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Reduced Functionality of Soil Food Webs in Burnt Boreal Forests: a Case Study in Central Russia[1]

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Abstract—Functionality of soil food webs after forest fires remains generally unexplored. We address this question by studying both burnt and unburnt spruce forests in Central European Russia (Tver Region). In August 2014 we sampled two spatially distant blocks consisting of forest areas burnt in 2010 and the respective unburnt controls. We analyzed biomass and structure of soil food webs as well as carbon mobilization with respect to carbon stocks in the dead wood, litter and soil after burning. The biomass of soil fauna was moderately reduced in the burnt plots. For some groups like testate amoebae and enchytraeids, however, this decrease was highly significant and corresponded with the decreased C-stock in litter. For the other taxa changes in biomass were insignificant. At the same time C-flow through the soil food web after fire was strongly reduced mainly due to the reduction of biomass of active fungi and secondary decomposers. The overall consumption rate of detritus by the soil food web strongly decreased in the burnt forests and was maintained predominantly by the decomposition activity of bacteria instead of fungi. This resulted in the reduction of the total soil food web functionality related with C-mobilization in the forests four years after a fire event.

BRIEF SUMMARY
We compared rates of carbon mobilization by soil food webs in burnt and unburnt boreal forests in Central Russia. Despite of only slight decrease in soil animal biomass, consumption rate of carbon in the soil food webs after fire was considerably lower and mainly associated with soil bacteria instead of fungi.

Keywords: ecosystem functioning, C-stock, soil fauna, soil bacteria, detritus, wildfire
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INTRODUCTION

Timber stocks along with carbon fixation and maintaining the stability of both ecosystems and the biosphere as a whole are considered the basic ecosystem services of forests (Gamfeldt et al., 2013). Quantitative assessment of the effects of local catastrophic events (e.g. droughts, forest fires, etc.) on the processes and mechanisms which safeguard these services is very important. The soil hosts almost 90% of the entire terrestrial biodiversity (Bardgett and van der Putten, 2014) and around 80% of the total zoomass in terrestrial ecosystems (Perry, 1994). Soil animals form complex food webs which, despite relatively moderate C-pool stored in them, may considerably regulate carbon trajectories, especially in boreal and temperate forests (Luxton, 1975). Thus soil biota greatly contribute to the overall provision of the abovementioned services but the exact mechanisms of that are not fully understood (Bradford et al., 2014). Further, finding links between the functional structure of communities and the performance of food webs in forest soils after disturbance are the burning problems in modern soil ecology (Hector and Bagchi, 2007; Nielsen et al., 2011; Bradford et al., 2014).

Wildfires as an environmental disturbance alter soil communities. However, this issue remains largely unexplored due to the high temporal and spatial variability, unpredictability of fire events and uncertainty of their outcomes (Keeley, 2009; Zaitsev et al., 2016). The aim of our study is to evaluate changes in biomass and carbon mobilization potential of soil food webs in boreal forests after a wildfire with respect to the changing carbon pools in pyrogenic forests.

To achieve this aim, we evaluate the effect of fire on the contribution of soil biota (including main groups of microbiota, micro-, meso- and some representa-

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