

Summary

Benefits

- Automated spatial data processing
- Generalized toolsets
- Combining and assessing normally incomparable data

Drawbacks

- Loss of information
- Subjective assignment of risk (dependent on professional knowledge of stakeholders)

Final Thoughts

ESRI Analysis and Geoprocessing Tool Gallery



ArcGIS 10.1 Python Add-In

A Relative Risk Model Toolbox

For Evaluating Disparate Ecological Data



Vincent Pelletier, URS Corporation
2012 ESRI Mid-Atlantic Users Conference



A Case Study



Stressors to Consider

Delaware Estuary and Environmental Database (DEED)

- Water Use
- Water Temperature
- Chemical Toxicants
- Nutrients
- Dissolved Oxygen
- Saltwater
- Habitat Loss / Degradation
- Vessel Strikes

Stressor	Indicator	Scale / Unit
Water Use
Water Temperature
Chemical Toxicants
Nutrients
Dissolved Oxygen
Saltwater
Habitat Loss / Degradation
Vessel Strikes




A Relative Risk Model Toolbox

For Evaluating Disparate
Ecological Data



Source: <http://www.archives.gov>

Vincent Pellerito, URS Corporation

 ESRI Mid-Atlantic Users Conference

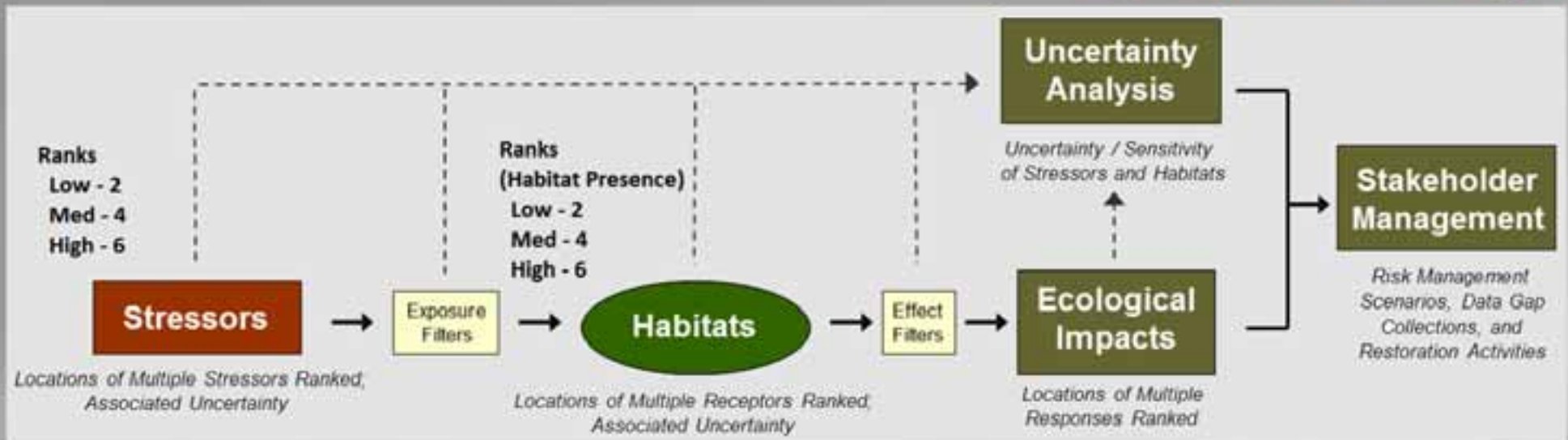
URS

What is an RRM?

Brief background

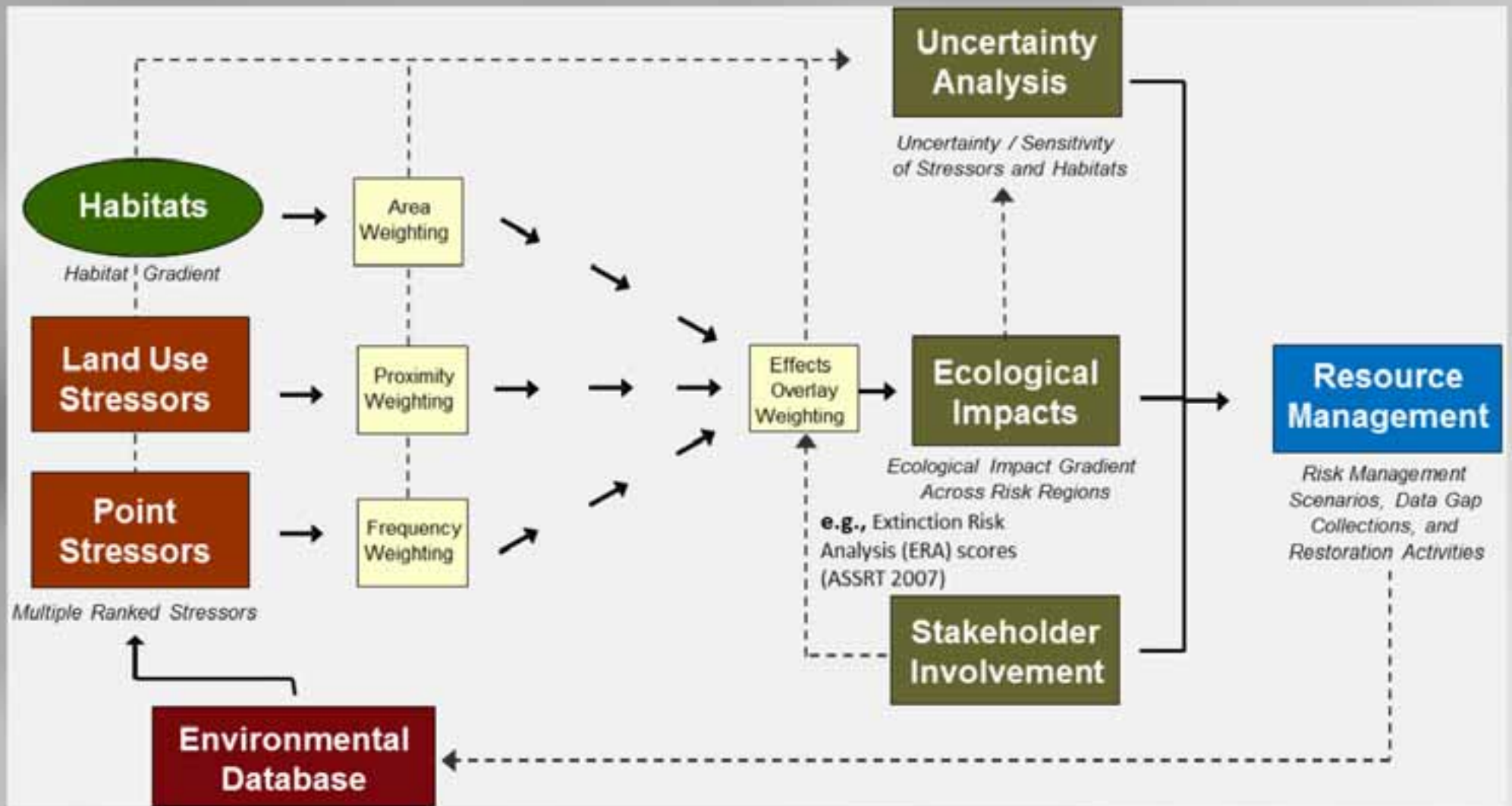
- Developed by Wayne Landis, et al.
 - Western Washington University
- Used for:
 - ecological resource management
 - addressing human impact
 - multiple, conflicting uses
 - at a regional scale

RRM Procedure



Adapted from Landis and Wiegiers, 2005

Adapted Procedure



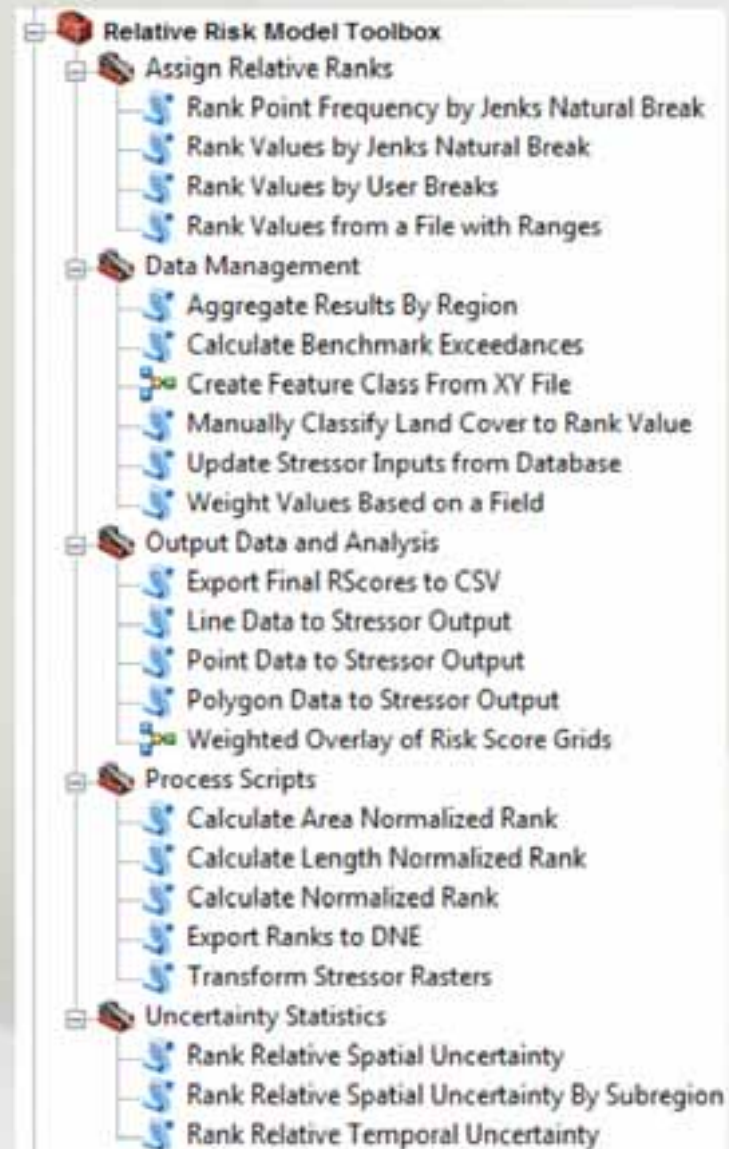
A Look inside...



Tool Sets

Features

- Generalized tools
- ArcGIS 10.0 ArcPy
- Customized script tools
 - ToolValidator class
 - Error handling
- Custom export options
 - CSV
 - DNE (Netica)



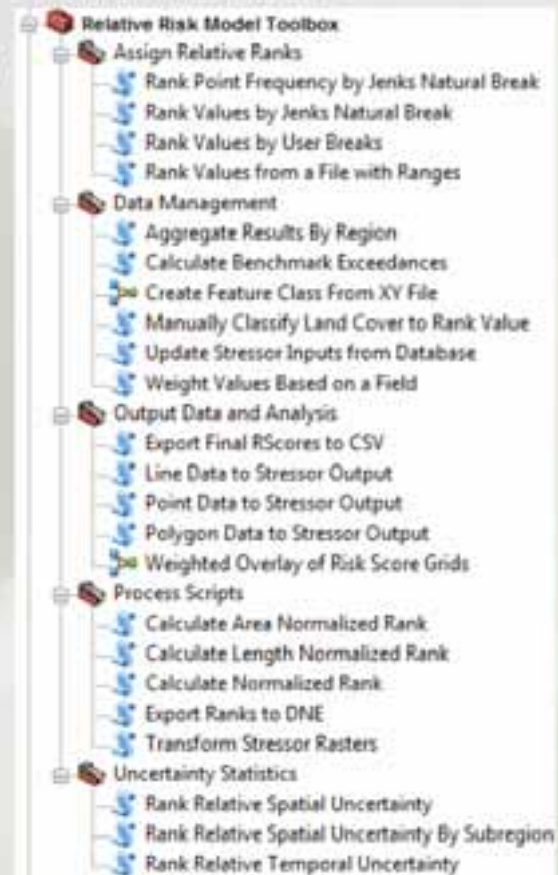
Python scripting

```
#####
def getJenksBreaks( dataList, numClass ):
    #Script from Python taken from here: http://danieljlewis.org/files/2010/04/Jenks.pdf
    #Python script and discussion by Daniel Lewis here:
    #http://danieljlewis.org/2010/04/07/jenks-natural-breaks-algorithm-in-python

    dataList.sort()
    mat1 = []
    for i in range(0, len(dataList)+1):
        temp = []
        for j in range(0, numClass+1):
            temp.append(0)
        mat1.append(temp)
    mat2 = []
    for i in range(0, len(dataList)+1):
        temp = []
        for j in range(0, numClass+1):
            temp.append(0)
        mat2.append(temp)
    for i in range(1, numClass+1):
        mat1[i][4] = 1
        mat2[i][4] = 0
        for j in range(2, len(dataList)+1):
            mat2[j][4] = float('inf')
    v = 0.0
    for i in range(2, len(dataList)+1):
        s1 = 0.0
        s2 = 0.0
        w = 0.0
        for m in range(1, i+1):
            i3 = i - m + 1
            val = float(dataList[i3-1])
            s2 += val * val
            s1 += val
            w += 1
            v = s2 - (s1 * s1) / w
            i4 = i3 - 1
            if i4 != 0:
                for j in range(2, numClass+1):
                    if mat2[i][j] >= (v + mat2[i4][j] - 1):
                        mat1[i][j] = i3
                        mat2[i][j] = v + mat2[i4][j] - 1
```


What the RRM tools are doing

- Manage, calculate, and assign risk ranks
- Process spatial data
 - Points, lines and polygons
- Export risk scores
- Assigning uncertainty ranks



Update Stressor From Database

Database File

S:\Projects\



Feature Directory or Folder

S:\Projects\



Select stressor inputs to update

- Nutrients - Total Nitrogen
- Nutrients - Total Phosphorus
- Reduction of Local Stocks
- Sediment - DioxinFurin
- Sediment - Metals
- Sediment - PAHs
- Sediment - PCBs
- Sediment - Pesticides
- Suspended Solids - Chlorophyl A

Select All

Unselect All

Add Value

Left sidebar of the software interface. A blue arrow points from the top of the sidebar to a button in the main window. The sidebar contains various tool icons and a list of items.

Model/Endpoint	Model/Stressor	Rank Type	Rank	Min Range	Max Range
SMB	TEMP	Rank Value	0 <		12.8
SMB	TEMP	Rank Value	0	12.8	27
SMB	TEMP	Rank Value	2	27	29
SMB	TEMP	Rank Value	4	29	32.3
SMB	TEMP	Rank Value	6	32.3 >	
SMB	DO	Rank Value	0	7 >	
SMB	DO	Rank Value	2	5	7
SMB	DO	Rank Value	4	1	5
SMB	DO	Rank Value	6 <		1
SMB	TURB	Rank Value	0	0	5
SMB	TURB	Rank Value	2	5	25
SMB	TURB	Rank Value	4	25	40
SMB	TURB	Rank Value	6	40 >	
SMB	CHEM	Rank Value	0	0	0.8
SMB	CHEM	Rank Value	2	0.8	3
SMB	CHEM	Rank Value	4	3	5
SMB	CHEM	Rank Value	6	5 >	
SMB	TEMP	Land Cover	0	Coniferous Forest	
SMB	TEMP	Land Cover	2	Dam	
SMB	TEMP	Land Cover	0	Deciduous Forest	

Assign Stressor Rank from File dialog box. The dialog contains the following fields and options:

- Input feature layer: [Empty field]
- Result field to rank: Result
- Model Stressor: [Dropdown menu]
- Model Endpoint: [Dropdown menu]
- Rank Table file: [Empty field]
- Output Workspace (optional): S:\Projects\JMS\DUPOINT\STHRIVER\RRM\Data\GIS\SR_RRMData.gdb\InterData
- Rank Type (Value or Land Cover): Rank Value

Processing Point Data

$$S = \sum_n f_n \times r_n$$

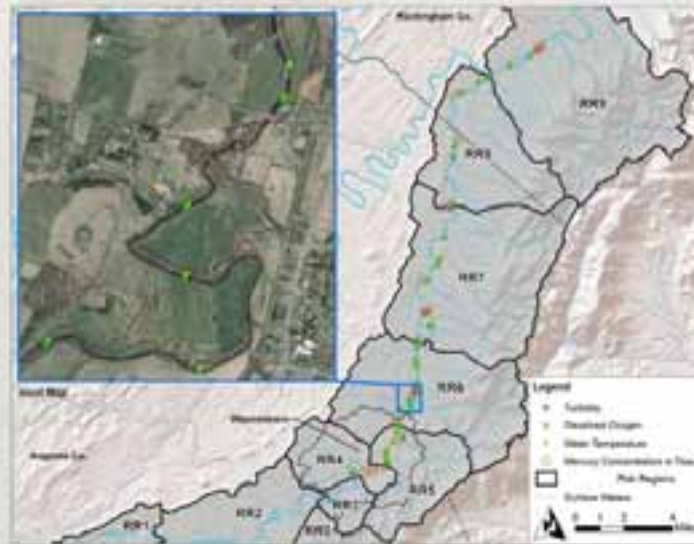
Where:

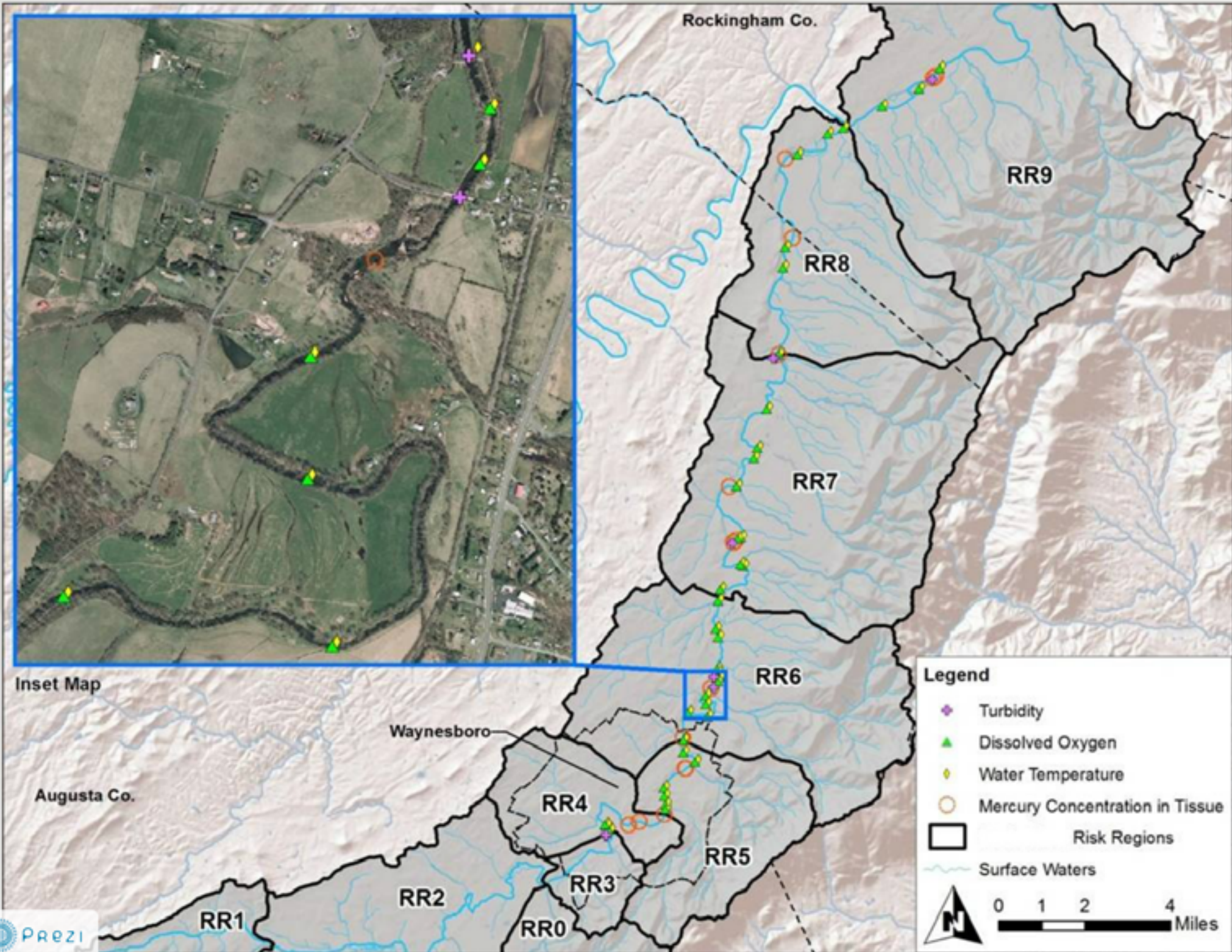
S = stress (point)

f = frequency

r = risk rank

for n number of data records within a risk region



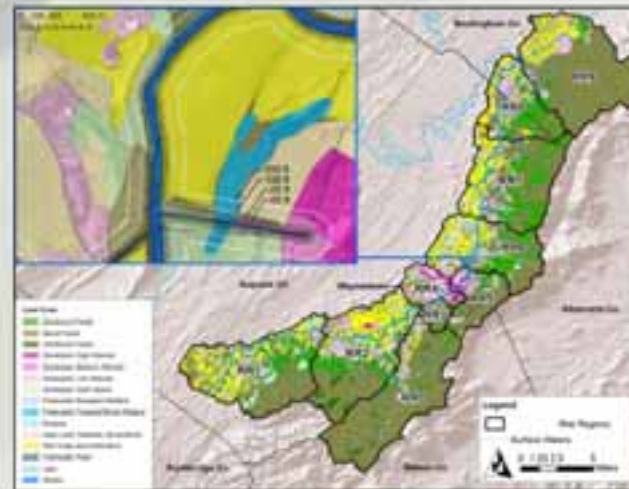


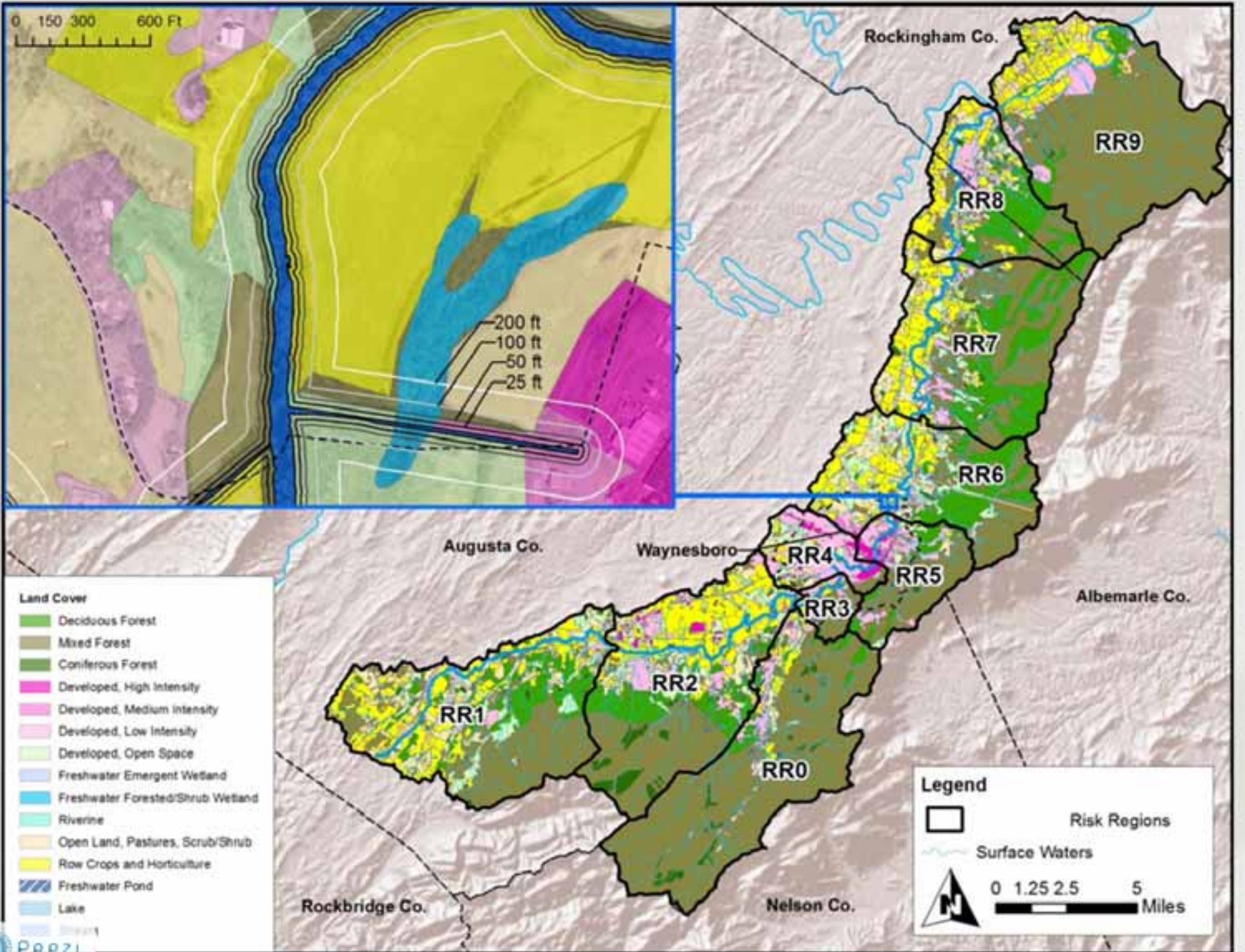
Processing Polygon Data

$$S = p \times \left[\sum_n r_n \times \frac{a_n}{A} \right]$$

Where:

- S = stress (region)
- p = weighting factor
- r = risk rank
- a = risk rank area
- A = region area





0 150 300 600 Ft

Rockingham Co.

RR9

RR8

RR7

RR6

200 ft
100 ft
50 ft
25 ft

Augusta Co.

Waynesboro

RR4

RR5

Albemarle Co.

RR1

RR2

RR3

RR0

Rockbridge Co.

Nelson Co.

Land Cover

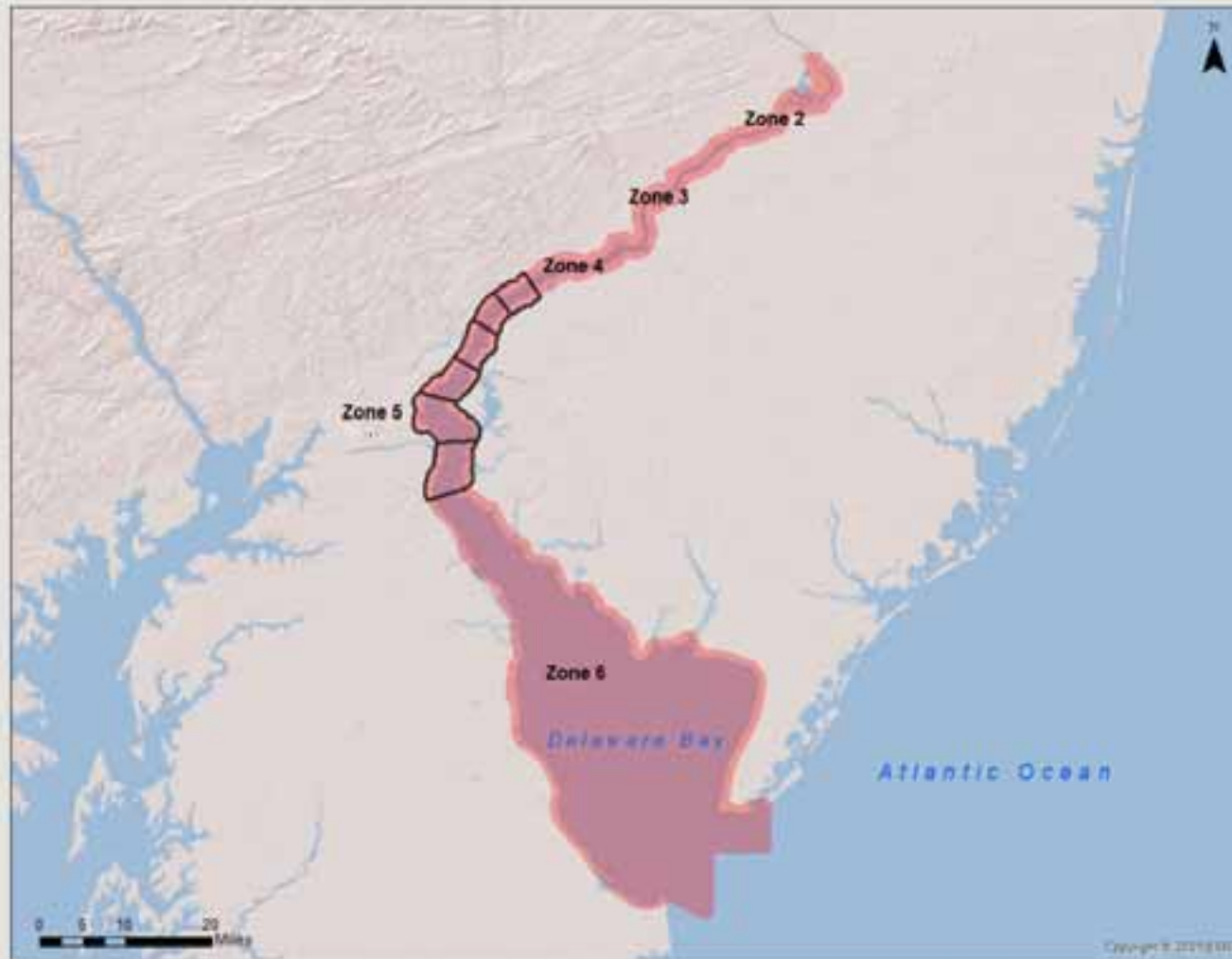
- Deciduous Forest
- Mixed Forest
- Coniferous Forest
- Developed, High Intensity
- Developed, Medium Intensity
- Developed, Low Intensity
- Developed, Open Space
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Riverine
- Open Land, Pastures, Scrub/Shrub
- Row Crops and Horticulture
- Freshwater Pond
- Lake
- Stream

Legend

- Risk Regions
- ~ Surface Waters
- ▲ 0 1.25 2.5 5 Miles

A Case Study

Atlantic Sturgeon



Atlantic sturgeon



Conservation status

Extinct (EX) | Threatened (EW, CR, EN, VU) | Least Concern (LC)

Near Threatened (IUCN 3.1)¹

Scientific classification

Kingdom: *Animalia*
Phylum: *Chordata*
Class: *Actinopterygii*
Order: *Acipenseriformes*
Family: *Acipenseridae*
Genus: *Acipenser*
Species: *A. oxyrinchus* (originally *A. sturio*)
Subspecies: *A. o. oxyrinchus*

Trinomial name

Acipenser oxyrinchus oxyrinchus
Macleay, 1881

wikipedia.org

Some facts

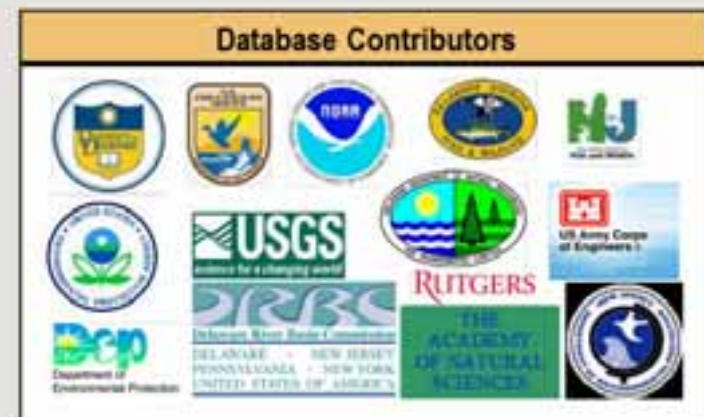
- one of the oldest fish
- ranges from New Brunswick to Florida
- lives up to 60 years
- up to 15 feet long, 800 lbs
- threatened or endangered
 - over fishing
 - water pollution

Stressors to Consider

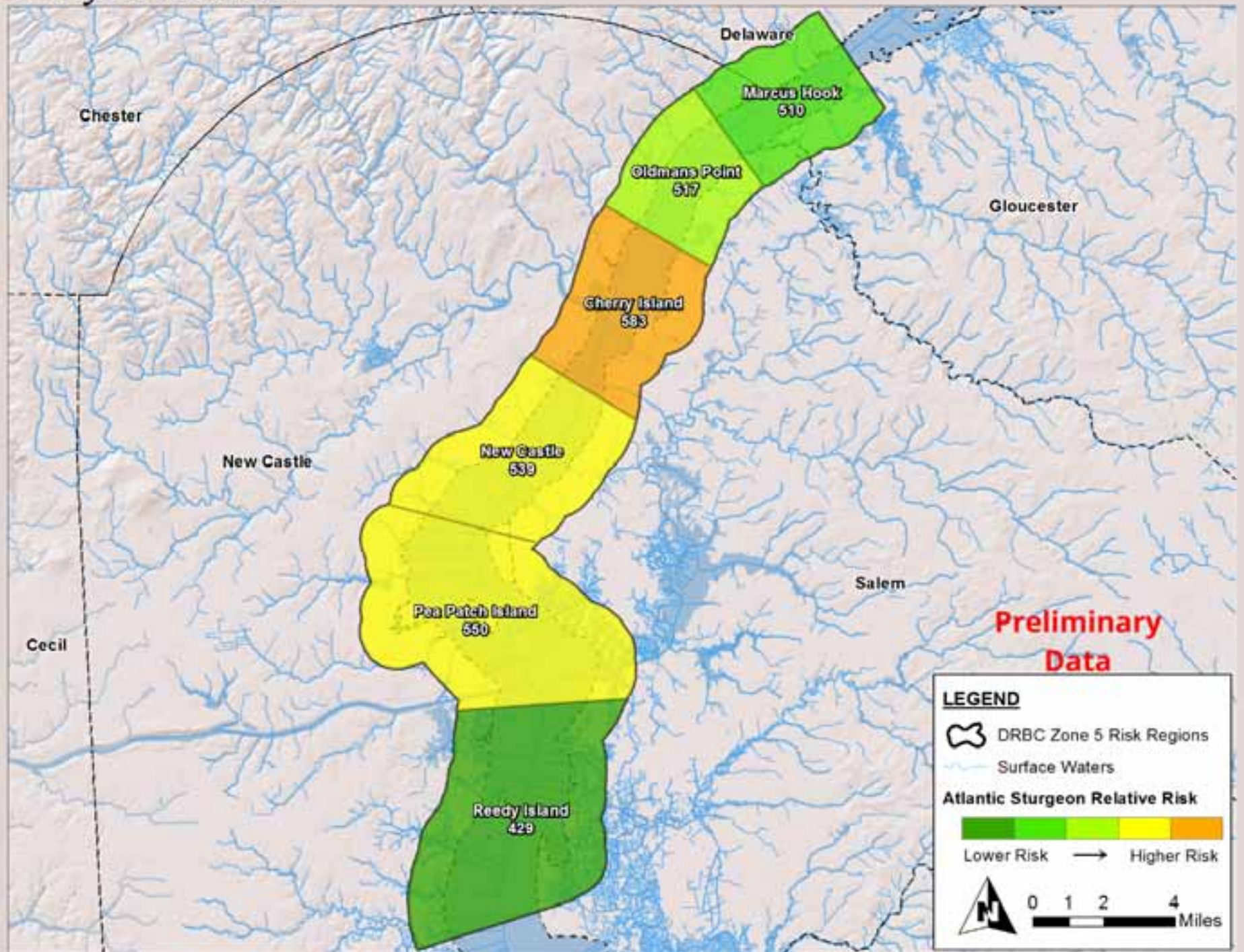
Delaware Estuary and Environmental Database (DEED)

- Water Use
- Water Temperature
- Chemical Toxicants
- Nutrients
- Dissolved Oxygen
- Saltwater
- Habitat Loss / Degradation
- Vessel Strikes

Data Type	Description	Records in Database
Chemical	PCBs, metals, pesticides, PAHs, DxFs, & others	>600,000
Physiochemical	DO, salinity, temperature, river flow	>730,000
Water use	Total & consumptive water use	>12,000
Biological	Ecological parameters & fish stocks	>40,000

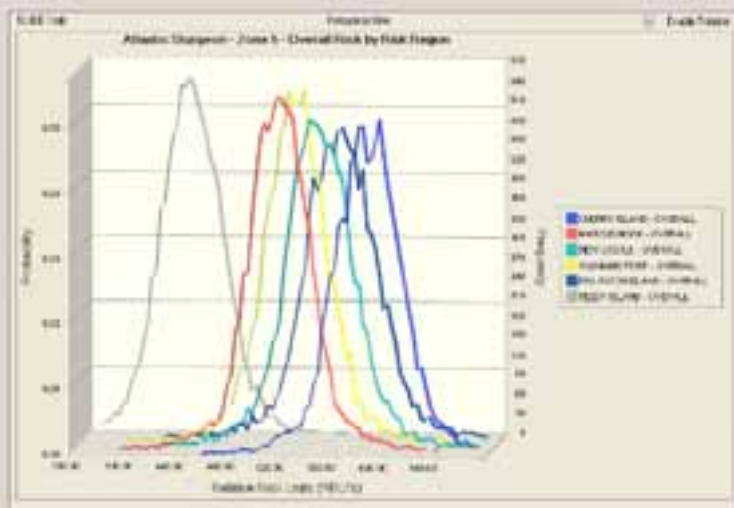


Analysis results...



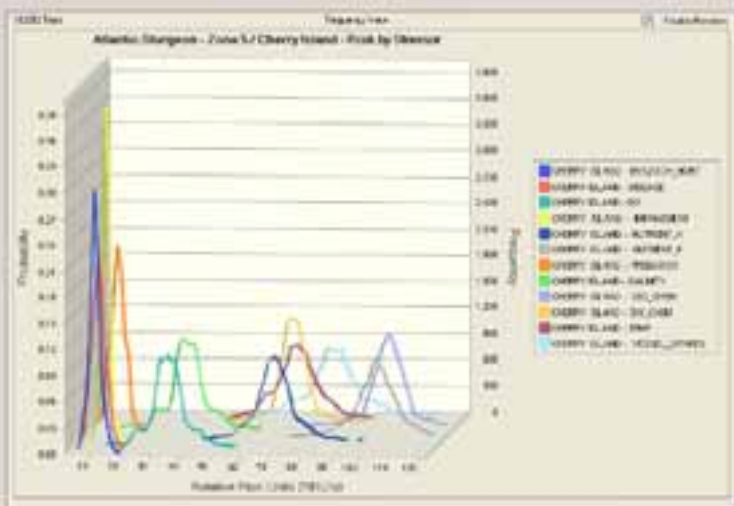
Considering uncertainty...

Preliminary Data



Overall Risk Scores and Uncertainty by Sub-region

- area of highest risk is also area of low uncertainty

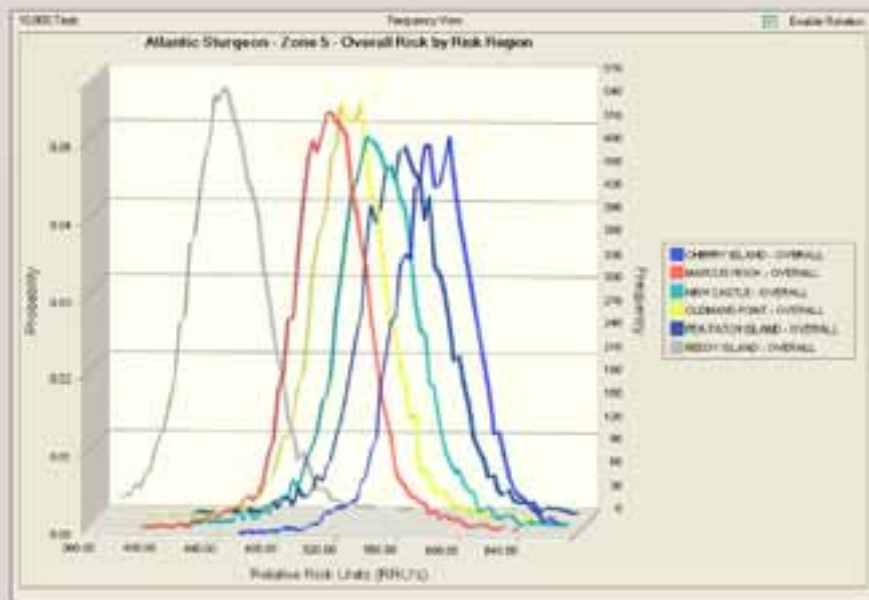


Risk Scores and Uncertainty 'Cherry Island' Sub-region

- uncertainty by stressors
- helpful in assessing data gaps

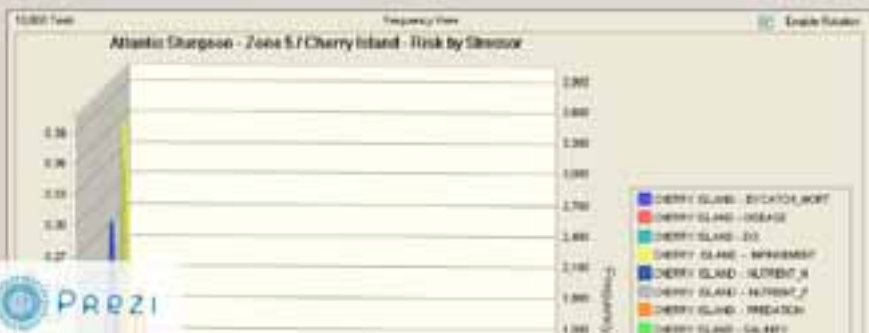
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Preliminary Data



Overall Risk Scores and Uncertainty by Sub-region

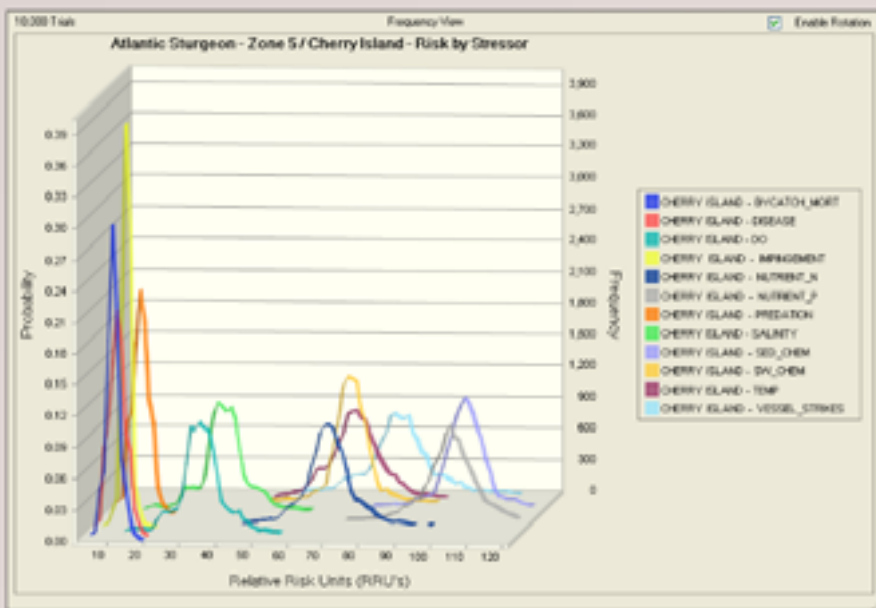
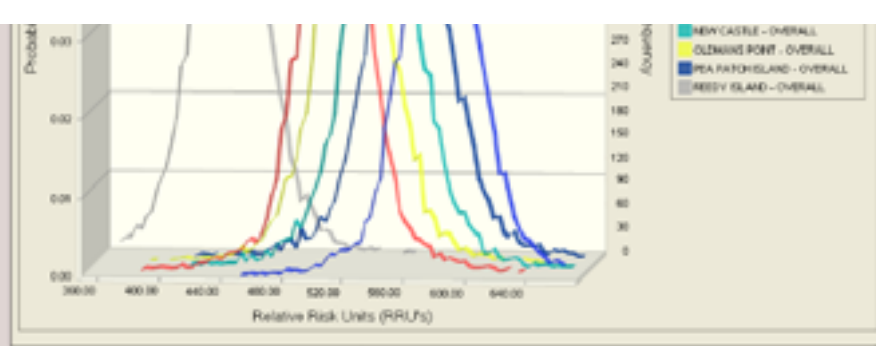
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- Subjective assignment of risk (dependent on professional knowledge of stakeholders)

Final Thoughts

ESRI Analysis and Geoprocessing Tool Gallery

The screenshot shows the ArcGIS Resources website. The header includes 'ArcGIS Resources', 'ArcGIS Online', 'Sign in', 'English', and the Esri logo. A navigation bar contains 'Home', 'Connective', 'Help', 'Blog', 'Forum', and 'Videos'. A search bar is on the right. The main heading is 'Introducing the Analysis and Geoprocessing Tool Gallery'. Below it, a quote states: 'ArcGIS Online is now Esri's primary site for sharing maps, data, and tools.' The main text explains that Esri has always provided a way for users to share tools, starting in the early 1980s with ArcInfo Workstation. It mentions the transition to ArcScripts and the Model and Script Tool Gallery. It then states that ArcGIS Online (www.arcgis.com) is now Esri's primary site for sharing maps, data, and tools, replacing ArcScripts and the Model and Script Tool Gallery. A public group in ArcGIS Online, the Analysis and Geoprocessing Tool Gallery group, is introduced as a place to search for tools, services, and samples. A table of topics is provided at the bottom.

ArcGIS Resources ArcGIS Online Sign in English

[Home](#) [Connective](#) [Help](#) [Blog](#) [Forum](#) [Videos](#)

Introducing the Analysis and Geoprocessing Tool Gallery

Community > Analysis and Geoprocessing

Esri has always provided a way for our user community to share tools. We began this effort in the early 1980s with the first versions of ArcInfo Workstation by distributing diskette tapes containing sample AML code. We then moved to the World Wide Web with ArcScripts, our first large-scale site and, more recently, the Model and Script Tool Gallery.

ArcGIS Online (www.arcgis.com) is now Esri's primary site for sharing maps, data, and tools. It replaces ArcScripts and the Model and Script Tool Gallery. We have created a public group in ArcGIS Online, the Analysis and Geoprocessing Tool Gallery group, where you can easily search for tools, services, and samples. Since this is a public group, you can share your geoprocessing items to this group.

You can learn all about the Analysis and Geoprocessing Tool Gallery by following the links below. You can also follow the previous and next navigation links at the bottom of each topic listed below.

Topic	Comments
Find, search, and download	This topic covers the basics of finding the Analysis and Geoprocessing Tool Gallery group in ArcGIS Online, searching the group, and downloading items.
Joining the group	How to join the group so you can share your items to the group.

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