

# Anthropic impact on the archaeological sites reflected in geospatial analysis. Study case: Ilfov County

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**Abstract:** *The spatial dimension of human behavior is an important research field in archaeology. The methods and techniques related with geomatics, especially GIS (Geographical Information System), are useful tools for archaeologists. The present study aims to analyze the anthropic impact on the archaeological sites in the Ilfov County, based on the data that covers a 150 years period (1864 – 2015) are used. Along with assessing anthropic impact, this paper presents a methodology of work which can be used in urban planning, in order to minimize uncontrolled losses on heritage.*

**Rezumat:** *Dimensiunea spațială a comportamentului uman a fost și este una dintre direcțiile importante de studiu în arheologie. Metodele și tehnicile de lucru care țin de domeniul geomaticii, în special GIS, sunt pentru arheologi un instrument util cu ajutorul cărora se pot examina seturi de date voluminoase în context spațial, abordare propusă și în articolul de față. Studiul prezentat a avut ca scop o analiză a impactului antropic, în ultimii 150 ani (1864 – 2015), asupra siturilor arheologice din județul Ilfov, utilizând seturi de date disponibile în spațiul public. Concomitent cu evaluarea impactului antropic, lucrarea de față prezintă o metodologie de lucru care, utilizată frecvent în alte domenii, în etapele de analiză a peisajului poate ajuta la diminuarea pierderilor în domeniul patrimoniului.*

**Keywords:** *Ilfov County, archaeological sites, anthropic impact, GIS analyses.*

**Cuvinte cheie:** *Județul Ilfov, situri arheologice, impactul antropic, analize GIS.*

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## ◆ Introduction

The spatial dimension of the human behavior is one important topic in archaeological research. The methods and techniques used in geomatics, especially GIS, are a very useful instrument for archaeologists, allowing them to examine large sets of data in spatial context.

This paper aims to analyze the anthropic impact, in the last 150 years (1864-2015), upon archaeological sites from Ilfov County. The data regarding the archaeological sites were taken from two data bases for archaeological sites in Romania, the National Archaeological Record of Romania (RAN)<sup>1</sup> and the List of Historical Monuments (LMI)<sup>2</sup>. Both of them are managed by the National Institute for Heritage. Another source of data was represented by the archaeological reports of the Ilfov County Department for Culture and National Heritage (DJC Ilfov). The archaeological reports for the years 2008–2009 were used for this study<sup>3</sup>.

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<sup>1</sup> RAN is a public database, until recently managed by the Institute of Cultural Memory (CIMEC); data provided can be found at <http://ran.cimec.ro>.

<sup>2</sup> LMI is updated every five years; the last update was made in 2010 and is available online at <http://www.cultura.ro/page/17>.

<sup>3</sup> Data provided by the Ilfov County Department for Culture are being processed; so far, only the data for 2008 year were finalized.

Ilfov County covers an area of 1583 km<sup>2</sup> (the area calculated according to GIS is 1564.2 km<sup>2</sup>). Its position around the capital city of Romania had many effects during time and influenced its evolution, not exactly in a positive way. This is how the successive changes in the administrative-territorial organization of the county in the last 150 years added or eliminated large areas of the county territory (M.Ș. Florea 2015, p. 343). With such a dynamic, any statistic applied to this county should take in consideration these facts.

A series of facilities already encouraged this study. Many of the used data sets, official and unofficial, are available on the internet for free. More data were added through the Government related institutions (ANCPI<sup>4</sup>, DTM<sup>5</sup>, DJC<sup>6</sup>, town halls) who kindly offered the requested information. Least but not last, the easy access to open source softs from the geomatics<sup>7</sup> area allowed the data integration, management and interrogation. The official data is offered by RAN, LMI, ANCPI, DTM and CORINE<sup>8</sup>. The unofficial data, accessed through specialized sites, often represent the results obtained mostly within research projects or through non-government organizations or even personal achievements. The following sources were used entirely or partially: *Charta 1864*<sup>9</sup>, *Historical Maps of the Habsburg Empire*<sup>10</sup>, *Planurile Directoare de Tragere*<sup>11</sup>, *GEOIDEA*<sup>12</sup>. Among the personal projects from web we can mention the following address <http://www.pug-puz.ro/><sup>13</sup> from where the data regarding the General Urban Plans (PUG) of Ilfov County were filtered.

### ◆ The geographic and administrative frame

Located in the South-East part of Romania, in the middle of the Romanian Plain, Ilfov County is surrounded by Dâmbovița County to the North-West, Prahova County to the North and Ialomița County to the North-East. Giurgiu County to the South-West and Călărași County to the South-East represent mostly territories of the former Ilfov County which was previously spreading up to Danube River.

Regarding the relief, Ilfov County belongs to the Romanian Plain with its three distinct sub-divisions, *Vlăsia Plain* in the North side, *Burnas Plain* in the South-East side and *Mostiștea Plain* in the East side. A comprehensive description of the area and its particularities was performed by Vintilă Mihăilescu in the paper *Vlăsia și Mostiștea. Evoluția*

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<sup>4</sup> National Agency for Cadaster and Land Registration.

<sup>5</sup> Directorate for Military Topography.

<sup>6</sup> Ilfov County Department of Culture and National Heritage.

<sup>7</sup> The most used for the present study was QGIS program that has numerous applications for the spatial analysis in general and applications dedicated for archaeology in particular (<http://www.qgis.org/en/site/>).

<sup>8</sup> Coordination of Information on the Environment. 2000 edition - <http://www.geo-spatial.org/download/datele-corine-landcover-reproiectate-in-stereo70>; 2006 edition - <http://www.eea.europa.eu/data-and-maps/data/clc-2006-vector-data-version>.

<sup>9</sup> Digital approaches in cartographic heritage: digitizing, georeferencing and publishing on web of the "Charta României Meridionale" - <http://www.charta1864.ro>.

<sup>10</sup> Several projects were combined into a single result, namely digitization of the historical maps of the Habsburg Empire; available at <http://mapire.eu/en>.

<sup>11</sup> <http://www.geo-spatial.org/download/planurile-directoare-de-tragere>.

<sup>12</sup> <http://geoidea.ethz.ch/> (data were used by Web Map Services method).

<sup>13</sup> The site is not permanently operational and some data may be removed by the owner (accessed during September - October 2015).

*geografică a două regiuni din Câmpia Română: Mostistei and Vlasiei plains are part from the central area of Romanian plain, were the largest number of valleys with waters was gathered and with a peninsula with more atmospheric humidity, a largest advancement of the forest toward the Danube, between two steppe lands and with the largest agglomeration of the villages and population from the hills and Danubian meadow.* (V. Mihăilescu 1925, p. 3). In the above mentioned paper there are also the limits of the two sub-divisions of the Romanian Plain (V. Mihăilescu 1925, p. 5, fig. 1; p. 9, fig. 2).

The hydrographic network cuts the county in a diagonal line, from North-West to South-East, having Dâmbovița and Colentina as main artery, Sabarul and Ciorogârla in South, Pasărea, Cociovaliștea and Vlășia in North. The hydrographic network is completed by the river edge type lakes (Bălteni, Snagov, Căldărușani) from Snagovului Plain (I. Ujvári 1972, p. 467; P.V. Coteș 1976, p. 188; vezi fig. 1).

Nowadays, Ilfov County counts 105 localities (from which 8 towns - Bragadiru, Buftea, Chitila, Măgurele, Otopeni, Pantelimon, Popești Leordeni and Voluntari) grouped in 40 communes (fig. 2).

The socio-economic characteristics of the Ilfov County are strongly influenced by its position near the capital city of Romania. Not long before, this county also included Bucharest in its administrative structure. For a long period of time, the only towns in the Ilfov County were Bucharest and Oltenița. Therefore, all the administrative institutions of the county are nowadays located in Bucharest.

The traditional cultural landscape of the Ilfov County included various types of vegetation representative for the ancient forms of agroforestry<sup>14</sup>, farmlands, grasslands for the animal husbandry, more or less wooded grasslands with natural forest element, deforested areas and areas with controlled forest exploitation<sup>15</sup> (P. Angelstam 2006, p. 125). Several modifications appeared during time in the landscape of Ilfov County and they can be structured in a few stages. In the first decade of the 20<sup>th</sup> century Ilfov County<sup>16</sup> is characterized by the existence of small and numerous settlements, surrounded by large forested surfaces and spread along the water courses<sup>17</sup>. An explication is given by V. Mihăilescu, who reminds of the recent alluvial deposits which formed limited gravel bars so the land for agriculture and settlement were restricted, leading to strong agglomerations (V. Mihăilescu 1925, p. 78). In the period after First World War until the 90's, there was a rising of the surface of agricultural land by deforestation and draining of some surfaces with humidity excess<sup>18</sup>. Also, this is a period characterized by strong industrialization. Agriculture on large surfaces almost disappeared after the 90's and until present day and the land is used for developing real estate investment projects and infrastructure works.

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<sup>14</sup> The term is very actual today and refers to the integration of the agroforestry systems (trees) in the areas of arable soils with the aim to improve the quality of soil and to reduce the erosion of biodiversity.

<sup>15</sup> Reference to the areas where the old trees were felled but the roots were retained and the obtained shoots were controlled for the development of the young forests.

<sup>16</sup> A Europe-wide analysis (P. Angelstam 2006).

<sup>17</sup> This image is very well captured in the Third Topographic survey of the Habsburg Empire (V. Crăciunescu 2006).

<sup>18</sup> This was the aim of the field research undertaken in the northern part of the County by Vasilica Sandu between the years 1986-1987 (V. Sandu 1992, p. 289).

In the actual context, a very strict record of what can be recovered from the already known archaeological sites and from those recorded during various occasions<sup>19</sup>, for the purpose of their protection / conservation, needs new strategies based on modern methods (GIS, photogrammetry etc.) and interdisciplinary approaches (C. Borș 2014, p. 142-147). The present paper, together with the evaluation of the anthropic impact on archaeological sites in Ilfov County, presents a methodology frequently used in other fields, which take in consideration the analysis of certain areas from the point of view of ecology, environment, urban landscape etc. and which can help the local and central authorities in order to diminish the loss in the field of immobile cultural heritage represented here by the archaeological sites (C.E. Ștefan, M.Ș. Florea 2010; L. Măruia *et alii* 2011; R.C. Stoiculescu *et alii* 2014).

### ◆ Methodology

The following sets of sources were used in this paper: data regarding the archaeological sites from Ilfov County, geospatial data regarding the administrative structure, the hydrographic network and relief, statistical data and maps (historical and modern).

A data base was created in the first part of this study, where the archaeological sites from Ilfov County were uploaded. All the data was extracted from LMI, RAN and the archive of DJC Ilfov.

The integration in GIS of the archaeological sites needed the official administrative-territorial data (UAT<sup>20</sup>) of Ilfov County. They were extracted from the data base published by ANCPI<sup>21</sup>. Because the RAN and LMI database does not include the limits of archaeological sites, their spatial representation was interpreted using the descriptive texts presented in the field named *adresă* (address) and defined in GIS as a point type vector. The information from the DJC Ilfov archive allowed the localization of surfaces on which archaeological excavations were carried on, but they do not give more information regarding the limits of the archaeological sites. The situation is the same for the other sources<sup>22</sup>, which did not provide a much clear situation regarding the sites limits.

The information about the land use in Ilfov County was extracted from CORINE Land Cover<sup>23</sup> (A-I. Petrișor 2011). CORINE represents the European reference data set for land use (coordinating the information about environment), a project which generated vector type files grouped in 44 classes and presented as a cartographic product at a 1:100 000 scale. For the present analysis the archaeological sites from Ilfov County were linked with CORINE data in order to follow the tendency of environment changes in the nearby of archaeological sites.

The demographic evolution was taken from the statistical data of the census from the years 1912, 1948, 1992 and 2011, provided by The National Institute for Statistics.

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<sup>19</sup> For example, the historical studies performed to achieve the PUGs (V. Sandu 2013, p. 66-67).

<sup>20</sup> Administrative territorial units.

<sup>21</sup> Data, available at web <http://geoportal.ancpi.ro>, were obtained at request in 30.04.2014.

<sup>22</sup> I referred in particular at the PUGs to which I had access; mostly they do not offer geographical coordinates and use, as the limits of the archaeological sites, underlining or drawings based on the descriptions founded in the published historical studies.

<sup>23</sup> When offered as an archive, these data are named CLC, CORINE Land Cover.

The maps used in this paper are as following: *Charta României Meridionale, Planurile Directoare de Tragere*, the maps of the Third Topographic survey of the Habsburg Empire, the *Topographic Map of Romania* (1:25000 scale and orthophotoplans (2010 edition) obtained from Directorate for Military Topography (DTM).

### ◆ Results and discussions

From the LMI database were extracted 568 records belonging to the archaeological sites from Ilfov County. Corroborated with the sites files from RAN database available until December 2015, they were grouped in a number of 206 points distributed on the territory of 39 communes<sup>24</sup>. The spatial distribution of the archaeological sites had as starting point the analysis carried out in the project entitled „Archaeological landscape. Outlook, History, Evolution”, funded by the National Cultural Fund Administration (AFCN) in the 2014 session of the cultural projects, with related updates in 2015<sup>25</sup> (fig. 3).

The analysis of the 206 sites from RAN and LMI databases, which represents the official record of the county, indicates differences from the real situation. This difference resulted from the comparative analysis with the data from:

(1) Field walking in Northern side of the county made by V. Sandu in 1987-1988 (V. Sandu 1992); its results, even though they were published, weren't totally integrated in LMI and RAN (fig. 4);

(2) The results of archaeological excavations made on the basis of the authorizations for construction from the DJC Ilfov archive. For the year 2008 there are 42 reports on rescue archaeological excavations and surveillance. In 80% of the mentioned cases the results of the archaeological excavations confirm the descriptions from the site file found in RAN and LMI databases (but not the exact location and area). The rest of 20% do not confirm the site file, partially (correct location but no archaeological traces were found / location is wrong but there are archaeological traces, indicating the existence of another site) or entirely (the location was wrong and there are no archaeological traces). The location referred to in this document type is the official one, offered by RAN and LMI. In each authorization issued by the related authorities, both RAN and LMI codes are mentioned.

(3) Historical studies made for the renewal of each commune PUG present differences regarding the recorded sites and the sites registered in RAN and LMI.

(4) In the case of the archaeological sites of necropolis type, which are hardly traced during field researches, it is even more difficult to estimate their limits. In this regard the excavations from Crețuleasca<sup>26</sup> can be mentioned, where an archaeological site was known (RAN 105437.01, LMI IF-I-s-B-20254) but after field walking and sondages the necropolis was still not found. The rescue excavations in the area of the future A3 highway (București – Brașov, București – Moara Vlăsiei segment) revealed, among other archaeological complexes, an inhumation necropolis with 271 graves. Archaeological researches were made only on the

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<sup>24</sup> By data plotting no archaeological site was allocated on the Nuci commune area.

<sup>25</sup><http://peisaje-arheologice.ro/index.php/concept/studii-de-caz/harta-siturilor-arheologice-din-judetul-ilfov>.

<sup>26</sup> Campaign 2010 - <http://cronica.cimec.ro/detaliu.asp?k=4632&d=Cretuleasca-Stefanestii-de-Jos-Ilfov-2010> and campaign 2011 <http://cronica.cimec.ro/detaliu.asp?k=4880&d=Cretuleasca-Stefanestii-de-Jos-Ilfov-malul-drept-al-vaii-Pasarea-km-7+900--8+250-2011>.

perimeter marked by the highway project, the rest of the area being investigated only by surface researches.

The analysis of LMI and RAN databases correlated with DJC Ilfov archive shows the impossibility to determine the area of archaeological sites because most of them are described as a point in space. There are only few information regarding the sites dimensions, more precisely their area. Accordingly, the analysis of human impact on archaeological sites can be made only when the surfaces are large enough<sup>27</sup>. The analysis on small size surfaces, like the archaeological investigations made as a consequence of the construction of an individual dwelling, can hardly reveal how much of an archaeological site was affected and which is its position within the site. These elements can be very useful for developing the strategies of collaboration between local/ central authorities and investors, when the existence of a site is known in an area which is about to be developed.

Regarding the analysis based on CORINE data, the representation for Ilfov County revealed the great degree of fragmentation of the land use. Forests, with large surfaces, were good interpreted by CORINE analysis. As for areas with constructions, it looks like there are only two main surfaces, but actually there are many, not so well individualized as they are aleatory and fragmentary distributed. These observations indicate that, for Ilfov County, the CORINE files can be used only in the analysis of surfaces with forests. The surface interpreted by CORINE as being covered by forests is of 26000 Ha, value which is very close to the one offered by DTM topographical map, second edition, 1980. Using the analysis of some historical maps, by comparative methods, we could extract the surface and distribution of forests for this county in the studied period. The surface of forests determined by the *Charta 1864* is 55965 Ha and their spatial distribution within the county does not indicate major differences compared with nowadays situation. The differences appear only at ground level (fig. 5). By correlating these data with the archaeological sites distribution it can be noticed that many of the sites from Northern Ilfov County were naturally protected for a long period. Once the land use changed (pastures, agricultural lands, residential complexes), this protection diminished and even vanished in some places.

Another type of analysis realized with geospatial instruments had as base the satellite images, aerial images and the orthophotoplans. It was applied for a series of sites which were selected from DJC Ilfov archive, sites which were affected by rescue archaeological researches imposed by projects of land development (real estate projects, infrastructure projects).

From the sites affected by archaeological excavations in order to develop great residential projects, we present here the *archaeological site*<sup>28</sup> from Balotești (com. Balotești) and *archaeological site from Buftea*<sup>29</sup> (Buftea town).

In the case of *Balotești Site* (O. Țentea *et alii* 2010) the archaeological investigation was made in the site having as code RAN 100978.02 and LMI IF-I-s-B-15142 but the residential project was not finalized. The surface investigated by archaeological excavations was cca. 3 Ha from the 20 Ha which is the estimated entire surface of the site. Even though it covered a consistent surface of the site, the archaeological research did not managed to offer some relevant conclusions regarding the dimensions of that settlement (O. Țentea *et alii* 2010, p. 184-185). Only a few individual residences were constructed after the excavation were done

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<sup>27</sup> This occurs whenever works at real estate projects or infrastructure plans (highways) are started.

<sup>28</sup> This is the name of the archaeological site in LMI 2010.

<sup>29</sup> This is the name of the archaeological site in LMI 2010.

in 2008 (fig. 6) as revealed by the satellite images investigated through Google Earth. In this case, the issue of site preservation is no longer a question, but that of the valorization of the archaeological materials found during field work and excavations.

As for the site in Balotești, in the case of *Buftenă archaeological site* (Buftenă town) - "La Cârna" archaeological researches were also carried on in 2007. The research affected 5 Ha of the estimated cca. 30 Ha surface of the site, because a residential complex was developing in the area. According with the material discovered in the 16 archaeological complexes, the file of the site from "La Cârna"<sup>30</sup> was confirmed. The site limits and amplitude of inhabited area in that zone remained unknown. The archaeological report in 2012 mentions the existence of Bronze Age materials, which can be added to the site file<sup>31</sup>.

Other major projects of land development (road infrastructure, industrial development) that affected Ilfov County on its entire surface are the highways București-Brașov and București-Constanța.

București-Brasov is another project that changed entirely the landscape and passed through two archaeological registered in RAN and LMI: Crețuleasca (RAN Code 105437.01, LMI code IF-I-s-B-20254) and Moara Vlăsiei (A. Frînculeasa *et alii* 2014). The effects are still felt nowadays because of the works of infrastructure (highway interchanges) between localities that are placed near sites. București-Constanța highway affected the archaeological sites from Vadul Anei, Tînganu and Cernica (E.S. Teodor 2011).

A comparison between the data of some census made in the studied period revealed that the demographic growth (V. Mihăilescu 1925, p. 89-91) is the main factor that affects the archaeological sites. The extension of urban surfaces in an area which until recently was far away from localities, will permanently create stress upon immobile cultural heritage.

## ◆ Conclusions

In this paper we present an approach less used in the archaeological field in Romania, in order to evaluate the anthropic impact upon archaeological sites. We used the combined analysis of CORINE data with the spatial distribution of archaeological sites. The analyzed data, extracted from the official RAN and LMI databases, correlated with DJC Ilfov archive, highlighted that the extension of urban surfaces correlated with the demographic growth represent the most important factor of the anthropic impact on archaeological sites. This generates during time a radical change in the nearby area of constructions and a diminishing of the archaeological sites surface. Nowadays, few sites from Ilfov County can still be found outside localities.

Considering the protection and preservation of archaeological heritage, more precisely the diminishing of uncontrolled damage of archaeological sites, the methodology presented in this paper could be added to the preliminary studies made in the initial stages of the major projects of land development in Ilfov County.

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<sup>30</sup> The results of the excavations and the investigated areas were extracted from the report obtained from the DJC Ilfov.

<sup>31</sup> <http://cronica.cimec.ro/detaliu.asp?k=4998&d=Buftenă-Ilfov-La-Carna-2012>.

### ◆ Acknowledgments

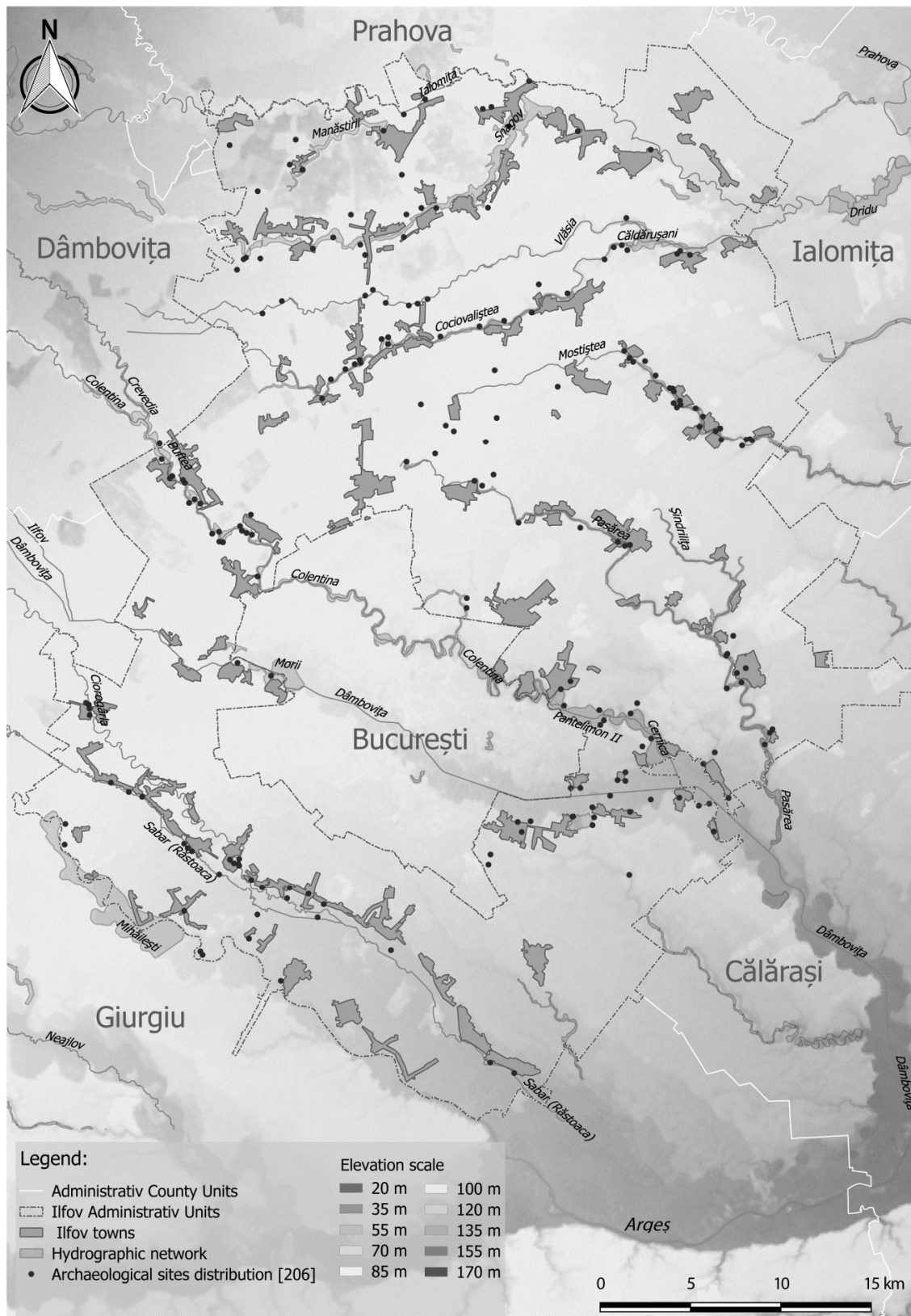
This work was supported by the project “Interdisciplinary excellence in doctoral scientific research in Romania - EXCELLENTIA” co-funded from the European Social Fund through the Development of Human Resources Operational Programme 2007-2013, contract no. POSDRU/187/1.5/S/155425.

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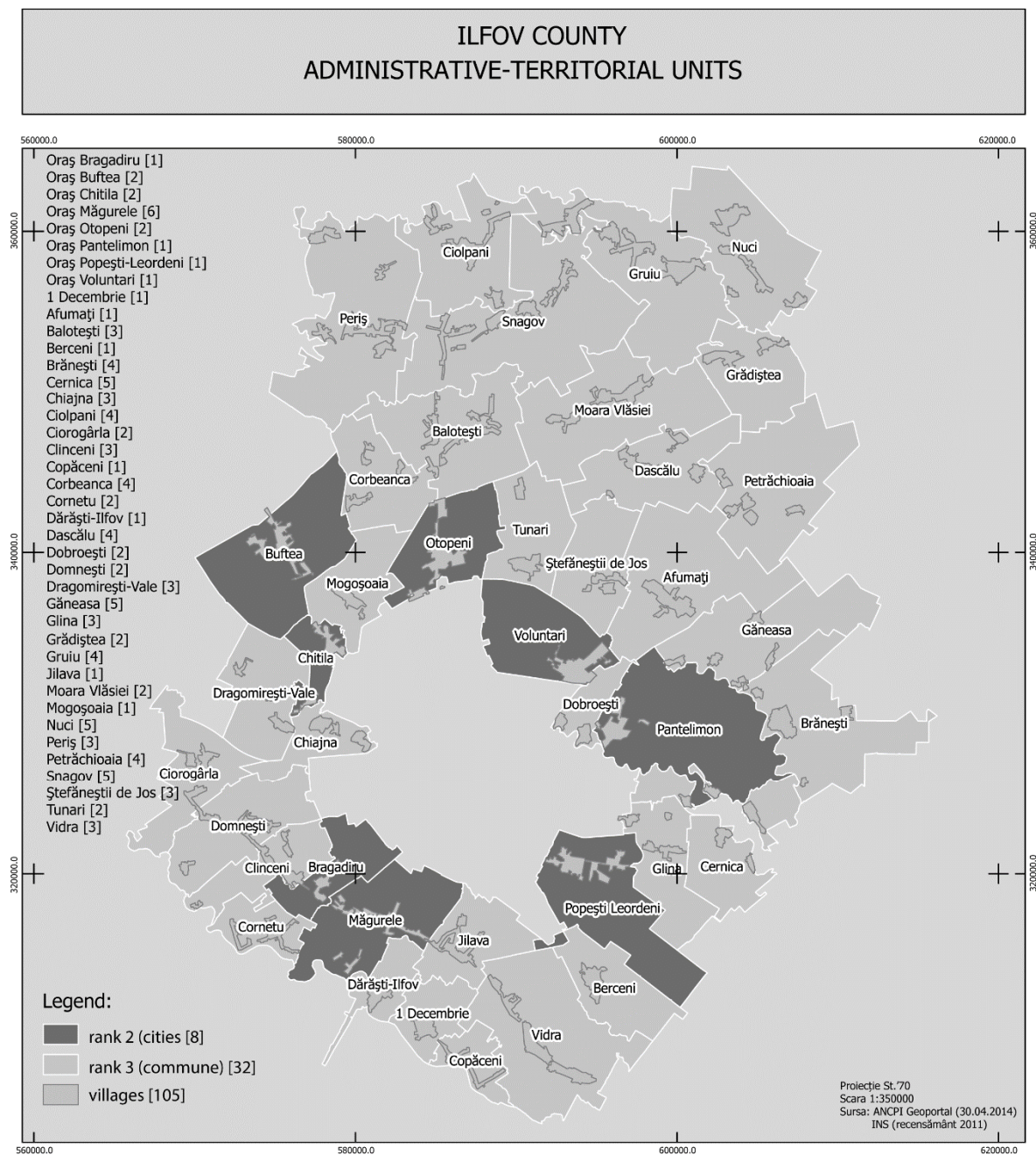
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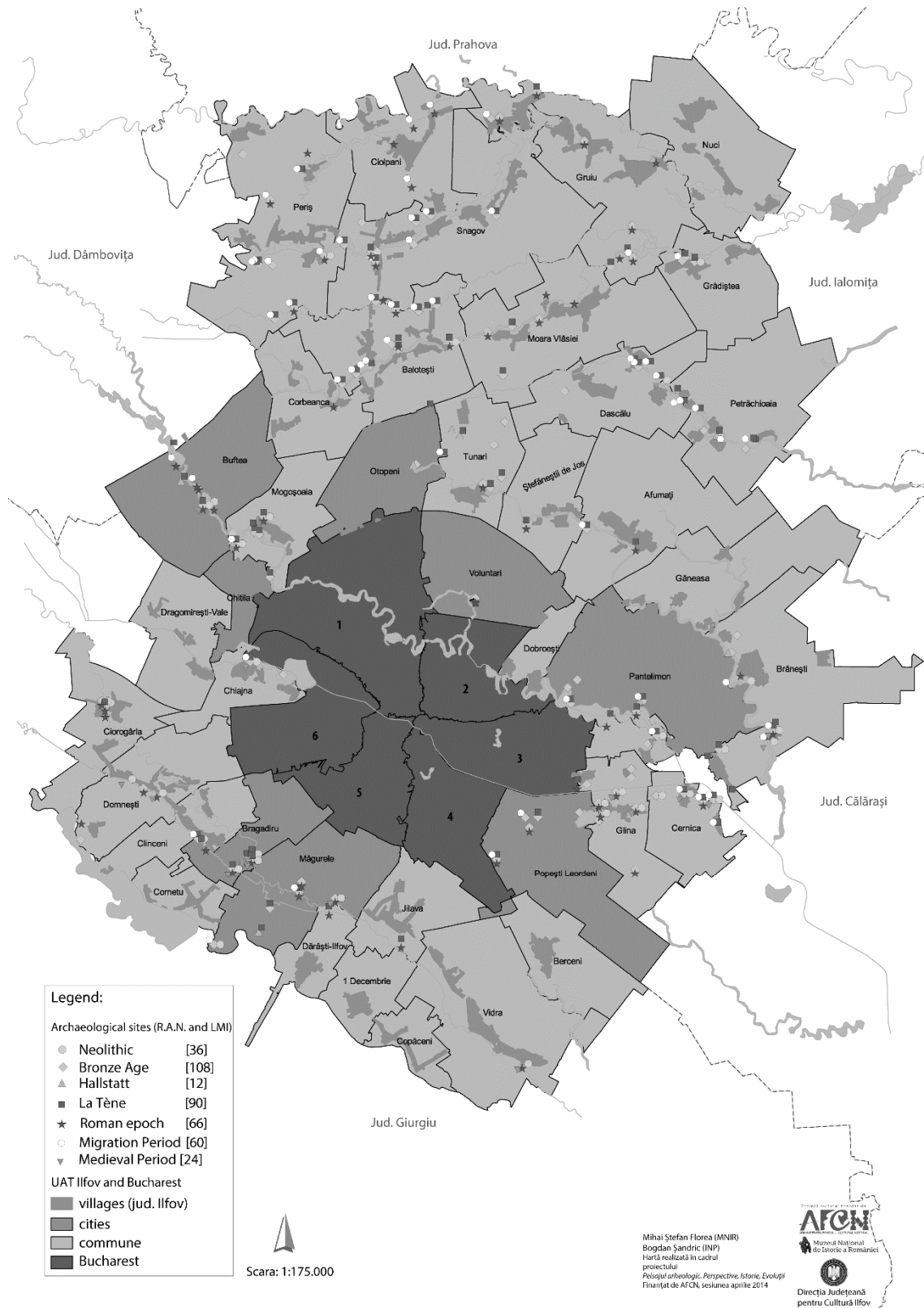
**Fig. 1.** Ilfov County. Geomorphological map and the distribution of the archaeological sites registered in RAN and LMI. Altitudes scales complies ASTER GDEM v.2.  
Județul Ilfov. Harta geomorfologică și distribuția siturilor arheologice înregistrate în RAN și LMI. Scara altitudinilor obținută după ASTER GDEM v.2.



**Fig. 2.** UAT Ilfov County after 1996 (according ANCPI 2014, INS 2011).

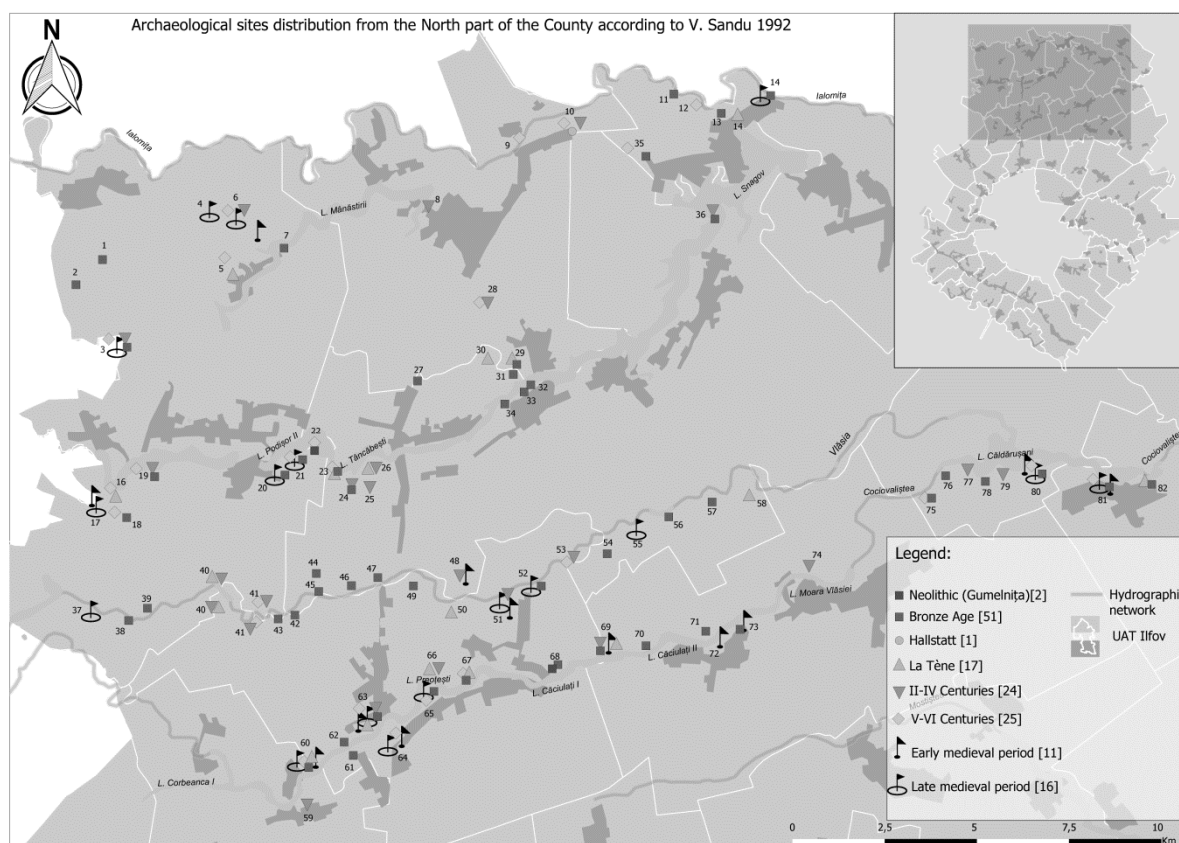
Unitățile administrativ-teritoriale ale județului Ilfov după anul 1996 (sursa INS 2011, ANCPI 2014).





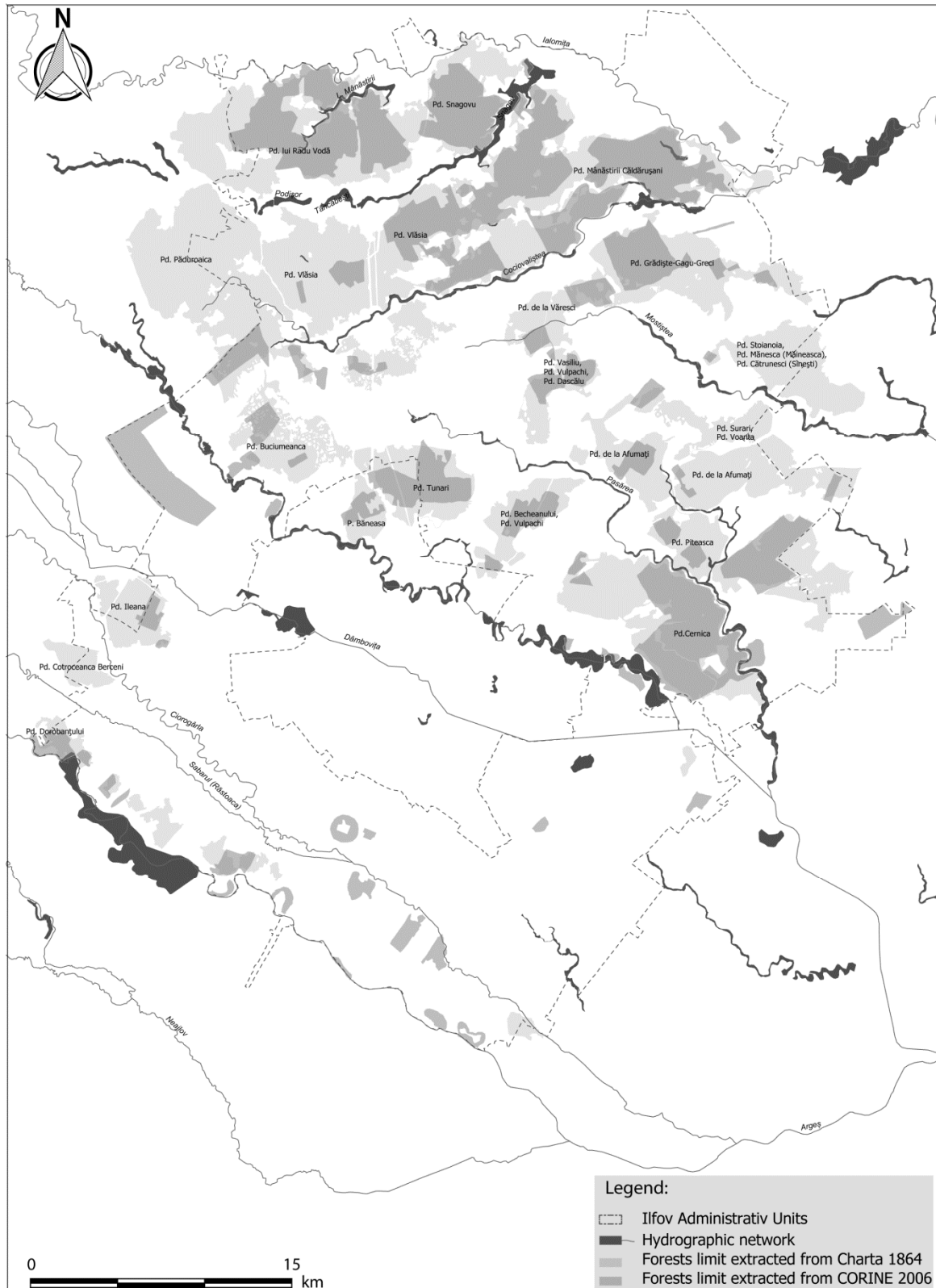
**Fig. 3.** The distribution of the archaeological sites from the Ilfov County according to the data from RAN and LMI.

Distribuția siturilor arheologice din județul Ilfov conform datelor RAN și LMI.



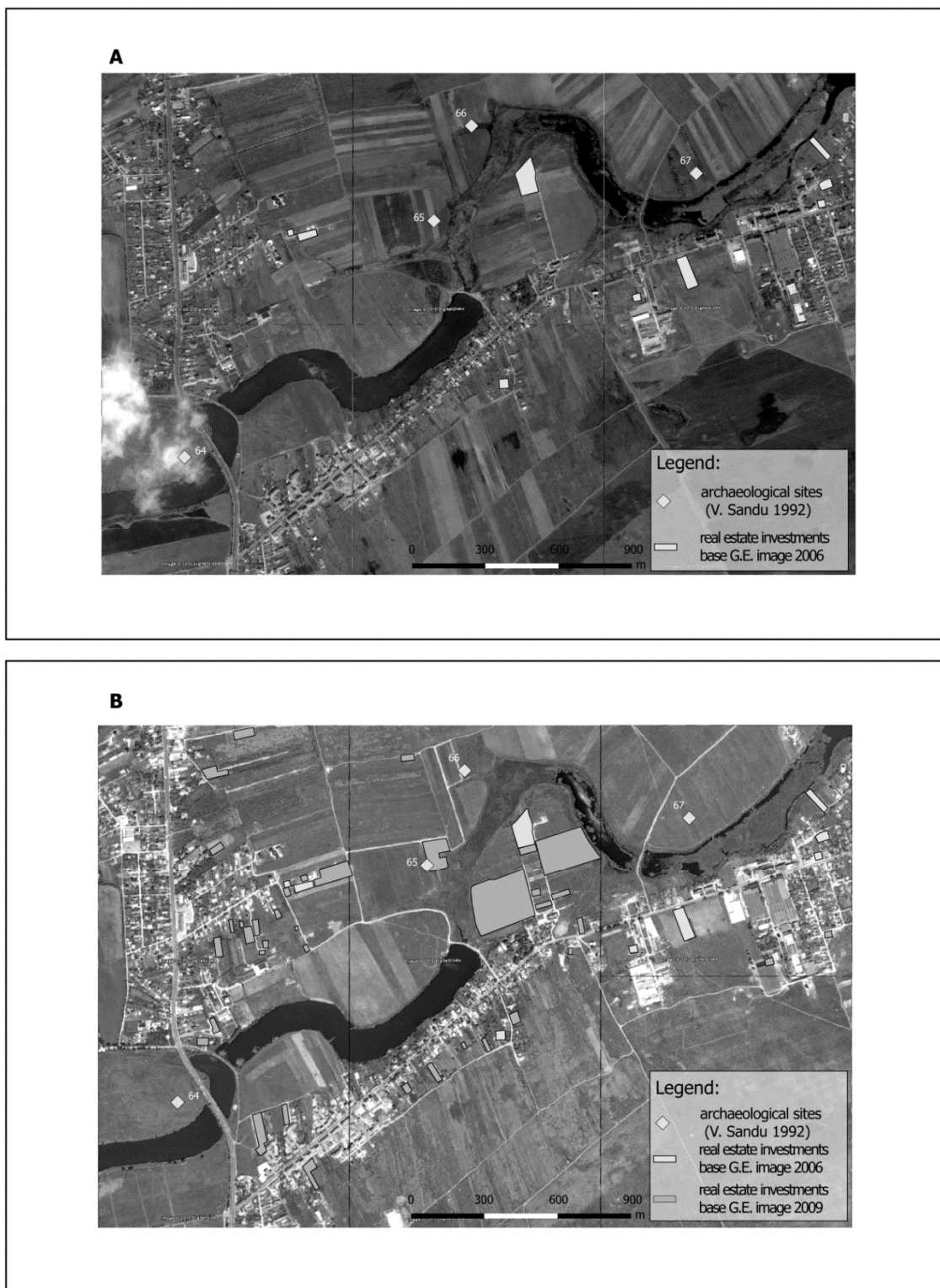
**Fig. 4.** The distribution of the archaeological sites from the North part of the Ilfov County according to V. Sandu 1992.

Distribuția siturilor arheologice din partea de nord a județului Ilfov, după V. Sandu 1992.



**Fig. 5.** The limit of the major areas of forests extracted from Charta 1864 overlaid on the CORINE data 2006, filtered by the layer "forests".

Limita suprafețelor majore de pădure extrase din Charta 1864 suprapuse pe datele CORINE 2006 filtrate pe stratul „păduri”.



**Fig. 6.** Balotești area studied with Google Earth image history service. 6. A. Real estate investments that appears in the image from 2006. 6. B. Real estate investments that appears in the image from 2009 overlaid on the 2006 ones (O. Țentea *et alii* 2010, pl. 5).

Zona Balotești analizată prin serviciul de imagini istorice Google Earth. 6. A. Investiții imobiliare care apar în imaginea din 2006; 6. B. Investiții imobiliare care apar în imaginea din 2009 suprapuse peste cele din 2006 (O. Țentea *et alii* 2010, pl. 5).