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Floristic Composition of the Farasan Archipelago in Southern Red Sea and its Affinities to Phytogeographical Regions

الجغرافيا النباتية لأرخبيل جزر فرسان في جنوب البحر الأحمر: التكوينات النباتية وانتماءاتها

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Abstract: This Floristic affinities of the Angiosperm flora of Farasan Archipelago are analyzed. Phytogeographically, it is an interesting area due to its location between a floristically rich North East Africa and the Arabian Peninsula. As per the current estimates, 201 species of higher plants belonging to 49 families are present in an area of less than 600 km^2. Among these 2.5% are regional endemics and 15 (7.5%) species are, so far, not reported from any other parts of the Arabian Peninsula. The endangered flora of the archipelago is of conservation concern, which is poorly recognized, both nationally and internationally. Populations of some of the locally endangered species are represented by 100-500 individuals distributed in less than 5 km^2. Among these Euphorbia collenetteae Al-Zahran and El-Karemy, an endemic species seen in limited numbers. The entire estimated degree of occurrence of this species is approximately less than 40 km^2, with the actual area of occupancy being less than 10 km^2. Since the topography, climate and the overall vegetation of these islands are more or less similar to that of the southwestern coastal regions of the Arabian Peninsula and the area lies within the Somalia-Masai regional centre of endemism (phytogeographical region), the majority of species are of African origin. Yet, islands also contain a significant number of other species that shape the vegetation of the Tihama Region of Jizan (Jazan) Province in the mainland. A detailed analysis carried out on various life-forms shows that the highest percentage share of species (38.46%) is with the Somali-Masai phytogeographical zone, followed by Tropical African (25.64%) and Saharo-Arabian (16.02%) phytogeographical zones.

Keywords: *Farasan Islands, floristic composition, phytogeography, Arabian Peninsula, Somalia-Masai, endemism.*

المستخلص: تمت دراسة وتحليل نبات ملقح ذاتيا ينتمي لأرخبيل جزر فرسان. ومن ناحية الجغرافيا النباتية فهي منطقة مثيرة للاهتمام نظرا لموقعها بين منطقة شمال شرق أفريقيا وشبه الجزيرة العربية الغنية بالنباتات. وفقا للتقديرات الحالية، هناك 201 نوع من النباتات الراقية تنتمي إلى 49 عائلة موجودة في مساحة تقل عن 600 كلم مربع. من بين هؤلاء 3.5 ٪ من النباتات متوطنة اقليمياً و 15 (7.5 ٪) من الأنواع لم تسجل حتى الآن في أي أجزاء أخرى من شبه الجزيرة العربية. هناك العديد من النباتات المهددة بالانقراض في الأرخبيل هي التي نهتم بالمحافظة عليها ، والتي هي في حالة سيئة ومعترف بها وطنيا ودوليا على حد سواء. المجتمعات النباتية لبعض الأنواع المهددة بالانقراض محليا تمثل 100 - 500 نوع موزعة في أقل من 5 كلم مربع. من بين هذه الانواع Euphorbia collenetteae Al-Zahran و El-Karemy ، على الأنواع المستوطنة وتشاهد في عدد محدود من المساحة. درجة بأكمله يقدر حدوث هذه الأنواع هي تقريبا أقل من 40 كلم مربع ، مع المجال الفعلي لشغل يجري أقل من 10 كلم مربع. ولأن التضاريس والمناخ والغطاء النباتي العام لهذه الجزر مماثلة بطريقة أو باخرى لتلك التي في المناطق الساحلية في جنوب غرب شبه الجزيرة العربية والمنطقة التي تقع داخل اقليم الصومال - ماساي والذي يعتبر المركز الإقليمي لهذه النباتات المتوطنة، فإن الغالبية العظمى من هذه الأنواع تعتبر من أصل أفريقي. وتحتوي الجزر أيضا على عدد كبير من الأنواع الأخرى التي تشكل الغطاء النباتي لإقليم تهامة بمنطقة جازان (جازان). تم إجراء تحليل مفصل نفذ على مختلف أشكال الحياة النباتية حيث تبين أن أعلى حصة من الأنواع (35 ٪) يأتي من المنطقة الصومالية - ماساي ، تليها منطقة أفريقيا الاستوائية (26.5 ٪) ثم المناطق العربية الصحراوية (13.5 ٪).

كلمات مدخلية: *جزر فرسان، الجغرافيا النباتية، شبه الجزيرة العربية ، الصومال - ماساي، التوطين.*

INTRODUCTION

In The migration and establishment of higher plants in isolated habitats within islands and remote mountainous areas are enhanced by historic factorssuch as uplifted coral reefs or the movement of tectonic plates resulting in ridges and folds. The Farasan Archipelago is believed to be a group of uplifted coral reefs (Dabbagh, *et al.* 1984) holding a significant number of higher plants, some of which are endemic to the region. Phytogeographically, the islands are in the middle of the Boreo-subtropical zone (Good, 1974).

Because of these islands' long term isolation and botanical wealth, an attempt is made to discuss the plant geography and main vegetation units of some of the important islands in the Archipelago and correlate them with the floristic units present in the Arabian and African mainlands.

The study area is situated on the southeastern end of the Red Sea where the sea reaches its maximum width of 360 km. Phytogeographically, the islands are located in a strategic position (16° 20` – 17° 20` N to 41° 24` – 42° 26` E), between the coast of Jizan (Jazan) in the Arabian Peninsula and the Dahlac Islands on the African side (Figure 1). The archipelago consists of over 36 large and small islands, each of which is believed to be of coral reefs, lime-stones and aeolian deposits. The islands are, generally, of undulated or uniform flat reef and attain an altitude ranging from a few meters to 70 (-75) m at a few locations. The climate of the islands is not different from that of the Jizan Province on the mainland; which is characterized by a long dry period (35-40 °C) and a mild, short period (28-30 °C) of three to four months. Precipitation is generally erratic and irregular, ranging from 5-20 mm/annum.

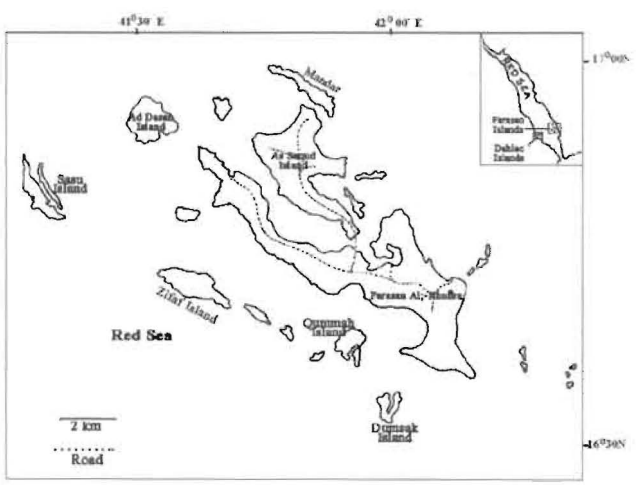

Fig. 1. Map of Farasan Islands.

The floristic components in Farasan Islands are not strikingly rich, compared to the flora of the Socotran Archipelago (a group of islands situated in the Indian Ocean, about 340 km south of Yemen), where 30 % of the flora is endemic (Miller and Nyberg, 1991). However, the floristic richness and taxonomic diversity of the Farasan Archipelago is, to a certain extent, distinct from the flora of the nearest mainland region, the Tihama region of the Jizan Province. This is primarily due to the presence of a few important floral elements which are not reported from any other parts of Saudi Arabia or Yemen.

The entire study area, particularly the main island, Farasan Al-Khubra (Farasan Al-Kabir) has been declared as a protected area by the National Commission for Wildlife Conservation and Development (NCWCD) because of the presence of a large population of Idimi Gazelle (Gazella gazella) and a few other animals such as amphibians, birds, foxes, turtles, eagles, etc. These islands also carry some particular ecological importance because they provide a 'safe' migratory route for certain birds of Siberian and Asian origin. The influence of external agents on the flora of these islands is also somewhat insignificant, except for the introduction of certain exotic species alongsides of the streets in some parts of the main island, such as Prosopis juliflora and some of the annual garden plants of lesser significance.

Based on the species prepared, which contained primarily perennial components, it was possible to categorize the chorological units. Until 1990, the vegetation and flora of the Farasan Archipelago was among the least known plant diversity hot-spots (species rich areas) within Saudi Arabia. Apart from the meticulous field work of Collenette (1985, 1999), a number of other researchers and plant collectors have contributed towards the knowledge of the flora and vegetation of these remarkable islands (Migahid, 1988-1990; Chaudhary, 1989, 1999-2001; Alfarhan, +., 2002). The main characteristics of the vegetation of the Farasan Islands have been reported by (Alwelaei, *et al.* 1993) and (El-Demerdash, 1996) while the floristic affinities of the entire Saudi Arabian Peninsula or some areas of particular interest have been presented by (Alfarhan, 1999) and (Konig, 1988) respectively.

The flora comprises about 200 species of flowering plants in 49 families. A detailed account on the floristic strength and major families that make up the bulk of the flora of theFarasan Islands has been given by several authors at various ecological and floristic levels (Alwelaie, 1993; Hassan and Al-Hemaid, 1996; Atiqur Rahman, *et al.* 2002) and particularly by (Alfarhan, *et al.* 2002). El-Demerdash, (1996) has identified seven vegetation stands linked to seven habitats (silty runnels, palm orchards, rocky plains, rocky plateau crevices, coastal sand dunes, sand plains and mangroves) while Alwelaie, *et al.* (1993) presented a broad spectrum of the vegetation of the five main islands.

Studying the distribution strategy of the vegetation at species level provided an accurate insight into the theories of the origin of the flora of the Farasan Islands. Phytogeographers who analyzed the floras of the southern parts of the Arabian Peninsula and North East Africa, (including Farasan Archipelago) placed the study area under various phytogeographical regions. Eig, (1931) and Zohary, (1950) included the region under the Sudano-Deccanian while Zohary (1973) and White and Leonard, (1991) placed the southwestern Arabian Peninsula along with the Farasan Archipelago in the Sudanian and Somali-Masai regional center of endemism respectively. However, all of them agreed on one point that the mountainous regions on the southwestern and southern parts of the Arabian Peninsula cannot be studied in isolation and that the floral elements present in these areas are only an extension of the plant communities present in the northeastern parts of Africa.

MATERIALS AND METHODS

Although the information pertaining to these islands is still emerging, the existing contributions written about various aspects of its flora and fauna show that the Farasan Islands have certain significant facts related to their biogeography. Plant collectors, especially S. Collenette, an enthusiastic and renowned plant collector of this region plus scientists from the National Commission for Wildlife

Conservation and Development (NCWCD) have been exploring the islands since 1984. This account of the vegetation and phytogeography of the Farasan Islands is mainly based on the field observations carried out by the authors themselves. The members team visited nine main islands in March-April, 2001 and again in March 2009, a few weeks after a little rain/drizzling. These islands (Farasan Al-Khubra, Sasid, Dissan, Zifaf, Dawshak, Dumsuq (Dumsaq), Ra's Rasib (Mandar), Abu Tuk, and Dissan) were explored on foot, and collections were made over the course of three years mainly during Spring (each trip comprising five to seven days). Over 1200 specimens of 187 species were collected, processed and housed at the herbarium of King Saud University (KSU). Between 1984 and 2009 field trips were conducted several investigators for various floristic studies. Herbarium and literature searches at various regional herbaria added 14 taxa that were not collected during the present study (Collenette, 1985, 1999; Alwelaie, *et al.* 1993; Chaudhary, 1999-2001, Alfarhan *et al.* 2002, Atiqur Rahman *et al.* 2002). All herbarium specimens of the studied location (E, KSU, RIY, MUZ, KSUP) were gathered and examined in detail.

Rain plays an important role in the vegetative cover of any region, particularly in the case of herbaceous taxa. Unfortunately, the study area had virtually no 'rains' for several consecutive years and a full knowledge about Therophytes is still lacking. Although 45 annuals have been collected from the area, these have been excluded from the analysis to avoid reaching any inaccurate or misleading results. An inventory of all available literature pertaining to the flora and vegetation of the islands was examined and the data incorporated into preparation of the final species analysis. The usual life-form categories suggested in Raunkiaer's system of classification have been followed in this study to segregate the floristic elements (Figure 2). Most floral elements of Farasan Islands fall into 5 categories: taxa with wider/global distribution, taxa distributed in the old world, taxa of arid parts of Africa and Asia, 4. taxa belonging to the subtropical regions of Africa and the Arabian Peninsula and. taxa with a narrow distribution range found in the Farasan Archipelago and neighbouring regions.

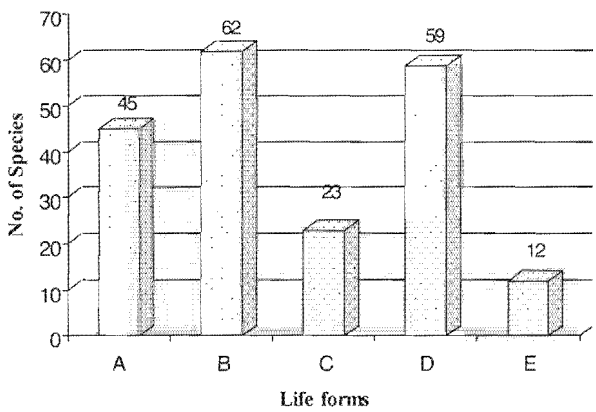

Fig. 2. Life form spectra of the flora of the Farasan Archipelago.
(A Therophytes; B. Phanerophytes; C. Hemicryptophytes; D. Chamaephytes; E. Cryptophytes)

RESULTS

Vegetation

The overall vegetation of the Farasan Islands is interesting in regards to two aspects: (a) because of its similarity to the distribution of natural plant communities and (b) its similarity to the floral elements of the Tihama Region of the southwestern region of mainland Saudi Arabia. The plant communities identified have, to a certain extent, similarities with the community structure prevailing in the northeastern and northern countries of the African Continent. The main island, Farasan Al-Khubra, is characterized by ravines and occasionally with open plains interspersed with large boulders. The plant communities at the southeastern area of the island, with noticeably high vegetation density, are dominated by small trees and shrubs such as *Acacia ehrenbergiana, Commiphora gileadensis and Salvadora persica.*

Occasionally trees like *Hyphaene thebaica* and *shrubs*, such as *Cadaba glandulosa, Grewia tenax and, Indigofera oblongifolia,* with climbers such as *Cissus quadrangularis* and *Pentatropis nivalis* are also present in varying densities. Annuals in this area are mainly, represented by *Zygophyllum simplex, Polycarpaea spicata, Euphorbia granulata* and others. At the edges of the ravines where the substrata are somewhat exposed due to erosion, isolated subshrubs such as *Aerva javanica, Capparis sinaica and*

Ochradenus baccatus were present, along with a considerable number of annuals.

On the basis of personal observation and information from published sources, four sets of distribution patterns are proposed, ranging from very narrow restricted distributions, such as rare to a wider general distribution pattern such as scattered, dominance or abundance in restricted in restricted localities (Figure 3). Apparently the populations of *Acacia ehrenbergiana* and *Zygophyllum simplex* are the most dominant species in the interior regions of the southern parts of Farasan Al-Khubra and other main islands while the populations of *Limonium axillare*, *Halopeplis perfoliata, Zygophyllum coccineum* and Suaeda monoica dominate the coastal and subcoastal regions. The occurrence of grasses is also significant throughout the area, mostly represented by *Sporobolus helvolus*, *Dichanthium foveolatum, Panicum turgidum, Hyparrhenia hirta, and Tricholaena teneriffae*. In open plains with plants mainly concentrated in and around small depressions and under shelters of boulders, the representative ephemerals are *Zygophyllum simplex, Eragrostis ciliaris, Amaranthus viridus*. The sheltered habitats of inlets and bays, particularly in Farasan Al-Khubra, are calm and allow the free flow of sea-water at high tide. These areas are conducive for the growth and survival of Mangrove species. However, known association of two mangrove species, *Avicennia marina* and *Rhizophora mucronata* known to occur was not observed in the inlets along the south eastern coastal regions of Farasan Al-Khubra, probably due to largescale urbanization and new part construction of a new port in the vicinity of the mangrove habitats.

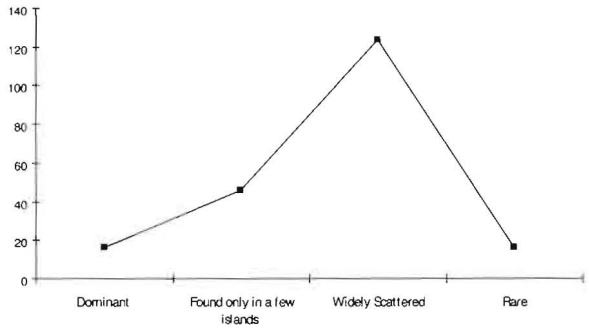

Fig. 3. Diagrammatic representation of the flora based on density.

Sasid (Sajid or Saqid) Island, the second largest island in the Archipelago, is also an open flat reef with shallow wadis. Vegetation of this island is dominated by halophytic communities such as Limonium axillare, Suaeda monoica and occasional trees such as Hyphaene thebaica. Abandoned agricultural lands are common on this island, especially near old dwellings. The most common species in these locations in order of abundance are: Acacia ehrenbergiana, Commiphora giladensis, Indigofera oblongifolia, Grewia tenax, Capparis sinaica, Indigofera spinosa, Aerva javanica, Blepharis ciliaris and Dichanthium foveolatum.

The topography of the other islands is more or less similar to the two major islands. Broad wadis between elevated ridges are characteristic of Zifaf Island. Mangrove populationsrepresented by both Avicennia marina and Rhizophora mucronata, are dense and rich, not impacted by external influences. The vegetation of coastal sandy areas is represented by Limonium axillare and Aeluropus lagopoides; along the gentle slopes and ridges vegetation is dominated by occasional clumps of Commiphora gileadensis, Cocculus pendulus, Aerva javanica and Indigofera oblongifolia. The vegetation of Dawshak and Dumsuq islands is also more or less similar to other smaller islands, except for the presence of species such as Commiphora erythraeaon Dumsuq. These two islands are devoid of any inlets favorable to the growth of mangroves, although the presence of mangroves was reported in some research. The terrain of some of the smaller islands (Ra's Rasib (Mandar), Abu-Tuk) along the northern sides of Sasid island is mostly, barren and sparsely vegetated. However, on the northern side of the Ra's Rasib island, dense communities of Limonium axillare, Suaeda vermiculata and Suaeda monoica were recorded.

Four species of sea grasses belonging to the Hydrocharitaceae and Cymodoceaceae families are apparently present near the shores of islands (Aleem, 1979). Among these, Enhalus acoroides was observedin deep water while Halodule uninervis occurred in shallow depth. The other two species, namely the Thalassia hemprichii and Cymodocea rotundus, were found at varying depths.

Flora of islands world-wide are significant

in many respects, especially in terms of endemism. In most of the islands, where external impact is comparatively small, the rate of endemism (comprising higher taxa such as families and genera) ranges from 30 to 90%. Concerning phytogeographical analyses of such islands, even genera are suitable units for comparing with nearby flora, whereas on islands like the Farasans Islands, with less significant endemism, phytogeographical elements are highly influenced by the surrounding phytogeographical regions, species arethe best unit for categorizing the chorological units.

The affinities of the mainland flora of theArabian Peninsula and the floras of northeastern African countries have been studied by several authors, but have never been expressed in figures. The present analysis shows a great similarity between vegetation of the study area and the vegetation of Tihama onthe mainland of Arabian Peninsula. Acacia ehrenbergiana and halophytes such as Suaeda monoica, Halopeplis perfoliata, Zygophyllum coccineium and Limonium axillare are the most dominant populations along the beaches of both areas. However, two dominant species in Tihama: Acacia tortilits and Leptadenia pyrotechnica, are absent in the Farasan Islands. Collection details indicated that out of 201 species (including Therophytes), Farasan Al-Khubra contains about 98%, of which 60% are restricted to a small area on the southeastern side.

Although particular interest in the indigenous flora of the Farasans lies in the nature and degree of its affinity to the flora of northeast area African countries, its relationship to the flora of Saudi Arabia in general and of its southwestern region in particular is almost equally important. Table (1) shows a comparative account of the flora and the endemism with respect to each of the regions and their area in square kilometers.

Table 1. A comparative account of endemism in three different areas of.

Locality	Area (sq.km)	Total no. of species	Species strictly endemic to the area	%	Regional endemics	%
Saudi Arabia	2,250,000	2243	60	% 2.67	242	% 10.78
Jizan Province , main land, SaudiArabia	8361	850	1	0.11	24	2.82
Farasan Archipelago	c. 520	201	0	0	5	2.5

White and Leonard, (1991) and Alfarhan, *et al.* (2005) have attempted to explain the biogeographic relationships between Eastern Africa and the southwestern Arabian Peninsula in light of similar climate and topographyof both. The life-form spectrum in the study area is characteristic of an arid climate with a dominant perennial component. Dominance and relative abundance of Halophytes over Mesophytes in the area, particularly towards the coastal regions, can be explained by the presence of highly saline soil. In general, the dominance of Phanerophytes and Chamaephytes over other life-forms seems to be a response to the hot, dry climate.

The greatest association of the flora of the Farasan Islands is with the Somalia-Masai phytogeographical region (38.46%), followed by Tropical African (25.64%), Saharo-Arabian (16.02%) and others (19.88%) (Table 2). As far as endemism is concerned, the study area of less than 600 km2 comprises five regional endemics (2.5%) compared to 2.82% for the Jizan area onthe mainland and 10.78% for the whole of mainland Saudi Arabia. Although Therophytes are excluded from the main analysis due to the absence of a full knowledge of their account, out of 201 species recorded so far, 45 are annuals (22.39%), of which the majority belongs to the Tropical African (28.89%), followed by Somali-Masai (24.44%), Pantropic (17.78%) and Paleotropic (17.78%) phytogeographical regions.

Table 2. Share of phytogeogrpahical elements in the flora of the Farasan Archipelago.

Life Forms	Saharo-Arabian		Somali-Masai		Pantropic		Tropical African		Cosmopolitan		Paleotropic		Tropical American		Mediterranean	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Phanerophytes [62, (39.74%)]	8	12.90	24	38.71	1	1.61	23	37.10	0	0	4	6.45	1	1.61	1	1.61
Hemicryptophytes [23, (14.74%)]	2	8.70	11	47.83	4	17.39	4	17.39	0	0	2	8.70	0	0	0	0
Chamaephytes [59, (37.82%)]	13	22.03	22	37.29	5	8.47	11	18.64	1	1.69	7	11.86	0	0	0	0
Cryptophytes [12, (7.69%)]	2	16.67	3	25	4	33.33	2	16.67	0	0	1	8.33	0	0	0	0
Total (156) (Excluding annuals)	25	16.02	60	38.46	14	8.97	40	25.64	1	0.64	14	8.97	1	0.64	1	0.64

DISCUSION AND CONCLUSION

Previous studies have indicated a strong presence of African elements in the Arabian Peninsula, yet most phytogeographers analyzed the floras of both sides of the Red Sea coast in isolation (White and Leonard, 1991). An in-depth analysis of all elements present on both mainlands in the past decades however, shown the influence of African elements along the southwestern part of the Arabian Peninsula is much greater than previously thought and that the phytogeographical studies of the Arabian Peninsula cannot be carried out in isolation.

Unlike many other islands where their floras have developed in long period of isolation, the flora of the Farasan Archipelago is believed to have originated only recently and to have been highly influenced by the mainland flora. A comparison of the flora of the Farasans with treatments published in floras and checklists from Jizan Province, northern parts of Yemen, Sudan and neighboring countries reveals about 93% of Farasan species are present in Jizan, 72.5% occur in Yemen and about 65-70% in Sudan, Somalia and Ertitrea in northeast Africa (Andrews, 1950-1956; Wood, 1997). As far as the taxa of thehigher ranks are concerned, the majority of floristic elements are of either cosmopolitan or of tropical origin (Figure 4). The highest share of taxa in lower category comes from countries

of northeast Africa or from the Tropical region. The share of arid regions of Saharo-Sindian sensu lato or subSaharan countries is also not negligible (16.02%) compared to Pantropical and Paleotropical elements.

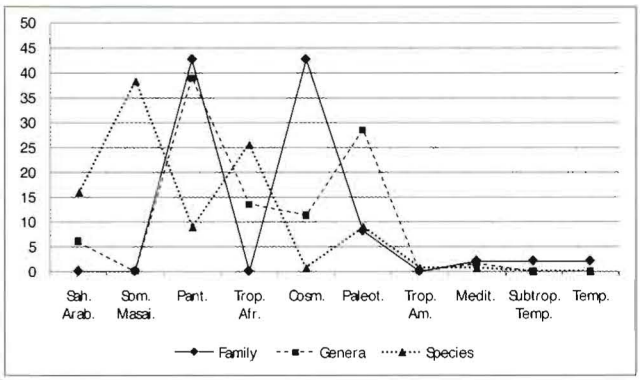

Fig. 4. Share (%) of chorological units within the flora of Farasan Islands.(Sah.-Arab.=Saharo-Arabian; Som.-Masai=Somali-Masai; Pant.= Prantropical; Trop.Afr.=Tropical African; Cosm.=Cosmopolitan; Paleot.=Paleotropical; Trop.-Am.=Tropical American; Medit.= Mediterranean; Subtrop.-Temp.=Subtropical-Temperate; Temp.=Tempera)

The islands' tree components and majority of the inlands' species have affinities towardthe Somali-Masai phytogeographical region while the littoral flora has greater affinities towards Saharo-Arabian flora. It is believed that the species Acacia ehrenbergiana with an extensive distribution on the island established itself on a limited area and later extended to surrounding areas. The presence of a number of other species (Suaeda monoica, Arthrocnemum macrostachyum, Zygophyllum simplex, etc.), common on islands such as Farasan Al-Khubra, Sasid (Sagid), Mandar and a few other smaller islands, can be considered as a sign of recent exchange. On the other hand, if two areas, either on the ONE island or on different islands, are occupied by different taxa of higher rank (genera and families), it can be speculated that these areas are intact topographically and floristically with no recent contact with each other (Hnatiuk and Maslin, 1988). As far as the islands of the Farasan Archipelago are concerned, the latter condition is, apparently, not applicable, except in cases where a few taxa of lower rank (species) can be observed in isolation (e.g. Commiphora erythraea). The importance of the flora lies in the occurrence of 15 species which have not been reported from in any other part of the Arabian Peninsula (Table 3). The majority of these species, particularly, Vahlia digyna, Ipomoea hochstetteri, Nothosaerva brachiata and Drake-brockmania somalensis have a disjunct distribution in the tropical region.

Table 3. Endangered species of the Farasan Archipelago with current threats (*Also reported from the mainland)

Species Name	Family	Status	Current threats
***Barleria hochstetteri**	Acanthaceae	Endangered	Poor regeneration
Basilicum polystachion	Lamiaceae	Locally endangered	Drought, off road traffic
Cleome noeana			
ssp. brachystyla	Capparaceae	Vulnerable	Habitat loss
Commiphora erythraea	Burseraceae	Endangered	Poor regeneration
Dinebra retroflexa	Poaceae	Locally endangered	Drought
Drake-brockmania somalensis	Poaceae	Locally endangered	Off road traffic
Euphorbia collenetteae	Euphorbiaceae	Locally endangered	Habitat Loss
Ficus populifolia	Moraceae	Vulnerable	Poor regeneration
Glossonema			
sp. aff. boveanum	Asclepiadaceae	Endangered	Habitat Loss
Indigofera semitrijuga	Leguminosae	Endangered	Habitat Loss
Ipomoea hochstetteri	Convolvulaceae	Endangered	Drought and Habitat Loss
Limonium cylindrifolium	Plumbaginaceae	Vulnerable	Habitat Loss

Micrococca mercurialis	Euphorbiaceae	Endangered	Off road traffic
Nothosaerva brachiata	Amaranthaceae	Vulnerable	Drought
Taverniera cuneifolia	Leguminosae	Vulnerable	Drought
Vahlia digyna	Vahliaceae	Vulnerable	Drought, off road traffic

The dispersal and establishment of plant populations in the Archipelago is interesting. Zohary, (1973) is of the opinion that most migrations of terrestrial plants require at least intermittent land connections or having areas at high tide. Dispersal ability of certain species with dissemenules to travel long distances and establish in a new area, such as the Farasan Archipelago, is a possible explanation in support of the current floristic composition. Another possible explanation is transport by the migratory birds traveling thousands of kilometers and nesting on these islands. Dispersal followed by permanent establishment of coastal plants along the coastal regions of the Farasan Islands is, to a certain extent, due to the action of the tides. However, the socalled long distance dispersal is considered a rare phenomenon, but it cannot be ruled out and may be effective, at least in the case of coastal plants and members with plumed disseminules. All these possibilities must be considered when seeking to understand the distribution patterns of floristic elements.

The vegetation of the Farasan Archipelago, especially of the coastal zones, is highly influenced by halophytes. The salinity level of the seas surrounding theFarasan Islands varies between 40ppt, and 45ppt whereas in enclosed lagoons, sea water is noticeably alkaline (Anonymous, 2000). Ions such as sodium, chlorine, magnesium and calcium play a major role in the toxicity level of soil plagued by salinity. Massive salt deposits were detected in Zifaf and Farasan Al-Khubra during petroleum explorations in the second and third decades of the previous century. Since these islands are surrounded by sea water, the density and abundance of halophytes are significant, particularly on smaller islands such as Mandar and Zifaf, where they dominate 90% of the vegetation. However, the diversity of halophytes is less significant as far as the flora of the Archipelago is concerned. Only 16 true halophytes (8%) are present in and around sabkhas (e.g. Aeluropus lagopoides, Arthrocnemum macrostachyum, Atriplex farinosa, Halopeplis perfoliata, Limonium axillare, Suaeda aegyptiaca, Suaeda vermiculata, Zygophyllum coccineum, Zygophyllum simplex, etc.). Zygophyllum simplex and Limonium axillare are the most dominant halophytes of the inland flora of the main islands while Suaeda vermiculata, S. monoica, Halopeplis perfoliata, Limonium cylindrifolium are dominant in the coastal zones on the majority of the islands.

Today, the islands of the Farasan Archipelago are the best preserved Islands in the Red Sea. However, they faces challenges that threaten the distinctive biodiversity of the islands, mainly along the coasts. Some of these problems have existed for more than a century, but many are new scenarios that have arisen over the past 20-30 years. The islands, particularly Farasan Al-Khubra and Saqid, (the only inhabited islands), are undergoing an increasing cycle of economic and population growth. The most apparent consequence of development is the destruction of habitats, such as clearing vegetation for the construction of buildings, roads, date palm orchards, etc. External pressures bring with them increased threats to local biodiversity which challenge current conservation efforts; among them the arrival of invasive species, destruction of mangroves, over-harvesting of marine resources and repeated pollution events, mainly lubricants and gasoline from mechanized water transport. The direct effects, at present, are more evident along the coastal regions, particularly near the port. Although some parts of the islands are under the control of the National Commission for Wildlife Conservation and Development (NCWCD) for the protection of Gazelles, the conservation measures, are sometimes, not sufficiently enforced to effectively reduce the risk of extinction of endangered plants.

A relatively high proportion of the native flora is of conservation concern, a situation which is poorly recognized, both locally and nationally. Threatened species occur inonly a few,

small, isolated populations, which face pressure from drought and unsustainable land use. Table (3) contains the threatened flora of the Farasan Archipelago, and provides an overview of the species' current status in their respective habitats. It provides an important first step towards the recognition and conservation of the threatened native flora of the Islands at both national and international levels. Invasive plants, such as Prosopis juliflora in addition to domesticated animals, such as camels and goats, inhabit the major islands. In some areas, especially around settlements, signs of overgrazing are obvious. Presence of well-established weedy species such as Amaranthus graecizans, A. viridis, Cenchrus ciliaris, close to settlements indicate of overgrazing problems. Prosopis juliflora (usually cultivated along the road sides) is a major problem to the island's natural vegetation as it has penetrated into the island's Acacia populations to several other areas away from roadsides. Offroad trafficking is another major threat to the entire vegetation of the two main islands. Some of the muddy tracks that crisscross the vegetation-rich areas of the southeastern part of Farasan Al-Khubra are, in fact, passing through the populations of some of the locally endangered species of the islands (e.g. Vahlia digyna, Basilicum polystachion, Ipomoea hochstetteri.). These species along with other endangered species, account for about 7.5 % of the flora of the Farasan Islands (Table 3). Since a majority of the endangered species are represented by 100-500 individual plants in less than 5 km2, any disturbance of the habitats will result in their extinction from the study area. It is also clear that climate change will increase these threats, as flora, especially island flora, has a limited ability to migrate to other regions. Among these, Euphorbia collenetteae Al-Zaharani and El-Karemi are endemic to the island in very low numbers, majority of which are seen outside protected areas. The population of this species contains less than 500 individual plants distributed within less than 40 km2. The only other locality where this plant could be seen in limited numbers are on the coastal plains of Sudan and Eritrea (Al-Zaharani and El-Karemi, 2007). Since anthropogenic pressure on the Archipelago is constantly increasing, this endemic species deserves a near- threatened status (NT).

The coastal areas of the Islands are a critical source of food, jobs and income for inhabitants. Protection of the islands' natural resources is vital for the local population. The Archipelago has high priority in terms of conservation and management of marine resources. The coastal vegetation, particularly the muddy habitats of mangroves, are suitable breeding grounds for several species of fish and prawns, such as Lutjanus ehrenbergi, Gerres oyena, Mugilids (January), Lutjanus ehrenbergi, Gerres oyena (February), Acanthopagrus bifasciatus (March), Atherinomorus lacunosus, Lutjanus ehrenbergi, Gerres oyena, Sargassum (April), Herklostichtys quadrimaculatus, Gerres oyena (October), Atherinomorus lacunosus, Lutjanus ehrenbergi, Gerres oyena (November) (Gladstone, 2002). However, the destruction of mangroves is on the rise these days. Apart from the clearing of a significant portion of the mangrove thickets for the development of the main port on the island, some of the inhabitants have a habit of cutting down branches of mangroves, particularly the Avicennia marina for the purpose of making traps for catching migratory birds on uninhabited islands. This practice must be stopped before it is too late. Conservation of the biodiversity of the Farasan Island is important and must go hand-in hand with sustainable economic development to maintain a balance where both inhabitants and habitats flourish. Although some legal protection measures are in place, these are poorly enforced in areas devoid of wild animals. It is therefore essential for the rejuvenation of the current action plan for the protection of the coastal zone vegetation and the endangered flora of the archipelago not only for the safety of the environment, sustainable development but for the benefits of local people as well.

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