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The current situation of the floral components in reach one region of the Nile River: A comprehensive review

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The current biodiversity crisis is motivating ecologists and conservation biologists to investigate the effects of human-induced changes to natural resources on species distribution and to comprehend ecological and evolutionary causes of spatial patterns of biodiversity. This work relies heavily on a variety of previously published works, and the large reference section includes all the literature citations required. The First Reach of the Nile River Region (FRNRR) extends from Old Aswan Dam to the new Esna barrages. It's characterized by a huge number of islands and the maximum flow velocity from Aswan to the Mediterranean. There are few studies covering the flora and biodiversity in this region. This study tries to introduce complete information about this region and its characterized species. The database of the vascular flora of (FRNRR) was compiled, which includes 246 species belonging to 172 genera and 56 families. Pantropical, Palaetropical, and Cosmopolitan elements (54.47 % of the total flora) were the dominant floristic categories among the total number of species. The flora of (FRNRR) contributes about 31.8 % of the whole flora of the Nile region and 11.6% of all species in Egypt. This study is the most recent and exhaustive review to date that examines floristic diversity.

Keywords: Flora, River Nile, vegetation, floristic diversity, phytogeographical

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INTRODUCTION

River Nile mainly consists of a single channel with a total length of 953.5 km from downstream High Aswan Dam (AHD) to Delta Barrage (Sadek et al., 2013). This channel is divided into four reaches from Aswan to Cairo and bifurcates into the Damietta and Rosetta branches (Figure 1). The four reaches are separated by five historical bridges over the Nile River. They include the Delta Barrage, Assiut Barrage, Esna Barrage, Naga Hammadi Barrage and High Aswan Dam (Said et al., 2014). The primary purpose of these barrages is to increase the water level and head of the irrigation canals that supply Upper Egypt's agricultural districts (El-Rawy et al., 2019). The First Reach spans 169.085 km from downstream of the Old Aswan Dam to the upstream of the new Esna barrages, with a huge number of islands and the maximum flow velocity from Aswan to the Mediterranean (Raslan et al., 2015). The second reach stretches across 192 kilometers between the Esna and Naga Hammadi barrages. The Aswan High Dam is located about 600 miles upstream from Cairo and 4 miles upstream from the first Aswan Dam. The third reach is 185 kilometers long, stretching from Naga Hammadi Barrage to Assuit Barrage. There is no considerable decline in water level drop due to dredging. With a total length of 408.75 km, the fourth reach is the most downstream reach between Assiut and Delta Barrages (Mobasher et al., 2015).

The longitudinal connectedness of rivers is greatly reduced by anthropogenic barriers like locks, dams, barrages, and weirs. These barriers also have an impact on downstream flow and significantly affect the riverine environment (Kumar et al., 2022a). The management of ecosystems through flow regulation, mixing, fertilizer delivery, light regimes, and suspended matter volume heavily relies on discharge from dams. River biodiversity is being negatively impacted by the construction of dams and barrages, which are also reducing the ecological integrity and water flow of rivers (Kumar et al., 2015b,c).

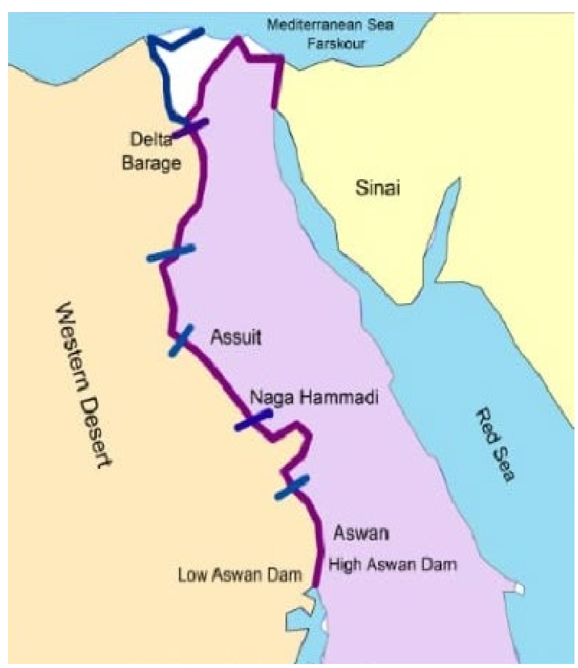

Figure 1. Four reaches along the Nile River in Egypt.

The High Aswan Dam (HAD) has, without a doubt, the biggest hydraulic impact on the Nile River. The morphology of the Nile River's reaches saw a clear alteration because of the building of the HAD, and the amount of suspended silt material was decreased. There are probably harmful effects (Schumm et al., 2007): Overtopping causes agricultural land on river islands and in nearby areas to become submerged. Impacts of erosion and sedimentation on river morphology (Said et al., 2014).

Large-scale river control plans have been implemented on the Nile system, which is indicated by the barrages and dams that have been constructed there. The natural hydro-biological system has been divided by them, and the impact on the biota is undeniable (Kassas, 1971). Several natural habitats in the Nile were destroyed with the construction of dams and barrages, and artificial habitats, like farms on river islands and aquaculture plots, were created in their place (Khattab and El-Gharably, 1984). The Nile River is distinguished by a variety of natural phenomena as well as human interventions, as seen in the peculiarities of the islands and the growth of different activities along the stream. Damming causes rapid hydrological regime changes and aquatic environment changes that result in the construction of islands and the transfer of silt into controlled rivers (Mahmoud et al., 2021). The river's linked islands can give a thorough description of the river's historical and contemporary activity. Due to their various widths, depths, slopes, etc., islands divide the whole river flow into at least two distinct channels, which results in variable hydraulic conditions (Thanh Noi and Kappas, 2017). According to El-Abassery and Hassan's (2008) estimation, the mainstream of the Nile and its Rosetta and Damietta branches contain about 500 islands. (El-Hadidi and Hosni, 2000) also noted that these islands are very diverse in terms of their origin, size, and construction; 144 of them have been declared as protected areas and are dispersed over 16 governorates; 27 of these protected islands are situated in Aswan (Amer et al., 2009). Moreover, the Beni-Suef governorate contains 46 islands, each of which varies in length, width, and area, according to (Amer et al., 2015).

Based on their floristic composition, structural elements, and ecological circumstances, the plant communities of the Nile Valley can be classified into many distinct plant community types (Springuel, 1990). Some academics' interest in the plant life of Egypt's Nile and related islands has increased in recent decades. Before the Aswan High Dam was built (1960–1955), the southern sector of the Nile in Upper Egypt (from Aswan to Assiut northward) was known as the Nile Islands. These islands are made up of heterogeneous deposits of silt, sand, and clay, indicating the great complexity of their origin and development. These islands, which range in size from 1.0 to 20.0 km2, are primarily agricultural (Seteha et al., 1965). The Nile Valley and Delta began to experience a shift in the river's characteristics due to the invasion of sand. Particularly on the western side of the river, many more islands, sand banks, and dune fields encroached upon the Nile silts (Bunbury et al., 2019). Ecosystems are dynamic and ever-changing due to both external (such as environmental change) and internal causes (such as succession). In recent years, changes in vegetation composition and variety have been significantly influenced by human-induced causes, specifically land-use change, atmospheric pollution, and climate change (Walther et al., 2005; Bobbink et al., 2010). Effective management and conservation of natural resources depend on an understanding of the consequences of the various drivers, both anthropogenic and natural (Kapfer et al., 2017). The First Reach of the Nile River needs to be continuously monitored and conserved since it is losing habitat and may perhaps experience plant extinction.

FACTORS RESPONSIBLE FOR THE HIGH BIODIVERSITY OF FRNRR

Geology and Geomorphology

The geology of (FRNRR) is very varied, and there is a great range of igneous and sedimentary rocks. This indicates that there are two types of islands. Alluvial islands that form naturally and are influenced by the hydrology and sediment transport capabilities of the system (Leopold and Wolman, 1957), and igneous granite (basement complex) islands are primarily found in the First Cataract area (Abu Al-Izz, 1971). The igneous islands foster distinctive combinations of local species, like the aquatic ecology of the River Nile. According to (Osterkamp et al., 1998). Along the riverbed channels and ravines of tectonic origin, the swirling rapids and shallows, whose intensity depended upon the seasonal gauge differences, created a stunning landscape. There are several larger islands with high-lying alluvial silt terraces to the north (Sehel, Saluga, and Elephantine) and south (El-Hesa, Biggeh, and Awad). These are the cultivated regions that give life to green strips in this picturesque scenery, together with the small floodplain deposits along the riverbanks. The stony islands that once prevented the Nile from meandering softly through Nubian sandstone and Eocene limestone formations as it passed through the Egyptian Nile Valley to the north, downstream of Elephantine, have vanished (Ritter 2012; Sampsell 2014). A fluvial island is a geomorphic feature surrounded by a channel that is higher than the mean water level (or the main network of nearby intermittent or ephemeral stream channels) and that lasts long enough to support the establishment of a permanent vegetation cover if sufficient moisture is present. The variation in the geological structure makes a major impact on the soil, drainage, topography, and vegetation (Çolak et al., 2006).

Climatic diversity

The FRNRR is located in a desert area of North Africa that is often characterized by scorching summers and colder winters with little rainfall (Ahmed et al., 2011). The area falls under the influence of the northeast trade winds between October and May, which causes the prevailing aridity (https://www.britannica.com/place/Nile-River/Climate-and-hydrology). Seasonally, the temperature is consistent. The lowest value temperatures may be as low as nine °C, while the highest temperatures may reach 43°C (Badry et al., 2019). The region experiences predominantly winter rainfall, which has Mediterranean origins and drops to less than an inch in bulk.

Hydrology of the FRNRR

The operation of the High Aswan Dam influences the flow rate and flow level downstream of Aswan Dam throughout the year. Historical records show a remarkable reduction in the maximum flow rate after the Aswan High Dam. Between 1982 and 2003, the maximum flow rate of (FRNRR) reduced from 700 million m3/day during the flood season to 280 million m3/day, and as a result, the suspended load and consequently, the overall load decreased (Raslan, 2015). According to (Shalash et al., 1996), (FRNRR) has deteriorated since HAD operation because of the decrease in suspended silt concentration (1996). (FRNRR) is the earliest reach to AHD; it has been most adversely affected by its construction and is currently experiencing sedimentation rather than degradation (Ahmed et al., 2014). The River Nile System's hydrology has changed as a result of the Nile water's regulation, creating water bodies with distinct water level regimes. This has led to variations in the species that predominate at each location as well as structural variations in aquatic plant communities and the vegetation (Al Sherif, 2009).

Morphological Variation of the FRNRR

The concept of "river morphology" refers to the shapes of river channels and how they alter over time in both shape and direction (Uddin et al., 2011). Due to anthropogenic disruptions and naturally occurring processes that are both temporally and spatially changeable, the long-term variation in the morphological properties of rivers is complex. Even by human standards, natural processes can move incredibly slowly and be virtually undetectable (Simon, 1989). The shifting of river channels over time has been a major focus of study in geomorphology. Sediment logical, historical sources, plan metric resurvey, repeated cross-profiling, erosion pins, and terrestrial photogrammetric techniques have all been used to measure riverbank erosion, bank collapse, deposition, channel direction change, and channel change (Asmare et al., 2019). The morphology of the Nile River has evolved during the past century because of geological, topographical, climatic, and human factors. It is affected by the composition and edibility of the river's bed and banks (such as sand, clay, and bedrock). Erosion is caused by the strength and consistency of the river's current. Also, the quantity of sediment (Mustafa et al., 2012). (FRNRR) showed a little change in the water's surface area during the period 1984 - 2011 and lost about 2.3% of its surface area (Negm et al., 2017). Three ecosystems make up the River Nile ecosystem along the reservoir: the slope, the water's edge, and the open water of the Nile Bank. Each of them has a unique type of vegetation (Badry et al., 2019).

Current situation of FRNRR

The main streams of the River Nile in Egypt and its Damietta and Rosetta branches are engulfing more than 300 islands, most of which are silt-covered, over its length of about 1200 km from Aswan to the Mediterranean coast. Islands are particularly crucial for maintaining the diversity of plants worldwide. Despite making up only 5% of the Earth's land surface, islands are home to nearly one-quarter of all known extant vascular plant species (Kreft et al., 2008). These islands grow and number as you travel north (Zahran and Willis, 2009). The islands display a wide range of origins, sizes, and structural characteristics (El Hadidi and Hosni, 2000). The number of islands in the Nile increased after the construction of the Aswan High Dam in 1965; because the Nile flood was completely controlled, and water levels downstream considerably decreased (Mohammed and Hekal, 2006). The total land area of islands in (FRNRR) dropped from 20.34 km2 (4841.96 feddan) to 16.01 km2 (3801.24 feddan), and the number of alluvial islands shrank from 37 to 32 between 1982 and 2003 (Raslan et al., 2015). According to (Abdel Azim et al., 2021), most of the islands in Aswan, which is situated at (24° 05' N, 32° 55' E), are made of granite, contributing to 30 islands of various sizes and structures, 12 of which are protected islands.

The flora of the FRNRR: the phytogeographical regions and their botanical richness

The database of the vascular flora of (FRNRR) was compiled, which includes 246 species belonging to 172 genera and 56 families (Appendix 1). The number of species given by (Täckholm et al., 1974) and (Boulos et al., 2009) is higher (773 species) because it relates to the Nile region. This means that the flora of (FRNRR) contributes about 31.8 % of the whole flora of the Nile region. According to (Boulos et al., 2009), Egypt's flora has 2121 species that are connected to 121 families on the national scale. This indicates that the flora of (FRNRR) contributes 11.6% of all species and 46.28% of all families. The combination of many environmental variables that are conducive to a large range of plant species may be the cause of the great diversity in this part of the River Nile (Badry et al., 2019). When a dam is built over a river, the biological and hydromorphological characteristics of the catchment are typically affected. The limnological regime is also greatly altered, both chemically and physically, which promotes the development of riparian and island plant communities and a notable increase in the variety of plant taxa (Ngcaba and Maroyi, 2017). The Poaceae (51 species = 20.73 %), Fabaceae (31 species = 12.60 %), and Asteraceae (22 species = 8.94 %) families were the most species-rich families. These families are also the most prevalent in the floristic composition of Egypt's irrigation and drainage canals, as well as the Nile River (Springuel 1981; Ali 2004; Hamedet al., 2012). This can be ascribed to their broad ecological tolerance range, effective seed dispersal ability, migration efficiency, and local water depth conditions (Al-Sherif et al., 2013). Followed by Euphorbiaceae and Brassicaceae represented by 4.47% (11 species). While Amaranthaceae and Cyperaceae were represented by 4.07% (each of 10 species) (Table 1, Figure 2). Egypt is divided into arid and hyper-arid regions and is in a dry tropical environment (Ayyad and Ghabour, 1986). Variable numbers of species indicate a variety of diverse floristic aspects, including Cosmopolitan, Pantropical, Palaeotropical, Saharo-Arabian, Sudano-Zambezian, Irano-Turanian, and Euro-Siberian elements. The occurrence of diverse floristic chorotypes with varying species counts can be attributed to various factors, including human activity, agricultural history, water fluctuations, and the ability of specific floristic elements to infiltrate the study area from nearby phytogeographical regions (Shalaby1995; Shaltout et al., 2010; Shaltout et al. 2015). The pantropical, palaeotropical, and cosmopolitan species, respectively were the most dominant in the study area (54.47 % of the total flora) (Figure 3). This is in line with the report's findings that most Egypt's plant species are cosmopolitan, palaeotropical, or pantropical (Shaheen et al., 2004).

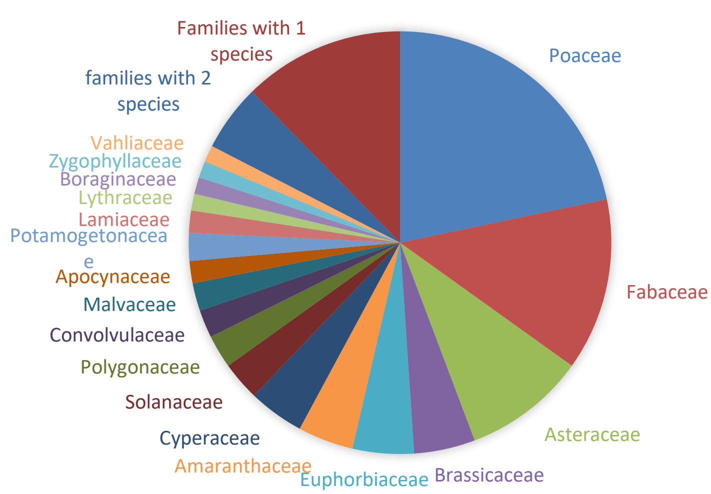

Figure 2. Numbers of the species in each of the 56 families surveyed in the First Reach of the Nile River Region (FRNRR).

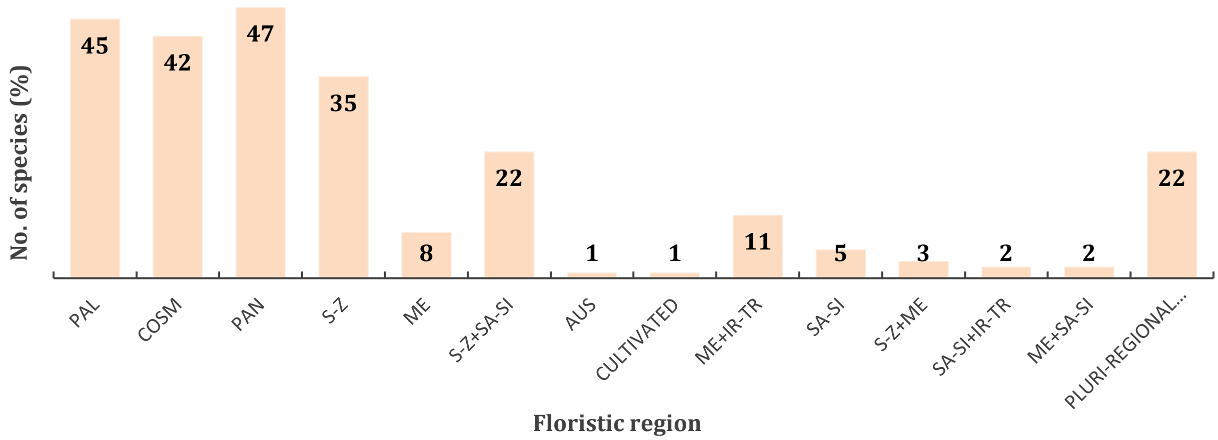

Figure 3. Chorological analysis of plant species recorded in the First Reach of the Nile River Region (FRNRR). *COSM: Cosmopolitan, ER-SR=Euro-Siberian, IR-TR: Irano-Turanian, ME: Mediterranean, PAL: Palaeotropical, PAN: Pantropical, SA-SI: Saharo-Sindian, S-Z: Sudano-Zambezian.*

Table 1. Total number of genera and species within each family with their percentages.

Families	Genera		Species	
	Total	%	Total	%
Poaceae	32	18.60	51	20.73
Fabaceae	23	13.37	31	12.60
Asteraceae	19	11.05	22	8.94
Brassicaceae	9	5.23	11	4.47
Euphorbiaceae	3	1.74	11	4.47
Amaranthaceae	4	2.33	10	4.07
Cyperaceae	3	1.74	10	4.07
Solanaceae	4	2.33	7	2.85
Polygonaceae	3	1.74	6	2.44
Convolvulaceae	3	2.33	5	2.03
Malvaceae	5	2.91	5	2.03
Apocynaceae	3	1.74	4	1.63
Potamogetonaceae	3	1.74	5	2.03
Lamiaceae	3	1.74	4	1.63
Lythraceae	2	1.16	3	1.22
Boraginaceae	3	1.74	3	1.22
Zygophyllaceae	2	1.16	3	1.22
Vahliaceae	1	0.58	3	1.22
Hydrocharitaceae	2	1.16	3	1.22
Salicaceae	1	0.58	2	0.81
Plantaginaceae	2	1.16	3	1.22
Caryophyllaceae	2	1.16	2	0.81
Verbenaceae	2	1.16	2	0.81
Rubiaceae	1	0.58	2	0.81
Apiacea	2	1.16	2	0.81
Onagraceae	2	1.16	2	0.81
Myrtaceae	2	1.16	2	0.81
Oxalidaceae	1	0.58	2	0.81
Arecaceae	2	1.16	2	0.81
Araceae	2	1.16	2	0.81
Families with 1 species	26	15.12	26	11.79
Total	172		246	

The major publications dealing with the entire flora of (FRNRR)

One of the earliest scientific descriptions of the vegetation of (FRNRR) was produced by (Springuel et al., 1981) from the granite islands of the First Cataract at Aswan, which recorded 94 species of flowering plants, belonging to 34 families. These islands are among the oldest known islands, which support natural vegetation and are believed to be the only remains of the original plant cover of the Nile land that survived after the establishment of the Aswan Dam (1902-1930) and the High Dam (1965-1969). Moreover, (Hamada et al., 2004) studied the plant life of seven islands in the Nile stream at Aswan Governorate (north of the Aswan dam until reaching Edfu). She recorded 206 plant species belonging to 153 genera and 51 families representing the flora of the studied islands. Ali et al., (2014) described the ecological characteristics and floristic composition of Ten River Nile islands in the area between Aswan and Esna, Of them, seven islands (At-Tiwysah, Billulah, Faris, Bisaw, El-Qanadlah, Al-Fuazah, and Zarnikh,) were declared among the protected Nile islands by the Prime Minister’s Decree under Law No. 1969 in 1998 and three islands (El-Kiman, Al Mi'allah and Al-Shagab) were chosen randomly for comparison with the protected islands. The dominant species recorded in most islands were *Acacia nilotica*, *Convolvulus arvensis*, *Oxalis cornculata*, *Cynodon dactylon*, *Ceratophyllum demersum,* and *Aster squamatus.* The study of Abdel Azim et al. (2021) recorded 112 species in the Suluga and Gezel protected area, which has semi-arid scrub and grassland remnants of the ancient Nubian Riverain Vegetation (Table 2).

Table 2. studies carried out in the first reach of the Nile River region showing the number of the plant taxa, genera and families, dominant families, and chorotypes. Family names are updated according to World Flora Online. The life form and the Chorotypes are abbreviated as follows: Th: Therophyte, Ph: Phanerophyte, Geo: Geophyte, H.H. Hydrophyte-Helophyte, COSM: Cosmopolitan, PAL: Palaeotropical, PAN: Pantropical and S-Z: Sudano-Zambezian.

study	Islands geology	No. of islands	Names of islands	Species No.	Families No.	Dominant Families	Dominant life form	Dominant chorotype
(Abdel Azim et. al., 2021)	Rocky islands	2	Ghazal-Saluga	112	37	Poaceae (21.4%) Fabaceae (15.2%) Asteraceae (10.7%)	Th. (54%) Ph. (16%) Geo. (7%)	Pal (23.2%) Cosm (17%) Pan (16.1%)
(Ali et al., 2014)	Sedimentry islands	10	Tiwgsah -Billulah – Faris- Bissawi - Ganadlah - Alfaouzah - Zarnikh – El Kiman- Al Mi'allah – Al Shaghab	162	51		Th. (52.46%) Ph. (17.28%) H.H. (12.34%)	
(Hamada et. al., 2004)	Rocky and Sedimentry	7	Ghazal-Saluga - Elephantina-Kubbanyia Mansouryia -Sarag –Melikyia	206	50	poaceae (19,40%) fabaceae (13.60%) Asteraceae (9.70%)	Th. (48.67%) Ph. (13.04%) H.H. (9.20%) Geo. (9.20%)	PAN (22.00%) PAL (20.00%) COSM (19.00%) S-Z (11.00%)
(Springuel et. Al., 1981)	Rocky and Sedimentary	5	Aswan_ Burbur-Sulaga - Ghazal-Sahayl	94				

This analysis found that within 40 years, + 28 species (20%) may have been extinct or highly rare. The current study area's human interface, extreme environmental circumstances, and climate change may be the cause of this extinction.

CONCLUSION

This work investigates the floristic composition and the major factors affecting the distribution and grouping of the plant species that are present along the first reach of the Nile River. A total of 246 species of flowering plants (Angiospermae) and ferns were recorded from the study area belonging to 172 genera in 56 families. Pantropical, Palaetropical, and Cosmopolitan elements (54.47 % of the total flora) were the dominant floristic categories among the total number of species. An overview of the resurveying of historical vegetation data along the first reach of the Nile River is given in this publication. The abundance of historical plot data available represents a valuable source for understanding long-term vegetation dynamics and how vegetation responds to various drivers. Resurveying historical vegetation data can offer unique insights into vegetation changes in relation to environmental changes over decades. However, there are certain challenges associated with using such data. The anthropization of their flora and vegetation linked to human activities may be tracked over time thanks to floristic inventories and the first vegetation maps. This lays the groundwork for longer-term research in the future on the evolution of the flora in relation to anthropogenic and climatic changes. The FRNRR can be considered a treasure that deserves conservation efforts to limit its ongoing degradation. Indeed, although most of the islands in this region are protected by law or state lands, they are still being degraded by grazing mammals and invasive plant species.

COMPETING INTERESTS

The authors report no conflicts of interest regarding this work.

AUTHORS CONTRIBUTIONS

Dalia Abd El-Azeem Ahmed and Fatma Adel Ali: conception and design, acquisition, drafting the article, and revising it. They approved the final version to be submitted for publication. Mohamed Gaber Sheded and Tarek Radwan: drafting the article and revising it. They approved the final version to be submitted for publication. All authors read and approved the final manuscript.

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AVAILABILITY OF DATA AND MATERIALS

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Appendix 1. Floral lists of the first reach of the Nile River region from 1981 to 2021. The Chorotypes are abbreviated as follows: COSM: Cosmopolitan, ER-SR=Euro-Siberian, IR-TR: Irano-Turanian, ME: Mediterranean, PAL: Palaeotropical, PAN: Pantropical, SA-SI: Saharo-Sindian, S-Z: Sudano-Zambezian.

Family	Species	Chorology	Abdel Azim (2021)	Ali (2014)	Hamada (2004)	Springuel (1981)
Salviniaceae Martinov	*Azolla filiculoides* Lam	PAN		+	+	
Pteridaceae **E.D.M.Kirchn.**	*Adiantum capillus-veneris* L.	ME + IR-TR + ER-SR		+		
Salicaceae Mirbel	*Salix mucronata* Thunb.	S-Z+SA-SI	+	+	+	+
	Salix tetrasperma Roxb.	PAL			+	
Polygonaceae Juss.	*Persicaria lanigera* (R. Br.) Soják	PAL		+	+	
	Persicaria decipiens (R.Br.) K.L.Wilson	PAL		+	+	
	Persicaria senegalensis (Meisn.) Soják	PAL	+	+	+	+
	Polygonum plebeium R. Br.	PAL			+	
	Rumex dentatus L.	ME+IR-TR+S-Z	+	+	+	
	Emex spinosa (L.) Campd.	ME		+	+	
Nyctaginaceae Juss.	*Boerhavia repens* L.	PAL		+	+	
Molluginaceae Bartl.	*Glinus lotoides* L.	PAL	+	+	+	+
Aizoaceae Martinov	*Trianthema portulacastrum* L.	PAN		+	+	
Portulacaceae Juss.	*Portulaca oleracea* L.	COSM	+	+	+	+
Caryophyllaceae Juss.	*Silene nocturna*L.	ME		+	+	
	Stellaria apetala Ucria.	ME+ER-SR		+	+	
Amaranthaceae Juss	*Beta vulgaris* L.	ME+IR-TR+ER-SR			+	
	Chenopodium berlandieri Moq.	COSM	+	+	+	+
	Dysphania ambrosioides (L.) Mosyakin & Clemants	COSM		+	+	
	Chenopodiastrum murale (L.) S.Fuentes, Uotila & Borsch	COSM	+	+	+	
	Alternanthera sessilis (L.) Dc.	PAN	+	+	+	
	Amaranthus blitoides S.Watson	PAN			+	
	Amaranthus graecizans L.	ME+IR-TR	+	+	+	+
	Amaranthus hybridus L. subsp. *hybridus*	COSM		+		
	Amaranthus blitum subsp. *oleraceus* (L.) Costea	ME+IR-TR		+		
	Amaranthus viridis L.	PAL	+	+	+	+
Ranunculaceae Juss.	*Ranunculus marginatus* d'Urv.	ME+IR-TR+ER-SR		+	+	
Ceratophyllaceae Gray	*Ceratophyllum demersum* L.	COSM	+	+	+	+
Cleomaceae Bercht. & J.Presl	*Cleome gynandra* L.	PAL	+	+	+	
Brassicaceae Burnett	*Capsella bursa-pastoris* (L.) Medik.	COSM		+	+	
	Coincya tournefortii (Gouan) Alcaraz, T.E.Díaz, Rivas Mart. & Sánchez-Gómez	ME+IR-TR			+	
	Lepidium didymum L.	COSM		+	+	
	Lepidium niloticum (Delile) Sieber ex Steud.	S-Z			+	
	Eruca vesicaria (L.) Cav.	ME+IR-TR+ER-SR			+	
	Erucastrum arabicum Fisch. & C.A.Mey.	PAL		+	+	+
	Rhamphospermum nigrum (L.) Al-Shehbaz	COSM		+	+	
	Rorippa indica (L.) Hiern	ME+IR-TR+ER-SR	+	+	+	
	Rorippa palustris (L.) Besser	COSM	+		+	
	Sinapis arvensis L.	COSM			+	
	Sisymbrium irio L.	ME+IR-TR+ER-SR		+	+	
Papaveraceae Juss.	*Argemone mexicana* L.	PAN		+	+	
Menispermaceae Juss.	*Cocculus pendulus* (J.R.Forst. & G.Forst.) Diels	PAL		+	+	+
Fabaceae Juss.	*Acacia nilotica* (L.) Delile	S-Z	+	+	+	+
	Albizia lebbeck (L.) Benth.	PAN			+	
	Alhagi graecorum Boiss.	PAL		+	+	
	Astragalus vogelii (Webb) Bornm.	S-Z+SA-SI		+	+	
	Biancaea decapetala (Roth) O.Deg.	PAN			+	
	Cajanus cajan (L.) Huth	S-Z		+	+	+
	Dalbergia sissoo Roxb. ex DC.	PAN			+	
	Desmodium tortuosum (Sw.) DC	PAN	+		+	
	Faidherbia albida (Delile) A. Chev.	S-Z	+		+	+
	Indigofera hochstetteri Baker	S-Z+SA-SI	+		+	
	Indigofera oblongifolia Forssk.	S-Z				+
	Lablab purpureus (L.) Sweet	S-Z	+		+	
	Lotus arabicus Sol. ex L.	S-Z+SA-SI	+	+	+	+
	Lotus glinoides Delile.	SA-SI		+		
	Medicago sativa L.	PAN			+	+
	Melilotus indicus (L.) All.	PAL	+	+	+	
	Mimosa pigra L.	PAN	+	+	+	+
	Senegalia laeta (R.Br. ex Benth.) Seigler & Ebinger	S-Z	+		+	+
	Senna italic Mill.	S-Z+SA-SI	+		+	
	Senna occidentalis (L.) Link	PAN			+	
	Senna sophera (L.) Roxb.	PAN			+	
	Sesbania sesban (L.) Merr.	S-Z	+	+	+	+
	Tephrosia purpurea subsp. *apollinea* (Delile) Hosni & El-Karemy	S-Z+SA-SI	+	+	+	+
	Trifolium alexandrinum L.	ME+IR-TR			+	
	Trifolium resupinatum L.	ME+IR-TR+ER-SR	+	+	+	
	Trigonella glabra Thunb.	ME+S-Z+SA-SI	+	+	+	+
	Trigonella laciniata L.	S-Z+SA-SI			+	
	Vachellia nilotica subsp. tomentosa (Benth.) Kyal. & Boatwr.	S-Z				+
	Vachellia seyal (Delile) P.J.H.Hurter	S-Z	+	+	+	+
	Vachellia tortilis subsp. raddiana (Savi) Kyal. & Boatwr.	S-Z	+		+	
	Vicia sativa L.	ME+IR-TR+ER-SR	+	+	+	
Oxalidaceae R. Br.	*Oxalis corniculata* L.	COSM	+	+	+	
	Oxalis violacea L.	PAN			+	
Zygophyllaceae R. Br.	*Balanites aegyptiaca* (L.) Delile.	S-Z+SA-SI			+	+
	Tribulus parvispinus C.Presl.	S-Z+SA-SI	+		+	
	Tribulus terrestris L.	COSM		+	+	+
Euphorbiaceae Juss.	*Euphorbia forsskaolii* J. Gay	S-Z+SA-SI	+		+	
	Euphorbia helioscopia L.	COSM		+	+	
	Euphorbia heterophylla L.	PAN		+	+	
	Euphorbia hirta L.	PAN	+	+	+	+
	Euphorbia hypericifolia L.	SA-SI+IR-TR				+

	Euphorbia indica Lam.	SA-SI		+		
	Euphorbia granulata Forssk.	SA-SI		+		
	Euphorbia peplus L.	COSM	+	+	+	
	Euphorbia prostrata Aiton.	PAN		+	+	
	Jatropha glauca Vahl.	S-Z				+
	Ricinus communis L.	PAN		+	+	+
Capparaceae Juss.	*Capparis decidua* Edgew.	S-Z				+
Rhamnaceae Juss.	*Ziziphus spina-christi* (L.) Willd.	S-Z+SA-SI	+	+	+	+
Casuarinaceae R.Br.	*Casuarina glauca* Spreng.	PAN		+		
Cucurbitaceae Juss.	*Citrullus colocynthis* (L.) Schrad.	ME+SA-SI			+	
Myrtaceae Juss.	*Eucalyptus camaldulensis* Dehnh.	AUS		+		
	Syzygium cumini (L.) Skeels	PAL		+	+	
Sapindaceae Juss.	*Cardiospermum halicacabum* L.	PAN	+		+	+
Urticaceae Juss.	*Urtica urens* L.	ME+IR-TR+ER-SR		+		
Malvaceae Juss.	*Abutilon pannosum* (G. Forst.) Schultdl.	S-Z	+		+	+
	Alcea rosea L.	ME			+	
	Corchorus olitorius L.	PAN	+		+	
	Malva parviflora L.	ME+IR-TR	+	+	+	
	Sida alba L.	PAN		+	+	
Tamaricaceae Link	*Tamarix senegalensis* DC.	S-Z+SA-SI	+	+	+	+
Lythraceae J.St.-Hil.	*Ammannia baccifera* L.	PAL		+	+	
	Ammannia senegalensis Lam.	COSM			+	
	Lawsonia inermis L.	S-Z	+	+	+	
Onagraceae Juss.	*Epilobium hirsutum* L.	PAL			+	
	Ludwigia adscendens subsp. diffusa (Forssk.) P.H.Raven	S-Z		+		
Haloragidaceae R. Br.	*Myriophyllum spicatum* L.	PAL	+	+	+	
Apiaceae Lindl.	*Cyclospermum leptophyllum* (Pers.) Sprague ex Britton & P.Wilson	PAN		+	+	
	Ammi majus L.	ME	+	+	+	
Primulaceae Batsch ex Borkh.	*Lysimachia arvensis* (L.) U.Manns & Anderb	COSM	+	+	+	
Gentianaceae Juss.	Centaurium pulchellum (Sw.) Druce	ME+IR-TR+ER-SR			+	
Apocynaceae Juss.	*Calotropis procera* (Aiton) Dryand	SA-SI	+	+	+	+
	Leptadenia arborea (Forssk.) Schweinf.	S-Z	+	+	+	+
	Leptadenia pyrotechnica (Forssk.) Decne.	S-Z+SA-SI		+		
	Oxystelma esculentum (L.f.) Sm.	S-Z	+	+	+	+
Rubiaceae Juss.	*Oldenlandia capensis* L.f.	PAL	+	+	+	+
	Oldenlandia fastigiata Bremek.	PAL				+
Convolvulaceae Juss.	*Convolvulus arvensis* L.	PAL	+	+	+	
	Ipomoea cairica (L.) Sweet	PAL	+	+	+	+
	Ipomoea carnea Jacq.	PAN			+	
	Ipomoea eriocarpa R. Br.	PAN	+	+	+	
	Cuscuta pedicellata Ledeb.	S-Z+ME	+	+	+	
Boraginaceae Juss.	*Cordia sinensis* Lam.	S-Z+SA-SI			+	
	Euploca ovalifolia (Forssk.) Diane & Hilger	PAL	+		+	+
	Heliotropium supinum L.	S-Z+ME	+	+	+	+
Verbenaceae J.St.-Hil.	*Lantana camara* L.	PAN			+	
	Phyla nodiflora (L.) Greene	PAN		+	+	
Lamiaceae Martinov	*Lamium amplexicaule* L.	COSM	+	+	+	
	Mentha longifolia (L.) Huds.	PAL		+	+	
	Mentha pulegium L.	ME+IR-TR+ER-SR			+	
	Ocimum basilicum L.	cultivated				+
Solanaceae Juss.	*Datura innoxia* Mill.	PAN	+	+	+	
	Datura stramonium L.	PAN			+	
	Hyoscyamus muticus L.	S-Z				+
	Physalis angulata L.	PAN	+	+	+	
	Solanum diphyllum L.	PAN			+	
	Solanum nigrum L.	COSM	+	+	+	+
	Withania somnifera (L.) Dunal	S-Z+SA-SI	+	+	+	
Vahliaceae Dandy	*Vahlia dichotoma (*Murray) Kuntze	S-Z				+
	Vahlia digyna (Retz.) Kuntze	S-Z	+	+	+	+
	Vahlia geminiflora (Caill. & Delile) Bridson	S-Z				+
Pedaliaceae R.Br.	*Sesamum indicum* L.	PAL		+		
Orobanchaceae Vent.	*Orobanche ramosa* L.	COSM		+	+	
Plantaginaceae Juss.	*Plantago lagopus* L.	ME+IR-TR			+	
	Plantago major L.	COSM		+	+	+
	Veronica anagallis-aquatica L.	COSM	+		+	+
Asteraceae Giseke	*Ageratum conyzoides* L.	PAN			+	
	Ambrosia polystachya DC.	ME		+	+	
	Anthemis pseudocotula Boiss.	ME+IR-TR			+	
	Bidens pilosa L.	PAN	+	+	+	
	Ceruana pratensis Forssk.	S-Z				+
	Cichorium endivia L.	ME+IR-TR		+	+	
	Nidorella aegyptiaca (L.) J.C.Manning & Goldblatt	S-Z	+	+	+	+
	Erigeron bonariensis L.	COSM			+	
	Eclipta prostrata (L.) L..	PAN	+	+	+	+
	Galinsoga parviflora Cav.	COSM			+	
	Lactuca sativa L.	S-Z			+	
	Pluchea dioscoridis (L.) DC.	S-Z+SA-SI	+	+	+	+
	Blumea viscosa (Mill.) V.M.Badillo	PAL	+		+	+
	Laphangium luteoalbum (L.) Tzvelev	COSM	+	+	+	+
	Pulicaria arabica Cass.	ME+IR-TR		+	+	
	Pulicaria undulata (L.) C.A.Mey.	S-Z+SA-SI	+	+	+	+
	Senecio aegyptius L. var. aegyptius	S-Z	+	+	+	+
	Senecio aegyptius L. var. discoideus Boiss	S-Z	+		+	
	Sonchus oleraceus L.	COSM	+	+	+	+
	Aster squamatus Hieron.	PAN	+	+	+	
	Urospermum picroides (L.) Scop. ex F.W.Schmidt	ME+IR-TR		+		
	Xanthium strumarium Lour.	PAL	+	+	+	
Hydrocharitaceae Juss.	*Najas marina subsp. intermedia* (Wolfg. ex Gorski) Casper	ME+SA-SI				+
	Najas horrida A.Braun ex Magnus	PAL		+	+	+

	Vallisneria spiralis L.	ME+ER-SR+S-Z	+	+	+	
Potamogetonaceae Bercht. & J.Presl	*Potamogeton crispus* L.	COSM	+	+	+	+
	Potamogeton nodosus Poir.	COSM		+	+	
	Stuckenia pectinata (L.) Börner.	COSM		+	+	+
	Potamogeton perfoliatus L.	COSM		+	+	+
	Zannichellia palustris L.	COSM				+
Pontederiaceae Kunt.	*Pontederia crassipes* Mart.	PAN		+	+	
Juncaceae Juss.	*Juncus rigidus* Desf.	ME+IR-TR+SA-SI	+		+	
Poaceae Barnhart	*Avena fatua* L.	COSM		+	+	+
	Avena sterilis L.	ME		+	+	
	Moorochloa eruciformis (Sm.)	ME+IR-TR			+	
	Urochloa reptans (L.) Stapf	COSM			+	
	Bromus catharticus Vahl.	PAN			+	
	Cenchrus biflorus Roxb.	PAL	+	+	+	
	Cenchrus violaceus (Lam.) Morrone	PAL		+		
	Chloris pycnothrix Trin.	S-Z	+		+	
	Chloris virgata Sw.	PAL	+	+	+	
	Sporobolus schoenoides (L.) P.M.Peterson	COSM	+	+	+	+
	Cynodon dactylon (L.) Pers	PAN	+	+	+	+
	Dactyloctenium aegyptium (L.) Willd.	PAL	+	+	+	
	Desmostachya bipinnata (L.) Stapf	S-Z+SA-SI	+	+	+	+
	Dichanthium annulatum (Forssk.) Stapf	PAL	+	+	+	
	Dichanthium foveolatum (Delile) Roberty	SA-SI+IR-TR				+
	Digitaria nodosa Parl.	SA-SI				+
	Digitaria sanguinalis (L.) Scop.	PAL	+	+	+	+
	Diplachne fusca (L.) P.Beauv. ex Roem. & Schult.	PAL	+	+		+
	Echinochloa colona (L.) Link	PAN	+	+	+	+
	Echinochloa stagnina (Retz.) P. Beauv.	PAN			+	
	Eleusine indica (L.) Gaertn.	PAL	+	+	+	
	Eragrostis aegyptiaca (Willd.) Delile	S-Z	+	+	+	+
	Eragrostis cilianensis (All.) Vignolo ex Janch.	COSM	+	+	+	+
	Eragrostis japonica (Thunb.) Trin.	PAL	+		+	
	Eragrostis pilosa (L.) P. Beauv.	PAL	+	+	+	+
	Hemarthria altissima (Poir.) Stapf & C.E.Hubb.	S-Z				
	Hemarthria natans Stapf.	S-Z				+
	Imperata cylindrica (L.) Raeusch.	PAL	+	+	+	+
	Leersia hexanda Sw.	ME+IR-TR+SA-SI			+	+
	Lolium perenne L.	ME+IR-TR+ER-SR		+	+	
	Lolium temulentum L.	ME+IR-TR+ER-SR			+	
	Panicum coloratum L.	S-Z	+	+	+	+
	Panicum repens L.	COSM	+	+	+	+
	Setaria geminata (Forssk.) Veldkamp	PAL		+	+	
	Paspalum distichum L.	PAL		+	+	
	Phalaris minor Retz.	ME+IR-TR+ER-SR		+	+	
	Phragmites australis (Cav.) Trin. ex Steud.	PAL	+	+	+	+
	Poa annua L.	ME+IR-TR+ER-SR		+		
	Poa infirma Kunth.	ME	+		+	
	Polypogon monspeliensis (L.) Desf.	COSM	+	+	+	+
	Polypogon viridis (Gouan) Breistr.	ME+IR-TR	+	+	+	
	Rostraria cristata (L.) Tzvelev	ME+IR-TR+ER-SR		+	+	
	Saccharum spontaneum L. subsp. *aegyptiacum* (Willd.) Hack	PAN		+	+	+
	Schoenefeldia gracilis Kunth	S-Z+SA-SI				+
	Setaria pumila (Poir.) Roem. & Schult.	COSM			+	
	Setaria verticillata (L.) P. Beauv.	COSM		+	+	
	Setaria viridis (L.) P. Beauv.	COSM		+	+	
	Sorghum halepense (L.) Pers.	PAN		+		
	Sorghum virgatum (Hack.) Stapf	S-Z	+	+	+	
	Sorghum × drummondii (Nees ex Steud.) Millsp. & Chase	PAL		+		
	Vossia cuspidata (Roxb.) Griff.	S-Z+SA-SI		+		
Araceae Juss.	*Lemna gibba* L.	COSM	+		+	
	Spirodela polyrhiza (L.) Schleid.	COSM			+	
Arecaceae Bercht. & J.Presl	*Hyphaene thebaica* (L.) Mart.	S-Z	+	+	+	+
	Phoenix dactylifera L.	S-Z+SA-SI	+		+	
Typhaceae Juss.	*Typha domingensis* (Pers.)	PAN	+	+	+	+
Cyperaceae Juss.	*Cyperus alopecuroides* Rottb.	PAN	+	+	+	
	Cyperus difformis L.	PAN	+	+	+	+
	Cyperus laevigatus L.	PAL			+	
	Cyperus longus L.	ME				+
	Cyperus maculatus Boeckeler	S-Z				+
	Cyperus michelianus (L.) Delile	PAL	+	+	+	
	Cyperus mundii var. *mundii*	S-Z+ME				+
	Cyperus rotundus L.	PAN	+	+	+	+
	Eleocharis geniculata (L.) Roem. & Schult	PAN			+	
	Fimbristylis bisumbellata (Forssk.) Bubani	PAL	+	+	+	+