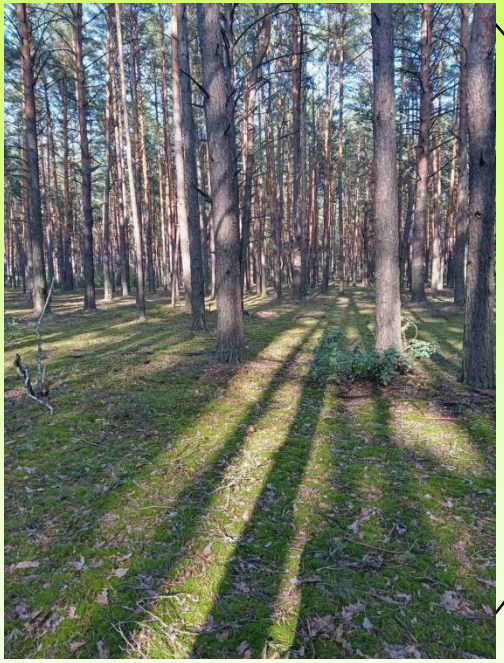
^{137}Cs and ^{90}Sr radionuclides accumulation by dominants and co-dominants of birch-pine forest communities of the *Peucedano-Pinetum* association



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Introduction

The ecological situation in the forests of Chernihiv region (Ukraine) is complicated by the factor of contamination of a significant area with radionuclides as a result of the accident at the Chernobyl nuclear power plant. The result of the accident is radioactive contamination of the territory with a mixture of products of nuclear decay and neutron activation. The radiation state of the territories is formed mainly under the influence of the long-existing radionuclides cesium-137 and strontium-90. The total area of the territories of Chernihiv Oblast classified as zones of radiation contamination due to the Chernobyl disaster by cesium-137 above 1 Ki/km2 is 174,715 thousand hectares, including agricultural land - 72,015 thousand ha, forests - 102,7 thousand ha and 107 settlements. Contamination of territories with Strontium-90 above 0.02 Ki/km2 is 97%.

Today, the most negative impact falls on forests, where pollution makes up more than 19% of the state forest fund. Of the 11 state forestry farms, nine are contaminated with Cesium-137 more than 1 Ki/km2, Strontium-90 – all.

Materials and methods

Samples were taken from forest communities on the territory of the Semenovsky forestry (northern part of the Chernihiv region).

The studied communities belong to the association *Peucedano-Pinetum* W.Mat. (1962) 1973, alliance *Dicrano-Pinion* Libbert 1933, order *Cladonio-Vaccinietalia* Kielland-Lund 1967, class *Vaccinio-Piceetea* Br.-Bl. 1939.

Sampling of plants determination of radionuclides performed according to existing methods. Determination of 137Cs content in plant samples produced on Tennelec-Oxford and Canberra-Pakard gamma ray spectrometers (USA), 90Sr - by radiochemical method with a radiometric ending at Canberra-2400.

Results

The ratio of the specific activity of radionuclides 137Cs and 90Sr

Plant sampling site	Plant species / Plant part	Specific activity, Bq/kg ^{137}Cs	Specific activity, Bq/kg ^{137}Cs
Bleshnianske forestry (I section)	*Betula pendula*, branches with leaves	135 (68%)	1050 (210%)
	Pinus sylvestris, branches with needles	95 (48%)	450 (90%)
	Vaccinium myrtillus, shoots	210 (105%)	1210 (242%)
	Calluna vulgaris, branches	123 (62%)	1520 (304%)
Bleshnianske forestry (II section)	*Betula pendula*, branches with leaves	160 (80%)	1200 (240%)
	Pinus sylvestris, branches with needles	125 (63%)	510 (102%)
	Vaccinium myrtillus, shoots	179 (90%)	1367 (273%)
	Pteridium aquilinum, leaves	236 (118%)	2860 (572%)
Orlykivske forestry (III section)	*Betula pendula* branches with leaves	204 (102%)	402 (80%)
	Pinus sylvestris, branches with needles	73 (37%)	457 (91%)
	Frangula alnus, branches with leaves	352 (176%)	212 (42%)
	Pleurozium schreberi, caulidia with philidia	135 (68%)	790 (158 %)
	Ptilium crista castrensis, caulidia with philidia	198 (99%)	480 (96%)

Discussion

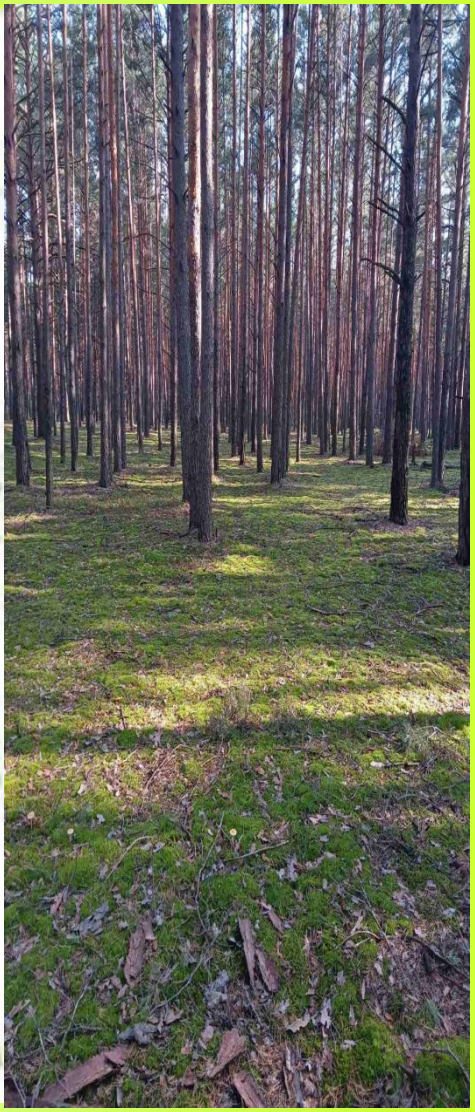
Analysis of the content of radionuclides in plant raw materials showed that the maximum content of 137Cs was recorded in plant samples of the common bracken - ***Pteridium aquilinum*** - 2860 Bq / kg (Bleshnyanske forestry, section II), common heather - Calluna vulgaris - 1520 Bq / kg (Bleshnyanske forestry, section I).

The minimum content of 137Cs was noted in Scots pine - ***Pinus sylvestris*** - 450 Bq / kg (Bleshnyanskoe forestry, section I), birch - ***Betula pendula-*** 402 Bq / kg (Orlikovskoe forestry), which is 0.9 and 0.8 times lower than the maximum allowable norms, the minimum content of 90Sr - in Scots pine - Pinus silvestris - 73 Bq / kg (Orlikovskoe forestry), Scots pine - Pinus silvestris - 95 Bq / kg (Bleshnyanske forestry, section I), which is below the maximum allowable norm.

Discussion

Exceeding the allowable rate of accumulation of 137Cs was recorded in representatives of both layers, while 90Sr was found only in the herbaceous-shrub layer.

The excess of the norm is in warty birch - by 110% (I plot) and 140% (II plot), blueberries - by 142% (I plot) and 173% (II plot), common heather - by 204% (I plot), bracken – by 472% (section II) for 137Cs; in common bracken - by 18% (plot II), blueberries - by 5% (plot I) for 90Sr.



Discussion

In terms of **137Cs** accumulation, plants form the following diminutive series:

common heather (1520 Bq/kg) – bilberry (1210 Bq/kg) –

warty birch (1050 Bq/kg) –

Scotch pine (450 Bq/kg)

in the first plot ;

common bracken (2860 Bq/kg) –

bilberry (1367 Bq/kg) –

warty birch (1200 Bq/kg) –

Scotch pine (510 Bq/kg)

in the first plot ;

Discussion

The decreasing series for the specific activity of **90Sr** in the areas of the Bleshnyanske forest area is as follows: **common bracken (236 Bq/kg) – blueberry (210 Bq/kg) – warty birch (160 Bq/kg) - Scotch pine (125 Bq/kg) – common heather (123 Bq/kg) – common pine (95 Bq/kg).**

Accordingly, the layers are arranged in the following order: grass-shrub - tree, which indicates that the maximum content of 137Cs and 90Sr is observed in the grass-shrub layer, in the tree - much less or is within the normal range.

Exceeding the accumulation rate for 137Cs was recorded in a representative of the moss layer - ***Pleurozium schreberi* - by 58%** and in 90Sr - *Frangula alnus* - by 76%.

Conclusion

- According to the indications of the specific activity of 137Cs, the plants form the following row (as they decrease): Pleurozium schreberi – Ptilium crista castrensis – Pinus sylvestris – Betula pendula – Frangula alnus. The decrease in the specific activity of 90Sr is observed in the following order: Frangula alnus – Betula pendula – Ptilium crista castrensis – Pleurozium schreberi – Pinus sylvestris.
- The obtained data on the accumulation of 137Cs and 90Sr radionuclides indicate that the accumulation of 90Sr by plants is less intense than that of 137Cs. In the soils of natural ecosystems, the distribution of radiostrontium is similar to the distribution of radioactive cesium.
- Nevertheless, 90Sr migrates down the soil profile more intensively and its main part is in the root-bearing soil layer. Therefore, the high bioavailability of 90Sr can subsequently cause significant equal accumulations of it by representatives of the vegetation cover of the forest biocenosis.