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REGIMUL DE UMIDITATE ȘI TEMPERATURĂ AL SOLURILOR DIN REZERVAȚIA „CODRII” ÎN TIMPUL PERIOADEI DE VEGETAȚIE 2023

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Pe teritoriul Rezervației clima se caracterizează prin alternarea perioadelor de secetă cu abundențe de precipitații. Iernile sunt relativ blânde cu puțină zăpadă, perioada caldă preponderent secetoasă. Ploile abundente pot condiționa scurgerea superficială, însă în pădure ele nu provoacă eroziunea solului.

Relieful are un rol important în formarea climei. Altitudinile variate și fragmentarea teritoriului provoacă perturbări, de la un loc la altul, ale presiunii atmosferice și temperaturii aerului, ale cantității de precipitații atmosferice.

Suprafețele de probă cercetate sunt situate pe partea superioară și mijlocie a pantelor, cu aflarea stratului freatic la adâncimi mari. Pentru aceste suprafețe este caracteristic regimul hidric periodic percolativ, adică are loc percolarea profilului de sol până la nivelul pânzei freatice numai în unii ani, și anume în acei cu precipitații abundente. Umiditatea se menține în sol numai din precipitațiile atmosferice.

Cuvinte-cheie: *suprafață de probă, perioadă de vegetație, șleau de deal, goruneto-fag, sol, procent de umiditate, temperatură, protosol, molisol, indice de ariditate.*

AMOISTURE AND TEMPERATURE REGIME OF THE SOILS IN THE „CODRII” RESERVE DURING THE 2023 VEGETATION PERIOD

On the territory of the Reserve, the climate is characterized by the variability of conditions, the alternation of periods of drought with abundance of precipitation. Winters are relatively mild with little snow, the warm period is mostly dry. Heavy rains can condition surface runoff, but in the forest they do not cause soil erosion.

Relief plays an important role in climate formation. The varied altitudes and the fragmentation of the territory cause disturbances, from one place to another, of atmospheric pressure and air temperature, of the amount of atmospheric precipitation.

The investigated sample surfaces are located on the upper and middle sides of the slopes, with the water table being found at great depths. For these surfaces, the periodic percolative water regime is characteristic, that is, the percolation of the soil profile to the level of the water table occurs only in some years, namely in those with abundant precipitation. Moisture is maintained in the soil only from atmospheric precipitation.

Keywords: *sample area, vegetation period, hill saddle, goruneto-fag, soil, moisture percentage, temperature, protosol, molisol, aridity index.*

Introduction

The soils of the Reserve demonstrate the action of vertical and horizontal zoning and some regional laws. Thanks to the research carried out so far, we can consider that on the predominant heights of the Codrilor Plateau (>280 m) the brown soils were formed - valuable products of hill plowing with gorun and beech.

In the altitudinal range 140–280 m gray soils are widespread, mostly typical. As well as on the brown loess soils, with which they are in contact, on these soils are spread the mountain sedges with gorun and oak and goruneto-fagetele [5].

The classification of the Reserve's soils is correlated with the major units of the FAO/UNESCO Legend (International System), with the respective units of the previous classification and of the Romanian Soil Classification System (Romanian System of Classification, 1980), implemented through a computerized program in the works of plot description by the Forestry Research and Development Institute (ICAS), [1; 3; 7].

According to the Planning of the „Codrii” Natural Reserve, 2020 edition, [2] and taking into account stationary factors, it was found that most of the resorts are of superior creditworthiness - 84%, followed by resorts of medium creditworthiness - 16%. The largest extent within the reserve is held by the hilly stands of gorunets, goruneto-sleaurs on sunny and semi-sunny slopes (64%), followed by the hilly stands of cycads with lower limit beech, mixed sallow and beech, on shaded slopes (21%).

In the forest fund of the reserve, the mollisol class predominates, which owns 65% of the total area of forests and lands intended for afforestation. Gray soils are the most prevalent in the reserve (65%), followed by brown soils (33%) and alluvial soils (2%).

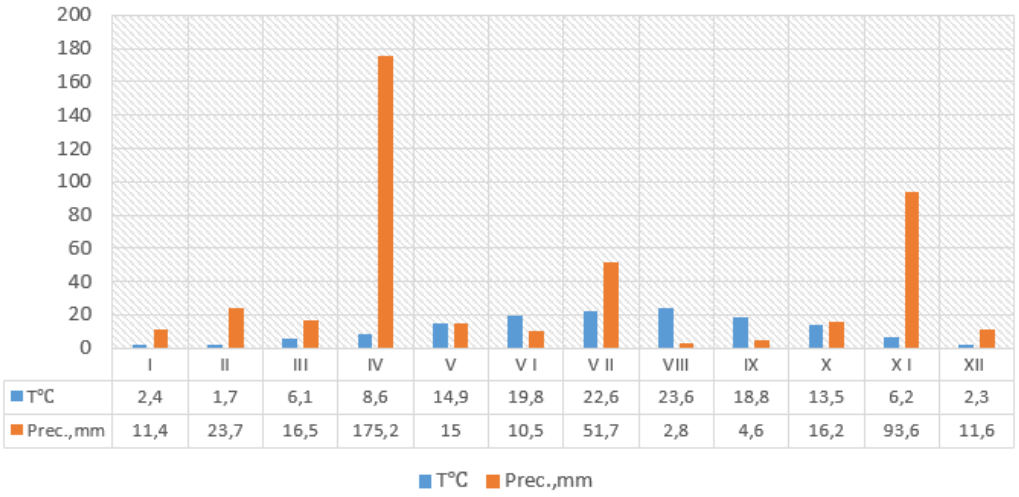
Importance for the iwrm

Climatic conditions directly condition the existence of forest resorts. On the territory of the Reserve, the climate is characterized by the variability of conditions, the alternation of periods of drought with abundant rainfall. Winters are relatively mild with little snow, the warm period is mostly dry. Heavy rains can condition surface runoff, but in the forest they do not cause soil erosion. The concentration of torrents that can cause linear erosion occurs only due to technological interventions – along roads, depressions, canals, etc.

Relief plays an important role in climate formation. The varied altitudes and the fragmentation of the territory cause disturbances, from one place to another, of atmospheric pressure and air temperature, of the amount of atmospheric precipitation. The forest massifs have a local impact on the climate by reducing the amplitudes of the air temperature, increasing the humidity and precipitation, reducing the wind speed, etc.

The highest temperatures were recorded in July – 22.6^{0}C and August – 23.6^{0}C. And the lowest - in February 1.7^{0}C (figure 1).

Fig. 1. The average air temperature and the amount of atmospheric precipitation (mm) monthly. Meteorological station „Codrii” (2023).



The largest amount of atmospheric precipitation fell in April – 175.2 mm. The lowest amount of atmospheric precipitation fell in August – 2.8 mm and 4.6 mm respectively in September.

Application methods and materials

Test surfaces 12G, 12F and 12A are located on the top and middle of the slopes, with the water table being found at great depths. For these surfaces, the periodic percolative water regime is characteristic, that is, the percolation of the soil profile to the level of the water table occurs only in some years, namely in those with abundant precipitation. Moisture is maintained in the soil only from atmospheric precipitation.

Samples for soil moisture determination are collected from the soil layers at the depth: 0-5cm; 5-10 cm; 15-20 cm; 45-50 cm; 95-100 cm from the test surfaces. The soil temperature is recorded at 0-5cm and at a depth of 95-100 cm.

Three samples are taken from each layer. The dishes are weighed with the technical scale with a precision of 0.01 gr. From the experimental land, 1/3 of the pot is filled with soil, weighed and dried in an oven at 105° C [8].

The soil dries 2-3 times. The first time - 6 hours, the second - 4 hours, the third - 4 hours. After each drying, the results are entered in the log. After drying, the pots are weighed and the soil moisture is calculated according to the formula: **W = a x 100 / b; W- soil moisture / % /; a – mass of evaporated moisture / gr /; b – mass of dry soil / gr /.**

Test surface 12A

Type of resort – 6271 – hilly with oaks and hornbeams, on the valley and lower third of the slope, with gray soils, Asperula-Asarum-Stelaria, Bs. Area – 353.0 ha (7%) and superior credit rating category – 353.0.

Forest type – 6211 - mountain oak, Ps;

Soil type – 1609 – (according to the 2020 Planning) - light gray sandy loam;

Soil type (A. Ursu, 2006) - whitish gray sandy-clay soil

Kneaded lower slope, NW exposure, inclination 26°, altitude 135-190 m.

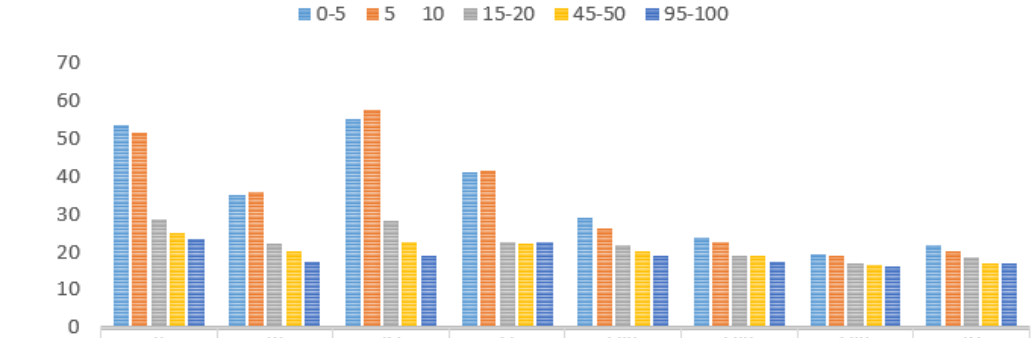
Current Comp. – 1St2St2Go1Fr1Fr1Ca1Ca1Ju

Composition - goal - 4St3Go1Fr1Ca1Ju

Sub-tree: Corn Cls Dirm Pad.So.n /0.2 PE 0.2S mixt

The average humidity [8] of the light gray sandy-loamy loam under the hill oak (plot 12A) in the 2023 vegetation period (0-100 cm layer) was: in February – 36.53%; March – 26.23%; April – 36.59%; May – 29.98%; June – 23.38%; July - 20.49%; August – 17.72% and respectively in September – 18.88%. Compared to the 2022 growing season: February – 34.62%; March – 34.31%; April – 36.08%; May – 37.60%; June – 25.20%; July - 17.47%; August – 20.52% and respectively in September – 19.91% (figure 2).

Fig. 2. The moisture dynamics of the light gray sandy-loamy loam under the mountain oak in the 2023 vegetation period (sample surface 12 A, % compared to the dry soil at 105^0 C).



	II	III	IV	V	VIII	VIII	VIII	IX
0-5	53,63	35,29	55,21	41,24	29,27	23,89	19,52	21,71
5 10	51,71	35,96	57,57	41,54	26,45	22,77	19,1	20,26
15-20	28,79	22,36	28,29	22,53	21,85	19,2	17,14	18,53
45-50	25,11	20,29	22,72	22,1	20,14	19,02	16,47	16,87
95-100	23,42	17,24	19,13	22,49	19,18	17,58	16,34	17,03

Test surface 12G

The type of station - 6253 – hilly of cycads with lower limit sedges, mixtures of sedge with beech on shaded slopes with typical gray soils, soft, brown edaphic loess high with Asperula-Asarum, Bs. Area – 777.9 ha (15%) and superior credit rating – 777.9.

Forest type - 5312 – mountain ridge with gorun and beech, Ps;

Soil type – 9401 (according to the 2020 Planning) – clayey alluvial protosol (unassessed soils);

Soil type (A. Ursu, 2006) – clayey protosol

The researched sample area is distinguished by its rugged relief and fossil landslides. The pedological pro-

file (0-100 cm) was excavated on a slope with an inclination of 20°, northeast exposure, altitude 150-250 m. The soil cover is inhomogeneous. Effervescence - from a depth of 8 cm.

Lower slope.

Current Comp. – 1Fa1Go1Fr1Te1Ca3Fa1Go1Go

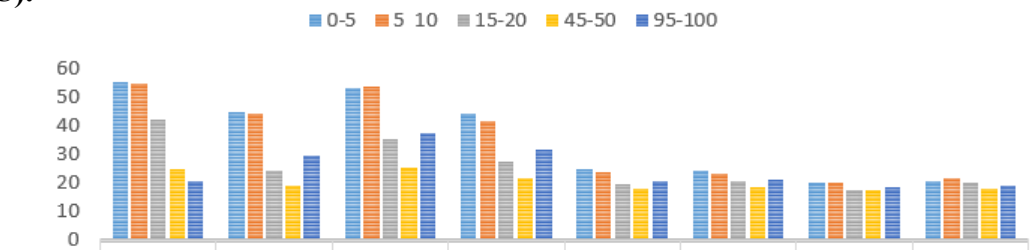
The target component - 3Fa4Go1Fr1Te1Ca

Natural fundamental superior production;

Subtree: Horn Cls Dirm Pad. /0.1 ON 0.2S int

The average humidity of the clayey alluvial protosol under the hill saddle with gorun and beech (plot 12G) in the 2023 vegetation period (0-100 cm layer) was: in February – 39.72%; March – 29.64%; April – 37.59%; May – 31.55%; June – 20.52%; July - 21.09%; August – 18.38% and respectively in September – 19.28%. Compared to the 2022 growing season: February – 36.36%; March – 36.62%; April – 36.24%; May – 39.06%; June – 24.03%; July - 17.71%; August – 21.28% and respectively in September – 21.48% (figure 3).

Fig. 3. The dynamics of the moisture of the clayey alluvial protosoil under the hill saddle with gorun and beech during the 2023 vegetation period (sample surface 12 G, % compared to the dry soil at 105⁰ C).



	II	III	IV	V	VI	VII	VIII	IX
0-5	55,3	45	53,59	44,56	24,85	24,45	20,19	20,76
5 10	55,14	44,21	53,9	41,53	23,73	23,41	20,11	21,57
15-20	42,39	24,58	35,48	27,62	19,61	20,9	17,66	19,91
45-50	25,15	19,05	25,45	21,66	18,2	18,51	17,37	17,78
95-100	20,64	29,64	37,59	31,55	20,52	21,09	18,38	19,28

Test surface 12F

The type of station – 6253 – hilly of cycads with lower limit sedges, mixtures of sedge with beech on shaded slopes with typical grey, soft, brown loess soils high edaphic with Asperula-Asarum, Bs. Area – 777.9 ha (15%) and superior credit rating – 777.9.

Forest type – 5311 – goruneto-sleau with beech, Ps;

Soil type – 1609 – (according to the 2020 Planning) - light gray clayey-loamy molisol;

Soil type (Ursu, 2006 classification) – light gray clay-loamy soil

The upper part of the slope on the 20º slope of a large wave of landslides with northeast exposure, altitude 155 - 270 m above sea level. Hill sled with gorun. Effervescence - from a depth of 77 cm.

Soil name - light gray clay-clay and loam on underlying strongly pseudoglazed (stagnant) clay-clay and clay-clay deposits.

Current Comp. – 1Go1Go2Go1Fr1Fr1Te2Te1Ca

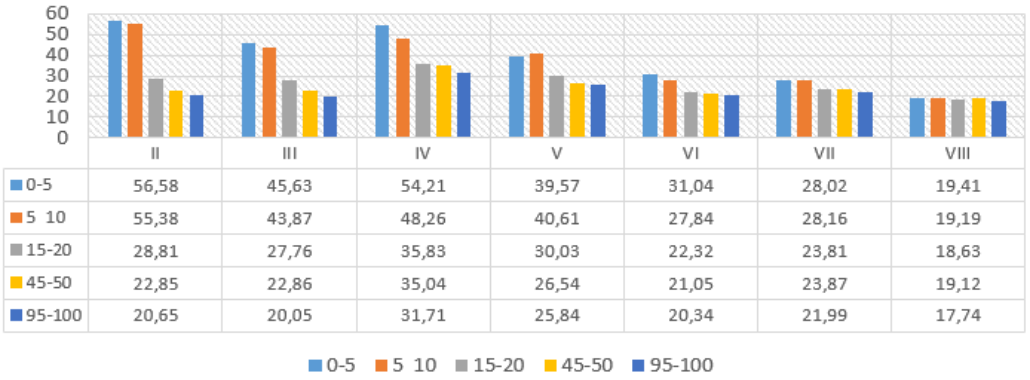
The target component - 5Go2Fr1Fr1Ca1Te

Subtree: Corn Cls Dirm Pad.Mcs. /0.2 ON 0.2S mixed

The average humidity of the light gray loamy clay loam under the goruneto-sleau with beech (plot 12F) in the 2023 vegetation period (0-100 cm layer) was: in February – 36.85%; March – 32.03%; April – 41.01%; may –32.52%; June – 24.52%; July - 25.17%; August – 18.82% and respectively in September – 20.13%.

Compared to the growing season 2022: February – 38 98%; March – 43.45%; April – 37.35%; May – 32.14%; June – 27.59%; July - 21.77%; August – 25.09% and respectively in September – 26.77% (figure 4).

Fig. 4. Moisture dynamics of the light gray clayey-loamy mollisol under goruneto-sleau with beech during the 2023 vegetation period (above sample 12F, % compared to dry soil at 105⁰ C).



	II	III	IV	V	VI	VII	VIII
0-5	56,58	45,63	54,21	39,57	31,04	28,02	19,41
5 10	55,38	43,87	48,26	40,61	27,84	28,16	19,19
15-20	28,81	27,76	35,83	30,03	22,32	23,81	18,63
45-50	22,85	22,86	35,04	26,54	21,05	23,87	19,12
95-100	20,65	20,05	31,71	25,84	20,34	21,99	17,74

Test surface 12V

Soil type (Ursu, 2006 classification) - stratified alluvial

The stratified alluvial soil was formed under predominantly underwater conditions. It occupies the meadow of plot 12. The soil profile is very different, the morphological construction has gleic characters. Altitude 146 m.

Morphological characterization:

Reserve meadow, hydrophilic vegetation, depression, altitude 146 m;

I - 0-13 cm, black, poorly structured, on the surface whitish, moist, clayey;

II - 13-44 cm, gray with rust spots, unstructured, moist, clayey;

III - 44-67 cm, grey-brown, non-homogeneous, with rust spots, clayey;

IV - 67-92, brown, inhomogeneous with rust and gray spots, clayey, gleic;

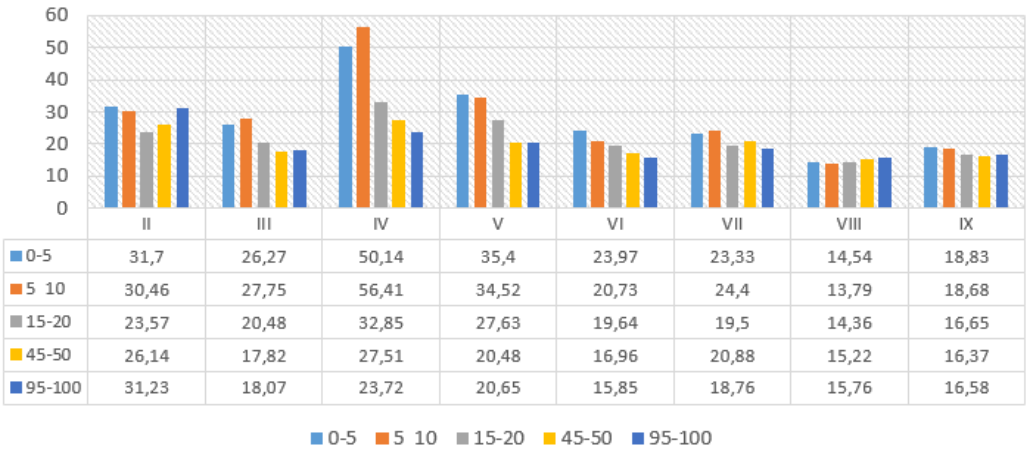
V - 92-115, yellowish, inhomogeneous, variegated, clayey;

The profile is obviously stratified, without structure, clayey predominantly anaerobic. The profile is weakly humiferous, the surface layer is weakly turfified. In the dry state, the surface is whitish. Effervescence is missing, the reaction of the soil is neutral.

The average humidity of the stratified alluvial soil from the reserve meadow (plot 12V) during the vegetation period of 2023 (0-100 cm layer) was: in February – 28.62%; March – 22.08%; April – 38.13%; May –27.74%; June – 19.43%; July - 21.37%; August – 14.73% and respectively in September – 17.42%.

Compared to the 2022 growing season: in February – 17.91%; March – 24.57%; April – 19.87%; May –22.90%; June – 19.85%; July - 14.11%; August – 15.17% and respectively in September – 13.23% (figure 5).

Fig. 5. The dynamics of the stratified alluvial soil humidity in the meadow of the reservation during the period of vegetation 2023 (sample surface 12V, % compared to dry soil at 105⁰ C).



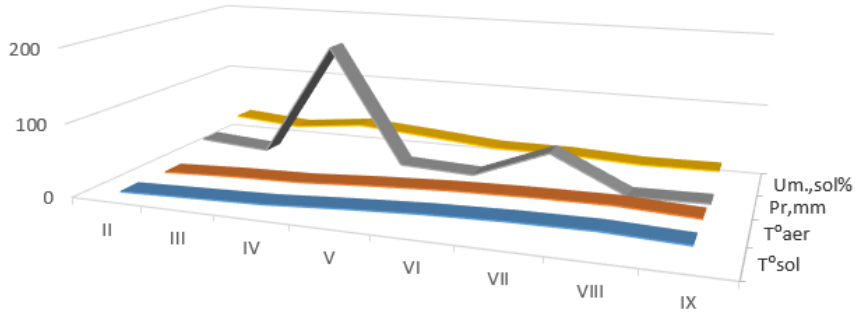
	II	III	IV	V	VI	VII	VIII	IX
0-5	31,7	26,27	50,14	35,4	23,97	23,33	14,54	18,83
5 10	30,46	27,75	56,41	34,52	20,73	24,4	13,79	18,68
15-20	23,57	20,48	32,85	27,63	19,64	19,5	14,36	16,65
45-50	26,14	17,82	27,51	20,48	16,96	20,88	15,22	16,37
95-100	31,23	18,07	23,72	20,65	15,85	18,76	15,76	16,58

Results and discussion

During the vegetation period of 2023, the highest percentage of soil moisture was recorded in all sample areas investigated in April - 38.33%, also in April the most atmospheric precipitation fell 175.2 mm. The lowest percentage of soil moisture – 17.41% was recorded in August, and the least precipitation fell in June and August – 10.5 mm and 2.8 mm, respectively.

The highest air temperatures were recorded in July and August – 22.6 ℃ and 23.6 ℃ respectively. And of the soil – 26.05℃ in August. The lowest air temperatures – 1.7℃ in February, and of the soil – 4.03℃ in February (figure 6).

Fig. 6. Correlation between soil moisture and temperature, air temperature and the amount of atmospheric precipitation in the growing season of 2023.



	II	III	IV	V	VI	VII	VIII	IX
T°sol	4,03	7,06	10	16,41	21,78	24,88	26,05	22,2
T°aer	1,7	6,1	8,6	14,9	19,8	22,6	23,6	18,8
Pr,mm	23,7	16,5	175,2	15	10,5	51,7	2,8	4,6
Um.,sol%	35,43	27,5	38,33	30,45	21,96	22,03	17,41	18,93

T°sol T°aer Pr,mm Um.,sol%

Some findings during the 2023 growing season:

During the vegetation period, the lowest percentage of humidity - 9.18% was recorded on June 7, 2023 in the stratified alluvial soil of the reserve's meadow - 12V- (95-100 cm). The highest percentage of humidity - 70.34% was recorded on April 25, 2023 in light gray sandy-loamy loam under the hill oak - 12A- (5-10 cm).

The lowest soil temperatures – 0.7℃ (0-5 cm) on February 11, 2023 and respectively 3.8℃ (95-100 cm) on February 13, 2023 were recorded in the stratified alluvial soil of the meadow reservation (12 V). The highest soil temperatures – 30.8℃ (0-5 cm) and 25.0℃ (95-100 cm), respectively, were in the stratified alluvial soil of the reserve meadow (12 V on August 27, 2023.

During that period there was a small danger of pedological drought in August, because very little atmospheric precipitation fell - 2.8 mm, air temperatures were high - 23.6℃ and air humidity was low, which led to a decrease in reserves of water from the soil.

* * *

The area of vulnerability of forest resorts in the reserve to drought can be reproduced by using the De Martonne Aridity Index, [4] calculated according to the formula:

IDM=P/(T+10), where:

P – annual average of atmospheric precipitation, mm - 438.2;

T – annual average air temperature, ^{0}C - 11.7;

The degree of aridity of the investigated surfaces, according to the De Martonne index, in 2023 is 20.2. In 2022 it was - 20.5. In 2021 - 38.1.

The values of this index – 20.2 correspond to the climatic conditions of the forest-steppe zone with an average level of vulnerability with some humidity disturbances.

References:

1. *Analele Naturii*, ediția 2022, 2023. Lozova, 2024.

2. *Amenajamentul Rezervației Naturale „Codrii”.* Chișinău, 2020.
3. *Fructificarea cvercineelor din Rezervația „Codrii”*. Litera, Chișinau, 2020.
4. NEDEALCOV, MARIA, DONICA, ALA. *Evaluări privind impactul secetei asupra speciilor de stejar (Quercus robur, Q.petraea, Q.pubescens) în condiții de aridizare a climei // Starea actuală a componentelor de mediu.* Chișinău, 2019.
5. URSU, ANDREI, BARCARI, ECATERINA. *Solurile Rezervației „Codrii”*. Chișinău - Lozova, 2011, 81 p. ISBN 978-9975-62-283-7.
6. URSU, A. *Degradarea solurilor și deșertificarea.* Chișinău,2000, 307 p. ISBN9975-9580-1-X.
7. УРСУ, А. *Природные условия и география почв Молдавии*. Кишинев, 1977.
8. КАУРИЧЕВ, И. С. *Практикум по почвоведению.* Москва «КОЛОС», 1980, с. 72-76.

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