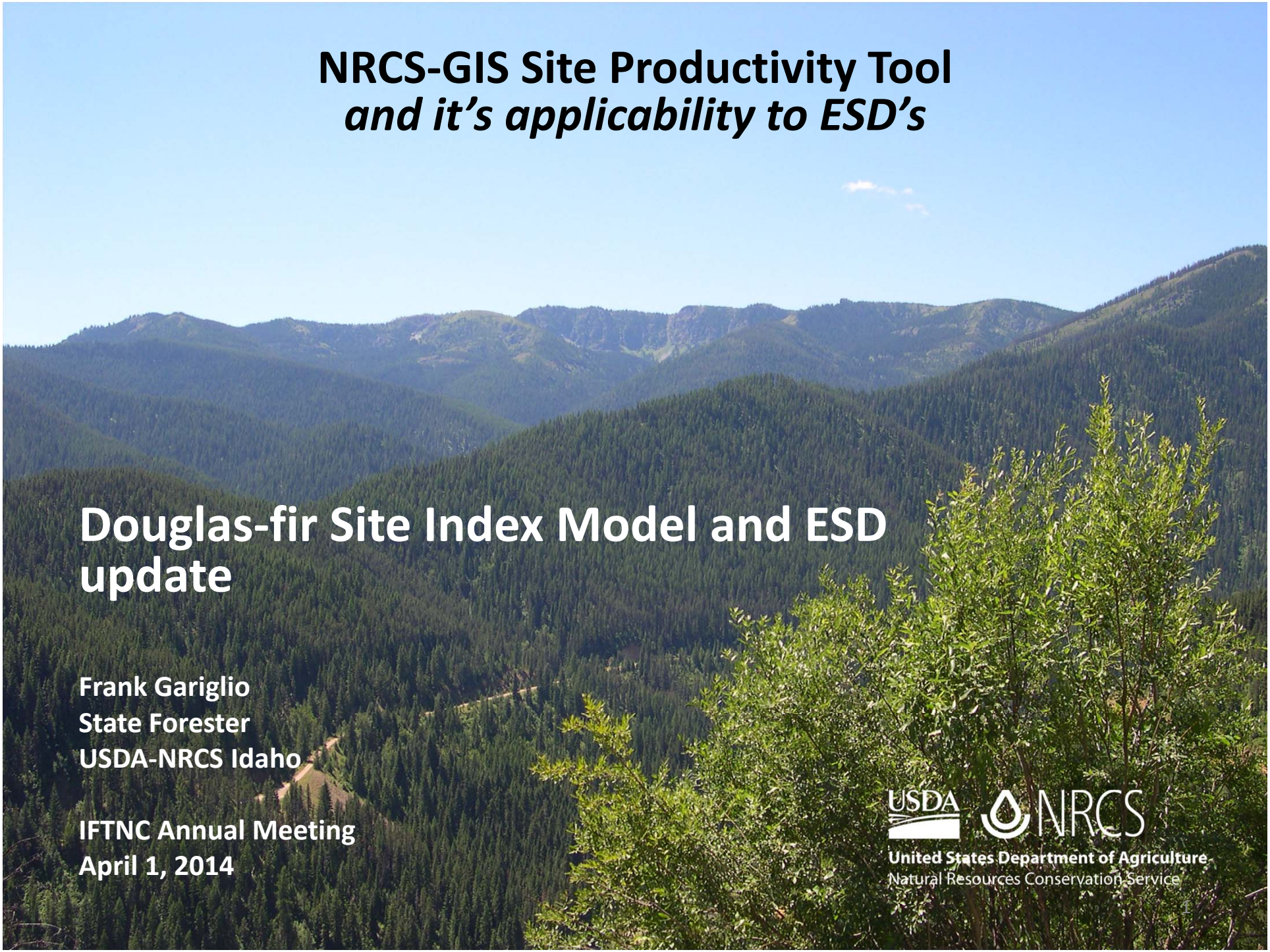
NRCS-GIS Site Productivity Tool
and it's applicability to ESD's



Douglas-fir Site Index Model and ESD update

Frank Gariglio
State Forester
USDA-NRCS Idaho

IFTNC Annual Meeting
April 1, 2014

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

DF site index model/ESD

1st: *the* ECOLOGICAL SITE

An ***ECOLOGICAL SITE (ES)*** is a distinctive kind of land with specific physical characteristics that differ from other kinds of land in its ***"ability to produce a distinctive kind and amount of vegetation"*** **(NFM)**

"Forestland landscapes are divided into *Ecological Sites* ***for the purpose of inventory, evaluation and management. . ."***

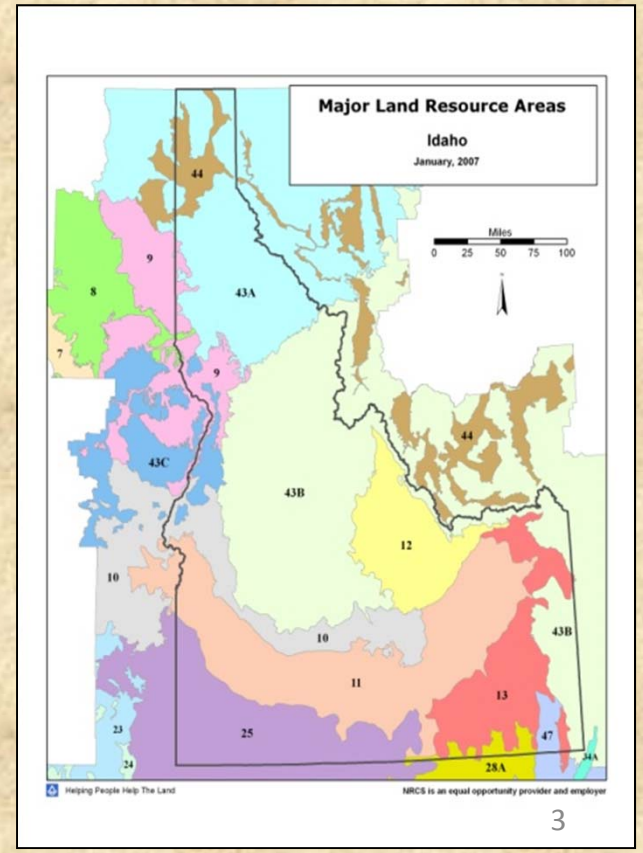
ESD's are Ecological Site Descriptions

NRCS

DF site index model/ESD

Background & Assumptions:

- The ***NRCS Soil Survey*** will serve as the base for the construction of ESD's.
- ESD's will be comprised of ***groupings of soils.***
- The groupings will be based on ***ecological and management parameters.***
- The NRCS ***Major Land Resource Areas (MLRA)*** will be the larger geographically represented boundary for ESDs.



NRCS

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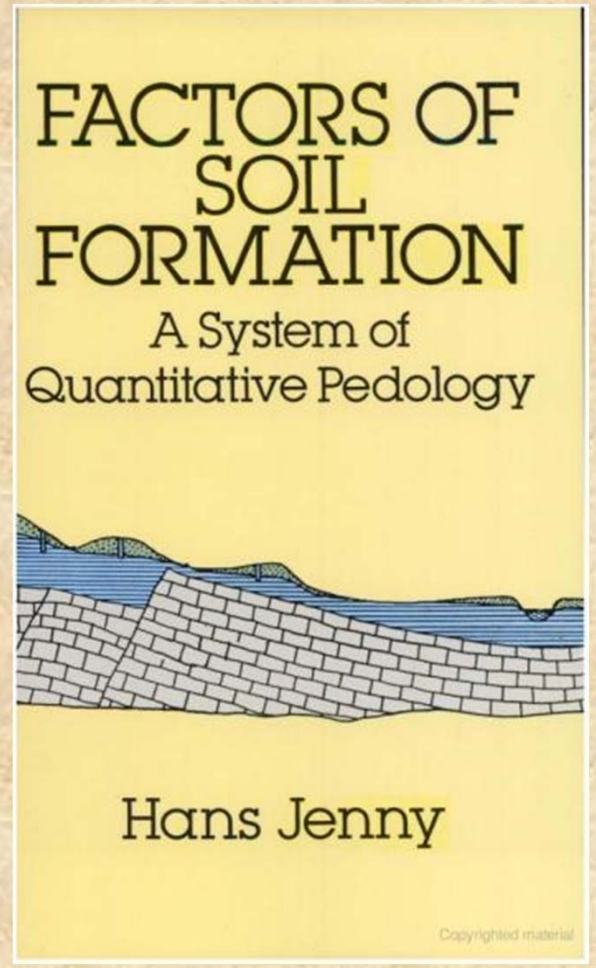
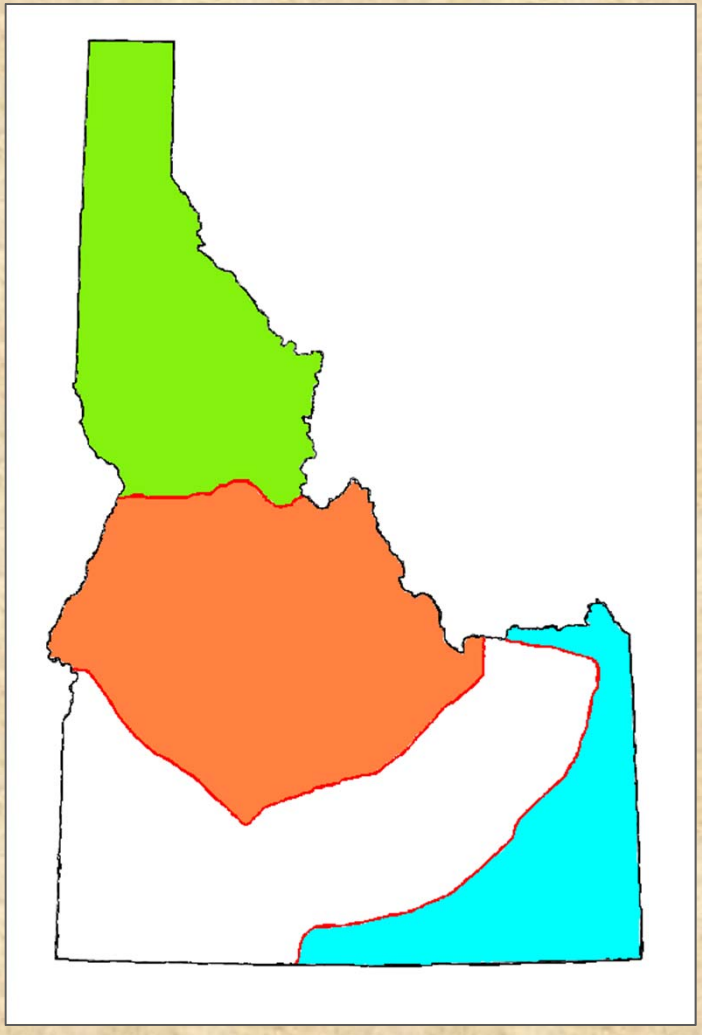


What Factors Combine to Produce a Unique ES?

Soils are a result of five major influences working together….

- Parent Material
- Topography
- ***Biota (including vegetation)***
- Climate
- Time

DF site index model/ESD

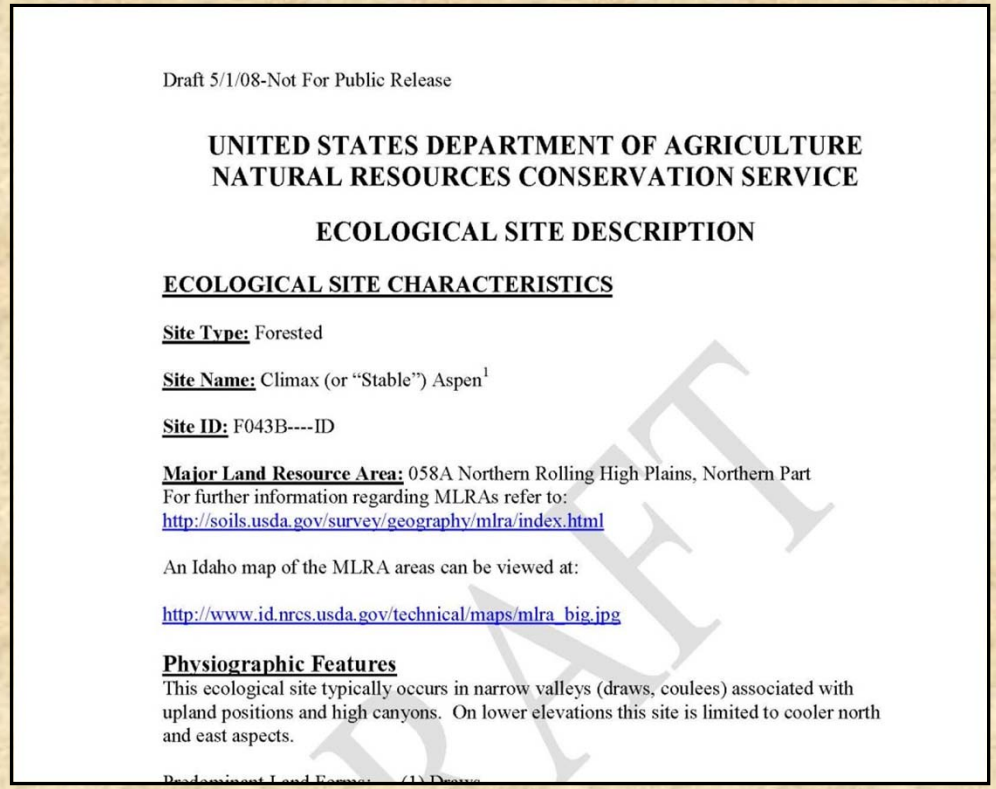


Forest Habitat Types:

- **Northern Idaho**
- Central Idaho
- Eastern Idaho

Habitat Types are a vegetation classification TOOL useful for conceptualizing and grouping Ecological Sites.

DF site index model/ESD



Draft 5/1/08-Not For Public Release

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forested

Site Name: Climax (or "Stable") Aspen[1]

Site ID: F043B----ID

Major Land Resource Area: 058A Northern Rolling High Plains, Northern Part
For further information regarding MLRAs refer to:
http://soils.usda.gov/survey/geography/mlra/index.html

An Idaho map of the MLRA areas can be viewed at:

http://www.id.nrcs.usda.gov/technical/maps/mlra_big.jpg

Physiographic Features
This ecological site typically occurs in narrow valleys (draws, coulees) associated with upland positions and high canyons. On lower elevations this site is limited to cooler north and east aspects.

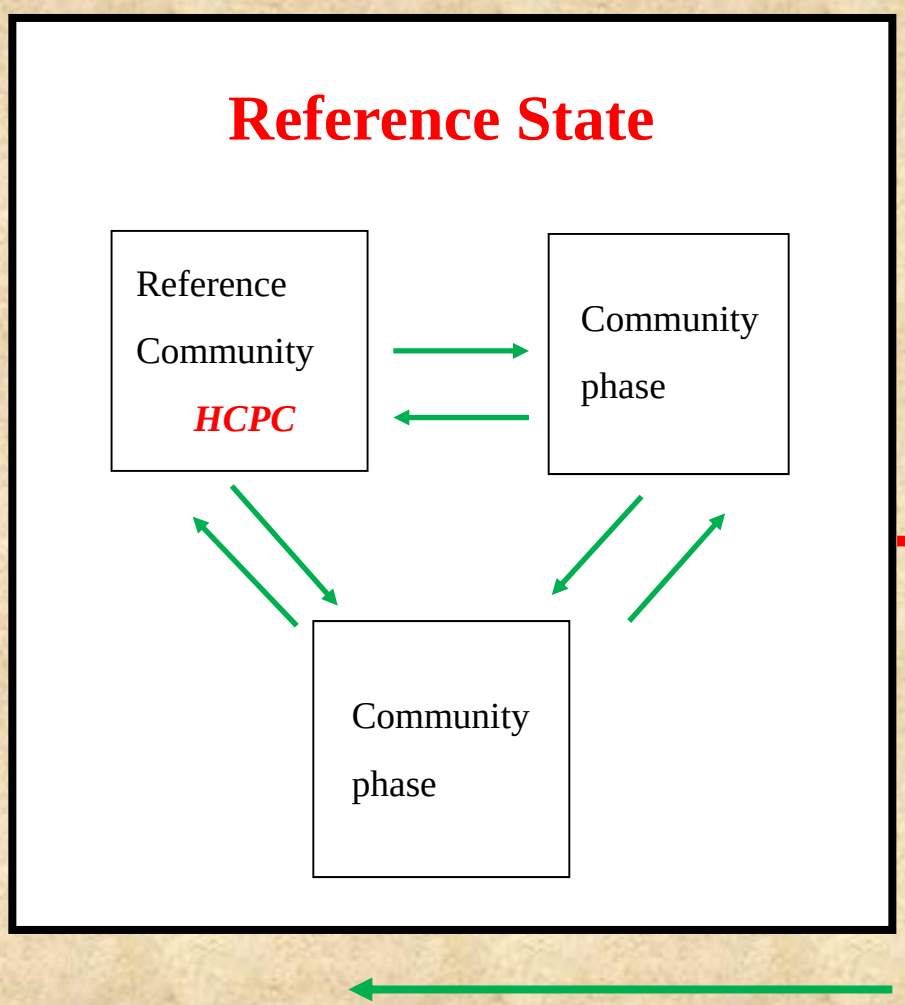
Predominant Land Forms: (1) Draws

ESD's will include:

- ESD name
- site information
- physiographic features
- climatic, water, soil, wildlife, etc. features
- plant communities
- site index, productivity, management and other interpretations

NRCS

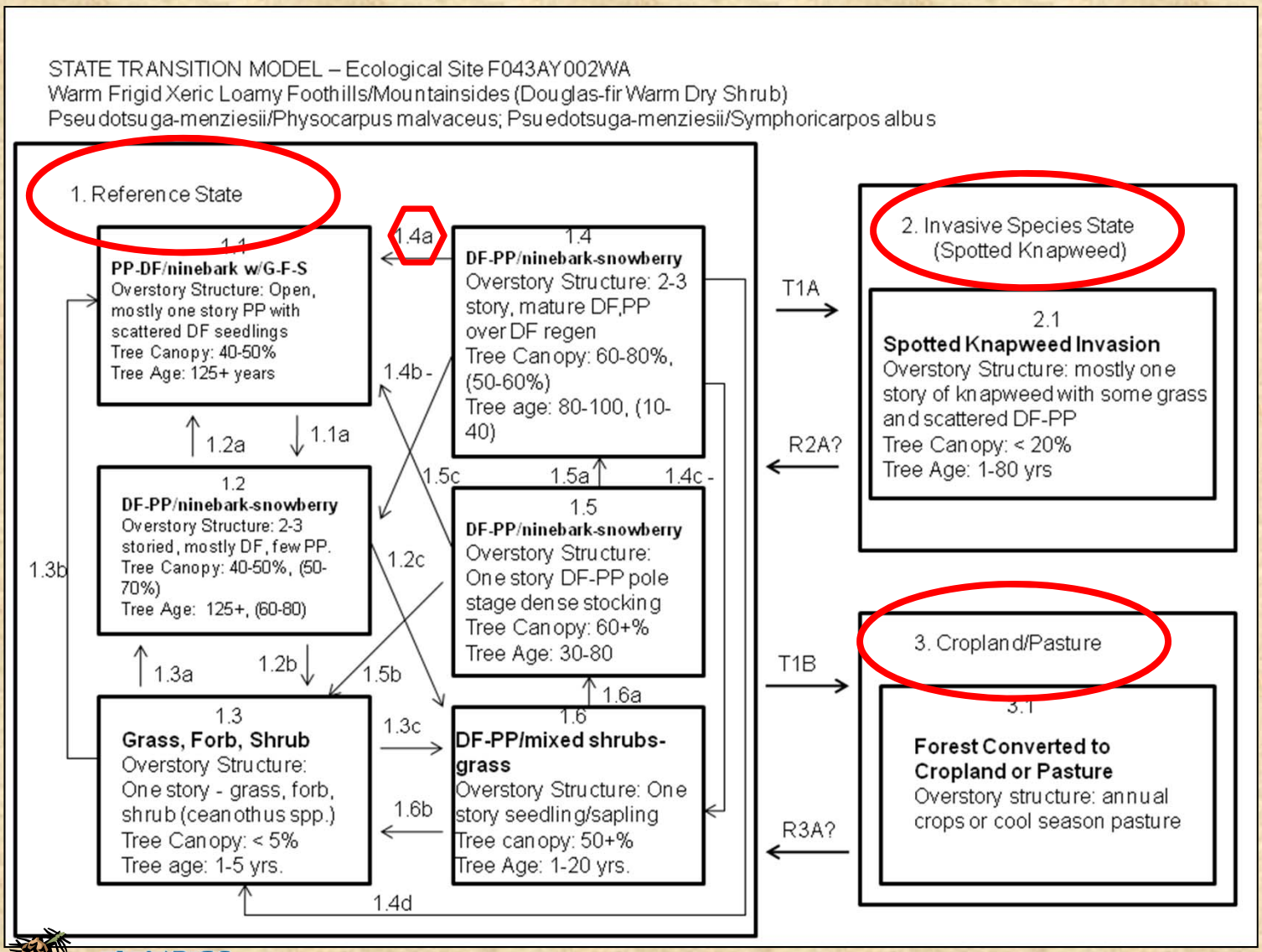
DF site index model/ESD



This line represents a transition to another state contained within the Ecological Site.

Community pathway: Time, disturbances, natural mortality, etc.

DF site index model/ESD



Pathway

DF site index model/ESD

ESD review

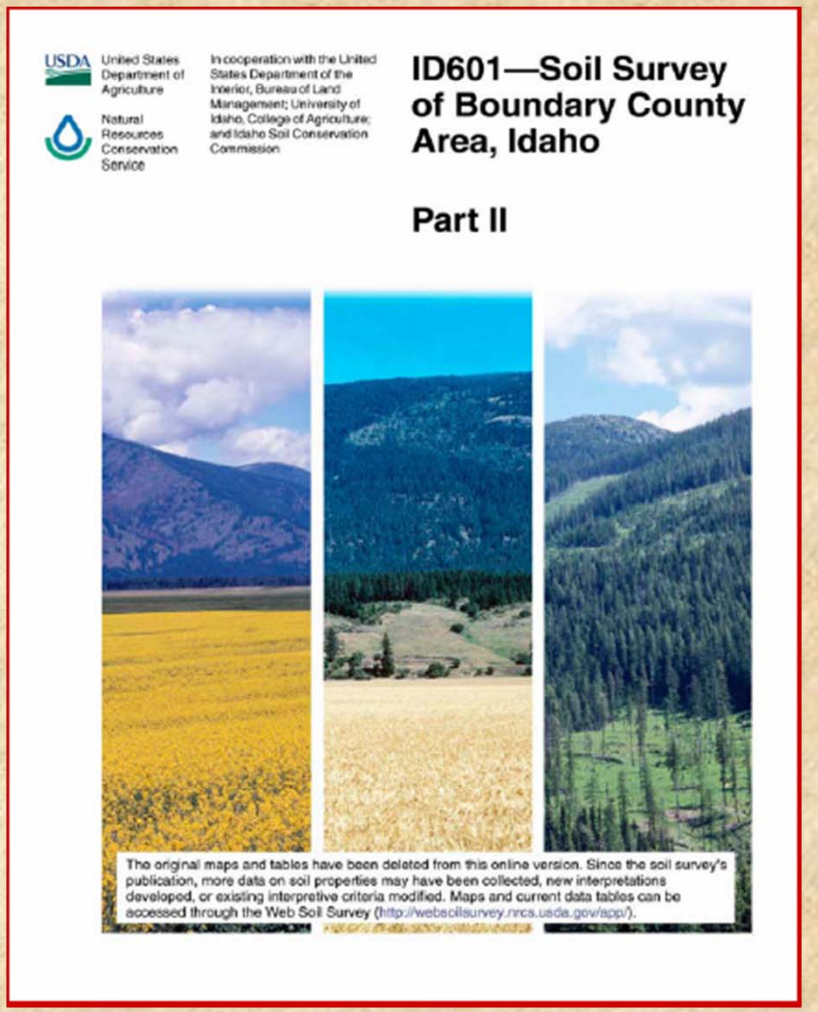
Site Index Model

DF site index model/ESD

2nd: THE MODEL

- Why did NRCS do this?
- What value will it have?

DF site index model/ESD


United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with the United States Department of the Interior, Bureau of Land Management; University of Idaho, College of Agriculture; and Idaho Soil Conservation Commission

ID601—Soil Survey of Boundary County Area, Idaho

Part II

The original maps and tables have been deleted from this online version. Since the soil survey's publication, more data on soil properties may have been collected, new interpretations developed, or existing interpretive criteria modified. Maps and current data tables can be accessed through the Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/).

A Soil Survey is:

- A systematic ***examination and mapping*** of soils across the landscape,
- A **description** of different soil types,
- An ***interpretation*** of the uses and limitations of various local soils.

NRCS

DF site index model/ESD

Forest Productivity Interpretations include:

✓***Site index value*** for viable commercial species

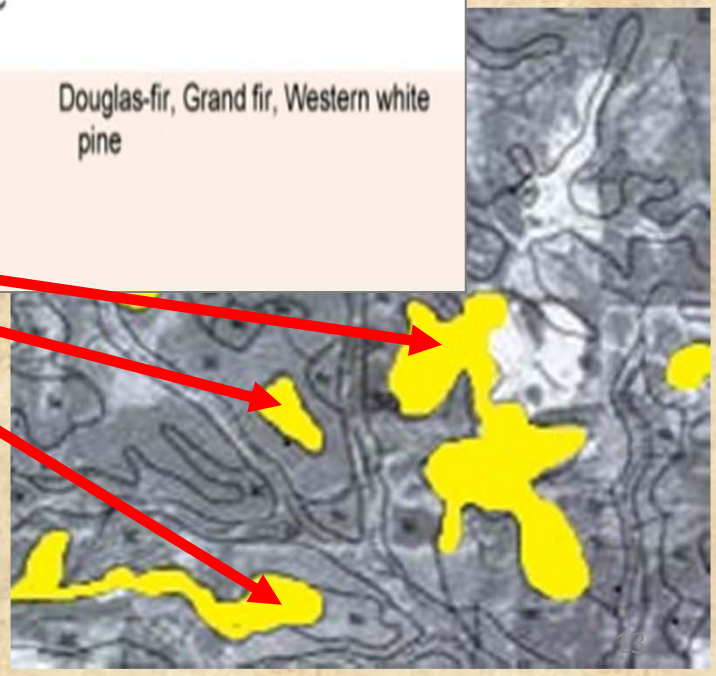
✓**Yield estimations** (shown at "Culmination of Mean Annual Increment-***CMAI***" at a specific age).

DF site index model/ESD

Forestland Productivity

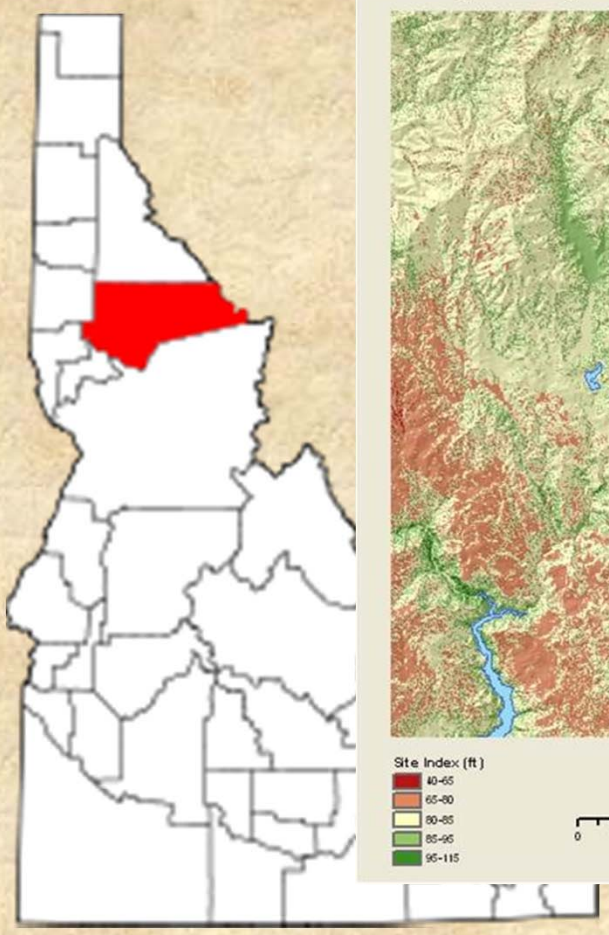
Benewah County Area, Idaho

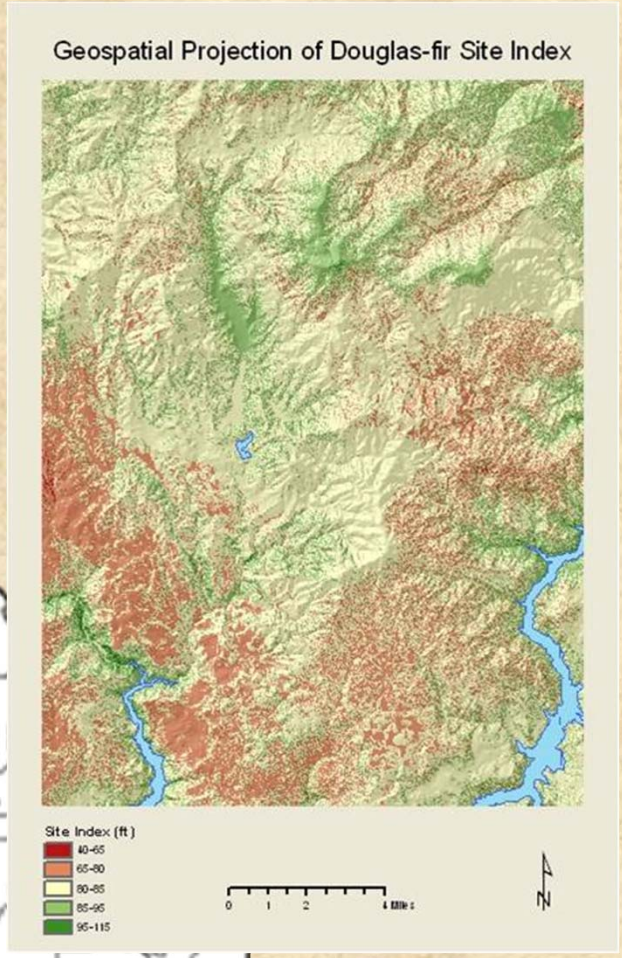
Map symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site index	Volume of wood fiber	
			Cu ft/ac	
1:				
Aquic Xerofluvents	Black cottonwood	---	---	Douglas-fir, Grand fir, Western white pine
	Grand fir	---	---	
	Western redcedar	---	---	
	Western white pine	66	129	



NRCS

DF site index model/ESD





Clearwater County Revelation:

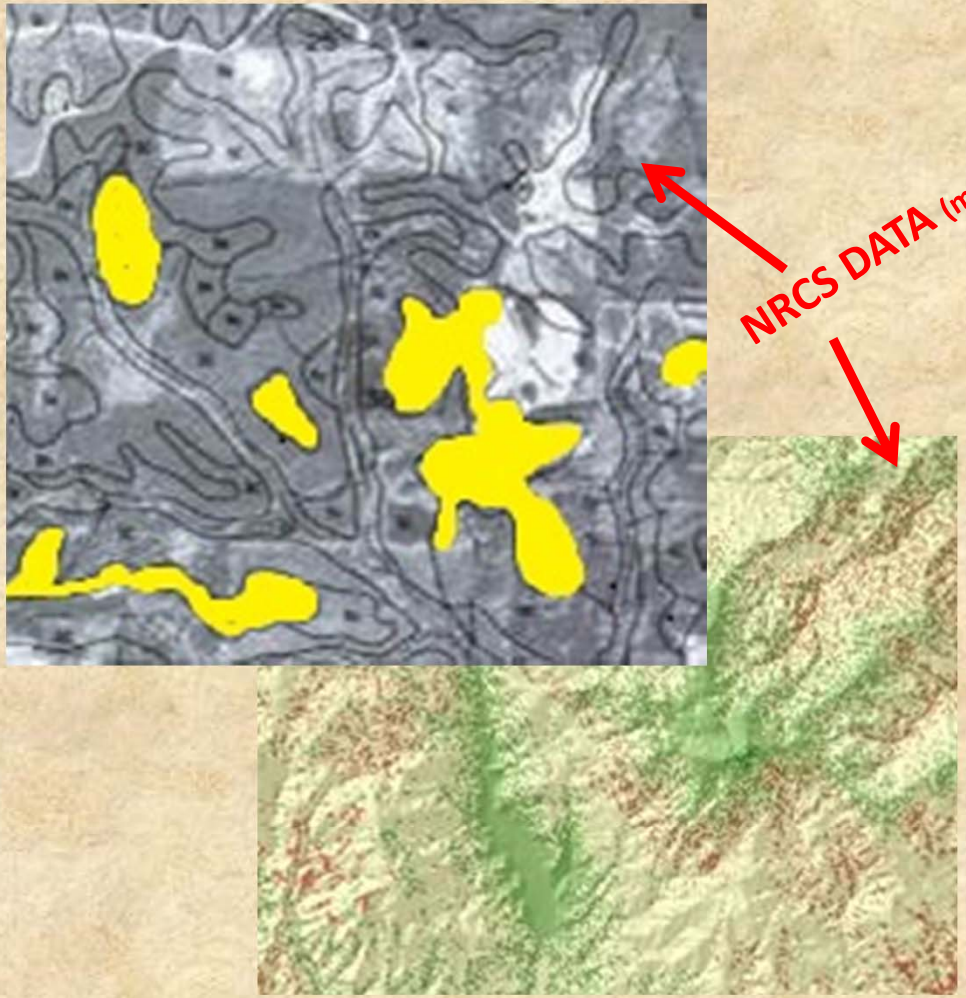
NRCS site index data

and the....

University of Idaho IFTNC geospatial project-Mark Kimsey

Pseudotsuga menziessi

DF site index model/ESD



Differences:

- *Fixed vs. Continuous data analysis*
- *Regional and local variation is captured*
- *GIS directly captures more site variables—climate, topography, etc.*

DF site index model/ESD

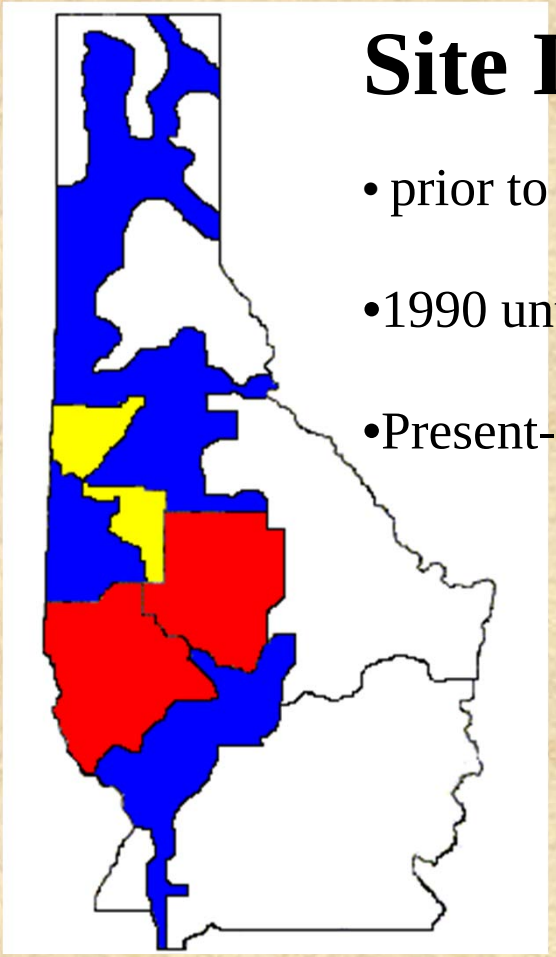
The NRCS Project Facts:

- ***Contract*** with University of Idaho (***IFTNC***) to develop the model
- Include the same area as Forest ***Habitat Types of Northern Idaho***
- Geospatially ***update and house all NRCS data***
- Will use ***Douglas-fir*** as the comparison species
  - Project ***Monserud*** as the site index reference
- Will ***gather as much outside Doug-fir site data as possible***
  - Involve a ***multitude of forest partnerships***

↓

- **Improve the reliability of Doug-fir site index predictions**

DF site index model/ESD

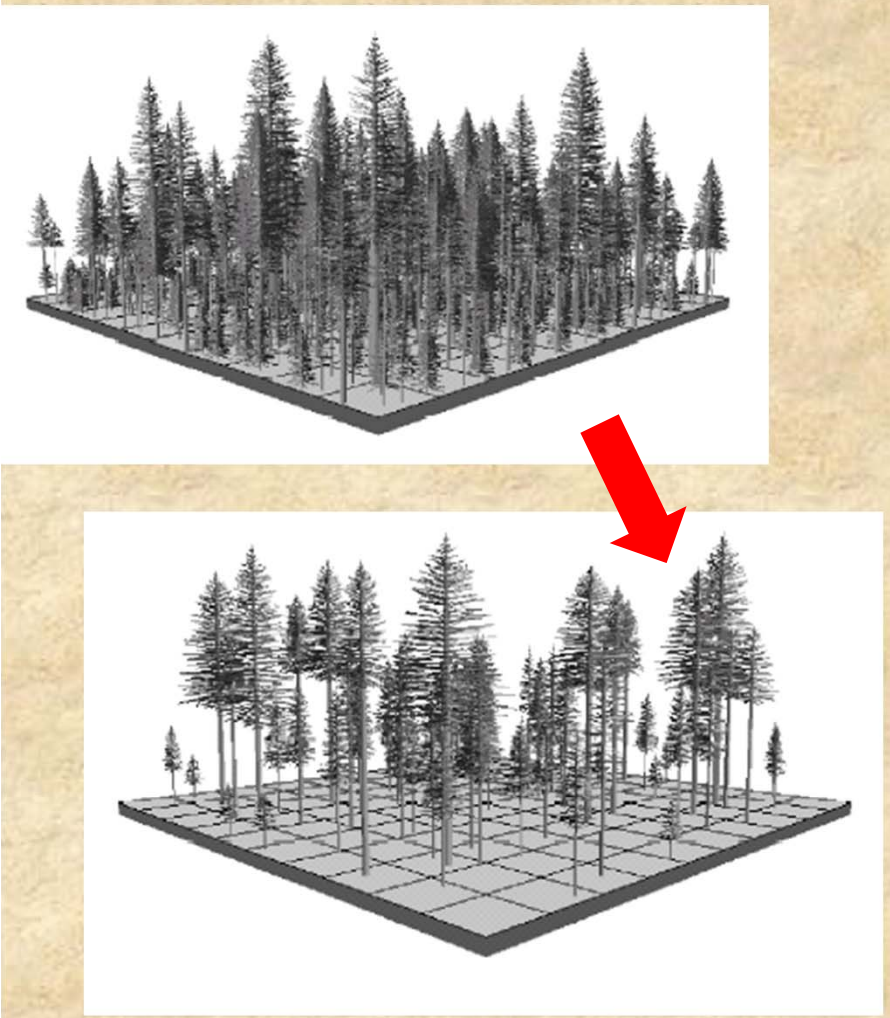


Site Index for Doug-fir:

- prior to 1990-Used **Meyer**
- 1990 until present-**Cochran**
- Present-**Monserud**

RE-PROJECT all to MONSERUD

DF site index model/ESD

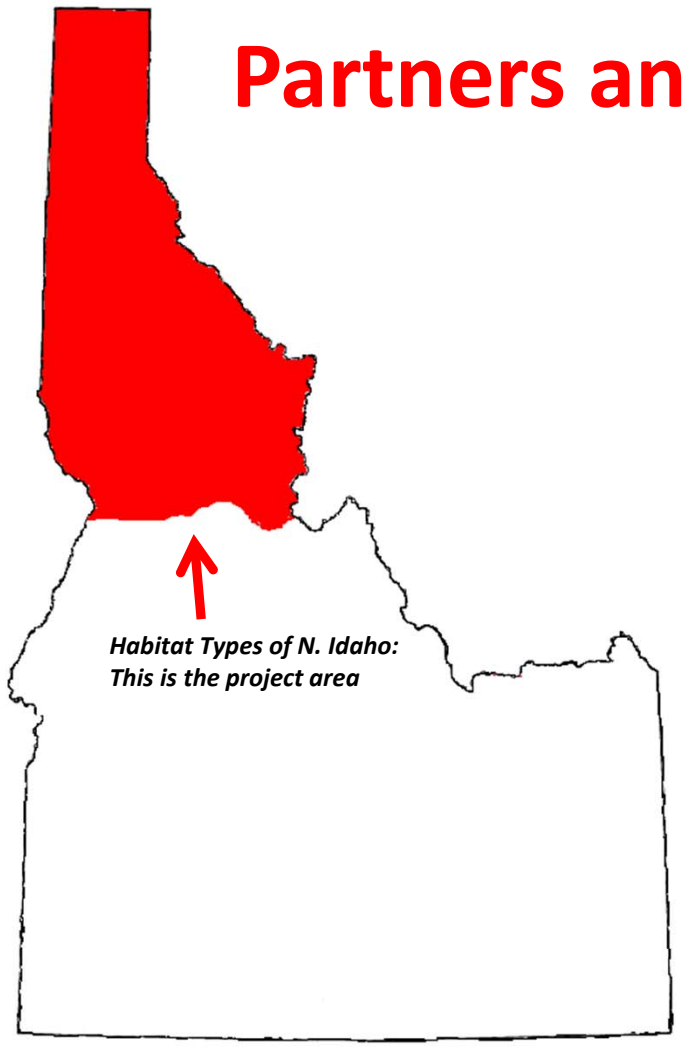


How NRCS will use the model:

- Strengthen soil survey interpretations
- To help develop and test NRCS Ecological Site Descriptions (ESD)
- Share results with partner agencies
- Aid in conservation planning
- Springboard to other forest/soils geospatial projects

DF site index model/ESD

Partners and Sources of Point Data



Habitat Types of N. Idaho:
This is the project area

INTERMOUNTAIN FOREST TREE NUTRITION COOPERATIVE

COEUR D'ALENE TRIBE

NEZ PERCE TRIBE
FORESTRY & FIRE MANAGEMENT

NRCS Natural Resources Conservation Service

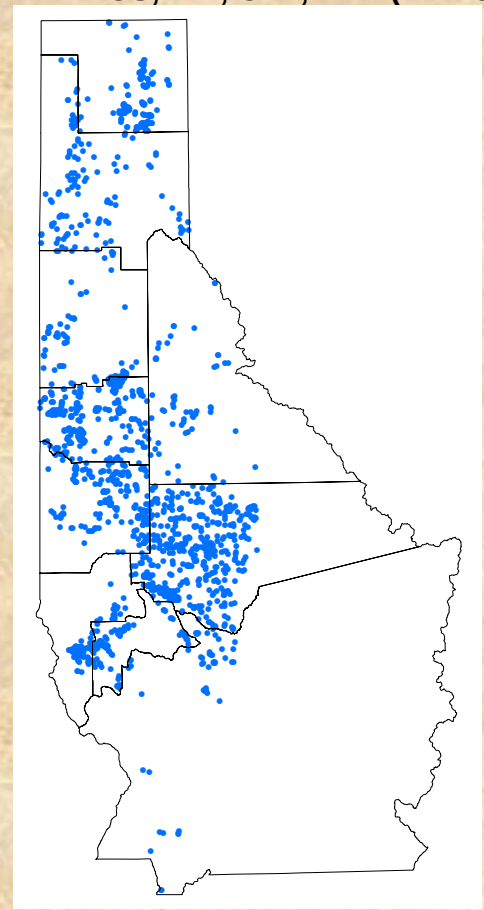
IDAHO DEPARTMENT OF LANDS

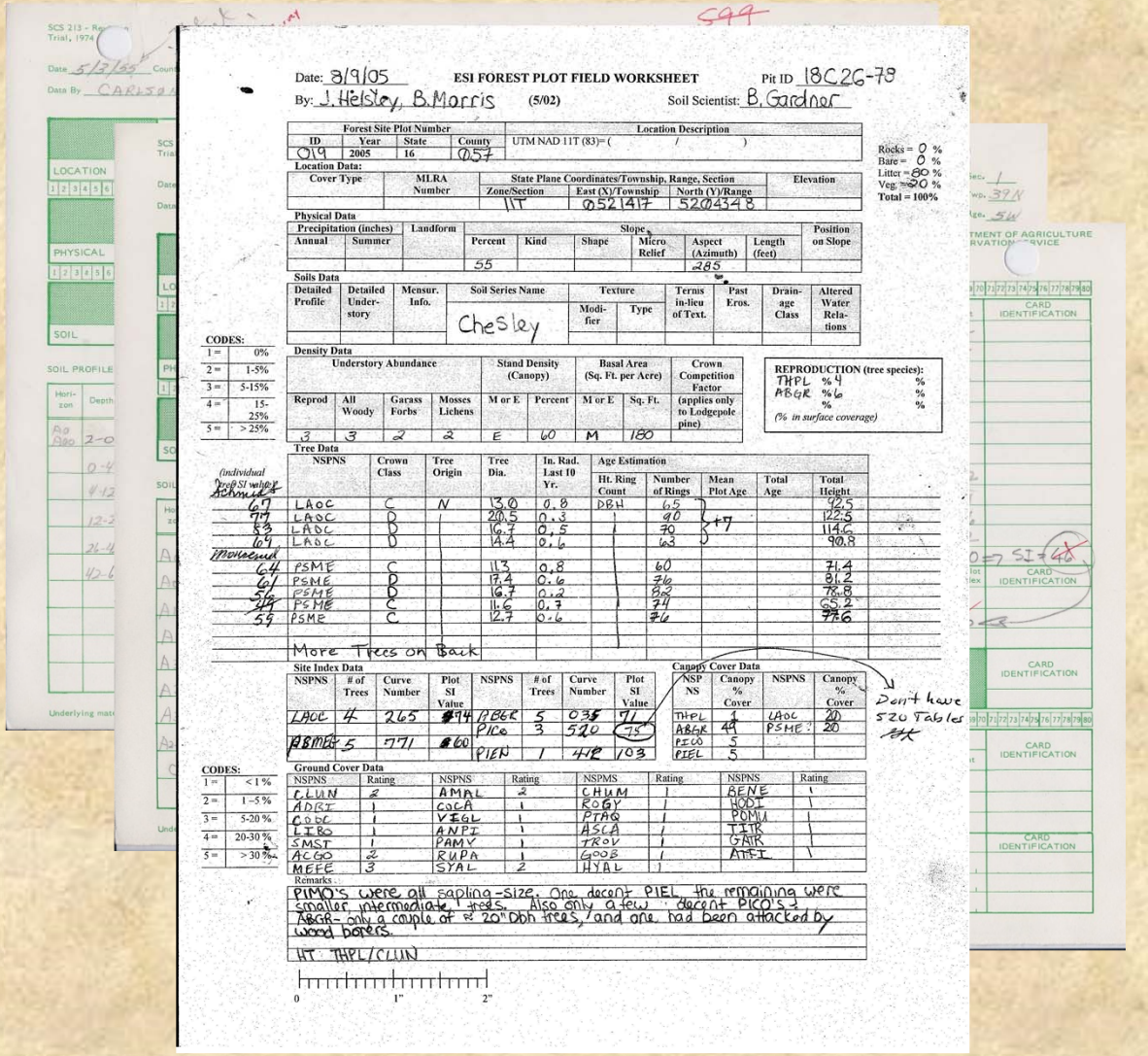
NRCS

DF site index model/ESD

North Idaho Site Index Study Area

- **NRCS, IDL, CDT, NPT (n = 1585)**





ESI FOREST PLOT FIELD WORKSHEET

Date: 8/9/05 By: J. Helsley, B. Morris (5/02) Soil Scientist: B. Gardner Pit ID 18C26-79

Forest Site Plot Number: ID 019, Year 2005, State 16, County 057. Location Description: UTM NAD 11T (83)=(/)

Location Data: Cover Type; MLRA Number; State Plane Coordinates/Township, Range, Section: Zone/Section 11T, East (X)/Township 052147, North (Y)/Range 5204548; Elevation

Rocks = 0 %, Bare = 0 %, Litter = 80 %, Veg. = 20 %, Total = 100%

Physical Data: Precipitation (inches): Annual, Summer; Landform; Slope: Percent 55, Kind, Shape, Micro Relief, Aspect (Azimuth) 285, Length (feet); Position on Slope

Soils Data: Detailed Profile; Detailed Understory; Mensur. Info.; Soil Series Name: Chesley; Texture: Modifier, Type; Ternis in-lieu of Text.; Past Eros.; Drainage Class; Altered Water Relations

CODES:
1 = 0%
2 = 1-5%
3 = 5-15%
4 = 15-25%
5 = >25%

Density Data: Understory Abundance: Reprod 3, All Woody 3, Garass Forbs 2, Mosses Lichens 2; Stand Density (Canopy): M or E E, Percent 60; Basal Area (Sq. Ft. per Acre): M or E M, Sq. Ft. 180; Crown Competition Factor (applies only to Lodgepole pine)

REPRODUCTION (tree species): THPL %4 %, ABGR %6 %, % %, (% in surface coverage)

Tree Data

NSPNS	Crown Class	Tree Origin	Tree Dia.	In. Rad. Last 10 Yr.	Age Estimation: Ht. Ring Count	Number of Rings	Mean Plot Age	Total Age	Total Height
LAOC	C	N	13.0	0.8	DBH	65			72.5
LAOC	D		20.5	0.3		90	+7		122.5
LADC	D		16.7	0.5		70			114.6
LAOC	D		14.4	0.6		63			90.8
PSME	C		11.3	0.8		60			71.4
PSME	D		17.4	0.6		76			81.2
PSME	D		16.7	0.2		82			78.8
PSME	C		11.6	0.7		74			65.2
PSME	C		12.7	0.6		76			77.6

More Trees on Back

Site Index Data

NSPNS	# of Trees	Curve Number	Plot SI Value
LAOC	4	265	94
PSME	5	771	60
ABGR	5	035	91
PICO	3	520	75
PIEN	1	472	103

Canopy Cover Data

NSP NS	Canopy % Cover	NSPNS	Canopy % Cover
THPL	1	LAOC	20
ABGR	49	PSME	20
PICO	5		
PIEL	5		

Don't have 520 Tables

CODES:
1 = <1%
2 = 1-5%
3 = 5-20%
4 = 20-30%
5 = >30%

Ground Cover Data

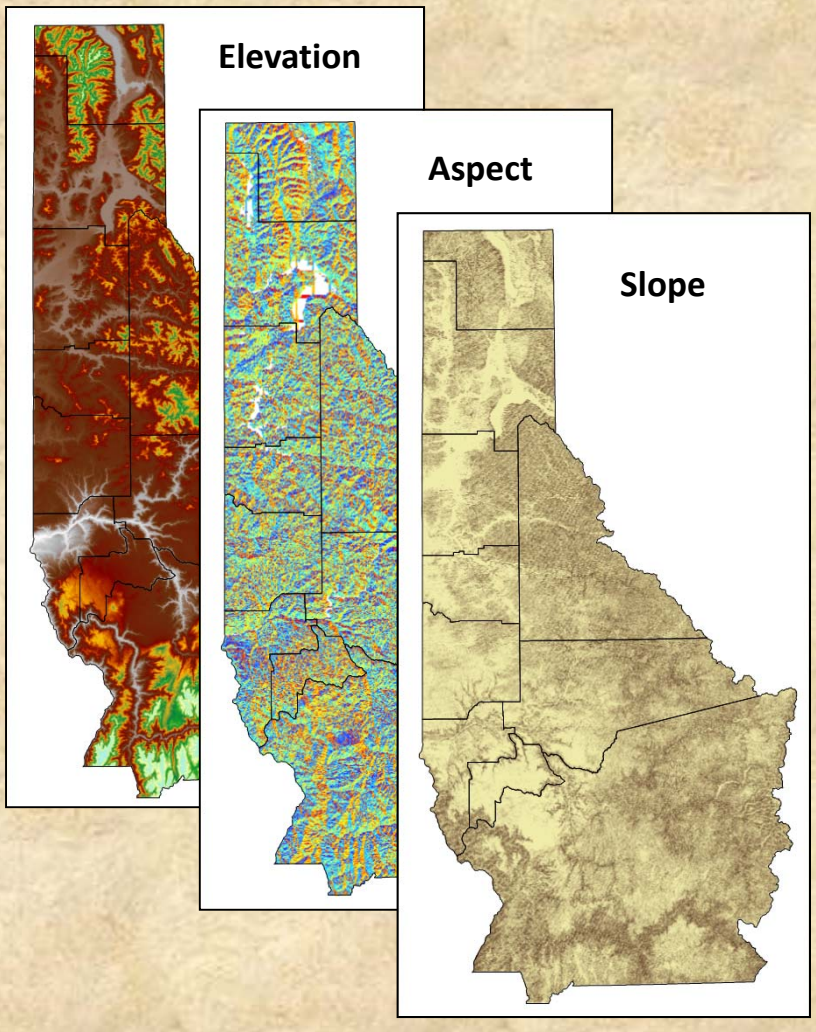
NSPNS	Rating	NSPNS	Rating	NSPMS	Rating	NSPNS	Rating
CLUN	2	AMAL	2	CHUM	1	BENE	1
ADBI	1	COCA	1	ROGY	1	HOST	1
COOC	1	VIGL	1	PTAQ	1	POMU	1
LIBO	1	ANPI	1	ASCA	1	TITR	1
SMST	1	PAMY	1	TROV	1	GAIR	1
ACGO	2	RUPA	1	GOOB	1	ATFI	1
MEFE	3	SYAL	2	HYAL	1		

Remarks: PIMO's were all sapling-size. One decent PIEL, the remaining were smaller intermediate trees. Also only a few decent PICO's. ABGR- only a couple of ≥ 20" DBH trees, and one had been attacked by wood borers.

HT: THPL/CLUN

0 1" 2"

DF site index model/ESD
Topographic factors

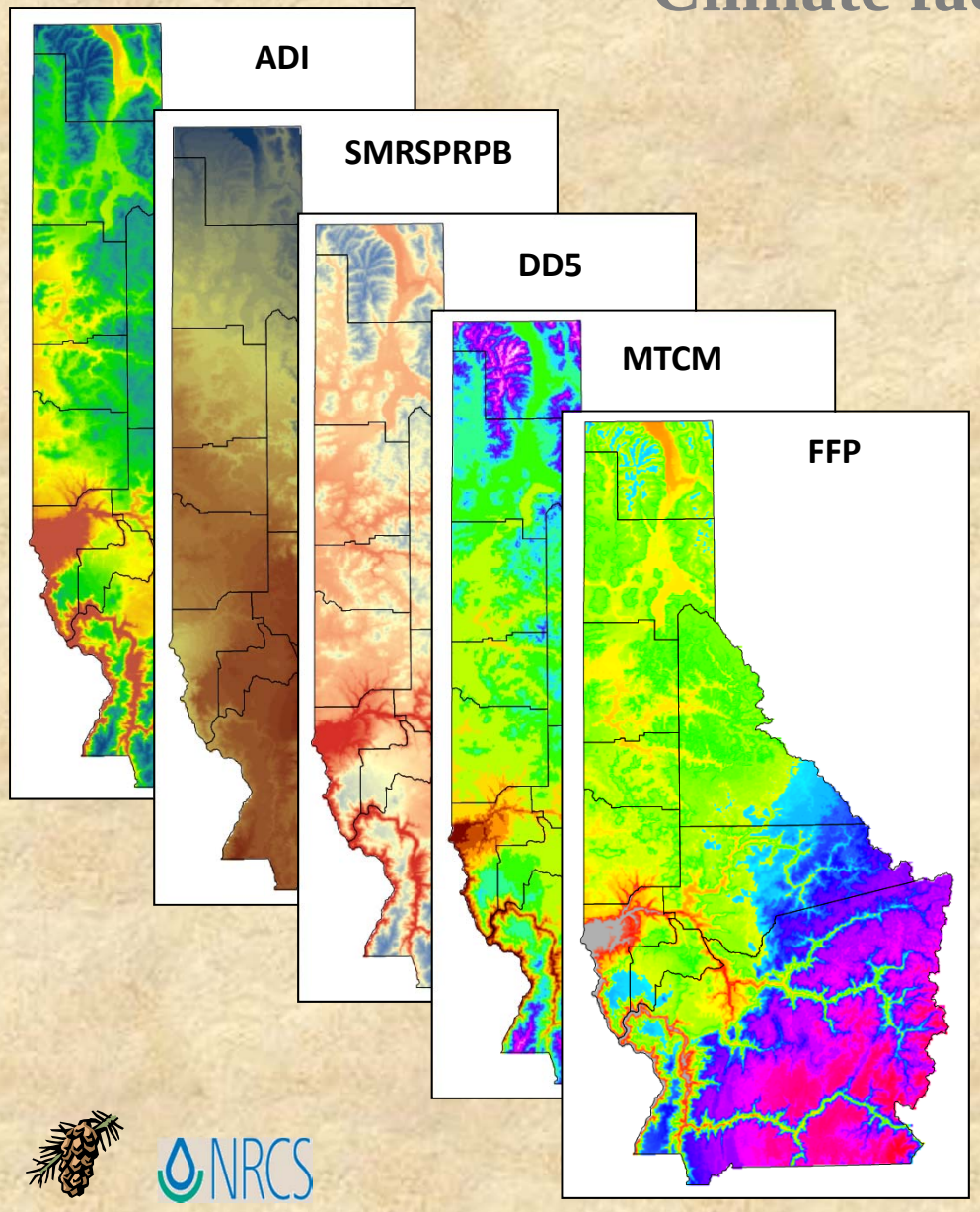


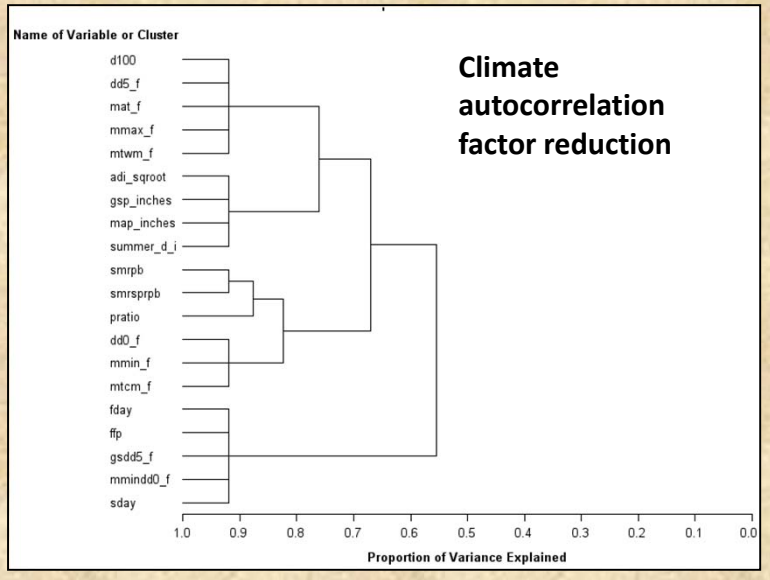
- **Stage Parameters (*1976*, 2007)**
  - Elevation
  - Elevation^2
  - *Slope*
  - *Slope x Cos(Aspect)*
  - *Slope x Sin(Aspect)*
  - lnElev x Slope
  - lnElev x Slope x Cos(Aspect)
  - lnElev x Slope x Sin(Aspect)
  - Elev^2 x Slope
  - Elev^2 x Slope x Cos(Aspect)
  - Elev^2 x Slope x Sin(Aspect)

- Parameters shown to be correlated with MAI and SI

NRCS

DF site index model/ESD
Climate factors

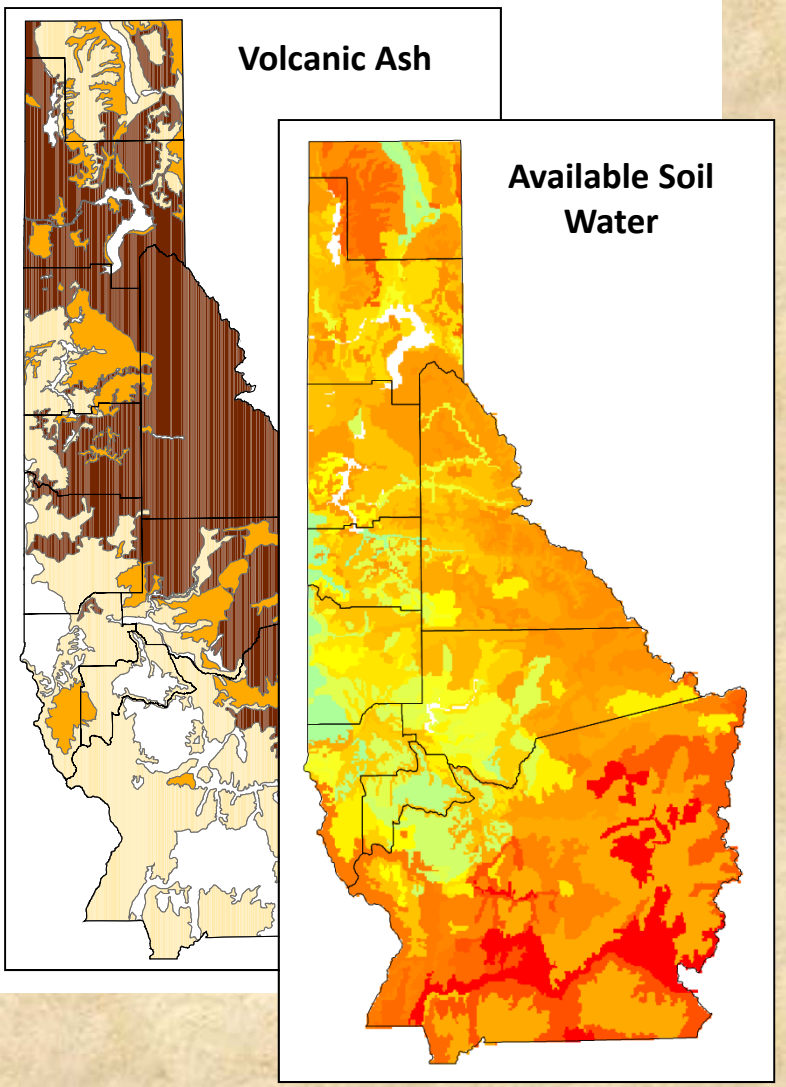




- Climate factors strongly correlated to max SDI
  - MTCM(-)
  - ADI (-)
  - FFP (+)
  - DD5 (-)
  - SMRSPRPB (+)

NRCS

DF site index model/ESD
Soil factors



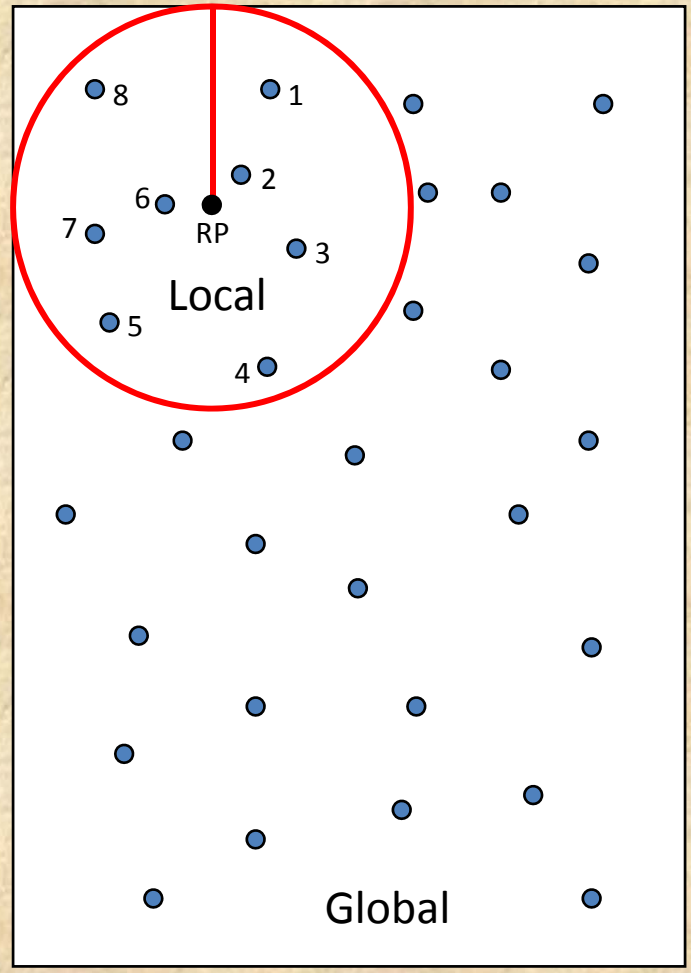
- Soil Available Water
  - Integrates OM, coarse fraction, soil texture, soil depth to limiting feature or 150cm
  - Concerned it masks the effect of volcanic ash as seen in max SDI modeling
  - Included ash cap layer derived from SSURGO and STATSGO data

DF site index model/ESD
Stationary or Nonstationary – That is the Question

- Typical regression modeling assumes the independent variable effect is constant across space
  - *Is this a valid assumption in biological systems designed with inherent phenotypic plasticity?*
  - *Can plasticity be captured using spatial modeling techniques that allow the effects of environmental variables to vary across space?*

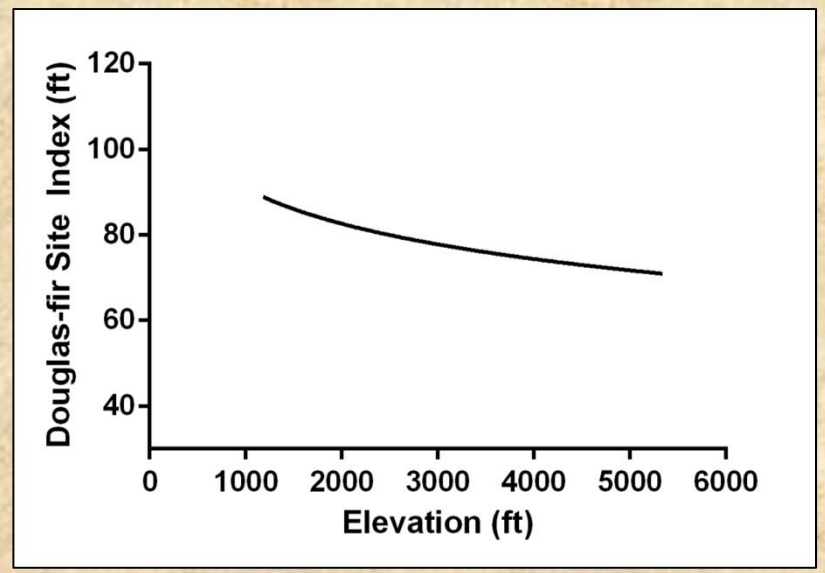
DF site index model/ESD
Testing for Non-Stationarity

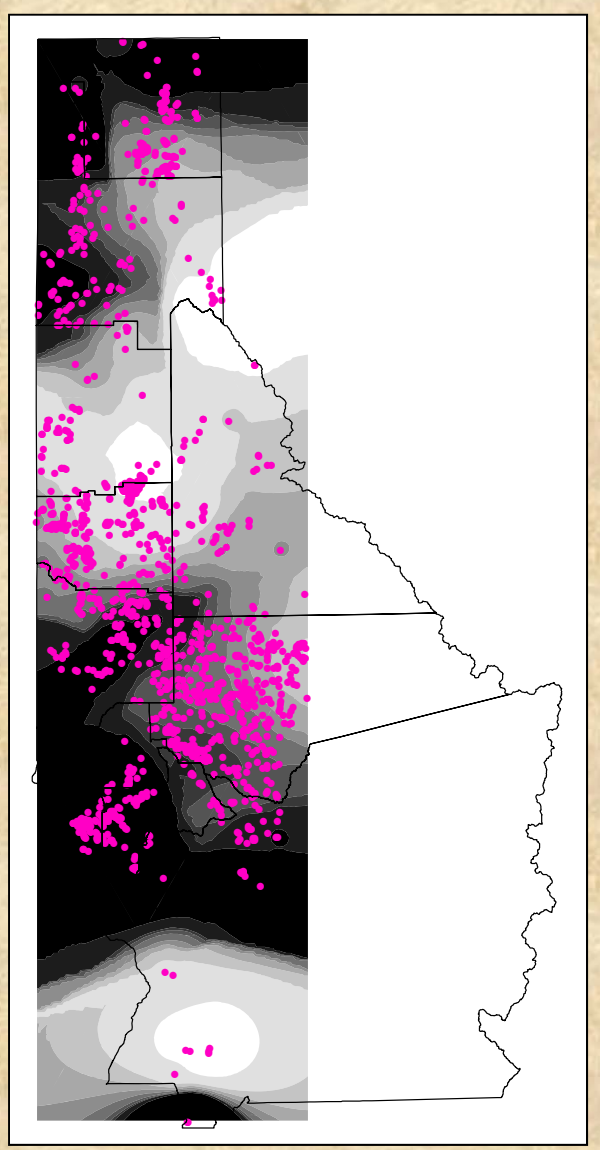
- Geographically Weighted Regression
  - Prediction surface derived from relationships between SI and environmental variables
  - Stepwise process used to identify correlated variables
  - A global **AND** local analysis of variable affect on SI
- Final model form:
  - $\hat{Y}_i = ß_{0(i)} + ß_{1(i)}X_{1(i)} + ß_{2(i)}X_{2(i)} + \ldots\ldots + ß_{k(n)}X_{k(n)} + \varepsilon_i$



DF site index model/ESD Results

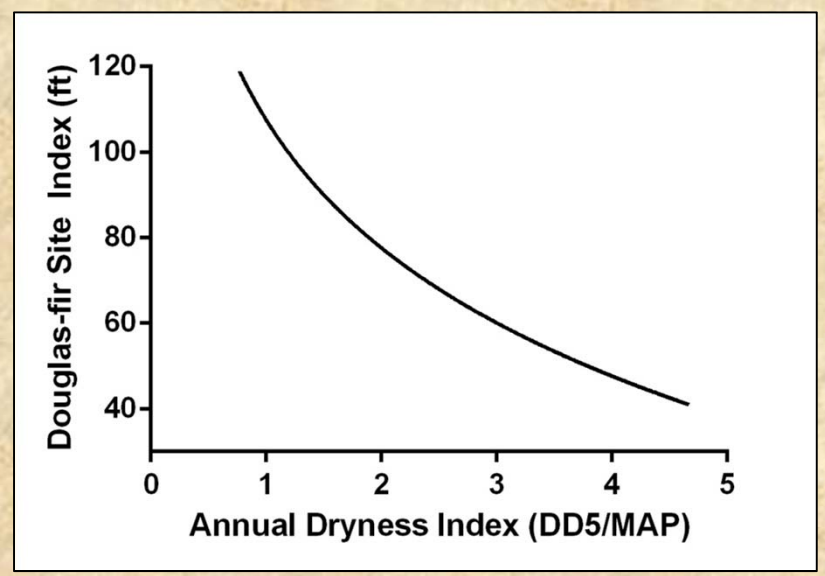
- Topographic variable
  - Ln(Elevation)
    - Nonstationary
    - Estimate range: 147 (-,+)

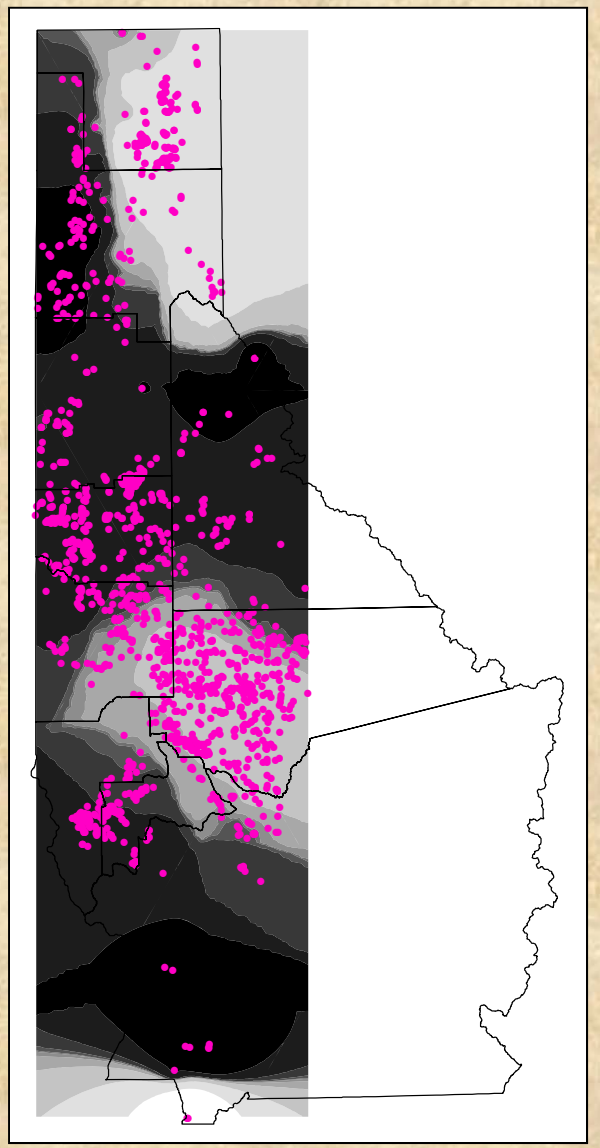




DF site index model/ESD Results

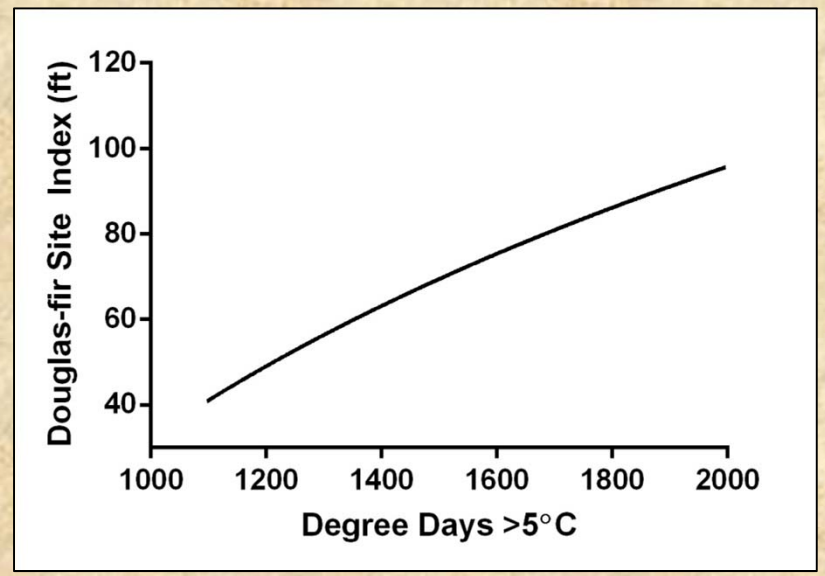
- Climate
  - Ln(Annual Dryness Index)
    - Nonstationary
    - Estimate range: 757 (-,+)

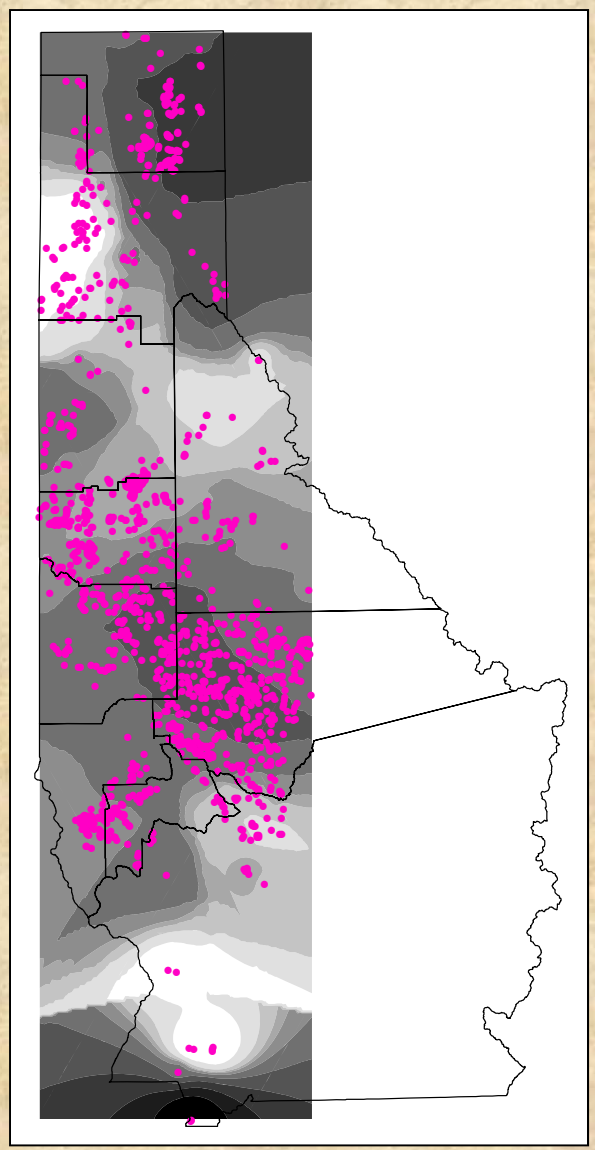




DF site index model/ESD Results

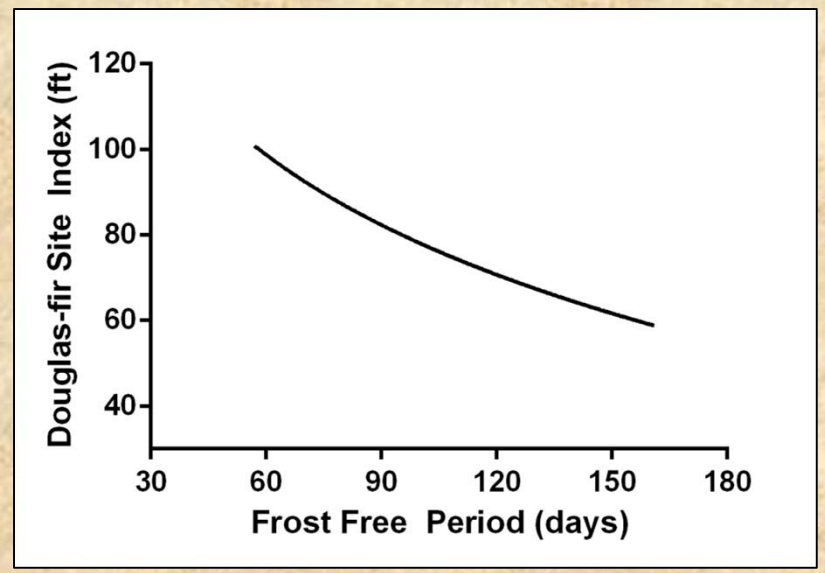
- Climate
  - Ln(Degree Days >5C)
    - Stationary
    - Estimate: 89

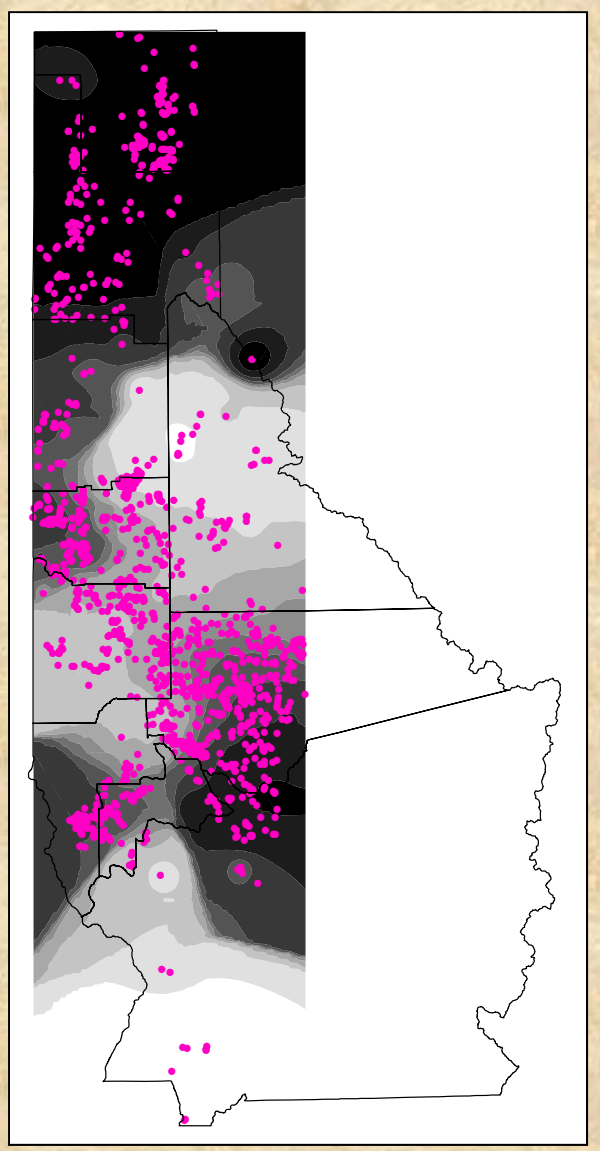




DF site index model/ESD Results

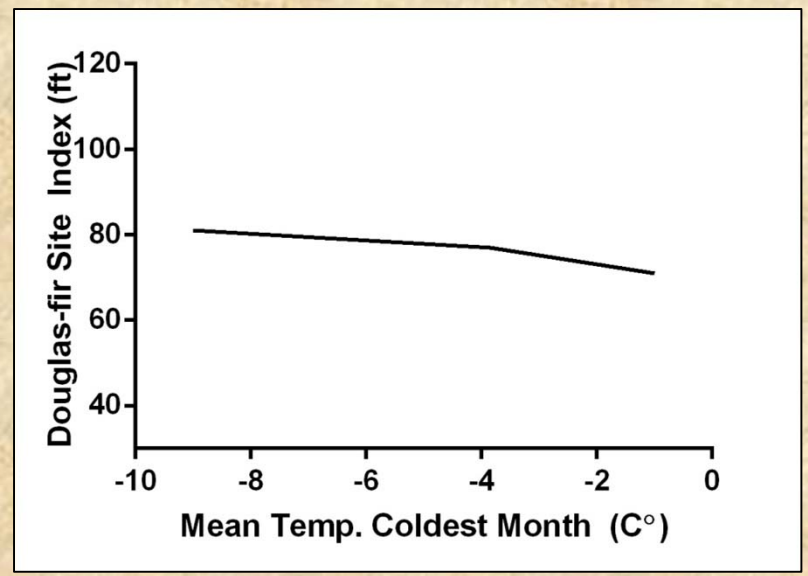
- Climate
  - Ln(Frost Free Period)
    - Nonstationary
    - Estimate Range: 260 (-,+)

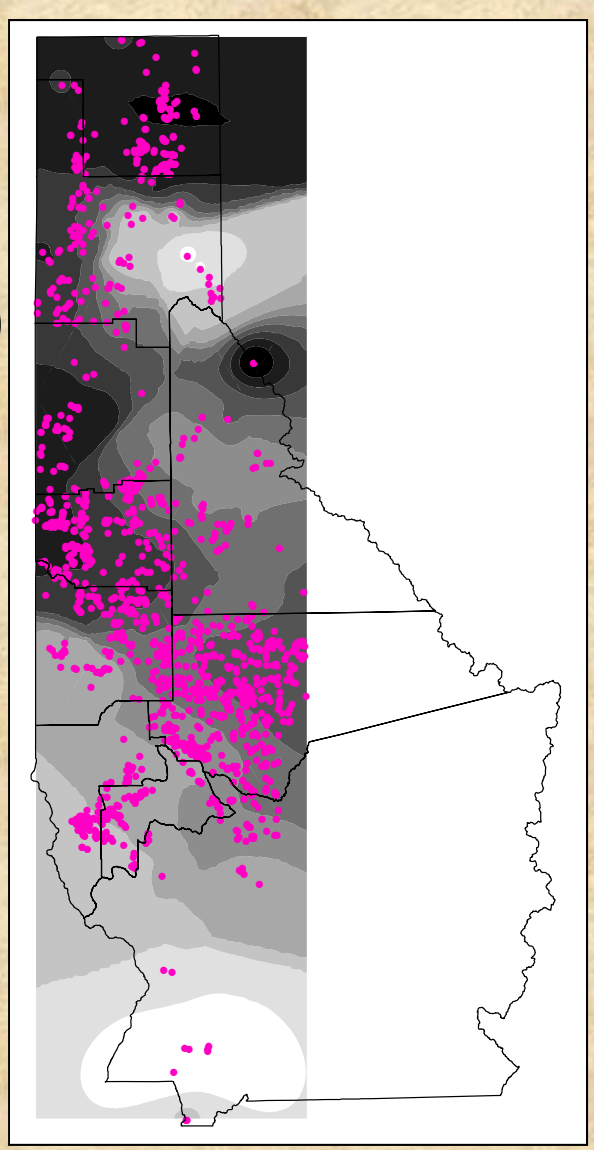




DF site index model/ESD Results

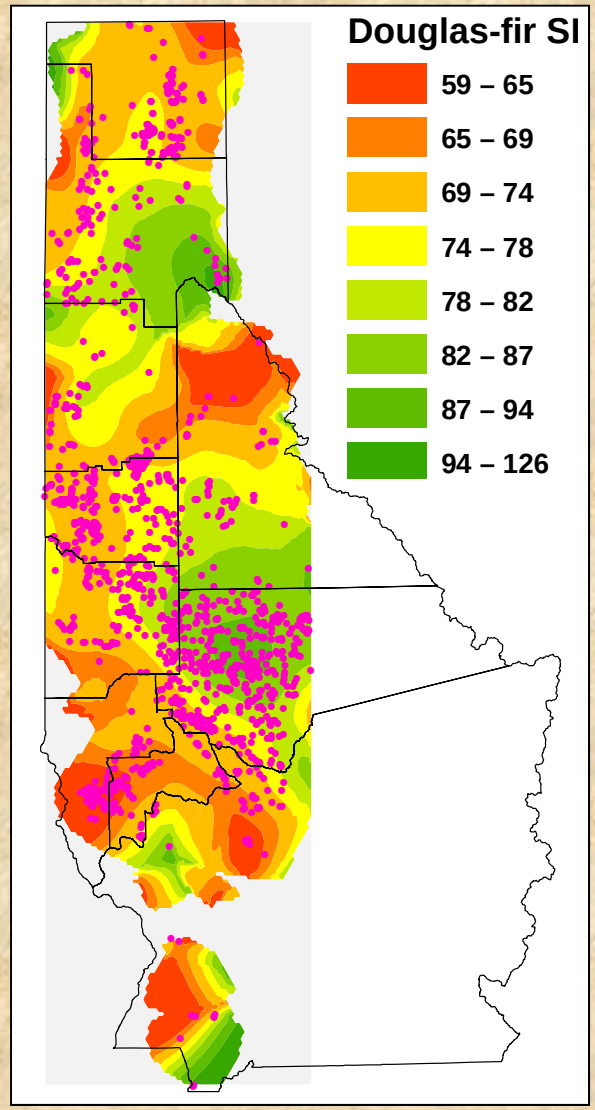
- Climate
  - Ln(Mean Temp Coldest Month)
    - Nonstationary
    - Estimate Range: 99 (-,+)





DF site index model/ESD Summary

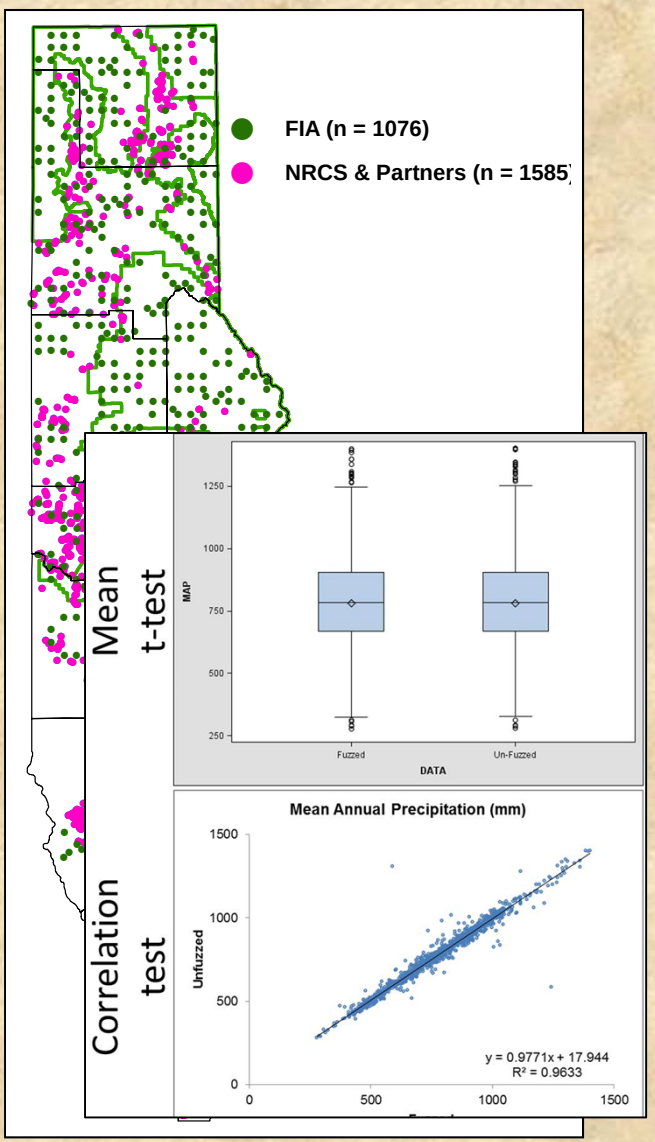
- Preliminary GWR Model
  - Elevation, climate driven
  - Aspect/slope and their interaction with elevation NS
  - Wo/climate variables, aspect/slope terms slightly significant (~+/-2 feet)
  - ASW input needs to be refined to better capture the ash cap effect
  - Model R^2 ~ 0.4
  - Douglas-fir is plastic - More data?



NRCS

DF site index model/ESD
Future Efforts

- If climate is the main driver
  - Include fuzzed FIA data points
  - Local GWR radius search is considerably larger than 1km climate grids
  - Plot elevation, slope, aspect observed
  - Issue will be soil/geology correlation
- Work with NRCS to refine soil inputs
- Invite other partners to enhance end product
- Final product out by June 30, 2014



DF site index model/ESD

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