Forest Inventory

Updating with imagery

—Glen Jordan

Introduction

Problem

Forest inventories are never complete. It seems there are always data errors to correct, new data to add, or existing data to change. Expanding and updating forest inventories is an ongoing, never-ending process.

Sources of new data vary, and as a result, updating methods vary somewhat as well. Existing paper maps, imagery, light detection and ranging (LiDAR), and Global Positioning System (GPS) are common data sources for expanding and updating forest inventories.

Paper maps and LiDAR and GPS data are *georeferenced;* that is, they use some coordinate system. That means they can be used directly to digitize the locations and attributes of features. Satellite imagery and aerial photos, on the other hand, must be georeferenced before they can be used to digitize information. You can find more background on georeferencing at the **Wikipedia** website.

How is geographic information system (GIS) technology used to georeference imagery, and how is the imagery then used to update a forest inventory?

Location

A small 1,400-hectare (ha) woodlot in the Acadian-New England forest region of North America

Time to complete the lab

Approximately three hours

Keywords: imagery; georeferencing; digitizing; editing feature classes; overlaying features

Prerequisites

A basic working knowledge of GIS, and ArcGIS® software in particular; familiarity with the Woodlot geodatabase inventory essential

Data used in this lab

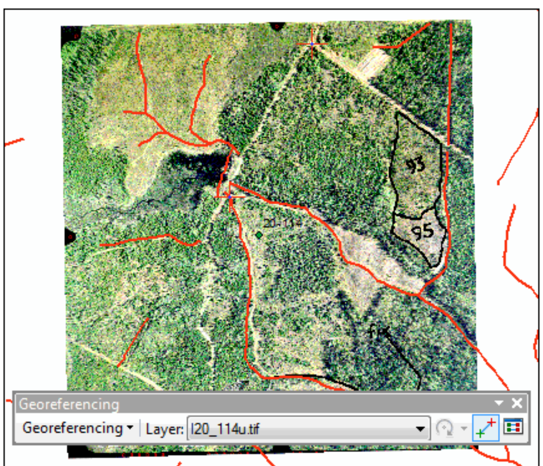
A personal geodatabase of several feature classes for a small (1,400 ha) woodlot in the Acadian-New England forest region of North America (All data is NAD83 datum with New Brunswick Double Stereographic projection, unless otherwise stated. An ungeoreferenced aerial photo is also used.)

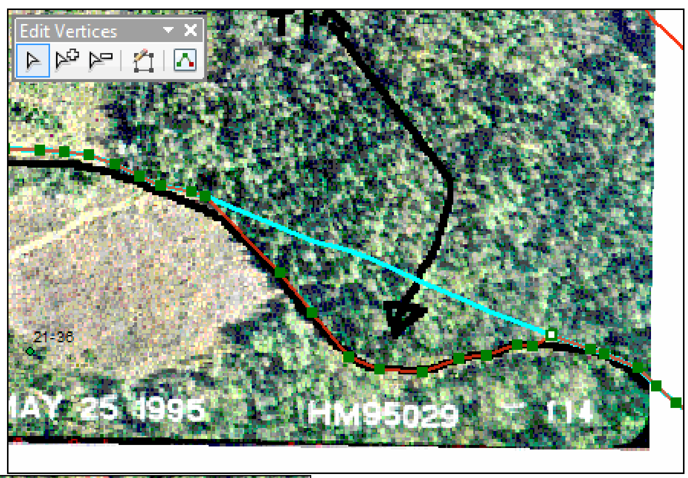
Student activity

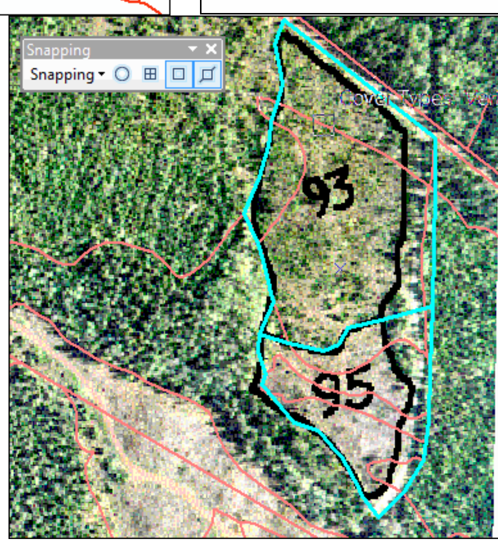
In this exercise, you'll use changes indicated on an aerial photo to update the Woodlot inventory. The photo flags a digitizing error in one of the road features in the secondary roads feature class (*roads*) that should be corrected. The photo also outlines the location of two recent clearcuts that need to be digitized and incorporated into the cover types feature class (*cover*).

Results expected

Georeferenced aerial photo l20_114u, secondary roads feature class with corrected road feature, and cover types feature class updated with recent clearcuts (see the three images below)







Data available

- Scanned aerial photo with a secondary road error indicated and two clearcuts outlined: *l20_114u*
- Secondary roads feature class: *roads*
- Cover types feature class: *cover*
- Management compartments feature class: *compart*
- Aerial photo centers feature class: *cpoints*

Solution steps

1. Georeference aerial photo *l20_114u*.
2. Correct the digitizing error in the secondary roads feature class.
3. Digitize two recent clearcuts.
4. Update the cover types feature class with clearcuts.

EXAMINE AERIAL PHOTO *L20_114U*

A number of color aerial photo images are located in the Woodlot inventory *Updates* folder. The photos were originally flown at a nominal scale of 1:5,000 and then digitally scanned at high resolution.

Most of the photos outline the location of clearcuts completed since the Woodlot inventory was originally constructed. One photo, *l20_114u*, also indicates the location of a digitizing error in a secondary road that occurred during construction of the original inventory.

RELATED CONCEPT: DIGITAL MAPPING—IMAGERY

1 In ArcCatalog™, preview *l20_114u* and examine its properties.

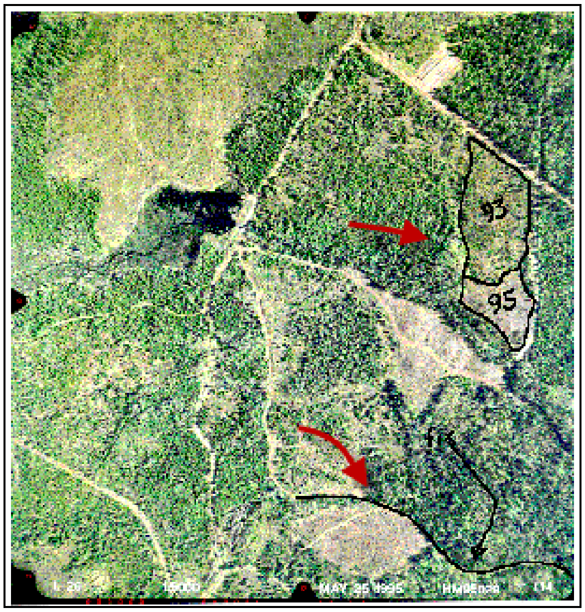


Figure 1. Aerial photo *l20_114u* indicates an incorrectly digitized road and two clearcuts.

Property	Value
⊟ **Data Source**	
Raster	l20_114u.tif
Data Type	File System Raster
Folder	Y:\Desktop\GISData\GIS\ESRI_Labs\Updates\
⊟ **Raster Information**	
Columns and Rows	638, 675
Number of Bands	1
Cellsize (X, Y)	0.00035277848, 0.00035277848
Uncompressed Size	420.56 KB
Format	TIFF
Source Type	discrete
Pixel Type	unsigned integer
Pixel Depth	8 Bit
NoData Value	256
Colormap	present
Pyramids	absent Build
Compression	None
⊟ **Extent**	

Figure 2. Properties of aerial photo *l20_114u*.

The photo image is a high-resolution (small cell size) color Tagged Image File Format (TIFF) image without any spatial reference.

Where is the photo located in the Woodlot?

You can add the centerpoints feature class (*cpoints*) in ArcMap™ to find out, since it locates the centerpoints of all Woodlot aerial photos.

2 Close ArcCatalog and then, in ArcMap, add the *cpoints* feature class, plus the management compartments feature class (*compart*) for reference.

3 Label *cpoints* features using the *NUMBER_* field.

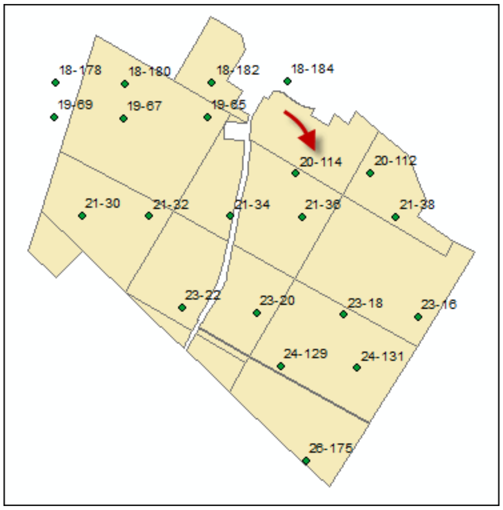


Figure 3. The centerpoint location of *l20_114u* and other aerial photos.

That tells you approximately where *l20_114u* is located in the Woodlot.

4 Zoom to the full extent and then add *l20_114u* (*Updates* folder). Click *OK* to dismiss the warning.

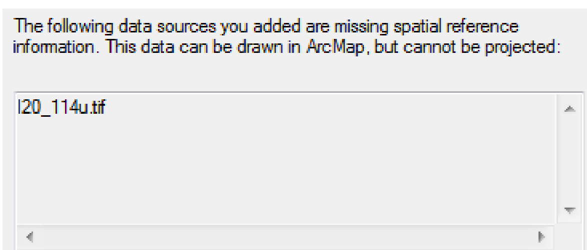


Figure 4. ArcMap issues a warning message when data lacks a spatial reference.

Because the photo isn't georeferenced, ArcMap has no way of knowing its geographic location within the Woodlot. As a result, you won't see it displayed in ArcMap.

Note: When georeferencing aerial photos or other imagery, it's critical that a georeferenced shapefile or feature class is added as a layer BEFORE adding the photo or image. That way, the ArcMap data frame will have a coordinate system reference.

Georeferencing *l20_114u* is next.

GEOREFERENCE AERIAL PHOTO *L20_114U*

Georeferencing is a simple process of reprocessing a digital image so that it is placed in its correct virtual geographic position by referencing a coordinate system. This is done using existing georeferenced datasets, including GPS data, shapefiles, feature classes, or coverages.

In this case, you'll use existing Woodlot feature classes and their NAD83 New Brunswick Stereographic coordinate system to georeference *l20_114u*.

RELATED CONCEPT: DIGITAL MAPPING—IMAGERY GEOREFERENCING

1 Go to *Customize » Toolbars* and add the *Georeferencing* toolbar.

2 From the *Georeferencing* drop-down list, select *Fit To Display*.

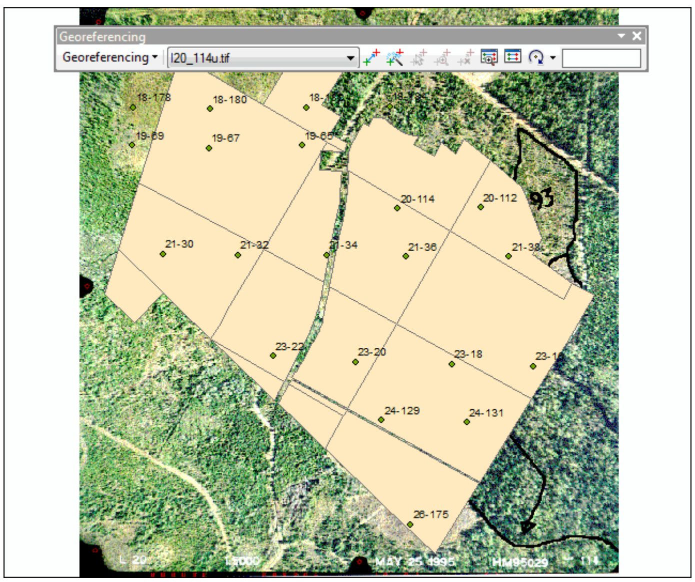


Figure 5. *Fit To Display* forces *l20_114u* to display in the background.

That at least displays the aerial photo. Now you can begin the process of georeferencing it.

Georeferencing in ArcMap is basically a matter of pointing to locations on the aerial photo—control points—and then pointing to their corresponding locations on one or more ArcMap layers. Your problem now, however, is that you don't presently have any useful layers loaded in ArcMap for doing that.

Lots of roads are evident in the photo and would make great control points. So, the roads feature classes in the Woodlot inventory, *roads* (secondary roads) and *clines* (main road centerlines), would make ideal layers for georeferencing *l20_114u*.

3 Remove *Management Compartments* and then add the *roads* and *clines* feature classes as layers. Turn the photo off for a moment.

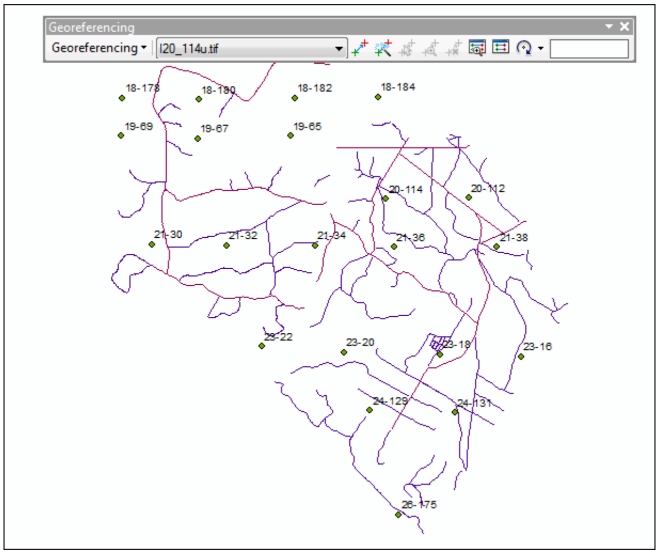


Figure 6. The Woodlot's road network.

All those road intersections provide a wealth of potential control points, but can you locate any on the *l20-114u* photo?

4 Turn the photo on and the road layers off.

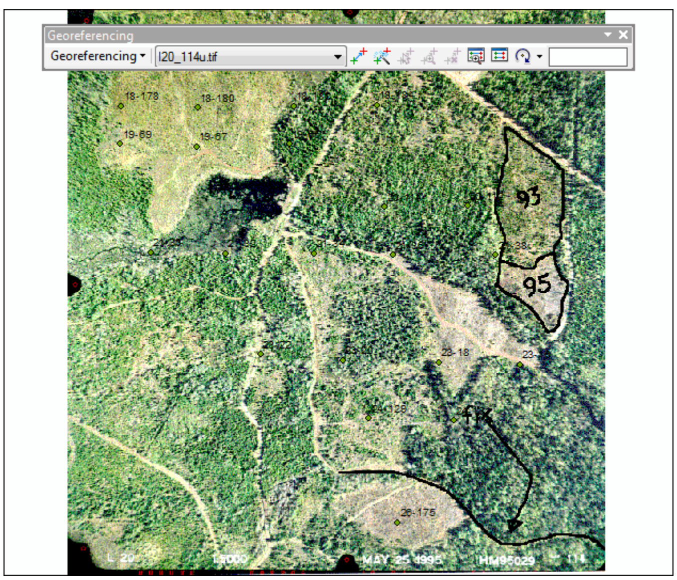


Figure 7. Numerous roads are evident in the aerial photo.

You can see lots of roads in the photo. It's a matter of associating photo roads with their corresponding features in either the *Main Road Centerlines* or *Secondary Roads* layers to establish control points. Usually, just four or so well-spaced control points are sufficient to get a good fit.

But, before you start establishing control points, it's best to disable the *Auto Adjust* feature. (You'll see what that does shortly.)

5 From the *Georeferencing* drop-down list, disable *Auto Adjust*.

6 Turn *Main Road Centerlines* on and symbolize in a bright color, like red, and then thicken the lines to 1.5.

If you move the *Georeferencing* toolbar out of the way to the bottom of the photo, an obvious control point is evident.

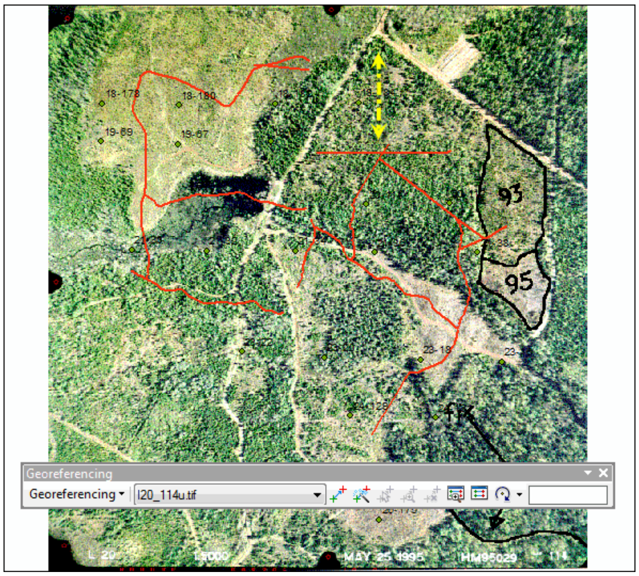


Figure 8. The location of a potential control point.

7 Zoom in on the control point for a close-up look.

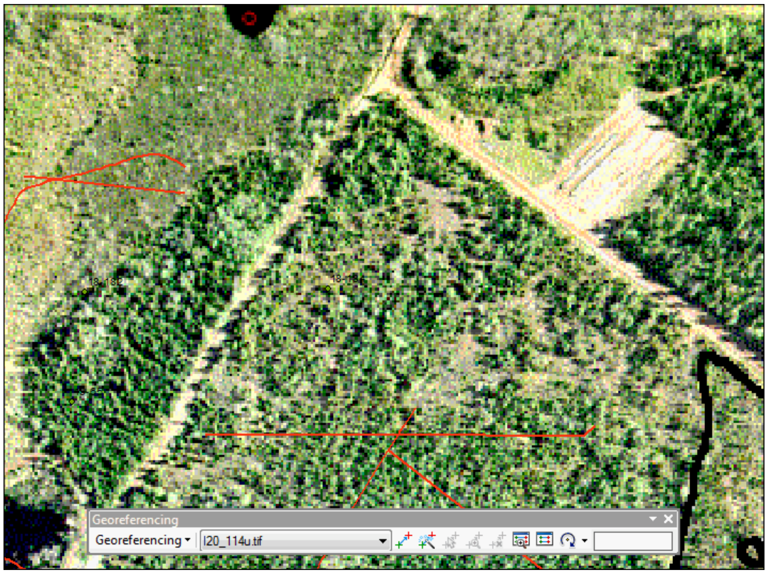


Figure 9. Zoomed in on the potential control point.

8 Using the  tool, precisely click the center of the road intersection on the photo and then precisely click the corresponding location in *Main Road Centerlines*.

The link that you've made between the photo and map layer is indicated with green and red crosses at the endpoints. The endpoints are also labeled with a "1", indicating control point 1. (You can turn off *l20_114u* to better see this.)

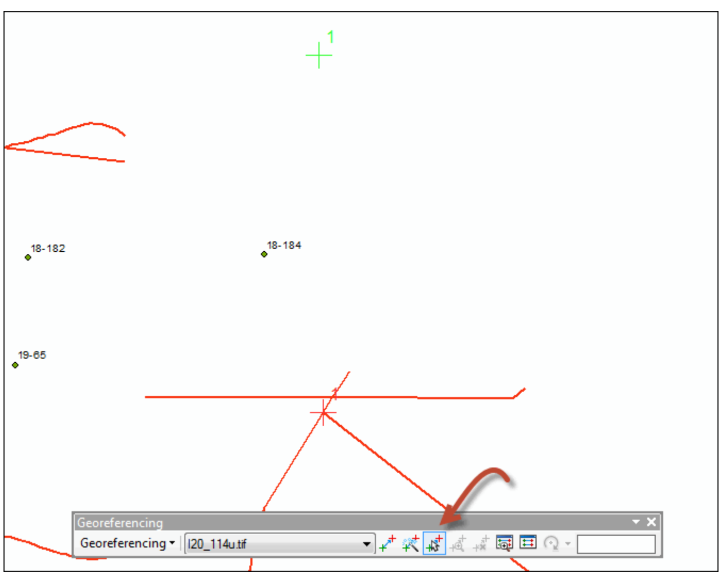


Figure 10. A control point established by associating a photo location with a map layer location.

If you mess up a control point (most often caused by connecting layer to photo, and not vice versa), you can undo the point: click the ,Select Link tool, click the control point (red cross) to select it, and then press the Delete key.

The remaining roads seen on the aerial photo are secondary roads, so you'll need the *Secondary Roads* layer to establish control points from here on.

9 Close *Main Road Centerlines* and display *Secondary Roads* with red thick lines. Turn the photo display back on.

It's not so obvious where the next control point is, is it?

10 Zoom out around the vicinity of the first control point to about 1:40,000.

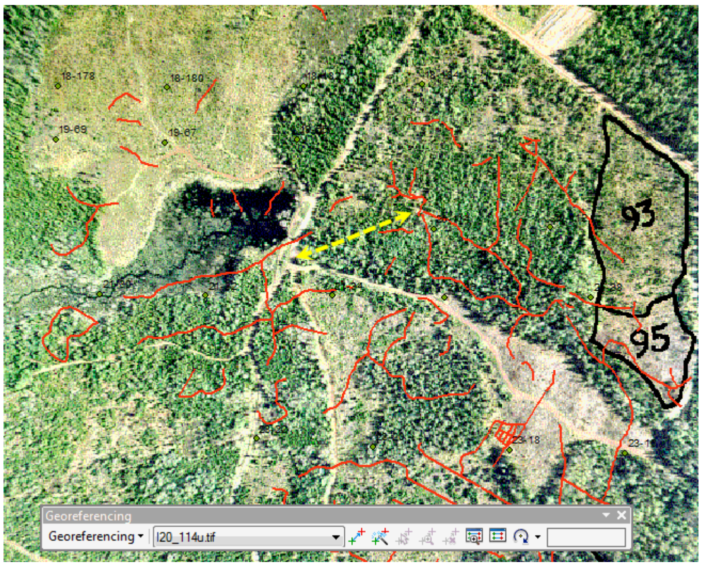


Figure 11. The location of a second potential control point.

A possible control point exists at the secondary road intersection indicated in figure 11 above.

11 Again, zoom in to the potential control point location and then, using the  tool, precisely click the center of the road intersection on the photo and then precisely click the corresponding location in *Secondary Roads*.

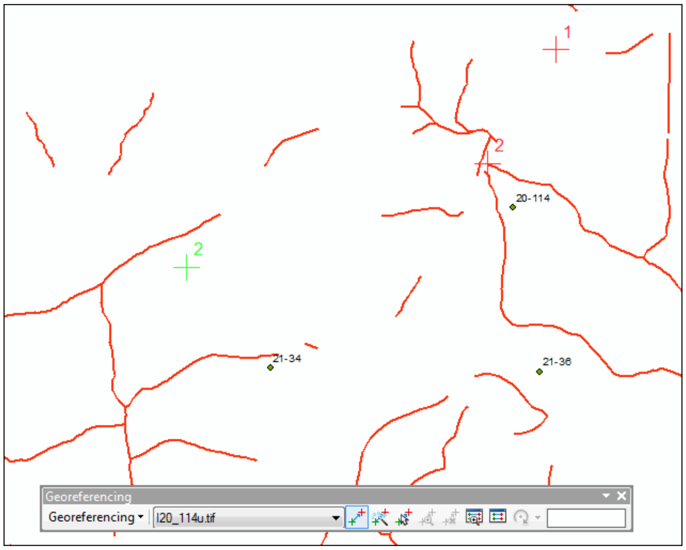


Figure 12. Establishing a second control point.

With your second control point established, it's time to see what sort of fit you have so far.

12 Zoom to the full extent, and with the photo display on, turn *Auto Adjust* on via the *Georeferencing* drop-down arrow.

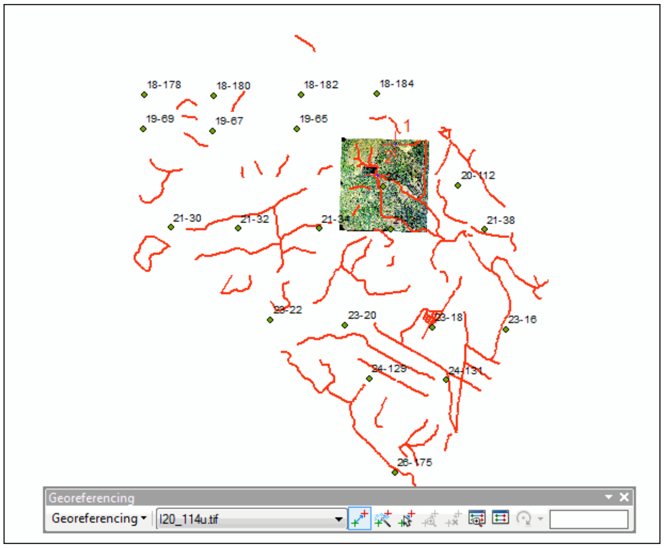


Figure 13. Aerial photo *I20_114u* positioned in its approximate geographic location in the Woodlot.

With just two control points established, you have *I20_114u* positioned to its approximate geographic location in the Woodlot.

13 Zoom in on the aerial photo using *Zoom To Layer*.

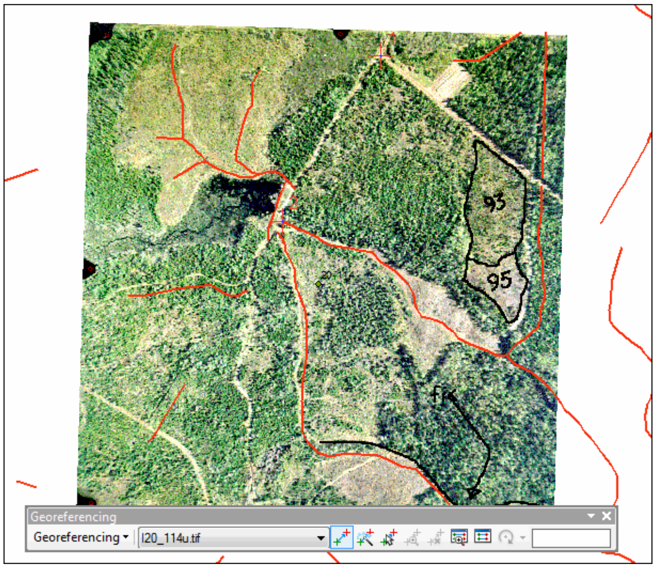


Figure 14. Zooming in on *l20_114u* shows fairly good alignment of secondary road features with their photo positions.

In this case, with just two control points, you have a pretty good fit. A couple of additional well-distributed points will fine-tune the fit. Can you see any?

How about the road interaction in the upper right corner as indicated in figure 15?

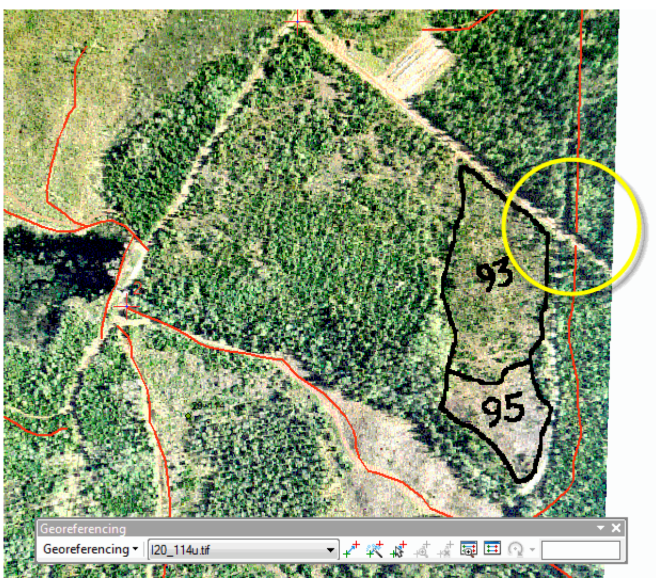


Figure 15. Possibility for a third control point.

14 Zoom in on that location and establish a third control point. (Keep in mind that the line in *Secondary Roads* connects to the side of the main road, not its centerline.)

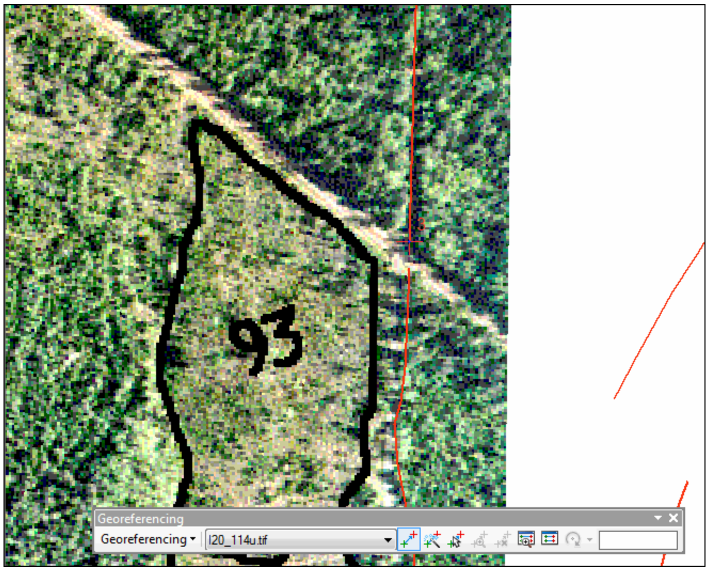


Figure 16. The third control point shifts the aerial photo's position slightly.

With *Auto Adjust* on, the photo shifts to reflect the influence of the new control point, presumably improving the alignment of photo roads and *Secondary Roads* features.

15 Return to the full photo view.

Do you see a fourth control point anywhere? You want your points well distributed across the photo, but you don't want to use that incorrectly digitized road.

There's a possibility down in the lower left of the photo.

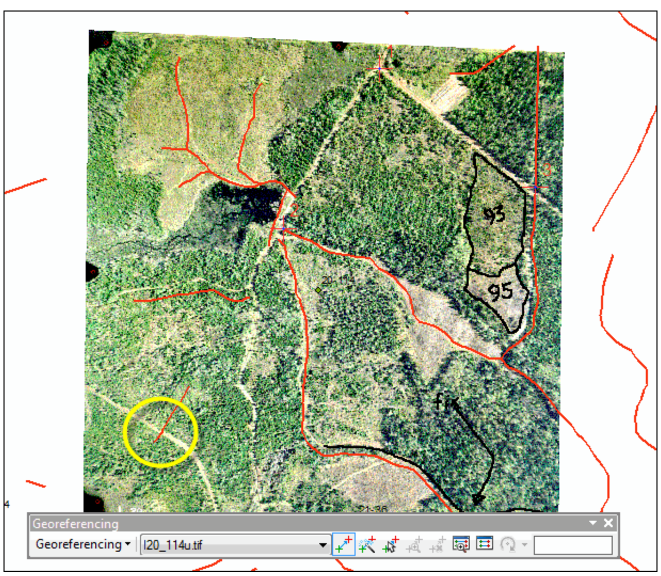


Figure 17. A fourth control point possibility.

16 Zoom in on the area and establish a control point. (Remember, connect photo to layer, not vice versa.)

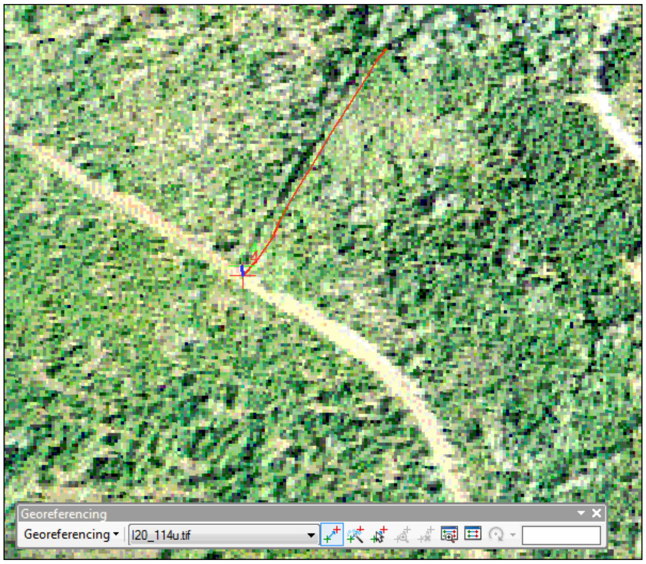
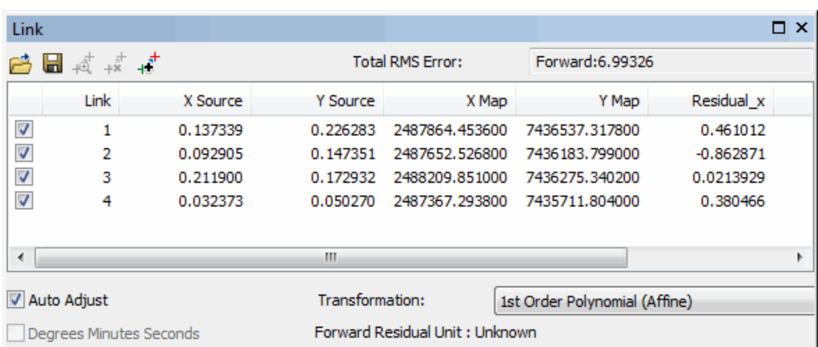


Figure 18. The fourth control further adjusts the photo.

That should do it. If you return to full photo view, you should now see a pretty good fit.

You can verify the precision of the fit by opening the link table.

17 Click and examine the control point residuals and root mean square (RMS) error.



Link

Total RMS Error: Forward:6.99326

	Link	X Source	Y Source	X Map	Y Map	Residual_x
☑	1	0.137339	0.226283	2487864.453600	7436537.317800	0.461012
☑	2	0.092905	0.147351	2487652.526800	7436183.799000	-0.862871
☑	3	0.211900	0.172932	2488209.851000	7436275.340200	0.0213929
☑	4	0.032373	0.050270	2487367.293800	7435711.804000	0.380466

☑ Auto Adjust Transformation: 1st Order Polynomial (Affine)

☐ Degrees Minutes Seconds Forward Residual Unit : Unknown

Question 1: *What does the RMS error measure?*

Figure 19. The link table shows a good fit with small residuals and an RMS error of almost 7 m.

The overall fit is excellent, with an RMS error of 6.99 meters (m) (yours will not be exactly the same).

If you were concerned about the fit, or if one control point had an obviously large residual, you could delete the control point, zoom in on the area, and try again. Keep in mind that the photo scale is 1:5,000, so a thin line is about 5 m on the ground.

Once you're satisfied with your georeferencing effort, you can get on with the original task of correcting the road digitizing error indicated on the photo.

First, save the georeferenced image before proceeding. That way, if you ever need it again, you won't have to go through a painful georeferencing process.

18 Select *Rectify* from the *Georeferencing* drop-down list and save the georeferenced image as *l20_114r.tif* in the *Updates* folder.

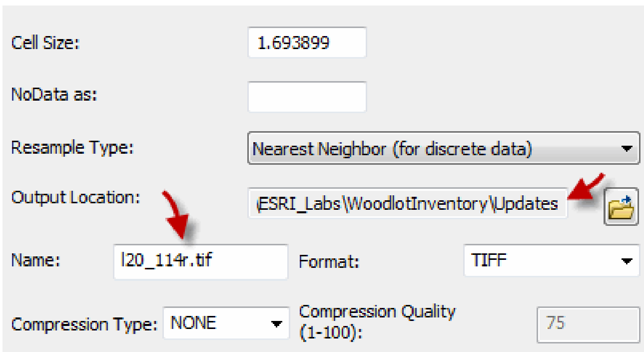


Figure 20. Saving the georeferenced photo as a TIFF image.

19 Close the *Georeferencing* toolbar.

Now you can fix that road digitizing error using your georeferenced image as a guide.

Correct the error in the secondary roads feature class

Correcting the secondary road error should be fairly straightforward using the ArcMap Editor. It should be a matter of simply moving incorrectly located road feature vertices until they align with their correct location on the secondary road visible in the georeferenced aerial photo.

Related Concept: Digital mapping—Feature class editing

1 Add the Editor toolbar (*Customize » Toolbars*). Position it at a convenient location.

2 From the *Editor* drop-down menu, click *Start Editing*. You can also close the *Editor* window, or pin it.

In the lower left corner of the aerial photo, you'll see where someone has marked up the photo to indicate an error in one of the secondary roads found in the *roads* feature class.

3 Zoom in on the error and then double-click the *Secondary Roads* line feature using the *Editor* pointer ().

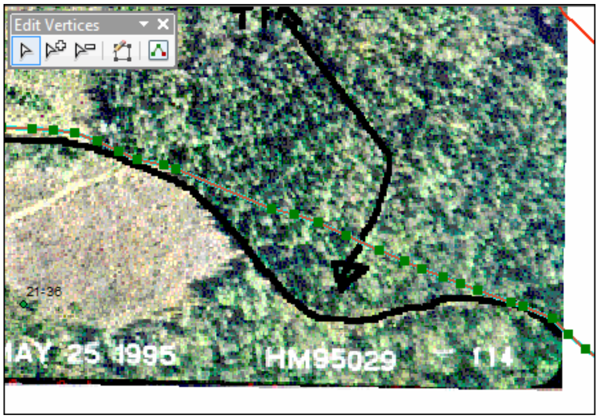


Figure 21. Double-clicking exposes individual line vertices (green squares) and an *Edit Vertices* toolbar.

4 Click and carefully drag the individual vertices to their correct positions as seen on the photo.

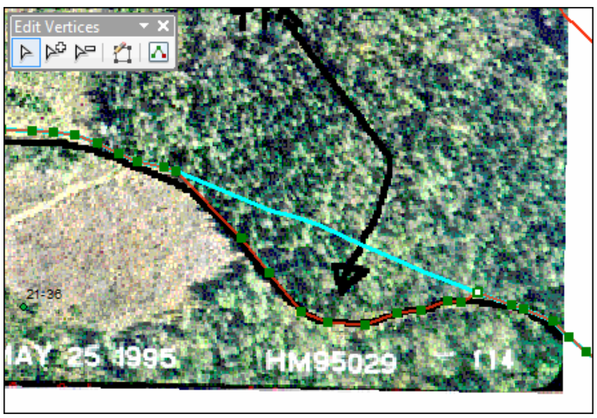


Figure 22. *Secondary Roads* feature vertices moved to align with the correct road location, leaving a ghost line (turquoise) behind.

If you click once, away from the edited line, you'll see the road feature in its new correct location.

5 Stop editing and save your edits.

You should probably rename roads to avoid any confusion later.

6 In the *Catalog* window, rename *roads* to *roads_fixed* with the alias *Secondary Roads (fixed)*.

With that, you're ready to tackle the second, but more challenging, task of updating the *cover* feature class to reflect recent harvesting activity.

Digitize two recent clearcuts

In forestry, updating an inventory with clearcuts, like other management activities, is accomplished in one of two ways. It can be done in situ, as you did with the secondary road correction, or using an overlay method.

The in situ method is more accurate but more time consuming. It also requires at least an ArcEditor™ license of ArcGIS. The overlay method is less accurate but faster. It's particularly well suited for mass updating of harvesting and silviculture activities where changes are captured in the field using aerial photos or GPS.

You'll use the overlay updating method. That means first digitizing the two clearcuts outlined on your recently georeferenced aerial photo *l20_114r*.

Related Concept: Digital mapping—Feature class editing

1 First, zoom in on the aerial photo using *Zoom To Layer*.

2 Remove all layers except *l20_114u*.

3 Add the cover types feature class (*cover*) as a layer.

Of course, that hides the photo.

4 Symbolize *Cover Types* polygons with a hollow fill and pinkish outline of width 1.5.

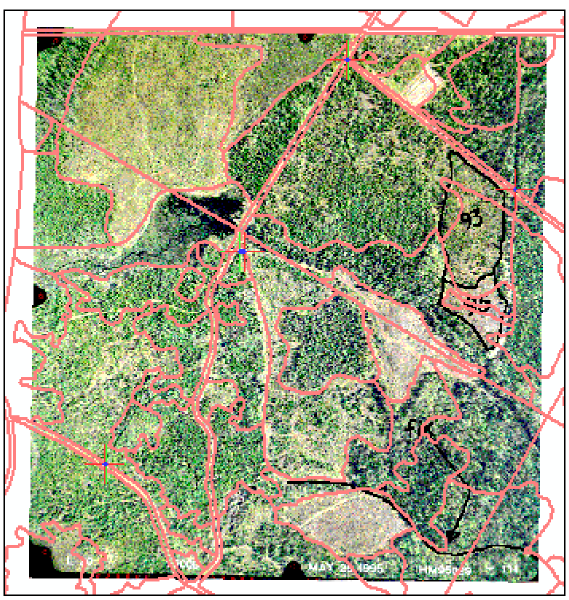


Figure 23. Two clearcuts, 93 and 95, have affected a number of Woodlot stands.

You can see where the two clearcuts, delineated on the aerial photo, have wholly or partially cut over a number of stands.

If you were using the in situ method, you'd rearrange or remove the boundaries of existing stands to reflect the clearcuts visible in the background photo. Using the overlay method, on the other hand, you'll instead simply digitize the boundaries of the clearcuts into a new feature class and then overlay that onto the cover types feature class to accomplish the update.

5 Create a new polygon feature class named *clearcuts* by right-clicking the *Woodlot* geodatabase in the *Catalog* window and selecting *New » Feature Class*. Import the feature class' coordinate system from *basemap*, and don't add any attribute fields.

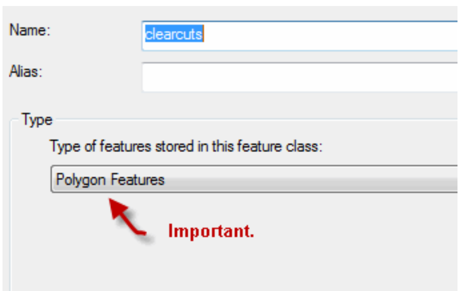


Figure 24. Creating a polygon feature class for digitizing the two clearcuts.

6 Start editing and select *clearcuts* as the editing layer. Pin the *Create Features* window.

7 Zoom in on the clearcuts.

Now, before you start digitizing the clearcuts, you'll need to set an Editor snapping specification. This setting will let you snap to stand boundaries (edges) or vertices in *Cover Types* as you digitize the clearcut polygons, preventing the creation of small remnant polygons.

8 In the *Editor* toolbar drop-down list, select *Snapping » Snapping Toolbar* and then enable both *vertex* and *edge* snapping.

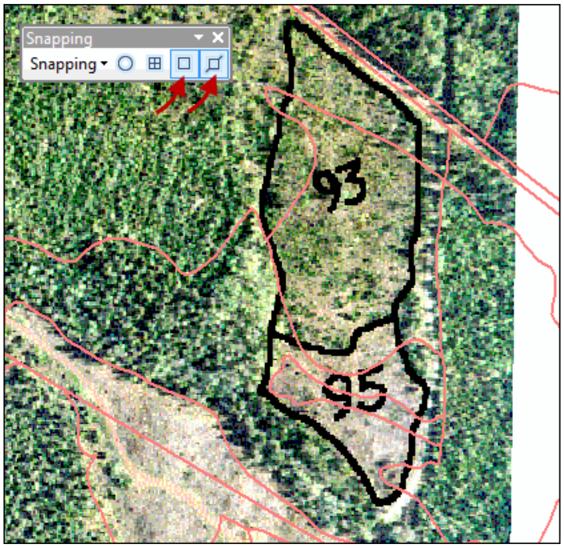


Figure 25. Enabling edge and vertex snapping.

9 Open the *Create Features* window and click *clearcuts*.

Start by digitizing the outside boundary that outlines the two clearcuts. Once that's done, it's easy to digitize the line that separates the two.

Note that considerable freedom can be exercised in digitizing the right boundary of the clearcuts. You'll want to follow existing stand boundaries as much as possible to avoid creating a number of small leftover polygons.

10 Click a boundary location to start digitizing vertices and then click at each change of direction as you trace the outside boundary. Double-click when you return to the start point. (If you mess up a vertex, you can undo it by pressing Ctrl+Z or by clicking the button.)

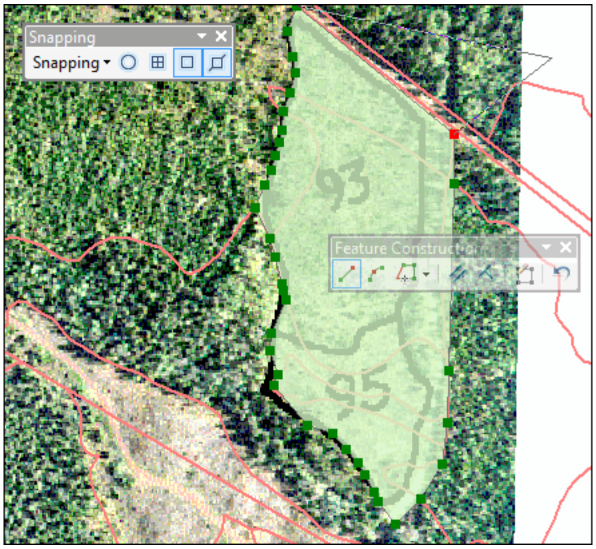


Figure 26. Digitizing vertices that define the outside boundary of the clearcuts.

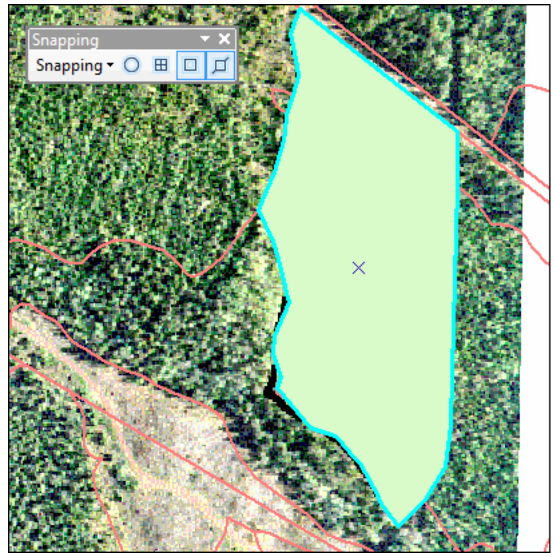


Figure 27. Completed clearcuts polygon.

You should end up with a single polygon feature in the *clearcuts* feature class.

Now you can digitize the line that separates the 93 and 95 clearcuts.

11 First, though, symbolize the *clearcuts* polygon with a hollow fill.

12 Now, with the *clearcuts* polygon still selected, click the *Split Polygons* tool () on the *Editor* toolbar and then use it to digitize the vertices of the line that separates the two clearcuts, making sure that you start and end on the new feature's boundaries (edges).

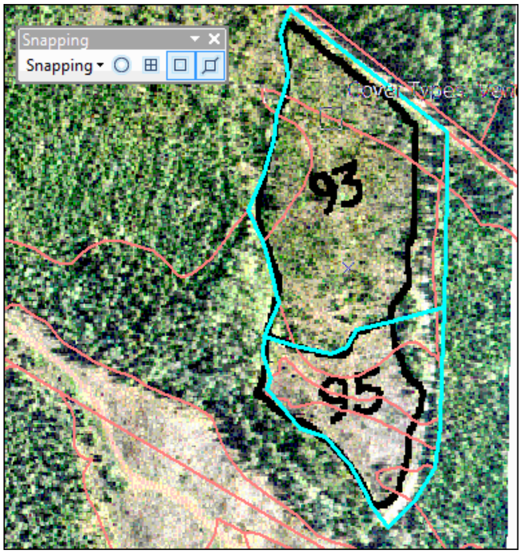


Figure 28. A digitized line has split the single *clearcuts* polygon into two.

Double-clicking either of the polygons would expose their vertices, allowing you to fine-tune their positions by clicking and dragging.

13 Stop editing and save your edits.

It's hard to see the new clearcuts now.

14 Turn off *Cover Types* and then symbolize *clearcuts* polygons with a red outline of width 1.5.

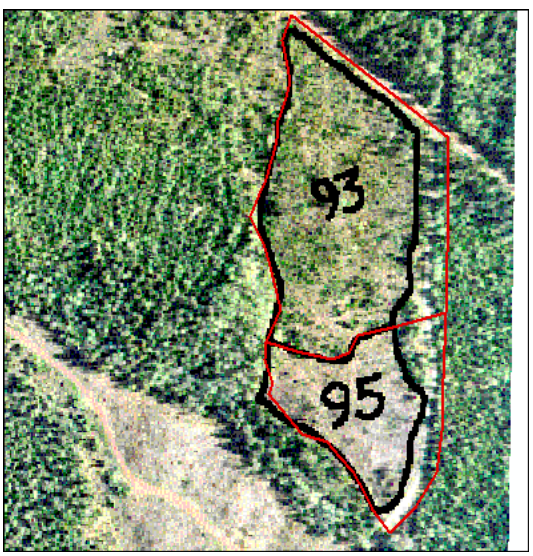


Figure 29. The two clearcuts stored in the *clearcuts* feature class.

With that, you have the 93 and 95 clearcuts digitized. It's a matter now of somehow integrating them into the cover types feature class. That's where the overlay comes in.

UPDATE THE COVER TYPES FEATURE CLASS WITH CLEARCUTS

You can't simply copy and paste (i.e., merge) the clearcuts features into the *cover types* feature class. You'll have to overlay the clearcuts on the cover types feature class and then carefully edit the result. Here's how that will work.

RELATED CONCEPT: GEOPROCESSING—OVERLAYING FEATURES

1 In your ArcMap document, remove all layers except *clearcuts*.

2 Using the *Union* tool in ArcToolbox™ (*Analysis Tools » Overlay*), overlay *cover* with *clearcuts*. Use an *XY Tolerance* of 3 m and disable *Gaps Allowed* to help eliminate polygon slivers. Name the output *cover_ clearcuts*.

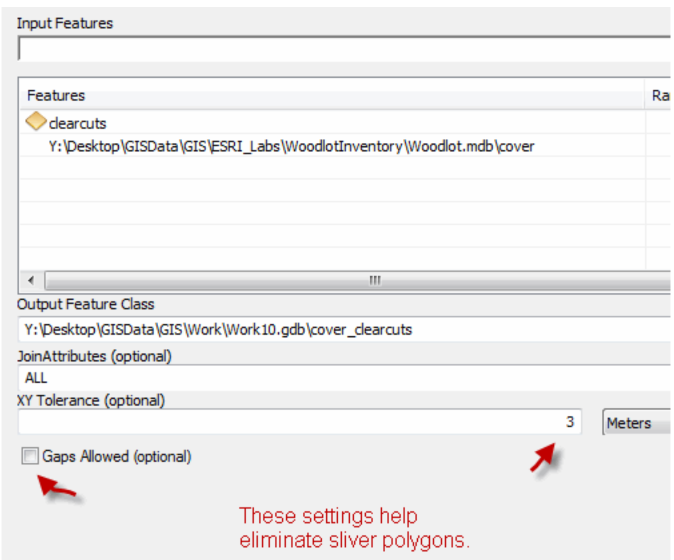


Figure 30. Overlaying clearcut polygons on the cover types feature class (*cover*).

Question 2: *When using the* Union *tool, what would happen if the* XY Tolerance *setting were larger, for instance, 4 or even 5 m, or smaller?*

3 If not already, zoom in on the *clearcuts* features.

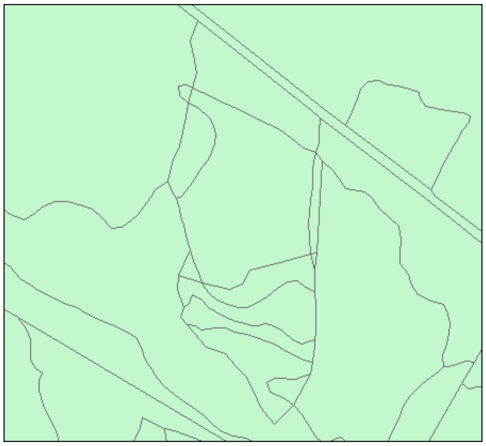
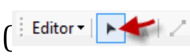


Figure 31. A new feature class incorporating clearcuts into existing cover types features.

Unlike a merge, the union overlay has integrated the *clearcuts* polygons with *cover* polygons by cutting the latter into pieces where intersects occurred. You'll note too, that in the process, clearcut boundaries were moved to snap to *cover* polygon boundaries wherever they were 3 m or less apart.

What you need to do now is erase all the interior polygons that have formed within the two clearcuts. You can see them in the ArcMap display, but how do you identify them?

4 Start editing again, but this time select *cover_clearcuts* as the target. Pin the *Create Features* window.

5 Then, using the *Editor* pointer (

), click and then press Shift and click the four internal features that comprise clearcut 93 (topmost).

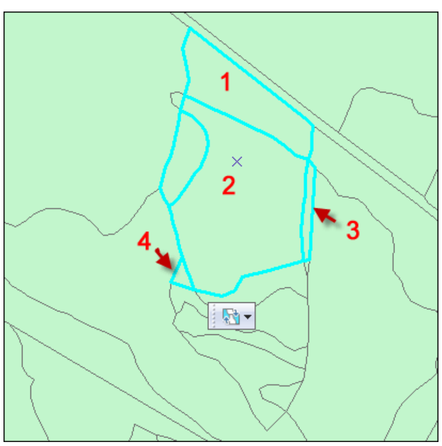


Figure 32. Selecting the four polygons that comprise the 93 clearcut in *cover_clearcuts*.

Question 3: *It looks like there are five polygons. Why are just four involved?*

6 Now, with the four selected, select *Merge* from the *Editor* drop-down list. Accept the default *merge feature*.

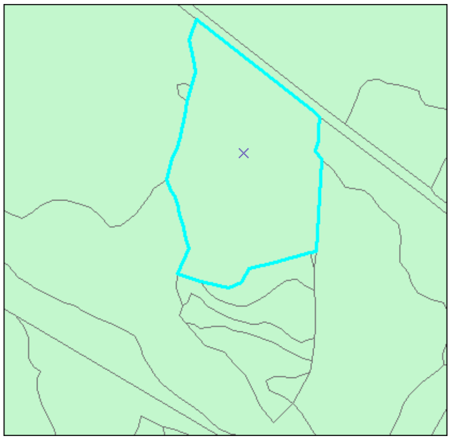


Figure 33. Merging leaves a single polygon for the 93 clearcut.

Question 4: *How would you remove the small leftover polygon that's occurred at the 10 o'clock position along the edge of the 93 clearcut?*

While the 93 clearcut polygon is selected, it would be a good time to updates its attributes.

7 Click the table *Attributes* button (   ) to display the polygon's existing attributes.

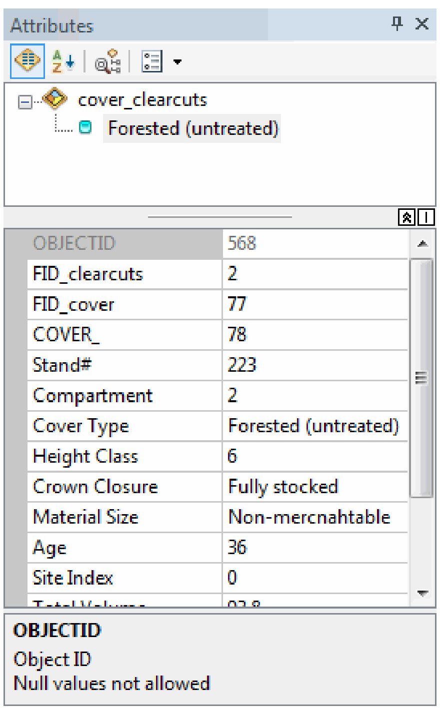


Figure 34. Attributes listed for the 93 clearcut need updating.

Obviously, these attributes were copied from an existing stand during the merge and are no longer valid. Fortunately, the entries are easily changed in the *Attributes* window.

8 Update 93 clearcut attributes as follows:

COVER_	78
Stand#	298
Compartment	2
Cover Type	Recent clearcut
Height Class	0
Crown Closure	Clearcut
Material Size	Non-mercnahtable
Age	0
Site Index	0
Total Volume	0
Volume Yield	0
SHAPE_Length	773.222436

Figure 35. Updated attributes for the 93 clearcut.

Now, isolate and reattribute the 95 clearcut using the same procedure.

9 Select all the polygons within the 95 clearcut, which is easiest if you zoom in further on the clearcut.

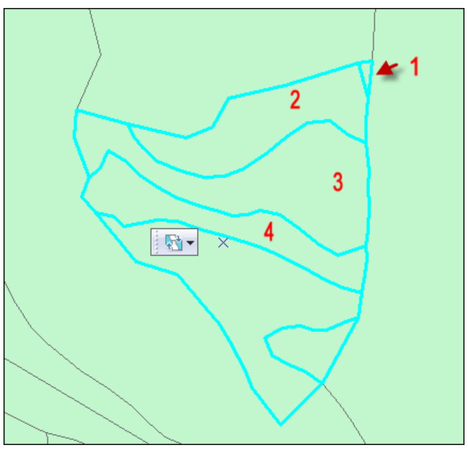


Figure 36. Selecting the four polygons that comprise the 95 clearcut in *cover_clearcuts*.

10 Select *Merge* from the *Editor* drop-down list. Accept the default *merge feature*.

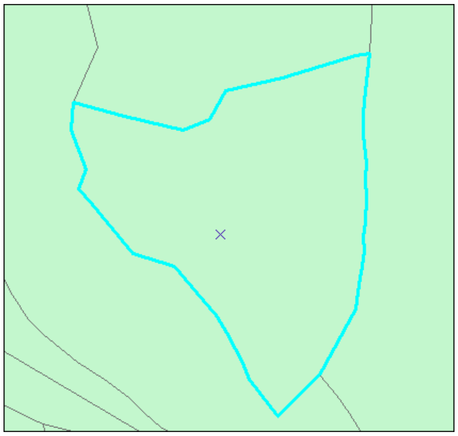


Figure 37. Merging leaves a single polygon for the 95 clearcut.

11 Update 95 clearcut attributes as follows:

COVER_	104
Stand#	297
Compartment	2
Cover Type	Recent clearcut
Height Class	0
Crown Closure	Clearcut
Material Size	Non-mercnahtable
Age	0
Site Index	0
Total Volume	0
Volume Yield	0
SHAPE_Length	571.080596
[illegible]	[illegible]

Figure 38. Updated attributes for the 95 clearcut.

12 Stop editing and save your edits.

Conclusion

This exercise was long and challenging, but such is life when updating forest inventories with ongoing activities like harvesting and silviculture, not to mention disturbances such as forest fires.

As you've probably concluded, updating feature classes, especially polygon feature classes, involves some rather complex and tedious procedures. Regardless, you should note that aerial photos or other imagery play a key role in the process. So, knowing how to georeference imagery is an important GIS skill.

Submit your work

Suggested student deliverables

- Woodlot secondary roads feature class corrected for an out-of-place road feature
- Woodlot cover types feature class updated with two recent clearcuts
- Answers to the questions posed in the exercise:
  - When georeferencing an image, what does the RMS error measure?
  - When using the *Union* tool, what would happen if the *XY Tolerance* setting were larger, for instance, 4 or even 5 m, or smaller?
  - When selecting the internal polygons in the 93 clearcut, only four were indicated, but it looked like there were five. Why?
  - In *cover_clearcuts*, how would you remove the small leftover polygon that exists at the 10 o'clock position along the edge of the 93 clearcut?
- An update of the cover types feature class (*cover_clearcuts*) for additional clearcuts using one of the other aerial photos in the Woodlot inventory, for example, *l24_129*

Credits

Sources of supplied data

Course Data

Data\cover, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\highway, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\newprop, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\tin, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Woodlot.mdb, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Codes\Woodlot_Codes.xls, courtesy of University of New Brunswick UNB Faculty of Forestry and Environmental Management

Data\Coordinate Systems\ATS 1977 New Brunswick Stereographic.prj, courtesy of ESRI
Data\Coordinate Systems\NAD 1983 CSRS New Brunswick Stereographic.prj, courtesy of ESRI

Data\GPS\Knowledge.shp, courtesy of University of New Brunswick
Data\GPS\towers.xls, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Layer Files\Age Classes.lyr, courtesy of Glen Jordan
Data\Layer Files\Air Photo Centre Points.lyr, courtesy of Glen Jordan
Data\Layer Files\Main Roads.lyr, courtesy of Glen Jordan
Data\Layer Files\Mgt Compartments.lyr, courtesy of Glen Jordan
Data\Layer Files\Non-forested.lyr, courtesy of Glen Jordan
Data\Layer Files\Secondary Roads.lyr, courtesy of Glen Jordan
Data\Layer Files\Streams.lyr, courtesy of Glen Jordan

Data\Mass Points\DTM.txt, courtesy of Service New Brunswick

Data\Models\Clearcutting.tbx, courtesy of Glen Jordan
Data\Models\Forest Analysis.tbx, courtesy of Glen Jordan
Data\Models\Forest Values.tbx, courtesy of Glen Jordan

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