DESCRIPTION OF THE AIR AND SOIL CONTAMINATION LEVEL BY MEANS OF HIGHER ZOOTESTORS (VERTEBRATA) IN THE INDUSTRIAL REGIONS

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1. Introduction

Intensive industrial development causes transformational processes in ecosystems. Only 0.3–3.0% of natural systems areas remained undamaged under industrial technologies influence in the Ukrainian industrial regions disturbed systems (Bulakhov, 2000). Simple and quick methods of contamination level determination are needed to launch wide scale activities aimed at the disturbed ecosystems restoration and environment normalization. A lot of analytical methods are used to determine these levels, but all of them are complex and require expensive equipment. The higher vertebrates which are super sensitive to the metallurgical, mining and chemical emissions can be used as well.

As a rule, industrial areas' ecosystems are totally polluted by the ingredients effecting synergically the species' variability, number, structure of the populations, their reproductive and etiological pecularities. It is often impossible to indicate the separate pollutant effect. That is why it is expedient to determine the total contamination level according to the maximum permissible concentration.

A lot of data indicating the degree of pollutants' accumulation either in the animals body as a whole or in the organs and tissues, in particular, can not be considered proper while determining the ecosystems' contamination level (Bragin et al, 1993; Glazov, Leontyeva, Onufriev et al, 1993,Jatksibayev, 1993; Reva, 1995). The main emphasis should be laid upon the higher animals which are characterised by a high level of the space translocation and alternation of habitat. Thus such indicators as: species variability; number; animals energetic significance, are very important.

2. Higher zootestors (Vertebratae) as indices of environmental pollution

2.1 Structure of vertebrates community under different levels of pollution

2.1.1 Species diversity and number of animals

We selected forest ecosystems with different soil and air maximum permissible concentration level (the first contamination levels with maximum permissible

W. Breh et al. (eds.), Field Screening Europe 2001, 331-335.

concentration equal to 1.5-2. the second equal to 2.1-5.0, the third that of 5–10 and the fourth — 20–100).

Then we investigated different reactions of various vertebrates on the contamination level mentioned above. These reactions can be used as test indicators to determine to total level of environment contamination.

Traditional technique was used to determine the vertebrates species variability and number (Novikov, 1953). Small mammals absolute number was determined by means of the relevant data calculation. The data was obtained while the animals were cought alive according to U.P. Gubar (1976): $P = A^2/(A-B)$, where P is animals' absolute number per definite area, A — animals cought during the first period of time (first two days), B — the second half of the period.

Animals energetic significance was determined according to the formula suggested by A.N.Hemmingsen (1960): for cold blooded animals (amphibia and reptiles): $Q=16,5 \times m^{0,75}$; for passerine and non passerine birds: $Q=78,3 \times m^{0,723}$ and $Q=129 \times m^{0,724}$ — V.R. Dolnik (1969), P.P. Vtorov and N.A. Drosdov (1969) and for mammals: $Q=70 \times m^{0,72}$ McNabBrian (1963) — where Q is the main energetic significance, m – mass in kg. Morphophysiological parameters were investigated as S.S. Shwartz and et al recommended in 1968.

The most important index is species variability and animals quantitative evaluation. In case there was not any pollution in the ecosystem, the species variability was taken for 100 %. Under the initial contamination stages and its further heighthening the species variability is as follows: first contamination level is: in amphibia — 88 %; in reptiles — 60 %; in birds — 75 %; in mammals — 83 %; the second contamination level respectively is in amphibia — 62 %; in reptiles — 20 %; in birds — 47 %; in mammals — 63 %; the third contamination level is 39 %, 0 %, 19%, 35%; catastrophic fourth level is 0–25 %; 0 %, 6 %, 15 %. Being aware of these animals species variability extent, it is possible to determine the system total contamination level (table 1).

The vertebrates total number decreases in 1.2; 1.6; 2.8; 7.3 times and their energetic equivalent reduces in 1.5; 2.3 % and in 12.5 times in case the contamination level increases.

Energetic equivalent and number in the different groups of vertebrates under various environment contaminations conditions, are shown on the table 1.

2.1.2 Functional trophic structure

Animals functional trophic structure disorder is the next important item. Phitophage biomass increases in accordance with the contamination level growth in 1.1; 1.3; 1.5; 1.7 times and zoophage-heterotrophic biomass of the 2nd trophic level reduces in 1.2; 1.8; 4.5; 27 times; zoophage — heterotrophic organism of the 3-d trophic level (predators) in 1.9; 3.7 times and in two latter — diminish.

TABLE 1. Vertebrates species variability, abundance and energetic significance under the different levels of pollution by industrial emissions (in comparison with the non contaminated environment, industrial steppe Pridneprovye, 1995-2000

Indices	Contamination level*	Amphibia	Reptilia	Aves	Mammalia
Species variability	0	1	1	1	1
	1	0.88 0.82–0.94	0.60 0.41–0.68	0.75 0.69–0.81	0.83 0.74–0.89
	2	0.62 0.54–0.71	0.20 0.09–0.29	0.47 0.39–0.56	0.63 0.61–0.74
	3	0.39 0.33–0.47	0	0.19 0.12–0.24	0.35 0.24–0.43
	4	0.25 0.18–0.30	0	0.06 0.04–0.07	0.15 0.12–0.21
Number	0	1	1	1	1
	1	0.91 0.84–0.96	0.69 0.58–0.72	0.84 0.72–0.89	0.88 0.79–0.93
	2	0.75 0.68–0.81	0.30 0.18–0.34	0.68 0.52–0.76	0.79 0.66–0.84
	3	0.53 0.48–0.59	0	0.41 0.34–0.46	0.49 0.41–0.55
	4	0.19 0.16–0.24	0	0.11 0.07–0.15	0.26 0.19–0.38
Energetic equivalent	0	1	1	1	1
	1	0.85 0.79–0.91	0.52 0.44–0.57	0.71 0.65–0.74	0.60 0.49–0.68
	2	0.56 0.49–0.63	0.16 0.11–0.23	0.54 0.48–0.59	0.46 0.34–0.53
	3	0.18 0.12–0.25	0	0.21 0.18–0.24	0.33 0.31–0.36
	4	0.04 0.02–0.07	0	0.05 0.04–0.08	0.15 0.13–0.18

*Contamination level indices are presented above in the text.

TABLE 2. Vertebrates population structure indices under different contamination levels of soil and air by the industrial emissions (June-July 1997-2000).

Vertebrates groups	Contamination levels	Population structure	
		Age (yuv:adv.)	Sexual
Amphibia	1	3.1-3.8:1	1.2-1.3:1
	2	7.6-8.3:1	1-1.1:1.2
	3	15.6-16.3:1	1:2.5-2.9
Reptilia	1	2.7-3.1:1	1.1-1.2:1
	2	6.3-7.4:1	1.0-1.1:1
	3	12.7-13.3:1	1:1.1-1.3
Aves	1	2.5-2.7:1	1.1-1.3:1
	2	6.4-7.5:1	1:1.1-1.2
	3	13.2-13.6:1	1:1.2-1.3
Mammalia	1	2.5-2.7:1	1.2-1.3:1
	2	6.4-7.3:1	1:1.1-1.2
	3	13.2-13.6:1	1:1.6-1.2
Vertebrata	1	2.5-3.8:1	1.1-1.3:1
	2	6.2-8.3:1	1:1.2-1.3
	3	12.7-16.3:1	1:1.6-2.9

2.2 Indicators of a contamination level

2.2.1 Population indicators

Population indicators such as: population structure increase in different animal groups in the relation yuv:adv are appropriate to the general nature laws and in the total contamination level growth line are distributed in the following way: 2.5-3.8:1; 6.2-8.3:1; 12.7-16.3:1 (table 2). On the forth level the reproduction process stops at all. In the extraordinary conditions vertebrates age populations are presented by the fry at the expense of the migrations from the other areas.

These indices are proved by the population sexual structure alteration (males-females) respectively: 1.1–1.3:1; 1:1.2–1.3; 1:1.6–2.9 and 1:3.2–6.9. These population indicies are connected and reflect the reproduction level, under which the reproduction degree for the compensation of losts in the extraordinary situations, increases.

2.2.2 Morphological and biochemical indicators

Morphophysiological and biochemical indicators. As the contamination level increases the body length and weight becomes smaller (in 1.1–1.15; in 1.1–1.2; in 1.18–1.22; in 1.21–1.32 times). Such indicators decrease proves some metabolic processes heightening. It is common knowledge that metabolic processes' level has reverse dependence on body's weight (Shwartz et al, 1968). At the same time the limbs length increases in case the contamination level grows in 1.11–1.19 times. The heart, kidneys and liver weight also enlarges (on each level on 2–8 % in different animals) and glycogene amount decreases (in 1.2–1.3; 1.3–1.5; 1.4–1.7 and 1.6–2 times). Liver microsomic fraction content grows on 3–4 % in accordance with the contamination level.