Relationships Between Surficial Soil Deposits and Timber Productivity Using Soil Survey Data

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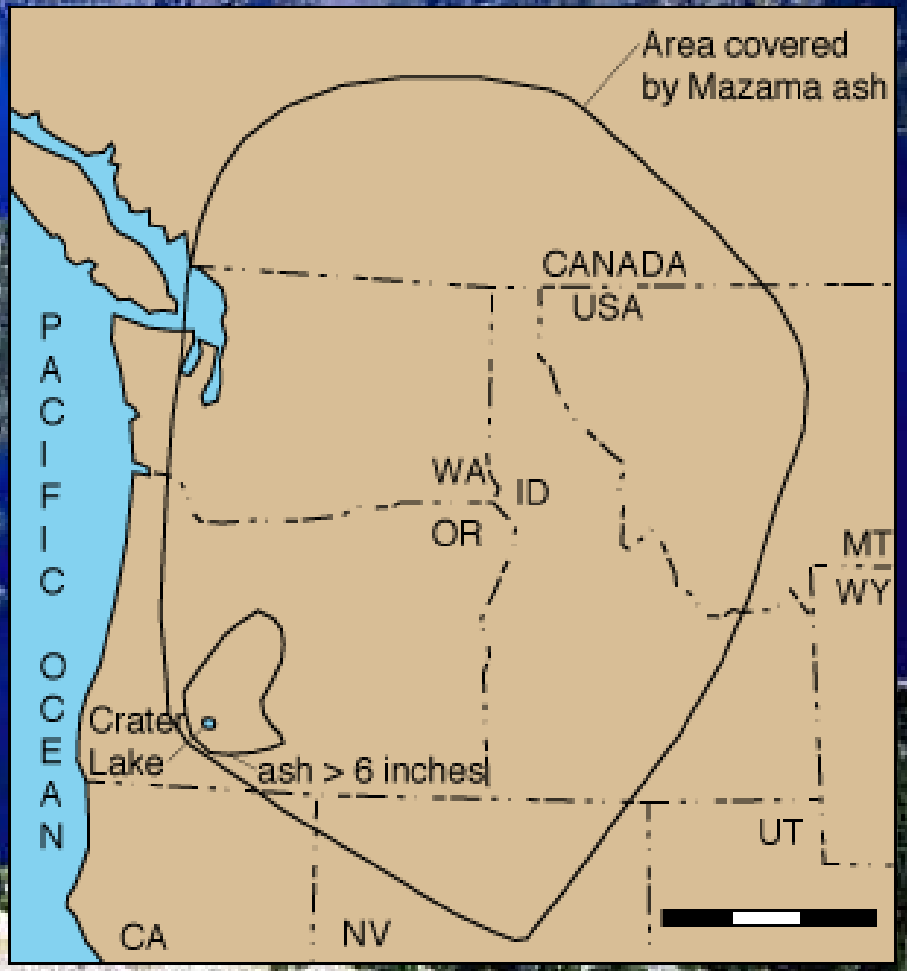
Forest Productivity

A function of complex interactions between local geology, topography, and climatic variables.

Often, many of these interactions are confounded by the deposition of a surficial soil deposit.



Typic Udivitrand

Bw ~ 16” volcanic ash

- primary rooting zone
- increases site water holding capacity

2Bw ~ 43” residual basalt

- rooting structures evident
- similar water holding cap.
- minimal coarse fraction

Typic Udivitrand

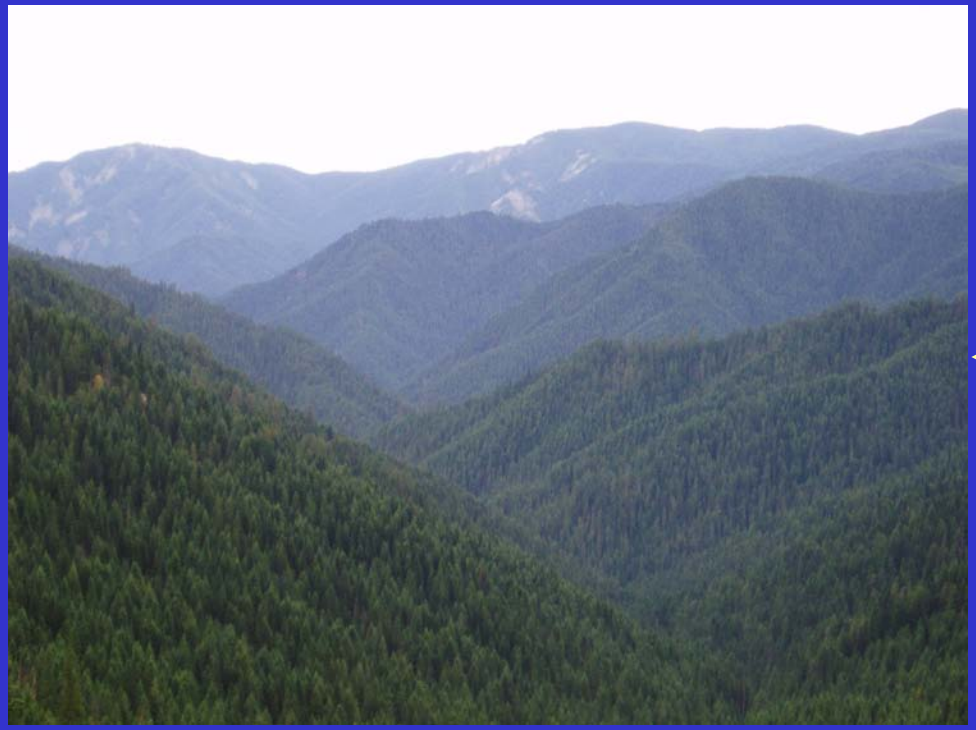
Bw ~ 16” volcanic ash

- primary rooting zone
- primary soil water holding capacity

2BC ~ 56” residual metased

- high coarse fraction
- low water holding capacity
- minimal root development

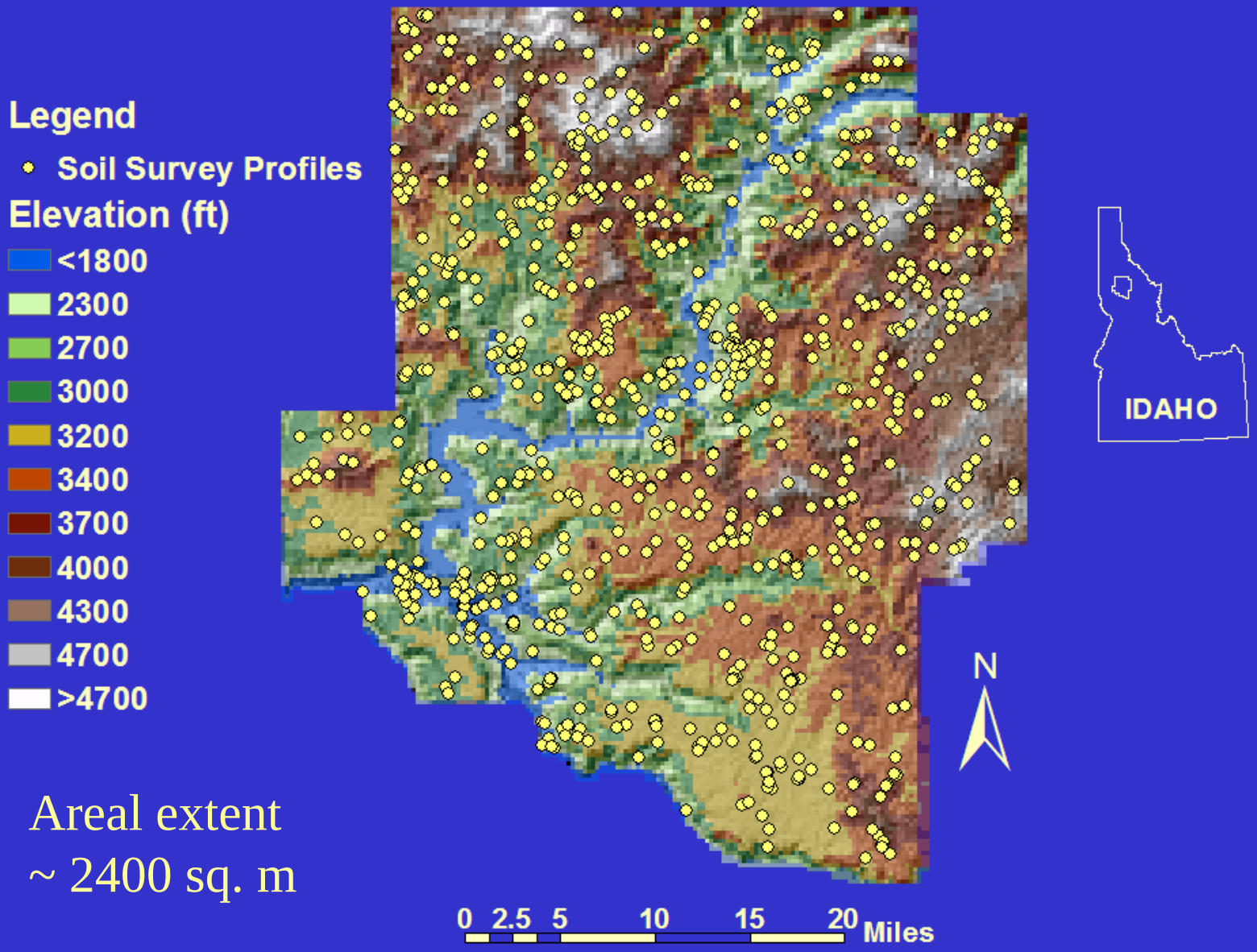
How do we integrate forest productivity with information on surficial soil deposits and underlying parent material?



A Case Study of the Clearwater Soil Survey Project

1979 - 1999

Clearwater Soil Survey Area

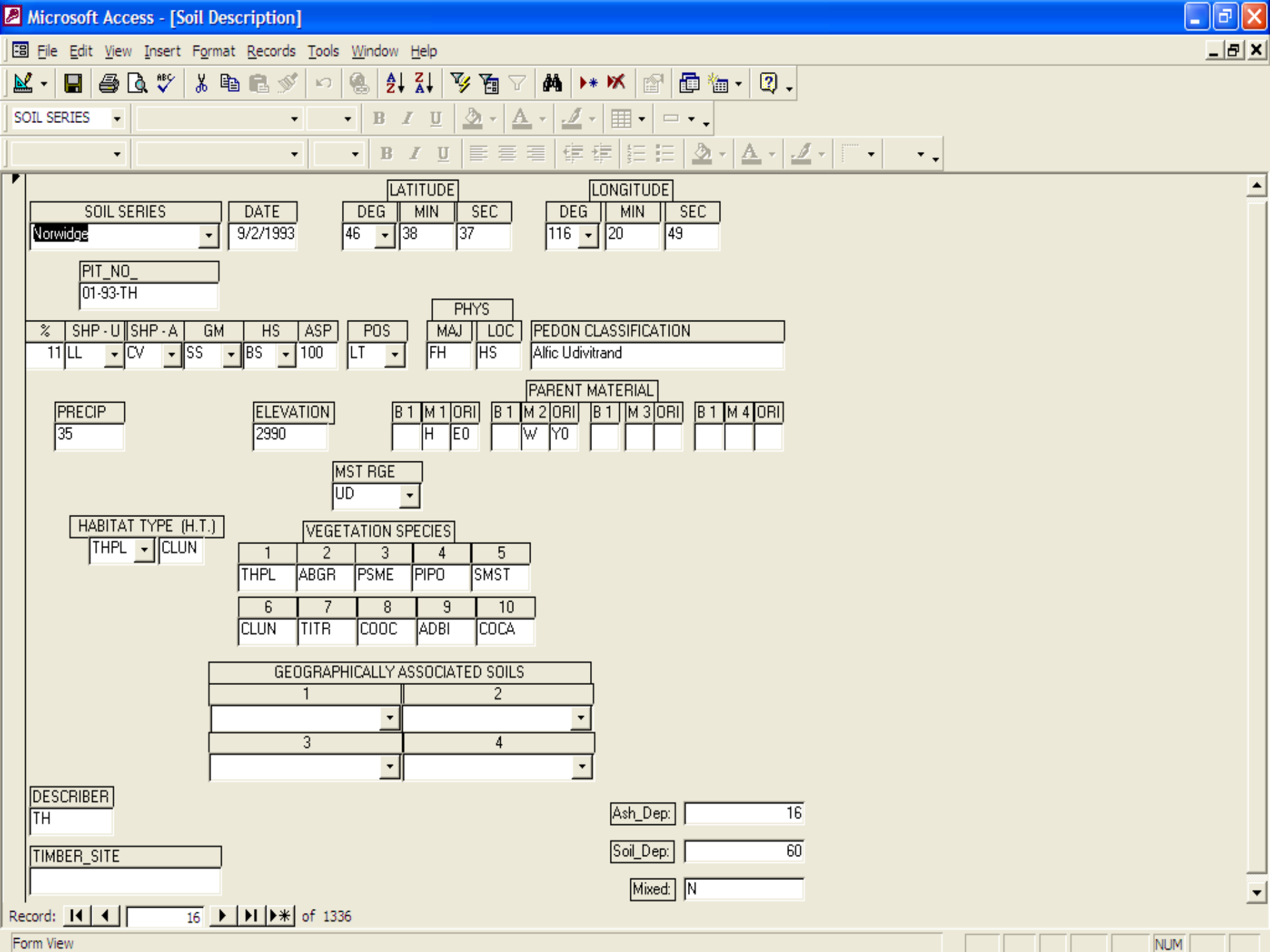


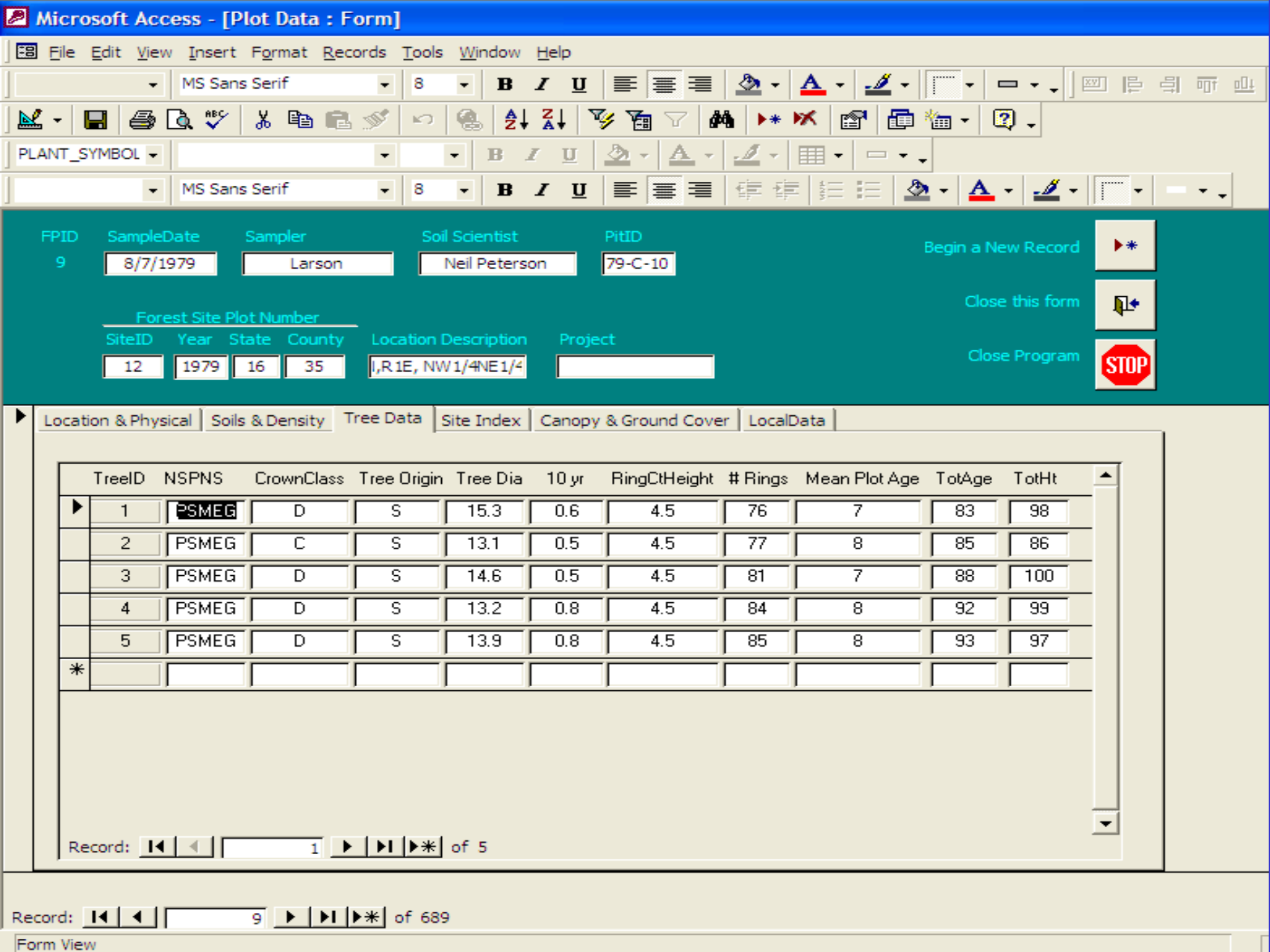
Areal extent
~ 2400 sq. m

Soil Survey Data Collection

- Soil profile data
  - Horizon description
  - Surficial deposit delineation
  - Soil classification
  - Parent material calls
  - Topographic relationships
- Timber productivity data*
  - Height/Age pairs for site trees
  - Decadal increment growth
  - Site index values for each tree specie
  - Basal area
  - Habitat type association

  (**Not available at all pits*)


Microsoft Access - [Soil Description]
File Edit View Insert Format Records Tools Window Help
SOIL SERIES
SOIL SERIES
Norwidge
DATE
9/2/1993
LATITUDE
DEG
46
MIN
38
SEC
37
LONGITUDE
DEG
116
MIN
20
SEC
49
PIT_NO_
01-93-TH
PHYS
%
11
SHP - U
LL
SHP - A
CV
GM
SS
HS
BS
ASP
100
POS
LT
MAJ
FH
LOC
HS
PEDON CLASSIFICATION
Alfic Udivitrand
PARENT MATERIAL
PRECIP
35
ELEVATION
2990
B 1
M 1
ORI
H
E0
B 1
M 2
ORI
W
Y0
B 1
M 3
ORI
B 1
M 4
ORI
MST RGE
UD
HABITAT TYPE (H.T.)
THPL
CLUN
VEGETATION SPECIES
1
THPL
2
ABGR
3
PSME
4
PIPO
5
SMST
6
CLUN
7
TITR
8
COOC
9
ADBI
10
COCA
GEOGRAPHICALLY ASSOCIATED SOILS
1
2
3
4
DESCRIBER
TH
TIMBER_SITE
Ash_Dep:
16
Soil_Dep:
60
Mixed:
N
Record:
16
of 1336
Form View
NUM


Microsoft Access - [Plot Data : Form]
File Edit View Insert Format Records Tools Window Help
MS Sans Serif
8
PLANT_SYMBOL
FPID
9
SampleDate
8/7/1979
Sampler
Larson
Soil Scientist
Neil Peterson
PitID
79-C-10
Begin a New Record
Close this form
Close Program
STOP
Forest Site Plot Number
SiteID
12
Year
1979
State
16
County
35
Location Description
I,R1E, NW1/4NE1/4
Project
Location & Physical
Soils & Density
Tree Data
Site Index
Canopy & Ground Cover
LocalData
TreeID NSPNS CrownClass Tree Origin Tree Dia 10 yr RingCtHeight # Rings Mean Plot Age TotAge TotHt
1 PSMEG D S 15.3 0.6 4.5 76 7 83 98
2 PSMEG C S 13.1 0.5 4.5 77 8 85 86
3 PSMEG D S 14.6 0.5 4.5 81 7 88 100
4 PSMEG D S 13.2 0.8 4.5 84 8 92 99
5 PSMEG D S 13.9 0.8 4.5 85 8 93 97
Record: 1 of 5
Record: 9 of 689
Form View

Preliminary Analysis of Soils and Douglas-fir Productivity

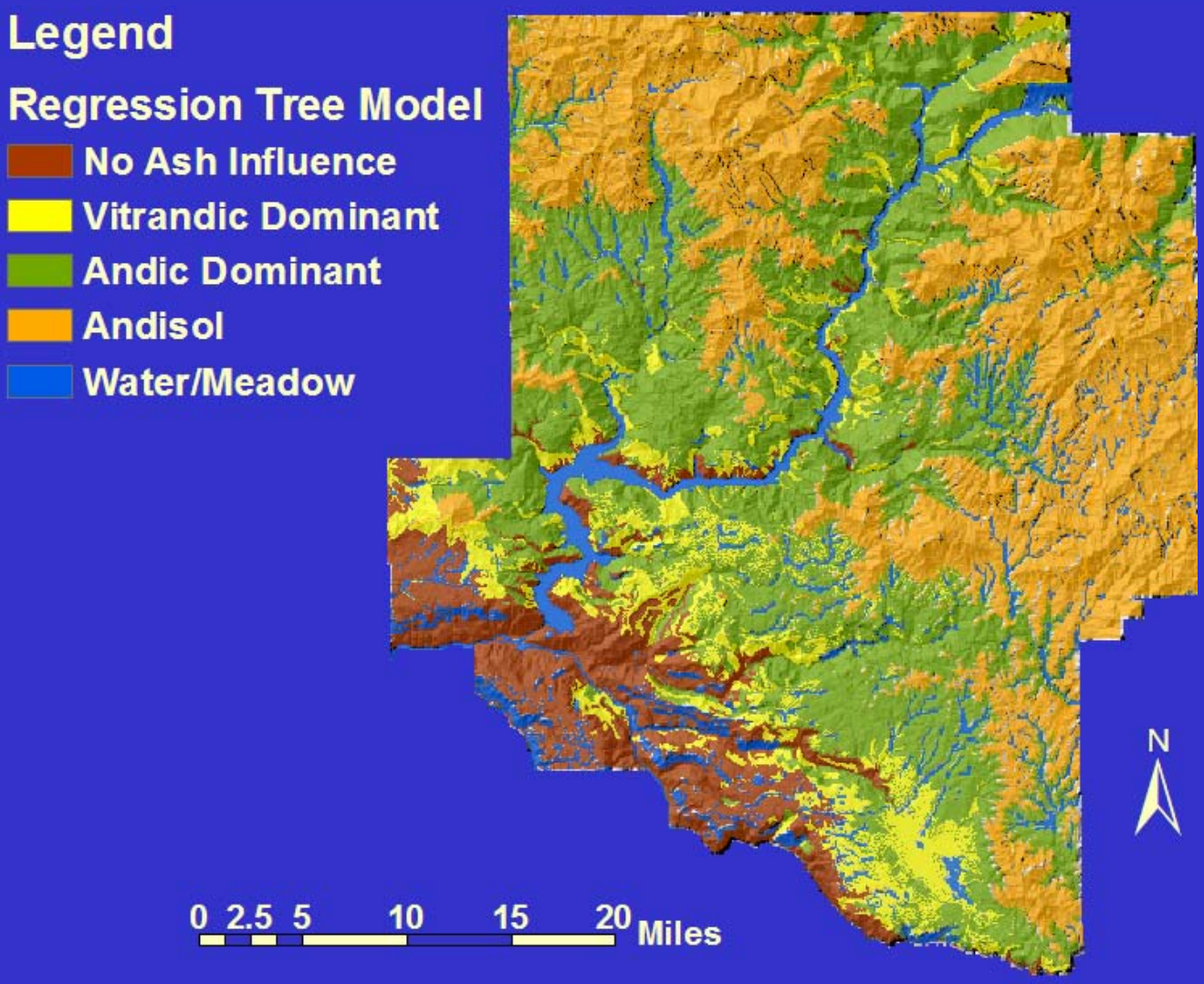
Summary Survey Statistics for PSME

- 16 residual soil parent materials
  - Alluvial, amphibolite, anorthosite, basalt, cs-gneiss, cs-quartzite, cs-schist, dacite, gneiss, granite, granodiorite, landslides, quartz diorite, quartzite, schist, tertiary sediments
    - WPI: Min. 4.2, Mean 15.4, Max. 26.2

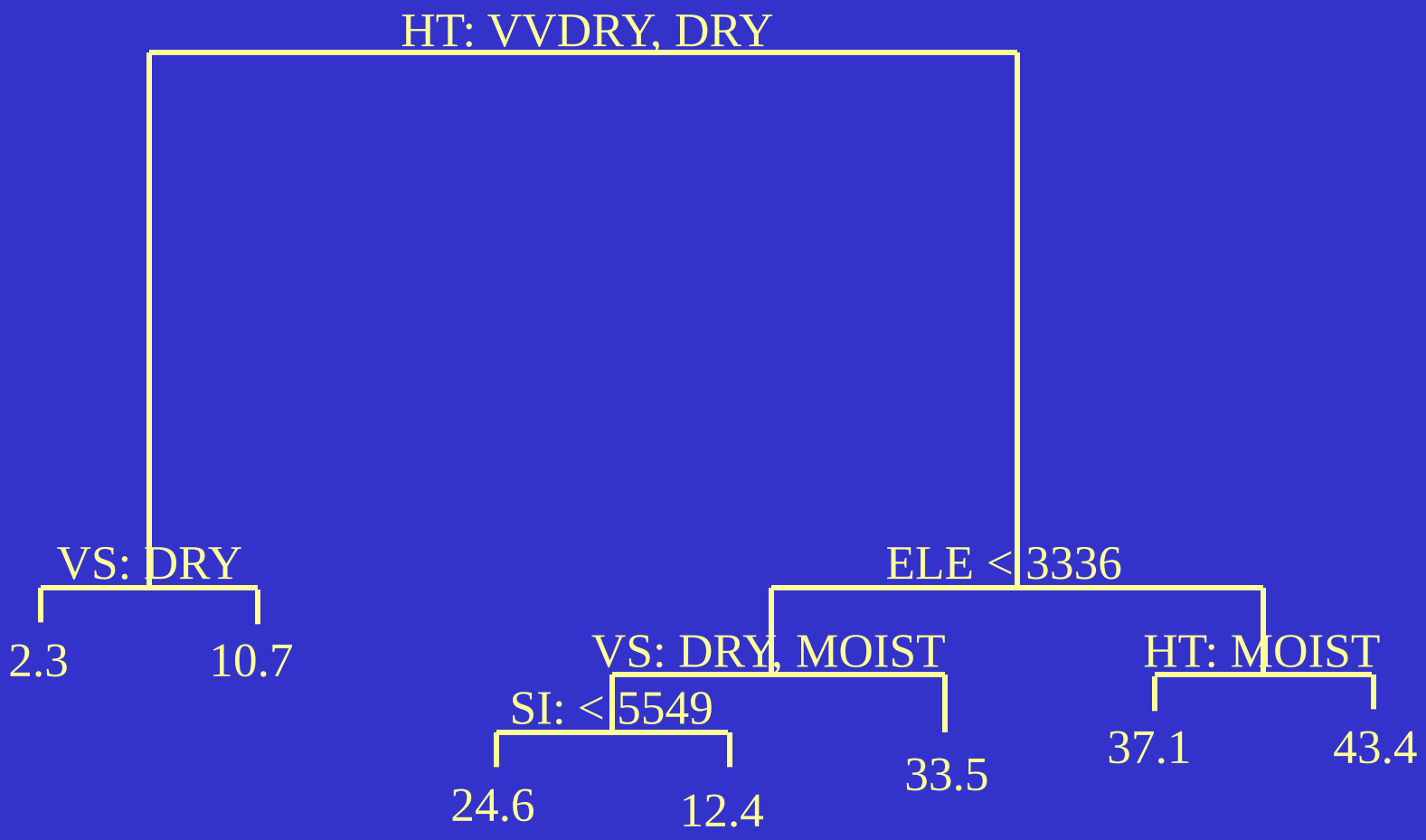
- 1 common soil surficial deposit
  - Volcanic Ash
    - Min. 0”, Mean 12.6”, Max. 28”

- 62 soil series

Volcanic Ash Distribution



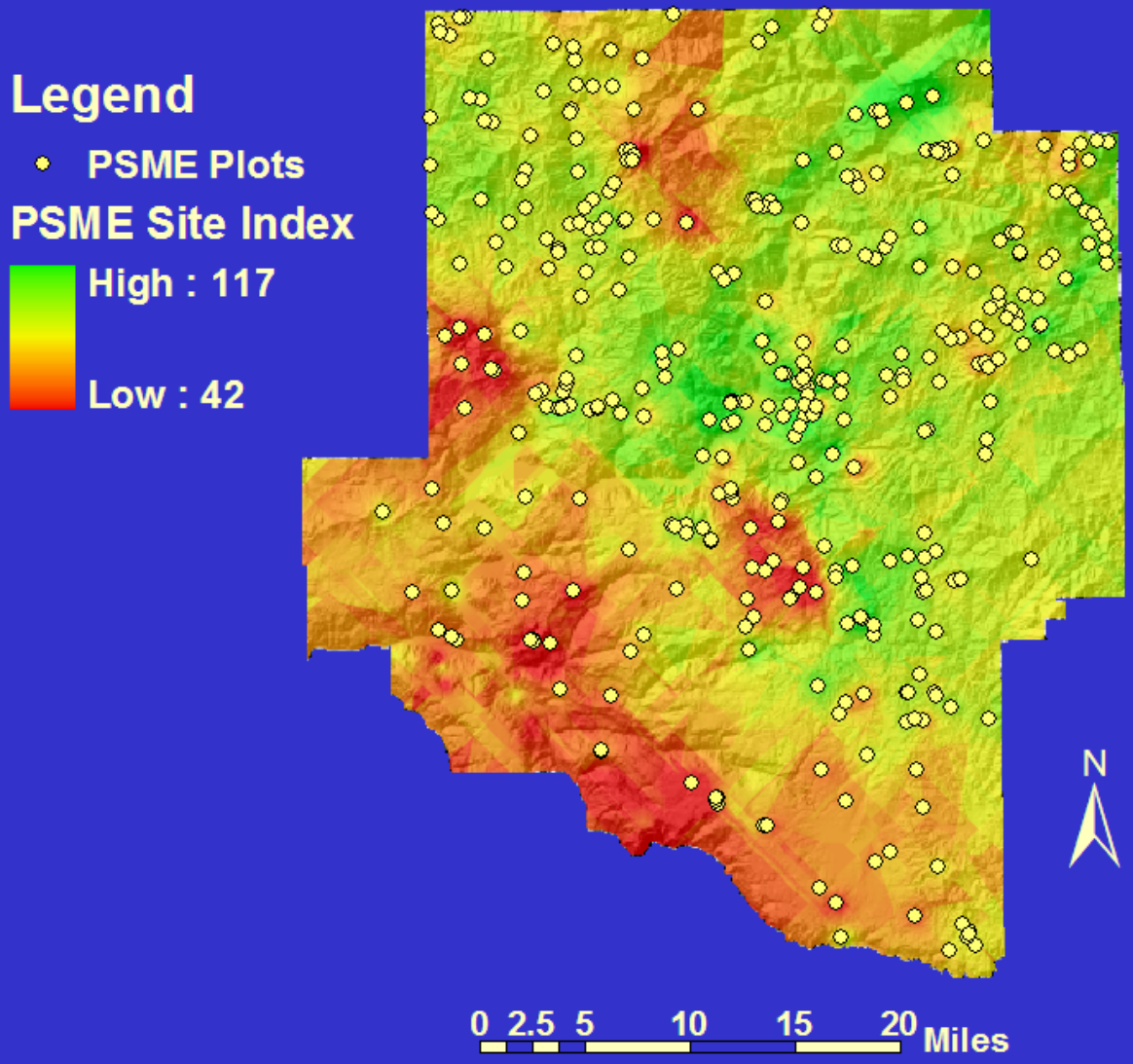
Volcanic Ash Model Variables



Summary Survey Statistics for PSME

- 245 forest plots with recorded Douglas-fir growth measurements
  - Site Index: Min. 42, Mean 82.3, Max. 117
  - Basal Area: Min. 60, Mean 200, Max. 360

Kriged Douglas-fir Productivity



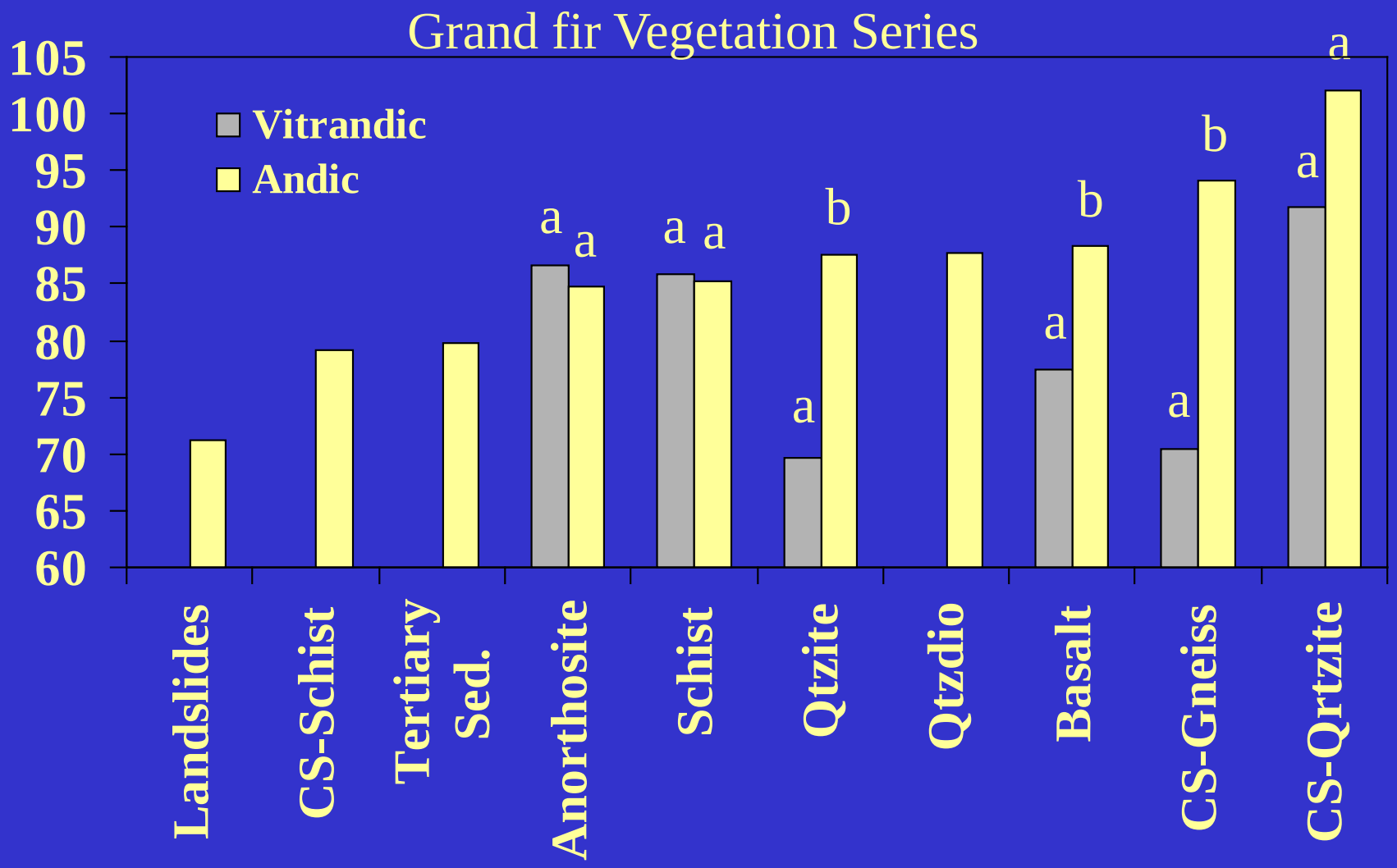
Modeling Douglas-fir Productivity

- Multiple linear regression was performed on a matrix of environmental, topographic, and soil variables
- Interactions between these variables were analyzed for model enhancement
- A stepwise procedure was employed to eliminate variables that failed to explain a significant portion of the overall variance (alpha = 0.2)

Modeling Douglas-fir Productivity

- MLR model accuracy:
  - F-Value = 2.77 (p=0.0001)
    - R^2 = 0.55
    - CV = 11.9
    - RMSE = 9.9
  - Variable significance
    - X (0.0011)
    - Y (0.0073)
    - Solar Insolation (p=0.0613)
    - Elevation*Habitat Type (0.0003)
    - Lithology*Vegetation Series*Ash Class (p=0.0003)

Douglas-fir Productivity & Ash Class



Summary

- The presence of volcanic ash significantly affects Douglas-fir productivity across the soil survey area
- Tentative results show that Andisols behave differently than their andic and vitrandic counterparts
- Rock type and volcanic ash are major factors in determining local Douglas-fir productivity
- More modeling efforts are required to fully realize the potential of the soil survey data and the complex interactions behind the variables

Acknowledgements

- USDA-NRCS
  - Orofino, Lewiston & Moscow Branch Offices
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- IFTNC personnel

Thank You, Any Questions?

Clearwater National Forest