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MAIN BIOCLIMATIC CHARACTERISTICS OF THE ROMANIAN SHORE ON THE BLACK SEA

NICOLETA IONAC

Introduction

Out of all the environmental factors of physiological stress, the climatic ones are, perhaps, the most aggressive, because of their wide temporal variation and large spatial extent. If man can, for instance, protect himself by not drinking infested water or by leaving some contaminated area, he can't avoid the invisible and permanent influences of cold or hot, dry or damp weather and climate, no matter how efficient steps of protection he may take. Since man is a "cosmic" being and, therefore, he must not only be aware of his weather-sensitive dimension, but also permanently assess his acclimatisation potential, in order to prevent any undesirable health effects. That is why, the bioclimatic study of some densely-populated or recreational regions may be beneficial in the systematic approach of environmental health, since human health is directly connected to climatic or microclimatic comfort. Moreover, some specific bioclimatic conditions may fruitfully be exploited for therapeutical activities which help human body to preserve or restore his vital capacity, greatly improving his efficiency.

Location and morphology

The Romanian shore of the Black Sea is 244 km long, stretching from the little Musura gulf (where one of the three Danube's main distributaries – Chilia, is building a second-order delta) in the north, to the Vama Veche village, located on the Romanian-Bulgarian border, in the south. The width of the Romanian sea-shore is highly variable, depending on the morphology of the transition zone between continental and maritime Dobrudja (as the two main physical domains of the Dobrudjan Plateau are called), which roughly follows the Mahmudia-Cotu Văii alignment, where the relief altitudes constantly keep 100 m above sea-level.

According to its specific morphogenetic elements, the maritime sector of the Dobrudjan Plateau is also geographically divided into a distinct northern unit (lacustrine Dobrudja), with low-lying areas evolved either from fluvial deposition of sand-bars at the mouth of the Danube channel which forked into numerous distributaries developing natural levees and acquiring other branching outlets worldwide known as the *Danube Delta*, or from sand-bar accumulation along the sea-front outlet of the large *Razim-Sinoe lagoon complex*, merging, close to the Cape Midia, with a southern unit (coastal Dobrudja) represented by a higher plateau area, fragmented by elongated depressions along draining valleys, and cliff shores abruptly falling into the sea.

The southern coastal area, stretching on a 82 km-long distance from the Cape Midia (in the north) to the Vama Veche village (in the south), is characterized by 5-12 km-wide gently-undulating platforms which smoothly-decline from W to E, into 25-30 m-wide sand-beaches locally bordered by 20-40 m-high, steep sea-walls. In fact, the specific relief forms in the southern coastal area may be grouped in two sectors: the seaside Cape Midia-Cape Siutghiol sector, with large sand-depositions intervening between seaward-extending promontories of varying dimensions and the coastal Cape Siutghiol-Vama Veche sector, with numerous 10-35 m-high cliff shores that are actively being eroded into ever-shrinking strips of land. As far as the beach areas are concerned, we must say that, although they represent only 1/4 of the total shore length and belong to different morphogenetic categories (erosional, sand-barred lagoons, artificial, etc), their fine-grained sand of mainly calcareous origin and east-oriented fronts, as well as their pretty large extent that may best accommodate modern touristic facilities, highly recommend them as one of the most important touristic destinations in Romania. That is why, the present study focuses on this specific much looked-for touristic area of the Romanian shore on the Black Sea, in order to give an accurate picture of the potential climatic benefits on human health and point to the probable restrictive bioclimatic elements that may impede human efficiency.

Main climatic factors of influence

Unlike continental Dobrudja, characterized by mid-latitude climate with eastern continental influences accounting for hot dry summers that maintain substantial soil moisture deficit or give severe droughts, the Black Sea coast is largely influenced by the moderating maritime conditions so that winters are generally milder, since air-temperatures often keep positive; the excessive heat during summer is greatly attenuated by the cooling sea-breezes; autumns are long and pleasant and springs are cool and damp, so that the resulting climate is considered an important factor of influence in balnear therapy. This is one of the reasons why investment has heavily been concentrated on the chain of

seaside resorts along the Black Sea coast, including Mamaia, Eforie, Neptun, Olimp, Jupiter, Venus and Cape Aurora between the two main port-cities of Constanța, located at the farther northern end of the 82 km-long coastline, and Mangalia, at its farther southern end.

First of all, the specific climate of the area under study is characterized by the highest radiative potential in the country, since the mean annual amount of ***total solar radiation*** exceeds 125 kcal/cm² (127.4 kcal/cm² at Constanța), although it is unevenly distributed throughout the year, so that the monthly amounts range from a maximum value of 18.7 kcal/cm² in July, to a minimum value of 2.1 kcal/cm² in December, depending on the cloudiness. However, the total radiation sums during the warm season represent over 60% of the annual amounts (May – 15.8 kcal/cm² = 12.4%; June – 17.6 kcal/cm² = 13.8%; July – 18.7 kcal/cm² = 14.7%; August – 16.6 kcal/cm² = 13% and September – 12.4 kcal/cm² = 9.7%), so that heliotherapy is an important component of the specific climatic therapy in the area. Moreover, the ***sunshine duration*** in the touristic season (May-September) also keeps constantly high: 52.3% of the annual totals in Mangalia and 63.4% in Constanța, both mean annual (2239.0 hours in Mangalia and 2284.1 hours in Constanța) and monthly values (Table 1) largely ranging between the two weather stations, because of local atmospheric conditions that account for higher cloudiness in Mangalia (partly due to its greater values of relative humidity) than in Constanța, where the summer lower values of relative humidity reduce convection intensity and, therefore, decrease cloudiness.

The spatial and temporal distribution of ***air-temperatures*** along the Black Sea coastline also reveals interesting climatic influences, although the mean annual (11.3°C in Constanța and 11.2°C in Mangalia) and the average maximum values (14.8°C in Constanța and 14.9°C in Mangalia) are very similar; the lower average minimum value in Mangalia (7.4°C) as compared to the corresponding one in Constanța (8.0°C) owing to the moderating climatic effects of sea-waters which get stronger towards south. These effects are also evident when analyzing the monthly mean, maximum and minimum air-temperatures which are sensibly lower at Mangalia, all through the summer months, but which keep higher during the winter months, due to the greater amount of heat released by the sea-waters, so that the mean air-temperature in January (0.1°C) and the minimum air-temperature in December (0.2°C) maintain above freezing point, in comparison to the corresponding values in Constanța which are negative (-0.2°C both in December and in January), emphasizing once more that the Black Sea plays an efficient part in thermal regulation processes. The same conclusion applies to mean, maximum and minimum annual air-temperature ranges as well, since they seem to be higher in Constanța, where the continental influences are stronger, than in Mangalia, where they are largely attenuated by the positive air-temperatures in winter.

Table 1

Main climatic and bioclimatic characteristics of the Romanian shore on the Black Sea (1900-1990)

Constanța	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Mean air-temperature (°C)	-0.2	1.1	4.4	9.4	15.0	19.6	22.1	21.9	18.2	13.2	7.7	2.7	11.3
Average maximum air-temperature (°C)	3.1	4.2	7.7	13.1	18.8	23.4	26.2	25.8	22.2	16.9	11.4	5.7	14.8
Average minimum air-temperature (°C)	2.9	1.7	1.3	6.3	11.8	15.7	18.0	17.8	14.5	9.7	5.2	-0.2	8.0
Relative humidity (%)	86	85	84	82	80	76	75	74	77	80	84	86	81
Wind-speed (m/s)	5.8	5.3	5.1	4.7	4.8	4.1	4.2	4.1	4.4	4.9	5.3	6.1	4.9
Mean number of summer days ($T_{max} > 25^{\circ}\text{C}$)			0.1	0.2	1.6	10.0	22.7	21.1	6.0	0.6			62.3
Mean number of winter days ($T_{max} < 0^{\circ}\text{C}$)	7.9	5.2	1.2							0.6	4.3		19.2
Sunshine duration (hours)	79.6	80.7	131.3	188.6	261.6	308.8	330.9	307.6	239.6	182.6	108.6	70.2	2284.1
Mean effective temperature (°C)	-7.5	-5.6	-0.6	6.9	14.8	17.1	18.3	18.2	16.4	12.6	4.3	-3.2	9.7
Maximum effective temperature (°C)	-2.6	-0.9	3.3	12.4	16.7	18.9	20.3	20.1	18.3	12.0	9.9	1.3	14.7
Minimum effective temperature (°C)	-11.6	-9.8	-5.3	2.2	10.5	15.1	16.4	16.2	14.5	7.3	0.6	-7.5	4.8
Mean wind-chill (kcal/m ² .h)	941	896	797	646	495	355	291	294	399	546	710	875	598
Minimum wind-chill (kcal/m ² .h)	858	809	705	545	390	254	181	190	291	444	606	788	205
Maximum wind-chill (kcal/m ² .h)	1030	975	884	731	583	458	400	402	499	643	781	959	690

Mangalia	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Mean air-temperature (°C)	0.1	1.3	4.4	9.1	14.5	19.1	21.7	21.7	18.0	13.2	7.9	3.1	11.2
Average maximum air-temperature (°C)	3.7	4.8	8.0	12.1	18.3	23.3	26.0	25.8	22.4	17.2	12.0	6.5	14.9
Average minimum air-temperature (°C)	-2.8	-1.9	1.1	5.7	10.9	14.5	17.0	16.8	13.5	9.2	5.2	0.2	7.4
Relative humidity (%)	86	86	86	84	83	81	80	78	78	81	84	87	83
Wind-speed (m/s)	4.6	4.6	4.4	4.1	3.6	3.5	3.6	3.3	4.0	4.3	4.3	5.3	4.2
Mean number of summer days ($T_{max} > 25^{\circ}\text{C}$)			0.2	1.1	9.4	20.9	20.9	5.7	0.8				59.0
Mean number of winter days ($T_{max} < 0^{\circ}\text{C}$)	6.7	3.8	0.7							0.4	3.3		14.9
Sunshine duration (hours)	82.8	89.6	125.9	179.1	296.3	291.1	313.5	300.0	241.8	197.0	112.0	60.4	2239.0
Mean effective temperature (°C)	-7.1	-5.3	-0.6	6.4	14.5	16.8	17.4	17.5	16.3	12.6	4.6	-2.6	9.6
Maximum effective temperature (°C)	-1.7	0	3.2	10.9	16.4	18.9	20.2	20.1	18.4	15.9	10.8	2.5	14.7
Minimum effective temperature (°C)	-11.4	-10.1	-5.6	1.3	9.1	14.5	15.8	15.7	13.0	6.6	0.6	-6.9	3.9
Mean wind-chill (kcal/m ² .h)	896	863	770	634	476	356	290	285	396	532	674	842	582
Minimum wind-chill (kcal/m ² .h)	805	768	673	554	378	248	180	181	280	424	564	746	483
Maximum wind-chill (kcal/m ² .h)	984	951	859	724	569	474	412	409	515	639	747	923	684

For instance, the mean annual air-temperature amplitude is 22.3°C at Constanța and 21.6°C at Mangalia; the maximum annual difference reaches 23.1°C at Constanța and decreases to 22.3°C at Mangalia, while the minimum annual range is 20.9°C in Constanța and only 19.8°C in Mangalia; this state of facts having a great bioclimatic importance as long as some major physiological indicators, such as effective temperature and wind-chill, largely depend on actual air-temperature values. In fact, the unquestionable bioclimatic benefits of the maritime environment are also attributable to the monthly and yearly number of summer days ($T_{\max} > 25^{\circ}\text{C}$) which is higher than anywhere else in the country, despite some minor spatial differences along the coastline (62.3 days at Constanța and 59.0 days at Mangalia) or to the mean monthly and yearly number of winter days ($T_{\max} < 0^{\circ}\text{C}$) which is lower than the rest of the country, because of the heat-generating effects of the adjoining Black Sea (14.9 days at Mangalia and 19.2 days at Constanța).

Although the values of ***relative humidity*** on the Black Sea coast are higher than the rest of the Dobrudjan territory, due to the moistening effect of the adjoining sea, they are lower at Constanța, (where the values range from 74% in August to 80% in May) than at Mangalia (where the corresponding values are 78% in August and 83% in May) especially during the summer months, and this accounts for lower cloudiness which ultimately increases air-temperatures and bioclimatic stress respectively.

Wind-speed, which directly depends on the value of the horizontal pressure gradient and on the local pattern of air-circulation generating sea and land breezes, is generally increasing in winter, when the thermal contrasts between land and water surfaces are more prominent, so that the mean wind-speed in December (6.1 m/s at Constanța and 5.3 m/s at Mangalia) and January (5.8 m/s at Constanța and 4.6 m/s at Mangalia) is considerably higher than in July (4.2 m/s at Constanța and 3.6 m/s at Mangalia) or August, when wind-speeds decrease to minimum values (4.1 m/s at Constanța and 3.3 m/s at Mangalia), although spatial disparities are evident even when comparing the mean annual wind-speed, which is greater at Constanța (4.9 m/s) than at Mangalia (4.2 m/s), or the monthly values of wind-speed which visibly decrease towards south, that is towards Mangalia (Table 1). In January, the highest mean values of wind-speed correspond to NE direction (8.7 m/s at Constanța and 6.9 m/s at Mangalia), due to the intensifying influence of the Siberian High, while the lowest mean values are specific of the SW direction (3.9 m/s at Constanța and 3.5 m/s at Mangalia). On the contrary, in July, the mean values of wind-speed are pretty evenly distributed among the eight cardinal directions; the highest values still corresponding to the N direction (5.5 m/s at Constanța and 4.5 m/s at Mangalia) and the lowest values, to the SW direction (2.9 m/s at Constanța and 3.2 m/s at Mangalia). But when analyzing the bioclimatic effects of winds, we must also refer to calm frequency, which reaches higher values in July (15.0% at Constanța and 13.6% at Mangalia) and decreases to lower values in January (8.9% at Constanța and 11.3% at Mangalia). Since wind may become an efficient factor of physiological stress, both by means of its cooling power and by its indirect effects induced by thermal and pressure

variations, it is unanimously taken into consideration in all bioclimatic assessments of human comfort, and that is why, the present study deals mainly with issues of concern.

Main bioclimatic characteristics

Bioclimatic comfort, which is an important component of climatic therapy, is primarily based on the complex relationship between air-temperature and humidity, on one side, and wind-speed, on the other side. But these climatic factors of influence don't entirely represent useful indicators of human comfort, since individual reactions depend not only on the elements of the heat exchange budget, but also on subjective factors that are highly variable between individuals. In this respect, bioclimatic studies make intense use of some illustrative indicators specifically pointing to actual climatic perceptions.

The *equivalent effective temperature (EET)* stands for the actual ambient temperature perceived by the human body under specific conditions of humidity and air-movement. Its value may be obtained either by means of computational (E. C. Thom or J. P. Besançonot formulae) or by graphical methods (ASHRAE Comfort Chart), according to the prevalent action of meteorological elements in a given area, but because the wet-bulb and dry-bulb temperatures were not available and, therefore, the ASHRAE method couldn't be applicable, we had to resort to computational means (Besançonot formula), which establish the effective temperature in relation with air-temperature and humidity, starting from the premises that evaporation of water from human skin is the main physical process of heat loss (cooling). In this respect, effective temperature accordingly decreases as relative humidity gets lower, but the decreasing rate gets higher as air-temperatures become negative. The practical significance of the effective temperature refers to the fact that it enables the assessment of human *thermal comfort* in a given area and it is generally admitted that TEE values ranging between 14.5-15.5°C best describe a state of optimum comfort, whereas TEE values below this physiological limit indicate hypothermal discomfort and above it, hyperthermal discomfort.

As far as the region of the Black Sea is concerned, the effective temperature variation and distribution largely depend on the same mechanisms of influence as the ones acting upon air-temperature and humidity, so that they decrease towards south, where the moderating effects of sea-waters are stronger (Table 1). However, the mean effective temperatures are lower at Mangalia during the summer months, because of the specific higher values of relative humidity as compared to those at Constanța, but keep higher than the corresponding ones in Constanța during winter, because of the positive air-temperature values that attenuate the decrease of effective temperature, although the mean annual value is quite similar (9.7°C in Constanța and 9.6°C in Mangalia). TEE comfortable values (14.5-15.5°C) are characteristic of only one single month (May) in both seaside resorts, so that open-air therapy is highly recommendable, but they point

to potential physiological discomfort in summer (June-August) and, therefore, special attention must be given to the extreme range of TEE values because they can greatly change the limits of human comfort. For instance, by analyzing the maximum TEE values, we can infer that hyperthermia is not so oppressive in Mangalia as compared to Constanța, since the former records higher values during the winter months and lower during summer, but thermal comfort is shifted towards fall (October), while all on-season months (May-September) are characterized by high values, indicating possible heat exhaust (*Fig. 1*). On the contrary, the minimum TEE values restrict all summer months to a moderate thermal comfort and impose acute hypothermia all through winter months, although the cooling effects seem to be lower in Mangalia because of the greater amount of heat released by sea-waters. However, since summer TEE minimum values in Mangalia keep lower than in Constanța, the annual minimum effective temperature in the southern sector of the coast decreases more than the one in the northern sector (3.9°C at Mangalia as compared to 4.8°C at Constanța), pointing to possible excessive ranges which are extremely trying for the human body.

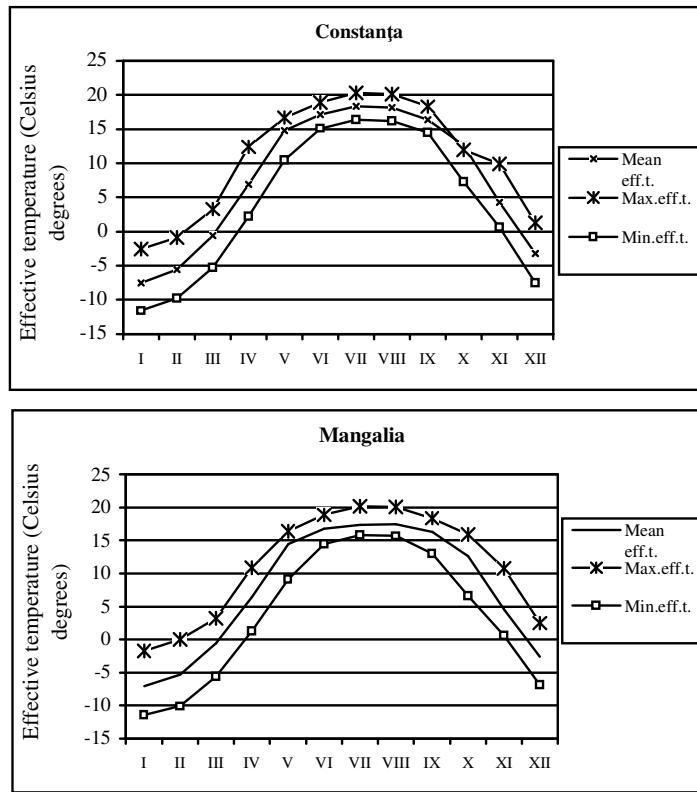


Fig. 1. Effective temperature (1900-1990)

Wind-chill is a bioclimatic indicator that objectively expresses the combined effect of air-temperature and wind-speed on the heat budget of the human body; its value representing the intensity of the heat loss per unit of body surface in one hour ($\text{kcal}/\text{m}^2 \text{ body surface.h}$) by means of different physical processes: radiation, convection, evaporation, etc, and resulting either from computational (P. A. Siple and Ch. F. Passel formula) or from graphical methods (Wind-chill Chart). It is true that the graphical methods also reveal the types of physiological effects induced by the two referred to meteorological factors of influence (air-temperature and wind-speed), so that subjective cooling or heating sensations are emphasized, but we have, nevertheless, chosen for the computational method, since it shows best the exact amount of heat that the human body loses under specific weather or climatic conditions, providing an objective basis of reference and comparison.

The wind-chill values in the region of the Black Sea coast generally keep among the lowest in summer and the highest in winter as compared to those in the rest of the country. But they are, however, highly variable from one location to another, according to their direct dependence on the wind-speed values. For instance, the wind-chill values in Constanța are higher than those in Mangalia simply because the wind-speed values are higher too (Table 1), but especially during summer months, they seem very similar, because even if the wind-speed is higher at Constanța, the lower air-temperature values in Mangalia largely increase the cooling power of air and consequently decrease the wind-chill values which otherwise should be lower than at Constanța (Fig. 2). The mean wind-chill values indicate a comfortable bioclimate only in June-September in Mangalia and July-August in Constanța; the maximum wind-chill values point to possible excessive cooling effects in November-April in both seaside resorts and the minimum wind-chill values reveal potential excessive heating effects only in July and August. However, the monthly distribution of mean and minimum wind-chill values clearly reflects that bioclimate is even more favourable towards south as long as neither the wind-speed and the cooling power of air are high, nor the yearly amplitudes of both the maximum and the mean wind-chill values are so great as in the northern sector, close to Constanța and these elements may be important since ample weather variations may be hazardous to human health.

Bioclimatic comfort, which has been assessed against the complex relationship between air-temperature, humidity and wind-speed, by means of a nomogram, best reveals the actual physiological sensations of well-being in any location and moment of year since its air-temperature-humidity relational component shows that physiological comfort decreases as humidity increases, even if air-temperatures are high or low, and air-temperature-wind component indicates that wind may reduce comfort when the air-temperatures are low, but it may increase comfort when the air-temperatures are too high. Of course, local

climatic factors of influence create visible differences of bioclimatic comfort from one place to another, so that therapeutical activities should be adjusted accordingly.

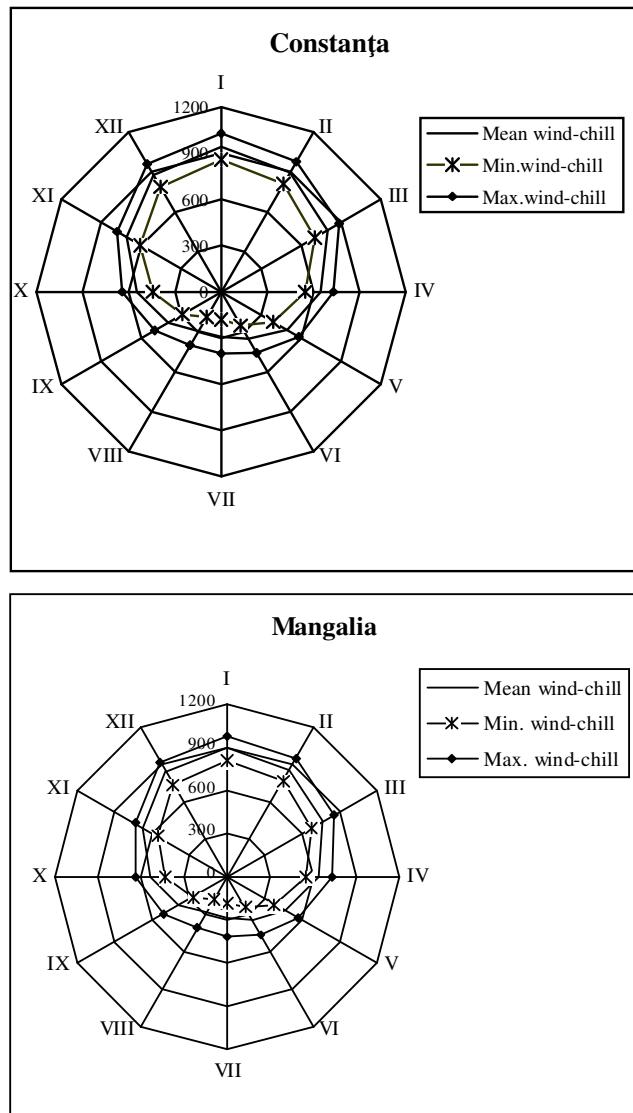


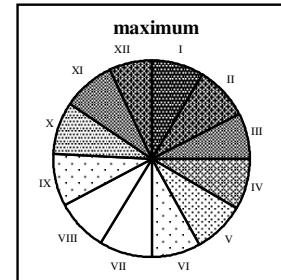
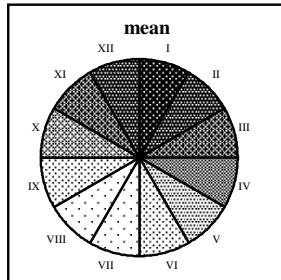
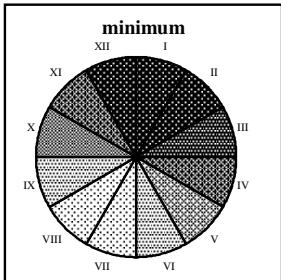
Fig. 2. Wind-chill (1900-1990)

The bioclimatic comfort on the Romanian shore of the Black Sea largely changes from bitterly cold, even freezing, to warm limits, according to the cooling or heating effects exerted by extreme (maximum and minimum) air-temperatures and wind-speed (*Fig. 3*). For instance, the minimum bioclimatic comfort, associated with minimum air-temperatures and maximum wind-speeds, is almost the same in both locations of interest (Constanța and Mangalia), except in July, when it's pleasant in Constanța and cool in Mangalia, or in September, when it's cool in Constanța and very cool in Mangalia. The state of facts changes in case of mean bioclimatic comfort (which was assessed against mean values of all climatic factors of influence) because it seems to be less favourable in Constanța, since November and January are perceived as being much colder than in Mangalia, where the bioclimatic stress during the winter-months is not so great. Quite unexpectedly, the maximum bioclimatic comfort is almost similar all along the Black Sea coast, but for a very slight difference in November which seems cold in Constanța and only very cool in Mangalia. In all cases, August stands for the month with the best bioclimatic comfort all over the area of interest, July is comfortable only when referring to mean climatic values, otherwise ranging from warm, under conditions of maximum comfort, to pleasant (Constanța) or cool (Mangalia), when dealing with minimum comfort. However, an interesting finding is that June displays a more stable bioclimatic comfort, since it keeps pleasant or comfortable, meaning that any health cure might be more efficient in the absence of high bioclimatic variations or bioclimatic stress.

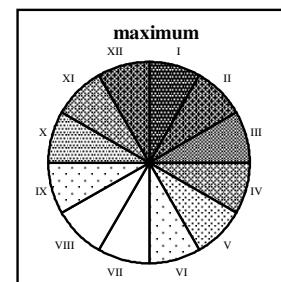
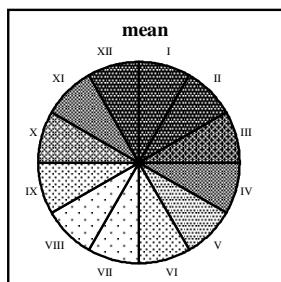
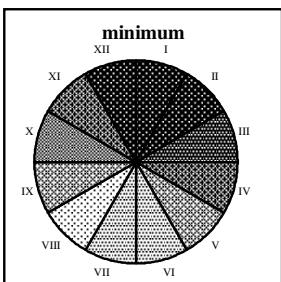
Conclusions

The bioclimatic factors (effective temperature, wind-chill and bioclimatic comfort) may represent useful tools in assessing the potential therapeutical effects of climate in a given area. These effects are not specific since they act upon the whole human body, but their general influence may be of sizable importance in the recovery and cure of some physiological disorders. In this respect, the specific bioclimate on the Romanian shore of the Black Sea may be efficiently exploited for helio-therapy during the summer months, because the radiative potential is the greatest in the country and for air-therapy from May to September, because the bioclimatic comfort keeps pleasant and the heat is not so oppressive in the summer. However, we shouldn't forget that there are some potential risks, referring mainly to excessive cooling in winter, but the optimum effective temperatures generally obscure the influence of wind-chill, so that the area under study may be considered as one of the most favourable bioclimatic areas in the country.

A. Constanța



B. Mangalia



freezing
 bitterly cold
 very cold

cold
 very cool
 cool

pleasant
 comfortable
 warm

Fig. 3. Bioclimatic comfort (1900-1990) on the Romanian Shore of the Black Sea

CONSIDERATIONS BIOCLIMATIQUE SUR LE LITTORAL ROUMAIN
DE LA MER NOIRE

Résumé

Parmi les facteurs physiologiques de stress, ceux climatiques sont probablement les plus agressifs à cause de leur variabilité temporelle et spatiale importante . L'étude bioclimatique sur le littoral roumain de la Mer Noire peut être valorisé dans des différentes activités de planification thérapeutique parce que la santé humaine est directement liée au confort climatique et microclimatique. De plus, des conditions bioclimatiques particulières aident l'organisme humain à conserver et à refaire sa capacité vitale et par conséquent à améliorer son l'efficience de sa fonctionnalité. Les approches bioclimatiques utilisent des indicateurs spécifiques pour exprimer les perceptions physiologiques réelles : la température effective, la force de raffraîchissement du vent et le confort bioclimatique, qui peuvent représenter des critères importantes pour évaluer les effets possibles (stimulateurs ou restrictifs) produits par le climat d'une région géographique sur le rendement et sur la santé humaine :

Mots-clefs: la température effective, la force de raffraîchissement du vent, le confort bioclimatique, le littoral roumain de la Mer Noire.

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THE INFLUENCE OF NORTH ATLANTIC OSCILLATION ON ROMANIAN BLACK SEA COAST WIND REGIME

ALFRED VESPREMEANU-STROE*, FLORIN TĂTUI

North Atlantic Oscillation (NAO) is a prominent recurrent patterns of atmospheric circulation variability defined as an anomaly in the sea level air pressure distribution in the North Atlantic region. NAO index is based on the difference of the standardized sea level pressure anomaly measured at Lisbon (Portugal) and Stykkisholmur (Iceland). Research studies revealed that changes in the mean air flow and storminess associated with swings in the NAO (positive and negative phases) are reflected in large-amplitude patterns in the anomalies of temperatures, precipitation, heat fluxes and wind speed in the Atlantic-European region. In Romania, thermal anomalies are directly correlated with NAO phases, while precipitation pattern is indirectly related to the NAO.

Based on related analysis of wind data from three coastal meteorological stations (Sulina, Sf. Gheorghe and Constanța) and NAO index values, our study demonstrates that, in the last four decades of the last century, coastal storms characteristics are close connected with NAO variability. Hence, positive anomalies of annual mean wind speed are associated with NAO negative phases; correlation coefficients are higher on the northern deltaic coast (Sulina: - 0.61) and they present a general southward decreasing tendency (Sf. Gheorghe: - 0.51; Constanța: - 0.42). The most powerful correlation is established between storm incidence frequency on the Danube Delta coast and NAO index ($r = -0.76$), this value being higher than all the other similar correlations established on European coasts. Wind regime analysis, especially coastal storms distribution, pointed out a prominent contrast between a very active interval from this point of view (1961-1978) and a relatively quiet period with low variability (1979 – 2000). Utilising complementary topographical databasis, we demonstrate the direct linkage between coastal storms magnitude and frequency and shoreline evolution. So, the intense stormic activity in the 60's and 70's is responsible for the high intensity of coastal processes (both erosional and accretional) with high sediment transport rates which seriously affected coast configuration.

Keywords: North Atlantic Oscillation, wind regime, coastal storm, correlation coefficients, shoteline evolution.

1. Introduction

North Atlantic Oscillation (NAO) is one of the oldest known world weather patterns, as some of the earliest descriptions of it were from seafaring Scandinavians several centuries ago. NAO is a prominent recurrent patterns of atmospheric circulation variability which dictates the climate variability from the eastern coast of the United States and Canada to Siberia and from the Arctic to the subtropical Atlantic. It occurs especially during boreal winter (when the atmosphere is dynamically the most active),

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while the NAO summer signal is quite null. By its impact on the Northern Hemisphere climate NAO is a conducive factor for environmental changes and important to human society.

The phenomenon has been defined as an anomaly in the sea level air pressure (SLP) distribution with centres of action near the Icelandic low and the Azores (Van Loon and Rogers, 1978). Conventionally, the index of the NAO is based on the difference of the standardized sea level pressure (SLP) anomaly measured at Lisbon, Portugal and at Stykkisholmur, Iceland (Hurrell, 1995). Research studies revealed that changes in the mean air flow and storminess associated with swings in the NAO are reflected in large-amplitude patterns in the anomalies of temperatures, precipitation, heat fluxes and wind speed in the Atlantic-European region (Kushmir, 1994; Hurrell, 1995). When the NAO index is positive, enhanced westerly flow across the North Atlantic during winter moves relatively warm (and moist) maritime air over much of Europe, enhanced precipitation over northern Europe associated with less precipitation over central and southern Europe occurs (Hurrell, 1995; Hurrell and van Loon, 1997; Rămbu *et al.*, 2002). A reverse situation occurs during the negative phase of the NAO.

In Romania, positive thermal anomalies are associated with positive NAO phases due to prevalence of zonal circulation over the Northern and Central Europe and negative thermal anomalies over Romania are associated with negative NAO phases. The winter precipitation pattern over Romania is indirectly related to the NAO (Bojariu and Paliu, 2001; Zaharia *et al.*, 2002). The study of NAO projection on temperature and precipitation regime in Romania show that the winter NAO related signal is stronger in the extra-Carpathian regions, due to the orographic effects imposed on the atmospheric flow by the Carpathian mountains (Bojariu and Paliu, 2001).

The Romanian Black Sea coast is subject to intense geomorphological processes with a net domination of erosion which affects about 70% of total shoreline length (Vespremeanu *et al.*, 2004; Constantinescu, 2005). The strongest coastal processes are recorded during winter, due to high storms frequency and magnitude. The storm activity is responsible for 61% from total longshore sediment transport (LST) and 78.5% from net southward LST (Vespremeanu-Stroe, 2004); moreover, the high prevalence of northern storms (89% from all storms), imposes an unidirectional development for many coastal processes as LST, aeolian sediment transport (the resultant direction of aelian transport is 197.1° at Sulina and 182.4° at Sfântu Gheorghe), deltaic lobes lop-sided developed and sand wave migration (Giosan *et al.*, 1999, 2004; Preoteasa and Vespremeanu-Stroe, 2004).

The goal of this paper is to investigate the NAO projection on the Romanian Black Sea coast wind regime; a special attention is paid to the NAO control on coastal storm occurrence.

2. Data and methods

2.1. Data

The primary data used in this study consist in monthly and annual means of wind speed and frequencies from three coastal meteorological stations (Sulina, Sf. Gheorghe and Constanța) and a mountain reference station (Vf. Omu – 2505m). For the meteorological stations placed on Danube delta coast, Sulina and Sf. Gheorghe, hourly data were used to extract the wind speed values higher than 10 m/s, respectively 15 m/s, in order to quantify the storm parameters. In addition we also used the Hurrell's NAO index defined as the difference of normalized SLP between Lisbon, Portugal and Stykkisholmur, Iceland (Hurrell, 1995). All wind and NAO data covered January 1961–December 2000 interval.

2.2. Methodology

Knowing the NAO is strongest in the cold season, and maritime winter covers December–March interval (Stoenescu, 1965; Vespremeanu-Stroe, 2004), we counted annual values for winter mean wind speed (December–March). The annual prevalence of storms was determined processing the hourly wind speed values. Further, the storm normalised anomalies were smoothed with a three-year running mean filter to obtain a multi-annual component of the series.

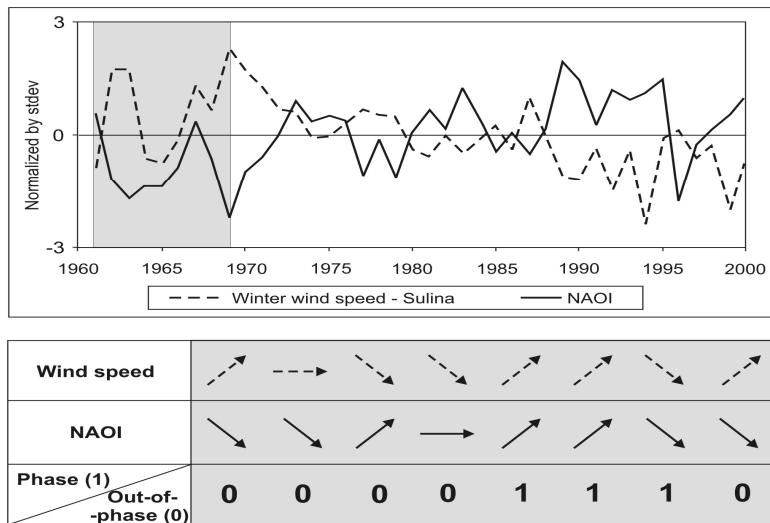


Fig. 1. The phase/out-of-phase co-evolution of NAO and wind data (For illustration we used the mean winter speed at Sulina and NAO index; the grey band from upper figure is detailed in the lower one)

The strongest linkage between NAO and local climate fluctuations is found in January, the first month of the active season for the Arctic Oscillation (Thompson and Wallace, 1998, 2000). Thus, for the west/east (W/E) wind frequency ratio were used only the January mean values. W/E ratio is obtained dividing the sum frequencies of western winds (from NW to SSW) to eastern winds (NNE-SSE).

All data were normalized extracting from each value the long-term mean and dividing it to standard deviation. The linkage between NAO variability and coastal wind regime is identified by determining the correlation coefficients between Hurrell's NAO index and wind data. Another linkage is established using the phase/out-of-phase co-evolution of NAO and wind data (*Fig. 1*).

3. Results

3.1. The linkage between NAO and winter mean wind speed

In order to quantify the NAO projection on winter wind speed pattern we computed the correlation and phase/out-of-phase coefficients between Hurrell's NAO index and winter mean wind speed. For all coastal meteorological stations the positive wind speed anomalies are associated with NAO negative phases. The highest correlation coefficients encounter in the northern part of Romanian Black Sea coast (Sulina: -0,61) in the context of a general southward decreasing trend (Sf. Gheorghe: -0,51; Constanța: -0,42). All these values are substantially higher than at Vf. Omu reference station (*Fig. 2*). The phase/out-of-phase coefficients point out the same spatial differences described above. Danube Delta coast shows a net dominance of out-of-phase relationship (-0,7) between wind speed anomalies and NAO index in comparison with the southern Romanian coast (-0,57). This spatial pattern hiddens important decadal variations: 1961-1975 interval is characterized by a well-balanced phase & out-of-phase relationship (-0,5) while 1976-2000 is strongly out-of-phase (-0,8).

3.2. The NAO control on coastal storms

For storm analysis we selected wind speed values higher than 10 m/s and 15 m/s, for minimum 6 hour interval. Storm distribution during the last four decades of XX century highlights a prominent contrast between a very active interval: 1961-1978 and a relatively quiet period with low variability: 1979-2000.

The time evolution of storm activity together with the Hurrell's NAO index are illustrated in figure 3. There is a direct linkage between storm frequency and magnitude and coastal evolution. Thus, the high storm activity from '60 (*Fig. 3: A1, B1*) is responsible for the increasing of coastal processes intensity, both erosion and deposition, with high sediment transport rates, which seriously affected the coast configuration (*Fig. 4*). This correlated analysis of storm data, topographical databasis and NAO index demonstrate that positive anomalies of coastal processes intensity are associated with negative NAO phases.

There is a strong connection between the sum of winter cases with strong winds ($u > 15$ m/s for more than 6 hours) and NAO index, reflected by high correlation coefficients (*Fig. 3: A2, B2*).

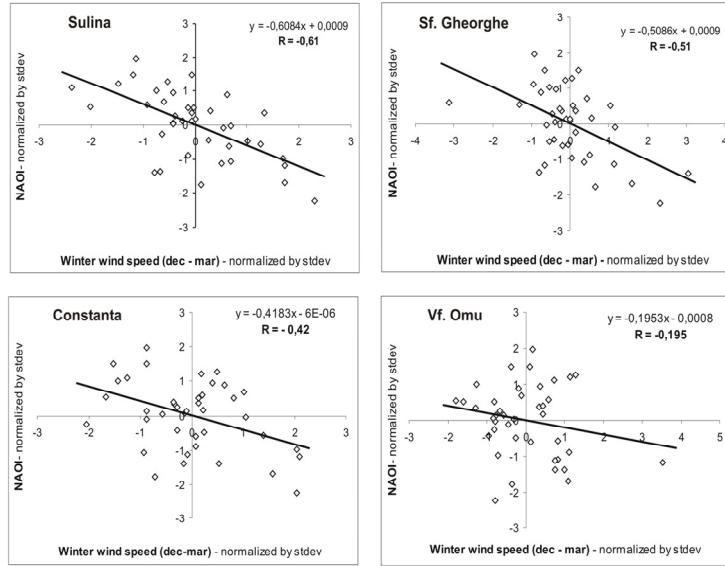


Fig. 2. Correlation coefficients between winter wind speed and NAO index (1961-2000)

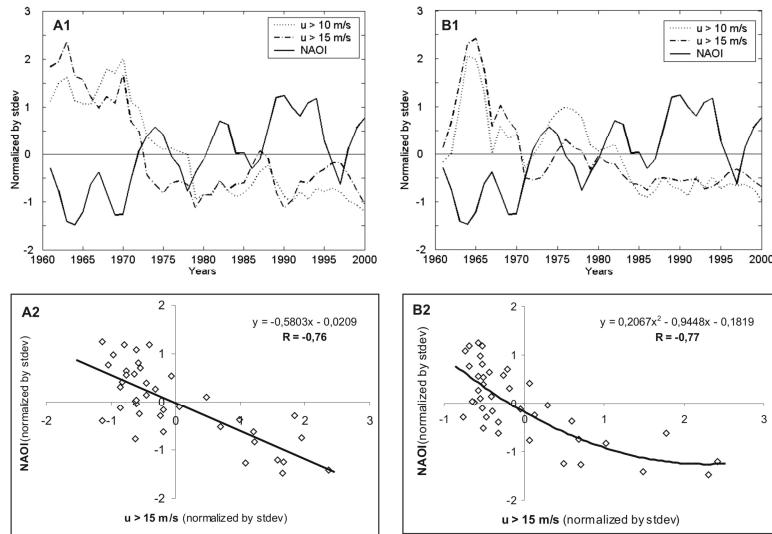


Fig. 3. Time evolution of storm incidence and Hurrel's NAO index (A1 – Sulina; B1 – Sf. Gheorghe). Correlation coefficients between winter cases with strong winds ($u > 15 \text{ m/s}$ for more than 6 hours) and NAO index (A2 – Sulina; B2 – Sf. Gheorghe)

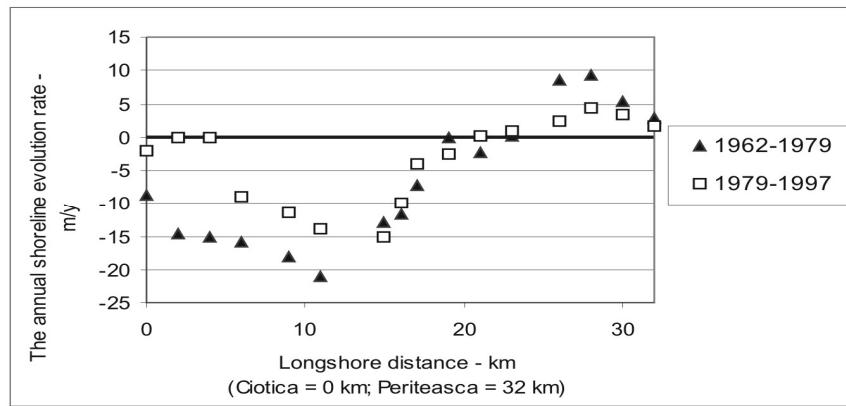


Fig. 4. The multidecadal shoreline evolution for a deltaic coast sector: Sacalin Island-Periteaşa beach ridge plain. Note the great intensity differences of coastal processes recorded in 1962-1979 interval in comparison with 1979-1997 interval

3.3. W/E wind frequency ratio variability

As NAO controls the mass circulation pattern over Europe, we tried to assess the NAO role in western circulation strengthening or weakening over Romanian Black Sea coast. The westerlies frequency was quantified by January mean values of W/E wind frequency ratio.

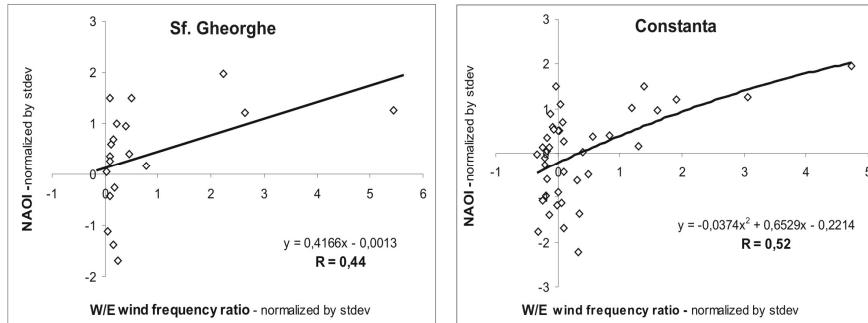


Fig. 5. The direct connection between western circulation and NAO index is increasingly southward

The spatial pattern of January W/E wind frequency ratio is partly presented in figure 5. It is noticeable a northward decreasing trend of correlation coefficients (Constanta:

0.52, Sf. Gheorghe: 0.44, Sulina: 0.41). Positive anomalies of western circulation in the Romanian coastal zone, in January, are associated with positive NAO phases.

4. Conclusions

The results presented above show evidence of NAO effects on wind regime anomalies over Romanian coastal zone. The correlation and phase/out-of-phase coefficients point out the positive winter wind speed anomalies associated with NAO negative phases.

It is widely accepted that NAO controls the West-Europe coastal storm characteristics (Hurrell and van Loon, 1997; Bojariu and Paliu, 2001) but our results clearly show that storms on Romanian Black Sea coast are strongly related to NAO index variations too, especially for a multi-decadal scale (Fig. 3 A1, B1). Further, based on wind data, topographical database and NAO index we demonstrate that positive anomalies of coastal processes intensity are associated with negative NAO phases (Fig. 4). From this point of view during the '60 and '70 encountered many harsh meteo-marine conditions which generally intensified the erosion processes with significant coastal landscape changes. A different coastal regime established during the '80 and '90 when the importance of depositional processes increased.

The western mass circulation over the Romanian Black Sea coast assessed by W/E wind frequency ratio is highly variable from year to year, from 0.25 to 45. There is a direct connection with NAO index, the positive anomalies of western circulation in January being associated with positive NAO phases.

A surprising result of this study regards the spatial distribution of coastal zone wind regime parameters and NAO variability. Two major longshore trends were identified: (i) a general southward decreasing tendency of correlation coefficients between NAO, on one hand, and winter mean wind speed and storm incidence on the other hand, and (ii) a general southward increasing tendency of correlation coefficients between western circulation intensity and NAO.

INFLUENȚA OSCILAȚIEI NORD-ATLANTICE ASUPRA REGIMULUI EOLIAN PE LITORALUL ROMÂNESC AL MĂRII NEGRE

Rezumat

Oscilația Nord-Atlantică (NAO) reprezintă un fenomen atmosferic complex, definit ca o anomalie a distribuției presiunii aerului la nivelul mării în Atlanticul de Nord. Indicele NAO se calculează pe baza diferenței dintre valorile standardizate ale presiunii aerului la nivelul mării, măsurate la Lisabona (Portugalia) și Stykkisholmur (Islanda). Cercetările efectuate până în prezent au arătat că schimbările în circulația generală a maselor de aer, asociate cu variațiile NAO – faze

pozitive și negative, sunt reflectate în modificări de mare amplitudine ale distribuției temperaturilor, precipitațiilor, fluxurilor de căldură și vitezei vântului în regiunea Nord-Atlantică, Europeană și Vest-Asiacică. În România, temperaturile sunt corelate direct cu indicele NAO, în timp ce precipitațiile cunosc o corelație inversă.

Pe baza analizei corelate a datelor de vânt de la trei stații de pe litoralul românesc al Mării Negre (Sulina, Sf. Gheorghe și Constanța) și a valorilor indicelui NAO, studiul de față demonstrează că, în ultimele patru decenii ale secolului trecut, caracteristicile furtunilor costiere sunt strâns legate de variațiile NAO. Astfel, anomaliiile pozitive ale vitezelor medii anuale ale vântului sunt asociate fazelor negative ale NAO; coeficienții de corelație sunt mari în nordul litoralului deltaic (Sulina: -0,61) și prezintă o tendință de scădere spre sud (Sf. Gheorghe: -0,51; Constanța: -0,42). Cea mai puternică corelație este stabilită între frecvența intensificărilor stormice pe țărmul Deltei Dunării și indicele NAO ($r = -0,76$), această valoare surclasând toate celelalte corelații similare stabilite pe coastele Europei. Analiza regimului eolian, în special a distribuției furtunilor costiere, a pus în evidență contrastul dintre un interval foarte activ din punct de vedere stormic (1961-1978) și o perioadă relativ calmă, cu variabilitate scăzută (1979-2000). Prin utilizarea complementară a datelor topografice, este evidențiată legătura directă care există între magnitudinea și frecvența furtunilor costiere și evoluția liniei țărmului. Astfel, activitatea stormică intensă din anii '60 și '70 este responsabilă pentru intensitatea ridicată a proceselor costiere (erozive și acumulative) cu rate mari ale transportului de sedimente care au afectat profund configurația țărmului. Dincolo de corelațiile stabilite între regimul eolian de pe litoralul românesc al Mării Negre și sistemele de oscilații climatice, rezultatele noastre indică faptul că anomaliiile pozitive ale intensității proceselor geomorfologice costiere sunt asociate cu fazele negative ale NAO.

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FAUNA PODIȘULUI DOBROGEI

SORIN GEACU

1. Introducere

Deși studierea faunei terestre a Podișului Dobrogei este în curs de desfășurare, putem aprecia că originea și evoluția, dar și zonarea grupărilor faunistice și elementelor zoogeografice are asemănare, în linii majore, cu cea a vegetației.

Fauna terestră dobrogeană este cea specifică zonelor de vegetație (forestieră, silvostepă, stepă), dar s-au produs modificări ale arealelor și dimensiunii populațiilor, din cauza restrângerii semnificative, dar și degradării formațiilor vegetale (cu care formează biocenoze), la care adăugăm și faptul că amestecurile faunistice interzonale sunt mult mai frecvente, datorită mobilității, dar și spectrului ecologic mai larg al componentelor sale.

Podișul Dobrogei este încadrat provinciilor biogeografice Moesică (în părțile de nord și sud-vest, cu o faună corespunzătoare pădurilor de foioase) și Pontică (în restul teritoriului, cu o faună adaptată spațiilor deschise de stepă).

În ansamblu, fauna regiunii se remarcă prin diversitatea taxonomică, ecologică și populațională, întâlnindu-se numeroase elemente de diferite origini, îndeosebi sudice, ceea ce conferă o puternică originalitate zoogeografică acestei provincii românești.

Luând în considerație importantul rol jucat în ecologia podișului, ca și în conturarea zonelor și subzonelor de peisaj geografic, ne vom referi în continuare, mai ales, la grupele mari de vertebrate: mamifere, păsări (efectivele pentru unele specii cinegetice se referă la anul 2003), reptile, amfibieni și pești.

2. Fauna pădurilor de foioase

În partea nordică a Dobrogei, în special în Munții Măcin, Dealurile Niculițelului și Podișul Babadag (mai puțin în Podișul Casimcei) sunt întinse păduri încadrate atât pădurilor mezofile de foioase – unitatea „Păduri moesic-vest pontice de gorun (*Quercus dalechampii*, *Q. polycarpa*, *Q. petraea*), carpen (*Carpinus betulus*), tei argintiu (*Tilia tomentosa*)”, la altitudini mai mari de 250 m –, cât și

pădurilor xeroterme de foioase – unitatea „Păduri vest-pontice de stejar pufos (*Quercus pubescens*), cărpiniță (*Carpinus orientalis*) și mojdrean (*Fraxinus ornus*)”. În sud-vestul Dobrogei, pădurile ocupă suprafețe mai mici (la altitudini cuprinse între 100-200 m) și sunt încadrate pădurilor xeroterme, unitatea “Păduri balcanice de cer (*Quercus cerris*) și stejar pufos (*Quercus pubescens*) cu cărpiniță (*Carpinus orientalis*), mojdrean (*Fraxinus ornus*) și scumpie (*Cotinus coggygria*)”.

În nordul Dobrogei, pădurile ocupă circa 70000 ha, iar în sud-vestul acesteia, circa 11.000 ha.

Dintre **mamifere**, amintim în primul rând cervidele. Astfel, căpriorul (*Capreolus capreolus*), datorită vânătoriei raționale și a măsurilor protective, a atins, pe alocuri, densități apreciabile. În sud-vestul Dobrogei sunt între 20-35 exemplare, iar în Dobrogea de Nord 60-90 exemplare, pe fiecare fond de vânătoare. Cei mai mulți căpriori se întâlnesc în zonele Negureni-Tudor Vladimirescu (65 ex.) pentru sud-vestul Dobrogei, iar pentru Dobrogea de Nord – 100 ex. la Atmagea, 107 ex. în sudul Dealurilor Niculițelului (Alba-Celic), valoarea maximă pentru Dobrogea fiind în pădurea Codru, de la sud de Babadag (120 ex.). În pădurile dintre Munții Măcin și Dealurile Niculițelului (Greci-Luncavița-Nifon), ca și în pădurile din sud-vestul Dobrogei, se întâlnesc cerbul (*Cervus elaphus*). În nord sunt 56 ex., în sud-vest fiind peste 260 ex. (cele mai multe (190 ex.), în zonele Dumbrăveni-Băneasa-Carvăń. Totodată, în pădurile din vestul Podișului Babadag (maxim 123 ex. în zona Cârjelari-Topolog, apoi 95 ex. lângă Atmagea), ca și în sud-vestul Dobrogei (circa 40 ex. la Băneasa-Răzoarele și Ion Corvin), a fost colonizat cerbul lopătar (*Dama dama*).

Suidele, reprezentate de mistreț (*Sus scrofa*), datorită gospodăririi fondurilor de vânătoare și recoltei moderate, formează populații semnificative. Astfel, în sud-vestul Dobrogei sunt circa 200 ex. (54 în pădurea Dumbrăveni, 40 în zona Băneasa, 30 între Ion Corvin și valea Urluia, 25 la Negureni etc.), iar în nord, cele mai numeroase efective (circa 40 ex.) sunt în pădurile situate de o parte și alta a drumului Luncavița-Nifon.

Un reprezentant al familiei Bovidae, muflonul (*Ovis musimon*), a fost colonizat în pădurile din sud-vestul Dobrogei (1965-1966), azi fiind puține exemplare lângă Negureni (jud. Constanța).

Dintre canide, vulpea (*Vulpes vulpes*) este mai frecventă în pădurile de la vest de Băneasa (Constanța) și de la sud de Babadag. Sporadică, numai în sud-vestul Dobrogei, este prezența lupului (*Canis lupus*).

Mustelidele sunt bine reprezentate în toată zona forestieră a Dobrogei. În puține exemplare se întâlnesc bursucul (*Meles meles*) (circa 30 ex. în zona Carvăń-Băneasa-Oltina din sud-vest și 12 ex. în pădurile de la sud de Babadag) și jderul de copac (*Martes martes*) (circa 30 ex. în pădurile din Podișul Babadag, 16 ex. în pădurile Niculițel-Celic și 15 ex. în pădurile din Munții Măcinului). Foarte rar, în sud-vestul Dobrogei, se întâlnesc jderul de piatră

(*Martes foina*). Mai frecvente sunt dihorul (*Putorius putorius*) și nevăstuica (*Mustela nivalis*), aceasta din urmă întâlnită prin poieni și la marginea pădurilor.

Unicul reprezentant al familiei Felidae este pisica sălbatică (*Felis silvestris*), dar destul de rară (8 ex. în pădurile de la Băneasa-Negureni, 4 ex. în cea de la Dumbrăveni) în sud-vestul Dobrogei, iar în nordul acesteia, este mai frecventă în pădurile dintre Luncavița și Nifon (12 ex.), în pădurile de lângă Babadag (20 ex.) și mai puțin în nordul Podișului Casimcea (5 ex. în pădurile de lângă Camena, 4 ex. în cele de lângă Cișmeaua Nouă).

Dintre mamiferele insectivore se întâlnesc ariciul răsăritean (*Erinaceus concolor*).

Rozătoarele mai caracteristice pădurilor de foioase din Podișul Dobrogei sunt: șoarecele de câmp (*Microtus arvalis*), în poieni și la marginea pădurilor, șoarecele vărgat de câmp (*Apodemus agrarius*), șoarecele gulerat (*Apodemus flavicollis*), șoarecele de pădure (*Apodemus sylvaticus*). Dintre gliride amintim: pârșul de pădure cu coada stufoasă (*Dryomys nitedula*), identificat, de exemplu, în pădurile de lângă Luncavița (Popescu, 1968), și pârșul de alun (*Muscardinus avellanarius*).

Călinescu (1956) semnalează și veverița (*Sciurus vulgaris*), în pădurile Canara (Cărpiniș – Băneasa), Frăsinet (Lipnița) și Cișmele (Negureni) din Podișul Oltinei.

Pe la marginea pădurilor se adăpostesc iepurii (*Lepus europaeus*).

Dintre chiroptere, au fost identificate mai multe specii. În zona Canaraua Fetii (com. Băneasa, jud. Constanța), se întâlnesc liliacul cu urechi crestate (*Myotis emarginatus*) și liliacul mic cu potcoavă (*Rhinolophus hipposideros*). În peștera Cișmeluța de lângă satul Șipotele (com. Deleni, jud. Constanța) a fost identificat rinoloful lui Mehelys (*Rhinolophus mehelyi*). În peșterile din dealul Consul de lângă Izvoarele (jud. Tulcea) au fost colectați: liliacul mare cu potcoavă (*Rhinolophus ferrumequinum*) și liliacul lui Natterer (*Myotis nattereri*).

Păsările sunt numeroase și aparțin de grupe sistematice variate.

Dintre picide amintim: ghionoaia sură (*Picus canus*), ghionoaia verde (*Picus viridis*), iar dintre ciocănitori – ciocănitarea pestriță mare (*Dendrocopos major*), ce are frecvența cea mai mare, ciocănitarea de grădină (*Dendrocopos syriacus*), ciocănitarea de stejar (*Dendrocopos medius*), toate, specii sedentare. Numai în pădurile din nordul Dobrogei cuibăresc ciocănitarea neagră (*Dryocopus martius*) și ciocănitarea cu spatele alb (*Dendrocopos leucotos*).

Răpitoarele de noapte (strigidele) sunt reprezentate în principal de: cucuvea (*Athene noctua*), huhurez mic (*Strix aluco*) și ciuf de pădure (*Asio otus*), toate, specii sedentare. Tot o specie sedentară, dar foarte rară, este buha (*Bubo bubo*). Numai în pădurile nord-dobrogene, cuibărit probabil are striga (*Tyto alba*). Oaspete de vară în pădurile dobrogene este ciușul (*Otus scops*).

Dacă picidele și strigidele nu se întâlnesc în număr mare, populații mari au paridele și silviidele. Primele sunt reprezentate de: pițgoi de livadă (*Parus lugubris*), pițgoi albastru (*Parus caeruleus*), pițgoi mare (*Parus major*) – specii sedentare – și boicușul (*Remiz pendulinus*), specie parțial migratoare. Numai în pădurile din nordul Dobrogei cuibărește și pițgoiul sur (*Parus palustris*). Dintre silviide

amintim: silvia porumbacă (*Sylvia nisoria*), silvia mică (*Sylvia curruca*) și silvia cu cap negru (*Sylvia atricapilla*), toate, oaspeți de vară. Numai în pădurile Dobrogei de Nord se întâlnesc silvia de zăvoi (*Sylvia borin*) și pitulicea mică (*Phylloscopus collybita*). În pădurile zonei forestiere a Dobrogei, cuibăresc pitulicea sfârâietoare (*Phylloscopus sibilatrix*, oaspete de vară) și frunzărița galbenă (*Hippolais icterina*). În sud-vestul Dobrogei, cuibărește și frunzărița cenușie (*Hippolais pallida*), oaspete de vară.

Dintre fringilide, o pasare des întâlnită este cinteza (*Fringilla coelebs*), specie parțial migratoare. Apar și florintele (*Carduelis chloris*), sticletele (*Carduelis carduelis*), câneparul (*Carduelis cannabina*). Un oaspete de vară întâlnit numai în pădurile Dobrogei de Nord este cănărașul (*Serinus serinus*). Fără a fi numeroase, sunt întâlnite și botgrosul (*Coccothraustes coccothraustes*), specie sedentară, ca și vrabia negricioasă (*Passer hispaniolensis*), oaspete de vară pătrunsă aici dinspre sud, relativ recent.

Turdidele sunt reprezentate de: sturzul cântător (*Turdus philomelos*), oaspete de vară și mierla (*Turdus merula*), specie sedentar-migratoare. Numai în pădurile nord-dobrogene se întâlnește sturzul de vâsc (*Turdus viscivorus*), migrator parțial și mierla de piatră (*Monticola saxatilis*), oaspete de vară.

În pădurile Podișului Dobrogei, rar se întâlnesc pietrarul sur (*Oenanthe oenathe*) și pietrarul negru (*Oenanthe pleschanka*). Un oaspete de vară semnalat recent în pădurile din nordul Dobrogei este pietrarul mediteranean (*Oenanthe hispanica*). Tot aici sunt semnalate: mărăcinarul mare (*Saxicola rubetra*), tot oaspete de vară, și codroșul de munte (*Phoenicurus ochruros*). Larg răspândite sunt: codroșul de pădure (*Phoenicurus phoenicurus*), privighetoarea roșcată (*Luscinia megarhynchos*) și măcăleandrul (*Erithacus rubecula*).

Numai în sud-vestul Dobrogei cuibărește privighetoarea de zăvoi (*Luscinia luscinia*), oaspete de vară.

Răpitoarele de zi (*falconiformele*) sunt reprezentate prin mai multe specii. Numai în Dobrogea de Nord se întâlnesc uliul păsărări (*Accipiter nisus*) și viesparul (*Pernis apivorus*). În rest, se întâlnesc uliul cu picioare scurte (*Accipiter brevipes*), ce cuibărește cu regularitate doar în Dobrogea, și şorecarul comun (*Buteo buteo*), cel mai frecvent. Foarte rar este şerparul (*Circaetus gallicus*). O specie ce cuibărește în pădurile de la Babadag și din Munții Măcinului (ca singurele locuri din țară), cu efectiv extrem de redus (sub 20 perechi), este şorecarul mare (*Buteo rufinus*). Numai în pădurile nord-dobrogene cuibărește acvila țipătoare mică (*Aquila pomarina*) și, foarte rar, acvila de câmp (*Aquila heliaca*). Foarte rară este și gaia neagră (*Milvus migrans*).

Foarte rar cuibăresc acvila mică (*Hieraetus pennatus*) și vânturelul mic (*Falco naumanni*). Frecvent este însă vânturelul roșu (*Falco tinnunculus*), dar și șoimul rândunelelor (*Falco subbuteo*). Doar în Munții Măcin – ca singur loc în țară –, cuibărește șoimul dunărean (*Falco cherrug*).

Dintre alaudide, în zona forestieră dobrogeană, cuibărește ciocârlia de pădure (*Lullula arborea*), oaspete de vară, iar dintre motacilide, numai în Dobrogea de Nord cuibărește fâsa de pădure (*Anthus trivialis*). Frecvente sunt însă codobatura albă (*Motacilla alba*) și codobatura galbenă (*Motacilla flava*). Se întâlnește și codobatura cu cap negru (*Motacilla flava feldegg*). Larg răspândite, dintre laniide, sunt sfrânciocul roșiatic (*Lanius collurio*) și sfrânciocul cu frunte neagră (*Lanius minor*). În număr extrem de redus, aici, ca singur loc din țară, cuibărește și sfrânciocul cu cap roșu (*Lanius senator*).

Dintre columbide, după 1930, s-a răspândit în Dobrogea, guguștiul (*Streptopelia decaocto*). În păduri, se întâlnesc porumbelul de scorbură (*Columba oenas*) și porumbelul gulerat (*Columba palumbus*), acesta din urmă cuibărind cert doar în pădurile Dobrogei de Nord. Larg răspândită e turturica (*Streptopelia tutur*).

Sedentare sunt corvidele: stâncuța (*Corvus monedula*), corbul (*Corvus corax*), coțofana (*Pica pica*), gaița (*Garrulus glandarius*).

Din alte familii, se întâlnesc: cucul (*Cuculus canorus*), pupăza (*Upupa epops*), dumbrăveanca (*Coracias garrulus*), presura galbenă (*Emberiza citrinella*), graurul (*Sturnus vulgaris*), grangurele (*Oriolus oriolus*), caprimulgul (*Caprimulgus europaeus*), țicleanul (*Sitta europaea*), rândunica (*Hirundo rustica*), muscarul sur (*Muscicapa striata*), muscarul mic (*Ficedula parva*), muscarul gulerat (*Ficedula albicollis*), pițigoușul codat (*Aegithalos caudatus*) și lăcustarul (*Sturnus roseus*). O specie de pasaj de interes cinegetic este sitarul (*Scolopax rusticola*). Cuibărit sigur numai în sud-vestul Dobrogei are presura cu cap negru (*Emberiza melanocephala*), care este însă extrem de rară. La fel de rară este și cojoaică de pădure (*Certhia familiaris*), care nu cuibărește decât în pădurile Dobrogei de Nord. Tot aici, însă sporadic, cuibărește și cojoaică cu degete scurte (*Certhia brachydactyla*).

În sud-vestul Dobrogei, a fost semnalată rândunica roșcată (*Hirundo daurica*), oaspete de vară. După 1960, s-a colonizat fazanul (*Phasianus colchicus*), specie cu un maxim populațional (câte 240-250 ex.), pe fondurile Băneasa și Adamclisi. În Dobrogea de Nord însă sunt numai 50-90 ex. de fazan în majoritatea fondurilor de vânătoare, cele mai multe exemplare fiind în zona Niculițel (255 ex.), apoi în arealul dintre Babadag și Slava Rusă (210 ex.), ca și în vestul Podișului Babadag (Atmagea-Cârjelari) (250 ex.).

Grupul **reptilelor** este bine reprezentat în Podișul Dobrogei. Testoasa *Testudo graeca ibera*, specie termofilă, a fost identificată la: Bugeac, Oltina, Canaraua Fetii, Șipote, Negureni, Dobromir, în județul Constanța și la Casimcea, Babadag, Slava Rusă, Ciucurova, Greci, Niculițel, Enisala, Luncavița, Cerna, în județul Tulcea.

Broasca testoasă cu coadă (*Emys orbicularis*) a fost găsită la Oltina, în sud-vestul Dobrogei, și la Enisala, lângă Babadag.

Ablepharus kitaibeli fitzingeri este o specie care a fost colectată din punctele: Bugeac, Oltina și Canaraua Fetii, în Dobrogea de sud-vest, precum și la Babadag, Slava Rusă și Luncavița în județul Tulcea.

O specie mezofilă este gușterul (*Lacerta viridis*), prezent în pădurile Dobrogei de Nord (Babadag, Enisala, Slava Rusă, Ciucurova, Atmagea, Greci, Niculițel, Mănăstirea Cocoș). La Atmagea, a fost colectată năpârca (*Anguis fragilis colchicus*) și balaurul (*Elaphe quatorlineata sauromates*). Mai rar apare șarpele *Coluber jugularis caspius* (Canaraua Fetii, Oltina, Bugeac, Babadag, Slava Rusă). În pădurea Codru (Babadag), se întâlnește șarpele *Elaphe longissima longissima*. În Canaraua Fetii, la Casimcea, Niculițel, pe valea Celic, se întâlnește și vipera cu corn (*Vipera ammodytes montandoni*).

Amfibienii sunt reprezentați de: broasca de pământ brună (*Pelobates fuscus*), broasca răioasă verde (*Bufo viridis*), brotăcelul (*Hyla arborea*). Numai în zona Munților Măcin, ca și în împrejurimile Mănăstirii Cocoș, se întâlnește broasca răioasă brună (*Bufo bufo*), specie crepusculară.

3. Fauna silvostepiei și stepei

În Podișul Dobrogei, silvostepa ocupă suprafețe restrânse în partea sa de sud-vest și ceva mai extinse în Podișul Casimcei, fiind reprezentată de „stepe danubiene de graminee și dicotiledonate în complex cu păduri de stejar brumăriu, stejar pufos și arțar tătărăsc”. Acestea mărginesc, la altitudini de 100-200 m, pădurile zonei forestiere.

Lumea animalelor, comparativ cu cea a pădurilor de foioase situate la altitudini mai mari, este mai săracă, ea suferind cel mai mult ca urmare a antropizării și, în primul rând, a extinderii terenurilor agricole pe spații întinse.

Mamiferele cele mai reprezentative aparțin ordinului *Rodentia* (rozătoarele). Dintre sciuride se întâlnește popândăul (*Spermophilus citellus*), atât pe terenurile cultivate, dar și islazuri, livezi, râpe, diguri, margini de drumuri neasfaltate. Spalacidele sunt reprezentate de orbetele mic (*Spalax leucodon*), caracteristic zonei de stepă, iar cricetidele de grivan sau hamsterul dobrogean (*Mesocricetus newtoni*), specie endemică pentru Peninsula Balcanică, fiind întâlnit numai în Dobrogea și estul Bulgariei.

Dintre arvicolide apar: șoarecele de câmp (*Microtus arvalis*), ce trăiește pe pajiști și în culturi de plante furajere, șoarecele răsăritean de câmp (*Microtus rossiaeemeridionalis*), care se întâlnește numai în partea de vest a Dobrogei. În 1956, a fost prins primul exemplar de bizam (*Ondatra zibethicus*), lângă Tulcea (Călinescu, Bunescu, 1958), după care specia s-a extins.

Muridele sunt reprezentate de: șobolanul cenușiu (*Rattus norvegicus*), ce populează și malurile apelor ori digurile canalelor de irigații, șoarecele de casă (*Mus musculus*), șoarecele de mișună (*Mus spicilegus*), șobolanul de câmp

(*Apodemus agrarius*), șoarecele de pădure (*Apodemus sylvaticus*) și șoarecele pitic (*Micromys minutus*).

Dintre diplodide, se întâlnește șoarecele săritor de stepă (*Sicista subtilis*), rozător rar în fauna României, în Podișul Dobrogei fiind semnalat la Malcoci – Tulcea și Valu lui Traian – Constanța.

Spațiilor deschise din Podișul Dobrogei le sunt caracteristice, dintre insectivore, cărtița (*Talpa europaea*), iar dintre soricide – chițcanul comun (*Sorex araneus*) și chițcanul de câmp (*Crocidura leucodon*), capturați în pădurea Comorova, chițcanul pitic (*Sorex minutus*), chițcanul de grădină (*Crocidura suaveolens*), găsit la Mangalia, Valu lui Traian, Hagieni, Comorova (toate, în județul Constanța) și chițcanul de casă (*Crocidura russula*).

Multe dintre rozătoare constituie hrana preferată a mustelidelor. Areal larg de răspândire au nevăstuica (*Mustela nivalis*) și dihorul comun (*Putorius putorius*). Numai în Dobrogea se întâlnește dihorul galben sau de stepă (*Putorius eversmanni*). Alături de acestea, se întâlnește și o a treia specie – dihorul pătat sau pestriț (*Vormela peregusna*, ssp. *euxina*). Dihorul are frecvență mai mare (10-15 ex.) în zonele Medgidia și Casimcea, iar nevăstuica, în vecinătatea localităților Peștera, Medgidia și Săcele. Bursucul (*Meles meles*), specie mai mult nocturnă, are cea mai ridicată frecvență din Dobrogea în zona Medgidia-Peștera (40 ex.). Rare apare în pădurea Negru Vodă, ca și în apropiere de Mihai Viteazu.

Răspândit este iepurele (*Lepus europaeus*). Cele mai mari efective din Dobrogea se află în zona Cobadin-Chirnogeni (circa 3000 ex.), efective ridicate (700-800 ex.) fiind și în zonele Vulturău, Cerchezu, Gârliciu, Mireasa, Cernavodă, iar în Dobrogea de Nord, în arealele: Făgărașu Nou-Dăeni, Babadag-Sarichioi și Beștepe-Sariniasuf. Efective mici de iepuri (sub 300 ex.) caracterizează zonele: Ceamurlia, Cotu Văii, Ivrinezu, Crucea, Năvodari, Ovidiu.

Dintre canide, două specii se evidențiază: vulpea (*Vulpes vulpes*) și șacalul (*Canis aureus*). Deși prezintă pe întreg arealul, vulpea este mai numeroasă (15-40 ex.) în punctele: Cochirleni, Negru Vodă, Hagieni, Medgidia, Corugea și Casimcea. Același lucru se poate spune și despre șacal, efectivele cele mai ridicate fiind la Cochirleni (45 ex.).

Sporadic, în sudul Dobrogei, se întâlnește pisica sălbatică, la Gura Dobrogei și Murfatlar, iar în nordul acesteia, câinele enot (Enisala, Mihail Kogălniceanu, Nalbant). În apropierea suprafețelor acvatice se întâlnește și bizamul (100 ex. la Peștera, 30 ex. la Medgidia).

Ca urmare a acțiunilor de gospodărire cinegetică, au sporit efectivele mistrețului (*Sus scrofa*) (câteva exemplare au ajuns până pe plajele de litoral în ultimul timp) și căpriorului (*Capreolus capreolus*). Mistrețul are efective mai mari în pădurea Negru Vodă (32 ex.), mai puține exemplare (10-12) fiind în pădurile Hagieni și Comorova, iar cu totul sporadic, apare în zonele Ivrinezu, Medgidia, Peștera, Murfatlar și Cechezu. Căpriorul, în sudul și centrul Dobrogei, are efective mai mari în zonele Cernavodă-Cochirleni (90 ex.) și

Casimcea (60 ex.). Pe toată latura estică a județului Constanța, ca și în sud-vestul Podișului Casimcei (Corugea-Făgărașu Nou), efectivele sunt foarte reduse (sub 10 ex. în fiecare fond de vânătoare). În nordul Dobrogei, efectivele variază de la 7 ex. (Beștepe) la 20 ex. în depresiunea Nalbant și 30 ex. în apropiere de Poșta. În pădurea Negru Vodă se întâlnește chiar și cerb (17 ex.).

Lumea *păsărilor* este variată. Dintre acestea amintim: potârnichea (*Perdix perdix*), prepelița (*Coturnix coturnix*), fâsa de câmp (*Anthus campestris*), ciocârlia de Bărăgan (*Melanocorypha calandra*), ciocârlia de câmp (*Alauda arvensis*), ciocârlanul (*Galerida cristata*), prigoria (*Merops apiaster*), graurul (*Sturnus vulgaris*), presurile (*Emberiza sp.*), guguștiucul (*Streptopelia decaocto*), turturica (*Streptopelia turtur*), cinteza (*Fringilla coelebs*), cucul (*Cuculus canorus*), sticletele (*Carduelis carduelis*), câneparul (*Carduelis cannabina*), pietrarii (*Oenanthe sp.*), silviile (*Sylvia sp.*), vrabia (*Passer sp.*), cioara de semănătură (*Corvus frugilegus*), cioara grivă (*Corvus corone cornix*), rândunica (*Hirundo rustica*), cristelul de câmp (*Crex crex*), pasărea ogorului (*Burhinus oedicnemus*), nagățul (*Vanellus vanellus*), dumbrăveanca (*Coracias garrulus*), ciocântoarea pestriță mare (*Dendrocopos major*), ciocântoarea de grădini (*Dendrocopos syriacus*), codobaturile (*Motacilla sp.*), mierla (*Turdus merula*), pițigoii (*Parus sp.*), grangurele (*Oriolus oriolus*), coțofana (*Pica pica*), stâncuța (*Corvus monedula*), florintele (*Carduelis chloris*) și altele.

Numai în Dobrogea este întâlnită ciocârlia de stol (*Calandrella brachydactyla*). În abrupturi, se observă lăstunul (*Riparia riparia*). În unele sate pot fi văzute cuiburi de barză albă (*Ciconia ciconia*). În arealele stâncioase (dar și în localități) se întâlnește drepneaua neagră (*Apus apus*). Dintre răpitoarele de zi, amintim vânturelul roșu (*Falco tinnunculus*), șoimul rândunelelor (*Falco subbuteo*), iar dintre răpitoarele de noapte – cucuveaua (*Athene noctua*) și huhurezul mic (*Strix aluco*). În ultimele 3-4 decenii s-a colonizat fazanul (*Phasianus colchicus*), cei mai mulți fazani fiind în zonele: Cochirleni (400 ex.), Ostrov-Tulcea (260 ex.), Siliștea (150 ex.), Negru Vodă (130 ex.) și Crucea (100 ex.). În alte areale sunt efective simbolice, ca de exemplu: Pantelimon (11 ex.) și Vulturu (15 ex.) din Podișul Casimcei. În multe părți, datorită resurselor reduse de apă (sau a lipsei acestia), nu se întâlnește această specie.

Referitor la efectivele potârnichii, acestea au valoarea maximă în zona Enisala-Jurilovca (circa 400 ex.). Numeroase sunt și în arealul Alba-Izvoarele (350 ex.), din nordul Dobrogei, și 240 ex. în fiecare din fondurile de vânătoare Negrești, Cerchezu și Chirnogeni, din sud. Doar câte 35-50 de potârnichi s-au observat în zonele: Crucea, Techirghiol, Topraisar, Valu lui Traian și Cotu Văii.

Reptilele. Testoasa *Testudo graeca ibera* a fost identificată la Valu lui Traian, Murfatlar, Cernavodă, Năvodari, Tulcea, Hagieni, Hârșova, Agigea, Amzacea, Negru Vodă, Beiaud, Plopeni, Nalbant, testoasa cu coadă (*Emys orbicularis*) la Agigea, Năvodari, Tulcea, iar specia *Ablepharus kitaibelii fitzingeri* la Murfatlar și Negru Vodă.

Răspândită (Tulcea, Beștepe, Histria, Mamaia, Mangalia, Rasova etc.) este șopârla de câmp (*Lacerta agilis chersonensis*). Biotopuri xerofile cu un anumit grad de petrofilie preferă gușterul vărgat dobrogean (*Lacerta trilineata dobrogica*). Aceasta a fost identificată la Mangalia, Cernavodă, Techirghiol, Năvodari, Somova, Tulcea. Sub arbuști, dar și pe formațiunile stâncoase ori calcaroase, se întâlnește *Lacerta viridis meridionalis*. Pe calcare (Bugeac, Șipote, Cernavodă, Tulcea, Beștepe) s-a observat și șopârla *Lacerta muralis aff. maculiventris*. Larg răspândită este însă șopârla Lacerta taurica. Numai în apropiere de Mamaia și Enisala apare șopârla pontică, *Eremias arguta deserti*. Din pădurea Comorova a fost recoltată năpârca (*Anguis fragilis colchicus*), iar din apropiere de Cernavodă, Cochirleni și Cârpiniș-Băneasa, șarpele *Eryx jaculus turcicus*. Pe pantele cu grade diferite de acoperire cu vegetație, stâncării, ravene adâncite în loess (Hagieni, Adamclisi, Tuzla, Murfatlar, Cernavodă, Năvodari, Tulcea, Măcin), se întâlnește șarpele *Coluber jugularis caspius*. Șarpele numit balaur (*Elaphe quatorlineata sauromates*) se întâlnește în numeroase regiuni, fiind colectat de la Tulcea, Gura Dobrogei, Cernavodă, Medgidia, Tuzla, Valu lui Traian, vârful Tuțuiat din Munții Măcin.

Pe terenurile pietroase, uscate, dar totdeauna în apropierea porțiunilor cu vegetație, apare și vipera cu corn (*Vipera ammodytes montandoni*). Răspândire largă are șarpele de casă (*Natrix natrix*).

Dintre **amfibieni**, amintim: broasca de pământ brună (*Pelobates fuscus*) identificată de exemplu la Cernavodă și Mangalia, broasca de pământ siriacă (*Pelobates syriacus balcanicus*) identificată în sud-estul Dobrogei (Agigea, Mangalia, Techirghiol, Năvodari) și broasca râioasă verde (*Bufo viridis*).

4. Fauna mediilor umede

Este reprezentată, cu precădere, la contactul Podișului Dobrogei cu zonele umede din vest, nord și est, dar și în interior, în marile lacuri.

Dintre mamifere amintim: chițcanul de apă (*Neomys fodiens*), șobolanul de apă (*Arvicola terrestris*), mistrețul (*Sus scrofa*), pisica sălbatică (*Felis silvestris*), câinele enot și bizamul (*Ondatra zibethicus*), ultimile două specii apărând începând cu anii '60-'70. Mistrețul realizează efective importante pe fondurile cinegetice: Ostrov-Constanța (60 ex.), Cochirleni (55 ex.), Isaccea (27 ex.). Câinele enot a fost semnalat numai în județul Tulcea (câte 14 ex. în zonele Smârdan și Somova, 12 ex. – Isaccea, 10 ex. – Crapina, 9 ex. – Ostrov). Pisica sălbatică este prezentă, în puține exemplare însă, în zonele Cochirleni, Ghindărești, Vadu Oii, Jijila și Somova, iar populația bizamului este apreciabilă.

Avifauna este variată, fiind reprezentată de multe specii de rațe sălbaticice (*Anas sp.*, *Aythya sp.*) și gâște sălbaticice (*Anser sp.*), corcodei (*Podiceps sp.*), stârci (*Ixobrychus sp.*), cristei de baltă (*Rallus aquaticus*), găinușe de baltă

(*Gallinula chloropus*), liște (*Fulica atra*), nagăți (*Vanellus vanellus*), chire de baltă (*Sterna hirundo*), chirighițe negre (*Chlidonias niger*), grușei de stuf (*Locustella lusciniooides*), lăcari (*Acrocephalus sp.*), ereți de stuf (*Circus aeruginosus*) și.a.

Dintre reptile, se întâlnesc șarpele de apă (*Natrix tessellata*), iar dintre amfibieni: sălămâzdra cu creastă (*Triturus cristatus*), identificată la Tulcea, apoi buhaiul de baltă (*Bombina bombina*), broasca mare de lac (*Rana ridibunda*), broasca mică de lac (*Rana esculenta*).

5. Considerații zoogeografice

Sub raport zoogeografic, se constată faptul că, deși majoritatea speciilor de vertebrate din Podișul Dobrogei au repartiție europeană, totuși, se întâlnesc și numeroase elemente zoogeografice sudice și estice. Pe baza încadrărilor făcute de Fuhn (1960), Fuhn și Vancea (1961), Vasiliu și Șova (1968) și Munteanu (1974), se pot separa următoarele categorii de elemente zoogeografice:

- elemente europene (inclusiv central-europene): *Cervus elaphus*, *Martes martes*, *Sciurus vulgaris*, *Spermophilus citellus*, *Meles meles*, *Putorius putorius*, *Apodemus flavicollis*, *Apodemus sylvaticus*, *Picus viridis*, *Dendrocopos medius*, *Lullula arborea*, *Oriolus oriolus*, *Turdus merula*, *Turdus philomelos*, *Sylvia atricapilla*, *Parus caeruleus*, *Fringilla coelebs* etc.

- elemente est europene, est europene-vest asiatiche și sud-est europene: *Spalax leucodon*, *Canis aureus*, *Microtus arvalis*, *Dryomys nitedula*, *Mesocricetus mewtoni*, *Mus spicilegus*, *Micromys minutus*, *Sicista subtilis* etc.

- elemente mediteraneene: *Ovis musimon*, *Rhinolophus mehelyi*, *Rhinolophus ferrumequinum*, *Dendrocopos syriacus*, *Melanocorypha calandra*, *Lanius senator*, *Hippolais pallida*, *Parus lugubris*, *Serinus serinus*, *Lacerta viridis*, *Lacerta viridis meridionalis*, *Lacerta trilineata dobrogica*, *Lacerta muralis aff. maculiventris*, *Eryx jaculus turcicus*, *Emys orbicularis*, *Vipera ammodytes montandoni*, *Elaphe longissima longissima*, *Bufo viridis* etc.

- elemente pontice: *Lacerta agilis chersonensis*, *Ablepharus kitaibeli fitzingeri*, *Eremias arguta deserti*, *Coluber jugularis caspius*, *Elaphe quatorlineata sauromates*.

- elemente holarcice: *Anas platyrhynchos*, *Buteo buteo*, *Asio otus*, *Hirundo rustica*, *Corvus corax* etc.

- elemente palearctice: *Ciconia ciconia*, *Aquila heliaca*, *Accipiter nisus*, *Falco subbuteo*, *Fulica atra*, *Vanellus vanellus*, *Scolopax rusticola*, *Bubo bubo*, *Cuculus canorus*, *Strix aluco*, *Dendrocopos major*, *Dendrocopos leucotos*, *Galerida cristata*, *Alauda arvensis*, *Garrulus glandarius*, *Pica pica*, *Corvus frugilegus*, *Parus major* etc.

- elemente europeo-turkestanice: *Perdix perdix*, *Columba palumbus*, *Columba oenas*, *Streptopelia turtur*, *Coracias garrulus*, *Sylvia curruca*, *Phylloscopus sibilatrix*, *Carduelis chloris*, *Carduelis carduelis* etc.

– elemente turkestano-mediteraneene: *Calandrella brachydactyla*, *Merops apiaster* etc.

Se mai întâlnesc și câteva specii care se încadrează altor grupe zoogeografice, ca de exemplu: *Falco cherrug* (mongolo-tibetan), *Buteo rufinus* (paleoxeric), *Pelobates syriacus balcanicus* (mediteranean-balcanic).

Mare importanță zoogeografică au endemismele și relictele. Dintre endemisme, amintim: *Putorius eversmanni*, *Vormela peregusna ssp. euxina*, *Lacerta trilineata dobrogica*, *Triturus cristatus*, *Mesocricetus newtoni*, dintre vertebrate, iar din entomofaună: *Pilinothrix dobrogicus* (Hymenoptera), *Chamaesphecia deltaica*, *Oegoconia caradjai*, *O. bacescui*, *Coleophora anaeli*, *Euchromius bleszynskiellus*, *Goniodoma nemesi* (Lepidoptera), *Melanothrips knechteli*, *Oxythrips ponteuxini*, *O. dentatus* (Thysanoptera), *Schendyla walachica*, *Brachyschendyla dobrogica*, *Clinopodes intermedius*, *Lithobius decui*, *L. dumitrescui* (Chilopoda), *Retinella malinowski* (Gasteropoda), *Paranemastoma zilchi* (Opilionidae).

Speciile *Amphyipyra styx*, *Deroceras melanocephalus* sunt relicte biogeografice terțiare, iar *Chironitis furcifer*, *Diachrysia metelkana*, relicte biogeografice postglaciare.

În ansamblu, Podișul Dobrogei se încadrează în cea mai mare parte în provincia biogeografică Pontică și numai porțiunile mai înalte și împădurite din nord și sud-vest fac parte din provincia biogeografică Moesică (Călinescu, 1969, Drugescu, 1994).

THE FAUNA OF THE DOBROGEA PLATEAU

Summary

Although terrestrial fauna studies in this area are underway, yet it can be assumed that the origin, evolution and zoning of faunistic groups and zoogeographical elements is, in broad lines, similar to vegetation. Dobrogea's terrestrial fauna is characteristic of the forest, sylvosteppe and steppe vegetation zones; however, its area and number appear to have shrunk considerably because the floristic formations, with which they form biocoenoses, have decreased and degraded. Besides, the mobility and wider ecological spectrum of its components makes the inter-zonal faunistic mix much more frequent. All in all, the Dobrogea Plateau is rich in faunistic elements and has a remarkable taxonomic, ecological and populational diversity, with numerous elements of different origins, mainly southern, which accounts for the great zoogeographical originality of this Romanian province.

Keywords: fauna, zoogeography, Dobrogea Plateau.

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PARTICULARITĂȚI ALE TEMPERATURII ȘI UMEZELII AERULUI ÎN ZONA CERNAVODĂ

ADRIAN TIȘCOVSCHI

În zona Cernavodă, orientarea nord-sud a văii Dunării și prezența unei limite clare spre vest a Podișului Dobrogean contribuie la amplificarea unor efecte generate de orientarea ramei montane carpaticice și de prezența Câmpiei Române. Ca urmare, asistăm la o canalizare accentuată a vântului pe direcția văii Dunării. Frecvențe ridicate ale vântului sunt înregistrate și pe direcția V-E. Lărgimea mare a văii Dunării și volumul important de apă transportat creează condiții favorabile apariției fenomenului de briză în anotimpul cald, în timp ce în perioada rece a anului, contribuie la sporirea numărului de zile cu ceată. Asociată condițiilor de climă semiaridă, permeabilitatea substratului, specifică acestui areal dobrogean, contribuie la scurtarea perioadei pentru care plantele dispun de rezerve hidrice, prin infiltrarea la adâncimi apreciabile a apei provenite din precipitații atmosferice. Particularitățile climatice ale regiunii sunt date de prezența văii Dunării și a Câmpiei Române în vest, a Podișului Dobrogean în est și nord și a canalului Dunăre-Marea Neagră construit pe valea Carasu.

Poziția României în sud-estul părții centrale a continentului și a Podișului Dobrogei în extremitatea sud-estică a României, face ca majoritatea maselor de aer care ajung în această parte a țării să capete caractere continentale. Ele se manifestă prin durata mare de strălucire a Soarelui (peste 2200 ore în medie anual), amplitudinile termice mari (amplitudinea anuală absolută la Cernavodă este de 66,8°C, la Hârșova 63,1°C, la Fetești 68,6°C, la Mărculești 67,5°C) și prin precipitațiile mai reduse decât în alte părți ale țării (sub 500 mm în medie anual). Apropierea Mării Negre are o influență redusă asupra condițiilor climatice din zona vestică a Dobrogei, întrucât la latitudinile medii este caracteristică circulația zonală (vest-est). Deoarece Dobrogea de Sud se situează pe direcția de deplasare a două categorii de mase de aer, continentale și mediteraneene, mase de aer cu caracteristici și origini diferite, ea suferă consecințele unor invazii de aer mai rece sau mai cald, ceea ce determină oscilații neregulate în mersul local al temperaturii. Față de temperaturile medii anuale, care vor fi analizate ulterior, mediile lunare reflectă caracteristicile anotimpuale.

Distanța până la care se manifestă influența mării în interiorul ușcatului dobrogeane depinde de intensitatea și direcția vântului dominant, de unghiul pe care acesta îl face cu linia țărmului, de masa de aer pe care o transportă, de configurația țărmului și de formele de relief aşezate în spatele său. Limita manifestării influenței termice a Mării Negre spre interiorul ușcatului pusă în evidență cu ajutorul abaterilor de temperatură față de țărm depinde de anotimp. Ea este mai atenuată primăvara și vara și mai extinsă toamna și iarna. În primul interval, din martie până în august, abaterile de temperatură sunt pozitive, ușcatul încălzindu-se mai puternic în comparație cu marea, care rămâne mai rece.

Abaterile ating valoarea zero la distanțe de 60-80 km depărtare de țărm. Toamna și iarna, din septembrie până în ianuarie, abaterile sunt negative, indicând o scădere a temperaturii, pe măsura depărtării de țărm.

Valorile medii anuale ale temperaturii aerului prezintă un parametru sintetic, care exprimă potențialul termic global al zonei la care ne referim. De aceea, mult mai expresive pentru cunoașterea modului cum se manifestă temperatura aerului sunt variațiile mediilor lunare. În cursul anului, se constată o creștere treptată a valorilor medii lunare ale temperaturii aerului, de la luna ianuarie către iulie și apoi descreșterea, din iulie către decembrie, în funcție de modificările sezoniere ale poziției Soarelui pe bolta cerească (Fig. 1).

Dinamica temperaturii aerului în timpul anului evidențiază creșteri mai accentuate ale mediilor lunare între martie-aprilie și aprilie-mai (între 5-6°C), urmate de creșteri ceva mai moderate până în iulie. În august, temperatura aerului înregistrează o scădere foarte ușoară față de iulie, care, în valori medii multianuale nu depășește 1°C (0,2°C la Fetești), urmată de scăderi ale temperaturii de 4-5°C în septembrie (4,7°C la Fetești), iar în următoarele luni, temperatura aerului scade de la o lună la alta cu 5-6°C (5,9°C între septembrie-octombrie la Fetești).

În luna ianuarie, ca efect al frecvențelor invaziilor de maselor de aer rece continental (arctic sau polar), care se deplasează iarna de pe teritoriul Rusiei (din zona anticicloului Siberian) deasupra țării noastre, temperatura aerului atinge valoarea medie cea mai scăzută. În arealul studiat, rezultă pentru această lună o temperatură medie multianuală de -2,3°C la Fetești, 1,7°C la Cernavodă și -1,5°C la Medgidia. Ianuarie este de fapt singura lună în care se înregistrează valori medii lunare multianuale negative. Februarie reprezintă, de asemenea, o lună rece, media multianuală fiind de 0,1°C la Fetești și 0,4°C la Cernavodă și Medgidia.

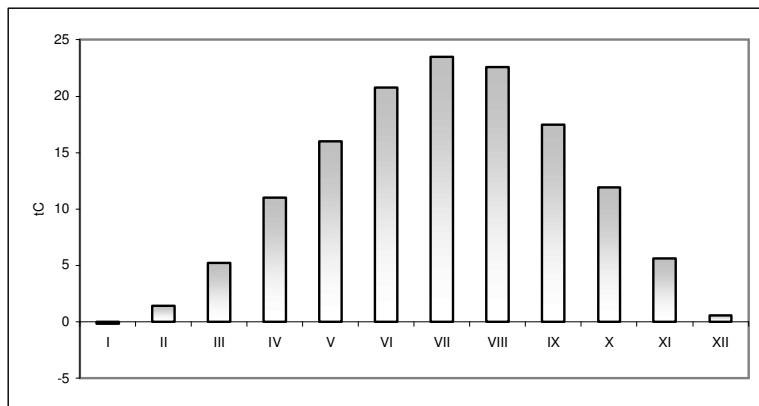


Fig. 1. Media lunărie a temperaturii aerului la Cernavodă (1985-2001)

În cursul lunii iulie, sub influența intensificării la maxim a radiației solare și a creșterii duratei zilei, temperatura aerului atinge în medie valorile cele mai ridicate din cursul anului, și anume 22,6°C la Fetești, 22,2°C la Cernavodă și 22,1°C la Medgidia.

Caracterul regimului temperaturii aerului este evidențiat și de valorile amplitudinii medii anuale, unul din parametrii ce reflectă continentalismul climei, exprimând contrastul de temperatură dintre luna cea mai căldă și cea mai rece a anului. La stațiile analizate, cea mai mare amplitudine medie a rezultat la Fetești (24,9°C), remarcându-se o scădere pe măsura apropierea de marele bazin de apă al Mării Negre, și anume 23,9°C la Cernavodă și 23,6°C la Medgidia. Deci, rolul de moderator al climei pe care îl are prezența Mării Negre, deși mai slab, se resimte și în zona studiată, rezultând ierni ceva mai blânde decât în restul țării, iar încălzirile din miezul verii sunt mai ponderate.

Variatărea locală posibilă a temperaturii aerului este redată de valorile extreme instantanee (maxime și minime) atinse de temperatura aerului în cazuri unice, într-un interval de mai mulți ani. La toate stațiile meteorologice vizate, cele mai ridicate valori ale temperaturii aerului, care s-au înscris de când funcționează stațiile respective, s-au produs în luna august și au depășit chiar 40°C (42,2°C la Cernavodă, în 1945, și 40,6°C la Fetești, în 1952). Temperaturi maxime absolute de peste 35°C s-au semnalat începând din luna mai până în octombrie, inclusiv, în această ultimă lună, mercurul termometrului urcând până la 37,4°C la Fetești, în anul 1952. În lunile martie și aprilie au fost situații de excepție când temperatura aerului în zonă a depășit 30°C. Numai în ianuarie, maxima absolută a temperaturii aerului nu a atins 20°C, ea urcând până la cel mult 17,9°C la Medgidia, în anul 1979.

De menționat că, în decursul anilor, aceste valori extreme s-au înregistrat în situațiile de invazii ale maselor de aer cald tropical, condițiile locale favorizând uneori accentuarea lor. Aceste valori instantanee s-au produs în ani diferiți, dar se remarcă, îndeosebi, anul 1952, când, de exemplu la Fetești, în cinci luni ale anului respectiv s-au înregistrat maximele absolute ale temperaturii aerului din întreaga perioadă de funcționare a stației.

Temperatura minimă absolută a aerului a înregistrat valori negative începând din luna septembrie până în aprilie, cele mai scăzute valori semnalându-se în lunile de iarnă, îndeosebi în ianuarie și februarie, când invaziile maselor de aer arctic sunt mai frecvente și persistente, răcirea fiind accentuată adeseori de prezența stratului de zăpadă și de valorile radiației nocturne.

În februarie 1954 s-au semnalat cele mai mici valori ale temperaturii minime absolute, și anume, -28°C la Fetești, $-24,6^{\circ}\text{C}$ la Cernavodă și $-23,0^{\circ}\text{C}$ la Medgidia. Temperaturile minime absolute sub -10°C s-au produs începând din luna noiembrie până în martie. În arealul studiat, au fost situații accidentale când în lunile de vară temperatura minimă a scăzut sub 10°C ($3,4^{\circ}\text{C}$ în iunie, $7,6^{\circ}\text{C}$ în iulie și $6,6^{\circ}\text{C}$ în august, la Fetești). De subliniat că, amplitudinea absolută rezultată din valorile extreme absolute ale temperaturii aerului este de peste 60°C , și anume, $68,6^{\circ}\text{C}$ la Fetești, $66,8^{\circ}\text{C}$ la Cernavodă și $62,4^{\circ}\text{C}$ la Medgidia. Menționăm că ecartul mare al acestor valori termice posibile, care se datorează advecției maselor de aer foarte reci (arctice) sau foarte calde (tropicale), rezultă în urma unor perturbații ce nu prezintă regularitate în apariții, ele având un caracter episodic.

Oscilațiile diurne ale temperaturii aerului au caracter periodic, fiind determinate în general de variația intensității radiației solare din cursul zilei și de mărimea radiației efective a suprafeței subiacente din cursul nopții. Mărimea oscilațiilor diurne ale temperaturii diferă de la o zi la alta, în funcție de condițiile de timp și, în special, de nebulozitate și vânt. În unele cazuri, schimbarea bruscă a maselor de aer, trecerea fronturilor și dezvoltarea fenomenelor meteorologice legate de acestea produc perturbații în mersul diurn al temperaturii aerului. Pentru a scoate în evidență particularitățile locale ale mersului diurn al temperaturii aerului s-au calculat valorile orare medii multianuale, în care, fiind aplatizate schimbările neperiodice, variațiile sistematice sunt bine reliefate.

Oscilațiile diurne ale valorilor orare medii multianuale sunt caracterizate, în toate anotimpurile, printr-un minim, în orele de dimineață, și un maxim, în primele ore de după-amiază. Între cea mai mică și cea mai mare medie orară, creșterea temperaturii aerului este mai intensă în lunile de vară și mai slabă în cele de iarnă. Descreșterea valorilor medii orare este mai rapidă până la apusul Soarelui, iar după aceea ea decurge mai lent, din cauza răciorii treptate, din cursul nopții, a suprafeței subiacente.

Iarna, când circulația generală a atmosferei se intensifică și când radiația solară este mai slabă, oscilațiile diurne ale temperaturii aerului sunt mult diminuate, valorile orare ale lunii ianuarie fiind cuprinse între $-3,5^{\circ}\text{C}$ și $0,2^{\circ}\text{C}$ la Fetești și între $-2,5^{\circ}\text{C}$ și $0,9^{\circ}\text{C}$ la Medgidia. Față de aceste valori multianuale, de-a

lungul anilor, mediile orare au înregistrat cele mai mici valori în anul 1963, când au scăzut până la $-9,9^{\circ}\text{C}$ la Fetești și $-8,5^{\circ}\text{C}$ la Medgidia, iar în anul 1983 s-au înregistrat cele mai ridicate valori orare ale acestei luni ($5,1^{\circ}\text{C}$ la Fetești și $5,2^{\circ}\text{C}$ la Medgidia).

Primăvara, limitele de variație ale temperaturilor medii orare multianuale sunt mult mai largi, astfel că, în luna aprilie, cele mai scăzute valori orare au fost de $6,6^{\circ}\text{C}$ la Fetești și $6,8^{\circ}\text{C}$ la Medgidia, iar cele mai ridicate au fost de $15,8^{\circ}\text{C}$ la Fetești și $15,0^{\circ}\text{C}$ la Medgidia. Din intervalul analizat la Fetești, cea mai mică valoare orară s-a semnalat în anul 1965 ($4,4^{\circ}\text{C}$), iar cea mai mare valoare a fost de $20,6^{\circ}\text{C}$, în anul 1968.

Vara, datorită insolației puternice, temperatura medie orară multianuală se ridică până la $26,9^{\circ}\text{C}$ la Fetești și $26,2^{\circ}\text{C}$ la Medgidia, în luna iulie, când minima nu coboară sub $16,6^{\circ}\text{C}$ la Fetești și sub $17,0^{\circ}\text{C}$ la Medgidia. Analizând an de an valorile medii orare ale temperaturii aerului din luna iulie, s-a constatat că cea mai mare valoare medie a fost de $29,5^{\circ}\text{C}$ în 1963 la Fetești și de $28,8^{\circ}\text{C}$ la Medgidia, în același an, iar cea mai mică valoare a fost măsurată în anul 1984 ($15,3^{\circ}\text{C}$ la Fetești și $15,5^{\circ}\text{C}$ la Medgidia).

În octombrie, temperaturile medii orare multianuale variază între $7,9^{\circ}\text{C}$ și $16,7^{\circ}\text{C}$, la Fetești, și între $8,6^{\circ}\text{C}$ și $16,7^{\circ}\text{C}$, la Medgidia. De-a lungul anilor, cea mai mică valoare orară din luna octombrie a fost de $4,8^{\circ}\text{C}$ în anul 1985, la Fetești, și $6,2^{\circ}\text{C}$ la Medgidia, iar în anul 1966 a fost înregistrată cea mai mare medie orară ($21,3^{\circ}\text{C}$ la Medgidia și $21,2^{\circ}\text{C}$ la Fetești). Cunoașterea variațiilor temperaturii aerului, privind valorile diurne, lunare, anuale și multianuale duce la o evidențiere a particularităților climatice a zonei în studiu, putându-ne indica cele mai favorabile situații și locuri pentru diverse scopuri practice.

În zona Cernavodă, ca urmare a variațiilor de mare amploare survenite în evoluția elementelor meteorologice, apar o serie de fenomene atmosferice de risc cu impact deosebit asupra activităților curente. Apropierea mării se face simțită de la distanță, prin procese de risipire a sistemelor noroase, întrucât deplasarea maselor de aer se face cel mai frecvent dinspre uscat spre mare. În zona amplasamentului CNE Cernavodă, se înregistrează în medie anuală aproximativ 27 de zile cu fenomene orajoase, cele mai numeroase apărând în luna iunie (circa 8 zile). Producerea maximului în această lună este legată de activitatea ciclonică intensă desfășurată la periferia anticicloului Azoric. Intervalul mai-august concentrează în medie 84 % din numărul total de zile cu oraje. În decursul perioadei de observație s-au înregistrat până la 16 zile cu oraje la Călărași, în iunie, și până la 14 zile cu oraje la Hârșova, în aceeași lună. În cursul iernii, umezeala mai ridicată a aerului nu favorizează acumulările de electricitate statică, chiar dacă fronturile reci determină dezvoltarea norilor de convecție dinamică, cu mare amploare verticală, astfel că numărul zilelor cu oraje este foarte mic în această zonă.

Trombele sunt fenomene specifice zonelor calde, care implică antrenarea unor importante mase de aer într-o dublă mișcare, una de rotație și alta de translație, ambele foarte rapide. Gradientul baric crește spre interiorul trombei, iar viteza vântului este atât de mare, încât multe obiecte sunt absorbite și purtate la distanțe apreciabile. Zona centrală a acestui fenomen se materializează astfel

într-o trombă formată din nisip, praf și alte obiecte luate de pe suprafața uscatului, având forma unei pâlnii întoarse. Deasupra trombei se dezvoltă nori groși de convecție din care cad averse. În țara noastră, situată în afara zonei de manifestare tipică a trombelor, probabilitatea apariției acestui fenomen este foarte mică. Ceva mai frecvent sunt semnalate vârtejuri, care reprezintă trombe la scară mică, ce preced uneori trecerea fronturilor reci.

Consemnarea unui număr redus cu astfel de fenomene se datorează și faptului că ele se extind pe suprafețe relativ restrânse, iar traiectoriile lor depind de foarte mulți factori variabili, astfel încât rareori se repetă. În anotimpul cald, vârtejurile transportă cantități însemnante de praf, în timp ce iarna este antrenată și zăpada. În sirul de fenomene deosebite care s-au succedat în proximitatea amplasamentului, prin efectele importante pe care le-a combinat, se distinge furtuna din 29-30 august 1924. Astfel, în cele două zile, în diverse localități, cantitatea de precipitații a atins valori exceptionale; la Casimcea, de exemplu, s-au înregistrat 660 mm în 24 de ore, iar la Letea, 691 mm în 16 ore. Valorile respective nu au mai fost atinse la nici una din stațiile de pe teritoriul țării noastre de când se fac măsurători pluviometrice. Cu anemometrul Howlett s-au înregistrat viteze ale vântului de până la 23 m/s în data de 29 august 1924, pentru ca în ziua următoare, viteză vântului să crească în aşa măsură, încât să defecteze aparatul (Buletinul meteo lunar I.M.C. din 1924).

În urma acțiunii de eroziune exercitată de vânt, de pe suprafața terestră este ridicată în atmosferă o cantitate de praf și nisip care rămâne în suspensie pe o durată ce depinde de diametrul particulelor și de viteză vântului. Practic, în permanență, deasupra uscatului se găsește o cantitate de praf. Când această cantitate este mare, fenomenul devine dăunător prin depunerea prafului pe diferite suprafețe și prin marea putere de pătrundere pe care o au particulele fine. Zile cu transport de praf au fost semnalate aproape în fiecare an, dar cu o frecvență mai mare până în deceniul săptă al secolului trecut. Explicația ar consta în predominarea în perioada respectivă a unui regim anticlonic în Câmpia Rusă, de unde au fost transportate spre țara noastră mari cantități de praf pe la periferia sudică a maximului barometric. Prin cantitate, durată și suprafață mare afectată se distinge transportul de praf, care a fost semnalat în anul 1962, luniile august și septembrie. Din 1976, frecvența transportului de praf a fost mai redusă, se pare datorită unei intensificări a activității ciclonice în Câmpia Rusă, lucru confirmat de creșterea nivelului Mării Caspice.

Umezeala aerului constituie unul din elementele caracteristice importante ale atmosferei, atât în ceea ce privește generarea unor procese atmosferice, cât și pentru întreținerea vieții animale și vegetale pe Pământ. În meteorologie, pentru definirea umezelii atmosferice se uzitează mai multe mărimi higrometrice, dintre care, în studiul de față interesează în mod deosebit umezeala relativă și umezeala absolută a aerului – care numeric este aproximativ egală cu tensiunea vaporilor de apă.

Variația anuală a umezelii relative prezintă, la Cernavodă, un maxim, în anotimpul rece, și un minim, în sezonul cald (*Fig. 2*). Astfel, la stațiile Fetești și Cernavodă umezeala relativă depășește 80 % începând din luna noiembrie până în februarie, valorile maxime înregistrându-se în decembrie (86 % la Fetești și 85 % la Cernavodă). La Medgidia, valori medii lunare de peste 80 % s-au semnalat într-un interval mai îndelungat, și anume, din octombrie până în martie, valoarea maximă de 90 % fiind în luna ianuarie. Dimpotrivă, cele mai mici valori medii lunare multianuale s-au observat în luna iulie la Cernavodă și Medgidia (67 %, respectiv 69 %) și, în august, la Fetești (63 %). Valorile medii anuale ale umezelii relative au fost de 74 % la Fetești, 75 % la Cernavodă și 80 % la Medgidia.

Variația zilnică a umezelii relative este mai puțin pronunțată în timpul anotimpului rece, astfel că în ianuarie valorile orare multianuale la Fetești oscilează între 77 %, la orele 14 și 15, și 90 %, între orele 4 și 6, iar la Medgidia, limitele de variație sunt 79 % la orele 14-15, și 90 % între orele 4 și 8. Rezultă o amplitudine medie diurnă de 13 % la Fetești și 11 % la Medgidia.

Analizându-se an de an valorile medii orare, s-a constatat că, în unii ani, umezeala relativă din luna ianuarie a înregistrat valori ce se situează cu mult sub media multianuală; astfel, în anul 1985, media lunară de la ora 14 a fost de 45 % la Fetești, iar la Medgidia, cea mai scăzută valoare medie orară, de 67 %, s-a semnalat în anul 1983, la ora 15.

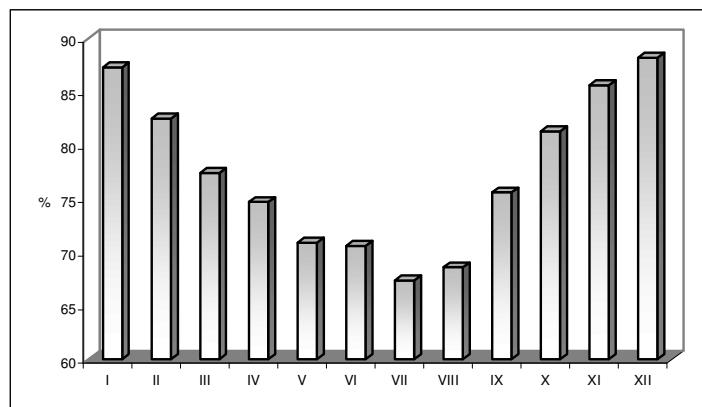


Fig. 2. Media lunară a umezelii relative (%) la Cernavodă (1985-2001)

Primăvara, media multianuală a umezelii relative cuprinde o gamă mult mai largă de valori, în luna aprilie oscilând între 52 %, la ora 15, și 90 %, la ora 6, la Fetești, iar la Medgidia, valoarea medie orară cea mai scăzută fiind de 55 % între orele 13 și 15, cea mai mare înregistrându-se între orele 5 și 6 (90 %). În luna

aprilie, a rezultat o amplitudine a valorilor medii orare multianuale de 38 % la Fetești și 35 % la Medgidia.

Vara, când contrastul termic este cel mai accentuat, variația umezelii relative capătă un aspect mult mai pronunțat datorită scăderii apreciabile a umezelii aerului, în orele de maximă insolărie. În luna iulie, media multianuală orară a umezelii relative a scăzut până la 47 % între orele 14 și 15, la Fetești, și 50 % între orele 13-14, la Medgidia. Amplitudinea medie diurnă a umezelii relative din luna iulie a atins 43 % la Fetești și 42 % la Medgidia. Față de valorile medii multianuale din orele de la amiază, în unii ani cu un grad mare de uscăciune, valorile medii lunare de la orele respective au coborât până la 34 % la Fetești și 28 % la Medgidia.

Toamna, mersul diurn al umezelii relative este asemănător cu cel de primăvară, în luna octombrie oscilând între 51 %, la orele 14 și 15, și 92 %, între orele 5 și 7. De-a lungul anilor, la orele de la amiază, cele mai mici valori au atins 41 %, în anii 1968 și 1983, la Fetești, și 38 %, în 1966, la Medgidia. Amplitudinea diurnă medie multianuală a umezelii relative este de 41 % la Fetești și 34 % la Medgidia.

Concluzii

Caracteristicile temperaturii și umezelii aerului în zona Cernavodă pun în evidență un topoclimat dunărean, unde, sub influența brizelor care se formează pe Dunăre, se produce o variație a principalilor parametri climatici. Putem aprecia și faptul că există o favorabilitate climatică pentru centrala nuclearo-electrică Cernavodă.

Lărgimea mare a Văii Dunării și volumul important de apă transportat creează condiții favorabile apariției fenomenului de briză în anotimpul cald, în timp ce, în perioada rece a anului, contribuie la sporirea numărului de zile cu ceață. Asociată condițiilor de climă semiaridă, permeabilitatea substratului, specifică acestui areal dobrogean, contribuie la scurtarea perioadei pentru care plantele dispun de rezerve hidrice, prin infiltrarea la adâncimi apreciabile a apei provenite din precipitații atmosferice.

DES PARTICULARITÉS DE LA TEMPERATURE ET DE L'HUMIDITÉ DE L'AIR CONCERNANT LA SURFACE DE CERNAVODĂ

Résumé

Le caractère du régime de la température de l'air à Cernavodă est aussi évident par les valeurs de l'amplitude moyen annuelle, l'un des paramètres qui reflètent le continentalisme de la climat exprimant par cette manière le contraste de température entre le mois le plus chaud et celui le plus froid de l'an. Aux stations analysées, la plus grande amplitude moyen a été résultée à

Fetești (24,9°C), étant remarquée une descendence à la mesure de l'approchement du basin de la Mer Noire, par exemple 23,9°C à Cernavodă et 23,6°C à Medgidia. Alors, le rôle de modérateur de la clime que la présence de la Mer Noir a, bien que plus faible, est aussi ressenti dans la surface de Cernavodă, en résultant des hivers un peu plus doux que dans le reste du pays, et les chaleurs du milieu de l'été sont plus ponderées. La variation quotidienne de l'humidité de l'air pendant les 24 heures, est conditionnée d'une part par la température et la nature de la surface active et d'autre part, par la possibilité de l'épargnement des vapeurs de l'eau dans le milieu entourant. Dans cette manière, pour une certaine température, l'air sera d'autant plus sèche que la tension des vapeurs de l'eau sera plus petite contre la tension maximale.

Mots clef: déviations de température, humidité relative, circulation zonale, électricité statique, Cernavodă.

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SOME CONSIDERATIONS UPON THE MORPHOLOGICAL FEATURES OF THE AEOLIAN LANDFORMS ON LETEA AND CARAORMAN COMPLEX RIDGE PLAINS – DANUBE DELTA

LUMINIȚA PREOTEASA

Introduction

Sand accumulations mainly occur in places of large sediment availability and wind intensity and frequency conducive for shaping the aeolian landforms. In the Danube Delta these conditions are highly met in the eastern part, which is usually called *marine delta* (Brătescu, 1923, Vespremeanu, 1995), where the terrestrial areas are represented by the Letea, Caraorman and Sărăturile complex ridge plains / prograded barrier.

According to Hesp *et al.* (2005), a **complex prograded barrier** is a barrier which displays a large variety of landforms, of different origins, with different evolution and different shapes. More exactly, Caraorman complex barrier displays low and narrow parallel ridges, regularly spaced, which are supposed to be relict, stranded beach ridges or/and foredune belts, intercalated by narrow depressions (swales) specific to the eastern and western part. In the central part of the Caraorman complex barrier, the large complexes of dunes are superimposed on ancient foredune ridges. This alternance of ridges and swales reflects their genesis: the sediment flux is trapped mainly into the ridge (foredunes) and is almost absent backward of this limit. The term points strictly to the *genesis and evolution of the barrier*. Referring to their present aspect like a plain and actual state in the frame of the deltaic system (they are no more acting as a barrier), we propose the term **complex ridge plains** for Letea and Caraorman due to the coexistence of beach and foredune ridges.

In our case the application of this term is based on the spatial distribution of the aeolian landforms and the regular alternance of the ridges on which they are superimposed. The concentration of the aeolian landforms on one main sector of the complex ridge plain is a clue for the existence of a larger sediment deposit which can be easily reworked by the wind. These deposits are supposed to be foredune belts intercalated between beach ridges.

In 1971, Popp published the first paper written on the dunes from Danube Delta which deals with the dunes from Caraorman complex ridge plain. The approach is highly descriptive, pointing to the regional distribution of the aeolian

landforms on Caraorman, a description of the dune form and a hypothesis about their evolution. An interesting issue of this paper is represented by the description of *barchan dunes* which, in his opinion, was the prevalent morphotype. The studies we made on the dune morphology and wind climate, largely correspond to his descriptions on these issues, which lead us to the conclusion that he misunderstood and misused the term of the barchan dune. All his basic observations referring to the dune shape and orientation are correct, unless the term he used to describe them. The proper term for the aeolian features he has described is largely recognised and used in the international literature as blowouts and parabolic dunes, depending on the shape, evolutionary stage or vegetation cover.

The aim of this paper is to review the distribution and the particular regional aspects of the sand dunes from Letea and Caraorman complex ridge plains.

The aeolian landforms display distinctive morphologic characteristics:

- a) complex vegetated transgressive dunefield from Letea complex ridge plain;
- b) complex semi-mobile transgressive dunes from Caraorman complex ridge plain.

Methodology

The present review of the dunes morphology in the Danube Delta is funded upon a combination of personal and foreign observations both from study area and from outside. These observations are combined with recent studies of wind climate, sand size, morphology and orientation of the dunes in study area (Preoteasa and Vespremeanu-Stroe, 2001, 2004). Thus, for the moment, it can not be more than a brief description of the present aspect of the sand dunes accompanied by an essay to describe their evolution. A more comprehensive explanation of their origin, evolution and form will be possible after some surveys on internal structure of eolian deposits coupled with termoluminiscence datation of sand samples that we prelevated; this will be the case of a next paper.

The dunes from the Danube Delta were firstly mentioned mostly as descriptive remarks in the works of Antipa, 1914, Brătescu, 1923 and Vălsan, 1934.

The present morphology and morphometry of the sand dunes in the eastern part of the Danube Delta generally reflect the climate since their formation which enabled a large amount of marine sand availability with a strong wind potential and constant frequency.

Their origin is closely related to coastal accretion. The quantitative distribution of aeolian landforms in the eastern Danube Delta, with large complexes of parabolic dunes on Letea and Caraorman complex ridge plains and some small individual dunes and foredunes on Sărăturile beach ridge plain reflects a decrease of the sediment availability for eolian reworking during late

Holocene (2800 BP – present) when Sf. Gheorghe deltaic lobe developed while the Sulina older updrift lobe was being eroded (Vălsan, 1936; Giosan *et al.*, 2005).

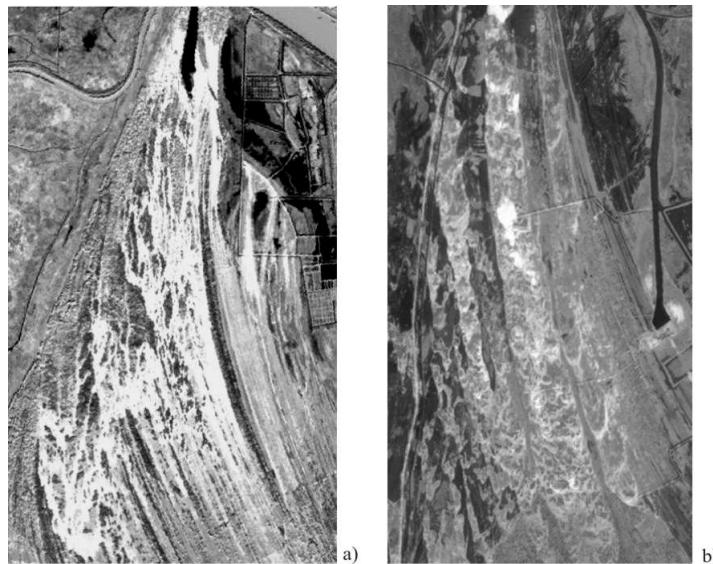


Fig. 1. a) ASTER satellite image showing the dunes on Letea complex ridge plain (2003); b) ASTER satellite image showing the dunes on Caraorman complex ridge plain (2001)

The study of the wind potential of the eastern part of the Danube delta (Preoteasa and Vespremeanu-Stroe, 2004) revealed a macroenergetical wind potential¹ and a resultant drift potential is southward orientated, according to Fryberger technique (1978). The aerophotograms and satellitary images were used in determining the regional distribution, shapes, orientation, dimensions and activity of the dunes.

Letea dunes

The dunes on the Letea complex ridge plain are present as a large complex of vegetated transgressive dunefield situated in the northwestern part

¹ The wind potential computed for Sfântu Gheorghe meteorological station is 72,5 vu (vector units) and for Caraorman is 63 vu while the computed resultant drift direction (RDD) is 197.1° for Sulina meteorological station (SSW-ward oriented), 182.4° for Sfântu Gheorghe and 178.1° for Caraorman; the value of RDD is expressed in sexagesimal degrees starting clockwise from North direction. Fryberger (1978) established three classes of aeolian potential: low aeolian potential: < 27 vu; moderate: 27-54 vu, high: >54 vu.

and which correspond to the greatest heights of the barrier. This dunefield consists of many overlapping, high (10-15 m) vegetated parabolic dunes intercalated by smaller (from 2-7 m height) individual dunes and blowouts of varying morphotypes. The sediment source at the origin of this dunefield was represented by some relict, parallel foredune ridges which were part of a complex barrier together with the beach ridges. Their current position in the NV part of the barrier reflects the proximity of the ancient sediment source which is supposed to be the Chilia arm.

The particular aspect of these dunes is given by their size which allowed for a more complex morphology. These are represented by large parabolic dunes with secondary blowouts of smaller size superimposed on them. The shape and orientation of these secondary features are the result both of airflow which is deflected mainly by the aeolian landforms and of preexisting topography. Thus, the arms of the three main complex parabolic dunes that can be distinguished on the NW part of Letea complex ridge plain (*Fig. 1a*) are anchored on ancient foredune ridges², while the apex of these dunes are spread over smaller parallel (beach) ridges intercalated between the larger foredune belts. The orientation of the aeolian landforms is discordant with the ridges on which there are superimposed. The parabolic dune complexes are opened to N and NNW, while the orientation of the (foredune) ridge beneath is NNE-SSW, in the northern end, and then N-S and NNV-SSE. The beach and foredune ridges are hardly distinguishable, as a great part of their subaerial component was reworked by aeolian activity or covered by sand. The dunes on Letea complex ridge plain display a great variety of sizes. There could be identified large complex parabolic dunes of 100-200 m width, 300-1000 m long and about 10-15 m height (*Photo 1a*) as well as smaller dunes (*Photo 1b*). Their dynamics is very low and manifests only in case of high wind speed intervals (>10m/s).

Caraorman dunes

On Caraorman ridge plain, the dunes are present mostly in the central part. Referring strictly to the area occupied by dunes, two concentrically zones can be distinguished. A somehow similar regional classification of the dunes was made by Popp (1971).

² The use of these notions: *beach ridge*, *foredune ridge*, *dune ridge*, in this context requires some additional explanations. As these notions are often interchangeably used, Hesp (2004) reviewed them and established the morphodynamic and genetic criteria as being fundamental in their differentiation. Thus a beach ridge consists in hydraulically laid deposits, while foredune or dune ridges in aeolian reworked deposits. Datation of sand samples and analysis of sand origin is in progress for Letea and Caraorman complex ridge plain.



Photo 1. a), b) – Parabolic dunes on Letea complex barrier
(photos by Alfred Vespremeanu-Stroe)

The inner zone is characterized by the most active, the highest and the most diverse morphology of the dunes. They display a wide range of morphologies and dimensions. Commonly the aeolian landscape is represented by dune complexes or individual dunes (*Photo 2*). The dune complexes regularly consist in parabolic dunes, blowouts and remnant knobs. Most of these evolve under more or less negative sand budget as no external sediment source to Caraorman barrier is available, but the reworking of the existent sand. The aeolian features are imposed on parallel ridges, which represent ancient shorelines and which are generally N-SSE orientated. The preexisting topography of these ancient shorelines influenced the spatial distribution of the aeolian landforms as parallel alignments on the Caraorman complex ridge plain. The dunes have a northward orientation, with small differences induced by wind deflection and channeling effects generated by the existent topography. The observations and measurements we performed

on five (5) representative dune complexes revealed a concordance between the steepest slope orientation and the prevalent winds. Thus the extensively existing steepest slopes are NNV exposed, while the resultant drifts direction in 178,1° reported to the north.

Three main blowouts have been identified amongst the aeolian landforms on Caraorman:

- Trough blowout
- Saucer blowout
- Bowl blowout



*Photo 2 – Parabolic dune on Caraorman complex ridge plain
(photo by Alfred Vespremeanu-Stroe)*

The generic term blowout is generally ascribed to an erosional hollow, depression, trough or swale within a dune complex (Carter, Hesp & Nordstrom, 1990). The initialization mechanism supposed to produce these landforms on Caraorman is represented by the acceleration of wind where deflation potential has increased due to vegetation cover deterioration, slope steepness or exposure.

Trough blowout is a common type among the aeolian features from Caraorman barrier. It displays an elongated, deep, narrow basin bordered by steep walls with a evident downwind depositional lobe. A profile through the longitudinal axis of the blowout shows firstly a flatter segment corresponding to a deflation surface, an intermediate concave slope on which the airflow dynamics is accelerated and a convex segment commensurate with the depositional processes. The depositional lobe presents a variety of shapes. It could be shaped like a narrow elongated steep sided slopes depositional form or a wide dissipated, radial dipped, gentle sloped delta like lobe (*Fig. 2*). The three functional units of the blowout – depression, ramp and depositional lobe

corresponds to the basic processes involved in its evolution: erosion, transport and deposition. Generally, blowouts act like transport corridors.

This kind of blowout readily evolves in parabolic dunes (*Photo 2*). Researches performed on blowouts genesis, dynamics and evolution (Jungerius and van der Meulen, 1989, Robertson-Rintoul, 1990, Carter *et al.*, 1990) points to crestal jets, closed eddies, spiral vortices and gravitational processes manifested on sided slopes as the leading factors in their evolution. The length of the blowouts usually depends on the available relief (Carter *et al.*, 1990). Their evolution stops when the eolian deflation cut in the sand deposits until the mean level of water table.

Saucer blowout (*Photo 3*): although it is reported as being a common presence among the dunes from Caraorman complex ridge plain (Popp, 1973), this type of blowout is the less documented aeolian feature both on national and international thematic bibliography. These features are closed, shallow, ovoid, dish-shaped hollows with a steep marginal rim (Carter *et al.*, 1990). The saucer blowouts inventoried on Caraorman display no evident depositional lobe as its circular shape promotes a radial dispersion of the blown sand. The degree of evolution is controlled by the dimensions of the pre-existing aeolian topography or by the vegetation installation.

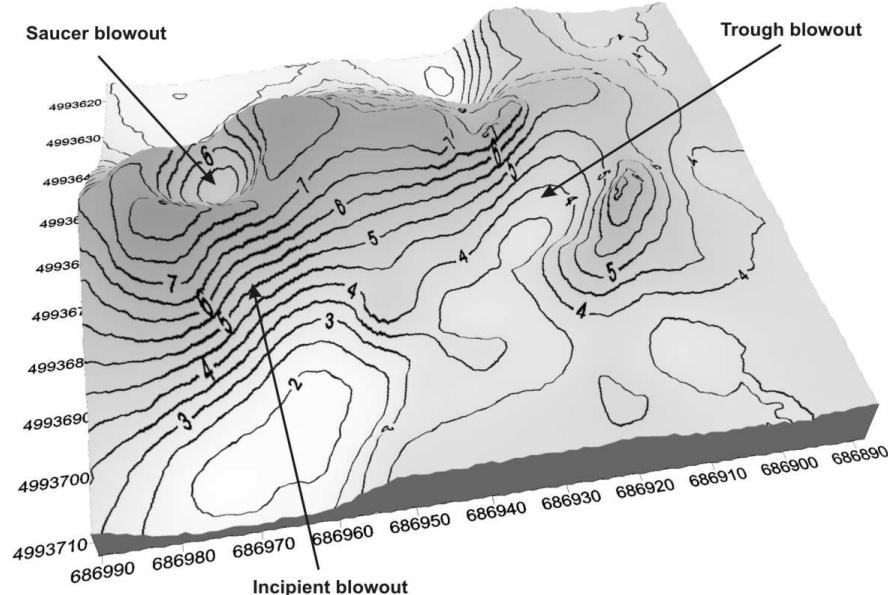


Fig. 2. Digital Elevation Model (DEM) upon an aeolian complex displaying: a trough blowout, a saucer blowout and an incipient blowout; surveys were carried out on the 9th May 2005



*Photo 3 – Saucer blowout on Caraorman complex barrier
(photo by Alfred Vespremeanu-Stroe)*



Photo 4 – Bowl blowout on Caraorman complex barrier

A maturity stage is represented by a deeper circular vegetated basin which is usually called ‘bowl blowout’ (*Photo 4*).

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L'IMAGERIE SATELLITALE ET SON USAGE POUR DÉLIMITER LES ZONES DE GLISSEMENT. CAS DE LA VALLÉE DE LA PRAHOVA (ROUMANIE)*

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ILEANA GEORGETA PĂTRU**

La Roumanie est exposée à divers risques naturels parmi lesquels les glissements de terrain représentent la forme la plus fréquente. Ces phénomènes prennent une importance particulière en zones habitées ; c'est le cas de la localité de Breaza sur la vallée de la Prahova (Roumanie) où le phénomène de glissement de terrain s'est accéléré de façon notable sous les effets conjugués de la nature du sol, de séquences pluviométriques particulières et de pression anthropique importante sur le milieu naturel.

L'objectif du présent travail est d'analyser l'apport de l'imagerie satellitaire haute et moyenne résolution pour la délimitation des zones de glissement. Bien qu'un glissement de terrain ne concerne généralement qu'une faible étendue, nous montrons qu'il est possible, moyennant des traitements spécifiques, d'appréhender les manifestations extérieures du phénomène et son impact sur la recomposition de l'espace.

Ce travail est mené dans le cadre d'un projet de recherche partagé financé par l'Agence Universitaire de la Francophonie.

Mots clefs : imagerie satellitaire, glissements de terrain, Spot, Landsat.

I. Introduction

La Roumanie est exposée à divers risques naturels parmi lesquels les glissements de terrain représentent la forme la plus fréquente. L'apparition d'un glissement de terrain est le résultat de la conjonction de plusieurs facteurs qui peuvent être : permanents (peu ou pas variables dans le temps ; dus à la présence de plans de rupture préférentiels par exemple, pente de terrain etc.) ou semi permanents (évolution dans le temps due à la teneur en eau des matériaux, à l'érosion en bas des pentes, à l'action anthropique). Lorsque l'un des facteurs subit une forte variation dans un laps de temps très court, il peut engendrer une déstabilisation du matériau et provoquer un glissement ou réactiver un

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glissement préexistant ; il peut s'agir, par exemple, d'un épisode pluvieux exceptionnel ou d'une pression anthropique.

Ces deux facteurs (pluviométrie et pression anthropique) ont effectivement subi une forte variation sur une échelle de temps courte pour la vallée de la Prahova. Ce constat nous amène à nous interroger sur la faisabilité d'un système d'aide à l'estimation et au suivi du phénomène de glissement et sur l'apport de l'imagerie satellitaire pour la réalisation de cet outil.

L'image satellitaire enregistre la réponse de la surface à une excitation électromagnétique extérieure pouvant se situer dans l'une des gammes de longueurs d'onde du visible ou du proche infra rouge, de l'infra rouge thermique ou des hyper fréquences. Le phénomène de glissement se manifeste par des variations de l'état de surface et serait donc appréhensible à partir de l'imagerie satellitaire à la condition minimale que l'échelle de variation corresponde à la résolution spatiale de l'image.

Cette étude s'inscrit dans le cadre d'une recherche partagée financée par le réseau de télédétection de l'AUF qui a permis, entre autre, l'acquisition de deux images satellites (SPOT XS 1992 et LANDSAT TM 2000) couvrant le secteur d'étude.

II. La perception du phénomène de glissement

II.1. *Les manifestations externes du glissement*

Les glissements de terrain font partie de la catégorie des processus de versant qui en changent la géomorphologie. Un glissement peut se caractériser par :

- des niches d'arrachement ou crevasses, principales et latérales, avec brusque rupture de pente (pente concave), dans sa partie amont ;
- un bourrelet de pied (ou frontal) à pente convexe dans sa partie aval ; la poussée exercée par le bourrelet de pied se marque fréquemment par un tracé anormal des cours d'eau en aval ;
- une surface topographique bosselée (ondulations, dissémination de blocs de forte taille, contre pente).

Des manifestations telles que fissurations des bâtiments, arbres couchés ou inclinés, déformation du réseau routier traversant la zone de glissement sont aussi des critères d'identification de mouvements actifs.

Selon le stade d'évolution du glissement, la désorganisation plus ou moins importante de la masse glissée et l'importance du couvert végétal peut rendre difficile la perception du glissement sur le terrain.

Dans notre zone d'étude, les glissements de terrain, par leur intensité, ont entraîné une modification majeure de la morphologie du versant (*figure 1*).



Figure 1. L'observation du paysage à une date donnée ne renseigne pas forcément sur la cause du changement

Les glissements de terrain sont des phénomènes dynamiques. La mise en évidence de leur évolution nécessite ainsi des observations multitudes. Une observation ponctuelle, image à un instant donné d'un paysage, ne peut pas nous amener à conclure quant à la cause et la vitesse de ces phénomènes.

Un glissement de terrain se traduit généralement par une modification de l'état de surface du sol : déplacement ou accumulation de masse, altération de la couverture végétale, changement d'organisation de l'espace, fissures.

Les effets du glissement peuvent également se ressentir sur la végétation (arbres déracinés ou inclinés, dégradation du couvert végétal), le sol ou les ouvrages construits dans le cas de zone urbanisée (bâti, routes, voies de communication).

Les glissements présentent des gradins qui peuvent se superposer par chevauchement en aval. Une partie de la masse glissée peut être graduellement poussée dans le lit majeur du cours d'eau, le matériel étant remanié par la rivière par érosion latérale, ce qui peut mener au sapement de la base du versant.

Au niveau des causes, de nombreux facteurs peuvent provoquer, séparément ou en combinaison, des glissements de terrain ; nous pouvons regrouper ces facteurs en deux grandes catégories : les facteurs naturels (la lithologie, la géomorphologie, le climat, l'hydrologie, le sol, les facteurs édaphiques et biotiques) et les facteurs anthropiques (construction, déforestation, pratiques culturelles).

II.2. Les facteurs discernables

Un glissement de terrain peut générer un certain nombre de situations caractéristiques facilement discernables à l'échelle de l'observation directe, mais moins observable sur une photographie aérienne et encore moins sur une image satellitaire à moyenne résolution. Parmi ces facteurs :

– Le recul d'un front de terrasse est facilement observable, comme c'est le cas de la zone de Breaza.

– L'apparition de ravines ou la coalescence de certains ravins de détachement et la création de quelques corniches en amphithéâtres peuvent engendrer localement le recul du front de terrasse et la disparition de tronçons de chemin ; c'est le cas du glissement du cimetière où, le chemin a été à moitié détruit en 1997.

– Les glissements de terrain induisent parfois un aspect ondulé et chaotique du paysage (*figure 2*) ; par exemple, dans le cas du cimetière et de l'école à Breaza, on remarque bien les ondulations qui apparaissent le long du front du glissement. Cet aspect est donné par l'alternance de micro-dépressions marécageuses avec les bourrelets de glissement ; la zone est couverte d'une végétation hydrophile caractéristique des dépressions marécageuses alimentées sans cesse par les nombreuses sources qui débouchent du versant.



Figure 2. Breaza : allure chaotique d'un versant affecté par un glissement de terrain

II.3. Quelles images utiliser ?

L'observation de l'impact d'un phénomène de glissement de terrain par imagerie satellitaire dépend d'un ensemble de facteurs dont nous retiendrons :

- l'étendue spatiale de ces impacts ; plus la surface des impacts est importante, plus la probabilité d'observation est grande ; ainsi des ravines isolées et de petite dimension ne seront probablement pas observables ;
- la résolution de l'image traduite en terme de taille du pixel ; plus les dimensions du pixel sont petites et plus la probabilité de discrimination de la zone affectée est grande ;
- la réponse spectrale particulière, bien sûr ; elle joue un rôle fondamental dans la distinction du thème ou de l'objet.

En réalité, ces effets sont intimement liés : sur un contexte homogène, un objet de faible surface (constitué d'un faible nombre de pixels) pourra être visible même sous conditions de faible contraste. En milieux hétérogènes, cas les plus fréquents, la visibilité d'un objet ne sera assurée qu'à deux conditions :

- i) un contraste élevé entre la réponse de l'objet et celle de son environnement ;
- ii) un nombre de pixels suffisamment conséquent pour représenter un thème.

Les *figures 3 et 4* illustrent ce concept.

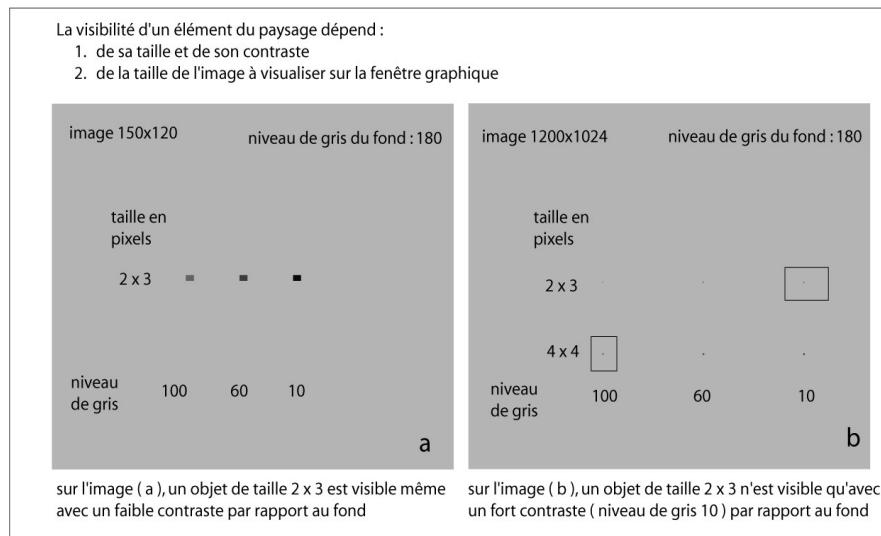


Figure 3. Cette figure montre que la visibilité d'un élément d'espace dépend de plusieurs facteurs : i) la taille de l'objet et son contraste par rapport à son environnement et ii) la taille de l'image à visualiser dans la fenêtre graphique

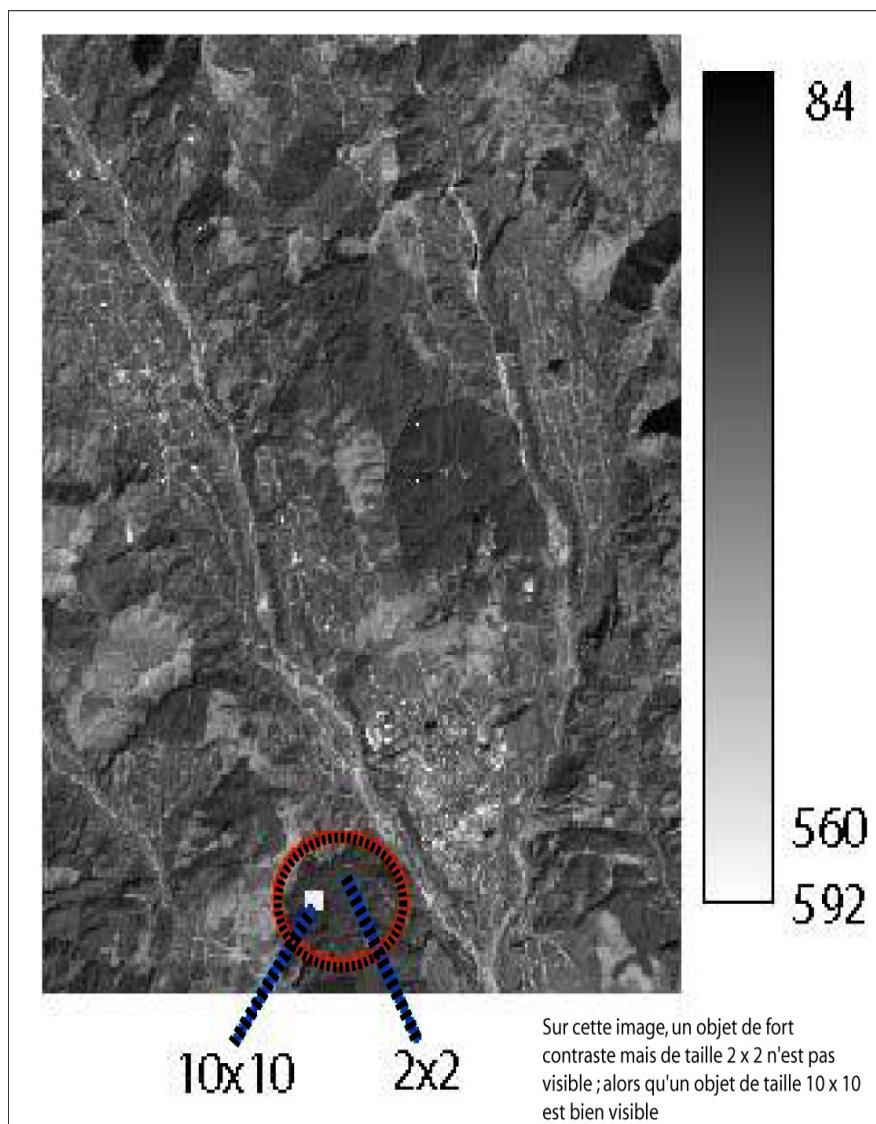


Figure 4

La perception d'un objet dépend également de la taille totale de l'image qui contient cet objet ; la *figure 5* montre un objet de 10×20 pixels à peine visible sur une image de 3000×3000 pixels.

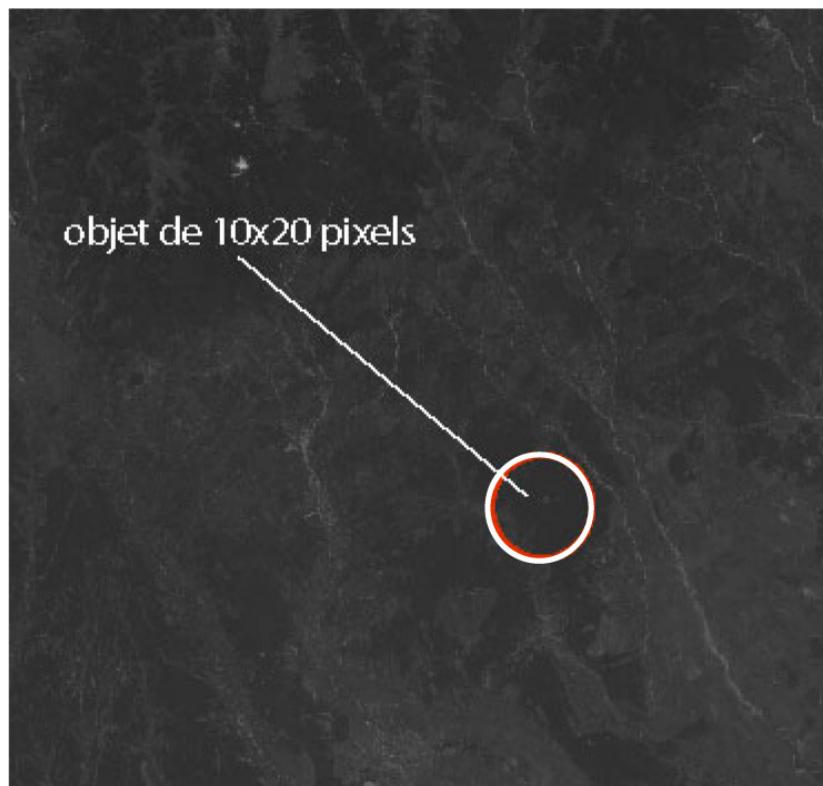


Figure 5. La perception d'un objet dépend aussi de sa taille relative par rapport à la taille de l'image qui le contient

La perception d'un objet dépend enfin de l'importance relative (surface, réflectance) de l'objet dans un pixel.

Enfin, la perception d'un objet dépendra également de sa surface relative dans le pixel et par rapport à un cumul de pixels (s'il s'agit d'un élément linéaire par exemple) ainsi que de l'importance de sa luminance par rapport à son contexte.

La figure 6 est une photo montrant un paysage affecté par un glissement de terrain. La grille superposée à la photo est constituée de mailles d'environ 2 m de côté. Sur le pixel (1), le phénomène d'arrachement de la végétation, conséquence du glissement occupe à peu près 90% de la surface du pixel mais possède une réflectance très forte par rapport à celles des autres pixels ; ce pixel sol sera par conséquent dominant ; cependant, le sol à nu ne représente que 1/100 ème d'un pixel SPOT XS (20m) et moins de 1/200 ème d'un pixel LANDSAT 30 m) ; il

ne pourra donc être observé qu'à la conjonction de deux facteurs : étalement suffisant sur plusieurs pixels et importance de la réflectance par rapport au contexte.

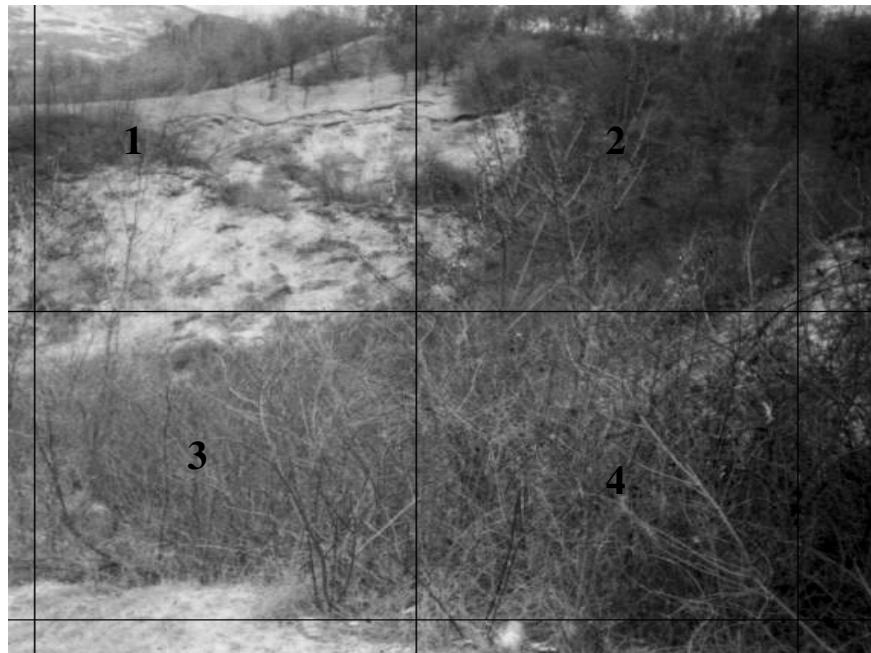


Figure 6. Effet de l'hétérogénéité du pixel

II.4. Quels traitements choisir ?

Les traitements à appliquer devront mettre en évidence les manifestations en surface du phénomène du glissement de terrain :

- dégradation du couvert végétal : densité de couverture, état de la végétation ;
- état de surface du sol ;
- état des routes : coupure, déformation.

Pour mettre en évidence ces divers thèmes, nous considérons trois groupes principaux de traitements :

- ceux qui visent l'amélioration de l'image : étalement dynamique, décorrélational, filtrage;
- ceux qui ont pour objectif d'accentuer un thème particulier, notamment les indices spécifiques (végétation, sol) ;
- ceux dédiés à la mise en évidence d'objets linéaires.

En plus des indices classiques de végétation (NDVI ou TVI par exemple), il est possible d'utiliser l'indice ARVI qui pourrait, en atténuant l'effet de diffusion atmosphérique, produire une image plus contrastée sur laquelle les détails d'une zone de petite surface apparaîtraient avec plus de netteté.

III. La zone de Breaza et les facteurs de glissement de terrain

III.1. Le facteur géologique

Le cadre général géotectonique de l'orogène carpathique est décrit comme une succession de couches qui se chevauchent du nord au sud. Le cadre tectonique est très compliqué à cause des déformations affectant les plis et des ruptures dans les unités structurales.

Le style général de plissement, déterminé par l'avancement et par la mise en place des couches, a mené à la formation d'alignements de synclinaux et d'anticlinaux orientés est-ouest. Ces structures sont très faillées avec des flancs subverticaux. La zone étudiée se superpose au synclinal Breaza-Buciumeni, qui représente un pli normal, axialement faillé, avec des flancs également développés.

Dans sa partie inférieure, affleurent les Conglomérats de Brebu. Par-dessus se trouve une série limoneuse supérieure, constituée des grès quartzeux traversés par des diaclases remplies de limon et d'anhydrite. Cette roche représente un élément essentiel dans la genèse du glissement de terrains.

III.2. Le facteur géomorphologique

La densité de fragmentation est élevée à cause de la présence de roches friables et de la proximité du niveau de nase (le lit de la rivière Prahova).

La plus grande densité (8 km/km^2) se trouve devant la gare de Breaza. Les valeurs moyennes sont de $2,5 \text{ km/km}^2$ et se retrouvent sur la plupart des versants de Prahova.

La profondeur de la fragmentation varie entre 0 et 50 m/km^2 d'une part et, d'autre part, jusqu'à 250 m/km^2 avec des valeurs dominantes entre 101 et 150 m/km^2 . Les valeurs assez élevées de la profondeur de la fragmentation s'expliquent par les différences lithologiques (des conglomérats et des grès durs en alternance avec des marnes, des argiles et des sables), ainsi que par les mouvements tectoniques et la proximité du niveau de base constitué par le lit de la Prahova.

La pente représente un facteur potentiel important pour le déclenchement des processus géomorphologiques actuels. On distingue :

- *des pentes en-dessous de 3°* : le lit majeur et les plateaux des terrasses, ainsi que quelques surfaces de l'interfluve attaquées par de faibles processus de dénudation ;
- *des pentes entre 3 et 10°* : sur les versants et les surfaces structurales dominés par l'érosion superficielles ;

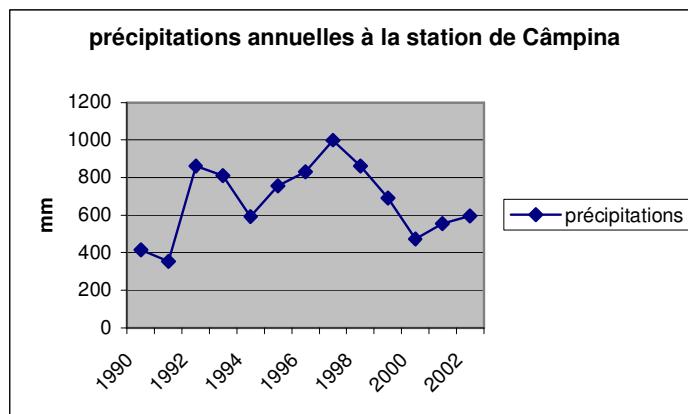
- des pentes entre 10 et 20° : surfaces de raccord entre les terrasses et le versant ; elles sont affectées de processus torrentiels complexes;
- des pentes supérieures à 20° : elles correspondent aux fronts de terrasses et aux crêtes qui se caractérisent par la présence de quelques processus intensifs d'érosion linéaire accompagnés de fréquents et rapides glissements de terrain combinés avec des processus d'écroulement, des détachements et des chutes de matériau.

III.3. Le facteur climatique

Le climat est le composant le plus dynamique du cadre naturel qui intervient dans la morphogenèse des versants.

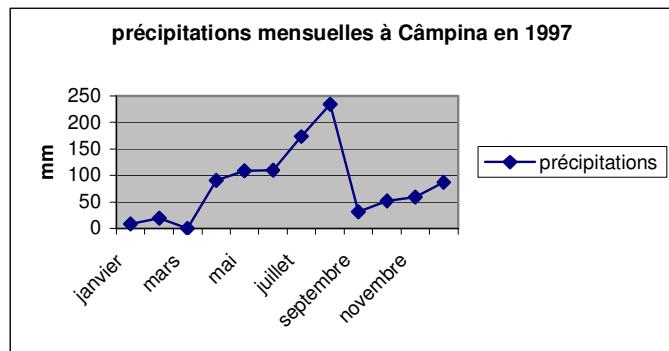
Les précipitations agissent sur la stabilité des versants par l'impact des gouttes de pluie et par l'influence sur le degré de cohésion des formations superficielles, sur le régime d'écoulement des rivières et sur les paramètres hydrogéologiques de la région.

Suite aux intenses précipitations de l'année 1997 et de janvier 1998, des glissements de terrain se sont produits ; ils ont provoqué la destruction de nombreuses rues, alors que d'autres ont été fortement détériorées, suite à l'effet répété du processus gel-dégel et à l'épaisseur insuffisante de la couverture d'asphalte. Ces effets entraînent la dégradation des chemins : fissures, fentes et trous. De l'analyse des précipitations annuelles entre 1990 et 2002, on remarque une alternance d'années sèches (1990 – 413 mm ; 1991 – 353 mm ; 2000 – 473 mm) et d'années pluvieuses (1992 – 861 mm ; 1993 – 809 mm ; 1996 – 830 mm ; 1997 – 999 mm; et 1998 – 860 mm) (*graphe 1*).



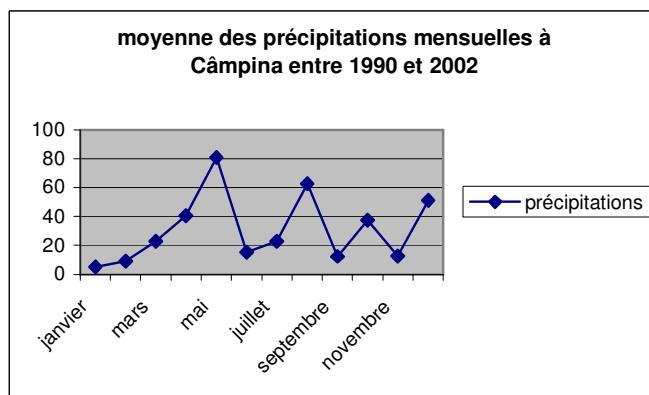
Graphe 1. Précipitations précipitations annuelles à la station de Câmpina entre 1990 et 2002

Du point de vue des précipitations, l'année 1997 était exceptionnelle, enregistrant à la station de Câmpina des valeurs maxima en juillet-août (142-274 mm), comme nous pouvons voir sur le *graphe 2*. Les précipitations tombées le 3 août 1997 ont été de 94,3 mm, ce qui représente des valeurs deux à trois fois plus grandes que les moyennes mensuelles d'autres années (20,7 mm en août 2000, par exemple).



Graphe 2. Précipitations mensuelles pour l'année 1997 à la station de Câmpina

De la comparaison entre les valeurs moyennes des précipitations mensuelles en août, entre 1990 et 2002 (*graphe 3*), on remarque que les précipitations du mois août 1997 sont dix fois plus grandes que celles d'août 2000 et, généralement, deux à trois fois plus grandes que celles des autres années analysées. Donc, c'est une valeur anormalement élevée pour ce mois, qui, en général, est sec.



Graphe 3. Moyennes mensuelles sur la période 1990-2002 à Câmpina

III.4. Le facteur hydrologique

Le débit maximum de la Prahova enregistré à la station de Câmpina a été de 369 m³/s, le 17.07.1998, tandis que le débit moyen annuel à la même station a été de 12,20 m³/s, en 1970, une année considérée comme exceptionnelle pour le régime hydrométéorologique de la Roumanie. Dans la zone étudiée, la nappe phréatique varie de façon désordonnée. Les ressources d'eau les plus riches se trouvent dans les formes d'accumulation : terrasses, lits majeurs, cônes de déjection, talus rocheux. Dans le lit majeur de la Prahova, le niveau hydrostatique est très proche de la surface (0,8-2,1m) et varie en fonction du niveau de l'eau de la rivière.

III.5. Le facteur anthropique

III.5.1. La population

L'évolution du nombre d'habitants entre 1912 et 1998 montre une croissance continue et implicitement une pression sur les versants, ayant des effets graves dans l'état d'équilibre de ceux-ci.

La densité de la population a augmenté de 306 hab./km² en 1930, à 435 hab./km² en 1992, reflétant la pression de plus en plus grande de l'homme sur l'environnement.

III.5.2. Le bâti

Le nombre de constructions à Breaza a augmenté comme suit : de 820 bâtiments en 1905 à 8486 bâtiments en 1992. Ce rythme de croissance rapide a engendré une augmentation de la densité des bâtiments et surtout une surcharge sur le versant. Certaines nouvelles voies de communication, perpendiculaires au versant, guident les eaux superficielles vers le versant alimentant ainsi les glissements de terrain.

La surcharge des terrains, les déforestations, les exploitations du gravier de la vallée de la Prahova, les tranchées pour des conduites, les fossés, les chemins, l'absence de réseau d'égouttage sont des facteurs anthropiques qui ont un impact extrêmement agressif sur les versants.

IV. Les traitements de l'image satellitaire

IV.1. Les images satellites disponibles et la localisation de la zone d'étude

Le terrain d'étude est situé sur la rive droite de la rivière Prahova entre Nistoreşti et la gare Breaza (*figures 7 et 8*) ; il s'agit d'un versant incliné ayant subi plusieurs modifications morphologiques au cours des dernières années. Le

versant présente une pente moyennement marquée, de 3° à 20° , se traduisant par plusieurs niveaux de pente :

- un premier palier supérieur à 20° et correspondant au front de terrasse ;
- un second niveau entre 20° et 10° ;
- un troisième palier situé entre 10° et 3° ;
- et un dernier palier en dessous de 3° .

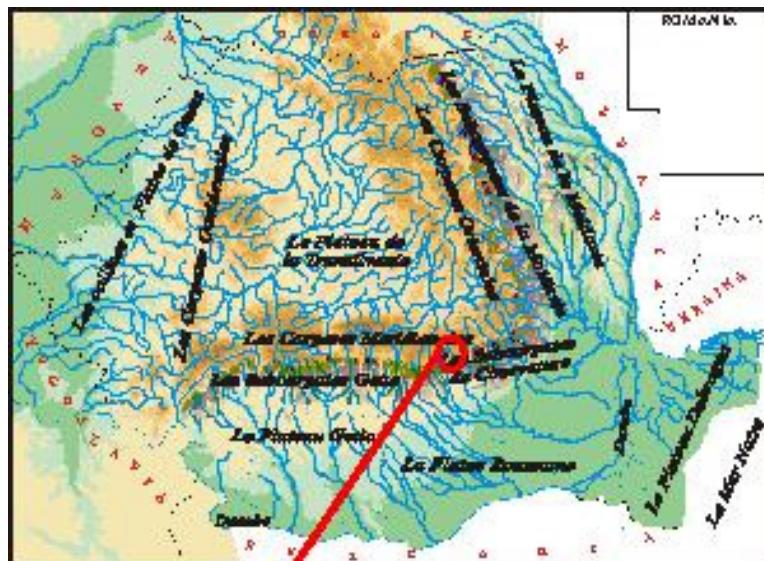


Figure 7. Localisation de la zone d'étude



Figure 8. Localisation de la zone de glissement sur la carte au 1/25 000e

Par les divers traitements spécifiques appliqués aux images SPOT et Landsat TM, nous essayons de mettre en évidence un changement d'apparence de la surface ou tout au moins un caractère de grande hétérogénéité qui pourrait traduire la présence de glissement de terrain : hétérogénéité anormale au niveau de la surface du sol ou de la végétation.

Les tentatives de localisation de la zone d'étude sur les images satellites laissent entrevoir de grandes difficultés pour son appréhension et la lisibilité de sa structure et de sa texture sur les images. La difficulté majeure est, bien évidemment, la taille de la surface à étudier : surface d'environ 30 x 6 pixels soit moins de 200 pixels sur l'image (*figure 9*).

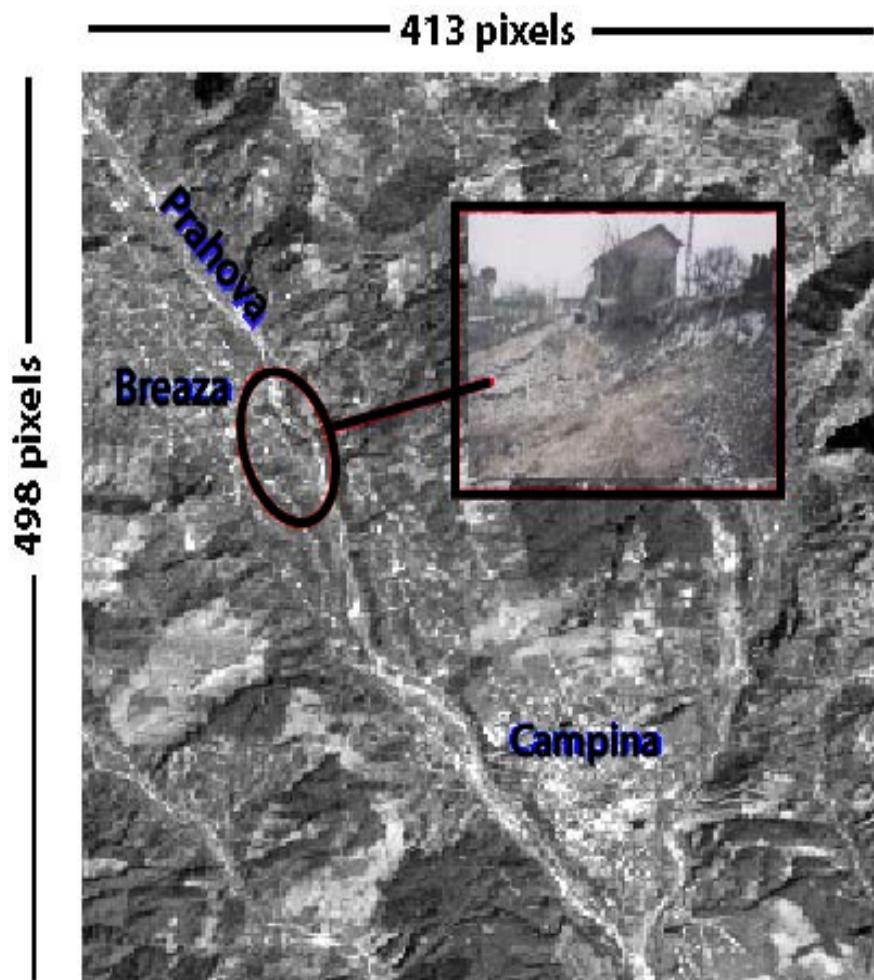


Figure 9. Localisation de la zone de glissement sur un extrait de scène Landsat TM

IV.2. Dynamique et corrélation

Il n'est pas utile de revenir ici sur les traitements d'amélioration préliminaires de l'image. Nous présentons cependant les résultats de l'analyse en composantes principales de l'image SPOT du 11 août 1992 (*figure 10*).

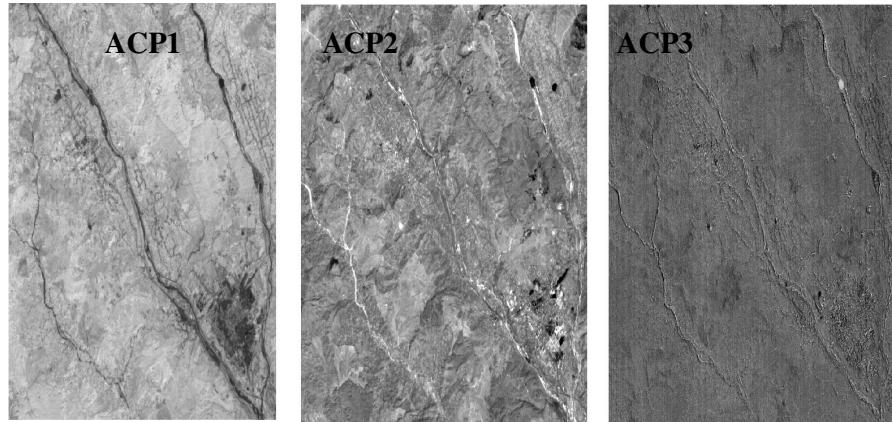


Figure 10. Analyse en composantes principales de l'image SPOT du 11 août 1992

La première composante principale est la plus riche en informations mais les deux autres composantes (auxquelles nous avons fait subir une amélioration de la dynamique) apportent un complément d'information.

Un agrandissement et un rehaussement de la partie d'image correspondant à la zone d'étude nous permet de mettre en évidence des agencements de pixels de thème sol nu ou végétation très altérée de direction correspondant à celle des glissements observés (figure 11).

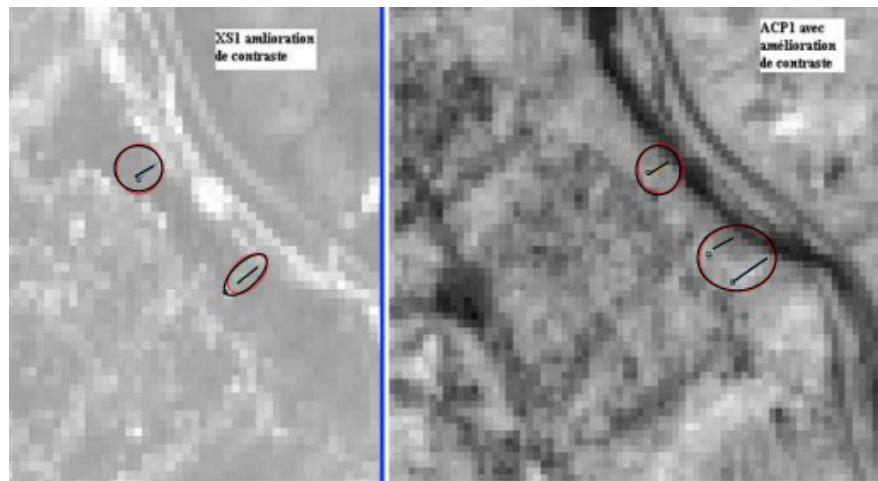


Figure 11. Mise en évidence d'agencements de pixels sur des directions privilégiées dans le sens de la pente du glissement

Ce résultat est confirmé par un traitement d'extraction de contour (utilisation de filtre de Sobel). Comme la zone d'étude est de très faible étendue, les parties affectées occupent un nombre réduit de pixels et les contours sont difficilement discernables (*figure 12*).

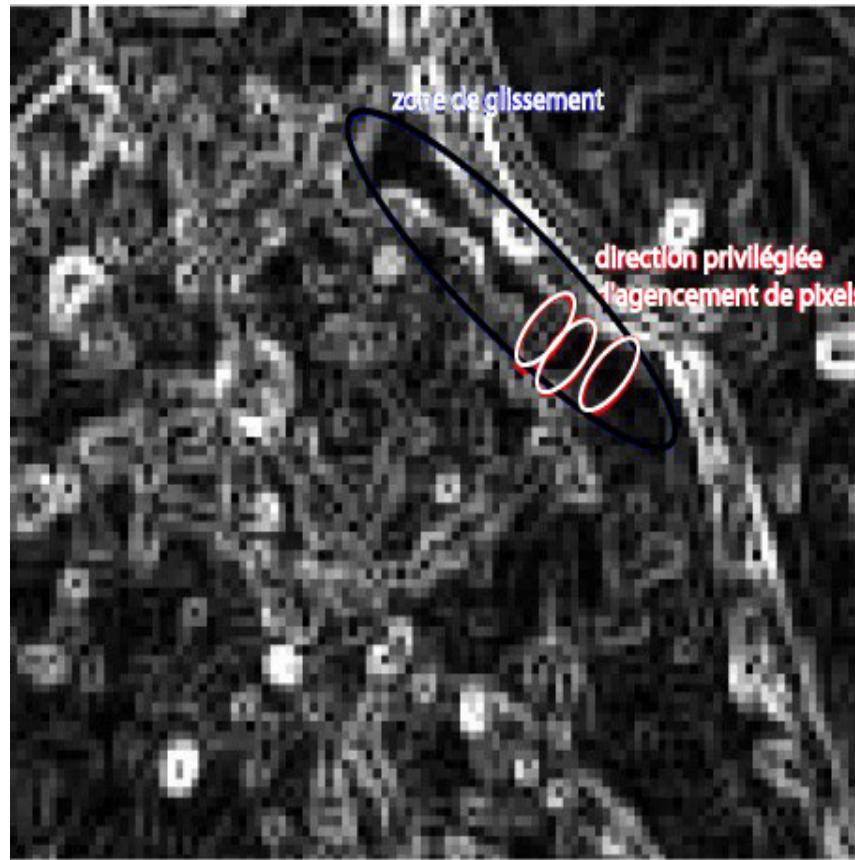


Figure 12. Extrait de l'image détection de contour à partir du canal XS1 (SPOT 1992)

IV.3. Les indices et combinaisons de canaux

Nous avons testé plusieurs combinaisons de canaux ; celle qui nous semble donner le meilleur résultat est la combinaison (XS2-XS1) que nous avons améliorée par un traitement spécifique (*figure 13*).

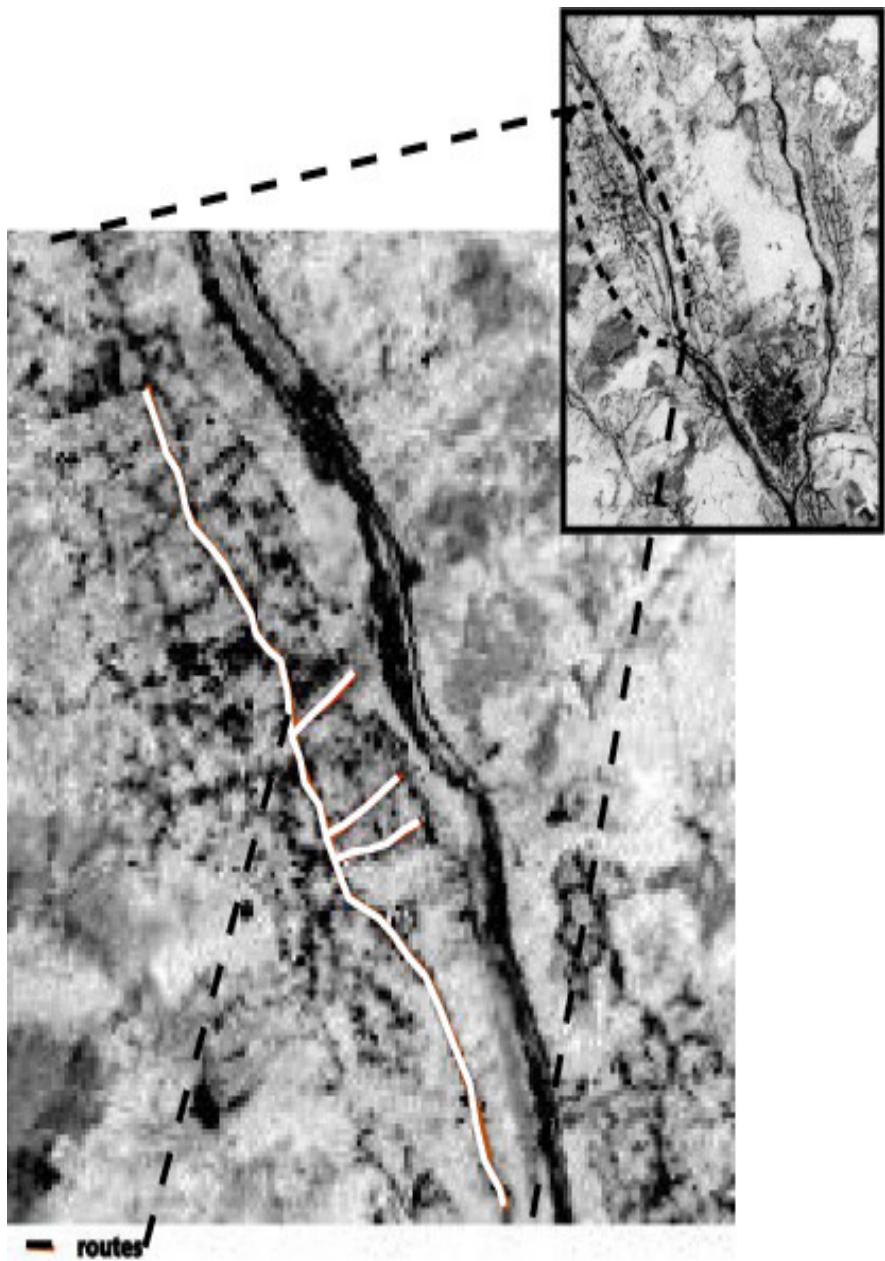


Figure 13. agrandissement amélioré de l'image XS2-XS1

Le même algorithme appliqué aux canaux de l'analyse en composantes principales confirme l'hétérogénéité des réponses des pixels sur la zone affectée et l'existence d'une direction privilégiée (front de terrasse-cours d'eau) d'agencement de pixels à forte réflectance pouvant correspondre au sol nu (*figure 14*).

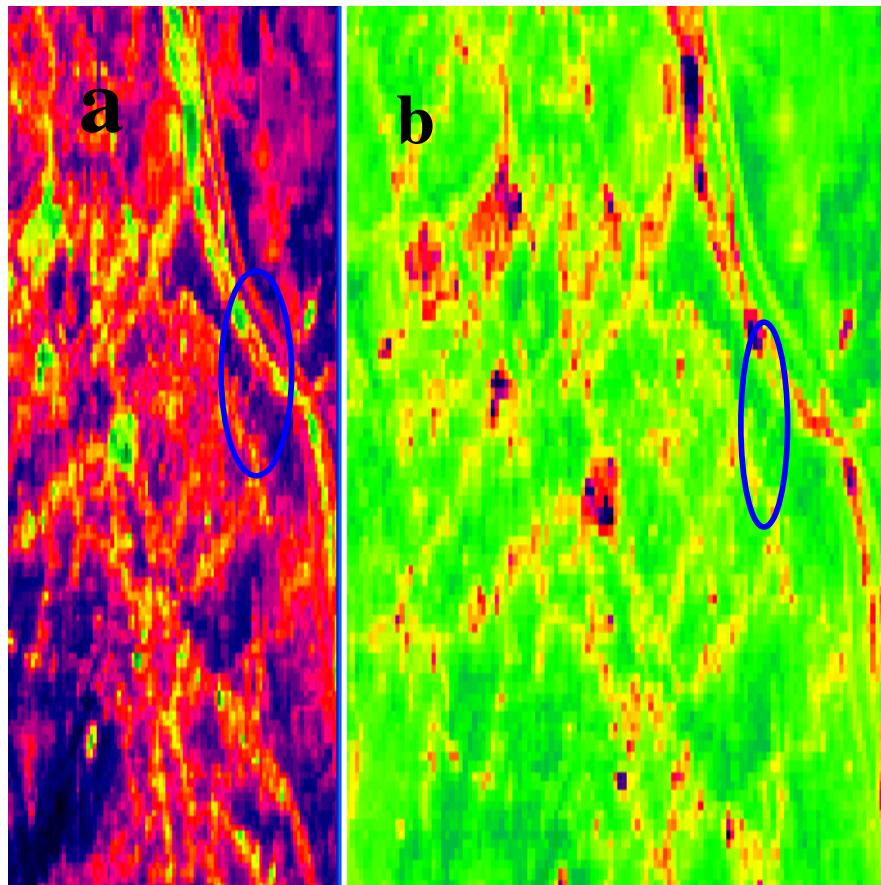


Figure 14. Combinaison 2-1 appliquée : aux canaux XS1 et XS2 (a) puis aux canaux de l'analyse en composantes principales ACP1 et ACP2 (b)

Nous avons testé l'indice de végétation (NDVI : *figure 15*), un ration (IR / R) et l'indice ARVI calculé selon la formule suivante :

$$\text{ARVI} = (\text{pIR} - \text{RB}) / (\text{pIR} + \text{RB})$$

Où : RB = R - B (canal rouge-canal bleu),

cet indice apparaît comme une nouvelle version de l'indice de végétation normalisé en introduisant une stabilisation par rapport aux effets d'atmosphère (*figure 16*).

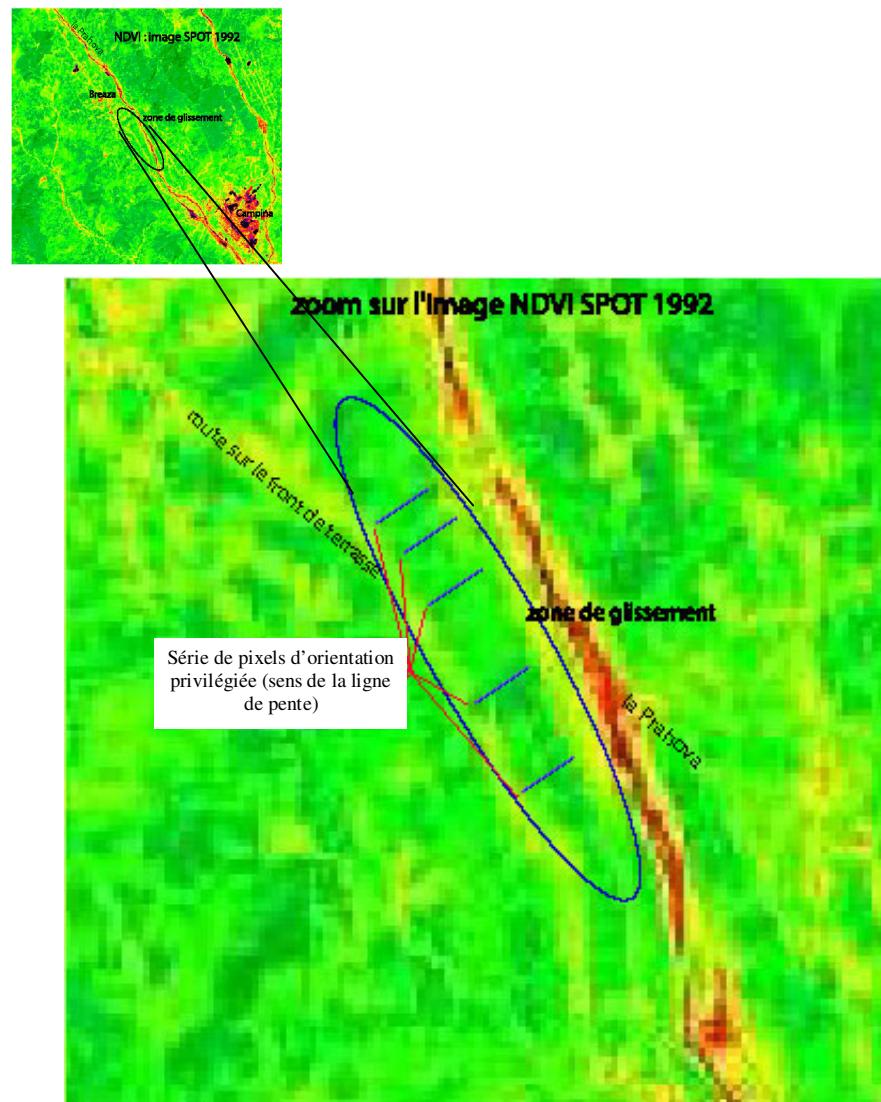


Figure 15. NDVI sur l'image SPOT de 1992 ; cette image confirme l'hétérogénéité de l'apparence des pixels de la zone de faible étendue et l'existence d'une direction privilégiée d'agencement des pixels dans le sens du glissement

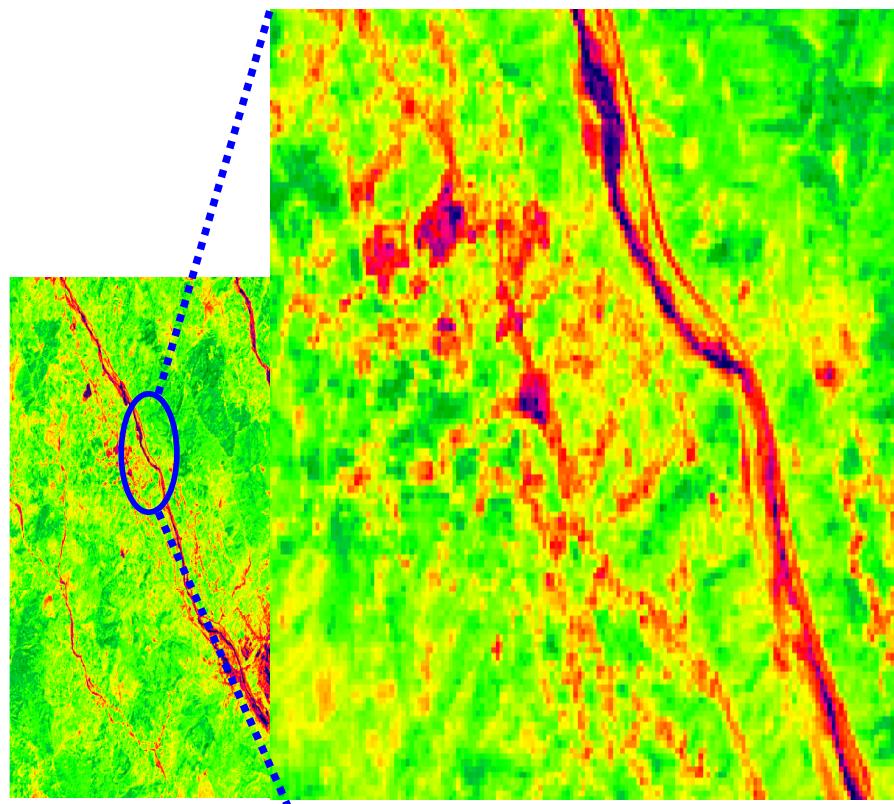


Figure 16. Indice ARVI appliqu   l'image SPOT du 11 ao鹴 1992

V. Interpr  tation et conclusion

Les divers traitements des donn  es satellitaires ne suffisent pas, pour un secteur aussi restreint que celui du glissement de terrain de Breaza, pour tudier ce ph  nom  ne. Seule l'analyse st  roscopique classique  partir de photographies a  riennes autorise l'tude g  omorphologique de tels transports de masse.

Par contre, l'analyse des donn  es satellitaires souligne des facteurs explicatifs de ces glissements comme une grande h  t  rog  n  t   du versant de la Prahova  hauteur de Breaza comme on le voit de fa  on assez nette sur l'image ASTER de 2003 (*figure 17*).

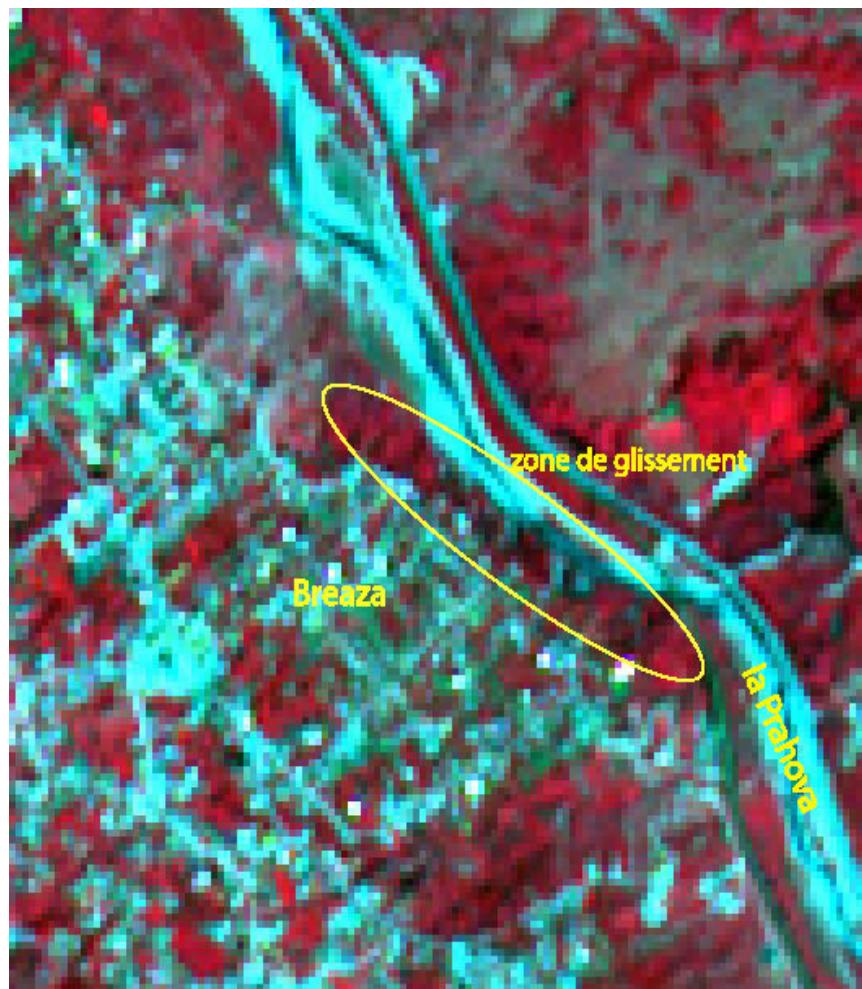
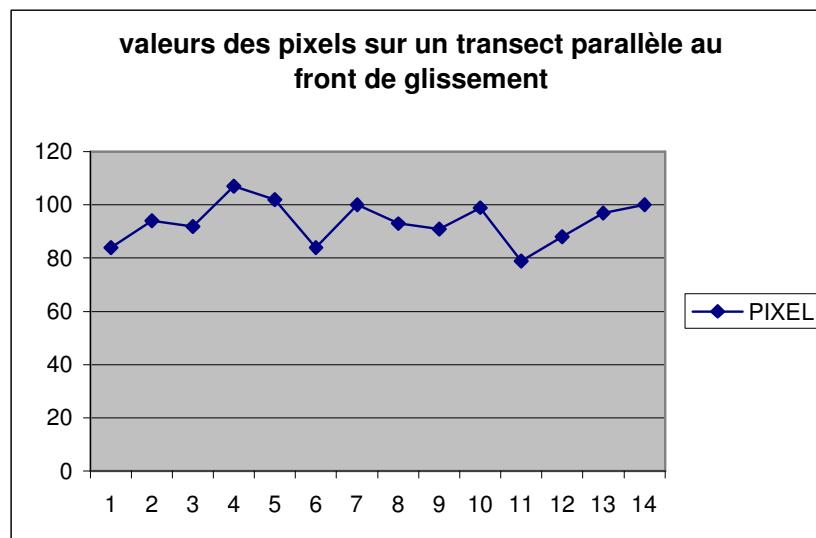


Figure 17. Composition colorée de l'image ASTER (2003) – conversion en Noir et Blanc

Le graphique 4 montre cette hétérogénéité sur un transect de l'image ASTER 2003, parallèle au lit de la Prahova. Sur l'image ASTER par exemple (figure 17) cette hétérogénéité se traduit par une diversité de couleur des pixels due à la juxtaposition de teintes rouges sombre (végétation dense de feuillus), rouge clair (pâturage arboré sur versant) et des zones gris-clair où le minéral domine, témoin de terrains dénudés soit par l'érosion, soit par des surfaces de décrochement, soit encore par des rejets d'inertes par le sommet.



Graphe 4. Hétérogénéité de la zone de glissement sur un transect parallèle au lit de la Prahova sur l'image ASTER 2003

Il faut souligner que les versants « normaux » de la Prahova présentent une couleur rouge sombre homogène témoin de versants boisés en liaison avec la forte pente des versants.

Les images satellites mettent aussi en évidence d'autres éléments qui peuvent mieux expliquer le développement de glissement à cet endroit :

- À la base du versant, le tracé concave de la Prahova au droit du glissement de terrain, permet d'expliquer l'érosion latérale du cours d'eau et donc le sapement à la base du versant.

- Au sommet, le plateau présente une densification croissante de l'habitat (mise en évidence lorsqu'on compare de données multi-sources : photographies aériennes, cartes topographiques et diverses images satellites), ce qui exerce une pression sur le versant.

- Enfin, toujours sur le plateau, l'image satellite souligne l'organisation du réseau routier et surtout l'existence d'une route perpendiculaire au versant et une pente régulière vers celui-ci, qui ne peut que drainer l'eau du nouveau lotissement vers le versant qui, lors de fortes précipitations ne fait qu'accélérer le déclenchement des transports de masse.

USAGE OF SATELITE IMAGERY IN DETERMINING LANDSLIDES.
CASE STUDY PRAHOVA VALLEY (ROMANIA)

Summary

Romania is exposed to various natural risks among which landslides represent the most frequent shape. These phenomena take a particular importance in urban zones; it is the case of the city of Breaza on the valley of Prahova (Romania) where the phenomenon of landslide accelerated in a considerable way under the combined effects of the nature of the ground, the particular pluviometric sequences and the important anthropological pressure on the natural medium.

The objective of the present work is to analyze the contribution of the satellitale imaging high and average resolution for the demarcation of the zones of gliding. Although a landslide concerns generally only a weak area, we show that it is possible, for specific treatments, to arrest the outside appearances of the phenomenon and its impact on the reorganization of the space.

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Keywords : satellite images, landslides, SPOT, Landsat.

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APLICAȚII ALE TEORIEI PROBABILITĂȚILOR CONDIȚIONATE ÎN GEOMORFOLOGIE

IONUT ȘANDRIC

1. Introducere

a. Materiale utilizate

Sursele de date pentru exemplificarea metodelor prezentate sunt: hărțile topografice la scara 1:25000, georeferențiate în proiecția Gauss-Krüger, fus 35, datum Pulkovo 1942. Datele au fost corectate și actualizate cu ajutorul imaginilor satelitare SPOT 4, Landsat TM și ETM+ (<http://www.glcf.umiacs.umd.edu>). Imaginile satelitare SPOT 4 (1997), cu o rezoluție de 10 m în pancromatic, oferă un bun suport informațional pentru actualizarea hărților topografice (Sabins, 1997, Lillesand, 2004). Imaginile Landsat TM (1992, 1997), ETM+ (2000), chiar dacă au o rezoluție spațială mai mică (30 m în multispectral), oferă totuși o informație suficient de precisă care, combinată cu observații de teren, pot îmbunătăți informațiile despre utilizarea terenurilor oferite de hărțile topografice la scara 1:25000 (ediția 1980). Pentru o bună interpretare a imaginilor satelitare, a fost realizat un produs pansharpened între imaginile satelitare SPOT 4 pancromatic și Landsat TM, în combinație fals color 453 și 321. Alunecările de teren, litologia și faliile au fost realizate în cadrul programului de cercetare „Vulnerabilitatea versanților la alunecări de teren în sectorul subcarpatic al Vaii Prahova”, finanțat de CNCSIS, 2001-2002. Datele utilizate au fost curbele de nivel, cotele altimetrice, rețeaua hidrografică, litologia, faliile obținute prin vectorizare manuală pe mai multe suporturi informaționale: hărți topografice, imagini satelitare completate cu observații din teren. Calitatea modelelor digitale de teren variază foarte mult, ca urmare a preciziei datelor spațiale și a metodelor de interpolare folosite (Burrough 1998, Eastman 2003). Pentru crearea modelului digital al altitudinilor a fost folosită ca metodă de interpolare „triangulația constransă”, implementată în programul Idrisi Kilimanjaro (Eastman, 2003).

b. Sisteme suport de decizie

Teoriile probabilităților condiționate Bayes și Dempster-Shafer fac parte din sistemele suport de decizie. Acestea oferă sprijin în luarea deciziilor, astfel încât să fie selectată cea mai bună alternativă. Pot exista mai multe alternative, reprezentate prin diverse ipoteze, elemente spațiale alternative ce pot fi incluse unui set sau altul de date etc., astfel, decizie însemnând alegerea din mai multe alternative.

Alternativele pot fi diferite acțiuni, diferite ipoteze, detalii, obiecte etc. Alegerea unei alternative este determinată de criterii; prin urmare, criteriile stau la baza deciziilor și pot fi cuantificate, măsurate și evaluate. Criteriile pot fi de două tipuri: factori și constrângeri; se referă atât la caracteristicile obiectelor dintr-un set de decizie, cât și la caracteristicile întregului set de decizie. Factorii sunt criterii care pot influența pozitiv sau negativ alegerea unei alternative și prin urmare se măsoară pe o scara continuă. Factorii mai sunt numiți și „variabile de decizie” sau „variabile structurate”. Constrângările servesc la limitarea alternativelor luate în considerare. În cele mai multe cazuri, pentru constrângeri se folosesc analizele boolean sau, uneori, sunt exprimate sub formă de condiții pe care setul de decizii trebuie să îl îndeplinească. Procedurile prin care sunt selectate și combinate criteriile pentru a se ajunge la o evaluare și prin care mai multe evaluări sunt comparate poartă numele de „reguli de decizie”. Acestea pot fi un prag (ex: toate suprafetele cu pante mai mari de 7°) sau pot fi complexe prin combinarea mai multor criterii de evaluare. De regulă, conțin proceduri pentru combinarea criteriilor într-un singur index compus și o declarație referitoare la modul în care vor fi comparate alternativele, folosind acel index compus (Eastman, 2003).

c. Incertitudini în procesul de decizie

Atunci când discutăm de sisteme suport de decizie discutăm și de erori, și de incertitudini. În sistemele informaționale geografice, probleme legate de incertitudine și erori au fost tratate încă de la început (Heuvelink, 1993, 1998; Burrough, 1998). Atenția a fost concentrată asupra incertitudinilor rezultate din măsurători (Burrough, 1986), evaluarea erorilor (Heuvelink, 1993, 1998; Burrough, 1998), propagarea erorilor (Heuvelink, 1993, Burrough, 1986) și raportul de calitate a datelor (Moellerling *et al.*, 1988), erorile exprimate prin seturile Fuzzy (Fisher, 1991; Burrough, 1998). Cu toate acestea, o mai puțină atenție a fost acordată modului prin care aceste erori influențează procesul de decizie. Pe măsură ce acest domeniu va deveni tot mai avansat în înțelegerea și manipularea erorilor și a influenței lor asupra procesului de decizie, se va observa în cadrul sistemelor informaționale geografice o migrare a procesului de decizie bazat pe criterii „rudimentare” (în care se apreciază că baza de date și modelele de evaluare sunt perfecte) către procesul de decizie bazat pe criterii avansate (Eastman, 2003). Dacă sunt cunoscute incertitudinile din baza de date și incertitudinile din regulile de decizie, este posibil ca rezultatele tradiționale bazate pe analizele boolean să migreze către rezultate probabilistice, adică de la o decizie de DA și NU la o probabilitate, astfel fiind utilizate mai multe niveluri de apreciere.

Migrarea către luarea de decizii pe bază de criterii avansate a determinat dezvoltarea sistemelor informaționale geografice prin implementarea de metadata care să conțină informații despre incertitudine, informații de care se va ține seama în procesul de decizie.

2. Teoria Bayes

De-a lungul timpului, au fost derulate numeroase studii de evaluare a susceptibilității la alunecări de teren, folosindu-se sistemele informaționale geografice (Chung and Fabbri, 1993; Lineback *et al.*, 2001; Lee *et al.*, 2002; Șandric, 2003¹, 2004²). În studiul de față, s-a folosit teoria probabilităților condiționate Bayes, cunoscută și sub denumirea de „Weight of Evidence” (Fig. 2), (Bonham-Carter *et al.*, 1988, 1989; Aspinall *et al.*, 1992, Chung & Fabbri, 1993, 1998; Lineback, 2001; Lee, 2002; Gorsevski, 2003; Șandric, 2004²)

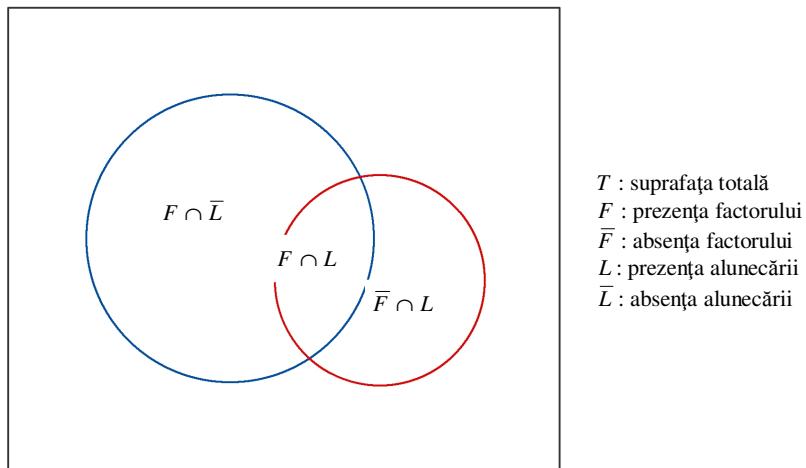


Fig. 2. Diagrama lui Venn pune în evidență calculul „Weight of Evidence”
(după Bonham-Carter, 1994)

Teoria probabilităților condiționate Bayes combină informații cunoscute sau presupuse despre un anumit eveniment exprimate ca probabilități *apriori* cu noi informații despre acel eveniment exprimate ca probabilități condiționate, cu scopul de a obține un grad de probabilitate pentru producerea unui eveniment, exprimat prin probabilitățile posterioare. Printre altele are o importanță deosebită în determinarea probabilității cauzelor și transformă informațiile cauzale în informații de diagnostic (Şandric, 2004²). În cazul analizei bayesiene absența evidenței pentru o ipoteză este considerată suport pentru ipoteza complementară (Eastman, 2003).

¹ I. ȘANDRIC, I. ARMAŞ, 2003, „Aplicarea teoriei de probabilitate Bayes în studiile de vulnerabilitate”, *Comunicări de Geografie*, VII-VIII, Bucureşti, prezentare.

² I. ȘANDRIC, ARMAŞ, R. DAMIAN, 2004, *Evaluarea vulnerabilității versanților la alunecări prin folosirea teoriilor de probabilitate*, 28 mai 2004, Sf. Gheorghe, al XXI-lea Simpozion național de Geomorfologie, prezentare.

Avantajul analizei bayesiene constă în faptul că orice informație nouă poate fi introdusă ulterior într-o nouă formulă de calcul. Astfel, odată obținută o probabilitate posterioară (în studiul de față probabilitatea de a se produce o alunecare) aceasta poate deveni evidență sau probabilitate apriori într-o nouă analiză Bayes, astfel se îmbunătățește rezultatul. Acest lucru poate continua la infinit, ori de câte ori se obțin noi informații (Bonham-Carter, 1994; Chung-Fabbri, 1998, Șandric 2004²).

$$P(L/F) = \frac{P(L \cap F)}{P(F)} = \frac{P(L) * P(F/L)}{P(F)} \quad \text{formula lui Bayes} \quad (1)$$

unde:

– $P(L)$ este *probabilitatea apriori (probabilitatea producerii evenimentului L)*, calculată ca raportul dintre suprafața cu alunecari pentru o anumită clasă cu suprafața totală cu alunecări, a zonei de studiu:

$$P(L) = \frac{N\{L\}}{N\{T\}}, \quad (2)$$

– $P(F/L)$ este *probabilitatea condiționată (probabilitatea acționării cauzei F când evenimentul L s-a produs)* calculată prin compararea suprafeței cu alunecări pe o anumită clasă cu suprafața totală a clasei;

– $P(L/F)$ este *probabilitatea aposteriori (probabilitatea producerii evenimentului L când acționează cauza F)*.

Pentru doi factori, formula de calcul devine:

$$P(L/F_1 \cap F_2) = \frac{P(L) * P(F_1 \cap F_2 / L)}{P(L) * P(F_1 \cap F_2 / L) + P(\bar{L}) * P(F_1 \cap F_2 / \bar{L})}, \quad (3)$$

Dacă sunt utilizăți mai mult de doi factori, ecuația (3) devine:

$$P(L/F_1 \cap F_2 \cap \dots \cap F_n) = \frac{P(L) * P(F_1 / L) * P(F_2 / L) * P(F_n / L)}{P(F_1) * P(F_2) * P(F_n)} \quad (4)$$

Una dintre condițiile pentru utilizarea analizei bayesiene este ca factorii utilizăți să fie independenți unul față de celălalt. Pentru a stabili care este relația alunecare/factor, s-a impus folosirea unei analize χ^2 (Bonham Carter, 1994). În această analiză s-au folosit următorii factori: pante, litologie, utilizarea terenului, altitudinea, desimea fragmentării, desimea falilor, expoziția versanților, curbura în plan, curbura în profil. Rezultatele analizei sunt prezentate în *tabelul 1*.

Tabelul 1

Tabela cu nivelul pentru valorile critice χ^2 și valorile obținute din calcule

	Grad de libertate	χ^2							
Litologie	22	11.9296	χ^2						
			Valoare critică χ^2 mică			Valoare critică χ^2 mare			
0.999	0.99	0.975	0.95	0.9	0.1	0.05	0.025	0.01	0.001
6.983	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	48.268
			11.9296						
Utilizare	11	8.9627	χ^2						
			Valoare critică χ^2 mică			Valoare critică χ^2 mare			
0.999	0.99	0.975	0.95	0.9	0.1	0.05	0.025	0.01	0.001
1.834	3.053	3.816	4.575	5.578	17.275	19.675	21.92	24.725	31.264
					8.9627				
Altitudine	5	4.2706	χ^2						
			Valoare critică χ^2 mică			Valoare critică χ^2 mare			
0.999	0.99	0.975	0.95	0.9	0.1	0.05	0.025	0.01	0.001
0.21	0.554	0.831	1.145	1.61	9.236	11.07	12.833	15.086	20.515
					4.2706				

Tabelul 1
(continuare)

	Grad de libertate	χ^2							
Desime fragmentare	9	11.2728		χ^2					
			Valoare critică χ^2mică			Valoare critică χ^2 mare			
0.999	0.99	0.975	0.95	0.9	0.1	0.05	0.025	0.01	0.001
1.152	2.088	2.7	3.325	4.168	14.684	16.919	19.023	21.666	27.877
					11.2728				
Expozitie versanti	7	1.0922		χ^2					
			Valoare critică χ^2mică			Valoare critică χ^2 mare			
0.999	0.99	0.975	0.95	0.9	0.1	0.05	0.025	0.01	0.001
0.598	1.239	1.69	2.167	2.833	12.017	14.067	16.013	18.475	24.322
	1.0922								
Pante	6	11.0621		χ^2					
			Valoare critică χ^2mică			Valoare critică χ^2 mare			
0.999	0.99	0.975	0.95	0.9	0.1	0.05	0.025	0.01	0.001
0.381	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	22.458
					11.0621				

Tabelul 1
(continuare)

	Grad de libertate	χ^2							
Curbura in plan	4	1.7016	χ^2						
			Valoare critică χ^2mică			Valoare critică χ^2 mare			
0.999	0.99	0.975	0.95	0.9	0.1	0.05	0.025	0.01	0.001
0.091	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	18.467
					1.7016				
Curbura in profil	4	0.6709	χ^2						
			Valoare critică χ^2mică			Valoare critică χ^2 mare			
0.999	0.99	0.975	0.95	0.9	0.1	0.05	0.025	0.01	0.001
0.381	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	22.458
Desime falii	6	4.1	χ^2						
			Valoare critică χ^2mică			Valoare critică χ^2 mare			
0.999	0.99	0.975	0.95	0.9	0.1	0.05	0.025	0.01	0.001
0.381	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	22.458
					4.1				

Analiza χ^2 , deși arată asocierea dintre alunecările produse și fiecare factor în parte, nu indică și importanța fiecărui factor în parte, motiv pentru care următorul pas a fost introducerea lor în analiza bayesiană. Au fost introdusi numai acei factori ce au valori χ^2 între 10% și 90% corelare cu alunecările produse. Excepție a făcut litologia, care în ciuda unei corelari extrem de mici, a fost totuși păstrată. Cei cinci factori (pante, litologie, desimea fragmentării, desimea faliilor, utilizarea terenului) reținuți în urma analizei χ^2 au fost introdusi în analiza bayesiană. Într-o primă analiză, au fost obținute probabilitățile pentru fiecare clasă de la fiecare factor care să fi participat la producerea alunecărilor deja existente. Această informație nouă a fost introdusă într-o nouă analiză bayesiană, de data aceasta ca probabilitate *a priori*. Rezultatele obținute prezintă probabilitatea de producere a alunecărilor de teren ca urmare a probabilităților calculate anterior. Acest tip de analiză corespunde în totalitate analizei bayesine pure, care folosește doar informațiile cunoscute pentru a obține probabilități posterioare. Rezultatele obținute au fost testate prin suprapunerea suprafețelor alunecate peste suprafețele cu susceptibilitate (probabilitate mare, peste 60%) de producere de alunecări de teren. Au fost reținute ca suprafețe susceptibile numai acele suprafețe cu o probabilitate de peste 30%, iar cele cu o probabilitate mai mare de 60% au fost considerate cu susceptibilitate mare (fig. 3.c). Graficul ce indică gradul de suprapunere pune în evidență rezultatul nesatisfăcator al analizei bayesiene. O mare parte din alunecările de teren existente se suprapun pe zonele cu susceptibilitate mică, iar cele cu susceptibilitate medie și mare ocupă o suprafață mai mică decât alunecările existente peste care se suprapun. Acest lucru este cauzat în mare parte de sursele de informație. Alunecările de teren reprezintă evidența pe baza careia analiza bayesiană se realizează, prin urmare se poate trage concluzia unor erori prea mari în cartarea alunecărilor de teren. Pe viitor se impune o cartare mai atentă a alunecărilor de teren existente și reluarea analizei bayesiene, diferențiat pentru fiecare tip de alunecare. O altă sursă de erori o reprezintă datele utilizate. Se impune îmbunătățirea lor. Pentru diminuarea erorilor introduse de analiza bayesiană se impune realizarea unui model de propagare a erorilor care să micșoreze influența negativa a analizei bayesiene asupra rezultatului final. Studiul urmează a fi îmbunătățit prin aplicarea de analize fuzzy pentru fiecare factor și simularea Monte Carlo.

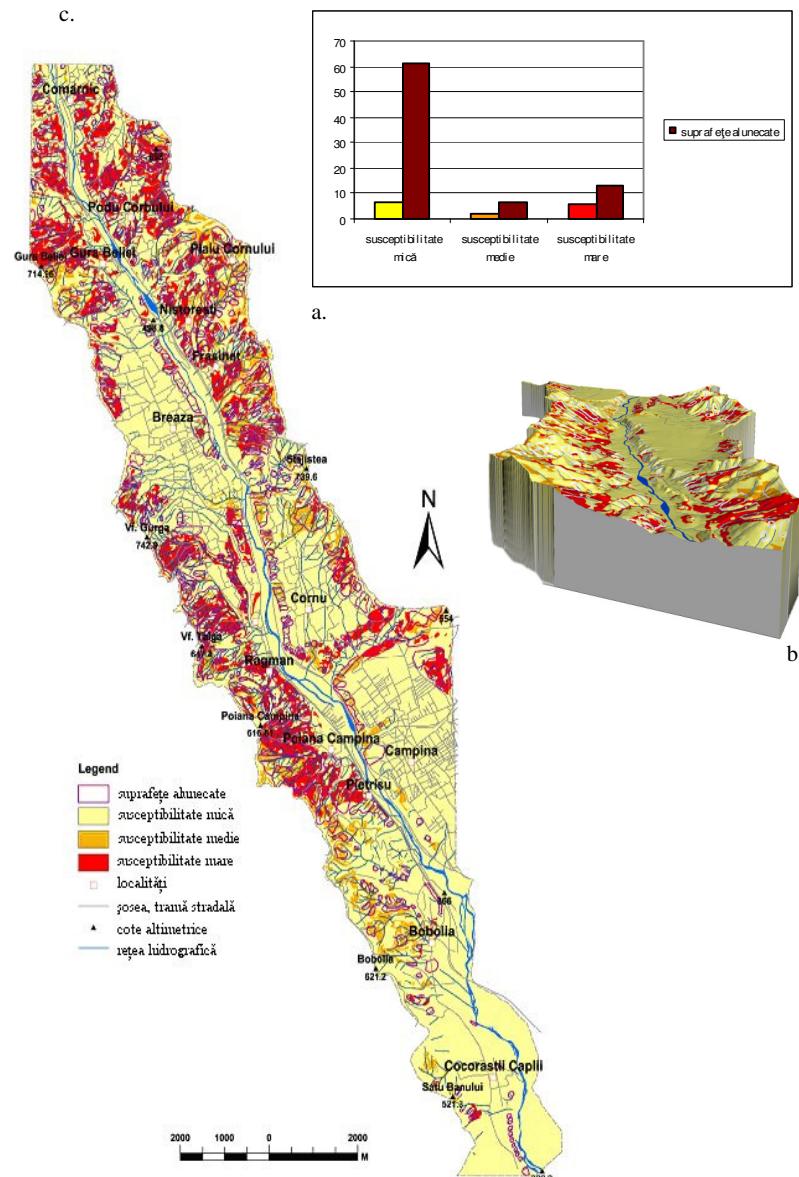


Fig. 3. Susceptibilitatea la alunecări de teren obținută în urma analizei bayesiene: a. Graficul corelării suprafețelor identificate cu susceptibilitate mare cu alunecările existente; b. Perspectivă 3D asupra orașului Breaza pe direcție nord-sud; c. harta susceptibilității la alunecări de teren obținută prin analiză bayesiană

3. Teoria Dempster-Shafer

Ipoteza de bază a teoriei Dempster-Shafer este aceea că incertitudinea există în cadrul informațiilor și a datelor, prin urmare rezultatul și încrederea într-o ipoteză („belief”, ceea ce la analiza bayesiană ar corespunde probabilităților *apriori*) nu este sau nu reprezintă neapărat suport pentru ipoteza opusă (Eastman, 2003). Probabilitățile de bază în analiza Dempster-Shafer distribuie informația rămasă celorlalte ipoteze, spre deosebire de probabilitățile clasice, ce atribuie absența informației ca suport pentru ipoteza complementară (Chung & Fabbri, 1996; Eastman, 2003; Gorsevski, 2005).

Pentru teoria de calcul a probabilităților Dempster-Shafer sunt folosite următoarele concepte: *atribuirea de probabilități de bază, suport total pentru o ipoteză sau încredere deplină pentru o ipoteză (belief), plauzibilitate (verosimilitate), ignoranță*:

- *Atribuirea de probabilități de bază* – care corespund suportului de informație sau evidență pentru una din ipoteze. Aceste probabilități de bază se pot obține fie prin metode empirice, fie prin metode statistice, geostatistice etc. Întotdeauna suma probabilităților de bază este egală cu 1 (Eastman, 2003):

$m(A, B)$ – probabilitățile de bază (pot fi comparate cu cele *apriori* în cazul analizei bayesiene).

- *Suport total pentru o ipoteză sau încredere deplină într-o ipoteză (belief)* – corespunde suportului total (încrederea deplină) într-o ipoteză. Se calculează ca suma probabilităților de bază:

$$SupTot(A) = \sum_{B \subseteq A} m(B) \quad (5)$$

Se consideră și *limita de jos a probabilității* pentru o ipoteză.

- *Plauzibilitate (Verosimilitate)* – este gradul de credibilitate într-o ipoteză A:

$$Plz(A) = \sum_{A \cap B \neq \emptyset} m(B) \quad (6)$$

Este considerată și *limita de sus a probabilității adevărate* pentru o ipoteză.

- *Ignoranță* – este gradul de nesiguranță (incertitudine) pentru o ipoteză, o măsură pentru încrederea totală într-o ipoteză:

$$Plz(A) - SupTot(A) = Ignoranță \quad (7)$$

Formula de calcul:

$$m(C) = \frac{\sum m_1(A) \cdot m_2(B)}{1 - \sum m_1(A) \cdot m_2(B)} \quad \begin{array}{l} \text{unde } (A \cap B) = C \\ \text{unde } (A \cap B) = \emptyset \end{array} \quad (8)$$

(după Chung & Fabbri, 1996; Eastman, 2003).

Dezavantajele și avantajele analizei Dempster-Shafer constau în cuantificarea ignoranței și incertitudinii, se pot combina evidențe pentru ipoteze diferite, se pot exprima diferențe de abstractizare, dar pot apărea probleme de calcul complexe – are curențe în ceea ce privește sistemul suport de decizie. În urma studiului efectuat de Gordon & Shortliffe, 1985, s-a comparat metoda Dempster-Shafer cu alte metode utilizate în medicină. S-a ajuns la concluzii ce au fost confirmate și de studiile pentru evaluarea susceptibilității la alunecări de teren:

- rezultatul este bun atunci când există informații de specialitate foarte bune, chiar dacă nu se folosesc metode foarte clare de calcul;
- rezultatul este slab atunci când există metode sau modele clare de calcul, dar nu există informații de specialitate precise.

Resultate

Analiza comparativă a graficelor ce indică gradul de suprapunere între suprafețele cu susceptibilitate mare și suprafețele cu susceptibilitate mică pun în evidență foarte clar diferențele între analiza bayesiană și analiza Dempster-Shafer. În cazul analizei bayesiene, se constată o subevaluare a zonelor cu susceptibilitate la alunecări de teren, cele mai evidente fiind fruntea de terasă din dreptul localității Breaza, unde, în cea mai mare parte, este identificată ca fiind fără susceptibilitate, fapt contrar realității, în această zonă alunecările de teren provocând pagube materiale și prezintă un risc ridicat pentru căile de acces și clădiri. Analiza Dempster-Shafer, spre deosebire de analiza bayesiană, supraveagă zonele cu susceptibilitate la alunecări de teren, fapt pus în evidență în mod special în zona Bobolia, unde litologia nu este favorabilă alunecărilor de teren. Acest lucru se explică prin ponderea foarte mare a declivității în calculul probabilităților condiționate. Se recomandă utilizarea unor funcții de ierarhizare a contribuției fiecărui factor pentru ambele analize, atât bayesiană, cât și Dempster-Shafer.

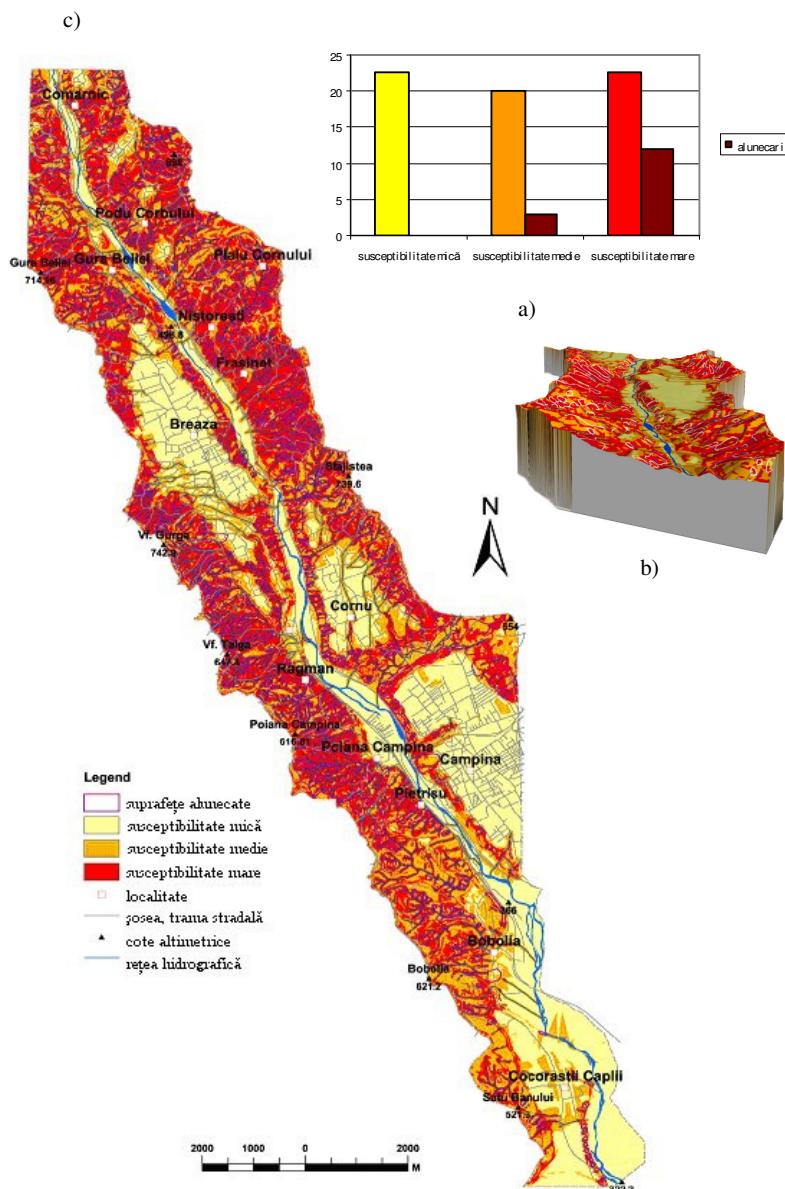


Fig. 4. Susceptibilitatea la alunecări de teren obținută în urma analizei Dempster-Shafer:
a) graficul corelării suprafețelor identificate cu susceptibilitate mare cu alunecările existente;
b) perspectivă 3D asupra orașului Breaza pe direcție nord-sud; c) harta susceptibilității la alunecări de teren rezultată din analiza Dempster-Shafer

4. Concluzii

Utilizarea teoriilor de calcul de probabilități în geomorfologie și în studiile pentru evaluarea susceptibilității versanților la alunecări de teren se dovedesc a fi folositoare. Deficiențele majore indicate și de studiile anterioare (Bonham-Carter, 1988; Lineback, 2001) arată că principalul factor de erori sunt sursele de date și, în mod special, erorile din datele ce servesc drept evidență și sunt folosite la calculul probabilităților *apriori*. O importanță deosebită se impune colectării și îmbunătățirii datelor existente, prin aplicarea de modele de calcul de erori sau de propagare a erorilor menite să micșoreze erorile existente. Concluzia principală care se poate obține din studiul prezentat, precum și din studiile efectuate de specialiști de-a lungul timpului, este încurajatoare pentru utilizarea teoriei probabilităților condiționate pentru studiile de susceptibilitate și chiar vulnerabilitate și risc. Suntem totuși rezervați față de concluzia obținută și considerăm că sunt necesare în continuare numeroase studii care să confirme această concluzie. Credem că nu numai datele au cea mai mare importanță în obținerea de rezultate satisfăcătoare, dar și metoda în sine. Aplicarea analizei bayesiene din punct de vedere strict al teoriei Bayes, anume utilizarea doar a datelor cunoscute, limitează mult reprezentarea spațială a realității. O abordare din prisma condiționalizării bayesine pare a fi mult mai eficientă, deoarece ne lasă posibilitatea introducerii și de cunoștințe „expert knowledge”, cu impact deosebit asupra rezultatului final (Cristakos *et al.*, 2002).

Avansarea în înțelegerea și manipularea erorilor și a influenței lor asupra procesului de decizie va determina, în cadrul sistemelor informaționale geografice și a analizei spațiale și temporale, o migrare a procesului de decizie bazat pe criterii „rudimentare” (în care se apreciază că baza de date și modelele de evaluare sunt perfecte) către procesul de decizie bazat pe criterii avansate. Cunoscându-se incertitudinile din baza de date și incertitudinile în regulile de decizie este posibil ca rezultatele tradiționale bazate pe analizele boolean să treacă spre rezultate probabilistice, adică de la o decizie de DA și NU la o probabilitate, astfel fiind utilizate mai multe niveluri de apreciere.

Migrarea catre luarea de decizii pe bază de criterii avansate a determinat dezvoltarea sistemelor informaționale geografice, prin implementarea de noi structuri a datelor care să poată conține informații despre incertitudine, informații de care se va ține seama în procesul de decizie. De asemenea, a determinat și implementarea de noi proceduri de analiză a diferențelor erori și incertitudini și a modului lor de propagare.

CONDITIONAL PROBABILITIES APPLIED IN GEOMORPHOLOGY

Summary

The use of conditional probability theories Bayes and Dempster-Shafer in spatial analysis is relative new in geosciences (Bonham Carter, 1988, 1989, 1994, Aspinall, 1992, Chung&Fabbri, 1993, Lineback, 2001, Gorsevski, 2003, Șandric în *Vulnerabilitatea versanților la alunecări de teren în sectorul subcarpatic al văii Prahova*, 2003, 2003³, 2004⁴) with increasing potential due to development of GIS and due to development of hardware software technologies (Wadge, 1988; Soeters *et. al.*, 1991, Carrara, 1993; Carrara și Guzzetti, 1995; van Westen, 1993, Bonham-Carter, 1994, Wilson, 2000). The type of GIS data used in spatial analysis has not suffer important modifications, but the quality of the data has improved due to improvment in data collections systems, LBA technologies. Still they are far from an objective reproduction of the spatial and temporal reality. In time a lot of papers were published about new methodology and new models for assessing the probability of a event to occur, but almost all the models have disadvantages. Unfortunately there are not so many papers on the disadvantages of the models. Very often the errors from the spatio-temporal modelling are assumed to be induced by the errors from the data (LineBack, 2001), but we think that the complexity of the events (natural phenomena, etc) have more importance than the data used.

The present study uses the conditional probability theories to assess slope susceptibility to landslides. The theories used and presented in this study are: Bayes and Dempster-Shafer, also named “Weight of Evidence”.

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LAND USE IN ROMANIA UNDER THE TRANSITION TO THE MARKET ECONOMY

DAN BĂLTEANU*, MARIN POPESCU, ANA URŞANU***

The end of 1989 marks the beginning of transition from a centralised economic system to the market economy. In the agriculture and the land use, as a result of decollectivisation, privatisation, and the creation of new private property-related exploitations, the types and forms of ownership changed and, likewise their place and role in the development of agriculture. The main change of transition to the market economy was the expansion of private property at the expense of the state public and private domain. Private property dominates all categories of the country's agricultural area (95.7%) and represents 96.4% of its arable terrain. The land fund in Romania (23,839 thous ha) consists of agricultural lands (arable, pastures, hayfields, vineyards and orchards, forest-covered areas, bodies of water, roads, railways, constructions, agrozootechnical installations, and other unproductive lands).

Keywords: transition, land use, soil quality.

1. Introduction

With the fall of the communist regime in the year 1989, Romania experienced radical changes in all fields of activity. A first branch to be seriously affected by the restructuring process was agriculture, due primarily to a fundamental change of property over the land. What had a particular bearing on agriculture and the land use was transition from state and collective property to private ownership, through the decollectivisation and privatisation of agriculture. The land was divided among a large number of owners (4.7 millions), each acquiring under 2 hectares. As a consequence, Romania lists close to the bottom of the European table in this matter. Moreover, the allocated piece of land is often fragmented into several parcels, depending on terrain configuration, fertility etc.

As a result, an estimate of over 47 million parcels emerged after the implementation of the Land Fund Law (No. 18/1991). So, instead of excessive concentration of the landed property, what came out was excessive crumbling, big exploitations being replaced by small peasant holdings. The fragmentation of landed property and the atomisation of agricultural exploitations will long be a stumbling block on the road to developing a modern, competitive agriculture like that of the developed countries.

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2. Evolution and structure of Romania's land use

2.1. Evolution of land use types. The land use in Romania (23,839 thous ha) consists of agricultural lands (arable, pastures, hayfields, vineyards and orchards), forest-covered areas, bodies of water, roads, railways, constructions, agrozootechnical installations, and other unproductive lands (Land Use Map).

At the end of 2000, there were 14,856.8 thous ha agricultural land (62% of the country's surface), 6,457.3 thous ha of forest land (27%), 857 thous ha occupied by waters and ponds (3.6%) and 1,646 thous ha of other land uses (6.9%) – Fig. 1a. The agricultural surface included arable land (63.2%), vineyards and orchards (3.5%), pastures (23.2%) and hayfields (10.1%) – Fig. 1b. Romania is one Europe's countries with the richest land resources, yet with only 0.6 ha agricultural and 0.41 arable terrain / inhabitant.

Over the 1990-2000 period the land use structure suffered slight changes, arable areas shrank (69.3 thous ha) as did the fruit-tree and vine nurseries (58.8 thous ha), while pastures and natural hayfields extended. Similarly, the area covered with waters and ponds decreased by 35.8 thous ha, other terrains extending by some 165.2 thous ha (Table 1).

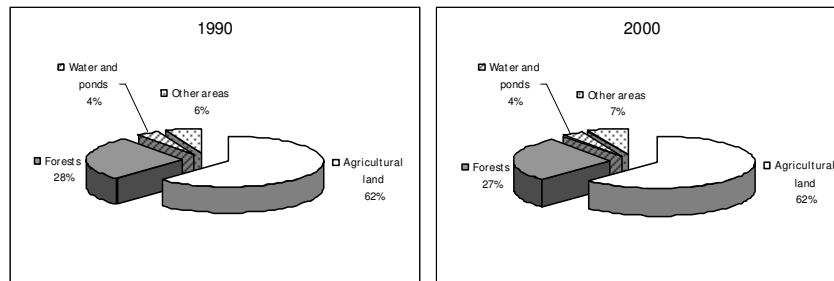


Fig. 1a. The categories of the land fund

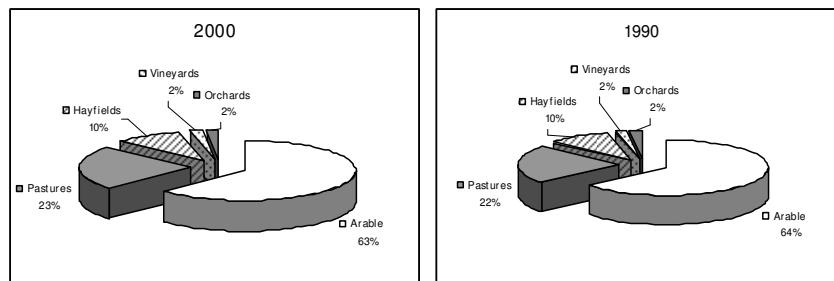


Fig. 1b. The categories of the agricultural land

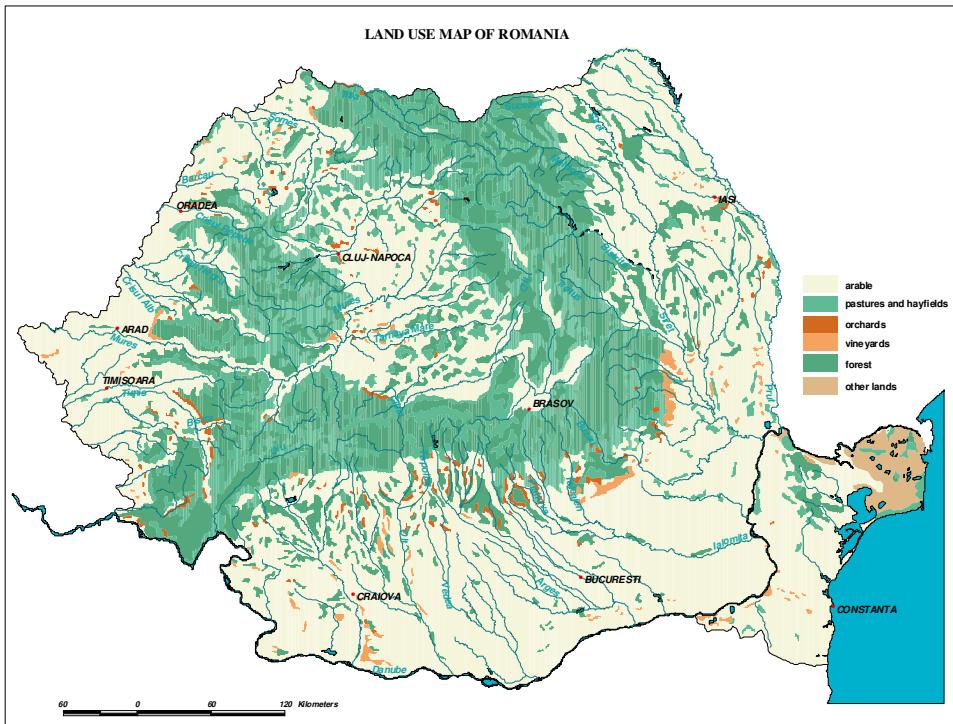


Table 1

Land use structure in Romania, 1990-2000

(thous ha)

Year	Agricultural land	Arable	Pastures	Hayfields	Vineyards	Orchards	Forests	Water and Ponds	Other terrains
1990	14,769.0	9,450.4	3,262.5	1,465.3	277.4	313.4	6,685.4	903.6	1,481.0
1991	14,798.3	9,423.5	3,309.8	1,467.9	285.8	311.3	6,681.8	892.7	1,474.3
1992	14,790.1	9,356.9	3,349.3	1,480.6	298.6	304.8	6,681.8	892.7	1,474.3
1993	14,793.1	9,341.5	3,362.6	1,489.3	303.9	295.8	6,681.0	892.6	1,472.3
1994	14,797.5	9,338.0	3,378.4	1,493.7	298.4	289.0	6,680.1	888.2	1,473.1
1995	14,797.2	9,337.1	3,392.4	1,497.7	292.4	277.6	6,680.1	889.8	1,471.9
1996	14,788.7	9,338.9	3,391.7	1,498.5	289.0	270.6	6,690.2	886.8	1,473.1
1997	14,794.0	9,341.4	3,409.8	1,490.8	286.3	265.7	6,688.5	886.0	1,470.5
1998	14,801.7	9,350.8	3,402.7	1,503.4	281.8	263.0	6,672.3	880.4	1,484.6
1999	14,730.7	9,358.1	3,322.8	1,512.0	281.1	256.7	6,790.5	879.2	1,438.5
2000	14,856.8	9,381.1	3,441.7	1,507.1	272.3	254.6	6,457.3	867.8	1,646.2

Source: Statistical Yearbook of Romania, 1991, 200.

2.2. Distribution of agricultural lands by landforms. The diversity and particularities of soil and climate conditions (with an almost equal spread among mountain, hill and lowland), together with general and regional social and economic characteristics shaped in the course of history, account for the dominance of agricultural lands (over 62%).

Most of them (>80%) are found in the lowlands (Romanian Plain, West Plain and the Central and Southern Dobrogea Plateau), the ratio dropping at 40-65% in hill regions and at under 20% in the mountain zone. The share of the main land use categories (arable, pastures, natural hayfields, vineyards and orchards), depends primarily on altitude. There is less arable terrain in the rough hilly area (40-60%) and in the mountain zone (under 20%) than in the lowlands (plains and certain tablelands-over 80%).

Pastures and natural hayfields occur largely in the mountain zones (60%), falling to under 10% in the plains. Vineyards and orchards grow on certain hillsides and tablelands at 300-700 m alt. (while one-third of the main vineyards and orchards of Romania are found at lower altitudes – 150-300 m, fruit-trees grow sometimes up to 800-1,000 m alt.). The large vine and fruit-tree plantations developing on the sandy soil of the Romanian Plain, or on the higher terraces of the Danube, or of other inland rivers, represent an azonal element.

2.3. Distribution of agricultural lands by capability class. The capability class indicates the extent to which a soil is suitable for a certain crop. Listing soils under one of the five capability classes has in view the economic ratio between the cost of land management and cost-effective agrarian activity.

In terms of non-reclaimed soil capability for various land uses, only 2.8% of the agricultural terrains list in class I, 24.7% in class II, 20.8% in class III, 24.4% in class IV and 27.3% in class V (*Table 2*).

While most arable land falls into the first three classes, pastures, hayfields, vineyards and orchards stay in the last two classes.

2.4. Forest stock. The growing stock in Romania consists of all existing forests, of grounds targeted for afforestation, of those serving for planting, production and administration purposes, as well as the unproductive terrains included in forest managements.

The forest area covers grounds with trees and bushes, which develop their particular environment for biological growth, at the same time representing the directly productive components of the growing stock.

At the end of the year 2000, Romania's forest area numbered 6,223 thous hectares. The specific species individualizing the forests of this country are: resinous (1,856 thous.ha), beech (1,951 thous.ha) and oak (1,120 thous.ha). Other species occupy 1,296 thous. hectares.

When the country had a socialist economy, the state owned the whole forested area. Under the Law No 18/1991, people who were dispossessed could claim back up to 1 ha forested terrain. The Law No 1/2000, stipulating the reappropriation of agricultural and forested lands, provides for the claimant the right to regain the

difference of forest land between 1 ha and the surface he had actually possessed, yet no more than 10 hectares. These laws are just being put into effect. In this way, the private forest stock of 8% in 2000 is to increase at 33% in the year 2004.

*Table 2
Agricultural lands by capability class (December 31, 1998)*

Capability class	Land use							
	Agricultural land		Arable		Pastures and hayfields		Vineyards and orchards	
	thous ha	%	thous ha	%	thous ha	%	thous ha	%
Total area – capability class	14,800	100.0	9,351	100.0	4,906	100.0	543	100.0
I very good	411	2.8	355	3.8	54	1.1	2	0.4
II good	3,656	24.7	3,353	35.9	220	4.5	83	15.3
III middle	3,086	20.8	2,369	25.3	597	12.1	121	22.3
IV poor	3,613	24.4	1,726	18.4	1,750	35.7	137	25.2
V very poor	4,034	27.3	1,549	16.6	2,285	46.6	200	36.8

Source: National Commission for Statistics.

2.5. Protected areas are zones under surveillance, protection and security to ensure the ecological value of the natural space. The 846 protected areas englobe 1,463,250 ha, that is 6.1% of the total forest stock.

Types of protected areas:

- Biosphere reserves are zones intended for the conservation and integrity of the animal and vegetal biotic communities living within their natural ecosystems, the protection of the genetic diversity of species essential for the future evolution. The areas involved include natural biomes, unique communities displaying natural characteristics of particular interest. There are three biosphere reserves in Romania: the Danube Delta, the Retezat and the Rodna massifs, which total 664,446 hectares.

- National parks are natural zones of national and international importance. They are protected against human intervention or settlement. Their fauna and flora have an overriding scientific, educational, recreational or aesthetic value. The exploitation of natural resources in these areas is prohibited. The 9 national parks of Romania, comprising massifs and gorges and covering 216,097,00 ha, are: Măcin Mountains, Semenic-Cheile Carașului, Piatra Craiului, Cozia, Călimani, Ceahlău, Cheile Bicazului, Cheile Nerei-Beușnița, Domogled-Valea Cernei. Retezat and Rodna Mountains are considered national parks, as well.

- Natural parks are protected natural areas benefiting by the protection and conservation of some landscape ensembles in which the man-nature

interaction has created along time a distinct zone of landscape and cultural relevance, often of great biological diversity. There are five natural parks (247,631,00 ha): Brăila Small Island, Grădiștea Muncelului-Cioclovina, Porțile de Fier, Apuseni and Bucegi.

- Scientific reservations are nature protected areas with the aim of maintaining the natural processes for the study of ecological specimens representative for the natural environment. The 53 scientific reservations occupy 101,287 hectares;
- Nature reserves are zones where natural conditions are preserved to allow the protection of significant species at county level, of biotic communities or of the physical characteristics of the environment. There are 543 nature reserves (128,611 ha).
- Monuments of nature (231) represent protected areas that cover 2,177 ha and are preserved for their rare or unique natural elements.

2.6. Tourist, spa and health resorts. Romania's offer represents 65 attested tourist, spa and health resorts, of great geographical, landform and climatic diversity. Resorts are of national or local interest, depending on the road infrastructure, urban utilities, accommodation structures, the quality of the natural environment and reception structures. Some of the resorts of national or international renown are located in the mountain zone – Sinaia and Bușteni (Prahova County), Moineasa (Arad County), Predeal and Timișul de Sus (Brașov County), others in the plain – Snagov (Ilfov County); spas: Băile Herculane, Borsec, Băile Olănești, Călimănești-Căciulata, Techirghiol etc.; the string of Black Sea coastal resorts: Mamaia, Jupiter, Neptun etc. In the year 2000 the population benefited by 298 thous. tickets offered by the Health Security State Agency, of which 239 thous. for spa cure and 59 thous. for rest and recreation.

2.7. Urban land fund. There are 265 towns and 93 municipia (in 2000). Towns' people represent 54.6% of Romania's population. The biggest towns are: Bucharest, the country's capital (2,009,200 inh. on July 1, 2000), Iași, Constanța, Timișoara, Cluj-Napoca, Galați, Craiova, Brașov, Ploiești and Brăila.

The surface-area occupied by towns and municipia covers 10.8% of the country's estate fund; the town area holds 9.3% of the agricultural surface and 8.6% of the arable surface. The urban residential area (towns and municipia) represents 16.5% of Romania's inhabitable surface.

2.8. Quality of land use. The System of Soil Quality Monitoring set up in 1977 as a division of the National Environment Quality System in Romania, was extended in 1992 to forest soils, and harmonised with other European systems. Out of the 944 monitoring points, 675 are located in agricultural zones and 269 in forest areas. From a total of 14.8 mil. ha agricultural surface, some 12 mill ha (of which 7.5 mill ha arable) are affected by quality limiting factors (*Table 3*).

Table 3
Soil quality limiting factors and size of affected area, 1992-2000

Soil quality limiting factors	Affected area		
	1992	2000	
	1000 hectares	1000 hectares	As per cent of total agricultural land
Areas affected by frequent droughts	3,900	7,100	48
Areas with frequent moisture excess	900	3,781	26
Water erosion	4,065	6,300	43
Landslides	700	702	5
Wind erosion	387	378	3
Excessive skeleton from soil surface	300	300	2
Soil salts	600	614	4
Soil compaction due to inadequate cultivation	6,500	6,500	44
Soil natural compaction	2,060	2,060	14
Crust formation	2,300	2,300	16
Small and very small humus deposit	7,114	7,485	50
Strong and moderate acidity	2,350	3,424	23
High alkalinity	165	223	1
Very poor and poor content of mobile phosphorus	4,475	6,330	43
Poor content of nitrogen	3,438	5,110	34
Microelement deficiency (zinc)	1,500	1,500	10
Chemical pollution	900	900	6
Oil and salt water pollution	50	50	0
Pollution from wind-carried substances	147	147	1

Source: National Commission for Statistics.

Some of the factors affecting soil quality to the highest degree are drought and overmoisture, various forms of erosion, low phosphorus and zinc content and chemical pollution. In the 1990 decade, the installations for irrigations (3,067 thous ha), surface draining (216 thous ha) and soil erosion control (2,208 thous ha) that had existed at the beginning of the transition period (1989), started deteriorating, with negative effects on soil quality and the productivity of land. For example, the drought that struck Romania in the year 2000 led to a 40% decrease in the cereal production as against 1991 figures.

Chemical pollution is high in the areas surrounding fertiliser manufacturing plants and sulphuric acid works; major sources of heavy metal pollution (Cu, Pb, Zn, Cd, Cr, Co, Ni) are the steel, cement and aluminium plants, the coal-based thermal-power stations etc.

Each year heavy losses of fertile soil are due to erosion. Nearly 40% of the agricultural terrains are affected by moderate and severe erosion (*Table 4*). Landslides and deep erosion are behind the annual elimination of over 5,000 ha cultivable soil from the farming circuit.

Table 4
Soil erosion intensity of agricultural land

	Soil loss (tonnes/ha/year)	Average soil loss (tonnes/ha/year)	Areas affected, as per cent of total agricultural land
Insignificant erosion	< 1	0.5	57.4
Weak erosion	2-8	5.0	3.0
Moderate erosion	8-16	12.0	19.0
Strong erosion	16-30	23.0	18.0
Excessive erosion	30-45	37.5	2.6

Source: Romania's Environment, CNS, 2000.

Table 5
Erosion by land use

	Soil loss	
	Million tonnes/year	per cent
Total land	126.0	100
Agricultural land of which :	106.6	85
Arable land	28.0	22
Pastures	45.0	36
Vineyards	1.7	1
Orchards	2.1	2
Non productive land (with deep erosion)	29.8	24
Forestland	6.7	5
Subtotal	113.3	90
Erosion on river banks and in human settlements	12.7	10

Source : Romania's Environment, CNS, 2000.

The quality of soils is influenced both by over-and under-fertilization. In Romania, under-fertilisation has reached alarming levels. The topsoil nitrogen balance, which stands for the annual difference between soil nitrogen input and output, indicates the following situations: 1) in 1985-1990, there was an average surplus of 50 kg nitrogen /ha; 2) in 1991-1996 that quantity fell to 12 kg/ha; 3) in 1997-1998 nitrogen deficiency set in. The same with phosphorus and potassium.

Forest quality. Healthy forests depend on the absence of air pollution, insects, diseases, fires, bad weather and other climate aggressions. The level of tree degradation is revealed by the degree of top crown defoliation (*Tabel 6*).

Table 6
Defoliation-affected forest area, 2000

	Forest area (thous ha)	Defoliation class – %				
		unaffected	Low	moderate	severe	dry
Total	6,223	64.8	20.9	12.8	1.1	0.4
– resinous	1,856	71.8	18.4	8.9	0.6	0.3
– broad-leaved	4,367	62.4	21.8	14.1	1.3	0.4

Source: Romania's Environment, CNS, 2001.

As from 1990, a tendency of deforestation and of decline in the rate of forest regeneration capacity is obvious. In 2000, the forest area covered 10,600 ha that is 25% of the average 1985-1989 levels. The regeneration rate dropped from 0.6% before 2000 to less than 0.2% over the 1996-2000 period, a situation bespeaking fastgoing degradation.

2.9. Agricultural land use by forms of property. Before 1989, socialist agriculture comprised two basic sectors: collective farms (64%) and state farms, inclusive of the state-owned public domain (24%). The private sector (12%) existed almost exclusively in the mountain zone.

In the period of transition, as a result of decollectivisation, privatisation, and the creation of new private property-related exploitations, the types and forms of ownership changed and, likewise their place and role in the development of agriculture. The main change of transition to the market economy was the expansion of private property at the expense of the state public and private domain.

Table 7

Agricultural area by land use and property structure, 2000

	Agricultural area (thous ha)		
	Total	Of which: majority private property	%
Total	14,856.8	14,218.2	95.7
Arable	9,381.1	9,050.7	96.4
Pastures	3,441.7	3,197.7	92,9
Hayfields	1,507.1	1,469.1	97,4
Vineyards	281.3	261.5	92,9
Orchards	254.6	239.2	93,9

Source: National Commission for Statistics, 2001.

Private property dominates all categories of the country's agricultural area (95.7%) and 96.4% of its arable terrain (*Table 7*). The reappropriation of some surface-areas (under Law No 1/2000) to physical and juristic persons entitled to it is an ongoing process.

3. Forms of economic organization set up by farmers to cultivate land

The reform in agriculture has generated a new economic social organisational structure of the farming world, featuring individual households, family associations without juristic person status and agricultural companies, juristic persons.

Individual households are the outcome of the Law No 18/1991. They include peasant households, commercial-type family exploitations, and other forms of capitalist exploitation. The majority of households produce for self-consumption, have a low share in the market production and few major investment possibilities. In 2000, there were 4.2 million individual households, each holding an average of 2.36 ha (*Table 8*).

Family associations and agricultural companies emerged under Law No 36/1991. The former are not juristic persons, being formed by agreement between two or more families with a view to exploiting the land, breeding animals, marketing their products, etc. In 2000, there were 6,836 family associations with an average of 95 ha each.

Agricultural companies, juristic persons, are private-type structures with capital put in freely by their members. The number of company members is variable. The purpose is to work the land, grow livestock and invest in farming activity. In 2000, there were 3,724 agricultural companies with an average of 427 ha each.

Apart from these forms of land exploitation, there are trading companies with private equity capital (Law No. 31/1990) engaged in processing and marketing agricultural products; and *agricultural trading companies* (former state farms) with majority state capital, listed for privatisation. Their number and area size change in the process of privatization. Some other lands in exploitation belong to the state public domain (not privatisable), scientific research stations, farms included in the learning network etc.

Table 8

Average size, and structure of agricultural exploitations, 1993-2000

Year	Agricultural companies			Family associations			Individual households		
	Number	Agricultural (thous ha)	Average (ha)	Number	Agricultural (thous ha)	Average (ha)	Number	Agricultural (thous ha)	Average (ha)
1993	4,265	1,910	448	13,772	1,763	128	3,419,736	7,333	2.11
1994	3,970	1,771	446	13,741	1,537	112	3,578,234	7,905	2.21
1995	3,973	1,734	446	15,915	1,517	100	3,597,384	8,053	2.24
1996	3,759	1,752	446	15,107	1,440	95	3,625,758	8,348	2.30
1997	3,913	1,714	438	9,489	1,000	105	3,973,329	8,897	2.24
1998	3,578	1,558	435	7,175	950	132	3,946,121	9,182	2.33
1999	3,573	1,416	396	6,264	869	139	4,119,611	9,377	2.28
2000	3,724	1,592	427	6,836	648	95	4,259,933	10,054	2.36

Source: Ministry of Agriculture, Alimentation and Forests

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CONSIDERATIONS ON POLLUTION CONTROL AND ABATEMENT COSTS IN OIL-DRILLING AND PROCESSING AREAS

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Oil-drilling and refining industry seeks to avoid the release of any substance in such a quantity that it will be harmful to human health or the environment. These releases and their potential impact represent the outcome of decisions taken with regard to environmental management. Several steps have been taken during the last decade to address this concern, predominantly through improved refining processes and environmental control devices and more responsive operating and maintenance procedures. These steps have resulted in fewer contaminants and/or reduced concentrations being discharged, leading to an improved environment. Consequently, in order to identify and adopt the most adequate pollution control and mitigation steps, it is important not only to know the potential polluting processes in oil-drilling and refining areas, as well as the extent of the environmental degradation in such critical areas, but also to anticipate their evolution in the following two decades (by the year 2020). However, the typical steps to reduce the generation and disposal of contaminants and minimize their release to the environment are not satisfactory enough because when choosing for specific guidelines, one must necessarily take into account the costs incurred in obtaining the desired efficiency.

In this respect, *Table 1* synthetically presents the overall image of oil contamination in Romania by referring to the probable evolution of pollution in some environmental areas of primary concern (air, water, groundwater, solid wastes), which is displayed in several scenarios likely to happen. Oil-pollution may, of course, be further detailed, but the prime objective of this study is merely restricted to the presentation of the amount of expenses required for the pollution mitigation strategies and for the ecological recovery of all decaying environmental factors.

Table 1
Main Polluting Processes in Oil-Drilling and Refining Areas

Nr. crt.	Polluted environmental factor	MU	Annual evolution according to different scenarios			
			2000	2005	2010	2020
1.	Contaminated soil: – Scenario A – Scenario B – Scenario C	ha	50 000	50 000	50 000	50 000
		ha	50 000	60 000	40 000	30 000
		ha	50 000	51 000	55 000	57 000
2.	Major pipeline leakage (pipeline length)	km	4 500	4 500	4 500	4 500
3.	Storage tanks in: – Constanța – Bărăgan Oil-filling stations Refineries	m ³	750 000			
		m ³	100 000			
		m ³	120 000			
		m ³	150 000			
4.	Oil-refinery modernization (reduced contaminants discharges): – in air – wastewaters – sludge – underground spills	tons	100			
		m ³ /t	4,2	2,1	2,1	2,1
		th. m ³	900			
		tons	100	110	160	170
5.	Polluted underground water : – in the Ploiești area	ha	8 000	8 000	8 000	8 100
6.	Wastewater (extraction site)	th. m ³	18 700			

For a systematic approach, the further sectoral analysis will point to the actual expenses required by oil-pollution control and mitigation strategies.

1. Losses due to pipeline leakage

Because the major oil pipelines are not adequately capped or blind-flanged, more than 50 000 tons of crude oil are lost every year, along the total 4 500 km-long routing. In order to cut down losses, it is necessary to replace the corroded pipelines; to continuously monitor the loading and unloading flows; to severely control the accidental or operating spills; to rigorously plan the pipeline network (as incurred in the Local Development Strategy of the Ploiești city); to remove abandoned pipelines and to set strict norms of operating duration.

The expenses needed for these immediate contingency actions address to the following aspects:

- doubling the proportion of investment destined for transport and distribution facilities, from 5-7% to 10-15% of the total investment made by transport companies;

- continuous monitoring of oil-discharges along pipelines (on condition that an oil-discharge detection finder costs about 1,000 \$);
- removing and replacing the old pipelines (provided that the replacement of a 1 km-long 4"-thick pipeline costs 27,000 \$; a 5/8"-thick pipeline requires 46,000 \$ and a 12"-thick pipeline totals 100,000 \$).

2. Losses due to storage tanks evaporation

If we take into account that the overall oil-storage capacity in Romania amounts to 3.55 millions m³, we may estimate that the potential losses due to on-site evaporation and entrainment processes exceed 100 thousand tons a year (2000). In order to reduce and avoid such losses from tankage, it is necessary to continuously monitor the underground spills inside refinery area; to use double seals and coatings for all storage tanks (legal regulation that has already been put into force in the EU); to replace all storage tanks after 18 years service and to implement modern control systems (that may thus lead to severe loss reductions, although the costs incurred by introducing computerized control systems are less than 10-20 cents/processed oil-barrel).

The potential expenditures for oil-pollution mitigation plans in on-site installations and facilities represent only 5-7% of the total investments for proper maintenance of refining equipment and, therefore, the replacement of faulty transport and storage facilities asks for increased investment.

3. On-site oil-pollution prevention and mitigation

On-site facilities (storage tanks, refining installations, waste treatment equipment, etc) usually dispose great amounts of contaminants that may adversely affect environmental components. Among them, combustion processes, wastes treatment, sludge disposal, hydrocarbon emissions, wastewater spills, pressure relief systems, pump losses, etc, may largely alter the quality of surrounding air, water or land.

Petroleum refining activities discharge many dangerous effluents (CO, NO, SO, CO, etc). According to PETROM National Society, the atmosphere within the area of the great petrochemical works contains more than 65 tons of SO, 9 tons of NO, 12 tons of suspended particles and 21 tons of lead. This means that release emissions must either be avoided by efficient prevention strategies (*Table 2*), or abated to minimum values (*Table 3*). Both plans of action also envisage to efficiently spend money on the most cost-effective pollution-abatement equipment.

Wastewater treatment seeks to upgrade the quality of effluent water so that it can safely be disposed of or recirculated within the refinery. Refinery

wastewaters typically contain oil, phenols, sulphides, ammonia and/or dissolved and suspended solids which must be removed. The wastewater treatment processes are compulsory in all refineries, for two main reasons:

- To separate sludge through centrifugation processes; in this respect, if a total 18 millions \$ capital investment is made, then 20 millions m³ of sludge might be recovered every year, thus reducing the capital costs to only 0.0002 \$ per kg of residue sludge.

- To recover heavy oil-fractions and oil sediment from other process wastes; in this respect, if a total 10 millions \$ capital investment is made, then 20 millions tons of dangerous effluents may be avoided.

In Romanian refineries, the efficiency of wastewater treatment units is not too great since they produce 42 millions m³ of refuse every year, on condition that the yearly amount of processed crude oil doesn't exceed 4.2 millions tons, meaning that the present operating practices should permit meeting the goals of maximum water reuse and recycle, water conservation and adequate wastewater treatment.

Table 2
Costs of Oil Refinery Effluent Control

Contaminant type	Pollution-abatement technology	Pollution efficiency	Pollution-abatement costs (\$/tons of effluent recovery)
Solid particles	ESP	97-98%	15-65
	High-efficiency ESP	99-99,9%	20-90
	Mechanical recovery	50-90%	10-70
SO	Dry absorbtion	30-80%	400-3 500
	Semi-dry absorbtion	80-95%	600-4 000
	West FGD	96-98%	800-5 000
NO	Burning device	30-70	750-7 000
	SCR	80-90	5 000-45 000
	Thermal remedial procedures		1 300-2 300

Table 3
Refinery Processes of NO Emissions Reduction

Technology	Details
Burning device	<ul style="list-style-type: none"> – The cost of one piece is 5 000 \$ – NO emissions may be reduced by 50-70% – Cost-effectiveness raises to 1 120 \$ per ton of avoided NO
NO fuel-dillution device	<ul style="list-style-type: none"> – The cost of one piece is 4 000 \$ – Cost-effectiveness raises to 527 \$ per ton of avoided NO
Integration system	<ul style="list-style-type: none"> – NO emissions may be reduced by 50-97% – Cost-effectiveness raises to 3 147 \$ per ton of avoided NO
High-performance burning device	<ul style="list-style-type: none"> – The cost of one piece is 20 000 \$ – Cost-effectiveness raises to 610 \$ per ton of avoided NO – NO concentration in volatile gases doesn't exceed 5-12 ppm

Sludge recovery is a complex procedure because it refers not only to refining activities, but also to transportation processes by train-tankers or ship barges or to oil-terminals in ports and storage tanks close to power plants. The overall stocks of sludge that are being deposited in the adjoining area of on-site and off-site facilities in Romania raise to 900,000 m³, meaning that recovery of potentially useful substances is desirable. In this respect, a 5 millions \$ capital investment is needed for sludge concentration and incineration, the resulting recovery costs amounting 0.5 \$ per kg of processed sludge which may be consequently reduced by 3,300 tons a year.

Underground spillage is involved mainly with faulty equipment that results in leakage of fuel oil, greases, gasoline, fuel gas, etc. The actual oil losses in Romanian refineries amount to about 10 tons per each million tons of processed crude oil, depending on the pollution control scenario. But estimates point to possible ample ranges (70-210 tons) by the year 2020 because of inconsistent regulatory requirements and spill prevention technique. In order to minimize contaminant spills, it is necessary to resort to computerized techniques of spill detection, that may thus reduce accidental losses by 3-8% every year and lead to annual savings of 0.5-1.5 millions \$.

Volatile Organic Compounds (VOC) emissions, which might efficiently be reduced by using double-seals on floating roof tanks or variable vapour space tanks which are equipped with expandable vapour reservoirs to limit vapour volume fluctuations due to temperature, barometric and pumping-induced changes, are extremely hazardous since they have a negative effect on the ozone layer and therefore must be avoided by all means. In this respect, the Plock refinery in Poland is a good example to follow since by investing 1 million \$ for sealing operations, 5-10 millions \$ for modern refining equipment, 200 thousand \$ for air-absorbtion installations and 5 millions \$ for tight seals on floating roof tanks, the VOC emissions have been reduced by 770 tons per year, on condition that actual mitigation costs keep well under 1.3-4.0 \$ per kg of processed petroleum.

Process water is the water that has been in intimate contact with process streams, originating from steam stripping, crude oil washing, some chemical oil treatment processes, etc. It contains variable amounts of oil and soluble material such as ammonium sulphide, phenols, thiophenols, organic acid and inorganic salts such as sodium chloride. Salts-containing water, amounting to over 50 millions tons each year, may be reused and recycled up to a maximum proportion of 80%, while oil-contaminated water must necessarily be separated and disposed of. In Romania, these wastewaters have already contaminated 2,264 ha of land out of the total area of 50,000 ha degraded land, meaning that an overall plan for wastewater treating should include strict regulations pertaining to stream use and quality. But these remedial measures

require heavy investment which should be allocated to existing refineries according to the quantitative of raw water available for wastewater treatment facilities.

4. Oil-Drilling and Refining Environmental Concerns

Contaminant discharges vary significantly, both in quantity and type, among oil-wells, terminals or refineries and their effect on the environment will vary according to factors that affect the amount and type of hazardous emissions: crude feedstocks, processes, types of equipment, pollution control measures, maintenance practices, the age and category of installations, etc. The potential environmental damage, referring to air, soil, underground and water pollution, must be avoided by effective mitigation strategies.

Restoration of polluted land may be successfully achieved only after an accurate assessment of pollution has been made. In this respect, it is essential to establish and impose standards of soil quality. Countries like Germany, Canada and Holland have long designed operating guidelines, and ISO has finally completed a set of regulations concerning sample prelevation, methods of chemical analysis, biological assessment, etc, in order to mitigate with industrial hazards. That is why remedial technologies have quickly developed lately, especially because governments required efficient and rapid measures of ecological reconstruction by restrictions on emission technologies, regulatory requirements, pollution fines, containment limits, etc. The large variety of clean-up technologies that is presented in Table 4 shows that any measures to minimize soil contamination depend, in fact, on siting control. The resulting costs of contaminated-soil recovery are impressive and require great financial efforts (*Table 5*), but if they are carefully programmed in long-term investment plans, as in Holland, they may prove highly efficient (*Table 6*). They may also be applied according to strict soil-quality ranking of cost-effectiveness, as in Norway (*Table 7*), but irrespective of goals, modern technology can only warrant for steady and permanent pollution reduction (*Table 8*).

Table 4
Contaminated-Land Restoration Technologies

Operating area	Restoration Technology
On-site/ off-site area	Excavation and storage
On-site area	Isolation by: – physical means: land-filling; vertical walls; waterproof coatings. – hydraulic means: centrifugal separation; hydraulic gradient control.
Off-site area	Discharge reduction by: incineration; vitrification; solidification; contaminant separation; solvent extraction; biological treatment; vacuum extraction; steam stripping; electro-chemical oxygenation; stabilisation.

Table 5

Costs of Oil-Contaminated Soil Recovery

Country	Estimated Recovery Costs
Norway	<ul style="list-style-type: none">• National investment of 1.5-2.3 billion \$ for the recovery of 80 polluted sites.• Site investment of 5.0 millions \$ for complete restoration.
USA	Total investment of 13 billions \$ for operating and maintenance of remedial facilities.
Canada	Total investment of 62.28 millions \$ for the recovery of 9 polluted sites, during 1993-1994.
Holland	<ul style="list-style-type: none">• National investment of: – 1 million \$ for the recovery of 3 sites in 1980 – 2 millions \$ for the recovery of 25 sites in 1983 – 3 millions \$ for the recovery of 210 polluted sites in 1986 – 0.5 billions \$ for remedial procedures on 450 sites in 1993-2000• Site investment of 5 millions \$ to neutralize contaminants.
Poland	<ul style="list-style-type: none">• National investment of 1-2 millions \$ for the restoration of polluted sites.• National investment of 0.7 million \$ for the underground-oil recovery.• National investment of 1.0 million \$ for sludge recovery.
Romania	National investment of 5 000-20 000 \$ for the remedial of each ha of polluted site, on condition that, during 1995-1997, 100 ha were completely restored.

Table 6
Total Oil-Contaminated Area and Actual Remedial Costs in Holland

Year of report	Number of suspected sites	Number of contaminated sites	Remedial Costs	Number of restored sites
1980	4 000	350	1	3
1983	4 300	1 000	2	25
1986	8 000	1 600	3	250
1990	60 000	110 000	50	1 000

Table 7
Cost-Effectiveness of Oil-Pollution Mitigation Ranking in Norway

First-order ranking	Second-order ranking	Third-order ranking
Contaminants evacuation	Remedial for land reuse	Complete restoration
Remedial measures to avoid underground pollution	Land restoration for agricultural use	Remedial restoration to initial quality
Total expenses: 1,5-2,3 billions \$	0,3-0,5 billions \$	0,1-0,15 billions \$
Site expenses: 5 billions \$	1 million \$ per site	350 000 \$ per site

Table 8
Conventional and Innovative Technologies of Oil-Polluted Sites in USA

Type of technology	Conventional technologies (58%)	Innovative technologies (42%)
Ground stabilisation	26	
On-site incineration	17	
Off-site incineration	13	
Other procedures	2	
Dechlorination		17
Off-site bio-remedial procedures		5
Thermal absorption		5
Land wash		4
On-site bio-remedial procedures		4
On-site washing		3
Solvent extraction		1
Other procedures		3

In Romania, the priorities concerning land restoration reffer to: the completion of a national inventory pertaining to pollution hazards and the continuous monitoring of oil-losses from tanks or pipelines; the development of specific research activities; the stimulation of private entreprise for remedial commitment by using clean technologies and cost-effective depolluting

strategies; the safe exploitation of processing equipment; the immediate ecological reconstruction of oil-drilling and processing areas (refinery sites, oil-wells, access roads, etc) in order to further reduce the areas of oil-contaminated land so that, by the year 2020, the improper land areas should be reduced to minimum.

Underground pollution occurs whenever liquid petroleum products from storage and transport facilities escape under the surface of the earth from above-ground spills, creating immediate danger to life and property, so that special attention must be given to this main issue of concern, especially if we take into account the fact that clearance operations might take years on end. Global preventive actions are designed to minimize the effect of any undesirable event which might result in pollution and these actions restrict the effects of pollution to a limited and controlled area, but for any preventive measure, the method adopted must be properly engineered. In this respect, it is important to: accurately assess the reserves of underground water; to control the above-ground spills; to isolate contaminated underground table; to protect human health by providing safe water; to establish strict responsibilities concerning pollution abatement operations; to choose the most suitable depolluting technology and to identify financing sources and to continuously monitor the quality of underground water after recovery actions. Some countries have done great financial efforts in order to decontaminate oil-polluted underground water. For instance, Norway has invested 1.5-2.3 millions \$ for underground recovery and 0.3-0.5 billions \$ for water quality remedial; the USA has recently (2001) allocated 23 billions \$ for the complete restoration of oil-contaminated sites (including underground water); the European Union has provided substantial financial assistance (200 millions \$) to all East-European countries in order to help them cope with the huge site-restoration costs, while West-European countries have raised reconstruction investment in oil-contaminated areas from 1.0 billions \$ in 1990 to 2.3 billions \$ in 1995, maintaining annual increase rates of 16.1% in 1996 as compared to only 8% in 1990. In Romania, great efforts are being done to identify financial sources for immediate ecological reconstruction, but regulatory requirements are not always operational and funding is scarce, so that the environment recovery process is slow and inefficient.

Ecological reconstruction is a complex and long-lasting process and, therefore, requires special concern. But for efficient action, important funding is needed. To meet the actual necessities, the European Union recommends to all East-European countries to increase the environment investment to 20% of total privatisation funds, so that environment restoration of contaminated areas should be compulsory for all newly-privatised companies and regulations should enforce their obligation to have solid banking securities in order to fully cover the depolluting costs. An important achievement in decontaminating strategies is the creation of SUPERFUND environment fund in USA, in 1980, mainly consisting of petrol-processing taxes and seeking to provide financial assistance and support for serious environmental damage. The ecological works of restoration are conducted by the US Environmental Protection agency (EPA) and by the end of

the '80s, the SUPERFUND revenues amounted to 8.5 billions \$, further supplemented by another 7.1 billions \$ in 1991. Under the circumstances, it is obvious, therefore, that environment preservation and restoration is not a theoretical domain to comply with, but a serious must requiring proportionate funding.

5. Conclusions

Environmental pollution with petroleum products is a hazardous phenomenon requiring the special attention of ecologists, policy-makers, development-planners, local and central authorities, population, etc, since its long-term effects may be ravaging on plants, animals, land, water, air. The environmental danger is greater as the time-resistance of some oil-fractions is higher. That is why, modern, cost-effective and efficient clean-up technologies must be developed, coherent policies of sustainable development must be produced, research activities must be intensified, supportive funding must be provided and release reductions must be enforced to abate pollution.

In order to achieve this goal at a large scale, oil-drilling and processing industries should:

- Minutely assess the existing polluted sites into extensive inventories referring to concentrations, contaminant types, extent of release, etc.
- Elaborate specific decontamination programmes for each site.
- Establish present and future responsibilities concerning pollution events.
- Identify financial sources for ecological remedial and restoration.
- Select the most appropriate depolluting technologies and strategies.
- Further investigate the potential environmental damage in order to minimize the effects.
- Continuously reduce pollutant emissions to mitigate with harmful effects.
- Enforce strict regulations concerning hazardous wastes.
- Stimulate restoration work by using clean technologies.

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DOMESTIC MIGRATION AND PROBLEMS OF RURAL POST-SOCIALIST ROMANIA STUDIED BY THE USE OF STATISTICS AND THROUGH THE EYES OF EXPERTS OF THE NATIONAL, REGIONAL AND LOCAL LEVEL

WILFRIED HELLER

1. Significance of the subject

Numerous migrations crossing international boundaries belong to the most conspicuous consequences of the political system change in the territory of the former Eastern bloc. In a shortened manner these migrations often are called East-West-Migration. On the one side these migrations accompanied the political and socio-economic system change or even accelerated this change, if you remember the mass flight of citizens of the former German Democratic Republic into the West-German embassy in Prague or from Hungary via Austria to West Germany in 1989, on the other side the migrations followed the radical political change, after the governments had opened the boundaries to citizens willing to emigrate. In Romania, too, after the fall of the Ceaușescu regime the number of emigrations increased rapidly, that is from about 40.000 in 1989 to about 100.000 in 1990. But most emigrants of Romania, that is about two third, have been ethnic Germans. After 1990 the number of emigrations decreased very fast, firstly, because most of the ethnic Germans of Romania had emigrated already, secondly, because the immigration into the western countries has been made more difficult by the governments of these countries. So, the present number of emigrations from Romania is similar to the number of emigrations before the system change.

Much more numerous and sustainable than the emigrations from Romania are the migrations inside of the country, these are the domestic migrations. Since some years the scientists and the general public pay increasing attention to the domestic migration, mainly in the context of rural development.

2. How the scientific literature deals with migration and rural Romania

Migration. There is a lot of studies about domestic migration of Romania. The studies deal with the migration processes on different spatial

levels, that is on the national level (Teodorescu, 1996; Rotariu/Polenda, 1997; Ianoş, 1998 and Lăzăroiu, 1998) as well on the regional level and on the local level (Hirschhausen von, 1998). Mostly, the studies on domestic migration start from studies on other issues, as for example from studies on the ageing of the rural population (Rotariu/Polenda, 1997), on the effects of the economic and regional politics, on the domestic migrations (Lăzăroiu, 1998) or on rural development in the context of reprivatization of agricultural land (Ianoş, 1994, a and b). Primarily, the scientific literature deals with following issues:

1. Rural Romania – and especially the weakly structured parts of rural Romania (weakly structured in terms of economy and infrastructure) – continues to be an out-migration area, and urban Romania continues to be an immigration area, because the cities are better equipped with regard to places of work and to infrastructure, and because the restrictions of immigration, that had existed in socialist time, have been dropped. However, the out-migrations from rural Romania decrease more and more and the out-migrations from urban Romania increase more and more.

2. But, rural Romania represents a potential immigration area for certain groups of population. These are persons who want to work again their land that they had lost in socialist time. In 1992, about 39 % of the owners of agricultural land lived in cities and towns. These were nearly 2 millions of persons. So, you could assume, that the return potential from urban to rural Romania must be big, even if a large part of the owners would stay in the cities. The following reasons could be incentives to a return migration:

a) In rural Romania the opportunities of private agriculture to offer self-sufficiency and to acquire income as well as the cheap dwelling attract immigrants. The increase of importance of agriculture can be demonstrated by statistics, because the percentage of the agricultural labour force increased from about 28 % in 1990 up to nearly 35 % in 1996 (*Table 1*).

b) In urban Romania pushing-off factors are the reduction of the number of places of work as a consequence of the industrial restructuring and – but the following factor is less important – the increase of prices of the housing market with regard to both private owned and rented apartments. Above all jobless and retired people have been mentioned as concerned groups. Indeed, industry dismissed many labour forces. The significance of industry for the country's situation of occupation changed from 1990 up to 1996 in a double sense (*Table 1*). Firstly, the percentage of the labour forces of industry decreased so much, that in 1996 the share is below 30 %. Secondly, the number of industrial labour forces has been reduced with nearly 1.3 million. That is a reduction which is much stronger in relative respect than the decrease of all labour forces. The decrease of the number of industrial labour forces was not compensated by a corresponding increase of occupation in other sectors of economy, because the number of the labour forces of the tertiary economic sector decreased, too. There

are growing branches in the tertiary sector, above all trade, financial, banking and insurance activities as well as public administration and defence and compulsory social assistance. But on the other side are still more dwindling branches.

Table 1
Romania: Employment by activities of national economy in 1990 and in 1996

Activity	1990		1996		Change of the absolute figures 1990-1996 (in %)
	Number (in 1.000)	%	Number (in 1.000)	%	
Agriculture	3.055	28,2	3.249	34,6	+ 6,4
Sylviculture, forestry, hunting	89	0,8	71	0,8	- 20,2
Industry	4.005	36,9	2.741	29,2	- 31,6
Construction	706	6,5	475	5,1	- 32,7
Trade	538	5,0	772	8,2	+ 43,5
Hotels and restaurants	186	1,7	116	1,2	- 37,5
Transport	667	6,2	448	4,8	- 32,8
Post and telecommunications	97	0,9	99	1,1	+ 2,1
Financial, banking and insurance activities	39	0,4	71	0,8	+ 82,1
Real estate and other services	388	3,6	257	2,7	- 33,8
Public administration and defence; Compulsory social assistance	88	0,8	125	1,3	+ 42,0
Education	411	3,8	441	4,7	+ 7,3
Health and social assistance	320	2,9	337	3,6	+ 5,3
Other activities of the national economy	251	2,3	177	1,9	- 29,5
Total:	10.840	100,0	9.379	100,0	- 13,5

Source: Comisia Națională pentru Statistică „Anuarul statistic”, 1996/p. 141, 1997/p. 125.

These observations could suggest the thesis of a re-ruralization of Romania, especially because the migration statistics of the neighbour countries Bulgaria and Hungary also report about increasing urban-rural migrations (Geschev/Kaltschev, 1997 and Csefalvay, 1997).

Rural Romania. Studies on rural Romania take into account spatially differently running developments, because they differentiate between rural and urban regions. Lately, a quite lot of studies on rural Romania of transformation phase were published by the agricultural sciences, geography and sociology. The main intention of these studies is to depict the problematic situation of rural

Romania at the end of the Ceaușescu era, the re-privatization of agriculture and the present trends and perspectives of rural development.

The studies on the present trends and perspectives of development in rural Romania focus essentially to three subjects: 1. to the ageing of the rural population; 2. to the relatively low education level of the rural population and 3. to the problems of finances, organization and production of agriculture. However, there is also pointed to the fact, that the development of agriculture is only one part of rural development. It is to complete by an extension and a strengthening of infrastructure, handicraft, small industry and tourism (including agrotourism). *Table 2* shall give an impression of the ageing and the relatively low education level of the rural population. The comparisons with the urban population show firstly the much stronger ageing (the statistical data concern the years of 1948, 1966 and 1992; these are census years) and secondly the significantly lower education level (1992) of rural population.

**Table 2
Urban and rural population with the age of 12 years and older
by the levels of education in Romania 1992**

Population with	Level of education	
	urban population %	rural population %
without finished education	1,5	7,4
primary school	15,4	33,1
secondary school and high-school	74,0	58,0
higher education	8,7	1,1
no information	0,4	0,4
Total	100,0	100,0

Source: Comisia Națională pentru Statistică „Recensământul Populației și Locuințelor din 7 Ianuarie 1992”, vol. I, București, 1994, pp. 770.

3. Domestic migration, presented by means of official statistics

The above mentioned problems of rural Romania studied by the literature, already indicate that the thesis of re-ruralization is to analyse, even if the absolute and relative increase of the number of agriculture labour forces speaks for this thesis. But the features of rural Romania are generally not characteristic for an attractive destination region of migrants. Therefore, the domestic migration is to analyse by means of statistics. The data published by the Romania's official statistical service are suitable to assess the thesis.

Urban-rural migration. Already an analysis of the migration statistics available for the national level shows, that you cannot speak about a general urban-rural migration. At least, this migration had to be regionally differentiated, because a re-agrarisation must not be coherent with a change of the place of residence (here, the meaning of re-agrarisation is the increase of the number and of the share of agricultural labour forces). Urban dwellers can commute to the countryside in order to cultivate the land they got by the process of re-privatization. The number of the persons concerned because of their land property rights is very high – as we saw, already (namely nearly two millions in 1992). There is a large labour commuting from the cities and the towns to villages with the target to cultivate the own land.

Indeed, the statistics show that you cannot speak about a large urban-rural migration with the meaning of changes of the places of residence, because since 1991 the migration flows between urban and rural areas equalize more and more. The migration effectiveness decreases drastically both in urban and in rural Romania. You can explain this in following manner: the urban economy is desolate, and the rural life does not offer a real alternative.

Concerning the issue „migration effectiveness“ we would like to notify that this statistical term takes into consideration both the volume of the migration flows (here: in urban respectively in rural Romania) and the balance of immigrations and out-migrations. So, this statistical term is suitable to measure migration quantity and quality. The more positive this term is, the more attractive the concerned administrative region (here: urban respectively rural Romania) is for migrants. In addition, the following informations depict the quantitative relations of urban-rural migrations to rural-urban migrations. With respect to that three points are interesting: 1. Recently, in rural Romania the number of out-migrations is nearly not larger than the number of immigrations. 2. In urban Romania the number of immigrations is nearly not larger than the number of out-migrations. 3. But that does not mean that there are no more migration flows between urban and rural Romania. It does only mean that the numbers of immigrations and out-migrations have become more alike. But in rural Romania there are still some more out-migrations than immigrations, and in urban Romania some more immigrations than out-migrations are registered.

In order to prevent a misunderstanding: The numbers of out-migrations from rural Romania not only concern the out-migrations to the urban Romania, but also out-migrations to other localities of rural Romania. Inversely, the number of immigrations in urban Romania contains not only immigrations from rural Romania, but from other cities and towns, too. So, the statistics of domestic migration with changes of the place of residence contains the numbers of four different migration flows: 1. rural-urban migration; 2. migration inside of rural Romania; 3. urban-rural migration and 4. migration between different urban localities.

Up to 1994 in Romania rural-urban migration is the largest migration flow among these four migration flows, and the migration flow of the inverse direction is

the smallest. Both the other flows are similar. Since 1991 the numbers of the four flows have become more alike. That means, that rural-urban migration decreases, and the other three flows increase. In 1995 and in 1996 most of the changes of the places of residence are migrations which take place between different urban localities.

Migration between Romania's different administrative regions – counties („județe“). If we differentiate the migration flows on the level of the counties, you see conspicuous regional differences. The recent domestic migration flows intensify the traditional regional disparities, because effective migration gains concern above all the following regions: Bucharest – capital and surroundings, the Banatian counties Timiș and Arad, the Transylvanian counties Sibiu, Mureș, Brașov and Cluj, the counties Brăila, Gorj and Hunedoara characterized by heavy industry, and Constanța County because of the sea part economy (including the free trade zone). A new feature of the spatial structure is the fact, that the western boundary Timiș and Arad counties are significantly more concerned by migration gains than the others. Here, the closer proximity to the economy of the western neighbour countries and of the central and western European countries has attractive effects on economy and on migration.

Also recently some counties, where cities with immense economic transformation problems are situated, have positive trends. So, in 1996 Brașov County belongs already again to the ten most attractive counties of Romania despite massive processes of de-industrialization and mass dismissals of labour forces from 1992 through 1994 as well as of short term out-migration tendencies up to 1995. But, in this county relatively large occupational potentials traditionally exist also without to take into account the large state industry which nearly collapsed. It can be suggested that for the future the Brașov County will continue to have an increase of attractivity. The spatial pattern is largely similar to the spatial pattern of migration effectiveness of the total county level.

Often the literature of population sciences uses migration rates in order to show regional differences (see for example Bahr, 1992, pp. 302). The statistical term „migration rate“ means the difference or balance between the number of immigrations and the number of out-migrations related to the number of inhabitants (as a rule: to 1,000 inhabitants). So, in contrast with the term „migration effectiveness“ the term „migration rate“ takes into consideration the inhabitants, too. Therefore, migration rate figures point to the significance of migration for the inhabitants.

The figures of *Table 3* let see that about half of Romania's population (49,7 %) lives in counties of positive migration rates. The rule is following: the larger the share of urban population, the more immigrations concern the county.

The natural population growth cannot any longer compensate the decrease of the number of population as consequence of the out-migrations within most

of the regions of negative migration balance. Like in all former socialist countries, in Romania, too, the natural population growth has slowed down.

Table 3
Romania 1996: Rates of out-migration and of in-migration by counties

Out-migrations and in-migrations for 1,000 inhabitants	Counties (with Bucharest municipality)		
	Number	Population Number %	
Rates of out-migration			
– 3,0 and more	1	462.703	2,0
– 2,0 to – 2,9	2	862.386	3,8
– 1,0 to – 1,9	10	4.989.297	22,1
0 to – 0,9	9	5.043.165	22,3
Rates of in-migration			
More than 0 to 0,9	12	7.219.108	31,9
1,0 to 1,9	4	1.836.007	8,1
2,0 to 2,9	1	747.122	3,3
3,0 and more	3	1.447.832	6,4
Total:	42	22.607.620	99,9

Source: calculated with Comisia Națională pentru Statistică „Schimbări de domiciliu în anul 1996”.

The natural population growth rate is in rural Romania lower than in urban Romania. That is true both for the time before system change and for recent time (*Table 4*). However, whereas before system change positive rates characterized the demographic development, after system change the population growth decreased even dramatically, and above all in the rural areas. There is following rule in the most cases concerning the demographic development on the county level: the smaller the share of urban population in the county, the smaller is the natural population growth in the rural area of the county. The reason for that is following: even less urbanized counties are concerned by out-migration and ageing of the remaining population. These counties have a special risk of out-migration, because they are relatively bad equipped with non-agricultural places of work and with services.

4. Migration processes in Romania through the eyes of experts of the national, regional and local level

Methodological procedure. In the following, the perceptions of Romanian experts of the migration processes in post-socialist Romania shall be

presented and interpreted. The reason for this procedure is following one: It is not sufficient, to carry out studies only with statistics and other records of objectivizable features ascertained in field researches. There is no doubt about it that you cannot do without this perspective within a scientific study. But further field researches have to take into consideration the perceptions of representatives and of persons affected by the socio-economic transformation of the rural area. This is important, because you cannot register the diverse facts of transformation if you look at it only from one single perspective, for example from the perspective of an observer who concentrates only on facts which you can show with quantitative terms.

Table 4
**Natural population growth in Romania 1989-1996 (according to counties
and to urban and rural areas)**

Counties whose share of urban population is %	Natural population growth rate (for 1,000 inhabitants)			
	1989		1996	
60.0 and More	3.5	3.1	- 2.3	- 4.4
50.0 - 59.9	6.0	2.9	- 0.3	- 3.9
40.0 - 49.9	8.3	4.9	1.2	- 5.3
Below 40.0	10.7	3.8	1.3	- 4.9
Total:	6.6	3.9	- 0.7	- 4.5

Source: calculated with data of Comisia Națională Pentru Statistică „Anuarul Statistic al României 1990 și 1997”.

We start explicitly from the assumption, that reality is perceived in a different manner by actors of transformation and other persons affected by transformation. The differences depend on the different occupations, social positions and interests of people. Therefore the transformation results in different pictures which are produced in the minds of people. For example, a leading officer of the ministry of agriculture looks at another picture than the president of a regional chamber of commerce and industry, and his picture is different from the picture of the mayor of a small, peripheral village. Therefore, here shall be depicted with interviews of institutions and other actors of different spatial levels, in which manner the transformation can be experienced and assessed. The spatial levels are the following ones: 1. the national level (this level is constituted by institutions and other actors of the national capital Bucharest), 2. the regional level (this level is constituted by the capitals of the different counties), and 3. the local level (this level is constituted by the rural communes and villages).

The knowledge about the different perceptions is interesting, because actors not only perceive but also act, what is expressed by the term „actor“. It can be assumed, that actors do act because of their perceptions, too. You can derive suggestions about their actions from their perceptions. Therefore, it makes sense to study, what subjects are mentioned and discussed by the different actors respectively are not mentioned, and in which manner the subjects are discussed.

The total number of interviews amounts to 92. 10 interviews have been carried out on the national level, 47 on the regional level and 35 on the local level. We made this research in cooperation with the chair of sociology of Babeş-Bolyai University (Cluj-Napoca). With regard to the selection of the studied rural communes – this is the local level – it was attempted to catch a range of different situations as wide as possible. The selected settlements differ from another by criteria of which it is assumed, that they influence the spatial differentiation of the transformation. It is supposed that the following criteria have this quality: a) the size of the commune according to the number of inhabitants; b) the distance to the next large city; c) the natural environment in terms of more or less favourable conditions for agriculture; d) the forms of agricultural enterprises which existed in the socialist era (these are state, collective and private enterprises), and e) the affiliation to the so-called historical regions of the country, these are the regions of the old empire (Valachia and Moldova) and the regions which belonged to the Austrian-Hungarian monarchy; this criterion means the affiliation to regions which show different levels of socio-cultural and economic development.

In the ten selected research settlements live between about 500 inhabitants (Vultureni in Cluj County) and about 7,000 inhabitants (Sândominic in Harghita County) in 1992. The settlements are situated between 15 km and 90 km away from the county town (that is Soleşti in Vaslui County respectively Ieud in Maramureş County). They lie in areas well equipped by natural conditions (above all Cobadin and Recaş in the black soil regions of Dobruja respectively of Banat) as well as in areas unfavourable for agriculture (especially Şirnea which is located 1,200 m high in the Southern Carpathians or Soleşti which is situated in a dry hill area damaged by erosion). And the settlements belong to regions which are at an advantage (mainly Gilău near Cluj-Napoca in Transylvania or Recaş near Timişoara in Banat), and the settlements belong to regions which are historically rather at a disadvantage (as for example Soleşti in Moldova or Rociu in Muntenia).

The selection of the counties research was made according to the research settlements. By doing so, one may get very different socio-economic situations of the rural area. By this way one may win: 1. spatially differentiated answers to the questions concerning the forms of socio-economic transformation and the perspectives of development in the rural area; 2. a higher degree of the generalization potential of the research results than by applying a more or less arbitrary selection.

So, the following presentation is based on information given by the interviewed persons to the following questions:

1. What are the advantages and disadvantages of the transformation after the system change compared with the time before?
2. What are the most important problems and hindrances for the future development of rural Romania?
3. What policies, concrete measures and perspectives of development of rural Romania do exist?

The answers can be arranged by following issues: 1. political and juridical issues (with regard to democratization, privatization, laws); 2. labour market and situation of occupation; 3. standard of living and income; 4. agriculture; 5. non-agricultural economy; 6. infrastructure and services; 7. migration; 8. demographic and social issues; 9. house building, environmental planning and regional development; 10. ecological problems. For the purpose of this presentation, which is part of a greater research project, we select only migration.

The national level. The interviewed representatives of the national level do not notice intensively the question for the advantages and disadvantages of the transformation after the radical political change compared with the time before. They mention only disadvantages, these are the following ones: 1. The commuting between city and countryside would be restricted immensely because of the reduction of the local public transport system. 2. Owing to the freedom of mobility, which would exist since the system change, there would exist a great desire to emigrate. Especially more qualified people, as for example students, would look for and would use the opportunity to emigrate on the occasion of stays in foreign countries.

Now, concerning the question for the most important problems and constraints for future development: The representatives of the national level take not much notice of this question, too. They point only to the rural-urban migration, which is, however, not only a problem of post-socialist Romania, but takes place vehemently since the '60s, already – as we know.

This out-migration would be a bleeding for rural Romania. In addition, this problem would be aggravated by the fact, that the out-migration would be selective. That is, that younger and better educated persons would emigrate over-proportionally and by that would cause the ageing of the rural population.

The representatives of the national level do not mention policies, concrete measures and perspectives for the future development of rural Romania directly connected with the issue of migration. However, they propose policies and measures in the course of the discussions about other subjects, these are the agriculture, the infrastructure and services as well as environmental planning and regional development. In the end, these proposed policies and measures should be right to improve the rural socio-economic situation in order to brake the dangerous out-migration.

The regional level. Whereas the representatives of the national level assess the migration processes only negatively, the statements of the interviewees

of the regional level are ambivalent. On the one side the interviewees complain about the urban-rural migration, because it is caused by the loss of places of work. Also the temptations of foreign countries would be damaging to Romania, because they would stimulate a brain drain from Romania. On the other side the interviewees see positive effects of a temporary labour migration to foreign countries, because the re-migrants would return with some capital. This fact would be positive, too, even if the re-migrants would not invest the savings in the production sector of economy, but would only spend the savings for renovation or construction of houses or for consumption articles.

However, the labour migration inside of Romania would have decreased considerably, because the big employers, as above all the large collective farms of the fertile plains of the country or the large state building contractors, would not exist any longer, and because the private succession enterprises would need not so many temporary labour forces.

Like the interviewees of the national level, the interviewees of the regional level do not mention migration among the problems of future development, apart from their remarks, that they would feel a strong desire to emigrate among young and well educated Romanians because of Romania's huge socio-economic development problems.

Because of the fact, that the interviewees do not discuss intensively migration as a problem you cannot expect that they make many remarks about ways of solution. Only some institutions point to measures which firstly shall stop or at least brake the out-migrations from rural Romania, secondly shall stimulate the emigrants to return, and thirdly shall give incentives for immigrations. In this context they discuss the following measures: 1. The system of central places ought to be improved in order to secure the supply of all rural communes. By this measure supply gaps as reasons for out-migration should be minimized. 2. A special support of small and medium size enterprises should create places of work. The offer of places of work should effectuate return migrations from the cities. 3. The opening of cheap plots of land for building in the villages should stimulate return migrations and immigrations.

Here, as an example of the first measure are to mention some ideas of environmental planning of the county council of Harghita with respect to the structuring of the county territory due to a central place hierarchy system. Harghita represents a county especially severely concerned by out-migrations. Due to the ideas of the county council the central place system should be so well improved that all central places would be within easy reach of all rural communes. By that the supply of the rural population should be made easier. This target should be achieved by special transfers of money from the central state budget to central places which are situated along important transport axes. These transport axes should function as development axes for the county territory.

As an example of the third measure (that is the opening of land for building) shall be regarded the village Cobadin in Constanța County: Cobadin would belong to the third category of settlements due to the development plan of the county of December 1995, namely to those settlements characterized by population decrease. Therefore, the ministry of agriculture would have given land to this commune in April 1996. It would be land bordering to the building area of the settlement. Now this new land would be part of the land where houses could be constructed. The new building land would contain 68 parcels of each 825 up to 1,000 square meter. One square meter would be rented out to a nearly only symbolic amount of 6 Lei in 1996. The rights to rent would be auctioned on the basis of the law 50/1991. An opening of further building would be intended. About half of the parcels would have been auctioned in June 1996, already. But, there would exist some other settlements of the county, where there would be so small demand for building land, that the communes give the right to rent without to pay for the auction. The state would bear the costs to open the building land.

The local level. Whereas migration processes are evaluated only negatively by the representatives of the national level and ambivalently by the representatives of the regional level the interviewees of the local level describe the migration processes after system change less negatively, even nearly in a neutral manner, and they mention even some advantages, too.

They describe the changes of labour force commuting as follows: many inhabitants of the villages lost their places of work in the cities because of the restructuring of urban economy. So, the rural-urban labour force commuting decreased. But in some rural communes the share of commuters is still high. For example in the study commune Vultureni (Cluj County) the share of commuters amounts to 28.5 % of all labour forces in 1996.

The interviewees depict two other issues as follows: 1. As a consequence of the re-privatization of land the connections between the villages and the former inhabitants have become closer, because many of the former inhabitants have become weekend commuters. On weekend they cultivate their land in the villages. For example, in the above mentioned rural commune Vultureni the number of private households increases by about one third. Many of these weekend migrants buy or build houses in the village, if they cannot stay at relatives. But only few people change their place of residence from city to village. If people do so, then they are mostly retired people. 2. The travel freedom is an advantage of the time after the political change. Therefore, for example, members of the folklore clubs and of other clubs travelled already several times into western foreign countries and made performances there, as for example the folklore club of Ieud (Maramureș) in Switzerland.

Policies, concrete measures and perspectives of regional development are not mentioned by the interviewees of the local level with direct regard to migration.

Results. On balance, the results of the interviews are the following ones:

1. The representatives of the national level assess the migration processes of rural Romania dominantly from a macro-economic perspective. They regard emigrations and out-migrations primarily as loss of human capital. The education level of the remained population would decrease because of the selective character of migration. The remained population would get older and older so that it would become more and more ineffective. Even the question of survival would rise in regions of high negative migration balance figures.

There would exist the danger, that the Romanian village would leave the world as mentioned in this newspaper article. Policies and measures suitable to solve the problems are not mentioned by the interviewees of the national level with direct respect to migration, by the way in contrast to their statements concerning agriculture, infrastructure and services as well as environmental planning. But these subjects are not studied in this presentation. Instead of this, the representatives of the national level point to the temptations of the destination regions of migrants which are damaging to the regions of origin. By doing so, the interviewees give the impression – so you can interpret – that the reasons for out-migration are more the opportunities of the destination areas and the individual motives of the migrants than the structural conditions of the areas of origin.

2. The representatives of the regional level register both advantages and disadvantages among the changes of the migration processes. Perhaps, you can explain their more differentiating view by the matter, that they communicate both with the institutions of the national level and with the rural communes. They accumulate informations and opinions from both sides. The policies and measures mentioned by the representatives of the regional level concern mainly the acting of the state. You can derive from this observation that they see their role respectively the role of the institutions they represent as role of actors. They show that they possess the potential to act.

3. The remarks of the interviewees of the local level are characterized by direct experiences of the migration processes „on the spot“. The village population experiences not only the economic, but also the social aspects of migration. The statements of the interviewees let see this fact. But they do not mention policies, concrete measures and perspectives, by the way they do not talk about this concerning most of the other subjects outside migration they discuss during the interviews. Perhaps, they do not deal with this question, because on local level they have less opportunity to participate in political and economic decisions. They understand themselves hardly as actors. They suggest their action horizon as strictly limited.

5. Prospects

At the end of my presentation I would like to widen the focus towards the following question: What policies for the improvement of the rural life conditions are discussed by the interviewees, apart from those which have been subject of this presentation? The proposals refer mainly to the changes of the structure and organization of agriculture and the other branches of economy, to the support of agrotourism, to the increase of pluriactivities in rural economy, to the improvement of infrastructure and to the strengthening of small and mid-size towns to attractive central places. Different structures of environmental planning and regional development are discussed, too. The forces of the relatively small counties ought to be combined within the frame of larger units (Romanian Government and European Community: Green Paper. Regional Development Policy in Romania. PHARE Programme. Bucharest 1997).

The main problem to apply the proposals is the lack of capital in the rural area and in Romania as a whole. Most other problems derive from this problem. What measures can be taken in order to solve the problems? The unanimous opinion of all experts who discussed this question in the course of our research project is this: Separate measures for the rural area are not sufficient. The basic precondition is economic growth of the whole country. The necessary means of investments can be won only by this way. How is it possible to create this basic precondition, that – spoken with the words of the well-known German social scientist Claus Offe – at the end of the light, that is spread by the political change, does not stand a tunnel? Two ways are often mentioned as answers to his question. The first way is the support from outside including the European integration. The second way are the politics of small steps, that is, to use persistently the existing opportunities of economic development. This requires staying power. At the moment you cannot see other ways. If Romania can take these ways successfully, then can be a light at the end of the tunnel.

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CHANGES IN THE DEMOGRAPHIC SIZE AND FUNCTIONAL STRUCTURE OF ROMANIA'S TOWNS (1966 - 2002)

GEORGE ERDELI, BIANCA DUMITRESCU*

Like in the other Central-European countries, Romania's industrial development model over 1950-1989, focused on the accelerated and extensive socialist-type industrialisation, explosive urbanisation and the implementation of urban and rural planning schemes. It was a stage in which the national urban system expanded and consolidated.

It might be said that the aim of post-war industrialisation and urbanisation was largely attained by a gradual transition from the traditional rural-agrarian society to the urban-industrial society of the 1990s. It was a stagewise evolution that took on different forms, had a dynamics of its own, and developed socio-cultural particularities in the course of urbanisation.

After 1989, reflected the urban system underwent a deep-going restructuring process that the country's socio-political changes; urbanisation itself acquiring new scope and breadth. This new stage of transition from the industrial to the services town-type mirrored the country's socio-political transition. The industrial function preserved its importance even more than in the economically developed West European states, modern industry and technology being expected to provide the Romanian urban system a development that would enable it to integrate into the town system of Europe.

The urban system is undergoing a process of restructuring now, the urban phenomenon acquiring new characteristics and dimensions. The industrial city – the representative type of urban settlement, is to be gradually replaced by the polifunctional and services town, as part of the country's economic and social-political development targets for the beginning of the third millennium.

A. Changes in the demographic size

In the second half of the 20th century, Romania's towns experienced different demographic growth rates in terms of urban category and period. This process was the direct reflection of the level of economic and social development

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and it was largely influenced by the tendency of reaching a balanced county urban network ratio through the preferential numerical increase of new towns and the creation of new urban structures in keeping with the goals set by the central power.

The studied interval featured two periods in the evolution of the urban network:

1. The socialist period based on centralised planning

That was the time when the political factor played a major role in the distribution of towns by size-category, in their balanced diffusion within the territory and in shaping an urban network.

Between 1966-1992, the number of towns surged spectacularly, from 183 to 260 through the following measures:

- in 1968, the administrative-territorial reorganisation granted in town status to 9 new localities;
- in 1989, 23 localities were declared towns.

The main characteristic feature is represented by the the numerical increase of small and medium-sized towns: 54 towns (20% of the total) were promoted to a higher demographic category and no town was demoted to a lower rank (*fig. 1*).

The urban population upsurge was the result of natural increase, the village-to-town migration, the promotion of some communes to urban status and the inclusion of some villages into the administrative boundaries of towns.

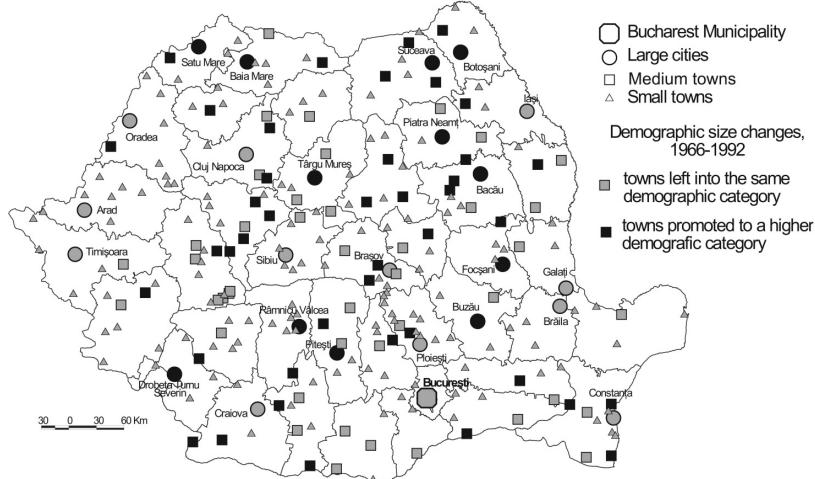


Fig. 1. The demographic size of Romania's towns – 1992

2. The transition period

The transition period from communism to democracy witnessed also demographic changes. Political and economic factors lie behind increased external migration and the change in internal migration which shifted from town to village. One town was promoted to a higher demographic-size category and five towns fell into a lower category (*fig. 2*).

1992-2002 featured a slow increase in the number of towns (by only 7); in 2002, the urban system numbered 267 towns.

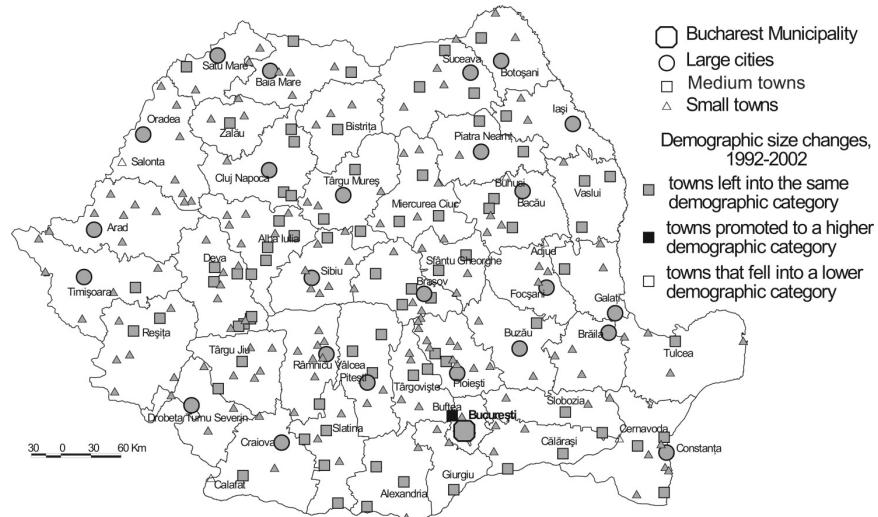


Fig. 2. The demographic size of Romania's towns – 2002

Romania's urban network included mainly small and medium-sized towns (under 100,000 inhabitants) that is 9/10th of the total town number, with more than half this group having under 20,000 inhabitants (*table 1*).

Table 1
Towns in Romania grouped by demographic size

Town group	No. of towns in 1966	No. of towns in 1992	No. of towns in 2002
Total towns in Romania of which	183	260	267
Small towns with:	119	150	162
Under 5,000 inh.	12	11	14
5,000 – 10,000 inh.	48	53	66
10,000 – 20,000 inh.	59	86	82
Medium towns with:	51	85	80
20,000 – 50,000 inh.	43	62	59
50,000 – 100,000 inh.	8	23	21
Large cities with:	12	24	24
100,000 – 200,000 inh.	12	13	14
200,000 – 300,000 inh.	–	4	5
300,000 – 400,000 inh.	–	7	5
Very large cities:	1	1	1
Over one million inh.			

Bucharest – Romania's capital

Bucharest is the largest and most important political, economic, financial-banking, commercial, cultural-scientific, educational, transport, informational, sporting and tourist centre.

Bucharest occupied an outstanding position among Romania's large cities, being over five times the size of Iași, the second city in the hierarchy. Throughout the 20th century this ratio was fluctuating, reaching a peak (8.83/1) right after the Second World War. As from 1948, the distance between the Capital and the 2nd-rank town was gradually shrinking to a minimum of 5.7/1 in 1985. After wards the gap would widen slightly. From 1989 on, as Bucharest offered better economic opportunities, the disparity increased again. However, in terms of the theoretical adjustment line and the country's urban population, the city holds an inferior position. This reality is emphasized also by the rank-size analysis, according to which only over three million inhabitants and a better representation of the large 2nd-rank cities could balance the situation.

The year 1992 registered a record high figure of 2,067,545 inhabitants followed by a slow decrease as part of the country's general demographic regression (1,926,334 inhabitants in 2002). What caused that situation was the sharp fall in birth rates associated with the migration of young people generally.

Large cities (over 100,000 inhabitants)

The role of large cities over the last 50 years has consolidated. Between 1966-2002, the number of large cities doubled (from 12 to 25) and their demographic size increased.

Half the cities had a population of 200,000-400,000 inhabitants, a figure unknown in any town in 1966.

In the post-war period they represented a distinct size-category within the national urban system. Every second town-dweller and every fourth inhabitant of Romania lived in a large city.

Large cities are true first-rank growth poles exerting a strong influence on spatial organisation, on the modernisation of localities and the dynamics of urbanisation, also balancing disparities between residential environments.

This urban category numbers many multisecular or millenary towns with an outstanding territorial and functional evolution at both regional and national levels.

Medium-sized towns (20,000 – 100,000 inhabitants)

The number of medium-sized towns rose from 51 in 1966 to 85 in 1992 due largely to promotions into higher demographic categories. Between 1992 and 2002, this category of towns registered a period of stagnation.

They play a major role in the structure of the national urban network, given that 17 towns act as county-seats assigned the administrative coordination of the territory. The concentration of gigantic industrial units and the lack of

functional flexibility makes this category of towns highly vulnerable, future evolutions depending on their ability to correlate industrial restructuring with the development of the tertiary sector.

Small towns (under 20,000 inhabitants)

This category (162 towns) represents 60% of the urban network. It was the most stable one in time and space, and registered a spectacular numerical increase under communism from 119 in 1966 to 150 in 1992.

Small towns are generally of recent date, in the socialist period alone 108 rural settlements were granted town status. The small towns, inhabited by every seventh town-dweller, hold a special place within the urban hierarchy, forming the base of the urban pyramid and discharging organisational functions within the national economy.

B. Changes in the functional structure

Among the main elements defining the urban system (demographic size, economic and socio-cultural activities, urban endowment, etc.), town functions (lying at the origin of the urban system and shaping urban development) have the greatest significance.

The easiest and most reliable method to determine town functions and establish town typologies and hierarchies in Romania in the latter half of the 20th century is to analyse the size and structure of the active population (periodically registered by population censuses).

The evolution of towns (like their demographic size changes) featured two periods:

1. *Extensive industrialisation* in the 7th, 8th and 9th decades, when nearly all the towns developed into economic centres. Towns used to concentrate some 95% of the volume and value of Romania's industrial production, with over 45% of the active urban population working in industry.

2. *The functional destrucuring* of towns in the 10th decade brought up into discussion the utility of the services-based functional model.

The large cities continued to develop as first rank economic and social centres of the urban national system.

The 1966-1992 period marked the steady industrial growth of large cities. In 1966, ten cities had under 50% of their active population working in industry, the other towns listing over 50% of the industrial workforce (fig. 3).

After the lapse of 25 years over 50% of the population of all large cities (with the exception of Constanța) worked in the secondary sector.

The industry of large cities was represented in principal by the processing and building branches.

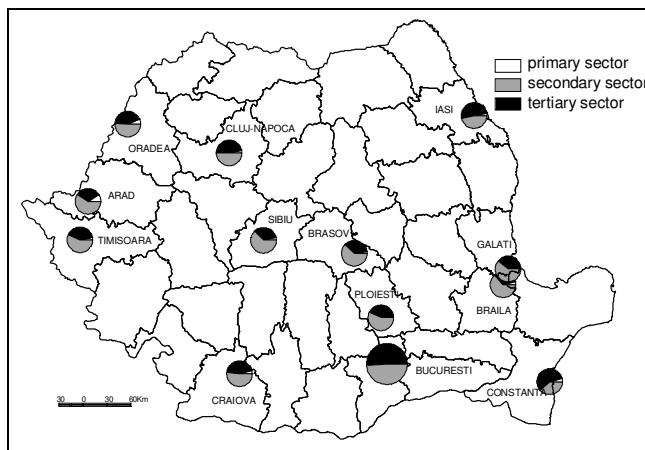


Fig. 3. Large cities – active population structure by sector of activity (1966)

Over the past few decades Romania's large cities formed a homogeneous group in terms of active population structure and dynamics:

- more than 50% of the active population worked in industry;
- one-third of the workforce was employed in the services sector which indicates insufficient tertiarisation;
- the agricultural function lost its relevance (under 3%), which is a positive trend.

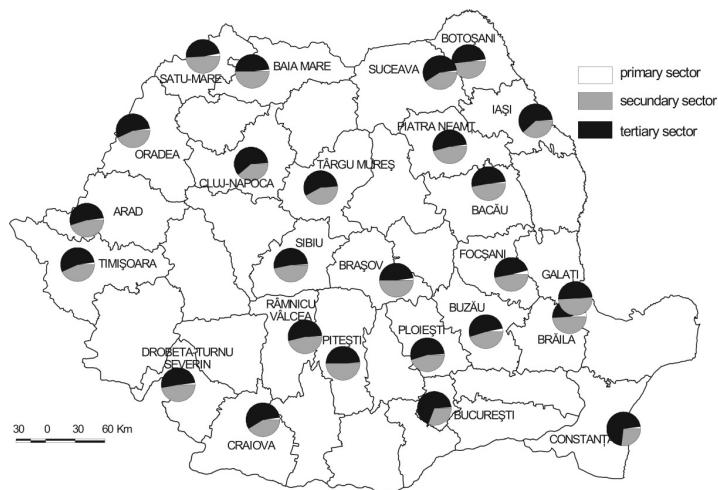


Fig. 4. Large cities – active population structure by sector of activity (2002)

The deep-going changes recorded in the functional dynamics of **medium-sized towns** were the consequence of specific urbanisation and industrialisation processes across the country, administrative transformations, geographical location and accessibility.

In 1966 medium-sized towns had a well-developed industrial profile (drawing over 50% of the active population to the primary sector). The largest industrial workforce recorded the centres with a specialised industrial profile. The active population of the tertiary and the secondary sectors accounted for 38% and 11%, respectively (fig. 5).

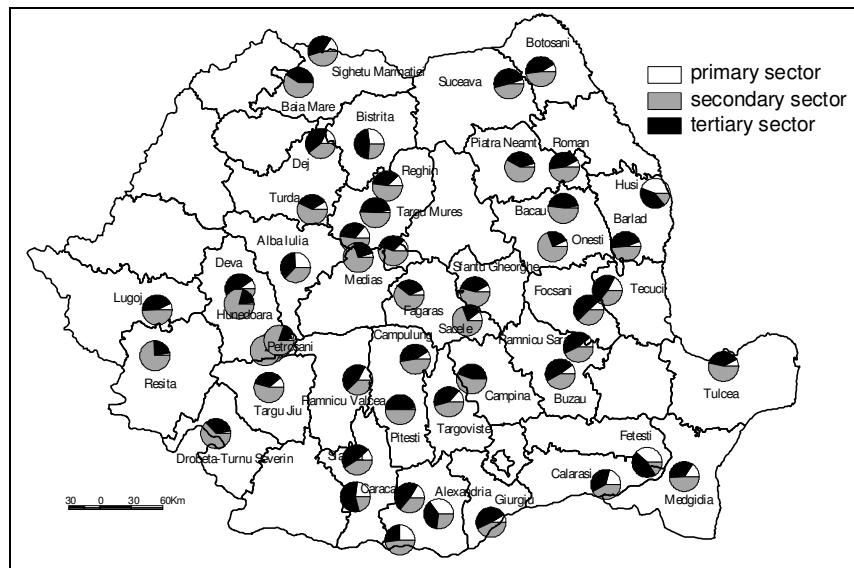


Fig. 5. Medium-sized towns – active population structure by sector of activity (1966)

After 1968, medium-sized towns experienced intensive industrial diversification, so that by the end of the 1980s the number of specialist industrial centres halved.

In 1992, the secondary sector of this category was progressing (60%), while the primary sector was regressing (5%). Industrial restructuring and numerous lay-offs during the period of transition account for the active population decrease in the secondary sector (50.1%), significant increases occurring in the tertiary sector which employed some of the people remitted from industry (45.1%). A decreasing trend was noted in the primary sector (4.8%), towns tending towards tertiarisation (fig. 6).

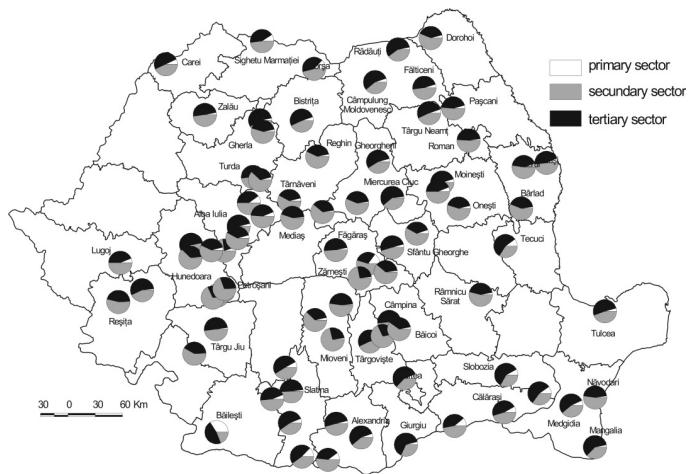


Fig. 6. Medium-sized towns – active population structure by sector of activity (2002)

In 1966 in small towns, showed a fairly balanced sectoral structure. Subsequent census data (1992) revealed a situation similar to that of other town categories, namely, an increase of the secondary sector (56.3%) and a decrease of the primary sector (12%).

In 2002 the secondary sector decreased substantially (43.0%) in the wake of industrial restructuring, as did the primary sector (14.1%), while the tertiary sector recorded a spectacular increase (42.9%). Most small towns had an industrial and services profile.

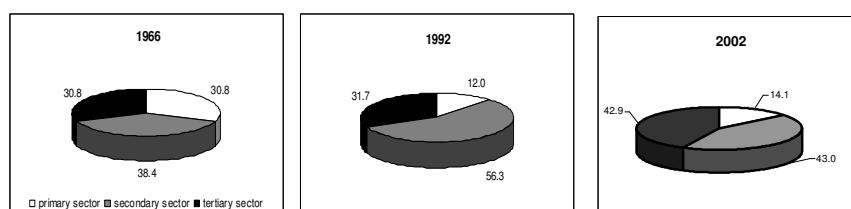


Fig. 7. Small towns – active population by sector of activity

In order to get an insight into the changes experienced by the three economic sectors, a number of graphs were plotted based on the 1966, 1992 and 2002 census data correlating the demographic town size with the active population of the secondary and tertiary sectors.

The three graphs show numerical increases and decreases of the industrial workforce over the 1966-1992 and 1992-2002 intervals, respectively.

Under socialism, industry played a major role in changing the Romanian economy, it becoming the dominant branch by producing goods for other fields of activity. The modernisation of industry was due largely to such branches as electrotechnics, machine-building, electrical and thermal energy production and chemicals. The industrial town became the representative type of progressive urban settlement.

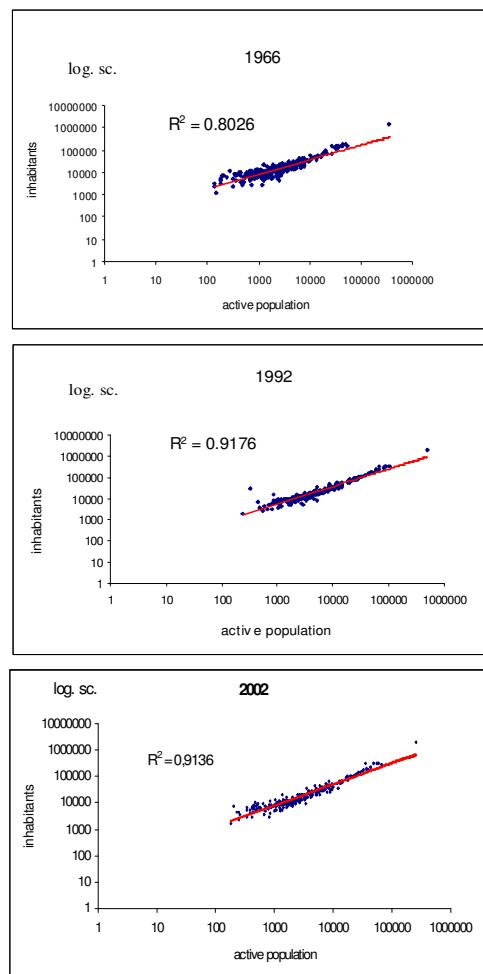


Fig. 8. Correlation between demographic size and active population in the secondary sector

After 1989 a new legislation was put in place and industry was restructured (beginning with Law No. 15/1990). The industrial sector declined even faster as the big combine-works lost power and control; a new competitive framework emerged, internal demand decreased, the COMECON was dismantled, some foreign markets were lost, and financial dysfunctions set in.

Under communism, the number of employees in the services sector increased slowly, being revigorated during the transition period. The positive trend of the first period was part of the general development of society. After 1989, the economic and urban crisis, the functional destrukturering of towns made tertiarisation a topical urban model; after 1990 services were boosted. The depleted value of the correlation index in 2002 was due to the decrease of population in the majority of towns. A notable growth was seen in such sectors as finances-banks, insurance, commerce, and public administration, with slow increases in the education and telecommunication area. Transports and transactions registered a slowdown.

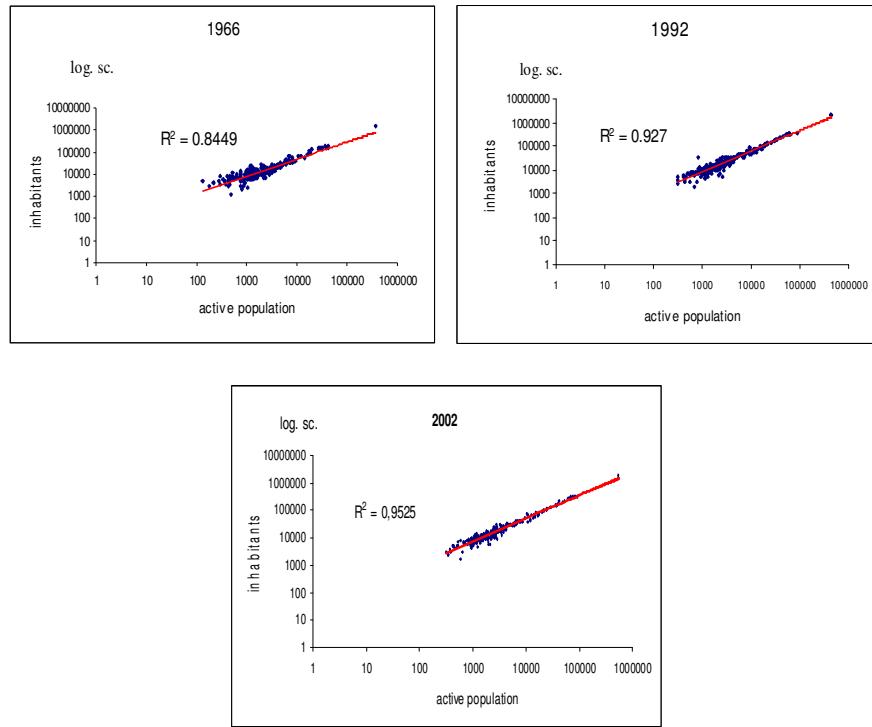


Fig. 9. Correlation between demographic size and active population in the tertiary sector

Summing up we would say that the analysed interval features two periods: the communist period marked by important demographic-size changes and major growths of the secondary sector and the transition period characterised by demographic-size stagnation, the decrease of the industrial workforce and the increase of tertiary sector employees.

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TYPES OF LANDSCAPE AND ASPECTS OF SPACE ORGANISATION IN THE SOUTHERN CARPATHIANS

MELINDA CÂNDEA

The Southern Carpathian Mountains, known as a massive range, have provided favourable conditions – mineral resources, rich forests, pasture lands and a good geo-ecological background for permanent settlement and the development of economic activities both on the summits and slopes, or in the mountain-sheltered depressions.

As important for human life, beside the depressionary areas, proved to be the numerous meadows and large erosion platforms, actual mountain plains, surprisingly smooth and suitable for agriculture.

Some significant areas in this respect are the intra-mountainous depressions of Hațeg, Petroșani and Loviștea-Lotru, together with the Bran-Rucăr-Dragoslavele Corridor. Their physico-geographical features are clearly outlined, showing special genetic affinities to the mountain block. They have played an outstanding historical and social-human role over the time, and stand out for their remarkable concentration of population and settlements, being extremely homogeneous ethnically. The penetration and settlement of some foreign communities is quite singular. It was here ...“that a kernel of the old, of the oldest and purest Romanian life bore fruit” (I. Conea, 1935). This repository of unaltered language, costume, customs, traditions and traces of settlements, bespeaks of the Romanian people’s continuity in these parts, and of its permanent relation with these lands.

The emergence and development of the human communities, and their pressure on the environment, though insignificant at the beginning, kept growing and changing the depressions’ natural landscape to the point of turning them step by step into areas of discontinuity – physical and economic-geographical alike. The incriminated element is man, whose complex and fairly generalised activities have altered both the ecological potential and the way of putting it to account.

The “natural infrastructure” has been overlapped by a certain economic and social infrastructure, partly dependent on the natural potential, on its degree of habitability and moreover by the technological level specific to a given moment.

Man’s presence and activities have marked the historical evolution of the natural landscape, the organisation and use of land. Each activity, intended to

put to account existing resources, has circumscribed its corresponding action space with a multitude of material forms of manifestation that shape and define it.

That would explain the long period of evolution of the Southern Carpathian landscape which has passed successively through several stages, from the early natural forms to the strikingly man-made and degraded ones of the present-day. All along this evolution it has largely been the depressions that have progressively become the conflictual battle-ground between man and the natural mountainous environment: productive activities and no less so the traditional agro-pastoral and sylvo-pastoral ones, on the one hand, and industrialisation and urbanisation, on the other; pastoral life and developing tourism. Therefore, it is but seldom that one can see natural landscapes as they had looked at their best.

As a result of the concrete forms taken by the man-nature relationship, of the interconditionings among the physical, biotic and anthropic factors, and of their own internal dynamics, several types of landscape have been individualised, each having its evolution: progressive, regressive and stable (balanced):

1. derived balanced landscapes;
2. anthropic landscapes with progressive or regressive evolution;
3. degraded landscapes, with pockets in the mountain space, too.

1. Derived balanced landscapes have the greatest expansion, corresponding either to areas with an apparently normal geographical scape, or to some areas where the landscape, presently stabilised and balanced, had nevertheless suffered a series of significant structural mutations. While in the former case, a state of natural equilibrium between the landscapes' ecological potential and their biological exploitation has been reached (despite the temporary man-induced alterations in the mutual relations between the component elements) (1a – pastoral landscape in the Carpathian Mts; 1b – forest landscape), in the latter instance, the type of natural biological exploitation, corresponding to the ecological potential, has been replaced thoroughly, or much of it, by a superstructure-governed biological exploitation (1c – agro-sylvo-pastoral landscape; 1d- agricultural lanscape).

Ia. The forest landscape is very extended, often covering the slope foot (the northern slopes of the Cozia, Căpățâni and even Retezat mountains) up to heights of 1,200-1,500-1,000 m, depending on slope exposure and the intensity of the human pressure exerted over the time upon the lower and the upper fringed forest bounds. The specific climatic conditions, with mean temperatures of 2-7 °C and 800-1,100 mm precipitation/year, are propitious to the optimal growth of a ligneous vegetation which dominates the landscape and its display on obvious altitudinal steps: mixed forests of *Quercus robur* and *Fagus sylvatica* at the base followed by compact woods of *Abies alba* and *Pinus sylvatica*, and finally by a more or less continuous strip of *Pinus sylvatica* and *Abies alba* forests.

This natural vegetal succession has occasionally been disturbed by man's intervention, so that spruce plantations would occur at the mountain foot, mixed or not with beech (on the northern side of the Vâlcan Mts). Where summits are smoother and slopes are milder, one can often see glady woods, with pastures of *Festuca rubra*, *Nardus stricta*, *Agrostis tenuis*, *Deschapia*, etc, developed on the dominant ferriluvial brown and acid brown soils. These glades are preferential sites for the setting up of lower sheepfolds where ovines and bovines of the "Băltata românească" and Pintzgan breeds are grown.

Forest exploitation and maintenance works have inevitably introduced new elements into the natural landscape: an ever denser net of forester's roads, railways and shacks, supply points for the forest workers, warehouses store the wooden mass, etc. Weekly or monthly flows of labour and logs move towards the wood-processing units: from Bran to Rucar, Dragoslavele, Stoeneşti, Câmpulung, Braşov and Râşnov; from the Lotru-Loviştea Depression to factories in Suceava, Brăila and the wood-processing combine of Piteşti. This Depression is one of the big wood suppliers to the mines of Petroşani, Motru-Rovinari and other exploitations.

Ib. Pastoral landscapes are characteristic of the upper third of mountain slopes. The higher levelled platform being widely developed, there is a wealth of alpine and sub-alpine meadows and pastures overlain by a very extended and rich plant cover, unique in Europe. The low annual mean temperatures (0-2 °C) and the considerable amounts of precipitation (over 1,000 mm/year), account for a relatively elevated moisture content which favours the development and preservation of grasses, mainly *Nardus stricta*, *Festuca ovensa*, *Festuca rubra*, *Carx curvula*, etc. The underlying substrate is formed of little evolved podzol and alpine soils with a short profile and reduced edaphic volume. Therefore, excessive grazing in some sectors and compaction are at the root of the very frequent and rapid degradation of the plant cover and the onset of various forms of erosion of the meagre soil layer.

Here is the realm of summer shepherding, which lasts for some 3-5 months, when the vegetation period is at its peak. There are hundreds of sheepfolds owned by the locals or by the families who had hired certain mountains for generations (people from Mărginime, Muscel and other regions), passing them from father to son. The organisation of pastoral festivals (nedei), which used to enliven this pastoral landscape by bringing together people from either side of the Southern Carpathians (specifically from the Retezat, Parâng, Lotru and Vâlcan massifs), is out of use.

The area can be far better put to account than it is done now. If revitalised, this space free of chemical pollution, could provide high-quality animal products. Besides, bringing to life old customs and traditions could polarise flows of domestic and, why not, of foreign tourists as well.

Ic. Agro-sylvo-pastoral landscapes appear as a discontinuous ring skirting the depressions and frequently encompassing the lower third of slopes, too (in the west and north-west of the Parâng, the south of the Șureanu and of the Retezat, the south-western ridge of the Făgăraș, etc.) and even the entire hearth, as is the case of the depressionary Lotru Basin and the Bran-Rucăr-Dragoslavele Corridor. This situation is largely the result of human intervention.

Successive fellings over the past 4-5 centuries to gain more land for cultivation and animal breeding, have greatly eliminated the biological exploitation of the ecological potential of these areas, replacing it by another type of vegetation, also natural, but meant to suit man's needs – pastures and especially secondary meadows, the main fodder source for animal husbandry.

The objective necessity to fell the forest and make room for grazes and farming land, as the population kept growing, has impaired the natural depressionary landscape; what also facilitated it was the Hațeg and Loviștea depressions' relief and the Bran-Rucăr-Dragoslavele Corridor, which allowed for the lateral access to the mountain zone and for the agro-pastoral utilisation of the adjacent slopes. The lower line of the forest and its glades kept dropping (especially on the southern slopes of the Șureanu and the Retezat Mts, the south-eastern part of the Făgăraș and the western side of the Parâng), a process associated with the cutting of the sub-alpine shrubs and of timberline spruce forests in order to enlarge grazing space (in the Retezat, Vâlcan, Lotru and other massifs).

The deforested surfaces of milder slopes and of the medium-high summits (600-1,000 m) were used as hay-fields, interspersed with frequent patches of arable land and invaded by seasonal shelters, shacks, and by whole families who would settle there permanently in a "swarming" drive from the original village. The considerable expansion of the pastoral and agro-pastoral sub-system has reduced not only the forest sub-system, but has also replaced the primary natural vegetation (woods and grasses) with a secondary vegetation, leading to the onset of some regressive or progressive vegetation series. So, component elements have suffered changes of quality and quantity: a more nuanced micro-climate, the alteration of the soil structure and of the physio-chemical properties of soils, of the soil water regime, etc.

The general aspect of this type of landscape is given by a mosaic of parcels of various geometrical forms and uses, a significant dispersion of seasonal households and settlements. The presence of acid brown forest soils, eumezobasic brown soils variously hydromorphic, developed below the forest floor, together with the conditions of relief (high horizontal fragmentation, occasionally steep slopes) and climate (frequent temperature inversions, short period of vegetation due to late spring and early autumn freeze) are adversely affecting the crops. However, some cultivated pockets are seen mainly among the hay-fields, rarely among pastures and other unfarmed lands (inclusive of forests). As a rule, agricultural lands are grouped within the perimeter of the

settlements. These are largely spread out or scattered even, displaying a host of seasonal shelters, shacks and various annexes for the exploitation of hay-fields.

There is obvious destracturing of the population stock due to the diverging fluxes of labour in search for opportunities other than what an extensive, traditional agro-pastoral agriculture can offer. Demographic destracturing entails the gradual loss of economic functionality. If the present social-economic and demographic trend continues, some landscape sectors will surely be hit by desertification (eg. the west, north-west of the Parâng Mts.).

The measures needed to maintain these landscapes so very characteristic of the Carpathians' depressionary areas, should be aimed at preserving the dynamic equilibrium of slopes affected by superficial degradation through landslides and deep erosion favoured by the shrinking of forests and the undercutting of slopes by larger of smaller streams, most of them torrential (in the Bănița depressionary bassinette, the Ohaba Pono-Fizești in the north-west of the Hațeg Depression, the eastern sides of the Loviștea Depression, etc.), and by a number of land management works. Since the demographic processes have a far greater inertia than the economic ones, one way of dynamising the rural settlements is transition from the traditional agro-pastoral society to an agro-pastoral society associated with various types of tourist services (in the Lotru Valley, the Bănița-Fizești-Ohaba Ponor limestone sector, the Bran-Rucăr-Dragoslavele Corridor, etc).

Id. Agricultural landscapes, unfolding in the lower piedmonts, the glacis and even the floodplain sectors of the Hațeg and the Loviștea depressions, have component elements of great stability, despite the huge structural changes undergone over the past few decades.

These scapes feature by numerous cultivated areas, which would explain why the depressionary sectors had been collectivised. The main crops: cereals, potatoes and fruit-trees, have optimum soil and climate conditions of vegetation.

The fact that the population – the main factor of landscape dynamic, is aging, creates serious problems. The process has been accentuated by numerous definitive departures due to the lack of prospects in the present agrarian economy. The falling demographic trend makes villages, both compact and scattered but tending to cluster, and the agricultural landscape as whole, have a regressive evolution. A return to private land ownership, concomitantly with the re-orientation of migratory fluxes from the urban industries (themselves passing through deep-going reorganisations for the sake of efficiency) towards the countryside is expected to somehow revitalise village life. It is hoped that the rural population shall be ready to make a minimum effort and grow into a real supply basis of farm products for the big human agglomeration of the Petroșani Basin, Sibiu and Râmnicu Vâlcea cities, Voineasa spa and health resort, or engage in agro-tourism.

2. Deeply anthropogenic-derived landscapes. But for the Petroşani coal basin, these scapes occur sporadically, especially in the depressionary sectors, where natural processes are replaced or dominated by artificial ones and maintenance works have substituted the natural equilibrium for controlled equilibrium.

Human activity has affected not only the biological exploitation (which in actual fact has ceased to exist), but also the ecological potential (the soil, the climate, the water regime and the relief morphology even).

The onset and development of these scapes is no less the outcome of a special demographic evolution correlating with the industrial upsurge, and the hydropower managements. It is the case of the industrial-urban landscape of the Jiu Valley (2a), of Brezoi area, the hydropower system of the Lotru, Râu Mare and Olt valleys, etc.

2a. The natural components of the Jiu Valley *industrial-urban* landscape have been severely impaired by the economic structure. Soils are largely anthropic protosols, undeveloped or rent soils, with no clearly outlined horizons and processes of soil genesis (in the neighbourhood of operated or deserted mines; in the whole hearth of the Petroşani Depression, the Petroşani Jiu-Lonea-Petrila area; south of Petroşani and Lupeni, etc).

The industrial activities and the powerful anthropic character of some depressions, or depressionary sectors, had a negative impact on the geographical landscape: secondary phenomena of pollution with various wastes and residues; underground mining or quarrying (coal, mica and bauxite) have engendered various anthropic landforms. Some are the outcome of waste dumps left by extraction or preparation (crushing, enriching and washing) at one of the transport line terminals.

The natural or secondary vegetation kept shrinking considerably, running and ground waters have been intensely polluted by industrial waste spills.

The very dynamic economic pace has triggered real crisis situations as industry and urbanisation have come into conflict with environmental protection and the natural components of the limitrophe scapes.

The very conception of space management is acquiring new dimensions, its primary role being to minimise the consequences of these conflictual situations, protect the natural environment and use it as aesthetic life framework and physical support of society. The intense fluxes of raw materials, of products, and labour generate a complex system of space interactions in various directions and of distinct intensities. The centripetal movements created by the great polarising force of Petroşani Depression make some of the adjacent gravitation zones lose their very identity (its rural environment, or even Haţeg Depression situated at the crossroads between these centripetal forces and those of the Hunedoara-Deva-Călan industrial-urban zone).

2b. Hydropower landscapes emerged as the huge water-power potential of most Carpathian rivers (the Lotru, Râu Mare, Sadu, Sebeş, Tismana, Cerna and Dâmboviţa) started being managed. Complex works entailed massive deforestations, the levelling of terrains, the construction of dams and roads, of storage-lakes and temporary settlements (barracks and blocks of flats for the colonies of workers). Some of them have later been turned into tourist sites, and accommodation points.

As it is, the construction of hydropower systems has deeply changed both the aspect of the drainage network and the discharge regime, but moreover the ecological potential of the floodplains and the marginal areas of storage-lakes, given that the increase or decrease of the ground water level engenders other types of soils and vegetation.

Some elements of the hydropower landscapes could stimulate the development of certain tourist activities, over the next few years, thereby revigorating the economy of some depressionary or mountainous sectors, also benefiting the neighbouring villages traditionally engaged in pastoral activities.

3. Degraded landscapes appear as depressionary pockets of temporal instability. In the Ohaba-Ponor sector they are related to the presence of dolomite limestone quarries; in the Lotru “cataracte” area to the mica mines; in Câmpul lui Neag to the exploitation of outcropping superior coal; in the Mateiaş and Albeştii de Argeş to the limestone exploitations. The exploitation of these subsoil resources, especially after 1970, has destroyed the original landforms, leading to huge changes as rectilinear slopes were turned into levelled steps of exploitation with 20-30 m-high escarpments in-between. In addition to the building of access roads, there appeared, in the colonies of workers, numerous barracks or blocks of flats and huge waste dumps.

In this pocket-like landscape type the equilibrium between the component parts has been seriously disturbed, biological exploitation is missing, and the whole physiognomy and structure of the natural biological potential is thoroughly modified in regard of particular qualitative and quantitative traits. The scarp of dumps is permanently affected by mass movements – down-saggings, topples or slides. Diffuse erosion and rilling, favoured by the loose structure of deposits on dump scarps, steps and slopes, as well as by the precipitation regime (>900 mm/year), increase the suspended sediment load of rivers to extreme, with negative effects on downstream reservoirs which have become severely silted. At present, the main problems raised by the organisation of the depressionary space, of the adjacent mountain zone, and the protection of the specific geographical landscapes involves the following:

- The revitalisation of the pastoral economy and the creation of efficient animal husbandry in the mountain zone without impairing the natural environment, especially the law-protected areas, basically the nature reserves. A

special role in this respect devolves on all categories of newer or older hypso-habitat (sheepfolds, seasonal dwellings and villages) which, while resuming traditional practices, should also promote intensive agro-pastoral forms, making best use of pastures and hay-fields, or of the small patches of arable land occurring in the mass of grass-covered terrains surrounding the seasonal dwellings, shacks or households. Whatever the mode in which settlements are, or will be remodelling their residential structure and productive bases, they should remain intimately linked to the productive capacities of the Carpathian land.

- The development of tourism, associated as far as possible with agriculture and forestry. The idea of mountain agro-tourism, of putting the rural tertiary sector in place on a general scale and of promoting secondary, residential tourism activities is being increasingly sustained by ever more tourists tending to prefer a relaxing and bracing mountain village vacation to a modern resort holiday.

Associating the two types of activities could become one of the labels of “intensive” practices in the Carpathian zone, a possible way to stabilise the population and an indirect support for mountain agriculture. To this end, using the big, well-structured agro-pastoral units dotting the mountains around the depressions, would benefit itinerant mountain tourism. With minimum effort they could be turned into lodgings integrated into the natural environment, into the dynamics and economy of the mountainous space.

- The formation of “a tourist product” means analysing the tourist potential (natural and cultural-historical, geographical position, manpower, the population’s psycho-social traits), the human and financial availabilities (financial sources and means), the possibilities of using and building a competitive tourist offer. Conjuncture studies could help choosing the best markets, the ways and means to further promotion and advertising.

What should be looked at are the value and diversity of tourist resources, the agro-pastoral occupations and the area’s ethno-folkloric traditions; locations along a major tourist thoroughfare, or in the vicinity of some well-known tourist centres and resorts; proximity to renowned massifs intensely circulated by tourists; a good socio-economic development of the countryside bespeaks of the locals’ comfortable living standard, allowing them the host foreign tourists, too; the psycho-structural features of the population recommend it for its great hospitality, honesty and morality; the villagers themselves are emancipated people, many having a knowledge of foreign languages.

- The upgrading of the barracks and dwellings left by the hydropower workers in the Lotru, Râu Mare or Dâmbovița valleys. These structures could become tourist bases for young people, for itinerant tourists, etc.

- The organic integration, within initially agro-pastoral or sylvo-pastoral spaces, of various types of industrial activities or handicrafts (using the local

natural and human resources), complementary to animal husbandry, based in principle on homework.

- The organisation and management of forestry works with focus on the autochthonous, local species and on the authentic natural structures, or on those improved by specialists for a specific finality. Each autochthonous species has a vegetation environment that suits its own biological properties, having adapted to those particular soil and climate conditions over thousands of years.

In this way, the forest can develop on a self-reliant basis, without any costly protection measures being necessary. Resistant to climatic conditions, it has a compositional structure that approaches the natural one, on the vertical too, displaying a wide range of environment protection functions.

- A basic prerequisite for sustainable forest organisation and protection is to make the forest stock more accessible. To this end, the building of forest transport roads should continue in order to facilitate the effective exploitation of all the principal and secondary forest products; the development of specific forestry works, of protection and watch actions should also focus the attention of managers and specialists. Meeting these demands implies raising the present density of forest roads from 6.5 m/ha to at least 9 m/ha in the near future. Other priorities should be to remake the damaged roads and modernise the network.

RECENZII

MARIAN ENE, *Bazinul hidrografic Râmniciu Sărat. Dinamica reliefului în sectoarele montan și subcarpatic*, Editura Universitară, București, 2004, 179 pag.(A4), schițe și hărți în text, fotografii color, tabele și 22 de anexe (planșe).

Relieful montan și subcarpatic a fost și rămâne un spațiu geografic de un amplu interes pentru cercetarea științifică, teoretică și, în ultimele decenii, de o neîndoelnică angajare pentru investigații de profil practic, aplicativ, cu privire la aceste trepte morfogenetice existente pe teritoriul țării noastre.

Este cât se poate de important și meritoriu, ca această teză de doctorat să angajeze o asemenea tematică de lucru care, în esență ei, a obligat la un studiu consistent și insisten desfășurat pe teren, timp de mai mulți ani, în corelație cu o documentare bibliografică propriu-zisă, reprezentând publicații anterioare, alături de care s-au folosit, prin interferență și prelucrare adecvată, baze documentare de genul hărtilor topografice, geologice, hidrogeologice, făcându-se apel inclusiv la fotoimagini aeriene și satelitare. Si nu numai atât, autorul a folosit atent și un impresionant volum de date statistice de profil climatologic, hidrologic etc.

Nota predominantă o constituie, în prezența lucrare, observația de lungă durată realizată pe teren, caracterizată de o cartare sistematică și de un mare detaliu, axată pe elementul permanent interpretativ.

Lucrarea, prin structura ei, este un studiu de geomorfologie dinamică, ce convinge prin *modelul de analiză a proceselor geomorfologice actuale*, legat de care se definește valoarea ei, teoretică și practică.

Valențele științifice, convingătoare prin nota lor de originalitate, se constată în textul studiului, dar și în diversitatea tipurilor de materiale illustrative, acestea din urmă surprinzând plăcut prin inedit, caracter analitic și specific de interpretare. Lucrarea reflectă o logică ordonată și de un evident efect pentru rezultatele cercetării geografice, prin numeroasele și aproape permanentele interrelații care se constată între hărți, schițe de hărți, profile, grafice, blocdiagrame, fotografii, diferite date din tabele etc., aspecte care se constată inclusiv și în cazul celor 22 de planșe anexe, color.

Depășind *sfera de prim interes a geomorfologiei*, prezentul studiu vizează și interesează și numeroase alte categorii de specialiști, mai ales din domeniul activităților practice de specific social-economic, cercetare științifică, învățământ, cei care urmează masterul, doctoranzii și.a.

Deci, o nouă lucrare de prestigiu vine să completeze fondul valoric al literaturii de specialitate geografică din România.

MIHAIL GRIGORE

GÉRARD BELTRANDO, *LES CLIMATS. Processus, variabilité et risques*, Armand Colin, Paris, 2004, 261 p., 61 fig.

Noua carte a profesorului Gérard Beltrando, de la Universitatea Paris VII, Denis Diderot, reușește, grație unui admirabil efort de esențializare, să concentreze în numai 261 de pagini, un

volum imens de informații științifice astfel selectate și organizate încât, la capătul lecturii, imaginea pe care și-o formează cititorul despre climate este una complexă, completă și credibilă, indiferent de perspectiva din care o abordează.

Materialul este structurat în trei secțiuni distincte: „Mecanismele climatice”, „Descrierea și repartitia spațială a climaterelor” și „Riscurile legate de excesele vremii și climei”.

În prima secțiune, autorul prezintă procesele și fenomenele atmosferice de bază, ceea ce conduce la înțelegerea exactă a modului în care se formează și funcționează climaterelor lumii. O atenție deosebită acordă energiei radiante solare și temperaturii în sistemul Pământ-Ocean-Atmosferă. Sunt analizate radiațiile de undă scurtă și lungă, precum și efectul de seră al atmosferei terestre, bilanțul radiativ și schimbările de energie, variațiile periodice și neperiodice ale fluxurilor radiative și temperaturii aerului, în măsura în care acestea servesc scopului urmărit. În aceeași manieră tratează și interacțiunea neîncetată dintre atmosferă și oceanul planetar, detaliind caracteristicile și mișcările interactive ale celor două medii distincte, fără a omite mult mediatele fenomene El Niño și La Niña. Ciclul apei încheie prima parte a lucrării, prin prezentarea proceselor de evaporare și condensare, a hidrometeorilor rezultați, a sistemelor pluviogenetice (cyclonii latitudinilor medii, cyclonii tropicali și procesele convective azonale) și a repartiției geografice a evaporației și precipitațiilor atmosferice.

Secțiunea a doua a lucrării cuprinde, pe de o parte, aspectele esențiale ale metodologiei cu ajutorul căreia se analizează climaterele, iar pe de alta, o succintă descriere a climaterelor lumii. Descrierea respectivă se referă la cele 13 tipuri de climă pe care autorul le-a identificat în clasificarea climaterelor globului terestru realizată împreună cu Laure Chémery (1995).

Secțiunea a treia prezintă riscurile și catastrofele legate de excesele vremii și ale climei, în conexiune cu vulnerabilitatea diferitelor comunități umane, altfel spus, cu capacitatea acestora de a preveni și surmonta crizele provocate de respectivele catastrofe. Sunt analizate pertinente seceta și excesul de apă, grindina și căderile abundente de zăpadă (cu precădere avalanșele), furtunile, tornadele, gerurile și arșițele etc. O atenție deosebită acordă autorul riscurilor unor posibile schimbări climatice, trecând în revistă cauzele acestora (efectul de seră etc.), metodele de prevedere a evoluțiilor climatice viitoare (modelarea numerică etc.) și efectele probabile asupra solului și vegetației forestiere, agriculturii, regiunilor litorale, sănătății umane etc.

Lucrarea profesorului Gérard Beltrando răspunde întru totul celor trei cerințe esențiale care trebuie să caracterizeze orice scriere științifică: precizie, concizie, claritate. Sunt remarcabile, în acest sens, utilizarea corectă și distincțiile pe care le face autorul în cazul unor termeni precum risc, hazard etc., fără a formula sentințe irevocabile și fără a nega dificultățile de natură semantică în definirea diverselor noțiuni. Dar, virtutea cea mai importantă a lucrării în discuție o constituie originalitatea, care constă, pe de o parte, în structurarea inedită a problemelor tratate (fără ca acest lucru să afecteze în vreun fel dialectica proceselor și fenomenelor analizate, ba dimpotrivă), iar pe de altă parte, în numeroasele contribuții proprii vizând clasificarea și descrierea climaterelor globului terestru, virtuțile și slăbiciunile metodelor de predicție a schimbărilor climatice, efectele încălzirii globale asupra unor domenii de activitate antropică precum viticultura etc.

Les Climats este o lucrare valoroasă, cu evidente însușiri de noutate, modernitate și accesibilitate, scrisă de un intelectual universitar stăpân pe mijloacele specifice de expresie și disponând de o remarcabilă capacitate de a manipula informații vaste și extrem de variate, făcându-le să exprime exact ceea ce și-a propus. Ea este totodată, un instrument de cunoaștere deosebit de util pentru studenții geografi care studiază climatologia, pentru climatologi și geografi în general, dar prezintă un real interes și pentru toți cei care vor să cunoască mai îndeaproape climaterele Pământ.

Valoarea intrinsecă a lucrării elaborate de profesorul Gérard Beltrando este confirmată, o dată în plus, de publicarea ei în prestigioasa editură Armand Colin. Ceea ce constituie, indubtabil, un certificat de garanție.

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