

Original research

## **Inventory and Conservation of Wild Flora in Gebel Shayeb El-Banat as a Potential Protected Area, the Red Sea Region, Egypt.**

**Abdelwahab A. Afefe**

*Ecologist, Nature Conservation Sector, Egyptian Environmental Affairs Agency*

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### **Abstract**

The objective of the present study is to assess the vegetation cover in Gebel Shayeb EL-Banat area, the Red Sea, Egypt. During the field study, we identified 33 plant species representing 22 families, which suggests the high ecological importance of the area. Our study should support the decision makers in Egypt in prioritizing areas for conservation, and we highly recommend if this area be considered as a future protected area. The objective of the proposed plan is protect of natural plant diversity and vegetation cover along with its underlying ecological structure and supporting ecosystems processes, and to promote education and recreation and to manage the area in order to perpetuate, in as natural a state as possible; contribute in particular to conservation of wide-ranging species, regional ecological processes and migration routes; manage visitor use for inspirational, educational, cultural and recreational purposes at a level which will not cause significant biological or ecological degradation to the natural resources; take into account the needs of local communities, including subsistence resource use.

**Keywords:** Protected Area; Vegetation; Plant Conservation

### **1- INTRODUCTION**

The Protected Areas (PAs) have long been regarded as an essential important tool for conserving biodiversity and habitats integrity (Brooks et al., 2004; Rodrigues et al., 2004; Coad et al., 2008; Butchart et al., 2010). The global PAs covering more than 12.7% of the world's land surface (Bertzky et al., 2012). Nowadays PAs are the main tool for conserving biodiversity and ecosystems (SERI and IUCN, 2004) and the area benefiting from legal protection has been increasing at the global level (Boitani et al., 2007). Aichi Biodiversity Targets (2011-2020) by the Convention on Biological Diversity were the key policy instruments to stimulate this increase worldwide (Tittensor et al., 2014). Moreover, there is considerable debate on the extent to which PAs deliver conservation outcomes in terms of habitat and species conservation (Brooks et al., 2006; Meir et al., 2004). It has been suggested that many of the world's PAs exist only as 'paper parks' (Dudley and Stolton, 1999), lacking effective management capacity, and unlikely to deliver effective conservation (Joppa et al., 2008).

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**Corresponding author\*:** E-mail address: [abdoafefe@hotmail.com](mailto:abdoafefe@hotmail.com)

PAs are often treated as a single conservation strategy. However, in reality, they are established for various reasons, with very different objectives and criteria for success. PAs have been set up for the conservation of ecosystems and their constituent species (Dudley, 2008), conservation of specific threatened species (Liu et al., 2001), or for cultural and social reasons (Coad et al., 2008). Understanding the conditions under which PAs deliver conservation benefits for species and habitats is essential for policymakers, managers, and conservation advocates (Brooks et al., 2004; Kleiman et al., 2000; Margules and Pressey, 2000). Egypt's flora is well documented in many referral books (Täckholm, 1974; Boulos, 1995; 1999; 2000; 2002; 2005; El-Hadidi and Fayed, 1995; El-Hadidi and Hosny, 2002; El-Hadidi et al., 2000). It comprises some 2121 species and 153 infraspecific epithets of vascular plants (Boulos, 1995), and 158 species of mosses and hepatics (El-Saadawi and Shabbara, 2007). Boulos (2008) reported that the flora of the northern wadis and mountains of the Eastern Desert at the Red Sea is richer than that of Sinai and Western Desert regions. Moreover, Zahran and Willis (1992) reported that there two major phytogeographical regions are usually recognized within the Eastern Desert of Egypt: the Red Sea coastal region and the inland desert. However, Khedr (2006) reported that there are 540 wild plant species recorded in the north part of the Eastern Desert of Egypt. The principal objective of the present study is to give an overview of knowledge on the flora of Gebel Shayeb El-Banat at Red sea costal in Egypt and identify the threats and the manifestations different attitudes towards underlying causes and recommended solutions to help scientists and decision-makers to declare this area as potential Protected Area in Egypt.

## **2- MATERIALS AND METHODS**

### **2.1. The Study Area**

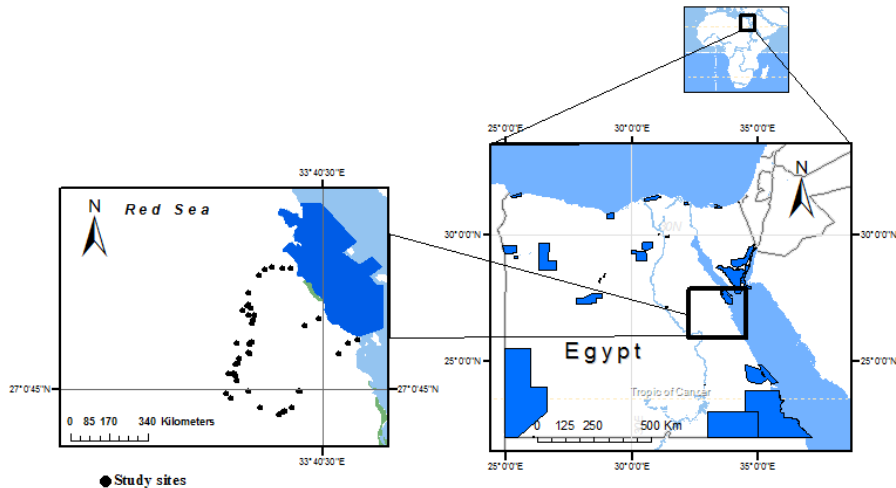
The Eastern Desert of Egypt occupies the area extending from the Nile Valley eastward to the Gulf of Suez and the Red Sea. The Eastern Desert is about 223,000 km<sup>2</sup> (21% of Egypt area) and this desert consists essentially of a backbone of high, rugged mountains running parallel and the peaks of many of these mountains are more than 1500 m above sea level (Abu Al-Izz, 1971).

The current study locations included three mountains and two Wadis at Red sea coastal namely (Boulos, 2008): Gebel Shayeb El-Banat at the elevation of (2187 m), Gebel Abu Dukhan at the elevation of (1705 m), Gebel Qattar at the elevation of (1963 m), and two wadies: Wadi Bali and Wadi Al- Mallaha (Figure 1). Zahran and Willis (2009) reported that Gebel Shayeb El-Banat is the highest peak within the Red Sea coastal mountains, where the Gebel Shayeb group thus forms hills facing the southern part of the Gulf of Suez and the northeast part of the Red Sea.

The world DIVA-GIS (BIOCLIM database) used to analysis the climate for the present study area (Hijmans et al., 2005) and the database recorded that: the area is situated within a dry climate region and the mean annual precipitation recorded 1mm, with the rainy season stretching from october to may yearly, and the mean monthly air temperature ranges between 8.9 °C (January) and 34.8 °C (August), while the annual mean temperature is 22.8 °C.

### **2.2. Data Inventory and Collection**

The primary qualitative data underpinning this paper was collected by the authors in 2016 during fieldwork in Gebel Shayeb El-Banat, Gebel Abu Dukhan, Gebel Abu Gattar, Wadi Bali, and Wadi Al- Mallaha at Redsea coastal area of Egypt. The research information resources were based on primary and secondary sources, where the primary sources of information depending on field visits and semi-structured interviews and the secondary sources of information depending on articles, reports, books, etc.



**Fig.1.** Map of Egypt and locations of the current protected areas of Egypt (right) and the map in the left shows the current study area.

The research approaches are consisting of three main phases: Screening phase, mapping phase, reporting phase as following:

- a) Screening Phase: During this phase, we organized for a field visit to collect all the necessary maps and information to identify the characterization of the study area biodiversity aspect, economic activities, and stakeholders.
- b) Mapping Phase: The research was carried out during the area field visits in September 2016 with undertaken and implemented in the study area using a quantitative inventory of the flora, fauna, geology components, and main features. Furthermore, the GPS point and tracks were recorded to identify the plant diversity rich locations. While Arc GIS was used to prepare the study area maps and zones. The social work was implemented using the semi-structural interview and meeting tools with key informants to understanding the linkages between different stakeholders.
- c) Reporting phase (data analysis): There many methods were used included: SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) is tries to establish a strategic fit between an organization or units internal strengths, weaknesses, opportunities and threats posed by its external environment (Beer et al., 2005). The SWOT method has its started used and origins in the 1960s (Learned et al., 1965). This analysis is a fundamental principle underlying strategic management (Beer et al., 2005). Venn diagram of stakeholders: is a tool helps to understand who will be affected by proposed development activities in the currently study area (FAO, 2001). It is used in this study to analyze links between the most important stakeholders in the study area and their impacts on natural vegetation.

### 3.RESULTS AND DISCUSSION

#### 3.1. Vegetation Cover:

In total, 33 plant species representing 22 families were identified and recorded in the current study. Table 1 shows the present composition of the flora of the study area. The results in the present study showed the recorded species as follows: Wadi Al- Mallaha is dominated by *Zilla spinosa*, *Zygophyllum coccineum* and *Cleome droserifolia* with co-dominance of *Cornulaca monacantha*, *Nitraria retusa*, *Tamarix aphalla*, *Phragmites australis*, *Juncus rigidus*, *Periploca*

*aphylla, Phoenix dactylifera, Acacia raddiana, Acacia tortilis, Citrullus colocynthis, Salvadoria persica, Pulicaria incisa and Leptadenia pyrotechnica, Chrozophora Oblongifolia, and Pulicaria crispa.*

Wadi Bali is dominated by *Moringa peregrine* with co-domination of *Capparis spinosa*. Gebel Gattar: is dominated by *Moringa peregrina, Zygophyllum coccineum, Zilla spinosa, Panicum turgidum, and Leptadenia pyrotechnica*. With co-domination of *Acacia raddiana, Acacia tortilis, Cleome droserifolia, Citrullus colocynthis, Adiantum capillus-veneris, Echinops spinosissimus, Aerva javanica, Ficus pseudosycomorus, Periploca aphylla, Pulicaria incisa, Capparis cartilaginea, Capparis spinosa, and Phragmites australis.*

Gebel Shayeb El-Banat is dominated by *Cleome droserifolia, Zilla spinosa, Leptadenia pyrotechnica*, with co-domination of *Artemisia judaica, Zygophyllum coccineum, Hyoscyamus muticus, Solenostemma arghel, Ziziphus spina-christi, Cyperus laevigatus, Imperata cylindrical, Ficus pseudosycomorus, Balanites aegyptiaca, Acacia raddiana, and Acacia tortilis.*

Through the present study field visits and literature review, there are three ecosystems was recognized for vegetation cover in the Red Sea coastal region based on the studies of many researchers as well as those by Zahran and Mashaly (1991), and Kassas and Zahran (1962, 1965, 1967, 1971) that the difference causes the pattern of the vegetation within the limestone plateau country to be such that the lower the altitude of the habitat the less arid it is, as it receives a greater proportion of drainage. This is not necessarily the case within the jagged mountains of the basement complex: high up the mountains, the vegetation may indicate habitat conditions less arid than those lower down the slope (Kassas, 1956; 1960).

Moreover, Zahran and Mashaly (1991) reported that the notable difference between the limestone plateau and the basement complex mountains is that the water resources available for plants in the former are mainly the run-off water of the convectional rainfall, whereas that in the latter also includes orographic condensation of cloud moisture. Moreover, the current results are in accordance with those of Zahran and Willis (2009), who reported, in one of the runnels across the eastern slope (facing the sea) of Gebel Shayeb El-Banat, the following plants have been recorded: *Acacia raddiana, Artemisia judaica, Capparis cartilaginea, Aerva javanica, Chrozophora oblongifolia, Citrullus colocynthis, Hyoscyamus muticus, Moringa peregrina, Periploca aphylla, Solenostemma arghel, Zilla spinosa and Zygophyllum coccineum, Cleome droserifolia.*

The table legend: *The life forms are:* Ph, phanerophytes; Ch, chamaephytes; G, geophytes; He, hemi-cryptophytes and Th, therophytes. *The floristic regions are* abbreviated as follows: ME: Mediterranean, IR-TR: Irano-Turanian, SA-AR: Saharo-Arabian, ER-SR: Euro-Siberian, SU-ZA: Sudano-Zambezian, NEO: Neotropical, and PAL: Palaeotropical, COSM, cosmopolitan

The present study recorded many individual and population of *Moringa peregrina* is associated with mountains of higher altitude during field survey as Kassas and Zahran (1971) pointed that the growth of *Moringa peregrine* is associated with mountains of higher altitude and suggest that within the northern mountain groups (Shayeb-Samiuki) an altitude over 1300m, is necessary for the interception of orographic precipitation of such amount that will feed the bases of mountains with the moisture required by the growth of this species. The ground where *Moringa peregrina* grows is usually covered with coarse rock debris, which characterizes the upstream runnels at the mountain's bases and slopes (Kassas and Zahran, 1971). Moreover, the current study field visits confirms, as also reported by Hegazy et al., (2008), that the populations

of *Moringa peregrina* are declining, threatened and their survival cannot be ensured without conservation measures. This is confirmed by the decrease in the net reproductive rate and intrinsic rate of increase with altitude. Since the populations of *Moringa peregrina* rely on the persistence of the established plants for their survival, conservation efforts in the future should focus on protecting established populations against human disturbances such as cutting and over-exploitation. However, Zahran and Willis (2009) reported the trees and shrubs that are less drought-tolerant include, apart from the *Acacia* spp., several species that are dominant within other communities such as *Moringa peregrina* that present on the higher zones of the north-facing slopes of the mountains such as the shayeb groups.

**Table 1.** List of the plant species that recorded in the study area

No.	Species	Family	Life form	Chorotype
1	<i>Acacia raddiana</i> (Savi) Brenan	Mimosaceae	Ph	SU
2	<i>Acacia tortilis</i> (Forssk.) Hayne	Mimosaceae	Ph	SU
3	<i>Adiantum capillus-veneris</i> , mosses	Adiantaceae	He	Cosm
4	<i>Aerva javanica</i> (Burm. f.) Juss. ex Schult. var. <i>bovei</i> Webb	Amaranthaceae	Th	TR
5	<i>Artemisia judaica</i> L.	Compositae	Ph	SA
6	<i>Balanites aegyptiaca</i> (L.) Delile.	Zygophyllaceae	Ph	SSI+SZ
7	<i>Capparis cartilaginea</i> Decne.	Capparaceae	He	SU
8	<i>Capparis spinosa</i> L. var. <i>aegyptia</i> (Lam.) Boiss.	Capparaceae	Ch	ME
9	<i>Chrozophora Oblongifolia</i> (Delile) Spreng.	Euphorbiaceae	Ch	SU
10	<i>Citrullus colocynthis</i> (L.) Schrad.	Cucurbitaceae	Th	SA
11	<i>Cleome droserifolia</i> (Forssk.) Delile	Cleomaceae	Ch	SU
12	<i>Cornulaca monacantha</i> Delile	Chenopodiaceae	He	Cosm
13	<i>Cyperus laevigatus</i> L.	Cyperaceae	Ge	Cosm
14	<i>Echinops spinosus</i> L.	Compositae	He	ME+SU
15	<i>Ficus palmata</i> Forssk.	Moraceae	Ph	IR-TR+ SA-AR
16	<i>Hyoscyamus muticus</i> L.	Solanaceae	Ph	SA+IT
17	<i>Pulicaria incise</i> (Lam.) DC.	Compositae	Ch	SA
18	<i>Imperata cylindrica</i> (L.) Raeusch	Poaceae	He	Cosm
19	<i>Juncus rigidus</i> Desf.	Juncaceae	Ge	IT+SA
20	<i>Leptadenia pyrotechnica</i> (Forssk.) Decne.	Asclepiadaceae	Ph	SA+SU
21	<i>Moringa peregrina</i> (Forssk.) Fiori	Moringaceae	Ph	SU
22	<i>Nitraria retusa</i> (Forssk.) Asch.	Zygophyllaceae	S	SA+IT
23	<i>Panicum turgidum</i> Forssk.	Poaceae	He	SA+SU
24	<i>Periploca aphylla</i> Decne.	Asclepiadaceae	He	IR-TR+ SA-AR
25	<i>Phoenix dactylifera</i> L.	Palmeae	Ph	SA
26	<i>Phragmites australis</i> (Cav.) Trin. Ex Steud.	Poaceae	He	Cosm
27	<i>Pulicaria crispa</i> (Cass.) Oliv. & Hiern	Compositae	Ch	SA+SU
28	<i>Salvadora persica</i> L.	Salvadoraceae	Ph	IR-TR+ SA-AR
29	<i>Solenostemma argel</i> (Delile) Hayne	Asclepiadaceae	S	SA+SZ
30	<i>Tamarix aphalla</i> (L.) H. Karst.	Tamaricaceae	Ph	SU
31	<i>Zilla spinosa</i> (Turra) Prantl	Cruciferae	S	SA

No.	Species	Family	Life form	Chorotype
32	<i>Ziziphus spina-christi</i> (L.) Desf.	Rhamnaceae	Ph	SA+SU
33	<i>Zygophyllum coccineum</i> L.	Zygophyllaceae	Ch	SA

Additionally, the *Ficus pseudosycomorus* is especially common in the northern mountain groups Samiuki-Shayeb at the Red Sea, and *Moringa peregrina* is a desert species restricted to the mountains of the Red Sea and South Sinai in Egypt and grows globally in North Africa and Southwest Asia (Boulos, 1999).

Through the literature review, the Eastern Desert's northern sector between governorates of Cairo, Suez, and Qena, 124 perennial species such as *Zilla spinosa*, *Zygophyllum coccineum*, *Pulicaria incisa*, and *Achillea fragrantissima* were reported by Fossati et al., (1998). They reported that *Zygophyllum coccineum* is a widespread xerosucculent inhabiting the drainage channels of the limestone desert. Shaltout et al. (2004) identified *Zygophyllum coccineum*-*Zilla spinosa* communities along with the Egyptian Red Sea coastal lands. Several studies recognized *Zygophyllum coccineum* as a community associated with *Zilla spinosa* (Kassas and Girgis, 1965; Abd El-Ghani, 1998).

The *Zygophyllum coccineum*-*Zilla spinosa* vegetation group is mainly characterized by soil rich in sand contents and calcium carbonates, with low salinity values (Hegazy et al., 2004). Moreover, Kassas and Zahran (1971) reported that the coastal hills and mountains' ecological set up demonstrate the influence of orographic precipitation on plant growth. While, Boulos (2008) recorded that there 40 species in both sides of the Gulf of Suez: the northern mountains and wadis of the Eastern Desert (west of the Gulf of Suez) and Sinai (east of the Gulf of Suez), these are not known elsewhere in Egypt and the largest families represented in this group of species were *Compositae* (11 species) and *Labiatae* (8 species). However, Zahran and Willis (2009) reported that the vegetation on the slopes of the mountains is delimited into altitudinal zones, the lower of which shows recognizable community structure characters and interpreted the relationship between the habitat condition and vegetation based on moisture requirements of species. This interpretation is supported by studies carried out on the mountain groups further south of Sudan (Kassas, 1956, 1960) and East Africa (Keay, 1959). The flora of the Egyptian Red Sea coastal mountain includes over 400 species recorded (Zahran and Mashaly, 1991).

### 3.2. General Threats and Status Understands

During the fieldwork, there many pressures and threats recorded facing the ecosystems and biodiversity in the area. The present study recorded that human' major pressures in the area included: plant overgrazing, over-collecting, and over-cutting, disturbance by cars or trampling, hunting, plans for establishing future car roads, mining, and quarrying activities. The SWOT analysis method aims to identify the key internal and external factors facing the conservation of biodiversity in an area. Table (2) summarizes various factors (strengths, weaknesses, opportunities, and threats) in the study area.

Venn diagram tool aims to analyze the degree of linkages between different stakeholders in Shayeb El-Banat. Most of the study area stakeholders have a direct/indirect role and are affecting /affected by the conservation actions of the ecosystems and biodiversity (Figure 2). Before and during the field visit to the area, we used the semi-structural interview and meeting tools with key informants.

The results highlight the lack of stakeholders' active cooperation in Shayeb El-Banat and the need for cooperation between different stakeholders and the Nature Conservation Sector

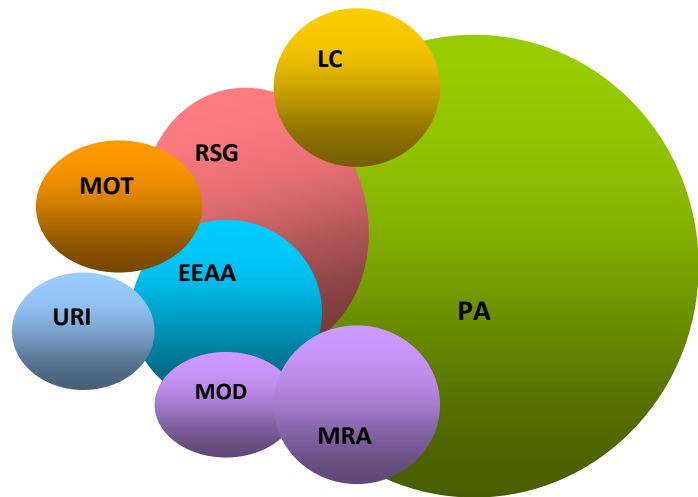
(NCS) within the Egyptian Environmental Affairs Agency to find measurements/ways to activate/improve future cooperation.

**Table 2.** SWOT analysis for biodiversity conservation

Element	Positive	Negative
Internal	<b>Strengths</b> <ul style="list-style-type: none"> <li>- Possibility of enforcing the law of the protected area.</li> <li>- The relations with main stakeholders.</li> <li>- Availability of a preliminary “master plan” in order to protect biodiversity.</li> </ul>	<b>Weaknesses</b> <ul style="list-style-type: none"> <li>- A lack of funding for established the proposed protectorate.</li> <li>- Weak law enforcement</li> <li>- Shortage of awareness and education programs to the local community and civil society</li> </ul>
External	<b>Opportunities</b> <ul style="list-style-type: none"> <li>- Law 102 /1983 for protected areas and 9/2009 for the environment.</li> <li>- Identified the area as one of twenty important plant areas in Egypt.</li> <li>- Implement community awareness/education programs to promote the unique ecosystems and environmental qualities and characteristics in the area.</li> <li>- Possibility of establishing a zoning system to protect the vegetation cover.</li> </ul>	<b>Threats</b> <ul style="list-style-type: none"> <li>- The negative human impacts such as overgrazing, over-collecting and over cutting, disturbance by cars or trampling, hunting, future car roads, mining and quarrying activities</li> </ul>

*Legend*

PA	Potential Protected Area
EEAA	Egyptian Environmental Affairs Agency
RSG	Red Sea Governorate
LC	Local Community
MOT	Ministry of Tourism
MOD	Ministry of Defense
MRA	Egyptian Mineral Resources Authority
URI	Universities and Research Institutions



**Note:** The circles are placed as follows: separate circles = no contact; touching circles = information passes between institutions; small overlap = some co-operation in decision making and considerable overlap = a lot of co-operation in decision making.

**Fig. 2.** Venn diagram of stakeholders in the study area that impacting on biodiversity

The potential protected area staff's role is important in achieving good cooperation with different governmental authorities, local communities, and owners of different economic activities. Egyptian Environmental Affairs Agency, Local Community, Ministry of Tourism, Red sea Governorate and Ministry of defense are the five most important actors affecting the nature and biodiversity in the area. The most underlying causes that will face the future plans to the conservation of nature and wild in the study area come from the lack of awareness, weak law enforcement, and lack of interest in the cooperation between stakeholders.

Perceptions of the local community and local authorities towards the potential protected area and biodiversity conservation activities. Most respondents held a positive attitude towards the protected area and the analysis of their attitudes and perceptions revealed potential conflicts that might affect biodiversity conservation and future management of the protected area. The results of this study agree with several authors such as (Cihar and Stankova, 2006; Bennett and Dearden, 2014) that the public perceptions, needs and preferences with regard to environmental quality should be added to any evaluation in order to produce and improve the planning process, and with (Roca et al., 2009) that, comprehensive and meaningful information on how local communities perceive protected areas and their management is valuable and can be effectively used to plan better environmental management and eventually develop sustainable tourism. However, the conservation initiatives require the active participation of local communities in decision-making processes and solutions to integrate local development with environmental conservation (Gerhardinger et al., 2009; Xu et al., 2006).

### **3.3. Conservation Action**

The global experiences for management of protected areas, like the World Commission on Protected Areas (WCPA - IUCN) characterizes a protected area system as having five linked elements (Dudley, 2008) can describe as following:

- Adequacy: integrity, the sufficiency of spatial extent and arrangement of contributing units, together with effective management, to support the viability of the environmental processes and/or species, populations and communities that make up the biodiversity.
- Cost-effectiveness, efficiency, and equity: the appropriate balance between the costs and benefits.
- Representativeness, comprehensiveness, and balance: including the highest quality examples of the full range of ecosystems and environment types within a country; includes the extent to which protected areas provide a balanced sampling of the environment types they purport to represent.
- Consistency: application of management objectives, policies and classifications under comparable conditions in standard ways.
- Coherence and complementarity: positive contribution of each protected area towards the whole set of conservation and sustainable development objectives defined.

Moreover, the conservation of the biodiversity and ecosystems in the study area requires two major activities as following:

#### ***a) Declare the area as a new protected area***

In the present study, we suggest declaring the area as National Park (IUCN Protected Area Category II). Where, the primary objective of the National Park category is the conservation of natural biodiversity along with its underlying ecological structure (ecosystem approach) and



supporting environmental processes, and to promote education and recreation. Dudley (2008) reported on the objectives of IUCN Protected Area Category II, and the objectives as following:

- I. Manage the area in order to perpetuate, in as natural a state as possible, representative examples of physiographic regions, biotic communities, genetic resources and unimpaired natural processes.
- II. Maintain viable and ecologically functional populations and assemblages of wild species at densities sufficient to conserve ecosystem approach in the long term.
- III. Contribute in particular to the conservation of wide-ranging species, regional ecological processes and migration routes.
- IV. Manage visitor use for inspirational, educational, cultural and recreational purposes at a level that will not cause significant biological or ecological degradation to the natural resources.
- V. Take into account local communities' needs, including subsistence resource use, in so far as these will not adversely affect the primary of biodiversity conservation management aim and objectives.
- VI. Contribute to local economies through tourism activity.

**b) Prepare a Management Plan**

The protected areas should aim to maintain the biodiversity and structure and function of ecosystems; Contribute to conservation strategies at the national and international level (Dudley, 2008). The Governments should propose that the units that make up the protected area systems be strengthened by establishing management plans and operative plans, particularly for those areas designated to be priority areas. The management plan should address many activities and programs as follows:

- I. Establishment of a monitoring program: it is important to assess the current condition and any changes that may affect the natural resources. This network's usefulness is to feed a local data bank with up-to-date information on the status of biodiversity and any other elements that may affect the health of natural resources.
- II. Establishment of Reference Collections and Data Bank: This activity can be presented at the potential Protected Area's visitor center. Reference collections will include flora (herbarium) and geology and soil types can be built, kept and updated through the scientific surveys. A data bank is a computerized depot for data on biodiversity (with its various elements), ecological monitoring and research results. It will also contain a geographical information system (GIS) database for the area. Eventually, this will be a part of the national database of protected areas and biodiversity at the Egyptian Environmental Affairs Agency. The data bank will also store periodical reports on the status of conservation and sustainable use of natural resources.
- III. Research and Studies Program: There is a need for research work on population- and ecosystem dynamics, assessing ecological changes, environmental impact studies related to new development schemes need to be carried out and submitted to EEAA.  
Rehabilitation program: Vegetation conservation urgently needs the evaluation of the success of rehabilitation trials implemented in other Egyptian protected areas network. This may help establish a rehabilitation program in the area (rare plants) to contribute to future conservation activities.
- IV. Public Awareness Program: to raise the awareness of people (of all ages) to ensure their support to, and participation in, the operations of the Protected Area and, in particular, the

conservation of natural vegetation. This activity is a shared priority and may include: Guided visits of school and university students to parts of the potential Protected Area and its visitor center. These visits should be available to all Red Sea Governorate; Special workshops for the NGOs interested in environment and conservation, share information about the potential protected area's activities and solicit their support and participation.

Moreover, the conservation tools needed for future biodiversity conservation plans can be achieved through using an effective implementation of the following conservation tools:

- Declare a new protected area on the site.
- Environmental regulations and law enforcement: law no. 102/1983 for protected areas, and law 4/1994 (amended by law 9/2009) for the Environment's Protection.
- Monitoring programs, encouragement of scientific research and Geographic Information System (GIS) mapping tools availability.
- Environmental Impact Assessment (EIA): any economic activities inside the protected areas in Egypt should be agreed upon by the EEAA after submitting an accepted EIA study following the guidelines of the EIA system in the national law 9/2009.
- Communication with others: through the meetings, lectures, publications, posters, pamphlets and the visitor center.

Jonas et al., (2013) analyzed 76 studies at local and global scales indicates that the protected areas experience lower rates of habitat loss than areas that are not protected. However, the studies that Jonas et al. (2013) compiled lend some support for effective protected areas, but are not unanimous. This highlights the importance of monitoring in protected area management and decision-making without monitoring we cannot manage effectively (Stem et al., 2005).

The majority of publications show at least some positive impact of plant conservation and establish the protected areas, but poor sample size and bias in geography make generalization unwise. Investment in antipoaching or over-collecting appears to be very effective; however, given the limited sample, it is impossible to tell whether publication bias has resulted in only positive or complex outcomes being reported, basing this conclusion.

Human impact has been recognized as the most important influence on the composition of the flora in the Middle East's arid environments during the last 5000 years (Zohary, 1983). The world's landscapes are now occupied by human-altered, where humans have been the primary agents in creating new plant communities (Anderson, 1956).

The population/community level approach is considered the level that can help explore the responses of the whole ecological system to various kinds of disturbance (Barbault and Hochberg, 1992). It has been stressed that special attention should be paid to habitat disturbances in biodiversity research because the populations of many species are being turned into metapopulations as a result of habitat fragmentation (Hanski and Gilpin, 1991). This landscape ecological level view has become a central focus point in conservation biology and biodiversity research (e.g. Hanski and Gilpin, 1991). Human impacts associated with livestock grazing can alter the abundance of palatable and unpalatable plant species and of woody versus herbaceous cover (Ali et al., 2000). However, the ecosystem approach is a strategy for the integrating management of land, water and living resources that promotes conservation and sustainable use in an equitable way (CBD, 2014). The International Union for Conservation of Nature (IUCN) has suggested that in-situ conservation's long-term success requires that the global system of

protected areas comprise a representative sample of each of the world's different ecosystems (Davey, 1998).

The present study agrees with Hegazy et al. (2008) that there many recommendations and measures should take to conserve the *Moringa peregrina* in the study area and to assist in devising moringa population management strategy, the conservation activities such as: (1) in-situ conservation of the existing populations as the present study recommend through establish the area as new protected area; (2) establishment of new populations in ecologically suitable habitats on the mountains of the Red Sea (groups Shayeb-Samiuki); (3) in-situ and ex-situ conservation (in-situ rehabilitation /restoration activities, ex-situ such as gene bank, seed bank, botanical gardens, etc.) for *Moringa* spp. for creating conditions conducive to optimum survival and reproduction; (4) increase the public awareness of the local communities and other stakeholders to reduce their dependence on the *Moringa* trees for fuelwood and other un-sustainable uses; (5) searching to offering other fuel resources and new economic activities to the local communities as alternatives to their dependence on *Moringa peregrina* and on the wild flora in general as an income source. Moreover, the current study agrees with Boulos (2008) that the Red Sea mountains and the coastal desert wadis in the study area receive more rain and enjoy natural protection through the high Red Sea chain of mountains against the severe dry and often hot winds from the Sahara. These conditions resulted in more isolated habitats with richer plant life than a poorer flora and hardly any endemics in the inland Eastern Desert.

## Conclusions

In conclusion, the plant life in the coastal desert wadis and mountains of the Eastern Desert is rather rich and interesting. This paper makes a big contribution to give an overview of the conservation planning process for vegetation cover in Gebel Shayeb El-Banat a potential protected area in Egypt. Considerations of the exploitation and conservation of wild plants must be take ecological principles into account. Moreover, sustainable management of the floral biodiversity in the study area requires stopping the severe human impacts that lead to eliminating certain plant populations and modifying the complex plant communities into simple fragile ones.

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