**Procedure**

Ken,

I’m working on an R package to cut out many of these steps, but here is a glimpse of the long way ‘round. There are four parts to this demo, and I uploaded the required files to <https://github.com/tmacwhite/TransectDemo>. As I’m writing this on my Mac (which doesn’t have Arc installed), the Part 2 instructions are for QGIS but are largely similar (and actually a bit easier) in ArcMap.

Part 1: (optional) Acquire raster and vector data

Part 2. Generate transects using QGIS/Arc

Part 3. Create transect map using R

Part 4. (optional) Refine map in Illustrator

**Part 1. (optional) Acquire raster and vector data**

For simplicity this demo uses 1 arc-second/30m elevation data from the Shuttle Radar Topography Mission Tile Grabber (<http://dwtkns.com/srtm/>) and large scale (1:10m) shapefiles downloaded from Natural Earth (<http://www.naturalearthdata.com>). These data are located in the GitHub repository if you want to skip these steps.

1. Create a project folder. Make it something simple, like “Crater\_Lake\_Transects,” and remember the file path.
2. Download the elevation data “[srtm\_12\_04](http://srtm.csi.cgiar.org/SRT-ZIP/SRTM_V41/SRTM_Data_GeoTiff/srtm_12_04.zip)”
3. Unzip the data and save it to the project folder.
4. Download the “[Parks and Protected Lands](https://www.naturalearthdata.com/http//www.naturalearthdata.com/download/10m/cultural/ne_10m_parks_and_protected_lands.zip)” shapefile from Natural Earth 1:10m cultural vectors
5. Unzip the data and save it to the project folder. This folder contains multiple shapefiles. You will use “ne\_10m\_parks\_and\_protected\_lands\_area”.

**Part 2. Generate transects using QGIS/ArcMap**

These instructions were written for QGIS, but the process is similar (and easier and more intuitive) in Arc. You can skip step 4 by using the “Crater\_Lake\_NP” shapefile from the GitHub repository. A note about map projections: This method requires that each transect line has a fixed latitude (y-value) and that lines of latitude are equally spaced. This will ensure that the transects on the final joymap are equally spaced. In practice I tailor the projection to complement the feature being mapped, but for simplicity this demo uses a Plate Carrée projection (EPSG: 32662).

1. Start a new project
2. Add the “srtm\_12\_04” DEM to the map.
3. Add the “ne\_10m\_parks\_and\_protected\_lands\_area” shapefile to the map and place it on top of the elevation raster.
4. Select Crater Lake National Park and create a new layer from this selection. Name it something simple like “Crater\_Lake\_NP”, save it to your project folder, and add it to the map.
5. Zoom to the Crater Lake NP layer
6. Change the projection to the WGS 84 / Plate Carrée projection (EPSG: 32662)
7. Open the vector creation tool “Create grid” (Vector > Research Tools > Create Grid or use the search window). The grid uses the same units of measurement as the projection (in this case, meters), so the spacing between transect lines be specified in those units. Enter these field values:

Grid type: Line

Grid extent: Use layer/canvas extent: Use extent from: Crater\_Lake\_NP

Horizontal spacing: 25,000

Vertical spacing: 500

Grid: Save to File: Save As: “Crater\_Lake\_grid500\_1” in your project folder

Use defaults for all other fields

1. You’ll only use the horizontal lines for your transects, so select the horizontal lines, save as a new layer named “Crater\_Lake\_grid500\_2”, and add them to the map.
2. Finally, you want to clip the lines to boundary of Crater Lake National Park, so open the vector overlay tool “Clip” (Vector > Geoprocessing Tools > Clip or use the search window) and enter these values:

Input layer: Crater\_Lake\_grid500\_2

Clip layer: Crater\_Lake\_NP

Clipped: Save to File: Save As: “Crater\_Lake\_grid500\_3” in your project folder

1. Open the vector creation tool “Generate points (pixel centroids) along line” (use the search window). Enter these field values:

Raster layer: srtm\_12\_04

Vector layer: Crater\_Lake\_grid500\_3

Points from polygons: Save to File: Save As: “Crater\_Lake\_grid500\_4” in your project folder

1. Produce a point file containing elevation values sampled from the elevation raster. This step requires the QGIS plug-in “Point Sampling Tool”. You can find it under “Plugins > Manage and Install Plugins… Once installed, you can find it at Plugins > Analyses > Point Sampling Tool. Enter these field values:

Layer containing sampling points: Crater\_Lake\_grid500\_4

Layers with fields/bands to get values from: srtm\_12\_04 : band 1 (raster)

Output point vector layer: Browse: Save As: “Crater\_Lake\_grid500\_5” in shapefile format and be sure to save it in your project folder

1. Now add a coordinate pair to each point. SAGA > Vector point tools > Add coordinates to points (use the search window). Enter these field values:

Points: Crater\_Lake\_grid500\_5

Points with coordinates: Save to File: Save As: “Crater\_Lake\_grid500\_6” in shapefile format and be sure to save it in your project folder

The Crater\_Lake\_grid500\_6.shp attribute table contains three columns: srtm\_12\_04 (elevation in meters), X (longitude), and Y (latitude).

1. Export the Crater\_Lake\_grid500\_6.shp data as a CSV file: Right-click on the layer in the table of contents, select “Save As…”, and enter these field values:

Format: Comma Separated Value CSV

File name: “Crater\_Lake\_grid500\_6” in your project folder

Use defaults for all other fields

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As you can see, the process requires a lot of minor adjustments to the initial transect line shapefile. In Arc the procedure is shorter and more intuitive. However, as I do not have Arc on my laptop, I can only outline the basic steps:

1. Load the DEM and Crater Lake shapefile.
2. Set the projection.
3. Create fishnet: specify # of desired rows (this is so much easier than in QGIS; also, the original Joy Division visualization used 80 rows!), use only 1-2 columns, and set template extent to the Crater Lake shapefile.
4. Create selection from the horizontal rows. We’ll call this new shapefile the transects
5. Use the Spatial Analyst tool “Extract Multi Values to Points” or “Extract Values to Points” to assign elevation values to the transects. (I cannot remember if you have to first perform the 3D Analyst Function “Interpolate Shape” first.)
6. Add x,y values to the transects.
7. Export the attribute table of the final transect file as a CSV (\*.txt files also work)

**Part 3. Create transect map using R**

1. Open the script file “Demo\_Transects\_Crater\_Lake.R” provided in the GitHub repository. The file is annotated to (briefly) explain the purpose of each step.
2. Install and load two packages. The first is ggplot2, the multipurpose graphics package from Hadley Wickham. The second is ggridges (formerly ggjoy) from Claus O. Wilke.

require(ggplot2)

require(ggridges)

1. Read the CSV file of transect values (Crater\_Lake\_grid500\_6.csv) created in the last step of Part 2.

Crater\_Lake <- read.csv ('.../Crater\_Lake\_Transects/Crater\_Lake\_grid500\_6.csv', header=T)

1. Call the CSV to ensure data values load correctly

Crater\_Lake

1. Create, then call, an unformatted joyplot using geom\_density\_ridges. I included a PDF of the unformatted joyplot in the GitHub repository.

Crater\_Lake\_joyplot <- ggplot(Crater\_Lake, aes(x = X, y = Y,

group = Y, height = srtm\_12\_04)) +

geom\_density\_ridges(stat = "identity", scale = 6, fill="gray10",

color = "white")

Crater\_Lake\_joyplot

1. Stylize the plot to add a title and remove axis labels, ticks, gridlines, etc. These settings are not perfect (particularly the title), but they’ll do for this demonstration.

Crater\_Lake\_joyplot + theme(panel.grid.major = element\_blank(),

panel.grid.minor = element\_blank(),

panel.background = element\_rect(fill = "gray10"),

axis.line = element\_blank(),

axis.title.x=element\_blank(),

axis.text.x=element\_blank(),

axis.ticks.x=element\_blank(),

axis.title.y=element\_blank(),

axis.text.y=element\_blank(),

axis.ticks.y=element\_blank()) +

annotate("text", x=Inf, y = Inf,

label = "CRATER LAKE NATIONAL PARK", vjust=35.5, hjust=1.5,

color = "white", size = 8)

1. Export the formatted joyplot as a PDF. You are done!

**Part 4. (optional) Refine map in Illustrator**

No instructions. If you wish to manipulate or refine the transect map outside of R, simply open the PDF in Illustrator to edit.