Expediting multi-agency environmental review with species distribution models in Virginia and throughout the eastern U.S.

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Challenges  (*e.g.* Virginia)

- mandate of T&E species consultation
  - Endangered Species Act
    (Section 6, 16 U.S.C. 1536c)
  - Virginia state code
    - Endangered Species Act (wildlife)
      (Title 29.1-109(A) and 563-570)
    - Endangered Plant and Insect Species Act
      (Section 3.2-1000)
    - Natural Area Preserves Act
      (Section 10.1-209)
Improving Project Review with Species Distribution Models

Previously, a project anywhere in these four counties would have triggered FWS consultation.

Now both agencies are beginning to use the same screening tools to trigger consultation. Inductive Species Distribution Models (SDM) are developed based on GIS and statistical analysis of the unique relationships between species locations and various habitat characteristics. Map outputs are used in USFWS and VA Natural Heritage online environmental review tools: IPaC (Information Planning and Conservation System) and NHDE (Natural Heritage Data Explorer). These objective methods and clear model outputs (for *R. michauxii*, in pink) enable better-informed survey requests, and expedited consultation for government and for clients. Virginia Natural Heritage is currently building a library of SDMs for all T&E species in Virginia.

In Virginia, the U.S. Fish and Wildlife Service (USFWS) has used county-level species presence/absence data, to determine a need for Threatened and Endangered (T&E) species consultation (for *Rhus michauxii*, counties in yellow). At the state level, VA Natural Heritage initiates consultation based on screening a project against known locations of T&E, via buffered Element Occurrence data (in purple). These two inconsistent approaches often result in differing requests for survey from state and federal agencies.
Brief History of Modeling at NH

• 2009 – 2014 – species modeling for Eastern Va Field Office of USF&WS

• Species prioritized based upon anticipated benefits to USF&WS via improvements to “best available data”

• 14 plants and 3 mussels modeled

• Consistent methods and outputs

• All into Information Planning and Conservation (IPaC) and Virginia’s Natural Heritage Data Explorer
Training Set

Species Occurrence Data

Absent

Negative or Background Data

Present

Environmental Variables (EV)

Extract Values

Class Label for 1 Tree

Build a Forest

Build thousands of trees, each from a different sample of training data.

Grow a Tree

Run each unknown raster cell down each tree of the forest.

Predict

VOTING
Probability suitable habitat = # trees that label cell present / # trees

Example in 2-D
(model uses all dimensions of EV selection)

Species Occurrence Data

Random Sample of Training Data

Run each unknown raster cell down each tree of the forest.

VOTING
Probability suitable habitat = # trees that label cell present / # trees

A different random selection of EV is used to find the best split at each node.
Example Output: Michaux’s Sumac 
(*Rhus michauxii*)
Example Output: Michaux’s Sumac
(Rhus michauxii)
Example Output: Dwarf wedgemussel *(Alasmidonta heterodon)*
Example Output: Dwarf wedgemussel (Alasmidonta heterodon)
The Tobacco Region Revitalization Commission

- 1998 MSA b/w 46 US states and four largest tobacco companies
- To settle state suits and recover costs for treating smoking related illnesses
- States to receive over $206B over 25 years
- To promote economic growth and development in tobacco-dependent communities

In Virginia:

- $4.1B
- 31-member body
- 1,831 grants to date
- ~ $1.1B
Threatened & Endangered Species Screening Tool for Virginia’s Tobacco Region

Objective: Develop SDM for all state and federally listed species that occur in the Tobacco Region of Virginia

Approach: Data gathering and data development
- Inductive model development with Random Forest and R statistical package

Funders/Partners: VDOT, Virginia Economic Development Partnership, Tobacco Region Revitalization Commission

Outcome: Species-specific screening layers
- Summary map output, clickable for summary list
Integration of At-risk and Range Restricted Species Models and Strategic Conservation Information into the SALCC Conservation Blueprint

Objectives:
- Develop predicted suitable habitat models for up to 10 federal T&E species
- Develop or refine information pertaining to stressors, habitat management objectives and conservation actions, in light of model outputs
Integration of At-risk and Range Restricted Species Models and Strategic Conservation Information into the SALCC Conservation Blueprint

**Approach:** Data gathering and data development
- Inductive model development with Random Forest and R statistical package
- Research to assess habitat management objectives and conservation actions

**Partners:** FWS, FNAl, state wildlife agencies and natural heritage programs from 6 states

**Outcome:** species model outputs for use in SALCC Conservation Blueprint, and in federal and state environmental review tools
Species Distribution Modeling throughout Northeastern U.S.

**Objective:** Develop predicted suitable habitat models for up to 10 federal T&E species

**Approach:** Data gathering and data development
- inductive model development with Random Forest and R statistical package

**Partners:** FWS, NYNHP, state wildlife agencies and natural heritage programs from 13 states

**Outcome:** model outputs for use in IPaC and in state environmental review tools
Current Virginia DCR- Natural Heritage Species Distribution Modeling Projects

SDM Species Distribution Modeling/Models
T&E Threatened and Endangered
VDCR Virginia Department of Conservation and Recreation
USFWS United States Fish and Wildlife Service
SALCC South Atlantic Landscape Conservation Cooperative
FNAI Florida Natural Areas Inventory
TICR Tobacco Indemnification and Community Revitalization Commission
FHWA Federal Highways Administration
VDOT Virginia Department of Transportation
NHP Natural Heritage Program

SDM Project Areas
NatureServe Network Modeling Center

USFWS Region 5

VDCR and New York NHP partnering, with support from eleven states, to develop regional environmental variable datasets and model 5-10 federal T&E species (to be determined).

SALCC

VDCR and FNAI partnering, with support from four states, to develop regional environmental variable datasets, and to model 5-10 "at risk and range-restricted species" (to be determined).

FHWA/VDOT

VDCR to develop SDM for all state and federal T&E species that occur in the Tobacco Region

VDCR to develop SDM for all state and federal T&E species that occur exclusively outside the Tobacco Region

Esn: HERE, DeLorme, MapmyIndia. © OpenStreetMap contributors and the OSM user community.
Thank you

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