Oregon Board of Forestry Indicators of Sustainability

And

Modeling Geographical Distributions of Wildlife Species

FPFO strategies

Indicator	Linkage With IMAP Products
B.a. Forest Revenues	Yes - Adams (OSU)
B.b. Forest Employment and Wages	Yes - ODF (Lettman)
B.d. Forest Products Sector Vitality	?
C.a. Area of Forestland	Yes - direct
C.b. Timber Harvests	Yes - direct
D.a. Water Quality Index	Possible?
D.b. Index of Biotic Integrity	Possible?
D.c. Forest Roads	GIS data – ODF/R6
E.a. Forest Vegetation	Yes - direct
E.b. Protected Areas	Yes - direct
E.c. Species at Risk	Yes - R6 focal species, OR/WA habitats
F.a. Tree Mortality	Yes - direct
F.b. Invasives	Yes - direct/indirect
F.c. Fuel Conditions and Treatment	Yes - direct
G.a. Carbon	Yes - McCarter (UW)

Forestry Program for Oregon **Strategy E: Contribute to the conservation of diverse native plant and animal populations and their habitats in Oregon's forests.**

- E.a. Composition, diversity, and structure of forest vegetation **$$**

Metrics:

  - o Vegetation species diversity: richness, evenness **‰**
  - o Vegetation structure, percent cover **‰**
  - o Vegetation change detection: plot #'s, area, percent cover **‰**

- E.b. Extent of area by forest cover type in protected area categories

  Metrics:

  - o Amount of area for each forest cover type
  - o Ownership/protection category

- E.c. Forest plant and animal species at risk

Metrics:

  - o Number of species in each federal ESA status ranking
  - o Number of forest species in Oregon Natural Heritage Program Information Center Lists 1 and 2
  - o Historic and current distribution of forest species

E.a. Composition, diversity, and structure of forest vegetation

Yes - direct

Metric	Data Source	Reporting Scale	Reporting Cycle	Reporting Responsibility	Limitations/Considerations
Vegetation species diversity: richness, evenness	USFS FIA	State	Five years	FIA PNW	Species misidentification, phenology, plot size, sampling time.
Vegetation structure, percent cover	USFS FIA	State	Five years	FIA PNW	Observer consistency, plot size
Vegetation change detection: plot #'s, area, percent cover	USFS FIA	State	Five years	FIA PNW	Accuracy and precision, sample size

Gray, A.N., Azuma, D.L. 2005. Repeatability and implementation of a forest vegetation indicator. Ecological Indicators. 5:57-71.

E.b. Extent of area by forest cover type in protected area categories

Yes - direct

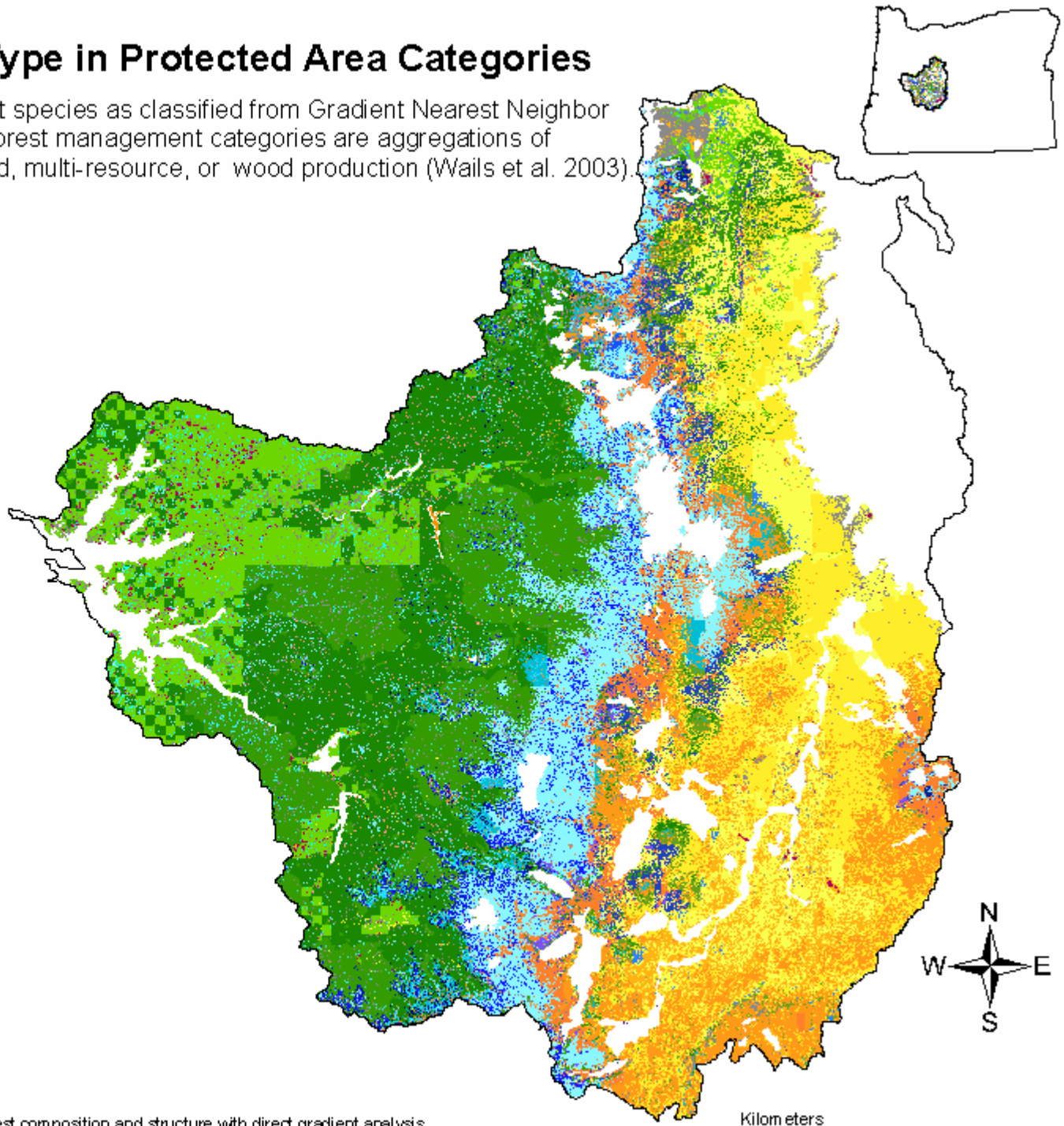
Metric	Data Source	Reporting Scale	Reporting Cycle	Reporting Responsibility	Limitations/Considerations
Amount of area for each forest cover type	USDA Forest Service	State	~ Ten years	FIA PNW	Coarse scale, modeling assumptions, cumulative errors
Ownership/protection category	ODF	State	Two to five years	ODF	Boundary and classification accuracy

Strategy E Indicator b
Extent of Area By Forest Type in Protected Area Categories

Forest Types are represented by dominant species as classified from Gradient Nearest Neighbor Analysis (Ohmann and Gregory 2002). Forest management categories are aggregations of forestland that can be considered reserved, multi-resource, or wood production (Wails et al. 2003).

Forest Type, Protection Category, and Area in Hectares

- PSME-MultiResource, 227.89 ha
- PSME-Reserved, 1666.97 ha
- PSME-WoodProduction, 1248 ha
- PIPO-WoodProduction, 939 ha
- PIPO-MultiResource, 1407 ha
- PIPO-Reserved, 562 ha
- TSHE-WoodProduction, 75.19 ha
- TSME-Reserved, 1176 ha
- TSHE_Reserved, 71.6 ha
- TSME-MultiResource, 132.73
- TSME-MultiResource, 54.14
- TSHE-MultiResource, 113
- JUOC-WoodProduction, 56.32
- PICO-WoodProduction, 347
- PICO-MultiResource, 954
- PICO-Reserved, 562
- ABLA-Reserved, 59
- ABAM-Reserved, 222 ha
- ABAM-MultiResource, 202
- ABLA-Reserved, 222.8
- ABGR-Reserved, 71.2
- ABMAS-Reserved, 64.9
- ABMAS-MultiResource, 43.3 ha
- THPL-MultiResource, 39.9
- Other
- NonForest

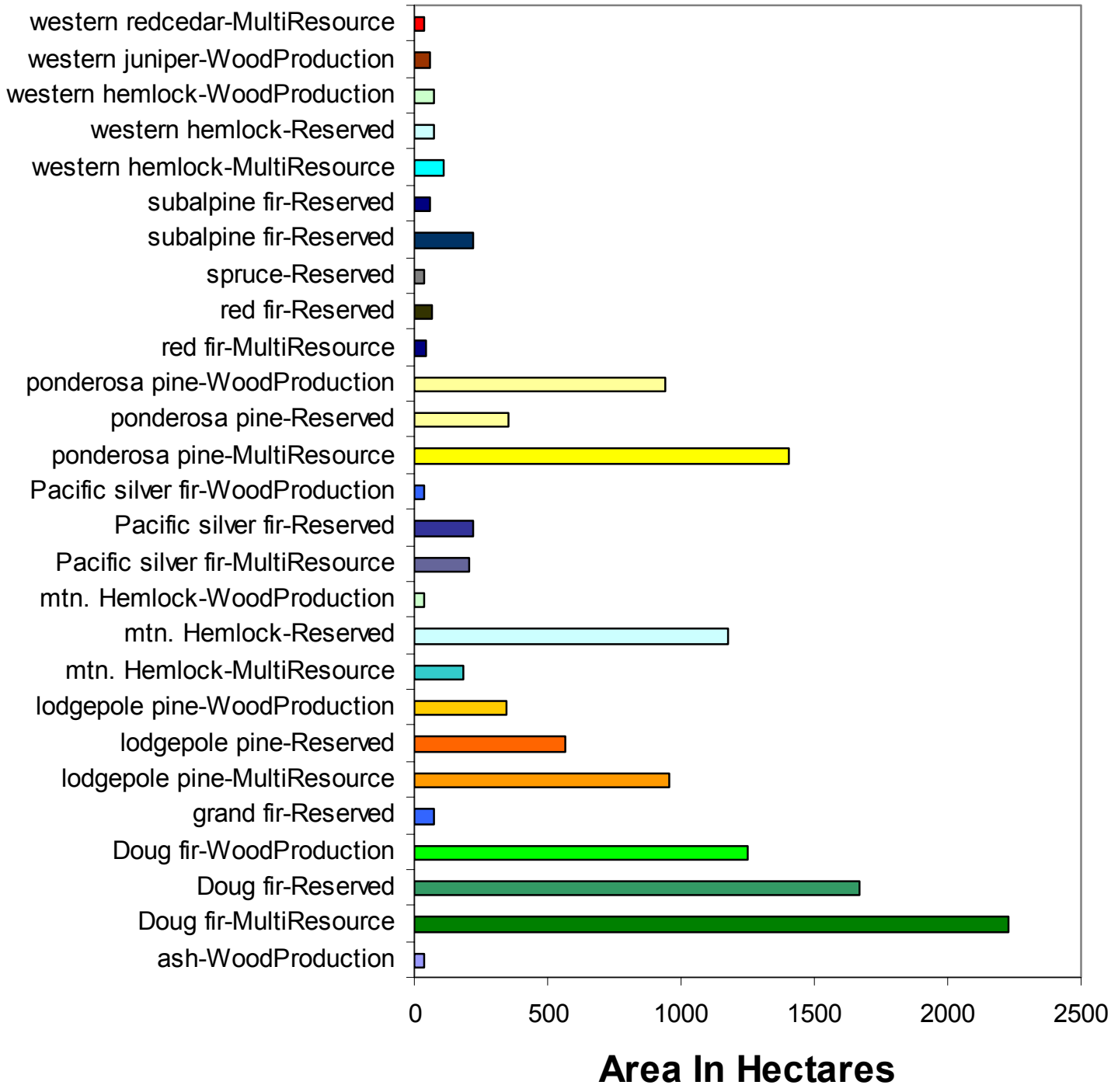


Ohmann, J.L., Gregory, M.J. 2002. Predictive mapping of forest composition and structure with direct gradient analysis and nearest neighbor imputation in coastal Oregon, USA. Canadian Journal of Forest Research. 32:725-741.

Wails, G., Herstrom, A., Cannon, L., Birch, K. 2003. Protecting Oregon's forestlands: a graphical view. Oregon Forest Resources Institute. 317 SW Sixth Avenue, Suite 400, Portland, OR 97204.

map and analysis prepared by Andrew Yost

E.b. Extent of area by forest cover type in protected area categories



E.c. Forest plant and animal species at risk

Yes - R6 focal species, OR/WA habitats

Metric	Data Source	Reporting Scale	Reporting Cycle	Reporting Responsibility	Limitations/Considerations
Number of forest species in each federal ESA status ranking	USFWS	State/Nation	Two months	USFWS	Incomplete spatial and temporal inventory and monitoring
Number of forest species in Oregon Natural Heritage Program Information Center Lists 1 and 2	ONHIC	State	Three years	ONHIC	For some species more information is needed before status can be determined.
Historic and current distribution of forest species	ONHIC	State	Periodic	ONHIC	Spatial accuracy, variety of sources and error, quality assurance

F b. Invasive species trends on forestlands

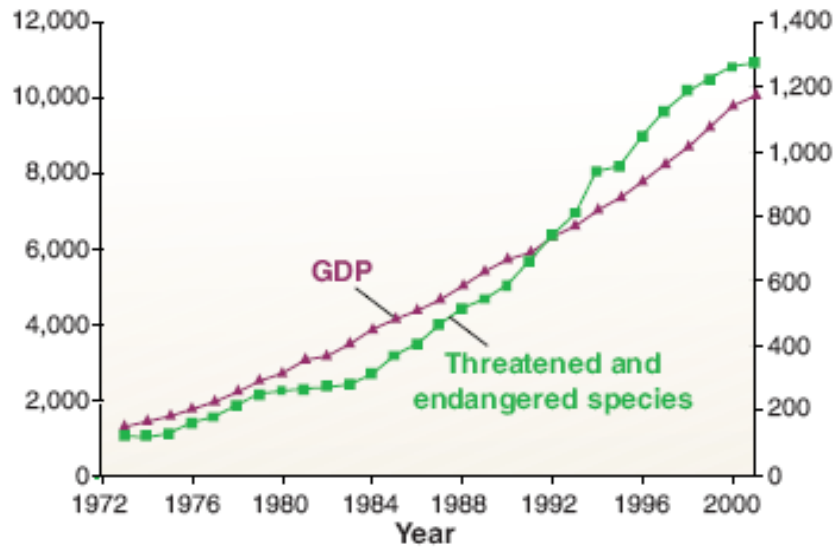
Yes – direct/Indirect

Metric	Data Source	Reporting Scale	Reporting Cycle	Reporting Responsibility	Limitations/ Considerations
Biotic stressors: exotic insects and diseases, invasive plants, and animals (acres affected)	USDA Forest Service FIA Oregon Department of Agriculture, Forest Health Protection	State	Five year for FIA Annual for Forest Health Protection and Oregon Department of Agriculture	USDA Forest Service FIA Oregon Department of Agriculture, Forest Health Protection	Data are available on relatively few species.
The number or percent of invasive pests on Oregon's 100 most dangerous list excluded or contained in native and urban forests.	Oregon Department of Agriculture, Oregon Invasive Species Council	State	Annual	Oregon Department of Agriculture	The list is updated annually. It is difficult to predict which exotic species will become significant pests.

Modeling the Potential Distribution of Wildlife Species

- Coarse filter monitoring
- Bayesian Belief Networks (BBN)
- Habitat Capability Index Models (HCI)

Indicators and Coarse (st) Filter Monitoring



U.S. GDP correlates with the number of U.S. threatened and endangered species. GDP figures are in billions of dollars (www.bea.doc.gov/bea/dn1.htm). Threatened and endangered species are those listed by 31 December of the corresponding year (http://ecos.fws.gov/tess_public/).

The tight correlation ($R2 = 0.99$) of U.S. GDP to the number of U.S. threatened and endangered species listed under the Endangered Species Act is unlikely to be a coincidence. The sectors comprising the economy are the same sectors endangering species (*5*).

Czech et al. VOL 792 308 SCIENCE

Bayesian Belief Networks (BBN)

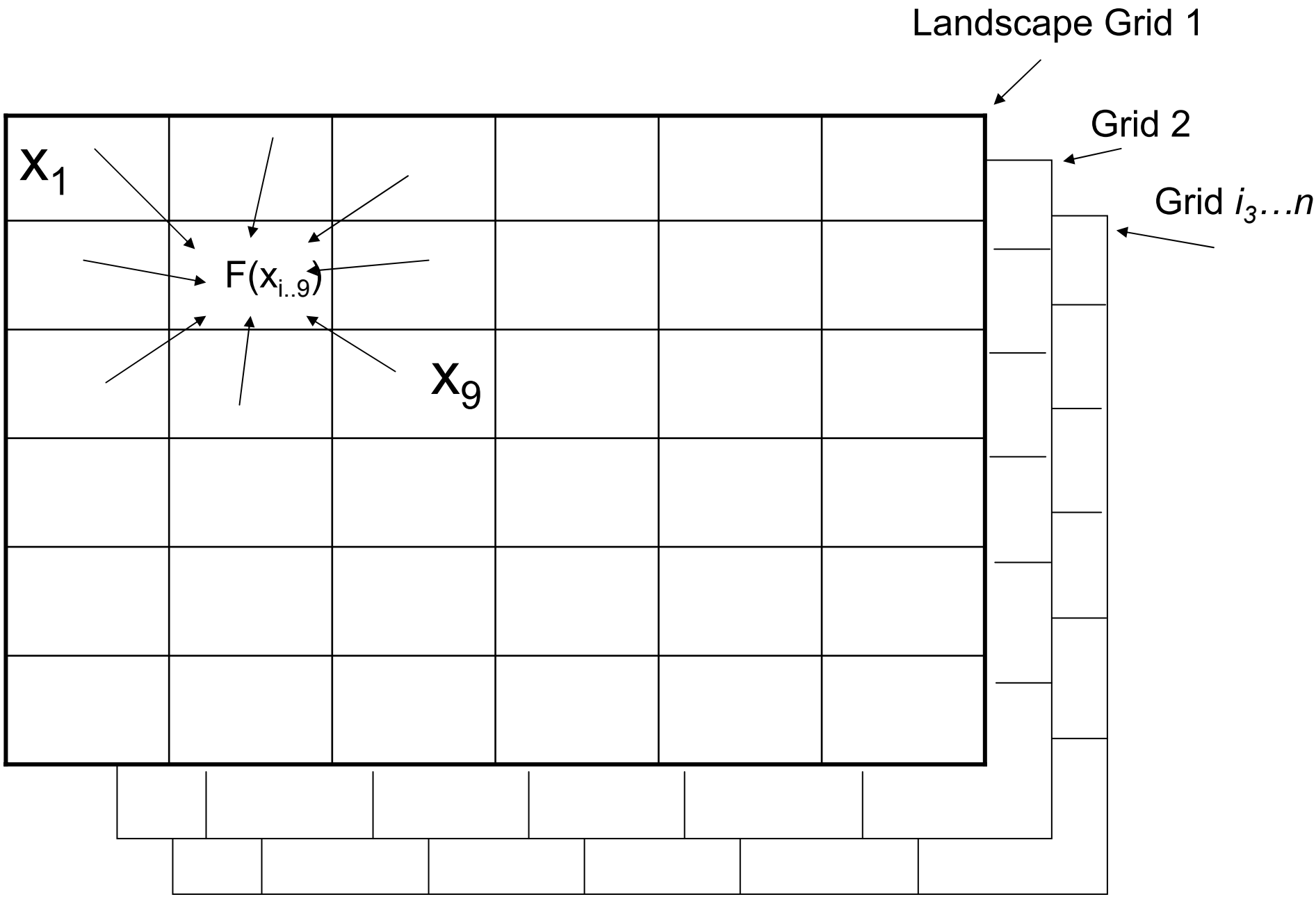
Wildlife

Habitat Capability Index Models

…a set of algorithms linking features of vegetation species, age of trees, and structural characteristics with the occurrence of wildlife.
The vegetation and structure foundation is based on Ohmann and Gregory's (2002) gradient nearest neighbor (GNN) vegetation mapping.

Spies et al. 2005

GIS Moving Window Analysis



The spotted owl model utilized a Habitat Capability Index (HCI) using the function below:

$$HCI_f = \sqrt[3]{(NCI_f^2 \times LCI)}$$

Where
f = the focal pixel
NCI = nest stand capability index
LCI = landscape capability index
The NCI was calculated with the following function:

$$NCI = \frac{\sum_{i=1}^{9} \frac{D1 + D2 + D3^2 + D4}{4}}{9}$$

Where:
f = focal pixel
i = pixel
D1 = index to density of trees with dbh ranging from 10 to 25 cm
D2 = index to density of trees with dbh ranging from 25 to 50 cm
D3 = index to density of trees with dbh > 75 cm
D4 = diameter diversity index.

$$LCI_f = \sqrt[6]{(S_1^3 \times S_2^2 \times S_3)}$$

Where:
S_1 = habitat index for the 28 ha circle surrounding the focal pixel
S_2 = habit index for the 212 ha circle that encompasses S_1
S3 = home range index for the 1,810 ha circle that encompasses S_2

The computational window approximates a circle and includes far more pixels (28 ha = 448 cells, 212 ha = 3392, and 1810 ha = 28960 cells). $S_{1\text{-}3}$ represent incrementally larger concentric circles centered on a focal pixel for which each S_x is calculated. Values for the S_x calculations depend on the proportion of area, within the circular representation of habitat under consideration, that is occupied by trees with large diameters.

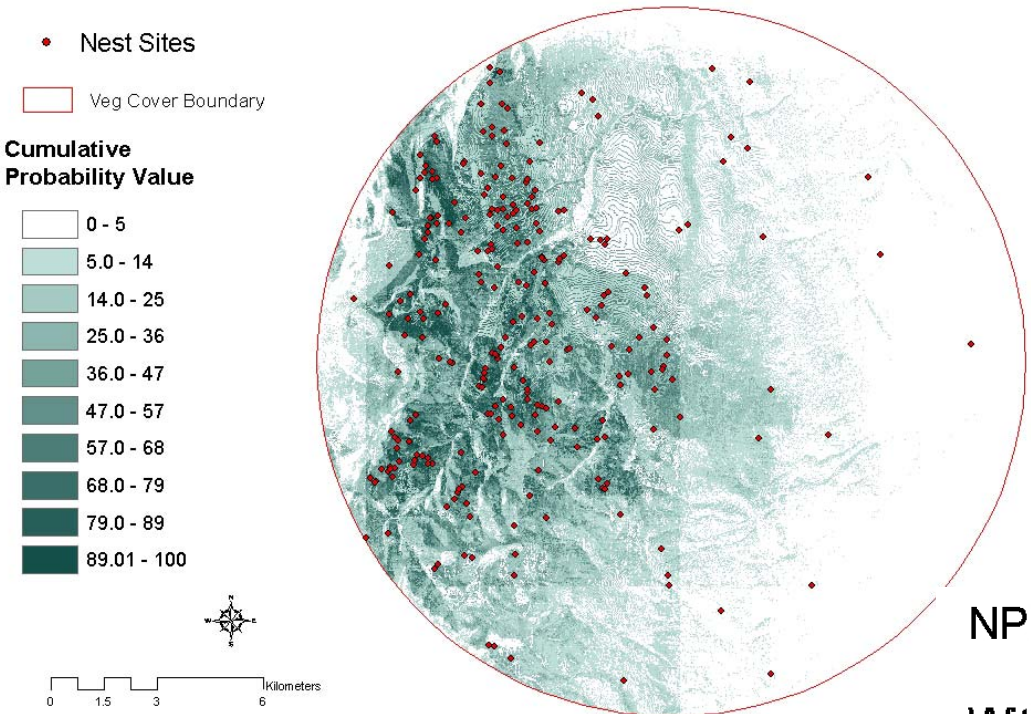
Habitat capability models for other species of wildlife….

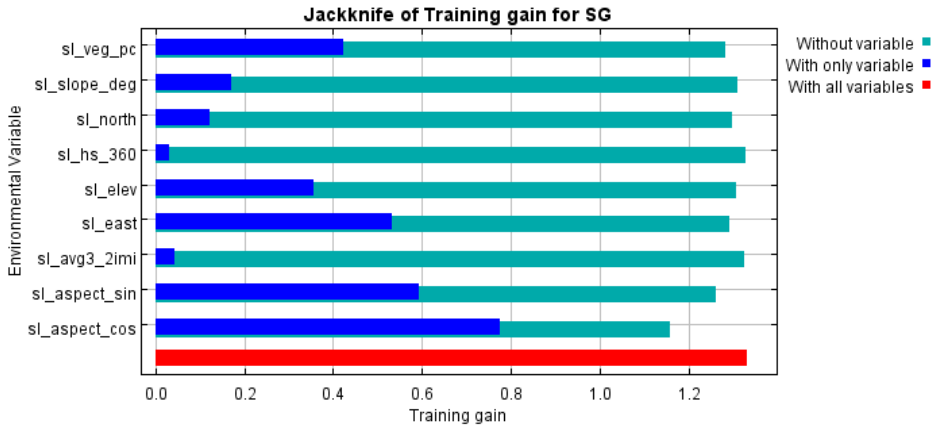
- red tree vole (*Arborimus longicaudus*),
- beaver (*Castor canadensis*),
- fisher (*Martes pennanti*),
- olive-sided flycatcher (*Contopus cooperi*),
- pileated woodpecker (*Dryocopus pileatus*),
- Western bluebird (*Sialia mexicana*),
- marbled murrelet, (*Brachyramphus marmoratus*),
- willow flycatcher *Empidonax traillii*.

Modeling the Actual Geographical Distribution of Wildlife Species

- Operate on actual locations, X & Y
- A set of environmental gradients—predictor variables
- NPMR (presence/absence and quantitative data)
- BIOMAPPER (presence only data)
- Maximum Entropy (presence only data)

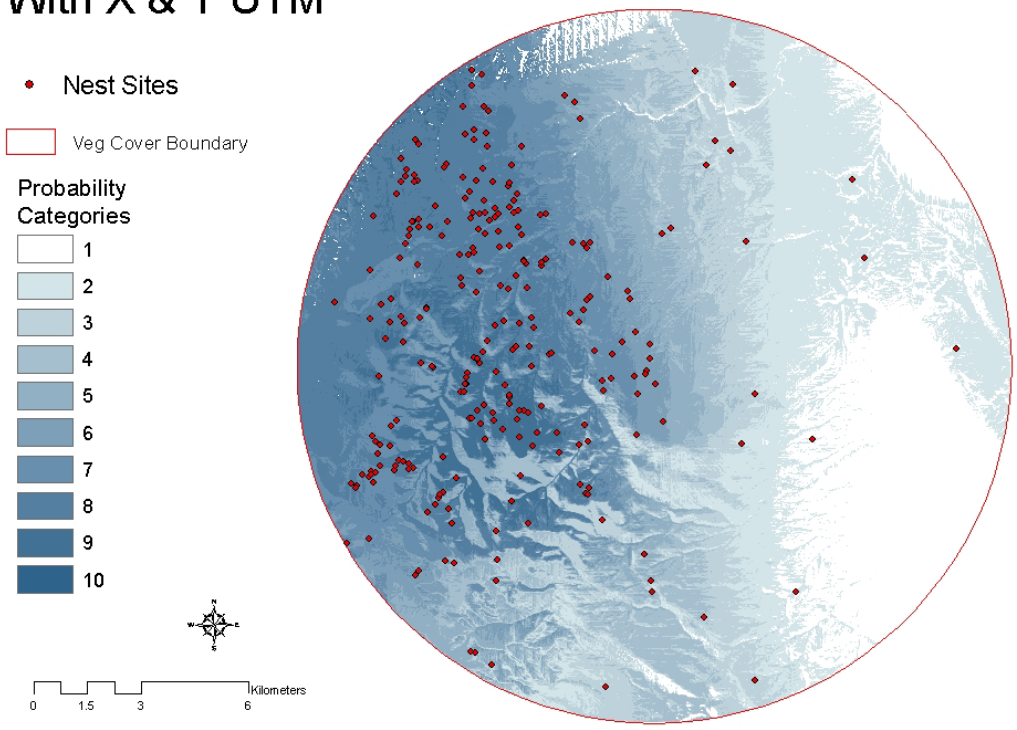
Maximum Entropy Distribution of Sage Grouse Nest Sites





NPMR Distribution of Sage Grouse Nest Sites

With X & Y UTM



Best Multiplicative Variable Set

Eval logB	Ave Size	Pred 1	Tolerance	Variable 2	Tolerance	Variable 3	Tolerance
28.1144	152.3	eastUTM	1742.9				
33.0093	41.2	eastUTM	1742.9	northUTM	1729		
37.8326	29.8	eastUTM	1742.9	northUTM	2593.5	imi	10.02778