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# TECHIRGHIOL LAKE'S SOUTH-WESTERN HILLS' FLORA

## FLORA COLINELOR DIN ZONA SUD-VESTICĂ A LACULUI TECHIRGHIOL

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**Key words**: Techirghiol Lake, Tuzla hills, flora, vascular taxa, rare plants, steppe vegetation;

**Summary**: *Tuzla hills from the south-western side of Techirghiol Lake are low hills (40-50 m maximum height), included in the Lake avifaunistic protected area (IBA), recent sit Natura 2000 (SPA). The hilly relief, the limestone soil and the submediteranean climate influences are reflected in the steppe vegetation composition, rich in Pontic, Balkans, Submediteranean and Mediteranean floristic elements.*

*Our floristic study, finalized with identification of 216 vascular taxa is meant to call botanist's attention upon this less-known but very interesting floristic area, rich in rare plants, many of them (18,05% from all taxa) included in the Romanian Red Lists and Bern Convention (Appendix I).*

*We must also take into consideration the setting up of a Natural Reserve in this area in order to proper preserve the natural habitats.*

## INTRODUCTION

Tuzla hills from the south-western side of Techirghiol Lake are low hills (40-50 m maximum height), with sunny and dry slopes, here and there eroded. The soils are represented through carbonated chernozems, fair soils and steppe rendzina formed on the sarmatics limestone. Local climate is influenced by the moderate effect of Black Sea and Techirghiol Lake. The yearly temperature average is 11.5 $^0$Celsius and the sum of precipitation average is 350-400 mm/year.

The hilly relief with plateau and slopes with different exposure, the dryness limestone soils and the submediteranean influences of climate are reflected in the steppe vegetation composition, rich in Pontics, Balkans and Submediteranean floristic elements, many of them rare plants.

Because large surfaces around the lake had been transformed in the agricultural plots, some natural habitats from this area and in the same time a lot of rare plant species had been affected.

The hilly area from the south-western side of Techirghiol Lake (Fig. 1) is relatively well preserved and interesting from floristic point of view. It is included in the Techirghiol Lake avifaunistic protected area (IBA), recent sit Natura 2000 (SPA). Anyway, the flora of this area is less known; contributions of Tuzla hills flora's knowledge are due to I. Prodan [11, 12, 13], Al.

Borza. [1] and Doina Ivan [6], who mentioned 147 plant species and described some steppe phytocoenosis from the Techirghiol Lake's western hills.

## MATERIAL AND METHOD

Our field researches have been done between years 2006-2007, during the entire vegetation season in order to capture all the phenology stages. The studied surface has been approximately 20 ha.

The plant species nomenclature follows the *Flora Europaea* [16, 17], *Flora ilustrată a României. Pteridophyta et Spermatophyta* [2] and *Flora României* [14]. The life forms, floristic elements and ecological categories have been established on the base of the synthesis works *Conspectul florei cormofitelor spontane din România* [10] and *Flora ilustrată a României. Pteridophyta et Spermatophyta* [2]. The sozologic framing of rare (R), vulnerable (V) and endangered (E) identified plant species was done according to the Romanian Red Lists [4, 7, 9]. The halophilous flora from the Techirghiol Lake banks is not presented in this paper.


**Fig. 1 – The localization of studied area (Peonies Hills) and the limits of Techirghiol Lake Important Birds Area (IBA)**
(http://iba.sor.ro/dobrogea.htm)

## RESULTS AND DISCUSSION

The floristical researches carried out on the hills from the south-western side of Techirghiol Lake have lead to identification of 216 vascular taxa, from which 206 species and 10 subspecies.

The following plants taxa have been identified in the studied area (the rare and threatened taxa according to Romanian Red Lists are highlighted): ***Achillea clypeolata* Sibth et Sm**. (V), ***Achillea coarctata* Poiret** (V), ***Achillea leptophylla* Bieb.** (R), *Achillea setacea* Waldst. et Kit., ***Achillea thracica* Velen [*A. millefoliata* Grec.]** (E), ***Adonis flammea* Jacq**. (R), ***Adonis vernalis* L**. (V), ***Adonis volgensis* Steven ex DC** (V), *Aegylops cylindrica* Host, *Agropyron cristatum* (L.) Gaertner ssp. *pectinatum* (Bieb.) Tzvelev, ***Agropyron ponticum* Nevski** (R), *Ajuga chamaepytis* (L.) Schreber, *Ajuga laxmanni* (L.) Bentham, *Allium oleraceum* L., *Allium rotundum* L., *Allium sphaerocephalon* L., *Alyssum alyssoides* L., *Alyssum desertorum* Stapf., ***Alyssum hirsutum* Bieb.** (R)**,** *Amaranthus retroflexus* L., *Androsace maxima* L., *Anthemis ruthenica* Bieb., *Anthemis tinctoria* L., *Anthriscus caucalis* Bieb. [syn. *A. scandicina* (Web.) Mansf.], *Arenaria serpyllifolia* L., *Artemisia absinthium* L., *Artemisia austriaca* Jacq., *Artemisia pontica* L., *Artemisia vulgaris* L., ***Astragalus hamosus* L**. (R), *Astragalus monspessulanus* L., *Astragalus onobrychis* L. *var. pseudohirsutus,* ***Astragalus spruneri* Boiss**. (E), ***Astragalus vesicarius* L. ssp. *pseudoglaucus* (Klokov) Ciocârlan** (R), *Ballota nigra* L., *Bassia prostrata (L.) G.Beck* [syn. *Kochia prostrata* (L.) Schrad], *Brassica rappa* L., *Bromus hordeaceus* L. [syn *B. mollis* L.], *Bromus squarrosus* L., *Bromus tectorum* L., *Bupleurum rotundifolium* L., *Calepina irregularis* (Asso) Thell., *Cannabis sativa* L. ssp. *spontanea, Capsella bursa-pastoris* (L.) Medicus, *Cardaria draba* (L.) Desv. [syn. *Lepidium draba* L.], *Carduus acanthoides* L., *Carduus hamulosus* Ehrh., *Carduus nutans* L., *Carduus thoermeri* Weinm. [syn. *C. leiophyllus*], *Carthamus lanatus* L., *Centaurea biebersteinii* D.C. [syn. *C. micranthos* Gmel. ex Hayek], *Centaurea diffusa* Lam., ***Centaurea napulifera* Rochel ssp. *thirkei* (Sch.Bip.) Dostal** (R), *Centaurea orientalis* L., *Centaurea solstitialis* L., *Cerastium semidecandrum* L., *Ceratocarpus arenarius* L., *Ceratocephala orthoceras* DC., *Chamomilla recutita* (L.) Rausch., *Chenopodium album* L., *Chenopodium opulifolium* Koch et Ziz., *Chrysopogon gryllus* (L.) Trin., *Chondrilla juncea* L., *Cichorium intybus* L., ***Colchicum triphyllum* Kunze** (syn. ***Colchicum biebersteinii* Rouy**) (R), *Conium maculatum* L., *Consolida regalis* S.F.Gray, *Convolvulus arvensis* L., ***Convolvulus cantabrica* L**. (R), *Conyza canadensis* (L.) Cronq., *Crepis foetida* L. *ssp. rhoeadifolia* (Bieb.) Celak, ***Crocus pallasii* Goldb**. (V), *Cruciata pedemontana* (Bellardi) Ehrend [syn. *Galium pedemontanum* (Bell.) All.], *Cynodon dactylon* (L.) Pers., *Daucus carota* L. ssp. *carota*, *Descurainia sophia* (L.) Webb., ***Dianthus leptopetalus* Willd**. (V), ***Dianthus pseudarmeria* Bieb**. (R), *Dichantium ischaemum* (L.) Roberty [syn. *Bothriochloa ischaemum* (L.) Keng], *Diplotaxis muralis* (L.) DC., ***Echinops ritro* L. ssp. *ruthenicus* (Bieb.) Nyman** (R), *Echium italicum* L., *Echium vulgare* L., *Elaeagnus angustifolia* L., *Erodium cicutarium* (L.) L'Herit., *Erophila verna* (L.) Chevall. [syn. *Draba verna* ], *Eryngium campestre* L., *Eryngium planum* L., *Erysimum diffusum* Ehrh., *Erysimum odoratum* Ehrh. [syn. *E. pannonicum*], *Euphorbia agraria* Bieb., ***Euphorbia nicaeensis* All. ssp. *dobrogensis* (Prodan) Kuzmanov** (V), *Euphorbia helioscopia* L., *Euphorbia seguieriana* Necker, *Festuca valesiaca* Schl., *Gagea pratensis* (Pers.) Dumort, *Galium humifusum* Bieb., *Galium molugo* L., *Gallium verum* L., *Geranium pussilum* Burm. fil., *Glaucium corniculatum* (L.) Rudolph, *Goniolimon besseranum* (Sch. et Reich.) Kusn., *Heliotropium europeum* L., *Herniaria incana* Lam., *Hesperis tristis* L., *Hippericum perforatum* L., *Holosteum umbellatum* L., *Hordeum murinum* L., ***Hyacinthella leucophaea* (Koch) Schur**.(R), *Inula germanica* L., *Inula oculus-christi* L., *Iris pumilla* L., ***Jurinea mollis* (L.) Reinchenb**. (R), *Kochia prostrata* (L.) Schrader, ***Koeleria lobata* (Bieb.) Roem. et Schult**. [syn. ***K. degenii* Domin**] (R), *Koeleria macrantha* (Ledeb) Schultes [syn*. K. gracilis* Pers.], *Kohlrauschia prolifera* (L.) Kunth [*Tunica prolifera* (L.) Scop.], *Lactuca serriola* L., *Lamium*

*amplexicaule* L., *Leontodon hispidus* L., *Linaria genistifolia* (L.), Mill., *Linum austriacum* L., *Linum tenuifolium* L., *Lithospermum arvensae* L., *Lotus corniculatus* L., *Lycopsis arvensis* L. *ssp. orientalis* (L.) Kuntze, *Marrubium peregrinum* L., *Marrubium vulgare* L., *Matricaria perforata* Merat [syn. *M. inodora* L.], *Medicago falcata* L., *Medicago lupulina* L., *Medicago minima* (L.) Bartal, ***Medicago orbicularis* (L.) Bartal** (R), *Melica ciliata* L. ssp. *ciliata, Melilotus albus* Medicus, *Melilotus officinalis* Lam., *Minuartia glomerata* (Bieb.) Degen, *Muscari comosum* (L.) Miller, *Muscari neglectum* Guss. ex Ten. [syn. *M. racemosum* (L.) Lam.], *Myosotis arvensis* (L.) Hill, *Myosotis stricta Link* ex Roem. et Schult. (*M. micrantha* auct. non Pallas), *Nigella arvensis* L., *Nonea pulla* (L.) Lam. et D.C., *Onopordum acanthium* L., *Onopordum tauricum* Willd., *Orlaya grandiflora* (L.) Hoffm., *Ornithogalum pyramidale* L., *Ornithogalum refractum* Kit., *Orobanche sp*., ***Paeonia tenuifolia* L**. (E), *Papaver rhoeas* L., *Phleum phleoides* (L.) Karsten., *Plantago lanceolata, Poa angustifolia* L., *Poa bulbosa* L. *var. vivipara, Polygala vulgaris* L, *Polygonum aviculare* L., *Potentilla argentea* L., *Potentilla taurica* Willd., *Ranunculus illiricus* L., ***Ranunculus oxyspermus* Willd**. (R), *Reseda lutea* L., ***Salvia aethiopis* L.** (E/R), *Salvia austriaca* Jacq., *Salvia nemorosa* L., ***Salvia nutans* L.** (V)**,** *Sanguisorba minor* Scop. ssp. *minor,* ***Satureja caerulea* Janka** (R), *Scabiosa ochroleuca* L., *Scleranthus perennis* L., *Sclerochloa dura* (L.) Beauv., ***Scolymus hyspanicus* L.** (R)**, *Scorzonera mollis* Bieb**. (R), ***Scutellaria orientalis* L. var. *pinnatifida* Rchb**. (R), *Senecio vernalis* Waldst. et Kit., ***Serratula radiata* (Waldst. et Kit.) Bieb**. (R), ***Seseli tortuosum* L**. (R), *Setaria viridis* (L.) Beauv., *Sideritis montana* L., ***Silene borysthenica* (Gruner) Walters** (R), *Sisymbrium officinale* (L.) Scop., *Sisymbrium orientale* L., *Sonchus oleraceus* L., *Stachys atherocalyx* C. Koch [syn. *S. patula* Griseb.], *Stachys recta* L., *Stipa capillata* L., *Stipa lessingiana* Trin. et Rupr., ***Stipa ucrainica* P.A. Smirn**. (R), ***Syrenia cana* (Piller & Mitterp.) Neilr**. (R), ***Tanacetum millefolium* (L.) Tzvelev**. [syn. ***Chrysanthemum millefolium* L**.] (R), *Taraxacum officinale* Weber, *Teucrium chamaedrys* L., *Teucrium polium* L., *Thalictrum minus* L., *Thesium arvensae* Horv. [syn. *T. ramosum* Hayne], *Thlaspi perfoliatum* L., *Thymelaea passerina* (L.) Coss. et Germ., *Thymus comptus* Friv. [syn. *Th. glaucus* Friv.], *Thymus glabrescens* Willd. ssp. *pillosus* (Opiz) Soo (syn. *Th. austriacus* Bernh.), *Thymus pannonicus* All. [syn. *Th. marschallianus*], ***Thymus zygioides* Griseb.** (R), *Tragopogon pratensis* L. [syn. *T. orientalis* (L.) Celak], *Trifolium campestre* Schreb., *Trifolium repens* L. ssp*. repens*, *Trigonella monspeliaca* L., *Valerianella locusta* (L.) Betcke, *Verbascum phlomoides* L., *Verbascum phoeniaceum* L., *Verbena officinalis* L., *Veronica polita* Fries, *Veronica prostrata* L., *Veronica teucrium* L. ssp. *teucrium, Vinca herbacea* Waldst et Kit., *Viola ambigua* Waldst. et Kit., *Xanthium italicum* Moretti, *Xanthium spinosum* L., *Xeranthemum annuum* L.

Among the identified taxa, 39 species and subspecies (18.05%) can be framed within one of the sozologic categories, accepted by IUCN. According to the Romanian Red List [4, 7, 9], 4 species are endangered (10.24%), 8 vulnerable (20.49%) and 27 are rare taxa (69.25%).

Some species as *Paeonia tenuifolia* and *Achillea thracica* are protected both at national and European level and are registered in the Bern Convention Appendix I [20]. Among these plants, the steppe peony (*Paeonia tenuifolia*) has an important local population on the limestone hills from the south-western side of Techirghiol Lake (near the end of the lake), which are named on that account the “Peonies Hills”.

Other numerous Pontic, Submediteranean and Mediteranean rare species can be find towards the end of Techirghiol Lake; we mention among these taxa: *Achillea leptophylla, Agropyron ponticum, Dianthus pseudarmeria, Centaurea napulifera* Rochel ssp. *thirkei, Astragalus vesicarius* L. ssp. *pseudoglaucus, Astragalus hamosus, Convolvulus cantabrica,*

*Colchicum triphyllum, Hyacinthella leucophaea, Jurinea mollis, Echinops ritro* L. ssp. *ruthenicus, Satureja caerulea, Scutellaria orientalis* L. var. *pinnatifida, Tanacetum millefolium, Thymus zygioides, Koeleria lobata*, etc.

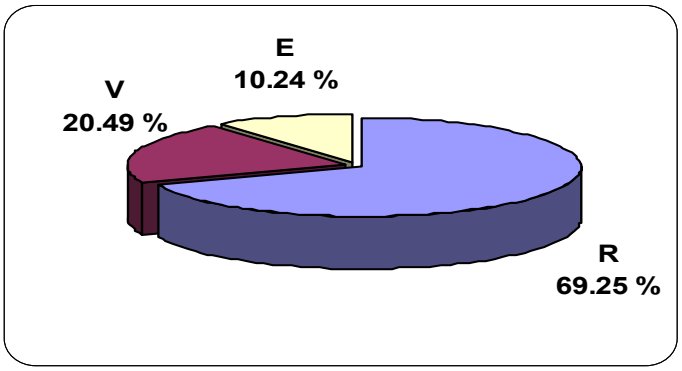


**Fig. 2 – The rate of the rare (R), vulnerable (V) and endangered (E) taxa within the studied area**

The rate of rare and threatened species from our study area is even higher than that from other steppe areas (Adamclisi) from the south of Dobrogea (Tab.1) which are known as areas with important concentration of rare plants [8].

**Tab. 1 – Comparative dates about rare and threatened taxa within study area and other southern areas of Dobrogea**

| Comparative values | **Study area** | **Adamclisi** (după Negrean, Anastasiu, 2003) [8] | **Cotul Văii** (după Negrean, Anastasiu, 2003) |
|---|---|---|---|
| No. of taxa | 216 | 164 | 247 |
| No. of rare and threatened taxa | 39 | 21 | 73 |
| Rate of rare and threatened taxa (%) | 18,05% | 12,80% | 29,55% |

The analysis of biological forms (Fig.3) indicates the large presence of hemicriptophytes (41.20%), followed by therophytes (34.72%), hemitherophytes (10.64%) and other less present life forms as camephytes (5.55%) and phanerophytes (0.46%).

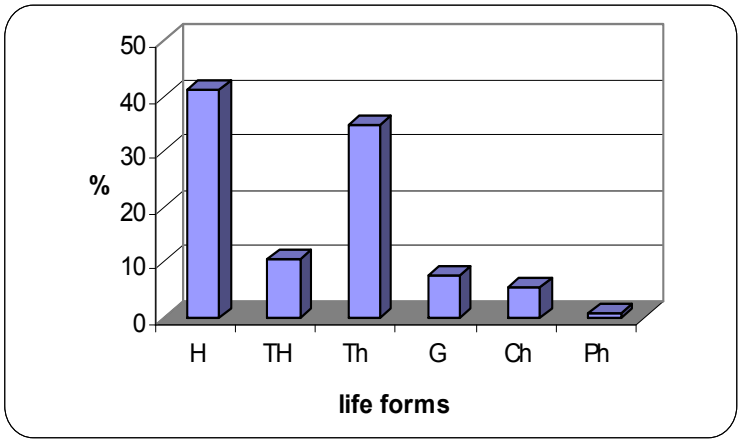


**Fig. 3 – The biological forms spectrum**

Among the phytogeographic elements (Fig.4) most of the species belong to the Eurasian elements (41.20%) which make up the steppe vegetation fund. Better represented are also the Pontic elements (in the large sense) (31.01%) which confer the specific character of sunny hills from the southern and central Dobrogea. The Submediteranean and Mediteranean elements (7.87%) and the Balkan ones (5.09%) are also well represented in the study area and emphasize the southern climate influences from the Techirghiol Lake area. Remarkable for this zone and rare case in Romanian flora is the higher rate of south and south-eastern origin species (Pontic, Balkan, Submediteranean, Mediteranean) (43.97%) than Eurasian elements (41.20%).

Other phytogeographic elements as Central-European (4.16%), European (3.70%), Cosmopolitan (4.16%), Adventive (1.48%) and Circumpolar (0.92%) have a smaller representation in the researched area.

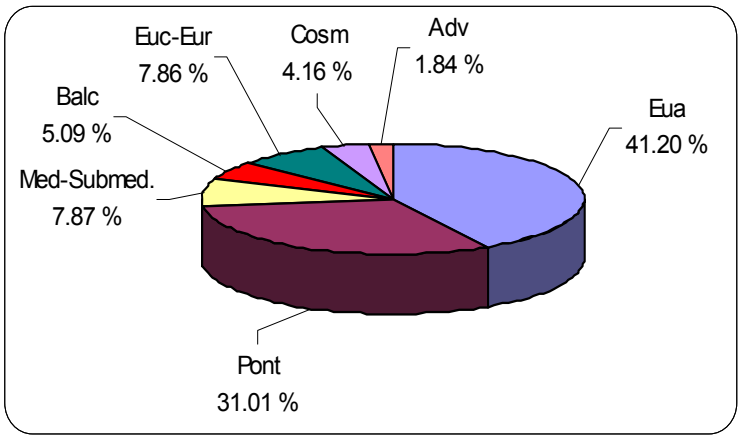


**Fig. 4 – The phytogeographic elements spectrum**

Among the Pontic elements, the Pontic-Mediteranean ones (37.31 %) and Pontic-Balkan ones (20.89 %) are well represented on the Tuzla hills (Fig. 5). They are transitional floristic elements between the Pontic-south Siberian Region (Dobrogea steppe District) and Mediteranean Region.

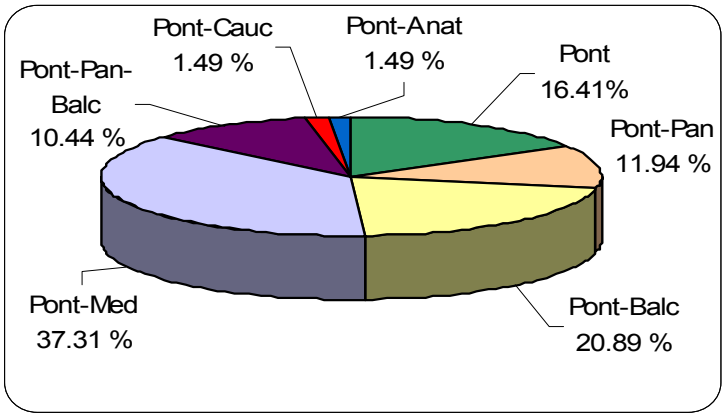


**Fig. 5 – The rate of different Pontic elements subcategories**

Comparative analysis of the main phytogeographic elements from study area and some protected zones of Dobrogea with the same climate (Tab.2), emphasize the similitude with Fantanita-Murfatlar Natural Reserve because of the alike rate of Pontic taxa and also with Hagieni Natural Reserve because of the alike percentage of Submediteranean and Mediteranean species.

**Tab. 2 – Comparative analysis of the main phytogeographical elements within study area and some protected areas from the south of Dobrogea**

| **Compared phytogeographic elements** | **Tuzla hills from south-western side of Techirghiol Lake** | **Fântânița-Murfatlar Natural Reserve** Gh. Dihoru et al., 1965; C.Zahariadi, 1965 [3, 18] | **Hagieni Natural Reserve** (V. Ionescu-Țeculescu, I. Cristurean, 1967) [5] |
|---|---|---|---|
| Eurasian | 41,20 % | 22,5 % | 24,59 % |
| European | 7,86 % | 12,5 % | 7,01 % |
| Pontic | 31,01 % | 30 % | 11,89 % |
| Submediteranean and Mediteranean | 7,87 % | 15 % | 6,82 % |
| No. of taxa | 216 | 500 | 516 |

The ecological categories' spectrum (Fig.5) reveals the prevalence of xero-mesophilous (55.55%) and xerophilous species (33.79%), normal values for the dry climate and soils within studied area. Remarkable is also the summing percentage of moderate-termophilous and termophilous species (56.93%) as a consequence of warm and dry climate of hills near the end of Techirghiol Lake. Concerning the soil reaction, the neutrophil-low acidophilus species (53.24%) are prevalent.

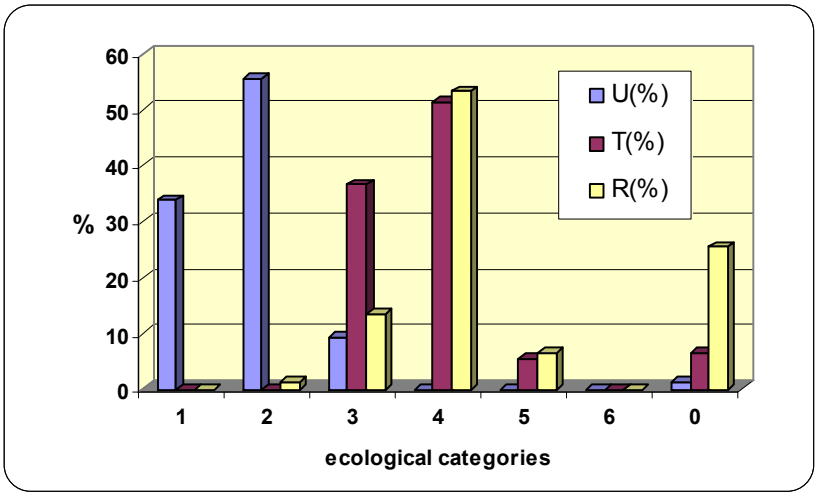


**Fig. 5 – The ecological categories' spectrum**

## CONCLUSIONS

The floristic studies carried out on the hills from the south-western side of Techirghiol Lake have lead to identification of 216 vascular taxa, from which 206 species and 10 subspecies.

The Pontic and south origin species (Balkans, Submediteranean, Mediteranean) are better represented and confer specificity of steppe grasslands within the studied area.

The analysis of ecological categories reveals the prevalence of xero-mesophilous and xerophilous species and also of moderate-termophilous and termophilous species, as a consequence of warm and dry climate within Tuzla hills area.

Among all identified taxa, 18.05% are rare and threatened according to Romanian Red Lists. The high percentage of these species and the important local population of steppe peony (*Paeonia tenuifolia*) emphasize the floristic importance of this less known zone and the opportunity of its natural habitats conservation, preferably as future Natural Reserve.

## BIBLIOGRAPHY

1. BORZA AL., 1931 – *Die excursions rute durch die Dobrogea und das Donau Delta. Guide de la sixiéme excursion phytogeographique internationale, Roumanie*, Cluj: 130-143.
2. CIOCARLAN V., 2000 – *Flora ilustrată a României* (Pteridophyta et Spermatophyta), *Edit. Ceres*, Bucureşti, 1139 pp..
3. DIHORU GH., ŢUCRA I., BAVARU A., 1965 – Flora şi vegetaţia rezervaţiei "Fîntînița" din Dobrogea. Ocrotirea Naturii, (**2**): 167-184.
4. DIHORU GH., DIHORU ALEXANDRINA, 1994 – *Plante rare, periclitate şi endemice în Flora României – Lista roşie*, Acta Botanica Horti Bucurestiensis, Proceedings of Botanical Garden, Bucureşti (1993-1994): 173-197.
5. IONESCU-ŢECULESCU V., CRISTUREAN I., 1967 – *Cercetări floristice în rezervaţia naturală Pădurea Hagieni*, Ocrotirea Naturii, Acad. RSR, tom. 11, nr. 1.

6. IVAN DOINA, 1969 – *Vegetaţia stepică a movilelor de la Techirghiol*, Analele Univ. Bucureşti, Seria Biologie vegetală, 18: 155-161.
7. NEGREAN G., 2001 – *Lista roşie a plantelor din România existente în pajişti, inclusiv endemite şi subendemite* (*Tracheophyta*) (pg. 30-57), în *Ghid pentru identificarea şi inventarierea pajiştilor seminaturale din România,* Sârbu Anca (ed.) & Coldea Gh., Sârbu I., Negrean G., 2001, Ed. "*alo Bucureşti*!, Bucharest, 58 pp.
8. NEGREAN G., ANASTASIU P., 2002 – *Rare plants concentrations in the SE of Dobrogea*, Analele St. Univ. "Al. I. Cuza" Iaşi, LVIII, s. a II-a, Biologie vegetală: 85-94.
9. OLTEAN M., NEGREAN G., POPESCU A., ROMAN N., DIHORU GH., SANDA V., Mihăilescu S., 1994 – *Lista roşie a plantelor superioare din România*, Studii, Sinteze, Documente de Ecologie, Bucureşti, (1): 1-52.
10. POPESCU A., SANDA V., 1998 – *Conspectul florei cormofitelor spontane din România*, Acta Botanica Horti Bucurestiensis, Edit. Universităţii din Bucureşti, 336 pp.
11. PRODAN I., 1934. *Conspectul florei Dobrogei* I, *Bul. Acad. de Înalte St. Agronomice*, Tipogr. Naţională S.A., Cluj, 5, 1, 170 pp.
12. PRODAN I., 1935-1936. *Conspectul florei Dobrogei* II, *Bul. Acad. de Înalte St. Agronomice*, Tipogr. Naţională S.A., Cluj, 6, 57 pp.
13. PRODAN I., 1938. *Conspectul florei Dobrogei* III, *Bul.Facult. de Agronomie*, Cluj, Tipogr. Cartea Românească., 7, 58 pp.
14. SAVULESCU T. (ed.), 1952-1976 – *Flora României*, vol. I-XIII, Edit.Academiei Române, Bucureşti.
15. ŞTEFUREAC I.TR., 1968 – *Consideraţii fitogeografice şi florogenetice asupra Dobrogei*, Comunicări de Botanică, a VI-a Consfătuire Naţională de Geobotanică (Dobrogea, Delta Dunării, 17-26 VII. 1968) : 51-80.
16. TUTIN T.G. (eds) et colab., 1964-1980 - *Flora Europaea*, Vols. 1-5, Cambridge, Cambridge University Press.
17. TUTIN T.G. (eds) et colab., 1993 (reprinted 1996) - *Flora Europaea*, 2nd ed., Vol. 1, Cambridge, Cambridge University Press.
18. ZAHARIADI C., 1965 – *La Réserve Naturelle "Fîntînitza"*. Rev. Roum. De Biologie, s. Botanique, tom.10, nr. 1-2.
19. *** http://iba.sor.ro/dobrogea.htm
20. *** http://conventions.coe.int/Treaty/EN/Treaties/Html/104.htm