Soils and Environmental Quality

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September 15, 2010
Short Outline

• What do soils do for us?
• Soils and environmental quality.
• What are soils?
• What is a “California soil”?
• What is soil quality?
• Conclusions
What do soils do for us?

- Grow food, fiber, biofuel (maybe)
- Substrate for waste disposal
- Filters water
- Substrate for building structures
- Basis for all natural terrestrial ecosystems--ecosystem services
What are the “environmental services” soils provide?

• Water
• Air
• Nutrients
• Support for plants
• Biological community (good and bad)
Soils and Environmental Quality?

Davis

San Joaquin Valley

Mali, West Africa

Lancaster area
Soils and Environmental Quality?
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Iowa gully

Yolo county rill erosion

Confluence, American and Sacramento rivers

Redwood National park
Soils and Environmental Quality?

Image from the California Legislative Analyst’s Office
What are Soils?

“A three dimensional, porous, environmental buffer”

The excited skin of the earth!
Pedons--the three-dimensional soil individual
Soil characteristics

• Three phase system
  – Solids
    • Inorganic
    • Organic (living and dead)
  – Liquids
    • Soil solution
  – Gases
    • Nitrogen, oxygen and carbon dioxide
Soil Components

Air spaces

Water in Pores

Mineral Matter
sand, silt, clay

Solids

Variable

Liquids and Gases ~50%

Organic Matter
Biodiversity

1 m² soil

>10000 bacterial and fungal types

100-1000 invertebrate species
The Soil Food Web

First trophic level: Photosynthesizers
Second trophic level: Decomposers, Mutualists, Pathogens, parasites, Root-feeders
Third trophic level: Shredders, Predators, Grazers
Fourth trophic level: Higher level predators
Fifth and higher trophic levels: Higher level predators

Plants
Shoots and roots

Organic Matter
Waste, residue and metabolites from plants, animals and microbes.

Fungi
Mycorrhizal fungi, Saprophytic fungi

Protozoa
Amoebae, flagellates, and ciliates

Nematodes
Root-feeders
Shredders
Fungal- and bacterial-feeders
Predators

Arthropods
Shredders
Predators

Bacteria

Animals

Birds
What is a “California” soil?

• Before defining soil quality, we need to answer this question.

• Trick question---no such thing exists.
California is a land of great contrasts.

Geology
Landscapes
Climate
Plants
Agriculture
Cities
People
Diverse parent material because California is at the edge of a continent and the continents are moving.
Enormous climate variability.
North coast precipitation distribution example
Desert precipitation distribution example
Vegetation reflects the diversity of geology, topography and climate.
Soil Development

California parent materials vary in age from recent to ancient.
Soil Quality?

“The capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation” Soil Science Society of America

An “unofficial” definition. Can a soil be managed to produce a product with minimum environmental damage? Is the land use sustainable?

Let’s look at some examples.
Defining Soil Quality

What soil properties define soil quality?

How does one quantify soil quality?

How does one combine quantitative measures of soil quality?
What is Soil Quality?
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Soil/Land Capability?

• Many measures of land capability exist to help land managers make land use decisions.
• USDA Land Capability Classification
• Storie Index
• Site Index for forests
Conclusions

• Soils are thin covering on the earth’s surface that support life at varying scales.
• Soils are three phase systems, solids, liquids and gasses.
• Soils are highly variable because they form under different climates, vegetation, landscapes, on different parent materials and over different time periods.
• Soil quality is difficult to define and nearly impossible to quantify.
• Many systems exist for rating soils for agricultural capability that will work for helping to select areas for biofuels and for managing the soils that are selected.