JJBS

Volume 6, Number 2, June.2012
ISSN 1995-6673
Pages 117 - 126

Jordan Journal of Biological Sciences

Challenges Towards *Hypericum sinaicum* Conservation in South Sinai, Egypt

Om-Mohamed A. Khafagi[1] , Elbialy. E. Hatab[2] and Karim. A. Omar[3,*]

[1] *Botany Department, Faculty of Science (Girls branch), Al-Azhar University, Cairo;*
[2] *Nature Conservation Sector, Egyptian Environmental Affairs Agency;*
[3] *Saint Katherine Protectorate, the Nature Conservation Sector, Egyptian Environmental Affairs Agency, Egypt.*

Received: November 5, 2012; accepted December 29, 2012

Abstract

Hypericum sinaicum is one of the near endemic plant species in Saint Katherine Protectorate. Found only in Sinai and Northwest Saudi Arabia, there are many challenges to the conservation of this species. The aim of this study is to: (1) identify and rank the different threats, and to identify their underlying root causes, as well as the barriers, affecting the conservation of the medicinal plants specially *Hypericum sinaicum* within the rich areas of SKP, and (2) compare and reassess documented by Assi (2007) in the same area. 237 circles with diameter 10 m were established to cover all environmental gradients with equal distance between each other. At each point we recorded all factors within the field that may be become Threat to the plant community, to medicinal plants. Results found that drought, feral donkeys and over collection are the most harmful threats for *Hypericum sinaicum* in Saint Katherine Protectorate, and most of root causes come from lack of awareness, weak law enforcement, lack of suitable strategies, weak financial support and lack of stakeholders' cooperation.

Keywords: Threat Assessment, *Hypericum sinanicum*, Conservation Challenges, Saint Katherine Protectorate, Threat Levels.

1. Introduction

It is clear that the loss of biodiversity has serious economic and social costs. The genes, species, ecosystems and human knowledge that are being lost represent a living library of options available for adapting to local and global change (UNEP, 1995). Environmental deterioration in arid ecosystems due to unmanaged human activities including harvesting of vegetation for fuel and medicine, overgrazing, urbanization and quarrying is evident in a decrease of plant cover, deterioration of soil productivity, and aggravation of soil erosion (Batanouny, 1983). Damage to vegetation and the soil surface and in arid lands is not easily repaired (Milton *et al*., 1994). These activities can impact the sustainable production of food, fiber, and fuel from these lands.

The Saint Katherine (SK) region is situated in the southern part of Sinai and is a part of the upper Sinai massif. It is located between 33˚ 55' to 34˚ 30' East and *28*° 30' to 28° 35' North. The Saint Katherine Protectorate (SKP) is one of Egypt's largest protected areas and includes the country's highest mountains. This arid, mountainous ecosystem supports a surprising biodiversity and a high proportion of rare and endemic plants. The flora of the mountains differs from other areas in Sinai, due to unique geology, morphology and climate (Hatab, 2009).

H. sinaicum is one of the near endemic species in SKP, as its distribution is limited to Sinai and Northwest Saudi Arabia (Boulos, 2002). *H. sinaicum* is listed as a rare species (IUCN, 1994), and it has high medicinal importance. Extraction from aerial parts produce substances like hypericin, protohypericin, pseudohypericin, protopseudohypericin, and hyperforin which have been shown to inhibit the growth of retroviruses in animals in addition to the treatment of depression (Rezanka and Sigler, 2007).

The vegetation in Saint Katherine Protectorate has been subjected to disturbance through human activities including "overgrazing, uprooting, tourism, quarrying and over-exploitation". For example, rarity of these species may be due to slow regeneration (e.g. *Thymus decussates*), or drought (e.g. *Hypericum sinaicum*) **(**Mosallam, 2007). Also *H. sinaicum* showed medium affect by tourism, construction and goat (*Capra hircus*) grazing (Assi, 2007).

The threat from feral donkeys (*Equus asinus*) is aggravated by the fact they cause destruction to a variety of plant species through trampling (Khafaja *et al*., 2006). Bedouins consume many plants in SKP (mainly as herbal infusion) (Khafaja *et al*., 2006). However, overharvesting is to a large extent due to commercial collecting and not collecting for personal use. The quantities collected for personal use are minor compared to those collected for trade (Assi, 2007).

Successful tourism attracts migrant labor, aggravating pressure on infrastructure and environmental resources. Even ecotourism can degrade the environment, because many of the places visited by ecotourists support fragile

* Corresponding author. e-mail: kariemomar@gmail.com.

ecosystems (Budowski, 1976). Structures in ecologically fragile areas destroy habitats. Access roads impact a greater area of habitat than the tourist projects themselves.

Bedouins used to have their own system of protection (Hilf): An agreement to close an area to grazing for a certain period to allow for recovery. Now because of Bedouins' settlement, overgrazing has become a threat because of the limited area for grazing around the settlements, this is in spite of a reduction in average herd size from 50 prior to settlement to 10 currently (Assi, 2007). Some collecting has stemmed from an increased interest at the national and international level in research on the active ingredients of medicinal plants (MPs) particularly rare and endemic species. Researchers are interested in conducting their studies on sources obtained from the wild and not from cultivation (Assi, 2007).

The aim of this study is to: (1) identify and rank the different threats, identify their underlying root causes, and identify the barriers affecting the conservation of the medicinal plants, especially *Hypericum sinaicum* within SKP and (2) compare and reassess populations documented by Assi (2007) in SKP.

2. Materials and Methods

From the previous surveys we extracted 22 locations where *Hypericum sinaicum* was present (Shak Itlah, Wadi Tenia, Farsh Messila, Elmaein, Shak Sakr, Abo Tweita, Kahf Elghola, Elmsirdi, Wadi Eltalaa, Sherage, Ain Shekaia, Tobok, Elzawitin, Elgalt Elazrak, Abu Hebeik, Eltibk, Farsh Elromana, Abu Kasaba, Abu Walei, Elgabal Elahmar, Shak Mosa, Wadi Elrotk) within Saint Katherine Protectorate. We used a systematic sampling approach to capture local environmental gradients, placing 237 circles with 10 m diameters at equal distances apart. Within each circle we recorded within the field that may be a threat to the plant community. These factors included the following: feral donkeys, plant over collection, tourist intrusions (e.g. trespassing beyond trail borders and collection of firewood during camping), overgrazing, collection for scientific research, urbanization and settlement expansion and quarries as they were recorded by Assi (2007). This study taken place in the period from March 2012 to September 2012.

At each site a GPS fix was recorded in decimal degrees and datum WGS84 using Garmin 12 XL receiver. The fix was recorded to the fifth decimal digit. Arc View GIS 9.2 was used to plot the study sites. Wadi boundaries were digitized from 1:50,000 topographic maps with Egyptian Transverse Mercator projection (Blue belt). The Natural Neighbor tool from GIS 9.2 software (Spatial Interpolation) was used to make hot spots analysis by use x and y coordinates.

2.1. Identifying Threats

From Assi (2007), we extracted 7 main threats affecting the distribution of wild plants within SKP. Each threat was evaluated as follows:

2.1.1. Feral Donkeys

Using the methods of Alqamy (2005), Hatab (2009), and Omar *et al.* (2012), numbers of dung (droppings) of donkeys were counted at each circle to frequency of animal presence.

2.1.2. Overcollection

At each circle we recorded any sign of plant collection for the purposes of trade as medicinal plants, fuel or any economic value. Also assessment through meetings and interviews with the relevant stakeholders (collectors, traders and cco guides) will cover the medicinal plants rich sites within SKP and identify the hot spots (Assi, 2007).

2.1.3. Tourist Intrusions

At each site we recorded any tourism activity (paths, camping, rest points and wastes) and ranked each point by density level (How much area it cover) (Very low 20%, Low 40%, Medium 60%, High 80% and Very high >80%).

2.1.4. Overgrazing

Level of grazing was measured by dung abundance and ranked each point by density level (How much area it cover) (Very low 20%, Low 40%, Medium 60%, High 80% and Very high >80%).) Mammal dung was surveyed by recording the species concerned (mainly camel, goat, ibex, and fox) and the number of droppings (Alqamy, 2005, and Omar et al., 2012).

2.1.5. Collection for Scientific Research

We recorded all sites and target species of scientific interest by universities, research centers and scientific scholarships within SKP by reviewing reports and notifications from EIA (Environmental Impact Assessment) created by SKP staff.

2.1.6. Urbanization and Settlement Expansion

In this factor we used several approaches. First, using satellite images available in Google Earth 6.0.1.2032 (beta) with build date 2010, we observed settlements, roads and gardens and characterized them according to boundaries and density. Second, we carried out field assessment to detect any expansion (buildings, dams, wells and roads). Third, we carried out meeting with stockholders (City committee) to identify the hot spot sites defined as high impact area.

2.1.7. Quarries

We recorded all quarrying sites within SKP and created maps describing the exposed area for its impact of each site.

2.2. Underlying threat root causes, barriers and solutions

For each threat, we assigned the root causes, barriers, area, intensity, urgency, total ranking and categorical threat level. The above terms will describe as follows: **Root causes:** These are the underlying factors, usually social, economic, political, institutional, or cultural in nature, which enable or otherwise contribute to the occurrence and/or persistence of direct threats (IUCN definition). There is typically a chain of underlying causes behind any given direct threat.

Barriers: These are constraints (institutional, legal, technical, knowledge), which limit effective conservation of MPs.

A = Area: Approximate proportion of the overall area of a site likely to be affected by a threat under current circumstances (i.e. given the continuation of the existing situation). *Since there are 8 direct threats, the highest

ranked threat for "Area" receives a score of 8, and the lowest ranked threat receives a score of 1 (Assi, 2007).

I = Intensity: refers to the impact of the threat within a micro-site. Will the threat completely destroy the habitat in a small locality, or will it only cause minor changes (i.e. given the continuation of the existing situation). Since there are 8 direct threats, the highest ranked threat for "Intensity" receives a score of 8, and the lowest ranked threat receives a score of 1 (Assi, 2007).

U = Urgency: The importance of taking immediate action to counter the threat. Since there are 8 direct threats, the highest ranked threat for "Urgency" receives a score of 8, and the lowest ranked threat receives a score of 1.

TR = Total Ranking: Sum of Area + Intensity + Urgency (Assi, 2007).

2.3. Threat Level

Threat levels have been arranged as:

1. **Very High (rating above 20):** The threat is likely to be very widespread or pervasive in its scope, is likely to destroy or eliminate the conservation target over some portion of the target's occurrence at the site and seriously affect the conservation target throughout the target's occurrence at the site. The threat must be countered immediately or limited action today will likely mitigate much more intensive action in the future.
2. **High (rating between 15 and 20):** The threat is likely to be widespread in its scope, to seriously degrade and affect the conservation target at many of its locations at the site. The threat must be countered in the next 5 years OR limited action in the next 5 years will likely mitigate much more intensive action in the future.
3. **Medium (rating between 9 and 14):** The threat is likely to be localized in its scope, to moderately degrade and affect the conservation target at some of the target's locations at the site. The threat probably will need to be countered in the next 5-10 years.
4. **Low (below 9):** The threat is likely to be very localized in its scope, is likely to only slightly impair and affect the conservation target within a limited portion of the target's location at the site. The threat does not need to be countered in the next 10 years (Assi, 2007).

3. Results and Discussion

A total of 237 circles with average 10 per location were studied and output results can surmised as follows:

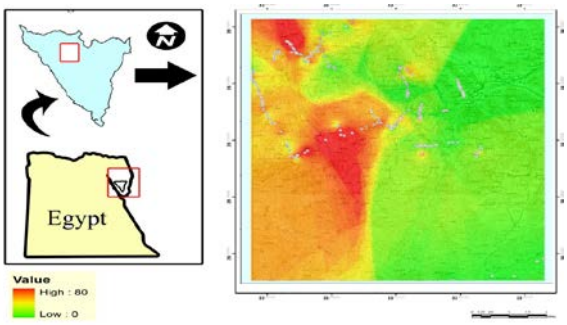
3.1. Threats hotspots and effect

3.1.1. Feral Donkeys

A total of 129 (54.4%) sites out of 237 were affected by feral donkeys. Twenty five (10.5%) sites had a high frequency of donkey occurrence, 45 (18.9%) had a medium level, 45 (18.9%) had a low level, 14 (5.9%) had a very low level and 108 (45.6%) sites had no donkey droppings.

It was observed that donkey's distribution affected by vegetation cover (donkeys concentrated on areas with high vegetation cover) which affecting by good water supply and showed negative relation with Bedouin community distribution (distributed away from human presence). Sites located within elevations ranging from 1800 m to 2000 m such as Abu Tweita, Wadi Gebal, Farsh Elromana and Farsh Messila recorded the highest presence for donkeys (Map 1). Grazing by these usually causes uprooting of the plants as indicated by Bedouins and field observations and this prevents plant regrowth. Soil compaction is associated with use by these animals and causes destruction to a variety of plant species through continuous trampling (Khafaja *et al*., 2006).

The field observations showed that feral donkeys grazed on a very wide spectrum of plant species compared with goats and camels; however, the numbers of feral donkeys have decreased sharply compared with the results of Assi (2007). The local community explained this was due to the sharp decrease in water supply.

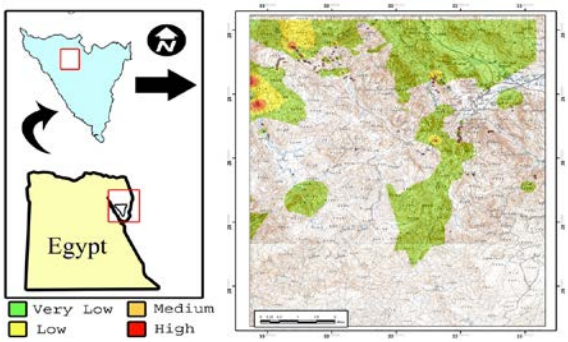


Map 1. Distribution of feral donkeys within study area

3.1.2. Over collection

Fifty-eight sites (24.4%) of 237 were affected by plant collection. One site 0.4%) had a high level of plant collection, 10 (4.2%) had a medium level, 16 (6.7%) had a low level, 32 (13.5%) had very low collection pressure and 178 (75%) sites showed no observations for plant collection.

Locations like Abo Hebik, Elgalt Elazrak, Abu Tweita, Sherige, Shak Musa, Elmesirdi and wadi Eltalaa are most targeted for collection (Map 2). These sites are characterized by high plant productivity and water supply; however, the collecting of plants increased with precipitation and was concentrated between March and December each year (flowering season). It was observed that collecting of plants may be affected by economic factors. In other words, when tourism levels fall, Bedouin start to collect plants for income. Results obtained from local communities showed that women are the most common collectors of plants, and they collect 5 times per season. Although the reasons for collecting these plants are always for trade or personal use as fuel, the use of plants as fuel has decreased sharply with the advent of butagaz.



Map 2. Hotspots of plant collection within study area

Results showed that *Origanum syriacum*, *Mentha longifolia*, *Salvia multicaulis*, *Chiliadenus montanus*, *Crataegus x sinaica* and *Thymus decussatus* are the most collected species for trade within the study area because of their medicinal value (Table 1), and these results confirm those of Assi, (2007). *Cotoneaster orbicularis*, *Phlomis aurea*, *Crataegus x sinaica*, *Ziziphus spina-christi*, *Rhamnus dispermus* and *Globularia arabica* are the most common species used as fuel (Table 1).

Table 1. Economic importance of some plant species within the study area

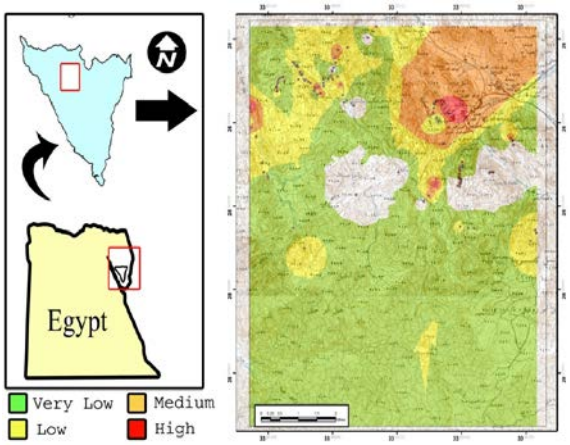
	Economic use		
Species	**Medicinal**	**Fuel**	**Food**
Ballota undulata (Fresen.) Benth.	Low		
Foeniculum vulgare (Ucria) Cout.	Low		
Globularia arabica Jaub. & Spach.	Medium	High	
Hyoscyamus boveanus (Dunal) Asch. & Schweinf.	Medium		
Plantago sinaica (Barneoud) Decne.	Medium		
Rhamnus dispermus Boiss.	Medium	High	
Rosa arabica Crep.	High	Medium	
Stachys aegyptiaca Pers.	High		
Tanacetum sinaicum (fresen.) Delile ex Bremer & humphries.	High		
Teucrium polium L.	High		
Verbascum sinaiticum Benth.	High		
Ziziphus spina-christi (L.)	High	High	High
Achillea fragrantissima (Forssk.) Sch. Bip.	High		
Serphedium herba-alba Asso.	High		
Artemisia judaica L.	High		
Chiliadenus montanus (Vahl) Brullo.	High		
Crataegus x sinaica Boiss.	High	High	
Mentha longifolia (L.) Huds.	High		
Origanum syriacum (Boiss.) Greater & Burdet.	High		
Pulicaria undulata (L.) C. A. Mey.	Medium		
Salvia multicaulis Vahl.	High		
Thymus decussatus Benth.	High		
Cotoneaster orbicularis Schltdl.		High	
Phlomis aurea Decne.		High	
Ficus carica L.			High

Hand picking of plant species is widely practiced as indicated by stakeholders, particularly collectors, which increases the rate of uprooting instead of using pruning shears. Collections of some species, such as *Origanum syriacum* and *Salvia multicaulis*, are limited to flowers. This could impact a plant species' life cycle and decrease the population size with time. It was observed that most collectors collect species with medicinal or economic value for personal consumption; however, the amount collected for this purpose is small compared with amounts collected for trade. Bedouin mentioned that *Hypericum sinaicum* with its great medicinal importance is still unused by local communities for folk medicine in SKP.

3.1.3. Tourist Intrusions

Two hundred one sites (84.8%) out of 237 were affected by tourism. Thirty eight sites (16%) had a high level of tourism, 47 (19.9%) had a medium level, 72 (30.3%) had a low level, 44 (18.5%) had a very low level and 36 (15%) sites showed no observations of tourism. Wadi Gebal, Farsh Elromana, Elgalt Elazrak, Abu Tweita, Wadi Tenia, Wadi Sherige and Wady Eltalaa were the sites with the highest levels of tourism (Map 3). About 3 million people from 51 nationalities visited SKP from 2003 to 2011 with an average 335.000 people per year. Most of them focused on the northern part of SKP, a world heritage site (Map 3). Many of the tourists do safari and camp in remote areas; usually safaris extend for many days using different camping sites; the most camping sites are in Firsh Elromana, Wadi Tenia, and Wadi Gebal.

Some of the negative impacts associated with tourists include collecting medicinal plants as souvenirs from the SKP and plant collection for fuel. Soil compactions due to trespassing leads to poor vegetation cover and results from trampling. Camping takes place in sheltered sites which provide water sources for tourists.



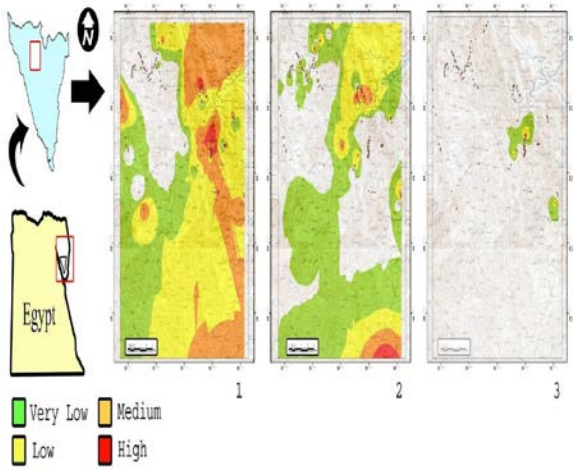
Map 3. Hotspots of tourism within study area

3.1.4. Grazing analysis

Results showed that the animals recorded within the greatest number of sites in the study area were goats followed by camels. A total of 158 sites (66.6%) out of 237 were affected by goats. Twenty eight sites (11.8%) had a high level of goat presence, 21 (8.8%) had a medium level, 69 (29.1%) had a low level, 39 (16.4%) had a very low level and 79 (33%) sites showed no observations for goat dung. Elmesirdi, Sheiage, Elahmar and Shak Musa had the most sites with goats presence which can be explained by their proximity to local community settlements (Map 4).

A total of 103 sites (43.5%) out of 237 were affected by camels. There were 14 sites (5.9%) with a high level of camel presence, 26 (10.9%) with a medium level, 42 (17.7%) with a low level, 21 (8.8%) with very low level and 134 (56.5%) sites with no observations for camel dung. Elawitein, Wadi Gebal, Wadi Tenia, Abu Tweita and Farsh Elromana had the most sites with recorded presence of camels. This can be explained by the easy access and heavy use by tourists for camping supported by camels (Map 4).

Ibex dung was found in low quantities at specific locations like Emesirdi, Shak Musa and Elahmar. The presence of these animals depended on the presence of water. Eleven sites (4.6%) sites out of 237 were affected by Ibex. Five (2.1%) had low presence, 6 (2.5%) recorded very low presence and 226 (95.3%) sites showed no observation for Ibex dung. There was significantly more domestic mammal dung (goats (58%) and camels (39%)) encountered than native mammal dung and this agrees with results observed by Guenther *et al*. (2005) and Omar *et al.* (2012).



Map 4. Hotspots of grazing animals within study area; 1- Goat, 2- Camel and 3- Ibex.

There were 18 plant families that showed heavy grazing; Asteraceae (33.3%), Lamiaceae (22.2%), Brassicaceae (16.6%) and Caryophyllaceae (16.6%) were the predominant families among grazed plants. It was observed that the following species were the most frequently grazed: *Juncus rigidus*, *Hypericum sinaicum*, *Galium sinaicum*, *Zilla spinosa*, *Mentha longifolia*, *Anarrhinum pubescens* and *Scrophularia libanotica*, See Tables (2, 3).

Table 2. Recorded families affected by grazing and number of species in each family

Family	Number of grazed species	Grazed species %
Asteraceae	6	33.3
Lamiaceae	4	22.2
Brassicaceae	3	16.7
Caryophyllaceae	3	16.7
Moraceae	2	11.1
Schrophulariaceae	2	11.1
Juncaceae	1	5.6
Asclepiadoideae	1	5.6
Dipsacaceae	1	5.6
Globulariaceae	1	5.6
Hypericaceae	1	5.6
Papaveraceae	1	5.6
Plantaginaceae	1	5.6
Poaceae	1	5.6
Resedaceae	1	5.6
Rosaceae	1	5.6
Umbelliferae	1	5.6
Zygophyllaceae	1	5.6

Table 3. Number of grazed stands by species within the study area and their frequency

Species	No of Grazed Stands
Juncus rigidus Desf.	25
Hypericum sinaicum Hochst.&Steud.	20
Galium sinaicum (Delile ex Decne.) Boiss.	14
Zilla spinosa Prantl.	13
Mentha longifolia (L.) Huds.	10
Anarrhinum pubescens Fresen.	10
Scrophularia libanotica Boiss.	9
Crataegus x sinaica Boiss.	9
Ficus palmata Forssk.	8
Diplotaxis harra. (Forssk.) Boiss	6
Centaurea eryngioides Lam.	6
Pterocephalus sanctus Decne.	6
Teucrium polium L.	5
Origanum syriacum (Boiss.) Greater & Burdet.	5
Achillea fragrantissima (Forssk.) Sch. Bip.	4
Silene schimperiana Boiss.	4
Phlomis aurea Decne.	3
Plantago sinaica (Barneoud) Decne.	3
Matthiola arabica Boiss.	3
Echinops spinosus L.	2
Seriphidium herba-album (Asso) Sojak.	2
Globularia Arabica Jaub. & Spach.	1
Arenaria deflexa Decne.	1
Fagonia mollis Delile	1
Ficus carica L.	1
Gymnocarpos decandrus Forssk	1
Bufonia multiceps Decne	1
Cynodon dactylon (L.)Pers.	1
Launaea spinosa (Forssk.) Sch. Bip. ex Kuntze	1
Caylusea hexagyna (Forssk.) M. L. Green.	1
Deverra triradiata Poir.	1
Launaea nudicaulis (L.) Hook. F.	1

Results showed that Tebok, Abo Twita, Ain Shekia, Shak Sakr and Elmesirdy had the highest number of grazed plants among the different locations (Table 4). These locations are having high levels of tourism and other human activities which are compounded by the presence of camels and donkeys used as transportation to and from historical sites. Bedouin communities are also settled beside these locations and this increases goat presence in these locations.

Table 4. Average no. of grazed individuals among different locations

Location	Average No. of Grazed Individuals
Tobok	9
Abu Tweita	7
Ain Shekaia	7
Shak Sakr	7
Abu Hebeik	6
Elahmar	6
Elgalt	6

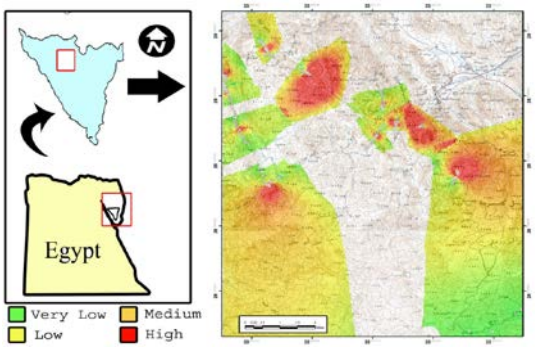
Elazrak	
Elmesirdy	6
Farsh Messila	5
Shak Itlah	5
Shak Musa	5
Sherage	5
Abu Kasaba	4
Elmaein	4
Wadi Eltalaa	4
Elzawitein	4
Farsh Elromana	4
Eltebk	3
Wadi Tenia	1
Abu Walei	0
Kahf Elghola	0

There is high grazing pressure on *Hypericum sinaicum* especially by goats which find *Hypericum* is a good source of moisture. Species like *Echinops spinosus and Hypericum sinaicum* with different morphological traits (High, width, leaf shape and size index) often differ in their responses to grazing (Landsberg *et al.*, 1999; McIntyre *et al.*, 1999; Bullock *et al.*, 2001; Diaz *et al.*, 2001; Dupre & Diekmann, 2001; McIntyre & Lavorel, 2001; Cingolani *et al.*, 2005; De Bello *et al.*, 2005; Louault *et al.*, 2005; and Omar *et al.*, 2012).

3.1.5. Collection for Scientific Research

A very low number of sites were affected by collection for scientific research (e.g., for the purpose of herbarium specimens, phytochemistry or genetics). The research that affected the most sites was the collection of specimens for herbaria. The collectors sometimes collected a big amount of plants complete with flowering parts and roots. Also, collection for phytochemistry requires more than a kilo for good extraction (traditional knowledge). Results showed that the most affected sites were Wadi Tennia, Abu Tweita, Elmesirdi, Abu Kasaba, Shak Musa and Elgalt Elazrak (Map 5).

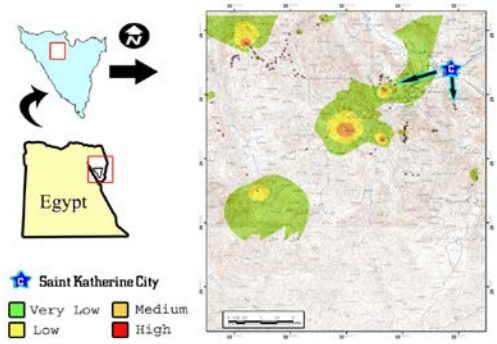
The organizations most associated with collecting for purposes of research were Egyptian research centers (Desert research center and National Research Center), Egyptian Universities (Cairo Univ. and Ain Shams) and foreign Universities (Nottingham Uni.).



Map 5. Hotspots of sites used for scientific research

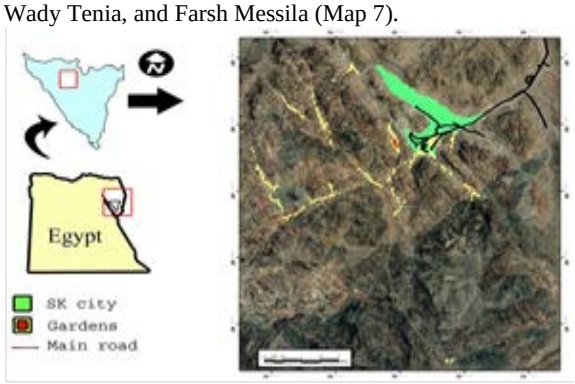
3.1.6. Urbanization and Settlements Expansion

The entire study area is located within a high mountain area, which is far from cities and Bedouin settlements. Within our study area, we recorded human activities, including destruction of rocks for building gardens and digging wells; the sites with the most frequent effects of human settlement were Abu Twita and Zawitein (Map 6).



Map 6. Hotspots of human activity within the study area

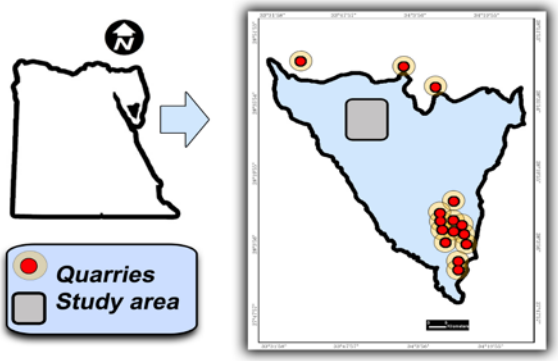
Main roads (asphalt roads) located and ending in SK City are also far from the study area. Bedouin gardens were distributed at all sites within the study area but had the highest frequency at Wadi Gebal, Farsh Elromana, Wady Tenia, and Farsh Messila (Map 7).



Map 7. Distribution of gardens within the study area

3.1.7. Quarries

No quarries were recorded within study area; all quarries are concentrated at the southern part of SKP (Wadi Elkabila, Wadi Elsamaa, Wadi Om Adawy and Al-Nheid (Map 8).



Map 8. Distribution of quarries within SKP

3.2. Threat ranking and level of effect

Results derived from current threat analysis were compared with those obtained by Assi (2007) (Table 5). The results showed that, some threats decreased such as feral donkeys (42%), over collection (29%) and quarries (25%) and others increased such as tourist intrusions (27%), overgrazing (20%), urbanization & settlement expansion (80%), and collection for scientific research (30%) this can be resulting from the change in climate conditions, it was recorded that the rainfall amount in 2007 was 17.60 mm comparing with 12.30 mm in 2012.

Table 5. Threat Analysis (TA) comparison between 2007 and 2012

Threats	Year	Criteria Rankings			Total Ranking	Threat level	change
		Area	Intensity	Urgency			
Feral Donkeys	2007	5	7	7	19	High	+
Feral Donkeys	2012	3	5	3	11	Medium	-
Over collection	2007	7	5	5	17	High	+
Over collection	2012	5	4	3	12	Medium	-
Tourist Intrusions	2007	3	4	4	11	Medium	-
Tourist Intrusions	2012	5	6	3	14	Medium	+
Overgrazing	2007	4	3	3	10	Medium	-
Overgrazing	2012	4	4	4	12	Medium	+
Collection for Scientific research	2007	2	2	2	6	Low	-
Collection for Scientificresearch	2012	3	3	2	8	Low	+
Urbanization & Settlements Expansion	2007	2	1	2	5	Low	-
Urbanization & Settlements Expansion	2012	3	3	3	9	Medium	+
Quarries	2007	1	2	1	4	Low	+
Quarries	2012	1	1	1	3	Low	-
Total 2007		24	24	24	72		+
Total 2012		23	25	19	69		-

3.3. Underlying threat root causes, barriers and solutions

From the previous results and from data collected from local comunities we can conclode and disscuss all threats, root causes, barriers and solutions in the following table (Table 6).

Table 6. Different threats root causes, barriers and solutions

Threat	**Root causes**	**Barriers**	**Solutions**
Feral Donkeys:	• Bedouins, after recent settlement around SK City, have left the donkeys neglected in the mountains. • Those animals require high amount of feeding and were largely replaced by camels. • The recent use of trucks for water transport.	• Lack of strategy to deal with invasive species. • Insufficient awareness on possible damages resulting from invasive species. • Loss of sufficient funding for addressing feral animal abundance.	• Use conventional methods of control including soft catch traps and hunting. • Increase awareness of Bedouins about the impacts (and potential impacts) of feral species on their environment and their culture emphasizing the importance of eradication and management. • Establish a comprehensive strategy, using a participatory approach with the local Bedouins, to deal with possible future colonization. • Establish a strategy to prevent and control invasive species.
Over collection:	• Quick economic gain. • Increased market demand for medicinal plants at the national level. • Firewood gathering for heating and cooking. • Bedouins recent settlements in “Wadis” around SK increased over collection around those settlements. • Poverty encourages intensive use of natural resources including medicinal plants. • Cheap prices offered per bag in the absence of added value and proper market linkages.	• Week enforcement of regulations. • Lack of awareness on plant values, endemism, and ecological role. • Most collectors are not organized in an association or cooperatives, etc. • Limited accessibility to firewood alternatives in remote settlements. • Land tenure: “Open access” system. • Inadequate alternative sources of income. • Cultivation areas insufficient to meet demand. • Cultivation programmers do not involve the wild collectors. • Lack of fund source to encourage local community to use other methods for gaining money.	• Develop species-specific regulations regarding harvesting quotas, rotation of collecting areas, etc. • Cultivation reduces the pressure on Medicinal Plants (MP) wild population and decreases overharvesting. The project should continue the cultivation program; however, there should be a focus to involve wild collectors in cultivation of MPs. • Increase awareness and capacities for the law enforcement cycle. • Enhance MP association (Association located at SK City) capacities for marketing of conservation friendly MP products. • Strengthen technical and capacities of the MP association for value-added process and product improvement. • Conduct extensive trainings for local collectors

	• It's away for money gain when tourism falls down.		on time of harvesting, suitable manners of transporting, and storing of medicinal plants to avoid loss in quality and quantity. • Increase consumer sensitivity towards biodiversity friendly MP-derived products. • Promote regeneration or reinforcement of populations by re-seeding or other ways of propagation as appropriate for each species. • Rehaplitation proses must take place for rare species affected by over collection. • Finding continues source for money to those who haven't any source for living except collection of medicinal plants.
Tourist Intrusions:	*Trespassing beyond trails borders:* • Negligence and saving time. *Collection of firewood during camping:* • Negligence. • Guide saving money (instead of buying the firewood from the city).	• Week enforcement of regulations. • Low level of awareness among tourists on plant values, endemism, and ecological role. • Insufficient awareness among tour operators and tour guides with respect to Protectorate's regulations. • Insufficient number of protectorate's staffing.	• Increase awareness regarding the regulations on firewood among stakeholders engaged in tourism businesses. • Increase awareness among tourists on plant values, endemism, and ecological role. • Produce awareness materials on the threat of firewood collection on biodiversity including MPs to be distributed in the protectorate visitor's center. • The appointment of people to work in order to monitor the activities of park visitors and provide environmental services and information to them.
Overgrazing:	•Bedouins recent settlements in "Wadis" around SK resulted in limited land available for grazing around those settlements. •Collapse of the traditional grazing system (Hilf).	• Lack of efficient and sustainable implementation of alternatives to grazing. • Limited access of the Bedouins to, and high cost, of supplementary animal feed. • Land tenure: "Open access" system. • Lack of extension and veterinary services for herds. • The Agricultural unit in SK is not active.	• Investigate local Feed block Unit feasibility. Promoting feed blocks as supplemental feeding may be a sustainable solution that could be investigated. Feed blocks make use of non-conventional local feed resources including olive and fruit remnants, etc. This is a cheap alternative and can alleviate some pressure on grazing resources. • Continue efforts in reviving the traditional grazing system "Hilf". • Increase the public awareness about the importance of MPs and endemism and the way they can select the most appropriate places for grazing.
Collection for Scientific Research:	•Increased interest at the national and international levels in studying the active ingredients and other characteristics of MPs species (particularly endemic and rare species). • Researchers are interested in conducting their studies on sources obtained from the wild rather than from cultivation. •Low of researcher awareness about the importance of MPs and the actual quantities they want.	• Week enforcement of regulations. • Low level of awareness on Good Harvesting Practices. • Insufficient number of rangers. • Most laboratories are using old equipment which requires large amount of plant material for extraction and detection of active ingredients. • Lack of communication between SKP and universities. • Low levels of trust between SK protectorate and universities which lead some researchers to collect plants without permission from SKP.	• Increase awareness in universities and research institutions on good harvesting practices when collecting for research studies. • Enforce regulations concerning collection permits signed by EEAA and universities and research institutes within and outside Egypt. • The appointment of new researchers to work within SKP in order to monitor the activities of park visitors and provide environmental services and information to them.
Urbanization and Settlements Expansion:	•More Bedouins are involved in tourism activities concentrated around SK City. •Expanding population. •Access to schools and other modern facilities. •Recently advices to reconstruction of Sinai by government to encourage youth to migrate to Sinai.	• Institutional planning deficiencies. • Lack of socio-economic development and adequate/essential services in remote areas. • Lack of cooperation between SKP and city council and the lack of trust between two organizations. • Encroachment of land by force from Bedouins.	• Increase the public awareness about how they can choose the places for gardens, dams, wells and houses. • Strength the cooperation between SKP and city council in planning and site management by sharing data about places and its importance.
Quarries:	• Meet high demand for construction in South Sinai. • Lucrative trade in granite, cement, limestone and sandstone inside and outside Egypt. • Part of Sinai re-construction by encourages peoples to work in this rich field.	• Institutional planning deficiencies. • Weak law enforcements.	• Increase public awareness about the importance of MPs and historical sites. • Select suitable sites far from valuable sites. • Raising the price of quarrying to reduce demand by Bedouins and people who interest in business.

Natural resource policies aim to provide people the opportunity to enjoy and benefit from natural environments evolving by natural processes with minimal influence by human actions. The National Park Service (NPS) will ensure that lands are protected within park boundaries. Where parks contain nonfederal lands, the NPS uses cost-effective protection methods. Preservation of character and resources of wilderness areas designated within a park, while providing for the appropriate use, represent the primary management responsibility. The National Parks and Conservation Association is a national nonprofit membership organization dedicated to defending, promoting, and enhancing our national parks, and educating the public about the NPS.

Hypericum sinaicum is an important target for scientific research. There is a current project at Egyptian National Research Center that is focused on *Hypericum* as the main source for deriving the substance hypercin, a primary substance in the manufacture of depression medicine. They use seeds

and leaves from SKP as the only site in Egypt for *Hypericum* tissue culture. Another human modification was the extent of water cannons relocating water from elevated wadies rich in water supply to low wadies. This activity leads to consume and loss of water from wells which directly affect the plant community health. This was observed clearly at Wadi Gebal, Farsh Elromana, Wady Tenia and Abu Tweita.

When Bedouin do not use their gardens for tourist camping, they can be a tool for in-situ conservation because they exclude grazers and provide a continuous water supply. Results showed that gardens provide good shelter for *Hypericum* where the water shades are present. We found that *H. sinaicum* cover and number of individuals increased inside gardens compared with outside. However drought is still the major factor (threat) affecting the distribution of *Hypericum sinaicum* within the study area. With drought, the effects of overgrazing, over collection and feral donkeys are compounded and may be lead to a decrease in the population size with time. It was showed that drought is the major factor controlling the distribution of feral donkeys. Results showed that these animals decreased from 2007 with about 40% of total frequency without achieving any of the above.

The results of evaluation of monitoring data will help to pinpoint where, and how, a plan should be remodeled. Restructuring or redesign of plan elements based on the results of this study, will contribute to adaptive management, i.e. management which is responsive to changing conditions and project objectives. The plan should set out the time intervals (mid-term, terminal) between evaluations and should state who (individual, organization, or agency) will carry out evaluations and who will be the recipients of reports. For the evaluation to have some practical effect in improving conservation management, there should be specific mechanisms for feeding the results of evaluation back into the management process, and assigned responsibilities for follow-up. As with monitoring, evaluation should be an ongoing part of biodiversity conservation management, rather than a project-based activity.

From the previous threat results we can conclude that most root causes of threats come from lack of awareness, weak law enforcement, lack of suitable strategies, weak financial support and lack of stakeholders cooperation. These results confirm the results of Assi (2007). Most of the presented solutions were obtained by Assi (2007); however, threats persist and some of them have increased due to lack of enforcement. Drought, feral donkeys and over collection are the most harmful threats for *Hypericum sinaicum* in SKP. To achieve these solutions and decrease the effect of previous threats within study area, Egyptian Environmental Affairs Agency must improve the annual budget of SKP and insert new departments within SKP organization.

Acknowledgement

I would like to express my deepest gratitude to Mr. Mohammed Kotb, General Manager of Saint Katherine Protectorate, for his support during research steps.

References

Alqamy H. 2005. Developing and assessing a population monitoring program for the Dorcas Gazelle *Gazella dorcas* using Distance Sampling in South Sinai, Egypt. MSc thesis, University of Saint Andrewsa, Scotland.

Assi R. 2007. MP Threat Analysis and Threat Reduction Assessment Report. Conservation and sustainable use of medicinal plants in arid and semi-arid ecosystems project.

Batanouny KH. 1983. Human impact on desert vegetation. In: Holzner W, Werger M J A and Ikusima I. (Eds**.) Man's Impact on Vegetation,** Dr. W. Junk Publishers, London.

Boulos L. 2002. **Flora of Egypt**, Al hadara publishing, Cairo, Egypt, Vol. 3: 373pp.

Budowski G. 1976. 'Tourism and environmental conservation: conflict, coexistence or symbiosis?' *Environmental Conservation* ,**3(1):**27-31.

Bullock JM, Franklin J, Stevenson MJ, Silvertown J, Coulson SJ, Gregory SJ. and Tofts R. 2001. A plant trait analysis of responses to grazing in a long-term experiment. *J Appl Ecol*., **38**:253-267.

Cingolani AM, Posse G and Collantes MB. 2005. Plant functional traits, herbivore selectivity and response to sheep grazing in Patagonian steppe grasslands. *J Appl Ecol*., **42**:50–59

De Bello F, Lepš J and Sebastia MT. 2005. Predictive value of plant traits to grazing along a climatic gradient in the Mediterranean. *J Appl Ecol.*, **42**:824-833.

Diaz S, Noy-Meir I and Cabido M. 2001. Can grazing response of herbaceous plants be predicted from simple vegetative traits. *J Appl Ecol*. ,**38**:497-508.

Dupre C and Diekmann M. 2001. Differences in species richness and life-history traits between grazed and abandoned grasslands in southern Sweden. - *Ecography* , **24**:275-286.

Guenther R, Gilbert F, Zalat S, Selimk and The volunteers of Operation Wallacea in Egypt 2005. Vegetation and grazing in the St Katherine Protectorate, South Sinai, Egypt. *Egyptian J Biol*., **7**: 55-65.

Hatab EE. 2009 Ecological studies on the *Acacia* Species and Ecosystem Restoration in the Saint Katherine Protectorate, South Sinai, Egypt. Ph.D., Thesis, Fac. Sci., Al-Azhar Univ.

IUCN 1994. IUCN Redlist Categories. Prepared by the Special Survival Commission. IUCN, Gland, Switzerland.

Khafaja T, Hatab A and Dsouki A. 2006. Report on the current situation of the plant vegetation cover in the high mountain area of Saint Katherine. Plant Conservation and Monitoring Programme, Saint Katherine Protectorate.

Landsberg J, O'Connor T and Freudenberger D. 1999. The impacts of livestock grazing on biodiversity in natural ecosystems. In: Jung, HJ and Fahey GC (Eds.) **Nutritional Ecology of Herbivores**. American Society of Animal Science, Savoy, IL, pp 752–777.

Louault F, Pillar VD, Aufrere J, Garnier E and Soussana JF. 2005. Plant traits and functional types in response to reduced disturbance in a semi-natural grassland. *J Veg Sci.*, **16**:150-160.

McIntyre S and Lavorel S. 2001. Livestock grazing in subtropical pastures: steps in the analysis of attribute response and plant functional types. *J Ecol.*, **89**:209-226.

McIntyre S, Lavorel S, Landsberg J and Forbes TDA. 1999. Disturbance response in vegetation - towards a global perspective on functional traits. *J Veg Sci.*, **10**:621-630.

Milton SJ, Dean WRJ, Duplessis MA and Siegfri WR. 1994. A conceptual model of arid rangeland degradation. *Bioscience*, **44**:70–76.

Mosallam HAM. 2007. Assessment of target species in Saint Katherine Protectorate, Sinai, Egypt. *J Appl Sci Res.*, **3(6):** 456-469.

Omar K, Khafagi O and Elkholy M. 2012. Eco-geographical analysis on mountain plants: A case study of Nepeta septemcrenata in South Sinai, Egypt. LAP LAMBERT Academic Publishing, Germany.

Řezanka T and Sigler K. 2007. Sinaicinone, a complex adamantanyl derivative from Hypericum sinaicum. *Phytochem.*, **68**(9): 1272–1276.

United Nations Environment Programme (UNEP). 1995. **Global Biodiversity Assessment**. Cambridge University Press. New York, NY.