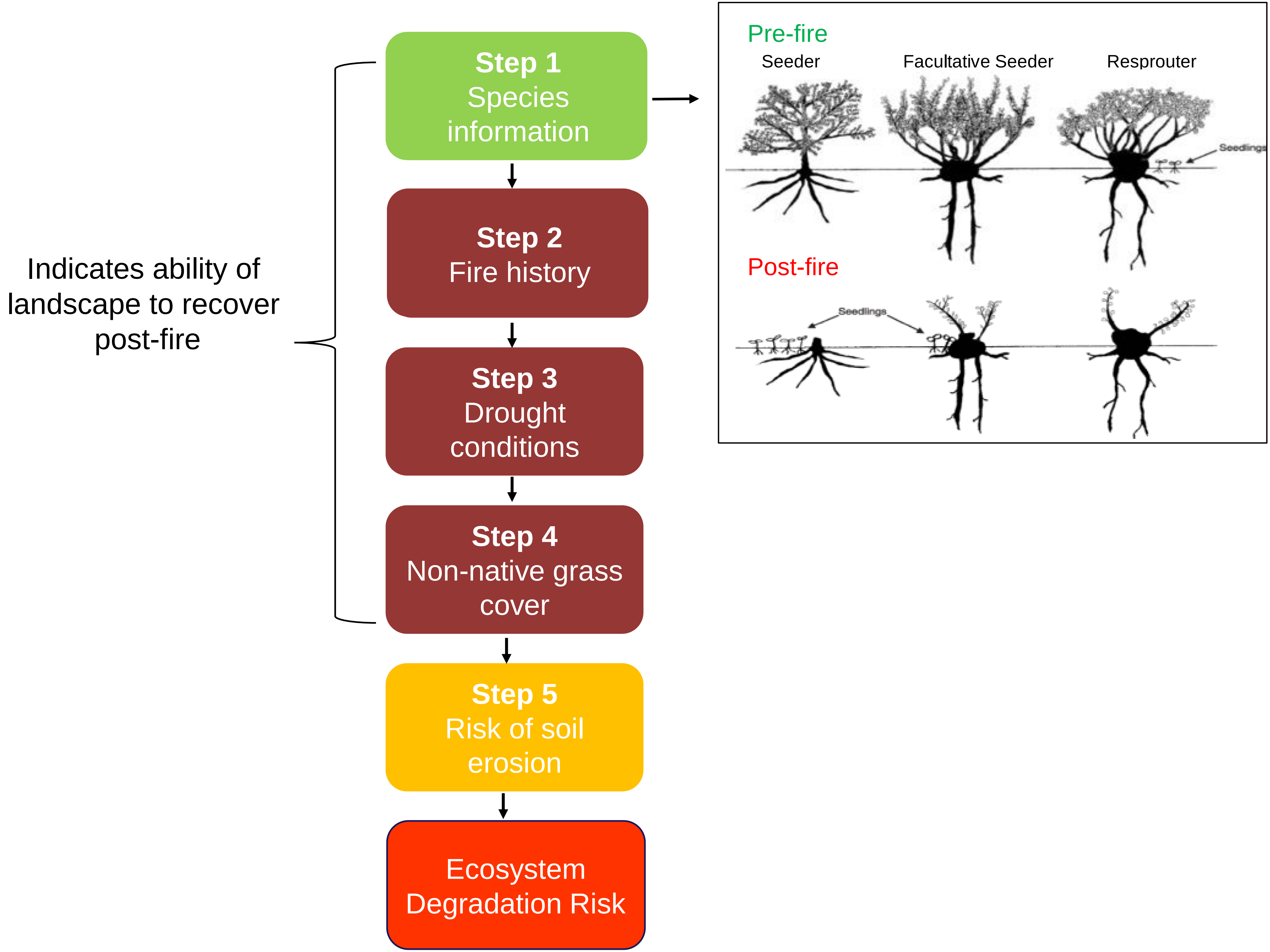
Post-fire Regeneration Tool for Chaparral Shrublands

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 PRT 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

Out[215]: The raw code for this Jupyter notebook is by default hidden for easier reading. To toggle on/off the raw code, click here.

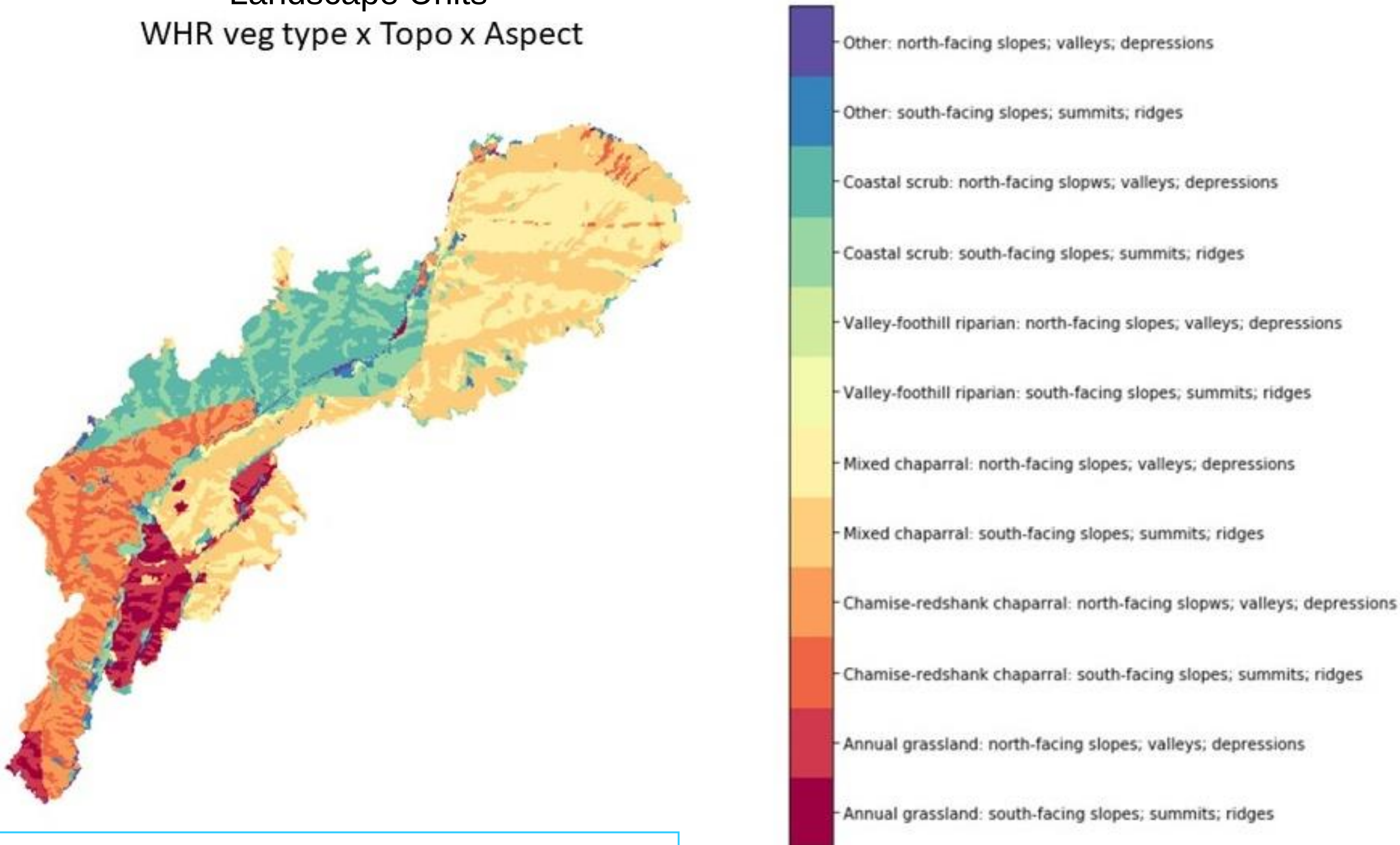
Step 1. Determine Post-fire Expected Regeneration Rate

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



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

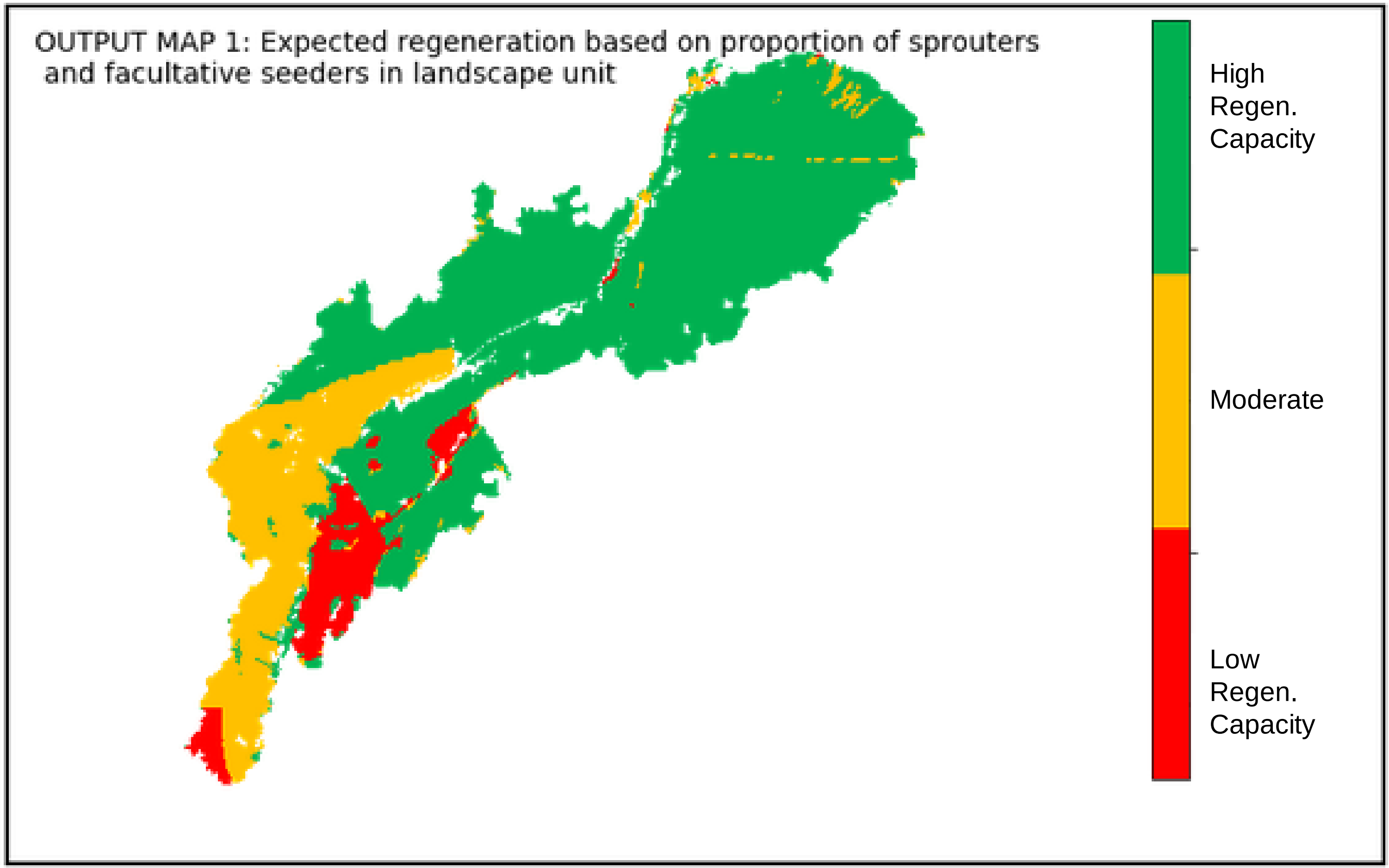
Select the proportion of resprouters in each class

These proportions have been determined based on field guides such as Gordon and White (1994) and FIA shrubland plots. Again, field work is recommended to confirm these

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



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

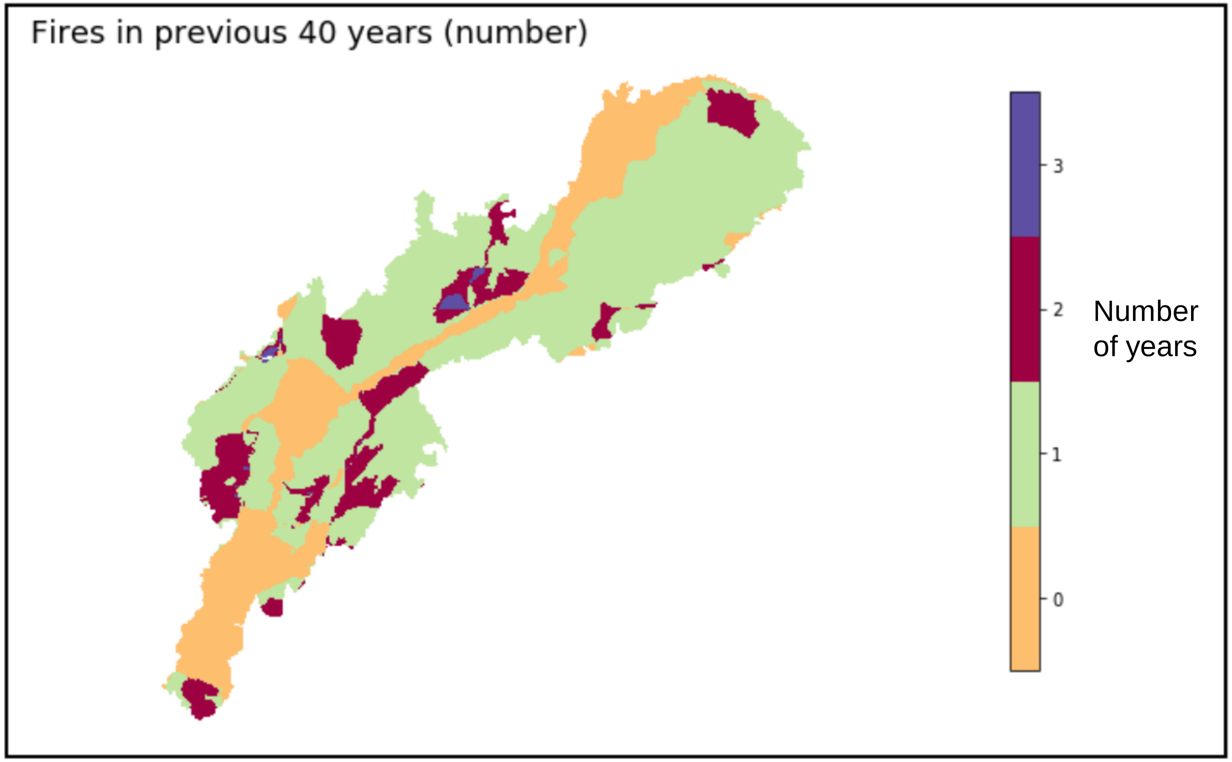


Table 2. Modification of regeneration rate score based on number of fires in last 40 years in each pixel

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

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

Task B. Specify time since last fire

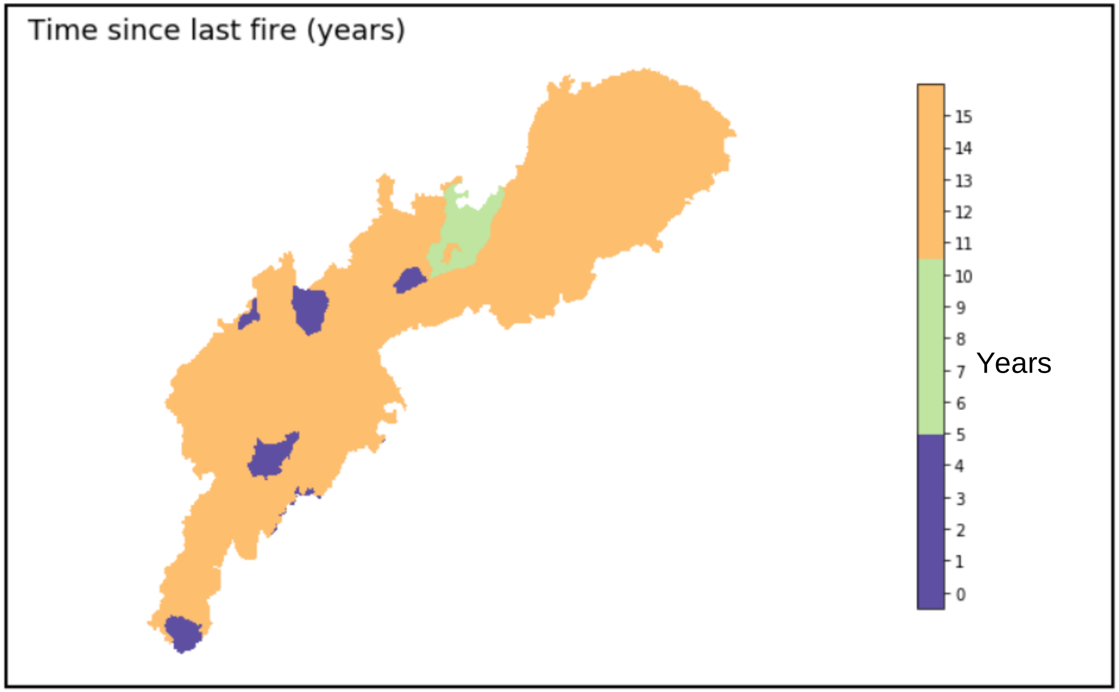
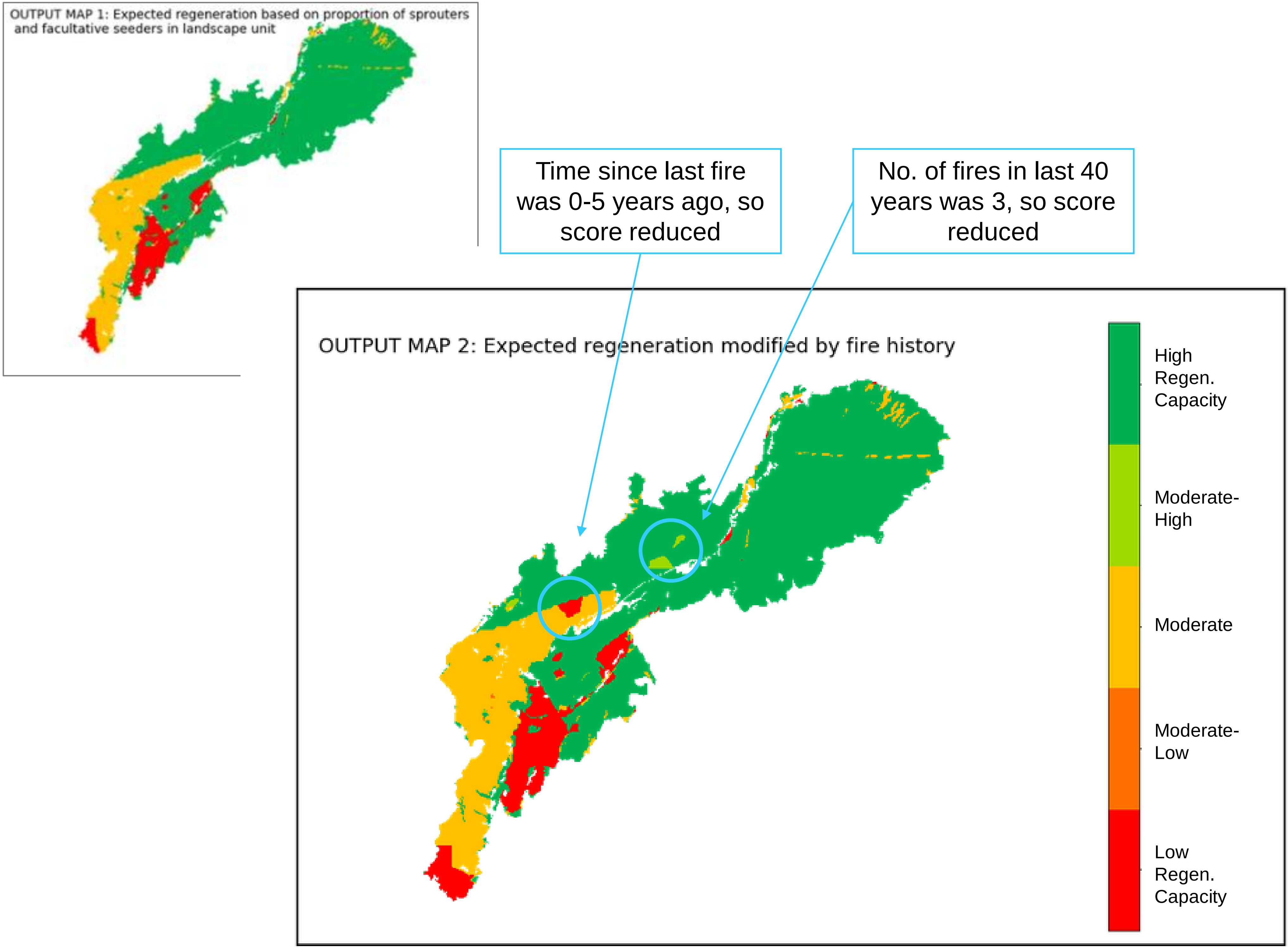


Table 3. Modification of regeneration rate score based on time since last fire. This modification is only applied to pixels with low regeneration rates (<10% resprouters or facultative seeders, i.e., 10-90% obligate seeders)

	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
Time since last fire was 0-5 years ago, so score reduced
No. of fires in last 40 years was 3, so score reduced
OUTPUT MAP 2: Expected regeneration modified by fire history
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 12 month... 3

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

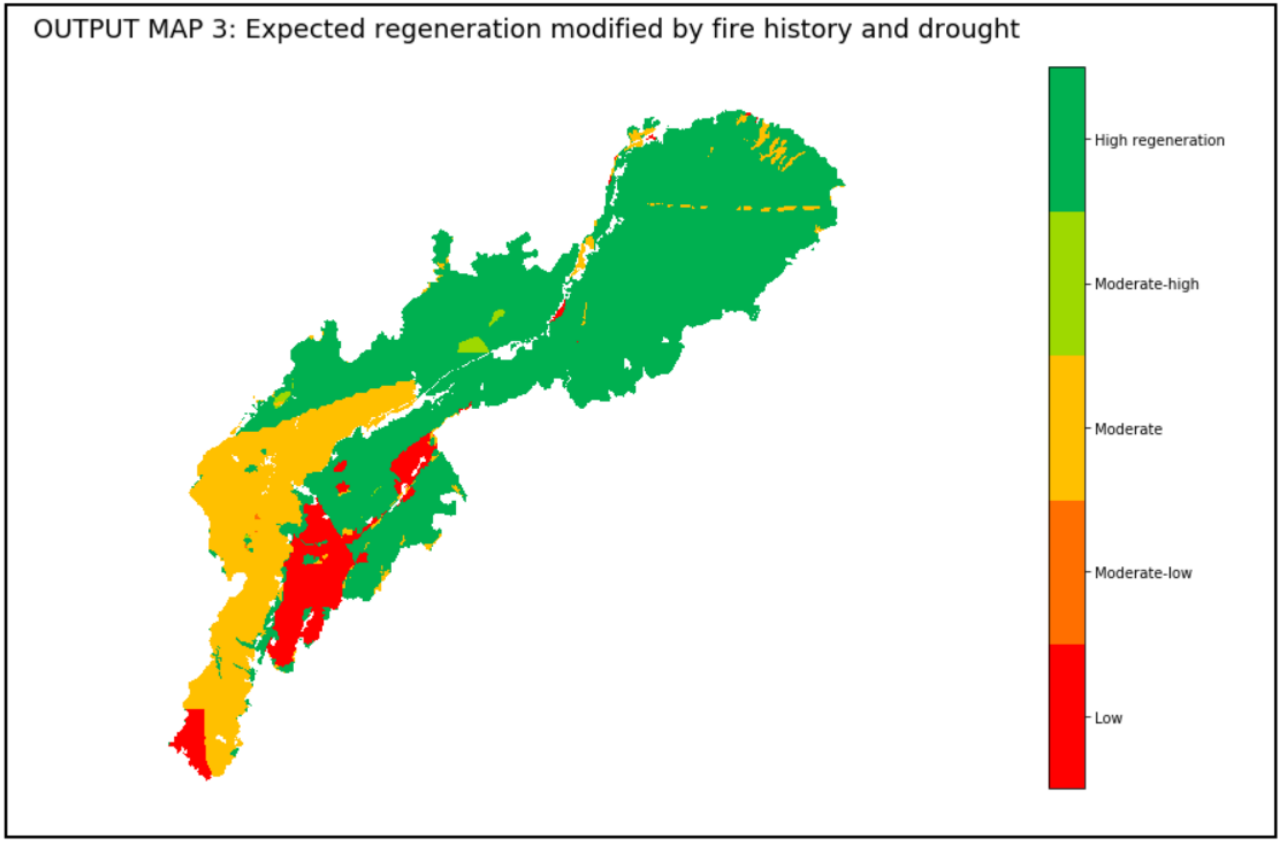
Post-fire year 2: Number of months 1

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

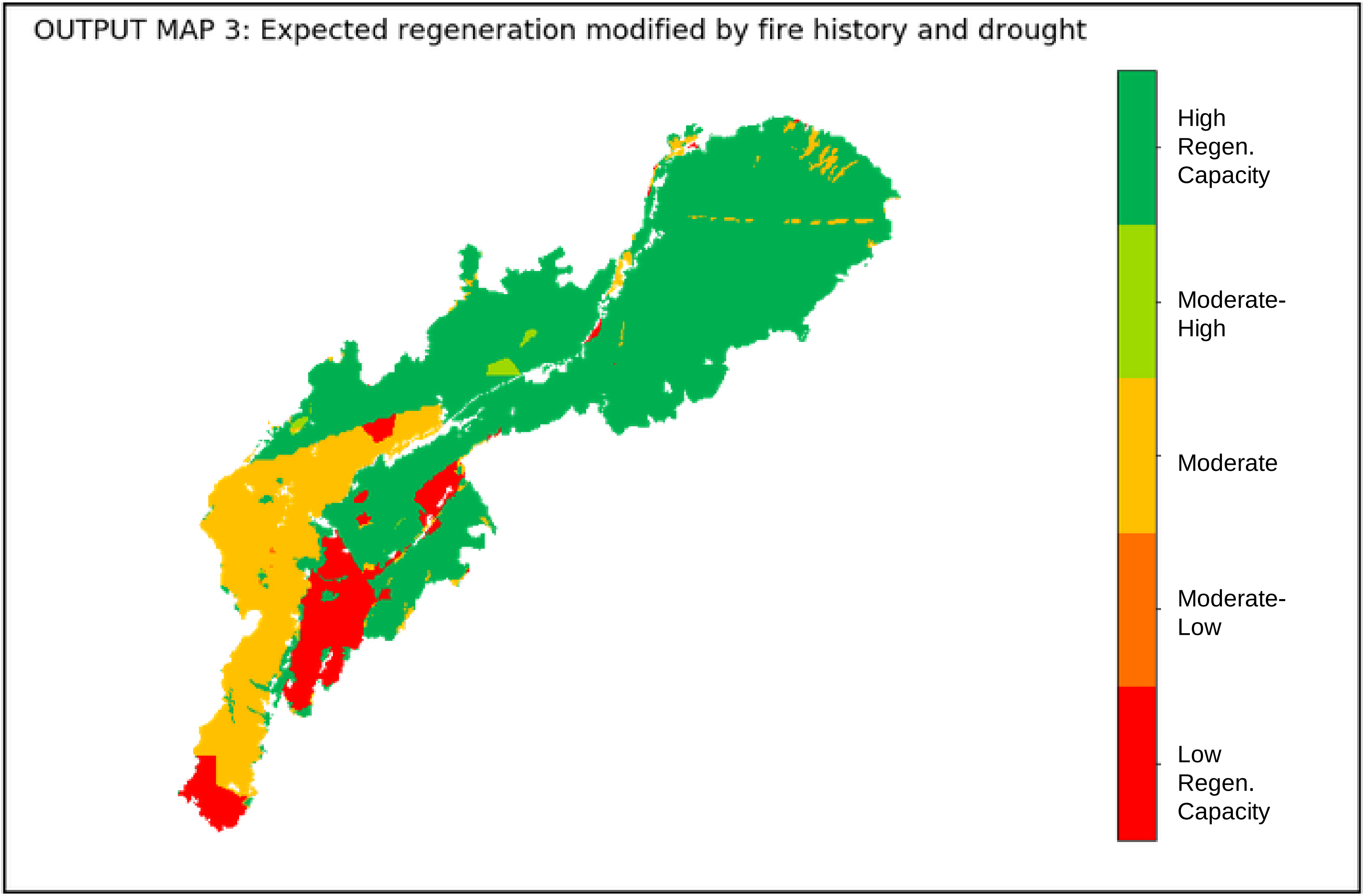
Task C. Specify if fire occurs in wet season or dry season

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



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

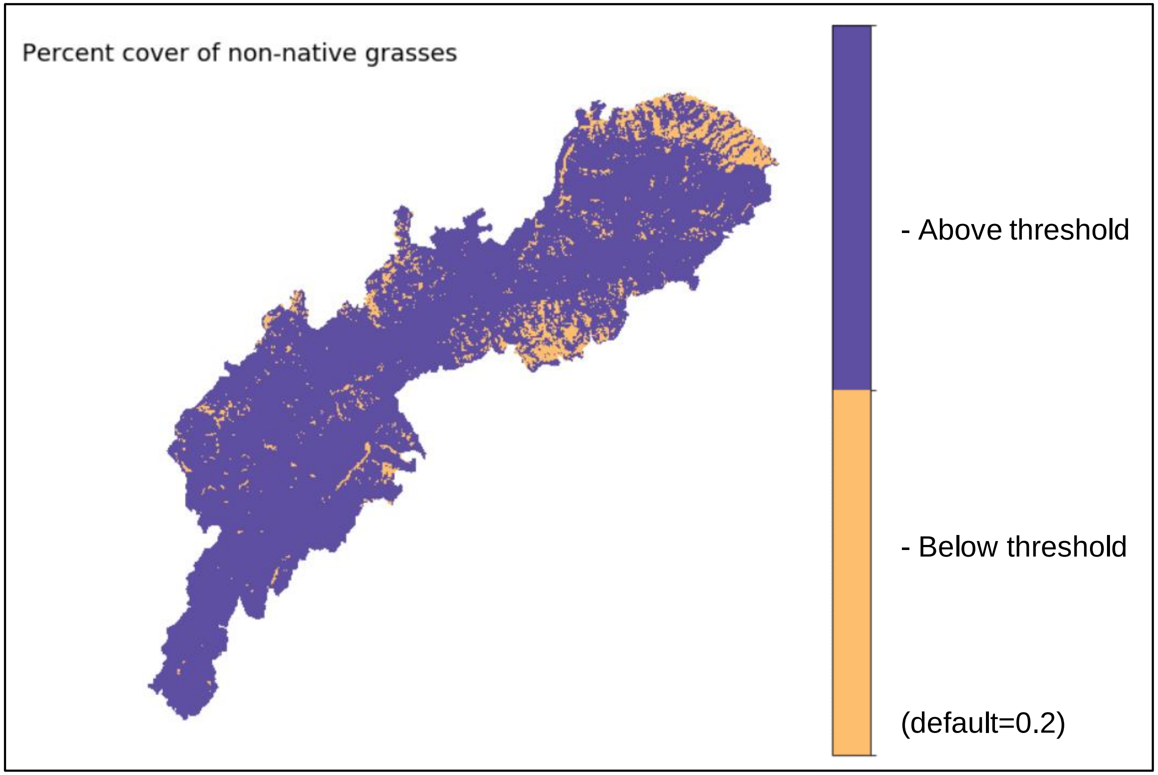


Download output d...

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

Specify abundance on non-native grasses

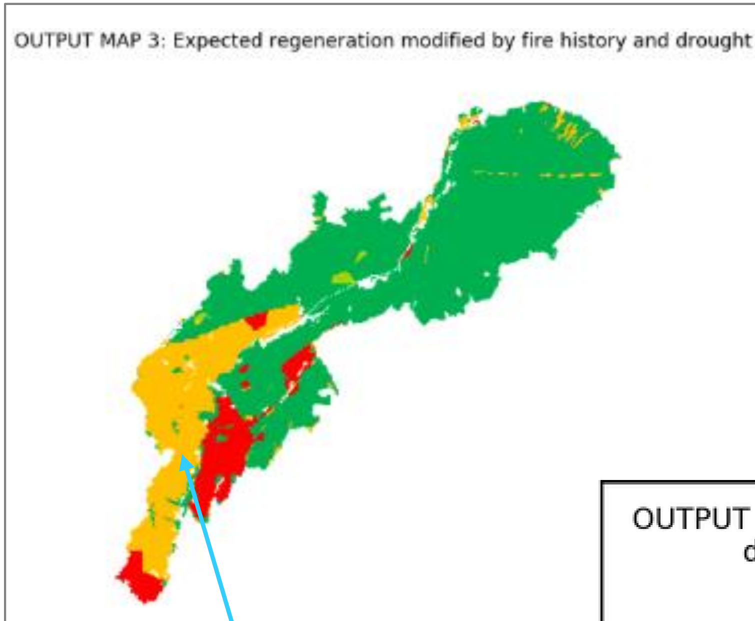
Data on non-native grasses developed by Park et al. (2018) was funded by the Angeles National Forest



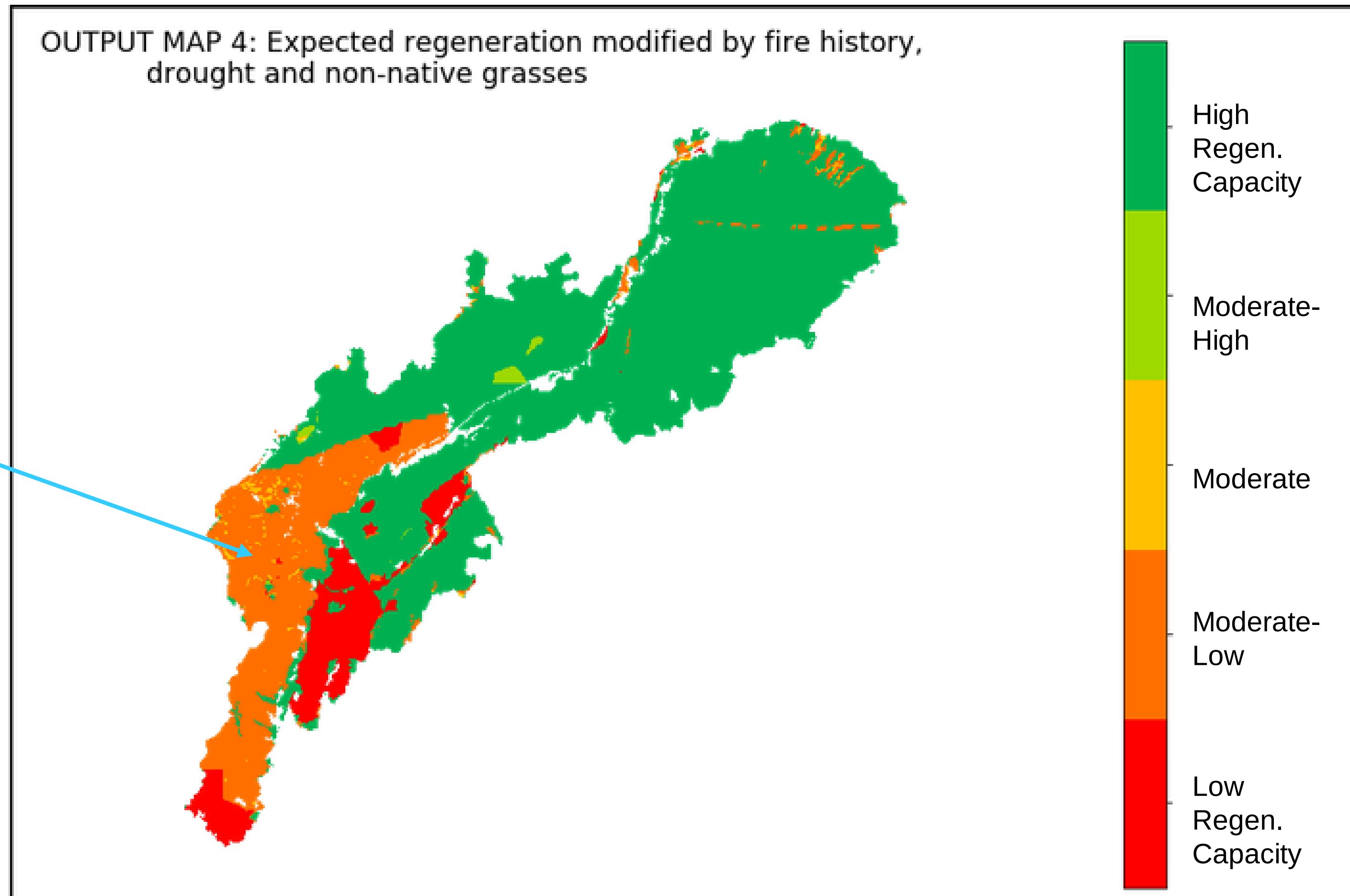
Enter % threshold of herbaceou... 20

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



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)



Download output d...

Step 1
Species information

Step 2
Fire history

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Non-native grass cover

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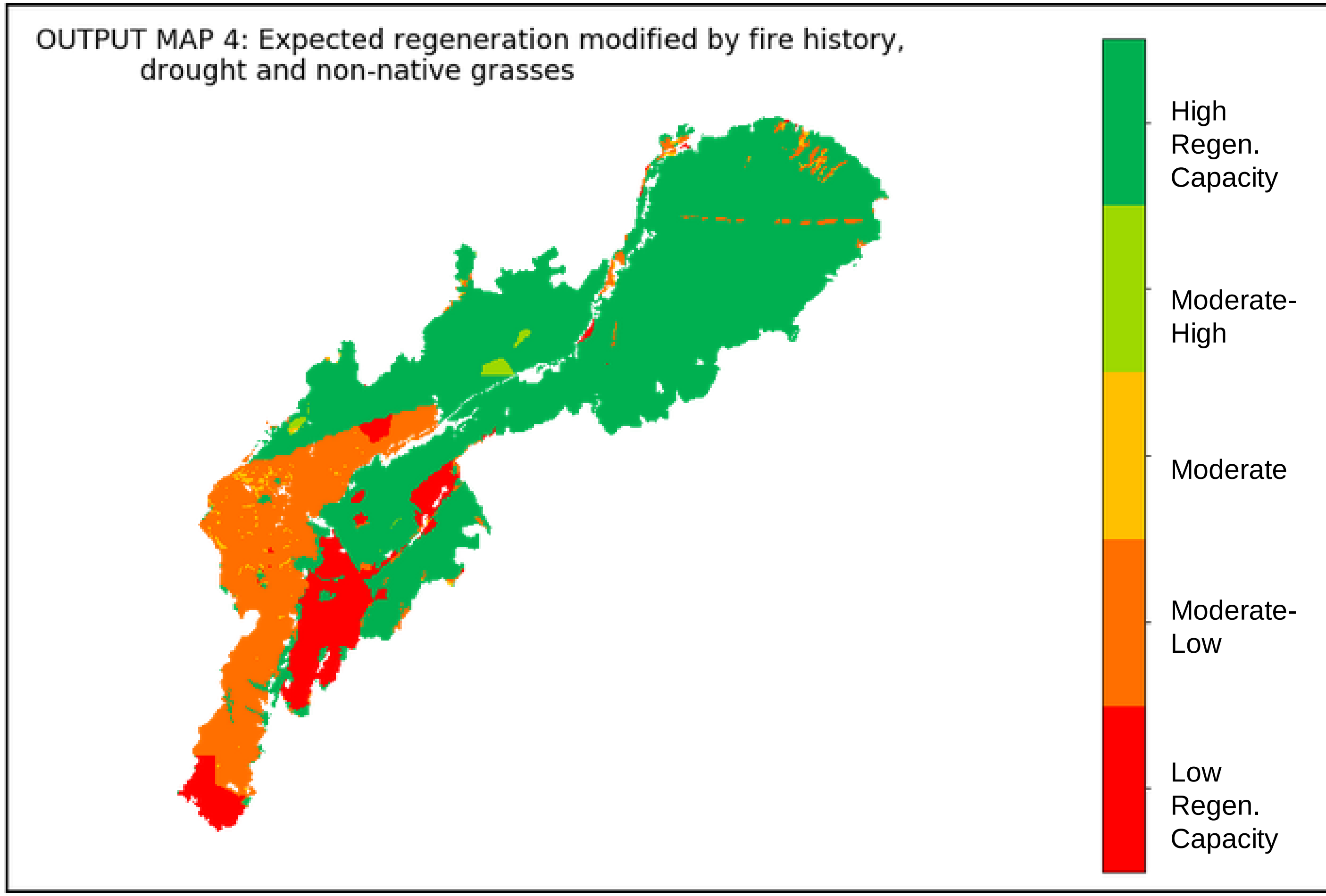
Risk of soil erosion

Ecosystem Degradation Risk



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

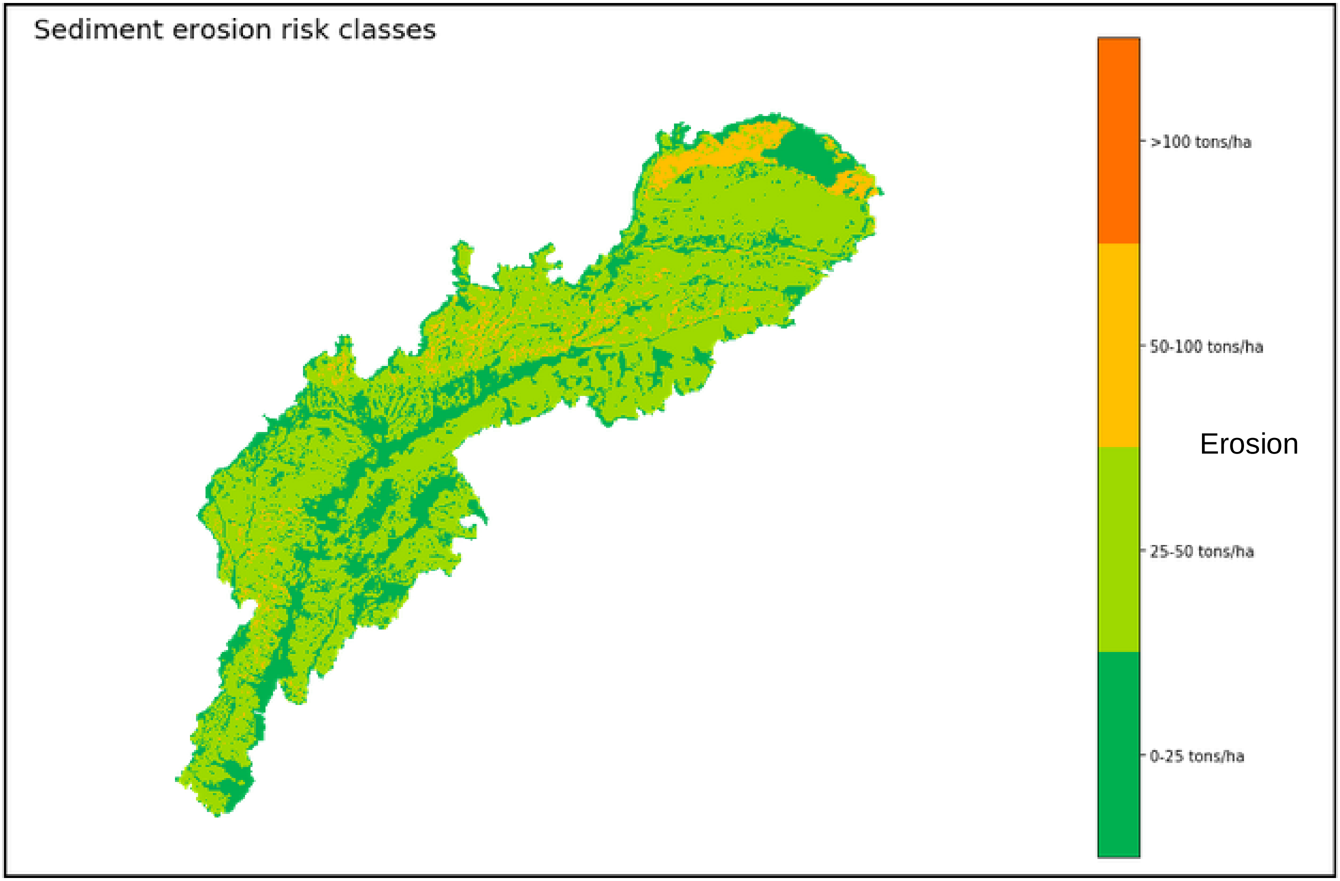
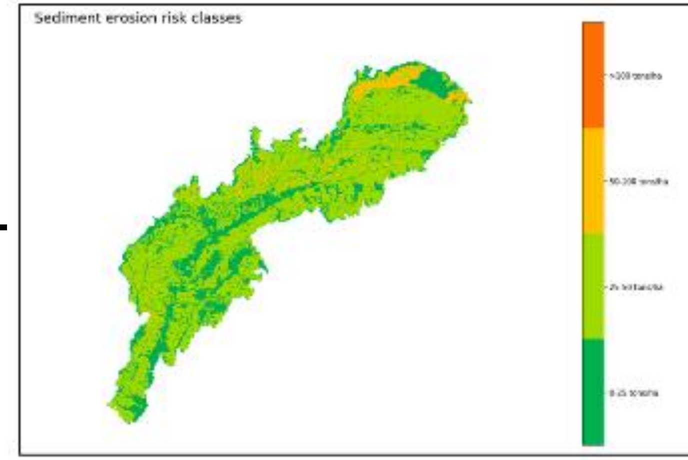
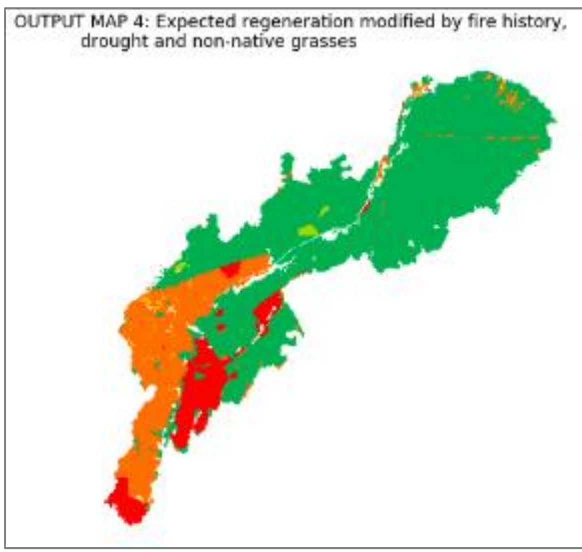
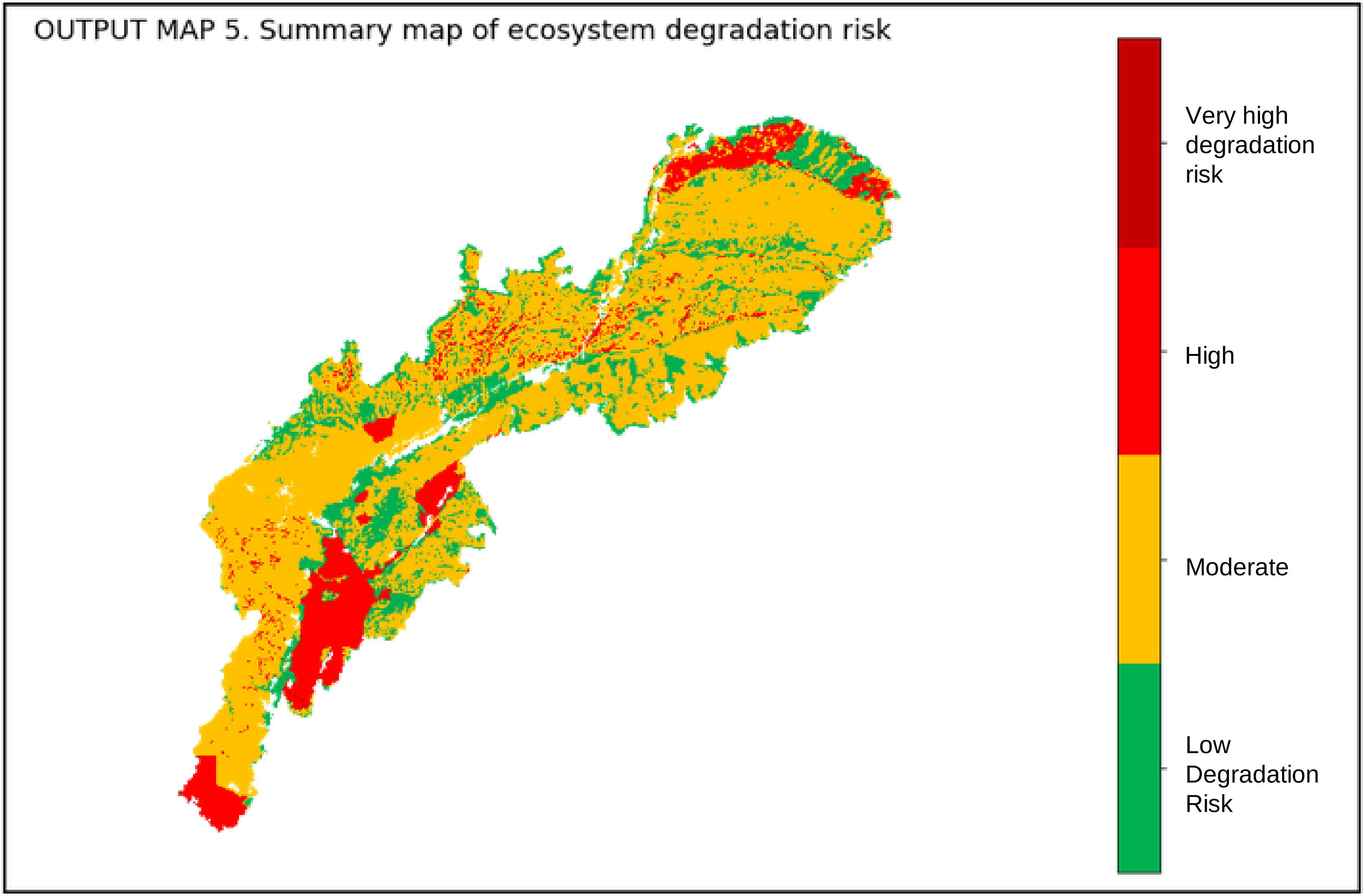


Table 8. Integration of the regeneration rate (based on post-fire reproductive strategy, fire history, pre- and post-fire drought, and non-native grass cover) and the BAER erosion risk data





		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

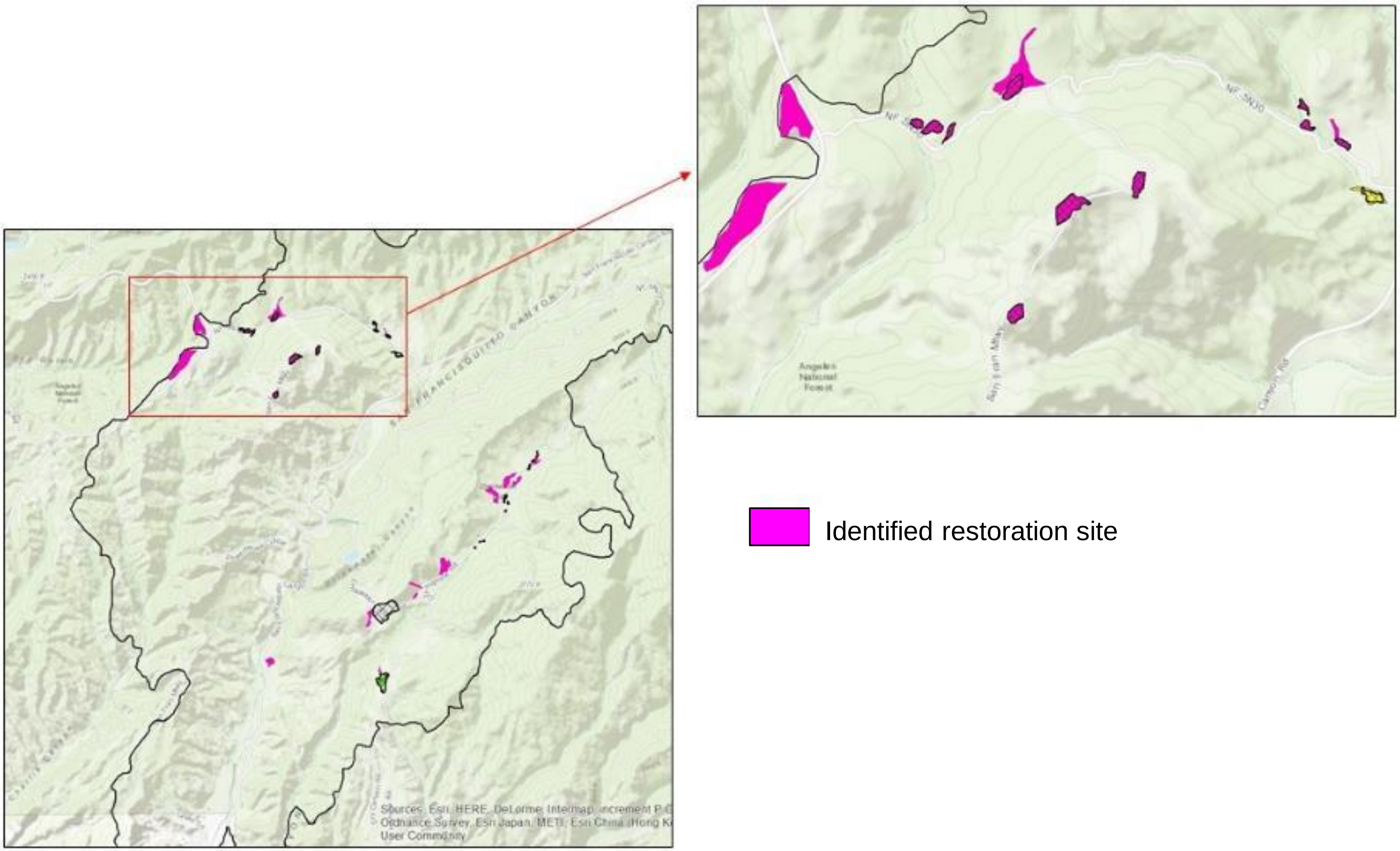


Download output d...

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?

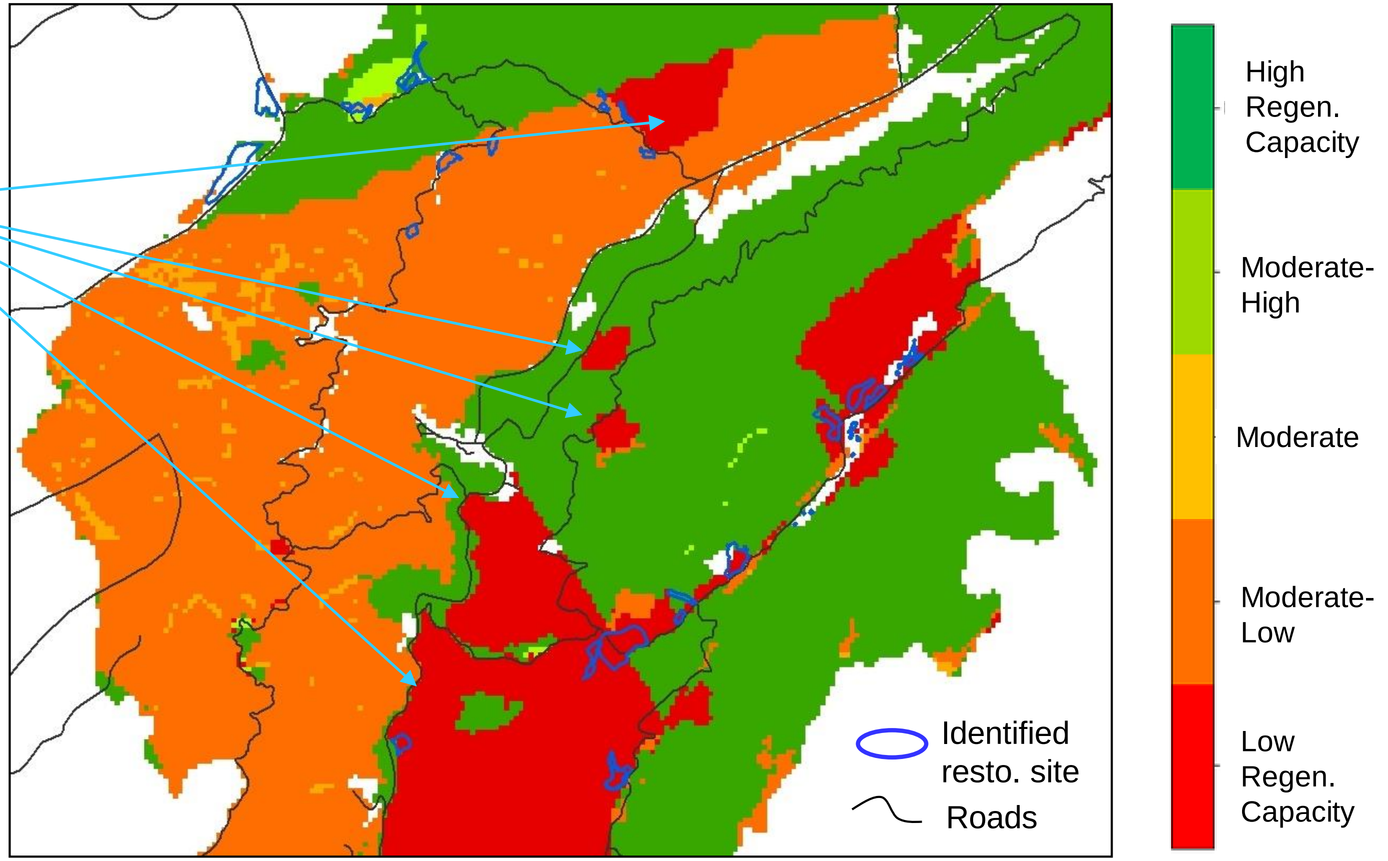
1. Compare tool outputs to sites identified for restoration



Restoration sites and regeneration capacity

(based on fire history, drought, and non-native grasses)

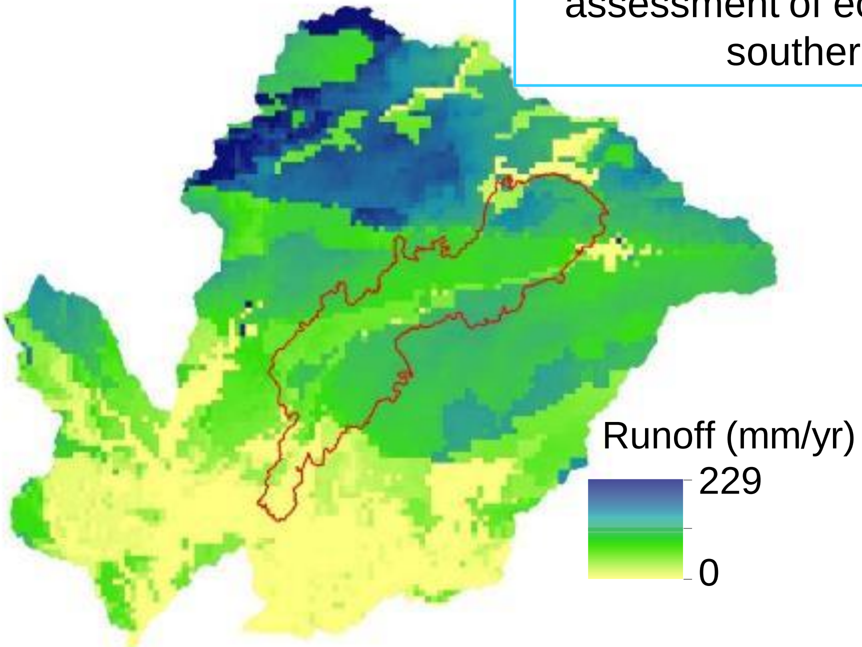
Areas of low regeneration capacity (and close to roads) that could be ground-truthed as possible restoration sites

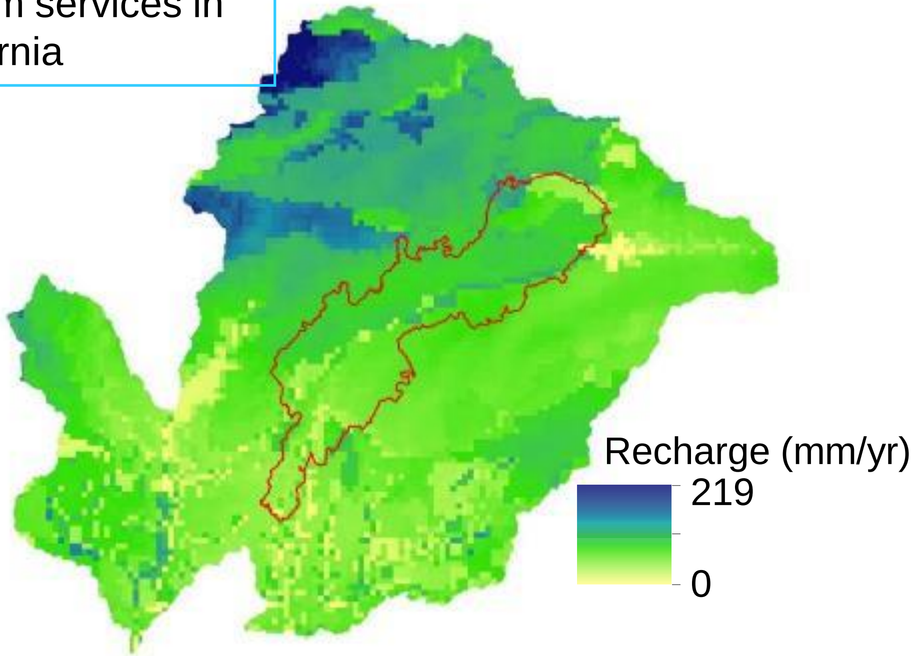


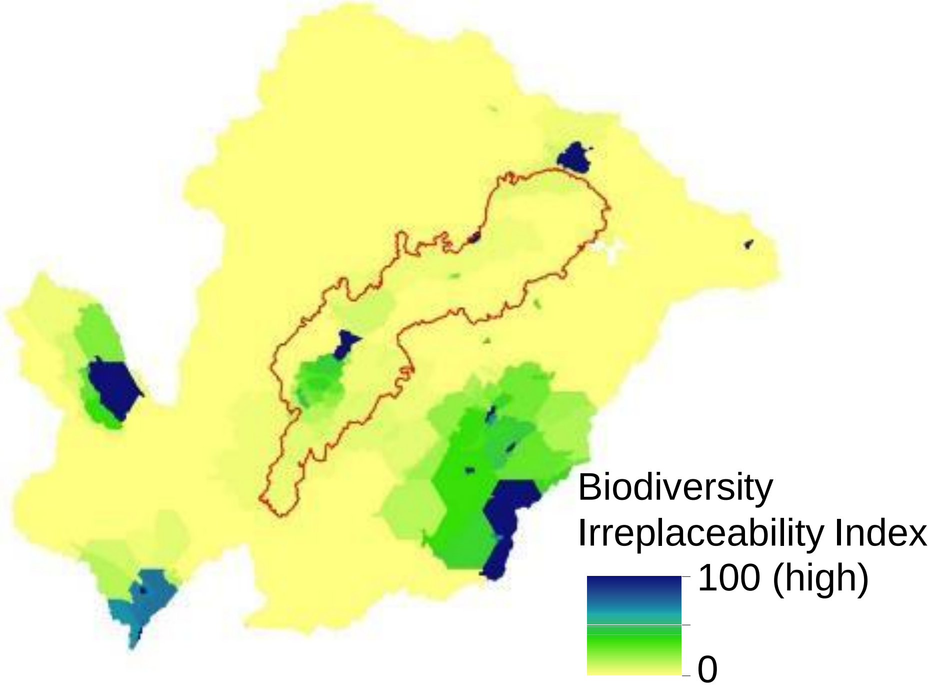
In this example, we are using Output Map 4, which indicates the modified regeneration capacity of the Copper fire. Overlain on this are roads to indicate accessibility of potential restoration sites

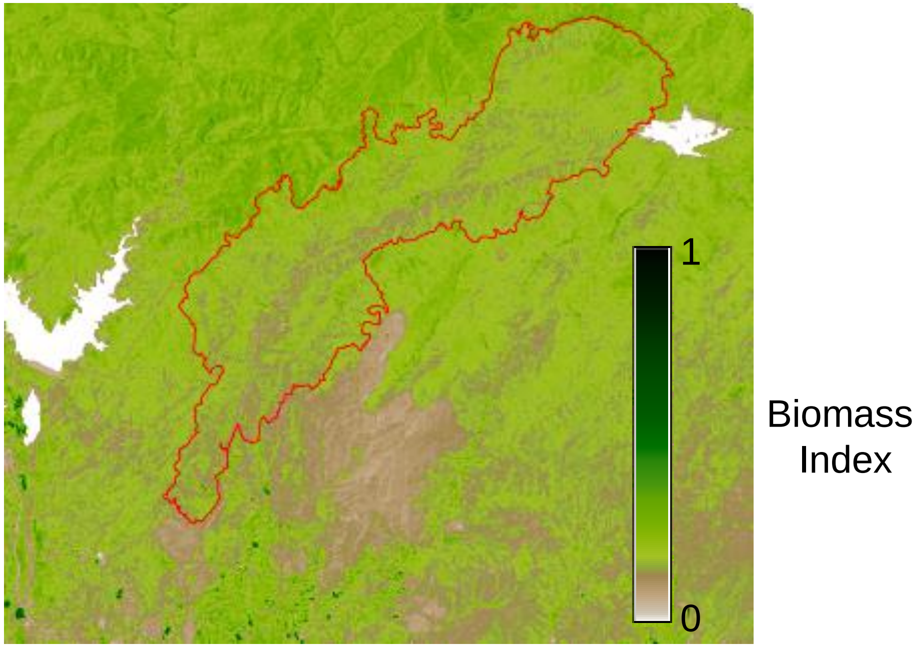
2. Prioritize restoration sites based on ecosystem services

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





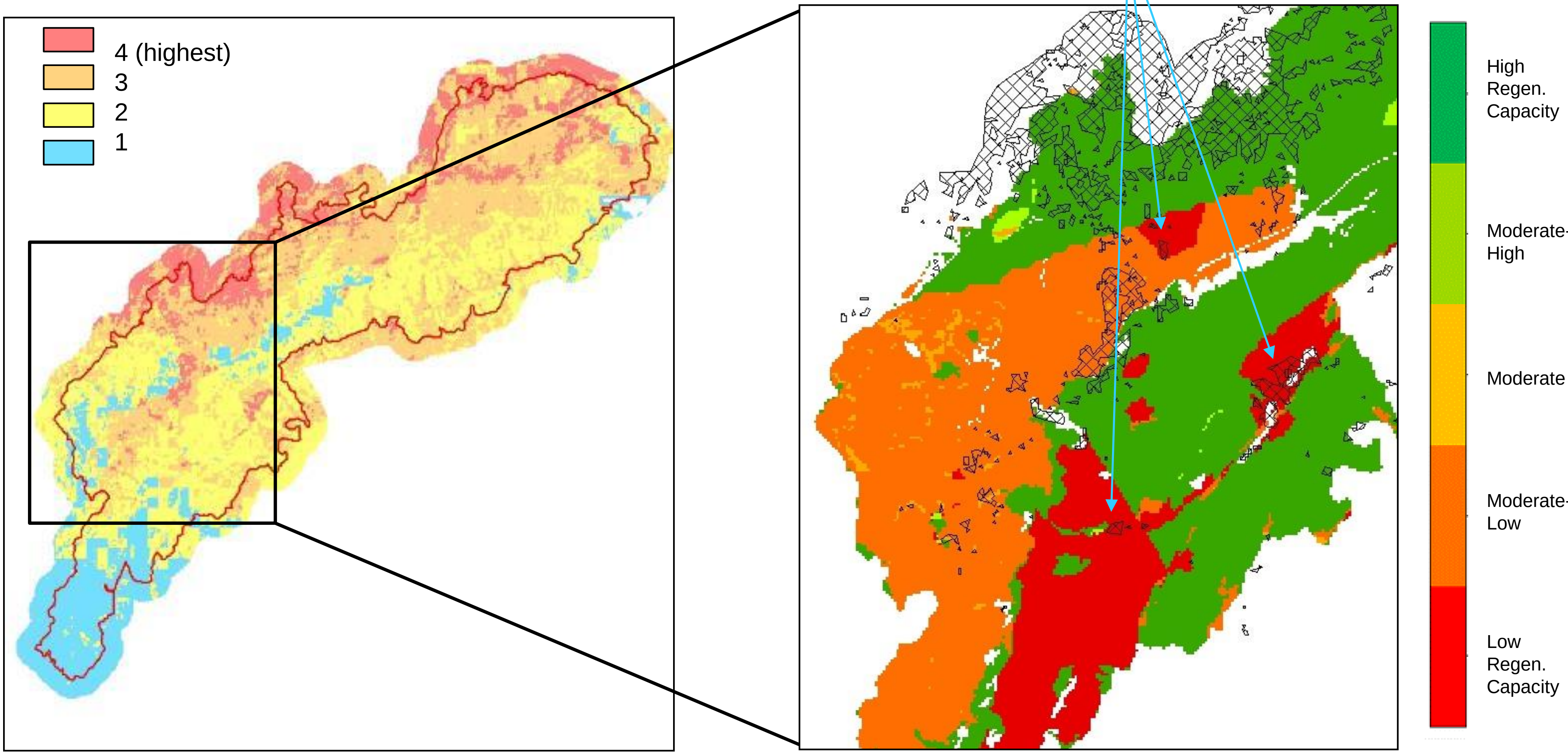




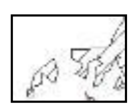
Underwood, E.C. et al. 2018. In Valuing chaparral: ecological, socio-economic, and management perspectives (Springer)

Priority areas for ecosystem services

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



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

 Priority area for ecosystem services