ABSTRACT

About 200 species of bryophytes are currently known from Egypt. The majority are mosses, while only 13 species belong to the liverworts and no hornworts exist. Regarding the liverworts, following simplified methods used by previous workers, 11 out of the 13 species are listed under threatened categories; 6 of them are in the CR category, 4 in the EN category, 1 in the VU category and 2 are considered not threatened. This evaluation documents the situation at the time of collection, i.e. from 1958 to 1999, which is quite a long time, however, it is basic for any future Red Listing of bryophytes in the country.

INTRODUCTION

Just over 200 bryophytes are, hitherto, known from Egypt (El-Saadawi and Shabbara, 2007; El-Saadawi et al., 2015; El-Sakaty et al., 2018; Khalil and Farag, 2018; Hassan et al., 2019; Taha and Holyoak in Ellis et al., 2019; Taha, 2020). The majority (188 taxa) are mosses while only 13 species belong to the liverworts. Anthocerotes are, at present, extinct in Egypt, weather conditions became drier than in the Holocene (started 11700 yr b.p.) and many genera of bryophytes (e.g. *Phaeoceros*, *Sphagnum*) and of pteridophytes (e.g. *Azolla*, *Lycopodium*, *Selaginella* … etc.) that flourished then in Egypt (Leroy, 1992; Kholeif, 2004; Ziada et al., 2018) became at present extinct in this country. The documentation and conservation of the remaining extant amphibians (i.e. bryophytes and pteridophytes) of the plant kingdom and plants in general and their diversity are, therefore, priority objectives.

A list of threatened bryophytes in Egypt is, therefore, much needed. It would serve; together with similar lists for all other African countries as data essential for determining the First Top 10 list of the IUCN Bryophyte Specialist Group (see Van Rooy et al., 2019).

Although the data to be presented here represent the situation of threatened hepatics in Egypt a long time ago (at the dates of collection between 1958 and 1999) yet the basic information given is indispensable for evaluating any future collection of hepatics from Egypt as an African country and is also necessary together with relevant information from all other African countries, in the preparation of a list of "The Top 10 Initiative" for the whole African Continent.

It is worth mentioning that, the recommendations given by Bergamini *et al.* (2019) for using the critical terms when applying IUCN red-listing criteria to bryophytes depend mainly on: generation length, mature individual and severe fragmentation which are quite
It is difficult to apply here due to severe data deficiency (e.g. no data available on: population size, range, and trend, the ability of individuals to reproduce, life-spans, ……etc.). Moreover, the growth of hepatics in Egypt is quite poor and the cover areas are usually small and sometimes only a few plants are found in a reported site (El-Saadawi and Shabbara, 2007).

**MATERIALS AND METHODS**

The present study is based on the floristic information pertaining to the 13 hepatics of Egypt given by El-Saadawi and Shabbara (2007) and other references therein included particularly Arnell (1963), Jovet-Ast and Bischler (1970), Bischler (1993) and Ros et al. (2007), which included details of collection data and distribution.

In this article the authors try to assign the 13 hepatics known from Egypt to the conservation categories of threatened species following the methods used by Martinčič (2016) in which species were classified under the Red List categories taking in consideration the only realistic threat assessment criterion, which is expressed in the number of currently known localities: 1 (Critically Endangered "CR"), 2-5 (Endangered "EN"), 6-10 (Vulnerable "VU")….etc.

**RESULTS AND DISCUSSION**

The hepatics of Egypt can, according to the above information, be evaluated or assigned to threat categories as follows in Table 1. It is clear that quite a small number of hepatics are recorded in Egypt; all are Marchantiales except Riella (Sphaerocarpales); all are rare and classified under threat categories (6 CR, 4 EN, 1 VU) except Riccia cavernosa and Riccia frostii which are considered not threatened being reported repeatedly from many localities in at least five of the phytogeographical territories of the country (El-Saadawi and Shabbara, 2007). The rarity and small population size of hepatics in Egypt are quite expected since these plants (known as amphibians of the plant kingdom) are water and shade-loving while Egypt is perhaps the aridest country in North Africa (Wickens, 1992). Furthermore, climate change (drying-up of fresh-water swamps; see Leroy, 1992; Kholief, 2004; Ziada et al., 2018) and human activities and their impact (Roberts et al., 2004; Shaltout et al., 2018) have become increasingly important agents in the modification of natural environments leading to loss of habitats suitable for bryophytes in general and hepatophytes in particular. As a result of these two main types of threat (climate change and human activities) and taking into consideration that the collection dates of most of the hepatics recorded in Egypt go back to more than 50 years ago it is highly expected that these species are now most probably extinct in Egypt and therefore become assigned under threat category "RE" (Regionally Extinct). Contemporary collection activities of hepatics in Egypt are evidently indispensable to update our knowledge and to be able to apply criterion B of the IUCN (International Union for Conservation of Nature) in order to estimate the AOO (Area of Occupancy) and prepare an up-to-date actual Red List. The need for Red Lists has been emphasized by many authors (e.g. Hallingbäck and Tan, 2010). Data presented in Table 1 showed also that hepatics of Egypt have more in common with Mediterranean countries (Afr1 and south of Europe of the Index Muscorum; Wijk et al., 1959) than with countries in the southern half of the African Continent (i.e. Afr2, 3 and 4 of the Index Muscorum). An article about threatened mosses in Egypt is probably worthwhile to complete our knowledge about bryophytes in the country in this regard, particularly that recent collection activities of mosses are taking place.
Table 1. Collection and distribution data of the 13 hepatic species known from Egypt and their threat categories based on El-Saadawi and Shabbara (2007); Ros et al. (2007); Youssef (2017) and https://www.tropicos.org/ (2019). Abbreviations of Egyptian territories names: Cai= Cairo area, Dg= Galala Desert, GE= Gebel Elba, Mm= western Mediterranean coastal land, Nd= Nile Delta, Nf= Nile Fayoum, Nv= Nile Valley, S= Southern Sinai massive. Abbreviations of threat categories names: CR= Critically Endangered, EN= Endangered, VU= Vulnerable. Other abbreviations: Afr= Africa, As= Asia, Am= America, Aust= Australia, Eur= Europe, N= North, C= Central, S= South, W= west, E= East. *= No collection data are available in the original publication (Schuster, 1992).

| Taxon | Collection Date | No. of localities | No. of countries | World Distribution | Threat Category |
|-------|----------------|------------------|-----------------|--------------------|----------------|
|       |                |                  | Medit. | African | S. Afr | S. w | As | Eur | CR  |
| 1. Marchantiales |         |        |       |         |       |       |       |       |    |
|   1. Marchantia androgyna (L.) A. Evans | 1982 | 1 in GE | 25 | 4 | 5 | N & S Afr, S. w, As, Eur | CR |
|   2. Marchantia decilis Gooes | 1967, 1977 | 2 in Nf, 2 in Nv, 3 in Nd | 1 | 1 | 5 | N, C & S Afr, Eur | VU |
|   3. Marchantia polymorpha L. | 1961 | 1 in Nv | 10 | 2 | 3 | N & C Afr, N, C & S Am, E As, Eur | CR |
|   4. Plagiochaeta rugosa (J. R. Forst. & G. Forst.) Steh. | 1982 | 4 in GE | 24 | 5 | 5 | N Afr, E As, N, C & S Am, Eur | EN |
|   5. Riccia atramarginata | 1961 | 1 in Mma | 18 | 6 | 6 | N Afr, N Am, S. w, As, Eur | CR |
|   6. Riccia cavaressa Hoffm. | 1961, 1962, 1967, 1995 | Scores in Nf, Nv, Cai, Dg, S, GE | 12 | 5 | 7 | N & S Afr, S Am, E As, Aust, Eur | - |
|   7. Riccia congobana Steh. | 1992 | 4 in GE | 0 | 0 | 2 | N & C Afr, S. w, As | EN |
|   8. Riccia crenata Treb. | 1961 | 2 in Mma | 12 | 4 | 4 | N Afr, Eur | EN |
|   9. Riccia frondal Austin | 1961, 1962, 1964, 1967, 1996 | Scores in Nf, Nv, Cai, Dg, GE | 9 | 2 | 2 | N Afr, N Am, E As, Eur | - |
|   10. Riccia lamellovii Kadl | 1961 | 1 in Mma | 24 | 6 | 6 | N Afr, N & S Am, Eur | CR |
|   11. Riccia sorocarpa var. sorocarpa Bisch. | 1961 | 2 in Mma | 29 | 6 | 6 | N Afr, N & S Am, E As, Eur | EN |
|   12. Targionia hypophylla L. | ? | ? | 30 | 6 | 9 | N, C & S Afr, N Am, S. w, E As, Eur | CR |
|   Sphaero carpalis | 1958 | 1 in Cai | 11 | 3 | 3 | N Afr, Eur | CR |

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Toward a red list of Egyptian Hepatics

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ARABIC SUMMARY

نحو قائمة حمراء للنباتات الحزازية في مصر. I. الحزازيات الكبدية

وجيه السعداوي ومي أحمد طه

قسم النبات. كلية العلوم- جامعة عين شمس- القاهرة- جمهورية مصر العربية

هناك حوالي 200 نوع من النباتات الحزازية معرفة حاليا من مصر. معظمها حزازيات قائمة، وأقلها (13 نوعا فقط) حزازيات كبدية؛ ليس بينها حزازيات قرناء. وبإتباع الطرق المبسطة التي استخدمها دارسون سابقون، تم إدراج 11 نوعا من أصل 13 نوعا ضمن الفئات المهددة بالانقراض؛ منها نوع واحد "معرض" و 4 أنواع "مهدية" و 6 أنواع "حرجة التهدد"، وبذلك يبقى نوعان فقط "غير مهديين". ويوثق هذا التقييم الوضع في وقت جمع النباتات، من سنة 1958 إلى سنة 1999، أي منذ زمن بعيد جدا، ولذلك، يعد هذا البحث أمرًا أساسيًا لأي دراسة مستقبلية تخص إدراج حزازيات مصر في قوائم حمراء.