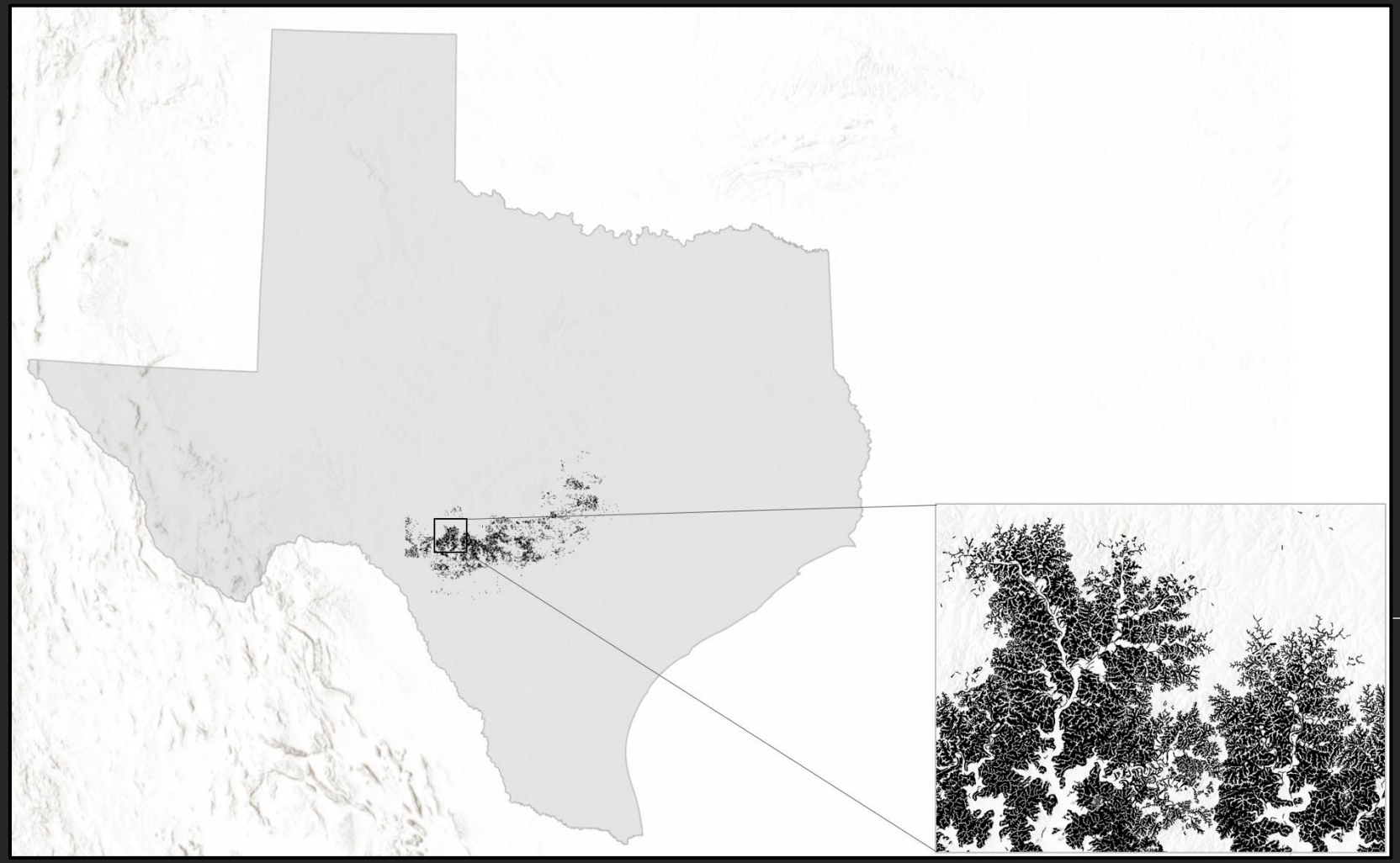


USING DIGITAL ELEVATION MODELS TO EXTRACT CANYONS WITHIN THE BALCONES ESCARPMENT, TEXAS

KELSI SCHWIND

LANDSCAPE ECOLOGY PROGRAM

TEXAS PARKS & WILDLIFE

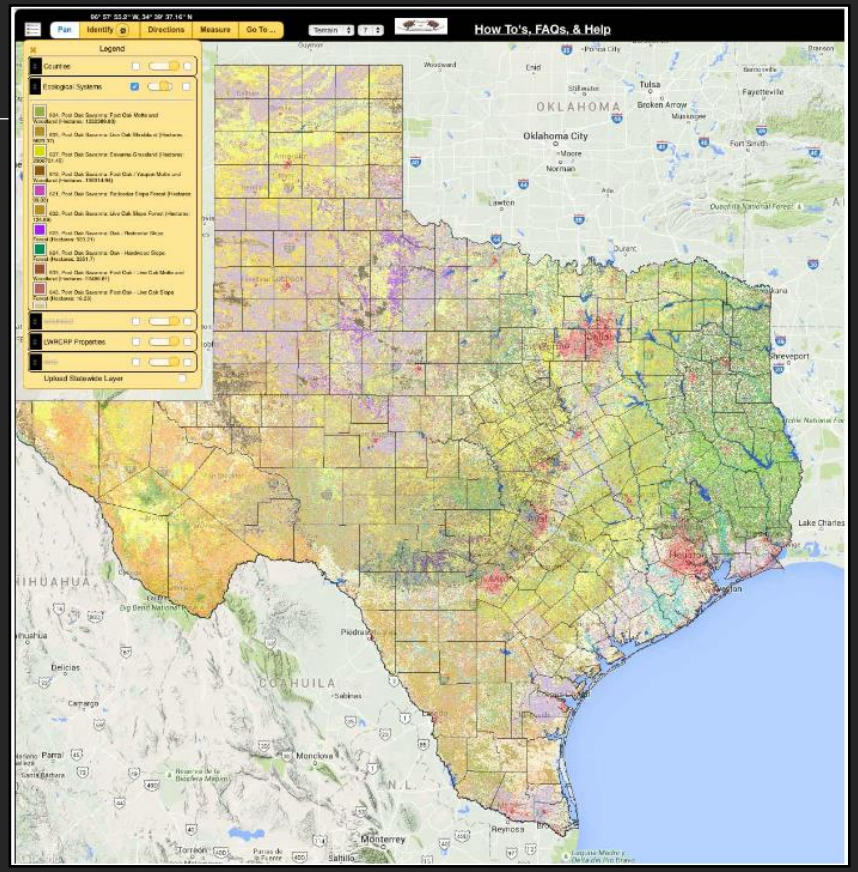
LANDSCAPE ECOLOGY PROGRAM

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

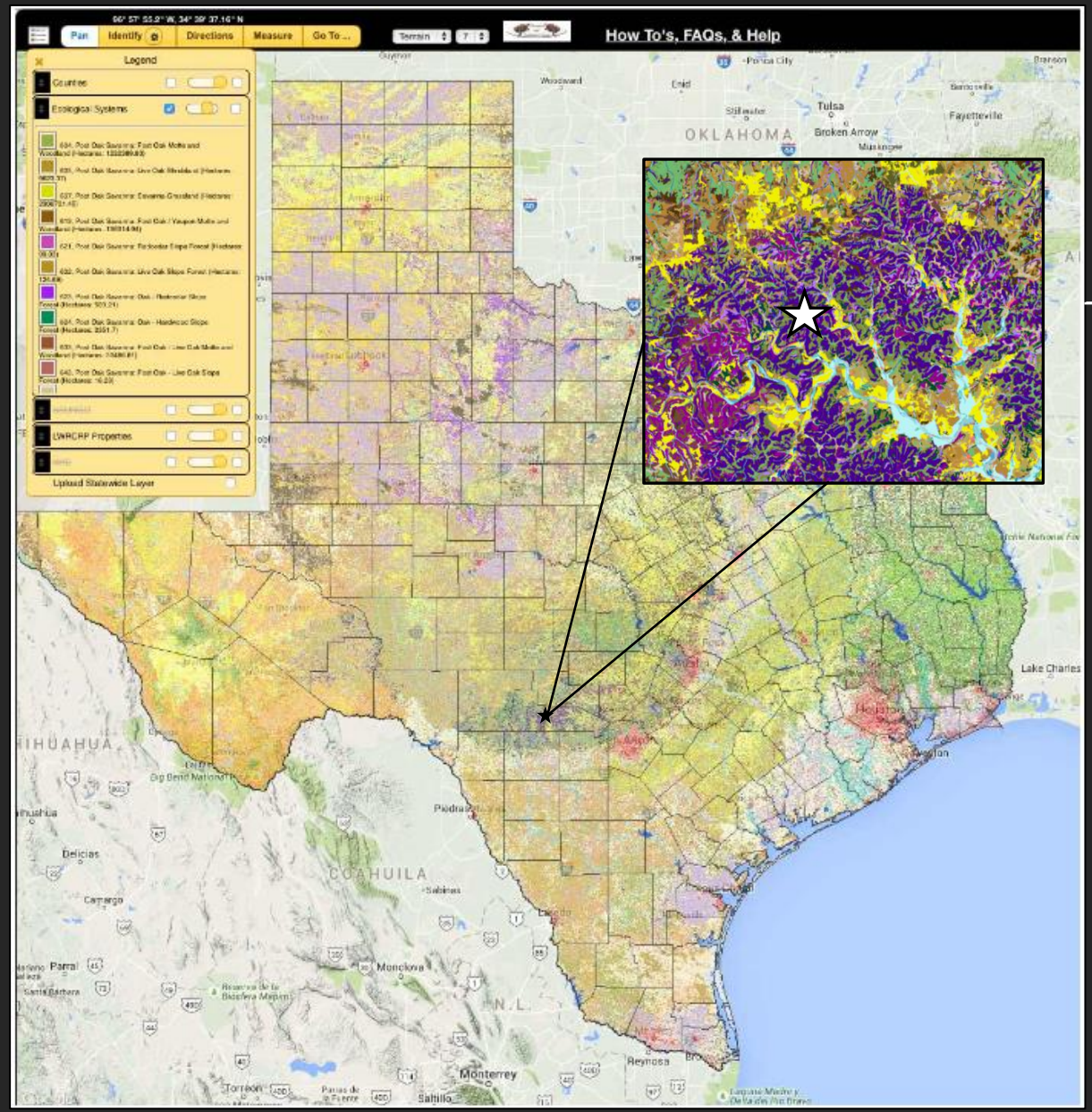
Ecological Mapping Systems Data (EMS)

- 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



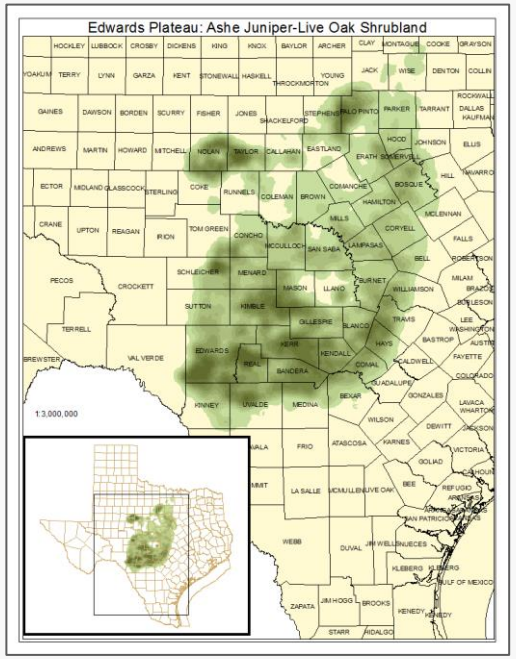
TEAMs

Texas Ecosystem Analytical Mapper



Description:

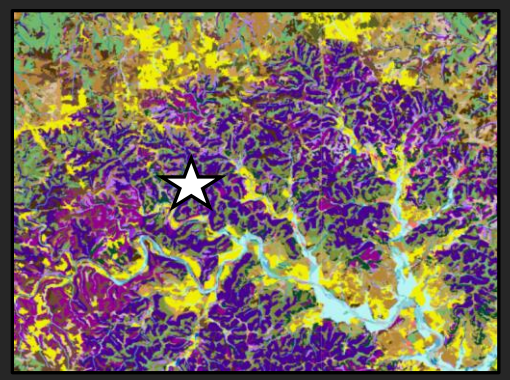
Common Name: Edwards Plateau: Ashe Juniper - Live Oak Shrubland
Description: Ashe juniper and plateau live oak are the most frequent dominants of this evergreen shrubland. Plateau live oak and/or Ashe juniper may form a sparse canopy and Vasey oak (west), white shin oak, Mohr's shin oak (west), agarito,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



TEAMs can also provide soil, hydrologic, and public land data

CANYON MAPPING PURPOSE

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



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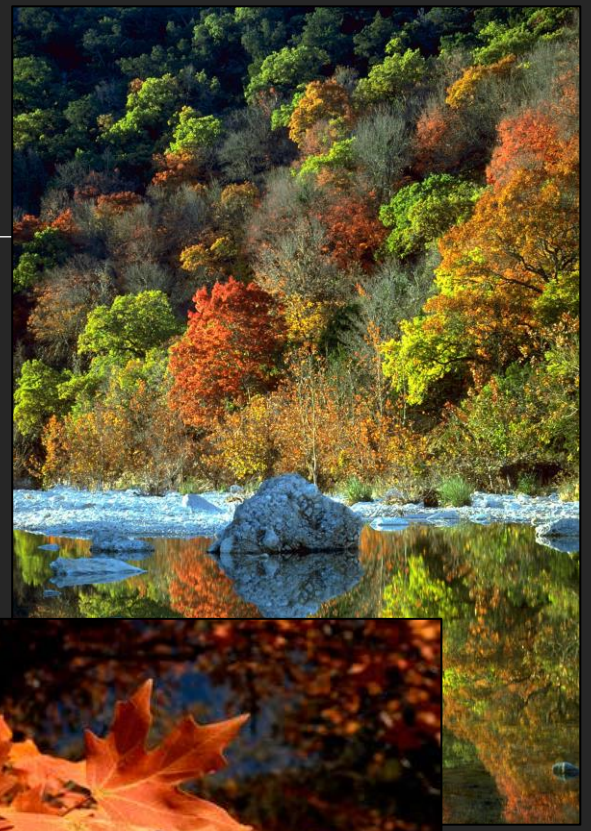
Since this location falls within a canyon, this mapped type would be “Edwards Plateau: Ashe Juniper-Live Oak Canyon” and the description would include the abiotic site conditions and plant species specific to these canyons

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*

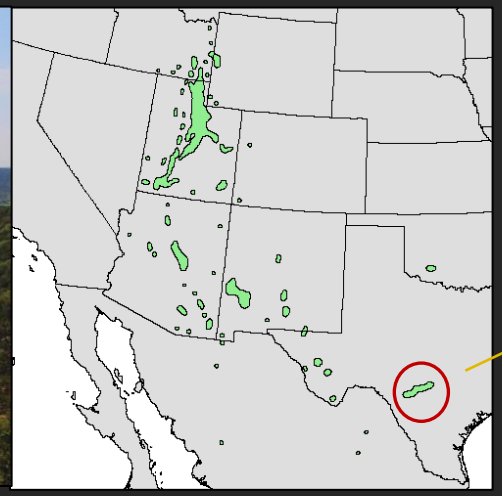


Images courtesy of the Texas Parks and Wildlife Image Gallery

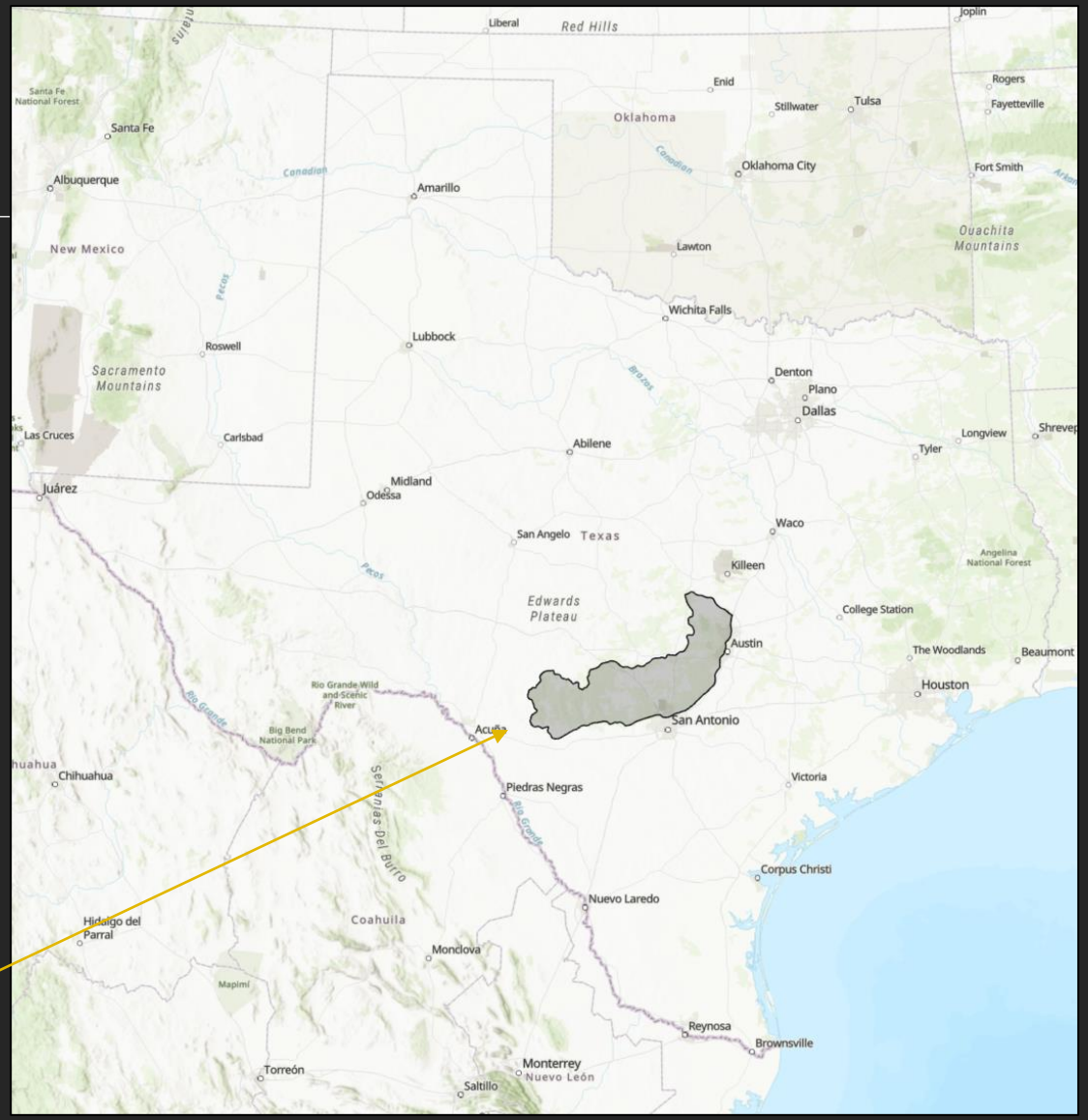
STUDY AREA

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



Images courtesy of the Texas Parks and Wildlife Image Gallery and Dickinson and Auken, (2016), Survival, Growth, and Recruitment of Bigtooth Maple (Acer grandidentatum) in Central Texas Relic Communities.

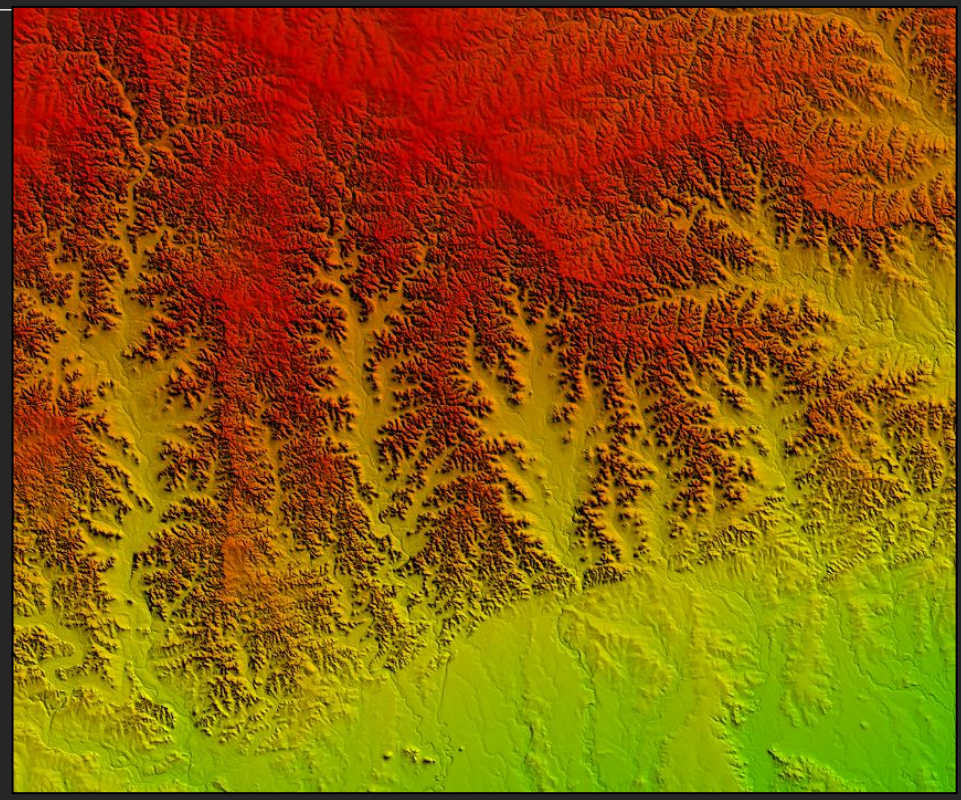
METHODS

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

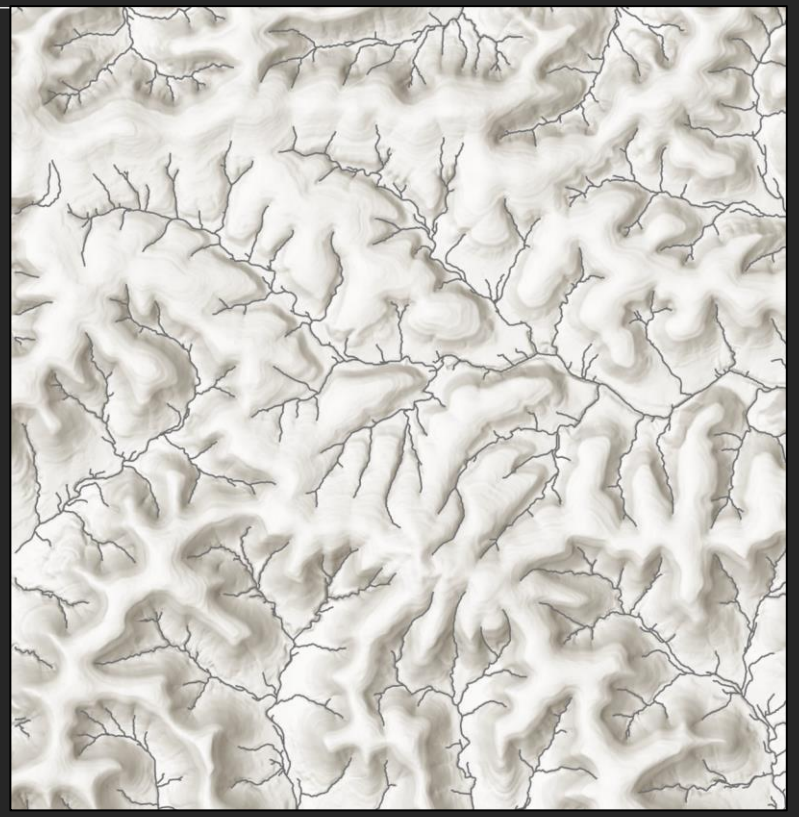
Creating a novel workflow

- 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)

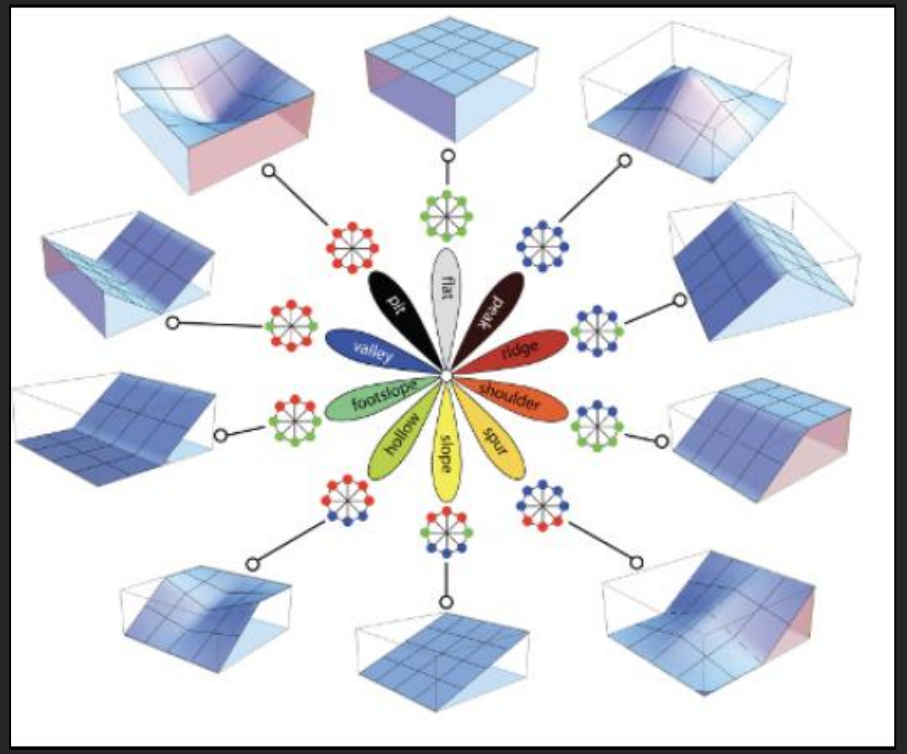


Image courtesy of grass.osgeo.org

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

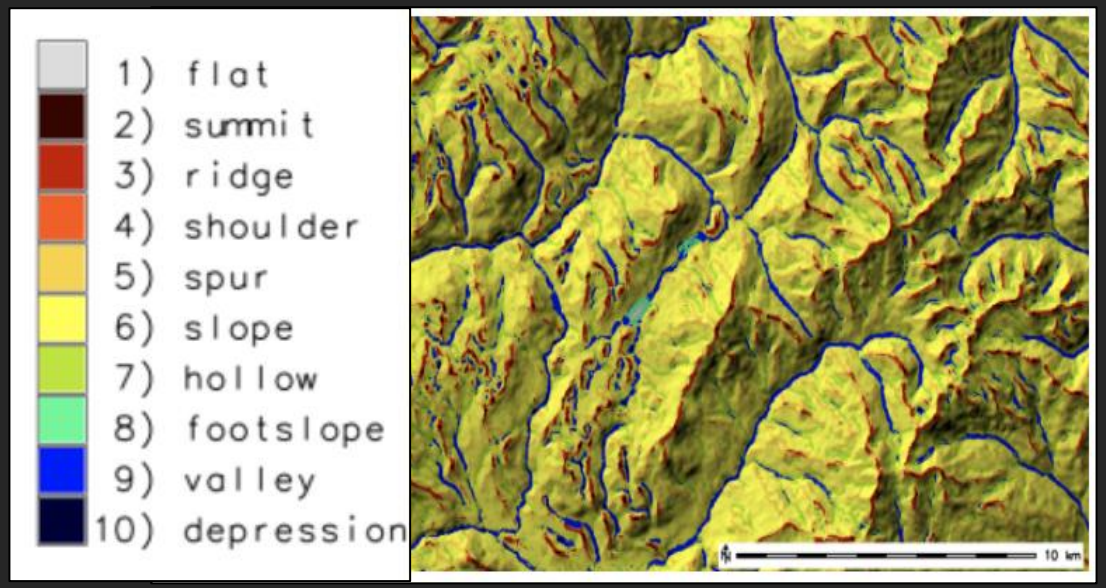
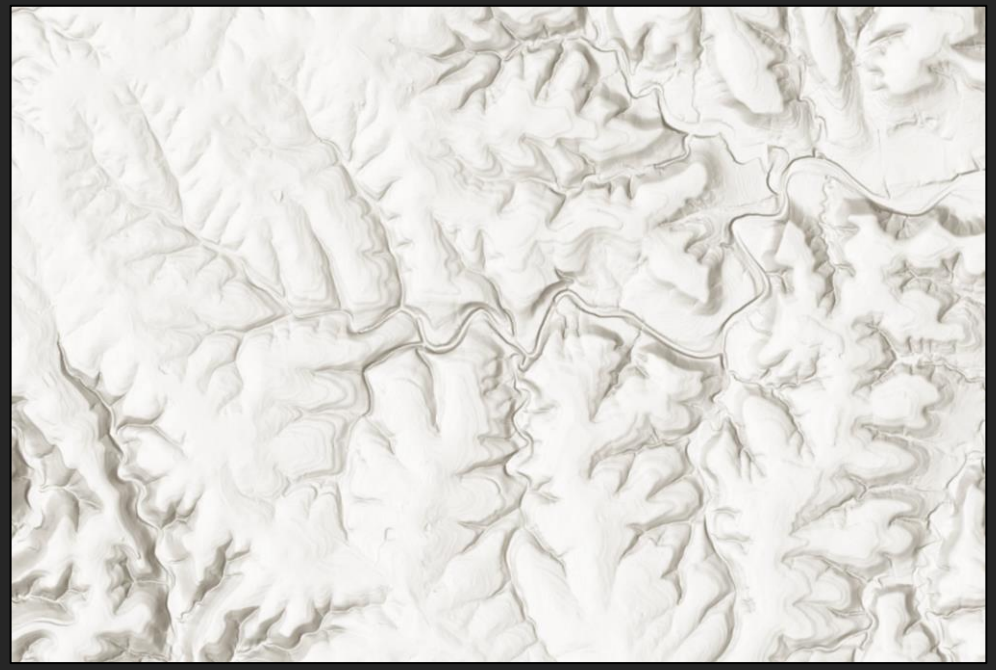
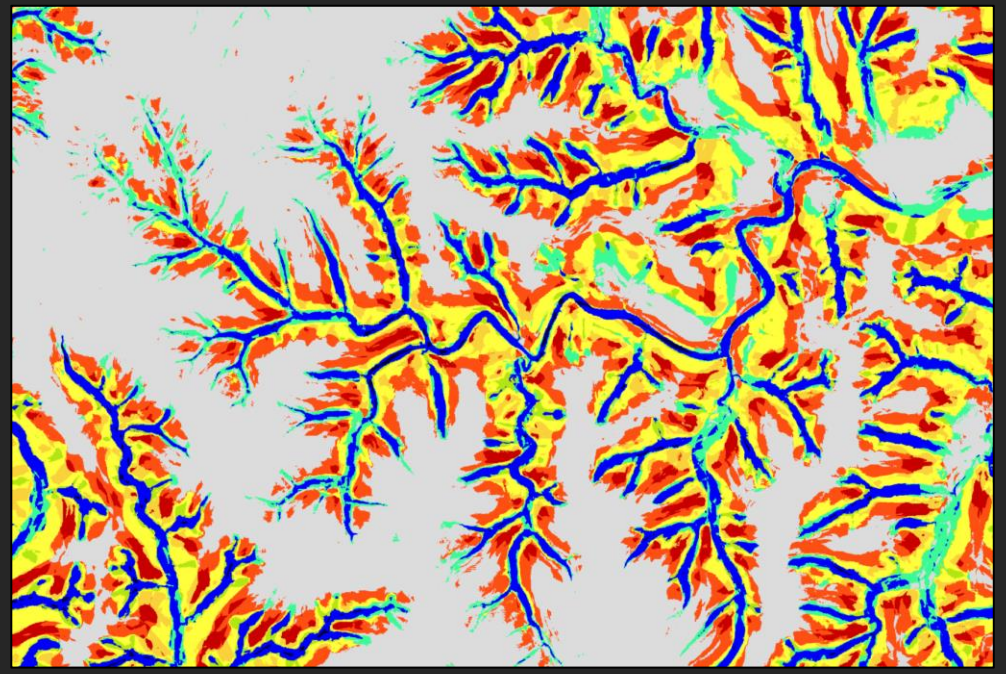


Image courtesy of grass.osgeo.org

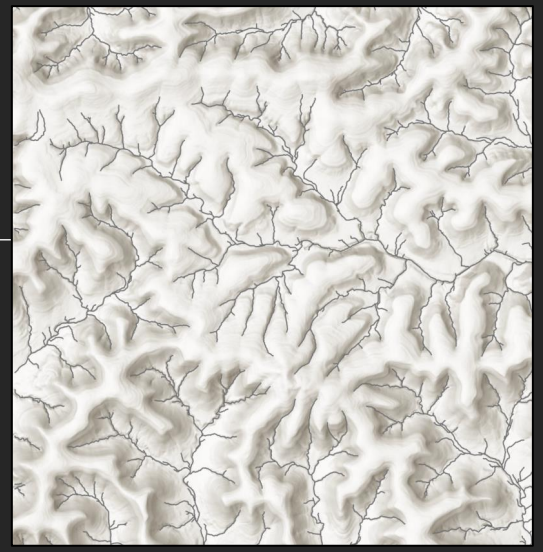
METHODS

Example output from Kendall County





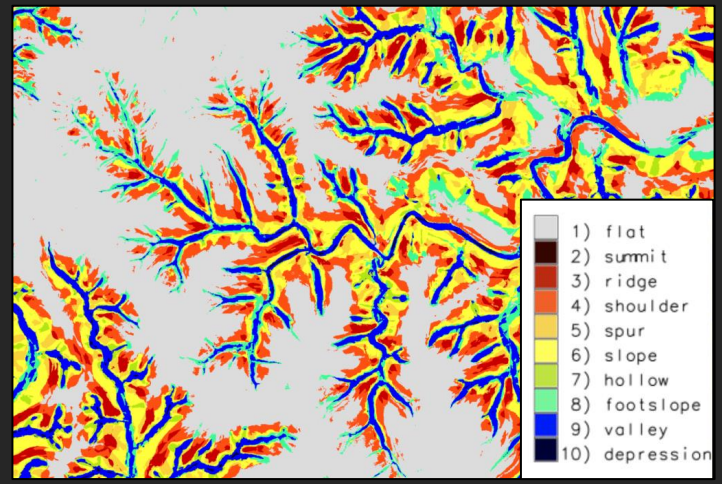
METHODS



ARCPRO MODELING

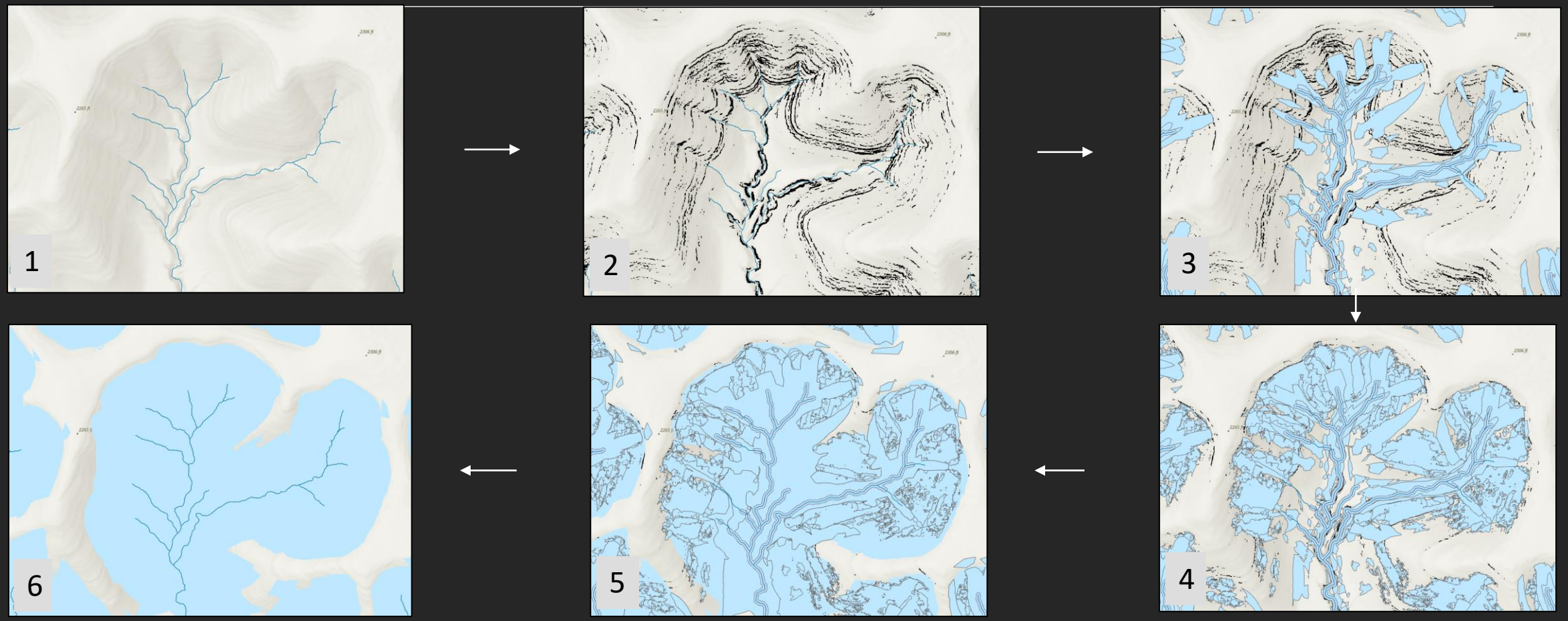
- Streams representing canyons meeting the slope threshold were isolated
  - Adjacent valley, footslope, hollow, spur, and slope features were extracted

- 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

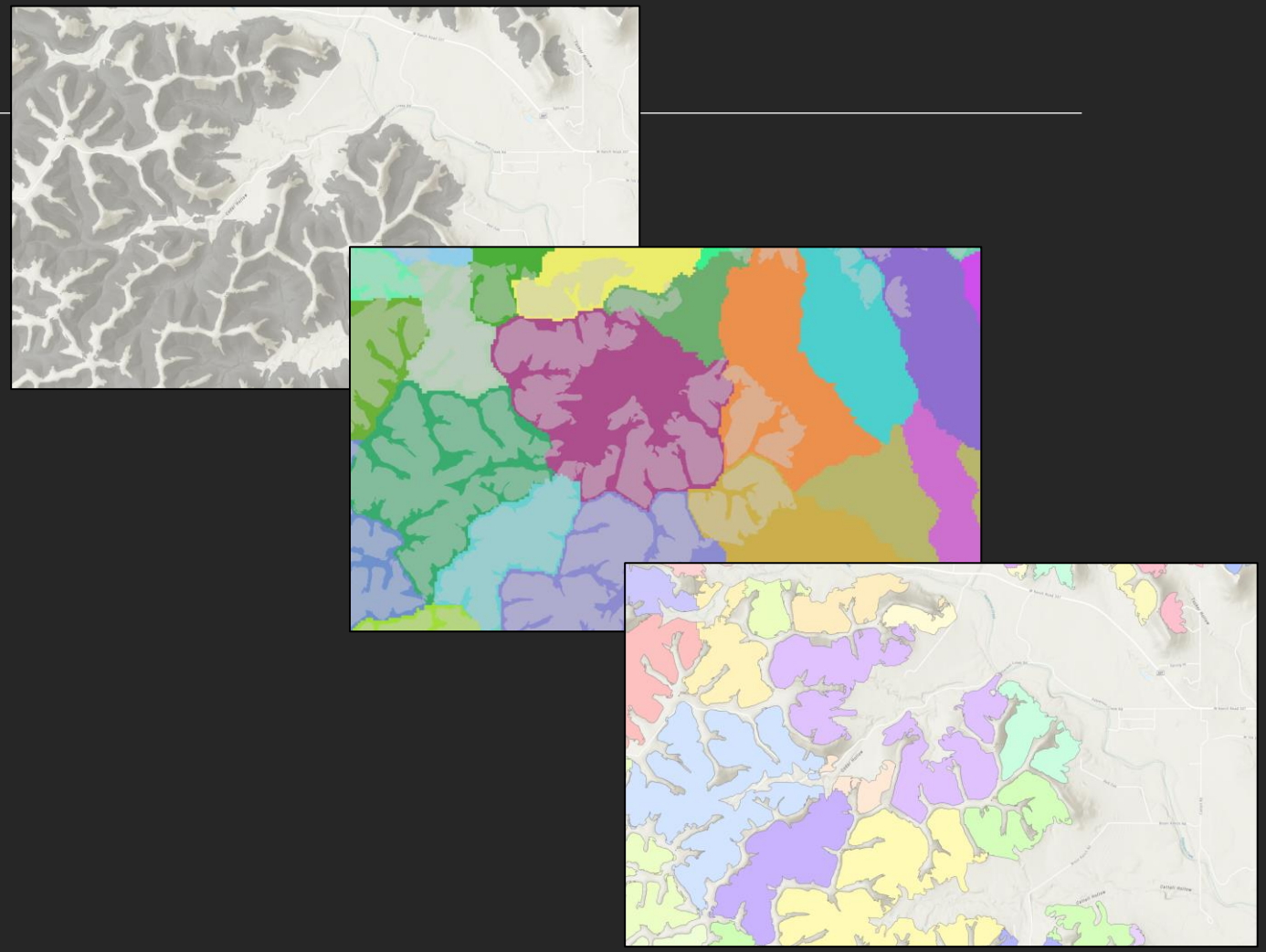
Adjacent feature extraction process to form canyons



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

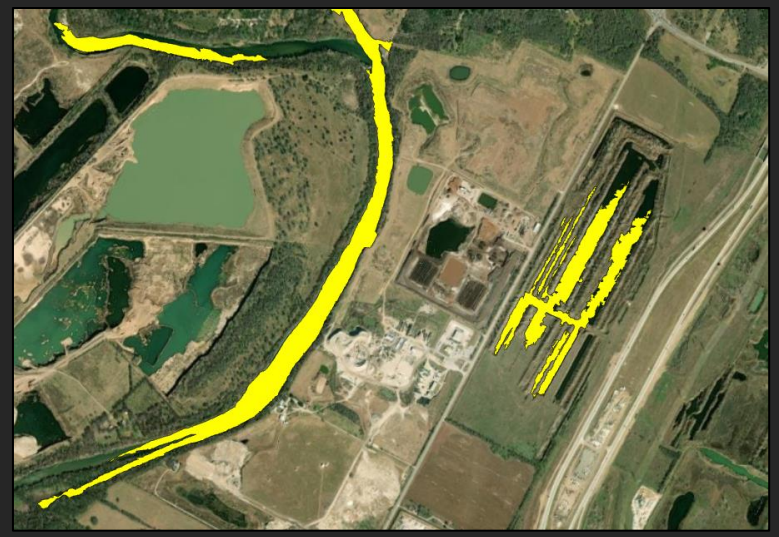
- Bluffs, riverbeds (erosion), retention ponds

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

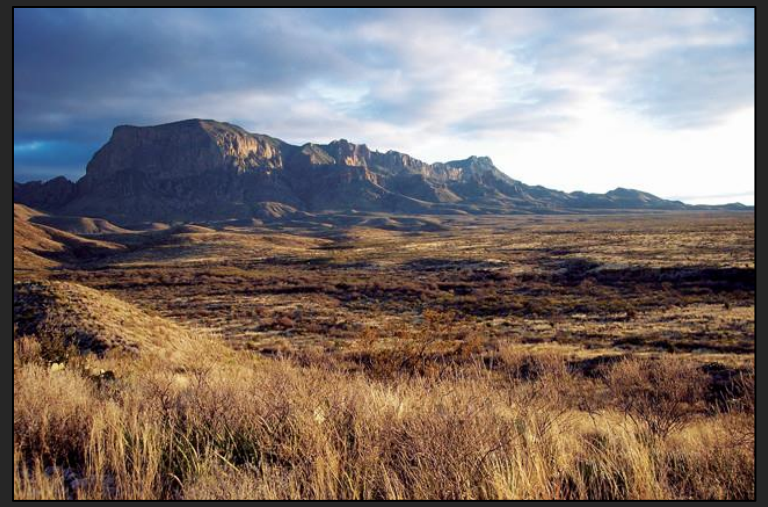
- Originally used multiple geomorphon outputs

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

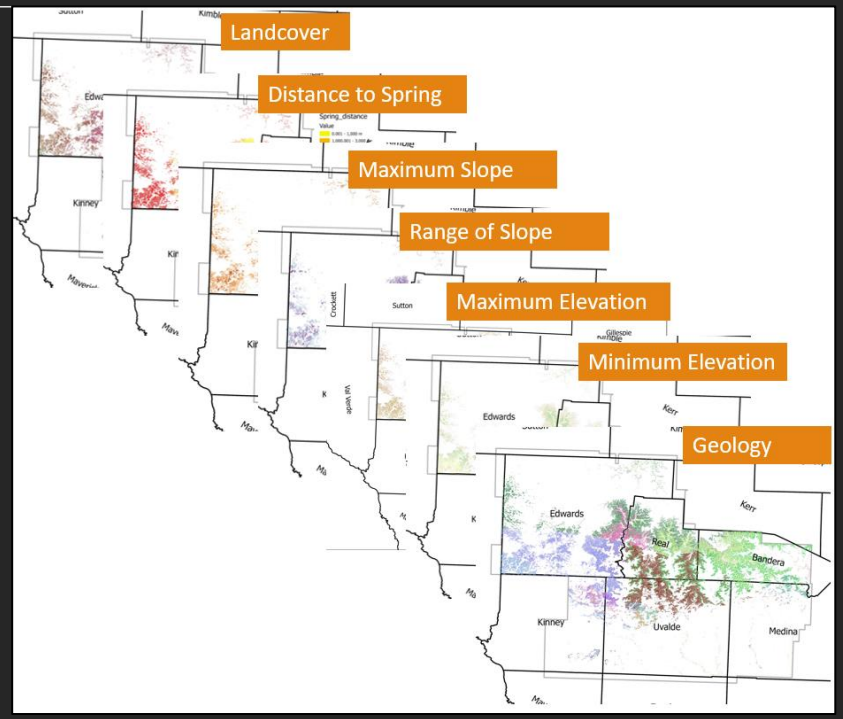


Images courtesy of Texas Parks and Wildlife Department (top), and Earthmagazine.org (bottom)

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

THANK YOU

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Wildlife Division

Texas Parks and Wildlife

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You can access ecological mapping systems data from the website

https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/

Bigtooth Maple Hunters

Amie Treuer-Kuehn

Lead Ecologist

Amie.treuer-kuehn@tpwd.texas.gov

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