MONITORING MARBLED MURRELET NESTING HABITAT ON FEDERAL LANDS USING A SYSTEMATIC GRID SAMPLING STRATEGY

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Effectiveness Monitoring for Marbled Murrelet

- Plan Objective: provide for persistence
- Monitoring Objective: status and trends
  - Plan-wide evaluations
  - Multiple scales

Study Questions

- **What is the amount potential nesting habitat on Federal lands at varying analysis scales?**

Challenge: develop "repeatable", effective and efficient methods to monitor habitat change

- **What is Marbled Murrelet nesting habitat (plan area)?**

Key Data Advances (~past decade)

- **What is Marbled Murrelet nesting habitat?**
  ~800 new "nesting" locations

- **What is the amount potential nesting habitat on Federal lands?**
  Large-scale systematic grid inventories of vegetation
    *unique estimation potential
    *exploit fine-scale attributes

Experimental Approach

Part I : What is Marbled Murrelet nesting habitat?

1. **Collect vegetation data from known occupied and absent sites**

2. **Develop equations that predict the environmental conditions associated with nesting**

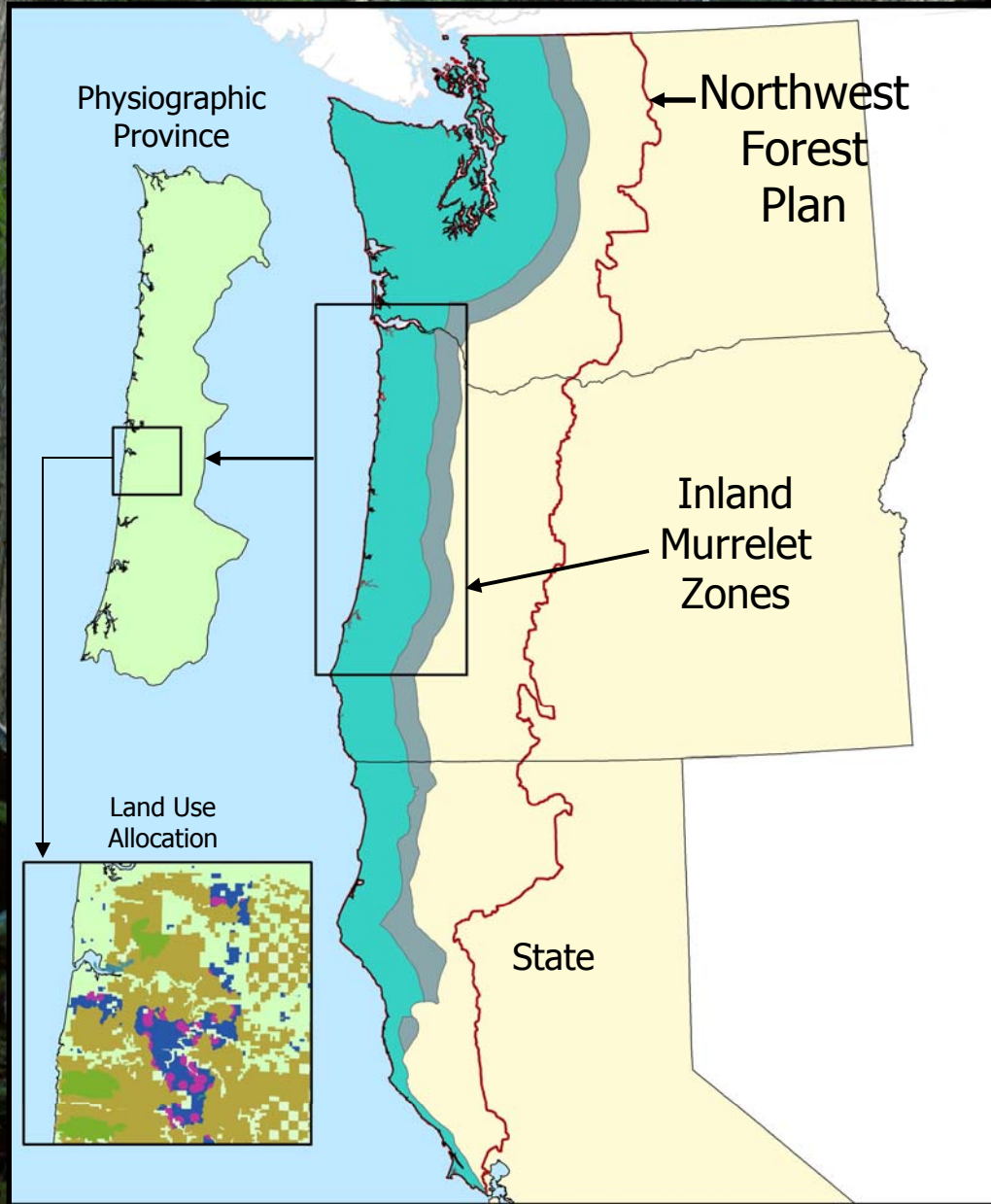
Experimental Approach

Part II : What is the amount of potential nesting habitat?

1. **Predict the "relative suitability" of inventory grid locations as nesting habitat**
2. **Estimate amount of nesting habitat by combining "relative suitability" with the area estimation capabilities of the grid inventory**

Experimental Approach

3. Establish baseline for monitoring at different scales (FS&BLM lands)



Part I-- What is Marbled Murrelet nesting habitat?

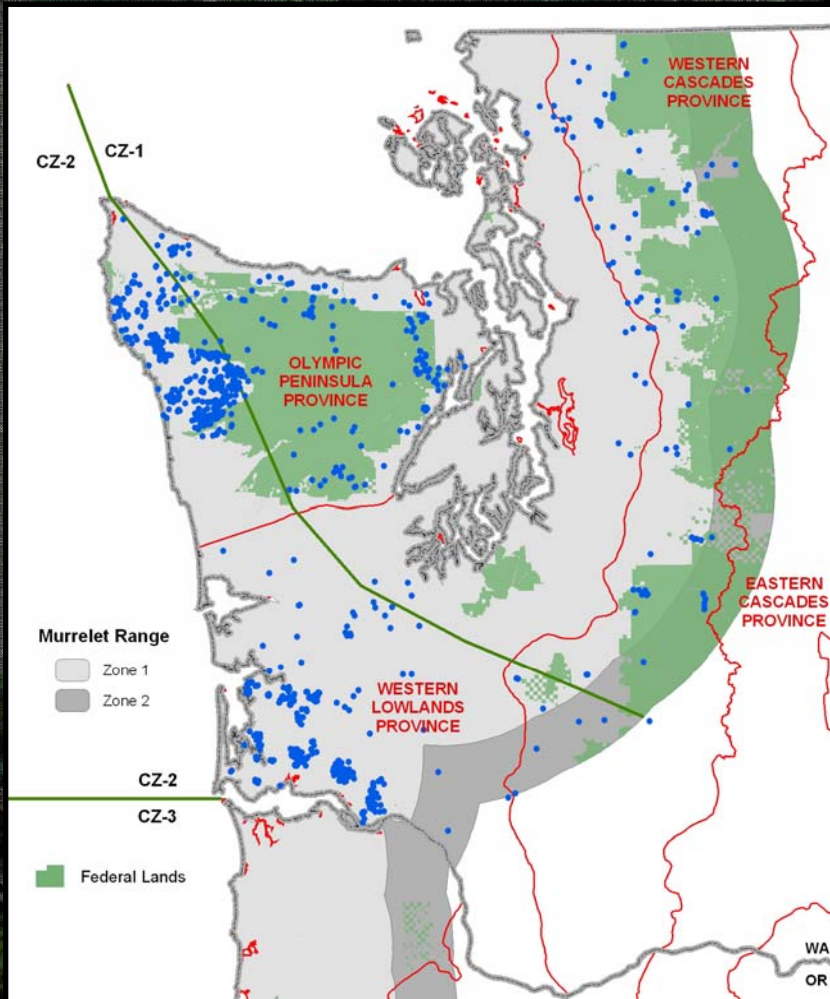
Murrelet survey data

State and federal pre-project surveys (standardized protocol)

Surveyed Sites (1994-2001):

“nesting” (n=~800)

absent (n=>2000)

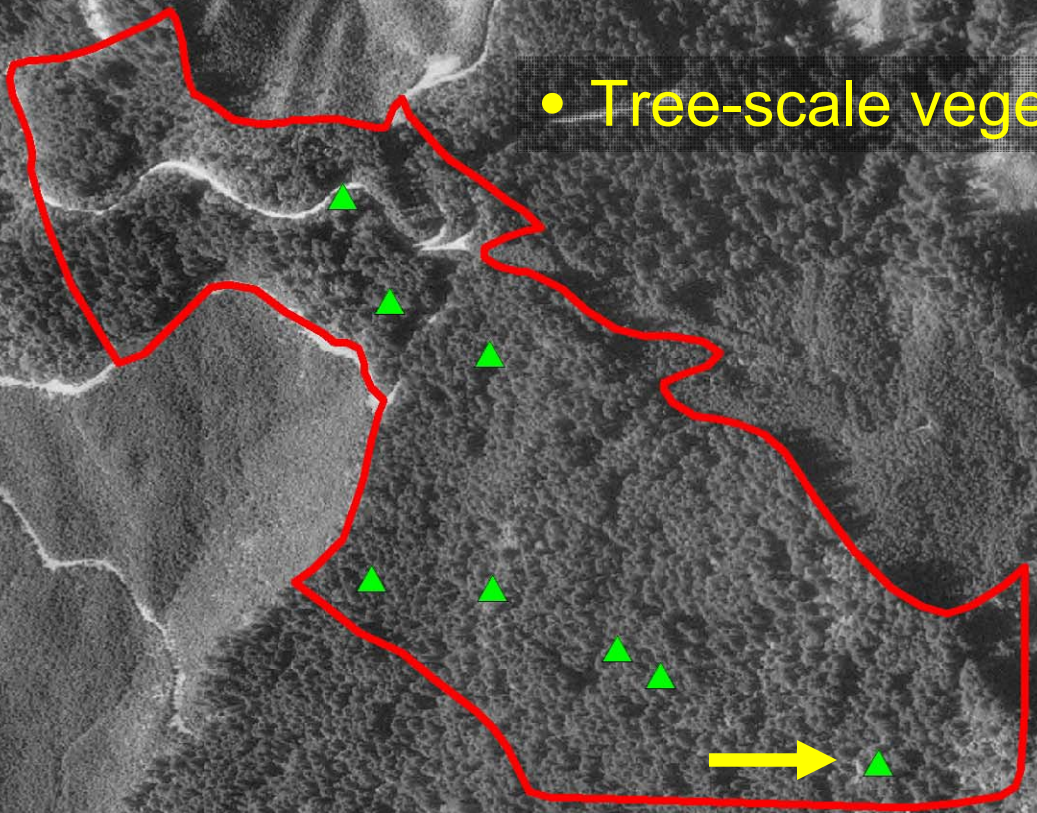


Murrelet Survey Study Sites

Province	State	"Nesting"	Absent	Total
Olympic Peninsula	WA	19	21	40
Western Cascades	WA	11	14	25
Oregon Coast	OR	20	20	40
Klamath Mountains	OR	19	20	39
Klamath Mountains	CA	--	4	4
California Coast	CA	18	3	21
Total		87	82	169

Habitat data

- Tree-scale vegetation data



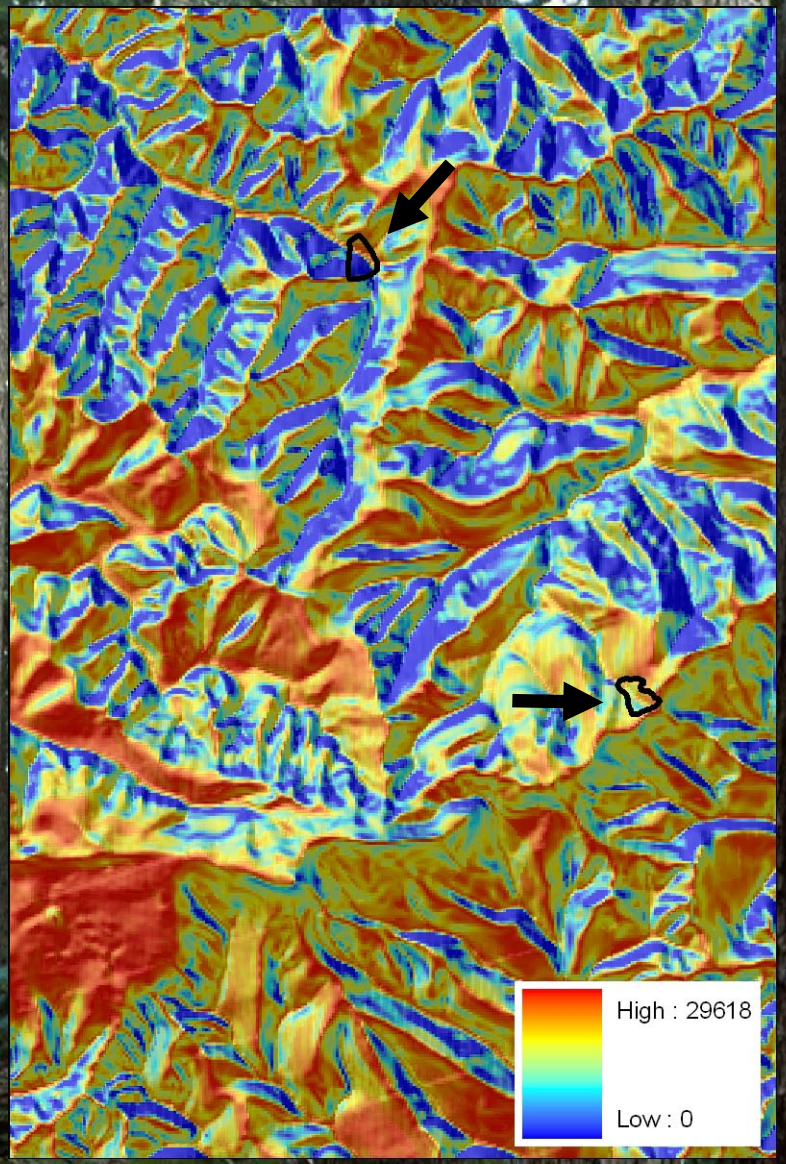
- 8 randomly located plots at each site.

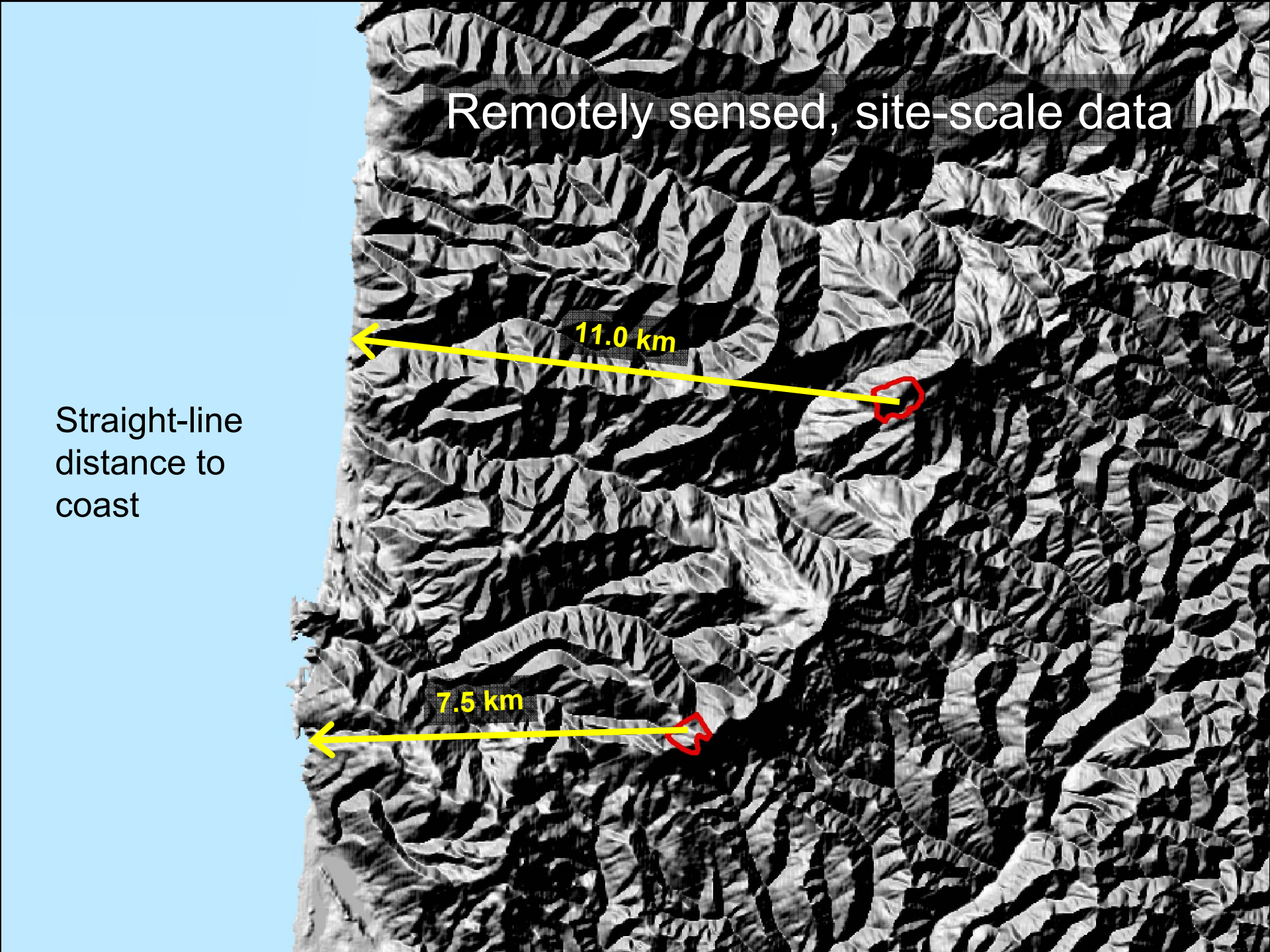
Remotely sensed, site-scale data

Solar radiation index

maximum shortwave radiation given:

- **slope**
- **aspect**
- **elevation**
- **solar angle**
- **length of daylight**
- **shading from nearby landforms**





Straight-line distance to coast

Habitat Predictor Variables

Forest Structure Variables:

- Mean number of conifer stems >10 in diam
- Mean number of conifer stems >30 in dbh
- Mean conifer basal area of trees >10 in dbh
- Mean conifer basal area of trees >30 in dbh

Remotely-sensed Variables:

- Mean solar radiation index
- Distance to coastline
- Mean elevation
- Mean slope

Prediction Equation

- Logistic regression model

  binary dependent variable: occupied or absent

- Program PRESENCE

Prediction Equation

1. All possible sets of predictor variables
2. Modified for inequitable detection effort and rate
3. Select top predictor model by “goodness of fit” (smallest AICc value)
4. Evaluate model fit using a 10-fold cross validation
5. Evaluate predictor variables based on the change in AICc

Prediction Equation

Zone 1-Only Model

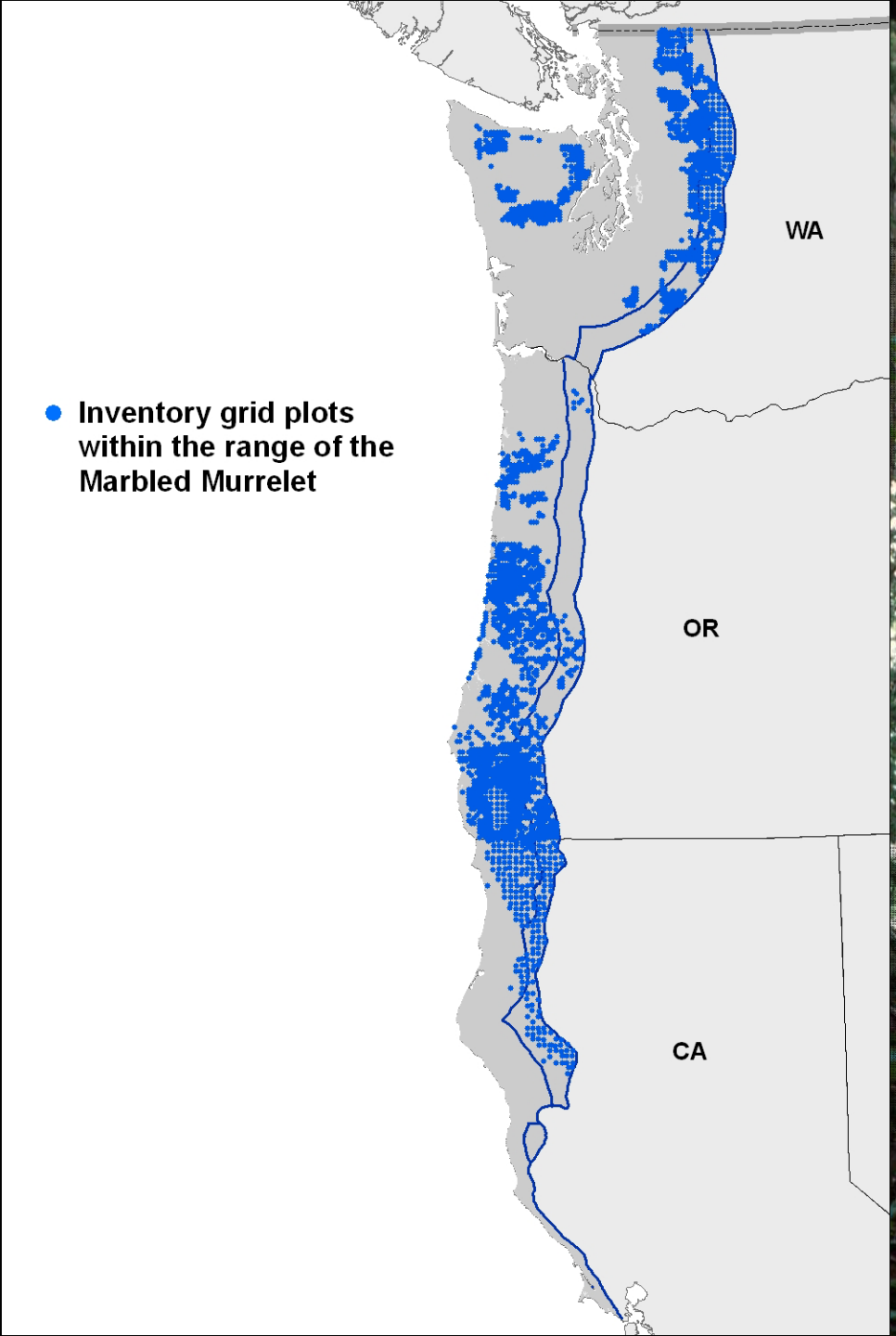
Rank	Variable	ΔAICc
1	Solar Radiation Index (-)	16.3
2	Distance to coastline (-)	13.4
3	Conifer density ≥10” dbh (-)	11.8
4	Basal area trees >10” dbh (+)	11.1
5	% Slope (-)	6.9
6	Basal area trees >30” dbh [below 436 ft^2/ac] (+)	1.9

Model Predictions of Known Sites ("Nesting"/Absent)

State	% Matching w/ SR variable	%Matching w/o SR variable
CA	72.0	72.0
OR	83.5	87.3
WA	76.9	60.0
All States	79.9	75.1

Part II : What is the amount of potential nesting habitat?

- Predict “nesting” habitat odds ratios as a suitability index
- Compute area, using expansion factors of the grid inventory plots



- Inventory grid plots within the range of the Marbled Murrelet

Grid Inventory Plot Data

Vegetation and other ecological characteristics sampled at each inventory location

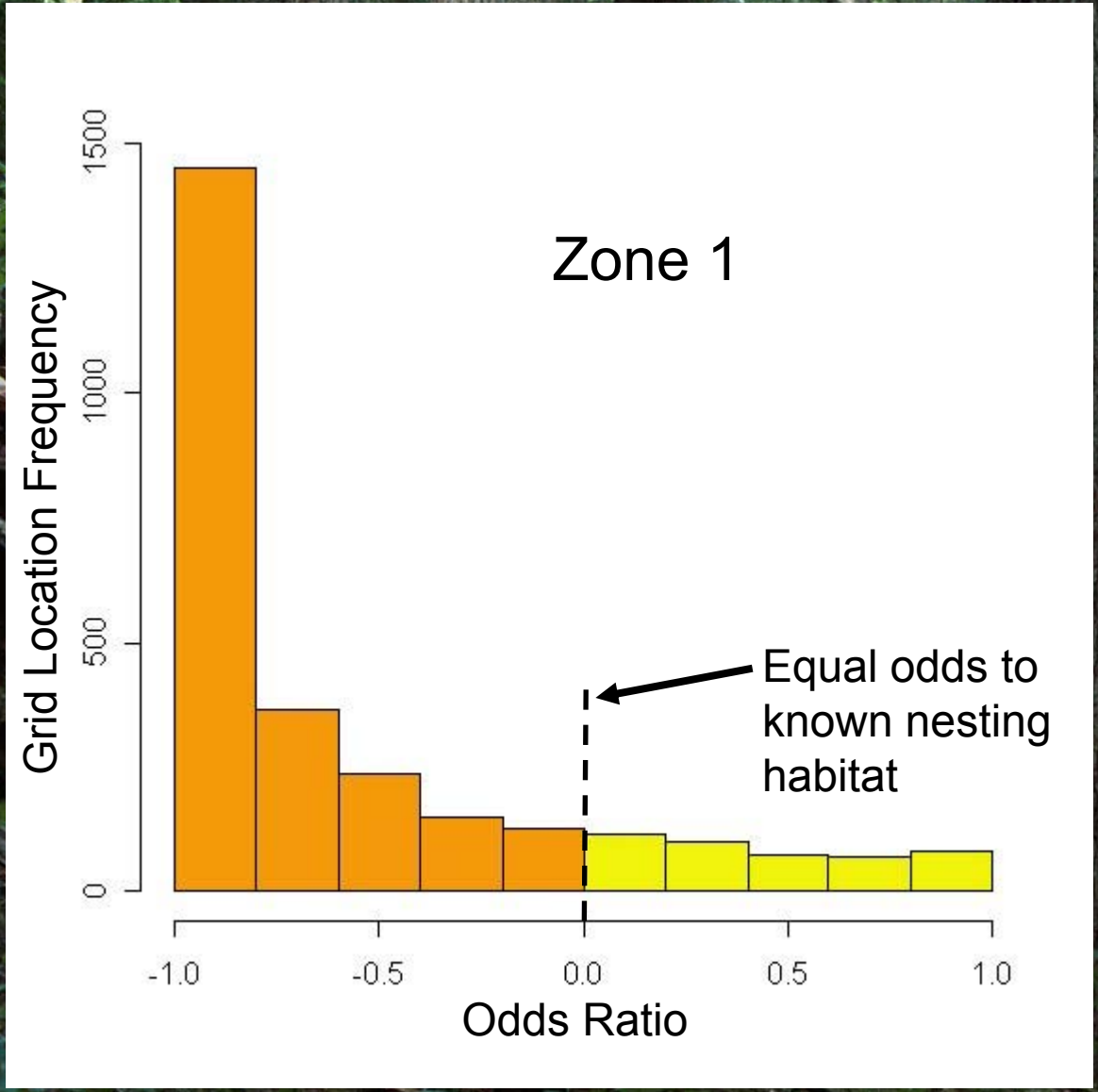
6.71 million acres

Obtained data for the same variables used in habitat prediction model:

4.55 million acres

- **Forest Stucture Variables** (e.g., mean number of conifer stems >10 in diam)
- **Remotely-sensed Variables** (e.g., mean solar radiation index)

Estimate odds ratios of grid inventory plots

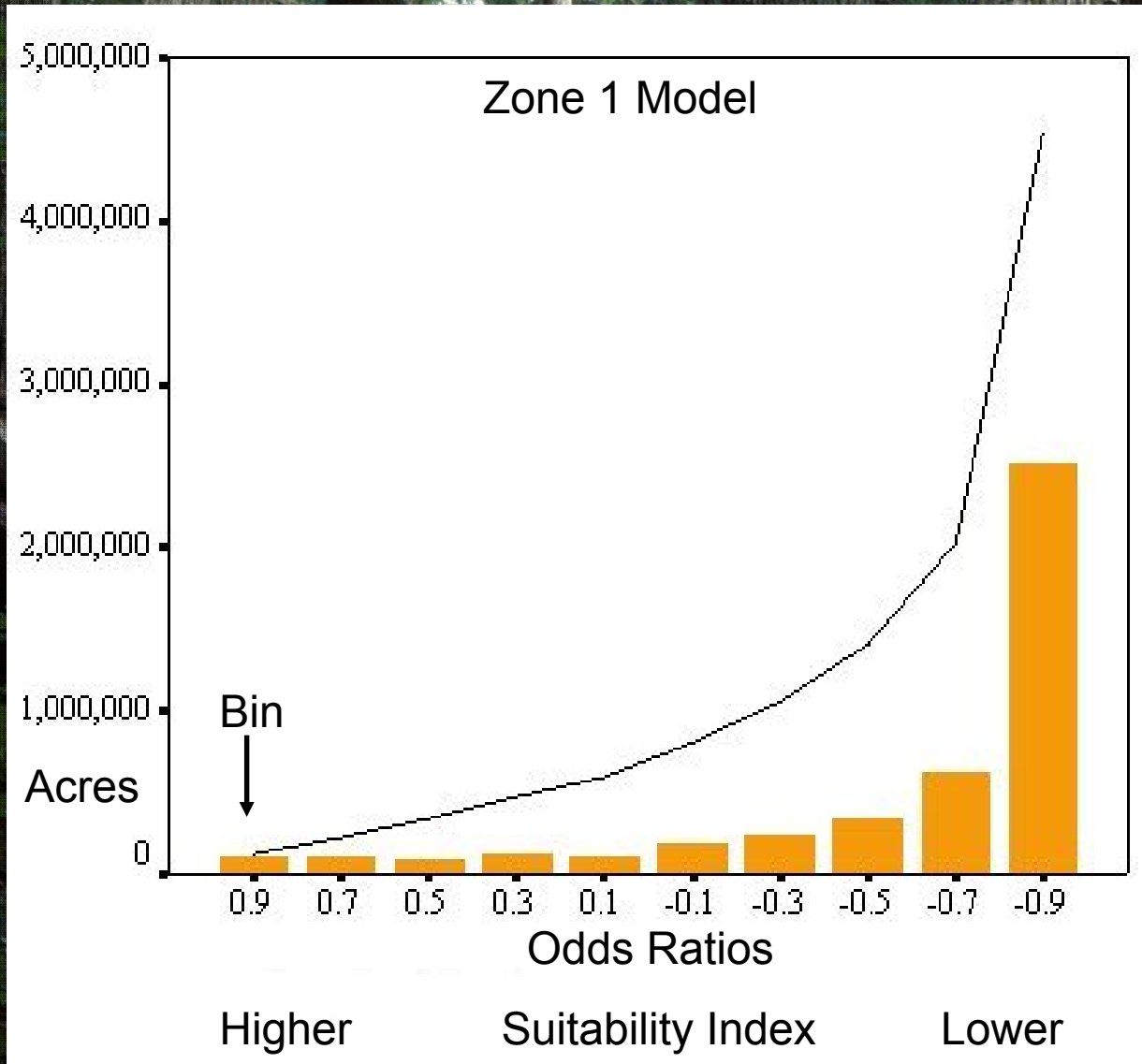


Estimate Amount of Potential Nesting Habitat

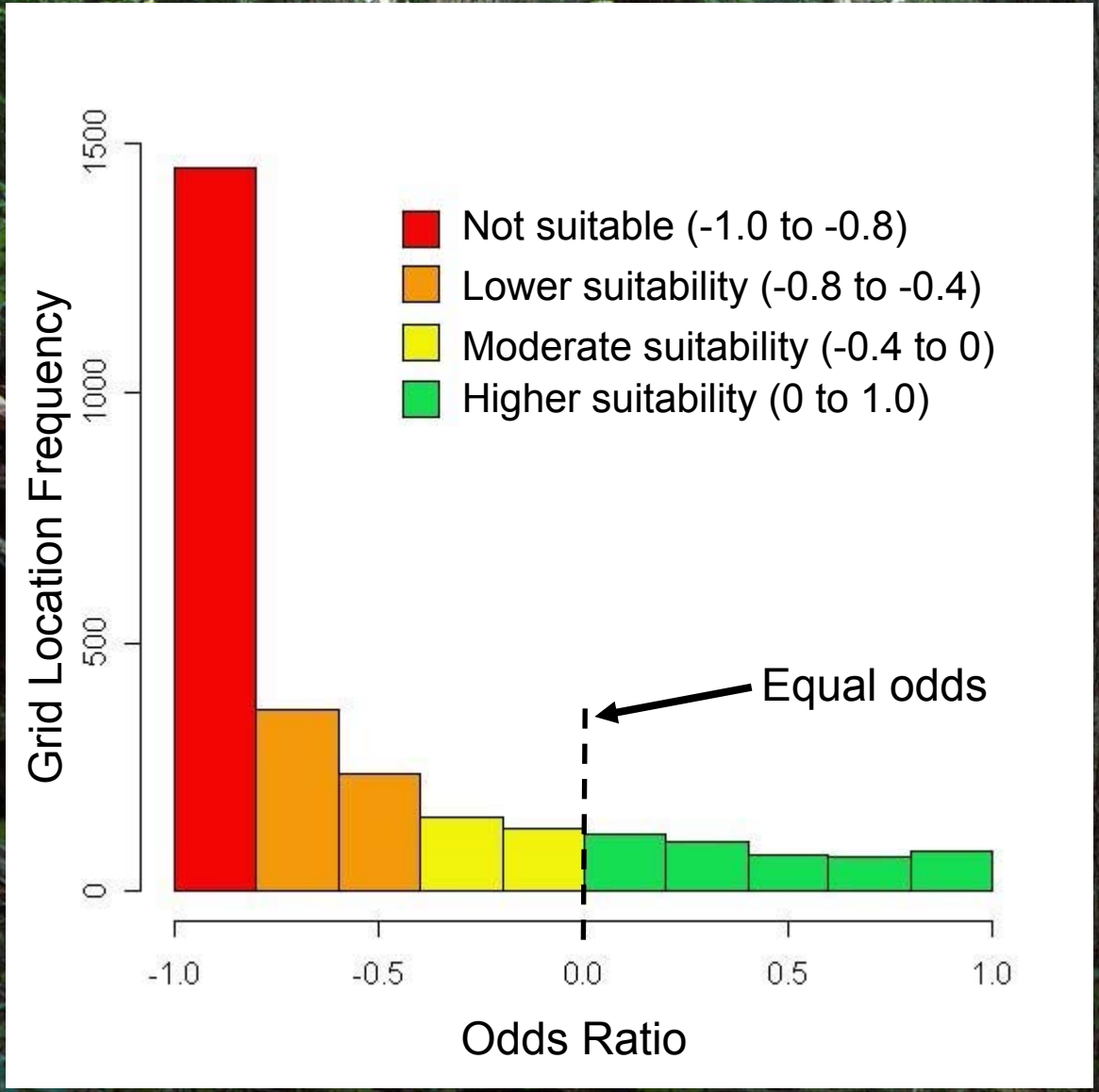
Odds ratios= Habitat suitability index

Select bin widths e.g., 0.2 (1.0-0.8)

Assign inventory grid locations to bins and sum area expansions*
(range 371-11,567 ac)



Suitability Classes



Zone 1 Estimated Acres

State

	Suitability Classes			
	Not	Low	Mod	High
Total acres (000)	2,518	977	460	594
% Acres	55.4	21.5	10.1	13.1
% CA	14.7	15.8	15.8	14.8
% OR	48.9	65.5	64.7	48.7
% WA	36.4	18.8	19.4	36.5

Zone 1 Estimated Acres

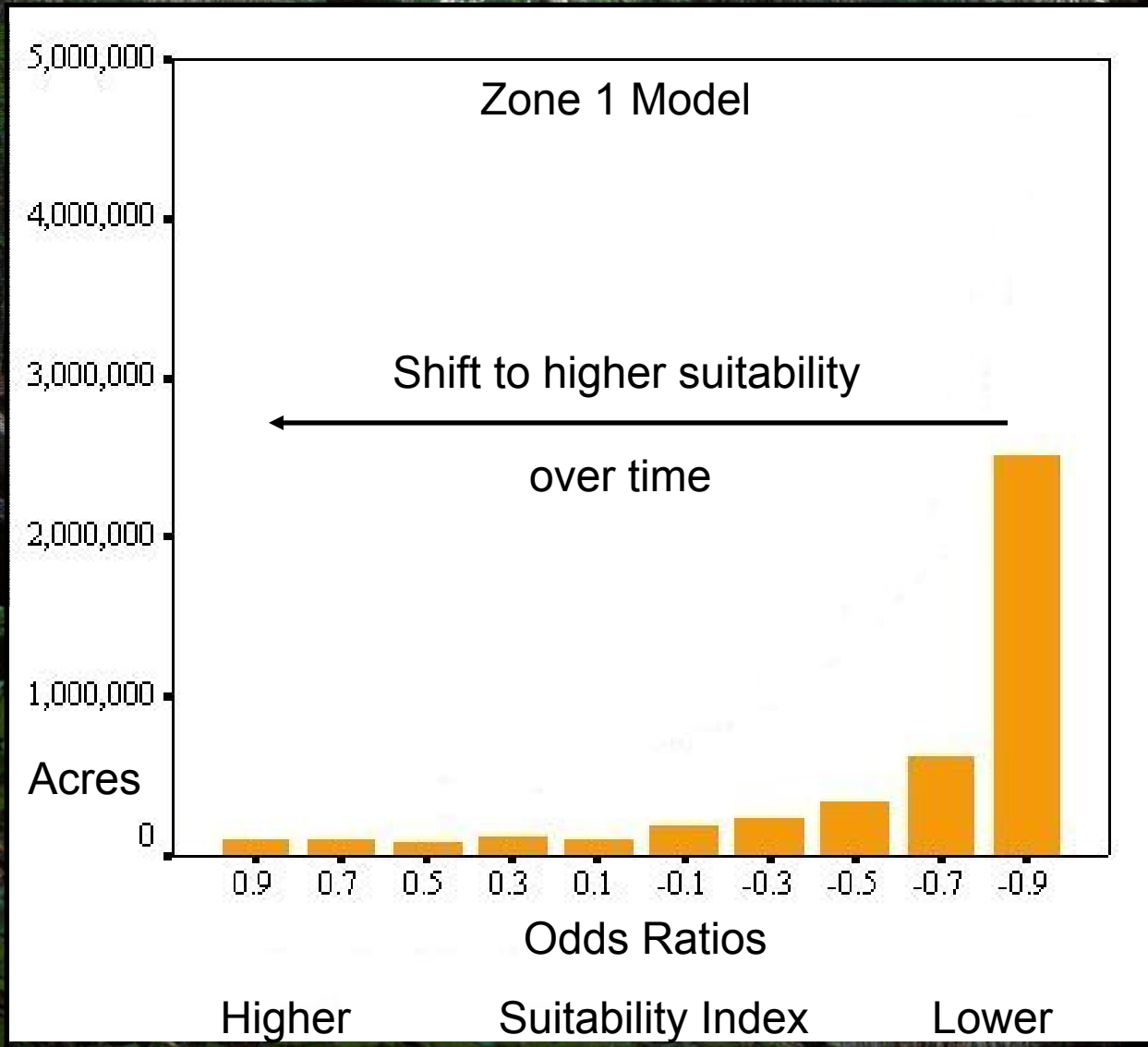
Reserve Status

	Suitability Classes			
	Not	Low	Mod	High
Total acres (000)	2,518	977	460	594
% Acres	55.4	21.5	10.1	13.1
% Not Reserve	27.0	19.1	22.7	12.3
% Reserve	73.0	89.9	77.3	87.7

Conclusions

1) We developed a new modeling approach for long-term monitoring of potential nesting habitat.

Promising?



Conclusions

2) Advantage (over habitat mapping) for monitoring long-term habitat changes

Higher precision with re-measured ground-based inventory than with satellite imagery

(may cost less?)

Disadvantage

Missing spatial context for local planning

Conclusions

3) Proposal for the Future

Goal: Shift from experimental to broad application

Objectives:

a. Improve habitat prediction model

*Increase sample size of occupied and absent sites

*Broaden the type and amount habitat structure variables

b. Focus modeling on Zone 1


The End