RED LIST OF ECOSYSTEMS

The IUCN Red List of Ecosystems
Scope: Sub-global / National
Language: English

Sand plain of the lake Burullus, Egypt

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Overall risk category **CR**

NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	ENDANGERED	CRITICALLY ENDANGERED	COLLAPSED
NE	DD	LC	NT	VU	EN	CR	CO

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Keywords:

Ecosystem assessment, Ecosystem collapse, Salt marshes, Sand dunes, Sand plain

Ecosystem Description

Burullus Protected Area (BPA) lies near to the Mediterranean Sea on the fringe of the Nile Delta of Egypt. It was declared as a national protected area in 1998 (Khalil, 2013). The sand bar has different geomorphologic features forming different ecosystems including sand flats, sand dunes, sand hillocks and salt marshes. The wetland also bears a community of reedbeds. The wetland was also declared as an International Important Bird Area (IBA) and Ramsar site since 1988 (Khalil, 2018). The marine bar takes an oblong outline with an area of approximately 165 km2 extending for about 47 km along with a coastline of about 65 Km. Its width is not constant from east to west; it varies between 5 and 11 km (Shaltout and Khalil, 2005; Khalil, 2013, 2018). About 45 plant species were recorded in sand plain ecosystem by Shaltout and Khalil (2005) 60% of them are perennials and the rest are annuals. It represents the principal geomorphologic feature affected by the sedimentation processes and is well-known by its distinguished sand dunes. The coastal sand dunes are sand formations that were predominantly formed by the action of the western winds through mixing the deposits of the ancient Nile Deltaic branches and the marine deposits transported by the marine currents (Bayomi, 1999). The main threats to the ecosystem are climate change and urban development which affect the geographic distribution of the marine bar ecosystems as well as the biotic and abiotic factors in the ecosystems.

Classification

IUCN Habitats Classification Scheme

- 13. Marine Coastal/Supratidal
  - 13.3. Marine Coastal/Supratidal - Coastal Sand Dunes

IUCN Global Typology

- Marine/Terrestrial
  - MT2. Supralittoral coastal

Distribution

Burullus Protected Area (BPA) lies near to the Mediterranean Sea on the fringe of the Nile Delta of Egypt. It was declared as a national protected area in 1998 (Khalil, 2013). The protected area encompasses the Burullus wetland area along with many islets within Burullus Lake and the flat sand bar at the north. The marine bar is the extended sand bar that separates the wetland from the Mediterranean Sea. The sand bar has different geomorphologic features forming different ecosystems including sand plain and salt marshes. The marine bar takes an oblong outline with an area of approximately 165 km2 extending for about 47 km along with a coastline of about 65 Km. Its width is not constant from east to west; it varies between 5 and 11 km (Shaltout and Khalil, 2005; Khalil, 2013, 2018).

System

Marine/Terrestrial

Biogeographic Realm

Palearctic

Countries

Egypt

Geographic Region

Northeast Africa

Characteristic Native Biota

About 45 plant species were recorded in the sand plain ecosystem by Shaltout and Khalil (2005), of which 60% of them are perennials and the rest are annuals. The most distinctive species include Cistanche phelypaea, Convolvulus lanatus, Cornulaca monacantha, Cyperus capitata, Elymus farctus, Heliotropium curassavicum, Orobanche cernua, Panicum turgidum, Silene succulenta, Bromus catharticus, Cakile maritima and Fagonia arabica.

Taxa

Bromus catharticus, *Cakile maritima*, *Cistanche phelypaea*, *Convolvulus lanatus*, *Cornulaca monacantha*, *Cyperus capitata*, *Elymus farctus*, *Fagonia arabica*, *Heliotropium curassavicum*, *Orobanche cernua*, *Panicum turgidum*, *Silene succulenta*

Abiotic Features

The sand plain ecosystem at Burullus wetland represents the principal geomorphologic feature affected by the sedimentation processes and is well-known for its distinguished sand dunes. There is a close relationship between the locations of the sand dunes and the ancient Nile Deltaic branches. The coastal sand dunes are sand formations that were predominantly formed by the action of the western winds through mixing the deposits of the ancient Nile Deltaic branches and the marine deposits transported by the marine currents (Bayomi, 1999). A belt of coastal dunes extends to the south along the coast between the Baltium and Burg El-Burullus village, where it is now encircled by a recently established international highway (El Banna, 2004).

Biotic Processes

Sand is drifted along the coast by waves, wind, and current action. High energy waves usually erode sand from the beach to be deposited offshore as submerged sand bars. While the low energy waves take sand from seaward sources and deposit it on the seashore to form the beach bar in the form of low sand dunes aligned parallel to the coastline. By the time plants and other material on the bar entrap windblown sand from the seashore leading to expansion in the bar width and increase in its height to form higher coastal dunes (O'Keefe, 1978; El Banna, 2004). Offshore, consecutive seashore berms might be formed, develop over time to create a sequence of dunes aligned parallel to the shoreline. The seawards side of the forefront dunes is reduced by the action of storm waves and currents. At the period of calm weather, currents develop up a new bar that will be parallel to the original forefront dunes. Sand fixing plant species colonize the new berm and accumulate windblown sand, and a new series of fore dunes is built up (Bird, 1972; El Banna, 2004).

Conceptual Model

It shows the various components of the ecosystem; the threats are illustrated in the red rectangles, the biotic components are shown in green polygons, the biotic processes are shown in green oval-shaped polygons, the abiotic processes are shown in blue oval-shaped polygons and the compartment in the dotted box represents ecosystem components functioning and interacting together.

Threatening Processes

The undisturbed system of dunes acts as a flexible coastal barrier against sea erosion. However, the system is disturbed during wave attacks that sand is lost to form off-shore bars. It may build up through calm weather as the plants on the beach entrap windblown sand that has been deposited by current actions (El Banna, 2004). The coastal dune areas are threatened by urban expansion and construction of the international coastal highway, land reclamation projects and establishment of fish farms (El-Asmar and Al-Olayan, 2013). Coastal dunes of Burullus wetland could also be vulnerable to the impacts of the expected sea-level rise (El Banna, 2008). That was noticed in the remnant fore dunes which are subjected to severe erosion by seawater floods. The coastline east of Burg El Burullus village and Baltium resorts are receding quickly due to seawater over-overflowing leading to continuous to cutting back of the dunes (Fanos et al., 1995; El Banna, 2004).

Collapse

The collapse state occurs when the ecosystem transformed into a different state other than its original state that cannot sustain its defining features (Bland et al., 2019). For the marine bar ecosystems, the collapse state is assumed when the mapped distribution of the ecosystem diminishes to zero for both Criteria A and B. Assessing functional criteria of the ecosystem was challenging due to the lack of regular monitoring data of biotic and abiotic variables. It has been indicated that the Nile Delta region where the marine bar ecosystem of Burullus is stretched is one of the most seriously vulnerable regions to the prospective impacts of sea-level rise (El Raey et al., 1999). The full understanding of how biological and physical processes interact in response to the sea level rise is still lacking (Alongi, 2008; Gilman et al., 2008; Krauss et al., 2008; Marshall et al., 2018). Therefore, it was difficult to collect long-term data and set thresholds of collapse for any of the possible variables for Criterion C. The threshold of collapse for Criterion D was assumed when the value of the floristic quality index measure is lower than 50%.

Ecosystem Risk Assessment

Assessment Protocol	IUCN Red List of Ecosystems Category and Criteria	Last Assessed
IUCN RLE v2.2	Critically Endangered A2b+B1	2021

Justification

The sand plain contains the sand dunes which protect the central part of the Delta shoreline and backshore cultivated land and acts as a barrier against sea erosion (El Banna, 2004). The analysis of the remotely-sensed data revealed that the area recognized as sand plain has changed dynamically over time. The maximum area of sand plain (10,648 ha) was detected in 1978, while the minimum area (4,005 ha) was detected in 2016. In the third period evaluated from 2003 to 2016 the area of sand plain decreased from 8,980 ha to 4,005 ha; this resulted in an annual current decline of 6.02%. Extrapolation of data for 50 years projected a rate of decline of 95.5%. Moreover, the EOO is 278 km2. The current floristic quality is lower than the historic state of the ecosystems as indicated by the lowest value of the Adjusted FQAI compared to the value attained by the floristic composition of the earlier studies by Zahran et al. (1990). A trend of decline in the floristic quality of the ecosystem can be observed over time as revealed by the values of Adjusted FQAI. The obtained value from the current study revealed a significant decline in the value of floristic quality that reached (47.1) due to a higher percentage of the recorded non-native species (8.5%). The decline in the floristic quality indices and the increase in the percentage of non-native species recently recorded compared to the previous studies indicated that deteriorations have occurred to the ecosystem from 1990 to 2019, and particularly accelerated in the last few years. Results of relative severity estimation revealed that the % severity of adjusted FQAI of sand plain is 20%. Therefore, the ecosystem is classified as Critically Endangered under subcriteria A2b and B1.

Criterion A CR

Summary

The analysis of the remotely-sensed data revealed that the sand plain of Burullus wetland has undergone dramatic changes over time between 1973 and 2016. The changes resulted in an annual decline rate of 98.45 ha per year, causing the sand plain to reach 4,005 ha in 2016. Extrapolation of data for 50 years projected a rate of decline of 95.5%. The outcomes of these analyses showed that the overall state of the ecosystem can be considered as Critically Endangered (CR) under subcriterion A2b.

Risk Category CR

Subcriterion	Category	Justification

A1	DD	No reliable information is available to assess the decline of the geographic distribution of the ecosystem in the past 50 years. Thus, it is classified as Data Deficient under subcriterion A1. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: Unknown
A2a	DD	No reliable information is available to assess the decline of the geographic distribution of the ecosystem in the next 50 years. Thus, it is classified as Data Deficient under subcriterion A2a. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: Unknown
A2b	CR	The analysis of the remotely-sensed data revealed that the sand plain of Burullus wetland has undergone dramatic changes over time between 1973 and 2016. The changes resulted in an annual decline rate of 98.45 ha per year, causing the sand plain to reach 4,005 ha in 2016. An estimate of the decline in the distribution of sand plain ecosystem over the three-time frames revealed that in the first period from 1973 to 2014 the area of sand plain has increased from 8,238.6 ha to 9,173.3 ha. In the second period from 1978 to 2015 the area of sand plain ecosystem decreased from 10,648.2 ha to 6,637.8 ha with an annual decline of 1.26%. Assuming this rate was constant for 50 year period, extrapolation produced an estimate of 47.2% decline in the area. However, in the third period from 2003 to 2016, the area of sand plain decreased from 8,980 to 4,005 ha. This resulted in an annual current decline of 6.02%. Extrapolation of data for 50 years projected a rate of decline of 95.5%. The outcomes of these analyses showed that the overall state of the ecosystem can be considered as Critically Endangered under subcriterion A2b. **Key Indicators in detail** Evidence of Continuing Decline: Decreasing Evidence of Threatening Processes: Yes **Indicator Variable:** Decline in distribution Extent (%): 95.5 Mapped distribution Year: 2016 Mapped distribution (ha): 4005
A3	DD	No reliable information is available to assess the decline of the geographic distribution of the ecosystem historically. Thus, it is classified as Data Deficient under subcriterion A3. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: Unknown

Criterion B CR

Summary

A minimum convex polygon enclosing all mapped occurrences of sand plain ecosystem has an area of 278 km2. Superimposing a 10×10 km grid over the mapped polygons of sand plain ecosystem showed that the ecosystem was occupied by 7 grid cells, of these only 4 grid cells contain more than 1% of the ecosystem. The ecosystem of sand plain is facing threats from human activities and stochastic events that can drive the ecosystem to be Critically Endangered in the future. Therefore, the ecosystem is classified as Critically Endangered (CR) under subcriterion B1.

Risk Category CR

Subcriterion	**Category**	**Justification**

B1 CR

A minimum convex polygon enclosing all mapped occurrences of the sand plain ecosystem has an area of 278 km2. Consequently, the status of the sand plain ecosystem under subcriterion B1 is Critically Endangered (CR).

Key Indicators in detail

Number of Threat-defined Locations: less than 5
Evidence of Continuing Decline: Decreasing
Evidence of Threatening Processes: Yes

Indicator Variable: EOO

Mapped distribution
Year: 2016
Mapped distribution (km2): 278

Indicator Variable: EOO

Mapped distribution
Year: 2016
Mapped distribution (km2): 278

B2 EN

Superimposing a 10×10 km grid over the mapped polygons of the sand plain ecosystem showed that the ecosystem was occupied by 7 grid cells, of these only 4 grid cells contain more than 1% of the ecosystem. This indicated that the ecosystem can be assessed as Endangered (EN) under subcriterion B2.

Key Indicators in detail

Number of Threat-defined Locations: less than 5
Evidence of Continuing Decline: Decreasing
Evidence of Threatening Processes: Yes

Indicator Variable: AOO

Year: 2016
Mapped distribution (10x10 km grid cells): 4

Indicator Variable: AOO

Mapped distribution
Year: 2016
Mapped distribution (10x10 km grid cells): 4

B3 VU

The ecosystem of the sand plain is facing threats from human activities and stochastic events that can drive the ecosystem to be Critically Endangered in the future. Thus, the state of the sand plain ecosystem can be declared as Vulnerable (VU) under subcriterion B3.

Key Indicators in detail

Number of Threat-defined Locations: less than 5
Evidence of Continuing Decline: Decreasing
Evidence of Threatening Processes: Yes

Criterion C DD

Rationale

No reliable information is available to assess the environmental degradation of the ecosystem. Thus, it is classified as Data Deficient under criterion C.

Risk Category DD

Subcriterion	Category	Justification
C1	DD	No reliable information is available to assess the environmental degradation of the ecosystem in the past 50 years. Thus, it is classified as Data Deficient under subcriterion C1. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: Unknown
C2a	DD	No reliable information is available to assess the environmental degradation of the ecosystem in the next 50 years. Thus, it is classified as Data Deficient under subcriterion C2a. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: Unknown
C2b	DD	No reliable information is available to assess the environmental degradation of the ecosystem in a 50-year period. Thus, it is classified as Data Deficient under subcriterion C2b. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: Unknown
C3	DD	No reliable information is available to assess the environmental degradation of the ecosystem historically. Thus, it is classified as Data Deficient under subcriterion C3. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: Unknown

Criterion D NT

Summary

The field investigation of the sand plain habitat resulted in the identification of 59 plant species. This number is lower than what was recorded by Shaltout et al. (1995) and Galal and Fawzy (2007). Five invasive species were documented in the ecosystem, representing 8.5% of the total species recorded, this number of invasive species in the region is higher compared to the previous records. A trend of decline in the floristic quality of the sand plain over time was observed for both floristic quality indices, the FQAI and Adjusted FQAI. The current floristic composition attained the lowest value of the Adjusted FQAI, while the highest value (77.03) was obtained by the floristic composition of the earlier investigation by Zahran et al. (1990) in which they have no records of non-native species. A trend of decline in the floristic quality of the ecosystem can be observed over time as revealed by the values of Adjusted FQAI. Results of relative severity estimation revealed that the % severity of adjusted FQAI of sand plain is 20%, which indicates that the ecosystem can be considered as Near Threatened (NT) under subcriterion D1.

Risk Category NT

Subcriterion	Category	Justification
D1	NT	The field investigation of the sand plain habitat resulted in the identification of 59 plant species. This number is lower than what was recorded by Shaltout et al. (1995) and Galal and Fawzy (2007). Five invasive species were documented in the ecosystem, representing 8.5% of the total species recorded. The recorded invasive species are namely Amaranthus hybridus L., Enarthrocarpus hydratus (Forssk) DC., Ricinus communis L., Speratularia rubra (L.) J. and C. presl and Trifolium alexandrinum L. The recorded number of invasive species in the region is higher compared to the previous records. The floristic quality assessment revealed that the mean coefficient of conservatism C-value of 4.9 obtained from the current investigations was the lowest compared to the values assessed for the ecosystems based on the previously

recorded species composition, which ranged from 5.2 to 5.7. A trend of decline in the floristic quality of the sand plain over time was observed for both floristic quality indices, the FQAI and Adjusted FQAI. The variation between the FQAI and Adjusted FQAI is because the FQAI is sensitive to the number of non-native species recorded in the investigated ecosystems. The current floristic composition attained the lowest value of the Adjusted FQAI, while the highest value (77.03) was obtained by the floristic composition of the earlier investigation by Zahran et al. (1990) in which they have no records of non-native species. A trend of decline in the floristic quality of the ecosystem can be observed over time as revealed by the values of Adjusted FQAI. Results of relative severity estimation revealed that the % severity of adjusted FQAI of sand plain is 20%, which indicates that the ecosystem can be considered as Near Threatened (NT) under subcriterion D1.

Key Indicators in detail

Evidence of Continuing Decline: Unknown
Evidence of Threatening Processes: Unknown

Indicator Variable: Floristic quality indices

Extent (%): 100
Relative Severity (%): 20

D2a DD

No reliable information is available to assess the disruption of biotic processes or interactions in the ecosystem in the next 50 years. Thus, it is classified as Data Deficient under subcriterion D2a.

Key Indicators in detail

Evidence of Continuing Decline: Unknown
Evidence of Threatening Processes: Unknown

D2b DD

No reliable information is available to assess the disruption of biotic processes or interactions in the ecosystem in a 50-year period. Thus, it is classified as Data Deficient under subcriterion D2b.

Key Indicators in detail

Evidence of Continuing Decline: Unknown
Evidence of Threatening Processes: Unknown

D3 DD

No reliable information is available to assess the disruption of biotic processes or interactions in the ecosystem historically. Thus, it is classified as Data Deficient under subcriterion D3.

Key Indicators in detail

Evidence of Continuing Decline: Unknown
Evidence of Threatening Processes: Unknown

Criterion E NE

Rationale

This criterion was not assessed.

Risk Category NE

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