Soil Quality in Working Forests

- ***Healthy Forest Soils***
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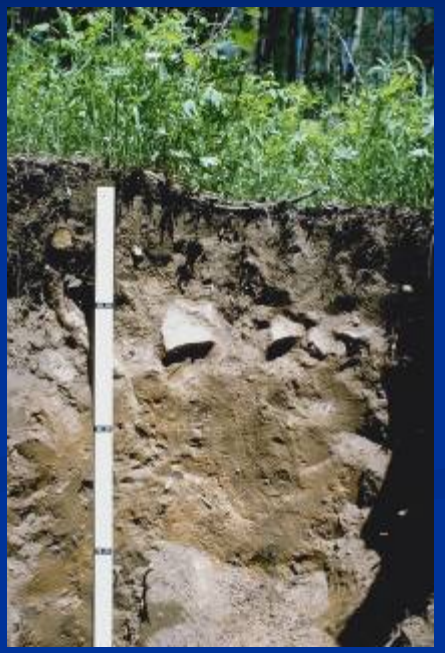
Objectives and Overview

- Introduction to ***Ecological Sites*** … a platform for initiating planning and conducting "healthy" forest management which includes consideration of soil
- Supporting this platform with 1) resource quality criteria requirements, 2) soil interpretations, 3) practice specifications; and 4) economic practicality for the landowner
- Identifying key soil attributes (that are at risk) and developing sensible forest practices performance criteria to maintain soil and site health



An ecological site is …

- A characteristic or distinctive kind of land with capacity to produce a distinctive kind and amount of vegetation.
- The kind of land consists of a specific and correlated set of named and mapped soil components.

U.S. Department of Agriculture
Natural Resources Conservation Service (NRCS)

Washington-Oregon
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Ecological Site Abstract

Site Description Identification: F002XN__WA

Common Name: Upland Well-drained (Douglas-fir-western redcedar/vine maple/swordfern)

Scientific Biotic Site Name: Pseudotsuga menziesii-Thuja plicata/Acer circinatum/Polystichum munitum

Location, Physiography, Climate, and Extent: Plant communities occur on gentle to steep slopes at lower elevations of the Coastal and Cascade Mountain Ranges in Major Land Resource Region (MLRA 2)[1]. Mean annual precipitation generally ranges from 24 to 60 inches. Prior to European settlement of the area, an estimated 25 percent (or 3,000 square miles) of MLRA 2 was occupied by plant communities within this ecological site.

Soils: Gentle to steeply sloping soils are typically well-drained and range from gravelly or cobbly loams to silty clay loams and may be on any aspect. Some representative soil series having components in this ecological site are Cinebar, Clackamas, Dollar, Hillsboro, Honeygrove, Katula, and Olympic. Contact the NRCS field office for a current list of mapped soil components correlated to this site and a complete, detailed ecological site description.

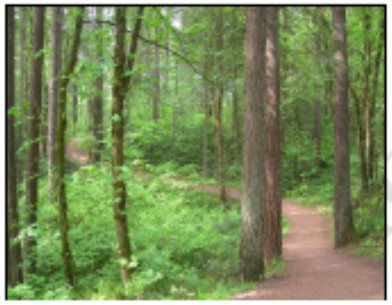


Figure 1. Douglas-fir established after "old growth" harvest and slash burning predominate the site (stand age 80 years). Bigleaf maple will persist as long as enough light penetrates through the upper-most canopy. Bark of these Douglas-fir is thick enough to withstand repeated surface fires. Vegetation will recover within one or two decades to pre-surface fire conditions and structure. (Reference community phase 1.7 on page 2.)

Figure 2. Bigleaf maple and red alder (stand age 45 years) have dominated the site since the harvest of "second growth" Douglas-fir and western redcedar. Reforestation by hardwoods at that time was by natural means and predates hand-planting of Douglas-fir which became the norm beginning about 1975. (Reference community phase 1.3 on page 2.)

Interpretations Overview:

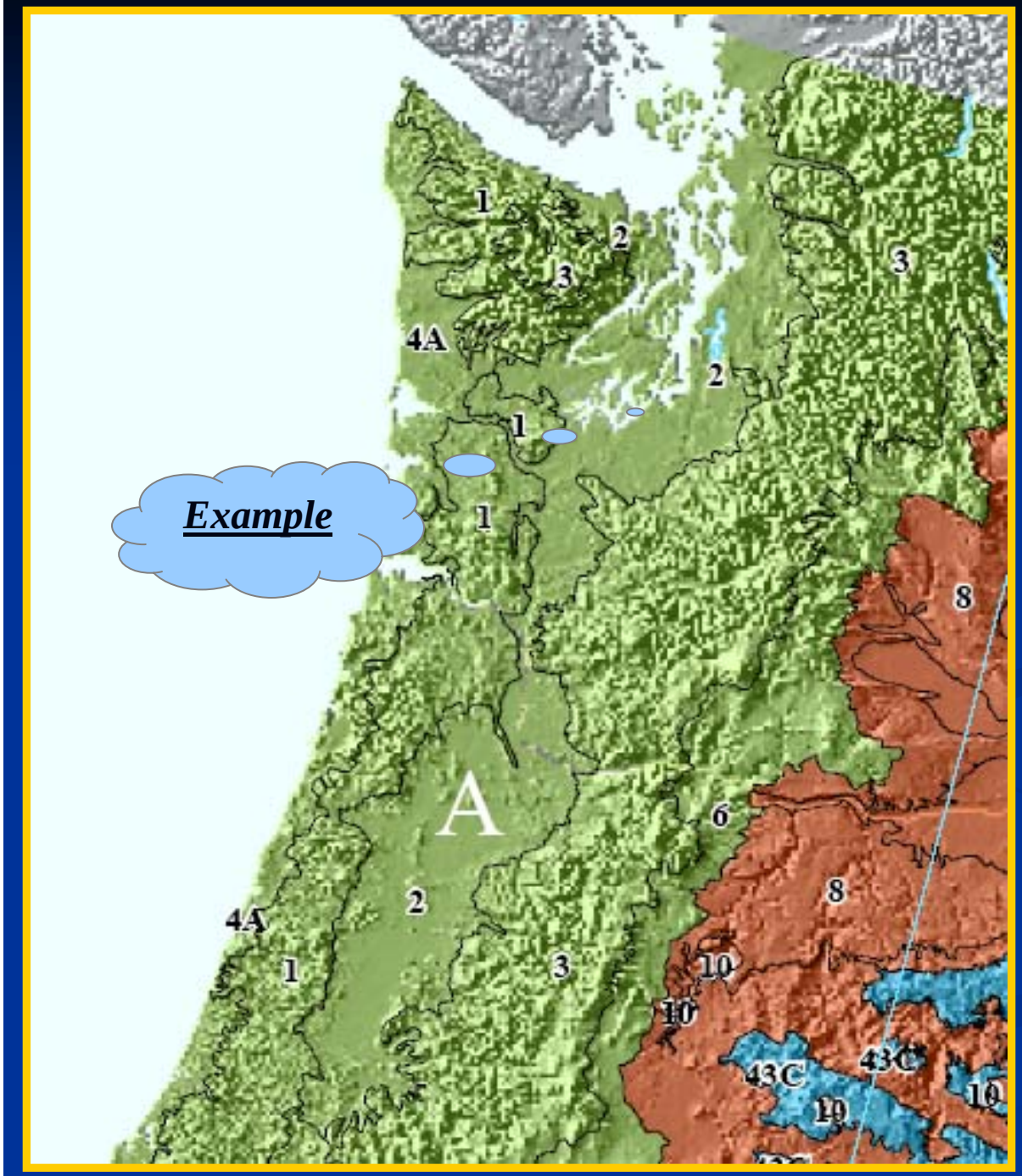
Forest Site Productivity - Site index (100-year basis) for Douglas-fir stands ranges from 150 to 170 with corresponding maximum average annual growth rates of 160 to 190 cubic feet per acre per year. Site index (50-year basis) for red alder stands ranges from 75 to 90 with corresponding maximum average annual growth rates of 75 to 100 cubic feet per acre per year. Specific site index estimates for certain species are typically made for each unique soil component and may be obtained from the NRCS.

Animal Community - A diverse group of wildlife species are correlated to each plant community phase. In general, a partial list of species can include: black bear, coyote, Mule Deer, Little brown bats, Deer mice, Red-backed voles, cavity nesting birds such as Pileated woodpecker, Red-breasted nuthatch, and brown creeper, numerous species of salamanders such as Rough-skinned newt and Ensatina, various invertebrates such as pollinating bees, bark beetles, and forest slugs.

[1]MLRA = Major Land Resource Areas; in Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, 2006. U.S. Department of Agriculture Handbook.

Revised July 19, 2007

Example

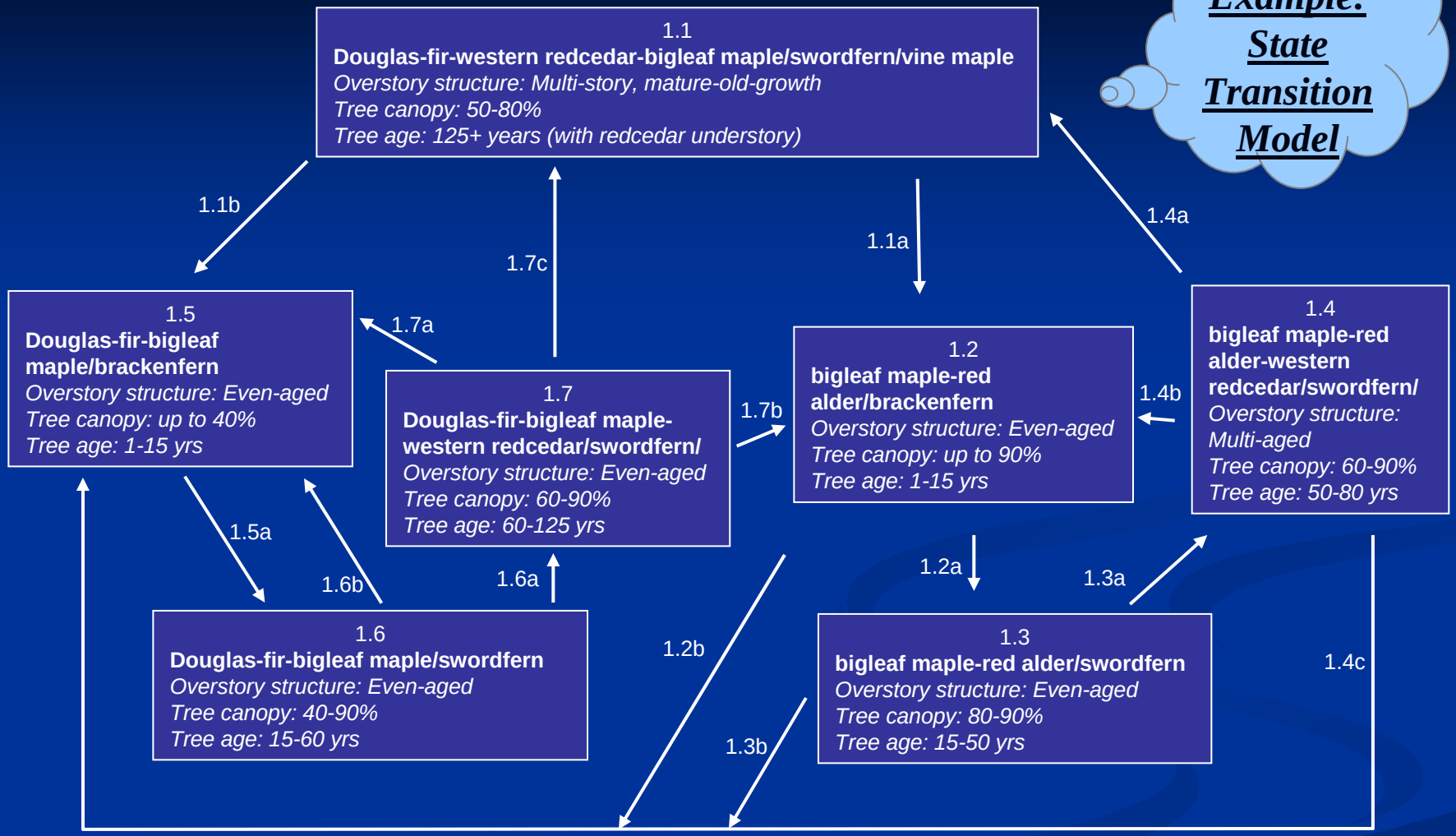


Correlated soils …

- Representative soil series having components making up the example ecological site are Cinebar, Clackamas, Dollar, Hillsboro, Honeygrove, Katula, and Olympic.

1. Reference State (Site ID: F002XN___WA)

Example: State Transition Model



(Pseudotsuga meniziesii-Thuja plicata-Acer macrophyllum/Polystichum munitum/Acer circinatum; Rev. 22May2007)

→ = Community phase pathway
1.X = Plant Community Phase
1.Xy = Pathways (ecological response to various natural and management disturbances)

The ecological site provides the platform for initiating forest management … reducing the risk of unsubstantiated or unessential information being transferred to the landowner or land manager.

Ecological Site: Context for Vegetation and Soils

Quality Criteria

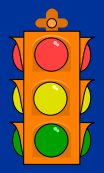
Economics

Soil Interpretations

Practice Specifications

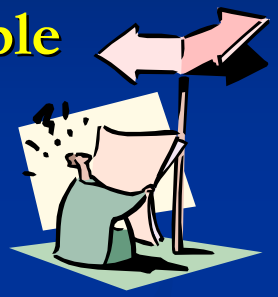
To support the platform on which to plan and implement forest and vegetation management, four elements related to forest soil quality must be integrated:

- Identifying key soil attributes that help define "health" of the local forest unit and the dynamic plant communities being managed

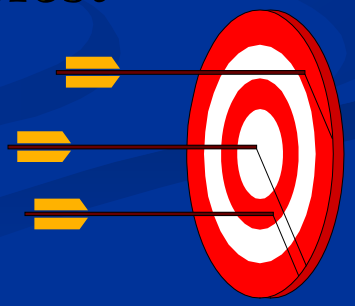


- Rating soil components on their susceptibility to degradation of identified soil attributes by various forest and vegetation management techniques (including equipment and timing of use)

- Developing sensible and understandable forest practices performance criteria that minimize degradation



- Assuring economic practicality for the forest landowner in carrying out prescribed forest practices



Status of integration …

http://www.fs.fed.us/cgi-bin/Directives/get_dirs/fsh?2509.18

- **Northern Region (R1), Rocky Mountain Region (R2), Southwestern Region (R3), Intermountain Region (R4), Pacific Southwest Region (R5), Pacific Northwest Region (R6), and the Eastern Region (R9) of the USDA-Forest Service**
  - **Soil Quality Elements: Displacement, Compaction, Rutting, Erosion, Soil Cover, Organic Matter, Burned Conditions**

- In 1979, the Pacific Northwest Region was the first Forest Service region to develop and implement soil quality standards … with a standardized protocol developed in 1983
- From 1975 to 1979, NRCS in the Pacific Northwest assisted in the development of interagency criteria and making widespread ratings at the soil component level (in soil surveys) for displacement, compaction, rutting, and burned conditions.

Some background …

- The Montreal Process criteria and indicators for the conservation and sustainable management of temperate and boreal forests were established following the endorsement, in 1995, of a statement of commitment to sustainable forest management known as the Santiago Declaration.

http://www.mpci.org/home_e.html

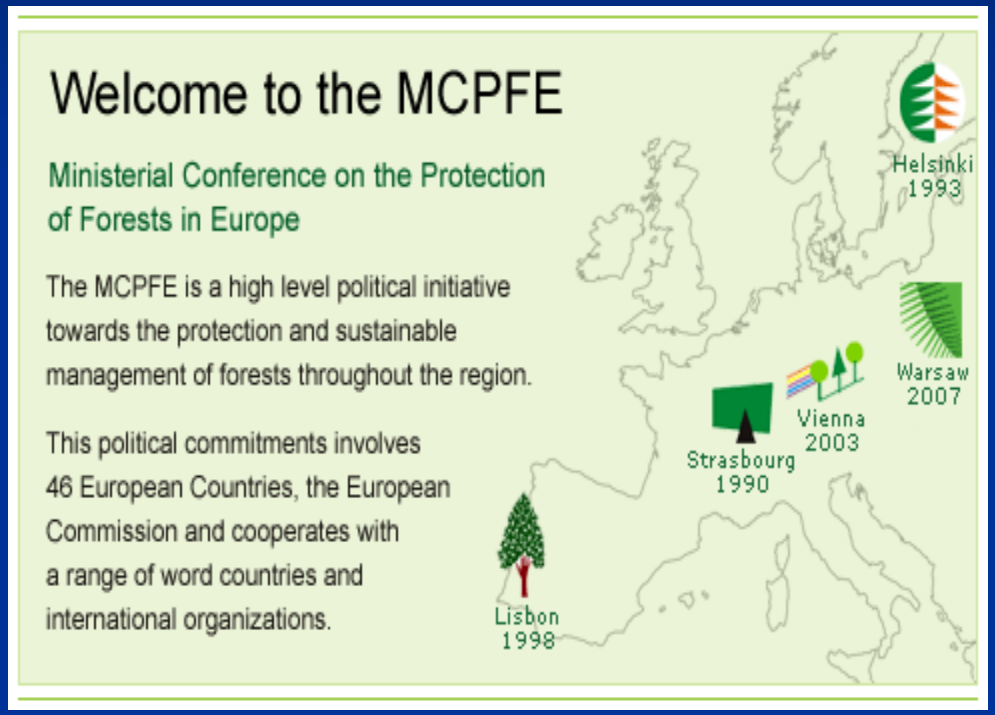
- Seven criteria and 67 indicators applicable to temperate and boreal forests were identified as important to sustainability.
- Member countries are: Argentina, Australia, Canada, Chile, China, Japan, Republic of Korea, Mexico, New Zealand, the Russian Federation, the United States of America and Uruguay.
- These countries on five continents represent 90 percent of the world's temperate and boreal forests and 60 percent of all forests. (The countries account for about 45 percent of world trade in wood and wood products and 35 percent of the world's population.)

Montreal Process …

Montréal Process Working Group Meetings:

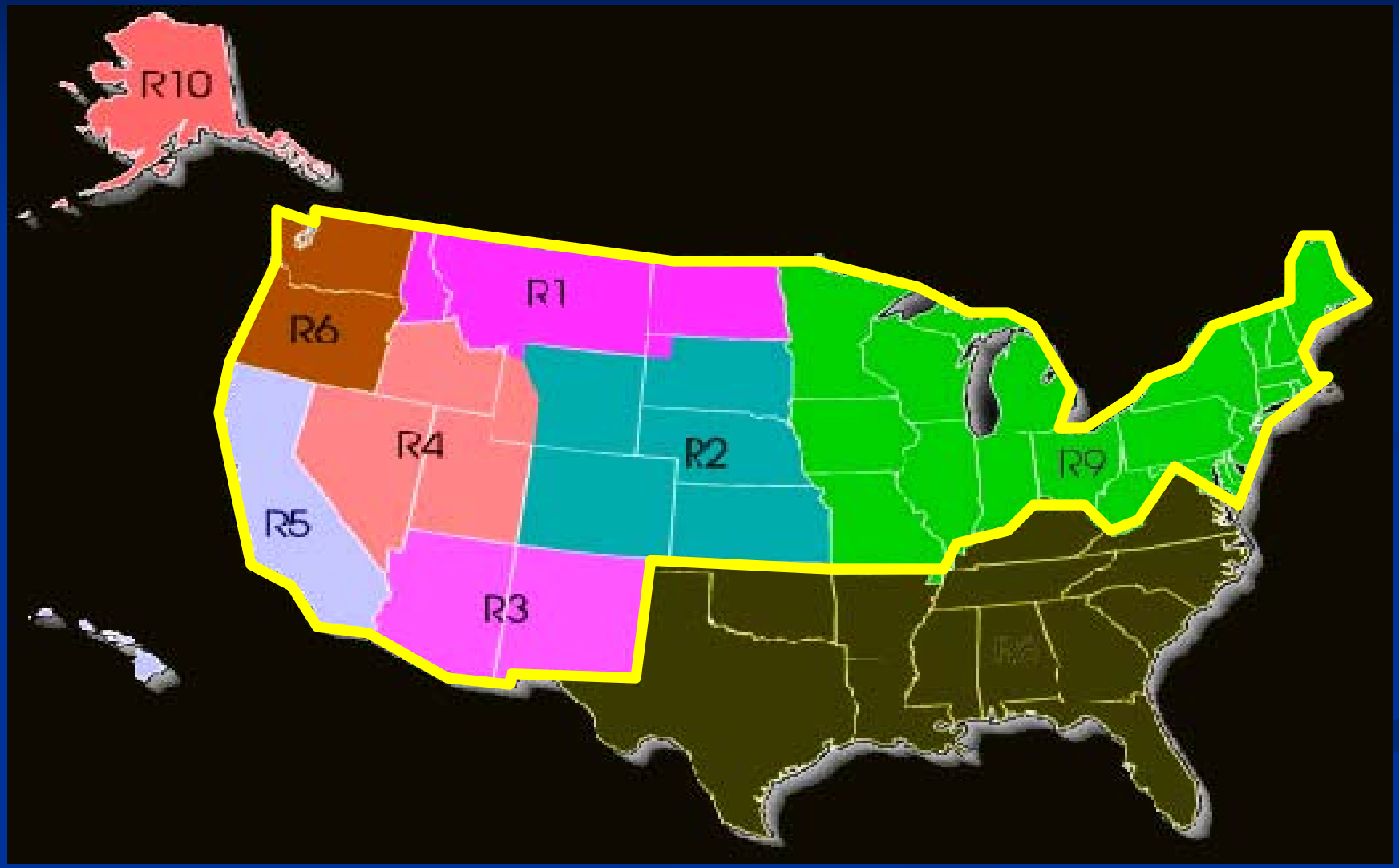
July 24-28, 2006	Seventeenth Meeting, Sapporo, Japan
October 18-23, 2004	Sixteenth Meeting, Edmonton/Jasper, Canada
September 2003	Fifteenth Meeting, Québec City, Canada
April 2003	Fourteenth Meeting, Montevideo, Uruguay
November 2001	Thirteenth Meeting, San Carlos de Bariloche, Argentina
November 2000	Twelfth Meeting, Beijing, People's Republic of China
November 1999	Eleventh Meeting, Charleston, SC, USA
October 1998	Tenth Meeting, Moscow, Russian Federation
July 1997	Ninth Meeting, Seoul, Republic of Korea
June 1996	Eighth Meeting, Canberra, Australia
November 1995	Seventh Meeting, Auckland, New Zealand
February 1995	Sixth Meeting, Santiago, Chile
November 1994	Fifth Meeting, Tokyo, Japan
October 1994	Fourth Meeting, Hull, Canada
September 1994	Third Meeting, Olympia, WA, USA
July 1994	Second Meeting, New Delhi, India
June 1994	First Meeting, Geneva, Switzerland

The Europe Ministerial Conference Process …



ALBANIA, ANDORRA, AUSTRIA, BELARUS, BELGIUM, BOSNIA and HERZEGOVINA, BULGARIA, CROATIA, CYPRUS, CZECH REPUBLIC, DENMARK, ESTONIA, FINLAND, FRANCE, GEORGIA, GERMANY, GREECE, HUNGARY, ICELAND, IRELAND, ITALY, LATVIA, LIECHTENSTEIN, LITHUANIA, LUXEMBOURG, MALTA, MOLDOVA, MONACO, MONTENEGRO, NETHERLANDS, NORWAY , POLAND, PORTUGAL, ROMANIA, RUSSIAN FEDERATION, SERBIA, SLOVAK REPUBLIC, SLOVENIA, SPAIN, SWEDEN, SWITZERLAND , THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA, TURKEY, UKRAINE, UNITED KINGDOM

Back to "status of integration" …

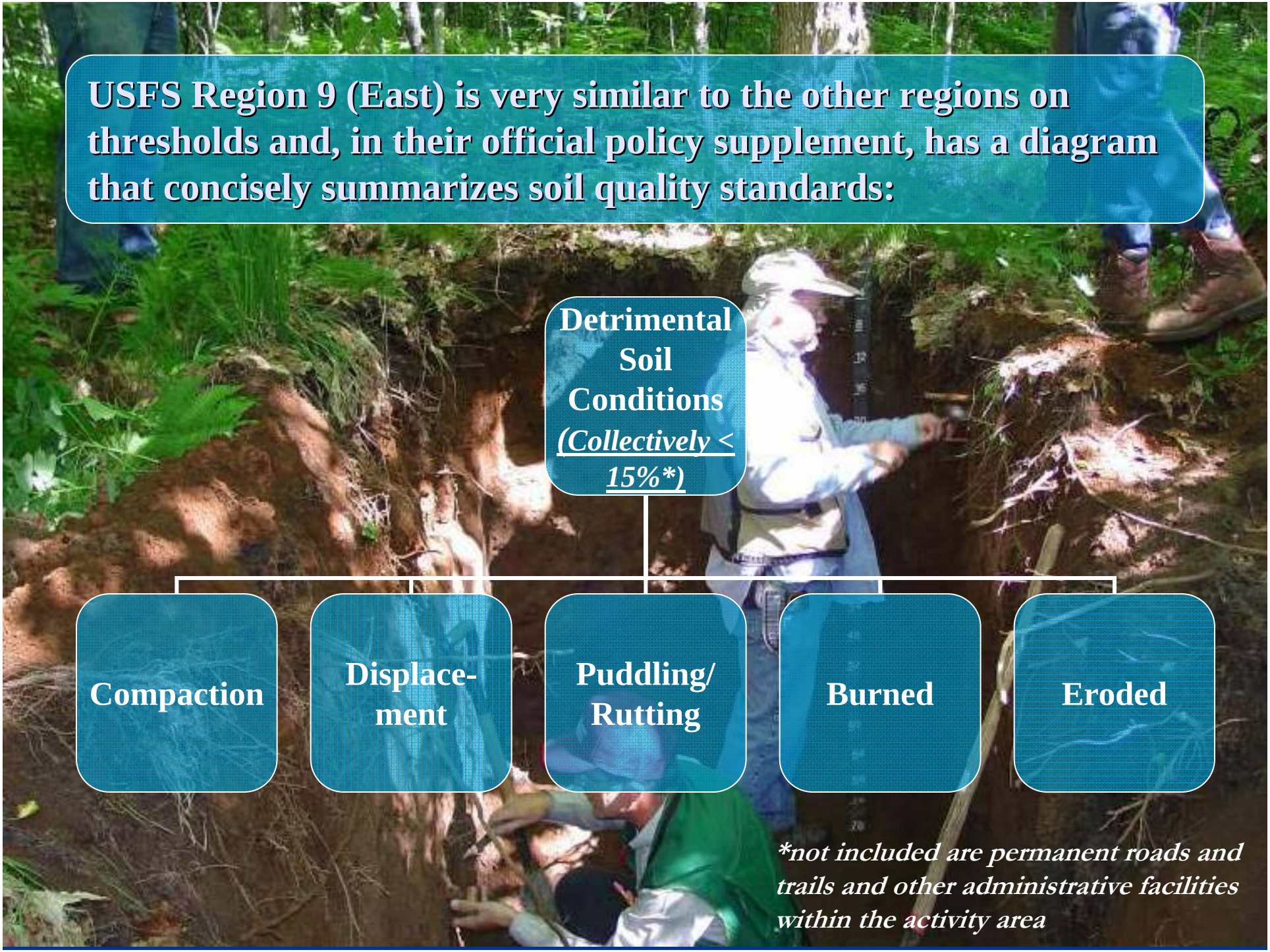


Soil quality standards comparison of USFS Regions 1 (Northern), 4 (Inter-mountain) and 6 (Pacific Northwest)

Table 8.3 USFS soil quality standards for the Northwest USA. 1: Northern Region; 4: Intermountain Region; 6: Pacific Northwest Region (from Page-Dumroese *et al.*, 2000)

Disturbance variable	USFS region	Thresholds
Soil displacement	1	Loss of 2.5 cm of any surface horizon, usually the A horizon
	4	Loss of either 5 cm or 0.5 of the humus-enriched topsoil, whichever is less
	6	Loss of 50% of the A horizon
Compaction	1	Bulk density increase of 15%, usually in the A horizon
	4	Reduction of >10% soil porosity or a doubling of soil strength
	6	15% bulk density increase (Volcanic soils: 20%)
Rutting and puddling	1	Wheel ruts at least 5 cm deep
	4	Ruts or hoof prints in mineral soil or Oa horizon
	6	Ruts to at least 15 cm depth
Erosion (surface)	1	Visual evidence of detrimental soil loss and maintenance of minimum ground cover based on local conditions (soil loss should be <2-4 t/ha/year)
	4	Establish local minimum ground cover guidelines to limit erosion (not to exceed the natural rate of soil formation)
	6	Visual evidence of detrimental soil loss and maintenance of minimum ground cover based on erosion hazard class (not to exceed the soil formation rate)
Soil cover	1	Enough cover to prevent erosion from exceeding natural rates of formation
	4	Too little to prevent erosion from exceeding natural rates of formation
	6	Less than 20% cover on sites with low erosion hazard ratings, 30% for moderate, 45% for high, and 60% for very high (for year 1 after disturbance)
Organic matter	1	Local guidelines developed based on ecological type
	4	Local guidelines developed based on ecological type
	6	Local guidelines developed based on ecological type
Burned conditions	1	Forest floor lost and A horizon has intense heating
	4	Loss of either 5 cm or 0.5 of litter layer, whichever is less
	6	Mineral soil oxidised and next 1.5 cm blackened due to charring of organic matter

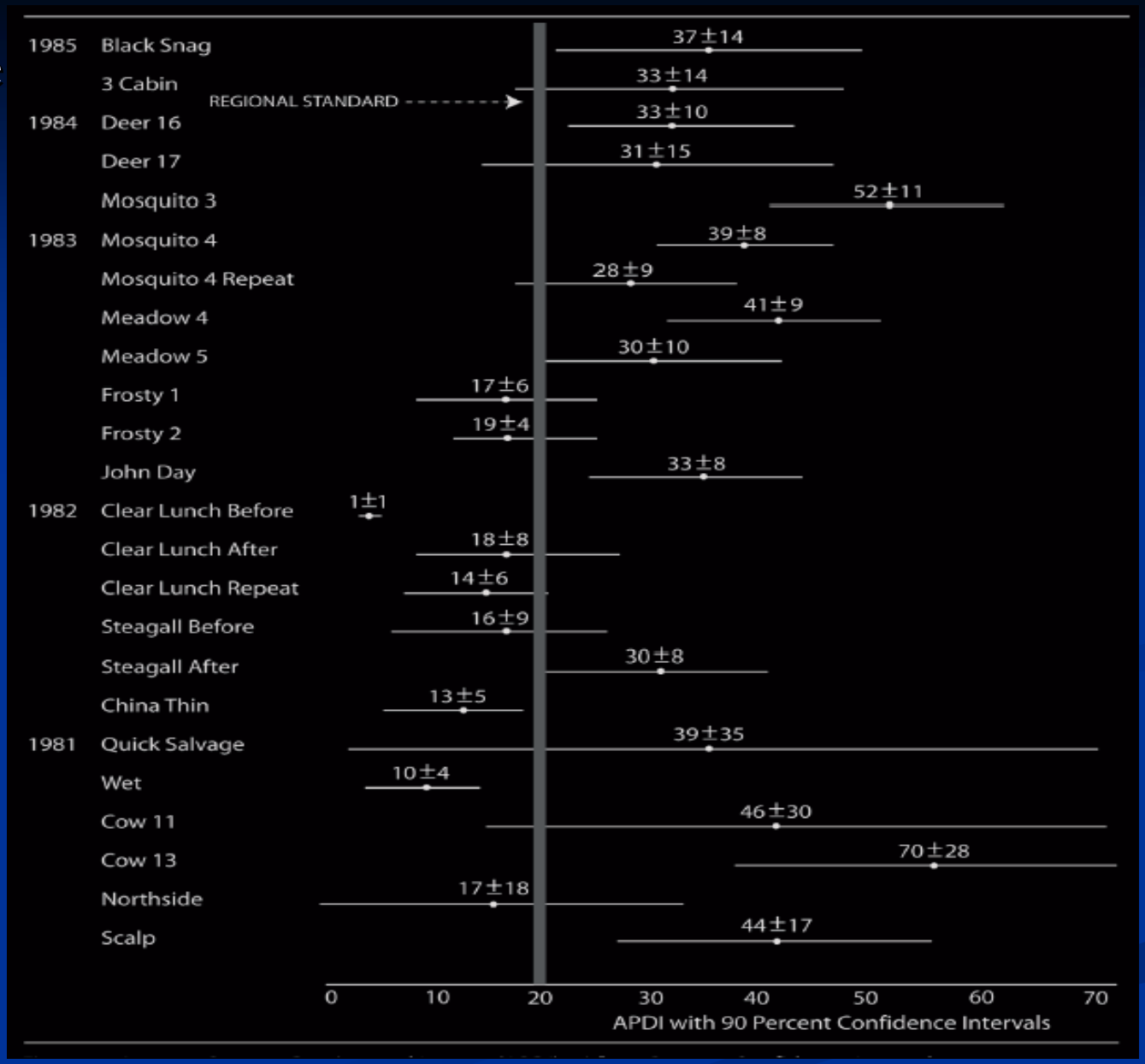
USFS Region 9 (East) is very similar to the other regions on thresholds and, in their official policy supplement, has a diagram that concisely summarizes soil quality standards:



**not included are permanent roads and trails and other administrative facilities within the activity area*

How do these standards translate on the ground?

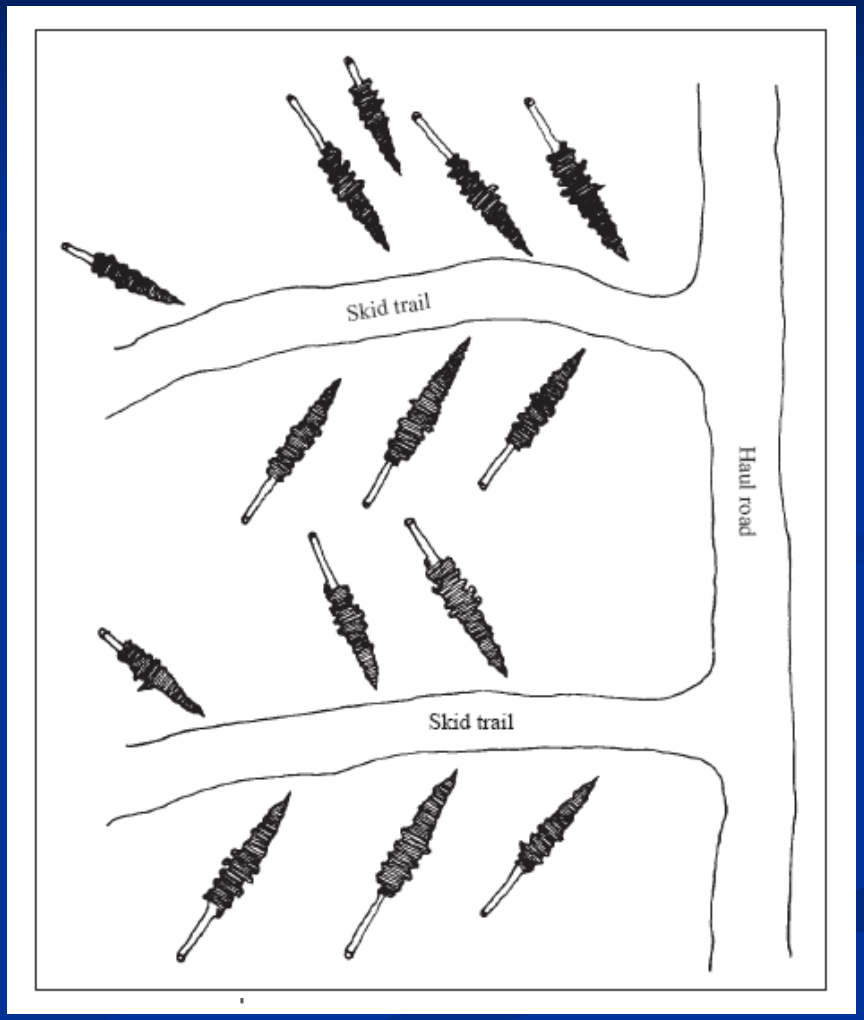
- Sullivan* compiled one of the most complete soil disturbance data sets on the impacts of ground-based harvesting systems (1981-1985) in NE Oregon …



Sullivan, T.E. 1987. Monitoring soil physical conditions on a national forest in Eastern Oregon. P.69-76 In G.W. Slaughter and T. Gasbarro (Eds.). Proc. Alaskan Forest Soil Productivity Workshop. USDA Forest Service. Pacific Northwest Forest and Range Exp. Sta. General Tech. Rep. PNW-GTR-219.

How do these standards translate on the ground?

- A classic case study (1995-1997) from the La Grande Ranger District in NE Oregon …
- "It demonstrated that operators at Limber Jim were able to meet Regional soil quality standards by keeping detrimental soil disturbance under 10 per-cent using cut-to-length timber harvest technology."



http://www.fs.fed.us/rm/pubs/rmrs_p042/rmrs_p042_929_935.pdf

Figure 10.2—Installing contour-felled logs for erosion control after a wildfire. (Photo by Peter Robichaud).

Some Closing Comments

- The Montreal and Ministerial Conference Processes have been involved with conceptual development of soil quality indicators and how to measure extent of impacts within member countries. With formulation of technical notes on each indicator (now underway), the processes will eventually progress to how indicators might work on-the-ground.

- The *costs* of soil quality degradation, meeting soil quality standards at field sites, and soil quality monitoring have to be linked to forest productivity and other environmental *benefits* … to explain and justify expenditures. Because benefit-cost validations have not reached a 'critical mass,' some agencies and private forest organizations have yet to establish national soil quality standards.

Some Closing Comments

- Can't divorce soil quality from vegetation -- ecological sites give the reference plant communities, altered states, and pathways of ecological response and transition … i.e., the scope of sensitivity expressed by vegetation to changes in soil attributes. NRCS is leading a pilot effort on "Dynamic Soil Properties" to link soil quality with changes in vegetation and forest productivity using ecological sites as a basis.

- NRCS and state forestry agencies as lead agencies working "on-the-ground" with private forest lands need to seriously consider adopting soil quality standards and incorporate the technology into ecological site descriptions, soil surveys, forestry plans, and forest practices performance requirements.

Thanks!

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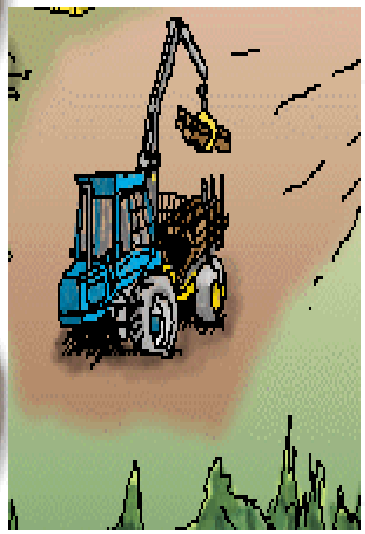
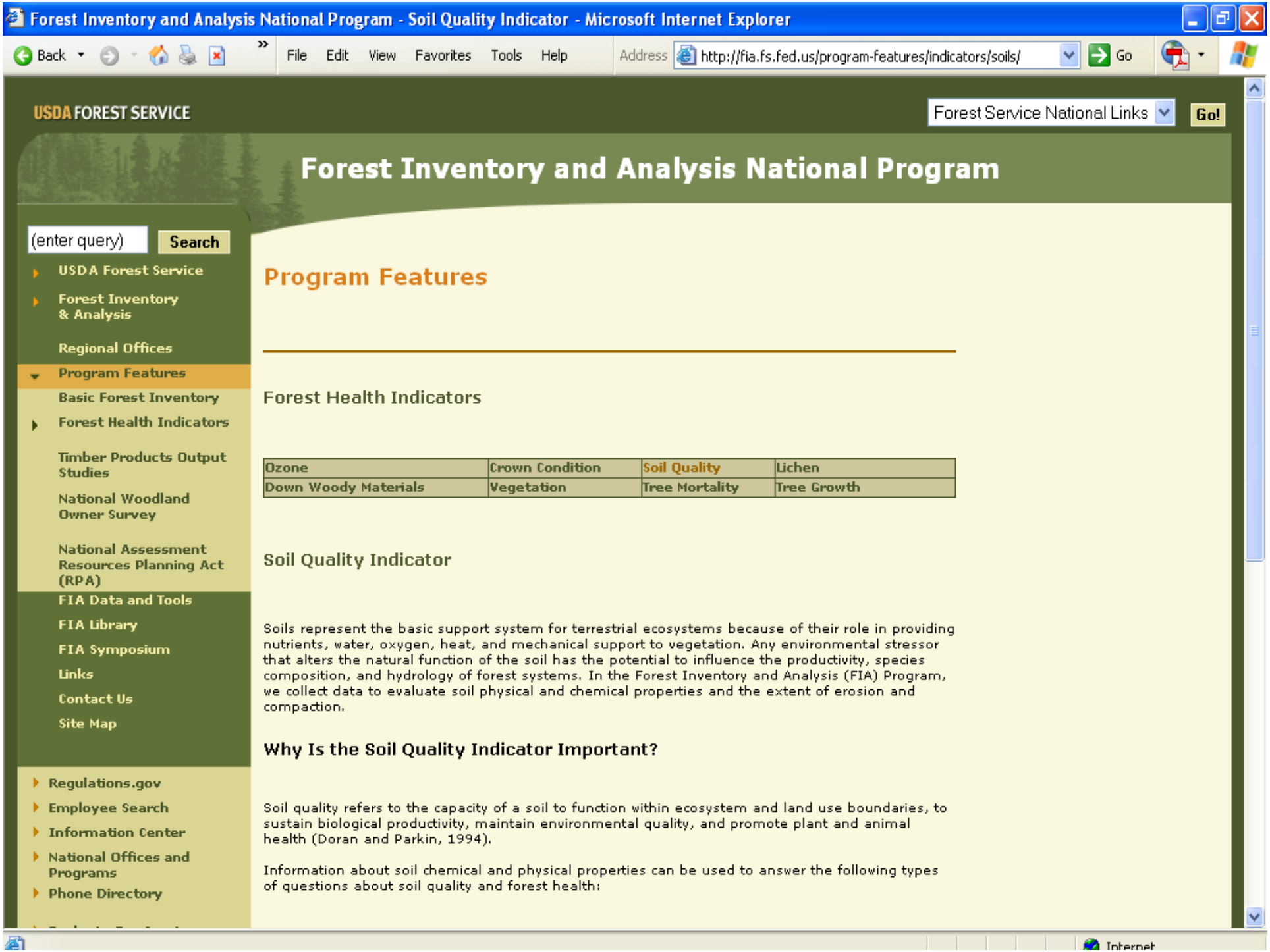


Forwarder

A Forwarder is a tracked or rubber tired machine consisting of a power plant, operator enclosure, dozer blade, articulating grapple, and a bunk to the rear. This machine usually follows the processor and picks up the cut-to-length logs, places them in the bunk and then takes the logs out of the woods and piles them at the landing. It then moves back into the woods to repeat the process. A forwarder may also be used to pick up bunched trees and forward them to the landing where a machine called a delimber is used to remove the limbs, cut off the tops, and pile the logs.


Forest Inventory and Analysis National Program - Soil Quality Indicator - Microsoft Internet Explorer
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Vegetation
Tree Mortality
Tree Growth
Soil Quality Indicator
Soils represent the basic support system for terrestrial ecosystems because of their role in providing nutrients, water, oxygen, heat, and mechanical support to vegetation. Any environmental stressor that alters the natural function of the soil has the potential to influence the productivity, species composition, and hydrology of forest systems. In the Forest Inventory and Analysis (FIA) Program, we collect data to evaluate soil physical and chemical properties and the extent of erosion and compaction.
Why Is the Soil Quality Indicator Important?
Soil quality refers to the capacity of a soil to function within ecosystem and land use boundaries, to sustain biological productivity, maintain environmental quality, and promote plant and animal health (Doran and Parkin, 1994).
Information about soil chemical and physical properties can be used to answer the following types of questions about soil quality and forest health:
Internet

U.S. Environmental Protection Agency

Environmental Monitoring & Assessment Program

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The Environmental Monitoring and Assessment Program (EMAP) is a research program to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP's goal is to develop the scientific understanding for translating environmental monitoring data from multiple spatial and temporal scales into assessments of current ecological condition and forecasts of future risks to our natural resources.

EMAP aims to advance the science of ecological monitoring and ecological risk assessment, guide national monitoring with improved scientific understanding of ecosystem integrity and dynamics, and demonstrate multi-agency monitoring through large regional projects. EMAP develops indicators to monitor the condition of ecological resources. EMAP also investigates designs that address the acquisition, aggregation, and analysis of multiscale and multitier data.

Web Site Statistics

Related Links

- EMAP Symposium 2007 - April 10-11, 2007, Washington, DC
- Ecological Condition of OR and WA Estuaries
- MAIA Flowing Waters Report
- EMAP Western Streams and Rivers Statistical Summary
- Great Rivers Reference Condition Workshop - Presentations are now available
- EMAP Marine Benthic Species Data in the Ocean Biogeographic Information System
- EMAP Data in STORET (Use ORG ID EMAP-CS)

Last updated on Wednesday, July 11th, 2007.
http://www.epa.gov/emap/index.html
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