

ECOLOGICAL CHARACTERISATION OF THE CORMOPHYTE FLORA FROM VALEA RECE BROOKBASIN (HARGHITA COUNTY)

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Key words: cormophytes, humidity, temperature, soil reaction, trophicity, light

INTRODUCTION

Valea Rece Brook is a tributary in the Upper Trotus River basin, with a length of 21 Km and a surface of 124 Km². It flows from Bolovanul Mare Peak (Tarcău Mountains), having tributaries all the way to the foot of Hațeg Mountains, on the territory of Harghita and Bacău counties. The flora of this region has only become known after 1990, because the studies dated before this period focused on the neighbouring areas of this valley.

MATERIAL AND METHOD

The field investigations were undertaken in 2011-2013. The ecological interpretations were performed using H. Elleberg (1992), A. Borhidi (1999) and Sârbu et al. (2013)

RESULTS AND DISCUSSIONS

There were identified 476 species listed below:

PTERIDOPHYTA: *Asplenium ruta-muraria* L.; *A. adnigrum* Milde; *A. trichomanes* L.; *A. viride* Huds.; *Athyrium filix-femina* (L.) Roth.; *Botrychium lunaria* (L.) Sw.; *Dryopteris filix-mas* (L.) Schott.; *D. thelypteris* (L.) A. Gray; *Cystopteris fragilis* (L.) Bernh.; *Equisetum arvense* L.; *E. hyemale* L.; *E. limosum* L.; *E. palustre* L.; *E. sylvaticum* L.; *Equisetum telmateja* Ehrh.; *Gymnocarpium dryopteris* (L.) Newman; *Lycopodium clavatum* L.; *L. complanatum* L.; *Phaegopteris dryopteris* Fée; *Polypodium vulgare* L.; *Polystichum lobatum* (Huds.) Presl.; *Pteridium aquilinum* (L.) Kuhn.

PINOPHYTA: *Abies alba* Mill.; *Juniperus communis* L.; *Picea abies* (L.) Karst.; *Pinus sylvestris* L.

MAGNOLIOPHYTA; MAGNOLIATA: *Acer campestre* L.; *A. platanoides* L.; *A. pseudoplatanus* L.; *Achillea collina* Becker; *Achillea distans* W. et K.; *A. millefolium* L.; *A. setacea* W. et K.; *Acoitum moldavicum* Hacq.; *A. lasianthum* (Rchb.) Simk.; *A. toxicum* Rchb.; *A. variegatum* L.; *Actaea*

spicata L.; *Adenostyles alliariae* (Gouan) Kern.; *Aethionema saxatile* (L.) R.Br.; *Agrimonia eupatoria* L.; *Ajuga genevensis* L.; *A. reptans* L.; *Alchemilla connivens* Buser; *A. xanthochlora* Rothm.; *Alliaria officinalis* Andr.; *Alnus incana* (L.) Mch.; *Amaranthus albus* L.; *Ambrosia trifida* L.; *Anagallis arvensis* L.; *Anchusa thessala* Boiss. et Sprün.; *Anemone narcissifolia* L.; *A. nemorosa* L.; *A. ranunculoides* L.; *Angelica palustris* (Bess.) Hoffm.; *Angelica sylvestris* L.; *Antennaria dioica* (L.) Gaertn.; *Anthemis tinctoria* L.; *Anthriscus sylvestris* (L.) Hoffm.; *Anthyllis vulneraria* L.; *Aquilegia nigricans* Baumg.; *A. vulgaris* L.; *Arabidopsis thaliana* (L.) Heinh.; *Arctium lappa* L.; *Arctium tomentosum* Mill.; *Arenaria serpyllifolia* L.; *Armoracia lapatifolia* Gilib.; *Artemisia absinthium* L.; *A. vulgaris* L.; *Asperula cynanchica* L.; *Astragalus cicer* L.; *Astrantia major* L.; *Atragene alpina* L.; *Atriplex tatarica* L.; *Atropa belladonna* L.; *Barbarea vulgaris* R. Br.; *Bellis perennis* L.; *Betula pendula* Roth.; *Bunias orientalis* L.; *Bupleurum falcatum* L.; *Calamintha alpina* (L.) Lam.; *Caltha palustris* L.; *Campanula abietina* Gris. et Sch.; *C. carpatia* Jacq.; *Campanula glomerata* L.; *Campanula patula* L.; *C. persicifolia* L.; *C. rapunculoides* L.; *C. rapunculus* L.; *C. serrata* (Schult) Hendrich.; *C. trachelium* L.; *Capsella bursa-pastoris* (L.) Mch.; *Cardamine amara* L.; *C. glanduligera* Schv.; *C. impatiens* L.; *C. pratensis* L.; *Cardaminopsis arenosa* (L.) Hay; *Carduus acanthoides* L.; *Carlina acaulis* L.; *Carpinus betulus* L.; *Carum carvi* L.; *Centaurea carpatia* (Porc.) Wagn.; *C. melanocalathia* Prod.; *C. phrygia* L.; *C. scabiosa* L. ssp. *apiculata* (Ledeb.) Mikheev; *C. spinulosa* Rochel; *C. triumfetti* All.; *Centaureum umbellatum* Gilib.; *Cerastium anomalum* W. et K.; *C. brachypetalum* Desp.; *C. fontanum* Baumg.; *C. glomeratum* Thuill.; *C. semidecandrum* L.; *C. silvaticum* W. et K.; *Chaerophyllum aromaticum* L.; *Ch. aureum* L.; *Ch. bulbosum* L.; *Ch. hirsutum* L.; *Ch. temulum* L.; *Chamaenerion angustifolium* (L.) Scop.; *Chenopodium glaucum* L.; *Chrysanthemum corymbosum* L.; *Chrysosplenium alternifolium* L.; *Cicerbita alpina* (L.) Wallr.; *Cichorium inthybus* L.; *Circaea lutetiana* L.; *Cirsium arvense* (L.) Scop.; *C. decussatum* Jka.; *C. erisihales* (Jacq.) Scop.; *C. oleraceum* (L.) Scop.; *C. pannonicum* (L. f.) Link.

Cirsium rivulare (Jacq.) Link.; *C. waldsteinii* Rouy.; *Clematis integrifolia* L.; *Clematis recta* L.; *Coronilla varia* L.; *Corylus avellana* L.; *Cotoneaster integerrima* Medik.; *Crataegus monogyna* Jacq.; *Cruciata laevipes* Opiz.; *Cruciata pedemontana* (Bellardi) Ehrend.; *Cytisus nigricans* L.; *Daphne mezereum* L.; *Daucus carota* L.; *Delphinium simonkaianum* Pawl.; *Dentaria bulbifera* L.; *D. glandulosa* W. et K.; *Dianthus armeria* L.; *Digitalis grandiflora* Mill.; *Dipsacus laciniatus* L.; *D. pilosus* L.; *Doronicum austriacum* Jacq.; *Echinocystis echinata* Torr. et Gray; *Echium vulgare* L.; *Ecinops exaltatus* Schrad.; *Epilobium collinum* Gmel.; *E. montanum* L.; *Erigeron acris* L.; *E. annuus* Pers.; *Erysimum witmannii* Zaw. ssp. *transilvanica* (Schur.) P. V. Ball; *Eupatorium cannabinum* L.; *Euphorbia amygdaloides* L.; *E. platyphyllos* L.; *E. polychroma* Kern.; *Euphrasia rostkoviana* Hayne; *E. salisburgensis* Funck.; *E. stricta* Host.; *Fagus sylvatica* L.; *Fragaria vesca* L.; *F. viridis* Duch.; *Fraxinus excelsior* L.; *Galeopsis speciosa* Mill.; *G. tetrahit* L.; *Galinsoga parviflora* Cav.; *Galium mollugo* L.; *G. odoratum* (L.) Scop.; *G. palustre* L.; *G. schultesii* Vest.; *G. verum* L.; *Genista sagittalis* L.; *G. tinctoria* L.; *Gentiana asclepiadea* L.; *G. cruciata* L.; *G. utriculosa* L.; *Gentianella praecox* (A. Kern et Jos. Kern.) Dostál; *Gentianopsis ciliata* (L.) Ma; *Geranium palustre* Torn.; *G. phaeum* L.; *G. pratense* L.; *G. robertianum* L.; *Geum rivale* L.; *Geum urbanum* L.; *Glechoma hederacea* L.; *Helianthemum alpestre* (Jacq.) DC.; *H. hirsutum* (Thuill) Mérat; *H. nummularium* (L.) Mill.; *Helleborus purpurascens* W et K.; *Hepatica transilvanica* Fuss; *Heracleum sphondylium* L.; *Hieracium aurantiacum* L.; *H. murorum* L.; *H. transylvanicum* Heuff.; *H. umbellatum* L.; *Hippophaë rhamnoides* L.; *Hypericum elegans* Steph.; *H. hirsutum* L.; *H. maculatum* Cr.; *H. montanum* L.; *H. perforatum* L.; *H. tetrapterum* Fries; *Hypochoeris maculata* Cr.; *H. radicata* L.; *H. uniflora* Vill.; *Impatiens noli-tangere* L.; *Inula britannica* L.; *I. hirta* L.; *Jovibarba heuffelii* (Schott) Á Löve et D. Löve; *Knautia arvensis* Coult.; *Lamium album* L.; *L. maculatum* (L.) L.; *Laserpitium prutenicum* L.; *Lathyrus pratensis* L.; *Leontodon autumnalis* L.; *Leucanthemum vulgare* Lam.; *Libanotis montana* Cr.; *Linaria vulgaris* Mill.; *Linum catharticum* L.; *Lithospermum officinale* L.; *Lonicera xylosteum* L.; *Lotus corniculatus* L.; *Lychnis viscaria* L.; *Mentha pulegium* L.; *Malus sylvestris* (L.) Mill.; *Medicago falcata* L.; *M. lupulina* L.; *Melampyrum bihariense* Kern.; *M. cristatum* L.; *Melilotus officinalis* (L.) Medik.; *Mentha longifolia* (L.) Nath.; *Mercurialis perennis* L.; *Moehringia trinervia* (L.) Clairv.; *Mycelis muralis* (L.) Dum.; *Myosotis sylvatica* Hoffm.; *Myosoton aquaticum* (L.) Moench.; *Myricaria germanica* (L.) Desf.; *Ononis arvensis* L.; *Origanum vulgare* L.; *Orthilia secunda* (L.) House; *Oxalis acetosella* L.; *Parnassia palustris* L.; *Petasites albus* (L.) Gärtn.; *P. hybridus* (L.) G. M. Sch.; *P.*

kablikianus Tausch.; *Peucedanum alsaticum* L.; *Phyteuma tetramerum* Schur; *Picris hieracioides* (L.) Huds.; *Pimpinella saxifraga* L.; *Plantago atrata* Hoppe; *Plantago lanceolata* L.; *P. media* L.; *Polygala amara* L.; *P. vulgaris* L.; *Polygonum hydropiper* L.; *P. lapathifolium* L.; *Potentilla erecta* (L.) Hampe; *Potentilla recta* L.; *P. reptans* L.; *Primula elatior* (L.) Hill.; *P. minima* L.; *P. veris* L.; *Prunella vulgaris* L.; *Pulmonaria rubra* Schott.; *Ranunculus carpathicus* Herbach; *R. platanifolius* L.; *R. acris* L. ssp. *acris*, ssp. *friesianus* (Jord.) Rouy et Foucaud.; *R. cassubicus* L.; *R. repens* L.; *Ribes uva-crispa* L.; *Rosa arvensis* Huds.; *R. canina* L.; *R. pendulina* L.; *R. tomentosa* Sm.; *Rubus caesius* L.; *R. hirtus* W et K; *R. idaeus* L.; *Rumex acetosa* L.; *Rumex acetosella* L.; *R. conglomeratus* Murr.; *R. crispus* L.; *Sagina procumbens* L.; *Salix alba* L.; *S. aurita* L.; *S. capraea* L.; *S. cinerea* L.; *S. elaeagnos* Scop.; *S. fragilis* L.; *S. pentandra* L.; *S. silesiaca* Willd.; *S. starkeana* Willd.; *S. triandra* L.; *S. viminalis* L.; *Salvia nutans* L.; *S. pratensis* L.; *S. verticillata* L.; *Sambucus nigra* L.; *S. racemosa* L.; *Sanicula europaea* L.; *Saxifraga adscendens* L.; *S. paniculata* Mill.; *Scabiosa columbaria* L.; *S. ochroleuca* L.; *Scorzonera rosea* W. et K.; *Sedum acre* L.; *Sempervivum montanum* L. ssp. *carpathicum* Wettst. Ex Hayek.; *Senecio doria* L.; *S. jacobaea* L.; *Senecio nemorensis* L.; *Senecio ovatus* (G. Gaertn. et al.) Willd.; *S. vulgaris* L.; *Seseli libanotis* Koch; *Silene dioica* (L.) Clairv.; *Silene latifolia* Poir. ssp. *alba* (Mill.) Greuter et Burdet; *Sisymbrium officinale* (L.) Scop.; *Sorbus aucuparia* L.; *Spiraea ulmifolia* Scop.; *S. chamaedrifolia* L.; *Stachys sylvatica* L.; *S. officinalis* Trev.; *Stellaria graminea* L.; *S. media* (L.) Cyr.; *S. nemorum* L.; *Symphytum cordatum* W et K.; *S. officinale* L.; *Syringa vulgaris* L.; *Tamarix ramosissima* Ldb.; *Telekia speciosa* (Schreb.) Baumg.; *Teucrium chamaedrys* L.; *Thalictrum aquilegifolium* Cr.; *Th. minus* L.; *Thesium bavarum* Schrank; *Th. alternans* Klokov; *Th. pannonicus* All.; *Th. pulegioides* L.; *Trifolium alpestre* L.; *T. campestre* Schreb.; *T. ochroleucon* Huds.; *T. pannonicum* Jacq.; *T. pratense* L.; *T. repens* L.; *T. spadiceum* L.; *Trollius europaeus* L.; *Tragopogon pratensis* L.; *Tussilago farfara* L.; *Urtica dioica* L.; *Vaccinium myrtillus* L.; *V. vitis-idaea* L.; *Valeriana officinalis* L.; *V. tripteris* L.; *Verbascum nigrum* L.; *V. speciosum* Schrad.; *V. thapsus* L.; *Veronica chamaedris* L.; *V. officinalis* L.; *V. serpyllifolia* L.; *Vicia cassubica* L.; *Vicia cracca* L.; *V. hirsuta* (L.) S.F. Gray; *sepium* L.; *V. sylvatica* L.; *V. tenuifolia* Roth.; *Viola declinata* W. et K.; *V. montana* L.; *V. reichenbachiana* Jord. Ex Boreau; *V. tricolor* L.;

LILIATAE: *Agrostis capillaris* L.; *A. stolonifera* L.; *Alisma plantago-aquatica* L.; *Alopecurus pratensis* L.; *A. ventricosus* Pers.; *Anthoxanthum odoratum* L.; *Apera spica-venti* (L.)

P. B.; *Arrhenatherum elatius* (L.) Presl.; *Avenula planiculmis* (Schr.) W. Sauer et Chmel.; *Blysmus compressus* (L.) Panz.; *Brachypodium pinnatum* (L.) P.B.; *B. sylvaticum* (Huds.) P. B.; *Briza media* L.; *Bromus arvensis* L.; *Calamagrostis epigejos* (L.) Roth.; *Carex digitata* L.; *C. distans* L.; *C. flacca* Schreb.; *C. flava* L.; *C. fusca* All.; *C. lasiocarpa* Ehrh.; *C. leporina* L.; *C. pallescens* L.; *C. pendula* Huds.; *C. rostrata* Stokes.; *C. sylvatica* Huds.; *C. vulpina* L.; *Cephalanthera damasonium* (Mill.) Druce; *C. longifolia* (Huds.) Frisch.; *C. rubra* (L.) L. C. Rich.; *Colchicum autumnale* L.; *Cynosurus cristatus* L.; *Dactylis glomerata* L.; *Dactylorhiza incarnata* (L.) Soó; *D. maculata* Soó; *Deschampsia cespitosa* (L.) P.B.; *Eleocharis palustris* (L.) Roem et Schult.; *Elymus repens* (L.) Gould.; *Epipactis atrorubens* (Hoffm.) Schult.; *E. helleborine* (L.) Crantz; *Epipactis palustris* Hoffm.; *Eriophorum latifolium* Hoppe; *Festuca nigrescens* Lam.; *F. pratensis* Huds.; *Festuca rubra* L.; *F. valesiaca* Schleich.; *Glyceria notata* Chevall.; *Gymnadenia conopsea* (L.) R. Br.; *Holcus lanatus* L.; *Hordelymus europaeus* (L.) Jess.; *Juncus articulatus* L.; *J. bufonius* L.; *J. compressus* Jacq.; *J. conglomerates* L.; *J. inflexus* L.; *J. tenuis* Willd.; *Lilium bulbiferum* L.; *Listera ovata* (L.) R.Br.; *Lolium perenne* L.; *Luzula luzuloides* (Lam.) Dandy; *L. pallescens* Hoppe; *Maianthemum bifolium* (L.) F. Schm.; *Melica uniflora* Retz.; *Nardus stricta* L.; *Neottia nidus-avis* (L.) Rich.; *Orchis sambucina* L.; *O. coriophora* L.; *O. globosa* L.; *O. maculata* L.; *O. morio* L.; *O.*

ustulata L.; *Phleum alpinum* L.; *Ph. pratense* L.; *Platanthera bifolia* (L.) L. Rich.; *P. chlorantha* (Cust.) Rchb.; *Poa nemoralis* L.; *P. pratensis* L.; *Polygonatum verticillatum* (L.) All.; *Scirpus sylvaticus* L.; *Sieglingia decumbens* (L.) Bernh.; *Triglochin palustris* L.; *Veratrum album* L..

The spectrum of bioforms

In the basin of this brook, the distribution of life forms on species is as follows: chameophytes 3.63%, chameophytes-phanerophytes 0.85%, chameophytes-hemicryptophytes 1.92%, geophytes 13.03%, geophytes-hemicryptophytes 1.50%, geophytes-helohydaphytes 0.21%, phanerophytes 10.04%, hemicryptophytes 48.50%, hemicryptophytes-helohydaphytes 0.85%, hemitherophytes 4.27%, hemitherophytes - hemicryptophytes 3.21%, helohydaphytes 0.43%, therophytes 9.83%, therophytes - hemicryptophytes 1.50%

The ratio of hemicryptophytes: geophytes of 48.50% to 13.03% is closer to the original vegetation of our country.

The small percentage of therophytes, compared with low altitude areas indicates a reduced degree of anthropisation.

Helohydaphytes are fewer because there are no humid areas, except for some swamps reduced in size.

Reported to country proportion, the number and surface of phanerophytes is higher because it is a forest area of middle mountain zone (Fig. 1)

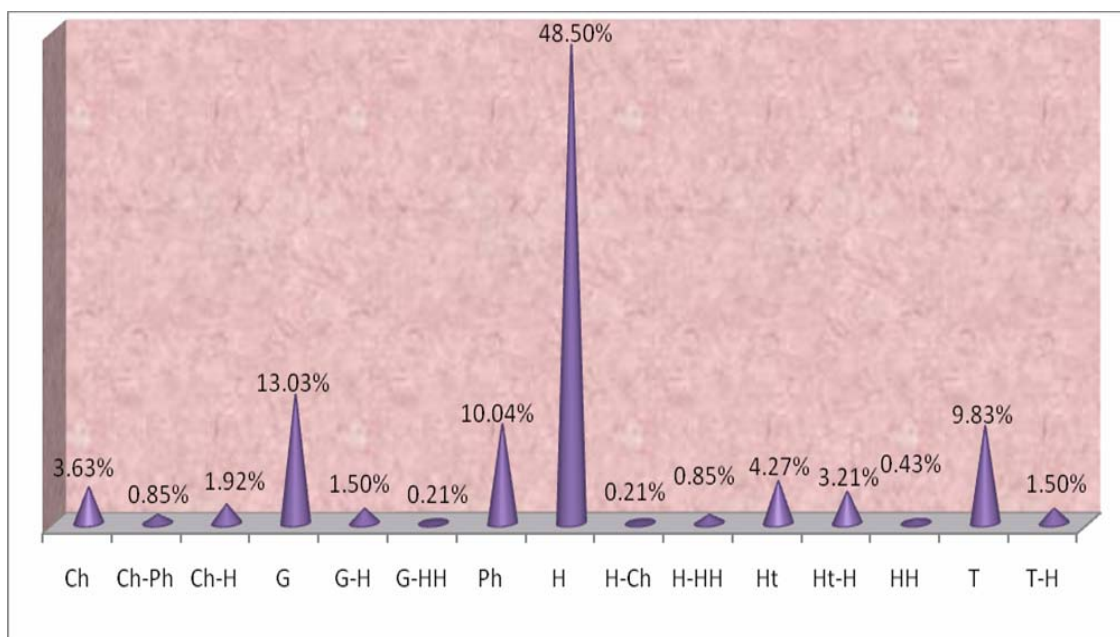


Fig.1 The spectrum of bioforms for cormophyte flora from Valea-Rece

Humidity

Xerophilespecies (U₁) detain a small share (0.42%); on rocky places were identified *Sedum acre*, *Aethionema saxatile*.

Xero-indicatorspecies (U₂) are found in a percentage of 2.54% including: *Achillea colina*, *Viola tricolor*, *Festuca valesiaca*, *Centaurea spinulosa*.

Xerotolerant species (U₃) represent 10.38% of all plants inventoried and include: *Medicago falcata*, *Origanum vulgare*, *Centaurea apiculata*, *Inula hirta*, *Senecio jacobaea*, *Verbascum thapus*.

Mesophyteto weak xerophytespecies (U₄+U₅+U₆) are plants living in areas with an optimum quantity of humidity, but surviving in places with a slight humidity deficit. They hold a significant proportion of all plants, ie 59.32%: *Lotus corniculatus*, *Ononis arvensis*, *Genista tinctoria*.

The species on damp soils (U₇) represent 12.24% (*Ulmus glabra*).

Plants tolerant to marshy soils (U₈) hold 7.65% (*Ranunculus repens*, *Angelica sylvestris*, *Myricaria germanica*, *Juncus articulatus*, etc.)

Plants on completely unaired soils (U₉) represent 4.59% (*Caltha palustris*, *Equisetum palustre*, *Salix alba*, *Angelica palustris*, *Carex flava*)

The species on frequently flooded soils (U₁₀) hold 1.02%. Examples: *Glyceria notata*, *Eleocharis palustris*, *Alisma plantago-aquatica* (Fig. 2).

Temperature. Most species are mesothermophile (T₅=42.98%) followed by submesothermophile (T₆=23.54%) and submesophile (T₄=14.25%). The lowest percentages are for: eurithermic (T₀=7.78%), subthermophile (T₇=5.18%), thermophile (T₈=2.16%) and subalpine species (T₃=3.46%) (Fig. 3).

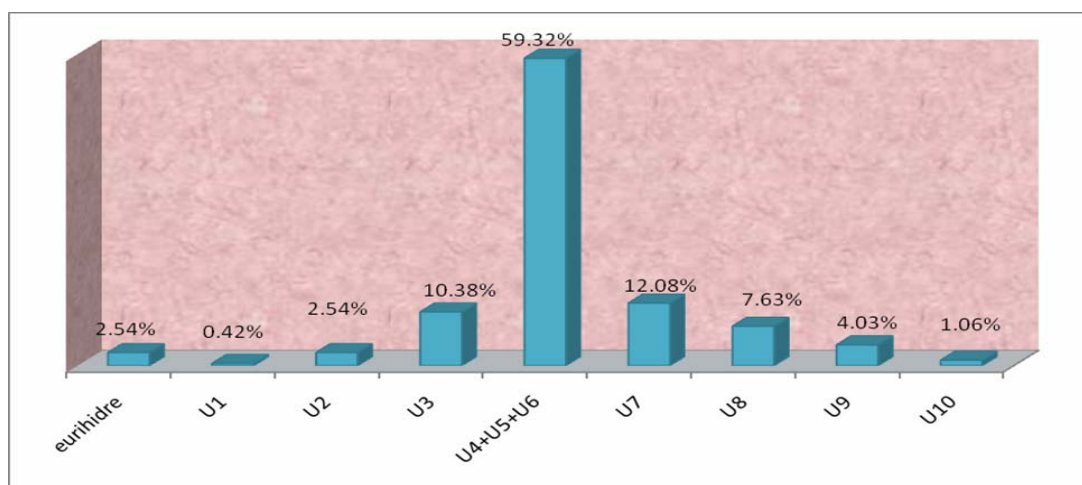


Fig.2. Dynamics of humidity indices for cormophyte flora from Valea-Rece

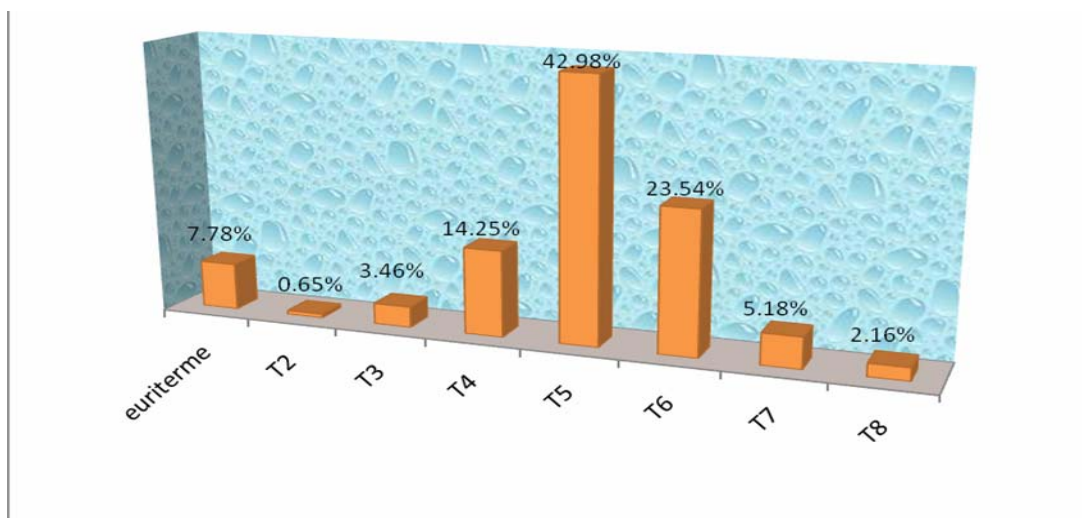


Fig. 3. Dynamics of temperature indices for cormophyte flora from Valea-Rece

Soil reaction

Depending on the preferences p-H, plants are grouped into the following categories: highly acid (R1= 0,22%), acid (R 2=1,09%), frequently acid (R3=2.61%), moderately acid (R4=7.41%), weakly acid (R5=12.64%), neuter (R6=25.27%), frequently basic (R7=23.09%), basophil (R8=18.08%), calciphile (R9=1.31%), euri-ionic (Rx=8.28%).

Plants with neuter and weakly basic pH are dominant, given that the substrate is predominantly calcareous, as in the neighbouring Hășmaș Mountains (Fig. 4)

Trophicity

There are eutrophic plants (Nx=9.85%), on

soils poor in mineral nitrogen (N1=2.51%), plants with preference between stages 1 and 3 (N2=14,88%), plants from poor in mineral nitrogen (N3=13,42%), plants with preference between stages 3and5 (N4=14,05%), plants on soils with a moderate concentration of mineral nitrogen (N5=15.93%), plants with preference between stages 5and7(N6=9,64%), plants from soils rich in mineral nitrogen (N7=10.69%), plants with preference between stages 7and9(N8=6.92%), plants on soils excessively rich in mineral nitrogen (N9=2.10%). It is a mountainous region where most species are adapted to low nitrogen concentrations. (Fig. 5)

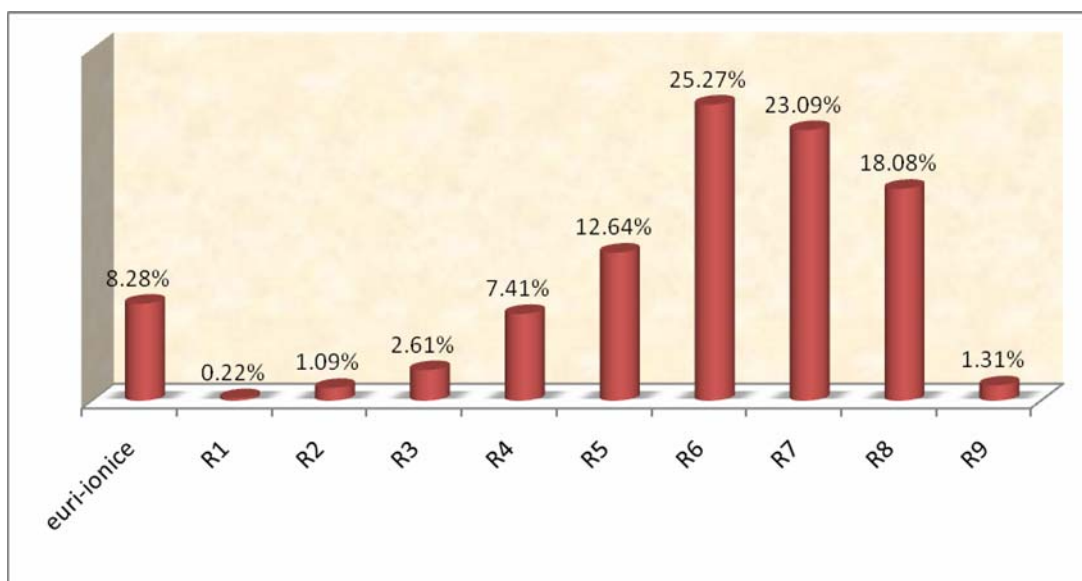


Fig. 4 Dynamics of soil reaction indices for cormophyte flora from Valea-Rece

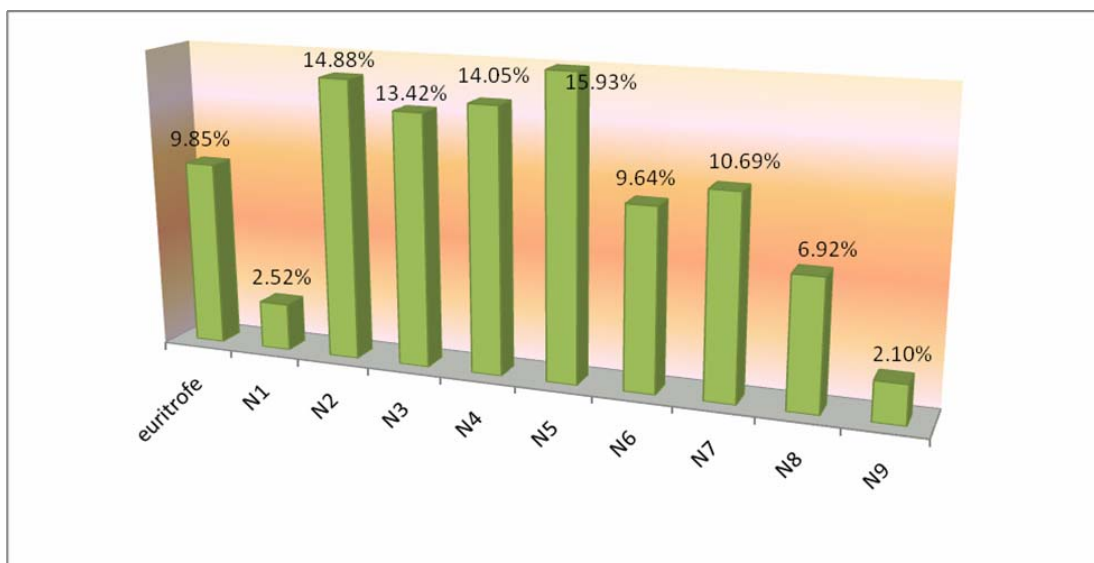


Fig. 5 Dynamics of trophicity indices for cormophyte flora from Valea-Rece

Light

Depending on this factor, there are the following categories: plants (W = 1.09%), with preference for permanently shady areas or occasionally lighted ones (L2 = 0.87%); plants (L3 = 3.26 %), with preference for shady areas and those that support temporary shading (L4 = 10.87%), shade-loving plants that enjoy partial shading (L5 = 8.91%), with preference between L5 and L7 (L6 = 13.48%); light-loving plants that prefer partial shading (L7 = 33.04%) or support exceptional shading for a short time (L8 = 21.96%); plants in full light (L9 = 6.52%).

Plants of L7, L8, L9 categories are light-loving and represent 61.52% (*Achillea collina*, *Cruciata pedemontana*, *Myricaria germanica*, *Rosa canina*, *Symphytum officinale*).

Plants of L3, L4, L5, L6 categories thriving in shade- light shade, detain a percentage of 36.52% (*Anemone nemorosa*, *Carex sylvatica*, *Oxalis acetosella*). The plants that prefer semi-shade are *Adenostyles alliariae*, *Spiraea ulmifolia* (Fig. 6)

Salinity

There are no salt-affected soils in the area. Out of the plant list, there are 19 species plants that occasionally tolerate a very low concentration of chloride salts (S1=0.01-0.1% Cl⁻), 1 species of oligohaline soil which can tolerate low concentration of chloride salts (S2=0.05-0.3% Cl⁻), 3 species of mesohaline soils tolerating low salinity (S3=0.3-0.5% Cl⁻) and 2 species found on mesohaline soils

which stand a medium concentration of chloride salts (S5=0.7-0.9% Cl⁻).

CONCLUSIONS

The area investigated is among the few zones with vegetation of primary type, exploited traditionally in adequate conditions and conserving a great variety of plants including rare species.

It is placed within the protected area ROSCI 0323- Basin Ciucul de Jos where some large villages delimit their grass lands and pastures. In this area, tourism and medicinal herb gathering is not a common practice.

ABSTRACT

In an area with pastures and forests at the middle mountain level where the limous rocky relief enabled extending the plant list with some rare species in Romania, the spectrum of bioforms is similar to the one encountered countrywide.

The interpretations for ecological factors were made for the entire plant list, which explains why it provides general information corresponding to the status of area of protective and economic interest. The list of plants does not have only the value of a species inventory, but also one of monitoring that needs to be taken into consideration on account of the fact that the area is within a Natura 2000 protected site.

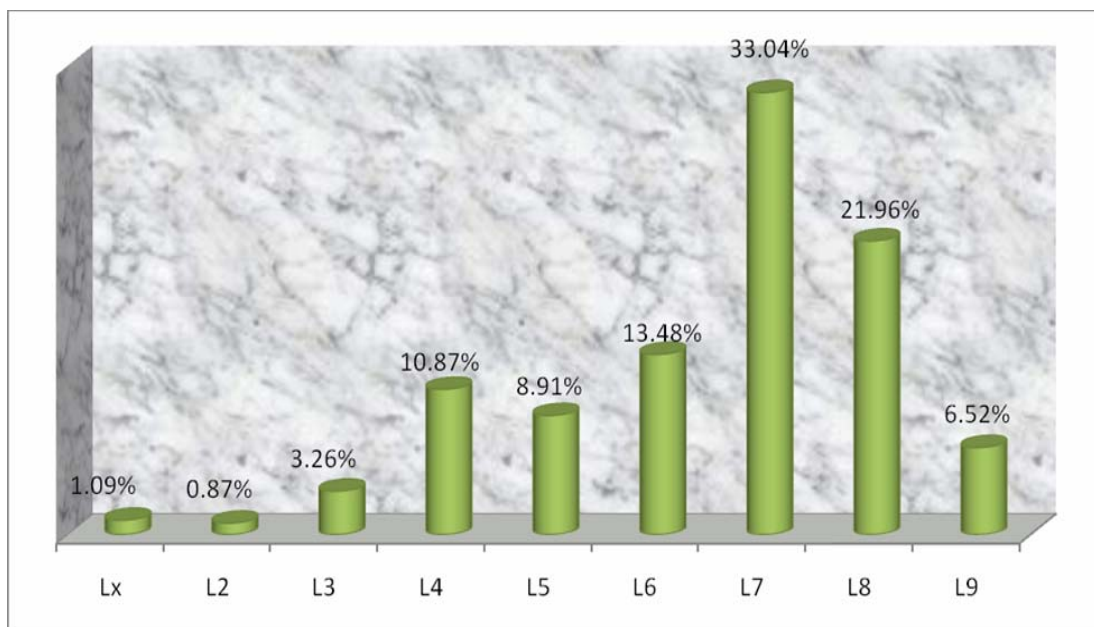


Fig. 6 Dynamics of light indices for cormophyte flora from Valea-Rece

REFERENCES

1. BORHIDI A., 1999 - Social behaviour types, the naturalness and relative ecological indicator values of the higher plants in the Hungarian flora. *Acta Botanica Hungarica*; 39 (1-2), 97-181;
2. CHIFUT., MÂNZU C., ZAMFIRACHE OANA, 2006 - Flora Moldovei (România); vol I, Ed. Universității „Alexandru Ioan Cuza”, Iași;
3. CIOCÂRLAN V., 2009 - Flora ilustrată a României. Pteridophyta et Spermatophyta; Ed. Ceres, București;
4. ELLENBERG H., 1992 - Indicator values of plants in Central Europe, *Scripta Geobotanica*, volume 18, Göttingen;
5. NECHITA NICOLETA, 2002 - Flora și vegetația din masivul Hășmaș, Cheile Bicazului și Lacul Roșu, Ed. Constantin Matasă, Piatra Neamț;
6. OPREA ADRIAN, 2005 - Lista critică a plantelor vasculare din România; Ed. Universitatea „Alexandru Ioan Cuza”, Iași;
7. SĂVULESCU TR. (edit.), 1952-1976 - Flora R.P.R.- R. S. România; Ed. Academiei Române, București;
8. SÂRBU I., ȘTEFAN N., OPREA A., 2013 - Plante vasculare din România: Determinator ilustrat de teren, Ed. Victor B. Victor, București.

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