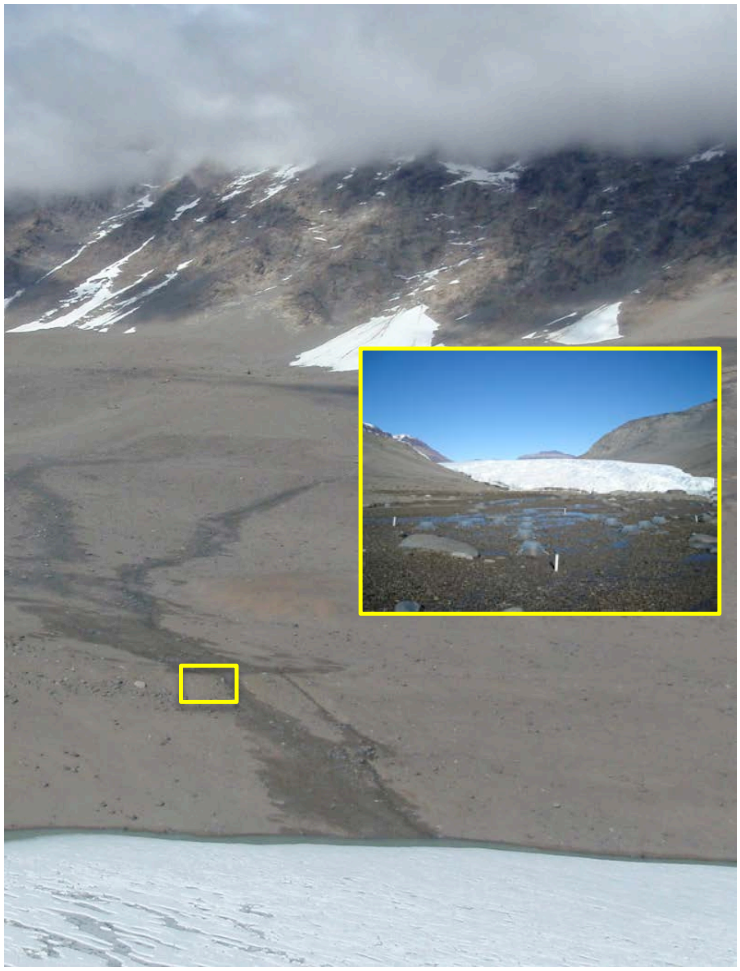
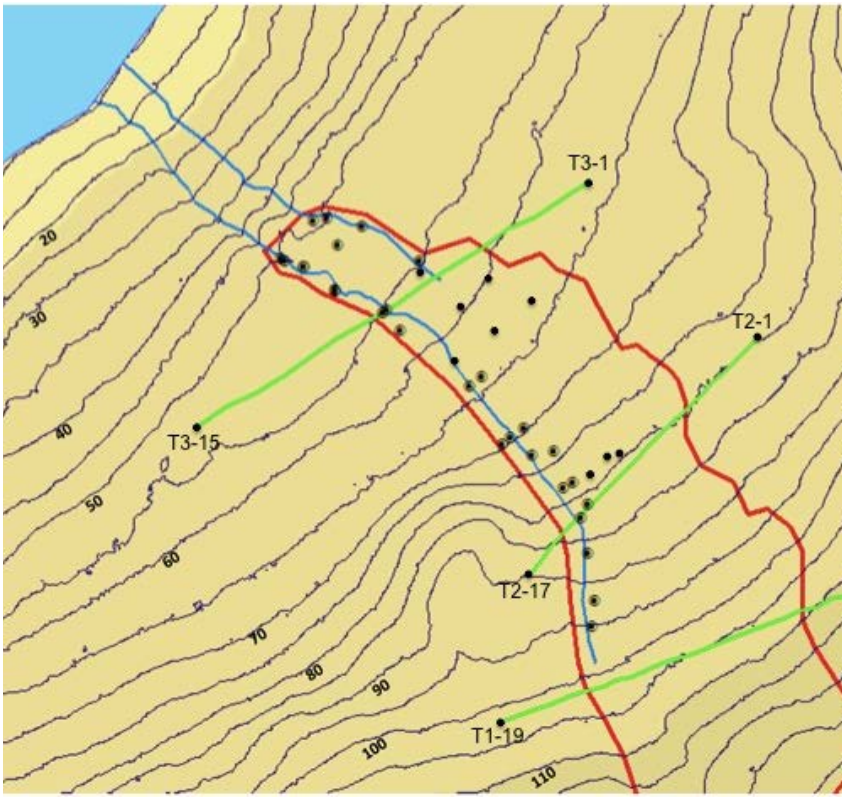
Wormherder Creek: Ecosystem connectivity and species distribution – Diana Wall



Wormherder Creek is an ephemeral stream and wetland system that has had flow only three times in the past 20 years. Located near Lake Bonney in Taylor Valley, in most years this hillside is bone-dry, making it an ideal site to investigate the long-term effects of extreme pulse/press events. The insert (right) shows an experiment that was flooded during the high flow of 2001-02 and 2008-09. We hypothesized that climate driven increases in the frequency and magnitude of high-flow events will lead to increased connectivity and subsequent redistribution of nutrients and biota across the landscape.

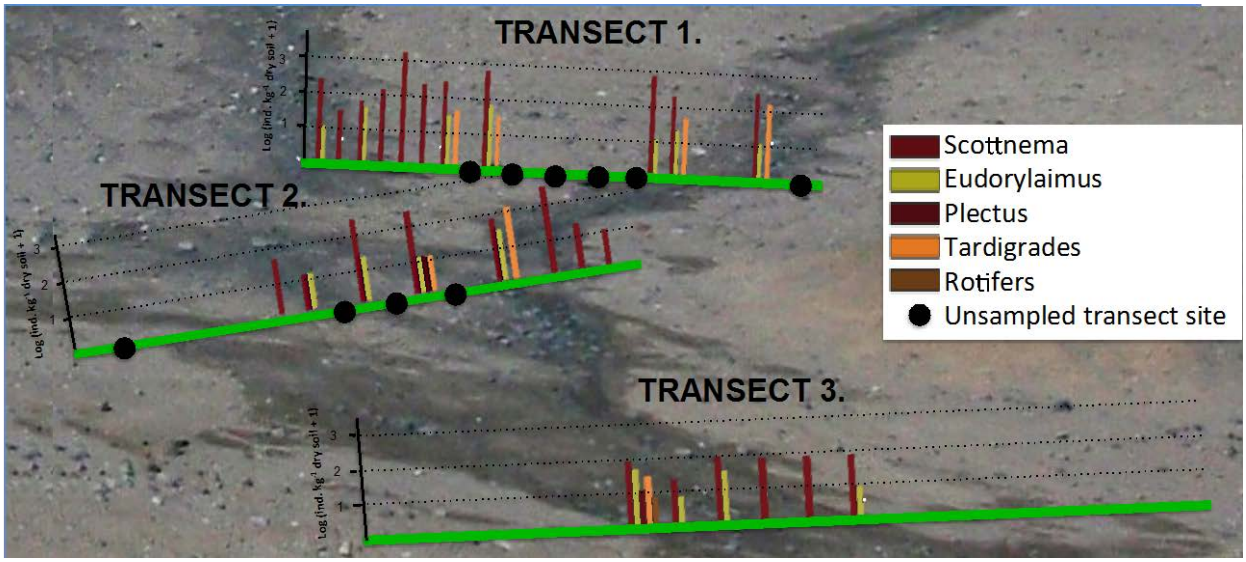
Study design: In 2008-2009, we used GPS to record the wetted zone, conducted a tracer study to explore the hydrology of the watershed and we analyzed soil samples within the wetted zone to determine how the flow of water influenced soil chemistry and soil fauna communities. Soil communities within the wetted zone were related to soil properties and aboveground water flow within the watershed (Nielsen et. al., 2012). We continued and expanded the sampling of this watershed in the field season of 2009-10 (see map below, and http://mcmsitereview.lternet.edu/sites/default/files/Click%20Here%20to%20Play%20Movie.m4v for a fly-over animation of the site).



Blue lines – main streams: both drain into Lake Bonney
Red lines represent the wetted zone
Black dots inside the red line represent the 39 samples analyzed in 2008-09

In 2009-10 we resampled these sites and established 3 transects (**green lines**, 51 sampling points) across the watershed to compare the fauna in the dry and the wet areas and monitor the development of soil communities as dry, depauperate soils become colonized over time. This setup encompassed 61 samples inside the wetted area and 29 samples outside of the wetted area.

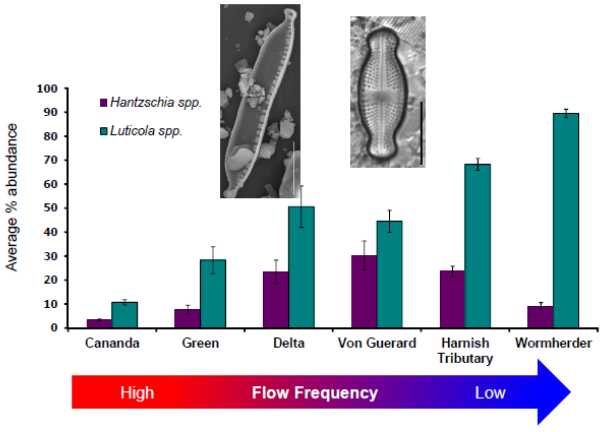
Results to date: The flow of water increases soil water availability and drastically decreases salinity within the wetted zone compared with the surrounding dry soils. Soil fauna distribution graphs (below) show the abundance of the three nematode genera, tardigrades and rotifers in samples collected along the three transects (**green** x axis) overlain over a photograph of the study site during flood (darker soils indicate wetting). Transect 1 was located furthest uphill and transect 3 furthest downhill. In the middle of transect 1 are a series of samples without soil fauna that coincides with the presence of a small, dry hill. Soils here were most similar to the dry soils outside the wetted zone.



The effect of the pulse event (flood) was twofold:
1. Periodic leaching of salts from flooding reduces soil osmotic stress to levels that are more favorable for soil organisms. The increased hydrological connectivity within the landscape unit led to improved habitat suitability, leaving a strong positive effect on soil animal abundance and diversity.
2. The hydrological pulse created increased connectivity within the watershed, providing increased reactivation and dispersal opportunities for soil fauna.

This study clearly demonstrates a lasting carry-over effect of extreme events on the distribution of soil fauna. It seems that any particularly extreme event or an increase in the frequency of less severe extreme events will change the biogeochemistry thus influencing the habitat suitability and colonization success of soil biota.

This study also provides insight into diatom community composition. Stanish et. al. (2012) showed that the relative importance of diatoms from the two genera with many endemic species varied along a gradient of flow frequency, with species of *Luticola* becoming dominant in Wormherder Creek.



Conclusions: The colonization of soil fauna within this landscape is limited by 'thresholds,' meaning that soil conditions have to reach a favorable state before successful colonization can occur. After this, environmental gradients, and in this system, soil moisture in particular, will influence community assembly greatly by determining which species will be able to survive in a particular spot. As models forecast extreme events to become more pronounced in the dry valleys, over time we predict an increase in habitable areas, greater productivity and more complex soil food webs. Thus, the Wormherder Creek study site serves as an excellent natural experiment for monitoring the effects of predicted increases in the magnitude and frequency of pulse events and increased connectivity in this ecosystem.