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Biodiversity and ecosystem services associated to urban plantations in the municipalities of Mecheria and Naâma (southwest Algeria)

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Abstract. Surveys were carried out in the municipalities of Mecheria and Naâma (southwest Algeria) to identify the biodiversity of urban plantations and determine the ecosystem services related to these plantations.
The results obtained enabled us to inventory 29 species belonging to 26 genera and 20 families, of which the Oleaceae family was the largest in terms of number of species. The only biological form identified was phanerophytes. Of the 29 taxa recorded, non-native taxa predominated (13 cultivated species, 4 introduced species, 4 naturalized/introduced species). Taxa of spontaneous origin number 7 and only one species is considered problematic. In terms of ecosystem services, we counted 5 shade species, 15 aesthetic species, and 9 food species.

Keywords: biological form, non-native taxa, spontaneous taxa, shade species, aesthetic species, food species

1. Introduction

Cities are full of numerous planted or natural plant formations. These plant formations are represented by parks, public gardens, street trees, green spaces, etc. [1, 2]. In urban areas, trees contribute to air purification by sequestration of

carbon dioxide [3], to the creation of a microclimate, to the natural balance, and to the attractiveness of the territory [4]. These advantages are attributed to the tree functions at the social, economic, and environmental levels [5], the importance of which is reflected by the ecosystem services [6]. In recent years, nature in the city has become one of the major themes addressed within the scientific community [7]. Cities must be planned in such a way as to improve the living environment of urban dwellers and make the city more pleasant [8].

In 2007, Algeria introduced a law on the maintenance, protection, and planning of green spaces, intending to improve the living environment of citizens, preserve human health, and maintain ecological and climatic balance. This law puts in place a "genuine policy" for the establishment of a network of green spaces, enabling the promotion of their extension in the urban environment, by making the introduction of green spaces, in all construction projects, an obligation that must be taken into account in public and private urban planning and architectural studies.

Furthermore, the notion of ecosystem service has become essential over the past ten years in the international biodiversity arenas [9]. It was publicized following a consultation of international experts between 2001 and 2005 known as the Millennium Ecosystem Assessment (MEA) [6]. This initiative marked the beginning of a new approach to biodiversity conservation policies based on the clarification of our dependencies on the proper functioning of ecosystems. By definition, ecosystem services are the conditions and processes through which natural ecosystems and the species that make them up sustain and fulfil human life [10]. The concept of ecosystem services encompasses the delivery, provision, production, protection, or maintenance of a set of goods and services that people perceive to be important [11, 12, 13].

Knowledge of the services provided by urban plantations to citizens and the types of species that provide them is necessary for the better integration of urban forestry into land-use planning. It is in this context that this research was carried out on the ecosystem services associated with urban plantations in the municipalities of Mecheria and Naâma (southwest Algeria).

2. Materials and methods

Study area

Two municipalities have been chosen to carry out this research. These are the municipalities of Mecheria and Naâma, which are considered the most important in terms of urban development in the province of Naâma (*Fig. 1*).

The municipality of Mecheria is located in the northeast of the province of Naâma, between 0°3' to 0°25' East longitude and 33°27' to 33°42' North latitude [14]. This municipality covers an area of 736.25 km^2 [15]. The municipality is in

the form of a vast asymmetrical syncline; the axis of this syncline presents the high points of Djebel Antar and Anitar. It has approximately 109,991 inhabitants, which represents almost a third of the total population of the province of Naâma [16].

The municipality of Naâma covers an area of 2,482.5 km^2. It is located 30 kilometres south of the municipality of Mecheria, between latitude 33°16' North and longitude 0°19' West [16]. The Naâma region is based on a massif dating from the Upper Jurassic and extends over a gentle relief whose altitude varies between 1,200 and 1,500 m [17, 18]. The population in the municipality of Naâma is estimated at approximately 28,753 inhabitants. This represents almost 9% of the total population of the province of Naâma [16].

The two study areas are characterized by an average annual rainfall of around 194.5 mm/year (period: 1992–2021). These precipitations are irregular, weak, and stormy. The average annual temperature is 19.5 °C. The hottest month is July at 30.5 °C and the coldest is January at 7.5 °C [19].

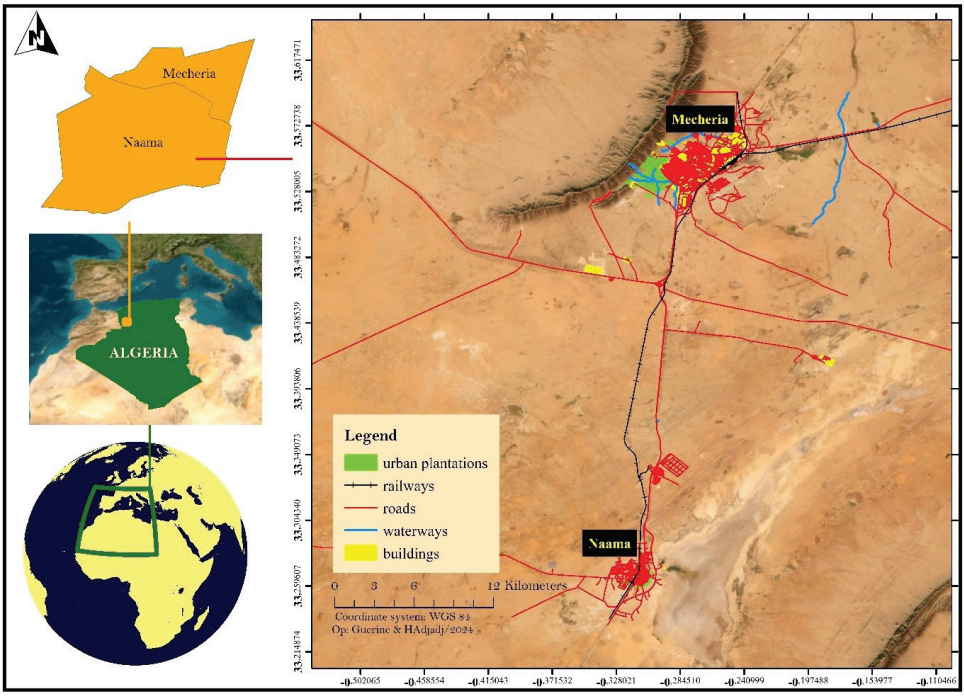

Figure 1. Localization of study zones

Methodology

The inventory of the horticultural flora of the study region was carried out during the year 2023. Main roads, green spaces, and public gardens were surveyed. The species encountered were photographed, and samples were collected for identification.

The identification was made by referring to [20], [21], [22], and [23]. The nomenclature is adjusted according to the synonymous index of [24]. The native or introduced status of the taxa listed refers to the North Africa database [25]. The life forms (or biological types) of the taxa observed are given according to [26].

Then, surveys were carried out among samples of residents of the two municipalities to understand the uses, as well as the services that urban plantations provide to populations (shading, aesthetic, medicinal, food…).

3. Results and discussions

Diversity of urban plantations

A total of 29 urban plant species belonging to 26 genera and 20 families were identified in public gardens, streets, and green spaces in the communes of Mecheria and Naâma (*Table 1*, *Fig. 2*). The Oleaceae family was the most important in terms of number of species, with a rate of 13.77% (4 species), followed by the Arecaceae family with 10.33% (3 species). The Cupressaceae, Fabaceae, Moraceae, and Myrtaceae families are represented by two species, i.e. a percentage of 6.90%. The Anacardiaceae, Elaeagnaceae, Salicaceae, Malvaceae, Pinaceae, Rutaceae, Punicaceae, Apocynaceae, Vitaceae, Celastraceae, Meliaceae, Casuarinaceae, Rosaceae, and Lamiaceae families are represented by just one species each (3.45%).

Table 1. List of identified species

Taxa	**Families**	**Biological type**	**Native status**	**Ecosystem services**
Cupressus sempervirens L.	Cupressaceae	Ph	Problematic	Aesthetics
Platycladus orientalis (L.) Franco		Ph	Cultivated	Aesthetics
Schinus molle L.	Anacardiaceae	Ph	Cultivated	Shadow

Taxa	Families	Biological type	Native status	Ecosystem services
Phoenix dactylifera L.	Arecaceae	Ph	Cultivated	Aesthetics
Washingtonia robusta H. Wendl		Ph	Cultivated	Aesthetics
Washingtoniafilifera (André) H. Wendl.		Ph	Cultivated	Aesthetics
L. igustrum ovalifolium Hassk	Oleaceae	Ph	Naturalized/ introduced	Aesthetics
L.igustrum japonicum Thunb		Ph	Naturalized/ introduced	Aesthetics
Fraxinus angustifolia Vahl		Ph	Spontaneous	Aesthetics
Olea europeae L.		Ph	Spontaneous	Food
Elaeagnus angustifolia L.	Elaeagnaceae	Ph	Spontaneous	Food
Populus nigra L.	Salicaceae	Ph	Introduced	Aesthetics
Brachychiton populneus (Schott & Endl.)	Malvaceae	Ph	Introduced	Aesthetics
Ceratonia siliqua L.	Fabaceae	Ph	Spontaneous	Food
Robinia pseudoacacia L.		Ph	Naturalized/ introduced	Aesthetics
Morus alba L.	Moraceae	Ph	Naturalized/ introduced	Food
Ficus carica L.		Ph	Cultivated	Food
Pinus halepensis Mill	Pinaceae	Ph	Spontaneous	Shadow
Eucalyptus globules L. abill.	Myrtaceae	Ph	Introduced	Shadow
Eucalyptus camaldulensis Dehnh.		Ph	Introduced	Shadow
Citrus limon (L.) Burm. f.	Rutaceae	Ph	Cultivated	Food
Punica granatum L.	Punicaceae	Ph	Cultivated	Food
Nerium oleander L.	Apocynaceae	Ph	Spontaneous	Aesthetics
Vitis vinifera L.	Vitaceae	Ph	Cultivated	Food
Euonymus japonicas L. f	Celastraceae	Ph	Cultivated	Aesthetics
Melia azedarah L.	Meliaceae	Ph	Cultivated	Aesthetics

Taxa	Families	Biological type	Native status	Ecosystem services
Casuarina equisetifolia L.	Casuarinaceae	Ph	Cultivated	Shadow
Pyrus communis L.	Rosaceae	Ph	Cultivated	Food
Rosmarinus officinalis L.	Lamiaceae	Ph	Spontaneous	Aesthetics

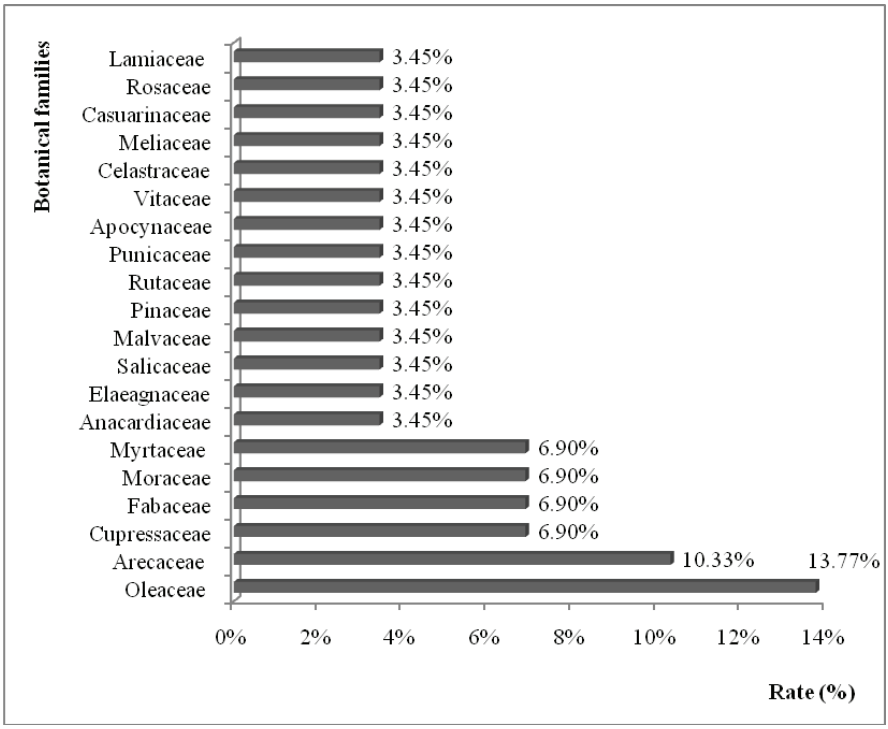

Figure 2. Rate of number of species by botanical families

Biological form

The only biological form determined was phanerophytes (29 taxa, i.e. 100%). The floristic composition made it possible to distinguish several plant groupings:

- forest taxa, the most dominant group, essentially represented by: *Cupressus sempervirens* L., *Platycladus orientalis* (L.) Franco, *Schinus molle* L., *Fraxinus angustifolia* Vahl, *Olea europaea* L., *Ceratonia siliqua* L., *Populus nigra* L., *Pinus halepensis* Mill, *Eucalyptus globules* Labill, *Eucalyptus camaldulensis* Dehnh, *Casuarina equisetifolia* L., *Rosmarinus officinalis* L.;

- fruit tree, represented by: *Phoenix dactylifera* L., *Washingtonia robusta* H. Wendl, *Washingtonia filifera* (André) H. Wendl, *Elaeagnus angustifolia* L., *Morus alba* L., *Ficus carica* L., *Citrus limon* (L.) Burm. f., *Punica granatum* L., *Vitis vinifera* L., *Pyrus communis* L.;
- ornamental tree, represented by: *Ligustrum ovalifolium* Hassk, *Ligustrum japonicum* Thunb. *Brachychiton populneus* (Schott & Endl.), *Robinia pseudoacacia* L., *Nerium oleander* L., *Euonymus japonicas* L. f., *Melia azedarah* L.

Native status

Of the 29 taxa recorded, non-native taxa predominate in the flora studied: 13 cultivated species, i.e. 44.83%; 4 introduced species, i.e. 13.79%; 4 naturalized/introduced species, i.e. 13.79% (*Fig. 3*, *Table 1*).

Taxa whose presence is problematic are represented by a single species (*Cupressus sempervirens* L.) (3.45%).

Taxa of spontaneous origin number 7 (24.14%): *Fraxinus angustifolia* Vahl, *Olea europeae* L., *Elaeagnus angustifolia* L., *Ceratonia siliqua* L., *Pinus halepensis* Mill, *Nerium oleander* L., *Rosmarinus officinalis* L.

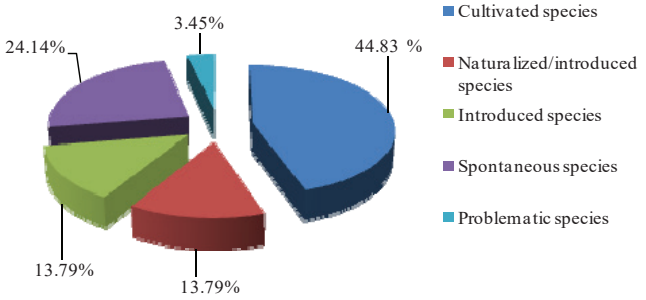

Figure 3. Native status of identified species

Ecosystem services

Shade species

This category is represented by 4 families, 4 genera, and 5 species (*Table 1*). The Myrtaceae family is the most represented, with 2 species. The other families are represented by a single species per family. These are generally species with well-developed symmetrical crowns and a large projection surface.

Aesthetic species

This category comprises 10 families, 13 genera, and 15 species (*Table 1*). The most dominant families are Arecaceae and Oleaceae with 3 species each and Cupressaceae with 2 species. The remaining families have just one species per family.

These species are characterized by their decorative habit and crowns. Examples include *Platycladus orientalis* (L.) Franco, *Washingtonia robusta* H. Wendl, *Ligustrumo valifolium* Hassk, *Ligustrum japonicum* Thunb., and *Fraxinus angustifolia* Vahl (*Table 1*).

Food species

9 species belonging to 8 families and 9 genera are included in this category. All these families are represented by a single species, except the Moraceae family, which has 2 species (*Table 1*).

The food species identified are either fruit trees, such as *Ficus carica* L., *Punica granatum* L., *Vitis vinifera* L., or *Pyrus communis* L., or forest trees offering edible fruit such as *Ceratonia siliqua* L. or *Olea europeae* L.

Figure 4. Photos of some identified species (a: *Brachychiton populneus* (Schott & Endl.); b: *Populus nigra* L.; c: *Pinus halepensis* Mill; d: *Euonymus japonicus* L.; e: *Morus alba* L.; f: *Phoenix dactylifera* L.)

4. Conclusions

The concept of urban forestry is beginning to gain ground as a way of extending the urban fabric. This concept is very little developed in Algeria's highland cities.

This first assessment focused on the biodiversity of urban plants in the communes of Mecheria and Naâma (southwest Algeria) and on their potential for producing social services. Through this first contribution, we have identified 29 species belonging to 26 genera and 20 families. These species provide shade for the people and are both aesthetic and food species. The majority of the species inventoried in streets and green spaces are introduced. Therefore, it would be recommended to consider mechanisms for integrating native species into these spaces.

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