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A New Lichen Record at Ain Quraychat, Siwa Oasis, Egypt

Talaat A. Hegazy
Department of Environmental Sciences, Faculty of Science, Damietta University, New Damietta 34517, Egypt

ABSTRACT

This study was conducted to investigate the presence of lichen species around the wells and springs in Siwa Oasis of the Western Desert of Egypt. Several sites were surveyed and lichen species were found only neighbour at a hot spring namely Ain Quraychat. The fruticose lichen *Usnea hirta* is reported as new to Siwa Oasis. The thalli are characterized by orange with shadow of brown yellow colour and yellow pigment in the medulla as well as the axis.

Key words: Fruticose, Lichen, *Usnea* species, Siwa Oasis, Egypt.

INTRODUCTION

Lichens are widely distributed in many different environments around the world. They are found in almost all terrestrial habitats from the hot desert and tropics to Polar Regions (Kappen, 1982; Alexopoulos *et al.*, 1996; Ahmadjian, 2004; Belnap and Lange, 2005).

The first data on lichens of Egypt were recorded in the works of Delile (1813), Nylander (1864; 1876) and Muller (1880 a, b and c; 1884). Sickenberger (1901) was the first to report a lichen checklist of Egypt. However, Galun and Garty (1972), Khalil (1995) and Galun and Mukhtar (1996) extensively studied the lichen vegetations of Sinai Peninsula, Egypt. Recently, Seaward and Sipman (2006) have published an updated checklist of lichenized and lichenicolous fungi for Egypt.

At the Deseret of Siwa Nylander (1864) reported one crustose lichen species namely; *Placodium murorum* DC, Nyl. However, Muller (1884) occurred the foliose lichen; *Ramalina evernioides* at the road from Alexanderia to Siwa. The lichen species of Siwa were listed by Sickenberger (1901). These lichens included five species: *Collema* sp., *Lecan* sp., *Arthonia adhaerens*, *Endocarp* sp., and *Verruc* sp. However, the sites and locations from which the lichen specimens were collected by all above workers were not defined.

Since that time to the present a number of regions at Siwa Oasis was still lichenologically uninvestigated and thus further studies were necessary to give the full picture of lichen diversity. Furthermore, the vegetation diversity at Siwa Oasis is relatively poor in species and confined to cultivated lands or favourable habitats. This is due to the presence of numerous landforms of salt marshes and salt lakes as well as inefficient drainage system, that make agricultural land more saline (Nakhla, 1999; Abd El-Ghani and Fawzy, 2006).

The present study provides the detection and revised the presence of lichen species around the wells and springs at Siwa Oasis of the Western Desert of Egypt. It is also herein as a part of the continuing effort towards a better knowledge of the tremendous lichen biodiversity in the harsh environments.

MATERIALS AND METHODS

Study Area

The oases are the most prominent features of the Western Desert of Egypt. They are green patches within the surrounding sterile desert. Siwa Oasis is one of the most common inhabited Egyptian Oases (Fig. 1). It is located in the northern part of the Western Desert (25° 18' - 26° 05' E, 29° 05' - 29° 20' N), and 70 km east of the Libyan frontier and 305 km south of the Mediterranean coast. At Siwa, the main sources of water are naturally flowing springs (some hot springs).

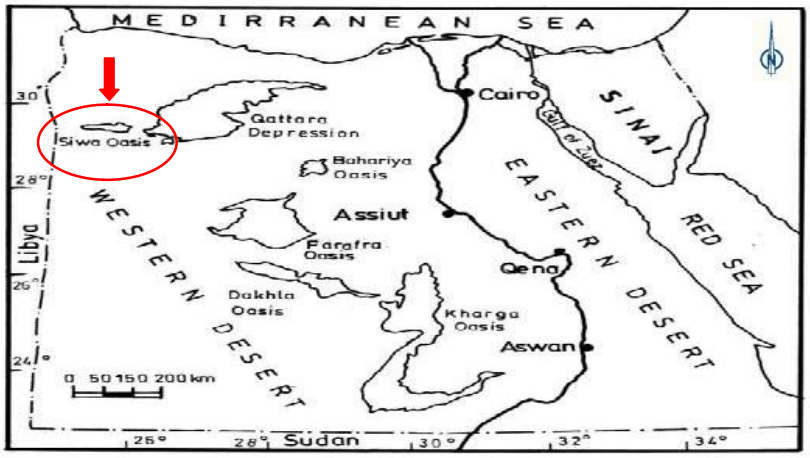

Figure (1): Egypt map. The red arrow indicates to Siwa Oasis. (Abd El-Ghani and Fawzy, 2006).

* *Corresponding Author: talaat_hegazy@mans.edu.eg*

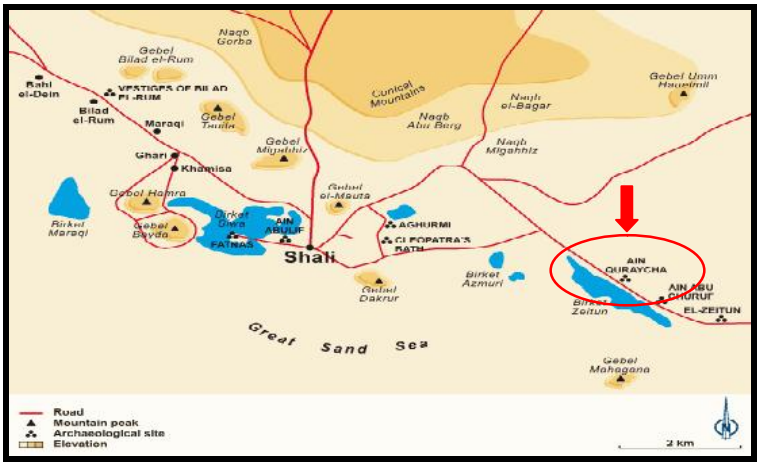

Figure (2): Siwa Oasis and Shali center. The red arrow indicates to the hot spring at the study area; Ain Quraychat.

as well as constructed wells. However, groundwater is one of the most valuable resources which contain the largest underground-water reservoir (Nubian Sandstone aquifer). In addition, the oasis floor is below sea level: ranges from zero to 18 m (Nakhla, 1999; Abd El-Ghani and Fawzy, 2006 and Heinzelmann, 2009). A hot spring was detected and investigated at site named Ain Quraycha (35 km South East of Shalli; the center of Siwa Oasis). The geographical coordinates of this site were: N 29° 10' 51"; E 25° 44' 50" (Fig. 2). Notably, at this site only, the lichen species were found with the vegetation community of Alhag or Aqoul (*Alhagi maurorum*) species (Fig. 3, 4, 5 and 6). Simultaneously, there was no any other lichen species at the detected study area.

Sampling Collection

An intensive field work during Februarys of 2011and 2012 was surveyed the different wells and springs at Siwa Oasis. Several sites in the study area were visited to investigate the presence of lichen species using landrover car. Figure (7) showed the author at the studied area, on 10 February 2012 during the field sample collections. All geographical coordinates of the surveyed sites were detected using GPS device (Garmin GPSMAP 175, USA, 1996). Some photographs of locations and lichen specimens in situ as well as in laboratory were taken using Sony Digital Camera (Model DSC-W300 Super Steady Shot with 13.6 Mega Pixels, Japan, April 2008).

The lichen samples with vegetation community of Alhag were collected during field trips in a plastic packages for further laboratory microscopic investigation. The field studies including the field observations and measurements of the vegetation area, length and height of plants were also recorded.

Lichen Examination

Anatomical investigations were performed according to Clerc (1984; 1992 and 1998). The main branch of lichen samples was microscopically examined using simple microscope (Optech Model E2, Germany, 40x) and binuclear microscope (Model Japan, 100x). Several cross and longitudinal sections of lichen sample were prepared for investigation the internal anatomical structures.

RESULTS

Morphological and Anatomical Descriptions

The recorded fruticose lichens are shrubby, fleshy richly branched and thallus is hair-like or strap-shaped and the branches mainly cylindrical. The thallus is anisotropic to isotomic dichotomously branched with very smooth surface, the stem not septated and papillae absent (Fig. 5 and 6).

The thalli are also aggregated together at the base as elongated swollen lobes or branches and gradually decrease forming thin or tapering ends. The number of these branches range from 8 to 12. They always hanging or stand out from the surface of the substrate (*Alhagi* species) to the atmosphere.

The morphological and anatomical feature indicated to the lichen was belonged to fruticose lichen. The lichen thallus varied in size from 5 cm to long 17-20 cm (Fig. 4, 5 and 6). They are many isidia, simple, warty globose outgrowth with a cortical covering. These vegetative structures are pale green color with very thin and small hyaline scales. Isidia are often fragile and can be easily broken.

The vegetation area occupied by the Alhag plants was approximately 3-5 m in length and 1.5-3 m width neighbor a hot spring namely Ain Quraychat (Fig. 8). The photo illustrated, the flow water from the hot spring at the study area. Notably, Alhag plants are perennial, leguminous and thorny shrublet, forming very complicated vegetation. The plants vary in their height from 75 to 100 cm. with sharply acute spine; 3.5 cm. long and 1 to 1.2 mm. thickness (Fig. 4).

Taxonomy Description of Lichen

The lichen colour exhibit a fantastic array of deep and/or hyaline orange with shadow of brown yellow colour (Fig. 3, 4, 5 and 6). At laboratory, (at room temperature; 18-23°C) the lichen sample was dried rapidly after two days only, getting brittle and easily destroyed. Moreover, the thallus colour was turned into deep yellow brown colour. Under binuclear microscope, cortex was thin, medulla or the central cord thick, usually compact or dense and generally round in cross sections with deep yellow-orange

Figure (3): General view of *Usnea hirta* with the vegetation community of *Alhagi maurorum.*

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Figure (4): *Usnea hirta* with the vegetation community of *Alhagi maurorum.*

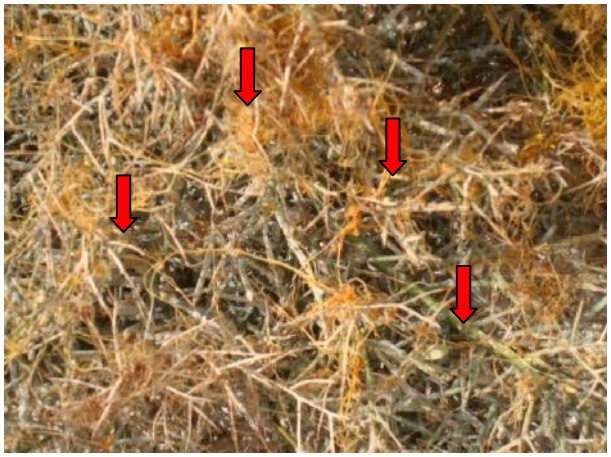

Figure (5): *Usnea hirta* epiphyte on *Alhagi maurorum.*

Color. All descriptions given in the identification manual keys of fruticose lichens by Goward (1999) and Rosentreter *et al., (*2007) were carefully mentioned.

The whole known taxonomical variations under *Usnea* species reported by Steiner (1907), Smith (1921), Clerc (1984; 1992 and 1998), Clerc and Herrera-Campos (1997), Tavares (1987 and 1997), Halonen (1997), Fos and Clerc (2000) and Saag *et al.*, (2011) were also extensively studied.

Figure (6): *Usnea hirta*. The red arrow indicates to the base branch.

Figure (7): The author at the studied area, 10 February 2012.

Figure (8): The hot spring at Ain Quraychat, Siwa Oasis.

The diagnostic morphological characters described at the references above indicated to the recorded lichen was belonging to the genus *Usnea*. Moreover, the distinguishing features of the examined species and from taxonomic point of view the lichen was classified under name *Usnea hirta*.

DISCUSSION

The genus *Usnea* is one of the most easily recognized of

the fruticose lichens. According to Clerc (1987a and b; 2004; 2008) the most diagnostic morphological characters in this genus are (1) the colour and the length of thalli, (2) the shape of main branches, the soralia and the anatomy of the inner structure, (3) the pigmentation of the medulla and the central axis, and (4) the development and density of fibrils, shape of papillae, presence of foveolae and their thickness. However, *Usnea* species were not reported previously by the first workers (Delile, 1813, Nylander, 1864 and 1876; Muller, 1880 a, b and c and 1884; Sickenberger, 1901; Galun and Garty, 1972 and Galun and Mukhtar, 1996) of lichen in Egypt.

Morphologically and anatomically, the recorded lichen was belonged to fruticose lichen. The lichen was hair-like, or shrubby and the branches may be flat or cylindrical as well as the branching pattern varied considerably among different systematic groups and also within a single genus. Among the all features indicated to the lichen *Usnea hirta* (Beard Lichen) that was the one shrubby lichen species but with some modified characteristics otherwise recorded by many authors (Steiner, 1907; Clerc, 2006; McCune, 2010). These characters included the absence of papilli and sordia as well as the branches were very smooth surface. *Usnea* species have a wide range of ecological amplitude. They occur commonly as epiphytes on trees, deciduous trees, shrubs and sub shrubs and occasionally can be found on rocks, coastal areas as well as on road sides (Clerc, 1992 and 1998; Halonen *et al.,* 1998). Thus, it extensively studied and several researches have focused on the systematic of *Usnea* species (Swinscow and Krog, 1979; Clerc, 1987 a and b, 2004, 2006 and 2008). Moreover, Herrera-Campos *et al.,* (1998), Halonen *et al*., (1998 and 1999), Ohmura (2001), Hermansson and Thor (2004) and Clerc and May (2006) have also provided valuable information on this difficult genus of fruticose lichens. *Usnea hirta* is primarily epiphytes and the majority of it is also occasionally found growing on lignum or especially decorticated wood (Halonen *et al.,* 1999). Clerc (2006) reported that several varieties of the genus *Usnea hirta* can grow on many kinds of trees, shrubs and sub shrubs such as *Alinus, Ficus, Olea, Prunus, Salix,* and *Pinus*. Otherwise, the presence of hanging *Usnea* with Alhag or Aqoul (*Alhagi maurorum*) species indicated to that the lichen was a fruticose. Alhag is a perennial plant, spiny leguminous and under shrub. It can grow in saline habitats and it is a favourable for camels (Batanouny, 1999).

Lichen species can dominate in distinct areas when the sufficient humidity was available. Only a few lichens can survive at continuously moist, temperate or even subtropical habitats (Smith, 1921; Kappen, 1985; Ahmadjian, 2004). Fruticose lichens can be found in a wide range of climates, from the desert to the wet rain forest and on various types of substrates. The high levels of fog in desert zones provide habitats extremely favourable for lichen growth (Paracer and Ahmadjian, 2000; Ahmadjian, 2004). Much of this moisture is unavailable to vascular plants, allowing a large biomass of lichens to occur in areas with little or no plant cover (Hogg, 2005; Honegger 2006; Staley *et al*., 2007).

However, the occurrence of lichen nearby the hot spring; Ain Quraychat strongly agreed that the position of lichen vegetation was the down word the winds of the hot spring and this levelled that the atmosphere around was very humid every time. This also revealed that these organisms were considered poikilohydric and often equilibrate their activities with that of atmospheric humidity or soil moisture content (Honegger, 2006).

The morphology and anatomy of many lichens are strongly influenced by the environment (Budel and Scheidegger, 2008 and Honegger, 2008 and 2009). Although lichens are tolerant of extremes of temperature and water loss, they have a well-known sensitivity to atmospheric pollutants such as dioxides of nitrogen and sulfur, ozone, and toxic metals (Batic and Mayrhofer, 1996; Blasco *et al.,* 2011). Apparently lichens absorb air pollutants, and the toxic components are harmful to the photosynthetic partner. Therefore, they can be used as passive and active bio indicators of air quality and even the surrounding environment (Muller and Burkhard, 2010; Pulselli and Bastianoni, 2010). Cities or urban setting with air pollution problems are devoid of lichens.

The presence of fruticose lichen at the study site indicated to the clean environment and good air quality (Hegazy *et al*., 2012 unpublished data) at Ain Quraychat, Siwa Oasis. These findings agreed with the fact that the epiphytic lichens are among the best known and extensively used bio-indicators of air pollution (Wolterbeek *et al*., 2003; Nash III, 2008; Purvis, 2010). Size varies tremendously, from *Usnea hirta* in situ to herbarium where it was turned dry and loss a large amount of water content that reached up to 70 % of their dry weight (Paracer and Ahmadjian, 2000). This agreed with the recorded lichen where it was dried quickly at room temperature.

Therefore, this lichen forms can be found preferentially either in very wet, humid climates, e.g. *Usnea xanthophana* and *U. rubicunda* in the temperate rain forest, or in arid climates with regular dew and fog events (Paracer and Ahmadjian, 2000; Honegger 2008 and 2009; Truong *et al*., 2011). A lichen thallus usually consists of upper and lower cortex layers, algal layer, and medulla. The layers differ in thickness and the medullary layer in most fruticose thalli, occupies the major part of the internal structures (Budel and Scheidegger, 2008). Accordingly, the tissue layers of our fruticose lichens were formed thick walled and compact medullary layer.

This structure may be formed as irregularly arranged hyphal strands as a central, thread-like elastic strand as in *Usnea* species. However, further studies would be carried out to investigate the eco-physiological characteristics as well as the chemical properties of the recorded lichen. Moreover, the anatomical structures using scan and transmission electron microscope were also prepared.

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تسجيل جديد لنوع من الأشنات بمنطقة عين قريشت- واحة سيوة- مصر

طلعت عبد المنعم حجازى

قسم علوم البيئة- كلية العلوم- جامعة دمياط- دمياط الجديدة- **مصر**

الملخص العربـــــى

تهدف الدراسة إلى الكشف عن وجود أنواع من الأشنات حول الآبار و العيون المائية بواحة سيوة بالصحراء الغربية، مصر. ولقد تم عمل مسح لعديد من العيون و الآبار بواحة سيوة و تم تسجيل نوع فريد من الأشنات حول عين مائى دافىء بمنطقة عين قريشت بواحة سيوة. هذا النوع من الأشنات يسمى *Usnea hirta* و يتبع مجموعة الأشنات الشجيرية المتفرعة و الذى يتميز بلونه الأصفر بظلال بنية اللون مع تواجد أصباغ صفراء اللون بداخل منطقة النخاع بمحور الأشنات.

الكلمات المفتاحية: الأشنات- الأشنات الشجيرية- أشن اليوزنيا- واحة سيوة- **مصر**.