British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

The Scottish Forestry Trust

Soils under Forests: What's the difference?

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Forest soils develop under natural conditions by the influence of permanent vegetation over a long period of time. They occur on many different types of geology and the presence of forests influence soil development in the following ways:

Aeration and Drainage: root growth and die-back create soil pores of varying sizes that aerates soils and helps soils to drain and transport water to deeper soil layers.

Organic matter, nutrients and water: Forests and understorey vegetation provide organic matter by creating a litter layer on the soil surface, which then decomposes into the soil creating a surface organic layer. Below ground root biomass provides organic material at deeper soil layers. Roots of different plants permit effective uptake and recycling of nutrients and store high water contents. The type of forest also regulates soil acidity.

Regulation of soil temperature: Plant cover reduces surface albedo and organic matter has insulating properties, which regulates soil temperature to be warmer in the winter and cooler in the summer.

Soil fauna and fungi: Organic matter supports diverse soil fauna, including fungi which are essential in the process of nutrient recycling and for the transformation and movement of organic matter through the vegetation/ soil system.

Mechanical and chemical breakdown of rocks: The physical force of roots penetrating into rock fissures, break down rocks and mycorrhizal root associations dissolve rocks making nutrients available for plant growth.

All these factors create a self-regulating almost closed-cycle, transferring nutrients between soil and vegetation adapted to site conditions

These factors create a resilient environment stable for plant growth, i.e. a cool microclimate, increased evapotranspiration, good rooting conditions with good porosity and sufficient soil moisture.

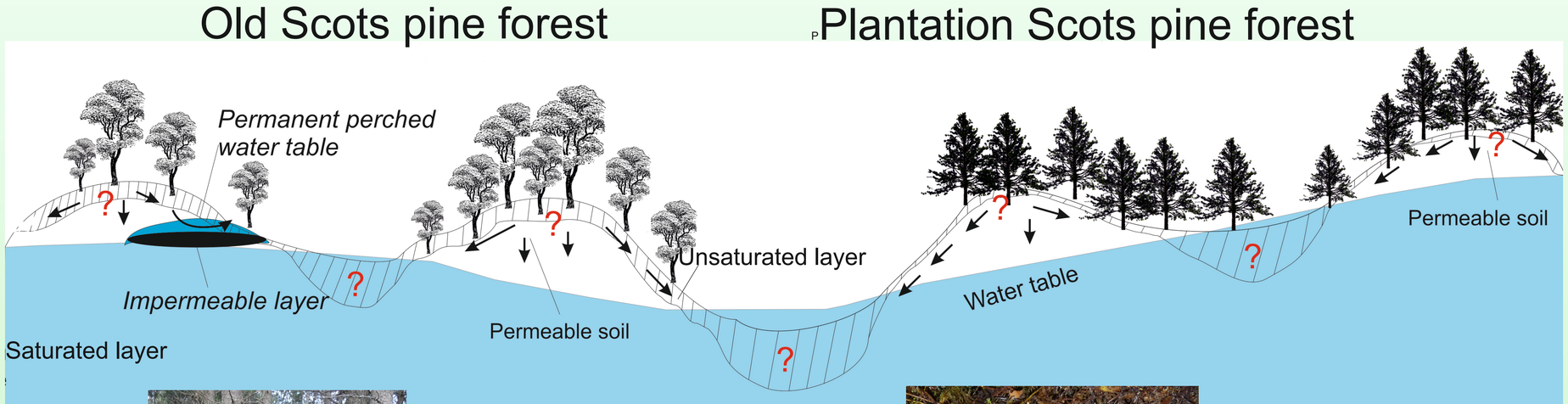
This facilitates water infiltration and prevents erosion and runoff, initiating clean water in the streams emanating from the area, a relatively smooth variation in streamflow during the year, and recharge of groundwater.

Understanding the relationship of forests and the development of soils above different superficial geology is important for better management of forests in terms of forest growth, resilience and flood mitigation. The British Geological Survey in collaboration with the Scottish Forestry Trust are investigating the development of optimum characteristics of water flow and storage under 350 old scots pines and adjacent forest plantations. The study investigates the role of glacial deposits and the development of forest soils. The study tests two hypotheses:

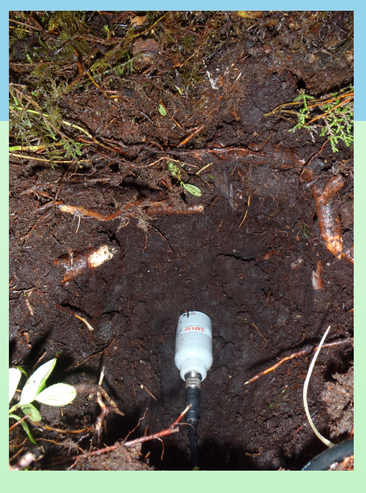
1. As the forest develops, the root system of the forest creates macropores and increases organic matter optimising water flow and storage.

2. Springs develop under mature forests because the forest interacts with and adjusts to the environment to form perched water tables in relationship with the superficial geology.

To investigate water movement below different aged forests on the same superficial geology, a 350 year old Scots pine forest and an adjacent 40 year old Scots pine plantation were chosen to investigate changes in sub-surface permeability and soil water storage and drainage as shown in the diagram. The question marks indicate measurement locations.



A Constant head well permeameter measures the rate of water that infiltrates into the soil at different depths.



Soil moisture sensors measure every 15 minutes providing information about soil hydrological characteristics and soil water movement.

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