Appalachian LCC Conservation Design: Phase 1 Progress

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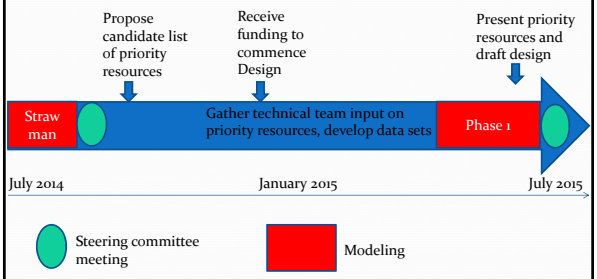
Goal of Conservation Design Phase 1 Appalachian LCC

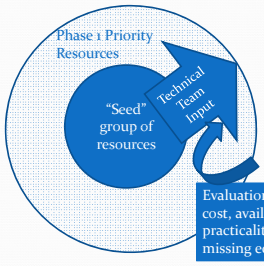
- Support the App LCC process of selecting priority resources
  - Objective A: Using App LCC technical input build a group of candidate priority resources and include them in a spatial modeling process to produce a draft, landscape-scale conservation design
  - Objective B: Identify additional priority resources to include in future iterations of the conservation design
  - Objective C: Build and acquire datasets, derive data modeling strategies needed to achieve A and B

Time line overview



Strategy to build priority resources

The beginning, or "seed" resources were assembled with input from LCC staff with the goal of representing key ecosystems or processes, and to begin the discussion about what to add



Evaluation of feasibility e.g., data cost, availability, modeling practicality, alternative surrogates, missing ecosystems

Technical team meetings

Date	Section	Estimated Participants
March 9	North	12-15
March 9	South	14-16
March 9	West	12-14
March 16	All	20-25
June 8	All	16-20

Paul Leonard conducted these webinars to receive feedback on seed priority resources and on how to use them as targets in Phase 1 Design

Feedback from Central Appalachians

- Consider incorporating Cave/Karst by taxonomic groupings
- Consider a species which captures Forested Wetlands
- High-elevation Forests and Streams (Red Spruce / riparian vegetation)
- Consider more representative early successional species (Field Sparrow)

Special Places

- Rocky Outcrops (Wood Rat)
- Shale Barrens (endemic flora?)

Feedback from Southern Appalachians

- Consider breaking out early successional habitat into subgroups (shrub, grass, young forests)
- High-elevation Forests (Flying Squirrel, Spruce)
- High-elevation Streams (Blacknose Dace) : Consider sensitive fish guilds as seeds instead of species
- Consider 2 species to better capture missing ecosystems from classification (Green Salamander & Wood Turtle)
- Aquatic integrity must identify high aquatic diversity on private lands since those are most quickly degraded

Special Places
- Bogs
- Springs

Feedback from Interior Low Plateau

- Better description of early successional (Prairie Warbler)
- Balancing life history traits of species used in modeling
- Can you incorporate community structures that are disturbance dependent?

Special Places
- Wet Prairie
- Acidic Fen (Endemic Flora)
- Glades / Rocky Outcrops

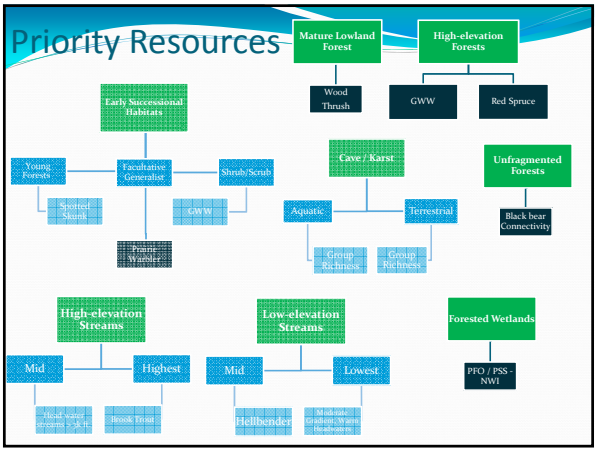
Modeling targets and tasks for supporting priority resource decisions in Phase 1

Candidate Resource	System or Process	Feedback from Technical Team	Data Obtained or Created	Methodology Developed	Integrated into Marxan
Golden Winged Warbler SDM	Early succession montane forests	Y	Y		Y
Spotted skunk SDM	Cryptic rare mammal higher elevation disturbed forest	Y	Y		Y
Wood thrush SDM	Low-mid elevation forest fragments	Y	Y		Y
Brook trout SDM	Higher elevation streams	Y	Y		Y
Hellbender SDM	Low-mid elevation larger streams and rivers	Y	Y		Y
Black bear landscape connectivity model	Large landscape connectivity region-scale fragmentation	Y	Y		Y
Aquatic integrity	Landscape level prediction of native and sensitive species by catchment based on watershed metrics condition	Y	Y - TRB only	Y - for full LCC	
Cultural framework	Spatially explicit elements with historical significance, relevant to public perception of landscape value	Y	N	Y	

Other priority resources proposed by technical teams

Special system or species	Possible Modeling strategy	Strategy Taken in Phase I
Rocky outcrops	Alleghany woodrat species distribution model	Geospatial analysis with Partial ELUs
Shale barrens	Remote sensing	Geospatial analysis with Partial ELUs
Balds – grassy or heath	Remote sensing	Investigate for Phase II
Coves	Surface metrics for topography, soils, geology perhaps ELU	Included Cove Forests with Ecological systems and partial ELUs
Springs	UNK	Investigate for Phase II
Glades	UNK – needs better definition	Investigate for Phase II
Acidic fen	National Wetlands Inventory filter and/or fine-grain remote sensing	Geospatial analysis with Partial ELUs and NWI
Prairie warbler – early succession generalist, grass	Species distribution model	Habitat Suitability Model
Red spruce – high elevation climate vulnerable	Species distribution model	USFS SDM

Priority Resources



Incorporating Changes in targets through 2030

- Resilient landscapes (TNC)
  - Incorporated top 10% of resilient scores
- Predicted yearly climate departure from historical baselines (1950-1979)
  - Mean Annual Temperature & Climate Moisture Deficit
    - Included top 25% of areas least likely to depart from baseline

Collaborations with LCC funded projects included in Phase I

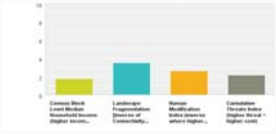
- The Nature Conservancy
  - Energy Development
  - Aquatic Classification
- Cave / Karst - Biological data
- Data Needs Project
- EFETAC / USFS Data
- TVA – Biological Data
- States who waived fees for Hellbender EO data

Online survey to assess Technical Team feedback on modeling targets

- Deployed with 4 multi-selection questions pertaining to phase I
- 1 Survey Question pertaining to potential phase II
- 48 surveyed
- 20 responses
- Opened June 8th / Closed June 12th

Survey Questions and Most Popular Responses

1. Please Rank How Would you Like To See 'Cost' Incorporated in the Design?
   - *Landscape Fragmentation (Inverse of Connectivity)*

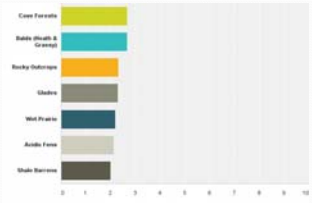


2. Rank How Would You Like to See Landscape Connectivity Incorporated into the Design?
   - *Implicitly in Solution because driven by 'Cost'*

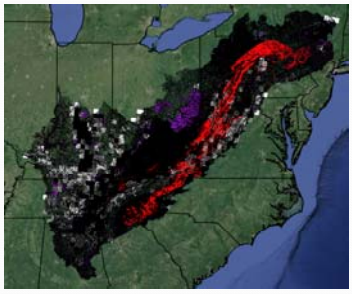
Survey Questions and Most Popular Responses

3. What top x % of the existing Priority Resource would you like to see in a prioritization framework?
   - *Varied for each Priority Resource. Included in Design*

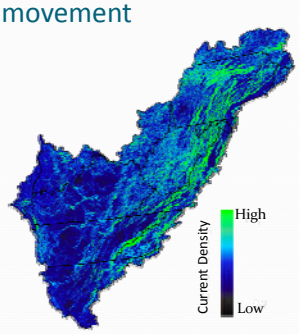
4. How Important is the inclusion of this conservation resource for the LCC's design process?



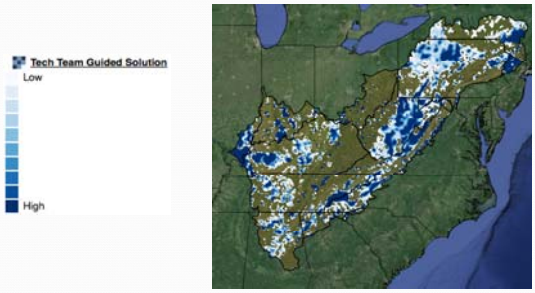
Spatial Distribution of all Targets (n = 20)



Model output of connectivity (270m), based on updated resistance map for black bear landscape movement



Model outputs of irreplaceability scenarios (500 million iterations)



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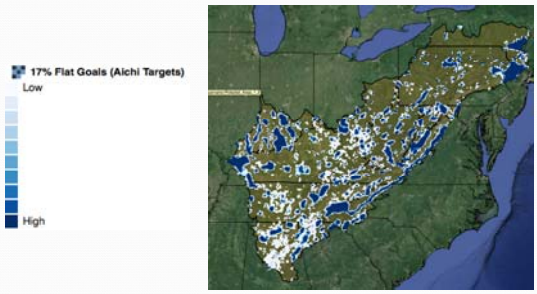
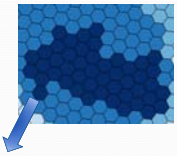
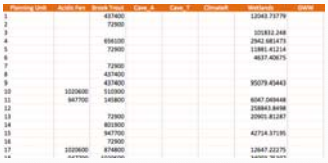


Scalable decision-making to 1km hexagons

- LCC broken up into 592,129 hexagons
  - Each hexagon contains data for each conservation target and can be summarized by:
    - Irreplaceability
    - Connectivity
    - Threat





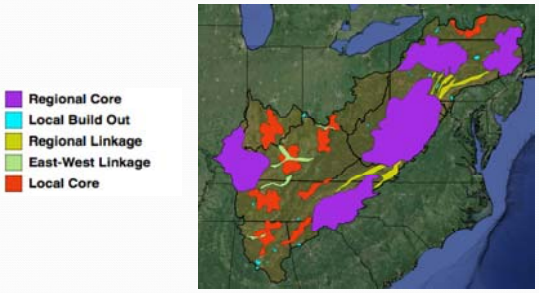
Moving from model output maps to a conservation design: Goals

- Produce generalized regions with specific conservation functions related to multi-scale process relevant to decision making locally and regionally
- Move beyond complex model outputs to simplified representations that can be more easily communicated and discussed
- Provide discrete areas to assess by threat
- Provide names for areas that have natural and cultural resonance and give "sense of place"

We mapped five conservation design elements

1. Regionally Connected Cores
2. Locally Connected Cores
3. East-West Linkages
4. Regional Linkages
5. Local Build Outs

Map of all conservation elements

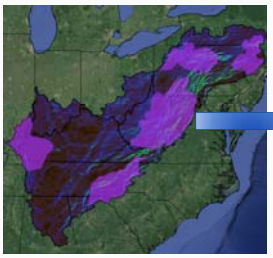


Regionally connected cores

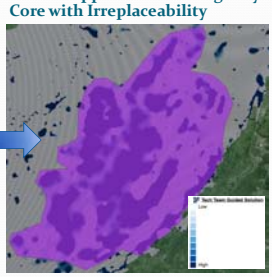
- Large regionally significant areas that have high internal connectivity, based on irreplaceability and current
- We mapped 5:
  1. Shawnee-Peabody-Land Between the Lakes Regional Core
  2. Southern Blue Ridge – Upper Tennessee River Basin Regional Core
  3. Central Appalachian-Alleghany Regional Core
  4. Heart's Content NW Pennsylvania Regional Core
  5. Delaware Water Gap-Catskills Regional Core

Regionally Connected Cores

Cores with Connectivity



Central Appalachian – Allegheny Core with Irreplaceability

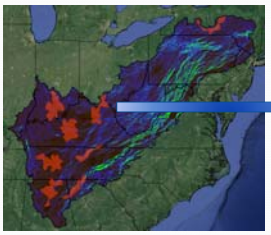


Locally Connected Cores

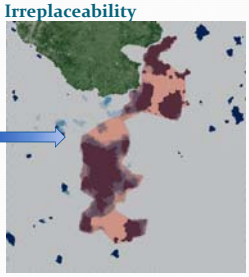
- Locally significant areas that have high internal connectivity, based on irreplaceability and current
- We mapped 8
  1. Cumberland Plateau – Chattanooga Local Core
  2. Daniel Boone Local Core
  3. Nashville Basin Local Core
  4. Hoosier – Interior Low Plateau Local Core
  5. Mammoth Cave-Campbellsville Local Core
  6. Cumberland Gap-Big South Fork-Chickamauga Local Core
  7. Southern Finger Lakes – Alleghany Plateau Local Core
  8. Lower Tennessee-Bankhead-Wheeler Local Core

Locally Connected Cores

Cores with Connectivity



Daniel Boone Local Core with Irreplaceability

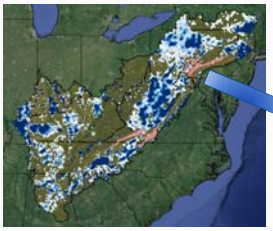


Regional Linkages

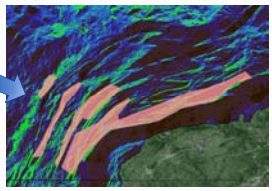
- Region scale corridors that provide connectivity among cores, based on current flow
- We mapped 3
  1. Northern Cumberland-Blue Ridge Linkage
  2. Southern Cumberland-Blue Ridge Linkage
  3. Northern Sandstone Ridges Linkage Connect Cores 3 & 5

Regional Linkages

Linkages with Irreplaceability



Northern Sandstone Ridges Linkage with Connectivity



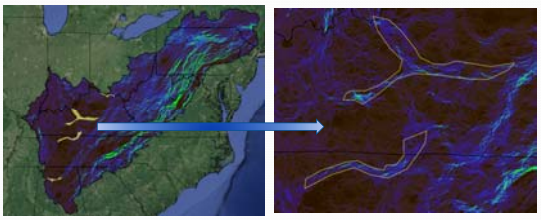
East-West Linkages

- Extensive areas of connectivity bridging Ridge and Valley topography and connecting mountains with low plateaus
- We mapped 4
  - Big South Fork-Cumberland River E-W Linkage
  - Cumberland-Interior Low Plateau E-W Linkage
  - Ohio River E-W Linkage
  - Flint Creek-Plateau Escarpment E-W Linkage

East-West Linkages

Lateral Linkages with Connectivity

Cumberland – ILP & Big South Fork Cumberland River Linkages with Connectivity



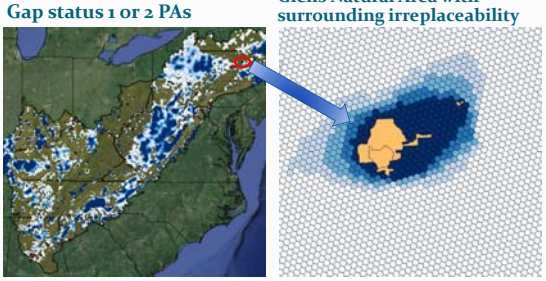
Local Built Outs

- Smaller, isolated areas seeded by a GAP 1-2 Protected Area around which Marxan added high irreplaceability, or small, local areas Marxan selected with no existing Protected Area
- We mapped 36
  - There are many and they have local importance

Local Build Outs

Local Build Outs around Gap status 1 or 2 PAs

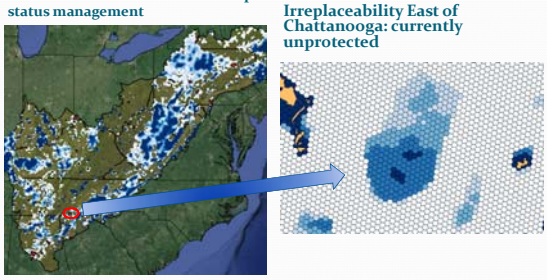
Glens Natural Area with surrounding irreplaceability



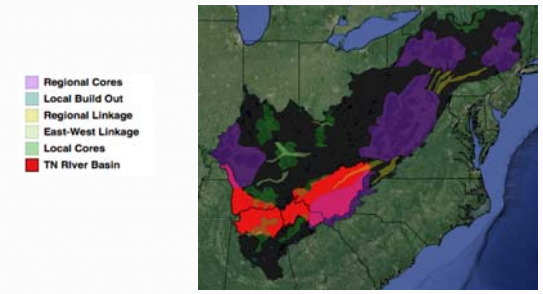
Local Build Outs

Local Build Outs: unprotected areas or areas to consider lower-level Gap status management

Irreplaceability East of Chattanooga: currently unprotected



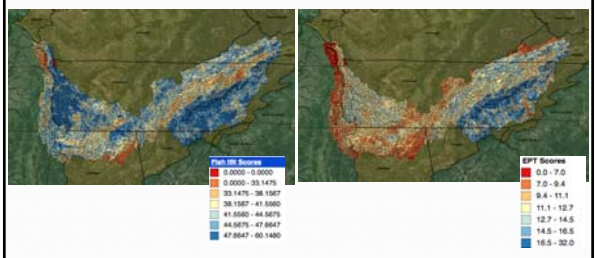
Importance of Tennessee River Basin for Regional Conservation Design



Multiscale appreciation of values within TN River Basin

TN River Basin Catchments: Fish Index of Biological Integrity

TN River Basin Catchments: Aquatic Macroinvertebrate Richness Scores



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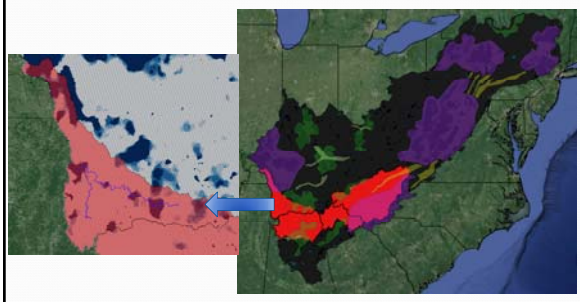

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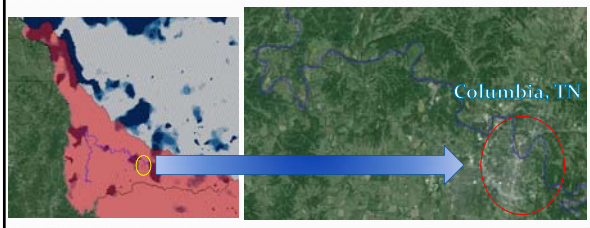
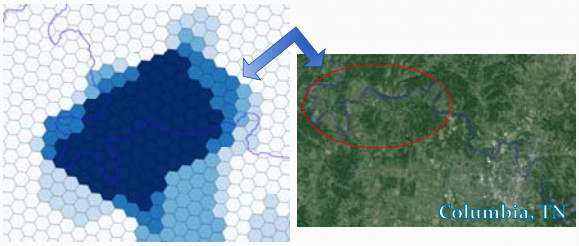


Multiscale appreciation of values within TN River Basin



Important for Hellbender, Matrix of lowland Mature Forests (> 75% Canopy Cover) with working lands (early successional) suitable for Prairie warbler. Landscape Connectivity is relatively high

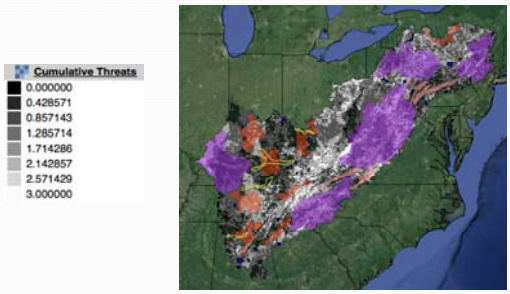
Final step in geographic prioritization – assessing threat

- We assessed level of threat to each element of the conservation design, mapped those levels of threats, and assigned the areas to a threat vs. irreplaceability matrix

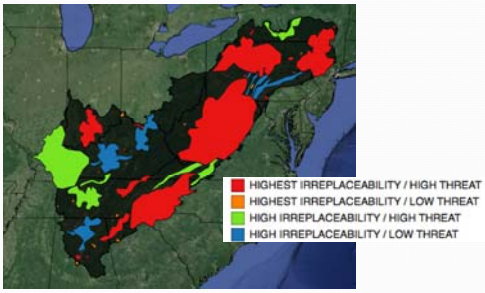
Assessing each conservation feature by level of threat

- We made a cumulative threat index comprised of
  - Climate Vulnerability (Departure from Baseline: 2030)
  - Housing Density (Projected to 2030)
  - Energy Development (Projected to 2030)

Map of conservation features categorized by threat



Relative Irreplaceability (accounting for connectivity) vs. Threats



Relevance for conservation decision making: a new set of geographic information for multi-scale decision support

- **Regional prioritization**
  - Understanding conservation pattern at the region scale (not been done before, using this many resources, for this region of the US)
- **Local prioritization**
  - Locally connected cores are areas where local conservation groups are likely already acting and this provides new information (upon this they can build co-occurrence models with fine-grained information only they possess)
- **Connectivity at multiple scales**
  - Fine grained connectivity analysis is completely unique to this region and reveals both large extent regional patterns and when zoomed in, surprising detail on local habitat connectivity

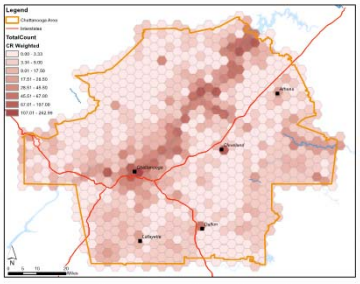
Conclusion

- Phase 1 conservation design complete
- Information available on individual priority resources
- Technical information will be summarized in project report

Management Uses at Hexagon Level

Agency / Entity	Action	Example LCD Product
Regional NGO	Prioritize by Threat / Regional Importance	Irreplaceability / Regional Core / Local Core
Land Trust	Acquisition / Easement	Local build-outs
State IFW	SWAPS Planning	Connectivity
FED – ES &T (USFWS)	Habitat Conservation Planning	Connectivity / Irreplaceability / Threat
FED – Multiuse (USFS)	Resource Management Plan	Connectivity / Irreplaceability / Threat
FED – Other (DOE/EPA/ACOE)	EIS / Mitigation (NEPA, CWA)	Local build-outs, Local cores, Connectivity
City/County Planning	Permitting / Road Construction	Connectivity, Local build outs

Cultural Example – Chattanooga Area



Discussion Break

- Priority Resources

Phase II Future Goals

1. Return to priority resource questions raised by technical teams and create and obtain new data to be used as targets in a final conservation design
2. Refine conservation design features by engaging local experts throughout the region in drawing better, more geographically and culturally resonant boundaries to assist in communication about landscape-level projects

Phase II Future Objectives

5. Work with EFETAC to incorporate a comprehensive and cumulative threats assessment in relation to individual modeling targets and priority resources
6. Climate-niche / species forecasts
7. Create modeling scenarios to mid-century time horizon
8. Formalize aquatic connectivity into reserve selection algorithm
9. Gather and incorporate hibernacula data for potential threats to bat populations