# ENVIRONMENTAL RESEARCHES - A WAY OF GUIDING HIGH SCHOOL STUDENTS TO SCIENTIFIC RESEARCH

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*Abstract. An air quality study using lichens as biomonitors was done by involving of high school students. After a detailed describing of every stage of the research and their personal studies, they have participated on the selection of study area, sampling and data notation, samples preparation, analytical study by EDXRF method, graphical representations and interpretation of results. In all of these activities students have applied basic and advanced knowledge's from subjects like Physics, Chemistry, Biology, Math and IT; also, they have used modern instrumentation for analytical studies and modern software packages for data processing and interpretation; thus, they were able to understand the impact of human and economical activities on the quality of the environment and to present it to their colleagues in an symposium. A study of air quality using lichens as biomonitors was achieved by involving high school students. After a detailed analysis describes each stage of their personal research and study, they participated in selecting the study area, sampling and data notation, sample preparation, analytical study by EDXRF method, graphics and interpretation of results. In all these activities, students apply basic and advanced knowledge is from subjects such as physics, chemistry, biology, mathematics and IT, also have used modern tools for analytical and modern software packages for processing and interpretation data, so they were able to understand the impact of human activities on the environment and economic and submit it to their colleagues in a symposium.*

*Keywords: teach, science, students, environment, metals, pollution*

## 1. INTRODUCTION

The environmental research have been done on the Dambovita County, especially on Targoviste City and its surroundings; here are some economical units that produces pollutant gasses (steel works, cement factory, oil exploitations) and high values of road and rail traffic; it was important for us and to our students to see how affect all of these activities the environment and, possibly, the health of the humans.

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Having some experience in environmental studies and technical support offered by Multidisciplinary Research Institute for Sciences and Technologies from Targoviste, we have discuss the opportunity to involve high school students in these kind of researches; we decided that this idea will have only positive results for them, for us and for our institutions.

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We found a group of 5 students of the third year interested to begin theoretical study of all the stages of the research, then we begin to practice the sampling procedure followed by the real sampling of the lichens from established places.

Many studies [1-3] have proved that biomonitoring method with lichens can be used to make a good evaluation of air pollution with metals. By this method we determined the concentrations of metals like Cr, Cu, Fe, Ni, Pb and Zn from samples taken from sites that surround Targoviste from different distances and coverage with forests; for every of the 12 samples, we noted the moment of sampling, the GPS coordinating and took a picture of the sampling place; the samples was stored in clear plastic cups covered with plastic bags.
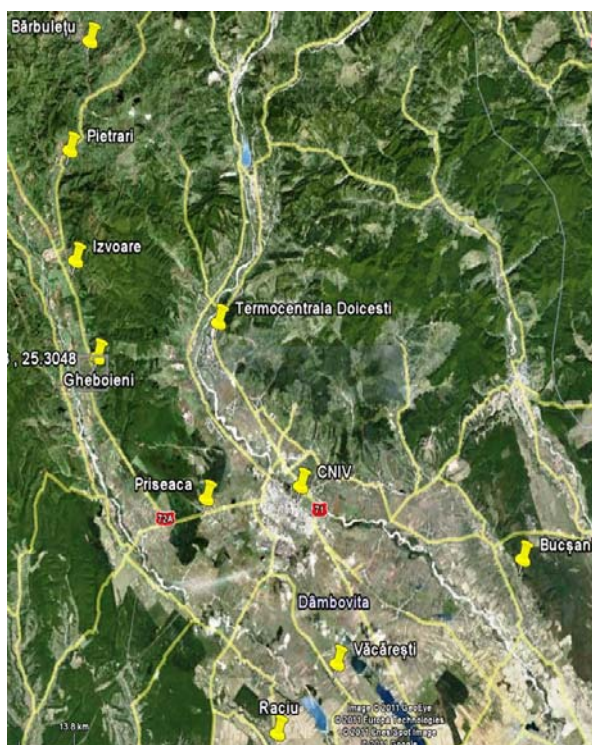


**Fig. 1. Places for sampling in Dambovita County.**

## 2. EXPERIMENTAL

The analytical method used in our research was Energy Dispersive X-ray Fluorescence (EDXRF); instrument that has been used was Elvatech Elvax EDXRF spectrometer; the lichen species sampled was *Xanthoria Parietina* during May of the 2011 year. The samples were prepared by drying followed by shredding and placing them into plastic cylinders covered with Mylar foils; this job was done by the students, helped by us, teachers. The XRF spectra for every sample were processed with the software of equipment and were obtained concentrations for Cr, Cu, Fe, Ni, Pb and Zn in mg/kg by an regression algorithm that have been build especially for lichen samples, based on analysis of the samples with known concentrations for these metals. Even subjects like X rays, X-ray tube and X-ray spectra are studied in the final year of high school at physics, we explained to the students the necessary knowledge's to understand the basics of X-rays emission and how the EDXRF spectrometer works.

## 3. RESULTS AND DISCUSSION

In Table 1 there are shown the concentrations and their corresponding errors for the studied elements.

**Table 1. The concentrations of Cr, Cu, Fe, Ni, Pb and Zn in lichen samples.**

| Element Location | Heavy metals concentration [mg/kg d.w.] | | | | | |
|---|---|---|---|---|---|---|
| | Cr | Cu | Fe | Ni | Pb | Zn |
| Priseaca | 6.79 ± 3.8 | 12.99 ± 0.82 | 174.11 ± 91.8 | 0.3 ± 0.62 | 40.76 ± 3.54 | 25.155 ± 10.26 |
| Doicesti | 7.13 ± 3.8 | 10.99 ± 0.82 | 318.08 ± 91.8 | 0.55 ± 0.62 | 37.5 ± 3.54 | 30.203 ± 10.26 |
| Raciu | 3.03 ± 3.8 | 9.61 ± 0.82 | 191.46 ± 91.8 | 0.33 ± 0.62 | 37.88 ± 3.54 | 26.334 ± 10.26 |
| Bucsani | 4.62 ± 3.8 | 6.3 ± 0.82 | 139.5 ± 91.8 | 0.24 ± 0.62 | 17.2 ± 3.54 | 14.46 ± 10.26 |
| Bucsani | 5.26 ± 3.8 | 5.77 ± 0.82 | 114.52 ± 91.8 | 0.2 ± 0.62 | 16.85 ± 3.54 | 14.063 ± 10.26 |
| Izvoare | 4.98 ± 3.8 | 8.75 ± 0.82 | 165.5 ± 91.8 | 0.52 ± 0.62 | 34.7 ± 3.54 | 21.3 ± 10.26 |
| Pietrari | 4.53 ± 3.8 | 6.11 ± 0.82 | 124.5 ± 91.8 | 0.45 ± 0.62 | 18.5 ± 3.54 | 19.6 ± 10.26 |
| Barbuletu | 4.12 ± 3.8 | 4.31 ± 0.82 | 118.5 ± 91.8 | 0.3 ± 0.62 | 15.8 ± 3.54 | 17.3 ± 10.26 |
| Gheboieni | 6.11 ± 3.8 | 7.98 ± 0.82 | 185.4 ± 91.8 | 0.41 ± 0.62 | 28.4 ± 3.54 | 20.15 ± 10.26 |
| Vacaresti | 13.34 ± 3.8 | 15.54 ± 0.82 | 791.25 ± 91.8 | 5.19 ± 0.62 | 23.48 ± 3.54 | 26.96 ± 10.26 |
| Targoviste | 39.19 ± 3.8 | 20.13 ± 0.82 | 5888.64 ± 91.8 | 10.12 ± 0.62 | 51.7 ± 3.54 | 104.22 ± 10.26 |
| Nat. Coll. I.Vacarescu | 22.83 ± 3.8 | 12.45 ± 0.82 | 1284.79 ± 91.8 | 2.21 ± 0.62 | 29.34 ± 3.54 | 55.49 ± 10.26 |

The data were used to draw the maps of equal concentrations for every element (Figs. 2- 7, the software used was Surfer).
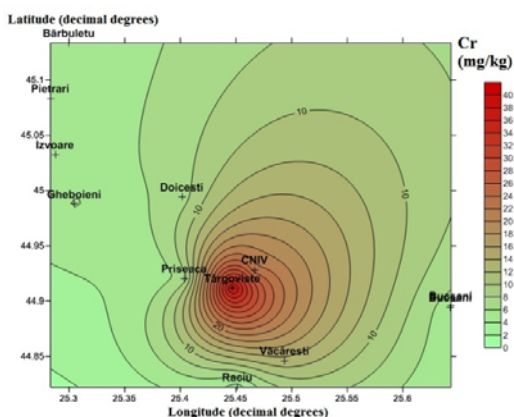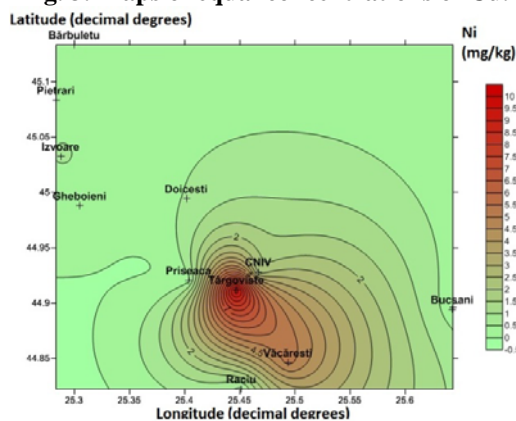


**Fig. 2. Maps of equal concentrations of Cr.**
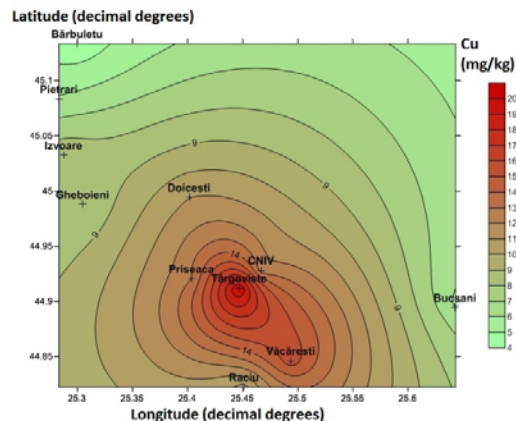


**Fig. 3. Maps of equal concentrations of Cu.**
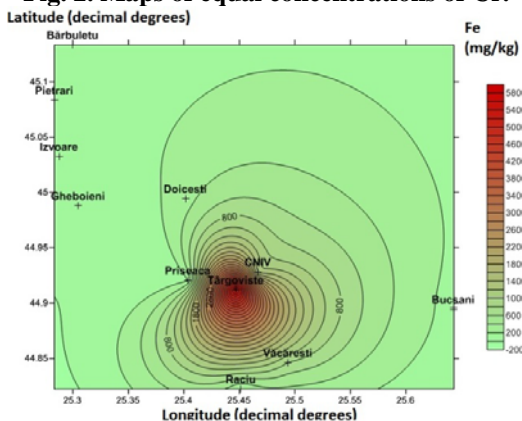


**Fig. 4. Maps of equal concentrations of Fe.**

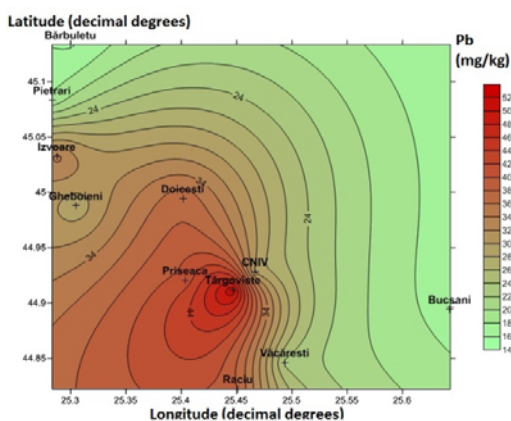

**Fig. 5. Maps of equal concentrations of Ni.**
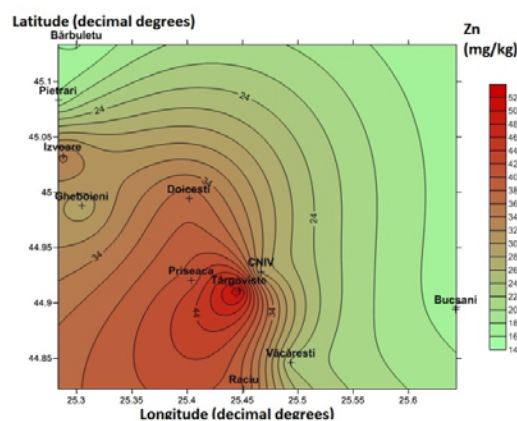
Fig. 6. Maps of equal concentrations of Pb.



Fig. 7. Maps of equal concentrations of Zn.

These maps helped students to find the sources of pollution and to see the distributions of the air pollutants on this area. They were able to see that distribution for pollutants like Pb is much less concentrated like the ones for Cr, Cu, Fe or Ni and this may be due to the contribution of the road and rail traffic in addition to the steel factories ones.

## 4. CONCLUSION

All activities performed in this research were considered interesting and useful by our students. They were excited to use modern instruments and complex software to obtain answers for relatively simple questions like: How much affect human activities the quality of the environment? For us, like teachers, was a positive experience in our concern to stimulate the scientific curiosity of our students.

## REFERENCES

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