

# BIOMONITORING OF ECOLOGICAL STATE OF THE ENVIRONMENT IN THE ZONE OF INFLUENCE OF THE “CHERVONOGRADSKA” MINE OF THE LVIV-VOLYN COALFIELD

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Coal mining has a very negative impact on the environment and it requires monitoring studies to assess the degree of environmental pollution.

Biological organisms are able to respond to negative changes in the environment. In particular, the environmental state of the environment can be estimated using the integral index of the fluctuating asymmetry of the assimilation apparatus of perennial tree plants. Fluctuating asymmetry are minor and random deviations from the strict bilaterally symmetry of biological objects. Fluctuating asymmetry of organisms by bilateral signs is an independent manifestation on one or both sides of the body, but to varying degrees of expressed signs, which makes it possible to use the fluctuating asymmetry to assess the stability of the organism's development. The degree of severity of the fluctuating asymmetry depends directly on the force of the factor's influence, the stronger the effect of the factor, the greater the deviation from the norm has the index of fluctuating asymmetry. A number of researchers have evaluated many urboecosystems in terms of fluctuating asymmetry. This method is not often used to assess the quality of the environment within the influence of mining objects. So we tried to apply the method of fluctuating asymmetry in the conditions of man-made influence of coal mine.

The research was conducted on the territory of the “Chervonogradska” mine. An analysis of the stability of development was carried out on an example of a leaf of Silver Birch (*Betula pendula*), as it is widespread. The material was collected after the growth of leaves was finished in August 2013, 2014 and 2017. We took 100 leaves of trees from each item (from 5 trees to 20 leaves). In total, 500 leaves were harvested and processed. The collection of leaves was based on the methodology of V. Zakharov. The method of determining the stability of the Silver Birch development by the magnitude of the fluctuating asymmetry of the leaf is based on the leaf measuring system. On each sheet we performed 5 measurements on the left and right sides of the leaf: the width of the halves of the leaf; the length of the second vein of the second order from the base of the leaf; the distance between the bases of the first and second veins of the second order; the distance between the ends of these veins; the corner between the main vein and the second from the base of the second-order vein. In addition, we took dusts from sheet plates, which were weighed and analyzed for the content of individual heavy metals.

According to the results of the calculations, we described the quality of the environment in the territory of the “Chervonogradska” mine. The rate of fluctuating asymmetry ranged from 0.041 to 0.041U within the background area. This indicates an initial deviation from the norm. Sheet plates have an asymmetry index within the limits of 0.053–0.055 on the upper part of the slagheap, 0.49–0.54 on the slopes of the slagheap, 0.47–0.51 at the foot of the slagheap. The value of the index of fluctuating asymmetry over 0.055 characterizes the ecological state of the environment as critical. The values of the indicator of the fluctuating asymmetry are closely correlated with the mass of dust collected from the surface of the leaf.

The dynamics of fluctuating asymmetry changes during field studies indicates a stable environmental situation within the background area and on the upper part of the slagheap and the deterioration of the environmental state of the environment on the slopes and foot of the slagheap.

*Conclusions.* The method of fluctuating asymmetry of birch leaves is characterized by good reproducibility. The values of the fluctuating asymmetry are closely correlated with the mass of dust. Therefore, the method of bioindication for determining the fluctuating asymmetry of the Silver Birch can be successfully applied to monitor the man-made impact of coal mines on the ecological state of the environment.

**Key words:** “Chervonogradska” Coal Mine, Fluctuating Asymmetry, *Betula pendula*