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Trees and Shrubs Prevailing in the Urban Green Spaces of the Gaza City in Palestine

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Abstract

Gaza is the main city in the Gaza Strip, having a variety of urban green spaces such as public parks, community gardens, and cemeteries. These urban ecosystems have never been studied for their woody components (trees and shrubs). Accordingly, the current study aims at identifying and recording the woody components of some selected urban green spaces. Three public parks and gardens; namely the Gaza Municipality, Barcelona, and Al-Azhar, were selected to carry out the current study. Frequent visits, observations, and discussions with stakeholders were carried out during a six-month study (October 2016 – March 2017) to satisfy the purpose of the study. A total number of 50 tree and shrub species belonging to 26 families and 14 orders were identified and recorded. The Gymnosperms included 4 species (8.0%) only, while the Angiosperms were represented by 46 species (92.0%), of which monocots were represented by 4 species (8.0%) and the dicots by 42 species (84.0%). The Fabales was the biggest order and comprised 7 (14.0%) of the recorded species, followed by Lamiales with 6 species (12.0%). The families Apocynaceae, Fabaceae, Malvaceae, and Moraceae were the biggest families and each was represented by 5 species (10.0%). The study recommends the selection of woody species adapted with the local prevailing environmental conditions in order to ensure environmental, ecological, recreational and socio-economical values needed by the Palestinian community in the Gaza Strip.

Keywords:

Urban green spaces, public parks, woody components, trees, shrubs, Gaza City characterization.

1. Introduction:

In spite of the ecological and environmental roles drawn by the natural ecosystems such as forests, deserts, sand dunes, wadis (valleys), swamps and wetlands worldwide, urban green spaces such as parks, reserves, sporting fields, green roofs, riparian areas, greenways, cemeteries and community gardens can be a significant part of sustainable development in cities and big towns (Roy et al., 2012). They provide a wide range of ecosystem services that could help combat many urban ills and improve the life of city dwellers; especially their health (Sister et al., 2010). Parks, as a good example of urban green areas, are known to serve as sites of physical activity, which is associated with enhanced health and reduced risk for all-cause mortality and

many chronic diseases (Hartig, 2008; Barton and Pretty, 2010). From an environmental point of view, green spaces are known to filter air, remove pollutants, attenuate noise, cool temperatures, infiltrate storm water, and replenish groundwater (Escobedo et al., 2011). Moreover, trees, shrubs and other floristic species prevailing in green spaces and nature reserves can provide food for both humans and wildlife (Cheers, 2008; Abd Rabou, 2011). Palestine (27,000 km²) harbors a rich wildlife in terms of flora and fauna because of its location at the meeting point of the three continents Asia, Africa and Europe. Its topography creates diverse habitats, niches and climates as well (Qumsiyeh, 1996). The mix of Mediterranean, Oriental and African desert

influences makes the great floristic diversity in Palestine. Palestine is home to about 2,700 species of wild plants. The most dominant families were the Compositae, Gramineae, Leguminosae, Cruciferae, Labiatae and Liliaceae (Ali-Shtayeh and Jamous, 2002; 2003).

The Gaza Strip, located along the southeastern Mediterranean Sea, is home to a considerable diversity of fauna and flora dominating in various natural and human-made ecosystems; particularly Wadi Gaza (Abd Rabou, 2005; 2011; Abd Rabou et al., 2007; 2008). The Gaza City, which is the main city of the Gaza Strip, is home to a variety of green spaces including public parks, community gardens, and cemeteries. Previous studies investigating the woody composition of the urban green spaces in the Gaza Strip seem to be rare. More recently, Abbas (2016) surveyed and assessed the median trees and shrubs in the Gaza City. She listed as many as 45 woody species belonging to 25 families and 15 orders in selected five streets in the Gaza City. Several researchers studied the current status and public uses of the Date Palm tree (*Phoenix dactylifera*) in the Gaza Strip. They highlighted the importance of the Date Palm as a fruit and horticultural tree in the Gaza Strip (Qofa 2014; Al-Agha, 2016; Radwan, 2017; Abd Rabou and Radwan, 2017).

Apart from the woody components of urban green spaces, many studies have been conducted locally to survey the floristic species in the Gaza Strip. Bolous (1959) described 251 floristic species prevailing in the Gaza Strip. Abd Rabou et al. (2008) described 70 floristic species occurring in Wadi Gaza ecosystem in the middle of the Gaza Strip. The two studies revealed that many woody species of Wadi Gaza have been found grown in the main roads and public gardens in the Gaza Strip. The examples of woody components included the Evergreen Cypress (*Cupressus sempervirens*), Date Palm (*Phoenix dactylifera*), Sycamore Fig (*Ficus sycomorus*), Oleander (*Nerium oleander*), Acacia (*Acacia cyanophylla*), River Redgum (*Eucalyptus camaldulensis*) and Christ's Thorn Jujube (*Ziziphus spina-christi*). These woody species were said to be used in herbal medicine and in timber and fuel production (Abd Rabou et al., 2008). Abou Auda (2010, 2011 and 2012) studied the plant ecology and potential uses in the Gaza Strip, with particular

emphasis on Wadi Gaza. Madi (2001 and 2005) and Madi et al. (2002) described the floristic species prevailing in the western coastal sand dune ecosystem of the Gaza Strip. Due to the valuable services the urban green spaces provide to the Palestinian community and environment, the current study aimed at surveying the woody components in terms of trees and shrubs of some selected urban green spaces in the Gaza City.

1. Methodology

2.1. Study Area

The Gaza Strip (31°25'N, 34°20'E) is 365 km² arid strip of the Palestinian area along the southeastern Mediterranean Sea. About 2.0 million residents, of whom the majority is United Nations-registered refugees, are living in the five governorates of the Gaza Strip (North Gaza, Gaza, Middle, Khan Younis and Rafah). The annual rainfall ranges from 200 mm in the south to 400 mm in the north. The Gaza City (**Figure 1**) is the largest city in the Gaza Strip. It has a total area of about 56 km², and a population of about 700,000 people, making it one of the most densely populated cities in the world.

2.2. Procedure

Frequent visits were carried out to three public parks and gardens in the Gaza City during a six-month period (October 2016 – March 2017) in order to identify and record the woody components. The Gaza Municipality, Barcelona, and Al-Azhar Parks, which are supervised and administered by the Municipality of Gaza in the Gaza City, are selected to conduct the current study (**Figure 1**). Observations and interviews with local people, workers and visitors were carried out to collect more data (**Figure 2**). A variety of texts and guidebooks were referred to in order to identify the woody components (trees and shrubs) of the parks or the green spaces selected (Karim and Quraan, 1986; Madi, 2001 and 2002; Abu Ayyash *et al.*, 2007; Cheers, 2008; Ali-Shtayeh *et al.*, 2003 and 2014 and Supreme Commission for the Development of Riyadh City, 2014).

2.3. Photography and Statistical Analysis

Professional digital cameras have been used throughout the study period and photos were taken for documentary and confirmatory purposes. The

data collected throughout the course of the study were statistically analyzed using SPSS computer program version 18.0 for Windows (Statistical Package for Social Sciences Inc, Chicago, Illinois).

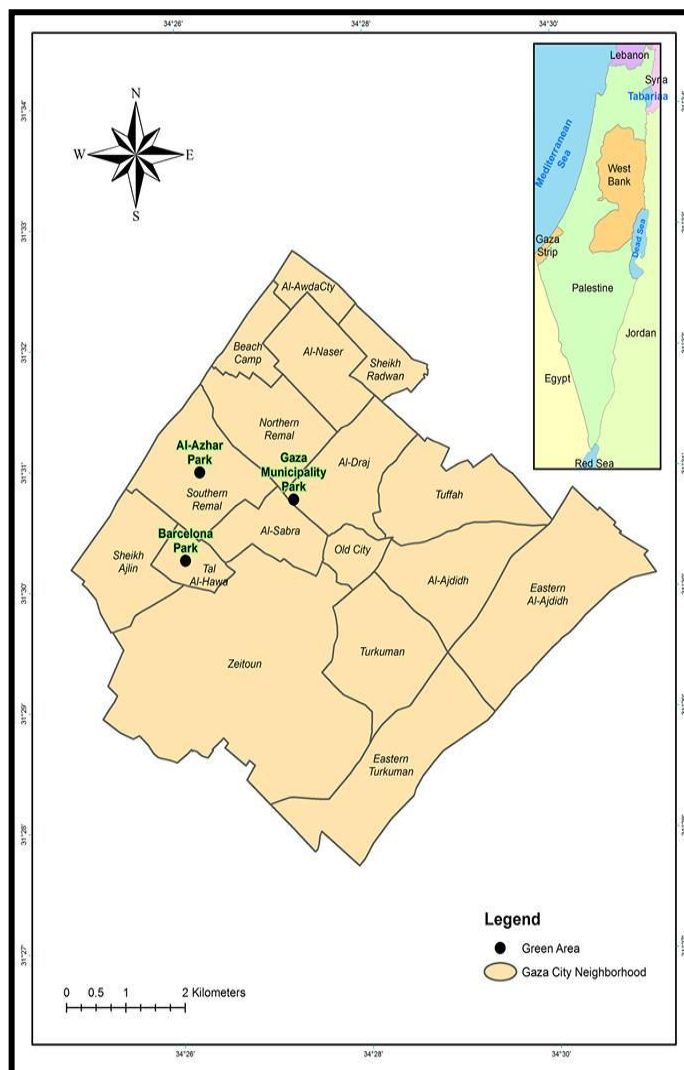


Figure 1 The public parks (Gaza Municipality, Barcelona and Al-Azhar) of the Gaza City investigated throughout the current study



Figure 2 Interviews and discussions with local stakeholders in the Gaza Municipality Park (January, 2017)

3. Results

The current survey pointed out that the targeted parks and gardens of the Gaza City harbor a mix of native and exotic vascular woody species (ornamental and agricultural) belonging to the major groups of plants; Gymnosperms (conifers or naked-seeded plants) and Angiosperms (flowering plants). A total number of 50 tree and shrub species belonging to 26 families and 14 orders were identified and recorded throughout the current study (**Table 1** and **Figures 3, 4 & 5**). The Gymnosperms included 4 species (8.0%) only, while the Angiosperms was represented by 46 species (92.0%), of which monocots were represented by 4 species (8.0%) and the dicots by 42 species (84.0%). The Fabales was the biggest order and represented by 7 (14.0%) of the recorded species, followed by Lamiales which comprised 6 (12.0%) of the recorded species (**Table 1**). The orders Gentianales, Malvales, and Rosales were represented by 5 species (10.0%) for each. The families Apocynaceae, Fabaceae, Malvaceae and Moraceae were the biggest families and each was represented by 5 species (10.0%).

Table 1: Trees and shrubs recorded in the public parks of Gaza City

Order	Family	Scientific Name	Common Name	Arabic Name	Native vs. Exotic*
Gymnosperms					
Pinales	Araucariaceae	<i>Araucaria heterophylla</i>	Norfolk Island Pine – Christmas Tree	شجرة الميلاد (الأروكاريا)	E
	Cupressaceae	<i>Cupressus sempervirens</i>	Evergreen Cypress	السرو	E
		<i>Cupressus macrocarpa</i>	Monterey Cypress	السرو الليموني	E
		<i>Platycladus (Thuja) orientalis</i>	Oriental or Chinese Thuja	سرو الثويا المكوية	E
Angiosperms (Monocots)					
Arecales	Arecaceae	<i>Phoenix dactylifera</i>	Date Palm	نخيل البلح	E
		<i>Washingtonia filifera</i>	California Fan Palm	نخيل واشنطنونيا	E
Asparagales	Asparagaceae	<i>Yucca gloriosa</i>	Spanish Dagger	اليوكا	E
		<i>Dracaena sp.</i>	Dracaena	الدراسينا	E
Angiosperms (Dicots)					
Gentianales	Apocynaceae	<i>Nerium oleander</i>	Oleander	الدفلة	E
		<i>Cascabela thevetia</i> or <i>Thevetia peruviana</i>	Yellow Oleander	الدفلة الصفراء	E
		<i>Carissa macrocarpa</i>	Num-num	الكريسة (الياسمين الهندي)	E
		<i>Acokanthera spectabilis</i>	Wintersweet (Bushman's Poison)	الكونترا	E
		<i>Plumeria obtusa</i>	Singapore Graveyard Flower	الفتنة (البوماريا)	E
Fabales	Leguminosae	<i>Acacia cyanophylla</i>	Acacia	أكاسيا الأحراش	E
		<i>Poinciana regia</i>	Royal Poinciana	البونسيانا	E
	Fabaceae	<i>Albizia lebbeck</i>	Lebbeck	اللبخ (ذقن الباشا)	E
		<i>Peltophorum africanum</i>	Weeping Wattle	السنط الأفريقي (البلتوفورم)	E
		<i>Erythrina corallodendrum</i>	Coral Tree	المرجان	E
		<i>Bauhinia (Phanera) variegata</i>	Camel's Foot Tree	خف الجمل	E
		<i>Tipuana tipu</i>	Rosewood	أبو المكارم (التبوانا)	E
Malvales	Malvaceae	<i>Hibiscus roas-sinensis</i>	Hibiscus	الكركدية الأحمر (الخطمي الوردي الصيني)	E
		<i>Hibiscus tilliaceus</i>	Coastal Hibiscus	كركدية الساحل (الخبازي الساحلي)	E
		<i>Malvaviscus arboreus</i>	Sleeping Hibiscus	كركدية النوم (الطربوش –	E

Order	Family	Scientific Name	Common Name	Arabic Name	Native vs. Exotic*
				الخباز الشمعي	
		<i>Brachychiton populneus</i>	Kurrajong or Bottletree	بودرة العفريت رفيع	E
		<i>Brachychiton acerifolius</i>	Flame Tree	بودرة العفريت شعلة	E
Myrtales	Myrtaceae	<i>Eucalyptus camaldulensis</i>	River Redgum	الكينا (الكافور)	E
		<i>Callistemon citrinus</i>	Callistemon	فرشاة الزجاج	E
		<i>Psidium guajava</i>	Guava	الجوافة	E
	Lythraceae	<i>Lawsonia indica</i>	Henna	التمر حنة	E
Sapindales	Meliaceae	<i>Melia azedarach</i>	China Berry Tree	الزرنخ (الأردخت)	E
	Rutaceae	<i>Citrus limon</i>	Lemon	الليمون	E
	Anacardiaceae	<i>Schinus terebinthifolius</i>	Brazilian Pepper	اللفل البرازيلي	E
	Sapindaceae	<i>Dodonea viscosa</i>	Hopbush	الديونيا (الشث)	E
Rosales	Moraceae	<i>Ficus sycomorus</i>	Sycamore Fig	الجميز	N
		<i>Ficus elastica</i>	Rubber Fig	التين المطاطي (الكاوتشوك)	E
		<i>Ficus nitida</i>	Weeping Fig	الغار الهندي (نيتدا)	E
		<i>Ficus benjamina</i>	Benjamin Fig	التين المتهدل	E
		<i>Ficus neriifolia</i>	Willow Leaf Fig	تين صفصافي الأوراق – فيكس تايلندي	E
Lamiales	Oleaceae	<i>Olea europea</i>	Olive Tree	الزيتون	N
	Verbenaceae	<i>Duranta erecta</i>	Golden Dewdrop	الدورنتا (توت الحمام)	E
	Bignoniaceae	<i>Jacaranda mimosifolia</i>	Jacarand	الجاكرندا	E
		<i>Tecoma stans</i>	Yellow Bells	الصفير (التيكوما)	E
	Scrophulariaceae	<i>Buddleja americana</i>	Butterfly Bush	البديا	E
	Verbenaceae	<i>Lantana camara</i>	Wild-sage (White-sage)	أم كلثوم (اللاتانا)	E
Malpighiales	Euphorbiaceae	<i>Acalypha hispida</i>	Philippines Medusa – Fox Tail	الأكاليف – الميدوزا الفلبينية	E
Caryophyllales	Nyctaginaceae	<i>Bougainvillea spectabilis</i>	Veranera	الجهنمية – المجنونة	E
	Cactaceae	<i>Opuntia ficus-indica</i>	Tuna Cactus	الصبر – التين الشوكي	N
Apiales	Araliaceae	<i>Schefflera arboricola</i>	Dwarf Umbrella Tree	الشيفوليرا	E
	Pittosporaceae	<i>Pittosporum tobira</i>	Japanese pittosporum	البتسبورم	E
Brassicales	Moringaceae	<i>Moringa oleifera</i>	Moringa	البان (اليسر)	E

* N (Native); E (Exotic)

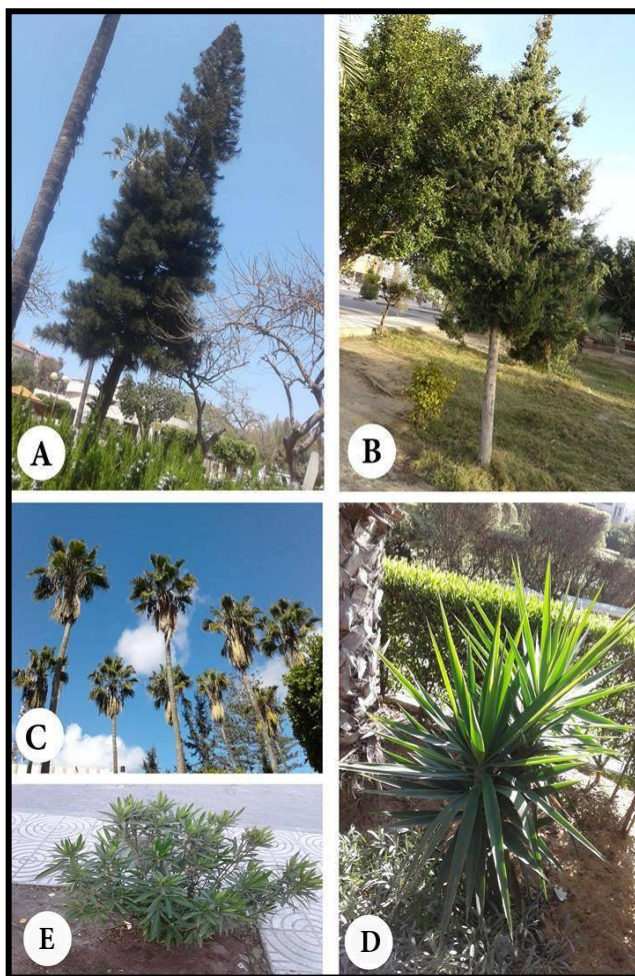


Figure 3 Trees and shrubs prevailing in Gaza parks:
(A) Norfolk Island Pine *Araucaria heterophylla* (B)
Evergreen Cypress *Cupressus sempervirens* (C)
California Fan Palm *Washingtonia filifera* (D)
Spanish Dagger *Yucca gloriosa* (E) Oleander *Nerium*
oleander

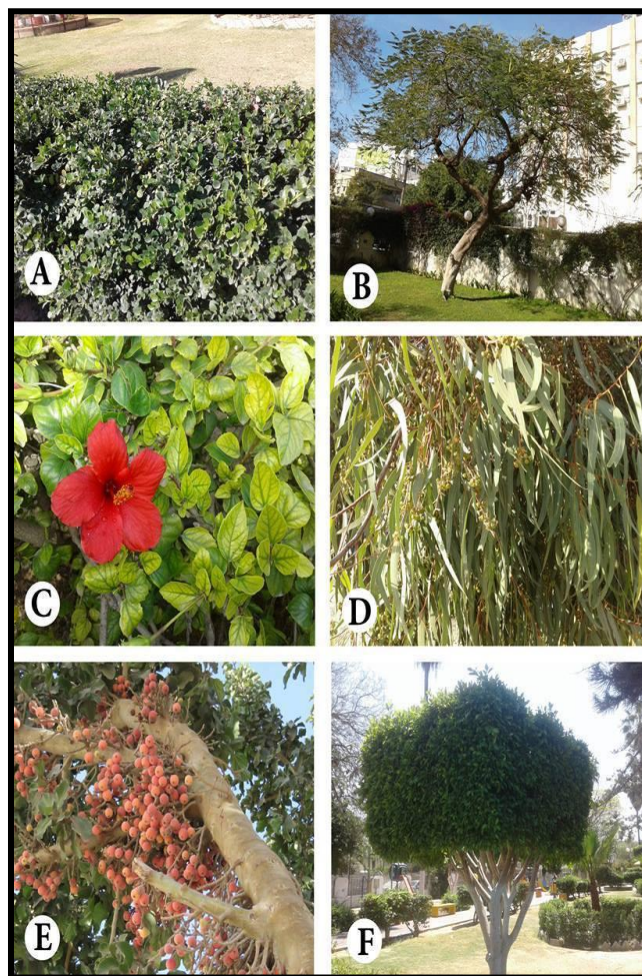


Figure 4 Trees and shrubs prevailing in Gaza parks:
(A) Num-num *Carissa macrocarpa* (B) Royal
Poinciana *Poinciana regia* (C) Hibiscus *Hibiscus*
roassinensis (D) River Redgum *Eucalyptus*
camaldulensis (E) Sycamore Fig *Ficus sycomorus* (F)
Weeping Fig *Ficus nitida*



Figure 5 Trees and shrubs prevailing in Gaza parks:
(A) Benjamin Fig *Ficus benjamina* (B) Philippines
Medusa *Acalypha hispida* (C) Veranera *Bougainvillea*
spectabilis

4. Discussion

The current work revealed a considerable number of horticultural, agricultural and even wild trees and shrubs grown in Gaza public parks and gardens. The majority of the species recorded are described as exotic (**Table 1**) in the sense that they find their way to the Palestinian environment from completely separate geographical areas via human intervention. In contrast, many of the recorded species are native in the sense that they occur naturally in the Palestine environment (Abu Ayyash *et al.*, 2007). A similar work carried out by Abbas (2016) revealed proximate findings. She listed as many as 45 woody species in street medians of the Gaza City, of which 37(80.4%) were exotic. The advantages drawn by exotic species seem to be many. They may be free of native pests and diseases, and they can attract a diversity of vertebrate and invertebrate fauna. Moro *et al.* (2014) pointed out that many deciduous exotic species can provide greater solar access to the locations they grown in through the winter months. As far as the gymnosperms are concerned, the Evergreen Cypress (*Cupressus sempervirens*) is commonly planted by the Gazans around agricultural field and along roads because of its importance in providing wind-break, shade and beauty characteristics. Abd Rabou *et al.* (2008) pointed out that the species was harvested as a source of timber in the last few decades in the Gaza

Strip. The planting of the Norfolk Island Pine (*Araucaria heterophylla*) as a horticultural plant in Gaza parks, institutions and even home yards may be attributed to its beautiful form and attractive branches arrangement. The other reasons promoting the planting of the species in the Gaza Strip may come from the fact that the fast growth rate, low susceptibility to pests and diseases, adaptability to different soil conditions, high tolerances to drought and salt-laden winds are good traits characterizing the species as indicated by Gilman and Watson (1993).

Angiosperms, which include both monocots and dicots taxa, are the largest group of plants on the earth, they were represented by 46 species (92.0%) in the current study. Their preference in public parks and gardens can be interpreted in the sense that they provide beautiful flowers, fruits and foods for both human and wildlife. Locally, Abd Rabou *et al.* (2007 and 2008) ensured the importance of woody trees and shrubs in Wadi Gaza Nature Reserve in providing food, shelter in addition to nesting, resting and roosting places for wildlife particularly bird fauna. Particular emphasis was paid by Abbas (2016), Radwan (2017), and Abd Rabou and Radwan (2017) to the monocot. Date Palm (*Phoenix dactylifera*) trees, which are very prevalent horticultural and agricultural plants in the Palestine Territories because of their support to the Palestinian community and environment and many wildlife species. Along with the Date Palm, the California Fan Palm (*Washingtonia filifera*) is very common exotic species among horticultural plants in all parks, gardens and even roads of the Gaza Strip. The municipalities of the Gaza Strip preferred to plant the species because of its low water requirements and high tolerance to drought and salinity (Jones, 1995), which are common environmental conditions of arid to semi-arid geographical locations like the Middle East including the very small area of the Gaza Strip.

The Oleander (*Nerium oleander*) is a very common horticultural plant in the targeted parks of the current study. It is commonly cultivated because of its expected tolerances to pests, drought, poor soils, air pollutants and water shortage. Abbas (2016) pointed out that the species prevails in Gaza roads because it is poisonous and unpalatable by grazing animals including goats and sheep.

In addition to its value in timber and charcoal production, the River Redgum (*Eucalyptus camaldulensis*) is beneficial as a source of nectar for honey production which is very loved by the Palestinian community (Abd Rabou et al., 2008). Many of the recorded species in the current study were selected for their beauty, evergreen status, crown structure, songbird attractiveness and easy pruning into any shape and size. The examples included the Hibiscus (*Hibiscus roassinensis*), Weeping Fig (*Ficus nitida*), Benjamin Fig (*Ficus benjamina*), Butterfly Bush (*Buddleja americana*), Philippines Medusa (*Acalypha hispida*), and many others.

The presence of many species of fruit trees and shrubs in the targeted urban green spaces in the Gaza City may be advantageous in the sense that they provide food for both people and wildlife. Olive Tree (*Olea europea*), Sycamore Fig (*Ficus sycomorus*), Lemon (*Citrus limonum*), Guava (*Psidium guajava*) and Date Palm (*Phoenix dactylifera*) are more or less represented in such public parks. Sometimes, the presence of these fruit plants may be disadvantageous as stated by many local people and municipalities officials. Those people claimed that the fruits of fruit trees and shrubs can pollute the park grounds by increasing the waste level, and attract annoying insects and harmful rodents. These facts were found to be consistent with the findings of many studies dealing with urban fruit trees and shrubs (Barker, 1986; Ferrini and Fini, 2011).

Finally, the current study recommends the increase of both woody components diversity and number in a sustainable fashion to ensure the environmental, ecological, recreational and the socio-economical values harvested. The selection of woody species corresponding with the prevailing local environmental conditions is very essential as well.

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الأشجار والشجيرات الشائعة في المساحات الخضراء الحضرية لمدينة غزة في فلسطين

الملخص

مدينة غزة هي مدينة رئيسة في قطاع غزة وتحظى بتشكيلة من المساحات الخضراء الحضرية مثل المتنزهات العامة والحدائق والمقابر. لم تدرس هذه النظم البيئية الحضرية من قبل بخصوص مكوناتها الخشبية (الأشجار والشجيرات). ولهذا هدفت الدراسة الحالية إلى تحديد وتسجيل المكونات الخشبية في بعض مساحات خضراء حضرية مختارة في مدينة غزة. اختيرت ثلاثة متنزهات وحدائق وهي متنزة بلدية غزة وحديقتنا برشونة والأزهر لإنجاز هذه الدراسة. عقدت العديد من الزيارات الميدانية والملاحظات والمناقشات مع المعنيين خلال ستة أشهر امتدت بين أكتوبر 2016 ومارس 2017 لتحقيق غرض الدراسة. بينت النتائج حدوث 50 نوعا من الأشجار والشجيرات تنتمي لـ 26 عائلة و 14 رتبة. تضمنت عاريات البذور (Gymnosperms) أربعة أنواع فقط (8.0%)، بينما تمثلت مفطاة البذور (Angiosperms) بـ 46 نوعا (92.0%) منها 4 أنواع (8.0%) من وحيدات الفلقة (monocots) و 42 نوعا (84.0%) من ثنائيات الفلقة (dicots). كانت الفوليات (Fabales) هي الرتبة الأكبر وشملت 7 (14.0%) من الأنواع المسجلة وتبعثها رتبة الشفويات (Lamiales) التي شملت 6 (12.0%) من الأنواع المسجلة. بينت الدراسة أن عائلات الدفلية (Apocynaceae) والفولية أو القرنية (Fabaceae) والخبازية (Malvaceae) والتوتية (Moraceae) هي الأكبر وشملت كل منها 5 أنواع (10.0%). أوصت الدراسة بضرورة اختيار أنواع خشبية تتوافق والظروف البيئية السائدة محليا لضمان قيمها البيئية والاستجمامية والاجتماعية والاقتصادية التي تقدمها للمجتمع الفلسطيني في قطاع غزة.

الكلمات المفتاحية: المساحات الخضراء الحضرية، المتنزهات العامة، المكونات الخشبية، الأشجار، الشجيرات، مدينة غزة.