HIGH-RESOLUTION DIGITAL CARTOGRAPHIC SUPPORT FOR BIODIVERSITY AND RESOURCES ASSESSMENT IN DANUBE DELTA BIOSPHERE RESERVE

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***Abstract**: Danube Delta Biosphere Reserve (DDBR), the most important Romanian Natura 2000 site - RoSCI 0065 Danube Delta 4.540km2, RoSCI 0066 Danube Delta Maritime Area 1.233km2 and RoSPA 0031 Danube Delta and Razim-Sinoie Complex 5.128 km2, RoSPA 0076 Black Sea 1.401km2, is the site with the most numerous species and habitats listed in the Habitats Directive (29 habitat types, 5 plant species, 5 species of mammals, 5 species of amphibians / reptiles, 15 species of fish, 11 species invertebrates - The site SPA with the most numerous species of birds (89 species out of 105 species in Annex I of the Birds Directive). This study aims to show the uses of digital data regarding the biodiversity of the DDBR. The main used data are LiDAR data that were transformed into secondary useful data in the geographical information system (GIS) analyses in regard of species and resources.*

***Keywords:** LiDAR data, GIS analyses, species potential distribution, reed source distribution.*

1. Introduction

The studied area within this paper is Danube Delta Biosphere Reserve which is situated in the East-SouthEast of the Romanian territory, country situated in the South-East region of Europe. The studied delta is formed at the end of the Danube River which flows into the Black Sea (figure 1).

Despite the fact that it is the second delta in Europe, taking into account the size (after the river Volga) and 20th in the world, taking into account the wealth landscape and the fauna in general and the birds in special Danube Delta occupies the most important place. Danube Delta arouse very special interest from the scientific point of view – because it is a real laboratory of formation of delta ecosystems, tourism and economic by its renewable natural resources. Only 4455 km2 surface from DDBR is considered as the Delta, the majority of this (79% meaning 3510 km2) is located on the Romania territory, focusing on three main arms (branches) - Sfantu Gheorghe, Sulina and Chilia, which are in the mentioned order taking into account the age, the oldest being Sfantu Gheorghe. This delta surface is found towards the "0" of the Black Sea as follows: 20.5% below this and 79.5% above thereof. The biggest representation has surfaces between 0 and 1 m altitude (54.5%). (Gastescu and Stiuca, 2006)
Due to the particular importance of the Natura 2000 Network and area occupied (2.5% of the Romania’s territory) the management plan elaboration is became a goal with special

importance. This, it could not be done without a cartographic high resolution support. All the data used in this study are as results of a project called: Development of a high-resolution digital cartographic support needed for development plans, strategies and management schemes in the Danube Delta Biosphere Reserve - CARTODD, founded by the SOP (EU-CSF). The reason of having these data is to offer to the decisional makers basis for their options in order to have a better understanding of the phenomena, processes and events that occurs within the Danube Delta Biosphere Reserve. The mentioned project focused on two objectives of the Management Plan of the Danube Delta Biosphere Reserve, as follows: the first one is to maintain / restore good ecological status of ecosystems, these could be achieved by taking into account other two secondary objectives that stipulates to fight and / or mitigate risk factors (pathogens, climate change, human activities, invasive species etc.) for the condition of habitats, identification and implementation of measures to mitigate adverse effects. The other sub-objective is referring to the functional zoning and management plans for achieving specific goals, taking into account the distribution of bird species with priority protection requirements to ensure maintenance of established values. The second main objective consists in an integrated monitoring system - support for biosphere reserve management which includes a specific objective identified in the development and implementation of an integrated monitoring plan for DDBR.

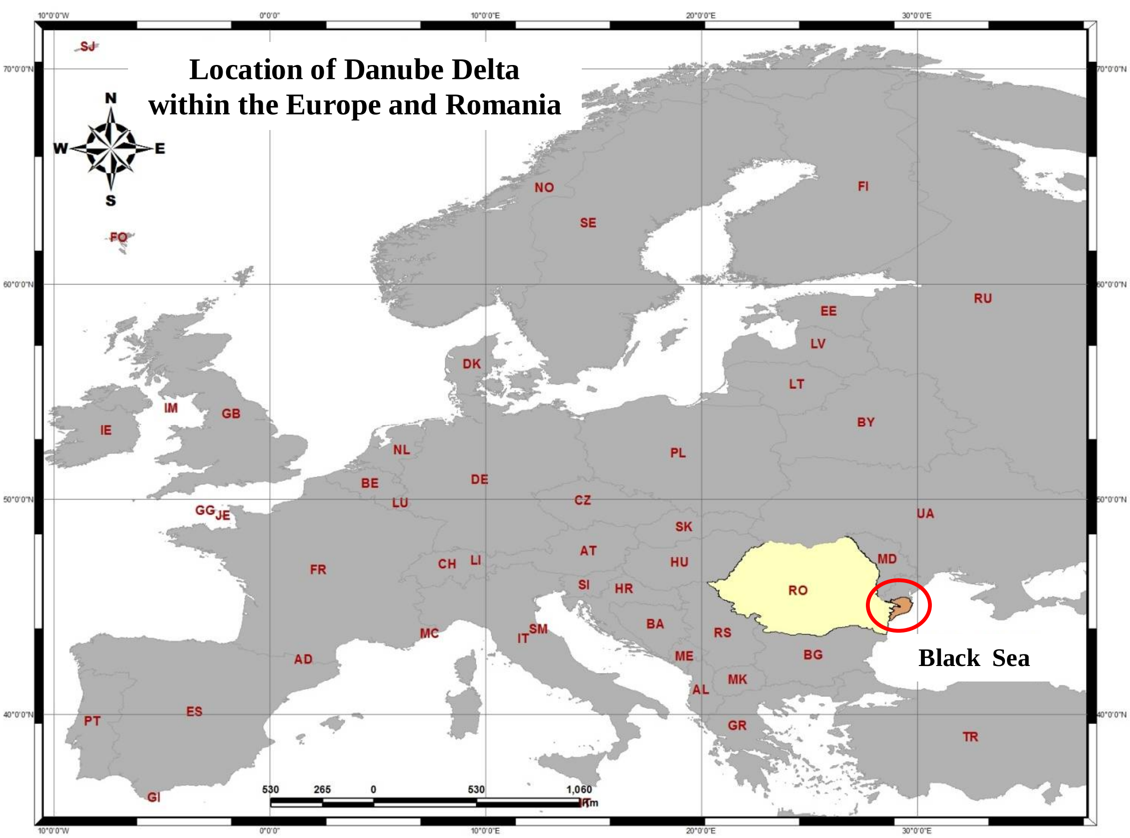

Figure 1 – Danube Delta Biosphere Reserve location within Europe and Romania

In order to monitor the species that have their habitats within the Danube Delta Biosphere Reserve, first of all it is necessary to have a map of their probable their habitats distribution. This map could serve to further investigate the places with higher probability of occurrence for a specific species or for a group of species, depending on the proprieties that were taking into account. For these maps there will be used data for elaborating a model of species distribution.

The use of species distribution models (SDM) to map and monitor animal and plant distributions has become increasingly important in the context of awareness of environmental change and its ecological consequences. (Jennifer Miller, 2010)

These models allow estimation of species' ecological requirements, although the degree to which causal relationships between species distributions and the predictor variables are unveiled depends on the adequacy of the predictors used for model building. (Miguel B. Araújo and Antoine Guisan, 2006).

The paper presents a simple way of potential distribution of species regarding the specific habitats parameters.

While potential distribution refers to the places where a species could live, realized distribution does to the places where a species actually lives. Importantly, both concepts refer to a particular moment or a discrete period in time (usually, present time). Therefore, the places pertaining to the potential or realized distribution of a species vary with time. However, they do not vary in the same way. The potential distribution of a species varies geographically with the oscillation of climatic conditions, but is environmentally invariant. At the same time, the realized distribution of the same species will vary in both the geographical and the environmental spaces when subject to the same climatic variations. In other words, while it can be assumed that the potential response of a species to environmental gradients is constant under some conditions, its realized response is context dependent. Therefore, depending on the question asked, we will be interested in describing or modelling one characteristic of the species distribution or the other. (Alberto Jiménez-Valverde, Jorge M. Lobo, Joaquín Hortal,.2008)

2. Materials and method

Materials that were used are coupled in two classes. One of the classes is referring to the LiDAR data as main source for the physical aspects and the other class consists in data that shows the visual aspects. From the first class there are derivate data from the LiDAR data. There are three datasets that derived from LiDAR data. The most important one is the DTM (Digital Terrain Model) which is the dataset with the altitudes of the points of the surface of the ground (figure 2). The second dataset is called DEM (Digital Elevation Model) which represents the altitudes of free ground points and the altitudes of the objects that occupy the surface of the terrain (figure 3). The last derived dataset consists only in altitudes of elements that are above the ground surface and it is called EC (Elevation classes). In this last dataset there are included buildings, cars, but also vegetation of different heights (figure 4).

To obtain the files with different kind of altitudes from LiDAR data there should be made a conversion (a first processing) of the raw data into files more friendly namely in text format or similar. Each raw of these files represents a point that is given by each beam that is reflected by a certain surface from the ground or different objects. Depending on the wave length of reflected wave from the surface each reflected beam is classified in separate categories. Thus, there are classes for vegetation, for buildings, for water etc. These text or similar files are processed by specialised GIS (Geographical Information Systems) in order to obtain grid files that were used in the analyses.

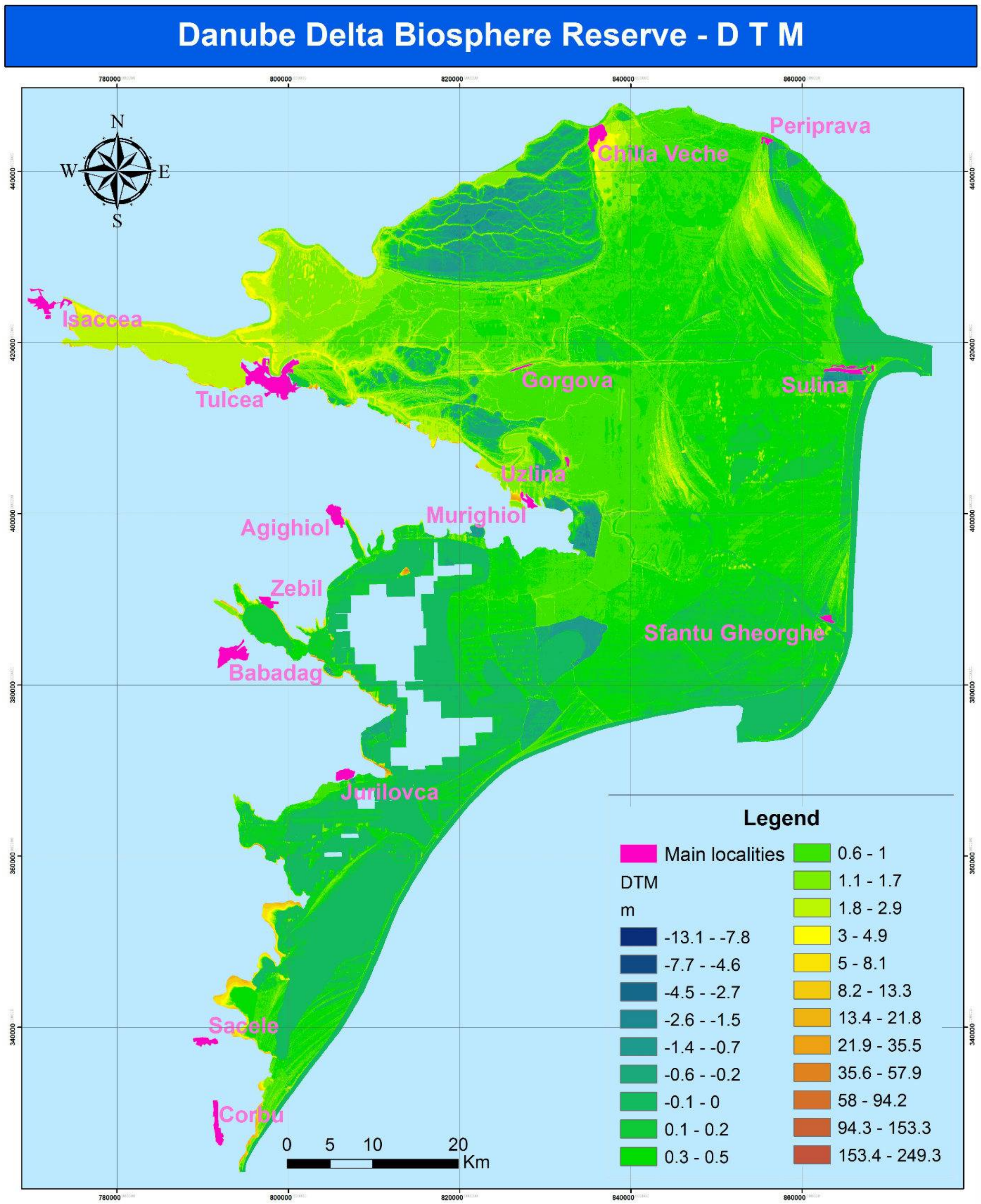

Figure 2 – Digital Terrain Model (DTM) for Danube Delta Biosphere Reserve

It can be easily seen on the figure 2 that there are some high levels of the terrain. Those high levels are from the hilly areas from the North Dobrogean Plateau altitudes that are in the West and South-West part of the DDBR. The biggest altitudes inside the DDBR could be spotted one the marine levee Letea and Caraorma and the Chilia Field.

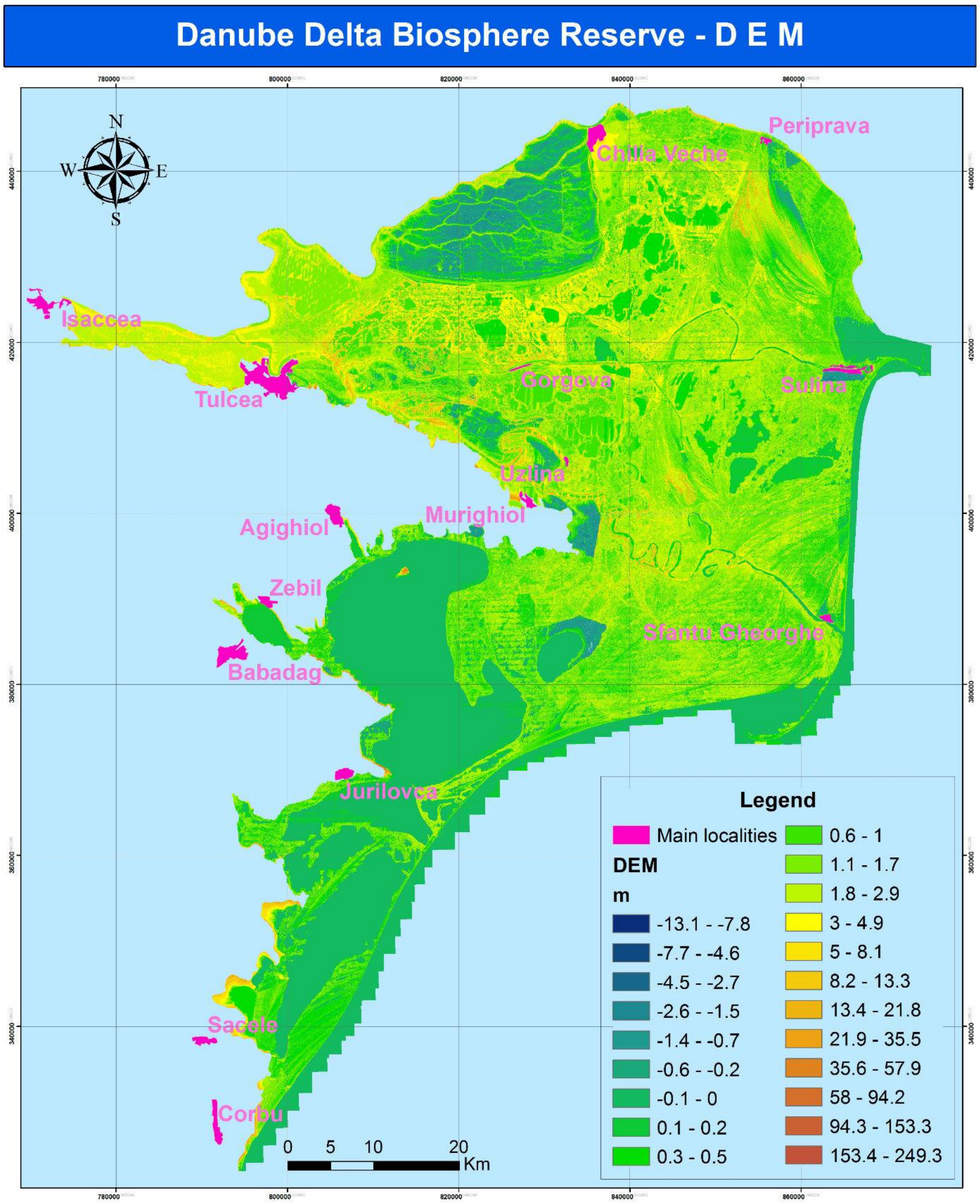

Figure 3 - Digital Elevation Model (DEM) for Danube Delta Biosphere Reserve

Figure 3 shows the terrain elevation together with the elevation of each object that reside on the surface of the ground. It can be easily spotted on figure 3 the forest from the marine levee Letea and Caraorman, but also there can be spotted also the reed bed vegetation in the central part of the DDBR and not only.

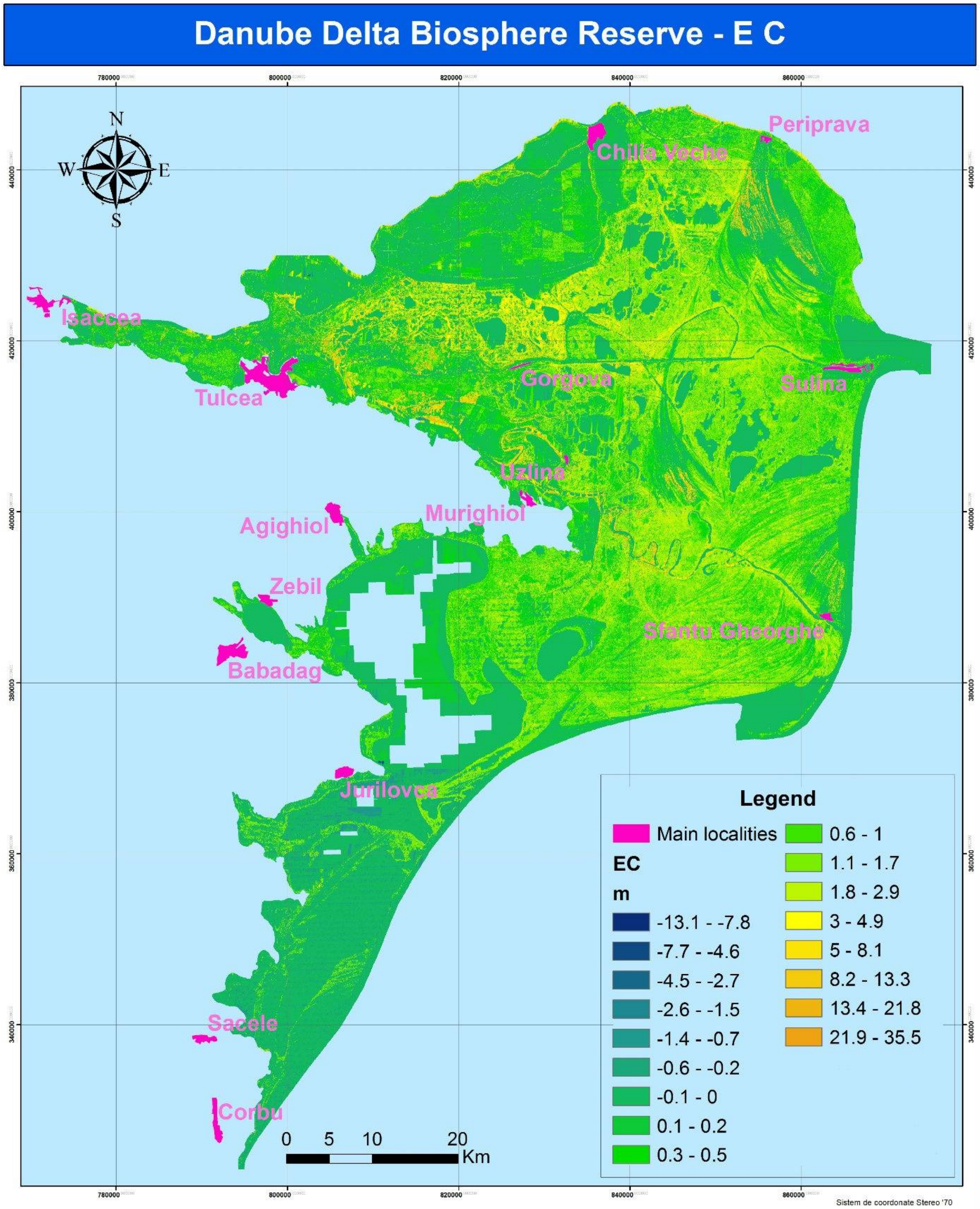

Figure 4 – Elevation Classes (EC) for Danube Delta Biosphere Reserve

On the figure 4 the vegetation could be easily seen especially the high elevation vegetation as is the forest from the marine levee and also the reed bed vegetation.

The second category of data that were used for the present paper (the visual) consists in orthophotos, imagery data that were taken from an airplane. There are two kinds of orthophotos: one in visible range (VIS) (figure 5) of sensors and the other one with IR

(InfraRed) sensor (figure 6). These datasets are useful for spotting different kind of objects and lands taking into account the difference of surfaces reflectance.

Figure 5 – The entire orthophotos imagery dataset in visible range (VIS) on DDBR

On the median part of the DDBR there can be seen the reed vegetation in a light green, but also it can be seen in the North part and in the South.

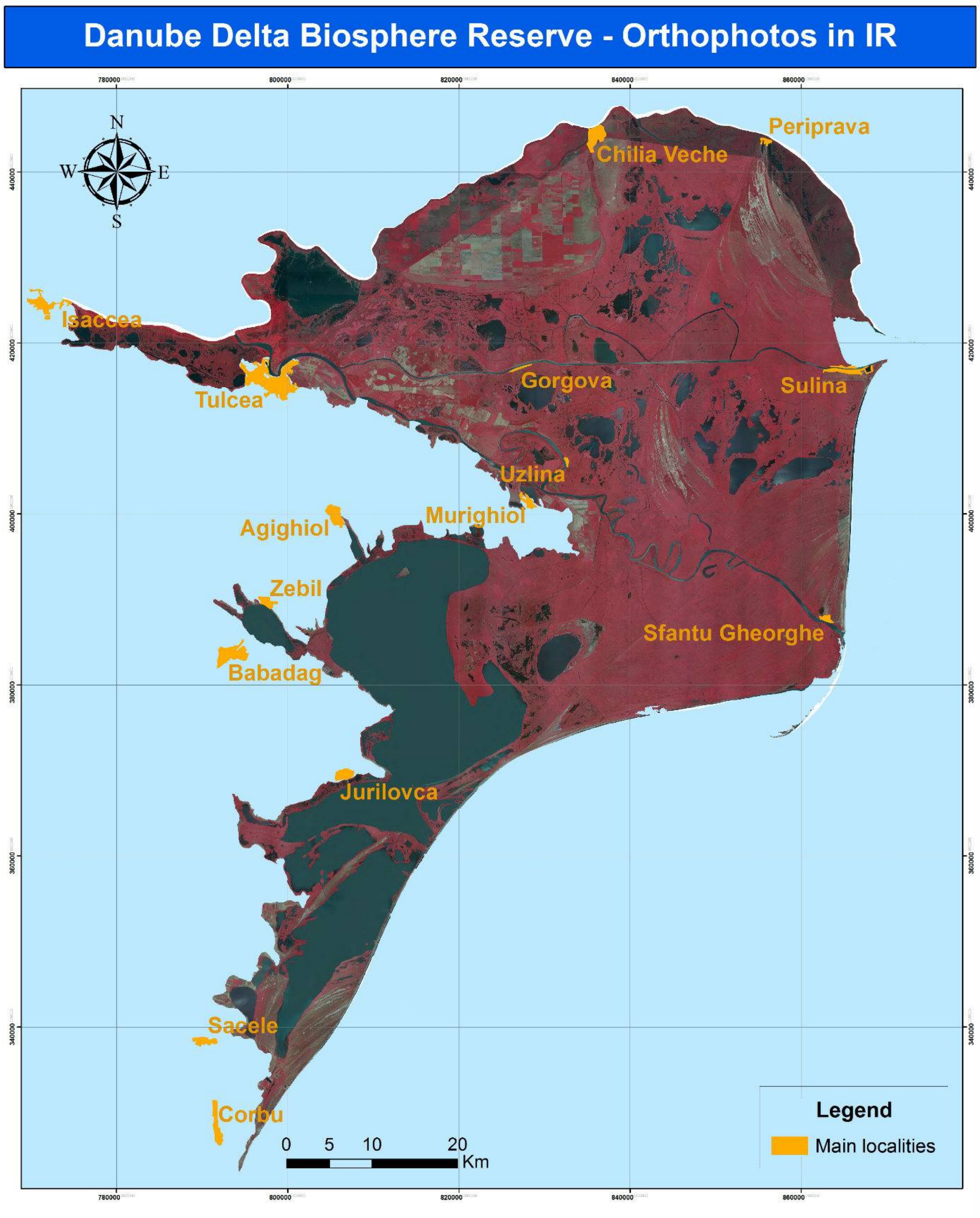

Figure 6 - The entire orthophotos imagery dataset in infrared range (IR) on DDBR

The InfraRed band of the orthophotos is very useful for assessing the vegetation as density and health of it, as the kinds of it.

The method is taking into account the preferences of the species that it is investigated depending the data that are available. There are preferences like terrain altitude, vegetation height and vegetation density. From each data sets there were extracted the pixels with the specific values for each species. All these extracted data were combined in order to obtain places with higher probability for each species.

3. Results and discussions

For this paper it was studied the potential distribution of the viper Vipera ursinii. It prefers medium to poor vegetation (figure 7), height of vegetation between 1-150 cm (figure 8) and an altitude of the terrain between 70-155 cm (figure 9). Figure 10 shows the final distribution potential of the studied species.

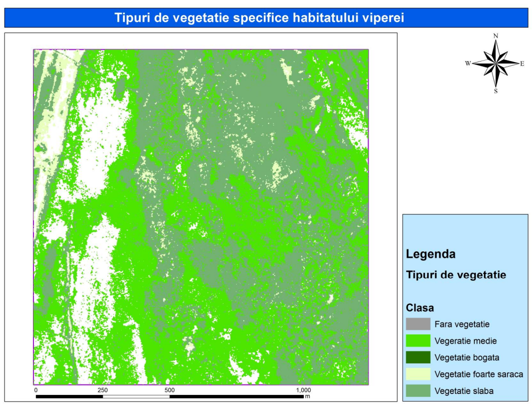

Figure 7 – types of vegetation

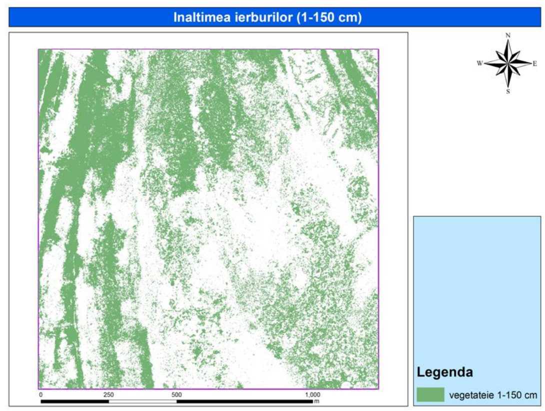

Figure 8 – height of vegetation

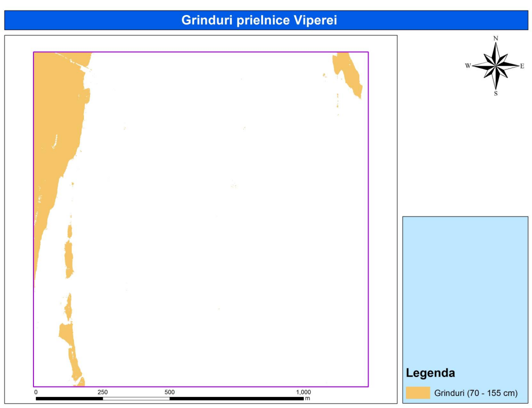

Figure 9 – terrain elevation preferred

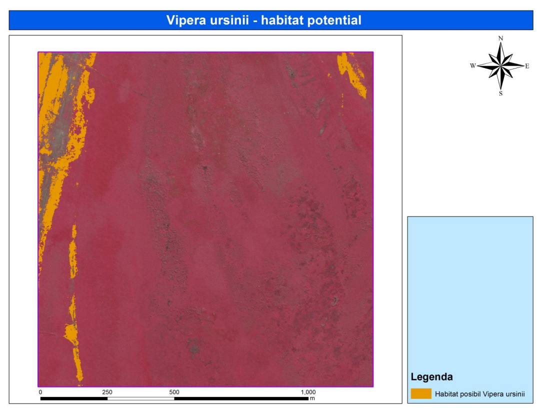

Figure 10 – potential distribution of the species

Potential distribution could be improved and certified by the specialist, after this the method could be improved and tuned in a certain way that the method could be applied in other wetland areas.

4. Conclusions

Applied at a bigger scale the method could be a good way to assess and investigate species distribution and evaluate their habitats.

Using other kind of data that comes for the same studied area the results of the presented method could be with an higher accuracy.

To model the potential distribution of species is an important step in the big process of monitoring the species which is a big step in the bigger process of sustainable development that implies spatial planning.

5. References

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