2015 NC Wildlife Action Plan

www.ncwildlife.org/plan

Decision Support Tools

- Habitat Threat Risk Assessment (TRA)

http://tecumseh.zo.ncsu.edu/coa

Threat Category Metadata

Last updated: November 9, 2017

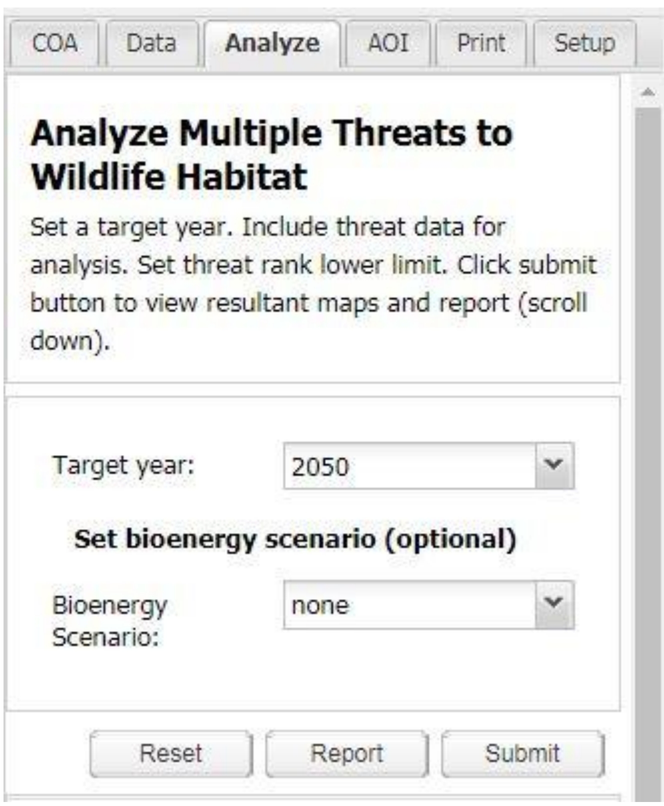
Threat Categories

Modeled on Decadal Time Stamp (2010 – 2050)

- Habitat loss – Forest, Wet Forest, Wet Herbaceous, Open, Scrub/Shrub
- Urban growth – Predicted urban development
- Fire suppression – Density of urban development
- Transportation – Divided center line highways
- Sea level rise – Undeveloped upland and terrestrial land cover change

Modeled on data sets

- Nutrient loading (2006) – Manure and synthetic nitrogen fertilizer application
- Atmospheric deposition – Total nitrogen (2003) and sulfur deposition (2006)
- Energy development (2012) – Triassic basin (fracking) and wind power potential
- Forest health (2010) – Forest insect and disease risk
- Hydrologic alteration (2013) – Number of dams
- Impaired waters 303(d) (2012) – Biota and metal impairments



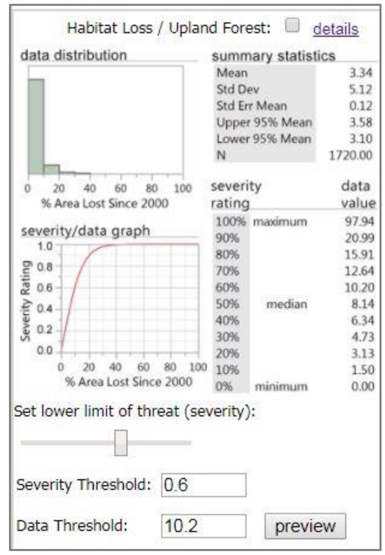
DEFINITIONS: Bioenergy Scenarios - Bioenergy (feedstocks) can refer to wood pellets burned to generate electricity or to liquid biofuels, and bioenergy sources range from crops like switchgrass and sweet sorghum to cultivated pine forests and natural pine and hardwood forest.

Information about bioenergy scenarios is available in two research papers, both published in 2016 and written by scientists with the USGS and NC Cooperative Fish and Wildlife Research Unit at NC State University.

None	Baseline scenario. Business-as-usual production of conventional forest products; no bioenergy production.
Conventional	Increased conventional forestry for bioenergy. - 100% of scenario derived from planted and natural forests.
Conventional + Marginal Agriculture	Increased conventional forestry and conversion of agricultural lands for bioenergy. - 15% of scenario derived from planted and natural forests. - 85% of scenario derived from conversion of agricultural lands on marginal soils to purpose-grown feedstocks.
Conventional + Marginal Agriculture & Forest	Increased conventional forestry and conversion of agricultural lands and forests for bioenergy. - 15% of scenario derived from planted and natural forests. - 42.5% of scenario derived from conversion of agricultural lands on marginal soils to purpose-grown feedstocks. - 42.5% of scenario derived from conversion of forests on marginal soils to purpose-grown feedstocks.
Marginal Agriculture	Conversion of agricultural lands for bioenergy. - 100% of scenario derived from conversion of agricultural lands on marginal soils to purpose-grown feedstocks.
Marginal Agriculture & Forest	Conversion of agricultural lands and forests for bioenergy. - 50% of scenario derived from conversion of agricultural lands on marginal soils to purpose-grown feedstocks. - 50% of scenario derived from conversion of forests on marginal soils to purpose-grown feedstocks.

Habitat Loss (2010-2050)

The scaled threat score was based on the percent of land cover category lost over time within each HUC12 subwatershed.



Habitat loss is defined as the conversion of 5 broad land cover categories into urban or impervious surfaces from 2000 to 2015 on a decadal time step (i.e., 2010, 2020, 2030, 2040 and 2050). These land cover categories were upland forest, wet forest, open, wet herbaceous and scrub-shrub. Predictive models of habitat change incorporating urban growth and landscape succession were developed by Costanza et.al (2015) by linking state-and-transition models with an economics-based timber supply model.

We do not include metrics of habitat fragmentation because species respond to scales of fragmentation differently and the effect of fragmentation on many species is poorly understood (Saunders et al. 1991, Brown et al. 2001, Watling et al. 2011). However, the loss of habitat is almost universally associated with a decline of species and persistence (Hanski 1998, Yackulic et al. 2015).

The default threat severity thresholds for percent loss of hectares for each habitat type (see the Analyze tab) are as follows:

Upland Forest	Wet Forest	Open	Wet Herbaceous	Scrub/Shrub
0.6	0.9	0.8	0.9	0.8

CITATIONS:

Brown et al. (2001): James H. Brown, S.K. Morgan Ernest, Jennifer M. Parody, John P. Haskell. Regulation of diversity: maintenance of species richness in changing environments. Oecologia 126(3):321-332. https://link.springer.com/article/10.1007%2Fs004420000536

Costanza et.al (2015): Jennifer K. Costanza, Robert C. Abt, Alexa J. McKerrow, Jaime A. Collazo. “Linking state-and-transition simulation and timber supply models for forest biomass production scenarios.” AIMS Environmental Science 2(2):180-202. http://www.aimspress.com/article/10.3934/environsci.2015.2.180

Hanski (1998): Ilkka Hanski. “Metapopulation dynamics.” Nature 396(6706): 41-49. doi:http://dx.doi.org.prox.lib.ncsu.edu/10.1038/23876

Saunders et al. 1991): Denis A. Saunders, Richard J. Hobbs, and Chris R. Margules. "Biological Consequences of Ecosystem Fragmentation: A Review." *Conservation Biology* 5(1): 18-32. http://www.jstor.org.prox.lib.ncsu.edu/stable/2386335

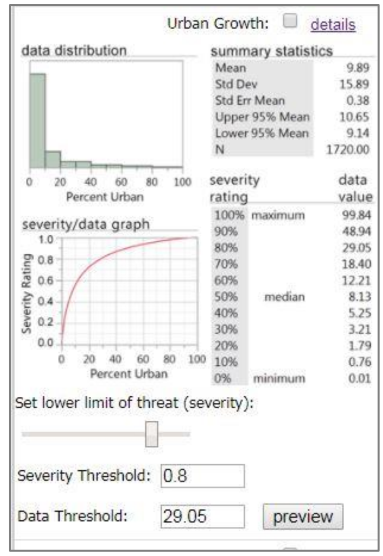
Watling et al. (2011): James I. Watling, A. Justin Nowakowski, Maureen A. Donnelly, John L. Orrock. “Meta-analysis reveals the importance of matrix composition for animals in fragmented habitat.”
Global Ecology and Biogeography 20(2):209-217. http://onlinelibrary.wiley.com/doi/10.1111/j.1466-8238.2010.00586.x/abstract

Yackulic et al. (2015): Charles B. Yackulic, James D. Nichols, Janice Reid, Ricky Der. “To predict the niche, model colonization and extinction.” Ecology 96(1):16-23. http://onlinelibrary.wiley.com/doi/10.1890/14-1361.1/abstract

Urban Growth (2010-2050)

Threat rank is based on the percent of urban development within each HUC12 subwatershed.

Urban growth was simulated throughout the southeastern United States by Terando et. al (2014) using the **SLEUTH** (Slope, Land use, Excluded, Urban, Transportation and Hillshade) modeling protocol. SLEUTH uses a flexible cellular automata urban-growth model based on past urban growth and transportation networks (Clark and Gaydos, 1998).



Restrictions to the probability of urbanization are implemented by natural and social land use controls such as topology or regulatory restrictions on sensitive environmental areas (Terando et. al 2014). The model produces a probability surface of urbanization. A 50% probability threshold was used to delineate urban areas which is consistent with previous applications of SLEUTH models (Earnhardt, 2012).

The default threat severity threshold for percent Urban Growth is 0.8 (see Analyze tab).

CITATIONS:

Clark and Gaydos (1998): Keith C. Clarke, Leonard J. Gaydos. “Loose-coupling a cellular automaton model and GIS: long-term urban growth prediction for San Francisco and Washington/Baltimore.” International Journal of Geographical Information Science 12(7):699-714. http://www.tandfonline.com/doi/abs/10.1080/136588198241617

Earnhardt (2012): Todd S. Earnhardt. “Vegetative Dynamic Modeling for the SAMBI Designing Sustainable Landscapes Project.” Alabama Cooperative Fish and Wildlife Research Unit. http://www.basic.ncsu.edu/dsl/lsc.html

Terando et. al (2014): Adam J. Terando , Jennifer Costanza, Curtis Belyea, Robert R. Dunn, Alexa McKerrow, Jaime A. Collazo. “The Southern Megalopolis: Using the Past to Predict the Future of Urban Sprawl in the Southeast U.S.” PLoS ONE9(7): e102261. https://doi.org/10.1371/journal.pone.0102261

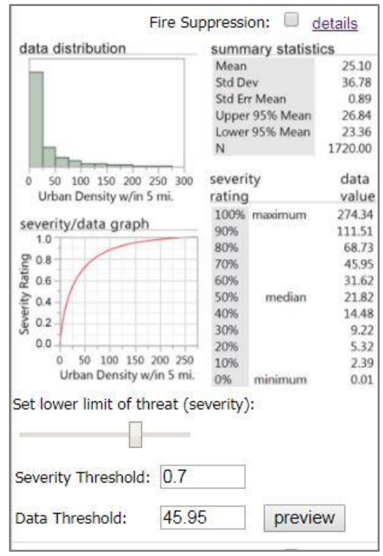
Fire Suppression (2010-2050)

The threat scaled score was based on the percent urban density within each HUC12 subwatershed.

Fire suppression is a threat to wildlife habitat in that it removes one of the key mechanisms that regulate fire depended systems which are so prevalent in North Carolina, especially in the Piedmont and coastal plain(Costanza et al. 2015).

An index to fire suppression was based on the density of urban land cover within a 8 km radius. It follows from the general practice that that more heavily populated areas have a greater propensity to suppress wildfires (Costanza et al. 2015).

The default threat severity threshold for percent Fire Suppression is 0.7 (see Analyze tab).

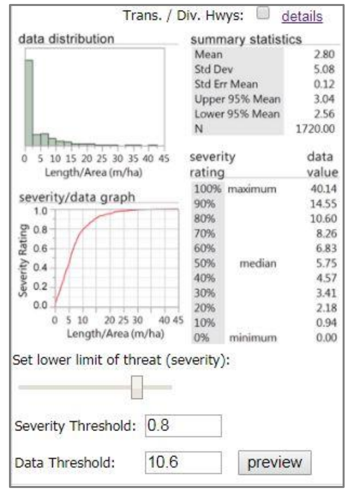


CITATIONS:

Costanza et al. (2015): Jennifer K. Costanza, Robert C. Abt, Alexa J. McKerrow, Jaime A. Collazo. “Linking state-and-transition simulation and timber supply models for forest biomass production scenarios.” AIMS Environmental Science 2(2): 180-202.
http://www.aimspress.com/article/10.3934/environsci.2015.2.180

Transportation Corridors - Divided Center Line Highways (2010-2050)

The threat scaled score was based on the linear total of divided center line (DCL) roadways (m/ha) within each HUC12 subwatershed, then divided by the size of the subwatershed.



Major transportation corridors disrupt wildlife habitat by creating barriers to movement, fragmentation and habitat loss when initially constructed (Lesbarreres and Fahrig 2012, Williams et al. 2015). We used North Carolina Department of Transportation data to identify existing divided center line (DCL) highways as well as proposed DCL highways (NC-DOT 2014).

The default threat severity threshold for meters per hectare of Transportation Corridors is 0.8 (see Analyze tab).

CITATIONS:

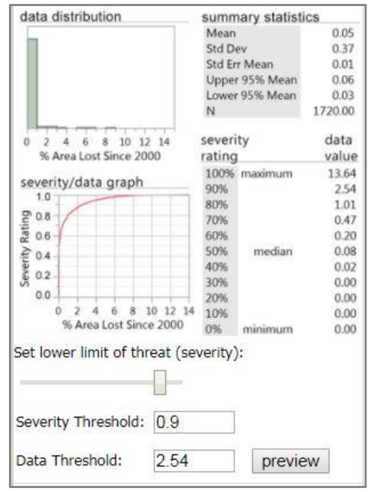
Lesbarreres and Fahrig (2012): David Lesbarrères, Lenore Fahrig. "Measures to reduce population fragmentation by roads: what has worked and how do we know?" Trends in Ecology & Evolution 27(7):374-380. http://www.cell.com/trends/ecology-evolution/abstract/S0169-5347%2812%2900034-1

NC-DOT (2014): https://connect.ncdot.gov/resources/gis/Pages/GIS-Data-Layers.aspx

Williams et al. (2015):

Sea Level Rise – Terrestrial Land Cover Change (2010–2050)

Terrestrial land cover change is the percent loss of all land cover types (including marshes) to open water since 2000. The threat scaled score was based on the amount of habitat loss (hectares) within each HUC12 subwatershed.



The effect of sea level rise (SLR) on coastal environments was used to project change in terrestrial land and undeveloped upland land cover. Projections were made at the Biodiversity and Spatial Information Center at the North Carolina Fish and Wildlife Cooperative Research Unit using the Sea Level Affection Marshes Model (SLAMM; Clough 2008, Rubino 2009).

Projections in habitat change were made on a decadal time-step from 2000 to 2050 based on IPCC's Fourth Assessment A1B climate scenario. SLAMM simulates transforming coastal environments by accounting for nearshore geomorphological processes such as accretion, erosion, and marsh migration dynamics due to long-term seas level rise (Park et al. 1986).

The default threat severity threshold for percent SLR Terrestrial Land Cover Change is 0.9 (see Analyze tab).

CITATIONS:

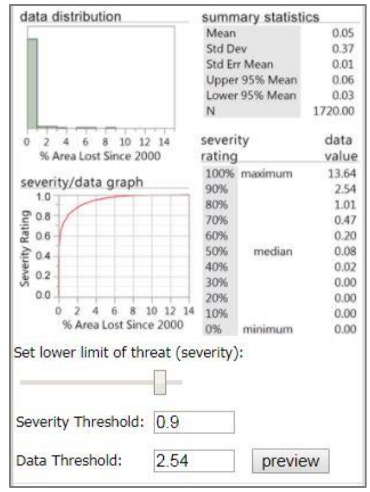
Clough (2008): J. S. Clough. "SLAMM 5.0.1. Technical documentation and executable program." http://www.warrenpinnacle.com/prof/SLAMM/index.html

Park et al. (1986): Richard A. Park, Manjit S. Trehan, Paul W. Mausel, Robert C. Howe. "The Effects of Sea Level Rise on U.S. Coastal Wetlands." U.S. EPA Office of Policy, Planning, and Evaluation, Appendix B: Sea Level Rise." Cooperative Agreement CR814578-01. http://research3.fit.edu/sealevelriselibrary/documents/doc_mgr/452/US_Effects_of_SLR_on_Coastal_Wetlands_-_Park_et_al._1989.pdf

Rubino (2009): Matthew J. Rubino. "Sea Level Rise Modeling for the SAMBI Designing Sustainable Landscapes Project." Cooperative Fish and Wildlife Research Unit, Biodiversity and Spatial Information Center, NC State University, Raleigh, NC. http://www.basic.ncsu.edu/dsl/slr.html

Sea Level Rise –Undeveloped Upland Change (2010–2050)

Undeveloped upland change monitors the percent loss of undeveloped upland habitat (forests, woodlands, open) to wetlands and open water. The threat scaled score was based on the amount of habitat loss (hectares) within each HUC12 subwatershed.



The effect of sea level rise (SLR) on coastal environments was used to project change in undeveloped upland land cover. Projections were made at the Biodiversity and Spatial Information Center at the North Carolina Fish and Wildlife Cooperative Research Unit using the Sea Level Affection Marshes Model (SLAMM; Clough 2008, Rubino 2009).

Projections in habitat change were made on a decadal time-step from 2000 to 2050 based on IPCC's Fourth Assessment A1B climate scenario. SLAMM simulates transforming coastal environments by accounting for nearshore geomorphological processes such as accretion, erosion, and marsh migration dynamics due to long-term sea level rise (Park et al. 1986).

The default threat severity threshold for percent SLR Undeveloped Upland Change is 0.9 (see Analyze tab).

CITATIONS:

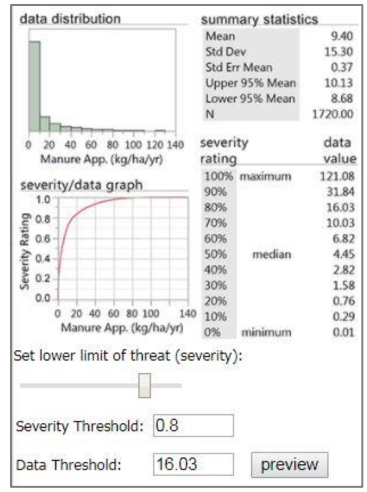
Clough (2008): J. S. Clough. "SLAMM 5.0.1. Technical documentation and executable program." http://www.warrenpinnacle.com/prof/SLAMM/index.html

Park et al. (1986): Richard A. Park, Manjit S. Trehan, Paul W. Mausel, Robert C. Howe. "The Effects of Sea Level Rise on U.S. Coastal Wetlands." U.S. EPA Office of Policy, Planning, and Evaluation, Appendix B: Sea Level Rise." Cooperative Agreement CR814578-01. http://research3.fit.edu/sealevelriselibrary/documents/doc_mgr/452/US_Effects_of_SLR_on_Coastal_Wetlands_-_Park_et_al._1989.pdf

Rubino (2009): Matthew J. Rubino. "Sea Level Rise Modeling for the SAMBI Designing Sustainable Landscapes Project." Cooperative Fish and Wildlife Research Unit, Biodiversity and Spatial Information Center, NC State University, Raleigh, NC. http://www.basic.ncsu.edu/dsl/slr.html

Nutrient Loading - Manure Application (2006)

The threat scaled score was based on the annual application rate of kilograms per hectare (kg/ha/yr) for each HUC12 subwatershed.



The application of manure from confined animal feeding operations is an important source of organic fertilizer which can increase crop production. However, misapplication can increase eutrophication of freshwater and coastal marine systems which negatively impact aquatic systems.

The EPA EnviroAtlas project compiled the mean rate of manure application for each sub-watershed based on county-scale estimates of livestock manure production (EnviroAtlas, 2013a).

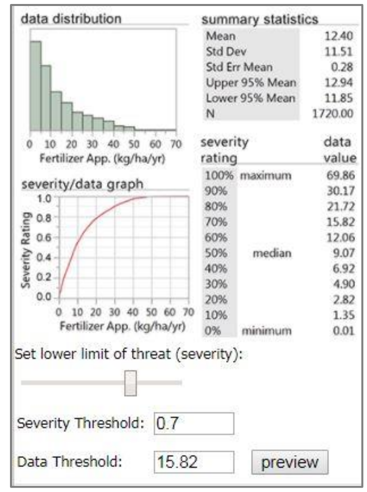
The default threat severity threshold for rate of Manure Application is 0.8 (see Analyze tab).

CITATIONS:

EnviroAtlas (2013a):
https://enviroatlas.epa.gov/enviroatlas/DataFactSheets/pdf/ESN/Manureapplication.pdf

Nutrient Loading - Synthetic Nitrogen Fertilizer (2006)

The threat scaled score was based on the annual application rate of kilograms per hectare (kg/ha/yr) for each HUC12 subwatershed.



Synthetic nitrogen fertilizer is the largest source of reactive nitrogen in the environment for the United States (Sobota et al. 2013) and is a critical component for maintaining high levels of food production. However, roughly half of the fertilizer is not utilized by the intended crop and ends up entering the surrounding landscape leading to increased eutrophication of water resources (Sobota et al. 2013, Compton et al. 2011). The EPA EnviroAtlas project compiled the mean rate of synthetic fertilizer application for each sub-watershed based on county-level data describing total farm-level inputs (EnviroAtlas 2013b).

The default threat severity threshold for rate of Synthetic Fertilizer Application is 0.7 (see Analyze tab).

CITATIONS:

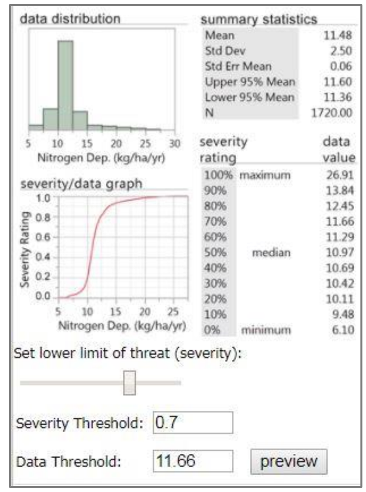
Compton et al. (2011): Jana E. Compton, John A. Harrison, Robin L. Dennis, Tara L. Greaver, Brian H. Hill, Stephen J. Jordan, Henry Walker, Holly V. Campbell. "Ecosystem services altered by human changes in the nitrogen cycle: a new perspective for US decision making." Ecology Letters 14(8):804-815.

EnviroAtlas (2013b): https://enviroatlas.epa.gov/enviroatlas/DataFactSheets/pdf/ESN/Syntheticnitrogenfertilizerapplication.pdf

Sobota et al. (2013): Daniel J Sobota, Jana E Compton, John A Harrison. "Reactive nitrogen inputs to US lands and waterways: how certain are we about sources and fluxes?" Frontiers in Ecology and the Environment 11(2):82-90. http://onlinelibrary.wiley.com/doi/10.1890/110216/abstract

Atmospheric Deposition – Nitrogen (2003)

The threat scaled score was based on the average annual kilograms per hectare (kg/ha/yr) for each HUC12 subwatershed.



Atmospheric deposition of nitrogen can negatively impact both terrestrial and aquatic ecosystems (Greaver et al. 2012, Lovett and Tear 2008). It is the primary source of acidifying chemicals lowering soil and water pH to the detriment of both flora and fauna (DeHayes et al. 1999, Dennis et al. 2007, Driscoll et al. 2001). Atmospheric deposition of nitrogen also contributes to excess nutrients which can lead to eutrophication, lower dissolved oxygen, fish kills and decreased productivity (Paerl et al. 2002).

The EPA EnviroAtlas project compiled annual total nitrogen deposition for 2003 based on data from the Community Multiscale Air Quality (CMAQ) modeling system and includes wet and dry oxidized and reduced nitrogen (EnviroAtlas 2013c).

The default threat severity threshold for percent Nitrogen Atmospheric Deposition is 0.7 (see Analyze tab).

CITATIONS:

DeHayes et al. (1999): Donald H. DeHayes, Paul G. Schaberg, Gary J. Hawley, G. Richard Strimbeck. “Acid Rain Impacts on Calcium Nutrition and Forest Health.” BioScience 49(1):789-800. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.496.8495&rep=rep1&type=pdf

Dennis et al. (2007): Robin Dennis, Richard Haeuber, Tamara Blett, Jack Cosby, Charles Driscoll, Joseph Sickles, John Johnston. “Sulfur and Nitrogen Deposition on Ecosystems in the United States.” Air & Waste Management Association. http://pubs.awma.org/gsearch/em/2007/12/dennis.pdf

Driscoll et al. (2001): Charles T. Driscoll, Gregory B. Lawrence, Arthur J. Bulger, Thomas J. Butler, Christopher S. Cronan, Christopher Eagar, Kathleen F. Lambert, Gene E. Likens, John L. Stoddard, And Kathleen C. Weathers. “Acidic Deposition in the Northeastern United States: Sources and Inputs, Ecosystem Effects, and Management Strategies.” BioScience 51(3):180-198. https://ny.water.usgs.gov/pubs/jrn/ny0177/i0006-3568-051-03-0180.pdf

EnviroAtlas (2013c): Estimating Atmospheric Deposition with CMAQ. https://www.epa.gov/cmaq/estimating-atmospheric-deposition-cmaq

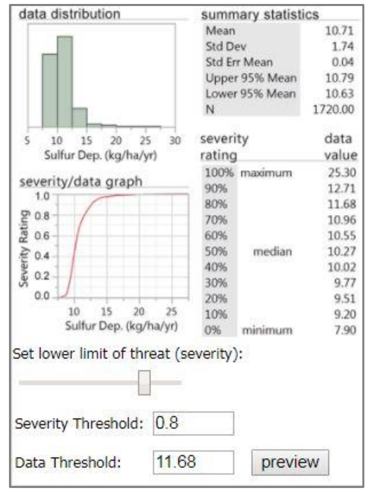
Greaver et al. (2012) Tara L Greaver, Timothy J Sullivan, Jeffrey D Herrick, Mary C Barber, Jill S Baron, Bernard J Cosby, Marion E Deerhake, Robin L Dennis, Jean-Jacques B Dubois, Christine L Goodale, Alan T Herlihy, Gregory B Lawrence, Lingli Liu, Jason A Lynch, Kristopher J Novak. “Ecological effects of nitrogen and sulfur air pollution in the US: what do we know?” Frontiers in Ecology and the Environment 10(&):365-372. http://onlinelibrary.wiley.com/doi/10.1890/110049/abstract

Lovett and Tear (2008): Gary M. Lovett, Timothy H. Tear. “Threats From Above: Air Pollution Impacts on Ecosystems and Biological Diversity in the Eastern United States.” The Nature Conservancy and the Cary Institute of Ecosystem Studies. https://www.nature.nps.gov/air/Pubs/pdf/Threats_from_above_TNC_2008.pdf

Paerl et al. (2002): Hans W. Paerl, Robin L. Dennis, David R. Whitall. “Atmospheric deposition of nitrogen: Implications for nutrient over-enrichment of coastal waters.” Estuaries 25(4)P:677-693. https://link.springer.com/article/10.1007%2FBF02804899

Atmospheric Deposition – Sulfur (2006)

The threat scaled score was based on the average annual kilograms per hectare (kg/ha/yr) for each HUC12 subwatershed.



Atmospheric deposition of sulfur can negate the inherent buffering capacity of soils leading to increased acidification of both soil and water with negative consequences for both flora and fauna (Dennis et al. 2007, Driscoll et al. 2001, Sullivan et al. 2008, Sullivan et al. 2006). Increased sulfur deposition can also lead to increases in methane gas and methyl mercury (Greaver et al. 2012).

The EPA EnviroAtlas project compiled annual total sulfur deposition for 2006 based on data from the Community Multiscale Air Quality (CMAQ) modeling system and includes wet and dry oxidized and reduced nitrogen (EnviroAtlas 2013d).

The default threat severity threshold for percent Sulfur Atmospheric Deposition is 0.8 (see Analyze tab).

CITATIONS:

Dennis et al. (2007): Robin Dennis, Richard Haeuber, Tamara Blett, Jack Cosby, Charles Driscoll, Joseph Sickles, John Johnston. “Sulfur and Nitrogen Deposition on Ecosystems in the United States.” Air & Waste Management Association. http://pubs.awma.org/gsearch/em/2007/12/dennis.pdf

Driscoll et al. (2001): Charles T. Driscoll, Gregory B. Lawrence, Arthur J. Bulger, Thomas J. Butler, Christopher S. Cronan, Christopher Eagar, Kathleen F. Lambert, Gene E. Likens, John L. Stoddard, And Kathleen C. Weathers. “Acidic Deposition in the Northeastern United States: Sources and Inputs, Ecosystem Effects, and Management Strategies.” BioScience 51(3):180-198. https://ny.water.usgs.gov/pubs/jrn/ny0177/i0006-3568-051-03-0180.pdf

EnviroAtlas (2013c): Estimating Atmospheric Deposition with CMAQ. https://www.epa.gov/cmaq/estimating-atmospheric-deposition-cmaq

Greaver et al. (2012) Tara L Greaver, Timothy J Sullivan, Jeffrey D Herrick, Mary C Barber, Jill S Baron, Bernard J Cosby, Marion E Deerhake, Robin L Dennis, Jean-Jacques B Dubois, Christine L Goodale, Alan T Herlihy, Gregory B Lawrence, Lingli Liu, Jason A Lynch, Kristopher J Novak. “Ecological effects of nitrogen and sulfur air pollution in the US: what do we know?” Frontiers in Ecology and the Environment 10(&):365-372. http://onlinelibrary.wiley.com/doi/10.1890/110049/abstract

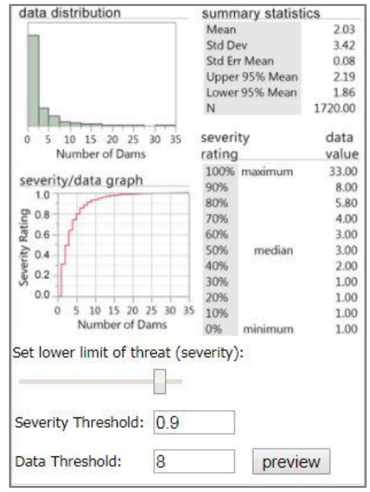
Sullivan et al. (2006): Timothy J. Sullivan, Ivan J. Fernandez, Alan T. Herlihy, Charles T. Driscoll, Todd C. Mcdonnell, Nancy A. Nowicki, Kai U. Snyder, James W. Sutherland.
“Acid-base characteristics of soils in the Adirondack Mountains, New York.” Soil Science Society of America Journal 70(1): 141-152.

Sullivan et al. (2008): T. J. Sullivan, B. J. CosbyJ. R. WebbR. L. DennisA. J. BulgerF. A. DevineyJr. “Streamwater acid-base chemistry and critical loads of atmospheric sulfur deposition in Shenandoah National Park, Virginia.” Environmental Monitoring and Assessment 137:85. https://link.springer.com/article/10.1007%2Fs10661-007-9731-1

Hydrologic Alteration – Number Of Dams (2013)

The threat scaled score was based on the number of dams present within each HUC12 subwatershed.

The National Inventory of Dams is a US Army Corps of Engineers database that documents dams more than 25 feet high, more than 50 acre-feet of water, or are considered a significant hazard if they fail (USACE, 2013). The potential impacts of these structures and associated management is well documented (Irwin and Kennedy 2008, Harris and Hightower 2012, Smith and Hightower 2012).



The EPA EnviroAtlas project summarized the number of dams within each sub-watershed.

The default threat severity threshold for percent Hydrologic Alteration (Dams) is 0.9 representing the presence of 8 dams (see Analyze tab).

CITATIONS:

Harris and Hightower (2012): Julianne E. Harris, Joseph E. Hightower. “Demographic Population Model for American Shad: Will Access to Additional Habitat Upstream of Dams Increase Population Sizes?” Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 4:262-283. http://www.bioone.org/doi/abs/10.1080/19425120.2012.675969

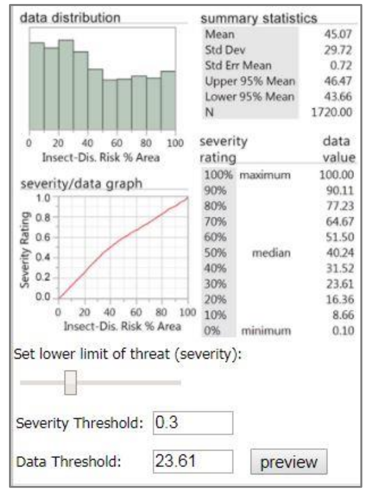
Irwin and Kennedy (2008): Elise R. Irwin, Kathryn D. Mickett Kennedy. “Engaging Stakeholders for Adaptive Management Using Structured Decision Analysis.” The Third Interagency Conference on Research in the Watersheds, Estes Park, CO. https://pubs.usgs.gov/sir/2009/5049/pdf/Irwin.pdf

Smith and Hightower (2012): Jospeh A. Smith, Joseph E. Hightower. “Effect of Low-Head Lock-and-Dam Structures on Migration and Spawning of American Shad and Striped Bass in the Cape Fear River, North Carolina.” Transactions of the American Fisheries Society 141(2):402-413. http://www-tandfonline-com.prox.lib.ncsu.edu/doi/abs/10.1080/00028487.2012.667043

USACE (2013): U. S. Army Corps of Engineers, Army Geospatial Center. http://www.agc.army.mil/Home/Article/480923/national-inventory-of-dams/

Forest Health – Forest Insect & Disease Risk (2010)

The threat scaled score was based on the percent presence or absence of the “moderate to high risk” in each HUC12 subwatershed.



The North Carolina Forest Service developed a Forest Health Priority map as part of their Forest Action Plan in 2010 (NCFS 2010). Moderate to high risk of damage from insects and diseases (native and/or established and imminent invasive threats) were assessed and mapped for the entire state. The analysis is not necessarily based on a specific time frame.

Specific pests included; southern pine beetle (*Dendroctonus frontalis*), hemlock woolly adelgid (*Adelges tsugae*), balsam woolly adelgid (*Adelges piceae*), emerald ash borer (*Agrilus planipennis*), Asian longhorned beetle (*Anoplophora glabripennis*), sirex woodwasp (*Sirex noctilio*), littleleaf disease, annosus root rot, fusiform rust (*Cronartium quercuum f.sp. fusiforme*), beech bark disease, and redbay ambrosia beetle-laurel wilt (*Raffaelea lauricola*).

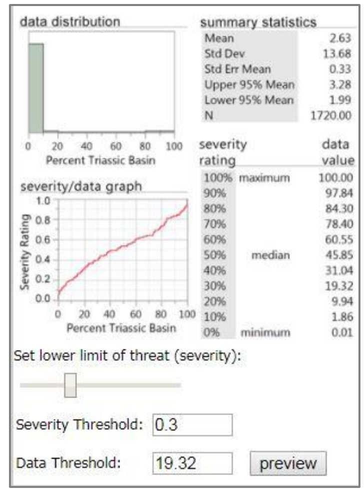
The default threat severity threshold for percent Forest Health is 0.3 (see Analyze tab).

CITATIONS:

NCFS (2010): North Carolina Forest Action Plan. http://www.ncforestactionplan.com/index.htm

Energy Development - Triassic Basin (2012)

The threat scaled score was based on the percentage of Triassic basin geology (hectares) within each HUC12 subwatershed.



The USGS has identified several Triassic basins in North Carolina as having moderate to high potential for hydrocarbon source rocks which could be accessed with drilling operations known as hydraulic fracturing (Milici et al. 2012).

Identified threats to biota include: surface and groundwater contamination; diminished stream flow; stream siltation; habitat loss and fragmentation; localized air, noise and light pollution; and contribution to climate change (Souther et. al 2014). North Carolina Geological Survey data was used to quantify the areal extent of the Deep River and Dan River-Danville basins within each sub-watershed.

The default threat severity threshold for percent Triassic Basin Energy Development (fracking) is 0.3 (see Analyze tab).

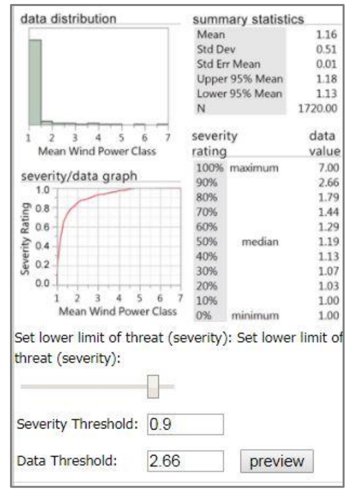
CITATIONS:

Milici et al. (2012): Robert C. Milici, James L. Coleman, Elisabeth L. Rowan, Troy A. Cook, Ronald R. Charpentier, Mark A. Kirschbaum, Timothy R. Klett, Richard M. Pollastro, Christopher J. Schenk. "Assessment of Undiscovered Oil and Gas Resources of the East Coast Mesozoic Basins of the Piedmont, Blue Ridge Thrust Belt, Atlantic Coastal Plain, and New England Provinces, 2011." U.S. Geological Survey Fact Sheet 2012–3075, 2 p.
https://pubs.usgs.gov/fs/2012/3075/

Souther et. al (2014): Sara Souther, Morgan W Tingley, Viorel D Popescu, David TS Hayman, Maureen E Ryan, Tabitha A Graves, Brett Hartl, Kimberly Terrell. "Biotic impacts of energy development from shale: research priorities and knowledge gaps." Frontiers in Ecology and the Environment 12(6):330-338.
http://onlinelibrary.wiley.com/doi/10.1890/130324/abstract

Energy Development – Wind Power (2012)

The threat scaled score was based on the average wind potential category of each HUC12 subwatershed.



Potential wind resource (50m height) is represented by data from the National Renewable Energy Laboratory (NREL 2012). This threat is included because it could lead to wildlife mortality (Jaber 2013).

Wind power is categorized into 8 categories (0 – Unassessed, 1 – Poor, 2 – Marginal, 3 – Fair, 4 – Good, 5 – Excellent, 6 – Outstanding, 7 – Superb).

The default threat severity threshold for percent Wind Energy Development is 0.9 (see Analyze tab).

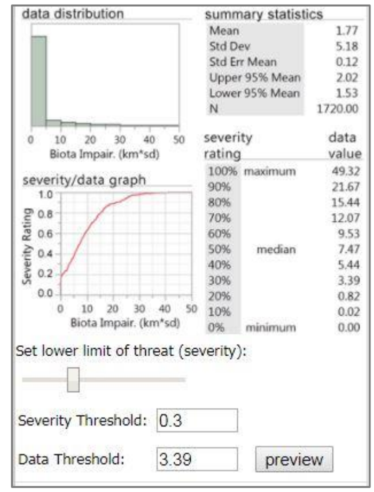
CITATIONS:

Jaber (2013): Suaad Jaber. "Environmental Impacts of Wind Energy." Journal of Clean Energy Technologies 1(3):251-254.
http://www.jocet.org/papers/057-J30009.pdf

NREL (2012): Wind Energy in North Carolina.
https://windexchange.energy.gov/states/nc

Impaired Waters (2012), 303(d) Clean Water Act – Biota

The threat scaled scores are based on the total length of the stream impaired (km), weighted by stream density in each HUC12 subwatershed.



The EPA monitors impaired waters and their causes as outlined by section 303(d) of the Clean Water Act. Impairments include pathogens, metals, turbidity, pH imbalance, algal growth, polychlorinated biphenyls, nutrients, temperature, dioxin, and others. The EnviroAtlas project compiled the length of stream impacted and impairment source for sub-watersheds within the continental US.

We included impairments of biota (EnviroAtlas 2013c) and metal contamination (EnviroAtlas 2013c). Biota represents biological integrity which is the ability of an aquatic ecosystem to support and maintain a balanced and indigenous community of organisms having species composition, diversity, population densities and functional organization similar to that of reference conditions. Waters shall be suitable for aquatic life propagation and maintenance of biological integrity, wildlife, secondary recreation, and agriculture. Sources of water pollution which preclude any of these uses on either a short-term or long-term basis shall be considered to be violating a water quality standard.

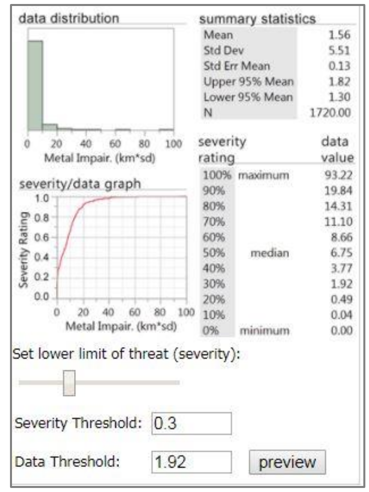
The default threat severity threshold for percent Impaired Waters - Biota is 0.3 (see Analyze tab).

CITATIONS:

EnviroAtlas (2013c): Clean Water Act Section 303(d): Impaired Waters and Total Maximum Daily Loads (TMDLs).
https://www.epa.gov/tmdl

Impaired Waters (2012), 303(d) Clean Water Act – Metals

The threat scaled scores are based on the total length of the stream impaired (km), weighted by stream density in each HUC12 subwatershed.



The EPA monitors impaired waters and their causes as outlined by section 303(d) of the Clean Water Act. Impairments include pathogens, metals, turbidity, pH imbalance, algal growth, polychlorinated biphenyls, nutrients, temperature, dioxin, and others. The EnviroAtlas project compiled the length of stream impacted and impairment source for sub-watersheds within the continental US. We included impairments of biota (EnviroAtlas 2013c) and metal contamination (EnviroAtlas 2013c).

The default threat severity threshold for percent Impaired Waters - Biota is 0.3 (see Analyze tab).

CITATIONS:

EnviroAtlas (2013c): Clean Water Act Section 303(d): Impaired Waters and Total Maximum Daily Loads (TMDLs).
https://www.epa.gov/tmdl