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RESEARCH ARTICLE

URBAN BIODIVERSITY IN THE COMMUNE OF SOUSSE: REALITY AND THREATS

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ABSTRACT

Sousse a Tunisian Sahelian city that benefits from a strategic position on the Mediterranean coast. It is characterized by landscape diversity: a sandy beach, farmland, wetlands and green spaces. From the sixties the effects of the combined development of tourism and industry awakened an urban boom. Today, the specific wealth of the municipality of Sousse is threatened by the effects of urban extension. This research work questions the threats of urban biodiversity in the commune of Sousse. This research is based on iconographic sources (photos) and on documentary studies and fieldwork.

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INTRODUCTION

The Convention on Biological Diversity (United Nations, 1992) provides the following definition of biodiversity: "The Variability of living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. are part of; this includes diversity within and between species and ecosystems." (Article 2 of the Convention on Biological Diversity, CBD, signed on the occasion of the Earth Summit in Rio de Janeiro, 1992). Urban biodiversity is one of the main indicators of sustainable development. In this research work, we have tried to shed light on the reality of urban biodiversity in the commune of Sousse.

Methodology framework: Our field of study is that of the municipal perimeter of Sousse. This research is based on cartographic sources, iconographic sources (photos) and documentary studies. Then, field work is needed to identify plant biodiversity in the main green areas of Sousse.

RESULT AND DISCUSSION

Site Presentation: The commune of Sousse covers an area of 45 km². It is located at the southern end of Hammamet Golf (Figure N ° 1).

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It is part of a larger geomorphological unit called the Tunisian Sahel. It is marked by a monotonous relief, consisting of vast plains and hilly hills, which do not exceed the 75 m of altitude. From the west to the south, the geomorphology progressively moves from low steppes to flat steppes plunging into the sea.

Socio-economic and environmental analysis

Demographic characteristics: The city of Sousse is the third demographic and economic pole of Tunisia. Figure N ° 2 gives the evolution of the number of inhabitants of the municipality between 1984 and 2014. The city has a population density of 4894 inhabitants / Km². This demographic growth, coupled with the large number of tourists generates new urban challenges, especially in terms of environmental impacts.

Economic characteristics: The economy of the municipality of Sousse is based on industry and tourism. The industries operate mainly in the field of textiles and clothing, agribusiness, mechanics and metallurgy. The geographical distribution of the industrial establishments reveals a concentration of industrial activity in Sidi Abdelhamid south of the city, which shelters almost 60% of the industrial units. Similarly, with a mild and sunny climate and beautiful sandy beaches, very diverse and picturesque landscapes and a Medina inscribed on the UNESCO World Heritage List since 1988. Table N ° 1, illustrates the evolution of the number of tourists and overnight stays in Sousse during (2012-2014).

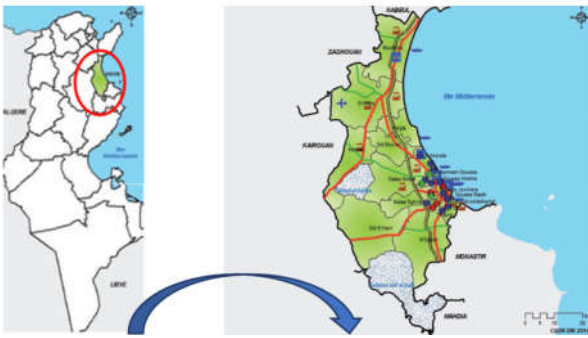


Figure N°1. Geographical situation of the governorate of Soussse

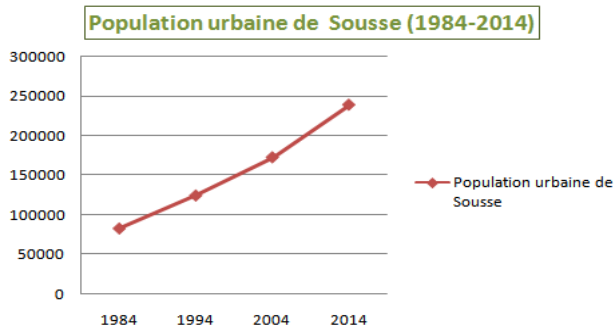


Figure N ° 2. evolution of the number of inhabitants of the municipality between 1984 and 2014

Année	2012	2013	2014
Nuitées globales	2750105	3032021	2848588
Nb.de touristes	507325	535166	531529

Table N ° 1: Evolution of the number of tourists and overnight stays in Soussse (Ministry of Development, Investment and International Cooperation, 2014)

The natural potentialities of the study area: Soussse once, is characterized by a rich and diversified ecological heritage. In this sense, Jatlaoui (2010) reports "Soussse, a Sahelian city, has a low, sandy coast where the beautiful beaches are abundant and the climate is mild, which explains its high traffic." Inland, the landscape of Greater Soussse "Is formed on the one hand by the olive groves and on the other hand the vast plains and high hills with their natural corridors (wadis, streams ...) containing a wide biodiversity of plant and animal species" (Jatlaoui, 2010). The city of Soussse, whose wealth of animal and plant biodiversity is described with enthusiasm by Charles Lallemandqui wrote in 1892: The city of Soussse can be considered the capital of the Tunisian Sahel, covered with beautiful trees, olive trees, figs, carob trees, almond and apricot trees; it is a colossal garden, which extends inland at a distance of 12 or 15 kilometers, and covers the coast from north to south over a distance of more than 100 kilometers. From March to July, they are loaded with flowers, fruits and populated with birds. Even in December and January, it is, under the dark foliage of magnificent olive trees, a perpetual chirping, where the songs and the chirping of the finches, the goldfinches, the verdiers, the larks, the buntings, the siskins, the linots and whites can scarcely be distinguished from each other, as they intermingle and merge. (...) If we could ride a captive balloon in Soussse, we would see around us a dark carpet of olive trees spread on the ground, stitched white spots very close to each other.

These are the towns and villages sown in the immense forest (Charles Lallemand, 1892, pp. 20-21).

The olive tree the sacred tree of Sahel: When it comes time to harvest, you do not hear a conversation in the streets of Soussse or the Arab cities of the Sahel, without the word "zitoun" "strikes your ears, almost every sentence. Zitoun: that's saying everything! Zitoun is the wealth of the country; it's the olive. Olive picking starts in November and ends in March. (...) Throughout the Sahel, picking is a kind of party. We settle in the gardens of olive trees, we spend the day there, we eat there; there are some who camp there when the olive trees are too far from their home. Charles Lallemand .1892 lists the benefits of the olive tree as follows: "The olive tree gives shade to the one the sun threatens; it produces wood, the edible olive has come out; it gives the oil which is the basis of the food of the Arab people, it provides for export millions of kilograms of this product; it is from him that comes the soap, the finest oils to grease and glycerine. Its wood is considered the best for the construction of plows and for the bodywork; cabinetmaking uses it for luxury items: its roots and old trunks become excellent firewood (Charles Lallemand, 1892.p23) ".



Figure N ° 3. Olive picking in the Sahel (Charles Lallemand, 1892, p.8)

Natural spaces in the municipality of Soussse: The rapid urbanization of the past 70 years has resulted in the loss of important farmland. That have given way to roads, residential neighborhoods and hotels and industrial units. There are only 3174 ha of natural areas covering the areas characterized by the ban to urbanization (the banks of Oued Kharroub in the north, the leperim of the public hydraulic domain of Sebkhha and the "corridor of the Tunisian Society of Electricity of gas "reserved for the high-voltage line from the thermal power plant) and 427.5 ha of farmland composed mainly of olive groves are located south of Sebkhhat (Figure No. 3) and on the border with the delegation. from KalâaSghira to the West of the Technological Pole (Derouiche.2012).

Ornamental flora: Savard et al. (2000) indicate that the quality of urban green spaces varies according to the structure and composition of their vegetation, which plays a key role in maintaining biodiversity in urban ecosystems (Savard et al., 2000).



Figure N ° 4: The predominance of olive growing in the agricultural areas bordering "Sebkhat de Sousse"
 Source: Hamrita, 2017p196

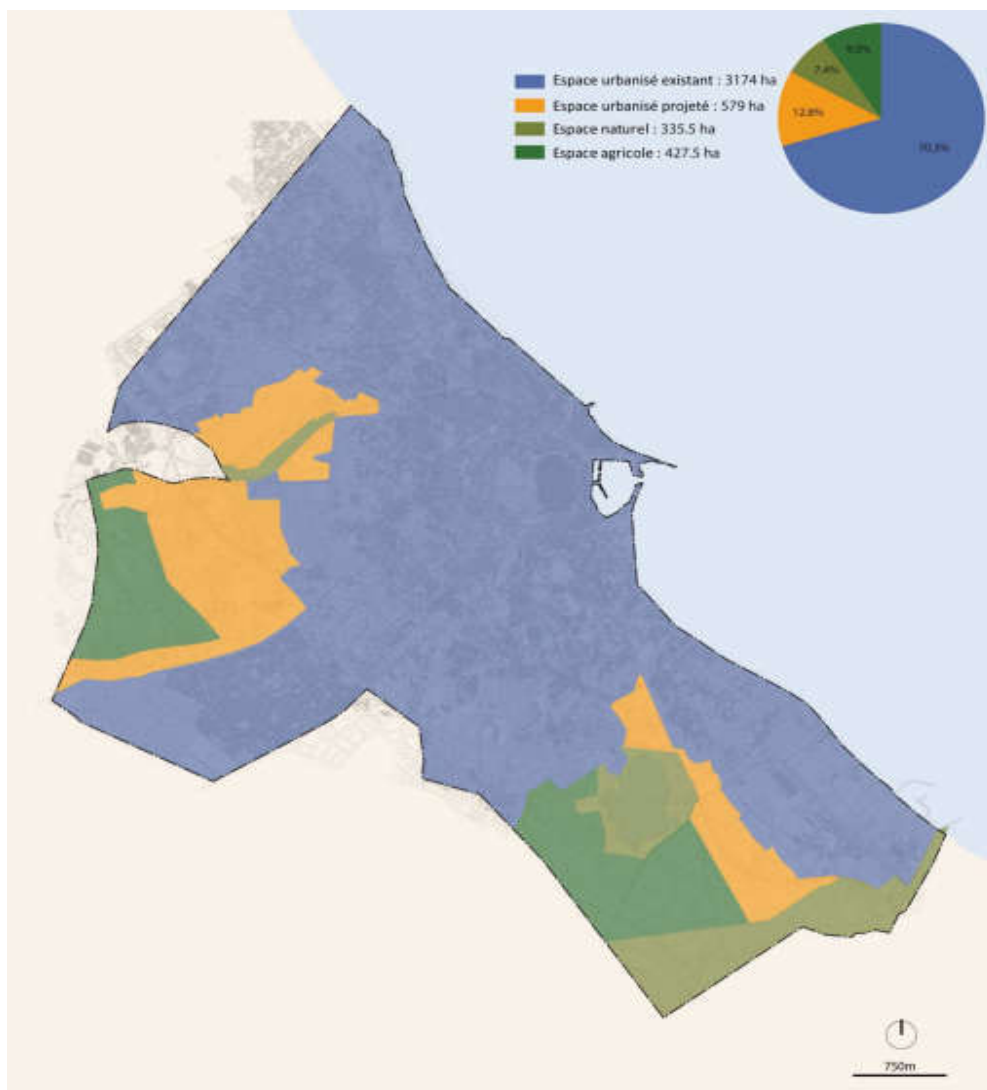


Figure N ° 5. A strong artificialisation of the Sousse territory (B.Derouiche.2012)



Figure N ° 6. *Ficus rebuginosa*



Figure N ° 7. *Phoenix dactylifera*



Figure N ° 8. A green space of the municipality of Sousse of deficient quality



Figure N ° 9. Ecological degradation of the Sebkhat de Sousse



Figure N ° 10. Various works in the city threaten biodiversity



Figure N ° 11. The yellow nightshade "Solanum elaeagnifolium" occupies the public garden of Erayhan

The ornamental flora of Tunisia consists of local species and others introduced. Thus, the species used for the development of the outside are, for the great majority, introduced or exotic and which have acclimated. The current diversity of ornamental shrub species used in Tunisia is historically and largely related to the creation of the Tunis Test Garden, by decree of September 9, 1913, with the main objective of collecting and studying plants interesting to agriculture, arboriculture and horticulture with a view to their acclimatization. More than 126 species of trees and ornamental shrubs are cultivated in Tunisia (Guillochon, 1943, Krichen, 2003). Many of the species listed by these authors have become common in Sousse (Araucaria, Bouguinvillea, Ficus nitida, Ficus australis, Ficus rebuginosa, Jacaranda, Phoenix, Schinus, Phoenix canariensis, Phoenix dactylifera, Washingtonia filifera, Chamoerops humilis, Pritchardia, ...). The majority of the ornamental flora of the municipality of Sousse has been developed for decoration purposes of the city. In this sense, Arce (2009) states that the demand for green spaces for recreational purposes has turned spontaneous urban flora into ornamental, exotic or simply simplified plants into herbaceous groups, which are often biotopes of poor quality.

Climate change: According to the results of the "National Adaptation Strategy for Tunisian Agriculture and Ecosystems to Climate Change" in 2005-2006, which made it possible to explore the possible impacts of climate change on natural resources by 2030, the effects of climate change would directly impact water resources, ecosystems, agrosystems and biodiversity in general. In addition, rising sea levels will affect coastal areas, drinking water supplies, coastal wetlands and adjacent groundwater, particularly by increasing their salinity (MARH, GTZ .2007).

The artificialization of natural environments: Since the twentieth century, the city of Sousse underwent a rapid urban expansion to the detriment of its fertile agricultural land (A. Jlassi et al. 2019). Thus, pollution, in various forms (solid, liquid, aerial ...), constitutes an increasingly restrictive obstacle to the conservation of biodiversity. The use of sebkha of Sousse as an uncontrolled landfill decreasing their productivity, thus causing the disappearance of the populations which live there (Figure n ° 3).

Air pollution: In 2016, the World Health Organization (WHO) has just published a report listing the most polluted cities in the world. Thus, the city of Sousse is part of this list. WHO has relied on data from national and international official reports to establish its own global record. These reports highlight the average annual concentrations of microscopic particulates, which are capable of threatening urban biodiversity. The sources of pollutants in the city of Sousse arise mainly from the transport sector and certain polluting industrial activities located in the city or in the peri-urban area.

The destruction and fragmentation of ecosystems: The theory of "metapopulations" (Hanski and Gilpin, 1991) is based on the assumption that the isolation of urban green spaces causes dispersal of species and presents a risk, at least for species with low dispersal capacity. Indeed, connectivity between green spaces can be improved by creating corridors. The rarefaction, fragmentation and isolation of habitats on the territory, therefore constitute real threats to biodiversity. Thus, the degradation and fragmentation of ecosystems is one of the most formidable causes of the degradation of urban biodiversity in Sousse (Figure N ° 5: Various works in the city threaten biodiversity).

The introduction of invasive alien species: Yellow lamorella "solanum elaeagnifolium", first observed in Tunisia in 1985. It is a small plant characterized by its purple flowers and thorny stems and leaves. Its fruits are round, yellow when ripe. This species is invasive and causes a decrease in the productivity of the land, when its vigorous character allows it to absorb water intended for other plants. During this research, we have inventoried the presence of "solanum elaeagnifolium" in the public garden of Erayhan (figure N ° 6). However, Article 6 of the Convention on Biological Diversity, ratified by Tunisia, in May 1993, incites the requirement to control or eradicate alien species that threaten ecosystems, habitats or species.

National biodiversity policy: Tunisia ratified the Convention on Biological Diversity in May 1993. The protection of biodiversity in Tunisia is provided by a fairly large legal arsenal, which includes provisions at different scales of the legal standard: Laws such as those relating to the protection of agricultural land, fishing, water and soil conservation, marine and coastal protected areas and Organic Law No. 2018-29 of 9 May 2018, relating to the Code of Local Government, which stipulates in its Article 253: The president of the commune is in charge of the municipal regulation, the environmental police, the execution of the decisions of the municipal council and the protection of the environment, within the whole communal perimeter, including the public domain of the state. Legislation of an institutional nature that specifically targets the protection of biodiversity, such as the laws on the establishment of the National Agency for the Protection of the Environment and the law on the creation of the Agency for the Protection and Development of the Environment. Littoral; Decrees such as those concerning the creation of the National Bank of Genes (BNG) and that relating to the creation of the National Council to Combat Desertification (CNLCD);

International conventions: Tunisia has signed and ratified, including the Convention on Biological Diversity (CBD), the Cartagena Protocol, the Nagoya Protocol, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the Convention for the Protection of Protection of the

World Cultural and Natural Heritage, the Ramsar Convention, the Bonn Convention, on the Conservation of Migratory Species, Wildlife Species, the United Nations Convention to Combat Desertification (LCD), the Framework Convention Climate Change (UNFCCC) and the Paris Agreement, ratified by Tunisia in October 2016, including the objectives of the Nationally Determined Contribution (NDC) on Climate Change Adaptation, the International Treaty, on plant genetic resources for food and agriculture; The 2030 Development Agenda and the 17 Sustainable Development Goals (SDGs); The Sendai framework for disaster risk reduction; Agenda 21.

Acknowledgement

The majority of the ornamental flora of the municipality of Sousse has been developed for decoration purposes of the city. Thus, we note a lack of local species enhancement that can play a key role in maintaining biodiversity in urban ecosystems. The dominance of exotic ornamental plants and an unconsciousness of the danger of the extension of "Solanum eleagnifolium", which constitutes a real danger for the biodiversity of the municipality of Sousse. In another context, urban biodiversity offers a range of opportunities for the municipality of Sousse, to develop sustainable economic activities (ecological tourism, medicinal plants), to maintain human well-being and to meet the needs of leisure of its urban population.

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