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A STUDY ON THE RANGE ECOSYSTEM OF WADI HABIS (EGYPT)

BY

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ABSTRACT

Fifty stands were selected to represented Wadi Habis (300 km west of Alexandria). Species cover and phytomass were recorded and soil samples were collected. Twenty-three perennials and 10 annuals were collected to evaluate the nutritive values. The matrix of stands x species was classified using TWINSPAN and eradicated using DECORANA techniques. The relationships between the vegetation and environmental variables were assessed statistically. Some of the diversity indices were calculated for the recognized vegetation groups in order to judge their relationships with other community and environmental properties, Five vegetation groups were recogmized: *Suaeda pruinosa, Thymelaea hirsute, Lygeum spartum, Aremisia herba-alba, Thymelaea hirsute, Artemisia herba-alba, Artemisia herba-alba, Asphodelus ramosus* and *Asphodelus uamosus, Gymnocarpos decander*

Hygroscopic moisture, organic matter and nitrogen are the most important soil factors that affect the distribution of the vegetation groups in this area. The present study indicated that each mm of annual rainfall produced about.5.5kg dry matter/ha/yr Also indicated that most of the species have relatively low content of P, N and K, but high of Ca, mg and Fe. In addition, Ca/P ratio was much higher than the optimum range for the animal diet. Also protein content was lower than the optimum level but the carbohydrate content is reasonable for most species.

INTRODUCTION

Rangeland is defined as "land carrying natural or semi-natural vegetation, which provides a habitat suitable for herds of wild or domestic ungulates" (Partt and Gwynne, 1977). Some of the present range areas have a potential for agriculture or other development, but most is destined in the present state of a technical knowledge to remain as rangeland because of low or erratic rainfall. An environmental management policy can be successful only if it is formulated with a basic understanding of the full complexity of the ecosystem, its structure and functions, a knowledge of its properties (in particular the properties of stability and resilience) and a consideration of the history of manipulation and perturbation that have induce changes in its components (Ayyad and Le Floc'h, 1983)

Grazing has long been an important practice in arid lands. In many areas the rangeland has deteriorated due to overgrazing. Destruction of natural vegetation leads to intense wind erosion that can locally remove several centimeters of surface material per year on sandy soil (Le Houerou, 1969 a). Pasture production depends on various factors such as climate, soil, botanical composition and vegetation structure and type and intensity of management *e.g.* grazing patterns and stocking rates, fire and wild life (including insects and rodents). Climatic elements such as rainfall and temperature are the two most important factors affecting distribution, as between them they are responsible for the amount of moisture that the vegetation will receive. Soil characters (physical and chemical) and soil conditions (*e.g. drainage*, depth) also affect the vegetation cover of range (Webster and Wilson, 1980).

The present study surveys the structure of vegetation and physical elements in the arid ecosystem of Wadi Habis (300 km west of Alexandria and 20 km west of Mersa Matruh, Egypt) and the main objectives are: 1) to depict the distributional behavior of plant species, 2) to correlate such behavior with some environmental factors as an essential information for future studies on land reclamation and 3) assessment of the nutritive values of the important range species.

STUDY AREA

Wadi Habis area (Fig. 1) about 20 km west of Mersa Matruh (31 24'N, 27 03'E). It is one of main wadis of the western physiographic province of the Mediterranean costal land of Egypt. Two landforms are distinguished in the study area (El-Hadidi and Ayyad, 1975) The first is the costal plain, which is delimited by dunes and marshes to the north. Large amounts of run-off water and alluvial soil accumulate in this plain providing good possibilities for cultivation. Ecologically, it may be distinguished into a distal section close to the salt marshes and a frontal *section* includes the southern limits of the coastal plain and the mouth of the Wadi. The second landform is the Wadi, where the main channel is about 3 km long cuts through a limestone tableland backwards nears the mouth of the Wadi. It attains a mean elevation of 50 m above sea level. Two main soil groups with different characteristics dominate this region:

Ermosols and Eutic Regosols (UNESCO/FAO, 1958 and EL-Gabaly *et al.*, 1969).

According to the Egyptian Academy of Scientific Research and Technology (ASRT, 1986). Soil of the area of study belong to the orders Aridisols and Entisols, falling within the great groups of Calciorthids Torriorthids, and Torripsamments (based on the "Soil Taxonomy" classification system of the USDA, 1975 and its revised edition of USDA, 1999).

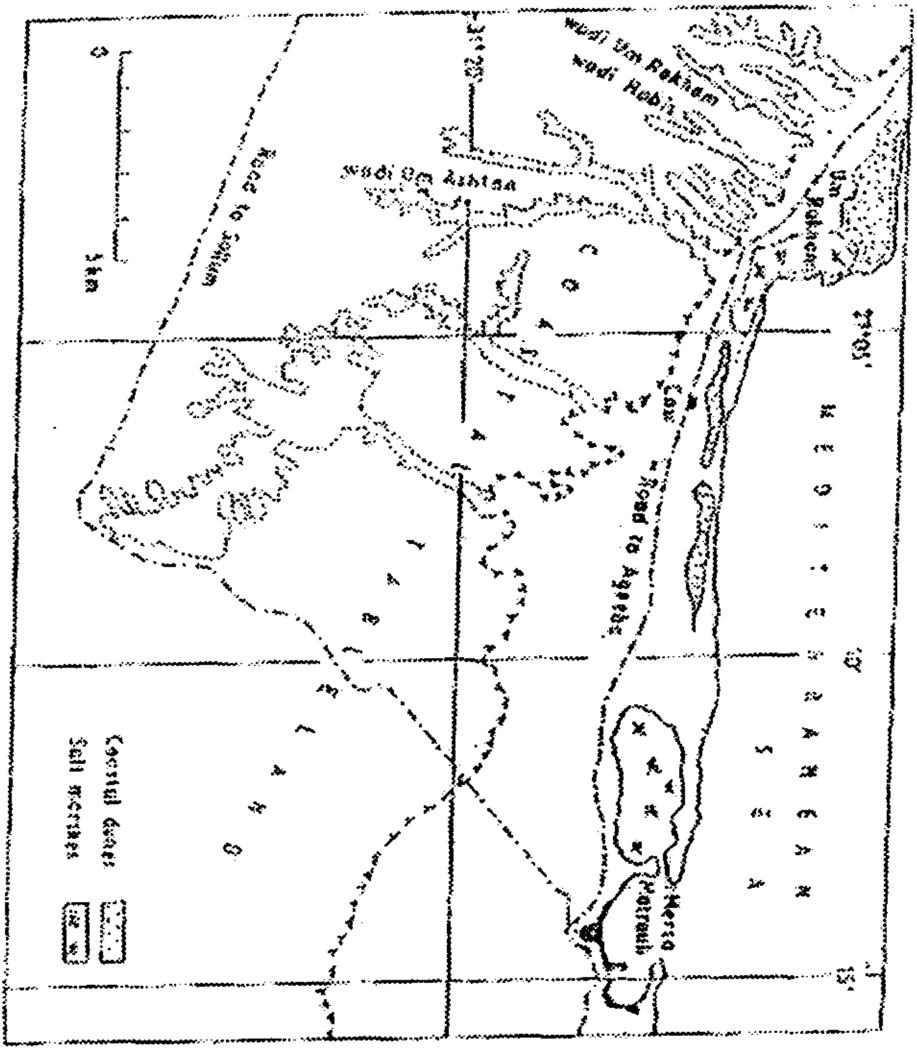

Fig. (1): A physiographic map of the Mediterranean coastal land of Egypt west of Mersa Matruh indication the location of Wadi Habis.

According to Meig's climatic classification (Meig 1973), the study area belongs to the "warm coastal desert" climate (summer warmest month with mean temperature above 20°C, occasional short rainstorms occur in winter and most of the days are sunny and mild). The general features of the climate of Wadi Habis are indicated by long-term monthly and annual averages at Mersea Matruh (Table 1). The highest long term mean maximum is 29.6°C in august but the mean maximum is 8.8°C in January. Cool nights with temperature of 10°C prevail from December till March. The relative humidity varies between 64.6% in March and 76.4% in July. The main evaporation rate ranges from 5.8mm/day in January and

November to 7.1mm /day in March. The duration of bright sunshine varies between minimum of 6.4hours/day in December and a maximum of 12.1 hours day in July. Vapor pressure varies between 8.3 mm in December and January, and 19.1 mm in August Dew point ranges from 7.0°C in February to 20.2°C in August. Atmospheric pressure increase generally in winter months, it varies between 10.6 m bar in July and 18.3 mbar in November.

METHODS

Fifty stands were selected to represent the five habitats of Wadi Habis (Wadi bed, lower and upper position of slope, cliff and plateau). Each stand was observed and a list of species, the first and second dominant species, visual estimates of the cover (%) were recorded (Muller–Dombois and Ellenbuerg, 1974). Taxonomic nomenclature is according to Tackholm (1979) and Boulos (1995).

The standing crop of the above-ground phytomass of species of Wadi Habis area was estimated using 70 randomly distributed 4m quadrates representing different physiographic units, where all the above-grounds organs were harvested and their dry weights were measured. The phytomass of 3 shrubby species (*Themlaca hirsute, Suaeda pruinosa* and *Halozylon scoparium*) was estimated by using an equation obtained through regression analysis. The dimensions of *Thymelaes hisuta* were converted to weights using the following regression equation: Y=35.96 +0.001X (Shaltout, 1983), and for *Suaeda pruinosa*, the equation Y =149.2+0.001X where Y is the weight of the diameter of the shrub per cm^3 (El-Kady, 1987). The above ground phytomass was expressed in kg dry matter/ha and converted into feed units (FU) per ha (1k dry matter = 0.33 FU) according to Le Houerou and Host (1977).

Samples of the grazeable parts of each species were collected from several locations of the study area and prepared for analysis. Na, K and Ca were analyzed using the flame photometer, and Mg and Fe using the atomic absorption. Molybdenum blue and Indo–phenol blue methods were applied for the determination of P and N respectively using the spectrophotometer. Ash content was estimated by ignition at 500°C for about 24 hours. Ether extract (crude fat) was determined by the soxhlet extraction method. All these procedures are according to Allen *et al.* (1974). The crude protein was calculated by multiplying the total insoluble nitrogen by the factor 6.25 (Pirie, 1955 and Oelbuerg, 1956). Crude fiber was estimated according to Association of Official Agriculture Chemists (AOAC, 1960). Carbohydrates were calculated from the following equation (Le Houerou, 1980): NFE=100–(CP+CF+FAT+MINS), where MFE is total carbohydrates, CP is crude protein, CF is crude fiber and MINS, is total minerals. Total digestible nutrients (TDN) were estimated according to the equation applied by Naga and El-Shazly (1971):TDN =0.5 (100 +1025 EE)–PK, where EE is the percentage of ether extract fraction, P is the percentage of crude protein, and k is a coefficient which depends on the protein and finer content. By the use of average beat of combustion values (kilocalores per g)) as quoted by Lofgreen (1951) (5.65 for protein, 4.15 for nitrogen-free extract and 9.4 for ether extract) it was possible to calculate the theoretical digestibility of energy (DE), and net energy (NE) where NE = ½ DE as mentioned by Le Houerou (1980c).

Table (1): Monthly and annual averages of some climatic factors along with monthly and annual rainfall at Mersa Matruh Meteorological station, (Average of 20 years 1967-1997).

Month	P	Temperature		Rh.	Ev	Wv.	SS	Vp	Dp	Ap	C
		Max	Min								
Jan.	41.9	17.5	8.8	68.8	5.8	10.6	6.5	8.3	7.4	18.5	3.6
Feb.	19.5	18.5	9.0	66.5	6.9	11.0	7.6	8.6	7.0	17.1	3.4
Mar.	13.1	20.1	10.5	64.6	7.1	11.1	8.1	9.0	8.4	15.9	3.2
Apr.	3.0	23.0	12.5	64.8	7.3	10.2	9.0	10.4	10.6	14.1	3.2
May.	1.5	25.4	15.2	71.3	6.8	8.9	10.0	13.2	14.1	14.0	2.4
Jun.	2.0	28.2	18.6	69.9	7.0	8.8	11.8	16.2	17.4	12.9	1.3
July.	0.0	28.7	20.8	76.4	6.7	9.5	12.1	18.7	19.9	10.6	1.2
Aug.	0.6	29.6	21.3	73.0	6.9	8.6	11.7	19.1	20.2	10.8	1.3
Sep.	2.2	28.5	19.9	69.8	7.1	7.9	10.4	16.9	18.2	14.0	1.8
Oct.	15.6	26.5	17.2	68.7	6.7	7.8	8.8	14.1	15.4	16.4	2.6
Nov.	17.6	22.9	13.6	68.7	5.8	8.5	7.7	11.3	11.8	18.3	3.2
Dec.	28.6	19.4	10.5	66.7	6.2	10.3	6.4	8.3	8.1	18.7	3.4
Annual	145.7	24.0	14.8	69.1	80.3	9.4	110.4	12.9	13.2	15.1	2.6

P. rainfall (mm), temperature) RH: relative humidity (%) Ev: evaporation (mm/day) Wv: wind velocity (knots),SS: sunshine hours (hr) Vp: vapor pressure (mm), Dp: dew Point (c), Ap: atmospheric (m.) bar) and C: cloud measurements (1/8 of sky) coverage).

Soil samples were collected in each stand (composite sample) representing a profile at depth of 50 cm and prepared for physical and chemical analysis. Soil texture was carried out by the Bouyoucos hydrometer method and organic matter expressed in terms of measurement of "Loss-on-ignition" "LOI" upon igniting the soil sample at 450°C using a muffle furnace. Thus LOI is considered a rough approximate of organic matter in soil. Soil water extract of 1 soil: 5 water were prepared for the determination of electric conductivity (EC) and soil pH was also determined. Determination of P, K, Ca, Na, Mg and Fe in soil was done using acetic acid extracts (2.5%). Total nitrogen was determined using the micro Kjeldahl apparatus. Flame photometer was used for the determination of K, Ca and Na in extracts. Atomic absorption measurement was used for the determination of Fe, Mg, and N. Procedures of chemical analysis and LOI are outlined by Allen *et al.* (1974). Determination of calcium carbonate was carried out using Berard's calcimeter of the type described by Betremieux (1984).

Two trends of multivariate analysis were applied in the present study, ordination and classification. Both have their merits in helping to understand the vegetation and environmental phenomena. The applied ordination technique was Detrended Correspondence Analysis (DECORAANA) and the classification one was Two–Way Indicator Species Analysis (TWINSPAN) (Hill, 1979 a & b). The Species richness (alpha – diversity) was calculated as the average number of species per stand within each community. Species turnover (beta diversity was calculated as the ration between the total number of species recorded in a certain community and its alpha –diversity (Whittaker, 1972 and Wilson and Shamid, 1984). Relative equitability or relative evenness (Shannon- Wiener index of the importance value of species was expressed according to the Shannon – Wiener index:

$$H' = \sum_{i=1} p_i \,(\log p_i)$$

and the relative concentration of dominance was measured using Simpson index:

$$c = \sum_{c=1}^{s} (p_i)^2$$

Where S is the total number of species and p_i is the relative importance value (relative cover) of the i[th] species (Pielou, 1975 and Megurran, 1988). The variation in soil variables in relation to vegetation groups was assessed by the one – way analysis of variance technique using a SAS software (SAS, 1983).

RESULTS

The application of two – way indictor species analysis TWINSPAN (Fig. 2) on the cover estimate of 61 plant species recorded in 50 sampled stands led to the recognition of five vegetation groups (Table, 2). The ordination of these stand along axes 1 and 2 of the DECORANA indicates a reasonable segregation among the five groups (Fig. 3). These groups were named after the first and the second dominant species.

Suaeda pruinosa-Thymelaea hirsute group (I) comprises 9 stands (18% of the total sampled stands), the first dominant species is *Suaeda pruinosa* (C = 10.2%and the second one is *Thymelaea hirsuta* (C = 9.1%). *Lygeum spartum – Artemisia herba-alba* group (II) comprises 12 stand (24% of the total sampled stands), the first dominant species is *Lygeum spartum* (C 15.5%) and the second is *Artemisia herba-alba* (C = 10.4%) *Thymelaea hirsute–Artemisia herba-alba* group (III) comprises 17 stands (34% of the total sampled stands), the first dominant species is *Thymelaea hirsuta* (C=7.3%) and the second is *Artemisia herba-alba* (C=6.3%). *Artemisia herba-alba Aspodelus ramosus* group (IV) comprises 3 stands (C= 6% of the total sampled stands), the first dominant species is *Artemisia herba-alba* (C= 6%) and the second is *Aspodelus. Asphodelus ramosus – Gymnocarpos decander* group (V) comprises 9 stand (18% of the total sampled stands), the first dominate species is *Asphodelus ramosus* (C=5.9% and the second is *Gymnocarpos decander* (C=4.8%).

The total number of species varies between 25 and 50 (Table 3). Group I has highest averages alpha diversity (18.9 species/stand). On the other hand group V has the lowest alpha diversity (12.6 species/stand. The highest beta diversity is that of group III (3.10) and the lowest is that of group IV (1.6). Group I is characterized by the highest value of the relative evenness of species (H=144). On the other hand, group V has the lowest H value (0.79), groups I and II have the highest value of the relative concentration of dominance (C = 0.05), while group IV has the lowest (C=0.01). The relation between species richness and species dominance is expressed in the form of dominance – diversity curves (Fig. 4). Its clear that all of these curves are steep except that of group I, which is of a relatively gentle slope.

Table (2): Presence percentage of recorded species in the five vegetation groups recognized in Wadi Habis (1: *Suaeda pruinosa*- II: *Lygeum spartum-Artemisa herba-alba*, III: *Thymelaea hirsua- Artemisia herba–alba*, IV: *Artemisia herba–alba- Asphodelus ramosus* and V: *Asphodelus ramosus –Gymnocarpos decander*).

Species	Vegetation groups					Total Presence
	I	II	III	IV	V	
Allium ashersonianum	22.2	16.7	23.5	33.3	0.0	18.0
Anabasis artirculata	11.1	16.7	0.0	0.0	0.0	6.0
A. oropediorum	22.2	8.3	0.0	66.7	11.1	12.0
Artemisia hherba-alba	66.7	100.0	94.1	66.7	66.7	84.0
Asparagus stipularis	11.1	50.0	23.5	0.0	0.0	22.0
Asphodelus ramosus	55.6	91.0	88.2	100.0	100.0	86.0
Astragalus boeticus	11.1	0.0	0.0	0.0	11.1	4.0
Atriplex halimus	66.7	8.3	5.9	0.0	11.1	18.0
Aveca sativa	66.7	0.0	0.0	0.0	11.1	14.0
Beta vulgaris	0.0	8.3	0.0	0.0	0.0	2.0
Capparis oriectalis	22.2	0.0	82.4	0.0	33.3	38.0
Carduncellus eriocephalus	0.0	33.3	29.4	33.3	44.4	28.0
Carthamus glaucus	100.0	41.7	52.9	66.7	66.7	62.0
Centaurea aetyptiaca	66.7	66.7	35.3	0.0	0.0	40.0
C. glomerata	66.7	50.0	41.1	33.3	33.3	46.0
Chenopodium murale	33.3	8.3	0.0	0.0	0.0	8.0
Convolvulus arvensis	33.3	0.0	0.0	0.0	0.0	6.0
Cutandia dichotoma	33.3	25.0	11.8	0.0	55.6	26.0
Cynodon dactylon	0.0	8.3	0.0	0.0	0.0	2.0
Echninops spinosissimus	0.0	8.3	5.9	33.3	44.4	28.0
Echium sericeum	33.3	0.0	0.0	0.0	0.0	2.0
Ephedra aphylla	0.0	0.0	29.4	66.7	222	18.0
Erdoium gruinum	33.3	0.0	0.0	0.0	0.0	2.0
Filago desertorum	11.1	50.0	41.2	66.7	77.8	46.0
Globulaia arabica	11.1	8.3	23.5	0.0	33.3	14.0
Gymnocarpos decander	33.3	91.7	94.1	100.0	100.0	84.0
Haloxylon scoparium	44.4	8.3	0.0	66.7	44.4	22.0
Helianthemum lippii	0.0	16.7	17.7	66.7	44.4	22.0
Herniaria hemistemon	33.3	0.0	5.9	66.7	0.0	12.0
Vartemia candicans	0.0	8.3	0.0	0.0	0.0	2.0
Bassia indica	11.1	0.0	0.0	0.0	11.1	4.
Limoniastrum monopetalum	0.0	8.3	0.0	0.0	0.0	2.0
Limonium tubiflorum	66.7	58.3	52.9	66.7	33.3	54.
Lotus creticus	0.0	8.3	17.7	0.0	11.1	10.0
Lycium europaeum	22.2	0.0	0.0	100.0	55.6	20.0
Lygeum spartum	66.7	83.3	58.8	0.0	0.0	52.0
Malva parviflora	77.8	0.0	0.0	0.0	0.0	6.0
Medicago lottoralis	11.1	0.0	0.0	0.0	11.1	4.0
Mesmbryanthemum noditlorum	0.0	0.0	17.0	0.0	0.0	2.0

Table (2): Count.

Species	Vegetation groups					Total Presence
	I	II	III	IV	V	
Nicotiana glauca	11.1	0.0	0.0	0.0	0.0	2.0
Noaea mucronata	77.8	41.7	52.9	66.7	77.8	60.0
Panicum turgidum	11.1	16.7	23.0	0.0	0.0	14.0
Papaver rhoeas	11.1	0.0	0.0	0.0	0.0	2.0
Phlaris minor	77.8	16.7	17.7	0.0	22.2	28.0
Phlomis floccose	11.1	0.0	5.9	0.0	0.0	4.0
Pisum sativa	22.0	25.0	0.0	0.0	0.0	10.0
Deverra tortuosua	66.7	33.3	94.1	33.3	88.9	70.0
Plantago albicans	11.1	25.0	5.9	66.7	0.0	14.0
Polygonum equisetiforme	44.4	0.0	0.0	0.0	0.0	8.0
Reaumuria vermiculata	0.0	8.3	5.9	0.0	0.0	4.0
Rumex pictures	33.3	75.0	5.9	66.7	33.3	36.0
Salsola Longifolia	11.1	8.3	5.9	0.0	11.1	10.0
Salvia aegytiaca	77.8	8.3	5.9	66.7	0.0	22.0
Sisymbrium irio	11.1	0.0	5.9	0.0	0.0	4.0
Sispagrostis ciliata	55.6	0.0	5.9	03.0	0.0	12.0
Suaeda pruimosa	77.8	100.0	11.8	33.3	11.1	48.8
Teucrium polium	0.0	33.3	41.2	33.3	0.0	24.0
Thesium humile	22.2	16.7	29.4	0.0	11.1	20.0
Thymelaea hirsuta	77.8	75.0	76.5	66.7	55.6	72.0
Thymus capitatus	11.1	83.3	41.2	0.0	33.3	42.0
Trionella arabica	33.3	8.3	17.7	66.7	0.0	18.0

Hygroscopic moisture, organic matter, clay, silt, Na, K and Mg contents attained the maximum averages of 2.3%, 3.7%, 10.6%, 11.4%, 3.7mg/g, respectively in stands representing group V and the minimum averages of 1%, 1.2%, 6%, 7%, 2,7% mg/g, 0.1mg/g and 16.7 mg/g, respectively in group I. On the other hand, sand content attained a maximum average of 87.0% in group I and a minimum of 78.0% in groups III and V and a minimum of 0.10% in group IV. Some soil characters (Moisture, organic, matter, sand, clay and N) varied significantly from one group to the other one way analysis of variance ($P<0.05$)

The aboveground phytomass according to the "one Way Analysis of Variance" (kg dry matter/ha and feed units (FU/ha) in Wadi Habis are presented in Table (5). It is noticed that *Thymelaea hirsute* attained the highest contribution (53.7%) followed by *Suaeda pruinosa* (22.8%) *Artemisia herba-alba* (4.7%) and *Deverra tortuosus* (3.4%) *Asparagus stipular* has the lowest contribution (0.01%). The total phytomass is 2248.s kg dry matter/ha or 741.9 FU/ha.

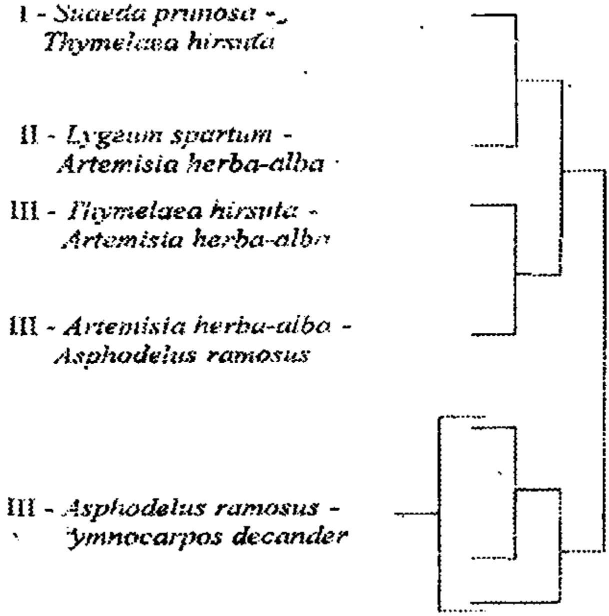

Fig (2): Dendrogram shows the five vegetation groups generated after the application of TWINSPAN technique on the 50 stands sampled in Wadi Habis.

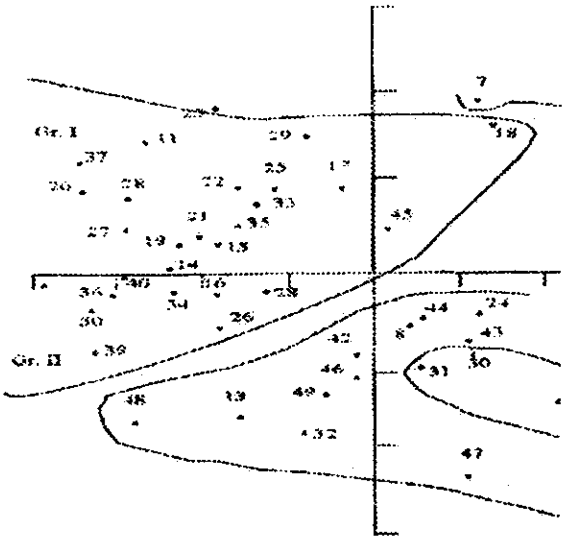

Fig (3): DECORNA ordination of the 50 stands of Wadi Habis. The input data are the absolute cover estimates the recorded species in the ordinate stands.

Of all species, *Suaeda pruinosa* had the highest concentration of ash (29.9%) in contrast with *Stipagrostis ciliata*, which has the lowest concentration (9.1%) as shown in Table (6). *Atriplex halimus* and *Limoniastrum monopetalum* have also a relatively high ash content (25.2% and 251%, respectively). The highest concentration of nrude fiber was that of *Helianthemum lipii* (382%), *Thymus capitatus, Asparagus stipularis, Stipagrostis iliata* and the annuals also had a relatively high crude fiver contents (33.5%, 33.3%, 32.9% and 32.4%, respectively). In contrast *Limoniastrum monoptalum* had the lowest content of crude fiber (14.8%). The highest total nitrogen and protein concentration was that of *Anabasis oropediorum* (0.1% and 0.6%, respectively) and the lowest was that of *Thymelaea hirsute* 0.1% and 0.6%, respectively). The carbohydrate concentration ranged between 38.7% in *Suaeda pruinosa* and 61% in *Teucrium polium*. The highest concentration of ether extract was recorded for *Asparagus stipularis* (6%), Followed by *Varthemia candicans* (5.2%), while *Gymnocarpos decander* and *Hlianthemum Lippii* had the lowest concentration (0.8%). *Anabasis oropediorum* has the highest content of Ca (112.5 mg/g), while *Stipagrostis ciliata* has the lowest (12.5mg/g). *Suaeda pruinosa* contains the highest content of Mg (171.8mg/g) but *Teucrium polium* had the lowest (5.1mg/g). The highest Na content was recorded in *Atriplex halimus* (122.5mg/g) and the lowest was in *Thymelaea hirsute* (15.5mg/g). Fe and K are generally low in all species with the highest of Fe in *Varthemia candicans* (23.1mg/g) and the highest of K in *Atriplex halimus* (35.0mg/g) P concentration was very low in all species. It ranged between 0.02 mg/g in *Gymnocarpos decander* and 1.1 mg/g in *Reaumuria vermiculata*.

The nutritive values (Table, 7) expressed as total digestible nutrients (TDN), varied between 48.0% for *Limoniastrum monopetalum* and 76.9% for *Asparagus stipularis*. Ca/P ratio varied between 33.5% for *Reaumuria vermiculata* and 703.1 for *Atriplex halimus*, and Ca/Mg ratio ranged between 0.2 for *Suaeda pruimosa* and 11.1 for *Globulria arabica*. Digestable crude protein (DCP) approached zero, nearly for all species except for *Anabasis oropediorum* (0.3) and *Varhtemia candicans* (0.1). Net energy (NE) had narrow range of variation among all species.

DISCUSSION

The flora of the western Mediterranean coastal region of Egypt is a product of climatic conditions during the Pleistocene era, as well as the long history of land use. The importance of this area from the phyogeogrpahical point of view may be attributed to its transition between the Mediterranean region to the north and the Sahara-sudanian region to the south. Its borderline with latter region has never been always clear either in climate or in vegetation (Good, 1953) and Huzayyin (1956)..

Wadi Habis and adjacent Wadis (*e.g.* Wadi um Rakham and um Ashtan) of the western Mediterranean region of Egypt may be regarded as Challow Wadi. According to Kassas and Girgis (1964), Shallow Wadis differ form the mature great Wadis of the eastern desert in several respects. Mature great Wadis are characterized by their wide, deep and well-defined channels cutting older limestone formations of the Eocene era. In shallow Wadis the main channels is comparatively shallow and narrow. This is presumably due to the fact that these Wadis are geologically more recent. Moreover. The channels of shallow Wadis are usually devoid of ancient silt terraces and deep valley fill deposits that may be found in the mature Wadis (El-Hadidi and Ayyad, 1975).

Table (3): Some diversity indices calculated for the vegetation groups of Wadi Habis (Values between are the coefficient of variations of alpha diversity), I: *Suaeda pruinosa- Thymelaea hirsute*, II: *Lygeum spartum – Aremisia herba alba*, III: *Thymelaea hirsute- Arremisia herba – alba*, IV: *Artemisia herba-alba –Asphodelus ramosus* and V: *Asphodelus ramosus* and V: *Asphodelus ramosus –Gymnocarpos decander*)

Vegetation groups	Cover (%)	Total Species	Alpha Diversity	Beta diversity	Shannon Weiner Index(H)	Simpson Index(C)
I	32	50	18.6 (0.14)	2.6	1.44	0.05
II	22	42	14.6(0.11)	2.9	1.04	0.05
III	16	40	13.1(0.16)	3.1	0.85	0.03
IV	15	25	15.3(0.14)	1.6	0.81	0.01
V	15	32	12.6(0.11)	2.5	0.79	0.03

Table (4): Means of different soil properties in stands representing soils under different vegetation groups of Wadi Habis I: *Suaeda pruinosa – Thymelaea hirsute*, II: *Lygeum spartum-Artemisia herba-alba*, II: *Thymelaea hirsute-Artemisa herba-alba*, IV: *Artemisia herba–alba– Asphodelus ramosus* and V: *Asphdelus ramosus-Gymnocarpls decander*.

	Groups of the soils of the study					F-test	P
	I	II	III	IV	V		
pH	6.6	6.7	68.	6.6	6.6	0.2	>0.05
EC-mmohs/cm)	0.9	1.0	1.0	15	1.4	0.4	>0.05
Moisture%	1.0	1.6	1.9	1.7	2.3	3.7	<0.05
LOI	1.2	3.5	2.7	3.1	3.7	6.1	<0.01
Sand %	87.0	84.7	82.5	84.2	7.0	2.8	<0.05
Clay %	6.0	7.2	7.7	7.7	10.6	3.2	<0.05
Silt %	7.0	8.1	9.8	8.1	11.4	2.1	>0.05
$CaCO_3$ (mg/g)	260.3	276.2	298.6	308.6	270.4	1.4	>0.05
N (mg/g)	0.11	0.12	0.14	0.10	0.14	2.8	<0.05
P (mg/g)	0.02	0.01	0.02	0.01	0.02	1.0	>0.05
Na (mg/g)	2.7	3.8	3.5	3.3	3.7	0.6	>0.05
Ca (mg/g)	4.1	4.8	4.1	4.6	3.7	2.2	>0.05
K (mg/g)	0.1	0.2	0.2	0.1	0.3	1.8	>0.05
Mg (mg/g)	16.7	19.8	19.8	20.6	20.7	1.4	>0.05
Fe (mg/g)	0.1	0.1	0.1	0.1	0.1	0.1	>0.05

Notes:

(1) pH in soil suspension 1: 2.5 (w:v soil:water)

(2) EC in soil water extract 1: 5 (w:v soil:water)

(3) LOI: loss-on-ignition, is a close appromixation of organic matter (ignition on 450°C)

(4) N, P, K, Na, Mg, and Fe denote "total contents" of each.

Table (5): The above ground phytomass (kg dry matter/ha) and feed units (Fu/ha) of the different species in Wadi Habis.

Species	Aboveground phytomass	Fu/ha
Allium ashersoniamum	0.5	0.2
Anabasis articulata	4.3	1.4
Anabasis oropediorum	28.7	9.5
Artemisia herba-alba	104.2	34.4
Asparagus stipularis	0.2	0.1
Asphodelus ramosus	26.8	8.8
Atriplex halimus	12.9	4.3
Cardumcellus eriocephalus	4.6	1.5
Cynodon dactylon	3.2	1.1
Echinops spinosissimus	0.7	0.2
Echium sericeum	1.4	0.5
Globularia arabica	1.0	0.3
Gymnocarpos decander	23.99	7.9
Haloxylon scoparium	71.0	23.4
Heliantheumu lippii	4.7	1.6
Varthemia candicans	12.4	4.1
Limoniastrum monopetalum	3.7	1.2
Lotus creticus	2.1	0.7
Lycium eutopaeum	3.4	1.1
Lygeum spartum	46.2	15.3
Moaea mucronaa	17.6	5.8
Panicum turgidum	2.2	0.7
Phlomis floccose	13.0	4.3
Deverra tortuosus	77.7	25.6
Reaumuria vermiculata	14.8	4.9
Salvia aegyptiaca	0.3	0.1
Salsola longifolia	25.0	8.3
Stipagrostis ciliata	5.4	1.8
Suaeda pruinose	513.5	169.5
Teucrium polium	0.6	0.2
Thymelaea hirsute	1208	398.8
Thymus capitatus	13.8	4.6
Total	2247.8	744

Table (6): Chemical composition of the different plant species at Wadi Habis. CF: crude fiber, TN: total nitrogen, (PR. Protein, NFE: nitrogen free extract and EE ether extract.

Species	Ash	CF	TN	Pr	NFE	EE	Ca	Mg	Na	Fe	K	P
	Percent						mg/g					
Anabais oropediorum	21.4	16.1	0.7	401	57.1	1.3	112.5	29.7	55.0	4.6	22.5	0.3
Artemisia herba-alba	16.7	27.8	0.5	3.4	50.3	1.8	50.0	6.1	47.5	6.2	20.0	0.8
Asparagus stipularis	16.9	33.3	0.6	3.4	6.0	6.0	25.0	6.4	27.5	2.3	12.5	0.4
Asphodelus ramosus	19.1	27.5	0.4	2.8	49.2	1.5	87.5	9.2	55.0	6.2	12.5	0.4
Atriplex halimus	25.2	20.5	0.6	3.7	49.0	1.7	112.5	19.0	122.5	9.2	35.0	0.2
Carduncellus eeriocephalus	19.8	24.1	0.6	3.6	49.4	3.0	75.0	6.9	52.5	4.2	30.0	0.5
Echinops spinosissmus	14.5	28.2	0.5	3.1	51.8	2.4	37.5	7.6	37.5	7.7	15.0	0.3
Globularisa arabica	19.8	24.5	0.6	3.5	50.7	1.5	87.5	7.9	42.5	2.3	17.5	1.0
Gymnocarpos decander	13.4	30.1	0.4	2.4	53.2	0.8	37.5	7.6	30.0	8.5	7.5	0.2
Helianthemum lippii	15.4	38.2	0.6	3.7	41.9	0.8	50.0	7.1	32.5	5.8	7.5	0.4
Varthemia candicans	16.8	12.7	0.6	3.9	52.5	5.2	50.0	11.6	35.0	23.1	10.0	0.5
Limoniastrum monopetalium	25.1	14.4	0.5	3.3	55.4	1.4	87.5	29.5	60.0	6.9	5.0	0.3
Lygeum spartum	10.5	29.0	0.5	3.1	54.2	2.6	12.5	8.2	37.5	10.4	12.5	0.1
Moaea mucuonaa	12.7	23.3	0.4	3.6	60.2	1.1	37.5	7.3	27.5	6.2	10.5	0.2
Panicum turgidum	13.2	26.0	-	3.1	56.7	1.0	37.5	4.9	42.5	4.6	27.5	0.6
Deverra tortuosus	10.9	29.0	-	2.8	54.4	2.9	25.0	4.6	25.0	3.9	12.5	0.1
Reaumuia vermiculata	20.9	19.1	0.5	3.1	55.6	1.3	37.5	9.0	55.0	6.5	5.0	1.1
Salvia aegyptiaca	10.2	29.4	0.6	3.7	56.1	0.6	62.5	12.4	35.0	16.2	7.5	0.4
Stipagrostis ciliata	9.1	32.9	0.5	3.1	53.5	1.4	12.5	5.9	17.5	8.9	5.0	0.3
Suaeda pruinosta	29.9	28.4	0.1	0.7	38.7	2.4	35.0	171.8	59.5	1.2	4.8	0.2
Teucrium polium	12.2	19.4	0.5	3.2	61.0	4.2	37.5	5.1	17.5	11.2	7.5	0.1
Thymelaea hirsute	12.4	31.1	0.1	0.6	53.2	2.8	16.3	19.4	15.5	1.6	7.8	0.4
Thtmus capitatus	9.5	33.5	0.5	3.1	51.7	2.2	25.0	4.6	27.5	7.3	15.0	0.3
Total annuals	18.6	32.4	0.1	0.7	46.3	2.1	32.5	16.8	37.8	2.0	13.5	0.4

The application of Two–Way Indicator Species Analysis (TWINNSPAN) on the vegetation units (stand) of the present study led to recognition of five vegetation clusters (plant communities). Two of them could be categorized as widespread communities in this area (represented by 12 and 17 stand respectively out of 50 sampled stands (*Lygeum spartum- Artemisia herba-alba* which dominates the upper slope and cliff of the Wadi, and *Thymelaea hirsute–Artemisia herba-alba* which dominates the plateau. The other two communities: *Suaeda pruinosa-Thymelaea hirsute* which dominates lower slope lf the Wadi, and *Asphodelus ramosus- Gymnocarpos decander* which dominates the Wadi bed are relatively less widespread (represented by 9 stand for each community): *Asphodelus ramosus* which dominates the transitional zones of the lower slope, upper slope and cliff. The application of TWINSPAN in the present study may be useful in classifying stands into several vegetation clusters. These communities already identified in other parts of the Mediterranean littoral of Egypt (*e.g.* Batanouny and Abul-Soud, 1971; Ayyad and El-Kady, 1982; El-Kady and Sadek, 1992; El-Kady, 1993 and Kamal and El-Kady, 1993) Perhaps the differences in the characteristic composition of species in the community revealed by the present study from their analogues recognized in previous studies may reflect the slight disanalogies in the habitat in this vast extension, but these differences are mainly due t the impact of land –use and may be to the changes in climatic factor mainly rainfall and temperature.

Table (7): Nutritive values of the above ground parts of the different species at Wadi Habis DCP: digestible crude protein, TDN: total digestible nutrients and NE: net energy.

Species	Ca/P	Ca/Mg	DCP	TDN	NE (MJ/kg DM)
	%				
Anabasis articulata	401.8	3.8	0.3	50.2	0.7
Artemisia herba-alba	61.7	8.2	0.0	65.8	0.8
Asparagus stipularis	64.1	3.9	0.0	76.9	0.8
Asphodelus ramosus	208.3	9.6	0.0	65.1	0.7
Atriplex halimus	703.1	5.9	0.0	48.1	0.7
Carduncellus erioceghalus	159.6	10.8	0.0	67.0	0.7
Echinopas spinosissimus	113.6	4.9	0.0	66.1	0.8
Globularia arabica	85.8	11.1	0.0	65.7	0.7
Gymnocarpos decander	187.5	4.9	0.0	70.0	0.8
Helianthemum lippii	131.6	7.1	0.0	48.6	0.8
Varthemia candicans	102.0	4.3	0.1	56.1	0.8
Limoniastrum monopetalum	324.1	3.0	0.0	48.0	0.8
Lygeum spratum	156.3	1.5	0.0	73.4	0.8
Noaea mucronata	170.5	5.1	0.0	64.8	0.8
Panicum turgidum	63.6	7.6	0.0	65.0	0.8
Deverra totuosus	178.6	5.4	0.0	66.3	0.8
Reaumuria vermiculata	33.5	4.2	0.0	50.5	0.7
Salvia aegyptiaca	160.3	5.0	0.0	62.9	0.8
Stipagrostis ciliata	39.1	2.1	0.0	72.5	0.8
Suaeda pruinosa	194.4	0.2	0.0	64.3	0.7
Teucrium polium	468.8	4.7	0.0	58.1	0.8
Thymelaea hirsute	43.9	0.8	0.0	65.9	0.8
Thymus capitatus	78.1	5.5	0.0	73.1	0.8
Total annuals	83.3	1.9	0.0	65.7	0.7

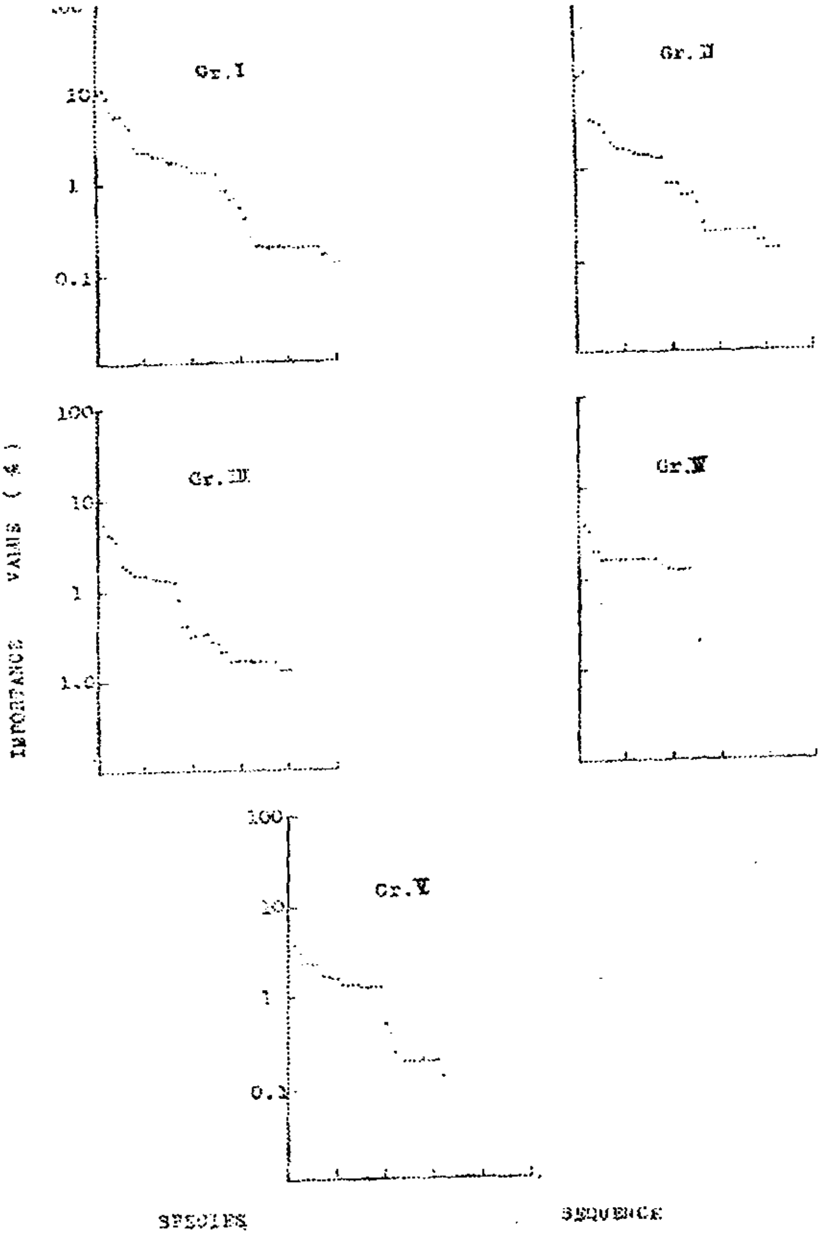

Fig. (4): Dominance–diversity curves of the five vegetation groups identified in Wadi Habis. Relative covers of species are used as importance values. Species are ranked Sequentially from the highest to lowest important.

The present study indicates that vegetation group *Suaeda pruinosa-Thymelaea hirsute* and *Lygeum spartum-Artemmisia herba-alba* are more diverse than the other groups, since they have higher relative specie evenness. The dominance diversity curves may add another support to the high diversity of such vegetation groups (De Jong, 1975 and Pielou, 1975). Higher diversity of the previous communities in the present stud may be related to the relatively increase in annuals during spring when the vegetation was sampled. Precsenyi (1981) found that the diversity of certain communities decreased from spring to autumn and such findings can support our conclusion. On the other hand, *Thymelaea hirsute-Artemisia herba-alba* and *Artemisa Artemisia herba-alba Asphodelus ramosus* and *Asphodlus ramosus-Gymnocarpos decander* groups are characterized by relatively low diversity; perhaps they inhabit the plateau, transitional zones of different positions of slope and Wadi bed, respectively. These positions of the Wadi received less rainfall water due to the run-off of rainfall water to the main channel of the Wadi. Also in the Wadi bed, the fine soil material has a little chance to settle due to the high velocity of the water stream during the rainy season, and this results in the decrease of annual species.

The study carried out by Shaltout and El-Ghareeb (1992) indicated not only a negative correlation between soil salinity and species diversity but also a negative correlation between species diversity and total species cover that gives a measure of phytomass (Muller-Dombois and Ellenberg, 1974). This means that the species diversity decreases as phytomass and soil salinity increase. The distribution of common perennials in the study area is closely related to the physiograhic factors. Ayyad and Ammar (1974) indicated that the distribution of common perennials of shallow soil habitat at Burg El-Arab is more sensitive due to the physiogrpahic factors that control the moisture availability through run-off rather than to those which determine the moisture balance through radiation.

The most important soil properties which correlate with the distribution of vegetation groups (as mentioned by Ayyad and El-Ghonemy, 1974; Kamal, 1982 and Shaltout, 1983) are: soil salinity, calcareous sedimentation, soil pH, depth of soil, fertility of soil (organic matter and P content) and moisture of soil (percentage of hygroscopic moisture and water holding capacity). El-Sharkawy *et al.* (1982 b) and Sharaf El-Din and Shaltout (1985) recognized that water and organic matter content seem to be the most limiting ecological factors in determining vegetation types and species richness in desert Wadis. A Study carried out by El-Kady and Sadek (1992) indicated that clay percentage was another important factor determining the vegetation groups This result agreed with that of Kamal and El-Kady (1993) besides that $CaCO_3$, Ca and K are other factors determining the vegetation. In the present study the analysis of variance of soil characters in the vegetation groups of Wadi Habis, indicated that the most important soil gradients which affected the vegetation distribution was the percentage of hygroscopic moisture which affected by soil depth, organic matter content, clay percentage which attains a maximum in the stands dominated by *Suaeda pruinosa* and a minimum in those dominated by *Asphodelus ramosus* and by *Asphodelus ramosus* and N concentration which attain maximum in the stand dominated by *Thymelaea hirsute*, while a minimum in those dominated by *Aremisia herba-alba.*

The primary production of an annual above-ground dry matter in Wadi Habis which was estimated using the turnover rate of 0.37 for the inland ecosystems (Shaltout and El-Ghareeb, 1985 and Shaltout *et al.*, 1986) amounted to 83.9 kg/ha/y consequently, the average grazeable production for each mm of the annual rainfall is 5.5kg/ha/y. This is a reasonable value if it is compared with the ranges of 5 to 9.5 kg/ha/y/mm rainfall estimated for the production of the north African vegetation (Le Houerou, 1975) Le Houerou and Hoste (1977) concluded that it is 4kg/ha/y/mm rainfall, in the Mediterranean basin. At the Maktala sector (400 km west Alexandria), El-Kady (1987) concluded that it is 5.2kg/ha/y and at Omayed (80km west Alexandria), Heneidy (1986) concluded that it is 4.8kg/ha/y.

Grazing animals often select their forage from a complex mixture of plant species (Edlessen *et al.*, 1960). Oelbuerg (1956) reported that the nutritive value of any forage is dependent up on its content of energy producing components essential to the body, normally protein, minerals and vitamins. The nutritive value of range forage is influenced in a major way by the stage of maturity, edaphically influences, plant species, climate, animal species, and range vegetation in the other related studies nay evaluate tier nutritional status as forage. The present study indicate that many of the evaluated species have a relatively low content of P, N and K but high Ca, Mg and Fe compared with many of the Egyptian range plant in the Mediterranean region (El-Ghonemy *et al.*, 1977 and El-Kady, 1987). This conclusion was based on the following comparison which show ranges of nutrient contents in plants (mg/g dry matter) reported in the current study and in some other previous studies by others:

Nutrient	The present study (24 specie in Wadi Habis	El-Ghonemy *et al.*, 1977 (55 species in Mareotis area)	El-Kady, 1987 (36 species 400 km west of Alexandria)
N	1.0-7.0	Not included	5.0-24.0
P	0.1-1.1	0.6-7.7	0.1-4.0
K	4.8-35.0	3.6-58.8	5.5-39.8
Ca	12.5-112.5	3.0-79.8	2.9-62.3
Mg	5.9-49.5	1.3-23.0	1.5-11.9
Na	15.5-122.5	0.3-49.5	not included
Fe	12-23.1	0.04-2.0	not included

The following data is another comparison between the range of variation in contents of some organic components and ash of species in the present study and those of the Egyptian Mediterranean region reported by El-Kady (1987).

Component (%)	The present study (24 specie)	El-Kady (1987) (36 species)
Protein	0.7-4.1	2.6-10.1
Carbohydrates	40.4-61.0	27.1-51.9
Total lipids	0.6-.6.0	0.8-8.3
Ash content	9.1-29.9	5.5-36.0
Crude fiber	14.8-38.2	14.6-3.5.6

It is obvious that the evaluated species in the present study have a relatively low content of protein, lipids and ash, but high of carbohydrates and crude fibers.

The Ministry of Agriculture, Fisheries and Food in England (Anonymous, 1975) reported that the minimum crude protein percentage in the diet range from 6% for dry ewes and weavers, to 12% for weaver weighting about 20kg. The protein requirement reported by Cook & Harris (1968) is 4.45. Protein content of many species in the western Mediterranean desert of Egypt is 1.1% on the average (El-Kady, 1987). (Gupta and Joshi, 1984) reported that the protein content of different grass species varied from 3% to 5%. In some non –grass species, it ranged from 8%to 13%, and that the species that have less than 2.5% digestible protein (DP), could not provide the maintenance needs of livestock in this nutrient.

In the present study the protein content in Wadi Habis species is 3%, which is far too low than the proper level. Low protein levels in pasture will affect their performance because dietary protein deficiency is associated with a relatively low voluntary feed consumption. With protein deficient diet, the metabolism of the rumen micro-biota may be depressed due to the deficiency in rumen nitrogen. This limitation will retard the rate of removal of organic matter from the rumen which in turn, may reduce intake (Weston, 1971). Also low protein level will affect the wool growth, which is determined by protein absorbed in the intestine, which in turn depends on the ingested nitrogen sources (Michalk and Saville, 1979). El-Kady (1987) reported that, animals in the western Mediterranean region of Egypt should be supplied with supplementary feed rich in protein, particularly during the reproductive states in order to maximize their productivity. Ayyad and Le Floc'h (1983) recognized the importance of adequate Ca: P ratio of 2-3:1 as a major factor affecting the utilization of the whole animal diet. El-Kady (1987) in the western Mediterranean desert of Egypt reported that, this ratio is far from optimum. Le Hourou (1980) reported that, the Ca/P ratio is usually much too high (11.0) for browse plants in north Africa. The present study indicates that this ratio for all the investigated species is very far from the optimum range. In general the high Ca: P ratio leads to low utilization of both Ca and P by animals. On the other hand, the Ca/Mg ration in Wadi Habis is about 1.9. El-Kady (1987) reported that, such ration is higher in herbaceous (about 1.50) than in woody species (about 0.7) Le Houerou (1980) reported that, a Ca/Mg ratio of 2.8 is about adequate on browse plants in north Africa. In the western desert of Egypt, Heneidy (1986) reported that a ratio of Ca/Mg is about 1.2. Comparing with the scale suggested by Boudet and Rivere (1968), all the investigated species in the present study would be considered as poor forage (DP<2.5 and Met energy < 3.1). Supplementary feeding strategies should aim at providing the pastoralist with a management procedure that can stabilize nutrient intake at acceptable levels. In addition to the direct effects on animal health and productivity, supplementation will reduce the effect of overgrazing.

Convolvulus plauricaulis ranged from 8% to 13% where the species that have less than 2.5% digestible protein (DP) would not provide the maintenance needs of livestock in this nutrient.

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دراسة للنظم البيئية الرعوية لوادي حابس (مصر)

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تم اختيار خمسون موقعا تمثل وادي حابس (٣٠٠ك م غرب الإسكندرية). تم تسجيل الغطاء النباتي و الوزن الحي للأنواع النباتية وجمعت عينات تربة من كل موقع لتحليلها. كما تم تقدير القيم الغذائية لـــ ٢٣ نوعا نباتيا معمرا، ١٠ أنواع حولية. وتــم تقييم العلاقات بين الغطاء النباتي وعوامل البيئة إحصائيا . كذلك قــدرت بعــض قــيم التنوع للمجتمعات النباتية وعلاقاتها البيئية . تم التعرف على خمس مجموعات نباتيـــة هي:

Suaeda pruinosa Thymelaea hirsute, Lygeum spartum Artemisia herba – alba, Thymeiaea hirsuta- Artemisia – herba-alba, Artemisia herba-alba- Asphodeius ramosus and Asphodelus ramosus – Gymnocarpos decander

أهم عوامل التربة التي أثرت على توزيع المجموعات النباتيـــة فـــي الـــوادي كانت الماء الهيجرسكوبي، المادة العضوية، النيتروجين. كما أوضحت الدارسة بأن كل مليمتر من المطر السنوي ينتج حوالي ٥، ٥ ك جم / مادة جافة / هكتار / سنة. كمـــا أوضحت الدارسة أن معظم الأنواع ذات محتوى قليل مـــن الفوســـفور والنيتـــروجين والبوتاسيوم ولكنها ذات محتوى عالي من الكالسيوم والمغنسيوم والحديد. بالإضافة إلى أن نسبة الكالسيوم إلى البوتاسيوم كانت أعلى من الحد الأمثل لوجبـــة الحيـــوان أمـــا محتوى البروتين فكان أقل من المستوى بينما محتوى الكربوهيدرات لمعظـــم الأنـــواع النباتية كان مناسبا.