GIS Poster Design & Infographic Tips

Fall 2018

GIS Poster Expo

May 8th, 2018 @ 3:30 – 5:00 PM

- Each May, Tufts holds the largest GIS Poster Expo
- Over 240 student entries!
- If you are in a GIS Class, your poster is automatically entered.
- No formal presentations
- There are cash prizes for **Best in Show** and **Runner Ups.**
- Food & refreshments are served.

Poster Printing Process

- Poster's can be printed in the Data lab in Tisch Library when an assistant is on duty.
  - Printing is free for your GIS posters
  - Can pick up your GIS poster anytime after the poster expo to keep
- Posters sized at 30x40 inches
  - Landscape or Portrait orientation
- Mount your project on poster board provided
- Leave the poster on the pile for your class

Poster Printing & Cataloging Info

- When you go to print, you will be asked to fill out a form about your poster. Info includes:
  - Name, Class, Semester, Year
  - Geographic Region
  - Topic Theme/Keywords (chosen from a list)
  - Methodological Keywords (chosen from a list)
- This form collects info for our Expo Explorer.
- Sign a release, allowing your poster to be displayed on our DataLab.tufts.edu website.

Poster Design Resources

- This presentation! Available on our website at GIS.tufts.edu and on your Trunk site!
- Designing and Creating your Poster – Publisher set-up and PDF directions
- Font Size Cheat Sheet
- GIS Expo Explorer
  - Design, Methods, Data Sources, Ideas
- Geodata.Tufts.edu

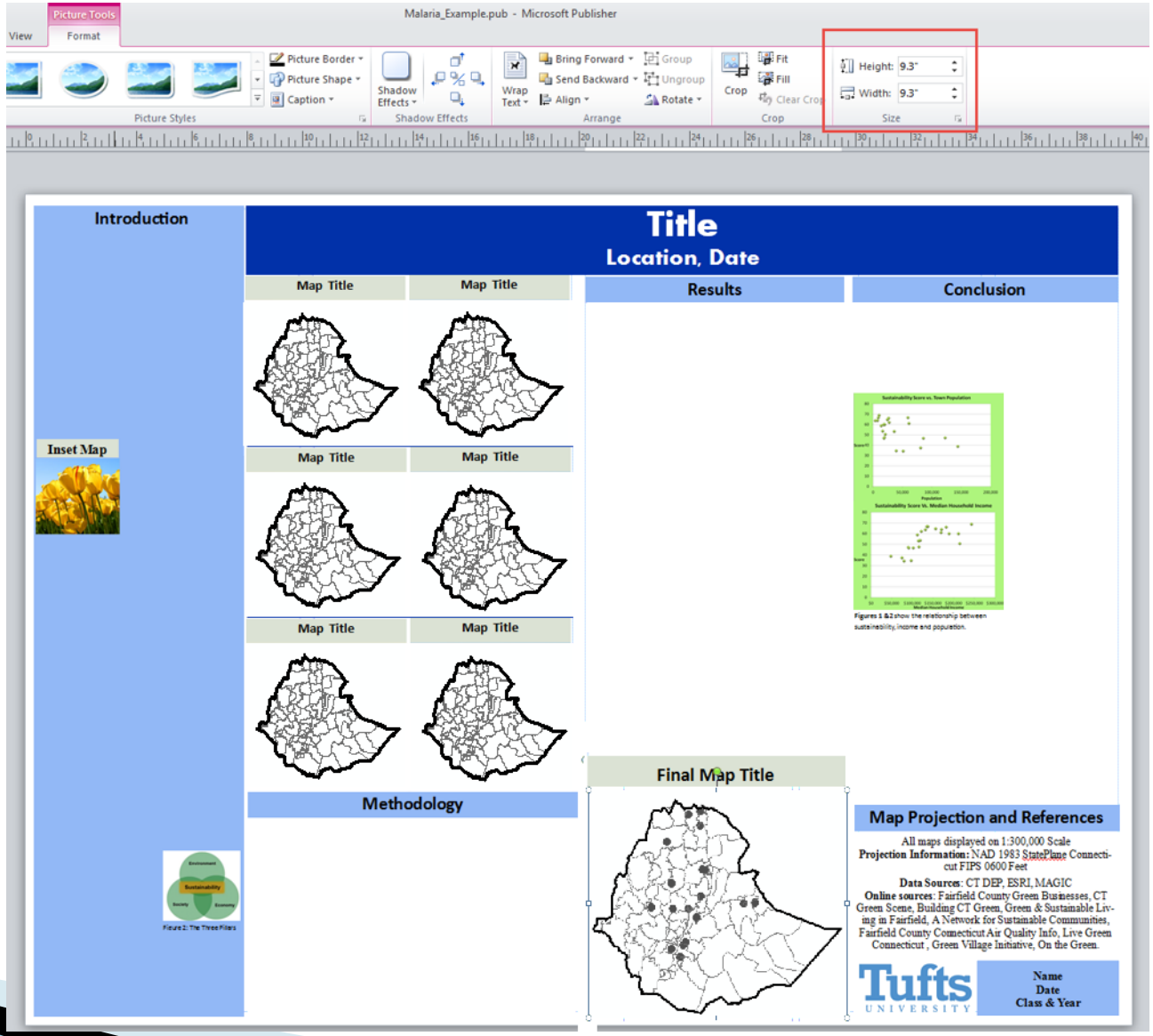
Font Cheat Sheet

(Times New Roman)	(Arial)
96 Poin	96 Poi
72 points	72 points
60 points —	60 points –
48 points – My	48 points – My
36 points – My GIS	36 points – My GIS
28 points – My GIS Poster	28 points – My GIS Poste
24 points – My GIS Poster	24 points – My GIS Poster
22 points – My GIS Poster	22 points – My GIS Poster
18 points – My GIS Poster	18 points – My GIS Poster
14 points – My GIS Poster	14 points – My GIS Poster

Pro Tips for Great GIS Posters

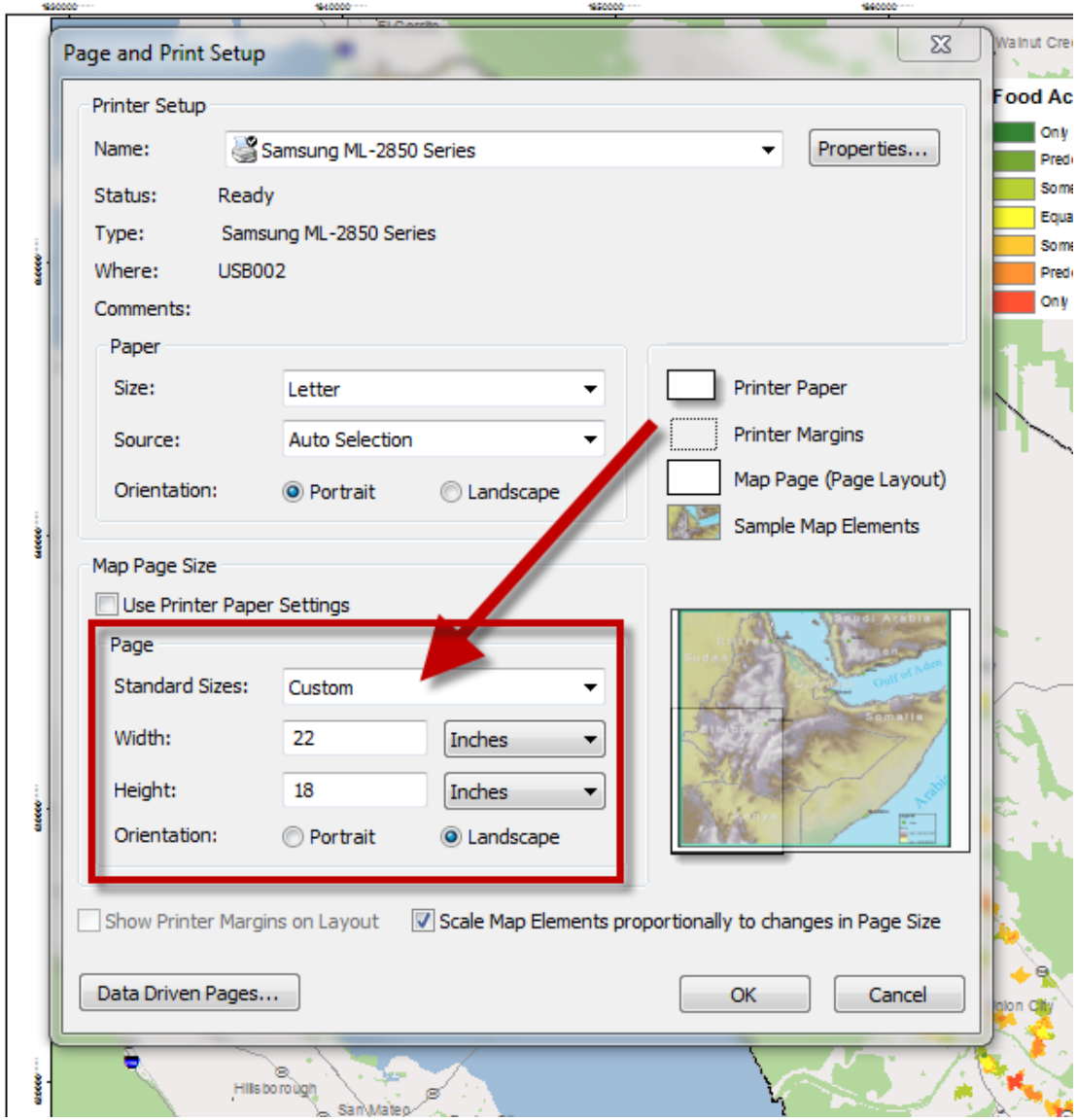
Think Ahead: Plan out your poster BEFORE exporting all your maps!

- Determine the shape of your study area
  - Square vs Rectangle
  - Horizontal vs Vertical
- Export 1 map of your study area extent and figure out where you want your maps to go.
- Create a "dummy" poster so you know what size to set you maps before exporting them!
  - That way you can check that legends, labels, north arrows, scale bars look good!



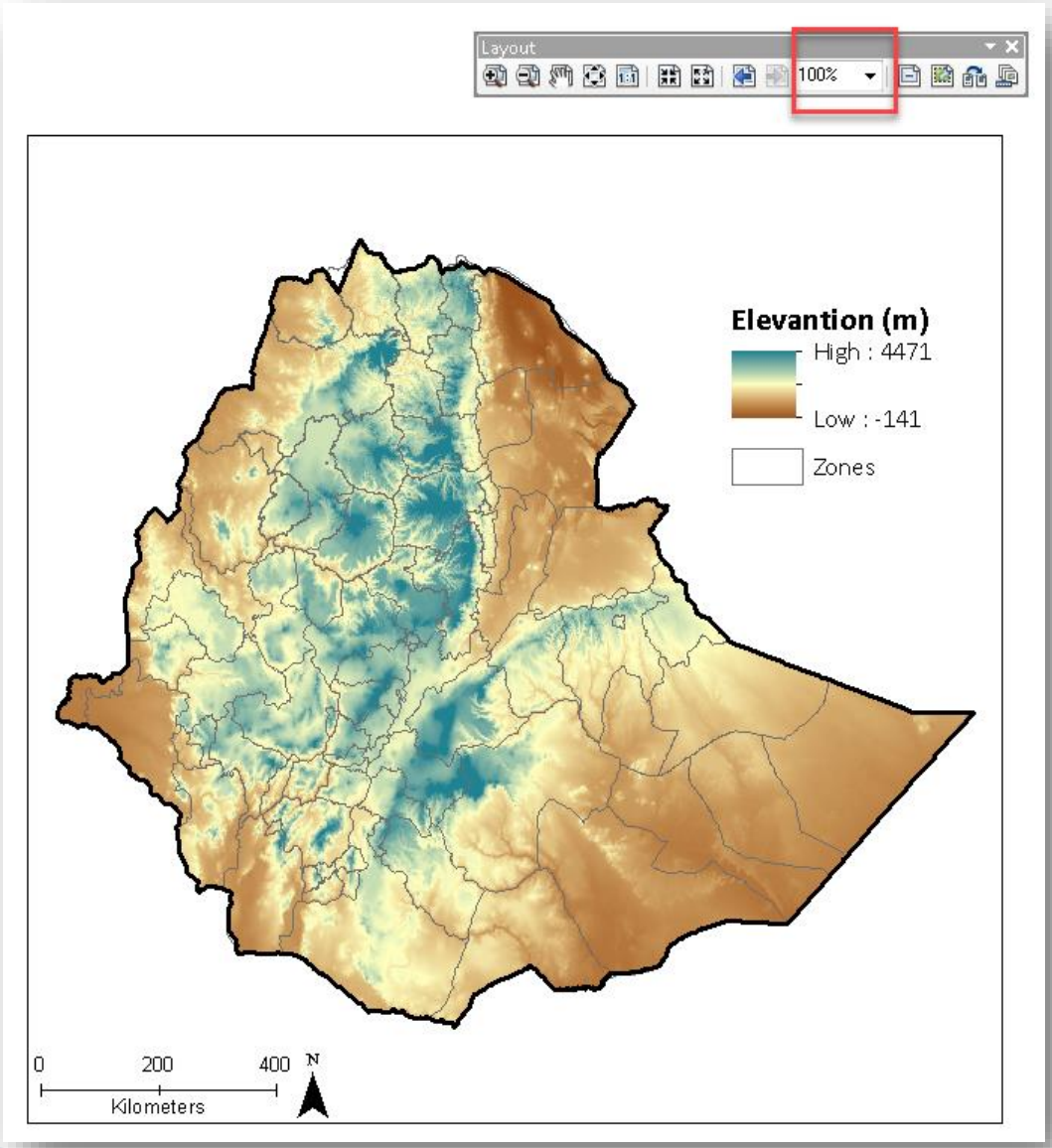
Set your Page Size in ArcMap

- Export maps at the CORRECT SIZE!
- This makes all map elements look good.
  - Legend
  - Scale bar
  - North Arrow
- Also guarantees the resolution looks good! Nothing pixely!



View your Map at 100% in ArcMap

- Use the **Layout Toolbar** to view your map at 100%
- If your page is sized correctly, this ensures all map elements look great!

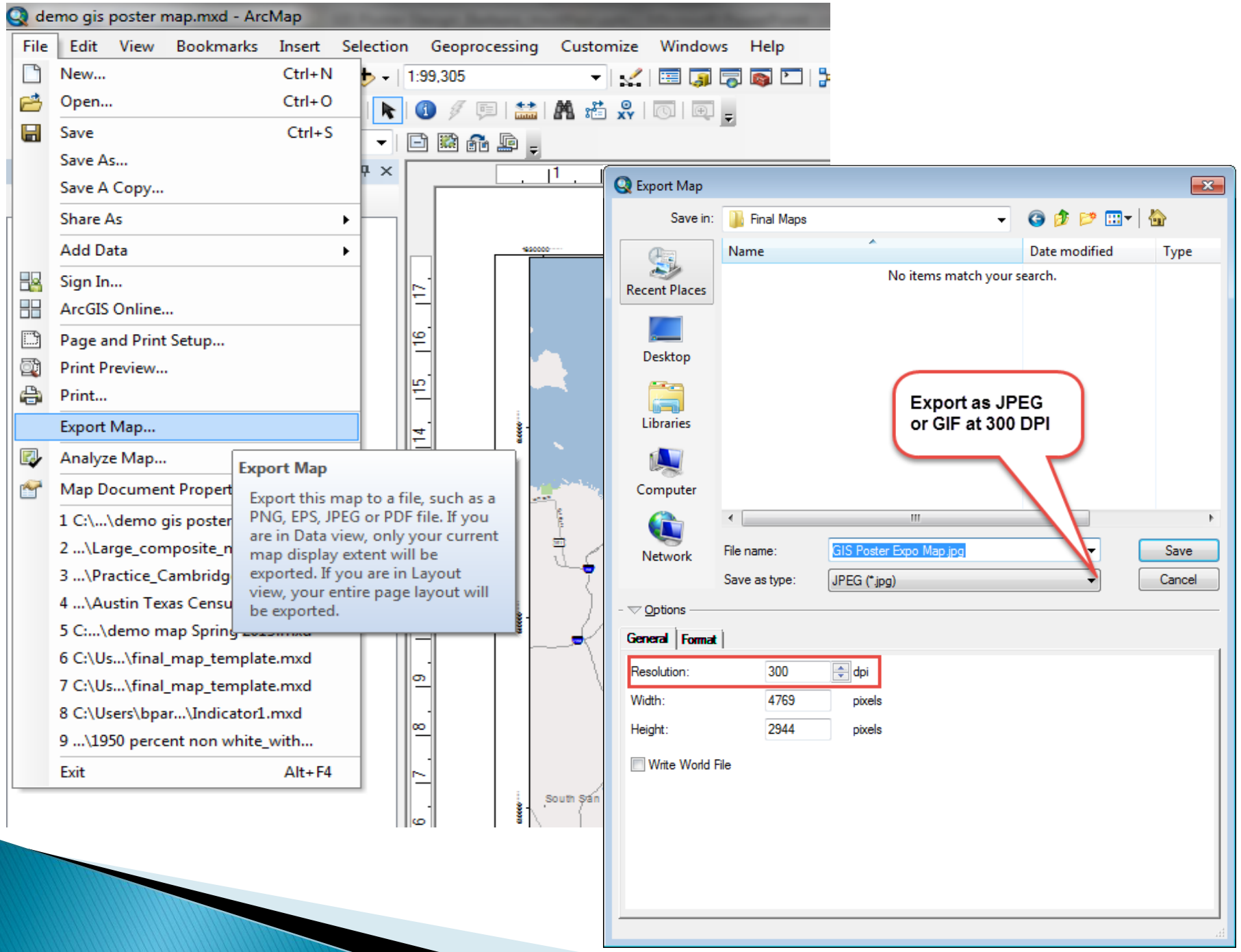


Exporting Maps & Images
What you see is NOT what you get!

- **Export maps with just legend, north arrow, and scale bar.**
  - Make sure your legend is big enough to read on a poster!
  - Don't keep it the default size!!
  - **Use Publisher to put in titles and other explanatory text**

- **Format**: JPG (photos)
  GIF (solid colors, text)
  PNG (Transparency)
  Do NOT use Tiffs! They export too large for publisher!
  Do NOT use PDFs, as you can't import them into publisher!

- **Resolution:** 300 dpi


demo gis poster map.mxd - ArcMap
File
Edit
View
Bookmarks
Insert
Selection
Geoprocessing
Customize
Windows
Help
New... Ctrl+N
Open... Ctrl+O
Save Ctrl+S
Save As...
Save A Copy...
Share As
Add Data
Sign In...
ArcGIS Online...
Page and Print Setup...
Print Preview...
Print...
Export Map...
Analyze Map...
Map Document Propert
1 C:\...\demo gis poster
2 ...\Large_composite_n
3 ...\Practice_Cambridg
4 ...\Austin Texas Censu
5 C:...\demo map Spring
6 C:\Us...\final_map_template.mxd
7 C:\Us...\final_map_template.mxd
8 C:\Users\bpar...\Indicator1.mxd
9 ...\1950 percent non white_with...
Exit Alt+F4
1:99,305
Export Map
Export this map to a file, such as a PNG, EPS, JPEG or PDF file. If you are in Data view, only your current map display extent will be exported. If you are in Layout view, your entire page layout will be exported.
Export Map
Save in: Final Maps
Recent Places
Desktop
Libraries
Computer
Network
Name
Date modified
Type
No items match your search.
Export as JPEG or GIF at 300 DPI
File name: GIS Poster Expo Map.jpg
Save as type: JPEG (*.jpg)
Save
Cancel
Options
General
Format
Resolution: 300 dpi
Width: 4769 pixels
Height: 2944 pixels
Write World File

Add Maps, Graphs and Headings First…

you don't need to write as much as you think!

Introduction

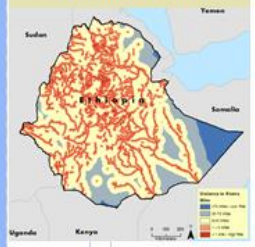
Ethiopia, Africa

Figure 2: The Three Pillars

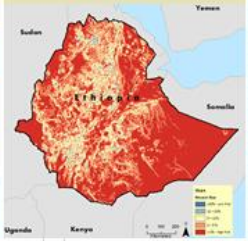
Determining the Risk for Malaria Transmission

Ethiopia, 2015

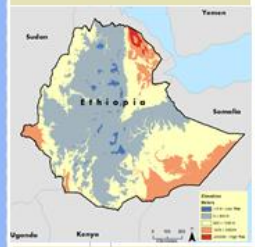
Distance to Rivers



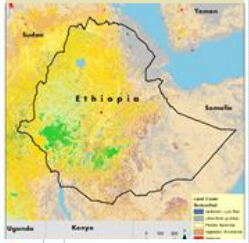
Slope



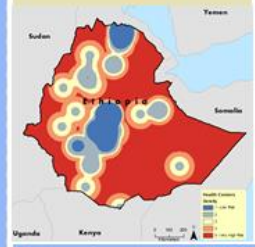
Elevation



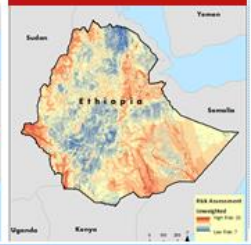
Land Cover Type



Health Centers



Final Risk Score

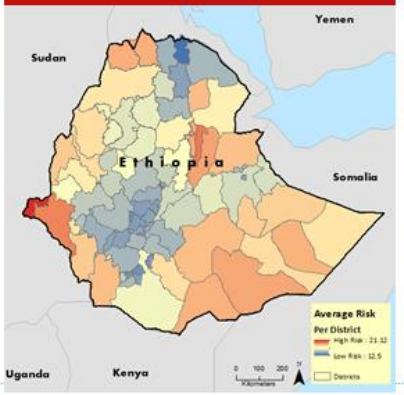


Methodology

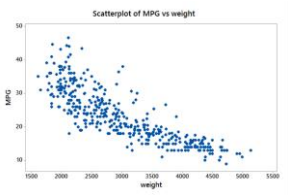
Results

District Name	Average Risk per District	STD	Majority Score	Minority Score	Median	Area Sq. m
Afar	21.119199	0.827169	21	16	21	4,797,000,000
Afar Zone 5	19.498585	1.111284	20	15	20	5,391,000,000
Amara	19.940621	1.764963	19	12	20	23,463,000,000
Afar Zone 2	19.64981	1.226418	19	12	19	16,551,000,000
Afar	19.551028	1.01626	19	12	19	81,542,000,000
Agaga	18.515151	1.416808	19	16	19	297,000,000
Oromia	18.501198	1.323224	18	14	18	3,789,000,000
Mi Hasay	18.451186	1.756069	19	12	19	13,176,000,000
Semiro Mi Hasay	18.378577	1.221445	18	12	18	11,494,000,000
Libon	18.343017	1.594403	19	12	18	25,919,000,000
Agaga	18.320491	1.426803	19	12	19	22,228,000,000
Afar Zone 4	18.160771	1.779996	19	13	18	10,773,000,000
Debub Mi q	18.118369	1.229763	18	11	18	12,794,000,000
Bale	18.105826	1.391782	18	12	18	34,612,000,000

Average Risk per District



Conclusion



Figures 1 &2 show the (relation) between sustainability, income and population.

Map Projection and References

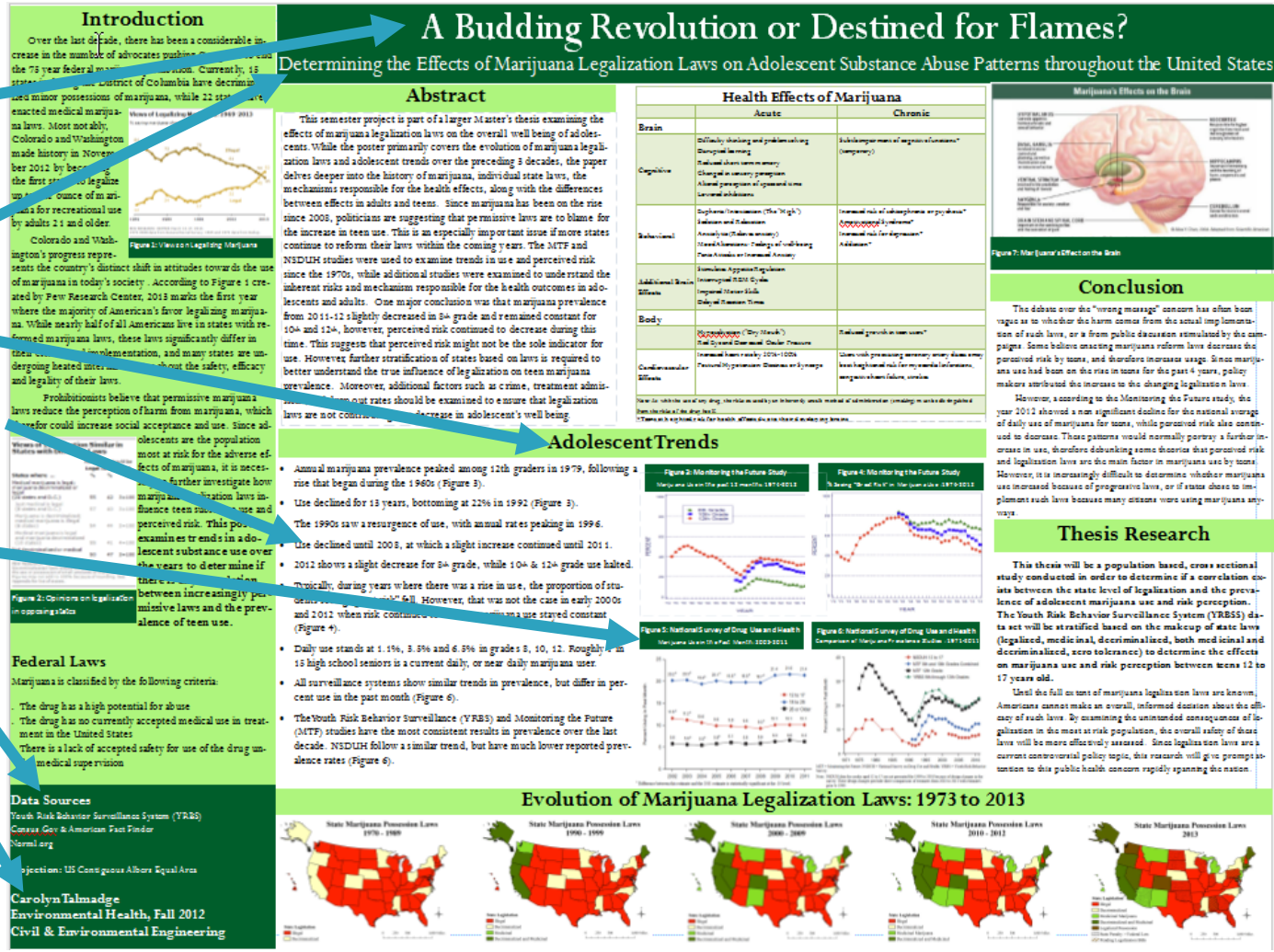
All maps displayed on 1:300,000 Scale
Projection Information: Africa Albers Equal Area Conic
Data Sources: GADM, ESRI, MAGIC
Online sources: Fairfield County Green Businesses, CT Green Scene, Building CT Green, Green & Sustainable Living in Fairfield, A Network for Sustainable Communities, Fairfield County Connecticut Air Quality Info, Live Green Connecticut , Green Village Initiative, On the Green.

Tufts UNIVERSITY

Name
Date
Class & Year

Text Sizes

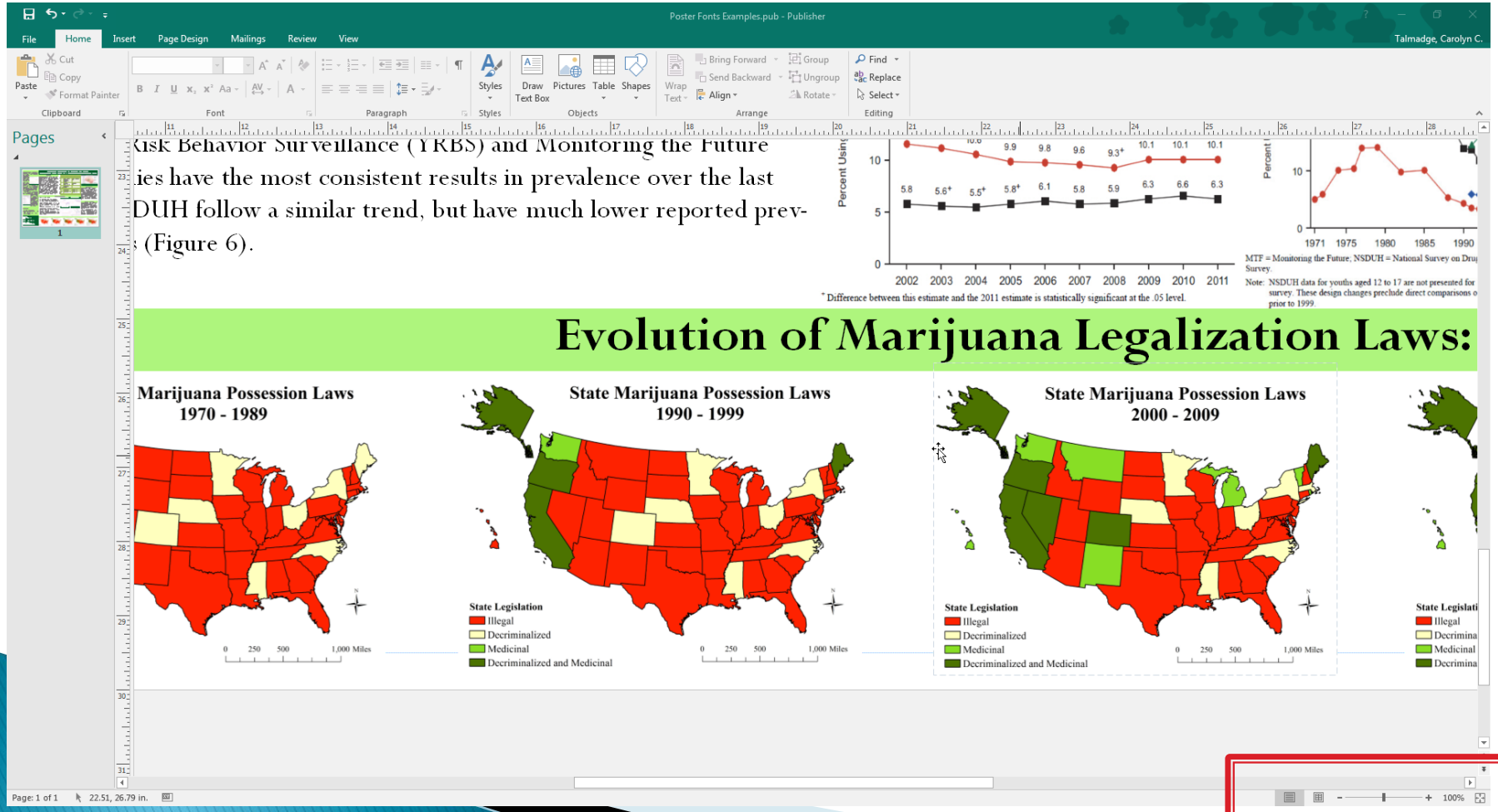
- Title: 80-100 pt
- Sub Title: 40-60 pt
- Headings: 35-55 pt
- Body Text: 24-35 pt
- Captions: 18-22 pt
- Sources: 18-30 pt
- Authors: 25-40 pt



Note: These are based on a 30 X 40in poster with **Serif** Font! This would change if the poster was bigger or smaller!

View your poster at 100% also!

- Put your "zoom" to 100% – Views "real size"
  - Can people read the text? Is the resolution okay?
- Especially important with maps, labels, legends!



What kind of Maps and figures should I include on my poster?

- **What information is important for your readers to understand?**
- **Overview or Inset map-** Important dates or locations
- **Factor Maps/ Individual Maps**
  - Maps that add to the readers understanding and tell the story
  - Factors that went into your model (not necessarily intermediary steps)
    - Ex: Suitability Analysis: Distance from Roads- Show the actual Euc Distance with distance values rather than the reclassify layer that doesn't have values but just numbers.
- **Final Map-** Some may have a "final" map, others might not (that's okay).
- **Summary Statistics** – Charts, Tables, Graphs that sum up your findings!

Analysis & Map Tips

- **Project, Project, Project!**
  - First, make sure your data frame is projected
  - Project your data (Data → Export Data) the MOMENT you decide you are going to keep it!
  - Remove the unprojected layer from your TOC

- **Set your Environments for Raster Analyses.**
  - **Raster Extent** – what area does the output cover?
  - **Raster Analysis** – Cell Size & Mask (aka clip to boundary)

- **Bookmark** your location – makes creating equal sized maps much easier!
  - Pick your page size and set up your layout early

- **Avoid the Floating Island Effect –**
  - Include surrounding boundaries (& labels) in your maps for towns, counties, states, countries, etc.
  - Use other location info that might help readers understand locations (Roads, POIs, etc)

- **Label** known locations (depending on scale).
  - Capitals & Major Cities (Points), Towns, Counties, States, etc

Analysis & Map Tips

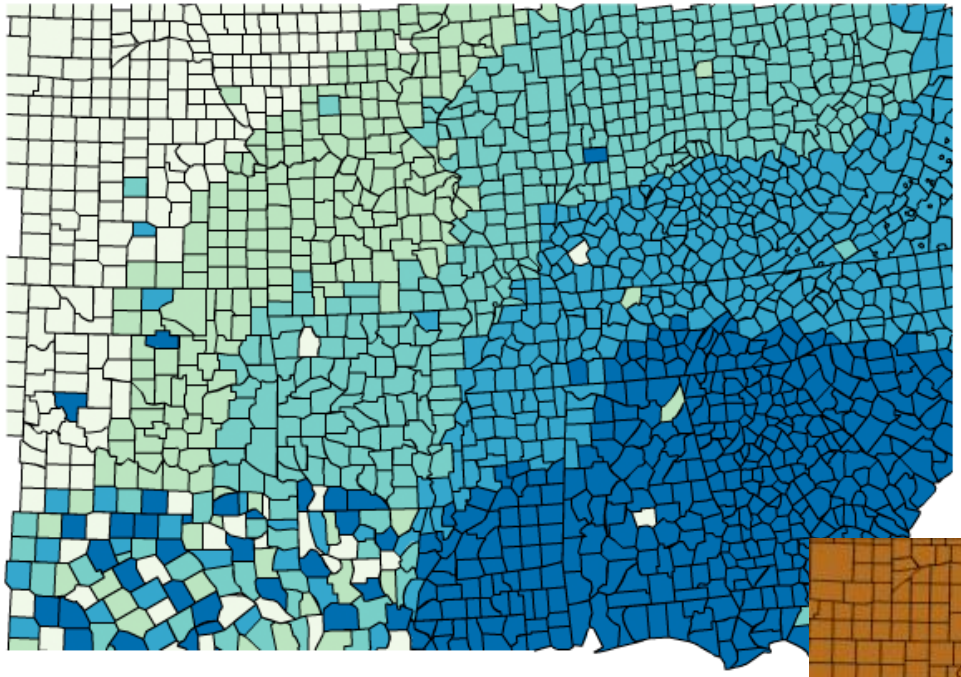
- Put a shaded relief/topology underneath your maps for environmental analyses!

- Set your own color ramp in symbology. Can edit the start and ending color.
  - Right click on the color ramp → properties → set color 1 and color 2

- Remove ESRIs Citation text: *Insert → Dynamic Text →Service Layer Credits*

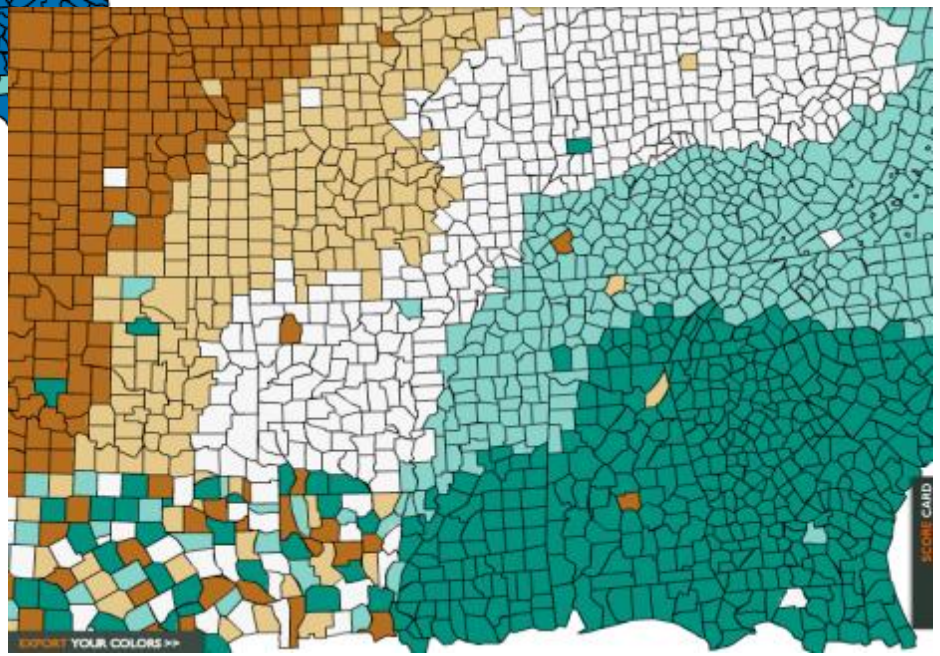
Analysis Tips & Tricks

- Make sure Background Geoprocessing is disabled.
- Can have multiple ArcMap sessions open at once.
- Start from 1 .mxd and every time you complete a new map/map layout, save as a new .mxd for that map. That way, you can go back to any individual map for easy edits later on!
- No spaces in folders or names. EVER!!!!!!! Really!
- Running out of space on your H drive? **Purchase a USB or External Hard drive**… or zip up the folder and upload to tufts box.



Use a color Generator to explore color themes!

https://coolors.co/
http://www.colorbrewer.org



Beware of the Plotter

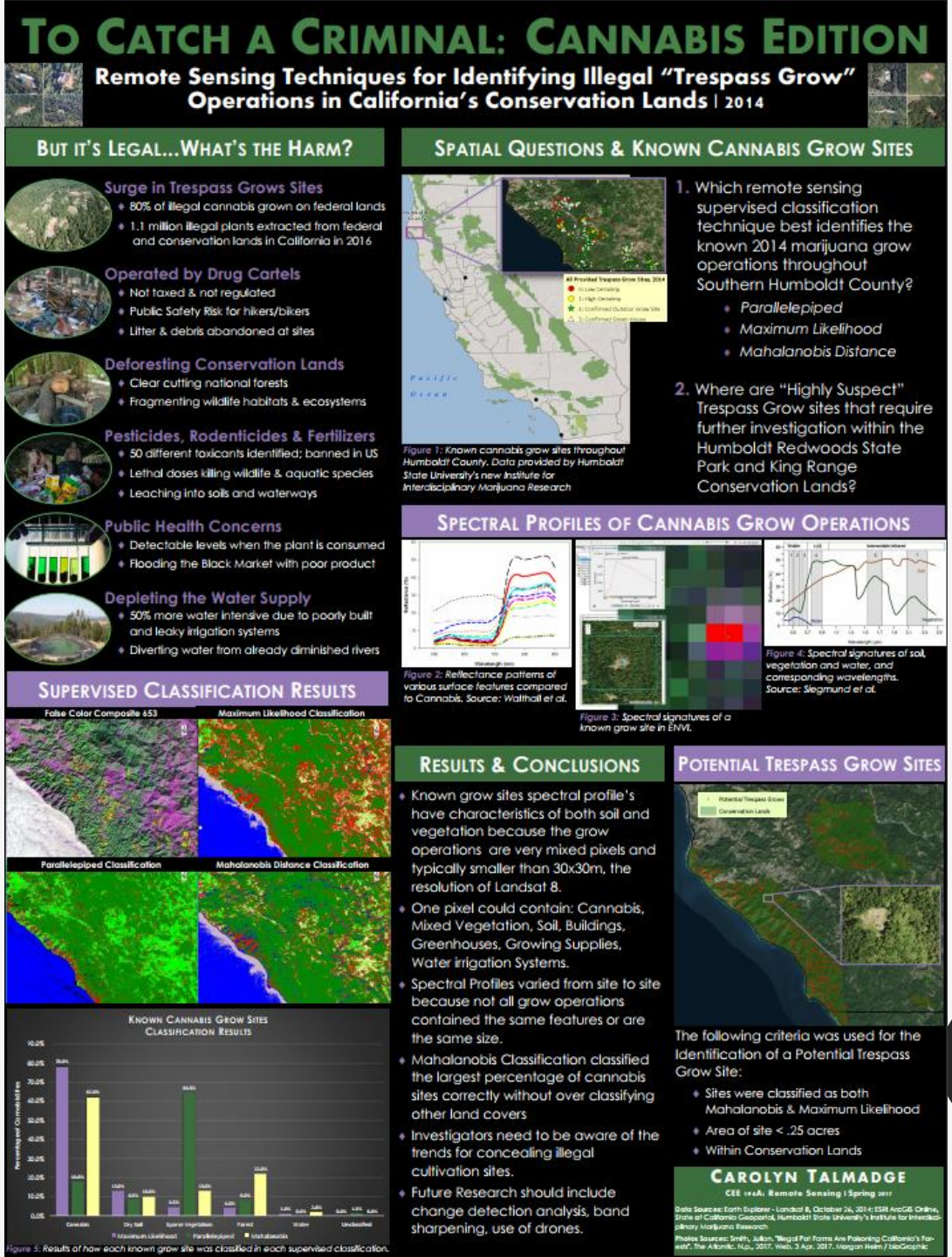
- What you see on the screen isn't always how the color prints on the plotter!

- Avoid using dark red and dark blue
  - Dark red → Brownish
  - Navy Blue → Purple

≠

Keep Posters Visual!

Images, charts, tables and graphs say much more than words!



Types of Visuals

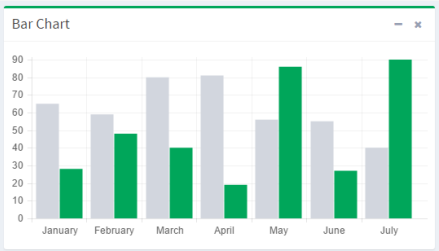
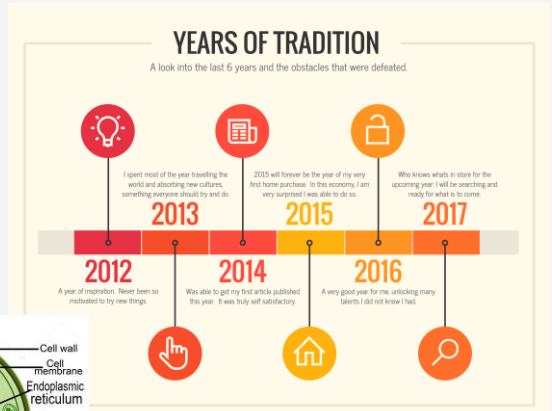
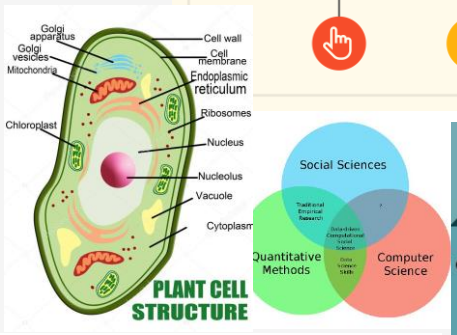


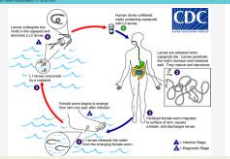
Table 1. Summary statistics for the mobile-monitoring sampling data.

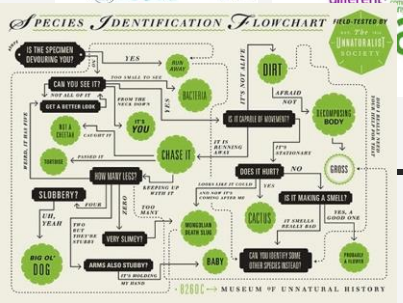
Parameter	Observations (*n*)	Mean ± SD	Median	5th percentile	95th percentile
UFP concentration (particles/cm^3)	8,225	44,000 ± 24,800	39,800	15,900	87,500
$PM_{2.5}$ concentration (μg/m^3)[a]	8,354	36 ± 30	29	10	129
PAH concentration (ng/m^3)	7,453	76 ± 55	55	8	212
Traffic count per minute					
WB	9,598	13.7 ± 2.3	13.2	10.2	17.7
BQE	9,553	36.7 ± 6.5	38.4	24.5	44.9
Wind speed (m/sec)	7,913	1.3 ± 1.0	0.9	0.4	3.6
Temperature (°C)	9,441	26.3 ± 3.5	26.7	19.8	30.7
RH (%)	9,441	45.8 ± 11.3	45.4	27.3	66.4

[a]Measured using DustTrak, which has a known but consistent bias by a factor of 2.5–3 relative to gravimetric measurements (Chang et al. 2001).





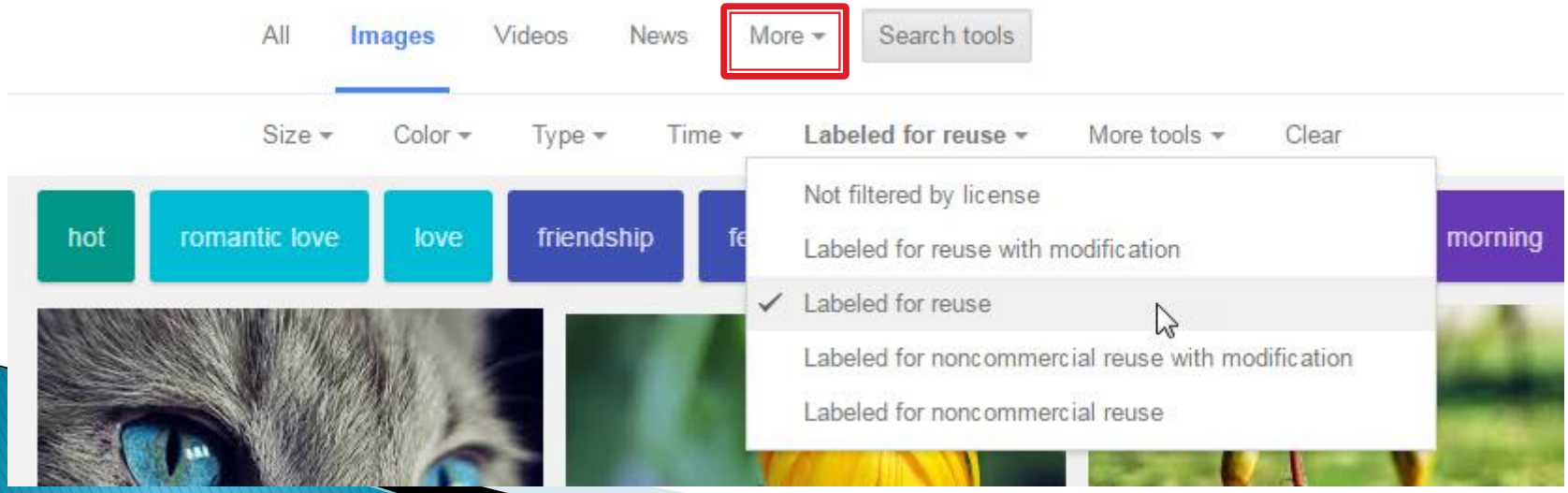




- Maps (obviously)
- Charts & Graphics
- Summary Statistics/Tables
- Photos and Images
- Timelines
- Infographics
- Image Diagrams
- Lifecycle Diagrams
- Venn Diagrams
- Word clouds
- Quotes
- Checklists
- Flow Charts
- Questionnaires/Surveys

Citing Images from Online

- MUST include citation *directly* under images taken from online.
- Credit the author along with a link.
- In google, change search options to “label for reuse” to avoid copyright infringement.



Tufts
UNIVERSITY

- Do NOT, I repeat, do NOT copy an tufts logo image from Google Images!
  - Resolution is ALWAYS terrible!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
- Download Logos from the Communications Page
  - http://communications.tufts.edu/marketing-and-branding/brand-guides-and-logos/download-logos/

Design Process:

Be in charge of your design decisions:

- **Color Palette:** Pick a color scheme and use it throughout your poster!
  - Use it for text/color blocking for headers or sections.
- **Fonts:** Pick 1 or 2 main fonts, but no more!
  - One serif and one sans-serif
  - Don't use 2 of the same types of fonts
  - Uses them through maps, charts and figures, and poster text.
- **Size:** Poster text is important, but graphic text is as well
  - Labels, legends, captions
- **Format:** Identify most important elements (title, headings, maps, tables, graphs) & place them on poster first. Then add text and secondary information.

DON'T JUST ACCEPT FONT & COLOR DEFAULTS.
PICK EVERYTHING WITH A PURPOSE!!

Design Tools & Concepts

Layout

- Visual Hierarchy
- Alignment – Use of columns
- Grouping -To box or not to Box?
- Contrast – Use of white space

Typography

- Font Type/Style
- Emphasis
- Column Width
- Justification/ Left Alignment
- Bullets & Paragraphs
- Size

Color

- Color Wheel
- Complimentary/contrasting Colors

Images/Figures

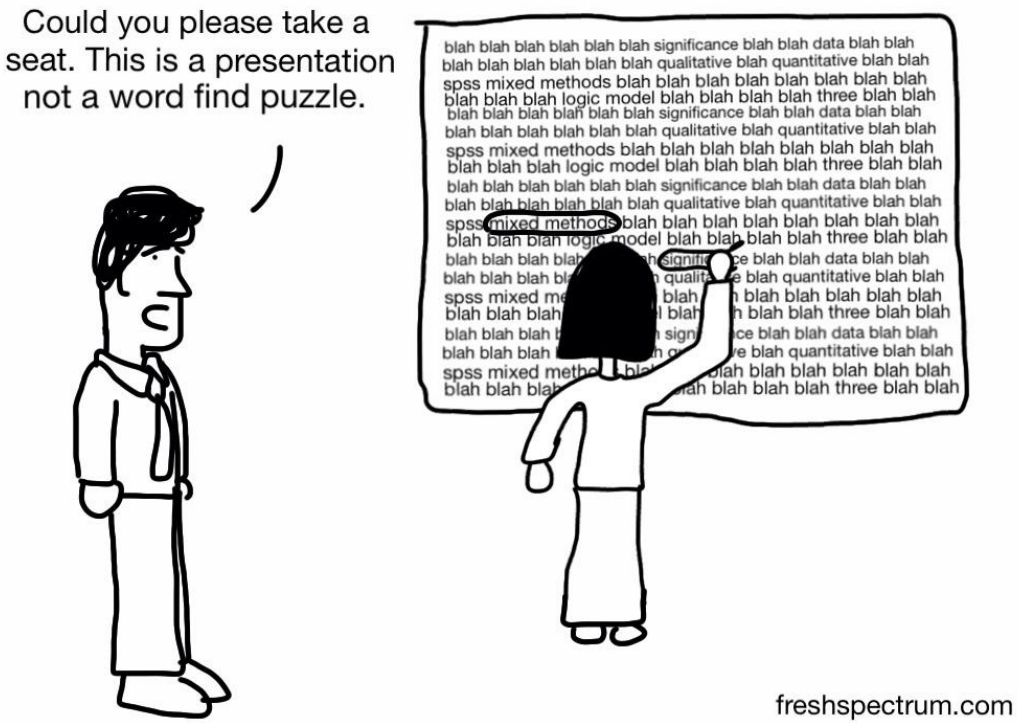
- Resolution

"OK, I'm now going to read out loud every single slide to you, word for word, until you all wish you'd just die."

Goal: Maximize Readability

Readability improves:

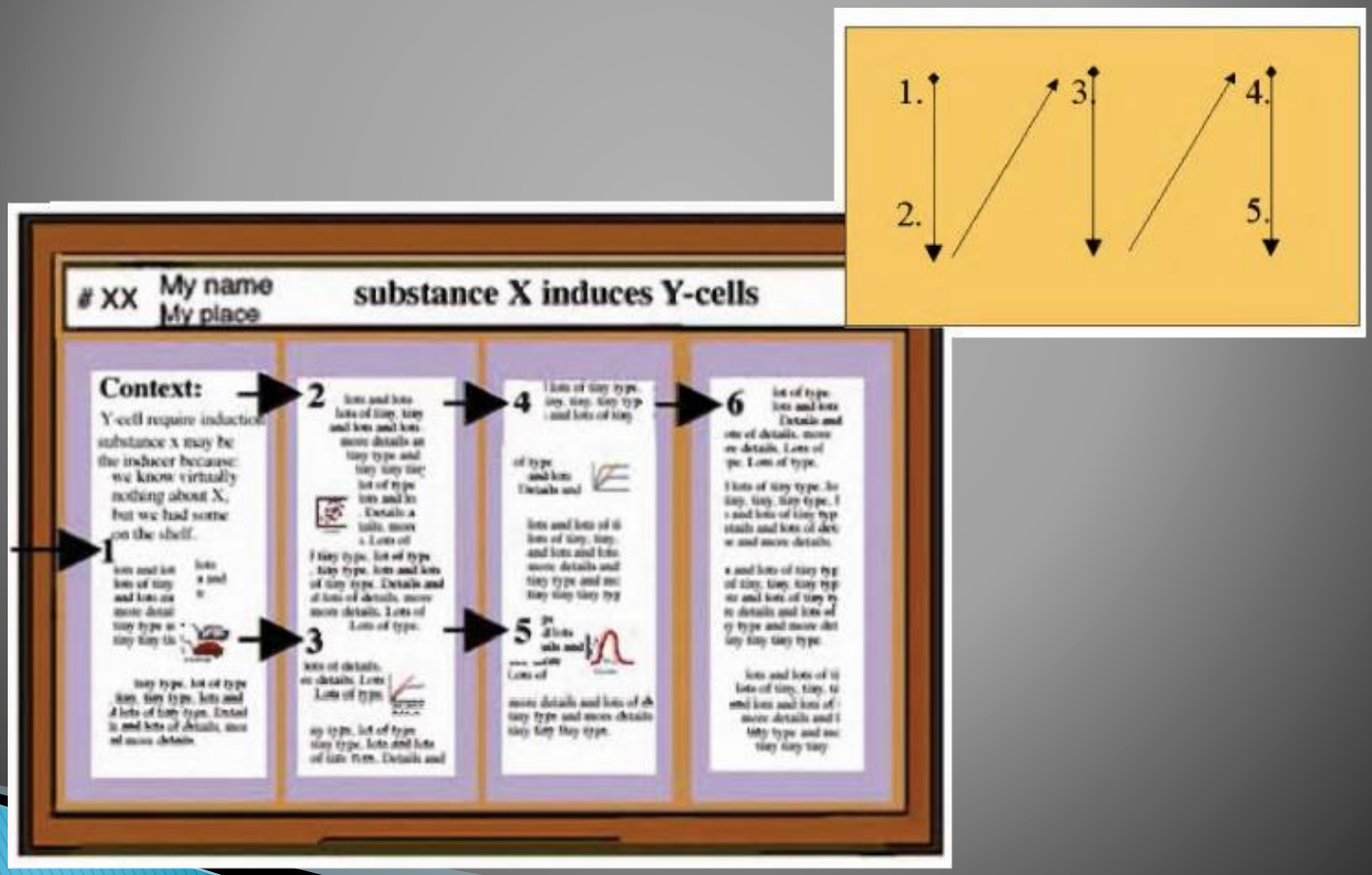
- Comprehension
- Retention
- Reading speed
- Reading persistence



READ THIS FIRST

and then read this.

THAT'S VISUAL HIERARCHY.



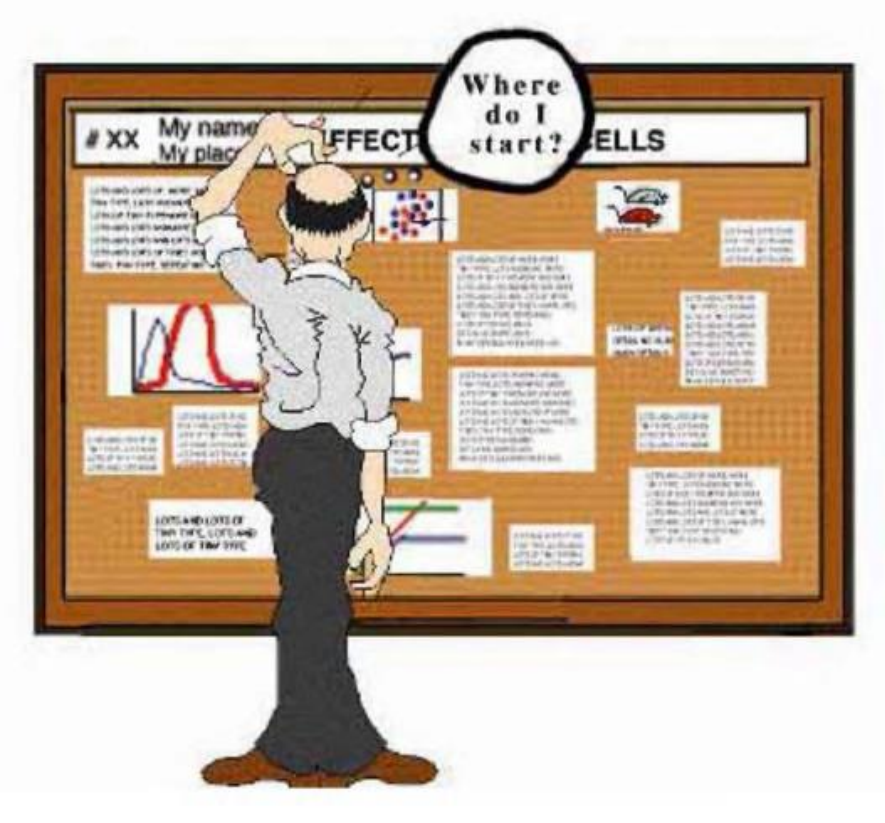
Visual Hierarchy

Visual hierarchy

What is it?

How can I get some?

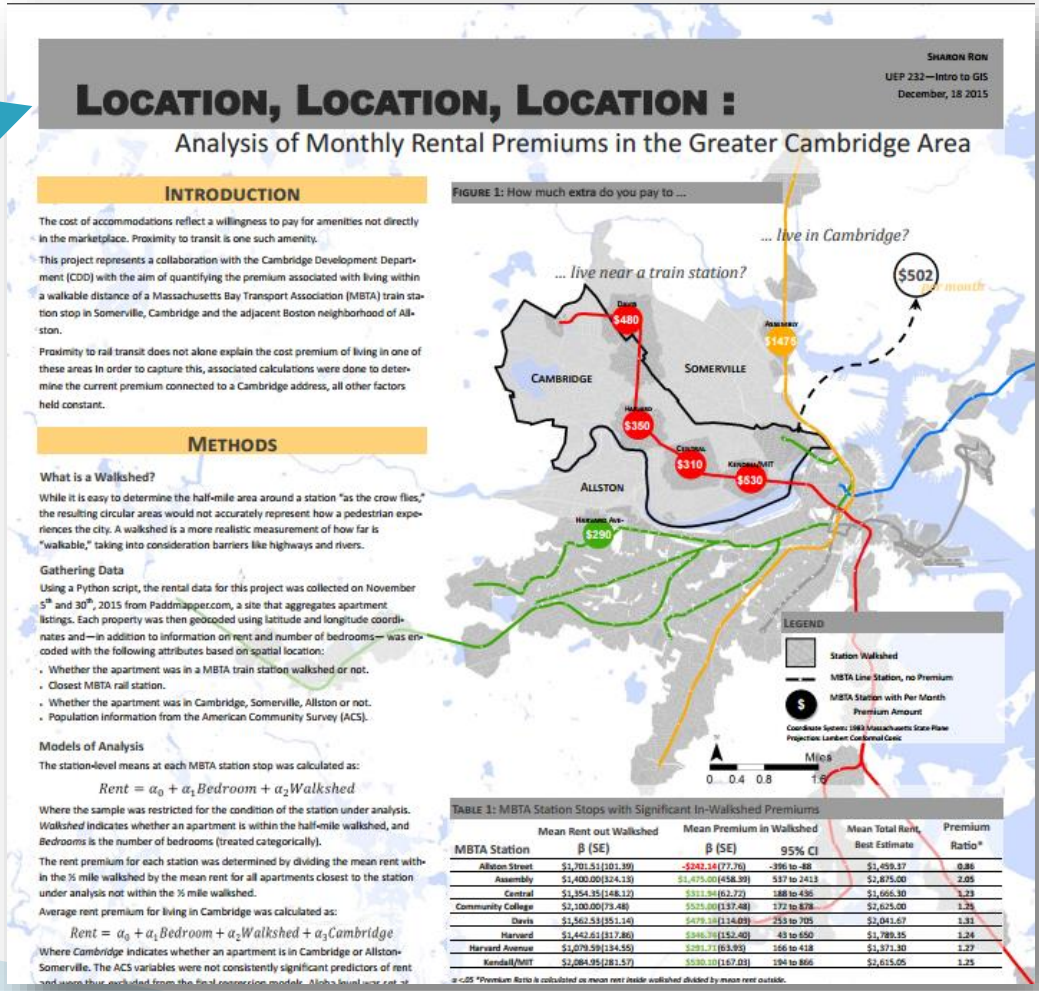
- More important info = bigger & higher up
- Rank info in order of importance
- Establishes a pattern for your eye to follow



Visual Hierarchy
starts with your TITLE!
Think Big! Really BIG!

Your biggest impact!
Boldface type!
SMALL CAPS are better than **BIG CAPS**

- **Be concise but creative!**
  Don't be afraid to use a little humor
- Use the **Subtitle** to provide more details & location/date information



LOCATION, LOCATION, LOCATION :

Analysis of Monthly Rental Premiums in the Greater Cambridge Area

SHARON RON
UEP 232—Intro to GIS
December, 18 2015

INTRODUCTION

The cost of accommodations reflect a willingness to pay for amenities not directly in the marketplace. Proximity to transit is one such amenity.

This project represents a collaboration with the Cambridge Development Department (CDD) with the aim of quantifying the premium associated with living within a walkable distance of a Massachusetts Bay Transport Association (MBTA) train station stop in Somerville, Cambridge and the adjacent Boston neighborhood of Allston.

Proximity to rail transit does not alone explain the cost premium of living in one of these areas In order to capture this, associated calculations were done to determine the current premium connected to a Cambridge address, all other factors held constant.

METHODS

What is a Walkshed?

While it is easy to determine the half-mile area around a station "as the crow flies," the resulting circular areas would not accurately represent how a pedestrian experiences the city. A walkshed is a more realistic measurement of how far is "walkable," taking into consideration barriers like highways and rivers.

Gathering Data

Using a Python script, the rental data for this project was collected on November 5th and 30th, 2015 from Paddmapper.com, a site that aggregates apartment listings. Each property was then geocoded using latitude and longitude coordinates and—in addition to information on rent and number of bedrooms— was encoded with the following attributes based on spatial location:

- Whether the apartment was in a MBTA train station walkshed or not.
- Closest MBTA rail station.
- Whether the apartment was in Cambridge, Somerville, Allston or not.
- Population information from the American Community Survey (ACS).

Models of Analysis

The station-level means at each MBTA station stop was calculated as:

$$Rent = \alpha_0 + \alpha_1 Bedroom + \alpha_2 Walkshed$$

Where the sample was restricted for the condition of the station under analysis. *Walkshed* indicates whether an apartment is within the half-mile walkshed, and *Bedrooms* is the number of bedrooms (treated categorically).

The rent premium for each station was determined by dividing the mean rent within the ½ mile walkshed by the mean rent for all apartments closest to the station under analysis not within the ½ mile walkshed.

Average rent premium for living in Cambridge was calculated as:

$$Rent = \alpha_0 + \alpha_1 Bedroom + \alpha_2 Walkshed + \alpha_3 Cambridge$$

Where *Cambridge* indicates whether an apartment is in Cambridge or Allston-Somerville. The ACS variables were not consistently significant predictors of rent

FIGURE 1: How much extra do you pay to ...

TABLE 1: MBTA Station Stops with Significant In-Walkshed Premiums

MBTA Station	Mean Rent out Walkshed β (SE)	Mean Premium in Walkshed β (SE)	95% CI	Mean Total Rent Best Estimate	Premium Ratio*
Allston Street	$1,701.51(101.39)	-$242.14(77.76)	-396 to -88	$1,459.37	0.86
Assembly	$1,400.00(324.13)	$1,475.00(458.39)	537 to 2413	$2,875.00	2.05
Central	$1,354.35(148.12)	$311.94(62.72)	188 to 436	$1,666.30	1.23
Community College	$2,100.00(73.48)	$525.00(137.48)	172 to 878	$2,625.00	1.25
Davis	$1,562.53(351.14)	$479.18(114.03)	253 to 705	$2,041.67	1.31
Harvard	$1,442.61(317.86)	$346.78(152.40)	43 to 650	$1,789.35	1.24
Harvard Avenue	$1,079.59(134.55)	$291.71(63.95)	166 to 418	$1,371.30	1.27
Kendall/MIT	$2,084.95(281.57)	$530.10(167.03)	194 to 866	$2,615.05	1.25

α <.05 *Premium Ratio is calculated as mean rent inside walkshed divided by mean rent outside.

BUZZKILL

MINIMIZING AIRCRAFT NOISE OVER DENALI NATIONAL PARK

BACKGROUND

A primary role the 1962 Wilderness Act sets for the National Park Service is to preserve "outstanding opportunities for solitude". Yet in Denali National Park in Alaska, this solitude is increasingly interrupted by small, low-flying aircraft, which carry flightseers and climbers between surrounding airports and the peaks at the heart of the park. Solitude-seeking hikers are outspokenly disturbed, and studies indicate noise pollution's effect on animal behavior can change ecosystems in yet-unknown ways.

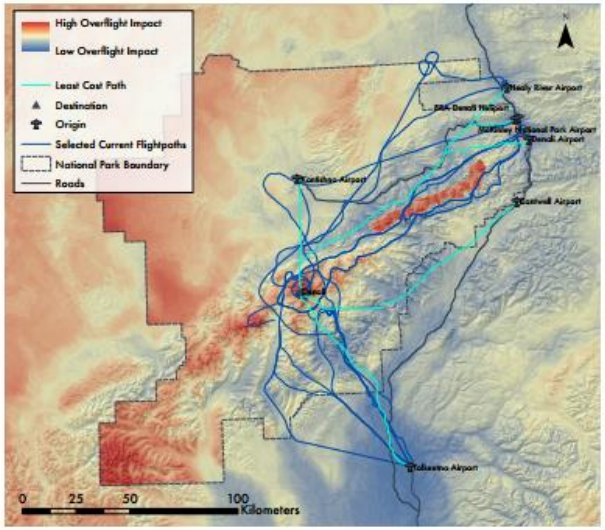
Pilots, scientists, and park officials have met to change common flight routes, trying to move them away from sound-sensitive areas while keeping them safe and practical. However, there are an overwhelming number of subjective factors involved in sound sensitivity and flight practicality, and many conflicting opinions about them. To help make this compromise, NPS would like a model for the optimal flight paths given all these considerations—one where stakeholders can interactively change the parameters to understand the problem and reach a compromise.

To build this model, I collaborated closely with scientists and GIS specialists in Denali National Park, where I am continuing this work over the summer.

METHODS

We considered this as a Least Cost Path problem, where given start points (airports), an end point (the Denali massif), and a "cost raster" of the undesirability of flying over each 500m cell, we found the paths with the least sum cost of cells traversed. NPS Denali created cost rasters for various sensitivity factors (see below)—we wanted to see how different weighted combinations of these would produce different optimal routes. Each component cost raster was normalized, multiplied by a weight (0, 2, or 8), then all summed to produce an overall cost raster. The weights of the compenent rasters acted as the parameters for the model.

For users to explore these parameters interactively, we needed to pre-compute all of their 2,187 unique combinations. I wrote a Python geoprocessing script to parallelize the tasks—a weighted sum and the ArcGIS Least Cost Path tools—between 10 networked computers over 20 hours. I then made a webpage to show and compare the resulting routes for any combinations of these weights.



Compared to current routes, optimal flight paths (cyan) avoid areas with greatest noise sensitivity (red), preferring regions with a higher natural ambient noise level (to mask aircraft noise), highest distance from the ground, and least existing opportunities for solitude. This is just one set of paths of the 2,187 possibilities computed by combining the routing factors below in different weighted sums.

RESULTS

There is no single best new route that comes from this project; that is for stakeholders to decide as they explore the possibilities it has generated. However, many of the optimal routes resemble changes that have already been proposed, such as avoiding popular backpacking areas south of the road in the northeast of the park. Politically, seeing this result lends those proposals more credibility, which may help drive their adoption. Other weight combinations suggest drastic but feasible changes, such as directing east-west flights along the southeastern park border, well away from popular hiking areas.

The model also uncovered flaws in the ArcGIS Least Cost Path algorithm. When run on a raster where every cell has cost 1, the paths it chooses are indirect and longer than straight lines–in other words, not optimal. Because it considers cost between cell centers, diagonal travel is penalized. But planes fly at any heading, not just the cardinal directions, so all 8 neighboring cells should be considered equidistant. Modifying this algorithm for my summer work should eliminate these "taxicab distance" paths and produce more valid results.

SOURCES

Aircraft Overflights Advisory Council. "2012 Factsheet." Healey, Alaska: 2012.

Denali National Park and Preserve. Backcountry Management Plan. National Park Service. Denali Park, Alaska: January 2006.

Wilderness Act of 1964, 16 U.S. C. 1131-1136.

Many thanks to Davyd Betchkal, Britta Schroeder, and Regan Sarwas of Denali National Park and Preserve for producing the cost rasters (cited below), and for the enthusiasm, support, and time they have given to this project.

This is a joint project for Earth & Ocean Sciences (GIS) and Computer Science (Visual Analytics).

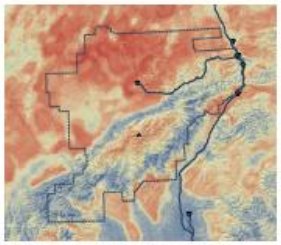
THE NATIONAL PARK SERVICE

TUFTS EARTH & OCEAN SCIENCES

TUFTS COMPUTER SCIENCE

GABE JOSEPH

ROUTING FACTORS



Natural Ambient Sound Level

Prefer flying over naturally louder areas, like streams, where noise is less intrusive than, say, a quiet, open field. Based on modeling of median sound pressure level across the entire state.

A geospatial model of ambient sound pressure levels in the contiguous United States. Mennitt, Daniel and Sherrill, Kirk and Fristrup, Kurt, The Journal of the Acoustical Society of America, 135, 2746-2764 (2014)

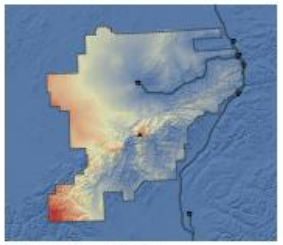
Backcountry Management Plan

Sets standards for the amount and intensity of noise permissible in different areas of the park.

National Park Service. 2006. Denali National Park and Preserve Final Backcountry Management Plan, Environmental Impact Statement. National Park Service, Denali Park, Alaska.

Don't make the reader hunt for your information!

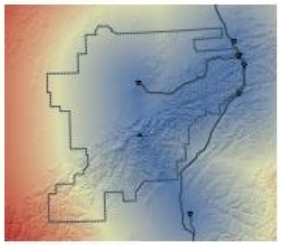
Group authors & make them easy to spot!



Hiking Accessibility

People who take the time to travel to hard-to-reach areas value their quietude significantly more. Encourage planes towards the road and other places where solitude is less important.

Burrows, R, D. Abbe, J. Tricker, P. Landres, J. Paynter, D. Schirokauer, P. Hooge. 2015. "Mapping Wilderness Character in Denali National Park and Preserve." In Progress.



Flight Directness

Prefer straighter lines from each airport to the Denali massif. Without this, ArcGIS Least Cost Paths are often wandering and impractically indirect.

Computed from data provided by the National Park Service.

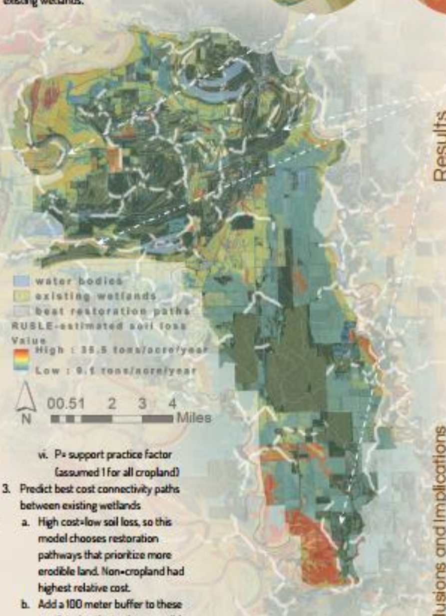
SWAMPED: Proposing wetland restoration corridors in Mississippi's Tallahatchie watershed

Introduction

Wetlands provide many functions including flood protection, nutrient and sediment pollution mitigation, carbon sequestration, and wildlife habitat. Prior to the Clean Water Act and during the era of "fencerow-to-fencerow" agricultural policy, however, draining wetlands for agriculture was relatively common in certain areas of the United States. Around 32% of America's cropland has been drained, and an even higher proportion was drained in the Mississippi Delta region.[1] More recently, though, conservation programs at the state and federal level can provide cost share payments to farmers who agree to restore wetlands on their properties, but funding in these programs is limited.

This project focuses on three subbasins of the Tallahatchie River watershed in Mississippi.

Highly segmented wetlands provide substantially fewer benefits than well-connected wetland systems.[1] Plus, agricultural areas which are losing tons of soil each year may be better off serving as agricultural pollutant remediation sites. In light of this, this project aims to predict areas where wetland remediation would be of most benefit, through restoring areas that were previously drained, prioritizing areas of high soil loss, and maintaining connectivity with existing wetlands.



Methods

1. Clip out areas that were cropped in 2015, have innately hydric soils, AND are not in the National Wetlands Inventory
2. Perform Revised Universal Soil Loss Equation (RUSLE) on these drained agricultural areas
   a. A= R*K*L*S*C*P
      i. A= average annual soil loss
      ii. R= rainfall-runoff erosivity factor (384 for entire area)[2]
      iii. K= soil erodibility factor (from SSURGO)
      iv. LS= slope length and steepness factor (length assumed 75 ft, then classified with conditionality matrix from USDA)[3]
      v. C= cover management factor (where higher residue/more soil-protective crops (eg small grains)=0.3 and less protective crops (eg corn)=0.6)
      vi. P= support practice factor (assumed 1 for all cropland)
3. Predict best cost connectivity paths between existing wetlands
   a. High cost=low soil loss, so this model chooses restoration pathways that prioritize more erodible land. Non-cropland had highest relative cost.
   b. Add a 100 meter buffer to these predicted paths to show possible wetland remediation areas.

2015 cropland

In 2015, these 3 subbasins were mostly cropped, and the area grew mostly soybeans (according to CDL). It should be noted that most crop farms would rotate crops, so these fields may have been mostly corn in another year. Rice production is also common in this area of Mississippi, and this rice cultivation is achieved with flooded fields for part of the growing season.

Drained wetlands

When using the methodology described above to determine areas that may have been drained for agriculture, it appears much of the region was indeed drained. About 85% of the farmed land in this region seems to have been hydrologically altered.

Soil K-factor

A soil's K-factor is a unitless number that describes the innate susceptibility of the soil type to erosion. This is important since conservation programs often use erosion as a criteria for retiring productive land. This factor is one of the most important drivers in the Universal Soil Loss Equation in my study area.

Results

This map shows all paths that were predicted via cost connectivity analysis, with a 100 meter buffer around each path to show regions where wetland restoration may be most beneficial, taking into account erosion rates and requiring paths to connect existing wetlands.

A few paths which show the capability of the model are displayed above. In many cases, paths snapped to narrow sections of high erosion as predicted by RUSLE, but in other cases, particularly when existing wetlands were near to each other, the model chose paths of relatively low erosion, owing to the lower cumulative cost distance.

These paths, coupled with aerial imagery of what is happening on the ground, show that areas of apparent intensive crop production and high erosion are often found around and between remaining natural wetlands, and that sometimes, the best path follows along the border of an existing wetland. Interestingly, some of the areas of high soil loss can be seen as areas of bare soil in aerial photos (see Path 1 above), even in cropped fields, giving credence to the spatial application of RUSLE used here.

Conclusions and Implications

Through working with these datasets, some problems were discovered. The SSURGO database shows noticeably different K-factor ranges for different counties, with no geographical feature to explain the discrepancy. The analysis shown covers two counties that had relatively similar ranges in K-factor but nonetheless these results may be skewed.

The Cropland Data Layer is known to have some measurement error, including isolated pixels of dubious crop determination within larger fields of likely accurate crop determination. For this work, these cells were left as-is because they were so few, but a better approach might be to clean this data source such that these isolated cells are converted to match the cells around them.

Many assumptions were made with the RUSLE calculation (e.g. assuming constant support practice factor), as this equation is designed more for field-level analyses. With more information about average management practices in the region as well as the length of crop fields, this calculation could be refined.

Finally, the "path" approach to wetland restoration has the function of connecting separate areas, but does not represent restoration benefits perfectly. Perhaps wetlands should not be restored in lines but rather in large blocks. Because of this, this analysis should be viewed as a starting point to develop more rigorous methods to produce variable-width wetland corridors, or include paths that simply expand existing wetlands.

The areas where paths were predicted are, of course, mostly privately owned, and perhaps more importantly, a source of income for landowners. This precludes the notion that a policymaker could simply reclaim these areas and restore them. However, with the incentives for conservation available now and in the future, policymakers could benefit from using a GIS method that informs prioritization and design of wetland restoration projects.

Elisabeth Spratt
UEP 294 | December 2016

All maps use UTM Zone 15N projection

Data sources:
Cropland Data Layer. US Department of Agriculture. 2015.
National Wetland Inventory. US Fish and Wildlife Service.
HUC 12 Watershed Boundaries. US Geological Survey. 2016.
Web Soil Survey/SSURGO. US Department of Agriculture.
Aerial imagery. ESRI World Imagery, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and The GIS User Community
Hydrography: Rivers and streams. USGS. 2016.

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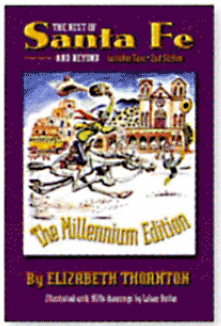

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Grouping

- Related information stays together
- Predetermined path for eye to follow

Contrast

- White space = Breathing Space
- Image Balance

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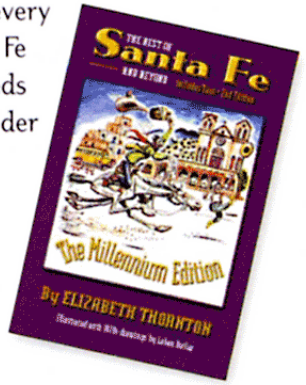

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Examples from Robin Williams' Design Workshop

Visual Hierarchy

- Predetermined path
- Most important info at the top & larger

Columns/Alignment

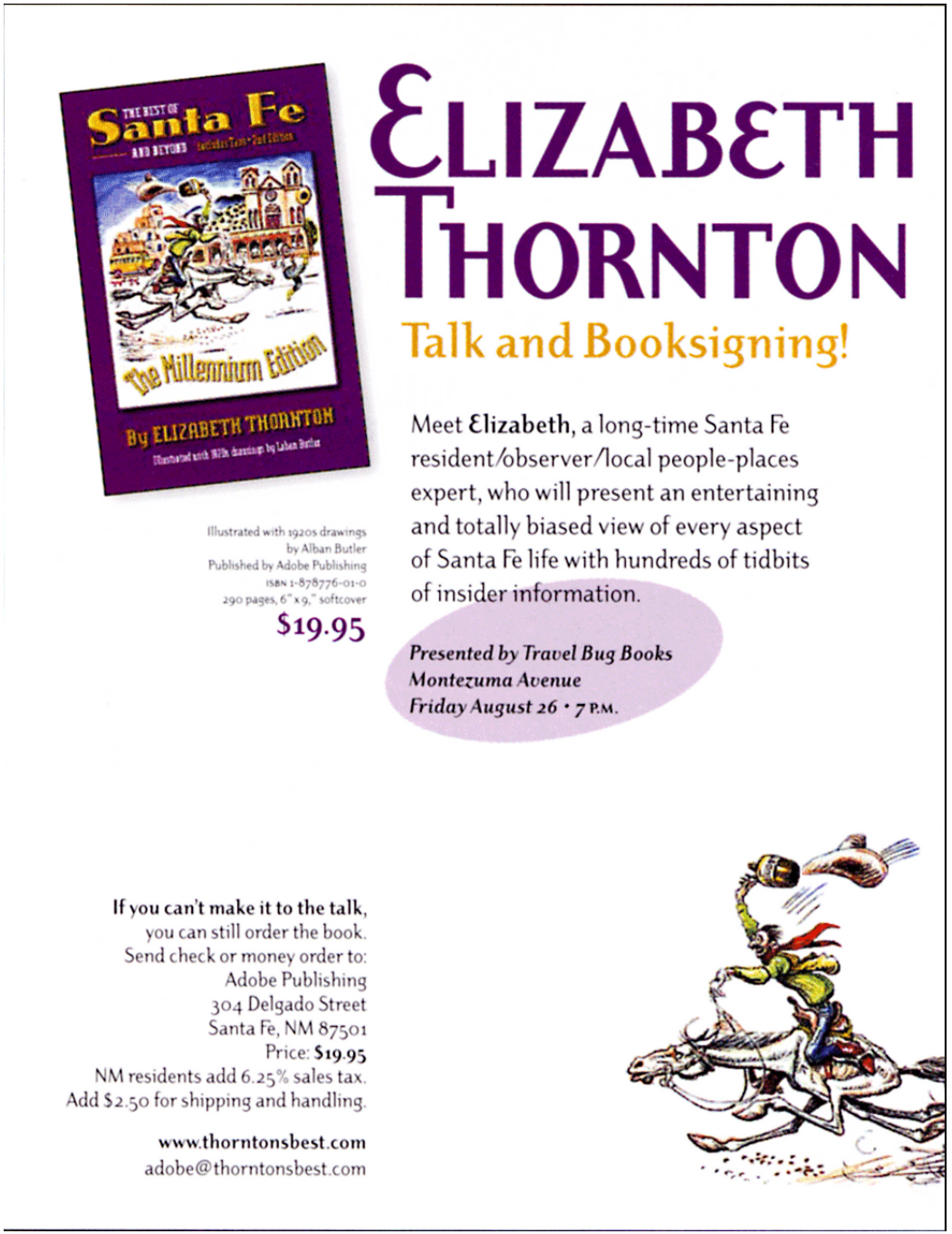
- More visually appealing
- Keeps it organized

Grouping

- Related information stays together
- Predetermined path for eye to follow

Contrast

- White space = Breathing Space
- Image Balance



Examples from Robin Williams' Design Workshop

Remove unnecessary elements like boxes – makes it feel cluttered.

Introduction to Remote Sensing

New UEP and Environmental Studies Course (Spring Semester)

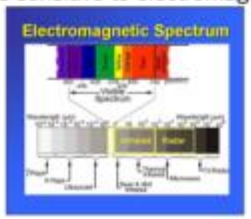
Tufts

What is Remote Sensing?

Remote sensing is the science of obtaining and interpreting information about the Earth from a distance, using sensors that are not in physical contact with the object being observed. Information can be collected about the Earth surface via a variety of methods, such as satellites.

Remote sensing deals with the detection and measurement of phenomena with devices sensitive to electromagnetic (EM) energy such as:

. Light (cameras and scanners)
. Heat (thermal scanners)
. Radio Waves (radar)



The EM spectrum ranges from the shorter wavelengths (including gamma and x-rays) to the longer wavelengths (including microwaves and radio waves). Satellite sensors measure EM radiation that has interacted with the Earth's surface. Interactions with matter can change the direction, intensity, wavelength content, and polarization of EM radiation.

What are the Uses of Remote Sensing?

. Monitoring urban growth, urban Heat Island, vegetation cover
. Deforestation activities
. Archaeological discoveries
. Geological and Mineral Exploration
. Coastal Change Detection

How is Remote Sensing Useful?

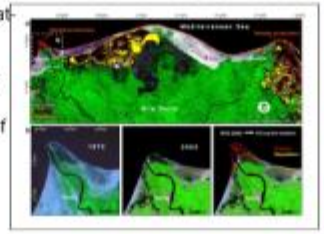
. It provides a unique perspective from which to observe large regions.
. Sensors can measure energy at wavelengths which are beyond the range of human vision.
. Global monitoring is possible from nearly any site on Earth.

For more information on this course, please contact Dr. Eman Ghoneim at salma@bu.edu or visit http://gis.tufts.edu

Applications in Remote Sensing

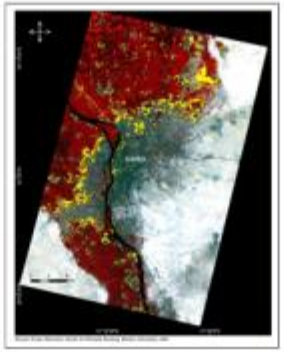
Sea Water Erosion at the Egyptian Nile Delta

The Nile delta is presently retreating due to accelerating erosion along the coastline, generally attributed to the construction of the Aswan High Dam and the entrapment of a large amount of sediments behind it. Optical satellite images reveal coastal erosion close to the Rosetta and Damietta promontories.

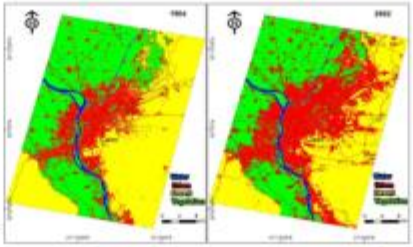


Analysis of Landsat satellite images reveal that the Rosetta promontory has lost approximately 9.5 km² in area and its coastline has retreated 3 km inland in only 30 years (1972 - 2003) or 100 m per year!

The southern part of the Nile Delta is presently suffering from the uncontrolled urbanization of the city of Cairo. The high economic growth and employment opportunities in this city caused an influx of labour migration. Local increase of population plus migrants caused the city to expand rapidly and in an uncontrollable fashion. Landsat images processing reveal that Cairo metropolitan area has doubled in size in less than 20 years (1984 - 2003).

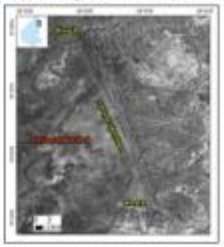


Based on image processing and change detection analysis it is estimated that about 62 km² (~ 12%) of the farmland areas in the vicinity of Cairo were lost in 18-year time span between 1984 and 2002. Once these lands have been converted to urban use, green areas and agricultural lands are generally lost forever, and in the long term could cause food scarcity.

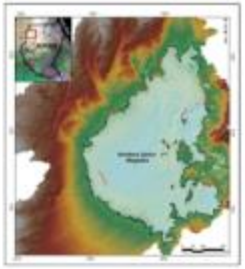


Buried Ancient Water Sources in Northern Darfur

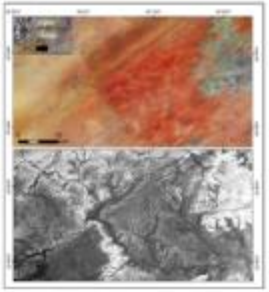
Northwestern Sudan is among the driest places on earth. However, during previous humid phases, the surface was veined by rivers and dotted by large lakes. Radar data from the Canadian Radarsat-1 satellite and the Shuttle Radar Topography Mission (SRTM) along with the optical Landsat data revealed a large endorheic drainage basin, which is centered by a large terminal palaeolake, in the northern Darfur State.



From the space data, segments of ancient lake shorelines have been discovered. At its maximum extent, the mega lake occupied an area of ~30,750km² (about the size of the state of Massachusetts), and would have contained approximately 2530km³ of water.



Radar long wavelength signals can penetrate up to several meters through the sand, providing imagery of subsurface fluvial features. The dark linear patterns in the radar imagery (b) present ancient river channels now filled with sand more than 3-meter deep. The detection of such buried rivers have significant consequences for improving our knowledge of continental climate change and regional palaeohydrology.



Much of the water carried by the discovered lake and associated drainage network would have percolated into the underlying rocks feeding the groundwater aquifer. Discoveries such as these will aid in providing water to areas in need.

Intro to Remote Sensing

New Course

New UEP and Environmental Studies Course, Spring Semester

Prof. Eman Ghoneim

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Japan's "Kodoma" satellite.

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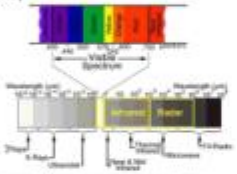

The EM spectrum's wave lengths.

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- Deforestation activities
- Archaeological discoveries
- Geological and Mineral Exploration
- Coastal Change Detection
- Monitoring weather condition, water quality, ice melt

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- Global monitoring is possible from nearly any site on Earth.

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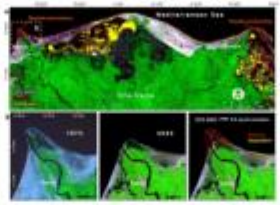

Landsat satellite images of the Rosetta Promontory, 1972 and 2003.

Land Change Analysis of Cairo Farmland

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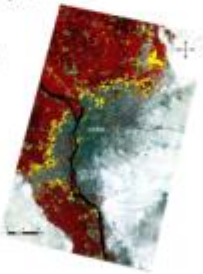
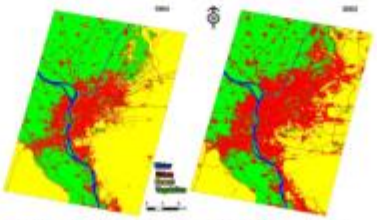


Cairo Landsat satellite image, 2003.

A change detection analysis revealed that approximately 62 km² (~ 12%) of the farmland areas in the vicinity of Cairo were lost in 18-year time span between 1984 and 2002. Once these lands have been converted to urban use, green areas and agricultural lands are generally lost forever, and in the long term could cause food scarcity.



Land change analysis of Cairo from 1984-2002 revealing the substantial increase in urbanized areas.

Increasing Coastlines with Artificial Islands

The Emirate of Dubai, UAE, has only a small stretch of coastline, thus the government has planned to increase the length of original coastline from 60 km to 1,200 km. The idea was to construct several artificial islands in the Arabia Gulf. The first manmade island project to be completed is called Palm Jumeirah. The artificial island, which measures 5 km², has created 560 ha of land and has added 78.6 km to the country's coastline.

Close-up view of Pal Jumeirah Island.

The artificial island of Pal Jumeirah.

Quickbird satellite images shows the construction and development of the artificial island of Palm Jumeirah, which constructed of sand dredged from the bottom of the Arabian Gulf. The use of satellite images helped engineering companies organize, plan and monitor Dubai, the number one tourist destination.

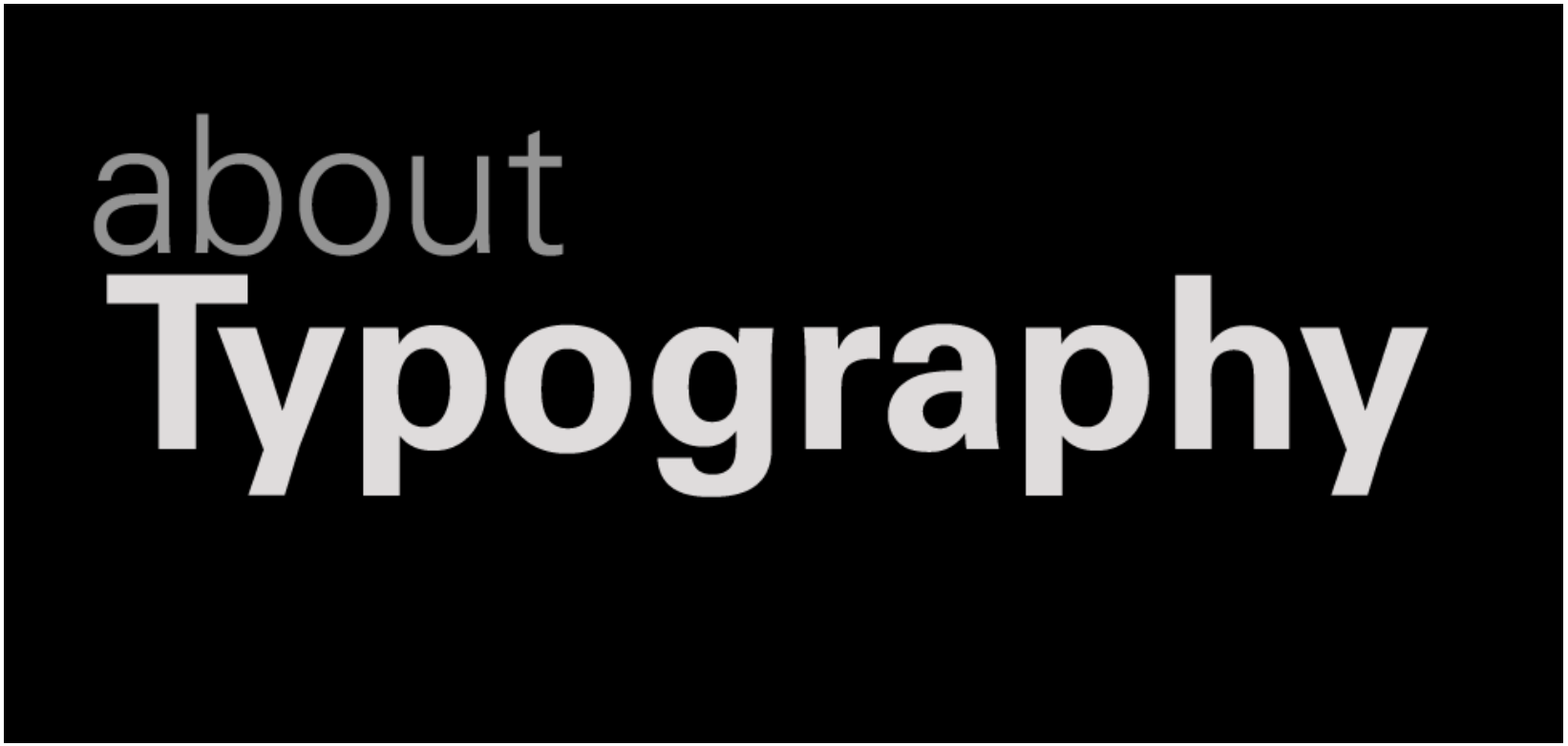
Quickbird satellite images from 2002-2006 showing the growing construction of the artificial island.

For more information: GIS@Tufts
http://gis.tufts.edu

Tufts

Layout

- ✓ Visual Hierarchy
- ✓ Grouping
- ✓ Columns
- ✓ Alignment
- ✓ Contrast
- ✓ Balance


about
Typography

KEEP OFF
GRASS


keep off
grass


FONTS MATTER
You'll always be mine...
YOU'LL ALWAYS BE MINE...

Before	After
WAL★MART®	Walmart

Before

MOTOROLA

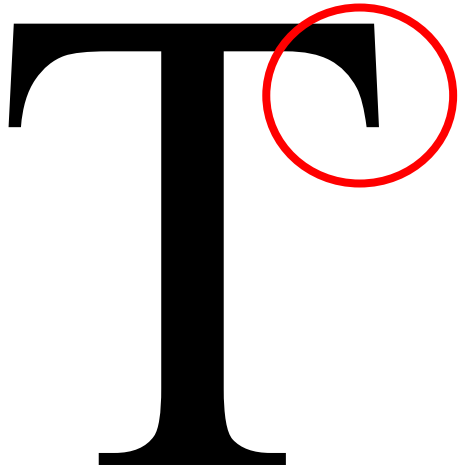
After

motorola

a Google company

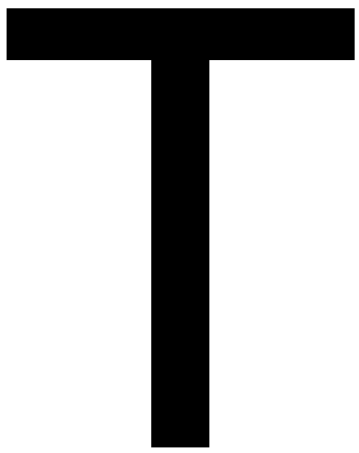
Corporate Logo Redesigns

Serif vs. Sans Serif



Times New Roman

Serif



Arial

Arial / Calibri / Helvetica

Sans Serif

March 24, 2009
Treasury Details Plan to Buy Risky Assets
By Brian Knowlton

WASHINGTON — The Obama administration formally presented the latest step in its financial rescue package on Monday, an attempt to draw private investors into partnership with a new federal entity that could eventually buy up to $1 trillion in troubled assets that are weighing down banks and clogging up the credit markets.

The Dow Jones industrial average was up sharply early Monday, gaining 250 points at one point, or 3.5 percentage points. When the Treasury secretary, Timothy F. Geithner, spoke on Feb. 10 of a bank rescue plan without offering much detail, investors took that as a worrying sign and the Dow fell sharply, losing 380 points.

The Treasury secretary did not deny the uncertainties inherent in the new program but defended it Monday as a practical approach. "There is no doubt the government is taking a risk," Mr. Geithner said, "the only question is how best to do it."

The success or failure of the plan carries not only enormous stakes for the nation's recovery but certain political risks for Mr. Geithner as well. At least two Republican senators have called for his resignation. And on Sunday, Senator Richard C. Shelby of Alabama, the ranking Republican on the Banking Committee, told Fox News that "if he keeps going down this road, I think that he won't last long."

Initially, a new Public-Private Investment Program will provide financing for $500 billion in purchasing power to buy those troubled or toxic assets — which the government refers to more diplomatically as legacy assets — with the potential of expanding later to as much as $1 trillion, according to a fact sheet issued by the Treasury Department.

At the core of the financing package will be $75 billion to $100 billion in capital from the existing financial bailout known as TARP, the Troubled Assets Relief Program, along with the share provided by private investors,

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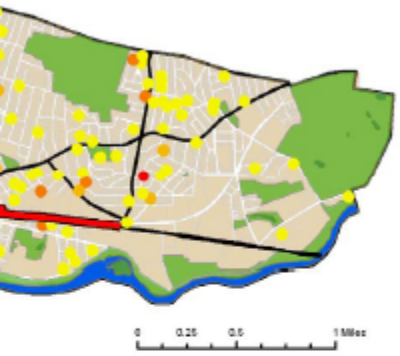
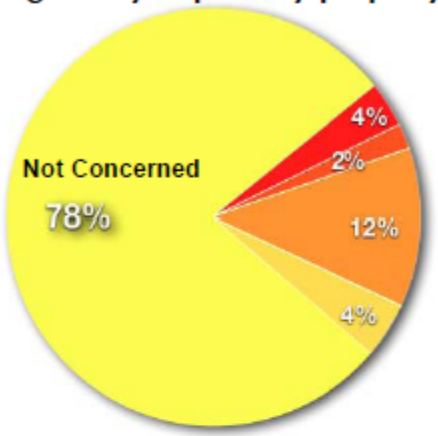
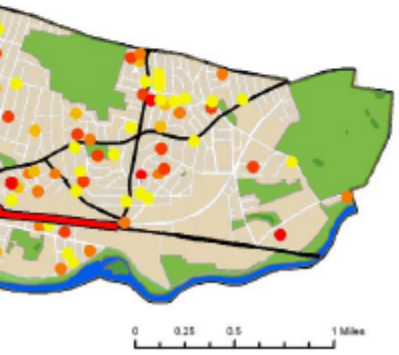
ve property impacts



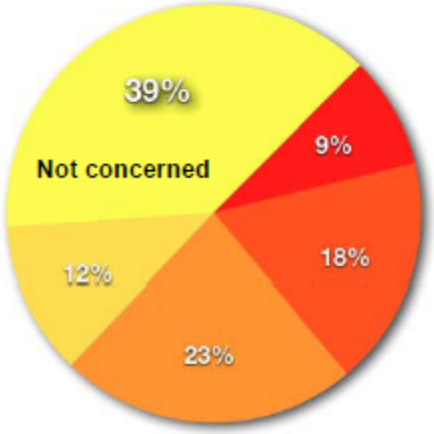
Concerns that the Path will negatively impact my property



along the Path



Concerns about safety in the area of the Path



Project Description

The Watertown Department of Community Development and Planning, in conjunction with the Bicycle and Pedestrian Committee and Watertown Citizens for Environmental Safety (WCES) are in the process of expanding off-street options for the citizens in the town. The Watertown Community Path will serve as a primarily off-street transportation option linking East Watertown, Watertown Square, and the Charles River. In the summer of 2010 the Massachusetts Department of Conservation and Recreation (DCR) will commence construction of a "rail trail" that will connect the Charles River Reservation Path in East Watertown to the Minuteman Commuter Bikeway in Cambridge. The next piece of this network expansion, the Community Path, has a more concentrated focus on meeting the needs of residents in Watertown by providing walking and biking access to businesses, public facilities, schools, and recreational opportunities.

Spatial analysis for this infrastructure project is critical to address both the goal of the Path anchoring the redevelopment of lower Arsenal street and the importance of addressing citizen concerns early in the process to avoid future backlash. Comparing the land use maps to the survey results will assist in the making of basic conclusions about how residents feel towards the project compared to business owners and managers.

Survey geocoding methodology

A survey completed by 256 people provides a qualitative analysis to help identify geographic areas of support and locate specific areas of concern. This information will be critical to the

San serif headers, serif Times New Roman body text

Comic Sans…

Story of Comic Sans: http://www.connare.com/comic.htm
(Now Chalkboard on Apple OS)

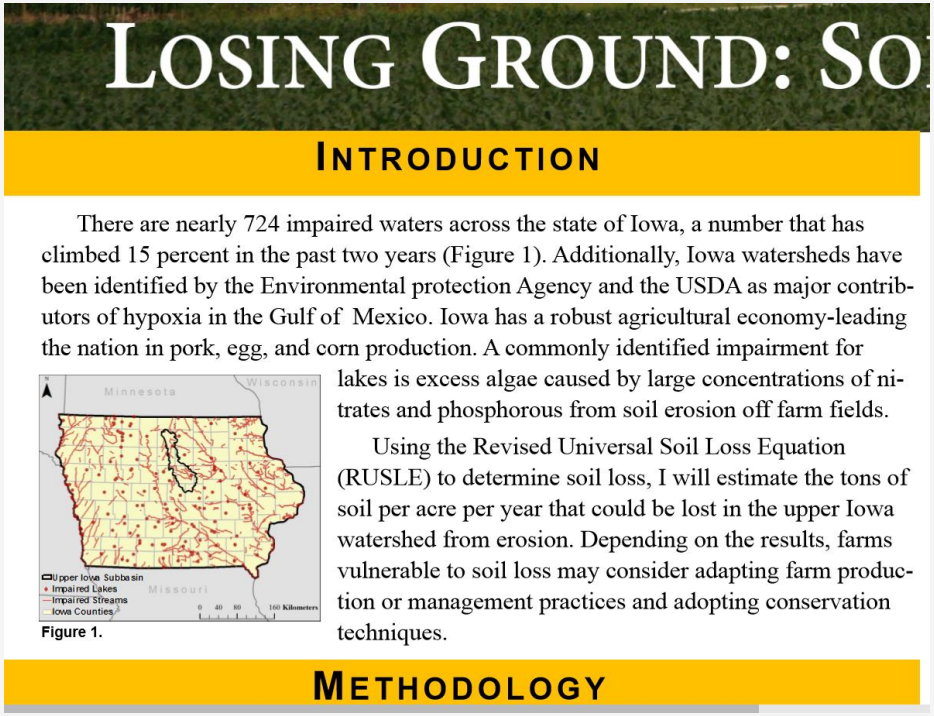
The bold, the underlined and the italicized

Character Spacing & Tracking

- Headers
  - Helps stand out
  - Fills the Space
- Improves readability
- Easily recognized
- Negative tracking is rarely used

Character Spacing & Tracking

- Use in **Section Headers**
  - Helps stand out
  - Fills the space
- Improves readability
- Easily recognized



LOSING GROUND: SO

INTRODUCTION

There are nearly 724 impaired waters across the state of Iowa, a number that has climbed 15 percent in the past two years (Figure 1). Additionally, Iowa watersheds have been identified by the Environmental protection Agency and the USDA as major contributors of hypoxia in the Gulf of Mexico. Iowa has a robust agricultural economy-leading the nation in pork, egg, and corn production. A commonly identified impairment for lakes is excess algae caused by large concentrations of nitrates and phosphorous from soil erosion off farm fields.

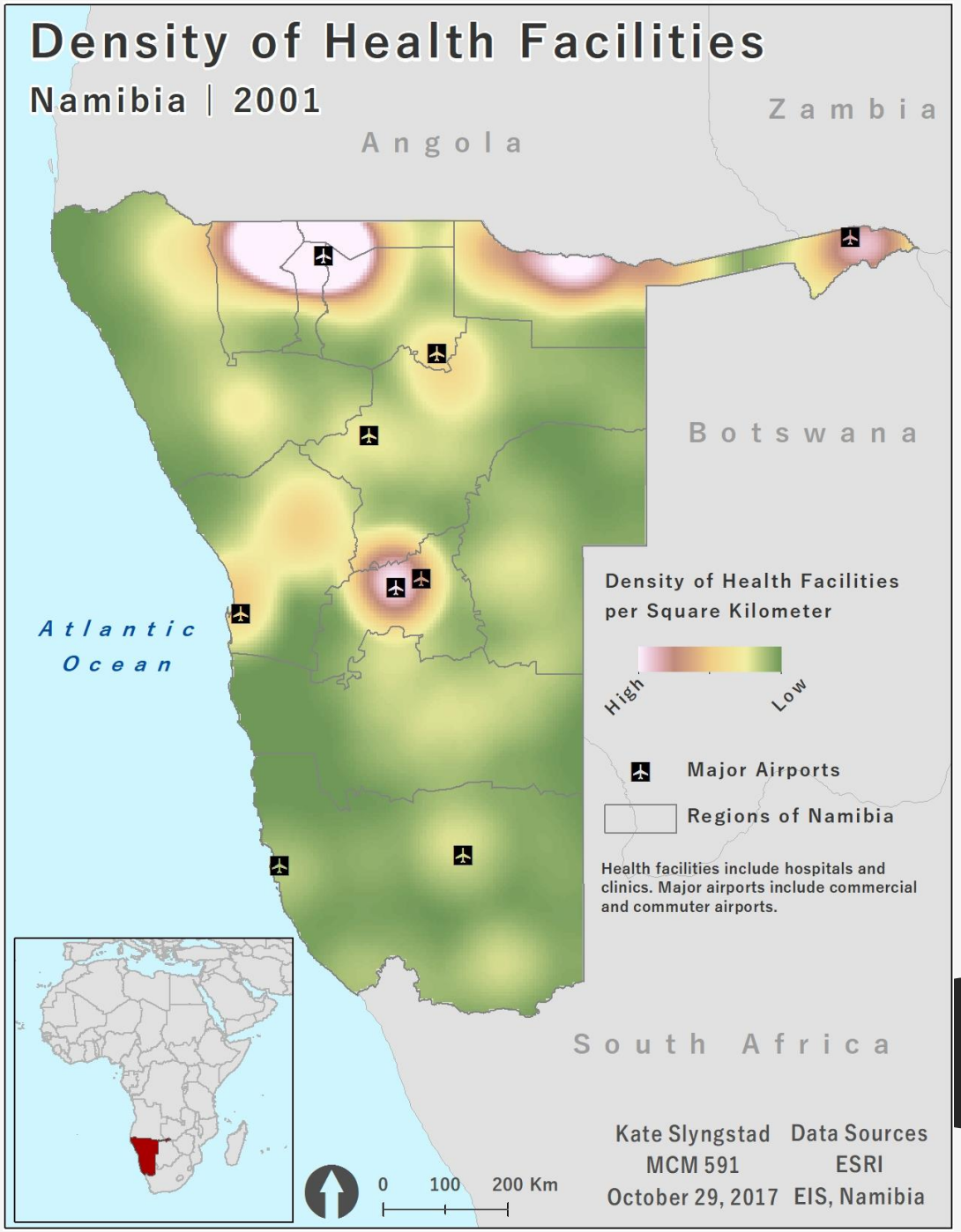
Figure 1.

Using the Revised Universal Soil Loss Equation (RUSLE) to determine soil loss, I will estimate the tons of soil per acre per year that could be lost in the upper Iowa watershed from erosion. Depending on the results, farms vulnerable to soil loss may consider adapting farm production or management practices and adopting conservation techniques.

METHODOLOGY

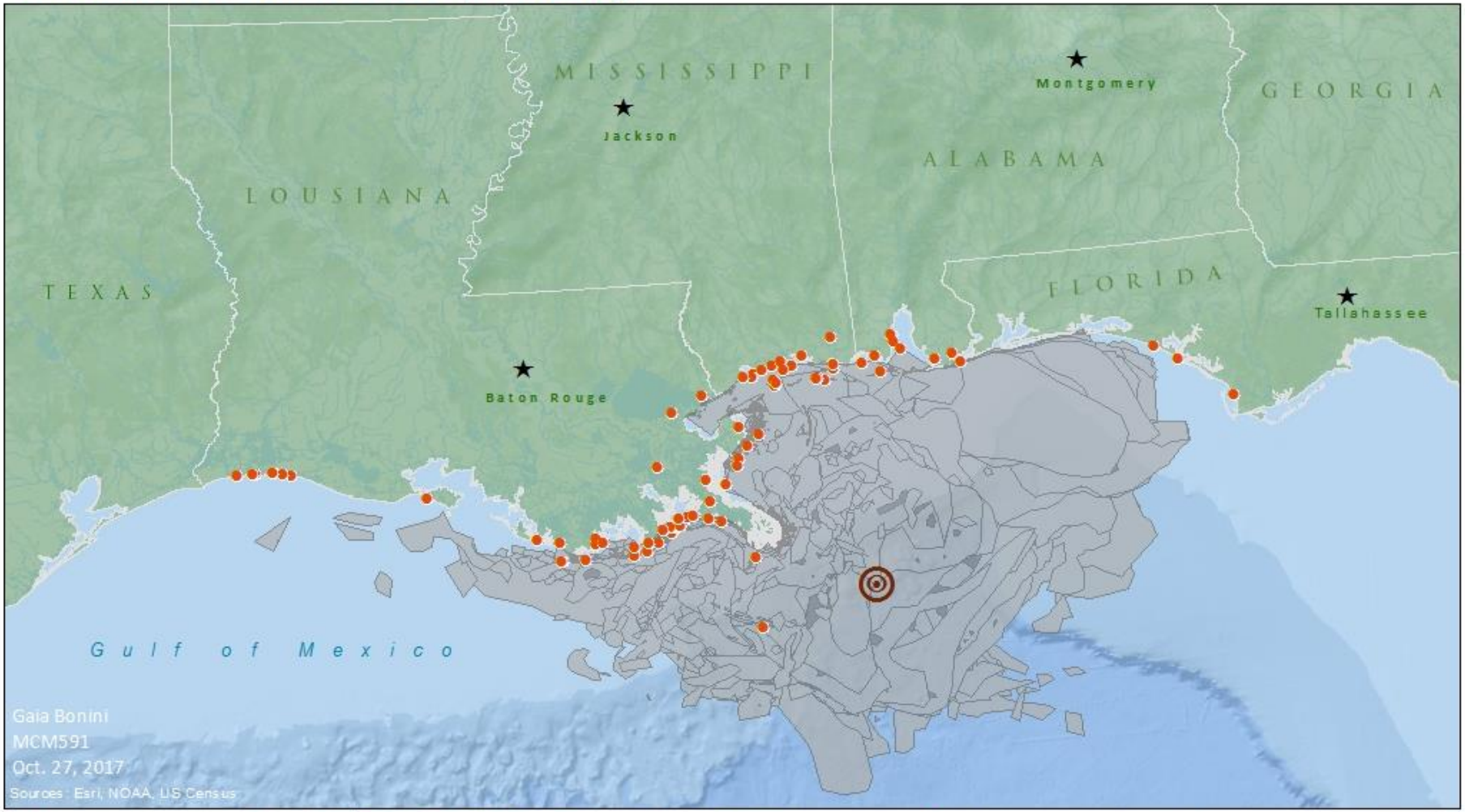
Use **character spacing** throughout your maps too!

- Labels
- Titles
- Legends
- Annotation



Bottlenose Dolphin Strandings During the Deepwater Horizon Oil Spill Response

Gulf Coast of the United States | 2010-2015



THE WORST SPILL IN HISTORY...

This map shows stranding incidents of Bottlenose dolphins (Turciops truncatus) for five years following the 2010 BP Oil spill at the Deepwater Horizon rig in the Gulf of Mexico. The worst oil spill in history, cetaceans and other marine mammals are still affected by the spill today.

The extent of this oil spill is a projection modeled by NOAA, illustrated in this forecast.

- Bottlenose Dolphin Strandings
- BP Deepwater Horizon Oil Rig
- State Capitals

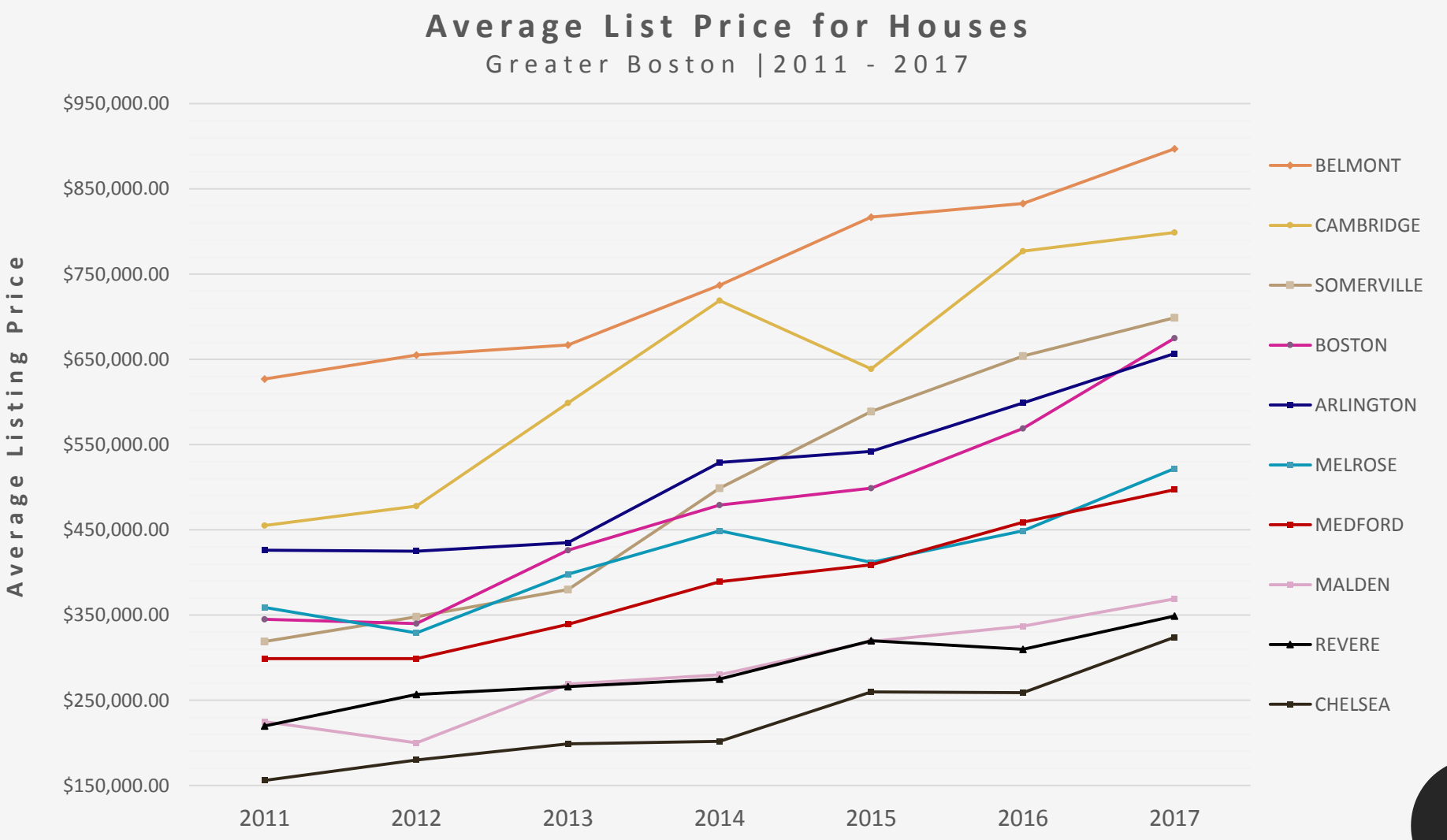
Oil Trajectory Forecast

Forecast

- Uncertain
- Light
- Medium
- Heavy

0 50 100 Miles

Character Spacing



Readability: Column Width

The "alphabet-and-a-half " line length rule:
the ideal line length at 39 characters
regardless of type size.

Land of Opportunity: The Use of GIS Network Analyst to Evaluate Transportation Access

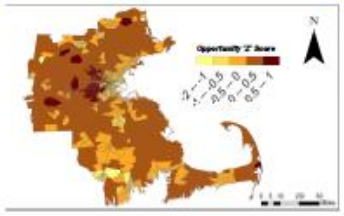
What is Opportunity?

The Kirwan Institute for the Study of Race and Ethnicity at Ohio State University has put together several data sets detailing differences in "opportunity" at the Census Tract level. In short, a community's "opportunity" rating, or its 'Z' score (explained in the methodology section) refers to a series of educational, employment, neighborhood, financial, and environmental factors.

This project displays a method of mapping transportation access — by car or by bus — from areas of markedly low comprehensive opportunity to areas of markedly high comprehensive opportunity. GIS Network Analyst, which allows users to map access to locations using existing transportation networks, was utilized to show average time taken to travel from low to high opportunity Census Tracts.

The use of this method in the future could potentially aid planners in improving transportation access in certain communities, and perhaps in spreading opportunity more equally across the board in neighborhoods such as Greater Boston. Note that this project serves as the demonstration of a method rather than as the verification of a hypothesis.

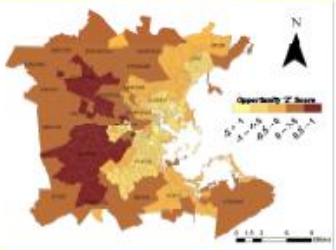
Comprehensive Opportunity in Eastern Massachusetts



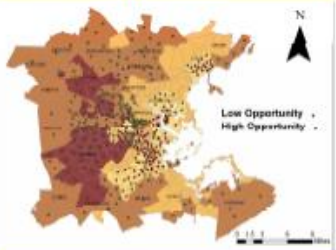
Methodology

The "Comprehensive Opportunity" data layer averages a variety of housing and neighborhood, economic, and educational factors to create a 'Z' score, rated in these maps from -2 to 1. Those Census Tracts in the Greater Boston area possessing Z scores between -2 and -0.5 were given a "low opportunity" rating and marked with a red dot at their centroid, and those Tracts having a Z score between 0 and 1 were given a "high opportunity" rating, as shown by green dots. Two transportation networks — one for roads and one for MBTA buses — were created using the Network Analyst tool. From the total mileage of each road or bus route and their respective speed limits (12 mph for all bus routes), total minutes taken on each stretch of the two networks could be calculated. Using Network Analyst's Origin -Destination Cost Matrix, the total minutes taken to travel from each point of low opportunity to each point of high opportunity was computed. Finally average total travel times from each origin of low opportunity were determined using the two networks.

Comprehensive Opportunity in Greater Boston

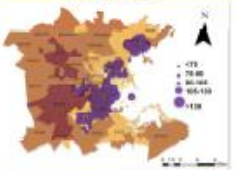


Points of Low and High Opportunity



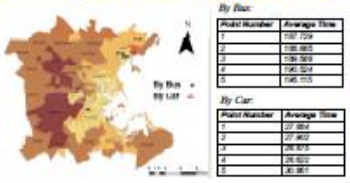
Average Time from Low Opp. To High Opp. by Car (in Minutes)

Average Time from Low Opp. to High Opp. by Bus (in Minutes)



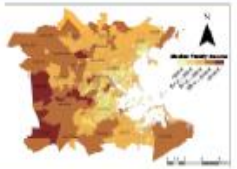
Lowest Average Times

Highest Average Times



Discussion

As mentioned, this project serves primarily as the demonstration of a method. As shown in the map below of median family income, this tool can be utilized to show how differing levels of transportation access relate to a household's financial situation. Not surprisingly, comprehensive opportunity and median income are quite related, a finding leading to the conclusion that perhaps opportunity itself should improve along with transportation accessibility in certain areas.



Limitations

Because one is unlikely to take a bus from Lynn to Waltham, and because the MBTA bus system does not stretch as far as does the roads system, true transportation access can only be modeled using a multimodal network including roads, public transit, and commuter trains. For more on methodology and results, see https://wikis.uit.tufts.edu/confluence/x/D0oTAg.

Cartographer: Jeremy Strauss
Date: May 6, 2010
Tufts University UEP
Introduction to GIS
Data Sources: Kirwan Institute, MassGIS, U.S. Census Bureau

Tufts

Left Align (GOOD!)

The Greeks and the Romans left a legacy in Europe which is evident in current language, thought, law and minds. Ancient Greece was a collection of city-states, out of which a primitive form of democracy developed. Athens was the most powerful and developed city, and a cradle of learning from the time of Pericles. Citizens forums debated and legislated policy of the state, and from here arose some of the most notable classical philosophers, such as Socrates, Plato, and Aristotle, the last of whom taught taught Alexander the Great.

Justified (BAD!)

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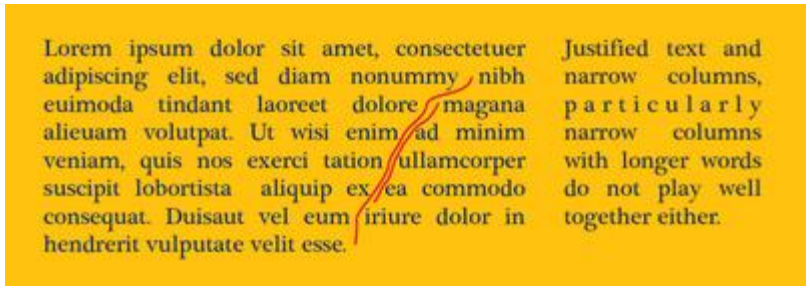

Avoid "Rivers"

"WIDOWS" & "ORPHANS"

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Morbi at diam vitae massa ornare ullamcorper. Morbi ut nisl ut urna mattis venenatis vel auctor leo. Ut et diam eu nisl luctus pretium sodales in elit. Curabitur sagittis, metus consequat sagittis lacinia, libero lacus vulputate metus, ut bibendum felis lacus vitae urna. Aliquam vulputate, lacus ac ultrices egestas, nulla felis porta arcu, ac convallis metus felis in turpis. Donec orci turpis, tincidunt sodales ante id, ultrices dignissim elit. Ut tempor neque sagittis velit vehicula, eu varius enim elit rutrum.

vel non est.

Vivamus nec posuere purus. Maecenas nec faucibus turpis. Mauris feugiat aliquam euismod. Sed euismod tortor quis metus volutpat, vel imperdiet ipsum ultrices. Aenean facilisis tortor quis sapien volutpat hendrerit. Morbi bibendum nisl eget massa congue, vitae placerat arcu porttitor. Mauris quis nunc vestibulum, vestibulum lectus non, consectetur purus. Sed aliquet odio et euismod molestie. Nam gravida suscipit ex, id feugiat ligula pretium nec. Vivamus eget odio mollis.

Orphan

Widow

Bullets: Give them Space!

Leonardo Da Vinci's Best Ideas:

• Mirror Writing: Was it a a way to avoid the inky mess of writing left-handed? Whatever his motives, Da Vinci sure liked mirror writing: most of his journals are scrawled in reverse.
• Scuba His diving suit was made of leather, connected to a snorkel made of cane and a bell that floated at the surface.
• The Revolving Bridge: The light yet sturdy materials, affixed to a rolling rope-and-pulley system, allowed an army to pick up and go at a moment's notice.

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And Paragraphs Too!

- Break your text into paragraphs & have a space *between* paragraphs
- Keep spacing the same between paragraphs
- Keep line spacing the same from paragraph to paragraph
- Don't indent & avoid hyphenation

DATA LIMITATION

Most political geographic research uses aggregate level data and survey tools as the preferred instrument of choice for this type of analysis because of the methodological inaccuracy and inconsistency related to voter and voter history data collection. Generally speaking, Massachusetts has a high voter registration rate but experiences low voter participation rates overall and even more so in this electorate. This problem is made worst due to annual local census counts in many urban municipalities that leads to high numbers of voters categorized as inactive, which expunges from the active voter precinct list. That is why originally, I wanted to also compare the eligible voter population analysis with actual voter turnout rates of this target electorate at the precinct level. Moreover, I developed a strategic voter history query using the voter history software Voter Activation Network (VAN): (1) People who voted in the 2008 election but missed the 2010 US Senate Special Election, (2) 2010 Governor's race, plus (3) People who voted in 2006 Governor's Race, 2007/2009/2011 Municipal Elections (4) Everyone who registered since 2008 and missed 2 elections; (5) Exclude those who were registered before 2008 and have never voted that would have kept us from overstating the role of this electorate. But since every individual city and town maintains their own information it would take a great deal of time to complete this analysis. The Census also has its own limitations: (1) it counts non-citizens and those incarcerates as eligible voters; (2) lacks consistent measure for races, particularly Hispanic. Therefore, the MRE analysis of 2002 overstates the amount of Hispanics. Although the 2012 Census accounts for this through the Non-White Hispanic category, race as uniform measurement is illusive due to self-reporting.

ANALYSIS & CONCLUSION

The main conclusion from this analysis is that with over 1,000,000 registered and unregistered voters the MRE is spatially concentrated in urban cities and towns through the Commonwealth. Secondly, this electorate is growing at dramatic rate experiencing over 164 percent growth in the last ten years. At all scales of analysis the MRE doubles in growth. Third, in 2002 approximately 41% of this electorate lived in Boston, Lynn, Worcester, Springfield, and Holyoke and now only 36 percent reside in these cities. Fourth, if one selects precincts with over 500 MRE residents, we observe the deep geographic concentration of this electorate has experienced in the last 10 years. Moreover, the geography indicates a growth in suburban cities of this population. Overall, these observations support the goals of this project and the potential impact that the MRE can play in the electoral and policy making process as this community is expected to continue its growth. Lastly, as further research is continued on this subject it is critical that we integrate voter history and voter regression models to this research. In doing so we can build an electoral power building map that can begin to rebuild a new Commonwealth and America, one household, one vote at a time.,

Don't Do This!

Crowd-Mapping and Human Security: The 2011-2012 Syrian Uprising

Introduction

For over a year, Syria has been the scene of what is perhaps the Arab Spring's most inscrutable uprising. What began as scattered demonstrations after young children were arrested for vandalism in the provincial city of Dara'a grew into a popular uprising led by a combination of furtive protester groups and shadowy insurgents. The lack of a robust media presence in the country has made information hard to come by, prompting various dissident groups both inside and outside the country to fill the void with SMS, Twitter and e-mail reports. From this crowd-sourced information, groups outside the country are not only analyzing the general human security situation but are increasingly able to geographically visualize the situation as well.

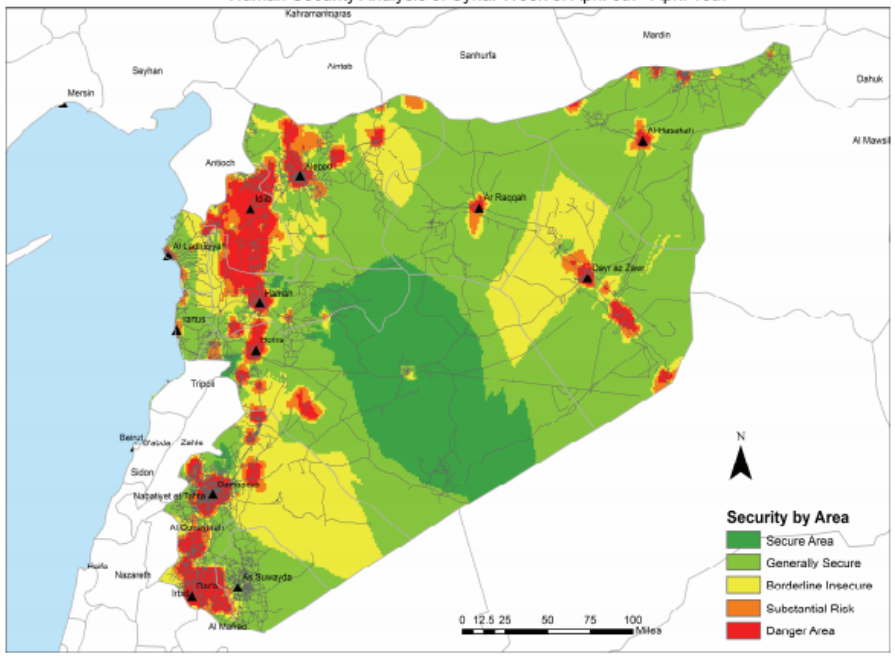
This project is an inquiry into the possibilities of crowd-sourced GIS data mapping out safe areas and routes for Syrians fleeing within and across their country's borders. By using crowd-sourced data and spatial analysis techniques, this project maps and analyzes current unrest and provides a regional and road-based analysis of safe areas and routes in the country.

Methodology

Crowd-sourced KML files detailing the locations of protests, killings, strikes and other civil disturbances during the week of April 8th-15th, 2012, were obtained from the Syrian Uprising Information Centre. Road data was downloaded from OpenStreetMap (available through a Creative Commons license) via the Cloudmade download page, with major city data points and administrative boundaries taken from the Tufts GIS servers. Except for the last two categories, all data mapped was crowd-sourced.

Incidents were broken down by type: protests against the al-Assad regime, killings carried out by the regime, general strikes, and other incidents ranging from reports of arrests to documentation of tank fire. First, a density analysis based on incident data gave a rudimentary look at the security situation from a spatial lens. Then a density kernel analysis was done on the incident data, which was then combined with road infrastructure data, with the result analyzing the safety of routes based on their proximity to clusters of unrest, as well as the density of incidents. The same process was used to analyze the relative safety of individual major cities. Finally, numerical rankings were assigned to incident data based on the potential security threat. Killings received a ranking of three, protests and strikes received a ranking of two based on the potential for a violent response, and other incidents with sparse information received a ranking of one. Similar rankings were given to roads based on their proximity to unrest. These data layers were then interpolated into new visual representations and combined using the raster calculator to provide a color-coded human security landscape of the entire country, with green representing the safest regions and roads passing through those regions representing the safest routes. Despite the three ranking categories for incident data, the final analysis layer had five categories for ranking insecurity to reflect the complexity of the combined data.

Human Security Analysis of Syria: Week of April 8th - April 15th



Issues

The situation on the ground in Syria has been changing very quickly, and the data in this project will necessarily have a short shelf life. One must consider that the data does not represent all of the human rights violations that occur in a given timespan (e.g. sexual violence, disappearances, attacks by opposition groups) and that the sources aggregating the data are themselves highly partisan.

Due to logistical limitations, a complete breakdown of the types of roads and transportation options was not possible. Gaps in data also meant that important security considerations such as road blocks were not accounted for in this analysis. Evaluating the security risks by incident type and proximity was inevitably a subjective endeavor, and the rankings assigned must be considered in light of their rather fluid context. The decision to exclude or include certain data points was also subject to logistical and subjective considerations; for example, crowd-sourced data from other sources was excluded because it was too sparse, and data such as police station locations was excluded because it was seen as irrelevant (troop movements and secret police infiltration may present more of a threat than the physical presence of a police station).

Conclusions

This project represents some of the possibilities of using crowd-sourced human rights data to analyze human security and safe routes. Using limited and almost solely crowd-sourced data, it is possible to do a rudimentary human security analysis that can be used by civilians and asylum-seekers to reach safe havens inside or outside the country. The ranking system and proximity can give a general sense of the potential for violence and insecurity in a given area, and can allow for a cost-benefit analysis in seeking refuge in a certain region or taking a specific route. Additionally, crowd-sourced data can also highlight unrest and human rights violations in areas that have not received media attention.

However, there are limitations to such a project that should be considered. A steady stream of reliable crowd-sourced data can be elusive, and a project made by people outside the country may rely on guesswork and subjective analysis ill-grounded in reality. The limited of degree of technological penetration and dearth of impartial sources in many countries also hinders implementation.

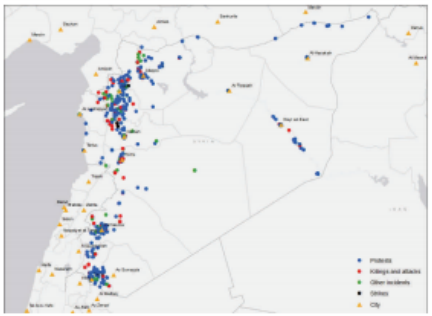
Created by:

May 8th, 2012

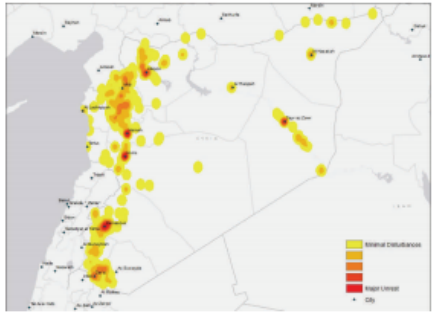
Projection: Lambert Conformal Conic

Data Sources: OpenStreetMap, Syrian Uprising Information Centre, Tufts GIS Data Server (World Folder)

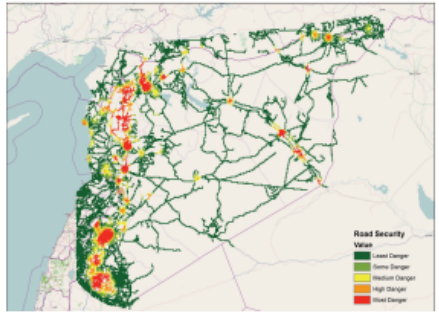
Type of Unrest



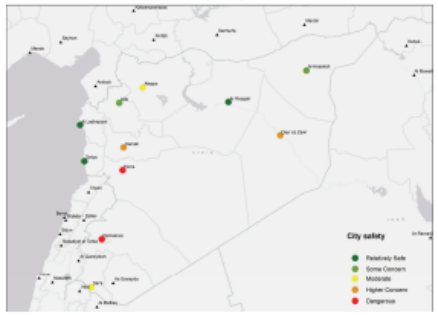
Density of Violence and Civil Unrest



Road Security Analysis based on Conflict Proximity and Density



City Security Levels



Quintessential One Health:
A Bovine Tuberculosis Risk Analysis in South Africa

INTRODUCTION

Bovine tuberculosis (BTB), caused by pathogen *Mycobacterium bovis*, is an infectious disease of importance to domestic livestock, wildlife, and humans. Endemic to bovids, BTB is known to spill over into wildlife populations where they cohabitate. First identified in greater kudu and common duiker in 1928, BTB spilled over from infected cattle to African buffalo in South Africa's Kruger National Park in the 1990s. It has since been diagnosed in a multitude of species ranging from felids (lions, leopards, cheetahs) to canids (African wild dogs) to primates (baboons) to ungulates (eland, impala etc.); many of these species are already rare or in decline. The occurrence of BTB in wildlife constitutes an infectious feedback loop, potentiating re-exposure and infection for livestock, thus thwarting eradication efforts. The ability of *M. bovis* to cause spill-over events and reside in various reservoir species makes it challenging to eradicate and presents a significant risk to wildlife health.

A noteworthy zoonosis for humans, BTB is closely related to *M. tuberculosis*, the causative agent of human tuberculosis (TB), and the leading infectious cause of death worldwide. Because developing nations often lack the resources for proper speciation, the exact proportion of BTB cases is unknown, and the true prevalence is suspected to be severely under-reported. However, due to reasons of increasing multi-drug resistance, it is of vital importance to make this distinction. On the South African landscape level, where wildlife is present to maintain the pathogen, where livestock range in close proximity to wildlife, and where livestock and people coexist, BTB remains a significant threat to public health, encapsulating how animal, human, and environmental factors collectively drive disease emergence and patterns.

Species of Conservation Interest


African Lion
Panthera leo
VULNERABLE

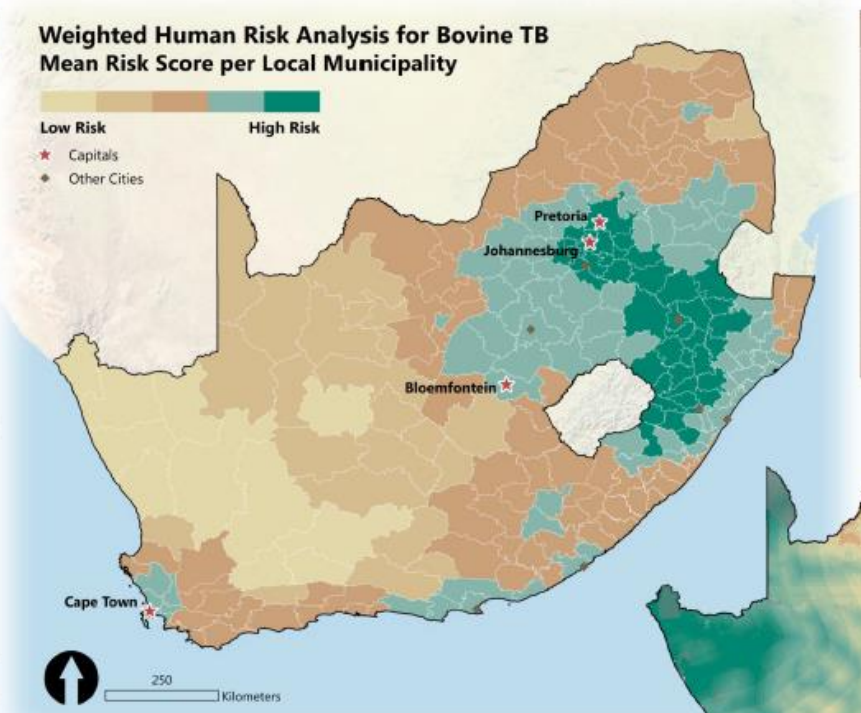

Leopard
Panthera pardus
VULNERABLE


Cheetah
Acinonyx jubatus
VULNERABLE


African Wild Dog
Lycaon pictus
ENDANGERED

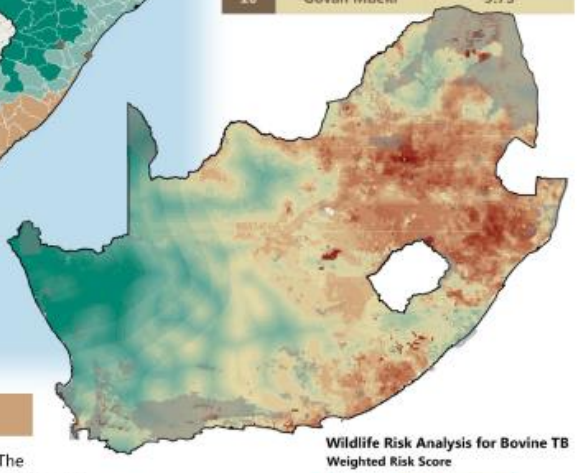
METHODS

A weighted risk analysis was performed for both human and wildlife populations. A variety of tools was used for each analysis (ie. Euclidean Distance and Kernel Density), and each factor was converted to a raster and reclassified. Zonal Statistics was applied to the human analysis to determine average risk per local municipality. From the wildlife analysis, the hot zones of risk were manually compared to the ranges of vulnerable species to determine which species might be most susceptible based on geospatial factors. For humans, weight was assigned as follows: 30% HIV prevalence + 30% bovine density + 20% abattoir density + 20% dairy production. For wildlife, the weight was assigned as follows: 35% bovine density + 30% distance from African buffalo range + 20% distance from water + 10% distance from overlapping warthog and kudu range + 5% distance from independent kudu and warthog ranges.



Municipalities of Highest Risk

#	Local Municipality	Mean Risk Score
1	Midvaal	6.82
2	Lesedi	6.72
3	Emfuleni	6.24
4	Dipaleseng	6.21
5	Ekurhuleni	6.19
6	Mpofana	6.11
7	uMngeni	5.97
8	Imbabazane	5.94
9	Indaka	5.79
10	Govan Mbeki	5.73



RESULTS & DISCUSSION

For the human analysis, the average BTB risk was determined per local municipality. The absolute minimum and maximum scores possible were 0.5 and 8.9, respectively. Average scores per local municipality ranged from 0.63 to 6.82, with the minimum and maximum scores being 0.5 and 7.7, respectively. The highest average risk of BTB was 6.82, in the Midvaal Local Municipality, within the Sedibeng District Municipality, and the Gauteng Province. For the wildlife analysis, some high-risk areas overlapped with cheetah ranges, while African lions and African wild dogs seem to range in lower-risk areas. Leopard ranges expand across the extent of South Africa, so they may also be considered a potentially at-risk population.

The value of such a vulnerability project is multifold. Public health agencies can use this geospatial analysis to establish targeted surveillance and prevention programs, engage in public outreach, and disseminate food safety, hygiene, and biosecurity information in highly at-risk areas. This project can also inform conservation efforts, identifying key regions and populations at risk. BTB is also notably a *global* disease, with varying risk factors. This methodology can be repeated in other regions and modified for different factors. For example, BTB is also a problem in invasive brush-tailed possums in New Zealand, badgers in the UK, and white-tailed deer in Michigan.

There are some limitations to this geospatial analysis. Many livestock production risk factors are challenging to represent geographically, such as age, breed, and various management practices. Other excluded datasets include wildlife population density, other immunosuppressive diseases, food safety (ex. milk pasteurization vs. souring), and hygiene factors. In addition, wildlife migration routes and livestock movement across the landscape are critical factors influencing BTB ecology, and due to difficulty in presenting such information, were not considered in this analysis. Furthermore, higher spatial resolution may be more informative in the implementation of targeted surveillance programs. Finally, my chosen factors approximate human population density, but perhaps a more nuanced analysis incorporating environmental and human-independent factors may be more suitable.

JENNIFER YU

MCM 591—GIS for Conservation Medicine
Presented on December 16, 2016

Projection: Africa Albers Equal Area Conic

Data Sources: Global Administrative Areas (GADM), IUCN Red List of Threatened Species, South Africa Protected Areas Database (SAPAD), Statistics South Africa, FAO Global Network, Milk Producers Organization, South African National HIV Prevalence, Incidence, and Behaviour Survey, 2012, ESRI Datamaps 10

Sincere thanks to Carolyn Talmadge for her steadfast support throughout this semester, and her significant contributions to this project.

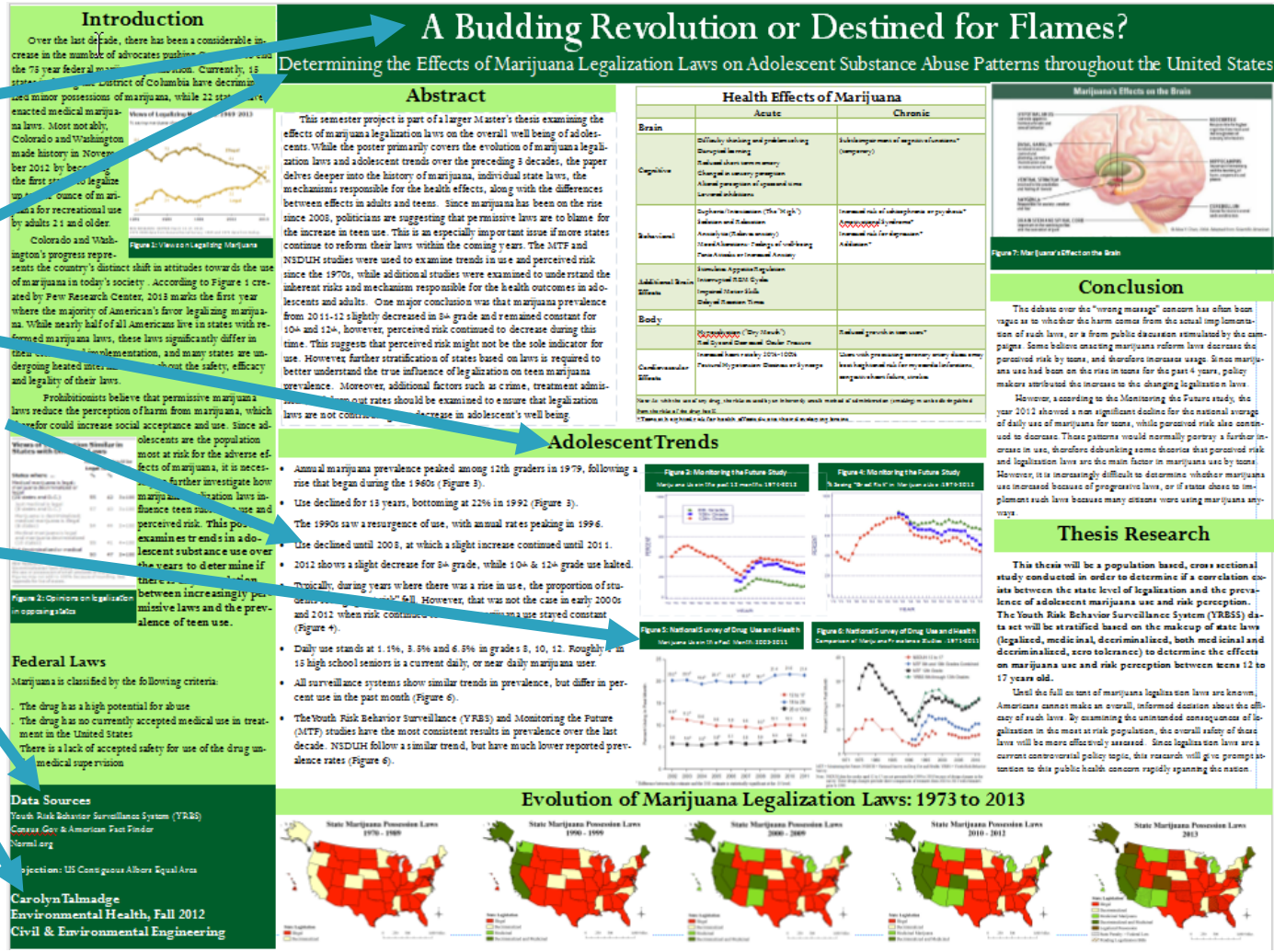
Font size

Font Cheat Sheet

(Times New Roman)	(Arial)
96 Poin	96 Poi
72 points	72 points
60 points —	60 points –
48 points – My	48 points – My
36 points – My GIS	36 points – My GIS
28 points – My GIS Poster	28 points – My GIS Poste
24 points – My GIS Poster	24 points – My GIS Poster
22 points – My GIS Poster	22 points – My GIS Poster
18 points – My GIS Poster	18 points – My GIS Poster
14 points – My GIS Poster	14 points – My GIS Poster

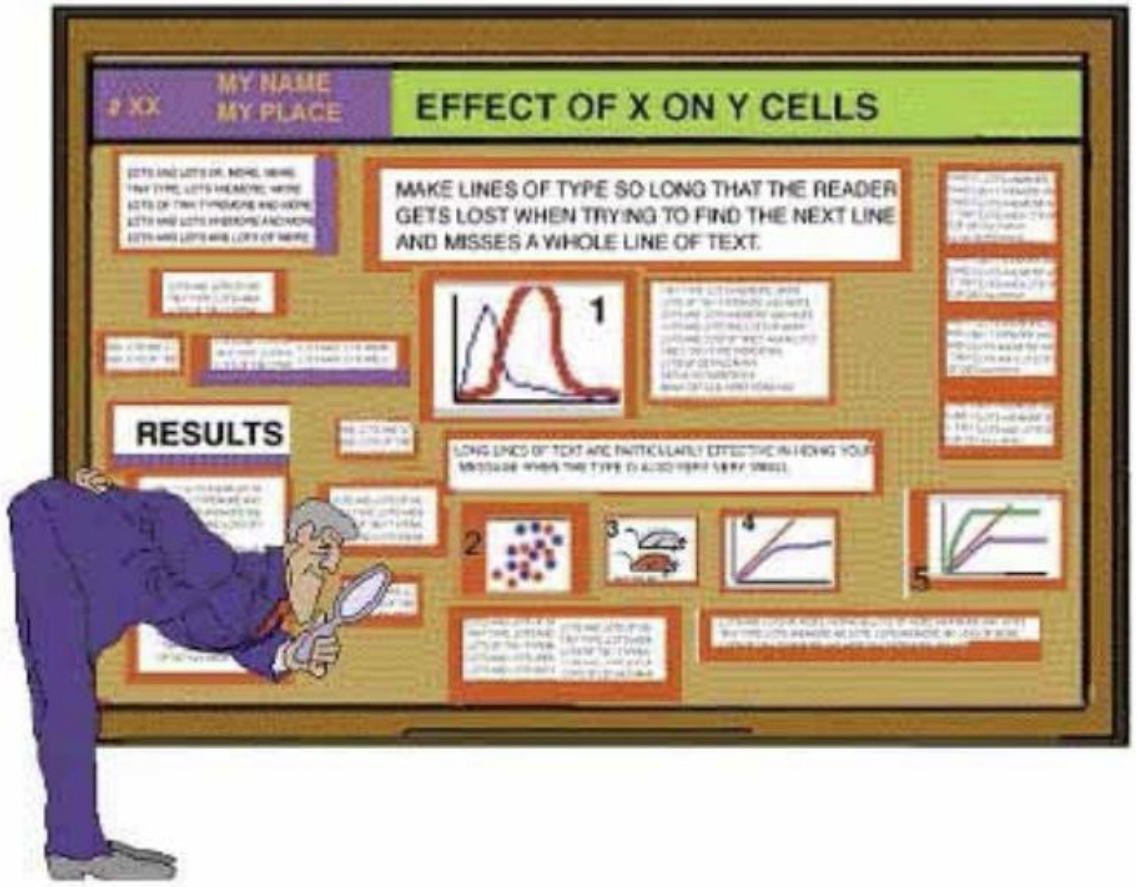
Text Sizes

- Title: 80-100 pt
- Sub Title: 40-60 pt
- Headings: 35-55 pt
- Body Text: 24-35 pt
- Captions: 18-22 pt
- Sources: 18-30 pt
- Authors: 25-40 pt



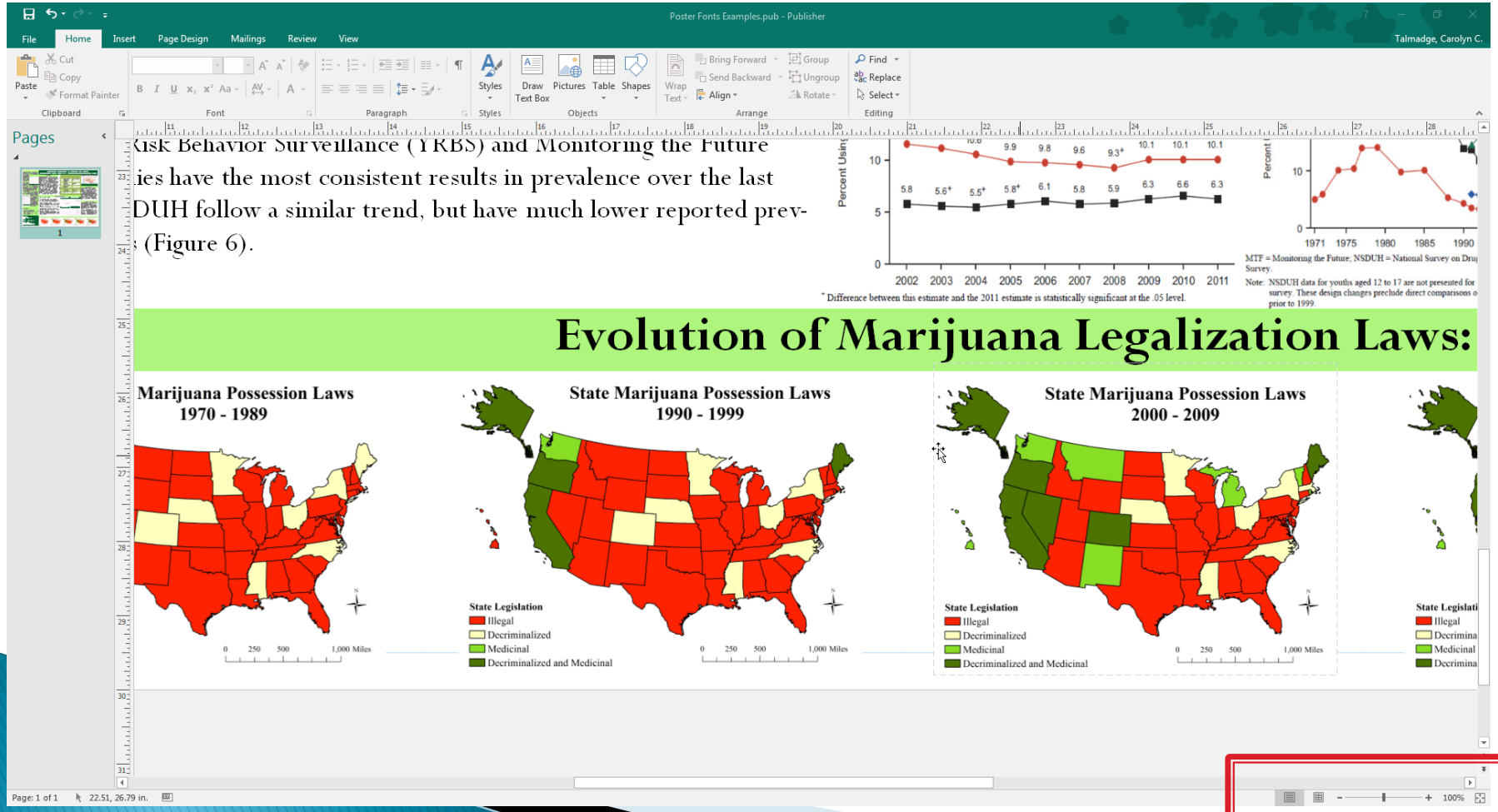
Note: These are based on a 30 X 40in poster with **Serif** Font! This would change if the poster was bigger or smaller!

Can anyone read your body text?



Pro Tip: View your poster at 100%

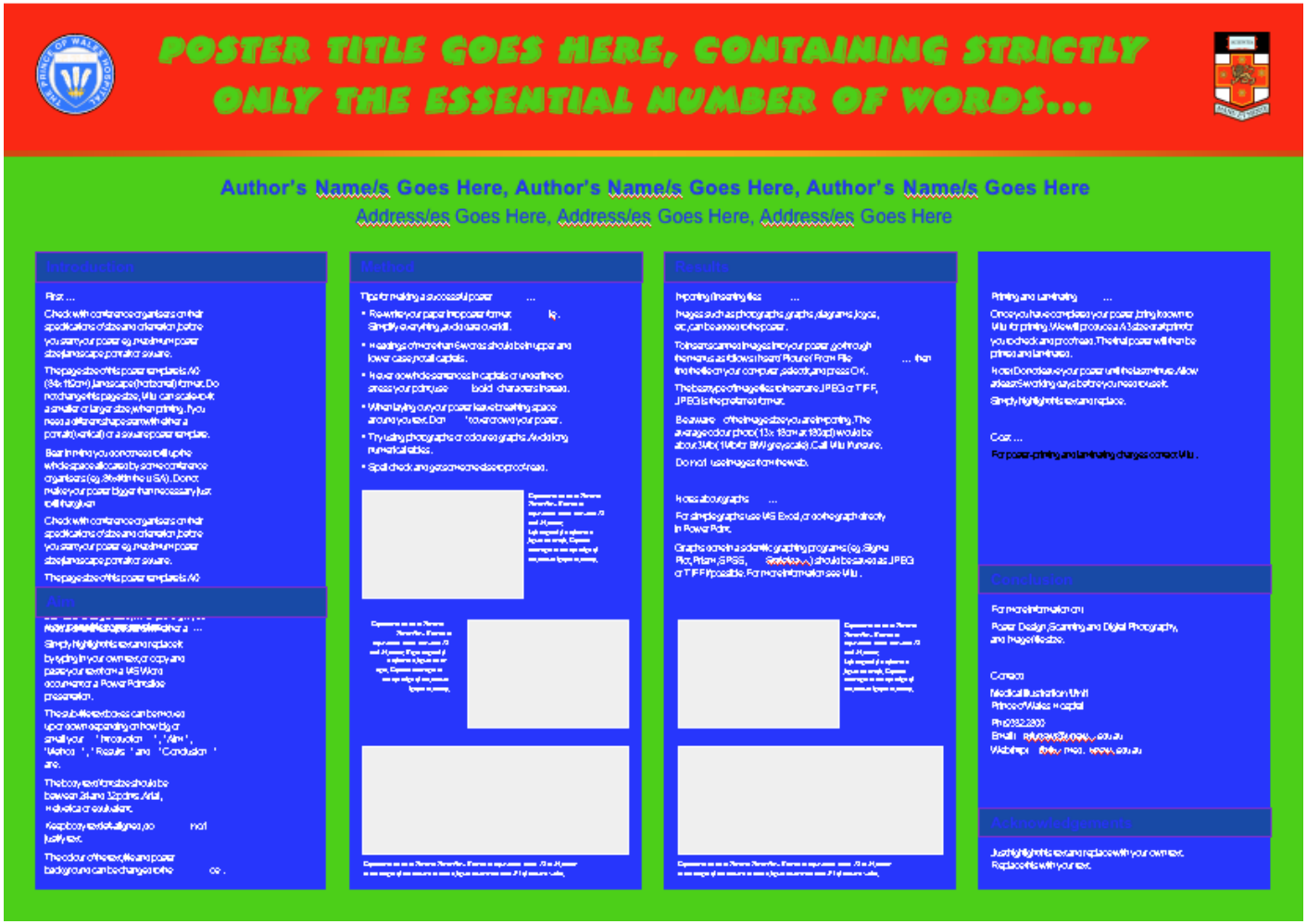
- Put your "zoom" to 100% – Views "real size"
  - Can people read the text? Is the resolution okay?
- Especially important with maps, labels, legends!
- Can do this on the **Layout Toolbar** in ArcMap as well!!



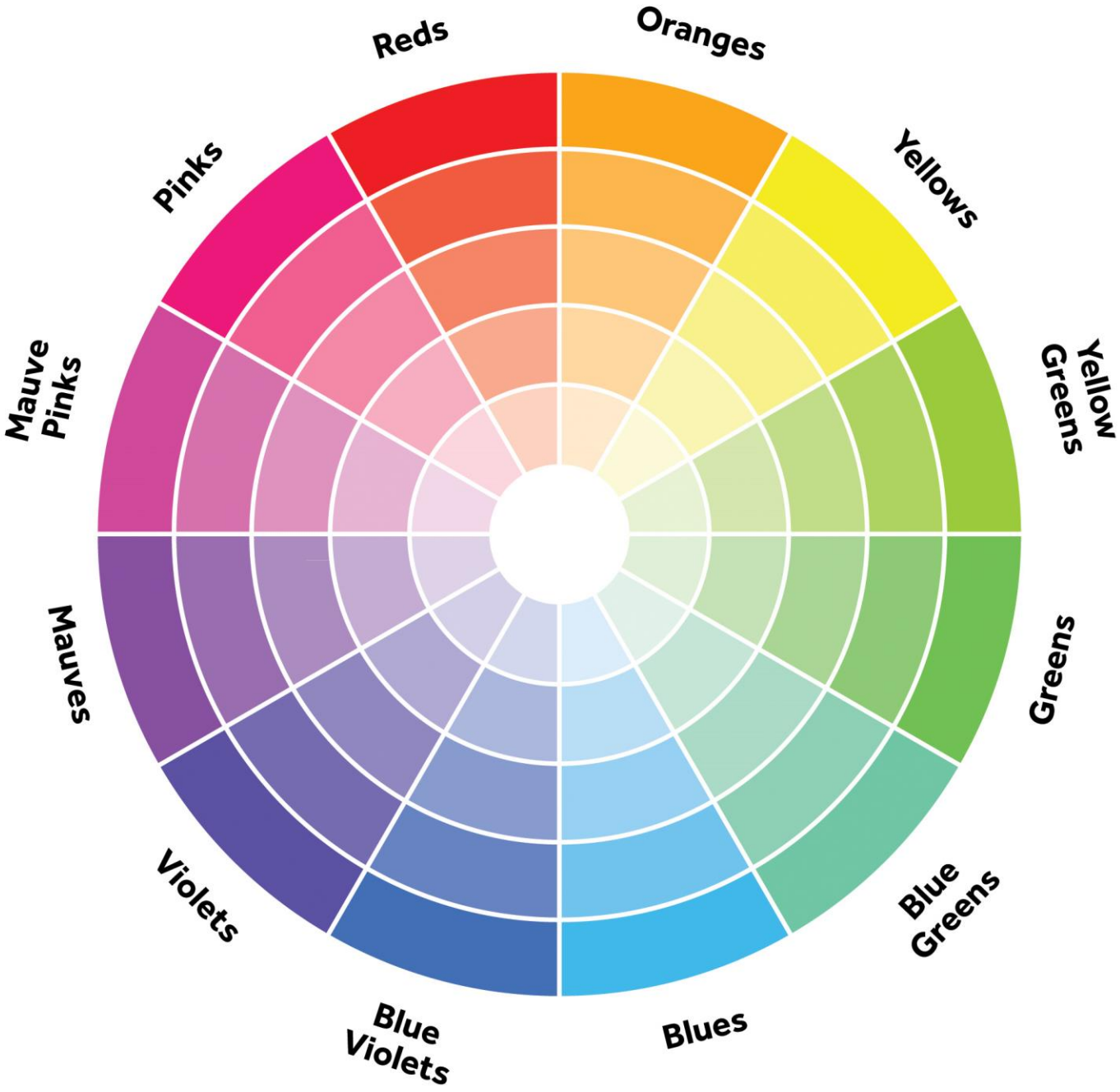
A few words about COLOR

Use 3–4 main colors throughout

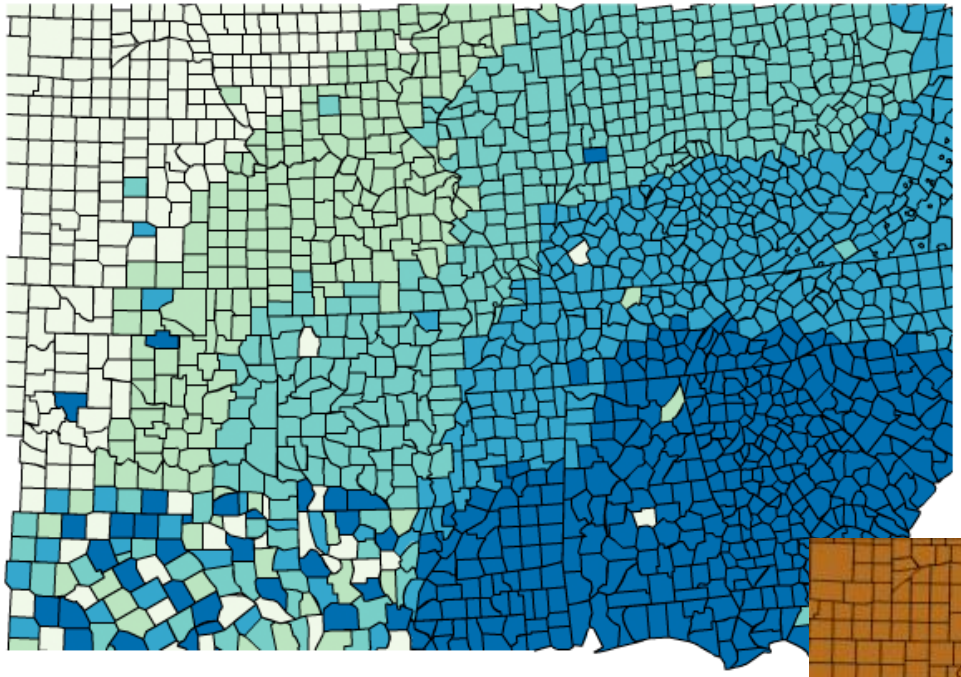
Dark type on light color backgrounds



This attracts attention, but tires the eyes!

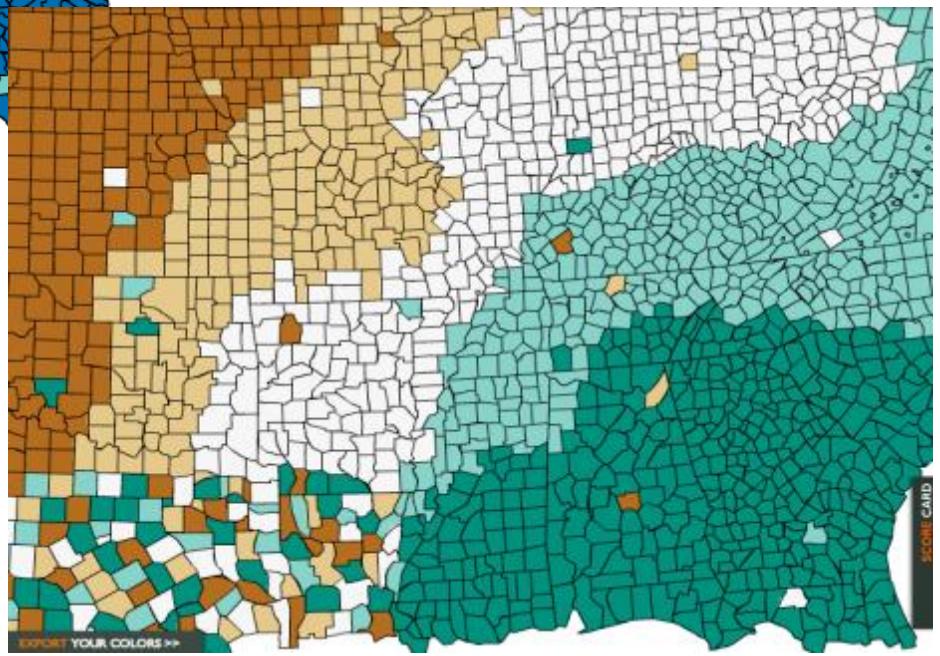


http://www.color-wheel-pro.com/color-theory-basics.html



Use a color Generator to explore color themes!

https://coolors.co/
http://www.colorbrewer.org

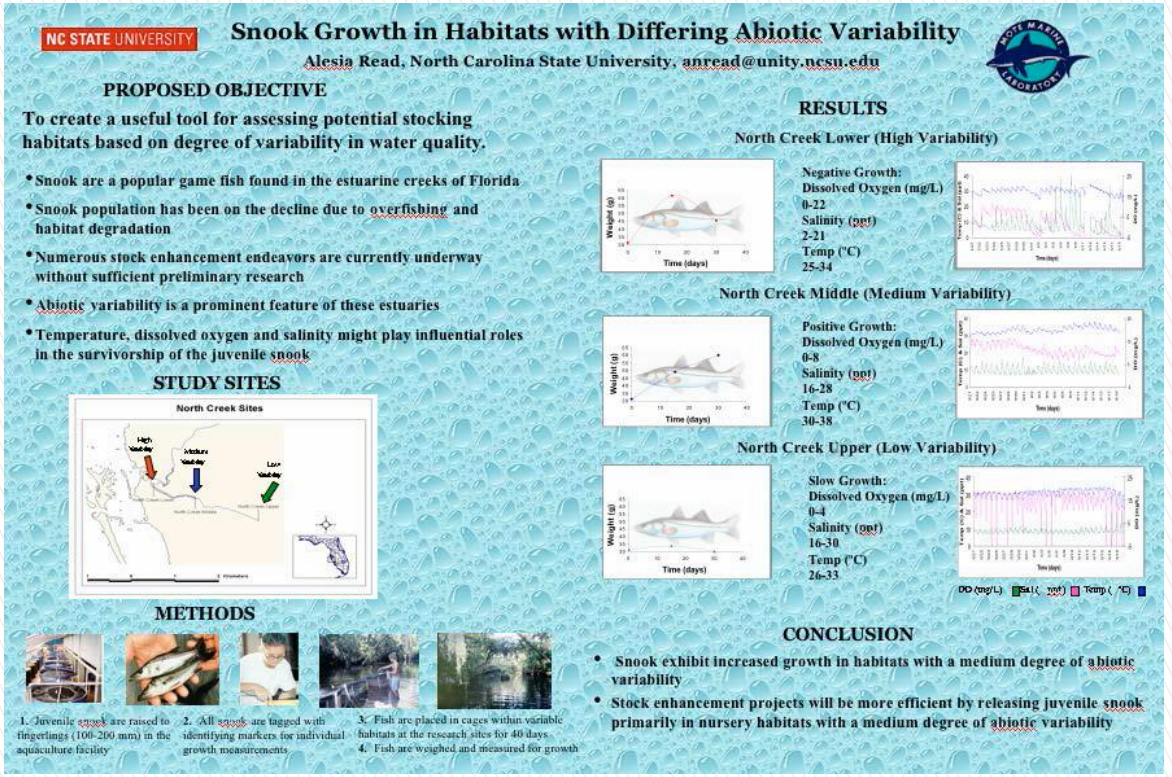


Be Careful though…

Red on blue also appears blurry to the human eye

Yellow on white is hard to read

Blue on Red appears blurry to the human eye



NC STATE UNIVERSITY

Snook Growth in Habitats with Differing Abiotic Variability

Alesia Read, North Carolina State University, anread@unity.ncsu.edu

PROPOSED OBJECTIVE

To create a useful tool for assessing potential stocking habitats based on degree of variability in water quality.

- Snook are a popular game fish found in the estuarine creeks of Florida
- Snook population has been on the decline due to overfishing and habitat degradation
- Numerous stock enhancement endeavors are currently underway without sufficient preliminary research
- Abiotic variability is a prominent feature of these estuaries
- Temperature, dissolved oxygen and salinity might play influential roles in the survivorship of the juvenile snook

STUDY SITES

North Creek Sites

METHODS

1. Juvenile snook are raised to fingerlings (100-200 mm) in the aquaculture facility
2. All snook are tagged with identifying markers for individual growth measurements
3. Fish are placed in cages within variable habitats at the research sites for 40 days
4. Fish are weighed and measured for growth

RESULTS

North Creek Lower (High Variability)

Negative Growth:
Dissolved Oxygen (mg/L)
0-22
Salinity (ppt)
2-21
Temp (°C)
25-34

North Creek Middle (Medium Variability)

Positive Growth:
Dissolved Oxygen (mg/L)
0-8
Salinity (ppt)
16-28
Temp (°C)
30-38

North Creek Upper (Low Variability)

Slow Growth:
Dissolved Oxygen (mg/L)
0-4
Salinity (ppt)
16-30
Temp (°C)
26-33

CONCLUSION

- Snook exhibit increased growth in habitats with a medium degree of abiotic variability
- Stock enhancement projects will be more efficient by releasing juvenile snook primarily in nursery habitats with a medium degree of abiotic variability

And remember backgrounds can be distracting!

Plotter colors to be aware of!
Dark red and **dark blue**

GEOSPATIAL ASSESSMENT OF ENVIRONMENTAL LEAD CONTAMINATION IN SOMERVILLE, MASSACHUSETTS

CAN WE IDENTIFY LEAD EXPOSURE HOTSPOTS FOR HUMANS, DOMESTIC ANIMALS, AND WILDLIFE?

Tufts University
Cummings School of Veterinary Medicine
Healing Animals. Helping Humans. Transforming Global Health.

Tatyana Jahn Kalani
Master of Science in Conservation Medicine, 2017
Cummings School of Veterinary Medicine, Tufts University
Advisors: Dr. Marieke Rosenbaum, Carolyn Talmadge, and Dr. Jessica Leibler

Tufts Institute of the ENVIRONMENT

ABSTRACT

Through increasing industrialization, environmental lead contamination impacts human, animal, and ecosystem health. Lead is known to be a health risk at even small concentrations, and any organism can acquire lead toxicity from soil, water, or air sources. Humans can additionally obtain lead toxicity through urban farming practices such as gardening, composting, and backyard chicken ownership. **Because there is currently a lack of data on the concentration of environmental lead contamination in urban areas, a geospatial assessment was performed for environmental lead exposure risk in the urbanized city of Somerville, Massachusetts during the summer of 2017.** Somerville has adopted sustainable policies and is growing into an active area of urban farming and backyard chicken ownership. Soil samples were collected and obtained with precise GPS coordinates, and a Delta handheld X-Ray Fluorescence analyzer was used to determine each sample's lead levels. Results were interpolated and then combined with other variables to create a risk map to identify areas of high environmental lead contamination in Somerville. Furthermore, this map was combined with demographic data and animal land-use data to determine how these hotspots change with demographic variables. This study discovered that 32.86% of the soil in public areas of Somerville had lead above the Massachusetts cutoff level of 200ppm, and 12.38% of the soil in public areas had lead above the Environmental Protection Agency cutoff level of 400ppm. In addition, house samples were much higher on average – showing that public soil samples alone do not capture the full range of environmental lead contamination in Somerville. Additionally, House Sparrows were the most prominent species seen interacting with soil during observations. Avenues for future research from this project, including increasing house participation and using the House Sparrow as a bioindicator for lead, are important to create a new conservation medicine-based approach to understanding and addressing lead contamination in urban environments.

LEAD IN URBAN AREAS

Lead is an inorganic, heavy metal – abbreviated as Pb – and is naturally found in the environment, including in air, soil, and water. Industrialization has increased the concentration of heavy metals like lead in the environment (Cai & Calisi, 2016). The historical use of leaded house paint and leaded gasoline has been shown to be an important source of lead exposure in humans. Although lead in paint and gasoline has been banned (in 1978 and 1996 respectively), lead from these products can still be maintained in the soil (Mielke & Reagan, 1998). Lead exposure poses a health risk to not only humans, but to domestic animals and wildlife as well. Additionally, the increase in urban farming practices such as gardening and backyard chicken ownership adds more routes of exposure for humans (Spliethoff et al., 2014).

SOMERVILLE, MA

The City of Somerville borders Boston to the north and is home to 75,635 people and 33,720 housing units (United States Census Bureau, 2010). In 2011, the City of Somerville addressed zoning regulations to allow for residents to secure permits for backyard flock ownership (Barth, 2014). Thus, Somerville has become a hot spot for urban farming, including the ownership of backyard chickens (Barth, 2014; Barth, 2015).

Figure 1: Location of Somerville, Massachusetts in relation to Boston, Massachusetts.

METHODOLOGY

Using ESRI's ArcMap, 219 sample sites were determined with a 240m x 240m fishnet grid. Soil samples were collected during the summer of 2017, and obtained using precise GPS handheld units, from houses and public areas in Somerville, MA. Samples were then examined at Boston University's Exposure Biology Laboratory using an x-ray fluorescence analyzer to determine each sample's lead concentrations. Soil results were interpolated using the Inverse Distance Weighted (IDW) method in ArcMap, and then combined with other risk factors (slope, density of gas stations, distance to major roads, parcel size, and year parcel was built) to create a lead exposure risk assessment map to identify areas of potentially high environmental lead contamination in Somerville. Furthermore, bivariate analyses were conducted to compare demographic data with the risk map, in order to determine how these hotspots interact with demographic variables. Wildlife observations were also obtained through five-minute point counts at each sampling location, and through the placement of camera traps. These observations were then overlaid onto the risk map by species to determine presence and absence in areas of high lead exposure risk.

RESULTS

Figure 2: Box-Whisker Plot of All Soil Samples

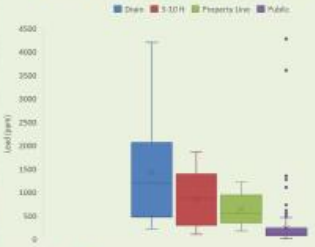


Figure 3: Wildlife Point Observations

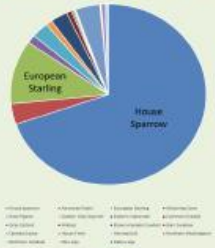


Figure 4: Camera Trap Observations

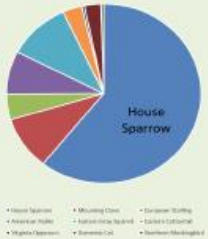


Figure 5: Weighted Lead Exposure Risk Map

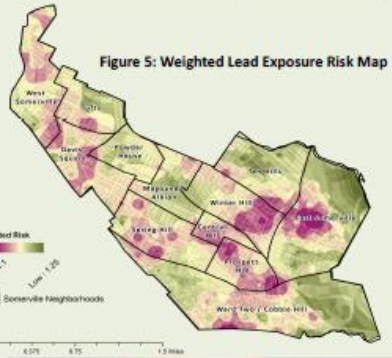
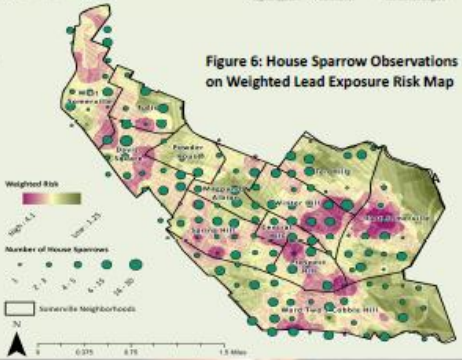


Figure 6: House Sparrow Observations on Weighted Lead Exposure Risk Map



DISCUSSION

The findings of this research show that over a third of public soil samples in Somerville (32.86%, n=69) had soil lead levels above the 200 ppm maximum allowed for soil of "unrestricted use" in the state of Massachusetts (Massachusetts Energy and Environmental Affairs, 2017). Comparatively, 12.38% (n=26) of public soil samples are above the 400 ppm maximum allowed for bare soil that children play in, as described by the Environmental Protection Agency (Environmental Protection Agency, 2017). Because of this discrepancy, federal and state governments and agencies should work together using the most recent scientific data to determine a more accurate and widely accepted measure for lead-safe soil levels to better understand who is at risk. House samples were much higher on average – showing that public soil samples alone do not capture the full range of environmental lead contamination in Somerville. Further research with an increased sample size from residential properties is needed to evaluate if public soil lead levels are predictive of nearby property soil lead levels. This study also discovered that the House Sparrow was the most prominent species seen interacting with soil during observations, and likely may be more affected by lead than other species. Additional studies that obtain a more robust sample size of soil samples near houses and that identify blood lead levels in the House Sparrow are avenues of future research that would improve our understanding of environmental lead contamination in Somerville and its impact on urban wildlife.

Figure 7: Image from camera trap placed in Somerville, MA captures an Eastern Grey Squirrel

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Don't Gyp the *Gyps*

Risk Assessment on Diclofenac Poisoning of Griffon Vultures in Spain

Introduction

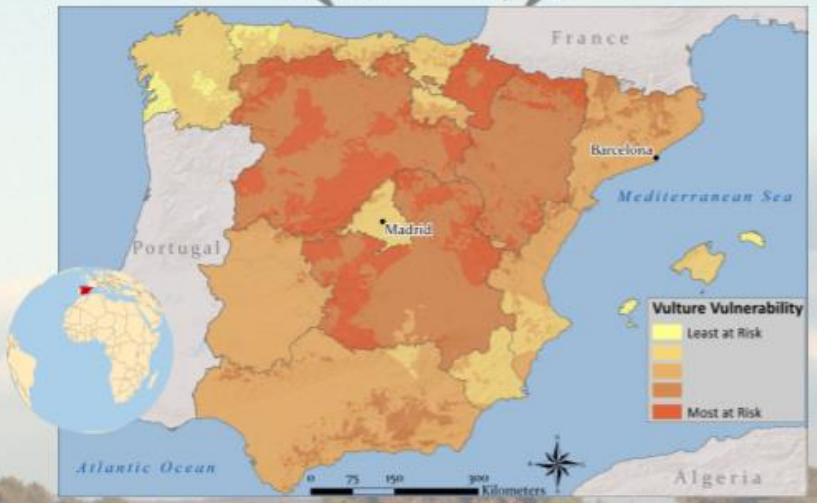
Vultures play a very important role in ecosystems by quickly removing carcasses preventing the proliferation of countless diseases. In addition, they prevent the population growth of many mammalian scavengers like feral dogs and rodents that would otherwise allow for the spread of many diseases, notably rabies. In Europe, vultures have traditionally been assailed by many factors and have largely been extirpated from the continent. In recent years, populations of 4 species of vultures have been making a comeback. The most successful species is the griffon vulture (*Gyps fulvus*). Despite a brief decline due to a scarcity of food following the Bovine Spongiform Encephalopathy outbreak, they are once more spreading throughout Europe. In Spain, with the reinstitution of feeding stations known as muladares, there are around 64,218 individuals.

Meanwhile, in India and other parts of Asia, the populations of *Gyps* vultures have plummeted by up to 99% in less than two decades. This decline is chiefly due to accidental poisoning from the popular NSAID diclofenac commonly used to treat livestock. Diclofenac has been banned from use in most Asian countries to protect vultures and with its absence, these populations will be able to recover. A safe drug for vultures promoted in its stead is meloxicam. In Spain, diclofenac usage in livestock is still legal despite the threat it poses to vultures. Consequently, so long as this drug and other similar NSAIDs are legal for use in livestock, the threat to griffon vultures remains very high with the potential for a similar population crash imminent. A weighted vulnerability analysis will be performed using five criteria: current range, topography, livestock prevalence, livestock donations for vultures, and muladares sites.

Methods

Vulnerability Analysis:

All categories were first converted from rasters to polygons. Then they were reclassified to value them on a 0-3 scale. A score of 3 correlated with the highest values for a category. Next, the union tool was used to combine the various factors. Finally, each category's value was summed together to get a final score. Higher scores were associated with a higher risk for vultures.



Data Sources

ESRI ArcMap 10.3

BirdLife International and NatureServe (2015) Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.

SANDACH de El Ministerio de Agricultura, Alimentación, y Medio Ambiente

WGS_1984_Complex_UTM_Zone_30N

Tufts | Cummings School of Veterinary Medicine

Acknowledgements

I would like to thank BirdLife International, NatureServe, and El Ministerio de Agricultura, Alimentación, y Medio Ambiente for providing invaluable data and resources to me. A huge thanks to Carolyn Talmadge for her immense support and expertise in teaching this course and advising this project.

Benjamin Miranda, MCM Candidate 2017, Tufts University

MCM 591 GIS for Conservation Medicine, December 2016

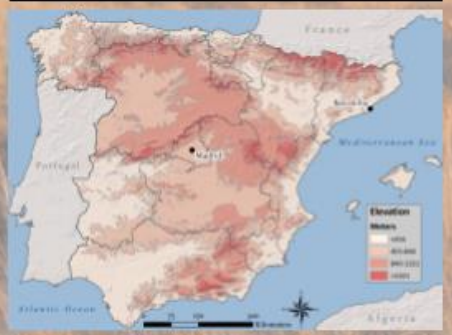
Conclusion

The weighted analysis showed the highest vulnerability in the autonomous community of Comunidad Foral de Navarra. High vulnerability was also found in Castilla y León and Castilla-La Mancha. The south and east of Spain displayed moderate vulnerability while the autonomous communities lining the coast in the Northwest of Spain showed the least vulnerability.

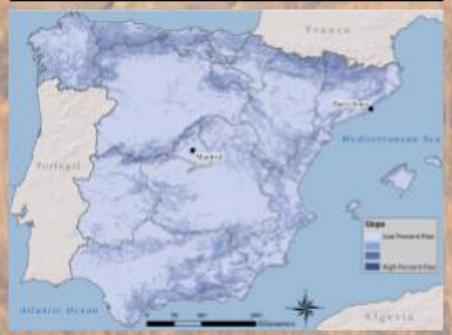
Since griffon vultures rely primarily on deceased livestock for food, diclofenac poisoning remains a very real threat. the percentage of livestock contaminated with diclofenac only needs to be less than 1% to cause a population crash in griffon vultures similar to what occurred in India. This analysis was performed to aid agencies in focusing their efforts on areas in which vulture poisoning would be most likely and hopefully would lead to better screening procedures until diclofenac can be completely banned from use.

Autonomous Community	Biomass Needs (Kg)	Contributions (Kg)	% of Needs Covered
Total España	14,359,508.0	6,518,066.0	46.0
Castilla y León	3,344,842.0	1,601,465.0	47.8
Aragón	2,515,901.0	1,597,163.0	63.5
Andalucía	1,635,008.0	No Data	No Data
Extremadura	1,437,755.0	860,121.0	57.4
Castilla-La Mancha	1,459,375.0	881,554.0	60.5
Comunidad Foral de Navarra	1,361,407.0	1,142,189.0	83.9
Cataluña	526,712.0	166,080.0	31.5
País Vasco	372,027.0	No Data	No Data
La Rioja	369,559.0	150,409.0	40.7
Comunidad de Madrid	304,640.0	0.0	0.0
Principado de Asturias	233,070.0	0.0	0.0
Cantabria	142,877.0	0.0	0.0
Illes Balears	136,484.0	0.0	0.0
Galicia	131,117.0	0.0	0.0
Comunidad Valenciana	125,096.0	117,085.0	93.6
Canarias	2,483.0	No Data	No Data
Región de Murcia	1,157.0	0.0	0.0

Elevation



Slope



Range & Muladares

Ranching

Leptospirosis Exposure Risk Analysis, Thailand

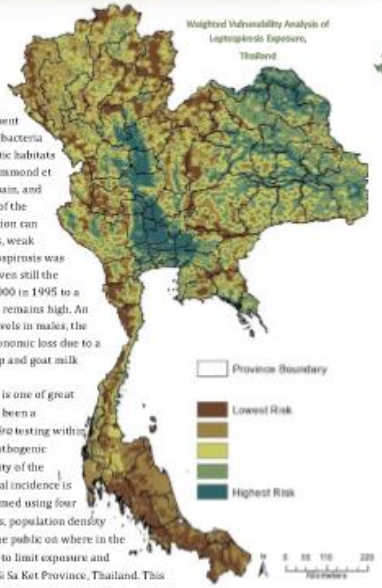
Allison Wright, MCM Candidate '16, Tufts University

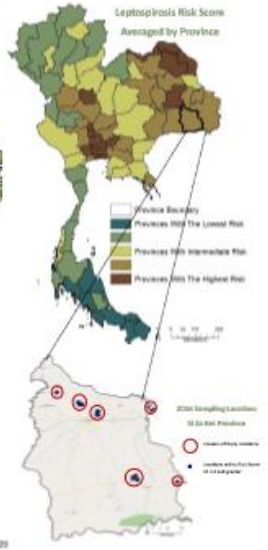
MCM 1009 May 2016

Leptospirosis In Thailand

Leptospirosis is a zoonotic disease derived from spirochete bacteria of the genus *Leptospira* (Hammond et al, 2014). Transmission of the bacteria, known as leptospires, involves contact with contaminated water. Leptospires are shed in the urine of infected host animals, and maintained in the environment due to chronic renal infection in carrier animals such as rats and cattle. These bacteria persist in certain environments because they can thriveen nutrient-poor aquatic habitats due to protective interactions with other bacteria and biofilm formation (Hammond et al, 2014). In humans common symptoms include fever, nerve, joint and head pain, and redness of the eyes, with patients developing renal complications about 10% of the time (Tangkanakul, 2005). In ruminants persistent reproductive system infection can lead to lowered fertility, prolonged time between calving, abortions, stillbirths, weak juveniles and a drop in milk production (Martins and Lilenbaum, 2014). Leptospirosis was first reported in Thailand in 1942 and has been on the rise since the 1960's. Even still the number of cases continues to rise, from an incidence of less than 0.3 per 100,000 in 1995 to a peak in the year 2000 with an incidence of 23.7 cases per 100,000 people and remains high. An average of 80% of cases are in people between 25-54 years old, with higher levels in males, the typical working class (Tangkanakul, 2005). This presents the burden of economic loss due to a drop in healthy working-age men compounded by the decrease in cattle, sheep and goat milk and meat yield.

Although it has been established that this disease is one of great environmental influence within Thailand, there has been a surprisingly low amount of environmental *Leptospira* testing within the country. Results have not found high levels of pathogenic leptospirosis in the water bodies, however a majority of the sampling is being done in Bangkok where the clinical incidence is low (Thaipadungpanit et al, 2013). A weighted vulnerability analysis is preformed using four risk factors for leptospirosis: amount of precipitation, proximity to flood zones, population density and land use type. This analysis is done in effort to inform researchers and the public on where in the country is most vulnerable to the risk of environmental leptospirosis in order to limit exposure and target their sampling efforts. Rodent sampling is already being performed in Si Sa Ket Province, Thailand. This analysis will not only give researchers a broad view of Leptospirosis risk within the country, but the results will be directly applied to a field sampling effort during May and June 2016.





Methods

Vulnerability Analysis: Raster calculator was used to perform a weighted risk analysis. See the reclassification table for weight of each risk factor.

Risk Score Average by Province: Zonal Statistics was performed on the vulnerability map for mean score within the province. Province boundaries were taken from Global Administrative Area (GADM), 2015.

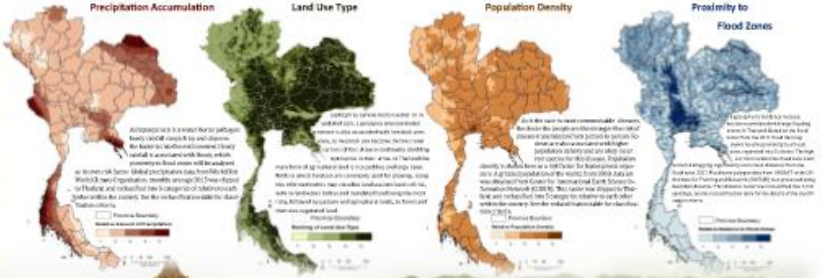
Si Sa Ket Focus: The vulnerability was clipped to the Si Sa Ket province. The raster was then converted to points, each of which contained an individual risk score. Select by attributes found all points over 4.2 to get 55 of the most risky points. An ESRI open street map background was used.

Table 1: Vulnerability Factors and Weights

Factors	Weight	Risk Score 1 (Lowest Risk)	Risk Score 2	Risk Score 3	Risk Score 4	Risk Score 5 (Highest Risk)
Accumulated Rain (Millimeters (mm))	30%	<100	100.1 – 200	200.1 – 300	300.1 – 400	>400.1
Population Density (Persons per sq. km)	10%	<100	100.1 – 1,000	1,000.1 – 10,000	10,000.1 – 19,000	>19,000
Distance to Flood Zones (Meters)	40%	0	>0 – 1,000	1,000.1 – 5,000	5,000.1 – 10,000	>10,000
Land Use Type	20%	Water, Tropical Evergreen Forest	Paddy Field, Orchard	Mixed Agricultural Land	Cropland, Pasture	Orchards, Industrial Water

Table 2: Top 10 Most Risky Provinces

Rank	Province Name	Risk Score
1	Ang Thong	3.858885
2	Phra Nakhon Si Ayutthaya	3.844457
3	Sing Buri	3.787817
4	Pathum Thani	3.690765
5	Suang Kan	3.588513
6	Nonthaburi	3.568071
7	Phichit	3.465416
8	Nakhon Pathom	3.457427
9	Nakhon Nayok	3.431587
10	Bangkok Metropolis	3.393048



Conclusions

The average vulnerability score within the country was 2.7. See the table 2 to the left for the top 10 provinces and their average risk score. The riskiest points within Si Sa Ket had a risk score range between 4.2 and 4.4. The points all tended to cluster together, most of which of the clusters were around a body of water of some sort. These 6 clusters represent the targeted sampling areas for the May and June 2016 sampling effort.

In a country in which Leptospirosis clinical incidence is high, however environmental sampling and testing yield is low, there is a clear disruption between sampling location and environmental presence of the bacteria. This analysis has produced very informative results. These results will be used summer 2016 to direct sampling efforts within the Si Sa Ket Province of Thailand. On a broader scale this project will contribute to the small, but growing, information base on environmental *Leptospira* presence. This vulnerability analysis highlights where within the country is the most at risk, as well as focuses on an average score per province. Governments can take this information and take measures to reduce exposure to this disease, in both humans and animals. This hypothetical project will help direct further research, efforts to raise quality of life in lower income areas and caution the public to ensure a stable agricultural economy and preserve human and animal health.

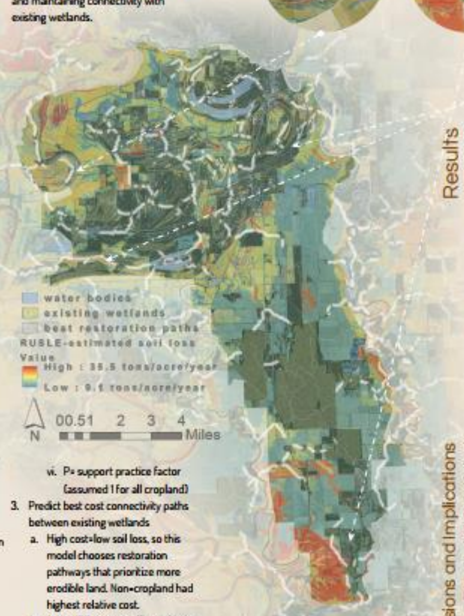
SWAMPED: Proposing wetland restoration corridors in Mississippi's Tallahatchie watershed

Introduction

Wetlands provide many functions including flood protection, nutrient and sediment pollution mitigation, carbon sequestration, and wildlife habitat. Prior to the Clean Water Act and during the era of "fencerow-to-fencerow" agricultural policy, however, draining wetlands for agriculture was relatively common in certain areas of the United States. Around 32% of America's cropland has been drained, and an even higher proportion was drained in the Mississippi Delta region.[1] More recently, though, conservation programs at the state and federal level can provide cost share payments to farmers who agree to restore wetlands on their properties, but funding in these programs is limited.

This project focuses on three subbasins of the Tallahatchie River watershed in Mississippi.

Highly segmented wetlands provide substantially fewer benefits than well-connected wetland systems.[1] Plus, agricultural areas which are losing tons of soil each year may be better off serving as agricultural pollutant remediation sites. In light of this, this project aims to predict areas where wetland remediation would be of most benefit, through restoring areas that were previously drained, prioritizing areas of high soil loss, and maintaining connectivity with existing wetlands.



Methods

1. Clip out areas that were cropped in 2015, have innately hydric soils, AND are not in the National Wetlands Inventory
2. Perform Revised Universal Soil Loss Equation (RUSLE) on these drained agricultural areas
   a. A= R*K*L*S*C*P
      i. A= average annual soil loss
      ii. R= rainfall-runoff erosivity factor (384 for entire area)[2]
      iii. K= soil erodibility factor (from SSURGO)
      iv. LS= slope length and steepness factor (length assumed 75 ft, then classified with conditionality matrix from USDA)[3]
      v. C= cover management factor (where higher residue/more soil-protective crops (eg small grains)=0.3 and less protective crops (eg corn)=0.6)
      vi. P= support practice factor (assumed 1 for all cropland)
3. Predict best cost connectivity paths between existing wetlands
   a. High cost=low soil loss, so this model chooses restoration pathways that prioritize more erodible land. Non-cropland had highest relative cost.
   b. Add a 100 meter buffer to these predicted paths to show possible wetland remediation areas.

2015 cropland

In 2015, these 3 subbasins were mostly cropped, and the area grew mostly soybeans (according to CDL). It should be noted that most crop farms would rotate crops, so these fields may have been mostly corn in another year. Rice production is also common in this area of Mississippi, and this rice cultivation is achieved with flooded fields for part of the growing season.

Drained wetlands

When using the methodology described above to determine areas that may have been drained for agriculture, it appears much of the region was indeed drained. About 85% of the farmed land in this region seems to have been hydrologically altered.

Soil K-factor

A soil's K-factor is a unitless number that describes the innate susceptibility of the soil type to erosion. This is important since conservation programs often use erosion as a criteria for retiring productive land. This factor is one of the most important drivers in the Universal Soil Loss Equation in my study area.

Results

This map shows all paths that were predicted via cost connectivity analysis, with a 100 meter buffer around each path to show regions where wetland restoration may be most beneficial, taking into account erosion rates and requiring paths to connect existing wetlands.

A few paths which show the capability of the model are displayed above. In many cases, paths snapped to narrow sections of high erosion as predicted by RUSLE, but in other cases, particularly when existing wetlands were near to each other, the model chose paths of relatively low erosion, owing to the lower cumulative cost distance.

These paths, coupled with aerial imagery of what is happening on the ground, show that areas of apparent intensive crop production and high erosion are often found around and between remaining natural wetlands, and that sometimes, the best path follows along the border of an existing wetland. Interestingly, some of the areas of high soil loss can be seen as areas of bare soil in aerial photos (see Path 1 above), even in cropped fields, giving credence to the spatial application of RUSLE used here.

Conclusions and Implications

Through working with these datasets, some problems were discovered. The SSURGO database shows noticeably different K-factor ranges for different counties, with no geographical feature to explain the discrepancy. The analysis shown covers two counties that had relatively similar ranges in K-factor but nonetheless these results may be skewed.

The Cropland Data Layer is known to have some measurement error, including isolated pixels of dubious crop determination within larger fields of likely accurate crop determination. For this work, these cells were left as-is because they were so few, but a better approach might be to clean this data source such that these isolated cells are converted to match the cells around them.

Many assumptions were made with the RUSLE calculation (e.g. assuming constant support practice factor), as this equation is designed more for field-level analyses. With more information about average management practices in the region as well as the length of crop fields, this calculation could be refined.

Finally, the "path" approach to wetland restoration has the function of connecting separate areas, but does not represent restoration benefits perfectly. Perhaps wetlands should not be restored in lines but rather in large blocks. Because of this, this analysis should be viewed as a starting point to develop more rigorous methods to produce variable-width wetland corridors, or include paths that simply expand existing wetlands.

The areas where paths were predicted are, of course, mostly privately owned, and perhaps more importantly, a source of income for landowners. This precludes the notion that a policymaker could simply reclaim these areas and restore them. However, with the incentives for conservation available now and in the future, policymakers could benefit from using a GIS method that informs prioritization and design of wetland restoration projects.

Elisabeth Spratt
UEP 294 | December 2016

All maps use UTM Zone 15N projection

Data sources
Cropland Data Layer. US Department of Agriculture. 2015.
National Wetland Inventory. US Fish and Wildlife Service.
HUC 12 Watershed Boundaries. US Geological Survey. 2016.
Web Soil Survey/SSURGO. US Department of Agriculture. 1980 (most recent).
Aerial imagery. ESRI World Imagery, DigitalGlobe, GeoEye, EarthStar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, Swisstopo, and The GIS User Community
Hydrography: Rivers and streams. USGS. 2016.

Tufts | Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy

Beware of the Plotter

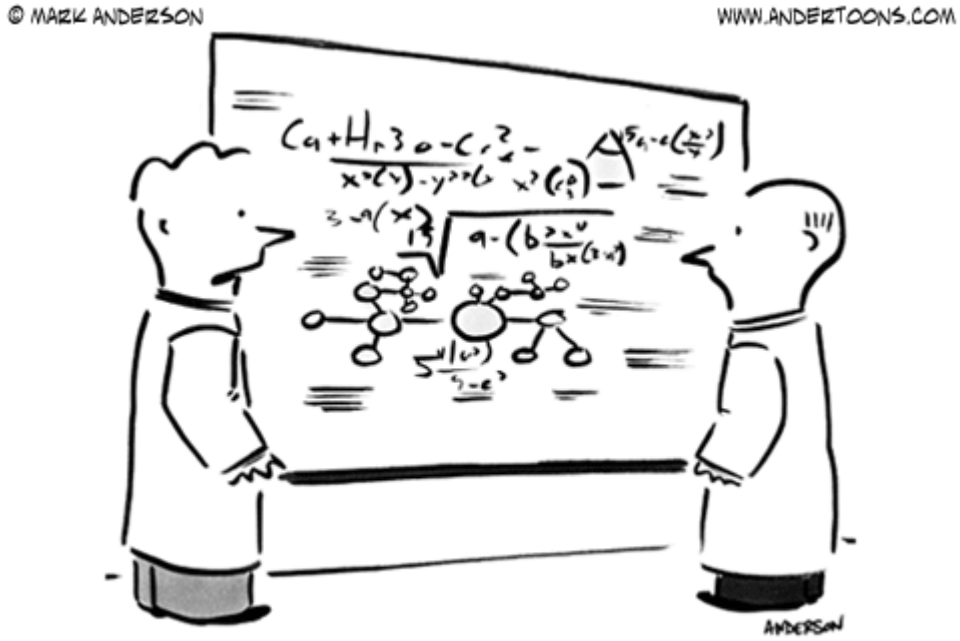
- **What you see on the screen isn't always how the color prints on the plotter!**

- Avoid using **dark red** and **dark blue**
  - **Dark red → Brownish**
  - **Dark blue → Purple**

≠

Design Process:
Know your Audience!

- Colleagues
- Students
- Scientists/Conference
- Government officials
- Community groups/Activists
- General public



"I don't know, it's a little formulaic."

Design Process:

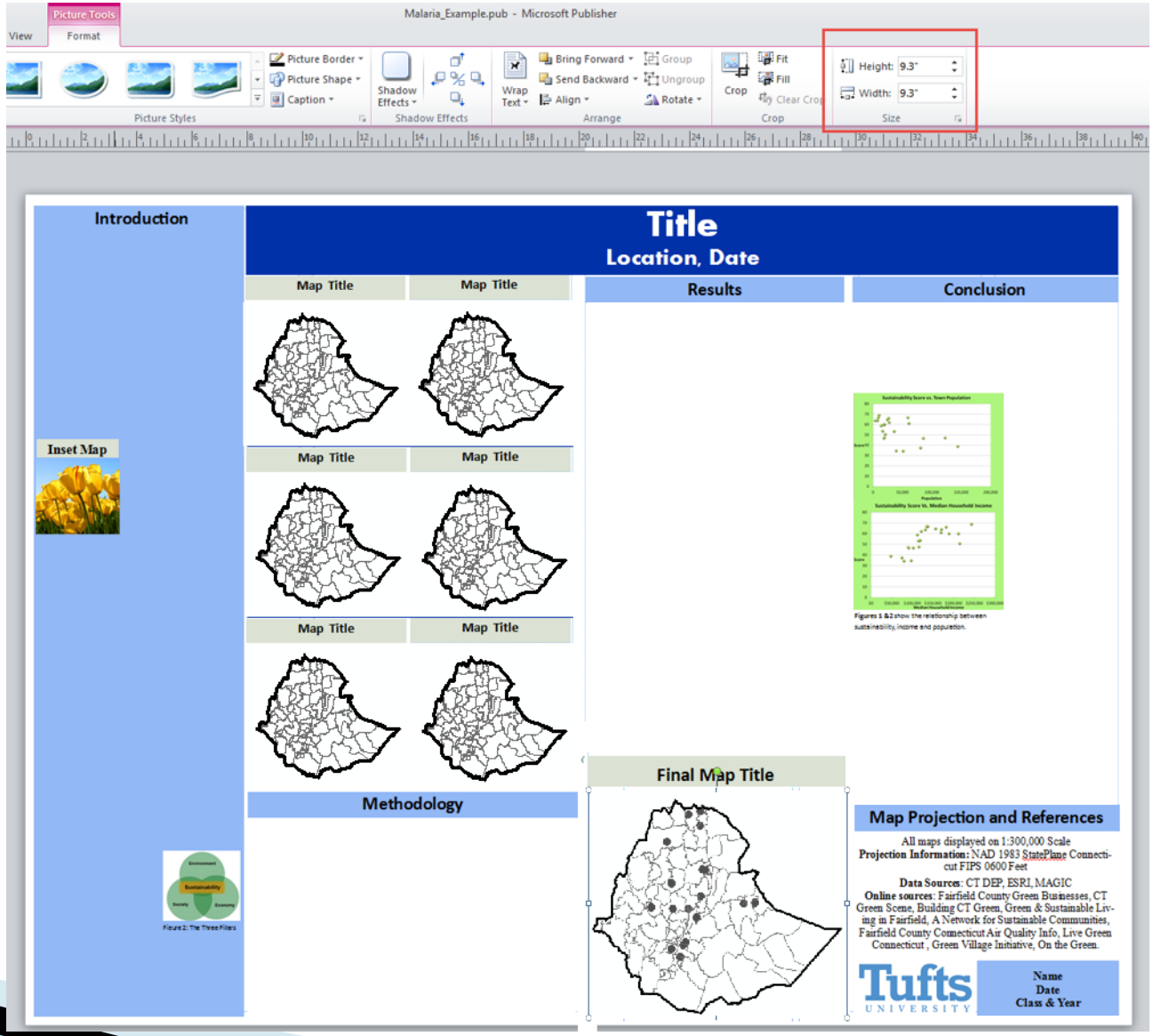
Be in charge of your design decisions:

- **Color Palette:** Pick a color scheme and use it throughout your poster!
  - Use it for text/color blocking for headers or sections.
- **Fonts:** Pick 1 or 2 main fonts, but no more!
  - One serif and one sans-serif
  - Don't use 2 of the same types of fonts
  - Uses them through maps, charts and figures, and poster text.
- **Size:** Poster text is important, but graphic text is as well
  - Labels, legends, captions
- **Format:** Identify most important elements (title, headings, maps, tables, graphs) & place them on poster first. Then add text and secondary information.

DON'T JUST ACCEPT FONT & COLOR DEFAULTS.
PICK EVERYTHING WITH A PURPOSE!!

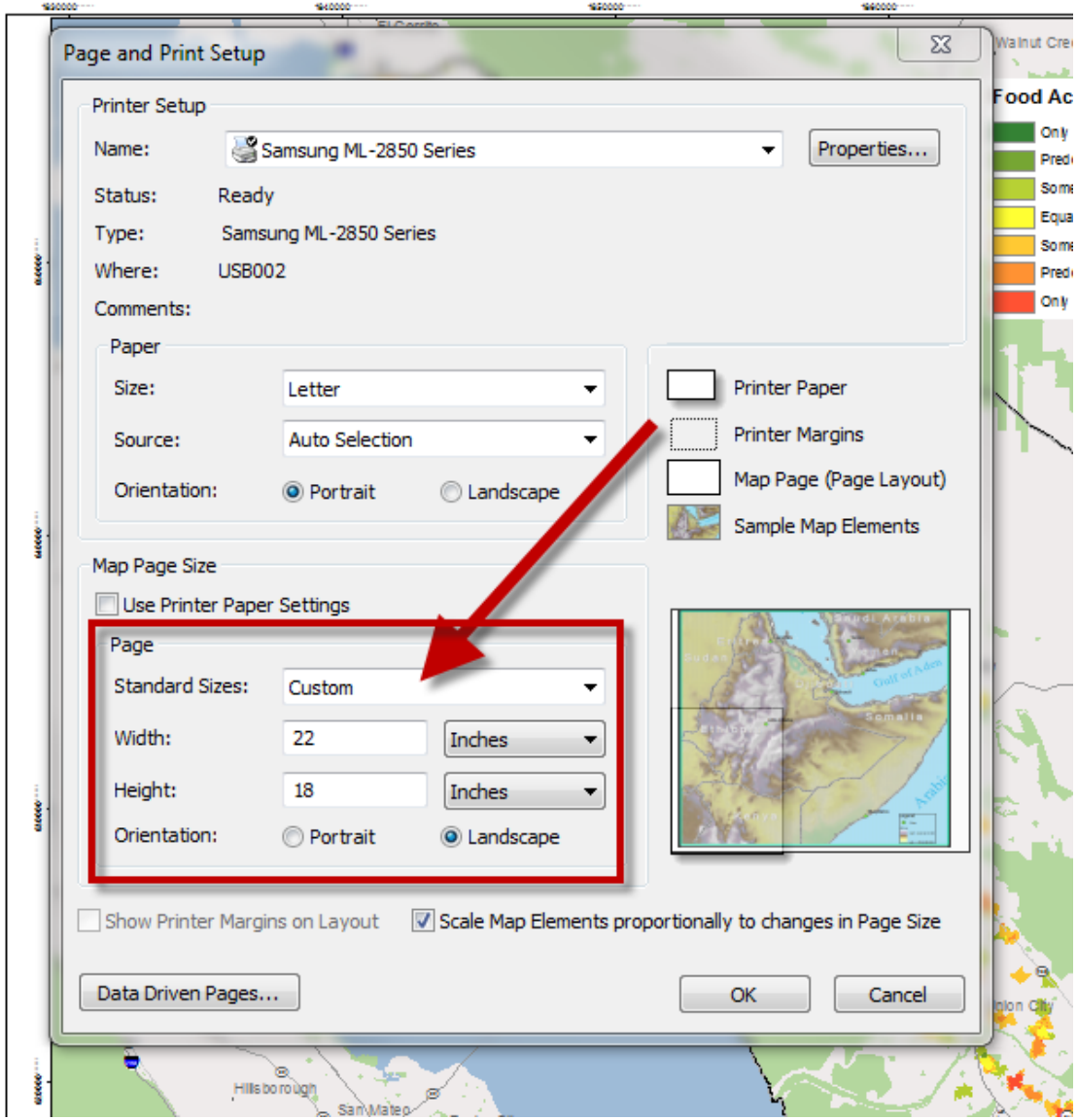
Think Ahead: Plan out your poster BEFORE exporting all your maps!

- Determine the shape of your study area
  - Square vs Rectangle
  - Horizontal vs Vertical
- Export 1 map of your study area extent and figure out where you want your maps to go.
- Create a "dummy" poster so you know what size to set you maps before exporting them!
  - That way you can check that legends, labels, north arrows, scale bars look good!



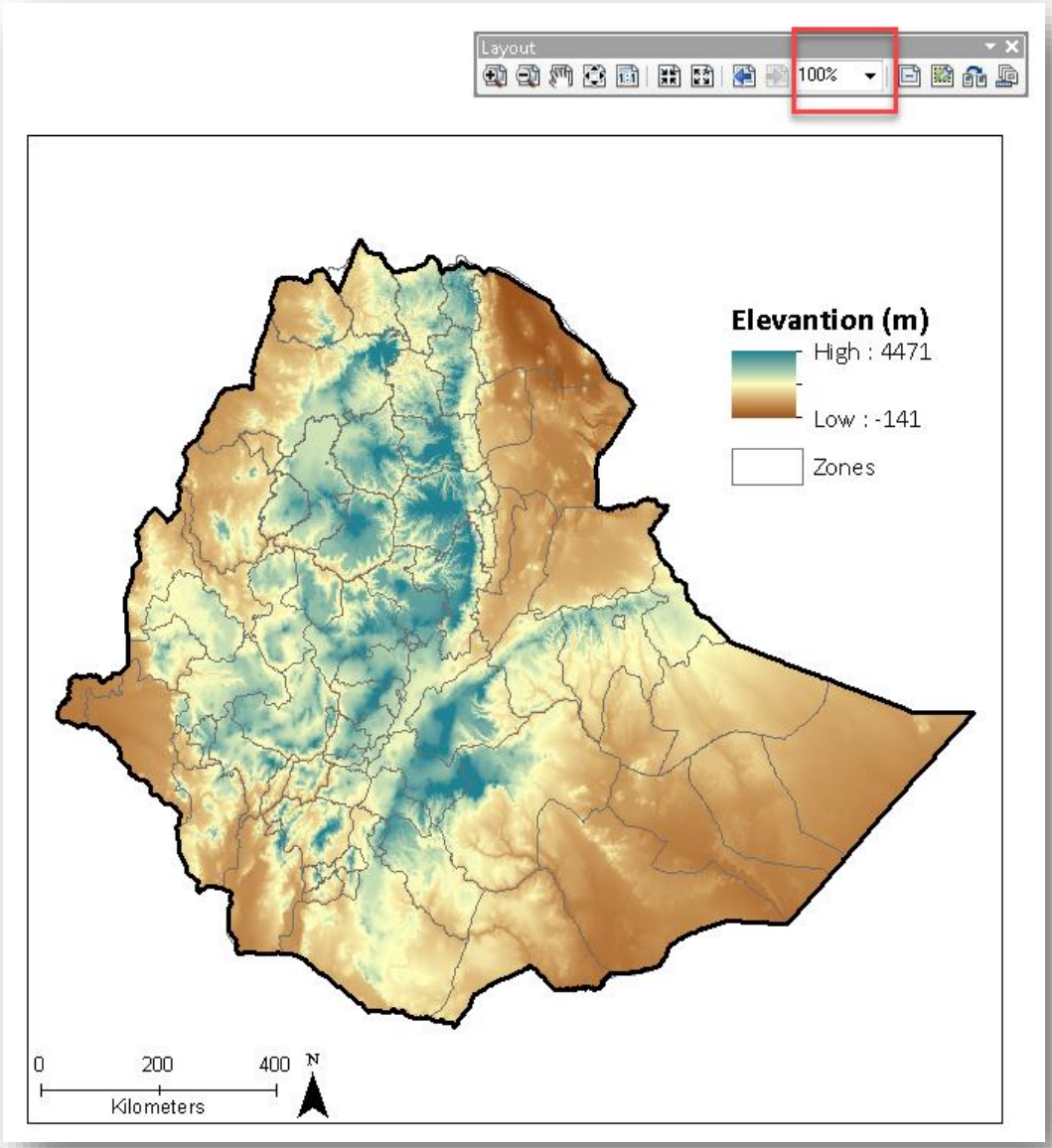
Set your Page Size in ArcMap

- Export maps at the CORRECT SIZE!
- This makes all map elements look good.
  - Legend
  - Scale bar
  - North Arrow
- Also guarantees the resolution looks good! Nothing pixely!



View your Map at 100% in ArcMap

- Use the **Layout Toolbar** to view your map at 100%
- If your page is sized correctly, this ensures all map elements look great!



Exporting Maps & Images

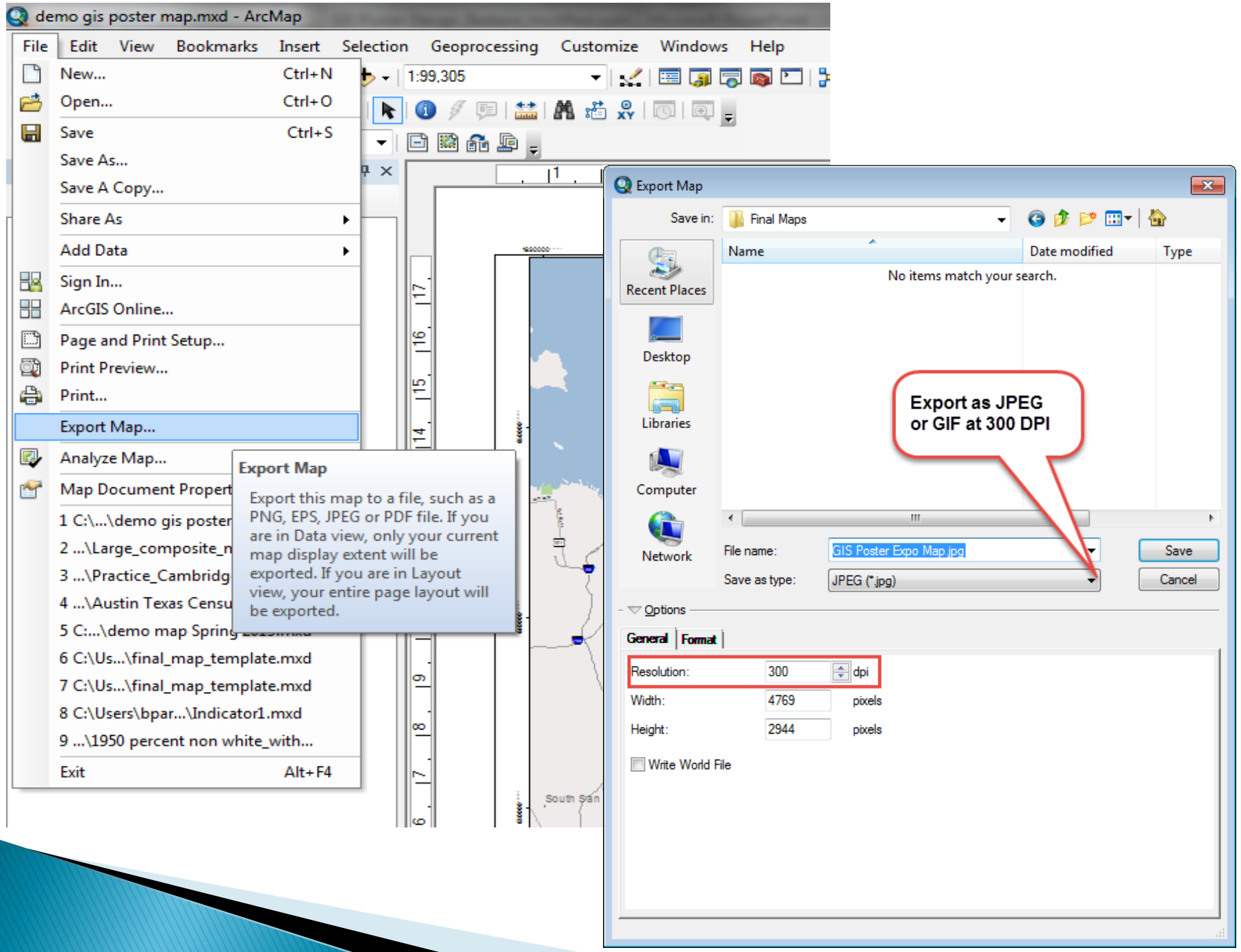
What you see is NOT what you get!

- **Export maps with just legend, north arrow, and scale bar.**
  - Make sure your legend is big enough to read on a poster!
  - Don't keep it the default size!!
  - **Use Publisher to put in titles and other explanatory text**

- **Format**: JPG (photos)
  GIF (solid colors, text)
  Do **NOT** use Tiffs! They export too large for publisher!
  Do **NOT** use PDFs, as you can't import them into publisher!

- **Resolution:** 300 dpi

- **Caution**: Web images are 72 dpi
  SnagIt – software increases image resolution


demo gis poster map.mxd - ArcMap
File
Edit
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Selection
Geoprocessing
Customize
Windows
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Open... Ctrl+O
Save Ctrl+S
Save As...
Save A Copy...
Share As
Add Data
Sign In...
ArcGIS Online...
Page and Print Setup...
Print Preview...
Print...
Export Map...
Analyze Map...
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1 C:\...\demo gis poster
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7 C:\Us...\final_map_template.mxd
8 C:\Users\bpar...\Indicator1.mxd
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Export Map
Export this map to a file, such as a PNG, EPS, JPEG or PDF file. If you are in Data view, only your current map display extent will be exported. If you are in Layout view, your entire page layout will be exported.
Export Map
Save in: Final Maps
Recent Places
Desktop
Libraries
Computer
Network
Name
Date modified
Type
No items match your search.
Export as JPEG or GIF at 300 DPI
File name: GIS Poster Expo Map.jpg
Save as type: JPEG (*.jpg)
Save
Cancel
Options
General
Format
Resolution: 300 dpi
Width: 4769 pixels
Height: 2944 pixels
Write World File

Add Maps, Graphs and Headings First…

you don't need to write as much as you think!

Introduction

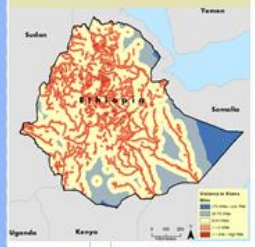
Ethiopia, Africa

Figure 2: The Three Pillars

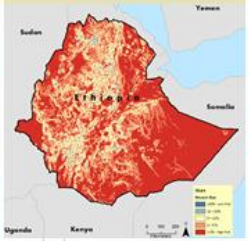
Determining the Risk for Malaria Transmission

Ethiopia, 2015

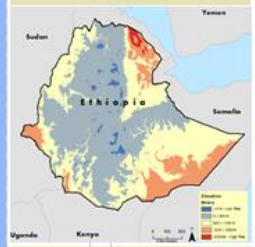
Distance to Rivers



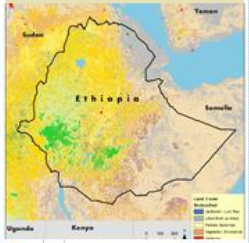
Slope



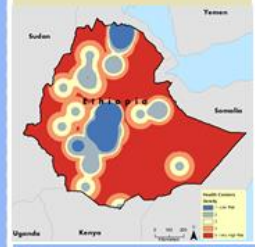
Elevation



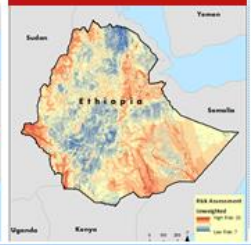
Land Cover Type



Health Centers



Final Risk Score

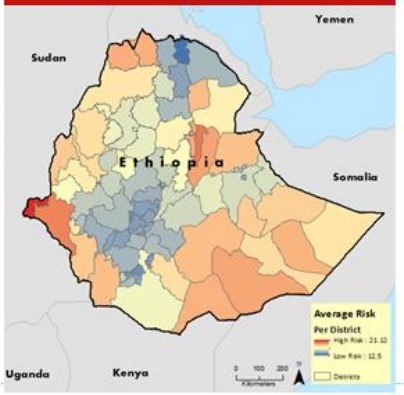


Methodology

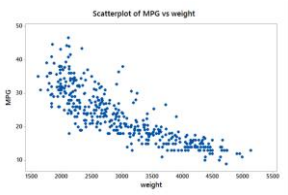
Results

District Name	Average Risk per District	STD	Majority Score	Minority Score	Median	Area Sq. m
Afar	21.119199	0.827169	21	16	21	4,797,000,000
Afar Zone 5	19.498585	1.111284	20	15	20	5,391,000,000
Amara	19.940621	1.764963	19	12	20	23,463,000,000
Afar Zone 2	19.64981	1.226418	19	12	19	16,551,000,000
Afar	19.551028	1.01626	19	12	19	81,542,000,000
Agaga	18.515151	1.416808	19	16	19	297,000,000
Oromia	18.501198	1.323224	18	14	18	3,789,000,000
Mi Hasay	18.451186	1.756069	19	12	19	13,176,000,000
Semiro Mi Hasay	18.378577	1.221445	18	12	18	11,494,000,000
Libon	18.343017	1.594403	19	12	18	25,919,000,000
Agaga	18.320491	1.426803	19	12	19	22,228,000,000
Afar Zone 4	18.160771	1.779996	19	13	18	10,773,000,000
Debub Mi q	18.118369	1.229763	18	11	18	12,794,000,000
Bale	18.105826	1.391782	18	12	18	34,612,000,000

Average Risk per District



Conclusion



Figures 1 &2 show the (relation) between sustainability, income and population.

Map Projection and References

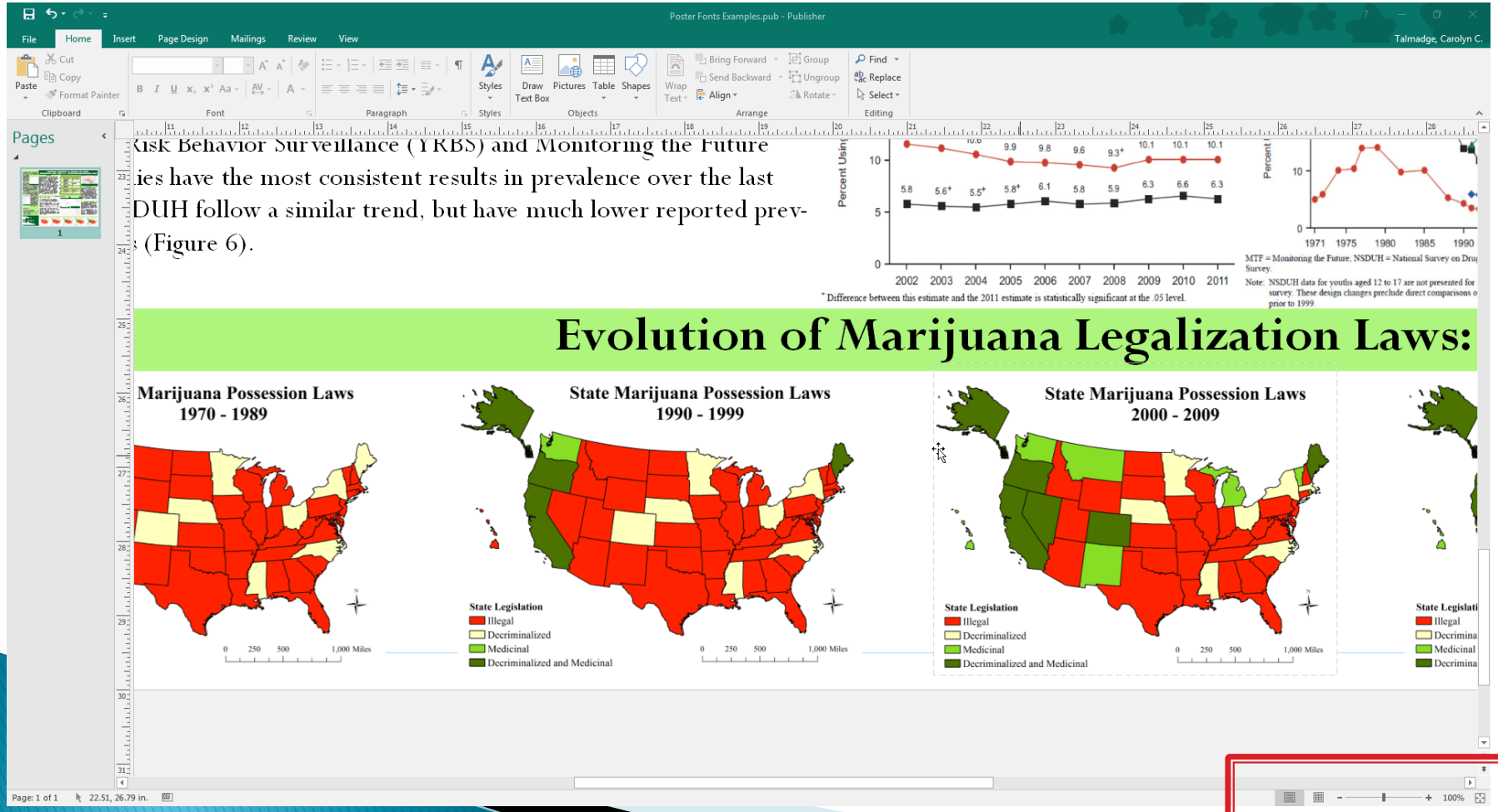
All maps displayed on 1:300,000 Scale
Projection Information: Africa Albers Equal Area Conic
Data Sources: GADM, ESRI, MAGIC
Online sources: Fairfield County Green Businesses, CT Green Scene, Building CT Green, Green & Sustainable Living in Fairfield, A Network for Sustainable Communities, Fairfield County Connecticut Air Quality Info, Live Green Connecticut , Green Village Initiative, On the Green.

Tufts UNIVERSITY

Name
Date
Class & Year

View your poster at 100% also!

- Put your "zoom" to 100% – Views "real size"
  - Can people read the text? Is the resolution okay?
- Especially important with maps, labels, legends!



Keep Posters Visual!

Images, charts, tables and graphs say much more than words!

Remote Sensing Techniques for Identifying Illegal "Trespass Grow" Operations in California's Conservation Lands | 2014

But it's Legal...What's the Harm?

Surge in Trespass Grows Sites
- 80% of illegal cannabis grown on federal lands
- 1.1 million illegal plants extracted from federal and conservation lands in California in 2016

Operated by Drug Cartels
- Not taxed & not regulated
- Public Safety Risk for hikers/bikers
- Litter & debris abandoned at sites

Deforesting Conservation Lands
- Clear cutting national forests
- Fragmenting wildlife habitats & ecosystems

Pesticides, Rodenticides & Fertilizers
- 50 different toxicants identified; banned in US
- Lethal doses killing wildlife & aquatic species
- Leaching into soils and waterways

Public Health Concerns
- Detectable levels when the plant is consumed
- Flooding the Black Market with poor product

Depleting the Water Supply
- 50% more water intensive due to poorly built and leaky irrigation systems
- Diverting water from already diminished rivers

Supervised Classification Results

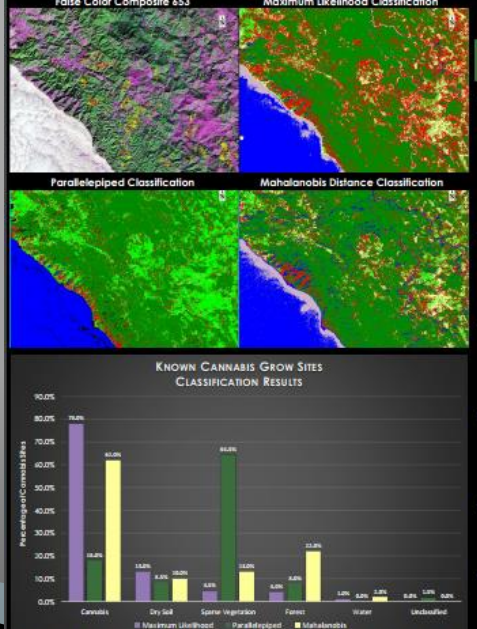


Figure 5: Results of how each known grow site was classified in each supervised classification.

Spatial Questions & Known Cannabis Grow Sites

Figure 1: Known cannabis grow sites throughout Humboldt County. Data provided by Humboldt State University's new Institute for Interdisciplinary Marijuana Research

1. Which remote sensing supervised classification technique best identifies the known 2014 marijuana grow operations throughout Southern Humboldt County?
   - *Parallelepiped*
   - *Maximum Likelihood*
   - *Mahalanobis Distance*
2. Where are "Highly Suspect" Trespass Grow sites that require further investigation within the Humboldt Redwoods State Park and King Range Conservation Lands?

Spectral Profiles of Cannabis Grow Operations

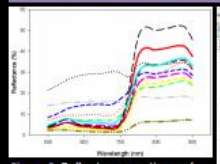


Figure 2: Reflectance patterns of various surface features compared to Cannabis. Source: Walthall et al.

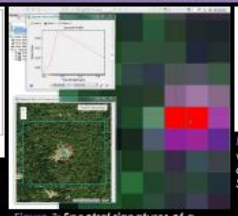


Figure 3: Spectral signatures of a known grow site in ENVI.

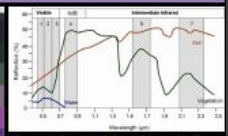


Figure 4: Spectral signatures of soil, vegetation and water, and corresponding wavelengths. Source: Siegmund et al.

Results & Conclusions

- Known grow sites spectral profile's have characteristics of both soil and vegetation because the grow operations are very mixed pixels and typically smaller than 30x30m, the resolution of Landsat 8.
- One pixel could contain: Cannabis, Mixed Vegetation, Soil, Buildings, Greenhouses, Growing Supplies, Water irrigation Systems.
- Spectral Profiles varied from site to site because not all grow operations contained the same features or are the same size.
- Mahalanobis Classification classified the largest percentage of cannabis sites correctly without over classifying other land covers
- Investigators need to be aware of the trends for concealing illegal cultivation sites.
- Future Research should include change detection analysis, band sharpening, use of drones.

Potential Trespass Grow Sites

The following criteria was used for the Identification of a Potential Trespass Grow Site:
- Sites were classified as both Mahalanobis & Maximum Likelihood
- Area of site < .25 acres
- Within Conservation Lands

Carolyn Talmadge
CEE 194A: Remote Sensing | Spring 2017

Data Sources: Earth Explorer - Landsat 8, October 26, 2014; ESRI ArcGIS Online, State of California Geoportal, Humboldt State University's Institute for Interdisciplinary Marijuana Research

Photos Sources: Smith, Julian. "Illegal Pot Farms Are Poisoning California's Forests". The Atlantic. N.p., 2017. Web. 3 Apr. 2017. Margari Helm / BioGraphic

Types of Visuals

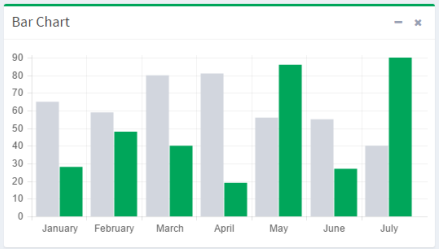
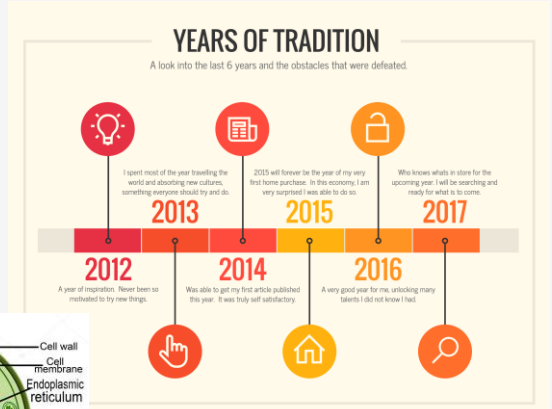
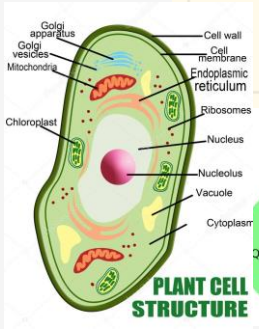


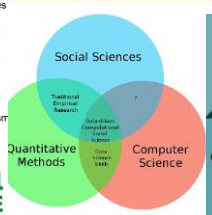
Table 1. Summary statistics for the mobile-monitoring sampling data.

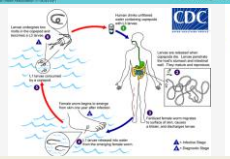
Parameter	Observations (*n*)	Mean ± SD	Median	5th percentile	95th percentile
UFP concentration (particles/cm^3)	8,225	44,000 ± 24,800	39,800	15,900	87,500
$PM_{2.5}$ concentration (μg/m^3)[a]	8,354	36 ± 30	29	10	129
PAH concentration (ng/m^3)	7,453	76 ± 55	55	8	212
Traffic count per minute					
WB	9,598	13.7 ± 2.3	13.2	10.2	17.7
BQE	9,553	36.7 ± 6.5	38.4	24.5	44.9
Wind speed (m/sec)	7,913	1.3 ± 1.0	0.9	0.4	3.6
Temperature (°C)	9,441	26.3 ± 3.5	26.7	19.8	30.7
RH (%)	9,441	45.8 ± 11.3	45.4	27.3	66.4

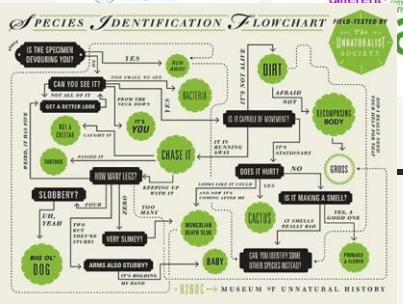
[a]Measured using DustTrak, which has a known but consistent bias by a factor of 2.5–3 relative to gravimetric measurements (Chang et al. 2001).







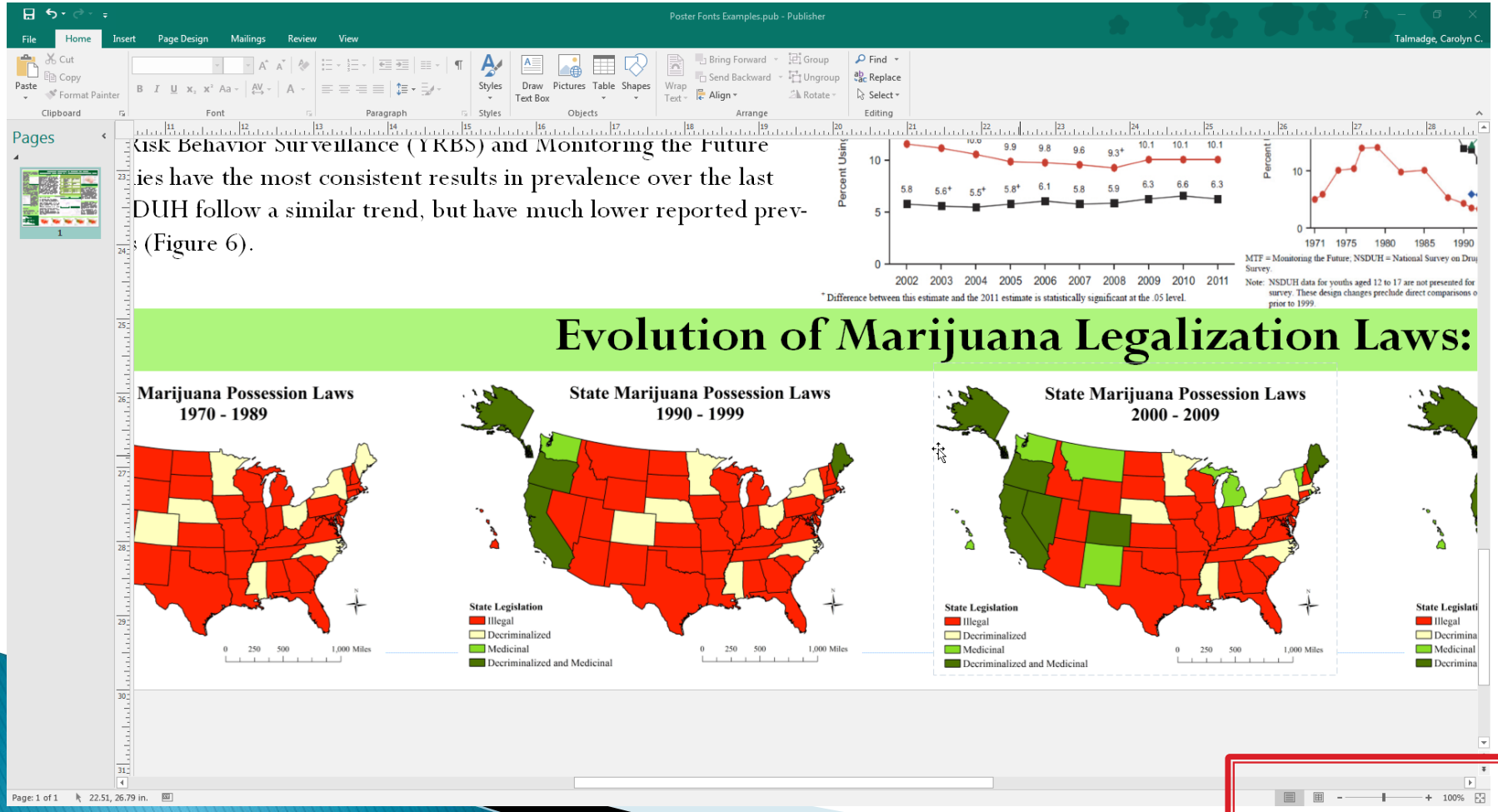




- Charts & Graphics
- Summary Statistics/Tables
- Photos and Images
- Timelines
- Maps
- Infographics
- Image Diagrams
- Lifecycle Diagrams
- Venn Diagrams
- Word clouds
- Quotes
- Checklists
- Flow Charts
- Questionnaires/Surveys

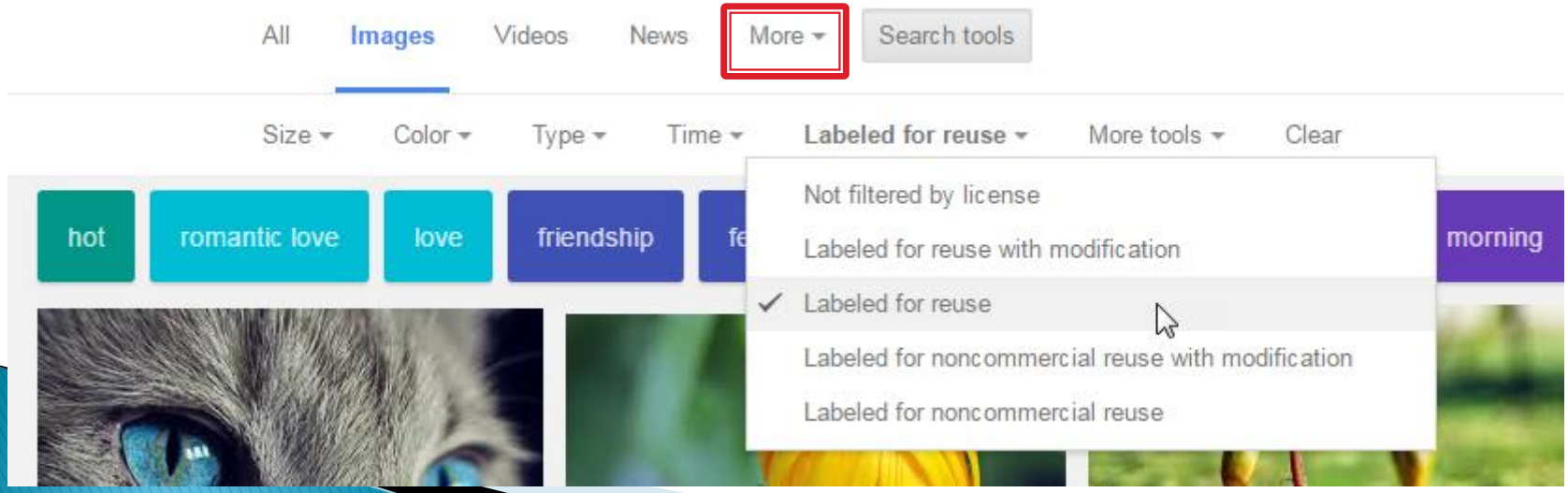
View your poster at 100% also!

- Put your "zoom" to 100% – Views "real size"
  - Can people read the text? Is the resolution okay?
- Especially important with maps, labels, legends!



Citing Images from Online

- MUST include citation *directly* under images taken from online.
- Credit the author along with a link.
- In google, change search options to “label for reuse” to avoid copyright infringement.



Tufts
UNIVERSITY

- Do NOT, I repeat, do NOT copy an tufts logo image from Google Images!
  - Resolution is ALWAYS terrible!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
- Download Logos from the Communications Page
  - http://communications.tufts.edu/marketing-and-branding/brand-guides-and-logos/download-logos/

What kind of Maps and figures should I include on my poster?

- **What information is important for your readers to understand for the project?**
- **Overview map**- Important data or locations
- **Factor Maps/ Individual Maps**
  - Maps that add to the readers understanding
  - Factors that went into your model (not necessarily intermediary steps)
    - Ex: Suitability Analysis: Distance from Roads- Show the actual Euc Distance with distance values rather than the reclassify layer that doesn't have values but just numbers.
- **Final Map**- Some may have a "final" map, others might not (that's okay).
- **Summary Statistics** – Charts, Tables, Graphs that sum up your findings!

Analysis & Map Tips

- **Project, Project, Project!**
  - First, make sure your data frame is projected
  - Project your data (Data → Export Data) the MOMENT you decide you are going to keep it!
  - Remove the unprojected layer from your TOC

- **Set your Environments for Raster Analyses.**
  - **Raster Extent –** what area does the output cover?
  - **Raster Analysis –** Cell Size & Mask (aka clip to boundary)

- **Bookmark** your location – makes creating equal sized maps much easier!
  - Pick your page size and set up your layout early

- **Avoid the Floating Island Effect –**
  - Include surrounding boundaries (& labels) in your maps for towns, counties, states, countries, etc.
  - Use other location info that might help readers understand locations (Roads, POIs, etc)

- **Label** known locations (depending on scale).
  - Capitals & Major Cities (Points), Towns, Counties, States, etc

Analysis & Map Tips

- Put a shaded relief/topology underneath your maps for environmental analyses!

- Set your own color ramp in symbology. Can edit the start and ending color.
  - Right click on the color ramp → properties → set color 1 and color 2

- Remove ESRIs Citation text: *Insert → Dynamic Text →Service Layer Credits*

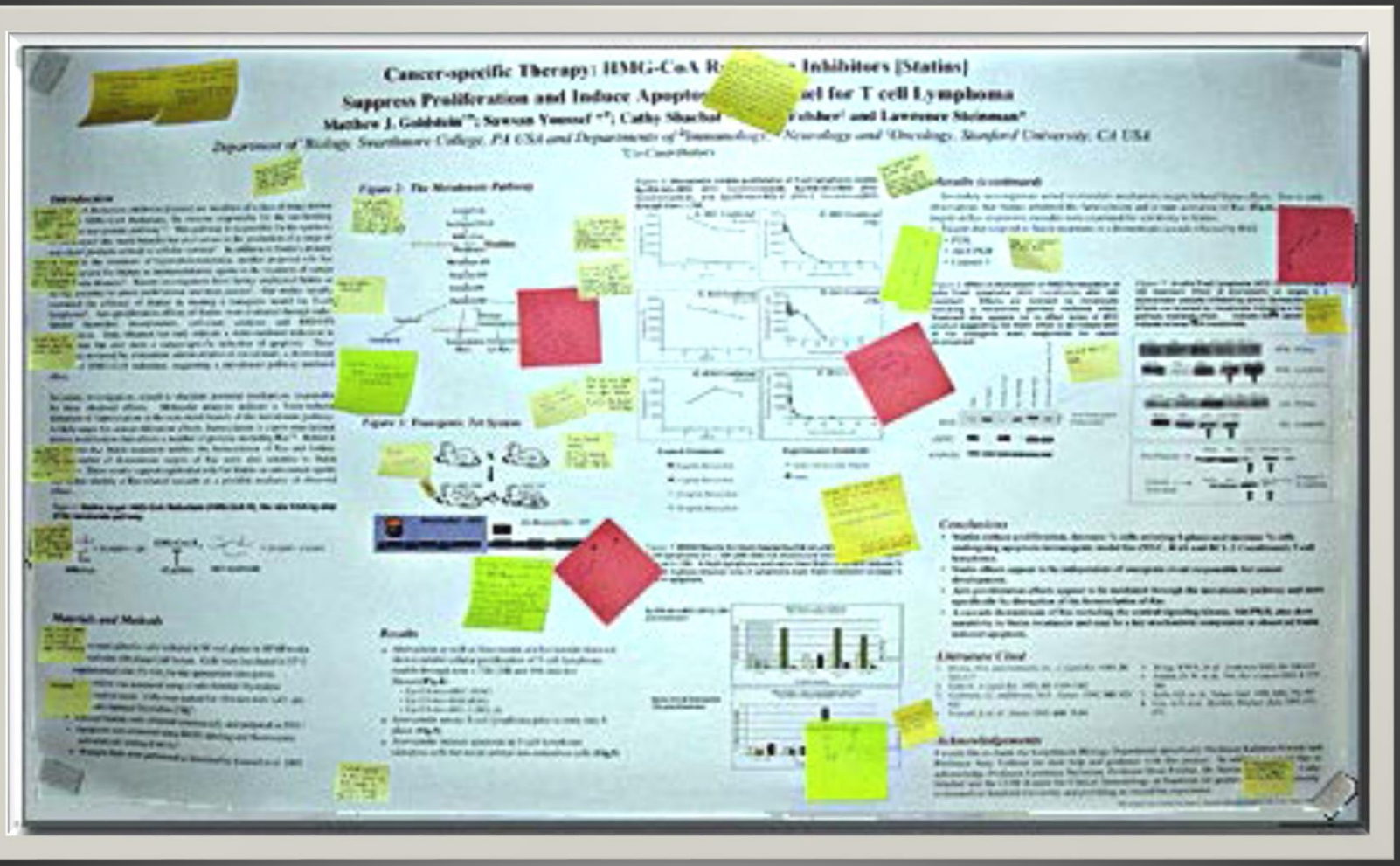
Analysis Tips & Tricks

- Can have multiple ArcMap sessions open at once.
- Start from 1 .mxd and every time you complete a new map/map layout, save as a new .mxd for that map. That way, you can go back to any individual map for easy edits later on!
- No spaces in folders or names. EVER!!!!!!! Really!
- Running out of space on your H drive? **Purchase a USB or External Hard drive…** or zip up the folder and upload to tufts box.

Is my poster effective?

- Why should anyone care?
- What am I adding to current knowledge?
- Are my visuals effective and understandable?
- Have I conveyed the findings clearly?
- Are my recommendations valid?

Edit, Edit, Edit and EVALUATE!



So you think your finally done?

- Print out a letter size draft.
  - Can you read the type? This includes the legends and map elements!
  - Are the colors what you really want?
  - Does it look too busy?
  - Do the main points pop out?

Which software to use

MS PowerPoint
Adobe InDesign
MS Publisher

My Great GIS Poster

Overview

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Methodology

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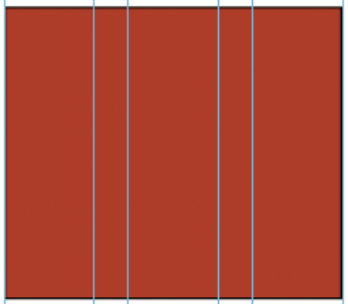

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Findings

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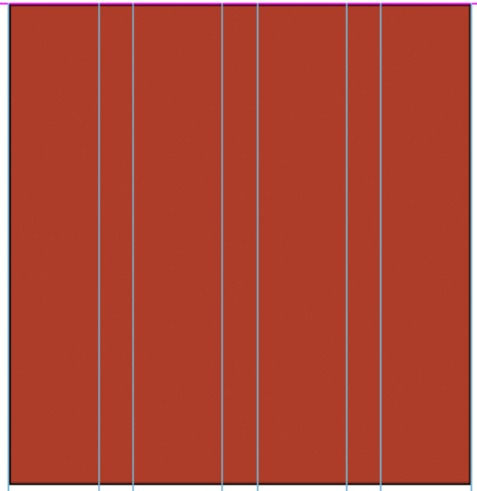

Caption goes here

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Conclusion

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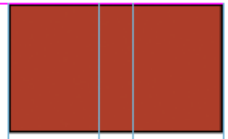

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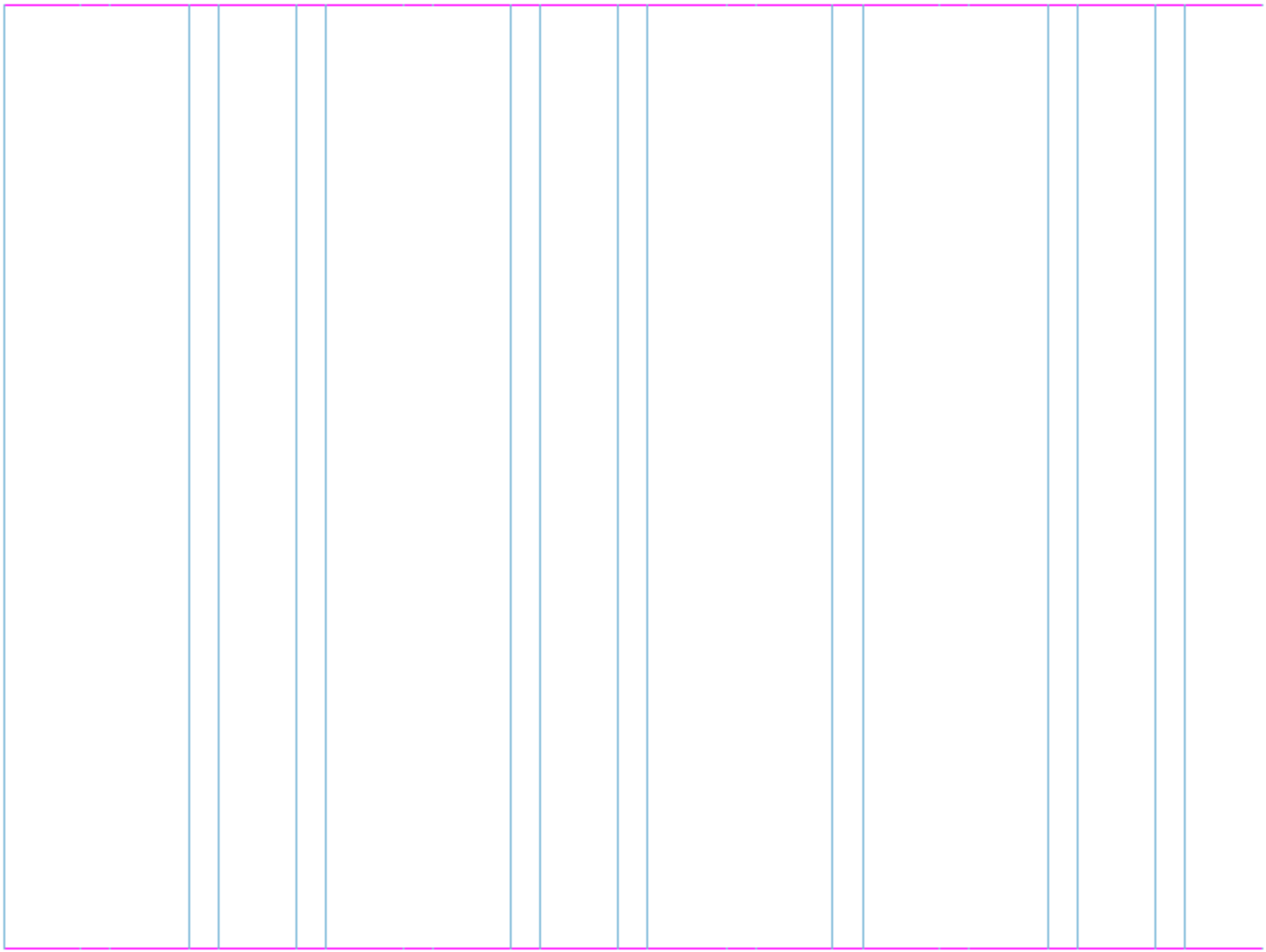
12 columns



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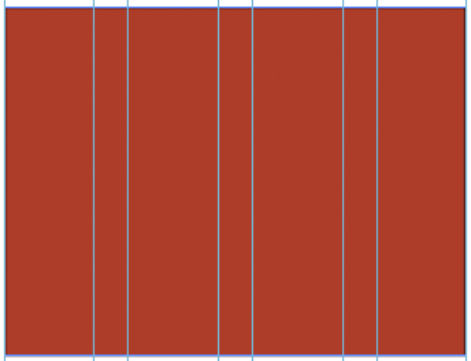

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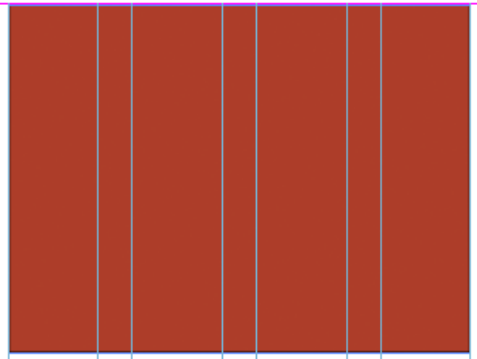

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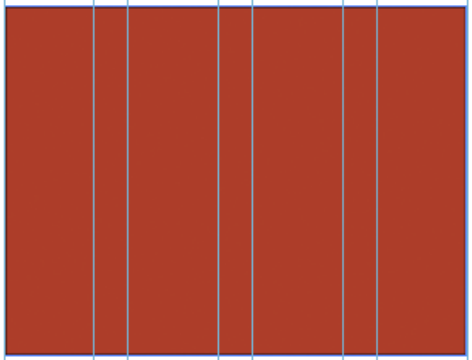

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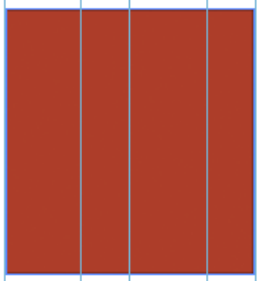

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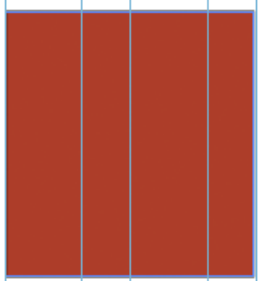

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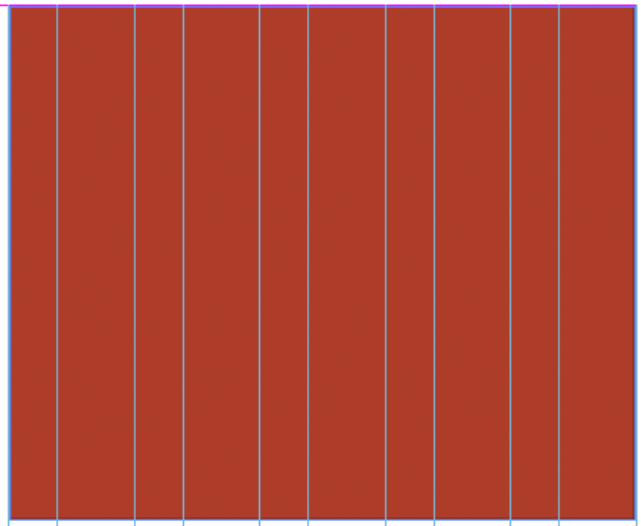

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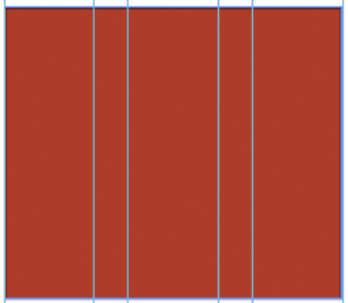

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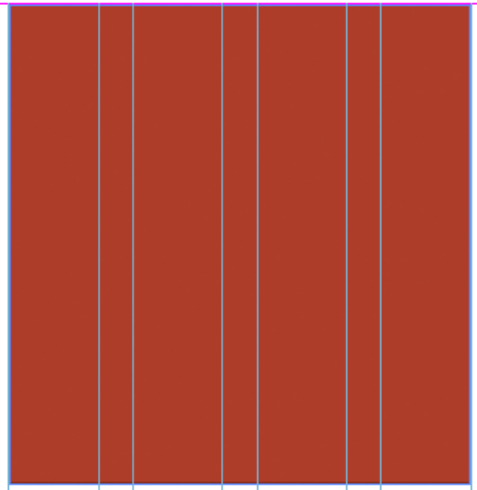

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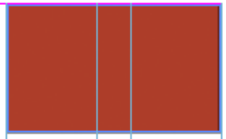

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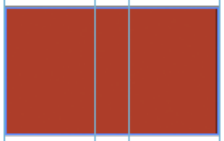

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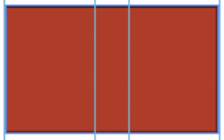

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Overview

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Methodology

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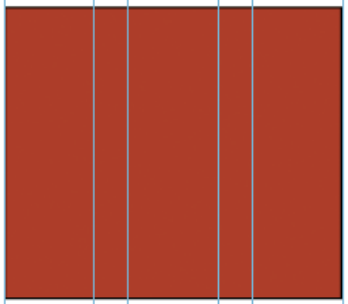

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Findings

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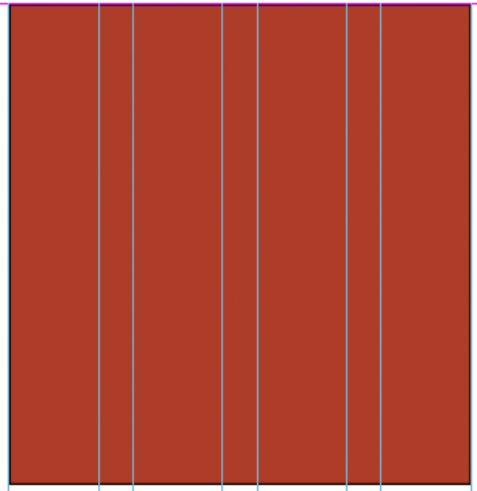

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Conclusion

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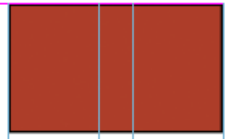

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Questions???

Special Thanks to Dr. Barbara Parmenter and Melanie St. James
for various slide graphics and information regarding design concepts