Vulnerability Plotting Tutorial

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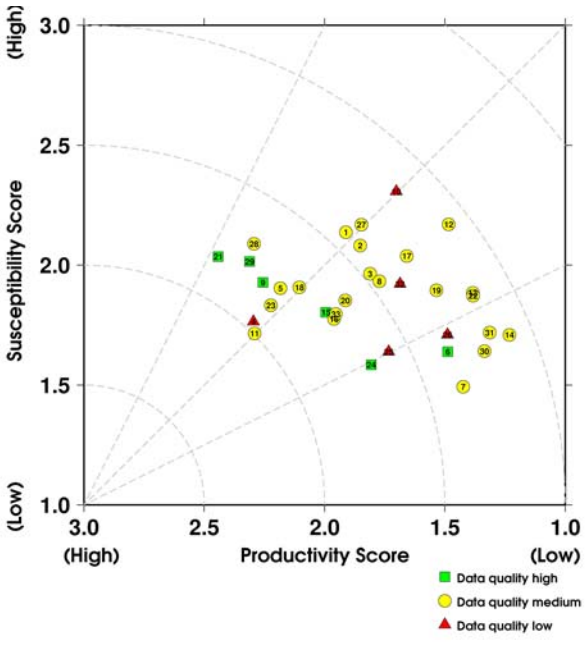
Introduction

The vulnerability plots presented in the VEWG report were created using freely available software licensed under the GNU General Public License. There are 2 software packages which must be downloaded and installed onto your systems to replicate the approach. Some software packages may require administrative privileges so please contact your systems administrator if FDCC permission issues arise. The following description works for the most common desktop and notebook Windows XP Professional 32-bit systems. The same software approach would also work with Linux, Unix, MacOS, and virtually every other operating system available but would require different installation files and additionally there may be minor changes in the gawk syntax used in the scripts. The examples presented here conform to the Windows version running in a Command Prompt window. This tutorial provides a brief description of the rationale for why special software was required, the software utilized, input data preparation, execution, and final products.

Rationale

The type of plot required for the vulnerability analysis (example shown at right) has several features not easily implemented in most plotting software:

- Reversed x-axis scale was required to maintain intuitive logic of axes and quadrants of the plot, where good vs. bad regions exist, for example.
- Flexible point labeling using values embedded in the data file.
- Flexible symbol type and colors determined by some other value(s) in the individual data record.
- Flexible gridline layout beyond standard horizontal and vertical lines.
- Ability to batch process for uniformity and efficiency.



While many software packages could create

something similar with much user intervention, it was desirable to have something quickly reproducible with alternate data. Therefore, a powerful command-line driven mapping software package was applied to accommodate these needs.

Software

The following is a list of utilized software package (2 required, 2 optional) versions available for download as of 25 March, 2009. Other versions may be available at the time of this reading, and it is highly recommended to check for current versions as this can change rapidly. There may be compatibility issues as well, so the user is cautioned to conduct some research prior to downloading and installing, if these particular versions are not used. The first 2 software packages are required to generate postscript graphic output. If this format is unsuitable, the latter 2 optional software packages enable handling and conversion of the postscript graphic output to other formats such as JPEG. This guide will assume the reader wishes to install the optional software packages. All software packages install easily with executable installation files or are simply unzipped into a folder.

- Generic Mapping Tools (required primary plotting software)
  - Information at http://gmt.soest.hawaii.edu/
  - Download 16.7MB executable installer:
    - ftp://ftp.soest.hawaii.edu/gmt/windows/GMT_basic_install.exe
- Gawk (required data parsing utility software)
  - Information at http://gnuwin32.sourceforge.net/packages/gawk.htm
  - Download 174KB zipped executable program:
    - ftp://ftp.soest.hawaii.edu/gmt/windows/gawk316.zip
- Ghostscript (optional software for handling GMT postscript graphic output)
  - Information at http://pages.cs.wisc.edu/~ghost/
  - Download 11.9MB executable installer:
    - http://downloads.sourceforge.net/ghostscript/gs864w32.exe
- GSview (optional user friendly interface for Ghostscript)
  - Information at http://pages.cs.wisc.edu/~ghost/
  - Download 1.43MB executable installer:
    - http://www.hawaiieod.com/gsv49w32.exe

After all 4 software packages are downloaded and installed, associate ps files with GSview by navigating to Control Panel, Folder Options, then scroll through the list until PS is highlighted, then be sure that this file type opens with GSview32.exe. Thereafter, by simply clicking on the postscript file output in Windows Explorer the file will load and be viewable it in the GSview interface. Within the GSview interface the file can be exported to a more compatible format graphic (e.g., JPEG) for embedding into Word or Powerpoint files. Check the path environmental variable in the Command Prompt window to be sure that pointers to folders holding software packages are incorporated (type ‘set’ or ‘set|more’ in the Command Prompt window to display the values of environmental variables). The installers should do this automatically but this can also be done manually by going to Control Panel, System, Advanced,

Environmental Variables and carefully adding entries to the path variable. This may also require temporary administrative privileges if FDCC permission issues arise.

Data Preparation

Input data for the script is ASCII comma delimited format with 11 columns of information separated by commas. The format of the columns 1-11 is as follows:

1. Code for ID, used for plotting within symbols, numeric or alpha.
2. Description of the species, for reference only, numeric or alpha.
3. Description of fishery, for reference only, numeric or alpha.
4. Productivity mean weighted attribute value, numeric.
5. Productivity mean weighted data quality value, numeric.
6. Susceptibility mean weighted attribute value, numeric.
7. Susceptibility mean weighted data quality value, numeric.
8. Grouping ID, for plotting subsets of the file, numeric or alpha.
9. Indexing ID within group, for reference only, numeric.
10. Number of productivity attributes scored, numeric.
11. Number of susceptibility attributes scored, numeric.

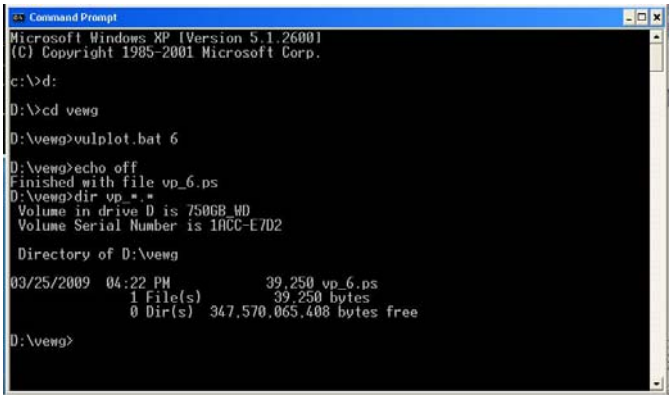
An example of the file is shown here which consists of 2 subsets of Hawaii data to be plotted separately using grouping values of 6 and 7. The data do not have to be sorted. For simplicity only the first 6 species in each of the 2 Hawaii longline fishery sectors are included in this example file called EXAMPLE.CSV. This type of file is easily created and exported from Excel:

File is available at http://www.hawaiieod.com/VEWG/new/EXAMPLE.CSV

```
------------------EXAMPLE.CSV--------------------------------------------------------------
97, Albacore, HI Pelagic Longline - Swordfish, 1.92, 2.52, 1.99, 1.94, 6, 1, 10, 11
98, Bigeye Tuna, HI Pelagic Longline - Swordfish, 1.95, 2.25, 2.10, 1.88, 6, 2, 10, 11
99, Black Marlin, HI Pelagic Longline - Swordfish, 1.77, 2.27, 1.79, 3.49, 6, 3, 10, 9
100, Bullet Tuna, HI Pelagic Longline - Swordfish, 2.34, 3.24, 1.76, 3.90, 6, 4, 10, 9
101, Pacific Pomfret, HI Pelagic Longline - Swordfish, 2.27, 3.25, 1.65, 3.29, 6, 5, 9, 9
102, Blue Shark, HI Pelagic Longline - Swordfish, 1.51, 2.01, 1.71, 1.94, 6, 6, 10, 11
130, Albacore, HI Pelagic Longline - Tuna, 1.91, 2.51, 2.14, 1.91, 7, 1, 10, 11
131, Bigeye Tuna, HI Pelagic Longline - Tuna, 1.85, 2.15, 2.08, 1.86, 7, 2, 10, 11
132, Black Marlin, HI Pelagic Longline - Tuna, 1.81, 2.31, 1.96, 3.47, 7, 3, 10, 9
133, Bullet Tuna, HI Pelagic Longline - Tuna, 2.30, 3.20, 1.76, 3.90, 7, 4, 10, 9
134, Pacific Pomfret, HI Pelagic Longline - Tuna, 2.18, 3.16, 1.90, 3.03, 7, 5, 9, 9
135, Blue Shark, HI Pelagic Longline - Tuna, 1.49, 1.99, 1.64, 1.86, 7, 6, 10, 11
-------------------------------------------------------------------------------------------
```

Execution

The file EXAMPLE.CSV is processed by a batch file which makes use of several of GMT's subroutines and gawk to parse the data. The batch file is run with a single argument (some value entered after the command) which designates the grouping of data to extract and plot. In this example, the



batch file is named VULPLOT.BAT and is invoked at the command prompt by typing (without the quotes) 'VULPLOT.BAT 6', which instructs the plotting commands to only plot grouping number 6 from the EXAMPLE.CSV file. The contents of the ASCII batch file VULPLOT.BAT are as follows:

File is available at http://www.hawaiieod.com/VEWG/new/vulplot.bat

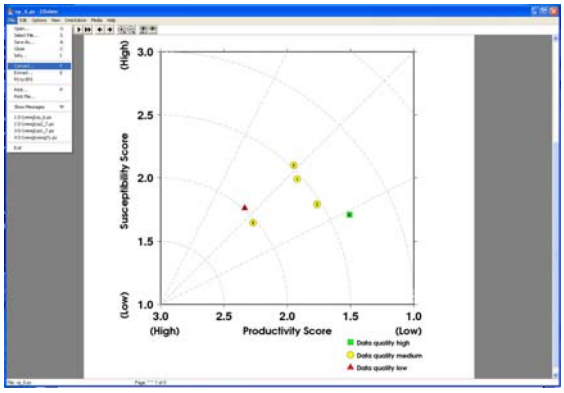
```
------------------VULPLOT.BAT---------------------------------------------------------------
echo off
rem this does subsets with one argument
rem Run by typing vulplot.bat <number to match in column 8>
gmtset BASEMAP_TYPE PLAIN
gmtset PAGE_ORIENTATION PORTRAIT
gmtset PAPER_MEDIA archC+
set range=1/3/1/3
set annot1=f0.5a0.5/f0.5a0.5WeSn
set xpos1=4.25
set ypos1=4.5
set scale=-7/7
set infile=EXAMPLE.CSV
set psfile=vp_%1.ps
set cptfile=vulplot.cpt
psbasemap -P -R%range% -Jx%scale% -K -B%annot1% -X%xpos1% -Y%ypos1% > %psfile%
psxy radius_1.dat -Jx -R -O -K -M -W0.75p/200/200/200ta >> %psfile%
psxy radius_2.dat -Jx -R -O -K -M -W0.75p/200/200/200ta >> %psfile%
psxy radius_3.dat -Jx -R -O -K -M -W0.75p/200/200/200ta >> %psfile%
psxy radius_4.dat -Jx -R -O -K -M -W0.75p/200/200/200ta >> %psfile%
psxy radius_5.dat -Jx -R -O -K -M -W0.75p/200/200/200ta >> %psfile%
psxy segments.dat -Jx -R -O -K -M -W0.75p/200/200/200ta >> %psfile%
gawk -F, "{if (($5+$7)/2<=2 && $8==GROUP) print $4, $6, .50, .40, S; else if (($5+$7)/2>2 &&
    ($5+$7)/2<3.5 && $8==GROUP) print $4, $6, 1.5, .38, C; else if (($5+$7)/2>=3.5 &&
    $8==GROUP) print $4, $6, 2.5, .40, T}" S="s" C="c" T="t" GROUP=%1 %infile% | psxy -
    C%cptfile% -W0.5/0/0/0 -S -O -K -R -Jx -N >> %psfile%
gawk -F, "{if ($8==GROUP) print $4, $6, 7, 0, 1, CM, $9 }" CM="CM" GROUP=%1 %infile% | pstext
    -G0/0/0 -O -K -R -Jx -N >> %psfile%
echo 2 .8 16 0 15 CM (High)                    Productivity Score
    (Low) | pstext -R%range% -Jx -O -K -N >> %psfile%
echo 3.3 2 16 90 15 CM (Low)                     Susceptibility Score
    (High) | pstext -R%range% -Jx -O -K -N >> %psfile%
echo 1.5 0.5 | psxy -St0.4 -G255/0/0 -W0.5/0/0/0 -N -O -K -R -Jx >> %psfile%
echo 1.5 0.6 | psxy -Sc0.38 -G255/255/0 -W.5/0/0/0 -N -O -K -R -Jx >> %psfile%
echo 1.5 0.7 | psxy -Ss0.4 -G0/255/0 -W.5/0/0/0 -N -O -K -R -Jx >> %psfile%
echo 1.45 0.7 10 0 15 LM Data quality high | pstext -R%range% -Jx -O -K -N >> %psfile%
echo 1.45 0.6 10 0 15 LM Data quality medium | pstext -R%range% -Jx -O -K -N >> %psfile%
echo 1.45 0.5 10 0 15 LM Data quality low | pstext -R%range% -Jx -O -N >> %psfile%
echo Finished with file %psfile%
```

Several accessory files are used in the above script for defining the RGB color palette for the symbols based on average data quality scores and x-y coordinates for drawing gridlines. These small ASCII data files simply reside in the folder where the batch file is run, and do not need to be modified or renamed:

- vulplot.cpt, file is available at http://www.hawaiieod.com/VEWG/new/vulplot.cpt
- radius_1.dat, file is available at http://www.hawaiieod.com/VEWG/new/radius_1.dat
- radius_2.dat, file is available at http://www.hawaiieod.com/VEWG/new/radius_2.dat
- radius_3.dat, file is available at http://www.hawaiieod.com/VEWG/new/radius_3.dat
- radius_4.dat, file is available at http://www.hawaiieod.com/VEWG/new/radius_4.dat
- radius_5.dat, file is available at http://www.hawaiieod.com/VEWG/new/radius_5.dat
- segments.dat, file is available at http://www.hawaiieod.com/VEWG/new/segments.dat

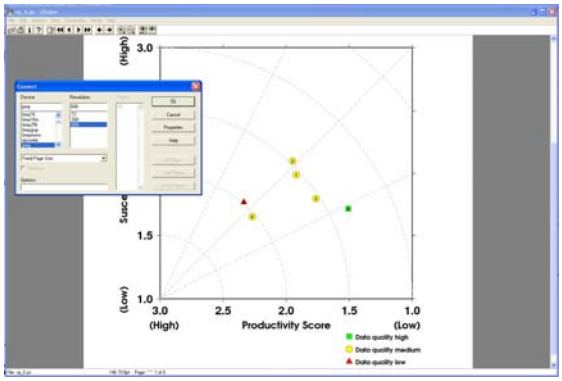
Final Products

The postscript output graphic file from the batch file execution will be named VP_6.PS where the 6 in this example originates from the single argument (6) passed to the batch file. If the Ghostscript and GSview software packages were installed correctly, then by simply double clicking on the file VP_6.PS in Windows Explorer will open up a GSview window with a view of the plot. Options for converting to other formats as well as a variety of other useful options are present.

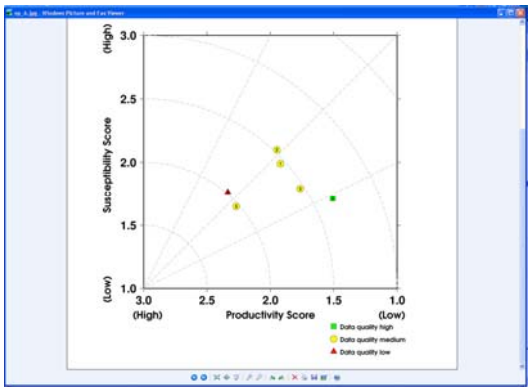


File is available at
http://www.hawaiieod.com/VEWG/new/vp_6.ps

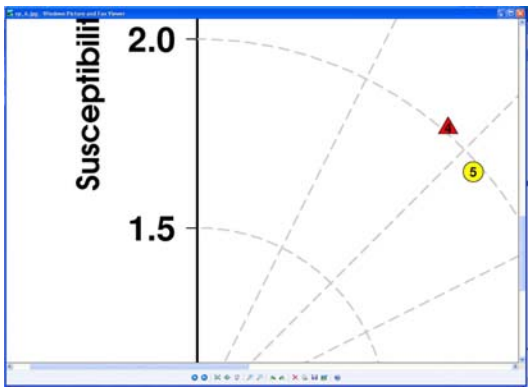
The resulting JPEG file can be opened in any common image viewer or imported into Word or Powerpoint. The resolution and JPEG quality settings can be adjusted to control file size. The settings used here (600dpi and default quality) produce an 800KB JPEG file which exhibits good clarity for both presentation and publication.



File is available at
http://www.hawaiieod.com/VEWG/new/vp_6.jpg



Normal view



Zoomed view