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Geographical Attributes Analysis for Egyptian *Hypericum Sinaicum*

O. Khafagi[a] And K. Omar[b]

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

Corresponding author: kariemomar@gmail.com

Abstract:

A study was carried out on a wild herb *Hypericum sinaicum* (Family: Hypericaceae) in Saint Katherine Protectorate, South Sinai, Egypt to increase the understanding about some applications of Geographical Information Systems (GIS) in analysis, management and making suitable decisions in plant conservation strategies. Also to detect the effect of environmental factors (Topography) on the distribution of *Hypericum sinaicum* as well as geographical attributes. The results showed that it was found that *H. sinaicum* has a narrow range of distribution between 1515 and 2036 m. It was shown that the highest presence for *H. sinaicum* was in elevation between 1800-2000m (42.7%) and the lowest presence detected was at elevation between 1400-1600m (0.8%). Extracted data came from 3d analysis by GIS found that *H. sinaicum* communities strongly affected by aspect and this shiny appears in the species distribution within special aspects. *H. sinaicum* was recorded at North East (44%), North (15.5%), East (15.5%), North West (13.8%), West (7.7%), South (1.7%), South East (0.8%) and Flat (0.8%), there was no records for the plant at the South West aspect. The slope degree of the populated sites was very high, as the species was found in slope aspect between 89.98 and 90 degree. Results showed that topography (elevation, aspect and slope) influences on physical and chemical properties of soil, plant morphology and plant community structure.

Keywords: Altitudinal gradient, geographical distribution, *Hypericum sinaicum,* mountain biodiversity, plant dynamics, Saint Katherine Protectorate.

1.0 Introduction:

Sinai Peninsula has the geographical importance and uniqueness of being the meeting place of Asia and Africa. For this reason its flora combines elements from these two continents, including Saharo-Arabian, Irano- Turanian, Mediterranean and sudanian elements. At the same time, the Gulf of Suez and the Gulf of Aqaba separate it from the phytogeographical regions of Africa and Asia and thus the flora of Sinai has involved in isolation (Hatab, 2009 and Omar *et al.* 2012). The unique formation of the south Sinai Mountain, lead to greater variation in the climate and the vegetation than elsewhere. The clearest characteristics of the desert vegetation are scarcity of plant growth and near lack of trees; many plant species have become endangered due to increasing aridity and human activities. The continuous overgrazing, overcutting and uprooting are leading to the disappearance of the pastoral plant communities, a reduction of plant cover and soil erosion (Hatab, 2003).

The Saint Katherine 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 plant endemics and rare plants. The flora of the mountains differs from the other areas, due to its unique geology, morphology and climatic aspects. The soil is formed mainly from mountains weathering, thus it is mainly granitic in origin. The soil layer is generally shallow were the bed rock is close to the surface. Annual rainfall is less than 50 mm. However, rainfall is not of annual character, rather 2 to 3 consecutive years without rainfall is common. Rain takes the form of sporadic flash floods or limited local showers, thus highly spatial heterogeneity in received moisture is also common (Hatab, 2009).

Topography is the principal controlling factor in vegetation growth and that the type of soils and the amount of rainfalls play secondary roles at the scale of hill slopes (O'Longhlin, 1981; Wood *et al.,* 1988 & Dawes and Short, 1994). Elevation, aspect, and slope are the three main topographic factors that control the distribution and patterns of vegetation in mountain areas (Titshall *et al.* 2000 and Omar *et al.,* 2012). Among these three factors, elevation is most important (Day and Monk, 1974 and Busing *et al.,* 1992). Elevation along with aspect and slope in many respects determines the microclimate and thus large-scale spatial distribution and patterns of vegetation (Geiger, 1966; Day and Monk, 1974; Johnson, 1981; Marks and Harcombe, 1981; Allen and Peet, 1990 and Busing *et al.,* 1992).

Through its effects on net solar radiation and microclimate, aspect can have an important influence on the formation of soils (Jenny, 1941; Buol *et al.,* 1989; Carter and Ciolkosz, 1991) and plant community structure (Cantlon, 1951; Gilbert and Wolfe, 1959; Whittaker, 1975; Yeaton and Cody, 1979; Hicks and Frank, 1981). This influence occurs in areas as diverse as interior Alaska (Krausc *et al.*, 1959). Alberta (Lieffers and Larkin, l987), Israel (Boyko, 1947), Spain (Dariage, 1987), Montana (Goldin and Ninlos, 1976), and the eastern United States (Franzmeier *et al*., 1969; Losche *et al.,* 1970, Hurtehins *et al.,* 1976 and Boemer, 1984).
Higher level of solar radiation on sun facing slopes result in higher soil temperatures than on slopes facing away from the sun (Franzmeier *et al.,* 1969; Hurtehins *et al.,* 1976 and Macyk *et al.,* 1978), lower soil moisture levels (Gilbert and Wolfe, 1959; Stoelker and Curtis, 1960), and decreased solum development (Cooper, 1960; Gilbert and Wolfe, 1959; Green, 1987 and Carter and Ciolkosz, 1991). Due to its effects on plant cover and soil depth, aspect influences runoff and soil erosion (Branson, *et al.,* 1981; Green, 1987; Agassi *et al.,* 1990 and Marques and Mora, 1992) and resulting levels of soil P (Klemmedson and Wienhold, 1992). Aspect also shows great influence on plant cover, (Branson *et al.,* 1981; Green, 1987; Agassi *et al.,* 1990 and Marques and Mora, 1992).

Ecologists concerned with the size of geographic range of species pointed out that, in certain cases, the range decreases with decreasing elevation (Brown *et al*., 1996). The Impact of Rock, Soil, and Climate on Floristic Parameters Following floristic investigations of the vegetation of granite outcrops in tropical countries (Alves & Kolbek, 1994; Porembski *et al.,* 1994; Porembski, 1996 and Fleischmann *et al.,* 1996), researchers have concluded that the most important environmental factor in the existence of endemic plants in these rocks is isolation. Guenther *et al.,* (2005) found that the different wadi systems at Saint Katherine Protectorate have notably different vegetation components depending on their elevation. Low elevational wadis were dominated by *Retama raetam, Hamada elegans*, and *Heliotropium digynum* with low plant coverage and low species richness. High elevation sites were dominated by *Artemisia herba-alba*, *Zilla spinosa, Matthiola arabica, Achillea fragrantissima* and *Pulicaria undulata* with considerably higher plant coverage and species richness (Guenther *et al.,* 2005). However, all the wadis surveyed have, on average, similar vegetation structure in the relative density, relative frequency, and relative cover of their plants. This indicates that although the different sites have different vegetation components, their vegetation structure is similar (Guenther *et al.,* 2005).

Marked aspect-related differences have been reported for a range of ecosystem properties: soil physical and chemical characteristics (Finney *et al.,* 1962; Franzmeier *et al.,* 1969; Macyk *et al.,* 1978; Hicks and Frank, 1981; Rech *et al.,* 2001; Yimer *et al.,* 2006 and Sidari *et al.,* 2008): soil genesis (Green, 1987; Carter and Ciolkosz, l99l and Eger and Hewitt 2008); stream water chemistry (Sallese *et al.,* 1982);plants species diversity (Boyko, 1947; Pook and Moore, 1966; Whitney, 1991; Kudel, l992 and Badano *et al.,* 2005): and forest site properties (Trnnble and Weitzman, 1956; Hurtehins *et al.,* 1976; Hicks *et al.,* 1982; Verbyla and Fisher, 1989; Bale and Charley, 1993 and Mudrick *et al.,* 1994). While the reported magnitudes of the impacts of aspect vary considerably and may be complicated by variations in other environmental factors, there is sufficient evidence to show that at some steep mid- latitude sites, aspect may exercise a primary control in maintaining ecosystem disjunctions (Bale and Charley 1993).

Mark *et al.,* (2000) found topographic features (elevation, exposure and slope) to be responsible for the macro scale patterns of alpine vegetation distribution on Mount Armstrong in New Zealand.

Temperature and elevation effects were pronounced on traits such as height, width, no of branches (Dierig *et al.,* 2006). Soil moisture availability, which is a function of altitude variation, slope degree, nature of soil surface and soil texture, is the most limiting factor in the distribution of plant communities in South Sinai (El-Ghareeb and Shabana, 1990; Moustafa and Zaghloul, 1996 & Moustafa and Zayed, 1996). The wide altitudinal variation in South Sinai represents a complex gradient related to its effect on temperature and moisture availability (Whittaker, 1975 and Peet, 1988). Landform type, and other elements such as elevation, soil physical characteristics (including soil texture and nature of the surface), slope, aspect and topography all play an important role in determining the distribution of plant communities recorded by Ayyad & Ammar, (1974), Danin, (1983), Kassas & Batanouny, (1984) and Moustafa, (1990). On the other hand, the high elevation district of South Sinai receives 35-50mm of precipitation per year (Moustafa and Zayed, 1996). Zohary (1973) concluded that moisture, in the form of rainfall, is the most decisive factor controlling productivity, plant distribution, and life form in arid lands.

One of the primary variables influencing evapo-transpiration and thus soil moisture in semi-arid regions is the amount of solar radiation (Monteith, 1973). Veera (2004) calculated potential evapo-transpiration (PET) for 230 sample sites located on two small volcanoes in the West Potrillo Mountains, NM located in the Chihuahuan Desert. He found that solar radiation and PET were highly correlated and both offered essentially the same prediction of plant distributions. Qiu *et al.,* (2001) found a positive correlation between the cosine of the aspect (shows north–south trends) and soil moisture content in a semi-arid region of China. *Hypericum sinaicum* is one of the near endemic species in SKP only found in Sinai (Egypt) and Northwest Saudi Arabia (Boulos, 2002). *H. sinaicum* recorded as rare species (IUCN, 1994), this species has a highly medicinal importance value, extraction from aerial parts give substances like hypericin, protohypericin, pseudohypericin, protopseudohypericin, and hyperforin which showed effect to inhibit the growth of retroviruses including HIV, the AIDS virus) in animals beside the treatment of depression (Rezanka and Sigler, 2007). Also Special micro-habitat (Mountainous sheltered moist crevices), over-collection for scientific research and overgrazing from feral donkeys put this species in a critical conservation condition.

This paper therefore tries to increase the understanding about some applications of Geographical Information Systems (GIS) in analysis, management and making suitable decisions in plant conservation strategies. Also to detect the effect of environmental factors (Topography) on the distribution of *Hypericum sinaicum* as well as geographical attributes.

2.0 Material and Methods:

A total of 22 locations where *Hypericum sinaicum* are present were surveyed (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 with average 10 circles for each location. Within each circle we recorded the following: soil characters (physical and chemical analysis) (Piper, 1950 and Jackson, 1967), *Hypericum sinaicum* morphology (leaf length, leaf width, leaf area, shape index and internode length), species richness (Barbour *et al.,* 1987), No. of individuals, vegetation analysis (Braun – Blanquet 1964, Mueller-Dombois and Ellenberg 1974 and Shukla, and Chandel, 1989). 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. In a Geographic Information System (GIS), digital elevation models (DEM) are commonly used to represent the surface (topography) of a place, through a raster (grid) dataset of elevations. Digital terrain models are another way to represent terrain in GIS (ESRI, 2001). Altitude was recorded for each site using GPS fix recorded in decimal degrees and datum WGS84 using Garmin 12 XL receiver. All data collected from the field will be classified according to elevation in order to detect the effect of elevation.

Recorded GPS points for each location were imported into GIS software as excel sheet then we add it on TIN map then from 3d analyst tool we choose TIN surface and then chose TIN aspect and slope degree, manual of topographic maps by Arc GIS are illustrated at ESRI, (2001). All data collected from the field will be classified according to its aspect and slope in order to detect the effect of these factors.

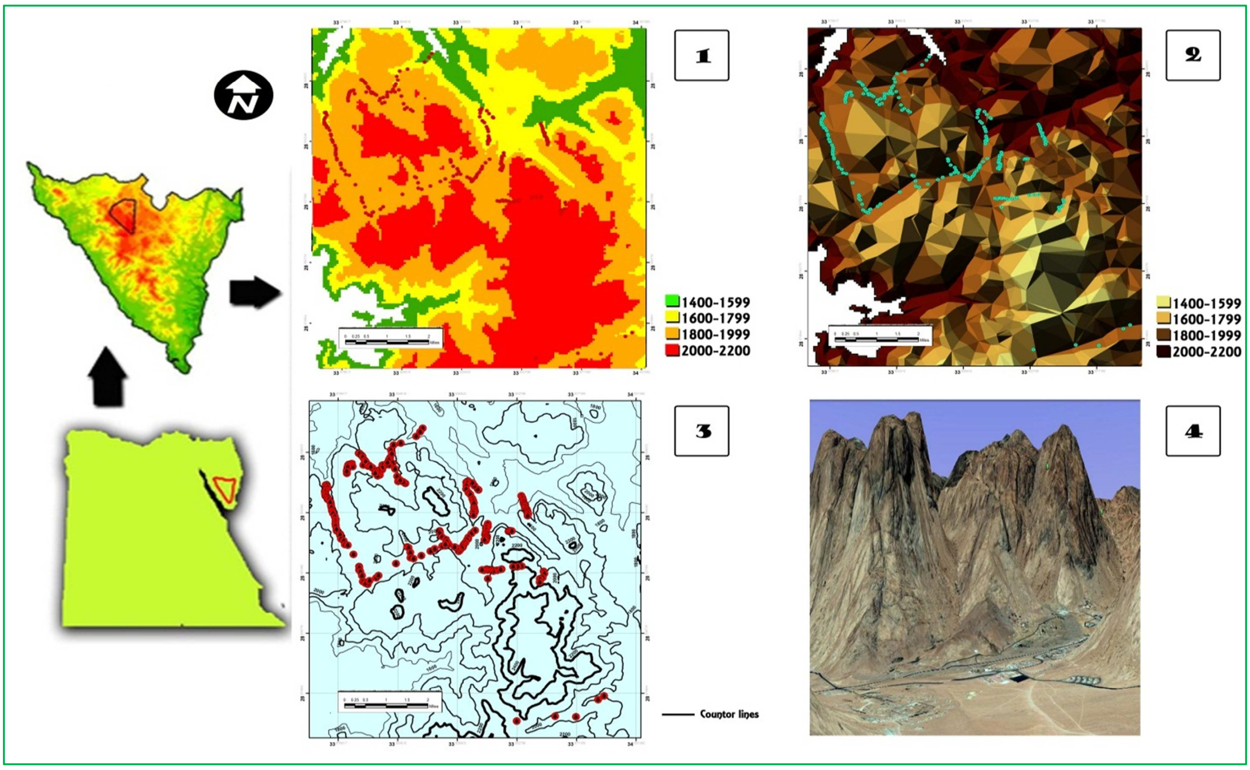
3.0 Results and Discussion:

Topographic factors include elevation, aspect and slope was determined and results illustrated as follows:

3.1 Elevation Effect:

The relationship was further confirmed when the distribution and altitude maps were superimposed by GIS. It was found that *H. sinaicum* has a narrow range of distribution between 1515 and 2036 m, the average alt is 1775m, it mean that the species' Alt niche length is occupied about 746 m upward, this niche represents about 20% of the total available alt-niche in SKP (min-alt = 50 m and max alt = 2642 m) (Map 1).

Sites within this study were classified in to 4 groups according to their altitude, it was shown that the highest presence for *H. sinaicum* was in elevation between 1800-2000m (42.7%) and the lowest presence detected was at elevation between 1400-1600m (0.8%).



Map 1. Elevation map show different elevation ranks extracted within study, (1) Digital Elevation Model, (2) Triangulated irregular network, (3) Contour lines and (4) 3d map.

Results showed that elevation influences on physical and chemical properties of soil as shown in Table (1) and Fig. (1). Soil moisture content show great variation among different elevation ranks and this agrees with results recorded by El-Ghareeb and Shabana (1990); Moustafa and Zaghloul (1996); Moustafa and Zayed (1996); Whittaker (1975), Peet (1988) and Omar *et al.* (2012) low elevation wadies showed the highest values while high elevation wadies showed the lowest soil moisture content values. Chemical prosperities of soil showed great variation among the different elevation ranks. Results found that soil pH values showed very quiet variation with altitude, $CaCo_3$, Ca, and HCo_3 contents decreased with elevation while Cl contents increased with elevation. T.D.S, EC, K, Cl, Na, Mg and SO_4 showed the highest values between 1800-2000m while Organic matter%, $CaCo_3$, Ca and HCo_3 showed the highest between 1400-1600 and this is quiet related to results obtained by Omar *et al.* (2012) (Fig. 1, Table 2).

Table 1: Physical properties of soil among different elevation ranks

Elevation ranks	Statistic	Alt	Soil moisture content%	%Sand	%Silt	%Clay
1400-1600	**Minimum**	1515	1.10	7.59	32.50	30.00
	Maximum	1515	1.10	7.59	32.50	30.00
	Mean	1515	1.10	7.59	32.50	30.00
	Range	0	0.00	0.00	0.00	0.00
1600-1800	**Minimum**	1633	0.32	1.72	19.00	7.00
	Maximum	1798	32.00	7.24	39.50	50.00
	Mean	1733	2.81	4.63	28.59	20.31
	Range	165	31.68	5.52	20.50	43.00
1800-2000	**Minimum**	1800	0.23	2.07	12.50	4.00
	Maximum	1981	4.80	10.00	47.00	45.00
	Mean	1862	0.97	4.75	28.13	19.93
	Range	181	4.57	7.93	34.50	41.00
2000-2200	**Minimum**	2001	0.34	2.76	17.50	18.00
	Maximum	2036	1.13	17.25	37.50	32.50
	Mean	2026	0.88	6.90	24.75	23.25
	Range	35	0.79	14.49	20.00	14.50
Total	**Minimum**	1515	0.23	1.72	12.50	4.00
	Maximum	2036	32.00	17.25	47.00	50.00
	Mean	1785	5.13	7.03	29.75	27.06
	Range	521	31.77	15.52	34.50	46.00

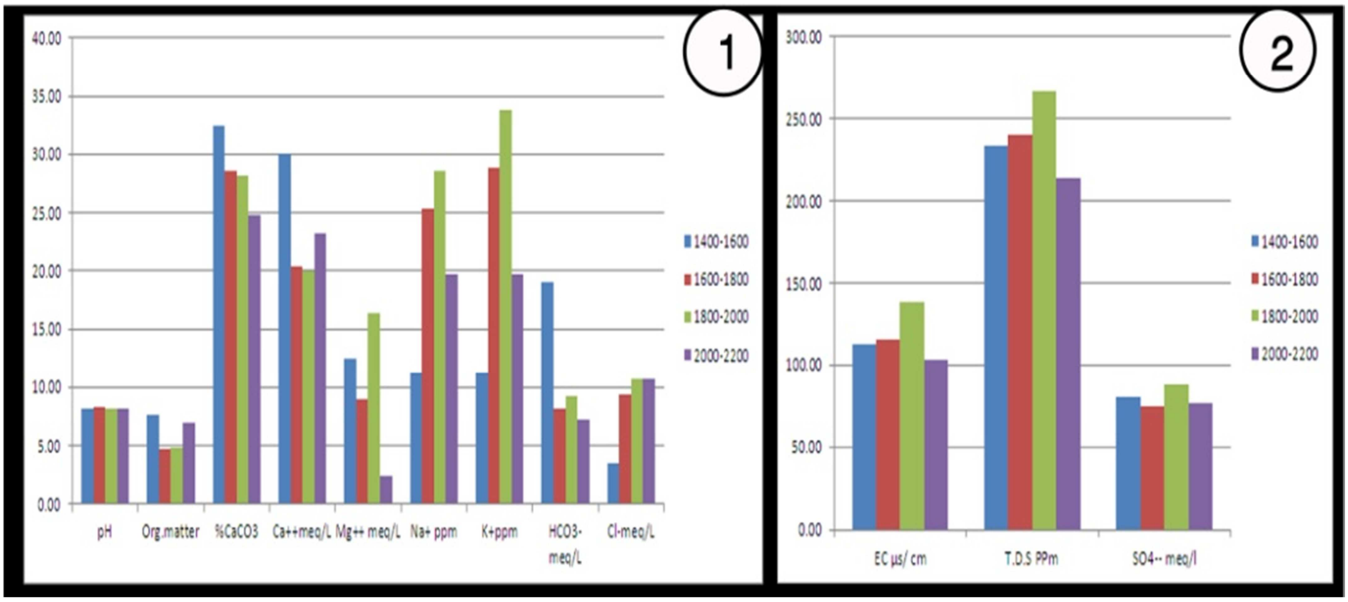


Figure 1. 1 and 2 present the chemical properties of soil among different elevation ranks.

Table 2: Chemical properties of soil among different Elevation ranks

Elevation ranks	Statistic	pH	T.D.S PPm	EC µs/ cm	Org. matter %	CaCO3 %	Ca++ meq/L	Mg++ meq/L	Na+ ppm	K+ ppm	HCO3- meq/L	Cl- meq/L	SO4-- meq/l
1400-1600	Minimum	8.10	234.00	112.50	7.59	32.50	30.00	12.50	11.30	11.30	19.00	3.50	80.00
	Maximum	8.10	234.00	112.50	7.59	32.50	30.00	12.50	11.30	11.30	19.00	3.50	80.00
	Mean	8.10	234.00	112.50	7.59	32.50	30.00	12.50	11.30	11.30	19.00	3.50	80.00
	Range	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1600-1800	Minimum	7.70	76.00	36.54	1.72	19.00	7.00	0.50	12.00	13.00	5.50	5.00	50.00
	Maximum	8.80	753.00	362.02	7.24	39.50	50.00	52.50	45.00	80.01	14.00	13.50	160.00
	Mean	8.28	240.50	115.63	4.63	28.59	20.31	9.00	25.30	28.78	8.19	9.41	75.06
	Range	1.10	677.00	325.48	5.52	20.50	43.00	52.00	33.00	67.01	8.50	8.50	110.00
1800-2000	Minimum	7.40	72.00	34.62	2.07	12.50	4.00	0.50	12.30	11.70	4.00	2.75	16.50
	Maximum	8.90	1400.00	673.08	10.00	47.00	45.00	187.50	57.14	163.82	16.00	41.00	430.00
	Mean	8.23	266.52	137.84	4.75	28.13	19.93	16.37	28.53	33.77	9.20	10.70	87.61
	Range	1.50	1328.00	638.46	7.93	34.50	41.00	187.00	44.84	152.12	12.00	38.25	413.50
2000-2200	Minimum	7.40	38.00	18.27	2.76	17.50	18.00	1.00	10.40	10.40	6.00	9.00	66.50
	Maximum	8.80	380.00	182.69	17.25	37.50	32.50	5.00	38.52	38.52	8.00	12.50	87.50
	Mean	8.15	214.00	102.88	6.90	24.75	23.25	2.38	19.68	19.68	7.25	10.75	76.88
	Range	1.40	342.00	164.42	14.49	20.00	14.50	4.00	28.12	28.12	2.00	3.50	21.00
Total	Minimum	7.40	38.00	18.27	1.72	12.50	4.00	0.50	10.40	10.40	4.00	2.75	16.50
	Maximum	8.90	1400.00	673.08	17.25	47.00	50.00	187.50	57.14	163.82	19.00	41.00	430.00
	Mean	8.15	398.38	191.53	7.03	29.75	27.06	34.00	24.75	42.51	11.44	11.34	121.31
	Range	1.50	1362.00	654.81	15.52	34.50	46.00	187.00	46.74	153.42	15.00	38.25	413.50

Plant traits were also affected by elevation gradient as shown in Figure (2) and Table (3). Results revealed that *H. sinaicum* I.V.I and number of individuals increased positively with elevation, while species richness, No. of leaves per individual, No. of Branches, internode length and vegetation cover affected negatively. Plant width, height and leaf area were also affected by elevation gradient and showed the highest values at elevation between 1800-2000m, thus accepted the results recorded by Dierig, *et al.* (2006) and Omar *et al.* (2012).

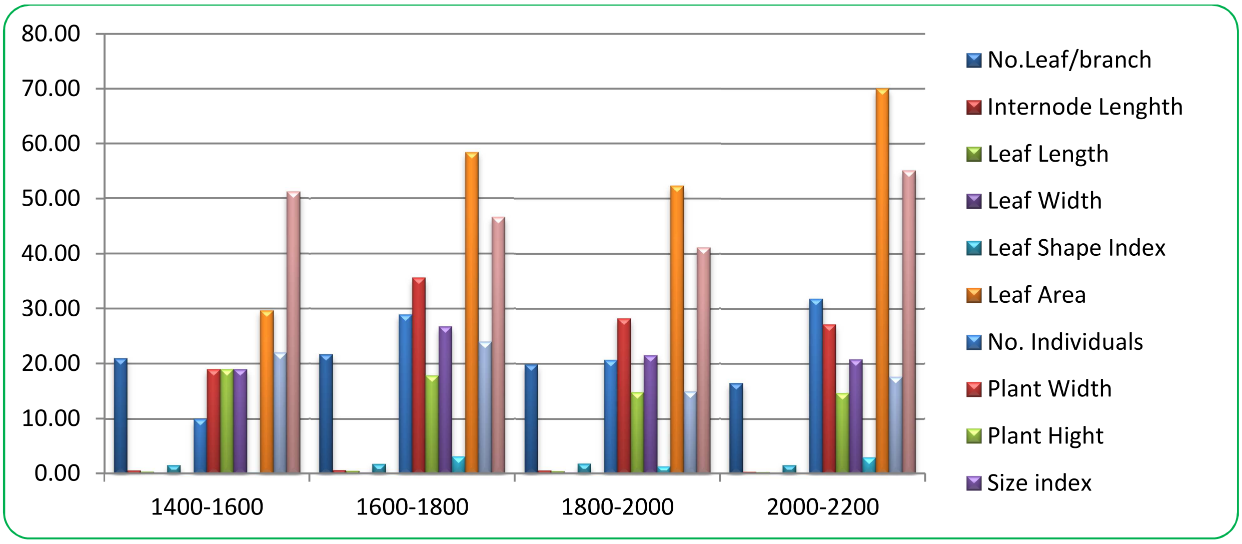


Figure 2: Morphological characters among different elevation ranks

Table 3: Morphological characters among different elevation ranks

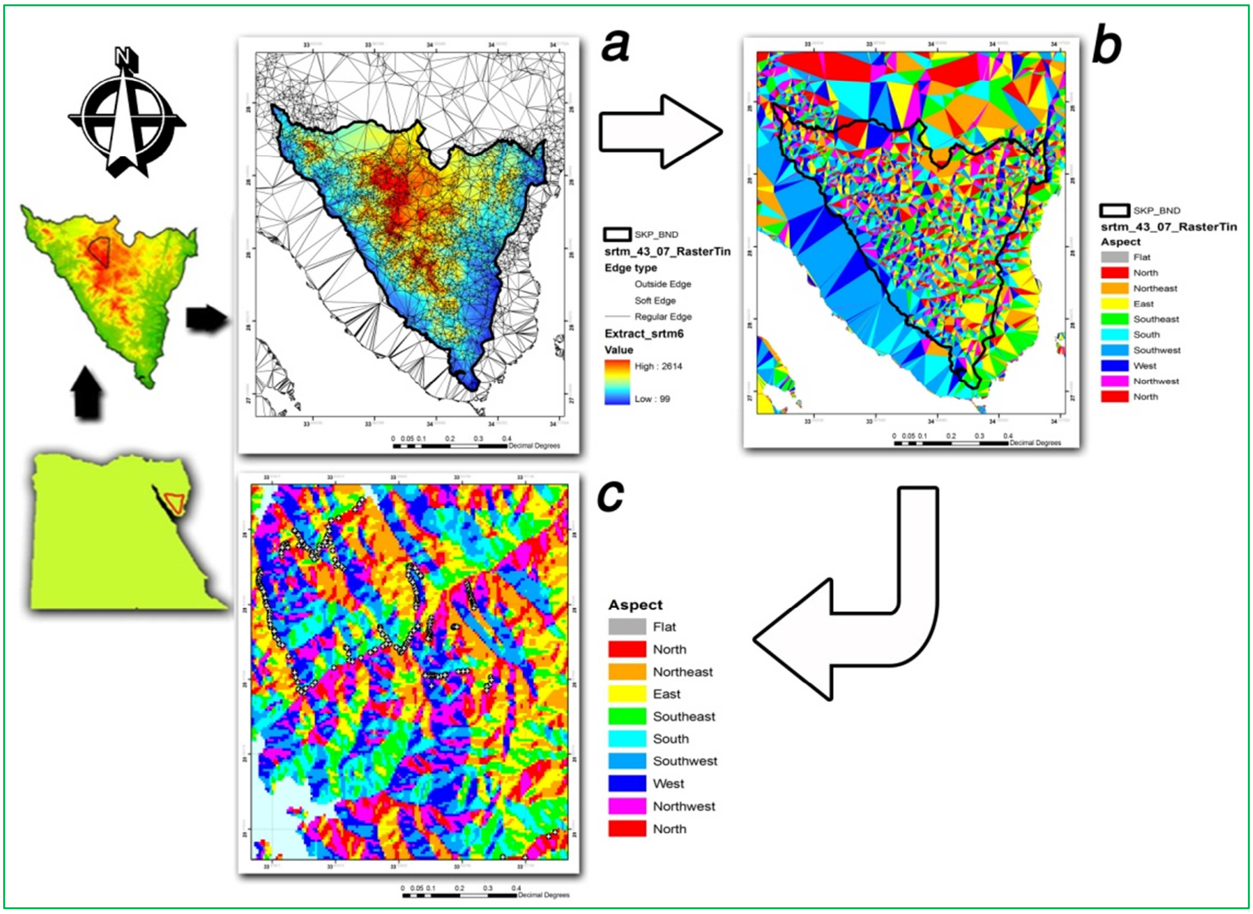
Elevation ranks	Statistic	No. Leaf /branch	No. Branches	Leaf/ indi	Internode Length	Leaf Shape Index	Leaf Area	No. Individuals	Plant Width	Plant Height	Size index	*Hypericum* Cover (m)	*Hypericum* I.V.I.	Sp. Richness
1400-1600	Minimum	21.00	205.00	4305	0.65	1.56	0.09	10.00	19.00	19.00	19.00	0.28	29.67	22.00
	Maximum	21.00	205.00	4305	0.65	1.56	0.09	10.00	19.00	19.00	19.00	0.28	29.67	22.00
	Mean	21.00	205.00	4305	0.65	1.56	0.09	10.00	19.00	19.00	19.00	0.28	29.67	22.00
	Range	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1600-1800	Minimum	10.00	15.00	150	0.25	1.44	0.03	1.00	12.00	5.00	9.00	0.02	6.10	14.00
	Maximum	34.00	425.00	13770	1.50	2.44	0.54	100.00	80.00	45.00	62.50	12.53	124.80	8.00
	Mean	21.72	155.56	4043.22	0.71	1.81	0.15	28.94	35.64	17.86	26.78	3.17	58.36	24.00
	Range	24.00	410.00	13620	1.25	0.99	0.52	99.00	68.00	40.00	53.50	12.51	118.70	16.95
1800-2000	Minimum	12.00	25.00	300	0.25	1.39	0.04	5.00	13.00	6.00	10.00	0.11	16.85	8.00
	Maximum	30.00	665.00	17955	1.30	2.33	0.23	49.00	40.00	25.00	32.00	4.17	146.06	22.00
	Mean	19.92	140.32	3208.20	0.64	1.86	0.11	20.68	28.22	14.84	21.53	1.35	52.34	14.96
	Range	18.00	640.00	17655	1.05	0.94	0.19	44.00	27.00	19.00	22.00	4.07	129.21	14.00
2000-2200	Minimum	8.00	18.00	144	0.30	1.55	0.04	5.00	7.00	5.00	6.00	0.03	35.36	15.00
	Maximum	25.00	308.00	7700	0.50	1.62	0.06	65.00	42.00	21.00	31.00	7.37	115.50	20.00
	Mean	16.50	141.17	3215.50	0.38	1.59	0.05	31.83	27.17	14.67	20.83	2.99	70.06	17.67
	Range	17.00	290.00	7556	0.20	0.07	0.02	60.00	35.00	16.00	25.00	7.34	80.14	5.00
Total	Minimum	8.00	15.00	144	0.25	1.39	0.03	1.00	7.00	5.00	6.00	0.02	6.10	8.00
	Maximum	34.00	665.00	17955	1.50	2.44	0.54	100.00	80.00	45.00	62.50	12.53	146.06	22.00
	Mean	19.79	160.51	3692.98	0.60	1.71	0.10	22.86	27.51	16.59	22.03	1.95	52.61	19.66
	Range	26.00	650.00	17811	1.25	1.05	0.52	99.00	73.00	40.00	56.50	12.51	139.96	14.00

Results extracted from GIS software version 9.2 about actual values for altitude of sampled sites; showed about 27.5 m difference between GPS records within field and values extracted from sited points in GIS 9.2. Cluster analysis for all sites representing 4 groups according to site altitude. Results showed that elevation gradient affect plant community structure, it was found that dominant species recorded within elevation rank1400-1600 m was *Achillea fragrantissima, Seriphidium herba-album, Fagonia mollis and Alkana oriantalis;* while dominant species in higher rank (1600-1800 m) present *Achillea fragrantissima, Diplotaxis harra, Fagonia mollis, Salix mucronata* and Juncus rigidus. *Achillea fragrantissima, Diplotaxis harra* recorded within elevation rank 1800-2000 m beside *Phlomis aurea and Globularia arabica. Tanacetum sinaicum, Phlomis aurea* and *Hypericum sinaicum* was the dominant in rank 2000-2200 m. Also Guenther *et al.,* (2005) found that the different wadi systems at Saint Katherine Protectorate have notably different vegetation components depending on their elevation.

3.2 Aspect effect:

Extracted data came from 3d analysis by GIS found that *H. sinaicum* communities strongly affected by aspect and this shiny appears in the species distribution within special aspects. *H. sinaicum* was recorded at North East (44%), North (15.5%), East (15.5%), North West (13.8%), West (7.7%), South (1.7%), South East (0.8%) and Flat (0.8%), there was no records for the plant at the South West aspect. This distribution pattern of the populated sites is not significantly different from the division of slope aspects among all survey sites. Most of *Hypericum* populations concentrated on Northeast, North and East aspect whish give the species more sheltered conditions, however these aspects are cooler and lower soil evaporation resulting from lower amount of solar radiation coming from lower hours of sun facing theses aspects (Map 2).

Results extracted from 3d analysis (TIN aspect) by GIS seemed more accurate than results recorded within the field by compass, sometimes compass give inaccurate data about slope aspect, this may come from the in accurate use of person who deal with it or from the hard of mountain nature. However GIS have the ability to extract accurate one depending on an accurate coordinates. Tin Aspect creates an output 2-D polygon feature class containing polygons that classify an input TIN by aspect. Each TIN triangle is classified into an aspect class. By default, aspect is divided into eight, 45-degree-wide classes: north, northeast, east, southeast, south, southwest, west, and northwest. Contiguous triangles belonging to the same class are merged during the formation of output polygons. Map 2 describes how an aspect works and gives a picture about topography of SKP. Condensed nodes and small polygons reflect the huge difference in mountain trends and curvatures that may lead to differences in vegetation communities coming from spatial differences in solar radiation absorption.



Map 2: Aspect ranks within study area. A- Triangle Irregular Network lead to aspect, b- Aspect of south Sinai and c- aspect of study area

Results recorded spatial variation in soil components, and plant traits due to the variation in aspect (Table 4). Soil physical properties showed significant variation among different aspect ranks; soil water content showed the highest value at Northeast aspect which characterized by cooler soil temperature resulting from lower duration of sun facing mountain and these results confirmed the results recorded by Franzmeier *et al.* (1969); Hutchins *et al* (1976); Macyk *et al.* (1978) and Omar *et al.* (2012).

Results also showed positive correlation between soil total dissolved solids and electrical conductivity. This component show highest degree at East aspect. Soil pH and organic carbon showed the highest value at south east aspect, while calcium, calcium carbonate and bicarbonate show highest value at Flat aspect (Fig. 3). Sodium and potassium recorded as highest value at south aspect. This variation in chemical and physical prosperities of the soil due to the spatial variation in solar radiation ratios (Finney *et al.* 1962; Franzmeier *et al*. 1969; Macyk *et al* 1978 & Hicks and Frank 1981 and

Omar *et al.* 2012). *H. sinaicum* size index, internode length, shape index and leaf area showed the highest values at south aspect, while *H. sinicum* height and width showed the highest at southeast aspect. *Hypericum sinaicum* I.V.I and No. of branches showed the highest values at west aspect while species richness, *Hypericum* cover% and total No. of *Hypericum* within each aspect showed the highest values at north aspect and lowest at south and this is due to the differences in solar radiation density this effect was recorded also by Branson *et al*. (1981); Green (1987); Agassi *et al*. (1990) & Marques and Mora (1992) and Omar *et al.* (2012) (Fig. 4).

Table 4: Variation in Soil prosperities and morphological characters of *H. sinaicum* among different habitat aspects

Aspect	N	NE	E	SE	S	W	NW	Flat
pH	8.27	8.25	8.19	8.60	8.55	8.23	8.2	8.1
EC µs/ cm	132.32	97.6	162.74	70.19	126.51	160.06	126.29	112.5
T.D.S PPm	275.22	203	338.5	146.00	119.5	274	262.68	234
Water content%	0.73	2.81	0.97	1.45	2.6	0.83	1.41	1.1
Org. matter	5.25	4.48	5.91	10.00	4.57	5.05	5.81	7.59
%CaCO3	27.44	29.69	27.06	19.50	20.75	24.33	29.17	32.5
Ca++meq/L	24.17	18.88	18.13	15.00	10.75	21	22.79	30
Mg++ meq/L	10.56	17.06	9.38	2.50	3.5	4.5	12.37	12.5
Na+ ppm	27.97	24.77	27.1	20.84	37.32	23.43	22.79	11.3
K+ppm	28.45	27.88	29.21	39.2	90.66	23.83	24.21	11.3
HCO3- meq/L	9.28	7.53	9.13	6.50	9	9	11.23	19
Cl-meq/L	13	10.94	9.13	8.00	7.13	7.25	9.14	3.5
SO4-- meq/l	88.33	88.13	74.63	65.00	41.75	60.5	82.77	80
Species richness	30	25	17	15	6	27	20	10
***Hypericum* Cover%**	2.44	1.53	1.12	0.37	0.37	1.82	1.33	0.23
***Hypericum* size index**	24.14	22.95	22.73	20	25.75	25.17	22.2	19
***Hypericum* I.V.I.**	61.19	54.39	51.1	28	22.9	69.69	49.09	29.67
No. Leaf	21	18	23	22	19	19	20	21
No. Branch	143	117	106	90	105	260	143	205
Leaf/indi	3301	2481	2419	1980	1935	6655	3126	4305
Internode (cm)	0.59	0.67	0.51	0.4	0.83	0.82	0.6	0.65
Shape Index (cm)	1.74	1.79	1.88	0.2	1.98	1.81	1.74	1.56
Leaf Area	0.1	0.14	0.08	0.1	0.18	0.09	0.1	0.09
Total Indv.	30	25	17	6	6	27	21	10
Plant Width (cm)	32.06	29.78	31.45	34	32.5	31	28.07	19
Plant Height (cm)	16.22	16.12	14	25	19	19.33	16.34	19

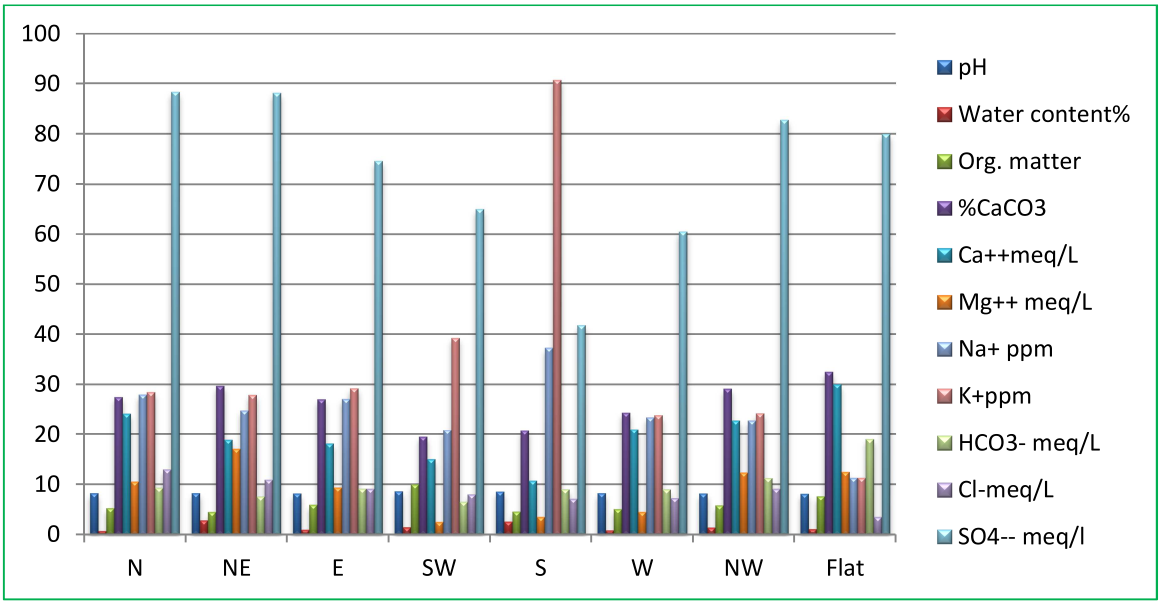


Figure 3: Variation in soil component among different aspect.

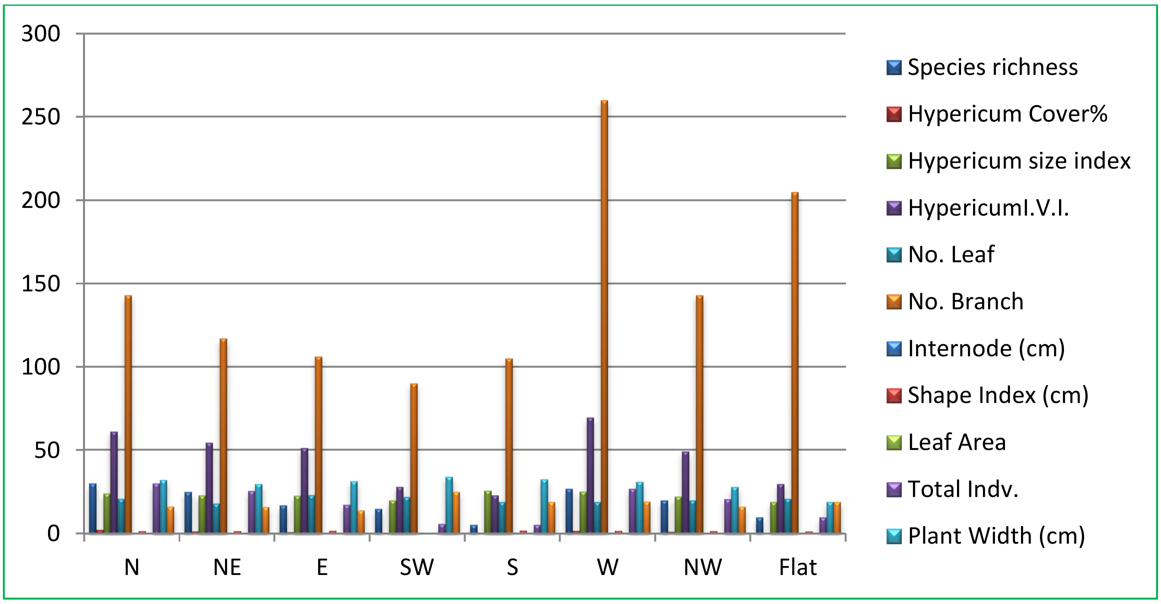


Figure 4: Morphological variation within different topographic aspects

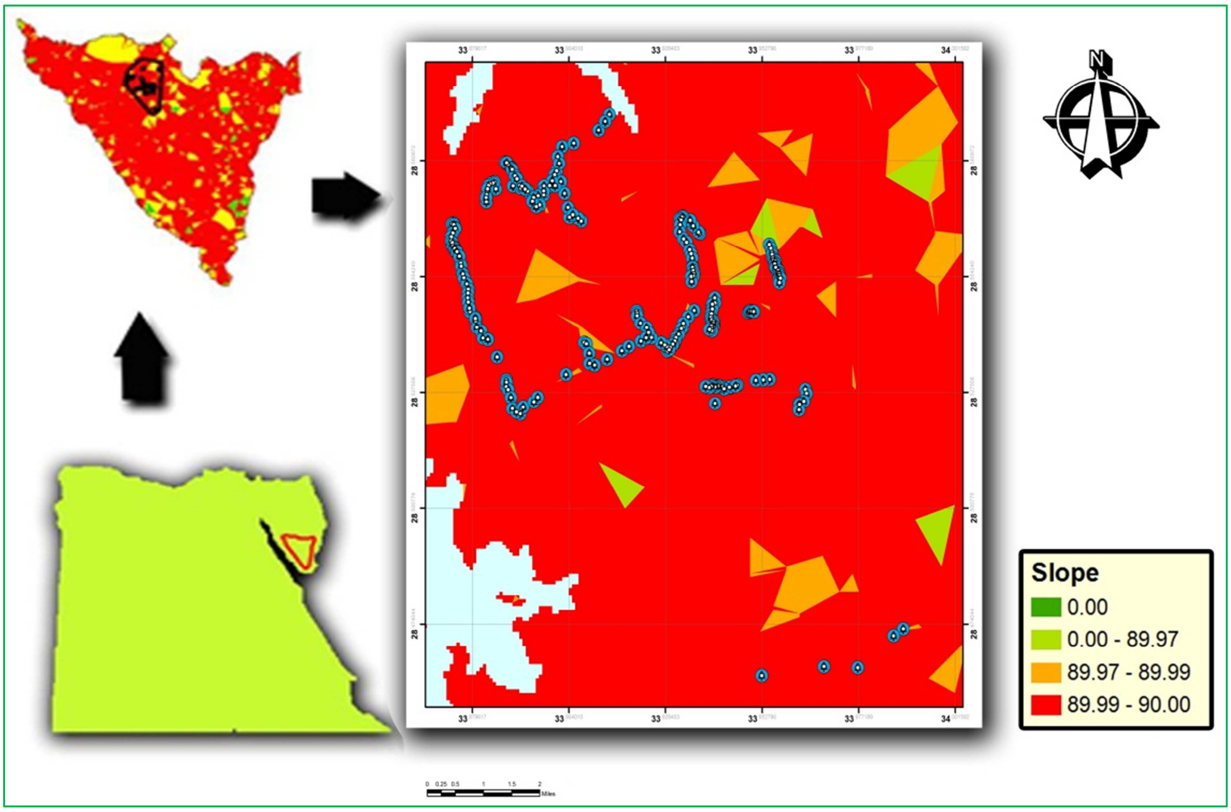
Topographic aspects also affect community structure, it was found that dominant species within each aspect as fellow:

- **East:** *Juncus rigidus*, *Diplotaxis harra* and *Achillea fragrantissima*.
- **Flat:** *Juncus rigidus.*
- **North:** *Achillea fragrantissima, Diplotaxis harra* and *Hypericum sinaicum.*
- **West:** *Phlomis aurea* and *Stachys aegyptiaca.*
- **Southeast:** *Achillea fragrantissima.*
- **South:** *Echinops spinosus, Diplotaxis harra.*
- **Northwest:** *Phlomis aurea, Achillea fragrantissima* and *Diplotaxis harra.*
- **Northeast:** *Diplotaxis harra, Achillea fragrantissima, Salix mucronata, Juncus rigidus* and *Hypericum sinaicum.*

It was observed that species like *Phlomis aurea, Achillea fragrantissima* and *Stachys aegyptiaca* have the ability to grow within mountain aspects facing high level of solar radiation and this not recorded with *Juncus rigidus* and *Hypericum sinaicum* which prefer sheltered one.

3.3 Slope:

The slope degree of the populated sites was very high, as the species was found in slope aspect between 89.98 and 90 degree as shown in Map 3.



Map 3: Slope rate among different *H. sinaicum* locations.

These results showed that SKP lies on the highest point in Egypt and this led to sharp mountain slopes with high angle and this explain the low presence rate of trees within this region which require low slope steepness for more stability; however slopes play an important role in irrigation and control the amount and places of rain water accumulation. In our situation slopes are very sharp and may case dramatically effect on vegetation communities' especially weak rooting species and this happened in floods of 2010 where unsheltered trees and large sharps uprooted from the water push. Beside this effect most of water lost in the sea and never be used to improve vegetation health and also not used by local communities for farming; this give alert for building more dames in recognized sites to save the gift of water for more plant community improvement.

Results also showed that topography is a principal controlling factor in vegetation growth and the type of soils as recorded by O'Longhlin (1981); Wood *et al.* (1988) & Dawes and Short (1994). Elevation, aspect, and slope are the three main topographic factors that control the distribution and patterns of vegetation in mountain areas (Titshall *et al*. 2000). Among these three factors, elevation is most important (Day and Monk 1974 & Busing *et al*. 1992). Elevation along with aspect and slope in many respects determines the microclimate and thus large-scale spatial distribution and patterns of vegetation (Geiger 1966; Day and Monk 1974; Johnson 1981; Marks and Harcombe 1981; Allen and Peet 1990 and Busing *et al*. 1992).

4.0 Conclusion:

It is clear from this study that GIS is an effective tool for mapping the pattern of environmental variations among areas and sets of areas. Also it was showed that GIS plays an important role as a tool for environmental management, with the current greater concern for sustainable use of resources, and conservation and monitoring of biodiversity. Topography is a principal controlling factor in vegetation growth and the type of soils. Elevation, aspect, and slope are the three main topographic factors that control the distribution and patterns of vegetation in mountain areas. Among these three factors, elevation is most important. This study can be use when rehabilitation process takes place for this species. It's important to use such study data when rehabilitation or restoration process tack place, it support decision makers where they can take their decision in the field of *Hypericum sinaicum* conservation.

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