

ACADÉMIE ROUMAINE

**REVUE
ROUMAINE**

DE BIOLOGIE

TOME 43

2 1998

juillét - décembre



EDITURA ACADEMIEI ROMÂNE

ACADÉMIE ROUMAINE

COMITÉ DE RÉDACTION

Rédacteur en chef:

Dr. NICOLAE BOȘCAIU, membre de l'Académie Roumaine

Rédacteur adjoint:

Prof. dr. CONSTANTIN TOMA, membre correspondant de l'Académie Roumaine

Rédacteur adjoint:

Prof. dr. OCTĂVIȚĂ AILIESEI, prof. dr. MARIN ANDREI, dr. AURELIA BREZEANU, prof. dr. TEODOR CHIFU, dr. CHEORGHE COLDEA, prof. dr. VASILE CRISTEA, prof. dr. IOAN CRISTUREANU, dr. NICOLAE DONIȚĂ, dr. GEORGETA FABIAN-GALAN, prof. dr. GOGU GHEORGHITĂ, dr. MIRCEA OLTEAN, dr. MIHAELA PAUCĂ-COMĂNESCU, prof. dr. LEONTIN ȘT. PÉTERFI, prof. dr. CONSTANTIN VOICA, prof. dr. GHEORGHE ZARNEA, membre de l'Académie Roumaine.

Secrétaire de rédaction: Dr. SIMONA MIHĂILESCU

Rédacteur editorial: OLGA DUMITRU

Toute commande sera adressée à:

EDITURA ACADEMIEI ROMÂNE, Calea 13 Septembrie nr. 13, Sector 5, P.O.Box 5-42, București, România, Tel. 401-411 9008, Tel./Fax 401-410 3448; e-mail: edacad@ear.ro.

RODIPET S.A., Piața Presei Libere nr. 1, Sector 1, P.O.Box 35-37, București, România, Tel. 401-618 5103; 401-222 4126, Fax 401-222 64 07.

ORION PRESS IMPEX 2000, P.O.Box 77-19, București 3, România, Tel. 401 653 7985, Fax 401-324 0638.

Les manuscrits ainsi que toute correspondance seront envoyés à la rédaction; les livres et les publications proposés en échange seront adressés à: INSTITUTUL DE BIOLOGIE, Splaiul Independenței 296, P.O.Box 56-53, 79651, București.

REVUE ROUMAINE DE BIOLOGIE
SÉRIE DE BIOLOGIE VÉGÉTALE
Calea Victoriei 125
R-79 717, București, România
Tél. 650 76 80

© 2000, EDITURA ACADEMIEI ROMÂNE
Calea 13 Septembrie, nr. 13, sector 5
R-76 117, București, România
Tél. 410 32 00; 401-411 90 08
Tél./Fax 401-410 39 83

REVUE ROUMAINE DE BIOLOGIE

SÉRIE DE BIOLOGIE VÉGÉTALE

TOME 43

1998

N° 2

juillet – décembre 1998

SOMMAIRE

C. SÎRBU, A. OPREA, <i>Grindelia squarrosa</i> (Pursh) Dunal en Roumanie.....	91
M. COSTEA, <i>Amaranthus</i> L., subgenus <i>albersia</i> (Kunth) Gren. & Godr. in Romania.....	95
AURICA TĂCINĂ, MIHAELA PAUCĂ-COMĂNESCU, Taxonomical considerations on some populations of <i>Tamarix ramosissima</i> Ledeb., in the Danube flood plain and Danube Delta.....	113
MIHAELA PAUCĂ-COMĂNESCU, G. ȘERBĂNESCU, Spatial and temporal dynamics of the plant species presence of <i>Tamarix ramosissima</i> shrublands growing in the Danube flood plain and Delta.....	121
V. SANDA, A. POPESCU, SIMONA MIHĂILESCU, Syntaxonomy of the nitrophilous phytocoenosis built up by the <i>Polygonum aviculare</i> on the Romanian's territory.....	143
T. CHIFU, G. LUPAȘCU, Structure, biomasse et productivité des forêts des monts Călimani (Roumanie), par rapport aux facteurs écologiques.....	155
P. BURESCU, Contributions to the study of reed swamp and moor vegetation in North- Western Romania. <i>Angelico-Cirsietum cani</i> ass. nova.....	165

GRINDELIA SQUARROSA (PURSH) DUNAL EN ROUMANIE

C. SÎRBU ⁽¹⁾, A. OPREA ⁽²⁾

Our studies over the fields situated by the embankment from the Socola - Iași shunting railway station, led us to the identification of some new or rare plants in Moldavia and in the whole Romania, in the last few years. So, we identified the North-American species, *Grindelia squarrosa*, in 1998. We quote now this one as a new spontaneous plant in Romanian's flora, for the first time, although it is cultivated in some collections in our country as a medicinal plant.

Mots clé: nouveauté floristique, Roumanie, *Grindelia*.

Les investigations dans les champs affectés à la gare – triage Socola – Iassy ont rendu possible, dans les derniers temps, l'identification de certaines espèces de plantes nouvelles ou rares pour la flore de notre pays, ou pour la Moldavie (5). Dans le même lieu, on a identifié aussi l'espèce qui fait l'objet de cette contribution.

Grindelia squarrosa (Pursh) Dunal in Mém. d. Mus. d. Hist. Natur. 5 (1819) 50.- *Donia squarrosa* Pursh, Fl. Am. Septen. II (1814) 559.- Fam *Asteraceae* (Fig. 1).

Plante pérennante, avec un rhizome gros, brun, ± vertical. La tige glabre, 25-60 (80) cm de haut, dressée ou ascendante, ramifiée surtout dans la moitié supérieure, ± visqueuse. Feuilles simples, alternes, glabres, ± rigides, celles inférieures (sèches à floraison) atténués en pétiole ailé, celles moyennes et supérieures sessiles, oblongues jusqu'à oblong-spathulées, d'habitude rétrécies vers la base, avec deux auricules semiamplexicaules et court-décurrentes; le bord de la feuille est aigu - denté ou denté en scie (parfois lacinié); sur les deux faces, les feuilles présentent des poches sécrétoires translucides. De la base vers le sommet de la tige, les feuilles sont lent - décroissantes, ayant 15-35 (65) mm en longueur et 6-12 mm en largeur.

Les anthodes sont solitaires dans le sommet des ramifications de la tige, urcéolées, comprimées dorsiventralement, 20-30 mm de large, très visqueuses. Les bractées de l'involucre sont rigides, linéaire-lancéolées, avec le sommet subulé et recourbé et présentent de nombreuses poches sécrétoires; les bractées externes sont irrégulièrement recourbées en dehors, ou largement étalées (aspect squarreux), celles internes sont imbriquées, convexes. Le réceptacle de l'anthode (le disque) est plat, glabre, fovéolé. Les fleurs sont jaunes, toutes fertiles, celles marginales femelles, ligulées jusqu'à 2,5 cm en longueur, avec la ligule rétrécie au sommet; les fleurs centrales tubuleuses, hermaphrodites; anthères avec deux lobes à la base; les rameaux du stigmate avec des papilles allongées vers la partie supérieure.

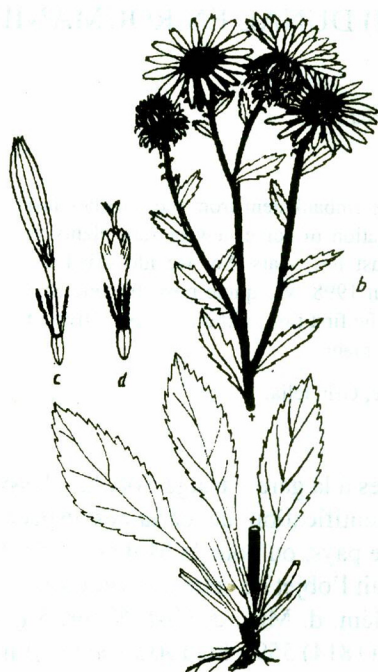


Fig. 1 – *Grindelia squarrosa*: a - feuilles inférieures; b - la partie supérieure de la plante; c - fleur ligulée; d - fleur tubuleuse.

Fruits blanc-ocreux, glabres, comprimés, 4 - costés, à 4-5,5 mm longueur, ceux extérieurs en général plus gros que ceux intérieurs; aigrette de 2-3 soies rigides (poils âpres et gros) qui tombent de bonne heure, plus longues que le fruit ou égales. VI - IX.

Nous présentons par la suite une clef pour la détermination de cette espèce dans le cadre de la subfamille *Asteroideae*:

- 1a. Les anthodes présentent des fleurs tubuleuses centrales et des fleurs ligulées marginales 2
- 1b. Toutes les fleurs sont tubuleuses x
- 2a. Feuilles alternes 3
- 2b. Feuilles opposées ou rosulaires x
- 3a. Aigrette constitué de poils, soies rigides (poils âpres et gros) ou squames 4
- 3b. Aigrette absente ou représentée par une coronule x
- 4a. Le réceptacle de l'anthode (le disque) glabre 5
- 4b. Le réceptacle de l'anthode avec des poils, soies, paillettes x
- 5a. L'inflorescence, dans l'ensemble, très visqueuse; les bractées de l'involucre recourbées vers le sommet, celles externes avec un aspect squarreux; l'aigrette constituée de 2-3 soies rigides (poils âpres et gros), qui tombent très précocement, plus longues que le fruit, ou égales *Grindelia squarrosa*
- 5b. Plantes avec d'autres caractères x

Matériel d'herbier: L'Herbier du Jardin Botanique de Jassy; L'Herbier de l'Université Agronomique de Jassy.

En ce qui concerne la présence de cette espèce dans la zone de la gare Socola - Jassy, nous supposons qu'elle est due, tant comme pour d'autres espèces adventives, au trafic de marchandises (en particulier ferroviaire), par la filière Amérique du Nord - U.R.S.S. - Roumanie.

Une autre supposition est que l'espèce, une fois cultivée au Jardin Botanique de Jassy (d'où elle est disparue depuis longtemps), est arrivée par hasard dans cette station.

À l'appui de la première hypothèse vient le fait que cette espèce a été identifiée récemment aussi dans la République de Moldavie, sur le terrassement du chemin de fer Chişinău - Odessa, et dans certaines localités sur la Vallée du Prut, par Dr. Tatiana Burac; en outre l'espèce est citée pour la région Nikolaevsk dans la Flore de l'U.R.S.S. (6) et pour Ukraine dans la Flora Europaea (3).

Mais, nous ne pouvons pas nous prononcer, avec certitude pour l'une ou l'autre des hypothèses. Il est certain que l'espèce s'est bien acclimatée ici, profitant du substratum pierreux - sablonneux, des conditions de microclimat et de la compétition minimale.

La dispersion générale: Amérique du Nord (Illinois, Minnesota, Manitoba, Missouri, Texas, Arizona, New Mexico etc), (1); Russie (acclimatée dans la région de Nikolaevsk) (6); République de Moldavie (après Dr. Tatiana Burac, 1998 - communication verbale); Ukraine (3).

BIBLIOGRAPHIE:

1. Britton N., Brown A., 1970, *An illustrated flora of the Northern United States and Canada* Dover Publication, Inc., New York, 3: 371.
2. Ciocîrlan V., 1990, *Flora ilustrată a României*, Edit. Ceres, Bucureşti, 2.
3. Hansen A., 1976, *Grindelia Willd.* in TUTIN T.G.(Edit.), *Flora Europaea*, Cambridge University Press, 4: 109.
4. Nyárády E. I., Prodan I., Morariu I., 1964, *Fam. Compositae* in Săvulescu T. (Red.), *Flora R.P.R.*, Edit. Academiei, Bucureşti, 9: 154 - 957.
5. Oprea A., Sîrbu C., Paraschiv Luminiţa - Nicoleta, 1997, *Lucr. Şt. Univ. Agron. Iaşi, Ser. Agronomie*, 40 (supl.): 91 - 97.
6. Tamamşian S. G., 1959, *Rod Grindelia Willd.* v Şişkin B. K. (Red.), *Flora S.S.S.R.*, Izd. Akad. Nauk, S.S.S.R., Moskva - Leningrad, 25: 30 - 31.

Reçu le 5 Avril, 1998

¹⁾ Université Agronomique de Jassy

Aleea M. Sadoveanu, No3, 6600, Roumanie

²⁾ Jardin Botanique de Jassy

Rue Dumbrava Roşie, No 9, 6600, Roumanie

AMARANTHUS L., SUBGENUS ALBERSIA (KUNTH) GREN. & GODR. IN ROMANIA

M. COSTEA

As a continuation of our previous work over the genus *Amaranthus*, subgenus *Amaranthus*, we present in this paper the revision of the subgenus *Albersia* in Romania. On this occasion we record for the first time in the Romanian Flora: two species (*Amaranthus viridis* L. and *A. acutifolius* Uline & Bray), one subspecies: *A. graecizans* L. subsp. *graecizans* and one variety *A. emarginatus* Moq. ex Uline & Bray var. *pseudogracilis* (Thell.) Costea. The rank of the taxa: *A. blitum* var. *oleraceus* (L.) Hooker fil. and *A. emarginatus* subsp. *pseudogracilis* (Thell.) Hugin, are reconsidered, for the first being proposed the subspecific rank and for the second, the variety rank. The classification of the genus, the nomenclature and taxonomy for all species are discussed, taking into consideration some new characters of seeds, fruits and pollen.

Key words: *Amaranthus*, *Albersia*, revision.

In spite of the fact that it was the object of many studies, the genus *Amaranthus* is still insufficiently elucidated being considered by many authors a "difficult" genus. At the moment the taxonomical problems are far from being clarified especially because of the widespread nomenclature disorder caused chiefly by repeated misapplications of names to different species along the time. Therefore an artificial confusion is however prevalent all over the world, in different herbaria and floras.

The revision of *Amaranthus*, subgenus *Amaranthus* in Romania was already accomplished (11). Therefore it remains to be clarified the subgenus *Albersia*, with the group of species "*blitum*". Unfortunately the genus *Amaranthus* in Romania is undercollected, the majority of the most recent herbaria material being already 30-50 years old. In this situation, collecting actual specimens and re-examination become necessary. The same Romanian Herbaria collections as in our previous study were surveyed. The Romanian material was examined comparatively with plants from the herbaria: VAB (Facultad de Ciencias Biológicas, Universidad de Valencia); VAL (Jardín Botánico de Valencia, Universidad de Valencia); VALA (Escuela Técnica de Ingenieros Agrónomos, Universidad Politécnica de Valencia); VF (Facultad de Farmacia, Universidad de Valencia) and WU (Botanischer Garten der Universität Wien). The photos were taken with the Hitachi S-4100 microscope. Herbaria material for all the taxa published as new for Romania was introduced in the Herbaria of the University of Agronomical Sciences Bucharest, and in BUCA and BUC Herbaria's.

Characters. Many species of the genus are greatly affected by the environmental factors (nutritional elements, availability of water, light conditions, injurious factors etc.) exhibiting a great morphological variability without much taxonomical significance. An enormous number of such inconstant states (mostly based on extremely variable characters like: plant height, branching, colour of wholly plant or only of stems or petioles, shape of inflorescence etc.) received various taxonomical ranks, increasing thus again artificially the complexity of the genus. In the present study, besides the well-known characters, we shall emphasize some less or unknown ones. Plants should be collected late in the year when well developed fruits and seeds are formed. In addition, for a good chance of correct identification a range of individuals from the same population and a range of flowers, fruits and seeds belonging to the same plant should be examined.

The flowers are providing most of the diagnostics and easier to observe characters. Because these characters are the best known and the most used, we shall accentuate other potential features. Regarding the flowers, less known are the characteristics of bracteoles and tepals venation. The unique vein of bracteoles and tepals may be not ramified (usually) or ramified. Furthermore, it may be gradually narrowed toward the apex (sometimes it disappears completely in this region) or it may be enlarged toward the apex. The colour of the mid-vein may be green or yellowish and it should be examined on dried material.

The fruits a. Morphological characters - as seen under $50 \times$ magnification.

- Fruit circumcissible or indehiscent.
- Form of the fruit: spherical, ovoid, ellipsoidal etc.
- Form of the fruit toward the stygma region: fruit abruptly narrowed toward the stygma region, a short beak being conspicuous and fruit gradually narrowed toward the stygma region with the apex - truncate to rounded or - acute.
- The ratio between the length and the width of the fruit.
- The position of the dehiscence line: in the upper half, at the middle or in the down half of the fruit.
- The general pattern of pericarp wrinkling.
- The ratio between the fruit and the seed: the cavity of the fruit is much larger than the seed, opposite to cavity of the fruit only a little larger than the seed.
- Stygma branches: length and width at the base; aspect of stigma branches: erect or recurved.

b. SEM characters - Surface of pericarp observed with the SEM at $300 \times$ magnification or more. To describe the patterns of the pericarp surface organisation we slightly modified the classification of Klopper and Robel (18) as follows:

Type A (*paniculatus* type of Klopper and Robel (1989)). - Cells very irregularly shaped and ramified. Principal axis of the cells not more than three times longer than the longest secondary axis. Anticlinal walls irregularly waved.

Type B (*bouchonii* type of Klopper and Robel - 1989). - Cells ramified 4-6 times longer than wide. The anticlinal walls Ω or s-waved.

Type C (*patulus* and *deflexus* types of Klopper and Robel - 1989). - cells less ramified or not ramified, 8-12 times longer than wide. Anticlinal walls mostly S-waved.

Type D (*albus* type of Klopper and Robel - 1989). - Cells less ramified or not ramified 1.5 -2 times longer than wide. Anticlinal walls weekly S-waved.

Type E (*lividus* type of Klopper and Robel - 1989) - Cells not ramified, 3-4 times longer than wide with anticlinal walls straight to S-waved.

The seeds. The diagnostic features of the seeds were largely neglected due to their smallness. Descriptions of seeds were also made by Koval (20) and Klopper & Roebel (19). All the following features (including the sculpture) may be observed under 50 $\times$ magnification.

- The size is defined by the length of the two diameters and it is constant when the plants grow in the same environmental conditions. Variation of 0.1 - 0.2mm fr.c.n the average is possible.
- The form. General aspect: as seen from above, the outline of the seeds is variable but constant depending on the species: circular, elliptic, obovate, etc. As seen laterally the seeds exhibit usually a lenticular shape. The seeds are usually differentiated in a central, convex zone and a marginal, plane zone; exceptions from this rule are rare and diagnostic.
- Appearance of the seed basis, namely of the part where the hilum and the radicle are located: the tip of the hilum is above (or at the same level) the tip of the radicle (subgenus *Amaranthus*) or the tip of the hilum is below the tip of the radicle (subgenus *Albersia*).
- The presence between the hilum and the radicle, toward the centre of the seed of: - a furrow; a concavity; a concavity continued by a furrow.
- The shape of the seeds margin observed from profile may be: - acute (usually); - rounded or truncated (rare).
- The sculpture of the seeds is the result of the concentric distribution of the cells from the exotesta. The following variations are possible: - the sculpture is evident only on the marginal zone, in the central zone being inconspicuous (usually), - both the central and the marginal zone are sculptured; both the central and the marginal zone are almost smooth and - the central zone is sculptured while the marginal one is smooth or distinctly wrinkled.
- The colour of the seeds is commonly dark-brown to blackish, or whitish - yellowish with reddish nuances at the species cultivated as cereals. The colour may be uniform or not uniform; in the latter case the outer zone exhibits a paler nuance.

SEM characters of seeds refer to the ornamentation of the exotesta as observed under 300 $\times$ or more magnification. We used the terminology proposed by Barthlott & Ehler (4). There were noted the shape of the cells, the aspect of the anticlinal (may be prominent or inconspicuous) and periclinal walls (may be plane, concave or convex) with the sculpture of the epicuticular waxes smooth or punctiform.

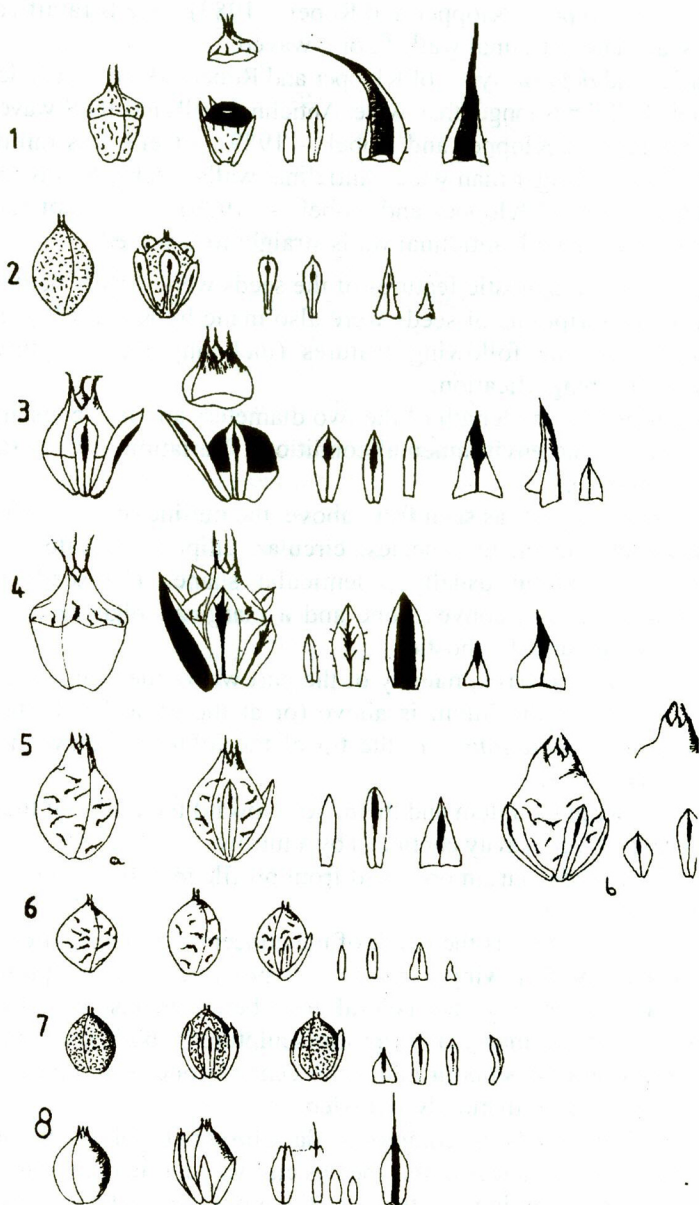


Plate I – The bracteoles, the perigon and the fruit in the subspecies of the subgenus *Albersia*: 1) *Amaranthus albus* L.; 2) *A. crispus* (Lesp. & Thev.) N. Terraciano; 3) *A. graecizans* L.; 4) *A. blitoides* S. Watson; 5a) *A. blitum* L. subsp. *blitum*; 5b) *A. blitum* subsp. *oleraceus* (L.) Costea; 6) *A. emarginatus* Moq. ex Uline & Bray; 7) *A. viridis* L.; 8) *A. acutilobus* Uline & Bray.

The pollen. - is polyaperturate, apolar, small (with $D = 18-28\mu m$), with echinulate ornamentation. The apertural membrane is slightly sunken. Generally with more than 18 pores having the apertural membrane granulated. Surface of grains with granules. Characters: - the diameter of the pollen grain; - number and diameter of pores; - density of granules on the surface of the pollen grain: high 20 - 30 granules or more/ μm^2 ; medium 10 - 19 granules/ μm^2 and low 2-9 granules/ μm^2 .

CLASSIFICATION

The infrageneric classification of the genus is for the moment unsatisfactory. In this account we accepted the division of the genus in 3 subgenera - *Acnida*, *Amaranthus* and *Albersia* - following the treatment of Mosyakin and Robertson (22).

The infrageneric position of the former genus *Acnida* L., based on the dioecious conditions of its species, is considered by all authors clear. A species belonging to the subgenus *Acnida*, *Amaranthus rudis* Sauer was erroneously published in Romania under the name "*A. tuberculatus* Nutt." (12). *Amaranthus tamariscinus* was rejected by Sauer (1972) as it seems that its type is in fact the sterile hybrid between a dioecious amaranth (*A. rudis*) and *A. hybridus*. The name "*A. tamariscinus*" and its synonyms, *Montelia tamariscina* (Nutt.) A. Gray and *Acnida tamariscina* (Nutt.) Wood, have long been applied to a distinct fertile species which was correctly described by Sauer as *A. rudis* Madrono 21: 426-437 (1972). For the description of the species and the drawings of the flowers, fruits and seeds see Costea (12) (unfortunately the plates of *A. palmeri* and *A. tamariscinus* are reversed).

As concerns the subgenera *Amaranthus* and *Albersia*, the traditional arguments based on the inflorescence type and the number of perigon tepals are insufficient to sustain the subgenera position. Therefore additional arguments are necessary:

1. Dioecious plants ----- Subgenus *Acnida*
 - Monoecious plants ----- 2
2. Phyllotaxy predominantly 2/5; largest leaf traces in stems with 9-11 bundles; hilum above the radicle level or at the same level ----- Subgenus *Amaranthus*
 - Phyllotaxy predominantly 1/3; largest leaf traces in stems with 3, 5, or 7 bundles; hilum under the tip of the radicle ----- Subgenus *Albersia*

Furthermore, as Priszter observed (23), strong reproductive barriers occur between the species of the subgenus *Amaranthus* and subgenus *Albersia*, hybrids between them being not known. On the contrary, hybrids between the species of the subgenus *Acnida* and the subgenus *Amaranthus* are well known. The species of the subgenus *Acnida* fall apart mostly due to their dioecious condition. If this character did not exist its species would be included either in the subgenus *Amaranthus* or in the subgenus *Albersia* (mostly in the subgenus *Amaranthus*).

This infrageneric classification allows subsequently rearrangements at sectional levels, already attempted by Mosyakin and Robertson (22) and partially followed in this account. The subgenus *Albersia* is the most polymorphic group of species of the genus, a revision at the section level being imperiously necessary.

Subgenus *Albersia* (Kunth) Gren. & Godr.
= Sect. *Blitopsis* Dumort. Fl. Belg. 19, 1827.

Amaranthus albus L., Syst Nat. ed. 10: 1268 (1759).

Annual with erect to ascendant stem, up to 10–70cm, divaricately branched from the base, whitish coloured at maturity, densely pubescent at least in the upper part. Stem leaves rhombic - ovate to oblong - obovate or spatulate, rounded at the apex, with finely undulated margins; leaves of the branches similar but smaller. Multiseriate trichomes present especially on stems. Flowers (Plate I, Fig. 1) in axillary spiciforme cymes shorter than leaves. Bracteoles spinescent, rigid, about twice as long as the perigonium. Tepals 3 unequal, erect, linear - elliptic to lanceolate, obtuse or shortly acuminate, whitish coloured with the nerve inconspicuous or yellowish. The longest tepal has 1.1–1.5mm and the shortest 0.5–0.6mm. Fruit dehiscent, 1.4–1.8mm long, round to obovoidal, about 1.5 times longer than wide, abruptly narrowed toward the stygma region. Dehiscence line in the upper part. Pericarp slightly wrinkled above the dehiscence line. Stygma branches weakly developed, erect, 0.9–1mm long and 0.15–0.2mm width. Type of pericarp surface - A. Seeds round to obovate, 0.8–1.1 × 0.8–1.1mm, lenticular, differentiated in a central smooth zone and a peripheral evidently sculptured zone. Above the hilum there is a concavity. The margin of the seed acute. The cells of the exotesta polygonal with the anticlinal walls prominent and the periclinal ones plane. Colour dark-brown to black, uniform. Native in southern N America and Mexico. Common weed especially in dry regions, on sandy substrate. Pollen grains 18–22µm, with 20–30 pores of 1.4–1.6µm in diameter. Density of granules low. 2n= 32. By reason of some morpho-anatomic peculiarities it may perhaps deserve a separate recognition at the section level.

Amaranthus blitoides S. Watson, Proc. Amer. Acad. Arts 12: 273 (1877).

Type : described from southern N America (Mexico to N Nevada and Iowa).

Annual with prostrate to ascending stems up to 1m long, in the upper part with papillae and characteristic uniseriate trichomes consisting from 2(3) cells, with the terminal cells spherical, much larger than the basal one(s). Leaves 1.5–3 × 0.6–1cm, obovate - spatulate to oblong - lanceolate, somewhat fleshy, with a conspicuous hyaline margin. Flowers in axillary cymes. Bracteoles shorter than the perigonium, about 1.5mm long, triangular-ovate, with the mid-vein ramified. Tepals 5, very unequal, oblong to elliptic, the largest with ramified veins (Plate I, Fig. 4). The fruit circumscissile, 2–2.2mm, globose to ovoid, gradually narrowed toward

the stygma region, with the dehiscence line at the middle or in the upper part. Pericarp slightly longitudinally wrinkled around the dehiscence zone. Stygma branches well developed, 1.9–2.2mm and 0.4–0.7mm wide at the base. Type of pericarp surface C. Seeds circular to broad – elliptic, $1.5 - 1.7 \times 1.4 - 1.5$ mm, lenticular, with a short furrow above the hilum, differentiated in a central zone and a marginal zone. Only the marginal zone slightly punctiform sculptured. Cells of the exotesta often tetragonal, 25–40 μ m length, with the anticlinal walls sunken and the periclinal ones convex shaped, evidently furrowed. Margin of the seed acute. Colour dark-brown to black, uniform. Pollen grains 20–26 μ m with 30 – 45 pores of 1.9–2.2 μ m in diameter. Density of granules: medium to low. $2n=32$. Native in the S-V North America and Mexico.

a. var. *blitoides* - leaf blade obovate-spathulate, obtuse.

b. var. *reverchonii* Uline & Bray, Bot. Gaz. (Crawfordsville) 19: 315 (1894) – leaf blade oblong – lanceolate to rhombic – ovate, shortly – acuminate.

Amaranthus graecizans L., Sp. Pl.: 990 (1753).

Type: "Habitat in Virginia"; LINN 1117/3

Annual with erect to ascendant stems, up to 80cm, in the upper part with trichomes like *A. blitoides*, in addition multicellular uniseriate trichomes are present. Leaves 2–4 (5) $\times$ 1–3 cm lanceolate to rhombic – ovate or rhombic-elliptic, without a conspicuous hyaline margin. Bracteoles equal or longer than the perigon with the mid-vein ramified. Tepals 3, very heterogeneous, the largest 2–2.3 $\times$ 0.6–0.9mm, elliptic to obovate, with the mid-vein ramified (Plate I, Fig. 3). Fruit transversally splitting, (2)2.2–2.5(2.7)mm, broad-ellipsoidal to globose, gradually narrowed toward the stygma region, with the dehiscence line in the down part, almost smooth. Stygma branches 2–2.25mm long and 0.4–0.6mm thickens at the base. Pericarp surface organisation variable C to E or D to E. Seeds circular, 1.4–1.7 $\times$ 1.4–1.7mm, lenticular, with a short furrow above the hilum, differentiated in a central zone and a marginal zone. The central zone is smooth, the marginal one almost smoothly sculptured. Margin of the seed acute. Colour not uniform, black with the marginal zone usually having a paler nuance. Pollen grains 21–25 μ m with 19–32 pores of 1.5–1.7 μ m in diameter. Density of granules medium. $2n=32$. If a revision of the subgenus *Albersia* is attempted, *A. blitoides* together with *A. graecizans* may probably deserve a separate section.

Native in the Mediterranean region, and N Africa. Varies in leaf shape and the sculpture of seeds, subspecific level being appropriate.

1. Leaf blade lanceolate, up to 1–1.5cm broad; Marginal zone of the seeds with prominent cells, whose periclinal walls are $\pm$ smooth (Fig. 2); Pericarp pattern C to E. ----- *A. graecizans* subsp. *graecizans*
– Leaf blade rhombic – ovate to ovate – elliptic, up to 4cm broad; Marginal zone of the seeds with inconspicuous cells, whose periclinal walls are minutely punctiform sculptured (Fig. 3); Pericarp pattern C to D ----- *A. graecizans* subsp. *sylvestris*.

a. *A. graecizans* subsp. **graecizans**

= *Amaranthus angustifolius* Lam., Encycl. 1:115 (1783), nom. illeg.

This taxon (Fig. 1) is recorded now for the first time in the Romanian Flora. It was found as ruderal in Bucharest, around the North railway station, in 1996. It can be confounded with *A. blitoides* var *reverchonii*, but easily differentiable by the number of tepals.

b. *A. graecizans* subsp. *sylvestris* (Vill.) Brenan, Watsonia 4: 273 (1961).

≡ *A. sylvestris* Vill., Cat. Pl. Jard. Strasbourg: 111 (1807) ≡ *A. graecizans* var. *sylvestris* (Vill.) Ascherson in Schweif., Beitr. Fl. Aethiop.: 176 (1867).

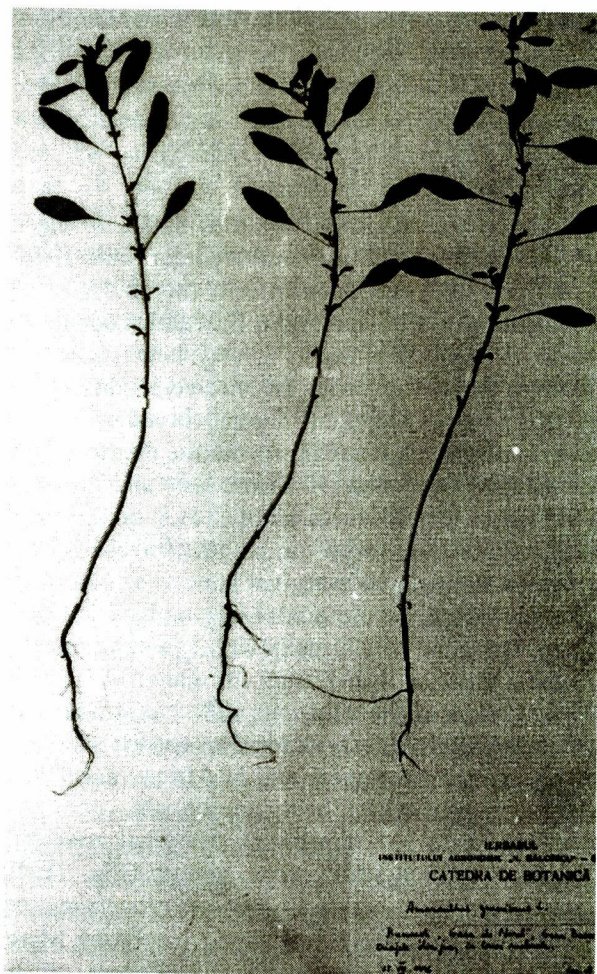


Fig. 1 – *Amaranthus graecizans* subsp. *graecizans*.

Fig 2 – Sculpture of the seed margin in *A. graecizans* subsp *graecizans* (300×).

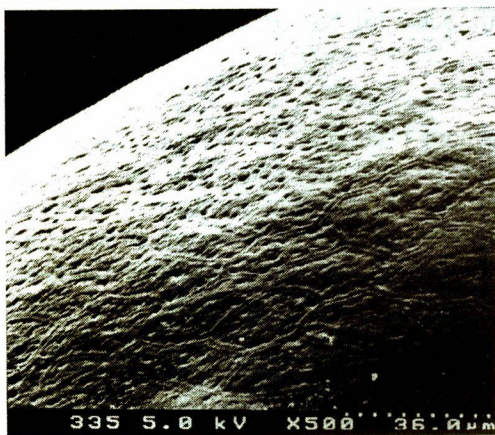
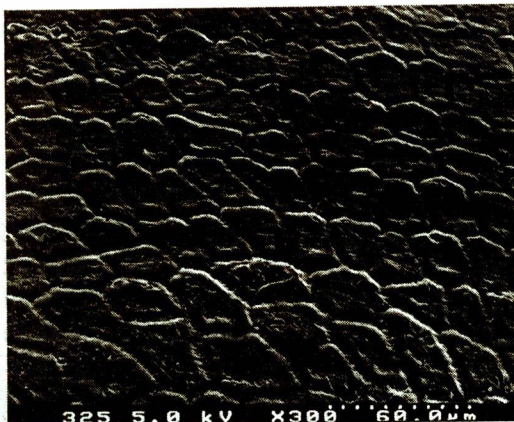


Fig. 3 – Sculpture of the seed margin in *A. graecizans* subsp *sylvestris* (500×).

Amaranthus blitum L., Sp. Pl.: 990 (1753).

Annual with stems up to 1m, procumbent, ascendant to erect, glabrous or with disperse, multicellular, uniseriate hairs. Leaves, $2-8 \times 1-5$, rhombic – ovate, short-cuneate to truncate at base, shallowly emarginated to obtuse-retuse at apex, somewhat fleshy, green or reddish. Flowers both in axillary cymose clusters and in a short, dense and thick, terminal inflorescence. Bracteoles triangular – ovate, shorter than the perigon, with the mid-vein green, usually with two lateral branches. Tepals 3, equal, $1.5-2 \times 0.2-0.4$ mm, linear to (rare) spatulate. One (2) tepal with green mid-vein enlarged above the middle, the others (other) wholly membranous, with the mid-vein hardly noticeable (Plate I, Fig. 5). Fruit indehiscent, $1-1.5 \times$ longer than wide, ellipsoidal to globose, gradually or abruptly – narrowed toward the stygma region. Cavity of the fruit only a bit larger than the seed. Type of pericarp surface- E. Pollen grains (Fig. 4) $19-23\mu\text{m}$ with 32 – 45 pores of $2.4-3.3\mu\text{m}$ in diameter. Density of granules medium. $2n=34$. Regarding

the infraspecific classification, on the basis of the morpho-ecological differences, two subspecies may be distinguished:

a. *Amaranthus blitum* subsp. *blitum*

Type: "Habitat in Europa temperiore"; LINN 1117/4 (the correct specimen, Fillias, Gaulliez & Guedes, 1980).

≡ *Albersia blitum* (L.) Kunth, Fl. Berol., ed 2, 2: 144 (1838) ≡ *Euxolus blitum* (L.) Gren., Mem. Soc. Emul. Doubs. ser 3, 10: 652 (1869) (= Flora Jurass. 652 (1869)).

= *Amaranthus ascendens* Loisel., Not. Fl. France: 141 (1810) ≡ *A. blitum* var. ("β") *ascendens* ("adscendens") (Loisel.) DC., Cat. Pl. Horti Monsp. 4 (1813) ≡ *A. lividus* proles *ascendens* (Loisel.) Thell., Ascherson & Graebner, Syn. Mitteleur. Fl. 5: 321 (1914) ≡ *A. lividus* var. *ascendens* (Loisel.) Thell. ex Hayw. & Druce, Advent. Flora Tweedside 177 (1919) ≡ *A. lividus* subsp. *ascendens* (Loisel.) Thell. ex Wachter, Heukels, Geill. Schoolpl. Nederl., ed 11, 169 (1934).

(*Euxolus viridis* sensu Moq., DC., Prodr. 13, 2: 243 (1849)).

(*A. viridis* auct. p.p., non L.).

- the stem procumbent to ascendant, without prominent ribs. Fruit, 2mm long, when fresh with the pericarp almost smooth when dried, irregularly wrinkled in the zone where the seed stands, the rest of the fruit being smooth. Stygma branches thin (0.9–1.1mm long and 0.2–0.25mm width at the base) often destroyed when the fruit is dried. Seeds, (1.1)1.2 × 1–1.1mm, broad-ovate to circular, differentiated in a central zone and a marginal zone. The marginal zone sculptured with the cells of the exotesta polygonal, 25–40µm length, with the anticlinal walls prominent and the periclinal walls plane, minutely punctiform sculptured (Fig. 6). The margin of the seed acute. Colour dark – brown to black with the marginal zone usually having a paler nuance. A frequent weed in vegetable gardens, and only rare as ruderal. Native to Eurasia and N Africa.

b. *Amaranthus blitum* subsp. *oleraceus* (L.) Costea, comb. et stat nov.

Type: LINN 1117/3

Basionym: *Amaranthus oleraceus* L., Sp. Pl., ed 2, 1403 (1763).

≡ *Euxolus oleraceus* (L.) Moq., DC., Prodr. 13, 2: 273 (1849) ≡ *Albersia oleracea* (L.) Boiss., Fl. Or. 4: 991 (1879) ≡ *A. blitum* var. *oleraceus* (L.) Hooker fil., Fl. Brit. Ind. 4: 721 (1885) ≡ *Amaranthus lividus* L. proles *oleraceus* (L.) Thell., Ascherson & Graebner, Syn. Mitteleur. Fl. 5: 321 (1914) ≡ *A. ascendens* Loisel. var. *oleraceus* (L.) Thell. ex Priszter, Agartud. Egyet. Kert-Szologazdasagtud. Karanak Evk. 2: 221 (1953) ≡ *A. lividus* subsp. *oleraceus* (L.) Soó, Acta Bot. Sci. Hung. 10: 376 (1964).

= *Amaranthus lividus* L., Sp. Pl. 990 (1753) ≡ *Euxolus lividus* (L.) Moq., DC. Prodr. 13, 2: 273 (1849) ≡ *A. lividus* L. proles *lividus* ("typicus") (L.) Thell., Ascherson & Graebner, Syn. Mitteleur. Fl. 5: 321 (1914).

Very much alike to subsp. *blitum* but differing in the following characters: Stem erect, very thick, strongly ribbed. Fruit 2.3–3.5mm, when dry with the pericarp coarsely wrinkled. Stygma branches well developed (2mm long and 0.5–0.6mm width at the base) persistent when the fruit is dried. Seeds 1.2–1.6(1.9) × 1.2–1.6(1.9), circular, not differentiated in a central and a marginal zone. The sculpture of the margin inconspicuous as seen at magnification < than 100. The cells of the exotesta in the marginal zone often inconspicuous (the anticlinal walls are inconspicuous) with the periclinal walls less punctiform sculptured comparatively to subsp. *blitum* (Fig. 7). Margin of the seed rounded. Colour dark-brown to blackish, uniform. Only cultivated as vegetable.

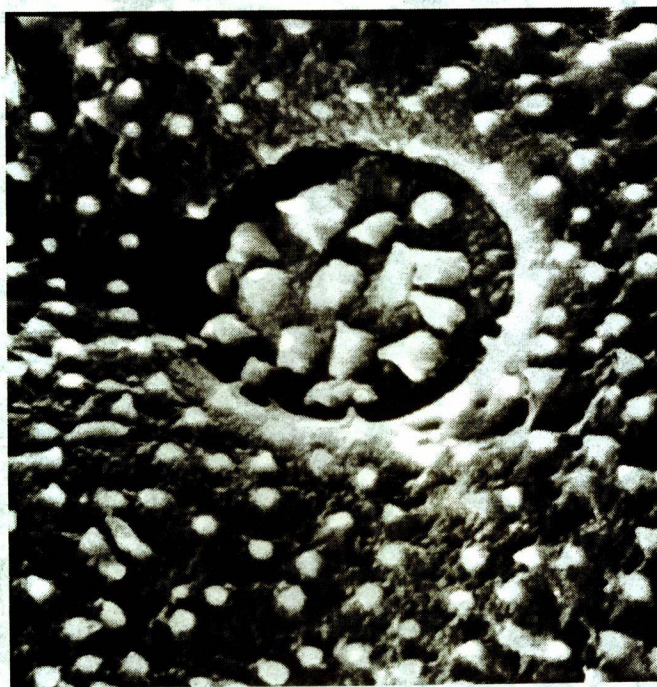


Fig. 4 – Pollen aperture in *A. blitum* (10000×).

Amaranthus emarginatus Moq. ex Uline & Bray, Bot. Gaz. (Crawfordsville) 19: 319 (1894).

Described from Indonezia: "*Amaranthus polygonoides* L. ?, Java, 1842-44, Zollinger 1646"(P, lecto; iso Fl. G, STR; cf. Hügin 1987: 461).

= *Euxolus viridis* L. var. (ε) *polygonoides* Moq., DC., Prodr. 13,2: 273 (1849).

≡ *Amaranthus ascendens* Loisel. var. *polygonoides* (Moq.) Thell., Mem. Soc. Sci. Nat. Cherbourg 38: 215 (1912) ≡ *A. lividus* L. proles *polygonoides* (Moq.) Thell., Ascherson & Graebner, Syn. Mitteleur. Fl. 5: 321 (1914) ≡ *A. lividus* L. var.

polygonoides (Moq.) Thell. ex Druce, Bot. Soc. Exch. Club Brit. Isles 5: 574 (1920) $\equiv$ *A. lividus* L. subsp. *polygonoides* (Moq.) Thell. ex Probst, Wolladventivfl. Mitteleur. 74 (1949) $\equiv$ *A. ascendens* subsp. *polygonoides* (Moq.) Thell. ex Priszter, Agartud. Egyet. Kert- Szologazdasagtud. Karanak Evk. 2:221 (1953) $\equiv$ *A. blitum* subsp. *polygonoides* (Zollinger ex Moq.) Carretero, Ann. J. Bot. Madrid 41(2):276 (1985) $\equiv$ *A. blitum* subsp. *emarginatus* (Moq. ex Uline & Bray) Carretero, Munoz Garmendia & Pedrol, Ann. J. Bot. Madrid 44: 599 (1987).

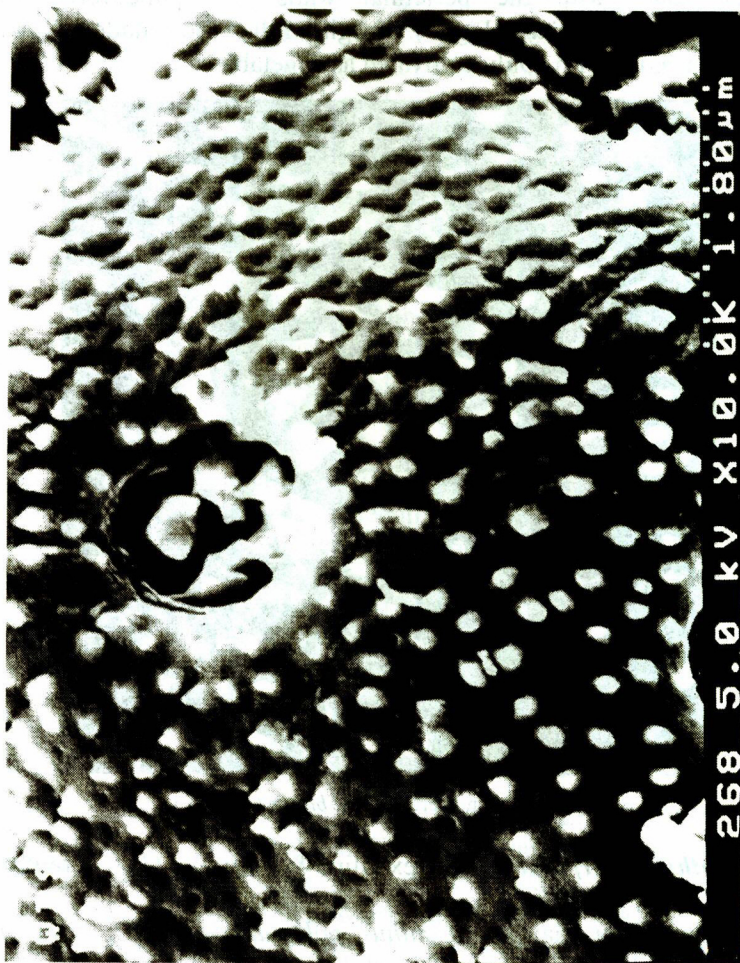


Fig. 5 – Pollen aperture in *A. emarginatus* (10000 $\times$).

Similar to *A. blitum* subsp. *blitum*, differing in the following characters: slender stems, up to 70cm, prostrate to ascendant. Leaves not fleshy, long-cuneate at base and deeply emarginated to bilobed at apex. Tepals 2(3), 0.75 – 1.5 (1.8)mm

long, obtuse (Plate I, Fig. 6). Fruit longer than the perigon, globose to ovoid (1.0)1.2–1.8(2.0) mm long, $1-1.5 \times$ longer than wide, evidently larger than the seed. Seeds $0.8-1.1 \times 0.8-1.1$ mm, circular, with the hilum prominent on the outline of the seed. The seeds differentiated in a central zone and a marginal zone, both sculptured. The marginal zone sculptured as seen in Fig. 8. The margin of the seed acute. Type of pericarp surface: E. Pollen grains (Fig. 5) with pores of $1.4-1.8 \mu\text{m}$ in diameter. $2n=34$.

Fig. 6 – Sculpture of the seed margin in *A. blitum* subsp. *blitum* (800 $\times$).

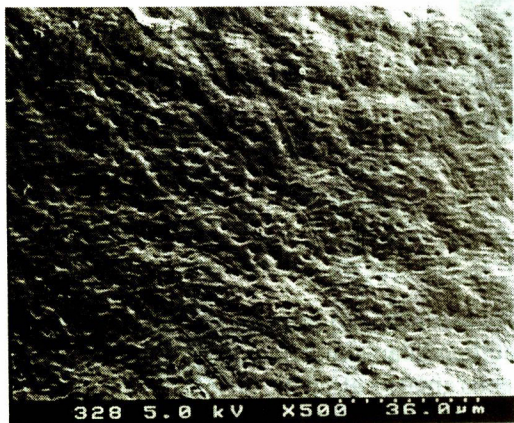
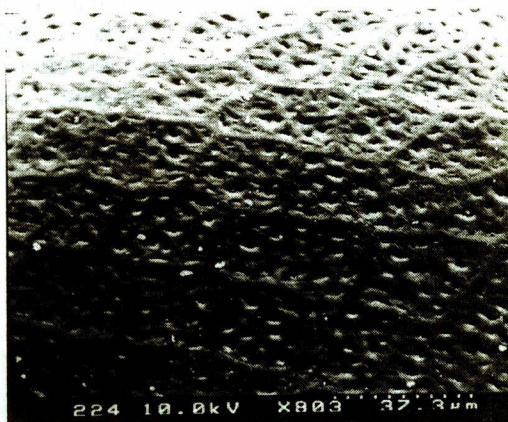


Fig. 7 – Sculpture of the seed margin in *A. blitum* subsp. *oleraceus* (500 $\times$).

Native in the Tropics, it was introduced into the temperate regions of N. America and Europe. It grows on sandy alluvia on the banks of the Danube, including the Danube Delta. It is more thermophil and tardive than *A. blitum*.

The habitus of the plants is variable:

1. Prostrate plants, leaves (0.75) 1–2(3.5) cm long; inflorescence entirely formed by axillary cymes (terminal part absent or reduced- var. *emarginatus*

- Ascendant, more vigorous plants with leaves 2–4(6) cm long, inflorescence mainly terminal, long, thin, flexuous -----var. *pseudogracilis*

a. *A. emarginatus* Moq. ex Uline & Bray var. *emarginatus*

b. *A. emarginatus* var. *pseudogracilis* (Thell.) Costea, comb. et stat. nov.

Type: im Botanischen Garten Strasburg", 8. 8 1904, A. Ludwig 12130 (B) specifying "Unter dem falschen Namen Euxolus caudatus" (= *A. gracilis* Desf. nom. nud. = *A. viridis* L.)

Basionym: *Amaranthus lividus* L. proles *polygonoides* f. *pseudogracilis* Thell., Ascherson & Graebner, Syn. Mitteleur. Fl. 5: 321 (1914) = *A. emarginatus* subsp. *pseudogracilis* (Thell.) Hügin, Willd. 16: 463 (1987).

This taxon is new for the Romanian flora being encountered in the Danube Delta since 1994. The two taxa are sometimes connected by intermediates and are not ecologically differentiated. Therefore the variety rank seems the most appropriate.

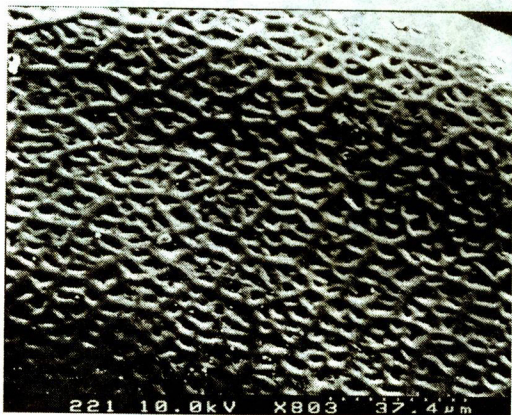


Fig. 8 – Sculpture of the seed margin in *A. emarginatus* (800×).

Amaranthus viridis L. Sp. Pl., ed. 2: 1405 (1763).

Type: "Habitat in Europa, Brasilia", LINN 1117/15

= *A. gracilis* Poirlet, Lam., Encycl. Suppl. 1: 312 (1810).

Annual, with stem up to 1m (Fig. 9), ascending to erect, glabrous to sparsely pubescent above, the trichomes being multicellular, uniseriate. Leaves 3–8 × 2–5 cm, rhombic-ovate, entire to shallowly emarginated at apex. Inflorescence mostly terminal, long, thin, flexuous, ramified or not. Bracteoles about 1mm long, acute, triangular-ovate, shorter than the perigon. Tepals 3, equal, 0.8–1.5 × 0.3–4mm, bent along the fruit, narrow – spatulate to narrow – obovate, with the mid – vein green, enlarged above the middle. Fruit indehiscent, 1.2–1.5mm, ellipsoidal to globose, usually gradually narrowed toward the stygma branches (Plate I, Fig. 7). The pericarp as a rule is strongly wrinkled, muricate, sometimes almost smooth. Stygma branches thin (0.9–1.1mm long and 0.05–0.075mm width at the base). Type of pericarp surface variable D to E. Seeds 1–1.2 × 0.9–1.1mm, circular with

unprominent hilum, differentiated in a central and a marginal zone. Above the hilum, a short furrow. The margin of the seed acute. It is interesting to show that the sculpture of the seeds is variable, two "types" being possible: 1) seeds entirely verrucose and 2) seeds with sculpture almost inconspicuous, resembling *A. blitum* subsp. *oleraceus*. The observation was made on typical plants from Spain, these features of the seeds being (at least apparently) not correlated with other morphological characters. It is evident that on the basis of such a character, the section *Puncticulata* Koval cannot be recognized. *A. viridis* is closely related to *A. blitum* agg. and may be included in the same section. Pollen grains 18–20µm with 32–40 pores of 2.8–3.2µm in diameter. Density of granules medium. Native from S

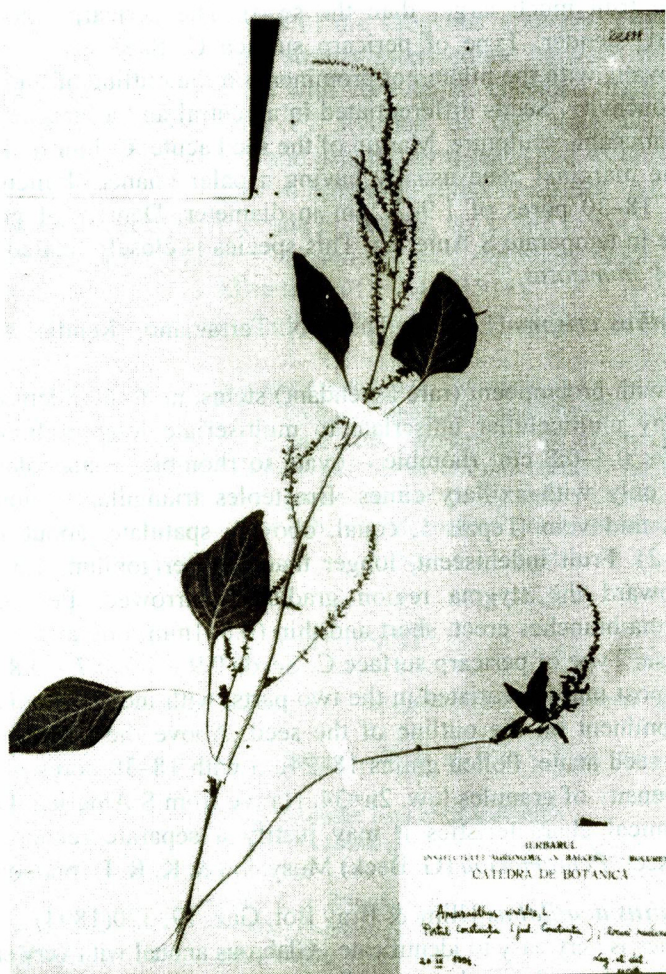


Fig. 9 – *Amaranthus viridis*.

America. It is now recorded for the first time in Romania its distribution not being well known. Turnu Măgurele 1974 (leg. G. Negrean); Constantza 1994, 1995, 1996.

Amaranthus deflexus L., Mant. Pl.: 295 (1771).

Perennial with decumbent stems up to 1m, puberulent in the upper part, trichomes multicellular uniseriate, brownish or green coloured. Leaves 3–5 × 1.5(2.5) cm, rhombic – ovate, to lanceolate – ovate obtuse or shallowly emarginate. Inflorescence axillary and terminal. Bracteoles triangular-ovate, shorter than the perigon. Tepals 2–3, equal, 1.2–1.5mm long, with the mid-vein green, uniform. Fruit indehiscent, 2–2.5(3)mm, 2× longer than wide, elongate-elliptic, toward the apex cylindrical, evidently longer than the perigonium, inflated (cavity of the fruit much larger than the seed). The pericarp smooth. Stigma branches short, slender. Type of pericarp surface C. Seeds 1–1.1 × 0.8–9mm, elliptic to obovate, with the hilum not prominent on the outline of the seed. Above the hilum a concavity. Seeds differentiated in a central and a marginal zone, both with hardly noticeable sculpture. Margin of the seed acute. Colour dark – brown to black with the marginal zone usually having a paler nuance. Pollen grains 22–24µm with 18–30 pores of 1.9–2.2µm in diameter. Density of granules low. 2n=34. Native in temperate S America. This species is closely related to the more thermophile *A. muricatus*.

Amaranthus crispus (Lesp. & Thev.) N. Terraciano, Rendic. Acad. Napol. 2: 188 (1890).

Annual with procumbent (rare ascendant) stems, up to 60–80cm in the upper part with many multicellular uniseriate to multiseriate long trichomes. Leaves small, 0.6–2.5 × 0.4–0.8 cm, rhombic – ovate to rhombic – lanceolate, crispule. Inflorescence only with axillary cymes. Bracteoles triangular – elongated with inconspicuous mid-vein. Tepals 5, equal, obovate-spatulate, about 1.5mm long (Plate I, Fig. 2). Fruit indehiscent, longer than the perigonium, 1.5–2mm long, ellipsoidal, toward the stigma region gradually narrowed. Pericarp strongly wrinkled. Stigma branches erect, short and thin (0.8–1mm long and 0.05–0.08mm wide at the base. Type of pericarp surface C. Seeds 0.9 – 1 × 0.7 – 0.8mm, elliptic to obovate, almost undifferentiated in the two parts, with inconspicuous sculpture. Hilum not prominent on the outline of the seed. Above the hilum a concavity. Margin of the seed acute. Pollen grains 18–24µm with 18–30 pores of 1.9–2.2µm in diameter. Density of granules low. 2n=34. Native from S America. Due to some morpho-anatomical characteristics it may justify a separate recognition at the section level (sect. *Pentamoron* (G. Beck) Mosyakin & K. R. Robertson)).

Amaranthus acutilobus Uline & Bray Bot. Gaz. 19: 320(1894).

The species is very easy to identify. Glabrous annual with very small leaves, deeply emarginated to bilobed (resembling *A. emarginatus* var. *emarginatus*). Inflorescence wholly axillary. Bracteoles spinescent, about 2× longer than the

perigonium, Female flowers with 4 tepals, male flowers with 5 tepals. Fruit indehiscent, smooth, elliptical to globose (Plate I, Fig. 8). Seeds $1-1.2 \times 1-1.3$ mm round, not differentiated in a central and a marginal zone, minutely verrucose sculptured. Native from the south of N America. The species is related with the *A. blitum* agg.

This species was not mentioned until now in the Romanian flora because it appeared only as a casual in Cluj (jud. Cluj). Plants were collected and deposited in HIC and SB herbaria since 1960 and 1962.

Hybrids

The species belonging to subgenus *Amaranthus* never hybridise with the species of the subgenus *Albersia*. There is a difference between the hybrids of the subgenus *Amaranthus* and the ones of the subgenus *Albersia*. The F1 hybrids of the subgenus *Amaranthus* are not strictly intermediate between the two parents, having an abnormal inflorescence with very dense, crowded branches. Also they are usually totally sterile. The F1 hybrids of the subgenus *Albersia* are intermediate between the parents and usually form seeds and fruits, even if sterile.

A. × budensis Priszter = *A. albus* × *A. blitoides*, Index Hort. Bot. 7:125 (1949).

≡ *A. dobrogensis* Morariu in Addenda Fl. R.P.R., vol I: 645 (1952).

A. × theveanui Deg et Thell. = *A. deflexus* var. *rufescens* Godr. × *A. crispus*, Ascherson & Graebner., Syn. Mitteleur. Fl. 5: 346 (1914).

= *A. deflexus* f. *pseudocrispus* Thell. in Fl. Advent. Montpell.: 215 (1912).

Acknowledgements. I am very grateful to dr. Gerold Hügin for his constant help along these years as well as to Prof. dr. Julio Iranzo who kindly made the SEM study possible. Also I am much indebted to Prof. dr. Jose Luis Carretero for his assistance and the useful discussions over the problems of the genus. Moreover I owe thanks to my teachers: Prof. dr. Vasile Ciocărlan, Prof. dr. Livia Ungurean and Prof. dr. Constantin Chirila. Not in the least I am obliged to dr. Gheorghe Dihoru, dr. Gavrilă Negrean and dr. Nicolae Roman for their observations and suggestions.

REFERENCES

1. Aellen P., 1959, *Amaranthus* L., Hegi G., *Illustrierte Flora von Mitteleuropa*, 2. Aufl. **3**, 2: 465-516, München.
2. Aellen P., 1964, *Amaranthus* L. Tutin T. G. & al. (Eds.), *Flora Europaea* **1**: 109-110, Cambridge.
3. Akeroyd J., 1993, *Amaranthus* L. *Flora Europaea* 2-nd ed., Cambridge.
4. Barthlott W. & Ehler N., 1977, *Raster-Elektronen-mikroskopie der Epidermis-Oberflächen von Spermatophyten*, Wiesbaden.
5. Brenan J.P.M., 1961—*Amaranthus* L. in *Britain*, *Watsonia*, **4**: 261-280.
6. Brenan J.P.M. & Townsend C. C., 1980, *Proposal to reject Amaranthus blitum* L. under art. 69 in favor of *A. lividus* L., *Taxon*, **29**: 695-696.
7. Brummit R., 1984, *Report of the Committee for Spermatophyta*, *Taxon*, **33**: 297-301.
8. Carretero J. L., 1979, *El genero Amaranthus en España*. *Collect. Bot.*, **11**: 105-142l, Barcelona.

9. Carretero J. L., 1985, *Consideraciones sobre las Amaranthaceas Ibericas*, Anales Jard. Bot. Madrid, **41**: 271-286.
10. Carretero J. L., 1990, *Amaranthus* L., Castroviejo S. & al.(Eds.), Flora Iberica. Plantas vasculares de la Peninsula Iberica e Islas Baleares, Vol.2: 559-570, Madrid.
11. Costea M., 1997, *The genus Amaranthus, section Amaranthus in Romania*, Acta Horti. Buc., 1995/1996, 105-125, București.
12. Costea M., 1997, *Amaranthus tamariscinus* Nutt. and *Amaranthus palmeri* S. Watson in Romania, Acta Horti. Buc., 1995/1996, 121-125, București.
13. Eliasson U., 1987, *Amaranthus*, G. H. Harling & L. Andersen (Eds) *Flora of Ecuador*, **28**: 20-36, Aarhus Council for Nordic Publication of Botany.
14. Filias F., Gaulliez R., Guedes M., 1980, *Amaranthus blitum* vs. *A. lividus* (Amaranthaceae), Taxon **29**: 149-150.
15. Gusev J. D., 1972, *The survey of the genus Amaranthus in U.S.S.R.*, Bot. Zurn., **57**: 457-464, Moscow-Leningrad.
16. Hügin G., 1987, *Einige Bemerkungen zu wenig bekannten Amaranthus - Sippen (Amaranthaceae) Mitteleuropas*, Willdenowia **16**: 453-478.
17. Jalas J. & Suominen J., 1980, *Atlas Florae Europaeae* 5: 90-98, Societas Biologica Fennica Vanamo, Helsinki.
18. Kloppe K. & Robel J., 1989, *Beitrge zur Systematik Morphologie und Anatomie der Gattung Amaranthus 1. Karpomorphologie und- anatomie ausgewahl- ter Vertreter*, Gleditschia, **17**: 3-21.
19. Kopper K. & Robel J., 1989, *Beitrge zur Systematik, Morphologie und Anatomie der Gattung Amaranthus 2. Samenphologie und- anatome ausgewahl- ter Vertreter*, Gleditschia, **17**: 171-182.
20. Koval T., 1954, *Cechy morfologiczne I anatomiczne nasion rodzaje Amaranthus L. oraz klucze do ich oznaczania*, Monogr. Bot., 170:193, Warszawa.
21. Morariu I., 1952, *Genul Amaranthus L.*, Flora R.P.R., Edit. Academiei, Vol I: 587- 607, București.
22. Mosyakin S. L. & Robertson K. R., 1996, *New infrageneric combination in Amaranthus (Amaranthaceae)*, Ann. Bot. Fennici, **33**: 275-281.
23. Priszter S., 1958, *Über die bisher bekannten Bastarde der Gatung Amaranthus*, Bauhinia, **1**:126-135.
24. Thellung A., 1907, *Beitrage zur Adventivflora der Schweiz*, Vierteljahrsschr. Naturf. Ges. Zurich, **52**: 434-473.
25. Thellung A., 1914, *Amaranthus*, Ascherson P. & Graebner P., Synopsis der Mitteleuropaischen Flora, **5**: 225-356.

Received on November 17th, 1997

University of Agricultural Sciences
Department of Botany
Bd. Mărăști 59, 71331, Bucharest

TAXONOMICAL CONSIDERATIONS ON SOME POPULATIONS OF *TAMARIX RAMOSISSIMA* LEDEB., IN THE DANUBE FLOOD PLAIN AND DANUBE DELTA

AURICA TĂCINĂ, MIHAELA PAUCĂ-COMĂNESCU

The paper presents a morpho-taxonomical and ecological analysis of *Tamarix ramosissima* populations in the Danube flood plain and Delta. The reason of our investigation is the Flora Europaea quotation that in Romania, *Tamarix smyrnensis* is growing while the *Tamarix ramosissima* areal would be situated only outside of Romania. The morpho-taxonomical comparison of the two taxa (*T. ramosissima* and *T. smyrnensis*) both quantitatively and qualitatively as well as the ecological comparison show the importance of the site, especially the ground but the stability of certain qualitative morphological differences (as the absence of petal keel or the shape of petal) and phenology too. Using these characters, the five investigated populations, spread on the Danube banks, belong to the species *Tamarix ramosissima* and therefore the extension of west limit of *T. ramosissima* areal is assessed.

Key words: Danube flood plain, Danube delta, petal keel, connivent, *Tamarix ramosissima*, *Tamarix smyrnensis*.

Tamarix L. genus includes some 100 species widely spread in Iran, around the Caspian Sea, in the oriental Mediterranean region and in North Africa. The number of species is low in Europe and very low in India, Japan and South Africa.

Three species were described in Romania: *T. tetrandra* Pall., *T. gallica* L., both used as ornamental plants and *T. ramosissima* Ledeb. (Fl. Alt.) (1829) 424; Gorsck. In Fl. URSS XV (1949) 311 – *T. pentandra* Pall. Fl. Ross. I, II (1788) 72, non tab. 79 – *T. Pallasii* Auct. Ross. Et rom., non Desv., (1824), sensu D.C. Prodr. III (1828) 26 – *T. paniculata* Stev. In DC. Prodr. III (1828) 26, n-nud. – *T. gallica*. Auct. rom. plur., *T. pentandra* Hort., *T. odessana*. Hort., *T. hispida aestivalis* Hort. Exs: FRE nr. 577, 578 sub *T. Pallasii*. Ic: Pl. 88, Fig. 1.1.-b. – Tamarisk.

The variability of the species is reduced to two forms: *albiflora* (G. Grinț.) *f. aestivalis* (Hort.) Zahariadi comb. nova and var. *odessana* (Stev.) Schmalh. (12).

The ecological investigations conducted by us during 1994–1998, with the purpose of characterizing ecosystemically the shrubberies from the Danube flood plain and Delta, the complex analysis of these types of ecosystems required a taxonomic analysis of *T. ramosissima* species (6, 7). The research is important, since according to Fl. Europaea (2), the species would not grow in Romania. The first citation of *T. ramosissima* species was in 1885, by D. Grecescu, under the name of *T. Pallasii* at Scăieni (Prahova county) and Slatina (Olt county). (4).

MATERIAL AND METHOD

The biological material was sampled from different *Tamarix* shrubs grown to maturity, with numerous inflorescences. The measurements were conducted under binoculars; the data were processed with general statistical calculations. The investigations were carried out in five sites in which the shrubbery formed natural associations well established; three of them are located in the Danube floodplain near Brăila: on the left bank of the Danube at the confluence with Călmățui river (Gura Gârлуței); in the Small Island of Brăila (close to the village of Mărașu); on the bank of Buzău river, at the confluence with Siret river, close to the place where it pours into the Danube (Latinu). The other two are located in the Danube Delta: on Caraorman sand bank, on the bank of the canal; at the place where Sulina branch pours into the Black Sea, at some 200 m from the beach, on the right bank, close to the locality with the same name.

In the above-mentioned sites (Fig.1), the soil consists of alluvia, it evolved on proto soils or on alluvia soils, with clay-sandy texture; the hydric regime is characterized by potential temporary flooding, annually, especially during the spring months. The pH is weakly to moderate alkaline in all sites (7.4-8.2); it increases with the depth. The salt concentration is high for carbonates (9-12 mg %); large amounts of chlorides and sulfates are present on some sites, especially during the dry season (60-288 mg %) (Paucă et al, 1999 – in print).

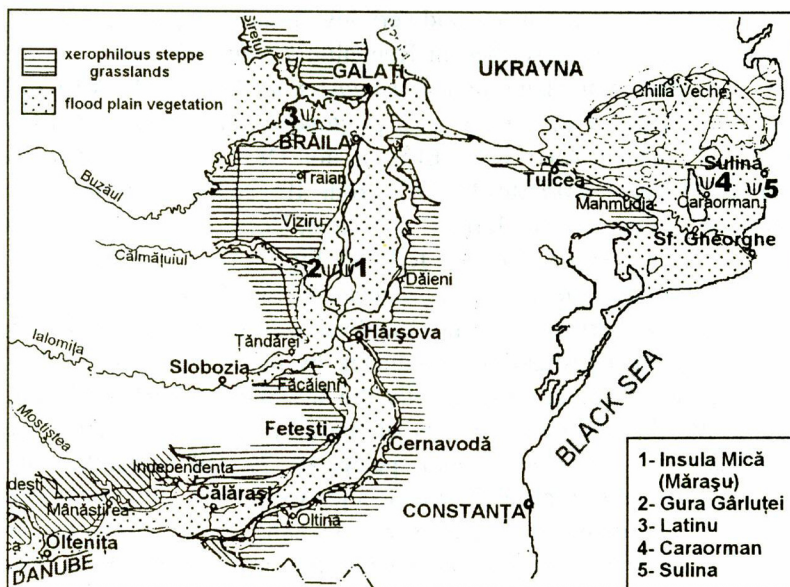


Fig. 1 – Location of the investigated sites.

The largest dimensions of the *Tamarix* shrubs vary between 1.0–6.5m according to the age, density of the populations and mainly, according to the manner of utilization of the shrubs; at Gura Gârluței and Latinu, the branches are collected intensely by the inhabitants, to make fire, fences and baskets; at Caraorman and Sulina the areas are intensely grazed by sheep and cattle; only in the Small Island of Brăila, the shrubbery was little affected by cutting or grazing during the past 25 years, the area having a natural state of “protection” and this is why the dimensions are the largest.

RESULTS AND DISCUSSION

According to Flora României (12), *T. ramosissima* inhabits the sites from the south and south-east Romania (Oltenia, Muntenia and Moldova); it is not mentioned in Transylvania.

In 1931, Al.Borza included it phytocoenotically in *Tamaricetum ramosissimi=pallassi* (according to V. Sanda and Gh. Șerbănescu) (9). Subsequently, the species was characterized taxonomically and phytocoenotically in the papers of Șt. Rubțov (8) T. Simon and Gh. Dihoru (10), I. Șerbănescu (11), M. Andrei, A. Popescu (1). Besides these, are the contributions to the ecosystemic characterization of the shrubberies of *T. ramosissima* from the Danube floodplain and Delta (5, 6, 7).

Flora Europaea (2) places the area of *T. ramosissima* species outside the territory of Romania (east of the Black Sea), conception according to which on our territory grows the species *T. smyrnensis* Bunge and not *T. ramosissima* Ledeb. Due to this reason, our research on individuals of *Tamarix* aimed mainly to observe the characters distinguishing the two species (*T. ramosissima* and *T. smyrnensis*) in order to clarify what plant inhabits the sites we analyzed.

Using the diagnosis given by B.Baum in the monograph of the genus (2, 3) for the two species, we identified the main qualitative traits differentiating the two taxa (Table 1).

Table 1

Comparative analysis of *T. ramosissima* Ledeb. and *T. smyrnensis* Bge. (according to Baum 1976)

Character	Species	
	<i>T. ramosissima</i>	<i>T. smyrnensis</i>
Petal shape	obovate, asymmetric, connivent	ovate to suborbicular, concrescent at least in inf. 1/2
Petal keel	absent	present at least in inf. 1/2
Flowering period	V-X	III-VIII
Habitat	sandy shores, salty river banks	near streams and river banks, also in mountain and damp stony slopes

Table 2

Qualitative analysis of investigated populations in the Danube flood plain and delta

Character	Site				
	Gura Gârluței n=154	Mărașu n=142	Latinu n=147	Caraorman n=280	Sulina n=334
Petal shape	obovate , connivent 100%	obovate, connivent 100%	obovate, connivent 100%	obovate, connivent 100%	obovate, connivent 100%
Petal keel	absent 100%	absent 100%	absent 100%	absent 100%	absent 100%
Flowering period**	May-Aug. *	May-Aug *	May-Aug*	May-Aug*.	May-Aug*.

* Sometimes on the same shrub are observed some flowering branches while all the other are in the fruit stage.

** The date is different from one to another year due to the annual variation of air temperature and spring flooding period.

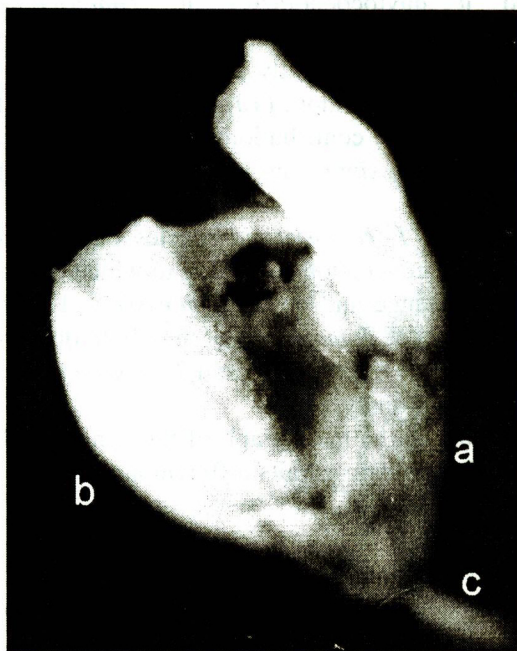


Fig. 2 – Flower at *Tamarix ramosissima* Ledeb; a. -calyx; b: -corolla; c: -floral pedicel. (×40)

We observed that the four characters differentiating the analyzed species are qualitative in nature, bearing a sure taxonomic value in our observations on the investigated populations growing in the Danube flood plain and Delta (Table 2), (Fig. 2, 3, 4). Our analysis was conducted on a number of samples which varied with the site; the form of petals is constantly obovate , 100% connivent; the absence of keel was noticed in all analyzed petals; anthesis, as a character of

differentiation with well-established taxonomic value, took place according to our phenological observations in May-August (Table 2) (Fig. 2, 3, 4).

Fig. 3 – The flower at *Tamarix*; details: a: -obovate petal - *T. ramosissima*; b: -ovate petal - *T. smyrnensis* (after Baum) ($\times 20$).

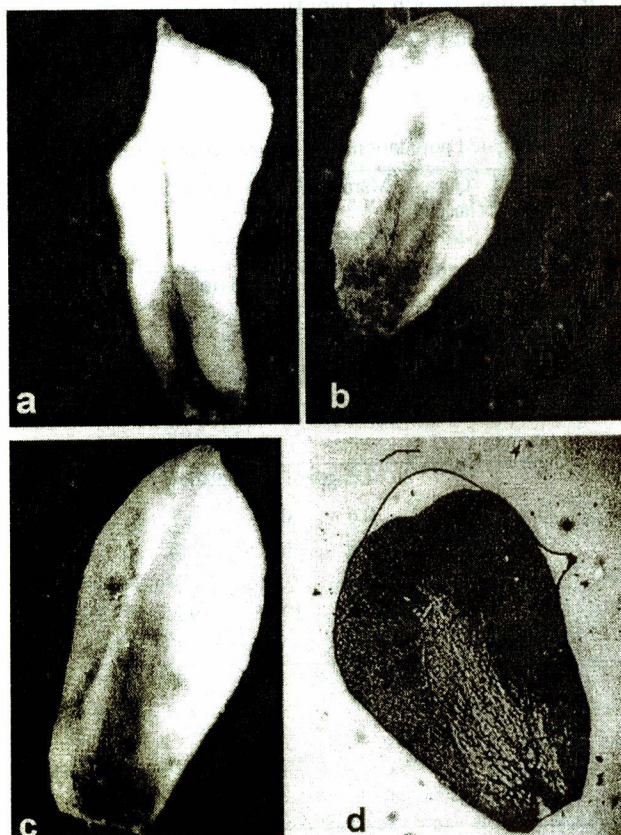
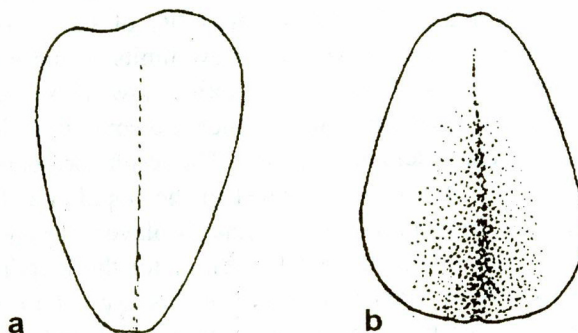


Fig. 4 – Petals at *Tamarix ramosissima*; details: a,c – connivent petal; b, d – petal in abaxial side.

Because Baum's monograph refers to the size of some floral elements in order to distinguish between the two taxa, we conducted biometric measurements on some

diagnosis characters, namely the floral elements (presence or absence of the keel), the dimensions (petals, calyx, floral pedicel, bract) required in order to identify the species, but also to determine the degree of variability of these characters.

Analyzing the biometric variability of some floral characters, we observed that their mean varied within narrow limits in the analyzed sites (Table 3). The intra-population variability is rather low if we consider the values of the coefficient of variation values, which are sometimes lower for the floral elements and for the characters of diagnosis. The results presented in Table 3 show that petal length varied at a very low level in the population from Mărașu site, while the populations from Latinu and Sulina displayed clearly high variation; an opposite situation was noticed for petal width or for the length of the floral pedicel, or the bract, exactly in Mărașu. Because of this, we cannot make a connection between the higher variability or stability of some floral characters and the degree of productivity or protection of *Tamarix* shrubs, which as mentioned, was observed at different developmental stages in the mentioned sites.

Table 3

Variability of floral characters at the investigated populations of *Tamarix ramosissima*

Site	Gura Gârлуței	Mărașu	Latinu	Caraorman	Sulina	Gura Gârлуței	Mărașu	Latinu	Caraorman	Sulina
Length of petal (mm)						Width of petal (mm)				
Mean	1.6	1.7	1.6	1.5	1.5	0.7	0.8	0.7	0.7	0.7
N	154	142	147	280	334	154	142	147	280	334
Stdev	0.25	0.3	0.28	0.22	0.23	0.16	0.2	0.17	0.16	0.22
s%	15.73	14.8	17.19	14.58	15.47	22.11	23.6	22.25	21.97	32.15
Length of calyx						Length of floral pedicel				
Mean	0.6	0.5	0.6	0.6	0.6	0.5	0.6	0.4	0.5	0.4
N	154	142	147	280	334	154	142	147	280	334
Stdev	0.06	0.1	0.17	0.10	0.15	0.10	0.3	0.07	0.09	0.09
s%	10.85	24.8	27.37	17.89	23.53	19.96	45.8	17.35	19.25	20.82
Length of bract										
Mean	1.0	1.1	1.0	1.4	1.4					
N	154	142	147	280	334					
Stdev	0.14	0.4	0.25	0.29	0.34					
s%	13.38	35.7	25.56	20.34	24.76					

Generally, the values obtained by us for the different analyzed populations are closer to those described by Zahariadi in Flora României (12), than to those

presented by Baum in the monograph of the genus, although these should ensure the variability of the species on a much wider area (2, 3).

We consider necessary the analysis of other *Tamarix* population growing on the Romanian territory, especially in the flood plain of the inner rivers, in order to clarify as much as possible the problem of the existence of *T. ramosissima* species in Romania and the limits of its areal. Maybe some sites are indeed inhabited by *T. smyrnensis*, either in the sites mentioned by Baum for Romania (according to the materials collected and determined by Grecescu under a different name, many years ago), or in other sites not yet investigated, in which the environmental conditions are closer to the ecology of the species.

CONCLUSIONS

The morphological and ecological characters of the analyzed individuals from the populations growing in the Danube flood plain and Delta are typical in the description of *T. ramosissima* species Ledeb. and are clearly distinguished from *T. smyrnensis* Bunge.

The analysis of the diagnosis characters, using the coefficient of variation, suggests a rather wide variability of the floral biometric characters (10.88–27.37%) showing the importance of the ecological, or site factors, but also a higher stability of some qualitative traits such as the absence of keel, the form of petals, etc.

The presence of *Tamarix ramosissima* species in the sites analyzed by us offers certified elements of the expansion of the eastern limit of the taxon's areal, which was identified by Baum only up to east of the Black Sea and the western area of it.

REFERENCES

1. Andrei M., Popescu A., 1967, *Aspecte din vegetația culmii Pricopan și împrejurimi*, St. cerc. Biol., seria biol.veget. **19**, 263, București.
2. Baum B., 1968, *The genus Tamarix in : Flora Europaea*, **2**, 293, Cambridge.
3. Baum B., 1978, *The genus Tamarix*, The Israel Academy of Sciences and Humanities, 19-47, Jerusalem.
4. Grecescu D., 1885, *Index plantarum exiccatorum Romaniae*, **3**, 247, București.
5. Paucă-Comănescu M., Șerbănescu Gh., Roșu C., Vicol C., 1995, *Structura producătorilor primari în tufărișul de Tamarix ramosissima din lunca Dunării inferioare*, Conf. Naț. de Ecologie, 82-89, Arad.
6. Paucă-Comănescu M. et al., 1996, *Ecosystemic characterization of a Tamarix ramosissima shrubland in the Danube Delta (Sulina)*, Rev. roum. de biol., Biol.végét., **41**(2):101-111, Bucharest.
7. Paucă-Comănescu M. et al., 1997, *Ecosystemic characterization of the shrubland of Tamarix ramosissima from Insula Mică a Brăilei (Danube flood plain)*, Proceedings of the Institute of Biology, 147-177, Bucharest.
8. Rubțov Șt., 1940, *Solurile zăvoaielor Buzăului și tipurile naturale de arborete*, Rev. pădurilor, **52**, 2.

9. Sanda V., Șerbănescu Gh., 1969, *Câteva unități fitocenologice hidrofite și higrofile semnalate între grindurile Crișan și Caraorman (Delta Dunării)*, Hidrobiologia, **10**, 97-107.
10. Simon T., Dihoru Gh., 1963, *Die Tamarix Auen am Flusse Buzău in Rumänien*, Ann.Univ. Sc. Budapest, s.Biol., **6**, 159-163.
11. Șerbănescu I., 1965, *Asociațiile halofite din Câmpia Română*, Com-Geol., Inst.geol., St. tehn. și econom., C, **15**, 88-90.
12. Zahariadi C., 1955, *Genul Tamarix* in: Flora RPR, Edit.Acad., **3**, 528-531, București.

Received on December 30, 1998

*Institute of Biology
Splaiul Independenței, 296
Bucharest*

SPATIAL AND TEMPORAL DYNAMICS OF THE PLANT SPECIES PRESENCE OF *TAMARIX RAMOSISSIMA* SHRUBLANDS GROWING IN THE DANUBE FLOOD PLAIN AND DELTA

MIHAELA PAUCĂ-COMĂNESCU, G. ȘERBĂNESCU

The paper presents the list of the 197 inventoried species of *Tamarix ramosissima* communities differentiated as age and site (seven sites in the Danube low flood plain and delta), during the 1994 – 1998 period. Only 30 – 40% of the present species of the site are permanent for 3 – 4 years, the other species being different from one year to another. The constant species in all investigated sites during the entire period were only one in the shrub layer – *Tamarix ramosissima* (92 – 100% cover) and only one in the herbaceous layer – *Cynodon dactylon*; *Agrostis stolonifera* and *Elymus (Agropyron) repens* had a higher frequency and productive importance among herbs too. The similarity of the analysed shrub communities was very reduced (values of coefficient Jaccard 35.77 – 20.56); even in the same site of the *Tamarix* community the similarity between consecutive years decreased (from 62.5 – 77.8 to 28.2 – 43.4) after 3 – 4 years.

Key words: plant mobility, flora, *Tamarix ramosissima*.

The flood plain vegetation and the Danube flood plain vegetation especially is very rich as species and diversified as communities, due to the special conditions of the ground, with permanent and periodical changes, sometimes very important. Within this diversity of vegetation existing in very different stages of development, we noticed the presence of shrublands and especially of those edified by *Tamarix ramosissima*, on rather extended areas. They were noticed as distinct associations on the inner rivers in, as early as, 1931 by Al. Borza, in the Romanian Plain, then along Buzău river (St. Rubțov, 1940, Simon *et al.*, 1962), I. Șerbănescu (1965) and along the Danube (A. Marin *et al.*, 1967, V. Sanda *et al.*, 1969), but their cenotaxonomy is not yet clarified. Ecological research regarding the productivity of several *Tamarix* shrublands from the Danube flood plain and the Danube Delta during 1994–1998, rendered evident an active dynamics of the primary producers, not only at the level of quantity, but also at the level of quality (Paucă-Comănescu *et al.* (4,5,6,7). In the following we shall approach the species of higher plants that compose these shrublands, as well as their evolution.

MATERIAL AND METHODS

The *Tamarix* shrublands assigned to our research developed naturally in the flood plain of the lower Danube, from the confluence of Călmățui river down to the place where the Danube pours into the Black Sea, in the following sites (Fig. 1): **1. Insula Mică (Small Island) of Brăila**, in front of the former village of Nedeicu destroyed by the two great floodings (1971 and 1975); the shrubs are spread in thick stripes, 12-16 m wide and 50-600 m long along channels that are usually dry, alternating with stripes of dry pastures, covering extended areas; **2. Gura Gârluței**, on the left Danube bank, at the confluence with Călmățui river, forming a continuous stripe of loose shrubbery, wider (50 -100 m), but not so

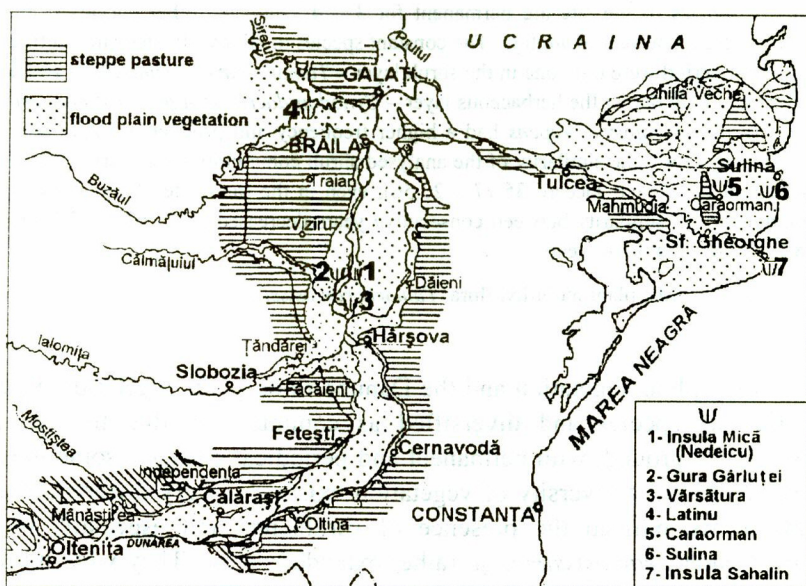


Fig. 1 – Geographical position of the investigated shrublands.

expanded, very intensely and frequently harvested by the neighboring inhabitants for their own use; **3. Vărsătura**, on the island with the same name, separated from the Insula Mică of Brăila by Vâlcu branch; the shrubbery is loose, distributed on a wide area and isolated from human settlements; **4. Latinu**, close to the confluence of Buzău and Siret rivers (near the place they pour into the Danube); the shrubbery makes a dense and wide stripe, parallel with the river, both on the high and on the depressed micro-relief; **5. Caraorman**, close to the common pasture of the village, along the channel cut towards the navigable Danube; the shrubbery is very expanded on a wide stripe, with a loose distribution; **6. Sulina**, where the branch

pours into the Black Sea, some 200 m away from the beach; the shrubbery makes a dense and wide (200 m) stripe, parallel with the sea, stretching on a varied micro-relief and very exposed to harvesting and grazing, due to its proximity to the locality; 7. **Sahalinu Mare Island**, close to Melele, where the shrubbery is growing again, perpendicularly to the sea, on a narrow stripe (2-5 m wide and 80-100 m long, for the time being).

All sites are characterized by the youth of the ground: a protosoil in the Insula Mică, an alluvial soil buried under new alluvia during the last great flooding of the Danube (1975) at Gura Gârluței; the youngest substrate is at Sahalin island, where the 1996 storm washed completely the *Tamarix* shrubs from the beach, although they were properly developed, uprooting, destroying and burying them under a new alluvial deposit. The other sites have a more evolved ground, up to the type of alluvial soil. The reaction of the ground is alkaline for almost all sites, and it gets more alkaline with the depth (Table 1). In some sites better investigated we have observed that the concentration of organic matter (humus) was low, the accumulation being recent, of low intensity and frequently washed out (Table 2); the carbonates are present throughout the profile, while other salts (sulfates and chlorides especially) were present especially below 50 cm. Under the conditions of marine sands, the soil was strongly salty. The texture was sandy – clay, the fine sand being predominant; gross sand can be found too in the marine areas.

Table 1

The dynamics of pH in the shrublands alluvial ground during 1998 summer

Layer	Depth (cm)	Lunca Dunării				Delta Dunării		
		Insula Mică	Gura Gârluței	Vărsătura	Latinu	Caraorman	Sulina	Sahalin
L		7.72	7.24	7.40	7.75	7.73	7.62	7.62
S ₁	0-3	7.80	7.61	7.70	8.07	8.32	8.13	8.13
S ₂	3-6	8.08	7.69	7.92	8.01	8.46	8.20	8.20
S ₃	6-9	8.11	7.58	8.03	8.09	-	-	-

Table 2

Physico - chemical characteristics of the shrublands ground in certain sites*

Sites	Horiz	Depth (cm)	Cl ⁻ mg/100g soil	SO ₄ ⁻² mg/100g soil	CaCO ₃ %	C _t x 1.724 humus (%)	Clay %	Silt %	Sand (fine) %	Sand (gross) %
Insula Mică	Ao ₃	0-3	-	-	8.9	3.06	21.2	20.8	59.0	0
	AC	35-40	5.7	12	10.1	1.09	14.6	13.2	72.2	0
	C4	>80	6.5	24	12.5	-	12.9	13.7	73.4	0
Gura Gârluței	Ao ₁	0-3	-	-	8.9	2.15	24.5	25.7	49.8	0

	ACsc	60-70	4	41	10.1	0.53	28.1	27.3	44.0	0
	A/C	125-130	-	32	9.9	0.53	19.9	21.1	59.0	0
Sulina	Ao ₁	0-3	.	.	9.9	3.59	2.0	2.1	81.8	14.1
	Ao ₃	10-20	12	39	9.7	-	-	-	-	-
	AC	20-30	66	60	9.7	0.45	2.5	2.3	83.7	11.5
	CI	30-40	288	56	12.3	-	28.5	36.0	33.8	11.6

* The determinations were used from the thermo-dynamics equilibrium analysis for 1996 realized by dr.Alexandra Vasu ; many thanks for her help.

During the period 1994 – 1996, the water level at the shrublands varied between 4.5 m and 0.5 m depth in the soil, with the highest level at the end of April; in the spring of 1995 the level was higher than in the previous year but it did not exceed the surface of the soil, while in the next spring, 1996, the shrubland was flooded for two weeks at Gura Gârлуței, the water being of 0.5 m height. This type of water regime is characteristic for *Tamarix* shrublands, alternating each and every year, the substrate being periodically saturated by water, getting then dry, sometimes even very dry.

The *Tamarix ramosissima* shrubs that were analysed are developed on a recent substrate covered by new alluvia, their growth and age being different (Table 3); the shrubs vary from about 25 years old and 6.5 m in the Insula Mică to only one year old in Sahalin where the old *Tamarix* shrubbery was buried; its dimension is small, corresponding to its annual growth.

The inventory of species was performed on wide areas, representative for the extension of each shrublands from each site (Table 3).

Table 3

Biometrical characteristics of investigated shrubs

Indices	Insula Mică	Gura Gârлуței	Vărsătura	Latinu	Caraorman	Sulina	Sahalin
Shrubs height (m)							
-maximum	6.5	2.4	3.44	2.50	2.83	1.5	0.3(1.1*)
-mean	4.0	0.96	2.40	1.50	1.53	0.6	0.1(0.8)
Basal diameter (cm)							
-maximum	28.9	4.45	5.0	3.1	3.39	3.5	0.6(4.5)
-mean	9.4	2.56	3.5	1.7	1.81	1.6	0.2(2.0)
Vegetation cover %							
-Shrub layer	95	60	60	80	50	90	10(60)
-Herbaceous layer	52-88	90	80	70	90	80	5(20)
Shrub age (year)	27	27	15	10	15	15	1
Investigated area (sq. m)	12000	2000	10000	5000	10000	2000	100

* the size before the storm

The nomenclature and characterization are in accordance with the Flora of Romania (Ciocârlan (2)). The relative abundance of the species was calculated on samples harvested on areas of 0.25 sq. m; the material was thereafter sorted, counted, weighed and dried at 85°C.

RESULTS AND DISCUSSION

The investigations conducted in the 7 sites with *Tamarix* shrubs, observing the seasonal and annual variations, showed a richness of species (Table 4) amounting to a total of 197. The number of species at a certain site at a given moment is much lower, amounting to only about 50. The indices Simpson/Pielou of diversity, calculated for the shrublands of the Insula Mică and Gura Gârлуței (4) ranged between 0.63 and 0.44, respectively, values reflecting a quantitative disproportion of the participation of these species to the composition of the vegetation cover, even though their number is so large.

The analysis of all the present species revealed a dominance of the Euro-Asiatic elements (Fig. 2), both continental and Mediterranean, followed by the European elements, general or with various degrees of specificity (Mediterranean, Pontic, etc.). Typical for these associations is the large rate of cosmopolite and adventive species, due to the open and evolutive character of the vegetal community.

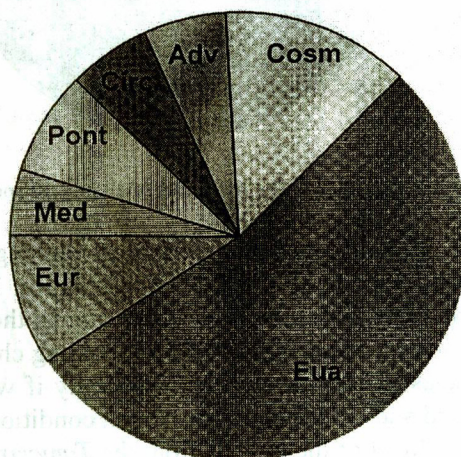


Fig. 2 – Geographical areal of all present species in the *Tamarix* shrublands (%).

The best represented life forms among all the species determined in the *Tamarix* shrublands were the therophytes, especially the annual ones, followed by the hemicryptophytes (Fig. 3). We observed the existence of very varied forms of life in these associations, within each layer of an association; for example, in the layer of shrubs where we have identified 10 species besides the edifying species, we detected tree individuals, in small number and of small size, but these are the species edifying the future forests towards which the vegetal community evolves (*Populus alba*, *Ulmus laevis*). We have only observed few species of wild shrubs and we did not find the species observed on the Buzău valley (10), in accordance with the notice of other authors for the Danube flood plain (1). We have also observed lianas or small bushes (chamaephytes) less frequently met. The rate of

species in the layer of shrubs is strongly out of balance, the dominance of *Tamarix ramosissima* averaging 92–100%, while the other species were quasi sporadic in all locations. In the herbaceous layer, many terophytes have a low persistence on the same area over time; not even the hemicryptophytes grow in large numbers, while the geophytes have a low representative participation in these associations.

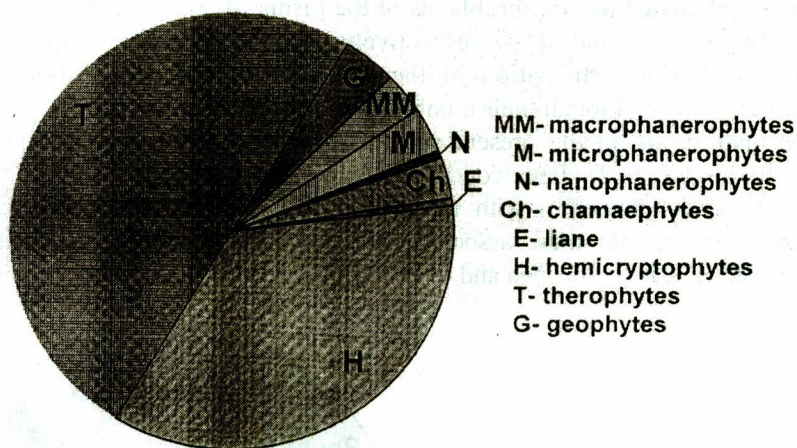


Fig. 3 – The life forms of all present species in the *Tamarix* shrublands (%).

Zonally, the analysed areas belong to the dry steppe pastures, and the actually strips of flood plain where the *Tamarix* shrubberies grow in the close vicinity of the water, range them among the azonal vegetation of wet lands; due to the interpenetration of these contrasting characters, the presence of the component species is very diversified, especially if we consider that the micro-relief is very varied and creates, here and there, conditions for a strongly salty soil.

Most of the species from the *Tamarix* shrublands are ruderal or segetal plants, both as presence and as relative abundance (Fig. 4); only then come the species of pasture and wet lands, swamp plants. Although they are in large number, the pasture species, both wet and dry, have a secondary character of ruderalization. We refer especially to *Cynodon dactylon*, *Elymus (Agropyron) repens* or *Agrostis stolonifera*, to which some authors (3) granted a value of species characteristic for *Tamaricetalia*, *Tamaricion*, but which, at the same time, are frequently met on ruderal areas. The presence of the species typical for shrublands is low, first because they are not generally too specific for this plain formation and second because the distribution of *Tamarix* shrublands in dense, but narrow stripes or in wide, but loose stripes, with wide spaces between them allowing the grasses to take over, makes the pasture species to be predominant. The forestry species are limited to few trees and to several herbaceous species living in the shadow.

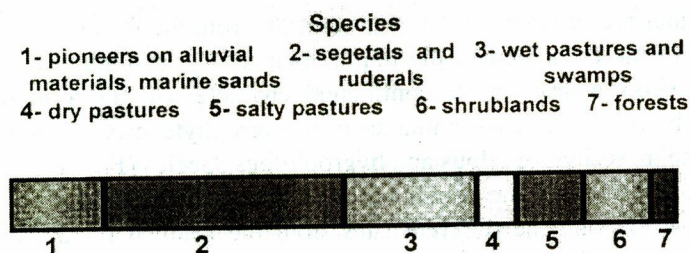


Fig. 4 – The belonging of all present species in the shrublands to the different vegetal formation (%).

The presence of pioneer species, on marine sands or on large alluvia was observed especially in the sites from the Black Sea beaches. They were also observed in the fields very close to the riverbed where, next to *Tamarix*, other few species of herbs grow, having low requirements for organic matter, nitrogen, etc.

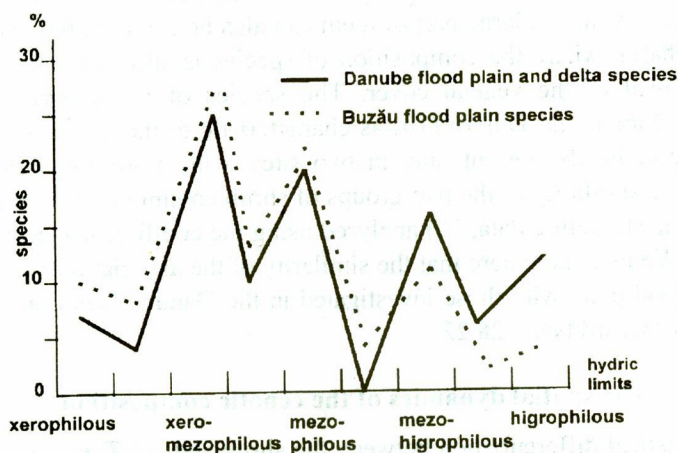


Fig. 5 – Hydric limits of all present species in the *Tamarix* shrublands (%).

The plants composing the *Tamarix ramosissima* associations have very different environmental requirements (Fig.5); the species determined range from xerophilous to hygrophilous and their proportion differs significantly from one site to another. On the average we noticed a dominance of the species with a domain of preference ranging from xero-meso to mesophilous, but due to the existence of a very varied micro-relief, other plants such as xerophilous and hygrophilous ones find proper conditions of development; the euryphytes species are not numerous (1.9%), but on the other hand, many species with a wider amplitude for water requirements grow there, ranging from xeric to mesohydric, and separately from mesohydric to hygrophilous domain.

The water requirement of the communities from the Danube flood plain and the Danube Delta, compared to the requirement of the communities from Buzău flood plain, show a drier, more continental character of the communities from Buzău, both by the numerical dominance of the xerophyte species and by the lower number of the meso-hygrophilous and hygrophilous species (Fig. 5).

The composition of the communities of *Tamarix* shrubberies showed only a slight similarity among the different sites from the Danube flood plain, the only species common to all seven sites, relatively far away in space, being the edifying shrub *Tamarix ramosissima* and the grass species *Cynodon dactylon* – with a rather wide ecological and coenological amplitude (pastures – ruderal areas, fields, xeromesophilous, subthermal species, sometimes halophilous). The species common only to the investigated sites from the Danube flood plain were more numerous (*Elymus repens*, *Poa pratensis*, *Daucus carota*, *Lappula squarrosa*, *Taraxacum officinalis*, *Carduus nutans*, *Rumex crispus*, *Sonchus arvensis*, *Xanthium strumarium*, *Veronica verna*, *Descurainia sophia*, *Capsella-bursa pastoris*), but they are all very spread in ruderal areas. A large part of them can also be found in the Danube Delta, but not in Sahalin, where the composition of species is still rather low due to the complete renewal of the vegetal cover. The species of *Calamagrostis epigeios*, considered by Simon and Dihoru (10) as characteristic to the association described by them is sporadically present only in two sites, with more continental climatic conditions. The similarity of the two groups of shrub communities from the Danube and from Buzău (literature data, 10) analysed using the coefficient Jaccard, was very low (29.27). We must note here that the similarity of the associations investigated in the Danube flood plain with those investigated in the Danube Delta, was no higher, the coefficient Jaccard being 28.22.

The spatial dynamics of the cenotic composition

The floristical differentiation between the shrublands of *Tamarix ramosissima* investigated in the sites along the Danube, presented in Table 4 and compared by calculating the coefficient Jaccard, shows spatial differences. The highest values of the similarity coefficient (35.77) were recorded for the shrublands from the Insula Mică and Gura Gârлуței, where the investigations conducted over a longer period of time and at shorter intervals, increased the number of present species. All other sites had only a low similarity, the lowest being recorded for Sahalin (the Insula Mică vs. Vărsătura 27.37; vs. Latinu 20.56; vs. Sulina 22.48; vs. Caraorman 25.00; vs. Sahalin 3.49). Considering the geographical and even ecological closeness we calculated the similarity between Caraorman and Crișan (literature data, 9), the value of the coefficient being 28.03, and the similarity between the Insula Mică and Carcaliu (literature data, 1), the value being unexpectedly low, 14.28. Similar results were calculated on the Buzău valley (10).

Taking into account these values of similarity, we consider that the simple presence of the species in such open and young associations, with a strong anthropical influence, is insufficient for an analysis of the *Tamarix* shrublands considered as a cenotic unit.

The number of species recorded for each shrublands differs (Table 4), the most numerous being noticed in Sulina, over 80, both for a single inventory (Fig. 6) and throughout the period of research; the fewest species (17) were recorded in Sahalin.

Table 4

The present species in the *Tamarix ramosissima* shrublands on the Danube (1994 - 1998)

No	Species	Species presence						
		Danube flood plain				Danube Delta		
		Insula Mică	Gura Gârluței	Vărsătura	Latinu	Caraorman	Sulina	Sahalin
0	1	2	3	4	5	6	7	8
1	<i>Abutilon theophrasti</i>		+					
2	<i>Achillea millefolium</i>			+		+		
3	<i>Agrostis stolonifera</i>	+			+	+	+	
4	<i>Althaea officinalis</i>	+	+			+	+	
5	<i>Amaranthus retroflexus</i>	+	+					
6	<i>Amorpha fruticosa</i>	+		+				
7	<i>Anagalis arvensis</i>		+					
8	<i>Anthemis ruthenica</i>						+	
9	<i>Anthriscus caucalis</i>		+					
10	<i>Apera spica-venti</i>					+	+	
11	<i>Apium graveolens</i>						+	
12	<i>Arctium lappa</i>	+	+		+			
13	<i>Arenaria serpyllifolia</i>			+		+	+	
14	<i>Argusia sibirica</i>						+	+
15	<i>Aristolochia clematitis</i>		+	+				
16	<i>Artemisia absinthium</i>				+			

0	1	2	3	4	5	6	7	8
17	<i>Artemisia annua</i>	+	+					
18	<i>Artemisia santonicum</i> (maritima ssp.m)		+					
19	<i>Aster tripolium</i>						+	
20	<i>Atriplex prostrata</i> (hastata)		+		+	+	+	
21	<i>Atriplex rosea</i>						+	+
22	<i>Atriplex tatarica</i>		+	+			+	
23	<i>Ballota nigra</i>	+						
24	<i>Bidens frondosa</i>	+	+					
25	<i>Bidens tripartita</i>	+						
26	<i>Bolboschoenus maritimus</i>					+	+	+
27	<i>Bromus commutatus</i>		+				+	
28	<i>Bromus hordeaceus</i>	+				+	+	
29	<i>Bromus japonicus</i>		+			+	+	
30	<i>Bromus squarrosus</i>		+					
31	<i>Bromus tectorum</i>	+		+	+	+	+	
32	<i>Bunias orientalis</i>				+			
33	<i>Calamagrostis epigeios</i>				+	+		
34	<i>Calystegia sepium</i>				+	+		
35	<i>Capsella bursa-pastoris</i>	+	+	+	+		+	
36	<i>Cardaria draba</i>		+		+			
37	<i>Carduus nutans</i>	+	+	+	+	+	+	
38	<i>Carex hirta</i>					+		
39	<i>Centaurea micranthos</i>				+		+	
40	<i>Centaureum pulchellum</i>		+			+	+	
41	<i>Cerastium glomeratum</i>			+		+	+	
42	<i>Chamomilla(Matricaria) recutita(ch)</i>		+					
43	<i>Chenopodium album</i>	+	+	+			+	
44	<i>Chondrilla juncea</i>	+						

0	1	2	3	4	5	6	7	8
45	<i>Cichorium intybus</i>	+	+	+		+		
46	<i>Cicuta virosa</i>				+			
48	<i>Cirsium alatum</i>						+	
49	<i>Cirsium arvense</i>	+	+	+	+	+		
50	<i>Cirsium furiens</i>			+	+			
51	<i>Convolvulus arvensis</i>				+			
52	<i>Conyza</i> (Erigeron) <i>canadensis</i>	+	+	+	+	+	+	
53	<i>Crepis biennis</i>		+	+				
54	<i>Crepis foetida</i>						+	
55	<i>Crypsis alopecuroides</i>		+					
47	<i>Cynanchum acutum</i>						+	
56	<i>Cynodon dactylon</i>	+	+	+	+	+	+	+
57	<i>Daucus carota</i>	+	+	+	+			
58	<i>Descurainia</i> (Sisymbrium) <i>sophia</i>	+	+	+	+		+	
59	<i>Draba muralis</i>						+	
60	<i>Echinochloa crus-galli</i>	+	+					
61	<i>Echium vulgare</i>	+						
62	Elaeagnus angustifolium					+	+	
63	<i>Elymus</i> (Agropyron) <i>repens</i>	+	+	+	+			
64	<i>Elymus arenarius</i> (Hordeum arenarium)							+
65	<i>Erigeron annuus</i>				+			
66	<i>Erodium cicutarium</i>			+			+	
67	<i>Eryngium maritimum</i>						+	
68	<i>Euphorbia palustris</i>	+			+			
69	<i>Euphorbia seguierana</i>						+	
70	Fraxinus pennsylvanica			+				

0	1	2	3	4	5	6	7	8
71	<i>Galega officinalis</i>	+						
72	<i>Galium aparine</i>	+	+	+				
73	<i>Galium humifusum</i>		+					
74	<i>Galium mollugo</i>	+						
75	<i>Galium palustre</i>	+				+		
76	<i>Geranium dissectum</i>	+	+				+	
77	<i>Geranium pusillum</i>			+			+	
78	<i>Glechoma hederacea</i>	+						
79	Gleditsia triacanthos				+			
80	<i>Glycyrrhiza echinata</i>	+						
81	<i>Gnaphalium uliginosum</i>					+		
82	<i>Gypsophila trichotoma</i>						+	
83	<i>Halimione (Oblione) verrucifera</i>							+
84	<i>Heleocharis (Eleocharis) palustris</i>					+		
85	Hippophaë rhamnoides						+	
86	<i>Holosteum umbellatum</i>						+	
87	<i>Hordeum marinum</i>	+	+				+	
88	<i>Hordeum murinum</i>						+	
89	<i>Inula britannica</i>		+			+	+	
90	<i>Juncus acutus</i>						+	
91	<i>Juncus articulatus</i>					+		
92	<i>Juncus conglomeratus</i>					+		+
93	<i>Juncus gerardi</i>		+			+	+	
94	<i>Juncus maritimus</i>					+	+	
95	<i>Kickxia elatine</i>		+					
96	<i>Lactuca tatarica</i>						+	

0	1	2	3	4	5	6	7	8
97	<i>Lamium amplexicaule</i>		+	+	+		+	
98	<i>Lamium purpureum</i>		+					
99	<i>Lappula squarrosa</i>	+	+	+	+		+	
100	<i>Leonurus marrubiastrum</i>		+		+			
101	<i>Lepidium perfoliatum</i>				+			
102	<i>Linaria vulgaris</i>			+	+			
103	<i>Lithospermum officinale</i>		+					
104	<i>Lolium perenne</i>		+				+	
105	<i>Lotus tenuis</i>	+	+			+	+	
106	<i>Lycopus europaeus</i>				+			
107	<i>Lycopus exaltatus</i>				+			
108	<i>Lysimachia nummularia</i>		+					
109	<i>Lysimachia vulgaris</i>					+		
110	<i>Marrubium vulgare</i>	+	+	+		+	+	
111	<i>Medicago lupulina</i>	+	+	+		+	+	
112	<i>Medicago minima</i>						+	
113	<i>Medicago sativa</i>							
114	<i>Melilotus dentata</i>				+			
115	<i>Melilotus officinalis</i>				+			
116	<i>Mentha aquatica</i>	+				+	+	
117	<i>Mentha longifolia</i>	+						
118	<i>Mentha pulegium</i>		+			+		
119	Morus alba	+			+			
120	<i>Myosotis arvensis</i>						+	
121	<i>Myosotis scorpioides</i>	+						
122	<i>Myosurus minimus</i>		+					
123	<i>Onopordum acanthium</i>			+			+	
124	<i>Periploca graeca</i>			+				

0	1	2	3	4	5	6	7	8
125	<i>Petasites spurius</i>							+
126	<i>Phragmites australis</i>			+	+		+	+
127	<i>Plantago scabra</i> (arenaria)						+	
128	<i>Plantago cornuti</i>						+	
129	<i>Plantago coronopus</i>					+	+	
130	<i>Plantago lanceolata</i>		+	+	+	+		
131	<i>Plantago major</i>	+	+			+		
132	<i>Poa angustifolia</i>		+					
133	<i>Poa annua</i>	+	+			+	+	
134	<i>Poa pratensis</i>	+	+	+	+		+	
135	<i>Podospermum</i> (Scorzonera) <i>canum</i>				+			
136	<i>Polygonum aviculare</i>	+	+				+	
137	<i>Polygonum hydropiper</i>	+						
138	<i>Polygonum persicaria</i>		+					
139	<i>Polypogon monspeliensis</i>							+
140	Populus alba	+						
141	Populus canadensis				+			
142	<i>Potentilla anserina</i>		+					
143	<i>Potentilla reptans</i>	+	+			+		
144	<i>Puccinellia distans</i>		+			+	+	
145	<i>Puccinellia gigantea</i>							+
146	<i>Ranunculus repens</i>				+			
147	<i>Rorippa austriaca</i>				+			
148	<i>Rorippa sylvestris</i>	+						
149	Rosa canina				+			
150	Rubus caesius	+		+	+			
151	<i>Rumex crispus</i>	+	+	+	+	+	+	

0	1	2	3	4	5	6	7	8
152	<i>Salicornia europaea</i>						+	+
153	<i>Samolus valerandi</i>					+	+	
154	<i>Scutellaria galericulata</i>	+						
155	<i>Secale sylvestre</i>						+	
156	<i>Senecio vernalis</i>		+	+	+		+	
157	<i>Setaria viridis</i>	+	+					
158	<i>Silene conica</i>						+	
159	<i>Silene otites</i>		+					
160	<i>Sisymbrium loeselii</i>				+			
161	<i>Sisymbrium orientale</i>			+	+			
162	<i>Solanum dulcamara</i>	+				+		
163	<i>Solanum nigrum</i>	+						
164	<i>Salsola kali</i>							+
165	<i>Sonchus arvensis</i>	+	+	+	+	+	+	
166	<i>Spergularia media</i> (maritima)		+				+	
167	<i>Spergularia rubra</i>						+	
168	<i>Stellaria media</i>	+	+	+		+	+	
169	<i>Stellaria palustris</i>	+						
170	<i>Suaeda maritima</i>						+	+
171	Tamarix ramosissima	+	+	+	+	+	+	+
172	<i>Tanacetum vulgare</i>			+				
173	<i>Taraxacum bessarabicum</i>		+				+	
174	<i>Taraxacum officinale</i>	+	+	+	+	+	+	
175	<i>Teucrium scordioides</i>	+	+			+	+	
176	<i>Thlaspi arvense</i>				+			
177	<i>Torilis arvensis</i>	+						
178	<i>Tragopogon dubius</i>			+	+		+	
179	<i>Trifolium campestre</i>					+	+	

0	1	2	3	4	5	6	7	8
180	<i>Trifolium fragiferum</i>		+			+	+	
181	<i>Trifolium repens</i>	+				+		
182	<i>Tripleurosp.</i> (<i>Matricaria</i>) <i>inodorum</i>		+		+			
183	<i>Typha angustifolia</i>							+
184	<i>Ulmus laevis</i>	+						
185	<i>Urtica dioica</i>	+	+		+	+		
186	<i>Urtica urens</i>	+					+	
187	<i>Valerianella locusta</i>		+	+	+			
188	<i>Verbascum blattaria</i>		+	+				
189	<i>Verbascum phlomoides</i>	+		+	+			
190	<i>Verbena officinalis</i>	+	+					
191	<i>Veronica arvensis</i>	+	+					
192	<i>Veronica verna</i>	+	+	+	+			
193	<i>Vicia angustifolia</i>			+				
194	<i>Vicia cracca</i>		+	+	+			
195	<i>Xanthium spinosum</i>	+					+	
196	<i>Xanthium strumarium</i>	+	+	+	+		+	+
197	<i>Xeranthemum annuum</i>						+	

+ Specii constante in perioada 1994-96 → constant species between 1994-96

+ Specii prezente minimum un an → species present for at least one year

The presence of species with a different geographical areal in the investigated *Tamarix* shrublands is rather resembling; with one exception, the Pontic elements are missing in the Insula Mică, and the strictly European species are missing in Sulina. In the other sites the differences concern the number of individuals, the rate being changed from 3–5% between the cosmopolite and Euro-Asiatic elements, both of them dominating all sites. On the other hand, as presence and rate the biological forms are much differentiated from one shrubland to another. The most important difference is the lack of tree species in all shrublands located in the Delta (Table 5).

If we analyse the species of the *Tamarix* shrublands from the viewpoint of their belonging to different categories of vegetal formations (Table 6), we observe that in all cases the ruderal and segetal species are dominating, except for Sahalin where they did not get yet; on the other hand, one can find here most of the pioneer species for marine sands, and from the total number of species growing there 25% are rare (marine sand environment).

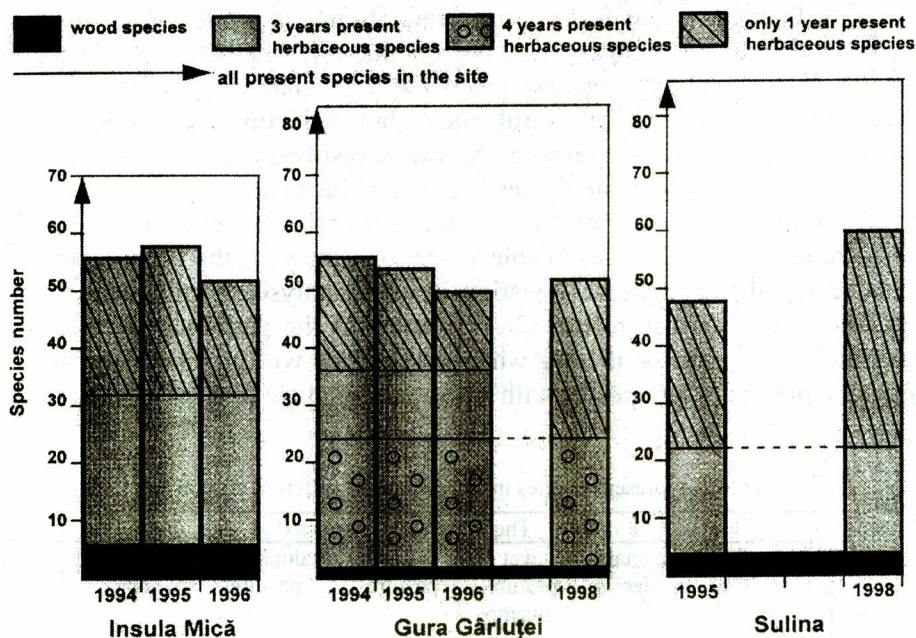


Fig. 6 – The species presence dynamics during some years in *Tamarix ramosissima* shrublands (Danube Delta and flood plain).

Table 5
The life forms of present species in different shrublands

Sites	Life forms (%)							
	MM	M	N	Ch	E	H	T	G
Insula Mică	4.2	1.4	-	2.8	-	39.4	47.9	4.2
Gura Gârлуței	-	2.6	-	-	-	33.3	56.4	7.7
Vărsătura	3.9	2.0	-	-	2.0	25.0	62.0	6.0
Latinu	1.7	5.2	3.5	1.7	-	34.0	48.0	5.2
Caraorman	-	4.0	-	2.0	-	52.0	31.0	11.0
Sulina	-	12.0	-	-	-	36.0	40.0	12.0
Sahalin	-	6.0	-	-	-	44.0	38.0	12.0

The least ruderalised shrubland seems to be the one in Caraorman, then the ones in Sulina and Latinu, although they are close to localities and they are intensively and frequently grazed. A more wet character, with more pasture and swamp species is characteristic to Caraorman, the Insula Mică and Sahalin – frequently covered by waves; the most obvious character of halophilous pasture can be observed again in Sahalin and at Gura Gârluței.

The species observed in the analysed shrublands differ much in their production and numerical abundance; their rate in the composition of the biomass is limited, as the herbaceous layer is concerned, to maximum 8–10 species (4,5,6,), for a site and at a given moment. We do not refer here to the shrubs layer, dominated exclusively by *Tamarix ramosissima*. Gathering together all these species, presented in several shrublands, but selecting only those with a participation exceeding 1% at least in one site, it resulted that from the total of 187 herbaceous species present there, the list was reduced to only 26. The relative abundance in producing the biomass (dry weight) varied between 69 and 0.5% for the most frequently met species (Table 7). In our analysis, the relative abundance was related to all the replicates existing in each analysed shrubland, so that the figures from the table also reflect the frequency of the particular species in each location during the month of May when the species with a short life cycle were still present, but the other species with a normal life cycle had developed too.

Table 6

The belonging of present species in shrublands to different vegetal formation

Sites	The presence of species (%)						
	alluvia materials, marine sand	segetals ruderals	wet pasture, swamp	dry pasture	halophilous pasture	shrub - land	forest
Gura Gârluței	3 -	42 56	25 15	14 8	4 16	7 5	4 -
Sulina	16	40	16	8	8	12	-
Varsătura	4	54	8	20	-	10	4
Latinu	-	40	21	12	5	15	7
Caraorman	6	28	39	9	8	9	-
Sahalin	38	-	25	6	25	6	-

Table 7

The variation of productive role of the present species in shrublands (with the values of biomass over 1% at least in one site)

Species	Relative abundance (dry biomass) (%)					
	Insula Mică	Gura Gârluței	Vărsătura	Latinu	Caraorman	Sulina
<i>Cynodon dactylon</i>	44.0	48.0	0.5	7.2	26.4	69.3
<i>Elymus (Agropyron) repens</i>	15.2	19.9	49.9	53.9	-	-

<i>Agrostis stolonifera</i>	21.8	-	-	1.3	15.4	5.8
<i>Bromus tectorum</i>	.	-	23.2	0.2	3.4	3.4
<i>Potentilla reptans</i>	.	4.1	-	-	10.0	-
<i>Urtica dioica</i>	15.5	.	-	.	.	-
<i>Stellaria media</i>	.	11.0	0.1	-	.	.
<i>Cerastium glomeratum</i> *	-	-	8.1	-	3.2	8.2
<i>Sonchus arvensis</i>	.	.	0.1	6.7	1.8	.
<i>Taraxacum officinale</i>	.	0.8	0.4	.	9.9	.
<i>Taraxacum bessarabicum</i>	-	8.9	-	-	-	.
<i>Trifolium fragiferum</i>	-	0.2	-	-	8.1	8.1
<i>Xanthium strumarium</i>	.	4.8	.	.	-	0.1
<i>Cardaria draba</i> *	-	.	-	18.4	-	-
<i>Artemisia absinthium</i>	-	-	-	8.2	-	-
<i>Arenaria serpyllifolia</i>	-	-	4.7	.	.	0.6
<i>Verbascum blattaria</i>	-	.	3.4	-	-	-
<i>Aristolochia clematidis</i>	-	.	3.4	-	-	-
<i>Phragmites australis</i>	-	-	2.7	.	-	-
<i>Capsella bursa - pastoris</i> *	.	.	1.3	.	-	.
<i>Bromus japonicus</i>	-	.	-	-	3.5	.
<i>Mentha longifolia</i>	2.4	.	.	.	.	.
<i>Mentha aquatica</i>	.	-	-	-	1.4	0.8
<i>Medicago lupulina</i>	.	.	.	-	3.3	3.2
<i>Daucus carota</i>	.	.	0.5	1.6	-	-
<i>Cirsium arvense</i>	0.4	.	0.5	1.6	1.3	-

.values under 0.1 in the analysed period
 *vernal species

In these associations of *Tamarix ramosissima*, the productive role within the herbaceous layer of the ecosystem was divided between the ruderal and segetal species without cenotic importance (75%) and the species belonging to wet pastures and/or slightly salty soils (25%). This shows best the unstable character of these shrublands, not consolidated as cenosis. The species of *Calamagrostis epigeios* contributed with less than 0.1%, in the only two sites where it was observed.

As we shall see, the quantitative role of these species was not constant for the same shrubland, differing from one year to the next and even within the same year; however, they contributed to an amplified diversity of the layer, with more species contributing with moderate values to the total composition of the biomass, unlike the sites where a few species were dominant, their proportion being very high. One such example is the shrubland from Caraorman (Table 7).

The temporal differentiation of the floristical composition

a. In different years

The thorough investigations conducted in the Insula Mică, Gura Gârлуței and Sulina revealed that within the *Tamarix* shrublands, besides the woody species, only 40-43% of the species could be found for a period of 3 years, the other ones being present even for only one year (Fig. 6). After 4 years, only 27-30% of the

species could be found again. Due to this large difference of the composition of the herbaceous layer over the years (although the total number of species was about the same), we have analysed the similarity of the vegetal cover based on the lists of the plants present in the previous years. The Jaccard coefficient for Gura Gârлуței – after 4 years, was 43.42 and for Sulina it was 28.23; on both sites, the shrubland did not get more stability over time because of the excessive use of *Tamarix* wood. In the Insula Mică, a more isolated and better preserved location, the similarity over the years was higher, the coefficient Jaccard varying between 62.5 and 77.8; the higher similarity between the years 1995 and 1996 compared to 1994, was due probably to an increased climatic resemblance (higher humidity, prolonged period of “high water”), because at Gura Gârлуței too, the coefficient of similarity between the same two years, was higher too (69.84).

Most of the species found again constantly over different years (28 in the Insula Mică, 22 species in Sulina), had a high relative abundance in all investigated sites, or at least in the site where they were constant (Table 4, Bold signs in a square).

These species, common for all years, were, most of them, ruderal and segetal too (42% in the Insula Mică, 51% at Gura Gârлуței), or species of wet pastures (37% in the Insula Mică), and among them, many were frequently met in crops or on ruderal areas (*Cynodon dactylon*, *Agrostis stolonifera*, *Elymus (Agropyron) repens*). At Gura Gârлуței the species of more or less salty pastures accounted for 15% of the species found over the 4 years.

Table 8

Relative abundance variation (number of individuals) of the dominant herbaceous species at Insula Mică in different years (after Pauca et al 1998)

Species	Relative abundance (number of individuals) %		
	1994	1995	1996
<i>Cynodon dactylon</i>	54.94	69.70	73.30
<i>Elymus (Agropyron) repens</i>	19.45	14.71	2.70
<i>Agrostis stolonifera</i>	0.82	8.49	7.18
<i>Urtica dioica</i>	7.02	1.04*	3.56**
<i>Lappula squarrosa</i>	4.46	0.52	1.72
<i>Solanum dulcamara</i>	2.27	0.70	2.70
Relative abundance (dry biomass) : *15.53; **45.81			

The relative abundance of the species common for all the investigated period may vary a lot from one year to the next one, as shown in Table 8. The numerical abundance of *Cynodon dactylon* and *Agrostis stolonifera* varied increasingly from 1994 to 1996, while it decreased for *Agropyron repens* in the years with a higher humidity of the substrate. The other species had a variation less directed by the hydric factor, but their role in preserving the density of the grass layer is lower too. We noticed the higher importance of *Urtica dioica* as rate in the biomass, due to its imposing size, especially in this site where it can grow 2-3 m high in the shadow of the *Tamarix* shrubs.

b. In the same year

The variation of the specific composition of *Tamarix ramosissima* shrublands within the same year confirmed the general rule valid for all the known associations in the vegetation of Romania, which says that species with a short life cycle limited to the period of spring-early summer add to the species with a developmental cycle unfolding throughout the entire period of vegetation (for the annual plants) and on a period prolonged on several years (for the perennial plants). The quantitative role of the species with a short life cycle can be rather significant, at least for some sites (Caraorman, Table 7), not only due to their mass development and to their higher biomass (*Cardaria draba*), but also to the late growth and development of some dominant species, such as *Cynodon dactylon*. Significant quantitative differences of the relative abundance between the beginning of the period of vegetation and the estival period were observed (Table 9) at Gura Gârлуței in some species representative for the herbaceous layer of the association. If the proportion of *Cynodon dactylon* or *Elymus repens* can double from the beginning of the active period to the maximum period (June, when stops the excess of water, the temperature was higher but the dryness characteristic to the continental climate was not yet present – (4,7). The species of *Descurainia sophia* or *Capsella-bursa pastoris* disappeared from the composition of the biomass of the herbaceous layer. We can notice that in the vernal species too (otherwise annual species), annual variations in quantity were observed from one year to the next or during the same vernal period (*Capsella bursa pastoris*, *Descurainia sophia*). The evolution of *Elymus repens* in biomass composition is very interesting, increasing from insignificant values at first, to 73% after 4 years.

Table 9

Quantitative variation of dominant species in the herbaceous layer at Gura Garlutei during the vegetation period, in different years

Species	Relative abundance (dry biomass) %		
	May 1995	June 1995	May 1998
<i>Cynodon dactylon</i>	48.3	84.5	0.89
<i>Elymus</i> (Agropyron) <i>repens</i>	0.1	0.34	73.11
<i>Stellaria media</i>	11.1	0.05	13.28
<i>Taraxacum bessarabicum</i>	8.9	1.34	1.25
<i>Descurainia sophia</i>	1.5	-	0.73
<i>Capsella bursa pastoris</i>	2.0	-	4.17

CONCLUSIONS

The spatial and temporal evolution of the species composing the *Tamarix ramosissima* shrublands was very active; not only the quantity of participation changed, but also the presence of species changed.

Only *Cynodon dactylon* could be found in all seven sites from the Danube flood plain and the Danube Delta, the other species being found in most of the sites: *Elymus repens* (especially in the Danube flood plain) and *Agrostis stolonifera* (especially in the Danube Delta).

Over a period of 3-4 years, the same herbaceous species could be found constantly only in a rate of 30-40%, the others changing from one year to the next. Therefore, although in one site we detected 70-86 species, only 50-60 species were present during the same year.

The species with a short cycle of development, vernal, were present sometimes in large quantities, but consisted only of ruderal or segetal species.

Because the composition of the shrubland was dominated quantitatively and qualitatively by ruderal and segetal species, it can be better characterized as cenosis by one of these species, much more faithful to the community, expressing its strongly anthropised and missing stability; the species of *Calamagrostis epigeios* seems to have no cenotic or ecological significance for the shrublands from the Danube flood plain and from the Danube Delta.

REFERENCES

1. Andrei M., Popescu A., 1967, *Aspecte din vegetația culmii Pricopan și împrejurimi*, St.și cerc. Biol., ser. Bot., **19**(3): 247-263.
2. Ciocârlan V., 1988, 1992, *Flora ilustrată a României*, vol 1, vol 2, Edit. Ceres, București.
3. Doniță N., Doina Ivan, Gh.Coldea, V. Sanda, A. Popescu, Th. Chifu, Mihaela Păucă-Comănescu, D. Mititelu, N. Boșcaiu, *Vegetația României*, Edit. Tehnică Agricolă, 407, București.
4. Păucă-Comănescu Mihaela, Gh.Șerbănescu, C. Roșu, C. Vicol, 1995, *Structura producătorilor primari în tufărișurile de Tamarix ramosissima din lunca Dunării inferioare*. Lucrările Conf. Naționale de Ecologie, **6**, 82-89, Arad.
5. Păucă-Comănescu Mihaela, Vasiliu-Oromulu Liliana, Vasu Alexandra, Bâzâc G., Arion C., Șerbănescu G., Tăcină Aurica, Falcă M., Honciuc Viorica, Tatole Victoria, Sterghiu Cleopatra, Cociu Maria, Ceianu I., 1996, *Ecosystemic characterization of a Tamarix ramosissima shrubland in the Danube Delta Sulina*. Rev. Roum. Biol., Biol. Veget. **41** (2): 105-118.
6. Păucă-Comănescu, Mihaela, Liliana Vasiliu-Oromulu, Alexandra Vasu, C. Arion, G. Șerbănescu, Aurica Tăcină, M. Falcă, Viorica Honciuc, Dorina Purice, Cleopatra Sterghiu, Maria Cociu, Victoria Tatole, Lucia Dumitru, Maria Faghi, Ioana Gomoiu, I. Ceianu, Rodica Popovici, C. Vicol, 1997, *Ecosystemic characterisation of the shrubland of Tamarix ramosissima from Insula Mică a Brăilei (Danube flood plain)*, Proceed. Inst. Biol., Ann. Sci. Session, Bucharest.
7. Păucă-Comănescu, Mihaela, C. Vicol, 1998, *Caracteristici ecosistemice ale tufărișurilor de Tamarix ramosissima (Cătină roșie) din lunca Dunării și rolul lor în instalarea naturală a pădurilor aluviale*, în Lucrările ICAS, "Cercetarea Științifică pentru gestionarea durabilă a pădurilor", Edit. Tehnică Agricolă, București, 104-113.
8. Rubțov, Ș., 1940, *Solurile zăvoaielor Buzăului și tipurile naturale de arborete*, Rev. Păd., **52**, 81-90.
9. Sanda, V., Șerbănescu, Gh., 1969, *Câteva unități fitosociologice hidrofile și higrofile semnalate între grindurile Crișan și Caraorman (Delta Dunării)*, Hidrologia, **10**, 97-107.
10. Simon, T., Dihoru, G., 1963, *Die Tamarix - Auen am Flusse Buzău in Rumanien*, Annales Universitatis Scientiarum Budapestiensis de Rolando Eotvos Nominatae, Sectia Biologica, **6**, 159-172.
11. Șerbănescu, I., 1965, *Asociațiile halofile din Câmpia Română*, Studii tehnice și econ. Com. Geol. Seria C., Pedologie, **15**, 88-90.

Received on June 20th, 1998

Institute of Biology, Bucharest
Spl. Independenței, 296

SYNTAXONOMY OF THE NITROPHILOUS PHYTOCOENOSIS BUILT UP BY THE *POLYGONUM AVICULARE* ON THE ROMANIA'S TERRITORY

V. SANDA, A. POPESCU, SIMONA MIHĂILESCU

This paper represents a synthesis of 244 relevés in the phytosociological literature, and based on these notices 12 subassociations have been delimited in the frame of the *Sclerochloo-Polygonetum avicularis* association (Gams 1927) Soó 1940.

Several coenotaxons such as: *Lepidio ruderalis-Sclerochloetum durae* Florița Diaconescu 1978, *Matricaria inodora-Polygonum aviculare* Soran 1962, *Polygono avicularis-Amarantheum crispum* Vicol et al. 1971 and *Amarantheum crispum* Mititelu 1972 are mentioned either as synonyms or as subassociations.

Key words: *Polygonum aviculare*, syntaxonomy, Romanian associations, Jaccard index.

INTRODUCTION

The high ecological amplitude of the nitrophilous phytocoenosis based on *Polygonum aviculare* shows the great number of the stations of this kind of plant community. These groups represent several species, conferring them specificity and the special cenotic synergism.

In Romanian phytosociological literature, these types of coenoses based on *Polygonum aviculare* species have different syntaxonomical appearance. Many authors subscribed these plant communities to *Polygonum aviculare* Gams 1927 association (3, 4, 5, 8, 10, 12, 13, 14, 16, 23) a part of them being differentiated in subassociations (5, 12, 21, 22).

A remarkable contribution concerning the *Polygonum aviculare* plant communities from Banat was realized by S. Grigore and I. Coste (7) which attributed these coenoses to *Sclerochloo durae-Polygonetum avicularis* (Gams 1927) Soó 1940 association therefore having a good ecological, stationary and coenotic stability.

We can evidence these aspects concerning the syntaxonomy of phytocoenosis with *Polygonum aviculare* using the cladistics method (6). We obtain a dendrogram of similarity based on calculation of the Jaccard similarity index.

RESULTS AND DISCUSSIONS

As part of *Sclerochloo durae-Polygonetum avicularis* (Gams 1927) Soó 1940 association, based on the analysis of the coenotic structure of relevés presented in literature (Table 1), we separated the following subassociations:

- typicum* Grigore 1971,
 - polygonetosum* Soó 1961,
 - sclerochloetosum* Gams 1927,
 - lepidietosum ruderalis* (Tim.-Bodrogek. 1959) Sissingh 1969, (Syn: *As. Lepidio ruderalis-Sclerochloetum durae* Florița Diaconescu 1978) (2),
 - matricarietosum discoideae* (Morariu 1967 n.n.) Grigore et Coste 1978,
 - matricarietosum perforatae* (Sorani 1962) stat nov. (Syn: *As. Matricaria inodora-Polygonum aviculare* Sorani 1962) (18),
 - anthemietosum cotulae* Vițalariu 1973,
 - chamomilletosum* Morariu 1943,
 - lolietosum* Morariu 1943 (9, 11),
 - coronopetosum squamati* Soó 1961 (Syn: *As. Sclerochloa dura-Coronopus procumbens* Br.-Bl. (1931) 1936),
 - euclidietosum* Morariu 1943,
 - amaranthesum crispum* (Vicol et al. 1971) stat. nov. (20) (Syn: *Polygono avicularis-Amaranthesum crispum* Vicol et al. 1971, *Amaranthesum crispum* Mititelu 1972).
- In the literature issued in Hungary, A. Borhidi (1), indicates two associations, well delimited, with the following syntaxonomic classification:
- Cl. *Polygono arenastri-Poëtea annuae* Rivas-Martinez 1975 corr. Rivas-Martinez et al. 1991,
- Ord. *Polygono arenastri-Poëtales annuae* R. Tx. in Géhu et al. 1972 corr. Rivas-Martinez et al. 1991,
- Al. *Matricario matricarioides-Polygonion arenastri* Rivas-Martinez 1975 corr. Rivas-Martinez et al. 1991,
- Sclerochloa-Polygonetum arenastri* Soó et Korneck 1969 corr. Mucina 1993,
- Polygonetum arenastri* Felföldy 1942 corr. Borhidi 1996, (*Polygonetum avicularis* Felföldy 1942, Syn: *Polygonetum avicularis* Gams 1927 em. Jehlik in Hejny et al. 1973).

Due to the fact that in our country the spreading area for *Polygonum aviculare* L. is bigger than the one of *Polygonum arenastrum* Boreau, we decided to attribute these plant communities to *Polygonion avicularis* Br.-Bl. 1931 emend. Tx. 1950 in:

- Cl. *Plantaginetea majoris* Tx. et Prsg. 1950
- Ord. *Plantaginetalia majoris* Tx. (1947) 1950
- Al. *Polygonion avicularis* Br.-Bl. 1931 emend. Tx. 1950

The classification of associations and the high rank coenotaxons (class, order and alliance) was done according to the paper issued in 1998 (17).

The association *Sclerochloa-Polygonetum avicularis* (Gams 1927) Soó 1940 grows in Romania along of the paths, sewers, along roads and railways, near gardens, trodden and settled places.

It is remarkable that the subassociations *matricarietosum discoideae*, *matricarietosum perforatae*, *chamomilletosum*, *euclidietosum*, *coronopetosum*

squamati and *lepidietosum ruderalis* grow on lands less trodden, sometimes even rummaged in opposition with the subassociations *polygonetosum* and especially *sclerochloetosum* which are mainly found on highly trodden lands (Fig. 1). The two characteristic species *Polygonum aviculare* and *Sclerochloa dura* are growing together only in spring, because the second is ending its vegetation cycle at the end of spring.

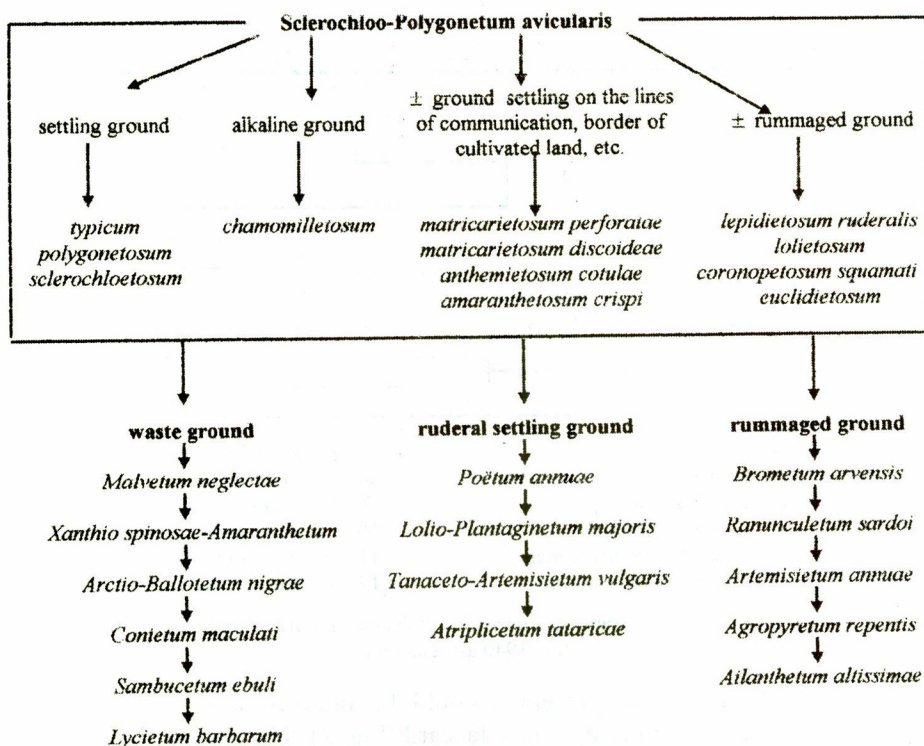


Fig. 1 – The scheme of distribution, succession and interference of phytocoenoses formed by *Polygonum aviculare* on the fields with anthropic influence.

For low alkaline and high humidity soils it is characteristic, at least at the beginning of vegetation season, the subassociation *chamomilletosum*. These places are fewer and fewer due to the improvement of alkaline soils through irrigation, which led to a major decrease of some populations with great medicinal value.

By a syndynamic point of view, subassociations *polygonetosum* and *sclerochloetosum* are considered as initial phytocoenosis secondary installed on denuded lands, highly trodden etc. having a great stability. These plant communities resist long time in places highly affected by human activities.

The subassociations *lepidietosum ruderalis*, *euclidietosum*, *chamomilletosum*, *lolietosum* and *coronopetosum squamati* exist as phytocoenosis secondary installed on less trodden lands, even rummaged placed at the ends of agricultural

fields. These phytocoenoses in natural conditions evolve fast to a vegetation characteristic for the plain, praticol, mezo-xerophytic, or to the ruderal type, nitrophilous and xero-mesophytic as *Lolio-Plantaginetum majoris* (Likola 1921) Beger 1950. The subassociation *amarenthetosum crispis* is growing mainly on the border of ditches and presents a greater degree of xerophilous and thermophilous being frequently met on hills area of Muntenia (Pietroasele, Buzău).

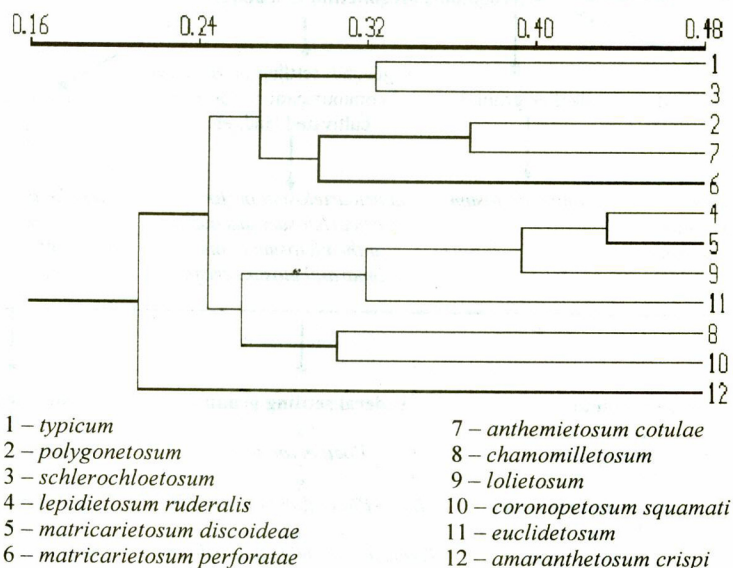


Fig. 2 – The Dendrogram of *Sclerochloo-Polygonetum avicularis* (Gams 1927) Soó 1940 association.

All of these aspects presented could be outlined also with a similarity dendrogram based on similarity index Jaccard (Fig. 2). The groups of these relevés in clusters highlight floristic affinities of subassociations. The presence, sometimes casual, of a large number of species with a large amplitude of place demands, expresses the ecological frame of association, with highly human and animal influences, where the coenotic nucleus of species characteristic for class, order and alliance is very well defined. This fact outlines, once again, the presence of a coenotaxon well drawn *Sclerochloa durae-Polygonetum avicularis* with a characteristic place demand and syndynamic, depending on interference of soil, climate and human activity factors.

The origin of the relevés presented in Table 1 is the following:

Column 1. *typicum* (= normale) Grigore 1971

20 relevés by S. Grigore, I. Coste, 1979, Banat; 19 relevés by A. Popescu et al. 1984, Câmpia Munteniei; 2 relevés by I. Morariu, 1943, Bucharest.

Table 1

Sclerochloo-Polygonetum avicularis (Gams 1927) Soó 1940

Number of column	1	2	3	4	5	6	7	8	9	10	11	12
Number of relevés	41	62	24	12	13	10	16	8	15	5	4	34

Polygonion**avicularis + dif.****subass.**

<i>Polygonum aviculare</i>	V	V	V	IV	V	V	V	IV	V	V	4	IV
<i>Sclerochloa dura</i>	IV	I	V	IV	I		I	IV	III	II	3	
<i>Lepidium ruderales</i>	II	I	I	V	I	I	V	II	I	I		
<i>Chamomilla suaveolens</i>	I	I	II	I	V	I					1	
<i>Matricaria perforata</i>	I	II		I	I	V	II		I		1	II
<i>Anthemis cotula</i>		I					V					
<i>Chamomilla recutita</i>	IV	I	II	III	II			V	III	V	3	
<i>Lolium perenne</i>	III	IV	IV	I	V	III	V	V	V	V	3	I
<i>Coronopus squamatus</i>		I			I		II			V		
<i>Euclidium syriacum</i>	I	I	I								4	
<i>Amaranthus crispus</i>	I	I										V
<i>Poa annua</i>	III	II	III	I	IV	IV	IV	II	IV			II
<i>Hordeum murinum</i>		I								II		
<i>Cichorium intybus</i>	I	II		I	I	II	IV	III	II	I	1	
<i>Malva pusilla</i>								II		III	1	II
<i>Centaurea calcitrapa</i>	I				II				I			
<i>Cynodon dactylon</i>		I	I				I	I	I			
<i>Eragrostis minor</i>						I						I
<i>Eragrostis pilosa</i>						II						

Plantaginetea+**Plantaginetalia**

<i>Plantago major</i>	III	IV	II	I	III	V	IV	IV	IV	II	1	III
<i>Trifolium repens</i>	III	II	II		II	IV	III	II	III	II	1	
<i>Taraxacum officinale</i>	III	II	III	II	III	I	I	II	V	II	1	I
<i>Medicago lupulina</i>	I	I	I	II	I	III	III	I		I		I
<i>Potentilla anserina</i>	I	I			I	II						II
<i>Lotus corniculatus</i>	I	I		I		II	I		I			
<i>Verbena officinalis</i>	I	I		I	I	II		I				IV
<i>Geranium pusillum</i>	I	I	I			II			I		1	I
<i>Trifolium fragiferum</i>	I	I					I	I		I		
<i>Potentilla reptans</i>	I	I			I	I	II		I			
<i>Ranunculus repens</i>	I	I			I		I					

<i>Leontodon autumnalis</i>						I						I
Sisymbrium + Sisymbria - brietalia												
<i>Erigeron canadensis</i>	II	I		I	I	III	IV	II	I		1	III
<i>Descurainia sophia</i>	II	I	I	III	I				I		1	
<i>Malva neglecta</i>	I	II	II	I	I	II	I		I			III
<i>Cardaria draba</i>	II	I	I	III			I			I	2	
<i>Convolvulus arvensis</i>	II	II	I	I	II	II	II	II	I		1	I
<i>Sisymbrium loeselii</i>				I			I					
<i>Xanthium italicum</i>		I					I					
<i>Erigeron annuus</i>						I						I
<i>Malva sylvestris</i>	I	I							I			I
<i>Chenopodium strictum</i>	I											I
<i>Chenopodium polyspermum</i>	I					I						I
<i>Artemisia annua</i>	I	I					IV					I
<i>Sisymbrium orientale</i>		I									1	
<i>Sisymbrium officinale</i>	I	I			I	III	II		I			I
<i>Veronica persica</i>	I	I				I						
<i>Bromus sterilis</i>	I	I		I							2	
<i>Anthemis austriaca</i>	I	I	I									
<i>Bromus tectorum</i>	I	I	I								1	
<i>Bromus hordeaceus</i>	I	I	I			I	I					
<i>Chenopodium vulvaria</i>	I	I							I			II
<i>Lactuca saligna</i>	I	I		I						I		
<i>Lactuca serriola</i>		I			II						1	
II: <i>Atriplex oblongifolia</i> (6), <i>Lappula squarrosa</i> (4).												
Onopordon + Onopordetalia + Arction												
<i>Xanthium spinosum</i>	I	I	I				II	II		III		I
<i>Artemisia absinthium</i>		I				I	IV					I
<i>Artemisia vulgaris</i>							I					I
<i>Ballota nigra</i>		I					II					I
<i>Onopordon acanthium</i>	I		I			I		II	I		1	
<i>Arctium minus</i>	I											I
<i>Marrubium vulgare</i>	I											I
<i>Conium maculatum</i>	I		I									
<i>Carduus nutans</i>	I	I	I							III		
<i>Arctium lappa</i>	II	I	I			I					1	I
<i>Carduus acanthoides</i>		I				II	I	I				

<i>Bromus arvensis</i>		I				I				I		
<i>Torilis arvensis</i>	I							I				
<i>Cirsium vulgare</i>		I	I			I		I		I		
II: <i>Salvia verticillata</i> (6).												
Chenopodietea												
(incl. Polygono-Chenopodietalia)												
<i>Capsella bursa-pastoris</i>	IV	II	III	II	IV	III	II	III	V	II	2	I
<i>Atriplex tatarica</i>	I	I	I	II	I		I		I	I	1	
<i>Chenopodium album</i>	II	I	I	I	II	III	I	I	II		1	III
<i>Galinsoga parviflora</i>	I	I										I
<i>Solanum nigrum</i>	I	I				I						I
<i>Amaranthus hypocondriacus</i>	I	I										
<i>Echinochloa crusgalli</i>	I	I			I	II	II	I		II		
<i>Xanthium strumarium</i>	I	I				III				II		
<i>Setaria pumilla</i>	I	I				II		I	II			
<i>Stellaria media</i>	I	I	I			II		I	II			
<i>Bromus japonicus</i>	I			I								
<i>Anagallis arvensis</i>	I	I		I		II				I		II
<i>Portulaca oleracea</i>	I	I	I									III
<i>Polygonum lapatifolium</i>		I				I						I
<i>Sonchus oleraceus</i>	I					I						
<i>Sonchus asper</i>		I				I		II		II		
<i>Cuscuta campestris</i>	I	I										
<i>Veronica persica</i>	I					I		I				
<i>Erodium cicutarium</i>	I	I	I					I				I
<i>Gagea arvensis</i>	I		I									
<i>Polygonum persicaria</i>	I				I	III						
<i>Amaranthus retroflexus</i>	I	I				II	II					II
<i>Veronica polita</i>	I		I								1	
<i>Spergula arvensis</i>	I							I				
<i>Urtica urens</i>	I	I			I					I		III
<i>Atriplex prostrata</i>	I									II		
<i>Sonchus arvensis</i>						I	I					
I: <i>Amaranthus albus</i> (12), <i>Amaranthus blitoides</i> (12), <i>Veronica opaca</i> (12);												
II: <i>Euphorbia platyphyllos</i> (6), <i>Fumaria schleicheri</i> (5), <i>Galinsoga ciliata</i> (6), <i>Veronica agrestis</i> (6)												
Molinio-Arrhenatheretea												
<i>Plantago lanceolata</i>	II	II	I	II	II	II	II	II	II	I	1	I
<i>Agropyron repens</i>		I		I	I		III		II	I		

<i>Achillea millefolium</i>	I	II	I	I	I	III	I		II		I	I
<i>Trifolium pratense</i>		I				III	I	I	I			
<i>Agrostis stolonifera</i>		I			I	I	I					
<i>Poa trivialis</i>		I				II						
<i>Ranunculus repens</i>	I		I				I					
<i>Trifolium hybridum</i>	I						I					
<i>Daucus carota</i>		I				I	II					
<i>Rumex crispus</i>	I	I	I				II					
<i>Poa pratensis</i>	I	I	I				II		II			
<i>Prunella vulgaris</i>	I	I			I	II	I					
<i>Bromus commutatus</i>	I	I	I									
<i>Plantago media</i>	I	I	I						I			
I: <i>Dactylis glomerata</i> (2)												
Companion												
<i>Ranunculus sardous</i>	I	I				II	I	I			I	
<i>Chenopodium glaucum</i>	I	I			I		II					I
<i>Rorippa sylvestris</i>	I	I				II	I	I				
<i>Mentha pulegium</i>		I										I
<i>Pulicaria vulgaris</i>		I					II					I
<i>Rorippa kernerii</i>		I	I									
<i>Inula britannica</i>		I			I		II					
<i>Bidens tripartita</i>	I	I				II	I					
<i>Veronica arvensis</i>	I		I			I		II				
<i>Poa bulbosa</i>	I	I	I									
<i>Potentilla supina</i>		I			I							I
<i>Anthemis arvensis</i>	I	I		I								
<i>Rorippa austriaca</i>		I				II						
<i>Medicago minima</i>	I								I			
<i>Rumex conglomeratus</i>		I					I					
<i>Medicago falcata</i>	I								I			
<i>Rumex crispus</i>		I				II						I
<i>Eryngium campestre</i>		I	I					I				
<i>Veronica triphyllos</i>	I										I	
<i>Hibiscus trionum</i>		I		I			I		I			I
<i>Bilderdykia convolvulus</i>						I						I
<i>Chorisporea tenella</i>	I										I	
<i>Crepis rheoadifolia</i>	I	I							I			
<i>Cirsium arvense</i>	I	I	I		I	I						
<i>Veronica officinalis</i>		I				I						
<i>Achillea collina</i>	I		I						I			
<i>Vulpia myuros</i>	I							I				I
<i>Polygonum orientale</i>	I							I				
<i>Mentha longifolia</i>		I				I					I	

<i>Sinapis arvensis</i>	I								I
<i>Holosteum umbellatum</i>	I		I						
<i>Filago arvensis</i>	I							I	
<i>Gypsophyla muralis</i>		I	I	I		I			
<i>Polygonum hydropiper</i>	I					I			
<i>Centaurea cyanus</i>	I		I						
<i>Juncus bufonius</i>						I	I		
<i>Hordeum vulgare</i>	I							I	
<i>Consolida regalis</i>	I								I
<i>Hordeum hystrix</i>			I					I	I
<i>Triticum aestivum</i>	I								I
<i>Arenaria serpyllifolia</i>	I		I			I			
<i>Ranunculus arvensis</i>	I								I
<i>Potentilla argentea</i>		I							I

I: *Centaureum pulchellum* (7), *Lotus tenuis* (2), *Coronilla varia* (7), *Melilotus officinalis* (11);

II: *Urtica dioica* (12).

Column 2. *polygonetosum* Soó 1961

4 relevés by V. Zanoschi 1974, Ceahlău; 5 relevés by G. Dihoru, 1975, Siriu; 1 relevés by N. Roman, 1974, Podișul Mehedinți; 1 relevé by G. Dihoru et al. 1973, Valea Mraconiei; 15 relevés by S. Grigore, I. Coste, 1978, Banat; 9 relevés by I. Pop, 1978, Interfluviul Crișul Negru-Crișul Repede; 1 relevé by I. Morariu et al. 1973, Moldova Veche; 7 relevés by I. Morariu, 1943, around Bucharest.

Column 3. *schlerochloetosum* Gams 1927

16 relevés by S. Grigore, I. Coste, 1978; 3 relevés by I. Sârbu et al., 1997, Gârboavele-Galați; 5 relevés by I. Morariu, 1943, Bucharest.

Column 4. *lepidetosum ruderalis* (Tim-Bodrogek. 1959) Sissingh 1969

5 relevés by S. Grigore, I. Coste, 1978, Banat; 7 relevés by Florița Diaconescu, 1978, Bazinul Bahluiului.

Column 5. *matricarietosum discoideae* (Morariu 1967 n.n.) Grigore et Coste 1978

10 relevés by S. Grigore, I. Coste, 1978, Banat; 2 relevés by G. Vițalariu 1979, Moldova; 1 relevé by C. Drăgulescu, 1995, Valea Sadului.

Column 6. *matricarietosum perforatae* (Soran 1962) stat. nov. (Syn: As. *Matricaria inodora*-*Polygonum aviculare* Soran 1962)

10 relevés by V. Soran, 1962, Apuseni Mountains.

Column 7. *anthemietosum cotulae* Vițalariu 1973

15 relevés by G. Vițalariu, 1973, Moldova; 1 relevé by G. Vițalariu et al. 1979, Moldova.

Column 8. *chamomilletosum* Morariu 1943

5 relevés by S. Grigore, I. Coste, 1978, Banat; 3 relevés by I. Morariu, 1943, Bucharest.

Column 9. *Iolietosum* Morariu 1943

12 relevés by S. Grigore, I. Coste, 1978, Banat; 3 relevé by I. Morariu, 1943, Bucharest.

Column 10. *coronopetosum squamati* Soó 1961

2 relevés by S. Grigore, I. Coste, 1978, Banat; 3 relevés by I. Morariu, 1957, Litoralul Mării Negre (Black Sea Coast).

Column 11. *euclidetosum* Morariu, 1943

3 relevés by S. Grigore, I. Coste, 1978, Banat; 1 relevé by I. Morariu 1943, Pantelimon.

Column 12. *amaranthetosum crispi* (E. Vicol et al. 1971) stat. nov. (Syn: *Polygono avicularis-Amarantheum crispi* E. Vicol et al. 1970)

24 relevés by E. Vicol et al. 1971, Mehedinți, Sibiu and Banat; 10 relevés by D. Mititelu, 1972, Moldova.

In the same Table 1, the following species are present in one relevé:

Column 1: *Agrimonia eupatoria*, *Agrimonia graecizans*, *Anethum graveolens*, *Atriplex patula*, *Botriochloa ischaemum*, *Clematis vitalba*, *Cerastium caespitosum*, *Eruca sativa*, *Galega officinalis*, *Glechoma hederacea*, *Lithospermum arvense*, *Medicago sativa*, *Poa silvicola*, *Rumex sanguineux*, *Rumex patientia*, *Rumex obtusifolium*, *Rubus caesius*, *Torilis rubella*, *Trifolium campestre*, *Veronica hederifolia*, *Veronica praecox*, *Viola odorata*.

Column 2: *Apera spica-venti*, *Ambrosia artemisiifolia*, *Anthemis ruthenica*, *Artemisia scoparia*, *Chenopodium rubrum*, *Erysimum repandum*, *Lepidium campestre*, *Juncus compressus*, *Linum usitatissimum*, *Ononis semihircina*, *Salvia nemorosa*, *Sagina procumbens*, *Sinapis arvensis*, *Trifolium campestre*, *Trifolium subterraneum*, *Trifolium echinatum*, *Veronica anagallis-aquatica*, *Vicia tetrasperma*.

Column 3: *Cerastium caespitosum*.

Column 5: *Amaranthus retroflexus*, *Rumex pulcher*.

Column 6: *Alyssum alyssoides*, *Agrostis capillaris*, *Ajuga genevensis*, *Chenopodium bonus-henricus*, *Curcubita pepo*, *Cannabis sativa*, *Echium vulgare*, *Filago arvensis*, *Galeopsis ladanum*, *Leucanthemum vulgare*, *Gnaphalium uliginosum*, *Melilotus albus*, *Stellaria graminea*, *Schleranthus annuus*, *Sedum hispanicum*, *Spergularia rubra*, *Vicia angustifolia*, *Vicia cracca*.

Column 7: *Althaea officinalis*, *Iva xanthifolia*, *Lythrum salicaria*, *Phleum pratense*, *Rumex confertus*.

Column 8: *Achillea setacea*, *Euphorbia cyparissias*.

Column 9: *Medicago sativa*.

Column 10: *Centaurea solstitialis*, *Kickxia elatine*.

Column 11: *Brassica nigra*, *Consolida orientalis*, *Lithospermum arvense*, *Papaver rhoeas*, *Veronica hederacea*.

Column 12: *Amaranthus deflexus*, *Juncus tenuis*, *Chelidonium majus*, *Chenopodium rubrum*, *Pimpinella saxifraga*, *Leonurus cardiaca*, *Cuscuta europaea*, *Senecio jacobea*.

The following species are present in two relevés:

Column 1: *Crepis setosa*, *Koeleria gracilis*, *Senecio vulgaris*.

Column 2: *Abutilon theophrasti*, *Atriplex littoralis*, *Chenopodium urbicum*, *Ranunculus stevenii*.

Column 5: *Setaria verticillata*.

Column 6: *Festuca pratensis*, *Oxalis corniculata*, *Solanum tuberosum*, *Verbascum phlomoides*, *Veronica serpyllifolia*.

Column 7: *Euphorbia stricta*.

Column 11: *Thlaspi arvense*.

REFERENCES

1. Borhidi A., 1996, *Critical revision of the Hungarian plant communities*. Pécs, 138 pp.
2. Diaconescu Florița, 1978, *Cercetări taxonomice, biologice și fitocenotice asupra plantelor antropofile din bazinul Bahluiului (jud. Iași)*. Abstract of thesis. Iași.
3. Dihoru G., 1975, *Învelișul vegetal din masivul Siriu*. Edit. Acad. R.S.R., Bucharest.
4. Dihoru G., Cristorean I., Andrei M., 1973, *Vegetația din Valea Mraconiei-depresiunea Dubova din Defileul Dunării*. Acta Bot. Horti Buc., 1972-1973, Bucharest, 353-423.
5. Drăgulescu C., 1995, *Flora și vegetația din bazinul văii Sadului*. Editura Constant, pp. 355, Sibiu.
6. Forey L.P. & al., 1994, *Cladistics-A Practical Course in Systematics*, Clarendon Press, Oxford
7. Grigore S., Coste I., 1978, *L'association Polygonetum avicularis Gams 1927 dans le Banat (Roumanie)*. Documents phyt. N.S.Lille, 2: 261-272.
8. Mihai G., 1970, *Cercetări asupra vegetației rudérale din bazinul Bașeului (jud. Botoșani)*. Analele Șt. ale Univ. "Al. I. Cuza", Iași, New series. Sect. II., Biol. 16(1): 133-146.
9. Mititelu D., 1972, *Asociații noi de buruieni din Moldova*. Analele Șt. ale Univ. "Al. I. Cuza", Iași, New series. Sect. II., Biol. 17(1): 119-126.
10. Morariu I., 1943, *Asociații de plante antropofile din jurul Bucureștiului cu observații asupra răspândirii lor în țară și mai ales în Transilvania*, Bul. Grăd. Bot., Muz. Bot. Cluj-Timișoara, 23 (3-4): 131-212.
11. Morariu I., 1957, *Contribuții la cunoașterea vegetației litoralului Mării Negre*. Bul. Șt. Sect. de Biol. Șt. Agricole, Seria Bot. 9 (4): 361-378.
12. Morariu I., 1967, *Clasificarea vegetației nitrofile din România*. Contrib. Bot. Cluj, 233-246.
13. Morariu I., Danciu M., Ularu P., 1973, *Die vegetation der Flussinsel Moldova Veche*. Acta Bot. Horti Buc., 1972-1973, Bucharest, 465-499.
14. Pop I., 1968, *Flora și vegetația Câmpiei Crișurilor. Interfluviul Crișul Negru-Crișul Repede*. Edit. Acad. R.S.R., Bucharest.
15. Popescu A., Sanda V., Doltu M. I., Nedelcu G. A., 1984, *Vegetația Câmpiei Munteniei*. Muz. Brukenthal. Sibiu. Stud., Comun. Șt. Nat., 26:173-241, 369-511.

16. Roman N., 1974, *Flora și vegetația din sudul podișului Mehedinți*. Edit. Acad.R.S.R., Bucharest.
17. Sanda V., Popescu A., Barabaș N., 1998, *Cenotaxonomia și caracterizarea grupărilor vegetale din România*. Stud., Comun. Seria Biol. veget. 1997, Edit. "I. Borcea" Bacău, **14**: 1-366.
18. Soran V., 1962, *Cercetări asupra buruienilor și asocierii lor în Munții Apuseni*. Probleme de Biol. Edit. Acad. R.P.R. Buc., 299-345.
19. Sârbu I., Oprea A., Tănase C., 1995, *Rezervația pădurii parc Gârboavele (jud. Galați)*. Bul. Grăd. Bot. Iași, **6**(2): 311-322.
20. Vicol E., Schneider-Binder Erika, Täuber F., 1971, *Polygono (avicularis)-Amaranthetum crispi nova ass.* Muz. Brukenthal. Stud. și Comun. Șt. Nat., Sibiu, **16**:173-182.
21. Vițalariu G., 1973, *Contribuții la cunoașterea vegetației ruderală din Moldova*. Muz. Șt. Nat. Bacău. Stud., Comun., **6**:333-342.
22. Vițalariu G., Zanoschi V., Turenschi E., 1979, *Noi contribuții la cunoașterea vegetației nitrofile*. Anuarul Muz.Șt. Nat. Seria Bot.-Zool., Piatra Neamț, **4**:109-115.
23. Zanoschi V., 1974, *Contribuții la cunoașterea vegetației nitrofile din Masivul Ceahlău*. Stud. și Cerc. de Geol.-Geogr.-Biol. Seria Bot.-Zool., Piatra Neamț, **2**:109-129.

Received on November 20th, 1998

Institute of Biology
Spl. Independenței, 296
79651, Bucharest

STRUCTURE, BIOMASSE ET PRODUCTIVITÉ DES FORÊTS DES MONTS CĂLIMANI (ROUMANIE), PAR RAPPORT AUX FACTEURS ÉCOLOGIQUES

T. CHIFU, G. LUPĂȘCU

Les recherches portent sur les associations *Hieracio rotundati* - *Piceetum* et *Rhododendo myrtifolii* - *Piceetum* situées dans la vallée du ruisseau Neagra, à une altitude comprise entre 1200 et 1780 m. Les résultats des recherches démontrent que l'altitude (et implicitement les conditions climatiques) influencent la composition floristique et écologique, la structure, les paramètres dendrométriques, la biomasse et la productivité, dans le sens de leur diminution avec l'altitude. Les interventions en ce qui concerne l'exploitation des forêts ont tout de même une influence décisive, les paramètres dendrométriques, la biomasse et la productivité enregistrant des valeurs accrues par rapport à l'âge de la strate arborescente.

Mots clef: écologie, structure, biomasse, productivité.

INTRODUCTION

Des recherches écologiques effectuées dans la période 1981-1990 dans le massif Călimani par un collectif pluridisciplinaire, ont fait l'objet de plusieurs travaux scientifiques concernant la flore, la végétation et la productivité (1-5, 7-9). Nous présentons dans cet article une synthèse concernant la variation de la composition floristique et écologique, de la structure, de la biomasse et de la productivité de la strate arborescente des phytocénoses ligneuses dominantes, par rapport aux facteurs écologiques.

Les recherches ont été effectuées dans trois stationnaires écologiques dans le bassin du ruisseau Neagra, dans la partie inférieure du bassin à une altitude de 1200-1300 m, sur le versant NE et à une altitude de 1400-1600 m et sur le versant SO à une altitude de 1400-1780 m.

Conditions stationnelles

Le massif Călimani fait partie du groupe de montagnes volcaniques et il est constitué d'une grande variété de roches volcaniques d'âge miocène et pliocène, dominées par la présence des andésites. L'ancien cratère volcanique domine l'environnement par des hauteurs de plus de 2.000 m. Les versants de la vallée ont une exposition générale nord, nord-est et nord-ouest et une pente dont l'inclinaison varie de 20 à 45 degrés.

Le climat est du type montagnard. La température et les précipitations atmosphériques ont des valeurs moyennes annuelles différentes en fonction de l'altitude et du relief: 3,2⁰ C et 750 mm de précipitations à 1200 m et 0⁰ et 900 mm à 1780 m (Fig. 1).

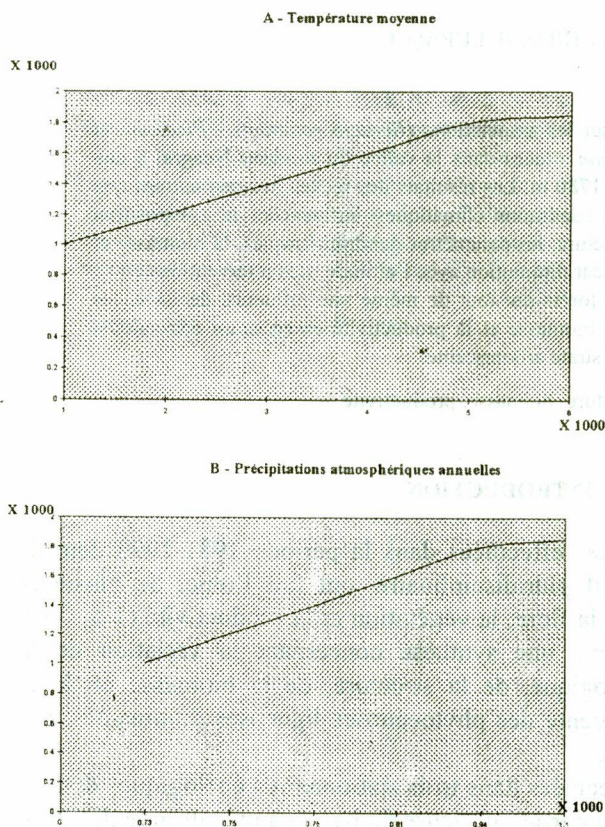


Fig. 1 – Variations de la température moyenne (A) et des précipitations atmosphériques annuelles (B).

Les sols sont de deux types principaux: brun acide andique et brun podzolique andique, à une réaction du sol modérément–fortement acide (pH 4,3–5,8) et une trophicité généralement moyenne–grande (V% = 22–52). Les sols ne constituent pas un facteur limitatif pour le développement de la végétation.

Caractérisation des phytocénoses

Les phytocénoses appartiennent à deux associations végétales: *Hieracio rotundati* - *Piceetum* Pawl. et Br. - Bl. 1939 (all. *Vaccinio* - *Piceion*, ord. *Vaccinio* - *Piceetalia*, cl. *Vaccinio* - *Piceentea*) et *Rhododendro myrtifolii* - *Piceetum* Coldea et Pânzaru 1986 (all. *Pinion mugi*, ord. *Vaccinio* - *Piceetalia*, cl. *Vaccinio* - *Piceetea*) (6) (Tableau 1).

Tableau 1

Les associations *Hieracio rotundati* - *Piceetum* et *Rhododendro myrtifolii* - *Piceetum*

Association	<i>Hieracio rotundati</i> - <i>Piceetum</i>										<i>Rhododendro myrtifolii</i> - <i>Piceetum</i>						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Numéro du relevé	120	120	120	135	125	130	140/150	140/150	151/160	161/170	171/175	176/180					
Altitude m.s.m. (en 10m)	E	E	N	SO	NO	NE	SV	0	NO	NO	N	N					
Exposition	10	15	25	20	15	25	20	N	25	35	30	20					
Pente (en degrés)	90	85	80	70	80	70	70	10	80	75	70	50					
Recouvrement de la strate arborescente (%)	-	-	-	-	-	-	-	90	5	5	5	60					
Recouvrement de la strate arbutive (%)	45	20	20	35	10	5	5	5	55	60	60	25					
Recouvrement de la strate herbacée (%)	10-20	25-40	41-60	81-100	100-120	121-140	121-140	45	101-120	121-140	141-160	141-160					
Âge (ans)	31	35	43	44	61	60	60	81-100	49	42	36	38					
Nombre des espèces								51									
Caract. d'ass.																	
<i>Hieracium rotundatum</i>	+	+	+	+	+	+	+	+	-	+	-	+					
<i>Rhododendrum myrtifolium</i>	-	-	-	-	-	-	-	-	-	-	-	-					
Vaccinio - Piceion																	
<i>Athyrium distentifolium</i>	-	-	-	-	-	-	-	-	-	-	-	-					
<i>Calamagrostis villosa</i>	-	-	-	-	+	+	+	1	2	+	2	-					
<i>Cicerbita alpina</i>	-	-	-	-	+	+	+	+	+	+	-	-					
<i>Diphysastrum alpinum</i>	-	-	-	-	-	-	-	+	+	+	+	+					
<i>Dryopteris dilatata</i>	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Gymnocarpium dryopteris</i>	-	-	-	+	+	+	+	+	+	+	+	+					
<i>Homogyne alpina</i>	-	-	-	+	+	+	+	+	+	+	+	+					
<i>Luzula luzuloides</i>	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Luzula sylvatica</i>	-	-	+	1	+	2	+	1	1	2	2	+					
<i>Soldanella hungarica</i>	-	-	-	-	-	-	-	+	+	1	+	+					
<i>Soldanella montana</i>	-	-	-	-	-	-	-	-	-	-	-	-					
Pinion mugii																	
<i>Juniperus alpestris</i>	-	-	-	-	-	-	-	-	-	-	-	-					
<i>Juniperus communis</i>	-	-	-	-	-	-	+	-	-	+	-	-					
<i>Melampyrum saxosum</i>	-	-	-	-	-	-	-	-	+	+	+	+					
<i>Pinus cembra</i>	-	-	-	-	-	-	-	1	1	1	2	2					
<i>Pinus mugo</i>	-	-	-	-	-	-	+	-	-	+	1	3					
<i>Potentilla aurea chryocraspeda</i>	-	-	-	-	-	-	-	-	-	-	-	+					
<i>Ribes petraea</i>	-	-	-	-	-	-	+	-	-	+	+	+					

[illegible]

[illegible]

Ass. *Hieracio rotundati* - *Piceetum*

Les phytocénoses de cette association sont influencées tant par des facteurs écologiques que par les activités humaines. Pour mettre en évidence ces influences nous avons étudié des plantations d'épicéa d'âges compris entre 15 et 50 ans, et des forêts d'épicéa de plus de 90 ans, à une altitude de 1200-1300 m et de 1400-1600 m.

Les phytocénoses sont situées dans un climat caractérisé par une température moyenne annuelle de 3,2°C à 1200 m et 1,3°C à 1600 m et des précipitations moyennes annuelles de 750 mm à 1200 m et 850 mm à 1600 m. Les sols sont brun acide andique à 1200-1300 m, caractérisés par une réaction du sol modérément – fortement acide (pH 4,3 - 5,8) et une trophicité moyenne – grande (V% = 45), et brun podzolique andique à 1400-1600 m, à une trophicité réduite (V% = 22).

La diversité spécifique est grande (80 espèces) mais dans des plantations elle est plus réduite (30-35 espèces) et beaucoup d'espèces sont absentes (*Luzula sylvatica*, *Dryopteris dilatata*, *Moneses uniflora*, etc), tandis que les pessières de plus de 90 ans à la même altitude ont une diversité plus grande (48 - 60 espèces), plus grande à l'altitude de plus de 1400 m, où s'ajoutent de nouvelles espèces (*Pinus mugo*, *Homogyne alpina*, *Deschampsia flexuosa*, etc).

L'analyse des éléments floristiques met en évidence la prédominance des espèces euroasiatiques et européennes, dont la participation diminue avec l'altitude en faveur des espèces circumpolaires (Fig. 2A: 1.a, 1.b, 1.c).

L'analyse écologique relève à la fois que les éléments acidophiles et à faibles trophicités réalisent des taux importants à des altitudes supérieures (Fig. 2B: 1.a, 1.b, 1.c).

Le diamètre moyen et la hauteur des arbres augmentent avec l'âge au contraire de la densité moyenne des arbres qui diminue dans le même sens (Tableau 2).

Tableau 2

Biomasse et productivité des associations végétales

Âge (ans)	Caractéristiques des stations				Caractéristiques dendrométriques			Biomasse moyenne (t/ha)	Productivité moyenne (t/ha/an)
	Altitude (m)	Exposition	Pente (degrés)	Sol	Densité moyenne (arb/ha)	Diamètre moyen (cm)	Hauteur moyenne (m)		
Ass. Hieracio rotundati - Piceetum									
10-20	1200	E,V	5-10	brun acide andique	2650	9,8	12,0	88,7	9,8
21-40	1200	E,NV	10-15	"	1345	14,8	13,9	130,5	10,9
41-50	1300	N,NV	20-25	"	1235	23,2	19,7	251,3	13,7
81-100	1250	SV,S	20-25	"	755	28,6	27,4	435,5	13,9
101-120	1300	NV,N	15-20	brun podzolique andique	632	33,4	28,3	542,2	12,9
101-120	1400	NV	20-25	"	1097	24,9	25,8	395,7	11,2
121-140	1300	NE,E	10-15	"	615	39,8	35,9	619,5	11,6
121-140	1600	NV	20-25	"	483	35,2	26,3	347,8	9,6

Ass. <i>Rhododendro myrtifolii</i> - <i>Piceetum</i>									
101-120	1400-1500	N	10-15	brun podzolique andique	902	24,7	23,6	361,6	9,1
121-140	1600-1700	N,NV	20-30	"	624	30,4	21,2	316,5	8,0
141-160	1780	NV	40-45	"	503	31,7	116,9	263,1	6,5

La structure verticale des phytocénoses varie en fonction de l'âge: les phytocénoses plus jeunes (plantations de 15-30 ans) ont une structure uniforme, tandis que les phytocénoses adultes ont une structure arborescente différenciée, au minimum en deux strates des l'âge de 40-50 ans. La pluristratification est plus évidente dans les phytocénoses situées à grande altitude.

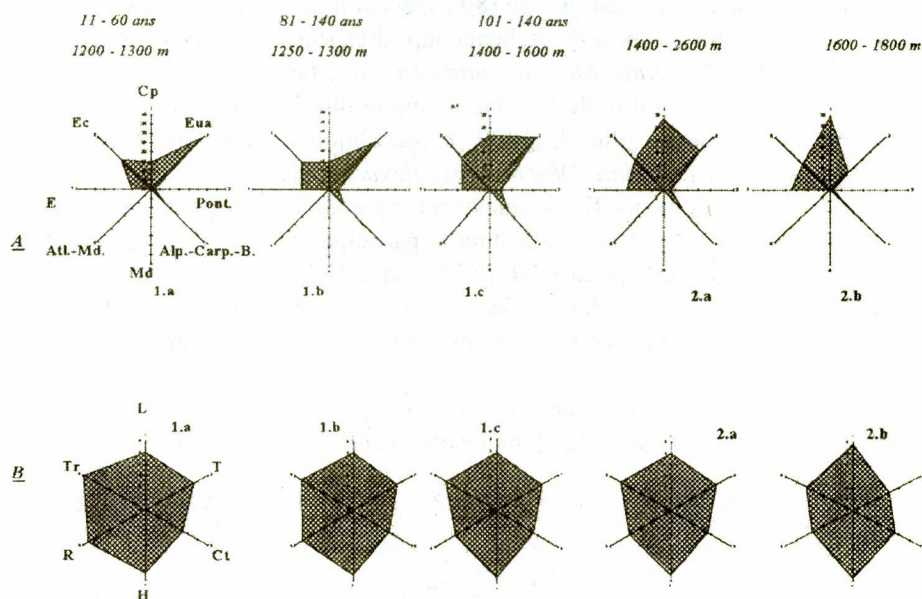


Fig. 2 – Corogramme (A) et écorgramme (B) des associations: 1. *Hieracio rotundati* – *Piceetum* de 10-60 ans à 1250-1300 m (b), et de 101-140 ans à 1400-1600 m; *Rhododendro myrtifolii* – *Piceetum* à 1400-1600 m (A) et à 1600-1800 m (b).

E = européens, Ec = centre-européens, Eua = euroasiatiques, Alp-Carp-B = alpino-carpato-balkaniques. L = lumière, T = température, Ct = continentalité, H = humidité, R = réaction du sol, Tr = trophicité du sol.

La biomasse augmente avec l'âge de la forêt: elle est faible dans les plantations (89-251 t/ha) et assez grande dans les pessières adultes (620 t/ha) (Tableau 2). Les valeurs de la biomasse des phytocénoses du même âge (100 ans) baissent avec l'altitude (de 453 t/ha à 1250 m à 348 t/ha à 1400 m).

La productivité augmente jusqu'à l'âge de 100 ans, puis se maintient ou diminue, surtout dans les pessières d'altitude.

Ass. *Rhododendro myrtifolii* - *Piceetum*

L'association est située à des altitudes comprises entre 1400 et 1780 m, sur le versant nord du massif Călimani. Elle est formée de phytocénoses de plus de 100 ans qui constituent des forêts de protection, fortement influencées par les facteurs écologiques.

Les conditions climatiques sont plus rudes. La température moyenne annuelle varie de 1,8°C à 1400 m à 0°C à 1600 m et les précipitations moyennes annuelles sont de 800-900 mm.

Le sol est brun podzolique andique avec un pH fortement acide, l'humus en très grandes quantités et la trophicité réduite.

La diversité spécifique relativement basse (60 espèces par phytocénoses dans l'association), mais le nombre d'espèces varie entre 20-40 espèces; ce nombre diminue avec l'altitude.

L'analyse des éléments floristiques démontre la prédominance des espèces circumpolaires dont la participation augmente avec l'altitude et au détriment des espèces euroasiatiques. De même, les éléments alpino-carpato-balkaniques ont une participation significative (Fig. 2A: 2.a, 2.b).

L'analyse écologique met en évidence le fait que les éléments acidophiles et à trophicité réduite ont une participation élevée à des altitudes supérieures (Fig. 2B: 2.a, 2.b).

Le diamètre moyen des arbres augmente avec l'altitude, contrairement à la hauteur moyenne et à la densité qui diminuent. *Pinus cembra* a un diamètre moyen plus élevé, *Picea abies* une hauteur moyenne plus basse et une densité moyenne supérieure, en relation avec la croissance de l'altitude (Tableau 2).

La biomasse, relativement uniforme jusqu'à 1700 m, est plus réduite que pour les pessières pures où elle est presque double; la biomasse de *Pinus cembra* est plus basse que celle de l'épicéa.

La productivité moyenne plus réduite que pour la pessière, diminue aussi avec l'altitude.

BIBLIOGRAPHIE

1. Chifu T., Ștefan N., Dăscălescu D., Mititelu D., Vițalariu Gh., Mihai Gh., 1984, *Moldișul de limită din Munții Călimani*, St. cert. biol., Biol. veg. et., **36** (1): 28-34.
2. Chifu T., Ștefan N., Mititelu D., Dăscălescu D., Mihai Gh., Vițalariu Gh., 1984, *Cercetări asupra biomasei și productivității moldișului cu zămbrou din Munții Călimani*, An. Șt. Univ. Iași, **XXX**, s. II a. Biol.: 42-43.
3. Chifu T., Davideanu G., Lupașcu Gh., Pisică-Donose A., Murariu A., Dăscălescu D., 1987, *Cercetări asupra moldișului cu zămbrou din Munții Călimani*, Mem. Sect. Șt. Acad. Rom., **VII**, 1: 201-214.
4. Chifu T. (coordonateur) et collab., 1989, *Cercetări ecologice în pădurile de limită și tufărișurile subalpine și alpine din Munții Călimani*, An. Șt. Univ. Iași, **XXXV**, s. II a. Biol. (supl.): 65-112.

5. Chifu T., Ștefan N., 1992, *Contributions to the spruce for forest study in the Călimani Mountains*, An. Șt. Univ. Iași, **XXXVIII**, s. II a. Biol. veget.: 45-51.
6. Coldea Gh., 1991, *Prodrome des associations végétales des Carpates du Sud-Est (Carpates Roumaines)*, Doc. Phytos., Camerino, 539 p.
7. Mititelu D., Chifu T., Vițalariu Gh. Ștefan N., Dăscălescu D., Horeanu Cl., 1986, *Contribuții la studiul vegetației lemnoase din Munții Călimani*, An. Șt. Univ. Iași, **XXXII**, s. II a Biol.: 31-32.
8. Mititelu D., Chifu T., Ștefan N., 1987, *Contribuții la studiul vegetației din Județul Suceava*, Anuar. Muz. Jud. Suceava, Șt. Nat. **X**: 51-60.
9. Mititelu D., Chifu T., Ștefan N., Pascal P., 1989, *Flora și vegetația Județului Suceava*, Anuar. Muz. Jud. Suceava, Șt. Nat. **X**: 93-120.

Reçu le 29 Avril 1998

Université de Iași
B-dul Copou 20 A
Roumanie

CONTRIBUTIONS TO THE STUDY OF REED SWAMP AND MOOR VEGETATION IN NORTH-WESTERN ROMANIA. *ANGELICO-CIRSIETUM CANI* ASS. NOVA

PETRU BURESCU

Angelico-Cirsietum cani in Romaniae septentrione-ocassu comperta est, in humidis caespitis et in palustribus caespitibus inferorum pratorum vegetans, a trecenti quavadraginta et tres ad quingenti septuaginta et duo pedum in altitudinem.

Propriae species huius associationis *Cirsium canum* abundantia et dominantia a una ad quattuor et *Angelica sylvestris* abundantia et dominantia a rara ad quattuor sunt.

Key words: swamp vegetation, *Angelico-Cirsietum cani*.

This paper presents a new *mesohygrophytic* association (Table 1 relevés 1-12) that has not been so far described in the literature.

It was identified in North-Western Romanian Plain (total area of 3600 km²) in seven locations as vegetating in *mesohygrophytic* and *hygrophytic meadows*. These meadows belong to low river meadows bordering valleys and brooks. The association was also found in swamps formed in the vicinity of accumulation ponds.

The associations *Angelico-Cirsietum oleracei* Tx. 1937 (17), *Angelico-Cirsietum palustris* Bal.-Tul. 1973 (3, 6), *Polygono-Cirsietum palustris* Bal.-Tul. 1974 (6), *Polygono-Cirsietum heterophylli* Bal.-Tul. 1975 (2, 6), were described from Central and Western Europe as vegetating in humid meadows from 800 m altitude, up to the mountain belt, 1800m.

Puşcaru-Soroceanu, E., et al. 1963 (13) described for Romania *hygrophytic meadows* dominated by *Cirsium canum* (A+D=3-4) with *Agrostis stolonifera* (A+D=1-2), *Cirsium canum* with *Symphytum officinale* in Transsilvania but without *Angelica sylvestris*.

As a result of the survey on phytosociological literature: Balátová-Tuláčkova E., (1, 2, 3, 4, 5, 6), Borhidi A., (7), Doniță, N. & collab. (8), Oberdorfer E. (9), Passarge H. (10), Pop, I. (11), Sanda V. & al. (14, 15), Popescu A. & al. (12), Soó R., (16), Tüxen R., (17), and the floristic association comparison of associations *Angelico-Cirsietum oleracei* Tx. 1937, *Angelico-Cirsietum palustris* Bal.-Tul. 1973, the association described in the present work by us cannot be considered identical with the aforementioned associations because of a different floristic composition. As a consequence, *Angelico-Cirsietum cani* must be considered a *new association*.

Mesohygrophytic and hygrophytic coenoses assimilated to this association were identified in seven locations described in 12 relevés (Table 1).

Table 1

Angelico-Cirstetum cani ass. nova hoc loco

Life Forms	Floral elements	Species/relevés no	1	2	3	4	5	6	7	8	9	10	11	12	C	H	T	R
		Area (m ²)	700	600	400	50	400	400	30	400	35	100	100	400				
		Cover (%)	100	100	100	100	100	100	100	100	100	100	100	100				
		Altitude (m)	102	102	130	120	115	110	160	160	160	170	170	170				
		Characteristic species of Association																
G	Eua-C	<i>Cirsium canum</i> (L.) All.	3	2	3	3	2	2	4	1	1	4	1	2	V	4,5	3	4,5
H	Eua	<i>Angelica sylvestris</i> L.	3	3	2	3	+	+	1	4	+	+	4	+	V	4	3	3
		Diagnostic species of Alliance																
		<i>Calthion</i> R. Tx. 1937																
H	Cp	<i>Caltha palustris</i> L. ssp. <i>laeta</i> Hegi	+	+	-	+	+	+	-	-	-	+	+	+	IV	5	3	0
G	Cp	<i>Equisetum palustre</i> L.	1	1	+	+	-	+	-	-	1	+	+	-	IV	5	2	0
Hh	Eua	<i>Lysimachia vulgaris</i> L.	-	-	-	+	-	+	+	-	3	-	-	-	II	5	0	0
H	Cp	<i>Juncus articulatus</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	I	5	2	0
H	E	<i>Senecio barbaraeifolius</i> (Krock) Wimm et Grab.	-	-	-	-	+	-	-	-	-	-	-	-	I	3,5	3,5	4,5
H	Cosm	<i>Juncus effusus</i> L.	-	-	-	-	-	-	-	-	-	+	-	+	I	4,5	3	3
H	E	<i>Trifolium hybridum</i> L.	-	-	+	-	-	-	-	-	-	-	-	-	I	3,5	3	4
H	Eua	<i>Valeriana officinalis</i> L.	-	-	-	-	+	+	-	-	-	-	-	-	I	4	3	4
Ch	Eua	<i>Lysimachia nummularia</i> L.	+	-	+	-	-	-	-	-	-	-	-	-	I	4	3	0
		Diagnostic species of Order																
		<i>Molinietalia</i> Koch 1926																
H	Eua	<i>Symphytum officinale</i> L.	-	+	+	+	-	-	+	2	+	+	+	+	IV	4	3	0
H	Eua	<i>Mentha longifolia</i> (L.) Nath.	-	+	-	+	+	-	+	1	-	-	+	-	III	4,5	3	0
H	Cp	<i>Gaium palustre</i> L.	-	-	+	-	2	-	-	-	-	-	+	-	III	5	3	0
H	Eua	<i>Juncus inflexus</i> L.	-	+	-	-	-	-	-	-	-	+	-	+	II	4	4	4
Hh	Cosm	<i>Polygonum amphibium</i> L.	-	+	+	+	-	+	-	-	-	-	-	-	II	6	3	0
H	Eua	<i>Euphorbia lucida</i> Waldst. et Kit.	-	-	+	-	-	+	-	-	-	-	-	-	I	5	3	4
H	Eua	<i>Stachys palustris</i> L.	-	-	+	-	-	-	+	-	-	-	-	-	I	4	3	4
H	Eua	<i>Lotus tenuis</i> Waldst. et Kit.	+	-	-	-	-	-	-	-	-	-	-	-	I	3,5	3	4
Th	Eua	<i>Polygonum mite</i> Schrank	-	+	-	-	-	-	-	-	-	-	-	-	I	5	3	4

Diagnostic species of Class Molinio-Arrhenatheretea R. Tx. 1937																				
H	Cosm	2	1	-	+	+	+	+	+	+	+	+	+	+	+	-	V	4	3	0
H	Eua	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	V	3,5	0	0
Hh	Eua	-	+	-	-	-	+	+	+	+	+	+	+	+	+	+	III	5	3	0
H	Eua	+	+	+	-	-	-	-	-	-	-	-	-	-	-	+	III	3	0	0
H	Eua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	II	3,5	3	4
H	Eua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	II	3	3	0
H	E	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	I	2	3	4
H	Eua	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	I	4	0	0
H	Cp	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	I	4	4	4
H	Eua	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	I	3	0	0
H	Eua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	3	0	3
H	Eua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	3	0	0
H	Eua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	3	0	0
H	Cp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	3,5	0	0
TH	Eua	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	I	3	4	4
Th	Atlm	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	I	2,5	3	4
Ch-H	DB	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	2,5	3	0
G	Eua	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	III	0	0	0
Hh	Eua	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	III	5	3	0
Hh	Eua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	III	4	3	4
Hh	Eua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	III	5	4	4
Hh	Eua	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	II	5	3	4
Hh	Eua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	II	4	0	0
G-Hh	Cp	-	-	2	+	+	+	+	+	+	+	+	+	+	+	-	I	5,5	0	0
Hh	E	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	I	6	0	4
Hh	Eua	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	I	6	3,5	0
Hh	Cp	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	I	5	3	4
Hh	Cp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	5	0	4
Hh	Cosm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	III	4	3	0
Hh	Eua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	II	4	3	0
H	Eua	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	I	3,5	3,5	3
H	Mp	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	I	3,5	3,5	3

H	Eua	<i>Epilobium parviflorum</i> (Schreb.) With.	-	+	-	+	-	-	-	-	-	-	I	5	3	4,5
H	Eua	<i>Althaea officinalis</i> L.	-	+	+	-	-	-	-	-	-	-	-	3	4	4
H	Eua	<i>Scrophularia umbrosa</i> Dumort	-	-	-	+	-	-	-	-	+	-	-	5	3,5	4,5
H	Cosm	<i>Potentilla anserina</i> L.	-	-	-	-	-	+	-	-	-	-	-	4	3	4
H	Eua	<i>Potentilla erecta</i> (L.) Hampe	-	-	-	-	-	-	-	-	-	-	+	0	0	0
H	Eua	<i>Calystegia sepium</i> (L.) R. Br.	-	-	-	-	-	-	-	-	-	-	+	4	3	4
H	E	<i>Epilobium obscurum</i> (Schreb.) Roth.	-	-	-	-	-	-	-	-	-	-	-	5	0	2
H	E	<i>Hypericum tetrapterum</i> Fries	-	-	-	-	-	-	-	-	-	-	-	4	3	4
H	Eua	<i>Sonchus arvensis</i> ssp. <i>uliginosus</i> (MB) Neumayer	+	-	-	-	-	-	-	-	-	-	-	4	3	4
MPh	Eua	<i>Alnus glutinosa</i> Gaertner.	-	+	-	-	-	-	-	-	-	-	-	4	3	3
MPh	Eua	<i>Salix cinerea</i> L.	-	-	-	-	-	-	+	-	-	-	-	5	3	3
TH	Atlm	<i>Dipsacus pilosus</i> L.	-	-	-	-	-	-	-	+	-	-	-	5	3	3
Th-TH	Adv	<i>Erigeron canadensis</i> L.	-	+	-	-	-	-	-	-	-	-	-	4	3,5	4
Th	Eua	<i>Xanthium strumarium</i> L.	-	-	-	-	-	-	-	-	-	-	-	2,5	0	0
Th	Eua	<i>Pulicaria vulgaris</i> Gaertn.	-	-	+	-	-	-	-	-	-	-	-	3,5	3,5	4
Th	Eua		-	-	-	-	-	+	-	-	-	-	-	4	3	3

C=constancies, H=humidity, T=temperature, R=chemical reaction of soil.

Companion species of low frequency and abundance: Relevés 2: *Odonites serotina* (Lem.) Rchb. +, *Solidago serotina* Ait. +, *Ambrosia artemisiifolia* L. +, *Trifolium strepens* Cr. +, *Lactuca serriola* Torr. +, Relevés 4: *Galium aparine* L. +, Relevés 5: *Picris hieracioides* L. +, *Linaria vulgaris* Mill. +, *Daucus carota* L. +, Relevés 6: *Picris hieracioides* L. +.

Relevés locations: 1-2 Șilindru, 3 Sanislău, 4 Galospetreu, 5 Curtuișeni, 6 Tarcea, 7-9 Săcuieni, 10-12 Crestur.

The investigated areas are located in North-Western Romanian Plain (altitude 102-170 m) along the river basins from Barcău Valley, Izer Valley and Berea Valley.

Characteristic species for *Angelico-Cirsietum cani* association are *Cirsium canum* and *Agelica sylvestris*. Both species vegetate only in the investigated region that confers to the association a more restricted area within the limits of North-Western Romanian Plain. This is without doubt different from the phytocoenoses with *Angelica sylvestris* described in Europe by Tüxen (1937) and Balátová-Tuláčková (1973).

The association is listed in Table 1. The characteristic species for the Alliance *Calthion* R. Tx. 1937, are *hygrophytic* and *mesohygrophytic* species: *Clatha palustris* ssp. *laeta*, *Equisetum palustre*, *Lysimachia vulgaris*, *Juncus articulatus*, *Juncus effusus*, *Valeriana officinalis*, *Lysimachia nummularia*, *Senecio barbaraeifolius*.

The characteristic *hygrophytic* and *mesohygrophytic* species for Order *Molinietalia* Koch 1926 are *Symphytum officinale*, *Mentha longifolia*, *Galium palustre*, *Juncus inflexus*, *Polygonum amphibium*, *Euphorbia lucida*, *Stachys palustris*. The list contains also characteristic species for Class *Molinio-Arrhenteretea* R. Tx. 1937 as *Lythrum salicaria*, *Ranunculus acris*, *Mentha aquatica*, *Centaurea jacea* f. *serotina*, *Lathyrus pratensis*, *Tanacetum vulgare*, *Centaurea pannonica*, *Ranunculus repens*, *Rumex conglomeratus*, *Vicia cracca*, *Plantago lanceolata*, *Achillea millefolium*, *Prunella vulgaris*.

Species as *Caltha palustris* ssp. *laeta*, *Equisetum palustris*, *Lysimachia vulgaris*, *Polygonum amphibium*, *Mentha aquatica*, *Lycopus europaeus*, *Iris pseudocorus*, *Sium latifolium*, *Epilobium parviflorum*, *Glyceria maxima*, *Phragmites australis*, that are listed can be found also in high grass swamp vegetation that is contiguous to the presented association.

Holotypus hoc loco: Table 1 no 1.

SPECTRUM OF ECOLOGICAL INDICES

Table 2 presents the *main ecological indices* of the phytocoenoses that are from *mesohygrophytic* to *hygrophytic* ($U_{4-4,5}=33.84\%$, 22 species; $U_{5-5,5}=29.23\%$, 19 species) *micromesothermal* ($T_{3-3,5}=63.77\%$, 42 species) weak *acid-neutrophilous* ($R_4=44.61\%$, 29 species) and tolerant for large amplitudes of ionic variation ($R_0=44.61\%$, 29 species) from the identified relevés (Fig.1).

SPECTRUM OF LIFE FORMS

$H=58.46\%$, 38 species; $Hh=18.46\%$, 12 species; $Th=7.69\%$, 5 species; $G=6.15\%$, 4 species; $TH=3.07\%$, 2 species; $Ch=3.07\%$, 2 species; $MPh=1.53\%$, 1 species; $mPh=1.53\%$, 1 species. The analysis of life forms with the highest

proportion of *hemicryptophytic* species followed by *helohidatophytic* species indicates a temperate continental climate dominated by humid meadows and swampy meadows that harbor the phytocenoses of the *Angelico-Cirsietum cani* association.

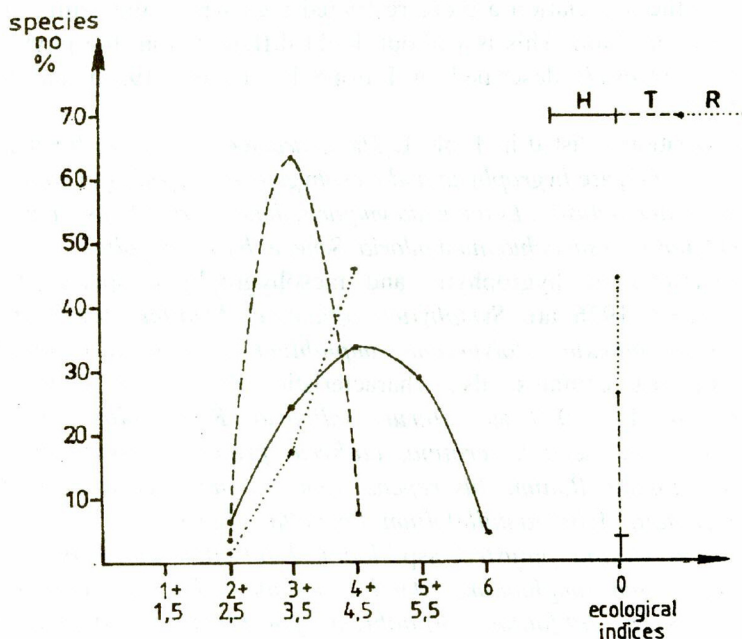


Fig. 1 – Diagrammatic representation of ecological indices ass. *Angelico-Cirsietum cani*.

SPECTRUM OF FLORISTIC ELEMENTS

Eua=63.07%, 41 species; Cp=13.84%, 9 species; E=9.23%, 6 species; Cosm=7.69 %, 5 species; Atlm=1.53%, 1 species; Mp=1.53%, 1 species; DB=1.53%, 1 species; Adv=1.535, 1 species;

The investigated humid meadows and swampy meadows are dominated by euro-asiatic species followed by circumpolar species.

ECONOMICAL IMPORTANCE

Meadows which harbour phytocenoses of *Angelico-Cirsietum cani* association have a high productivity, yet the biomass is of a low nutritional quality also of a low protein content due to lignified stems.

Table 2

Spectrum of main ecological indices

Ecological indices	Values	1-1.5	2-2.5	3-3.5	4-4.5	5	6	0	Total species
H	no.species	-	4	16	22	19	3	2	66
	%	-	6.14	24.60	33.84	29.23	4.62	3.07	
T	no.species	-	2	42	5	-	-	17	66
	%	-	3.07	63.77	7.69	-	-	26.15	
R	no.species	-	1	7	29	-	-	29	66
	%	-	1.53	10.76	44.61	-	-	44.61	

H=humidity, T=temperature, R=chemical reaction of soil

REFERENCES

1. Balátová-Tuláčková E., 1974, *Zur phytozönologischen Bewertung der Feuchtwiesen mit Cirsium palustre in Nordwestböhmen*, Folia Geobot. Phytotax., Praha, 9: 153-166.
2. Balátová-Tuláčková E., 1975, *Cirsium heterophyllum-Feuchtwiesen und ihre pflanzensoziologische Charakteristik*, Folia Geobot. Phytotax., Praha, 10: 59-65.
3. Balátová-Tuláčková E., 1979, *Phytozönologische Charakteristik des Angelico-Cirsietum palustris*, Documents phytosociologiques Lille, NS., 4: 1-8.
4. Balátová-Tuláčková E., 1983, *Feuchtwiesen des Landschaftsschutzgebietes Jizerské hory I, II*, Folia Geobot. Phytotax., Praha, 18: 113-136 et 247-285.
5. Balátová-Tuláčková E., 1983, *Beitrag zu Nass- und Feuchtwiesen des Gebirges Česky les*, Tuexenia, Göttingen, NS, 3: 227-239.
6. Balátová-Tuláčková E., 1983, *Feuchtwiesen des Landschaftsschutzgebietes Sumava (Böhmerwald)*, Folia Musei Rerum Naturalium Bohemiae Occidentalis, Plzeň, Botanica, 18-19: 3-16 et 37-51.
7. Borhidi A., 1996, *An annotated checklist of the Hungarian plant communities I. The non-forest vegetation*. Critical revision of the Hungarian plant communities, Janus Pannonius University, Pécs, 43-80.
8. Doniță N. & colab., 1992, *Vegetația României*, Ed. Tehnică Agricolă, București.
9. Oberdorfer E., 1977, 1978, 1983, 1992, *Süddeutsche Pflanzengesellschaften*, Zweite Auflage, Teil I, II, III, IV, Jena.
10. Passarge H., 1978, *Übersicht über mitteleuropäische Gefäßpflanzengesellschaften*, Feddes Repert., Berlin, 89: 133-195.
11. Pop I., 1968, *Flora și vegetația Câmpiei Crișurilor, interfluviul Crișul Negru-Crișul Repede*, Edit. Acad. R.S.R., București.
12. Popescu A., Sanda V., Doltu M. I., Nedelcu G. A., 1984, *Vegetația Câmpiei Munteniei*, Stud., Comun. Supl. Șt. nat., Muzeul Brukenthal, Sibiu, 26: 173-241 et 360-511.
13. Pușcaru-Soroceanu E. et al., 1963, *Pășunile și fânețele din R.P. România*, Edit. Acad. R.P.R., București.
14. Sanda V., Popescu A., Doltu M. I., Nedelcu G. A., 1979, *Conspectul vegetației acvatice și palustre din România*, Stud., Comun. Supl. Șt. nat., Muzeul Brukenthal, Sibiu, 23: 119-148.
15. Sanda V., Popescu A., Doltu M. I., 1980, *Cenotaxonomia și corologia grupărilor vegetale din România*, Stud., Comun., Muzeul Brukenthal, Sibiu, 24.

16. Soó R., 1964, 1973, 1980, *A magyar flora és vegetáció rendszertani növényföldrajzi kézikönyve. Synopsis sistematico-geobotanica florae vegetationisque Hungarie*, Akadémiai Kiado, Budapest, 1: 130-246, 5: 533-626, 6: 525-538.
17. Tüxen R., 1937, *Die Pflanzengesellschaften*, Mitt. Florist.-Sociol. Arbeitsgem. Niedersachsen, Hannover, 3: 1-170.

Received on May 5th, 1998

University of Oradea
The Environmental Protection Faculty,
Str. Gen. Magheru nr.26



AVIS AUX COLLABORATEURS

La «Revue roumaine de biologie – Série végétale» publie des articles originaux des domaines suivants de la biologie végétale: biologie moléculaire, cytologie, cytogénétique, morphologie, physiologie, génétique, microbiologie, systématique, chorologie, géobotanique, écologie végétale et phytopathologie. La sommaire est complété par les rubriques: 1. La vie scientifique, qui traite des manifestations scientifiques dans le domaine de la biologie (symposiums, conférences, etc); 2. Comptes rendus des plus récentes parutions dans la littérature.

Les auteurs sont priés de présenter leurs articles en double exemplaire et espacés à double interligne. Le contenu des articles sera introduit sur des disquettes dans un langage connu, préférablement Word 6.0. La composition et la mise en vedette seront faites selon l'usage de la revue: caractères de 11/13 points pour le texte, de 12/14 points pour le titre de l'article et de 9/11 pour les annexes (tableaux, bibliographie, explication des figures, notes, etc.) et le résumé en anglais de 10 lignes au maximum, qui sera placé au début de l'article. Il est obligatoire que sur les disquettes il soit spécifié le nom des fichiers ainsi que le programme utilisé.

Le matériel graphique sera envoyé sur disquette, scanné, avec les mêmes spécifications. En l'absence d'un scanner, le matériel graphique sera exécuté en encre de Chine sur papier calque.

Les tableaux et les illustrations seront numérotés en chiffres arabes dans l'ordre de l'apparition. Les titres des revues seront abrégés conformément aux usages internationaux.

Les textes ne doivent pas dépasser 10 pages (y compris les tableaux, la bibliographie et l'explication des figures).

La responsabilité pour le contenu des articles revient exclusivement aux auteurs.

TRAVAUX PARUS AUX ÉDITIONS DE L'ACADÉMIE ROUMAINE

CONSTANTIN TOMA, RODICA RUGINĂ, *Anatomia plantelor medicinale (Atlas)*,
Editura Academiei Române, 1998, 320 p, 155 pl., ISBN 973-27-0601-5

ISSN 0035-3914

REV. ROUM. BIOL.-VÉGÉT., TOME 43, N° 2, P. 89 - 172, BUCAREST, 1998