IMPORTANT PLANT AREAS
PILOT MODEL FOR THE CALIFORNIA CENTRAL VALLEY
IMPORTANT PLANT AREAS

• What are Important Plant Areas, and how are they a solution to current problems?

• How do we model Important Plant Areas?

• What are our Preliminary Results?

• Where do we go next?
Background and Context

Biodiversity is on the decline on a global scale

• Global Strategy for plant conservation first adopted in 2000
  • Called for protecting 50% of the most important areas for plant conservation
  • PlantLife International published criteria for identifying Important Plant Areas in 2002
Background and Context

California is a Global Biodiversity Hotspot

- More than 6500 taxa, approximately 25% of which are found nowhere else
- East Bay Chapter of CNPS publishes assessment of Botanical Priority Conservation Areas in 2006
- Governor’s Office issues Executive Order declaring September 7 CA Biodiversity Day, and calling for implementation of the California Biodiversity Initiative
But there are competing demands for resources...
Current Problems in California

We are losing natural communities faster than we can map and direct conservation resources to them

• This is creating a need for regional planning assessments

Botanical data are under represented in conservation data sets

• Large portions of recorded data are not available digitally or are in diffuse locations

Photo: Nick Jensen
IPAs as a Solution

- Centralization of existing data
- Digitizing and aggregating expert information at regional workshops
- Highlighting survey needs for data poor areas
- Map of conservation priority at a regional scale
- Transparent, collaborative, and stakeholder driven process
HOW DO IMPORTANT PLANT AREAS WORK?

Photo: Nancy Buck

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Important Plant Areas are:

• The areas most critical to preserving the flora of California which is under threat from changing land use and a changing climate.

• IPAs are identified by significant:
  • Rare plant populations
  • Rare vegetation communities
  • Ethnobotanical/cultural value
  • Species richness/Phylodiversity
  • Soil/Geology/other Unique Habitat features
Study Region
Environmental Evaluation Modeling System (EEMS)

- Developed by Conservation Biology Institute
- Normalized Logic Model
- Input attributes are resampled and processed to cells within a master shapefile
- Attributes are then stretched on a continuous spectrum from “False” (-1) to True (+1) based on how they contribute to conservation value
- Logic operators, weights, and thresholds allow for the combination and manipulation of normalized attributes to produce a final “heat map for Conservation
Environmental Evaluation Modeling System (EEMS)

• Assigns relative “value” score to each 1km2 cell within the modeling region

• Scores are relative to one another rather than objective

• The model is highly transparent allowing reviewers to look at weights, thresholds, and outputs at each stage in the model for informed contribution to model development

• This is an iterative process and is dependent on end-user/stakeholder participation

Photo: Jeff Bibeau
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Is (x) Attribute Important for Plant Biodiversity Conservation?

- Attributes stretched to a normalized scale between -1 and +1
  - Ex: Species Richness, Vegetation Type Cover, Etc.
- Attributes can be thresholded at critical values
  - Ex:
    - If one endangered species is present assign +1 as index value, attribute becomes a 0, 1 binary
    - If 50% of reporting unit is covered by a rare natural community assign +1 as index value, 0 to 50% coverage stretched from -1 to +1
    - If 10 or less records for native species present assign -1, 10 to maximum number of records stretched from -1 to +1
The Fishnet

A regular grid over the entire state
Produces master file for input data
Output assigns a score to each 1km² cell
Model V1

Identification of IPAs

OR: Top score between each category selected

IPA Analysis Categories

- Threatened/Rare Species IPAs
- Threatened/Rare Habitat IPAs
- Cultural Plant Areas
- Botanically Significant IPAs

Moved based on TAC rec
Model V2

Identification of IPAs

OR: Top score between each category selected

Threatened/Rare Species IPAs

Threatened/Rare Habitat IPAs

Botanically Significant IPAs
Model V3

Important Plant Areas

Set threshold

Relative Conservation Value “Heat Map”

OR: Top score between each category selected

Delineated IPAs

Delineation Threshold

Relative Conservation Index Value

Operator

Output Categories

Rare Species

Rare Vegetation and Habitat Features

Botanically Significant Areas
Model V1

Threatened/Rare Species IPAs

Weighted Union

Weighted Union of Count of unique rare/special status species within each reporting unit

Set Thresholds: 0 = FALSE; Greatest Value = TRUE

Weight = 1, 0.8

Weighted Union of unique rare/special status species SDM within each reporting unit

Set Thresholds: 0 = FALSE; Greatest Value = TRUE

Weight = 1, 0.8

CNDDB: Extirpated/ Historic Occurrences Removed

CNPS RPI

CCH/Symbiota/iNaturalist/CalFlora

All Location Data from Workshops

Modeled Range Data

Delineating threshold from output “heat map”

EEMS Normalization Parameters

Fishnet Evaluation Metric

Input Data

Weights are for CESA/FESA/List 1/List 2 plants, and List 3/List 4 Plants respectively
Threatened/Rare Species IPAs

Set Thresholds: 0 = FALSE; Greatest Value = TRUE

Weighted Union

Weight = 1, 0.5

Weighted Sum

Weight = 1, 0.8

CNDDDB: Recent/Extant Occurrences

CNDDDB: Extirpated/ Historic Occurrences

CCH/Symbiota/iNaturalist/CalFlora

All Location Data from Workshops

Modeled Range Data

Delineating threshold from output “heat map”

EEMS Normalization Parameters

Fishnet Evaluation Metric

Input Data

Weights are for CESA/FESA/List 1/List 2 plants, and List 3/List 4 Plants respectively
Model V3

Rare Species

Weighted Union

Set Thresholds: 0 = FALSE; 1 = TRUE

Weighted Sum
Species Richness: Recent Presumed Extant Occurrences

Set Thresholds: 0 = FALSE; 1 = TRUE

Weighted Sum
Species Richness: Historic Presumed Extant Occurrences

Set Thresholds: 0 = FALSE; 1 = TRUE

Weighted Sum
Species Richness: Exirpated Occurrences

Set Thresholds: 0 = FALSE; 1 = TRUE

Sum
Species Richness: Occurrences for species presumed to be extinct

Set Thresholds: 0 = FALSE; 24 = TRUE

Weighted Sum
Modeled Range Data
Occurrence Data

**California Natural Diversity Database – May 2019 Download. Will be updated in next iteration**
- Removed occurrences with less than .25mi accuracy

**California Consortium of Herbaria – February 2019 extraction from CCH database**
- Added 0.25mi buffer to points to standardize accuracy

**Calflora**
- Includes “research grade” iNaturalist records which Calflora imports
- Some spatial data does not export from CalFlora – specifically regional checklist information which contains observation locations.
- Added 0.25mi buffer to standardize accuracy

**Workshop Input**
- New and updated occurrence information provided at 2017 expert workshop in Bakersfield, CA.
Occurrence Data

• All occurrence data is joined with CNPS Rare Plant Inventory export tables to standardize nomenclature and assign appropriate rare plant rank if applicable

• Separated extirpated and possibly extirpated occurrences as independent input

• Separated occurrences older than 20 years as independent input

• Separated occurrences from within the last 20 years as independent input

• Separated occurrences for species thought to be extinct in California

• Combined count of unique species in each as measure of species richness
Species Distribution Models

- Thornhill et al., 2017 (https://dash.berkeley.edu/stash/dataset/doi:10.6078/D1QQ2S) species distribution models for over 5,000 species in California

- Special status species copied to subfolder using custom .bat file and aggregated by Rare Plant Rank:
  - 1A – Species presumed to be extinct
  - 2A – Species presumed to be extinct in California, but are still present elsewhere
  - 1B – Rare, threatened, or endangered in California and elsewhere
  - 2B – Rare, threatened, or endangered in California, but more common elsewhere
  - 3 – plants which have little data available (review list)
  - 4 – plants of limited distribution (watch list) (https://www.cnps.org/rare-plants/cnps-inventory-of-rare-plants)

- Used sum of continuous MaxEnt score for all species modeled in each California Rare Plant Rank List.
Model V1

Threatened/Rare Habitat IPAs

VegCAMP/CalVeg /other land cover datasets
Set Thresholds: 0 = FALSE; Mean = TRUE

CNDDB Rare Natural Communities: Extirpated/ Historic Occurrences Removed
Set Thresholds: 0 = FALSE; 1 = TRUE

OR: maximum proportion of coverage index in the reporting unit
Set Thresholds: 0 = FALSE; 1 = TRUE

All Location Data from Workshops

Weighted Union
Weight = 0.75

Weight = 1, 0.8 S1/S2 and S3 respectively

Selected Union: Average of top two values
Set Thresholds: 0 = FALSE; 1 = TRUE

Selected Union: Average of top three values
Set Thresholds: 0 = FALSE; 1 = TRUE

Weight = 0.5

Selected Union: Poorly Drained Soils
Set Thresholds: 0 = FALSE; 1 = TRUE

Weight = 0.5

Selected Union: Wetlands/Vernal Pools
Set Thresholds: 0 = FALSE; 1 = TRUE

Weight = 0.5

Selected Union: Serpentine, Saline/Sodic/Alkali, Volcanic, Sand, Carbonate soils/Geology
Set Thresholds: 0 = FALSE; 1 = TRUE
Model V2

Threatened/Rare Habitat IPAs

Set Thresholds: 0 = FALSE; 1 = TRUE

Selected Union: Average of top three values

Set Thresholds: 0 = FALSE; 1 = TRUE

Selected Union: Average of top two values

Set Thresholds: 0 = FALSE; 1 = TRUE

Selected Union: Average of top one value

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VegCAMP/CalVeg /other land cover datasets

Set Thresholds: 0 = FALSE; Mean = TRUE

CNDDDB Rare Natural Communities: Extirpated/ Historic Occurrences Removed

Set Thresholds: 0 = FALSE; 1 = TRUE

All Location Data from Workshops

OR: maximum proportion of coverage index in the reporting unit

Set Thresholds: 0 = FALSE; 1 = TRUE

OR: maximum proportion of coverage index in the reporting unit

Set Thresholds: 0 = FALSE; 1 = TRUE

OR: maximum proportion of coverage index in the reporting unit

Set Thresholds: 0 = FALSE; 1 = TRUE

Serpentine, Saline/Sodic/Alkali, Volcanic, Sand, Carbonate soils/Geology

Set Thresholds: 0 = FALSE; 1 = TRUE

Poorly Drained Soils

Wetlands/Vernal Pools
Model V3

Rare Vegetation and Habitat Types

Selected Union: Average of top two values

OR: maximum normalized index value in the reporting unit

Selected Union: Average of top three values

Set Thresholds: 0 = FALSE; MEAN = TRUE

USFWS Critical Habitat

Workshop Rare Vegetation Data

Set Thresholds: 0 = FALSE; MEAN = TRUE

USGS: CA Geology

Set Thresholds: 0 = FALSE; MEAN = TRUE

SSURGO: Serpentine, Saline/Sodic/Alkali, Volcanic, Sand, and Carbonate soils

VegCAMP: Riparian Cover

Weighted Union

OR: maximum normalized index value in the reporting unit

Set Thresholds: 0 = FALSE; MEAN = TRUE (vegCAMP), 2 = TRUE (CNDDB RNC)

S1 and S2 Vegetation Type Cover: VegCAMP or CNDDB RNC

Set Thresholds: 0 = FALSE; MEAN = TRUE (vegCAMP), 2 = TRUE (CNDDB RNC)

S3 and Other Rare Vegetation Type Cover: VegCAMP or CNDDB RNC

USFWS Central Valley Vernal Pools Cover, CDFW BIOS Wetlands Cover, SSURGO Poorly Drained Soil Cover

SSURGO: Serpentine, Saline/Sodic/Alkali, Volcanic, Sand, and Carbonate soils

VegCAMP: Riparian Cover
Vegetation

**VegCAMP Great Valley Vegetation Dataset**
- Extracted “rare” polygons
- Categorized by S1 – S3 or unlabeled
- Extracted Riparian polygons

**CNDDDB Rare Natural Communities – May 2018**
- Removed all extirpated or possibly extirpated occurrences
- Categorized by S1 – S3

**Workshop Data**
- Rare vegetation type occurrence data gathered at the South San Joaquin Workshop in 2017

Protected Habitat

**USFWS Critical Habitat**
- Extracted critical habitat polygons for plant species in California
Wetlands and Vernal Pools

California Wetlands Shapefile From BIOS

Central Valley Vernal Pools Data from USFWS study

Soils

SSURGO Map Unit Soil Survey Data
- Alkaline/Alkali, Saline, Sodic, Calcareous, Serpentine/Mafic, MetaVolcanic, and Sand/Dune soils
- Poorly Drained Soils as indication of wetlands

Geology

USGS map of California geology
- Mafic, meta volcanic, and calcareous rock types

All data intersected with 1km2 fishnet, and area per 1km2 reporting unit used as input metric.
Botanically Significant IPAs

Delineating threshold from output “heat map”

EEMS Function

EEMS Normalization Parameters

Fishnet Evaluation Metrics

Weight = 0.8
Set Thresholds: Least Value = FALSE; Greatest Value = TRUE

Weight = 0.75
Set Thresholds: 0 = FALSE; 1 = TRUE

Workshop Input

Weight = 1

Modeled Native Species Richness

Weight = 0.5

High native species richness from Baldwin data

Phylodiversity/Phyloendemism (Survival Time)

Weight = 0.5

Union of topographic features

Set Thresholds: Least Value = FALSE; Greatest Value = TRUE

Aspect Variability

Relative Relief

Slope Variability

Input Data
Botanically Significant IPAs

Delineating threshold from output “heat map”

EEMS Function

EEMS Normalization Parameters

Fishnet Evaluation Metrics

Input Data

**Set Thresholds:** Least Value = FALSE; Greatest Value = TRUE

**Weight**

- 0.8
- 1
- 0.5

**Workshop Input**

- Modeled Native Species Richness
- High native species richness from Baldwin data
- Phylodiversity/Phyloendemism (Survival Time)

**AdaptWest LandFacets**
**Model V3**

**Botanically Significant Areas**

- **Union**
  - **OR:** maximum proportion of coverage index in the reporting unit

- **Set Thresholds:**
  - $0 = \text{FALSE}; \ \text{MEAN} = \text{TRUE}$
  - $0 = \text{FALSE}; \ 1 = \text{TRUE}$
  - $0 = \text{FALSE}; \ 175 = \text{TRUE}$
  - $0 = \text{FALSE}; \ 36 = \text{TRUE}$
  - $0 = \text{FALSE}; \ 1 = \text{TRUE}$

- **AdaptWest: Western North America Land Facets**
- **Lineage survival time**
- **Workshop Botanically Significant Areas**
- **Species Distribution Models**
- **Native Species Herbarium Record Data**
- **Workshop Cultural/ Ethnobotanically Significant Areas**
Species richness

  - Full composite for all species
- Occurrence Data

Phylodiversity

- Lineage survival time dataset from Kling et al. (2018) (https://bnhm-shiny.berkeley.edu/cappa/)

Workshop Data

- Botanically significant location data gathered at the South San Joaquin Workshop in 2017
Topfacets

- Elevation diversity
- HLI
- LandForm
- Soil Order

Ethnobotanical Value

- Workshop input from indigenous members (expected for other workshops; no indigenous representation was present at the 2017 Bakersfield workshop)
- Cultural value in this workshop included wildflower viewing
PRELIMINARY RESULTS

Photo: Nancy Buck
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1. Sacramento National Wildlife Refuge
2. Butte Sink Wetlands
3. East Sacramento Valley Vernal Pool Complexes
4. Travis Air Force Base Vernal Pools
5. San Luis National Wildlife Refuge, Merced National Wildlife Refuge, and Mud Slough Wetlands
6. Merced Vernal Pools Complexes
7. Mendota Waterfowl Management Area
8. Pixley National Wildlife Refuge, Kern National Wildlife Refuge, and South San Joaquin Vernal Pool Complexes
9. Southwest San Joaquin Valley Edge
10. Tejon Ranch Wildflower Fields

cnps.org
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Model V3 Results

1. Sacramento National Wildlife Refuge
2. Butte Sink Wetlands
3. East Sacramento Valley Vernal Pool Complexes
4. Travis Air Force Base Vernal Pools
5. San Luis National Wildlife Refuge, Merced National Wildlife Refuge, and Mud Slough Wetlands
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Remaining natural habitats in the California Central Valley are highly valuable for regional biodiversity conservation.

- Model consistently identified similar areas as high or highest relative conservation value across all three versions despite differences in input metrics and operators.
- These consistently aligned with remaining natural habitat in the central valley.
- Many of these areas are already have some form of protected status with the exception of the southeastern valley edge – possible conservation opportunity?
Important Plant Areas uses:

• A map of conservation priority

• A decision support tool for land managers

• A lever for conservation advocacy

• A transparent method for agencies to allocate limited conservation resources most efficiently
Next Steps

1) Broader stakeholder engagement and additional model iteration

2) Replication of process for the rest of California’s Ecoregions
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