APPALACHIAN LLC DATA NEEDS ASSESSMENT
FINAL REPORT

Trishna Dutta, Robert F Baldwin and Don Lipscomb

April 2014

Table of Contents

EXECUTIVE SUMMARY

Systematic conservation planning is a rapidly maturing field in applied ecology. Numerous methods and data sources have been developed, serving multiple scales and conservation planning goals. There is an extensive academic literature, web presence, and track record of practical application to draw upon in order to conduct conservation planning for the Appalachian LCC.

This project was undertaken to evaluate existing datasets for the AppLCC region, package relevant datasets, review of some of the most commonly used conservation planning tools, provide interpretive text and graphics for datasets and tools, identify data gaps that could improve conservation planning in AppLCC. Additionally, we reviewed and analyzed State Wildlife Action Plans (SWAP) from 15 states that intersect with the LCC, and corresponded with the SWAP coordinators to get their input on summaries and information on the upcoming 2015 revisions.

During the evaluation of the 39 datasets, we ranked them based on their resolution, coverage of AppLCC, quality of data, and relevance to the region. This resulted in 21 datasets that scored very high in its relevance to AppLCC. We downloaded and packaged the top ranking datasets into folders and a geodatabase. We provided interpretive text and graphics for each of the datasets that can be uploaded to the AppLCC web portal for users to access.

We reviewed 21 conservation planning tools grouped according to their function and relevance to AppLCC. While this list is not exhaustive, we hope that users will use this as a starting point when choosing between the many options available for each purpose. Making a decision about which approach to use may require additional comparisons. We interpreted ten conservation tools along with graphics for the AppLCC web portal.

On reviewing the data availability for the AppLCC, we realized that current datasets available at the LCC extent are at the level of being able to run coarse filter analysis. An optimal conservation planning strategy considers both short and long term solutions and requires both fine and coarse scale data. Accordingly, we short listed other datasets that would be useful in filling these data gaps. After cross walking our list with already funded / ongoing projects in the AppLCC region, we short listed eight RFAs that could meet needs for the AppLCC.

The SWAP analysis involved reading thousands of document pages, from which we extracted some key information in an effort to characterize and quantify the objectivity and conservation planning efforts across the 15 partner states. When examining the SWAPs as a whole, their primary feature is heterogeneity. While the SWAPs in many cases are well calibrated to the needs of the individual state,

and in some cases effort has been made to homogenize across state boundaries, their role in the App LCC remains unclear. If the App LCC were to adopt a regional conservation planning strategy that is science-based, the information in the SWAPs, as documented in this report, could be drawn upon to select focal species and ecosystems, parameterize models, and bridge coarse-fine-filter gaps. On the other hand, lack of uniform methodology across SWAPs could impede regional study. The AppLCC can use the information collected in this study to collect some finer scaled data from states, expand some of the work done at individual state levels to the LCC and also deliver data in a format that is useful for individual states, but also for ecoregional planning at a scale that makes ecological sense.

TASK 1: CRITERIA EVALUATION

Task 1 – Evaluate the 31 datasets listed in the Statement of Work (submitted to the U.S. Fish and Wildlife Service on 12/17/2013) for the following criteria A) coverage of Appalachian LCC spatial extent, and B) grain size (resolution) relevant to App LCC conservation planning (e.g., grain size > 10km may not be relevant for local-scale planning), C) quality of data (age, evidence of accuracy, completeness), D) quality of documentation (completeness of metadata), and E) rank as to overall relevance for AppLCC conservation planning goals, based on the previous 4 criteria. Deliverable: Document describing process, data, data sources (e.g., **Table** 1), and how each of the datasets met each of the 5 criteria.

Summary of Task 1 - A total of 39 datasets (an additional 8 sources to the original proposed 31 datasets) were evaluated on 5 criteria - coverage of LCC, resolution (grain), quality of data, quality of documentation, and relevance to Appalachian LCC. Each dataset was scored on a scale from 1-3, in increasing order of importance for this region. A total score (out of a total possible 15 points) was calculated, and datasets with the higher total scores were accordingly ranked high in the evaluation. This has been summarized in Table **1**, and explained in details in this document.

Landuse / Landcover / Habitat

USGS NLCD 2011:

1. Current web location: http://www.mrlc.gov/nlcd11_data.php
2. Coverage of Appalachian LCC: 100%
3. Data type: Raster
4. Grain -- 30 meter (Good)
5. Spatial reference of downloads: Albers Equal Area Conic, NAD-83, Linear units in meters.
6. Quality of data: Good

a. Age – 2006 (7 years old)
b. Accuracy – "provisional"
c. Completeness – version dated February 15, 2011.

7. Documentation: Good
8. Quotes: "For NLCD 2006, there are 3 primary data products: 1) NLCD 2006 Land Cover map; 2) NLCD 2001/2006 Change Pixels labeled with the 2006 land cover class; and 3) NLCD 2006 Percent Developed Imperviousness. Four additional data products were developed to provide supporting documentation and to provide information for land cover change analysis tasks: 4) NLCD 2001/2006 Percent Developed Imperviousness Change; 5) NLCD 2001/2006 Maximum Potential Change derived from the raw spectral change analysis; 6) NLCD 2001/2006 From-To Change pixels; and 7) NLCD 2006 Path/Row Index vector file showing the footprint of Landsat scene pairs used to derive 2001/2006 spectral change with change pair acquisition dates and scene identification numbers included in the attribute table."
9. Notes: The USGS NLCD maps 16 land cover classes in the conterminous U.S. It is the basis for many other data products developed for conservation planning. It is also a primary dataset used by a number of conservation planning programs or models. The NLCD primary dataset downloads as a raster with 30 meter square cells.

The land cover classes are usually reclassified and / or combined with other data for use with regional conservation systems. The mapped data covers the entire Appalachian LCC area.

10. Rank: 2 (Score 14/15)

NatureServe Terrestrial Ecological Systems:

1. Current web location: http://www.natureserve.org/getData/USecologyData.jsp
2. Coverage of Appalachian LCC: 100%
3. Data type: Raster
4. Grain: 30 meter (Good)
5. Spatial reference of downloads: Albers Equal Area Conic, NAD-83, Linear units in meters.
6. Quality of data: Good

a. Age – Ongoing system, development began in the mid 1990's.
b. Accuracy – Raster data used NLCD 2000
c. Completeness - Ongoing

7. Documentation – Good

8. Quote: "NatureServe has developed a mid-scale ecological classification for uplands and wetlands, useful for conservation and environmental planning. Terrestrial Ecological Systems represent recurring groups of plant communities that are found in similar physical environments and are influenced by similar dynamic ecological processes, such as fire or flooding. Our classification describes over 800 upland and wetland ecological system types found in the United States, and in adjacent portions of Mexico and Canada. "
9. Notes: The high number of categories may prove to be an impediment if combined with complex algorithms, although supercomputing may help. However, the mapped data covers the entire Appalachian LCC area and can be modified into courser groups.
10. **Rank: 4 (Score 12/15)**

TNC Terrestrial Habitat Maps:

1. Current web location: http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/habitatmap/Pages/default.aspx
2. Coverage of Appalachian LCC - Northeast portion only (i.e., Virginia, West Virginia, Maryland, Penn., New York, New Jersey, and states northeast of them).
3. Data type: Raster
4. Grain -- 30 meter (Good where it exists)
5. Spatial Reference of downloads: NAD_83, Albers with linear units in meters.
6. Quality of data: good

a. Age -- 2008
b. Accuracy – No formal accuracy report
c. Completeness – Only 13 northeast states

7. Documentation: Good
8. Quotes: "The Northeastern Terrestrial Habitat Classification System (NETHCS) was developed as a comprehensive and standardized representation of habitats for wildlife that would be consistent with other regional classification and mapping efforts. It is based on the ecological systems classification created by NatureServe, with additional classes for developed and highly altered lands. These Habitat Systems are intended to be applicable at medium and large scales, and to supplement the finer-scale approaches used within states for specific projects and needs. They include types that are extensive and cover areas in the 1000s of hectares, as well as small, specific-environment types that may cover only a hectare or two. (Many of these "small patch" systems will not be amenable to regional mapping, but are often important for characterizing wildlife habitat.) The 143 Habitat Systems are grouped into 35 "macro-groups", broader-scale units (e.g. Northern Hardwood and Conifer Forest) tied to the U.S. National Vegetation Classification standard."

The Northeastern Aquatic Habitat Classification System (NEAHCS) presents a standard aquatic classification and GIS map for 13 northeastern states and the District of Columbia. The classification and GIS dataset focus on freshwater streams and rivers, with a basic layer for lakes, and were designed to consistently represent aquatic habitat types across this region in a manner appropriate and useful for conservation planning by the participating states.

9. Notes: Complete system documentation would improve this resource for the App LCC as it would allow the modeling process to be repeated, and maps generated for the full extent.

10. Rank: 6 (Score 10/15)

USGS Phenology (NDVI):

1. Current web location: http://phenology.cr.usgs.gov/get_data_250e.php
2. Coverage of Appalachian LCC: 100%
3. Data type: Raster with layer file
4. Grain: 250 meter
5. Spatial reference of downloads:
6. Quality of data: Excellent

a. Age: Range of years thru 2011
b. Accuracy: Coarse index
c. Completeness: Ongoing by year

7. Documentation: Good
8. Quotes: "Historical remote sensing phenology (RSP) image data and graphics for the conterminous U.S. are made freely available from the USGS/EROS Center through this website. Three data sets are distributed: CONUS 1 km AVHRR RSP data, Eastern CONUS 250 m eMODIS RSP data, and Western CONUS 250 m eMODIS RSP data."
9. Notes: The App. LCC data source is the Eastern CONUS 250 m eMODIS RSP data. There are multiple products available for each year:
   Start of Season – Time
   Start of Season – NDVI
   End of Season – Time
   End of Season – NDVI
   Time of Maximum
   Maximum NDVI
   Duration
   Amplitude
   Time Integrated NDVI

10. Rank: 2 (Score 14/15)

Elevation Data

USGS National Elevation Data:

1. Current web location:
http://ned.usgs.gov/
2. Coverage of Appalachian LCC: 100%
3. Data type: Raster
4. Grain: 30 meter (Good)
5. Spatial reference of downloads: GCS_North_American_1983
6. Quality of data: Excellent
a. Age – Updated 2011
b. Accuracy – Good
c. Completeness – Complete for App. LCC area, but ongoing technique updates.
7. Documentation: Good
8. Quotes: "The National Elevation Dataset (NED) is the primary elevation data product of the USGS. The NED is a seamless dataset with the best available raster elevation data of the conterminous United States."
9 Notes: This is not the highest resolution elevation data available, but it is the most accessible at the whole LCC level. Finer grain data may be difficult to process at this extent without supercomputing. Beware however of some applications, for example streamside management zones that incorporate slope may not be able to be calculated if the buffer width is less than 30m.
10. Rank: 1 (Score 15/15)

USGS Digital Elevation Model Data:

1. Current web location:
http://ned.usgs.gov/
2. Coverage of Appalachian LCC: 100%
3. Data type: Raster
4. Grain: 10 meter (Very Good)
5. Spatial reference of downloads: GCS_North_American_1983
6. Quality of data: Excellent
a. Age – Updated 2011
b. Accuracy – Good
c. Completeness – Complete for App. LCC area, but ongoing technique updates.
7. Documentation: Good
8. Quotes: None
9. Notes: To the best of our knowledge, must be downloaded state by state. Fine grain might be necessary for some applications (e.g., SMZs discussed above).
10. Rank: 4 (Score 12/15)

NASA Aster Satellite Data:

1. Current web location: http://reverb.echo.nasa.gov/reverb/#utf8=%E2%9C%93&spatial_map=satellite&spatial_type=rectangle&spatial=32.101%2C%20-75.190%2C%2041.837%2C%20-87.539&selected=C197265171-LPDAAC_ECS
2. Coverage of Appalachian LCC: Unknown
3. Data type: Raster
4. Grain: 60 meter
5. Spatial reference of downloads: Geographic DD
6. Quality of data:
a. Age – 1999
b. Accuracy – Fair
c. Completeness – complete
7. Documentation: Some
8. Quotes: N/A
9. Notes: Too much data, 137 granules to download; Data from 1999; There is 2010 data available from other sources. Not very useful for this project.
10. **Rank: 6 Score (9/15)**

Global Multi-resolution Terrain Elevation Data 2010 (GMTED2010):

1. Current web location: http://topotools.cr.usgs.gov/GMTED_viewer/
2. Coverage of Appalachian LCC: 100%
3. Data type: Raster
4. Grain: 26 to 30 meter
5. Spatial reference of downloads: GCS_North_American_1983
6. Quality of data: Good
7. Documentation: Good
8. Quotes: "The U.S. Geological Survey (USGS) and the National Geospatial-Intelligence Agency (NGA) have collaborated on the development of a notably enhanced global elevation model named the Global Multi-resolution Terrain Elevation Data 2010 (GMTED2010) that replaces GTOPO30 as the elevation dataset of choice for global and continental scale applications. Since the time GTOPO30 was completed, the availability of higher-quality elevation data over large geographic areas has improved markedly. New data sources include global Digital Terrain Elevation Data (DTED®) from the Shuttle Radar Topography Mission (SRTM), Canadian elevation data, Spot 5 Reference3D data, and data from the Ice, Cloud, and land Elevation Satellite (ICESat). GMTED2010 provides a new level of detail in global topographic data. The GMTED2010 product suite contains seven new raster elevation products for each of the 30-, 15-, and 7.5-arc-second spatial resolutions and incorporates the current best available global elevation data. The new elevation products have been produced using the following aggregation methods: minimum elevation, maximum elevation, mean elevation, median elevation, standard deviation of elevation, systematic subsample, and breakline emphasis. Metadata have also been produced to identify the source and attributes of all the input elevation data used to derive the output products. Many of these products will be suitable for various regional continental-scale land cover mapping, extraction of drainage

features for hydrologic modeling, and geometric and radiometric correction of medium and coarse resolution satellite image data."

9. Notes: Mean elevations were downloaded at 7.5 arc-seconds. This data could be useful, but given the issue of varying resolution the NED will probably be better for the App LCC.

10. Rank: 6 (Score 10/15)

App. LCC States with LIDAR DATA:

1. Current web location: multiple sources
2. Coverage of Appalachian LCC: Spotty, a few states and some county projects.
3. Data type: point
4. Grain: Less than one meter
5. Spatial reference of downloads:
6. Quality of data: (Varies)

a. Age – (Varies)
b. Accuracy – N/A
c. Completeness – N/A

7. Documentation
8. Quotes: None
9. Notes: Lidar data provides excellent microtopographic variation which can be very useful for identifying important habitats. However, fine-scale data (e.g., 1-2m) at the App LCC extent poses a massive processing problem. LiDAR data with consistency of product or coverage of the whole AppLCC area is not available at this time (April 9, 2013). Lidar produces different data products of which high resolution DTMs are the most used at this time.

10. Rank: 8 (Score 7/15)

Species Distribution Data

NatureServe Species Explorer:

1. Current web location: http://www.natureserve.org/explorer/
2. Coverage of Appalachian LCC: Coverage of the App LCC is a difficult metric to assess given biogeographic variation. Varies with range of the species; however coverage is complete in that all potential ranges have been assessed.
3. Data type: Vector (depending on species, point or polygon)
4. Grain: Tabular data with location information, or shapefile
5. Spatial reference of downloads: Geographic DD
6. Quality of data: unknown

a. Age – Ongoing
b. Accuracy – No formal accuracy report
c. Completeness – Ongoing

7. Documentation: Good
8. Quotes: "NatureServe and its network of member programs are a leading source for reliable scientific information about species and ecosystems of the Western Hemisphere. This site serves as a portal for accessing several types of publicly available biodiversity data."
9. Notes: Data can be used to generate species distribution maps; however accuracy varies as to minimum spatial unit that is mapped (e.g., county-level occurrence vs. coordinates).
10. **Rank: 3 (Score 13/15)**

USGS GAP Species Data:

1. Current web location: http://gapanalysis.usgs.gov/species/data/download/
2. Coverage of Appalachian LCC - 100% by regional ancillary data.
3. Data type – ESRI Grid
4. Grain -- 30 meter, with ancillary information in tabular.
5. Spatial reference of downloads: NAD83 Albers, Units in meters.
6. Quality of data:

a. Age – Unknown
b. Accuracy – No formal accuracy report
c. Completeness – Continuing project

7. Documentation: Good
8. Quotes: "GAP distribution models represent the areas where species are predicted to occur based on habitat associations. GAP distribution models are the spatial arrangement of environments suitable for occupation by a species. In other words, a species distribution is created using a deductive model to predict areas suitable for occupation within a species range. To represent these suitable environments, GAP compiled existing GAP data, where available, and compiled additional data where needed. Existing data sources were the Southwest Regional Gap Analysis Project (SWReGAP) and the Southeast Gap Analysis Project (SEGAP) as well as a data compiled by Sanborn Solutions and Mason, Bruce and Girard. Habitat associations were based on GAP National Land Cover data of ecological

systems, elevation data, hydrological characteristics, human avoidance characteristics, forest edge, and ecotone widths."

9. Notes: Best available species distribution models for the region; however may want to do finer species-environment modeling for focal (or surrogate) species.

10. Rank: 2 (Score 14/15)

GBIF Species Data:

1. Current web location: http://data.gbif.org/countries/US
2. Coverage of Appalachian LCC: Theoretically 100% because global service. We do not know how complete the records are for relevant species for the App LCC; our guess is less reliable or redundant with NS or BISON.
3. Data type: Google Earth point overlay
4. Grain: N/A
5. Spatial reference of downloads: Geographic
6. Quality of data:

a. Age – N/A
b. Accuracy – N/A
c. Completeness – Ongoing

7. Documentation:
8. Quotes: None
9. Notes: A global dataset with 396 million species global and over 97 million for the USA. The best approach might be to select focal species and convert the data for those from KML to Shape or other GIS format.

10. Rank: 6 (Score 10/15)

Hydrology / Hydrography Data

USGS Hydrologic Units:

1. Current web location: ftp://ftp.ftw.nrcs.usda.gov/wbd/
2. Coverage of Appalachian LCC: 100%
3. Data type: Vector
4. Grain: N/A
5. Spatial reference of downloads: NAD_27, Albers, linear units in meters.
6. Quality of data:
a. Age – Revised 2006
b. Accuracy – The National Map Accuracy Standard
c. Completeness – On going
7. Documentation: Good
8. Quotes: "The Geographic Information Retrieval and Analysis System (GIRAS) was developed in the mid 70s to put into digital form a number of data layers which were of interest to the USGS. One of these data layers was the Hydrologic Units. The map is based on the Hydrologic Unit Maps published by the U.S. Geological Survey Office of Water Data Coordination, together with the list descriptions and name of region, subregion, accounting units, and cataloging unit. The hydrologic units are encoded with an eight-digit number that indicates the hydrologic region (first two digits), hydrologic subregion (second two digits), accounting unit (third two digits), and cataloging unit (fourth two digits)."
9. Notes: Notes: High quality data of use for many aspects of terrestrial conservation planning. For example reserve selection projects have used watersheds as planning units; also they are very useful for aquatic conservation planning. HUC codes now go to 12 digits and indicate the watershed unit, and a sub-watershed management unit. HUC 12 boundaries are also available for the Appalachain LCC area. New HU 14 and Hu16 boundaries may not be available for the entire area.
10. **Rank: 1 (Score 15/15)**

National Hydrography Dataset:

1. Current web location: ftp://nhdftp.usgs.gov/DataSets/Staged/States/FileGDB/HighResolution/
2. Coverage of Appalachian LCC: 100%
3. Data type: Vector
4. Grain: N/A
5. Spatial reference of downloads: NAD_27, Albers, linear units in meters.
6. Quality of data:
a. Age – 2011 –2013
b. Accuracy – The National Map Accuracy Standard
c. Completeness – On going
7. Documentation: Good

8. Quotes: The National Hydrography Dataset (NHD) is the surface water component of *The National Map*. The NHD is a digital vector dataset used by geographic information systems (GIS). It contains aquatic features i.e., lakes, ponds, streams, rivers, canals, dams, and stream gages. These data are designed to be used in general mapping and in the analysis of surface-water systems.
9. Notes: The largest area of the high resolution geodata that could be downloaded was by state. We downloaded this data for the 15 states that intersect the Appl. LCC area. We also downloaded a medium resolution dataset that covers the entire buffered AppLCC (i.e. all the HUC 8 watersheds that intersect it).
10. **Rank: 1 (Score 15/15)**

USFWS National Wetlands Inventory:

1. Current web location: http://www.fws.gov/wetlands/Data/State-Downloads.html
2. Coverage of Appalachian LCC: 98% (a few quads in upstate New York are missing).
3. Data type: Vector
4. Grain: N/A
5. Spatial reference of downloads: GCS_North_American_1983
6. Quality of data: Good
a. Age – Updates posted Oct. 2010
b. Accuracy – No statement of accuracy.
c. Completeness – Ongoing
7. Documentation: Good
8. Quotes: "This data set represents the extent, approximate location and type of wetlands and deepwater habitats in the conterminous United States. These data delineate the areal extent of wetlands and surface waters as defined by Cowardin et al. (1979). Not all of the United States and U.S. Territories have been digitally mapped by the U.S. Fish and Wildlife Service. Please refer to the Wetlands Mapper Wetlands Data Availability layer to view where wetlands have been mapped. Each download also includes a Metadata data layer that identifies where and when wetlands were mapped within the state."
9. Notes: The NWI is the best available, large extent dataset for occurrence of wetlands. As wetlands are highly critical for maintenance of many aspects of biodiversity, this is an important dataset for regional conservation planning. However, small isolated wetlands are systematically omitted by the NWI. Some states have programs to map these using CIR and LiDAR. The largest area that could be downloaded was by state. We downloaded this data for the 15 states that intersect the Appl. LCC area, and then merged them into a single geodatabase that covers the entire buffered AppLCC area. However, not all the quads have been completed, so their data is missing.
10. **Rank: 2 (Score 14/15)**

FEMA Floodplains Data:

1. Current web location: https://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1
2. Coverage of Appalachian LCC: Most, but not complete.
3. Data type: Vector
4. Grain: N/A
5. Spatial reference of downloads: N/A
6. Quality of data:
a. Age – N/A
b. Accuracy – N/A
c. Completeness – N/A
7. Documentation: Good
8. Quotes: None
9. Notes: The issue with this dataset is that it is county based and FEMA charges per county basis. As there are 598 counties that intersect with the App LCC using this data could be prohibitive, unless it can be obtained for free, or reduced cost. Data may be viewed in map viewer: https://hazards.fema.gov/femaportal/wps/portal/!ut/p/c5/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gDCyNfM_OAYGcLA2cjdwMnwwADKADKR2LKmxrD5fHrDgfZh1Dh7mTg7uHj6x3iagjXj80EZPPB8jiAo4G-n0d-bqp-pH6UOYYplgEmMFMic1LTE5Mr9QtyIwwyAzICAfXM7Ys!/dl3/d3/L0lJSklna21DU1EhIS9JRGpBQU15QUJFUkNKRXFnLzRGR2dzbzBWdnphOUlBOW9JQSEhLzdfMDgyTTY3UFNDODBDMkcwQjlQNDAwMDAwMDAvTVpNSmk1OTY5MDAxOS9zYS5sZWdlbmQuTGVnZW5kRm9ybUFjdGlvbg!!/#7_082M67PSC80C2G0B9P40000000

Availalable to downloadby county at a price: https://msc.fema.gov/webapp/wcs/stores/servlet/CategoryDisplay?storeId=10001&catalogId=10001&langId=-1&categoryId=12001&parent_category_rn=12001&type=1&stateId=&countyId=&communityId=&stateName=&countyName=&communityName=&dfirm_kit_id=&future=false&dfirmCatId=null&isCountySelected=0&isCommSelected=0&userType=G&urlUserType=G&sfc=0&cat_state=13007&cat_county=

Available by Web Map Service (WMS) with limited view scale: https://hazards.fema.gov/femaportal/wps/portal/NFHLWMS

We have not downloaded any of these data at this time (April 8, 2013).

10. Rank: 3 (Score 13/15)

Human Impact Data: In general there are numerous approaches to mapping relative levels of human influence, landscape integrity, or measures of land use transformation. They vary in methodology and extent. Most use the same input data (e.g., NLCD) but they vary in how the data are analyzed, the weights given to different factors, whether local or neighborhood calculations are used, and other factors. While several are fairly recent and national in scope they may only be accessed through arrangement with the authors.

Index Naturalness (Index of Ecological Integrity):

1. Current web location: No one web site, other than NatureServe's "Terrestrial Ecological Systems" dataset already cited.
2. Coverage of Appalachian LCC: We found state level efforts; No single dataset specifically for the App LCC area. The computing processes that are available may be easily adapted for the App LCC.
3. Data type: Usually raster
4. Grain: 30 meter is most used by states
5. Spatial reference of downloads: No universal
6. Quality of data: Each state is different

a. Age – N/A
b. Accuracy – N/A
c. Completeness – N/A

7. Documentation: Many articles
8. Quotes: "To have ecological integrity, an ecosystem should be relatively unimpaired across a range of ecological attributes and spatial and temporal scales (De Leo and Levin 1997). The notion of naturalness depends on an understanding of how the presence and impact of human activity relates to natural ecological patterns and processes (Kapos et al. 2002). "
9. Notes: A number of valid approaches exist for calculating relative measures of human influence. App LCC needs to pick one and have it calculated for the region. Each state appears to have a different approach to "ecological integrity" and use different input data to produce an index layer or map. Some use NatureServe's model, but their own datasets and others develop their own spatial model.

Since NaturServe's dataset is based on the 2001 NLCD, the Appalachian LCC might want to develop their own based on the 2006 NLCD or later versions. The idea is to assess ecosystem integrity across the landscape resulting in a map showing ecosystems with the least to the most integrity based on chosen available data layers.

10. Rank: 6 (Score 10/15)

Index of Human Influence:

1. Current web location: http://www.cec.org/Page.asp?PageID=122&ContentID=1340&SiteNodeID=501&BL_ExpandID=
2. Coverage of Appalachian LCC: All
3. Data type: Raster
4. Grain: 816.6927635, 816.6927635 meters
5. Spatial reference of downloads: Sphere_Arc_Info_Lambert_Azmithal_Equal_Area
6. Quality of data: Moderate
7. Documentation: Good

a. Age – 2005
b. Accuracy – N/A
c. Completeness – Complete

8. Quotes: "This map shows the direct influence of humans on terrestrial ecosystems across North America. The Human Influence Index (HII) is based on population density, built-up areas, roads, railroads, navigable rivers, coastlines, land use/land cover, and nighttime lights. HII values range from 0 to 64, with 0 representing no human influence and 64 representing maximum human influence, based on all eight measures of human influence."
9. Notes: This is North American Continent data from the CEC and is fairly coarse.
10. **Rank: 7 (Score 9/15)**

Last of the Wild – Human Footprint:

1. Current web location: http://sedac.ciesin.columbia.edu/data/collection/wildareas-v2/sets/browse
2. Coverage of Appalachian LCC: All
3. Data type: Raster
4. Grain: 0.00833333, 0.00833333 degrees
5. Spatial reference of downloads: GCS_Clark_1866
6. Quality of data: Coarse

a. Age – 2005
b. Accuracy – N/A
c. Completeness – Complete

7. Documentation: Good
8. Quotes: "The Global Human Footprint Dataset of the Last of the Wild Project, Version 2, 2005 (LWP-2) is the Human Influence Index (HII) normalized by biome. The HII is a global dataset of 1-kilometer grid cells, created from nine global data layers covering human population pressure (population density), human land use and infrastructure (built-up areas, nighttime lights, land use/land cover), and human access (coastlines, roads, railroads, navigable rivers). The dataset is produced by the Wildlife Conservation Society (WCS) and the Columbia University Center for International Earth Science Information Network (CIESIN).
9. Notes: None
10. **Rank: 5 (Score 11/15)**

Last of the Wild – Human Influence:

1. Current web location: http://sedac.ciesin.columbia.edu/data/set/wildareas-v2-human-influence-index-geographic/data-download
2. Coverage of Appalachian LCC:
3. Data type: Raster
4. Grain: 0.00833333, 0.00833333 degrees
5. Spatial reference of downloads: GCS_Clark_1866
6. Quality of data: Coarse
a. Age – 2004
b. Accuracy – N/A
c. Completeness – Complete
7. Documentation: Good

8. Quotes: "The Global Human Influence Index Dataset of the Last of the Wild Project, Version 2, 2005 (LWP-2) is a global dataset of 1-kilometer grid cells, created from nine global data layers covering human population pressure (population density), human land use and infrastructure (built-up areas, nighttime lights, land use/land cover), and human access (coastlines, roads, railroads, navigable rivers). The dataset is produced by the Wildlife Conservation Society (WCS) and the Columbia University Center for International Earth Science Information Network (CIESIN)."
9. Notes: The last three datasets are closely related. A paper by Woolmer et al. (2007) compared results of a 90m resolution human influence map with 1km resolution and found some important differences. We ended up recommending 90m for regional planning.
10. Rank: 6 Score (10/15)

Impervious Surface:

1. Current web location: http://www.mrlc.gov/nlcd01_data.php
2. Coverage of Appalachian LCC: All
3. Data type: Raster
4. Grain: 30 meter
5. Spatial reference of downloads: USA_Contiguous_Albers_Equal_Area_Version, NAD-83, Linear units in meters.
6. Quality of data: Good
a. Age – 2006
b. Accuracy – Assessment in progress
c. Completeness – Complete
7. Documentation: Good
8. Quotes: Version 2.0 of the 2001 percent developed imperviousness for the conterminous United States for all pixels. Updated version of NLCD2001 percent developed imperviousness for direct comparison with NLCD2006 percent developed imperviousness.
9. Notes: From the 2006 NLCD data site.

10. Rank: 2 (Score 14/15)

Housing Density:

1. Current web location: ftp://ftp2.census.gov/geo/pvs/tiger2010st/
2. Coverage of Appalachian LCC: 100%
3. Data type: Vector -- polygon
4. Grain: N/A
5. Spatial reference of downloads: GCS_North_American_1983; Geographic DD
6. Quality of data: Good

a. Age – 2010
b. Accuracy – Census compiled
c. Completeness – Unknown

7. Documentation: Good
8. Quotes: None
9. Notes: Housing density is an extremely important dataset for conservation planning. Housing does not exactly track population and the places where they are different are significant for planning. Where amenity development occurs, housing can be greater than population density. Population is actual census count and housing number is count for the block (polygon).
   The site in the table was Dave Theobald's at Colorado State University. The data layer is not publicly available at this time.

10. Rank: 1 (Score 15/15)

Energy Development (Oil, Gas other)

Existing Oil & Gas:

1. Current web location: http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/maps/maps.htm#field
2. Coverage of Appalachian LCC: Variable
3. Data type: Vector
4. Grain: N/A
5. Spatial reference of downloads: NAD_1927_UTM_Zone_16N, Linear Units = Meters.
6. Quality of data: Fair

a. Age: 2005
b. Accuracy: Unknown
c. Completeness: Unknown

7. Documentation: Poor
8. Quotes: "Map panels show the drilling history and the natural gas proved reserves, production, and proved ultimate recovery histories of selected low-permeability, self-sourced, continuous-type shale reservoirs. Selected geologic characteristics pertinent to occurrence of producible gas resources in the reservoir are also shown when available."
9. Notes: There is a currently funded project for the App LCC that will provide the coverage and quality necessary for conservation planning.
10. **Rank 6 (Score 10/15)**

Other Threats

Climate Wizard:

1. Current web location: http://www.climatewizard.org/
2. Coverage of Appalachian LCC: All
3. Data type: Model data output
4. Grain: N/A
5. Spatial reference of downloads: N/A
6. Quality of data: Model data output
7. Documentation: Good

a. Age – 2007
b. Accuracy – N/A
c. Completeness – Complete

8. Quotes: "Climate Wizard enables technical and non-technical audiences alike to access leading climate change information and visualize the impacts anywhere on Earth. The first generation of this web-based program allows the user to choose a state or country and both assess how climate has changed over time and to project what future changes are predicted to occur in a given area. Climate Wizard represents the first time ever the full range of climate history and impacts for a landscape have been brought together in a user-friendly format.
9. Notes: Climate Wizard was developed by The Nature Conservancy and other partners specifically for conservation planning. The intent was to package and serve relevant map data to incorporate climate variables into conservation planning (e.g., through bioclimatic models). Is a web model that produces maps that can be downloaded for use in ArcGIS as a ASCII raster file.
10. **Rank: 4 (Score 12/15)**

Climate Datasets at National Climatic Data Center:

1. Current web location: ftp://ftp.ncdc.noaa.gov/pub/data/normals/1981-2010/
2. Coverage of Appalachian LCC: points (stations); 100% of App LCC
3. Data type: text, csv
4. Grain: N/A
5. Spatial reference of downloads: N/A
6. Quality of data: Good

a. Age – 1981 -- 2010
b. Accuracy – direct records
c. Completeness – complete

7. Documentation:
8. Quotes: "The 1981-2010 Climate Normals are NCDC's latest three-decade averages of climatological variables, including temperature and precipitation. This new product replaces the 1971-2000 Climate Normals product, which remains available as historical data."
9. Notes: NCDC has a huge variety of climate data sets many of which are relevant for conservation planning. However the interface is not as friendly for conservation planning as is Climate Wizard; an experienced climate scientist should be consulted. Climate data is 1 (Score 15/15) searchable through a web interface.

10. Rank: 2 (Score 14/15)

Climate Vulnerability Index:

1. Current web location: https://connect.natureserve.org/science/climate-change/ccvi
2. Coverage of Appalachian LCC: N/A; coverage is as good as species distribution models for a region
3. Data type: Index calculation in Excel
4. Grain: As good as SDM
5. Spatial reference of downloads: None
6. Quality of data: Good

a. Age – unknown
b. Accuracy – N/A
c. Completeness – N/A

7. Documentation: Good
8. Quotes: "The NatureServe Climate Change Vulnerability Index can help identify plant and animal species that are particularly vulnerable to the effects of climate change**.** Using the Index, you apply readily available information about a species' natural history, distribution and landscape circumstances to predict whether it will likely suffer a range contraction and/or population reductions due to climate change. You can use the Index as part of a variety of analyses, including assessing the relative risk of species listed in State Wildlife Action Plans or part of any assessment of the vulnerability of species to climate change.
9. Notes: CVI has broad application for conservation planning in the App LCC. Not a map dataset as many of these others; yet can be used to make mapped climate vulnerability data. Requires species distribution and natural history data. May be useful after focal species groups are chosen.

10. Rank: 7 (9/15)

Climate Impacts Assessment:

1. Current web location: http://www.northeastclimatedata.org/welcome_home.php?userID=1381
2. Coverage of Appalachian LCC: Only northeastern portion
3. Data type: ASCII
4. Grain: Unknown
5. Spatial reference of downloads: Unknown
6. Quality of data: Unknown

a. Age – 2000 -2005
b. Accuracy – Unknown
c. Completeness – Unknown

7. Documentation
8. Quotes: "This database provides projections of changes in temperature, precipitation, relative humidity, and snow cover for the U.S. Northeast that can be expected over the coming century under higher and lower emission scenarios. The data compiled here was

generated as part of the Northeast Climate Impacts Assessment, a collaborative research effort between the Union of Concerned Scientists and more than 50 independent scientists from across the Northeast region and beyond."

9. Notes: Data download not currently available
10. **Rank: 8 (Score 7/15)**

Natural Disasters:

1. Current web location: http://www.ldeo.columbia.edu/chrr/research/hotspots/coredata.html
2. Coverage of Appalachian LCC: 100% for drought and cyclone
3. Data type: Raster
4. Grain: 0.041666667, 0.041666667 degrees
5. Spatial reference of downloads: D_WGS_1984; decimal degrees.
6. Quality of data: Very coarse data

a. Age – Published 2005 (data 1980 –2000)
b. Accuracy – Unknown
c. Completeness –

7. Documentation: Some
8. Quotes: "Disasters represent a major source of risk for the poor. These natural events can wipe out development gains and accumulated wealth in developing countries. In this project we have assessed the global risks of two disaster-related outcomes: mortality and economic losses. We have estimated risk levels by combining hazard exposure with historical vulnerability for two indicators of elements at risk—gridded population and Gross Domestic Product (GDP) per unit area—for six major natural hazards: earthquakes, volcanoes, landslides, floods, drought, and cyclones. By calculating relative risks for each grid cell rather than for countries as a whole, we have been able to estimate risk levels at sub-national scales. Such information can inform a range of disaster prevention and preparedness measures, including prioritization of resources, targeting of more localized and detailed risk assessments, implementation of risk-based disaster management and emergency response strategies, and development of long-term land-use plans and multihazard risk management strategies."
9. Notes: Global level datasets with frequency and economic index information in ascii grids. This is a coarse resolution dataset used for global models that may not be applicable to the App LCC.
10. **Rank: 9 (Score 6/15)**

Landfire Dataset:

1. Current web location: http://landfire.cr.usgs.gov/viewer/viewer.html
2. Coverage of Appalachian LCC: 100%
3. Data type: Raster
4. Grain: 30 meter
5. Spatial reference of downloads: NAD_1983_Albers

6. Quality of data: Good
a. Age – 2008
b. Accuracy – N/A
c. Completeness – Complete
7. Documentation:
8. Quotes: "This tool was based on the ESRI Sample JavaScript Viewer. This was hosted as part of the ESRI JavaScript API code gallery, prior to the new arcgis.com. It is no longer available from the ESRI site."
9. Notes: Excellent source of data for conservation planning for the App LCC. Includes products that could be adapted including vegetation types, forest structural metrics, and biophysical setting. Some issues for App LCC include different classification systems for parts of the region; these can be adapted and updated.

10. Rank: 2 (Score 14/15)

Protected Areas and other Assets

USGS PAD_US:

1. Current web location: http://gapanalysis.usgs.gov/padus/data/download/
2. Coverage of Appalachian LCC: 100%
3. Data type: Vector -- polygon
4. Grain: N/A
5. Spatial reference of downloads: USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
6. Quality of data: Good

a. Age – 2005 -- 2012
b. Accuracy – Good
c. Completeness – On going

7. Documentation:
8. Quotes: "PAD-US is the national inventory of U.S. terrestrial and marine protected areas that are dedicated to the preservation of biological diversity and to other natural, recreation and cultural uses, managed for these purposes through legal or other effective means. Lands in PAD-US are mainly open space/resource lands owned in fee by agencies and non-profits. The current data set includes the "gap ranks" of these lands, indicating how they are being managed for conservation purposes. PAD-US includes all federal and most state conservation lands, and many areas at regional and local scales, with plans underway to expand these holdings in the database."
9. Notes: Excellent source of data for protected areas (public lands ranked in the GAP system); should be used in concert with the National Conservation Easement Database (NCED). Newest version (1.3; 2012) allows linking with NCED. Contains more records, and is more comprehensive than CBI PAD, especially in the GAP 4 category (non-protected areas).
10. **Rank: 1 (Score 15/15)**

CBI PAD_US:

1. Current web location: http://databasin.org/datasets/f10a00eff36945c9a1660fc6dc54812e
2. Coverage of Appalachian LCC: All
3. Data type: Vector -- polygon
4. Grain: N/A
5. Spatial reference of downloads: USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
6. Quality of data: Good
7. Documentation: Good
8. Quotes: "PAD-US (CBI Edition) Version 2 is a national database of protected fee lands in the United States. PAD-US (CBI Edition) Version 2 has been redesigned to be used along with the National Conservation Easement Database (NCED), to visualize the entire terrestrial conservation estate of the United States. PAD-US (CBI Edition) Version 2 is limited to the

continental U.S., Alaska, and Hawaii. It does not include protected areas data for U.S. territories at this time."

9. Notes: Not clear why there have to be two databases for protected areas in the US; given that PAD-US USGS has complete documentation it might be better to use for App LCC.
10. **Rank: 2 (Score 14/15)**

IUCN World Database on Protected Areas:

1. Current web location: http://protectedplanet.net/search?country_id=232&marine=0#
2. Coverage of Appalachian LCC: A subset of protected areas; not complete compared to PAD US
3. Data type: Vector -- polygon
4. Grain: N/A
5. Spatial reference of downloads: Geographic: GCS_WGS_1984 : units = DD
6. Quality of data: very coarse
7. Documentation: Good
8. Quotes: "Protectedplanet.net is the new face of the World Database on Protected Areas (WDPA), a joint initiative between IUCN and UNEP-WCMC. Its humble beginnings started 30 years ago as a basic global list of national parks and has evolved into the only global, spatially referenced information source on parks and protected areas. We have created protectedplanet.net not only to showcase this wealth of information but also give tools to willing 'citizen scientists' who can feed their knowledge about protected areas into the WDPA. "
9. Notes: PAD US is far more complete for the US. The WDPA has 21,539 sites for the entire USA compared to over 700,000 in the PAD_US dataset. Part of the reason for the discrepancy is that WDPA has a different ranking system; also PAD US is more inclusive of local sites. WDPA is the gold standard internationally; it has not historically worked as well for the US.
10. **Rank: 6 (10/15)**

TNC Ecoregional Conservation Planning Data:

1. Current web location: http://conserveonline.org/workspaces/ecs/napaj/nap/
2. Coverage of Appalachian LCC: Northern portion only; "The study area encompasses parts of New England, New York and southern Quebec, and all of the Gaspe Peninsula and the Maritime Provinces."
3. Data type: Vector -- polygons
4. Grain: N/A
5. Spatial reference of downloads: NAD_1927_Albers; GCS_North_American_1927; Linear units = Meters.
6. Quality of data:

a. Age – N/A N/A
b. Accuracy –
c. Completeness – On going since 1999

7. Documentation:
8. Quotes: This study, "represents a massive revision of the 1999 material that is far more comprehensive in its scope."
9. Notes: TNC dataset is highly relevant for conservation planning for the App LCC. However its availability for the entire region is not complete and what is available publically is not current.

Data available for download: The files will download as .zip files. To display them in ArcGIS, open the .lyr file first, and set the data source to the actual shapefile.

- Ecoregions
- Subregions
- Ecological Drainage Units
- Areas Secured from conversion (U.S. only)
- Matrix Blocks
- Portfolio Streams
- Floodplains
- Steep Slopes
- Wetbasins
- Ravines
- Ecological Land Units
- Land Cover

10. Rank: 6 (Score 10/15)

Two Countries, One Forest Ecoregional Planning Data:

1. Current web location: N/A
2. Coverage of Appalachian LCC: Only most northeastern portion
3. Data type: N/A
4. Grain: N/A
5. Spatial reference of downloads: N/A
6. Quality of data: N/A
7. Documentation: N/A
8. Quotes: None
9. Notes: Most of this was part of a regional collaboration that included The Nature Conservancy. The source is redundant with TNC and is only a subset for the App LCC. However the structure and approach is relevant. This appears to be the same study as the one containing the TNC Ecoregional Conservation Planning data.

10. Rank: 8 (Score 7/15)

CBI National Conservation Easement Database:

1. Current web location: http://databasin.org/datasets/cfc20244ec6b4f739cce35d55da240ce
2. Coverage of Appalachian LCC: 100%
3. Data type: Vector -- polygon
4. Grain: N/A
5. Spatial reference of downloads:
   USA_Contiguous_Albers_Equal_Area_Conic_USGS_version ;
   GCS_North_American_1983;

Linear unit = meters.

6. Quality of data: Good
7. Documentation: Very little
8. Quotes: "The National Conservation Easement Database (NCED) is a collaborative venture to compile easement records (both spatial and tabular) from land trusts and public agencies throughout the United States in a single, up-to-date, sustainable, GIS compatible, online source. The goal of the NCED is to provide a comprehensive picture of the privately owned conservation easement lands, recognizing their contribution to America's natural heritage, a vibrant economy, and healthy communities. Conservation easements are legal agreements voluntarily entered into between landowners and conservation entities (agencies or land trusts) for the express purpose of protecting certain societal values such as open space or vital wildlife habitats."
9. Notes: This dataset may be among the very most important for the Appalachian LCC. Private lands conservation is most concentrated in the eastern US and is likely the most viable real mechanism for new conserved lands, that will be applied broadly in the App LCC. The NCED is under constant development as new easements are always being added. There are sensitivity issues, resulting in less than complete coverage for some areas.
10. **Rank: 2 (Score 14/15)**

Demographic / Socioeconomic Data

U.S. Census:

1. Current web location: http://www.census.gov/did/www/saipe/data/statecounty/data/index.html
2. Coverage of Appalachian LCC: 100%
3. Data type: Excel table
4. Grain: N/A
5. Spatial reference of downloads: N/A
6. Quality of data:

a. Age – 2011
b. Accuracy – unknown
c. Completeness –

7. Documentation: Good
8. Quotes: "The U.S. Census Bureau's Small Area Income and Poverty Estimates (SAIPE) program provides annual estimates of income and poverty statistics for all school districts, counties, and states. The main objective of this program is to provide estimates of income and poverty for the administration of federal programs and the allocation of federal funds to local jurisdictions. In addition to these federal programs, state and local programs use the income and poverty estimates for distributing funds and managing programs."
9. Notes: US Census data are extremely important for conservation planning as they can be used to describe and map trends and forecast future development. These Excel files contain the state and county FIPS codes, so they can be linked to a U.S. county polygon layer. Population estimates and housing estimates were also available via Tiger Linefile data.
10. **Rank: 2 (Score 14/15)**

Other Data

GAP Landcover:

1. Current web location: http://gapanalysis.usgs.gov/gaplandcover/
2. Coverage of Appalachian LCC: 100%
3. Data type: Raster
4. Grain: 30 meter
5. Spatial reference of downloads: Albers_Conical_Equal_Area; NAD83 datum; Linear units = meters
6. Quality of data: Good
a. Age – 2000 NLCD
b. Accuracy – Unknown
c. Completeness – Complete
7. Documentation:
8. Quotes: "The USGS GAP Land Cover Data Set includes detailed vegetation and land use patterns for the continental United States. The data set incorporates the Ecological System classification system developed by NatureServe to represent natural and semi-natural land cover. The 590 land use classes in the data set can be displayed at three levels of detail, from general (8 classes) to most detailed. The Land Cover Data Set can be used to identify those places in the country with sufficient good quality habitat to support wildlife, a key step in developing sound conservation plans."
9. Notes: Level of detail is very much better than the NLCD; however this is based on older imagery (up to 2000). We were unable to find an updated version at this time (April 8, 2013).
10. **Rank: 5 (Score 11/15)**

USGS BISON (Biodiversity Information Serving Our Nation):

1. Current web location: http://bison.usgs.ornl.gov/#
2. Coverage of Appalachian LCC: Variable based on species
3. Data type: Vector/Point
4. Grain: N/A
5. Spatial reference of downloads: Albers_Conical_Equal_Area; NAD83 datum; Linear units = meters
6. Quality of data: Unknown
7. Documentation:
8. Quotes: "Biodiversity Information Serving Our Nation (BISON) is a product of the U.S. Geological Survey's Core Science Analytics and Synthesis Program. BISON is an information system that allows users to access, explore, and download U.S. species occurrence data from participating data providers."
9. Notes: This is a brand new service of the USGS as of spring 2013. It will be completely valuable for conservation planning if it continues to be serviced and grows. However functionality at this point may not be 100% as we had difficulty downloading data at this time (April 23, 2013). This data is not 100% complete for all species; depending on focal

species may or may not be useful. Data may be incomplete at this time. For example we searched for Ursus americanus which is common in some portions of NC and SC and came up with 0 locations.

10. Rank: 6 (Score 10/15)

Energy Development:

CEC Powerplant Locations:

1. Current web location: http://www.cec.org/Page.asp?PageID=924&ContentID=25146&AA_SiteLanguageID=1
2. Coverage of Appalachian LCC: 100%
3. Data type: Vector/Point
4. Grain: N/A
5. Spatial reference of downloads: Sphere_ARC_INFO_Lambert_Azimuthal_Equal_Area; Linear Units = meters
6. Quality of data: Unknown
7. Documentation: Good
8. Quotes: "The North American Power Plants map displays over 3,000 power-generating facilities using fossil fuel sources in 2005. These facilities are classified based on the primary source of fuel used to generate electricity: oil, natural gas, coal, or other fuels. Each map illustrates the emissions of a specific pollutant from the facilities (SO_2, NO_X, Hg, $PM_{2.5}$, PM_{10}, and CO_2). These maps were developed for the Commission for Environmental Cooperation's 2011 publication, *North American Power Plant Air Emissions*."
9. Notes: Power plant locations may be useful for conservation planning in that they indicate carbon sources, and other sources of atmospheric pollutants. Thus they may be used in threat mapping; on the other hand we know of no specific application to do so, thus far.
10. **Rank: 2 (Score 14/15)**

Table 1: Summary of evaluated datasets, ranked by the cumulative score. (* indicate the additional datasets that were evaluated).

Data name	File Type	Coverage of LCC	Resolution (Grain)	Quality of Data	Quality of Documentation	Relevance to App LCC	Total Score	Remarks
Score		(1-3)	(1-3)	(1-3)	(1-3)	(1-3)	(1-15)	
Digital Elevation Model (NED)	Raster	3	3	3	3	3	15	
Hydrologic Units	Vector	3	3	3	3	3	15	
National Hydrography Dataset	Vector	3	3	3	3	3	15	
Housing Density	Raster	3	3	3	3	3	15	
USGS Protected Areas Database	Vector	3	3	3	3	3	15	
National Land Cover Dataset (NLCD)	Raster	3	3	2	3	3	14	
Phenology (NDVI)	Raster	3	3	3	3	2	14	
USGS GAP Species Data	Raster	3	3	2	3	3	14	May have value when focal species selected
Wetland Inventory (NWI)	Vector	2	3	3	3	3	14	
Impervious Surface	Raster	3	3	2	3	3	14	
National Climatic Data	Varies	3	3	3	2	3	14	
Landfire	Raster	3	3	2	3	3	14	
CBI Protected Area Database	Vector	3	3	3	2	3	14	
National Conservation Easement	Vector	3	3	2	3	3	14	
US Census	Excel	3	3	3	2	3	14	
CEC Powerplant Locations*	Vector/Point	3	3	3	3	2	14	
Nature Serve Species Explorer	Vector/Point	3	2	2	3	3	13	May have value when focal species selected
Floodplains	Vector	3	3	3	2	2	13	
Terrestrial Ecological Systems (Habitat Proxy)	Raster	3	3	1	2	3	12	
Climate Wizard	Raster	3	2	2	3	2	12	
USGS Digital Elevation Model Data *	Raster	2	3	3	2	2	12	
Human Footprint/Last of the Wild	Raster	3	1	1	3	3	11	
GAP Landcover*	Raster	3	3	1	2	2	11	
Terrestrial Habitat Maps	Raster	1	3	2	1	3	10	Not full coverage -- Northeast only
GBIF	Vector/Point	2	2	2	2	2	10	May have value when focal species selected
Index of Naturalness	Raster	1	2	1	3	3	10	
Existing Oil & Gas	Vector	2	2	2	2	2	10	
WDPA	Vector	2	2	2	3	1	10	
TNC Ecoregional Conservation	Vector	1	2	3	2	2	10	
GMTED2010*	Raster	3	2	2	2	1	10	
Human Influence/Last of the Wild*	Raster	3	1	1	3	2	10	
Biodiversity Information (BISON)*	Vector/Point	2	2	1	2	3	10	May have value when focal species selected
Aster Satellite (DEM)	Raster	3	2	1	2	1	9	
Climate Vulnerability Index	Excel	1	1	1	3	3	9	Requires choosing a taxonomic group
CEC Index of Human Influence*	Raster	3	1	1	3	1	9	
LIDAR	Raster	1	2	2	1	1	7	Not full coverage
Northeast Climate Impacts	Varies	1	1	1	3	1	7	Not full coverage -- Northeast only
Two Countries, One Forest	Vector	1	1	1	3	1	7	
Natural Disasters (Multi-Hazard)	Raster	2	1	1	1	1	6	Very coarse global raster data

TASK 2: APPALACHAIN LANDSCAPE CONSERVATION COOPERATIVE GIS DATASETS

Task 2 - Assemble GIS data (shapefiles, rasters) resulting from (1E) and compile a geodatabase of the top-ranked datasets and metadata. Deliverable: Data will be packaged and delivered to AppLCC GIS staff in two formats A) individual shapefiles and rasters and B) compiled geodatabase.

Summary of Task 2 – The GIS data has been assembled and compiled into a geodatabase. 10 folders containing different datasets have been clipped to the AppLCC boundary with specifications of each dataset in the following description. There are 32 feature layers in the file geodatabase (15 raster and 17 vector), with a table associating the file names in the folders with the layers in the geodatabase.

Folders

The Appalachain Landscape Conservation Cooperative Datasets are located in a folder named "AppLCC_USGS_ConicEA_Projection" and each theme has its own folder. Most folders have a layer file for displaying the raster datasets, however if there is more than one raster in the folder, it may be necessary to point the layer to the desired raster each time it is loaded. Also there are a few layer files and one geodataset (NWI) that will only work in ArcGIS 10.x. The layer file with the same name as the raster dataset should work in both ArcGIS 9.x and 10.x. In each case we attempted to download the latest (Spring 2013) revision of the dataset that completely covered the Appalachain LCC. There are nineteen parent folders as follows:

Folder One (App_LCC_project boundary): This folder has two vector (polygon) files that define boundaries:

1. The first is the Appalachain Landscape Conservation Cooperative (AppLCC) boundary downloaded in March of 2013 and reprojected to Albers Conic Equal Area, NAD83 with linear units in meters.

2. The second is a 175 kilometer buffer polygon of the first boundary. This is indended to include all of the HUC8 watersheds that make input to or have output from the Appalachain Landscape Conservation Cooperative (AppLCC) area. It is used to clip / extract data to avoid cutting off the data at the defined AppLCC boundary. This is useful when calculating surfaces involving drainage or hydrological units.

3. Occasionally an alternative method is used to select vector polygons that are self contained or political units with data pertaining to their areas. For example counties with data for county units or watersheds with data for their areas. In these cases I selected the polygon units that intersected by the actual AppLCC boundary area and exported those whole polygons with their data to a new layer.

Folder Two (AppLCC_2006NLCD): This folder contains the 2006 national land cover dataset downloaded from http://www.mrlc.gov/nlcd06_data.php and extracted using the AppLCC buffer boundry. This extract has the land cover name and is projected to Albers Conic Equal Area, NAD83. This raster dataset has been reformatted to the Imagine (.img) file format. In this folder there is a text file containing the NLCD metadata for the original downloaded data.

Folder Three (AppLcc_Avg_AnnualPrecipitation_1951_2006): This folder contains a raster of historical precipitation data for a 50 period produced as output from the Climate Wizard model (http://www.climatewizard.org/). This precipitation data is for the period 1951 to 2006 and has been extracted for the AppLCC buffer boundary. It is in the same projection as the other layers in this dataset.

Folder Four (AppLCC_Avg_AnnualTemperature_1951_2006): This folder contains a raster of historical temperature data for a 50 period produced as output from the Climate Wizard model (http://www.climatewizard.org/). This temperature data is for the period 1951 to 2006 and has been extracted for the AppLCC buffer boundary. It is in the same projection as the other layers in this dataset.

Folder Five (AppLCC_hfp2): This folder contains the raster dataset for the human footprint (Last of the Wild, version 2, 2005) downloaded from http://sedac.ciesin.columbia.edu/data/collection/wildareas-v2/sets/browse. This raster dataset has also been extracted to the AppLCC buffer boundry. In this raster's attributes the cell values indicate the extent of human impact with 0 being the least and 100 being the greatest (on a normalized scale). In this dataset there is not text data, only the cell values are important. This dataset is also reprojected to Albers Conic Equal Area, NAD83 and is in the .img file format. In this folder there is also a text file containing the metadata for the original downloaded file.

Folder Six (AppLCC_hii): This is the human influence raster dataset from the same source (Also from http://sedac.ciesin.columbia.edu/data/collection/wildareas-v2/sets/browse) as the human footprint. Basically the human influence is the non-normalized version of the human footprint with cell values from 0 to 64. In this dataset there is not text data, only the cell values are important. This dataset has also been extracted to the AppLCC buffer boundary and all other aspects of it are the same as the human footprint in folder three. In this folder there is also a text file containing the metadata for the original downloaded file.

Folder Seven (AppLCC_HUC8s): This contains a vector (polygon) dataset that has the USGS hydrologic Unit Code level 8 watersheds that influence or are influenced by the core AppLCC area. The base dataset for these was downloaded for a USGS ftp site: ftp://ftp.ftw.nrcs.usda.gov/wbd/ and then the watersheds in this dataset were selected by their intersection with any part of the AppLCC area. This vector dataset is in Albers Conic Equal Area, NAD83 projection also, and is a subset of the USGS national hydrology dataset. In this dataset the metadata is in ESRI format and can be displayed via ArcCatalog.

Folder Eight (AppLCC_Impervious_Surface): This folder contains a raster dataset that has the percent impervious as the value for each cell. This dataset is extracted from one of the layers created by the national land cover process (from http://www.mrlc.gov/nlcd06_data.php). It is in the same projection as the other layers. In this folder there is also a text file containing the NLCD impervious surface metadata for the original downloaded file.

Folder Nine (AppLCC_NatureServe_EcologicSyst): Natureserve updated their ecologic systems data in the Spring of 2013 and this updated dataset was downloaded in June 2013 from https://tranxfer.natureserve.org/download/Longterm/Ecosystem_National_Map/national_map and then extracted for the AppLCC buffer area. This folder contains that data in the common Albers projection. The attribute data with this dataset contains many more vegetation descriptions than the national land cover data alone. These vegetative descriptions might be translated into habitats for various species of interest by conservation planners. In this dataset

the boundaries and attributes are in the ESRI format metadata, but the description information is not.

Folder Ten (AppLCC_NDVI_2011): The national NDVI dataset is updated annually and it contains multiple datasets in raster format pertaining to seasonal phenology. At the time this data as downloaded the data for 2012 was not posted, so this folder contains 3 raster datasets with their layer files that pertain to the beginning, end, and maximum flowering in the Eastern U.S. Each folder has both the Eastern U.S. raster and the one extracted for the AppLCC buffer area. Each has only one layer file which can be used to point of either of the raster datasets in it. **Metadata**, providing processing details, are bundled with the image data. This data is intended as sample data because the information changes each year. There are three sample data folders in this folder:

1. NDVI_Begin_East_USA – A raster layer of the NDVI at the beginning of the 2011 season for the eastern half of the US.
2. NDVI_End_East_USA – A raster layer of the NDVI at the end of 2011 season for the eastern half of the US.
3. NDVI_Max_East_USA – A raster layer of the NDVI at the maximum point of the season for the eastern US in 2011.

Folder Eleven (AppLCC_NHD_MediumRes): This folder contains vector (polyline) data that is the flowlines from the USGS national hydrologic dataset at medium resolution. Theses have been clipped to the AppLCC buffer boundary. The attribute data identifies each line segment, its stream name, flow direction and so on. The projection is the same as the others layers. In this dataset the metadata is in ESRI format and can be displayed via ArcCatalog.

Folder Twelve (AppLCC_Pop_Housing_2010): This folder contains vector data (polygons) of the counties intersected by the base AppLCC boundary. Each county has the 2010 population count and housing count Census Bureau data added to its attribute table. These values were derived by summing the census blocks for each county that were posted in the Census Bureau's data for 2010, thus each record is for a whole county. The projection of this data is the same as the previous layers. This folder also contains the same data intersected with a U.S. County dataset, so the state and county names show in the attribute records. In this dataset the boundaries and attributes are in the ESRI format metadata, but the description information is not because the data was in separate tables, not the county layer shapefile.

Folder Thirteen (AppLCC_Poverty2011): This folder contains vector data (polygons) of the counties intersected by the base AppLCC boundary. In addition to the County name, State, and FIPS codes, this layer has Estimated poverty and percent for each county. Each record also has an estimated median household income for 2011. This data was downloaded from the Census Bureau's SAIP site as a table and permanently joined to the county shapefile using the FIPS code in the two datasets. In this dataset the boundaries and attributes are in the ESRI format metadata, but the description information is not because the data was in separate tables, not the county layer shapefile.

Folder Fourteen (AppLCC_TNC_Habitats): This folder contains the Nature Conservancy's habitat classification data for the Northeastern U.S (downloaded from http://conserveonline.org/workspaces/ecs/napaj/nap/). It does not cover the entire AppLCC area, but uses a technique that might be of interest and could be extended to cover the whole AppLCC area. These habitats could then be used to examine the species of interest for conservation planning. In this dataset the boundaries and attributes are in the ESRI format metadata, but the description information is not.

Folder Fifteen (AppLCC_USFWS_NWI): This layer contains the U.S. Fish and Wildlife Service's national wetlands inventory dataset (downloaded from http://www.fws.gov/wetlands/Data/State-Downloads.html) and then clipped to the AppLCC buffer boundary. Almost all of the AppLCC area has been processed for the national wetlands inventory. This data maps and classifies the wetlands in the area by 7.5 minute quadrangle. The data has been reprojected to match the other layers in this dataset. The metadata is in ESRI format and can be reviewed in ArcCatalog.

Folder Sixteen (AppLCC_USGS_NED): This dataset (http://ned.usgs.gov/) contains 30 meter square cells with the elevation of the surface for the entire AppLCC buffer area. This layer is in the same projection as the other layers. This data can be used to calculate contours, and a number of surface drainage layers.

Folder Seventeen (AppLCC_USGS_PAD_US): This is the USGS version of the protected area data (http://gapanalysis.usgs.gov/padus/data/download/). It contains both the public and privately owned protected areas for which the data is publicly available. It also contains codes to indicate the level of protection given to each parcel according to their management. These levels are indicated by both GAP category and IUCN codes. The Metadata is in ESRI format and can be viewed in ArcCatalog.

Folder Eighteen (GAP_Species_Info): In this folder we have selected some of the potential species for selection (http://gapanalysis.usgs.gov/species/data/download/) as indicatiors and included county maps of their range with any other information that was available. Most were found in existing GAP datasets and those missing were mapped (by county) from their graphic maps by registering them to county datasets. All are in the same projection as the other layers. In this folder there are six species folders:

1. Alleg_woodrat:
2. Amer_Blackbear:
3. AmericanBlackDuck:
4. GAP_Amer_Woodcock:
5. Gap_longtailed_salamander:
6. Gap_Cerulean_warbler:
7. Non-GAP_Salamanders:

Each contains range and other information available through the GAP program. The Non-GAP folder contains range layers for two salamanders of interest that were not found in the GAP species list.

Folder Nineteen (LandfireDataAccess): This folder contains the Landfire dataset (http://landfire.cr.usgs.gov/viewer/viewer.html) extracted to the AppLCC buffer boundary. This data is in the same projection as the other layers. It was downloaded from the Landfire site in six blocks and reassembled with the Landfire Data Access Tool for ArcGIS 9.3. Then it was extracted for the buffered AppLCC area with the attribute data intact. The Landfire layers in this folder are for the vegetation. There are other layers with information about vegetative heights or fire fuels, but the vegetation was thought to be most useful. There are two folders with landfire vegetation data:

1. Landfire vegetation type:
2. Landfire vegetation cover:

File Geodatabase

This geodatabase will only work in ArcGIS 10.x. In the file geodatabase there are 32 featurelayers (15 raster and 17 vector). Since there are no folders to make clear what each represents, the layer names have been changed to make clear what each featurelayer represents. The following is a list that shows the equivalent names:

File names in folders	File names in File Geodatabase
AlbersCEA_meters_NAD83.shp	AppLCC_Boundary
LCC_Buf_bndry.shp	AppLCC_buffered_boundary
appnlcd_buffclip2.ige	AppLCC _National_Landcover
aplcc_precip	AppLCC _average_annual_precipatation_1951_2006
aplcc_temp	AppLCC _average_annual_temperature_1951_2006
AppLCC_hfp2_USGS_Albers.img	AppLCC_Human_Footprint
AppLCC_hii.img	AppLCC_Human_Influence
AppLCC_HUC8_USGS_Albers.shp	AppLCC_HUC8
nlcd2006_impervious_5-4-11F.ige	AppLCC _nlcd2006_impervious-5_4_11F
ap_ns_ecolsy2	AppLCC_NatureServe_EcologicalSys
lcndvibegin11	AppLCC_ndvi_begin2011
lcndvi_end11	AppLCC_ndvi_end2011
lcndvi_max11	AppLCC_ndvi_max2011
AppLCC_NHD_Flowlines_Med_ACEA	AppLCC_NHD_Flowlines_Medium_Res
AppLCC_Pop_Hse_2010_Cnty_Intersect	AppLCC_Population_Housing_2010_Counties
AppLCC_Poverty_2011.shp	AppLCC_Poverty_2011
AppLCC_TNC_Habitats.ige	AppLCC_TNC_Northeast_Habitats
AppLCC_NWI.gdb	AppLCC_NWI
AppLCC_ned_30.ige	AppLCC_NED_30
AppLCC_ned_int.ige	AppLCC_NED_Int
AppLCC_PADUS_clip2.shp	AppLCC_PADUS_clip2
aplcvegtyp	AppLCC_Landfire_Vegetative_type
aplcvegcover	AppLCC_Landfire_Vegetative_cover
AppLCC_Woodrat_County.shp	AppLCC_Woodrat_Counties
AppLCC_BlackBear_County.shp	AppLCC_Blackbear_Counties
Blackducks_Cnty_withData.shp	AppLCC _Blackducks_Counties
AmerWoodcock_Cnty_withData.shp	AppLCC _American_Woodcock_Counties
AppLCC_LtSalamander_County.shp	AppLCC_LongtailedSalamander_Counties
AppLCC_Warbler_County.shp	AppLCC_Warbler_Counties
AppLCC_SugarMaple.shp	AppLCC_SugarMaple_Counties
Eastern_Hellbender_counties.shp	AppLCC _Eastern_Hellbender_Counties
GreeSalamander_counties2.shp	AppLCC _GreenSalamander_Counties

The file geodatabase folder also contains 15 layer files with names equivalent to the rasters in the geodatabase. These layer files will hopefully give some meaning to the display of each raster dataset. There are no layer files for the vector datasets and it is not necessary to use the layer files even for the rasters, because all datasets can be displayed directly from the file geodatabase. However, most raster datasets will display in shades of gray by default. Layer files do not alter the data in the attribute tables.

All of these featurelayers, except one, have attribute tables with the associated values for each feature (record). Raster datasets have cell values plus other information and vector data has numerous fields of data associated with each line, point, or polygon feature. The one exception is the NED_30 raster dataset which is a continuous or floating point raster dataset, and has no value attribute table. The cell values exist if you query each cell, but there is no corresponding table. To assist in using these data, I calculated an integer version of this national elevation data for the Appalachian LCC area. This "int" version has the floating point values for each cell truncated and retains only the integer of those values in an attribute table. Both versions have been included in the file geodatabase.

TASK 3: APPALACHAIN LANDSCAPE CONSERVATION COOPERATIVE GIS DATASETS

Task 3 - Based on (Task #2) define what conservation planning purposes can be met with available, quality data, using available conservation planning software tools (Table 2). Deliverable: A document containing an annotated list of conservation planning tools, their functions, and relevance to AppLCC conservation planning goals.

Summary of Task 3 – The number of conservation planning tools and approaches is a growing and dynamic field of research, and it is nearly impossible to review all available tools. Here, we present description and evaluation of 21 conservation planning tools grouped according to their function. While this list and review is not exhaustive, we selected tools that were published, accessible and could be readily applied to any LCC.

List of conservation planning tools, their functions, and relevance to AppLCC conservation planning goals

The number of conservation planning tools and approaches is a growing and dynamic field of research. Here, we present description and evaluation of 21 conservation planning tools. To reduce the complexity of the conservation planning tools we decided to take a functional-grouping approach. These six groups are: reserve planning, habitat connectivity, species distribution modeling and viability, planning process integration, threats and climate change. To do the review, we used our own knowledge of conservation planning software and approaches, surveyed the literature for references to published programs, and searched the internet for emerging programs. We have condensed this information into a table (Table 2) and used it as a springboard for further exploration and discussion.

In our discussion we first give an overview of conservation planning tools in general and explore how they work and how they don't work. Second, we discuss the workings of representative program from each group with details about what they do including their working environment, inputs, and outputs. In addition we discuss how they might be used to assist decision making in the Appalachian LCC project area. Some of these tools are coarse filter approaches (based on ecological integrity), and some are fine filter approaches (species based). Based on our experience with the tools, we have provided recommendations about its applicability to the AppLCC.

The ultimate purpose of our review is to list and describe existing programs that might be useful at different levels and/or at different stages of conservation planning in the Appalachian LCC region. Making a decision about which approach to use may require additional comparisons in which new approaches (e.g., LCAD) are evaluated in the App LCC along with existing and previous approaches.

Table 2: Overview of conservation planning tools.
Most are software; four are data models representing scenarios that are used in conservation planning.

Software purpose	**Software name**	**Computing environment**	**Programming language**	**Difficulty** (1 = easy, 5 = lots of time investment)	**Data requirements** (1 = standard inputs, 5 = specialized)	**Quality and availability of documentation** (1 = very accessible, 5 = technical language only)	**Website for further information**
Reserve selection	Marxan	Zonae Cogito		5	2	3	http://www.uq.edu.au/marxan/
	Marxan with zones	Zonae Cogito		5	3	3	http://www.uq.edu.au/marxan/
	Sites	ArcView		5			http://www.biogeog.ucsb.edu/projects/tnc/toolbox.html
	Zonation	Stand alone	Compiled	5			http://www.helsinki.fi/bioscience/consplan/software/Zonation/index.html
Habitat connectivity	Corridor Designer	ArcGIS 10	Python	4	2	2	http://corridordesign.org/
	Circuitscape	ArcGIS	Python	5	2	4	http://www.circuitscape.org/Circuitscape/Welcome.html

	Linkage mapper	ArcGIS	Python	5		5	http://code.google.com/p/linkage-mapper/
	Unicor	ArcGIS	Python	5		5	None found
	FunConn	ArcGIS 9.1	Python	4	2	5	http://www.nrel.colostate.edu/projects/starmap/funconn_index.htm
	Wild Lifelines	ArcGIS 10		3	1	3	http://www.twp.org/what-we-do/scientific-approach/wild-lifelines
Species Distribution Modeling and Viability	Expert Opinion	ArcGIS 10	N/A	5	1	1	
	Maxent		JAVA	3	3	4	http://www.cs.princeton.edu/~schapire/maxent/
	Presence			5	3	4	http://www.mbr-pwrc.usgs.gov/software/presence.html

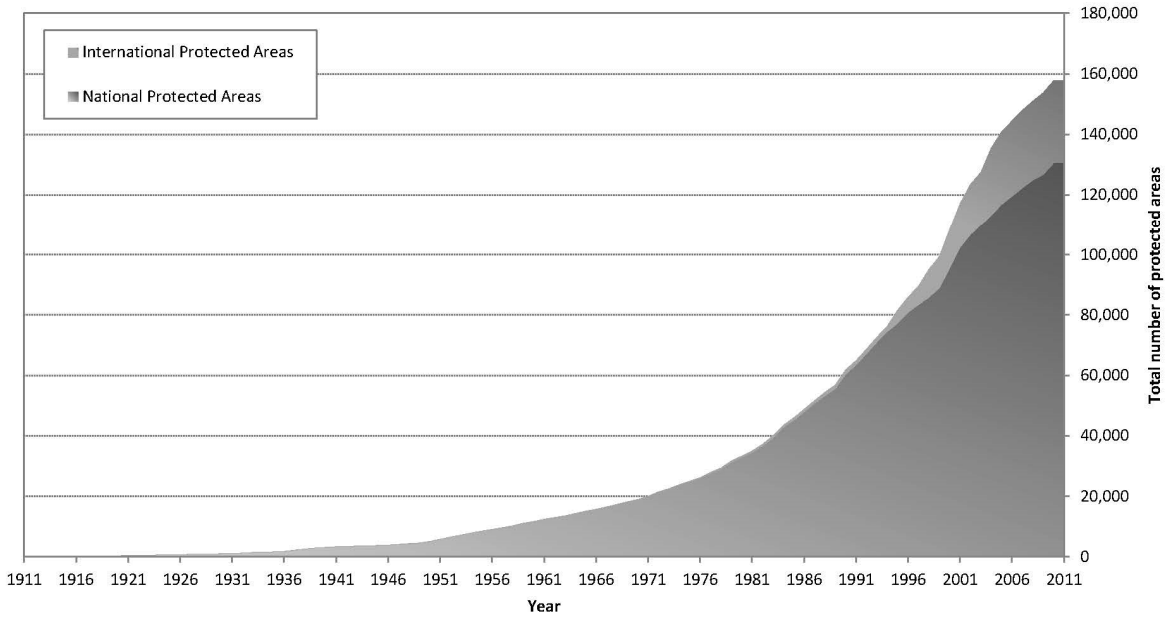
	RAMAS GIS (viability)	Stand alone	Compiled	5	5	3	http://www.ramas.com/index.php?option=com_k2&view=itemlist&layout=category&task=category&id=41&Itemid=80&lang=en#gis
Planning process integration	Natureserve Vista	ArcGIS 10	Python	2	2	2	http://www.natureserve.org/prodServices/vista/overview.jsp
	Miradi	Stand alone	Compiled	2			https://miradi.org/
Threats	Community Viz (Local Buildout)	ArcGIS 10		3		2	http://placeways.com/communityviz/
	Global Human Footprint	Raster dataset for ArcGIS, web interface	NA	3	1	3	http://sedac.ciesin.columbia.edu/wildareas/
	Future Human Footprint scenarios	Raster dataset for ArcGIS, web interface	NA	3	1	3	http://www.2c1forest.org/

	Future housing and impervious surface scenarios	Raster dataset for ArcGIS	NA	5	1	5	http://www.pnas.org/content/107/49/20887.full
Climate	Climate forecasts, historical data	Raster datasets, web interface	NA	3	1	3	http://www.climatewizard.org/

Reserve selection

One might well ask, are new reserves being established today? The answer would be most definitely yes; the World Database on Protected Areas shows a century of exponential growth in numbers of new protected areas globally (Figure 1) and the National Conservation Easement Database recently completed for the United States maps 80,756 easements (nearly 18 million acres) most established in the recent two decades (http://www.conservationeasement.us/).

Figure 1. Growth in number of internationally and nationally designated protected areas 1911-2011. Source: World Database on Protected Areas.



Source: IUCN and UNEP-WCMC (2012) The World Database on Protected Areas (WDPA): February 2012. Cambridge, UK: UNEP-WCMC.

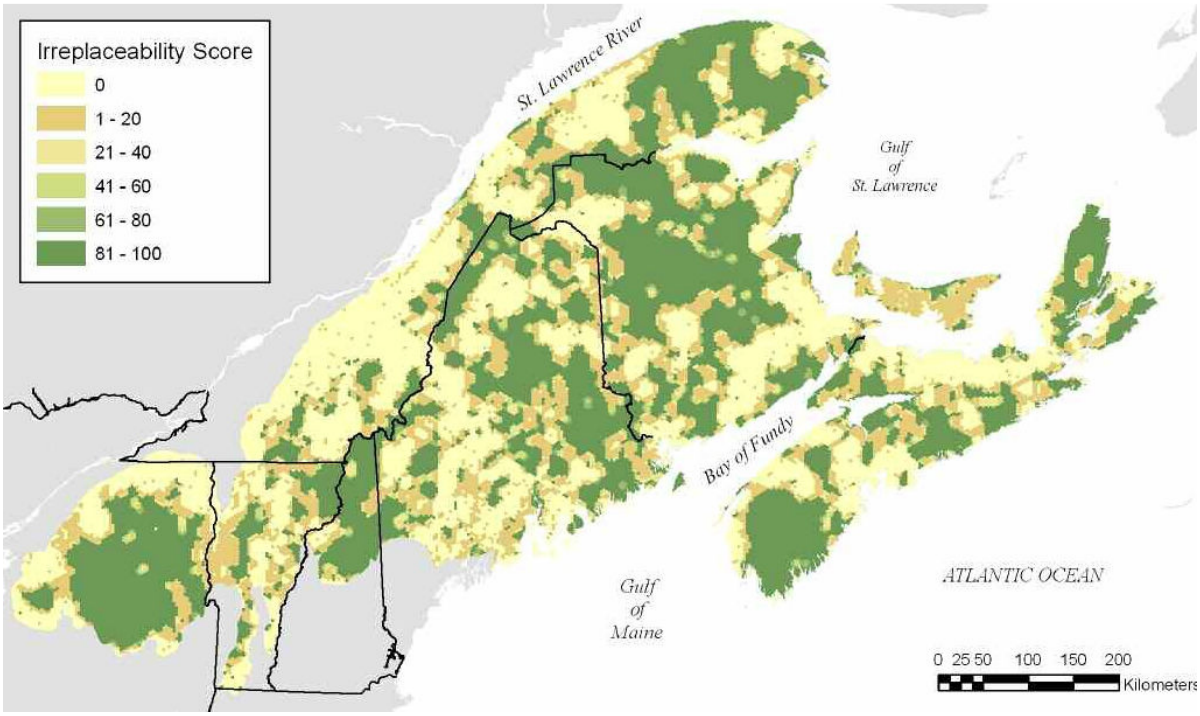
The selection of new reserves or areas to expand existing reserves relates to the concept of "habitat cores". Habitat cores may be described those areas of land and water extensive enough and containing enough habitat of specific types that viable populations may be maintained. This means that natural patterns of disturbance may act to maintain diversity. Also that the area is large enough to allow range shifts of species due to changes in ambient conditions and that the area is free of interference from roads and other human infrastructure (i.e. protected). An ideal system of reserves is thought to represent the regional pool of species and ecosystems, such that reserves are "irreplaceable" areas for maintenance of biodiversity (Noss et al. 2002, Trombulak 2010).

In practice, most existing reserves were put into place in something other than a systematic biological selection process (Margules and Pressey 2000). The emerging field of systematic conservation planning seeks to identify areas that are irreplaceable, categorize them as to levels of threat and vulnerability, and thus prioritize conservation action. Reserve selection is almost inseparable from other conservation

planning activities including habitat connectivity (linking cores), and climate resilience. Several major pieces of conservation planning software, however, treat these as separate processes having the same end goal of a resilient, representative, interconnected network to protect biodiversity.

Reserve selection algorithms frequently employ the concept of optimality, which means that the goal is to identify the most valuable areas for conservation using the least amount of area (least cost). The software involves setting numerous assumptions, usually arrived at through consultation with regional experts and other stakeholders. For example, conservation goals (how much?) are frequently set through an iterative process for conservation targets (what?). Reserve selection then implies that the goals and targets have already been decided. The following is an example of output from the program MARXAN (Trombulak et al. 2008):

Figure 2. One scenario for reserve selection in the Northern Appalachian ecoregion of the United States and Canada. Irreplaceability scores come from the reserve selection software MARXAN, and represent the number of solutions in which a particular area was selected by the software given input parameters (Trombulak et al. 2008).



Key Resources for Understanding Reserve Selection:

Books:

Moilanen, A., K. A. Wilson, and H. P. Possingham, editors. 2009. Spatial Conservation Prioritization: Quantitative Methods and Computational Tools. Oxford University Press.

Trombulak, S. C. and R. F. Baldwin, editors. 2010. Landscape-scale Conservation Planning. Springer-Verlag, New York.

Online:

MARXAN website http://www.uq.edu.au/marxan/

Selected Articles:

Margules, C. R. and R. L. Pressey. 2000. Systematic conservation planning. Nature **405**:243-253.

Noss, R., C. Carroll, K. Vance-Borland, and G. Wuerthner. 2002. A multicriteria assessment of the irreplaceability and vulnerability of sites in the Greater Yellowstone Ecosystem. Conservation Biology **16**:895-908.

Pressey, R. L., H. P. Possingham, and C. R. Margules. 1996. Optimality in reserve selection algorithms:when does it matter and how much? Biological Conservation **76**:259-267.

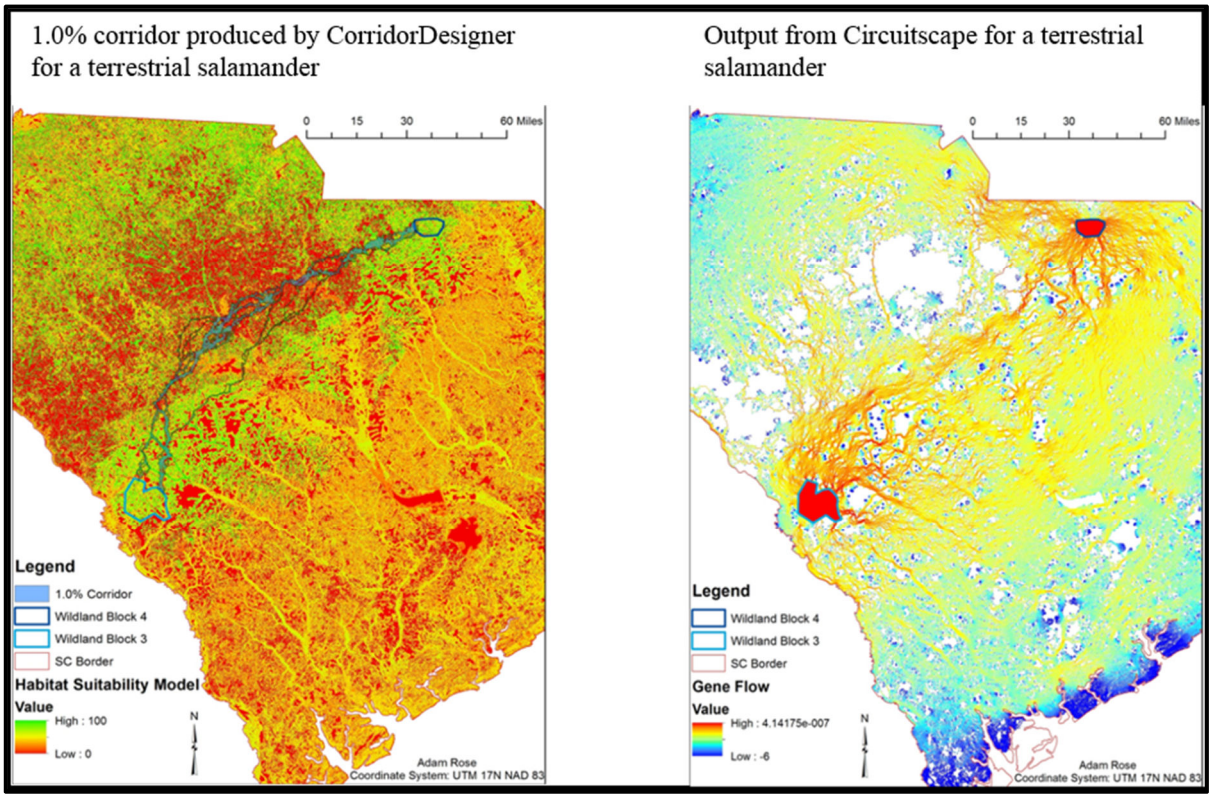
Habitat connectivity

Reserves that are not connected with natural land cover to other reserves become ecologically isolated and lose the diversity they were established to maintain (MacArthur and Wilson 1967, Newmark 1987). Island biogeographic processes act on "islands" on land as well as on sea, yet on land the processes of extinction, colonization, establishment, and adaptive radiation are influenced greatly by the variable quality of the surrounding "matrix" of land and water in which the reserve sits. Essentially, the more connected a reserve to others, the larger it acts and the more diversity it can support. Short of very large protected areas, protected areas connected through strategically located "corridors" or "linkages" will function better to protect biodiversity than those that are not(Noss 1983, Dobson et al. 1999).

In recent decades mapping corridors has become a sophisticated modeling process, with alternative choices of location. First, the basic concept of a discrete area called a "corridor" needs to be critically examined, and we need to ask whether it is biologically realistic to implement discrete polygons that are "highways" for focal organisms (Beier and Noss 1998, McRae et al. 2008, Beier et al. 2011). In some cases discrete corridors or connective areas may be desired. For example, if administrators of two reserves want to map passages for wildlife to move between their areas by creating road overpasses or underpasses, or removing other barriers. Then it would become desirable to identify and map discrete habitat areas or specific pinch points where passage is allowed (Figure 3a). Models can help identify

important areas for connectivity, and where flow and resistance accumulate creating “pinch points” that, if removed might “unblock” movement (Figure 3b).

Figure 3. Output of two different modeling approaches for the same organism and landscape showing discrete corridors on the left, and a more diffuse flow of propagules with darker “pinch points” on the right. Also note the different pathways implied in each model even though the species, and input data are identical (A. Rose, P. Leonard, R. Baldwin unpublished data).



Land use planners would probably prefer to have more discrete polygon maps (Figure 3a) from which to make decisions, than a more diffuse output (Figure 3b) that could be more open to interpretation. Nonetheless, nature is highly variable and the more generalized approach (Figure 3b) may more accurately portray the many potential pathways. Therefore, land use planners should be open to both approaches and the potential for not just one, but multiple potential habitat corridors, for their landscape plans.

The growth in approaches to mapping habitat connectivity and pieces of software to do so matches the complexity of the problem. The website “Corridor Design” not only offers its own software (CorridorDesigner), but provides background on habitat connectivity as well as links to numerous other sources of information and software (http://www.corridordesign.org/). Likewise there are numerous scientific publications e.g., (Urban and Keitt 2001, Carroll 2006, Compton et al. 2007, Beier et al. 2008, Beier et al. 2011) and several recent books (Crooks and Sanjayan 2006, Hilty et al. 2006).

All pieces of connectivity software use an input layer that represents landscape resistance. Resistance is the degree that any kind of land cover presents resistance to movement by organisms. Resistance is sometimes scaled to individual species or taxa based on known habitat requirements; this more often is the approach in very localized habitat connectivity mapping projects (e.g., the example above for corridors between two known patches), but sometimes is employed regionally for species with well-known movement parameters. More often however there is the attempt to create generalized resistance surfaces that might work for groups of organisms; such resistance layers are often derived from mapped indexes of land cover transformation by humans, and naturalness (see below).

Changing climate has spurred on research on how to connect natural areas for predicted range shifts. Given the difficulty in predicting current species distributions, that is compounded when trying to predict future species distributions by the coarse grain size and relatively great uncertainty of future climate models, habitat connectivity models that incorporate climate change have utilized a coarse filter approach (see below). In such approaches identifying linkages/corridors incorporating similar land forms (i.e., "land facets") selected from the underlying heterogeneity of landscapes is assumed to provide for smooth range shifts by species adapted for those conditions (Beier and Brost 2010, Nuñez 2011).

Key Resources for Understanding Habitat Connectivity:

Books:

Crooks, K. R. and M. Sanjayan, editors. 2006. Connectivity Conservation. Cambridge University Press, Cambridge, U.K.

Hilty, J. A., B. Z. Lidicker, and A. M. Merenlender, editors. 2006. Corridor Ecology: the Science and Practice of Linking Landscapes for Biodiversity Conservation. Island Press, Washington D.C.

Online:

Corridor Design http://www.corridordesign.org/

Circuitscape http://www.circuitscape.org/Circuitscape/Welcome.html

Selected Articles:

Beier, P., W. D. Spencer, R. F. Baldwin, and B. H. McRae. 2011. Toward best practices for developing regional connectivity maps. Conservation Biology **25**:879-892.

Carroll, C., B. H. McRae, and A. Brookes. 2011. Use of linkage mapping and centrality analysis across habitat gradients to conserve connectivity of gray wolf populations in Western North America. Conservation Biology **26**:78-87.

Theobald, D. M., S. E. Reed, K. Fields, and M. E. Soule. 2012. Connecting natural landscapes using a landscape permeability model to prioritize conservation activities in the United States. Conservation Letters **2012**:1-11.

Species Distributions and Viability

Accurate species distributions are one of the most fundamental and difficult to obtain sources of information, for conservation planning. Yet, if they exist, reliable species distribution models (SDMs) can form the basis of irreplaceability analyses that are integral to the selection of resilient systems of reserves (Trombulak 2010). Difficulties in producing accurate SDMs include sparse point locations for known locations, coarse environmental data, lack of information on confirmed absences, land use changes, and climate (Scott 2002, Mackenzie et al. 2006, Franklin 2009). Conservation planning has attempted to circumvent some of these problems by using "coarse-filter" approaches that assume relationships between underlying environmental variability and species diversity (Hunter 1991, Anderson and Ferree 2010).

Historically, SDMS were species range maps produced by experts examining field collections and conditions in which specimens were collected (e.g., habitat, elevation), and drawing potential range boundaries based on an extrapolation of those conditions (e.g., maps found in field guides). The current way of doing this is not very different, yet involves a number of approaches using mapping software. Maps of species distributions are products of a modeling process in which known locations are used to develop predictive models based on mapped environmental variables. The goal is to predict where species might occur, based on known conditions at known locations where they do occur. Approaches vary as to the degree of expert opinion involved, number and distribution of known species locations, information on absences, and use of environmental data (Franklin 2009). All SDMs are recognized as incomplete as they will likely change not only as environments change, but as more data are available to parameterize the models.

Accurate maps of species distributions can be integral to conservation planning. For instance one goal of reserve selection is to represent regional species diversity in a set of reserves. Software like Marxan can use mapped species distributions as targets in the conservation scenarios. Endangered Species conservation is a particularly compelling case for accurate mapped species distributions.

Recently in conservation planning there has emerged the idea that the underlying diversity of land forms, elevation, and soils may be used as a surrogate for species distributions. Such "coarse filter" approaches may be particularly useful in two situations 1) at very large spatial extents, and 2) in times of rapid environmental change. Bioclimatic envelope modeling for species distributions helps to understand how change may influence specific biotic communities, and can be included in conservation plans, yetis subject to a great deal of uncertainty(Lawler et al. 2009, Seo et al. 2009). Coarse filter approaches recognize uncertainty and make as a goal overall conservation of diversity without as much regard to species or current assemblages.

For single species management (e.g., under the Endangered Species Act) the gold standard of prediction is accurate population viability models. Such models rely upon demographic data that is difficult, time consuming, and expensive to obtain. Nonetheless if demographic data can be obtained for habitat areas, maps can be produced for predicted population viability under alternative management/conservation scenarios(Akcakaya et al. 2004). For conservation planning it can be particularly powerful to understand the influence of habitat connectivity, reserve size and shape, and various management scenarios on long-term viability of populations. For example, the restoration of populations of large carnivores, which has

umbrella effects for other species, is a case where population viability modeling has helped to identify areas important for connectivity and core habitat (Carroll et al. 2003, Carroll 2006, 2007, Carroll et al. 2011). The Joint Venture partnerships utilize population-habitat-area relationships in their conservation plans (e.g., http://www.chjv.org/).

Key Resources for Understanding Species Distributions and Viability:

Books:

Akcakaya, H. R., M. Burgman, O. Kindvall, C. Wood, P. Sjogren-Gulve, J. S. Hatfield, and M. A. McCarthy, editors. 2004. Species Conservation and Management: Case Studies for RAMAS GIS. Oxford University Press, Oxford, U.K.

Franklin, J. 2009. Mapping Species Distributions: Spatial Inference and Prediction.Cambridge University Press, Cambridge, UK.

Online:

Maxent software for species habitat modeling http://www.cs.princeton.edu/~schapire/maxent/

AMNH Species distribution modeling courses and background information

http://biodiversityinformatics.amnh.org/index.php?section_id=82&content_id=140

Selected Articles:

Carroll, C., R. F. Noss, P. C. Paquet, and N. H. Schumaker. 2003. Use of population viability analysis and reserve selection algorithms in regional conservation plans. Ecological Applications **13**:1771-1789.

Elith, J., S. J. Phillips, T. Hastie, M. Dudik, Y. E. Chee, and C. J. Yates. 2011. A statistical explanation of MaxEnt for ecologists. Diversity and Distributions:43-57.

Threats (Buildouts and Naturalness)

Conservation planning anticipates threats to biodiversity and to prioritize conservation actions based on how vulnerable sites are to threats (Abbitt et al. 2000, Lawler et al. 2003, Theobald 2003). Generally speaking, threats are human activities that have a negative impact on conservation goals. Not all threats to biodiversity are anthropogenic, and not all anthropogenic activities are threats (some things people do enhance diversity)(Baldwin 2010). Conservation planning seeks to identify, understand, and map the distribution of activities that are known to threaten diversity and function of ecosystems. Such threats include: human population density, housing density, roads, road traffic, gas and oil development, some forestry and agricultural methods. Fire suppression, flood control, and other activities to control ecological process have also been considered threats (van Lear and Waldrop 1989, Rood et al. 2005, Noss et al. 2006).

Modeling land use change has been a productive area of conservation planning research. There is a large amount of evidence that of all the influences on biodiversity, land use change is the most proximate and severe threat, resulting in habitat degradation, loss, and fragmentation (Tilman et al. 1994, Vitousek et

al. 1997, Harding et al. 1998). The ability to develop predictive maps of land use change and loss of naturalness in the landscape has increased rapidly over the past decade, and they have been used prioritize landscapes for conservation action (Trombulak et al. 2008).

Key Resources for Understanding Mapping of Threats:

Books:

Turner, M. G., R. H. Gardner, and R. V. O'Neill. 2001. Landscape Ecology in Theory and Practice. Springer-Verlag, New York.

Online:

Stein, S. M., R. E. McRoberts, R. J. Alig, M. D. Nelson, D. M. Theobald, M. Eley, M. Dechter, and M. Carr. 2005. Forests on the edge: housing development on America's private forests. Gen. Tech. Rep. PNW-GTR-636, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.http://www.fs.fed.us/openspace/fote/

Landscape Change Program, USFS North Central Research Station http://ncrs.fs.fed.us/4153/deltaIMS/

Selected Articles:

Baldwin, R. F. and P. G. deMaynadier. 2009. Assessing threats to pool-breeding amphibian habitat in an urbanizing landscape. Biological Conservation **142**:1628-1638.

Sanderson, E. W., M. Jaiteh, M. A. Levy, K. H. Redford, A. V. Wannebo, and G. Woolmer. 2002. The human footprint and the last of the wild. Bioscience **52**:891-904.

Theobald, D. M. 2003. Targeting conservation action through assessment of protection and exurban threats. Conservation Biology **17**:1624-1637.

Climate

The scientific community has strongly communicated the need to understand human actions in the context of rapid, current and future climate change (Dale 1997, Walther et al. 2002, Thomas et al. 2004). Conservation planning seeks to integrate climate change, and as such is considered a "climate adaptation" strategy (Girvetz et al. 2009, Nuñez 2011). Large, interconnected areas of high naturalness are more likely to provide climate corridors to accommodate range shifts, than many, smaller, fragmented areas, and will likely also sequester carbon, mitigate effects of drought, flood, and storm events (Dale 1997, Vorosmarty et al. 2000, Hilty et al. 2012). While a great deal of uncertainty exists as to how many areas and ecosystems will be influenced by climate, climate change has changed the context of conservation planning.

Conservation planning that integrates climate change addresses the problem of interacting stressors and how they are likely to influence the resilience of systems, including the ability of species to shift their ranges given land use change and habitat fragmentation. During past climate change events species' ranges shifted; that is the history of the Earth (Davis et al. 1980). Under the situation we currently face,

habitat fragmentation due to roads, agriculture, and other land uses threatens the ability of species to shift their ranges (Heller and Zavaleta 2009). In response conservation planners have developed various approaches to develop "climate corridors" (Beier and Brost 2010, Nuñez 2011). Climate corridors attempt to "string together" landscape elements that will provide a smooth transition for populations that are migrating over time, in response to climate.

As mentioned earlier under "Species Distributions and Viability", a "coarse-filter" approach to conservation planning seeks to conserve enough area with enough underlying diversity of land forms, soils, and topographic features that would become the "arena" for future evolution. New communities will assemble over time as ambient conditions change. Modeling approaches represent the diversity of Ecological Land Units (ELUs), in addition to or instead of species ranges in conservation plans (Anderson et al. 2006, Anderson and Ferree 2010).

Key Resources for Climate and Conservation Planning:

Books:

Hilty, J. A., C. C. Chester, and M. S. Cross, editors. 2012. Climate and Conservation: Landscape and Seascape Science, Planning, and Action. Island Press, Washington D.C.

Online:

Climate Wizard http://www.climatewizard.org/

Climate and conservation http://www.conservation.org/learn/climate/Pages/climate_overview.aspx

Climate change and landscapes http://www.wcs.org/conservation-challenges/climate-change.aspx

Selected Articles:

Bierwagen, B. G., D. M. Theobald, C. R. Pyke, A. Choate, P. Groth, J. V. Thomas, and P. Morefield. 2010. National housing and impervious surface scenarios for integrated climate impact assessments. PNAS **107**:20887-20892.

Girvetz, E. H., C. Zganjar, G. T. Raber, E. P. Maurer, P. Kareiva, and J. J. Lawler. 2009. Applied climate-change analysis: The Climate Wizard Tool. PloS ONE **4**:e8320. doi:8310.1371/journal.pone.0008320.

Hannah, L., G. F. Midgley, T. Lovejoy, W. J. Bond, M. Bush, J. C. Lovett, D. Scott, and F. I. Woodward. 2002. Conservation of biodiversity in a changing climate. Conservation Biology **16**:264-268.

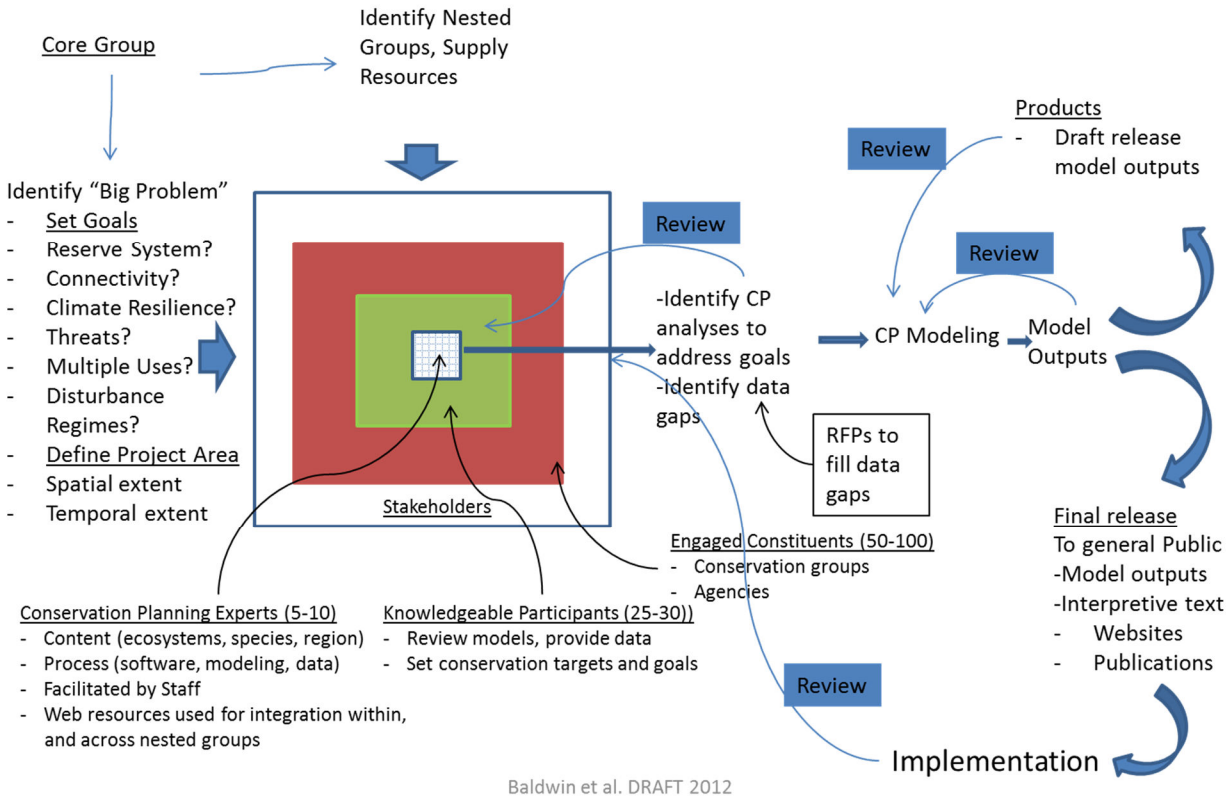
Integrative Planning

Conservation planning cannot succeed as an academic project alone; doing research and publishing papers is the basis for systematic conservation planning but most of the people involved with making plans work will not read those papers, and are more concerned with social context(Jacobson and Duff 1998). If those "stakeholders" are engaged in the conservation planning process from the beginning,

they will be more likely to understand and implement plans. For conservation planning, integration of people throughout the scientific planning process and including feedback loops from stakeholders after implementation is what distinguishes the field as something that is not a purely academic exercise.

The process of conservation planning explicitly integrates people throughout. Ideally this occurs in nested groups with those with more engagement and expertise closer to the modeling effort, and those more interested in application/implementation further removed yet fully informed (Beier et al. 2011). A core group of conservation planning experts conducts modeling exercises informed by larger groups. Feedback loops at every stage of the project are essential for insuring that the planning products make sense to stakeholders. Following implementation, monitoring for success and more review occurs (Figure 4).

Figure 4. Flow of steps and feedback loops involving nested groups of participants in a conservation planning process.



Expert input and review is often part of conservation planning processes (Noss et al. 2002, Trombulak et al. 2008, Beier et al. 2011). In the past expert review was kept more or less as a black box. There is evidence that "unpacking" the box of expert review and treating that input as qualitative data improves the conservation planning process by making decisions about modeling more transparent and thus more amenable to wider groups of stakeholders and implementation (Beazley et al. 2010).

Adaptive Approach to Conservation Planning

Conservation planning can be considered in an adaptive management context. Maps and models are subject to repeated review by nested groups of stakeholders. Feedback from monitoring and new data become integrated into new rounds of modeling; such an iterative process is thought to engage stakeholders and lead to longer term success (Margoluis and Salafsky 1998, Knight et al. 2009).

Because conservation planning involves multiple scales and thus levels of governance, attempts to model complex biological systems and often predict the future, relies upon experts for model input and review, it rapidly becomes a complex social process. The decisions may be science-driven, but the process of making decisions based on maps and models and other research implies an organizational structure that is managed. Specific measures of success are identified (e.g., population targets, areas conserved), and monitoring assesses to what degree goals are met.

Evaluation of Conservation Planning Software for use by the Appalachian LCC

Conservation software provides tools for support of specific situations (see Table 2). Many of these programs are written to assist with problems commonly encountered in planning conservation strategies and activities for an area. Some deal with specific facets of conservation issues, like habitat analysis, population assessment, or land use planning. These were written to deal with specific elements or targets in conservation planning and are considered to be modeling tools. Most are based on land cover and land use datasets with some attributes added to give more detail that might allow translating into habitat or ecosystem niches. The land class or interpreted data is often imported to the modeling software and then new attribute values (like weights) are added or calculated to make the program work. For example land cover is easily assigned habitat value (for any target species) if one knows its size and position both in the terrain and relative to other features on the surface of the earth. Most conservation software programs cannot be used in all situations to solve all conservation issues in a project area. Often a project will require using several programs as tools working independently, but used in combination. However, there are a few that are written or, have been adapted, to manage the whole conservation planning process while allowing incorporation of some of the others as tools.

This gives rise to the idea that these tools might need to be used in some particular order to plan regional or sub-regional conservation. For example reserve selection software cannot be used until the conservation goals and targets have been decided and connectivity requires that the larger reserves have been designated. Also, habitat interpretations only occur after target species have been decided. So, the first software to be considered for any area is the one that helps frame and give direction to the use of the others. In table 1 these programs are listed under “planning process integration” and for purposes of our discussion will include Miradi, NatureServe Vista, and CommunityViz. All three of these have been used separately to structure large conservation planning projects.

MIRADI

Description of the program: Miradi is based on the 'Open Standards for the Practice of Conservation' published in 2007 (Version 2; there is now a version 3, published in 2013). Miradi is one of the few holistic approaches to conservation planning that is generic enough to help organize and manage entire projects. CAP's Open Standards are a project management framework specifically tailored to be applied to a broad range of conservation projects. Because it is independent of sites and frames a process that is not tied to any one project, it can be used in any conservation planning project. Miradi programs this framework to standardize the management of any conservation project.

Miradi uses the following, loosely paraphrased (by me), steps found in the "Open Standards" framework:

1. Identify the conservation elements or targets that are important (**Identify elements**).
2. Assess the targets for location, quantity, quality, and threats (**Assess targets**).
3. Evaluate them against the project plan and objectives to set goals (**Identify Conflicts**).
4. Develop conservation strategies to best resolve conflicts and meet goals (**Set goals**).
5. Develop a plan of action to accomplish the conservation goals (**Plan actions**).
6. Provide some way to evaluate the success of the plan of action (**Monitor & Evaluate**).
7. Be prepared to repeat the process frequently to accommodate new changes or adjust for failures resulting from the original plan (**Adjust actions**).

Miradi's graphic user interface (GUI) looks like a cross between "TurboTax" and a graphic modeling tool and is fairly user friendly. It does not use GIS layer information directly, work in a GIS environment, or link to a GIS program. Because it implements the Open Standards framework, Miradi gives support to holistic planning, management, and monitoring of conservation projects, leaving the resolution of specific issues with specific elements to expert and stake holder opinion. It does not use other modeling tools directly, but allows them to be used as independent support of planning steps. Therefore like the Open Standards framework, Miradi is not a site specific program, however, the projects it is used to plan and manage are all site specific and all its steps require that the project area be decided before planning begins. Then each step can be decide by the stakeholder group with or without the support of other modeling software, however conservation planning models are specifically designed to support decision making actions like these.

Relevance to AppLCC: Miradi has built in helps (from the open conservation framework) that could be used to give structure to and support conservation planning at the overall Appalachian LCC level. It might also provide structure to planning projects for sub regions of the Appalachian LCC area. While direct inputs are all interactive with the program, land cover, terrain, and environmental can be used independently and in combination with other tools to support decision making in answering the direct inputs required by this program. These data layers are in our collection of datasets for the Appalachian LCC area.

VISTA

Description of the program: VISTA started as a support tool for land use planning, that would give due consideration to conservation elements of interest and help reconcile their needs with other land uses by identifying conflicts and offering alternatives. It is supported by NatureServe and its later versions are envisioned as a toolkit framework that can incorporate the other conservation planning programs as part of an adaptive management process. However, the toolkit envisioned is more like a confederation than a unified box of tools that support an entire conservation planning process in a single working environment. Even though some other conservation programs do not run in the same GIS environment, they are viewed as support tools with results that can feed VISTA's decision support process. For example, VISTA can create output to be used in MARXAN and can also import results from MARXAN to support suggested solution alternatives. Other conservation programs are incorporated into VISTA's adaptive management process as "Development Planning" tools, "Planning Process" tools, "Data and Modeling" tools, and "Conservation and Mitigation" tools. FromTable 1, VISTA would include 'Community VIZ' and 'Urban Sim' in the development planning category. 'Miradi' is listed as planning process; "Marxan", "Marxan with Zones, and "Zonation" are in the conservation and mitigation category and most other programs are in the data and modeling category. So after the conservation elements of importance have been decided, and after they have been assigned their levels of importance, prioritized and evaluated with the support of the appropriate tools, VISTA can help you identify conflicts in the landscape and by "out-sourcing" to optimization software (like MARXAN) help formulate policy to reconcile those conflicts with project goals. Monitoring and adjusting plans are added to make the adaptive process complete.

So, it's possible to envision VISTA as a toolkit to support MIRADI's open framework process, or to see MIRADI as a "Planning Process" tool to support VISTA's adaptive process. In either program the Appalachian LCC stakeholders with support from experts would have to decide targets, weights of targets, and cost among other values to input. NatureServe provides direct support for the VISTA program.

Relevance to AppLCC: Land cover is the main input dataset for VISTA. Land cover with interpretative factors of the different focal species and estimates of change in the land cover or land use. Other data is required, most as spatial data layers about the elements of interest chosen to represent the project area. These may include species distribution, required habitat, and other biological and ecological system layers. In addition to the conservation databases including element goals, you will need a vector or raster GIS layer of the project area that indicates different land uses as separate features which are identified in an associated database (or separate layers for each land use). These additional layer are not in our dataset collection, but can be derived from them using some of the other conservation planning programs.

CommunityViz

Description of the program: CommunityViz planning software is an extension for ArcGIS Desktop. As a GIS-based decision-support tool, it demonstrates the implications of different plans and choices. It supports scenario planning, sketch planning, 3-D visualization, suitability analysis, impact assessment, growth modeling and other techniques. While CommunityViz may be most suitable to localized planning, it has been used for state wide resource analysis and to get a vision of the future for a region under a "business as usual" assumption that gives planners an opportunity to target where change might do the most good.

Because it runs in a GIS environment, CommunityViz, unlike the other project programs, can incorporate numerous data layers that might include the entire infrastructure of a region. Also it has a number of built in tools to assist with viewing alternative scenarios. The alternatives can be based on the built in tools or on user built tools and equations. This makes it a powerful tool for getting a vision of impacts caused by planned changes or that result from natural changes, like climate change. In addition CommunityViz has the visualization tools to communicate the need for change or additional funding.

Relevance to AppLCC: The input datasets for CommunityViz include all of the datasets in our collection plus more with data about infrastructure like roads, transmission right of ways and anything else that occupies a significant area of the surface of the earth in the project area and might influence the focal species. This program might also use some of the data layers interpreted or developed by other conservation planning programs. In addition it requires inputs about planned changes, like development areas or energy farms that might impact the future of the project area.

The Appalachian LCC could use CommunityViz as a data repository for conservation resources and planning throughout the region. By doing this they would eventually build a complete set of infrastructure layers that could be used to both evaluate alternative scenarios in their region and provide data for other conservation software programs. While CommunityViz does not have the conservation planning structure of the other two programs discussed, it supports decision making within such planning environments.

Reserve Planning Software

Description of the program: Optimization programs, like MARXAN combined with a GIS environment (raster), or Zonation, with its prioritization of theme layers (large scale raster layers), attempt to minimize cost while maximizing biodiversity. Both of these programs were originally written using metallurgy equations to select the best blend of species diversity and cost. They have been expanded to handle multiple layers and zones to prioritize suggested solutions from best to worst (MARXAN with Zones; Zonation). They require expert input about species presence (based on sampling or best estimates) and reliable input data about cost. Cost in these models are not necessarily defined in terms of money, but may refer to tradeoffs in ecosystem services. They require that each of these data inputs and each land use be in separate raster layers for analysis. Zonation has been extended to allow input of point observation data and include analysis of connectivity and edge effects. Our list of optimization

programs is not complete, it has only the most well known ones at this time. There is a fairly new program called 'InVest' that is designed to use GIS (raster layers) to investigate ecosystem benefit tradeoffs. This program is designed to give insight to what is lost or gained by changes to one ecosystem element in terms of the other benefits produced by that same ecosystem. With additional learning and data, this program can also offer decision support for proposed actions and help explore alternatives toward achieving project goals.

Relevance to AppLCC: While these programs may be used abstractly to support decisions about levels of protection, zoning regulations, minimizing economic losses to stake holders, they were designed to select areas for the protection of target species. They support the selection of areas large enough to perpetuate target species and maintain biodiversity while minimizing losses (coarse filter) can be done with existing data, but no fine filter approach can be undertaken until target species have been selected and existing protected areas have been evaluated. The Appalachian LCC might use one of these software programs at the LCC region level or to evaluate alternatives at some sub regional level for a specific project with already defined goals.

The grid layers for defining the input data to these programs are usually developed in ArcGIS as raster data and then exported as ASCII grid datasets. There have to be ASCII grid data layers for land cover, cost, and zones, because these are required inputs. There may also be layers for ground sample data. Output data are graphs that can be interpreted into ASCII grid layers and imported back into ArcGIS to aide in the visualization process. Usually repeated runs are necessary to evaluate alternative scenarios. Of the required direct input data, only land cover is currently in our data collection for the Appalachian LCC.

Connectivity Programs

Description of the program: Here, we present evaluations of three connectivity programs: circuitscape, corridor designer, and linkage-mapper. There are several others in Table 2 that appear to be out of date and several new programs and tool kits that focus on more than just connectivity alone and may add some functionality to these three (CAT, CONEFOR SENSINODE, CONNECT, AND UNICOR).

There are several different approaches to the application of connectivity software. The first assumes there are large patches of suitable protected habitat for a given focal species and that the objective is to connect them. The second is a more general approach to analyzing the landscape to develop a sustainable network of habitat corridors with the objective of maintaining a focal species with greatest biodiversity. Third a combination of these two can be used to develop and maintain a diversity of habitat to sustain multiple focal species in a larger region.

Circuitscape

Circuitscape is a stand-alone python program that models ecological connectivity across landscape networks. Circuitscape was developed to apply (electric) circuit theory to problems in landscape ecology. For a given species it is supposed to identify connectors between habitat patches and give a

probability that animals (or other things) use that path or do not use it. It is also used to identify 'choke' points in the connecting network.

It uses maps of habitat in ASCII grid format that can be exported from raster maps used or created in ArcGIS. Maps that have been reclassified to reflect conductance or resistance based on the original habitat types. Also another map (optional) that defines regions or patches of very high quality habitat for grouping. The GUI prompts for additional information like whether or not the input grid contain resistance or conductance values.

In the Appalachian LCC area or a sub-area, once focal species and goals have been decided, Circuitscape might be useful as one of several tools to evaluate connectivity between protected areas. While Circuitscape identifies multiple pathways to connect larger patches, other software might be more useful in identifying robust networks and maintaining them.

Relevance to AppLCC: The input data sets for Circuitscape do not exists in their proper format for the Appalachian LCC area. They will have to be developed for each target species selected based on published information, expert opinion, and stakeholder input. This data usually comes from interpretation of the land cover data combined with surface location and other influences thought to be important. The land cover data and terrain data are in our datasets for the Appalachian LCC area.

Corridor designer

Description of the program: Corridor designer is a toolkit that works within the ArcGIS environment. Corridor designer classifies habitat suitability for a target species into population habitat, breeding habitat, or habitat patches. It then calculates best connecting routes, and identifies barriers and bottlenecks. It attempts to connect breeding habitat patches with each other, but can also connect habitat patches.

This program uses raster analysis and reclassification to identify suitable habitat for the target species. It then groups those areas into patches and evaluates their suitability for population, breeding, or just suitable habitat patches based on size and other parameters. It then attempts to classify links of usable habitat between the major habitat patches, giving first priority to linking breeding habitat patches. In calculating and evaluating possible linkages, bottlenecks and barriers might be identified.

Relevance to AppLCC: Initial inputs for Corridor designer are land cover, Dem, roads, and text files with reclassification information. Land cover and DEM datasets for the whole Appalachian LCC area are included in our collection of data. Road data changes frequently, and is not currently in our data collection. The reclassification tables are developed independently for each focal species/project area and do not exists at this time. Additional input data for Corridor Designer are developed by the program tool from these initial inputs.

Linkage-mapper

Description of the program: Linkage-mapper is a GIS tool designed to support regional wildlife habitat connectivity analyses. It consists of several Python scripts, packaged as an ArcGIS toolbox, that automate mapping of wildlife habitat corridors. It uses GIS maps of core habitat areas and resistances to identify and map linkages between core areas. Each cell in a resistance map is attributed with a value reflecting the energetic cost, difficulty, or mortality risk of moving across that cell. Resistance values are typically determined by cell characteristics, such as land cover or housing density, combined with species-specific landscape resistance models. As animals move away from specific core areas, cost-weighted distance analyses produce maps of total movement resistance accumulated.

Linkage-mapper tools can identify adjacent (neighboring) core areas and create maps of least-cost corridors between them. It then mosaics the individual corridors to create a single composite corridor map. The result shows the relative value of each grid cell in providing connectivity between core areas, allowing users to identify which routes encounter more or fewer features that facilitate or impede movement between core areas. Linkage Mapper also produces vector layers that can be queried for corridor statistics.

Relevance to AppLCC: The latest version of Linkage-mapper uses several other programs in its toolbox to make it more robust than the above programs. For example, it uses Circuitscape to help identify bottlenecks; Centrality Mapper to derive corridor centrality; Barrier Mapper to detect important barriers; and Climate Linkage Mapper to identify corridor shifts due to climate change. This program requires input data similar to the two previously discussed. As before, land cover and terrain data (DEM) are in our datasets, but roads are not and the reclass tables do not yet exists for the Appalachian LCC area.

The use of Linkage-mapper in the Appalachian LCC area will require a great deal of research and thought put into the interpretation and creation of data layers for the project area. However, this program expands the ability of the previously discussed connectivity programs when linkage is an apparent or pre-decided goal.

Overall comments connectivity analysis: For most connectivity programs described above, we have the basic layers (land cover, DEM for entire AppLCC), to undertake a structural (coarse filter approach). In our current dataset, we lack data on road network and permeability/traffic on these roads. Resistance maps will have to be developed for each species on a case by case basis, and this can be done when a suite of species have been selected. It is important to note that a number of new connectivity approaches are evolving now, including the resilient landscapes/resistant kernel approach being applied by The Nature Conservancy. Connectivity is an ever-moving target and an area of rich development at the moment. Resistant surfaces that were once static now have the option of being considered dynamic (see NALCC LCAD work).

Species Distribution Modeling and Viability

Species distribution models can help identify and prepare data layers for input to some of the above programs. They include programs to estimate the presence, absence, or distribution of a target species. They may also be used to evaluate the viability of a target species' population. Others may use existing data to build a history of a population's existence and distribution. And others may assist in translating land cover into habitat maps for target species. All of the programs have use during the process of

building data layers of the input rasters for many of the reserve location and connectivity programs. They might also be of use in evaluating which species to target in conservation planning.

Maxent

Description of the program: Maxent uses environmental layers key to the existence of a specie along with known location of the species to predict where the target species might exists. This program breaks down the range of a focal species to identify where that species might exist based on the environmental characteristics (temperature, precipitation, aspect, and so on) where it is already known to exist. In other words, it attempts to identify its niches. The frequency and geographical distribution of these niches may also give some insight to its survivability under current conditions. This, in turn, could provide a starting point of evaluating the impact of any proposed changes in the quantity and/or quality of the target species' niches.

Relevance to AppLCC: This program could be used by the Appalachian LCC as a tool to evaluate the current state of a potential target species and do risk assessment to its niches and thus its future existence. It supports decision making in choosing target species and in evaluating activity impacts later on. Because of urban growth in such a large area this type of evaluation may need to be repeated frequently.

The inputs for these evaluations are the environmental datasets and terrain data. Temperature and precipitation are in our collection of datasets. Land cover is also in this collection, but slope location, aspect and other terrain data will have to be developed from the digital elevation model (DEM) that is in the data collection for the entire Appalachian LCC area.

RAMAS GIS

Description of the program: RAMAS GIS is a "stand alone" program with several tools to assist in analysis of metapopulations of a species, building time change maps, assessing ecological risk and/or risk of extinction for the focal species. It runs independently, but the input data is ASCII grid layers like those used in other models. In addition, it is a user interactive program, requiring the user to have expert knowledge about the species of interest and its habitat requirements. RAMAS GIS, like maxent, can be useful in evaluating potential target species and identifying the locations of their habitat.

Relevance to AppLCC: The input datasets are specific for each focal species and project area combination. They do not exist for the Appalachian LCC area at this time. Some of these raster data can be developed in a GIS program and exported to the ASCII grid format required for input to this GIS program. RAMAS GIS contains tools to develop the other layers required. The same land cover, terrain, and environmental used above and in our data collection are the layers necessary to build these inputs.

Conclusions

The current state of programs (tools) for conservation planning is that there are numerous disjunctive programs that are designed to assist with different facets of conservation planning. The number of modeling tools is growing rapidly, but each new tool seems to operate in its own working environment and be aimed at an isolated problem identified by the authors. While a few claim to have evolved into programs to deal with the whole process, none really do that in a convenient manner in a single working environment. GIS appears to be the most used and convenient working environment for planning and resolving conservation issues. Since each of these tools requires massive amounts of work and comes from different parts of the world, the current approach is to try to patch the different programs together to support as much of the whole conservation planning process as possible. We have attempted to demonstrate that the whole process is not currently supported.

We have discussed and listed what conservation tools presently exist. We tried to give some insight as to how they work, what datasets might be needed and how each might be used to support the conservation planning process. We have attempted to point out where each tool might be used in conservation planning for the Appalachian LCC and that there are no tools to automate the entire process of conservation planning for the Appalachain LCC, nor for any other defined project area. Before any of these tools can help, there needs to be a vision of what needs to be accomplished including some idea of what need to be adjusted (fixed) and some goals to go with that vision. Then it is necessary to select some target species that are true indicators of those problems and can be used to measure the current state of affairs and the progress of planned activities; be it positive or negative.

In all cases, conservation planning is for a single defined project area on the surface of the earth and each project is site and resource specific. Also, each project is independent of others and has a different set of stake holders with different interest. It appears that what is needed is a set of tools to choose from that can deal with all these different situations and, at the same time, work together and trade data for more or less seamless analysis and planning.

Key Resources for Understanding Integrative Planning:

Books:

Margoluis, R. A. and N. N. Salafsky. 1998. Designing, Managing, and Monitoring Conservation and Development Projects. Island Press, Washington D.C.

Trombulak, S. C. and R. F. Baldwin, editors. 2010. Landscape-scale Conservation Planning. Springer-Verlag, New York.

Online:

Miradi software for conservation decision support https://miradi.org/

NatureServe Vista software for conservation decision support
http://www.natureserve.org/prodServices/vista/overview.jsp

California Essential Habitat Connectivity Projecthttp://www.dfg.ca.gov/habcon/connectivity/

Selected Articles:

Knight, A. T., R. M. Cowling, H. P. Possingham, and K. A. Wilson. 2009. From theory to practice: designing and situating spatial prioritization approaches to better implement conservation action. Pages 249-259 *in* A. Moilanen, K. A. Wilson, and H. P. Possingham, editors. Spatial Conservation Prioritization: Quantitative Methods and Computational Tools. Oxford University Press, Oxford, UK.

Stem, C., R. A. Margoluis, N. N. Salafsky, and M. Brown. 2005. Monitoring and evaluation in conservation: a review of trends and approaches. Conservation Biology **19**:295-309.

Theobald, D. M., T. Spies, J. D. Kline, B. Maxwell, N. T. Hobbs, and V. H. Dale. 2005. Ecological support for rural land-use planning. Ecological Applications **15**:1906-1914.

TASK 4: IDENTIFY DATA GAPS

Task 4 - Identify what conservation planning problems could be addressed with available software if data gaps were filled and what those data gaps are. Deliverable: A document describing A) how conservation planning in the App LCC could be improved, by development of specific datasets, B) estimate of cost, sources for each dataset C) one or two paragraph descriptions of new AppLCC RFAs that would meet those needs.

Summary of Task 4 – After reviewing the data availability for the AppLCC, we short listed other datasets that would be useful in addressing conservation planning issues in this region. In order to reduce redundancy, we cross walked our list with funded projects that are ongoing in the AppLCC region, and removed ongoing projects. Such examples include mapping of Caves and Karsts, standardized stream classification, energy extraction locations, etc. Finally, we short listed eight RFAs that could meet needs for the AppLCC.

Filling Data Gaps

In order to improve conservation planning in the AppLCC, we recommend a combination of coarse filter and fine filter approaches. Coarse filter conservation planning considers the long term time horizon; as such the level of uncertainty is high especially as the forecast approaches the further reaches of its temporal scale. The fine filter has a greater degree of certainty especially in the near term. The fine filter captures landscape features and biotic communities that are of known, current conservation importance. An optimal conservation planning strategy considers both short and long term solutions and requires both fine and coarse scale data.

Current datasets available at the LCC extent are at the level of being able to run coarse filter analysis. Accordingly we recommend obtaining, downloading, collating or creating the following datasets for the LCC. In addition to the datasets explained below, we had also short-listed several other datasets, but did not include them in this document because we noticed that there are ongoing AppLCC funded projects on developing these datasets. Examples include mapping and characterization of Caves and Karsts, Standardized Stream classification, Resource and energy extraction locations such and mineral and coal mines, etc.

The time lines and costs are very rough estimates. In most cases, the data is freely available, but it has to be downscaled and/or collated for the AppLCC boundaries. Therefore most costs will be personnel costs.

Some examples that these additional datasets may be used are to identify and prioritize conservation targets using coarse and fine filter approaches, create landscape wide connectivity models, identify and design critical corridors, and test for functionality of these corridors using occupancy, individual movement patterns and linking with genetic patterns in the landscape. These datasets can also be used to identify key sites and impacts of building or removing dams, culverts, etc. In conjunction with other datasets that are lacking at his point (such as phylogenetic diversity and genetic diversity information), one can begin to think of designing conservation landscapes that are best representation of evolutionary change with a potential to persist in light of climate change and human activities that may impact this landscape.

Following is a list and short RFA description of the identified data gaps

1. **Downscaled climate data**

   Current available climate forecast data is based on based on global climatic models. In order to perform a fine scale analysis in the AppLCC, we recommend developing downscaled climate data for the region. Global Climate Models (GCMs) have the ability to account for the physics and chemistry of the earth system, as well as important climate feedbacks such as water vapor and methane release. However, GCMs are not perfect because they produce low resolution climate projections for the whole globe and do not model smaller scale local or regional climate trends, or account for short term climatic changes. For conservation planning efforts, small changes in climate data may significantly affect species and their ecosystems, effects that are masked by the coarser data currently available. Recently, county level climate data for continental U.S has been made available by the USGS. The purpose of these datasets is to provide a set of high resolution, bias-corrected climate change projections that can be used to evaluate climate change impacts on processes that are sensitive to finer-scale climate gradients and the effects of local topography on climate conditions from the IPCC fifth assessment. These downscaled data need to verified for its accuracy and applicability in the region.

   Source: http://www.ncdc.noaa.gov/climate-monitoring/

   http://www.usgs.gov/climate_landuse/clu_rd/nex-dcp30.asp

   Estimated cost: The data is freely available, but there will be some personnel costs involved. ~3 months.

2. **Fine scale vegetation and habitat classification relevant to the AppLCC**: In order to undertake conservation planning exercise in the LCC, we need to develop a consistent, fine scale vegetation and habitat classification. Current datasets in our geodatabase are global or national level datasets. State-wide classifications are sometimes at a finer scale, but they are not uniform across the entire region. To obtain consistent, across the region and with neighboring LCCs, we recommend extending the Northeast Terrestrial Habitat Mapping Project (NETHM). The NETHM was initially completed by the Eastern Conservation Science office of The Nature Conservancy's Eastern Region for 13 NE states, some of which are also parts of the AppLCC. This classification is based on the ecological systems classification created by NatureServe, with additional systems for altered habitats and land-use types. These Habitat Systems are intended to be applicable at medium and large scales, and to supplement the finer-scale approaches used within states for specific projects and needs. They include types that are extensive and cover large areas, as well as small, specific-environment types

that may cover only a hectare or two. This will take advantage of an existing framework, and provide a common system and language for conservation planning and wildlife management across the state borders. This approach will generate a seamless habitat classification that can be used for various conservation planning purposes in the AppLCC. The methods used in this classification are well described, and can be extended to cover the rest of the AppLCC.
Costs: Personnel cost, about 4 months
Source: Published methods are available, eg.:
http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/habitatmap/Pages/default.aspx

3. **Transportation networks**: We currently lack an AppLCC-wide data layer on transportation networks that contains homogenous, high-density information for the whole region. A data layer on rail, roads and traffic volumes will help design better resistance maps for the landscape. Currently data on traffic volumes are maintained by Department of Transportation (DoT) separately for each state, and vary in level of detail. Data on the Annual Average Daily Traffic (AADT), is a measure of the total volume of vehicular traffic of a highway or road for a year divided by 365 days. AADT is a useful and simple measurement of how busy the road is, and can be used as a measure to build into resistance maps for connectivity analysis. This task will involve collating information on transportation networks across the different road categories from all states into a single traffic and transportation layer for the entire LCC.
   Cost: Personnel cost, about 3 months
   Source: US DoT http://www.fhwa.dot.gov/planning/processes/tools/nhpn/,
   State DOTs

4. **Topologically integrated stream and river network:** Conservation of aquatic communities depends on maintenance of connectivity in stream and river networks. The first barrier to modeling aquatic network connectivity is having network data that are topologically connected. Stream network analysis is influenced by breaks in the network, and also direction line segments were drawn. Fixing such issues is a major component of doing stream network analysis. The National Hydrography Dataset for the App LCC needs to be thoroughly checked for these kinds of errors. Previous experience in the north eastern states has shown that the stream network in NHD is much

better than NHDPlus. NHD streams align better and have a much better representation of smaller streams whereas NHDPlus has fewer errors but is at a much lower resolution. This can be a relatively intensive and long process, critical to aquatic conservation and planning.

Cost: Personnel costs, about 2-6 months depending on condition of source dataset.
Source: NHD http://nhd.usgs.gov/
NHDPlus http://www.horizon-systems.com/nhdplus/

5. **Minor Dams and culverts:** Barriers to aquatic connectivity include dams and culverts. The App LCC needs a complete coverage of dams. These can be point locations, snapped to the stream network. Major dams are mapped throughout the region by states and on the National Hydrography dataset. Minor dams would need focused field and online research to find and map in a heads-up digitizing mode. Culverts are vastly more numerous than dams. Culverts are mapped by some state DOTs, but not uniformly as to size. Assembling a reliable culvert dataset will involve field data collection and validation.
   Cost: Personnel and travel: 6 months plus 20,000 miles travel
   Source: National Inventory of Dams http://geo.usace.army.mil/pgis/f?p=397:1:0::NO:
   NHD http://nhd.usgs.gov/
   NHDPlus http://www.horizon-systems.com/nhdplus/

6. **Small, isolated wetlands:** Small, isolated wetlands are of immense ecological significance, disproportionate to their size. Their ephemeral nature provides unique environmental conditions for aquatic and semi-aquatic species adapted for a flooding-drying cycle, a cycle which can exclude some fish and invertebrate predators. Small, isolated wetlands provide islands of energetic and nutritional resource in forested landscapes. Their cumulative impact on floods can have watershed-level benefit for people. Yet, because of their small size and cryptic signatures, they are omitted to a large degree (50-80% in some areas) by the national standard wetlands data map, the National Wetland Inventory. States and EPA regions have engaged in mapping efforts for small wetlands. Several State Wildlife Action Plans have identified the need to map isolated wetlands. The most effective means of mapping such wetlands remains aerial photo interpretation, although algorithms for interpretation of LiDAR data have been developed. The North Atlantic LCC has supported development of region-wide map resources and conservation planning tools for vernal pools, a kind

of small, isolated wetland. The App LCC, with less of a glaciated history, has fewer of these kinds of wetlands but where they occur they have key ecological importance. We recommend a region-wide mapping effort for small, isolated wetlands. Base air photos are widely available (e.g., CIR DOQs); higher resolution imagery would be expensive and we have demonstrated that these free public sources can be very effective. Testing LiDAR where available would provide cooperators with high resolution maps. Our idea is to develop a comprehensive project for 1.5-2 years, in combination with other objectives (see cost).

Cost: $175,000; timeline 2 years (could be combined with Hydrography dataset cleaning for $210,000 total; both could be combined with dams and culverts for $300,000 total).

7. **Focal and Endemic species for AppLCC**: Focal species are often used in conservation planning, if their habitat needs represent those of larger groups of organisms and/or if they are of particular conservation interest, e.g., T&E. We recommend identifying a suite of species that is representative of the habitat and/or management needs of larger groups of species and to AppLCC's conservation plans. Once such a set of species has been identified, known records of the species presence across its range, from all different state and county records will be collected. Further, the Appalachians are home to several endemic species of plants and animals. Information on these endangered, endemic or rare biodiversity warrants a special layer of information, because the sites containing known locations of such species should be set as priority conservation targets in downstream planning efforts. This aspect of data needs should be done in cooperation with all partner states and agencies to build a rich layer of species distribution information for the ecoregion. This compiled database can then be used to develop Species Distribution Models in the LCC.

   Cost: Personnel cost, ~6 months

   Source: State Wildlife Offices, Museum collections.

8. **Developing a genetic database**: We recommend a compilation of a genetic database from studies that have generated genetic data within the AppLCC. This approach can go parallel to the landscape conservation planning tools by measuring and mapping hotspots of genetic diversity in the region. As a first step towards this integrated approach, published information on genetic information from multiple taxa has to be compiled. Using this genetic information on endangered or endemic species, areas of high allelic diversity and heterozygosity can be identified. Genetic approaches have also been widely used in combination with movement studies to evaluate dispersal, connectivity and

habitat use. This initial data-mining effort can lead into a meta-analysis of all genetic studies within the AppLCC, and help identify further needs and RFPs for threatened or endangered species or species of commercial importance. Coupled with GIS data, genetic information can help identify geographic patterns of intraspecific genetic diversity and evolutionary hotspots, which can be built into conservation planning efforts. This will also be an enormous edge over other concurrent efforts in neighboring LCCs.

Costs: Personnel costs ~ 4 months

TASK 5: INTERPRET USES OF DATA AND CONSERVATION PLANNING TOOLS

Task 5 - Interpret uses of data and conservation planning tools by developing interpretive text and graphics for AppLCC web portal. Deliverable: A) Document containing text that describes data and tools and that can be posted to AppLCC webportal by AppLCC staff B) map images of data that can be posted to AppLCC webportal by AppLCC staff.

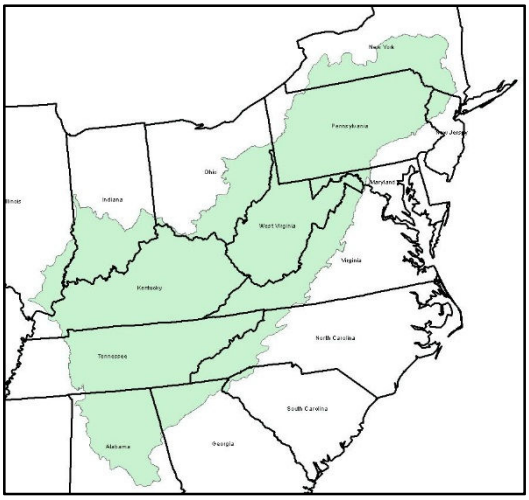
Summary of Task 5 - We interpreted eighteen datasets and ten conservation tools with graphics and text for the AppLCC web portal.

Interpretive text and graphics for AppLCC web portal (data)

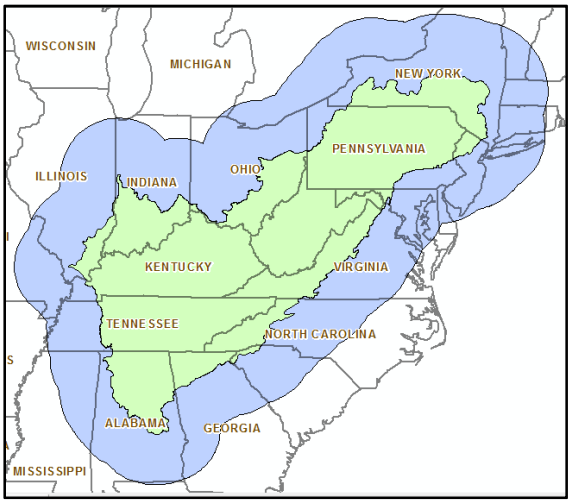
This document presents map images and text that describes the data that can be posted to the AppLCC web portal. The arrangement follows the layout of the Appalachain Landscape Conservation Cooperative GIS Datasets that is also attached with this quarterly progress report (Task two).

Common for all data: All data presented is the latest and updated as possible at the time of this compilation. All layers have been reprojected to Albers Conic Equal Area, NAD83 with linear units in meters.

1. AppLCC project boundary

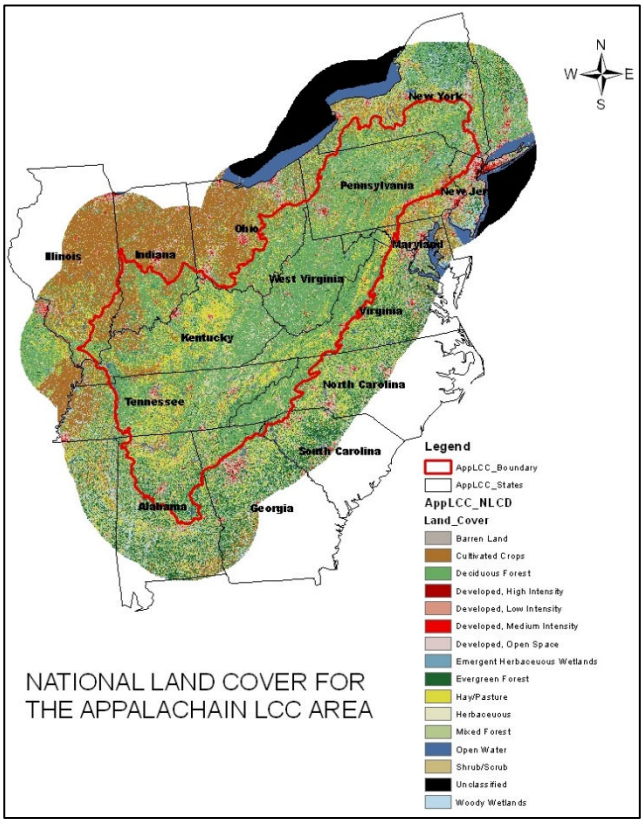


This vector (polygon) file defines the AppLCC boundary and the fifteen states that it covers.



This file shows the AppLCC boundary, with a buffer of 175 kms. This buffer polygon is intended to include all of the HUC8 watersheds that make input to or have output from the AppLCC area.

2. AppLCC_2006 NLCD



Table

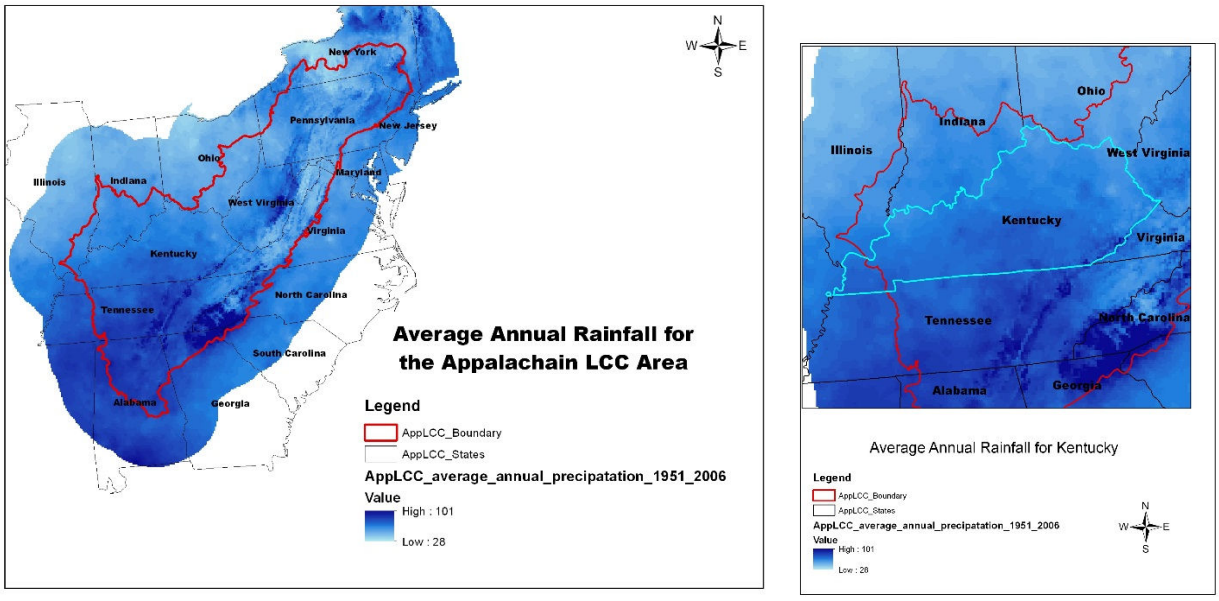
appnlcd_buffclip2.img

OID	Value	Count	Red	Green	Blue	Opacity	Land_Cover
0	0	74547116	0	0	0	1	Unclassified
1	11	67178915	0.28	0.42	0.63	1	Open Water
2	21	91698591	0.87	0.79	0.79	1	Developed, Open Space
3	22	41330309	0.85	0.58	0.51	1	Developed, Low Intensity
4	23	15278752	0.93	0	0	1	Developed, Medium Intensity
5	24	5934159	0.67	0	0	1	Developed, High Intensity
6	31	4115672	0.7	0.68	0.64	1	Barren Land
7	41	560243490	0.41	0.67	0.39	1	Deciduous Forest
8	42	109885615	0.11	0.39	0.19	1	Evergreen Forest
9	43	57612634	0.71	0.79	0.56	1	Mixed Forest
10	52	35754399	0.8	0.73	0.49	1	Shrub/Scrub
11	71	36743810	0.89	0.89	0.76	1	Herbaceuous
12	81	200695374	0.86	0.85	0.24	1	Hay/Pasture
13	82	242128365	0.67	0.44	0.16	1	Cultivated Crops
14	90	45705714	0.73	0.85	0.92	1	Woody Wetlands
15	95	5500365	0.44	0.64	0.73	1	Emergent Herbaceuous Wetlands

National Land Cover Database 2006 (NLCD2006) is a 16-class land cover classification scheme that has been applied consistently across the conterminous United States at a spatial resolution of 30 meters. It is also a primary dataset used by a number of conservation planning programs or models. This dataset has been extracted using the AppLCC buffer boundary. Shown here are examples of the 16 cover classes of the entire LCC, zoomed into PA, and the attribute table. A recently updated version of NLCD2011 is now available. It keeps the same 16-class land cover classification scheme that has been applied consistently across the United States at a spatial resolution of 30 meters.

Source: http://www.mrlc.gov/nlcd2011.php

3. AppLCC Average Annual Precipitation (1951-2006)

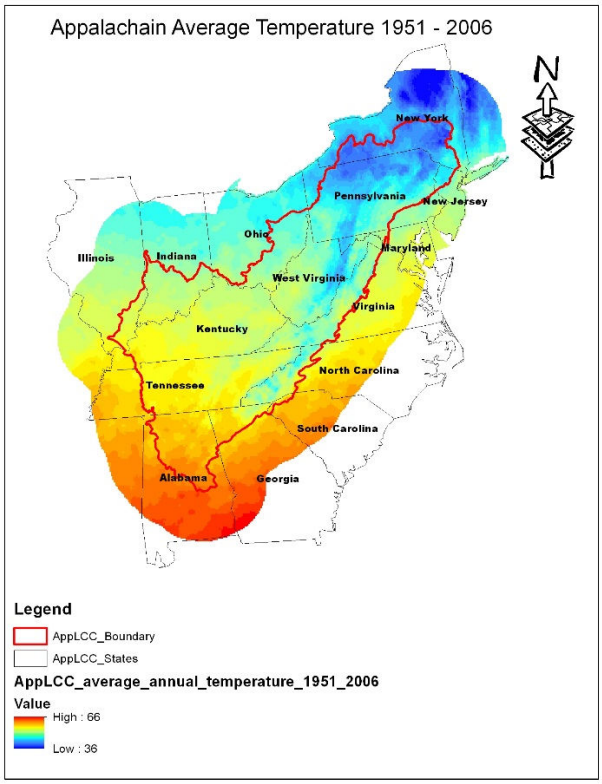


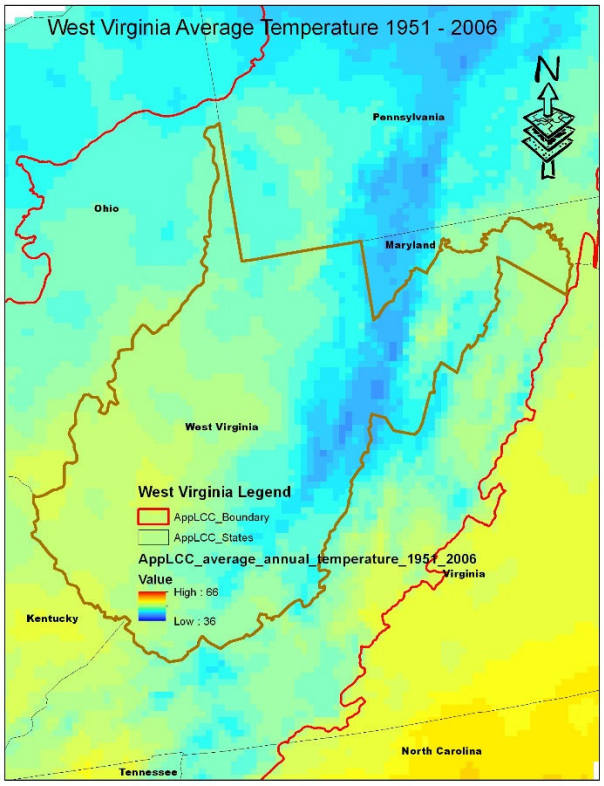
This dataset represents a raster of historical precipitation data for a 50 period produced as output from the Climate Wizard model. The source data for this raster is the PRISM (Parameter-elevation Regressions on Independent Slopes Model) climate mapping system. PRISM uses point measurements of precipitation, temperature, and other climatic factors to produce continuous, digital grid estimates of monthly, yearly, and event-based climatic parameters. The images shown here are for the entire LCC and zoomed into KY.

Source: http://www.climatewizard.org/

4. AppLCC Average Annual Temperature (1951-2006)

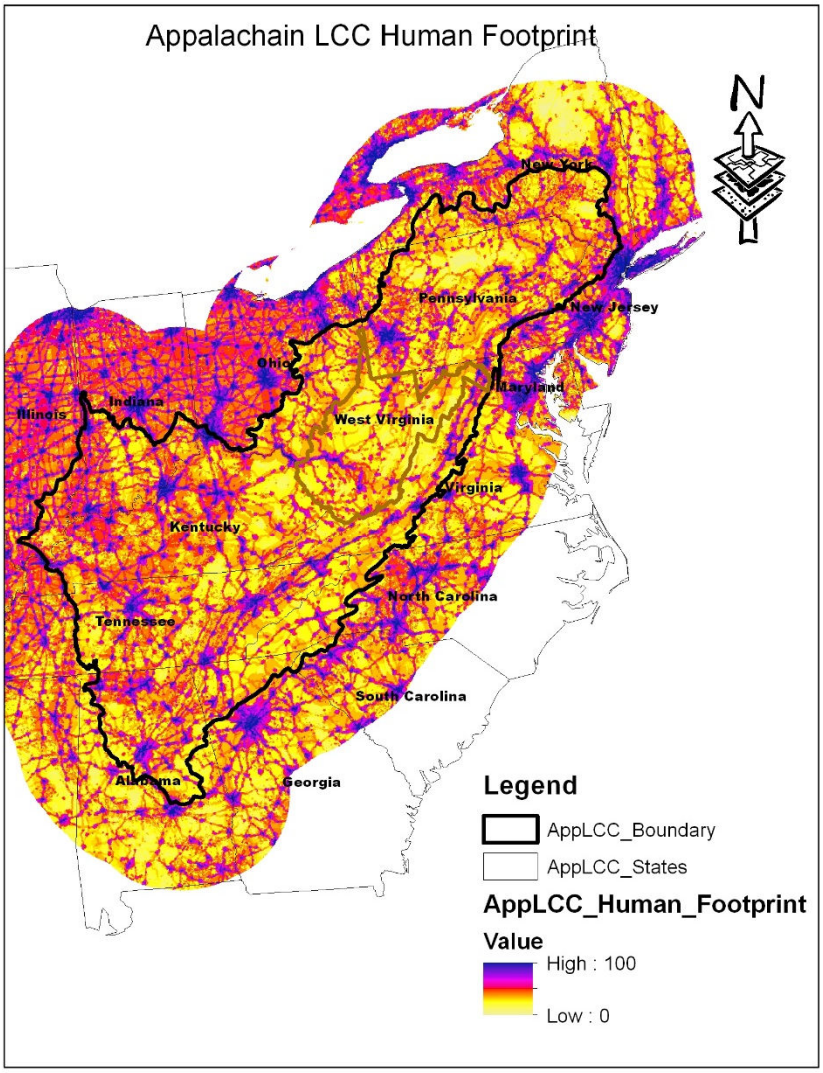
This is a raster dataset containing information of the historical temperature data for a 50 period produced as output from the Climate Wizard model. The source data for this raster is the PRISM (Parameter-elevation Regressions on Independent Slopes Model) climate mapping system. PRISM uses point measurements of precipitation, temperature, and other climatic factors to produce continuous, digital grid estimates of monthly, yearly, and event-based climatic parameters. The images shown here are for the entire LCC and zoomed into WV.





Source: http://www.climatewizard.org/

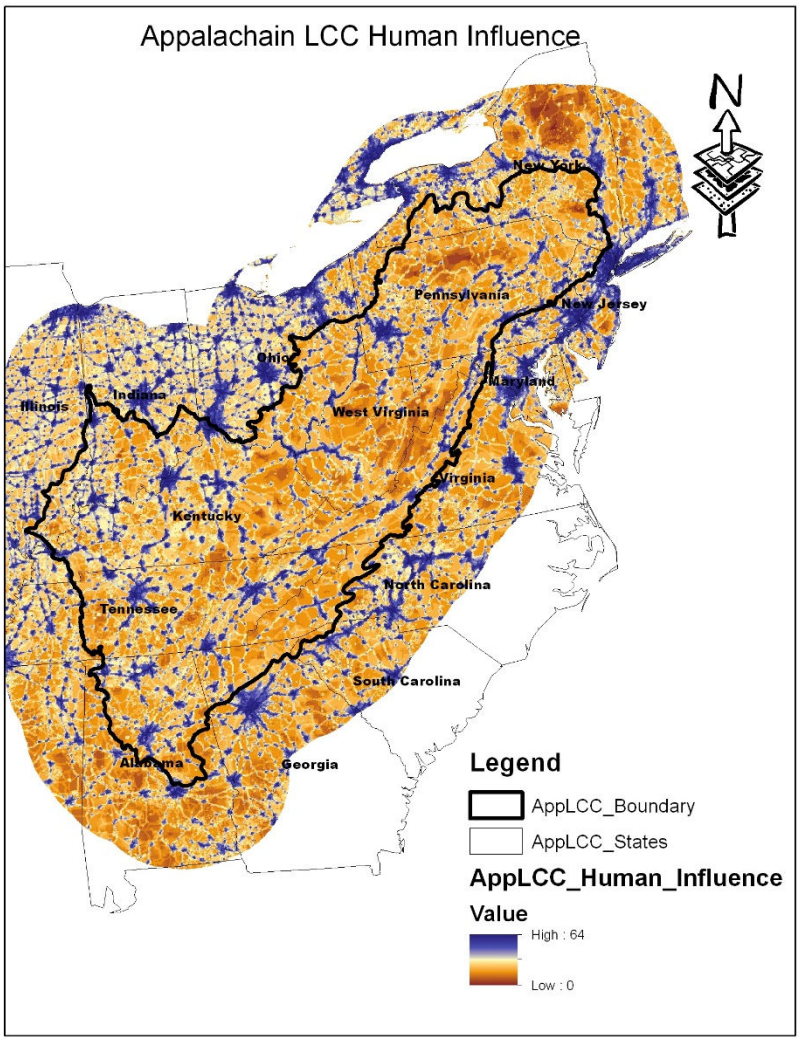
5. Human footprint data



The Global Human Footprint Dataset of the Last of the Wild Project, Version 2, 2005 (LWP-2) is the Human Influence Index (HII) normalized by biome. The HII is a global dataset of 1-kilometer grid cells, created from nine global data layers covering human population pressure (population density), human land use and infrastructure (built-up areas, nighttime lights, land use/land cover), and human access (coastlines, roads, railroads, navigable rivers). The dataset is produced by the Wildlife Conservation Society (WCS) and the Columbia University Center for International Earth Science Information Network (CIESIN). In this raster's attributes, the cell values indicate the extent of human impact with 0 being the least and 100 being the greatest (on a normalized scale).

Source: http://sedac.ciesin.columbia.edu/data/collection/wildareas-v2/sets/browse

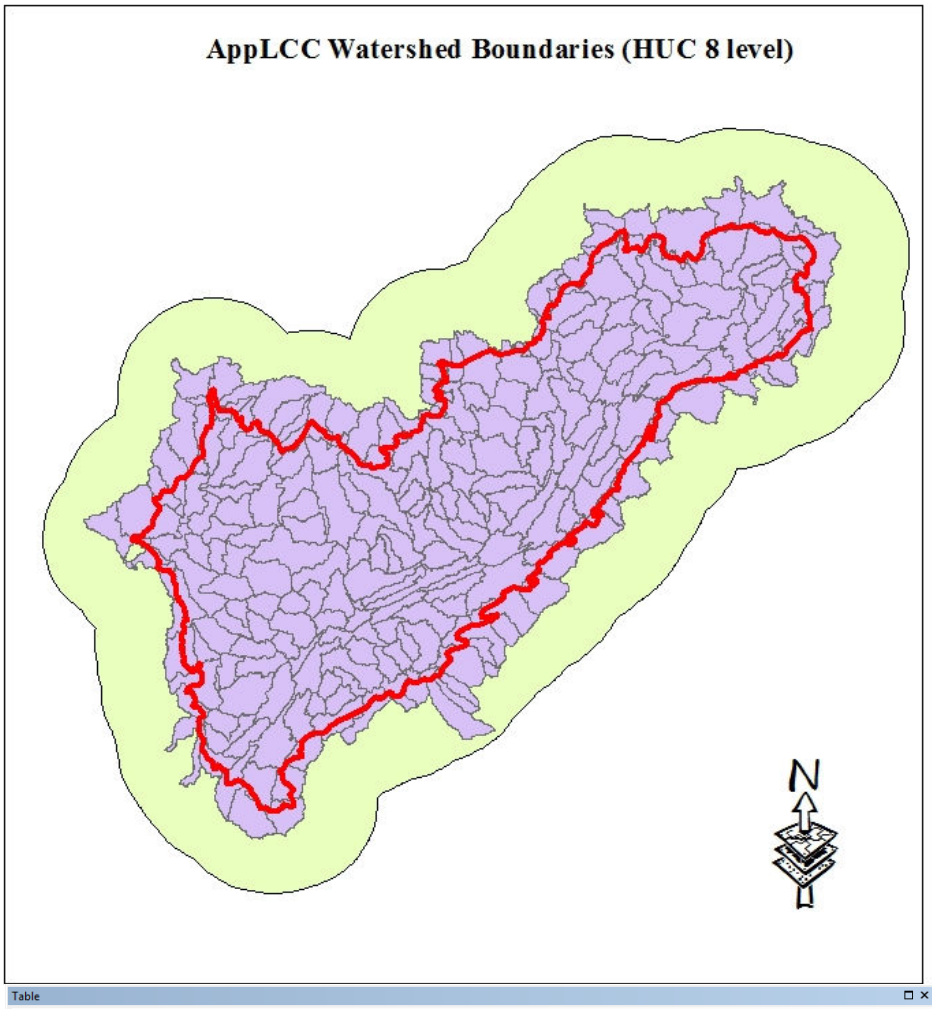
6. Human influence data



The human influence raster dataset is basically the non-normalized version of the human footprint dataset, with cell values ranging from 0 to 64. The HII is a global dataset of 1-kilometer grid cells, created from nine global data layers covering human population pressure (population density), human land use and infrastructure (built-up areas, nighttime lights, land use/land cover), and human access (coastlines, roads, railroads, navigable rivers). The dataset is produced by the Wildlife Conservation Society (WCS) and the Columbia University Center for International Earth Science Information Network (CIESIN).

Source: http://sedac.ciesin.columbia.edu/data/collection/wildareas-v2/sets/browse

7. USGS Hydrologic Units (HUC8s)



Table

AppLCC_HUC8_USGS_Albers

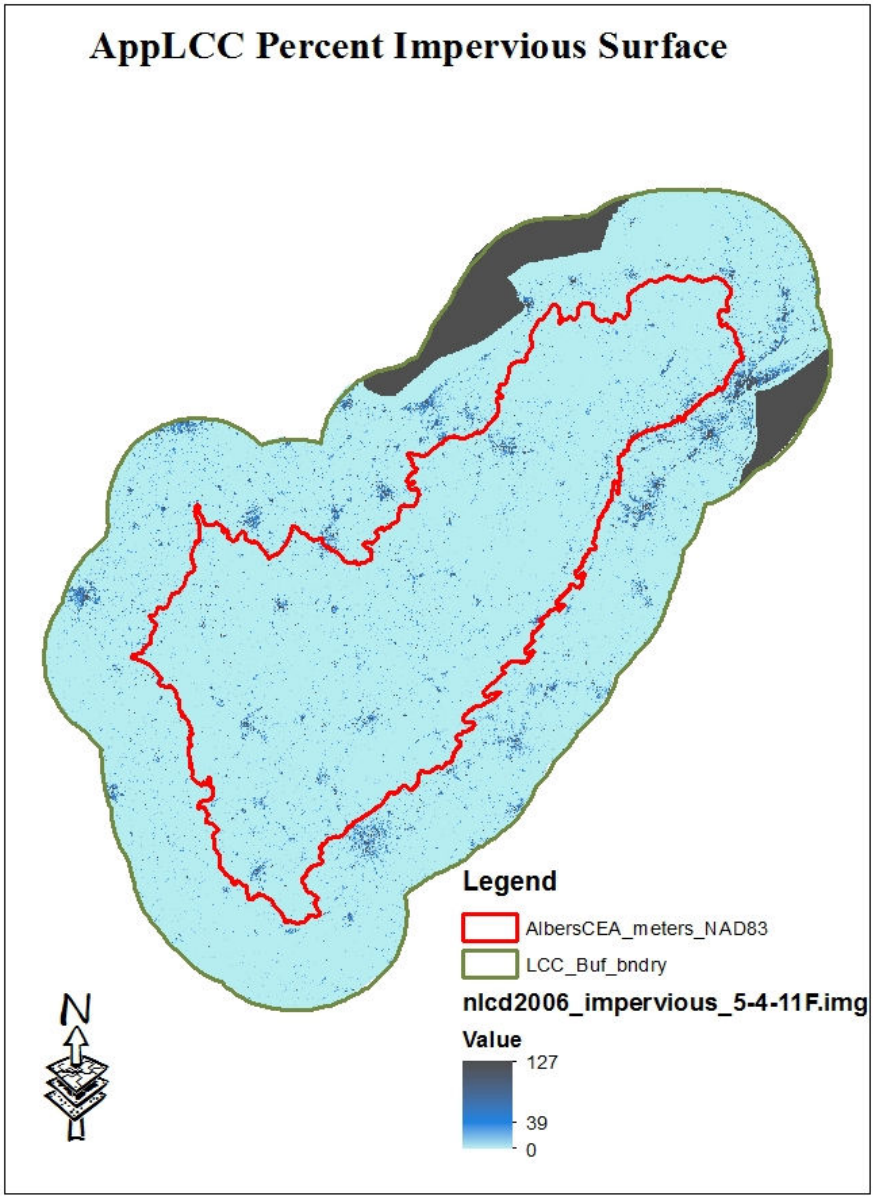
FID	Shape *	AREA	PERIMETER	HUC250K_	HUC250K_ID	HUC_CODE	HUC_NAME	REG	SUB	ACC	CAT
0	Polygon	6699747648.16	695948.550209	484	483	02020004	Mohawk	02	0202	020200	02020004
1	Polygon	3769880968.88	410583.380778	492	492	04140202	Oneida	04	0414	041402	04140202
2	Polygon	2407091029.69	346818.450161	548	552	02020005	Schoharie	02	0202	020200	02020005
3	Polygon	6293946751.05	544893.735116	549	553	02020006	Middle Hudson	02	0202	020200	02020006
4	Polygon	8951274752.41	624277.284747	557	560	04140201	Seneca	04	0414	041402	04140201
5	Polygon	5934573973.44	521775.394019	562	565	02050101	Upper Susquehanna	02	0205	020501	02050101
6	Polygon	4142984797.63	373779.451394	581	584	02050102	Chenango	02	0205	020501	02050102
7	Polygon	2838198609.09	312257.028646	582	585	04130003	Lower Genesee	04	0413	041300	04130003
8	Polygon	2020954130.55	290445.208558	600	604	04120104	Niagara	04	0412	041201	04120104

21 (0 out of 229 Selected)

This dataset contains a vector (polygon) that has the USGS hydrologic Unit Code level 8 watersheds that influence or are influenced by the core AppLCC area. This dataset was created by intersecting the AppLCC area with the base layer of HUC8 level watersheds. This screen shot shows the HUC 8 units in the AppLCC along with the buffer. The table shows the structure of the attribute table, which contains information on area, perimeter, name, HUC code, etc.

Source: ftp://ftp.ftw.nrcs.usda.gov/wbd/

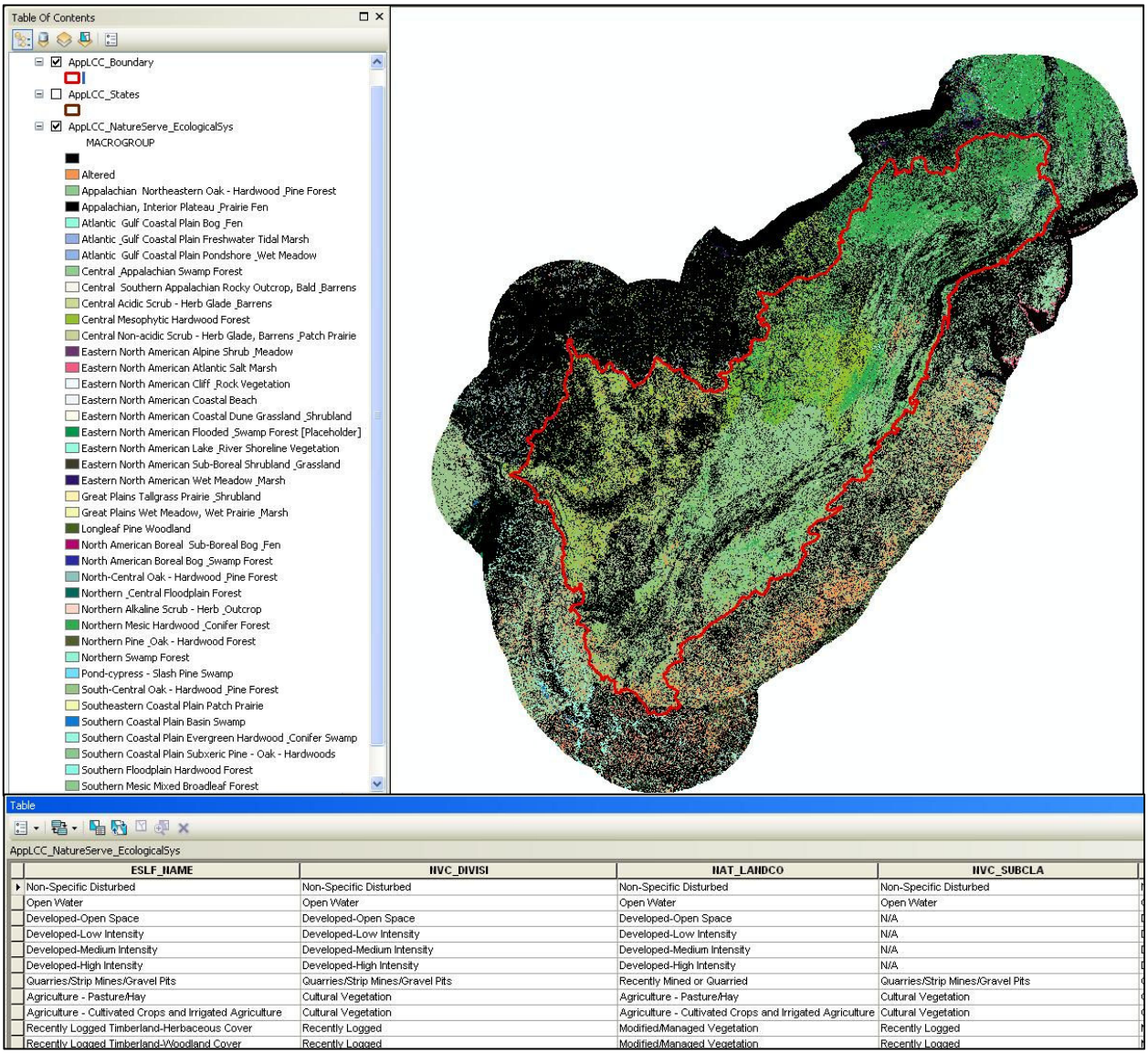
8. AppLCC Impervious Surface



The National Land Cover Database (NLCD) Percent Developed Impervious surface provides nationally consistent estimates of the amount of man-made impervious surfaces present over a given area in a seamless form. Each cell in this raster dataset contains information on the percent impervious value. These raster data sets are derived from Landsat satellite imagery, using classification and regression tree analysis. Values range from 0 to 100 percent, indicating the degree to which the area is covered by impervious features. This data is at a 30 meter resolution and clipped from the conterminous US dataset.

Source: http://www.mrlc.gov/nlcd06_data.php

9. NatureServe Ecological Systems



ESLF_NAME	NVC_DIVISI	NAT_LANDCO	NVC_SUBCLA
Non-Specific Disturbed	Non-Specific Disturbed	Non-Specific Disturbed	Non-Specific Disturbed
Open Water	Open Water	Open Water	Open Water
Developed-Open Space	Developed-Open Space	Developed-Open Space	N/A
Developed-Low Intensity	Developed-Low Intensity	Developed-Low Intensity	N/A
Developed-Medium Intensity	Developed-Medium Intensity	Developed-Medium Intensity	N/A
Developed-High Intensity	Developed-High Intensity	Developed-High Intensity	N/A
Quarries/Strip Mines/Gravel Pits	Quarries/Strip Mines/Gravel Pits	Recently Mined or Quarried	Quarries/Strip Mines/Gravel Pits
Agriculture - Pasture/Hay	Cultural Vegetation	Agriculture - Pasture/Hay	Cultural Vegetation
Agriculture - Cultivated Crops and Irrigated Agriculture	Cultural Vegetation	Agriculture - Cultivated Crops and Irrigated Agriculture	Cultural Vegetation
Recently Logged Timberland-Herbaceous Cover	Recently Logged	Modified/Managed Vegetation	Recently Logged
Recently Logged Timberland-Woodland Cover	Recently Logged	Modified/Managed Vegetation	Recently Logged

Natureserve updated their ecologic systems data in the spring of 2013. The attribute data with this dataset contains many more vegetation descriptions than the national land cover data alone. These vegetative descriptions might be translated into habitats for various species of interest by conservation planners. This screenshot shows the AppLCC boundary with buffer, along with a screenshot of the attribute table.

Source:
https://tranxfer.natureserve.org/download/Longterm/Ecosystem_National_Map/national_map

10. NDVI_2011 (Normalized Difference Vegetation Index)

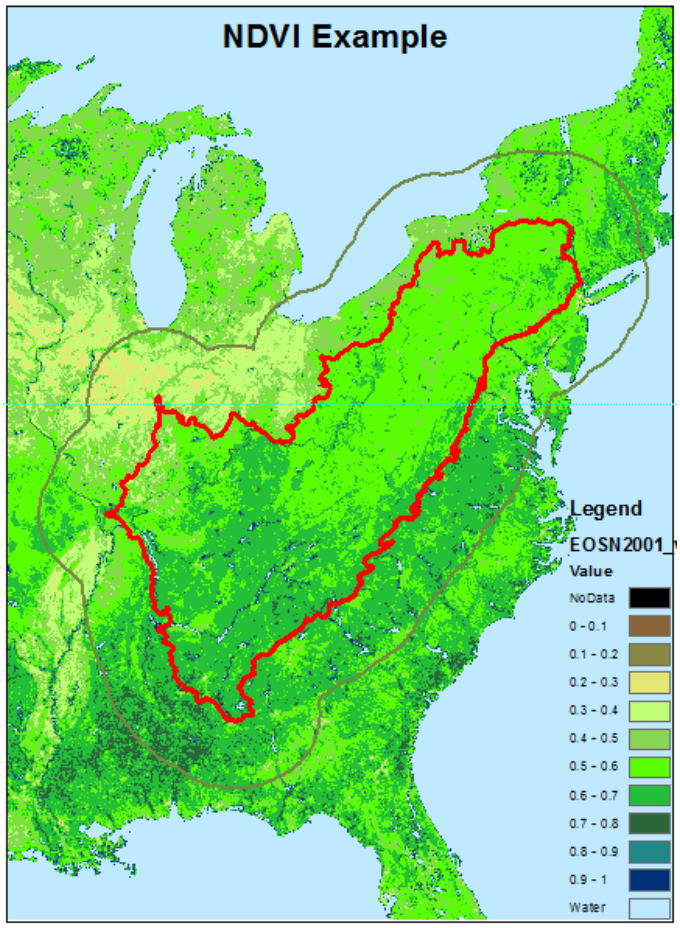
The national NDVI dataset is updated annually and it contains multiple datasets in raster format pertaining to seasonal phenology. Values of NDVI can range from -1.0 to +1.0, but values less than zero typically do not have any ecological meaning, so the range of the index is truncated to 0.0 to +1.0. Higher values signify a larger difference between the red and near infrared radiation recorded by the sensor - a condition associated with highly photosynthetically-active vegetation.

At the time that this data was downloaded, 2012 data was not posted, so this folder contains 3 raster datasets with their layer files that pertain to the beginning, end, and maximum flowering in the Eastern U.S. This data is intended as sample data because the information changes each year. There are three sample data layers:

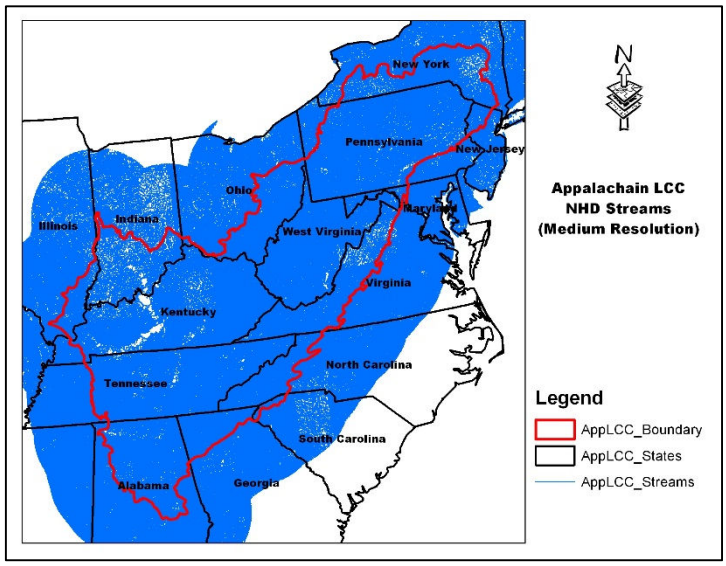
NDVI_Begin_East_USA – A raster layer of the NDVI at the beginning of the 2011 season for the eastern half of the US.

NDVI_End_East_USA – A raster layer of the NDVI at the end of 2011 season for the eastern half of the US.

NDVI_Max_East_USA – A raster layer of the NDVI at the maximum point of the season for the eastern US in 2011.



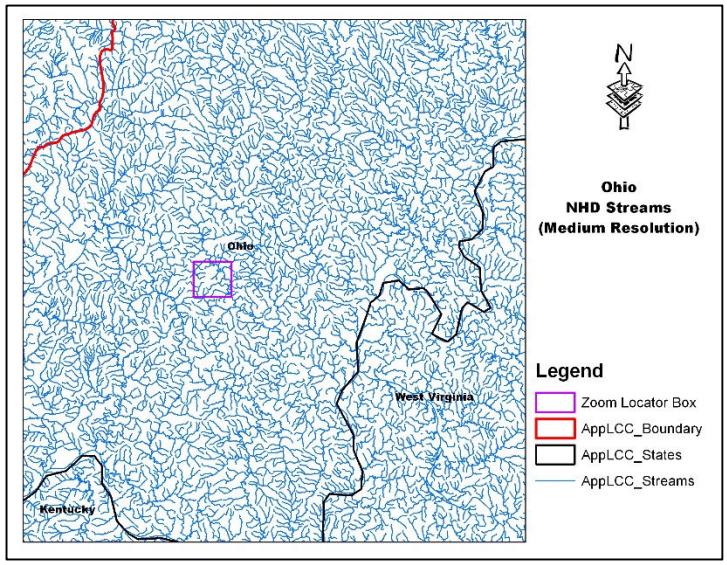
National Hydrologic Data (NHD)

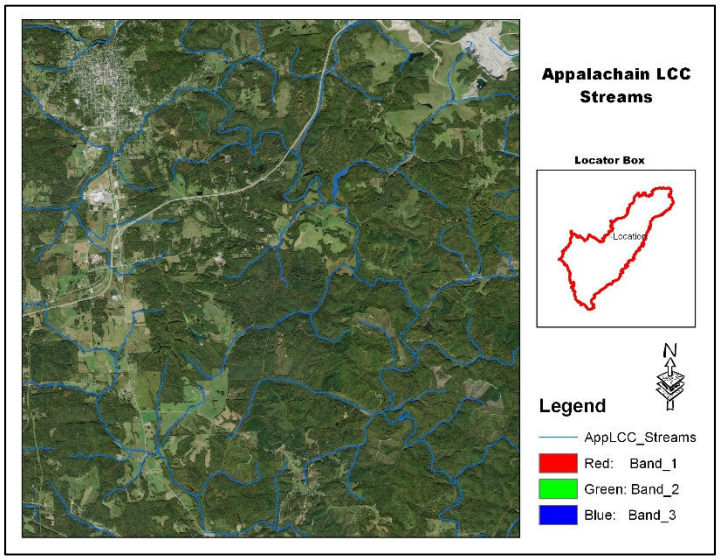


Table

AppLCC_NHD_Flowlines_Medium_Res

OBJECTID *	Shape *	COMID	FDATE	RESOLUTION	GNIS_ID	GNIS_NAME	LENGTHKM	REACHCODE	FLOWDIR
1	Polyline ZM	445308	8/1/2004	Medium			1.22	03140305000578	With Digitized
2	Polyline ZM	445310	8/1/2004	Medium			0.101	03140305000575	With Digitized
3	Polyline ZM	445312	8/1/2004	Medium	00158785	Big Escambia Creek	1.031	03140305000149	With Digitized
4	Polyline ZM	445314	8/1/2004	Medium			0.563	03140305000578	With Digitized
5	Polyline ZM	445316	8/1/2004	Medium			2.115	03140305000579	With Digitized
6	Polyline ZM	445318	8/1/2004	Medium			0.381	03140305000577	With Digitized
7	Polyline ZM	445320	8/1/2004	Medium			0.28	03140305000580	With Digitized
8	Polyline ZM	445322	8/1/2004	Medium	00157946	Escambia Creek	1.109	03140305000770	With Digitized
9	Polyline ZM	445324	8/1/2004	Medium			0.071	03140305000769	With Digitized
10	Polyline ZM	445326	8/1/2004	Medium	00157946	Escambia Creek	0.538	03140305000770	With Digitized
11	Polyline ZM	445328	8/1/2004	Medium			2.467	03140305000574	With Digitized

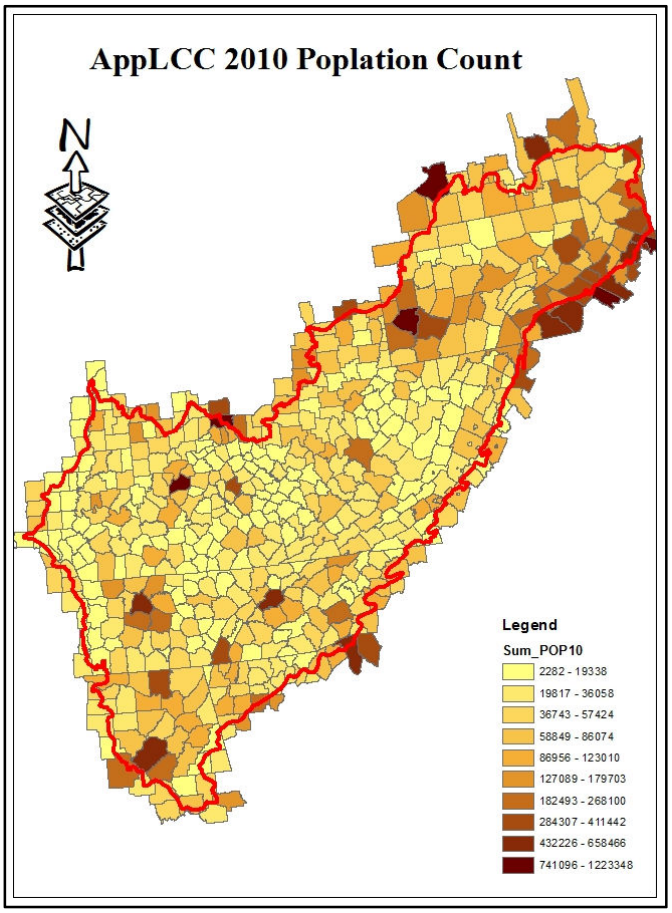




This dataset contains vector (polyline) data that is the flowlines from the USGS NHD dataset at medium resolution. The images here show the entire LCC and zoomed in sections to show details of the flowlines. The attribute table identifies each line segment, its stream name, flow direction and so on.

Source: ftp://nhdftp.usgs.gov/DataSets/Staged/States/FileGDB/HighResolution/

11. Population count and housing count (2010)



Table

AppLCC_Pop_Hse_2010

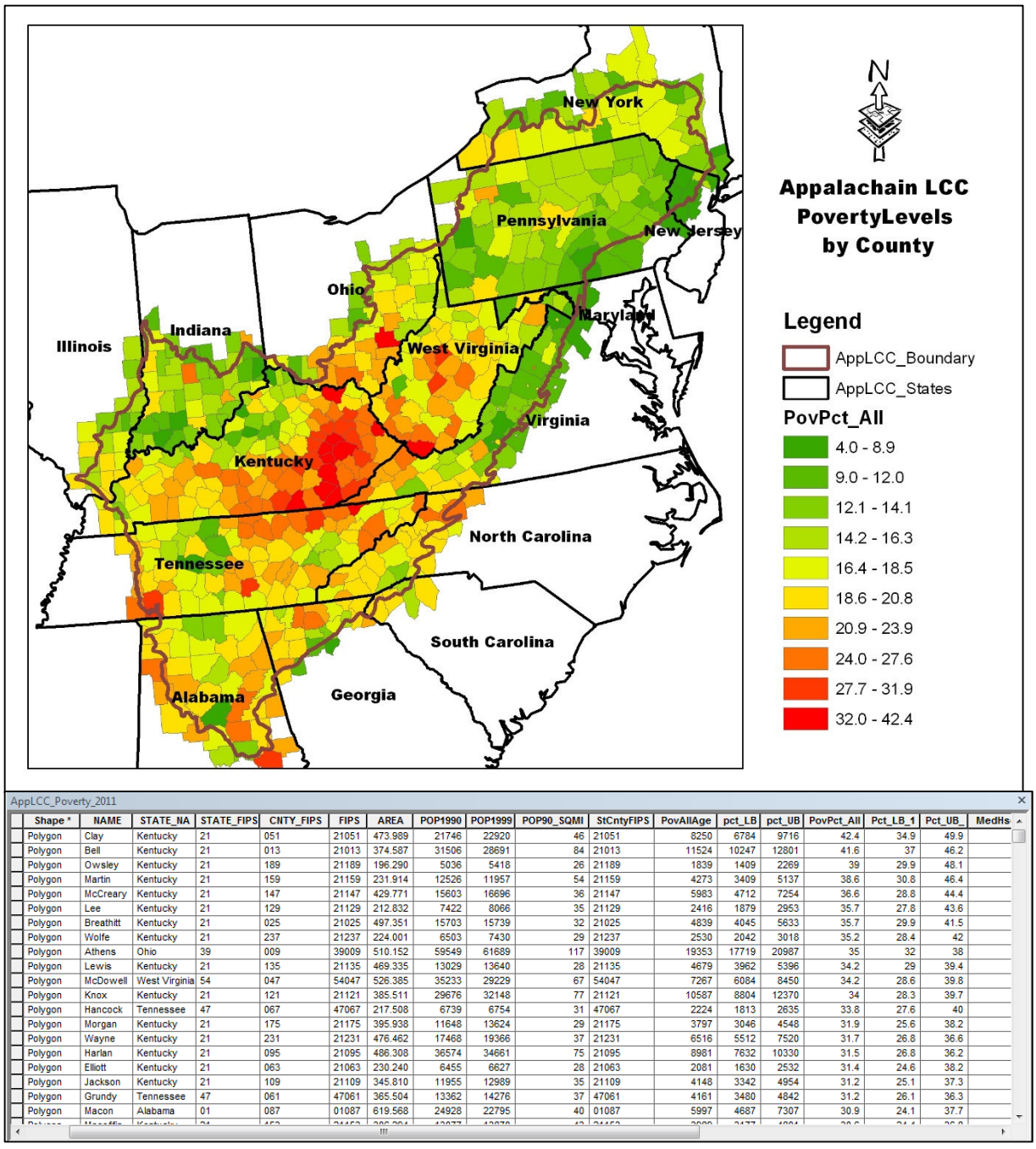
FID	Shape *	COUNTYFP10	OID_	COUNTYFP_1	Cnt_COUNTY	First_STAT	Sum_HOUSIN	Sum_POP10
0	Polygon	001	0	001	1887	01	22135	54571
1	Polygon	007	3	007	1777	01	8981	22915
2	Polygon	009	4	009	2750	01	23887	57322
3	Polygon	015	7	015	6919	01	53289	118572
4	Polygon	019	9	019	2497	01	16267	25989
5	Polygon	021	10	021	2208	01	19278	43643
6	Polygon	027	13	027	1588	01	6776	13932
7	Polygon	029	14	029	1471	01	6718	14972
8	Polygon	033	16	033	3799	01	25758	54428
9	Polygon	037	18	037	1534	01	6478	11539
10	Polygon	043	21	043	4363	01	37054	80406
11	Polygon	049	24	049	4435	01	31109	71109
12	Polygon	051	25	051	3680	01	32657	79303
13	Polygon	055	27	055	5044	01	47454	104430
14	Polygon	057	28	057	1731	01	8437	17241
15	Polygon	059	29	059	2556	01	14022	31704
16	Polygon	071	35	071	4476	01	24786	53227
17	Polygon	073	36	073	28737	01	300552	658466
18	Polygon	077	38	077	4233	01	43791	92709
19	Polygon	079	39	079	2304	01	15229	34339
20	Polygon	081	40	081	4059	01	62391	140247
21	Polygon	083	41	083	3809	01	34977	82782

1 (0 out of 598 Selected)

This dataset contains vector data (polygons) of the counties intersected by the base AppLCC boundary. Each county has the 2010 population count and housing count Census Bureau data added to its attribute table. These values were derived by summing the census blocks for each county that were posted in the Census Bureau's data for 2010, thus each record is for a whole county. Shown here is an example of the population count and attribute table.

Source: ftp://ftp2.census.gov/geo/pvs/tiger2010st/

12. Poverty2011

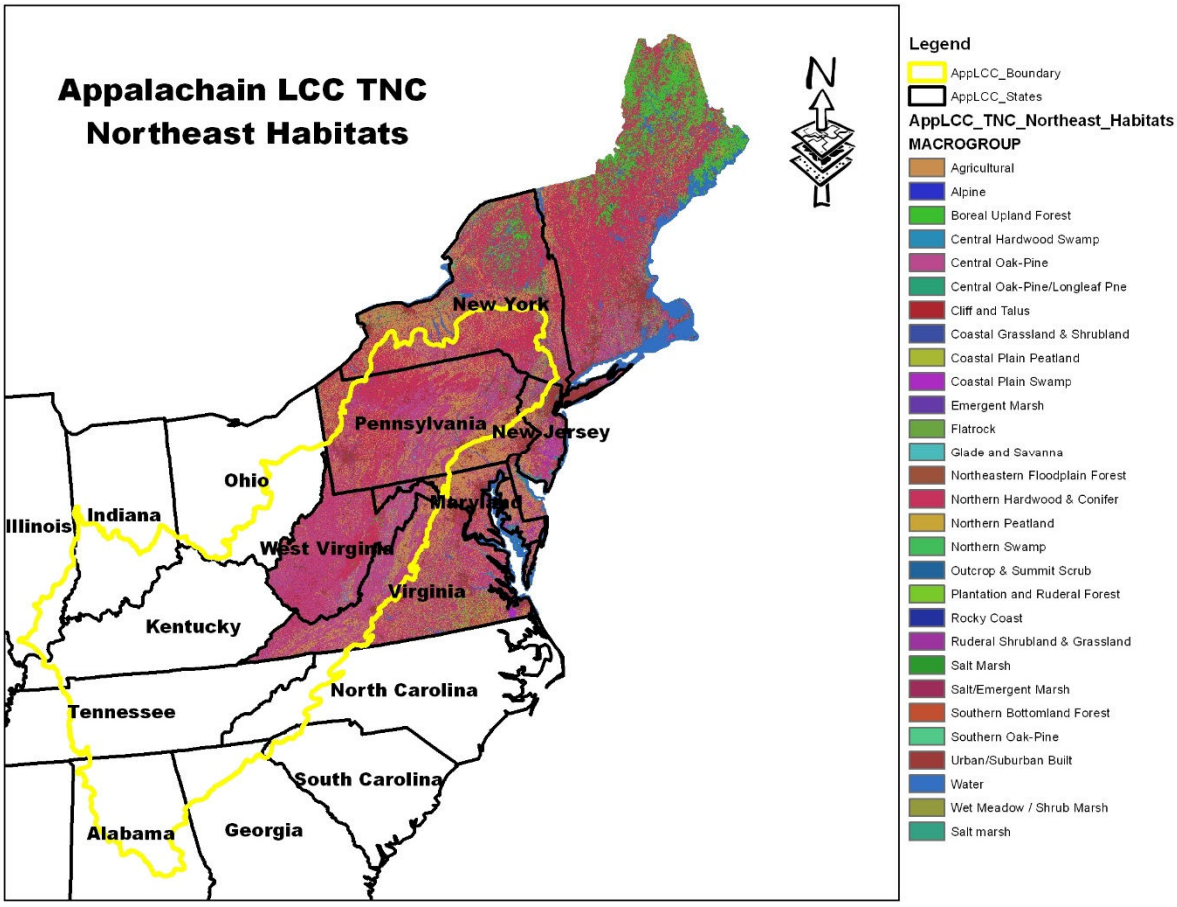


AppLCC_Poverty_2011

Shape *	NAME	STATE_NA	STATE_FIPS	CNTY_FIPS	FIPS	AREA	POP1990	POP1999	POP90_SQMI	StCntyFIPS	PovAllAge	pct_LB	pct_UB	PovPct_All	Pct_LB_1	Pct_UB_	MedHs
Polygon	Clay	Kentucky	21	051	21051	473.989	21746	22920	46	21051	8250	6784	9716	42.4	34.9	49.9	
Polygon	Bell	Kentucky	21	013	21013	374.587	31506	28691	84	21013	11524	10247	12801	41.6	37	46.2	
Polygon	Owsley	Kentucky	21	189	21189	196.290	5036	5418	26	21189	1839	1409	2269	39	29.9	48.1	
Polygon	Martin	Kentucky	21	159	21159	231.914	12526	11957	54	21159	4273	3409	5137	38.6	30.8	46.4	
Polygon	McCreary	Kentucky	21	147	21147	429.771	15603	16696	36	21147	5983	4712	7254	36.6	28.8	44.4	
Polygon	Lee	Kentucky	21	129	21129	212.832	7422	8066	35	21129	2416	1879	2953	35.7	27.8	43.6	
Polygon	Breathitt	Kentucky	21	025	21025	497.351	15703	15739	32	21025	4839	4045	5633	35.7	29.9	41.5	
Polygon	Wolfe	Kentucky	21	237	21237	224.001	6503	7430	29	21237	2530	2042	3018	35.2	28.4	42	
Polygon	Athens	Ohio	39	009	39009	510.152	59549	61689	117	39009	19353	17719	20987	35	32	38	
Polygon	Lewis	Kentucky	21	135	21135	469.335	13029	13640	28	21135	4679	3962	5396	34.2	29	39.4	
Polygon	McDowell	West Virginia	54	047	54047	526.385	35233	29229	67	54047	7267	6084	8450	34.2	28.6	39.8	
Polygon	Knox	Kentucky	21	121	21121	385.511	29676	32148	77	21121	10587	8804	12370	34	28.3	39.7	
Polygon	Hancock	Tennessee	47	067	47067	217.508	6739	6754	31	47067	2224	1813	2635	33.8	27.6	40	
Polygon	Morgan	Kentucky	21	175	21175	395.938	11648	13624	29	21175	3797	3046	4548	31.9	25.6	38.2	
Polygon	Wayne	Kentucky	21	231	21231	476.462	17468	19366	37	21231	6516	5512	7520	31.7	26.8	36.6	
Polygon	Harlan	Kentucky	21	095	21095	486.308	36574	34661	75	21095	8981	7632	10330	31.5	26.8	36.2	
Polygon	Elliott	Kentucky	21	063	21063	230.240	6455	6627	28	21063	2081	1630	2532	31.4	24.6	38.2	
Polygon	Jackson	Kentucky	21	109	21109	345.810	11955	12989	35	21109	4148	3342	4954	31.2	25.1	37.3	
Polygon	Grundy	Tennessee	47	061	47061	365.504	13362	14276	37	47061	4161	3480	4842	31.2	26.1	36.3	
Polygon	Macon	Alabama	01	087	01087	619.568	24928	22795	40	01087	5997	4687	7307	30.9	24.1	37.7	

This dataset contains vector data (polygons) of the counties intersected by the base AppLCC boundary. Shown here is an image of this data symbolized by Percent Poverty. In addition to the County name, State, and FIPS codes, this layer has estimated poverty and percent for each county (as shown in the attribute table).

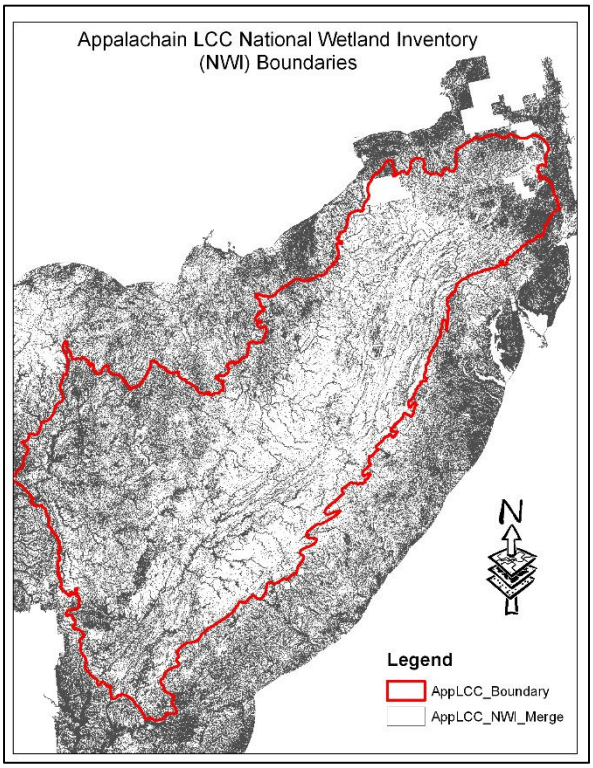
13. TNC Habitats

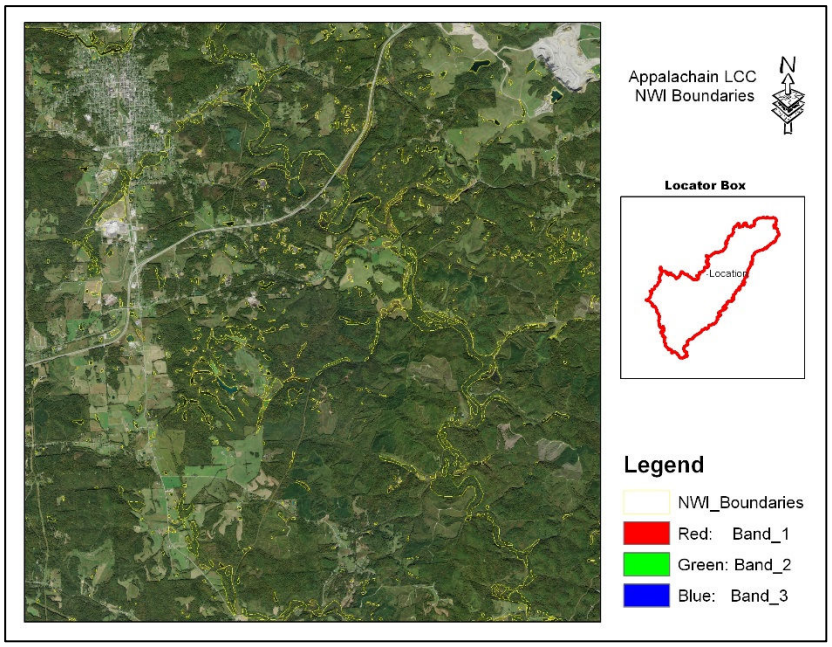


This dataset contains the Nature Conservancy's habitat classification data for the Northeastern U.S. It does not cover the entire AppLCC area, but uses a technique that might be of interest and could be extended to cover the whole AppLCC area. These habitats could then be used to examine the species of interest for conservation planning.

Source: http://conserveonline.org/workspaces/ecs/napaj/nap/

14. Folder Fifteen (AppLCC_USFWS_NWI):

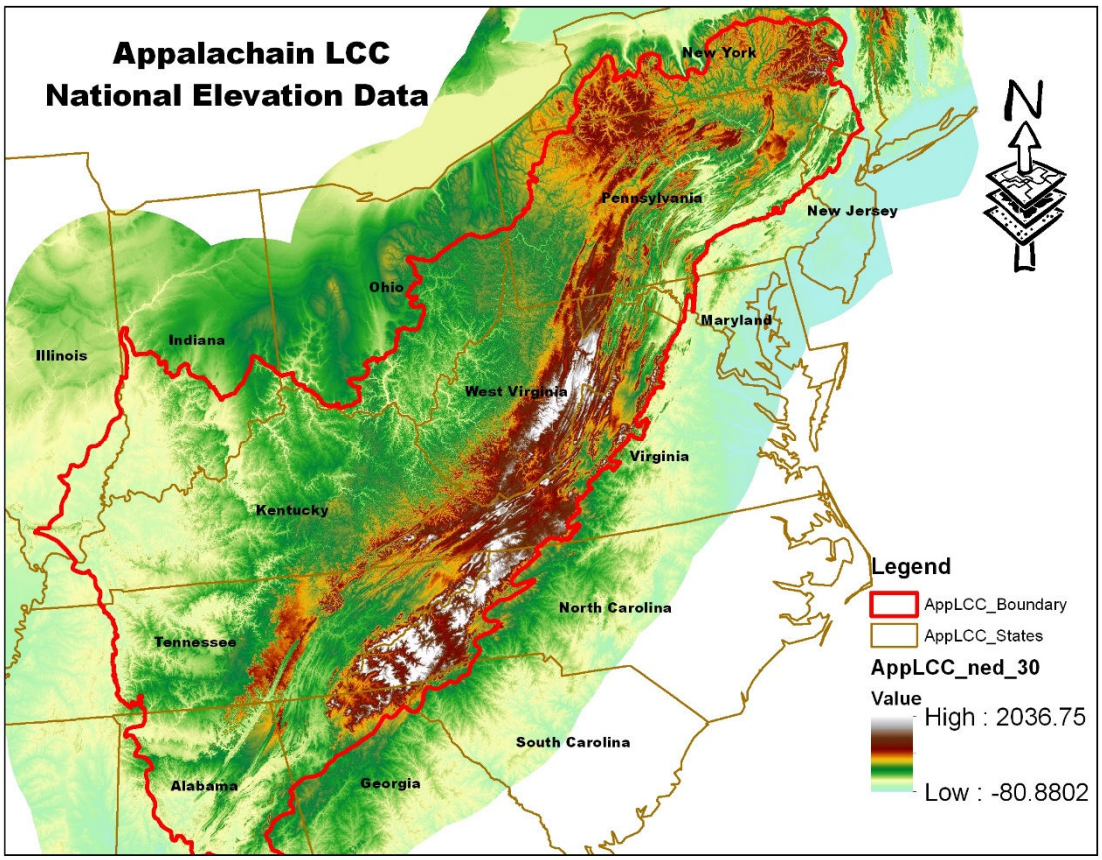




This dataset contains the U.S. Fish and Wildlife Service's national wetlands inventory dataset clipped to the AppLCC buffer boundary. Almost all of the AppLCC area has been processed for the national wetlands inventory (a few quads in upperstate New York are missing). This data maps and classifies the wetlands in the area by 7.5 minute quadrangle.

Source: http://www.fws.gov/wetlands/Data/State-Downloads.html

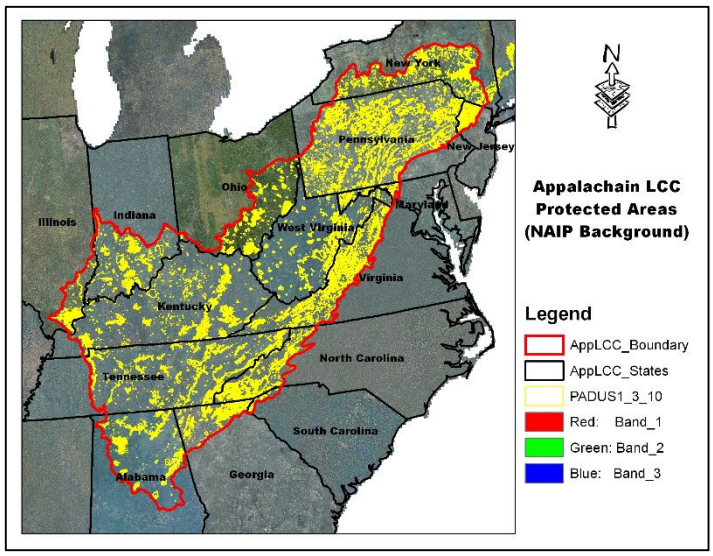
15. Folder Sixteen (AppLCC_USGS_NED):

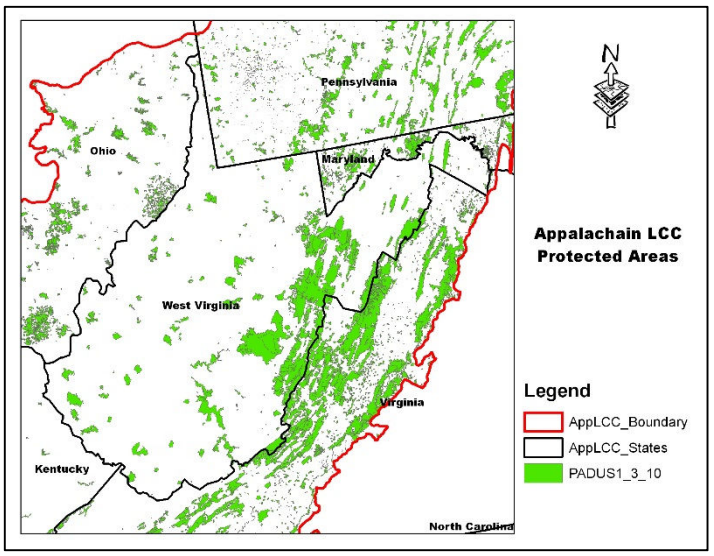


This dataset contains 30 meter square cells with the elevation of the surface for the entire AppLCC buffer area. This data can be used to calculate contours, and a number of surface drainage layers.

Source: http://ned.usgs.gov/

16. Folder Seventeen (AppLCC_USGS_PAD_US):

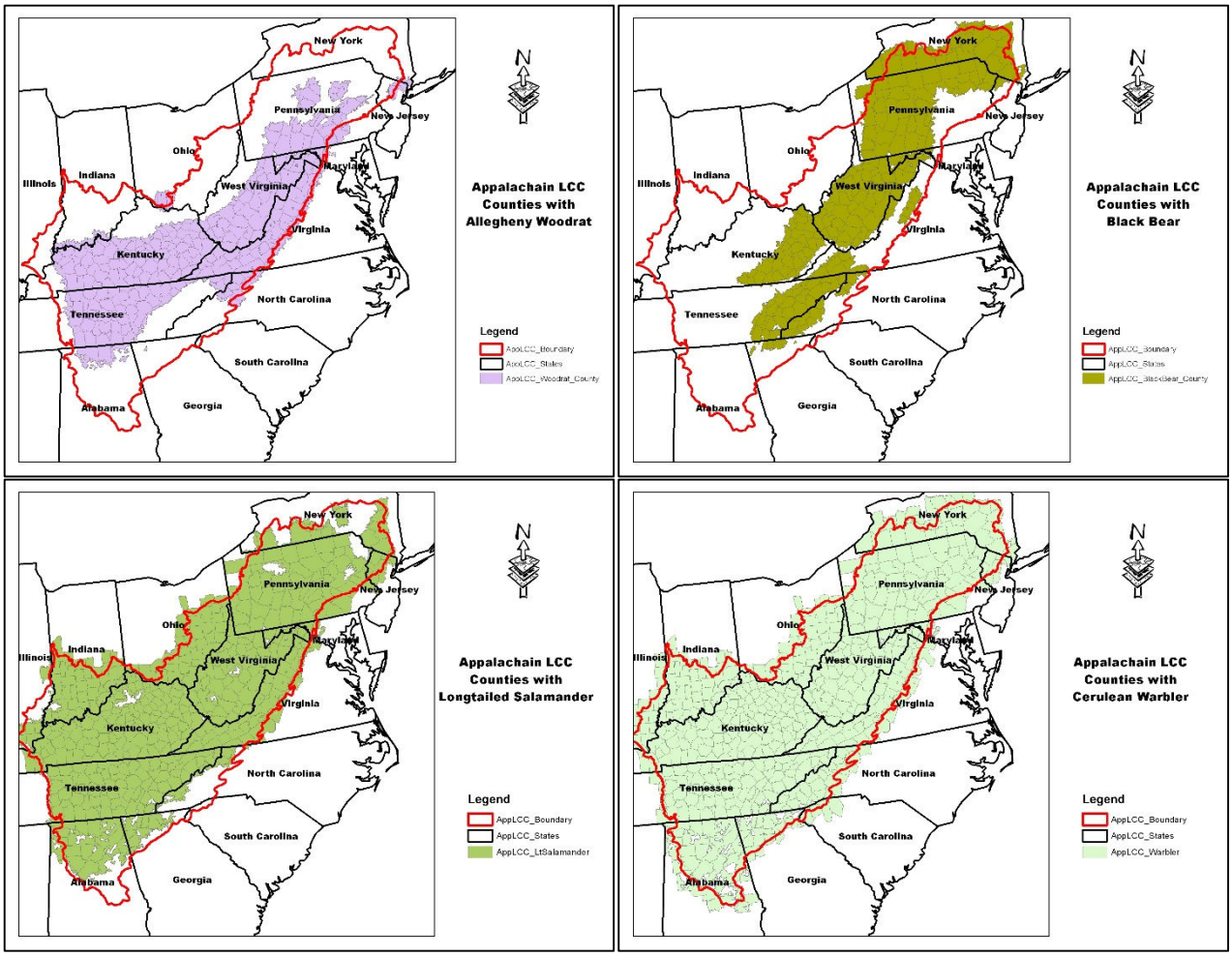




This dataset contains the USGS version of the protected area data. It contains both the public and privately owned protected areas for which the data is publicly available. It also contains codes to indicate the level of protection given to each parcel according to their management. These levels are indicated by both GAP category and IUCN codes.

Source: http://gapanalysis.usgs.gov/padus/data/download

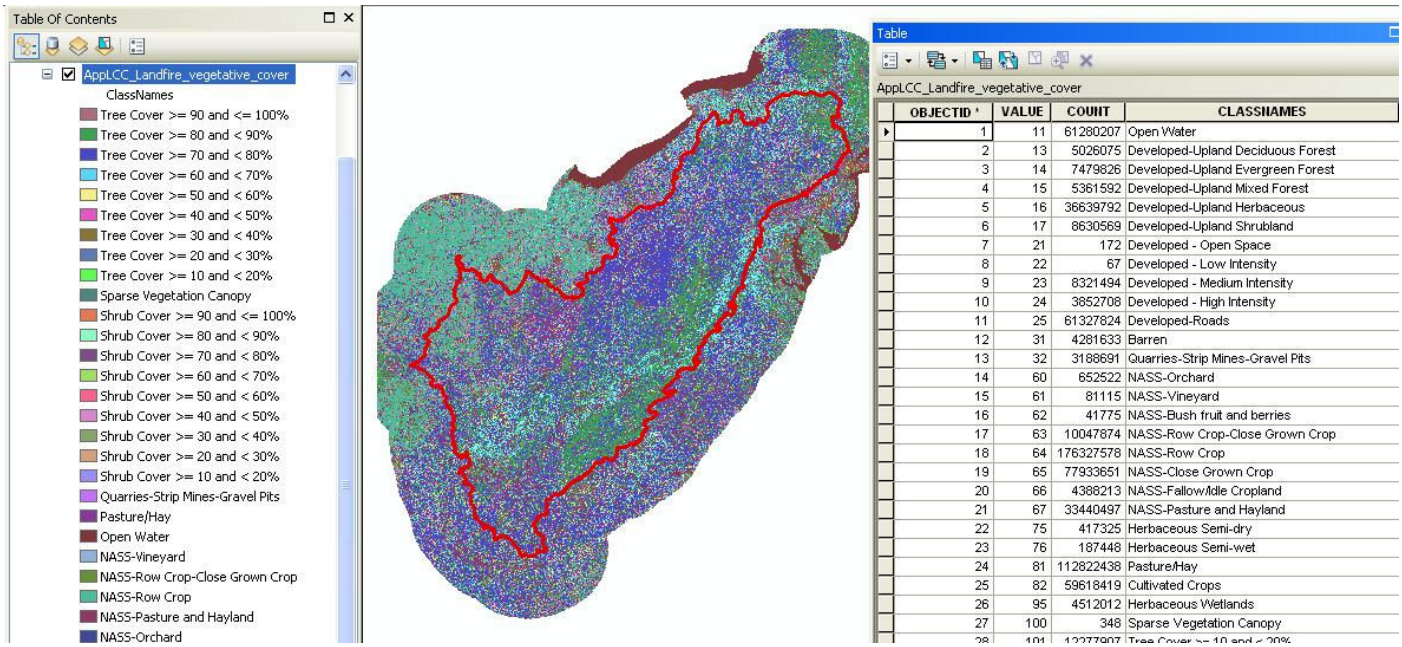
17. Representative species in the AppLCC



We have selected some of the potential candidate species to represent the AppLCC. We included county maps of their range with any other information that was available. Most were found in existing GAP datasets and those missing were mapped (by county) from their graphic maps by registering them to county datasets. Some examples are represented in these images. Top Left: Allegheny woodrat. Top Right: Black Bear, Low Left: Longtailed Salamander, Low Right: Cerulean warbler.

Source: http://gapanalysis.usgs.gov/species/data/download

18. Landfire dataset



OBJECTID *	VALUE	COUNT	CLASSNAMES
1	11	61280207	Open Water
2	13	5026075	Developed-Upland Deciduous Forest
3	14	7479826	Developed-Upland Evergreen Forest
4	15	5361592	Developed-Upland Mixed Forest
5	16	36639792	Developed-Upland Herbaceous
6	17	8630569	Developed-Upland Shrubland
7	21	172	Developed - Open Space
8	22	67	Developed - Low Intensity
9	23	8321494	Developed - Medium Intensity
10	24	3852708	Developed - High Intensity
11	25	61327824	Developed-Roads
12	31	4281633	Barren
13	32	3188691	Quarries-Strip Mines-Gravel Pits
14	60	652522	NASS-Orchard
15	61	81115	NASS-Vineyard
16	62	41775	NASS-Bush fruit and berries
17	63	10047874	NASS-Row Crop-Close Grown Crop
18	64	176327578	NASS-Row Crop
19	65	77933651	NASS-Close Grown Crop
20	66	4388213	NASS-Fallow/Idle Cropland
21	67	33440497	NASS-Pasture and Hayland
22	75	417325	Herbaceous Semi-dry
23	76	187448	Herbaceous Semi-wet
24	81	112822438	Pasture/Hay
25	82	59618419	Cultivated Crops
26	95	4512012	Herbaceous Wetlands
27	100	348	Sparse Vegetation Canopy

The Landfire dataset represents vegetation type and vegetation cover at 30 meters resolution. Vegetation is mapped using predictive landscape models based on extensive field-referenced data, satellite imagery and biophysical gradient layers using classification and regression trees. This image shows information on vegetation type on the right and vegetation cover on the left legend respectively.

Source: http://landfire.cr.usgs.gov/viewer/viewer.html

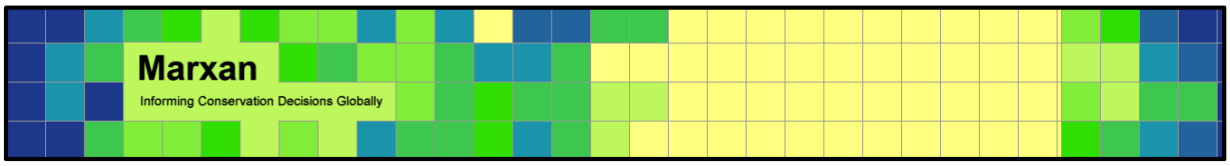
Interpretive text and graphics for AppLCC web portal (conservation planning tools)

We have provided some interpretation material and text for conservation planning tools. These programs have been grouped into broad, sometime overlapping purposes. These brief descriptions of the various conservation planning tools can be put up on the AppLCC web portal, for users to get an idea about the tools available and what purposes they could serve. We have alo provided other links, where users can get detailed information about the tool.

RESERVE SELECTION

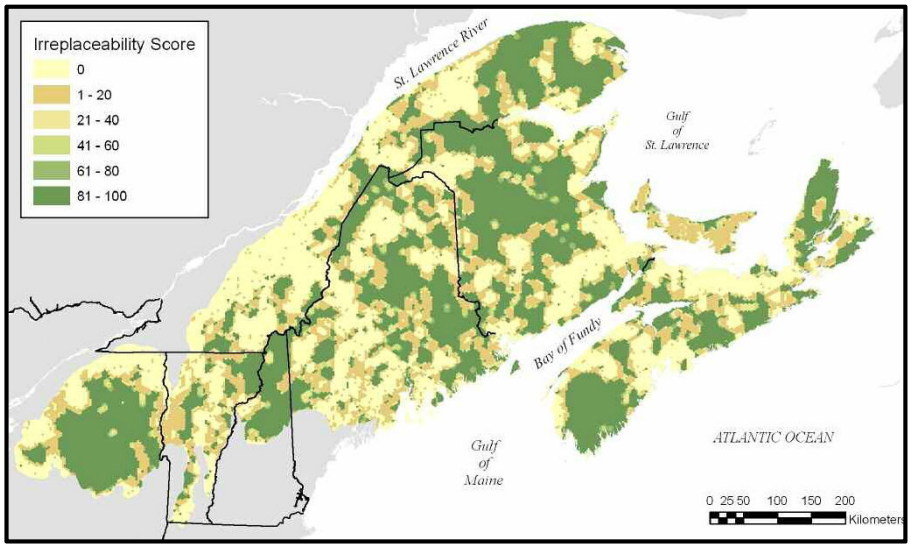
Most existing reserves were put into place in something other than a systematic biological selection process (Margules and Pressey 2000). The emerging field of systematic conservation planning seeks to identify areas that are irreplaceable, categorize them as to levels of threat and vulnerability, and thus prioritize conservation action. The software involves setting numerous assumptions, usually arrived at through consultation with regional experts and other stakeholders. For example, conservation goals (how much?) are frequently set through an iterative process for conservation targets (what?). Reserve selection then implies that the goals and targets have already been decided. This process usually involves stakeholder and multi-agency input to determine goals, targets and trade-offs.

Examples of some reserve selection tools



Marxan is freely available conservation planning software that helps address several reserve selection issues such as to what is the determining the performance of existing reserve systems; how and where to design new reserve systems; and developing multiple-use zoning plans for natural resource management. They support the selection of areas large enough to perpetuate target species and maintain biodiversity while minimizing losses.

Marxan combined with a GIS environment (raster), or Zonation, with its prioritization of theme layers (large scale raster layers), attempt to minimize cost while maximizing biodiversity. Cost in these models are not necessarily defined in terms of money, but may refer to tradeoffs in ecosystem services. An example of a possible scenario for reserve selection in the Northern Appalachian ecoregion of the United States and Canada. Irreplaceability scores come from the reserve selection software MARXAN, and represent the number of solutions in which a particular area was selected by the software given input parameters (Trombulak et al. 2008).



Zonation is a conservation planning framework and software. It produces a hierarchical prioritization of the landscape based on the occurrence levels of biodiversity features in sites (cells) by iteratively removing the least valuable remaining cell while accounting for connectivity and generalized complementarity. The output of Zonation can be imported into GIS software to create maps or for further analysis. Zonation v. 3.1 can process very large data sets containing up to ~50 million grid cells with effective data.

Please explore these and other available tools at

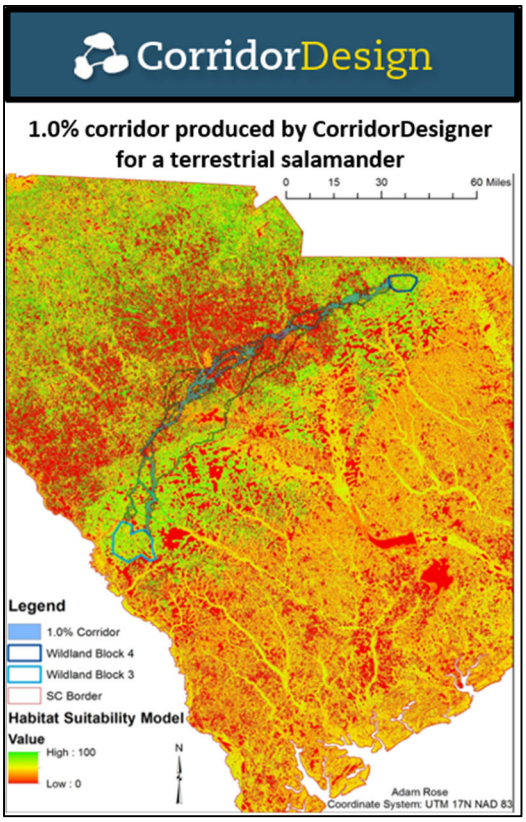
Marxan	http://www.uq.edu.au/marxan/
Marxan with zones	http://www.uq.edu.au/marxan/
Sites	http://www.biogeog.ucsb.edu/projects/tnc/toolbox.html
Zonation	http://www.helsinki.fi/bioscience/consplan/software/Zonation/index.html

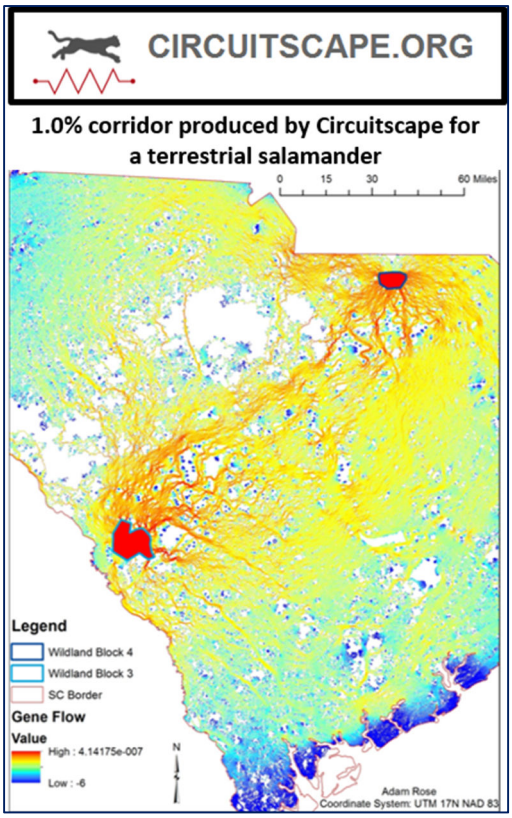
HABITAT CONNECTIVITY

Habitat connectivity is the degree to which a landscape facilitates animal movement gene flow, and other ecological flows. Maintaining connectivity between habitat patches allows species to move between different habitats in adjacent areas and is an integral component of landscape level conservation planning.

All pieces of connectivity software use an input layer that represents landscape resistance. Resistance is the degree that any kind of land cover presents resistance to movement by organisms. Resistance is sometimes scaled to individual species or taxa based on known habitat requirements; this more often is the approach in very localized habitat connectivity mapping projects (e.g., the example for corridors between two known patches), but sometimes is employed regionally for species with well-known movement parameters. More often however there is the attempt to create generalized resistance surfaces that might work for groups of organisms; such resistance layers are often derived from mapped indexes of land cover transformation by humans, and naturalness.

Examples of some connectivity tools





Example of connectivity analysis: Output of two different modeling approaches (Corridor Designer and Circuitscape) for the same organism and landscape showing different outputs. As seen in the images, the output implies different pathways in each model even though the species, and input data are identical (A. Rose, P. Leonard, R. Baldwin unpublished data). Users will have to select a particular program based on what their question, scale, and purpose is.

Please explore these and other available tools at

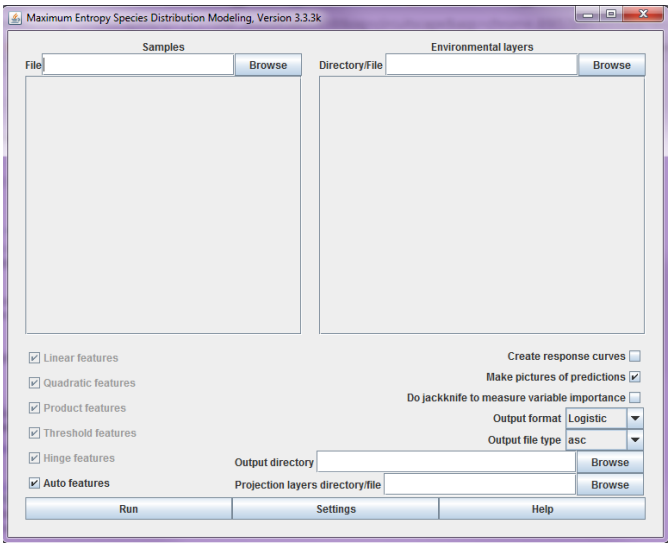
Corridor Design	http://www.corridordesign.org/
Circuitscape	http://www.circuitscape.org/Circuitscape/Welcome.html
Linkage mapper	http://code.google.com/p/linkage-mapper/
FunConn	http://www.nrel.colostate.edu/projects/starmap/funconn_index.htm
Wild Lifelines	http://www.twp.org/what-we-do/scientific-approach/wild-lifelines

SPECIES DISTRIBUTIONS AND VIABILITY

Accurate species distributions are one of the most fundamental and difficult to obtain sources of information, for conservation planning. Accurate maps of species distributions can be integral to conservation planning. For instance one goal of reserve selection is to represent regional species diversity in a set of reserves. Software like Marxan can use mapped species distributions as targets in the conservation scenarios. Endangered Species conservation is a particularly compelling case for accurate mapped species distributions. The goal is to predict where species might occur, based on known conditions at known locations where they do occur.

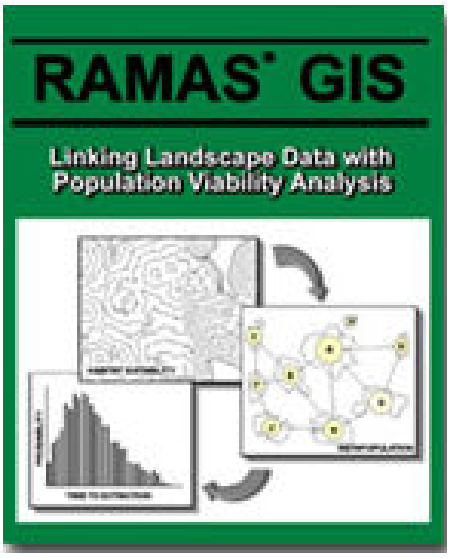
Examples of some Species distribution and viability tools:

Maxent



Maxent can generate maps of species distributions by using a modeling process in which known locations are used to develop predictive models based on mapped environmental variables. Maxent uses environmental layers key to the existence of a specie along with known location of the species to predict where the target species might exists. This program breaks down the range of a focal species to identify where that species might exist based on the environmental characteristics (temperature, precipitation, aspect, and so on) where it is already known to exist.
The above picture is a screenshot of a blank project in Maxent.

RAMAS GIS



RAMAS GIS is a program that links metapopulation modeling with landscape data and GIS technology. It has several tools to assist in building metapopulations of a species, building time change maps, assessing ecological risk and/or risk of extinction for the focal species. Like maxent, RAMAS GIS, can be useful in evaluating potential target species and identifying the locations of their habitat.

Please explore these and other available tools at

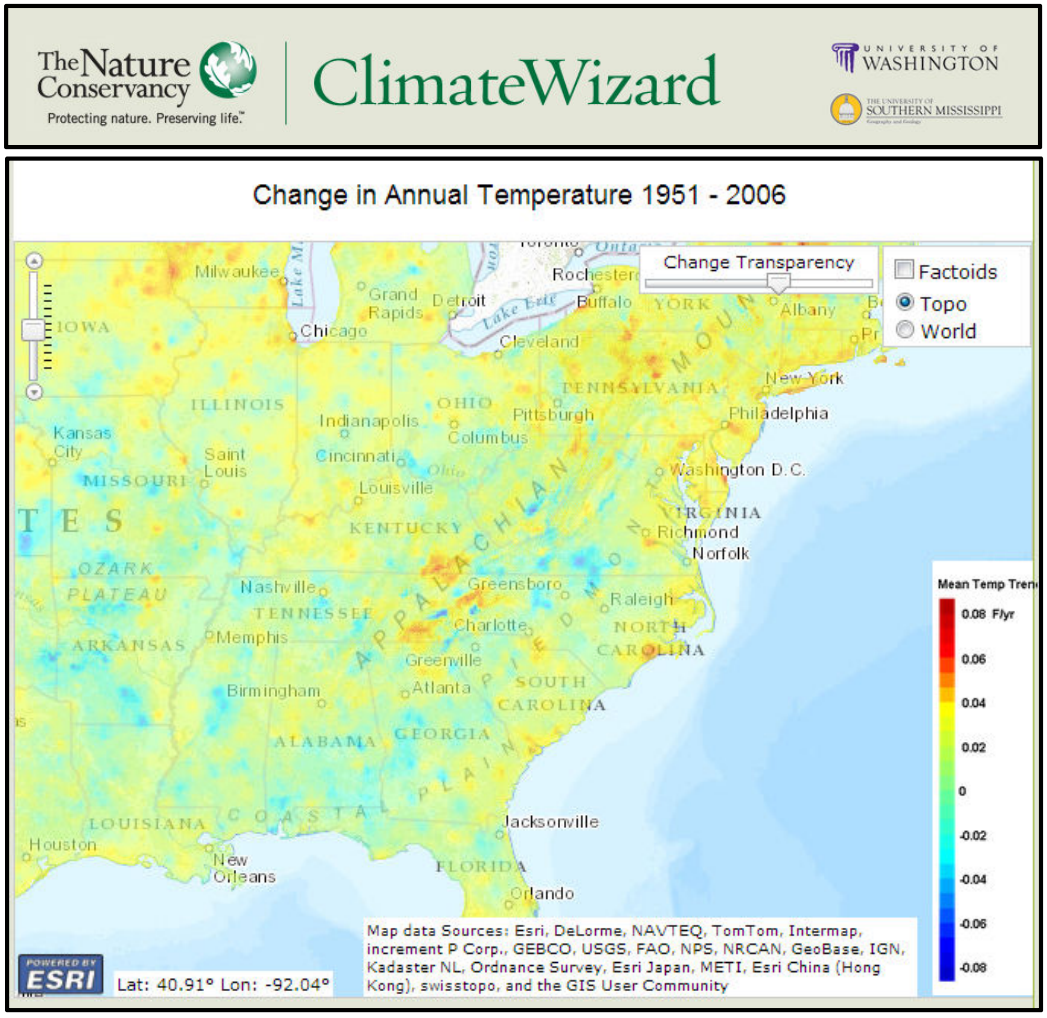
Presence	http://www.mbr-pwrc.usgs.gov/software/presence.html
Maxent	http://www.cs.princeton.edu/~schapire/maxent/
RAMAS GIS	http://www.ramas.com/ramas.htm#gis

CLIMATE

Conservation planning seeks to integrate climate change, and as such is considered a "climate adaptation" strategy. Large, interconnected areas of high naturalness are more likely to provide climate corridors to accommodate range shifts, than many, smaller, fragmented areas, and will likely also sequester carbon, mitigate effects of drought, flood, and storm events. Conservation planning that integrates climate change addresses the problem of interacting stressors and how they are likely to influence the resilience of systems, including the ability of species to shift their ranges given land use change and habitat fragmentation.

Examples of some Climate adaptability tools

Climate Wizard



Climate Wizard can be used to assess how climate has changed over time and to project what future changes are likely to occur in a given area. Climate Wizard represents the first time ever the full range of climate history and impacts for a landscape have been brought together in a user-friendly format.

Please explore these and other available tools at

Climate Wizard http://www.climatewizard.org/

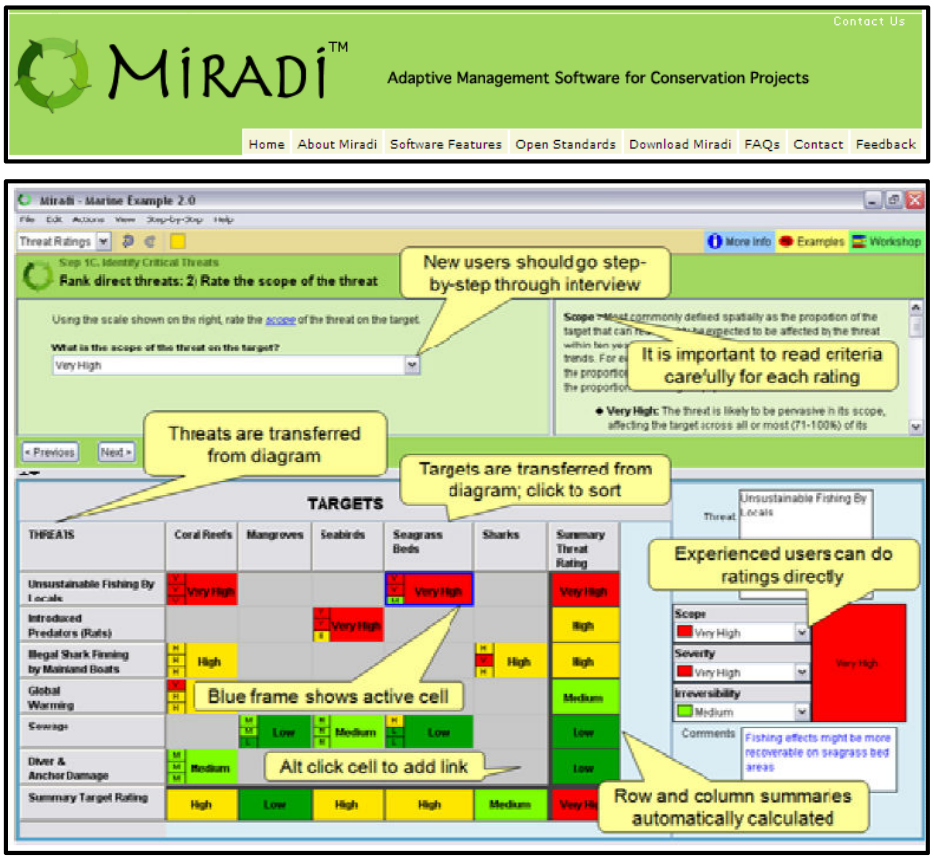
Climate and conservation http://www.conservation.org/learn/climate/Pages/climate_overview.aspx

Climate change and landscapes http://www.wcs.org/conservation-challenges/climate-change.aspx

INTEGRATIVE PLANNING

Conservation planning in more than an academic and scientific exercise. This suit of software provide ways to engage multiple partners and stakeholders in an integrated and systematic workflow. The process of conservation planning explicitly integrates people throughout. Ideally this occurs in nested groups with a core group of conservation planning experts conducting modeling exercises, and informed by larger groups. Feedback loops at every stage of the project are essential for insuring that the planning products make sense to stakeholders. Following implementation, monitoring for success and more review occurs

Examples of some integrative planning tools



Miradi is project management software designed by conservation practitioners, for conservation practitioners. It was built as a tool to implement planning and measurement best practices adopted by the CMP (Conservation Measures Partnership) Open Standards for the Practice of Conservation. Miradi's graphic user interface (GUI) looks like a cross between "TurboTax" and a graphic modeling tool and is fairly user friendly.

NatureServe Vista free decision-support system that helps users integrate conservation with land use and resource planning of all types. Vista can be used to conduct conservation planning and assessments; integrate conservation values with other planning and assessment activities, such as land use, transportation, energy, natural resource, and ecosystem-based management; evaluate, create, implement, and monitor land use and resource management scenarios designed to achieve conservation goals within existing economic, social, and political contexts. Later versions of Vista are envisioned as a toolkit framework that can incorporate the other conservation planning programs such as Marxan, community viz , etc as part of an adaptive management process.

Please explore these tools at

Natureserve Vista	http://www.natureserve.org/prodServices/vista/overview.jsp
Miradi	https://miradi.org/

THREATS (BUILDOUTS AND NATURALNESS)

Conservation planning anticipates threats to biodiversity and to prioritize conservation actions based on how vulnerable sites are to threatsConservation planning seeks to identify, understand, and map the distribution of activities that are known to threaten diversity and function of ecosystems. Such threats include: human population density, housing density, roads, road traffic, gas and oil development, some forestry and agricultural methods. Fire suppression, flood control, and other activities to control ecological process have also been considered threats. Modeling land use change has been a productive area of conservation planning research. The ability to develop predictive maps of land use change and loss of naturalness in the landscape has increased rapidly over the past decade, and they have been used prioritize landscapes for conservation action.

Examples of some tools

CommunityViz planning software is an extension for ArcGIS Desktop. As a GIS-based decision-support tool, it demonstrates the implications of different plans and choices. It supports scenario planning, sketch planning, 3-D visualization, suitability analysis, impact assessment, growth modeling and other techniques. Because it runs in a GIS environment, CommunityViz, unlike the other project programs, can incorporate numerous data layers that might include the entire infrastructure of a region.

Please explore these and other tools and datasets at

Community Viz (Local Buildout)	http://placeways.com/communityviz/
Global Human Footprint	http://sedac.ciesin.columbia.edu/wildareas/
Future Human Footprint scenarios	http://www.2c1forest.org/
Future housing and impervious surface scenarios	http://www.pnas.org/content/107/49/20887.full

TASK 6: SWAP ANALYSIS

Task 6 - Perform an analysis of existing or ongoing planning efforts being conducted by cooperators (SWAP and AFWA BMPs, JV, and/or other state and local partner conservation initiatives to be identified through communication with App LCC staff) to document them in a systematic framework that includes extent and grain size of effort, species and ecosystem goals, and landscape-level context, and to identify opportunities to integrate state and local-scale efforts into a regional conservation framework. Deliverable: A document that A) characterizes cooperating projects as to their extent, grain size, species and ecosystem goals, and landscape context, B) identifies opportunities to integrate cooperator projects to meet regional priorities, and C) identifies how the results of 1-5 may help support cooperator projects.

Summary of Task 6 – Here we take an in-depth analysis of the State Wildlife Action Plans of the 15 states that intersect with the AppLCC. This task involved reading thousands of document pages, from which we extracted some key information about the SWAPs. In this synthesis, we describe how the information contained in the individual State Wildlife Action Plans and conservation plans by other agencies can be linked together towards identifying opportunities to integrate state and local scale efforts into regional conservation framework for the AppLCC. When examining the SWAPs as a whole, their primary feature is heterogeneity. While the SWAPs in many cases are well calibrated to the needs of the individual state, and in some cases effort has been made to homogenize across state boundaries, their role in the App LCC remains unclear. If the App LCC were to adopt a regional conservation planning strategy that is science-based, the information in the SWAPs, as documented in this report, could be drawn upon to select focal species and ecosystems, parameterize models, and bridge coarse-fine-filter gaps. On the other hand, lack of uniform methodology across SWAPs could impede regional study. The AppLCC can use the information collected in this study to collect some finer scaled data from states, expand some of the work done at individual state levels to the LCC and also deliver data in a format that is useful for individual states, but also for ecoregional planning at a scale that makes ecological sense.

BACKGROUND

This is the final task of the data needs assessment project. In our previous tasks, we did the following:

1. Evaluated existing spatial data for coverage, conservation planning relevance, and quality
2. Assembled public data in geodatabase
3. Defined conservation planning tasks that can be accomplished with available, quality data, using some of the available software tools
4. Identified what other problems could be addressed if data gaps were filled, and
5. Interpreted uses of data and tools for website

During the Data Needs Assessment we came to the conclusion that there are two essential issues facing the App LCC. First, there is the problem of selecting a conservation planning methodology. Second, is the problem of bridging a fine-filter data gap so conservation planning can help with more local decisions? There are a number of conservation planning frameworks that are science-based. We strongly recommend the App LCC select for testing 2-3 well-reviewed methodologies. Examples include combining a reserve selection algorithm that integrates data from multiple scales, with a habitat connectivity algorithm. Three methods that could be tested include 1) Marxan, Marxan with Zones combined with a gene flow model for connectivity and resistant kernels, 2) Resistant Landscape approach (TNC), and 3) NALCC conservation planning method, LCAD. Each of these approaches has philosophical and methodological similarities as well as differences. This will allow the AppLCC to test and select the most appropriate method for its circumstances. We caution that the entire LCC system should, if it is to follow the underlying principles of science-based conservation planning, attempt as much as possible within biomes to adopt methods and datasets that are homogenous across LCC boundaries.

Part of understanding the needs of a region is knowing what has come before. The purpose of a regional approach to conservation is to transcend localities and make decisions to insure optimal conditions for biodiversity across multiple jurisdictional and political boundaries. Ecoregional approaches to conservation planning, of which the LCC system is a recent, agency-driven iteration, are well documented and extend back to the 1980s. The recognition that ecosystems do not observe political boundaries has rich coverage in the literature, well back to the early 20th century. At the same time, state governments in the United States bear the greatest responsibility for managing populations of wildlife. States have developed plans for wildlife conservation, and those plans must be considered in the context of regional conservation.

In this synthesis, we describe how the information contained in the individual State Wildlife Action Plans and conservation plans by other agencies can be linked together towards identifying opportunities to integrate state and local scale efforts into regional conservation framework for the AppLCC. Specifically, our aim was to quantify the objectivity and efforts across the 15 partner states. We are particularly interested in the commonalities of methodology and results across plans. Throughout the document, we integrate our previous efforts in this data needs assessment to figure out ways that state efforts can be upscaled to meet regional planning goals.

This review of the State Wildlife Action Plans (SWAPs) and other conservation planning efforts in the region is a timely and important effort toward synthesizing the extent and resolution of effort, species and ecosystem goals, and landscape-level context, in order to identify opportunities to integrate state and local-scale efforts into a regional conservation framework.

JVs, AFWA BMPs and SWAPs:

Joint Ventures and SWAPs operate at different spatial scales. SWAPs are restricted to state boundaries. JVs are regional partnerships involving federal, state, and local government agencies, corporations, tribes, individuals, and a wide range of non-governmental organizations which advance conservation efforts and help identify local land use priorities. JVs provide coordination for conservation planning and implementation that benefit specific species (Eastern Brook Trout Joint Venture), or certain taxonomic groups across an ecoregion (such as Appalachian Mountains Joint Venture, Central Hardwoods Joint Venture). JVs develop science-based goals and strategies, and a non-regulatory approach for achieving conservation. While the extent of certain JV may overlap with LCCs, the focus of the two efforts are different (Table 3). JV tend to focus on one or a few species (usually vertebrates, especially birds), whereas LCCs and State Wildlife Action Plans cover a much wider taxonomic strata. Given the restrictions of time, we decide to focus our analysis on the fifteen SWAPs in the AppLCC.

Table 3: Summary of Conservation Planning efforts active in the AppLCC region

	State Wildlife Action Plans	**AFWA Best Practicies for State Wildlife Action Plans (Voluntary guidance to states for revision and implementation)**	**AFWA BMP for trapping in the United States**	**Eastern Brook Trout Joint Venture (EBJV)**	**Atlantic Coast Joint Venture (ACJV)**	**Central Hardwoods Joint Venture Concept Plan (CHJV)**	**Appalachian Mountains Joint Venture (AMJV)**
Extent	Statewide, long term	National	National or regional	Ecoregional	Ecoregional	Ecoregional	Ecoregional
Grain Size	Usually 30 m datasets, differentHUCs	Statewide	Species Specific	Usually 30m datasets, HUC 6			
Goals (Sp/Eco)	Multiple Species and multiple habitats	Voluntary guidance for SWAP and SWAP revisions for standardization across different state action plans	Trapping game species	One species across entire region	Multiple bird species across the Atlantic coast	Multiple species fo forest interior birds	Habitats for Breeding, wintering and migrating bird species
Sp Goals	Several top SGCN	None specifically	Trapping animals to address animal welfare and increase trappers' efficiency	Brook Trout	Migratory Birds		To maintain sustainable populations of native avifauna
Ecosyst Goals	Varies by state	None specifically	None specifically	Identify streams occupied by EBT and	Identify and protect Migratory Stop overs		Restore and sustain viable habitats for birds in the region
LS context	State	National, applicable at state level	None specifically	AppLCC and NAPLCC	Mostly along the Atlantic Coast, but little of AppLCC		Overlaps with AppLCC

Approach to analyzing SWAPs

In order conduct this study, we read and analyzed the State Wildlife Action Plans from all 15 AppLCC partner states. We extracted information from the plans in a way that would enable us to analyze and synthesize the data dependency and objectivity across the SWAPs. We extracted key information of the plans, so that they can be presented here in a consolidated, organized and systematic manner. We also contacted all SWAP coordinators in all 15 partner states, with whom we had one on one email conversations regarding the upcoming SWAP revision. All states responded at-least once to my emails. In the emails, I asked questions on proposed changes in SWAP revisions, datasets in progress and conservation planning efforts in the different states. I also shared a consolidated summary document with each state, and gave them an opportunity to review and comment on it Appendix 1 contains all the state summaries. Some of our surveys are still out, and we will update the revised summaries as soon as we hear back from them.

While there are major differences in the methods and efforts across the states, putting them in one systematic framework allows a comprehensive picture of the conservation planning efforts conducted in the 2005 SWAP and the self-reported changes in the upcoming SWAP revision.

State Composition of LCCs

As a first step towards understanding the geography of the AppLCC, we did some basic analysis to understand the composition of all 22 LCCs that have been designated by the USFW. AppLCC spans over has fifteen state partners across the Northern, Mid-West, Eastern and Southern states. Our analysis shows that the AppLCC has the largest number of state partners across all the LCCs across the US and US territories (Table 4). This multi-state partner membership in the AppLCC probably creates greater challenges in coordination efforts. The North Atlantic LCC (NALCC) and Gulf Coastal Plains and Ozarks LCC have the next highest number of partner states (13 each).

Table 4: Snapshot of the composition of LCCs with respect to the number of state partners

LCC Nos (Assigned by USFW)	Names of LCC	No states
1	Appalachian	15
9	Gulf Coastal Plains and Ozarks	13
10	North Atlantic	13
4	Eastern Tallgrass Prairie and Big Rivers	12
16	Upper Midwest and Great Lakes	10
7	Great Plains	8
6	Great Northern	7
13	Plains and Prairie Potholes	7
15	Southern Rockies	7
3	Desert	6
5	Great Basin	6
8	Gulf Coast Prairie	6
14	South Atlantic	6
11	North Pacific	4
22	Caribbean	3
2	California	1
12	Peninsular Florida	1
17	Aleutian and Bering Sea Islands	1
18	Arctic	1
19	Northwest Boreal	1
20	Western Alaska	1
21	Pacific Islands	1

We then tried to assess how many LCCs each state within the AppLCC was a member of. Within the partner states of the AppLCC, most states have partnerships in other neighboring LCCs (Table 5). Eight out of the 15 states have LCC partnerships in more than 3 LCCs, six states are members of 2 LCCs, and West Virginia is the only state within the region that is completely and exclusively within the AppLCC. Alabama and Illinois have four LCCs intersecting their state. Just as it is difficult for the LCC to coordinate across so many state partners, a state that has members in different LCCs probably puts some strain on the logistical and coordination efforts at the state level.

Table 5: Partner states within the AppLCC and other neighboring LCCs (not arranged in any specific order)

S. No	State	No. LCCs	LCC 1	LCC 2	LCC 3	LCC 4
1	AL	4	Appalachian	Gulf Coastal Plains and Ozarks	Gulf Coast Prairie	South Atlantic
2	IL	4	Appalachian	Gulf Coastal Plains and Ozarks	Upper Midwest and Great Lakes	Eastern Tallgrass Prairie and Big Rivers
3	GA	3	Appalachian	Gulf Coastal Plains and Ozarks	South Atlantic	
4	IN	3	Appalachian	Eastern Tallgrass Prairie and Big Rivers	Upper Midwest and Great Lakes	
5	NY	3	Appalachian	North Atlantic	Upper Midwest and Great Lakes	
6	OH	3	Appalachian	Eastern Tallgrass Prairie and Big Rivers	Upper Midwest and Great Lakes	
7	PA	3	Appalachian	North Atlantic	Upper Midwest and Great Lakes	
8	VA	3	Appalachian	North Atlantic	South Atlantic	
9	KY	2	Appalachian	Gulf Coastal Plains and Ozarks		
10	MD	2	Appalachian	North Atlantic		
11	NC	2	Appalachian	South Atlantic		
12	NJ	2	Appalachian	North Atlantic		
13	SC	2	Appalachian	South Atlantic		
14	TN	2	Appalachian	Gulf Coastal Plains and Ozarks		
15	WV	1	Appalachian			

This analysis reckons some of the top-down (Table 4) and bottom up (Table 5) problems that are involved in multi-stakeholder, multiple partnership driven conservation initiatives face. Given such a diverse portfolio of the AppLCC, having the highest number of state partners most certainly presents

unique challenges in coordinating and obtaining outcomes in a timely manner. However, such endeavors have been undertaken, and very successfully so, by neighboring LCCs such as the South Atlantic and North Atlantic LCCs. NALCC has 13 states (although several states belong entirely to the NALCC) has been very successful at ecoregional conservation planning projects, such as the LCAD effort. On the other end, being a member of several different LCCs can also pose unique challenges for each state, such as coordination, and dedicating enough time and resources to the LCC. Being a member of a fewer number of regional conservation efforts may be more efficient, because then states can devote their complete attention toward one regional planning effort.

Conservation planning at the regional scale is also challenging when there is heterogeneity in data and conservation planning efforts at the state level. Thus, a comprehensive synthesis of the state wildlife action plans seems very critical in the AppLCC, as it could serve as a way to understanding the level of variation in state conservation goals, efforts, approaches, and outcomes, and integrate efforts to produce rational decision making and conservation planning at the ecoregional level.

State Wildlife Action Plans

In the United States, wildlife conservation historically has been carried out through hunting and fishing regulations focused on game species, through establishment of public wildlife refuges and conservation lands, and through endangered species protection laws. These approaches had left a large portion of wildlife and habitat unaddressed by laws and policies, especially for non-game species and habitat types. In order to fill this gap, Congress created the State Wildlife Grants (SWG) in 2000. SWG provides states with funds to protect and prevent species from becoming imperiled. This theme is commonly known as "Keep common species common". In order to be eligible for the SWG funding, each state had to develop a comprehensive state wildlife action plan by 2005. States were allowed to take any approach they wished to, as long as it fulfilled the eight basic elements that were issues as guidelines. These are:

1. Identify the distribution and abundance of species of greatest conservation need (SGCN).
2. Describe the location and condition of key habitats essential to the SGCN.
3. Describe the threats to and research needs for SGCN and their habitats.
4. Describe the conservation actions required to conserve the identified species and their habitats.
5. Identify monitoring plans for SGCN, their habitats, and the proposed conservation actions.
6. Describe the review process of the WAP at intervals not to exceed ten years.
7. Coordinate the WAP with other federal, state, and local agencies' wildlife and land management plans.
8. Include a public involvement process in the development and implementation of the WAP.

We chose to focus our synthesis on the first two elements (SGCN and habitat). This is the baseline information on which recovery plans, monitoring and adaptive management are based on. The monitoring, review, coordination with agencies and public involvement are more logistical in their intent. In the following sections, we present details of our synthesis on these four elements. Along the way, we cross walk our synthesis of SWAPs with the previous tasks in this project.

Species

The initial mandate for the development of wildlife action plans was to "Keep common species common". Identifying the species of greatest conservation need is a critical exercise, which sets the stage for all downstream conservation planning efforts. One of the main purpose of selecting focal species in planning is to provide focus and context to the development of specific conservation actions. These prioritized species may then become candidates for setting conservation targets in the long or short term. Thus, investing time, resources and effort in defining the species are of critical importance in downstream planning efforts. Using a standardized/objective approach for identification of SGCN helps in objective re-iterations of the process, and may provide ways of replicating the process outside the states.

The fifteen states used a variety of approaches in determining the Species of Greatest Conservation Need (SGCN), and organized the SGCN lists in different ways. Nine states prepared lists of SGCN, whereas the other six states categorized their SGCN lists into two or more tiers, based on various criteria. In the way that states defined taxonomic groups, there was clear definition of vertebrates (mammals, birds, amphibians, reptiles, and fishes), and to a large extent, crayfish and mussels. The invertebrate taxonomic group was variously presented in the different states (Table 6). For example, WV categorized invertebrates very extensively into butterflies, cave invertebrates, land snails, moths, spiders, stoneflies, tiger beetles, and dragonflies and damselflies. Several of the states expressed the need to include plants, but could not proceed because it was not in the mandate of the USFW directive, or there was not enough data and/or expertise at hand.

States followed a variety of criteria and undertook a sleuth of approaches in deciding their SGCN lists. Species selection for inclusion in the SGCN lists was primarily driven by expert opinion based on available literature. States sometimes supplemented the expert opinion process by self-devised ranking of species in various categories (Eg. VA, NC, etc) or following published approaches. The most common approach in identifying SGCN was to start with the compilation of multiple lists (Federal/ Natureserve Global and State ranks; and taxa specific lists such as Partners in Flight, Waterbird conservation plans, etc), work through the lists with experts by means of workshops, Taxon Advisory Committees, online surveys, or a combination of any of these means. Two states (NJ and IL) incorporated a measure of confidence in their species assessments and rankings. NJ devised a species selection procedure based on the Delphi Status Review, which is an iterative, consensus building exercise (Clark et al. 2006). Another available method is the Millsap et al (1990) approach that some states have alluded to using in the upcoming revision. In order to capture this underlying factor, we tabulated the criteria of SGCN selection across the states (Table 7). On tabulating the criteria of SGCN selection, we found certain characteristics such as state and federally listed species, species distribution, population trend, and endemism to be the most commonly used criteria for SGCN identification. Several other criteria were used to prioritize the lists.

As one step further in this process, we tabulated the mammalian species that states had listed in their SGCN or in the top two tiers of tiered lists (Table 8). We used mammal lists as an example, to illustrate that certain species that may be contiguous across different states may often be prioritized differently, depending on the criteria that were used. This list can also serve as a starting template to be used for AppLCC indicator/surrogate species determination. Currently the AppLCC does not have a defined list/suite of focal species. Focal species are often used in conservation planning, if their habitat needs represent those of larger groups of organisms and/or if they are of particular conservation interest. We

have previously recommended identifying a suite of species that is representative of the habitat and/or management needs of larger groups of species and to AppLCC's conservation plans (Task 4).

Habitat

Different states identified habits in a variety of ways, leading to a no. of different terrestrial and aquatic habitat categories (details in Appendix I). Several states used their GAP analysis to develop habitat classifications, while others conducted and explained new habitat classification methods in their SWAPs. For example, Indiana identified a total of ~ 80 habitats clubbed into eight broad categories, which they used to write the State CWS (Agriculture, Aquatic Systems, Barren Lands, Developed Lands, Forested Lands, Grasslands, Subterranean systems, and Wetlands). Tennessee used a five level hierarchical approach to defining habitat. The Landscape project in NJ highlights an effort to use data-dependent objective and scientific approach towards habitat conservation, prioritization, and planning. Some states developed habitat classifications, and explained the process in details in their SWAP. Other states were more descriptive of the habitats. I broadly categorized terrestrial habitats into forest, grassland, rocky outcrops, wetlands, and anthropogenic habitat (although there may be some overlap between these categories), and cross tabulated the different habitats across all 15 states (Table 9).

A cursory glance through this matric shows that different states have described habitats in a variety of ways. This is just a tabulation, and I have not attempted any cross walk between definitions of habitats across states, thus there is definitely some redundancy in this matrix. However, it is not difficult to see that there exists a variety of habitat descriptions and delineations across the states. For example, there are a total of 34 different categories of rocky habitats overall. PA had just one designation for this kind of habitat, which involved caves, rock outcrops, mines, and talus slopes. On the other hand, IL had a much more detailed classification of rock habitats. They identified a total of five rock habitats: Glade, Bluff & Cliff, Lakeshore, aquatic caves, and terrestrial caves. Nine states had a category for anthropogenic lands, and had various levels of classification within it (1-7 categories per state). At the same time, MD, NC, GA, OH, SC and NJ did not have a single category for anthropogenic habitats.

While some heterogeneity can be dealt with for ecoregional conservation planning, some common way to identify habitats at a finer scale than currently availble would be extremely useful to the AppLCC. The Northeast Terrestrial Habitat Mapping Project (NETHM) overcomes this by creating a classification system based on the ecological systems classification created by NatureServe, with additional systems for altered habitats and land-use types. These Habitat Systems are intended to be applicable at medium and large scales, and to supplement the finer-scale approaches used within states for specific projects and needs. They include types that are extensive and cover large areas, as well as small, specific-environment types that may cover only a hectare or two. Several Northern states are planning to use this in their revisions, and it may be worth extending the classification to cover the other AppLCC states as well.

We then developed a ranking system during our meta-analysis of the SWAPs. We recorded the number of conservation planning efforts taken by the states, and calculated a cumulative score (Table 10). We decided to do this as a way to measure objectivity/complexity and data-driven-ness in the SWAPs. We also gave states multiple opportunities to comment on a previous version of this table, and have incorporated most changes if they responded. As far this ranking system goes, VA and TN score very high, because of the number of individual analysis they have completed in their SWAPs. They are followed by several states that score similarly in different blocks. Most states that had a higher score did

5 out of the 13 tasks. The most frequently completed exercise across the states was identifying areas of conservation priority. Several of the states used mapping and overlaying species richness maps of various taxa to identify terrestrial and aquatic areas of conservation priority (Eg: KY, VA). The only state that did not score in these categories was SC. It will be very interesting to use this (or a modification of this) rubric to measure change in scores after the SWAP revision is completed.

Revisions to SWAPS

During our communication with the state SWAP coordinators, I asked them about the changes they will be undertaking in the 2015 revisions of the plans. The states are in different stages (from early stages in TN, AL to more advanced stages where SGCN lists have been revised in NC). Most plans that I used were 2005, or 2008 revisions (eg PA), except for KY, which has already completed its revision in 2013. Given this disparity in the stages of revisions, we present a very brief summary in two tables (Table 11, Table 12) highlighting some of the most important changes that states have mentioned as being important in their revisions. Climate change and wildlife disease are important across the border additions in the revisions. Improving partnership involvement, electronic means of disseminating information are other big issues states are trying to improve upon. Several northern states are planning to use North East Terrestrial and Aquatic Habitat Classifications for their revisions, and several states are planning to adopt AFWA voluntary best practices for SWAP revisions (Table 9).

Please note that we are still in communication with states, and are waiting to hear back from several of them. We anticipate that there will be newer information in the revision section will be significantly updated once we hear from them, and maybe some minor changes to the other sections. For more details on each state, please refer to the appendices.

We also asked states to share any information on data that is being currently developed. This information is summarized in Table 13. This table can be helpful in developing AppLCC wide datasets for conservation planning efforts in the near future.

Caveats

With this intensive analysis of the SWAPs, we hope that we have presented the heterogeneity of the efforts undertaken by the states within the AppLCC ecoregion in a systematic, meaningful manner. Several states communicated with us that they are moving towards a more standardized/objective approach towards writing their plans in the upcoming revisions. While the information here is to the best of our (and also the state's) knowledge, we suggest that the revision section be taken as tentative, given that things may change during the process.

Conclusions

When examining the SWAPs as a whole, their primary feature is heterogeneity. While the SWAPs in many cases are well calibrated to the needs of the individual state, and in some cases effort has been made to homogenize across state boundaries, their role in the App LCC remains unclear. If the App LCC were to adopt a regional conservation planning strategy that is science-based, the information in the SWAPs, as documented in this report, could be drawn upon to select focal species and ecosystems, parameterize models, and bridge coarse-fine-filter gaps. On the other hand, lack of uniform methodology across SWAPs could impede regional study.

The level of data dependency varies by state: from SGCN determination, habitat delineation to conservation planning exercises- there is a wide range of methods, data usage, complexity and objectivity. From our correspondence with states, we found that they are in different stages of the

revision, and we hope that the information in this report will be helpful for them as they proceed in their revision work.

Scaling up to a certain degree, following standardized and replicable approaches in all steps will help planning at the LCC level. The LCAD approach in the NALCC is a fine example of what ecoregional conservation planning can be achieved, even when multiple state agencies are involved. The AppLCC can use the information collected in this study to collect some finer scaled data from states, expand some of the work done at individual state levels to the LCC and also deliver data in a format that is useful for individual states, but also for ecoregional planning at a scale that makes ecological sense.

References Cited

Millsap, B., J. A. Gore, D. E. Runde, and S. I. Cerulean. 1990. Setting priorities for the conservation of fish and wildlife species in Florida. Wildlife Monographs 111.

Clark, K.E., J. E. Applegate, L. J. Niles, and David S. Dobkin. 2006. An Objective Means of Species Status Assessment: Adapting the Delphi Technique. Wildlife Society Bulletin 34(2):419-425.

Table 6: A summary of SGCN species across the 15 AppLCC states from the 2005 SWAP summaries (available from http://www.teaming.com/wildlife-action-plan)

State	KY		NC		IL		MD		NY		WV		TN		VA		PA		OH		SC		IN	AL		GA		NJ	
Type of list	Not Tiered		Not Tiered		Not tiered		Not Tiered		Not Tiered		Tiered		Tiered		Not tiered		Tiered		Not Tiered		Tiered		Not Tiered	Tiered		Tiered		Not Tiered	
	Total No	Total SGCN	Total No	Total SGCN	Total No	Total SGCN	Total No	Total SGCN	Total No	Total SGCN	Total No	Total SGCN	Total No	Total SGCN	Total No	Total SGCN	Total No	Total SGCN	Total No	Total SGCN	Total No	Total SGCN	SGCN	Total No	Total SGCN	Total No	Total SGCN	Total No	Total SGCN
Mussels	134	46	56	40	61	29					69	43	132	77	89	63	65	41	81	31	29	26	24	153	92			14	9
Fish	269	59	231	83	187	80	635	40	Freshwater >160 Diadromous 16 Marine Unknown	Freshwater 40 Diadromous 8 Marine 51	180	73	>325	85	210	97	194	69			Marine 256, Freshwater and diadromous 146	Marine 163, Freshwater and diadromous 62	25	306	57	250	74	400	20
Amphibian and reptiles									70	44											142	52							
Amphibians	74	22	80	41	41	14	41	17			49	19	70	24	74	32	36	15	14	10			10	73	14	86	22	33	11
Reptiles	80	27	79	43	60	23	49	25			39	20	61	17	61	28	37	22	70	22			18	93	26	83	22	44	17
Birds	361	81	260	92	300	83	~410	141	>450	118	234	74	>300	81	374	96	394	44	200 (breeding)	89	390	111	40	244	28	328	33	327	149
Mammals	94	16	80	38	59	20	97	34	92	22	72	26	89	29	85	24	73	14	56	25	(terrestrial and marine) 106	24	22	64	24	92	23	89	17
FW Snails																					24	4		135	34				
Crayfish			41	21							21	9			unknown	14	13	4	20	1	36	23	2	83	28				
Reptiles and Amphibians																													
Snails			62	10	~170000	347			10 families	14 freshwater, 1 terrestrial	Land: 130	10	374	120	unknown	96	>170	52	169	0			2					85	0
Crayfish and other crustaceans													101	52															
Crustacean					207	22																							
Invertebrates							~20000	245					unknown	59	?	185					Marine 803	775							
Mussels and Clams									82 known freshwater unknown marine	55, 5																			
Insects													Unknown	120	20,000+	290	>10,120	312	Thousands	22(terrestrial)							>10,000	66
Butterflies											128	31																	
Tiger beetles											12	12																	
Stoneflies											12	12																	
Odontates											146	72																	
Moths											92	17																	
Spiders											401	18																	
Cave invertebrates											190	47																	
Other arthropods and invertebrates																							129						
Molluscks																										191	75		
Aquatic arthropods																										unknown	47		
Plants																										3000+	323		

Table 7: SGCN criteria tabulated across the 15 AppLCC states. Column totals represent the number of states that used that particular criteria, whereas row totals represent the number of criteria used by each state.

	AL	PA	MD	NC	VA	SC	OH	NY	WV	KY	IN	IL	NJ	GA	TN	Total
Federal Status		Threatened and endangered	Endangered, threatened and candidate			Endangered, threatened, rare or special concern		Endangered or threatened			Endangered, threatened and candidate	Listed species			Endangered, threatened and candidate	
State Status		State-listed threatened and endangered	Endangered, threatened and candidate	Endangered, threatened and candidate		endangered, threatened, rare or special concern		endangered or threatened, special concern			Endangered or Special Concern	Threatened or endangered			endangered or threatened, special concern	
Natural Heritage Global Ranks		Natural Heritage Program tracked and watch-list animal species							G1-G3G4	G1, G2, and G3		G1, G2, G3	G1-G3	global rarity	G1 - G3	
Natural Heritage State Ranks		1		S1-S5		S1-S5		S1-S2	SH, S1, S1S2	S1-S2			S1-S3	state rarity	Used as supplementary info	
Population Trends	1			1	1	1								1	1	6
Endemic species		1	1							1		1		1		5
Distribution				1		1				1			1		1	5
Species with limited dispersal		1	1		1											3
Responsibility species		1	1									1				3
Population Status (known/unknown)				1		1				1						3
Condition of Habitat					2								1			3
Degree of Exploitation				1	1	1										3
Fesability measure				1		1								1		3
Funding				2		1										3
Current relative to historial distr							1				1	1				3
Threats									1		1		1	1		4
Status in adjacent states								1							1	2
Species of regional conservation concern		1											1			2
Imperiled species (globally rare)		1	1													2
Declining species	1		1						1				1			4
Disjunct species populations	1		1													2
Vulnerable species			1									1				2
Species with fragmented or isolated populations		1	1													2
Species of special, or conservation, concern		1	1													2
Specialized habitat Needs	1											1				2
Rarity												1			1	2
Range in State					1									1		2
Abundance							1						1			2
Knowledge of Limiting Factors				1		1										2
Species with small, localized "at-risk" populations		1	1													2
Extreme rarity	1															1
Restricted distribution	1															1
Immedeate Research/conservation action needed	1															1
Lack of information									1			1				2
Focal species			1													1
Indicator species			1													1
Use as an indicator species												1				
Species that aggregate in concentration areas			1													1
Legal Status															1	1
Overall Population Size (Inc/Dec)											1					1
Mobility					1											1
Life History Characteristics										1						1
Competition with Invasive species					1											1
Environmental quality (pollution sensitivity)					1											1
Status of closely related taxa/niche											1					1
Sensitive aquatic species		1														1
Extirpated species that may be re-introduced										1						1
SUM	**7**	**10**	**13**	**8**	**9**	**7**	**2**	**1**	**3**	**5**	**4**	**8**	**6**	**5**	**5**	

Table 8: Mammalian species identified in the top two tiers of SGCN lists across the 15 AppLCC states. Column totals represent the number of states that had the species in their list, whereas row totals represent the number of mammalian SGCN species in each state.

Common Name	Scientific Name	AL	GA	IL	IN	KY	MD	NJ	NY	NC	OH	PA	SC	TN	VA	WV	Total across states
Indiana Bat/ Indiana Myotis	*Myotis sodalis*	1	1		1	1	1	1	1	1	1	1		1	1	1	**13**
Rafinesque's/Eastern big eared bat	*Corynorhinus rafinesquii*	1	1	1	1	1	1			1	1		1		1	1	**11**
Allegheny Woodrat	*Neotoma magister*	1			1	1	1	1	1	1	1	1		1		1	**11**
Eastern Small-footed Bat	*Myotis leibii/subulatus*		1			1	1	1		1	1	1	1	1		1	**10**
Southeastern Myotis	*Myotis austroriparius*	1	1	1	1	1	1			1			1	1			**9**
Silver-haired Bat	*Lasionycteris noctivagans*				1		1	1		1	1	1	1			1	**8**
Gray Myotis	*Myotis grisescens*	1	1	1	1	1				1				1	1		**8**
Hoary Bat	*Lasiurus cinereus*				1		1	1		1	1		1			1	**7**
Eastern Spotted Skunk	*Spilogale putorius*	1				1	1			1		1		1		1	**7**
Southern Bog Lemming	*Synaptomys cooperi*		1				1	1		1	1			1		1	**7**
Star-nosed Mole	*Condylura cristata*		1		1					1	1			1		1	**6**
Eastern Red Bat	*Lasiurus borealis*				1		1	1			1		1			1	**6**
Least weasel	*Mustela nivalis*		1	1	1		1			1				1			**6**
Long-tailed/ Rock Shrew	*Sorex dispar*		1				1	1		1				1		1	**6**
Appalachian Cottontail	*Sylvilagus obscurus*	1	1			1				1		1				1	**6**
Virginia Big-eared Bat	*Corynorhinus townsendii virginianus*					1				1				1	1	1	**5**
Least Shrew	*Cryptotis parva*						1			1	1	1				1	**5**
River Otter	*Lontra canadensis*			1	1				1		1					1	**5**
Southern Rock Vole	*Microtus chrotorrhinus carolinensis*						1			1				1	1	1	**5**
Northern Long-eared Bat	*Myotis septentrionalis*				1					1	1		1				**4**
Smoky Shrew	*Sorex fumeus*				1		1			1	1			1			**5**
Pygmy Shrew	*Sorex hoyi*	1		1	1						1			1			**5**
Water Shrew	*Sorex palustris*		1				1			1				1	1		**5**
Black Bear	*Ursus americanus*	1	1			1					1		1				**5**
Meadow Jumping Mouse	*Zapus hudsonius*	1								1	1			1		1	**5**
Snowshoe Hare	*Lepus americanus*						1				1			1	1		**4**
Evening Bat	*Nycticeius humeralis*				1	1					1					1	**4**
Hairy-tailed Mole	*Parascalops breweri*		1							1	1			1			**4**
Coinerous shrew	*Sorex cinereus*		1			1				1				1			**4**
Bobcat	*Lynx rufus*			1			1				1						**3**
northern Flying Squirrel	*Glaucomys sabrinus*						1					1			1		**3**
Bobcat	*Lynx rufus*				1		1	1									**3**
Fisher	*Martes pennanti*													1	1	1	**3**
Little Brown Bat	*Myotis lucifugus*	1			1								1				**3**
Woodland Jumping Mouse	*Napaeozapus insignis*									1	1			1			**3**
Golden mouse	*Ochrotomys nuttalli*			1										1		1	**3**
Cotton Mouse	*Peromyscus gossypinus*			1		1				1							**3**
Eastern Fox Squirrel/ Serman's Fox Squirel	*Sciurus niger*		1							1		1					**3**
Delmarva fox squirrel	*Sciurus niger cinereus*						1					1			1		**3**
Southern Pygmy shrew	*Sorex hoyi winnemana*						1			1						1	**3**
Big Brown bat	*Eptesicus fuscus*										1		1				**2**
Carolina Northern Flying Squirrel	*Glaucomys sabrinus coloratus*									1				1			**2**
Northern Yellow Bat	*Lasiurus intermedius*	1								1							**2**
Seminole Bat	*Lasiurus seminolus*									1			1				**2**
Pine/woodland Vole	*Microtus pinetorum*			1							1						**2**
Long tailed Weasel	*Mustela frenata*	1								1							**2**
Eastern Woodrat	*Neotoma floridana*			1						1							**2**
Eastern Pipistrelle. Tri colored bat	*Pipistrellus subflavus*				1								1				**2**
Eastern Harvest Mouse	*Reithrodontomys humulis*						1									1	**2**
West-Virginia water shrew	*Sorex palustris punctulatus*											1				1	**2**
Swamp Rabbit	*Sylvilagus aquaticus*				1	1											**2**
New England cottontail	*Sylvilagus transitionalis*								1					1			**2**
Franklin's Ground Squirrel	*Spermophilus franklinii*			1	1												**2**
Marsh Rabbit	*Sylvilagus palustris*	1								1							**2**
Red Squirrel	*Tamiasciurus hudsonicus*		1											1			**2**
Badger	*Taxidea taxus*				1						1						**2**
Gray Wolf	*Canis lupus*			1													**1**
Southern Red backed Vole	*Clethrionomys gapperi*										1						**1**
Kentucky red backed vole	*Clethrionomys gapperi maurus*					1											**1**
Star nosed mole	*Condylura cristata parva*						1										**1**
Virginia Opposum	*Didelphis virginiana*										1						**1**

North American Porcupine	*Erethizon dorsatum*						1										**1**
South eastern pocket gopher	*Geomys pinetis*	1															**1**
Plains pocket gopher	*Geomys bursarius*				1												**1**
West Virginia Northern Flying Squirrel	*Glaucomys sabrinus fuscus*															1	**1**
American Marten	*Martes americana*								1								**1**
Prairie Vole	*Microtus ochrogaster*															1	**1**
Meadow Vole	*Microtus pennsylvanicus*									1							**1**
Ermine	*Mustela erminea*										1						**1**
Southern Appalachian Woodrat	*Neotoma floridana haematoreia*													1			**1**
Eastern Woodrat	*Neotoma floridana illinoensis*													1			**1**
Muskrat	*Ondatra zibethicus*			1													**1**
Marsh Rice Rat	*Oryzomys palustris*							1									**1**
White Footed Mouse	*Peromyscus leucopus easti*									1							**1**
Old-field Mouse	*Peromyscus polionotus*									1							**1**
Alabama beach Mouse	*Peromyscus polionotus ammobates*	1															**1**
Perdido beach Mouse	*Peromyscus polionotus trissylepsis*	1															**1**
Eastern Mole	*Scalopus aquaticus*									1							**1**
Long-tailed/ Rock Shrew	*Sorex dispar blitchi*					1											**1**
South eastern shrew	*Sorex longirostris*													1			**1**
Brazilian free tailed bat	*Tadarida brasiliensis*	1															**1**
Total mammals in state	**Total in state**	**18**	**16**	**14**	**22**	**16**	**25**	**10**	**5**	**37**	**27**	**11**	**12**	**28**	**10**	**25**	

Table 9: Habitat classifications employed by the 15 AppLCC states. Column totals represent the number of states that had that habitat description in their SWAP, whereas row totals represent the number of habitats in each state.

	AL	PA	MD	NC	VA	SC	OH	NY	WV	KY	IN	IL	NJ	GA	TN	Total
Forest																67
Floodplain Forest	1		1	1							1	1				5
Dry Oak - Pine Forests			1	1		1								1		4
Northern Conifer - Hardwood Forests			1	1										1		3
Mesic Hardwood Forest	1													1		2
Basic Mesic Forest				1		1										2
Dry Hardwood Forest	1			1												2
Dry Longleaf Pine Forest	1													1		2
Deciduous Forest					1			1								2
Old Growth Forests			1								1					2
Early Successional Forests			1	1												2
Cove forest				1										1		2
Mixed Forest					1			1								2
Mixed Mesophytic Forests							1		1							2
Evergreen Forest					1			1								2
Upland Forest										1		1				2
Coniferous forests		1														1
Coniferous Plantation												1				1
Forest Plantation															1	1
Urban / Suburban Managed Forest															1	1
Mesic Deciduous Forests			1													1
Acidic Mesic Forest						1										1
Spruce-fir forest				1												1
Floodplain Hardwood Forests														1		1
Wet Pine Savanna and Flatwoods	1															1
Riverbank, Stream Bank, Alder zones						1										1
Deciduous/Mixed Forest		1														1
Pre Forest											1					1
Early Forest											1					1
mature high canopy stage											1					1
Generalist forest											1					1
Successional Forests												1				1
Pole Stage											1					1
High-Elevation Early Successional Habitats														1		1
High Elevation Forested Heath Thickets														1		1
Moist or wet Forest types due to unique Landform						1										1
High Elevation Forest						1										1
Sugar Oak-Maple forests							1									1
Elm-Ash Swamp forests							1									1
Mixed Oak Forest							1									1
Oak Woodlands														1		1
Bottomland Hardwood Forests							1									1
Oak Savannas							1									1
Beech Forest							1									1
Red Spruce Forest									1							1
Hemlock Forests									1							1
Calcareous Forests and Woodlands									1							1
Calcareous Flatwoods (Hardwood Flats)														1		1
Hill Country Deciduous Forests									1							1
Oak/Hickory and Dry/Mesic Oak Forest									1							1
Oak/Heath and Oak/White Pine Forests									1							1
Dry Rocky Pine/Oak Forests and Woodlands									1							1
Successional Conifer Forests and Woodlands									1							1
Successional Deciduous Forest									1							1
Cumberland Highland Forest										1						1
Upland Deciduous forest															1	1
Upland Coniferous forest															1	1
Upland Mixed forest															1	1
Forested Rock Outcrop															1	1
Red Maple/Blackgum Swamps														1		1
Boulderfield Forests														1		1
Hemlock-Hardwood-White Pine Forests														1		1
Low Elevation Seepy Thickets and Wet Woods														1		1
Mixed Pine-Hardwood Forests														1		1
Xeric Pine Woodlands														1		1
Sand Forest												1				1
Forest													1			1
Flatwood forests												1				1
State total	5	2	6	8	3	6	7	3	10	2	7	6	1	16	6	

Grassland/scrub/balds	**AL**	**PA**	**MD**	**NC**	**VA**	**SC**	**OH**	**NY**	**WV**	**KY**	**IN**	**IL**	**NJ**	**GA**	**TN**	**37**
Grassland		1									1		1			3
Old Fields									1			1			1	3
Prairie grasslands							1				1	1				3
Limestone Barrens and Glades									1					1		2
Riparian thicket/Forests		1									1					2
Savanna											1	1				2
Grassland/scrub/balds			1													1
Reclaimed Minelands											1					1
Acidic Meadows Over Sandstone or Shale														1		1
Agriculture											1					1
Bald / Summit															1	1
Barren												1				1
Barrens and Dry Glades			1													1
Calcareous Prairies (Coosa Valley Prairies)														1		1
Canebrakes														1		1
Dolomite Prairie												1				1
Early Successional Grasslands											1					1
Farm Bill Grasslands											1					1
Forested Limestone Slopes and Terraces														1		1
Glade / Barrens															1	1
Glades and Prairie	1															1
Grassland/agricultural										1						1
Grasslands Fescue											1					1
Gravel Prairie												1				1
Heath/Grass Barrens and Balds									1							1
High Elevation Rocky Summits and Shrub Balds														1		1
Hill Prairie												1				1
Open Woodland												1				1
Prairie / Barrens															1	1
Sand Praire												1				1
Sand Savanna												1				1
Sandstone Glades									1							1
Shale Barrens									1							1
Shrub praire												1				1
Shrub/Scrub											1					1
Thicket/Shrub		1														1
Vegetated Dunes and Swales											1					1
State total	**1**	**3**	**2**	**0**	**0**	**0**	**1**	**0**	**5**	**1**	**11**	**11**	**1**	**6**	**4**	
ROCK HABITATS	**AL**	**PA**	**MD**	**NC**	**VA**	**SC**	**OH**	**NY**	**WV**	**KY**	**IN**	**IL**	**NJ**	**GA**	**TN**	**34**
Cliffs and Rockhouses	1		1													2
Caves and Mines	1			1												2
Barren; quarries, strip mines and gravel pits					1			1								2
Barren; bare rock and sand					1											1
Rock Habitats		1														1
Transitional					1											1
Caves Mines and Springs			1													1
Low elevation cliffs/rock outcrops				1												1
High elevation rock outcrops				1												1
Vertical or Horizontal Rock Outcrop						1										1
Groundwater														1		1
Rock Outcrops/Cliffs/Talus									1							1
Karst, Caves, Rock Shelters, And Clifflines										1						1
Barren lands											1					1
Barren Lands Active Quarries											1					1
Barren Lands Bare Dunes											1					1
Barren Lands Cliffs											1					1
Barren Lands Rock Outcrops											1					1
Other Barren																0
Subterranean									1							1
Caves, Rock Shelters, Talus Slopes														1		1
Subterranean Systems Cave Entrances											1					1
Subterranean Systems Caves											1					1
Sandstone Barrens and Outcrops														1		1
Moist Cliff Faces and Spray Cliffs														1		1
Rocky Bluffs and Streambanks														1		1
Glade												1				1
Bluff & Cliff												1				1
Lakeshore												1				1
Aquatic caves												1				1
Terrestrial caves												1				1
Excavated Land (Strip Mine / Road Cut / Rock Quarry / Gravel Pit)															1	1
Excavated Land (Mine Shaft / Rock Quarry / Tunnel)															1	1
Cave/Sinkhole															1	1
State total	**2**	**1**	**2**	**3**	**3**	**1**	**0**	**1**	**2**	**1**	**7**	**5**	**0**	**5**	**3**	

ANTHROPOGENIC (HUMAN-CREATED) HABITATS	AL	PA	MD	NC	VA	SC	OH	NY	WV	KY	IN	IL	NJ	GA	TN	22
Pasture/ Hay					1			1							1	3
Row crops					1			1				1				3
Developed											1	1				2
Low Intensity Residential					1			1								2
High intensity residential					1			1								2
Urban/suburban		1								1						2
Hay											1	1				2
Pasture											1	1				2
Artificial Habitats	1															1
Parks, Lawns, Golf Courses								1								
Developed Lands Golf Courses											1					1
Developed Lands Industrial Lands											1					1
Developed Lands Roads/Rails/Bridges											1					1
Commercial/Industrial/Transportation					1											1
High Intensity Commercial/Industrial								1								1
Other grasses																0
Anthropogenic Grassland									1							1
Urban/recreational grasses					1											1
Idle-introduced												1				1
Urban / Suburban Managed Grassland															1	1
Cropland															1	1
Edifice / Other Man-made Structure															1	1
Impervious Landscape															1	1
State total	**1**	**1**	**0**	**0**	**6**	**0**	**0**	**6**	**1**	**1**	**6**	**5**	**0**	**0**	**5**	

Wetlands	AL	PA	MD	NC	VA	SC	OH	NY	WV	KY	IN	IL	NJ	GA	TN	37
Wetlands		1														1
emergent wetlands/marshes (wetland)								1			1	1	1			4
Isolated Wetland	1													1	1	3
Vernal Pools		1	1									1				3
Forested wetlands											1		1			2
shrub-scrub swamps (wetland)										1	1					2
Bogs and Seepage Communities	1			1												2
Swamp	1											1				2
Bog and Fen Wetland Complexes			1											1		2
Woody Wetlands					1			1								2
Floodplain Forests and Swamps									1			1				2
Emergent And Shrub-dominated Wetlands					1					1						2
Ephemeral											1					1
forested wetlands and bogs (wetland)										1						1
Forested Seepage Wetlands			1													1
Nontidal Shrub Wetlands			1													1
Nontidal Emergent Wetlands			1													1
Sphagnum peat Bogs							1									1
Marshes and Fens							1									1
Marshes and Wet Meadows									1							1
Forest Seeps and Vernal Pools									1							1
Savanna/ Shrub-scrub										1						1
Herbaceous Marsh											1					1
Mudflat											1					1
Fen												1				1
Bog												1				1
Sedge meadow												1				1
Panne												1				1
Flat bare soil receeding waters												1				1
Seep & Springs												1				1
Marsh												1				1
High Allegheny Swamp									1							1
High Allegheny Bogs and Fens									1							1
Riparian															1	1
Converted Wetland (Palustrine)															1	1
Converted Wetland (Riverine)															1	1
Converted Wetland (Lacustrine)															1	1
State total	**3**	**2**	**5**	**1**	**2**	**0**	**2**	**2**	**5**	**4**	**6**	**11**	**2**	**2**	**5**	

Aquatic	**AL**	**PA**	**MD**	**NC**	**VA**	**SC**	**OH**	**NY**	**WV**	**KY**	**IN**	**IL**	**NJ**	**GA**	**TN**	**48**
Aquatic Systems									1							**1**
Backwater												1				**1**
Cave streams										1						**1**
Channelized River/ Stream															1	**1**
Coldwater streams			1									1				**2**
Creek / Headwater Stream															1	**1**
Great River											1					**1**
Headwater											1					**1**
High Gradient First- and Second-Order Streams														1		**1**
Highland Rivers			1													**1**
Highland Streams			1													**1**
Impoundment											1	1				**2**
Kettle Lake											1					**1**
Lakes															1	**1**
Lakes and ponds	1											1				**2**
Large River															1	**1**
Large Rivers in Current/Slackwater										1						**1**
Limewater streams			1													**1**
Lowland Streams in Riffles/ Slackwater										1						**1**
Major River Channel												1				**1**
Major River Side-Channel												1				**1**
Medium River															1	**1**
Medium to Large Rivers														1		**1**
Medium to large streams										1						**1**
Natural Lakes											1					**1**
Navigable streams						1										**1**
Open water					1											**1**
Oxbows/Backwaters/Sloughs/Embayments											1					**1**
Pond												1				**1**
Reservoir															1	**1**
River											1					**1**
River Basins	1			1								1				**3**
Riverscour Communities									1							**1**
Running Water										1						**1**
Small River															1	**1**
Small to Medium Streams										1						**1**
Springs and Spring Runs; Gravelly Seeps														1		**1**
Standing Water										1						**1**
Streams												1		1		**2**
Streams and Rivers		1														**1**
Upland Headwater Streams in pools										1						**1**
Upland Streams in pools										1						**1**
Upland Streams in riffles										1						**1**
Wadeable streams						1										**1**
Wadeable/ large Rivers											1					**1**
Water								1								**1**
State total	**2**	**1**	**4**	**1**	**1**	**2**	**0**	**1**	**2**	**10**	**8**	**9**	**0**	**4**	**7**	
Total	**14**	**10**	**19**	**13**	**15**	**9**	**10**	**13**	**25**	**19**	**45**	**47**	**4**	**33**	**30**	

Table 10: Conservation planning efforts tabulated across the 15 AppLCC states. Column totals represent the number of states that used that particular effort, whereas row totals represent the number of efforts used by each state. All Conservation planning efforts were drawn from the SWAPs. This table does not indicate the depth of any analysis, but it is an attempt to collate data driven, objective approaches in the SWAPs.

S.No	Conservtion Planning efforts	VA	TN	NJ	MD	PA	GA	KY	NC	IL	OH	WV	AL	NY	IN	SC	Total
1	Identifying areas of conservation priority	1	1	1			1	1	1	1	1		1	**1**			**10**
2	SDM/ other models for sp presence/ occurance	1	1	1				1	1	1							**6**
3	Species Richness Maps	1			1	1		1	1								**5**
4	Mapping caves and Karsts		1		1			1					1		1		**5**
5	Land Cover/ Land Use change mapping	1		1	1	1	1										**5**
6	Identifying high priority habitats		1	1	1		1					1					**5**
7	Measuring and mapping protectedness	1				1	1										**3**
8	Mapping forest blocks by area			1		1			*								**2**
9	Mapping corridors				1				**								**1**
10	Prioritization of restoration sites		1							1	**1**						**3**
11	Population Viability Analysis		1														**1**
12	Mapping threats											1					**1**
13	Predictive threat modelling	**1**															**1**
	TOTAL Planning score	**6**	**6**	**5**	**5**	**4**	**4**	**4**	**3**	**3**	**2**	**2**	**2**	**1**	**1**		
	Rank	**1**	**1**	**2**	**2**	**3**	**3**	**3**	**4**	**4**	**5**	**5**	**5**	**6**	**6**		

* Used a previous example: Onslow Bight Conservation Design Plan
** Used a previous example: Sandhills Conservation Partnership

Table 11: Summary of anticipated changes in the SWAP revisions across the LCC states

Status										Drafted species assessments for all SGCN and candidates	Several taxa of SGCN re-evaluated		Currently drafting task list and timeline for revision.
													Review of fish SGNC is complete, others in review
Overall changes	IAFWA SWAP guidelines	X		X						SWAP will not be organized by watersheds			Improve connections between species outcomes and the habitat actions
SGCN	Reevaluate/reacess list					X	X	X		focus conservation actions that are operationally feasible in a ten year time frame			X
	Changes	Improve ranking and SGCN prioritization						NE lexicon		Used improved data sources	Used improved data sources		Considering various criteria for adding or removing species from the SGCN list
	SGCN standard procedure	IUCN, Natureserve, Digitize ranking								Decision Tree model for SGCN	Millsap et al (1990)		
Habitat	Reevaluate/reacess habitat classifications	X				X					X		X
	Changes in Terrestrial Habitat classification	NC new habitat Classification		NETHC	NETHC					NETHC cross walked with NY classification	Single list of habitat instead of terrestrial and aquatic		
		Expand habitat types from 23 to ~40.											
	Changes in Aquatic Habitat Classification									NEAHC	Single list of habitat instead of terrestrial and aquatic		A hierarchical framework for streams has been developed
										Stream classifications are determined by size, gradient, buffering, and temperature	Fill data gaps , inventory habitats, prioritize restoration and reintroduction stes, use information for management actions.		
										lake classifications are based on size			
New Habitat Classification maps		X				X							
Shift in emphasis						Development of proactive strategies that address wildlife conservation needs from both state and regional contexts.							Implementation guide
	Better monitoring					tools such as Wildlife TRACS							

New inclusions	Climate Change	X		X	X	X	X			Wildlife Health, White Nose Syndrome			In discussions
		Incorporate results from state wide climate change vulnerability assessment Natural Heritage Program			Conducted statewide CC modelling/ dynamic downscaling								
		Upgrading use of GIS data to incorporate Climate Change and other threats that impact species and habitats											
	SDM	X											
	Fire Maintaence	X											
	Corridor delineation	X											
	identifying Buffers	X											
	Identify Cons Easement location	X											
Threats								IUCN classification from the NE Lexicon		Scope, severity, irreversibility and # of species impacted		Source and Stress of threats identified	
Conservation Action								focus on priority species and habitats		Classified with the IUCN terminology			
										Prioritization in a Structured Decision Making matrix based on a cost/benefit analysis			
										Operationally feasible in a ten year time frame			
Challenges	Funding					X					X		
	Politics						X						
	Partnerships												
	Data handling												
	Lack of GIS secialist	X											
	Time	X											
	Logistics/coordination	X									X		
	Tracking system												X
	Mapping pvt lands						X						
	Communication												X
	Limited Resources										X		
Dissemination	epublication	X											

Table 12 Status of some past, ongoing and future conservation planning efforts across the AppLCC states

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas	GA, IL, OH, KY, NC, NJ	SC, NC, AL, PA, GA, IL, OH, NJ		NY, VA, MD, PA, IL, NJ	IL: regional conservation areas
Species Distribution Modeling	NC, KY	SC, VA, AL, NJ	NY, MD, OH	MD, PA, GA, IL	
Mapping terrestrial corridors/connectivity	MD	SC, VA, AL, MD, PA, IL, NJ	NY	NC, GA,OH	
Measuring/ Mapping aquatic connectivity		SC, VA, AL	NY, NC	GA, IL, OH, NJ	
Prioritization of restoration sites	OH	NY, AL, OH	SC, NC, KY, NJ	VA, MD, PA, GA, IL	
Predictive threat modeling	VA	AL	SC, NY, IL, KY, NJ	NC, MD, GA, OH	
Climate resiliency modeling		VA,	SC, KY	NY, NC, AL, MD, GA	IL: deciding on how to use it, OH: not sure yet
Species of Greatest Conservation Need analysis		NC			
Urban Environment		IL			

Table 13 Status of some datasets that are at various staged of availability that may be useful to the AppLCC.

Datasets	**Completed and available**	**Complete but not yet available**	**In progress**	**Planned in the near future**	**Planned in long term**	**Not planned**	**Available for AppLCC area?**
LIDAR data	MD		SC,NY, AL, PA, GA, IL		OH, NJ	VA	
Stream Networks with corrected topology	VA		AL, IL		OH	SC, NY, NJ	VA
Cave and Karst mapping	VA	PA, GA	AL		OH	SC, NY, MD, NJ	VA
Isolated wetlands/vernal pool mapping/identification	PA, NJ		SC, AL, GA	MD?,	OH	NY	
Isolated Wetlands identification	VA						
Vernal Pool Mapping						VA	
Climate Change Models for A1Fi and B1 scenarios at mid-century and end of century	VA, WV, MD						VA, WV, MD

APPENDIX

DATA NEEDS PROJECT

Summary of 2005 SWAPs

(Feedback received)

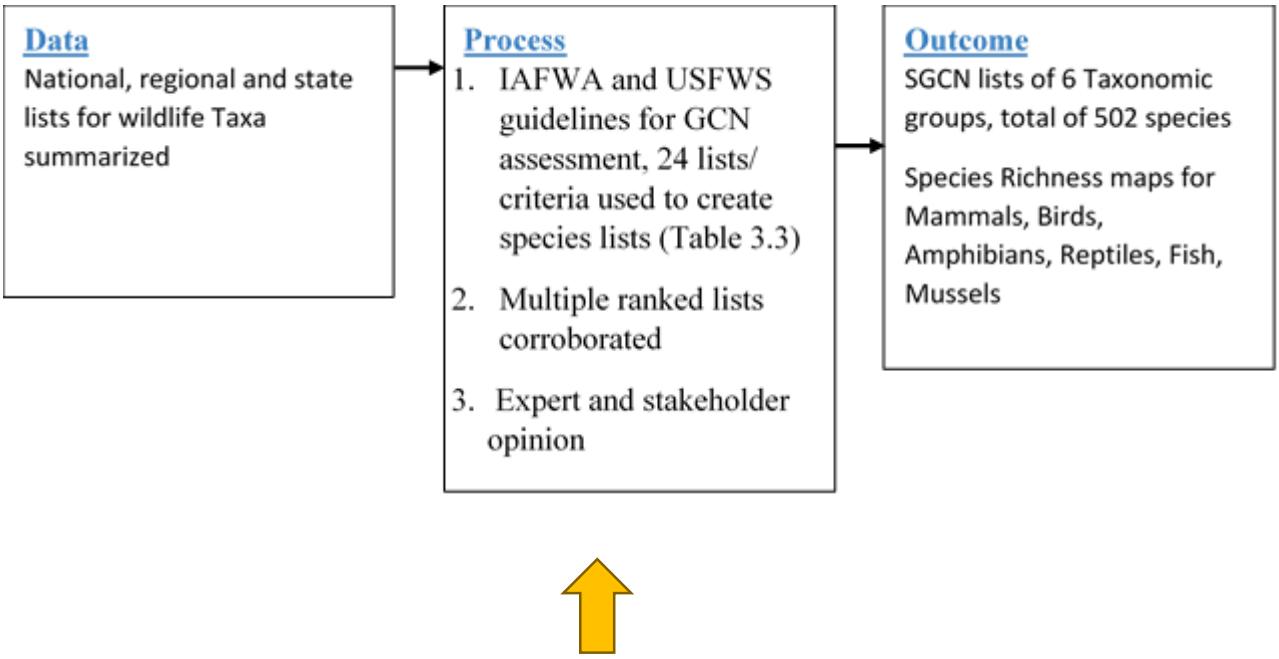
OVERALL CHANGES

- improve section on effectiveness monitoring and measurement
- New incorporated aspects: climate change, sea level rise; information from regional plans, including NE region SWAP under development; "BioNet" project that identifies areas important to maintain biodiversity in the state; will be drawing from regional efforts and products from JVs, LCCs; possibly include plants and natural communities
- Explore methods for prioritization and connections between threats and conservation actions (Miradi, for example, and methods that take costs and balancing actions into account)
- getting together all of the regional project results that may be useful, looking for updates from regional groups as to status of species, threats assessments, etc.- there is a lot of information out there and it takes time to go through and pick out pieces useful for this planning effort
- Incorporate information from completed surveys and inventories to establish baseline information; research to identify, document, or understand biological issues; mapping and prioritization; coordination with landscape-level efforts; habitat restoration; and database updates and enhancements.
- Incorporate outcomes of recently completed regional projects that are ready to be incorporated into state conservation plan revisions, promoting coordinated conservation at the landscape level.
- Incorporate new or revised partner plans such as state forest assessments
- Communication plan to assist with partner outreach, etc.

Expected outcomes of revision:

(1) information on the distribution and abundance of wildlife, especially species of greatest conservation need;
(2) descriptions of locations and conditions of key habitats and communities;
(3) descriptions of problems that may adversely affect species of greatest conservation need, including climate change;
(4) descriptions and prioritization of conservation actions needed to conserve these species; (5) information from recently-completed regional projects;
(6) plans for monitoring species, their habitats, and the effectiveness of conservation actions;
(7) descriptions of procedures to review and update the Plan; and
(8) plans for coordinating with appropriate partners for revising and implementing the Plan

SGCN



Revise list of SGCN
Include new updated information on the distribution and abundance of wildlife species, including changes in species state listing status and addition of newly described species
Current information on potential climate change impacts and vulnerability assessments of species of greatest conservation need
Consider tiered prioritization of SGCN in terms of what species are targets for the upcoming 10-year period vs. those that are not, and/or species that are targets for particular kinds of activities (such as inventory and monitoring)
Consider species identified through regional SGCN analyses for special emphasis or addition to list and any changes in regional lists used before (PIF, Shorebirds, Waterfowl)
Consider mention of plant species and plant communities of greatest conservation need since these also have assigned state conservation statuses (have not decided on this yet- may be more of an appendix)

TERRESTRIAL HABITAT ASSESSMENT

Data

Bailey's ecoregion and NatureServe's Terrestrial ecological Systems

Bailey's ecoregion and NatureServe's Terrestrial ecological Systems

Species data: Predictive models of terrestrial vertebrate distribution developed in conjunction with the Mid-Atlantic Gap Analysis Program/USFWS/UMES

Following layers for generating Habitat distribution Maps:

1. USFWS National Wetlands Inventory data (NWI);
2. USGS Mid-Atlantic Gap Analysis Program vegetation data (MDN-GAP),
3. National Elevation Dataset(NED),
4. National Hydrography Dataset (NHD), and
5. Geographic Names Information System (GNIS);
6. USDA Soil Conservation Service generalized soils data (STATSGO);
7. FEMA Q3 Floodplain data;
8. MD Department of Planning's Land Use/Land Cover data;
9. UMD Appalachian Environmental Lab (AEL) deep mines dataset;
10. MD DNR MBSS/Versar Inc streams data (MBSS100k);
11. other MD DNR data provided by various sources, including Maryland Geological Survey (MGS), Resource Assessment Service (RAS) and NHP.

Process

Initial list of habitats cross walked with NatureServe's Terrestrial Ecological Systems

Expert and stakeholder opinion

Outcome

5 ecoregions, 35 wildlife habitat types 15 within AppLCC

Error! Reference source not found.

Data:

- NE habitat classifications, descriptions, and lexicon developed through grants from NE Wildlife Diversity Technical Committee
- Data from completed regional partnership projects such as JVs, LCCs, etc; state forest assessment, climate change maps
- State status for rare natural

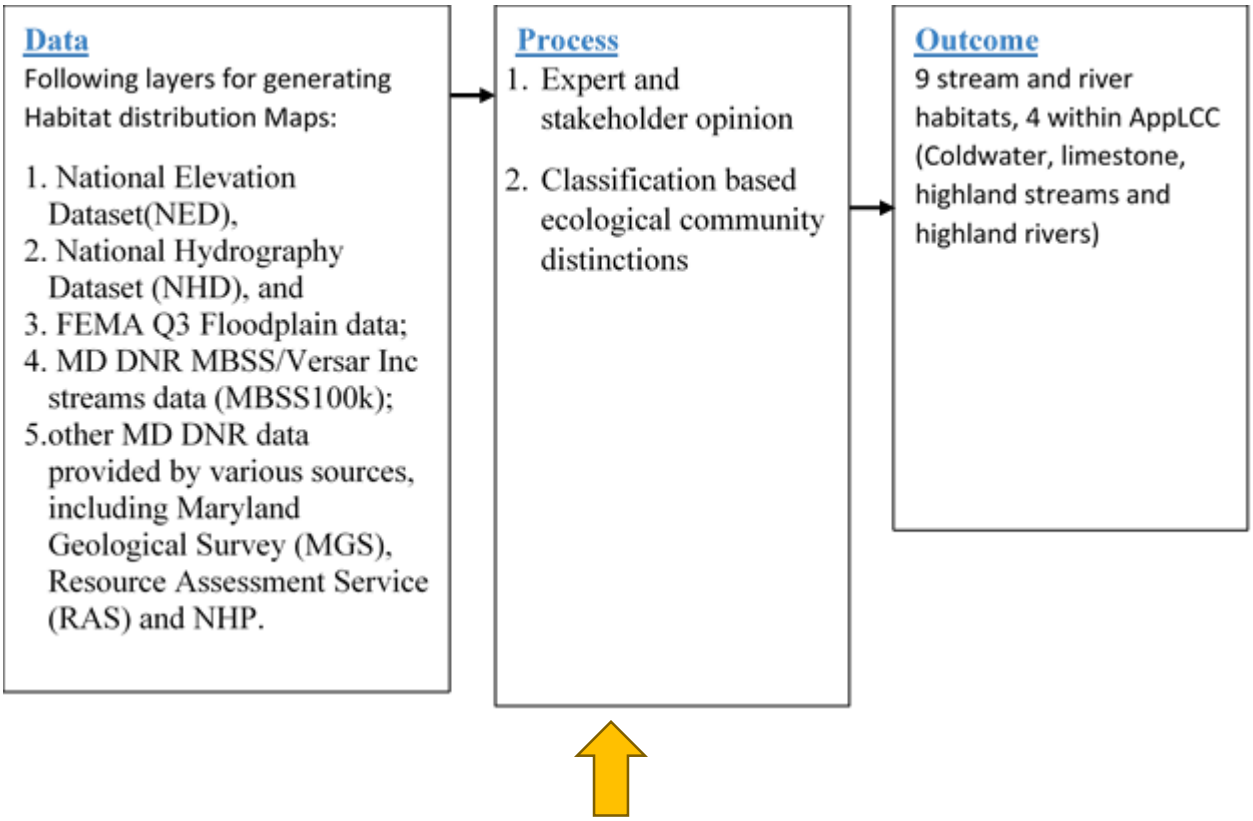
Process

- BioNet project (identifies important terrestrial areas to maintain biodiversity in the state): identifies tiers of areas significant for MD biodiversity conservation-irreplaceable and rare species and habitats, corridors and core areas.

Outcome

- Mapping and prioritization of habitats
- Habitat restoration sites
- Climate change effects on habitat

AQUATIC CLASSIFICATION



Data:

- NEAHC? Yes but we are likely to modify it to add in biological resource considerations
- Data from completed regional partnership projects such as JVs, LCCs, etc
- Climate change maps

Process

- BioNet project (identifies freshwater areas important to maintain biodiversity in the state): identifies tiers of areas significant for MD biodiversity conservation- irreplaceable and rare species and habitats, corridors and core areas.
- Stronghold watersheds have been mapped and will be considered in addition to watershed-level analyses

Outcome

- Mapping and prioritization of habitats
- Habitat restoration sites
- Climate change effects on habitat

Conservation planning efforts: Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list. Please add information as you deem suitable.

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas			1	1	Completed a project for this a few years ago, so it is ready to go in
Species Distribution Modelling			1	1	Started down this path for 2005 version, but did not work out; we will use whatever might be useful from regional SWAP project, other products
Mapping terrestrial corridors/connectivity	1	1			Green infrastructure
Measuring/ Mapping aquatic connectivity			1	1	Blue infrastructure
Prioritization of restoration sites			1	1	we have an existing prioritization and will be adding it in
Predictive threat modelling			1	1?	Will be including energy impacts if available from ALCC
Climate resiliency modelling			1	1	

Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers not included in this list that may be in various stages of development.

Datasets	Completed and available	Complete but not yet available	In progress	Planned in the near future	Planned in long term	Not planned	Available for AppLCC area?
LIDAR data	1						1
Stream Networks with corrected topology	1?						1?
Cave and Karst mapping						1	Hope to use ALCC products when available
Isolated wetlands/vernal pool mapping/identification				1?			May try to get a SWAP enhancement grant to do this; will use RCN grant product when available

OHIO

(Feedback received)

Overarching changes in 2015 WAP:

- Much more focused document, stressing on the key elements. Use Best Practices for State Wildlife Action Plans, and a host of other documents. Concise and sharp.
- Emphasis on climate change in the conservation threats and actions sections.
- Methodologies have changed and improved: additional data has been collected, invasive species have changed the management landscape, new relationships with management partners, research partners, and constituents have been established, and we have turned over a generation of management professionals in our own agency. Our SWAP revision will be a reflection of all of that.
  Fisheries example: implementation of our Inland Management System (IMS) in 2003. This system changed the way we collect and analyze data for inland fisheries. Standardization of gear, data collection techniques, and data analysis with this system allows us to leverage data to make statewide management decisions. This system also allowed us to increase data collection coverage across the state

  Wildlife example: establishment of the Terrestrial Wildlife Ecology Lab at The Ohio State University in the early 2000's. This partnership allowed us to increase our wildlife research capacity, and access university equipment and expertise to help solve wildlife management issues.

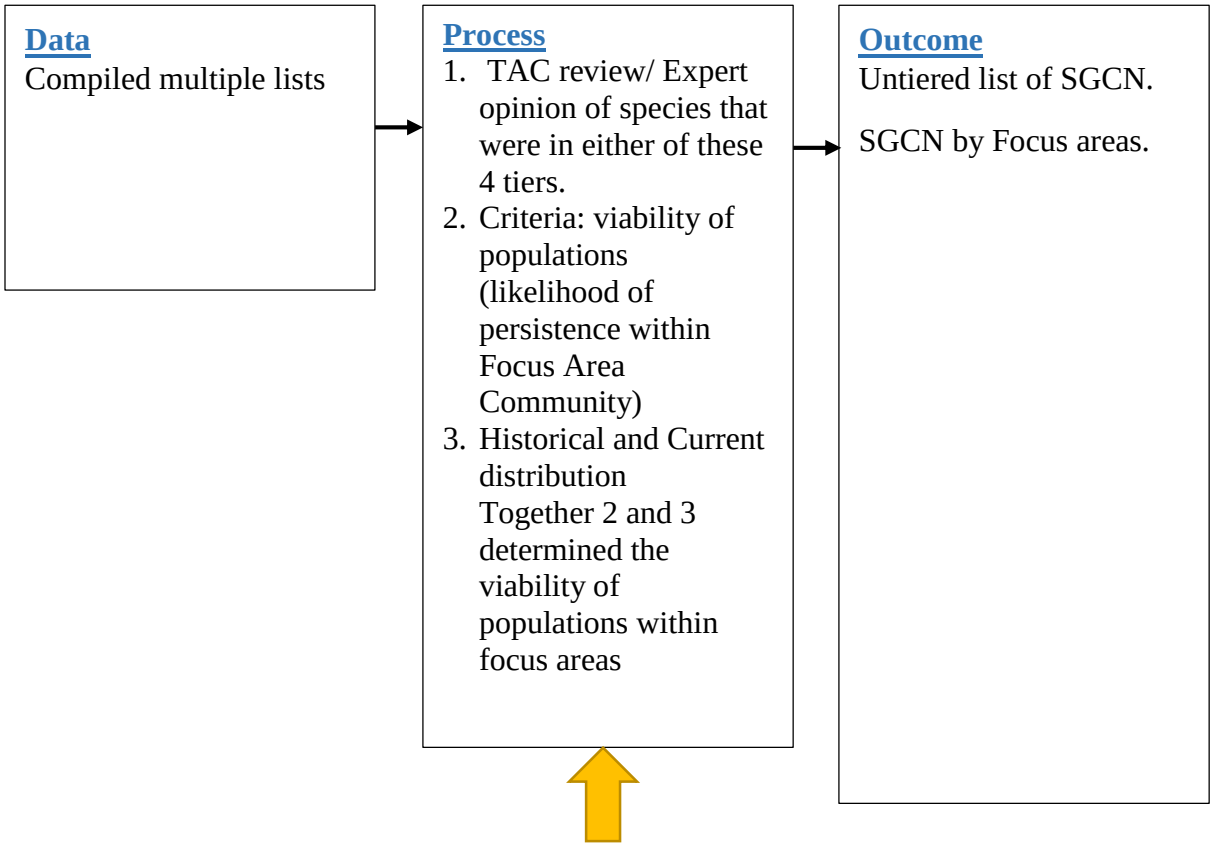
  Database example: The Division of Wildlife took control of the Natural Heritage Database when the Division of Natural Areas was absorbed into other ODNR Divisions in 2008. This database contains information on all Ohio wildlife species.

  Problems and research needs determined through scoping sessions will include the advisory team.
  Project reviews will be conducted biennially through the performance reporting process currently used by the DOW.

Challenges: Logistics and funding, limited resources.

SGCN

2005 WAP



2015 Revision

- Incorporate abundance and distribution data for all wildlife species from the Ohio Wildlife database, Ohio Biodiversity database, and the Ohio Fisheries Information System database (esp for low/declining sp)
- research other states' approaches
  The decision was made to generate Ohio's SGCN lists by scoring all species using the system developed by the state of Florida (Millsap et al. 1990). The species groups of fish, crayfish, dragonflies, damselflies, and mussels have now been scored by panels of internal and external species experts using the system developed by Millsap et al. Terrestrial species had been previously scored using the Florida system, but some revisions were made to the species groups of birds, mammals, reptiles, amphibians, butterflies, and skippers

HABITAT: TERRESTRIAL

The terrestrial information is categorized by five habitat tactical plans and **eight focus area plans**:

2005 WAP

Data

1. Native vegetative communities described and mapped by the Ohio Biological Survey in "TheNatural Vegetation of Ohio In Pioneer Days" (Fig2)
2. Focus Areas (now Conservation Opportunity Areas) were selected by internal habitat experts

→

Process

1. Identification of Focus Areas (concentrate efforts and resources to a few, relatively large units of major habitat types + unique habitats).
2. Within the Focus areas, habitat requirements of more vulnerable species were used to calculate the minimum area needed to maintain viable self-sustaining populations.
3. Expert Opinion

→

Outcome

Eight Focus areas containing majority of four habitat types

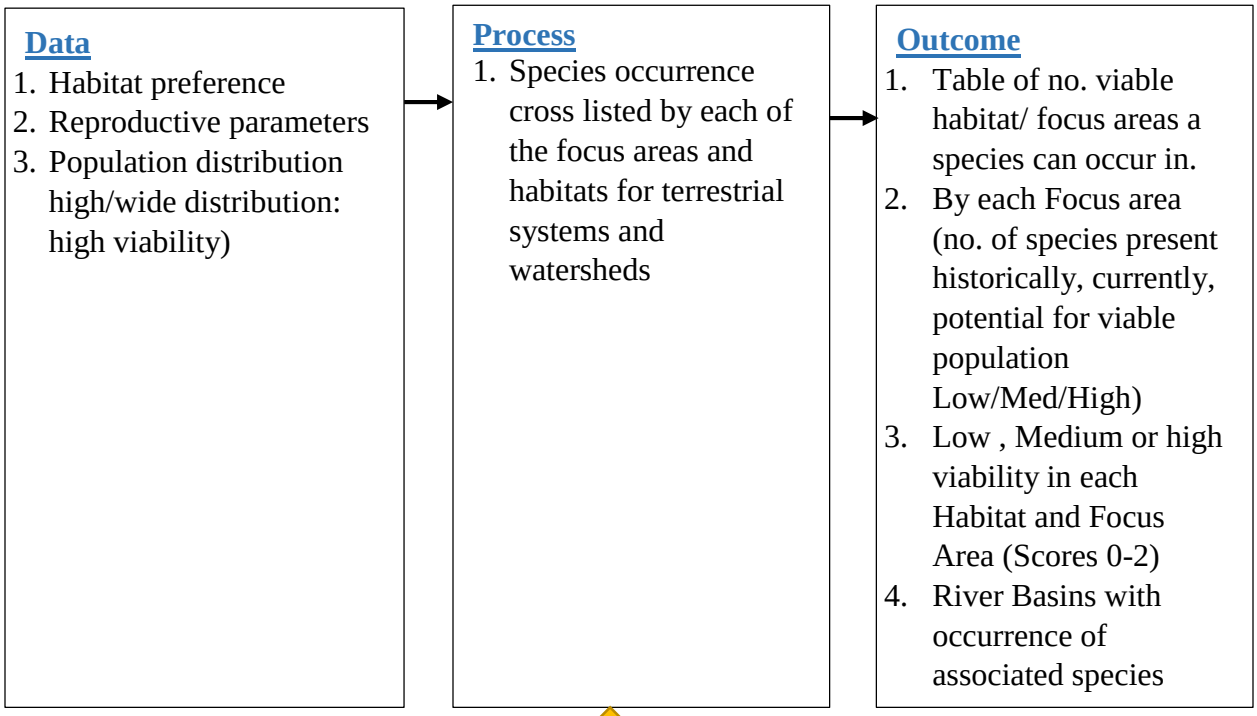
2015 Revision

The list of habitats will be expanded beyond what was included in the original CWCS

- Instead of separate aquatic and terrestrial sections, new CWCS will incorporate a single list of habitat types
- Draft list of key habitats will be approved by committee and final list will be developed with external researchers and conservation partners.
- Fill habitat data gaps identified during the above exercise
- Inventory habitats and prioritize restoration and reintroduction areas for species based on physical, biological and geographical features.
- Answer fundamental questions regarding distribution, relative abundance, population dynamics, habitat requirements, and factors limiting population growth and range expansion.
- Use all this data to describe habitats and conditions in enough detail that management actions will be apparent.

SPECIES-HABITAT ASSOCIATION

2005 WAP



2015 Revision

More data from new research/ studies will be incorporated

AQUATIC:

Watersheds: delineated by HUC 8 levels. 11 watersheds in OH. Each watershed plan identifies the characteristics of the watershed, the aquatic species present, the conservation issues concerning the area, as well as the proposed actions and plans for monitoring the area and the impacts of the conservation actions taken. Within AppLCC: Ohio Brush Creek Watershed, Muskingum Watershed, Great Miami River Watershed

2005 WAP

Data

USGS data

= = = = = = = = = = = = =

1. Physical Habitat (3 criteria)
2. Biological Integrity (5 criteria)
3. Biological Diversity (6 criteria)
4. Recreational Opportunity (2 criteria)

Total of 16 stream attributes within four categories

Process

Focus Watersheds were drawn from the ODNR Candidate Streams for Protection and Restoration. This rates Ohio watersheds by integrating measures of physical and biological integrity, biodiversity, and recreational opportunity. All watersheds received a Prioritization score which ranks their relative importance for protection and restoration activities.

= = = = = = = = = = = =

Total score/ rank for each stream by summing across all categories

Outcome

1. Maps of each watershed with land cover (Urban, agricultural, shrub/scrub, Wooded, open water, open wetland, barren)
2. Maps of watershed with Protected lands (Local; national (forest, refuge, park, or area); State (forest, park, WL area) or other
3. Maps of distribution of SGCN Aq species (fish/ amphibian/ insect/ mollusk) in each watershed

= = = = = = = = = = = = =

4. Streams of priority protection and restoration: 5 categories of priorities based on total scores.

2015 Revision

- More data from new research/ studies will be incorporated

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list. Please add information as you deem suitable.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas	1	1			
Species Distribution Modelling			1		
Mapping terrestrial corridors/connectivity				1	
Measuring/ Mapping aquatic connectivity				1	
Prioritization of restoration sites	1	1			
Predictive threat modelling				1	
Climate resiliency modelling					Not sure yet

Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers not included in this list that may be in various stages of development.

Datasets	Completed and available	Complete but not yet available	In progress	Planned in the near future	Planned in long term	Not planned	Available for AppLCC area?
LIDAR data					1		
Stream Networks with corrected topology					1		
Cave and Karst mapping					1		
Isolated wetlands/vernal pool mapping/identification					1		
Datasets							
LIDAR data					1		
Stream Networks with corrected topology					1		

VIRGINIA

(Feedback received)

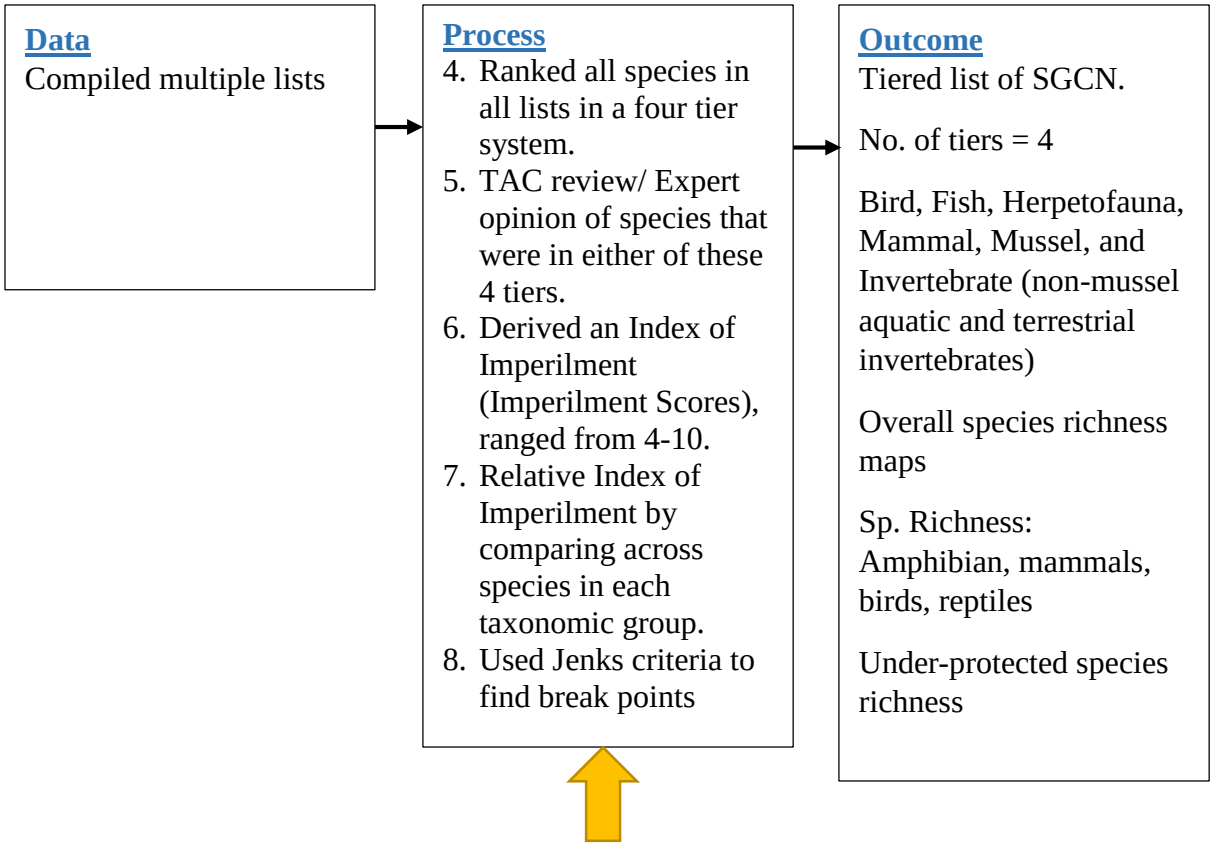
Overarching changes in 2015 WAP:

1. Local summaries will form the backbone of the next action plan. Through SWG, DGIF and CMI (VT) have collaborated to produce a series of locally focused summaries of the WAP. These local summaries identify and prioritize the SGCN, habitats, conservation threats, and conservation actions relevant to each of Virginia's Planning District Commissions. Each PDC summary has a list of SGCN that have a significant portion of their range contained within that PDC's boundary. About 12 PDCs (total 21) intersect with the AppLCC boundary (detailed example provided: New River Valley PDC).
2. Work with teams, partners and other parties to refine, revise, and prioritize
    - Conservation actions and research that will help address threats impacting SGCN and their habitats in the different regions of Virginia.
    - Threats known to be impacting SGCN and their habitats in the different regions of VA.
    - Identify and evaluate existing systems that track the status of SGCN populations and habitats so we may determine which will be most appropriate for guiding implementation efforts.
3. Use standardized effectiveness measures identified in, *Measuring the Effectiveness of State Wildlife Grants – Final Report* (2011).
4. Determine an appropriate interval for reviewing and updating Virginia's Wildlife Action Plan.
5. Coordinate with partners and stakeholders to review plan materials and incorporate feedback and input in revised plan.
6. Public feedback and input will be solicited on WAP revision.

SGCN

For birds, used Partners in Flight approach: incorporating trend and range data into modification of bird tiers + expert opinion (only avail for this TAC)

2005 WAP



2015 Revision

- Review and refine this list of SGCN to ensure the list is as comprehensive and descriptive as possible
- Modify SGCN ranking process: consider issues of species rarity, population status, habitat status, and management opportunities.
- Incorporate 2009 report on Climate Strategy for revision of SGCN.

HABITAT: TERRESTRIAL

2005 WAP

Data

1. Bailey's (1995) ecoregions
2. Place (physical env: Montane/submontane/ high elevation/ estuarine-mrine) derived from elevation, slope, RPI and salinity)
3. Land Cover (NCLD) 1992 Reclassification: Classes were aggregated into six types (water/developed /barren/ forest/ag-open/wetland)
4. Elevation (NED),
5. Relative Phenological Index: integrates geographic position with elevation to compensate for phonological events.
6. Slope (NED),
7. Aspect (NED),
8. Landform Index (NED)
9. Topographic Moisture Index: influence of topography on local moisture regime, shows degree to which a site is concave or convex.

→

Process

1. Mapped habitats by physical characteristics.
2. Mapped habitat for some Tier I species, and provided information on habitat status at the state and ecoregional levels.

→

Outcome

1. State maps of the nine layers (Ecoregion, Place, Land cover, Elevation, RPI, Slope, Aspect, Landform Index, TMI)
2. Map of conservation lands in VA

↑

2015 Revision

- Incorporate NE Terrestrial Habitat map and regional SGCN focal areas into WAP's habitat discussions.
- Incorporate Climate Strategy/Climate vulnerability assessment (Dec 2012) to determine how likely CC will impact conserved lands in Virginia.
- Build CC into prioritization of habitat types and areas for future acquisition, inform management planning of existing properties.
- Data used: regional modeling efforts and reports (e.g., CCSP, 2008; Pyke et al 2008; Najjar et al, 2010) and online tools (The Nature Conservancy's Climate Wizard).
- As new SGCN are added, distribution maps will be developed and habitat associations will be identified.
- Use local summaries

SPECIES-HABITAT ASSOCIATION

2005 WAP

Data

4. Species habitat and presence: NatureServe Explorer Online Encyclopedia (NatureServe 2004) and BOVA (DGIF 2004b).
5. NLCD (USGS 1992): Landsat TM imagery
6. NLCD (USGS 2001) Landsat 5&7
7. USFS Continuous Inventory of Stand Condition (CISC) timber stands, data digitized 1:24,000 7.5-minute series quad maps (UFSF 2002)
8. Southern Appalachian Assessment (SAA) spruce-fir areas digitized at 1:24,000 scale (SAMAB 1996)
9. Elevation (NED),
10. USFWS National Wetlands Inventory (NWI), data for which is continuously updated, and metadata for which varies by quad; scale ranges from 1:24,000 to 1:63,360 (USFWS 1995).
11. Tidal Marsh Inventory, data collected through site visits using aerial photography for assistance and digitized at a 1:24,000 scale (CCRM 1992).
12. Range: Terrestrial (BOVA) Aquatic (DCR's 14 digit HU) museum collections
13. DCR conservations land database to measure

Process

1. Review by expert/TAC
2. Mapped the potential habitat to the best of our abilities using the range information, data layers and habitat parameters (i.e selecting habitat features that have similar characteristics as the known sites)
3. Supplemented information with DCR-NH's Natural Heritage Screening Coverage. Includes data on Conservation Sites, including Stream Conservation Units and Karst Conservation Sites.
4. Clipped potential habitat by conservation lands.

Outcome

1. Maps of confirmed habitat and potential habitat for terrestrial, aquatic and subterranean species

   Terrestrial: points (confirmed locations) + potential habitat (polygon)

   Agquatic: Confirmed and potential habitat displayed as lines

2. Areas of conservation importance: overlaid all available potential and confirmed habitat layers for all Tier I species in one state map. Used for identifying areas of high priority/ extraordinary conservation opportunities.
3. Maps of Protectedness

2015 Revision

- Climate and habitat models
- Use local summaries
- Display SGCN distribution in HUC6 (6th order watershed): Improves accuracy and makes plan more actionable.

AQUATIC:

2005 WAP

Data

1. 14 Ecological Drainage Units Angermeier and Winston (1999).
2. 6 ecoregions
3. Stream Classification: link (NHD)
4. Connectivity (to lake and Link magnitude: Shreve order instead of Strahler order)
5. Gradient (NED)
6. Geology (NHD, Lithology of VA(1:500,000))
7. Stream temperature (reach elevation as a proxy)
8. Lit review

→

Process

1. Followed basic str. of TNC aq. community classification and MORAP (Missouri Resource Assessment Program's Aquatic GAP study)
2. Edited disconnected and looping stream arcs
3. Merged 14-digit hydrologic units developed by DCR into larger hu using HUC-8

→

Outcome

1. 34 EDUs in VA
2. Streams categorized by size (5), connectivity (6), and gradient (4)
3. % developed land use within each EDU
4. % agriculture within each EDU

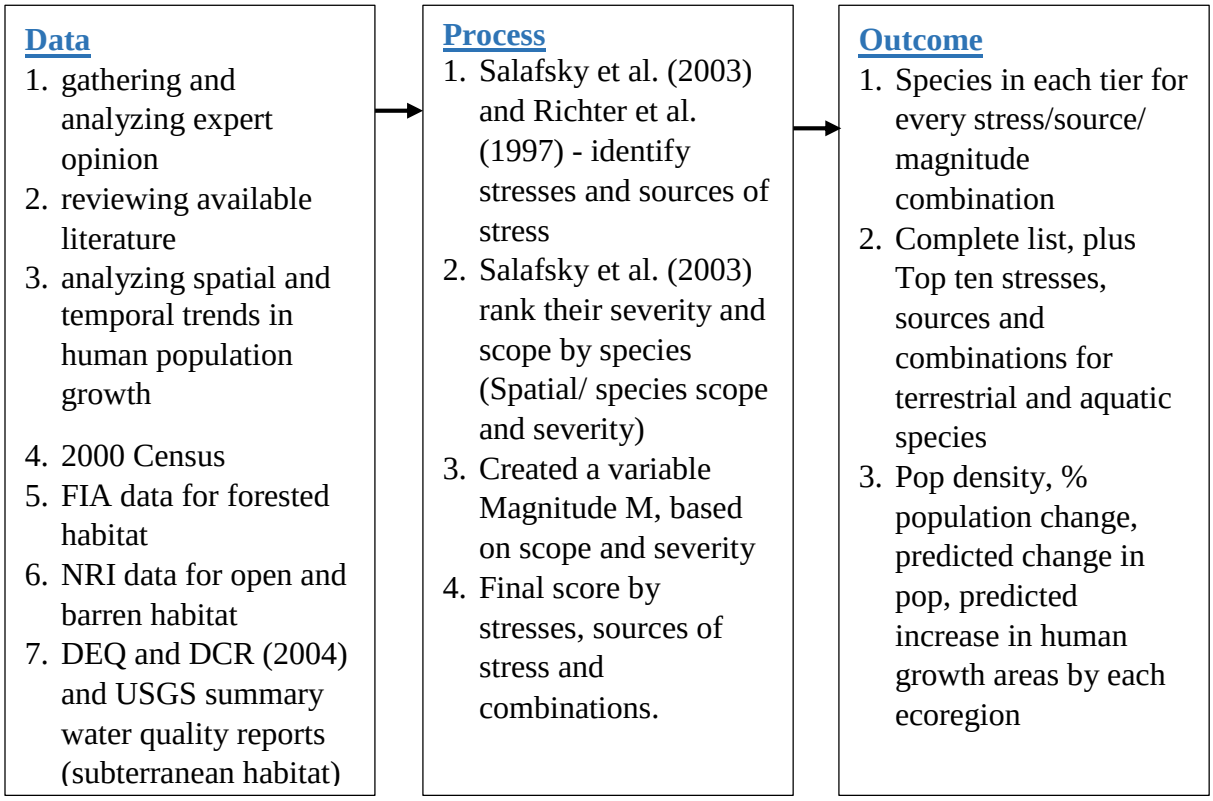
↑

2015 Revision

- Climate and habitat models
- Use local summaries
- Use HUC 6 instead of HUC 8

THREAT ASSESSMENT

2005 WAP



Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas				1	
Species Distribution Modelling	1	1			
Mapping terrestrial corridors/connectivity		1			Materials developed by Dept. of Conservation and Recreation after original action plan completed.
Measuring/ Mapping aquatic connectivity		1			New tools have been developed to help identify and prioritize dams and other river impediments.
Prioritization of restoration sites				1	
Predictive threat modelling	1				Original action plan included predictions of urban growth. This didn't prove to be very useful since the agency did not establish a clear set of implementation goals.
Climate resiliency modelling		1			Some climate modeling has been completed. We are currently working on an analysis of likely impacts climate change could have on conserved lands.

Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers not included in this list that may be in various stages of development.

LIDAR – various portions of Virginia have been mapped using LIDAR. However, this technology has not been consistently applied across the state. No statewide catalogue currently exists to indicate exactly which portions of Virginia have been mapped in this manner

Vernal Pools – Virginia Commonwealth University is working with DGIF and some of the master naturalist chapters to map and monitor vernal pools on public lands. At this time, however, efforts are concentrated in a few areas outside of the App LCC's boundaries.

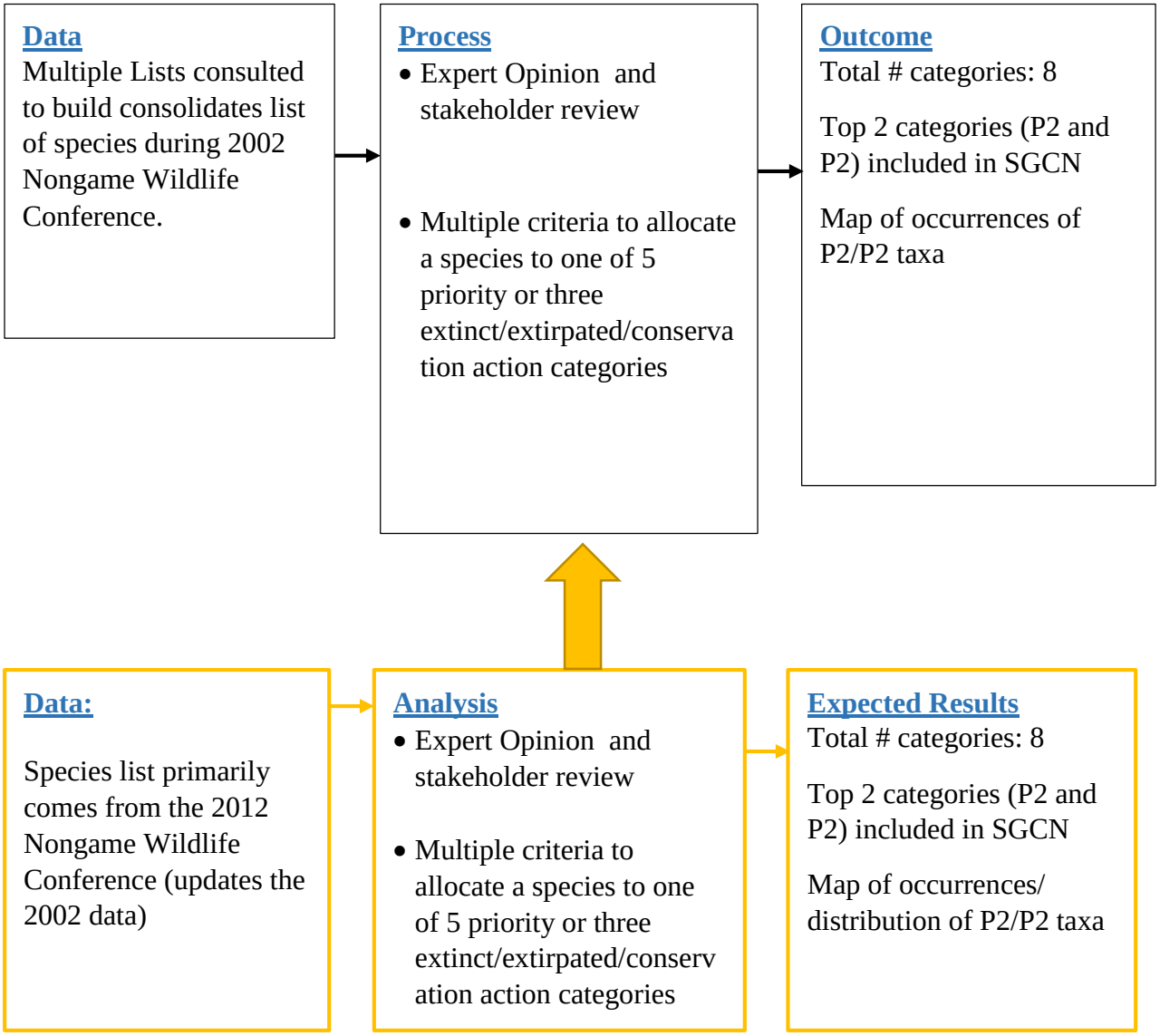
Considerable wetland information can be accessed from the National Hydrography Dataset. However, this material is generally at too coarse a resolution to provide locations for vernal ponds and small isolated wetlands.

Datasets	Completed and available	Complete but not yet available	In progress	Planned in the near future	Planned in long term	Not planned	Available for AppLCC area?
LIDAR data						1	See below
Stream Networks with corrected topology	1						1
Cave and Karst mapping	1						1
Isolated wetlands identification	1						See below
vernal pool mapping/						1	See below
Climate Change Models for A1Fi and B1 scenarios at mid-century and end of century		1					VA, WV, and MD

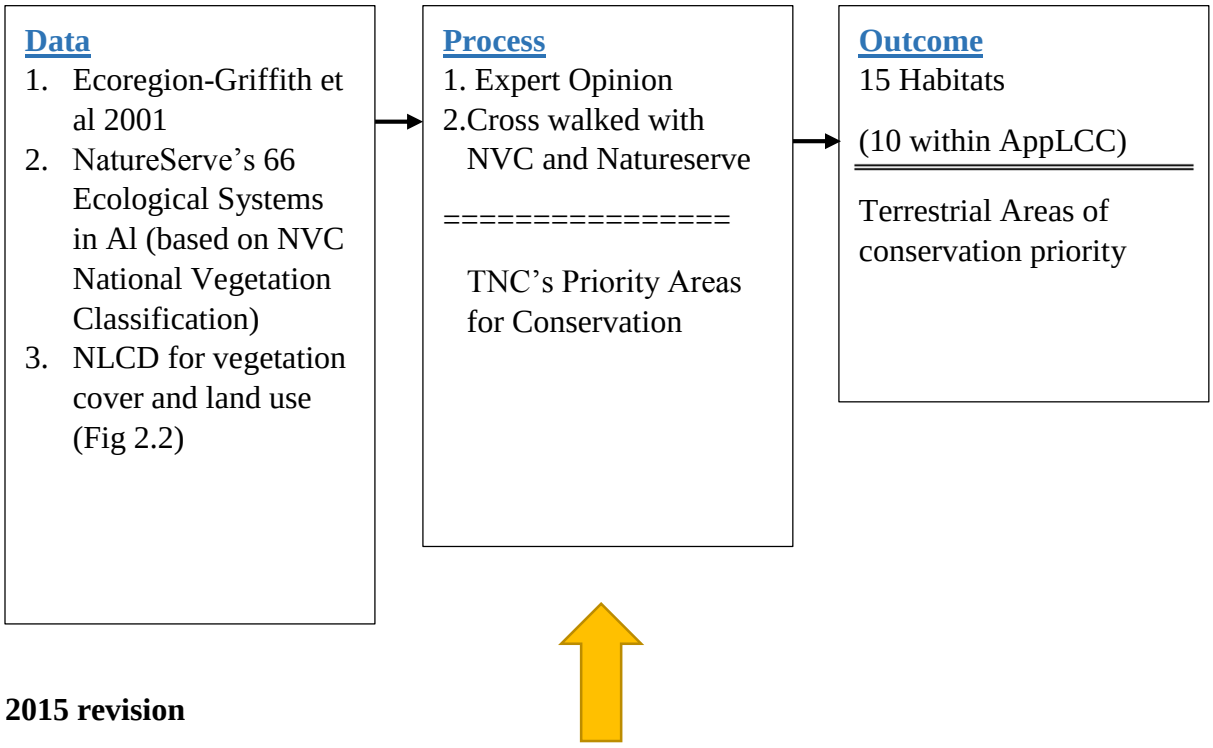
ALABAMA

(Feedback received)

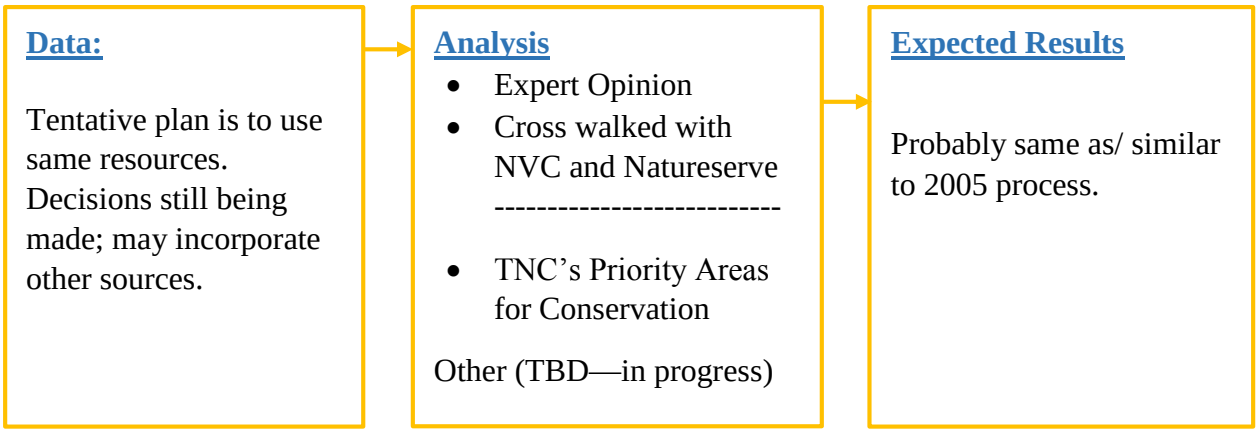
SGCN:



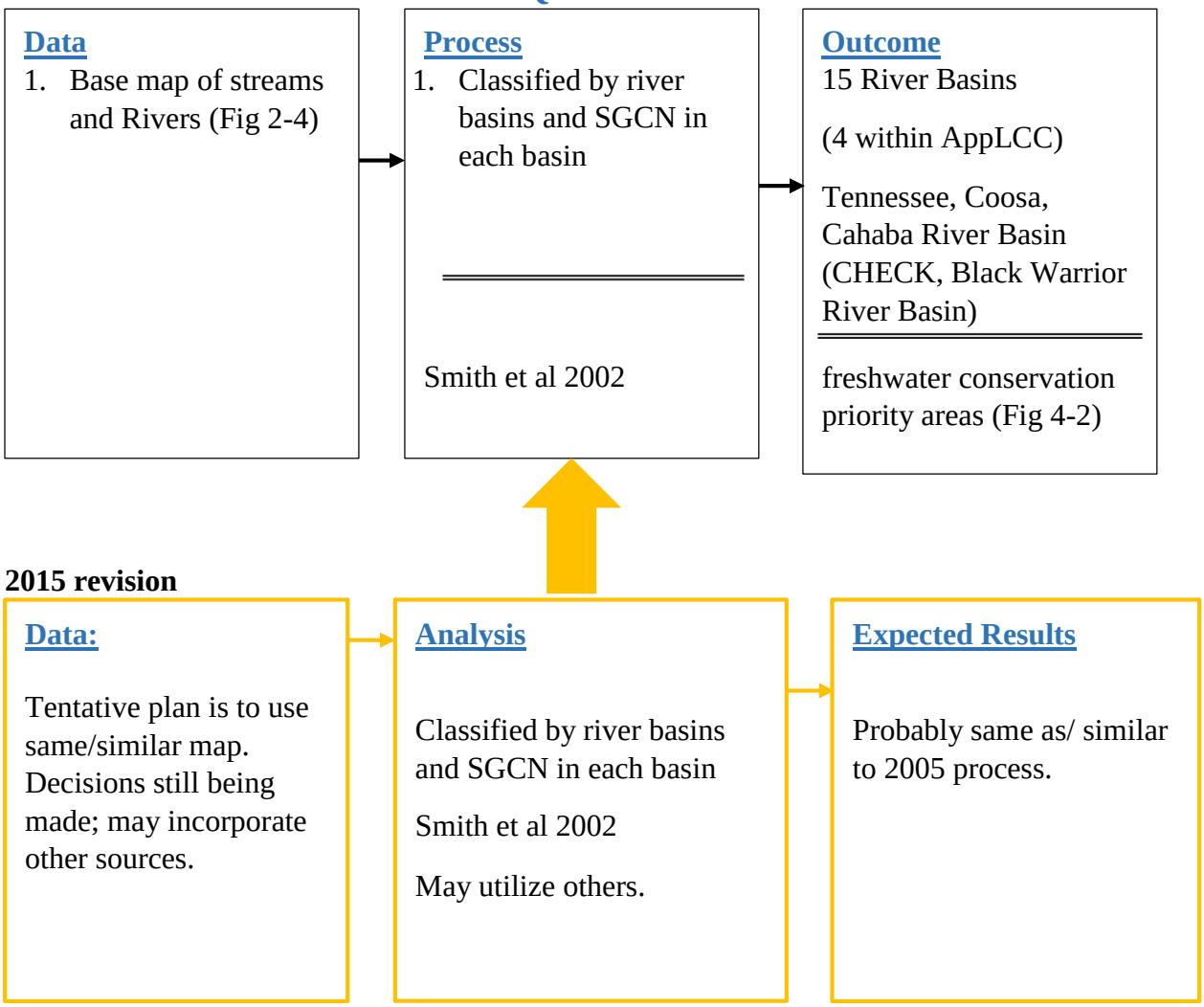
HABITAT IDENTIFICATION-TERRESTRIAL



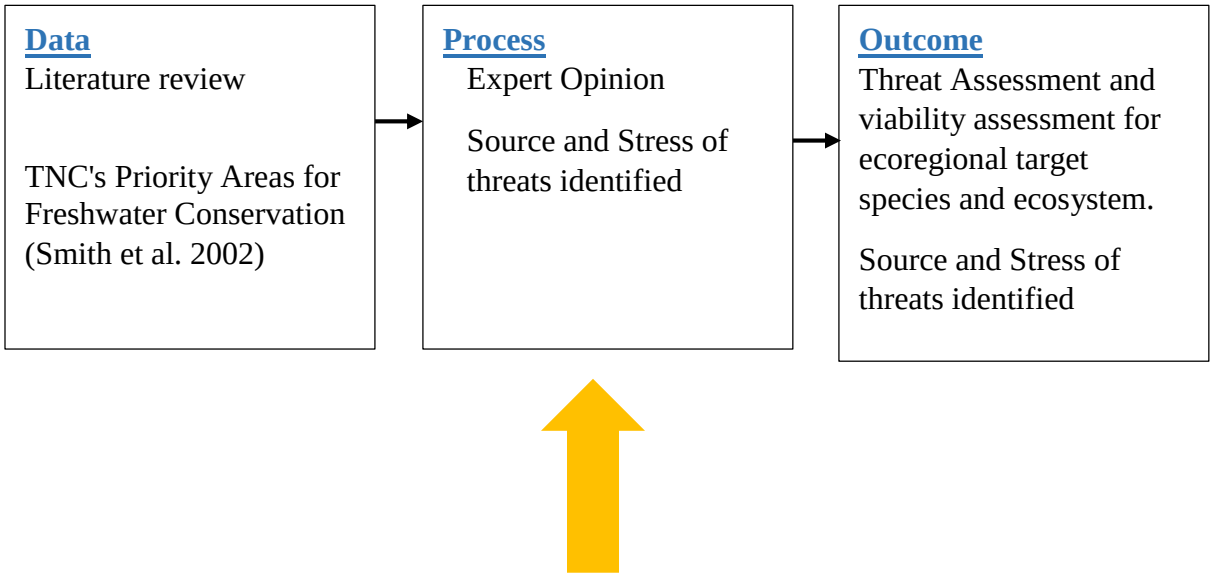
2015 revision



HABITAT IDENTIFICATION-AQUATIC

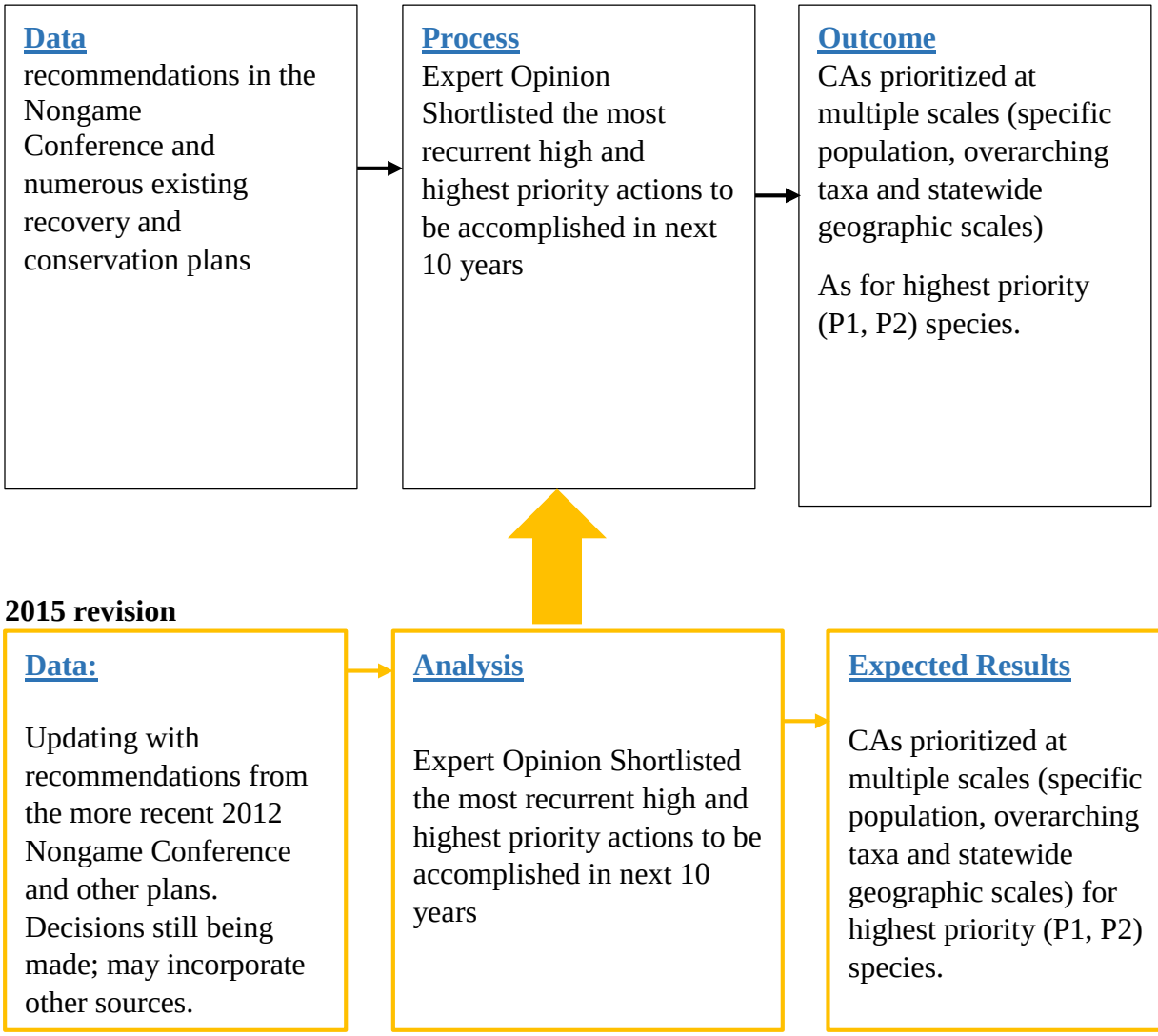


THREAT IDENTIFICATION



2015 revision

CONSERVATION ACTION PRIORITIZATION



Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list. Please add information as you deem suitable.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas		1 *			
Species Distribution Modelling		1 *			
Mapping terrestrial corridors/connectivity		1*			
Measuring/ Mapping aquatic connectivity		1*			
Prioritization of restoration sites		1*			
Predictive threat modelling		1*			
Climate resiliency modelling				1*	

*-To the extent possible with available information in 2005 and again in 2014. These were all used at some level in the 2005 and will be improved with the best available information for 2015.

Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers not included in this list that may be in various stages of development.

Datasets	Completed and available	Complete but not yet available	In progress	Planned in the near future	Planned in long term	Not planned	Available for AppLCC area?
LIDAR data			1*				
Stream Networks with corrected topology			1*				
Cave and Karst mapping			1*				
Isolated wetlands/vernal pool mapping/identification			1*				
Datasets			1*				
LIDAR data			1*				
Stream Networks with corrected topology			1*				

*These are all being done at some level dependent upon funding and staff

PENNSYLVANIA

Overarching changes in 2015 WAP:

National Best Practices for State Wildlife Action Plans will be used to the fullest extent practicable.

We also plan to use Northeast regional projects (e.g., Lexicon, Synthesis, Geospatial Condition Analysis), conducted in collaboration with the North Atlantic LCC, that will assist in providing a regional context for our state work

Progress:

An administrative structure has been established to provide a coordinated and cohesive process to the revision process. The Pennsylvania team is working to convene a spatial analysis ad hoc technical team to delve deeper into specific subject areas.

Additions:

A minor amendment on climate change to the 2005 SWAP was approved by USFWS. This amendment noted that climate change would be more fully addressed in the next comprehensive revision. As major amendments, two species, native eastern brook trout (*Salvelinus fontinalis*) and American shad (*Alosa sapidissima*) were also added to the 2005 SWAP. Other emerging issues will also be more fully addressed in the 2015 version, such as energy development, wildlife diseases (e.g., white-nose syndrome) and invasive species.

Changes:

Greater emphasis will be placed on northeast regional coordination and collaboration associated with the State Wildlife Action Plans. Two Projects: "Synthesis Project" (compilation of regional conservation need grant products, competitive State Wildlife Grant products and North Atlantic LCC products to provide a regional context for SWAPs in the Northeast). "Lexicon Project" (developed a common language for expressing content related to the eight required elements in northeast SWAPs).

Challenges:

New and expanding energy extraction methods, ever-increasing invasive species concerns, wildlife diseases (e.g., WNS), and climate change uncertainty represent important challenges to implementing the revised plan.

SGCN

2005 SWAP

Data
Global, national, regional and state rankings and lists for wildlife Taxa summarized

Process
Expert opinion

Outcome
Tiered list of SGCN (5 tiers: Immediate concern, High level concern, Responsibility species, PA Vulnerable, Maintenance concern)

Species Richness maps for Mammals, Birds, Amphibians, Reptiles, Fish, Mussels

2015 Revision

TERRESTRIAL HABITAT ASSESSMENT

TERRESTRIAL HABITATS

Forests and Woodlands:	Deciduous/Mixed Forests
	Coniferous Forests
	Riparian Forests
	Grassland (Farmland, Naturally occurring, reclaimed, other anthropogenic)
	Thicket/Shrub
Anthropogenic habitats:	Urban/Suburban Habitats
AQUATIC HABITATS:	Wetlands
	Seasonal Wetlands (Vernal Pools)
	Rivers and Streams**
SPECIAL HABITATS:	Rock Habitats (Caves, Rock outcrops, Mines, Talus slopes)
	Sandy Beach Habitats

Data

Ecoregion base information: 1999 Eco-region Map for Pennsylvania (Myers and Bishop 1999)

Pennsylvania GAP Analysis Project (Myers et al. 2000)

National Resource Inventory mapping (NRCS 1997)

Land cover classification: Goodrich et al 2002

Process

Gap Analysis compared with National Resource Inventory mapping

Outcome

Eight different habitat types, (5 terrestrial, 3 Aquatic, 1special, and 1 human-associated)

Broad habitat categories map of the state (Fig 11.1)

Forest cover map (PA GAP, Fig 12.2)

Maps of forest by their area (Fig 12.5)

Bird richness for coniferous forest (13.1), grasslands (Fig 20.6), thickets (Fig 21.1)

Data:

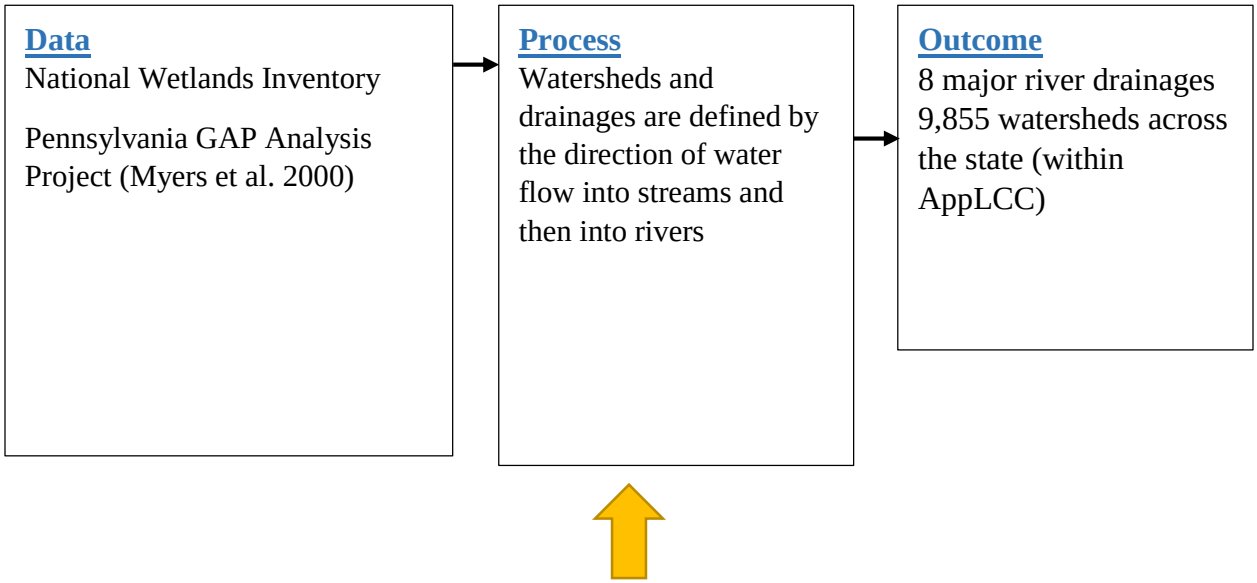
-

Process

Outcome

AQUATIC CLASSIFICATION

HUC codes were not used.



Data:

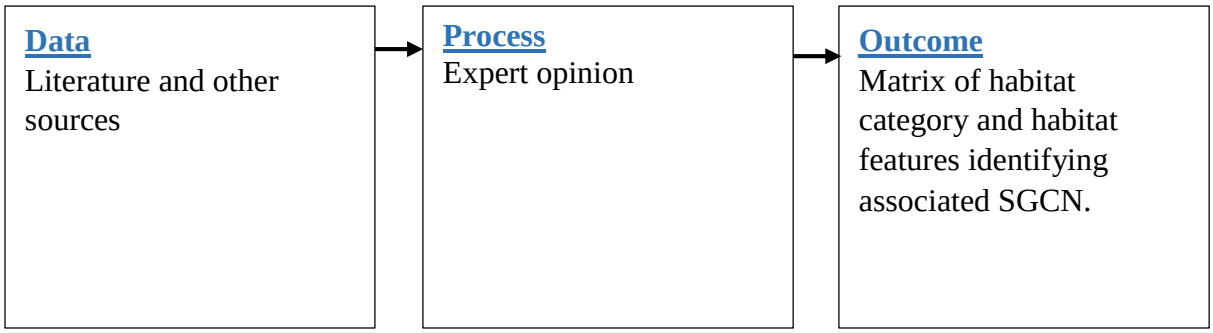
Process

There was a classification system (Aquatic Community Classification System) developed after the 2005 SWAP was produced and it will likely be a substantial component of the revised 2015 SWAP.

Outcome

SPECIES-HABITAT ASSOCIATION

2005 WAP



2015 Revision

-

THREAT ASSESSMENT

2005 WAP

Data	Process	Outcome
Literature review	Expert Opinion	Description of threats to habitat and associated species

2015 Revision

- The species threats assessment was embedded in the NatureServe rank calculation for species conservation statuses. Expert opinion and literature review were used to identify scope, severity and timing of threats.
- Threats will be further described using the NE Lexicon for 2015 SGCN.

CONSERVATION ACTION

2005 WAP

Data	**Process**	**Outcome**
Literature review	Expert Opinion	Prioritized actions (Level 1: 1-5 yrs, Level 2: 5-10 yrs) lists of Conservation actions for each habitat type and species associated with the habitat. 751 prioritized implementation actions for habitats.

2015 Revision

- The 2015 Revision will still use literature review and expert opinion to help identify conservation actions. However, we will use more categorized actions and will improve the linkage between threats and conservation actions.

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list. Please add information as you deem suitable.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas		1		1	
Species Distribution Modelling				1	
Mapping terrestrial corridors/connectivity		1			
Measuring/ Mapping aquatic connectivity					
Prioritization of restoration sites				1	
Predictive threat modelling					May use existing sources
Climate resiliency modelling					May use existing sources, such as TNC work for NE region.

Please add other data layers not I Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers not included in this list that may be in various stages of development.

Datasets	Completed and available	Complete but not yet available	In progress	Planned in the near future	Planned in long term	Not planned	Available for AppLCC area?
LIDAR data			1				
Stream Networks with corrected topology							
Cave and Karst mapping		1					
Isolated wetlands/vernal pool mapping/identification	1						

(Awaiting detailed response)

Overarching changes in 2015 WAP:

Progress: Core team has been formed within Indiana Division of Fish and Wildlife to ensure the completion of the revised plan and implementation of it throughout the division. Also formed an advisory committee consisting of various state agency partners and external conservation, recreation, and industry partners.

Additions

Changes

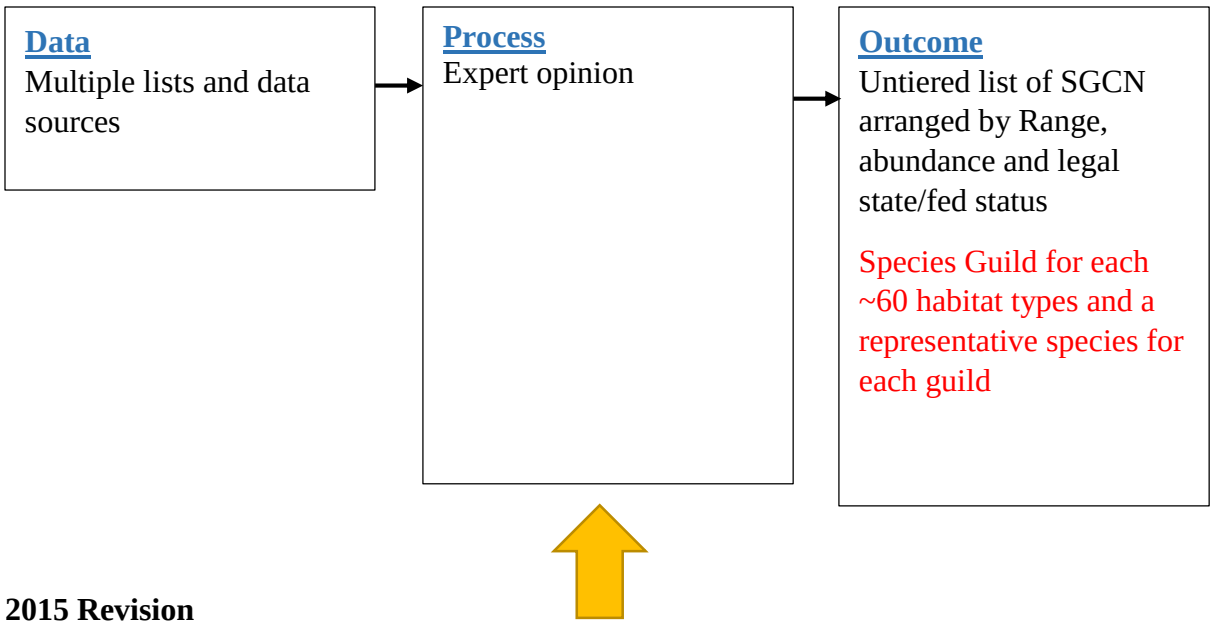
Increase participation from internal and external partners. More in-person meetings.

Challenges

The current SWAP served as a great baseline, but it has been found that the Plan has not been utilized to the extent intended or desired. Thus, during this revision process, there is a concerted effort to increase participation from internal and external partners with the expectation to increase implementation of the final revised plan.

SGCN

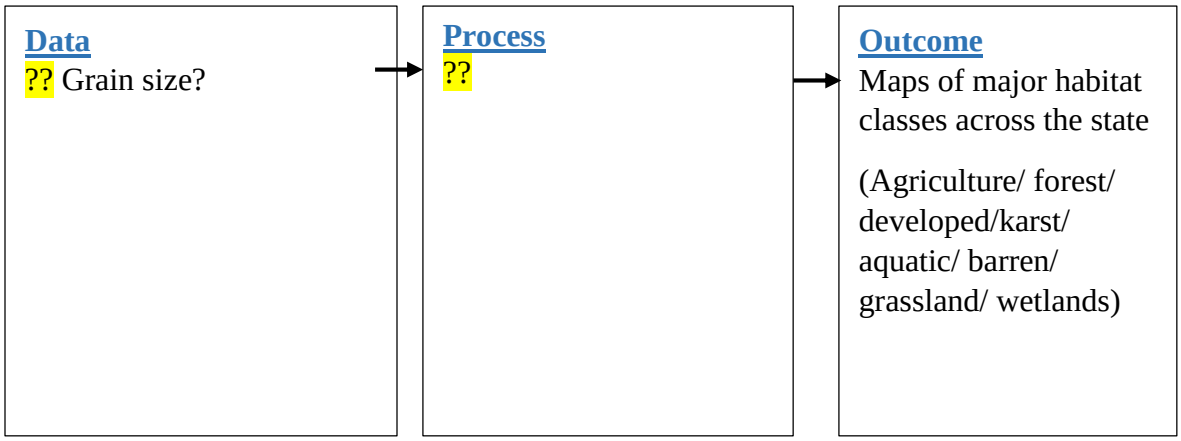
2005 WAP



2015 Revision

HABITAT: TERRESTRIAL

2005 WAP



2015 Revision

- New data layers: Habitat classification based on ASTER data or LANDSAT 7 ETM+
- Compile trends in wildlife species occurrences for each habitat type 1800/1900/2000 [historic overview of the changes in the eight major habitat categories in Indiana from pre-European settlement to present, in hundred-year intervals, with associated changes in fauna]
- Quantified index on total acreage, geographic distribution, patch size, native-nonnative, vegetation diversity, relative abundance, ownership and condition of habitats

AQUATIC:

The Qualitative Habitat Evaluation Index (QHEI) is a standardized system designed by the Ohio EPA and modified for Indiana to evaluate the physical and chemical characteristics of river and stream habitats.

2005 WAP

Data	Process	Outcome
Eg: NWI/ HUC levels?	Qualitative Habitat Evaluation Index (QHEI) is a standardized system designed by the Ohio EPA and modified for Indiana Rivers and streams classified first by drainage/watershed, and then by size order	Quality of wetlands to support aquatic (stream fish and invertebrate communities) life. 5 levels of habitat classification (broad to fine scale) Aquatic systems classified by size (headwater, wadeable /large river, great river, etc) , characteristic: natural lakes, Impoundments, Oxbows/Backwaters/Sloughs/Embayments

2015 Revision

-

THREAT ASSESSMENT

2005 WAP

Data	Process	Outcome
8. Questionnaire to experts	Expert opinion	Threats to wildlife and habitats ranked across the major eight habitats

2015 Revision

-

CONSERVATION ACTION

2005 WAP

Data	**Process**	**Outcome**
1. Questionnaire to experts	Expert opinion	Conservation Actions for wildlife and habitats ranked across the major eight habitats Conservation Actions prioritized for each habitat and associated species.

2015 Revision

-

State: Indiana

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list. Please add information as you deem suitable.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas					
Species Distribution Modelling					
Mapping terrestrial corridors/connectivity					
Measuring/ Mapping aquatic connectivity					
Prioritization of restoration sites					
Predictive threat modelling					
Climate resiliency modelling					

Please add other data layers not I Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers not included in this list that may be in various stages of development.

Datasets	Completed and available	Complete but not yet available	In progress	Planned in the near future	Planned in long term	Not planned	Available for AppLCC area?
LIDAR data							
Stream Networks with corrected topology							
Cave and Karst mapping							
Isolated wetlands/vernal pool mapping/identification							
Datasets							
LIDAR data							
Stream Networks with corrected topology							

ILLINOIS

(Feedback received)

Overarching changes in 2015 WAP:

Progress: Currently drafting task list and timeline for our revision

As part of the SGNC review, we convened 38 taxa experts to discuss our listing criteria and potential refinements.

Additionally, we have completed or initiated reviews of the various taxonomic groups.

Survey we conducted with our core implementation partners to evaluate changes in SWAP revision.

Additions: Review of fish SGNC is complete. Mussels, herps, and non-mussel inverts are in review. Bird review will be initiated soon. The intent of the species review is to 1) standardize habitats and crosswalk those with our Campaigns, 2) provide a measure of spatial status for each animal, and 3) identify those that have declined in the last decade. Declining species will be a priority for conservation actions in our revised Plan.

Changes:

Overarching theme of the revision will be to improve connections between species outcomes and the habitat actions that get us there. To support that, IL will be creating more of an implementation guide to support the original Action Plan, rather than revising specific parts of the text from the original document.

Re-organization of the new document to have all conservation actions across the document to be grouped by habitat types in the Campaign sections.

Challenges:

Narrowing the focus of the WAP revision

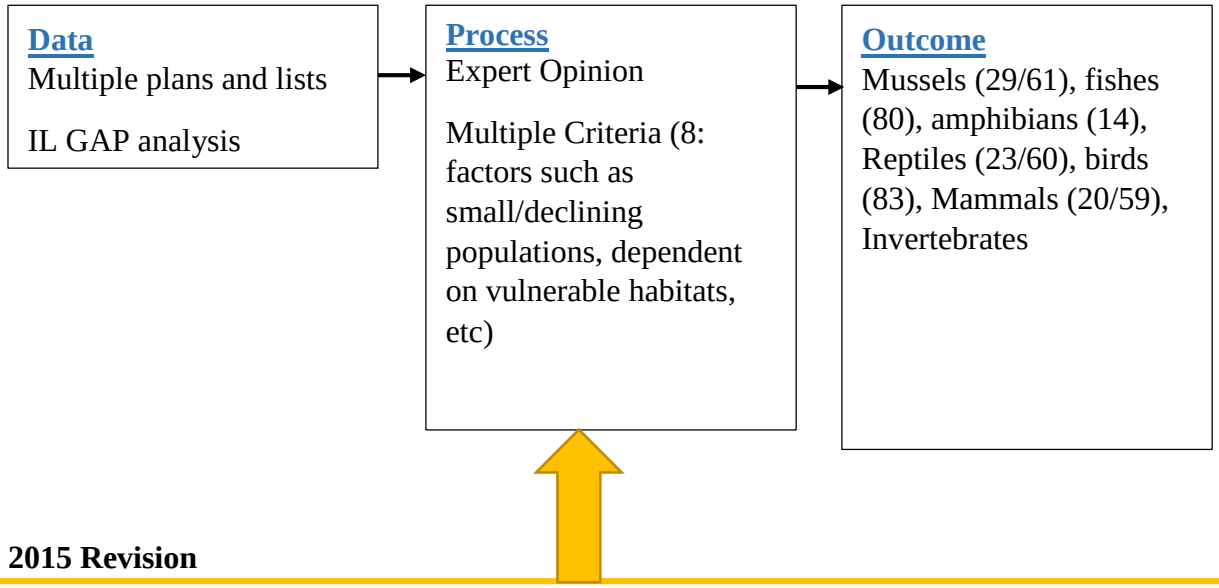
Deciding where to list conservation actions that address habitats not currently covered by existing Campaigns

Communicating the “why” behind the conversation actions

Creating a tracking system that will track habitat work by IDNR and partners and the species response to the habitat improvements

SGCN

2005 WAP



2015 Revision

- Considering various criteria for adding or removing species from the SGCN list. Survey conducted to get feedback on revision process.
- Review species list, and clarify why species are on the list (Currently there are 638 species, which is too many to focus on).
- Identify a limited set of species that respond well to the management actions we are promoting through our Plan. These will be the species we monitor and report on over the next 10 years.

HABITAT: TERRESTRIAL

2005 WAP

Data

Illinois Land Cover, and its statistical summary based on satellite imagery 1999-2000

Illinois Natural Areas Inventory and TNC Portfolio sites

Critical Trends Assessment Project (also for Inventory of resource rich areas)

Process

Used previously identified priority areas, current SWAP efforts, and partner selected areas.

Used info on SGCN habitat associations

Using GIS, ranked the entire state on basis of Patch size, IL natural Areas Inventory designation (Biotics 4 database), diversity of SGCN in which habitat based on modeled distribution maps (IL GAP analysis), known presence of threatened and Endangered Sp in IL NR Biotics 4 database.

Participants helped identify COA by placing five markers per participant on state maps (including one for restoration opportunities)

Outcome

Important conservation areas for IL SGCN for five habitat types: Forests, emergent wetlands, forested wetlands, grasslands, streams (Fig.H,I,J,K,L)

Agreement in all three methods

Conservation Opportunity Areas for 32 Sites, across 15 Natural Divisions and 9 habitat types (Table 8)

2015 Revision

- Identified opportunities to standardize habitats, which will relate back to our campaigns.
- Need to identify purpose of each COA. Some of the existing COAs represent opportunities to protect/restore a specific habitat (e.g., hill prairies) and the associated SGNC. However, others represent opportunities where we have willing partners. Without a clear purpose defined, it's been difficult to communicate the priority for each COA.

SPECIES-HABITAT ASSOCIATION

2005 WAP

Data	Process	Outcome
SGCN associated with one or more broad habitat categories (IL Natural Areas Inventory, Table 5) Lit review	• Expert Opinion • Where possible data dependent) abundance , population trend and official status (threatened/endangered) recorded • Ranked each datum by level of confidence (high-medium, low, very low) • Matric of distribution, abundance and habitat association subjected to internal and external peer review	Species associated with habitat types

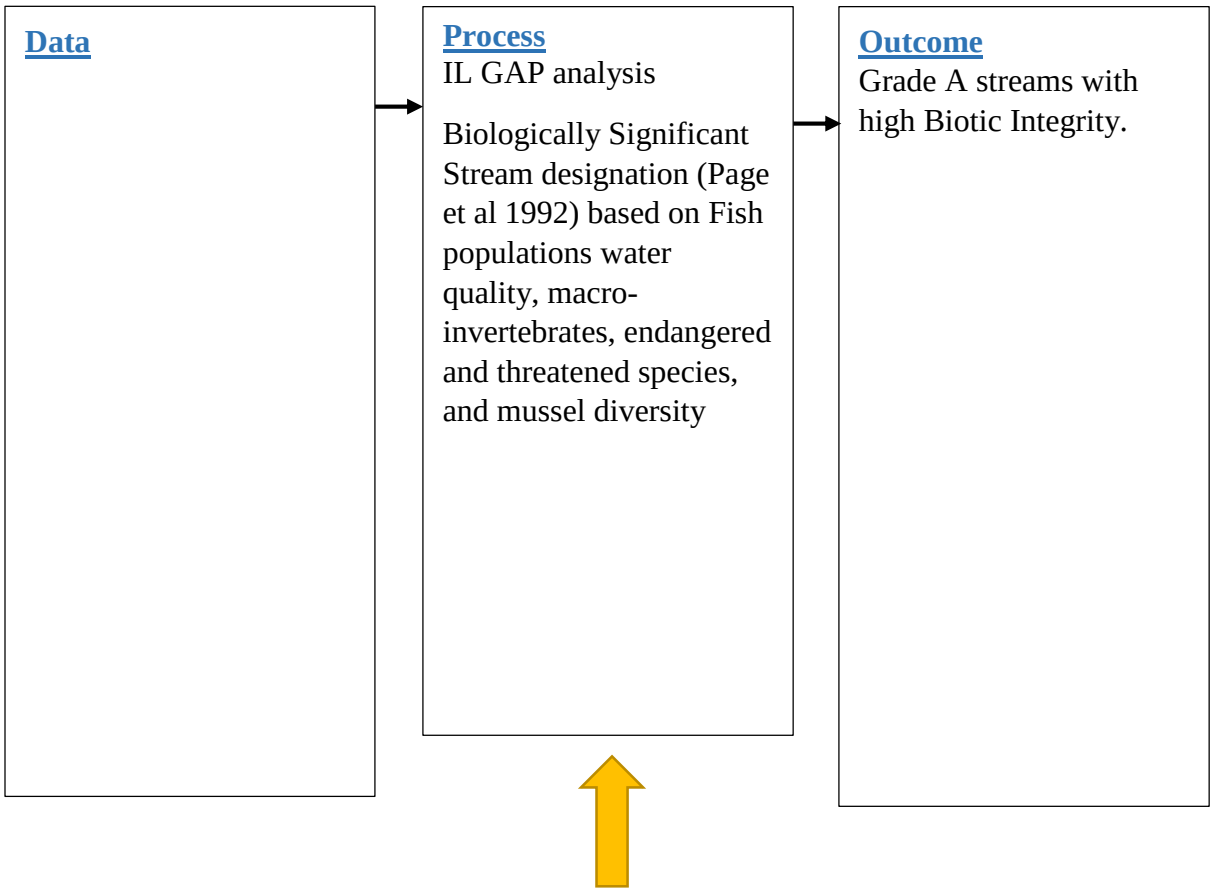
2015 Revision

Appendix I will be modified. The current habitat column will be replaced with the general habitat on the left. A second column for "Detailed Habitat" will be added. The detailed habitat will be completed by species experts and will vary by species.

AQUATIC:

The distinction between stream and river was based on size. Streams were discussed in natural division assessments, but other regional frameworks were not applied. A stated need in the Plan was to develop an ecological stream classification and use as a framework for identifying conservation actions.

2005 WAP



2015 Revision

- Fish and mussel SGNC were reviewed at a HUC 8 scale.
- A hierarchical framework for streams has been developed and will be incorporated into the revision.
- Two types of conservation actions will be identified for streams. In addition to the habitat-based ones, we will also include policy actions. Majority of the aquatic conservation partners in IL are advocacy groups. Policy actions such as water quality rulemaking changes will be incorporated to facility participation by our conservation partners.

THREAT ASSESSMENT

2005 WAP

Data

9. Twenty stresses, grouped into the major classes of habitat, community, population, and direct human stresses
10. Sources of stresses at statewide and smaller geographic scales
11. Various conservation plans and literature review

Process

1. Expert opinion
2. Ranked on its affects or potential affects on each of the SGCN taxa groups and habitat types by the level of the potential stress (3 point scale)
3. Confidence indicator associated with each stress score.
4. Matrices subjected to internal and external peer review

Outcome

1. Stress score for each SGCN taxa and habitat type
2. Large scale stresses and sources of stress are categorized as related to habitat (6) /population (4) / community (7) /human (3) **and** rated as weak, moderate and strong effects **and** stress scored by three categories of confidence. "Issues" of "Priority Conservation Actions for Illinois Wildlife & Habitat Resources"
3. Small scale stresses and sources outlined

2015 Revision

- During the SGNC expert session, changes to the list of stressors were discussed. Participants felt we should keep the existing list, but clarify the meaning of each.
- We are discussing moving the habitat-based stressors out of the species portion of Appendix II and into the habitat portion of Appendix II. The reason for doing so it that progress can be tracked better at the habitat scale than by each individual species.
- We are still discussing how to include climate change in the revision.

CONSERVATION ACTION

2005 WAP

Data

Existing plans collated

Process

1. Conservation actions determined on basis of being most **feasible** and **effective** in reaching the State's wildlife and habitat objectives
2. Expert opinion, workshops
3. Compilation of proposed actions, quantified expert opinions by consensus and frequency of suggestion, perceived effectiveness and feasibility, and arranged actions into overlapping, complimentary campaigns

Outcome

1. CAs outlines taxonomically, by habitat and topically.
2. CAs compiled into seven overlapping statewide "campaigns:"Streams, Forests, Farmland & Prairie, Wetlands, Exotic Species, Land & Water Stewardship, & Green Cities
3. Smaller scale: Conservation actions described for COAs

2015 Revision

- We anticipate the Campaign sections of our Plan expanding in the implementation guide.
- Reorganize actions that are currently described throughout the document (especially in the natural division assessments) and move them to the Campaign sections. The new version then will have all the conservation actions group by habitat type, rather than spread throughout the document.
- Incorporate policy actions where applicable.
- Prioritize conservation actions and highlight those that address needs of declining species.

State: Illinois

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list. Please add information as you deem suitable.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas	Identification not prioritization	We are reviewing our COAs. Additionally, we are working with the UMGL LCC to develop regional COAs for grasslands and streams.		The regional part is new for 2015.	
Species Distribution Modeling				We now have models complete for fish, mussels, Il chorus frog, and some aquatic invertebrates.	
Mapping terrestrial corridors/connectivity		Some of this was done in 2005. We are discussing cooperative mapping of protected lands with the statewide association of land trusts. When the mapping is complete, we can see where gaps exist and work			

		together to protect key corridors.			
Measuring/ Mapping aquatic connectivity		Some of this was done in 2005. Recently, we've developed some GIS connectivity models to look at fish movement across barriers.			
Prioritization of restoration sites				x	
Predictive threat modeling			x		
Climate resiliency modeling				We funded a climate vulnerability assessment. At this point, we're not sure how we're going to use it in the revision.	
Urban environment		A green cities campaign was included in our 2005 Plan. We're discussing ways to improve this section. We have lots of conservation partners in the Chicago Wilderness region that are interested in revising this section.			

Please add other data layers not I Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers not included in this list that may be in various stages of development.

Datasets	Completed and available	Complete but not yet availabl e	In progress	Planned in the near future	Planned in long term	Not planned	Availabl e for AppLCC area?
LIDAR data			LIDAR is available for part of IL				Not sure
Stream Networks with corrected topology			We are working with ESRI to create a statewide streams applicatio n. This includes a major editing of our stream lines.				
Cave and Karst mapping	Not sure						
Isolated wetlands/vernal pool mapping/identificati on	Not sure						
Datasets							
LIDAR data							
Stream Networks with corrected topology							

NEW YORK

(Feedback received)

Overarching changes in 2015 WAP:

Changes:

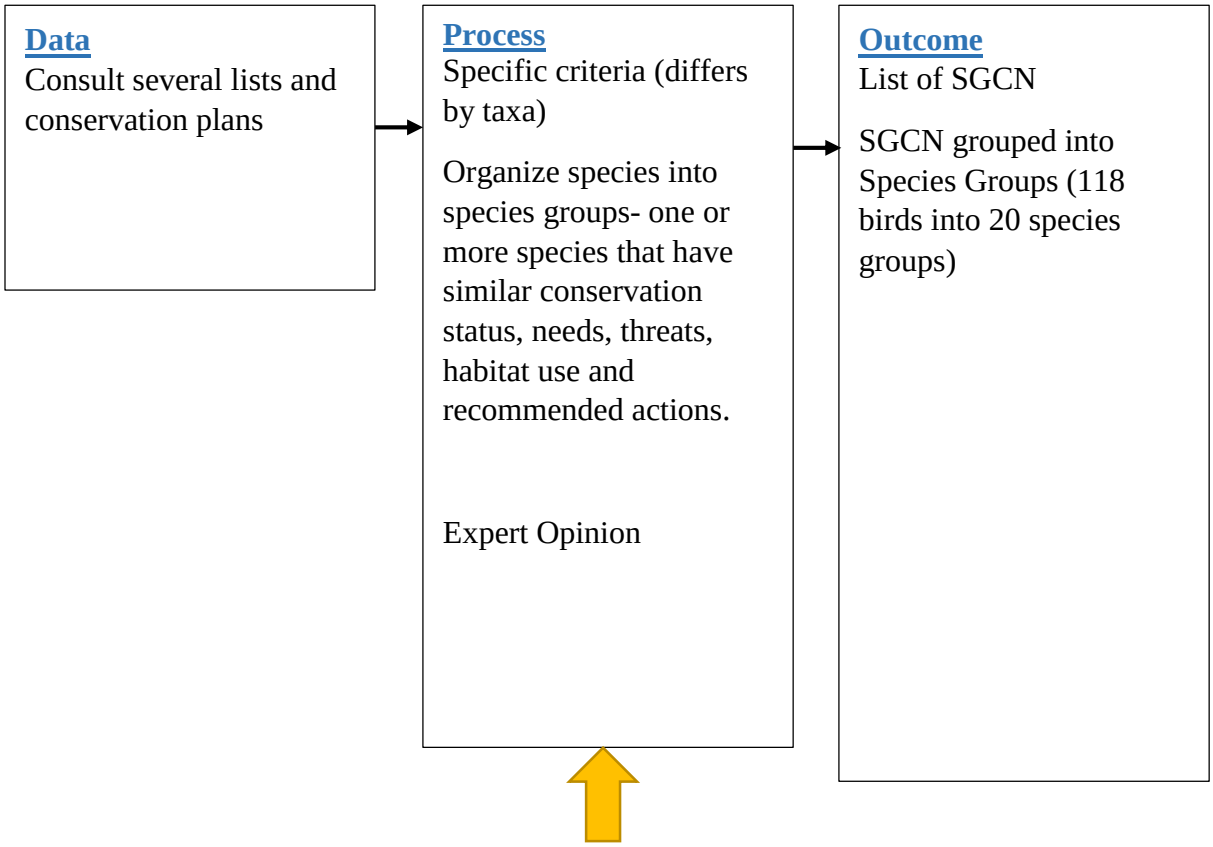
- Changed focus from a Comprehensive Strategic Plan to a 10 year Action Plan.
- SGCN categorized by conservation need, and focus conservation actions that are operationally feasible in a ten year time frame.
- SWAP will not be organized by watersheds. The 2015 SWAP will be organized by the 8 required elements.

New issues:

- White Nose Syndrome in bats and greater awareness overall of the importance of Wildlife Health.

SGCN

2005 WAP



2015 Revision

Drafted species assessments for all SGCN and candidates. Species assessments provide the inputs for SGCN categorization model

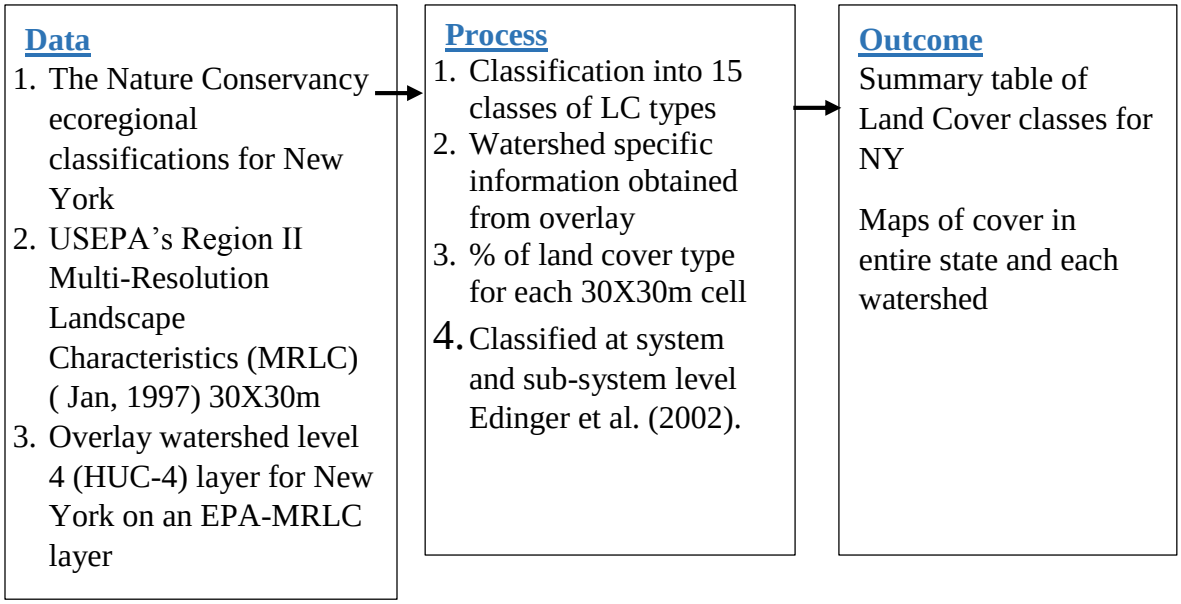
Use of a decision tree model for designating and categorizing SGCN, in order to reduce subjectivity

Categorize SGCN list according to conservation need

Use improved data sources, utilized SWG funding

HABITAT: TERRESTRIAL

2005 WAP



2015 Revision

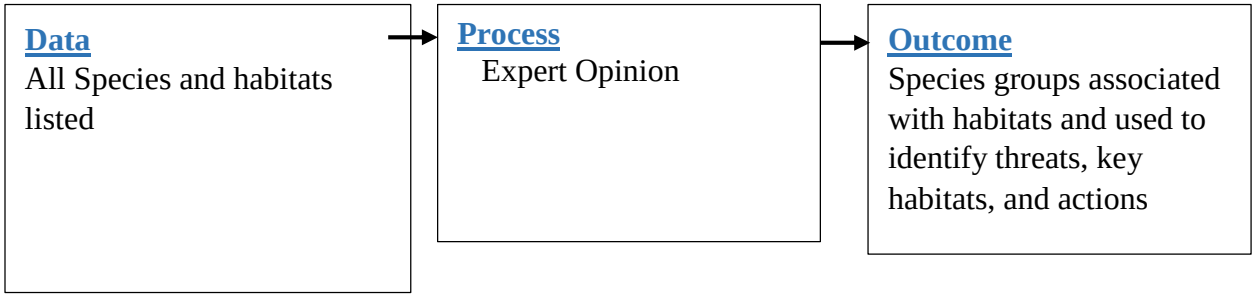
Not organized by watershed, but by the 8 required elements. Terrestrial habitat classifications will be based on the Northeast system developed by the Regional Conservation Needs Program, which have been crosswalked to a NY classification to reduce the number of classifications.

SPECIES-HABITAT ASSOCIATION

Species historical distribution: Ecoregion + watershed

Species current distribution: Ecoregion+ watershed

2005 WAP



2015 Revision

Species-habitat associations are listed in the species assessments, again using expert opinions. This will again be used to identify key habitats and possible conservation actions.

AQUATIC:

All discussions arranged by watersheds.

2005 WAP

Data	Process	Outcome
HUC 4: USGS watershed boundaries	Watershed basins delineated Classified at system and sub-system level Edinger et al. (2002).	Watershed Maps Watersheds with Land cover

2015 Revision

Aquatic habitats are also based on the Northeast RCN Program crosswalked to a NY classification system. Stream classifications are determined by size, gradient, buffering, and temperature, lake classifications are based on size. Marine habitats are classified by salinity, depth, vegetation, and geomorphology.

THREAT ASSESSMENT

2005 WAP

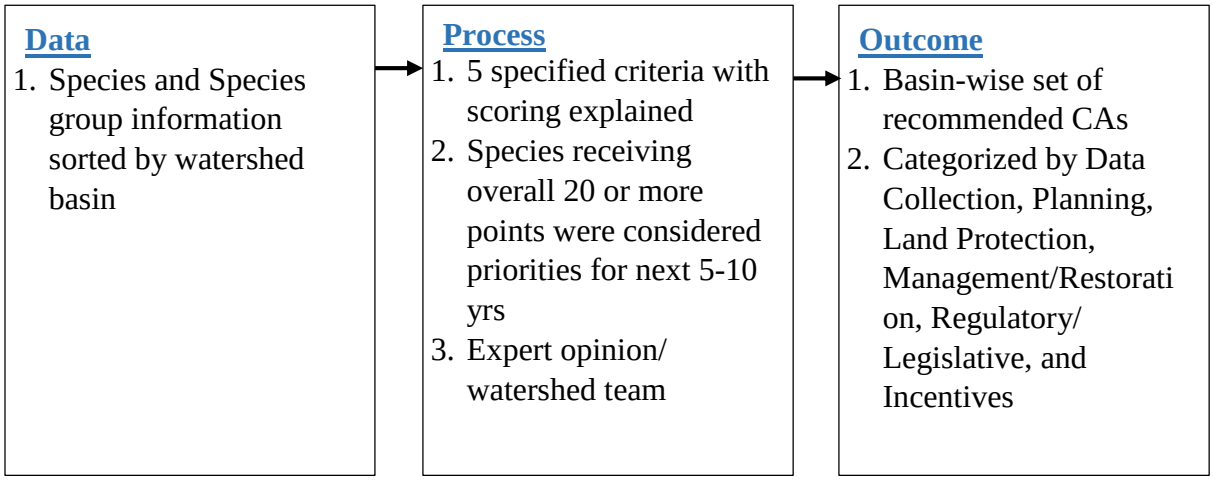
Data	Process	Outcome
12. Exhaustive list of Threats	1. Prioritized statewide and for each watershed by expert opinion	List of 36 Threats outlined and organized by # Species groups affected, % of all species groups in basin and % of all threats in basin

2015 Revision

Threats identified by expert opinion and classified by IUCN terminology. Scope, severity, irreversibility and # of species impacted will be used to assess threats.

CONSERVATION ACTION

2005 WAP



2015 revision

Conservation actions will be classified with the IUCN terminology, and prioritized in a Structured Decision Making matrix based on a cost/benefit analysis, which will focus efforts on conservation actions which are operationally feasible in a ten year time frame.

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/ Prioritization of Conservation Areas				1	
Species Distribution Modelling			1		Used by Natural Heritage in prioritizing survey work, but not directly applied in the SWAP
Mapping terrestrial corridors/connectivity			1		Completed for some areas by discrete projects
Measuring/ Mapping aquatic connectivity			1		Completed for some areas by discrete projects
Prioritization of restoration sites		1			
Predictive threat modelling			1		
Climate resiliency modelling				1	

Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned)

Datasets	Status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned)
LIDAR data	Possibly used in assessing estuarine habitats
Stream Networks with corrected topology	No
Cave and Karst mapping	No
Isolated wetlands/vernal pool mapping/identification	Not in SWAP, but identified in wetlands regulations

NEW JERSEY

(Received response)

Overarching changes in 2015 WAP:

Progress:

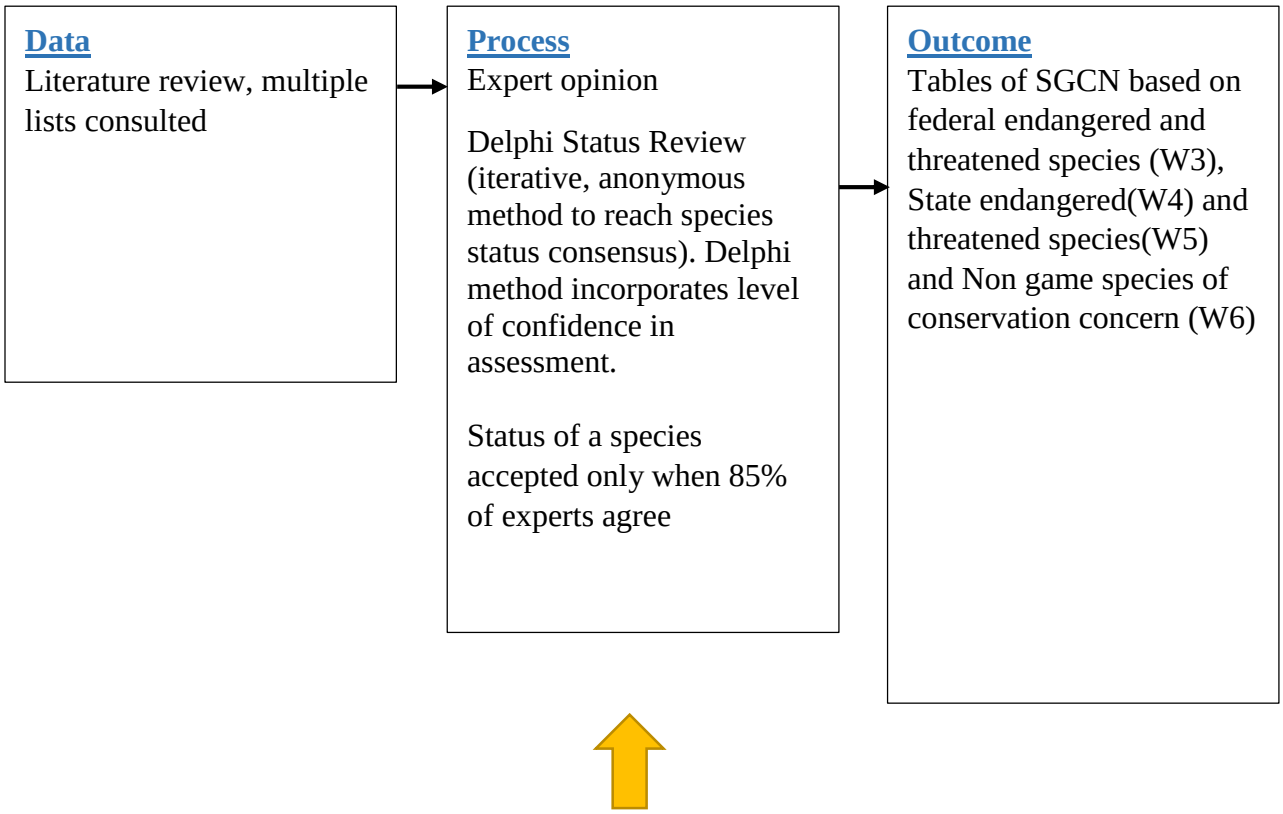
Additions:

Changes:

Challenges:

SGCN

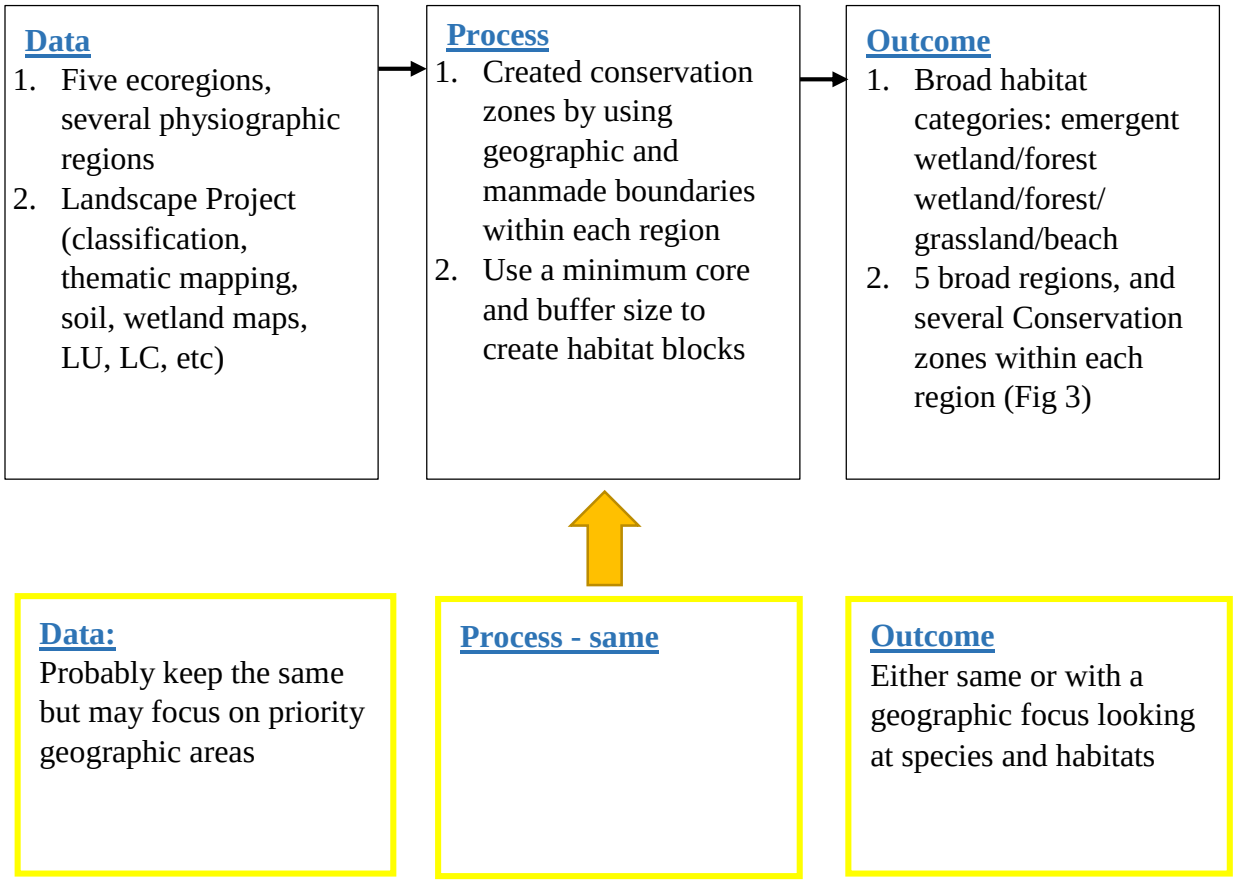
SGCN lists in Tables W3-W6 in Appendix I, or was it all of them? **Table W3.** Federal Endangered and Threatened Species***Table W4.** State Endangered Species **Table W5.** State Threatened Species **Table W6.** Nongame Species of Conservation Concern Note: Recovery goals based upon regional plans.



We are not using expert opinion unless absolutely required. We will follow the NE lexicon suggestion for inclusion.
We are also going to prioritize our species and focus on those species that rank high.

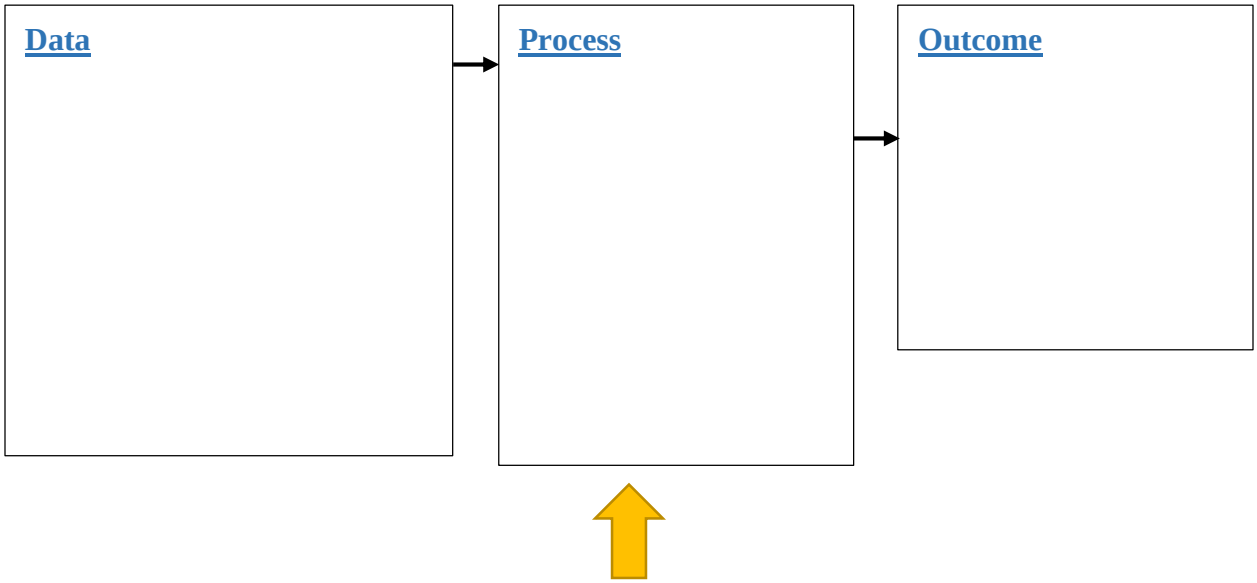
TERRESTRIAL HABITAT ASSESSMENT

Biotics is NatureServe's biodiversity data management software, which in New Jersey is managed jointly by the NJ Department of Environmental Protection's Office of Natural Lands Management's Natural Heritage Program and the Division of Fish and Wildlife's ENSP.



AQUATIC CLASSIFICATION -

No aquatic classification in the SWAP



Data:

We will use aquatic classification but I'm not sure how it will play out.

Process

Outcome

SPECIES-HABITAT ASSOCIATION

2005 WAP

Data	Process	Outcome
Aerial photography based land-use and land cover	1. LU/LC categorized into 5 categories (forest/grassland/forested wetland/emergent wetland/beach-dune) 2. County level roads used to determine contiguous patches of habitat 3. Habitat patches intersected with documented occurrence of Nongame wildlife species (Biotics) 4. Habitat patches were ranked from 5-1 (decreasing order of priority) by the species that occupied the patches 5. SDMs	1. Map of critical landscapes for imperiled species (Ranks 5,4,3), priority species (Rank 2), and suitable for other species (Rank 1) across four habitat types.(Fig1) 2. Critical areas for individual species across the state (Fig 2) 3. Tables of suites of species across conservation zones within each region (eg. Table s8)

2015 Revision

- We may or may not change this.

THREAT ASSESSMENT

Categorized by scope
1. National and Interstate Threats
2. Statewide Threats: Direct human and indirect human impacts

2005 WAP

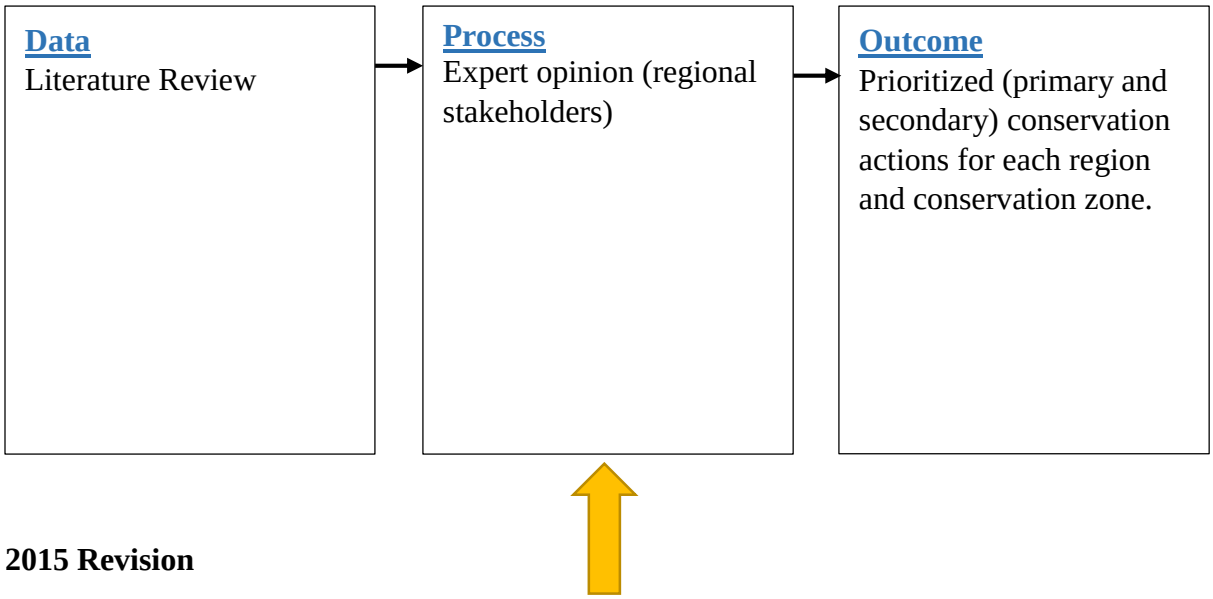
Data	**Process**	**Outcome**
Literature review	Summary and description	Threats listed by the SGCN, suites of wildlife.

2015 Revision

- We will prioritize our threats and use the IUCN classification from the NE Lexicon.

CONSERVATION ACTION

2005 WAP



2015 Revision

- Actions will focus on priority species and habitats. We will have stakeholder meetings to develop actions addressing prioritized threats.

State: New Jersey

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list. Please add information as you deem suitable.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas	1	1			
Species Distribution Modelling	1	1			I don't expect we will do true species modeling for this round I have said we would improve it in case
Mapping terrestrial corridors/connectivity		1		1	
Measuring/ Mapping aquatic connectivity				1	
Prioritization of restoration sites			1		
Predictive threat modelling			1		
Climate resiliency modelling					Not sure what we will do.

Please add other data layers not I Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers not included in this list that may be in various stages of development.

Datasets	Completed and available	Complete but not yet available	In progress	Planned in the near future	Planned in long term	Not planned	Available for AppLCC area?
LIDAR data					1		
Stream Networks with corrected topology						1	
Cave and Karst mapping						1	
Isolated wetlands/vernal pool mapping/identification	1						
Datasets							
LIDAR data							
Stream Networks with corrected topology							

KENTUCKY

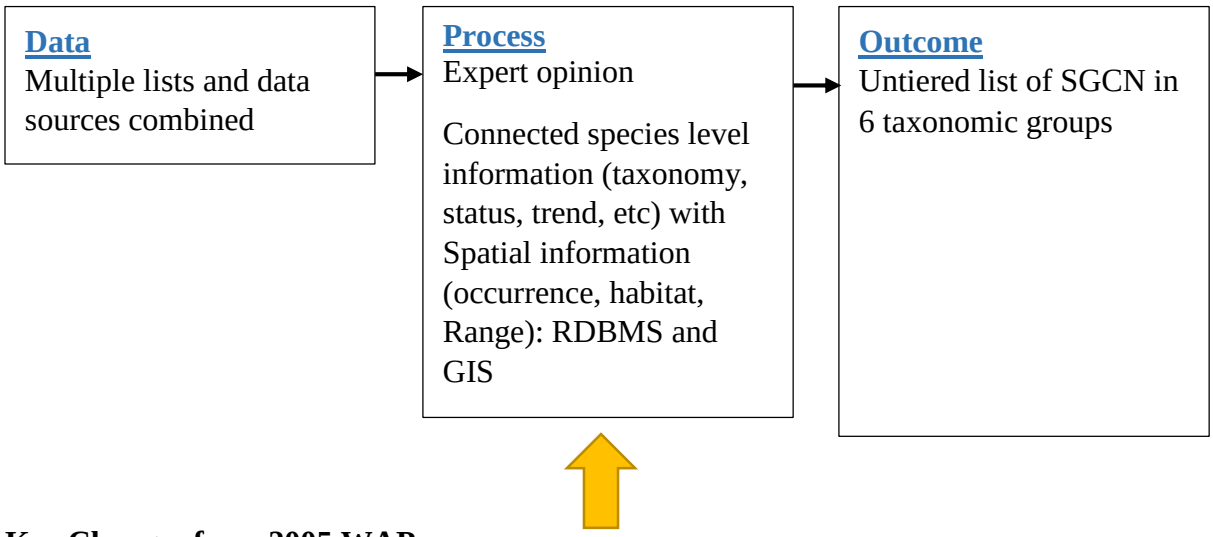
(Received response)

Overarching changes in 2015 WAP revision (completed in 2013):

- Additions: a climate change chapter,
  crayfish as a taxonomic group,
  4 new conservation actions (including addressing disease issues like white nose syndrome in bats)
- Changes: TNC's Climate Wizard for Kentucky-specific climate change models.
  Revision of terrestrial habitat guild
- Challenges: revision completed prior to AFWA "Best Practices" document, resulting in problems in interpreting the guidance from USFWS.

SGCN

2013 WAP



Key Changes from 2005 WAP

- 2005 did not have crayfish as a taxonomic group
- Any methodological changes?

HABITAT: TERRESTRIAL

2013 WAP

Data

Species Occurrence records from 1984 onnwards (point, quad, county)

Spatial Units: Level IV Ecoregion

Quantified index of species richness/ Rarity

Data organized taxonomically (Amphibians, birds, forest birds, grassland birds, wetland birds, combined birds, mammals, and reptiles)

KY GAP

Process

Relational Database management system GIS used to create species richness maps for each taxa group.

Expert Opinion

Identified areas of overlap in each taxonomic group and across the groups

Outcome

Terrestrial PCAs for Amphibians, birds, reptiles and mammals

Combined terrestrial PCAs

Key Changes from 2005 WAP

AQUATIC:

Data

Species Occurrence records from 1984 onnwards (point, quad, county)

Spatial Units: Watershed (HUC 8 and 14)

Quantified index of species richness/ Rarity

Data organized taxonomically by class

Process

Relational Database management system GIS used to create species richness maps for each taxa group: Basis of PCA identification

Expert Opinion

Identified areas within the state where overlap occurred between different species and groups

Outcome

Aquatic PCAs for mussels (Nine HUC8 watersheds),

Fish and Lamprey: Ten HUC 8 watersheds

Crayfish: Eleven HUC 8 watersheds

Combined Aquatic PCA: 5 overlapping HUC 8 watersheds and one non-overlapping HUC 8 watershed (4 in AppLCC)

Two tiers of PCAs. Regions of highest overlap were identified as Tier I Priority Conservation Areas

Key Changes from 2005 WAP

COMBINED TERRESTRIAL AND AQUATIC PRIORITY CONSERVATION AREAS

Data

PCAs for each taxonomic group

Spatial Units: Level IV Ecoregion

Quantified index of species richness/ Rarity

Data organized taxonomically (Amphibians, birds, forest birds, grassland birds, wetland birds, combined area by order and class

Process

Overlap areas for all taxonomic groups

Each taxonomic conservation area (6 total) was assigned a value of 1 and then all were summed together.

Scores ranged from 1(at least one taxonomic group) – 6 (at least some species from all 6 taxonomic groups) likely to occur. Inspected areas where values of 4, 5, and 6 occurred: Drew polygons around clusters: Tier I PCA

Prioritize within Tier I List of known SGCN occurrences from the KFWIS database that are within the boundaries of each Tier I PCA

Outcome

A map was created to illustrate the overlap of combined aquatic and terrestrial PCAs.

Two tiers of PCAs: 3 Tier I, 3 Tier 2 PCAs

Tier I~~: Mississippi-Ohio Valley Plains~~, Interior Low Plateau Karst, SW Appalachian Plateau

Mississippi-Ohio Valley Plains most SGCN rich> Interior Low Plateau Karst> SW Appalachian Plateau

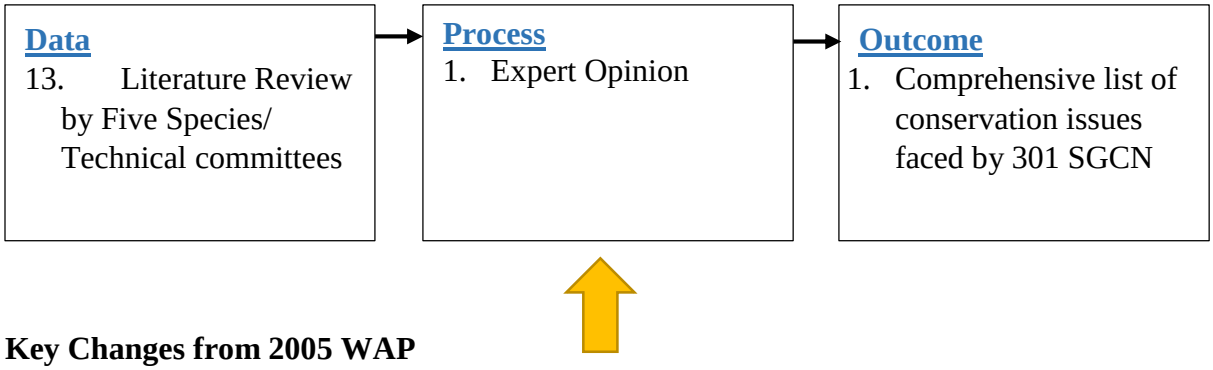
Unique species in each Tier I

Land ownership in each of the 3 Tier I PCAs

Key Changes from 2005 WAP

THREAT ASSESSMENT

2013 WAP



Key Changes from 2005 WAP

CONSERVATION ACTION

2013 WAP

Data

1. Terrestrial and Aquatic Teams developed comprehensive list of conservation issues faced by 301 SGCN
2. Group species into habitat guilds (guild as a collection of species that occur in the same habitat) : Jones et al (2005) for terrestrial guilds and Burr and Warren (1986) for aquatic Guilds

Process

1. Redundancies removed by combining both lists (79 conservation issues)
2. Expert Opinion
3. Conservation issues cross referenced with conservation actions

Outcome

Cross list of issues and CAs
Research and survey needs designed for multiple scales (landscape or site-specific), include both habitat and population based efforts, and are organized by taxonomic group.

Top 10 conservation action for each guild

CAs by species in habitat guilds (20 (10 terrestrial, 10 Aq) guilds)

Key Changes from 2005 WAP

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas	1				
Species Distribution Modelling	1				
Mapping terrestrial corridors/connectivity		?			Our revision has been complete, but we are working on this now.
Measuring/ Mapping aquatic connectivity		?			Our revision has been completed, but we are working on this now.
Prioritization of restoration sites			1		
Predictive threat modelling			1		
Climate resiliency modelling			1		

Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned)

Datasets	Status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned)
LIDAR data	
Stream Networks with corrected topology	
Cave and Karst mapping	
Isolated wetlands/vernal pool mapping/identification	

TENNESSEE

(Awaiting response)

Overarching changes in 2015 WAP:

SGCN

2005 WAP

Data	Process	Outcome
Compiled multiple lists	Multiple criteria (rarity, legal status, declining population & distribution trends, status in adj. states) Species organized by habitats, sp exclusively assigned to terrestrial, aquatic or subterranean environments Prioritization into 3 tiers (based on legal status: wildlife vs game)	Tiered list of SGCN Total No SGCN Sp: 66 Regional lists for terrestrial (238), aquatic (247) or subterranean (179)habitats. # Tiers: 3

2015 Revision

SETTING CONSERVATION GOALS

2005 WAP

Data

Species Occurrences collected from sources/databases

GPS locations recorded

Process

1. Delineation of species populations

Eliminate duplicate records: 100m buffer around terrestrial species, join overlapping buffers (based on Natureseve Explorer).

Aq Species: occurrences segregated into HUC12 watersheds

Subterrenean: known cave locations-same cave system considered as one occurrence

2. Goal setting How many populations necessary for 100 yrs (endemics assigned higher values)

3. Population Viability Analysis

Outcome

Populations of GCN delineated by region (MS/CU/BR/Co/TN) and across habitat types (Terr/Aq/Subterr)

2015 Revision

TERRESTRIAL HABTIAT DELINATION

2005 WAP

Data	Process	Outcome
Heirarchial habitat delineation (five levels) Landcover map developed by the Tennessee GAP project at TWRA (Whitehead et al. 2000). Road Network: U.S. Census Bureau's 2003 'Tiger' Data.	Cover types identified in the GAP project were "cross walked" in GIS to NatureServe's ecological systems (Cross walk methodology ~ linking each GAP class to an appropriate ecological system) 17 of 56 terrestrial ecological systems matched with 30 landcover GAP classes Mapped roadless blocks/polygons	Terrestrial habitat mapped (map3) at Level 2 of terrestrial habitat hierarchy

2015 Revision

AQUATIC HABTIAT DELINATION

2005 WAP

Data

Followed TNC's Fresh Water Initiative (Sith et al 2002)

Process

1. physiochemical habitat variables (i.e. stream size, gradient, elevation, downstream connectivity, and bedrock & other surficial geology).

2. GIS data layers of these habitat variables

3. Determining classes that correspond to ecologically meaningful breaks in environmental gradients and attributing each stream reach with a value for the variables.

4. Classifying the types of systems by identifying all distinct combinations of physiochemical attributes.

5. Mapping aquatic systems by assigning system types to stream reaches at the small watershed scale.

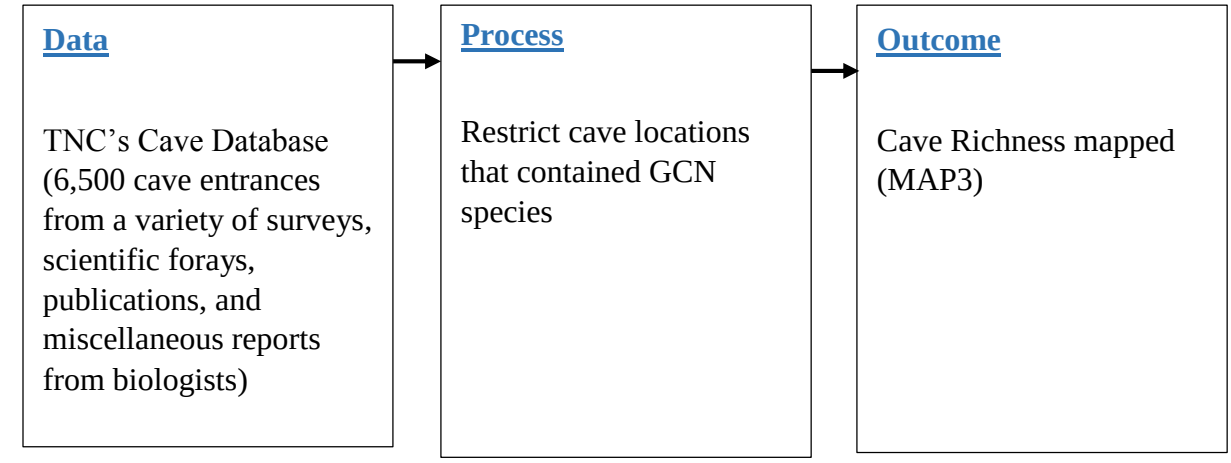
Individual aquatic systems were mapped in GIS using the EPA's Reach File 3 hydrography data

Outcome

Aquatic regions and subregions mapped (MAP3)

2015 Revision

SUBTERRANEAN HABITAT MAPPING



2015 Revision

SPECIES-HABITAT ASSOCIATION

2005 WAP

Data

1. Terrestrial fauna: database form was created using Microsoft Access that listed each level of the habitat hierarchy
   = = = = = =
1. Aquatic system Hierarchy

Process

1. Listed each species' habitat preference as a yes or no in the access database (lit review)- for ecological systems
2. Preference of species for each region (MAP/UGCP/ILP/CPM/RV/SBR) rated as "Preferred", "Suitable", "Marginal", or "unsuitable"
   = = = = = = =
3. Occurrences of each aquatic species overlaid onto a map of aquatic systems distributed across various HUC-12 watersheds.
4. Tallied by occurrence within a given watershed.
5. Computerized habitat preferences selection
6. Manual checking
7. Different criteria for preferred/suitable/ etc

Outcome

Habitat preference (categorize relative utility of one habitat type over another for a species) for each GCN species: terrestrial and aquatic

2015 Revision

THREAT ASSESSMENT

A decision was made to adopt the stress – source of stress methodology utilized in TNC's *5-S* system of conservation planning (TNC 2001): determining the exact stresses that negatively affect a species, in addition to distinguishing the sources that generate each stress

2005 WAP

Data

Lit Review n synthesis

Adopted the Stress-Source methodology by TNC 5-S system.

14. Stress: list of stress categories known to affect fauna was adapted (5 major stress categories containing 20 stress types)
15. Sources cataloged: Catalog (~50, Lumped into 37 categories) of potential sources of stress was developed for terrestrial, aquatic, and subterranean GCN species in Tennessee.
16. 37 Sources were linked with 5 stress categories

Process

1. Expert Opinion in identifying source affecting each GCN species.
2. **Scope** (i.e. estimated %) of populations potentially affected by the stress-source either in each region or across all regions
3. **Severity** of each sress-source combination categorized into 4 (low/med/ high/ v high)
4. **Timing** historic-continuing/current/1-5 yrs/next 6-10 yrs)
5. Ease of **Reversilibilty** (none/ low/ med/ high)
6. **Contribution** to others stress/ sources (low/med/ high/ v high)
7. Overall Imperilment: Species linked with individual ratings for above 5 categories of source/stress
8. Cumulative points assigned to each evaluative criteria I each region

Outcome

1. List of relevant stress – source groupings believed to be currently affecting each GCN species.

2. Overall imperilment assessed. (The combined "stress" scores from each evaluative category were linked to species occurrences in GIS to generate a relative estimate of regional susceptibility to various sources of stress)

2015 Revision

CONSERVATION ACTION

2005 WAP

Data

1. Conservation Measures Partnership (CMP) with modifications (6 categories and 29 classes)

Process

1. Modification of CMP (2 categories, 6 classes and 22 general actions)
2. Additional 90 specific actions under each general action
3. Expert opinion
4. Link source/stress with CAs in the database
5. Linked actions scored as Low/ Medium/ High

Evaluation of each actions:

6. **Scope** (i.e. estimated %) of populations potentially affected by action
7. **Benefit** (low/med/ high/ v high)
8. **Fesability** ease of implementation (low/med/ high/ v high)
9. **Duration/ Timing** (single/ongoing1-5 yrs, 6-10 yrs, >10 yr)
10. **Cost** (<$10,000/10-100k/100k-1M/ >1M)
11. Totals tallied to obtain combined evaluator rating and cross walked with source-stress combinations and Terr/aq/Sub habitats

CA Prioritization:

9. Prioritization Score = (R)arity x (V)iability (R) = Global Rank + State Rank (V) = Size x Condition x

Outcome

1. List of 97 general conservation actions listed by habitat (Terr/Aq/Subterr) with their overall abatement scores.
2. The highest scoring habitat areas of GCN species generated for each region based on clusters of the rarest and most viable species occurrences within various habitat units
3. Combined conservation Action scores linked to individual occurrences for all species
4. Habitats containing clusters of high action scores (easily implemented) Not mapped

2015 Revision

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list.
Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas					
Species Distribution Modelling					
Mapping terrestrial corridors/connectivity					
Measuring/ Mapping aquatic connectivity					
Prioritization of restoration sites					
Predictive threat modelling					
Climate resiliency modelling					

Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned)

Datasets	Status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned)
LIDAR data	
Stream Networks with corrected topology	
Cave and Karst mapping	
Isolated wetlands/vernal pool mapping/identification	

(Awaiting response)

Overarching changes in 2015 WAP:

Progress
Received RCN grant for WVCAP revision

Additions

- Emerging wildlife diseases such as Ranavirus and White Nose Syndrome
- Increased wind energy development
- Effects of climate change and sea level rise.

- Relational Database that includes tables for species, habitats issues, actions and other WAP information and which facilitates tracking of plan implementation.
- GIS data for species and habitats
- Web-based resources to provide viewers with general information on West Virginia's WAP review and revision and allows users to download documents, share comments, and review current progress on plan revision efforts.
- Publication of the *West Virginia Wildlife Conservation Action Plan*, 2nd Edition, in both digital and hard copy formats.

Changes
A regional habitat classification system was developed and habitat mapping was completed (Is this the NE Terrestrial Habitat Classification or something else)
Incorporate the following publications

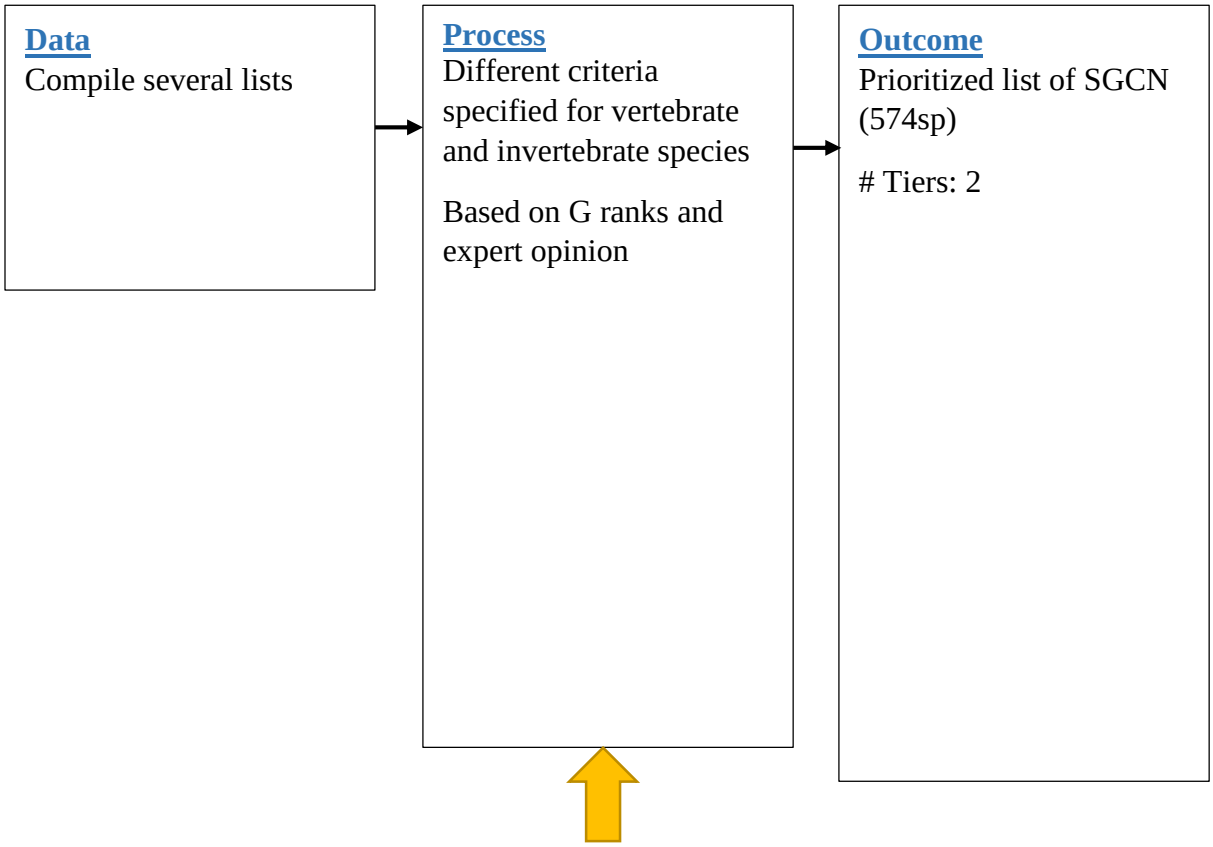
- Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans and Other Management Plans;
- Best Practices for State Wildlife Action Plans: Voluntary Guidance to States for Revision and Implementation; and
- Measuring the Effectiveness of State Wildlife Grants.

Challenges

SGCN

Taxa Work groups:

2005 WAP

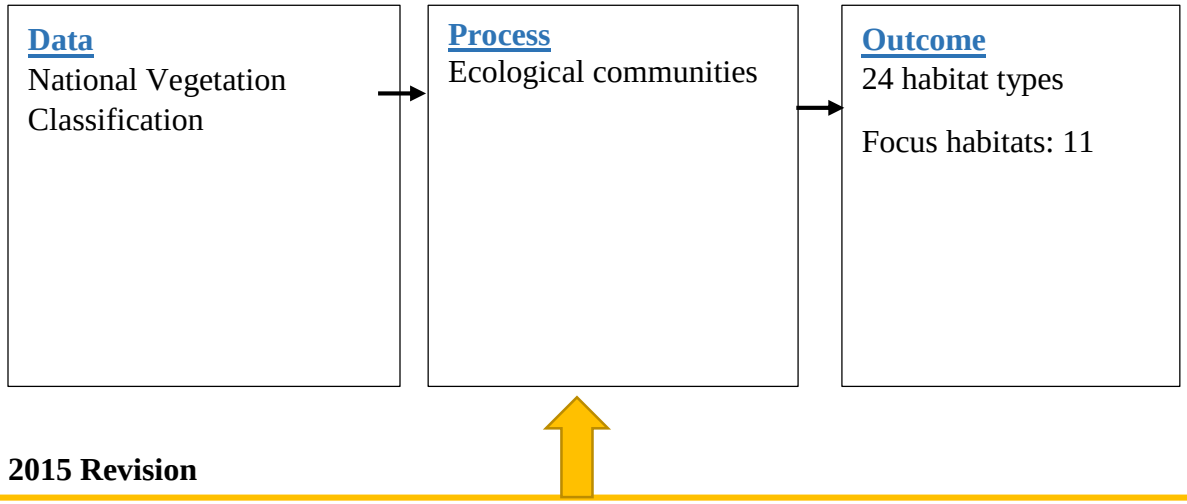


2015 Revision

- Updated information on the status and distribution of wildlife within the state will be evaluated to establish enhanced baseline data before analyses are conducted.
- Working group meetings will be convened to review data, aid in the analyses, and review final materials.
- The evaluation criteria will also be reviewed to determine if modifications are needed.
- Regional efforts to assess species vulnerability to climate change will be incorporated into the review process.

HABITAT: TERRESTRIAL

2005 WAP



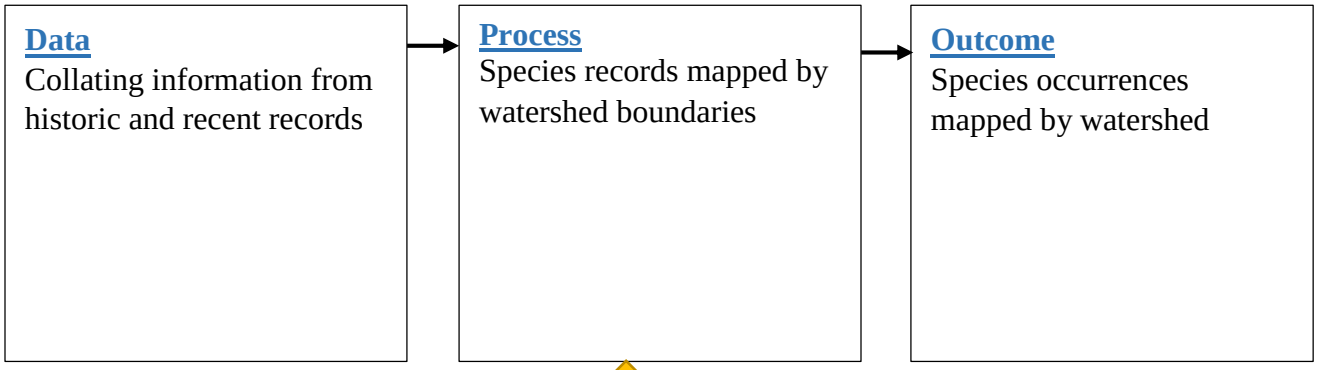
2015 Revision

- Existing habitat classes will be expanded and classifications will be updated and cross-referenced to both the Northeast Habitat Classification and the National Vegetation Classification System.
- Species will be linked to or associated with habitats where possible.
- Habitat associations and completed vulnerability assessments will be reviewed and evaluated, augmented and revised as necessary and included as appropriate.

SPECIES-HABITAT ASSOCIATION

For birds: following habitat specific aggregations:

2005 WAP

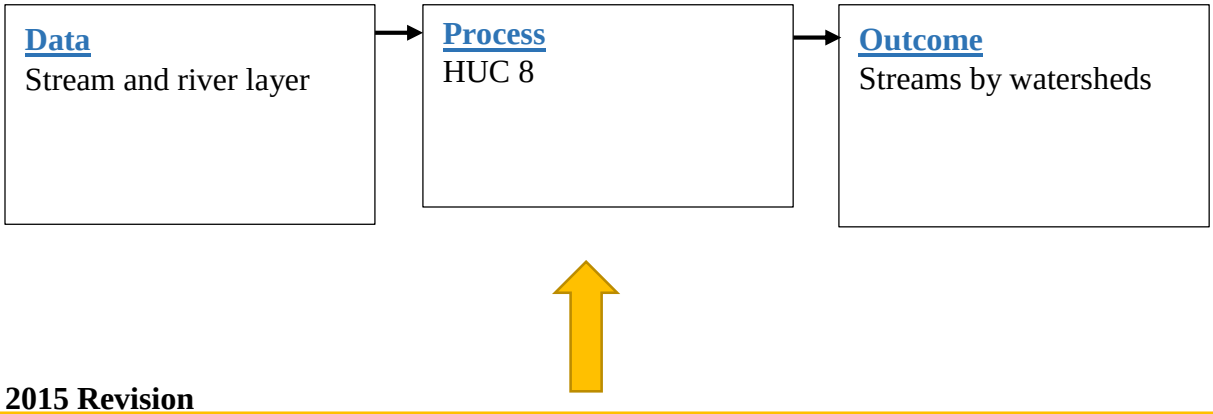


2015 Revision

AQUATIC:

No stream habitat classification at time of 2005 SWAP.

2005 WAP

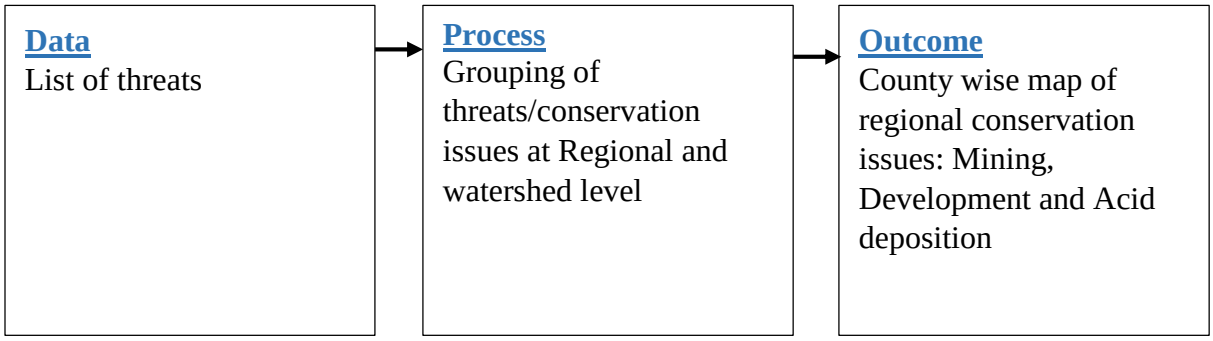


2015 Revision

-

THREAT ASSESSMENT

2005 WAP

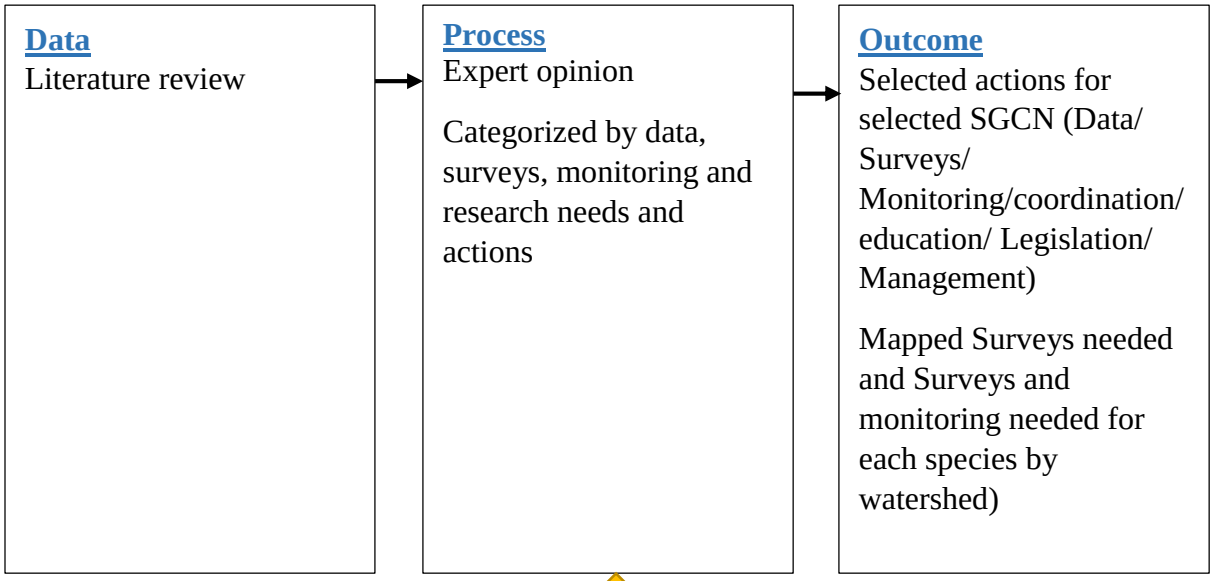


2015 revision

- Descriptions of threats on conservation actions will be standardized to the greatest extent possible.
- RCN program efforts to develop a common lexicon, standardization created through the development of Wildlife TRACS, and *A Standard Lexicon for Biodiversity Conservation: Unified Classifications of Threats and Actions* (Salafksy et. al., 2008) will all be used to organize and classify threats and conservation actions and to enhance regional and national consistency in WAPs.
- Additional detail may be incorporated to ensure that relevance and meaning to West Virginia's conservation partners, stakeholders, and the general public is retained.

CONSERVATION ACTION

2005 WAP



2015 revision

- Specific actions and projects for the highest priority issues will be identified.
- Effectiveness measures for monitoring implementation success will be included.

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas					
Species Distribution Modelling					
Mapping terrestrial corridors/connectivity					
Measuring/ Mapping aquatic connectivity					
Prioritization of restoration sites					
Predictive threat modelling					
Climate resiliency modelling					

Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers that are in various stages of development.

Datasets	Status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned)
LIDAR data	
Stream Networks with corrected topology	
Cave and Karst mapping	
Isolated wetlands/vernal pool mapping/identification	

(Feedback received)

Other overarching changes in 2015 WAP:

- SLAMM analysis of the coastline to see how sea level rise may affect our coastal resources (wading and shorebird habitat, sea turtle nesting beaches, marsh migration, etc.).
- SWG summaries will be provided all grants from inception to present to show what we have accomplished through the program. Full final reports will be available in an online repository once the plan is completed and approved.

SPECIES

2005 Published WAP

Data
Species lists created by combining/ consulting multiple Lists

Process
1. Multiple (10) criteria listed for creating initial list (Protection status, Ranks, funding, knowledge of distribution/population status/ etc)
2. Grouped criteria into Concern and Knowledge groups
3. Expert Opinion ranked species by five criteria under knowledge and concern
4. Overall score/ rank for each species weighting concern and knowledge criteria to determine priority species

Outcome
SGCN lists of 8 Taxonomic groups, along with known knowledge deficiency and population trends.

2015 Revised WAP

Fine Tune SGCN listing process
Incorporated Ranking criteria and scoring metrics by IUCN, NatureServe, and Millsap et al 1990 to create original criteria

(i) Conservation Need (status of species within and outside state),
(ii) Knowledge Gap, and
(iii) Management Concern (considers occurrences only in NC).

} SGCN Priority Species

Use of agency's PAWS (Portal Access to Wildlife Systems) web site to collect metric responses by Taxa teams of species experts and calculation of final ranking scores.

Peer-review of metric responses and ranking scores as a means of collecting input from additional species experts.

TERRESTRIAL HABITAT

2005 Published WAP

Data

Basis: NC Natural Heritage Program report

NC Gap analysis (1992) Landcover Classification

Bailey (1995) ecoregions

Species Distribution Models

Process

1. Habitat types mapped in state, derived from NCNHP 2001 and Schafale and Weakley 1990
2. Standardize habitat labels by crosswalking with 1992 NC Gap analysis Landcover Classification
3. Ecoregions linked with habitats
4. Technical Feedback/ Expert Opinion

Outcome

Ecoregional designations crosswalked with 23 habitat types, 12 within AppLCC

Species richness maps: (Birds, Mammals, Amphibian, Reptile)

North Carolina stewardship map by GAP status and ownership type

2015 Revised WAP

Data:

- Upgrading use of GIS data to incorporate Climate Change and other threats that impact species and habitats
- Develop unique GIS layers represent likely conservation opportunity areas (COAs) that would best conserve habitats and species.

Analysis

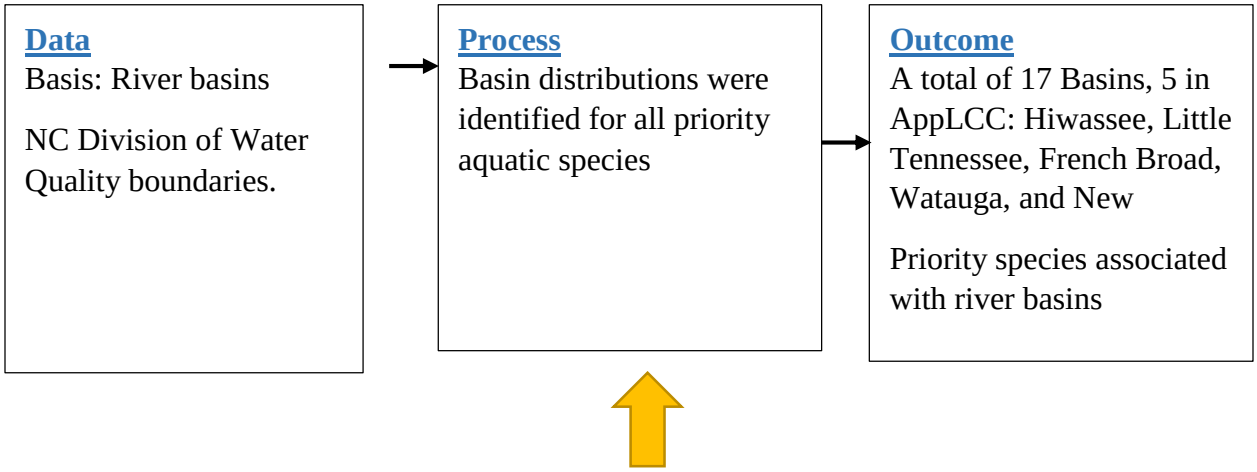
- GIS modelling for species distribution modelling of priority species.
- Incorporate results from state-wide climate change vulnerability assessment Natural Heritage Program (2010).
- The GIS analysis to identify habitats requiring fire maintenance.
- Model how predicted urban growth could encroach on habitats and identify areas and habitats where buffers are needed.
- Identify location of conservation easements to facilitate animal movement based on SLR.
- Incorporation of results from GIS modeling projects funded by the SALCC

Expected Results

- Expand habitat types from 23 to ~40.
- For Priority Species, identify appropriate habitat (existing and expected) based on land cover classification
- Climate change effects on habitat, and locating movement corridors.
- Identification of buffers to protect against urban encroachment
- Identify location of conservation easements to facilitate animal movement based on SLR

AQUATIC HABITAT

2005 Published WAP



2015 Revised WAP

Upgrading use of GIS data to incorporate Climate Change and other threats that impact species and habitats. Will review an aquatic sensitivity analysis currently in process by The Nature Conservancy (NC Chapter) and incorporate results as appropriate.

AppLCC involvement: I don't get much correspondence from the AppLCC, so that would be the first improvement that would facilitate participation. I know there is a web page but I don't have time to visit sites randomly to see if there's new information posted yet or not.

State: North Carolina

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list. Please add information as you deem suitable.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas	1	1			Minimal information was provided in the 2005 SWAP. GIS modeling will be done for 2015 SWAP.
Species Distribution Modelling	1				NCGAP data was published in 2005 SWAP. No revisions are planned at this time.
Mapping terrestrial corridors/connectivity				1	This will be included in the efforts used to identify COAs.
Measuring/ Mapping aquatic connectivity			1		While a specific aquatic connectivity project was not conducted, local partner TNC chapter has conducted a watershed sensitivity analysis which will be incorporated into the 2051 SWAP.
Prioritization of restoration sites			1		Important restoration needs were identified in 2005 and will be updated in 2015 SWAP but they will not be prioritized.

Predictive threat modelling				1	GIS modeling results will be incorporated with the 2015 SWAP.
Climate resiliency modelling				1	2010 Climate analysis report produced by Defenders of Wildlife for NCWRC will be used
Species of Greatest Conservation Need analysis		1			New evaluation and ranking metrics were designed to utilized current scientific knowledge about a species as the basis for conservation concern. Database of results will be maintained and shared with partners.

Please add other data layers not I Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers not included in this list that may be in various stages of development.

Datasets	Completed and available	Complete but not yet available	In progress	Planned in the near future	Planned in long term	Not planned	Available for AppLCC area?
LIDAR data							
Stream Networks with corrected topology							
Cave and Karst mapping							
Isolated wetlands/vernal pool mapping/identification							
Datasets							
LIDAR data							
Stream Networks with corrected topology							

(Feedback received)

SGCN

2005 CWCS (used NC and Georgia's approach**)**

Data
Compiled multiple lists and ranks.

Process
1. Eight criteria for consideration in determination of priority species (Box 2-1. State/Fed rank/ SCNHR rank, harvest, funding, feasibility to make change in SC, knowledge of status, distribution, limiting factors, pop trend)
9. TAC review/ Expert opinion.
10. Scoring/ ranking methods explicitly explained for birds (Rich et al 2004) and fresh-water fishes (knowledge and conservation).

Outcome
1. Prioritized list of SGCN.
2. # tiers: 3 (Highest/ high/ moderate)
3. 12 taxonomic groups (mammals, birds, reptiles, amphibians, freshwater fishes, ~~diadromous fishes, marine fishes, marine invertebrates~~, crayfish, freshwater mussels, freshwater snails, and insects (both freshwater and terrestrial))

2015 Revision

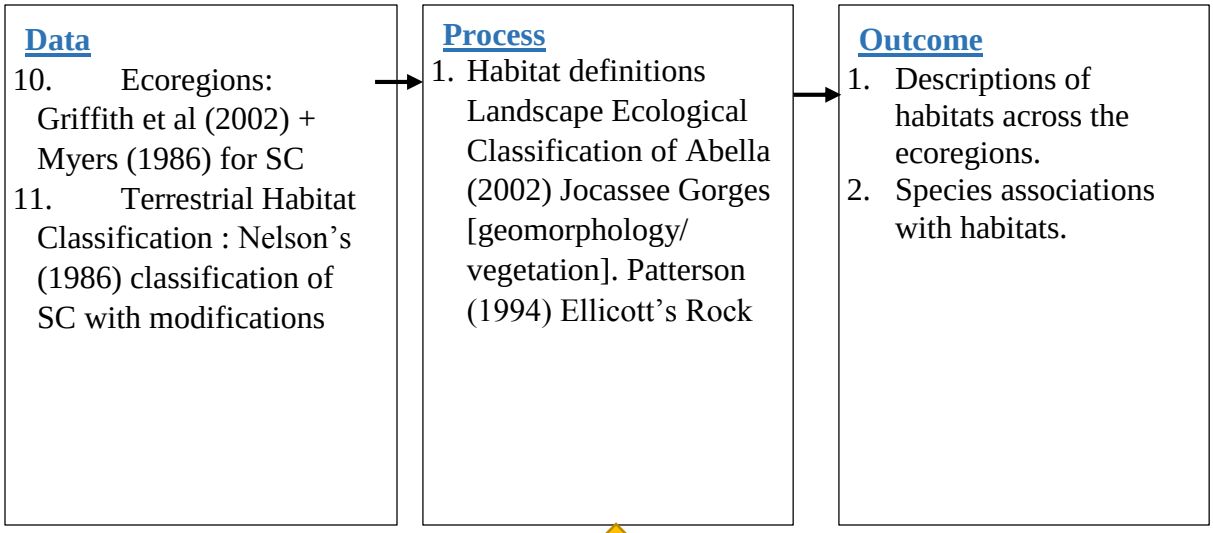
- Climate change resilience will be incorporated in SGCN selection
- Lists revised: methods same, but actual list will change due to improved data availability

- Cancelled out because it is not relevant to AppLCC

HABITAT: TERRESTRIAL

- Overall condition of the forest trends toward mid-successional; both early- and late-successional ("old growth") stages tend to be lacking in the Blue Ridge. Major biological changes to forest community composition within historic times include removal of the American chestnut (*Castanea dentata*) as the dominant canopy tree species, removal of the Eastern cougar (*Felis concolor*) as the top predator and extinction of the Carolina parakeet (*Conuropsis carolinensis*).

2005 CWCS



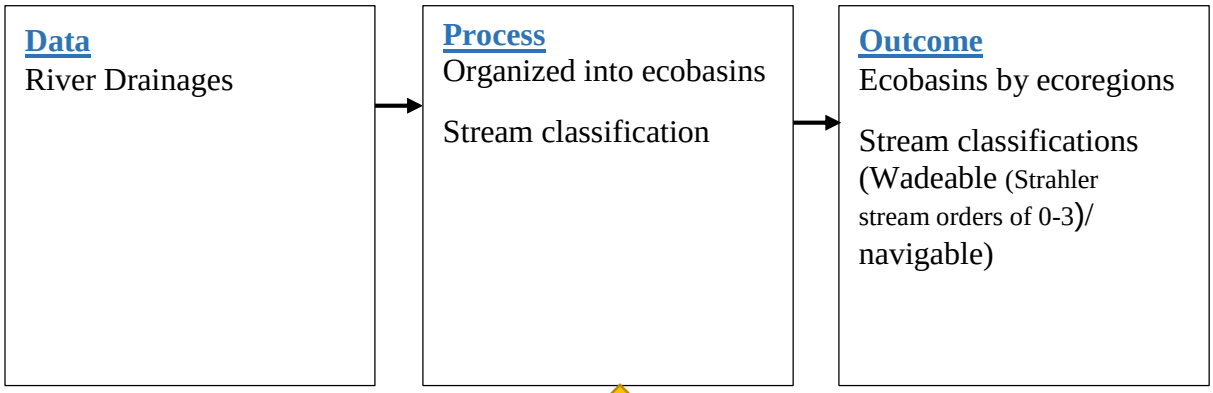
2015 Revision

- Climate will be incorporated in habitat discussion

AQUATIC:

Unit: drainage basins and sub-basins, called ecobasins

2005 CWCS



2015 Revision

GEORGIA

(Feedback received)

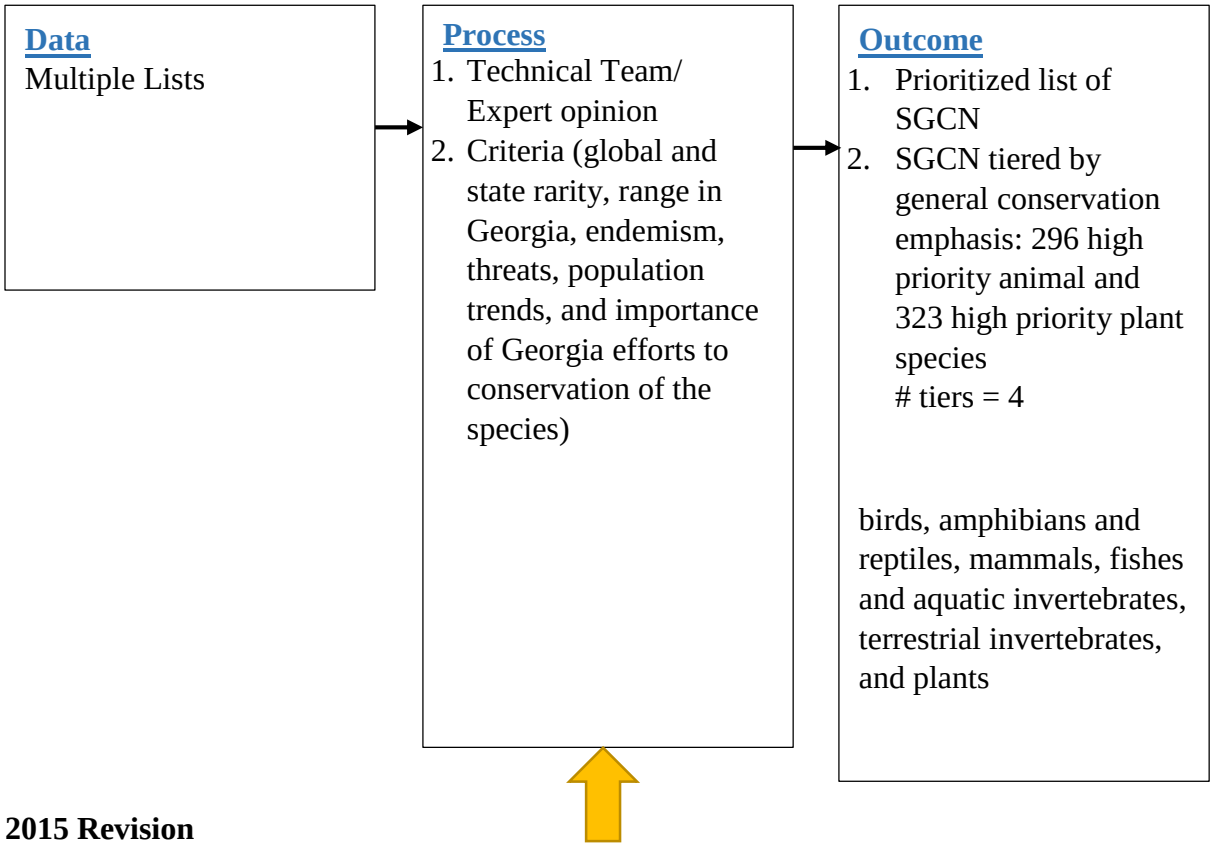
Overarching changes in 2015 WAP:

- Emphasize on the development of proactive strategies that address wildlife conservation needs from both state and regional contexts.
- Outline conservation programs that provide options for maintaining natural diversity in the face of changing climatic conditions.
- Develop and implement monitoring programs to assess and report on the status of priority species and habitats and the results of conservation programs. Explore ways to involve conservation partners in these monitoring efforts, and will use tools such as Wildlife TRACS to report on the results of our conservation actions.

LCCs:
Participation in the Landscape Conservation Cooperatives will be instrumental in shaping these regional conservation strategies. We hope to be able to use data being developed or compiled by the LCCs to assess broad-scale and long-term conservation needs.

SGCN

2005 WAP



2015 Revision

- Revise/Reassess SGCN list
- Incorporate information on potential impacts of climate change on species and habitats in Georgia and the Southeast

HABITAT: TERRESTRIAL

2005 WAP

Data

1. Ecoregions: Griffith et al. (2001)
2. Species-Habitat Models for GA GAP
3. Natural vegetation patches(from 1998 sat Img of 44 classes used in Land Cover GA-GAP)
4. weighted density of rare species (plant and animal) occurrences, and
5. predicted occurrences of terrestrial vertebrate species of conservation concern.

Species Occurrence

Historic LU and change

Landlot surveys from 1800s

18 class LC dataset from Landsat Thematic Mapper imagery

Process

1. Expert opinion
2. Recoded data layers (3,4,5)
3. Combinations of size, predicted value for species of conservation need, and documented value for species of conservation need (2,3,4).
4. FRAGSTATS used to categorize and rank patches (size, shape, contiguity, proximity)
5. Mapped prioritized patches with existing conservation lands

Historic LU and change

Land lot surveys georectified, information on witness trees documented in surveys

Outcome

1. Prioritized map of areas of high conservation habitat
2. Identification of Conservation Opportunity Areas

Historic LU and change

maps showing general historical vegetation patterns for three areas of the state.

Maps and statistics on land cover for 4 ref years (74, 85, 92, 98)

Land use change from

2015 Revision

- Incorporate information on potential impacts of climate change on species and habitats in Georgia and the Southeast

AQUATIC:

2005 WAP

Data

1. Georgia Aquatic Gap Analysis Program
2. previous aquatic assessment completed by The Nature Conservancy (Smith et al 2002)
3. Rare species occurrence

Process

1. Expert opinion
2. Mapped known or documented occurrence of species and high quality streams.
3. Biotic Integrity scores
4. Prioritization

Outcome

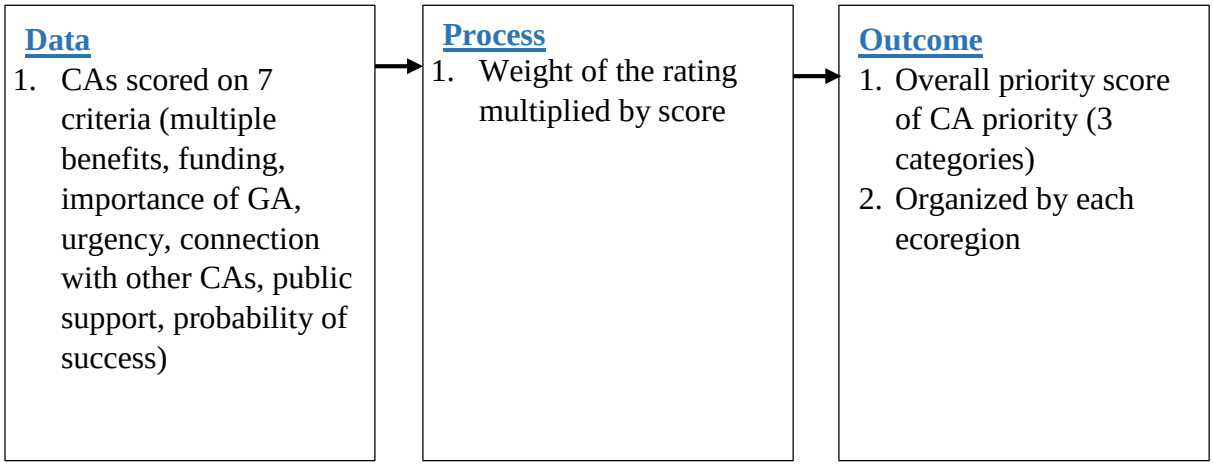
1. 212 high priority waters (streams) in Georgia
2. High priority watersheds (HUC 12)

2015 Revision

- Incorporate information on potential impacts of climate change on species and habitats in Georgia and the Southeast

CONSERVATION ACTION

2005 WAP



State: Georgia

Please add 1 to the tools that apply. Blank columns are for additional efforts that are not in this list. Please add information as you deem suitable.

Conservation planning efforts

	Attempted/ completed in 2005 SWAP	Will improve on existing work in 2015 SWAP revision	Not attempted in 2005 SWAP or 2015 SWAP revision	Will attempt for the first time in 2015 SWAP revision	Comments
Identification/Prioritization of Conservation Areas	1	1			
Species Distribution Modelling				1	Limited to a few priority species
Mapping terrestrial corridors/connectivity				1	
Measuring/ Mapping aquatic connectivity				1	
Prioritization of restoration sites				1	
Predictive threat modelling				1	Will make use of existing models
Climate resiliency modelling				1	Will make use of existing models

Please let me know if your state is building new data sources along with their status (completed and available/complete but not yet available/ in progress/ planned in the near future/ planned in long term/ not planned). Please add other data layers not included in this list that may be in various stages of development.

Datasets	Completed and available	Complete but not yet available	In progress	Planned in the near future	Planned in long term	Not planned	Available for AppLCC area?
LIDAR data			1				Some areas
Stream Networks with corrected topology						?	Not sure about this
Cave and Karst mapping		1					Requires data license with Georgia DNR
Isolated wetlands/vernal pool mapping/identification			1				Mostly mtn. bogs
Datasets							
LIDAR data							
Stream Networks with corrected topology							