Vegetation of Lake Burullus and its potentiality for carbon sequestration

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Lake Burullus
The Mediterranean coastal land of Egypt extends for about 970 km, from Sallum in the west to Rafah in the east. Five natural lakes extend along this coast: Mariut (Western Coast), Edku, Burullus, Manzala (Deltaic Coast) and Bardawil (Sinai Coast).
* Lake Burullus is a shallow basin with a depth varies between 40 cm near the shores and 200 cm near the sea outlet (Boughaz El-Burullus).

* Lake Burullus has the highest value of fish productivity (1.2 ton/ha) among the 5 northern lakes.
### Morphometric dimensions of Lake Burullus in 1984 and 1997

<table>
<thead>
<tr>
<th>Character</th>
<th>1984</th>
<th>Now</th>
<th>Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (km²)</td>
<td>502.7</td>
<td>410.0</td>
<td>18.4</td>
</tr>
<tr>
<td>Circumference (km)</td>
<td>160.0</td>
<td>143.0</td>
<td>10.6</td>
</tr>
<tr>
<td>Maximum length (km)</td>
<td>56.0</td>
<td>47.0</td>
<td>16.1</td>
</tr>
<tr>
<td>Maximum width (km)</td>
<td>15.0</td>
<td>14.0</td>
<td>6.7</td>
</tr>
<tr>
<td>Length/width ratio</td>
<td>3.7</td>
<td>3.3</td>
<td>10.8</td>
</tr>
<tr>
<td>Depth (cm)</td>
<td></td>
<td>20-200</td>
<td></td>
</tr>
</tbody>
</table>
HABITAT TYPES

Burullus Wetland includes 10 types of habitat: Sand formations; salt marshes; lake cuts; terraces, slopes, water edges and open waters of the drains; islets, shores and open waters of the lake.
## Distribution of species among different habitats

<table>
<thead>
<tr>
<th>Zone</th>
<th>Total species</th>
<th>Unique species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>R</td>
</tr>
<tr>
<td>Salt marshes</td>
<td>51</td>
<td>25.9</td>
</tr>
<tr>
<td>Sand formations</td>
<td>45</td>
<td>22.8</td>
</tr>
<tr>
<td>Lake cuts</td>
<td>29</td>
<td>14.7</td>
</tr>
<tr>
<td>Drain terraces</td>
<td>87</td>
<td>44.2</td>
</tr>
<tr>
<td>Drain slopes</td>
<td>69</td>
<td>35.0</td>
</tr>
<tr>
<td>Drain water edge</td>
<td>59</td>
<td>29.9</td>
</tr>
<tr>
<td>Drain open water</td>
<td>14</td>
<td>7.1</td>
</tr>
<tr>
<td>Lake shorelines</td>
<td>65</td>
<td>33.0</td>
</tr>
<tr>
<td>Lake open water</td>
<td>16</td>
<td>8.1</td>
</tr>
<tr>
<td>Lake islets</td>
<td>89</td>
<td>45.2</td>
</tr>
</tbody>
</table>
224 species → 149 genera → 47 families

114 annuals

Cakile maritima
Ranunculus sceleratus
Salsola kali

110 perennials

Phragmites australis
Typha domingensis
Potamogeton pectinatus
Compared with the five northern lakes, Lake Burullus had the highest number of species followed by Lakes Mariut, Manzala, Bardawil and Edku with 198, 144\%, 136\% and 120 species, respectively.
Spectrum of the global distribution of the recorded species in Burullus Wetland.

<table>
<thead>
<tr>
<th>Floristic region</th>
<th>Number of species</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endemics</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>Cosmopolitan</td>
<td>31</td>
<td>15.7</td>
</tr>
<tr>
<td>Monoregionals</td>
<td>40</td>
<td>20.3</td>
</tr>
<tr>
<td>Bi-regionals</td>
<td>27</td>
<td>28.9</td>
</tr>
<tr>
<td>Pluri-regionals</td>
<td>65</td>
<td>33.0</td>
</tr>
</tbody>
</table>
Endemic and rare species

Three endemic species were recorded in Lake Burullus: one perennial (*Zygophyllum album* subsp. *album*) and 2 annuals (*Sinapis arvensis* subsp. *allionii* and *Sonchus macrocarpus*).

Thirty- three species were recorded as rare; of them 15 annuals and 18 perennials
Vegetation Analysis

The application of TWINSPAN program on the cover estimates of 197 species recorded in 227 stands led to the recognition of 13 vegetation groups representing the common communities in the Lake: Six groups are dominated or co-dominated with the common reed (*Phragmites australis*); other five groups are dominated by halophytic species (*Arthrocnemum macrostachyum*, *Suaeda vera*, *Sarcocornia fruticosa*, *Halocnemum strobilaceum* and *Salsola kali*), and the remaining two groups are dominated by the emergent *Typha domingensis* and submergent *Potamogeton pectinatus*. 
1. *Arthrocnemum macrostachyum–Juncus acutus*

2. *Phragmites australis-Suaeda pruinosa*

3. *Phragmites australis-Arthrocnemum macrostachyum*

4. *Suaeda vera-Limbarda crithmoides*

5. *Juncus acutus*

6. *Sarcocornia fruticosa*

7. *Potamogeton pectinatus*

8. *Halocnemum strobilaceum*

9. *Salsola kali*

10. *Phragmites australis*

11. *Phragmites australis-Potamogeton pectinatus*

12. *Typha domingensis-Ceratophyllum demersum*

13. *Phragmites australis-Potamogeton pectinatus*
The dendrogram resulting from the application of TWINSPAN on the 227 sampled stands in Lake Burullus.
DCA ordination of the 13 vegetation groups identified after the application of TWINSPLAN on the 227 sampled stands in Lake Burullus.
Persicaria salicifolia  
Phragmites australis  
Typha domingensis  
Ludwigia stolonifera  
Sarcocorinia fruticosa
The economic uses of the recorded species could be arranged descendingly as follows:

grazing → medicinal → human food → fuel → timber

**Carbon Sequestration:** One of the main importance of the vegetation in Lake Burullus is carbon sequestration (e.g. *Phragmites australis*, *Typha domingensis*, *Eichhornia crassipes*, *Potamogeton pectinatus*)
REED BEDS (*PHRAGMITES AUSTRALIS*)

* Reed beds of Lake Burullus represent one of the most important reed beds in the Mediterranean region, where this type of habitat is becoming rare and threatened.

* Wintering and migrant birds are strongly dependent on this habitat for foraging, refuge and breeding; thus Lake Burullus was registered as one of the sites of Ramsar Convention.

* The reed beds also create a suitable shelter for the fishes of this lake, particularly fry and juveniles.
Globally, Common reed (*Phragmites australis*) is believed to be the most widely distributed of all angiosperms in Lake Burullus.

It reproduces from propagules and has a vigorous, branched rhizome system that runs quickly to new areas in either the submerged or dry lands.

It provides shelter, material for thatching, food for animals, chemicals, fuel, fertilizer, biofilter, and raw material for paper making industry.
The area occupied by the common reed had decreased from 10416 ha to 6972 ha (reduction rate = 33.1 %).

The estimated maximum standing crop phytomass in the lake as a whole was 239,040 ton dry matter: 170,980 ton represents the above water standing crop, and 68,060 ton represents the submerged portion.

The underground parts of reeds (rhizomes and roots) had a more or less similar phytomass as the aboveground parts (239,040 ton).

Therefore, the productivity of reeds in the lake approximates half million (480,000) ton dry matter.
Land Sat images of Lake Burullus indicating the changes in the areas of the lake and common reed (*Phragmites australis*) during 1988 and 1998
In *P. australis*, the photosynthetic production, net growth, and dead litter production produces approximately 4469, 4596 and 2191 g C m$^{-2}$ yr$^{-1}$, respectively (i.e. 11256 g C m$^{-2}$ yr$^{-1}$).

Respiration of the above- and below-ground organs consumed about 13% of the C production, while 87% were stored in the different plant organs.

Thus, now we can imagine the amount of carbon sequestered in the biomass of a single species in Lake Burullus.
Another important and common plant in Lake Burullus that contributes in carbon sequestration is water hyacinth \((Eichhornea crassipes)\), which is claimed to be the highest yielding plant in the world.

In addition, \(P. \text{pectinatus}\), which produces a maximum above-ground biomass of 20.4 ton DM ha\(^{-1}\).

The maximum above-ground biomass of Southern Cattail \((Typha domingensis)\) was approximately 63 t DW ha\(^{-1}\).
Threats upon the Ecosystem

* The continuous reduction in the area of Lake Burullus and its adjacent reed swamps and marshlands through substantial land reclamation.

* The villagers in the middle sector of the southern shore of the lake have collected huge piles of reed stems (*Phragmites australis*), left them to dry in the sun, prior to weaving them into mats for sale in other parts of the area.

* Some fishermen burn the dried stems of *Phragmites australis* as means of warming the water and consequently attracting more fishes.
Collection of reeds from the lake
Burning of reeds in Lake Burullus
A goat grazes the water hyacinth along the lake shore
Plant collection for using as fuel
Thanks