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KEY CLIMATE FEATURES TO SUPPORT BIOLOGICAL DIVERSITY IN A NATURA 2000 SITE: ROSPA0106 LOWER OLT VALLEY

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Abstract

Natura 2000 Network is the main European Union mechanism to support biodiversity and nature conservation especially when discussing natural or semi-natural areas hosting vulnerable flora and fauna. These protection sites also stand for natural habitats of European interest relying on two European Union Directives: Habitats and Birds. The paper is aiming to assess the key climatic features to support biological diversity in a Natura 2000 site: ROSPA0106 Lower Olt Valley, designated to protect bird species in accordance with the provisions of Birds Directive (Directive 2009/147/EEC). The authors processed annual, monthly and daily climatic values (temperature, relative humidity, precipitations, wind) and parameters (dangerous climatic phenomena) from all the relevant meteorological stations in the study-area in order to draw up the key climatic parameters in relation to the requirements of the main habitats hosted by this Natura 2000 site. The main outcome of this paper resides in the complex assessment of the key climatic driving forces and their impact on the biological diversity and ecological balance of ROSPA0106 Lower Olt Valley.

Keywords: climate features, biological diversity, Natura 2000 network, ROSPA0106 Lower Olt Valley

INTRODUCTION

Natura 2000 Network embodies the main European Union mechanism to maintain habitats and species in a favorable status, to support biodiversity and nature conservation especially when discussing natural or semi-natural areas hosting vulnerable flora and fauna. Among the total number of 533 Natura 2000 sites (both terrestrial and marine), 148 are represented by Special Protection Areas (SPAs) (European Commission, 2012). These protection sites also stand for natural habitats of European interest relying on two European Union Directives: Habitats and Birds Directive. It is proved that by 2080, out of the 58% species of European concern that would not benefit of suitable climate in protected areas, about 63% will be in Natura 2000 areas (Araujo, 2011).

Climate-related features (key meteorological elements and parameters, climate variability and change) grow to be of great importance when arguing their role in ecosystem's dynamics and functioning (Grigorescu&colab, 2011). As a result, the complexity of interactions between these two key global drivers – climate change and biodiversity - has significantly increased over the last period, thus triggering a wide spectrum of environmental damages (Burgiel&Muir, 2010) in terms of: habitat degradation and loss, native flora extinction, changes in ecosystem functioning etc. (Shea&Chesson, 2002; Arim&colab., 2006).

A complex assessment of the current climate parameters in protected areas, such as Natura 2000 sites, would greatly contribute to undertaken further vulnerabilities to climate variability and change, namely in determining whether or not species or habitats are able to adapt to the transformations caused by climate change (Bouwma&el., 2012; Vos&colab., 2012). Therefore, understanding the vulnerability of species and habitats to the changing of climate parameters becomes important task when dealing with developing adaptation strategies for biodiversity and its conservation (Harley, 2011). In view of that, several research initiatives dealt with this complex issue of linking climate-related aspects with nature and biodiversity such as: FP6 MACIS project, 2006-2008; FP6 ALARM project, 2004-2008; The European Commission project *Biodiversity and climate change in relation to the Natura 2000 network;* the study *A methodology for assessing the vulnerability to climate change of habitats in the Natura 2000 network* etc. (Harley&colab., 2010; Harley, 2011).

In Romania, following the European Union accession in 2007, by way of the Government Decision no. 2151/2004 it was set the regime of Special Protection Area (SPA) for lakes Strejesti and Slatina, while for Lake Ipotesti it was obained the favourable notification no. 820/CJ/08.08.2005 of the Romanian Academy's Commission for Natural Monuments for areas included within this site. In 2004, the site was

designated as protected area at national level. The legislative document by means of which it was designated as SPA is Government Decision no. 1284/2007**.**

METHODS AND DATA

In assessing the key climatic parameters of SPA Lower Olt Valley in relation to the native flora and fauna the authors used and processed annual, monthly and daily climatic values (temperature, relative humidity, precipitations, wind) and parameters (dangerous climatic phenomena) from relevant weather stations in the study-area (Râmnicu Vâlcea, Drăgăşani and Turnu Măgurele) in order to draw up the key climatic parameters in relation to the requirements of the fauna and fauna that are hosted by this Natura 2000 site. The database covers mainly the time period from 1961 to 2007. Additionally, cross-reference bibliographical literature (geographical and biological) as well as on several field surveys were undertaken in order to provide a complex assessment of the key climatic driving forces and their impact on the biological diversity and ecological balance of ROSPA0106 Lower Olt Valley.

THE STUDY-AREA

The SPA Lower Olt Valley (SPA Valea Oltului Inferior) area spreads out in the lower Olt River, downstream Râmnicu Vâlcea Municipality to the Danube River (Fig. 1) covering a surface of 54,074 ha along the administrative units (NUTS 3 level) of Olt, Teleorman and Vâlcea Counties.

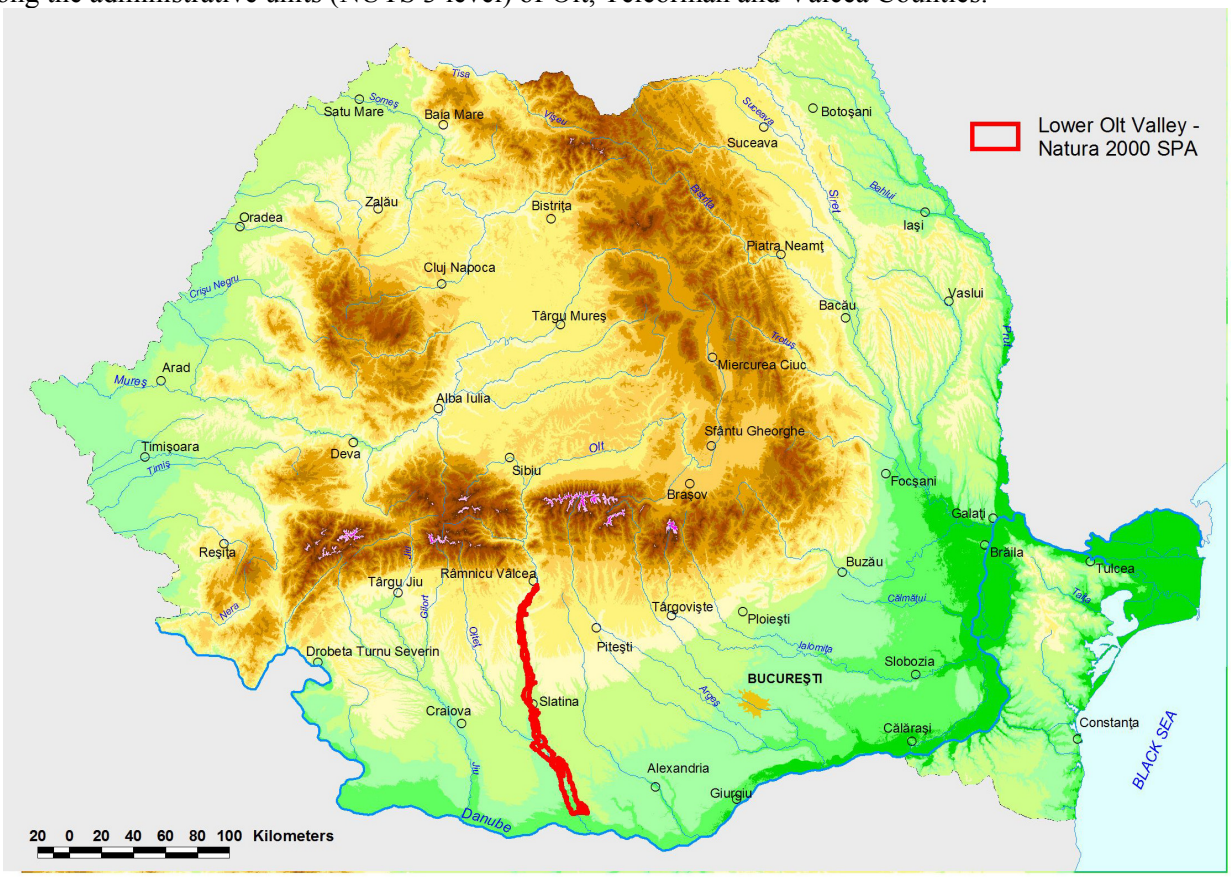

Figure 1. Location of the SPA Lower Olt Valley

The area displays some particular environmental features which individualize it from the neighboring regions, thus adding, from climatic and topoclimate point of view, special traits. Therefore, the underlying active surface is represented by the floodplain sector which is defined by: lower altitudes, maximum longitudinal extension, thin shelter provided by the western (Olteț Piedmont and Caracal Plain) and eastern relief forms (Cotmeana Piedmont and Boian Plain), permanent air and soil surcharge moisture due to the presence of the Olt River and areas of confluence, the presence of alluvial and hydromorphic soils, the specific natural vegetation and agricultural crops and not least the reservoirs (Râmnicu Vâlcea, Râureni,

Govora, Băbeni, Ioneşti, Zavideni, Drăgaşani, Strejeşti, Arceşti, Slatina, Ipoteşti, Drăgăneşti-Olt, Frunzaru, Rusăneşti, Izbiceni.

From physical-geographical point of view, in the Lower Olt Valley two distinct sectors can be distinguished: the *Râmnicu Vâlcea-Slatina Sector*, where the Olt River cuts the Subcarpathian and Piedmont relief units and the *Slatina-Izbiceni Sector,* overlapping the Romanian Plain area. As a consequence of crossing different relief units with particular climatic features, the study-area displays climatic differentiations which are mainly enforced by the various types dominant of atmospheric circulation (western and southern), by the characteristics of the local relief (mainly floodplain) and by the presence of the Olt River's large valley corridor.

From biogeographical point of view, ROSPA 0106 Lower Olt Valley is part of the continental biogeographical region.

THE KEY CLIMATIC FEATURES OF THE SPA LOWER OLT VALLEY

The SPA Lower Olt Valley displays a transitional temperate continental climate with sub-Mediterranean to moderate excessive influences specific to the hilly and plain regions the area cuts into. The geomorphological features of this natural protected area, consisting in low altitudes, floodplain microrelief and relative uniformity, large water-covered areas, the absence of major orographic barriers and the north-south openness to wind channelling, lead to several climatic features: the advection of different origin air masses causing periodic and non-periodic variations but without significant amplitudes, high humidity, slight north-south differentiations between the Râmnicu Vâlcea-Slatina and Slatina-Izbiceni sectors and between the high terraces and the floodplain etc. When discussing the occurrence of extreme weather phenomena (e.g. dryness and drought, heavy rainfall) the high terraces from the southern sector are more exposed as compared to the northern sector and the flood plain area where moderate thermal and pluvial parameters occur etc.

Moreover, the key climatic factors, mainly through their microclimatic and topoclimatic components, favor moderate diurnal and annual amplitudes of the thermal, hydric and higric parameters, increased wind speeds due to the reduced roughness and the wind channeling on the direction imposed by the configuration of Olt Valley and its tributaries etc. On a temporal scale, these effects are stronger felt during the warm semester of the year, especially in summertime, when, during the drought periods which are affecting the neighboring plain areas, the climate extremes are eased by the increased air moisture, the active interaction between air - soil - water active components and the high consumption of latent heat through evaporation. Similar effects are felt during the cold season, as well, overlapped to the vegetative pause, when, besides the diminution of the climate contrasts, the raising of groundwater levels occurs, often causing the salinization.

The **sunshine time**, closely linked to the astronomical factor (Earth – Sun rapport) and the cloudiness regime (conditioned by the atmospheric circulation) registers in the study-area mean annual values of up to 2000 – 2100 hours. Major differences are registered during the year, between the warm semester (April-September) with the main share of over 1500 hours and cold semester with values ranging between 600 – and 800 hours. Spatial differences are also registered between the northern and southern areas due to the higher-intensity foehn downstream Râmnicu Valcea to Slatina and the lower stratiform cloudiness which causes a sunshine time of more than 700 hours during the cold semester of the year. The monthly maximum values are registered in July around the summer solstice (over 300 hours of sunshine time) and minimum in December (less than 75 hours), the month with the shortest astronomical day.

The **air temperature**, conditioned by the combined genetic effects of solar radiation and the general atmospheric circulation, overlapping the characteristics of the active surface, displays from north to south, across the Lower Olt Valley ROSPA0106, relatively uniform values.

However, slightly different climate characteristics imposed by the adjacent relief units: the piedmontan and subcarpathian sectors (between Râmnicu Vâlcea and Slatina) and plain areas (between Slatina and Turnu Măgurele-Carabia) are noticed.

On annual regime, the *average multiannual temperatures* range between 10.5 ºC at Râmnicu Vâlcea and 10.6 at Slatina, up to over 11 ºC at Corabia and Turnu Măgurele weather stations (Fig. 2). The same variations are distinguished during both characteristic month of the year: *January* and *July*. In *January* (when minimum annual air temperatures are registered) in the Râmnicu Vâlcea - Slatina sector and the confluence of Olt River with Danube (Turnu Măgurele weather station), the average values does not fall below -2 °C, while between Slatina and Izbiceni localities the temperature values descend to about - 3 °C. In *July*, when the highest annual temperatures occur, the values vary between 20-21 °C in the north, 21-22 °C

in the central section (Slatina - Slobozia Mândra), to values of up to 23 °C in the south. During the transition seasons (spring and autumn), the thermal values are moderate providing average values of 11-12 °C both in April and October.

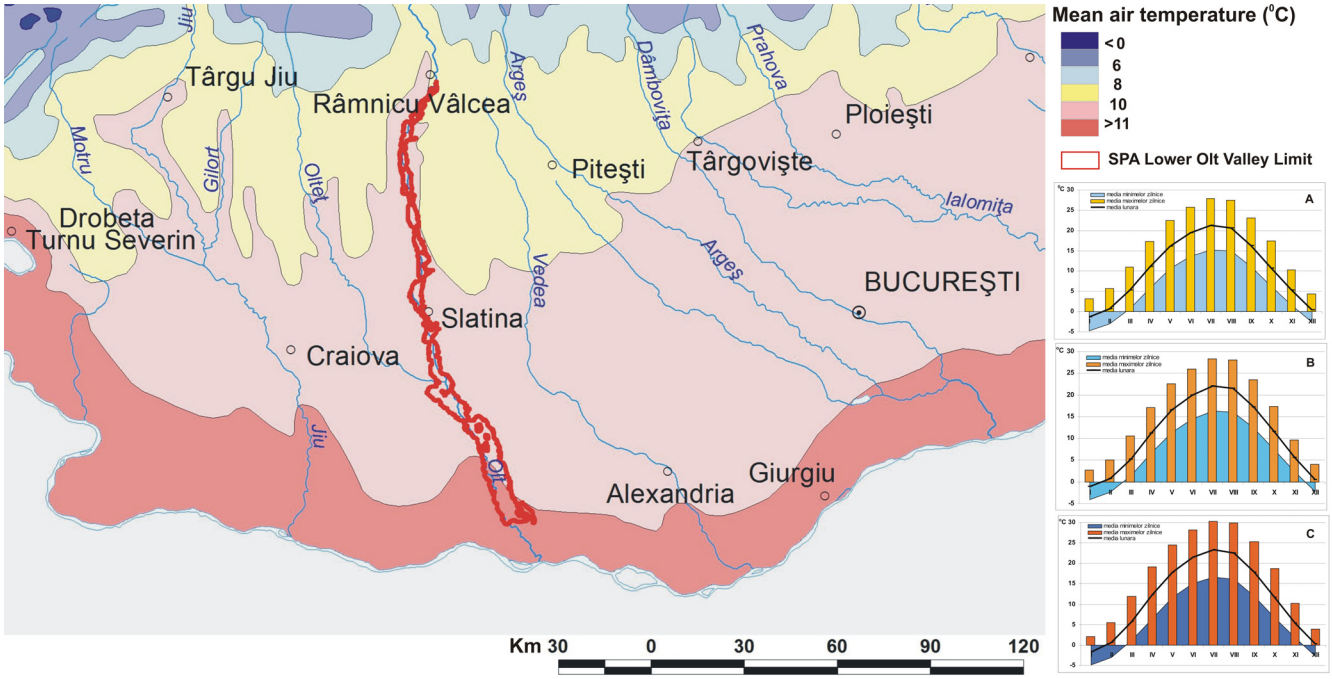

Figure 2. Mean multiannual air temperatures and the highest (max) and lowest (min) mean monthly and annual air values at Râmnicu Vâlcea (A), Drăgăşani (B) and Turnu Măgurele (C) weather stations (1961-2007) (processed after Bogdan&Frumuşelu, 2002 Sandu&colab., 2010; National Meteorological Administration database)

In terms of thermal extremes, the mean and absolute values, as well as the days with characteristic temperatures during the warm and cold semesters of the year are moderated by the particular floodplain relief features displayed by the Lower Olt through smoothing down the thermal amplitudes, lowering the frequency and intensity of dangerous phenomena etc.

Relative air humidity has higher annual mean values of 76 to 78-79% with a fairly uniform distribution throughout all analyzed area (the smallest, below 76% in Râmnicu Vâlcea and exceeding 78% in the southernmost areas). Due to its lower altitudes (300-400 m), throughout the year, two maximum peaks are registered (December and June) generated by high quantities and frequencies of heavy rainfall and two minimum (July-August and April-May). The spatial variability of this climatic parameter points to decreasing values southwards, significantly smoothed by the floodplain topoclimate. Additionally, the reduced frequency of days with relative humidity ≤ 30% ("droughty days") totalizes, on mean annual regime, less than 10-15 cases and during the warm semester of the year, when conditions are conducive to install drought, up to 5-10 cases.

Precipitation, generated by the action of the main pressure centers with dominant frequency in this plain area (the Mediterranean Cyclone and Azores Anticyclone) overlapping local environmental characteristics (the intensity of the thermal convection, the shelter of the Carpathian chain, the rich sources of moisture, the vegetation cover etc.) shows a moderate-uniform spatial distribution, both under annually regime and throughout the year. The piedmont sector on which Olt Valley north of Slatina was embedded, receives *mean annual quantities* of between 700 and 600 mm, and the plain area in south between 600 and 500 mm (Fig. 3).

Seasonally, the highest share of precipitation amounts falls during the warm semester, nearly 60-65% (300-400 mm), June being the rainiest month while, February, generally stands for the deficient. Throughout the year, liquid precipitation prevails, their frequency being higher at the contact with the plateau regions in north and lower to the south, at contact with the plain areas. Once more, the floodplain topoclimate defines an excess of moisture, based on groundwater intake, presence of lakes (rivers, lakes and ponds), aquatic vegetation, high levels of evapotranspiration, etc.

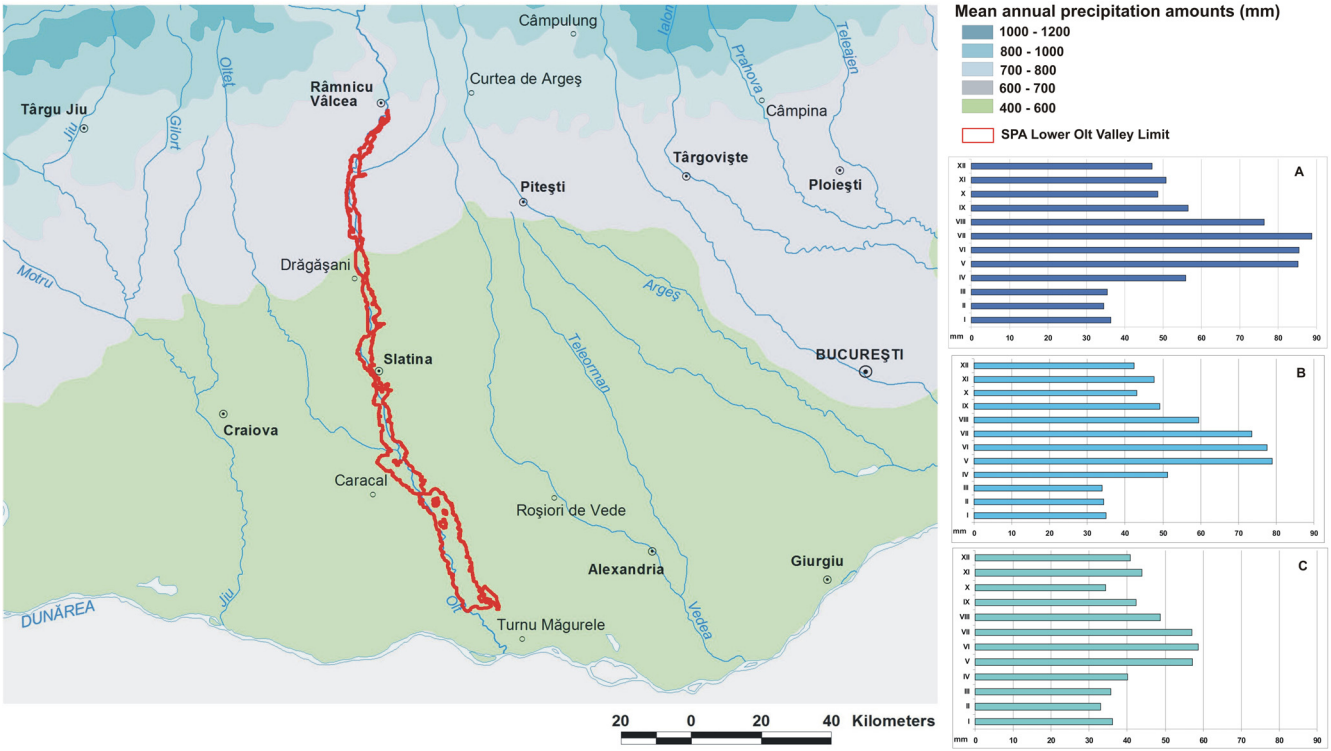

Figure 3. Mean annual precipitation amounts in the SPA Lower Olt Valley and multiannual monthly quantities at Râmnicu Vâlcea (A), Drăgăşani (B) and Turnu Măgurele (C) weather stations (1961-2007) (processed after Bogdan&Frumuşelu, 2002; Sandu&colab., 2010; National Meteorological Administration database)

Winds. The Romanian Plain, the major relief unit Lower Olt Valley is framing into, displays a dominant west-east direction dictated by general and local atmospheric circulation overlapped and the general north-south direction of Olt Valley. The same characteristics are specific to the plateau region, where an enhanced roughness leads to the diversification of wind frequency and speeds on directions. Thus, if at Râmnicu Vâlcea whether station the north-west direction is dominant, in Slatina and downstream Drăgăşani it becomes western, as well as in the Danube Floodplain at Turnu Magurele. The wind speed values, usually from the same dominant direction, increases from south (1-2m/s) to the central floodplain sector, at the contact between plain and piedmont areas (2-3 m/s), decreasing again northwards alongside the increasing values of atmospheric calm (la 1-2 m/s) (Fig. 4).

The average frequency of days with strong wind (≥ 16m/s) is usually low, of 10 to 25 cases/year in the central sector, while in the northern and southern areas under 10 cases/year are registered, in relation to the reduced maximum speeds (< 30m/s).

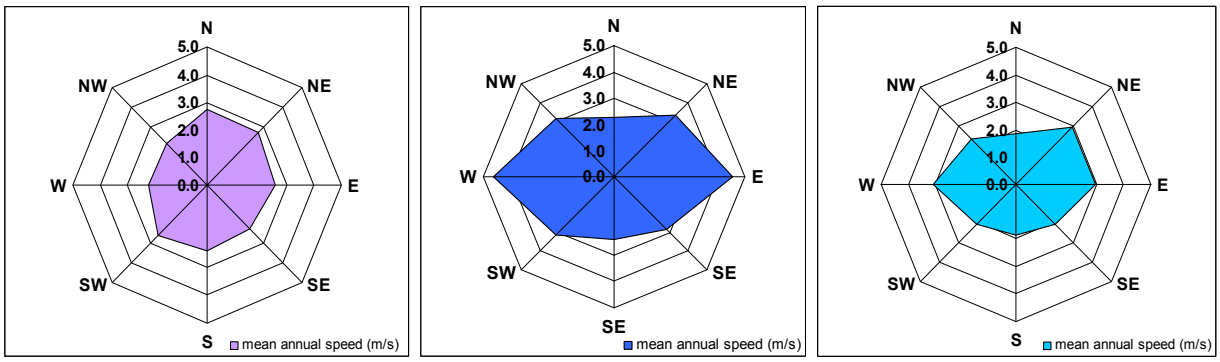

Figure 4. Average annual wind speed roses from weather stations Râmnicu Vâlcea, Drăgăşani subsequently Turnu Magurele (1961-2007) (processed after Sandu&colab., 2010; National Meteorological Administration database)

Dangerous climatic phenomena which are particular to the study-area are genetically connected to the presence of water-covered surfaces coupled with the freezing/melting point, easily reached, even exceed in the temperate climate zone. Under the favorable atmospheric dynamics some dominant hydrometeors

occur, usually along with photometeors and electrometeors (e.g. thunderstorms). Particular hydrometeors that occur in the study-area are *fog*, whose annual rate exceed 60-80 cases, *hail*, most common in the lowland topoclimate areas under a more frequent and intense convection, *hoarfrost* (between 70 and 90 days/year) and *glazed frost* (15-20 days/year).

BIOLOGICAL DIVERSITY IN THE LOWER OLT VALLEY

In the study-area the habitat classes are represented by sand beaches, rivers, lakes, crops (arable land), pastures, other arable lands, deciduous forests, forest habitats (forests in transition). It hosts important effectives of some protected bird species: 13 Bird SPECIES Covered by Article 4 of Directive 79/409/EEC and listed in Annex II of Directive 92/43/EEC. The site has a particular importance during the migration periods and for hibernating. Its vulnerability is rendered by the socio-economic activities and pollution sources that may have impact upon bird populations such as: pollution generated by the treatment of neighboring agricultural crops with various phytosanitary substances, different economic agents, domestic and industrial waste etc. Therefore, the dominant plant frmations of the study-area are the following:

Salix alba and Populus alba galleries. The preffered climate conditions are described by mean air temperatures of 10 - 11.5 ^{0}C and mean annul preacipitation amounts of 400–600 mm. It develops on bank sand dunes relief forms in large flood plains overalpping sandy and layered alluvia (Doniță&colab., 2005). The phytocenoses established within this habitat type belong to the nemoral European species. Tree layer is made up of white poplar (*Populus alba*), exclusively or in mix with black poplar (*P. nigra*), willow (*Salix alba*), elm tree (*Ulmus laevis*), rarely, pedunculate oak (*Quercus robur*), ash tree (*Fraxinus angustifolia*), mulberry tree (*Morus alba*) etc.; it covers (40) 70-90% and grows up to 25-30 m height when 100 years old. Shrubbery layer, usually very well-developed, is made up of *Cornus sanguinea, Crataegus monogyna, Rosa canina, Evonymus europaeus, Sambucus nigra, Prunus spinosa, Amorpha fruticosa. Lianas: Clematis vitalba, Humulus lupulus, Vitis sylvestris*. Herb and subshrubbery layer is usually strongly developed and dominated by *Rubus caesius*.

Natural eutrophic lakes with Magnopotamition or Hydrocharition – type vegetation. The main climate conditions which characterize this habitat are of 10 - 11.5 ^{0}C mean annual air temperature and mean annual precipitation of 350–700 mm and the specific relief is flat land or slightly inclined lying on an alluvial and sapropelic deposits sublayer (Doniță&colab., 2005). The main phytocenoses of this habitat, *Sparganium erectum,* develops on the margins of aquatic basins, where water does not exceed 25–40 cm. the dominant species is *Sparganium erectum*, which covers up to 75-80% of the study-area. The high density of the dominant species limits the installation of other paludous species, out of which the following have been identified: *Sium latifolium, Berula erecta, Oenanthe aquatica, Bolboschoenus maritimus, Lycopus europaeus, Alisma plantago aquatica, Stachys palustris, Iris pseudacorus, Ranunculus lingua, Lythrum salicaria, Myosotis scorpioides, Solanum dulcamara, Polygonum amphibium*. All these make up the superior vegetation layer, with high density and coverage. The inferior layer is weakly represented, the signaled species being: *Galium palustre, Scutellaria galericulata, Agrostis stolonifera, Lysimachia nummularia*. The conservative value of this habitat type is moderate.

Riparian willow formations overlap the northern sector of the study-area as it usually prefers mountain valleys developed on sedimentary coarse matter and prund-sands. The specific climatic conditions is characterized by mean annual air temperatures of 9 – 10 ^{0}C and mean annual precipitation amounts of up to 750–850 mm (Doniță&colab., 2005). This phytocenosis is made up of hydrophyle, mesotherme and eu-mesotherme species. The shrubbery layer consists of *Salix purpurea, especially* ssp. *purpurea,* located on higher altitude water courses. The other species of *Salix* (*S. viminalis, S. triandra, S. alba, S. fragilis*) contribute to this phytocenosis in smaller proportions. Additionally, alder tree species are also met (*Alnus incana, Alnus glutinosa*). The heights layer varies between 2–4 m and the herb layer is generally poor, with few and sometimes no species, mainly related to the occurrence of extreme hydro-climatic events, such as heavy rainfall triggering floods.

CONCLUSIONS

The coupling of the key climatic parameters with the local environmental features of the SPA Lower Olt Valley (relief forms, soil, water etc.) turn into essential drivers for in-depth climate assessments of both current condition and future predictions, thus conditioning the development of local habitats of ecological

importance. The study evaluates the achievement of optimum thermal, hydric and aeolian conditions for the habitats development (in terms of specific bioclimatic requirements). The favourable climate conditions of the study-are correlated with habitats' requirements sum up to:

- relatively reduced mean thermal differences between north (10.5 – 10.6 ^{0}C in the Râmnicu Vâlcea-Slatina Sector) and south (over 11.^{0}C in the Slatina-Izbiceni Sector);
- moderate thermal extremes (mean and absolute values) smoothened by the particular floodplain relief features, thus lowering the frequency and intensity of dangerous thermal phenomena;
- reduced frequency of days with relative humidity ≤ 30% ("droughty days"), pointing to a high favorability for the development of specific habitats;
- the annual precipitation amounts ranging between 600-700 mm in the northern sector and 500-600 mm in the southern indicates values very close/exceeding the optimal thresholds for physiological development of plants;
- the moderate climatic effect induced by the water-covered areas and the floodplain vegetation which favours the development of natural ecosystems and related habitats;
- high constant values of relative air humidity (over 75%), thus favouring the development of forest vegetation combined with different hydrophyllic phytocenosis;
- the monthly and annual variation in the number of days with strong wind, hail, hoarfrost and glazed frost and other dangerous meteorological phenomena that mark individual or combined mechanical, thermal and hydric stress elements to natural habitats.

All of these key climatic phenomena become either favourable or hostile driving forces for the development of native species and their habitats though changes in their distribution, physiology, phenology etc. Therefore, it is important to assess the impact of changing climate conditions upon Natura 2000 sites in order to understand future climate trends in Europe and, ultimately to develop possible adaptation strategies.

REFFERENCES

Araujo M. B., Alagador D., Cabeza M., Nogués-Bravo D., Thuiller W. (2011), *Climate change threatens European conservation areas*, vol. 14, issue 5, 484-482, DOI: 10.1111/j.1461-0248.2011.01610.x

Arim M., Abades S. R., Neill P. E., Lima M., Marquet P.A., (2006), *Spread dynamics of invasive species*, PNAS, vol. 103, no. 2, 374–378, doi_10.1073_pnas.0504272102

Bogdan Octavia, Frumuşelu Doina (eds.) (2002), *Romania*. *The Environment and the Electric Transportation Network. Geographical Atlas,* Editura Academiei Romane, Bucuresti.

Bouwma Irene, Vos Claire., Biemans M, McIntosh N, van Apeldoorn R. & Verdonschot P. (2012), *Draft Guidelines on Climate Change and Natura 2000,* European Commission.

Burgiel S.W., Muir A.A., (2010) *Invasive Species, Climate Change and Ecosystem-Based Adaptation: Addressing Multiple Drivers of Global Change,* Global Invasive Species Programme (GISP), Washington, DC, US, and Nairobi, Kenya.

Doniță N., Popescu A., Păucă-Comănescu Mihaela, Mihăilescu Simona, Biriș I.A. (2005). *Habitatele din România,* Editura Tehnică Silvică Bucureşti, 442 p.

European Commission, (2012), *NATURA 2000 – Celebrating 20 years of the Habitats Directive*, Nature and Biodiversity Newsletter, no. 32/2012. http://ec.europa.eu/environment/nature/info/pubs/docs/nat2000newsl/nat32_en.pdf.

Harley M., Chambers T., Hodgson N., van Minnen, J. & Pooley M. (2010). *A methodology for assessing the vulnerability to climate change of habitats in the Natura 2000 network.* European Topic Centre on Air and Climate Change Technical Paper 2010/14, European Environment Agency.

Harley M. (2011), *Climate change and the Natura 2000 network: assessments of species and habitat vulnerability*, European Conference on Biodiversity and Climate Change - Science, Practice & Policy; 12–13 April 2011.

Sandu I., Pescaru V., Poiană I., Geicu A. Cândea I. and Țâștea D. (eds.) (2008), *Clima României*, Editura Academiei Române, Bucureşti

Grigorescu Ines, Dragotă Carmen-Sofia, Dumitraşcu Monica, Năstase Mihaela (2011), *The climatic potential and the key meteorological drivers for the dynamics of invasive terrestrial plant species in Comana Natural Park,* Annals of the Valahia University, Geographical Series, Tome 11, 45-55, ISSN 1528-6198.

Shea K, Chesson P (2002), *Community ecology theory as a framework for biological invasion*. Trends in Ecology and Evolution, 17, no.4, 170–176.

Vos Claire, Bouwma Irene, Verdonschot P., Geertsema W., van Riel Marielle, (2012), *Draft Guidelines on dealing with the impact of climate change on the management of Natura 2000*, Supplement. Assessment of the vulnerability of Natura 2000 species and habitats for climate change: species and habitat types most at risk. Overall approach and the result of the analyses. (ENV B.3./SER/2010/0015r), European Commission.