

# MICROBIAL PROPERTIES OF URBAN SOILS IN APATITY, MURMANSK REGION



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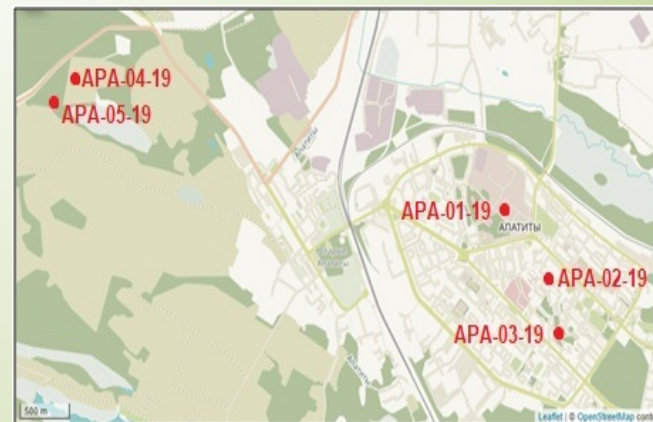


**APATITY** [67°34'N 33°24'E](#)

Founded 1935

Area 7.5 km<sup>2</sup>

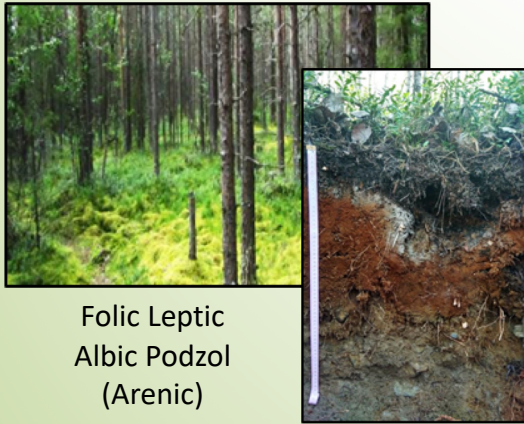
Population 55 201 (2019)





## FOREST ZONE (BACKGROUND)

**FT**



Folic Leptic  
Albic Podzol  
(Arenic)

## RESIDENTIAL ZONE (OUTER COURTYARD)

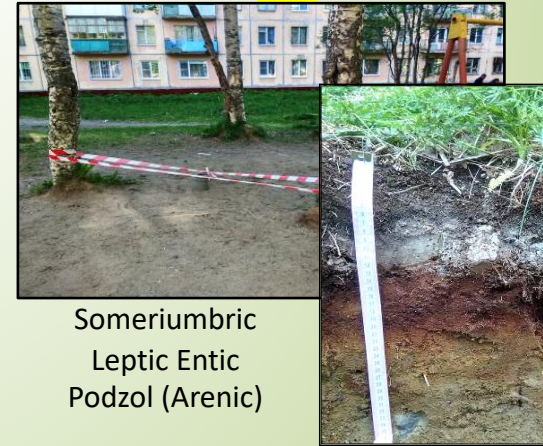
**RZ-O**



Someriumbric  
Leptic Entic Podzol  
(Arenic, Technic)

## RESIDENTIAL ZONE (INNER COURTYARD)

**RZ-I**



Someriumbric  
Leptic Entic  
Podzol (Arenic)

## AGRICULTURAL ZONE (ARABLE EXPERIMENTAL FIELD) **AR**



Plaggic Stagnic Entic Podzol (Arenic)

## SOCIAL and RECREATIONAL ZONE (AKADEMGORODOK) **S-R**

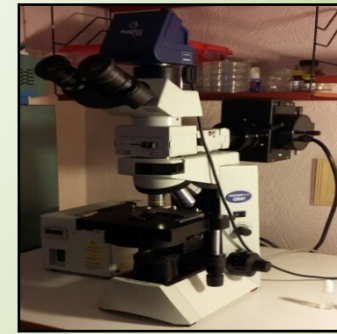


Someriumbric Leptic Entic Podzol (Arenic, Technic)



## Bacterial biomass

luminescence microscopy method using acridine orange fluorescence



## Fungal biomass

luminescence microscopy method using calcofluor white fluorescence

## Number of rRNA ribosomal genes copies of bacteria, archaea, and fungi

real-time polymerase chain reaction (PCR)  
The *Escherichia coli* (Sigma) ribosomal operon was used as the control for bacteria, the FG-07 *Halobacterium salinarum* strain for archaea (Jurgens and Saano, 1999), and the *Saccharomyces cerevisiae* Meyen 1B-D1606 yeast strain for fungi.

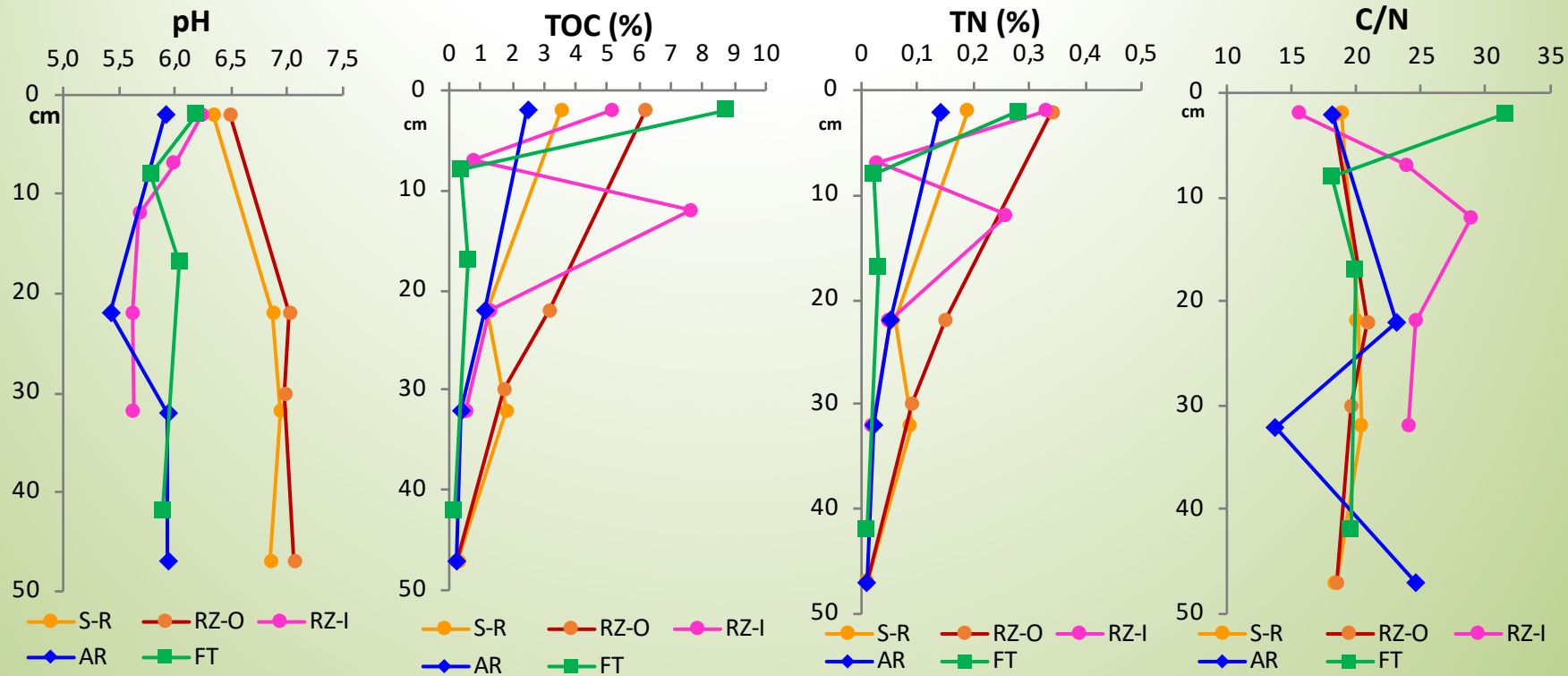


## Diversity of fungi (cultivable)

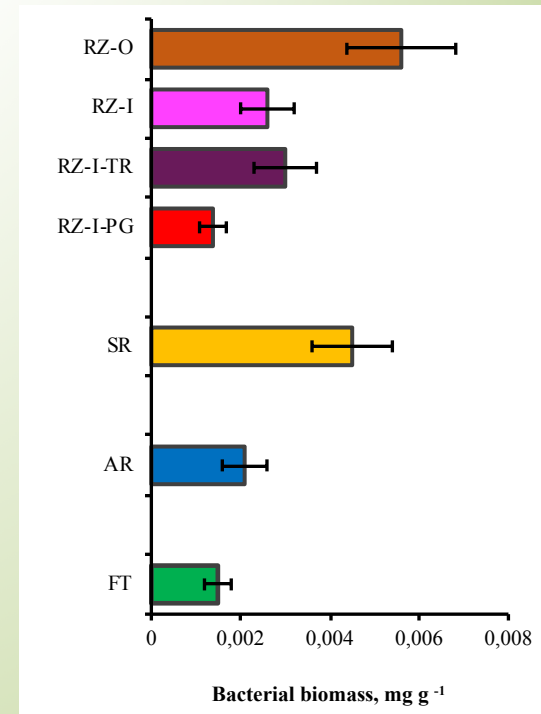
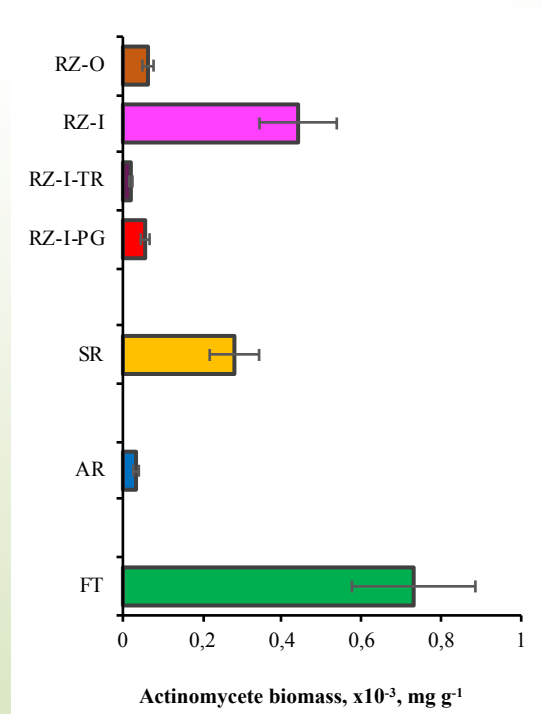
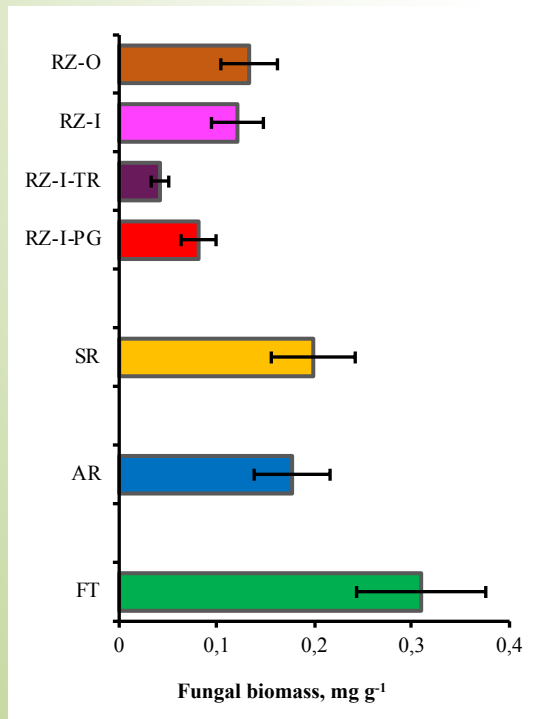
Identification of fungi on the basis of cultural-morphological characteristics with the use of keys [Raper and Thom 1968, Domsh et al. 2007, Seifert et al. 2011] and molecular genetic methods based on the analysis of the ITS1–5.8 S–ITS2 rDNA site







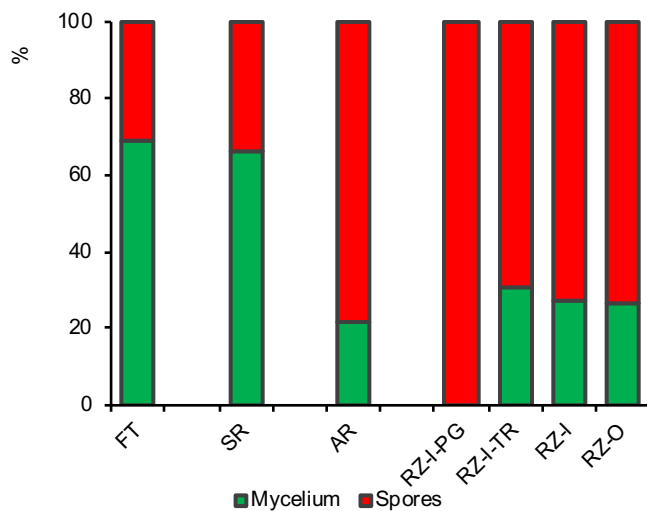
- More alkaline pH values in urban soils.
- Litter of trees, mosses and lichens is source of organic carbon in humus Follic horizon in background Podzol. Litter of grasses is the main source of organic carbon in modern humus someriumbric horizon in urban area.
- These someriumbric horizons have been formed over the last 30-50 years on a new anthropogenic substrate with a capacity of 30-40 cm overlapping the partially cut topsoil horizons of the natural forest Podzols.



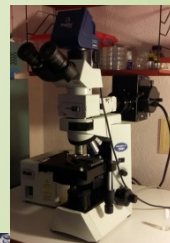
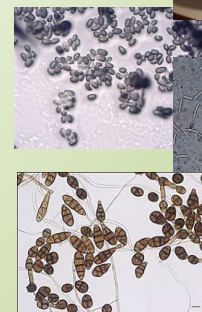
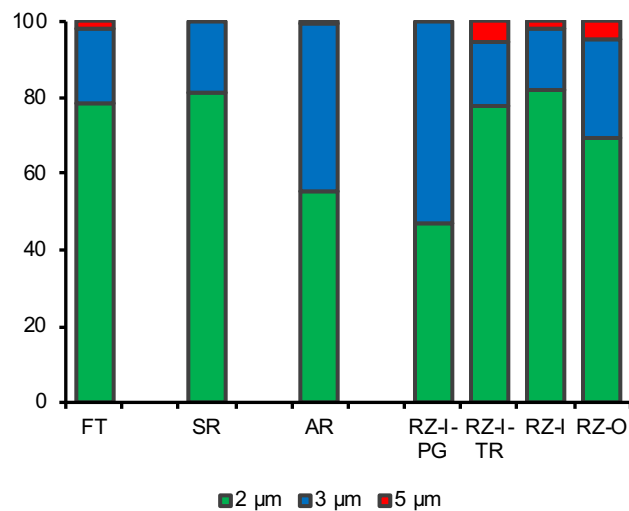
- Total microbial biomass in the soils is relatively large and ranges from hundredths to tenths of mg/g of soil.
- Fungal biomass significantly prevailed over the biomass of bacteria and actinomycete in both urban and forest soils.
- Fungal and actinomycete biomass reduced in the urban soil in comparison with the forest soil.
- Actinomycetes group was the most sensitive to anthropogenic impact compared to bacteria and fungi.
- Fungal biomass demonstrated high negative correlation with soil density.



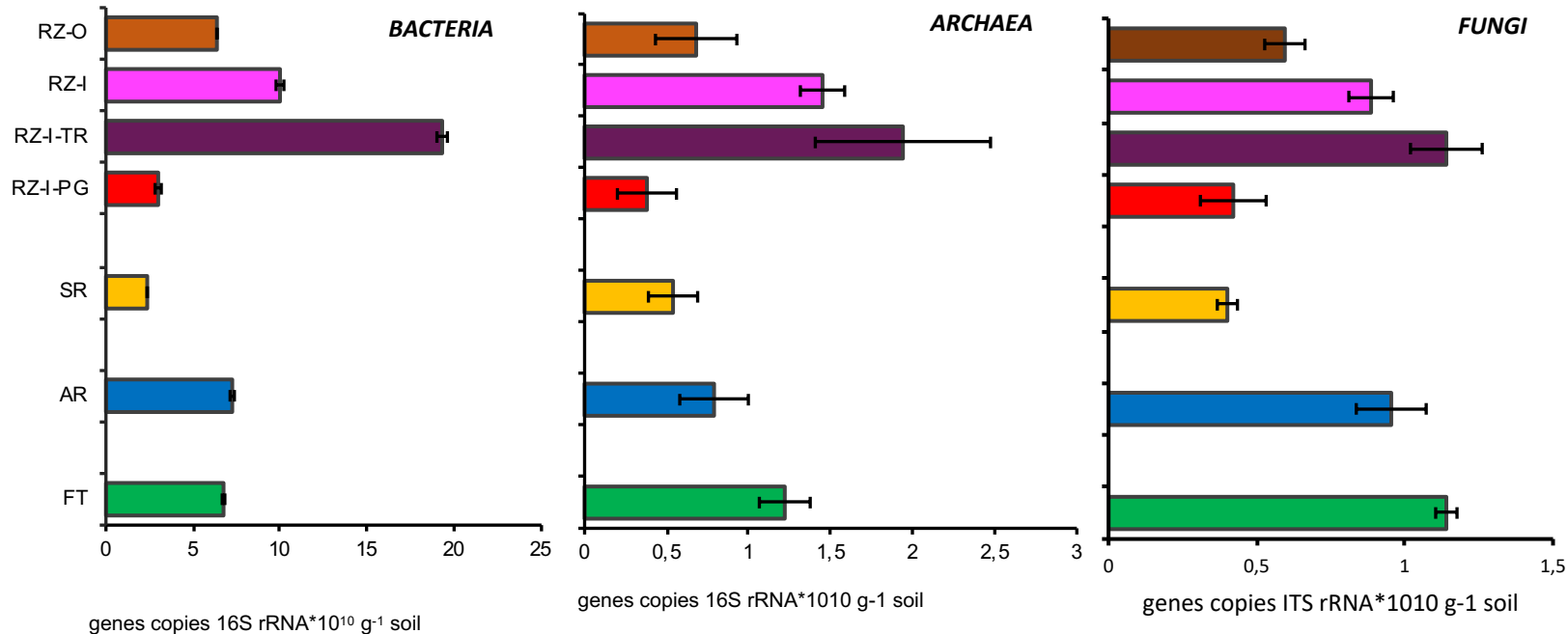
## MYCELIUM AND SPORES RATIO



## NUMBER OF SPORES WITH DIFFERENT SIZE

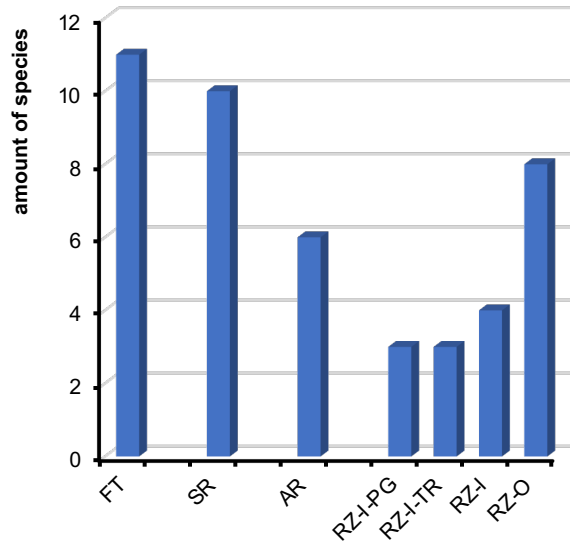


- Number of fungal spores varied from several thousand to several hundred thousand per gram of soil.
- In urban soil, the fungi are mainly in the form of a spores, whereas in a forest dominated by mycelium forms.
- Small spores predominated ( $10^4$ - $10^5$  cells / g of soil) in both urban and forest soils, while large propagules were no more than  $10^3$  cells/g of soil.
- Specific morphological features of large fungal spores and mycelium in the urban soil in comparison with the forest soil were revealed.



- By the number of genes copies, bacteria prevailed over fungi and Archaea in both urban and forest soils.
- Tendency to increase the number of genes copies in urban soils for both prokaryotes and eukaryotes was revealed.
- Number of Archaea ribosomal genes copies in the urban soil was 8-10 times higher than for background tundra soils.
- Number of ribosomal genes copies of microorganisms demonstrated high positive correlation with content of phosphorus in the soil.





## In urban soils

- Species diversity of microfungi decreases.
- There are species of microfungi that are atypical for background soils.
- Structure of the microfungal community changes to monodominant in comparison with the polydominant in background soil.
- Dominant species of fungi are plant pathogens and potentially pathogenic to human health.

