



The significance of visitors' pressure for soil status in an urban park in Tel-Aviv

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A park is one of the most important elements of sustainable development and optimization of the urban environment. The equilibrium within the complex of natural and anthropogenic factors defines the status of a park's ecosystem.

The seasonal dynamics and spatial variations of soil properties in areas under differing levels of visitors' pressure were studied in a park in Tel-Aviv. Soil was sampled twice a year, in wet (March) and dry (July) seasons, from three types of areas, subjected to differing levels of visitors' pressure: high, low and none (control). In each type of area samples were taken from two depths (0-2 cm and 5-10 cm), at 14-39 points. In total, 268 soil samples were taken. Before the soil sampling, penetration depth was determined at each point. In addition, the numbers of barbecue fires in each of the three areas were counted. Gravimetric soil moisture, organic matter, pH, electrical conductivity, and soluble ions were measured in 1:1 water extraction. Penetration depth and electrical conductivity, and organic matter, sodium, potassium and chlorite contents differed under differing levels of visitors' pressure, whereas soil moisture, pH and calcium content exhibited only minor differences. Soil moisture, electrical conductivity, and magnesium and chlorite contents exhibited strong seasonal changes, whereas the organic matter, potassium and pH levels were unaffected by seasonal dynamics. Calcium, organic matter, magnesium and chlorite contents, and electrical conductivity were significantly affected by the depth of soil sampling, whereas pH was not so affected. The seasonal changes in soil properties in the area subjected to high visitors' pressure were higher than in the one under low visitors' pressure.

In most cases, visitors' pressure led to increases in variance and coefficient of variation.

Different soil properties were differently affected by visitors' pressure, seasonal dynamics and soil depth. The surface of the soil was more sensitive to both seasonal dynamics and visitors' pressure, than the deeper layer. Visitors' pressure increased seasonal changes in the studied soil properties, and also increased the spatial heterogeneity of the soil.

The differences in organic matter, electrical conductivity and soluble ions among the areas under differing visitors' pressure are attributed to anthropogenic additions, which accompanied the recreational activities in the urban parks: remnants of barbecue fires and meals, and excreta of urban animals. Addition of urban dust, enriched in CaCO₃, minimized the effect of visitors' pressure on soil calcium content.

All the above anthropogenic additions enhance the differentiation in soil layers. The notable effect of visitors' pressure on variations in soil properties highlighted its high significance for urban parks.