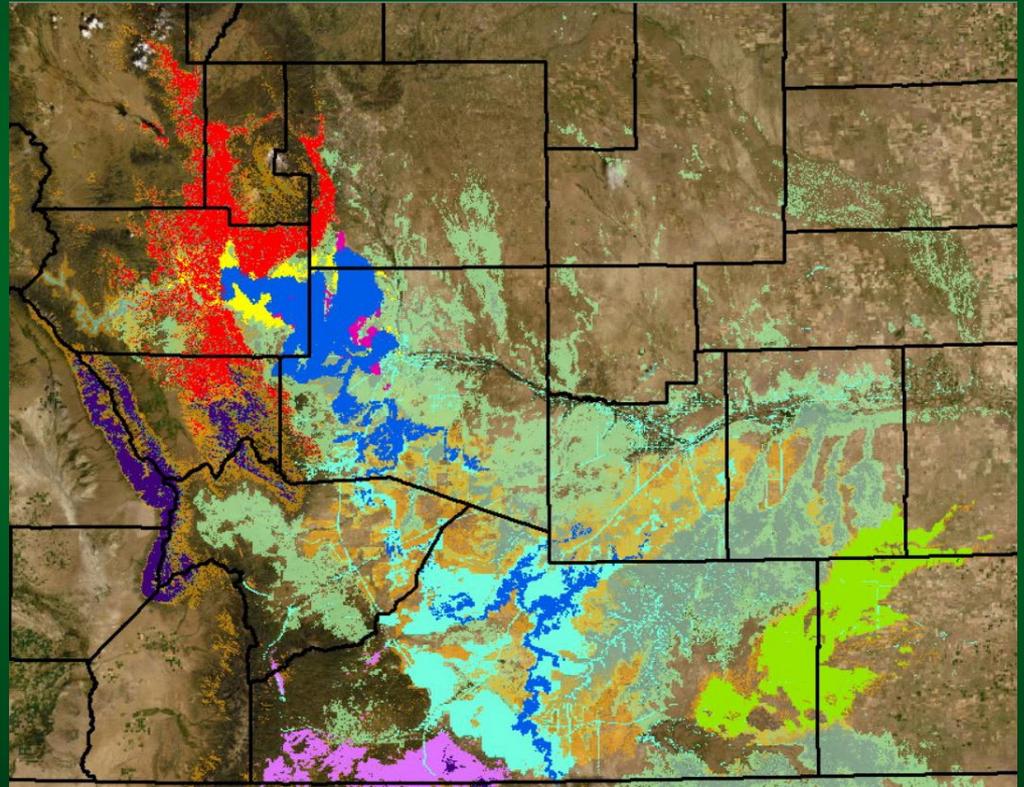


Species distribution modeling of Colorado Plants of Greatest Conservation Need

Jessica Smith, Karin Decker, Jill Handwerk
Georgia Doyle

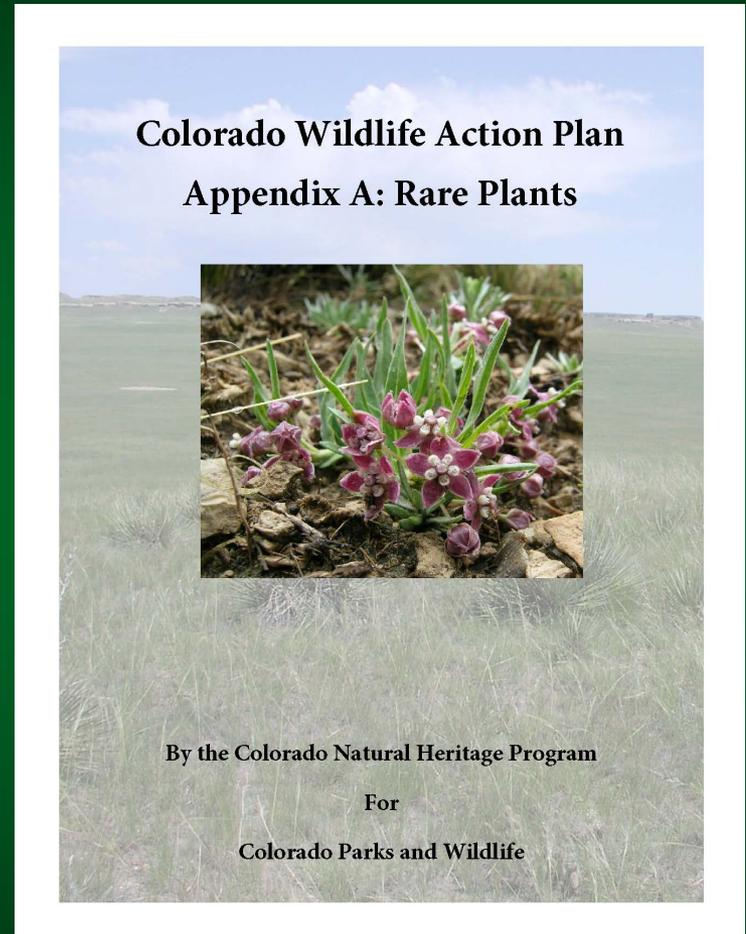
18th Annual Rare Plant Symposium
September 10th, 2021

Funding from the Colorado Natural Areas Program



Project Rationale

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



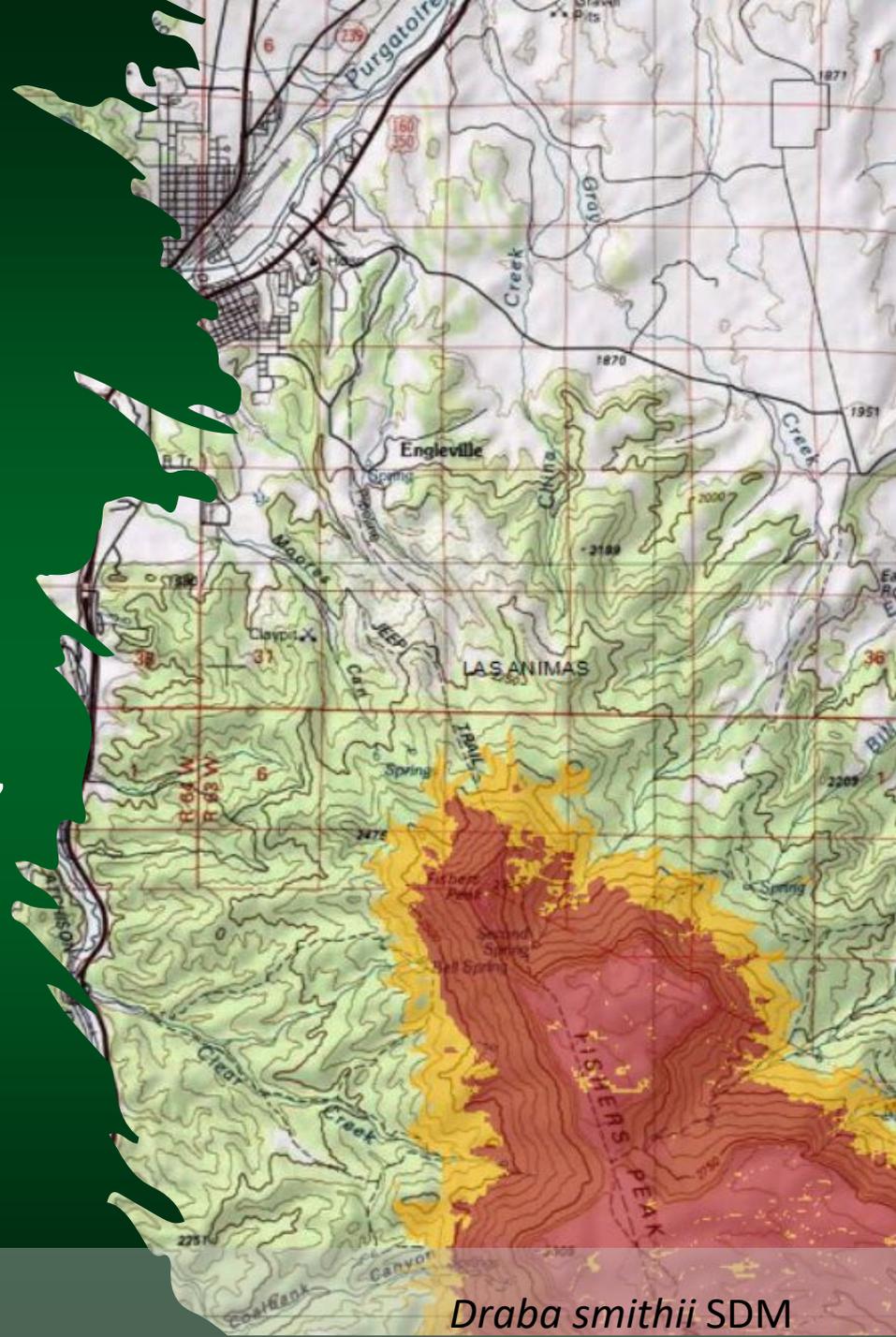
Project Rationale

- Model Inputs
 - CNHP geospatial database of rare plant locations
 - Spatial environmental variables
 - Chosen by habitat requirements



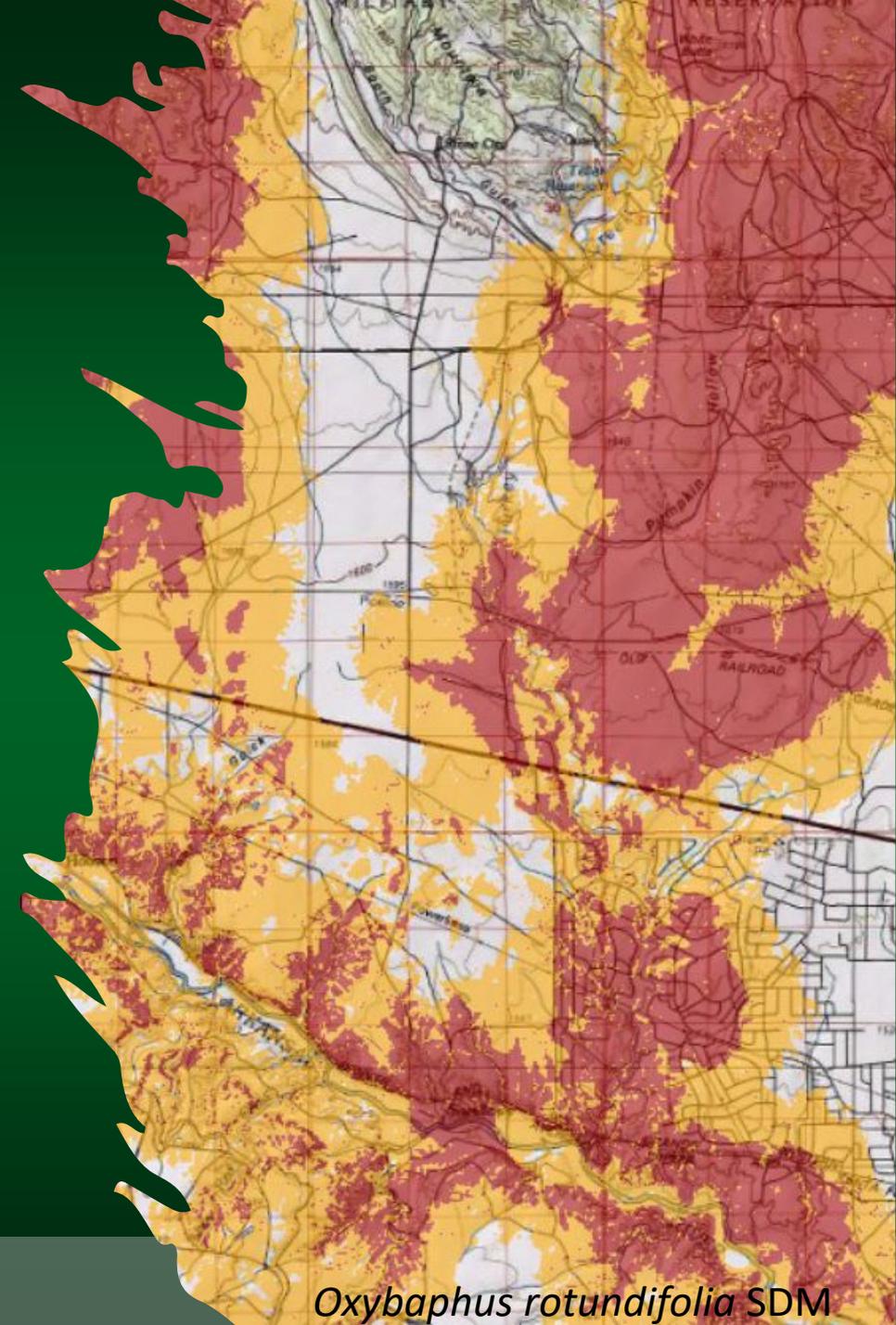
Project Introduction

- Species distribution models
 - Inductive modeling (Maxent)
 - Returns a probability of species occurrence
- Model review
 - Correctness, known locations, geographical extent
 - High, medium, & unlikely classes



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

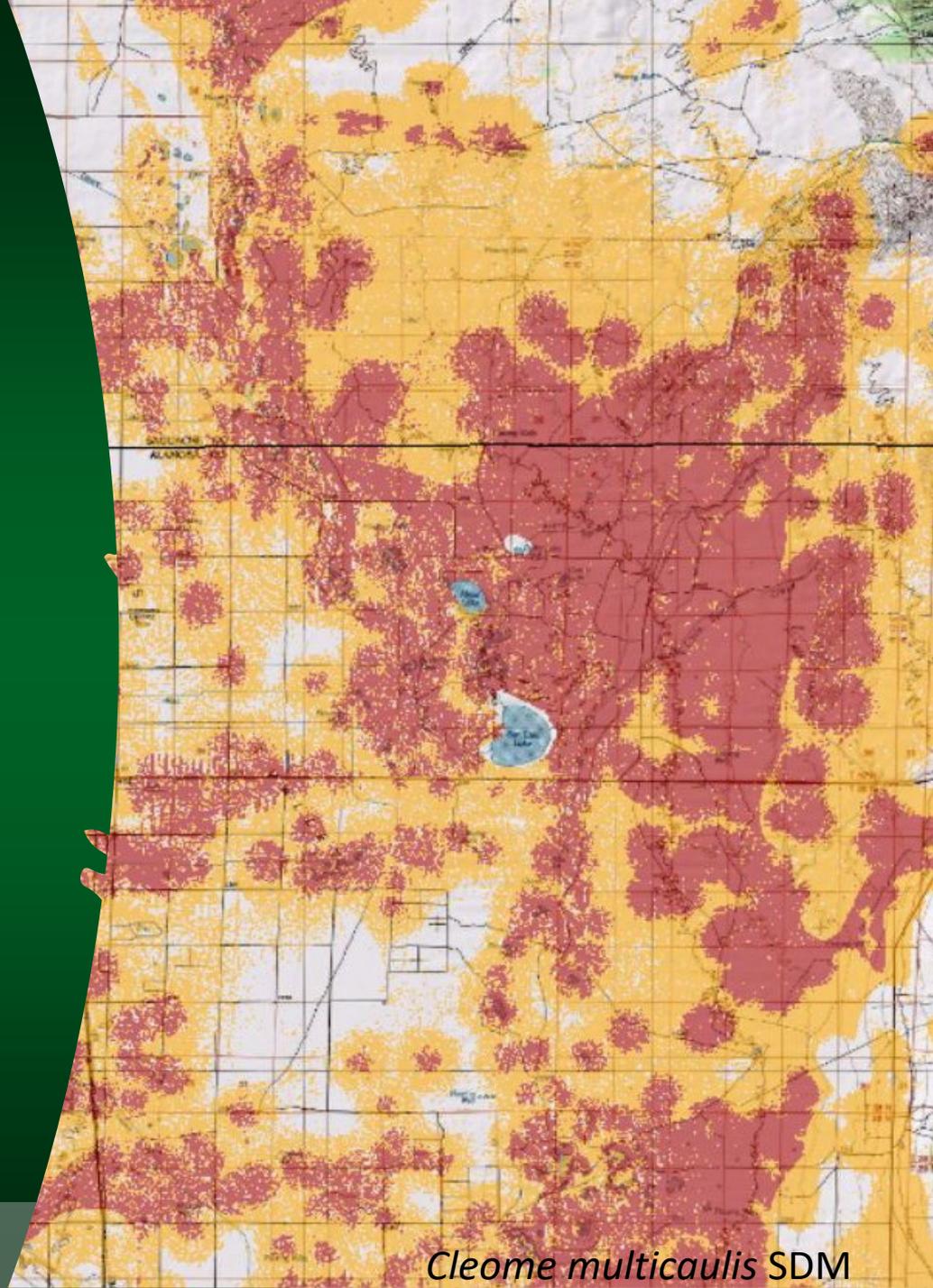


Oxybaphus rotundifolia SDM



Project Introduction

- Goal to model all PGCN
 - 45 completed in Phase I
 - 30% of PGCN previously modeled
 - Phase II will add final 33 models





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



Nuttallia densa

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

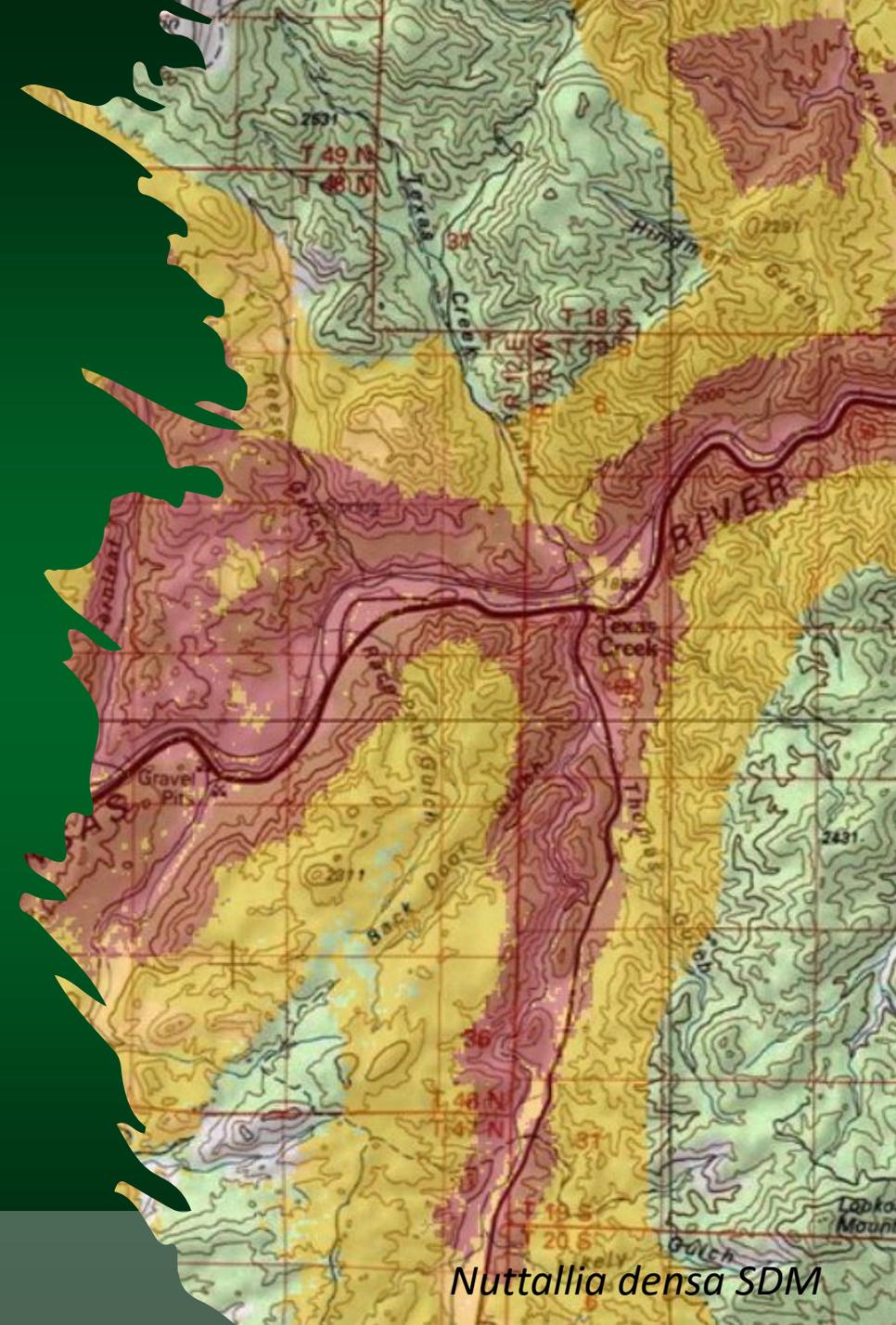


Penstemon yampaensis



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

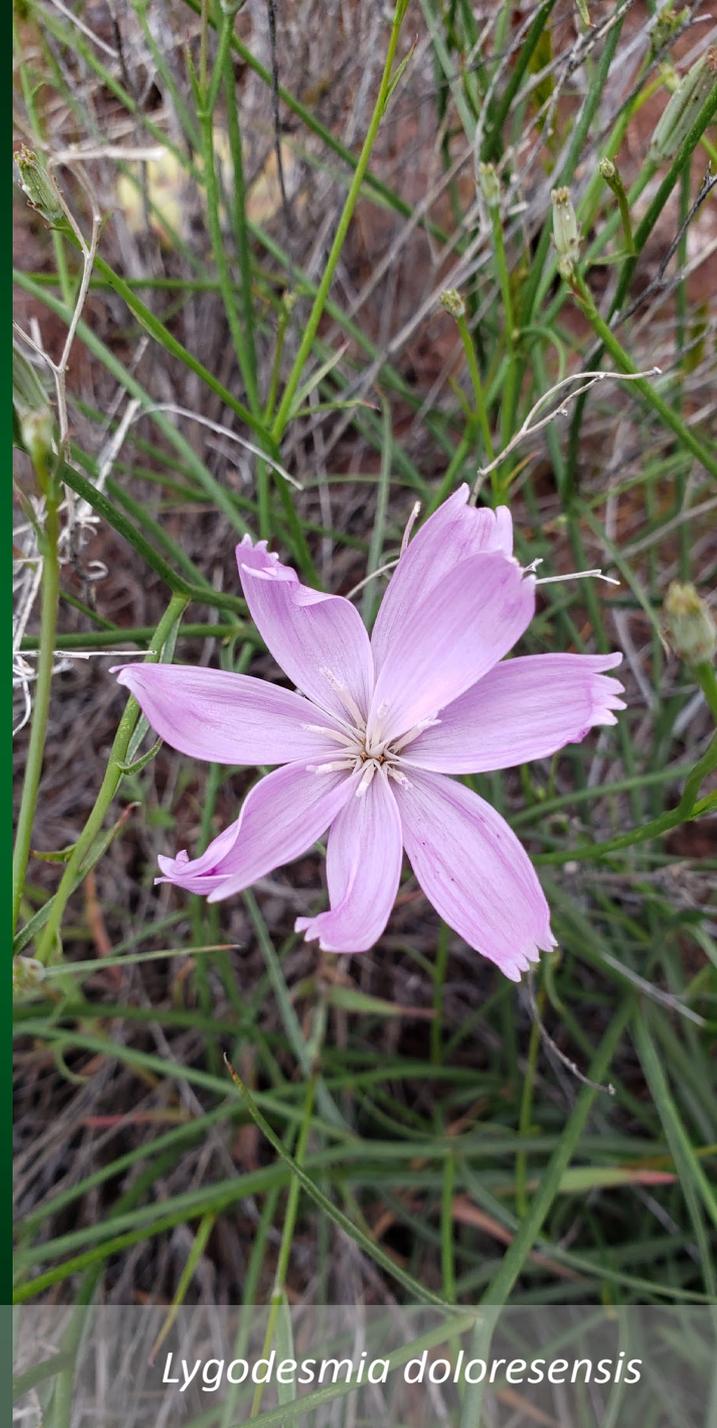
- Model imperfect
- Absence of modeled habitat does not mean the species cannot occur
- This should be a factor in planning decision
- Reviewed but not validated



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 Quadrant

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 Quadrant

Aletes humilis
Astragalus sparsiflorus
Castilleja puberula
Ipomopsis globularis
Mimulus gemmiparus
Oenothera coloradensis
Physaria bellii

Ptilagrostis porteri

Southwest Quadrant

Aliciella sedifolia
Astragalus rafaensis
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 Quadrant

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



Frasera coloradensis (Colorado green gentian), Tier 2

- 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



Oenopsis 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



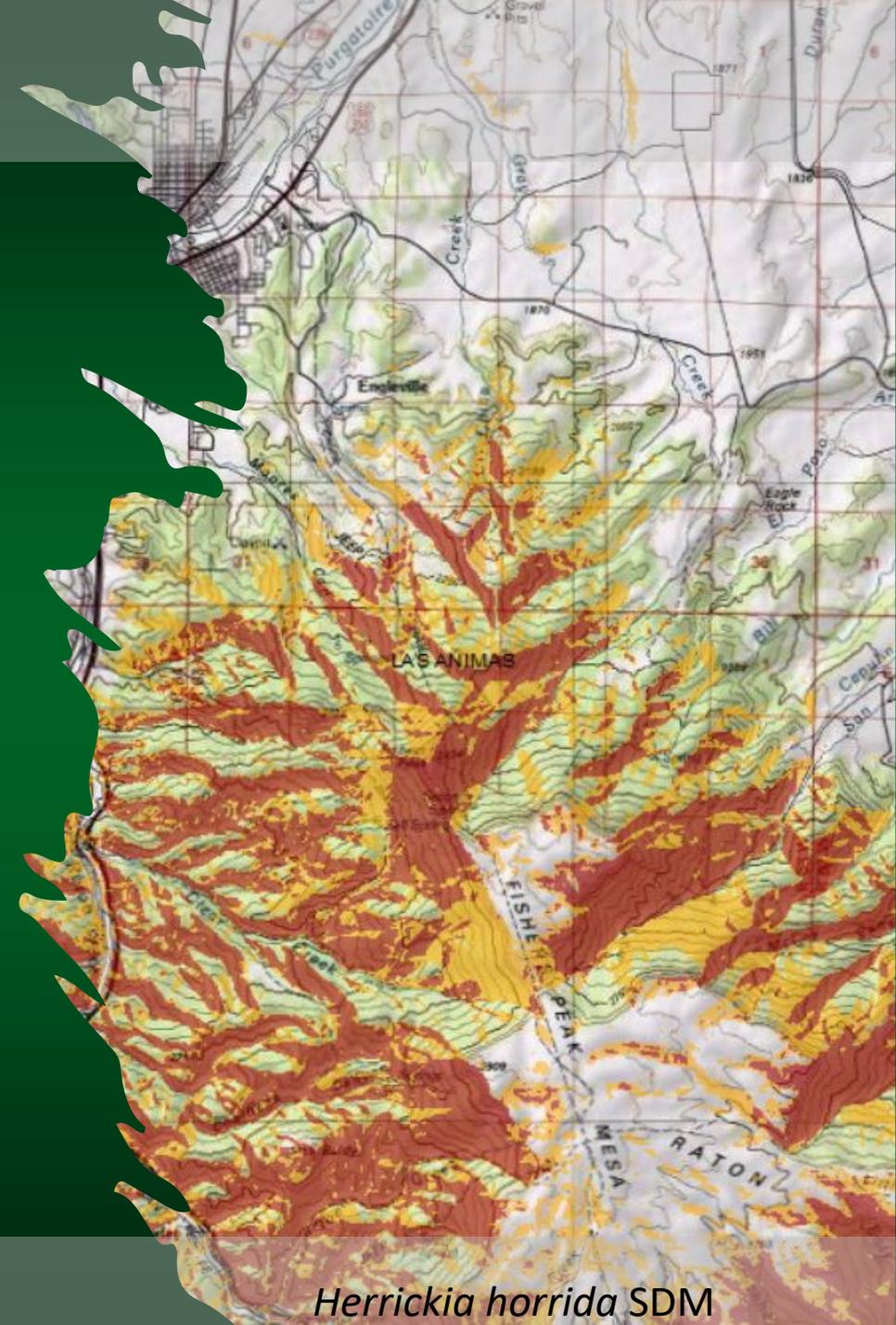
Oenopsis foliosa var. *monocephala* (Rayless goldenweed), Tier 2

- 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

