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# Assessment of Climate Changes Effectiveness on Floristic Diversity of Riparian Plants in The Area of the First Cataract Islands (Suluga and Gezel protected area) - River Nile, Upper Egypt

Shazely A. M. Abdel Azim [1], Adel A. Abdullah [1], Ashraf H.I. Salem[2] , Hazem H. Ibrahim [1]

[1]Ministry of Investment and international Cooperation, Egypt
[2]Sustainable Development of Environment and its Projects Management Department, Environmental Studies and Research Institute, University of Sadat City, Monufia 32897, Egypt

**ABSTRACT**

The vegetation of Suluga and Gezel PA represents relicts of the original Nubian Riverain Vegetation, a semi-arid scrub and grassland, which have successfully survived up to the present, particularly after the construction of the Aswan old and High Dams. 112 species, representing 23 orders, 37 families and 90 genera; 29 families are Dicotyledonoae (78.4 %) with 76 species, and 7 families are Monocotyledonous (21.6%) with 36 species (32.1 %). In accordance to flora of the studied islands as a whole, 64 annuals (57.1%) and 48 perennials (42.9%). With regards to most represented families are Poaceae has the highest contribution to the total flora (24 species: 21.4%), followed by Fabaceae (17 species15.2%), Asteraceae (12 species: 10.7%). The vegetation life form spectrum of Suluga and Gezel islands reflects a typical desert flora, the greater part of species are therophytes and phanerophytes (70.5%). The phytogeographical analysis of the 112 plant species surveyed in this study revealed that the Palaeotropical have the highest contribution (26 species: 23.2%) followed by the Cosmopolitan (19 species: 17%) and Pantropical (18 species: 16.1%). The monoregional represented by (22 species: 19.6%) of which 19 species were Sudano-Zambezian, 2 species Mediterranean and one species Saharo-Sindian. The bi-regional chorotype was represented by 21 species (18.8% of the total flora) of which 8 species (7.1%) Saharo-Sindian and Sudano-Zambezian, 7 species (6.3%) belonging to Sudano-Zambezian and Saharo-Sindian, 3 species (2.7%) belonging to Mediterranean-Irano-Turanian chorotype, 2 species (1.8) were belonging to Sudano-Zambezian and Mediterranean and only one species (0.9%) belonging to Mediterranean and Sudano-Zambezian chorotype. Pluriregional represented by 6 species (5.4%). Species richness, Shannon-Weiner H, and Margalef indices measurements indicated that shoreline and islands banks are the most diverse habitat and followed by “mosaic pattern of vegetation” in which plant aggregates grow together forming complex stands. These results indicate that altitudinal gradient, habitat types and edaphic conditions that control soil moisture have significant influences on species diversity. Comparative analysis and long term analysis indicated that + 28 species (+20 %) were lost or may be extremely very rare within 40 years. This could be due to severe environmental conditions, climate changes and Human interface in the present study area.

**Keywords**: conservation; diversity; habitats; human; interference; climate changes.

**الملخص**

لا تعد النباتات بمحمية سالوجا وغزال إلا آثارًا للنباتات النهرية النوبية الأصلية ، والتى نجت فى البقاء حتى الوقت الحاضر ، لا سيما بعد بناء سد وخزان أسوان. 112 نوعًا ، تمثل 23 رتبة و37 عائلة و90 جنسًا ؛ 29 عائلة من ثنائية الفلقة 87,4 ٪ مثلت 76 نوعًا ، و7 عائلات أحادية الفلقة (21,6 ٪) مثلت 36 نوعًا (32,1 ٪). وفقًا لنباتات الجزر المدروسة يتبين أن 64 نباتًا نوعاً حولى (57.1٪) و 48 نباتًا معمرًا (42,9٪). فيما يتعلق بالعائلات الأكثر تمثيلًا ، تمتلك العائلة النجيلية أعلى مساهمة في إجمالي النباتات (24 نوعًا: 21,4٪) ، تليها العائلة البقولية (القرنية) (17 نوعًا 15,2٪) ، العائلة( المركبة (12نوعًا: 10,7٪). بصفة عامة يعكس طيف الحياة النباتية لجزر سالوجا وغزال نباتات البيئات الصحراوية النموذجى . حيث تلاحظ أن النباتات الحولية والنباتات الظاهرة مثلت نحو 70,5٪ .

أظهر التحليل الجغرافي النباتي لـ 112 نوعًا من النباتات التى أجريت المسوح الحقلية عليها هذه الدراسة أن نباتات الأقاليم الأستوائية القديمة لها أعلى مساهمة (26 نوعًا: 23,2٪) تليها نباتاتات الأقاليم العالمية (19 نوعًا 17٪) ونباتات إقاليم حول الإستوائية (18 نوعًا: 16,1٪). بينما مثلت المنطقة الأحادية بـ (22 نوعًا: 19,6٪) منها 19 نوعًا ينتمى إلى الإقليم السودانى الزامبيزى) ، نوعان ينتميان لإقليم البحر الأبيض المتوسط ونوع واحد صحراوي– سودانى (السندى). مثلت النباتات ثنائية الموطن 21 نوعًا (18,8 ٪ من إجمالي النباتات) منها 8 أنواع (7,1 ٪) تنتمى لإقليمى الصحراوى السودانى السندى والسودانى الزامبيزى)، 7 أنواع تنتمى لإقليم السودانى الزامبيزى والصحراوى السودانى السندى، 3 انواع (2,7٪) تنتمى لإقليم حوض البحر الأبيض المتوسط الإيرانى الطورانى.، نوعان (1.8) ينتمون إلى الأقليم السودانى الزامبيزى وحوض البحر الأبيض المتوسط ونوع واحد فقط (0,9٪) ينتمى إلى أقليم البحر الأبيض المتوسط السودانى الزامبيزى وأخيرا مثلت نباتات متعدد الأقاليم (الموطن) بـ 6 أنواع (5,4٪).

أشارت قياسات ثراء الأنواع وقياسات مؤشرات شانون ومارجرليف إلى أن ضفاف الشواطئ والجزر هي أكثر الموائل تنوعًا ويتبعها "باقى المناطق الرطبة من الغطاء النباتي" حيث تنمو مجاميع النباتات معًا لتشكل مجموعات معقدة. تشير هذه النتائج إلى أن التدرج الطولي وأنواع الموائل وظروف وخصائص التربة التي تتحكم في رطوبة التربة لها تأثيرات كبيرة على تنوع الأنواع. أشار التحليل المقارن والتحليل طويل المدى إلى أن أكثر 28 نوعًا (+20٪) قد فُقدت أو قد تكون نادرة جدًا الوجود خلال الأربعون عاماً الماضية . قد يكون هذا بسبب الظروف البيئية القاسية والتغيرات المناخية والتدخلات البشرية في منطقة الدراسة الحالية.

**الكلمات الدالة** : التنوع البيولوجى –البيئات – التغيرات المناخية – العوائق

## 1. INTRODUCTION

However, nature reserves are considered as a successful way to conserve the vegetation cover, especially in arid regions and extremely arid ecosystems. This helps to combat desertification, which is a product of land use and climate change. Hence, there is good reason for the selection of nature reserve in an arid region, Suluga and Gezel protected area (±0.5 square kilometers) in the extremely south desert to study the effects of climate change on this type of fragile ecosystem. It is expected that the impact of climate change on ecosystems will alter abundance and distribution of species (Parmesan 2006), direct loss of some species and populations and habitat loss (Walther et al. 2002; Thomas *et al*. 2004), as well as gradual or rapid depletion and decline of the services that these offer. In Egypt, the Nile extends for about 1200 km from Aswan at the south to the Mediterranean coast at the north. A large number of islands that differ in size and age exist in the part of the River Nile that lies within the Egyptian territories. During the French Campaign (1798-1801), these islands were counted to be 215. At the beginning of the 20th century. The Nile at Aswan located at (24° 05′ N, 32° 55′ E) is interrupted by about 30 islands varying in size and structure. Twelve of them are protected islands. Most of them are granite. Islands are dominant landforms of pristine alluvial rivers. Because islands integrate hydrologic, morphologic and vegetation attributes, the presence of various succession stages of islands provides a landscape-level indicator of the condition of river corridors (Ward et al. 2002). The diversity of species on islands impacted by climatic changes as well as human activities such as cultivation, urbanization and introduction of burning, medicinal plant collection, cutting…. etc.

The igneous granite (basement complex) islands mainly located at the First Cataract area (Abu Al-ezz 1971). Before the construction of the old Aswan Dam in 1902 and the Aswan High Dam in the 1960s, most of the First Cataract Islands were intermittently under water. However, now most of them are permanently exposed with loamy-sand deposits between them. The islands of the First Cataract of the Nile River, such as Bigeh, Philae and Agilkia in the Aswan Reservoir, were the fortification controlled the access to ancient Upper Egypt and Nubia. These igneous islands of the First Cataract area are the most ancient archaeological sites in the River Nile and this is a World Heritage Site. These islands are among the oldest known islands, support unique assemblages of native species characteristic of the aquatic life in the River Nile (El-Hadidi and Springuel, 1978and 1981 1990). Suluga and Gezel are two of the First Cataract Islands that were declared a conservation area by the Prime Minister's Decree under Law No. 928 in 1986 and has had Protected status since then within the Egyptian Environmental Affairs Agency. According to Springuel (1981) a total of 94 species of angiosperms belongings to 34 families were recorded from the first cataract islands. The vegetation of these islands is heterogeneous.

Springuel (1981) indicates that definite changes in plant distribution in the area of the First Cataract Islands are associated with the increasing depth of soil deposits due to the sedimentation of fine material suspended in water. According to the Bioclimatic Map of the Mediterranean Zone (1963), the study area is in a true desert climate. The rainfall of this area is not only scanty, but also extremely irregular and variable (Kassas 1955). The First Cataract Islands are characterized by shallow water of low current velocity and support rich floristic diversity (Ali *et al.* 1999). The present study aimed to assessing of climate changes effectiveness on floristic diversity of riparian plants in the area of the First Cataract islands (Suluga and Gezel Protected area) and at what degree these vegetation communities affected also by the human interface, this study deal with the long term vegetation changes.

## 2. MATERIAL AND METHODS

One hundred and twenty two sites selected to represent the locations within Suluga and Gezel Reserve. The sites were selected to represent a wide range of physiographic and environmental variation in each in the present study area. This study Conducted during the period from the November 2018 to December 2020.Vegetation sampling was carried out using the réléve method described by Müller-Dombois and Ellenberg (1974). The size of each site was determined according to the certain parameters such as width of each area, the variation in density and size of species, species identified and recorded and as well as the soil variation. Species were identified after Tackholm 1974, Boulos 1999, 2000 and 2002 and 2005 Species life forms were determined depending upon the location of the regenerative buds and the shed parts during the unfavorable season (Raunkier 1934).

Soil samples were collected from each stand. Sizes of soil particles were estimated using the pipette method (Kilmer and Alexander 1949. Soil water extracts (1:5) were prepared for determination of EC and pH using conductivity and pH meters, chlorides by direct titration against silver nitrate using potassium chromate as an indicator, carbonates and bicarbonates by direct titration against HCl using phenolphthalein and methyl orange as indicators, calcium and magnesium by titration against EDTA (ethylenediamine dihydrogen tetraacetic acid) using ammonium purpurate and eriochrome black T as indicators (Jackson1977). Two-way indicator species analysis (Twinspan), as a classification technique and detrended correspondence analysis (DCA) as an ordination technique, were applied to the presence estimates of 112 species in 122 vegetation site according to the computer programs of HILL (1979 a, b). The relationship between the vegetation and edaphic variables were assessed by calculating the simple linear correlation coefficient (r) between the DCA axes (reflect the vegetation gradient) and the soil variables. Comparison analysis carried out between present and past species list recorded in the present study area Springuel et al. (1981), (Hamada (2004) and other recorded reports and published papers Up to date. Global geographical distributions of the recorded species were gathered from Zohary (1972), Boulos (1995, 1999, 2000 and 2005).

Species diversity in the present study area was calculated using a Biodiversity (PAST software in which the Shannon's index (H') was chosen (eq.1). This method was selected because it provides an account for both abundance and evenness (Magurran 1988). The Shannon's index ranges typically from 1.5 to 3.5 and rarely reaches 4.5 (Gaines et al. 1999). In addition, the Simpson index (D) and the evenness index (E=Evenness) are considered as a measure of species dominances and a measure for evenness of spread, respectively (Magurran 1988). Eq. 2. Species evenness is often assessed by Shannon's equitability index (H'E) which is calculated by eq. 3. The Jaccard's index (Krebs 1989) was used to calculate the species similarities between the vegetation types in different vegetation fragments eq. 4. Species richness was calculated as the total number of species per site and vegetation cluster. Species turnover (beta diversity) was calculated using 1-Jaccard's index of similarity since it provides a way to measure the species turnover between different areas (Magurran 1988). The calculation of the index has been designed to equal 1 in cases of complete similarities. 5. Plant ***β*-** diversity as species turnover between individual sites, vegetation cluster was assessed using Whittaker's index eq.6. Similarity was estimated between any two vegetation cluster and the selected rich areas vegetation, using the Sorensen's coefficient (Sorensen's 1948), based on a binary presence -absence of species and sites eq.7

$$\mathbf{H' = -\sum_{i=1}^{s} (pi \ln pi)}$$ Eq. 1.

$$\mathbf{D = \sum_{i=1}^{s} (pi)\ 2}$$ Eq. 2.

$$H'E = H' / H\ max$$ Eq. 3.

$$Ci = a / + b + c$$ Eq. 4.

$$\mathbf{s = \sum_{i=}^{s} n}$$ Eq. 5.

$$\mathbf{\beta w = \frac{S}{\propto} - 1}$$ Eq. 6.

$$S = 2W/ (a + b)$$ Eq. 7.

**2.2. Study area**

The Nile at Aswan (24° 05’ N, 32° 55’ E) is interrupted by about 30 islands varying in size and structure, where the river is deflected westwards and the current becomes stronger, indicating the real beginning of the First Cataract. Before the construction of the old Aswan Dam in 1902 and the Aswan High Dam in the 1960s, most of the First Cataract Islands were intermittently under water. However, now most of them are permanently exposed with loamy-sand deposits between them. These granite islands, among the oldest known islands, support unique assemblages of native species characteristic of the aquatic life in the River Nile (El-Hadidi and Springuel 1978).

**2.2. Island description**

"Suluga Island” which is about ±1160 m long and varies from ±50 up to±540 m. The central and southern parts of old high granite rocks are barren and plant growth is confined to the narrow silt terraces on the east-west banks of the larger islands Suluga. The present study habitat area represents the high rocks in the southern part of Gezel Island or in the central parts of (Suluga I). These granite rocks, which are different in size and height, are the base for deposits of soil-forming material brought by the river water behind them. The biggest rocks, which form the core of the islands Suluga a height of up to 30 meters. Usually rocks higher than 20 meters are bare, without vegetation cover. A very thin layer of soil is wind-borne and accumulates in the cracks between the rocks. It mostly consists soft material, which is a mixture of fine and coarse sand. The process of the weathering of rocks also takes part in the formation of soil. The remains of plants promote the accumulation of organic matter in the soil. Again, the water supply is very poor. The main reason for this is that the soil has no contact with the river water, due to the granite bedrock. The soil is supplied with water only by precipitation, which happens once in many years, and from the condensation of water due to the large fluctuation in day and night temperatures (Springuel 1981). The "Gezel Island which is about 850 m long and varies from ±160 to±260 m broad. The general cross-section of the southern rocky part of the island along. Illustrated that, Phragmites australis is a dominant on the partly submerged land and Salix, together with Mimosa pigra, are associated species. The high rocks, 6m above the water level, are bare except for a few individuals of Tamarix, and Imperata cylindrica, which grow in the cracks of the rocks. The narrow strip of silt deposit, 3 m above the water level, is occupied by Tamarix and on the low part of the steep slope panicum and cynodon is present. The partly submerged and is occupied by polygonum and other aquatic vegetation (**Fig.1**).

The climate of the South Eastern Desert of Egypt is extremely arid (Ayyad and Ghabbour 1986), with an aridity index of less than 0.05. A mean minimum temperature of 8.1 ºC has been recorded in January 1960; On the other hand, the mean maximum temperature of 41.8 ºC has been recorded in July, which can often reach above 45 ºC especially in August (Wadi Allaqi Metereological Station: August 1997). On the other hand, the long term monthly mean relative humidity (1960 to 1980) ranged between 14.0 and 38%, while the annual mean was 22.7%, monthly mean relative humidity (1960 to 1980) ranged between 14.0 and 38%, while the annual mean was 22.7%. Regarding the annual variation, it varies from 38.4 in 1996 to 52.3 % in 2005. The wind speed at Aswan ranged between 4 to 8 km h-1 between 1960 and 1980 with an annual mean wind speed of 5.9 km h-1. In contrast, the mean annual wind speed in Wadi Allaqi meteorological station ranged between 7.6 and 10.1 km h-1 from 1996 to 2005 (Springuel and Belal 1996). The water evaporation from 1960 to 2010 ranged between 10.5 and 26.7 (picha) on the other hand, with a mean annual of 18.5 mm day-1 picha (Zahran and Willis 1992).

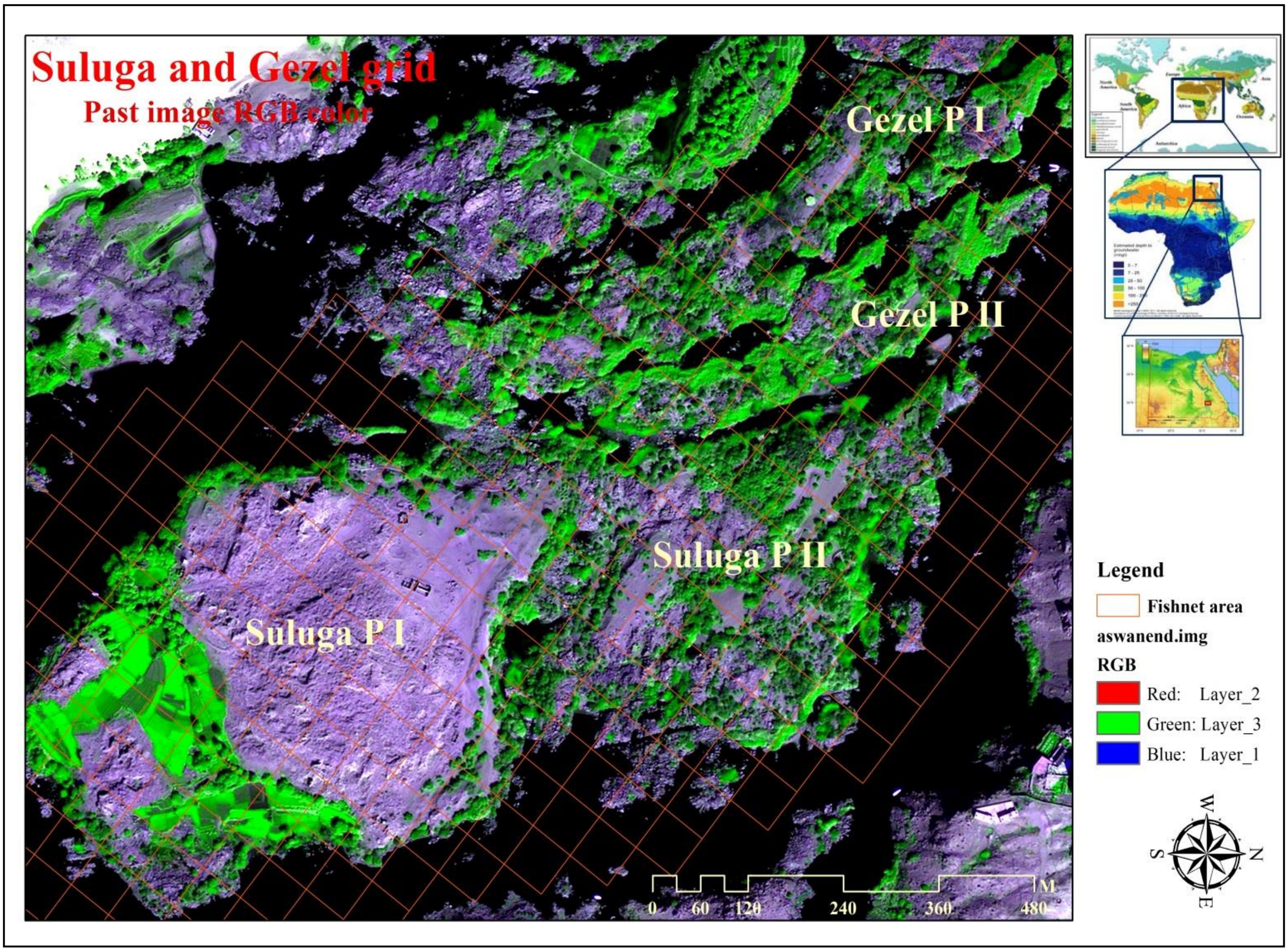


**Figure 1:** General map of the study area of the first cataract islands (Suluga and Gezel) at Aswan.

## 3. RESULTS

Sites classification according to TWINSPAN led to the identification of 13 clusters of sites similar in terms of their species composition (Fig 2); they are named after the dominant species as follows: *Panicum coloratum*. *Acacia tortilis* subsp. *raddiana* and *Acacia seyal*. *Juncus rigidus*. *Fimbristylis bisumbellata*. *Amaranthus viridis*. *Mimosa pigra*, and *Leptadenia arborea, Acacia nilotica, Crypsis schoenoides Mimosa pigra*, *Amaranthus graecizans*, *Phoenix dactylifera*, *Sesbania sesban* and *Hyphaene thebaica*. *Phragmites australis*, *Ziziphus spina-christi*, *Faidherbia albida*, *Cynodon dactylon*, *Cyperus rotundus, Eragrostis cilianensis, Panicum repens* and *Persicaria senegalensis* One Hundred and twelve species were recorded along the different sites of the catchment area of Suluga and Gezel region: 64 annuals (57.1%) and 48 perennials (42.9%). These species belong to 37 families and 90 genera (Table. 2). The Family Poaceae has the highest contribution to the total flora (24 species: 21.4%), followed by Fabaceae (17 species15.2%), Asteraceae (12 species: 10.7%), Amaranthaeeae (5 species: 4.5%), Cyperaceae (5 species: 4.5%) and Solanaceae, (4 species: 3.6%), Convolvulaceae (4 species: 3.6%), Euphorbiaceae, Brassicaeeae, Malvaceae, and Apoeynaceae each of (3 species: 2.7%, see table 1 and fig. 3).

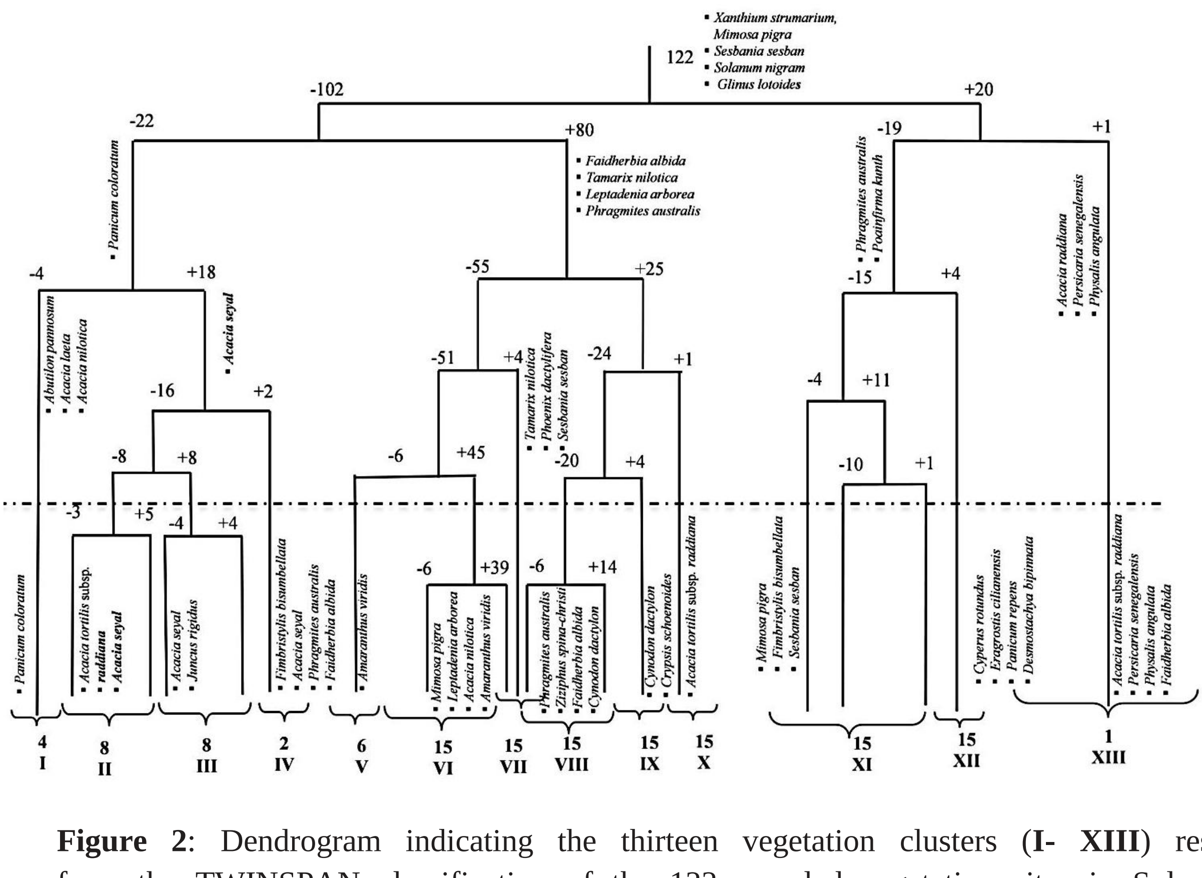


**Figure 2**: Dendrogram indicating the thirteen vegetation clusters (**I- XIII**) resulting from the TWINSPAN classification of the 122 sampled vegetation sites in Suluga and Gezel PA.

**Table 1:** List of the recorded plant species in area of the First cataract island (Suluga and Gezel protected area) area along with their families, life span, life form and chorotypes, presence value (P %) of the Floristic composition of the vegetation clusters (**I-XIII**) and **Dis** : vegetation **Abundance.**

| Family | Species | Chorotype | Life form | Life span | Dis | P% |
|---|---|---|---|---|---|---|
| | **I :Dicotyledonoae** | | | | | |
| ***Cerarophyllaeea*** | *Ceratophyllmn demersum* L. | COSM | Hydrophyte | Preinnal | **cc** | **9.0** |
| ***Haloragaceae*** | *Myriophyllum spicalam* L. | PAL | Hydrophyte | Preinnal | **rr** | **4.1** |
| ***Amaranthaeeae*** | *Alternanthera sessilis* (L.) DC. | PAN | Therophyte | annual | **c** | **3.3** |
| | ***Amaranthus graecizans* L. subsp. thellungiam's (Nevski).** | Me + IR – TR | Therophyte | annual | **cc** | **2.5** |
| | *Amaranthus viridis* L. | PAL | Therophyte | annual | **cc** | **3.3** |
| | *Chenopodium album* L. | COSM | Therophyte | annual | **c** | **2.5** |
| | *Chenopodium murale* L. | COSM | Therophyte | annual | **cc** | **2.5** |
| ***Molluginaceae*** | *Glinus lotoides* L. | PAL | Therophyte | annual | **cc** | **8.2** |
| ***Polygonaceae*** | *Persicaria senegalensis* (Meisn.) Soják | PAL | Geophyte/ | Preinnal | **cc** | **0.8** |
| ***Polygonaceae*** | *Rumex dentatus* L. | ME- IR-TR+ S- | Therophyte | annual | **rr** | **4.9** |
| ***Portulacaceae*** | *Portulaca oleracea* L. | COSM | Therophyte | annual | **cc** | **2.5** |
| ***Tamaricaceae*** | *Tamarix nilotica* (Ehrenb.) | S-Z+ SA-SI | Phanerophyte | Preinnal | **cc** | **34.4** |
| ***Zygophyllaceae*** | *Tribulus parvipinus* presl **var**. | S-Z+ SA-SI | Therophyte | annual | **r** | **0.8** |
| ***Oxalidaceae*** | *Oxalis corniculata* L. | COSM | Geophyte | Preinnal | **cc** | **0.8** |
| | *Oxalis villosa* L. (M. bieb). | PAN | Geophyte | Perennial | **cn** | **0.8** |
| **Rhamnaceae** | *Ziziphus spina-christi* (L.) Desf. | SA-SI+S-Z | Phanerophyte | Perennial | **cc** | **4.1** |
| **Fabaceae** | *Acacia laeta* R.Br. ex Benth . | S-Z | Phanerophyte | Perennial | **r** | **5.7** |
| | *Acacia nilotica* (L.) Delile | S-Z | Phanerophyte | Perennial | **cc** | **17.2** |
| | *Acacia seyal* Delile | SA-SI+ S-Z | Phanerophyte | Perennial | **r** | **94.3** |
| | *Acacia tortilis* **subsp**. *raddiana* | S-Z | Phanerophyte | Perennial | **c** | **8.2** |
| | *Desmodium tortuosum* (Sw.) | PAN | Phanerophyte | Perennial | **rr** | **1.6** |
| | *Faidherbia albida* (Delile) A. | S-Z | Phanerophyte | Perennial | **r** | **42.6** |
| | *Indigofera hochstetteri* Baker | SA-SI+ S-Z | Therophyte | annual | **r** | **3.3** |
| | *Lablab purpureus* (L.)Sweet | S-Z | Chamaephyte | Perennial | rr | **0.8** |
| | *Lotus arabicus* L. | S-Z+ SA-SI | Therophyte | Perennial | **cc** | **2.5** |
| | *Melilotus indicus* (L.) All. | PAL | Therophyte | annual | **cc** | **4.1** |
| | *Mimosa pigra* L. | PAN | Phanerophyte | Perennial | **rr** | **26.2** |
| | *Sesbania sesban* (L.) Merr. | S-Z | Phanerophyte | Perennial | **cc** | **13.9** |
| | *Tephrosia purpurea* subsp. *apollinea* (Delile) Hosni & El- | S-Z+ SA-SI | Chamaephyte | Perennial | **rr** | **1.6** |
| | *Trifolium resvpinatum* L. | ME+IR-TR+ | Therophyte | annual | **cc** | **4.1** |
| | *Trigonella hemosa* L. | ME+ SA-SI + | Therophyte | annual | **cc** | **5.7** |
| | *Senaa italica* Mill. | S-Z +SA-S1 | Phanerophyte | Perennial | **cc** | **0.8** |
| | *Vicia sativa* L. | ME+ IR-TR+ | Therophyte | annual | **rr** | **1.6** |
| ***Enphorbiaceae*** | *Euphorbia fresskeolii* L.Gay | S-Z +SA-SI | Therophyte | annual | **c** | **3.3** |
| | *Euphorbia hirta* L. | PAN | Therophyte | annual | **c** | **4.9** |
| | *Euphorbia peptus* L. | COSM | Therophyte | annual | **cc** | **4.1** |
| ***Salicaeeue*** | *Salix subserrata.* Thueb | *S-Z+ SA-SI* | Phanerophyte | Perennial | **c** | **0.8** |
| **Myrtaceae** | *Lawsoni inermis* L. | S-Z | Phanerophyte | Perennial | **r** | **1.6** |

| Family | Species | Chorotype | Life form | Life span | Dis | P% |
|---|---|---|---|---|---|---|
| **Brassicaeeae** | *Rorippa islandica* (L.) Hiern | **ME+ IR-TR+** | Therophyte | Perennial | **rr** | **2.5** |
| | *Rorippa palustris* (L.) Besser | COSM | Therophyte | Perennial | **c** | **0.8** |
| | *Gynandropsis gynandra* (L.) | PAL | Therophyte | annual | **r** | **3.3** |
| **Malvaceae** | *Abutilon pannosum* (G. Forst.) Schltdl. | S-Z | Chamaephyte | Perennial | **r** | **4.1** |
| | *Corchorus olitorius* L. | PAN | Therophyte | annual | **r** | **1.6** |
| | *Malva parviflora* L. | ME+ IR-TR | Therophyte | annual | **cc** | **1.6** |
| **Sapindaceae** | *Cardiospermum* | PAN | Therophyte | Perennial | **rr** | **0.8** |
| **Primulaceae** | *Anagalis arvensis* L. | COSM | Therophyte | annual | **cc** | **2.5** |
| **Vahliaceae** | *Vahlia digyna* (Retz.) Kuntze | S-Z | Therophyte | annual | **c** | **1.6** |
| **Apoeynaceae** | *Calotropis procera* (Aiton) W.T. Aiton. | SA-SI | Phanerophyte | **perennial** | **cc** | **1.6** |
| | *Leptadenia arborea* (Forssk.) Schweinf. | S-Z | Phanerophyte | **perennial** | **rr** | **32.0** |
| | *Oxystelma esculentum* (L. f.) R.Br. var.alpini (Decne.)N. | S-Z | Phanerophyte | **perennial** | **c** | **0.8** |
| **Rubiaceae** | *Oldenlandia capensis* L. **var**. Capensis | PAL | Therophyte | annual | **r** | **0.8** |
| **Boraginaceae** | *Heliotropium ovalifolium* | PAL | Therophyte | annual | **r** | **6.6** |
| | *Heliotropium supinum* L. | S-Z+ME | Therophyte | annual | **c** | **4.9** |
| **Convolvulacea** | *Convolvulus arvensis* L. | PAL | **Hemicrypt** | **perennial** | **cc** | 4.1 |
| | *Cuscuta pedicellata Ledeb.* | ME+ S-Z | Parasite | annual | **cc** | **4.9** |
| | *Ipomoea cairica* (L.) Sweet. | PAL | Geophyte | Perennial | **cc** | **0.8** |
| | *Ipomoea eriocarpa* R. BR. | PAN | Therophyte | annual | c | 2.5 |
| ***Solanaceae*** | *Datura innoxia* Mill. | PAN | Therophyte | annual | **c** | **1.6** |
| | *Physalis angulata* L. | PAN | Therophyte | annual | **r** | **0.8** |
| | *Solanum nigrum* L. | COSM | Therophyte | annual | **cc** | **10.7** |
| | *Withania somnifera* (L.) | SA – SI + S – | Chamaephy | annual | **r** | 1.6 |
| **Lamiaceae** | *Lamium amplexicaule* L. | COSM | Therophyte | annual | **cc** | **0.8** |
| **Scrophulariaceae** | *Veronica enagallis-aquatica* L. | COSM | Geophyte/ | Perennial | **cc** | 1.6 |
| ***Apiaceae*** | *Ammi majus* L. | ME | Therophyte | annual | **cc** | **0.8** |
| **Asteraceae** | *Bidens pilosa* L. | PAN | Therophyte | annual | **cc** | **2.5** |
| | *Conyza aegyptiaca* (L.) | S – Z | Therophyte | annual | **cc** | **6.6** |
| | *Eclipta prostrate* (L.) L. | PAN | Therophyte | annual | **cc** | **4.1** |
| | *Phiehea dioscoridis* (L.) DC. | SA – SI + S – | Phanerophy | annual | **cc** | **2.5** |
| | *Pseudococyza viscose* (Mill) | PAL | Therophyte | annual | **r** | **2.5** |
| | *Pseudognaphalium luteo* | COSM | Therophyte | annual | **cc** | **2.5** |
| | *Pulicaria undulata* (L.) C.A | SA – SI + S – | Chamaephy | Perennial | **cc** | **5.7** |
| | *Senecio aegyptius* L. **var**. | S-Z | Therophyte | annual | **c** | **4.9** |
| | *Senecio aegyptius* L. var discoideus Boiss | S-Z | Therophyte | annual | **c** | **4.9** |
| | *Sonchus oleraceus* L. | COSM | Therophyte | annual | **cc** | **6.6** |
| | *Symphyotricum squamatum* (Spreng) Nesom | PAN | Chamaephyte | annual | **cwn** | **3.3** |
| | *Xanthium strumarium* **L.** | PAL | Therophyte | annual | **c** | **13.9** |
| | | | | **II-Monocotyledoneae** | | |
| **Araceae** | *Lemna gibba* **L.** | COSM | Hydrophyte | annual | **cc** | **0.8** |
| **Potamogetona** | *Potamogeton crispus* **L.** | COSM | Hydrophyte | Perennial | **cc** | **3.3** |

| Family | Species | Chorotype | Life form | Life span | Dis | P% |
|---|---|---|---|---|---|---|
| **Arecaceae** | *Hyphaene thebaica* (L.) | S-Z | Phanerophyt | Perennial | **c** | **2.5** |
| | *Phoenix dactylifera* L. | SA-SI+S-Z | Phanerophyt | Perennial | **cc** | **4.1** |
| **Cyperaceae** | *Cyperus alopecuroides* Rotth. | PAN | Geophyte | annual | **cc** | **4.9** |
| | *Cyperus difformis* L. | PAN | Geophyte | Perennial | **c** | **2.5** |
| | *Cyperus michelianus* (L.) | PAL | Therophyte | annual | **c** | **4.9** |
| | *Cyperus rotundus* L. | PAN | Geophyte | Perennial | **cc** | **2.5** |
| | *Fimbristylis bisumbellata* (Forssk.) Bubani | PAL | Therophyte | annual | **cc** | **9.0** |
| **Juncaceae** | *Juncus rigidus* Desf. | **ME+IR-** | Geophyte | Perennial | **rr** | **5.7** |
| **Poaceae** | *Cenchrus biflorus* Roxb. | PAL | Therophyte | annual | **rr** | **1.6** |
| | *Chloris pycnothrix* Trin. | S-Z | Therophyte | annual | **rr** | **0.8** |
| | *Cnloris virgata* Sw. | PAL | Therophyte | annual | **r** | **0.8** |
| | *Crypsis schoenoides* (L.) | COSM | Therophyte | annual | **c** | **6.6** |
| | *Cynodon dactylon* (L.) Pers. | PAN | Geophyte | Perennial | **cc** | **12.3** |
| | *Dactyloctenium aegyptium* (L.)Willd. | PAL | Therophyte | Perennial | **cc** | **3.3** |
| | *Desmostachya bipinnata* | SA-SI+S-Z | Geophyte | Perennial | **cc** | **23.8** |
| | *Dichanthium annulatum* (Forssk.) Stapf | PAL | Geophyte | Perennial | **cc** | **5.7** |
| | *Digitaria sanguinalis* (L.) | PAL | Therophyte | annual | **r** | **4.9** |
| | *Echinochloa colona* (L.) | PAL | Therophyte | annual | **cc** | **2.5** |
| | *Eleusine indica* (L.) Gaertn. | PAL | Therophyte | annual | **r** | **1.6** |
| | *Eragrostis aegyptiaca* | S-Z | Therophyte | annual | **c** | **4.1** |
| | *Eragrostis cilianensis* (All.) F. T. Hubb. | COSM | Therophyte | annual | **c** | **4.1** |
| | *Eragrostis japoniea* | PAL | Therophyte | annual | **rr** | **2.5** |
| | *Eragrostis pilosa* (L.) P. | PAL | Therophyte | annual | **cc** | **1.6** |
| | *Imperata cylindrica* (L.) | PAL | Geophyte | Perennial | **cc** | **5.7** |
| | *Leptochloa fusca* (L.) Kunth | PAL | Geophyte | Perennial | **c** | **2.5** |
| | *Panicum coloratum* L. | S-Z | Geophyte | Perennial | **c** | **4.1** |
| | *Panicum repens* L. | COSM | Geophyte | Perennial | **cc** | **6.6** |
| | *Phragmites australis* (Cav.) Trin ex Steud. | PAL | Geophyte/ | Perennial | **cc** | **79.5** |
| | *Poa infirma* kunth. | ME | Therophyte | annual | **c** | **1.6** |
| | *Polypogon monospeliensis* | COSM | Therophyte | annual | **cc** | **1.6** |
| | *Polypogon viridis* (Gouan) | ME+IR-TR | Therophyte | Perennial | **cu** | **2.5** |
| | *Sorghum virgatum* (Hack.) Stapf | S-Z | Geophyte/ | annual | **cc** | **1.6** |
| **Typhaceae** | *Typha domingensis* (Pers.) Poir. Ex Steud. | PAN | Geophyte/ Hydrophyte | Perennial | **cc** | **0.8** |
| **Hydrocharitac** | *Vallisneria spiralis* **L.** | ME+ER- | Hydrophyte | Perennial | **c** | **1.6** |

### 3.1. Phytogeographical ffinities

The phytogeographical analysis of the 112 plant species surveyed in this study revealed that the Palaeotropical have the highest contribution (26 species: 23.2%) followed by the Cosmopolitan (19 species: 17%) and Pantropical (18 species: 16.1%). The monoregional represented by (22 species: 19.6%) of which 19 species were Sudano-Zambezian, 2 species Mediterranean and one species Saharo-Sindian. On the other hand, the bi-regional chorotype was represented by 21 species (18.8% of the total flora) of which 8 species (7.1%) Saharo-Sindian and Sudano-Zambezian, 7 species (6.3%) belonging to Sudano-Zambezian and Saharo-Sindian, 3 species (2.7%) belonging to Mediterranean-Irano-Turanian chorotype, 2 species (1.8) were belonging to Sudano-Zambezian and Mediterranean and only one species (0.9%) belonging to Mediterranean and Sudano-Zambezian chorotype. On the other hand, Pluriregional represented by 6 species (5.4%, Fig 4).

### 3.2. Life form spectrum (Biological spectrum of species)

Seven life forms of species were reorganized depending on the location of buds and of plants shed parts during the unfavorable season. The life-form spectrum in the present study is characteristic of an extremely arid desert region with the dominance of therophytes: Therophytes have the highest contribution and considered the most abundant life form (61 species 54%), followed by phanerophytes 18 species 16%) and Geophytes 8 species 7%), Chamaephyte (7 species 6%), Geophyte/Helophytes (4 species 4%), Geophyte/Hydrophyte (4 species 4%), Hydrophyte (5 species 4.5%), Hemicryptophyte (2 species 1.8%), Helophytes, Hydrophyte /Helophytes and parasitic represented each by (1species 1%) respectively. The majority of annuals were winter species season species; some were hot-weather species (e.g., *Portulaca oleracea*, *Eragrostis aegyptiaca* and a few were non-seasonal species responding to rainfall at any time of the year (e.g., *Tribulus* spp., *Chenopodium murale* and the occurrence of the 1 parasitic plants indicates the importance of water conservation (Fig. 5).

### 3.3. V. 3. Soil Characteristics of the Vegetation Clusters

Sand attains the highest percentage in cluster I and cluster XII (94.8%) and lowest value in cluster XIII (84.4%). Clay has the highest value in cluster X (5.4%) (and lowest value in cluster I (1.28%). While silt has the highest in cluster VII (10.3) and the lowest in cluster II (3.9).The minimum value of pH is attained in cluster IV, VII and XI (7.3) and the maximum in cluster I (7.85). EC has a maximum in cluster IV (1.7) mmohs/cm and a minimum in cluster I (0.35) mmohs/cm. Total dissolved salts attains the highest percentage in cluster IV (1114.6%) and lowest value in cluster IX (309.3), Calcium (Ca) attains the highest concentration in cluster I (45%) and lowest value in cluster XIII (10.0%), Mg attains the highest concentration in cluster X(23.0%) and lowest value in cluster V (9.0%).Na attains the highest concentration in cluster X(62.0 %) and lowest value in cluster II (1.1%), K attains the highest concentration in cluster IV and XIII (2.0%) and lowest value in cluster XII (0.2%), $HCO_3$ attains the highest concentration in cluster IX (9.0%) and lowest value in cluster V (3.0%), Cl attains the highest concentration in cluster I (30.0%) and lowest value in cluster IX (5.7%) and $SO_4$ attains the highest concentration in cluster X (75.9%) and lowest value in cluster VII (10.1%, table 2).

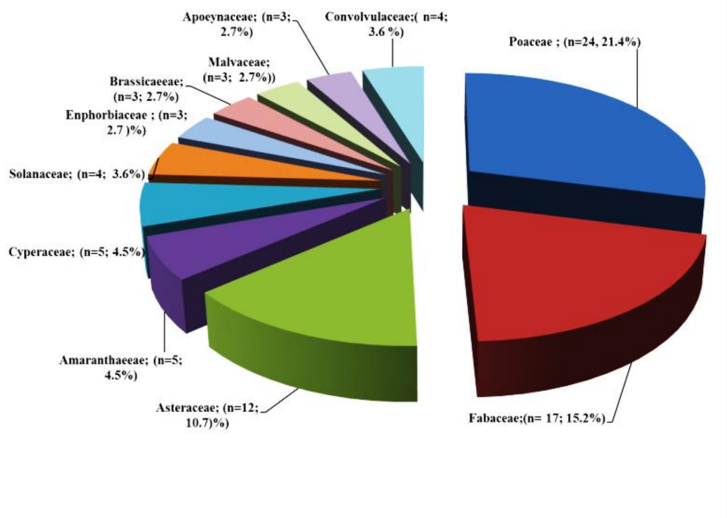


**Figure 3**: Diagram of floristic composition with the 12 families richest in species separately, notated (n= number of species)

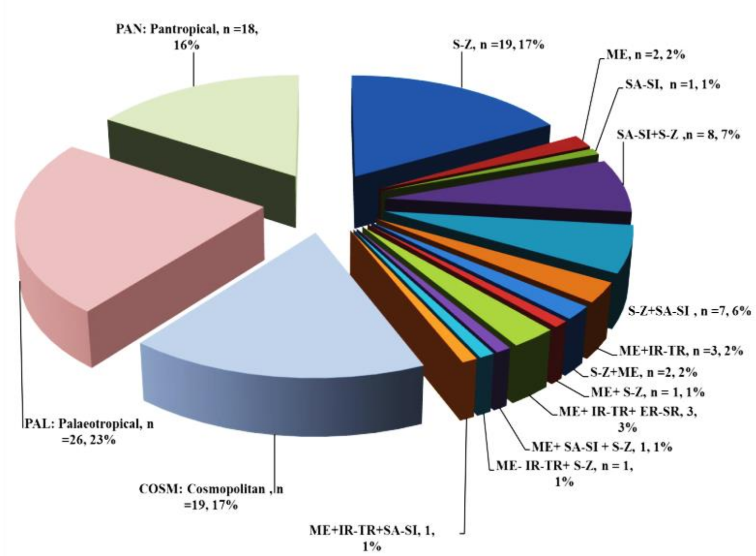


**Figure 4**: Chorotype spectrum of Suluga and Gezel. **COSM**: Cosmopolitan, **Pal**: Palaeotropical, **Pan**: Pantropical, **SA-SI**: Saharo-Sindian, **S-Z**: Sudano-Zambezian, **ME**: Mediterranean, **IR-TR**: Irano-Turanian and **ER-SR**=Euro-Siberian.

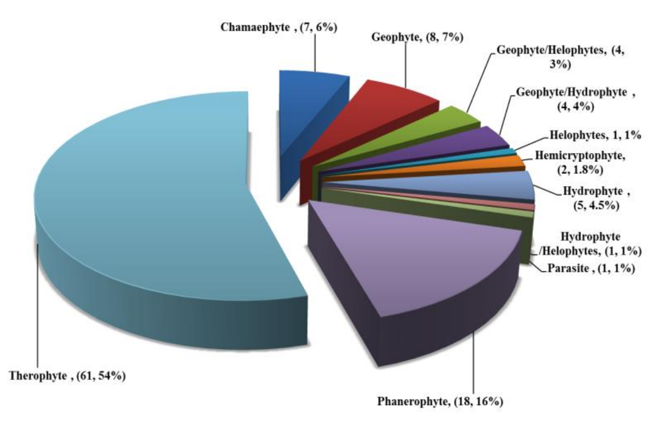


**Fig. 5.** Life form spectrum of the recorded species in Suluga and Gezel islands.

**Table 2**: The mean ± SD (Standard Deviation) of the soil characteristics of the thirteen vegetation clusters identified in Suluga and Gezel islands

| Cluster | pH | TDS | E C | Physical analysis | | | Chemical analysis % | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppt | mm ohs/cm | Silt | sand | clay | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
| **I** | 7.85 | 224.0 | 0.35 | 4.84 | 94.80 | 1.28 | 45.00 | 10.0 | 1.48 | 0.28 | - | 5.00 | 30.0 | 21.76 |
| **II** | 7.5 | 398.4 | 0.6 | 3.9 | 94.6 | 1.8 | 26.8 | 12.5 | 1.1 | 0.3 | - | 4.0 | 14.8 | 21.6 |
| **III** | 7.4 | 563.5 | 0.9 | 7.9 | 89.4 | 3.2 | 24.3 | 10.0 | 2.3 | 0.9 | - | 5.5 | 11.5 | 20.5 |
| **IV** | 7.3 | 1114.6 | 1.7 | 6.8 | 89.6 | 3.6 | 35.0 | 15.0 | 3.2 | 2.0 | - | 4.0 | 10.0 | 41.2 |
| **V** | 7.4 | 150.4 | 0.2 | 9.3 | 89.6 | 1.8 | 11.0 | 9.0 | 1.5 | 1.6 | - | 3.0 | 9.0 | 11.2 |
| **VI** | 7.3 | 299.9 | 0.5 | 7.0 | 90.3 | 2.7 | 18.7 | 17.4 | 18.5 | 0.7 | - | 6.6 | 11.4 | 38.3 |
| **VII** | 7.3 | 540.8 | 0.8 | 10.3 | 87.0 | 2.7 | 18.5 | 11.5 | 1.7 | 0.4 | - | 7.5 | 14.5 | 10.1 |
| **VIII** | 7.4 | 357.0 | 0.6 | 6.1 | 90.8 | 2.9 | 22.3 | 16.3 | 15.0 | 0.4 | - | 6.5 | 14.4 | 36.2 |
| **IX** | 7.3 | 309.3 | 0.5 | 5.5 | 93.1 | 1.4 | 24.0 | 16.0 | 1.8 | 0.2 | - | 9.0 | 5.7 | 33.7 |
| **X** | 7.3 | 448.1 | 0.7 | 7.6 | 87.0 | 5.4 | 13.5 | 23.0 | 62.0 | 1.1 | - | 6.3 | 21.5 | 75.9 |
| **XI** | 7.4 | 356.8 | 0.6 | 5.6 | 92.2 | 2.5 | 22.3 | 15.0 | 16.7 | 0.5 | - | 6.6 | 14.4 | 36.8 |
| **XII** | 7.5 | 343.5 | 0.5 | 4.4 | 94.8 | 1.6 | 26.3 | 8.7 | 1.4 | 0.2 | - | 4.3 | 18.3 | 13.9 |
| **XIII** | 7.5 | 806.6 | 1.3 | 8.3 | 84.4 | 7.3 | 10.0 | 15.0 | 4.0 | 2.0 | - | 5.0 | 18.0 | 27.5 |

### 3.4. The vegetation and Edaphic variables

The relationship between the vegetation and edaphic variables are assessed by calculating the simple linear correlation between the DCA axes that reflected the vegetation gradient and the soil variables (Table 3). The second DCA axis II correlated negatively with electric conductivity (r = - 0.75), and. On the other hand, electric conductivity correlated positively with sand (r = 0.63), and Bicarbonates (r = 0.65). Calcium correlated (r = -0.88) negatively with DCA axis II and positively with TDS (r = 0.60) and negatively with sand (r = -0.84). On the other hand, magnesium correlated positively with pH (r = 0.56) and sand (r = 0.68) and negatively with silt (r = - 0.61). Potassium correlated positively with Sodium (r = 0.82) and sulfate with pH value (r = 0.76).

**Table 3.** Correlation coefficient between the soil variables and DCA axes (AX1- AX3) *: $P < 0.05$, **: $P < 0.01$.

| Variable | DCA axis | | | pH | TDS | EC | Silt | Sand | Ca | Mg | Na | K | $HCO_3$ | Cl | $SO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AX1 | AX2 | AX3 | mg $L^{-1}$ | | | | | | | | | | | |
| AX1 | 1 | | | | | | | | | | | | | | |
| AX2 | 0.66** | 1 | | | | | | | | | | | | | |
| AX3 | -0.09 | -0.12 | 1 | | | | | | | | | | | | |
| pH | -0.04 | -0.14 | 0.33 | 1 | | | | | | | | | | | |
| TDS | -0.11 | -0.55 | -0.31 | -0.27 | 1 | | | | | | | | | | |
| EC | -0.12 | -0.57** | -0.31 | -0.27 | 0.997** | 1 | | | | | | | | | |
| Silt | 0.01 | -0.03 | -0.04 | -0.45 | 0.24 | 0.23 | 1 | | | | | | | | |
| Sand | 0.23 | 0.42 | -0.01 | 0.45 | -0.5 | -0.52 | -0.85** | 1 | | | | | | | |
| Ca | -0.43 | -0.76** | 0.12 | -0.21 | 0.60** | 0.63** | 0.44 | -0.84** | 1 | | | | | | |
| Mg | 0.31 | 0.16 | 0.01 | 0.56** | 0.06 | 0.05 | -0.61* | 0.68* | -0.52 | 1 | | | | | |
| Na | -0.21 | -0.22 | 0.13 | -0.49 | 0.18 | 0.22 | 0.03 | -0.38 | 0.52 | -0.31 | 1 | | | | |
| K | -0.23 | -0.24 | 0.41 | -0.32 | -0.07 | -0.05 | 0.10 | -0.32 | 0.43 | -0.35 | 0.82** | 1 | | | |
| $HCO_3$ | -0.05 | -0.53 | -0.24 | -0.22 | 0.65** | 0.65** | 0.53 | -0.69** | 0.68* | -0.35 | 0.15 | 0.08 | 1 | | |
| CL | -0.20 | 0.22 | 0.10 | -0.39 | -0.15 | -0.12 | 0.07 | -0.09 | -0.03 | -0.11 | 0.47 | 0.24 | -0.47 | 1 | |
| $SO_4$ | -0.30 | -0.34 | 0.55 | 0.76** | -0.14 | -0.14 | -0.25 | 0.11 | 0.14 | 0.36 | -0.03 | 0.26 | -0.18 | -0.19 | 1 |

## 4. DISCUSSION

One hundred and twelve plant species were recorded from the studied islands, representing one division Spermatophyta (Angiosperm). The angiosperms flora includes 112 species, representing 23 orders, 37 families and 90 genera; 29 families are Dicotyledonoae (78.4 %) with 76 species, and 7 families are Monocotyledonous (21.6%) with 36 species (32.1 %). In accordance to flora of the studied islands as a whole, 64 annuals (57.1%) and 48 perennials (42.9%).This trend is similar to the spectrum reported for the Nubian flora as a whole (Shaheen 2004) and for the Egyptian flora (Hassib 1951). Generally the dominance of annuals could be attributed to the fact that annuals have higher reproduction capacity, ecological amplitude, certain morphological structure and genetic flexibility under high levels of disturbance such as the agricultural practices (Frenkel 1970 and Baker 1974).

With regards to the Family the Family Poaceae has the highest contribution to the total flora (24 species: 21.4%), followed by Fabaceae (17 species15.2%), Asteraceae (12 species: 10.7%), Amaranthaeeae (5 species: 4.5%), Cyperaceae (5 species: 4.5%) and Solanaceae, (4 species: 3.6%), Convolvulaceae (4 species: 3.6%), Euphorbiaceae, Brassicaeeae, Malvaceae, Apoeynaceae and Convolvulaceae each of (3 species: 2.7%). The present study indicates that the vegetation life form spectrum of Suluga and Gezel islands reflects a typical desert flora, the greater part of species are therophytes and phanerophytes (70.5%). According to Hassib (1951), therophytes are the most common life form in the Egyptian flora. In the present study Raunkiaer system was useful in characterizing the flora of Suluga and Gezel islands. The predominance of therophytes reflects an effective strategy for avoiding water losses due to high temperature, extreme aridity and water deficiencies (Van Rooyen *et al*. 1990, Salem 2006 and 2016).

It is also necessary to point out that the increase in both (Fabaceae) Leguminosae and therophytes in a local flora can be considered a relative index of disturbance for Mediterranean ecosystems. The importance of the study area from a phytogeographical point of view may be due to its position in the South Eastern Desert of Egypt, which is characterized by the connection of the different phytogeographical regions: Mediterranean, Irano-Turanian, Sudano-Zambezian and the Saharo-Sidinan region Abd El-Ghani and Amer 2003 and Salem 2016). This may reflect the relatively rich floristic diversity of the Eastern Desert. On the other hand, this attributed to the fact that plants of the Saharo- Sindian species are good indicators for desert environmental conditions, while Mediterranean species stand for more mesic environment for instances. Wickens (1977) and Boulos (1997) mentioned that the Saharo- Sindian region is characterized by the presence of few endemic species and genera, and absence of endemic families.

Regarding to the phytogeographical analysis of the 112 plant species surveyed in this study revealed that the Palaeotropical have the highest contribution (26 species: 23.2%) followed by the Cosmopolitan (19 species: 17%) and Pantropical (18 species: 16.1%). The monoregional represented by (22 species: 19.6%) of which 19 species were Sudano-Zambezian, 2 species Mediterranean and one species Saharo-Sindian. On the other hand, the bi-regional chorotype was represented by 21 species (18.8% of the total flora) of which 8 species (7.1%) Saharo-Sindian and Sudano-Zambezian, 7 species (6.3%) belonging to Sudano-Zambezian and Saharo-Sindian, 3 species (2.7%) belonging to Mediterranean-Irano-Turanian chorotype, 2 species (1.8) were belonging to Sudano-Zambezian and Mediterranean and only one species (0.9%) belonging to Mediterranean and Sudano-Zambezian chorotype. On the other hand, Pluriregional represented by 6 species (5.4%,This results come in harmony with El Hadidi (1993) who concluded that the major percentage of the weed flora in Egypt is represented by the widely spread Cosmopolitan, Palaeotropical, and Pantropical taxa. furthermore Shaheen (2004), who concluded that the Sudano-Zarnbesian elements in the entire flora of the Nubia surpass that of Mediterranean ones. This tendency agrees with El Hadidi and Fayed (1994-1995), who reported that the percentages of the Sahelian and Sudanian taxa are highest in Upper Egypt while Mediterranean taxa is the lowest. This may be due to the narrow alluvial strips coupled with a hot and dry atmosphere which allow only a very limited movement of Mediterranean species to the Nubia (Shaheen 2002-a).

In Egypt, few studies were concerned with the plant life of the Riverain islands in the Upper Nile Valley; Springuel (1981) studied the natural vegetation of the islands of the first Cataract at Aswan, El-Khatib (1997) described the current and past vegetation types of Kraman Islands in the River Nile at Sohag Governorate, Mohamed and Hassan (1998) studied the plant life of sedimentary islands (43 islands) in Minya Governorate. Recently, the plant life of seven islands in the Nile stream at Aswan Governorate was studied by Hamada (2004, Sheded *et al.* 2014 and Badry *et al.* 2019). The floristic composition of Suluga and Gezel varies according to geographical locations, rock formation and weathering activities which affects the features of the surface deposits and hence the ecological relationships. The spatial distribution of plant species and communities over a small geographic area in desert ecosystems is related to heterogeneous topography and landform pattern (Kassas and Batanouny 1984). The heterogeneity of local topography, edaphic factors, microclimatic conditions lead to variation of the distributional behavior of the plant associations of the study area.

One Hundred and twelve species were recorded in the present, which contribute about 97.4% out of the 115 species recorded in the same region by (Hamada 2004), (93.3 and 80%) out of the species recorded by the (Springuel 1981, 1990, Shaheen (1987and 2002-a) Suluga and Gezel protected area. This investigation demonstrated that (+28) species (+ 20%) were lost or may be extremely very rare within 40 years. This could be due to severe environmental conditions and climate changes such as water deficiency or rainless since 1995/1996, except slightly rain events. Over-exploitation, human pressure, human constraints, are among the major reasons for the decrease of species diversity and species decline in this region (Ali *et al*. 2000, Salem 2006, Shaltout *et al*. 2010 and Salem 2016). Of the encountered species 17 species (15.2 %) are considered rare species, 14 (12.5%) very rare, 53 (47.3%) very common and 25 (22.3%) as common. This means that of all encountered species 50.0 % under critical conditions and need more efforts for conservation and special managements in Suluga and Gezel protected area.

In terms of classification, the vegetation that characterizes the study area divided into thirteen vegetation clusters. Most of the identified vegetation clusters have very much in common with that recorded in some regions of the Eastern Desert (Kassas and Zahran 1965), Western Desert (Bornkamm and Kehl 1990; Abd El-Ghani 2000a,b) along the eastern (western Mediterranean region (Ayyad and El-Ghareeb 1982) and in south Sinai region (El-Kady *et al.* 1998). The members of each of cluster are, in some cases, linked together by having one or more of the dominant species in common. These species are named after the dominant species as follows: *Panicum coloratum*. *Acacia tortilis* subsp. *raddiana* and *Acacia seyal*. *Juncus rigidus*. *Fimbristylis bisumbellata*. *Amaranthus viridis*. *Mimosa pigra*, and *Leptadenia arborea, Acacia nilotica, Crypsis schoenoides Mimosa pigra, Amaranthus graecizans, Phoenix dactylifera, Sesbania sesban* and *Hyphaene thebaica*. *Phragmites australis, Ziziphus spina-christi*, *Faidherbia albida*, *Cynodon dactylon*, *Cyperus rotundus, Eragrostis cilianensis, Panicum repens* and *Persicaria senegalensis.* Springuel (1990) reported that *Phragmites australis* in swampy formation of the riverain vegetation in Upper Egypt. *Cyperus rotundus, Eragrostis cilianensis, Panicum repens,* and *Desmostachya bipinnata.* It was. According to Springuel (1981), Hamada (2004) this is considered as "mosaic pattern of vegetation" in which plant aggregates grow together forming complex stands. According to (Hassan and Sheded (1995), Springuel 1981) considered, *Persicaria senegalensis* as one of the dominant species of the riverain swampy formation in Upper Egypt, on the other hand, Serag (1991) reported that *Ceratophyllmn demersum* in the Nile valley is in its occurrence all year round with vigorous growth during summer than in winter in most stands.

In accordance to sociological ranges of species only one species was recoded in one cluster (i.e.) a limited number of species have a wide ecological range and so present in many clusters. *Acacia seyal* presented in thirteen clusters, *Faidherbia albida* and *Phragmites australis* presented *eleven* clusters. On the other hand, *Leptadenia arborea* presented in ten clusters and. *Acacia nilotica* presented in nine clusters, *Mimosa pigra* and *Desmostachya bipinnata* recorded in eight clusters. *Tamarix nilotica* is well represented in seven clusters. Thirteen species presented *eleven* clusters, three species *Sesbania sesban*, *Cynodon dactylon* and *Solanum nigram* are present in six clusters, four species are presented in five clusters, Seventeen species are present in three clusters, thirty species recorded in one cluster namely, and thirty seven species recorded in two clusters.

As reported above most of species have limited ecological ranges and so represented in one or a few number of clusters, on the other hand, a limited number of species have aboard range of ecological range and so presented in most of the studied clusters. (Shaltout and El sheikh 1991, Salem 2016) reported that the growth and the abundance of species are enhanced with soil variable on the other hand, plant height is an important factor in the competitive and hence the structure of vegetation (Nilsson et al 1991). Species richness is a measure of the number of species found in a sample site. Since the larger the sample, the more species we would expect to find, thus according to the Menhinick's index. The highest species richness value was recorded in cluster XI (5.29 species/site) species/sites), whereas the lowest was recorded in cluster VI (1.23 species/site) on the other according to Margalef index the highest was cluster XI (15.24 species/site) and the lowest was cluster III and V and (2.43 species/site).

Diversity is of theoretical interest because it can be related to stability, maturity, productivity, evolutionary time, predation pressure and spatial heterogeneity (Hill 1973, Abd El-Ghani and Amer 2003). (Simpson_1-D index) characterized the cluster XI and so the highest Simpson index cluster was XI = 0.98 and so as Shannon_H = 4.08. It is also of vital importance for conservation of natural communities which are increasingly threatened by human activities and natural and environmental constraints (Naveh and Whittaker 1980). Basically Shannon-Weiner H, and Margalef indices measurements showed significant differences among habitats clusters in the study area on the other hand, these results indicate that altitudinal gradient, habitat types and edaphic conditions that control soil moisture and have significant influences on species diversity (Abd El-Wahab *et al*. 2008). Moderate similarity between the floristic compositions the studied isalnds Suluga and Gezel (50.8 %). Due to the same environmental conditions and located in the same habitats (Gezel and Suluga are uninhabited islands, Shaheen 2002-a). A high beta diversity index indicates a low level of similarity, while a low beta diversity index shows a high level of similarity Abd El-Ghani and Amer (2003). Based on our data high level of similarity occurs between the first cataract isalnds (Suluga and Gezel.).

Soil organic matter is an indicator of changes in soil and landscape characteristics. On the other hand, the loss of organic matter because of improper soil management causes a degradation of soil structure and loss of water and nutrients available to plants and microorganisms. Once the organic carbon content falls below, about 2 % of a soil is likely to be easily eroded (Lewis and Berry 1988; Warren 2002). In Southern Italy Brandt *et al*. (2003) reported that areas affected by desertification possessed soils in which there was a reduced amount of soil organic carbon content (<1.5%). A resembling study was carried out on Wadi Allaqi indicated that the organic matter ranged from 0.7 to 1.5% OC. Sheded (2002) pointed out in his study on wadi Allaqi PA that the percentage values of organic matter ranged between (0.35% and 1.34%). The sand fraction was relatively high in the study area. This situation could be attributed to the physical and chemical weathering process of granite components which distinguished most of the study area, especially the Suluga I. Physical weathering is a process that breaks up and disintegrates the parent rock or primary minerals, within the study area. (Salem 2006 and Shaltout *et al.* 2010). Green land was changed to bare land or non-vegetation area. Generally speaking, the fieldarea or planted areas are at risk of losing vegetation or said desertification what already investigated at server portion of Suluga I and a formation of sand dunes appears and that means that land changed to no vegetation (bare land).

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