USING DIGITAL ELEVATION MODELS TO EXTRACT CANYONS WITHIN THE BALCONES ESCARPMENT, TEXAS

KELSI SCHWIND
LANDSCAPE ECOLOGY PROGRAM

TEXAS PARKS & WILDLIFE
LANDSCAPE ECOLOGY PROGRAM

Provides ecological data to Texas Parks and Wildlife Department and to external parties
- Provides data support for data-driven conservation decisions at the landscape scale
- Field data collection, GIS, remote sensing, application development

Ecological Mapping Systems Data (EMS)
- Land cover classification
- 411 current habitat types, at 10 m resolution
- Raster and vector format
- Accessible through TEAMS application and the Landscape Ecology Program web page

TEAMs
Texas Ecosystem Analytical Mapper
TEAMs can also provide soil, hydrologic, and public land data.

Description:
**Common Name:** Edwards Plateau: Ashe Juniper - Live Oak Shrubland

**Description:** Ashe juniper and plateau live oak are the most frequent dominants of this evergreen shrubland. Plateau live oak and/or Ashe juniper may form a sparse canopy and Vasey oak (west), white shin oak, Mohr's shin oak (west), agarito, Texas persimmon, Texas mountain-laurel, mesquite, Lindheimer's pricklypear may be common in the understory.
CANYON MAPPING PURPOSE

1) Update the Ecological Mapping Systems for higher thematic resolution
   • Include if the location is within a canyon

Since this location falls within a canyon, this mapped type would be “Edwards Plateau: Ashe Juniper-Live Oak Canyon” and the description would include the abiotic site conditions and plant species specific to these canyons.

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CANYON MAPPING PURPOSE

2) Locate canyons that may contain Bigtooth Maple communities to inform data-driven conservation actions by the Texas Parks and Wildlife Department

- Drive ground-truthing efforts
- Landowner incentives, land preservation

• What we know:
  - Deciduous tree, multi-stemmed, well-known for its fall color
  - Not very common in Texas
  - Observations indicate they prefer deep, limestone canyons
  - Isolated communities in the Edward’s Plateau
    - Considered imperiled in this ecoregion

Images courtesy of the Texas Parks and Wildlife Image Gallery
STUDY AREA

Balcones Escarpment
- Geologic, normal fault zone that is comprised of mostly limestone
- 4.4 million acres, representing the eastern portion of the Texas hill country
- Most Bigtooth Maple observations occur in this region
- *Lost Maples State Natural Area*

Counties include:
Edwards, Real, Uvalde, Kerr, Bandera, Kendall, Medina, Bexar, Blanco, Comal, Hays, Travis, Blanco, Burnet, and Williamson
METHODS

DATA COMPILATION

Acquired 1-meter elevation data from TNRIS
- Compiled and mosaicked digital elevation models from across the study region
- Derived from airborne lidar surveys
- Resampled to 2m resolution

The final elevation model was used to derive a slope map
METHODS

Starting from scratch
- Limited literature, could not find any landscape-level geospatial data
- Only park-specific canyon maps available

Creating a novel workflow
- Establishing a canyon slope threshold using visual interpretation
- Set a 30-to-35-degree minimum threshold, depending on the location and landscape within the Balcones Escarpment

Establishing the bottom of potential canyons
- Hydrologic modeling to create a stream network in ArcPro
- Buffered to see if the streams were within the slope threshold

“How do we expand from here to capture the entire canyon feature?”
METHODS

GEOMORPHONS

Geomorphon tool in GRASS GIS
- `r.geomorphon`

Maps terrain types using a machine vision approach
- Input was the digital elevation model of the study area
- Outputs a raster of land terrain types
- Uses neighboring cells to determine the feature type (−, +, 0)
METHODS

Trial-and-error to determine which parameter settings best classified features from the landscape for canyon extraction

- Parameters include:
  - Search radius
  - Flatness distance
  - Vague when it comes to default conditions

Sensitive algorithm

- Had to change parameters across the landscape

Image courtesy of grass.osgeo.org
METHODS

ARCPRO MODELING

• Streams representing canyons meeting the slope threshold were isolated
  • Adjacent valley, footslope, hollow, spur, and slope features were extracted

• An iterative model was run to capture additional features of interest
  • 10m buffer → capture adjacent landform features → merge → dissolve → repeat using output
  • Prevented slope capture outside the canyon walls
METHODS

Adjacent feature extraction process to form canyons

1 2 3

4 5 6
SPLITTING CANYONS

Canyons were largely dissolved and did not represent individual canyons

- Decided to split by high-resolution watershed to represent canyons
- Watershed Analysis in Global Mapper to generate watersheds
RESULTS

10,162 canyons were extracted, representing over 1.2 million acres of the study area
• Edwards, Uvalde, Bandera, Kerr, Real containing the highest number of canyons

Overall, the workflow was very successful at capturing the entirety of canyons
RESULTS
CHALLENGES

Unintentional extraction results
- Bluffs, riverbeds (erosion), retention ponds

Multiple GIS software utilized
- ArcPro, Global Mapper, GRASS GIS

Geomorphon outputs and slope thresholds will need to evolve as the landscape evolves
- No single set of parameters worked well for the entire study area
FUTURE WORK

Simplify workflow
• Originally used multiple geomorphon outputs

Test geomorphon tool in ArcPro
• Minimizing software to help streamline workflow

Continue extracting canyons for other regions of the state for Ecological Mapping System updates
• West Texas, Crosstimbers
FUTURE WORK

Determine if modeling canyons can help predict where Bigtooth Maple communities are located

- Using the canyons, ground observations, and environmental variables to predict where other maple communities could be located
- Drive ground – truthing in the field
- Collaborating with TPWD biologists and private landowners
MAPLE OBSERVATIONS

You can help!

The Landscape Ecology Program needs more Bigtooth Maple observations for modeling efforts
  • The model will improve with more observations
  • Looking for more observations outside of Lost Maples State Natural Area
  • iNaturalist – Bigtooth Maple Hunters Project

If you’re interested in learning more, please reach out!

Counties include:
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THANK YOU

Kelsi Schwind

GIS / Remote Sensing Specialist

Landscape Ecology Program, Ecological and Environmental Planning Program

Wildlife Division

Texas Parks and Wildlife

kelsi.schwind@tpwd.Texas.gov

You can access ecological mapping systems data from the website


Amie Treuer-Kuehn

Lead Ecologist

Amie.treuer-kuehn@tpwd.texas.gov

https://www.inaturalist.org/projects/bigtooth-maple-hunters