Resource Use by Northern Spotted Owls in Mixed Conifer Forests of the Klamath Province: a Hierarchical Approach

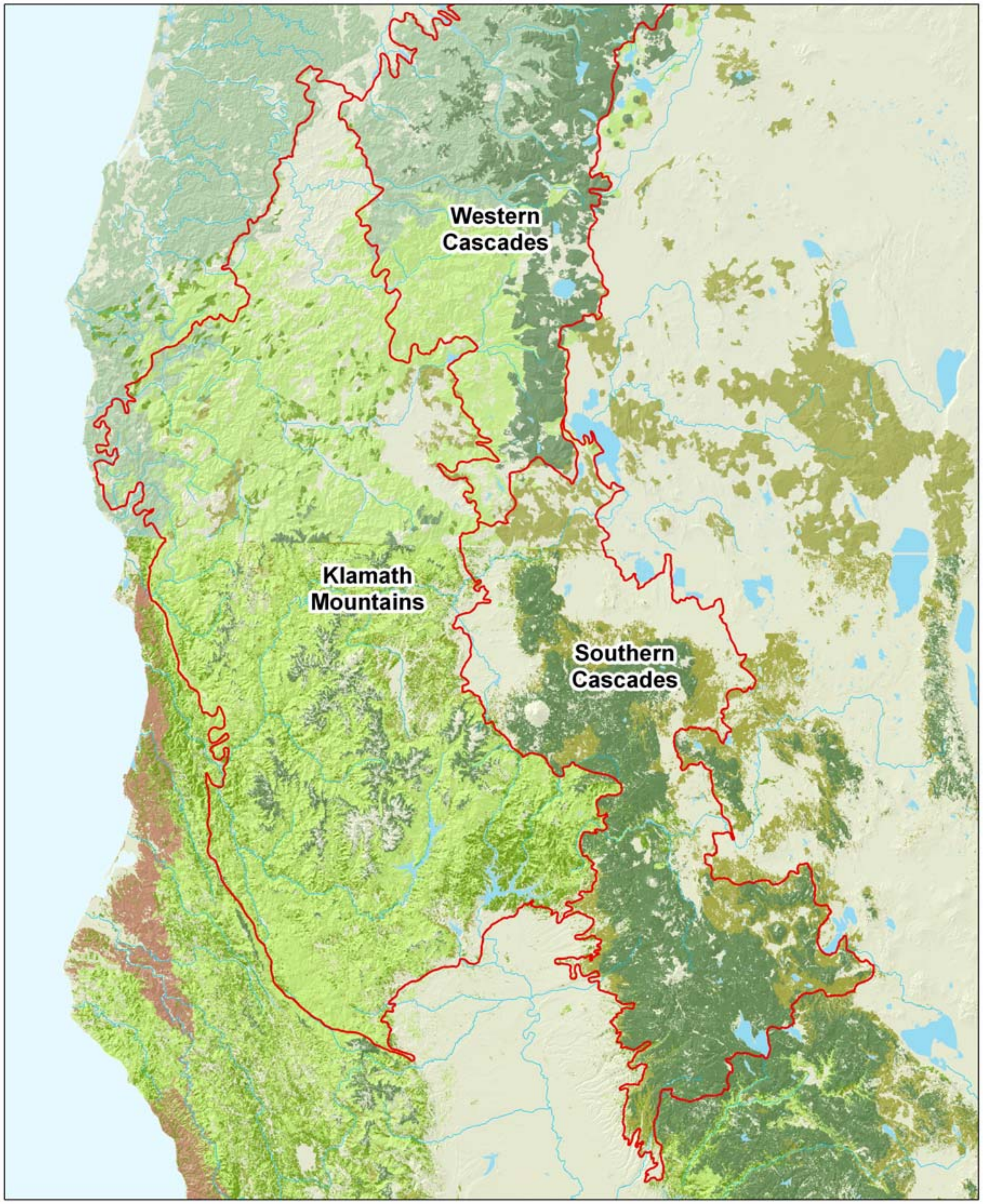
Brian Woodbridge and Jennifer Jones,
US Fish and Wildlife Service
Yreka Fish and Wildlife Office

Objectives

- Provide a conceptual model of resource use by northern spotted owls in Klamath mixed conifer forests.
- Provide data to support project design and evaluation of risk.
- Introduce tools to assist with incorporating spotted owls into project planning.
- Avoid abusing/misusing anyone’s research results too badly.

Klamath Region

This presentation is focused on the Klamath Mixed Conifer forest type. The ecology of NSO occupying this forest type within the Klamath Province may be different from NSO in other forest types, even within the Klamath Province.

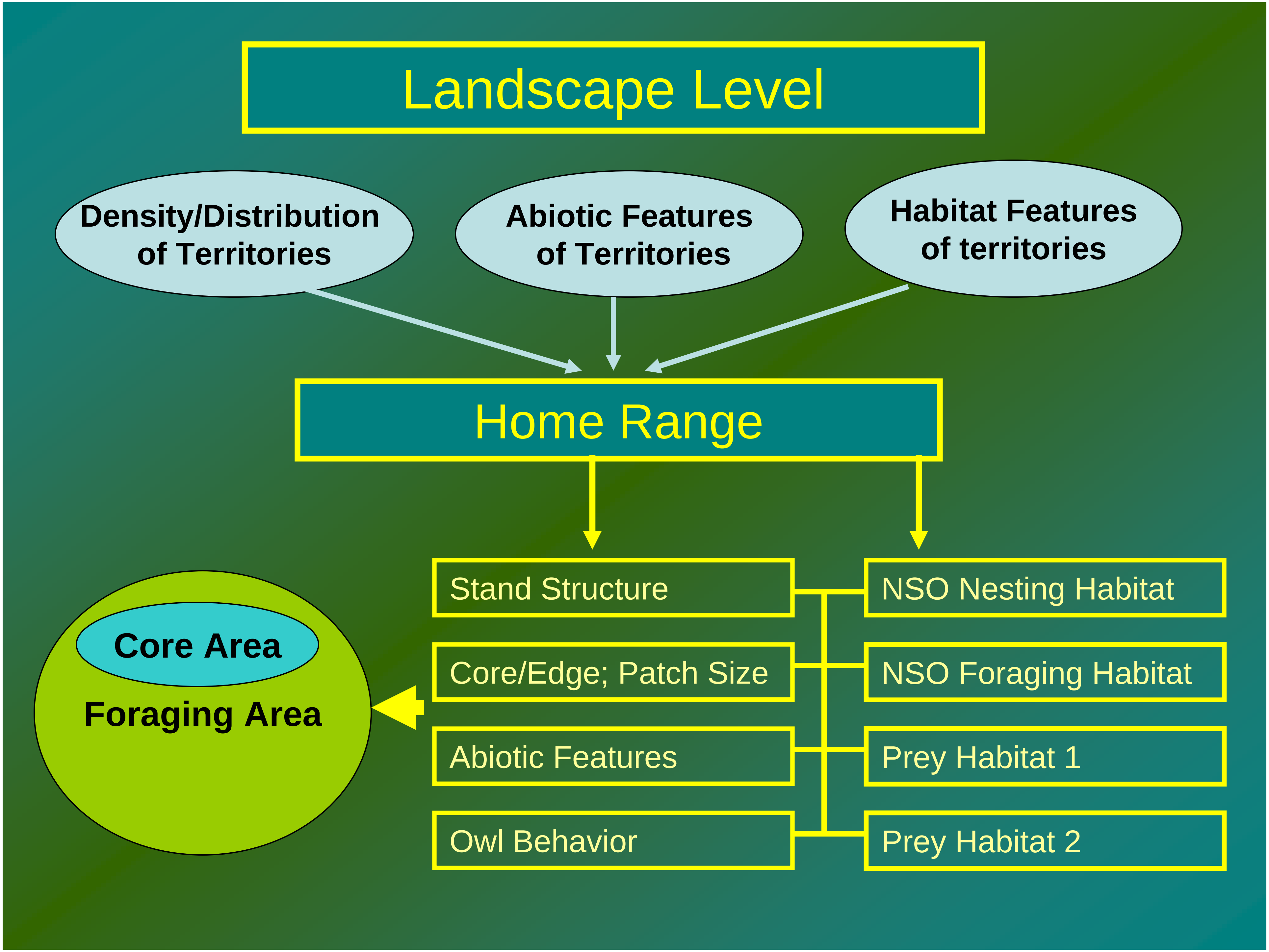


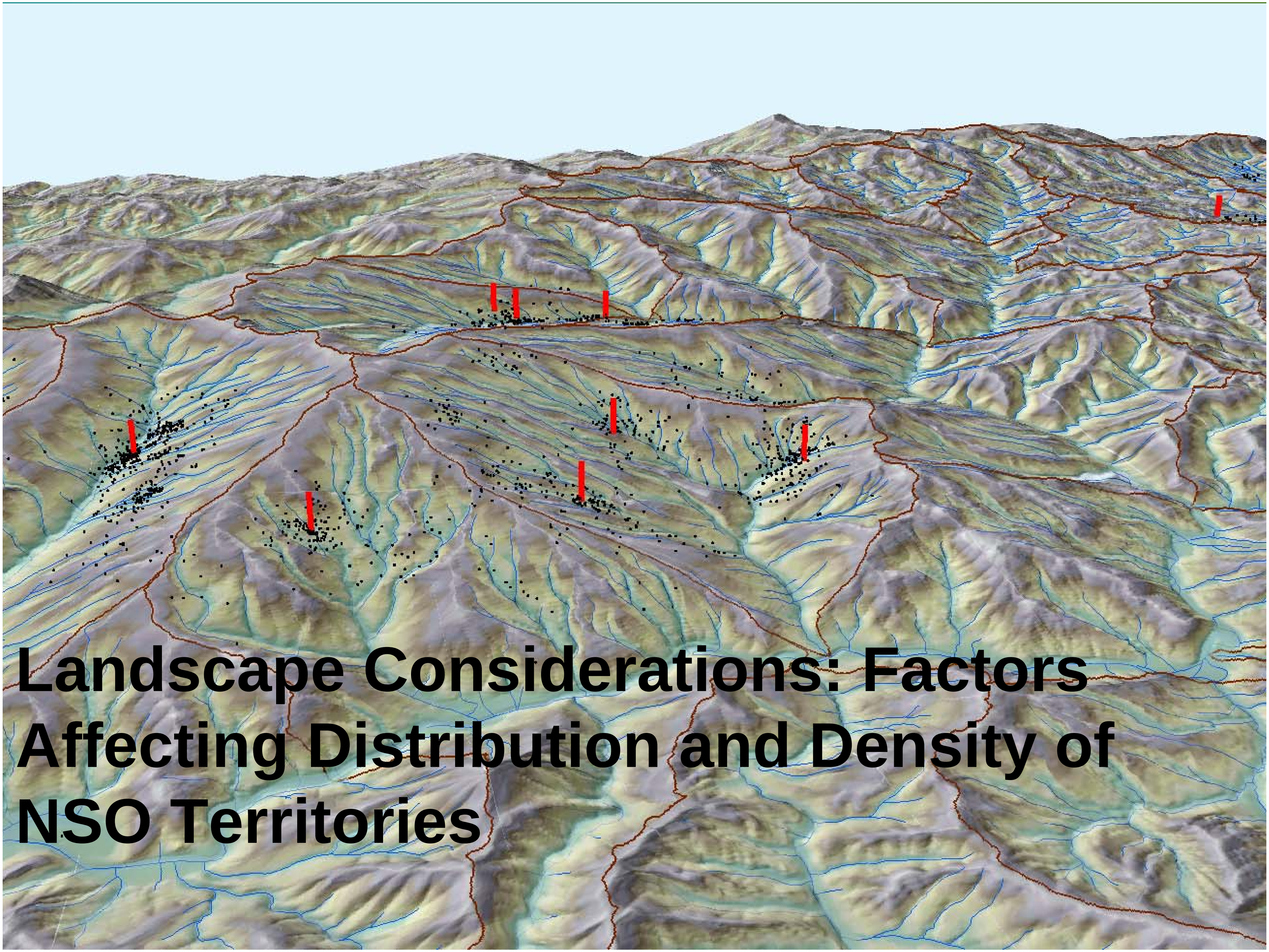
What's different about spotted owls in Klamath mixed conifer forests?

- Preybase: Utilization of woodrats is 2-3 times higher than in Cascades, coastal forests (except south coast and redwoods)
- Woodrats comprise 28% of diet (48% of biomass)
- Flying Squirrels also comprise 28% of diet (30% of biomass)
- * From Forsman et al. 2004, and other studies

So What?

- Woodrat abundance not strongly linked to mature/OG forest; occupy brushy habitats, young forest open forest (Sakai and Noon 1993, others)
- NSO home ranges are significantly smaller in areas where woodrats are important prey (Zabel et al. 1995)
- Increased use of edges by NSO foraging for woodrats (Zabel et al. 1995)
- Use of woodrats “reduces markedly the amount of older forest used for foraging by NSO” (Carey et al. 1992)
- High energetic reward per unit from woodrats (they’re big and fat) (Ward et al. 1998)
- However, high degree of temporal variability in local woodrat populations – importance of other prey species


Landscape Level
Density/Distribution of Territories
Abiotic Features of Territories
Habitat Features of territories
Home Range
Stand Structure
Core/Edge; Patch Size
Abiotic Features
Owl Behavior
NSO Nesting Habitat
NSO Foraging Habitat
Prey Habitat 1
Prey Habitat 2
Core Area
Foraging Area


Landscape Considerations: Factors Affecting Distribution and Density of NSO Territories

Landscape Considerations:
Factors affecting distribution and density of NSO

- Territoriality: NSO behavior; nearest-neighbor distances, competitors
- Abiotic Features: elevation, slope position, aspect, water
- Habitat Features: distribution of seral stages, forest community types, past disturbance

Territoriality

- Nearest-neighbor distance:
- Mean 0.93 miles (range 0.26 – 1.5 miles; N=37) (Hunter et al. 1995; Willow Creek Study Area)
- Mean 1.21 miles (range 0.7 – 1.7 miles; N=22) (USFWS; 3 LSRs in E. Siskiyou Co.)
- Home ranges overlap, interaction among neighbors

Abiotic factors influence the distribution of NSO territories

- Locations of NSO nest sites are strongly correlated with landscape variables such as elevation, slope position, and distance to stream.

- Abiotic features can be used to evaluate the probability of use of a given area by NSO.

- Valuable tool for large-scale and/or long-term planning of stand treatments.

Modeling Landscape Suitability Using Abiotic Features

- Requires sample of NSO nest sites and comparison sites; either large random sample or smaller sample from census area.
- Derive landscape variables from DEM at a variety of scales; we used 70, 140, and 500 acre circular plots
- Compare values at nest sites to random plots; combine variables with significant coefficients into model

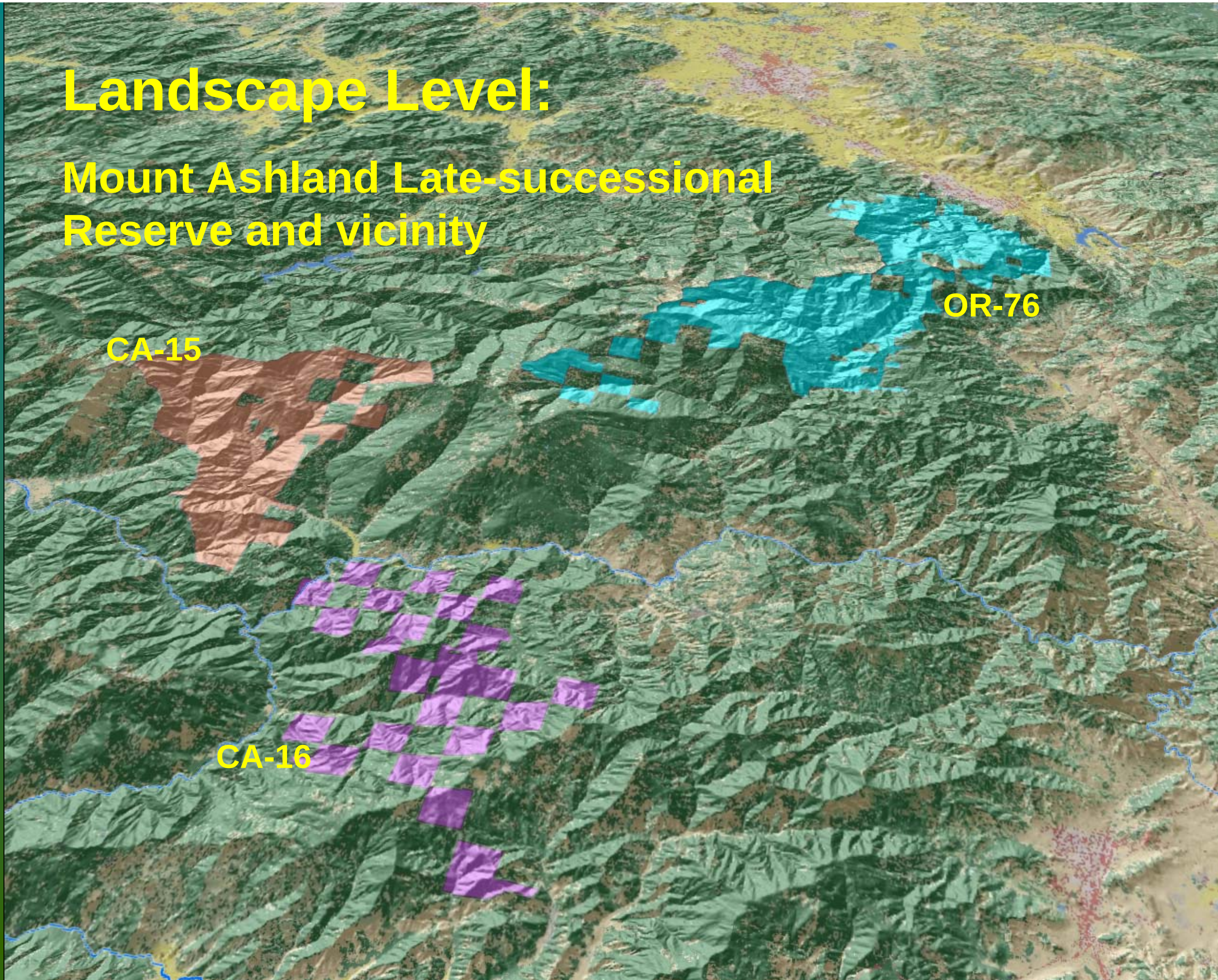
Abiotic Suitability Model Development

Variable	Statistic	P*	Value Range
		NSO vs. random	50th percentile around mean
Elevation	mean	0.027	1027 to 1393 meters
Curvature	sum	<0.001	-809 to -171
Dist to road	mean	0.038	109 to 199 meters
Dist to stream	mean	<0.001	102 to 158 meters
Slope position	mean	<0.001	34 to 47 percent
7th field position	mean	0.041	31 to 51 percent

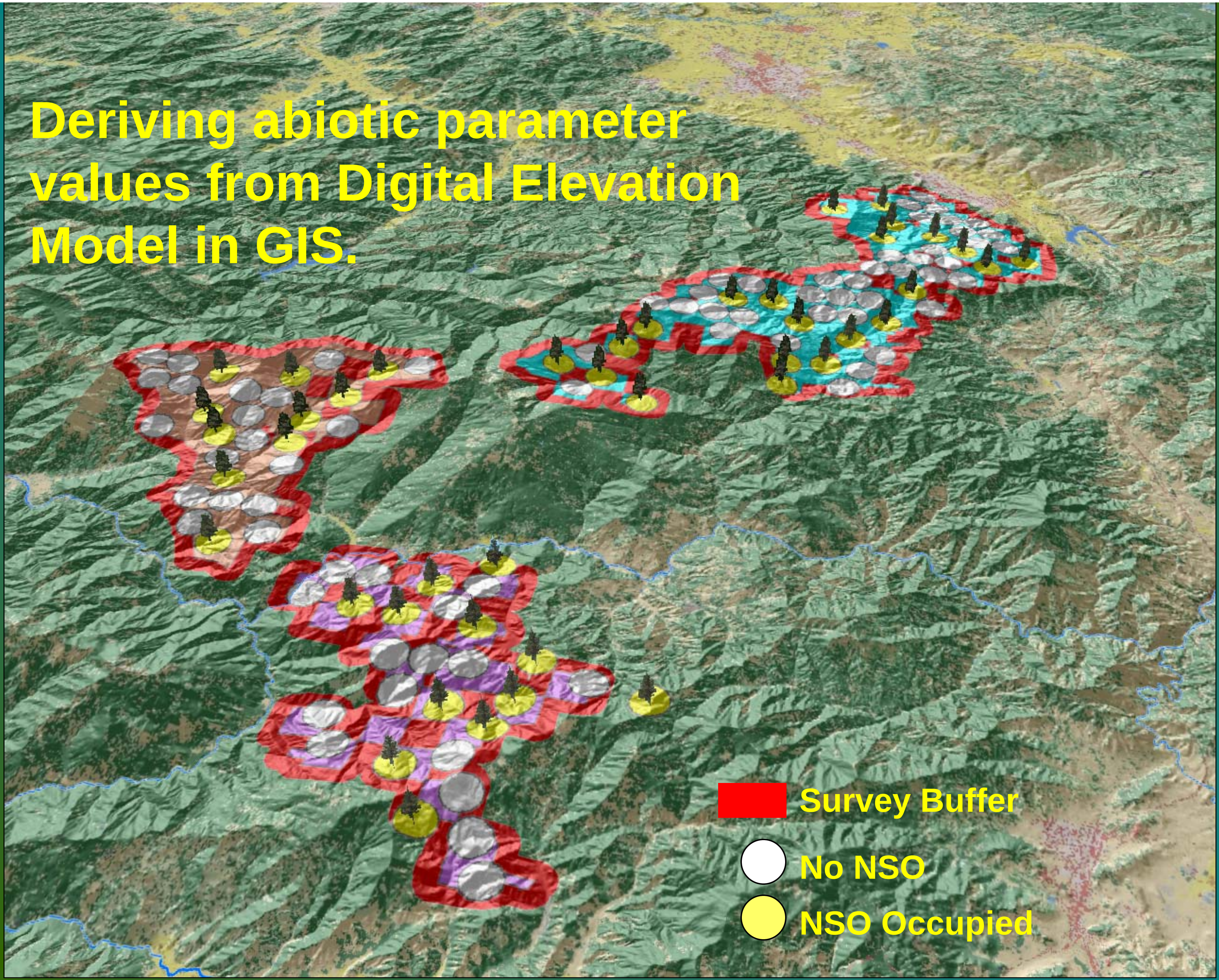
* Mann-Whitney U test

Landscape Level:

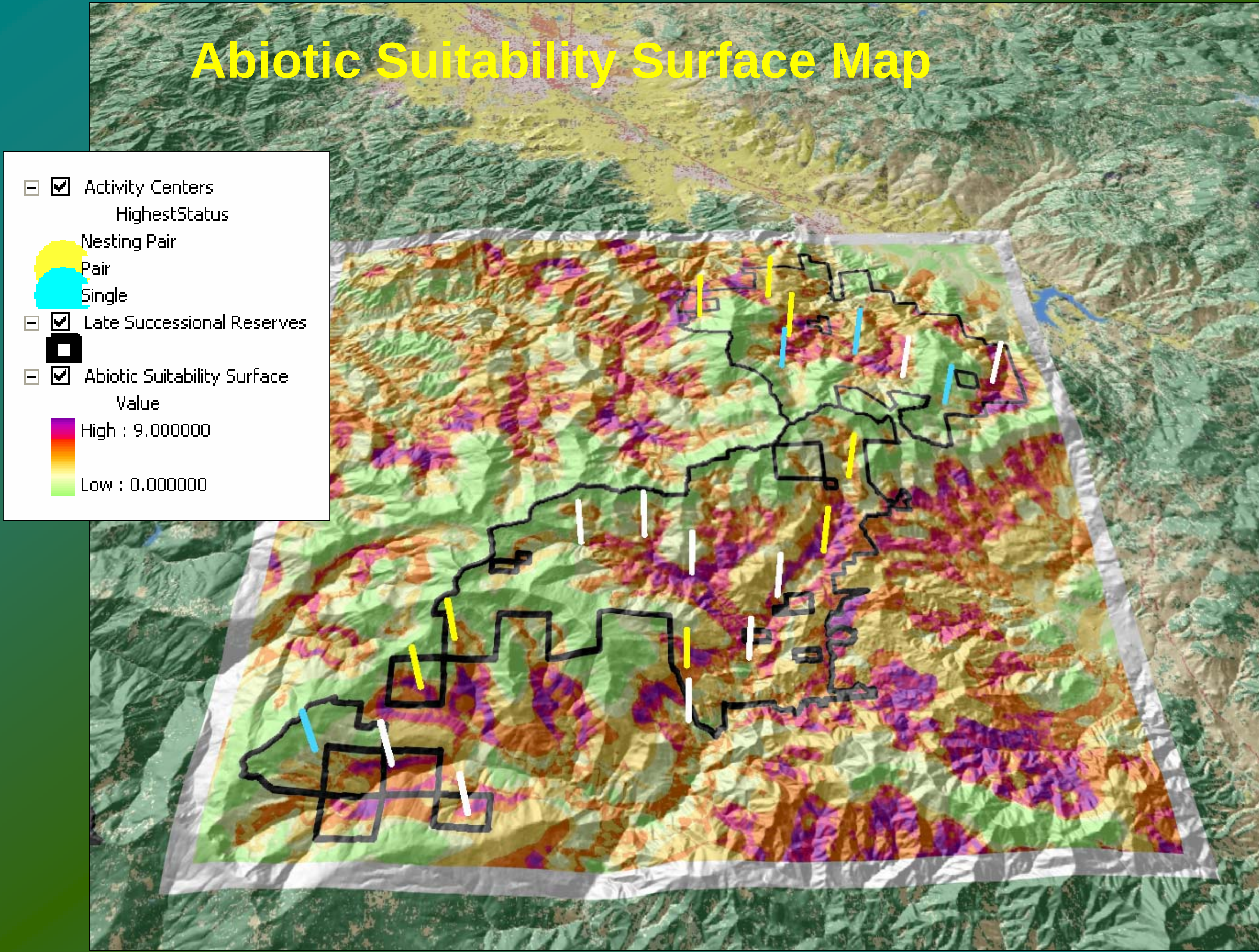
Mount Ashland Late-successional Reserve and vicinity



Deriving abiotic parameter values from Digital Elevation Model in GIS.



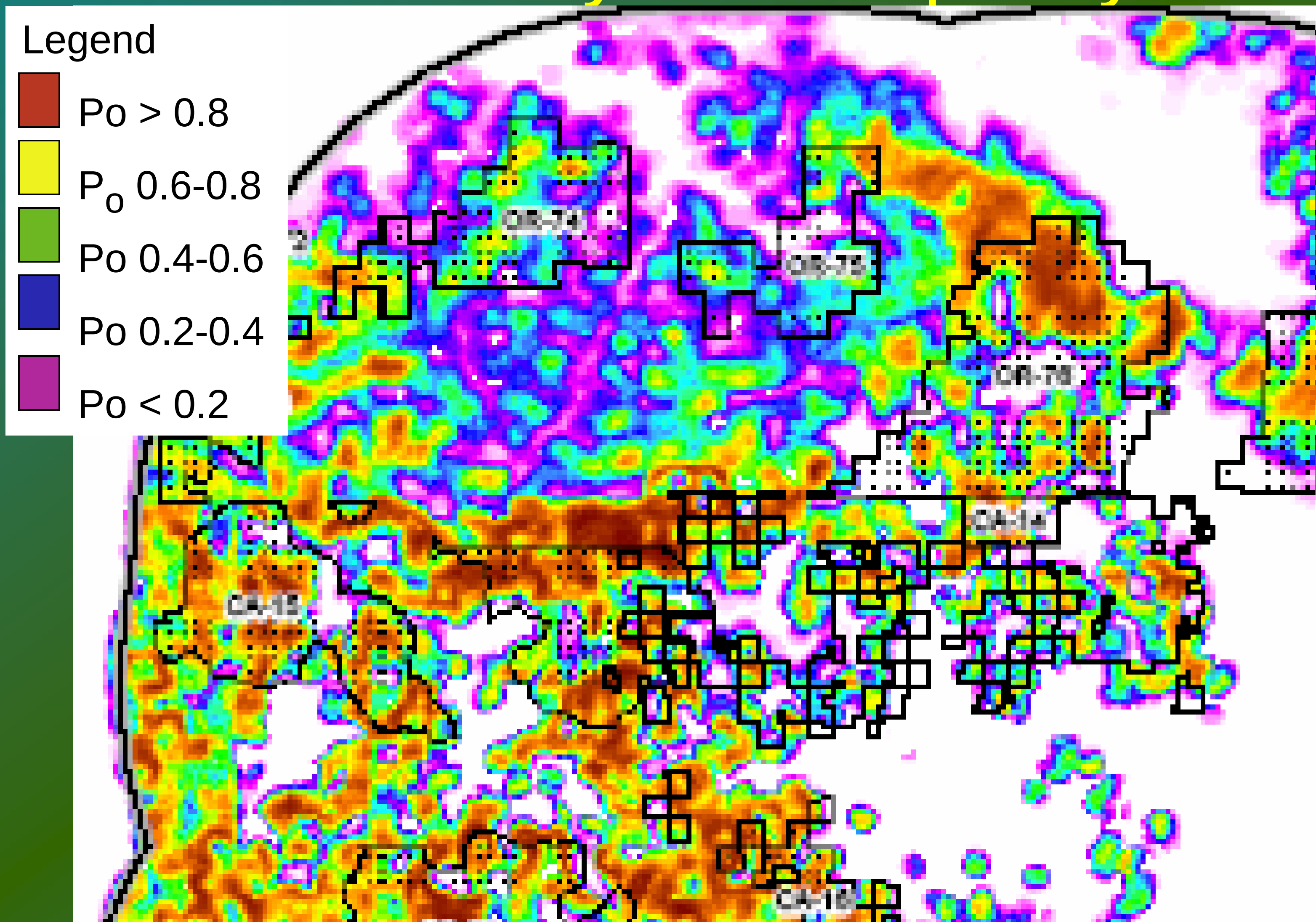
Abiotic Suitability Surface Map

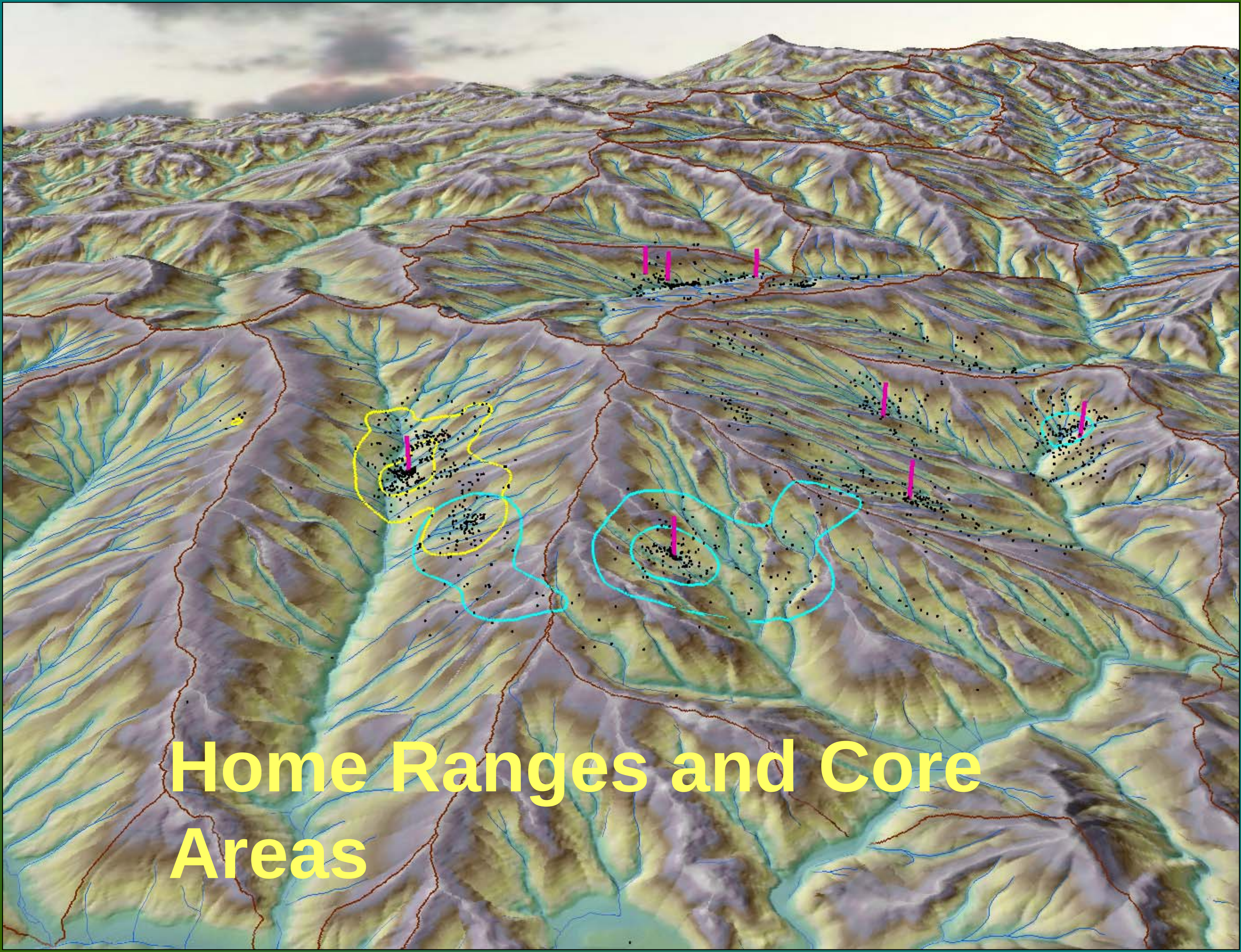


Modeling Landscape Suitability Using Forest Habitat Features

- Zabel et al. (2003) model: uses amount, configuration and ratio of nesting and foraging habitat, as well as abiotic features, to model probability of occupancy by NSO.
- Model validated on several independent study areas; 88% to 93% correct classification.
- Klamath Province specific!

Application of Habitat Suitability Model: Probability of Occupancy

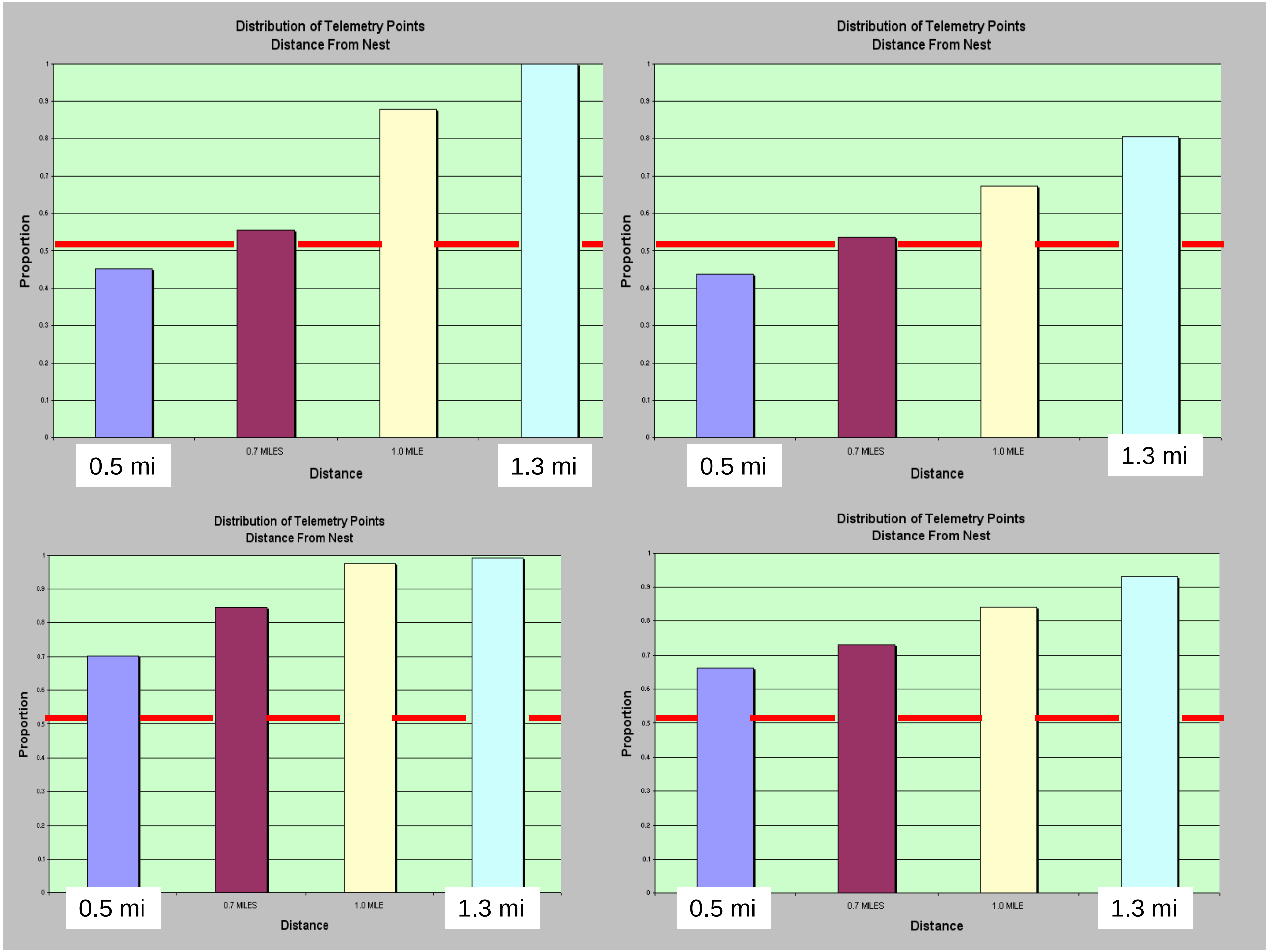




Home Ranges and Core Areas

Home Range Area

			Home Range Area (acres)		
Study Area	N	# Locs	95% Kernel (AK or FK)	MMCP	Source
SW OR-MCLUMP	3	1138	N/A	1166 (106)	Carey et al 1992
SW OR-MCFRAG	6	3221	N/A	2985 (672)	Carey et al 1992
S. OR			3867 (AK)	N/A	Wagner and Anthony 1999
Medford	8	5041	1588 (367) FK	3239 (1447)	Irwin et al. 2005
Yreka	9	3151	1489 (399) FK	2691 (1309)	Irwin et al. 2005
Hilt	11	2414	2100 (1048) FK	3645 (2525)	Irwin et al. 2005


Distribution of Telemetry Points
Distance From Nest
Proportion
0.5 mi
0.7 MILES
1.0 MILE
1.3 mi
Distance
Distribution of Telemetry Points
Distance From Nest
Proportion
0.5 mi
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Distance

Home Range Size - conclusions

- High variability in area estimates based on differences in methods used (MCP, MMCP, FK, AK, breeding season, annual??)
- Each method measures a different aspect of NSO use of space: kernel estimates highlight areas of disproportionate use. MCP methods simply connect the dots. Neither translates well into “circle analysis” radii
- Need to compare with simple Distance to nest histogram to describe radius of NSO use

Home Ranges: Habitat Composition

- Typically described in terms of proportion of home range in various categories of habitat: seral stages (old forest etc.) or size class/density (WHR)
- Great variation in habitat classifications used
- At this scale, complex stand structural descriptions not available
- Most studies too general to be useful for management planning

Core Areas

- Area within home range that receives disproportionate amount of use.
- Described as encompassing 60% to 70% of telemetry locations; 20-21% of home range (Bingham and Noon 1997).
- Important determinant of owl occupancy, fitness (Dugger et al. 2005, Franklin et al. 2000, Zabel et al. 2003)

Core Area Size

- Bingham and Noon (1997) recommended using mean core area + 1 SE = 475 acres, based on radio telemetry.
- Wagner and Anthony (1999) used the 50% Adaptive Kernel isopleth to define a 413 acre core area.
- Franklin et al (2000) found NSO fitness to be correlated with habitat features within 389 acre area (1/2 median nearest-neighbor distance.

Core Area Size (cont.)

- Hunter et al. (1995) and Meyer et al.(1998) found strongest habitat relationships at 500 acre scale.
- Zabel et al. (2003) tested predictive models at several scales; best model at 500 acre scale.

Core Area Sizes: fixed kernel estimates

(from Irwin et al. 2005)

Study Area	N	# Locs	50% FK Acres (SE)	75% FK Acres (SE)
Medford	8	5041	210 (81)	510 (147)
Yreka	9	3151	128 (55)	364.4 (114)
Hilt	11	2414	147 (73)	415 (191)
Chico	9	4018	198 (110)	530 (275)
mean			171 (87)	456 (198)

Core Areas: Habitat Composition

- Despite dissimilar study designs and approaches, high degree of concordance in results.
- In all studies reviewed, core areas contained sig. greater amounts of OG/mature forest than random circles.
- Bart (1995) suggested at least 30-50% of core be OG/mature forest (150-250 acres).

Core Area: Habitat Composition (cont.)

	Amount OG/mature forest* mean acres (range %)		
Area	Occupied	Random	Source
NW CA	232 (33.6-59.4%)	177 (21.6-49.3%)	Hunter et al. 1995
SW OR	312 (67.5%)	214 (43.9%)	Meyer et al. 1998
NW CA	160 (32%)	110 (22%)	Gutierrez et al. 1998

* Wide variation in definitions of old-growth/mature forest habitat

Core Area: Habitat Composition and Fitness (cont.)

- Franklin et al. (2000) found that fitness (both survival and reproduction) of NSO was correlated with features of core area habitat.
- High fitness was associated with roughly 60% of 389-acre core composed of mature forest habitat (239 acres). Remainder can be mix of younger/ more open types to provide preybase and foraging habitat (A. Franklin, pers. comm).
- Core/Edge ratio and patchiness also important.
- Apparent tradeoff between survival (amount of core mature habitat) and fecundity (edge, foraging habitats)

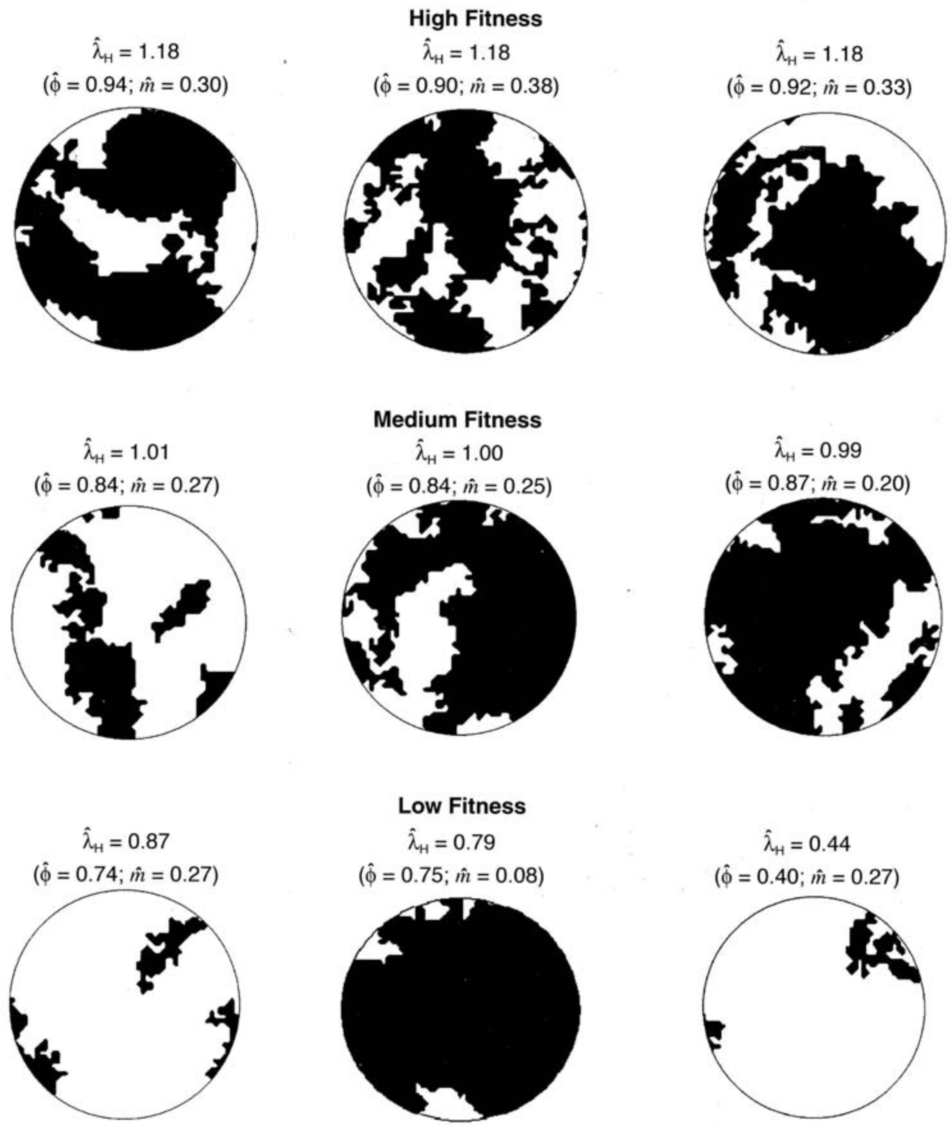


FIG. 10. Landscape habitat characteristics (within 0.71 km radius circles used to define Northern Spotted Owl territories) at three levels of habitat fitness potential in northwestern California. Dark areas are Northern Spotted Owl habitat; white areas are other vegetation types. Estimates of ϕ (apparent survival) and m (fecundity) are for owls $\geq$3 yr old.

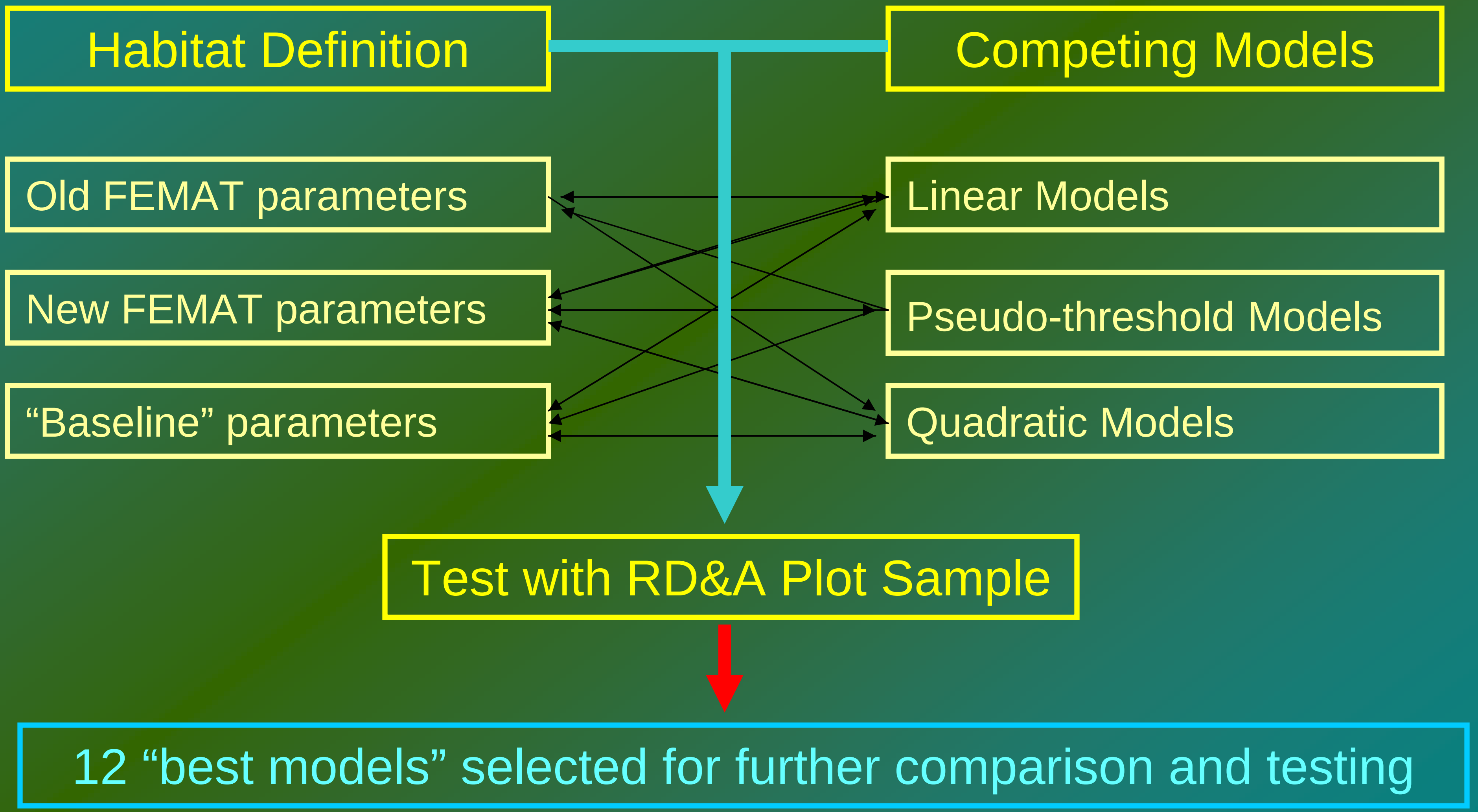
Core Area Habitat Composition and Fitness (cont.)

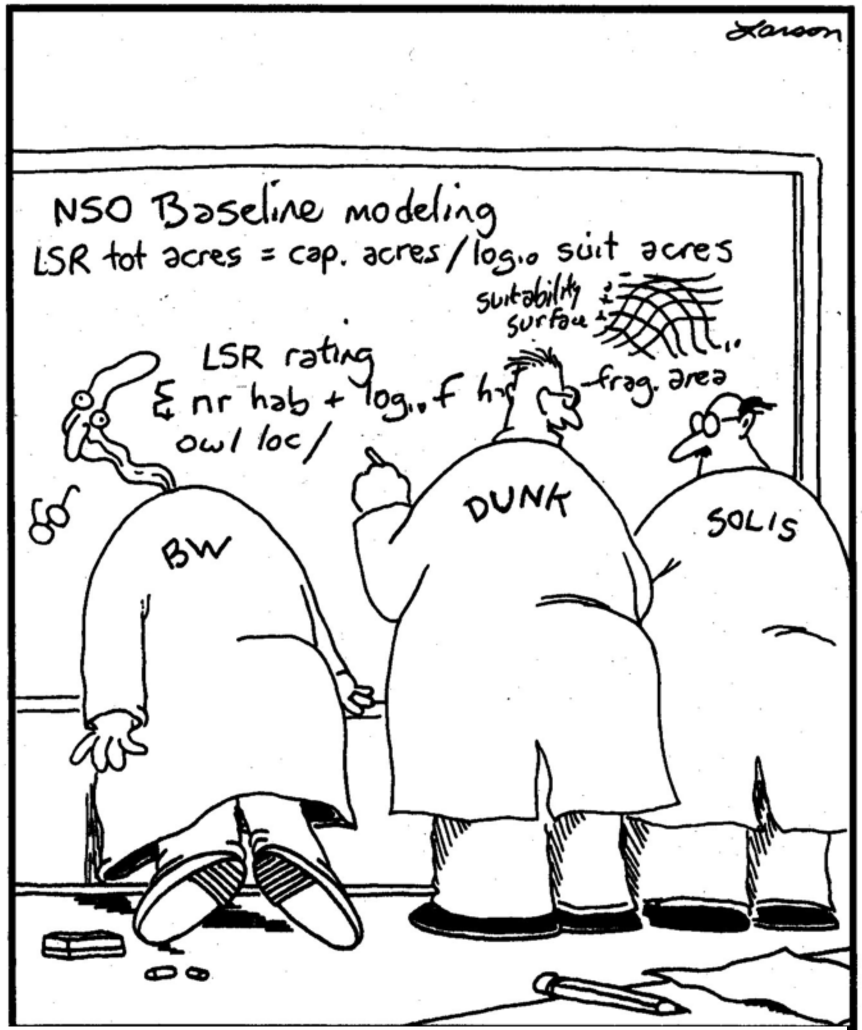
- In southern Oregon, Dugger et al. (2005) found results similar to Franklin's
- In general, 413-acre core areas with >40% old forest had high fitness potentials (>1)
- Did not find evidence for a positive relationship with edge

Core Area: Habitat Composition

- Zabel et al. (2003) developed a predictive habitat-association model based on USFS RD&A program (74 random locations in Klamath Province).
- Used refined definitions of Nesting/ Roosting and Foraging habitat; incorporated elevation, aspect, species composition, ecological zone.

Model Selection Process





Hah! Woodbridge's blown his cerebral cortex!

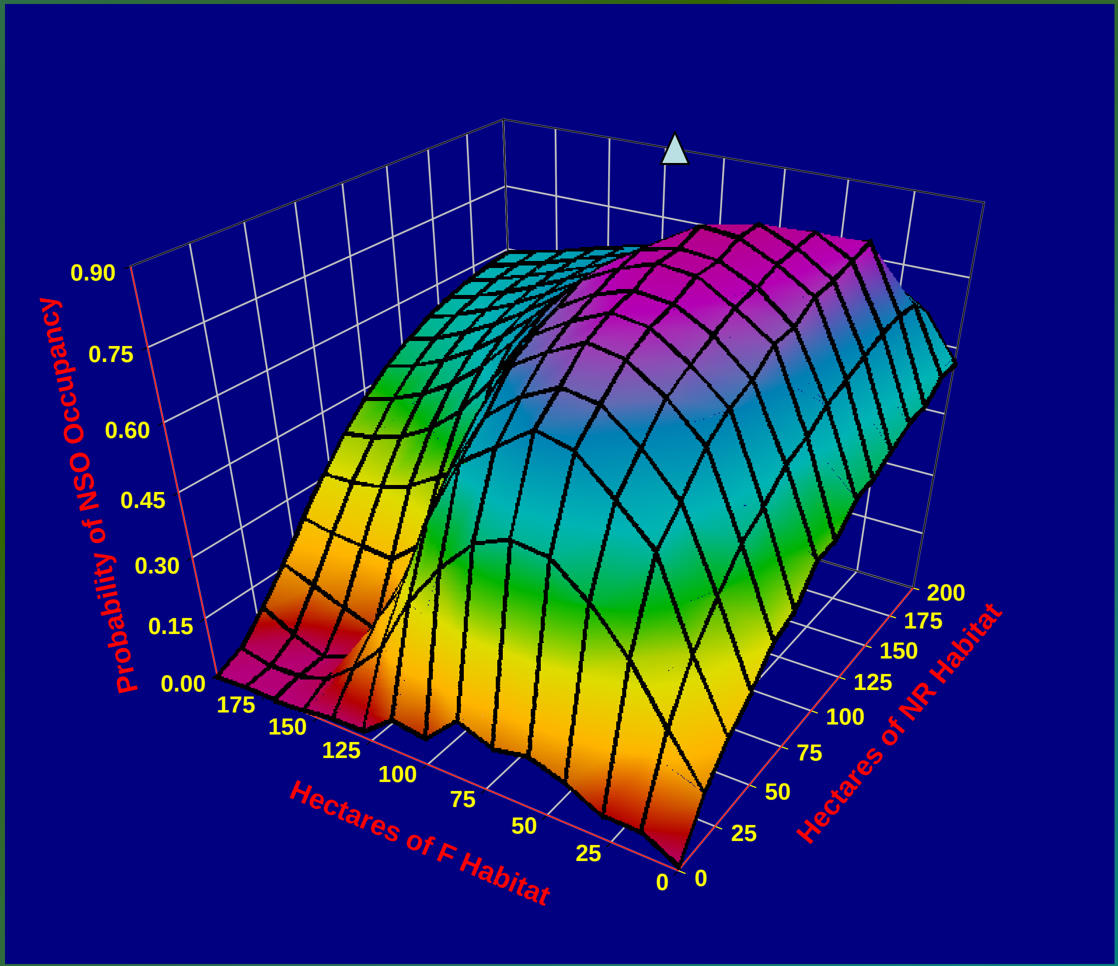
Model Testing

- Data from 8 independent study areas were used to test and compare the accuracy of the 12 best models at each spatial scale
- Each independent study area had been completely censused for owls. Thus, both presence and absence were known
- Sample sizes ranged from 24 to 180 for the test data study areas

Results: Best model LOGNR + F + F^2 at 500-acre scale

		Probability of
ac of NR	ac of F	Occupancy
500	0	0.567
0	500	0.000
346	148	0.901

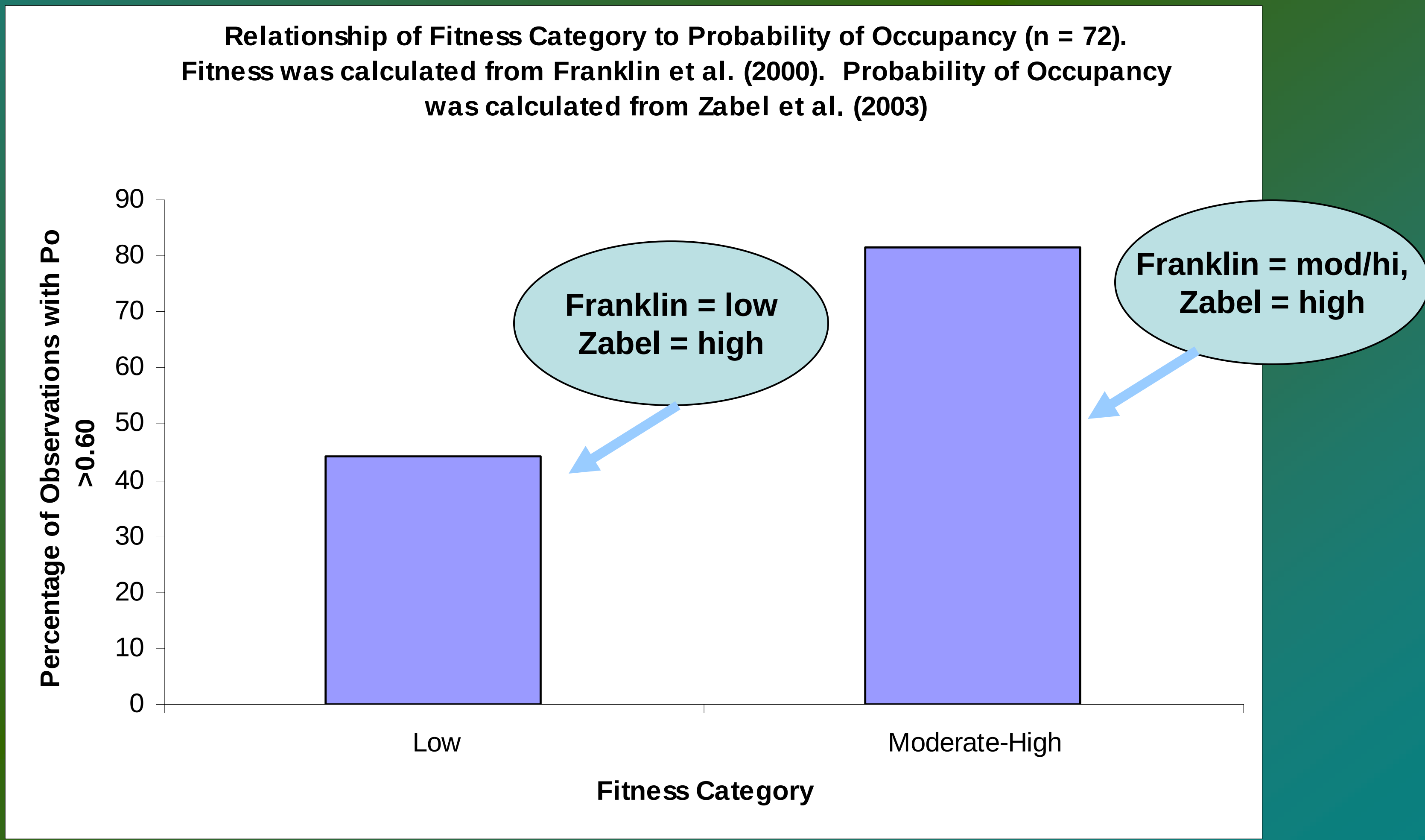
This model resulted in 93% correct classification of occupied owl sites.



Core Area: Habitat Composition

- Zabel Model (cont.)
- Highest probability of occupancy values occurred when 500-acre core between 60-70% NR and 30-40% F habitat
- Can evaluate effect of changing habitat on estimated probability of occupancy.

Relationship Between Fitness (survival and fecundity) and Probability of Occupancy



Qualitative Features of Nesting and Foraging Habitat

- Many assumptions made about the functional differences between nesting and foraging habitats
-
- Different approaches used to describe habitat: what's around nests versus telemetry
- Greater attention to describing nesting habitat (it's easy to do)
- Foraging habitat makes up majority of home range but is poorly described (telemetry studies difficult and expensive)

Nesting Habitat

- Defined as habitat structure typically associated with NSO nest sites (small scale)
- May provide more cover, thermal protection, nest structures associated with stand decadence than foraging habitats
- Majority of “NR” habitat within home range is used for foraging

Nesting Habitat

- Described as closed-canopied mature to old-growth forest, multilayered, with some degree of decadence
- Canopy closures typically >70%
- At stand level, high degree of variation in mean diameter, basal area, trees per acre
- At microhabitat level, nest sites typically associated with large (>30”) trees with structure (mistletoe, cavity, deformity)

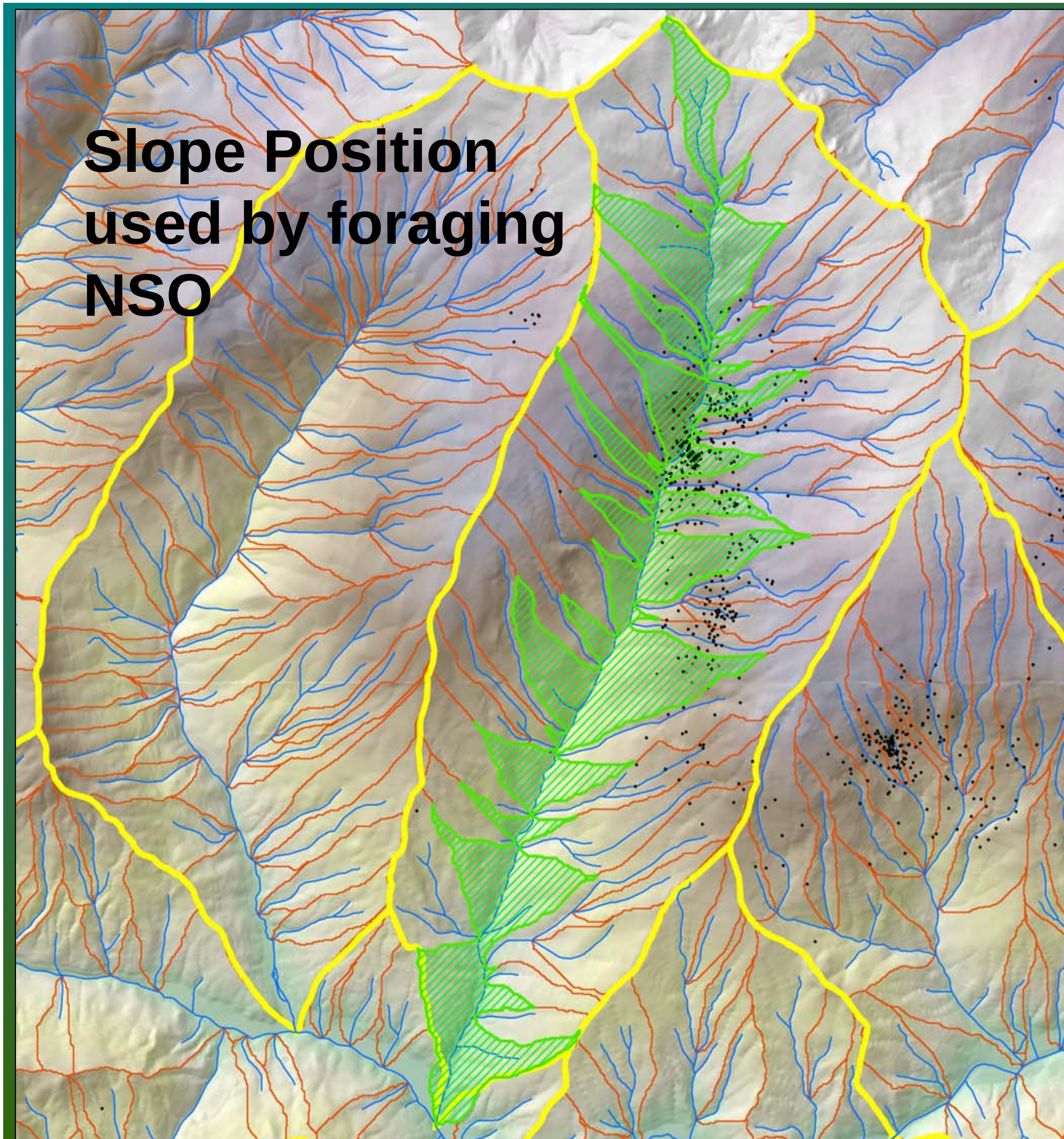
Foraging Habitat

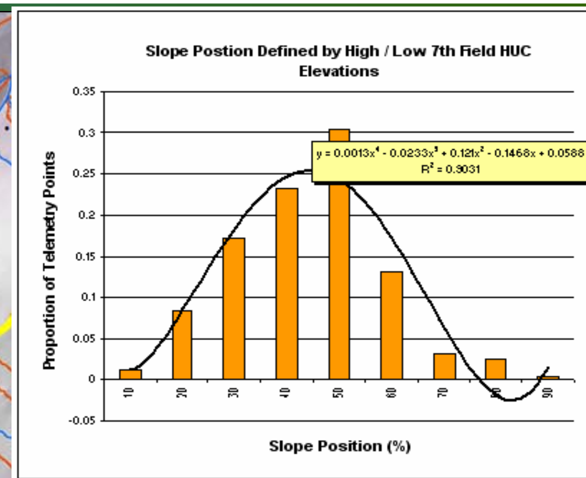
- Few published studies have used radio telemetry and plot data to describe habitats used by foraging NSO in the Klamath area
- Even fewer have described habitat in terms useful to managers (i.e structural parameters)
- Most studies used seral classes (OG/mature/pole/sapling) or remotely classified vegetation maps (WHR, timber typing)

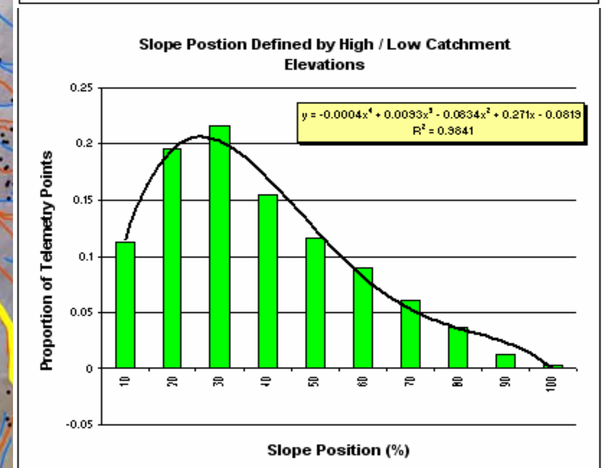
Foraging Habitat: Abiotic Influences

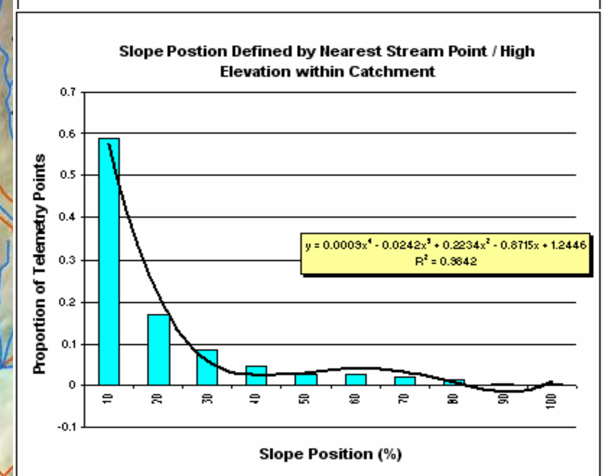
- Use of stands by NSO is strongly influenced by abiotic features (where it is versus what it is):
- Distance to nest site: important variable for central-place forager
- Slope Position: foraging activity is concentrated on lower 1/3 of slopes. Not equivalent to distance from water
- Elevation: Some preference for lower elevations within home range
- Aspect: Preference for north slopes (variable)

Slope Position used by foraging NSO









Structural Features of Habitats Used for Foraging: Basal Area

	Optimal Range	Source
Live trees	307 - 334 ft/^{2}ac	Solis 1983*
Live trees >35"	157 - 176 ft^2/ac	Solis 1983*
Live trees <11"	10 ft^2/ac	Solis 1983*
Snags	31 – 38 ft^2/ac	Solis 1983*
Live trees	180 - 220 ft^2/ac	Gutierrez et al. 1992
Live trees >20"	50 - 60% of total	Gutierrez et al. 1992
Snags > 15"	7 - 17 ft^2/ac	Gutierrez et al. 1992
Live trees	160 - 240 ft^2/ac	Irwin et al. 2005

*** study conducted in Douglas-fir/tanoak**

Structural Features of Habitats Used for Foraging: Tree Size/Density

	Mean =/- SE	Source
All Trees	450 – 489/ ac	Irwin et al. 2005
Trees 5 – 9.8” dbh	102 – 110/ ac.	Irwin et al. 2005
Trees > 26” dbh	6.8 – 7.2/ ac	Irwin et al. 2005
QMD	14.1 – 14.3/ ac	Irwin et al. 2005
All Trees	205 – 216/ ac	Solis 1983
Trees 5 – 10.9” dbh	100 – 108/ ac	Solis 1983
Trees > 21” dbh	29 – 32/ ac	Solis 1983
70% of locations in stands > 20.7” dbh		Solis 1983

Structural Features of Foraging Habitat: Other Considerations

- Coarse Woody Debris: typically greater at foraging sites than random:
  - 10-15 tons/ac (Gutierrez et al. 1992)
- Shrub Cover: typically less at foraging than random sites
  - 6.7 – 8% shrub cover (about ½ of random) (Solis 1983)

Habitat Relationships of Primary Prey

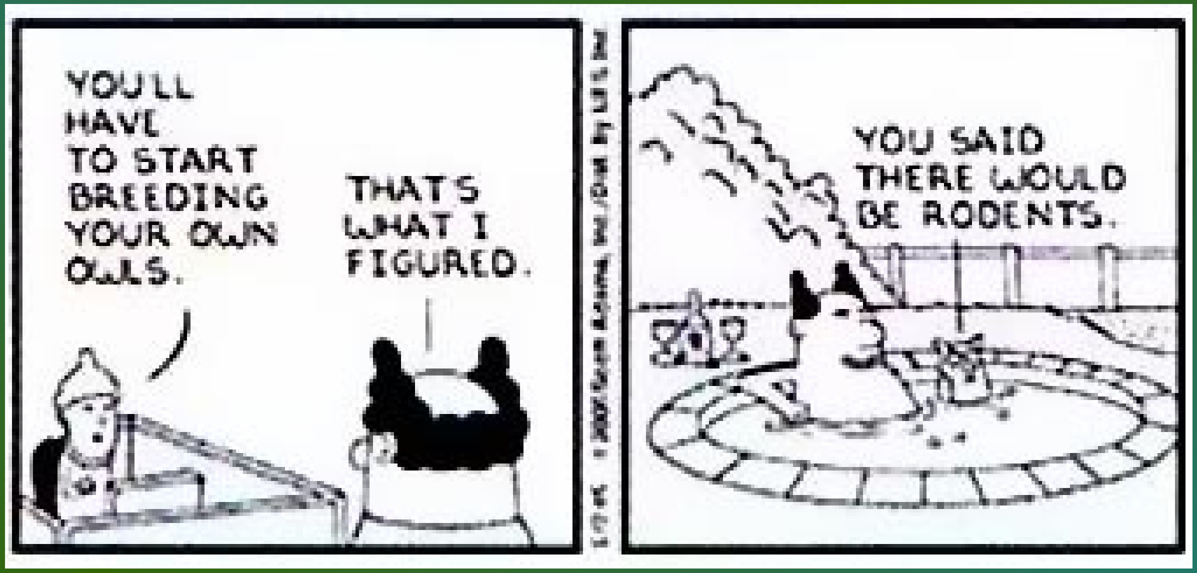
- Habitats supporting prey populations may not be the same as those typically associated with NSO use
- In Klamath Mixed Conifer habitats, habitat relationships of two primary prey species; Dusky-footed Woodrats and Flying Squirrels likely dictate optimum home range composition

Habitat Relationships of Primary Prey (cont.)

- Woodrats occupy brushy openings, riparian and early-seral habitats; may disperse into adjacent mature stands
- Woodrat populations are often unstable at local level, woodrat habitat is short-lived due to succession
- Flying Squirrels are most abundant in mature, closed canopied stands, often use cavities in snags as den/nest sites

Habitat Relationships of Primary Prey

- Through time, dispersion of woodrat habitat within forest matrix providing for stable flying squirrel populations may be an important management goal



This could be you….

Conclusions

- Spatial characteristics of NSO home range use, combined with the influence of abiotic factors, can be used to assist planning of silvicultural and fuels treatments (and risk assessments)
- Integrating spatial/abiotic influences with evaluation of stand characteristics (owl suitability versus fuel model?) before and after treatment can provide a consistent approach for planning treatments