

Mid Scale Data

Data to Model Ecosystem Service Outputs for Agency Planning

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OSU | PSU | UO



Oregon

Biodiversity
Information Center



Portland State
UNIVERSITY

Presentation Goals & Outline

1. What is Mid-Scale Data and how does it compare to National and Local scale info?
2. How is it generated?
3. What does it get you and why is it needed for ecosystem service outputs?
4. How is it used in agency planning?

What is Mid-Scale Data?

- Defined by
 - Spatial Extent
 - Spatial Resolution
 - Attribute Resolution

Spatial Extent

- Local (e.g., map of birds at PDX)
- Regional (e.g., GNN maps of the PNW)
- Nationwide (e.g., LANDFIRE EVT, USGS GAP vegetation)

Spatial Resolution

- Fine-scale data = 1m or finer spatial resolution (NAIP or LIDAR)
- Mid-scale resolution = 30m spatial resolution (Landsat)
- Broad-scale resolution $\geq$ 250m spatial resolution (Modis)

Attribute resolution

- Single-species maps
- Community types (e.g., Ecological Systems)
- Multivariate information on vegetation community composition and structure
 - NN Imputation = a multivariate prediction
 - Maintenance of covariance structure (Henderson et al. 2009)
- Confidence of predictions

Uses for estimating ecosystem services

- When data depth is needed
- Flexible vegetation summaries.
- When accurate areal representation over large areas is of primary importance. (e.g., 'how much of watershed 'x' is covered with closed-canopy forests?')

National Gap Analysis Program (GAP) | Land Cover Data Viewer

[GAP HOME](#)

[LAND COVER HOME](#)

[Contact](#)

Build a Map

Select a Land Cover Area

State

County

- or -

LCC

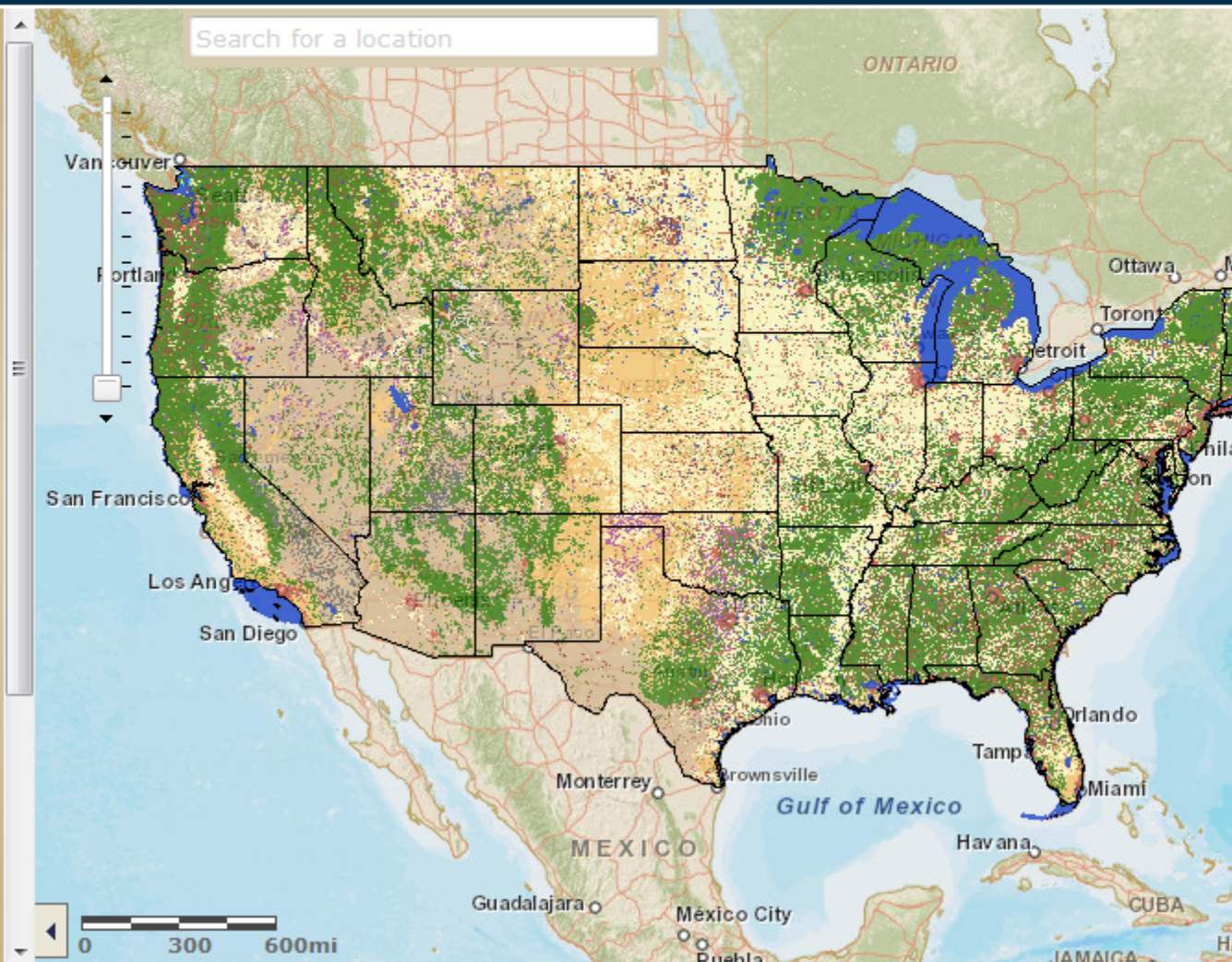
Select NVC Level or Land Use Class

- ☒ Class
☐ Formation
☐ Macrogroup
☐ Ecological System

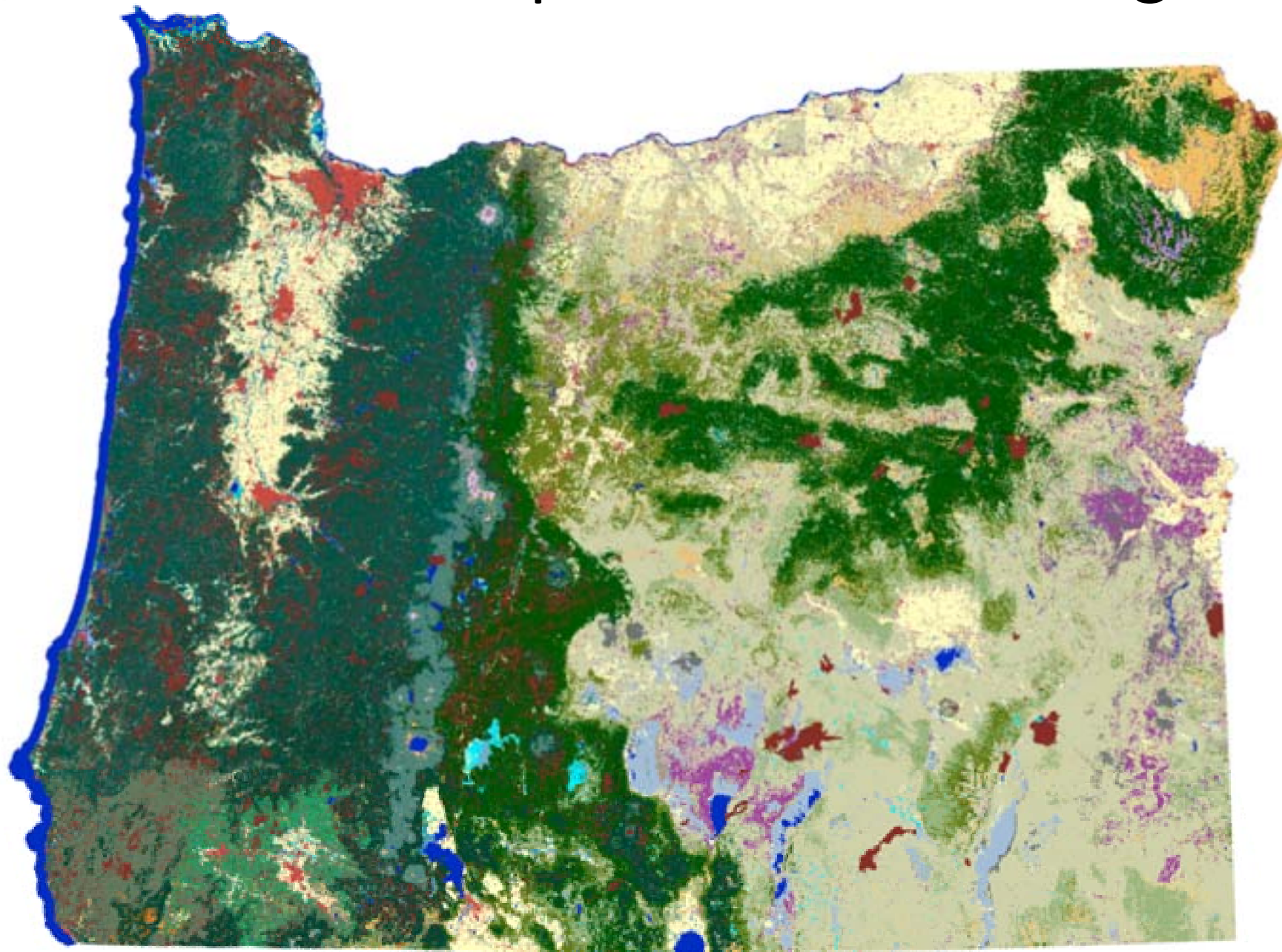
Please select a state or LCC to view Macrogroups and Ecological Systems.

Legend

- Forest & Woodland
- Shrubland & Grassland
- Semi-Desert
- Polar & High Montane Vegetation
- Aquatic Vegetation
- Nonvascular & Sparse Vascular Rock Vegetation
- Agricultural Vegetation
- Developed & Other Human Use
- Introduced & Semi Natural Vegetation



2008 USGS Gap Landcover in Oregon



Legend

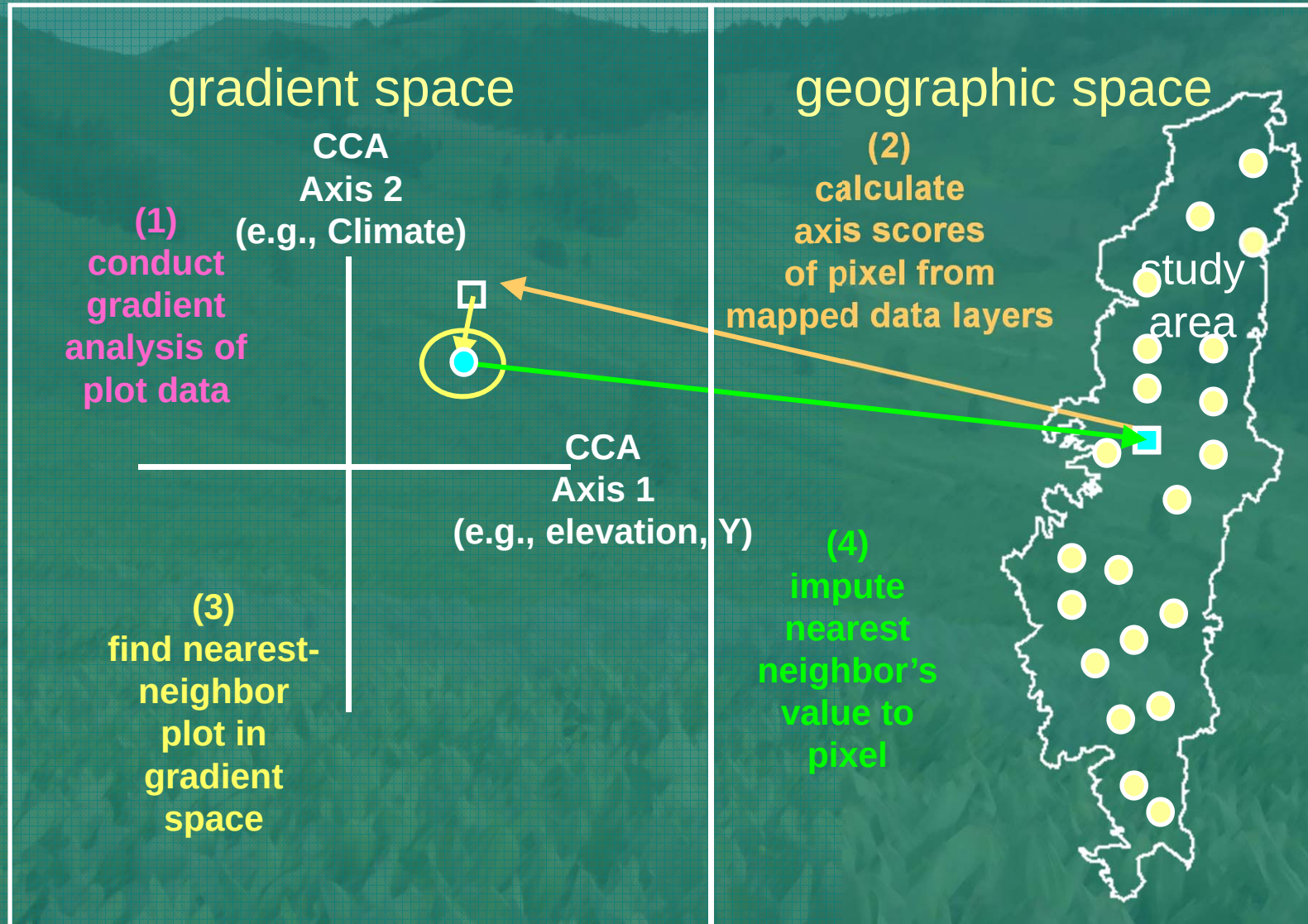
ECOLSYS_LU

California Coastal Closed-Cone Conifer Forest and Woodland	Inter-Mountain Basins Cliff and Canyon	North Pacific Alpine and Subalpine Bedrock and Scree	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland
California Coastal Redwood Forest	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	North Pacific Alpine and Subalpine Dry Grassland	Northern Rocky Mountain Ponderosa Pine Woodland and Savanna
California Mesic Chaparral	Inter-Mountain Basins Greasewood Flat	North Pacific Avalanche Chute Shrubland	Northern Rocky Mountain Subalpine Deciduous Shrubland
California Mesic Serpentine Grassland	Inter-Mountain Basins Juniper Savanna	North Pacific Bog and Fen	Northern Rocky Mountain Subalpine Woodland and Parkland
California Montane Jeffrey Pine-(Ponderosa Pine) Woodland	Inter-Mountain Basins Mixed Salt Desert Scrub	North Pacific Broadleaf Landslide Forest and Shrubland	Northern Rocky Mountain Subalpine-Upper Montane Grassland
California Montane Woodland and Chaparral	Inter-Mountain Basins Montane Sagebrush Steppe	North Pacific Coastal Cliff and Bluff	Northern Rocky Mountain Western Larch Savanna
California Northern Coastal Grassland	Inter-Mountain Basins Playa	North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow	Open Water (Brackish/Salt)
California Xeric Serpentine Chaparral	Inter-Mountain Basins Semi-Desert Grassland	North Pacific Dry Douglas-fir-(Madroño) Forest and Woodland	Open Water (Fresh)
Columbia Basin Foothill and Canyon Dry Grassland	Inter-Mountain Basins Semi-Desert Shrub Steppe	North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest	Orchards/Vineyards and Other High Structure Agriculture
Columbia Basin Foothill Riparian Woodland and Shrubland	Inter-Mountain Basins Volcanic Rock and Cinder Land	North Pacific Hardwood-Conifer Swamp	Pasture/Hay
Columbia Basin Palouse Prairie	Inter-Mountain Basins Wash	North Pacific Herbaceous Bald and Bluff	Quarries, Mines, Gravel Pits and Oil Wells
Columbia Plateau Ash and Tuff Badland	Introduced Riparian and Wetland Vegetation	North Pacific Hypermaritime Shrub and Herbaceous Headland	Recently Burned
Columbia Plateau Low Sagebrush Steppe	Introduced Upland Vegetation - Annual Grassland	North Pacific Hypermaritime Sitka Spruce Forest	Recently burned forest
Columbia Plateau Scabland Shrubland	Introduced Upland Vegetation - Perennial Grassland and Forbland	North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest	Recently burned grassland
Columbia Plateau Silver Sagebrush Seasonally Flooded Shrub-Steppe	Introduced Upland Vegetation - Shrub	North Pacific Intertidal Freshwater Wetland	Recently burned shrubland
Columbia Plateau Stepped and Grassland	Introduced Upland Vegetation - Treed	North Pacific Lowland Mixed Hardwood-Conifer Forest and Woodland	Rocky Mountain Alpine Bedrock and Scree
Columbia Plateau Vernal Pool	Klamath-Siskiyou Cliff and Outcrop	North Pacific Lowland Riparian Forest and Shrubland	Rocky Mountain Alpine Fell-Field
Columbia Plateau Western Juniper Woodland and Savanna	Klamath-Siskiyou Lower Montane Serpentine Mixed Conifer Woodland	North Pacific Maritime Coastal Sand Dune and Strand	Rocky Mountain Alpine-Montane Wet Meadow
Cultivated Cropland	Klamath-Siskiyou Upper Montane Serpentine Mixed Conifer Woodland	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	Rocky Mountain Aspen Forest and Woodland
Developed, High Intensity	Klamath-Siskiyou Xeromorphic Serpentine Savanna and Chaparral	North Pacific Maritime Mesic Subalpine Parkland	Rocky Mountain Cliff, Canyon and Massive Bedrock
Developed, Low Intensity	Mediterranean California Alpine Dry Tundra	North Pacific Maritime Mesic Wet Douglas-fir-Western Hemlock Forest	Rocky Mountain Lodgepole Pine Forest
Developed, Medium Intensity	Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland	North Pacific Mesic Western Hemlock-Silver Fir Forest	Rocky Mountain Lower Montane Riparian Woodland and Shrubland
Developed, Open Space	Mediterranean California Foothill and Lower Montane Riparian Woodland	North Pacific Montane Grassland	Rocky Mountain Poor-Site Lodgepole Pine Forest
Disturbed, Non-specific	Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland	North Pacific Montane Massive Bedrock, Cliff and Talus	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
East Cascades Mesic Montane Mixed-Conifer Forest and Woodland	Mediterranean California Mesic Mixed Conifer Forest and Woodland	North Pacific Montane Riparian Woodland and Shrubland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland
East Cascades Oak-Ponderosa Pine Forest and Woodland	Mediterranean California Mesic Serpentine Woodland and Chaparral	North Pacific Montane Shrubland	Rocky Mountain Subalpine-Montane Fen
Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland	Mediterranean California Mixed Evergreen Forest	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland
Great Basin Piñon-Juniper Woodland	Mediterranean California Mixed Oak Woodland	North Pacific Oak Woodland	Rocky Mountain Subalpine-Montane Mesic Meadow
Great Basin Xeric Mixed Sagebrush Shrubland	Mediterranean California Northern Coastal Dune	North Pacific Shrub Swamp	Rocky Mountain Subalpine-Montane Riparian Shrubland
Harvested Forest - Grass/Forb Regeneration	Mediterranean California Red Fir Forest	North Pacific Wooded Volcanic Flowage	Rocky Mountain Subalpine-Montane Riparian Woodland
Harvested Forest - Northwestern Conifer Regeneration	Mediterranean California Serpentine Barrens	Northern and Central California Dry-Mesic Chaparral	Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland
Harvested Forest-Shrub Regeneration	Mediterranean California Serpentine Fen	Northern California Claypan Vernal Pool	Sierran-Intermontane Desert Western White Pine-White Fir Woodland
Inter-Mountain Basins Active and Stabilized Dune	Mediterranean California Serpentine Foothill and Lower Montane Riparian Woodland and Shrubland	Northern California Coastal Scrub	Temperate Pacific Freshwater Aquatic Bed
Inter-Mountain Basins Alkaline Closed Depression	Mediterranean California Subalpine Meadow	Northern California Mesic Subalpine Woodland	Temperate Pacific Freshwater Emergent Marsh
Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	Mediterranean California Subalpine Woodland	Northern Rocky Mountain Conifer Swamp	Temperate Pacific Freshwater Mudflat
Inter-Mountain Basins Big Sagebrush Shrubland	Mediterranean California Subalpine-Montane Fen	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	Temperate Pacific Montane Wet Meadow
Inter-Mountain Basins Big Sagebrush Steppe	North American Alpine Ice Field	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland	Temperate Pacific Tidal Salt and Brackish Marsh
	North American Arid West Emergent Marsh	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland	Unconsolidated Shore
	North Pacific Active Volcanic Rock and Cinder Land	Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	Willamette Valley Upland Prairie and Savanna
			Willamette Valley Wet Prairie

What's missing in GAP?

- Vegetation Structure
 - useful for estimating habitat value for wildlife or carbon or wood product availability
- Site attributes (down wood, snags, litter)
 - Useful for evaluating fire risk, wildlife habitat or biomass
- Species Composition of the Vegetation (system)
 - Useful for summarizing ecological condition
 - (e.g., invasive species)

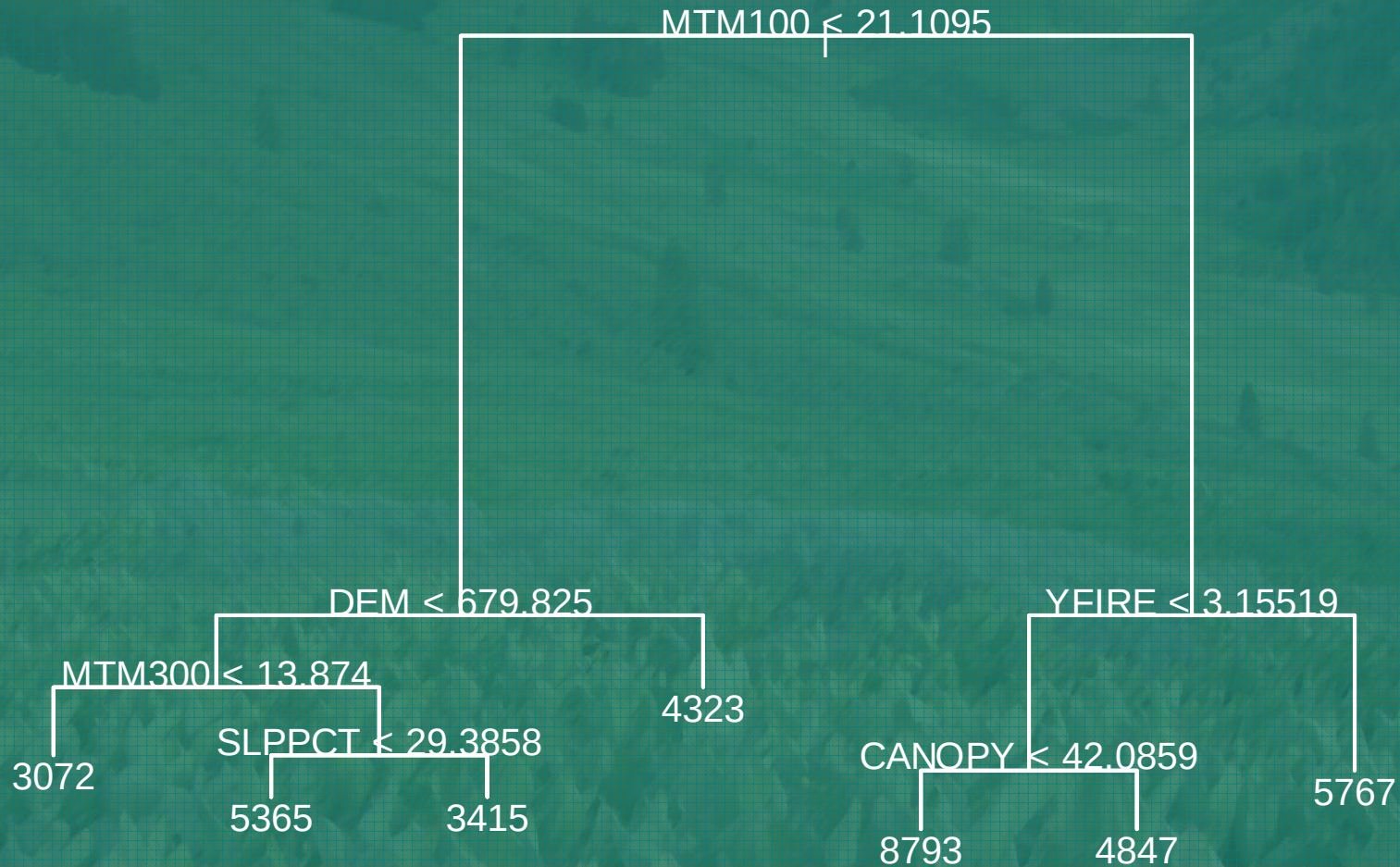
Methods: GNN



Using nationally available FIA & AIM data to generate midscale data

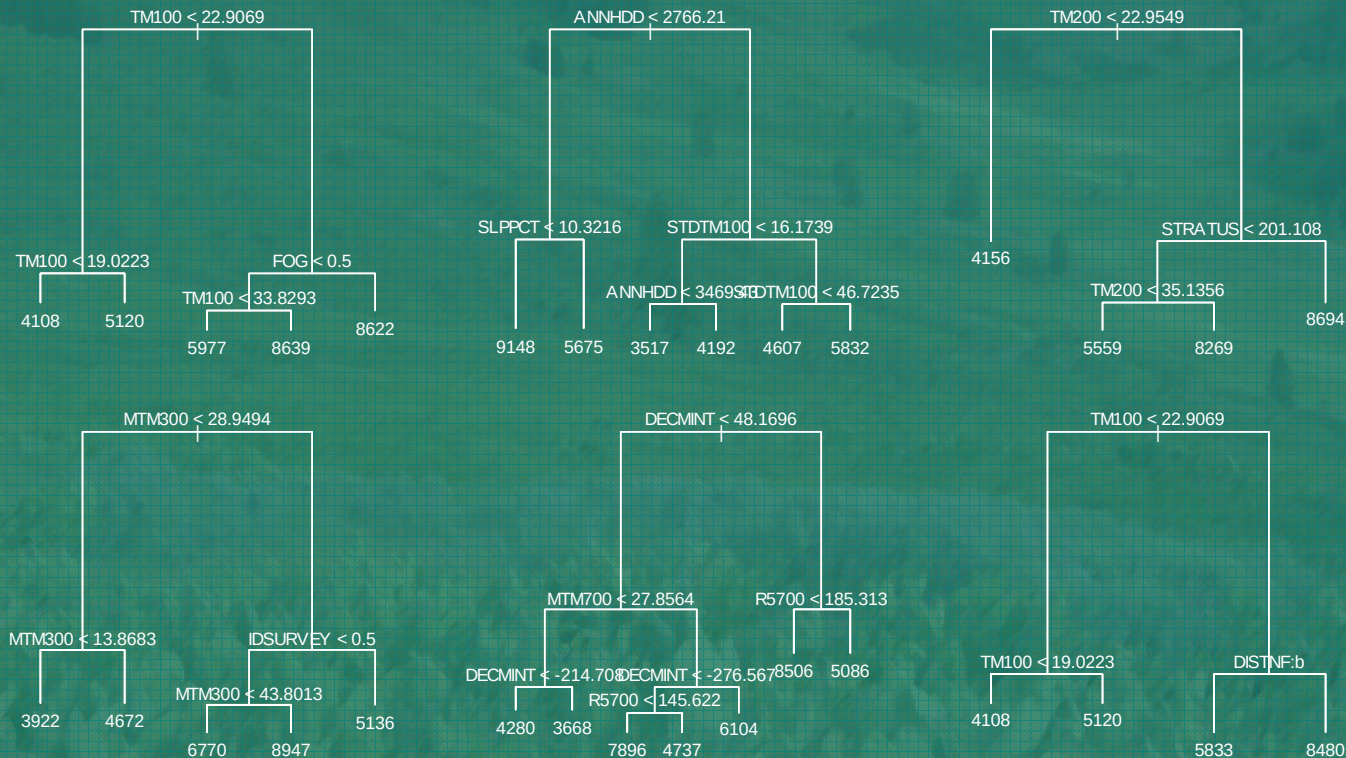
Methods: Random Forest (RFNN)

- One Classification Tree:



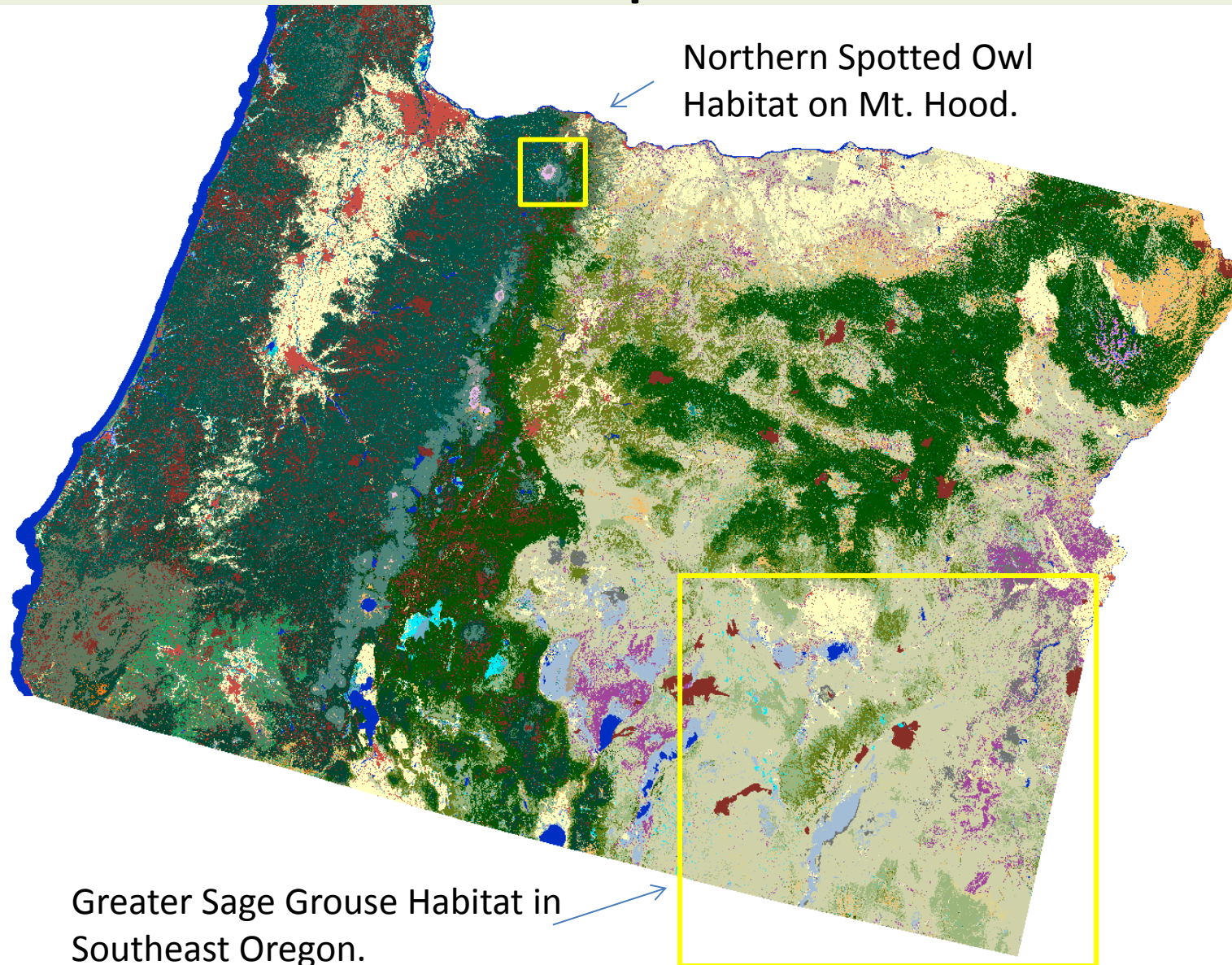
Methods: Random Forest (RFNN)

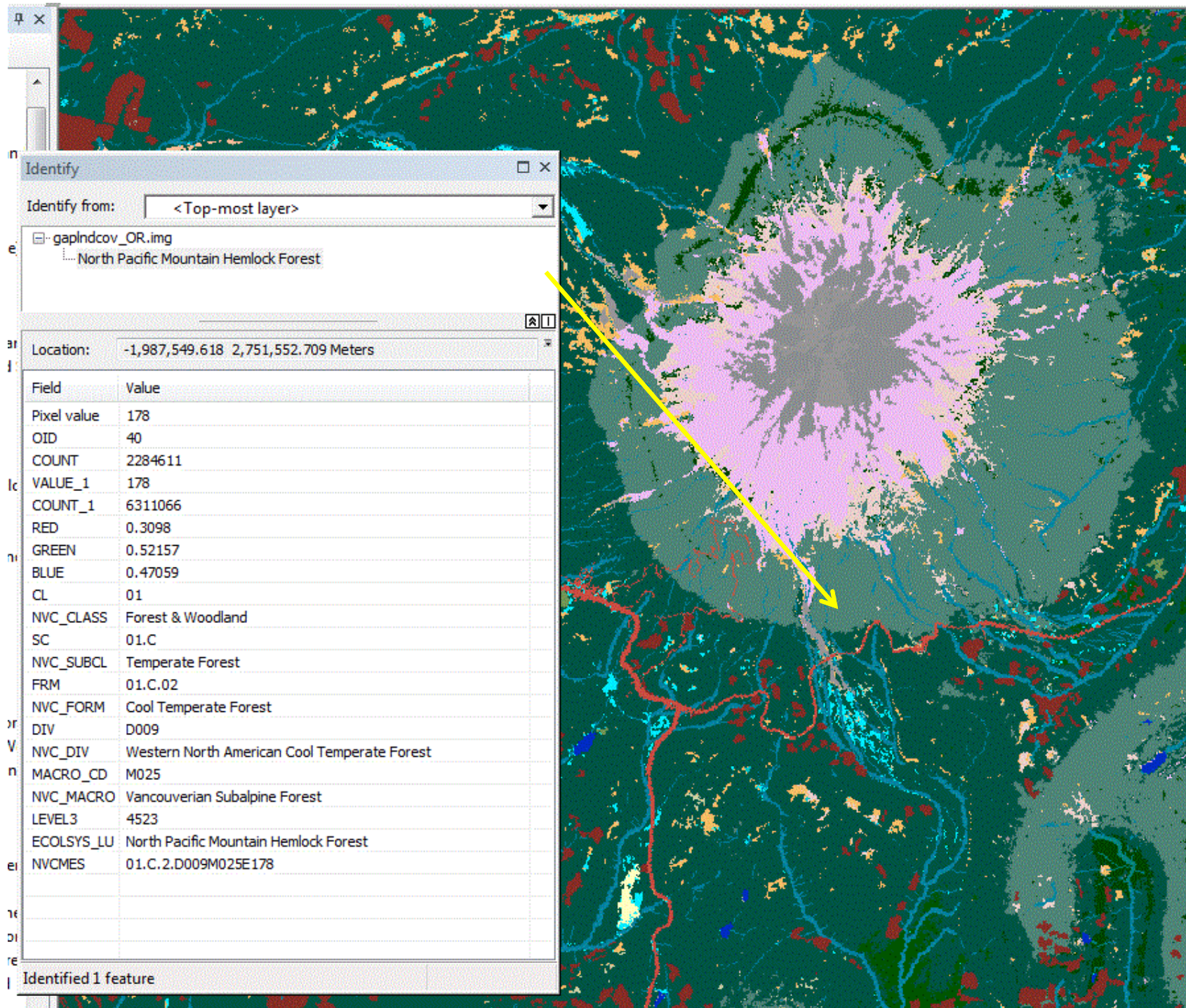
- A whole forest of classification trees!



- Each tree model is built from a random subset of explanatory variables and input data.
- When the model is applied to mapped data, each tree 'votes' on which Plot best represents a pixel should be.

Mid-Scale Data vs National Data for Species Habitat Mapping





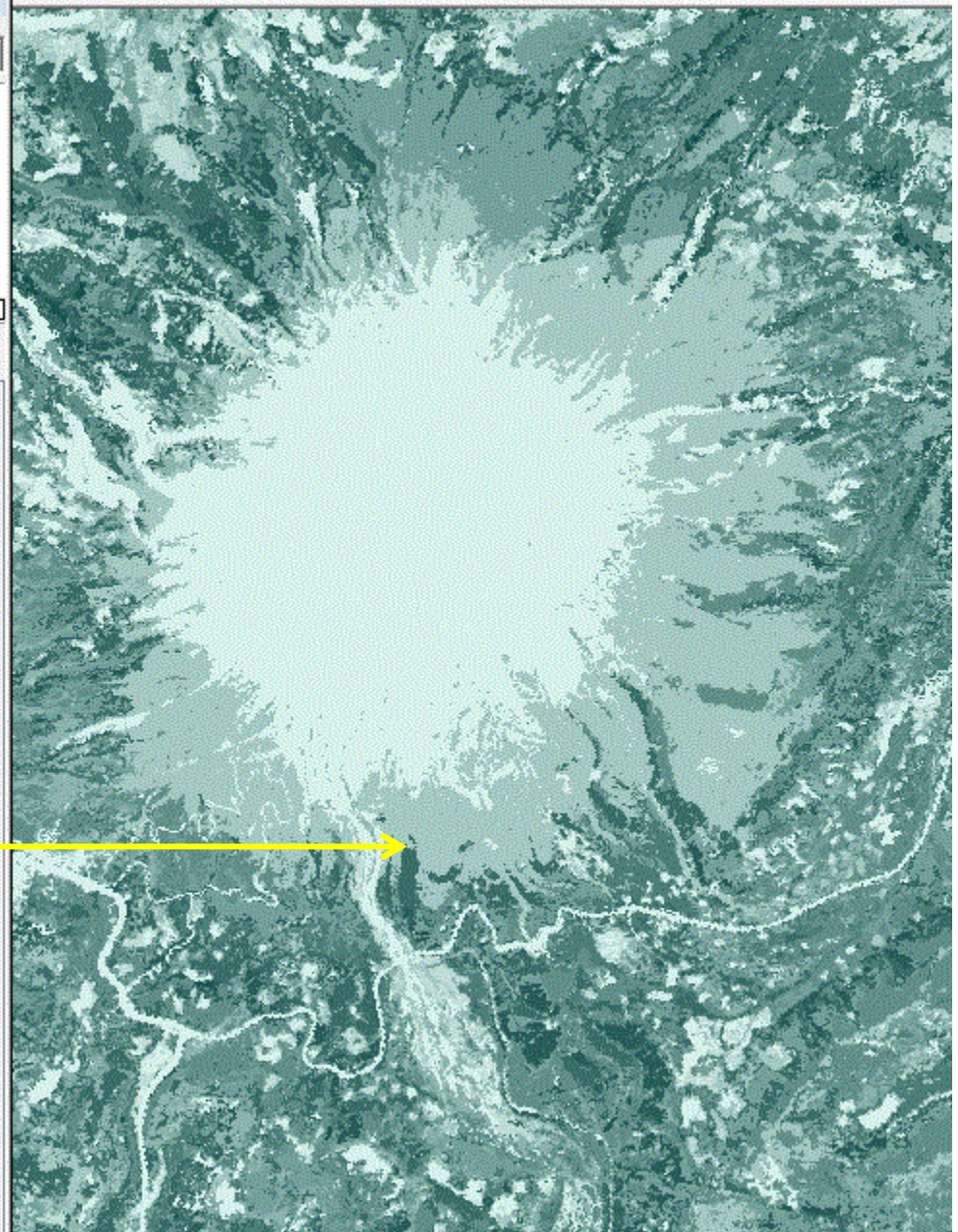
Identify

Identify from: <All layers>

- gmn_mosaic
- gaplndcov_OR.img
 - North Pacific Mountain Hemlock Forest

Location: -1,987,914.516 2,751,353.674 Meters

Field	Value
TPHTOL_GE_3	1020.9199
TPHINTOL_GE_3	216.2655
VPH_GE_3	748.3249
VPH_3_25	32.5781
VPH_25_50	99.3645
VPH_50_75	234.927
VPH_75_100	185.3636
VPH_GE_100	196.0917
VPHC_GE_3	748.3249
VPHH_GE_3	0
QMDC_DOM	63.9997
QMDH_DOM	0
QMDA_DOM	63.9997
QMDC_GE_3	24.563
QMDH_GE_3	0
QMDA_GE_3	24.563
QMDC_75PCT	49.0139
MNDBHBA_ALL	63.0359
MNDBHBA_CON	63.0359
MNDBHBA_HDW	0
STPH_12_25	158.1472
STPH_25_50	107.1534
STPH_50_75	15.7452
STPH_75_100	2
STPH_GE_100	205.0452



Identify

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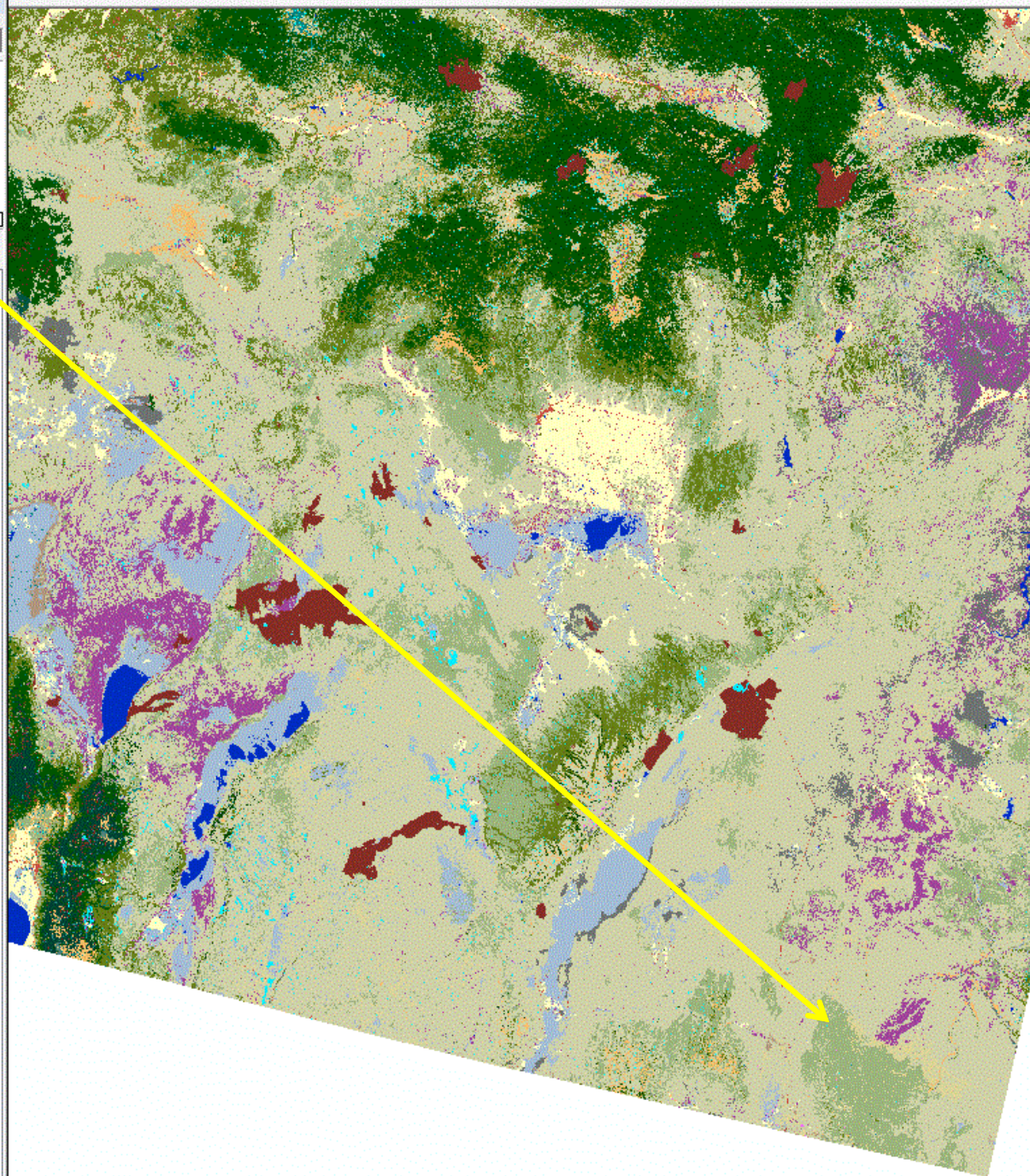
currentveg

gaplndcov_OR.img

Columbia Plateau Low Sagebrush Steppe

Location: -1,757,614.546 2,343,210.301 Meters

Field	Value
Pixel value	493
OID	112
COUNT	11159644
VALUE_1	493
COUNT_1	16021083
RED	0.61176
GREEN	0.7098
BLUE	0.4902
CL	03
NVC_CLASS	Semi-Desert
SC	03.B
NVC_SUBCL	Cool Semi-Desert Scrub & Grassland
FRM	03.B.01
NVC_FORM	Cool Semi-Desert Scrub & Grassland
DIV	D040
NVC_DIV	Western North American Cool Semi-Desert Scrub & Grassland
MACRO_CD	M170
NVC_MACRO	Great Basin & Intermountain Dwarf Sage Shrubland & Steppe
LEVEL3	5306
ECOLSYS_LU	Columbia Plateau Low Sagebrush Steppe
NVCMES	03.B.1.D040M170E493



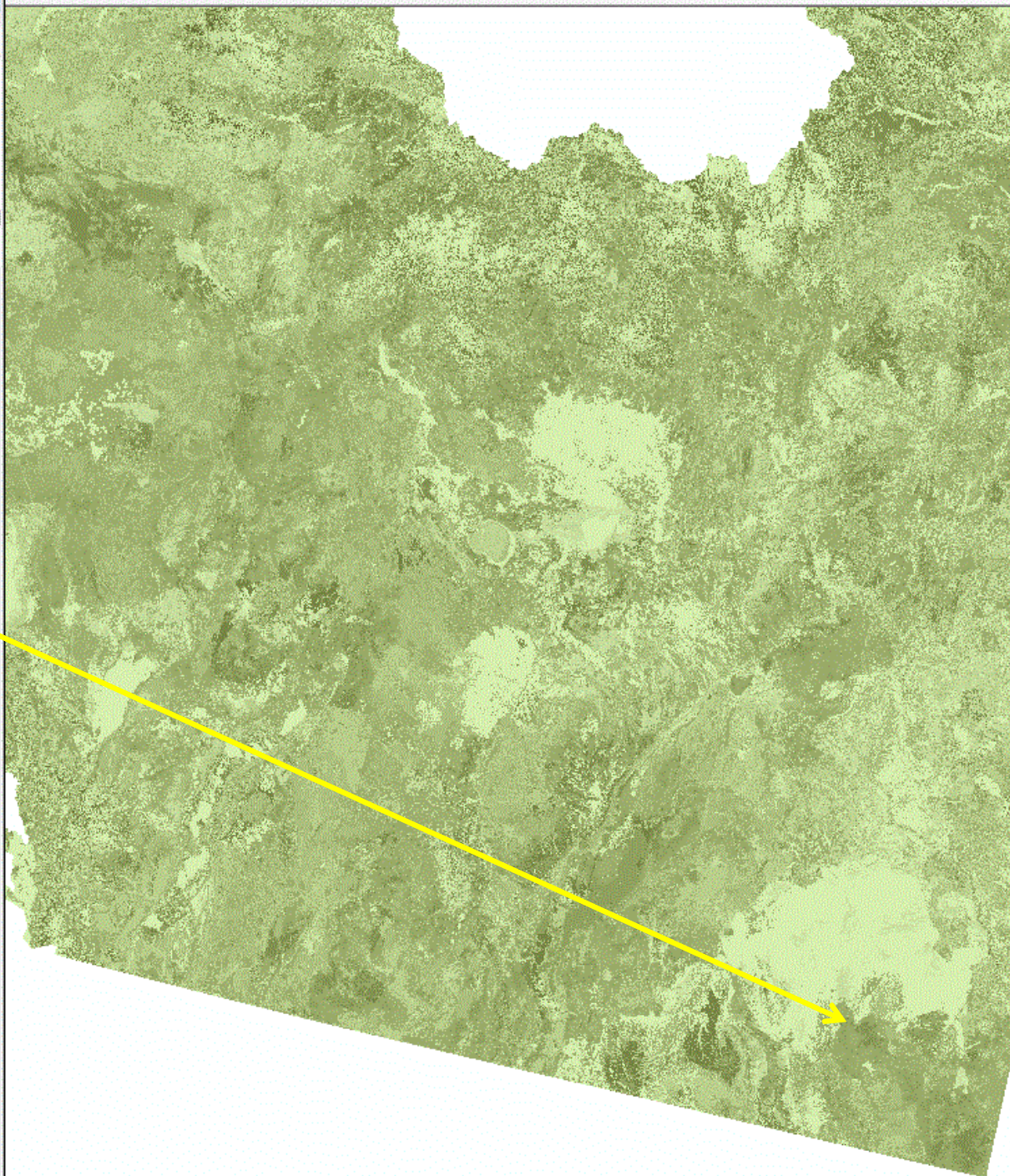
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currentveg
23
gaplndcov_.img

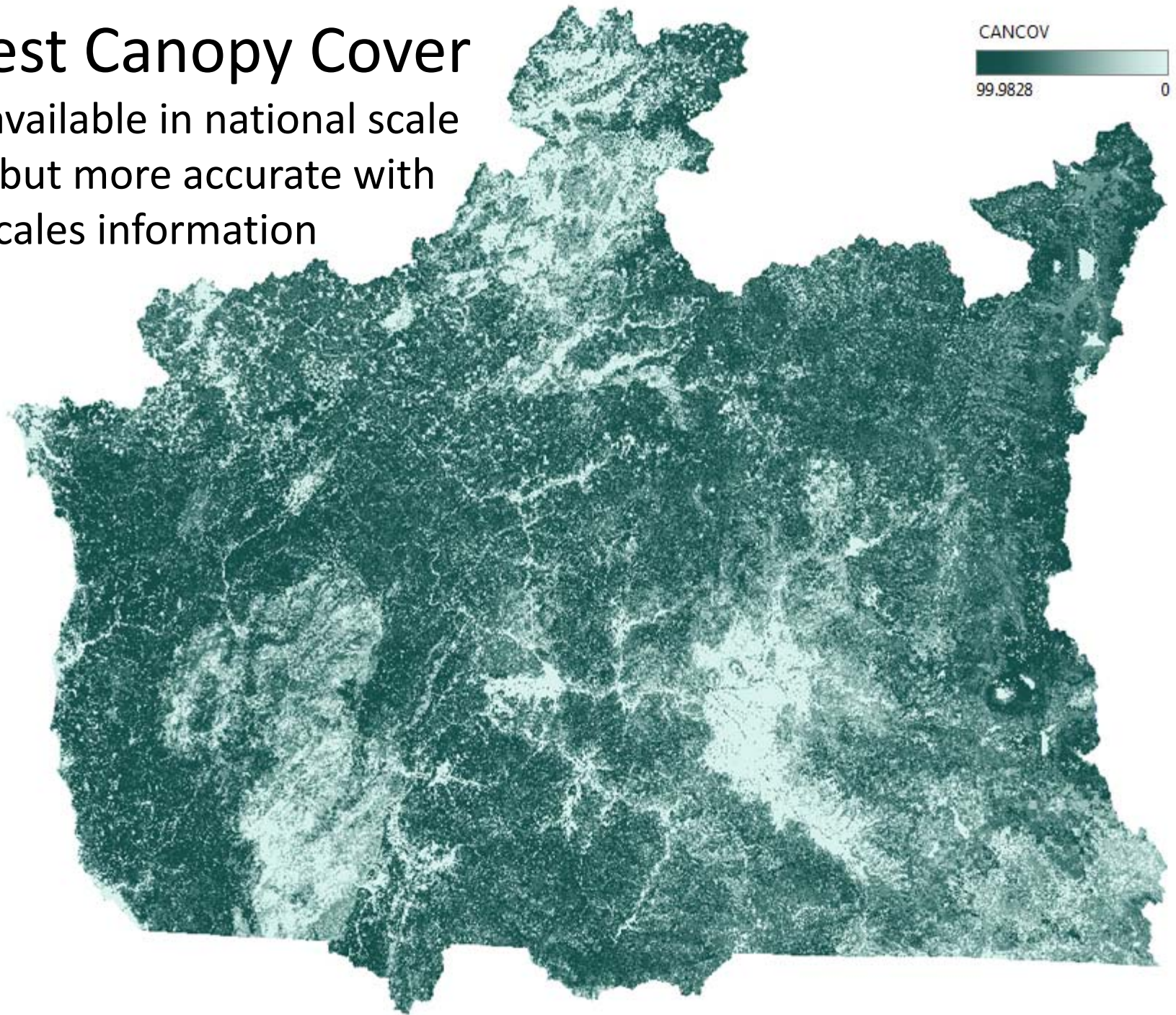
Location: 794,969.014 915,476.592 Meters

Field	Value
Class value	4
Pixel value	83018
Rowid	6784
COUNT	11732
DOMINANTSPECIES	Artemisia tridentata
TOTCOV	52.5
TREE_COV	0
SHRUB_COV	23
GRASS_COV	25
FORB_HERB_COV	4.5
SP1	ARTR2
SP2	PSSPS
SP3	FEID
SP4	PUTR2
COV1	15
COV2	15
COV3	7
COV4	5
EXOTICANNUALCOV	0
EXANNGRCOV	0
PRISTINEGRASSCOV	22
NATIVEGRASSCOV	25
ABGR	0
ABLA	0
ACGL	0
ACHY	0
ACOC3	0
ACOCO	0
ACTH7	0
AGCR	0
ALIN2	0
AMAL2	0
ARAR8	0
ARARA	0
ARCA13	0
ARNE	0
ARNO4	0
ARR12	0



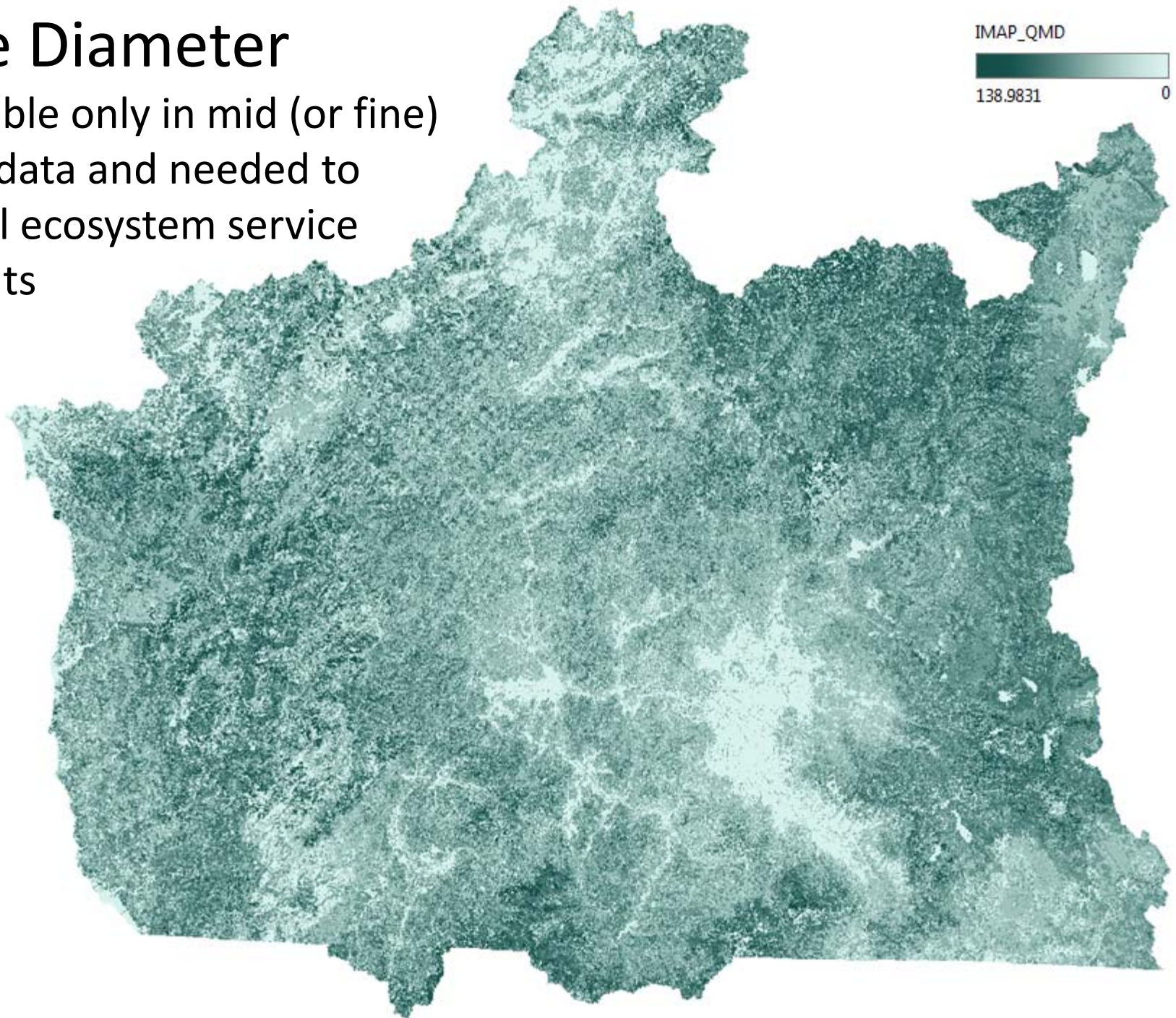
Forest Canopy Cover

Also available in national scale data, but more accurate with mid scales information



Tree Diameter

Available only in mid (or fine)
scale data and needed to
model ecosystem service
outputs

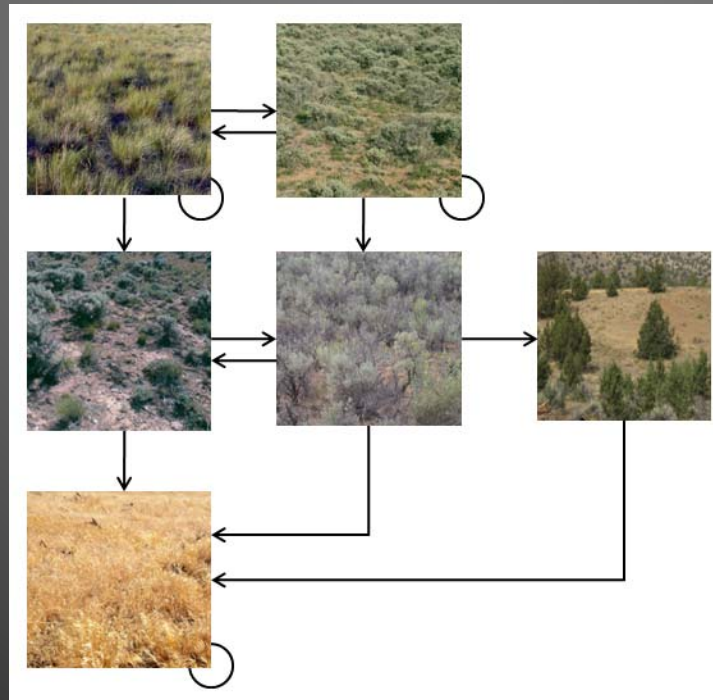


Why Is Mid Scale Data Needed to Model Ecosystem Service Outputs for Land Management Agency Planning?

Because it is the data needed to make
State and Transition Models work

State-and-Transition Models (STMs)

- Simulate changes in vegetation over time due to succession, disturbance, and management activities
- Are a modeling form of Box and Arrow Diagrams
- Agency models historically were developed in the Vegetation Dynamics Development Tool (VDDT) which are non-spatial simulations.
- These simulations run in the Path Landscape Model
- A spatial version (ST-Sim) is available from APEX (apexrms.com)



State-and-Transition Models

Herbaceous → Open shrub → Closed shrub → Woodland

Herbaceous layer:

SUCCESSION

Perennial
bunchgrasses

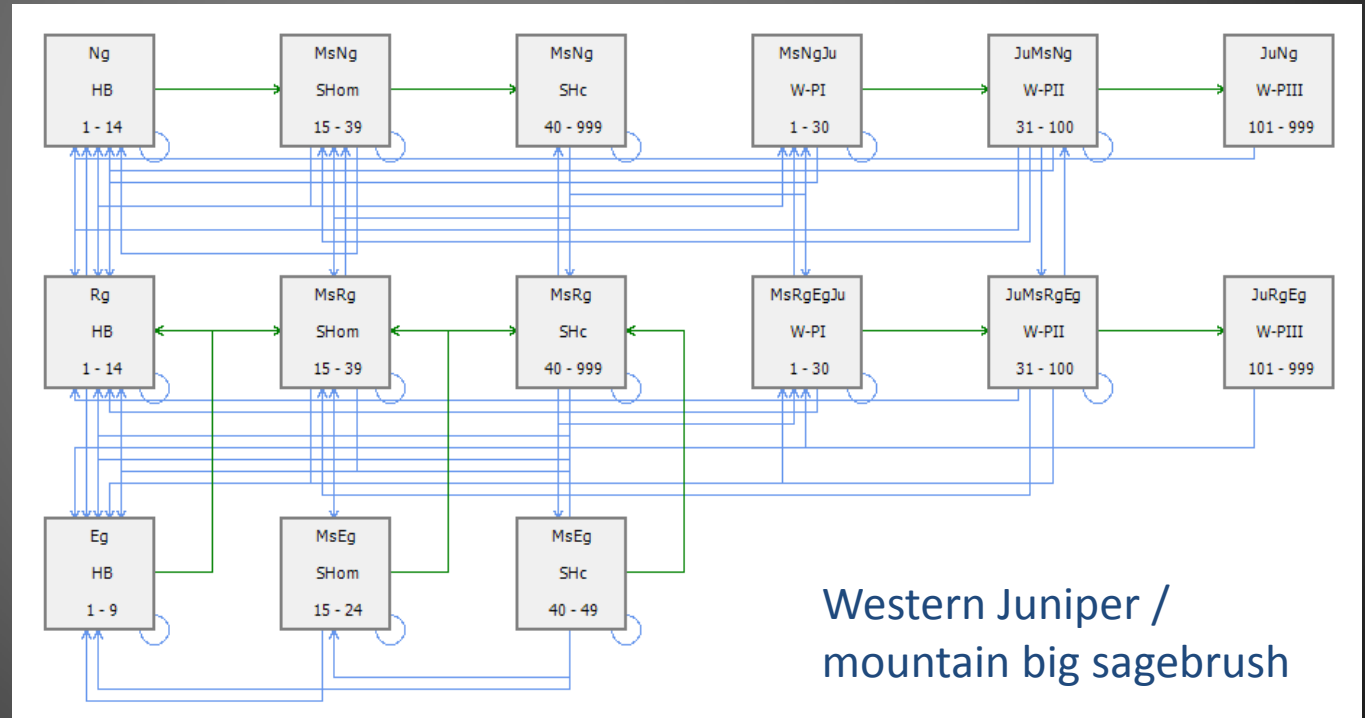


Mixed grass



Exotic annual
grasses

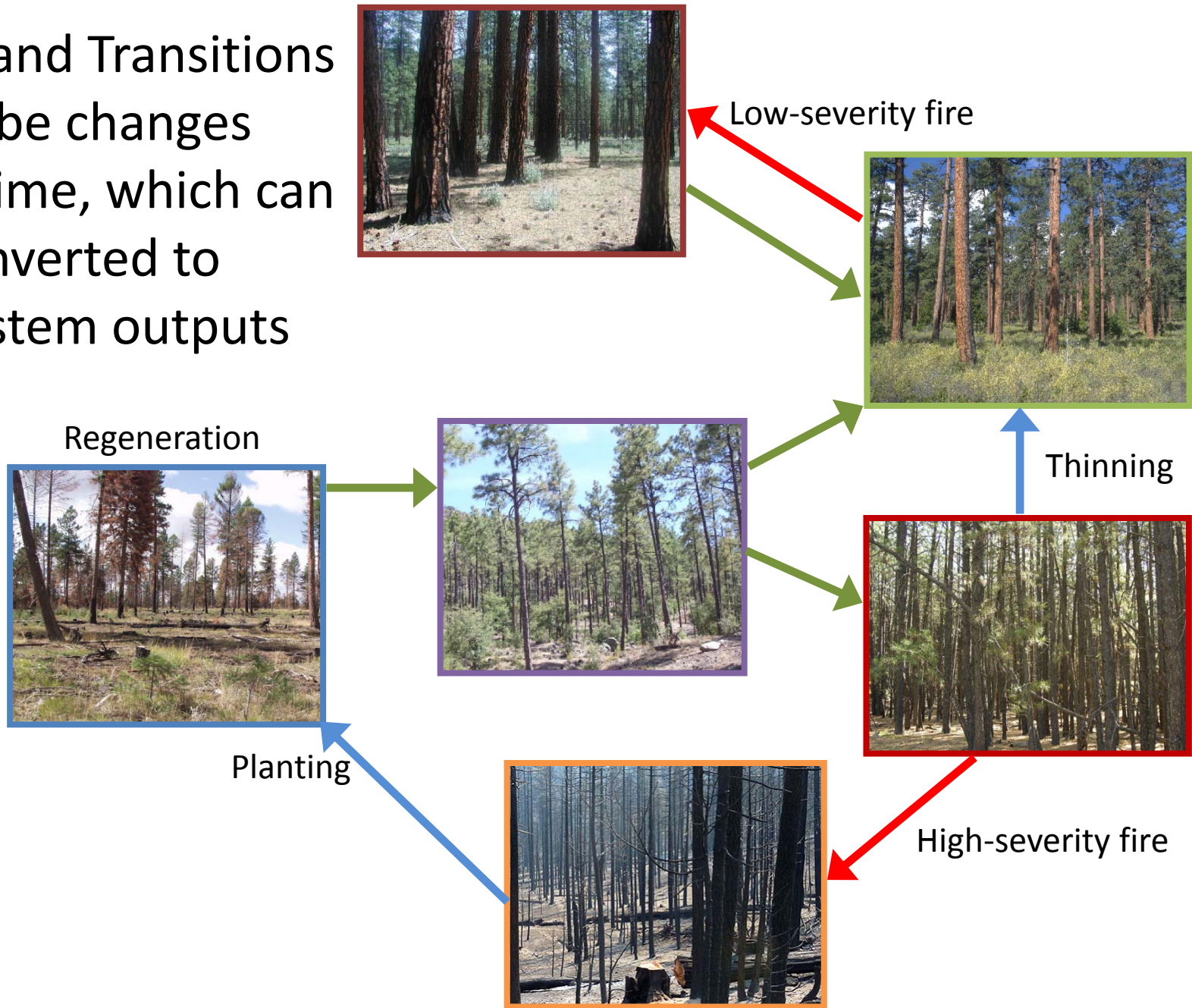
DEGRADATION



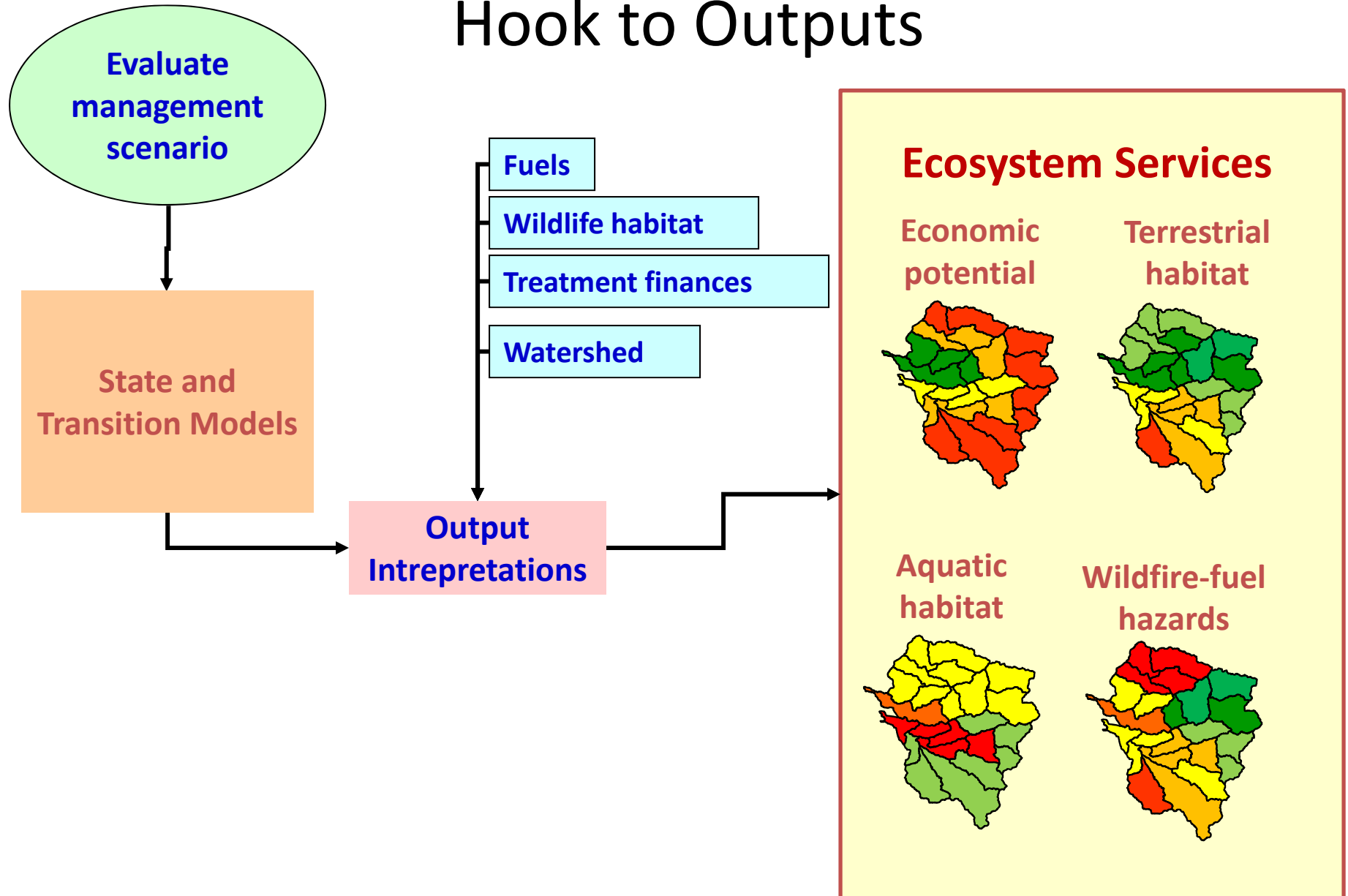
DISTURBANCE



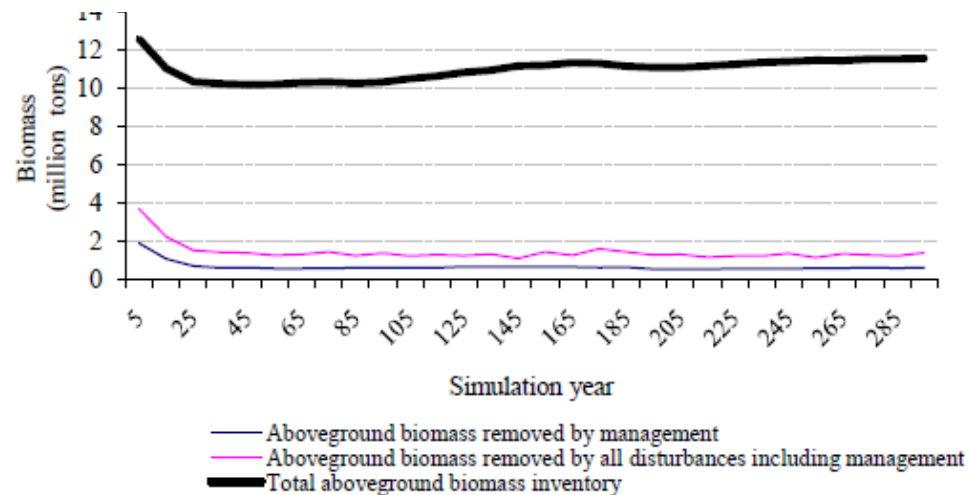
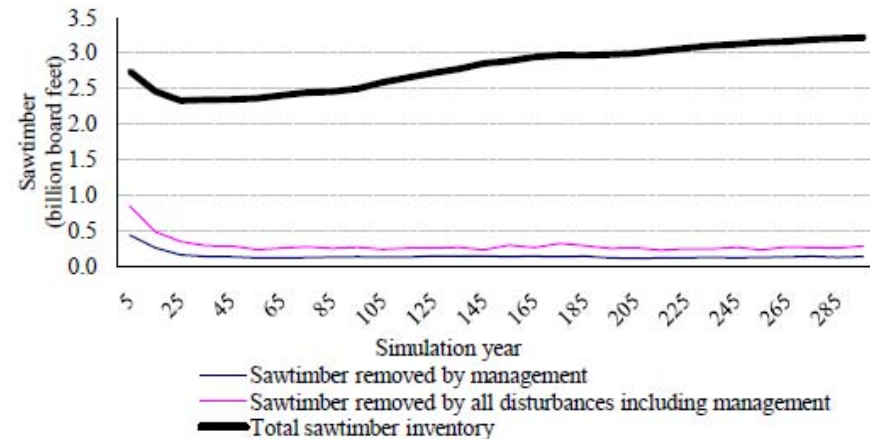
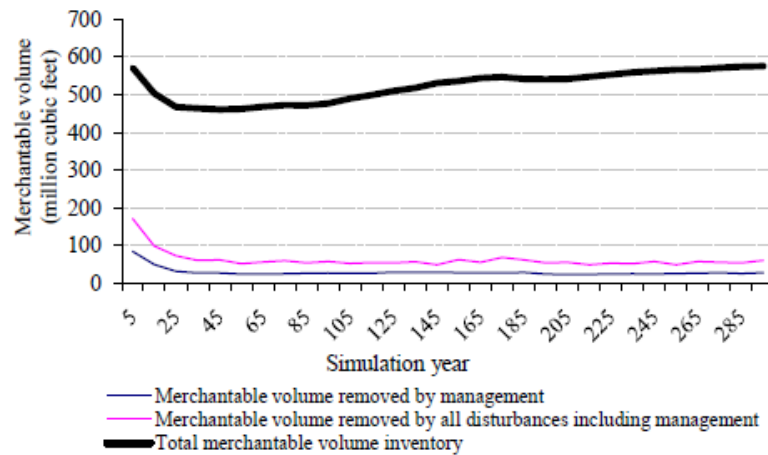
State and Transitions describe changes over time, which can be converted to ecosystem outputs



Use Mid Scale Data to Run Models and Hook to Outputs

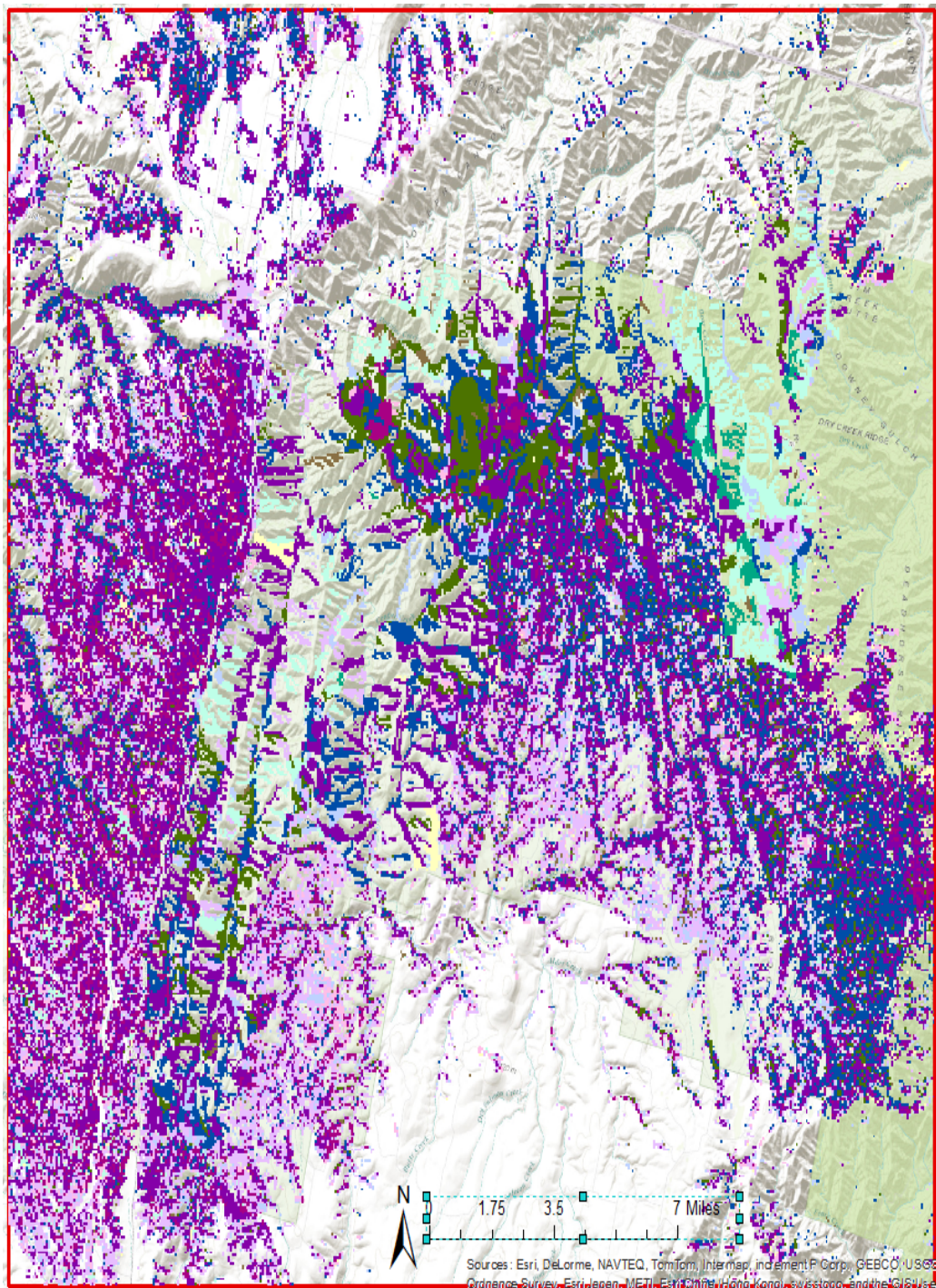


Merchantable Volume, Sawtimber, Biomass

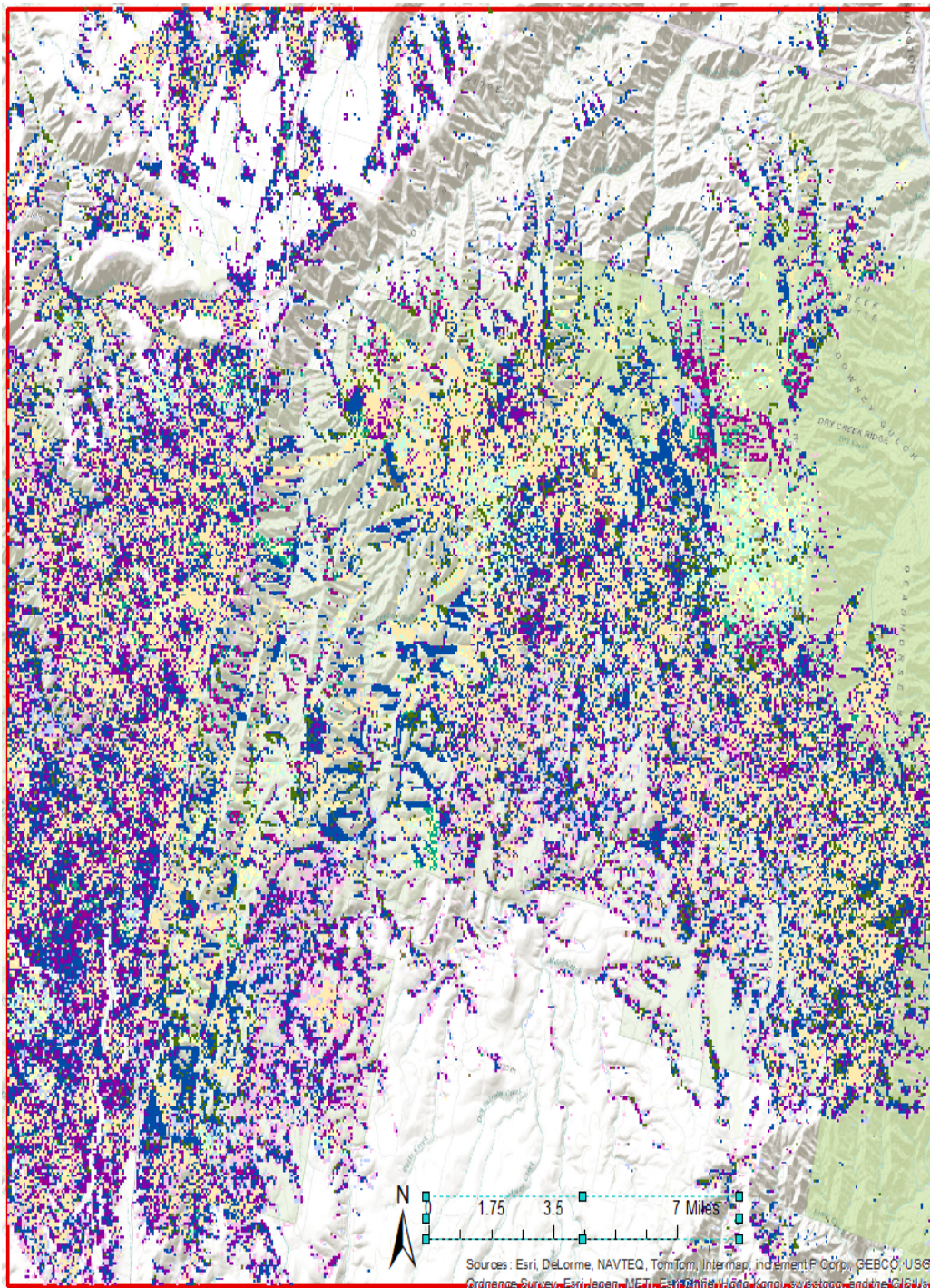


Deschutes National Forest Output Example

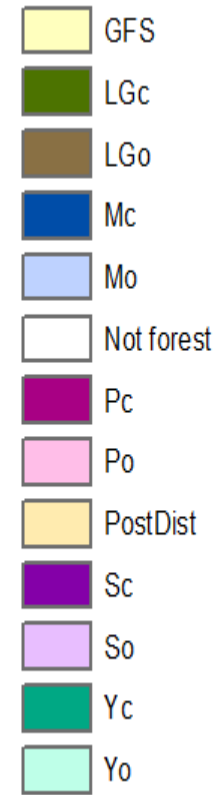
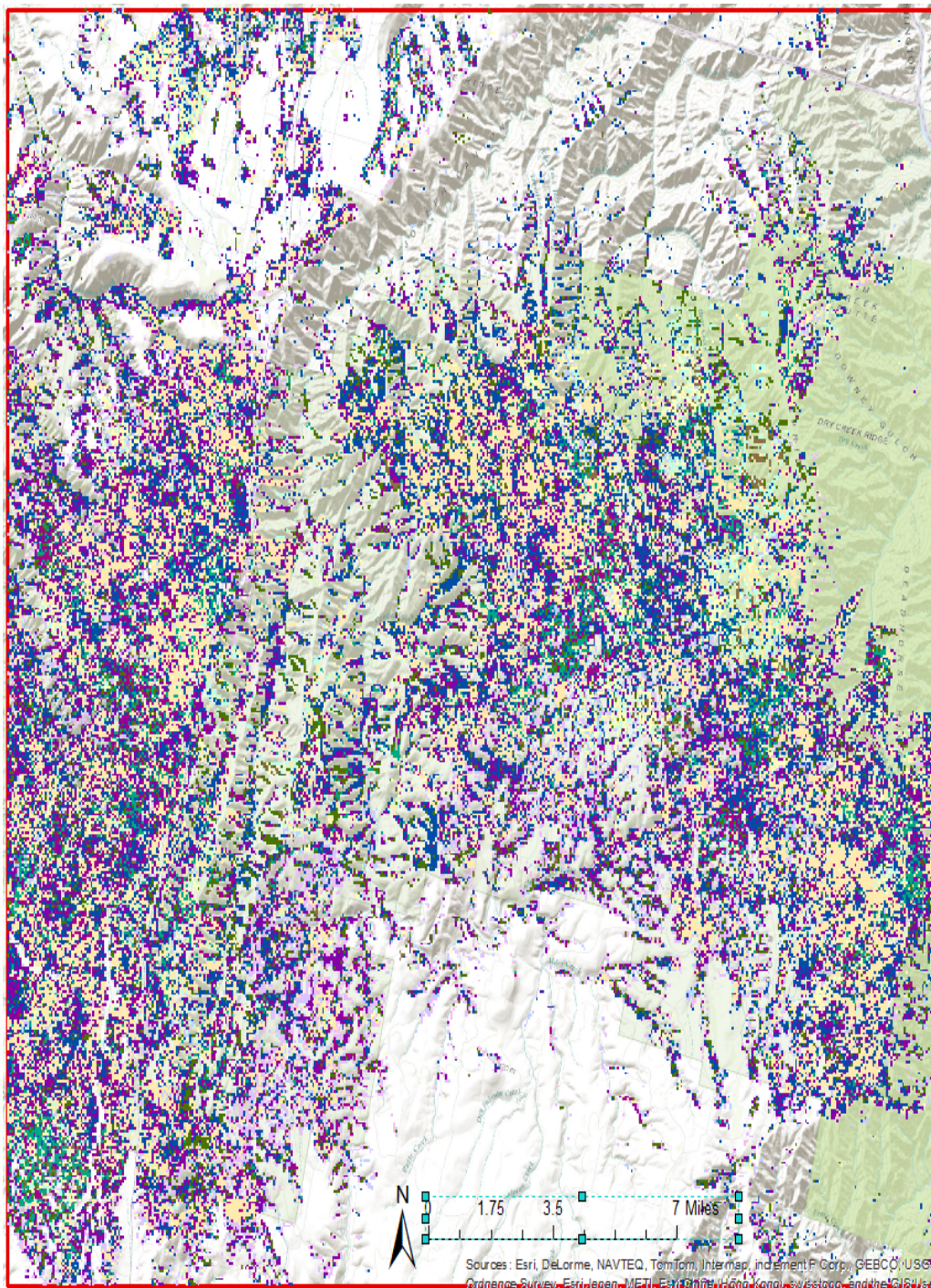
Wallowa-Whitman project area – Current Vegetation



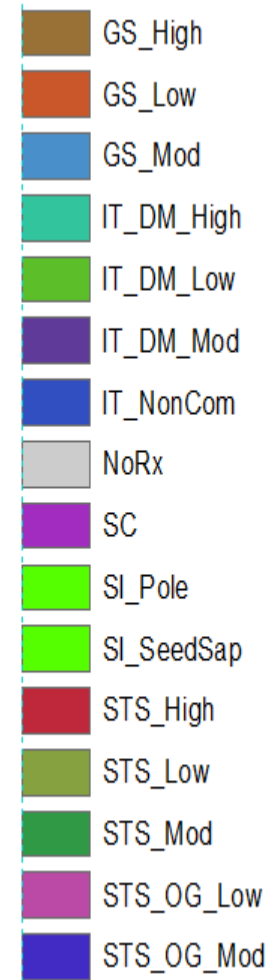
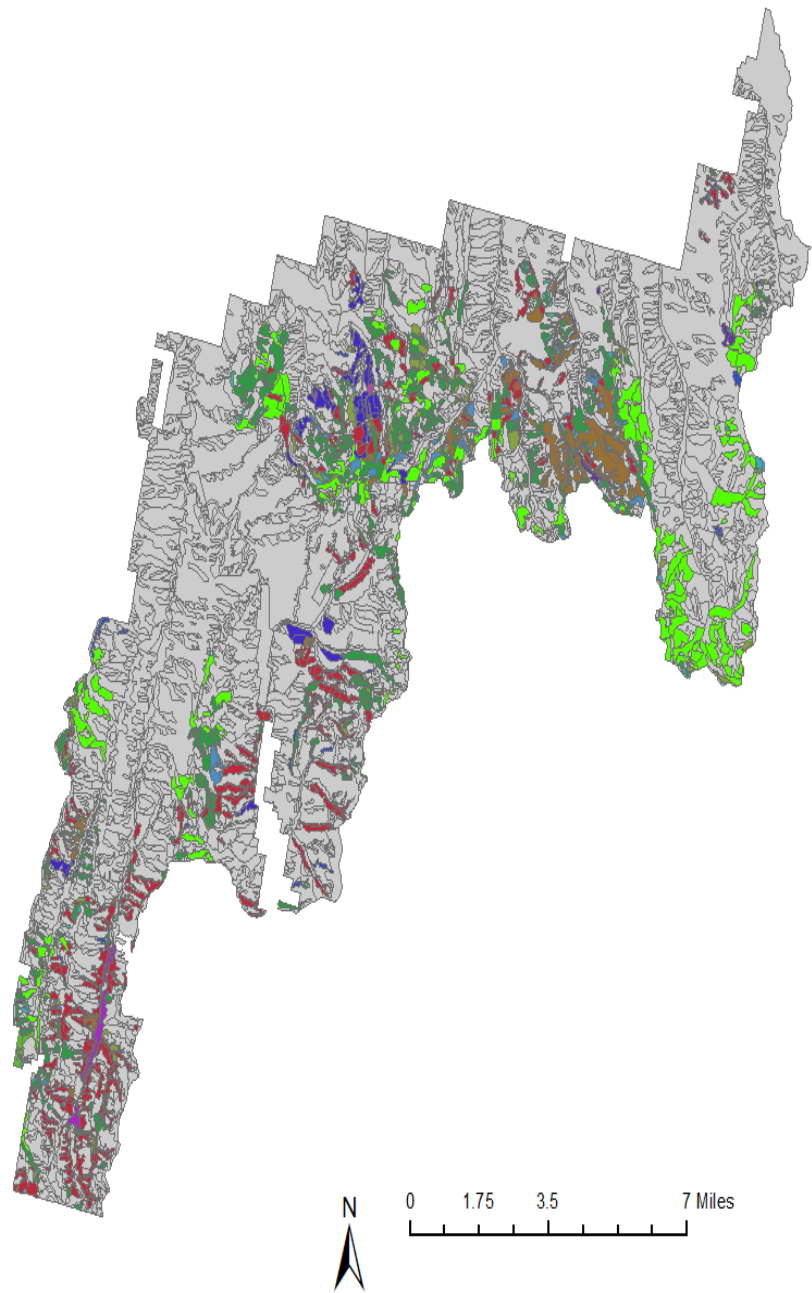
Vegetation No Treatments 30 Years



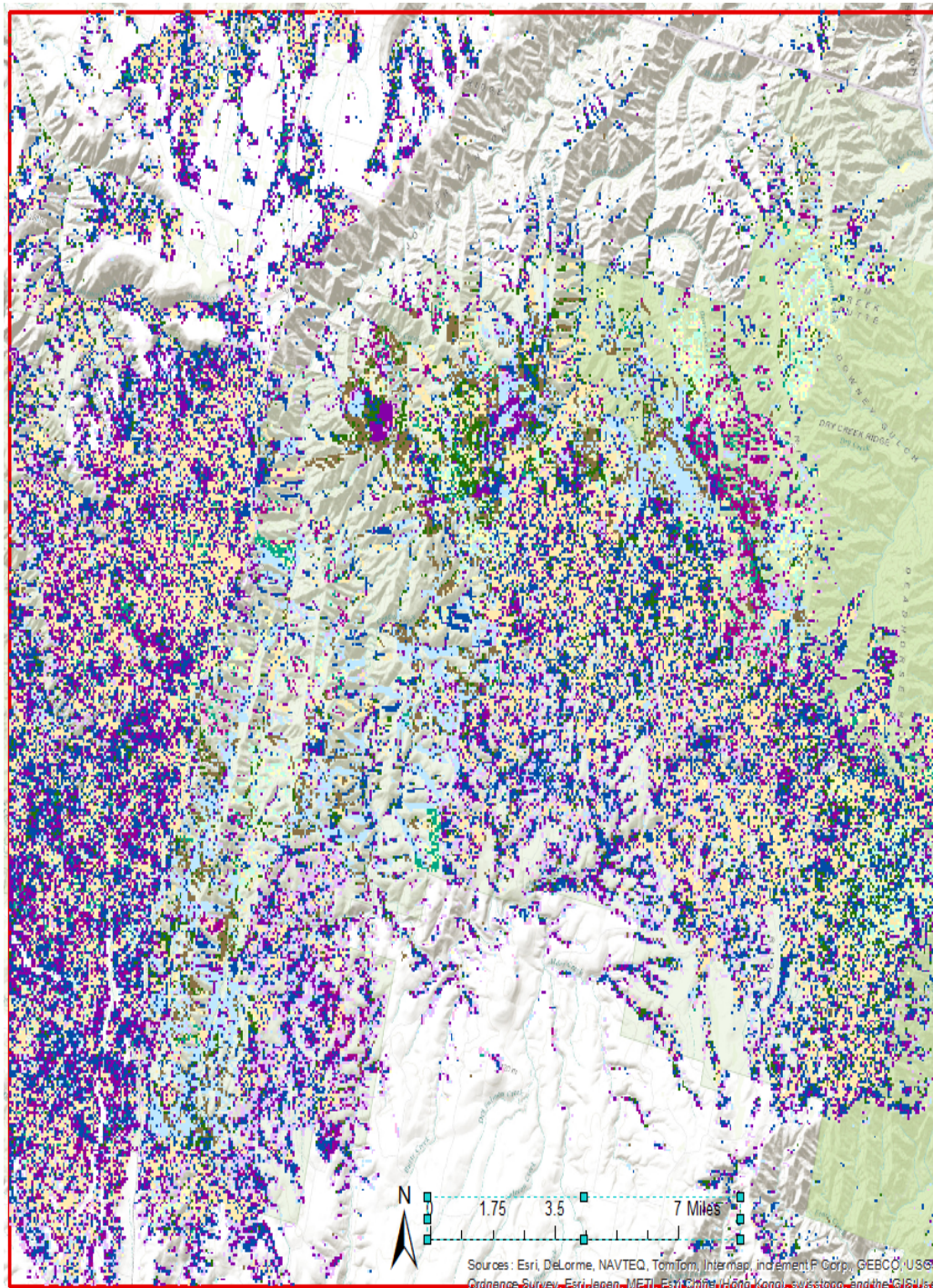
Vegetation No Management 150 years



Alternative 2 Treatments first decade



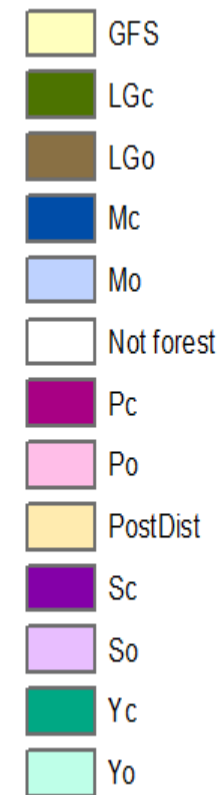
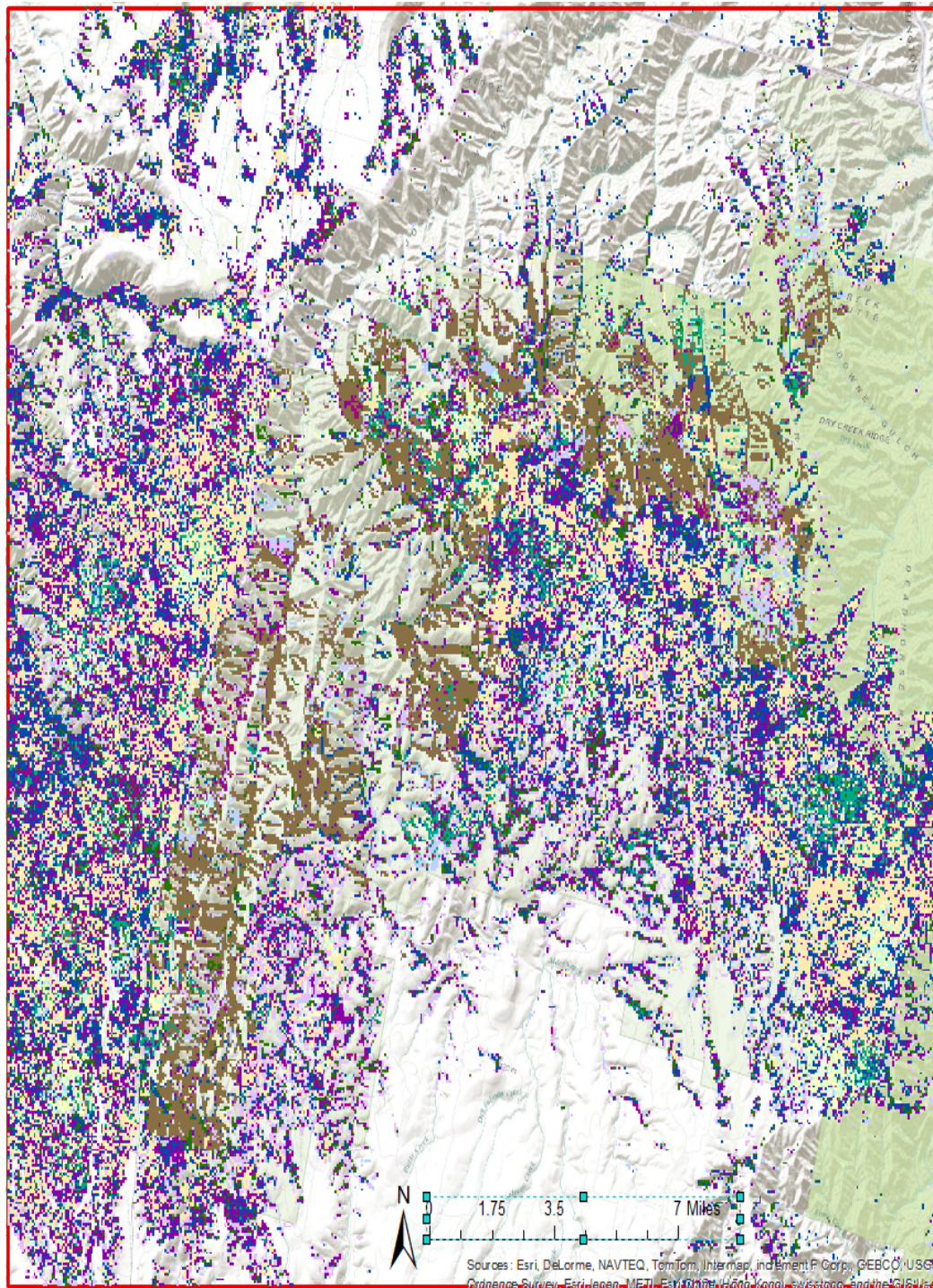
Vegetation, Alt. 2, 30 Years



- GFS
- LGc
- LGo
- Mc
- Mo
- Not forest
- Pc
- Po
- PostDist
- Sc
- So
- Yc
- Yo

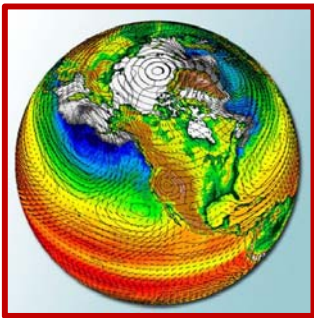
Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, independent P Corp., GEBCO, USGS, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, and the GIS User

Vegetation, Alt 2, 150 years

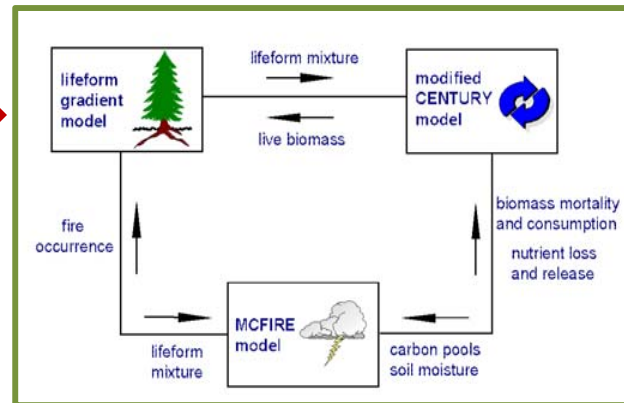


Integrating Climate Change & Land Management Models

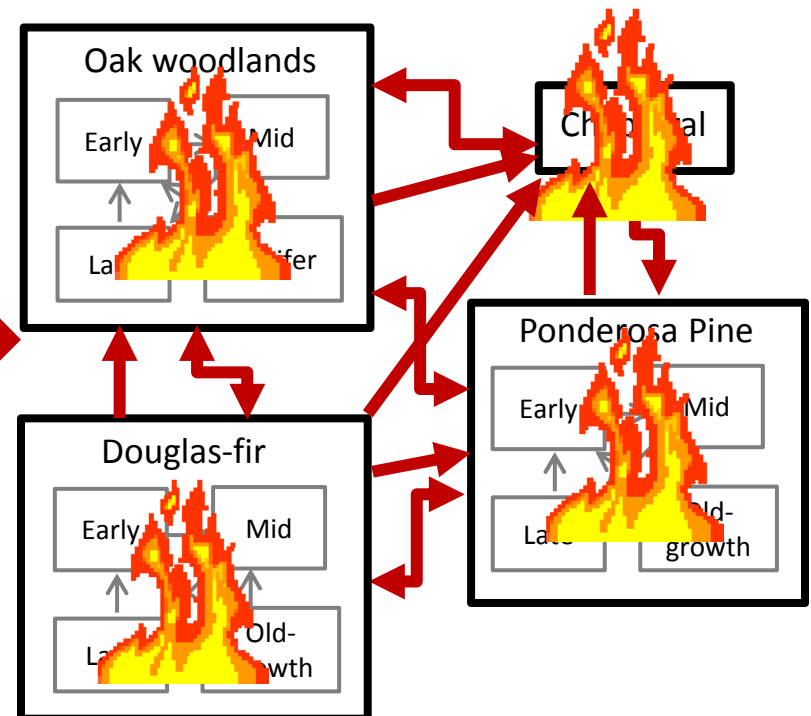
Climate
Information



MC2 Dynamic Global
Vegetation Model

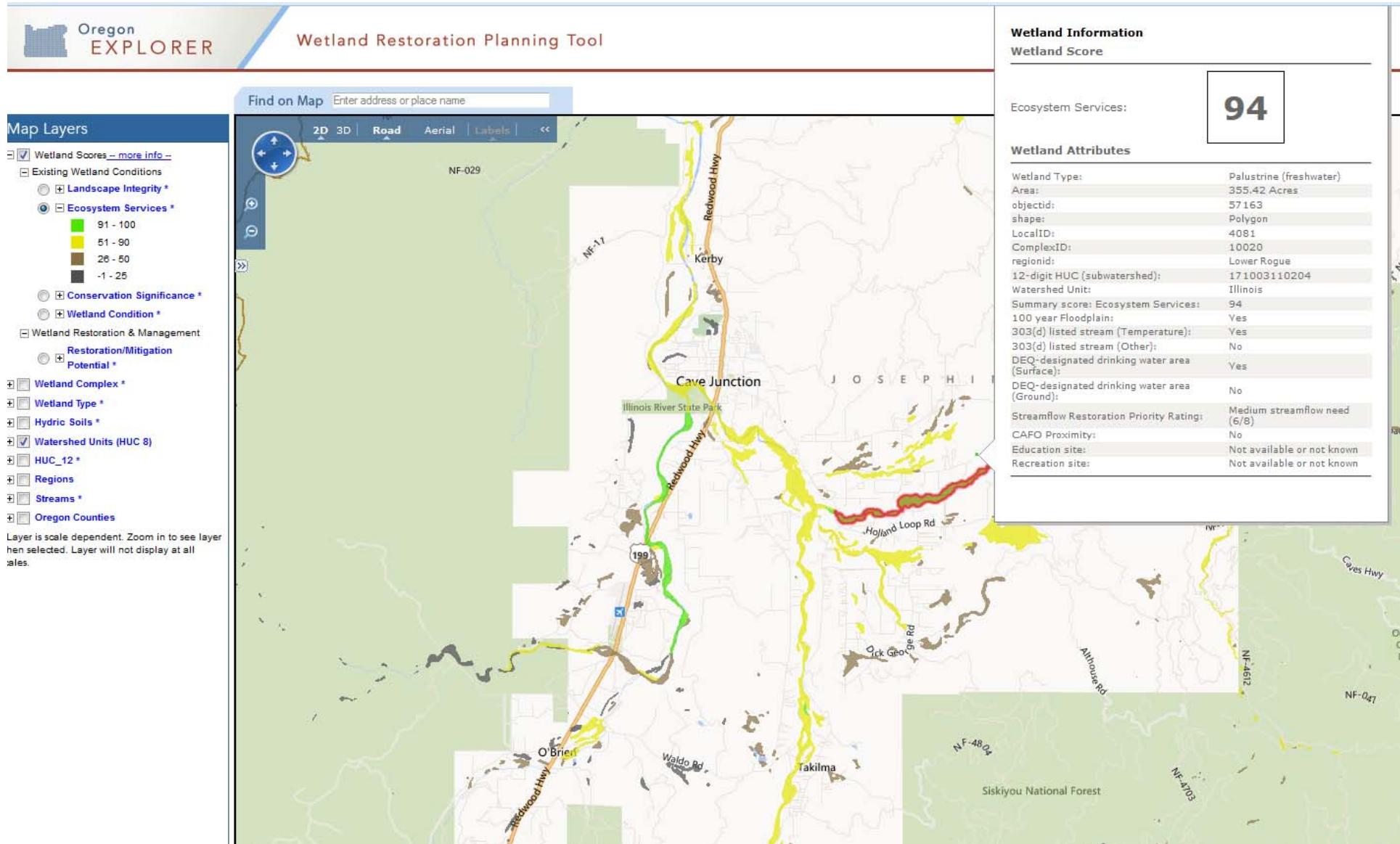


Climate-informed
State-and-Transition Models

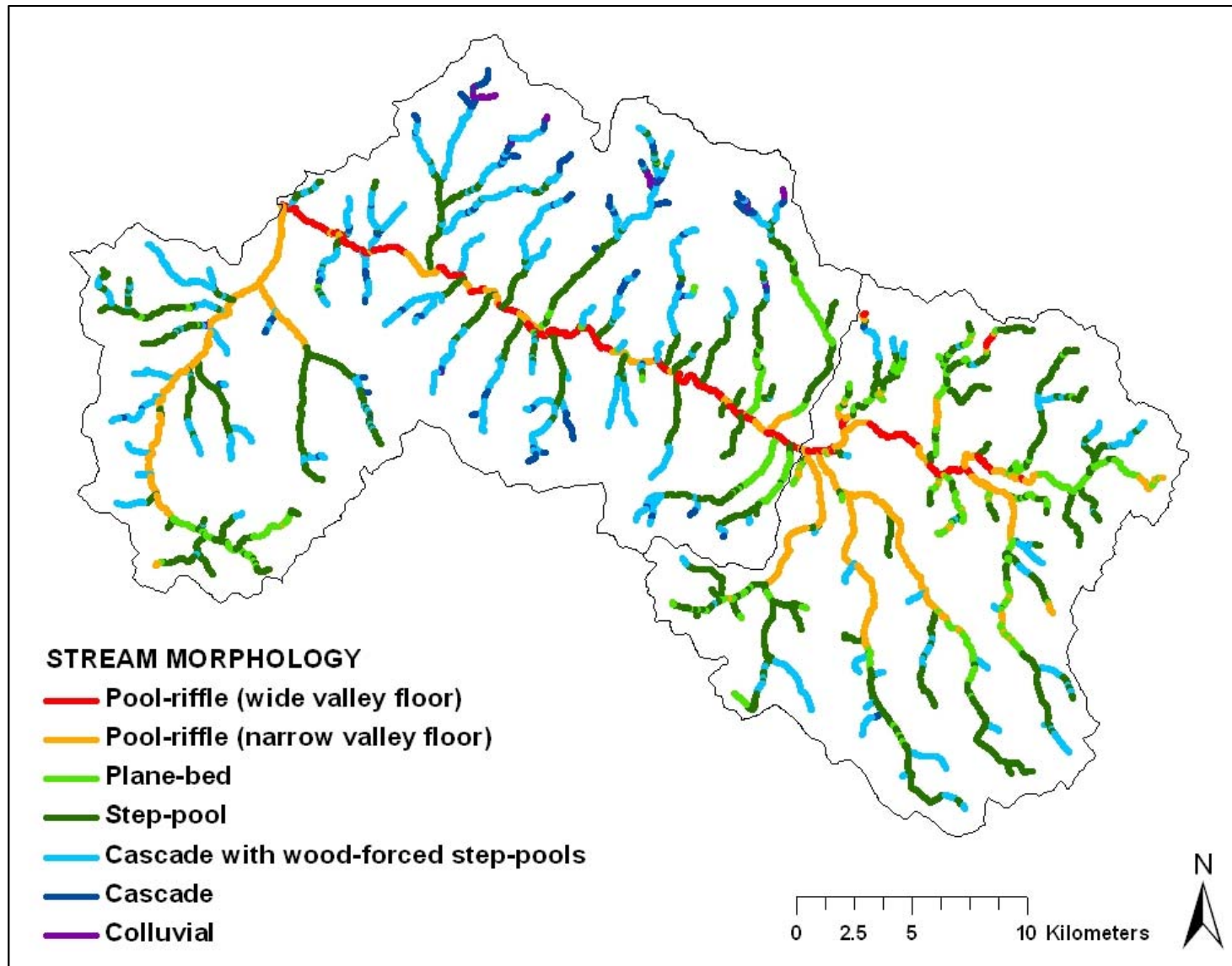


Midscale data is not all Terrestrial

NWI is relatively high spatial resolution with uncertain accuracy....yet can

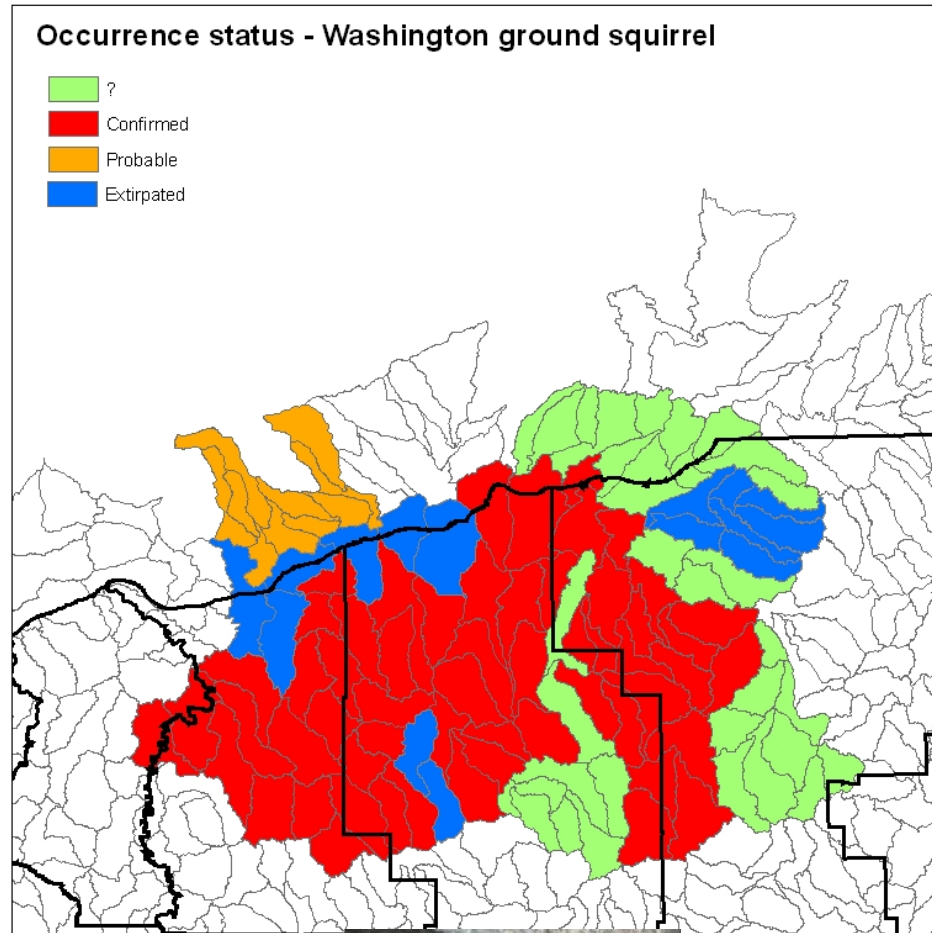


Channel Type Classification



Based on Montgomery and Buffington 1997

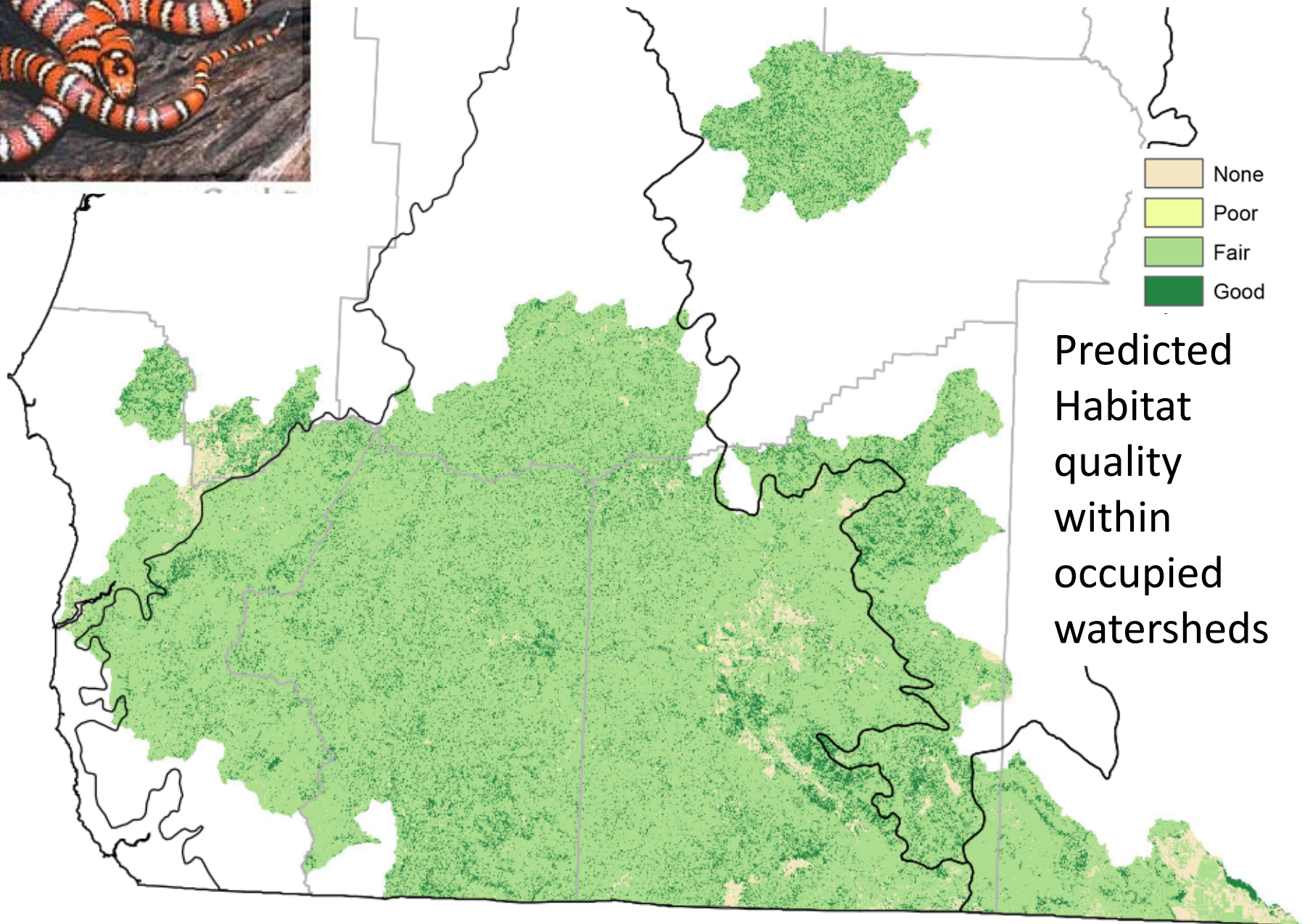
And Can Include Species





Mid-scale data can improve species maps

California mountain kingsnake *Lampropeltis zonata*



Conclusions

- Mid Scale data can provide information to improve modeling of ecosystem service outputs
- Mid Scale data provides critical inputs into state and transition models which predict many ecosystem service outputs from management decisions
- Mid Scale data is created from nationally available datasets with proven methods
- Mid Scale data is available in some areas of the US, and can be developed across the country if federal agencies worked together and decided to make it happen

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