

## Vegetation Composition and Structure of Woody Plant Communities in Ajloun Forest Reserve

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### ABSTRACT

The study area is located in Ajloun Forest Reserve (AFR) northern part of Jordan. It consists of Mediterranean hills dominated by open woodlands of oak and pistachio. This reserve is partly encompasses the village of Um El-Yanabee' and the surrounding area including the villages of Tyarra, Baoun and Rasun. The Ajloun forest reserve plays a fundamental role in Ajloun area development and the existence of initiatives of nature conservation in the area supports various socio-economic activities around the reserve that contribute towards the development of local communities in Ajloun area. The research objectives was to conduct a field survey to study the impact of Ajloun forest reserve on vegetation composition and the structure of the woody plant communities. Conducting such study on the biodiversity content especially for vegetation will determine the economic impacts of AFR on its surroundings in Ajloun. In this study, and to fill the objectives, a point centered quarter method conducted through selecting randomly 50 plots at the study site. The collected data from the field showed that the absolute density was (1031.24 plant per hectare). Species density was recorded and found to be the highest for *Quercus coccifera* (412.4p/ha), and relative density of (73.7%), this was followed by *Arbutus andrachne* (165p/ha) and relative density (7.1%), *Pistacia palaestina* (144.3p/ha) and relative density (10.5%) and *Crataegus azarulus* (82.5 p/ha) and relative density (5.1%), Where the least dense species was *Quercus infectoria*, (41.2 p/ha), *Rhamnus palastinus* (20.6 p/ha, ) *Styrax officinalis* (20.6 p/ha).

**Keywords:** Vegetation Composition, Ajloun Forest Reserve.

### INTRODUCTION

Forest in Jordan where studied by Kasapligi (1955) and Tillawi (1989) who have considered a special type of forest called mixed forest. Kasapligi (1956) considered five major vegetation types in Jordan: Secondary (degraded) forests, Coniferous forest (*Pinus halepensis* forests, *Juniperus* spp

forests). Broad-leaf forests (evergreen and deciduous Oak forest). Another studies conducted by Al-Eisawi (1996) mention that there is a forest type in Jordan names a mixed forest. It's natural to have two different formation at the boundary of each other, due to that *Pinus halepensis* was mixed with *Quercus coccifera* and *Quercus ithaburensis* was mixed with *Quercus coccifera* at the borders of their distribution. Similarly, the mixture of *Quercus coccifera* with *Juniperus phoenicia* in Southern Jordan. El-Oqlaeh and Lahham (1985-a) summarized the current knowledge of the vascular plants of Ajloun Mountain. Their study covered areas of Umm Qis, Ajloun and Jarash hill areas, Jordan rift valley from the east and western part merge into the Syrian Desert. Their results showed that the area could be subdivided into

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two phytogeographical regions, The Mediterranean region that is a rich flora of evergreen forests and maquis climax. While in another study was conducted by El-Oqlah and Lahham (1985-b) showed a detailed floristic analysis of floral species at Ajloun mountain were the Mediterranean element is represented (40%) species which were recorded, the total number of species description of vegetation divided in to three group Pine forests, Deciduous oak forest, evergreen oak forest. RSCN (2001) conducted an ecological baseline surveys in AFR aimed to cover the flora, carnivores, rodents, reptiles and birds of the reserve. A total number of 172 plant species belong to 49 families were recorded. On other hand, a flora monitoring survey was conduct in Ajloun reserve that aimed to update the plant species. A total of 150 plant species were recorded inside the reserve, our of which, 71 species were new records in the reserve, in addition to one new to Jordan *Hypericum emptrifolium* (RSCN, 2006). Tayfour and el-oqlah (2017) mentioned that the number of flora species are 2531 according the APG3 system within 112 families. Also, Thomas *et al.* (2010) performed an inventory at Ajloun aimed to quantify the tree biomass, quantify structure and composition and establishment permanent photo points at each inventory point to monitor vegetation changes over time. Their results showed that *Quercus coccifera* is well-represented in all diameter classes, including the recruitment class. While, *Arbutus andrachne* and *Pistacia palestina* are present in far fewer numbers. Another monitoring survey conducted by Ananbeh (2010) for threatened plant conducted in Ajloun reserve showed that the highest diversity of threatened plant species with four Orchid species are, *Cephalanthera longifolia*, *Limodorum abortivum*, *Ophrys transhyrcana* and *Orchis anatolica*. The most abundant threatened plant species during the survey was the *Orchis tridentata*, followed by the *Cephalanthera longifolia* which showed the higher specimens recorded during the survey.

### 3. Material and Methods

#### 3.1 Point-Centered Quarter Method

This method was used based on Cottam and Curtis

(1956) whom developed this method as a plot-less technique to estimate density. It assumes that the dominant species follow a random spatial pattern, and is sensitive to bias when plants exhibit a more contagious arrangement. It also requires extra field effort and computational input than many of the other distance methods. Despite these disadvantages, the point-centered quarter method has been used in a wide variety of vegetation types, including some attempts to sample herbaceous vegetation (Cottam and Curtis, 1956).

The procedure outlined below describes how to conduct the point-centered quarter method for data collection from 50 plots. This analysis can be carried out alone (Fig. 1).

1. Locate the sampling plot, 50 plots Selected randomly in study area.
2. The area around each point is divided into four 90° quadrants, and the plant closest to the point in each quadrant is identified., each point represents the center of four compass (N, S, E, W) which divided the sampling into four quarters (Fig. 2)
3. In each quadrant, the following was recorded
  1. The nearest tree in each quadrate
  2. The distance from the sample point to the tree
  3. The diameter at breast height of the tree
  4. Repeat this procedure for all plots.

#### 3.2 Calculation in the Point-Centered Quarter Method

The procedure outlined below describes how to carry out point-centered quarter method. In which it starts with calculation of the total distance, the average distance between trees, the average area occupied per tree, and the absolute density for all trees (trees per hectare) (Mitchell, 2007).

##### 3.2.1 Absolute Density

The absolute density of each species is calculated based on the expected number of tree of that species per hectare. In which the point center quarter method allows us to estimate this value without having to count tree within such a large area (Mitchell, 2007).

### 3.2.2 Relative density of species

The relative density of each species is simply the proportion of observation of that species time 100 to make it a percentage (Curtis and McIntosh 1951)

### 3.2.3 Absolute cover of species

The cover of an individual tree is measured by its basal area (Curtis and McIntosh 1951)

### 3.2.4 Relative cover of species

The relative cover (Cottam and Curtis, 1956) for a particular species is defined to be the absolute cover for that species divided by the total cover time 100 to express as a percentage.

### 3.2.5 Absolute frequency of species

The Absolute frequency of a species is the percentage of sample point at which species occurs .

After the data are collected, calculation of the density, relative density, frequency, relative frequency, dominance, relative dominance, importance value and relative importance value for each species in study area were calculated and presented.

### 3.2.6 The Importance Value of a Species

The importance value (Curtis and McIntosh, 1951) of a species is defined as the sum of three relative measures:

Importance value = Relative density + Relative cover (Relative dominance) + Relative frequency

## 4. Results

### 4.1 Woody Species Structure: Absolute Density and Species Density

As per the collected field data, the absolute density was (1031.24 plant per hectare). From the absolute density and relative density were calculated for each species. Density was recorded to be highest in *Quercus coccifera* (412.4p/ha), and relative density of (73.7%), this was followed by *Arbutus andrachne* (165p/ha) and relative density (7.1%), *Pistacia palaestina* (144.3p/ha) and relative density (10.5%) and *Crataegus azarulus* (82.5 p/ha) and relative density (5.1%), Where the least dense species was *Quercus infectoria*, (41.2 p/ha),

*Rhamnus palastinus*(20.6 p/ha,) *Styrax officinalis* (20.6 p/ha) (Table1).

### 4.2 Basal Area of Species

From the collected data of the field mean basal area of species ranged between 3.129 m<sup>2</sup>/ha to 0.035 m<sup>2</sup>/ha. The maximum mean basal area recorded was for *Quercus coccifera* (3.129m<sup>2</sup>/ha) and *Pistacia palaestina* (0.858m<sup>2</sup>/ha). While the least mean of basal area for *Styrax officinalis* was (0.035m<sup>2</sup>/ha) (Table 1).

### 4.3 Relative density

Relative density of each species is the percentages of the total number of observation of that species. (Table 2)

### 4.4 Relative Cover of species (Dominance )

The cover of an individual tree is measured by its basal area, the unit for cover are m<sup>2</sup>/ha .For data analysis, the cover ranged between (3.129 m<sup>2</sup> /ha to 0.035m<sup>2</sup> /ha. The maximum cover was recorded in *Quercus coccifera* (3.129 m<sup>2</sup> /ha), and relative cover of (60.3 %), followed by *Arbutus andrachne* and *Pistacia palaestina* 0.8270 (m<sup>2</sup> /ha) and relative cover (15.94%) and while the least cover species recorded were *Styrax officinalis* and *Rhamnus palastinus* (Table 2)

### 4.5 Frequency of Species

According to the data obtained from this method, frequency was found to range between 0.4 and 0.02. The most frequent species recorded were *Quercus coccifera* 0.4, and relative frequency 74.29% and *Arbutus andrachne* 0.16 with relative frequency (7.14%). While the least frequent species were *Styrax officinalis* (0.02%) and *Rhamnus palastinus* (0.02 %) as shown in Table (2).

### 4.6 Importance value

According to the data obtained, it was found that the most important forest species in means of dominance over other forest species is the *Quercus coccifera* with scores of 180.4, while the least important forested species found to be *Rhamnus palastinus* with value of 3.976 (Table 2). The importance value was calculated based on equal weights of the three factors of relative density, relative cover and relative frequency. This mean that small tree

(i.e. with small basal area) can be dominant only if there are enough of them widely distributed important value can range from 0 to 300 (Table 2).

## 5- Discussion

### 5.1 Vegetation attributes

Point-center quarter method was found as the appropriate methodology to be used for studying forest structure and density of trees determination due to the ease of use and less time requirements for collection data. In addition, it was found that the highest relative density and frequency of woody species belongs to *Quercus coccifera* followed by *Pistacia palaestina*. In addition, results of this method confirmed the forest stability since *Quercus coccifera* showed the highest relative density and distribution which refers to good regeneration at Ajloun forest reserve. Tomas et al., (2010) indicated that the best estimate was recorded for *Quercus coccifera* which was well-represented in all diameter classes, including the recruitment class, and therefore appears to be viable.

### 5.2 Woody species structure

Two species of the genus *Quercus* are known to occur naturally in this study area with a general range of distribution extending. These species are *Quercus coccifera* L., and *Quercus infectoria* reported by (Kasapligi, 1956; Long, 1957; Zohary, 1961, 1962). *Q. coccifera* is the most widespread evergreen species in Ajloun forest reserve while *Q. infectoria* is the least abundant and deciduous species; restricted largely in the eastern part of the reserve, mainly around cites of Wadi Sus Rauson with elevation 900m according to (Al -Eisawi 1996).

The Evergreen oak forests are the most typical and common formation of the Mediterranean part in Palestine and East Jordan (Zohary 1962, Alaham & Al -Oqlahh 1985, AL-Eiswai 1996). Several studies confirmed the importance of the terra rossa soil type in forest formation (Zohary 1962 & 1973, Al Eisawi 1996). In addition, their studies showed that this soil type is dominant in Ajloun reserve which enhanced the presence of forests dominated by *Quercus coccifera* and *pistacia palaestina*. Through the

reading of importance value by point –centered quarter method, it was revealed the highest in *Quercus coccifera* followed by *Pistacia palaestina*. In addition, it was clear that the *Quercus coccifera* is the dominant forest species and *pistacia palaestina* is the co-dominant species. Therefore, this entitles that the community appeared at Ajloun reserve is the *Quercus coccifera* community. These results were in accordance to Al Eisawi, 1996 who stated that Ajloun is dominated by communities of *Quercus coccifera*

### 5.3 Importance Value

The Evergreen oak forests are the most typical and common formation of the Mediterranean part in Palestine and East Jordan (Zohary (1962&1973), Alaham & Al -Oqlahh 1985, AL-Eiswai 1986).

The study were in accordance with Kasapligi, (1956; Long, (1957); Zohary, (1962& 1973) and Aqllah and Lahahm (1985 )and Jwarneh (2012) whom reported that both *Quercus calliprinos* L., and *Quercus infectoria* are least common species in Ajloun reserve at 900m elevation. A was conducted in west bank, showed that the *Quercus boissieri* is an associated species within the *Q. calliprinos* - *Pistacia palaestina* association of the Mediterranean sclerophyllus broad-leaf forests (Schiller et al., 2004). The small genetic distance among and within populations of *Q. boissieri* in west bank. *Quercus boissieri* described is a synonymous of *Quercus infectoria* (Zohary 1960). *Quercus infectoria* are least common species in Ajloun reserve in 900 elevations it accordance with Tillawy, (1989). *Quercus calliprinos* is well-represented in all diameter classes, including the recruitment class, and therefore appears to be viable. *Arbutus andrachne* and *Pistacia palestina* are present in far fewer numbers (Tomas, et al. 2010).

In this study two species of the genus *Crataegus* were recorded and these are *Crataegus aronia* and *Crataegus azarolus* where considered a rare species. The survey results revealed a mistake in taxonomical identification of a species belong to genus *crataegus* in Ajloun forest in

Jordan (Zohary 1962). The easy and sure way to differentiate between them is by the color of the fruit only Azarole Hawthorn grows in a humid Maqui of *Quercus calliprinos* (Palestine oak) and *Quercus boissieri* (Boissier oak). This species was recorded from dense area association it grow at elevation 960 m association *Q.Infectoria*, *Q.callprinos* and *Arbutus andrachne* and association with *Asparagus* and *smilex aspera* in deep terra-rosa soli rare plant found individual tree.

### 6. Conclusion

This study was importance as it is the first of its kind to develop woody vegetation parameter and these are: vegetation cover, species density, species frequency, importance value, and basal area. This should support the management of this reserve especially established to conserve the evergreen forest vegetation types that are limited in specific reserved forest areas in the Hashemite Kingdome of Jordan.

Two species of the genus *Quercus* are known to occur naturally in this study area with a general range of distribution extending. These oak species were recorded *Quercus coccifera* L. and *Quercus infectoria*. This study found that the highest relative density and frequency of

woody species belongs to *Quercus coccifera* followed by *Pistacia palestinea* and the lowest was *Styrax officinalis*. And based on these measures the *Q. coccifera* is the dominant forest species and *P. palaestina* is the co-dominant species. Therefore, this entitles that the community appeared at Ajloun reserve is the *Quercus coccifera* community. In addition, results of this method confirmed the forest stability since *Quercus coccifera* showed the highest relative density and distribution which refers to good regeneration at Ajloun forest reserve. Also, two of the genus *Crataegus* species were recorded *Crataegus aronia* and *Crataegus azarolus* which is considered a rare.

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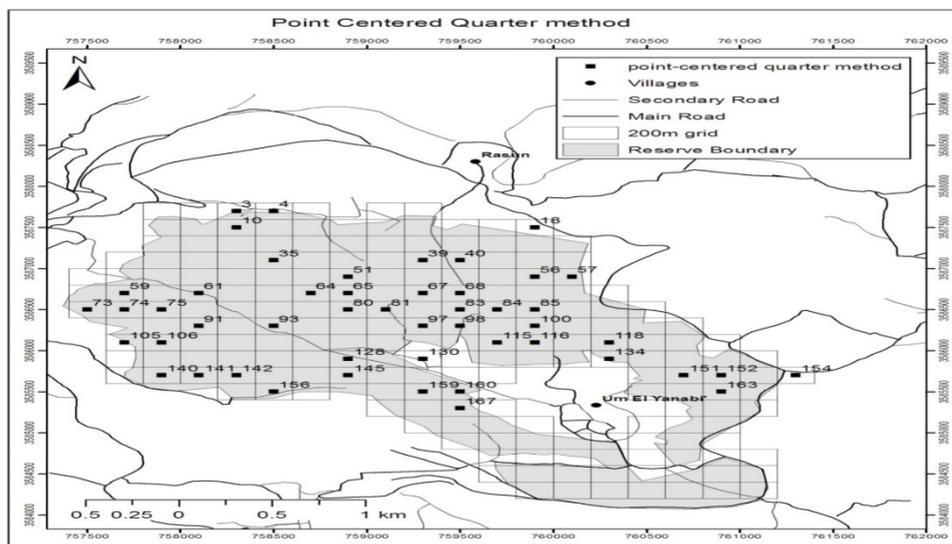
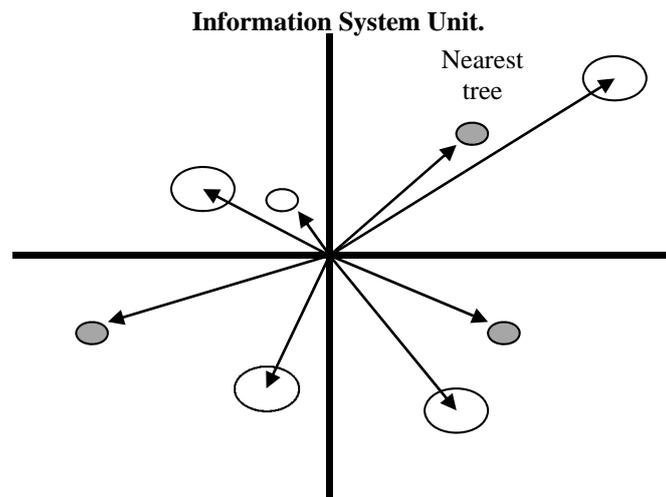


Figure 1. Location of Point –center quarter method in Ajloun Forest Reserve (AFR) by the Geographical



### Point- Center Quarter method

Figure2. Point –center quarter method used in this study where the shaded circles close to the center are the ones considered in calculated data.

Table1: The absolute density and the total basal area (m<sup>2</sup>/ha) for woody species in study area.

Species	Mean BA (m <sup>2</sup> /ha)	No. of trees /ha	Total BA (m <sup>2</sup> /ha)
<i>Quercus coccifera</i>	0.00759	412.4	3.129
<i>Arbutus andrachne</i>	0.00520	165.0	0.858
<i>Pistacia palaestina</i>	0.00573	144.3	0.827
<i>Quercus infectoria</i>	0.00246	41.2	0.102
<i>Rhamnus palastinus</i>	0.00202	20.6	0.042
<i>Styrax officinalis</i>	0.00169	20.6	0.035
<i>Crataegus azarulus</i>	0.00239	82.5	0.197

Table2: Relative density of forest tree species was recorded in study area.

Species	Relative Density	Relative frequency	Relative cover	Importance	Dominance Rank
<i>Quercus coccifera</i>	73.7	46.5	60.30	180.470	1.00
<i>Arbutus andrachne</i>	7.1	18.6	16.53	42.218	3.00
<i>Pistacia palaestina</i>	10.5	16.3	15.94	42.699	2.00
<i>Quercus infectoria</i>	1.7	4.7	1.96	8.308	5.00
<i>Rhamnus palastinus</i>	0.8	2.3	0.80	3.976	7.00
<i>Styrax officinalis</i>	1.1	2.3	0.67	4.128	6.00
<i>Crataegus aronia</i>	5.1	9.3	3.80	18.200	4.00

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## بنية الغطاء النباتي وتركيبه المجتمعات النباتية الشجرية في "محمية غابة عجلون" في الأردن

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### ملخص

أجريت هذه الدراسة في موقع محمية عجلون، شمال المملكة الأردنية الهاشمية، والواقعة ضمن مناخ منطقة البحر الأبيض المتوسط. تهدف هذه الدراسة إلى عمل مراجعة لتأثير تأسيس محمية غابات عجلون ودورها في الحفاظ على الطبيعة والتنوع الحيوي وخاصة الأشجار الحرجية بتنوعها وتركيبها ضمن الموقع. وفي هذه الدراسة تم استخدام عدد من الطرق لدراسة التنوع الحيوي النباتي من خلال المسح الشامل للموقع وأخذ القراءات التي تتناسب متطلبات الدراسة. وتم اتباع طريقة جمع البيانات الكمية من خلال استخدام طريقة المربعات العشوائية وطريقة رابعة النقطة المركزية لدراسة الغطاء النباتي وتركيبه. أظهرت نتيجة المسح للأصناف النباتية أن العدد الكلي للأصناف المسجلة خلال الدراسة في محمية غابات عجلون 100 نوع تنتمي إلى 34 عائلة. وأظهرت نتائج تحليل نمط الحياة للنباتات أن السيادة كانت للنباتات نسبة 46% ومن نتائج التوزيع الجغرافي كانت السيادة لنباتات منطقة البحر الأبيض المتوسط بنسبة 57% وفي دراسة الأصناف الشجرية أن السنديان دائم الخضرة أعلى كثافة وعددا مقارنة مع الأصناف الشجرية الأخرى. ومن النتائج لهذه الدراسة، تبين أن النبات السائد هو السنديان دائم الخضرة يتبعه البطم الفلسطيني. وأظهرت الدراسة أن الغطاء النباتي ذا الارتفاع العالي السنديان دائم الخضرة والبطم الأطلسي وأشجار القيقب ويليهما طبقة الشجيرات والمتسلقات وطبقة الأعشاب. وأوضحت الدراسة أن كثافة الأصناف المسجلة ووجد أن أعلى معدل *Quercus coccifera* (412.4 شجرة/هكتار)، والكثافة النسبية (73.7%)، وتبع ذلك القيقب *Arbutus andrachne* (165 شجرة/هكتار) والكثافة النسبية (7.1%)، بطم فلسطيني *Pistacia palaestina* (144.3 شجرة/هكتار) والكثافة النسبية (10.5%) وزعرور *Crataegus azarulus* (82.5 شجرة/هكتار) والكثافة النسبية (5.1%)، حيث كانت هذه الأصناف الأقل كثافة سنديان *Quercus infectoria* (41.2 شجرة/هكتار)، *Rhamnus palastinus* (20.6 شجرة/هكتار)، و العبهر *Styrax officinalis* (20.6 شجرة/هكتار).

الكلمات الدالة: بنية الغطاء النباتي، محمية غابات عجلون.

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