

Spatial and temporal dynamics of human pressure within the Preajba catchment area, Romania

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Abstract

This study refers to the spatio-temporal dynamics of human pressure in Preajba basin, located in the southeastern part of Craiova municipality. The statistic and cartographic analysis is based on the determination of a variety of environmental indices: index of human pressure by demographic dynamics, index of human stress through agricultural land use, naturalness index, artificialization index and environmental change index. Choosing a grid of 1.5 sqkm for calculating and comparing the artificialization index of the landscape allows a concise analysis on the environmental transformation in the above-mentioned area. Complementary, temporal dynamics of the environmental indices values is highlighted by the choice of some benchmark years, i.e. 1992, 2002, 2012, 2014 to which data and recent cartographic materials from 2009 and 2014 are added. Results, materialized in the obtained values present the state of the environment and the human pressure implications on the Preajba lacustrine ecosystem (maximum values obtained at period level): physiological or agrarian density - 52 inhabitants/ha in 1992 (Craiova); human pressure index through arable - 1.4 ha/inhabitants in 1992 and 2002 (Malu Mare); naturalness index of the landscape - 9.43 in 1992 (Malu Mare); environmental change index - 3.69 in 2012 (Coșoveni). Field campaigns conducted in 2015 and 2016 confirm the research results and visually support human pressure on the environment. The proposed measures, in order to stabilize and maintain the good environmental quality in the Preajba basin targets the lacustrine ecosystem by involving local authorities in order to protect the avi-faunistic natural area status of "Preajba-Făcăi Lacustrine Complex".

Keywords: human pressure, indices, spatial evolution, lakes, Preajba Valley

Rezumat. Dinamica spațială și temporală a presiunii umane în bazinul hidrografic Preajba, România

Prezentul studiu face referire la dinamica spațio-temporală a presiunii umane la nivelul bazinului hidrografic Preajba localizat în sud-estul municipiului Craiova. Analiza statistică și cartografică se bazează pe determinarea unei varietăți de indici de mediu: indicii de presiune umană prin dinamica demografică, indicii de presiune umană prin utilizarea terenurilor agricole, indicii de naturalitate, indicii de artificializare și indicii de transformări de mediu. Alegerea unui carouaj de 1,5 kmp în vederea calculării și comparării indicelui de artificializare a peisajului permite o analiză concisă asupra transformării mediului în arealul anterior menționat. Complementar, dinamica temporală a valorilor indicilor de mediu este evidențiată prin alegerea unor ani etalon 1992, 2002, 2014 cărora li se adaugă date și materiale cartografice recente din 2009 și 2015. Rezultatele, materializate în valorile obținute redau starea mediului și implicațiile presiunii umane asupra ecosistemului lacustru Preajba (valori maxime obținute la nivel de perioadă): densitatea fiziologică sau agrară - 52 loc/ha în 1992 (Craiova); indicii de presiune umană prin arabil - 1,4 ha/loc în 1992 și 2002 (Malu Mare); indicii de naturalitate al peisajului - 9,43 în 1992 (Malu Mare); indicii de transformări de mediu - 3,69 în 2012 (Coșoveni). Campanii de teren realizate în anii 2015 și 2016 confirmă rezultatele cercetării susțin vizual presiunea umană asupra mediului. Măsurile propuse, în vederea stabilizării și menținerii calității bune a mediului în bazinul hidrografic Preajba vizează ecosistemul lacustru prin implicarea autorităților locale în vederea respectării statutului de arie naturală de protecție avi-faunistică, "Complexul Lacustru Preajba-Făcăi".

Cuvinte-cheie: presiune umană, indici, evoluție spațială, lacuri, Valea Preajba

Introduction

The landscape is a basic component of the European natural and cultural heritage, contributing to human welfare and strengthening the identities of local, regional and European communities (Pătroescu 2000 cited by Dumitrașcu, 2006). The lakes of the Preajba river valley and the surrounding area present a varied landscape typology and more than that, they are included in the "Avi-faunistic protected area - Preajba-Făcăi Lacustrine Complex", with an area of 28 ha, only 5.35% of the catchment basin.

According to the project *The educational-ecological measures and dissemination of information about protected areas on the Preajba-Făcăi Lacustrine Complex*: *Ciconia ciconia* (White

stork); *Anas platyrhynchos* (Mallard); *Aythya ferina* (Common pochard); *Anser anser* (Greylag goose); *Fulica atra* (Eurasian coot); *Neomys anomalus* (Mediterranean water shrew); *Natrix tessellata* (Dice snake); *Lacerta viridis* (European green lizard); *Gobio kessleri* (Kessler's gudgeon); *Umbra krameri* (European mudminnow) are the main species needed protection and the reason for which it had been declared a Natural Protected Area. In 2002 Cioboiu and Brezeanu remembered that the Preajba Valley Lakes can be used for pisciculture, as well as for tourist and entertainment purposes. At the moment, most of the lakes are invaded by paludous and aquatic macrophytes, which is a feature of the eutrophic ecosystems (Goga, 2009).

The main aim of the protected areas is biodiversity conservation and the preservation of representative samples of the natural regions in a state close to the maximum balance, as well as getting on this basis some scientific or social benefits. However, it must be achieved a compromise between the protection of biological diversity, ecosystems functions and meeting short-term and long-term resource needs of human communities and governments (MEA, 2005b cited by Primack et al., 2008; Pham et al., 2012). The present work represents a qualitative temporal analysis of the study area, necessary to enable the development of some strategic decisions that must be anticipated and understood, precursory to some processes and complex phenomena in the future. The prospective evaluation of the environment permits to avoid some dysfunctions, which are not visible in the present, haven't been registered in the past, but in combination with other sources may become very active in perspective (Henrichs et al., 2009).

The phrase environmental conflict defines an "incompatible interaction between at least two actors aimed at using one natural resource, in which one of the actors is affected by interaction and the other ignores this damage" (Mason and Muller, 2007). Another definition of this type of conflict is proposed by Melé (2012), which characterizes it as "a complaint

regarding the pollution or the technogenic risk to which those living in the proximity of activities with environmental impact are exposed to".

Study area

Preajba-Făcăi Lacustrine Complex is located in the proximity of Craiova, in the southeastern part of the city, at a distance of about 10 kilometers. Regarding the spatial coordinates, it falls between 44°15'25" - 44°17'00" lat. N and 23°48'40" - 23°54'30" long. E. The lakes chain was built during the communist period (1976-1979) with the stated purpose of serving as a recreational area for the residents of the municipality.

The neighboring territorial administrative units of Preajba river basin (15 km², *Romanian Water Cadastre Atlas*, 1992) are: Preajba village belonging to Malu Mare commune, Făcăi neighborhood - part of Craiova municipality, Coșoveni and Cârcea local administrative units (Fig. 1). These neighboring anthropogenic areas have both direct and indirect influence over the lacustrine ecosystem, exerting a constant pressure that we attempted to quantify in the present study. Aquatic ecosystems constitute an important factor of attractiveness for secondary housing, especially due to the high quality of the environment and suitable recreational activities (Pătroescu et al., 2012).

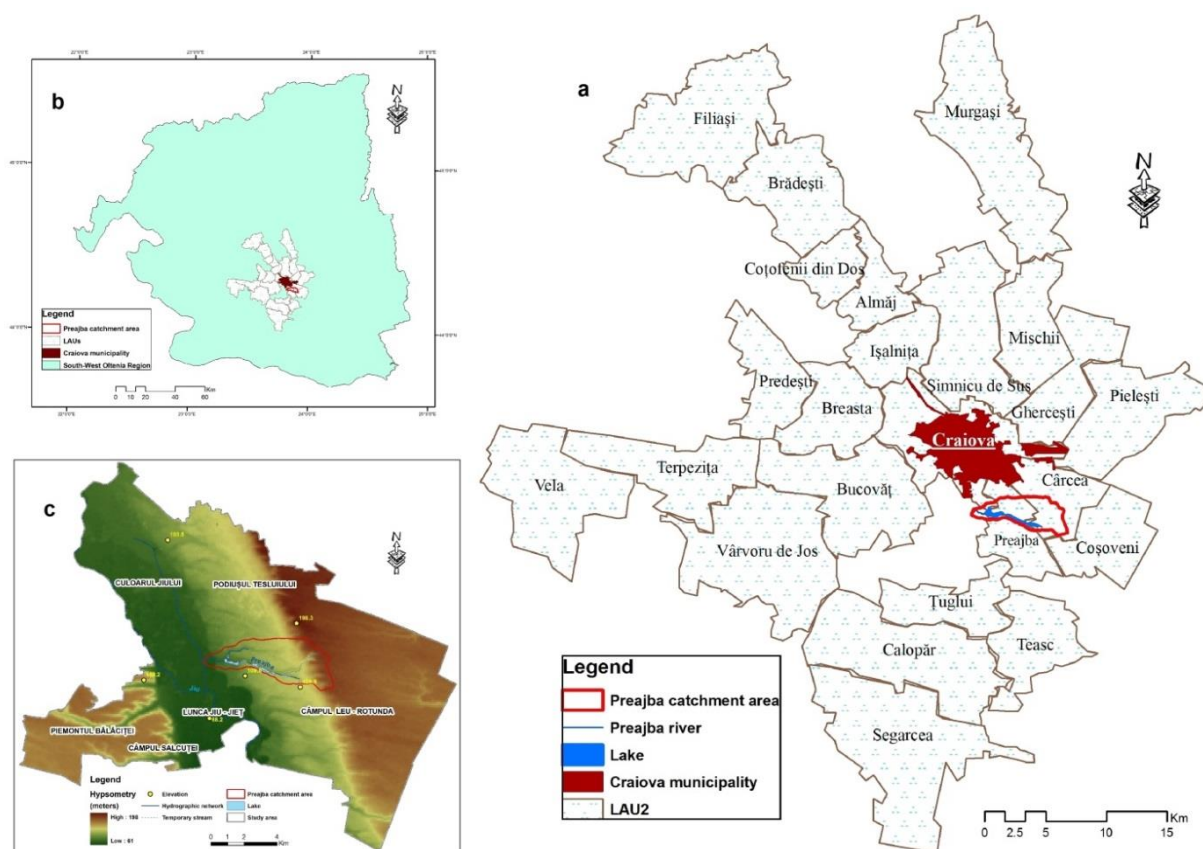


Fig. 1: Study area: a. framing in the Craiova metropolitan area; b. location within the Oltenia Region; c. hypsometric map

Preajba creek has its source near Cârcea, the difference till the point of shedding, the confluence with Craiovița collector channel being of 121.1 m. In this natural context, to provide the gravity flow of the lakes water, surface spillways and raised dams were built in front of the water bodies. Currently this area is an *Avi-faunistic protected area - Preajba-Făcăi Lacustrine Complex*, which is administered by Diana County Association of Hunters and Anglers Diana Dolj (A.J.V.P.S. Diana Dolj).

In terms of legality, the *Craiova Metropolitan Area* association was constituted in accordance with the Law of local public administration no. 215/2001, republished, Law no. 351/2001 regarding the approval National Landscaping Plan with subsequent amendments, Law no. 350/2001 regarding landscaping and town planning with subsequent amendments and following the O.G. no. 26/2000 regarding associations and foundations.

The Craiova town's Local Council Decision no. 297/27.11.2008, allowed the association of Craiova municipality initially with five communes from the northern part of the town (Mischii, Breasta, Ghercești, Șimnicu de Sus and Pielești) and later on with another 10 communes (Predești, Vârvoru de Jos, Ișalnița, Bucovăț, Țuglui, Almăj, Murgași, Terpezița, Filiași, Segarcea, Coțofenii din Față and Calopăr) and two small towns – Filiași and Segarcea. Just one neighbouring commune – Podari – was not included in Craiova metropolitan area, since its local administration decided not to become a member in order to avoid the annual financial contribution to the administrative association (Fig. 1).

Currently, Craiova Metropolitan Area has 149.862 ha, represents 20% of the total area of the county (741,400 ha), and counts 356,544 inhabitants, accounting for 54% of the entire population of Dolj county.

The expansion of residential areas involves the conversion of other land use mode into spaces for residential use, triggering a set of processes with accelerated dynamics in the conditions of continued growth in the number of inhabitants and promotion

of some housing models focused on the individual accommodation type (Stanciu, 2009). The expansion of built areas and consequently of residential areas is included in this general trend, presenting specific elements related to causes, manifestations and effects (Ioja et al., 2011a; Vânău, 2011; Verhoef and Nijkamp, 2002). Common elements of the expansion processes of residential spaces, regardless of the level of development or geographical location, lead to environmental consequences and various manifestation forms.

The geographical position of the study area in the metropolitan area of Craiova municipality constitute an element of attractiveness, both for residents and visitors, in the context of the development of food and relaxation infrastructure on the lakes shore. In terms of expansion of constructed areas, it should be noted that it is not just individual housing, but also spaces for services, the construction of which led to artificialization.

The causes of diversification of anthropogenic pressure forms on the environment are in accordance with the economic development of Craiova municipality, which determines the need for more space, i.e. the inclusion of new territories in periburban space. Also, it can be discussed about an exodus of residents with certain financial potency to rural areas surrounding town (low cost of land and commuting to the town, to work), integrating the specific urban infrastructure to the new housing.

The spatio-temporal analysis (Fig. 2) at the level of the existing cartographic materials (*General Austrian Map of the Central Europe, Military Topographic Map, Soviet Military Topographic Map*) reveal the existence of a naturally formed lacustrine cuvette, by corroborating relief's hypsometry with soil type, of limnocrane springs with level curves (Avram & Ionuș, 2015).

The extension of artificialized surfaces is a defining feature of the 21st century, but the changes they cause in the protected areas constitute violations of the law and the endangerment of flora and fauna species and related biotope.

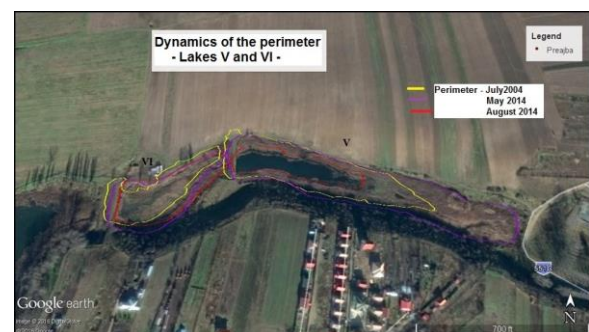
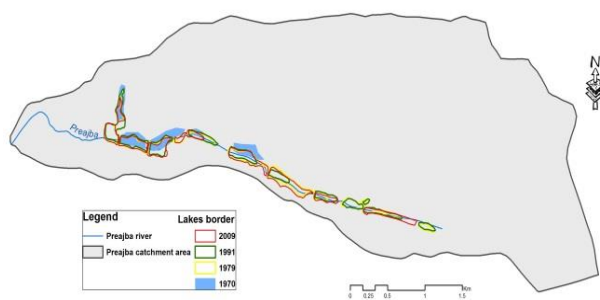


Fig. 2: Spatial and temporal dynamics of the lakes perimeter on Preajba Valley (left). Case studies: Lake V and Lake VI (right)

The habitats of community interest, which were identified in the "Natural protected area - Preajba-

Făcăi Lacustrine Complex", are specific to wetlands: R 3150 natural eutrophic lakes, R 3160 natural dystrophic lakes and ponds, biotopes the existence of which is conditioned by forces who act on the rolling movement of water. In the riverbeds, a series of dynamic phenomena (currents, speeds variations, levels variations etc.) occur, their instability being linked to the regime of rivers and morphological elements of the riverbed. The forces acting on the mass of water flowing through riverbeds: gravity, the force of Coriolis and centrifugal force trigger these processes (Loghin, 2009).

The exoreic character of Preajba creek: springs near the Cârcea locality, the shedding into Craiovița collector channel and then into the river Jiu, maintain the previously mentioned habitats.

This study is aimed primarily to local and regional authorities, because it reveals certain sanogenesis state of the lacustrine environment, part of the "Preajba-Făcăi" avi-faunistic protected area. Decision makers could take measures to preserve the characteristic landscape, by implementing measures closely with residents of the neighboring settlements. Thus, resolving the human pressure on the environment problem, even if a protected area or an area with high ecological valence is possible only through an authority – residents – tourist's synergy, for a sustainable development and an enhancement of the life quality within Craiova metropolitan area.

The research results will have the function of informing and diagnostic the environment within "Preajba-Făcăi avi-faunistic protected area", their quantification being possible by calculating some environmental quality indices and by studying the existing cartographic materials. It's also desired not only to identify dysfunctionalities, but also to propose solutions to gain a favorable conservation status. The lacks of accurate and fair demographic information, values about morphometry of the lakes, and also the lack of support from local authorities for this study, are restrictive elements in achieving the set goals.

Data and Methods

Human pressure on the environment is a synthetic indicator of its quality and of its transformation degree as a result of human intervention (Goudie and Viles, 2003; Goudie, 2006). It is considered that for an adult to have a high standard of living, in the temperate zone, it takes 2 hectares of land, which should be divided as follows: untouched natural area (0.8 ha), land used for agriculture (0.6 ha), forests (0.4 ha) and 0.2 ha of land for construction, industrial platforms and transport infrastructure (Dumitrașcu, 2006).

In this regard, to achieve results, various environmental quality indices were calculated, namely:

- index of human pressure by demographic dynamics ($Di=Inh./Sagra$);
- index of human pressure through arable land use ($S.t.A.=Sarab./Inh.$);
- naturality index ($Ni=Sforest/Stotal$) and the environmental change index [$Eci.=(Sforest+Shay)/Stotal$]

(Ioja, 2013; Zarea and Ionuș, 2012; Kimberly et al., 2007; Dumitrașcu, 2006; Pătroescu et al., 2000).

It was considered necessary to obtain not only values, but for a better understanding of the phenomena, apart from determining the values of this indices, we worked to identify a trend using the reference years 1992, 2002, 2012 and 2014.

This method has been used in literature by Călin (2010), Ionuș et al. (2011), but also by Vartolomei and Armaș (2010). Internationally, however, the issue of environmental change in morphology and physiology due to increasing human pressure has been addressed in papers belonging to Burgoyne et al. (2016). To highlight the degree of human intervention on environmental quality, we used series of synthetic indices; the quantitative value obtained being calculated based on statistical data.

The human pressure index highlights the demographic dynamics of the local administrative units analyzed, but also regarding land use, in sense of extension of built surfaces in the detriment of agricultural ones. The trend identified by calculating this previous indicator should be correlated with the residents need for food, so with the size of the arable area which is assigned for each one of these.

Agricultural land use in the areas dominated by residential is also controversial, if we consider the potential of these activities of damaging the housing quality through the use of chemicals such as pesticides or fertilizers, odours and biological risk (Holt et al., 2010; Ioja et al., 2011a; Rull et al., 2009). The dynamics of some forest surfaces for the layout of residential assemblies is another macro-territorial matter recorded in the analyzed areas, identified by calculating the naturality index. The deepening of the change ratio between natural and man-made surface was performed by analysing the environmental change index. This indicator was introduced and used for the first time by Maruszczak (1988), to assess the human impact on the Carpathian sub-landscape in Poland and then used by many Romanian authors (Armaș et al., 2003; Manea, 2003; Pătru-Stupariu, 2011; Ionuș et al., 2011; Zarea and Ionuș, 2012).

The present study includes a cartographic analysis through GIS techniques "that are becoming more commonly used in qualitative and quantitative evaluation of the environment, allowing not only the

highlighting of the environmental elements dynamics, but also their spatial distribution" (Andrews et al., 2002). The cartographic representation is conditioned by the existence of some plans, maps, satellite images, aerial photos, which can be georeferenced based on them, there results, the spatial dimension of the final products. GIS techniques are used to analyze neighborhoods (Balram and Dragicevic, 2005), overlapping thematic layers (El Baroudy, 2011) and for quantifying the

environmental status at spaces level. In this sense, the analysis of the artificialization index for Preajba basin was performed by using a grids system (1.5 km²), equivalent to 1/16 of the map sheet 1:25,000, georeferenced. Subsequently, grids were imported into Google Earth PRO using the transformation of .shp into .kml (Fig. 3). Using orthophotos (2009) and Google Earth Pro (2014) vectorization and comparison of the artificial surfaces were performed.

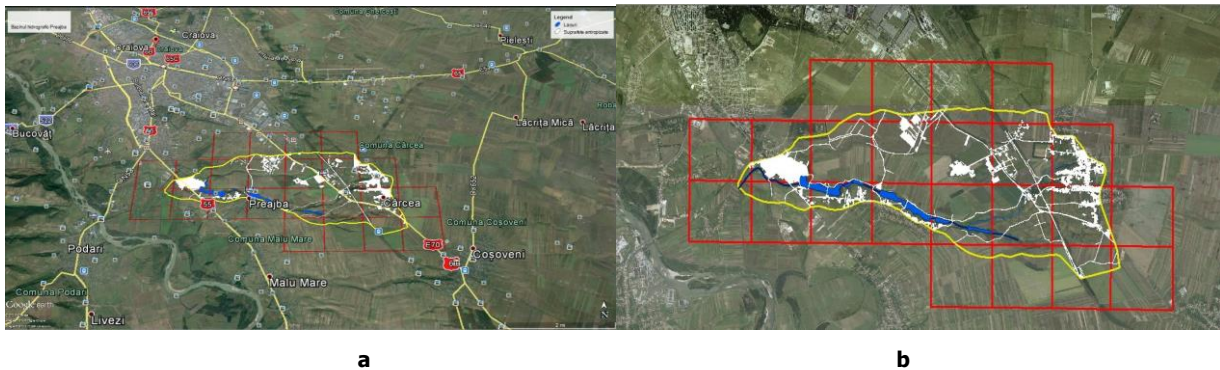
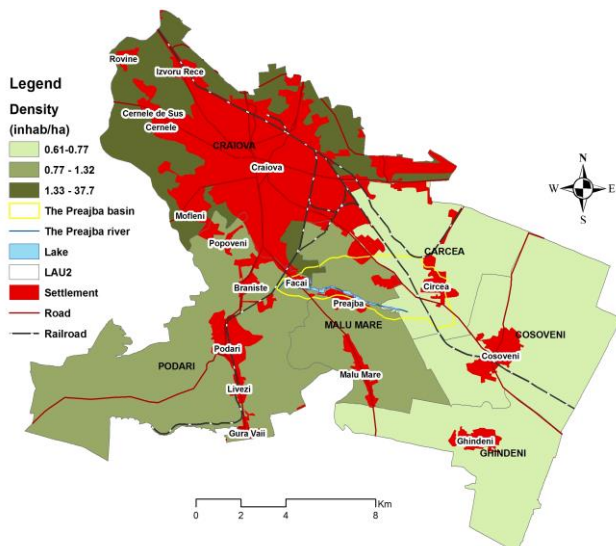


Fig. 3: Spatial dynamics of human pressure in Preajba basin using grids method: a. Orthophotos - 2009; b. Google Earth PRO - 2014

Results and Discussions

Physiological density index

The calculation of the physiological density index, as ratio between the number of inhabitants and the agricultural area reveals the existence of three classes of values: 0.61-0.77 inh./ha, 0.78-1.32 inh./ha and 1.33-37.7 inh./ha (Fig. 4).



(Source: GIS processing; Tempo Online data)

Fig. 4: Spatial variation of the physiological density in the study area, year 2014

The greatest human pressure through agricultural areas is felt in the northern extremity of

Preajba basin, an area that overlaps a neighborhood of Craiova (Făcăi neighborhood). The expansion of human settlements usually occurs in peripheral areas with favorable environmental qualities (Primack et al., 2008), at least initially. As the territorial expansion continues, new spaces (unmodified, little modified or unbuilt) are included in the suburbs, while on the previous positions the anthropization process is practically irreversible (Antrop, 2004; Tissot et al., 2005). Thus, it is noticed the temporary nature of environmental favorability offered by the peripheral areas, but with negative implications on the natural environmental characteristics and the inhabitants' life quality (northern extremity of Preajba basin) (Fig. 5).



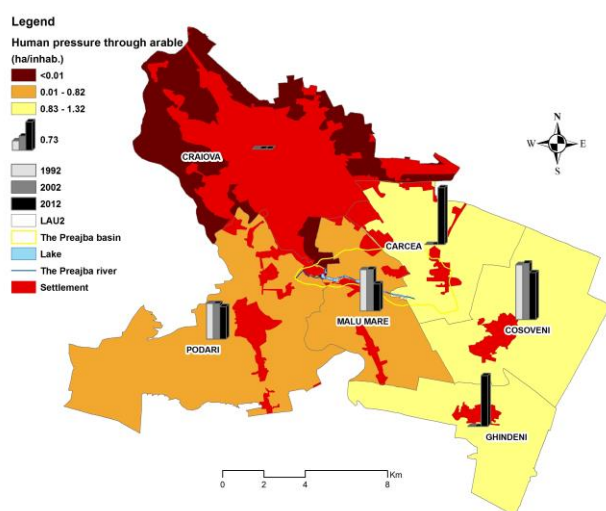
(Avram M., March 2016)

Fig. 5: Improper storage of household garbage in the northern extremity of Preajba basin – Magnolia residential area

The human pressure through arable

The human pressure through arable index (ha/inh.) is revealing in terms of decreasing arable

land surfaces in the detriment of areas occupied by constructions, but also in terms of growing number of residents in the settlements that overlap Preajba-Făcăi protected area. Thus, the downward dynamics of this parameter may be linked to an increased human impact on the environment. Minimum values obtained at the level of 2014 (under 0.01 ha/inh.) characterize Făcăi neighborhood, while to Coșoveni inhabitants are assigned 0.83-1.32 hectares of arable land (Fig. 6). In this context, we can say that there is an undeniable link between the regional pole of attraction that is Craiova municipality and the increase of demographic density, and residential at its periphery. But, by creating shelter for new inhabitants, the new residential areas have automatically introduced forms of aggression specific for household sources, i.e. consumption of resources and generation of environmental problems (Vânău, 2011).



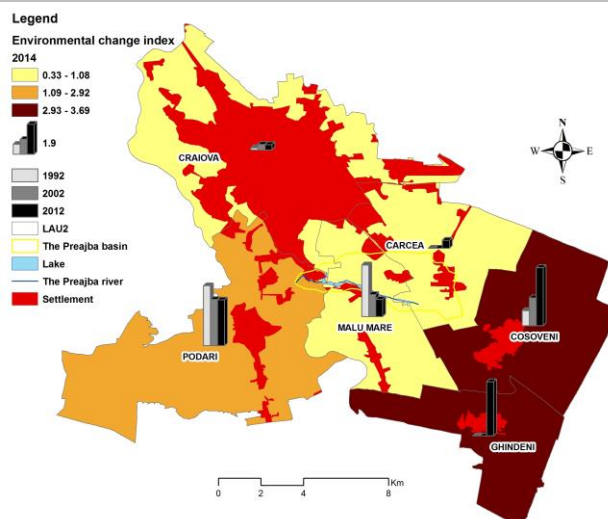
(Source: GIS processing; Tempo Online data)

Fig. 6: Human pressure through arable, 1992-2014 period

Environmental change index

Values of the environmental change index for 1992, 2002, 2012 and 2014 dramatically declined, which testifies for the expansion of the artificialized areas. This *de facto* state is best evidenced in Malu Mare, with values between 0.33-1.08 (Fig. 7). It should be noted that the administrative division made in 2004 prevented us from obtaining data for Cârcea and Coșoveni local administrative units which became distinct local administrative units in accordance with Law 5/2004.

The environmental change index is a parameter with major functions: to generate vital information on the current status or viability of residential spaces, on one hand, and on the role of residential spaces in structural and functional changes of other systems with which they interact, on the other hand (Pătroescu et al., 2012).



(Source: GIS processing; Tempo Online data)

Fig. 7: Environmental change index dynamics, 1992-2014 period

Naturality index

The naturality index, the ratio between the area occupied by forests and the total area, reveals the actual situation of Preajba basin and related settlements, the decrease of forest areas. The situation highlighted by this parameter is a dramatic one, with maximum values of 6.10% of the areas on which trees and brushes are grafted (Fig. 8). This indicator should be linked on one hand with the expansion of the residential area and hence the need for building space (Fig. 9), and on the other hand with the expansion of arable land to meet the needs of residents for food. As a result, the increase of built surface induced major changes in land use, redistribution of the population which is a consumer of goods or generator of waste, loss of neighborhood's personality or villages and changing the structure of oxygenated surfaces (Chiesura, 2004; Daniels, 1999; Eisner et al., 1992; Hui et al., 2007).

Artificialization index

Regarding the graphical analysis, Orthophotos 2009 and Google Earth Pro 2014 cartographic documents were used. Analysis of the mentioned issue involved vectorization of anthropogenic surfaces and overlapping a 1,5 km² grid in diameter over Preaja basin, thus resulting 23 equal surface areas. Those two reference years were benchmarked (absolute value and percentage) by reference to a common class of values. The results show an upward dynamic of the artificialization index: 7 polygons with value of this parameter between 32.04-54.11% in 2014 and two in 2009 (Fig. 10). The anthropogenic areas (residences, household annexes, access roads etc.) increased by 22%, meaning automatically a shrinking of natural areas.

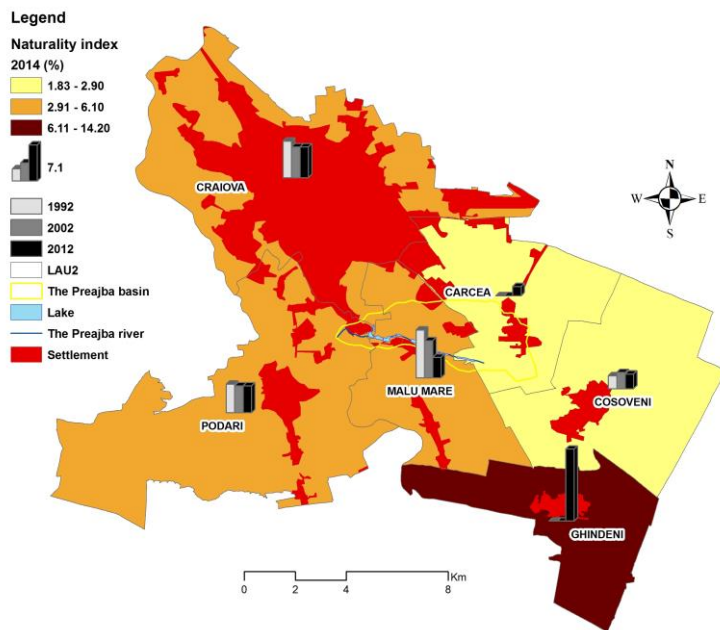


Fig. 8: Naturality index dynamics, 1992-2014 period

(Source: GIS processing; Tempo Online data)



Fig. 9: New constructions of Magnolia residential area

(Avram M., March 2016)

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Expanding vegetation at the expense of water bodies determines chemical-physical imbalances of stagnant organisms, which entails a reduction in the number of species that constitute ichthyofauna. Also, the deforestation of the slopes is causing denudational processes, the most important being rill surface washing and landslides. These hazards constitute limiting factors in terms of tourist attractiveness of the area, along with household waste disposal on the bank and even into lakes.

Maintaining the significant or characteristic features of a landscape, justified by its heritage value derived from its natural configuration and/or

human intervention, include actions aiming at a sustainable development perspective, landscape maintenance in order to target and harmonize changes induced by social, economic and environmental developments (Călin, 2010).

Thus, the values of the artificialization index (5 classes) point to the landscape equilibrium or disequilibrium, i.e. totally affected ecological balance (32.04% - 54.11%); strongly affected ecological balance (11.64% - 32.03%); moderately affected ecological balance (5.61% - 11.63%); slightly affected ecological balance (1.45% - 5.60%); relatively stable ecological balance (<1.44%).

Insularity index

The implications of this parameter, but also of the other indicators mentioned above at the level of Preajba-Făcăi Lacustrine Complex, are extremely important and reveal a steady trend in anthropic expansion and thus diminishing natural areas. Strictly at the lakes level, there can be forecasted changes in the specific biotope due to land use change in bordering terrains, but also an extension of hydrophilic vegetation in the detriment of water bodies (Fig. 11, 12).

Thus, there are noted values of over 80% vegetation for the lakes V and VI, in 2004, but also in 2014 (May and August). There is an upward trend of the vegetation for lakes III, IV, VI and X (Fig. 13), while the situation for lacustrine basins I and IX is atypical. The novelty regarding the lakes previously

mentioned is the existence of a downward dynamics of the vegetation, which shows their regular cleaning. The first lacustrine basin of Preajba lacustrine complex is the only one arranged for fishing. The

access for people who want to fish in the first lake is permitted only after they pay a tax, so it is in the interest of administrators to prevent clogging and eutrophication of lacustrine basins (Fig. 14).

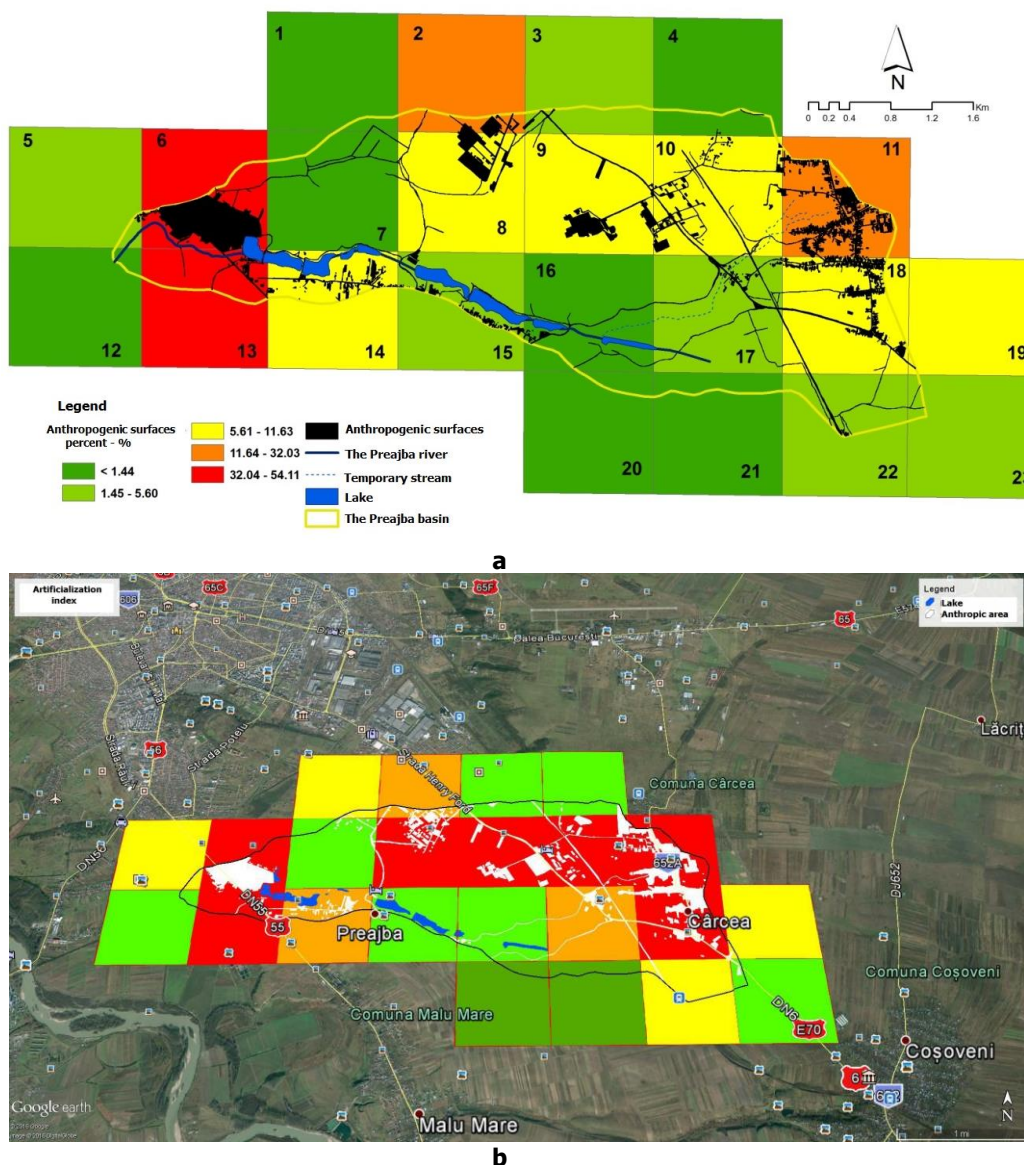


Fig. 10: Spatial dynamics of artificialization index within the Preajba basin: a. Orthophotos – 2009; b. Google Earth PRO – 2014



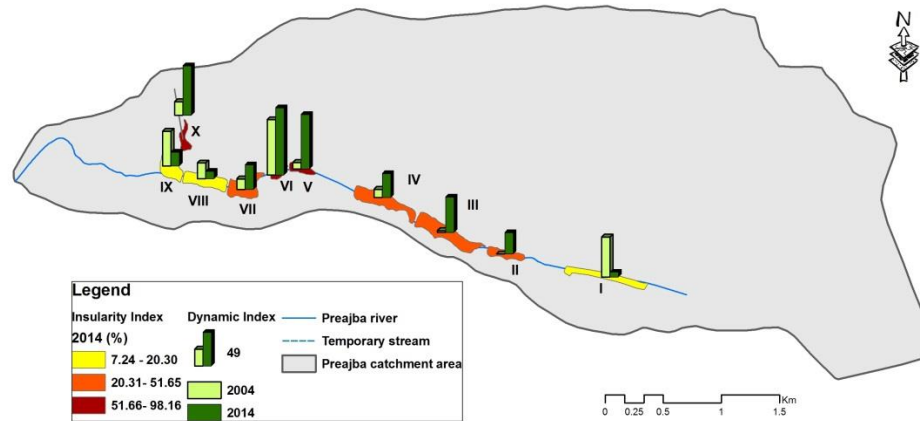
(Avram M., April 2016)

Fig. 11: Vegetation (*Typha*) expansion in Lake V



(Avram M., April 2016)

Fig. 12: Vegetation (*Typha*) expansion in Lake VI



(2004 and 2014 values, source Google Earth PRO)

Fig. 13: The variation of insularity index values of the lakes on Preajba Valley



Fig. 14: Spatial and temporal distribution of perimeter and vegetation - Lake V and Lake VI (mappings from 2004 - left and 2014 - right, source Google Earth PRO)

The sanogenesis condition of the lakes on Preajba Valley may correlate with the dynamics of hydro and hygrophilic vegetation. To quantify the evolution of plants in relation to the water body in

the study area, we calculated the insularity index. This parameter renders the share of hydrophilic vegetation from the total surface of the lacustrine surface (Table 1).

Table 1: Temporal dynamics of the insularity index – Preajba lacustrine complex

(%)	I	II	III	IV	V	VI	VII	VIII	IX	X
2004 Iul	58.52	0	2.37	11.95	9.31	80.67	15.62	23.04	50.77	19.67
2014 Mai	7.24	47.7	35.66	34.83	90.74	70.85	29.25	71	42.59	62.89
2014 Aug	7.24	31.2	51.66	35.14	79.26	98.17	36.22	10.95	20.31	72.28

(Source: Google Earth PRO data extraction)

The environmental conflict, in general, and the one of Preajba lacustrine complex is characterized by the following dimensions: the spatial dimension or place of event; temporal dimension or time event; environmental dimension and the socio/economic one. In particular, the conflict in the study area is manifested throughout the protected area, due to the divergent interests of residents on one hand and

environmental policies and legislation regarding the status of the study area, on the other hand. Regarding the outbreak moment of disagreement between the warring parties, it can be considered the year 2000, when the lakes on Preajba Valley have received the "avi-faunistic protected area" status.

The environmental dimension is not related only to the negative effects of some anthropic activities

on the environment's structure and functionality, but also the accordance with the principles of environmental law, objectives of environmental policies and strategies and compliance with environmental legislation.

Conclusions

The study area corresponds to class V considering the IUCN classification, and in these protected areas it is recommended that all economic activities should be carried out with particular attention to the values for which they were granted this status (Stanciu and Florescu, 2009). In this context, in the study area economic and touristic activities should be allowed in the extent that these don't cause imbalances to the characteristic flora and fauna.

The results of this study are intended to be not only an environmental analysis, but also a useful analysis to local authorities, showing a real situation that will be positively changed by taking concrete and immediate measures. Although the expansion of built areas is a feature of the development of the society, in the studied area, this might be made respecting the avi-faunistic protected area status, namely opting for reducing environmental impact. It's heady necessary to establish strict criteria for the granting of building permits, as well as how these are realized, whereas the anthropic expansion in a 20% per 5 years progression will lead to the disappearance of the area in the next 25 years.

Human activity materialized through residential areas, agricultural activity or with applications in the tertiary domain should become striving for the harmony of human-environment co-existence.

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