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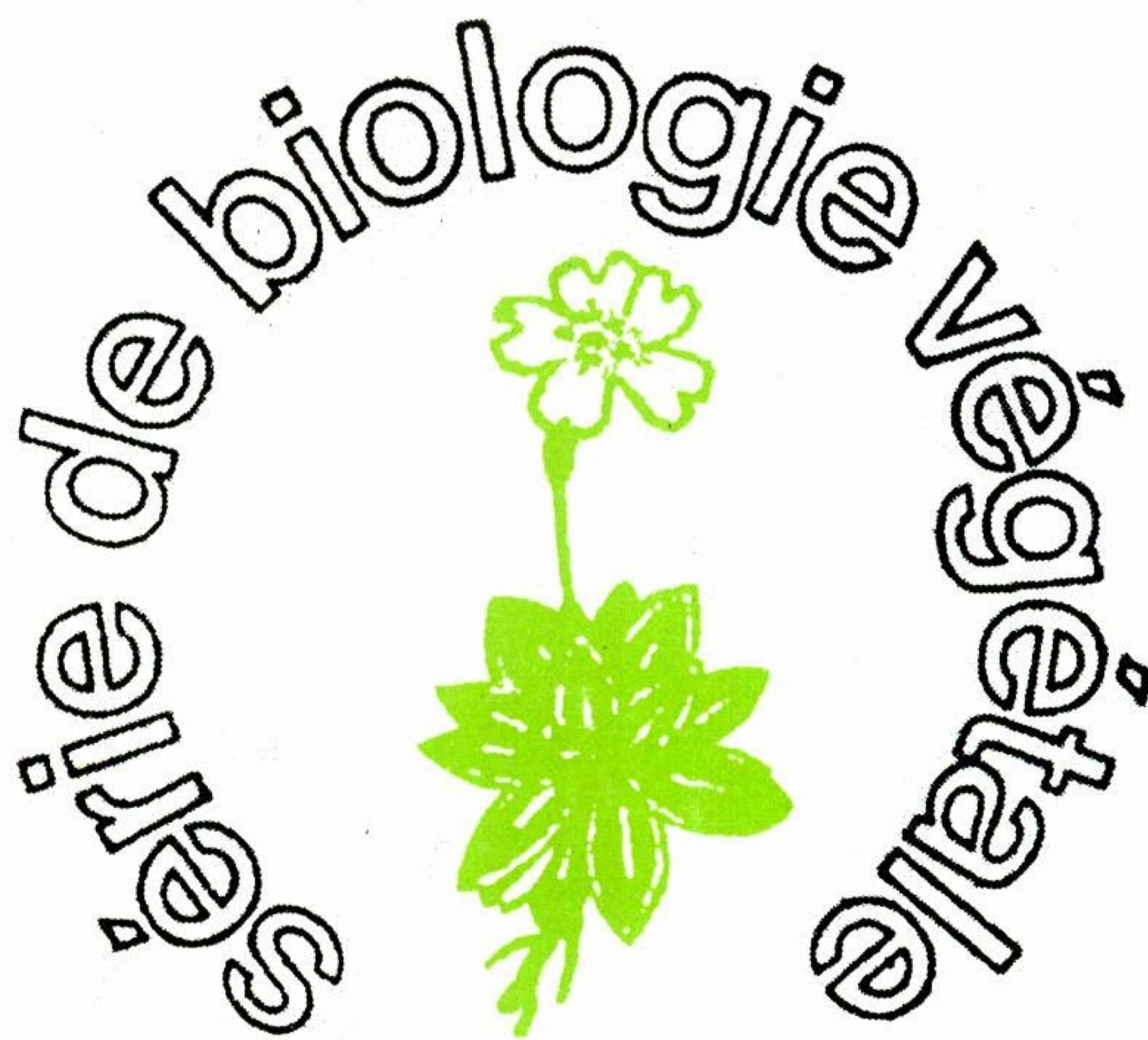
REVUE
ROUMAINE
DE BIOLOGIE

29480

TOME 45

2 2000

juillet – décembre



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SOMMAIRE

ELENA ENACHE, ANA-MARIA FAGHI, GABRIELA TEODOSIU, LUCIA DUMITRU, GHEORGHE ZARNEA, The halophilic microorganisms response to heavy metals	111
ECATERINA FODOR, Macrofungal communities in artificial stands at Bărăgan Experimental Station – Ialomița county (1991–1997)	117
MONICA NEBLEA, VALERIU ALEXIU, The anatomical structure of vegetative organs with <i>Ginkgo biloba</i> L.	133
SIMONA MIHĂILESCU, MICHAEL KIEHN, Chromosome counts for some plant species in the mountain area	137
DOINA IONICĂ, ALEXANDRA SIMON-GRUIȚĂ, Caractérisation microbiologique du sol pollué par des résidus pétroliers	141
EUGENIA STOIANOVICI, NICOLAE NICOLESCU, The evaluation of possible phytoplankton, a direct support for zooplankton primary consumers, in the Danube Delta Roșu Lake	147
MIHAELA PAUCĂ-COMĂNESCU, AURICA TĂCINĂ, LILIANA VASILIU-OROMULU, VIORICA HONCIUC, MARIN FALCĂ, MARILENA ONETE, DORINA PURICE, MINODORA STĂNESCU, VIOREL BLUJDEA, MONICA IONESCU, Structure of the main biocoenotic components in <i>Tamarix</i> shrublands of Prahova and Teleajen low floodplains	155
PETRE BURESCU, NICOLAE DONIȚĂ, Au-, Sumpf- und Wasservegetation der Ebene von NW.-Rumänien	181
 <i>VIE SCIENTIFIQUE</i>	
Prof. Dr. Constantin Toma on his 65 th anniversary (Acad. Valeriu D. Cotea) ...	199

THE HALOPHILIC MICROORGANISMS RESPONSE TO HEAVY METALS

ELENA ENACHE, ANA-MARIA FAGHI, GABRIELA TEODOSIU,
LUCIA DUMITRU, GHEORGHE ZARNEA



The susceptibility of four moderately halophilic eubacteria and four extremely halophilic archaea to six heavy metal ions was surveyed by using an agar dilution method. The well-known differences among the two halophilic groups were reflected in their responses to heavy metal tested too. The minimal inhibitory concentrations (MIC_s) for moderately halophilic eubacteria show a highly increased tolerance to metallic ions compared to extreme halophiles.

Key words: halophilic microorganisms, MIC_s , heavy metal.

INTRODUCTION

In hypersaline waters biota is severely diminished, in extreme cases being represented only by prokaryotes. Extremely high salt concentrations could be toxic for the living cells, either because of dehydration, when cells are impermeable for salts, or because of protein precipitation, if cells are permeable for salts. Both moderately halophilic and those extremely halophilic microorganisms have mechanisms that enable them to adapt to high salt concentrations of their habitats (1, 6).

Although much attention has been lately paid to the studies related to the taxonomy, physiology and ecology of these microorganisms, few data are available regarding their response to potential inhibitors such as heavy metals (not mentioning their capacity to develop heavy metal resistance). Such information have a special importance mainly due to the fact that some halophilic microorganisms, potentially metal resistant, could be used as indicators in polluted saline waters. Secondly, useful information regarding the ecologic role of halophiles in heavy metals biotransformations, in natural ecosystems, could be obtained through adequate studies of these microorganisms. At the same time *Archaea* and moderately halophilic bacteria resistance to heavy metals may be used as genetic markers (4).

The lack of genetic markers for halophilic microorganisms is well known and it represents an obstacle when studying the genetic transfer mechanisms of these microorganisms (2, 4).

The aim of this study was to select new halophilic strains resistant to heavy metal ions. In order to achieve this goal the growth conditions for six out of eight strains were determined (for the other two strains they were previously established) and the MIC_s for all of them were determined.

MATERIAL AND METHODS

Four strains of moderately halophilic eubacteria were tested. They were marked GR1, BR2, BV1, BB1, as per the abbreviation of the lake names (Grotă Miresei, Baia Roșie, Baia Verde, Baia Baciului). Modified RV medium with the following composition (g/l) (NaCl 118, MgSO₄ 1, CaCl₂ 0.36, KCl 2, NaHCO₃ 0.06, proteose peptone 5, yeast extract 10, glucose 1, agar 20) was used. According to previous tests 118 g/l NaCl proved to represent the optimum concentration for the above strains.

Four extremely halophilic strains were also tested. For these extreme halophiles modified medium I with the following composition (g/l) (NaCl 250, MgCl₂ • 6 H₂O 32, K₂SO₄ 5, CaCl₂ 0.1, yeast extract 1, bactopectone 1, soluble starch 2, agar 20) was used. The increase of the NaCl concentration from 125 g/l to 250 g/l and the decrease of MgCl₂ from 160 g/l to 32 g/l were used according to the studied strains optimum growth.

The heavy metals as AgNO₃, Na₂HAsO₄, K₂Cr₂O₄, CuSO₄, HgCl₂ and Pb (NO₃)₂ were tested in the following concentrations (mM): 0.005, 0.01, 0.05, 0.1, 0.5, 1.0, 2.5, 5.0, 10, 20, 40 and 80 (3, 4).

The stock solutions were sterilized through filtrations (Millipore filter Ø 22 µm). The concentration range is the one usually used in heavy metal eubacteria resistance studies (2, 3).

Petri dishes containing 20 ml solid medium and metallic ions were inoculated with microorganism's suspensions in logarithmic growth phase (3, 5). The utilized inocula were diluted to have D.O. (660 nm) between 0.22–0.25. On each Petri dish four strains were inoculated. All experiments were three times repeated and for each experiment three Petri dishes without ions included were used.

The incubation was performed at 30°C for moderate halophiles and at 37°C for extreme halophiles. Minimal inhibitory concentration (MIC) was established for each strain after four days for moderate halophiles and ten days for extreme halophiles.

RESULTS AND DISCUSSIONS

Figs. 1–4 show the growth of the four moderately halophilic bacteria strains related to the pH values in culture medium. It is obvious that the optimal pH value for these strains is 8.0 and that usually maximum growth occurs in 48 h.

Fig. 5 presents the growth evolution of the strains BR2G and BV2G in a 250g/l NaCl (4.3 M) and 32 g/l MgCl₂ (0.15 M) medium at 8.0 pH. Maximum growth of the BR2G strain was obtained on the fourth day (~ 90 h) while as for the BV2G strain the maximum growth reached its peak on the third day (~ 70 h).

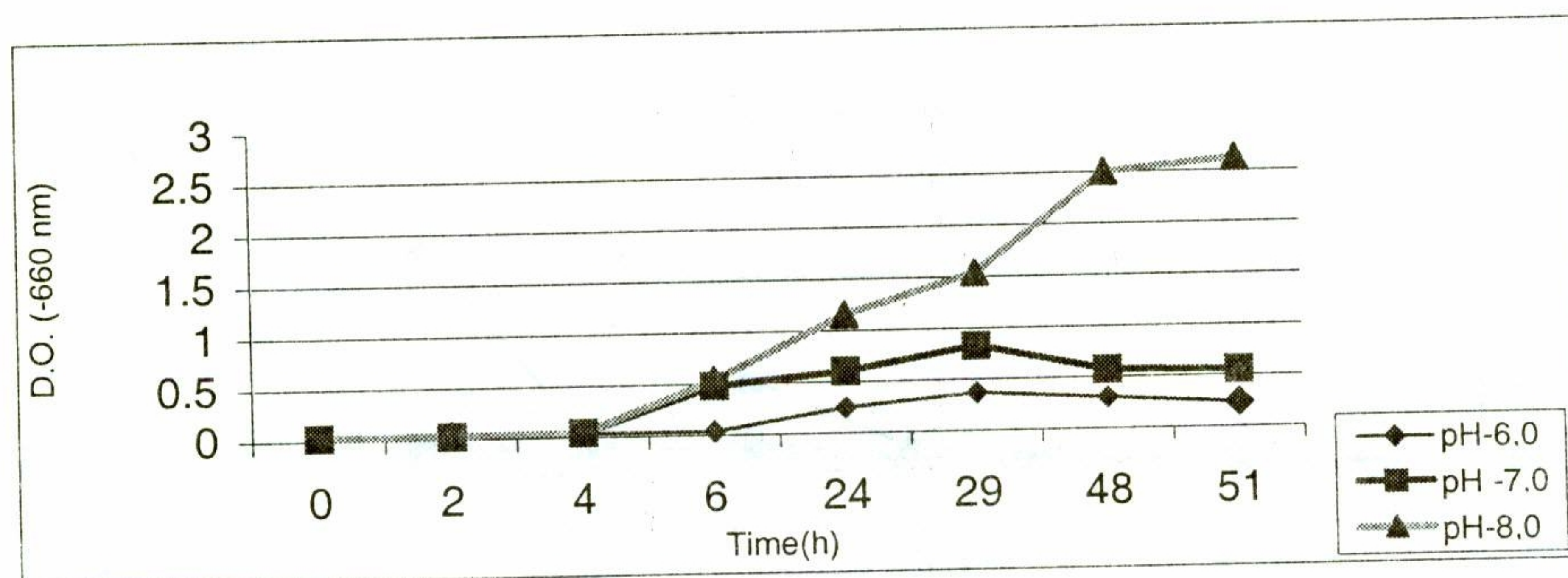


Fig. 1 – Growth of moderately halophilic strain GR1 on media with different pH values.

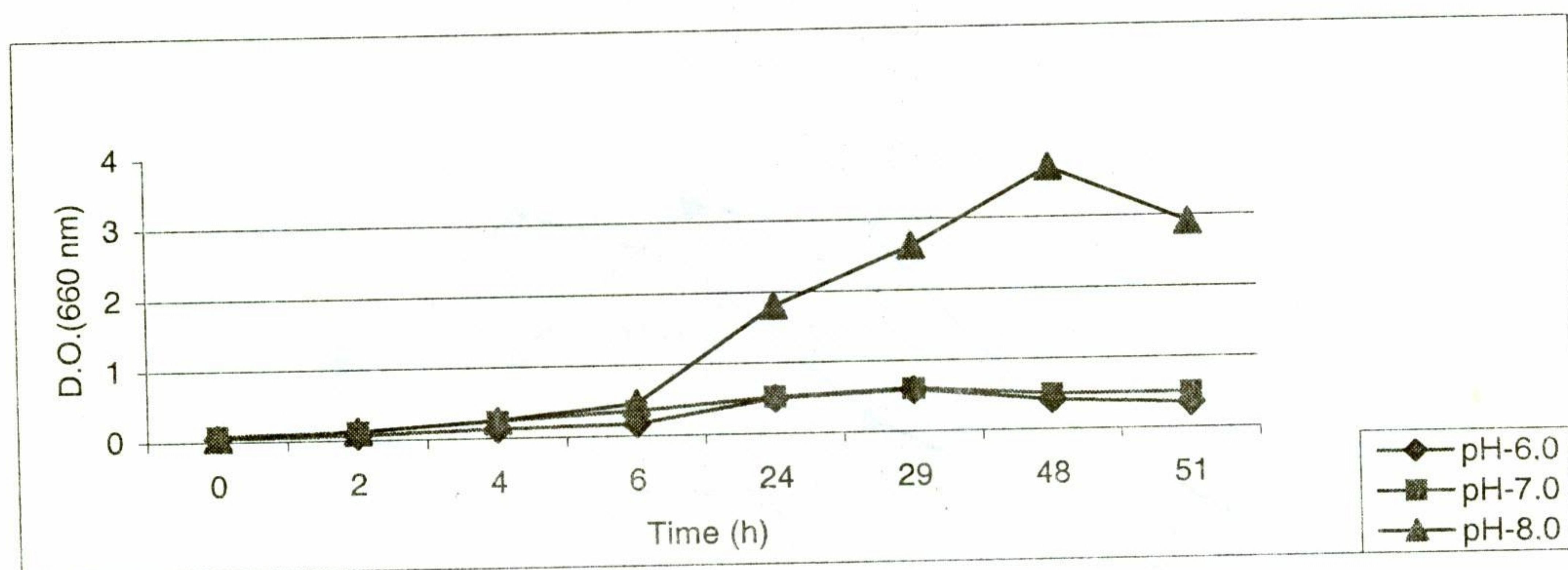


Fig. 2 – Growth of moderately halophilic strain BR2 on media with different pH values.

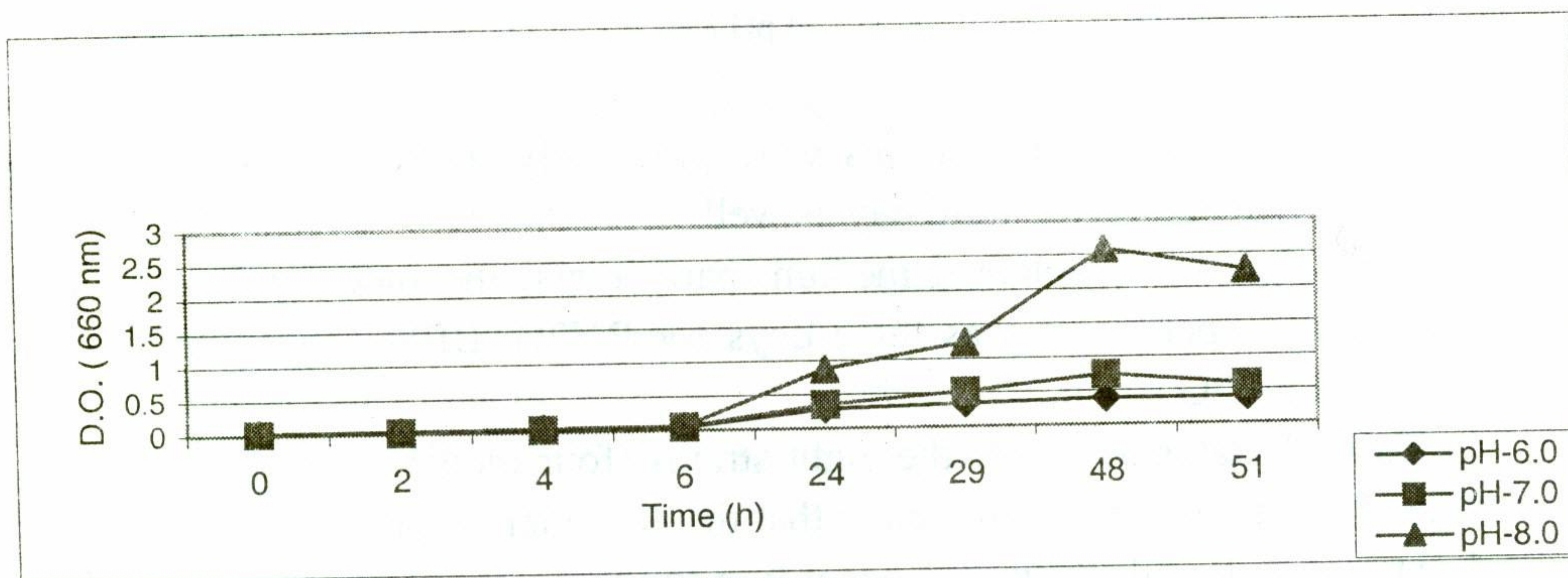


Fig. 3 – Growth of moderately halophilic strain BB1 on media with different pH values.

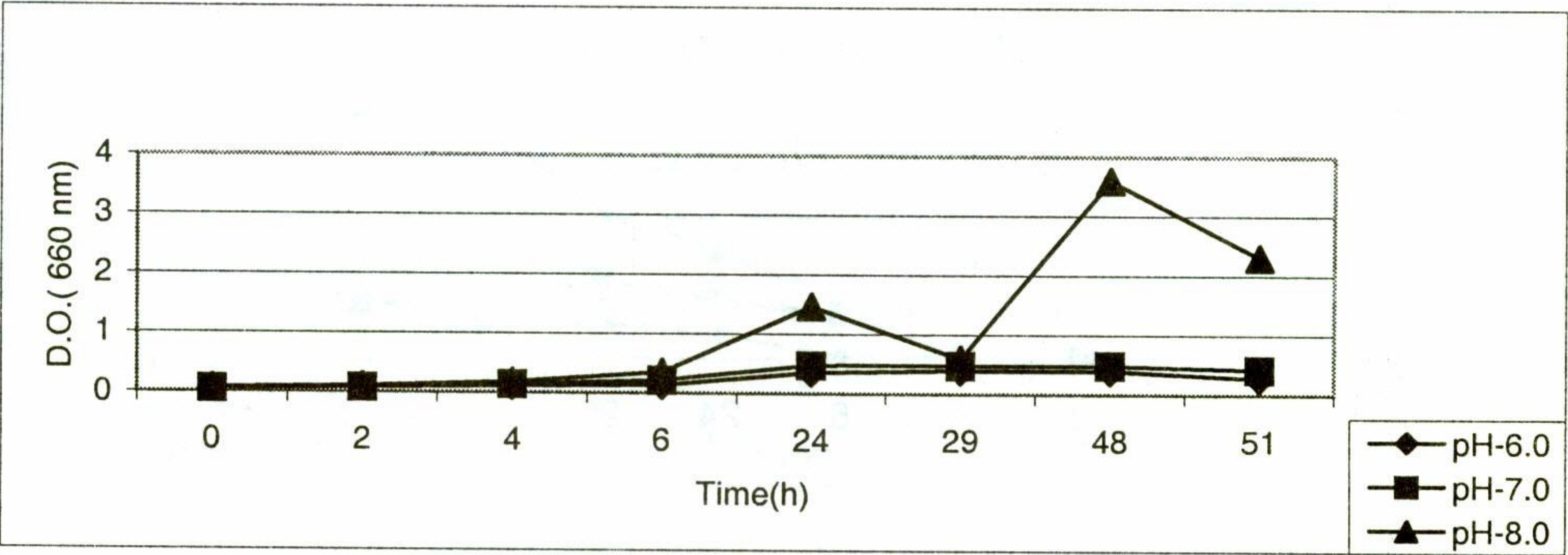


Fig. 4 – Growth of moderately halophilic strain BV1 on media with different pH values.

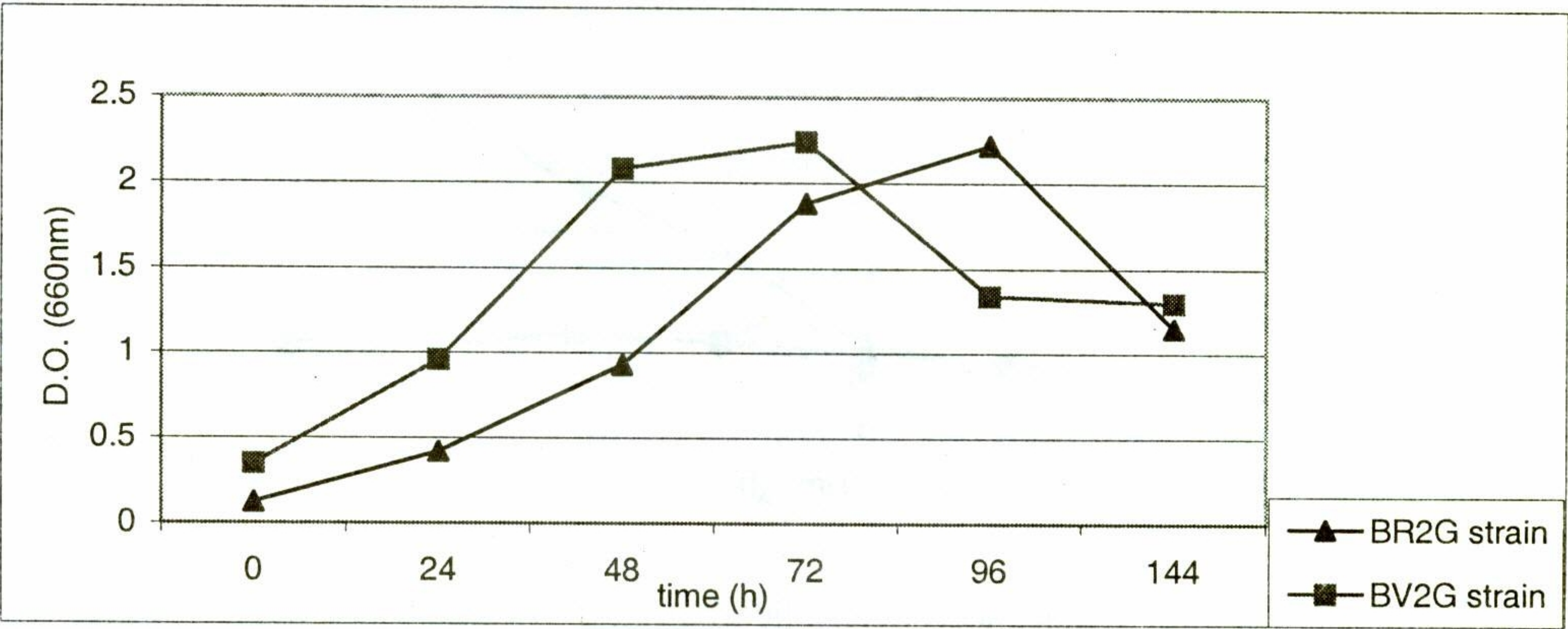


Fig. 5 – Growth of extremely halophilic strains on medium with 4.3 M NaCl and 0.15 M MgCl₂, at pH 8.0.

The BB8G and TL6G strains were previously studied and their maximum growth was reached on the third day as well.

Thus, for the established medium parameters, the inoculum’s duration for metallic ions experiments was three days for BV2G, BB8G and TL6G and four days for the BR2G strain.

Table 1 states MIC_s for the eight strains (four moderate halophiles and four extreme halophiles). It is rather clear that the two microorganism groups (moderate and extreme halophiles) diverge according to their response to heavy metals used for the experiment.

Table 1

MIC_s of six metal ions against moderately and extremely halophilic strains

Strain	MIC (mM)					
	Hg	Ag	As	Cu	Cr	Pb
GR1	0.01	0.5	>80	5	>80	10
BR2	0.05	0.5	>80	5	>80	10
BV1	0.05	0.5	>80	5	>80	10
BB1	0.05	0.5	>80	5	40	10
BV2G	0.05	1	10	1	1	1
BB8G	0.05	0.5	10	0.5	2.5	2.5
BR2G	0.05	0.5	20	0.5	5	5
TL6G	0.05	0.5	20	0.5	5	5

Thus moderately halophilic eubacteria show a highly increased tolerance to metallic ions as compared to extreme halophiles.

The moderate halophiles strong resistance to As (known as a highly toxic ion) and to Cr, made the culture development possible for concentrations as high as 80 mM and determined us to repeat the experiment, but the results were similar.

The extreme halophiles were much more susceptible to metallic ions with the Hg being the most toxic of the tested once, followed in a toxicity decreasing series by Ag, Cu, Cr, Pb and As.

It is stated that strains which were not inhibited to grow in a 10 mM As, 1 mM Ag, 1 mM Cu, 1 mM Cr, 1 mM Pb and 0.1 mM Hg medium are to be resistant to these ions.

Out of the extreme halophiles group BV2G shows resistance to five of the six studied ions, respectively Ag, As, Cu, Cr and Pb. The other three extremely halophilic strains show resistance to three metallic ions: As, Cu and Pb.

CONCLUSIONS

1. Maximum growth of moderately halophilic bacteria was obtained in 48 h in a 118 g NaCl/l medium, pH 8.0, while maximum growth for extremely halophilic microorganisms occurred on the third or the fourth day in a 250 g NaCl/l, 32g MgCl₂/l medium, pH 8.0.

2. The microorganisms' different response to metallic ions in their culture medium makes clear their belonging to extremely or respectively moderately halophilic groups.

3. While moderate halophiles are highly resistant to increased concentrations of As, Cr, Pb and Cu and susceptible to Hg and Ag, the extreme halophiles show

lower MIC values, although BV2G could be considered resistant to Ag, As, Cu, Cr, Pb and the other three strains tolerate only As, Cr and Pb.

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Received December 15, 2000

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MACROFUNGAL COMMUNITIES IN ARTIFICIAL STANDS AT BĂRĂGAN EXPERIMENTAL STATION – IALOMIȚA COUNTY (1991–1997)

ECATERINA FODOR

The growing interest in afforestation and forest shield plantation during last decades is the consequence of prolonged droughts and increasing aridisation that affects southern areas of Romania. The Bărăgan Experimental Station is situated in south-eastern Romania, in Bărăgan steppe. The macrofungal composition of the site was investigated between 1991–1994 and in 1997, 1998 in forest stands, forest shields and plantations. 128 macrofungal species were identified, the list being dominated by typical forest species (93%). The major part of inventory is represented by wood-inhabiting fungi, humicolous saprotrophic species and litter decomposers, the proportion depending on the type of vegetation under study. The number of ectomycorrhizal species is low due to the climatic stress, the inhibiting effect of woody debris, management practices and physiological status of the trees.

Key words: fungi, artificial stands, Bărăgan.

INTRODUCTION

The last decades of the XXth century were marked by repeated and prolonged drought in the south and south-eastern Europe. This phenomenon generated a multitude of practical problems with regard to natural and cultivated vegetation. In south-eastern Romania, large territories are dominated by a continental climate characterised by prolonged droughts, consequently, studies concerning the management of forested areas, as protective factors against this relatively harsh climate, are of a rising interest (13).

Bărăgan Experimental Station was created in 1946 with the aim of experimenting optimal plantation solutions with regard to woody species most adapted to a largely fluctuating climate and less favourable soil types (26).

The present study was initiated as a part of a larger project between 1990–1992 concerning the evolution of ecosystem changes produced in a fifty year period in forest stands and plantations at Bărăgan Experimental Station (8,9). The work hypothesis of newly initiated research at the beginning of '90 was the evolution of the artificial communities, initially composed of planted woody perennials toward complex natural equivalents of forestry vegetation.

This work hypothesis was tested through studies about plant communities, insects, microfungal and macrofungal communities, as major components of the biocoenoses that evolved at Bărăgan Experimental Station.

The macromycetes are considered as components of major functional groups as: wood inhabiting fungi, litter decomposers, humicolous fungi, parasites, saproparasites and mycorrhizal fungi (22).

These groups are involved in major community level processes as litter decomposition, nutrient cycling, mineralisation, and population level processes as population control by means of parasitism.

The aims of the present study are:

1. characterization of the fungal communities: species richness as it is evaluated in protection forest shields, plantations, forest stands that vegetate under environmental stresses (temperature and humidity in steppic climate).
2. evaluation of compositional variation of fungal communities in forest shields as compared to forest stands and adjacent steppic and agricultural vegetation.
3. characterization of compositional differences in macrofungal communities due to habitat fragmentation and different types of phytocoenoses.

MATERIALS AND METHOD

Site description

Bărăgan Experimental Station is situated in south-eastern Romania at 44°34' north latitude and 27°36' eastern longitude in southern Bărăgan Plain (named also Ialomita Plain) and covers an area of 328 ha. The relief is represented by a wavy plain with microdepressions and microelevations of an average altitude of 150 m. The substrate is represented by loess deposits of variable thickness (between 20–25 km), with a deep water table.

The climate is moderately continental of steppic type with an average annual temperature of 10.6 C° (summer average of 20 C° and winter average of –2C°). The temperature oscillations are caused by a rapid shift from warm to cold years. The regime of precipitations is of a continental type with a high summer maximum. The abiotic limit imposed to forest vegetation is set by the winter – spring and late summer droughts. The precipitation's average of 47 mm/yr places the investigated area in the steppe at the limit with silvo-steppe. The year to year oscillations are large, between 322 and 813 mm/yr, corresponding to series of rainy and dry years. The long term tendency is anyway towards aridisation (6, 8).

The wind regime is typical for open areas, which are exposed to air currents blowing from north and north-east. Practically, there is a permanent air movement in the investigated area with average wind velocities between 1.4–2.4 m/s. The wind affects the vegetation through an increased evapotranspiration, abrasion of foliar surfaces, branch cracking. On the other hand, wind plays an important role as a dispersion vector for insects and fungal propagules.

The cultivated forest vegetation is spatially organized in blocks which are divided in forest stands, perimetral and interior forest shields, intensive tree plantations, an arboretum and a tree nursery. The B block is cultivated mainly with *Quercus pedunculiflora*, *Quercus robur*, *Quercus cerris* and *Quercus pubescens* in pure or mixed stands of 0.25–0.5 ha situated in the north-eastern limit of the Experimental Station. Some blocks contain also perimetral forest shields. Apart from trees of genus *Quercus* which are predominating, trees of other species are disseminated through the stands and shields such as *Fraxinus angustifolia*, *Sophora japonica* and species of *Ulmus*. The V block is situated at the southern limit of the station and is composed of stands (1ha each) with different mix formulas of *Quercus pedunculiflora* with *Robinia pseudoacacia*, *Fraxinus angustifolia* and conifers like *Picea abies* and *Pseudotsuga metziesii*. A perimetral forest shield is bordering the block (23).

Macromycetes were collected between 1990 and 1994 with additional visits in 1997 and 1998, during late summer.

In the proximity of the station there are several forest stands which are important colonization sources: the Bazarghideanu forest at 3 km west and Ciunga forest at 15 km north. There forests are cultivated but they contain nuclei of old natural forests of approximately 100 yr, with few *Quercus pedunculiflora* specimens. Trees are sparse, the forest floor being invaded by grasses with few forest elements, with abundant forest shrubs and grassy clearings. The trees are of small habitus and abundant branching.

The study of the macrofungal community

The term “macromycete” is used in this paper in the sense of Ainsworth (2) as applied to fungi, which produce fructifications larger than 1 mm. The arbitrariness of the term is compensated by the possibility of comparing ecosystems with regard to their fungal components (3). The species inventory was accomplished during the vegetation seasons of 1991–1994 and 1997, 1998. As fructification in macromycetes is a fluctuating phenomenon, it is specifically recommended to extend the research over several years at least 3 or 5 yr. (29). The investigated forest stands from B block with *Q. pedunculiflora*, *Q. robur* and *Q. cerris*, from I block with *Fraxinus angustifolia* and *Q. pedunculiflora*; stands from V block with *F. angustifolia* and *Q. pedunculiflora*, perimetral and interior forest protection shields and plantations with *Pseudotsuga menziensis*, *Picea abies*, *Populus* hybrids, with *Betula pendula* and *Tilia platyphyllos* were visited once each month during the vegetation period (from March till November), every year.

The observation data were considered as presence/absence data used to compare stands through the Sørensen similarity index. Species ordination in functional groups was performed according to their substratum relation in:

mycorrhizal, wood-inhabiting, humicolous, litter saprophytic species, and parasites (22). As several species are metabolically versatile, they were placed in more than one group. The identification and nomenclature follow Jülich & Moser (17), Sălăgean (27), Kuhner & Romagnesi (21), Buczacki (4).

RESULTS

Between 1991–1994 (additional, episodic visits in 1997 and 1990) in the studied area were identified 128 species (Table 1) of which 42% are humicolous, 15% litter saprophytic species, 35% wood-inhabiting species, 18% mycorrhizal and 6% parasites.

Table 1

Macromycetes identified in forest stands, forest shields and plantation
at Bărăgan experimental Station: 1991–1997

Species	Functional groups	Substratum	1	2	3	4	5
1. <i>Agaricus campestris</i> L.ex Fr.	sh, slit	g, we	+	+	+		+
2. <i>Agaricus comtulus</i> Fr.	sh	w	+				
3. <i>Agaricus haemorrhoidarius</i> Kalchbr. Et Schultz	sh	w, we	+	+	+	+	+
4. <i>Agaricus xanthodermus</i> Genevier	sh	we	+	+	+		
5. <i>Astraeus hygrometricus</i> (Pers.) Morg.	Sh	w		+			
6. <i>Auricularia auricula - judae</i> (Hook.) Underv.	Sw, p	w, we	+	+	+		+
7. <i>Auricularia mesenterica</i> Pers.	sw, p	w, we			+		
8. <i>Bjerkandera adusta</i> (Willd. et Fr.) Karst.	Sw	w	+	+	+	+	+
9. <i>Calvatia caelata</i> var. <i>hungarica</i> (Holl.) Smrda	sh	g	+	+	+		+
10. <i>Calvatia candida</i> (Rost K.) Holl.	Sh	g			+		
11. <i>Calvatia cretacea</i> (Berk.) Lloyd	sh	g		+			
12. <i>Ciboria</i> sp.	sw	w	+				
13. <i>Clytocybe flaccida</i> Fr. Ex Sow.	sw, slit	w		+	+		
14. <i>Collybia aquosa</i> (Bull. Ex Fr.) Kumm.	slit	w			+		
15. <i>Collybia confluens</i> (Pers.:Fr.) Kumm.	sh	w		+		+	
16. <i>Collybia dryophila</i> (Bull. Ex Fr.) Kumm.	slit	w	+	+	+	+	+
17. <i>Collybia marasmiioides</i> (Britz) Brasky et Stangl.	Slit	w		+			

Table 1 (continued)

Species	Functional groups	Substratum	1	2	3	4	5
18. <i>Collybia succinea</i>	sh	w			+	+	
19. <i>Coprinus disseminatus</i> (Pers.:Fr.) S.F. Cray	sw	w		+	+	+	
20. <i>Coprinus micacaeus</i> (Bull.:Fr.) Fr.	sh	w		+	+	+	
21. <i>Crepidotus mollis</i>	sw	w	+	+			
22. <i>Crucibulum laeve</i> (Bull.:D.C.) Kambly	sw	w		+			
23. <i>Cyathus olla</i> (Batsch.) ex Pers.	sw	w, we	+				
24. <i>Cystostereum murraini</i>	sw	w		+			+
25. <i>Dacrymyces styllatus</i> Nee. Ex Fr.	sw, slit	w		+			
26. <i>Flammulina velutipes</i> (Curt.:Fr.) Sing.	sw	w				+	
27. <i>Fomes fomentarius</i> (L. ex Fr.) Gill.	sw, p	w			+		
28. <i>Ganoderma applanatum</i> (Pers. Ex Wallr.) Pat.	sw, p	w		+			
29. <i>Geastrum badium</i> Pers.	sh	g			+		+
30. <i>Geastrum corollinum</i> (Batsch.) Hollos	sh	w			+		+
31. <i>Geastrum lageniforme</i> Vitt.	sh	w		+	+		+
32. <i>Geastrum melanocephalum</i> (Czern.) Stanek	sh	w, we	+	+	+	+	+
33. <i>Geastrum striatum</i> D.C.	sh	w		+	+		+
34. <i>Geastrum triplex</i> Jungh. Jungh.	sh	w			+		+
35. <i>Geopyxis cupularis</i> (L. ex Fr.) Sacc.	sh	w		+			
36. <i>Grandinia crustosa</i> (Pers. ex Fr.) Fr.	sw	w		+			
37. <i>Hapalopilus fibrilosus</i> (Karst.) Bond. et Sing.	sw	w		+			
38. <i>Hydrophorus</i> sp.	m	w					+
39. <i>Hymenogaster olivaceus</i> Vitt	m	w		+			
40. <i>Hypholoma fasciculare</i> (Huds. ex Fr.) Kumm.	sh, sw	w		+		+	
41. <i>Inocybe acuta</i>	m	w			+		+
42. <i>Inocybe pentiginosa</i> (Fr: Fr.) Gill.	m	w			+		
43. <i>Inocybe terrigena</i> (Fr.) Kumm.	m	w			+		+
44. <i>Kavinia himantia</i> (Schw.) Eriks.	sw	w			+		
45. <i>Laccaria laccata</i> (Scop. ex Fr.) Berk. et Br.	m	w		+			
46. <i>Lasiosphaera gigantea</i> (Pers.) F. Smrda	sh	g			+		
47. <i>Lentinus</i> sp.	sw	w			+		

Table 1 (continued)

Species	Functional groups	Substratum	1	2	3	4	5
48. <i>Lepiota clypeolaria</i> (Bull. ex Fr.) Kumm.	sh, slit	w	+	+	+	+	+
49. <i>Lepiota cristata</i> (Bolt. ex Fr.) Kumm.	slit, sh	w	+	+		+	
50. <i>Lepista nuda</i> (Bull. ex Fr.) Cooke	m	w	+		+		
51. <i>Leptopodia albipes</i> (Fuck) Bond.	sw	w	+	+	+	+	
52. <i>Leptopodia atra</i> (König ex Fr.) Bond.	sw	w	+		+		
53. <i>Lycoperdon candium</i> Pers.	sh	w	+	+	+	+	
54. <i>Lycoperdon depressum</i> Bon.	sh	w		+			
55. <i>Lycoperdon perlatum</i> Pers.	slit, m?	w	+	+	+	+	+
56. <i>Lycoperdon pyriforme</i> Pers.	sw	w			+		
57. <i>Macrolepiota procera</i> (Scop. ex Fr.) Sing.	sh	w					+
58. <i>Marasmius oreades</i> (Bolt. ex Fr.) Fr.	sh, m?	we, g	+	+	+	+	+
59. <i>Melanoleuca melanoleuca</i> (Fr. ex Pers.) Kuhn.	sh, m?	g, w, we		+	+		+
60. <i>Microtyphula</i> sp.	slit	w		+			
61. <i>Morchella</i> sp.	sh	w	+				
62. <i>Mycena mirata</i>	sh, slit	w					+
63. <i>Mycena polygramma</i> (Bull: Fr.) S. F. Gray	sh, slit	w, we					+
64. <i>Mycena vulgaris</i> (Pers: Fr.) Quel.	sh, slit	w, we	+			+	+
65. <i>Mycena</i> sp.	sh	w, we		+			+
66. <i>Mycenastrum corium</i> (Guers. in D.C.) Desv.	sh	g			+		
67. <i>Mycoacia fuscoatra</i> (Fr. ex Fr.) Donk	sw	w	+				+
68. <i>Myriostoma colliforme</i> (Dicks. ex Pers.) Corda	sh	g			+		+
69. <i>Nectria cinnabarina</i> (Tobe ex Fr.) Fr.	sw, p	w	+	+	+	+	+
70. <i>Oudemansiella radicata</i>	sw	w		+			+
71. <i>Panellus mitis</i> (Pers.: Fr.) Sing.	sw	w				+	+
72. <i>Paxina acetabulum</i> (L. ex St-Am.) O. Kunze	sh	w					+
73. <i>Paxina sulcata</i> (Pers.) O. Kunze	sh	w					
74. <i>Peniophora gigantea</i> (Fr.) Mass	sw	w	+				+
75. <i>Peniophora pubera</i> (Fr.) Sacc.	sw	w	+	+	+		
76. <i>Peniophora limitata</i> (Chaill. ex Fr.) Cooke	sw	w			+		
77. <i>Peziza cerea</i> Sow. ex Fr.	sh	w		+			

Table 1 (continued)

Species	Functional groups	Substratum	1	2	3	4	5
78. <i>Phallus hadriani</i> Vent.	sh, m	we, g, w	+	+	+		+
79. <i>Pluteus cervinus</i> (Schiff. ex Fr.) Kumm.	sw	w	+	+	+		
80. <i>Pluteus hispidulus</i> (Fr.) Gill.	sw	w		+			
81. <i>Pluteus pallescens</i>	sh	w			+		+
82. <i>Polyporus</i> sp.	sw	w		+			
83. <i>Polyporus squamosus</i> Mich. ex Fr.	sw, p	w		+			
84. <i>Psathyra</i> sp.	sh	w			+		
85. <i>Psathyrella albidula</i>	sh	w		+			
86. <i>Psathyrella fatua</i>	sh	w		+			
87. <i>Psathyrella hydrophila</i> (Bull. ex Merat) Mre.	sh	w					+
88. <i>Psathyrella pygmaea</i> Kumm. et Romagn.	sh	w					+
89. <i>Ramaria stricta</i> (Pers. ex Fr.) Quel.	sh, sw, m?	w	+	+	+	+	+
90. <i>Rhyzopogon luteolus</i> Fr. et Nordh.	m	w		+			
91. <i>Russula foetens</i> Pers. ex Fr.	m	w		+		+	
92. <i>Russula cyanoxantha</i> (Schaeff. ex Schw) Fr.	m	w				+	
93. <i>Sarcoscypha coccinea</i> (Jaq. per Gray) Lamb	sh	w	+				+
94. <i>Schizophyllum commune</i> Fr.	sw, p	w	+	+	+	+	+
95. <i>Scleroderma areolatum</i> Ehnreb.	m, sh	w	+	+	+	+	+
96. <i>Stereum hirsutum</i> (Willd. ex Fr.) Fr.	sw, p	w	+	+	+	+	+
97. <i>Telephora terrestris</i> Ehrb. ex Fr.	m	w	+				
98. <i>Trametes cervinus</i>	sw	w				+	
99. <i>Trametes hirsutus</i> (Wulf. ex Fr.) Pil.	sw	w		+		+	+
100. <i>Trametes versicolor</i> (L. ex Fr.) Pil.	sw	w	+	+	+	+	+
101. <i>Trehispora albo-pallescent</i>	sw	w				+	
102. <i>Tricholoma</i> sp.	m	w	+				
103. <i>Tubaria conspersa</i> (Pers.: Fr.) Fay	slit	w		+	+		
104. <i>Typhula</i> sp.	slit	w		+			
105. <i>Volvariella</i> sp.	sw, sh	w					+
106. <i>Xylaria polymorpha</i> (Scop.) Gub.	sw	w		+	+		+
107. <i>Xylaria carpophila</i>	sw	w					+
108. <i>Boletus luridus</i> Schff ex Fr.	m	w	+				
109. <i>Collybia butyracea</i>	slit	w	+				
110. <i>Cystolepiota systrata</i>	slit	w				+	
111. <i>Scleroderma citrinum</i> Pers.	sh, m	w		+		+	+

Table 1 (continued)

Species	Functional groups	Substratum	1	2	3	4	5
112. <i>Collybia tuberosa</i> (Bull: Fr.) Quel.	slit	w			+		
113. <i>Mycena pura</i> (Pers.: Fr.) Kumm.	slit	w	+				
114. <i>Odontia arguta</i> (Fr.) Quel.	slit	w	+				
115. <i>Inocybe praetervisa</i> Quel.	sw	w		+			
116. <i>Macrolepiota rhacodes</i> (Vitt.) Sing.	sh	w, we					+
117. <i>Melanoleuca excissa</i>	sh	w	+	+	+	+	+
118. <i>Tomentella feruginea</i>	sh	w	+				
119. <i>Lactarius quietus</i> Fr.	m	w				+	
120. <i>Lepista alba</i>	m	w	+				
121. <i>Entoloma jubatum</i> (Fr.) Karst	sh, m?	w				+	
122. <i>Russula velenovsky</i> Melz. et Zv.	m	w				+	
123. <i>Russula pseudointegra</i> Arn.&Gor.	m	w				+	
124. <i>Russula rosea</i> Quel.	m	w				+	
125. <i>Entoloma clypeatum</i> (L.) Kumm.	sh, m?	w, we	+	+	+	+	+
126. <i>Marasmius rotula</i> (Scop: Fr.) Fr.	slit	w					+
127. <i>Daedalea quercinum</i> L. ex Fr.	sw	w			+		
128. <i>Exidia glandulosa</i> (Bull: St.Am)	sw	w	+	+	+	+	+

Symbols:

1. plantations;
2. forest stands (block V);
3. forest shields;
4. forest stands (block B);
5. forest stands (block I);
- sh – saprotrophs; slit – litter saprotrophs; sw – wood inhabitants; m – mycorrhizal;
- p – parasites; g – grassland; w – woodland; we – woodland edger.

Some species of the list play several functional roles depending on the circumstances, therefore they are registered in more than one functional group. Most of the species are forest dwellers (93%), few are grassland species (8%) and only 9% are forest edge species. The plantations harbour 38% of species, 32% are found in forest stands of B block and 46% of species were identified in forest shields. Forest stands with *Q. pedunculiflora* and *F. angustifolia* from V block harbour 39% of species. The maximum species richness was reached in forest stands of I block with *Q. pedunculiflora* and *F. angustifolia*. The species composition of the stands is edified by older trees originating from the preexisting forest vegetation which occupied a microdepression. The values of the calculated Sørensen similarity index are summarised in Table 2.

Table 2

Sørensen similarity index calculated in the presence/absence of data in forest stands, forest protection shields and plantation at Bărăgan Experimental Station (1991–1994, 1997, 1998)

Combinations	Sørensen similarity index
plantations/forest stands, block V	0.46
plantations/forest protection shields	0.37
plantations/forest stands, block B	0.37
plantations/forest stands, block I	0.32
forest protection shields/forest stands block V	0.42
forest stands block B/forest stands block V	0.39
forest stands block V/ forest stands, block I	0.44
forest protection shields/ forest stands block V	0.32
forest protection shields/ forest stands, block I	0.47

(the species composition of forest stands, forest protection shields and plantations are briefly presented in the text)

The maximum similarity is between the forest shields and forest stands of I block which is adjacent to a perimetral forest protection shield. The 128 identified species are included in 77 genera corresponding to a genera index (14) of 44.5%. Genera with many species recorded are *Collybia* with 8 species, *Geastrum* with 7 species, *Russula* and *Mycena* with 5 species each, *Agaricus* and *Lycoperdon* with 4 species each. 63 species were recorded only once. The species distribution partitioned by genera is approximating a lognormal distribution, with few genera diversified at species level and many genera represented by few or only one species. The repartition of species in functional groups is summarised in Table 3. Several species are plurifunctional; correspondingly they are recorded in two or even three functional groups.

Table 3

Functional groups of macromycetes (%) in different types of cultivated forest vegetation areas at the Bărăgan Experimental Station (1991–1994, 1997, 1998)

Vegetation	Functional groups of macromycetes			
Type	Humicolous	Litter decomposers	Wood inhabitants	Mycorrhizal
Plantations	49	16	41	22
V block	48	14	39	11
B block	41	12	36	34
I block	58	17	37	19
Forest shields	42	10	42	20

Saprophytic fungi dominate in all the investigated areas, a fact that is consistent with the detrital model of the deciduous forest (19,31). Mycorrhizal species are few, with a maximum richness reached in forest stands of I block (34%). The humicolous species dominate the macrofungal community in forest stands of I block and litter decomposers are moderately represented in all the investigated areas. The wood inhabitants represent a third of the species pool and the few mycorrhizal species belong to *Russula* and *Lactarius* genera mainly recorded during the rainy summer of 1997. The summer of 1998 was particularly hot and dry, conditions that reduced drastically the macrofungal species fructification. Only species of *Geastrum*, *Trametes versicolor* and *Bjerkandera adusta* were recorded.

DISCUSSIONS

The most important factors that affect and shape the macrofungal communities at the Experimental Station are: habitat fragmentation, the great heterogeneity of phytocoenoses due to the various woody vegetation combinations as well as relatively uniform age structure, the ecotone effect played by the forest shields, tree climatic stress and the relatively uniform edaphic conditions.

The inventory of macrofungi revealed the dominance of wood inhabiting species, humicolous species and litter decomposers which represent a characteristic of the deciduous forest. The diversity of saprophytic species is a preliminary condition for the mycorrhizal species colonization (31). The climatic stress that affects the forest vegetation at Bărăgan Experimental Station reduces the chances to carpophore production in mycorrhizal species, generally characterised by a fluctuating fructification. In forest stands of same age and same species composition, under different climatic conditions, the references display data on larger species lists: Keizer and Arnolds (19) record ten mycorrhizal species associated with *Q. robur* in roadside verges in Drenthe, Netherlands, among which *Amanita*, *Cortinarius* and *Chalciporus*, species of these genera never being recorded at Bărăgan. In natural forests dominated by species of *Quercus* in Russian silvo-steppe, Ivanova (16) recorded 320 species, a richer macrofungal community compared to what we found at Bărăgan. The species diversity is generally affected by limiting factors, natural or anthropogenic (32). Habitat fragmentation, especially of anthropogenic origin, modifies species diversity and the interaction between populations of different species (24).

The forest species (93% of the pool) are immigrants that invaded the area, were brought together with the seedlings and young trees. The wind and the animals propagated spores from adjacent areas covered with forest vegetation. *Phallus hadriani* is a dune dweller, facultatively mycorrhizal and has colonised the

forest stands at Bărăgan being introduced with the sand used in the greenhouse and nursery. Another sand dune species, *Myriostoma colliforme*, was also recorded along the paths that stretch the forest stands. Grassland species are confined to pathways and stands' limits being immigrants from abandoned cultivated areas near the station (*Calvatia* species, for instance) or native pre-existing species as *Marasmius oreades* which form large fairy rings along the pathways and forest edges, mostly in I block. A restricted number of common species belonging to different functional groups and early successional stages were recorded in all study sites (*Bjerkandera adusta*, *Collybia driophyla*, *Geastrum melanocephalum*, *Lycoperdon perlatum*, *Scleroderma areolatum*, *Stereum hirsutum*, *Entoloma clypeatum*, *Agaricus haemorrhoidarius*, *Schizophyllum commune*). Most of the recorded species are generalist: among the humicolous and litter decomposers there are few resource specific species (sensu Swift, 1976). *Marasmius rotula*, for instance, is a colonizer of *Quercus* foliar litter being a resource specific species while *Collybia driophyla* and *C. flaccida* have been found on foliar litter shed by various species of deciduous trees. Their mycelial domains are restraint and these species initiate the degradation of lignin before the cellulose degradation is completed (28).

Wood inhabiting species dominate the species records as a consequence of the abundance of slash in the stands, a sign of physiological limits reached by the trees under climatic stress at Bărăgan. On fallen twigs were found *Schizophyllum commune*, *Exidia glandulosa*, *Nectria cinnabarina*, *Cyathus olla*, *Peniophora* spp, *Stereum hirsutum*. *Polyporus squamosus*, *Auricularia auricula-judae* were identified on living trees. Ectomycorrhizal species were introduced together with the planting trees and dispersed by wind and mycophagous rodents. Climatic stress, silvicultural practices and previous land use are the causes for such a poor ectomycorrhizal community, the fructification in these species being a fluctuating event even under better environmental conditions (29). The trees' harvest, for instance, disrupts the mycelial mats of mycorrhizal species (10) and the presence of abundant woody debris has an inhibitory effect (22). *Telephora terrestris*, which was found in coniferous stands and plantations, spreads by means of spore inocula and co-exist with early stage and late stage species, depending on the level of site disturbance (19, 20). Mature stand species as *Russula xerampelina* and *Lactarius quietus* which disperse via mycelial roots' contact, were recorded only during the rainy summer of 1997 certifying the status of ectomycorrhizal multistage community (7). A short inspection of assimilative roots of *Quercus pedunculiflora* and *Q. cerris* revealed the prevailing presence of *Coenococcum graniforme* also a multistage species, a robust mycobiont adapted to climatic and edaphic stresses (1).

The climatic and anthropogenic disturbances at Bărăgan affect the internal successions of the forest ecosystems: early stage species like *Scleroderma*

areolatum co-exist with late stage species as *Lactarius quietus* and *Russula foetens* in the same stand. Same species *Lactarius quietus* is an associate of both *Q. pedunculiflora*, *Q. cerris* and *Cornus sanguineus* pleading for the hypothesis that mycorrhiza construct a social structure for the translocation of water and nutrients. An ectomycorrhizal species as *Rhizopogon luteolus*, considered a rare mycobiont (30), was found as an associate of *Quercus pedunculiflora*. The distribution of carpophores along the pathways enhances the spore dispersion, the reason of this type of dissemination being unclear for species that rely mainly on mycelial colonization of the roots.

The model of early stage *versus* late stage, still a matter of debate (18, 19), is partially infirmed by the ectomycorrhizal community structure in the investigated forest stands; early stage species co-exist with late stage species within the same stand and even in the same host. Apparently, it is a consequence of anthropogenic influences as the accidental deposition of fertilizers blown from the adjacent cultivated fields, climatic and edaphic stresses.

Sørensen similarity index reflects the consequences of habitat fragmentation and vegetation heterogeneity. Soil type, which is considered as a good predictor of such dissimilarities (29), is constantly the same in the investigated area, correspondingly, the vegetation type being the proposed predictor. Every plant community harbours a particular macrofungal community (15). The continuous forest vegetation cover in perimetral forest shield transient to forest stands from I block raises the value of the similarity index to 0.47 due to spatial continuity.

There is a small number of common species confined to one or few such areas covered with different types of cultivated forest vegetation. A comparison between litter micromycetocoenoses from *Q. pedunculiflora* and *Q. cerris* in the same stands revealed a greater number of shared species than in the corresponding macromycetocoenoses, Sørensen similarity index taking a value of 0.61 (11). The greater or smaller resemblance of macromycetous or micromycetous communities is scale dependent. The micromycetes are cosmopolitan and display different substrate colonization strategies from the macromycetes. An ecotone effect was depicted in several areas in what concerns the species composition where grassland species co-exist with forest edge and typical forest species. An example is the presence within the same stand of *Lycoperdon depressum*, a grassland species, *L. perlatum*, a humicolous species and *L. pyriforme*, a wood inhabiting species.

The genus *Geastrum* is represented by 7 species in the area, mainly in forest shields, species that are characteristic for mixed and deciduous forests, steppes, heathlands and dunes (25). The most frequent species at Bărgan Experimental Station, *Geastrum melanocephalum*, is, in fact, a rare species (5). This representation is consistent with the observation of Swift (1976) that species within a genus are functionally equivalent. In perimetral shield species of *Geastrum* there

was found, together with *Astraeus hygrometricus*, an ectomycorrhizal species (12). The redundancy at species level is a scale dependent phenomenon; at the scale of individual observation plot, the distribution of species depends on the macrofungal community type, species being in some kind of competition or competition avoidance by means of resource partition. At a larger scale as steppic landscape, the species richness has a cumulative character.

The resource specificity of saprophytic species is illustrated by such alien species (*sensu* Arnolds, 1988) that follow their natural substrata out the confines of the original phytocoenosis. It is the case of *Marasmius rotula* colonising the leaf litter of *Q. pedunculiflora* blown into the stands with Douglas fir.

The successional dynamics of Bărăgan communities follows the model of a secondary successsion. The woody vegetation, mainly the trees, vegetates at a physiological limit imposed by harsh climatic conditions. The corresponding communities are not mature, evidence being made by the presence of such pioneers as weeds. Both dynamic aspects model the composition of macrofungal communities, which are distinct with regard to forest vegetation type. The mycorrhizal species are scarce and few on a background of a forest type macrofungal community dominance.

CONCLUSIONS

Forest vegetation at Bărăgan Experimental Station has evolved towards a typical forest environment creating appropriate conditions for the development of other communities as insect and fungal communities. Despite the fact that those stands are artificial, the influences of the topoclimate and the typical biotic resources represented by trees determine the selection of forest organisms. This observation is particularly important for a sustainable forest management in sites with rehabilitation or ameliorative function. The recruitment of fungal propagules is stochastic and it is expected that wherever forest vegetation is established forest fungi will also appear.

The macrofungal communities are dominated by forest species, mostly saprophytic corresponding to a detrital type of community, the deciduous forest fungal community. The ecotone effect is observed in forest shields where grassland, forest edge and forest species co-exist.

The dissimilarities between macrofungal communities corresponding to different types of phytocoenoses are accentuated by habitat fragmentation. The spatial distribution and species richness at the macrofungal community level are scale dependent.

The gradual modification towards a typical forest environment of artificially forested areas is an argument for researches dedicated to forest shields and

reforestation, as aridisation progresses and climatic changes shape the natural vegetation in an undesired way.

Acknowledgements: I am profoundly indebted to the staff working at Bărăgan Experimental Station for the support and assistance, as well as to the professor, dr. ing. Nicolae Doniță, member of the Agricultural and Forestry Academy of Romania, to dr. ing. Contantin Bândiu and to the research team from the Ecology Department of the Institute of Forest Research and Management in Bucharest, to dr. Mircea Petrescu and dr. Gavrilă Negrean and to my laboratory assistant, Mioara Niculaie La Naia.

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Received December 20, 2000.

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THE ANATOMICAL STRUCTURE OF VEGETATIVE ORGANS WITH *GINKGO BILOBA* L.

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The present paper studies some aspects of the anatomical structure of *Ginkgo biloba* L. The observations have been made on a transversal section through the vegetative organs of this species.

We have studied sections made on 1 year old branches, on the petiole and the limb of the leaf. We have shown the presence of the secretive channels in the secondary structure of the trunk, in the structure of the petiole as well as in the mesophyll of the leaf. We have also noted that there are not annex cells and liberian fibers in the structure of the secondary wood.

Key words: morphology, anatomy, trunk, petiole, leaf, *Ginkgo biloba* L.

INTRODUCTION

Ginkgo biloba L. (syn.: *Salisburia adiantifolia* Smith.) is the only representative of the Ginkgoales order, the Ginkgoaceae family, one of the oldest ligneous species continuously present in the flora of the Farthest Orient since the Jurassic age till nowadays being thus considered quite a "living fossil". A decorative tree coming from the Northern India and Nepal, spread throughout Japan and China, reaches heights of 20–30 meters in Romania and in the Farthest Orient, where it is wildly spread, up to 40 meters. Brought to Europe in Holland in 1730, it is grown in parks and botanical gardens having cultivated grounds such as: *Aurea*, *Fastigiata*, *Laciniata*, *Pendula*, *Variegata*, *Macrophylla*. It was brought to our country for the first time at the Botanical Gardens of the University of Cluj, being spread nowadays from Timișoara towards the Southern part of the country, the Center and the East of Transylvania.

The following authors have brought their contribution to the study of the anatomical structure and the vegetative organs of this gymnosperm: I. Mut, R. Dragoș, I. Davidoiu, I. Chetan.

MORPHOLOGICAL CHARACTERIZATION

The corona, pyramidal at first, becomes tabular when they are getting old. The trunk is irregularly verticillate and the bark is smooth and gray; it has a thin, blackish bark (ritidom), much alike the acacia tree. The stems are long, brown, shiny, smooth, with spiral buds; the stems that are 3 cm long, ring-shaped notched, with terminal buds.

The leaves are falling, leather-like, fan-shaped, 10–12 cm long and 6–8 cm wide, with a long petiole (9 cm), with a bi-lobial top, or the ones on the short stem, are sometimes complete, of a light green that becomes yellow in autumn. Dioecious plants have axillary flowers, grouped on the short stems. The male flowers have the shape of an amentum 2.53 cm long whose stamens have short disk-shaped widened fibrous antenna hanging down.

The female flowers have a dichotomic, ramified axis with an open ovule at both ends. The seeds are some false drupes (galbules) that are long, pedunculated, ovoid or ellipsoidal, 2.5 cm long with a pulpy, yellow, bad-smelling cover that comes from the altering of the outer stratum of the ovule.

MATERIAL AND METHODS

The analyzed material belongs to the *Ginkgo biloba* L. species, being collected from the dendrological park "Florica", Ștefănești, Argeș District. Cross sections were made through the trunk (microblast and macroblast) petiole and foliar limb. The section was made with the help of the botanical razor and the material was held in common elder pith. The cross sections at the level of the trunk and petiole were clarified with favel water, then colored with chrysoidine. The epidermis of the leaves was parted by removing the mesophyll and scrapping it off with the spatula needle and lamella. Both the cross-sections through the foliar limb and the parted epidermis were clarified with favel water.

All the sections obtained were put in gelatinous glycerin, then analyzed with a binocular microscope MC-5, where the photos were being taken, too.

RESULTS AND DISCUSSIONS

Section through the branch (made on a 1 year old branch) (Fig. 1)

One-layer epidermis is covered with a thick layer of cutina forming the cuticle; here and there the epidermis is exfoliated, having somatic cells, too.

The suber presents 4–5 strata of flattened, dead cells, with thickened, suberized walls whose membranes are sinuous.

The phellogen is made of 1–2 strata of living cells, hardly visible.

The phelloderm has 3–4 cells strata with evenly thickened walls, making a tabular collenchyma.

The bark (the parenchyma) presents big parenchymatic cells, with intercells space.

Outwards, the bark presents druses (ursines) cells, secretive channels with oval or circular lumen that spread mucilaginous substances.

Inwards, this has sclereids and a fiber sclerenchyma, forming a sinuous, interrupted area.

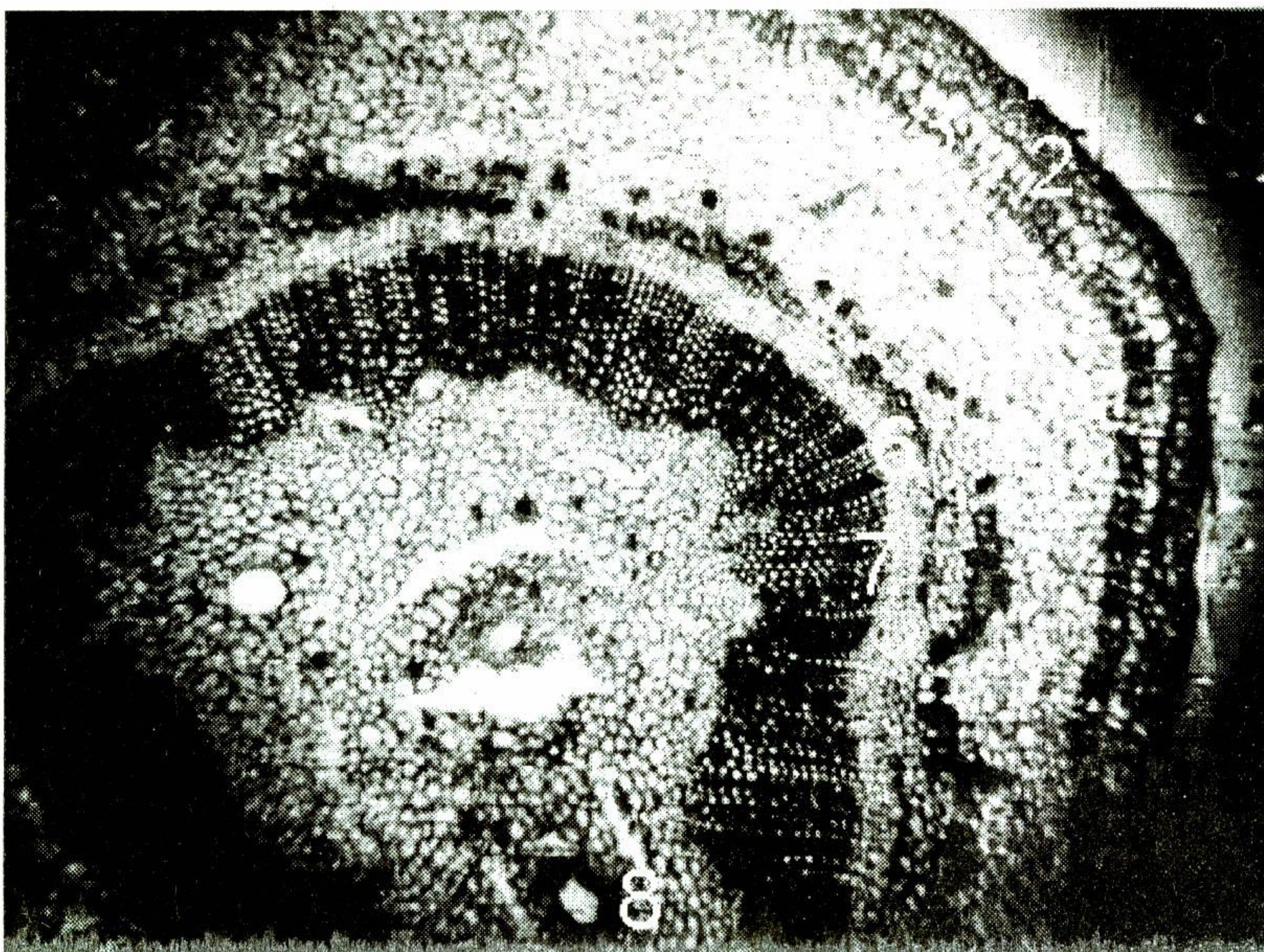


Fig. 1 – Section through the trunk (made on 1 year old branch) (*Ginkgo biloba* L. – 90 ×):
 1 – epidermis; 2 – suber; 3 – phelloderm; 4 – outwards bark; 5 – inwards bark;
 6 – secondary phloem; 7 – secondary xylem; 8 – secretive channel.



Fig. 2 – Section through the petiole (*Ginkgo biloba* L. – 90 ×): 1 – epidermis; 2 – parenchyma;
 3 – xylem; 4 – phloem; 5 – collenchyma; 6 – secretive channel.

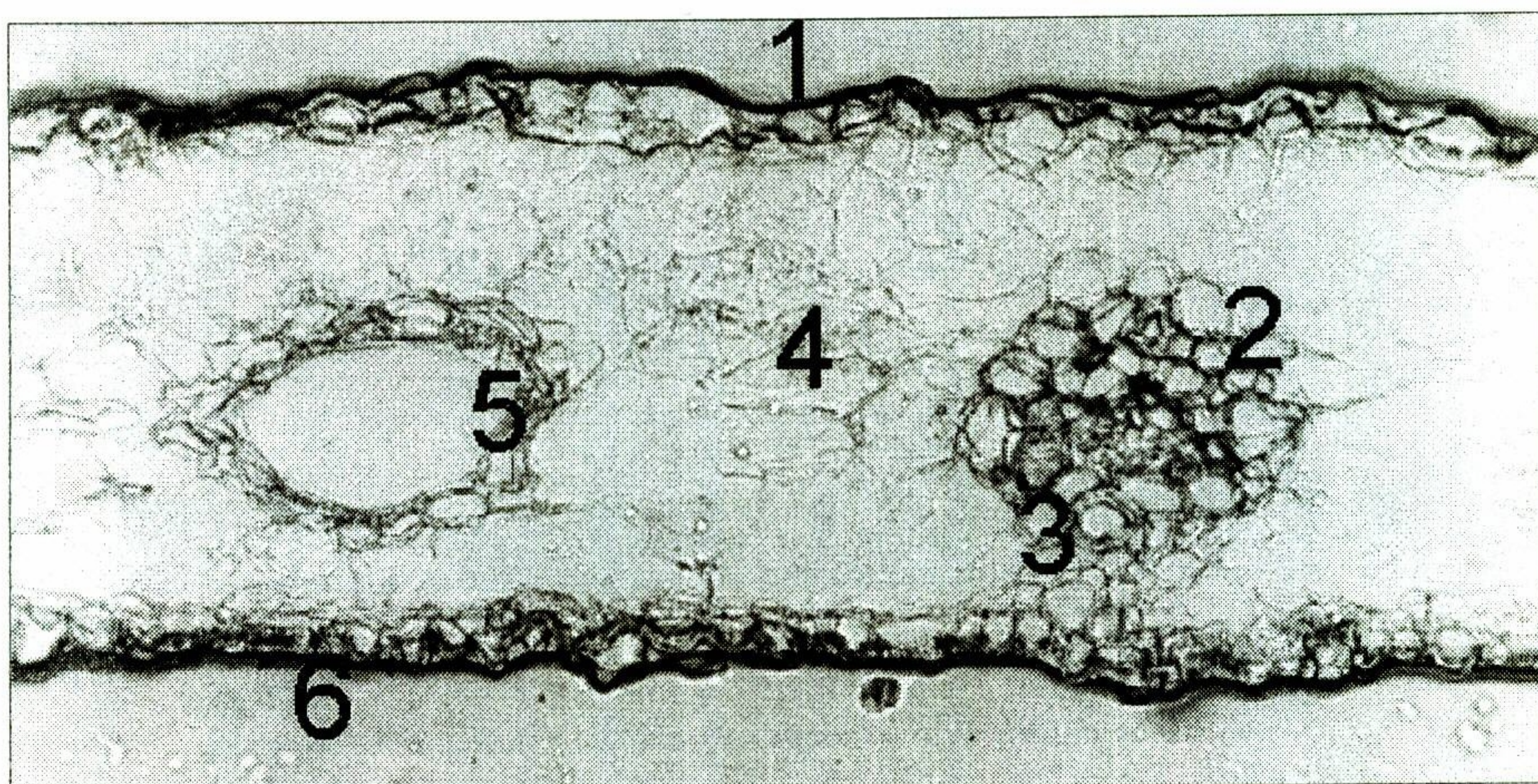


Fig. 3 – Section through the leaf (*Ginkgo biloba* L. – 90 ×):
1 – superior epidermis; 2 – xylem; 3 – phloem; 4 – mesophyll; 5 – secretive channel;
6 – inferior epidermis.

The secondary phloem appears in the shape of some packs of cells with cellulosic walls; it is made of pierced tubes and liberian parenchyma with liberian fibers and the annexed cells missing.

The cambium has a few strata of flattened cells radiating from a circular line.

The secondary xylem, made of cells with thickened, lignified walls with areolate punctuation. The ligneous vessels are only the tracheids (the homoxile species) radiating, with a more or less rectangular seldom polygonal margin.

The secondary medullar beams are placed only near the secondary xylem, being placed on a single row, made of parenchymatic cells with a rectangular margin, prolonged in a radiating way.

The primary wood made of flattened parenchymatic cells where mineral substances (druzus) are kept; here and there one can notice the secretive channels similar to those in the bark plus idioblastic ones.

Section through the petiole (Fig. 2)

The one-layer epidermis has more or less polygonal cells covered by a thick cuticle. Among the epidermic cells one may notice stomatic cells similar to the ones in the trunk.

The tabular collenchyma is made of 2–3 cell strata with evenly thickened walls.

The parenchymatic tissue presents big cells, with inter-cells space where one can notice secretive channels and druze cells (ursinis).

Two conducting fascicles, collaterally closed, placed in the center, each being made of ligneous conducting vessels towards the lower part, with thin, celluloid walls. Both the wood and the liber are penetrated by one-series medullar beams.

Section through the foliar limb (Fig. 3)

The one-layer superior epidermis has cells having a polygonal margin in a cross-section, covered with a thick cuticle. Parting the epidermis, one has noticed that its cells have a rectangular margin, prolonged along the leaf, with thin, sinuous, stomata-lacking membranes.

The mesophyll is divided into: the palisade tissue directed towards both the superior and the inferior surface and the lacunulose tissue (bifacial leaf).

The lacunulose tissue is made of parenchymatic cells with big inter-cells space; here and there one may notice druze cells. In the mesophyll one may notice the secretive channels and one conducting fascicle with the wood towards the superior epidermis and the liber towards the inferior one.

The one-layer inferior epidermis presents polygon-shaped cells when cross-sectioned, covered with a cuticle. Unlike the superior epidermis, at this level one may notice stomata cells of the amarylidaceus type, surrounded by four small annex cells.

CONCLUSIONS

In the secondary structure of the trunk, in the structure of the petiole as well as of the foliar mesophyll there exist some secretive channels.

The secondary wood structure presents tracheides (a homoxile species).

The annex cells and liberian fibers fail from the structure of the secondary liberian.

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Received July 5, 2000.

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CHROMOSOME COUNTS FOR SOME PLANT SPECIES IN THE MOUNTAIN AREA

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This paper represents the chromosome counts for some plant species taken into account which were searched using two different staining methods: Feulgen and Giemsa. We confirmed the known chromosome counts for *Dianthus callizonus* ($2n = 30$). We determined the chromosome counts for the first time in Piatra Craiului Massif for the following species: *Arenaria serpyllifolia* ($2n = 40$), *Bromus benekenii* ($2n = 28$), *Centaurea triumfetti* ($2n = 22$), *Dianthus spiculifolius* ($2n = 90$), *Euphorbia platyphyllos* ($2n = 14$), *Salix retusa* ssp. *kitaibeliana* ($2n = 144$), *Scabiosa columbaria* ($2n = 16$). For *Thymus comosus* ($2n = 28$) the chromosome counts were unknown till present determination.

Key words: chromosome counts, plant species, Piatra Craiului.

INTRODUCTION

The topic of this paper concerns the karyological investigations of the Carpathians Mountains Flora, as I was particularly interested in mountain area taxa. During the time, in Romania there were studied plant chromosome numbers and, sometimes, the karyotype, but not in a systematic order.

Another aim of this study was to gain further insights into the theoretical background concerning meiosis and mitosis nuclear phase, chromosome counts techniques (particularly two methods: Feulgen and Giemsa).

We were also interested in a confirmation of the chromosome counts for a part of species existing in the Piatra Craiului Massif plant population. On the other hand, we determined the chromosome counts for one plant species for the first time.

In our study we confirmed the known chromosome counts for: *Arenaria serpyllifolia*, *Bromus benekenii*, *Centaurea triumfetti*, *Dianthus spiculifolius*, *Euphorbia platyphyllos*, *Salix retusa* ssp. *kitaibeliana*, *Scabiosa columbaria* and we determined the chromosome counts for these species for the first time in Piatra Craiului Massif.

In Piatra Craiului Massif there were studied plant chromosome numbers for *Dianthus callizonus* (1, 10, 11), but for *Thymus comosus* the chromosome counts was unknown till the present determination.

MATERIAL AND METHODS

These studies were mainly focused on some perennial species in the Piatra Craiului Massif, part of greater Romanian Carpathian Mountains.

All the experiments were done using living material and germinated seeds isolated from species belonging to the subalpine and alpine level and to the mountain level as well.

We determined the chromosome counts for the following taxa:

Arenaria serpyllifolia L. (Caryophyllaceae), Bârsa Valley, 750 m alt., August 24th 1996 (N° 055781, Herb. BUCA).

Bromus benekenii (Lange) Trimen (Poaceae), Padina lui Călineț, 1000 m alt., September 18th 1997 (N° 055782, Herb. BUCA).

Centaurea triumfetti All. (Asteraceae), Turnu Peak, 1700 m alt., September 28th 1997 (N° 055783, Herb. BUCA).

Dianthus callizonus Schott & Kotschy (Caryophyllaceae), Piatra Craiului Mică, 1700 m alt., September 25th 1996 (N° 0557814, Herb. BUCA).

Dianthus spiculifolius Schur (Caryophyllaceae), Piatra Craiului Mică, 1700 m alt., September 28th 1997 (N° 055785, Herb. BUCA).

Euphorbia platyphyllos L. (Euphorbiaceae), Prăpăstiile Zărneștiului, 900 m alt., July 27th 1996 (N° 055786, Herb. BUCA).

Salix retusa L. ssp. *kitaibeliana* (Willd.) Jáv. (Salicaceae), Piatra Craiului Mică, 1650 m alt., September 25th 1996 (N° 055787, Herb. BUCA).

Scabiosa columbaria L. (Dipsacaceae), Padina lui Călineț, 1700 m alt., September 28th 1997 (N° 055788, Herb. BUCA).

Thymus comosus Heuffel ex Griseb. (Lamiaceae), Piatra Craiului Mică, 1700 m alt., September 28th 1997 (N° 055789, Herb. BUCA).

Different species taken into account were searched for the chromosome counts using two different staining methods: Feulgen and Giemsa.

Each individual mitotic chromosome was studied from root tip squashes, and counted in 3–4 metaphase stages. Roots were obtained either from seeds collected in the field and germinated in Petri dishes, or from transplanted plants, grown in the experimental garden. For the fixation, we cut the root tips when they reached 0.5–1 cm.

The root tips were fixed in glacial acetic acid : ethanol (1:3) after 4 hours pre-treatment in 0.002 M hydroxyquinoline or 0.1 % colchicine. For staining, the Giemsa standard method was used. After 5–10 min washing in distilled water, the root tips were hydrolysed for 50 min in HCl (5 N) at room temperature, then transferred to distilled water.

For the Giemsa method, the material was squashed in 45 % acetic acid on a slide. Cover slips were detached over a cold plate and the slides were air dried and stained for 2–7 min with a 4 % Giemsa solution. After a short washing in running tap water, the slides were air-dried and finally put on the ice-machine at –80°C, for 15 min. Chromosome preparations were examined with a POLYVAR microscope immersed in oil ($\times 100$).

For the Feulgen method, the material was immersed in a Feulgen solution for two hours in dark. Then it was transferred into distilled water and used for the

Plate I



Fig. 1 – *Arenaria serpyllifolia* $2n = 40$.

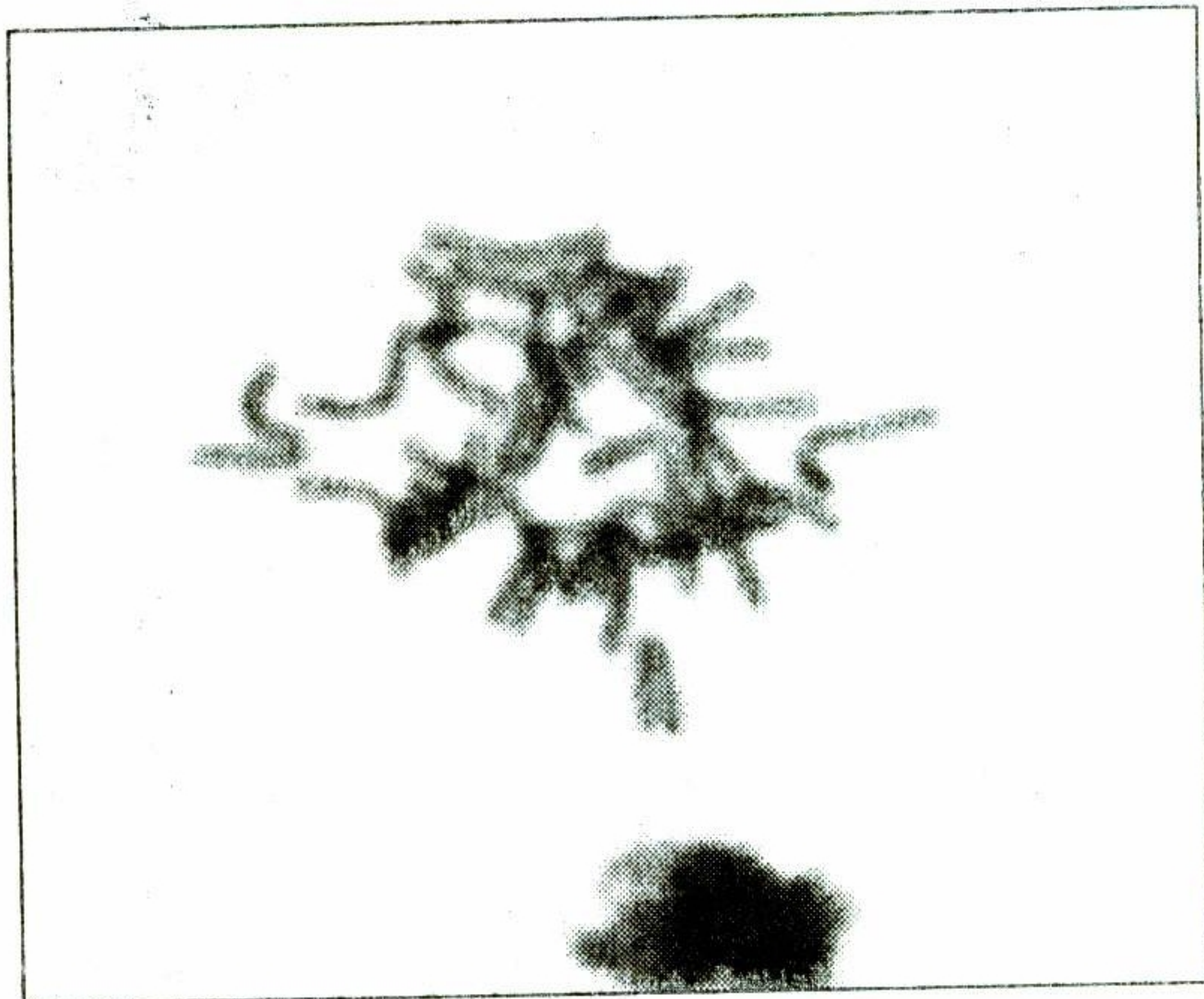


Fig. 2 – *Bromus benekenii* $2n = 28$.



Fig. 3 – *Centaurea triumfetti* $2n = 22$.

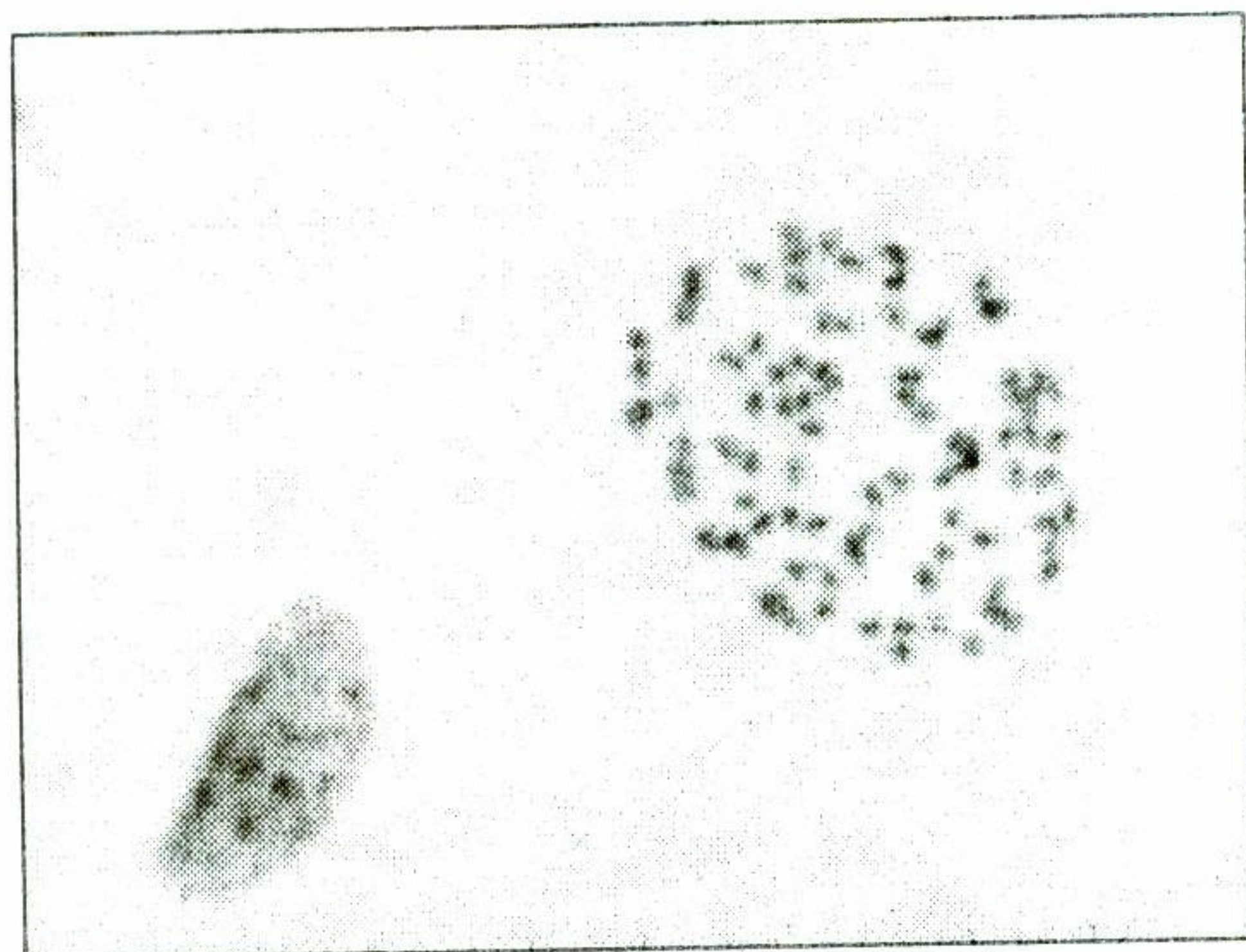


Fig. 4 – *Dianthus spiculifolius* $2n = 90$.

Plate II

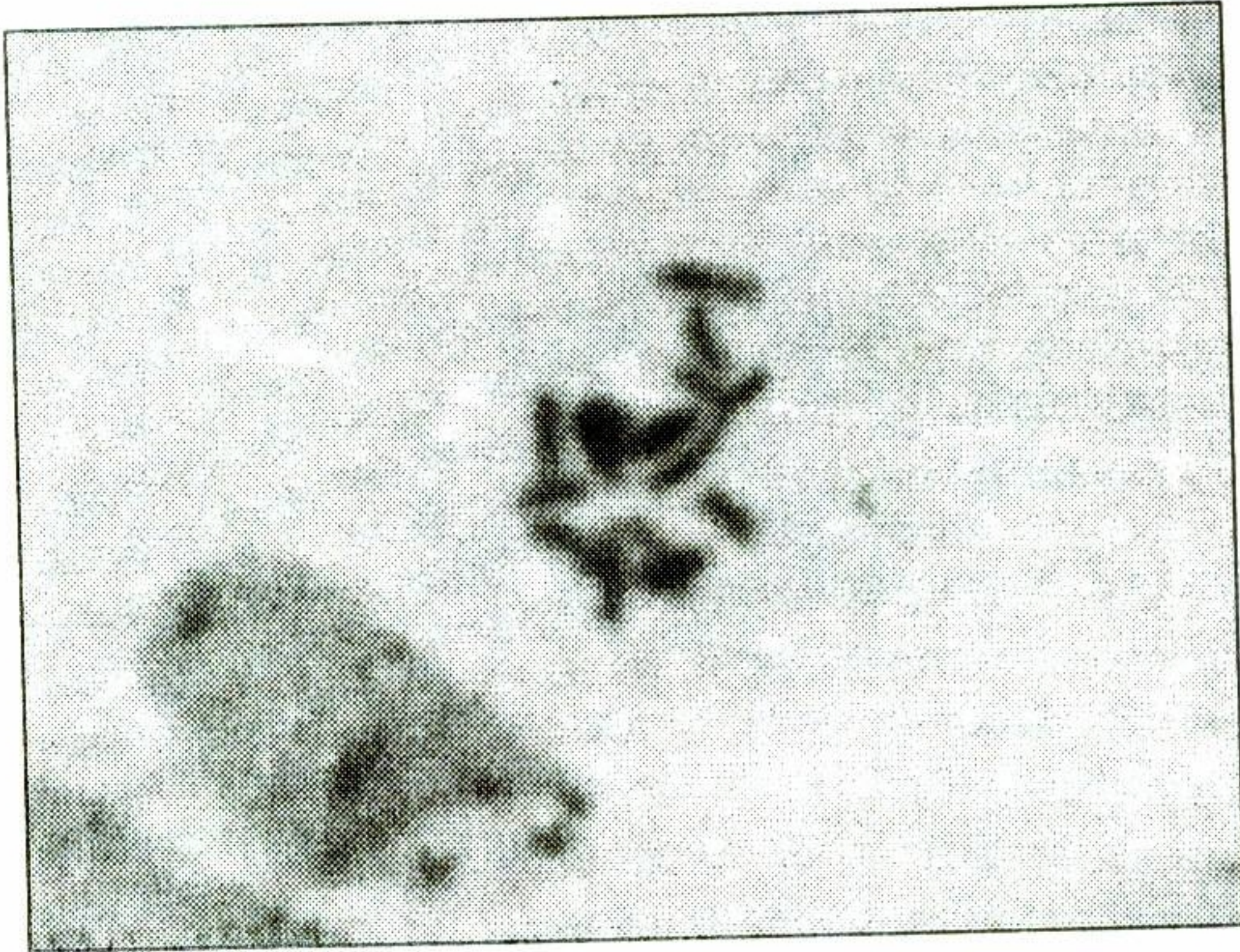


Fig. 5 – *Euphorbia platyphyllos* $2n = 14$.



Fig. 6 – *Scabiosa columbaria* $2n = 16$.

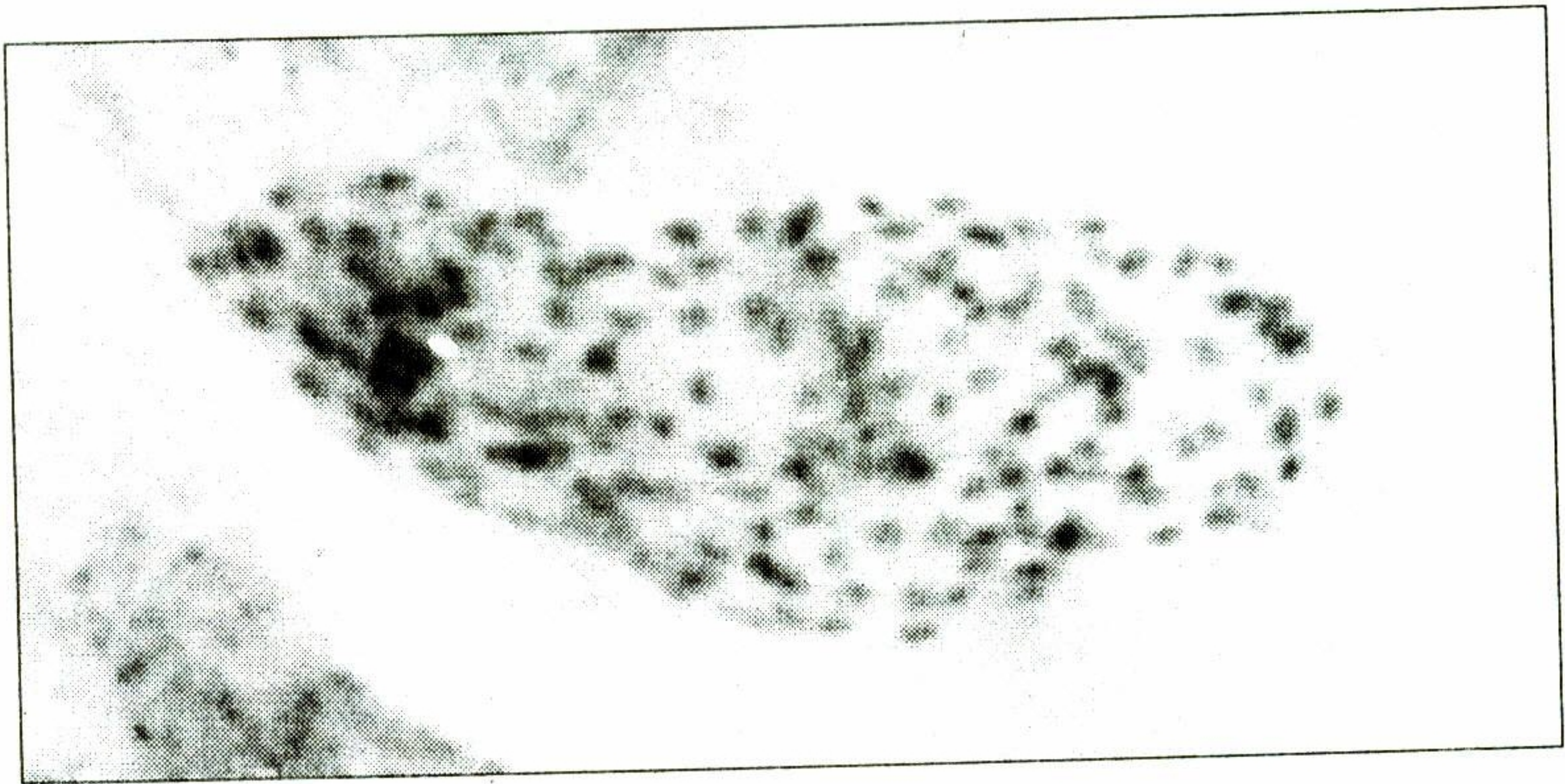


Fig. 7 – *Salix retusa* $2n = 144$.

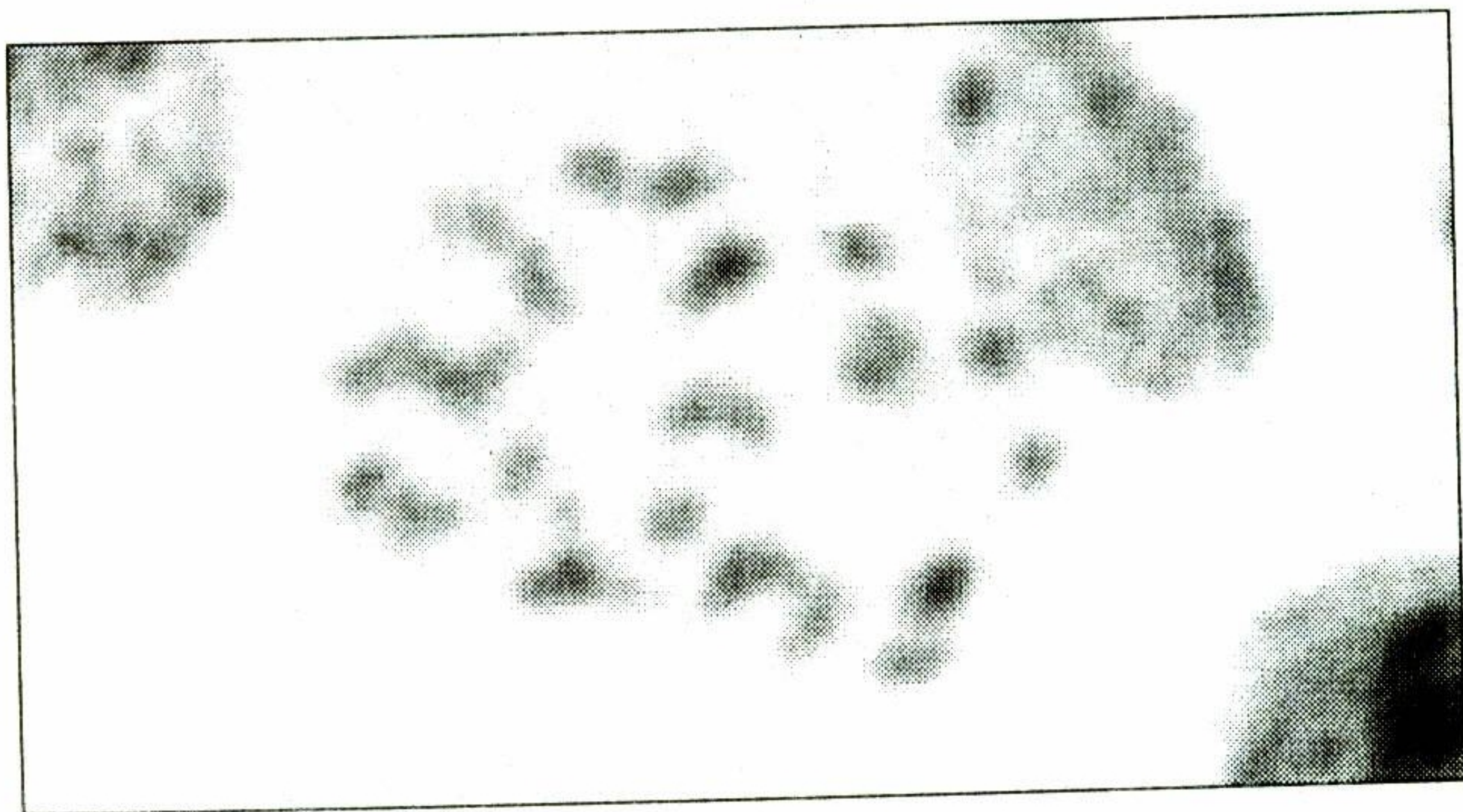


Fig. 8 – *Thymus comosus* $2n = 28$.

preparation of slides. The slides were examined with a POLYVAR microscope immersed in oil ($\times 100$).

RESULTS AND DISCUSSIONS

The results of staining methods used for some plant population in the Piatra Craiului Massif were:

Arenaria serpyllifolia $2n = 40$ (Plate I, Fig. 1) – it was determined that it has the same number of chromosomes as in other occurrences (5, 6, 7).

Bromus benekenii $2n = 28$ (Plate I, Fig. 2) – it was determined that it has the same number of chromosomes as in other occurrences (5, 9).

Centaurea triumfetti $2n = 22$ (Plate I, Fig. 3) – it was determined that it has the same number of chromosomes as in other occurrences (8).

Dianthus callizonus $2n = 30$ – we confirmed the known chromosome number (1, 10, 11). This species is endemic for the Romanian Carpathian Mountains.

Dianthus spiculifolius $2n = 90$ (Plate I, Fig. 4) – it was determined the chromosome number by different authors $2n = 45$ ($x = 15$) (2) and $2n = 30$ (10). The plant population in Piatra Craiului Massif is probably polyploid ($2n = 90$). This species is an endemic for the Romanian Carpathian Mountains.

Euphorbia platyphyllos $2n = 14$ (Plate II, Fig. 5) – the number of chromosomes was determined $2n = 28, 30, 36$ by different authors (5, 8, 9, 12). The plant population in Piatra Craiului Massif is diploid ($2n = 14$).

Salix retusa ssp. *kitaibeliana* $2n = 144$ (Plate II, Fig. 6) – the plant population in Piatra Craiului Massif is probably polyploid and $2n = 144$. The number of chromosomes for *Salix retusa* L. was determined $2n = 114$ (3) and $2n = 76, 114, 152$ (4). The number of chromosomes for *Salix kitaibeliana* Willd. was determined $2n = 130, 140, 152$ (3) and $2n = 76, 152$ (4).

Scabiosa columbaria $2n = 16$ (Plate II, Fig. 7) – it was determined that it has the same number of chromosomes as in other occurrences (5, 7, 8, 9).

Thymus comosus $2n = 28$ (Plate II, Fig. 8) – the number of chromosomes was determined for the first time. *Thymus comosus* is an endemic species for the Romanian Carpathian Mountains.

We mentioned that we checked the known chromosome number using “Index to plant chromosome numbers” (5, 6, 7, 8) for each species taken into account. We were especially interested in plant species from Romania. We consider important for studies the chromosome count for different populations situated in different mountain areas or in different places from the massif.

On the other hand, for the Red List of Threatened Species, a taxon may be well studied, and its biology well known, but the data on its abundance and/or distribution are important. For the taxonomical studies the chromosome count sometimes brings the adequate clarification.

The criteria are clearly quantitative in nature. However, the absence of high quality data should not determine attempts when applying the criteria, as the methods involving estimation, inference and projection are emphasized to be acceptable throughout. Inference and projection may be based on extrapolation of current or potential threats into the future (including their rate of change), or of factors related to population abundance or distribution (including dependence on other taxa), so long as these can reasonably be supported. Suspected or inferred patterns in either the recent past, present or near future can be based on any of a series of related factors, and these factors should be specified (13).

Acknowledgements: As part of the collaboration between the Austrian and Romanian Academies of Sciences I was given a fellowship for a practical staying at the Institute of Botany and Botanical Gardens of the University of Vienna. My application for this fellowship was kindly supported by Emer. Prof. Dr. F. Ehrendorfer and Dr. N. Boşcaiu, member of the Romanian Academy.

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Received on November 20, 1999.

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CARACTÉRISATION MICROBIOLOGIQUE DU SOL POLLUÉ PAR DES RÉSIDUS PÉTROLIERS

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This paper presents the results of the research concerning the microbiological characterisation of the pollution zones with crude oil and petroleum derivatives in the Midia Petrochemical Works. Aerobe microorganisms, vegetative forms and sporogene forms, prevail. Also, the results of the test concerning the ability of using the hydrocarbons of the microbial associations selected from these zones are presented. Degradation process is determined not only by oxygen dissolved and temperature but also by the composition of crude oil. Percentage of hydrocarbon degradation varies between 24 and 51%.

Key words: aerobe microorganisms, pollution.

INTRODUCTION

Le développement de la civilisation humaine a eu comme effet un développement des activités, surtout de l'industrie et de l'agriculture dont la conséquence s'est fait remarquée assez rapidement par la détérioration du milieu ambiant (1).

La pollution est une des formes de détérioration; elle se manifeste par l'introduction dans le milieu des déchets de l'activité humaine.

Durant les 20 à 30 dernières années toute une série de technologies de valorisation des déchets s'est développée; la majorité sont très coûteuses. Mais la pratique a démontré que les biotechnologies représentent une alternative moins coûteuse pour combattre la dégradation du milieu ambiant. Le but des biotechnologies est le bioremède des sites pollués. Elles utilisent l'activité biologique, surtout celle des bactéries, pour dégrader les substances polluantes, en remédiant et même en éliminant la contamination du milieu (4).

La biodégradation «in situ» attire de plus en plus l'attention des chercheurs, les microorganismes ayant un rôle important dans la réduction de la pollution. Grâce à leur activité comme force motrice des circuits biogéochimiques, les substances organiques polluantes sont transformées en produits non-toxiques. Donc la dégradation «in situ» des substances organiques complexes par les microorganismes joue un rôle majeur pour un bon fonctionnement de la biosphère.

L'utilisation des technologies de bioremède du milieu est basée sur la connaissance de la biodiversité des microorganismes déjà présents dans la nature, surtout dans les zones polluées.

Caractérisés par une remarquable potentialité physiologique, basée sur un équipement enzymatique flexible, les microorganismes peuvent utiliser les substances organiques les plus diverses, y compris les agents polluants.

Les microorganismes qui attaquent non seulement le pétrole, mais aussi les nombreux produits pétroliers (pétrole lampant, gazoline, kérosène, etc.) sont utilisés pour dépolluer les milieux aquatiques et terrestres ou les produits dérivés du pétrole (7).

Ce travail présente les résultats des recherches concernant la caractérisation microbiologique de certaines zones polluées par des résidus pétroliers dans l'enceinte du Complexe Pétrochimique de Midia. On présente de même les résultats des tests concernant la possibilité de certaines associations de microorganismes de dégrader le pétrole brut.

MATÉRIEL ET MÉTHODE

Les échantillons ont été prélevés de l'enceinte du C. P. Midia, zone où les produits pétroliers sont déposés. Pour leur caractérisation microbiologique on a utilisé des milieux sélectifs liquides ou solidifiés qui mettent en évidence la présence de certains groupes physiologiques de microorganismes. On a utilisé la méthode des dilutions successives; l'appréciation quantitative de la présence de ces microorganismes a été effectuée par la méthode MPN (Most Probable Number) sur la base des tableaux statistiques Mc Cready (6).

Puis on a utilisé trois types de milieux de culture: bouillon nutritif, milieu minéral Koronelli et milieu minéral Vorosilova qui isolent et sélectent des associations de microorganismes capables de dégrader le pétrole brut.

On a utilisé la méthode des cultures enrichies, agitées durant 7–10 jours, à une température de 28 °C.

On a obtenu de cette manière des associations de microorganismes, dont on a testé la capacité de dégrader le pétrole brut. La consommation du pétrole brut par des microorganismes a été déterminée par la méthode d'extraction avec de l'éther du pétrole (2), (5).

RÉSULTATS ET DISCUSSION

Les microorganismes qui dégradent le pétrole sont assez nombreux; ils appartiennent aux bactéries, actinomycètes, cyanobactéries, levures, champignons filamenteux et algues. Ils ont la capacité d'utiliser les hydrocarbures gazeux, liquides et solides tant de la série aliphatique que des séries aromatiques ou asphaltiques comme unique source de carbone et d'énergie, en les décomposant en composants plus simples ou même en eau et dioxyde de carbone.

La présence dans le sol et l'importance de ces microorganismes dans la nature ont été signalées pour la première fois par Seyer (1933) et Chiball & collab. (1934). Leur abondance de plus en plus grande, corrélée avec une intense activité métabolique ne font pas possible l'accumulation des hydrocarbures synthétisés par les plantes et de certains cires produits par les insectes.

Le nombre des microorganismes dégradant les hydrocarbures augmente de manière significative après la pollution et se maintient parfois longtemps. Un exemple: les champignons (fungi) dégradateurs des hydrocarbures se développent rapidement après la contamination et représentent 60–82% de la flore fongique totale et les bactéries dégradateurs des hydrocarbures représentent 50% de la microflore totale, le genre *Pseudomonas* pouvant représenter 60% (9).

Dans les zones non-polluées, ces microorganismes hydrocarbure-oxydants ne dépassent pas 0,1% du nombre total des microorganismes, comparativement aux zones polluées où leur pourcentage peut atteindre 100% du nombre des microorganismes viables.

Le processus de dégradation microbienne du pétrole ne dépend pas seulement de la nature et de la proportion des différents constituants du pétrole, mais aussi de la nature des communautés de microorganismes caractéristiques des milieux pollués et des facteurs de milieu qui influencent leur activité.

Le spectre des microorganismes décelés dans les échantillons de sol pollué par le pétrole et les résidus pétroliers comprend les catégories physiologiques suivantes:

1. *Bactéries hétérotrophes aérobies* – formes végétatives. Ces microorganismes ont la capacité d'oxyder le substrat organique par le transfert des électrons à l'oxygène moléculaire. On a utilisé comme milieu nutritif la gélose simple, on a effectué l'inoculation sur la surface du milieu et l'incubation a été réalisée pendant 48 h à une température de 20–22°.

2. *Bactéries hétérotrophes* – formes sporogènes. Le milieu utilisé est la gélose simple et l'inoculation a été effectuée par incorporation.

3. *Bactéries aérobies, facultativement anaérobies*. Le milieu utilisé est le bouillon, la quantité d'inoculé 1 ml/tube.

4. *Bactéries strictement anaérobies*, capables de se développer seulement dans l'absence de l'oxygène. On a utilisé le milieu VF, quantité de l'inoculé 1 ml/tube. Les cultures se développent dans la partie basale de l'éprouvette.

5. *Bactéries sulfato-réductrices*. On a utilisé le milieu Postgate qui contient du sulfate de fer, dont la réduction en sulfure de fer détermine le noircissement du milieu.

6. *Ferrobactéries*. Ce groupe de microorganismes a la capacité d'extraire le fer ferreux du milieu et de le déposer sous forme d'hydroxyde de fer, ayant l'aspect de sécrétions mucilagineuses. On a utilisé le milieu Winogradski.

7. *Bactéries hydrocarbure-oxydantes* qui jouent un rôle important dans le processus de dégradation aérobie ou anaérobie des hydrocarbures. Elles sont mises

en évidence sur le milieu liquide Koronelli et sur le milieu Vorosilova, dans des conditions statiques.

Les deux catégories d'échantillons font partie de la même aire contaminée, donc les différences que l'on constate sont insignifiantes. Ce qui est significatif dans les résultats obtenus (Tableau 1) est la grande abondance de la microflore aérobie hétérotrophe, dont la densité varie entre $1,13 \times 10^7$ et $1,33 \times 10^9$ cel./g sol, comparativement aux bactéries hétérotrophes facultativement anaérobies et strictement anaérobies, dont la densité varie entre $2,5 \times 10^3$ et $2,5 \times 10^4$ cel./g sol.

Tableau 1

Caractérisation microbiologique des échantillons de sol
(nr./gr. sol humide)

Groupe fonctionnel	Echantillon	
	M ₁	M ₂
Bactéries hétérotrophes aérobies végétatives	$1,33 \times 10^9$	$1,13 \times 10^7$
Bactéries hétérotrophes sporogènes	1×10^6	1×10^6
Bactéries hétérotrophes aérobies facultativement anaérobies	$2,5 \times 10^4$	$2,5 \times 10^4$
Bactéries hétérotrophes strictement anaérobies	$2,5 \times 10^4$	$2,5 \times 10^4$
Bactéries sulfato-réductrices	$1,9 \times 10^5$	5×10^3
Ferro-bactéries	$2,5 \times 10^4$	$2,5 \times 10^4$
Bactéries hydrocarbure-oxydantes	$2,5 \times 10^2$	$9,5 \times 10^4$

Les formes sporogènes de cette microflore atteignent l'ordre de grandeur de 10^6 cel./g. Ces microorganismes attaquent, en général les produits difficilement dégradables une longue période de temps, donc leur présence significative n'est pas surprenante. Les autres groupes physiologiques varient entre les ordres de grandeur 10^3 et 10^5 , ayant toutes un dénominateur commun: le caractère réducteur.

Les bactéries hydrocarbure-oxydantes présentent la plus petite densité ($10^2 - 10^4$ cel./g) probablement à cause des conditions réduites d'aération. La biodégradation du pétrole est très active en aérobiose, l'oxygène étant un important facteur écologique. On a constaté que dans les sols pollués par le pétrole a lieu une augmentation de la densité numérique totale des bactéries, mais aussi une réduction de la diversité des espèces qui dégradent les hydrocarbures en composés plus simples.

Partant de l'observation que l'oxygène moléculaire joue un rôle majeur dans le processus de dégradation du pétrole, on a initié de nombreuses technologies destinées à hâter ce processus.

La biodégradation du pétrole, stimulée dans le laboratoire a démontré que ce processus dépend tant des conditions du milieu que de l'activité des microorganismes hydrocarbure-oxydantes.

L'isolation et la sélection des associations de microorganismes de la zone polluée, réalisées sur les trois variantes de milieu de culture, ont eu comme résultat

la sélection du milieu minéral Vorosilova; pour l'enrichissement des cultures de microorganismes il a été utilisé en double concentration ayant comme source unique de carbone le pétrole brut du C. P. Midia. On a obtenu de cette manière trois types d'association de microorganismes, notés avec C_b , C_k , C_v .

Les tests concernant la détermination du pourcentage de la biodégradation du pétrole brut consistent en l'inoculation de quantités connues des trois types des associations, milieu minéral et pétrole brut. On a utilisé de cette façon 150 ml milieu minéral Vorosilova, 3 ml inoculé et 2 ml pétrole brut/échantillon. Parallèlement on a préparé aussi une épreuve témoin. Pour chaque association on a répété l'expérience cinq fois, les résultats étant présentés plus bas (Tableau 2).

Tableau 2

Le pourcentage de dégradation du pétrole

Eprouvette	C_B	C_v	C_K
% pétrole dégradé	51	33	22

La comparaison des résultats des trois associations de microorganismes permet les conclusions suivantes:

– Le processus de biodégradation du pétrole dépend de l'état physiologique des microorganismes d'association. C'est ainsi que s'explique le pourcentage de dégradation plus grand réalisé par l'association C_b qui a été sélectionnée et développée sur bouillon nutritif, en comparaison avec les deux autres associations sélectionnées et développé sur des milieux minéraux.

– L'activité de dégradation peut augmenter quand la diversité des espèces est plus grande et leur action synergique sur le substrat est ainsi plus intense.

– Le processus d'aération continue et la température constante pendant la dégradation sont des facteurs déterminants qui favorisent ce processus.

Nous mentionnons que les valeurs des tests présentés sont moindres, mais comparables à celles citées dans la littérature spécialisée, malgré le fait que le type de pétrole brut utilisé a un contenu plus élevé de soufre que les types mentionnés dans la littérature (3, 8, 7).

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Reçu le 6 septembre, 2000

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THE EVALUATION OF POSSIBLE PHYTOPLANKTON, A DIRECT SUPPORT FOR ZOOPLANKTON PRIMARY CONSUMERS, IN THE DANUBE DELTA ROȘU LAKE

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The investigation object is represented by the Roșu Lake phytoplankton, which exclusively constitutes the primary producers in this Lake from the Danube Delta. The newness consists in the study direction to evaluate the qualitative and quantitative phytoplankton structure and biomass, on taxonomic groups and size classes (between 0–50 μ – nanophytoplankton and above 50 μ – microphytoplankton).

These were done in order to establish a possible correlation between phytoplankton algae of different sizes and primary consumers (the “peaceful” zooplank-ton, a consumer of phytoplankton and detritobacterial aggregates). 349 algae species and subspecies were identified in Roșu Lake, in 1991–1999 period (Stoianovici E., 2000), while in 1999, only 196. 41 of these (29.92 %) are nanophytoplankton species. As for biomass, an annual average of 11.815 mg.wet weight/l was registered, nanophytoplankton representing 12.8 % of it.

Key words: phytoplankton, nanophytoplankton, microphytoplankton, taxonomic structure, diversity, biomass.

INTRODUCTION

The characteristics of the phytoplankton communities from the Danube Delta low deep Lakes reflect the climatic and chemical conditions of these ecosystems. The taxonomic components, density and biomass of phytoplankton, are different from Lake to Lake, and modify alongside seasons. The phytoplankton quantity susceptible to develop at one moment depends on the available nutritive elements (resulted from the allochthon input or from the biomass stock), on the illumination and transparency. It can be influenced both by the macrophytes and phytoplankton competition, and by the allochthon input of organic or inorganic particle suspensions. The macrophytes can play an important role in this process, in different ways (7, 6). Both the highly colored water and the large number of inorganic particles stirred up by wind can cause suboptimal light conditions during summer (2, 3). The meteorological conditions can influence the phytoplankton development. For example, the wind can stir up the sedimented particles from the bottom making the water more turbid and richer in mineral nutrients (1).

MATERIAL AND METHODS

Our studies were carried out in Roșu Lake from the Danube Delta.

The Roşu Lake, with a 1375 ha surface and an average depth of 2.5 m (maximum depth – 4.5 m) is the biggest Lake from the Danube Delta and is considered the youngest among the important Lakes. It is located in the maritime Danube Delta, South of the Sulina branch. It has numerous connections: through Litcov canal to Puiu Lake, through several canals to Roşuleţ Lake and within this to Busurca channel (Fig. 1).

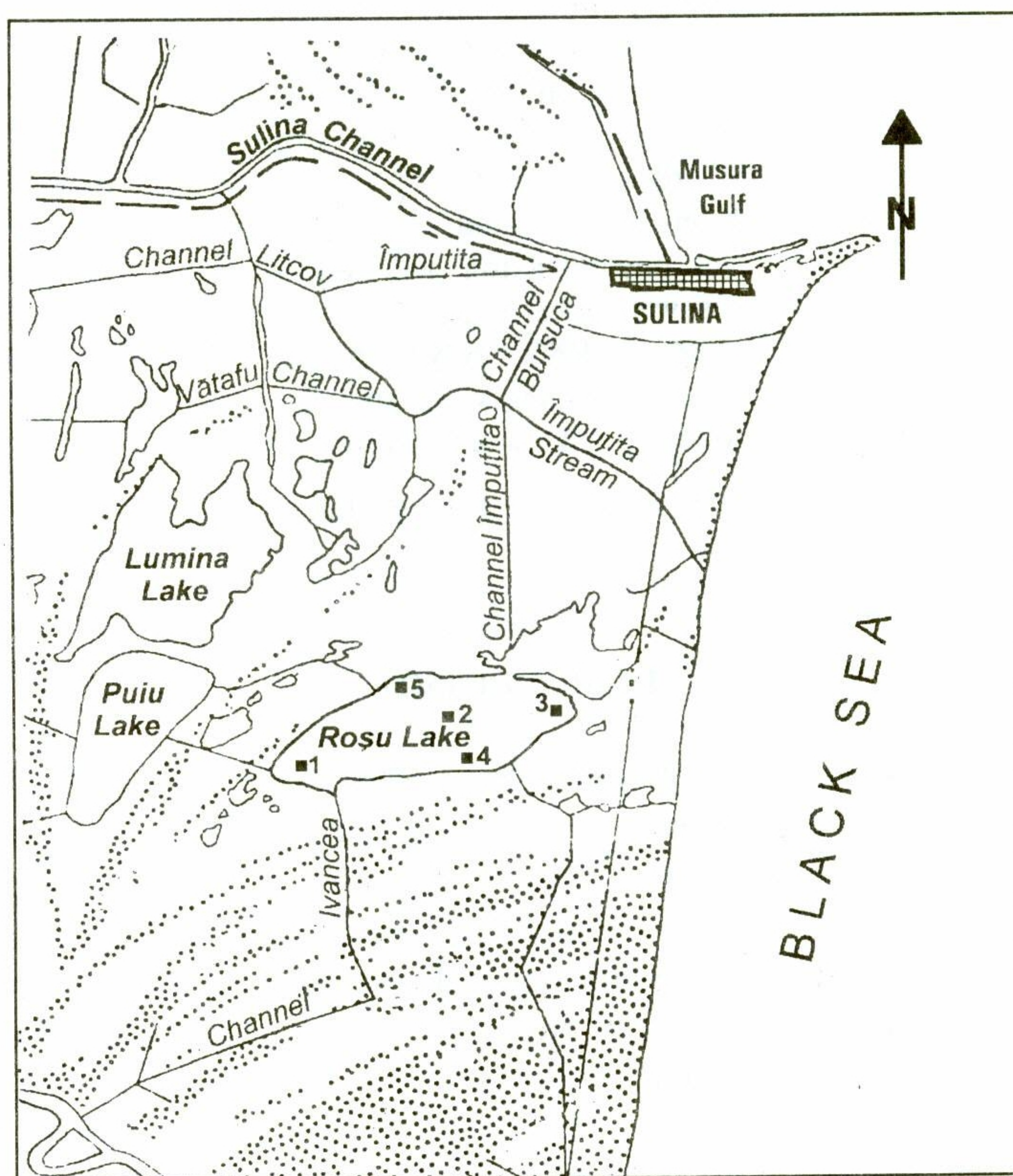


Fig. 1 – Collecting points in Roşu Lake (1–5).

Because of a reduced depth, a proper thermal stratification does not exist (differences of 1–2°C were found between the surface and the bottom).

The samples were collected seasonally in 1999. Five stations were established, on two directions: one from West to East, along water course going downstream; the other from North to South, along dominant wind direction.

The samples were collected with a Patalas-Schindler modified device, on three water levels: surface, middle and bottom; a pool from these was obtained. The qualitative and quantitative algae analyses were realized using the Kolkwitz cell.

The numerical density was expressed as thousands of individuals/l. The phytoplankton biomass was estimated by volumetrical method, using the number and specific average volumes and assuming the cell density to 1. The results were expressed as mg wet weight/l.

RESULTS AND DISCUSSION

The studies carried out in 1999 year, in the Danube Delta Roşu Lake, on phytoplankton communities, were directed to evaluate their qualitative and quantitative structure, and their biomass, on taxonomic and size groups (between 0–50 μ – nanophytoplankton and above 50 μ – microphytoplankton). These were done in order to establish a possible correlation between phytoplankton algae of different sizes and primary consumers (the “peaceful” zooplankton, a consumer of phytoplankton and detritobacterial aggregates).

196 algae species and subspecies, belonging to six taxonomic groups: Cyanobacteria (33); Euglenophyceae (15); Pyrrophyceae (9); Heterokontae (7); Bacillariophyceae (72) and Chlorophyceae (58) were identified in Roşu Lake, in 1999. The species number gradually increased from spring to autumn (Fig. 2).

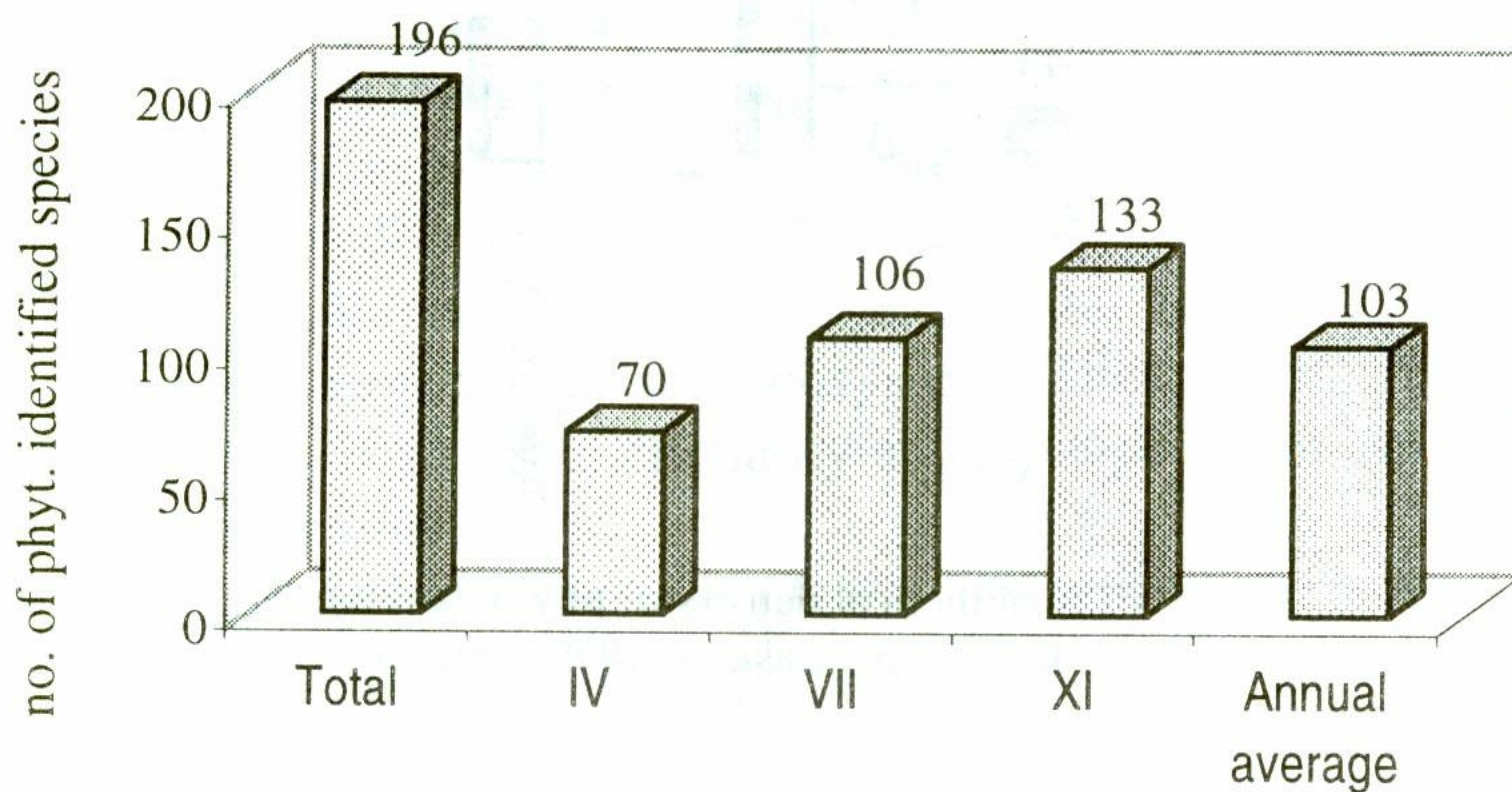


Fig. 2 – The evolution of the phytoplankton identified species number in Danube Delta Roşu Lake, in 1999.

This represents a first index concerning the trophic state of this ecosystem with a small quantity of macrophytes. The phytoplankton evolution follows an ascendant curve, from spring towards autumn, when the greatest species number is noticed. The curve shows the “algae blooming” phenomenon, as a result of use of the water nutrients exclusively by phytoplankton (10).

The April taxonomic spectrum represented 35.71% of the entire year one, that of July 54.08%, and that of November 67.86%.

Diatoms and Chlorophyceae were the dominant groups during the entire year, to which Cyanobacteria are added, in June.

From a total of 196 identified taxons, 36.22% are constant (31 = 15.18%) and accessory (42 = 21.43%) elements, totalizing 71 species. Thus, it is noticed a smaller number of constant elements as compared to that of accessory ones, as a result of a wide range of environmental conditions, owing to the lack of macrophytes.

We can notice a special remark about the size classes of the identified algae: 41 species belong to nanophytoplankton respectively, only 20.92 % of total number of identified species, a relatively small figure.

The annual average of phytoplankton numerical density was 1236×10^3 ex/l. The numerical density had a gradually ascendant evolution in 1999 year, starting from spring (April) towards autumn (November). Its values ranged between 411×10^3 ex/l and 2629×10^3 ex/l (Fig. 3).

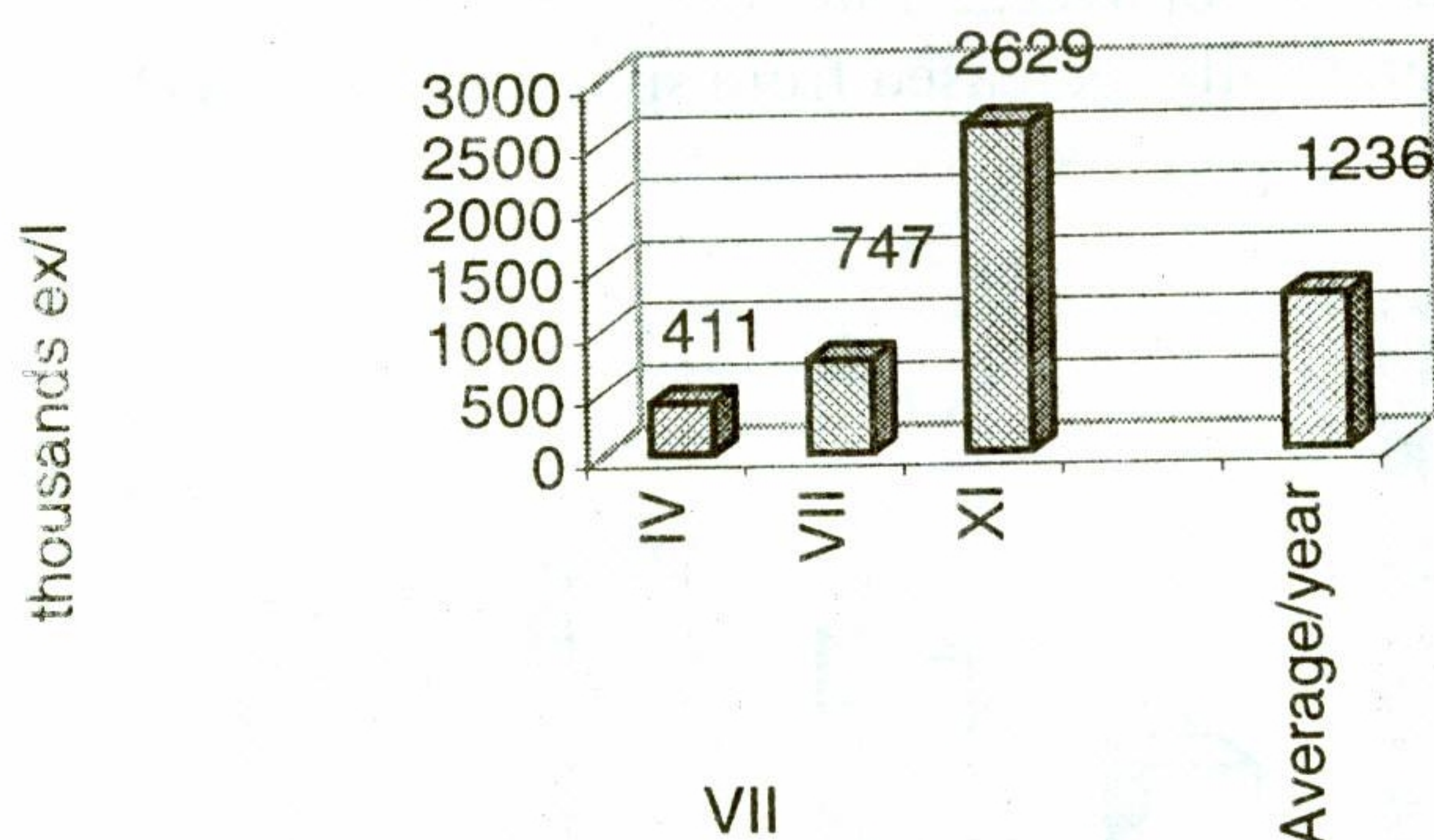


Fig. 3 – The numerical density of phytoplankton from the Danube Delta Roșu Lake, in 1999 (thousands ex./l).

As regards the numerical density of Roșu Lake phytoplankton, on size groups, the nanophytoplankton represents 52.18 % of total quantity/year. It is interesting to note that the percents of the microphytoplankton and nanophytoplankton remain almost unchanged during spring and summer (Fig. 4).

The analysis of the phytoplankton numerical dominance, on taxonomic groups, shows that the phytoplankton communities are dominated by the Bacillariophyceae and Chlorophyceae, during the entire study period. An explosive development of Cyanobacteria is observed at the beginning of July.

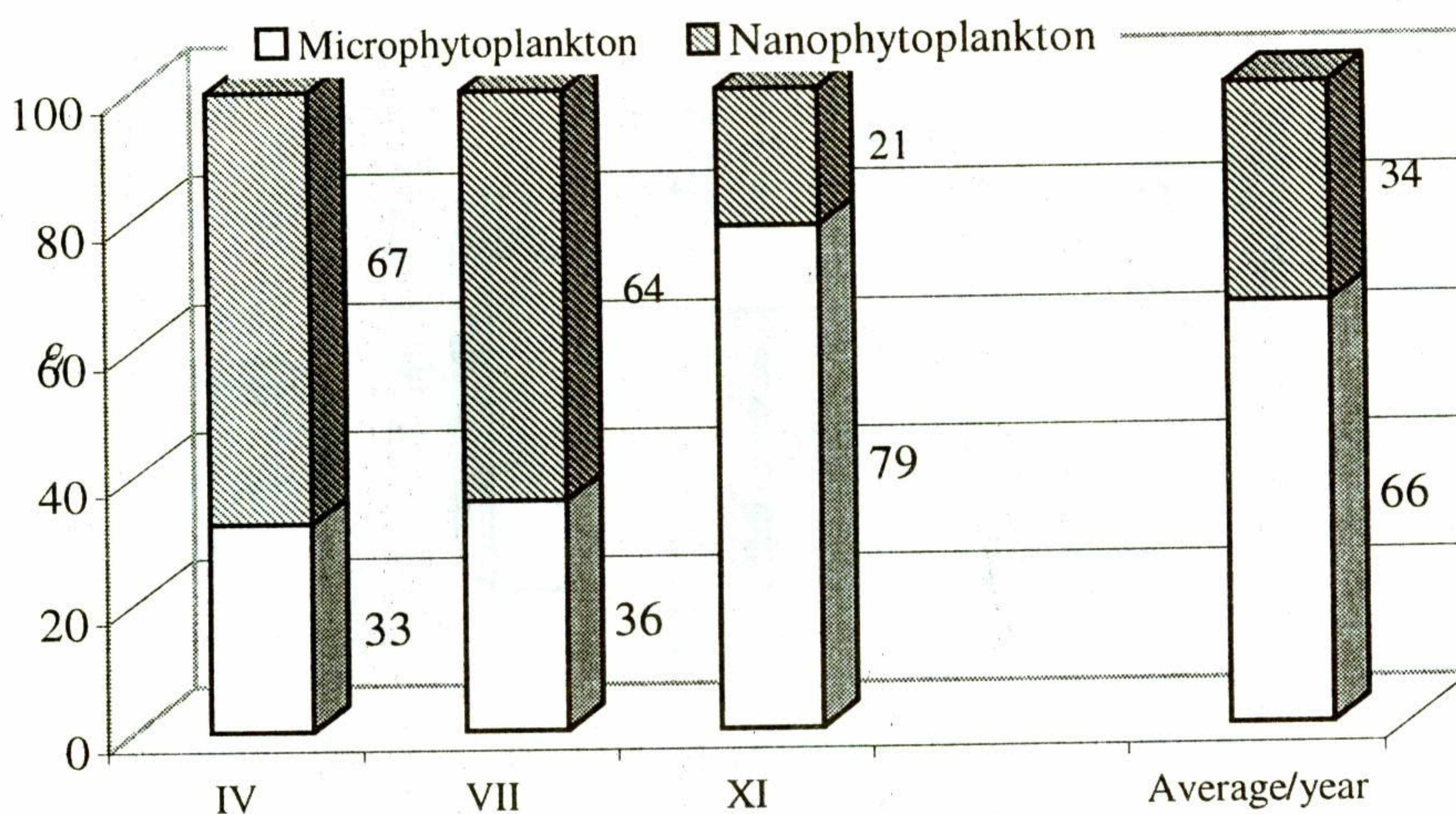


Fig. 4 – The size class percents of phytoplankton numerical density, in the Danube Delta Roşu Lake, in 1999.

The phytoplankton biomass is considered a decisive factor of the aquatic ecosystem quality state, by most authors (5), (8), (9). The phytoplankton represents a coordinating sub-system of aquatic ecosystems (especially from those poor in macrophyte vegetation), which determines both the mineral substance mobilization from hydro-chemical sub-system, and the functionality, respectively the trophicity of the consumers and decomposers.

The phytoplankton development expresses the eutrophication process, through the induced effects in the ecosystem. The phytoplankton biomass size manifests the phytoplankton functionality and its capacity of absorption and use of the chemical components.

The biomass annual average of the phytoplankton was 11.815 mg wet weight/l. The algae biomass value was under the blooming threshold (considered by us to be 5 mg wet weight/l, (4) in April (1.788 mg wet weight/l). It increased gradually reaching a maximum value in November (19.194 mg wet weight/l) (Fig. 5).

The biomass value of July exceeds three times the blooming threshold. This situation is in concordance with the absence of macrophytes from this ecosystem. Consequently, the phytoplankton biomass curve is a result of utilization of available nutrients and incident light energy exclusively by phytoplankton. The Cyanobacteria blooming is favoured by warm waters rich in nutrients, frequently present in the Danube Delta Lakes, mostly at the end of summer, towards autumn. Although the water temperature begins to decrease, an increased nutrient stock is present following the “fall” of the macrophytes.

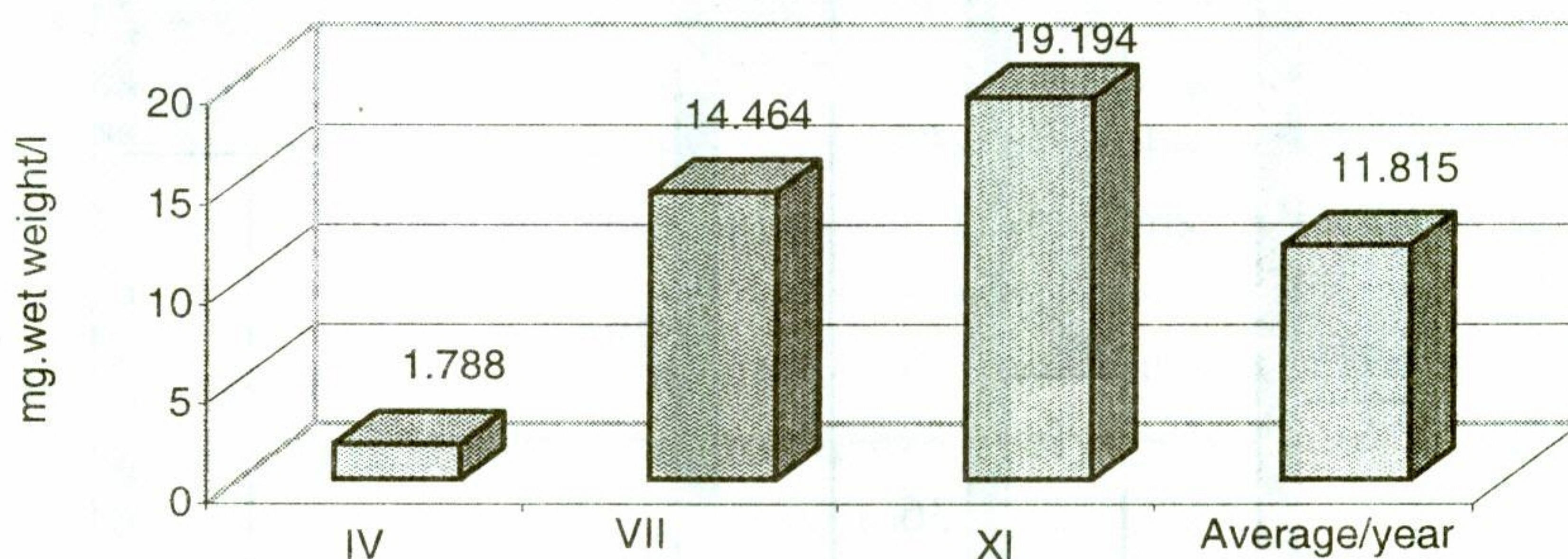


Fig. 5 – The evolution of phytoplankton biomass, in the Danube Delta Roşu Lake, in 1999.

The massive development of the Cyanobacteria algae took place following the dominance of diatoms and green algae. This corresponds to the optimum growth temperatures for the respective groups, to stable thermic stratification, to their floating properties in water surfacing level.

As for the phytoplankton biomass, on size classes, we can remark: nanophytoplankton consists of 12.8 % as average/year (Figs. 6, 7). This segment constitutes a direct nutrient for the I grade zooplankton consumers.

The analysis of the biomass annual averages, on taxonomic groups reveals that the Cyanobacteria was the dominant group (42.07 %), followed by Bacillariophyceae (30.18 %) and Heterokontae (15.60 %). The Chlorophyceae (7.78 %) are situated on the fourth place. As for nanophytoplankton, it represents only 12.8 %, a percent which becomes below 1 %, on taxonomic groups. The dominant groups of this size class are Bacillariophyta, Chlorophyta and Cyanobacteria.

CONCLUSIONS

1. In 1999, in the Danube Delta Roşu Lake, 196 algae species and subspecies were identified, belonging to six taxonomic groups: Cyanobacteria (33), Euglenophyceae (15), Pyrrophyceae (9), Heterokontae (7), Bacillariophyceae (72) and Chlorophyceae (58), 41 of which (20.92 %) are nanophytoplankton species;

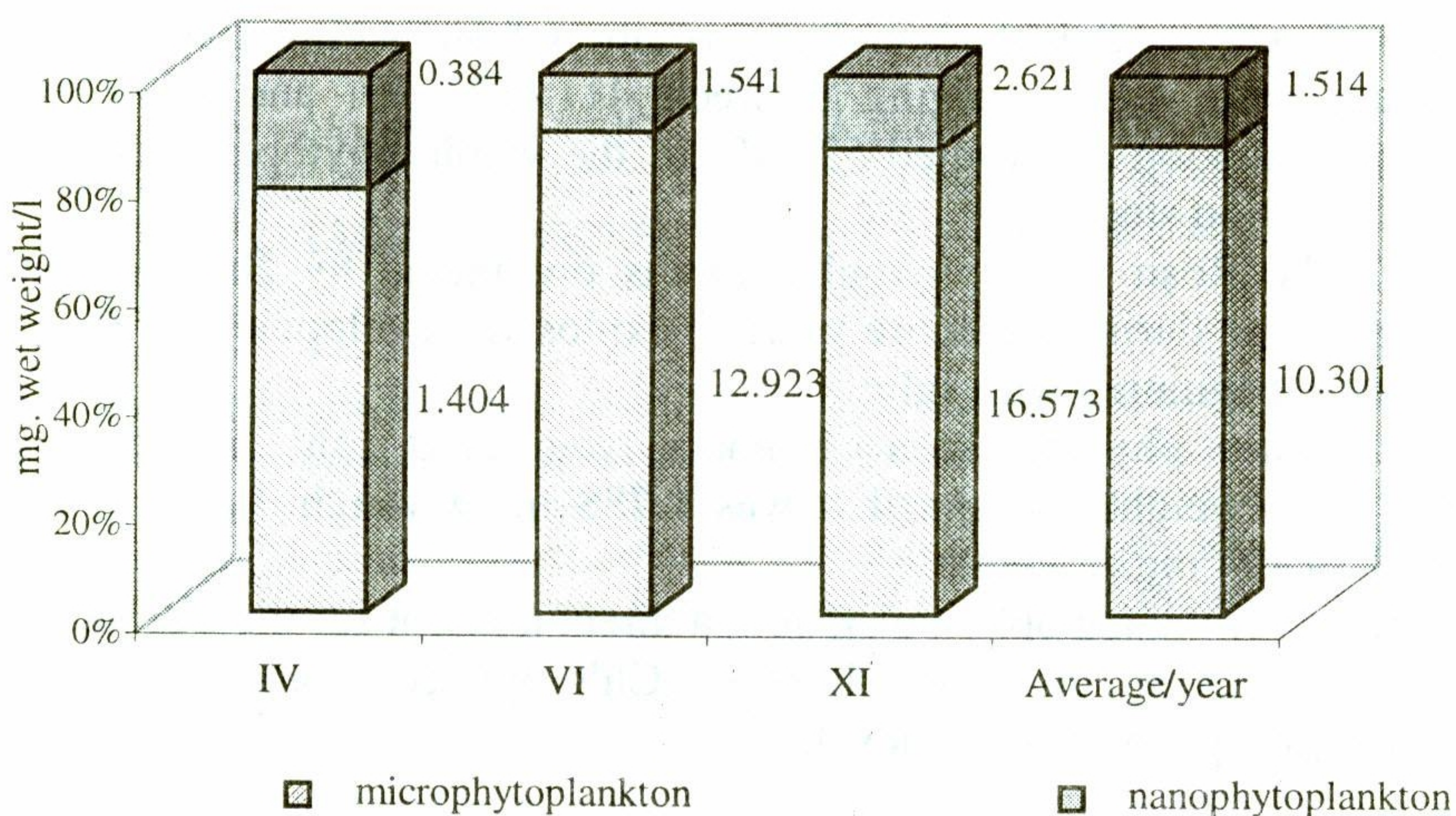
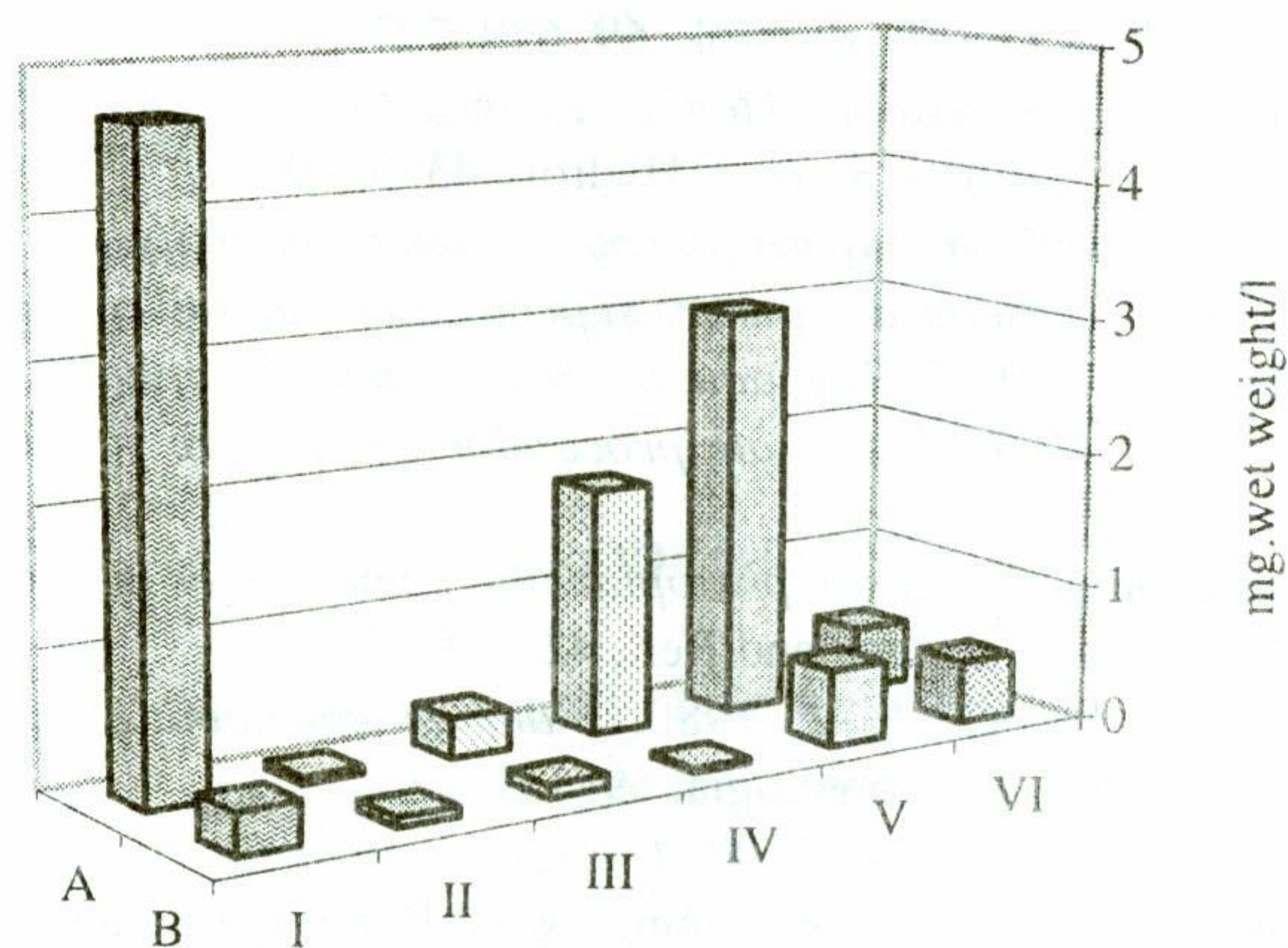


Fig. 6 – The evolution of phytoplankton biomass, on size classes, in the Danube Delta Roșu Lake, in 1999.



A = microphytoplankton; B = nanophytoplankton

I = Cyanobacteria; II = Euglenophyceae; III = Pyrrophyceae;
 IV = Heterokontae; V = Bacillariophyceae; VI = Chlorophyceae

Fig. 7 – The phytoplankton biomass, on class size, in the Danube Delta Roșu Lake, in 1999.

2. The annual average of the phytoplankton numerical density was 1236×10^3 ex/l; a gradual ascendant evolution from spring towards autumn was observed, with values ranging between 411×10^3 ex/l and 629×10^3 ex/l. The nanophytoplankton constituted 52.18% of the whole phytoplankton value, during the entire period studied;

3. The Roşu Lake phytoplankton is dominated by Bacillariophyceae and Chlorophyceae during the entire year; an explosive development of Cyanobacteriae is observed beginning with July;

4. The phytoplankton biomass registered an annual average of 11.815 mg.w.weight/l; in April it was 1.788 mg.w.weight/l and in November it reached 19.194 mg.w.weight/l;

5. As for the nanophytoplankton, a direct nutrient for the I group zooplankton represents 12.8 %. Bacillariophyceae, Chlorophyceae and Cyanobacteria are dominant groups for this size level.

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Received October 15, 2000.

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STRUCTURE OF THE MAIN BIOCOENOTIC COMPONENTS IN *TAMARIX* SHRUBLANDS OF PRAHOVA AND TELEAJEN LOW FLOODPLAINS

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The article presents the structure of the main coenotic components (primary producers, consumers and decomposers) of *Tamarix ramosissima* biocoenosis in inner river floodplains of the Prahova and Teleajen rivers; some representative sites as Scăeni, Pisculești, Dridu are compared with the structure of *Tamarix* shrublands in the Danube floodplain and delta. It was noticed a high diversity of the shrub layer structure (about 10 species present), a higher production capacity of herbaceous layer (14.1–18.4 kg/ha) and its very active seasonal dynamics. Organic matter decomposition is a rapid process, but its accumulation along a vegetation season is rapid too. Primary and secondary consumers are very different in each *Tamarix* shrubland both at shrub canopy level as well as at herbaceous layer, not only by different superspecific taxons of invertebrates but also by different species. The present invertebrate fauna above ground is rich, especially in spring and it is dominated by acarids and collembola; among coleoptera, the carabids are characterized by floodplain species only during wet period (spring). Soil fauna of nematodes, enchytraeids, lumbricids, acarids, collembola although qualitatively and quantitatively is not so rich as other evaluated ecosystems (forest, pastures) it is however differentiated among the observed shrublands in relation to the degree of ground structure development.

Key words: primary production, secondary production, biocoenosis structure, shrubland, *Tamarix ramosissima*, Prahova floodplain, Teleajen floodplain.

INTRODUCTION

The floodplains of Prahova and Teleajen rivers have the wide diversity typical for this type of environment, ecotone between water and land, and also a specificity determined by their geographical position, which argues for the scientific interest to determine the composition and structure of the different biocoenoses formed there.

Previous papers have presented the composition of phytocoenoses of *Tamarix* shrubland both for the Danube floodplain (Andrei and Popescu 1967; Sanda and Șerbănescu, 1969; Paucă and Șerbănescu, 1998) and for the floodplains of the inland rivers, tributaries to the Danube (Rubțov, 1940; Simon and Dihoru G., 1963; Șerbănescu, 1965; Dihoru A., 1976).

The structure of the shrubland biocoenoses from Romania is, however, much less investigated, being known so far only for the *Tamarix* shrublands from Sulina, where the Danube pours into the Black Sea (Paucă *et al.*, 1996), and from Insula Mică a Brăilei (Paucă *et al.*, 1997).

The floodplain of Prahova and its tributary, Teleajen, have a strongly anthropic character, because they cross areas more or less populated almost all along their length.

Their geographical position south of the Undercarpathians, in the Romanian Plain, determines the influence of a typical temperate continental climate, with obvious effects on the living world even in this terrestrial area at the boundary of permanent flowing waters. We consider these investigations may notice the differences existing in the formation of *Tamarix* shrublands as ecosystem close to small rivers, compared to those by the large rivers.

MATERIAL AND METHOD

The *Tamarix* shrublands covered by our investigations are located on the Prahova river, close to the villages of Pisculești and Dridu and on the Teleajen, close to Scăieni (Figure 1). The *Tamarix* shrublands are localized on 6.5 hydrodegrees, therefore in the major waterbed of the two rivers, at the altitude at which the land is seldom flooded by the high spring waters.

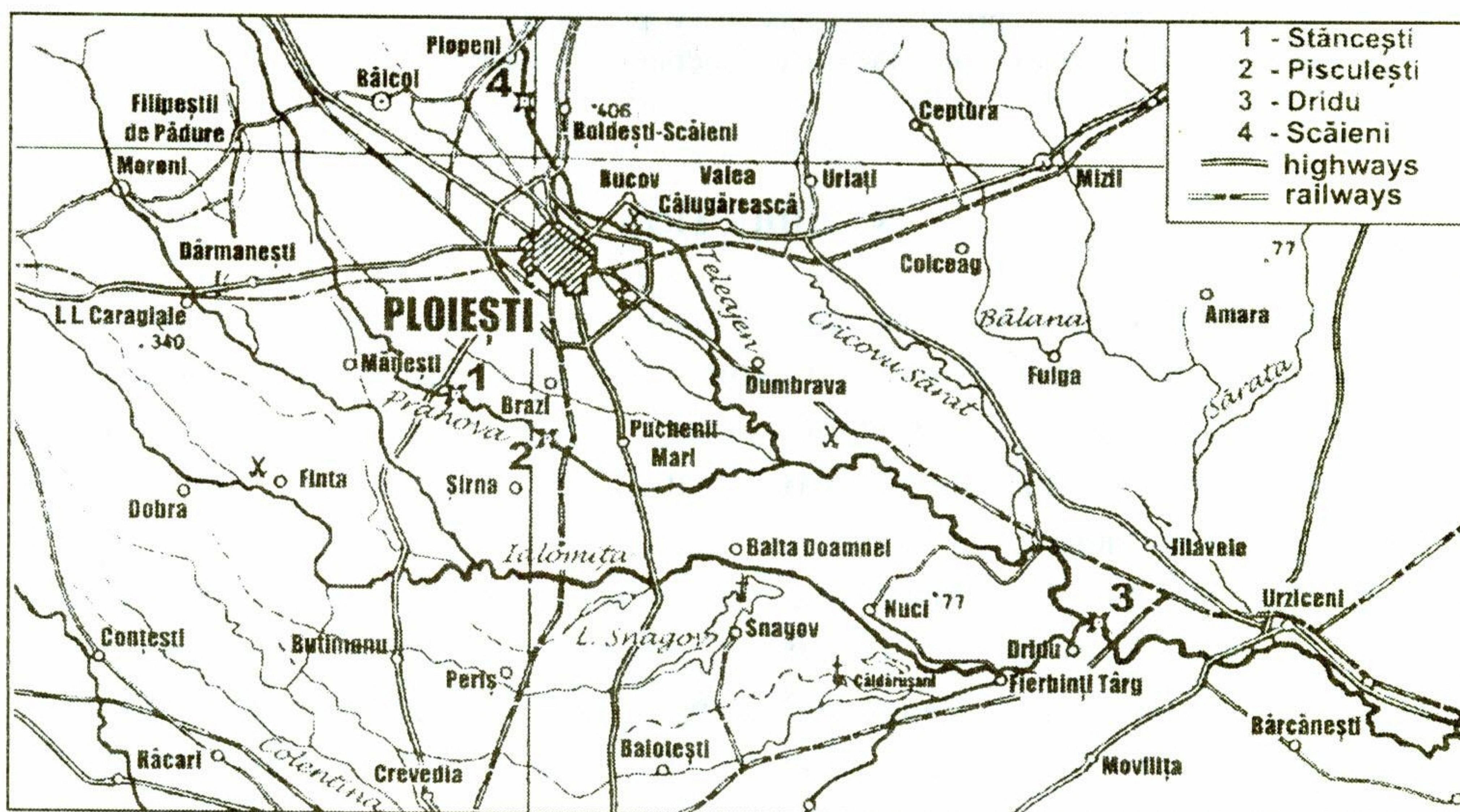
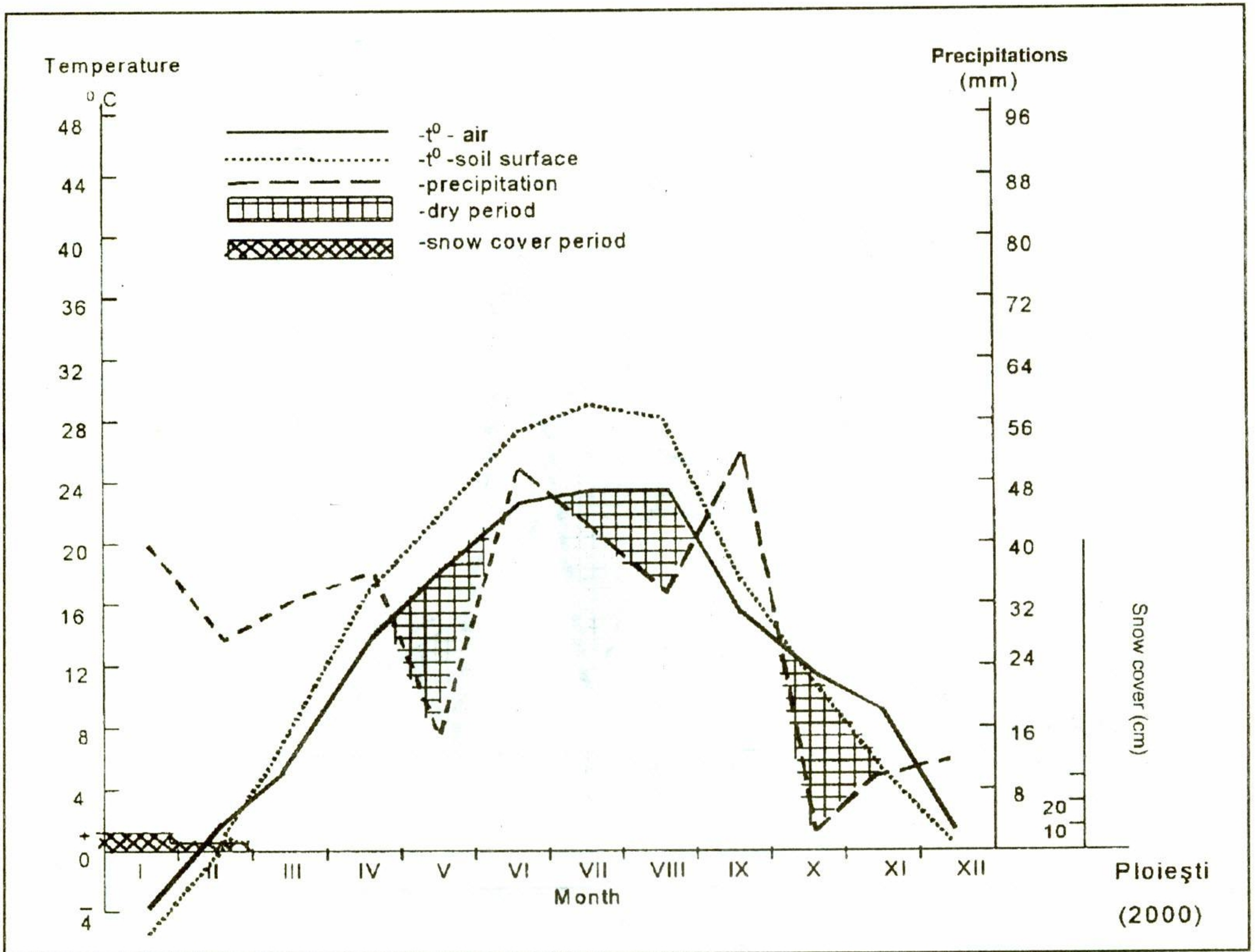
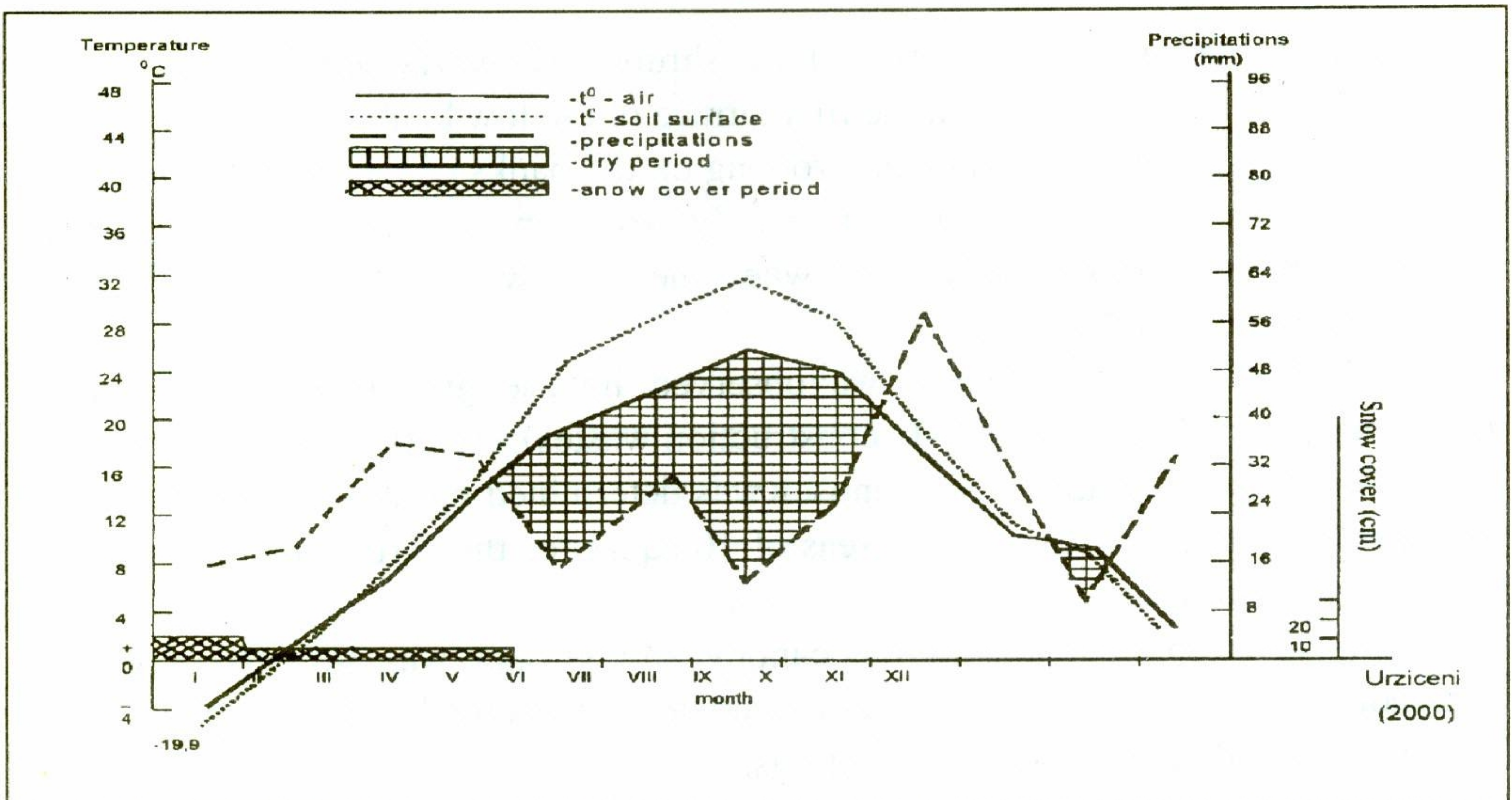


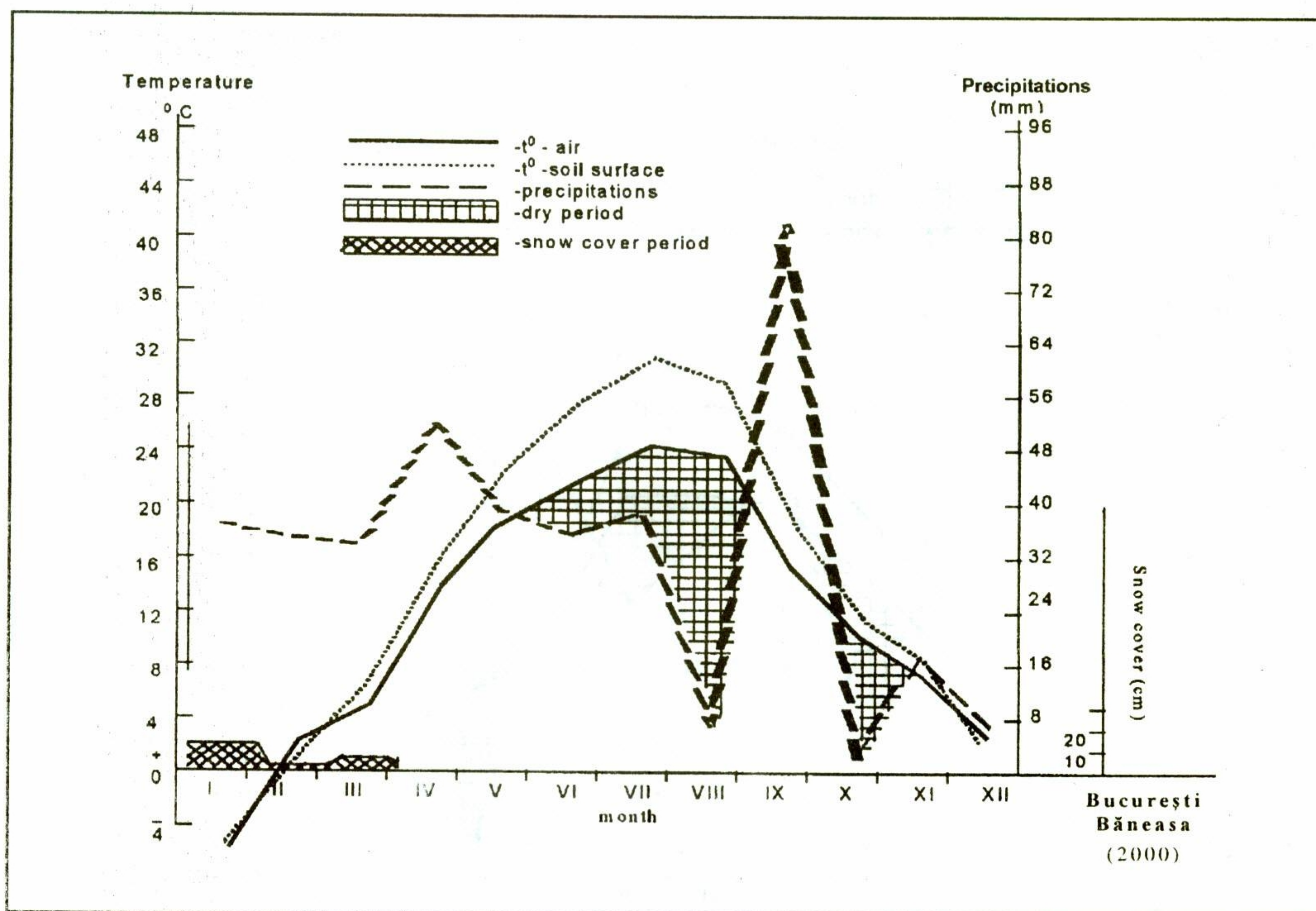
Fig. 1 – Site location.



2a



2b



2c

Fig. 2 – Gausse-type climadiagram.

The vegetation is barely installed, the shrubs of *Tamarix* being distributed on strips parallel to the riverbed, on the first terrace of the low bank.

The young *Tamarix* shrubland growing on the banks of the Prahova spot was analyzed in the station near Dridu; it actually grows on the former minor riverbed of the Ialomița river, currently dried when the river was diverted from the dam constructed upriver of this site.

In all *Tamarix* shrublands we observed intense grazing of animals and numerous piles of garbage (mainly construction wastes) and other industrial waste.

The structure of the phytocoenoses was determined by quantification and by direct biometric measurement, on areas of 10 sq.m. for the shrubs and on areas of 0.25² for the grasses.

The invertebrate fauna of the canopy and grasses was sampled with the entomological net of 60 and 30 cm diameter, respectively, 10 samples, each replicate formed of 50 shakings or cuttings.

The mobile fauna of the soil surface was collected with Barber traps, 9 samples for each *Tamarix* shrubland.

The soil fauna was determined with MacFadyen corer for the nematodes, enchytraeids, collembola and acari, 10 samples for each group of organisms. The fauna was extracted from the samples by the methods specific to each group. The lumbricidae were sampled directly, on 4 layers of depths up to 40 cm, 10 samples each.

The physico-chemical determinations for soil were done according to ICPA protocol.

The investigations were conducted in the annual dynamics (1999 and 2000) and in the seasonal dynamics of 2000.

The climatic data supplied by the National Weather Stations closest to the investigated *Tamarix* shrublands (București-Băneasa, Ploiești, Urziceni) shows that all three *Tamarix* shrublands have continental macroclimate with a multiannual average temperature of 10.6 to 11.0 °C and a average annual rainfall of 589 to 517 mm, with repeated dry summer seasons (Figure 2 a, b, c), with normal to high humidity in spring and again draught in autumn, particularly in October. The heat of July–August is even higher at the soil level, about 4–5 °C over the air temperature. The draught period is longer and harsher on the Prahova than at Scăieni and at Dridu than at Pisculești, as shown by Gaussen-type climadiagram (Figure 2 a, b, c).

The snow cover was short and unusually shallow during the investigated period.

The macroclimatic differences between the two years of investigations were significant (Figure 3 a, b); thus, in 2000 the temperature, even the average value, was excessively cold in winter (January) compared to 1999, while in summer the average temperature was about 2 °C higher (July–August). April and May, although had different average temperatures and rainfall between the two years, had the most favorable conditions for the activity of growth and development particularly for the plants, but also for the other components of the *Tamarix* shrublands under examination. Average rainfalls were significantly different in the two years, 1999 being much rainier in spring and particularly in late summer and in autumn compared to the average conditions of the region (Figure 3b); it was also much drier in late spring and early summer (May, June, July); 2000 was excessively dry in all seasons, except for September.

These climatic characteristics account for much of the annual and multiannual dynamics of the developmental cycle of the biocoenotic components and their biological production.

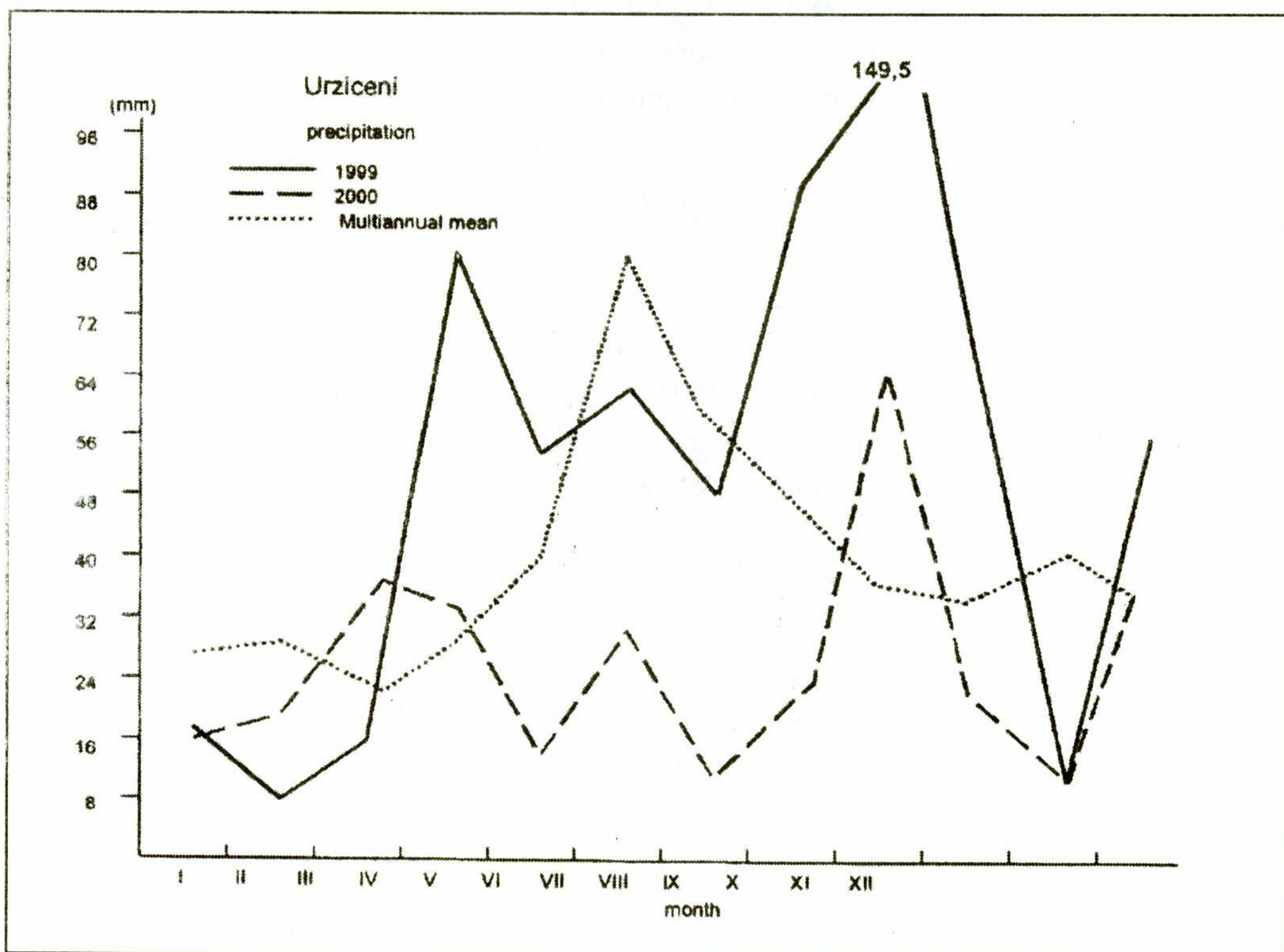
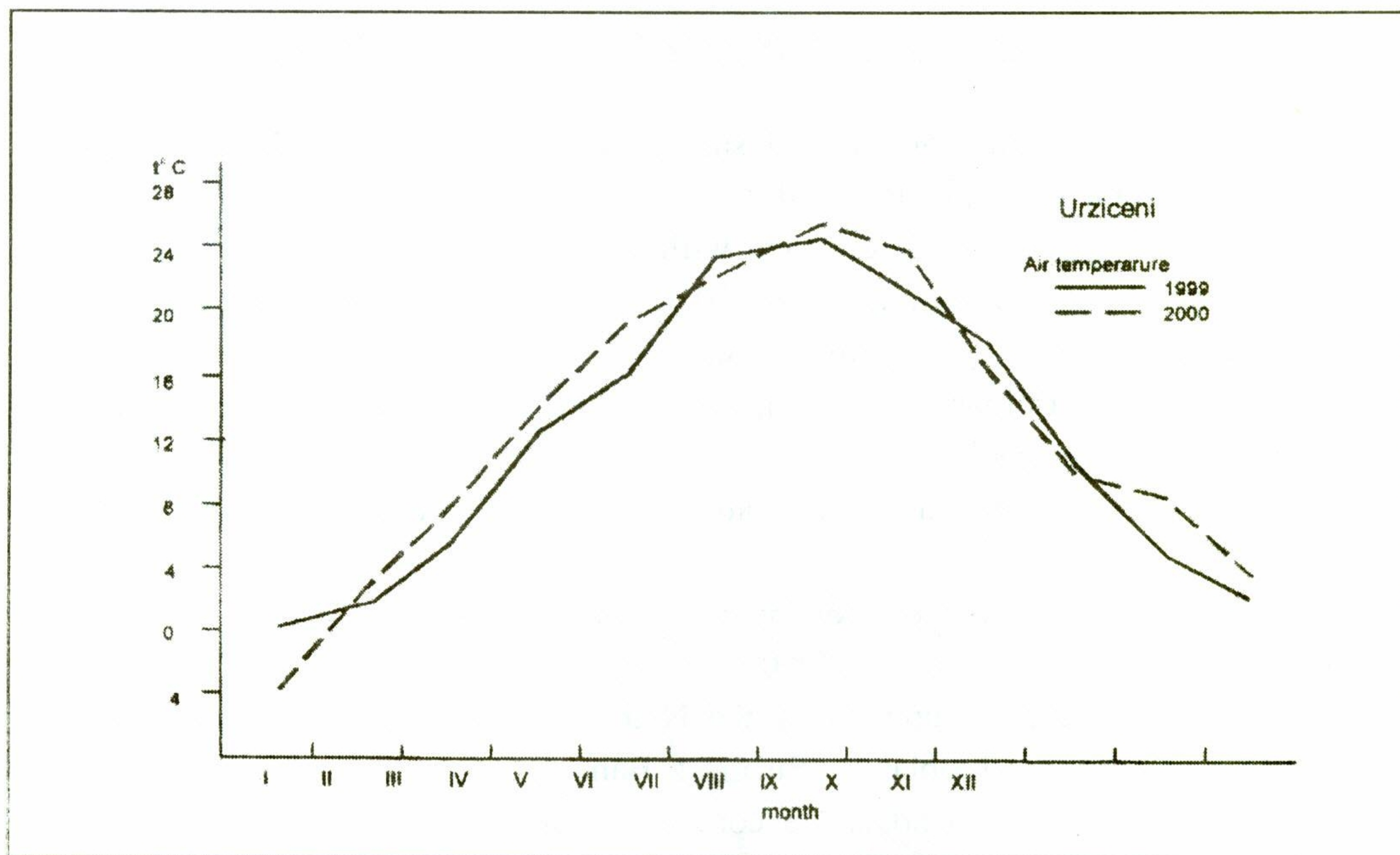


Fig. 3 – Annual dynamics in 1999 and 2000 years
a – mean monthly air temperature
b – monthly precipitation.

RESULTS AND DISCUSSION

The ground of the *Tamarix* shrublands biocoenoses is, in all investigated sites, protoil, sandy-clayey, alluvial with the texture dominated by sand.

The first 40 cm of ground are slightly alkaline (Table 1) increasing from the surface in depth (7.62 to 7.95), with insignificant differences in 2000 between spring (April) and summer (July).

The content of soluble salts is high both in spring and particularly in summer; only sulfates were identified, and there were no chloride salts detected (Table 1). The sulfates soluble in acetic acid and ammonium acetate, in amounts higher than 16 ppm, characterize the substrate as strongly salty. During summer the ground gets even saltier. It is remarkable that in inland floodplains too, the *Tamarix* shrublands cover very salty sites, although the grass layer of the shrubland only has species growing on low salt ground (*Trifolium fragiferum*, *Atriplex littoralis*). The nutrients used by the plants are found in low amounts in the ground, both the humus, the organic matter and the total N (Table 1); although the floodplain grounds are known for their fertility, in the case of *Tamarix* shrublands they are insufficiently evolved and the supply is below the level known in other phytocoenoses (such as the alluvial forests).

PRIMARY PRODUCERS

The biocoenoses were structured on vertical on two layers:

- the layer of shrubs, with a maximal height of 3.5 m at Pisculești and Scăieni and only 2.6 m at Dridu; most shrubs are up to 1.30 m at Pisculești and 0.96 m at Dridu.

- the grass layer with an average height of 30 to 50 cm, sporadically up to 1.5 m by species of *Dipsacus laciniatus* or *Verbascum phlomoides*.

The degree of vegetation cover is 100 % in all sites under examination, but the coverage by layers is different.

At Pisculești the shrub layer reaches 80 % with a dense distribution, rather uniform all over the surface and with a very diversified composition (about 12 species); the coverage is lower in Scăieni (60 to 70 %) with lax distribution on parallel strips within the wider strip of *Tamarix* shrublands, with a lower composition of species. At Dridu¹ the rather recent expansion of the analyzed *Tamarix* shrubland, combined with the intense grazing particularly by large cattle resulted in a coverage of 80 % but with thick shrubs, only of *Tamarix*, with a lower habitus, a lower diameter of the shoots and with no horizontal secondary or tertiary branches of the shrub; the number of branches is also much lower.

¹At Dridu, the *Tamarix* shrubland analyzed as ecosystem is very young, installed recently, but in the neighborhood there are *Tamarix* shrublands mixed with other shrub species, older and with another spatial structure.

Table 1

Physical and chemical characteristics of soils

Site Date of collection	pH	Salt S-SO ₄ ppm	Humus	Nt g%	ACCESSIBLE COMPONENTS						Depth (cm)
					P ₂ O ₅ mg %	K ₂ O mg %	CaO mg %	NaO mg %	Mg ppm	Mn ppm	
PISCULEȘTI 24.04.2000	7.62	37.00	1.889	0.0918	0.40	14.0	250.0	3.25	234.3	3.42	0-10
	7.83	35.75	0.963	0.0423	0.10	10.0	212.5	2.50	213.1	2.28	10-20
	7.95	34.50	0.702	0.0341	0.05	8.5	175.0	2.80	187.0	2.68	20-30
PISCULEȘTI 3.07.2000	7.68	28.75	1.444	0.0659	2.00	26.8	212.5	3.45	398.1	1.11	0-10
	7.80	58.00	1.021	0.0447	1.00	19.0	225.0	2.80	388.7	0.43	10-20
	7.85	51.75	1.305	0.0635	0.65	13.3	187.5	3.25	281.0	0.53	20-30
SCĂIENI 20.04.2000	7.68	58.00	1.012	0.0447	1.70	12.8	306.3	3.25	266.2	3.18	0-10
	7.78	50.50	0.529	0.0235	0.65	7.3	200.0	2.80	218.7	1.89	10-20
	7.84	33.00	0.345	0.0164	1.10	5.0	125.0	2.80	128.1	2.80	20-30
SCĂIENI 3.07.2000	7.69	58.00	0.797	0.0376	1.80	13.6	237.5	3.65	264.2	1.39	0-10
	7.79	54.60	0.495	0.0223	0.90	7.3	187.5	3.00	211.6	1.06	10-20
	7.82	55.75	0.332	0.0153	2.30	5.7	181.3	3.05	213.5	0.65	20-30

Shoot diameter at substrate basis (cm) in the two sites on Prahova floodplain

Site	Shrub diameter	Shoot diameter at substrate surface		
		Average	Highest	Lowest
Pisculești	5.0	0.96	3.53	0.36
Dridu	3.9	0.96	2.29	0.36

The average shrub number is about 0.38/sq.m. or (38/100 sq.m. at Pisculești – optimal surface for shrub exposure) and 1.645/sq.m., or 164/100 sq.m. at Dridu; the number of shoots starting from the soil surface is 11 shoots/sq.m. at Pisculești and 12.3/ sq.m. at Dridu. There are 7 to 28 shoots in a shrub at Pisculești, with sizes inversely proportional to their number, while at Dridu there are from 1 to 49 live shoots, the destructive effect of the “farm” consumers being obvious.

The aboveground biomass accumulated by the *Tamarix* shrublands from Pisculești amounted to about 18.43 kg/ha, of which the assimilating part (shoots with the characteristic squamiform leaves) may account for up to 51 % of the total weight while at Dridu it reached 14.118 kg/ha, of which the assimilating part (1.36 kg/ha) represented just 11 %.

Comparing these data with the state of the Danube *Tamarix* shrublands we observe that the accumulated biomass is much lower than in Insula Mică a Brăilei, where it yielded 197 t/ha (Paucă *et al.*, 1997) at the age of 25 years, result of the protective conditions particular to that area and to the older age of that ecosystem. On the other hand, shoot density is higher in the *Tamarix* shrublands from the area where the Danube reaches the Black Sea, at Sulina, due to the more intense grazing but the shoots are much smaller too (Paucă *et al.*, 1995).

The herbaceous layer is properly developed in all sites under examination; in the shrub shadow, the composition is more diversified as compared to the less shaded area between shrubs. The degree of coverage is higher (95 to 100 %) and its seasonal dynamics is very active, as well as the dynamics of the necromass and the resulting litter.

The diversity of the herbaceous layer of the *Tamarix* shrublands analyzed in a separate paper (Paucă *et al.*, 2000) is high, the Simpson/Pielou index varying from 0.57 at Dridu to 0.90 at Pisculești, reflecting a balanced quantitative distribution of the species. Each site has a wealth of over 100 plant species, but only 37 species are common for all three phytocoenoses. The only species present to all *Tamarix* shrublands investigated in the inland floodplains and in the Danube floodplain and Delta was *Cynodon dactylon*; in the floodplains of the inland rivers *Calamostris*

epigeios is always present and has an important productive and quantitative role, next to its important coenotaxonomic role.

Phytogeographically, the flora is dominated by Eurasiatic species, with an important contribution of the adventive and cosmopolitan species. The most bioforms of the shrub layer are the microphanerophytes followed closely by the macrophanerophytes; the dominant species of the herbaceous layer are the hemicryptophytes followed by the annual and biannual species (Figure 4).

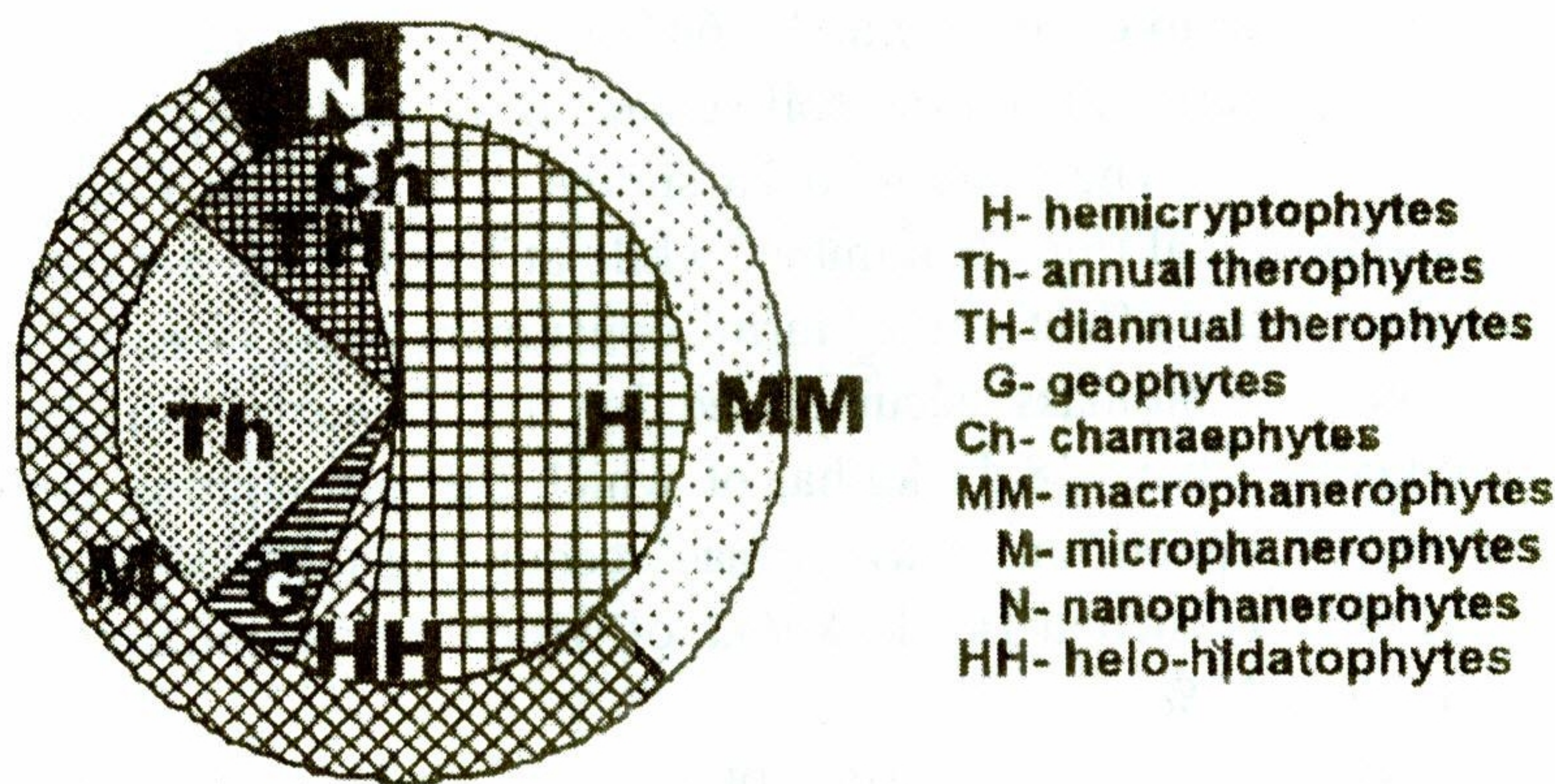


Fig. 4 – Bioforms proportion in Tamarix shrublands in the two layers.

Biomass accumulation started in March (in 2000) and increased continuously until July at Pisculești (2.02 kg D.W./sq.m.) and until August at Scăeni (1.874 kg D.W./sq.m.) (Figure 5). The seasonal difference between the two slopes is due to the dominance of some herbaceous populations with a particular cycle of development (Table 2).

Table 2

Biocoenotic importance of main populations in the herbaceous layer of Tamarix shrubland

No.	S P E C I E S	Frequency %	Biomass g/m ²	Percent of biomass %
1	2	3	4	5
PISCULEȘTI – 29.08.2000				
1	<i>Rubus caesius*</i>	60	279.59	30.65
2	<i>Poa pratensis</i>	50	25.48	2.79

Table 2 (continued)

1	2	3	4	5
3	<i>Cynodon dactylon</i>	30	339.27	37.20
4	<i>Plantago lanceolata</i>	30	15.45	1.69
5	<i>Tamarix ramosissima</i> *	20	35.74	3.92
6	<i>Galium aparine</i>	10	53.60	5.88
7	<i>Bromus commutatus</i>	10	39.78	4.36
8	<i>Coronilla varia</i>	10	23.98	2.63
9	<i>Brachypodium sylvaticum</i>	10	19.30	2.12
10	<i>Bromus tectorum</i>	10	9.11	1.00
11	<i>Salix purpurea</i> *	10	9.15	1.00
SCĂIENI – 28.08.2000				
1	<i>Cynodon dactylon</i>	90	1230.44	65.80
2	<i>Agrostis stolonifera</i>	60	239.07	12.79
3	<i>Equisetum arvense</i>	50	47.52	2.54
4	<i>Poa angustifolia</i>	40	135.85	7.27
5	<i>Elymus</i> (<i>Agropyron</i>) <i>repens</i>	20	26.97	1.39
6	<i>Mentha aquatica</i>	20	20.12	1.08
7	<i>Tanacetum vulgare</i>	10	91.23	4.88
8	<i>Lycopus europaeus</i>	10	26.46	1.42

* annual twigs or seedlings

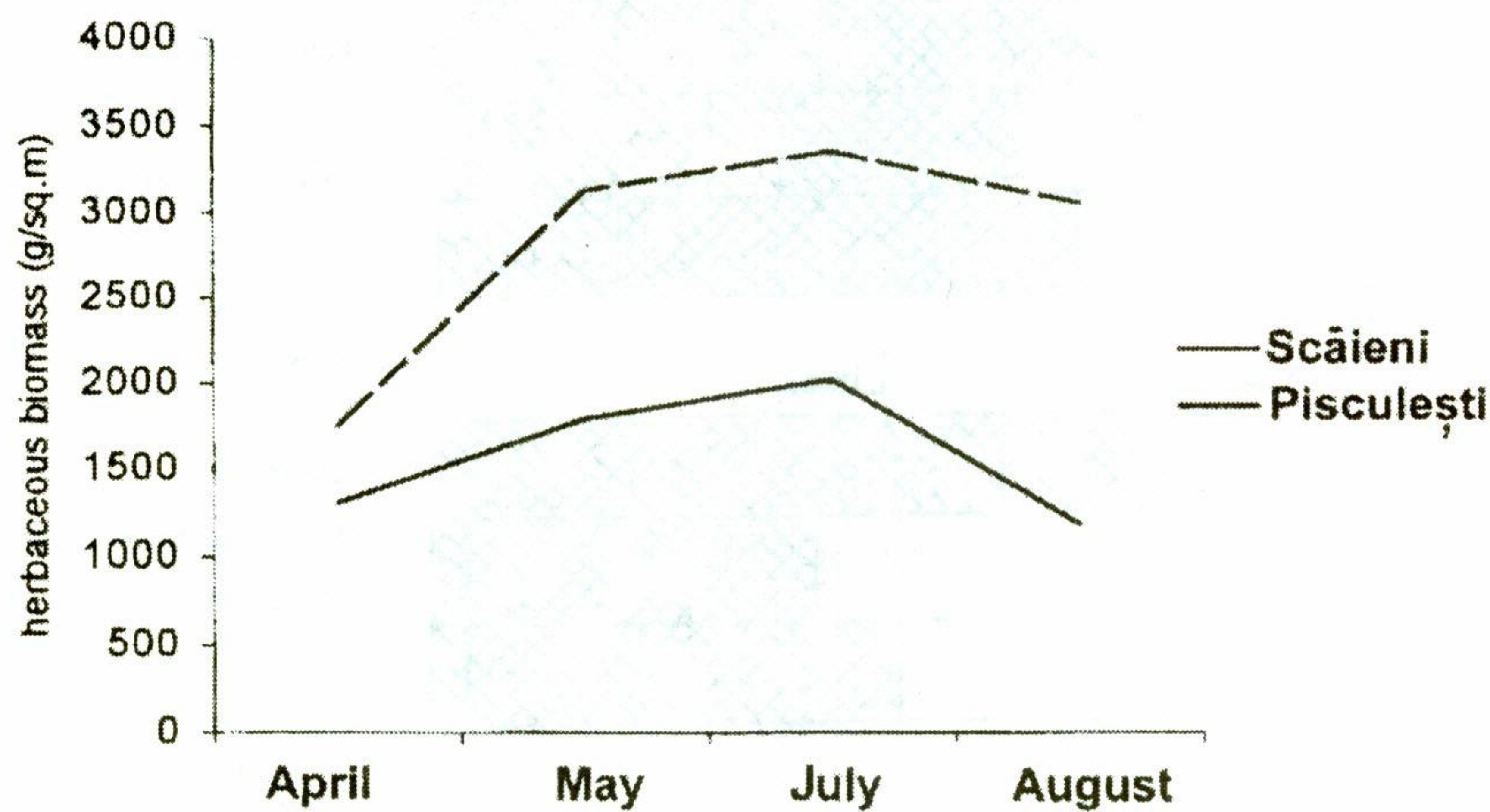


Fig. 5 – Herbaceous biomass dynamics along 2000 year in different shrublands.

The spring species have a low quantitative contribution so there was no seasonal dynamics with two different peaks in spring and summer as observed in other forest ecosystems. Compared to herbaceous biomass accumulation in Insula

Mică a Brăilei (0.266 kg D.W./sq.m.), the values are much higher in both investigated sites due to the lower shadowing of the soil by shrubs.

We noticed that much of the organic biomass accumulated in the herbaceous layer maintained in different stages namely, as biomass – living, active mass, as necromass – dead mass standing , mixed with the living mass and many times even with the stems of the living shoots and as litter – dead mass already fallen to the ground, mixed, however, with the base of the living shoots. Although decomposition is active, as reflected by the drop of the total litter mass from April till May by about 30% (from 3.560 to 2.522 kg D.W./sq.m.) at Pisculești and by about 65% (from 2.746 to 0.960 kg D.W./sq.m.) at Scăieni, the nonliving organic mass remained permanently high in these ecosystems, being equal or even higher than the green biomass (3.873 kg D.W. compared to 2.022 kg D.W./sq.m. at Pisculești and 1.858 kg D.W. compared to 1.858 kg D.W./sq.m.). The ratio of the living mass to litter changed every month according to the intensity of growth and of the organic matter decomposition (Figure 6).

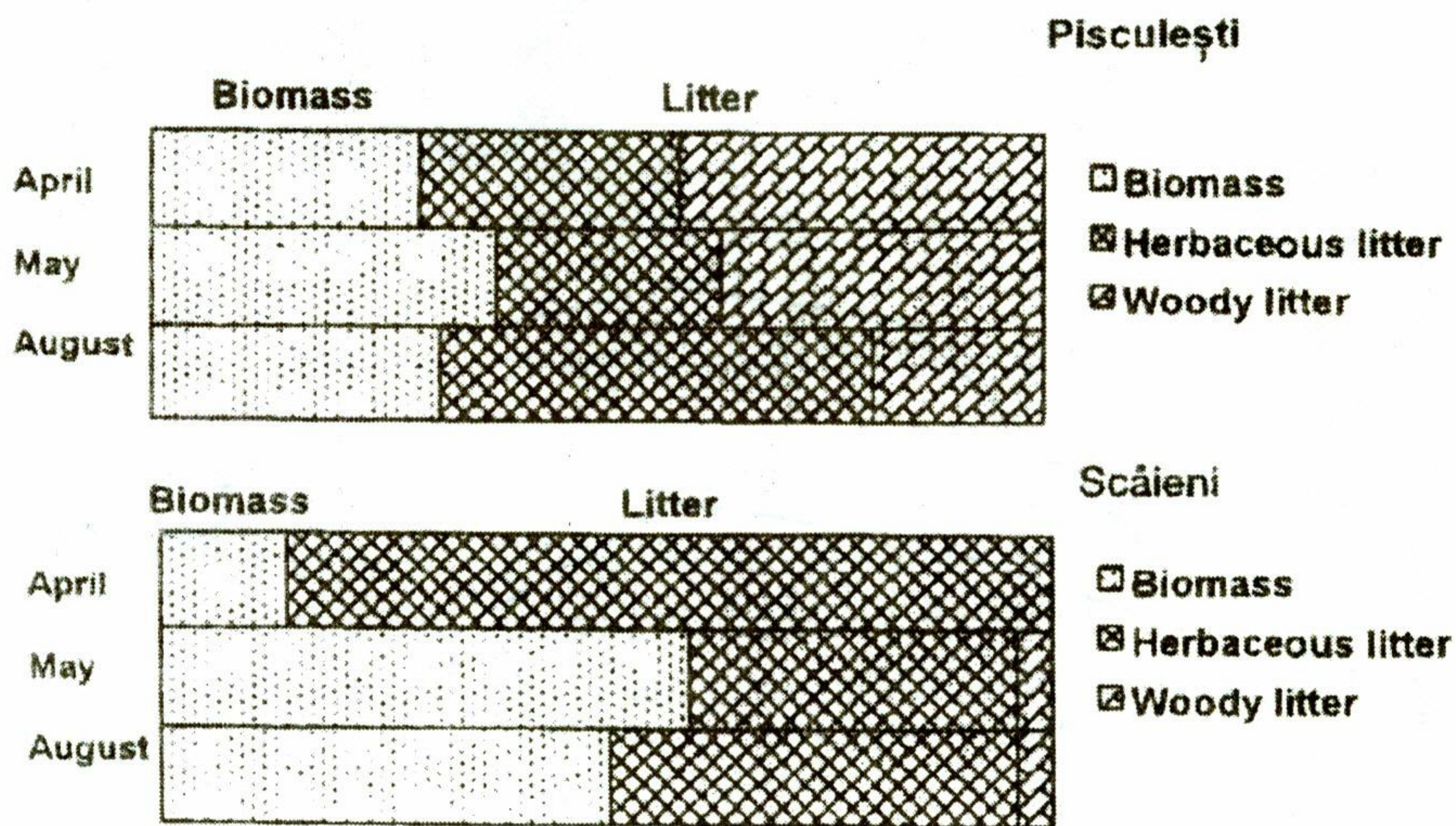


Fig. 6 – Rate of biomass necromass and litter in different Tamarix shrublands in 2000 year.

The litter also differs qualitatively, as shown in Figure 6. Thus, at Pisculești the litter of shrub wood, consisting mainly of the annual growth starting from the ground surface, is much higher and maintained permanently, compared to the litter from Dridu where accumulation and decomposition are much higher. At the end of

summer (August) the amount of wood was proportionally lower than in the previous months.

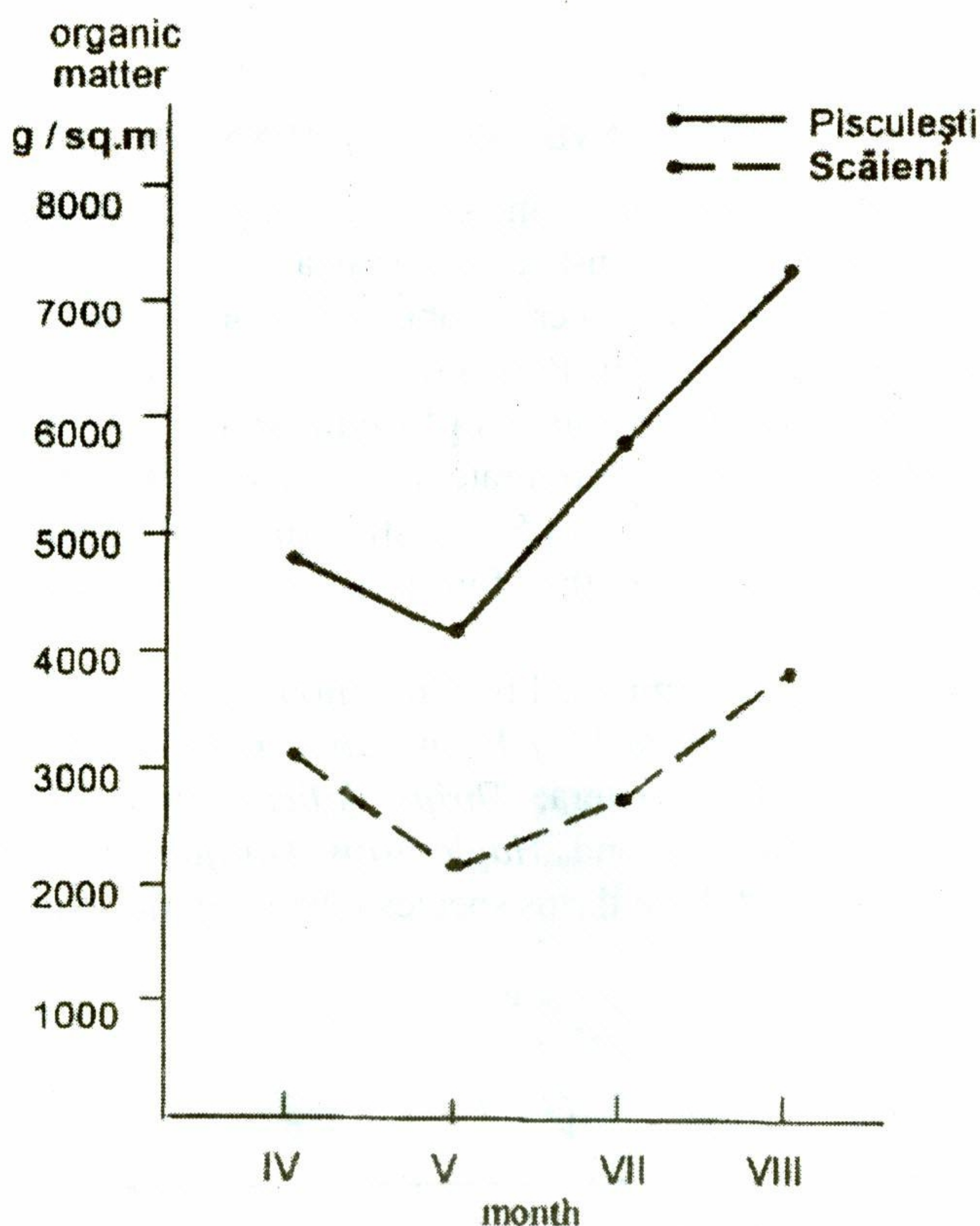


Fig. 7 – Organic matter dynamics along vegetation period in different *Tamarix* shrublands.

Analyzing the dynamics of the organic matter accumulated throughout one year (Figure 7) we can observe that it expresses a continuous growth from spring until end summer, except for May, when the accumulated biomass was not so high as to compensate the amount decomposed by the secondary consumers.

CONSUMERS AND DECOMPOSERS

The main macroconsumers from all *Tamarix* shrublands are the domesticated animals that graze in a more or less organized manner the shrubs with discontinuous development; quantitatively, these are the organisms consuming

most of the primary production. Due to the high frequency of grazing animals, no many bird nests or of wild animals were observed in any *Tamarix* shrublands because there is no safety for such shelters.

The microconsumers are presented on the four levels of the ecosystemic scaffold – the plants.

CANOPY INVERTEBRATE FAUNA

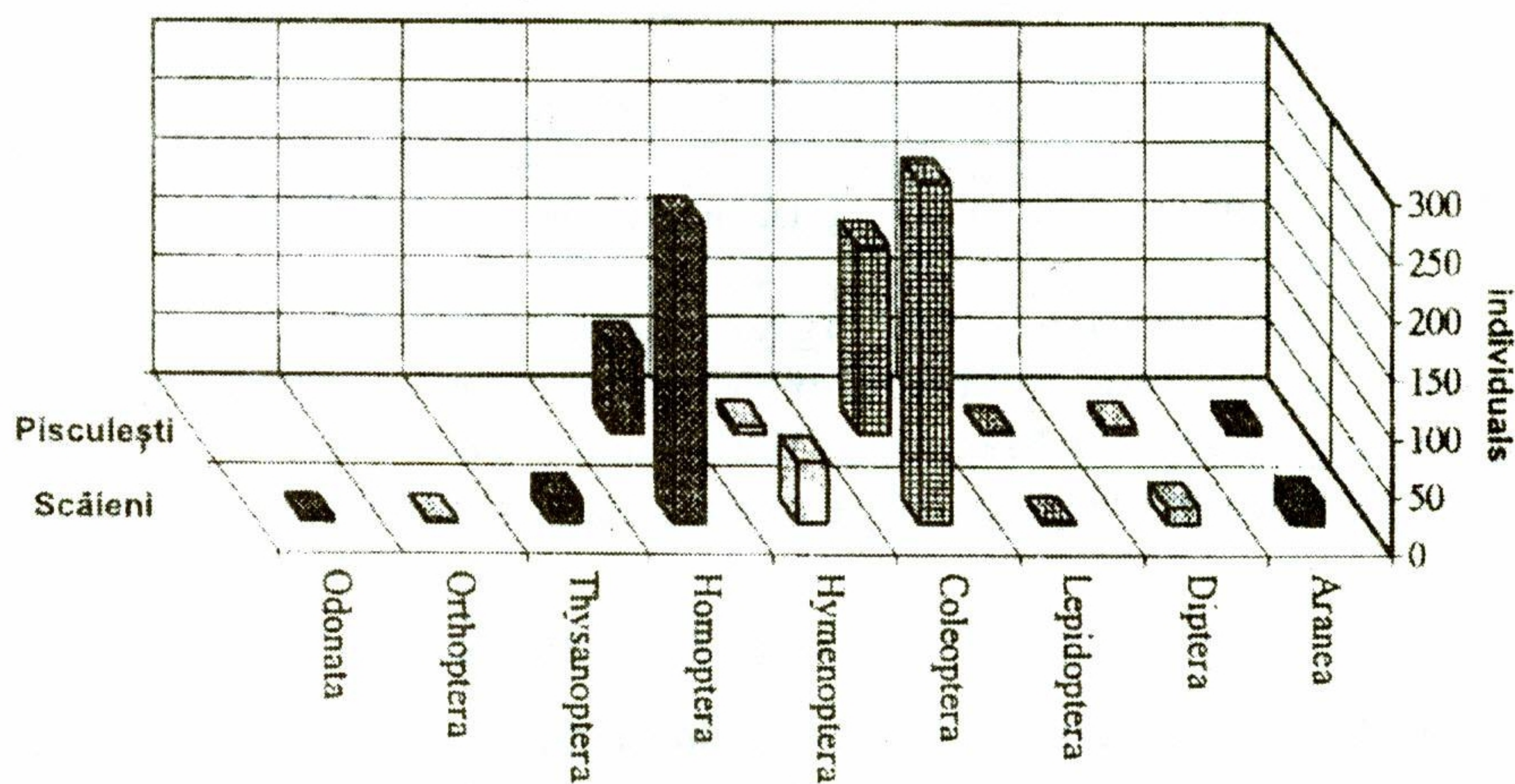
The invertebrate fauna inhabiting the canopy is characterized by 8 supraspecific taxa belonging to the insects and aranea.

The annual dynamics of the numerical abundance of the microarthropod fauna revealed higher values in 2000 than in 1999, probably due to the long draught.

In Dridu we observed a lower number of supraspecific taxa and low values of the numeric abundance of the invertebrate fauna due to the anthropic impact. Compared to other *Tamarix* shrublands Stăncești harbours the highest invertebrate count due to the larger canopy and therefore to the wider area available to fauna development.

The canopy coenosis is dominated by Curculionidae (*Coniatus splendidulus*) with mass replication in Dridu, and by Homopterae *Opsius stactogalus* (cicads) (Figure 8a, b). Among Thysanoptera, *Thrips difficilis* dominates at Stăncești, *Thrips minutissimus* at Scăieni and *Haplothrips kurdjumovi* and *Haplothrips subtilissimus* at Pisculești, all these thrips species inhabiting the canopy.

a



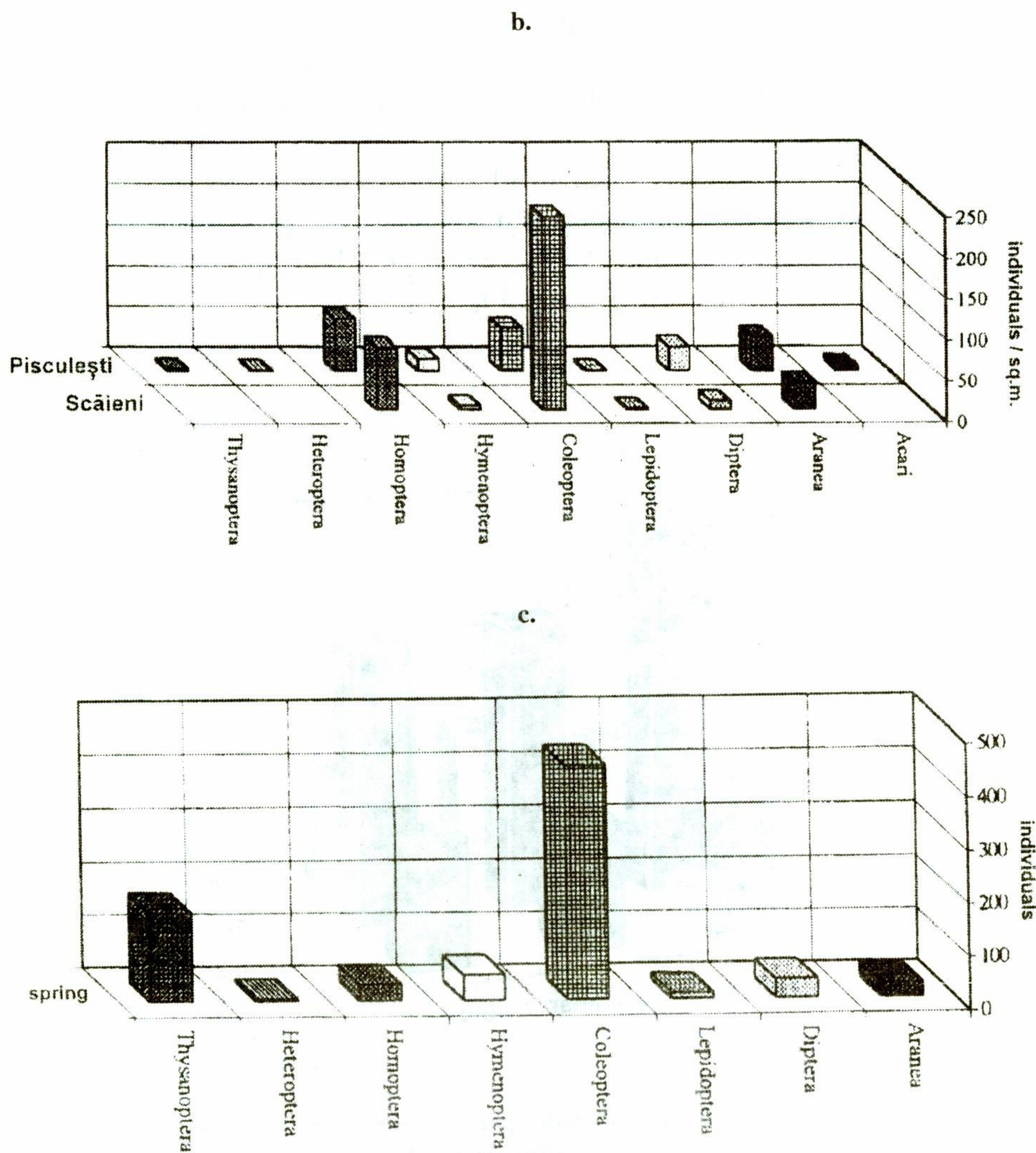


Fig. 8 – Numerical abundance of canopy invertebrate fauna
a. spring period 2000
b. estival period 2000
c. spring period 2000 at Stăncești.

The highest specific diversity was observed at Stăncești, with seven species: 5 primary and 2 secondary consumers (*Aelothrips intermedius* and *Haplothrips suntillissimus*); also here, the age structure revealed a very large number of larvae (86.39%), showing a high replicating capacity of the thrips population (Figure 8c).

FAUNA OF MOBILE INVERTEBRATES ON THE GROUND SURFACE

The fauna of mobile invertebrates inhabiting the ground surface has a specific dynamics in the period of observation, but there are also some general rules:

- the total count peaked in spring in all *Tamarix* shrublands;
- the number of supraspecific taxa is much higher in spring in all investigated sites (Oligochaeta, Trichoptera and Crustacea appear only in spring);
- the *Tamarix* shrubland from Scăieni harbours large counts on invertebrates (Figure 9).

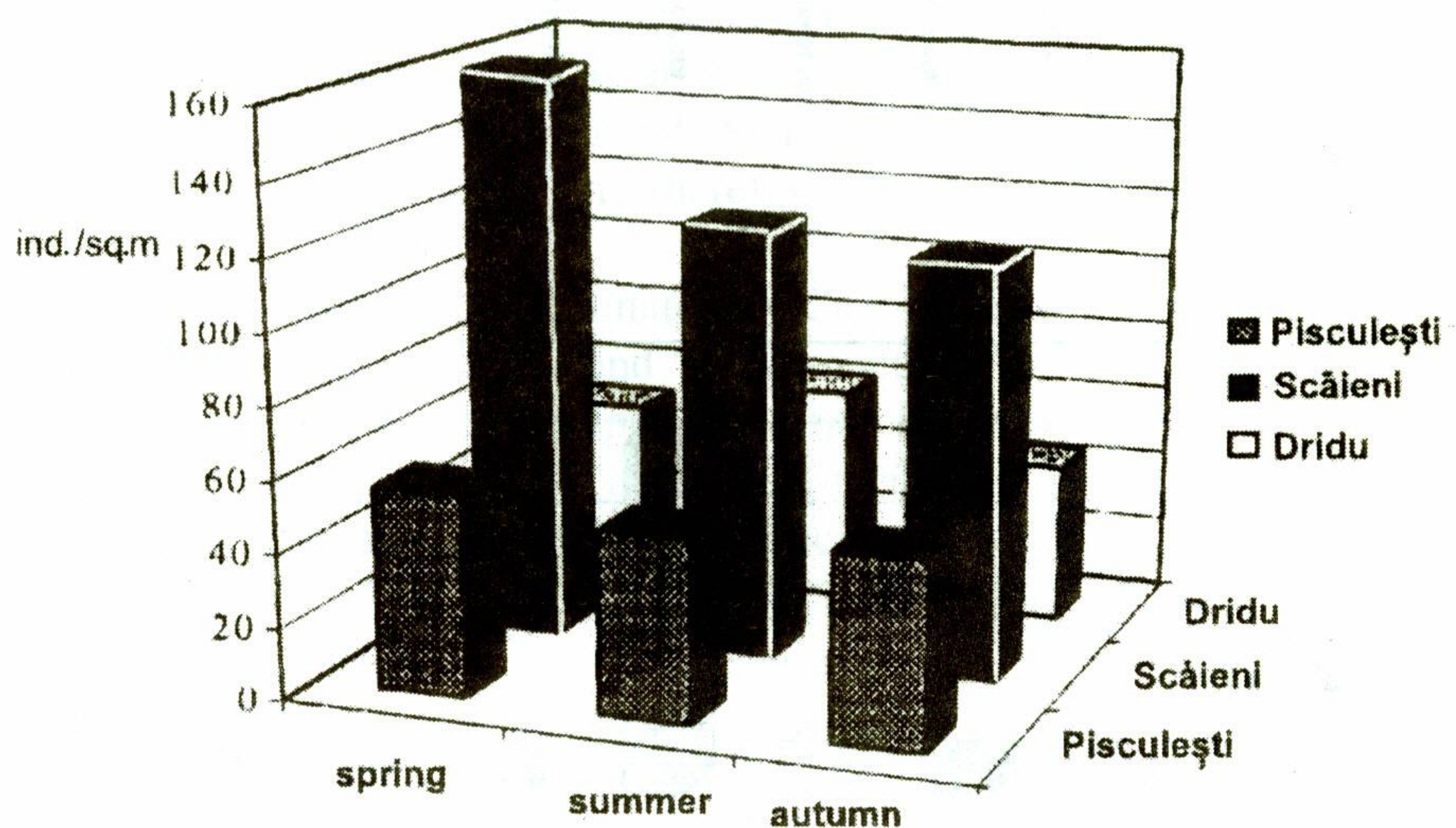


Fig. 9 – Mean density variation (ind/ sq.m.) of epigeic invertebrate fauna in different *Tamarix* shrublands.

The proportion of the supraspecific taxa has an individual character variable with the season, with no pattern (Table 3). However, the peak relative abundance in all *Tamarix* shrublands belongs to Collembola; the highest value of the relative abundance was observed in Dridu (72 %). The seasonal dynamics of the Collembola followed a decreasing pattern from spring to autumn in all sites under observation, but at Scăieni the value of the relative abundance dropped drastically in summer (13 %) becoming again significant in autumn (34 %) when the litter started to accumulate.

Table 3

Relative abundance of super specific taxons epigeic invertebrate fauna in a different annual period

TAXON	SPPRING			SUMMER			AUTUMN		
	Pisculești	Dridu	Scăieni	Pisculești	Dridu	Scăieni	Pisculești	Dridu	Scăieni
Gasteropoda	1.32	7.7	5.21	0.5	3.1	0.38	1.1	1.2	3.8
Oligochaeta	0.06	0.03	0.15						
Acarina	15.5	3.36	18.65	19.3	3.11	14.18	18.8	3.03	36.04
Opilionida									0.85
Araneae	7.57	3.12	3.73	7.13	2.12	9.83	5.62	4.13	2.88
Crustacea	1.91	0.39	0.58			1.79			
Miriapoda	2.56	3.27	0.81		1.6	1.79		1.4	0.7
Collembola	57.54	72.14	51.76	13.11	26.46	2.02	13.0	25.14	34.37
Trichoptera	2.32		0.46						
Orthoptera	0.06	0.24	0.06	0.5	4.84	0.25	1.4	3.5	1.47
Homoptera	1.35	0.5	1.13	10.33	0.86	3.83	7.5	1.47	1.89
Heteroptera		0.03	0.17		0.67	0.51		0.5	0.25
Hymenoptera	3.34	3	8.19	14.13	4.16	54.15	10.1	4.11	8.65
Coleoptera	2.8	3.9	2.54	16.4	7.4	5.37	28.08	17.47	4.46
Lepidoptera				3.5			7.1		
Diptera	3.4	2.32	6.56	9.2	45.68	5.88	7.1	38.05	4.64

Acari is another taxon properly represented as relative abundance in all investigated sites except for Dridu (3 %), with a seasonal dynamics similar to the Collembola, decreasing in summer and increasing back in autumn.

Another taxon constantly noticed as numerical abundance in all *Tamarix* shrublands is the Diptera: although its relative abundance is often 3 to 6 % it may reach 46 % in some sites (Dridu); it has a significant representation throughout the biologically active season.

Orthoptera, Homoptera and Heteroptera including phytophagous species are poorly represented numerically in the analyzed mobile fauna; being tied to the plant food their presence and count increase in summer and autumn.

Oligochaeta were observed in all sites, in low numbers (0.003 to 0.006 %) as well as the Trichoptera (0.45 to 2.36 %), except for Dridu. Both taxa appear only in spring disappearing probably in the subsequent period of draught.

Among the Coleoptera, the presence of the phytophagous species from the families of Chrysomelidae, Curculionidae, Elateridae was expressed by higher relative abundance in summer than in the other seasons. Homoptera and Heteroptera had the highest relative abundance at Scăieni.

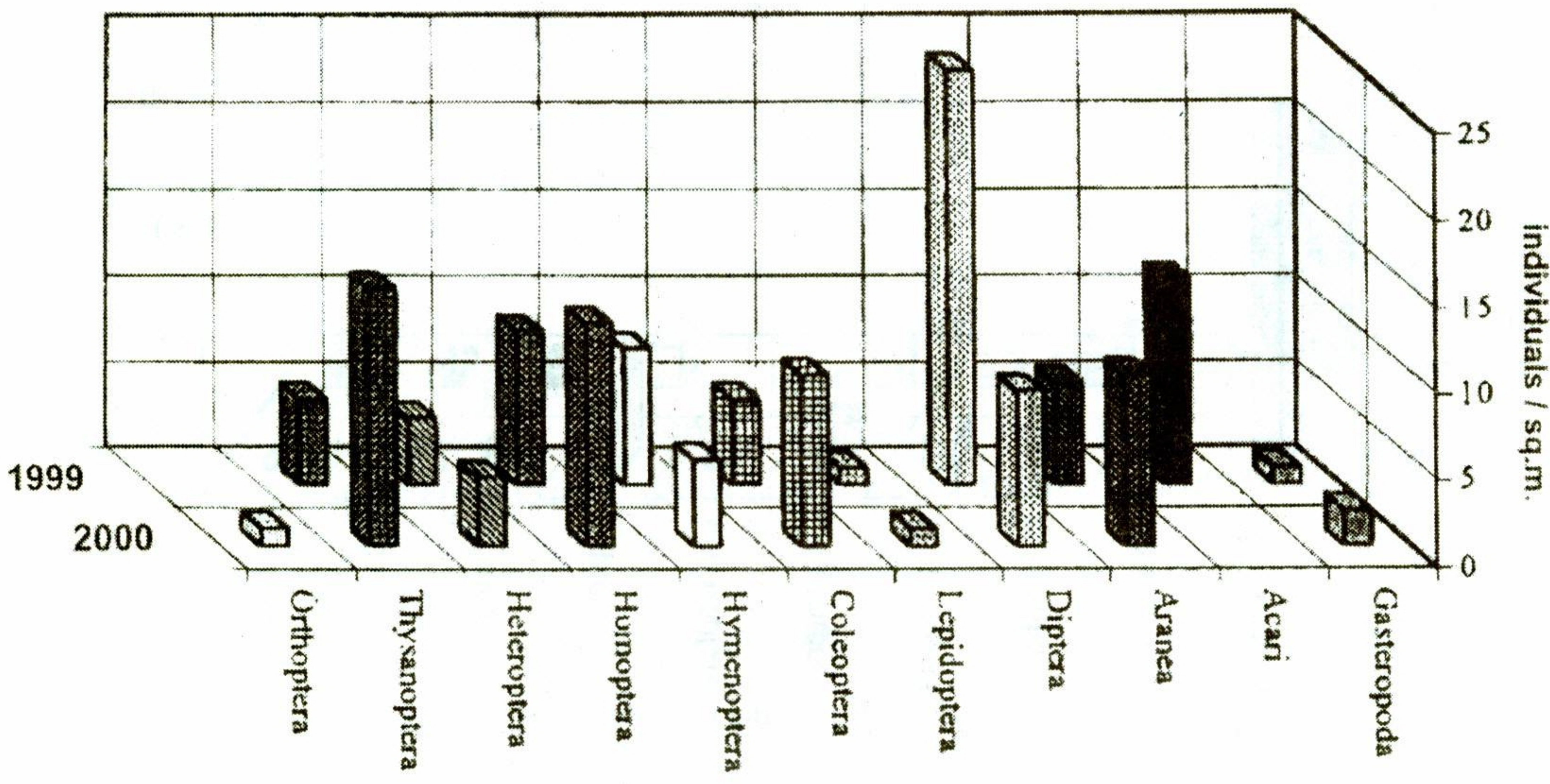
The predators Aranea and Coleoptera (Carabidae and Stafilinidae) had lower counts, as all secondary consumers.

The dynamics of Aranea is different in all *Tamarix* shrublands, the relative abundance reached a maximum value during spring at Pisculești, autumn at Dridu and summer at Scăeni. The numbers of Aranea have a maximum value during the periods in which the phytophagous species that form their food (Homoptera, Heteroptera, Hymenoptera) have a numerical peak.

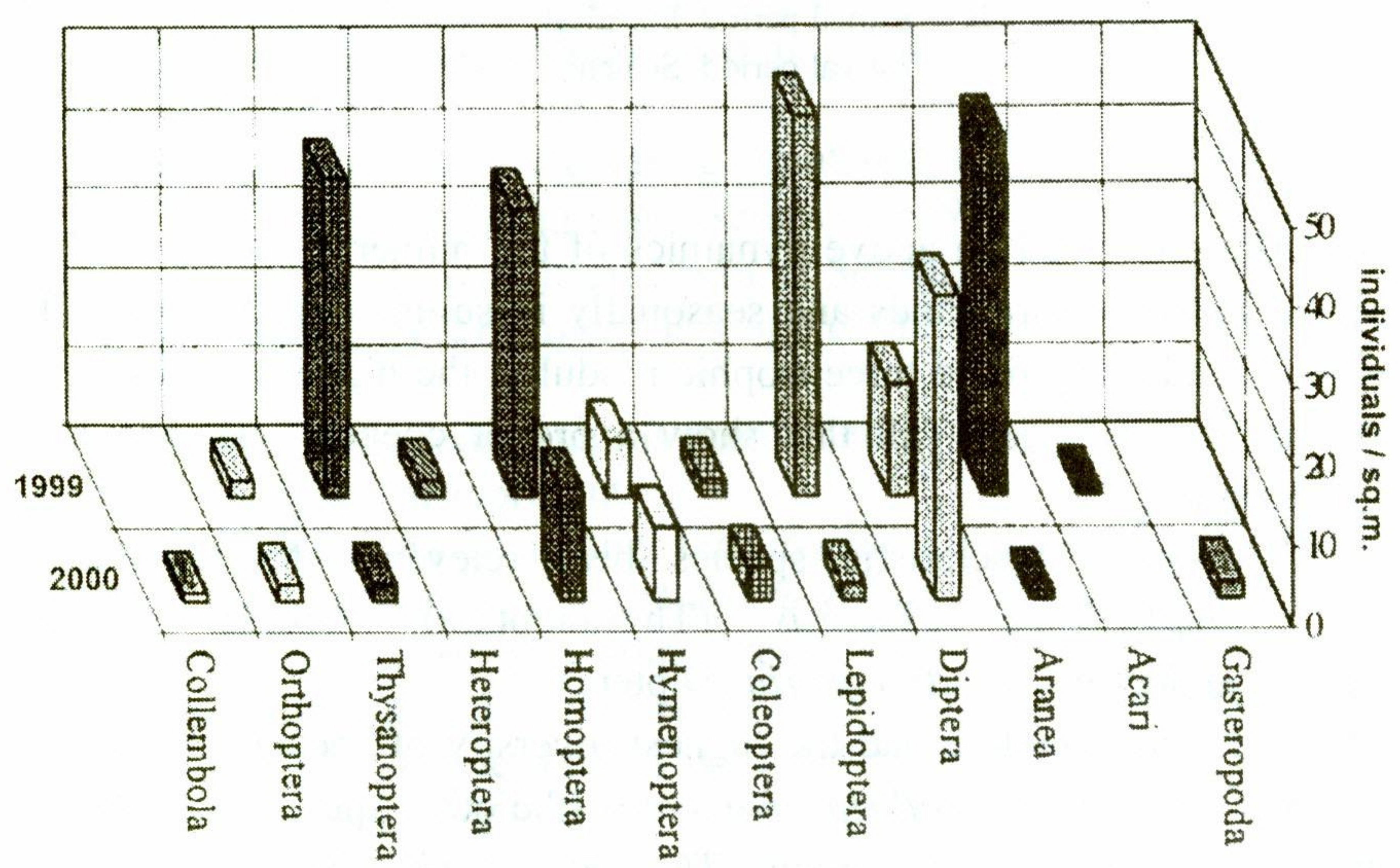
The Carabid fauna was dominated numerically in all sites by the species of *Pterostichus* genus but the species of *Carabus* genus (*Carabus violaceus* and *Carabus coriaceus*) dominated clearly as biomass. The hygrophilous species were more abundant in spring than in other seasons when the draught and heat decreased their count and they were replaced by thermophilous and xerophilous species.

INVERTEBRATE FAUNA OF THE HERBACEOUS LAYER

The invertebrate fauna of the herbaceous layer is properly represented both quantitatively and qualitatively at Scăeni (189 individuals/sq.m.) (Figure 10a) and Pisculești (197 individuals/sq.m.) (Figure 10b), being lower at Dridu due to the intense grazing.



a.



b.

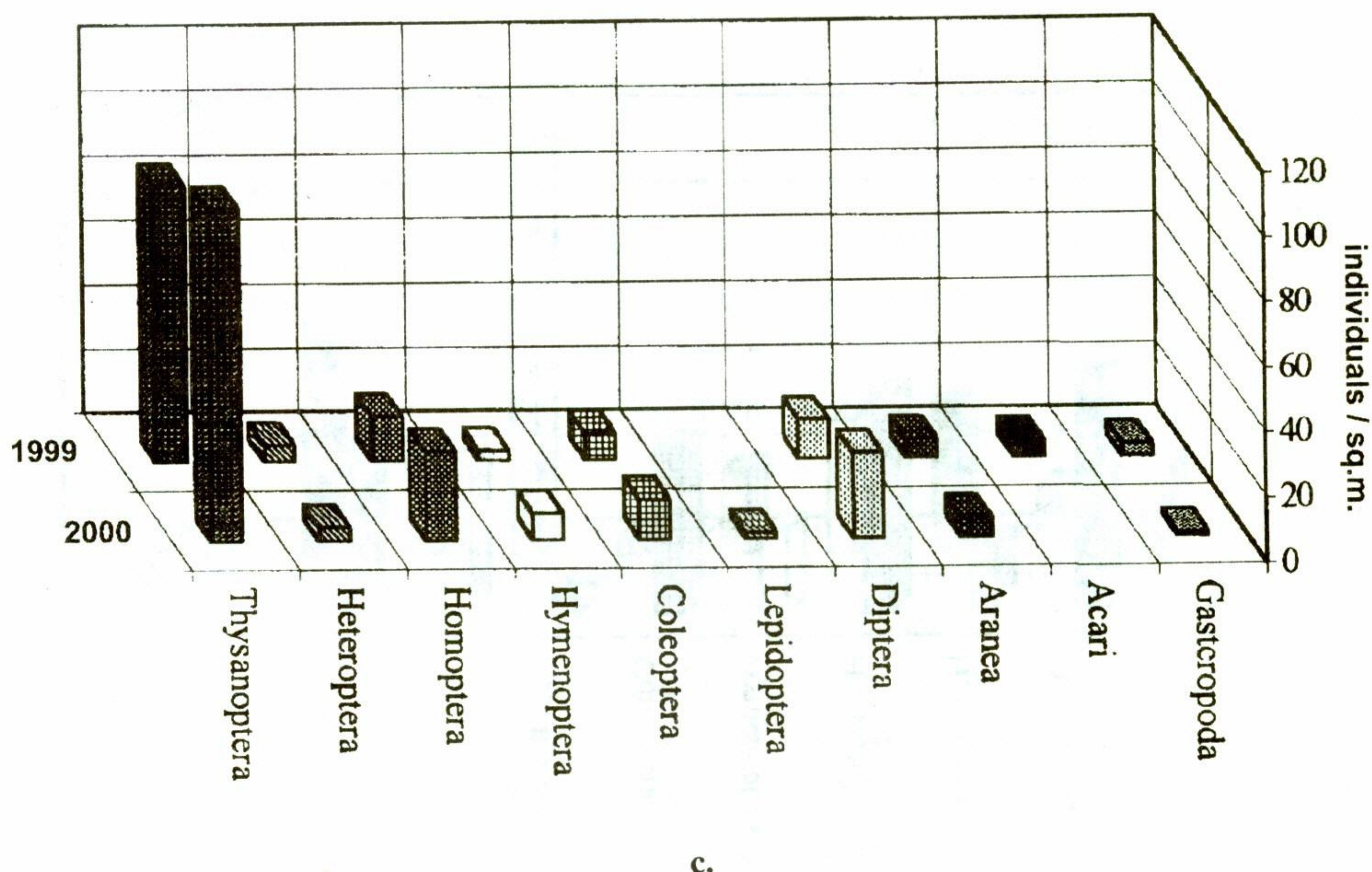


Fig. 10 – Numerical abundance/ sq.m. of invertebrate fauna in the herbaceous layer

- a. spring period, Scăieni
- b. estival period, Pisculești
- c. estival period, Scăieni.

Microarthropods had an active dynamics of the numeric density peaking in 2000 in most *Tamarix* shrublands and seasonally in summer (at Scăieni). The 10 supraspecific taxa belonging to three trophic modules, the higher than one ratio of phytophagous to zoophagous, all this show a proper coenotic balance in most *Tamarix* shrublands.

The following characteristic species bear relevance for this layer of vegetation: *Anaphothrips obscurus* (Thysanoptera), *Opsius stactogalus* (Homoptera) and *Scatophoga stercoraria* (Diptera).

At Scăeni, Thysanoptera had the highest diversity of species, 15 dominated by *Haplothrips niger* and *Chirothrips manicatus* (the other species are *Chirothrips aculeatus*, *Thrips atratus*, *Th. Flavus*, *Th. Tabaci*, *Th. Trehernei*, *Bolothrips bicolor*, *B. icarus*, *Haplothrips aculeatus*, *H. distinguendus*, *H. leucanthemi*, *H. niger*, *H. reuteri*, *H. setiger*, *H. triticei*).

Six species were identified at Pisculești, dominated by *Aelothrips albicinctus*, next to *Franklinella intonsa*, *Thrips major*, *Th. Physapus*, *Chirothrips manicatus* and *Haplothrips niger*.

At Dridu, the graminicolous, aptera species *Aptinothrips rufus* was observed, with parthenogenetic reproduction, next to the dominant species *Anaphothrips obscurus*.

By the number of supraspecific taxa and by the values of structural indices, the invertebrate fauna of the canopy and herbaceous layer from Teleajen and Prahova floodplains are lower than the values recorded for Insula Mică a Brăilei (Paucă *et al.*, 1997), which is a very rich coenosis, properly balanced and with dynamic evolution compared to the microarthropods of the sites analyzed in this paper.

SOIL INVERTEBRATE FAUNA

Nematoda have the lowest counts among the different types of forest ecosystems.

In the spatial dynamics, among the investigated sites, the *Tamarix* shrublands from Scăieni have the highest counts followed by Pisculești and Dridu (Figure 11a, b).

The temporal dynamics showed higher values at Pisculești in 2000 than in 1999 (2529 and 134,000 individuals/sq.m., respectively), the peak counts being recorded in spring.

To the depth of 9 cm, the spring count was 130.7×10^3 individuals/sq.m. at Dridu, 83×10^3 individuals/sq.m. at Pisculești in 1999, 142×10^3 individuals/sq.m. in 2000 and 281.5×10^3 individuals/sq.m. at Scăeni.

Nematoda biomass follows the slope of the numerical distribution peaking in spring.

In all sites *Nematoda* fauna is dominated by Tylenchidae, but Dorylaimidae and Areolaimidae are also present.

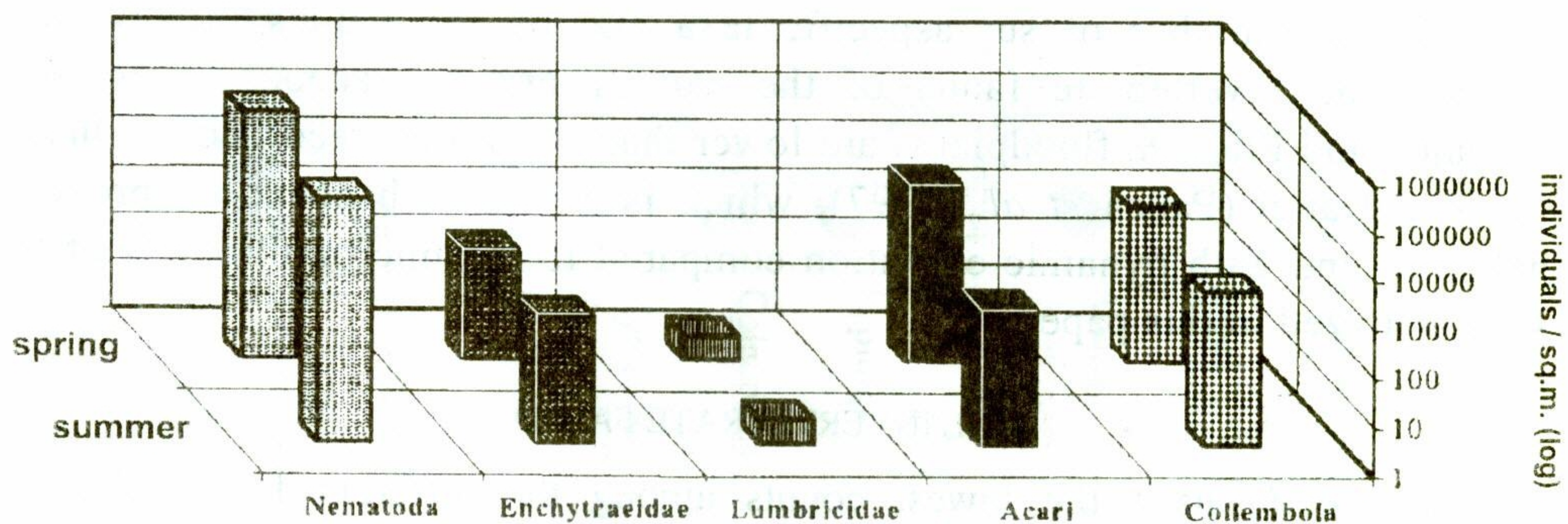
Enchytraeidae have among the lowest counts and are represented by eurybiotic, cosmopolitan species: *Achaeta eiseni* and *Fridericia ratzeli*, only the first species being observed on some areas (Pisculești, spring 1999). Some of the factors determining these low counts are both soil oxygenation and texture and the low amount of food. Higher counts were observed in the *Tamarix* shrubland from Scăeni, peaking in summer with 1.2×10^3 individuals/sq.m.

Lumbricidae were represented only by 3 species dominated by *Allophophora caliginosa* both at Pisculești and Scăeni.

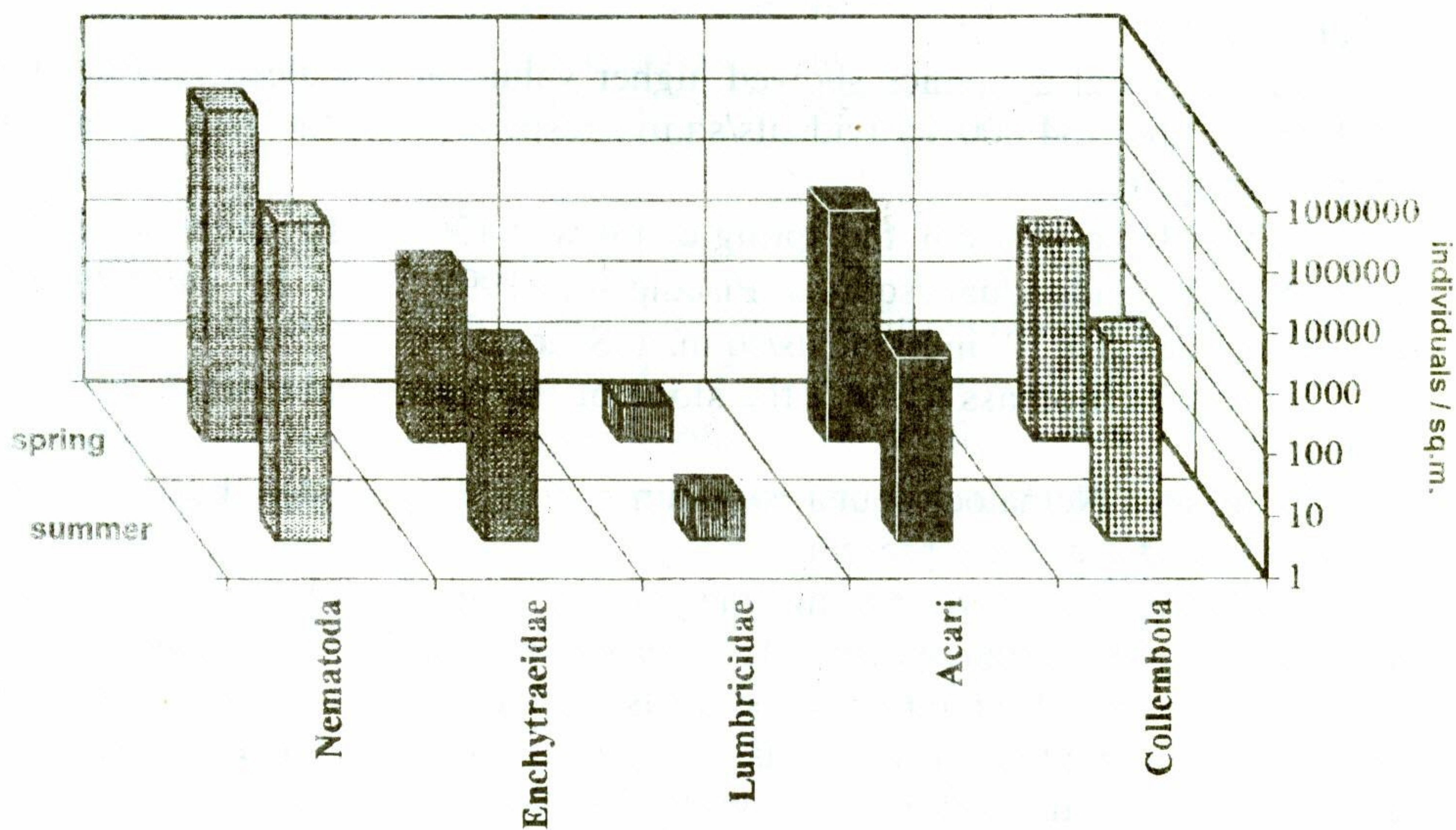
The count was low only in the layer 0–10. At Pisculești the count was 1.6 individuals/sq.m. in summer 1999 and 7 times higher in the same period of 2000 due to favourable microstational conditions.

At Scăeni, the slope of seasonal dynamics peaked in autumn, with 8.0 individuals/sq.m.

The age structure showed the high proportion of juvenile stages, 86 %, in summer at Pisculești and 67 % in autumn at Scăeni.



a.



b.

Fig. 11 – Numerical density of soil invertebrate fauna

a. Pisculești, 2000 year

b. Scăeni, 2000 year.

Acari (in total). The annual count peaked at Scăeni (3835 individuals/sq.m. in 2000 and had the lowest value at Dridu (1600 ind. sq.m.). At Scăeni the count peak was in spring with 6600 ind/sq.m.

The values of biomass density follow the evolution of the numerical density.

There is a species, *Scheloribates laevigatus*, common to all investigated *Tamarix* shrublands; *Tectocephus valeatus* and *Chamobates cuspidatus* (praticolous* species) are specific only to Pisculești, while *Dissorhina ornata*, *Microppia minus* and *Ceratopia sexipilosa* (forest species) are specific both to Pisculești and Scăeni.

The presence of praticolous species in these shrubs shows a high proportion of field covered only with grasses (20 to 40 %); the presence of forest species shows a good representation of the shrub species.

Collembola – the numerical density was low at Dridu (1000 ind./sq.m.) where the anthropic impact was the strongest.

At Pisculești and Scăeni the peak counts were recorded in spring (1800 ind./sq.m. and 2200 ind./sq.m., respectively).

The vertical distribution showed in summer a migration of collembola to the lower layer S_2 and particularly to the ground due to the high temperature of the air.

Collembola biomass was low too, in all investigated sites.

The edaphic fauna of the *Tamarix* shrublands from Teleajen and Prahova floodplains is less represented than the ground fauna of the *Tamarix* shrublands from Sulina as number and biomass of nematoda and acari; on the other hand, enchytraeidae and lumbricidae are superior qualitatively and quantitatively to the sites investigated in Sulina, where these species are almost absent due to soil structure and scarce food (Paucă, 1996).

CONCLUSIONS

The structure of primary producers is obviously different in the *Tamarix* shrublands from the banks of inland rivers than from the Danube floodplain and Delta, both as quality and as quantity.

The primary producers provide a stable frame for the biocoenoses up to 3.5 height by the shrub species dominated by *Tamarix ramosissima* in all sites; a higher quantitative presence of other woody species was only observed at Pisculești;

* grassland species.

The herbaceous layer is properly developed, covering well the ground (90 to 100 %), and with an active dynamics of biomass accumulation (2.02 kg D.W./sq.m.) and transformation in necromass and litter (3.560–2.522 kg D.W./sq.m.).

The canopy and herbaceous invertebrate fauna, belonging to two trophic modules, primary, phytophagous consumers and secondary, zoophagous consumers, is characterized by the presence of different groups in every *Tamarix* shrubland.

Microarthropod structure both in the canopy and the herbaceous layer showed a proper coenotic balance in the *Tamarix* shrublands from Pisculești and a strong anthropic influence at Dridu; the anthropic impact due to grazing and wood cutting caused a high number of Diptera and partially of Hymenoptera.

The structure of the epigeic fauna is overall more balanced at Scăieni than at Dridu and Pisculești, although typical seasonal variations for the year 2000 were determined in all three *Tamarix* shrublands under observation, partly due to the climate, to the long and deep draught; the heat and water stress is shown by the structure of the Carabid fauna that changes in the heat and draughty seasons (summer and autumn).

In the soil, the fauna of nematodes, enchytraeides, lumbricides, acari and collembola peaked numerically and as biomass at Scăieni.

The specific structure of the oribatida in the soil of *Tamarix* shrublands is dominated by *Scheloribates laevigatus*, *Tectocephus velatus* at Dridu and Pisculești and by *Dissorhina ornata* and *Micropopia minus* at Scăieni and Pisculești.

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Received November 2, 2002.

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AU-, SUMPF- UND WASSERVEGETATION DER EBENE VON NW.-RUMÄNIEN

PETRE BURESCU, NICOLAE DONIȚĂ

The inventory of the plant associations revealed a considerable number of theses but also a restriction of their area because of brutal interventions of the anthropogenic factor.

A number of 5 associations: *Angelico-Cirsietum cani* P. Burescu 1998, *Carici paniculatae - Alnetum glutinosae* P. Burescu et N. Doniță 1999, *Irideto-Caricetum otrubae* P. Burescu 1999, *Callitrichetum palustris* (Dihoru 1975 nom. nud.) P. Burescu 1999, presents scientific novelty.

Also, a number of 8 associations include rare and endangered plants (40 species) which entered the "Red list", for these being imposed the set up protection and monitoring systems; these associations are: *Stratiotetum aloidis* Nowinski 1930, *Najadetum minoris* Ubrizsy 1948, *Zannichellietum pedicellatae* Nordh. 1954 em. Pott 1992, *Nymphaeetum albo-luteae* Nowinski 1928, *Hottonietum palustris* R.Tx.1937, *Utricularietum neglectae* Th. Müller et Görs 1960 em. Pott 1978, *Lemno-Utricularietum vulgaris* Soó 1928, *Lemno-Salvinietum natantis* Miyawaki et J.Tx.1960.

Key words: plant associations, northwest Romania.

INTRODUCTION

Die niedrige, flache Ebene von Nord-Westrumänien war ursprünglich eine ganz besondere Landschaft, geprägt von riesigen Flachmoore, unzähligen Seen und Wasserflächen, unterzogen den häufigen Überschwemmungen der vielen, durch die Gegend irrenden Flüssen. Es war ein Reich der Sumpf- und Wasservegetation und der entsprechenden Fauna. Nur beschränkte Flächen waren von anderen Pflanzengesellschaften (Auenwälder, Salzwiesen u.a.) bedeckt.

Die grossen Meliorationsarbeiten die im vorrigen Jahrhundert aber auch in den letzten fünfzig Jahren durchgeführt wurden haben diese wilde Landschaft in ein typisches Landwirtschaftsland verwandelt. Die einstigen natürlichen Pflanzengesellschaften sind fast verschwunden – zB. die Moorgesellschaften sind nur auf 0,07 %, die Wasservegetation nur auf 0,55 %, die Auwiesen nur auf 1 %, die Salzwiesen nur auf 4,5 % die Auwälder nur auf 0,1 % der ganzen Fläche verbreitet.

Die auf kleinen Flächen erhaltene natürliche Pflanzengesellschaften, Zeugen der einstigen reichen biologischen Diversität, bewahren noch manche seltene, auch aussterbende Arten und sollten dringends unter Schutz gestellt werden.

Über die Au-, Sumpf- und Wasservegetation der nord – westlichen Ebene Rumäniens gibt es wenige Arbeiten. Nach älteren, mehr pflanzengeographischen Schilderungen (14, 22, 23, 25, 26) wurden erst in den näheren Zeiten pflanzensoziologische Untersuchungen unternommen (5, 6, 8, 9, 10, 11, 12, 13, 15, 16, 19, 20).

In dieser Arbeit wird eine Übersicht der bisher bekannten Au-, Sumpf- und Wasserpflanzengesellschaften dieser Ebene gegeben. Die behandelten Vegetationseinheiten sind im Sinne der neusten Arbeiten von E. Oberdorfer (18), L. Mucina *et al.* (17), R. Pott (21), A. Borhidi (4), Balátová-Tulácková E., (1, 2, 3) abgefasst.

a) **Auwälder** – kleine Flächen an den Flüssen Ieru, Crasna, Barcău, Someș auf feuchten, selten überschwemmten Böden:

Klasse: *Querco-Fagetea* Br.-Bl. et Vlieger in Vlieger 1937, em. Borhidi 1996.

Ordnung: *Fagetalia sylvaticae* (Paw.) 1928 Tx. et Diem. 1936.

Verband: *Alno-Ulmion* Br.-Bl. Und Tx. 1943 em. Müller et Görs 1958.

Unterverband: *Ulmenion* (Tx.1952) Ober.1953.

Assoziation ***Fraxino-Ulmetum*** (Tx.1952) Oberd. 1953 (Syn.: *Querco-Ulmetum* Issler 1924, *Querco-Fraxinetum* Rutki 1949, *Fraxino pannonicae-Ulmetum* Soó 1960).

Kennarten der Assoziation *Ulmus laevis*, *Ulmus minor*, *Fraxinus angustifolia* ssp. *oxycarpa*, *Quercus robur*, *Populus alba*, *Frangula alnus*, *Acer campestre*, *Cornus sanguinea*, u.a.. Zur Zeit nur auf kleinen Flächen bei Cadea, Săcuieni, Șiter-Ganaș, Hotoan, erhalten.

b) **Salzwiesen** – in den kleinen Niederungen der Ebene auf schwach – mässig salzigen Böden.

Klasse: *Festuco-Puccinellietea* Soó 1968

Ordnung: *Artemisio-Festucetalia pseudovinae* Soó 1968

Verband: *Festucion pseudovinae* Soó 1968

Assoziation ***Artemisio-Festucetum pseudovinae*** Soó in Mathé 1933 corr. Borhidi 1966.

Kennarten der Assoziation: *Festuca pseudovina*, *Artemisia maritima* ssp. *monogyna*.

Früher auf grossen Flächen, zur Zeit nur auf beschränkten Flächen mit Salzböden, im Frühling feucht und im Sommer trocken, längs des Ier-Tal bei Diosig-Săcuieni-Andrid-Hotoan.

Assoziation ***Peucedano officinalis-Asteretum punctati*** (Rapaics 1927) I. Pop 1968.

Kennarten der Assoziation: *Festuca pseudovina*, *Peucedanum officinale*. Begleiter: *Poa pratensis*, *Carex praecox*, *Potentilla argentea*, *Achillea collina*, *Bupleurum tenuissimum*, *Aster linosyris*, *Aster sedifolius*, *Podospermum canum*.

Diese Assoziation ist auf kleinen Flächen, auf Salzböden bei Diosig, Sălacea, Hotoan, verbreitet.

Kleinflächig kommen noch folgende halophile Assoziationen vor: *Hordeetum hystricis* Wendelbg. 1943, *Puccinellietum distantis* Soó 1937, *Agrostio-Caricetum distantis* Rapaics ex Soó 1938, *Camphorosmetum annuae* (Rapaics 1916) Soó 1933 corr. Soó 1968, *Heleochloëtum* (*Crypsis*) *schoenoidis* (Soó 1933) Topa 1939.

c) **Moorwälder** – auf Moorböden in den Auen des Ier-Flusses, im Diosig, am „Plaurul Vărgat” – See, im Săcuieni und im Foieni-Gemeindewald.

Klasse: *Alnetea glutinosae* Br.-Bl. et Tx. ex Westhoff und al. 1946.

Ordnung: *Alnetalia glutinosae* Tx. 1937.

Verband: *Alnion glutinosae* Malcuit 1929.

Assoziation: *Carici paniculatae* – *Alnetum glutinosae* P. Burescu und N. Doniță 1999; Tabelle 1 (Aufn.1–20)

Kennarten der Assoziation: *Alnus glutinosa*, *Carex paniculata*.

Ordnung: *Salicetalia auritae* Doing 1962.

Verband: *Salicion cinereae* Th. Müller et Görs ex Pass. 1961.

Assoziation: *Thelypteridi-Salicetum cinereae* Šamšak 1963.

Kennarten der Assoziation: *Salix cinerea*, *Thelypetris palustris*.

Gebüsche in feuchten Niederungen, auf Torfböden bei Diosig, Săcuieni, Piru Nou.

d) **Sumpfvvegetation** – auf Sumpfböden zeitweilig oder beständig von Wasser bedeckt – am Rand der Seen, Wasserpfützen, Kanäle bei Șimian, Valea lui Mihai, Vășad, Tarcea, Otomani, Hotoan u.a..

Folgenden Assoziationen, sind öfter verbreitet:

Klasse: *Phragmitetea* R.Tx. et Preising 1942.

Ordnung: *Phragmitetalia* Koch 1926.

Verband: *Phragmition communis* Koch 1926.

Assoziation: *Glycerietum maximae* Hueck 1931.

Kennarten der Assoziation: *Glyceria maxima*.

Assoziation: *Phragmitetum communis* Soó 1927 em. Schmale 1939

Kennarten der Assoziation: *Phragmites communis*.

Kompakte Schilfbestände am Rande der Seen, Wasserpfützen, auf der Ier-Ebene bei Săcuieni, Diosig, Șimian, Galoșpetreu, Otomani, Ghenci, u.a..

Assoziation: *Typhetum angustifoliae* Pignatti 1953.

– Fazies mit *Lemna minor* P.Burescu, 1999

Kennarten der Assoziation: *Typha angustifolia*. Differentialart des Fazies: *Lemna minor*.

Tabelle 1 (Fortsetzung)

Arten, Nr. der Aufnahme	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	K
<i>Menyanthes trifoliata</i>	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	I
<i>Lythrum salicaria</i>	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	I
Phragmitetea																					
<i>Berula erecta</i>	+	+	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	II
<i>Sium latifolium</i>	+	.	.	+	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	II
<i>Ranunculus lingua</i>	+	+	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	II
<i>Calystegia sepium</i>	+	.	.	+	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	II
<i>Scrophularia umbrosa</i>	+	.	+	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	II
<i>Glyceria maxima</i>	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	I
<i>Phragmites communis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	I
<i>Alisma plantago-aquatica</i>	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I
<i>Typha latifolia</i>	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	I
<i>Stachys palustris</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I
<i>Epilobium hirsutum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I
<i>Sparganium erectum ssp. neglectum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I
<i>Schoenoplectus lacustris</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I
Bidentetea																					
<i>Polygonum lapathifolium</i>	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	III
<i>Polygonum hydropiper</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I
<i>Rumex palustris</i>	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I
<i>Stellaria media</i>	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Bidens cernua</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I

Tabelle 1 (Fortsetzung)

Arten, Nr. der Aufnahme	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	K
Molinio-Arrhenatheretea																					
<i>Equisetum palustre</i>	1	+	1	1	1	+	1	1	1	+	.	.	.	.	.	.	.	.	.	.	III
<i>Lysimachia vulgaris</i>	.	.	.	.	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	II
<i>Ranunculus acris</i>	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	
Begleiter																					
<i>Circaea lutetiana</i>	+	.	+	+	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	II
<i>Geranium robertianum</i>	+	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I
<i>Geum urbanum</i>	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	.	I
<i>Salix fragilis</i>	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	I
<i>Lemna gibba</i>	.	.	.	.	.	.	.	.	.	.	2	2	2	1	.	.	.	2	+	2	II
<i>Spirodela polyrhiza</i>	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	1	2	.	.	.	I

Aufnahmeorte: 1–10. Lunca Văii Fazanului com. Diosig; 11–20. Lacul Plaurul Vărgat com. Săcueni.

Reine Bestände in Kanäle, Seen mit beständigen Wasser in der Ier-Ebene bei: Vășad, Șilindru, Valea lui Mihai, Galoșpetreu, Otomani, Tarcea, Ghenci.

Assoziation: *Schoenoplectetum lacustris* Chouard 1924.

Kennarten der Assoziation: *Schoenoplectus lacustris*.

Kolonien in Wasserpfützen, Kanäle, Seen ohne Schilf, auf moorig-sandige Böden beständig von Wasser bedeckt bei Vășad, Galoșpetreu, Otomani, Tarcea, Hotoan.

Assoziation: *Bolboschoenetum maritimi* Eggler 1933.

Kennarten der Assoziation: *Bolboschoenus maritimus*.

Ringe an schwach salzhaltigten Seen, Wasserpfützen, Sümpfen in der Ier-Ebene bei: Vășad, Valea lui Mihai, Otomani, Hotoan.

Ordnung: *Magnocaricetalia* Pignatti 1953.

Verband: *Magnocaricion elatae* Koch 1926.

Unterverband: *Caricenion gracilis* (Neuhäusl 1959) Oberd. et al. 1967.

Assoziation: *Caricetum gracilis* (Almguist 1919) Graebner et Hueck 1931.

Unterass.: – *equisetetosum palustris* P. Burescu 1999.

Kennarten der Assoziation: *Carex gracilis*. Differentialarten der Unterassoziation: *Equisetum palustris*.

Auf saueren, immer wasserbedeckten Sumpfflächen bei Cadea, Săcuieni, Șimian, Căuaș, Hotoan.

Assoziation: *Caricetum acutiformis* Eggler 1933.

– Fazies mit *Phragmites communis* P. Burescu 1999.

– Fazies mit *Mentha aquatica* P. Burescu 1999.

Kennarten der Assoziation: *Carex acutiformis*. Differentialarten der Fazies: *Phragmites communis*, *Mentha aquatica*.

Ringe an Wasserpfützen, Seen, Sumpfgränder auf zeitweilig überschwemmten Tonböden in der Ieru – Ebene bei Șiamian, Șilindru, Vășad, Diosig, Galoșpetreu, Otomani, Hotoan.

Assoziation: *Irideto-Caricetum otrubae* P. Burescu 1999; Tabelle 2 (Aufn.1–7).

Kennarten der Assoziation: *Carex otrubae*, *Iris pseudacorus*.

Tabelle 2

Irideto - Caricetum otrubae P. Burescu 1999

Nr. der Aufnahme	1	2	3	4	5	6	7	K
Meereshöhe (m ü. M.)	110	128	116	117	117	120	120	
Aufnahmefläche (m ²)	20	100	100	80	40	100	100	
Deckungsgrad (%)	50	90	95	80	80	80	100	
Kennarten der Assoz.								
<i>Carex otrubae</i>	3	4	5	4	4	4	5	V
<i>Iris pseudacorus</i>	+	.	+	+	+	+	+	V

Tabelle 2 (Fortsetzung)

Arten, Nr. der Aufnahme	1	2	3	4	5	6	7	K
Caricenion gracilis								
<i>Mentha aquatica</i>	+	+	.	+	+	+	+	V
<i>Carex riparia</i>	+	.	+	+	.	+	1	IV
<i>Carex vulpina</i>	+	.	.	+	+	.	.	III
<i>Carex vesicaria</i>	+	.	.	.	.	.	.	I
<i>Poa palustris</i>	.	+	+	.	.	+	+	III
Magnocaricion, Magnocaricetalia								
<i>Galium palustre</i>	.	+	.	.	.	+	+	III
<i>Lysimachia vulgaris</i>	.	+	.	.	.	+	+	III
<i>Lathyrus palustris</i>	.	+	.	.	.	.	.	I
<i>Calamagrostis canescens</i>	.	.	.	.	+	+	.	II
Phragmitetea								
<i>Lycopus europaeus</i>	.	.	.	.	+	+	+	III
<i>Stachys palustris</i>	.	.	.	+	+	.	.	II
<i>Calystegia sepium</i>	.	.	.	+	+	.	.	II
<i>Polygonum amphibium</i> <i>f.terrestre</i>	+	.	.	+	+	.	.	III
<i>Schoenoplectus lacustris</i>	.	.	.	+	1	.	.	II
<i>Glyceria maxima</i>	.	+	.	.	.	.	.	I
Nasturtio-Glycerietalia								
<i>Myosotis scorpioides</i>	.	.	.	.	.	+	+	II
<i>Berula erecta</i>	.	.	+	.	.	.	.	I
Oenanthetalia								
<i>Eleocharis palustris</i>	+	+	+	.	.	.	.	III
<i>Alisma plantago-</i> <i>aquatica</i>	+	.	+	.	.	.	.	II
Molinio-Arrhenatheretea								
<i>Ranunculus acris</i>	.	+	.	+	+	+	+	IV
<i>Caltha palustris</i> <i>ssp.laeta</i>	.	2	.	.	.	+	+	III
<i>Potentilla reptans</i>	.	.	.	+	+	.	.	II
<i>Lythrum salicaria</i>	+	+	.	+	+	+	+	V
<i>Symphytum officinale</i>	.	.	.	+	+	+	.	III
<i>Gratiola officinalis</i>	.	.	.	.	.	+	+	II
<i>Trifolium hybridum</i>	.	.	.	.	.	1	+	II
<i>Orchis laxiflora</i>	.	+	.	.	.	.	.	I
<i>Juncus articulatus</i>	.	+	+	1	+	.	.	III
<i>Juncus effusus</i>	.	.	.	+	+	+	+	III

Tabelle 2 (Fortsetzung)

Arten, Nr. der Aufnahme	1	2	3	4	5	6	7	K
<i>Juncus inflexus</i>	+	+	.	.	.	.	.	II
<i>Juncus subnodulosus</i>	.	.	.	.	.	+	+	II
<i>Agrostris stolonifera</i>	.	.	.	+	+	.	.	II
Begleiter								
<i>Rumex conglomeratus</i>	.	.	.	+	+	+	+	III
<i>Myosoton aquaticum</i>	.	.	+	.	.	.	.	I
<i>Solanum dulcamara</i>	.	.	.	.	.	+	.	I
<i>Carex paniculata</i>	.	.	+	+	.	.	.	I
<i>Rubus caesius</i>	+	.	.	.	.	+	.	II
<i>Salix cinerea</i>	.	.	.	.	.	+	+	II
<i>Frangula alnus</i>	.	.	.	.	.	+	.	I

Einmal vorkommende Begleiter: *Lysimachia nummularia* (1); *Lathyrus pratensis* (2); *Alopecurus pratensis* (7); *Festuca arundinacea* (7); *Potentilla anserina* (2); *Althaea officinalis* (5); *Lychnis flos-cuculi* (7); *Cirsium canum* (2).

Aufnahmeorte: 1. Mlařtina Ecedea com. Căpleni; 2. Balta Resighea com. Piřcolt; 3. Mlařtina Căuař; 4–5. Balta Ghenci; 6–7. Lunca Someřului com. Pomi.

Die Asoziation wurde in den Ecedea-Sümpfe – Gemeinde, Căpleni, Resighea Pfütze – Gemeinde Piscolt, Ghenci Pfütze – Gemeinde Ghenci, Someř Au – Gemeinde Pomi gefunden.

Aus dieser Klasse sind auch andere, für die Wissenschaft interessante Assoziationen zu erwähnen: *Typhetum latifolie* Lang 1973, *Glycerietum fluitantis* Eggler 1938, *Sparganietum erecti* Roll 1938 *Alismato-Eleocharitetum* M.Kovács et Máthé 1967, Unterass. – *eleocharietosum palustris* P. Burescu 1999, *Rorippo amphibiae* – *Oenanthetum aquaticae* (Soó 1928) Lohmeyer 1950, *Caricetum ripariae* Soó 1928, *Caricetum vesicariae* Chouard 1924.

Klasse: *Molinio-Arrhenatheretea* R.Tx.1937.

Ordnung: *Molinietalia* Koch 1926.

Verband: *Calthion* R.Tx. 1937.

Assoziation: *Angelico-Cirsietum cani* P. Burescu 1998 (Tabelle 3, Aufn.1–13).

Kennarten der Assoziation: *Cirsium canum*, *Angelica sylvestris*.

Feuchte Wiesen in den Niederungen ohne Ausfluss, mit Grundwasser an der Oberfläche, entlang der Ier-Ebene bei řilindru, Săcuieni, Tarcea, Galořpetreu, Ghenci, in der Buduslău-Ebene bei “Părau Crestur”-Sumpf, “Plaurul Vărgat”-See, Săcuieni, in der Carei-Ebene bei Curtuiřeni-Sumpf.

[illegible]

Tabelle 3 (Fortsetzung)

Arten, Nr. der Aufnahme	1	2	3	4	5	6	7	8	9	10	11	12	13	K
<i>Scrophularia umbrosa</i>	.	.	.	.	+	.	.	.	.	.	.	+	.	I
<i>Berula erecta</i>	.	.	+	+	.	.	+	.	.	.	.	.	.	II
<i>Sium latifolium</i>	.	.	+	+	.	+	.	+	.	.	.	.	.	II
<i>Iris pseudacorus</i>	.	+	.	.	.	.	+	.	.	.	.	.	.	I
<i>Carex acutiformis</i>	.	+	.	.	+	2	+	.	.	.	+	+	2	III
<i>Carex gracilis</i>	.	.	+	.	.	.	.	.	1	+	.	.	.	II
<i>Carex riparia</i>	.	.	+	+	.	.	+	.	.	.	.	.	.	II
<i>Carex vulpina</i>	.	+	+	.	.	+	.	.	.	.	.	+	.	II
<i>Carex vesicaria</i>	.	.	.	.	.	.	.	.	.	.	+	+	.	I
<i>Glyceria maxima</i>	.	.	.	.	.	.	+	.	.	.	.	.	.	I
<i>Phragmites communis</i>	.	.	.	.	.	.	+	.	.	.	.	.	.	II
<i>Poa palustris</i>	.	.	.	.	.	.	.	.	.	.	.	+	+	I
Bidentetea														
<i>Rumex conglomeratus</i>	.	+	.	.	.	+	+	.	.	.	+	.	.	II
<i>Polygonum mite</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	I
<i>Galega officinalis</i>	.	.	.	+	.	.	.	.	.	.	.	.	.	I
<i>Xanthium strumarium</i>	.	.	+	.	.	.	.	.	.	.	.	.	.	I
Begleiter														
<i>Lysimachia punctata</i>	+	+	.	.	.	.	.	.	.	.	.	.	.	I
<i>Cephalaria pilosa</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	I
<i>Cirsium arvense</i>	.	.	+	.	+	.	+	.	.	.	.	+	+	II
<i>Erigeron annuus</i>	.	.	.	.	.	+	.	.	.	.	.	.	.	I
<i>Alnus glutinosa</i>	.	.	.	.	.	.	.	.	+	.	.	.	.	I
<i>Salix cinerea</i>	.	.	.	.	.	+	.	.	.	+	.	.	.	I

Einmal vorkommende Begleiter: *Centaurea pannonica* (1); *Pastinaca sativa* (2); *Oenanthe aquatica* (4).
Aufnahmeorte: 1–2. Lacul Șilindru com. Șimian; 3–4. Mlaștina Verneș com. Sanislău; 5. Mlaștina Galoșpetreu; 6. Mlaștina Curtuișeni; 7. Mlaștina Tarcea; 8–10. Lacul Plaurul Vărgat; 11–13. Mlaștina Pârâu Crestur.

Assoziation: *Calthetum laetae* V. Krajina 1933.
Unterass.: – *caricetosum leporinae* P. Burescu 1999.
Kennarten der Assoziation: *Caltha palustris* ssp. *laeta*. Differentialarten der Unterass.: *Carex leporina*.

Auf kleinen Flächen in Niederungen, auf fast ganzjährliche von Wasser bedeckten hydromorphen Böden bei Șimian, Săcuieni, Tarcea, Hotoan.

Verband: *Agrostion stoloniferae* Soó (1933) 1971.

Assoziation: *Agrostetum stoloniferae* (Újvárosi 1941) Burduja und al. 1956.

– Fazies mit *Phragmites communis* P. Burescu 1999.

– Fazies mit *Juncus effusus* Zaharia 1972.

– Fazies mit *Juncus inflexus* Zaharia 1972.

Kennarten der Assoziation: *Agrostis stolonifera*. Differentialarten der Fazies: *Phragmites communis*, *Juncus effusus*, *Juncus inflexus*.

Feuchte Wiesen in Niederungen ohne Ausfluss, periodisch überschwemmt entlang dem Ier-Tal bei Săcuieni, Tarcea, Otomani, Hotoan.

Auf moorigen Flächen sind auch andere, für die Wissenschaft interessante. Assoziationen aus dieser Klasse zu finden: *Scirpetum sylvatici* Ralski 1931, *Ranunculeto (strigulosi) – Equisetetum palustris* Gh. Popescu (1974) 1975, *Calamagrostietum pseudophragmites* Kopecki 1968, *Poëtum pratensis* Răv. Căzăc. und Turenschi 1956, *Poëtum trivialis* Soó 1940, *Carici vulpine-Alopecuretum pratensis* (M.Kovács et Máthé 1967) Soó 1971 cor. Borhidi 1996, *Agrostio-Deschampsietum caespitosae* (Soó 1928), Újvárosi 1947, *Juncetum effusi* Soó (1931) 1949 – Unterass. *Agrostetosum stoloniferae* P. Burescu 1999, *Junco inflexi-Menthetum longifoliae* Lohmeyer 1953.

e) **Wasservegetation** – schwimmende, zweischichtige Pflanzengesellschaften in stehenden und fliessenden Gewässer, reich an Mineralsalzen im Ier-Tal bei Șimian, Cadea, Săcuieni, Diosig, Tarcea, Hotoan.

Klasse: *Lemnetea* de Bolós et Masclans 1955.

Ordnung: *Lemnetalia minoris* de Bolós et Masclans 1955.

Verband: *Lemnion minoris* de Bolós et Masclans 1955.

Assoziation: *Lemnetum minoris* Soó 1927.

Kennarten der Assoziation: *Lemna minor*, *Lemna trisulca*, *Spirodela polyrrhiza*.

Bistratifizierte, schwimmende Pflanzengesellschaften welche in stehenden und sanft fliessenden Gewässer, reich an Mineralsalzen vorkommen.

Assoziation: *Lemno-Hydrocharitetum morsus-ranae* (Oberd.) Pass. 1978.

Kennarten der Assoziation: *Hydrocharis morsus-ranae*, *Lemna minor*.

In stark eutrophen Gewässer, mit basischer Reaktion bei Șilindru, Diosig, Adoni, Tarcea, Otomani, Hotoan, Piru Nou.

Assoziation: *Lemno-Salvinietum natantis* Miyawaki et Tx. 1960.

Kennarten der Assoziation: *Salvinia natans*, *Lemna minor*, *Utricularia vulgaris*.

In windgeschützten Schilflichtungen der alten Armen und verstopften Kanäle mit beständigen Wasser bei Diosig, Adoni, Tarcea, Otomani, Salacea.

Assoziation: *Stratiotetum aloidis* Novinski 1930.

– Fazies mit *Lemna trisulca* P. Burescu 2000.

Kennarten der Assoziation: *Stratiotes aloides*, *Hydrocharis morsus-ranae*, *Lemna trisulca*.

Früher auf grösseren Flächen in stillen Gewässer im Kolmatationstadium bei Otomani und Hotoan.

Assoziation: ***Ceratophylletum demersi*** Hild 1956.

Kennarten der Assoziation: *Ceratophyllum demersum*, *Najas minor*, *Utricularia vulgaris*, *Myriophyllum spicatum*.

Unterwasserpflanzengesellschaften in alten Gewässer bei Șilindru, Șimian, Galoșpetreu, Vășad, Hotoan.

Aus dieser Klasse gibt es auch andere Assoziationen, wie: *Lemnetum gibbae* Bennemma *et al.* 1943 em. Miyawaki *et J.*Tx. 1960, *Spirodeletum polyrhizae* W.Koch 1954, *Lemno-Utricularietum vulgaris* Soó 1928, *Salvinio-Hydrocharitetum* (Oberd. 1957), Boșcaiu 1966.

Klasse: *Potametea* R.Tx. und Reising 1942.

Ordnung: *Potametalia* Koch 1926.

Verband: *Potamion lucentis* Rivas Mrtinez 1973.

Assoziation: ***Myriophyllo-Potametum*** Soó 1934.

Kennarten der Assoziation: *Myriophyllum spicatum*, *Potamogeton crispus*.

Unterwasserpflanzengesellschaften die in seichten Gewässer mit sapropelischen Schlamm bei Vășad, Otomani, Hotoan vorkommen.

Ordnung: *Callitricho-Batrachietalia* Passarge 1978.

Verband: *Ranunculion aquatilis* Passarge 1964.

Assoziation: ***Ranunculetum aquatilis*** Géhu 1961.

Kennarten der Assoziation: *Ranunculus aquatilis*, *Utricularia vulgaris*, *Myriophyllum spicatum*, *Ceratophyllum demersum*.

Unterwasserpflanzengesellschaften in nicht zu tiefen Gewässer bei Vășad, Otomani, Hotoan.

Assoziation: ***Callitrichetum palustris*** (Dihoru 1975 nom.nud.) P. Burescu 1999 b; Tabelle 4 (Aufn.1–20).

Kennarten der Assoziation: *Callitriche palustris*.

Unterwasserpflanzengesellschaften in klaren sauerstoffreichen, nicht so tiefen Gewässer, auf moorige-sandigen Böden, zwischen Schilf und Rohrichte entlang dem Ier-Tal, in der Buduslău-Ebene: “Pârâu Crestur” -Sümpfe, Buduslău-See neben den Forstkanton, “Plaurul Vărgat”-See, Gemeinde Săcuieni; in der Barcău-Ebene: Tămășeu-Barcău Kanal, Gemeinde Biharia; in der Carei Ebene, “Via Baroti” – Sümpfe, Gemeinde Curtuișeni.

Assoziationen mit begrenzter Verbreitung sind: *Potametum nodosi* (Soó 1960) Segal 1964, *Najadetum minoris* Ubrizsy 1948, *Zannichellietum pedicelatae* Nord. 1954 em.Pott.1992, *Hottonietum palustris* Tx.1937, *Nymphaeetum albo-luteae* Nowinski 1928, *Utricularietum neglectae* Th. Müller *et* Görs 1960, em. Pott 1979.

Tabelle 4

Callitrichetum palustris (Dihoru 1975 nom. nud.) P. Burescu 1999
– Fazies mit *Lemna minor* P. Burescu 1999 (rel. 3–8)

Nr. der Aufnahme	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	K
Meereshöhe (m ü. M.)	150	150	150	150	150	150	150	150	155	155	155	155	155	125	110	110	110	125	125	142	
Aufnahmefläche (m²)	4	3	3	2	3	2	3	4	4	4	6	6	4	3	6	6	10	5	4	2	
Deckungsgrad (%)	90	65	70	100	95	80	45	70	90	90	95	85	65	80	95	95	95	100	90	90	
Kennart der Assoz.																					
<i>Callitriche palustris</i>	5	4	4	3	5	4	3	4	5	5	5	4	4	3	5	5	5	5	5	5	V
Ranunculion aquatilis, Callitriche-Batrachietalia, Potametea																					
<i>Ranunculus aquatilis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	I
<i>Ranunculus trichophyllus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	I
<i>Potamogeton crispus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	I
<i>Sagittaria sagittifolia</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	I
Lemnetea																					
<i>Lemna minor</i>	+	+	1	4	1	2	1	1	.	.	.	.	.	+	+	+	+	1	1	.	IV
Phragmitetea																					
<i>Sparganium erectum</i>	.	+	.	.	+	.	+	.	.	.	+	2	1	3	.	.	.	+	+	.	III
<i>ssp.neglectum</i>																					
<i>Stachys palustris</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	I

Tabelle 4 (Fortsetzung)

Arten, Nr. der Aufnahme	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	K
<i>Oenanthe aquatica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I
<i>Myosotis scorpioides</i>	.	.	.	.	.	.	.	.	+	.	1	+	+	+	.	.	.	.	.	.	II
<i>Alisma plantago-aquatica</i>	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	+	II
<i>Berula erecta</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	I
<i>Veronica anagallis-aquatica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	+	I
<i>Eleocharis palustris</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	I
<i>Schoenoplectus lacustris</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I
<i>Glyceria maxima</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	I
<i>Glyceria fluitans</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	I
<i>Phragmites communis</i>	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	.	.	+	.	.	II
<i>Typha latifolia</i>	.	+	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	I
<i>Carex acutiformis</i>	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	.	.	.	.	.	I
<i>Carex vesicaria</i>	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	+	+	.	II
.	Begleiter																				
<i>Lycopus europaeus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	I
<i>Polygonum hydropiper</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	I

Aufnahmeorte: 1–8. Mlaştina Pârâu Crestur; 9–14. Lacul Buduslău-Canton Silvic; 15–17. Canal Tămăşeşu-Barcău Biharia; 18–19. Canal Via Baroti com. Curtuişeni; 20. Lacul Plaurul Vărgat Săcueni.

Acht der vorherr angeführten Assoziationen enthalten 40 gefährdete Pflanzenarten der Rotliste. Es handelt sich um die Assoziation: *Stratiotetum aloidis* Nowinski 1930, *Najadetum minoris* Ubrizsy 1948, *Zannichellietum pedicellatae* Nordh. 1954 em. Pott 1992, *Nymphaeetum albo-luteae* Nowinski 1928, *Hottonietum palustris* R.Tx.1937, *Utricularietum neglectae* Th. Müller et Görs 1960 em. Pott 1978, *Lemno-Utricularietum vulgaris* Soó 1928, *Lemno-Salvinietum natantis* Miyawaki et J.Tx.1960.

Besondere Schutzmassnahmen im Fall dieser Assoziation sind dringend nötig.

In der gegenwärtiger Landschaft sind noch vorhanden:

– Nitrophyle Unkräutergesellschaften aus der Klasse *Bidentetea tripartitae* R.Tx et al. In Tx. 1950, Ordnung *Bidentetalia* Br.-Bl. et R.Tx. “ex” Klika & Hadac 1944, Verband *Bidention tripartiti* Nordhagen 1940 em. R.Tx. în Poli et J.Tx. 1960: *Polygono hidropiperi-Bidentetum* Lohm. In tx. 1950, *Polygono laphatifolio-Bidentetum* Klika 1935, *Xanthio strumarii-Bidentetum* Timár 1947, *Bidentetum cernui* Slavnič 1951, *Echinochloo-Polygonetum laphatifolii* Soó et Csűrös 1947, Unterass. *Chlorocyperetosum glomerati* P.Burescu 1999.

– Halbnatürliche Wiesenassoziationen: *Lolio-Potentilletum anserinae* (Rapaics 1927) Knapp 1946, *Trifolio (fragifero)-Cynodontetum* Br.-Bl. et Bolos 1958, *Alopecuretum pratensis* Soó 1938, *Agropyretum repentis* Felföldy 1942, u.a..

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Vorgelegt am Januar 2000.

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PROF. DR. CONSTANTIN TOMA ON HIS 65TH ANNIVERSARY

The Gugești village, in the Botești commune, Vaslui county, has as neighbors, gifted by Mother Nature, some majestic oak forests, and some glades and clearings, which compete with one another in beauty and tranquility. It also has some lakes destined by eternity to reflect in their brilliance the rays of the sun, the light of the moon, as well as the magic twinkling of the stars at clear nights.

The beauty of these places confirms our faith that it was over there that the great Stephen retired, after the bloody battles from Podu Înalt, as to raise songs of praise to the sky for the historical defeat of the Turks.

Among the hardworking peasants of the village, retired as if in solitude, there lived, until after the Second World War, the farmer and skinner Irimia Toma, who, together with his wife, Virginia Toma, wished their children to rise above the wants implied by the struggling and humble life of those who labor in the field.

Born in the second quarter of the 20th century (November 19th 1935) and originating from a family that knew how to value honesty and truth, professor Constantin Toma did not enjoy a very plentiful childhood, especially since his father, being a called-up reservist, spent more time on the front than at home. Together with his five younger brothers and sisters, he did enjoy, as he sometimes likes to confess, a great deal of affection. He represents the dignified example of the person born in the countryside who never denies his origin, but on the contrary, he is proud of it. He completed the first two grades of elementary school (1943–1945) in the native village, and the other two (1945–1947) in Huși.

Being a good student, and eager to “move on”, after several attempts (military high-school, theological seminar), he enrolled, in 1947, at “Cuza Vodă” high-school in Huși. After less than a month, his father, following an accident, although admitted to hospital and operated on, died on the 14th of October, on Saint Paraschiva’s day. Thus, the guiding parent was gone.

Under such circumstances, the pupil Constantin I. Toma wanted to interrupt his studies to provide help to his family, being the eldest (12 years old) of the six children. His mother, although overwhelmed by sadness and burdened with wants, did not agree. Interweaving with mastership, in the same thread, the deceased husband's dream and her noble sacrifice, she did everything in her power so that her son could continue his studies.

The education reform of 1948 created even more difficulties in his existence as a student, being forced to continue his second cycle of the elementary school in his native village (1948–1950), and the secondary studies (grades 8th through 11th) at “Cuza Vodă” high-school in Huși.

With his chin always up and with great confidence that the chosen path would eventually get him where he wanted, the pupil of those times has never forgotten that he went to school due to great family sacrifices. He also enjoys to recollect the high-school years, decisive in his intellectual formation, directing a well-deserved gratitude towards his teachers, and especially to his biology teacher, Elena Chirică, whom he mentions among the great guides of his life.

After graduating from high-school in meritorious conditions, Constantin Toma took the admission exam at the Faculty of Natural Sciences in Iași. As a student, not benefiting from a scholarship because of the hindrances from those times, he had to work for nights, unloading coal wagons, in order to ensure a minimum daily existence and at the same time to send some money to the other members of the family, out of the little he had. Maybe the highest satisfactions cannot be really tasted unless by the one who has the courage, temerity and resistance to climb the defying mountain of life, even in one’s knees if one has to.

During his University years, he was always in the top group, proving not only skill and passion for the study of natural sciences, but also real researcher aptitudes, participating in scientific sessions of the student circles on numerous occasions. The prizes that he obtained under those circumstances constitute as many proofs as support the above.

He was very lucky to attend, during his university studies, lectures taught by great personalities of Romanian biology, like the Academy members Petre Jitariu and Olga Necrasov, as well as professors Mihai Constantineanu, Constantin Popp, Sergiu Cărbăușu, Zicman Feider, etc. A really special role was played by Professor Constantin Burduja who, in 1958, invited him to participate in the contest for the

employment of a laboratory assistant in the subject "The Morphology and Anatomy of Plants", where, as a professor, he was his true mentor for over 25 years.

In 1957 he married Leontina Schmidt, thus founding a family. She offered him the most precious gift of life, his son, Ovidiu, who is at present a university professor within the Department of Biochemistry of "Gh.Asachi" University of Iași.

His attachment to discipline, his love, passion and skill in solving the problems devolved on him, rapidly placed him in the center of attention, and thus he was promoted in 1959 as a university assistant, position that he occupied until 1966, when he became a lecturer.

In 1962, he enrolled for a doctor's degree, in the specialty of Botany, at the University of Bucharest, under the guidance of the reputed morphologist Ion T. Tarnavschi, having as subject "Morphologic and Anatomo-histological Researches on the Species *Trifolium* L., *Onobrychis* Scop. and *Coronilla* L. from Romania". He defended his thesis on the 11th of December 1969, having as chairman of the board N. Botnariuc, member of the Academy, and as reviewers Prof. Dr. D. Gr. Constantinescu, Prof. Dr. Gh. Anghel and Prof. Dr. C. Burduja.

In the academic year 1971–1972, he went to a specialization at the Carnoy Laboratory from the Catholic University in Louvain – Belgium, directed by the reputed professor P. Moens.

With such ascending lines, Constantin Toma went through the other two university stages (associate professor in 1972 and professor since 1978) in a record time for those days. None of his promotion or even generation colleagues achieved such a performance. For more than 40 series of students whom he taught, he became a personality of the first rank. He became so appreciated as a botanist, and especially as a morphologist, that in time he could afford a slight independence of his illustrious predecessors, even expressing distinct hypotheses on some issues.

Armed with a great intellectual energy and with many years of experience and work, Prof. C. Toma manages to confer to the domain to which he devoted the actuality it needs. Following Professors C. Papp and C. Burduja, he has succeeded not only in preserving all-through the years the Morphology and Anatomy of Plants school of Iași, but also in consolidating it, giving it a new shine. He is truly an academic spirit, a doctor's degree adviser (from 1988) of great authority, who knows and can do more than he shows. His lectures enjoy a good audience, asserting by means of a severe intellectual discipline, supported by a good ordering of ideas and a clear expression. The ones that he edited (as such, or under the form of eight academic manuals) as main author and as co-author, are written in a careful and analytical way, stimulating the student to a mental game, to a pleasant and captivating reading. In the amphitheater or in the laboratory, as well as outside

these, he takes constant care that the academic education goes on the path that it deserves.

Calculated and authoritarian, he wishes to imprint his collaborators passion for the research work. He has the talent to create a comforting state of good around him. The people consider him a binder of team solidarity. He is fair in appreciations and he treats earnestly all his colleagues. He pays special attention to those who come from behind, whom he selects and guides attentively. Generous with the younger generation, paying attention to what they are working on, he guides them tactfully, without imposing on them a certain point of view, only lucidity.

Having become an authority hard to contest, and always being in an equilibrium that cannot be inclined, he has had the tact to solve conflicts. It is known that until recently the Biology Faculty of Iași has benefited from the support of two great professors: Corneliu Zolyneak and Napoleon Topala. The link between them was Prof. C. Toma, and when situation demanded it, the spiritual bridge between the two and the teaching staff of the faculty was also Prof. C. Toma. Assuming sometimes even the role of the edge, he shows the mastership to do that gesture of intellectual solidarity, especially when there are valuable people involved. Personally, I have found that in difficult situations you can rely on his help, about which he keeps a delicate discretion.

Like any person inclined to study, he tried to avoid doing administrative work. But due to his managerial qualities, he had to do it. Since he was 35 years old until present, no matter what teaching position he occupied, the University entrusted him many responsibilities, placing him on the chessboard of the administrative activities any time it was necessary. As the director of the Botanical Gardens of Iași (1970–1973), where he followed the reputed botanist Emilian Țopa, who had laid the foundations of this prestigious institution, he showed a remarkable practical sense, proving that he knew how to elaborate and support long-term projects and works. Among these, there are to be mentioned the project of constructing the “Palmariu” greenhouse, the creation of a useful plants section, etc.

Showing industriousness, seriousness, strictness, and especially self-strictness, he was entrusted, between 1975 and 1977, the position of vice-dean of the Faculty of Biology-Geography-Geology, quality in which, with his characteristic clairvoyance, he knew how to maintain the balance between the three sections which later became self-supporting faculties.

As head of the Biology Department, between 1986 and 1996, position that spiritually he feels to be the most tied to, he proved that he did not appreciate the hastily-done work, the lack of rigor, and the half-performed duty. Respecting work,

attachment, skill, and the points of view of the department colleagues, he saluted, supported and promoted values. And, as far this issue is concerned, I think that the list of those who owe him their career is quite long.

As a director of the Biological Research Institute of Iași (1986–1990), where, according to his own confession, he engaged into a responsibility far greater than he could have imagined, he managed to keep things under control. Dynamic, modern, flexible, but exact in attitudes, he knew how to impose his points of view, which were typical to vocational leaders.

Taking over, in 1989, the management of the Faculty of Biology, in Iași, he was the victim of several disparagements, to which he could not respond immediately. Nevertheless, he proved to be capable to rise above them and surpass them unaffected. In 1996, resuming the position of dean – which he still holds at present – he proved that he had the force to calm things down, and lead them towards the area of the rational. Having the intuition of knowing when and how to retire, or – on the contrary – when to keep the initiative, he has numerous achievements recognized through all the country and appreciated abroad, which the Faculty of Biology from Iași is proud of.

Endowed with that availability to relate to the audience, in front of which he presents himself as a very good speaker, capable of convincing the audience, Professor C. Toma has the mastership to represent the faculty at an advanced level. No matter how many preoccupations he might have, he makes time to be present at anniversary or commemorative moments of personalities to whom he pays proper homage. As far as this issue is concerned, there are revealing his over 30 articles edited by various publications.

We can have an even more complete image of Professor C. Toma when we evaluate his scientific activity. The great number of papers (over 300 titles) and the variety of the approached topics confirm an exceptional scientific evolution. As I cannot afford an exhaustive presentation of these, I shall limit myself in the following lines to their general presentation.

Especially useful and convincing researches are those of floristics, chorology and phytocoenology, where there are presented intra-specific species and units which are new to the flora of Moldavia, rarely or not mentioned in the flora of Romania. For some areas, the author even publishes their integral flora, and for others (Cotnari), he shows which are the vegetal associations that accompany the agricultural cultures. He is also very well-informed regarding the 400 decorative ligneous species of the ornamental flora of Moldavia, emphasizing that among these 14 have not been signalled in the area yet, and a new form is not mentioned in the flora of Romania. Also meticulous and exact is the bio-static study of the leaf of the Romanian beech species.

Exactly and correctly performed are also the blastogeny researches. Using the method of statistic calculation and starting with concrete facts regarding the morphology of the plantlets of over 100 leguminous plants, Professor C. Toma has the merit of presenting new data, which can lead to their more rapid identification.

The morphology and structure of the stipels, studied also in the case of 100 species of leguminous plants, led the author to emphasize that the results, mostly original, have a great applicability in taxonomy and phytocoenology, especially for the determination of the plants that are not yet blossomed.

The morphology and structure of the buds, studied in ontogenesis at 30 species of trees, and of leaves at over 80 species of fruit bearing trees and shrubs, emphasizes that the author is not only well-informed with everything that appears in this field, but also proves that he can bring valuable scientific contributions to adjacent domains.

Meritorious and doubtlessly more than meritorious are also his works in the field of ecological anatomy. Researching from this point of view the plants pertaining to fields and plains, mountainous and alpine, sands and salt marshes etc., these studies, besides their theoretical importance, also have a practical one in the appreciation of the lawns and forests productivity.

A major domain to which proper attention was given is also that of experimental anatomy. Illustrative in this regard are the researches upon the influence of fertilizers, pesticides, of some micromycetes, of gamma radiations, electromagnetic fields, alkaloids, of mutagenic substances etc. over the form and structure of some plants, cultivated or from the spontaneous flora.

Written with skill and documentary precision, *The Symbiosis in the Living World*, a book which should not be absent from any school or university library, presents a special interest for the teachers in biology and agricultural sciences.

A scientific work of great value, which imposes itself through conception, concision, accuracy, and a rich iconography, is also the atlas entitled *The Anatomy of Medicinal Plants*. Proposed by us for the prize of the Academy, this book represents Professor C. Toma as a reference author, to whom the school he created in Iași is acknowledged.

These monographs and treatises, as well as many of his scientific works presented at symposiums, colloquiums, sessions, congresses etc., and published in prestigious journals in Romania and abroad, have found a well-reserved place in the specialty literature, where they are cited and commented upon for their originality and value.

Knowing his skill, strictness and the large availability to theorize concrete facts, several periodicals ("Natura", "Revue roumaine de biologie", the "V. Adamachi" magazine, "The Scientific Annals of «Al. I. Cuza» University of

Iași” etc.) have asked him to honor them with his presence – as an editor-in-chief or as a member – in their editorial board, where he confers them a plus of scientific authority.

Acknowledged as a good pedagogue, a great researcher and equally a good organizer, Professor C. Toma was granted several honorific positions as well (president of the Society of Biological Sciences in Romania – Iași branch, president of the Sub-commission of Nature Monuments – Iași branch of Romanian Academy, member of the National Council for Academic Evaluation and Accreditation, etc.), of which he takes care in an exemplary manner.

The activity and the results achieved by Professor C. Toma all-through the years have called the attention and appreciation of several organisms from other countries (American Biographical Institution, International Biographical Center from Cambridge, etc.), honoring him and honoring themselves by including his name in different biographical dictionaries.

A distinct presence on the scenery of the Romanian and foreign biological science and with great performances in the field to which he devoted himself, the Romanian Academy receiving him among its members in 1991 honors him with a recognition of the first rank, thus ensuring him a well-deserved name among the “immortals”.

A passionate naturalist, nature lover and convinced of the necessity of its protection and of the environment in general, Professor C. Toma has approached researches on some scientific reservations ever since his youth, investigating from a morphological and anatomo-ecological point of view rare and endemic plants which grow in different regions of the country, from the Black Sea to the peaks of our highest mountains.

As honorific custodian, scientific secretary and then, from 1991, as president of the Sub-commission for Nature Monuments in Iași, Professor C. Toma has had constant and responsible preoccupations and interests in the state of scientific reservations, of natural monuments and national parks, and he has organized together with his collaborators different regional scientific reunions, having as theme the protection of nature.

As a teacher and scientist, he has carried out a productive activity of educating the studious youth in the spirit of the environment protection, has written popularization articles, has had radio and television appearances, has been present at international reunions dedicated to the protection of nature, has held conferences on this theme in front of a public from various social media.

For over four decades, Professor C. Toma has enrolled in the gallery of the naturalists who militate, with all strength, on every occasion and with every

possible means, in favor of the protection of rare plants and animals, of all monuments and scientific reservations which are protected by law.

Now, at the end of the second millennium, the 65 years of Professor C. Toma, which the documents uncover, are more than an anniversary; they are the result of a discrete glory, for if we consider his look, we could think that he is 55, and if we consider his wisdom, we could think he is 75.

At this age, worn with such a grace, when the rhythm of his works and books show him in full creative strength, we wish him to preserve the same spiritual vigour, to enjoy many years in good health, and to be always successful.

Acad. VALERIU D. COTEA

AVIS AUX COLLABORATEURS

La «Revue roumaine de biologie – Série de biologie végétale» publie des articles originaux dans les domaines suivants de la biologie végétale: biologie moléculaire, cytologie, cytogénétique, morphologie, physiologie, génétique, microbiologie, systématique, chorologie, géobotanique, écologie végétale et phytopathologie. Le 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, préférentiellement 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 de spécifier sur les disquettes le nom des fichiers ainsi que le programme utilisé.

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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 (Anatomie des plantes médicinales. Atlas)*, Editura Academiei Române, 1998, 320 p., 155 pl., ISBN 973-27-0601-5

**EDITAT CU SPRIJINUL
MINISTERULUI EDUCAȚIEI ȘI CERCETĂRII**

ISSN 0035-3914

REV. ROUM. BIOL.–BIOL. VÉGÉT., TOME 45, N° 2, P. 109 – 206, BUCAREST, 2000