Zygodon Hook. ex Taylor a New Record to Libya

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ABSTRACT

A new epiphytic moss, *Zygodon catarinoi* C. García, F. Lara, Sérgio and Sim-Sim, was recorded from Libya for the first time. The new species is characterized by ovate to elliptic gemmae, narrowly lanceolate, loosely erect leaves, the abaxial surface of the costae in the distal 1/3-1/2 of the leaf covered with forked papillae, leaf lamina bistratose, rudimentary peristome and with cucullate smooth calyptra. This study is to collected the genus *Zygodon* growing on trunks of some trees in Al-Jebel Al-Akhdar (Libya) throughout the winter season (January-March, 2007) and May 2008, in order to revision the genus in Libya. The taxa moss flora of Libya after this record became 108.

INTRODUCTION

Zygodon Hook. ex Taylor includes approximately 131 species, subspecies, varieties, forms and cultivars primarily distributed in the tropics and subtropics, extending into the temperate regions of both hemispheres, e.g., Africa (Ros *et al*., 1999); America (Vitt, 2003; Calabrese, 2006); Asia (Redfearn *et al.,* 1996; Ignatov and Ignatova, 2003; Wilbraham and Long, 2005; Calabrese and Muñoz, 2006; Garcia *et al*., 2006; Guo *et al.,* 2007); Australasia (Lewinsky, 1990) and Europe (Düll, 1985, 1992; Frahm and Frey, 1992; Lewinsky-Haapasaari, 1998; Pedrotti, 2001; Smith, 2004; Hill *et al.,* 2006; Calabrese and Muñoz, 2008). The morphological variations within *Zygodon* is provided by Malta (1926) and a critical revision of the taxonomic characters by Calabrese (2006).

In many species of *Zygodon* are delimited on characters derived exclusively from the gametophyte, however sporophyte are rare produced (Calabrese and Muñoz, 2008).

About the habitat of *Zygodon*, epiphytic, on branches and trunks of some shrubs and the trees especially oak, ash, elder, maple, sycamore, apple, willows, beech, birch,….etc, in humid valley woodlands, where, it sometimes clothes the trunks of trees. It also occur on sickly trees, both spears and pollards, that have hollow trunks or high bosses that fill up with dead leaves and rainwater, forming an infusion that trickles down the trunk from a fissure, forming a seepage-track. Sometimes found on lightly shaded rocks and in rock crevices, especially limestone and is sometimes found on walls of stone or brick (Amann and Meylan, 1918; Malta, 1926; Karttunen, 1984; Smith, 2004).

Thus, the aim of the present study is to describe the *Zygodon catarinoi* was which recorded for the first time from Libya.

MATERIALS AND METHODS

One hundred samples were collected throughout the winter (January-March, 2007) and May 2008 on the trunks bases of *Quercus coccifera* L., *Olea europaea* L., *Ceratonia siliqua* L., *Juniperus phoenicea* L., *Pistacia lentscus* L. and *Phillyrea latifolia* L. trees, that dominant in Wadi Kouf area.

Wadi Kouf area is a part of Al-Jebel Al-Akhdar in Libya. Al-Jebel Al-Akhdar lies between 32°30'-32°50' N and 21°2' -22° E in the North-East of Libya between Benghazi and Darnah (Fig. 1). This Jebel covering by arching Plateau built of upper Cretaceous and Tertiary sediments of limestone, subordinate dolomites and marls. These sediments were deposited at the southern margin of the Tethys sea (Röhlich, 1978).

The climate of Al-Jebel Al-Akhdar fit in the Mediterranean climate, which characterized by moderate temperature and more reliable rain fall from autumn to early spring. Wadi Kouf is a humid wadi getting rains from September to May and rarely in Summer. The average annual rainfall ranges between 450-650 mm, 24-30% falling in January. The temperature is 8-13°C in winter and 22-27°C in summer, while winds are Northern in Winter but Southern and East Southern in other seasons. On the other hand, the parent rock is mainly limestone of Tertiary age. All these above conditions are suitable for a good bryophytes plants.

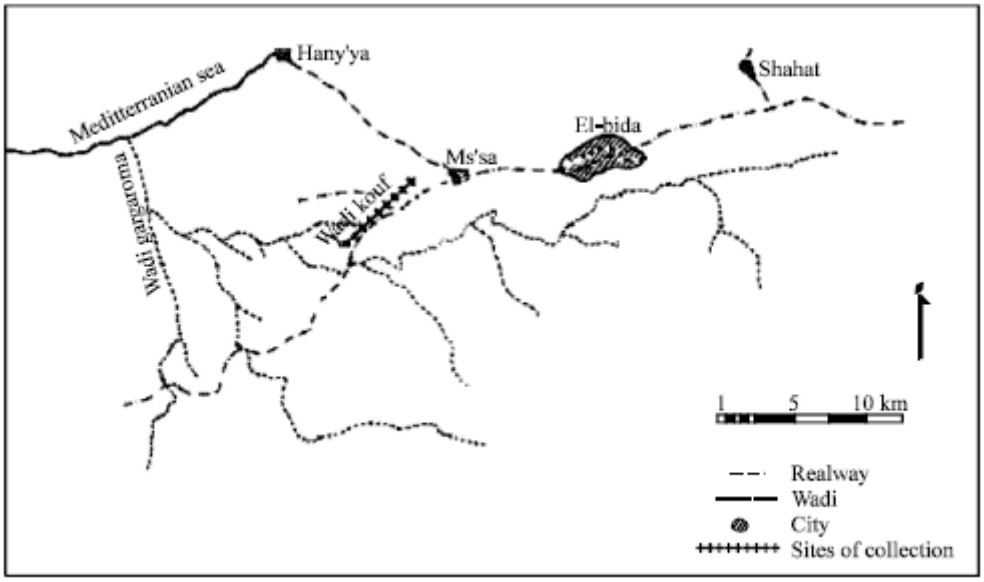

Fig. 1: Map showing the site of study area (Wadi kouf)

Specimens were kept to dry in the laboratory away from direct sunlight, examined and cleaned in water using a small brush and a needle to remove sticking soil particles. Free-hand transfers sections were prepared from the leaves and stems of gametophytes and longitudinally section from the capsules. The sections were made by placing the specimen in a drop of hot Gelatin 10% (w/v) on a clean glass slides under a suitable power of a binocular stereoscopic microscope and cutting by a sharp razor with the help of a needle. The lid was removed and the capsule was cut transversely just below the peristome teeth. The specimens (whole plants, leaves, capsules, spores, sections, etc.) were photographed using OLYMPUS camera (C-7070, 7.1 Megapixal).

RESULTS

As a result of the identification of the bryophytes growing on *Quercus coccifera* L., *Olea europaea* L., *Ceratonia siliqua* L., *Juniperus phoenicea* L., *Pistacia lentscus* L. and *Phillyrea latifolia* L. trees, nine specimens out of one hundred samples belonging to *Zygodon* (Table 1). The main gametophyte and sporophyte characters were shown in Fig. 2 and 3.

Gametophytic characters: Fig. 2b-q and Fig. 3a-i, k-m, q: Plants to 0.8 cm. tall, light green above, reddish-brown bellow (Fig. 2b-d). Stems erect branched or non-branched, dioicous (Fig. 2b-d). Stem leaves loosely-erect and ±twisted to somewhat contorted, sometimes falcate-secund in distal portions of stems when dry (Fig. 2b, c), erect-spreading to spreading-recurved when moist (Fig. 2d), lanceolate to narrow lanceolate, or linear-lanceolate, 0.3-1 mm, acute, with gradual, 1-few celled apiculus, ±keeled below (Fig. 2e-j), decurrent; margins entire or with sharp, irregular teeth near apex; costa, ending below apex, smooth except at the tip where few papillae cover the costa cells and also with quadrate papillose cells at 1/3 to 1/2 of leaf (Fig. 2k-m, 3a-c), ventrally smooth throughout, with two small ventral guide cells and dorsal stereids in cross-section, lamina unistratose partially bistratose (Fig. 3i, h, k-m); distal laminal cells rounded-hexagonal, thick-walled 7-11 µm wide, with 2-4 forked papillae per cell (Fig. 3k-m); basal laminal cells smooth, pale-yellow to whitish, subquadrate to rectangular, shorter towards the margins, moderately thick-walled, 8x10-25x30 µm., smooth (Fig. 2n-p); gemmae fusiform-cylindric, clavate, with transverse walls never with longitudinal wall (Fig. 3d-g).

Table 1: *Zygodon catarinoi* recorded throughout the study period

	Date of collection				
Plant taxa	Juan 2007	Feb. 2007	March 2007	May 2008	Samples No.
Quercus coccifera L.	+		+		2
Olea europaea L.	+			+	2
Ceratonia siliqua L.					0
Juniperus phoenicea L.				+	1
Pistacia lentscus L.		+		+	2
Phillyrea latifolia L.	+		+		2

Sporophytic characters Figure 2a-d and Fig. 3 j, n, o, p, r: Seta erect, up to 3 mm long, yellowish, dextrorse above (Fig. 2b-d). Capsule erect, fusiform-ellipsoidal, 1-1.25 mm long, with 8 longitudinal ribs (Fig. 2a, Fig. 3p), with 3-6 rows of smaller red cells around the mouth of the capsule (Fig. 3n), stomata superficial (Fig. 3j), operculum conical with rostrate (Fig. 3o), with rudimentary peristome (Fig. 3n); spores, 12-17 µm in diameter, with rough surface (Fig. 3r). Calyptra cucullate, smooth and split from the base to the half of it, with red-brownish end.

The above characters referred to the *Zygodon* known as *Zygodon catarinoi* C. Garcia, F. Lara, Sergio and Sim-Sim.

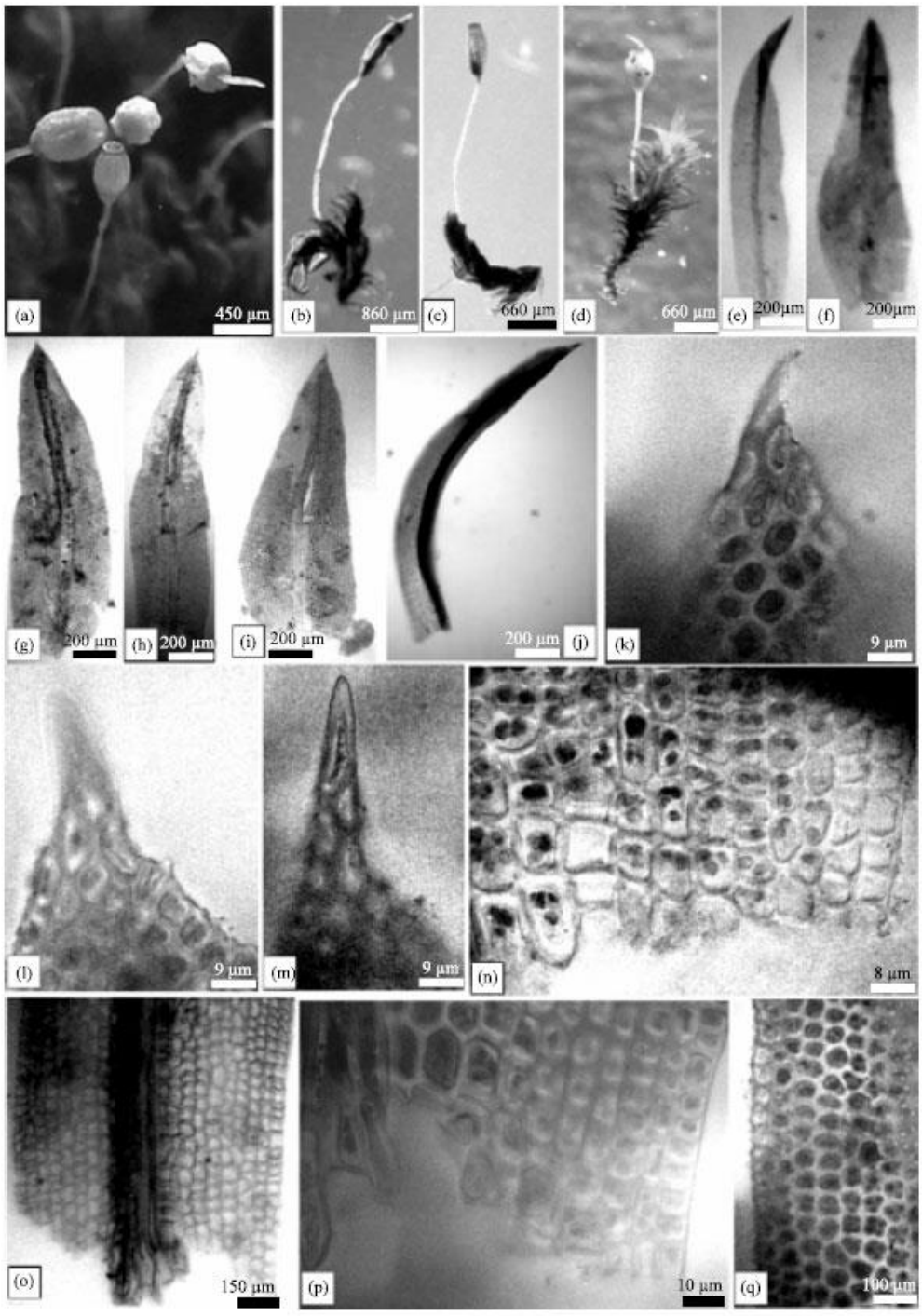

Fig. 2: *Zygodon catarinoi* a-q. (a-c). dry gametophyte. (d). moist gametophyte. (e-j) different shapes of stem leaves. (K-m). apex of stem leaves. (n-p). base of stem leaves. (q). middle part of stem leaf

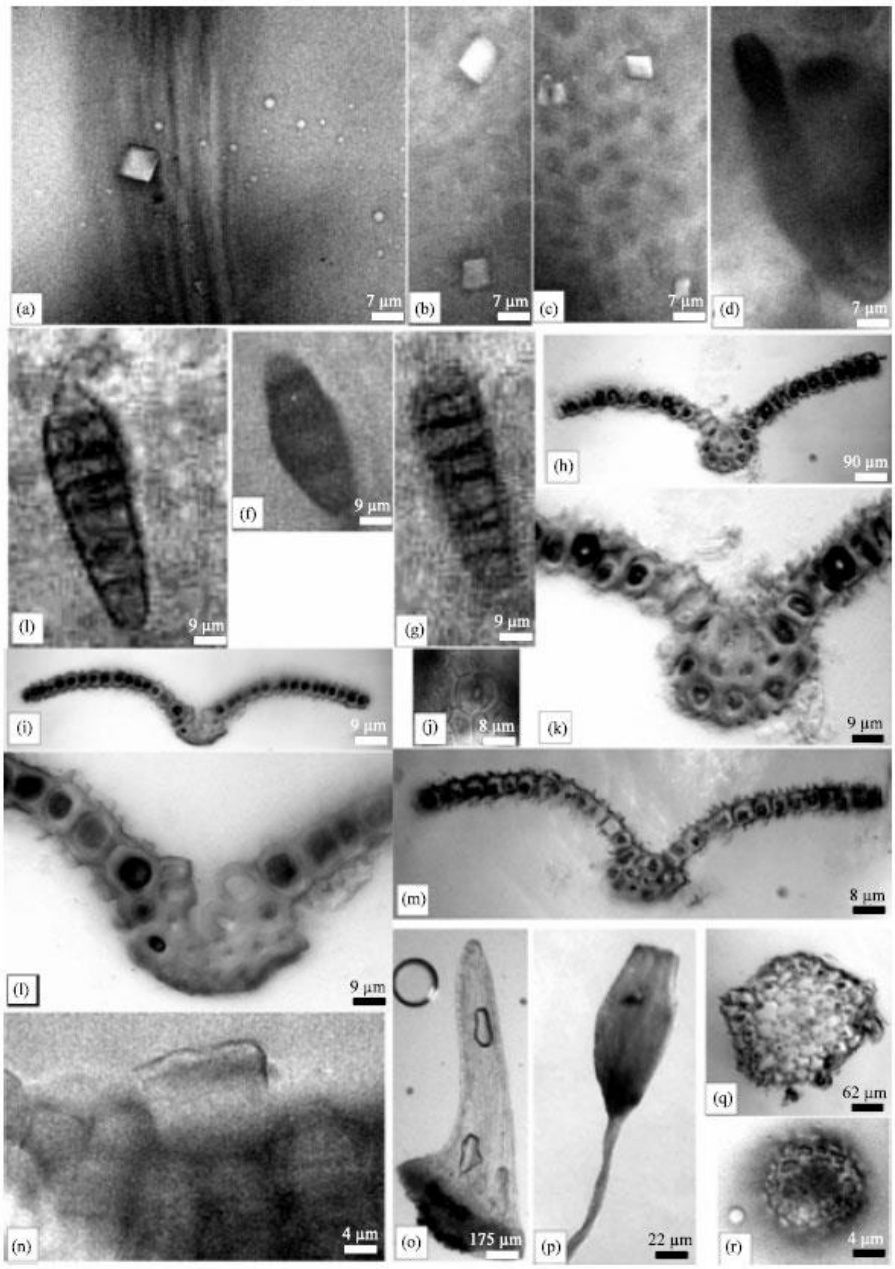

Fig. 3: *Zygodon catarinoi* a-r. (a-c). papillose, quadrate. (d-g). gemmae. (h-m). t.s of stem leaves. (n). rudimentary peristome teeth. (o). lid. (p). capsule and twisted seta. (q). t.s of stem. (r). rough spore

DISCUSSION

Zygodon catarinoi was characterized by: (1) ovate to elliptic gemmae, (2) narrowly lanceolate, loosely erect leaves, (3) the abaxial surface of the costae in the distal 1/3--1/2 of the leaf covered with forked papillae, (4) with rudimentary peristome and (5) leaf lamina bistratose. No other species in the genus *Zygodon* has bistratose leaf lamina, even partially and thus, this later character was separate this species from any other *Zygodon* (Calabrese and Muñoz 2008). By comparing the *Zygodon catarinoi* (the new record) with those

recorded before from north Africa (*Z. dimorphus* Thér. ex Jelenc, Z. forestry (Dicks.) Mitt*., Z. rupestris* Schimp. Ex Lorentz and *Z. viridissimus* (Dicks.) Brid.) it was found that, there are others different characters as the following: *Z. forestry* is lacking peristome teeth; *Z. dimorphus* has another types of gemmae; *Z. rupestris* has gemmae fusiform-clavate or fusiform, only with transverse septa, rarely with some longitudinal, oblique septa and finally *Zygodon viridissimus* has gemmae with horizontal rather than vertical division. However, *Zygodon catarinoi* is closely similar to *Z. apiculatus*. Redfearn recorded from North American but the latter has pluripapillose laminal cells, oblong-lanceolate to oblong-ovate leaves with recurved tips when moist (Redfearn, 1967).

Zygodon catarinoi was considered as a new species to moss flora of Libyan country. It was recorded on the bases trunks of *Quercus canariensis*, *Q. faginea, Q. pyrenaica, Q. rotundifolia* and *Olea europaea* in a humid Wadi Kouf. This in accordance with the data reported before in Britain and Ireland by Smith (2004) and in Iberian Peninsula by Calabrese and Muñoz (2008).

According to this, *Zygodon catarinoi* was ranged to include Libya besides Morocco (García et al., 2006), Portugal, Spain, Iberian Peninsula (Calabrese and Muñoz, 2008), China (Guo *et al.,* 2007). Although, Calabrese and Muñoz (2008) stated that most of species of *Zygodon* was recorded before about different parts of the world without sporophyte, the thirteen specimens in this study were recorded however, containing sporophyte. The appearance or disappearance of *Zygodon* sporophyte is may be attributed to the variation in the weather and increased or decreased of the pollutants in the study area.

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