JOURNAL OF MARINE SCIENCES & ENVIRONMENTAL TECHNOLOGIES
Vol. 2, Issue No.1 (June-2016)

ISSN: 2413-5267

Ecological Studies on The Vegetation of Sand Bar of Lake Burollos Protectorate and Effect of Salinity on Some Developing Species

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دراسات بيئية على الغطاء النباتي بالحاجز الرملي لمحمية بحيرة البرلس وتأثير الملوحة على بعض الأنواع النامية

عادل الورفلي وابتسام دومه

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Abstract

Plant communities of Lake Burollos sand bar were analyzed using 30 stands (each 5×5 *m*) representing the different habitats by multivariate analysis. Four vegetation groups were identified using TWINSPAN analysis. These groups represent the main habitats recognized in the sand bar; *Group A* represents stabilized sand dunes and indicated by *Pancratium maritimum* L., and *Cyperus capitatus* Burm F.; *Group B* of sand flat and mobile dunes with *Alhagi Gracorum* Boiss, and *Elymus Farctus* Viv as indicator species; *Group C* represents the salt marsh habitat with the indicator species *Arthrocnemum Macrostachyum* Moric. K., and *Juncus Rigidus* Desf; Young fore-dunes are represented by *group D* and the indicator species *Cakile Maritime* Scop. These groups are separated mainly on the basis of soil salinity, and age of sand dune formations along CCA-axis 1 and 2, respectively. The first axis of CCA separates halophytic species from psammophytes along soil salinity, organic carbon and calcium carbonates gradients. The behavior of each species against the environmental severity and its relative importance in sand bar stabilization is explained. Responses of seed germination to salinity were examined musing 12 species collected from salt marshes stable dunes and fore dunes along sand bar of Lake Burollos. Six concentrations of salt were added to plant grown in pots supported by nonabsorbent foam growth rate and the percentage of living material were measured. Also, a SWOT analysis will give more information to identify the key internal and external factors that are important to conservation of plants in the Lake Burollos Protectorate Area.

Keywords: *Burollos Protectorate; Mediterranean coast; Salt marshes; Sand dunes.*

الملخص

تم تحليل الكساء النباتي على الحاجز الرملي باستخدام ثلاثون موقعاً (5م×5م) كما تم تحليل البيانات باستخدام برامج التصنيف والتسلسل حيث أمكن التعرف على أربعة مجموعات نباتيه: المجموعة (A) كانت ممثله للكثبان الرملية الثابتة، والتي يسودها نبات بصل النرجس ونبات السعد الرملي. المجموعة (B) كانت ممثله للكثبان الرملية المتحركة، والمصاطب الرملية، ويسودها نبات الجازوف ونبات العاقول. المجموعة (C) كانت ممثله للسبخات الملحية، ويسودها نباتات الحطب الأحمر ونبات السمار المر. المجموعة (D) تمثل التكوينات الرملية الحديثة، ويسودها نبات صاروخ البحر. تبين من الدراسة وجود ارتباط قوي بين عوامل التربة، وتوزيع الكساء النباتي على الحاجز الرملي، وكانت أهم العوامل: ملوحة التربة وكربونات الكالسيوم والكربون

العضوي، كما أعطت بعض العوامل دلاله قوية على أهمية النباتات في حماية البحيرة من المد البحري. تم فحص استجابة إنبات البذور للملوحة لـ 12 نوعاً من النباتات تم جمعها من البيئات المختلفة والتي تمثل المستنقعات المالحة، والكثبان المستقرة، وكذلك الكثبان الرملية الساحلية على طول الشريط الرملي لمحمية بحيرة البرلس. تم معاملة الأنواع النباتية باستخدام ستة تراكيز مختلفة من تراكيز كلوريد الصوديوم حيث تم قياس معدل النمو النسبي للأنواع، وكذلك قياس كتلة المادة الحية. معظم الأنواع المختارة استجابة، ولم تتأثر بصوره كبيره للتراكيز المختلفة للملوحة، حيث إن توزيع مثل هذه الأنواع هو أساسا مرتبط بالبيئات المالحة. من خلال الدراسة تم تحليل الروابط بين أصحاب المصلحة في المحمية، ومدي تأثيرهم على حاله الغطاء النباتي كما تم تقييم نقاط القوة والضعف والفرص والتهديدات التي تواجه عمليات الحماية، والإدارة المختلفة للغطاء النباتي كما بالمنطقة.

الكلمات الدلالية: *محمية البرلس، ساحل البحر الأبيض المتوسط، سبخة ملحية، الكثبان الرملية.*

1. Introduction

The coastline in the Arab countries extends 19,758 *km*, 9,456 *km* in the Asian Arab countries and 10,302 *km* in the African Arab countries. This represents huge resources for these countries. The population in the coastal urban agglomerations in the Arab countries was 23,507,000 in the 1980s, and is expected to rise to 52,159,000 in the year 2000 (World Resources, 1994-95). Population growth will continue to threaten the fragile coastal areas. The environmental impact of demographic pressure in the coastal ecosystems is exacerbated by land use policies and infrastructure development.

In Egypt the coastline is 2,450 *km* long. The population in the coastal urban agglomerations was 4,246,000 in the 1980s and was expected to increase to 8,020,000 in the year 2000 (World Resources, 1994-95). The coastal land is subjected to innumerable human activities, with drastic impacts on all the components of the environment. The Mediterranean coast of Egypt extends over about 900 *km*, the major part of it is ordered by sand dunes of different nature and type. A great part of the coastal dunes, has been destroyed, this is due to the continuous construction of summer resort villages (El Hadidi and Hosni, 2000). The consequences of the human activities in the area are numerous. These include impacts on the soil, water resources, the flora and the fauna, migrating birds, trends of the indigenous people, and the cultural environment (Mashaly, 1987; Zahran and Willis, 1992; Ayyad and Fakhry, 1994; and Okasha *et al*., 2013).

The sand dunes represent a particular landscape with special characteristics and features, and consequently plants with particular attributes. In the eastern part of Lake Burollos a belt of sand dunes has developed immediately south of the shore and these dunes may rise up to 10 *m* in height and extend about 0.5-1.5 *km* inland from the shore. These dunes are famous as a habitat for the fig (*Ficus carica* L.) cultivation depending on the irregular rainfall. They also represent a landing station and a cross-road for birds such as quail migrating from Europe in the north. In the past, summer resort areas were confined to limited areas with few people, these same areas support the growth of some important plant species, for example, sand binders, medicinal and range plants (Batanouny, 1999). For more than two decades, there has been considerable changes in the sand bar such as the creation of new high way, which join the whole Mediterranean coast of Egypt. One of the consequences of this change is that a great

ISSN: 2413-5267

part of the coastal dune has been subjected to destruction, due to the continuous construction of fishermen villages and land reclamation for agricultural purposes. These changes cause destruction of the natural vegetation and their habitats. The area already covered by the dunes is now almost occupied by new buildings gardens and other infra-structure (Batanouny, 1999). The consequences of these human activities are numerous and include impacts on the soil, water resources, flora and fauna, migrating birds, trends of the indigenous people, and the cultural environment.

The present paper gives a concise environmental setting of the sand bar of Lake Burollos, and the role of plant communities in stabilizing the sand bar which protect the lake from the sea water. The ecological consequences of the recent human activities.

2. Materials and Methods

2.1. Study Area

Lake Burollos is the second-largest natural lake in Egypt, located in the central part of the northern section of the Nile Delta. It is a shallow slightly brackish water lake situated along the Mediterranean Sea coast; it lies between Longitude 30° 30- and 31° 10- E and latitude 31° 21-and 31° 35-N. The length of the lake is about 65 *km*. and its width varies between 6 and 16 *km*, with an average of about 11 *km* as shown in Figure (1).

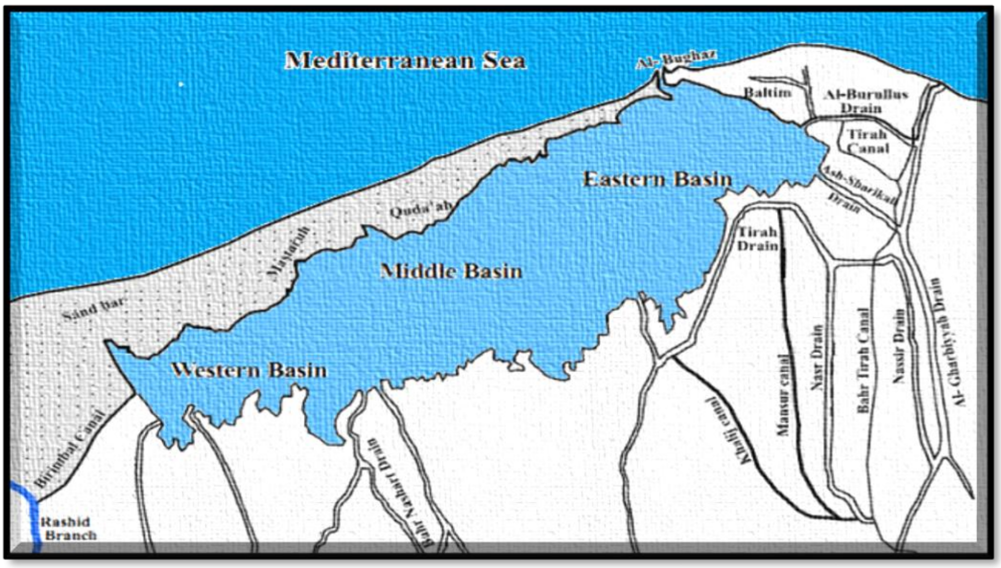

Figure 1. Map of Lake Burollos showing the studied sand bar between the lake and the Mediterranean Sea

Marine bar or sand bar of Lake Burollos is the zone that separates the Mediterranean coast in the north from the lake shore in the south. It covers an area of about 165 km^2. The sand bar has different geomorphological features that had been formed up on it as a result of the evolution and development of the geomorphological processes. Some of these features are related to sedimentation process such as sand flats, sand dunes and sand hillocks; and some others were due to change of sea level such as salt marshes and tidal flats (Shaltout and Khalil, 2005).

2.2. Vegetation Analysis

A total of 30 stands (5×5 *m*) were surveyed on sand bar, the northern shoreline of Lake Burollos. Each stand was homogenous in vegetation structure in different habitats (e.g. sabkhahs, dune-base, interdune, dune-top). In each stand, perennial and annual plant species were recorded.

The cover value of each species was estimated with the modified line-intercept method (Etchberger and Krausman, 1997). The relative cover of each species was calculated. The cover data were transformed using ordinal transformation (Van der Maarel, 1979). Taxonomic nomenclature follows (Täckholm, 1974) revised by (Boulos, 1999 and 2009).

2.3. Soil Analysis

In each stand, three soil samples were collected to 30 *cm* depth, packed in plastic bags and transported to the laboratory. The samples were air dried, thoroughly mixed to form one composite sample and passed through 2-*mm* sieve to remove debris and gravel. Soil texture, moisture content and calcium carbonates were determined following the procedures of the United States Salinity Laboratory Staff (Anon, 1954; and Jackson, 1962). Oxidizable organic carbon was determined using the Walkely and Black rapid titration (Black, 1965). Soil pH and electrical conductivity (EC) were determined in 1:5 soil extract (100 *g* soil dissolved in 500 *ml* distilled water and manually shaken for 2 *hrs*) using a digital pH-meter (model 5995) and YSI conductivity meter (model 35), respectively. From the soil extracts the following anions were determined by titration: Cl^- and HCO_3^-. The *N*-total was determined using the micro-Kjeldahl method. Total phosphorus was determined by the method adopted by the American Public Health Association (1992). Na^+, Ca^{++}, and K^+ were determined using a flame photometer type M7D according to (Allen *et al*., 1974).

2.4. Data Analysis

TWINSPAN (Two-Way Indicator Species Analysis) was applied to the cover estimates of plant species in 30 stands (Hill, 1979). The aim of using TWINSPAN was to distinguish between different plant communities based on the dominance of each species, a criterion which has been used by many researchers in arid and semi-arid environments (e.g. Fossati *et al*., 1999). We used Canonical Correspondence Analysis (CCA) ordination which is weighted averaging ordination techniques whose performance is best when the species have a unimodal response to the environmental gradients (species-axis>4 SD-units). In DCA the environmental variables are correlated with the axes after the ordination procedure, whereas in CCA the axes are constrained by the environmental variables (Ter Braak, 1987).

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2.5. Effect of Salinity on Seed Germination on Selected Species from Sand Bar of Lake Burollos

2.5.1. Seed Collection

The species selected were representative of coastal habitats which are frequently affected by salt spray and sand burial. Seeds of most of the species were self-hand harvested.

2.5.2. Seed Viability

The presence of white, healthy and intact embryo was determined through the cut test method. Viability was evaluated from three replicates of 30 seeds each and only species with seed viability higher than 15% were used in the experiment. Although initially 25 selected species were examined, only 12 had the acceptable viability and minimum germination values applicable for the experiment. Minimum germination was set at >5%.

2.5.3. Seed Germination and Salinity

Twelve species were grown in nurse water culture before being transferred for the experiment to ¼ strength Hoagland solution, in petri dishes. Six individual plants were placed in each pot, supported by non-absorbent foam. Each pot of the six plants represented one harvest and was carefully matched in plant size and vigor with all other treatments and harvests for that species. There were three replicates set in randomized block design. All species were grown in salinity (*NaCl*) concentration of 1%, 0.75%, 0.50%, 0.25%, and control (0%), plus either 2% and 1.5% for the halophytic species e.g. *Arthrocnemum macrostachyum* Moric.K, *Halocnemum strobilaceum* M. Bieb , *Juncus acutus* L., *J. rigidus* Desf, *Atriplex halimus* L, *A. leucoclada* Boiss, *A. portulacoides* L. The Lab was lit by an extra 32 $W.m^{-2}$ light intensity. Temperature exceeded 20 ^{o}C during March-April, 2013.

A first harvest of the whole pot was taken after 30 *days* and a second 60 *days* later. Longer periods of continuous salinity have had different effects. At each harvest, plants were removed from their pots, rinsed and oven dried at 80 ^{o}C for 48 *hrs.* The results were calculated on mean weight per plant. The salinity gradient of the established strategy of the studied species was compared with their regenerative phase.

3. Results

Forty perennial plant species were recorded, some of them have high cover values from the salt marsh habitat to the stabilized sand dunes of the sand bar of Lake Burollos (e.g. *A. macrostachyum* Moric. K, *Z. aegyptium* Hosny and *A. graecorum* Boiss), while others are restricted to either sides of the high way road or wet ends of this gradient (e.g. *Atriplex halimus* L, *T. hirsute* Endl and *Phragmites australis* (Cav). Steud). On the other hand, there is a gradient along the sand bar where the vegetation showed a clear response to salinity. The preliminary reconnaissance of sand bar of Lake Burollos shows five major habitat types are: salt marshes, sand flats, mobile dunes, stabilized dunes, and aquatic habitats.

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3.1. Multivariate Analysis

3.1.1. Classification

The dendrogram shown in Figure (2) resulting from TWINSPAN analysis produced four vegetation groups. Each group comprises a set of stands with great homogeneity of vegetation.

Group A is indicated by *Cyperus capitatus* Burm. f, and *Pancratium maritimum* L. Field studies indicate that these species dominate the stabilized dunes. Other important species are *Plantago squrrosa* Murray and *Salsola kali* L are growing on the peripheral edge of the stabilized dunes.

Group B is indicated by *Elymus farctus* Viv and *Alhagi graecorum* Boiss in the eastern and middle sections of the sand bar on mobile dunes and sand flats habitats.

Group C is indicated by *Arthrocnemum macrostachyum* Moric.K and *Juncus rigidus* Desf. These species dominate wet saline habitat of the sand bar. The most common associated species are mainly halophytes such as H*alocnemum strobilaceum* M.Bieb, *Atriplex halimus* L and *Phragmites australis* (Cav). Steud.

Group D is indicated by *Cakile maritma* Scop. This species dominates beach and fore dunes.

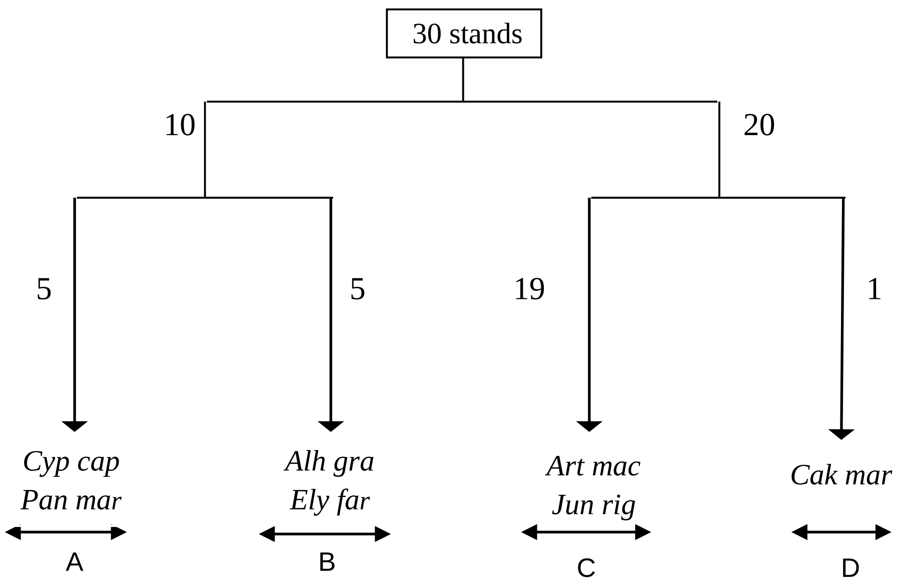

Figure 2. TWINSPAN dendrogram of 30 stands based on cover values of plant species on sand bar of Lake Burollos. The indicator species of each group are shown. Species names are abbreviated to the first three letters of genus and species names, respectively. For complete species names see Table (1).

3.1.2 Ordination

The ordination diagram provided by the first two axes of canonical correspondence analysis ordination is shown in Figure (3). This diagram displays the species-environment

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relationships, and consisted of species which are represented by points and environmental variables which are represented by arrows. The angle between an arrow and each axis is a reflection of its degree of correlation with the axis. Thus, the soil variables (e.g. EC, Cl^-, Na^+, and clay) are highly correlated with axis 1. In addition, the CCA axis 2 showed high correlation with soil variables such as *P* and pH. The axis 1 displays 17.5%, while axis 2 accounts for 15.1% of the variance in the species-environment biplot (Table.2).

Table 1. Relative cover values of perennial species recorded in the four vegetation groups recognized along sand bar of Lake Burollos

Species	***Groups***			
	A	***B***	***C***	***D***
Alhagi graecorum Boiss.	26.5	**27**	22.5	0
Arthrocnemum macrostachyum Moric.K.	0	0	**25**	0
Astragalus subsessilis Boiss.	0	0	5	0
Atriplex halimus L.	0	0	19	0
Atriplex leucoclada Boiss.	0	0	50	0
Atriplex portulacoides L.	0	0	0	0
Bassia indica Wight.	0	0	22.5	0
Bromus catharticus Vahl.	0	10	5	0
Cakile maritime Scop.	0	0	30	**55**
Calligonum polygonoides L.	0	0	0	5
Centaurea calcitrapa L.	0	10	30	2
Conyza Canadensis L. Cronquist	5	0	0	0
Cressa cretica L.	10	0	0	0
Cynanchum acutum L.	0	10	14.2	0
Cynodon dactylon L. Pers.	10	10	7.5	0
Cyperus capitatus Burn.f.	**40**	8.8	0	0
Echinops spinosissimus Freyn.	0	5	0	0
Echium sericeum Vahl.	0	10	0	0
Elymus farctus Viv.	0	**55**	22	0
Halocnemum strobilaceum M.B.ieb.	0	0	46.7	0
Heliotropium curassavicum L.	0	0	30	0
Inula crithmoides L	0	10	21.3	0
Juncus acutus L.	0	0	17.5	0
Juncus rigidus Desf.	0	0	**32.5**	0
Lycium shawii Roem.	7.5	0	0	0
Mesembryanthemum crystallinum L.	10	0	5	0

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Moltkiopsis ciliate (Forssk.) I. M. Johnston.	0	0	0	10
Najas marina L.	0	60	10	0
Pancratium maritimum L.	**24**	0	0	0
Paspalidium geminatum Forssk.	0	0	10	0
Phragmites australis (Cav) Steud.	35	0	28	0
Plantago squarrosa Murray.	35	0	0	5
Polygonum equisetiforme SM.	0	0	20	0
Salsola kali L.	17	0	28	0
Senecio desfontanii L.	0	0	10	0
Spergularia marina Besser.	0	0	5	0
Suaeda maritime L.	0	0	23.8	0
Tamarix nilotica (Ehrenb) Bunge.	0	0	35	0
Thymelaea hirsute Endl.	0	40	0	0
Zygophyllum aegyptium Hosny.	0	10	12.5	5

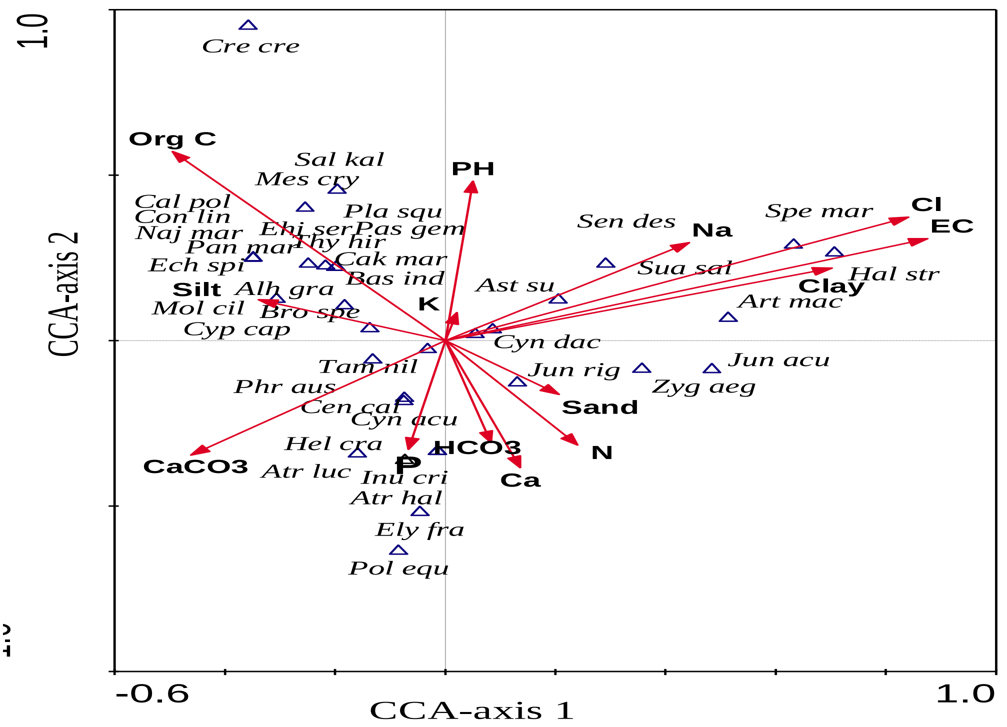

Figure 3. CCA-ordination diagram with 14 soil factors represented by arrows and plant species represented by points. Species names are abbreviated to the first three letters of genus and species names respectively. For complete species names see Table 1.

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Table 2. Canonical correspondence analysis of 30 stands alongside the sand bar of Lake Burollos. Eigenvalues, species-environment correlation (*r*, *S/E*), percentage of species variance accounted for by first 4 axes.

Data	Axis			
	1	2	3	4
Eigen values	0.64	0.55	0.46	0.41
% of species variance	17.5	15.1	13.61	11.3
r (S/E)	0.93	0.92	0.91	0.94

The CCA-biplot shown in Figure (3) showed that the halophytic species (*A. macrostachyum* Moric.K, *Halocnemum strobilaceum* M. Bieb and *Suaeda salsa* L) occupying the top right side of the diagram. These species occur in saline habitats with high Na^{+}, Cl^{-}, EC and clay in the soil. Similar comparisons make it clear that the psammophytic species e.g. *Elymus* farctus Viv, *Polygonum equsiteforme* Sm, *Cyperus capitatus* Burm. f and *Pancratium maritimum* L are highly correlated along the gradient of $CaCO_3$, Ca^{2+} and phosphorus in the soil. *Calligonum polygnoides* L and *Cressa cretica* L are highly correlated along the gradient of organic carbon in the soil in the top left side of the diagram. *Juncus rigidus* Desf and *Tamarix nilotica* (Ehrenb) Bunge occur in habitats with intermediate gradient of the studied soil variables.

The eigenvalues of the first four axes of the canonical correspondence analysis are presented in Table (2). These values were clearly decreased and suggested a well-structured data set. This gives an idea of the stability of the ordination. The first three axes explain 46.21% of the species variance in the data set. The eigenvalues are much better measure of the quality of the ordination and of the strength of the species-environment relationship than so-called species-environment correlation.

3.1.3. Soil Variables

There is a significant correlation between the studied soil variables supporting the growth of the studied plant species. Clay showed highly significant positive relationship with EC, Cl^{-} ($P<0.001$), K^{+}, pH (<0.01) and organic carbon ($P<0.05$); a highly significant negative correlation was found between clay and $CaCO_3$ ($P< 0.001$) and phosphorus ($P<0.01$). Organic carbon content the soil showed significant negative correlation with nitrogen ($P<0.001$) and Ca^{2+} ($P< 0.01$); and significant positive correlation with silt ($P<0.05$).

3.2. Effect of Salinity on Coastal Plant (Relative Growth Rate (RGR) and Biomass)

Glycophyte has been defined as a plant that com tolerate up to 0.5% *NaCl* and halophyte as a plant that can tolerate greater than 0.5% *NaCl* at any stage of life cycle. There was a general decrease in RGR with increased salinity as shown in Table (3) and Figure (4) though species differed significantly ($P<0.05$) in their response. The percentage of Living material shown in Table (4) and Figure (5) generally decreases with increasing salinity, though species differed in their response.

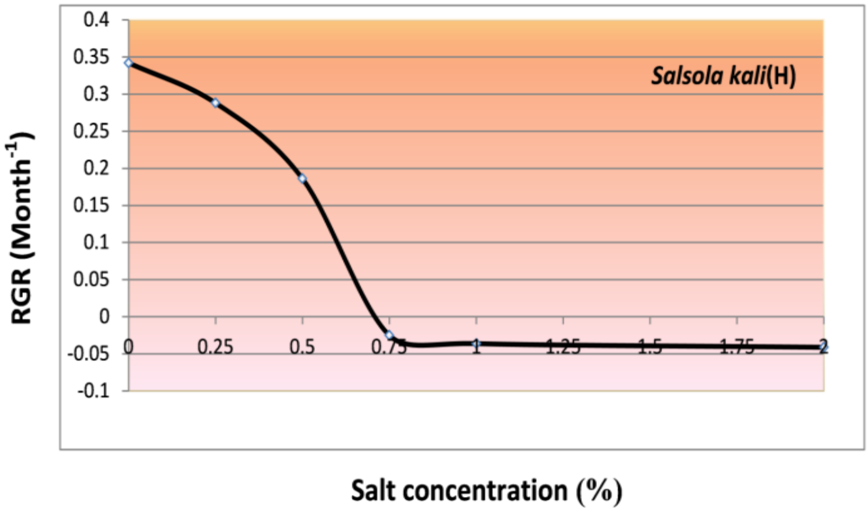

Figure 4. Effect of salinity on relative growth rate (RGR, *Month*$^{-1}$)

Table 3. Effect of salinity on relative growth rate (RGR, *Month*$^{-1}$) of some sand bar species of Lake Burollos. Salinity with the same letter of same species have a RGR which is not significantly different ($P<0.05$).

Species	***Salt concentration (%)***					
	0.00	**0.25**	**0.50**	**0.75**	**1.00**	**2.00**
Alhagi graecorum (H)	0.401^{a}	0.432^{a}	0.372^{a}	0.236^{b}	0.209^{b}	0.181^{b}
Arthrocnemum macrostachyum (H)	0.562^{a}	0.611^{a}	0.753^{a}	0.482^{b}	0.411^{b}	0.381^{b}
Atriplex halimus (H)	0.601^{a}	0.732^{a}	0.542^{a}	0.511^{a}	0.430^{b}	0.311^{b}
Atriplex portulacoides (H)	0.713^{a}	0.841^{a}	0.843^{a}	0.614^{b}	0.312^{b}	0.301^{b}
Bassia indica (H)	0.314^{a}	0.307^{a}	0.352^{a}	0.216^{a}	0.231^{a}	0.202^{a}
Cynanchum acutum (M)	0.231^{a}	0.254^{a}	0.236^{a}	0.198^{a}	0.113^{a}	0.112^{a}
Elymus farctus (P)	0.213^{a}	0.278^{a}	0.291^{a}	0.314^{a}	0.153^{b}	-0.092^{c}
Inula crithmoides (H)	0.222^{a}	0.314^{a}	0.231^{a}	-0.114^{b}	-0.091^{b}	-0.008^{c}
Juncus rigidus (H)	0.493^{a}	0.467^{a}	0.381^{a}	0.261^{b}	0.287^{b}	0.187^{b}
Pancratium maritimum (P)	0.031^{b}	0.113^{a}	0.084^{b}	-0.093^{b}	-0.051^{b}	-0.006^{b}
Salsola kali (H)	0.342^{a}	0.288^{a}	0.186^{a}	-0.025^{b}	-0.036^{b}	-0.041^{b}
Zygophyllum aegyptium (H)	0.426^{a}	0.415^{a}	0.382^{a}	0.371^{a}	0.235^{b}	0.211^{b}

H= halophyte, P= psammphyte, M= mesophyte

ISSN: 2413-5267

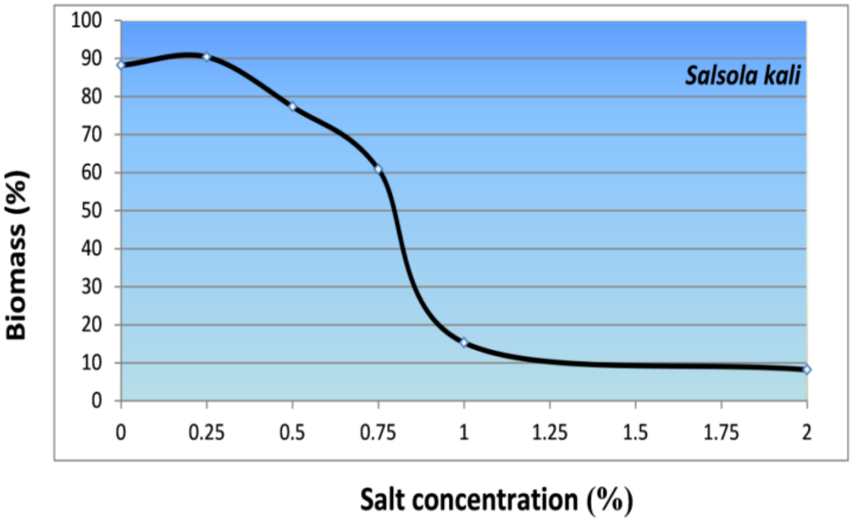

Figure 5. Biomass (Living material) weight as a percentage of the total plant weight

Table 4: Biomass (Living material) weight as a percentage of the total plant weight in some plant species common to sand bar of Lake Burollos

Species	***Salt concentration (%)***					
	0.00	**0.25**	**0.50**	**0.75**	**1.00**	**2.00**
Alhagi graecorum	71.2	76.4	63.2	15.4	12.1	10.2
Arthrocnemum macrostachyum	93.6	92.5	83.4	60.1	40.8	40.2
Atriplex halimus	95.6	94.2	91.3	82.1	42.9	12.4
Atriplex portulacoides	98.1	96.3	88.4	56.8	57.3	40.6
Bassia indica	88.2	76.5	50.4	50.2	38.4	30.1
Cynanchum acutum	89.1	76.2	62.3	18.1	15.2	10.0
Elymus farctus	81.3	83.4	89.2	83.1	74.3	2.5
Inula crithmoides	78.6	70.4	55.3	20.9	15.8	7.5
Juncus rigidus	96.5	94.8	92.3	91.9	85.8	81.4
Pancratium maritimum	91.8	83.5	79.1	5.2	0.0	0.0
Salsola kali	88.2	90.4	77.3	60.9	15.3	8.2
Zygophyllum aegyptium	91.7	89.2	92.3	90.2	76.1	50.1

The most important factor for long-term survival is RGR this character is typical for dune plants which are affected by increasing salinity. For example, *Pancratium maritimum* L can't tolerate salinity above 0.5%. *Elymus farctus*is Viv a pioneer of sand dune and can tolerate salinity up to 1.0%, with live material 74.3%. Both *Cynanchum acutum* L and *Bassia indica* Wight showed no significant variation in the RGR with in the salinity Rage in the study. The Results of this confirm the halophytic status of most species growing on sand bar of Lake Burollos. The most salt tolerate species are *Arthrocnemum macrostachyum* Moric. K, *Atriplex halimus* L, *Atriplex portulacoides* L, *Juncus rigidus* Desf, *Juncus acutus* L, and *Zygophyllum aegyptium* Hosny (Table.3) in all of there, plants survived in 2% salt. Both *Inula crithmoides* L and *Salsola kali* L showed reduced growth after 0.5% salinity which indicates their glycophytic nature.

3.3. SWOT Analysis

SWOT analysis has its origins in the 1960s. The analysis aims to identify the strengths and weaknesses of a vegetation cover in Lake Burollos Protectorate Area and the opportunities and threats in the environment as shown in Table (5). Also a SWOT analysis will give more information to identify the key internal and external factors that are important to conservation of plants in Lake Burollos Protectorate Area

Table 5. SWOT analysis for vegetation of Lake Burollos Protectorate Area

Element		*Positive*		*Negative*
		Strengths		**Weaknesses**
Internal	1	Possibility of enforce the rules of the protected area.	1	A lack of funding for the upkeep and maintenance of vehicles and equipment.
	2	The relations with main stakeholders.		
	3	Availability of a preliminary "master plan" in order to protect of vegetation cover.	2	Shortage of botanist researchers in Lake Burollos Protectorate Area.
			3	Shortage of awareness and education programs to local community and economic activities owners.
		Opportunities		**Threats**
External	1	Law 102/1983 for protected areas and 9/2009 for Environment.	1	Decreasing of water level due to Lack of water coming to the lakes.
	2	Designated the area by Ramsar as Wetland of International importance.	2	Overusing of lakes water.
	3	Identified the area asone of Twenty IPAs in Egypt.	3	Infringements at natural areas and habitat destruction
	4	Implement community awareness / education programs to promote the unique environmental qualities	4	The negative human impacts such as overgrazing, unsustainable tourism, pollution, Fires of common reed.
	5	Possibility of establish a zonation system to protect the vegetation cover.	5	Climate Change: Climate change is increasingly becoming a threat to biodiversity.

4. Discussion

Kershaw and Looney (1985) stressed the importance of a comprehensive description of vegetation, to build a mental picture of an area and its vegetation and to allow a comparison as

ISSN: 2413-5267

well as the ultimate classification of different vegetation units. Modern synecological studies have preferred a more objective methodology for use at a local and sometimes regional scale. These have sought to reduce the complexity of a set of field data either by classification and/or ordination based on floristic data. The results of vegetation analyses have then been related to environmental data. Alternatively, vegetation-habitat relationships have been derived from a single analysis of combined floristic and environmental variables (Ter Braak, 1987). The classification of the natural vegetation of Lake Burollos sand bar by using TWINSPAN analysis identified four distinct vegetation groups each is defined by one or more indicator species. Most of these species are reported in similar habitats in the Mediterranean coast of Egypt (Zahran *et al*., 1989; Zahran and Willis, 1992; Ayyad *et al*., 1993; and Zahran *et al*., 1994). Such studies have shown similar distribution pattern of the dominant species in our study.

The ordination analysis is used to recognize the relationship between the species composition and the underlying environmental factors. Many studies assert that a few gradients often comprising simple factors are responsible for the variation in distribution of population of the species (Zahran *et al*., 1990; and Ter Braak, 1994). In the present study the CCA ordination diagram shown in Figure (3) indicated that the abundance of halophytic vegetation is confined to sites of relatively high salinity. *A. macrostachyum* Moric.K and *J. rigidus* Desf occupy the highest position along the soil salinity gradient. This is confirmed by their wide distribution in the northern lakes of Egypt (Khedr, 1989; and Shaltout *et al*., 1995). The analysis of the relationships between variations in vegetation composition and those in soil variables indicated that the distribution of psammophytic vegetation (e.g. *C. polygonoides* L, *P. maritimum* L, and *Echinops spinosissimus*) Freyn is mainly controlled by calcium carbonates and organic matter in the soil. *Z. aegyptium* Hosny, *J. rigidus* Desf and *J. acutus* L are correlated along the gradients of nitrogen in the soil.

The results presented suggest a possible zonal distribution of species in relation to the prevailing environmental factors. There will always be areas which will need to restore plants, especially in the degraded area of settlements and other human impacts.

The sand bar of Lake Burollos includes several types of sand formations (sand flats, sand hillocks, and sand dunes), as well as wet and dry salt mash habitats. It has high species diversity, coupled with high phytomass; and in some places with rain fed agriculture, settlements and other human impacts. Some parts of the sand bar may go unplanted, this can create weak points that limit its effectiveness against protecting Lake Burollos fresh water from sea water intrusion, while others host visually natural vegetation that stabilize the sand bar. Human activities and natural processes operate within coastal environments; these processes include events such as sea level change, and sediment supply changes. For integrated management, the sand bar is considered as an important part of the coast. It is the land’s first defense against the forces of the sea. The concept of integrated management can be applied to the sand bar habitats through conserving the natural habitats and develop types of land use suitable for these conditions.

Several studies (Williams and Ungar, 1972; Enomoto, 1987; Easton and Kleindorfer, 2009; Williams *et al*., 1998; Cordazzo, 2007; Akbarimoghaddam *et al*., 2011; and Zhang, 2012) have reported that the seeds of the majority of halophytes germinate best under non- saline conditions. Macke and Ungar (1971) pointed out that an important attribute of halophytes is the ability of their seeds to withstand high salinity for long periods and then germinate when this condition is a meliorated. However, the amelioration in salt marshes rarely occurs. There was a general decrease in (RGR) with increased salinity (shown in Table.3) though species differed significantly (P<0.05) in their Response the percentage of live material (shown in Table.4) generally decrease with increasing salinity, though again species differed in their Response. In contrast, salt tolerance in seed germination is of less importance for coastal dune species. In the present study the germination of dune species e.g *Pancratium maritimum* L and *Elymus fractus* Viv like inland species, is sensitive to salinity which is in accordance with previous studies on beach and dune species (Seneca, 1969; and Barbour, 1978) concluded that the salt concentration in soil water in dunes in temperate regions would be less than 1% (172 *m mal\l NaCl*). This evidence suggests that germination at high salinity is not required for colonizing coastal dune habitats. Criteria for coasts and lakes water Quality criteria depended on international parameter so in near future Egypt must have her own local permissible level of those parameters controlling the water quality.

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