From grasses to shrubs: How plants reinforce desertification

November 5 2012

(Phys.org)—Research into how fragile dryland ecosystems degrade into deserts has revealed that the transition from grasslands to desert shrubs may be reinforced by the plants themselves. The study, conducted at the University of Bristol, demonstrates for the first time that grass and shrub areas lose very different amounts of nutrients during rainfall events, which may be significant in how desert shrubs persist in these landscapes.

Desertification – the reduction in fertility of dryland areas caused by human activities or climatic changes – is a significant global issue. Dryland environments occupy 41 per cent of the Earth's surface and are home to one third of the world's population. It is estimated that up to 12 million square kilometres are affected by desertification and the 250 million people around the world who rely on drylands for their livelihoods are directly impacted.

Previous research has shown that shrubs accumulate nutrients below their canopies in mounds known as 'islands of fertility' which allow shrubs to survive in harsh desert conditions. This recent research shows that during rainstorms the fragile grassland areas lose double the amount of total nitrogen and phosphorus than the shrubland areas for the same runoff and erosion rates. In particular, the research found that the eroded sediment was the dominant carrier of nutrients – a component that has so far been neglected in previous research.

Dr Katerina Michaelides, a senior lecturer in hydrology at the University of Bristol, and lead author on the paper said: "If we think of a degrading dryland landscape as a mosaic of grass- and shrub-covered areas, then if grasslands are consistently losing high amounts of nutrients and the shrublands are conserving them, we can see how the process of desertification is continually reinforced through replacement of grasses with shrubs."

The research was carried out in the Jornada Basin, New Mexico, USA. The scientists conducted a series of rainfall-simulation experiments, measuring runoff, soil erosion, and associated nitrogen, phosphorus and potassium losses.

Dr Michaelides continued: "We found that grasslands tend to lose substantially more nutrients than the shrubs, even though the amount of runoff and erosion is similar. These stark contrasts in nutrient losses are due to differences in the canopy of grasses and shrubs and in the topography around them which affect the quality of the soil eroded."

This study highlights the important role of eroded sediment as a transporter of the majority of all the nitrogen and phosphorus lost from the plant communities.

"By better understanding differences in nutrient losses between grassland

and shrubland areas, and the reasons for them, any efforts to manage or reverse desertification can be much more informed and targeted," Dr Michaelides said.

More information: Lister, D. Linking runoff and erosion dynamics to nutrient fluxes in a degrading dryland landscape. *Journal of Geophysical Research – Biogeosciences*. www.agu.org/pubs/crossref/2012/2012JG002071.shtml

Provided by University of Bristol