

**The ecological-geochemical assessment in recreational zones of  
Moscow based on the study of three environmental  
components (soil, vegetation, atmospheric air)**

**Shvetsova M.S.**

The study was performed from June to September 2018 on the territory of seven Moscow parks



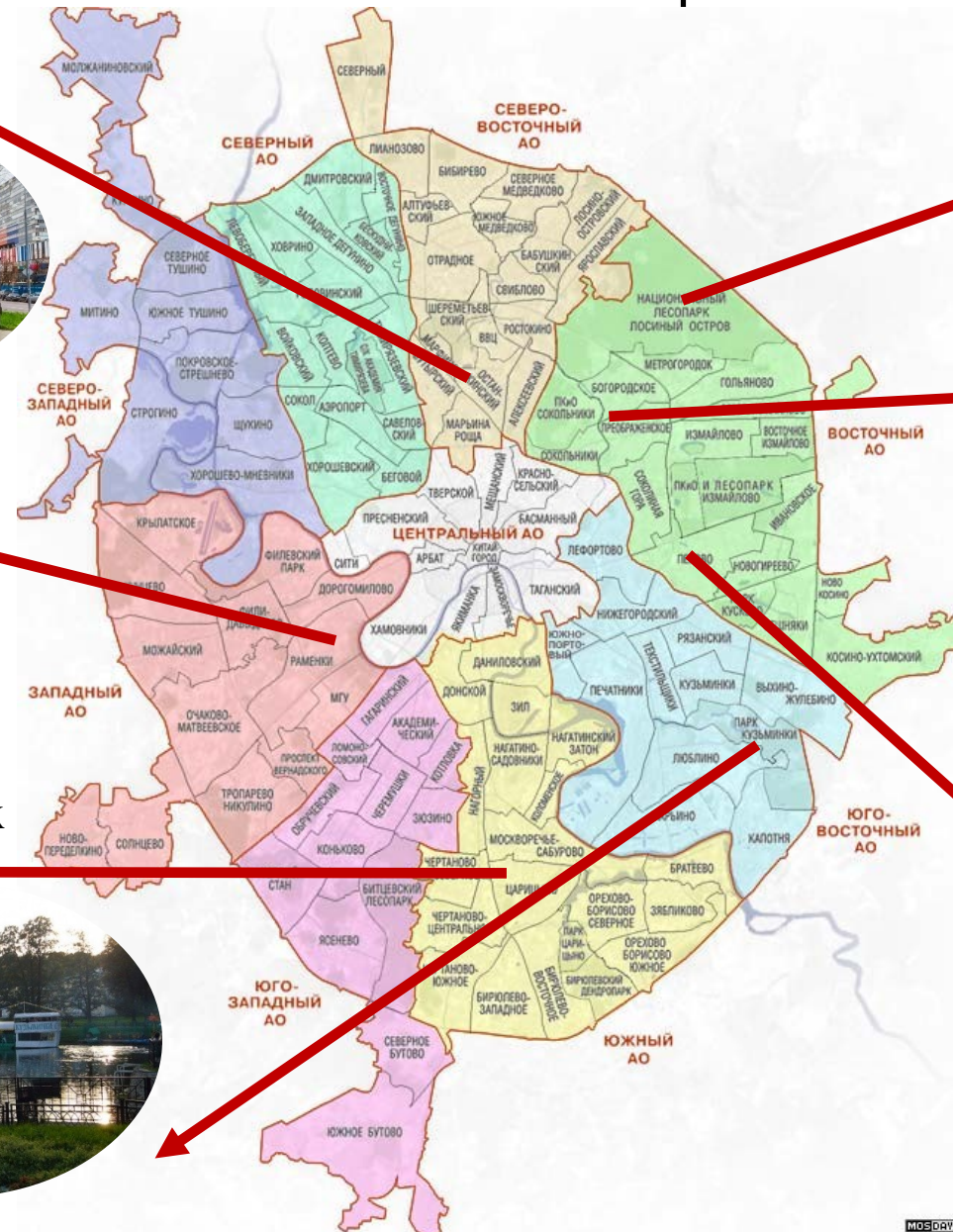
5. Losiny Ostrov



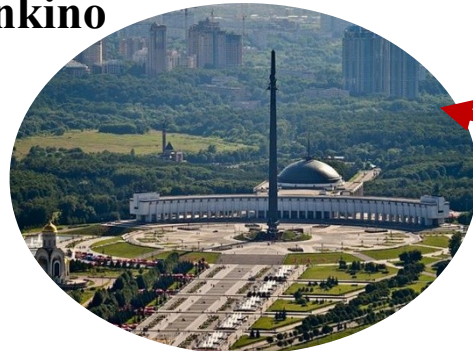
6. Sokolniki



7. Izmailovo



1. Ostankino



2. Victory Park



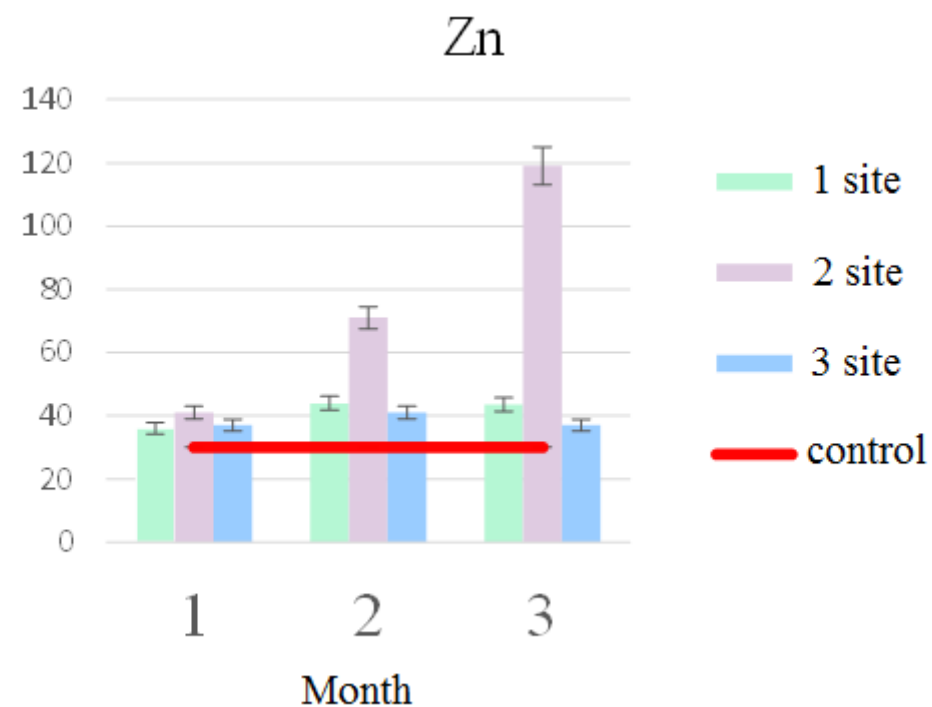
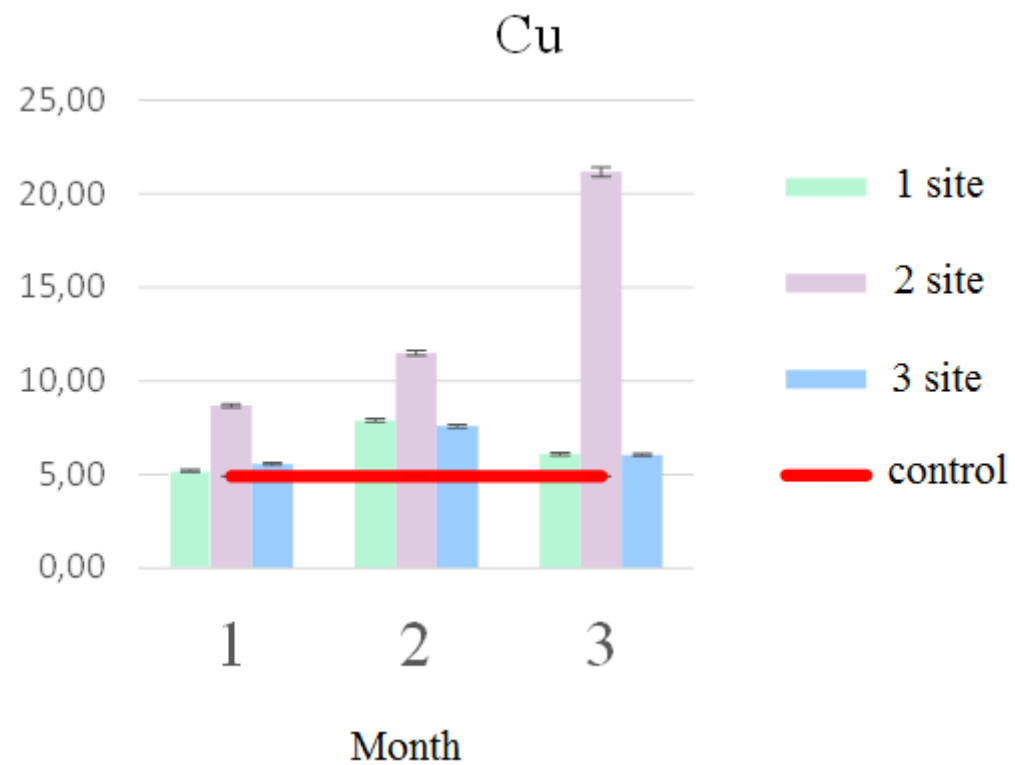
3. Tsaritsyno

4. Kuzminki-Lublino

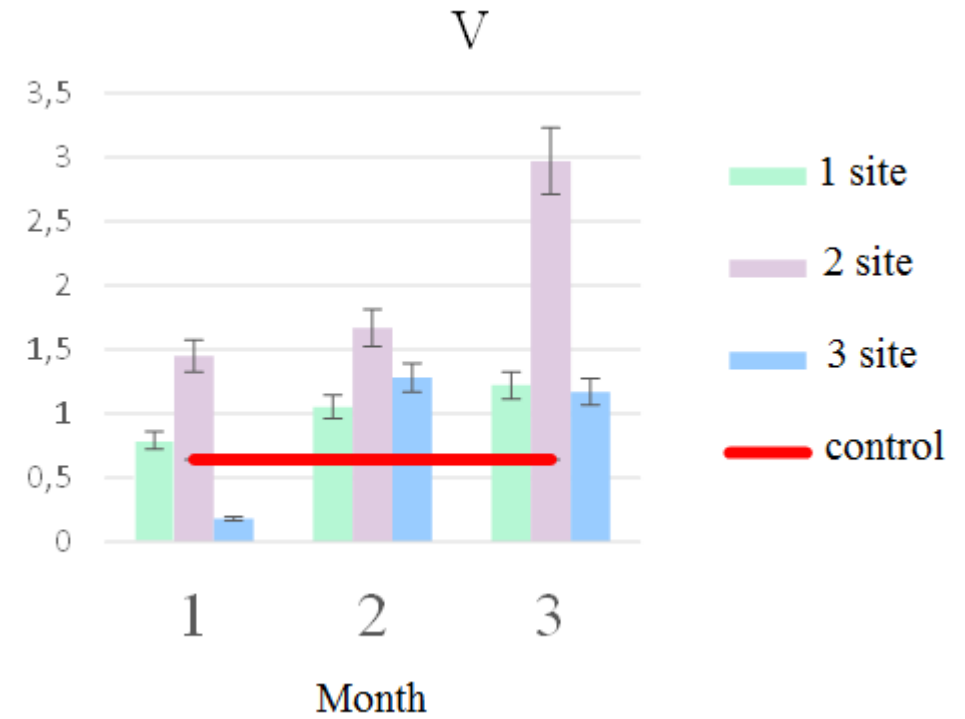
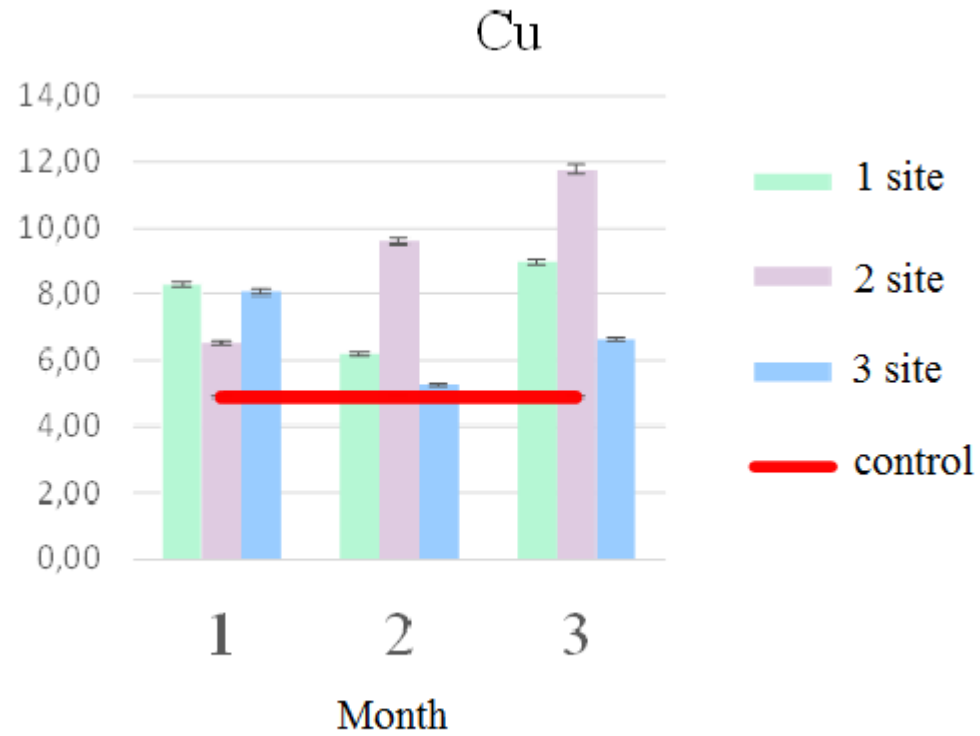




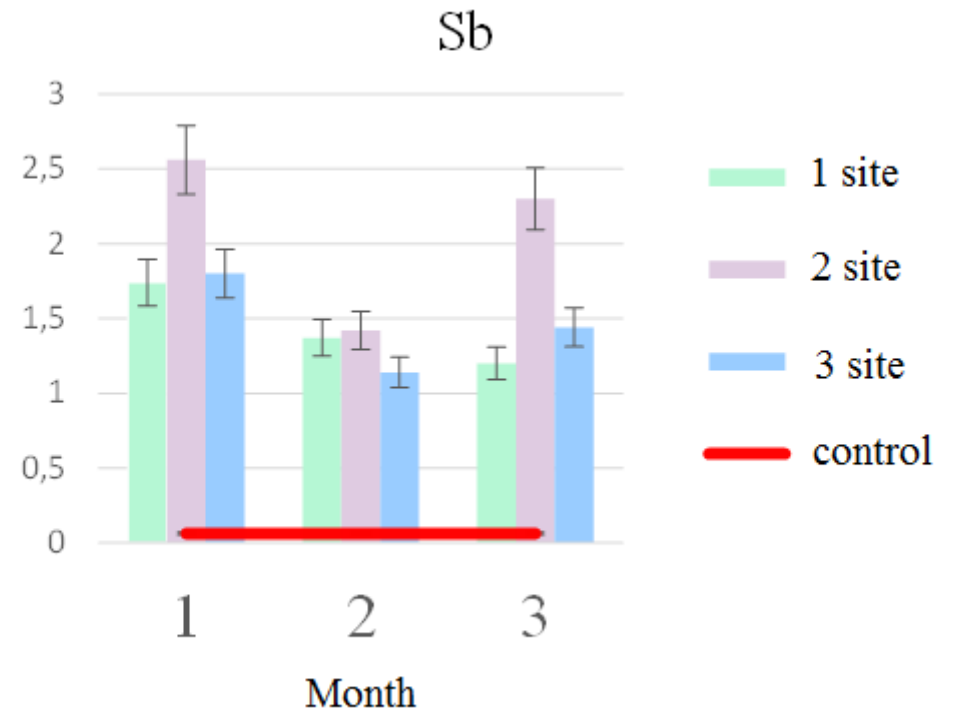
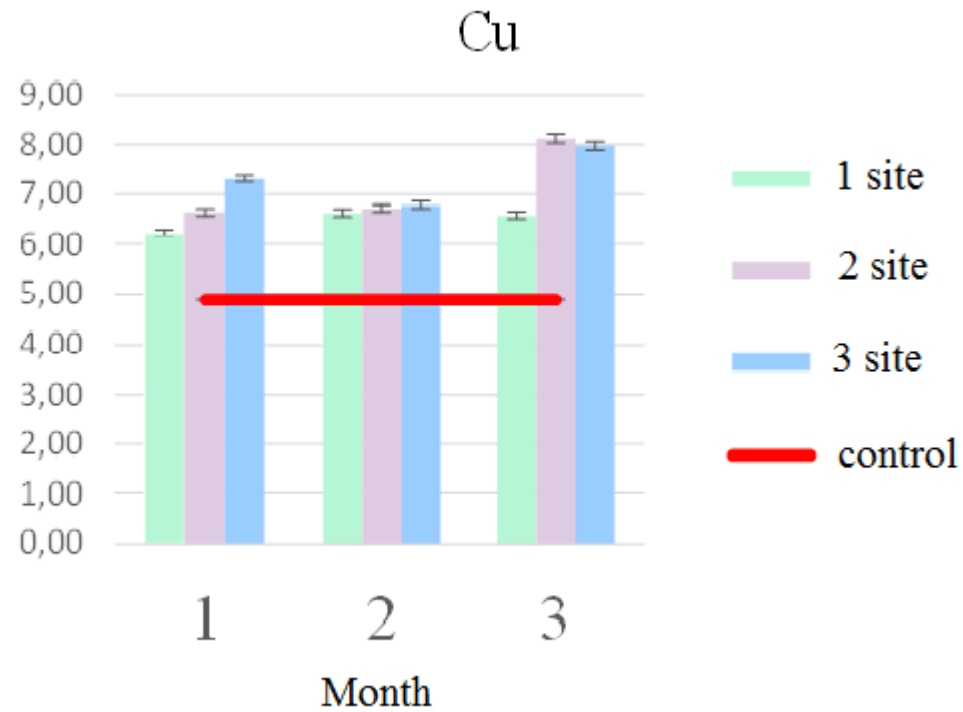
# The concentrations of Cu and Zn on territory of Losiny Ostrov, mg/kg



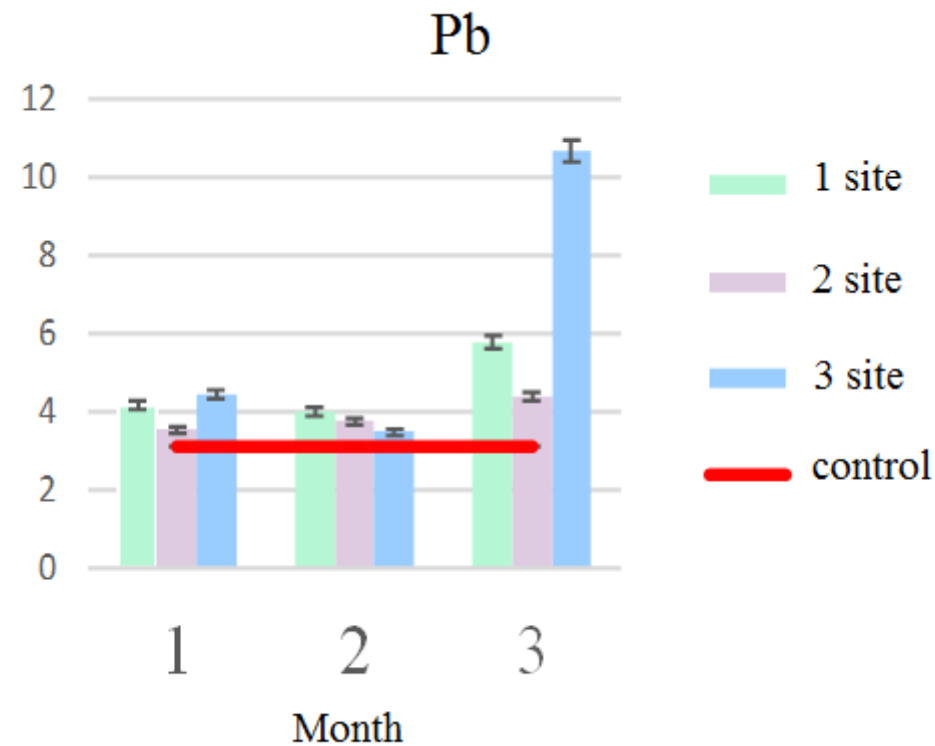
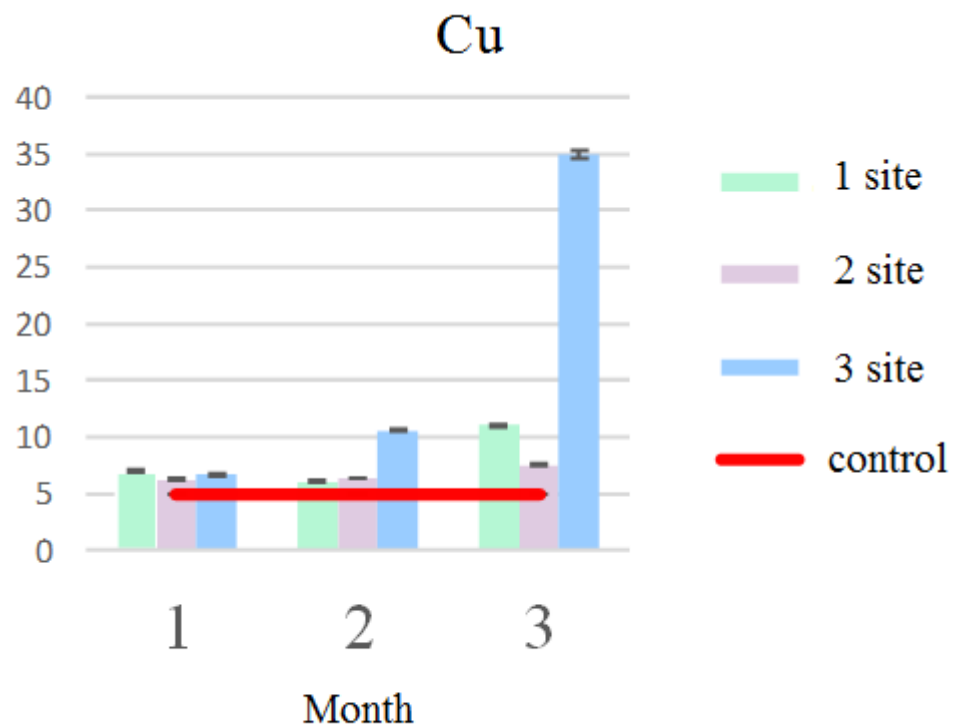
# The concentrations of Cu and V on territory of Izmailovo, mg/kg



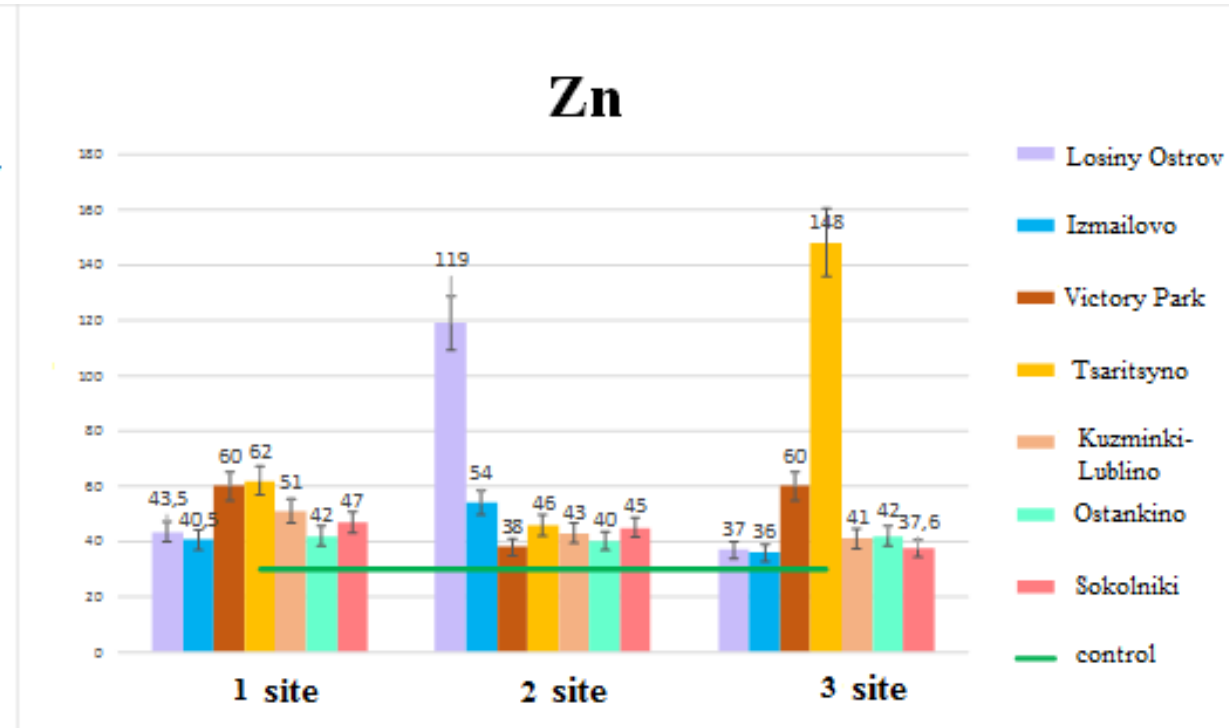
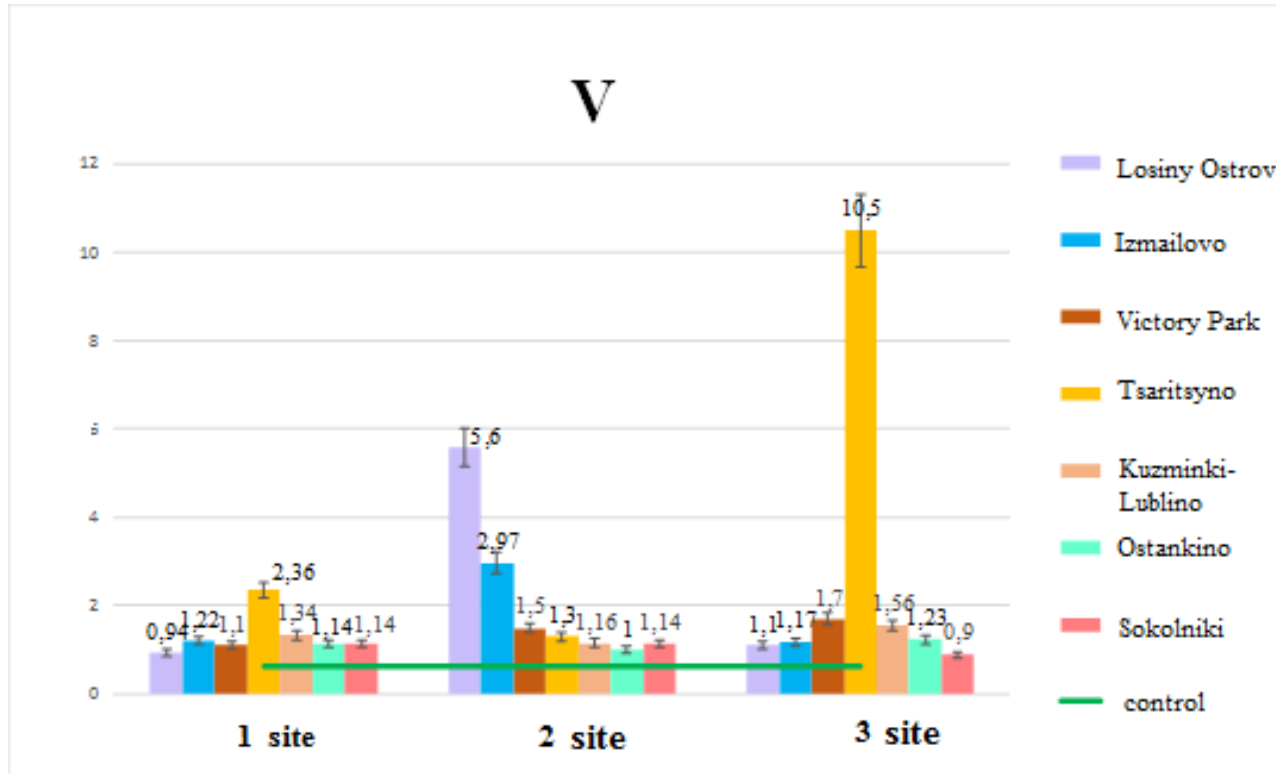
# The concentrations of Cu and Sb on territory of Victory Park, mg/kg



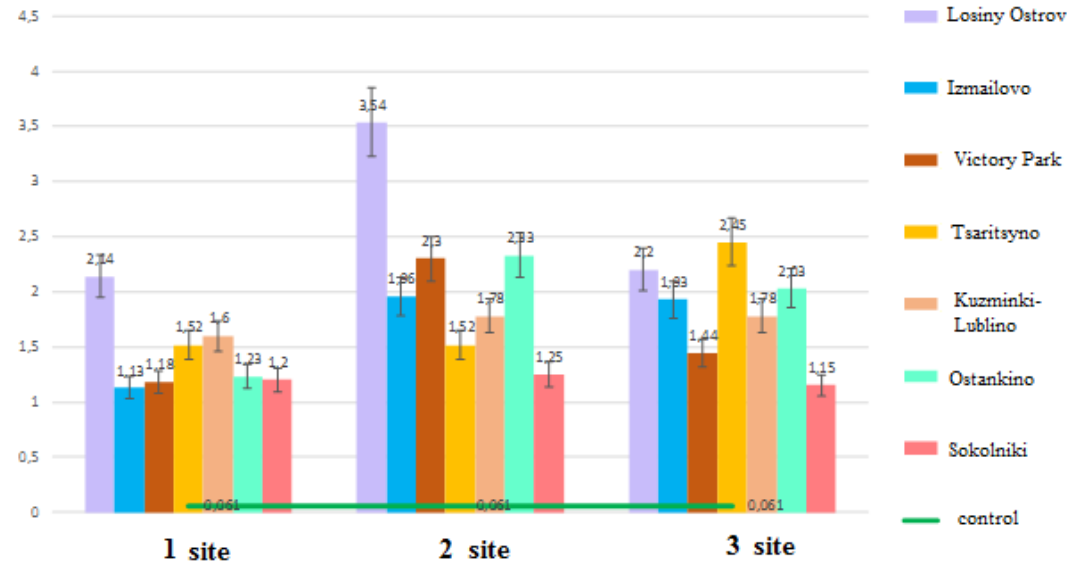
# The concentrations of Cu and Sb on territory of Tsaritsyno, mg/kg



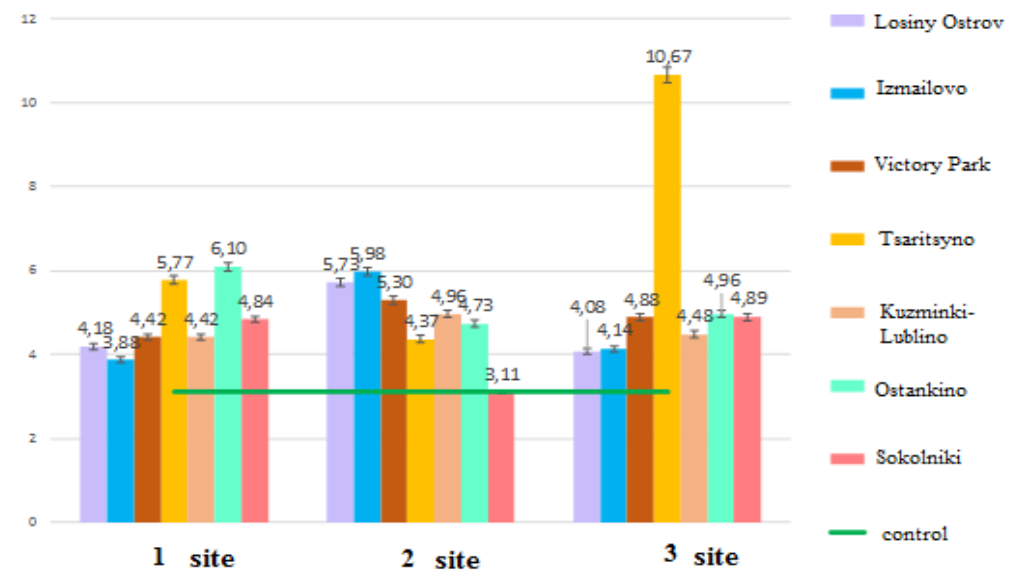
# The concentrations of the elements in moss bags exposed for 3 months at three sites on territory all parks, mg/kg



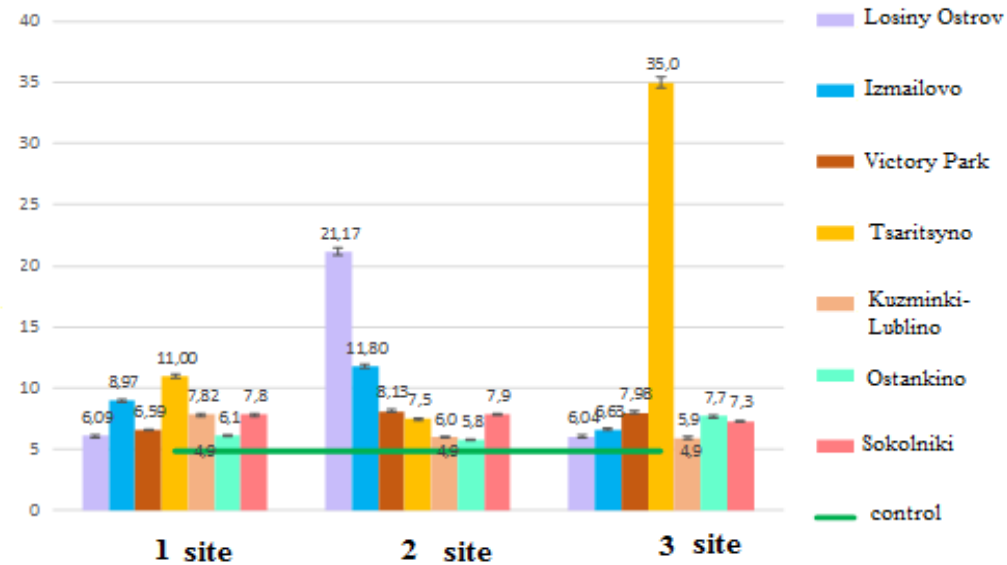
## Sb



## Pb



## Cu



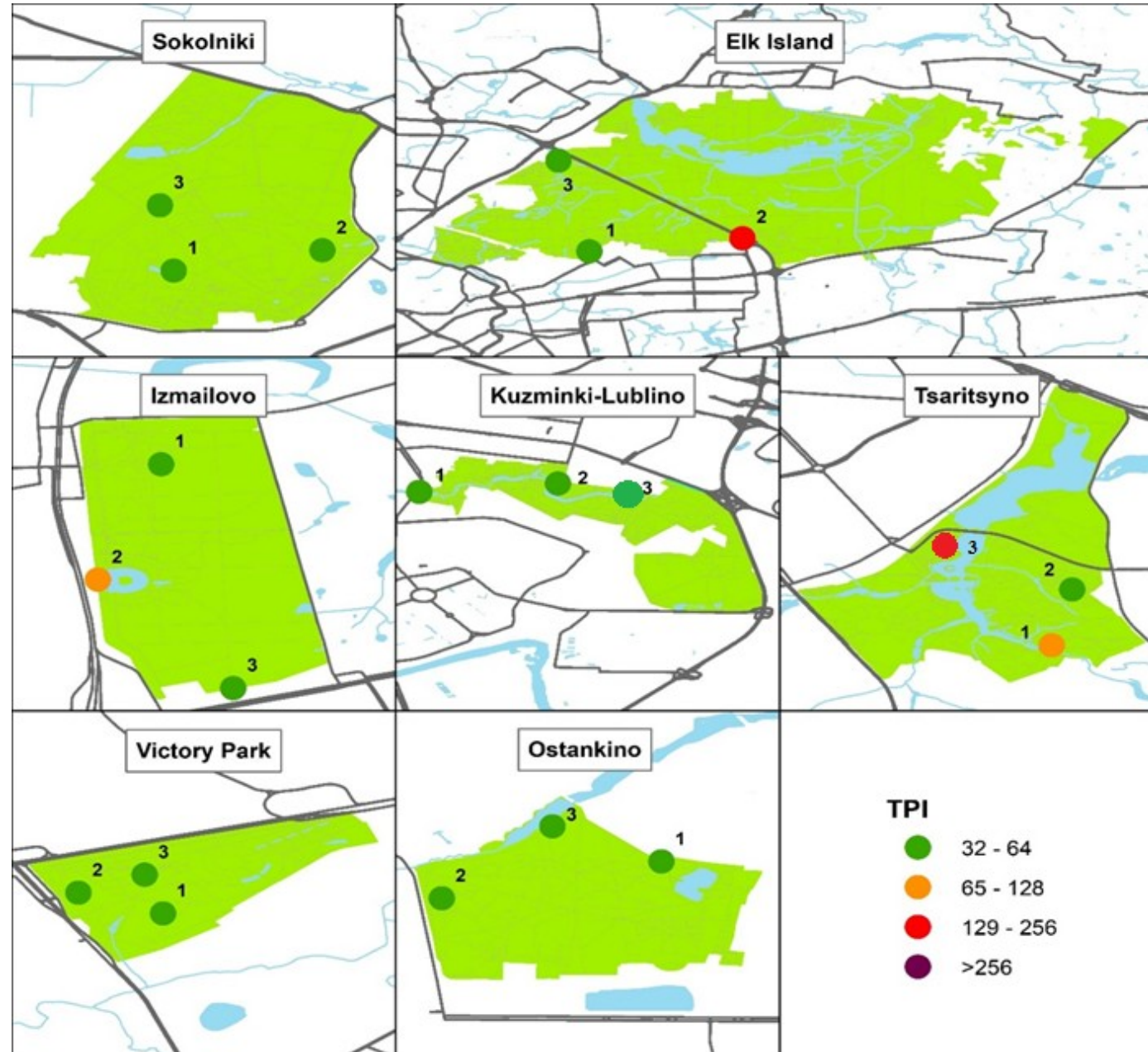


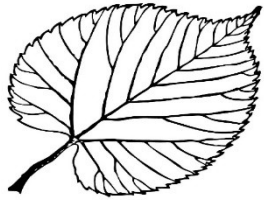
A total of 32 chemical elements in atmospheric deposition in the parks were identified, including heavy metals belonging to 1, 2 and 3 hazard classes.

At most sites in the parks, after three months of exposure, a decrease in the concentrations of physiologically active elements K, Cl and alkali elements Rb and Cs in the samples was observed, which may be due to damage of the moss cell membrane under the influence of air pollutants and ion exchange processes.

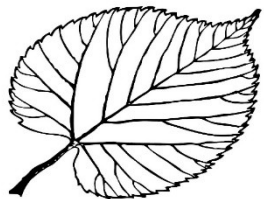
The most polluted sites on the territory of the parks under study include the territory of the Tsaritsyno located near the road and railways, the territory of the Izmailovo located next to the North-Eastern Expressway, and the territory of the Losiny Ostrov close to the Moscow Ring Road.

# Exposure sites and TPI value

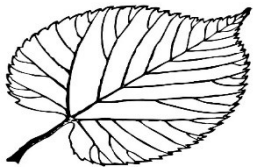




**1. Izmailovo**



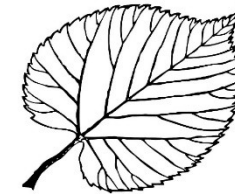
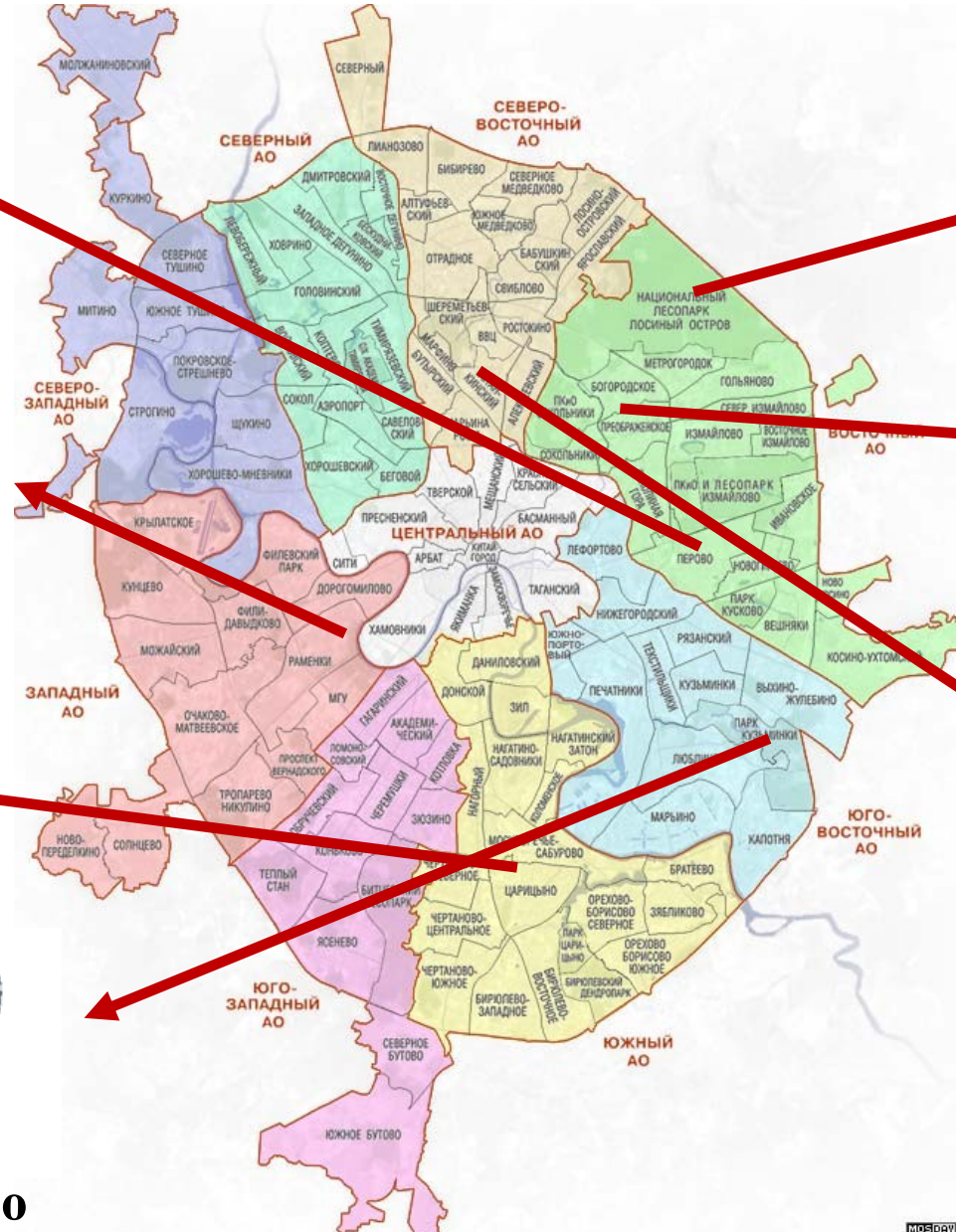
**2. Victory Park**



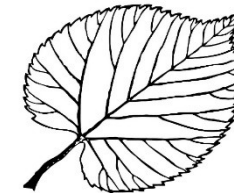
**3. Tsaritsyno**



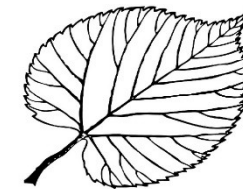
**4. Kuzminki-Lyublino**



**5. Losiny Ostrov**



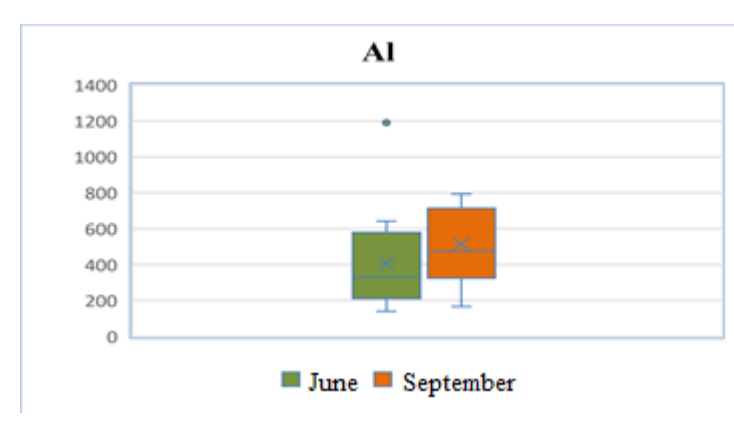
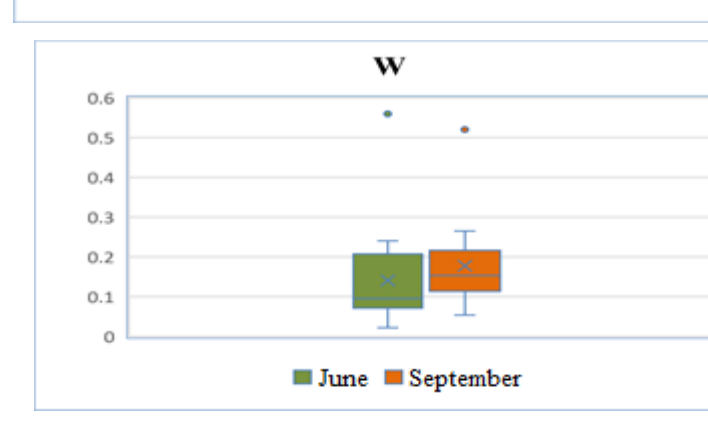
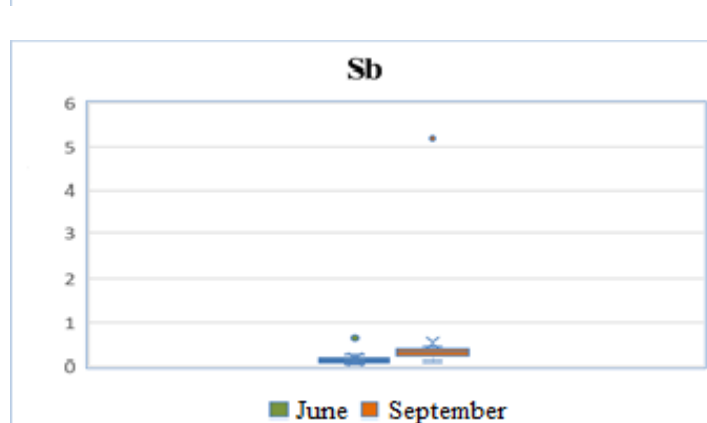
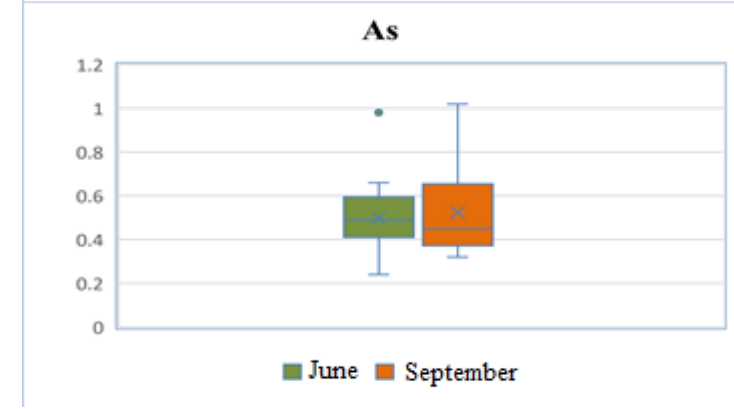
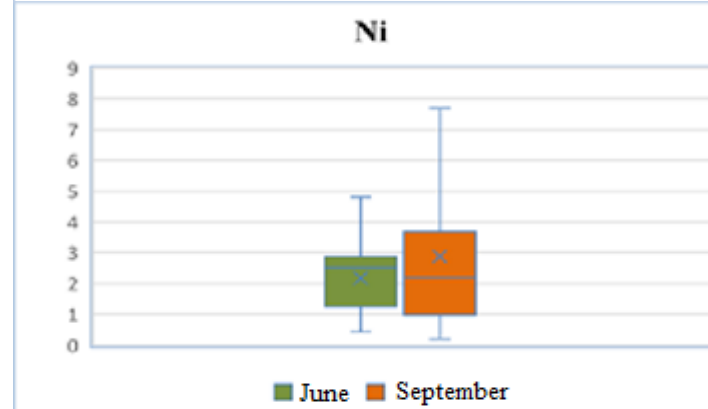
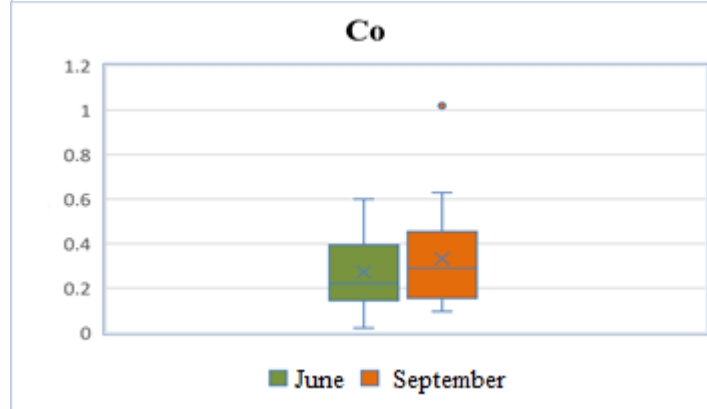
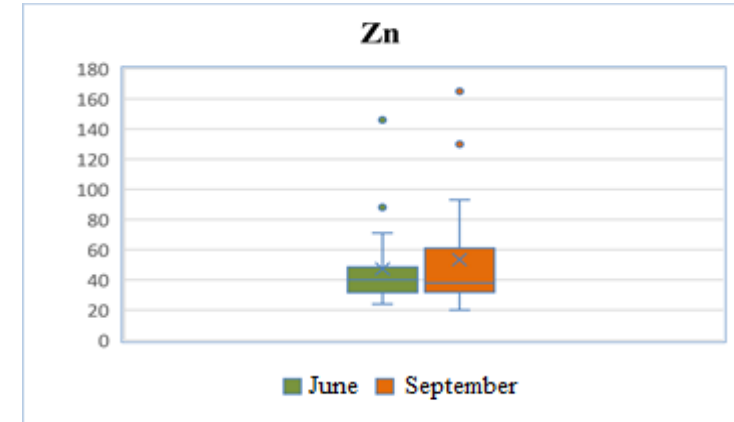
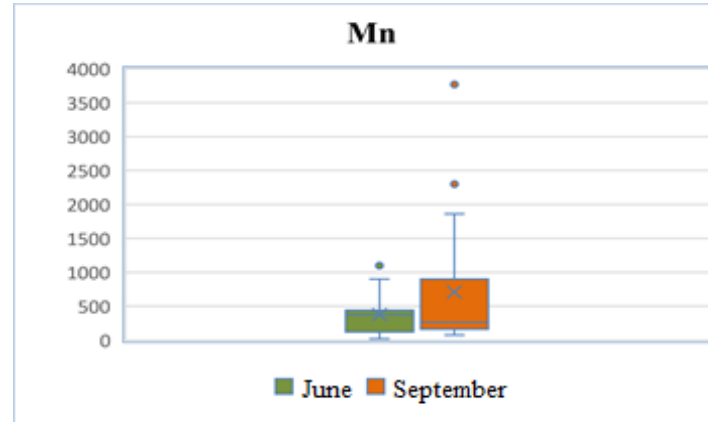
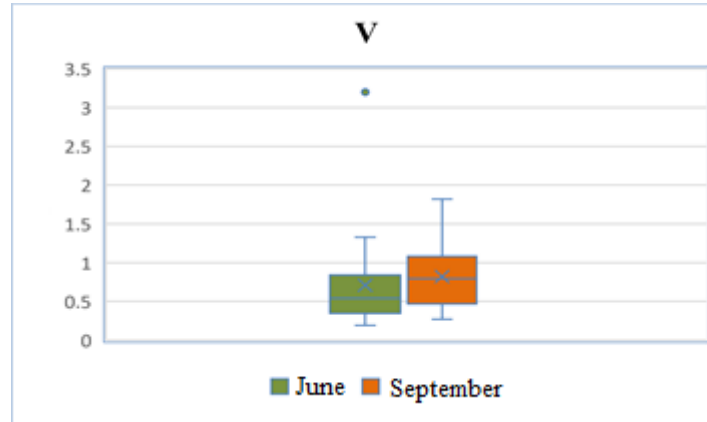
**6. Sokolniki**



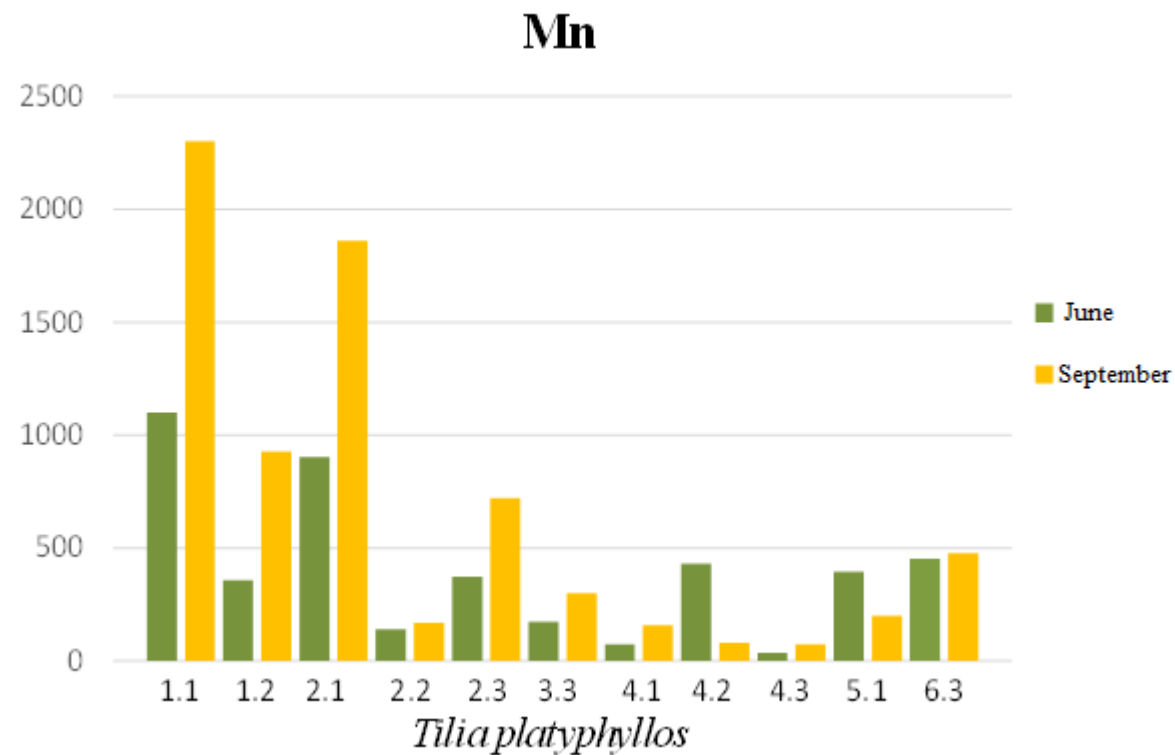
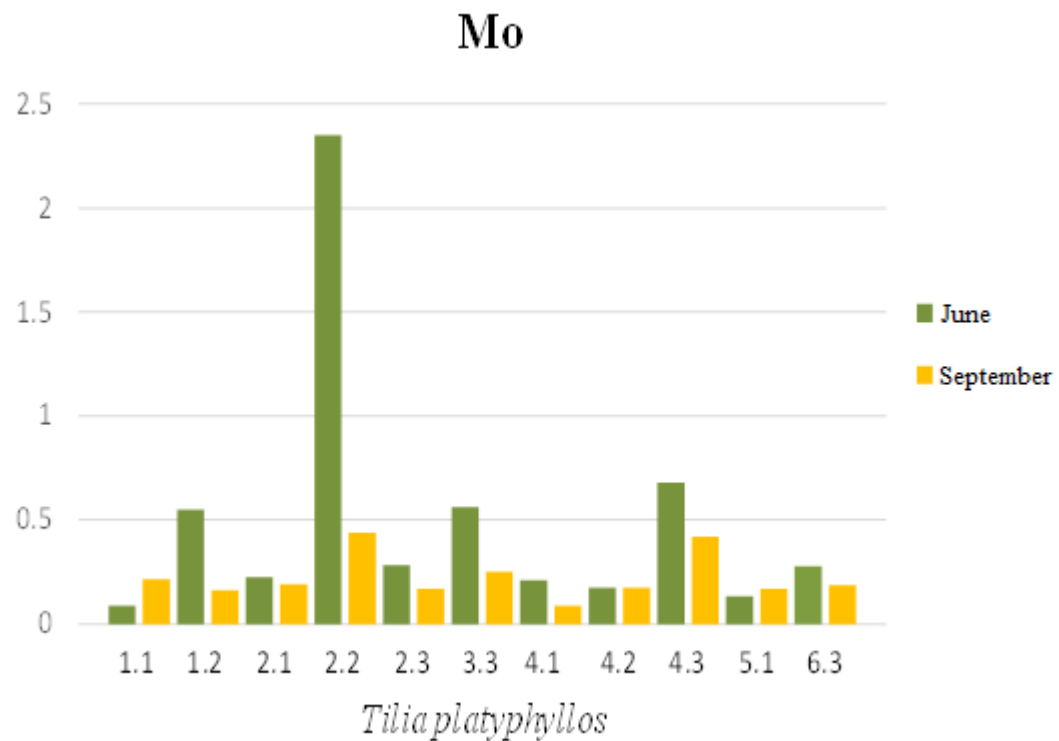
**7. Ostankino**



# The concentrations of elements in leaves of all studied species, collected on the territory of 7 parks in June and September, mg/kg

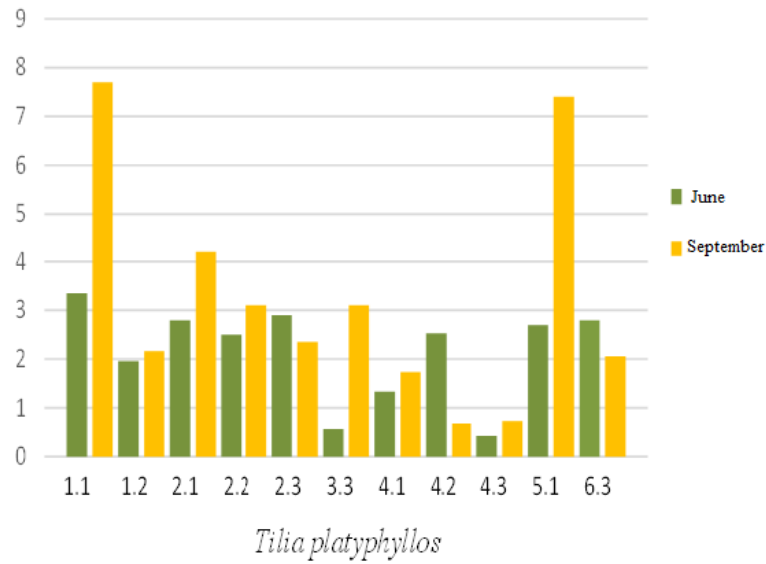
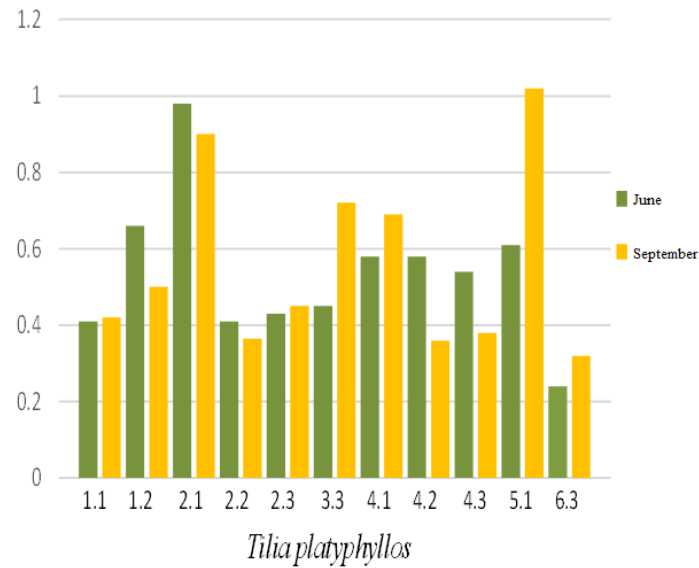
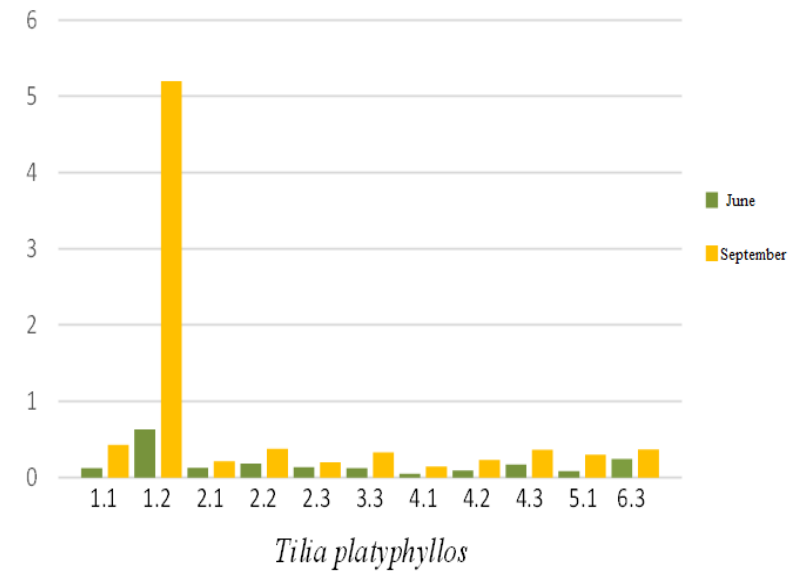






**The concentrations of elements in linden leaves at the beginning and the end of the vegetation period (mg/kg)**

- 1.1 – Losiny Ostrov site 1 ; 1.2 – Losiny Ostrov site 2 ;
- 2.1 – Izmailovo site 1 ; 2.2 – Izmailovo site 2; 2.3 – Izmailovo site 3 ;
- 3.3 – Victory Park site 3 ;
- 4.1 – Tsaritsyno site 1 ; 4.2 – Tsaritsyno site 2 ; 4.3 – Tsaritsyno site 3;
- 5.1 – Ostankino site 1;
- 6.3 – Sokolniki site 3.

**Ni****As****Sb**

## The concentrations of elements in linden leaves at the beginning and the end of the vegetation period (mg/kg)

1.1 – Losiny Ostrov site 1 – Losiny Ostrov site 2 ;

2.1 – Izmailovo site 1 ; 2.2 – Izmailovo site 2 ; 2.3 – Izmailovo site 3 ;

3.3 – Victory Park site 3;

4.1 – Tsaritsyno site 1; 4.2 – Tsaritsyno site 2; 4.3 – Tsaritsyno site 3 ;

5.1 – Ostankino site 1;

6.3 – Sokolniki site 3 .

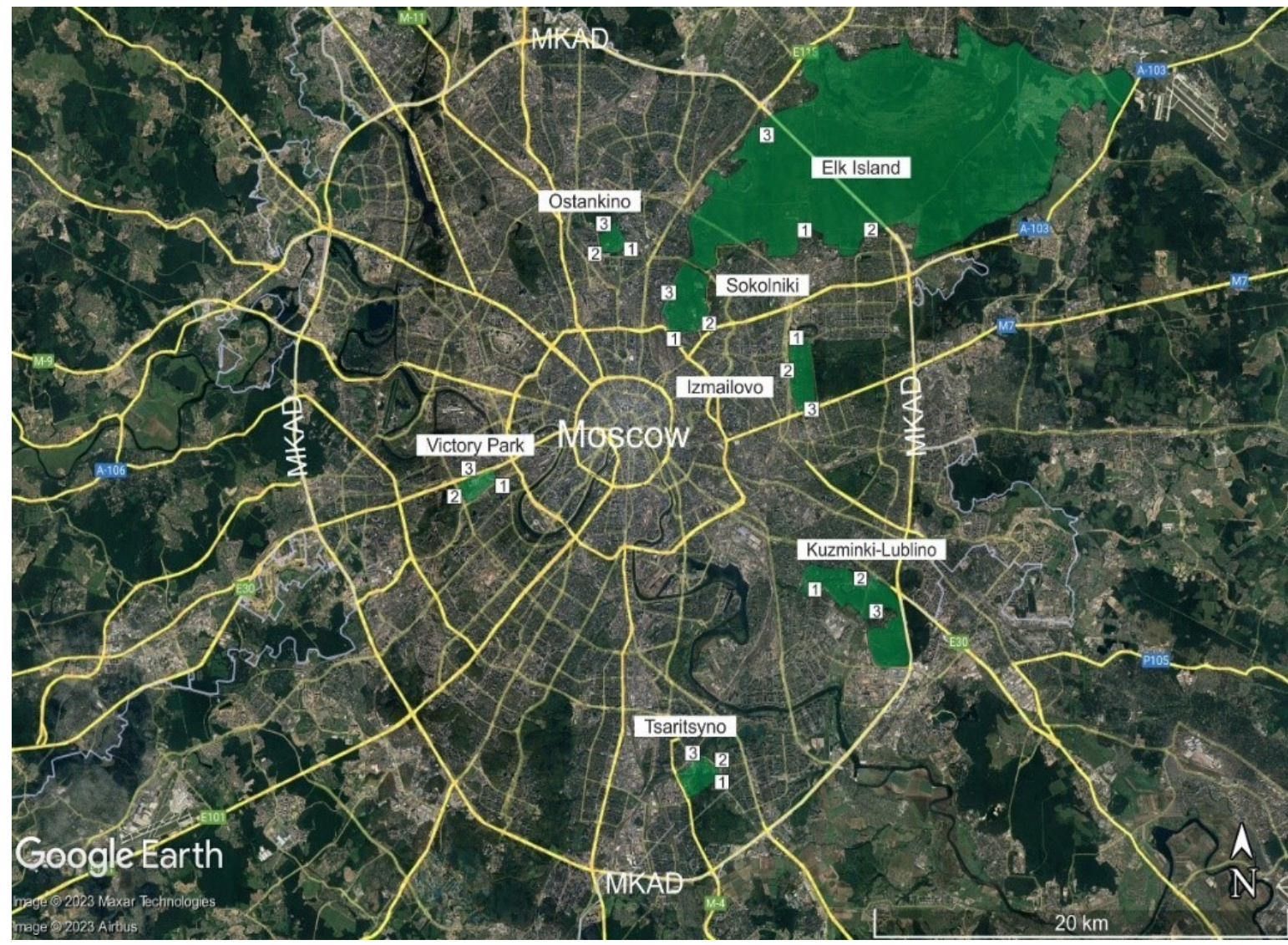
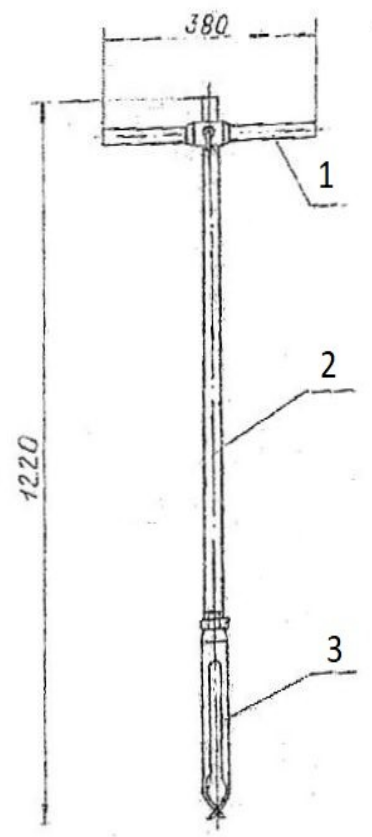


According to the correlation analysis the content of elements in leaves and in moss samples showed a strong and very strong correlation at  $P = 0.95$  ( $r = 0.6-1$ ) for all plant species. The obtained results indicated that accumulation of elements in leaves is determined by aerotechnogenic impact.



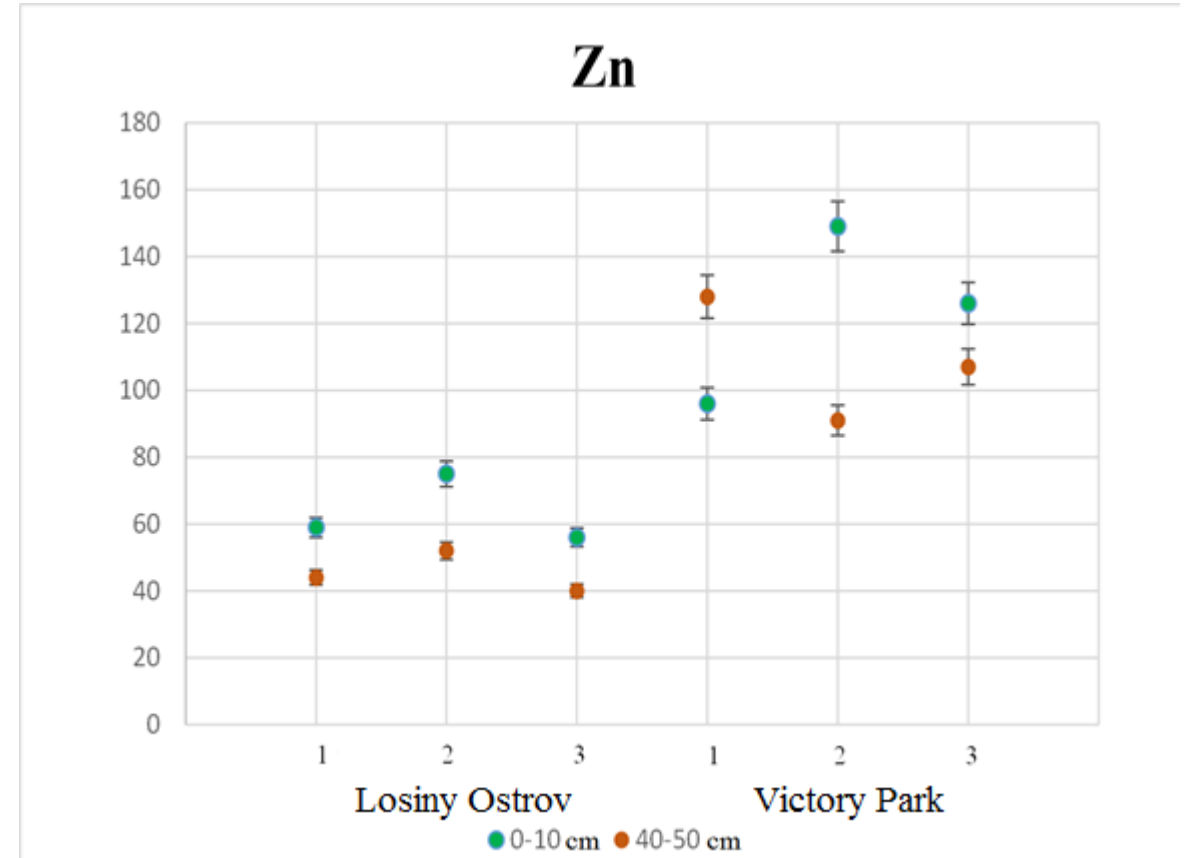
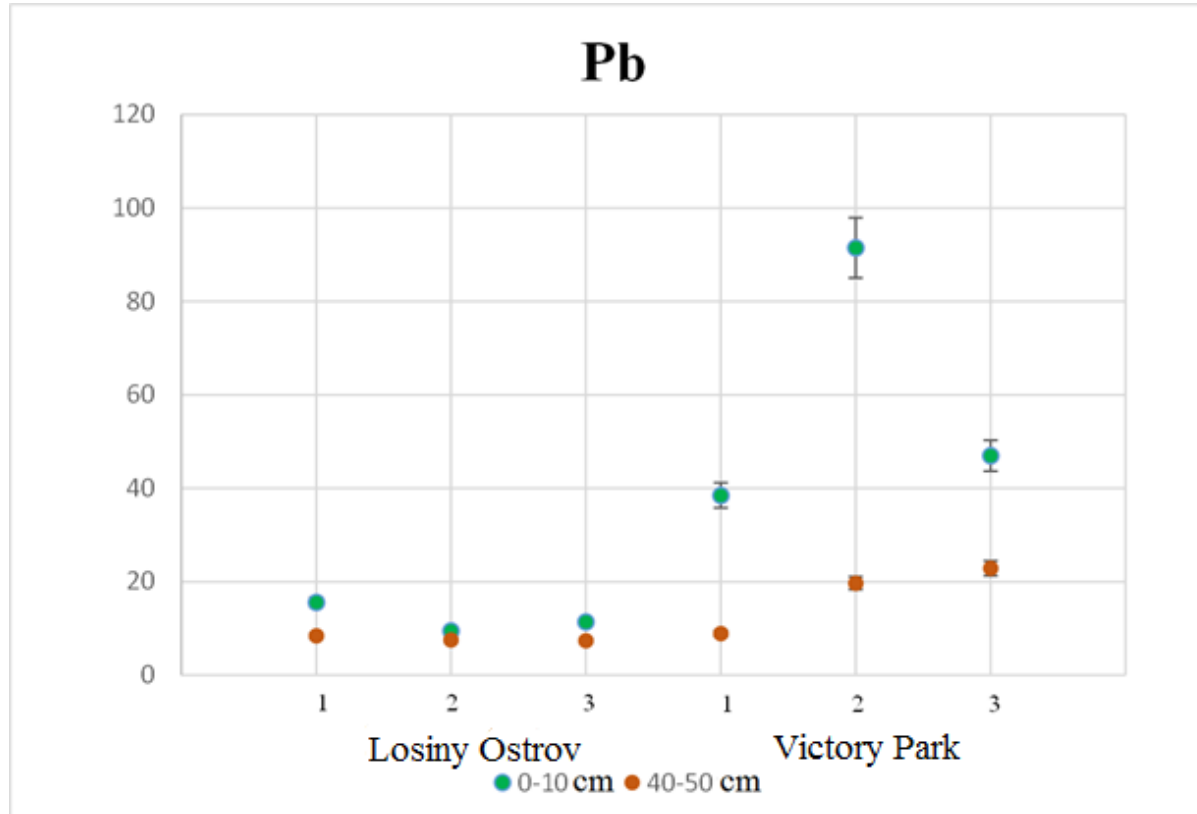


Soil samples were collected at different depths: **0-10 cm** and **40-50 cm**. For collected a special soil drill was used.



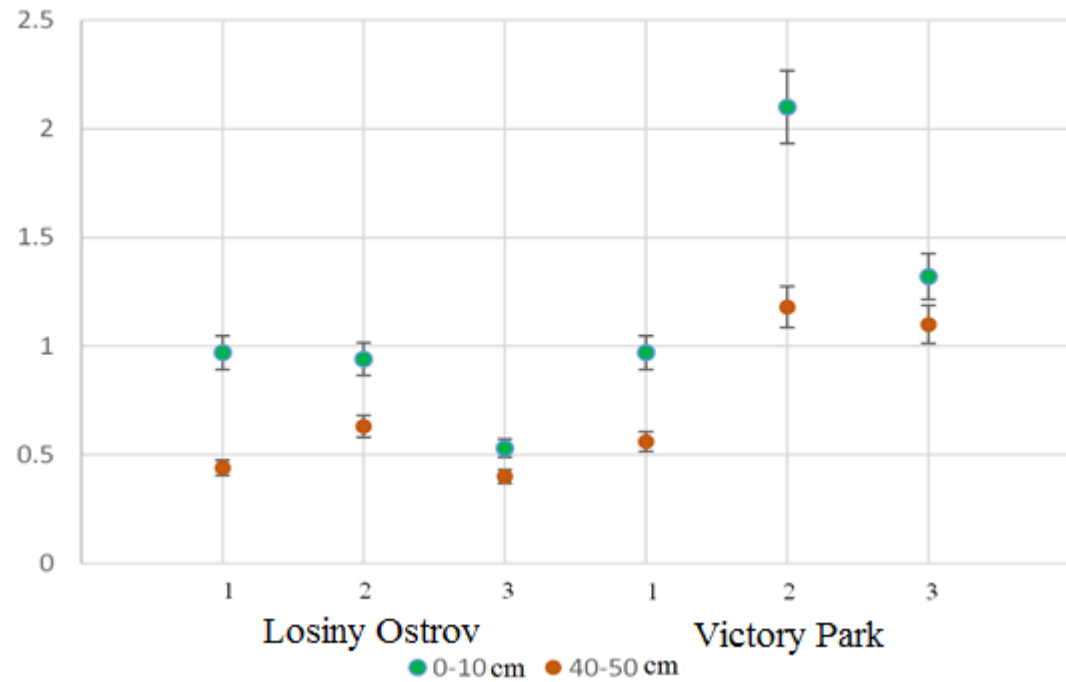
1. On territory of the Sokolniki, Izmailovo, Ostankino and Losiny Ostrov, a minor excesses of the maximum permissible concentration of elements of the 1st hazard class (As, Cd, Zn) was obtained.
2. According to the total pollution index calculated taking into account elements of hazard classes 1–3, the soils of Losiny Ostrov, Ostankino, Tsaritsyno and Kuzminki-Lublino are characterized by low level of pollution. A moderate level of pollution was identified on some sites on the territory of the Sokolniki, Izmailovo and Victory Park.
3. The total pollution index calculated taking into account all indentified elements increased by average of 15 units, thus more than 50% of the studied area is characterized by the hazardous level of pollution.

# The concentrations of Pb and Zn on the territory of Losiny Ostrov and Victory Park

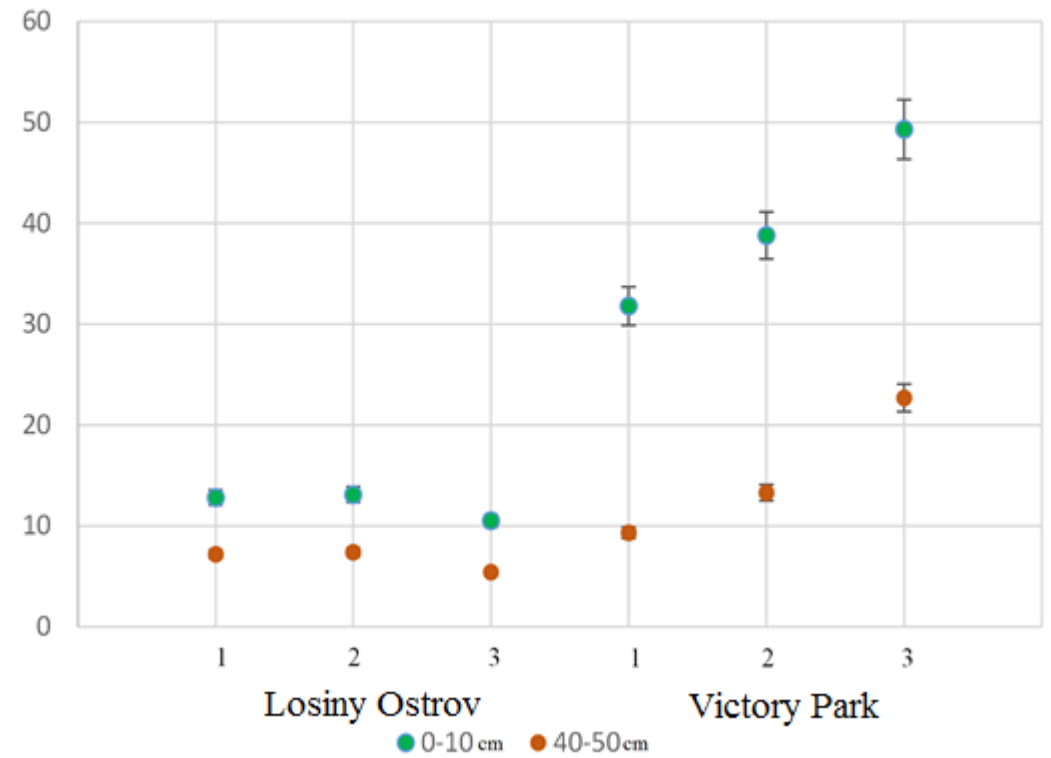


# The concentrations of Sb and Cu on the territory of Losiny Ostrov and Victory Park

## Sb

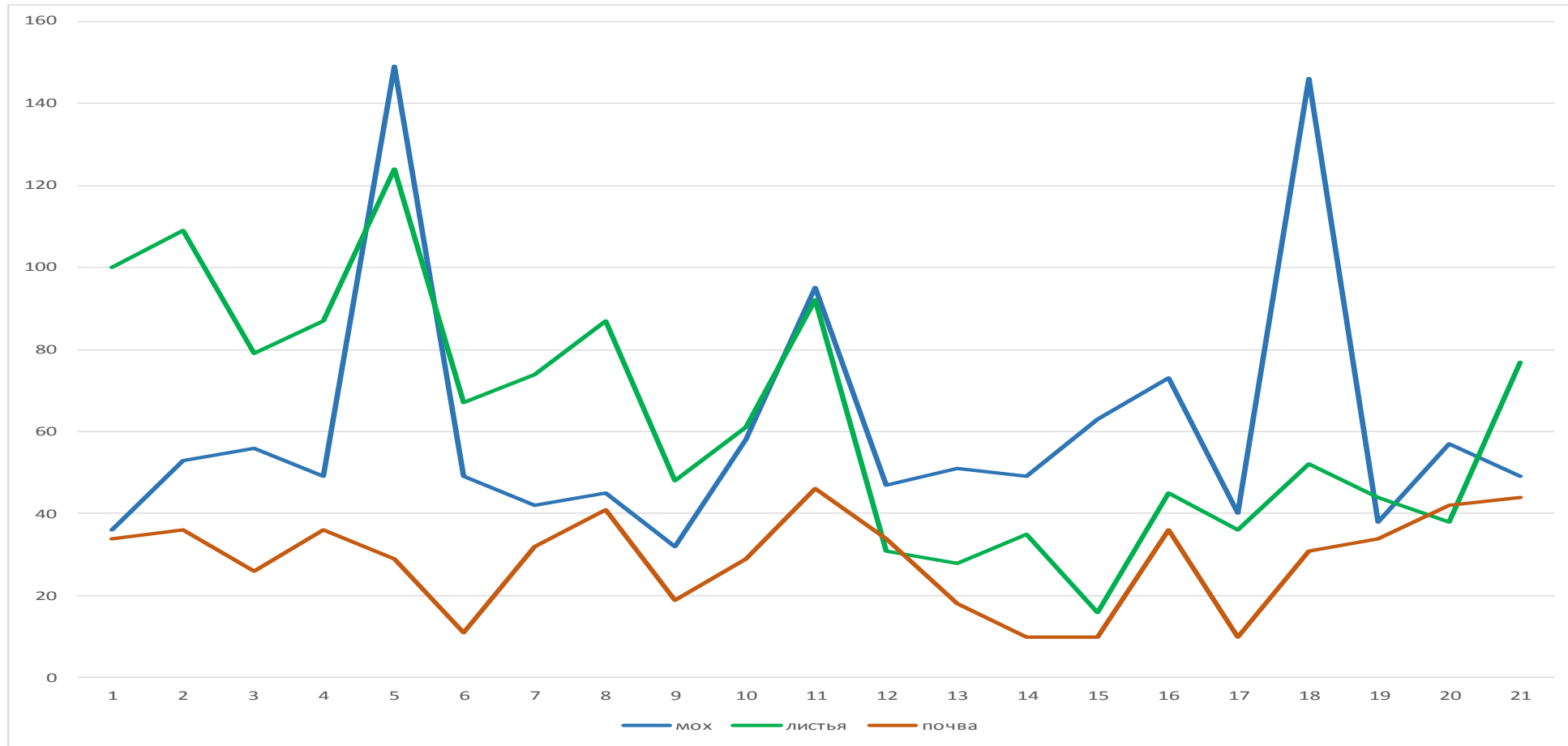


## Cu





The **low level** of pollution of all studied components was obtained on the territory of the **Tsaritsyno** and **Kuzminki-Lublino**; **high and moderate levels** of pollution were characteristic for the **Losiny Ostrov**, **Tsaritsyno** and **Izmailovo**. In other parks different degree of pollution levels for one or two studied components was identified.



1,2,3 – 1,2,3 sites **Ostankino**; 4,5,6 – 1,2,3 sites **Losiny Ostrov**; 7,8,9 – 1,2,3 sites **Сокольники**; 10,11,12 – 1,2,3 sites **Izmailovo**; 13,14,15 – 1,2,3 sites **Kuzminki-Lyublino**; 16,17,18 – 1,2,3 sites **Tsaritsyno**; 19,20,21 – 1,2,3 sites **Victory Park**



The pollution levels obtained when calculating  $Z_c$  for soils for more than half of the cases (**57%**) indicate high pollution, that can be associated with the ability of the soil to accumulate pollutants and a longer period of pollutants release into the soil by aerotechnogenic way.

In addition, a high level of soil pollution with insignificant aerotechnogenic impact may be associated with the other source of pollutants release, beside atmospheric deposition.

# Thank you for your attention!

