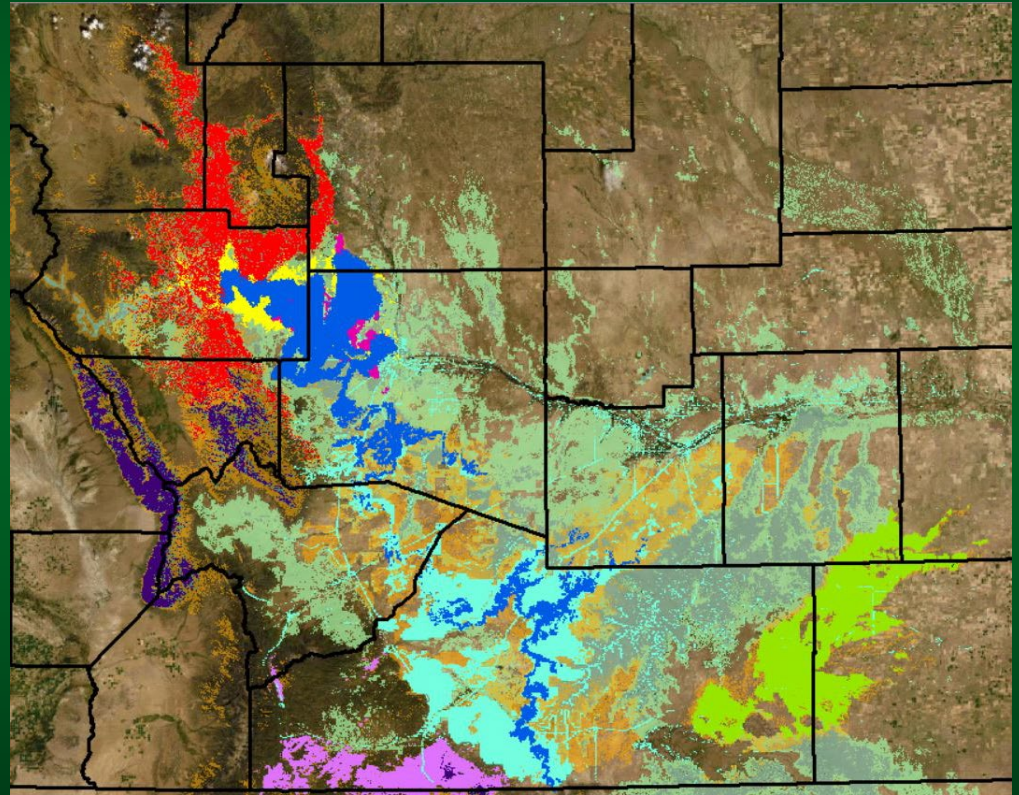# Species distribution modeling of Colorado Plants of Greatest Conservation Need

Jessica Smith, Karin Decker, Jill Handwerk Georgia Doyle

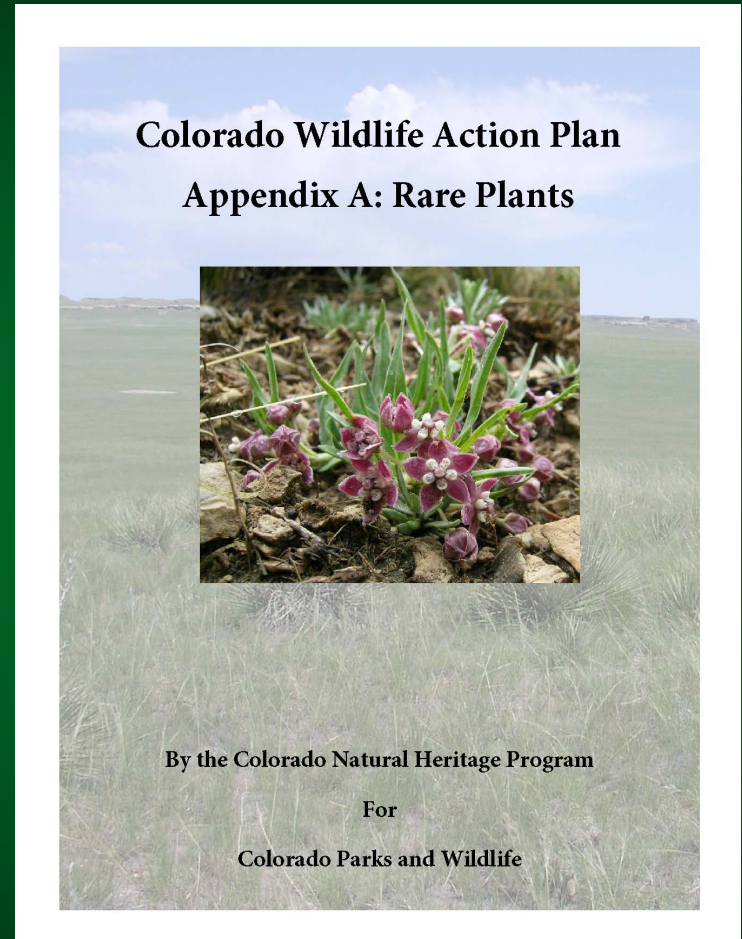18th Annual Rare Plant Symposium September 10th, 2021

Funding from the Colorado Natural Areas Program

Colorado Natural Heritage Program

Project Rationale

- Plants of Greatest Conservation Need
  - Rare Plant Addendum of SWAP
  - 117 plant species
  - Tier 1 & Tier 2

Colorado Wildlife Action Plan

Appendix A: Rare Plants

By the Colorado Natural Heritage Program
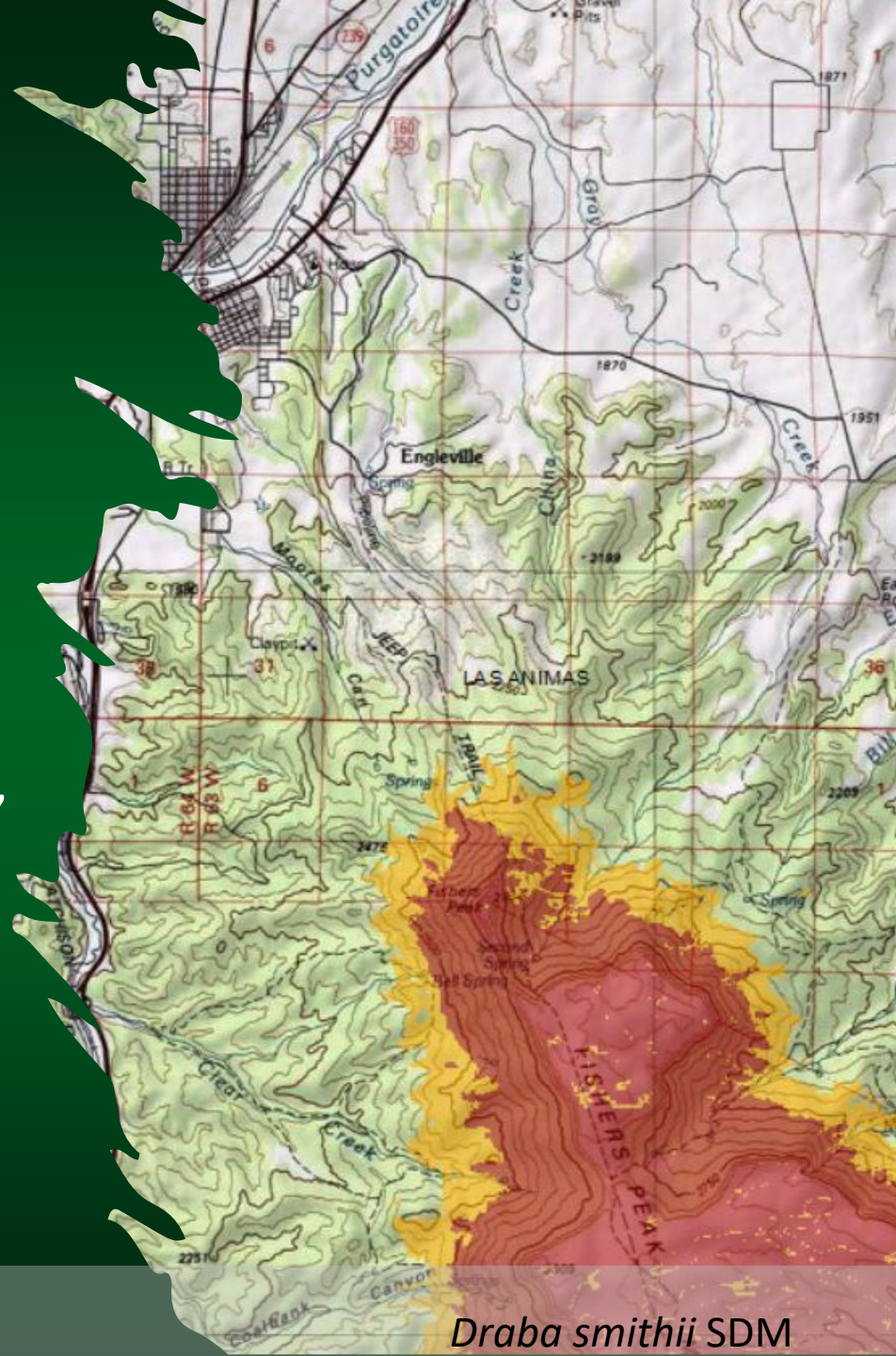
For

Colorado Parks and Wildlife

Project Rationale

- Model Inputs

  - CNHP geospatial database of rare plant locations

  - Spatial environmental variables
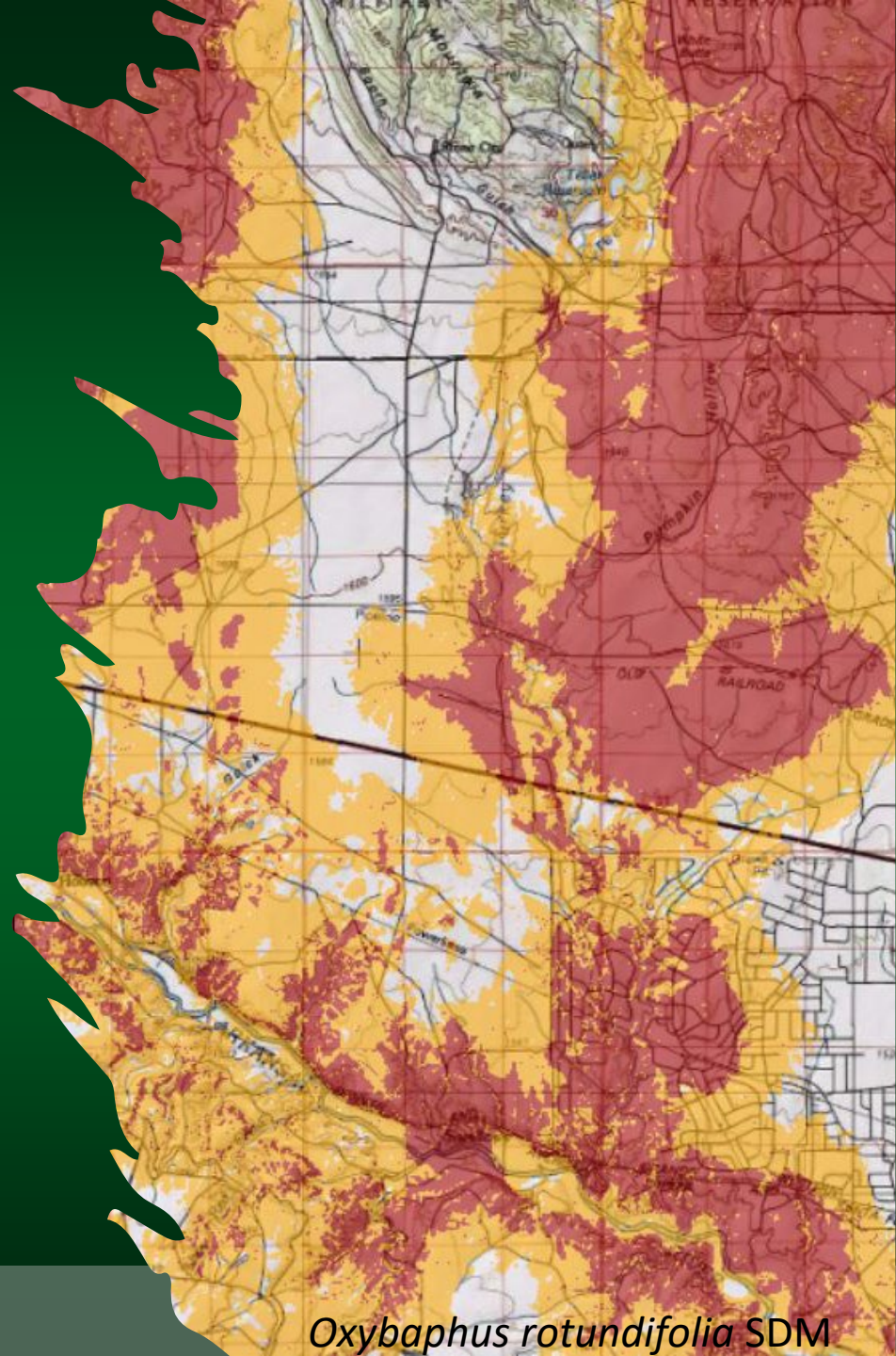
    - Chosen by habitat requirements

Project Introduction

- Species distribution models

    - Inductive modeling (Maxent)

    - Returns a probability of species occurrence

- Model review

    - Correctness, known locations, geographical extent

    - High, medium, & unlikely classes

Draba smithii SDM

Project Introduction

- Deliverables

    - Model raster image

    - Layer file, classified into 3 tiers

    - Metadata with summary of maxent results and usage

    - CODEX model, binary version

    - Report including important environmental drivers for each species, methodology, discussion
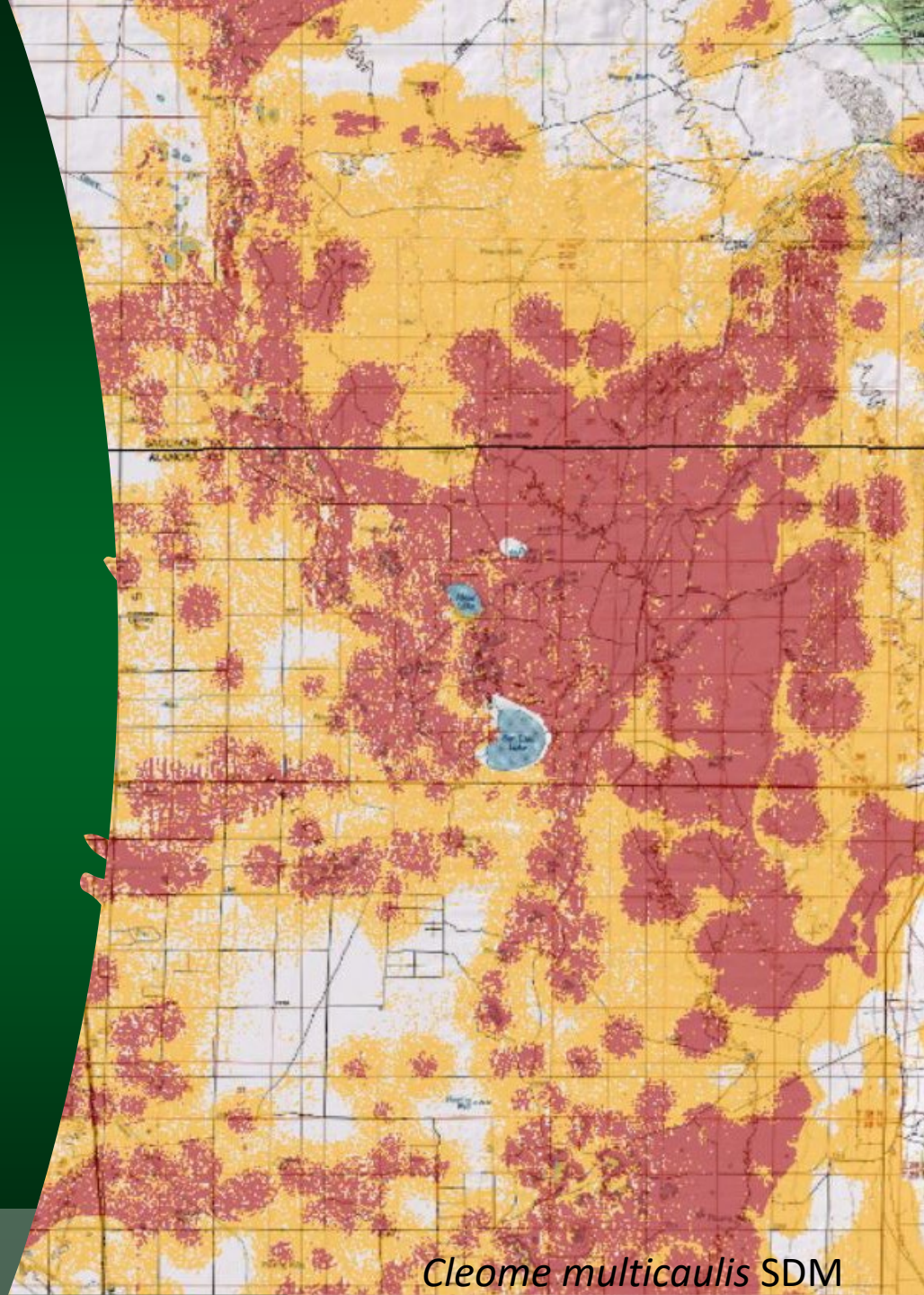
Oxybaphus rotundifolia SDM

Project Introduction

- Goal to model all PGCN

  - 45 completed in Phase I

  - 30% of PGCN previously modeled

  - Phase II will add final 33 models

Cleome multicaulis SDM

Nuttallia densa

Model Uses

- Map locations of potential habitat

  - Target areas for surveys

  - Landscape scale spatial analysis

  - Aid in management & avoidance of impacts

- Identify environmental drivers of habitat

- Environmental review and conservation planning in the CODEX

CODEX

- Colorado Conservation Data Explorer – Coming Soon!

  – Web-based, interactive mapping tool

  – Conservation planning, environmental review

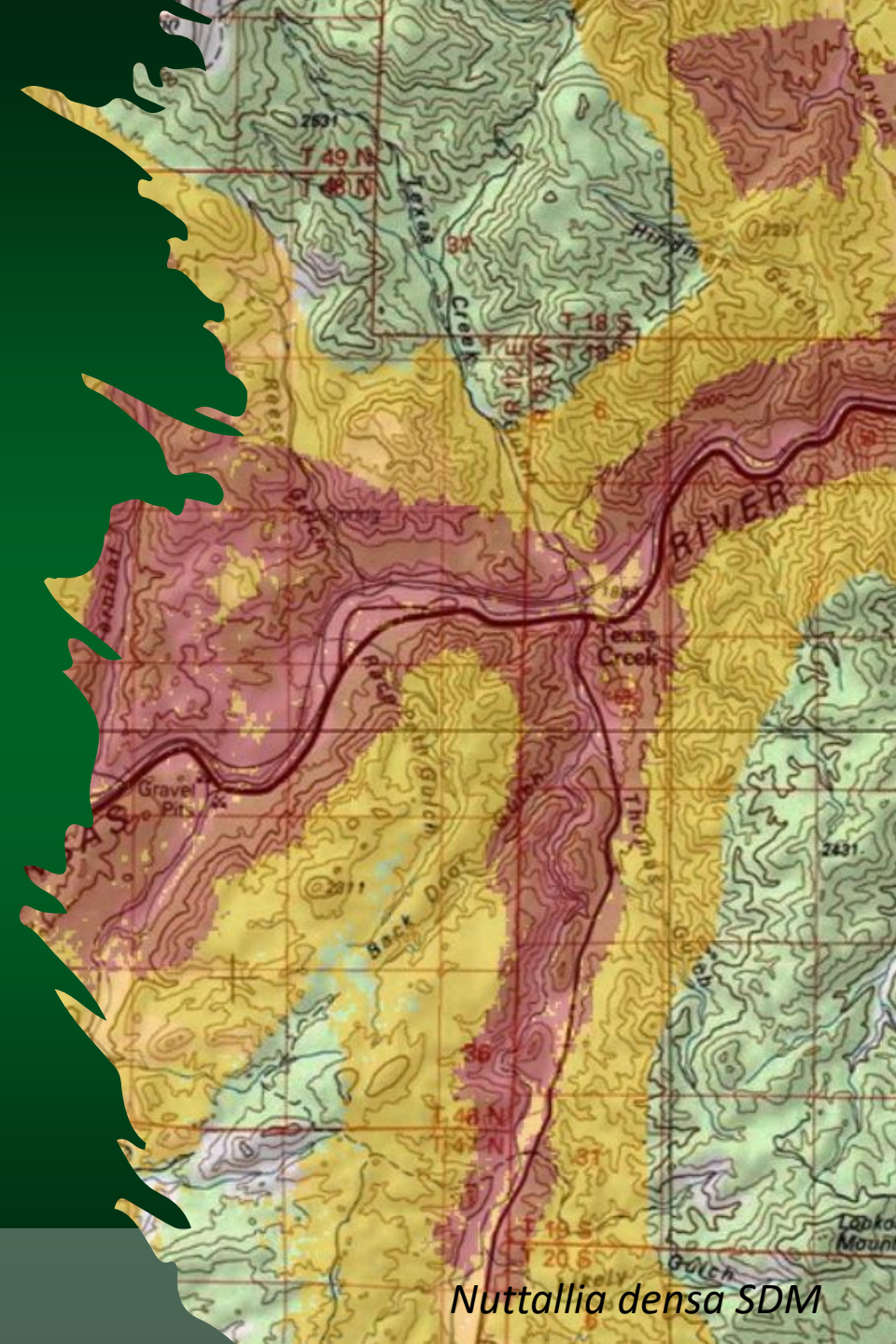 – Synthesize sensitive species data from CNHP and many partners

Penstemon yampaensis

Models in CODEX

- PGCN Models in CODEX
  - Binary models
  - Output in a list
  - Balance in cutoff threshold
- Availability of full models
  - Signed data sharing agreement required
- Model goal: identify most likely areas of suitable habitat

Nuttallia densa SDM

Model Constraints

- Model imperfect
- Absence of modeled habitat does not mean the species cannot occur
- This should be a factor in planning decision
- Reviewed but not validated

Cleome multicaulis

Expert Model Review

- Solicit Expert Review
  - Identify any problems
  - Document confidence level
- Model Review Feedback
  - Overall correctness, fit, distribution
  - Include locations with similar habitat to nearby known populations?
  - Exclude reasonable suitable habitat?

Lygodesmia doloresensis

45 PGCN Models Available

Northwest Quadrat

Lepidium huberi

Mentzelia rhizomata

Oenothera acutissima

Oxytropis besseyi var. obnapiformis

Penstemon fremontii var. glabrescens

Penstemon gibbensii

Penstemon scariosus var. albifluvis

Penstemon scariosus var. cyanomontanus

Penstemon yampaensis

Phacelia gina-glenneae

Physaria parviflora

Thalictrum heliophilum

Northeast Quadrat

Aletes humilis

Astragalus sparsiflorus

Castilleja puberula

Ipomopsis globularis

Mimulus gemmiparus

Oenothera coloradensis

Physaria bellii

Ptilagrostis porteri

Southwest Quadrat

Aliciella sedifolia

Astragalus rafaelensis

Camissonia eastwoodiae

Cleome multicaulis

Ipomopsis ramosa

Lupinus crassus

Lygodesmia doloresensis

Oreocarya revealii

Packera mancosana

Pediocactus knowltonii

Physaria vicina

Physaria rollinsii

Physaria scrotiformis

Puccinellia parishii

Townsendia glabella

Southeast Quadrat

Asclepias uncialis ssp. uncialis

Draba smithii

Eriogonum brandegeei

Frasera coloradensis

Herrickia horrida

Nuttallia chrysantha

Nuttallia densa

Oonopsis foliosa var. monocephala

Oonopsis puebloensis

Oxybaphus rotundifolius

Penstemon degeneri

Model Review

- Wifi:
  - Username: TSPublic
  - Password: Students1st

- Enter the following URL into your browser:
  - https://tinyurl.com/PGCNmdlrv

Draba smithii (Smith whitlow-grass), Tier 2

- Colorado endemic (may also occur in NM)
- 36 documented Colorado occurrences
  - Talus and scree slopes, upper foothills to lower alpine
- Important environmental factors
  - Distance to selected Tertiary volcanic formations
  - Terrain roughness index
  - Winter (driest season) precipitation
  - Summer (wettest season) precipitation
- Range: Only included modeled habitat in southern Colorado counties

- Colorado endemic
- 32 occurrences
  - Shale and sandstone breaks in grasslands
- Important environmental factors
  - Distance to Carlisle shale/Greenhorn Limestone and Graneros shale (Kcg)
- Modeled habitat followed overall species range

Herrickia horrida (Canadian River spiny aster), Tier 2

- Extreme south-central CO, northern NM
- 11 element occurrence records in the state
- Important environmental variables
  - Distance to Raton formation
  - South-facing slopes
  - Higher summer precipitation

Nuttallia chrysantha (Golden blazing star), Tier 2

- Colorado endemic

- 26 occurrences

  - Fremont and Pueblo Counties

  - Moderately steep, barren slopes

  - Calcareous substrates, upper Cretaceous geology

- Important environmental variables

  - Distance to shale barrens

  - Minimum level of fall precipitation, around 5 cm

  - Gentle to moderate slopes

- Modeled habitat followed overall species range

Oonopsis puebloensis (Pueblo goldenweed), Tier 2

- Colorado endemic

- 28 occurrences
  - North and west of Pueblo
  - Smoky Hill member of the Niobrara Formation.

- Important environmental drivers
  - Distance to shale barrens
  - Distance to Niobrara Formation

- Cutoff threshold of 0.42
  - Lowered to include two highly ranked EOs

- Predicted habitat approximate to known distribution
  - Southernmost location is not covered.

Oxybaphus rotundifolius (Round-leaf four o'clock), Tier 2

- Colorado endemic
- 40 occurrences
  - Calciphilic, Smoky Hill member of the Niobrara formation
- Important environmental drivers:
  - Distance to shale barrens
  - First frost in fall during the first week of October
- Cutoff threshold of 0.275
  - Include highly ranked, large EOs, better fit
- Predicted habitat approximate to known distribution
  - Eastern edge of range not covered.
  - Additional habitat north of Huerfano River & NW of PCMS included

Penstemon degeneri (Degener beardtongue), Tier 2

- Colorado endemic
- 25 occurrences
  - Precambrian age metamorphic and igneous outcrops
- Important environmental drivers
  - Distance to metamorphic and igneous outcrops
  - Dry winters (generally less than 10 cm of precipitation)
  - Wet summer months (16 cm or more)
  - Average last frost date around the end of May
  - Slopes were moderate to steep

Nuttallia densa (Arkansas Canyon stickleaf), Tier 2

- Colorado endemic
- 17 occurrences
  - Arkansas River Canyon between Salida and Cañon City
  - Dry open areas
  - In washes, roadsides, and naturally disturbed sites.
- Important environmental drivers
  - Lower fall precipitation
  - Steep slopes
- Cut-off threshold of 0.112 (medium classification)
  - Include highly ranked, large EOs, better fit
- Wider range: Buena Vista to Cañon City.

Asclepias uncialis ssp. *uncialis* (Dwarf milkweed), Tier 2

- Not a Colorado endemic
  - In Colorado, variety of soil types and microsites
    - 44 occurrences
  - Associated with grasslands
- Extremely challenging to model
  - Large, sparsely populated range
  - Lack of obvious narrow environmental influence
  - Much habitat probably converted to agricultural use
- Important environmental factors:
  - Distance to shortgrass prairie
  - Soil depth
- Cutoff threshold of 0.107
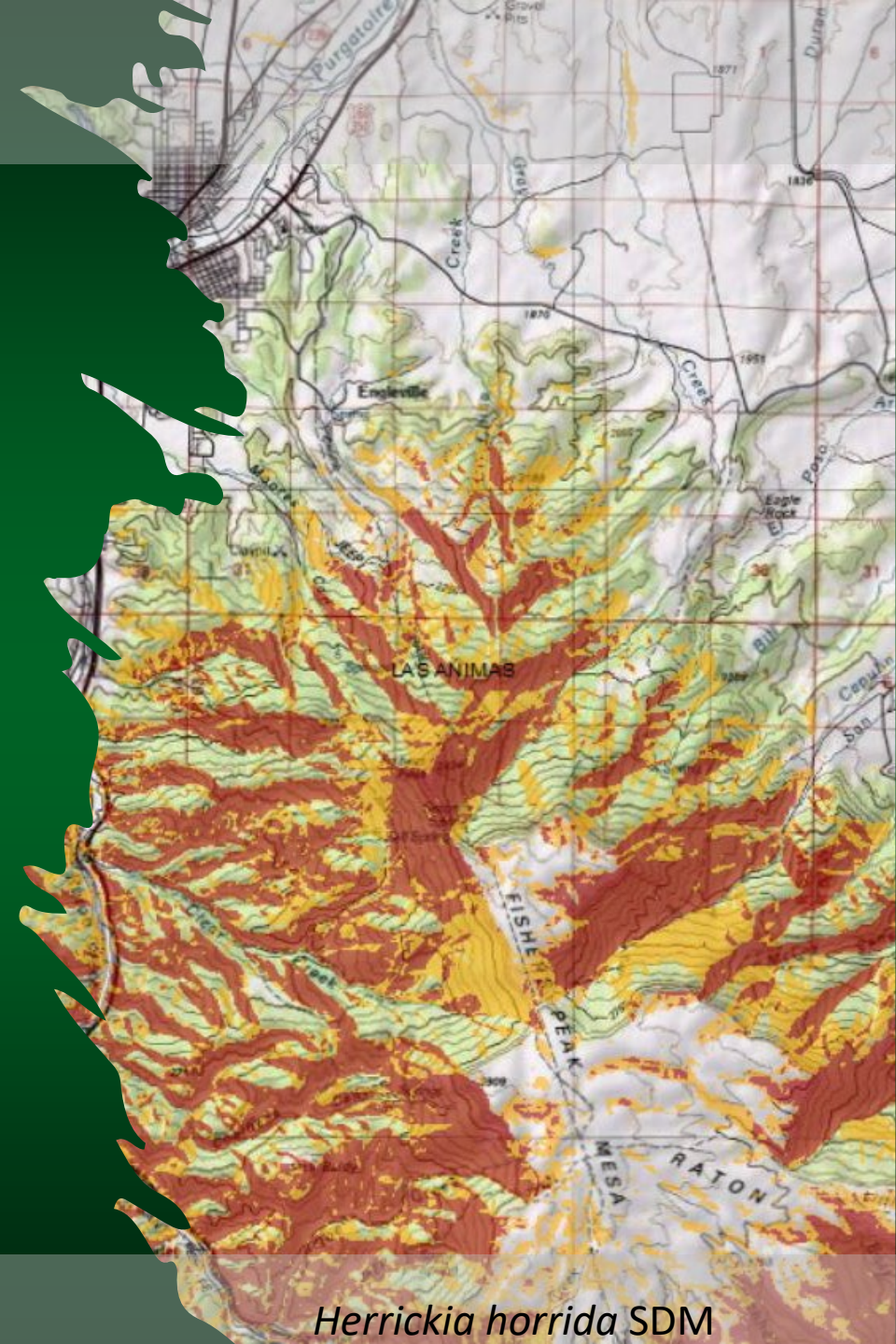 - Include modeled habitat in NE corner of CO

Oonopsis foliosa var. *monocephala* (Rayless goldenweed), Tier 2

- Colorado endemic, 20 occurrences
  - Restricted range, Las Animas County
  - Semi-arid shortgrass steppe, highly eroded soils
- Important environmental drivers
  - Distance to shale barrens
  - Average percent silt in soil
  - Colorado National Vegetation Classification type, developed areas excluded
  - Distance to the Niobrara formation.
- Range: predicted high probability habitat to Denver
  - Truncated to areas further south.

Next Steps

- To help with model review, contact Jessica Smith
  - jp.smith@colostate.edu

- Check out the CODEX Website
  - cnhp.colostate.edu/ maps/CODEX

- Project report available!
  - https://cnhp.colostate .edu/library/reports/

Herrickia horrida SDM