THE NATIONAL SOIL DRAINAGE INDEX MAP
A FACTOR IN FOREST HEALTH RISK ASSESSMENT
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Background
With the widespread availability of published Natural Resources Conservation Service (NRCS) maps in digital format, resource managers can now begin to incorporate soilscape analysis into risk assessment exercises. Recent work, including the compilation of the National Insect and Disease Risk Map (NIDRM) by the USDA Forest Service, State and Private Forestry Area, Forest Health Protection Unit, has demonstrated the significance of soils and soil patterns in risk analysis. In particular, patterns related to soil water content, both the excess and scarcity of, are often a primary factor related to tree stress, and thus to insects and diseases (Elliott and Swank 1994, He and Richard 2000). Current measures available from the NRCS soils data, such as available water holding capacity (AWC), do not adequately describe natural soil wetness because they only reflect the soil’s ability to retain and release water to plants, not the long-term mean amount of water that is actually in the soil. In order to address this data gap, a soil drainage index (DI) was used in the construction of the 2006 National Insect and Disease Risk Map (NIDRM). Of the ten primary contributions to the NIDRM risk decline, southern pine beetle, gypsy moth, IPS beetle, and hardwood decline have DI as a significant factor in their models.

What is the Drainage Index or DI?
Originally named the “natural soil wetness index” (Schaetzl 1986), the DI is a measure of the long-term wetness of a soil. It indicates the amount of water that a soil contains and makes available to plants under normal climatic conditions. It is not meant to mimic the concept of “plant available water”, which is mostly dependent upon soil texture. The DI only loosely/secondarily takes soil texture into consideration. The main factors affecting DI are the depth to the water table, soil moisture regime and volume available for rooting, and (lastly) texture. Therefore, the DI is calculated from the soil’s taxonomic subgroup classification in the US system of Soil Taxonomy, along with its textural family and slope class. The DI concept was first initiated by Hole (1978) and Hole and Campbell (1985), and expanded upon by Schaetzl (1986). The DI ranges from 0 to 99. The higher the DI, the more water the soil can supply to plants. Soils with a DI of 99 are, essentially, open water. A soil with a DI of 1 is thin and dry enough to almost have bare bedrock. Because a soil’s taxonomic classification is not (initially) affected by such factors as irrigation or artificial drainage, the DI does not change as soils become irrigated or drained (unlike the long-term effects of this involve a change in the soil’s taxonomic classification). Instead, the DI reflects the soil’s NATURAL wetness condition. Each soil SERIES has, in theory, its own unique DI. Some soil suites span two or more drainage classes, and thus may have more than one DI.

References:

Examples of Risk Maps which include Drainage Index (DI) as factors

Available Water Holding Capacity (AWC) Map
based on Soil Texture

Drainage Index (DI) Map
based on The Depth to the Water Table, Soil Volume available for rooting and Slope

Some regions seem too wet or too dry on the AWC map. Tree stress is not adequately represented.

Too Wet

Too Dry

AWC
DI

The DI map is a better relative measure of natural soil wetness which makes it a more effective tool for identifying areas of tree stress.

Legend
Risk of mortality
Basal area loss (sq. ft./acre)
Water

National 2006 Composite Insect and Disease Risk* Map

Oak Decline Model Outline

Potential Basal Area Lost
Oak Decline

DI Map
based on The Depth to the Water Table, Soil Volume available for rooting and Slope

Acres at risk: Approximately 58 million

Total BA NEW
RO BA
Oak FTC
Mean DBH
Precip
RO Pct BA
Aspect
Soil Drainage Index (DI)
Reclass
Weighted Overlay
Arithmetic Overlay
Weighted Overlay
Reclass
Reclass
Reclass
Reclass
Reclass
RO Vulner
RO BA Lost
% Forest Lost (ROD)
RO Suscept
Mean DBH
Reclass
DI Reclass
Precip Reclass
RO Pct BA
Reclass
Aspect
Reclass

Potential Basal Area Loss*
Oak Decline

*The potential basal area loss per acre for all hosts affected by an agent.

770.7 million sq. feet

Legend
Basal area loss (sq. ft./acre)
1 - 9
10 - 25
26 - 168
Forested Lands
Host data gaps in tree mortality and growth

Soil Drainage Index (DI)

Rock, Pits, Other (0)
Very Dry (1-6)
7-15
16-22
23-28
29-34
35-40
41-46
47-51
52-58
59-73
74-86
87-93
Very Wet (94-98)
Water/Playas (99)