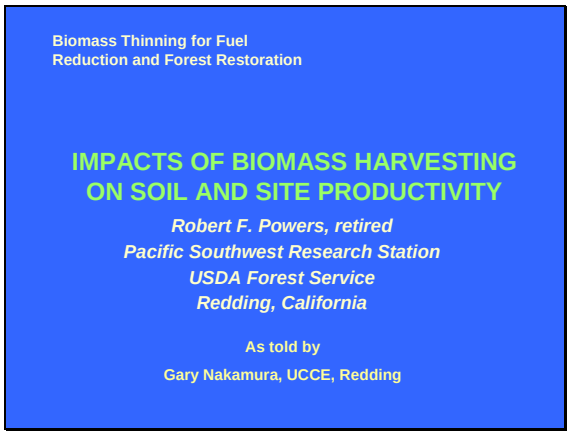

Woody Biomass Utilization Workshop
May 25 and 26, 2010 Quincy, CA

Impacts of biomass harvesting on soil and site productivity

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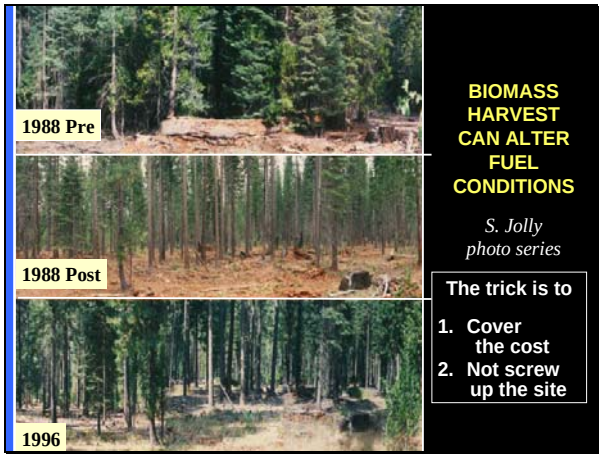
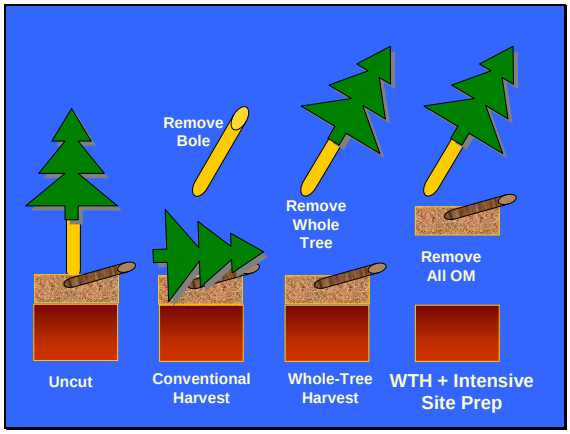


Biomass harvesting can generate income to cover treatment costs depending upon chip markets, distance to powerplant. Biomass harvesting has the potential to damage site productivity and functions.

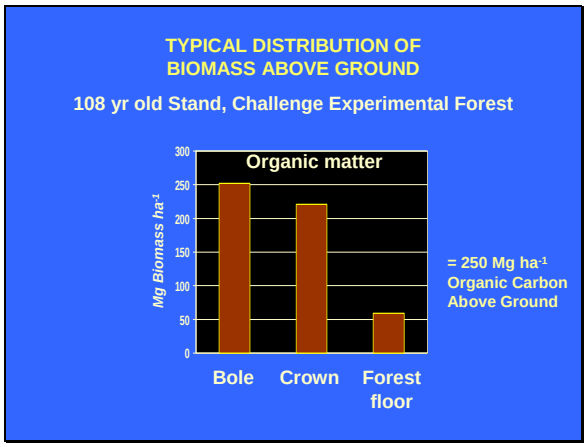
By removing nutrients

By compacting the soil

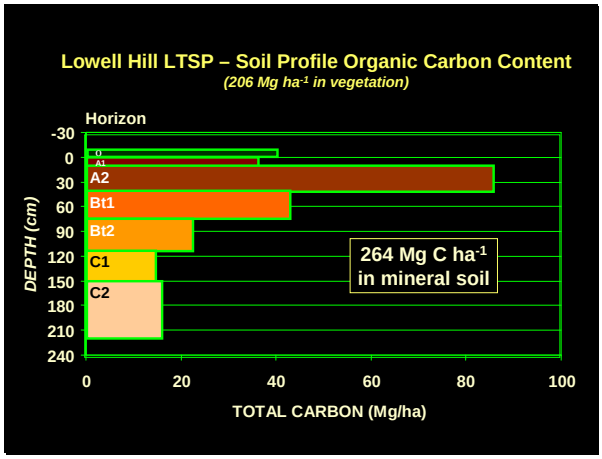
By removing organic matter



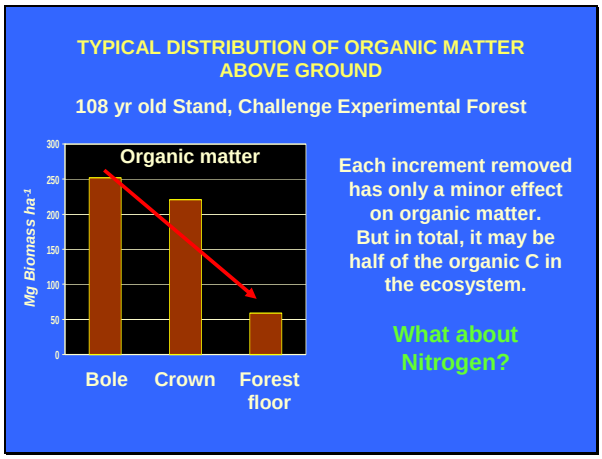
We will look at three levels of biomass removal and their effect on nutrients, compaction, and soil organic matter.



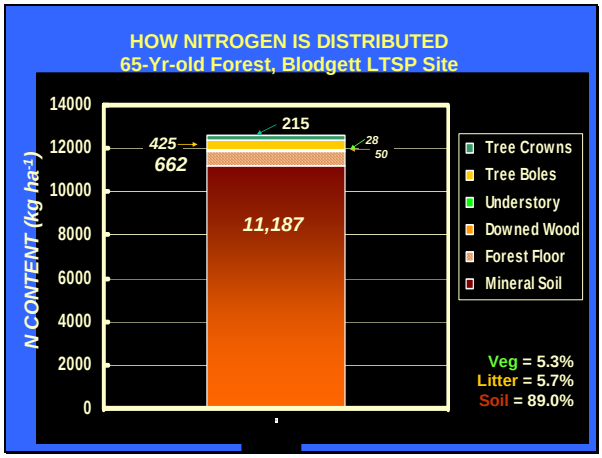
Above ground biomass distribution in a high productivity Sierra Nevada mixed conifer site. 500 metric tons/ha (225 tons/ac) above ground biomass, 250 metric tons carbon/ha.



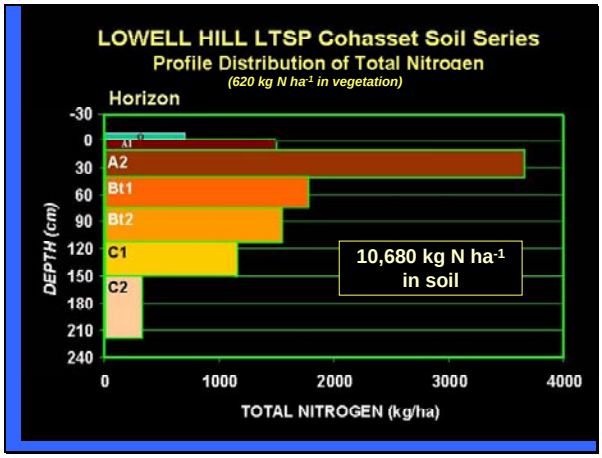
Carbon distribution in a forest soil. Organic matter and C is concentrated in the surface 60 cm (2 ft), topsoil. About equal to above ground C, 260 metric tons/ha



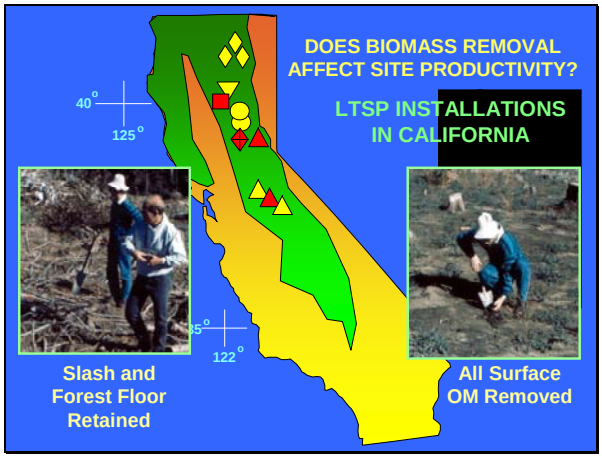
Removing stem (logs) only removes 50% of above ground organic matter, 25% of total ecosystem organic matter. Harvesting stems, leaves, branches and forest floor removes 50% of the total ecosystem organic matter.



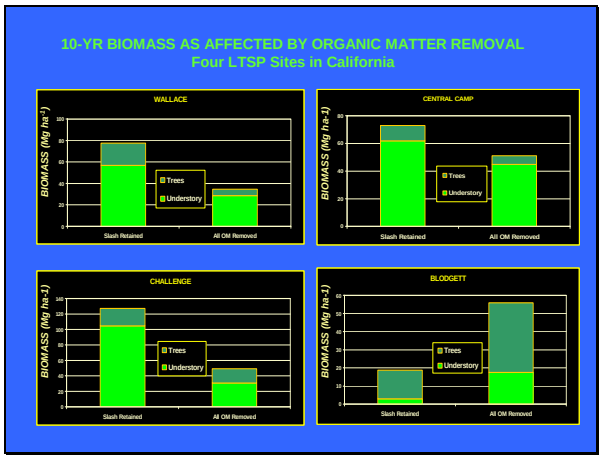
Nitrogen (proxy for fertility) distribution in a high productivity Sierra Nevada mixed conifer forest. 5% of total ecosystem N is in the above ground vegetation, 5% in the forest floor, and 90% in the soil.



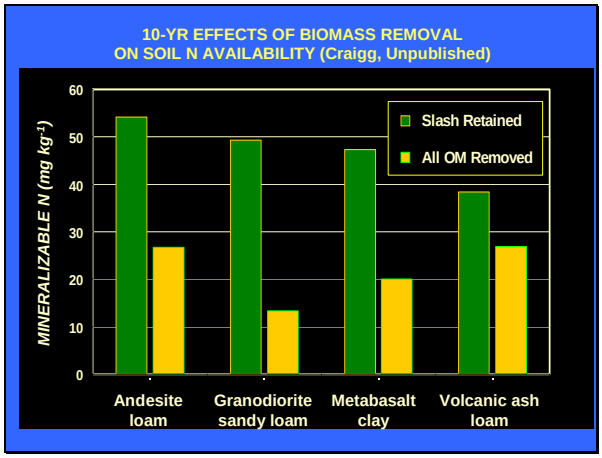
Distribution of N in a high productivity mixed conifer soil. Concentrated in the surface 30 cm, 1 foot, topsoil.



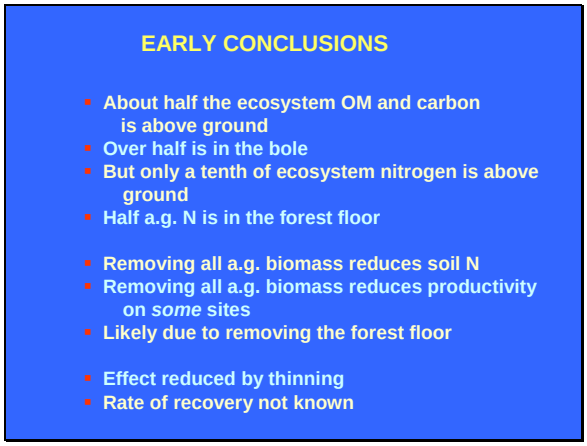
Long-term soil productivity study (LTSP) sites in California. 60 sites – SE US loblolly pine, BC aspen and conifer, Missouri oaks, shortleaf pine, California conifers. Three levels of OM removal, stem only, whole tree, whole tree and forest floor; three levels of compaction, none, moderate, severe.



10-year biomass production. Stem only removal produced more biomass than total OM removal, except at Blodgett Forest. Allocation of biomass production to trees and understory (shrubs) – on three sites most of the biomass production was in shrubs. Again, Blodgett was the exception with most of the biomass growth in the tree component. Total site prep at Blodgett allowed the conifers to dominate the site, while at the other sites, total site prep reduced both shrub and tree growth. Tree biomass production was comparable among all the sites, 10 to 20 MT/ha.



Mineralizable N varied with soil type and organic matter removal.



Compaction effects on productivity. Compaction levels from none (no equipment impact) to severe (actively compacted).

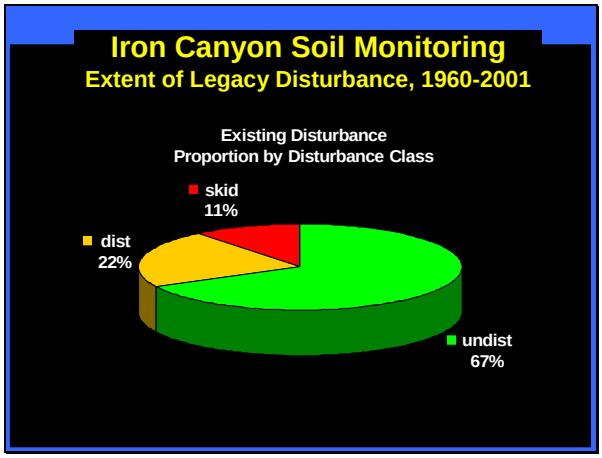
Iron Canyon Late Seral Reserve thinning. Shasta County. Legacy of skid trails from 1960s logging.

Findings from the 2002 soil quality survey at the Iron Canyon Late Seral Reserve unit thinned in spring-summer 2001

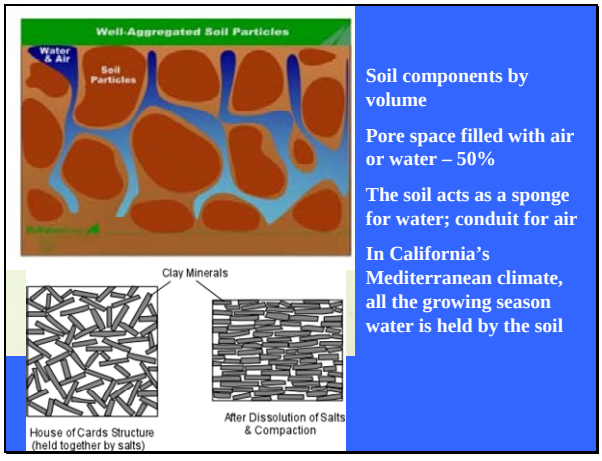
The unit was surveyed on May 2, 2002, and characterized by three soil disturbance classes:

- Low disturbance (forest floor completely intact)
- Moderate disturbance (forest floor disturbed, no skid trails or soil displacement)
- Heavy disturbance (skid trails or ruts, litter heavily disturbed, soil exposed and/or displaced)

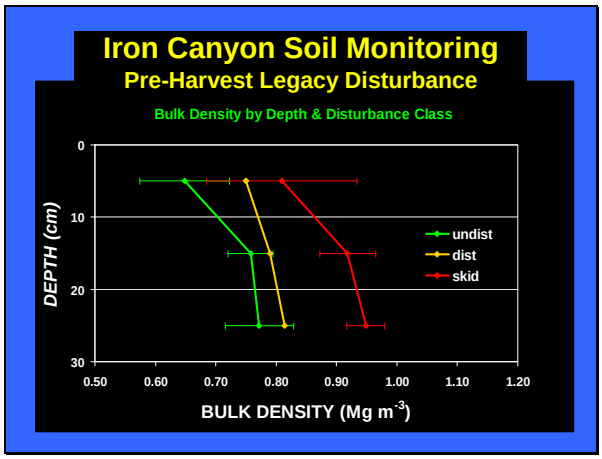
Three soil disturbance levels determined by visible surface disturbance – litter displacement, soil displacement and exposure, ruts.



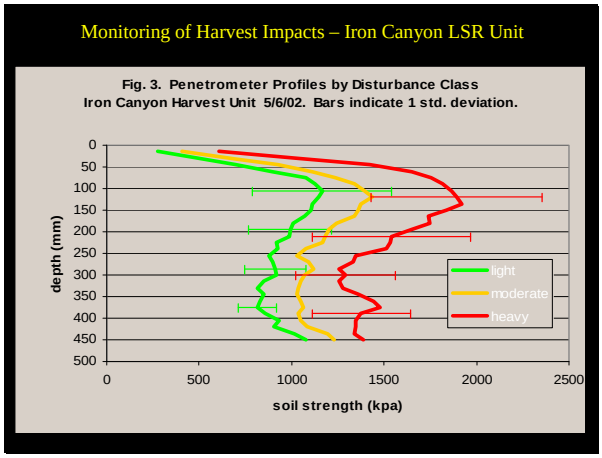
Pre-harvest soil disturbance distribution. Legacy from 1960s logging.



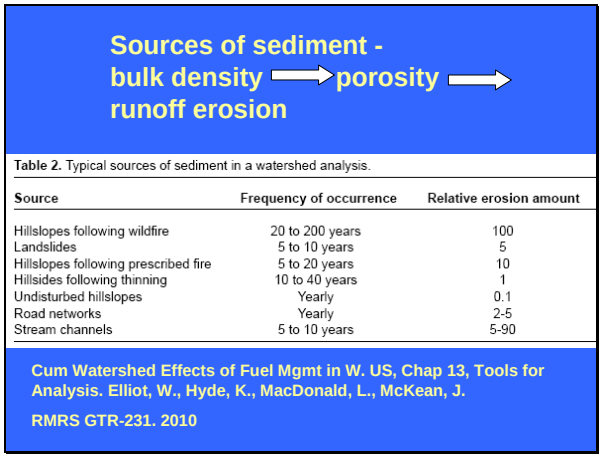
Soil structure – a soil is like a sponge, comprised of 50% solid mineral particles (sand, silt, clay) and 50% voids or space between the mineral particles. This space is filled with water and air. The larger pores hold soil water which comes in the winter, for use by the plant during the dry, growing season in California. Compaction reduces the amount of pore space available to hold water and thus reduces the water available to plants during the growing season.



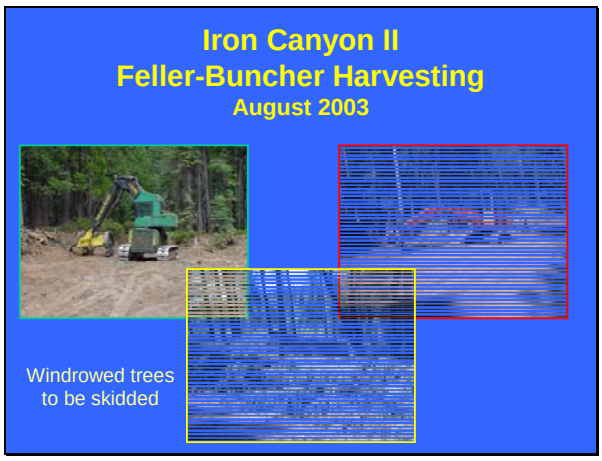
Soil bulk density by depth and disturbance class. Bulk density increase results in reduction of macropore space and waterholding capacity, and water infiltration rates.



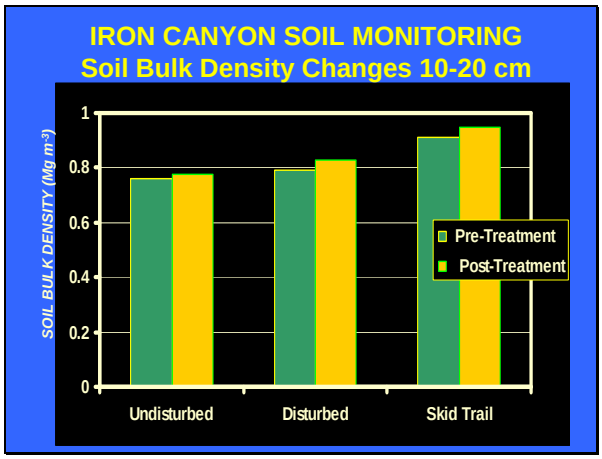
Soil strength by disturbance class. 2500 kpa, threshold for restricting root penetration.



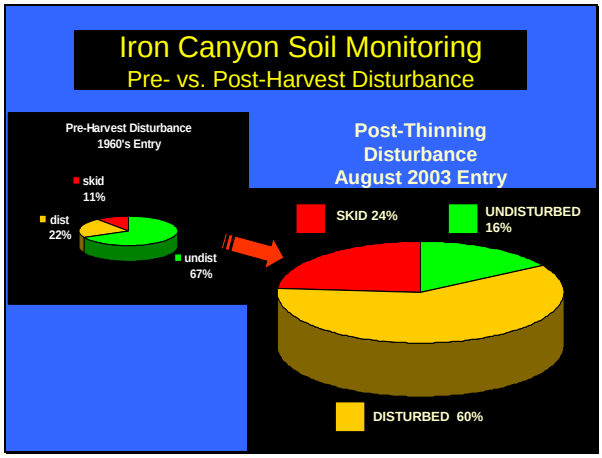
Compaction can affect soil porosity, water infiltration, surface runoff and erosion. Hillsides following thinning presumably have compacted skid trails. Thinning is less an erosion problem than wildfires, prescribed fires, or roads. Surface cover is the most important factor in soil erosion.



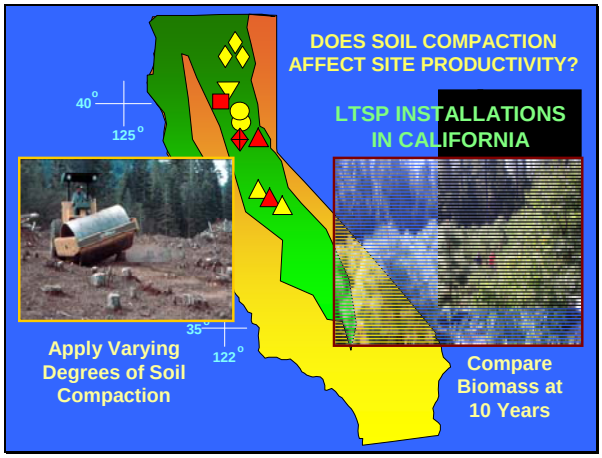
Feller-bunching equipment used in the Iron Canyon thinning



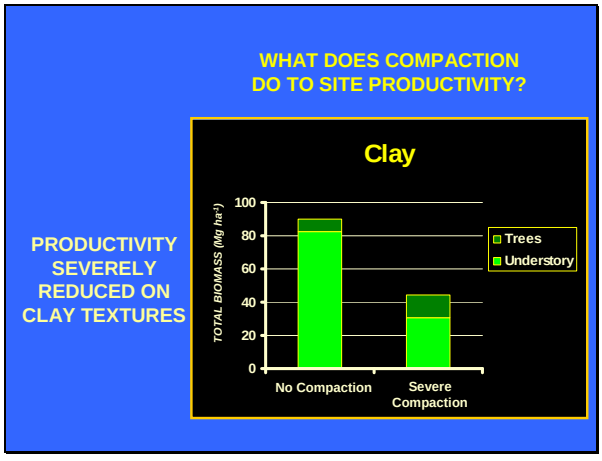
Bulk density by disturbance class



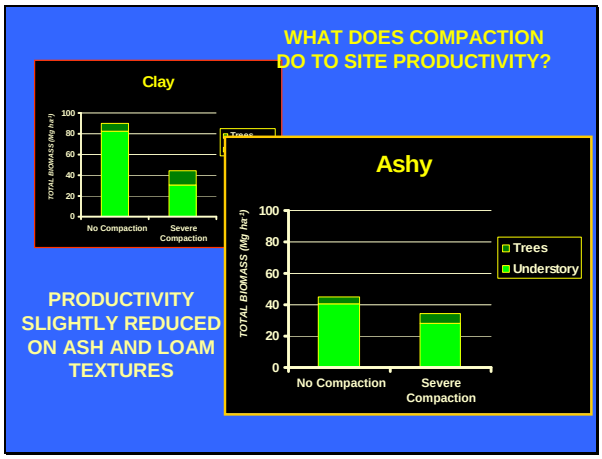
Thinning operations increased the area disturbed, increasing bulk density, and increasing potential for surface runoff and erosion, reduced root penetration, reduced aeration, and reduced productivity.



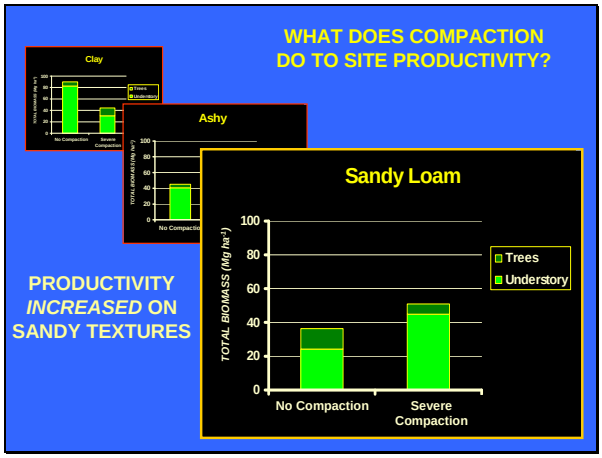
Effect of soil compaction on site productivity



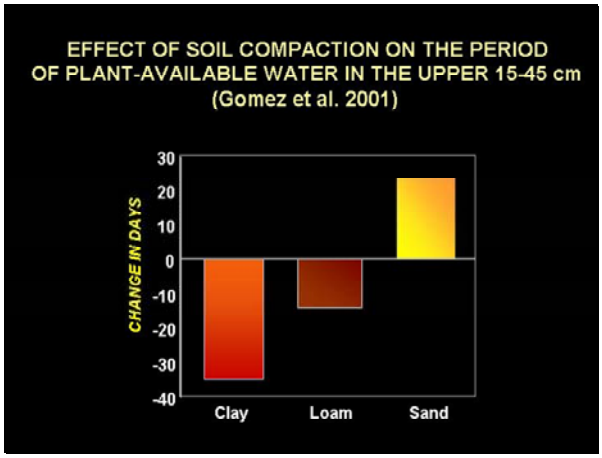
Total biomass production on clay textured soils is decreased by severe compaction. However tree biomass is increased with compaction, perhaps because of decrease in competition, shrub biomass, due to germination difficulty on hard soils.



Biomass productivity is slightly reduced on loam and ash textured soils, again with an increase in the tree biomass with severe compaction and reduced understory vegetation (competition).



Biomass productivity increases on sandy textured soils. However, tree biomass reduced when understory biomass increases. Increase in biomass production may be the result of increasing waterholding capacity of the soil by decreasing soil pore size.



Effect of soil compaction on available soil water