Biodiversity and Effects of Management Actions on Species

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Planning to Protect Biodiversity

- A Developing Field: Limited large-scale examples
- Two Common Components:
  - Representation of vegetation types & ecological processes = COARSE FILTER approach
  - Consideration of individual elements, usually species = FINE FILTER approach
- Mixed approach (COARSE + FINE) is accepted by scientific community.
- Examples from other organizations: TNC, *ForestERA*

Coarse Filter Assumptions Re: Species

"…cost effective and easy to implement…" Schulte et al. (2006)

Coarse

Vegetation Structure

Assumptions ↘

Habitat Quality

Population Status & Trend

Coarse Filter Challenges for Species Viability

Coarse

Vegetation Structure

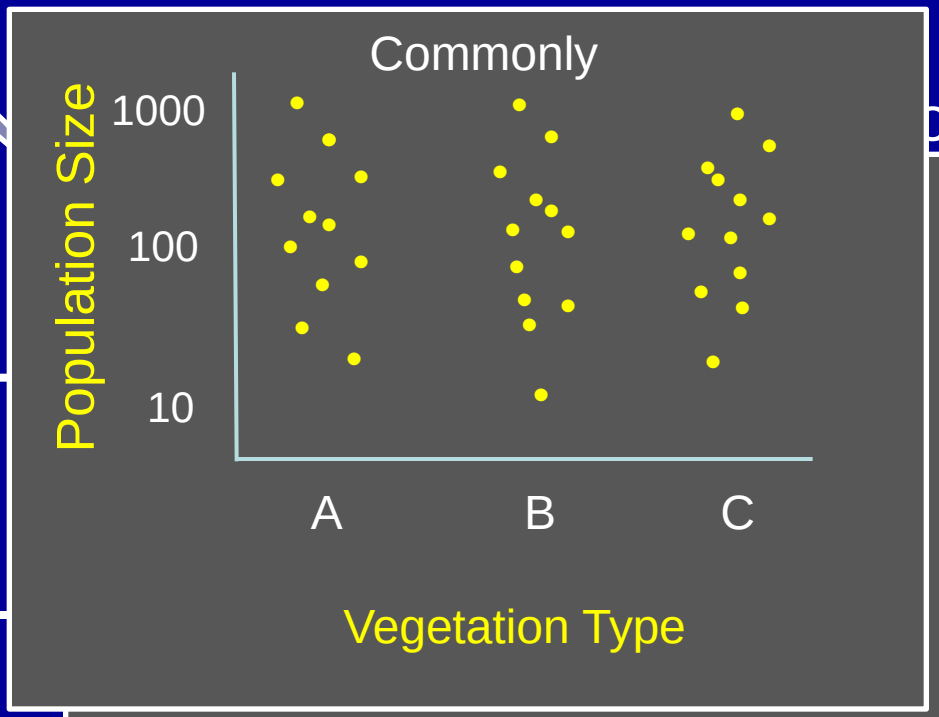
Assumptions

Habitat Quality

Popu

Status & Trend

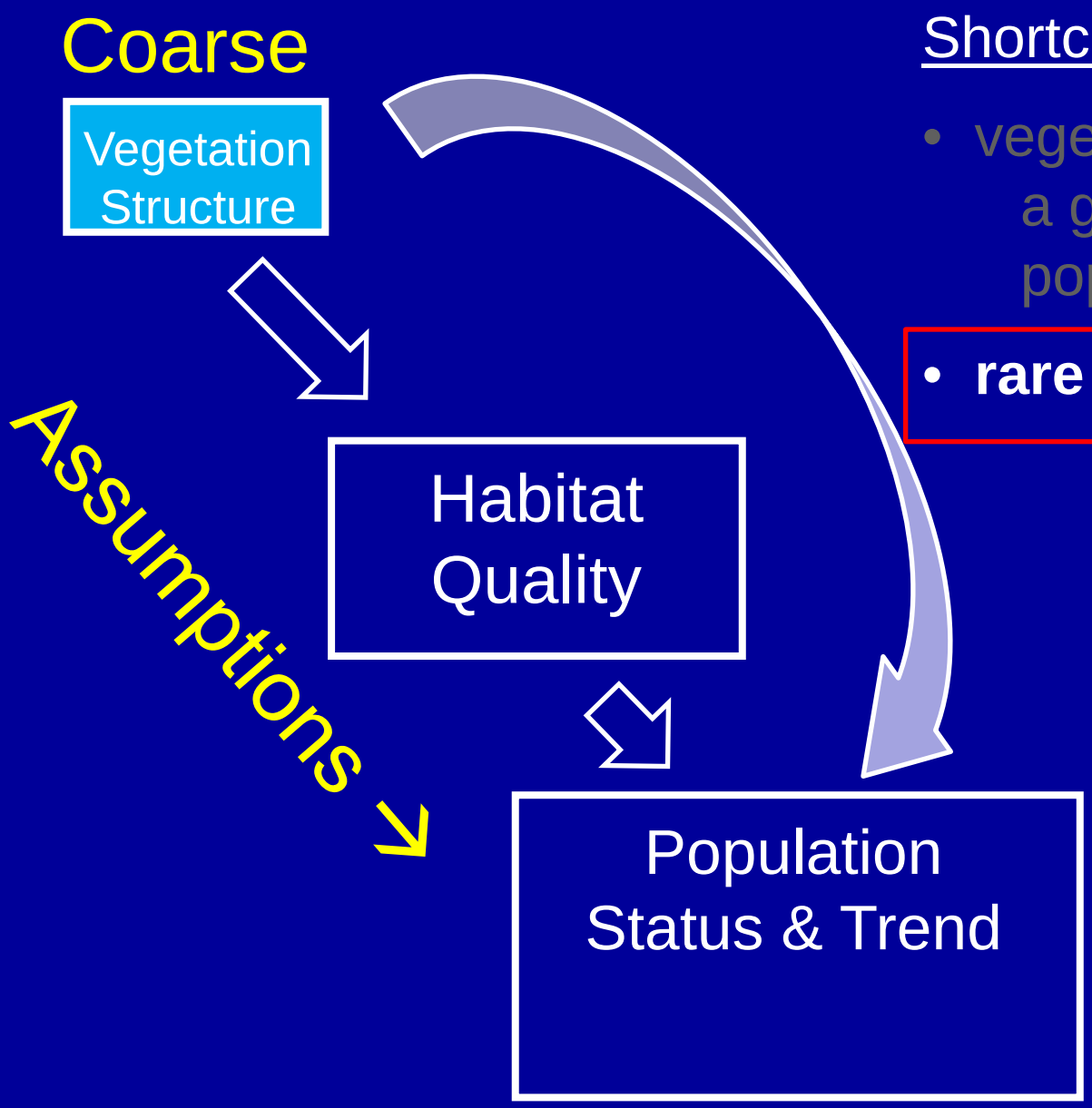
Shortcomings:



or of

Flather et al. (1997)
Noon et al. (2009)
Schlossberg & King (2009)

Coarse Filter Challenges for Species Viability

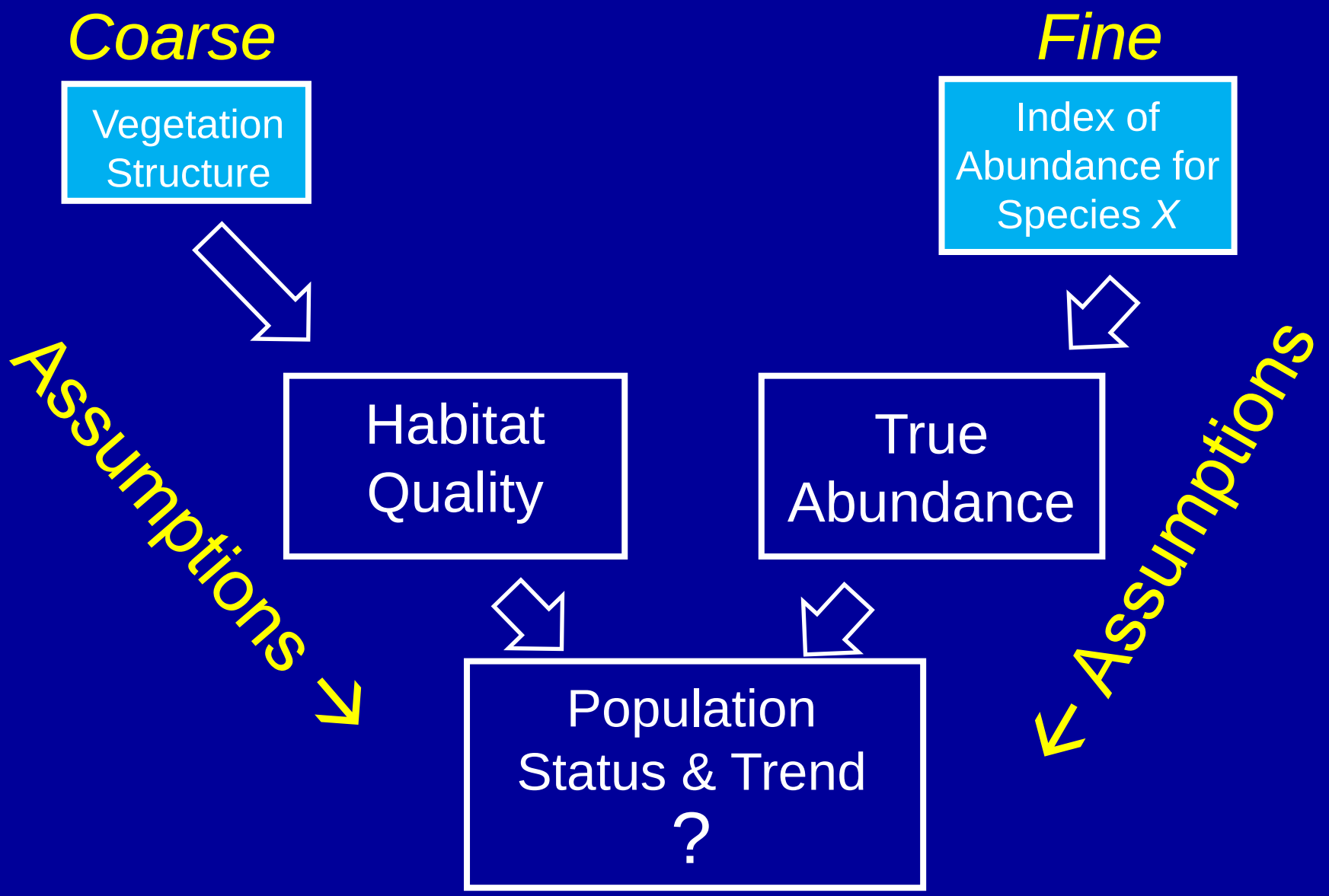


Shortcomings:

- vegetation type often not a good predictor of population status
- **rare species**

Flather et al. (1997)
Noon et al. (2009)
Schlossberg & King (2009)

Instead….Coarse + Fine



Respect our Ignorance

- System Dynamics: We don't understand the complexity of nature sufficiently to develop a protocol for sustaining ecosystems

  What to *protect*? What to *restore*? What to *connect*?

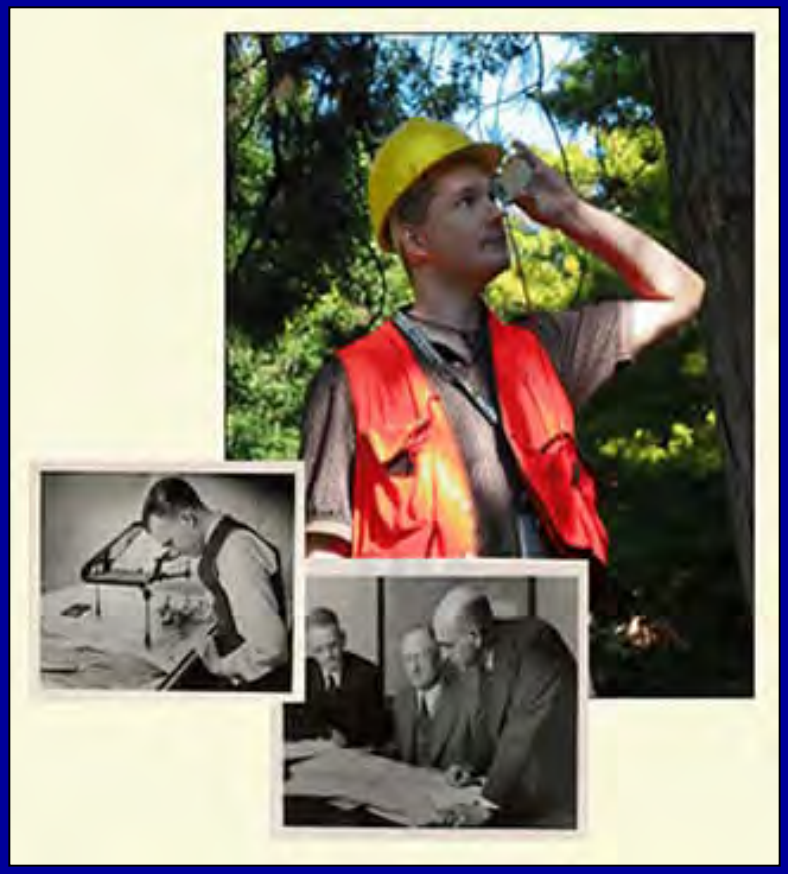
- Biodiversity: We can't wait until we understand the extent of diversity on public lands (genetic, species, community).

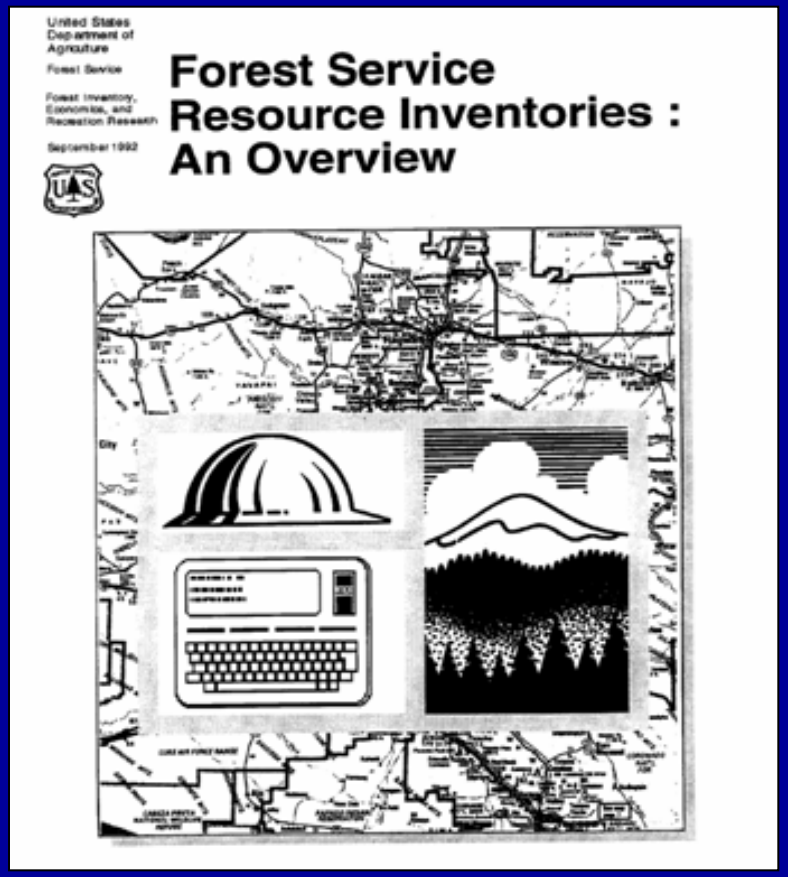
Needed: A spatially extensive & economical method for monitoring the status of realistic number of species

Monitoring and Predictive Modeling:
Exploit Existing Programs & Platforms

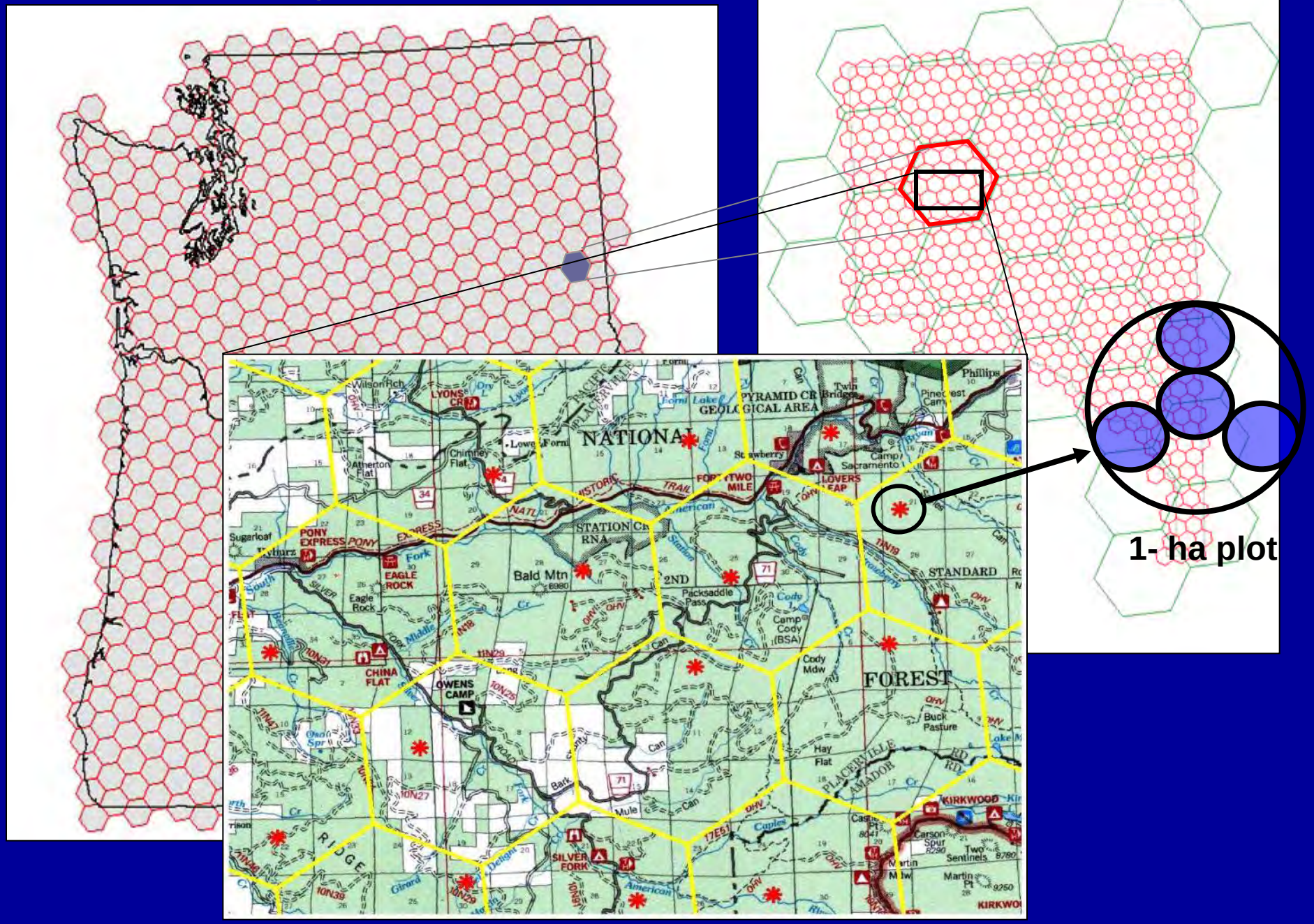
- Forest Inventory Analysis plots (**FIA**) as source for:
    - sampling
    - modeling and
    - monitoring effects on terrestrial wildlife
- Forest Vegetation Simulator (**FVS**), linked to models, as a platform for predicting effects of future management on wildlife species

Use Routinely Collected FIA data to Build Predictive Habitat Models

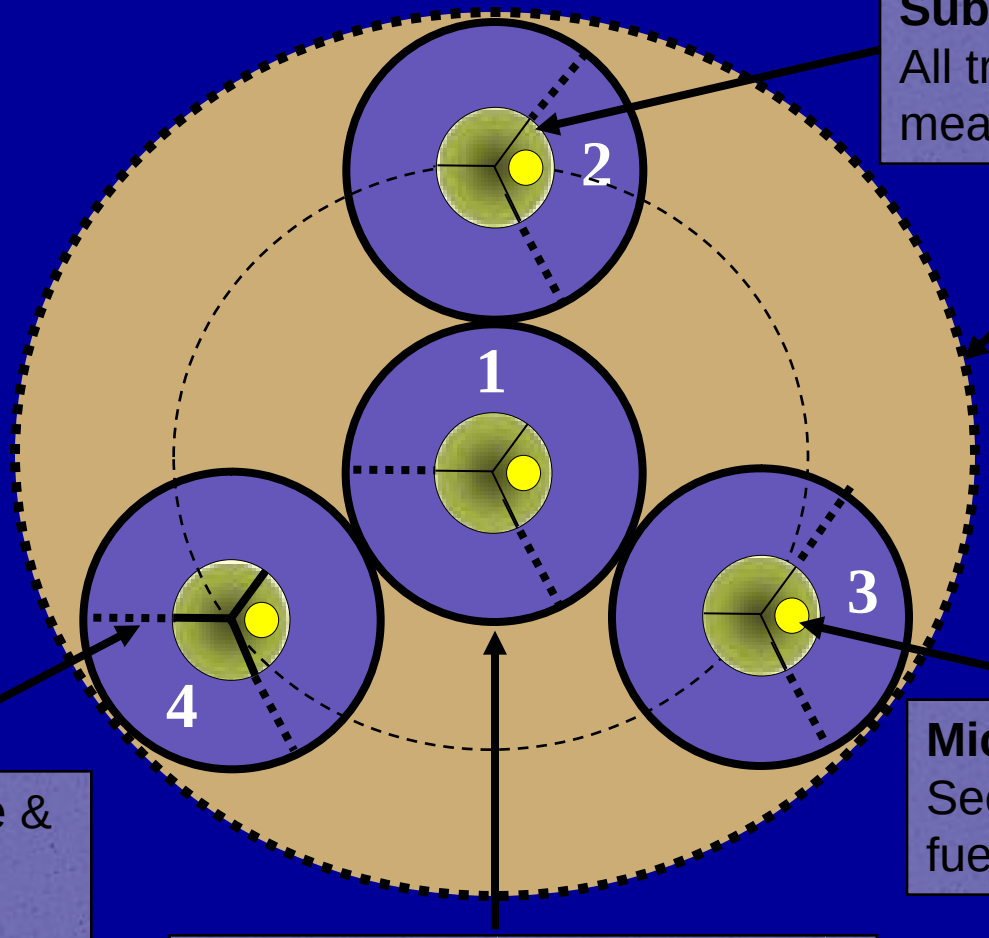




The FIA System



Plot Design
(1 ha, ~ 2.5 acres)



Subplot (24 ft radius): All trees ≥ 5” dbh; measure understory veg.

1-hectare plot (~180 ft radius): Very large trees

Microplot (6.8 ft radius) Seedlings & saplings; fuels data

Transects: Coarse & fine woody debris; ground cover data.

Annular Plot (58.9 ft radius): For sample intensification or sampling rare events.

How to apply an FIA-based approach to diverse species?

Small species w/ small home ranges

~ 0.00001 km^2

Larger species w/ large home ranges

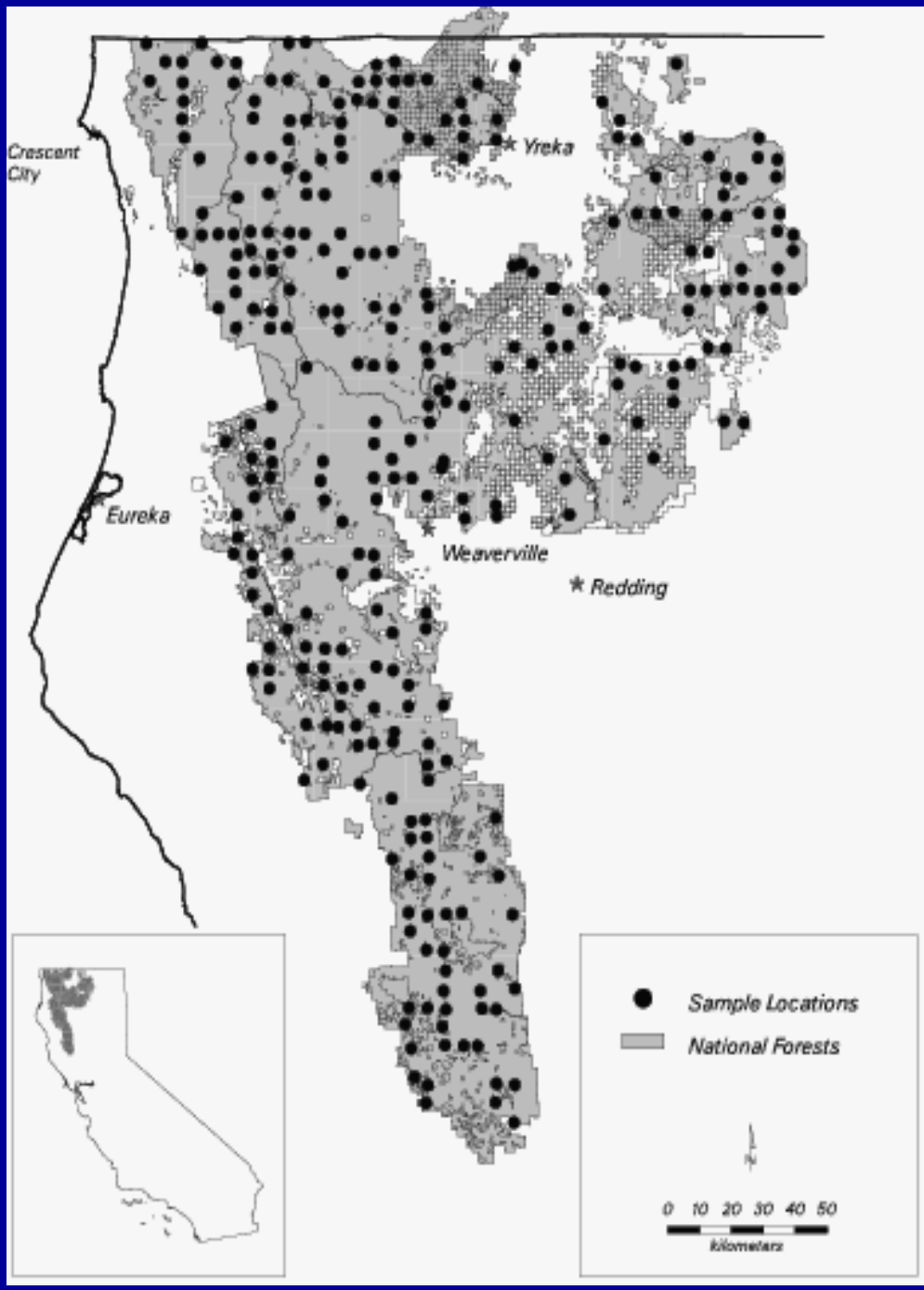
~ 40 km^2

The Small, High-Density Species

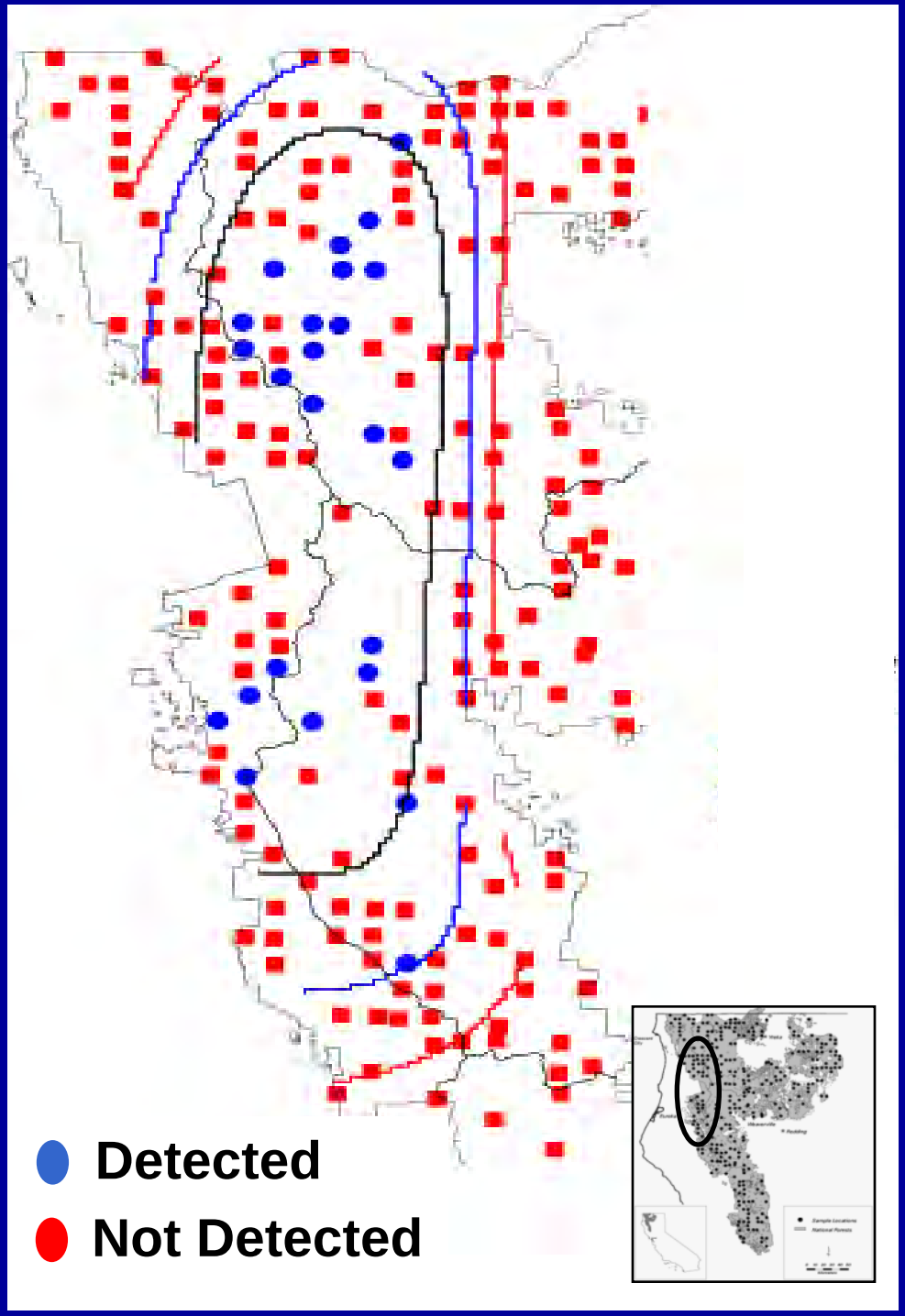
- Conduct careful sampling at set of FIA plots
- Build a habitat model that can predict occurrence at all FIA plots

Building the Model: Sampling

Randomly select FIA plots within 4 National Forests



Hooded lancetooth
(Ancotrema voyanum)



A Predictive Habitat Model: Hooded lancetooth

Variables	AIC_c	AIC_c wt
Conifer Dbh, Hardwood Canopy, *Quercus* Basal Area, CV_Precip, Annual Precip	81.50	0.228
Conifer CV_Pr		0.143
Conifer CV_Pr	82.80	0.119
Conifer DBH, Hardwood CC, *Quercus* BA, CV_Precip, UTMs	83.68	0.077

Predicted Probability of Occurence Value:
0 → 1.0

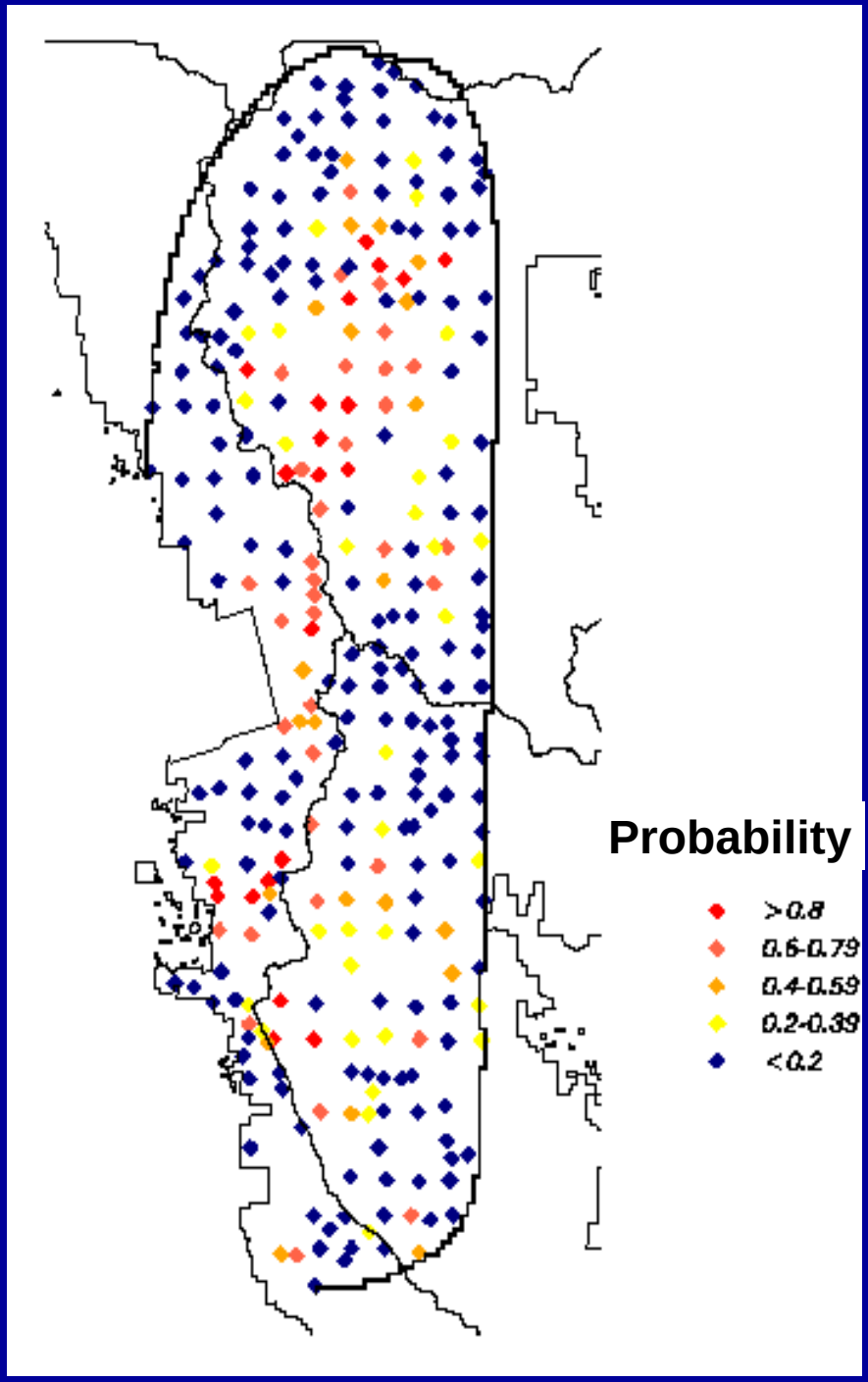
Dunk et al. (2004)

Applying the Model

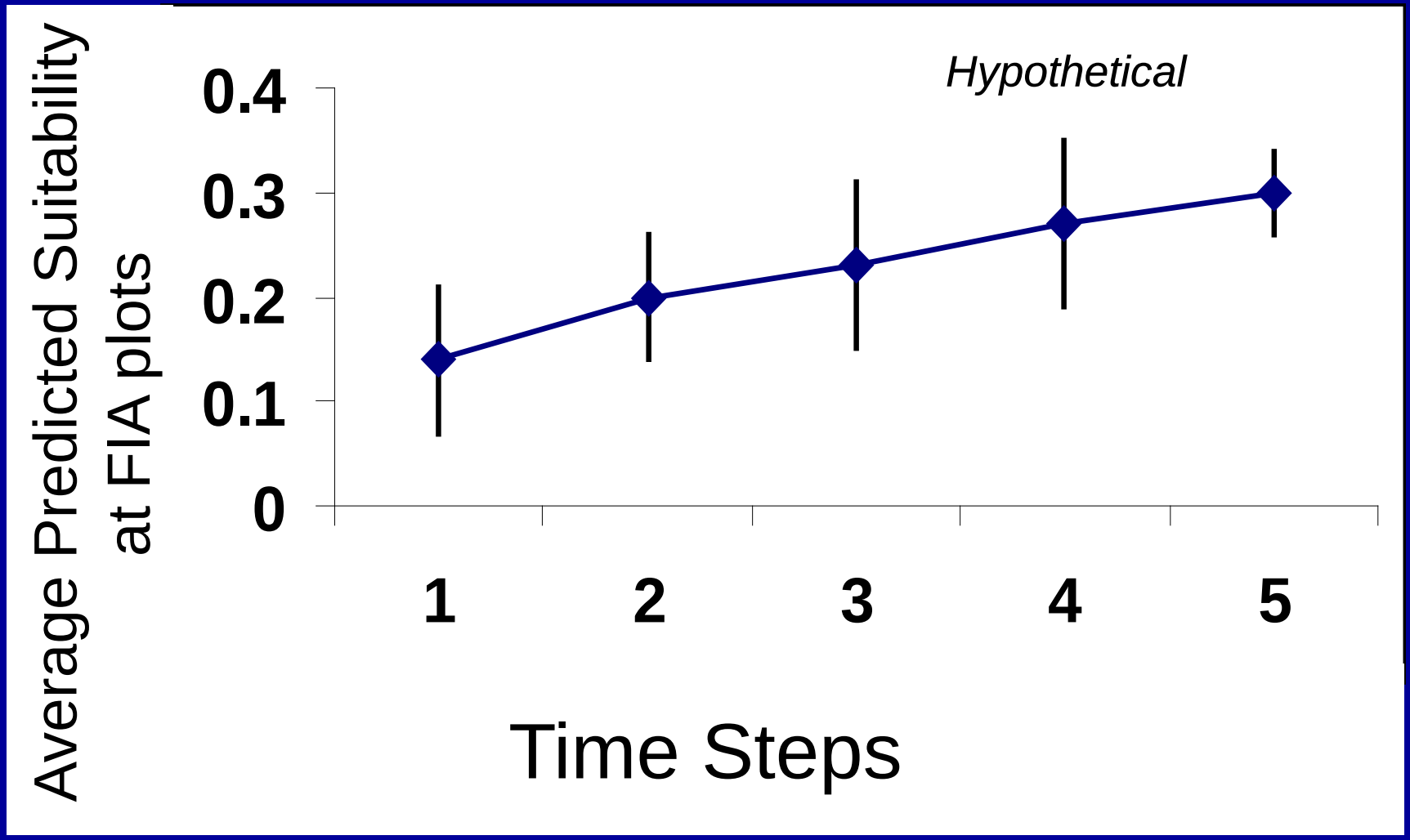
1. Predicted values can be generated for *each FIA plot* within reasonable area of inference = *Assessment*

2. Predicted values can be generated *every time* the FIA plots are resampled ~ 10 yrs = *Monitoring*

Predict Habitat Value at Unsampled FIA Plot Locations



Use FIA-based model to Monitor Predicted Habitat Suitability over Time



The Larger, Low-Density Species

- Install FIA plot at a sample of important habitat features (e.g. fisher = resting site).
- Develop predictive model by comparing FIA data at resting sites with plots in the regular FIA grid

A Predictive Habitat Model:
Fisher

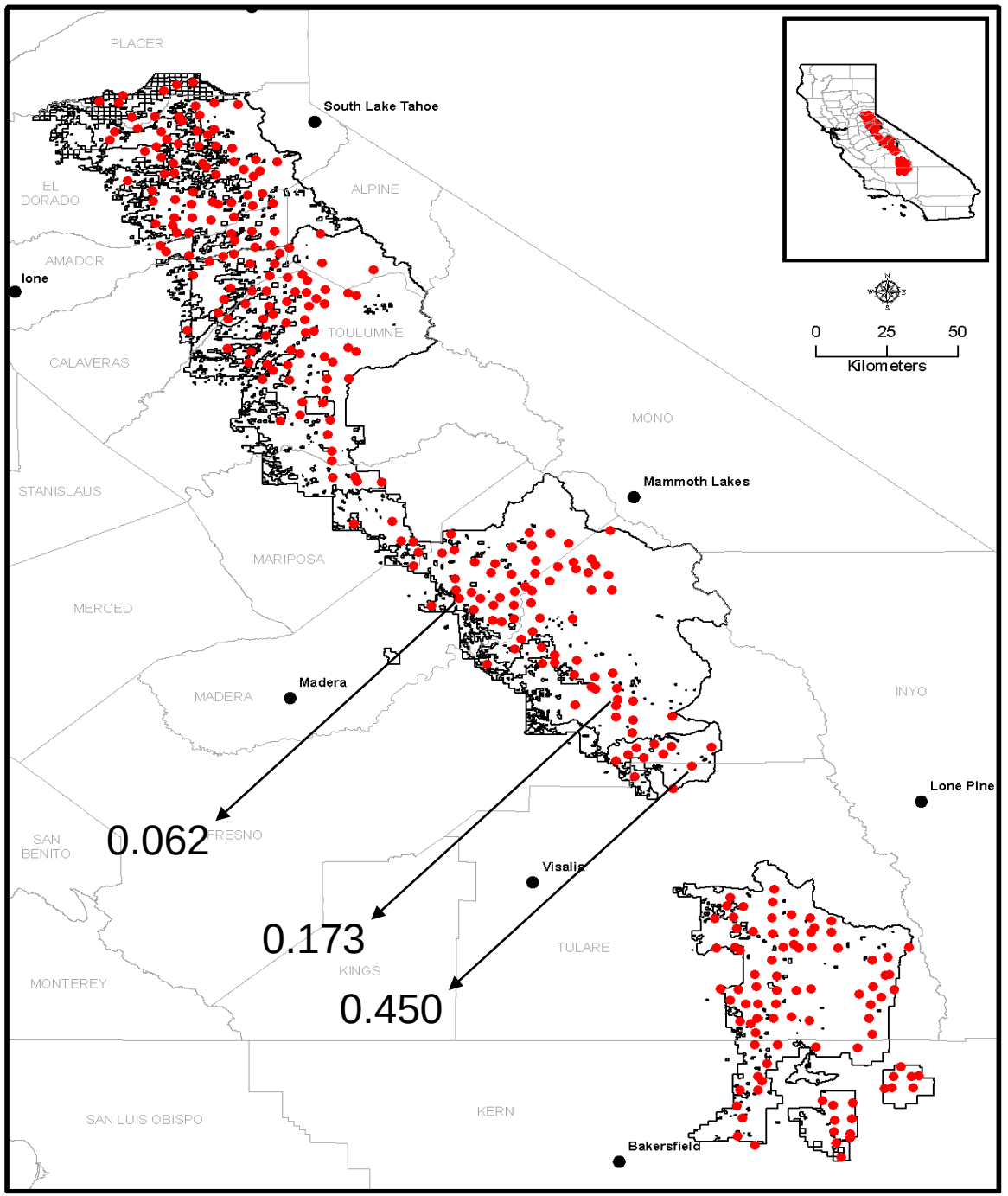
Variables	AIC_c	ΔAIC	AIC_c wt
Canopy Cover; Basal Area_small trees; D[illegible] Slope;			**.879**
CC, BA, H[illegible]			.020
CC, BA, H[illegible]			.020
CC, DBH[illegible]			.015
CC, BA, HBA, SLOPE, HIGHSHRUB	281.2	8.76	0.011

Predicted Fisher Resting Habitat
Value: 0 → 1.0

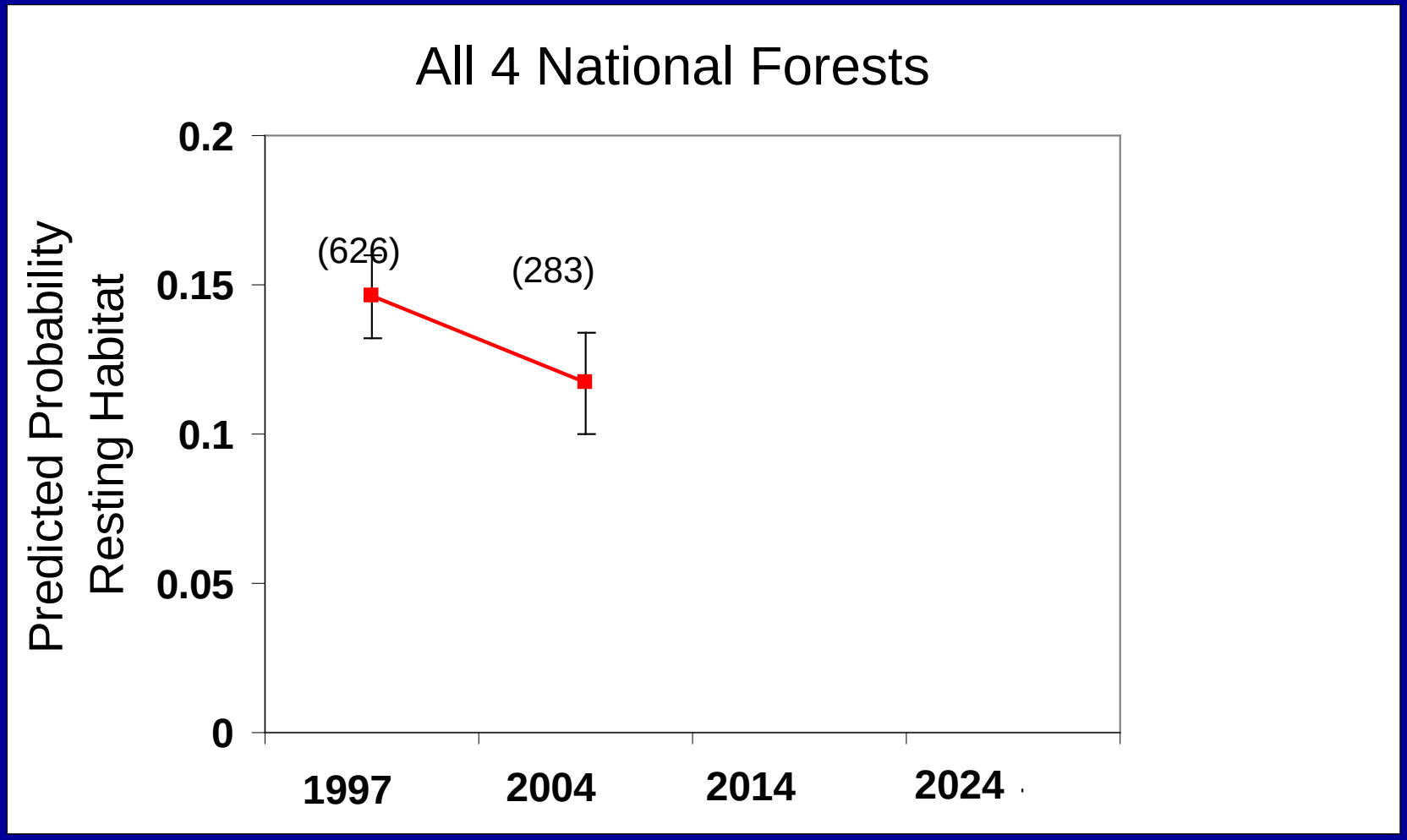
Zielinski et al. (2006)

FIA plots in 4 Southern Sierra Nevada Forests

n = 283



Applications: Regional Monitoring



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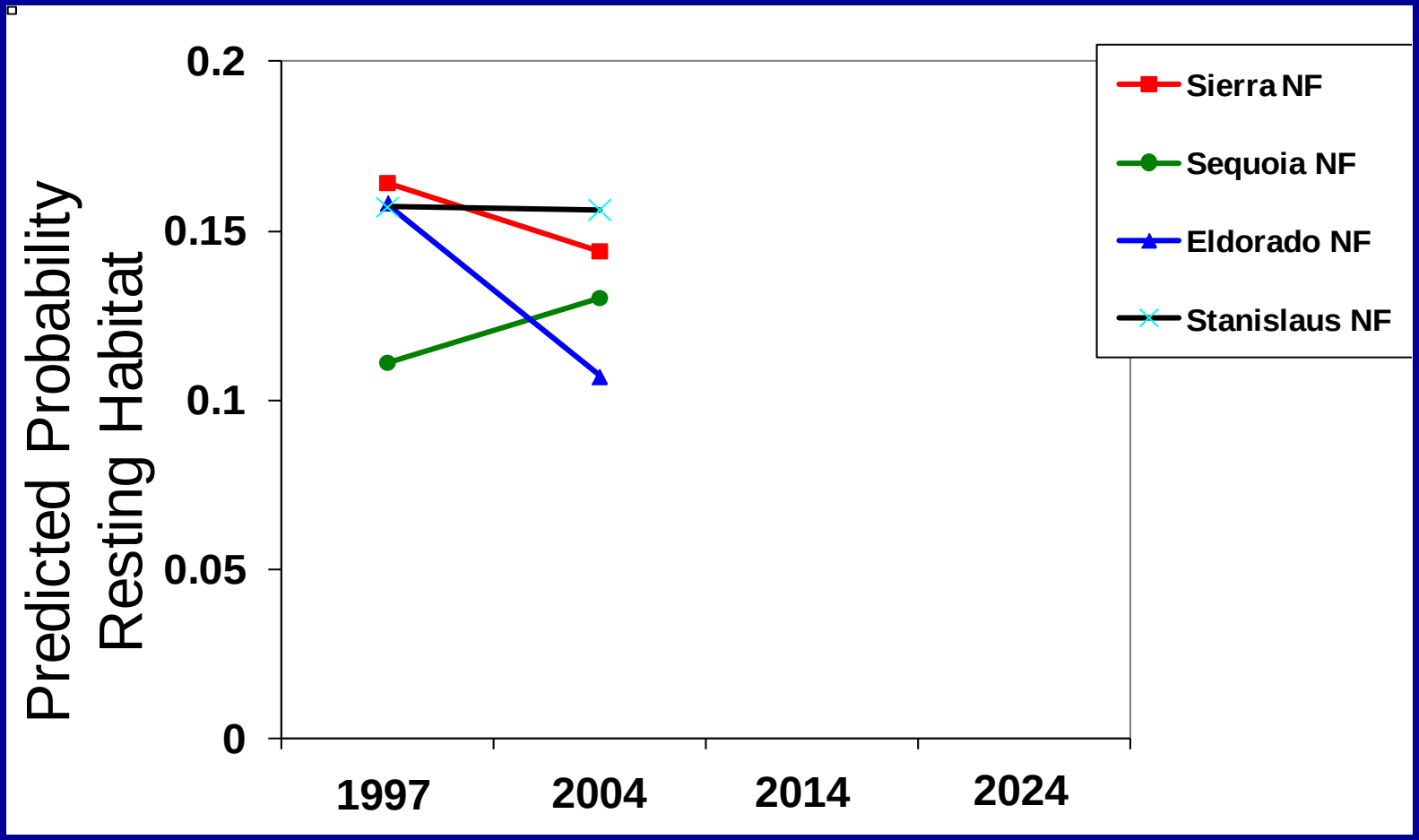
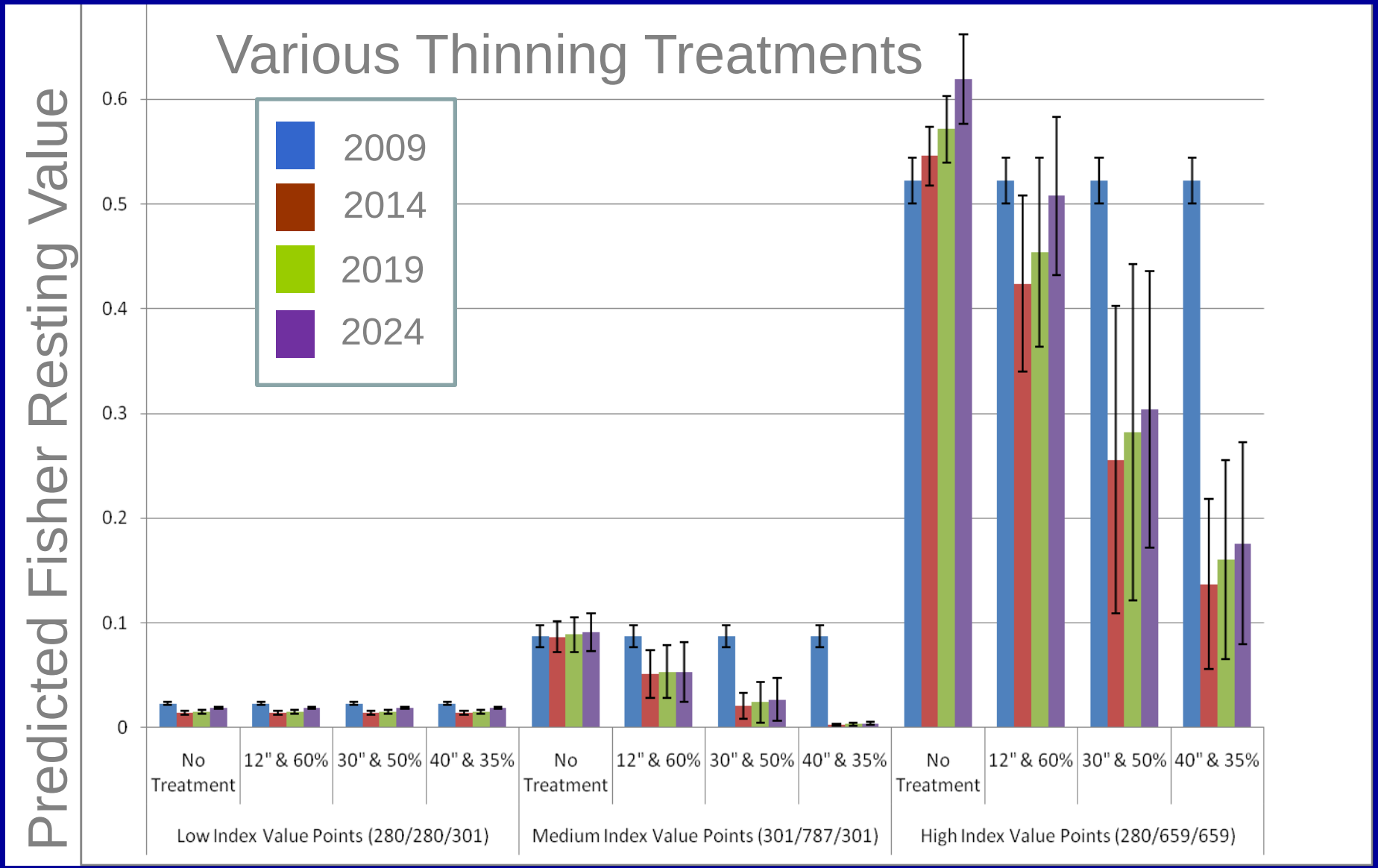
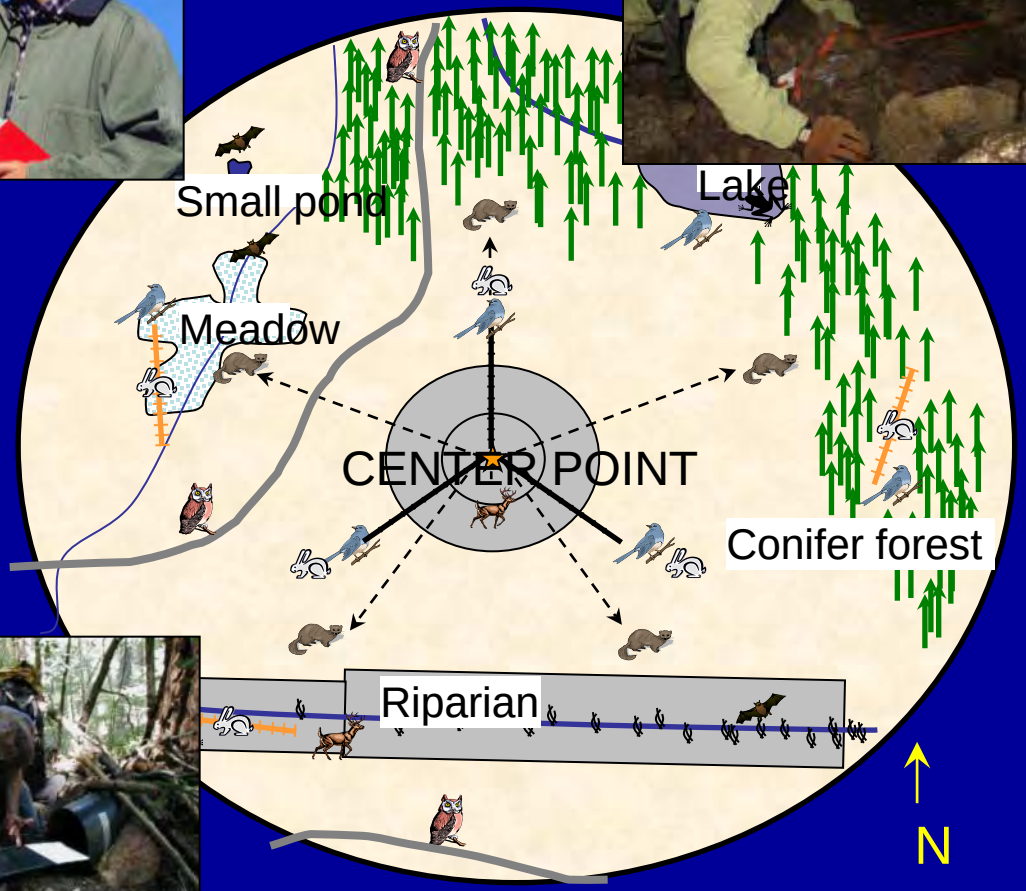


Forecasting Future Habitat Value:
Forest Vegetation Simulator (FVS)



Approach Can Be Expanded to Multiple Species with Simple Detection Surveys

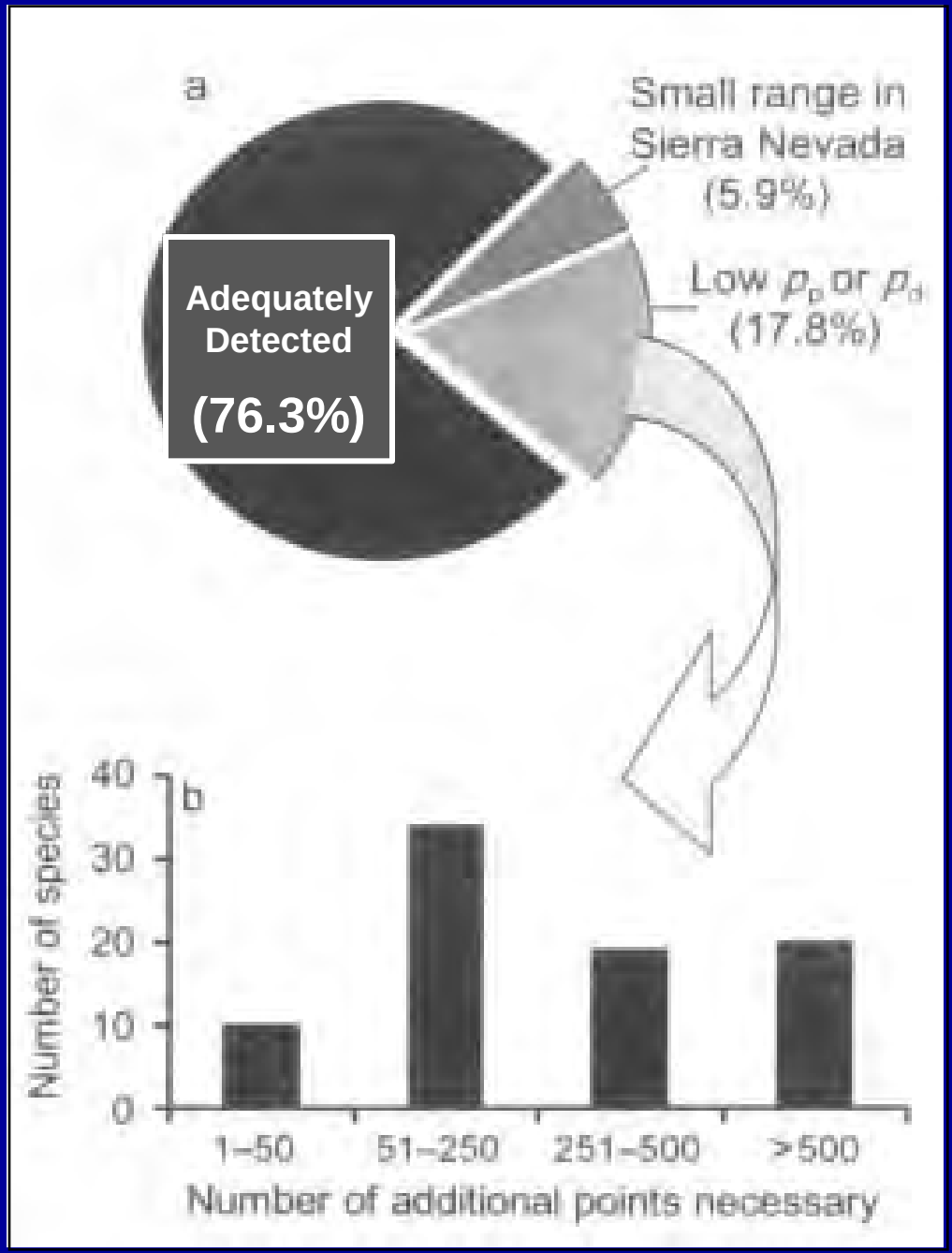


Manley et al. (2004, 2006)

Prediction:
Sierra Nevada

Changes in the geographic distributions of ~75% of species in would be adequately detected using grid-based "presence/absence" sampling

Manley et al. (2004)



Methods for Achieving Efficiency

1. Link passive, noninvasive sampling to FIA grid
2. For key species, build habitat models using FIA attributes & apply to the FIA system
3. Link FIA-based models to FVS to predict effects of proposed management activities
4. For wide-ranging species, use vegetation characteristics of their home ranges as a target landscape condition

Summary:
Logical Actions in the Face of Uncertainty

1. We will know more, and learn more, with a *systematic* collection of new information

2. With limited resources, we should collect that information strategically…..Considerations:
   - Mix of coarse and fine filter elements
   - Legal requirements for species
   - Elements that are limiting (big trees)
   - Elements that are at risk (vulnerable species)
   - Elements that, collectively, represent the state of an ecosystem (i.e. focal species)
   - Use field-based, noninvasive monitoring methods to index populations & for habitat modeling.

Summary (cont)

3. We can advance quickly using existing programs & platforms (FIA, FVS, remote sensing)

4. We can learn from other organizations (i.e., TNC) but also exploit the talents within NFS and research stations.

Black Salamander (*Aneides flavipunctatus*)