

RESEARCH ARTICLE

(Open Access)**A GIS Approach for the Management Purposes and the Floristic and Vegetation Features of the “Grand Park” of Tirana**AJOLA MESITI¹, LIRI DINGA², MARTA GALLONI³, GIOVANNA PEZZI³¹Botanical Garden, Research Centre of Flora and Fauna, Faculty of Natural Science, University of Tirana, Albania² Professor, Faculty of Natural Science, University of Tirana, Albania³Department of Biological Geological and Environmental Sciences, Bologna University, Italy**Abstract**

Environmental analysis of flora, vegetation and zoning in the “Grand Park” of Tirana (Albania) were carried out for management purposes with GIS program. The Grand Park, which lies in the hills south of the city, covers a land area of about 220 ha plus 48 ha of water. The Park was built on an existing area of vegetation where species of Albanian flora were planted and some exotic species introduced, thus representing a “hybrid” park with natural and artificial features. It is surrounded by residential buildings, commercial and national roads with heavy traffic. The species and vegetation types of the park were sampled to identify the most important for conservation and management purposes; to analyse their origin and distribution in relation to anthropogenic impacts, and to provide general information on their ecology. Distribution of different green areas within the park was derived by interpreting aerial photographs, and by using Geographical Information Systems (Esri ArcGIS). The current map was compared with a previous one to detect the dynamics of the green urban areas. The environmental diagnosis identified several types of activities potentially harmful to the biodiversity of the “Grand Park” and the environmental quality of the city. Implementation of a management plan would be essential to maintain and preserve this urban park, aiming to ensure its role in improving the quality of urban life. The survey results showed that within the park area 69% of the species were wild and 31% introduced.

Keywords: Urban green area, quality of life, GIS**1. Introduction**

Green areas have become a fundamental element of urban landscapes. Urban nature is crucial in order to connect half the world's population with their natural environment. The process of urbanisation, which so profoundly changed the European landscape, also created new environmental conditions for plants [20; 21]. The city is not a single ecosystem habitat, but ideally, a concentric structure can be seen from the inside, distinguishing the following zones: Zone of closed buildings, the development zone of loose, inner circle and the outer circle [24]. Over the last few decades, urban areas have expanded by 1.5 km per year, swallowing farmland and forests, in worldwide trend. The ecosystems most affected by this phenomenon are herbaceous vegetation and shrub mouldings. Parks have always been recognised as major contributors to

the quality and aesthetics of the residential neighbourhoods. However, nowadays this perception has changed toward more recognition of the ecosystem services parks provide, mainly associated with air filtration, microclimate regulation, rainwater drainage, noise reduction, and both recreational and cultural values.

An “Urban Park” is such a green area that is used for public purposes, with little or no construction, which is near the city and used for recreational and ornamental purposes [16]. Tirana Park Vegetation has been, and continues to be, under pressure from anthropogenic factors: crime (*e.g.* arson, illegal cutting, etc) and intrusive construction of buildings, which has led to the reduction of the green area of the park. Inside its territory is building a variety of objects and moreover this park is surrounded by urban streets, which carry the heavy traffic of the capital city,

*Corresponding author: Ajola Mesiti; E-mail: ajola_mesiti@yahoo.com
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leading to a "stress" on all the ecological zones. The analytical approaches used in this study emphasise the power of geographic information systems (GIS) as a basic method, which serves as a planning aid for green parks. Their use allows not only proposal for reorganisation plans, but also to give decision-makers a better understanding of their priorities.

Tirana district is located in Western Lowland in central Albania. It has an extent of 31 km². The average altitude is 521 m above sea level, with the two highest peaks: Dajt 1,612 m and "Mali me Gropa" 1,828 m [19]. According to preliminary data from the 2011 national census, the population of Tirana within the city limits is 421,286 inhabitants. The first Tirana census, after it became a capital, was conducted in 1923 and showed a total population of 10,845 inhabitants in Tirana. Up to the 1950s, Tirana rapid experienced industrial growth and the population increased to about 137,000 inhabitants. In 1990, Tirana had 250,000 inhabitants [12]. After the end of Communist rule in 1991, Tirana experienced its fastest population growth when people from rural areas moved to the capital for better economic opportunities. Few studies have been conducted on the urban parks of Tirana, even though its population has tripled, with a large harmful impact on the vegetation. The purpose of this study is to find out the role of the Grand Park in a city that is evolving and to find the ecological role of this park and its subunits for the pollinators. These results will be related to its management plan to ensure its role in improving the quality of urban life.

2. Materials and Methods

2.1 Study Area

The "Grand Park of Tirana" lies in the hills south of the city, in an area of about 250 ha vegetation dominated by shrubs and trees, especially Mediterranean germander (Association *Arbuto-Quercetumilicis* Br.-Bl. 1936), in addition to which thousands of trees, shrubs and herbaceous ornamental plants have been planted. This park was built in the autumn of 1958. Within the territory of the park the artificial Lake Tirana, with a surface of 48 ha, was also raised. Inside the Great Park are build many facilities of a true urban park such as the Summer Theatre and the memorial centre also there are diverse artwork. The Park also includes the "Presidential Palace Park" which is surrounded by walls and it is not accessible to the city inhabitants. The climate is classified as Mediterranean with wet winters and

warm, dry summers. The temperature amplitude is of particular importance, ranging from 15 to 22^o C in summer to below zero in winter [14]. Hence the site represents a "hybrid" park with both natural and artificial features. It is surrounded by residential buildings, commercial and national roads with heavy traffic (Figure 1).



Figure 1. Orthophoto of the Tirana "Grand Park"

Methodology

This environmental analysis was based on application of the following procedures: 1) mapping of the landscape characteristics; 2) to analyse their origin and distribution in relation to the anthropogenic impact, and 4) to provide general information on their ecology.

The distribution of different green areas within the park was derived by interpreting aerial photographs, and by using Geographical Information Systems (Esri ArcGIS). The study was conducted using topographic maps of Tirana for the years 1957 (1:10000), 1990 (1:10000) and 2013 (GIS format). Maps of the "Presidential Palace" (1: 1250) and the "Grand Lake" (1:1250) were obtained from the State Archives Building; and 9 aero-photogrammetric maps (WGS 1984) were also used [1]. All these maps were digitised using EsriGIS Arc Map 10.1 (trial mode) software, which was also used to process and analyse these geo-referenced digital data [8].

We carried out a detailed analysis of spontaneous and cultivated flora. The study is based on spontaneous vegetation observed by the surveyor at locations marked by GPS software (Garmin) at every 15 m. For the analysis of herbaceous vegetation, the park was divided into plots 1x1m² and for the woody vegetation it was divided into plots of 10x10 m² [7]. In

each plot the presence of different plant species was marked by making a herbarium of plants and defining

their Latin name [3;15; 18; 23].



Figure 2: The GPS Locations and transects that have been done in the Park

The flora of the park was analysed according to the following parameters:

- 1) **Anthropo-tolerance**[2;24]
 - a. Urbano-phile plants (UPHIL)*i.e.* species that prefer human-disturbed or human-altered habitats.
 - b. Urbano-neutral plants (UN)*i.e.* species that can grow in undisturbed natural habitats as well as in human-disturbed habitats,
 - c. Urbano-phobe plants (UPHO)*i.e.*species that avoid human-altered urban habitats.

2) **Origin of species**[5; 6; 11]

- a. spontaneous
- b. cultivated

3) **Blossom classes**. [10; 13]

Blossom opens during anthesis – open during anthesis

- i. Dish to bowl shaped flower. The sexual organs are located in the centre of the flower where the insects work on or from the top of the organs.
- ii. Bell shaped flower. The pollinator is obligated to immerse itself within the flower, because the sexual organs are generally elevated.
- iii. Brush shaped flower. The external surface of the pollination unit is made by the sexual organs, while the perianth is reduced.
- iv. Gullet shaped flower - the sexual organs are restricted in the functionality of the upper side of the pollination unit.

- v. Flag shaped flower - the sexual organs are restricted in the functionality of the lower side of the pollination unit.
- vi. Tube shaped flower – this is not equal to the previous ones, because the criterion is not the disposition of sexual organs but the accessibility of the nectar. This kind of flower excludes a lot of pollinators.

3. Results and Discussions

The elaborated and geo-referenced maps of Tirana “Grand Park” show a correlation between the city boundary and the park surface. This correlation is shown in Figure nr.3. Thanks to its geographical position, the diversity of relief forms, geology and hydrology and the variety of specific microclimates, the "Tirana Grand Park" contains very rich vegetation.

The vegetation types belong to formations of Mediterranean shrub land area (Eu-Med and Med). This association is Quercetum- frainetocerris with the species *Quercusfrainetto* Tenand *Quercuscerris* L. and closely associated with calcareous substrates and Quercetumilicis dominated mainly by *Arbutus unedo* L. and *Erica arborea* L., is evident in the bottom levels of the Park, where the negative impact of human activity is higher. Despite the low frequency of *Quercus ilex* L., the floristic composition, is typical of this association.

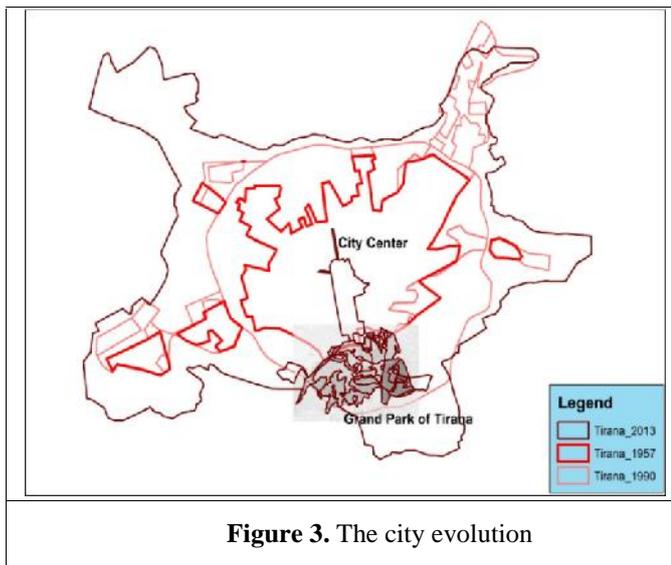


Figure 3. The city evolution

The park flora consists of about 87 plant families and 377 species [18; 23], of which 60% are spontaneous species. Among those families within the spontaneous vegetation, the richest in species is the *Poaceae* with 30 species. However, the richest family in genus is the *Fabaceae*, due to the large number of species of all kinds, including ornamental plants. Within the park, there exist species that are in the Plant Red Book of Albania: *Agrimonia eupatoria* L. (E-endangered), *Colchicum autumnale* L. (Vulnerable), *Hypericum perforatum* L. (E-endangered) and *Sanguisorba minor* L. (E-endangered) [22].

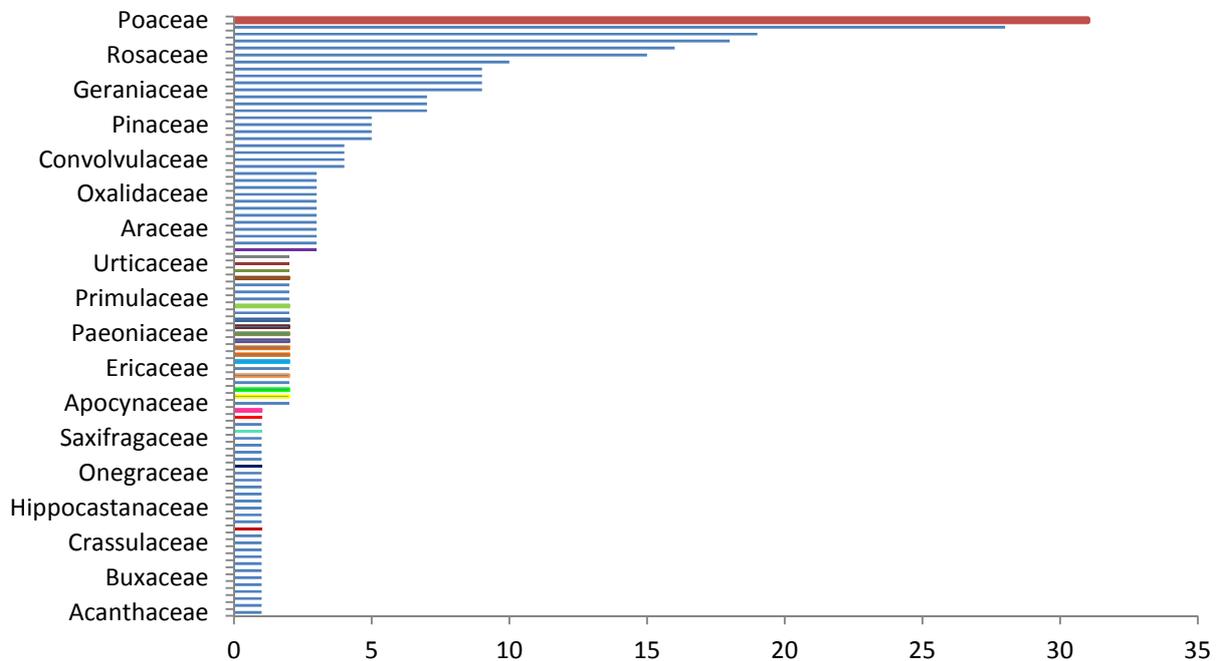


Figure 4. Plants Families Analysis

Because of the parks aesthetic aspect, many species have been planted and those are the 40 % of the park flora and which have been naturalised over the years. These include fruit trees like apple, lemon, plum, etc, [4; 9] whilst the richest families are the *Asteraceae* and *Rosaceae*, due to their high number of ornamental species.

The life form analysis indicates that the richest form within the spontaneous plants is the Hemicriptophyte and within the cultivated flora the Phanerophyte (Tab.2).

The floristic investigations show that most of the spontaneous flora is Urbanophobe and it is represented by 105 species, such as *Carpinus betulus* L., *Colchicum autumnale* L., *Crocus boryi*

Gay., *Cydonia oblonga* Mill. etc. Meanwhile most of the cultivated flora is Urban-neutral and is represented by 35 species (Tab.3).

The ecological analyses of park flora showed a large percentage (35%) of dish to bowl shaped flower-types.

Table 1. Results of the anthropo-tolerance parameter analysis

ANTHROPOTOLERANCA	No of Species
No data	60
UN	105
UPHI	69
UPHO	134

4. Conclusions

The Grand Park of Tirana is becoming relatively “smaller” in a city that has tripled in size since 1957. The park is the biggest green area of the capital meanwhile the total green surface in the city is 2.8 m² per inhabitant. So this park is invaded by the local population for its beautiful landscape and its richness in habitat and vegetation. Our study invastigated that the most significant factor limiting floral diversity is anthropogenic pressure, including air pollution, trampling, and disturbances such as building construction and maintenance work typical of city environments. The frequent deterioration of the Grand Park is due to the lack of administration, anthropogenic impact.

A new management plant is therefore needed for this park to fulfil the needs of its inhabitants that doesnot affect the vegetation deleteriously. It is needed to raise the public awareness, especially in the surroundings.

Decision making regarding this land use planning should aim to conserve and integrate the park within the urban landscape and to involve the implementation of environmental zoning plan.

The presence of the “Presidential Palace”, where access is forbidden to the city inhabitants (surrounded by walls and guarded by the Albanian Military)creates an “island” within this “Grand Park” where a large number of urbanophobe spontaneous plants occur, which are rare and/or have a conservation status in Albania.

Different flower classes provide opportunities for a variety of insects (butterflies, bees *etc*) and a “green way” to connect habitats to each other.

Any initiative to improve the environmental quality of the “Grand Park” of Tirana will necessarily depend on the commitment and participation of the community.

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