Studies on Family Pottiaceae (Musci) in El-Sharkyia Province

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By

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Dedication

I dedicate this thesis

All Thanks to Allah

To my family; my lovely mum, my dearest brothers and sister and my little sweeties Zeyad, Radwa, Omar and Salma. Every day I pray to Allah to keep you in good health and give you long life.

Thank you for your presence in my life, thank you for supporting me with kindness, advice, encouragement and love, thank you for being my family with all what the word "family" means and thank you for illuminating all my days.

Declaration

I declare that this thesis has been composed by my self and that the work of which is a record has been done by my self.

It has not been submitted for a degree at this or any other University.

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Introduction

Pottiaceae is a large, widely distributed, heterogeneous moss family, in which delimitation of genera may often be rather difficult **(Saito and Hirohama, 1974)**. In 1909, it was shown to include 46 genera in four subfamilies (**Brotherus, 1902-1909)**. In **1924-1925, Brotherus** again recognized 71 genera within 5 subfamilies. Some years later **Chen (1941)** recognized 32 genera in 6 subfamilies and provided quite excellent illustrations of all species including important details as papillae morphology and leaf anatomy. Four decades later, **Crosby and Magill (1981)** in their "Dictionary of Mosses" recognized 90 genera of Pottiaceae. Finally **Zander (1993)** in his long intensive work classified Pottiaceae taxa within 7 subfamilies, 6 tribes, 76 genera, 1457 species, 31 subspecies, 536 varieties, 339 formae and 7 subformae.

The large number of pottiaceous taxa and their wide spectrum of spreading all over the world were rendered to their efficient tolerance to low humidity in xeric habitats, adaptation to climatic changes, withstanding pollution conditions and exhibiting a wide range of morphological variations **(Saito, 1975)**.

In Egypt, as in many parts of the world of similar latitude, Pottiaceae is the largest moss family, its taxa occupy various

habitats, xeric, ruderal and polluted (e.g. North Africa: **Ros *et al.*, 1999**; Iraq: **Agnew and Vondracek, 1975**; Kuwait: **El-Saadawi, 1976** and Texas: **Magill, 1976)**. Pottiaceae represents over 50% (111 taxa) of the presently known moss flora of Egypt, which consists of 215 entities **(Ibrahim, 2010)**. Pottiaceae, in Egypt, is represented by four subfamilies, i.e. Trichostomoideae, Pottioideae, Merceyoideae and Timmielloideae. Pottioideae and Merceyoideae are represented by 53 and 47 taxa respectively, then comes Trichostomoideae with 9 taxa followed by Timmielloideae with only one taxon **(El-Saadawi *et al.*, 2003; El-Sakaty, 2009 and Ibrahim, 2010)**.

In Egypt serious bryofloristic studies have been done especially during the last decade by **Shabbara *et al.* (2000); El-Saadawi *et al.* (2003); Shabbara and El-Saadawi (2006); Ibrahim (2006), Shabbara (2007) and Ibrahim (2010)**, recording 50 moss genera in 15 families.

Twenty out of the 50 moss genera reported from Egypt belong to family Pottiaceae. *Didymodon* Hedw. is the largest genus (26 taxa) followed by *Tortula* Hedw. (17 taxa) then *Barbula* Hedw. (12 taxa) and *Crossidium* Jur. (8 taxa). The remaining 16 Pottiaceae genera are represented by a few taxa each **(El-Saadawi *et al.*, 2003;**

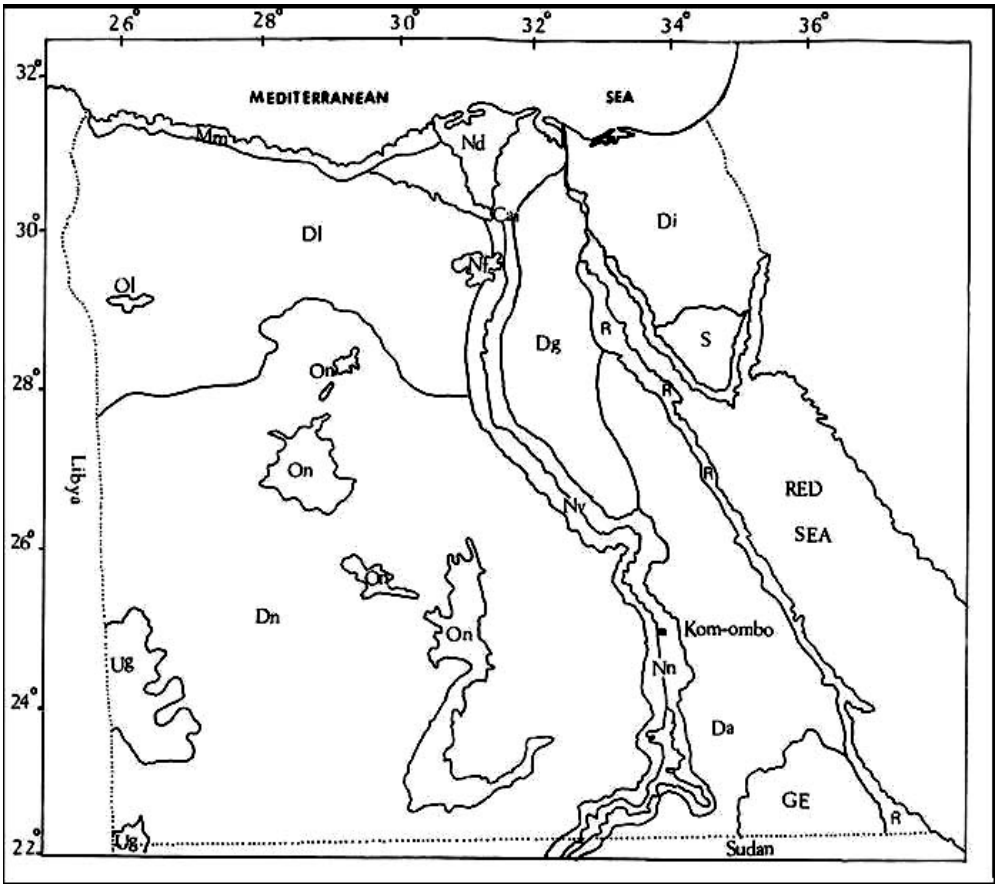
Shabbara and El-Saadawi, 2006; Ibrahim, 2006, Shabbara, 2007, El-Sakaty, 2009 and Ibrahim, 2010).

The distribution of Pottiaceae in Egypt shows great variation between different territories (Map 1), thus there are: 56 taxa recorded from Mm (the Western Mediterranean Coast), 41 taxa from S (Southern Sinai), 30 from Nd (Nile Delta), 27 from Di (Isthmic Desert), 15 from Nf (Nile Faiyum), 12 from each of Cai (Cairo) region and Dg (Galala Desert), 11 from Ol and On (Western Desert Oases), 8 from Nv (Nile Valley), 4 from GE (Gebel Elba) and 3 from Nn (Nile Nubia). **(El-Saadawi *et al.*, 2003; Shabbara and El-Saadawi, 2006; El-Sakaty, 2009 and Ibrahim, 2010)**.

The distribution of the 30 Pottiaceae mosses of the Nd in its provinces is as follows arranged in an ascending order: 3 taxa in Damietta, 4 taxa in each of Behaira and Daqahliya, 5 taxa in Kafr-El Sheikh, 6 taxa in each of Gharbiya and El-Sharkyia, 17 taxa in Menoufiya and 20 taxa in Qaleobiya **(El-Saadawi *et al.*, 1986; Youssef, 1987 and Ibrahim, 2006 and 2010)**.

This great variation in the numbers of taxa reported from the different provinces is mainly due to difference in the extent of survey. The relatively large number of mosses reported from

Qaleobiya and Menoufiya is due to the more intensive studies done recently by **Ibrahim in 2006** and **2010**.



Map 1: Phytogeographical territories of Egypt (after **El-Saadawi *et al.*, 2003**). Cai: Cairo area; Da: Arabian desert; Dg: Galala Desert; Di: Isthmic Desert; Dl: Libyan Desert; Dn: Nubiean desert; GE: Gebel Elba; Mm: western Mediterranean coastal land (Mareotic sector); Nd: Nile Delta; Nf: Nile Fayoum; Nn: Nile Nubia, from Kom Ombo southwards to Egyptian bounceries with the Sudan including the areas now inundated by the waters of Lake Naser since 1965; Nv: Nile Valley, from Cairo-Giza to Kom Ombo; On & Ol: Oasis of the Nubian and Libyan Desert; R: Red Sea coastal plains; S: Southern Sinai massive (Sinai proper i.e. relatively high mountains, south of Isthmic desert).

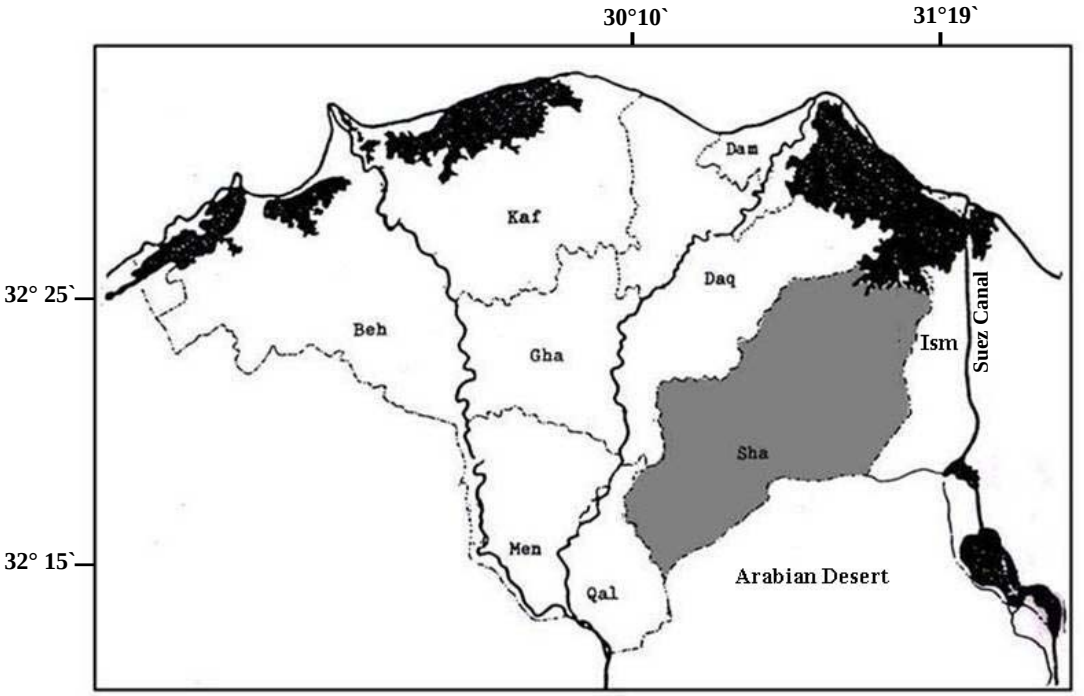
The aim of this work is, therefore, the furtherance of our knowledge about the Pottiaceae flora of the second largest province in the Nd, namely; El-Sharkyia province since only 6 Pottiaceae taxa (as already mentioned) are, up till now, known from this large province. To achieve this aim it was necessary to revise old samples which found in CAIA (Ain Shams University herbarium) and collect new ones. This will help also to study the changes which happened in the pottiaceous taxa by comparing taxa in old and new collections parallel to the work done on Pottiaceae of Menoufiya province by **Ibrahim (2010)**. She **(2010)** showed that, some taxa were found in old collections but not in new ones. On the other hand, some taxa were found in the new collections and not found in old ones. Because biodiversity conservation is currently a principal goal for resource management and protecting endangered and other threatened species, it was necessary to take conservation status into consideration in the present work, as far as possible.

The 6 Pottiaceae mosses reported from El-Sharkyia province are: *Barbula ehrenbergii* (Lorentz.) M. Fleisch., *B. indica* (Hook.) Spreng., *B. unguiculata* Hedw. (= *B. unguiculata* fo. *obtusifolia*), *Didymodon tophaceus* (Brid.) Lisa., *Gyroweisia tenuis* (Hedw.) Schimp. and *Tortula mularis* Hedw. **(El-Saadawi *et al.,* 1986** and **Youssef, 1987)**.

Study Area

El-Sharkyia (Map. 2) is one of Lower Egypt provinces. It is located east to Damietta branch of the River Nile between longitudes 30° 10` E and 31° 19` E, and latitudes 32° 15` N and 32° 25` N occupying an area reaching 9411 km2. It is the second largest province regarding area in the Nile Delta. It is bounded by Lake Manzala and Daqahliyah province in the north and northwest, Ismailiyah province in the east, Arabian Desert and Qaleobyia province in the south and southwest. The western inhabited sector of El-Sharkyia forms the main part of the province. The eastern sector of El-Sharkyia province is a desert and almost barren of mosses **(Youssef, 1987)**.

The climate of El-Sharkyia province changed remarkably in the last 30 years. In 1981-1982, maximum temperature was 19°C and minimum was 6°C during winter; while during summer maximum and minimum temperatures were 31°C, 15°C respectively. The total annual rainfall on El-Sharkyia province was between 17 mm and 50 mm. The annual mean of relative humidity was 69.5% during winter and 43.5% during summer **(Egyptian Meteorological Authority, 1981 & 1982)**.



Map 2: Showing location of El-Sharkyia province in Lower Egypt, **Ism**=Ismailiyah, **Sha**=Sharkyia, **Daq**=Daqahliyah, **Qal**=Qaleobyia, **Dam**=Damietta, **Gha**=Gharbyia, **Men**=Menoufyia, **Kaf**=Kafr El-Shaik, **Beh**=Behairah.

In the present study (2008-2009) of El-Sharkyia province, the maximum temperature was 18°C and the minimum temperature was 8°C during winter; while during summer maximum and minimum temperatures were 35°C and 19°C respectively. In general, temperature in the study area increases southward and eastward and decreases northward and westward by a maximum of 2 to 4 degrees. Rainfall takes place from November to February. The total annual rainfall of El-Sharkyia was between