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Assessment of the Wild Plants in the Egyptian Botanic Gardens; Nile Region

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Introduction

Botanic gardens are often persistent institutions that change through time, adapting to society. They can play important roles both for the conservation of threatened plant species and as potential sources of invasive species (Blackmore 2017). Egypt constitute an important area for botanical diversity in North Africa, covering 35.5% of the native and 50% of alien threatened species in the region (https://www.iucnredlist.org). We here assess the role of Egyptian botanic gardens in Nile Region for the conservation of threatened species and as potential sources of invasive species through an inventory of their wild plants, assessing life forms, geographical distributions, economic uses and ecological functions, conservation categories and threats to their persistence in their natural habitats.

Material and methods

The study area is the Egyptian Nile Region with a length of about 1520 km (23 % of the total length of the river; Fig. 1), spanning grassland, desert and semi-desert biomes and harbouring a population of about 80,000,000 people.

One hundred and ninety-four visits were performed over 183 gardens from summer 2012 to winter 2017 to inventory their wild plants, with taxonomy following according to the African Plant Database (https://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php) and the Plant List (http://www.theplantlist.org), life forms according to the Raunkiaer (1937) system, and their geographical distribution in Egypt according to Boulos (2009). Voucher specimens were deposited in Tanta University Herbarium (TANE).

Six economic uses (grazing, medicine, feeding, timber, fuel, plus other uses, including e.g., oils and fats industry) and six ecological functions (sand accumulation, bank retainer, nitrogen fixation, wind break, water purification, and shading) were
determined by field observations, collected information from local inhabitants, and literature review (e.g. Shaltout et al. 2010; Shaltout and Ahmed 2012). Seven natural habitats were identified after Boulos (2009): rocky formations, sand formations, crop fields, wetlands, waste lands and salt-marshes. In addition, six threats (causes for ecosystem degradation and species impoverishment) were recorded: over-grazing, over-collecting, clearance for agriculture, habitat loss to urban and industry growth, and disturbance by cars and mining (Seif El-Nasr and Bidak 2005). Conservation categories and ecological status of species were collected from Shaltout et al. (2016); Shaltout et al. (2018); (https://www.iucnredlist.org/).

**Results and Discussion**

Ninety-six wild plant species belonging to 79 genera and 47 families were recorded. The most represented family was Poaceae (8 species, 8.3%), while the most represented genera were *Acacia*, *Ficus* and *Ipomoea* (each 3 species, 4.2%). Therophytes (38 species, 39.6%) were the most represented life form. The prevalence of therophytes over other life forms among the wild plants likely reflects that Egypt is a hyper-arid country, where desert conditions prevail throughout (Wickens 1992).

Most of the species (70 species, 72.9 %) occur as natives in the Nile region of Egypt, with the Mediterranean zone of the country as the second-most common source area (48 species, 50.0 %). Hence, most of the wild plants in Egyptian botanic gardens are from the national flora and not introduced from elsewhere. In terms of continental distribution; African species are the most represented (52 species, 54.2 %).

Eighty-eight species (91.7 %) have at least one economic use (Table 1). There were 58 medicinal species (e.g., the aerial parts of *Adiantum capillus-veneris* are used to treat coughs, mucus and sore throat: Chevallier 1996), while various parts of 38
species are eaten by local inhabitants (e.g., leaves and shoots of *Malva parviflora* and *Portulaca oleracea* are cooked or eaten as a salad: Al-Eiswi and Takruri 1989).

Twenty-nine species (30.2%) have at least one ecological function. Nitrogen fixers (mainly Fabaceae) constituted the majority, with 11 species, all with modulating-bacteria that convert atmospheric nitrogen into ammonia (Simpson and Ogorzaly 1995). Eight species are used as wind breaks, e.g. *Salix* spp., protecting agricultural crops from damage (El-Beheiry et al. 2015) (Table 1).

In terms of habitats, 46 species inhabit crop fields, while 30 species inhabit aquatic formations (e.g. Nile canals, banks, lakes), likely reflecting that most gardens are located in zones of agriculture close to the Nile River (Shaltout and Ahmed 2012). Fifty-four species occur in just one of these habitats, while 30 species occur in both habitats. Eighty-eight species (91.7 %) were affected by at least one threat in their natural habitats, with the most common threat being over-collecting (58 species) (Table 1). Shaltout and Ahmed (2012) reported that over-collecting of wild medicinal plants by herbalists for trade as a dangerous, unregulated threat to the wild flora in Egypt. In terms of global conservation status following IUCN, seven species are threatened (7.3%), while five species are least concern. In addition, *Dracaena ombet* is endangered, facing high risk of extinction due to habitat loss as result of dune removal and agriculture plus over-collecting. The palm *Medemia argun* is critically endangered, as it removed for agriculture in the wild. Nationally; *Ficus carica* and *Pteris vittata* are least concern, *Dichrostachys cinerea* is near threatened, threatened by over-grazing and/or mining, while *Cyperus papyrus* is vulnerable (species faces a high risk of extinction in the wild as result of its over collecting).

Twenty-three plant species in the studied botanic gardens are aliens (Shaltout et al. 2016), (Fig. 2): 8 are casuals (aliens reproducing occasionally in an area, but not
forming self-replacing populations; e.g. *Alcea rosea*), 13 are naturalized (aliens reproduce consistently and sustain populations over many life cycles without direct intervention by humans) (e.g. *Amaranthus hybridus*), while two are invasive (aliens produce reproductive offspring, often in very large numbers, at considerable distances from parent plants), namely *Eichornia crassipes* and *Ipomoea carnea*. This suggests a limited role of the botanic gardens in the Nile region of Egypt as sources of invasive plants, albeit both of these species are serious invasive species in the region (Eid and Shaltout 2017).

**Conclusion:**

Assessment of conserved wild plants in the Egyptian botanic gardens; Nile Region, especially threatened and alien species, is a preliminary step for introduction of new regional species; especially African threatened species.

**Acknowledgments:**

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**Conflicts of Interest:** None.

**References**


Web sites:
https://www.arcgis.com
1. https://www.iucnredlist.org/
Table 1. The wild species recorded in the Egyptian botanic gardens. Economic uses (88 species) are: **ME**: Medicine, **FE**: Feeding, **OT**: Other uses (e.g. industry), **GR**: Grazing, **TI**: Timber and **FU**: Fuel. Ecological functions (29 species) are: **NF**: Nitrogen fixer, **SA**: Sand accumulator, **WB**: Wind break, **BR**: Bank retainer, **WP**: Water purifier and **SH**: Shading. Natural habitats (96 Species) are: **CF**: Crop fields, **AQ**: Aquatic formations, **SA**: Sandy formations, **RO**: Rocky formations, **WE**: Wetlands, **WA**: Waste lands and **SL**: Salt marshes. Threats (88 species) are: **OC**: Over-collecting, **OG**: Over-grazing, **CA**: Clearance for agriculture, **MI**: Mining and **HL**: Habitat loss.

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