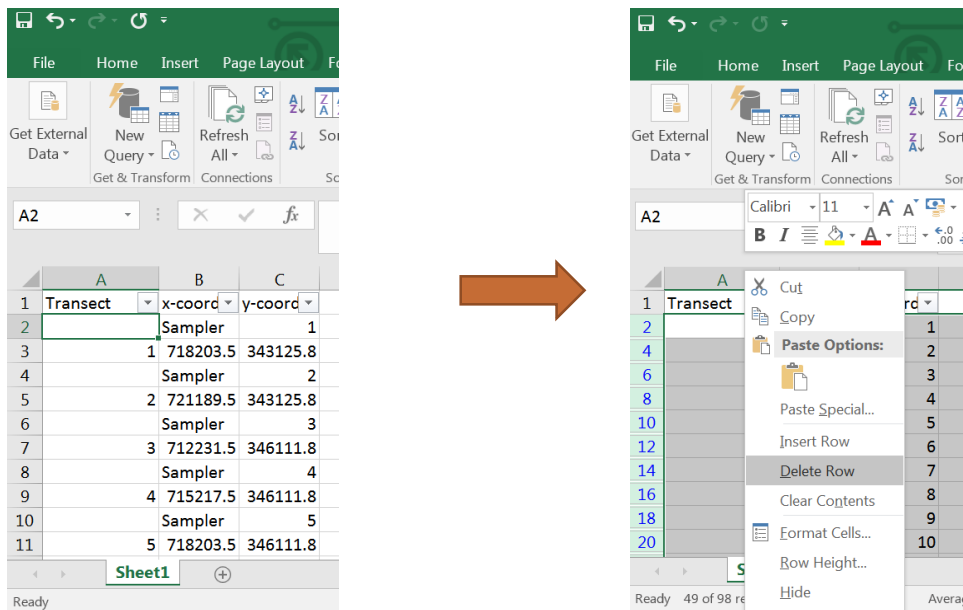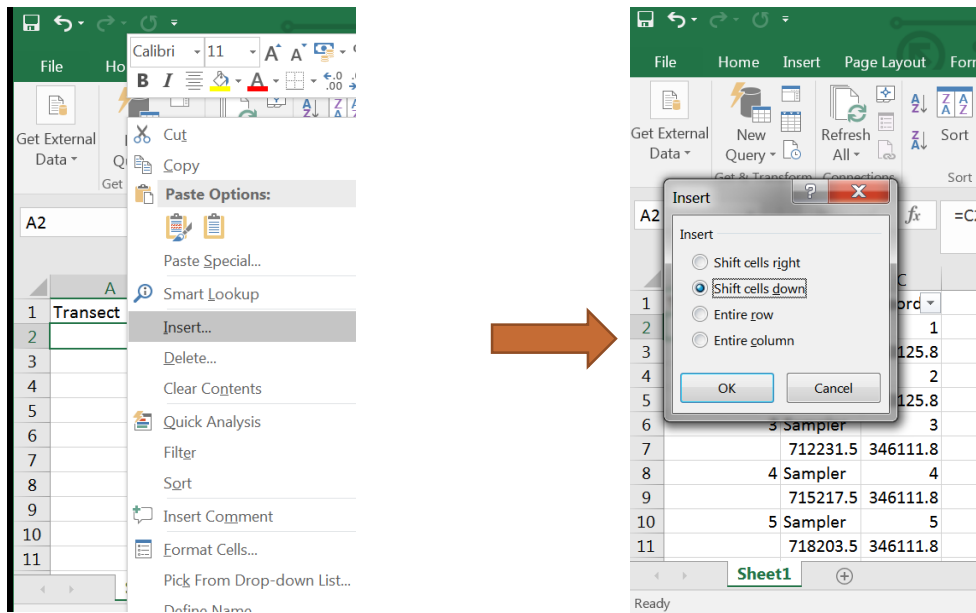
All we have to do now is use the filter to delete all the lines containing the word "Sampler", and the file is ready. Save it under "Waypoints_PointTransects_Mokabi.xlsx". This file can be downloaded to your GPS and SMART-ER sampling plan.

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