Ecosystem engineering of *Sarcopoterium spinosum* promotes resilience to anthropogenic disturbances

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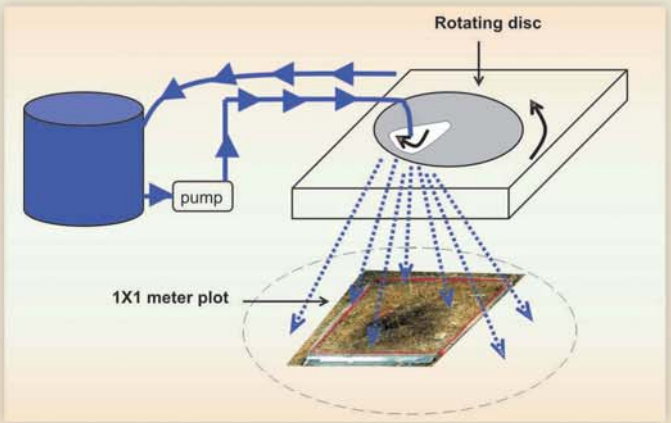
Introduction

Shrubs remain an important component of the semi-arid rangelands of the Old World despite millennia of anthropogenic disturbances, including grazing and cutting for fuel. Shrubs in water-limited ecosystems increase their resource availability by acting as a sink to water that is redistributed by crust source areas. We examined the effect of cutting the shrub *Sarcopoterium spinosum* on these source – sink relations.

Methods

The study area is located in the Goral hills, next to the Lehavim settlement in the northern Negev of Israel (31°21'52N, 34°49'46E) with an average annual precipitation of 305 mm.
We used an artificial rainfall simulator which delivers raindrops for half an hour to an area of two m^2 at a constant rate of 40 mm per hour. The size distribution and kinetic energy of the simulated raindrops are similar to those of natural rain.
Treatments were: *Sarcopoterium spinosum* with intact canopy, *S. spinosum* with removed canopy and crusts without *S. spinosum*.
During the rainfall simulation, we measured the runoff that was generated at one-minute intervals. After the simulation, we dug transects and measured the depth of water penetration in the different patches. In a different experiment, we counted the number of separate individuals per patch. We cut the canopy and after a year we counted the number of individuals that re-grew and the number of individuals that root-sprouted.

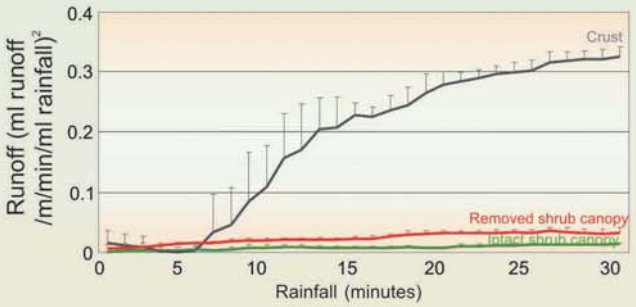


Research questions:

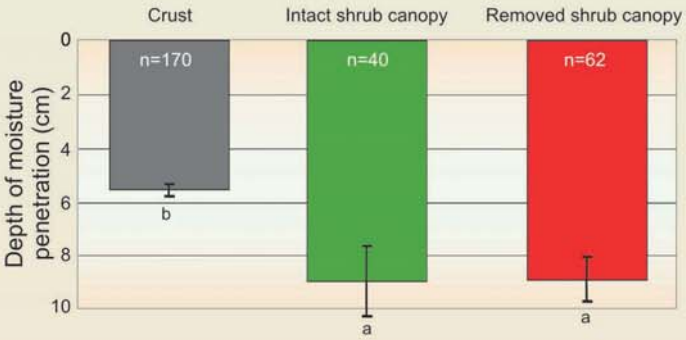
1. Is the rainfall redistributed between the crust and the *Sarcopoterium spinosum*?
2. Does redistribution of the rainfall continue after removal of the canopy?

Results

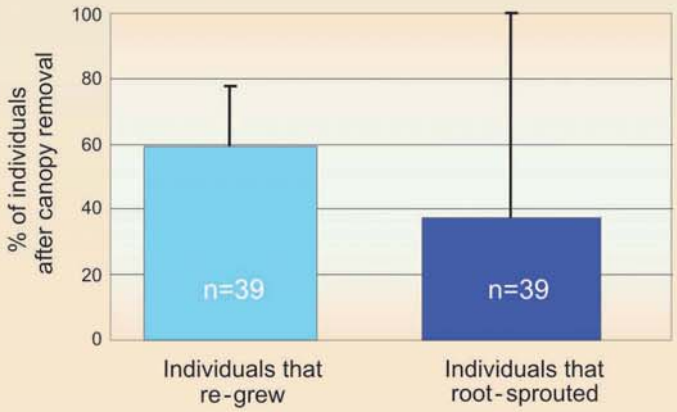
Crust generated more than 10 times more runoff compared to Shrubs, whether with intact canopy or removed canopy (ANOVA: $F_{2,10}=28.15$, $P<0.001$).



Shrubs (whether with intact canopy or removed canopy) had deeper water infiltration compared to the crust (t-test with unequal variance: $t_{122.85}=8.94$, $P<0.001$).



Over 50% of *Sarcopoterium spinosum* individuals re-grew and about 40% root-sprouted after one year. Average number of individuals per patch before removal was 14 ± 6.



Conclusions:

The rainfall is redistributed between the crust and *Sarcopoterium spinosum*, allowing the *S. spinosum* to increase the absorption of water under it. Canopy removal does not affect the redistribution of water and allows the shrubs to recover easily from the disturbance. This property provides resilience of the *Sarcopoterium spinosum* and the ecosystem to anthropogenic disturbances.

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