AN ANALYSIS OF SOIL AND PLANT (TARAXACUM OFFICINALE) CONTAMINATION WITH HEAVY METALS AND POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN THE AREA OF THE RAILWAY JUNCTION IŁAWA GŁÓWNA, POLAND

M. MALAWSKA and B. WIŁKOMIRSKI*
Department of Plant Systematics and Geography, University of Warsaw, Warsaw, Poland
(* author for correspondence; fax: +48 226226646)

(Received 16 January 1998; accepted 16 May 2000)

Abstract. Polycyclic aromatic hydrocarbon and heavy metal (Pb, Cd, Cu, Zn, Hg, Fe, Co, Cr, Mo) contents were established in soil and plant samples collected in different areas of the railway junction Iława Główna, Poland. Soil and plant samples were collected in four functional parts of the junction, i.e. the loading ramp, platform area, rolling stock cleaning bay and the railway siding. It was found that the PAH contamination of soil and plants was the highest in the platform area and near the railway siding and lowest in the loading ramp and cleaning bay areas. The contamination exceeded control levels up to almost twenty fold. The heavy metal contamination pattern was different. The soil and plants were very highly contaminated in the cleaning bay and side track areas while the loading ramp and platform areas were less contaminated. A particularly high pollution level was observed for mercury in the cleaning bay area. Also lead, zinc and copper pollution levels were relatively high in the cleaning bay and side track areas. No significant increase in molybdenum content was observed in comparison with the control area.

Keywords: analysis, contamination, heavy metals, PAHs, plant, railway, soil

1. Introduction

Heavy metals and polycyclic aromatic hydrocarbons (PAHs) are important and well known pollutants that have been identified in diverse environmental matrices world-wide. Aliphatic and aromatic hydrocarbons as well as their chlorinated derivatives are common organic compounds that are part of the carbon cycle in the modern day environment (Kannan et al., 1995). Natural hydrocarbons are generally encountered at trace levels, whereas anthropogenic hydrocarbons originating from different sources are found at higher levels, particularly in areas associated with industrial and transportation activities. Amongst hydrocarbons, polycyclic aromatic hydrocarbons (PAHs) deserve particular attention due to their acute and chronic toxicity, as well as their stability which delays their degradation. During recent years many studies have been published concerning their levels in various biological materials, as well as their migration mechanisms. (Gardner et al., 1995; Jones et al., 1995; Wilcke et al., 1996).
The toxic influence of heavy metals on living organisms is indisputable. In excessive concentrations these elements cause internal body organ damage in animals and humans. While the natural content of heavy metals in soil is the result of formation factors (the soil type, climate, topography, time of appearance and biota), their current increase was caused by local and long-range pollution (Esser, 1996).

Rail junction areas in Poland are contaminated with numerous compounds and chemical substances, the source of which has not been fully established. Both substances used for rolling stock exploitation (machine grease, fuel oils, sleeper impregnation oils, transformer oils) and toxic substances processed by railway transport (some amounts of which may get into the environment due to the lack of proper security measures) may pollute surface soil layers, as well as plants and animals. More and more often information is being collected about mutagenic and carcinogenic effects of substances from the polycyclic aromatic hydrocarbon (PAH) group.

Soil and plant monitoring programmes concerning heavy metals have become routine in Poland. However, they only concern industrial areas and the surroundings of motors transport routes. There is a lack of data on the influence of railway transport on the levels of natural environment pollution. Due to our best knowledge (literature survey and information from Railway Scientific Centre of PKP – Polish State Railways) the present paper is the first publication concerning contamination due to railway activities.

The aim of this work is to present information concerning the pollution level of soil and plants of the *Taraxacum officinale* with heavy metals (Pb, Cd, Cu, Zn, Hg, Fe, Co, Cr, Mo) and PAHs in the area of the railway junction Iława Główna and to provide evidence that the railway transport is the source of above contamination.

### 2. Materials and Methods

#### 2.1. Study Area

The study was conducted in the area of the railway junction Iława Główna in northern Poland. The junction was built in about 1870. Between 1870 and 1945 it was situated in Germany and it constituted a strategic railway junction during the war.

After World War II it became an important junction in Polish Railway Network mostly due to its well-preserved infrastructure, but also because of its situation at the crossing of railway tracks connecting the east with the west, as well as southern and northern Poland. Geographically, the Iława Główna junction is situated about 200 km north of Warsaw on the Warsaw-Gdańsk railway route, in the western part of the Mazurian Lake Region. This area is not heavily polluted, since no heavy industry is concentrated there, and forests and lakes cover a high percentage of