Effect of habitat size, resource concentrations and temperature on food-chain length in natural microbial communities

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Many factors, such as habitat size, resource, and temperature, have been assumed to affect food-chain length. However, no study has investigated more than two factors at a time. Here, we used the ecosystem living within the water-filled leaves of *Sarracenia purpurea* with *Euplotes* sp. as the predator and ciliate protozoa as prey to test how habitat volume, resource concentration, and temperature, alone and in combination, affect food-chain length and dynamics. This entire plant ecosystem is advantageous in lab conditions because control of parameters is performed easily and with replication. We conducted a three-factorial experiment with four habitat volumes, three resource concentrations and three temperatures. We measured the number of trophic levels, and the prey and predator abundance across time. We found that food-chain length was affected positively by habitat size and temperature, and by their pairwise interaction. In addition, the abundance of prey and predator were significantly affected by resource supply. However, our study does not support an effect of resource concentration nor a pairwise interactive effect with resource on number of trophic levels. This work does not confirm results obtained about energy limitation and productive space hypothesis, but it is providing support for the ecosystem size hypothesis when prey and predator abundance is high in the ecosystem. Importantly in a climate change context, temperature affected the food-chain length in this aquatic system, with a preference through time for a moderate temperature instead of the optimal maximum temperature of the thermal performance curve.

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