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Impact of warm winters on microbial growth

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Growth of soil bacteria has an asymmetrical response to higher temperature with a gradual increase with increasing temperatures until an optimum after which a steep decline occurs. In laboratory studies it has been shown that by exposing a soil bacterial community to a temperature above the community's optimum temperature for two months, the bacterial community grows warm-adapted, and the optimum temperature of bacterial growth shifts towards higher temperatures. This result suggests a change in the intrinsic temperature dependence of bacterial growth, as temperature influenced the bacterial growth even though all other factors were kept constant. An intrinsic temperature dependence could be explained by either a change in the bacterial community composition, exchanging less tolerant bacteria towards more tolerant ones, or it could be due to adaptation within the bacteria present. No matter what the shift in temperature tolerance is due to, the shift could have ecosystem scale implications, as winters in northern Europe are getting warmer. To address the question of how microbes and plants are affected by warmer winters, a winter-warming experiment was established in a South Swedish grassland. Results suggest a positive response in microbial growth rate in plots where winter soil temperatures were around 6 °C above ambient. Both bacterial and fungal growth (leucine incorporation, and acetate into ergosterol incorporation, respectively) appeared stimulated, and there are two candidate explanations for these results. Either (i) warming directly influence microbial communities by modulating their temperature adaptation, or (ii) warming indirectly affected the microbial communities via temperature induced changes in bacterial growth conditions. The first explanation is in accordance with what has been shown in laboratory conditions (explained above), where the differences in the intrinsic temperature relationships were examined. To test this explanation the temperature relationships of the bacterial community from winter-warmed plots and plots with ambient soil temperatures were compared. No change in optimum temperature for growth could be detected, indicating that the microbial community has not been warm-adapted. This fits with what was seen also in the laboratory experiment where no changes in temperature response occurred when exposing bacteria to temperatures below 10 °C within two months. The increase in activity measured during winter should thereby be due to changes in environmental factors, which will be further investigated. One big difference between heated and control plots was that heated plots were snow free during the entire winter, while control plots were covered by a 10 cm snow cover. The plant community composition and flowering time also differed in the warmed and ambient plot.