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# Panarchy: erosion and the dynamic interactions of plants with their surroundings

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John Thorne's research and interests in vegetation and erosion focussed on the challenge of modelling the processes he was observing. In areas where there was a partial vegetation cover because of a harsh climate or disturbance by erosion processes he conceived the notion of competition between plants and erosion. This will be illustrated by examples from Alpine, Arctic, Mediterranean and Arid environments and different process regimes. Later Thornes (2008) became interested in insights that the panarchy or adaptive management framework gave him. These included showing how vegetation –erosion interactions occur at different spatial and temporal scales. This was also present in hierarchy theory and the desertification response unit idea which could be applied to explain vegetation and erosion patterns at different scales. Examples of these will be demonstrated. The aim here is to provide details about the actual processes themselves.
The main part of the paper describes the dynamic interactions and erosion that take place during the growing season on fields or during many years in forests. As Thornes imagined, two conditions can be observed, one in which usually under a canopy the vegetation seems to be on top. At other places erosion occurs. But is this negative?
The interactions involve things that are complex if the focus is on the details of the chemistry and micro-organisms of the soil but quite simple if the focus is on emergent indicators that can be used to describe and identify the competitive state and whether or not erosion is possible or likely.

What adaptive management demonstrates is that plants and vegetation are changing and managing their environment to create the conditions they need. When seeds germinate or plants grow, at a higher emergent scale , change the hydraulic and physical properties of their surroundings in an ordered and structured way creating patters. Plants influence the behaviour of animals, including man. So plants need to be able to manage and regulate water storage in the soil. A really important mechamism in this respect is to make the soil water repellent or hydrophobic. An impermeable barrier is created which keeps water out.
Investigations in Spain and Holland using rainfall simulators and Holland, as well as in many other places show that the actual expected relationships between vegetation-erosion-runoff-percolation are absent when hydrophobicity is functioning.

Examples will be shown illustrating how plants use hydrophobicity to alter soil conditions into ones that are beneficial to them. Erosion also has beneficial aspects because of the effect of sorting during deposition or the removal of toxic chemicals or too much clay. On badland slopes erosion is often a pre-requisite needed to create favourable growing conditions.

If a plant or vegetation can't survive on a slope, erosion can be very beneficial from a panarchy perspective. The soil and seeds are taken down slope where there are better conditions created by slope deposits and alluvium. Erosion is at the right time and place an inevitable consequence of soil formation and slope evolution and we can adapt to it. When it is the wrong place this is because of bad land management.