Post-fire Restoration Prioritization Tool for Chaparral Shrublands

Example of running tool with annotated outputs for the Copper fire (2002)
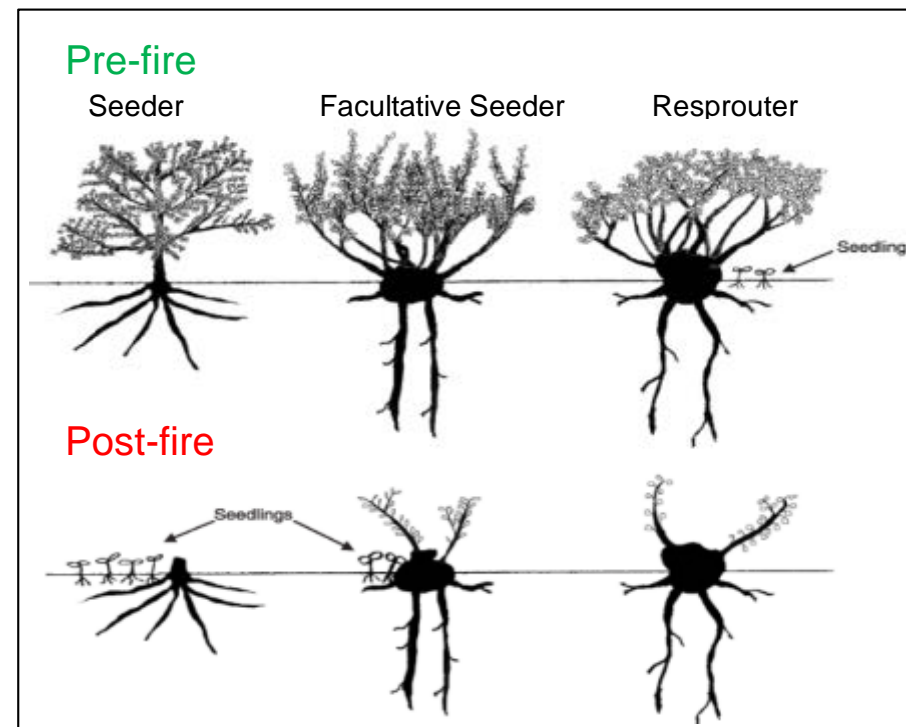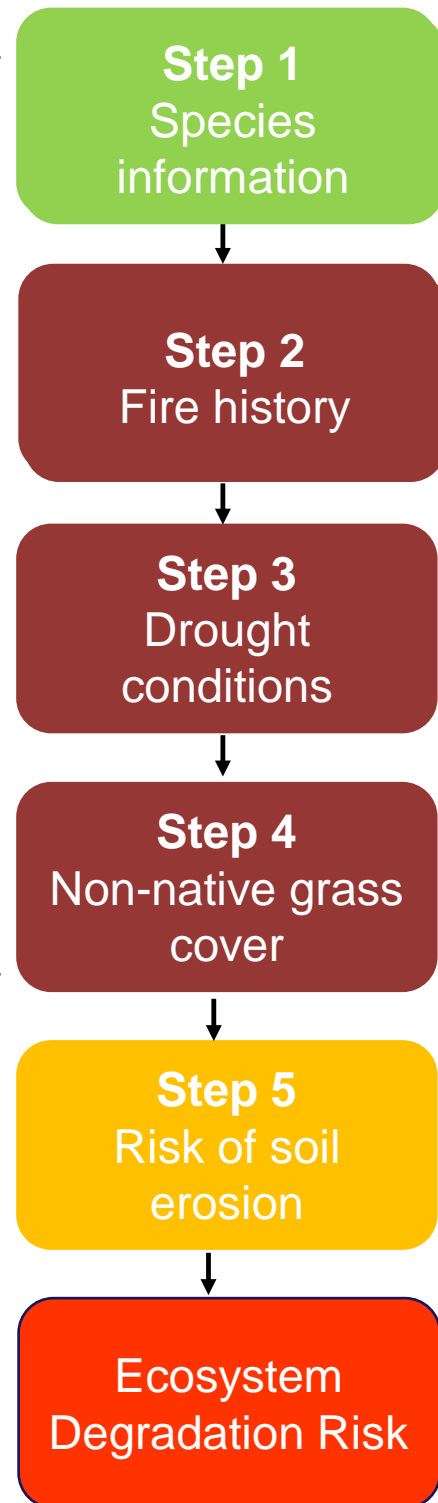
Objectives of Tool

1. Assess regeneration ability of landscape post-fire

2. Predict areas of degradation on the landscape

3. Identify priorities for restoration

4. Inform species for restoration

Please read the Technical Guide to fully understand this example of running the Post-fire Restoration Prioritization (PReP) Tool for the Copper fire (2002)

Indicates ability of landscape to recover post-fire

Step 1 Species information

Step 2 Fire history

Step 3 Drought conditions

Step 4 Non-native grass cover

Step 5 Risk of soil erosion

Ecosystem Degradation Risk

Pre-fire
Seeder Facultative Seeder Resprouter
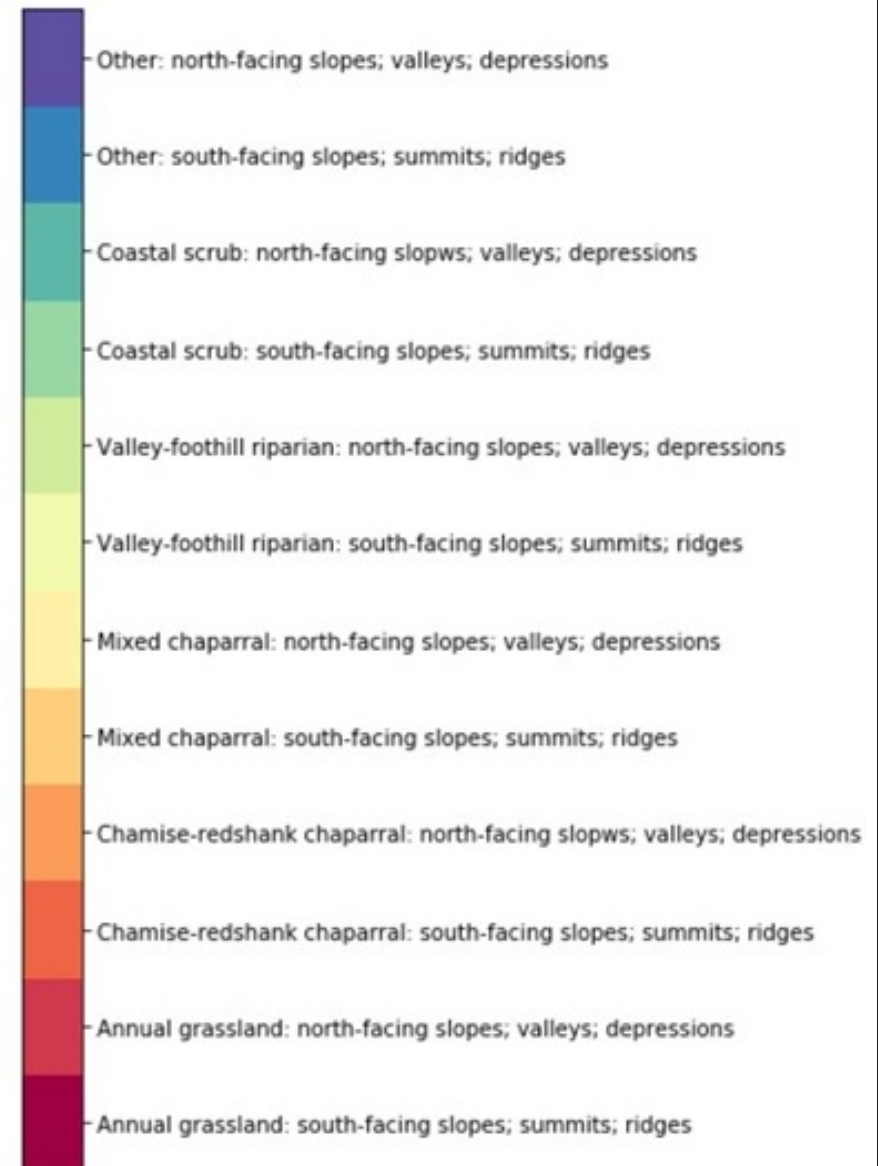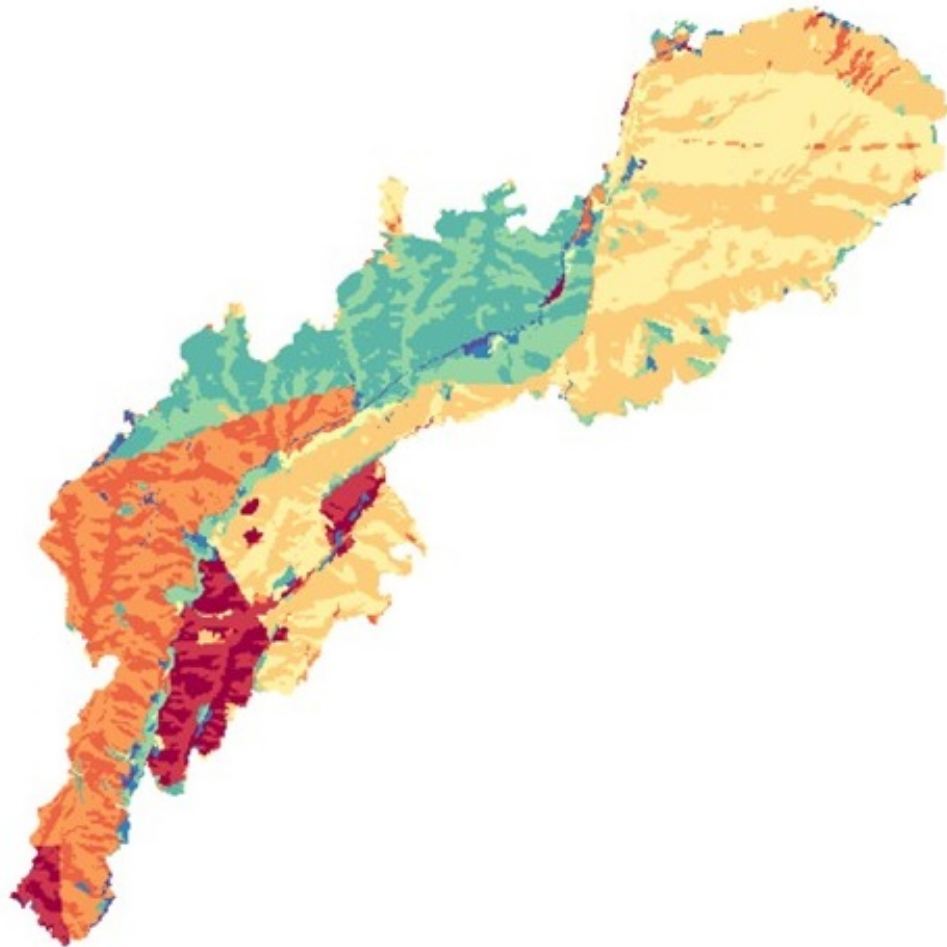Seedlings

Post-fire
Seedlings

Step 1. Determine Post-fire Expected Regeneration Rate

Assign pre-fire proportion of resprouters and facultative seeders

Landscape units ○ Use WHR veg types only
                 ● Use WHR veg types x aspect x topography

Landscape Units
WHR veg type x Topo x Aspect

Color legend (top to bottom):
- Other: north-facing slopes; valleys; depressions
- Other: south-facing slopes; summits; ridges
- Coastal scrub: north-facing slopws; valleys; depressions
- Coastal scrub: south-facing slopes; summits; ridges
- Valley-foothill riparian: north-facing slopes; valleys; depressions
- Valley-foothill riparian: south-facing slopes; summits; ridges
- Mixed chaparral: north-facing slopes; valleys; depressions
- Mixed chaparral: south-facing slopes; summits; ridges
- Chamise-redshank chaparral: north-facing slopws; valleys; depressions
- Chamise-redshank chaparral: south-facing slopes; summits; ridges
- Annual grassland: north-facing slopes; valleys; depressions
- Annual grassland: south-facing slopes; summits; ridges

These categories can be updated with local knowledge and field work, e.g., coastal scrub is likely misclassified in the WHR vegetation map

**Select the proportion of resprouters in each class**

AGS: south-facing slopes; summits; ridges	0-10%
AGS: north-facing slopes; valleys; depressions	0-10%
CRC: south-facing slopes; summits; ridges	10-40%
CRC: north-facing slopes; valleys; depressions	10-40%
MCH: south-facing slopes; summits; ridges	40-100%
MCH: north-facing slopes; valleys; depressions	40-100%
VRI: south-facing slopes; summits; ridges	N/A
VRI: north-facing slopes; valleys; depressions	N/A
CSC: south-facing slopes; summits; ridges	40-100%
CSC: north-facing slopes; valleys; depressions	40-100%
Other: north-facing slopes; valleys; depressions	N/A
Other: south-facing slopes; summits; ridges	N/A

Table 1. Assignment of scores based on regeneration rate determined based on the relative proportion of resprouting and facultative seeding post-fire reproductive strategies: R = resprouter species, FS = facultative seeder species

Regeneration rate			
High (≥40% R or FS)	Moderate (10-40% R or FS)	Low (<10% R or FS)	No data
High (5 points)	Moderate (3 points)	Low (1 point)	No data

OUTPUT MAP 1: Expected regeneration based on proportion of sprouters and facultative seeders in landscape unit

High Regen. Capacity

Moderate

Low Regen. Capacity
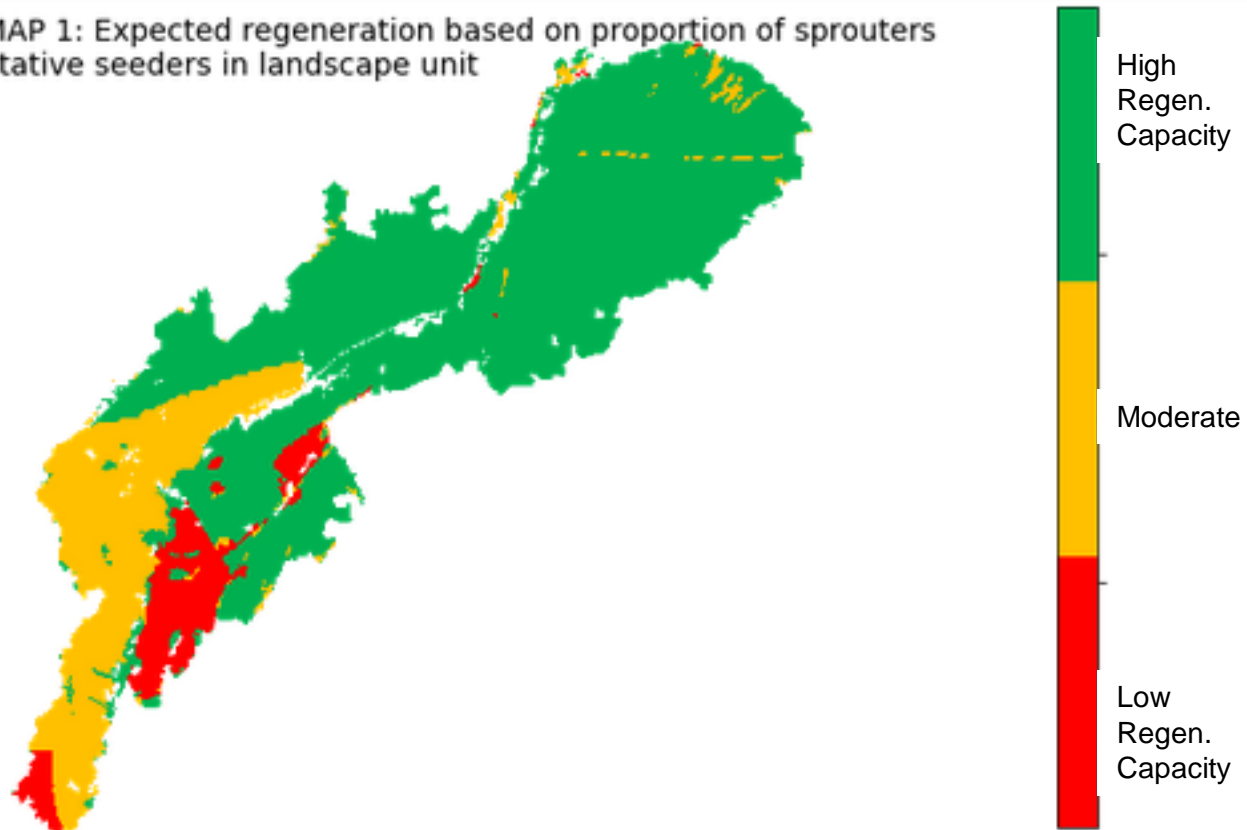
Download output d...

Step 2. Modify Regeneration Rate Based on Fire History

Task A. Specify number of fires in previous 40 years

> The modification of scoring based on the number of fires in last 40 years is applied to both resprouter, facultative seeder, and obligate seeder dominated pixels
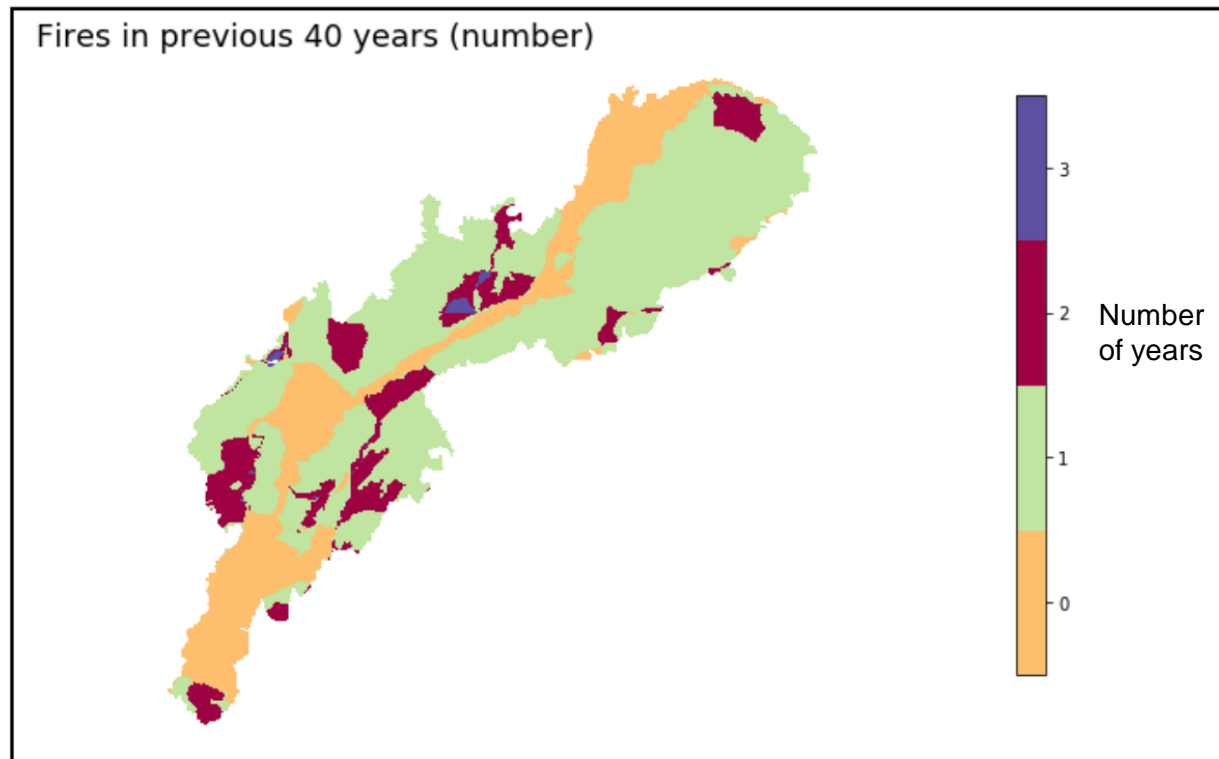

Fires in previous 40 years (number)

Number of years

Table 2. Modification of regeneration rate score based on number of fires in last 40 years in each pixel

	Number of fires last 40 years			
	1	2	3	>3
All regen. rates	no change	no change	reduce 1 class	reduce 2 classes

Task B. Specify time since last fire

The modification of scoring based on the time since last fire is applied to pixels dominated by resprouters and facultative seeders
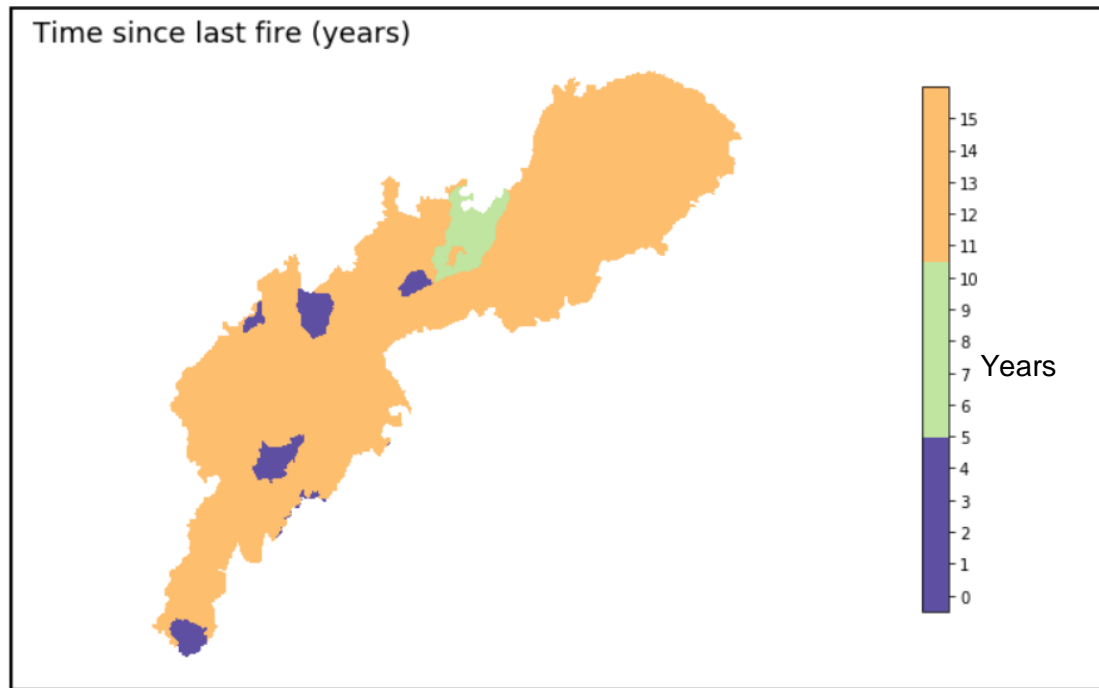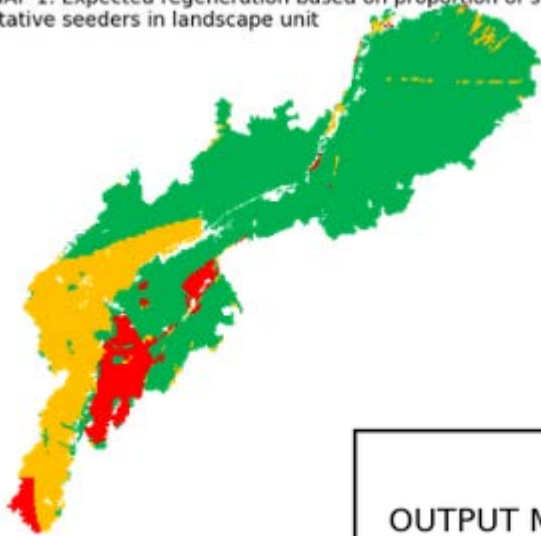

Table 3. Modification of regeneration rate score based on time since last fire. This modification is only applied to pixels with low regeneration rates (<10% resprouters or facultative seeders, i.e., 10-90% obligate seeders)

|	Time since last fire		
	0-5 years	5-10 years	≥10 years
Low regen. rate (<10% R or FS)	reduce 2 classes	reduce 1 class	no change

OUTPUT MAP 1: Expected regeneration based on proportion of sprouters and facultative seeders in landscape unit

OUTPUT MAP 2: Expected regeneration modified by fire history

Time since last fire was 0-5 years ago, so score reduced

No. of fires in last 40 years was 3, so score reduced

High Regen. Capacity

Moderate-High

Moderate

Moderate-Low

Low Regen. Capacity
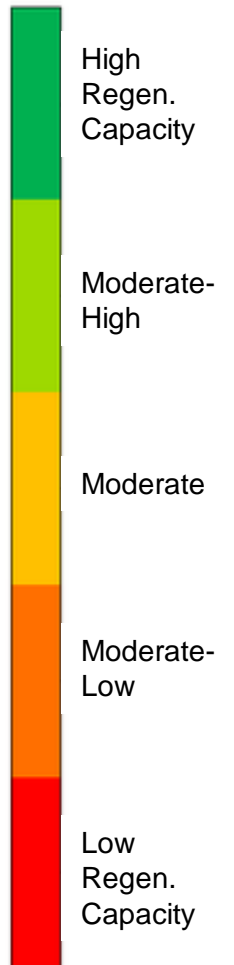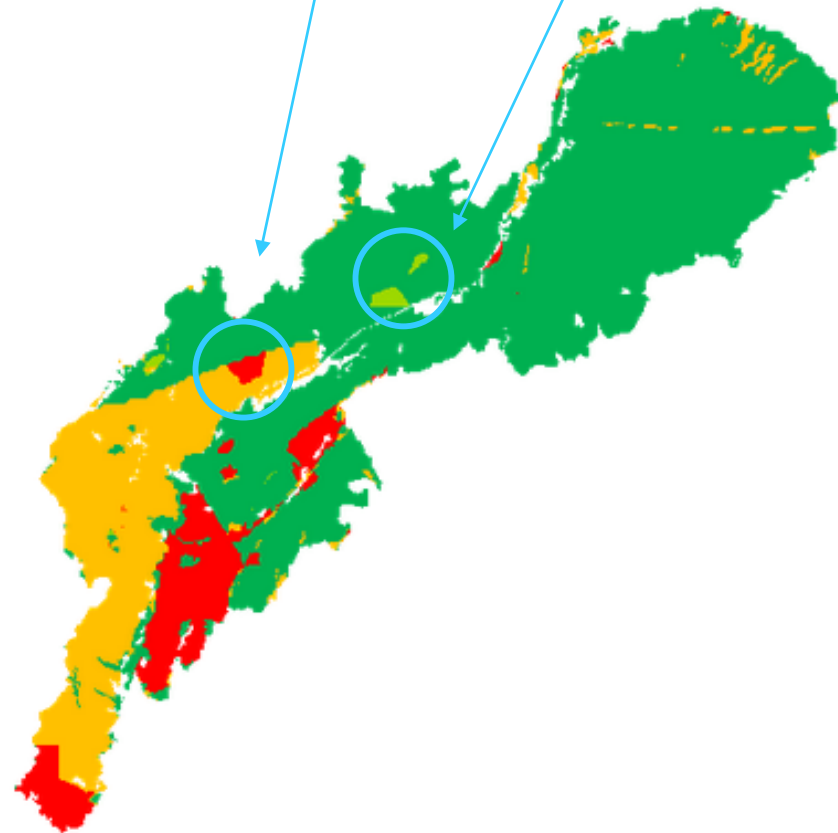
Step 3. Modify Regeneration Rate Based on Drought

Task A. Specify drought or non-drought conditions pre-fire

The modification of scoring affects pixels dominated by resprouters and facultative seeders

Link to: NOAA Palmer Drought Severity Index website and enter the 'start month' (November before the fire start data) and the 'end year' and 'end month' (May before the fire start date). Record the number of months that the South Coast ecoregion is shown as 'severe' (<-3PDSI)or 'extreme' (<-4 PDSI). Where this is four or more months during the growing season then the score of pixels dominated by resprouting species is reduced.

Number of months in previous growing s…   4

Table 4. Modification of regeneration rate score in pixels with ≥ 40% resprouter or facultative seeders, based on occurrence of severe or extreme drought in four of the seven months of the growing season (November to May) before the fire

	Regeneration rate
	High (≥40% R or FS)
Year pre-fire	reduce by 1 class

Task B. Specify drought or non-drought conditions post-fire

The modification of scoring affects all pixels

Link to: NOAA Palmer Drought Severity Index website and enter the 'start year' and 'start month' (the first November after the fire start date) and the 'end year' and 'end month' (following May). Record the number of months that the South Coast ecoregion is shown as 'severe' (<-3PDSI)or 'extreme' (<-4 PDSI). Repeat this query for post-fire year 2

No. of years post-fire drought d...   2
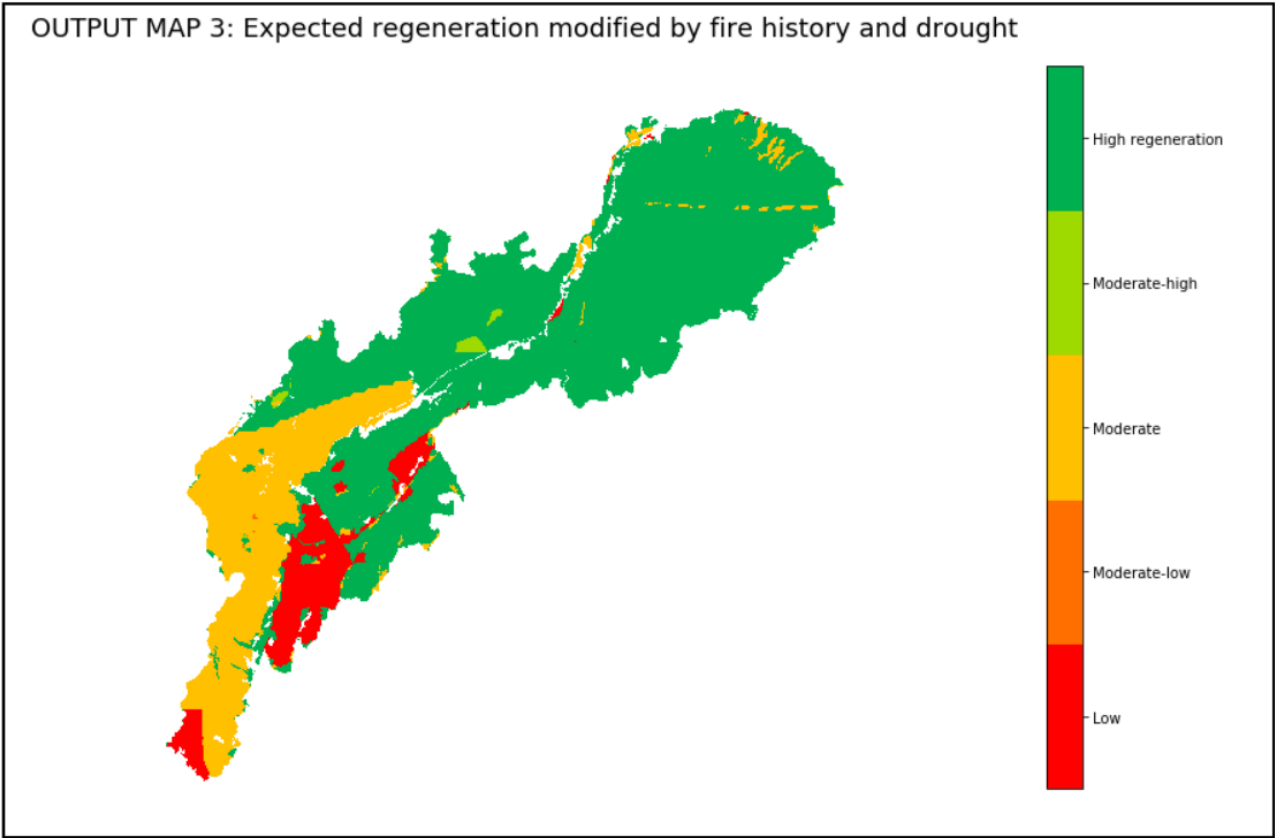
Post-fire year 1: Number of months   3

Post-fire year 2: Number of months   1

Task C. Specify if fire occurs in wet season or dry season

Modification of scoring affects pixels dominated by obligate seeders. No change is occurs here as the Copper fire was in June 2002

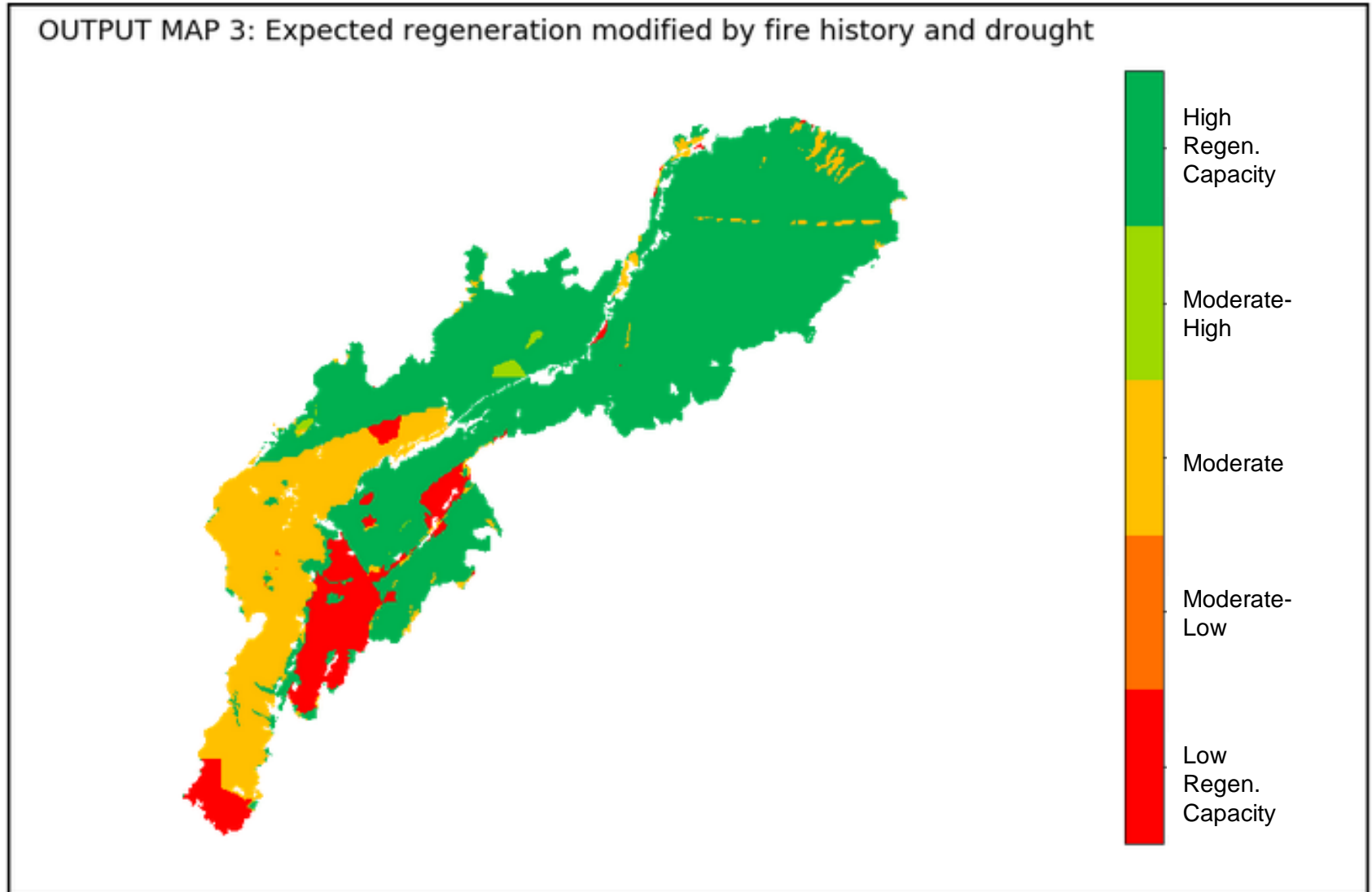Table 6. Modification of regeneration rate score in pixels with 10-40% and <10% resprouter or facultative seeders, based on occurrence of fire in the wet season

	Regeneration rate
	Moderate (10-40% R or FS) or Low (<10% R or FS)
Wet season fire	reduce by 1 class

OUTPUT MAP 3: Expected regeneration modified by fire history and drought

High regeneration

Moderate-high

Moderate

Moderate-low

Low

OUTPUT MAP 3: Expected regeneration modified by fire history and drought

There is no change in this map compared to Output Map 2, since there is no pre- or post-fire drought in 2002 and it was not a wet season fire

Legend:
- High Regen. Capacity
- Moderate-High
- Moderate
- Moderate-Low
- Low Regen. Capacity

Download output d…

Step 4. Modify Regeneration Rate Based on Non-Native Grasses

Specify abundance on non-native grasses

Data on non-native grasses developed by Park et al. (2018) was funded by the Angeles National Forest
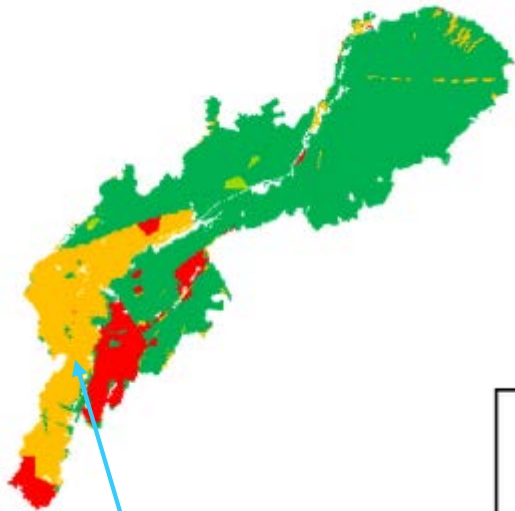

Percent cover of non-native grasses

- Above threshold

- Below threshold

(default=0.2)
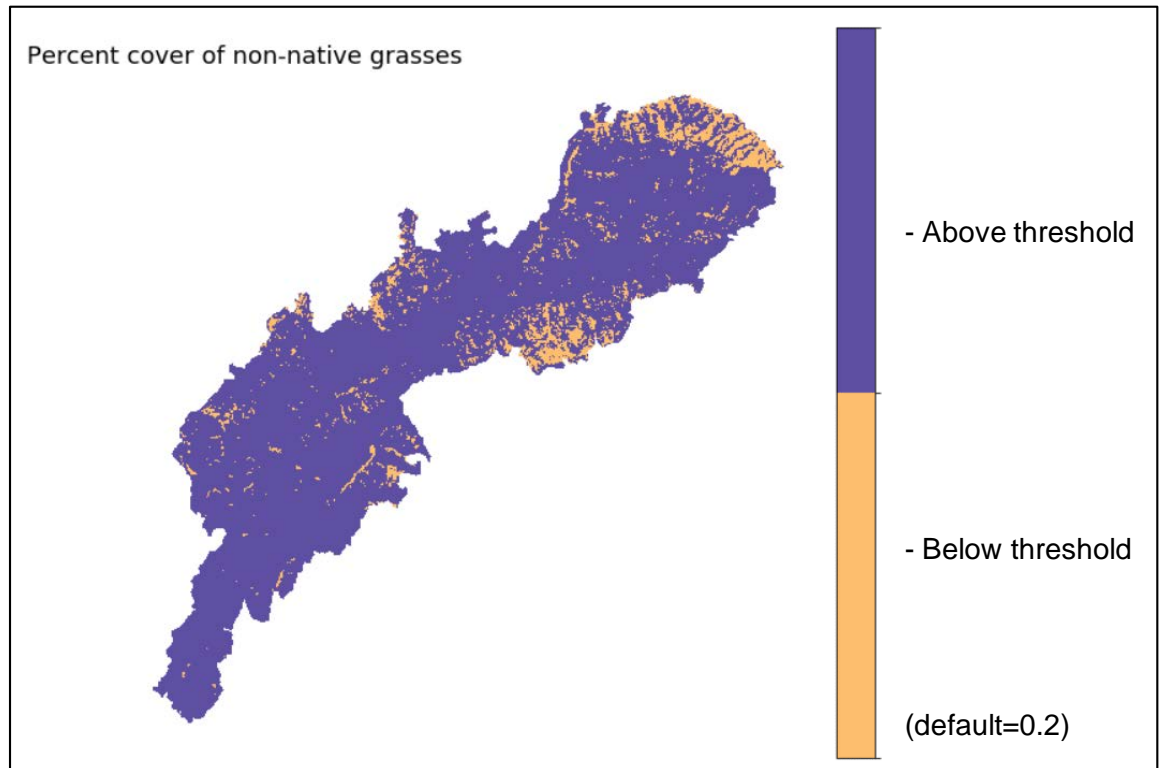
Enter % threshold of herbaceou...   20

Table 7. Modification of regeneration rate score based on % cover of non-native grasses in each pixel

		Non-native grasses threshold (%)	
		below	above
Regen. rate	≥40% R or FS	no change	no change
	10-40% R or FS	no change	reduce 1 class
	<10% R or FS	no change	reduce 1 class

OUTPUT MAP 3: Expected regeneration modified by fire history and drought

OUTPUT MAP 4: Expected regeneration modified by fire history, drought and non-native grasses

Pixels in this obligate seeder dominated class, are reduced by one class owing to the cover of non-native grasses being above the 20% threshold (moving from 'moderate' to 'moderate low' regeneration capacity)

High Regen. Capacity

Moderate-High

Moderate

Moderate-Low

Low Regen. Capacity

Step 1
Species information

Step 2
Fire history

Step 3
Drought conditions

Step 4
Non-native grass cover

Step 5
Risk of soil erosion

Ecosystem Degradation Risk

OUTPUT MAP 4: Expected regeneration modified by fire history, drought and non-native grasses

High Regen. Capacity

Moderate-High

Moderate

Moderate-Low
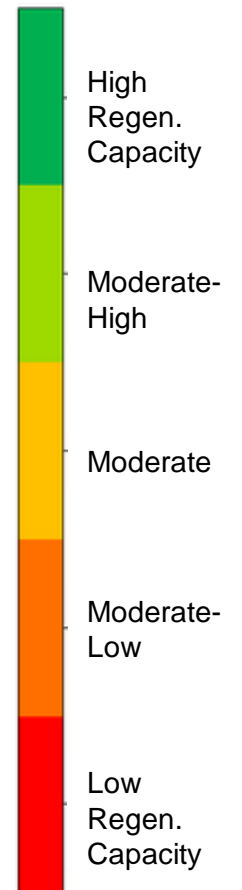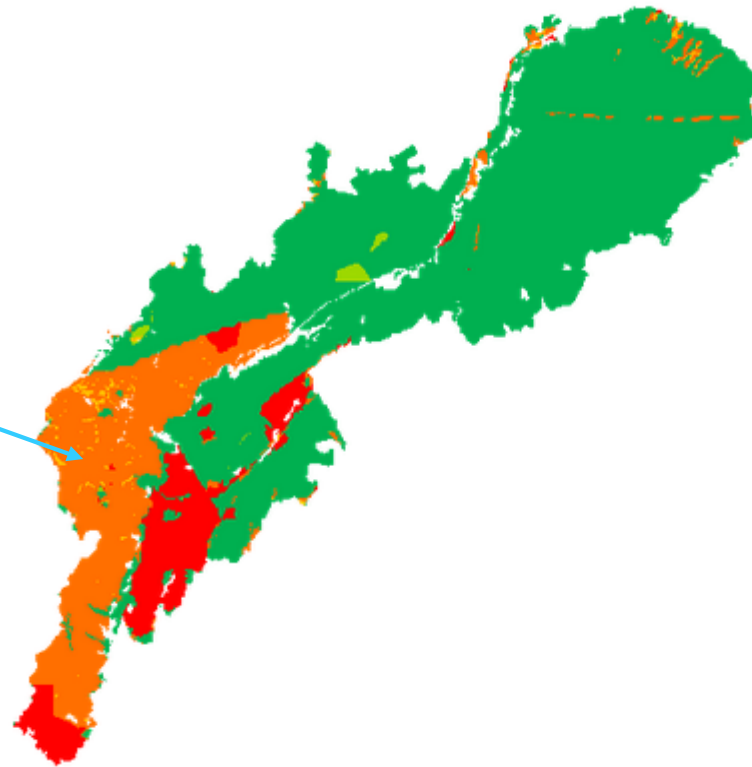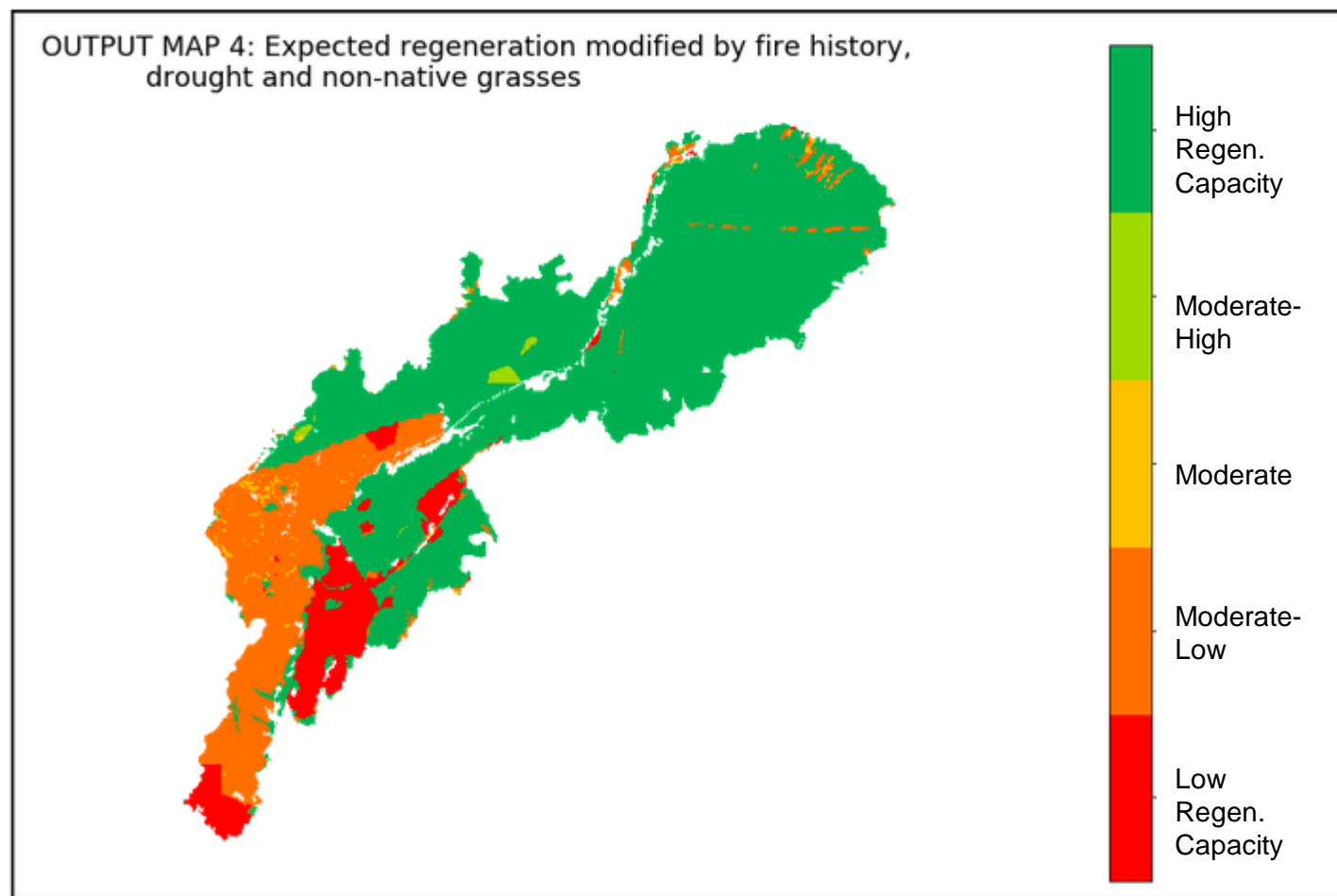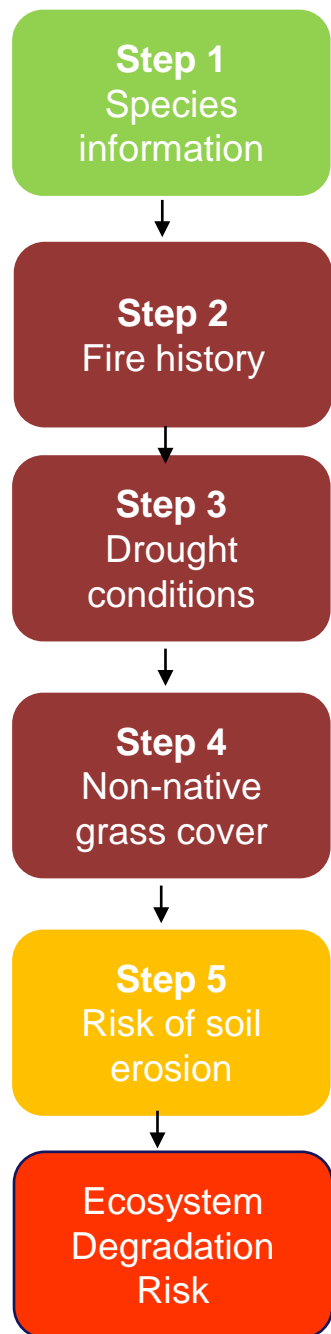
Low Regen. Capacity

Download output d...

Output Map 4 indicates the ability of the Copper fire to recover post-fire, based on the regeneration capacity of the species and accounting for fire history, drought, and non-native species in each pixel

Step 5. Integrate Erosion Risk

The loss of vegetation cover post-fire increases the risk of erosion. This sediment erosion risk data are from the BAER assessment

Sediment erosion risk classes

>100 tons/ha
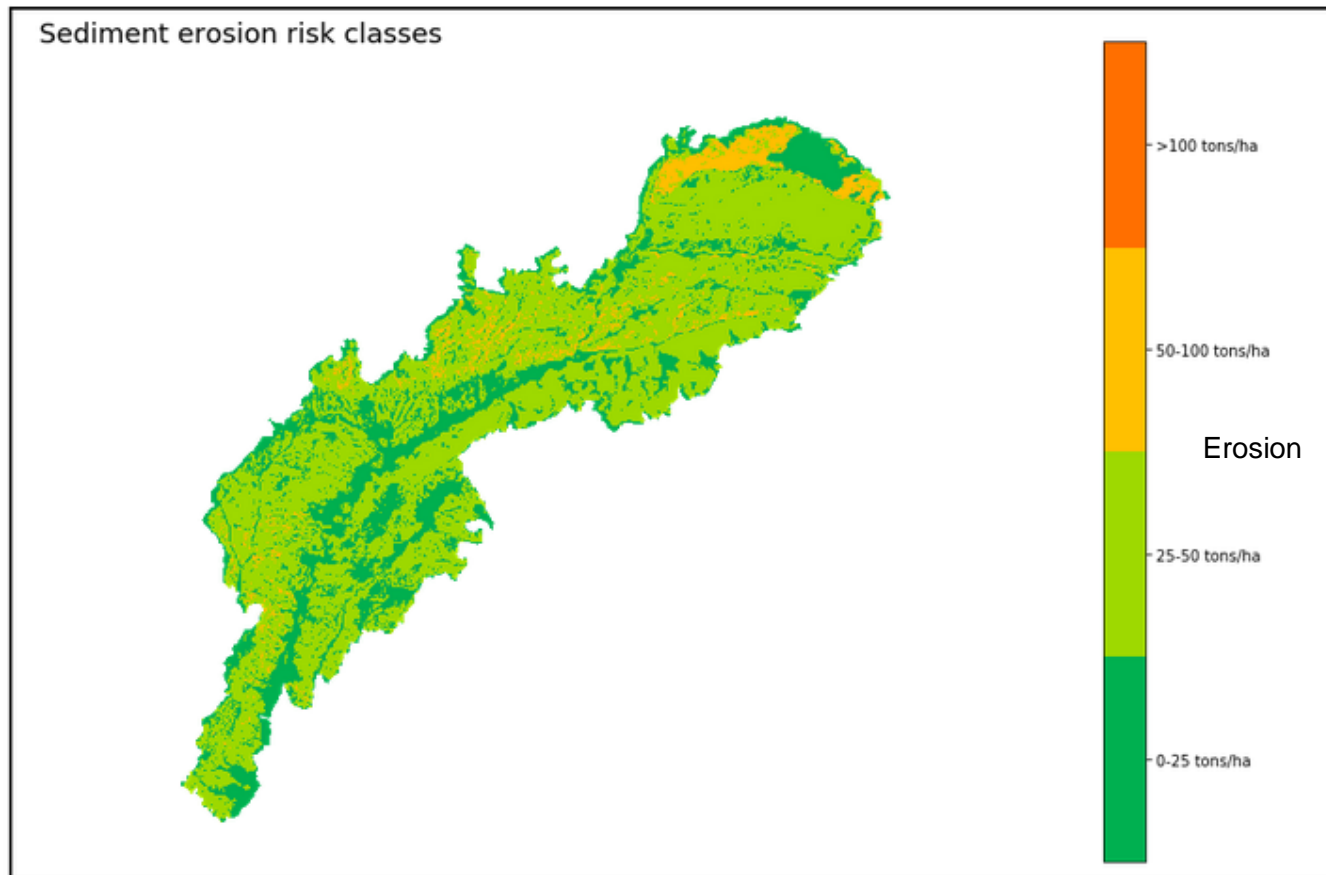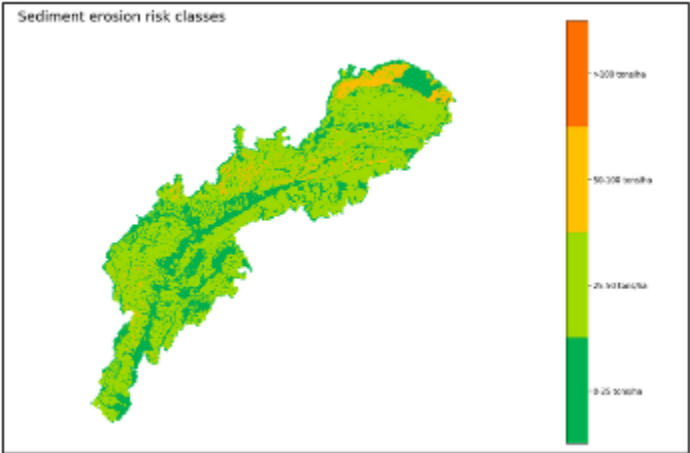
50-100 tons/ha

Erosion

25-50 tons/ha

0-25 tons/ha

Table 8. Integration of the regeneration rate (based on post-fire reproductive strategy, fire history, pre- and post-fire drought, and non-native grass cover) and the BAER erosion risk data


Sediment erosion risk classes

OUTPUT MAP 4: Expected regeneration modified by fire history, drought and non-native grasses

		Erosion risk (units are t/ha/yr)			
		Low (<=25)	Moderate (25-50)	High (50-100)	Very high (>100)
Regeneration rate	High	Low	Moderate	High	High
	Moderate-high	Low	Moderate	High	High
	Moderate	Moderate	Moderate	High	Very high
	Moderate-low	Moderate	Moderate	High	Very high
	Low	High	High	Very high	Very high

OUTPUT MAP 5. Summary map of ecosystem degradation risk

Legend:
- Very high degradation risk
- High
- Moderate
- Low Degradation Risk
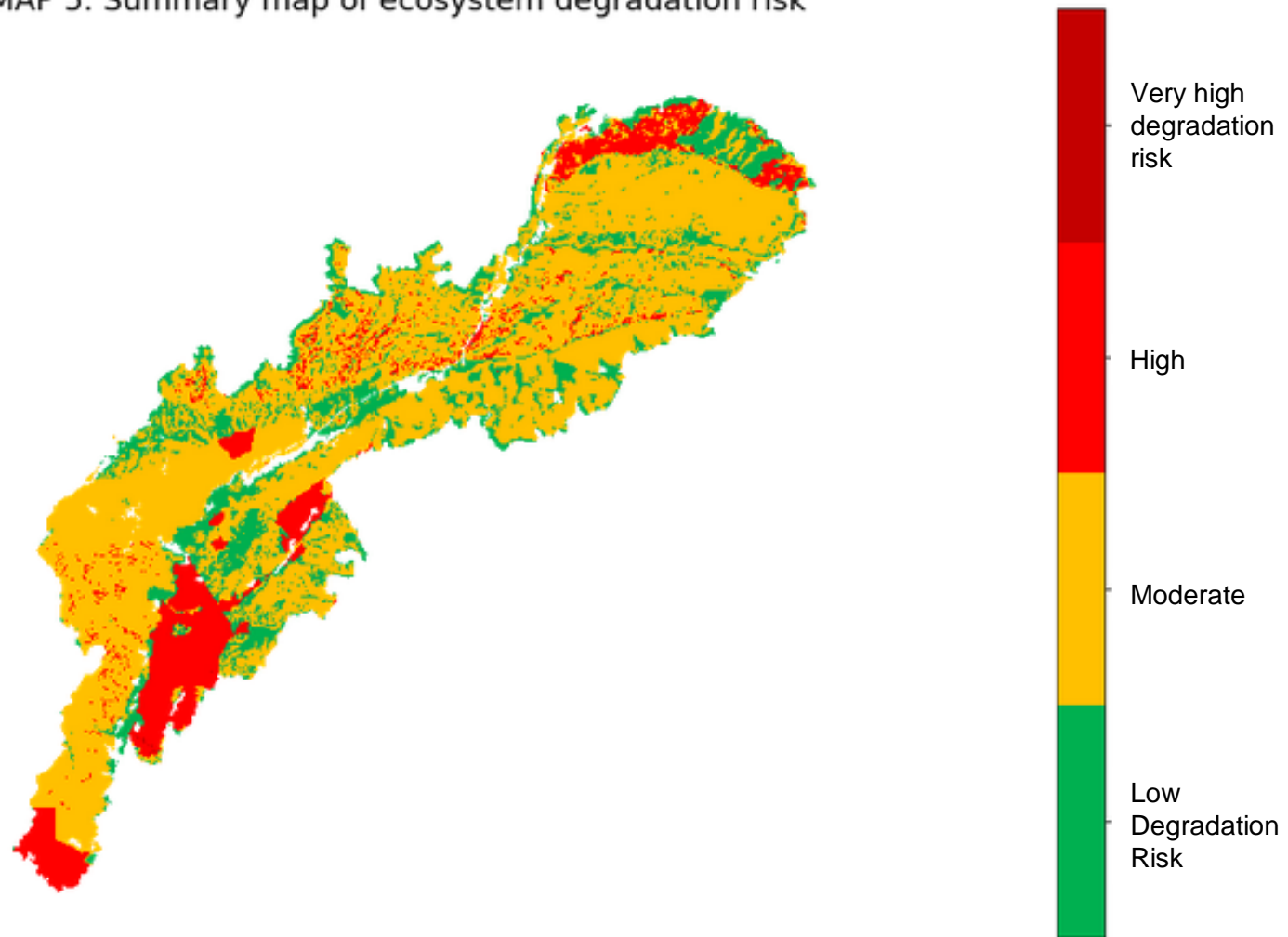
Download output d...

The integration of soil erosion risk and modified expected regeneration leads to the identification of areas with the greatest **degradation risk** post-fire. Note, in the case of the Copper fire (2002), the effects of erosion almost two decades later, are likely to be minimal, in which case users might wish to focus on Output Map 4 and omit the erosion risk step

How can we use the outputs from the tool?

1. Compare tool outputs to sites identified for restoration

■ Identified restoration site
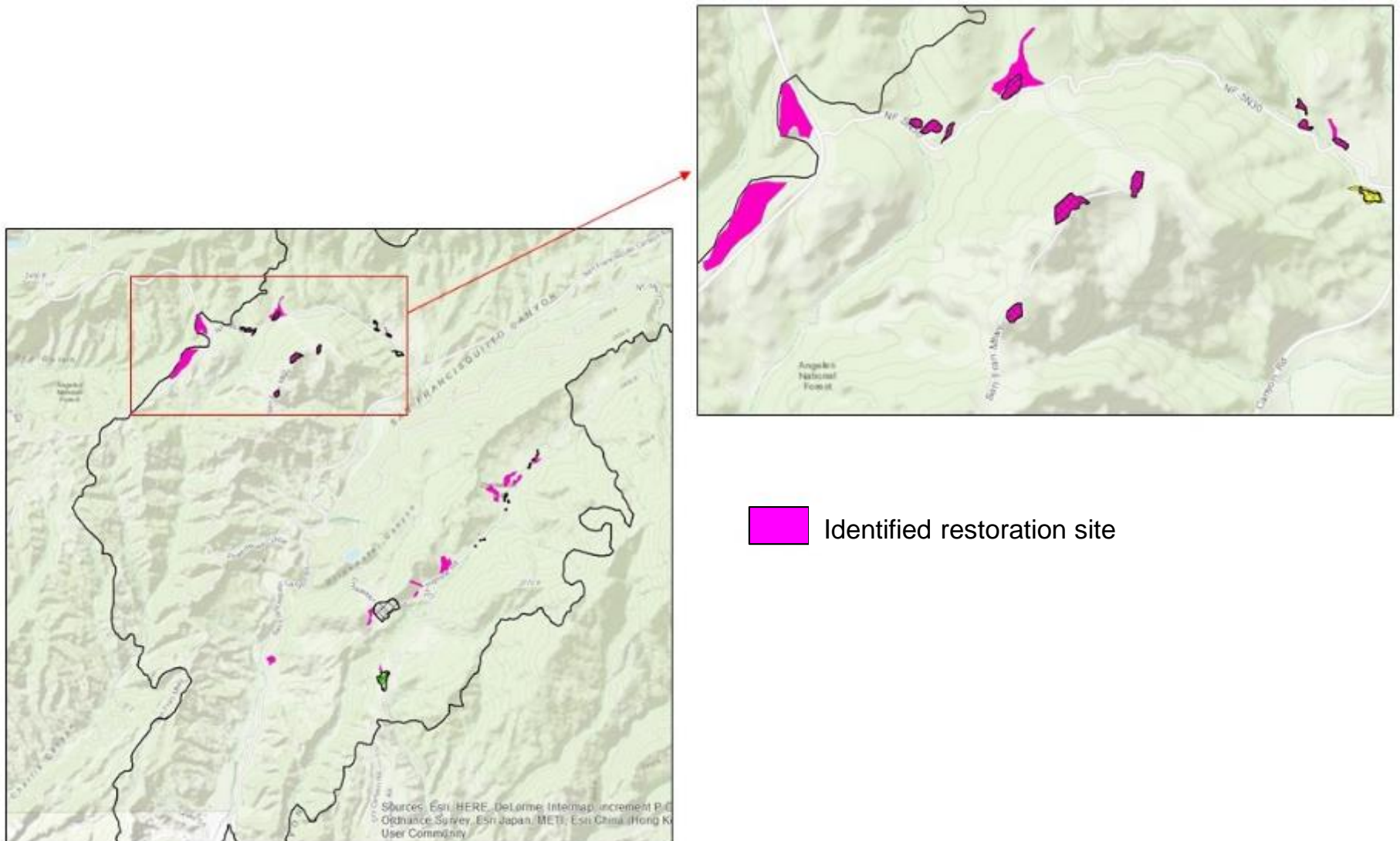
Restoration sites and regeneration capacity
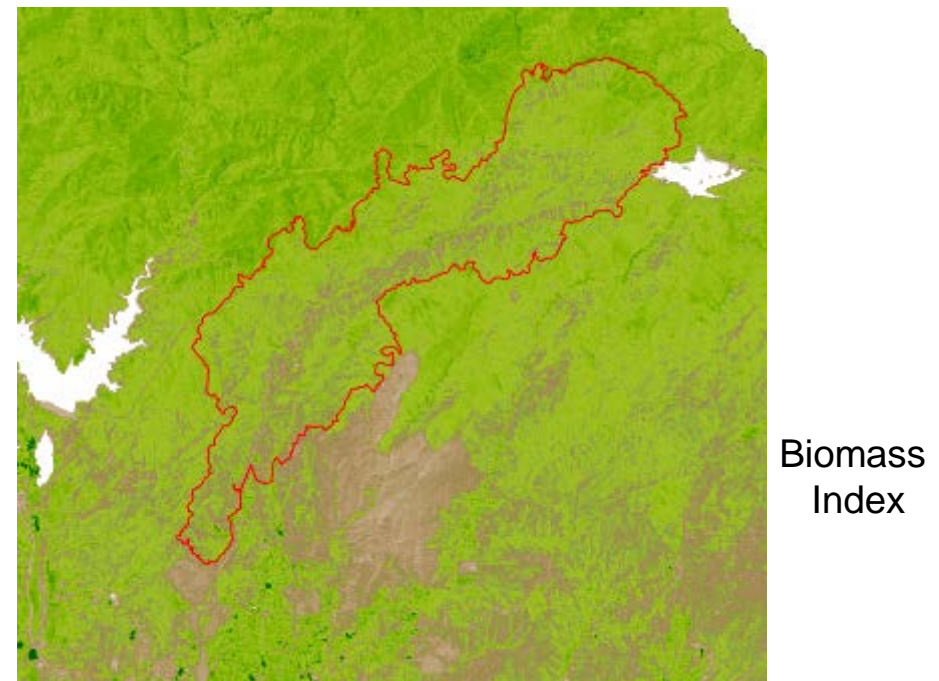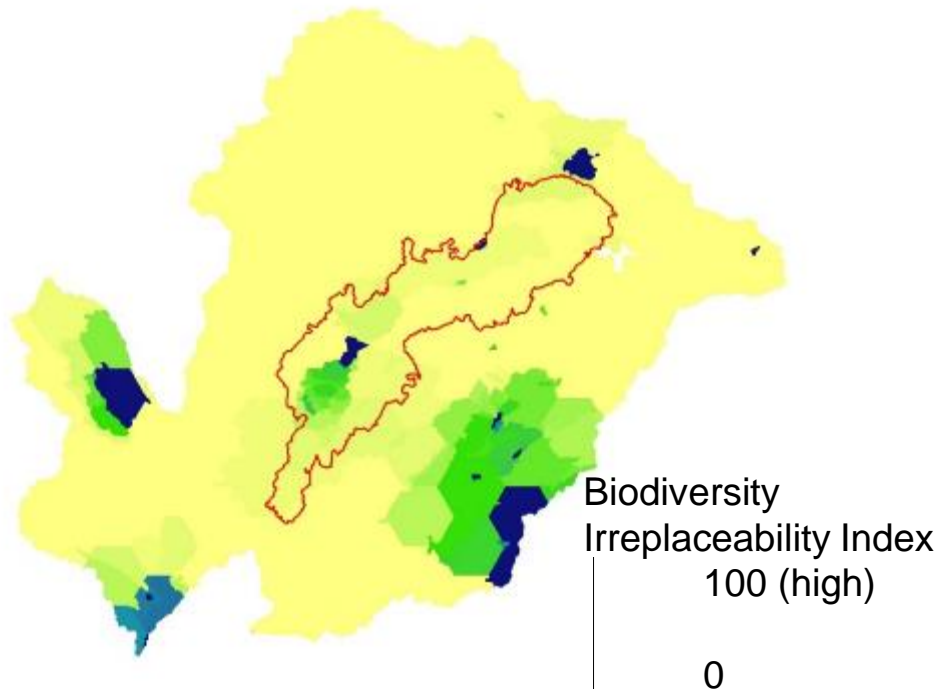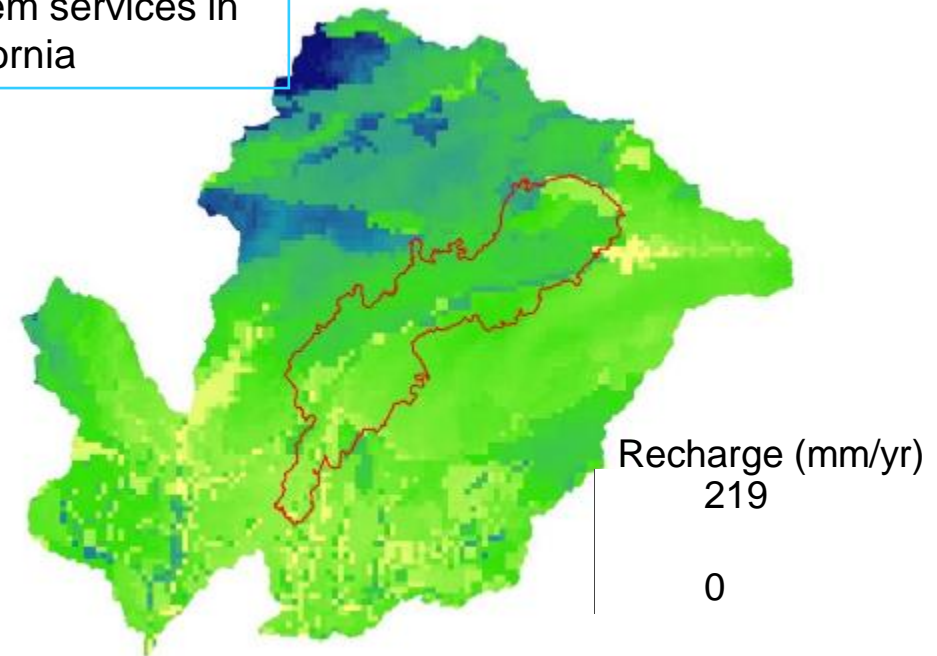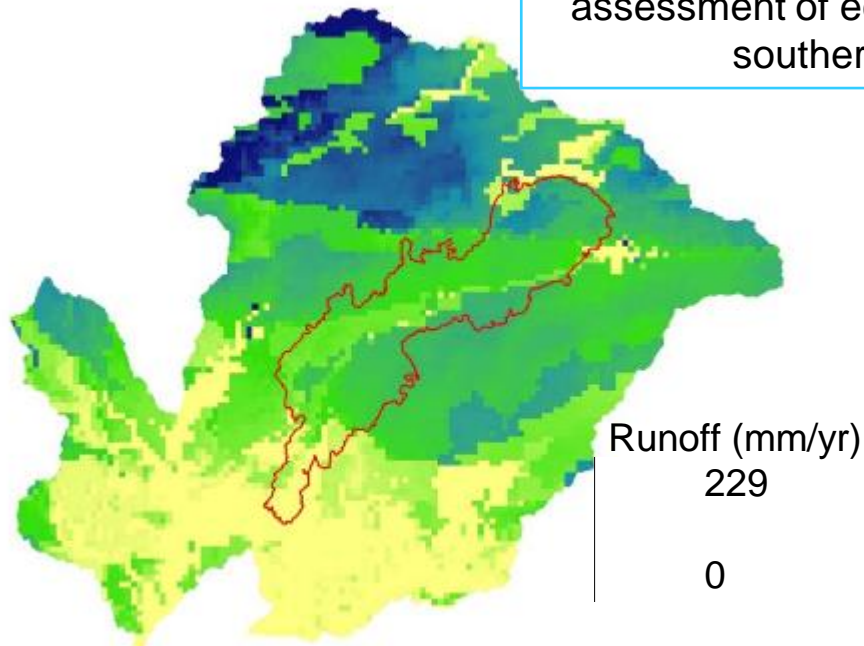## (based on fire history, drought, and non-native grasses)

Areas of low regeneration capacity (and close to roads) that could be ground-truthed as possible restoration sites

High Regen. Capacity

Moderate-High

Moderate

Moderate-Low

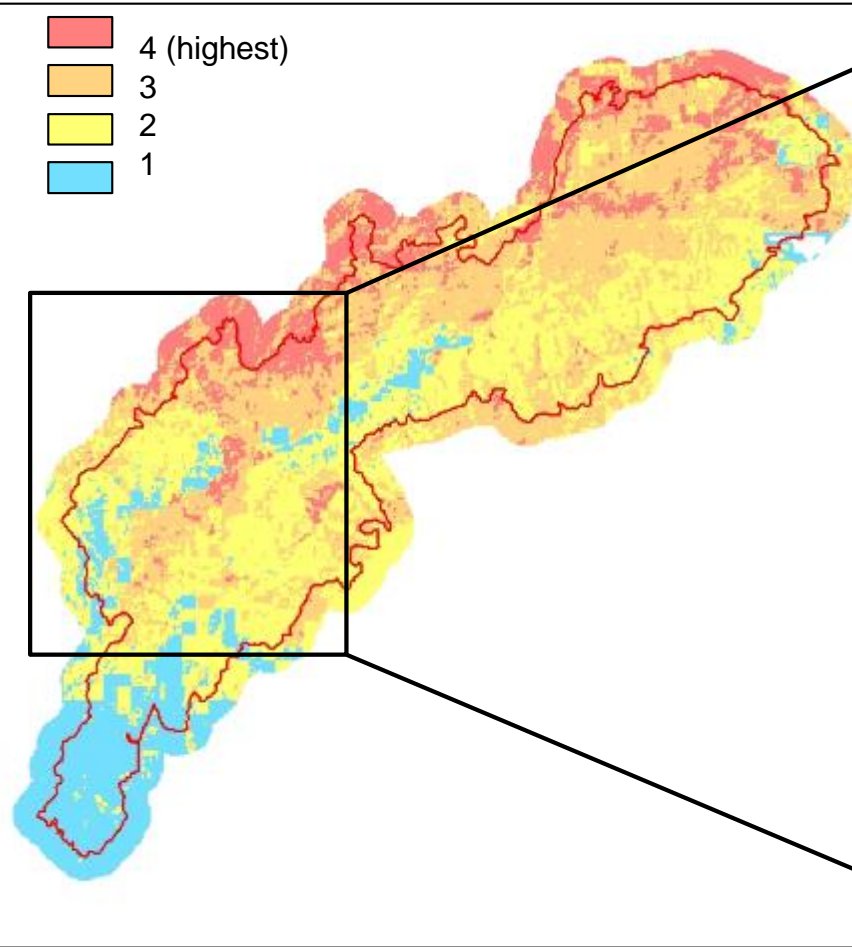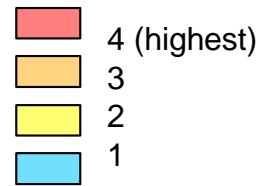Low Regen. Capacity

Identified resto. site
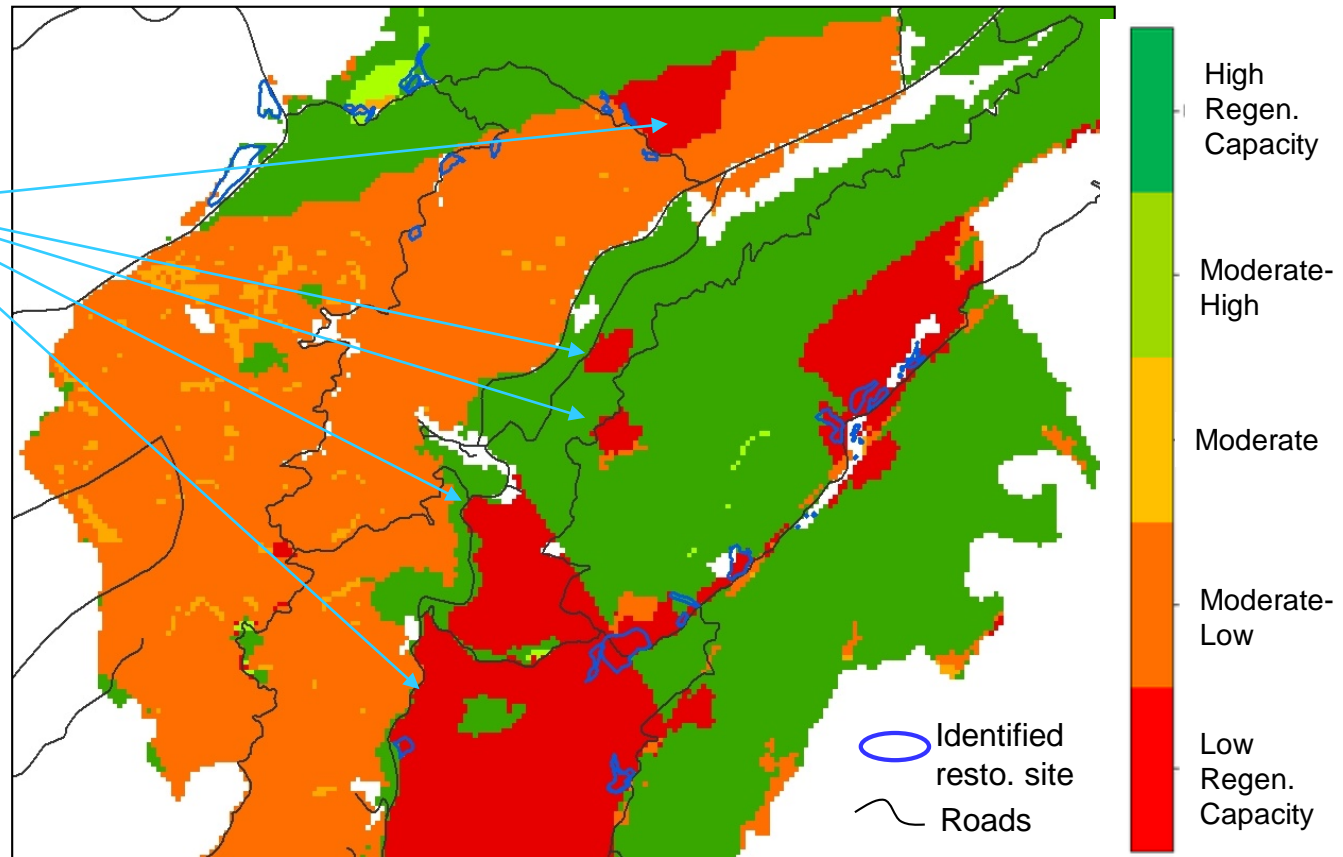
Roads

In this example, we are using Output Map 4, which indicates the modified regeneration capacity of the Copper fire. Overlain on this are roads to indicate accessibility of potential restoration sites

2. Prioritize restoration sites based on ecosystem services

These four layers are extracted from an assessment of ecosystem services in southern California
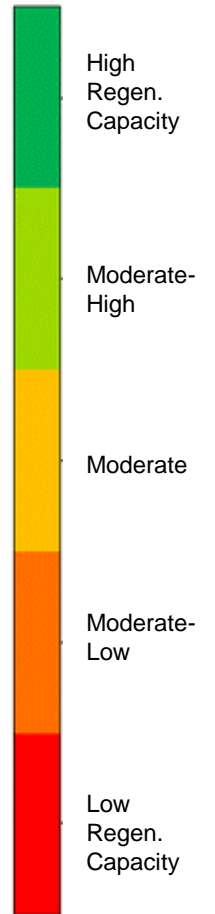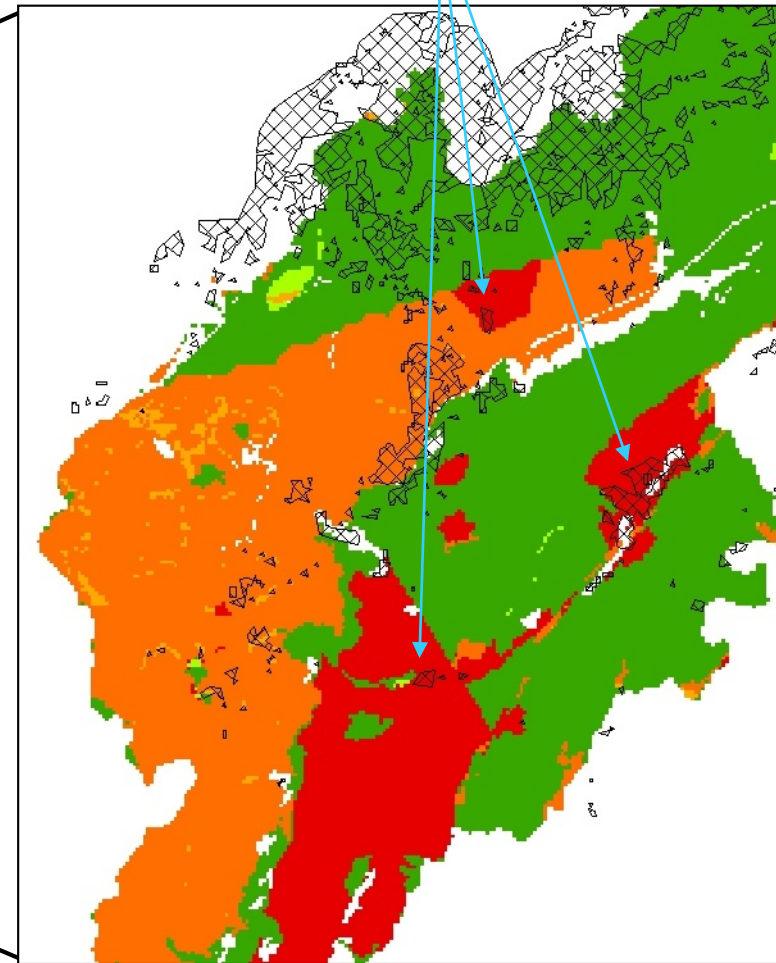

Runoff (mm/yr)
229

0

Recharge (mm/yr)
219

0

Biodiversity
Irreplaceability Index
100 (high)

0

Biomass
Index

Underwood, E.C. et al. 2018. In Valuing chaparral: ecological, socio-economic, and management perspectives (Springer)

Priority areas for ecosystem services

Legend:
- 4 (highest)
- 3
- 2
- 1

Regeneration Capacity legend:
- High Regen. Capacity
- Moderate-High
- Moderate
- Moderate-Low
- Low Regen. Capacity

Areas with low regeneration capacity and high value for services could be priorities for restoration

Priority area for ecosystem services
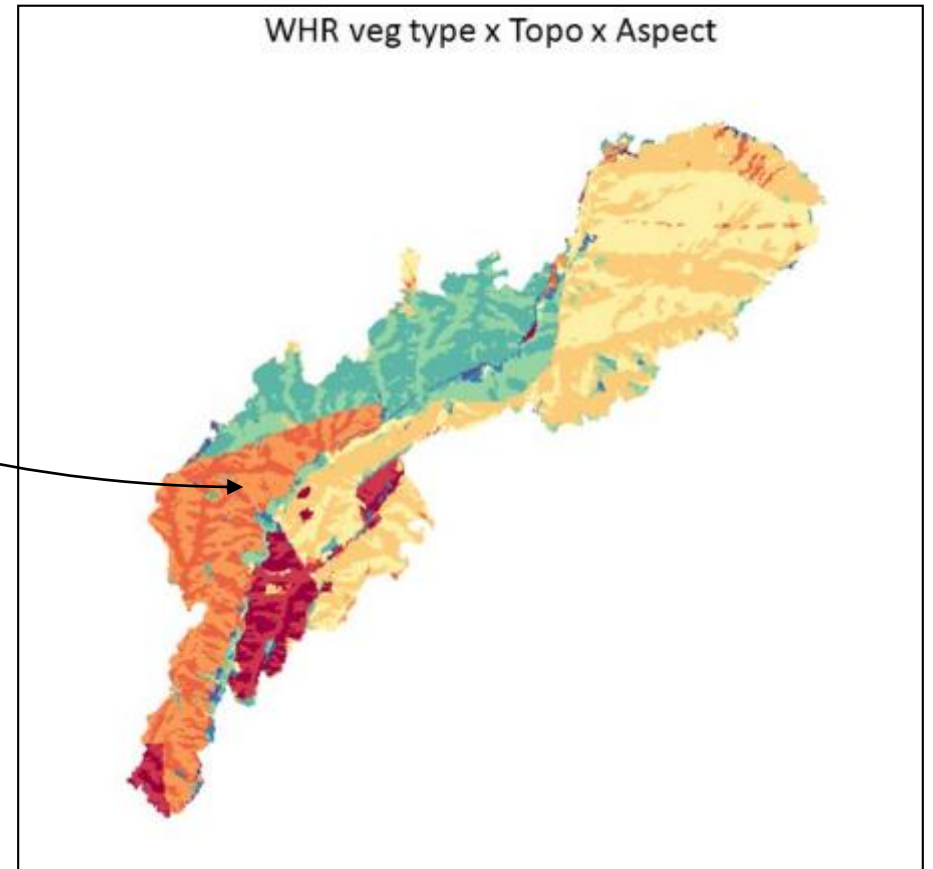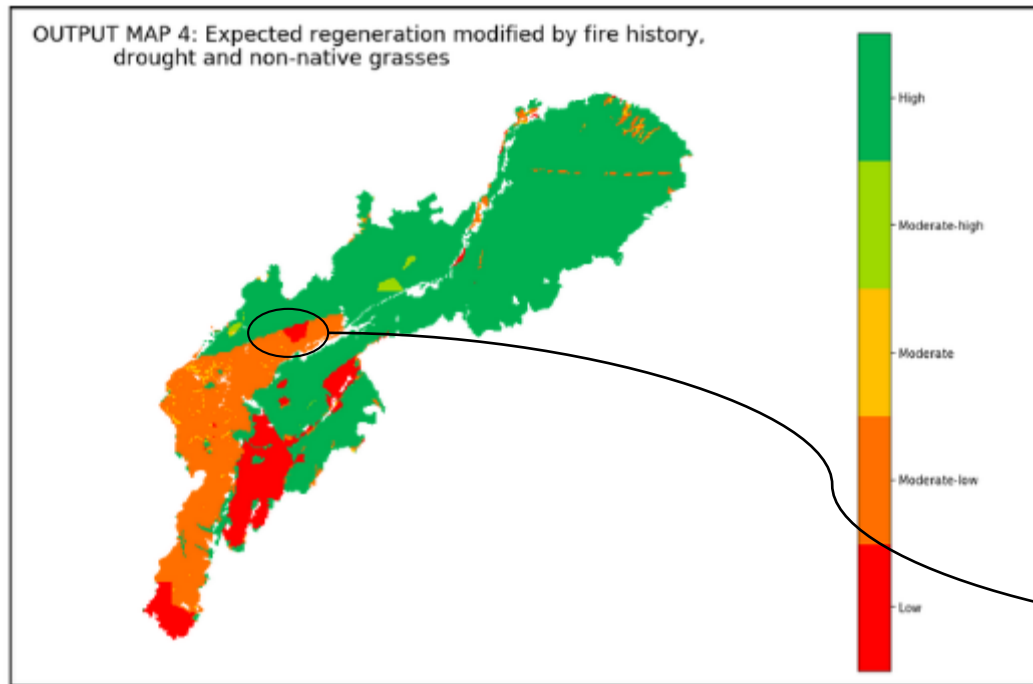
The values in the four individual layers were converted to deciles, summed, and classified into four classes for ease of interpretation

Inform species for restoration

OUTPUT MAP 4: Expected regeneration modified by fire history, drought and non-native grasses

High
Moderate-high
Moderate
Moderate-low
Low

WHR veg type x Topo x Aspect

1. Identify site

2. Determine landscape unit of site
e.g., chamise redshank chaparral south facing slopes, summits and ridges

3. Checklist of characteristic species of 'chamise redshank chaparral on south facing slopes, summits and ridges'

Species	Reproductive strategy
Adenostoma fasciculatum	Facultative seeder
Eriogonum fasciculatum	Facultative seeder
Salvia mellifera	Facultative seeder
Ceanothus vestitus	Seeder
Hesperoyucca whipplei	Resprouter

3. Determine goals of restoration

- Erosion control
- Habitat provision
- Increase carbon storage
- Increase diversity

Species	Common name	Reproductive strategy	Erosion control	Habitat provision
Adenostoma fasciculatum	Chamise chaparral	Facultative seeder	high	high
Salvia mellifera	Black sage	Facultative seeder	high	med
Eriodictyon crassifolium	Yerba santa	Facultative seeder	high	med
Eriogonum fasciculatum	California buckwheat	Facultative seeder	high	med
Artemisa californica	California sagebrush	Facultative seeder	high	high
Ceanothus leucodermis	Chaparral whitethorn	Facultative seeder	med	low-med
Arctostaphylos glauca	Manzanita (big berrry)	Seeder	high	high
Acmispon glaber	Deerweed	Seeder	high	high
Ceanothus vestitus	Desert ceanothus	Seeder	med	high
Ceanothus cuneatus	Wedgeleaf ceanothus	Seeder	high	high
Ceanothus crassifolius	Hoaryleaf ceanothus	Seeder	med	high
Cercocarpus betuloides	Mountain mahogany	Resprouter	high	high
Quercus berberdifolia	Scrub oak	Resprouter	high	high
Hesperoyucca whipplei	Chaparral yucca	Resprouter	med	low
Prunus ilicifolia	Holly-leaf cherry	Resprouter	med	high