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Main Characteristics of Trails on Yarmouk Forest Reserve, A Quantitative Approach to Trails Assessment

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ABSTRACT

The necessity to pay attention to the tourism sector and protect natural resources has sparked a growing interest in scientific studies on the international value of ecotourism. Furthermore, eco-friendly tourist attractions should be developed and expanded to achieve long-term tourism growth. To achieve this aim, however, it is important to recognize the adverse effects of visitor activity on the natural environment and the experience of tourism to direct management activities and, thus, to maintain the resources on which ecotourism ultimately depends. This study aimed to assess the environmental impact of the four trails in the Yarmouk Forest Reserve in the Irbid governorate in northern Jordan. Field trips were used to determine the trail's characteristics. The findings revealed a basic description of the reserve's four routes in terms of path width, trail surface type, kind of vegetation, landscapes, and tourist attractions.

INTRODUCTION

Ecotourism is a rapidly growing industry that is well-known for its environmentally friendly approach to tourist-local destination engagement. Jordan is one of the few Middle Eastern countries having feasible or approved tourism options (Abuamoud et al. 2015). Jordan has established an integrated network of ecologically and culturally significant protected areas that covers 1.73 percent of the country's land area. In addition to their environmental protection efforts, these regions are frequently regarded as prominent tourist attractions, particularly for nature-based tourism. Jordanian protected area tourism, on the other hand, is still a relatively recent phenomenon (Jamaliah et al. 2019).

Hiking is generally defined as an activity involving, on foot, for sporting and cultural purposes, following paths that may or may not be marked. Hiking has long been associated with mountaineering and rambling groups across the country, however, there are significant regional differences. Hiking evolved from a sporting and cultural activity (mostly enjoyed by minorities and elitist groups) to a type of tourism and leisure, coinciding with the birth and consolidation of what has come to be known as alternative forms of tourism (Gómez-Martín 2019). Hiking in mountain regions and protected areas is usually the most significant recreational activity and can provide significant tourism income for the local population. In latest years, many rural locations have made enormous attempts to facilitate hiking and thus benefit from the growing demand of visitors for nature destination experiences and events that promote their health and well-being (Nordbø & Prebensen 2015). Recreation trails are becoming acknowledged as drivers of financial and tourism growth. It also becomes evident that financial advantages can improve even if trails are designed and managed as a network of interconnected communities and attractions (Hungria et al 2013).

Tourism activity is a significant contributor of 18.7% of GDP to Jordan's national economy. Tourism ranked as one of Jordan's most important foreign exchange sources, in 2017, 7,659 USD billion was generated, and it is forecast to rise to 13,611 USD billion by 2028 (23.5% of GDP) and raise jobs to 332,000 in 2028 through a private sector partnership (WTTC 2018). Tourism, which includes restaurants, hotels, airlines, local communities, and ground transportation, provides a new type of business to the local community, producing new jobs and revenue (Abuamoud et al. 2019). According to the World Tourism Organization, tourism in the Middle East is anticipated to increase by 50% between 2010 and 2020 (UNWTO 2016).

PAST STUDIES

Hiking, due to its low effect on natural environments, is one of these suitable forms of tourism within the reserve. It is

likely that natural disasters will both destroy the infrastructure and cause fatal injuries to tourists as hiking trails are laid down across natural landscapes (Luzhkova 2012). Recreational trails are recognized as economic drivers in tourism if they are established and maintained as a network of interconnected community links with a variety of complementary attractions and services. The number of economic benefits can also increase (Recreation Sites and Trails BC 2012). In 2018, 1.4 billion visitors from all over the world generated 1340 USD billion in income (UNWTO 2015). Most outdoor recreational activities can adversely impact the natural environment, and the growing popularity of outdoor recreation has inevitably led to broader and wider ecological effects on natural ecosystems (Lynn & Brown 2003). Nature-based tourism is considered to be one of the most popular forms of tourism and one of the few human activities permitted in many protected areas. Nature-based tourism including ecotourism has a variety of negative effects on wildlife in general, water, and soils (Ballantyne & Pickering 2012). Monitoring the condition of the trails, such as soil erosion, trail length, and informal trails is a task that requires constant monitoring to ensure the long-term conservation of the landscape and to restrict the area directly affected by trails (Ancin-Murguzur et al. 2020). Many trail systems are designed and managed to maintain high traffic while reducing related impacts on the environment. Well-designed trails, for instance, avoid steep grades and (*fall line*) alignments parallel to landform grades that are difficult to drain and intercept natural water flows (Olive & Marion 2009). Trampling disruption can alter the look and composition of trailside vegetation by raising plant height and favoring trampling-resistant species. Loss of tree and shrub cover may increase exposure to sunlight, resulting in greater compositional changes when shade-intolerant plant species take over (Leung & Marion 2000). Trampling can cause more damage during the flowering and seeding seasons than during the non-productive seasons (Liddle 1997). Nevertheless, soil exposure on natural surface trails can lead to several impacts on the site, including soil compaction, muddiness, erosion, and widening of the trail (Cole 2004).

STUDY AREA

Yarmouk Forest Reserve is located in the northernmost part of Jordan (Center Coordinates; East 754351/North 3618381). It is approximately 140 km north of Amman's capital city and 40 km north of Irbid city. The Royal Society Conservation of Nature (RSCN) established Yarmouk Natural Reserve on the 6th of January 2010 with the agreement of the Prime Minister, and it became part of the national reserves network, which is run and managed by the RSCN and is located in the northwestern part of Jordan on the border of Golan hill. The Yarmouk Forest Reserve covers a total area of 20 km2 (Fig. 1). From three different locations, the reserve is surrounded by tiny villages (RSCN 2015).

Yarmouk Forest Reserve is located within the Mediterranean biogeographical zone, which provides a warm climate in summer and a cold one in winter with an average rainfall of 400mm per year. Overlooking the River Yarmouk, which marks the border between Jordan and Syria, it protects a swathe of deciduous oak forest (85% of Jordan's surviving cover), along with two species of rare orchid, mammals including otters, hyenas, wolves, and the threatened mountain gazelle, reptiles, fish and birds. The Yarmouk Nature Reserve spreads over a small area (20Km²) of the hills beside Umm Qais. The total financial income for local communities living around Yarmouk Forest Reserve in 2019 has reached 225,504 JOD.

MATERIALS AND METHODS

Field Trips

At Yarmouk Reserve, a variety of procedures have been used to assess the current management scheme and practices, including visitor management, opening hours, illegal logging, soil erosion, topography, annual rainfall, and the percentage of vegetation cover (including trees and other plants) to the overall reserve area. To determine these characteristics, preliminary field research was conducted to assess the direct characteristics that can be assessed in the field, such as (the width of the trail between the outer (median) boundaries [m], the dominant type of surface, the presence of stairs along the trail, the number of information panels, the number of rest stops along the trail, food services throughout the trail, picturesque views, and the possibility of accommodation across the trail mountain

Other characteristics that can be assessed using Geographic Information System (GIS) software include trail length [m], kind of path, dominating ground cover type, several types of land cover, average trail slope [degree], and water flow parallel to or intersecting with the route segment. According to the methodologies for assessing the characteristics, we divided them into two groups: qualities directly tested in the field and attributes dissected using GIS software. From March to September 2019, the reserve management provided visitor statistics (4331 visitors). However, the year 2020, which is plagued by the Coronavirus (COVID-19), would result in significant losses in various sectors, particularly the tourism sector.

Trails have been divided into the: A) Easy trails: that is ideal for hikers and novices. Normally they are easy to follow, being along a Wadi, path, or lane. Grades are friendly

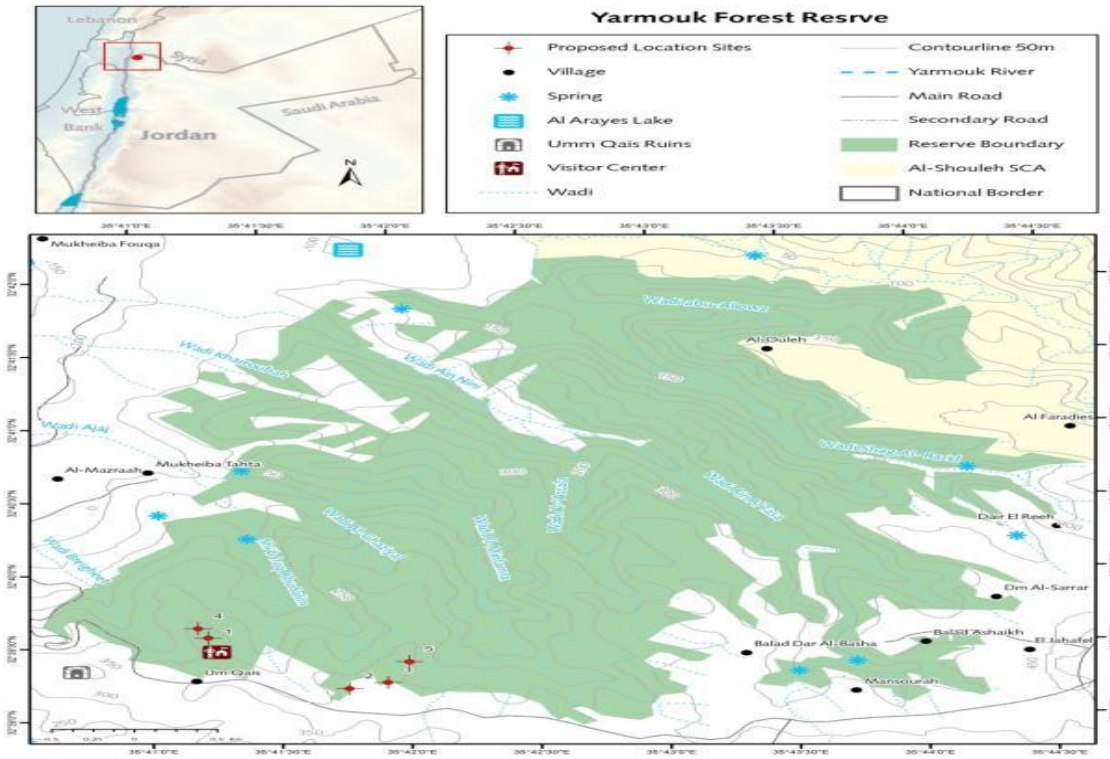

Fig. 1: Yarmouk forest reserve location.

and with be very few obstacles. B) Moderate trails: that is for intermediate or experienced hikers. The terrain is steeper and it is likely to meet more obstacles with no signs of the trail or specific directions that you can use. C) Advanced trails: that is also done for experienced hikers. The terrain can be steep and there are no direct paths, with the ability and self-reliance to navigate.

Interviews

Interviews have been conducted with the reserve director manager and employee of the reserve to determine the natural features in the reserve, find out the number of tourists coming to the reserve, and know what the next projects in the reserve are. Interviews have been documented by voice record for each sample through the use of a smartphone, which has been taken and analyzed.

RESULTS AND DISCUSSION

A total of 4 trail segments representing the basic space units in the Yarmouk Forest Reserve have been designated:

Al-Hreith Educational Trail Condition in Yarmouk Forest Reserve

Field evaluation of the Al-Hreith educational trail segment showed that the most common surface types were vegetation (60% of trail segment) and rocky (32% of trail segment) where there is slight erosion of the soil at the beginning of the trail due to the slope and rocky ground on which the soil is present, which enhances the process of erosion. The width of the Al-Hreith educational trail ranges from 1.7 m to 2.5 m in some areas. The edges of the trail were identified by small stones on the sides with the presence of few natural rock stairs The trail is relatively short and educational, as there is no point for rest or places to supply the tourist with water or food; also, the trail contains information and warning panels (Figure 2). The trail starts with an exceptional perspective on the Oak timberland on one hand and the planted Pinewood on the other. During the walk, you will experience some annual plants and trees, for example, the Hawthorn Rhamnus, Calicotome, horse chestnut, and the Chiliadenus.

The trail gives proof of past human advancements, as you will discover water channels utilized in the Roman time, caves and sedimentary rocks, military trenches, and the point of cannon from the 1860s. Toward the end of the trail at an altitude 380 m above sea level where, you can see and appreciate a dazzling perspective on the lake of Tiberias, the Tur Mount, and the Golan Heights.

Fig. 2: Information panels on the Al-Hreith educational trail.

Wadi Al-Muntamra Trail

Field evaluation of the Wadi Al-Muntamra trail segment showed that the most common surface types were gravels (65% of trail segment) and vegetation (30% of trail segment). The length of the Wadi Al-Muntamra trail reaches about 6 km, starting from Mansoura, by looking at the Golan Heights, and then disappears during the descent into the valley. The floor of the trail consists of gravel and stones when walking in the course of the valley, and the soil and plants when walking on the banks of the valley, where the width of the trail ranges between 0.7 to 1.8 m.

There are some caves and caverns of limestone extending along the valley, and some of them have been used as places for overnight cattle herds that spread in this region. The valley water is used to water the flocks of sheep and livestock. Like other trails, this trail is characterized by high plant diversity than the other trails with Oleander trees, Carob trees, and aquatic plants. At the end of the trail, the visitor sees a view of the Golan Heights, the Yarmouk River, and Lake Tiberias. To meet at the end of the Al-Shreif mountain trail in the village of Al-Mukhaiba Al-Tahta.

Al-Shreif Mountain Trail Condition in Yarmouk Forest Reserve

Field evaluation of the Al-Shreif mountain trail segment showed that the most common surface types were rocky (75% of trail segment) and vegetation cover (20% of trail segment) where there is slight erosion along the trail because the base ground which enhances erosion. Stones were used to delineating the route's limits, which had been lost from much of the trail segment, either due to human actions or herds of animals and sheep, which remained grazing in the area and scattered throughout most of the path's length.

The Al-Shreif mountain trail, which is around 5 km, has no rest spots or places to get water or food. In addition, the path lacks information and warning panels, particularly in the absence of the trail's features and limits, which necessitates the presence of a tourist guide with experience in the region. The width of the Al-Shreif mountain trail ranges from 1.5 m to more than 2 m in some areas. The trail starts from Umm Qais, all the way to the village of Al-Mukhaiba Al-Tahta passing through a semi-flat mountain range with slight elevations and slopes, and through rocky terrain that covers approximately 70% of the trail length.

The Al-Shreif mountain trail, upon reaching a panoramic site that rises 352 m above sea level, is characterized by a distinct view of the Lake of Tiberias, Safed, The Golan Heights, At-Tur Mount, the West Bank, and Al-sheikh Mountain in Syria and Lebanon (Figure 3), also the trail contains some caves, rock formations, and ancient Roman wells and water channels.

Arqoub Romi Mountain Trail

The Arqoub Romi Mountain Trail is the longest trail in the Yarmouk Forest Reserve, with a length of about 12 km, and it is considered a moderately difficult trail, as most of the floor of this trail is rocky, as the ratio exceeds 75% of trail segment, vegetation (10% of trail segment), and gravels (13% of trail segment). The trail begins with views of the Great Rift Valley and the Golan Heights. After about 1.5 km, the trail splits into two sections: one for enjoying the best possible landscape view in the spring and summer, and

another for protecting us from the cold western air, which can be bothersome at times. The width of the Arqoub Romi mountain trail ranges from 1.6 m to 2.6 m, and there are no indications along the trail or locations to supply tourists with water and food save Ain Nene, which is located roughly 10 km from the trail's commencement.

Approximately after 8 km, the trail will lead to a panoramic site located 308 m above sea level, where visitors can find distinguished views of the Jordanian Himmah area and the presence of a Roman grave near the site in addition to some caves and rock formation. The Arqoub Romi mountain trail continues down toward Ain Nene, which rises 142 m above sea level, where water can be supplied there. And after about 200 m there is an abandoned military area consisting of several old buildings, where visitors are located on the area overlooking the Great Rift Valley that passes through the region and the Hejaz railway, which is used to come from Al Madinah Al Munawwarah to Bilad al-Sham to Turkey countries through the Ottoman period, before reaching the final station of Arqoub Romi mountain trail at Al-Arayes pond

CONCLUSION

The Yarmouk Forest Reserve faces a variety of threats, including woodcutting, overgrazing, and wild plant collection (uprooting wild plants), and should draw on the experience of tourist-friendly countries in managing natural reserves and the activities that can be offered to attract more visitors, while also providing the highest level of wildlife protection. To avoid problems, outdoor recreation management in protected natural areas requires an understanding of visitor desires and their use of the protected environment. In protected natural areas around the world, trails are an essential and expanding infrastructure that concentrates tourist mobility (Miller et al. 2017). Our study applied a quantitative approach to investigate the determinants of the visitor's path selection and how the path characteristics affect the number of visitors and the ability of the reserve management to preserve the environment.

Our study found that the Al-Shreif Mountain Trail, Wadi Al-Muntamra Trail, and the Arqoub Romi Mountain Trail need to be re-maintained in terms of reorganizing the boundaries of the trail, cleaning the sides of the trail of tree stumps and stiff branches, and cleaning the waste, especially the old car tires that are located in the Wadi Al-Muntamra (Fig. 3), It should also be highlighted that the region breeds guard dogs, who are commonly seen with herds of livestock and sheep, which could make the tourist journey dangerous.

The results of our study indicate that most of the surfaces of the trails in the reserve are rocky.

GIS was used to analyze all trails where they are used for hiking only. The dominant land cover types along trails were natural grasslands (predominant along 31% of segments) gravel (19% of segments), and rocky (46% of segments). The majority of the segments (45%) were located through four different land cover types and a water stream was absent along 75% of the trails. The results of GIS analyses are summarized in (Table 1).

An interview was conducted with the director of the reserve, Mohammed Malkawi, who spoke briefly about the reserve, saying: "The area of the reserve is about 20 square

Fig. 3: A and B) Tree stumps and stiff branches along with Arqoub Romi, and Muntamra trails; C) Old car tires along Al-Shreif, mountain trail

Table 1: The main characteristics that can be evaluated by GIS software.

Trail name	Trail length	Trail type (hiking, cycling, horse riding, etc.)	No. of land cover type	The dominant type of land cover	Average trail slope	Water stream
Al-Hreith Educational Trail	3556m	Hiking	2	Coniferous forests	8.65%	No stream
Wadi Al-Muntamra Trail	5713m	Hiking	4	Transitional forests – shrubs;	6.0%	stream following the trail
Al-Shreif Mountain Trail	3927m	Hiking	2	Natural grasslands	7.9%	No stream
Arqoub Romi Mountain Trail	6920m	Hiking	2	Natural grasslands	8.15%	No stream

km. It contains 43 types of mammals, 574 plant species, and 117 bird species. It is considered an important area for bird migration. On three continents Asia, Europe, and Africa, it is considered a resting station for birds, in addition to the fact that residential areas fall within its scope. The reserve is distinguished by its biological and environmental diversity, including the flat areas, the mountain, the valley, freshwater sources, and endangered animals. The reserve contains a pattern of deciduous oak woodlands (*Quercus ithaburensis*), which is Jordan's national tree, as well as the Jordanian national flower (black iris). The reserve's role in ecotourism has recently been active, and four tourism trails have been opened within the reserve at various lengths depending on the visitors' desires, including mountains, valleys, and an educational trail for school and university students. As for the problems and challenges facing the reserve in general and the management of the reserve in particular, Malkawi said: Among the most prominent problems that occur are tree cutting in the fall season, forest fires in the summer, and overgrazing, especially in the beginning of the spring season, as most of the region's residents depend on breeding Cattle. Regarding future projects, Malkawi explained the implementation of the ecolodge (environmental hostel) project, which has been approved, and one million Jordanian dinars have been customized for implementation to do it in two phases during the years 2019 and 2020 within the projects of the Irbid Governorate. It aims to advance the development and provide job opportunities for youth and the local community, to alleviate unemployment, specifically in the poorest regions. Quality requirements primarily ensure comparability and appreciation. Quality standards, which are primarily accommodation services, restaurants, transport companies, and visitor offices, can act as a marketing tool, a benchmark; and can be taken into account when establishing a strategy to better serve the requirements of visitors. Moreover, the increase of quality hiking tourism along Yarmouk reserve trails should contribute to the development of a marketing strategy and a brand for hiking tourism.

Management was able to recognize the major consequences by soliciting the opinions and expectations of recent visitors to the Yarmouk forest reserve. The most major visible impacts were woodcutting, litter, and vegetation destruction, all of which have the potential to decrease ecotourism's natural experience offerings. Litter, erosion, deforestation, reserve infrastructure, and vegetation damage are among the most common management problems expressed by respondents. As a result, these management issues could be utilized to measure how visitors to the Yarmouk forest reserve affect the environment.

Finally, this research is one of the first to look at the effects of ecotourism and associated indicators in the Yarmouk Forest Reserve through the eyes of visitors. This effort lays the groundwork for a comprehensive visitor management structure in the Yarmouk Forests reserve. More broadly, the sociopolitical method used in this study leads to a better understanding of the ecotourist experience's consequences for ecotourism management in Jordan's natural ecosystems.

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