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RESEARCH ARTICLE

PRELIMINARY ANALYSING OF PLANT DIVERSITY OF HIGH ALTITUDE AREA OF ALBAHA REGION, SAUDI ARABIA.

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Abstract

The study on the floristic analysis and plant diversity was carried out during the years 2014 and 2016 covering the high altitudinal plateau between 1900 to 2475 mater above sea level (m. a. s. l.) of Al Baha region, Saudi Arabia. This attempt was made, to document the density; frequency and diversity of plant species existing in different land forms, to identify the priorities of conservation and rehabilitation for the least occurrence plant species and *Juniperus procera* and *Acacia origena* habitats in the future plan.

Random quadrat methods of 25*25 m were laid out in various parts of the region to reach the total of 73 sample plots. The data was analyzed using different ecological indices and tools. The out come of the analyzed data showed a total of 187 plant species belonging to 147 genera and 67 families, in which 3 are endemic to Arabian Peninsula and one is endemic to Saudi Arabia. *Hyparrhenia hirta, Achillea biebersteinii, Cynodon dactylon, Themeda triandra Juniperus procera* and *Eragrostis papposa* have the highest density per hectare with a value of 226, 176, 167, 134, 116 and 107 respectively. Frequency of plant species showed different trend of plant arrangement in different sample plots unlike the density. For instance *Juniperus procera, Acacia origena, Dodonaea viscose, Psiadia punctulata* and *Sageretia thea* have more frequency with a value of 0.86, 0.67, 0.47, 0.45 and 0.44 respectively. The dominant vegetation structure is a woodland dominated by *Juniperus procera* and *Acacia origena* and grassland dominated by *Hyparrhenia hirta* and *Themeda triandra*. Average tree cover is 25%, shrub cover is 17% and herbaceous cover is 36% with an average of 77% vegetation cover.

Introduction:-

Al-Baha highlands are the habitats of highly significant plant diversity of Saudi Arabia and the Arabian Peninsula. In the region plateaus and mountains with scattered hills are the dominant characteristics of land forms and their vegetation compositions are highly influenced by the occurrences of intensive seasonal fogs. Harvesting of moisture from the fog may contribute to the occurrence of diverse plant species in the area. Similarly in some highland and arid regions of Asia and South America thick or rather open fog forests are well supported through the trees special

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ability to the trees to harvest moisture from the fog or passing clouds [1-3] .

In the Arabian Peninsula, *Juniper* woodlands are well developed and widely occur in southern mountains of Saudi Arabia, Jabal Eraf (Yemen) and Jabal Al Akhdhar north of Oman. It is well adapted to arid climate conditions with annual rainfall of 300-600 mm [4-6]. The *Juniper* woodland is the most prominent component of woodlands or as co-dominant with other trees species at or above 1600 m in Asir Mountains [1, 2] and in Al-Baha highlands of Saudi Arabia. Juniper woodlands are important because many species grow associated with species having moisture harvesting abilities from fog and passing clouds.

Moreover, because of the existing of *Juniperus procera* woodland with abandoned agricultural farm lands and plateaus dominated by *Acacia origena* community make the study area is made as one of the richest plant diversity in the region. Within high land areas, gradients in elevation are well known to create varied climates with subsequent soil differentiation that contributes to the diversification of plant species [7, 8]. All such phenomenon makes the area as one of hot spots to study the species diversity in the region.

This strip of Al-Baha highland plateau, stretched from an elevation of 2000-2400 m above sea level has been occupied and used for farming, animal husbandry and extensive construction by humans for long periods. Moreover, the threat of exotic species to natural habitats obviously, resulted in the decrease of the number of native species in their habitat and replaced them with the invasive widespread species such as *Nicotiana glauca*. Thus, this causes regional homogenization of ecosystems. This species forms dense stands that can destroy the habitats by encroaching native vegetation that serves as food sources or habitat for wildlife.

Frequency is defined as the number of times at which a plant species occurs within a given numbers of sampling sites of uniform size placed across a given vegetation cover [9-10]. It is also generally expressed as a percentage of total placements [11]. So, frequency is useful information for monitoring vegetation changes over time at the same locations or for comparisons of different locations. Besides species frequency; plant density and species diversity are important information and have been used by ecologist to evaluate plant species in different ecosystems [12] as well as to determine species richness and evenness within a plant community [13]. Moreover, species diversity has been considered as a factor alongside species composition, disturbance, soil type and climate that influence ecosystem functioning [14].

Many studies have investigated species richness variations along elevation gradient across habits and taxa [15-18]. Such species have also been investigated as part of efforts to understand the ecosystem effects on biodiversity and its conservation [17, 19]. Many researchers have explored altitudinal biodiversity patterns of plants and reported that altitude plays a great role in regulating species richness patterns [20-22]. Moreover, Qian *et al,* [23] reported that altitude plays stronger role in maintaining large-scale species richness in China than in any other area because China encompasses the world's widest range of altitudes. So in this study frequency and species diversity across elevation gradient will be considered as important parameters in the analysis of floristic composition of the region.

Studies on the vegetation of Al Baha region go back to the last two decades of the nineteenth century [24-25]. Moreover, Al-Aklabi, *et al*., [26] have tried to analyze the vegetation types of the region and come up with interesting reports about species composition and vegetation of the region. However, the studies were mainly focused along accessible roads and there are many important pocket points not covered in these studies. Moreover, in the presence of intense anthropogenic disturbance and climate changes; monitoring of vegetation changes over time is very important to assess the trends of species diversity, density, richness and associated contributing factors in the dynamics of plant community and species richness of the region. In this regard Tilman [14] and Vitousek *et al*., [27] reported the occurrences of declining of species diversity declining and the extinction acceleration of different species within many plant habitats as a result of human interferences.

The aim of the current study is to conduct the floristic composition of the target area through analyzing the density, frequency and diversity of plant species that existing in different land forms.

Materials and Methods:-

Study area:-

Al Baha region is located in the south west of Saudi Arabia, it is situated between 41/42 E and longitude and 19/20 N latitude. It is the smallest region among the 13 administration regions of the Kingdom of Saudi Arabia with an

area of about 12,000 km2 representing almost 0.6 of the total land area of the country [28]. Climate is greatly affected by its varying geographic features, a high altitude mountains is greatly affected by fog. The current research is conducted in the high altitude area of Al Baha region, that covers about 920 km2 area (Fig. 1). The dominant plant communities of the study area are *Juniperus procera* and *Acacia origena* communities.

The study area climate is greatly affected by fog, because it is located at a high altitude mountain. The area temperature is relatively moderate with 22 – 32 ºC in summer and 10 – 22 ºC in winter. The average annual rainfall ranges between 229– 581 mm [29-30].

According to Koppen's, [31], reported that the predominant climate of the Arabian Peninsula is dry and semiarid climates (Bwh). Al Baha the entire area almost belongs to the climate class of Bwh of tropical / subtropical desert [32]. The study area landscape consists of moderately to steep rocky slope mountain, wadis, rocky outcrops, terraces, fallow and cultivated fields. The altitude ranges between 1900 - 2475 m above sea level.

Sampling Procedures:-
The sampling procedures were carried out according to the method described by [9, 33-34]. A total of 73 sample plots 25 m × 25 m were laid out in different land forms (Fig. 2). The land form types and plots number of plots laid out in each land form are rocky slope (36 plotes), wadi bed (18 plots), rocky outcrops (5 plots), follow land (7 plots), terraces (4 plots) and plains (3 plots). Within each plot, information on percentage of vegetation cover, number of each plant species, land form, species enumeration, were recorded. One voucher specimen was collected from each plant species and deposited at Al Baha University.

Data analyze:-
The collected data was entered in to the excel sheet and subjected to different diversity indices such as:

Density:-
Number of individuals refers to the density of each species that has been recorded in the sample sites (quadrat 25 m × 25 m) during the vegetation survey. The numbers of individuals in each site were calculated per hectare. This is achieved by dividing the total number of individuals by the total areas surveyed in the different land forms. Further using the Arc-GIS (ArcMap), the plant density was plotted along the study area (Fig. 3).

Frequency:-
Frequency was calculated by dividing the number of plots in which a species occurs into the total number of plots sampled.

$$\text{Frequency} = \frac{\text{No. of plots with a species}}{\text{Total number of plots}} \qquad (1)$$

Diversity:-
Plant Species diversity was analysed using the following methods:
Shannon's diversity index, (Shannon and Weaver, 1949)

$$H' = \sum_{i=1}^{S} Pi \ln(\text{pi}) \qquad (2)$$

Where pi is the proportion of individuals of species in the species

$$D = \sum \left(\frac{ni(ni-1)}{N(N-1)}\right) \qquad (3)$$

Where, ni= the number of individuals in the i^{th} species, N the total number of individuals.

Evenness

$$J' = H'/\ln s \qquad (4)$$

where, H' is the Shannon's diversity index

Importance Value Index (IVI):-
Importance values refer to how important a species is in terms of the structure of a community or species composition. To determine the importance of each species sampled, the importance value index (IVI) of each plant species was calculated in all study sites by summing the relative density value, the relative dominance value, and the relative frequency value [35-36]. These values are expressed in an absolute form and as relative density, relative

dominance, and relative frequency, which shows the percentage of an individual species with respect to the total species. These values are calculated by the following equations:-

$$\text{Relative density} = \frac{\text{Density (number of individuals) of a species}}{\text{total density for all species}} \times 100 \quad (5)$$

$$\text{Relative dominance} = \frac{\text{Dominance for a species}}{\text{total dominance for all species}} \times 100 \quad (6)$$

$$\text{Relative Frequency} = \frac{\text{Frequency value for a species}}{\text{total of frequency values for all species}} \times 100 \quad (7)$$

$$(\text{IVI}) = \text{relative density} + \text{relative dominance} + \text{relative frequency} \quad (8)$$

Table 1:- Major families with respective number of species and generas recorded in the study.

family	Species	Genera
Asteraceae (Compositae)	32	23
Poaceae (Graminea)	12	11
Lamiaceae (Labiatae)	12	10
Apocynaceae (Asclepiadaceae)	9	6
Solanaceae	7	4
Chenopodiaceae	6	3
Euphorbiaceae	6	4
Malvaceae	6	3
Fabaceae (Papilionoideae)	5	2
Moraceae	5	1
Mimosaceae	4	2
Polygonaceae	4	2
Scrophulariaceae	4	4

Table 2:- Number of individuals per hectare for the most dominant species over the different landforms.

density/ha	plant name
226	*Hyparrhenia hirta*
176	*Achillea biebersteinii*
167	*Cynodon dactylon*
134	*Themeda triandra*
116	*Juniperus procera*

Table 3:- The frequency of five most dominance plant species

frequency	Plant name
0.86	*Juniperus procera*
0.67	*Acacia origena*
0.47	*Dodonaea viscosa*
0.45	*Psiadia punctulata*
0.44	*Sageretia thea*

Table 4:- The comparative distribution of species and genera within the families

Family	Species	Genera	Family	Species	Genera
Asteraceae	32	23	Capparaceae	1	1
Poaceae(Graminea)	12	11	Caryophyllaceae	1	1
Lamiaceae	12	10	Celastraceae	1	1
Apocynaceae	9	6	Convolvulaceae	1	1
Solanaceae	7	4	Crassulaceae	1	1
Chenopodiaceae	6	3	Cucurbitaceae	1	1
Euphorbiaceae	6	4	Cupressaceae	1	1
Malvaceae	6	3	Ebenaceae	1	1

Fabaceae	5	2	Ephedraceae	1	1
Moraceae	5	1	Ericaceae	1	1
Mimosaceae	4	2	Juncaceae	1	1
Polygonaceae	4	2	Loranthaceae	1	1
Scrophulariaceae	4	4	Myrtaceae	1	1
Amaranthaceae	3	3	Oxalidaceae	1	1
Anacardiaceae	3	2	Papaveraceae	1	1
Boraginaceae	3	3	Plantaginaceae	1	1
Brassicaceae (Cruciferae)	3	3	Polygalaceae	1	1
Geraniaceae	3	3	Portulacaceae	1	1
Nyctaginaceae	3	3	Primulaceae	1	1
Oleaceae	3	2	Ranunculaceae	1	1
Rhamnaceae	3	3	Rosaceae	1	1
Zygophyllaceae	3	2	Rubiaceae	1	1
Acanthaceae	2	2	Rutaceae	1	1
Loganiaceae	2	2	Salicaceae	1	1
Resedaceae	2	2	Santalaceae	1	1
Adiantaceae	1	1	Sapindaceae	1	1
Aizoaceae	1	1	Tamaricaceae	1	1
Aloeaceae	1	1	Tiliaceae	1	1
Apiaceae (Umbelliferae)	1	1	Typhaceae	1	1
Asparagaceae	1	1	Ulmaceae	1	1
Asphodelaceae	1	1	Urticaceae	1	1
Barbeyaceae	1	1	Verbenaceae	1	1
Cactaceae	1	1			
Caesalpiniaceae	1	1			

Table 6:- Importance Value Index of most dominant plant species of the study area.

Scientific name	**Relative dominance**	**relative frequency**	**Relative density**	**Importance Value Index (IVI)**
Juniperus procera	15.26	5.09	4.77	25.1
Hyparrhenia hirta	4.95	2.34	9.27	16.6
Acacia origena	8.71	3.96	2.72	15.4
Achillea biebersteinii	3.85	1.29	7.22	12.4
Themeda triandra	2.93	2.50	5.49	10.9
Eragrostis spec.	2.34	1.78	4.38	8.5
Dodonaea viscosa	3.22	2.74	2.01	8.0
Maytenus parviflora	3.38	2.50	1.32	7.2
Psiadia punctulata	2.29	2.66	1.79	6.7
Tripteris vaillantii	1.56	2.02	2.92	6.5
Olea europaea	2.96	2.50	0.93	6.4
Onopordum heteracanthum	2.64	1.78	1.65	6.1
Sageretia thea	2.14	2.58	0.84	5.6
Halothamnus bottae	1.38	1.29	2.59	5.3
Andropogon sp.	1.39	1.13	2.61	5.1
Marrubium vulgare	1.47	0.81	2.76	5.0
Rumex nervosus	1.85	1.53	1.16	4.5
Asphodelus fistulosus	0.95	1.61	1.79	4.4
Cenchrus ciliaris	1.28	0.65	2.40	4.3
Aristida adscensionis	0.97	1.53	1.82	4.3
Pulicaria undulata	0.72	2.18	1.34	4.2
Echinops sp	1.00	1.21	1.87	4.1
Acacia gerrardii	1.90	1.37	0.59	3.9
Solanum incanum	0.47	2.50	0.88	3.9

Nicotiana glauca	1.18	1.53	0.74	3.4
Lavandula pubescens	0.63	1.29	1.19	3.1
Periploca aphylla	1.01	1.61	0.40	3.0
Lavandula dentate	0.47	1.45	0.87	2.8
Ficus palmata	0.80	1.05	0.25	2.1

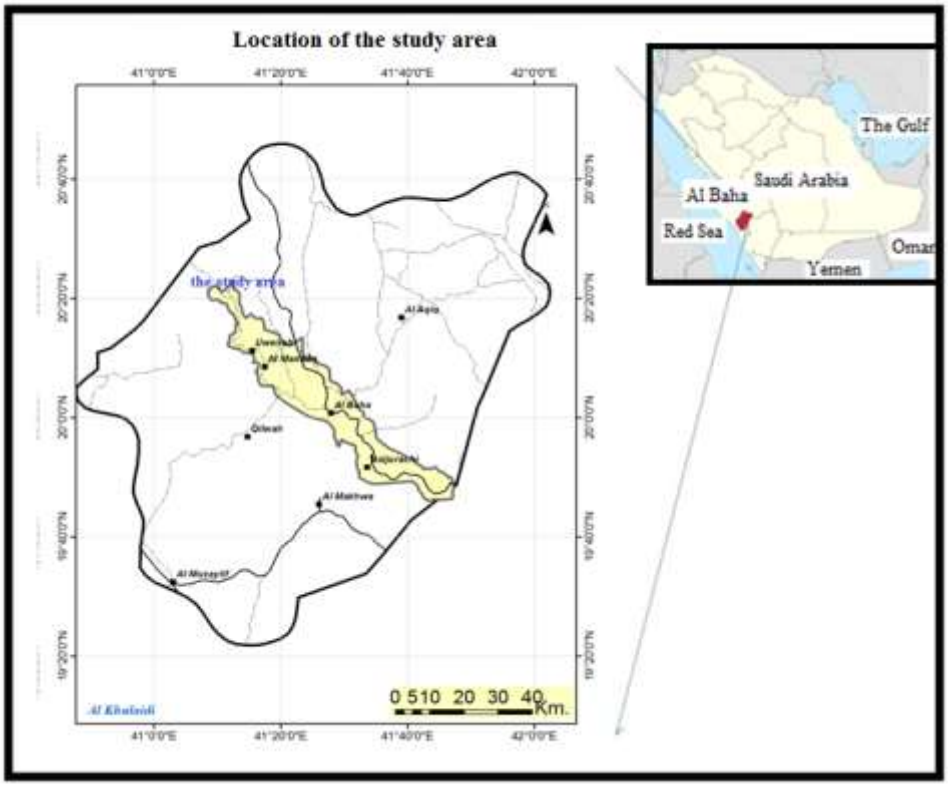

Fig. 1:- The map of the study area

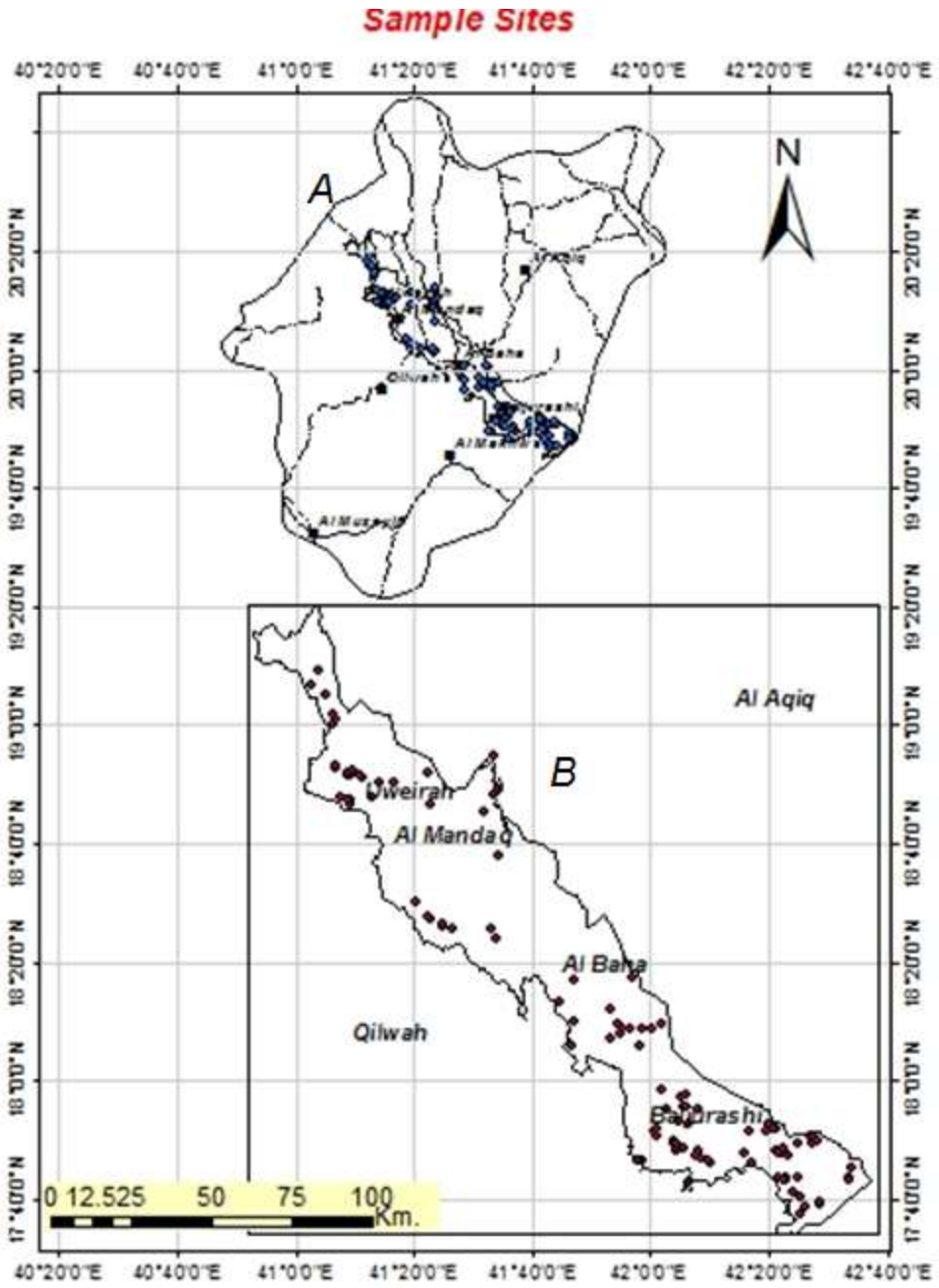

Fig. 2:- The locations of sample sites (Plots) over the study area. A = Map of Albaha region, B = map of the study are.

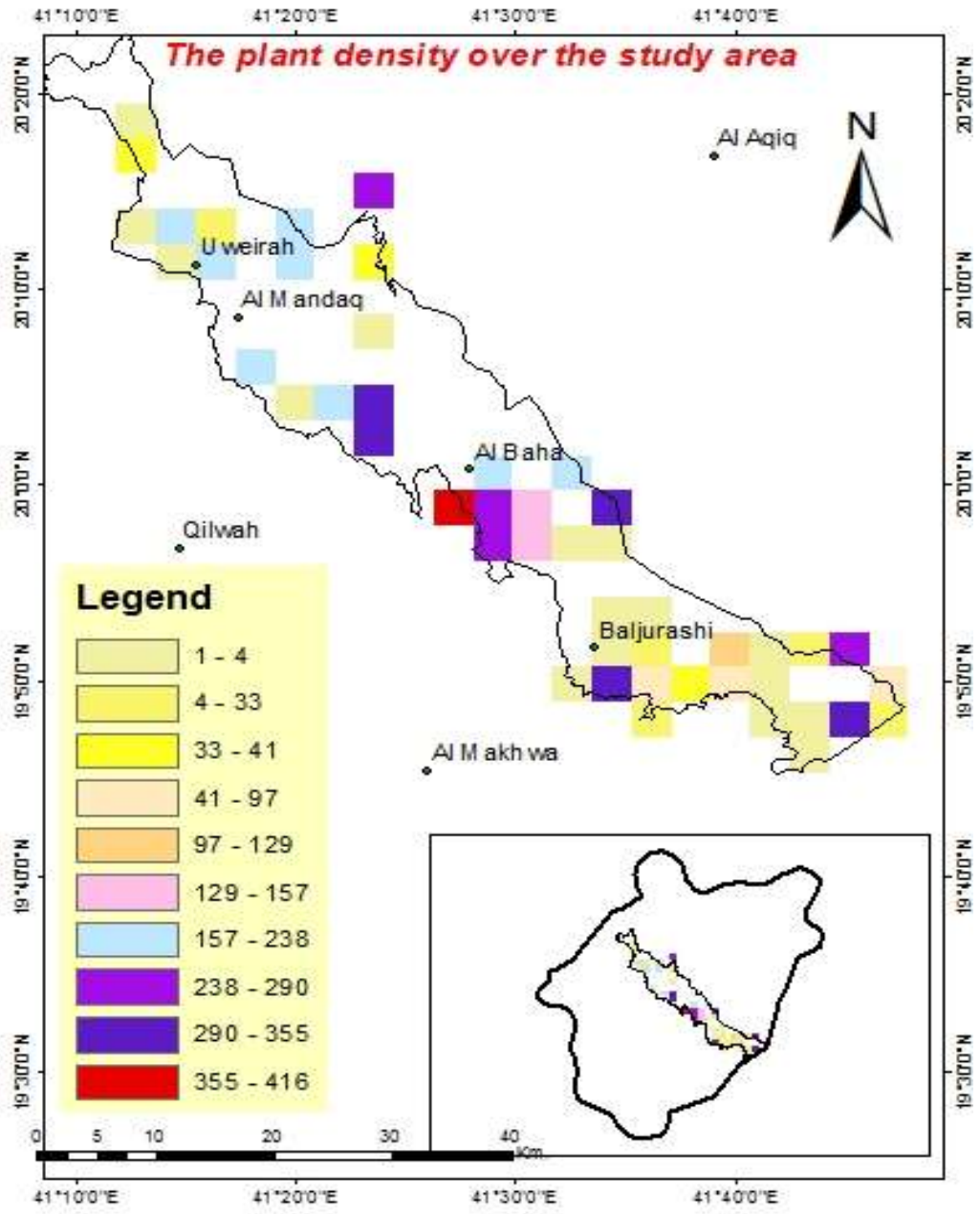

Fig. 3:- The plant density over the study area

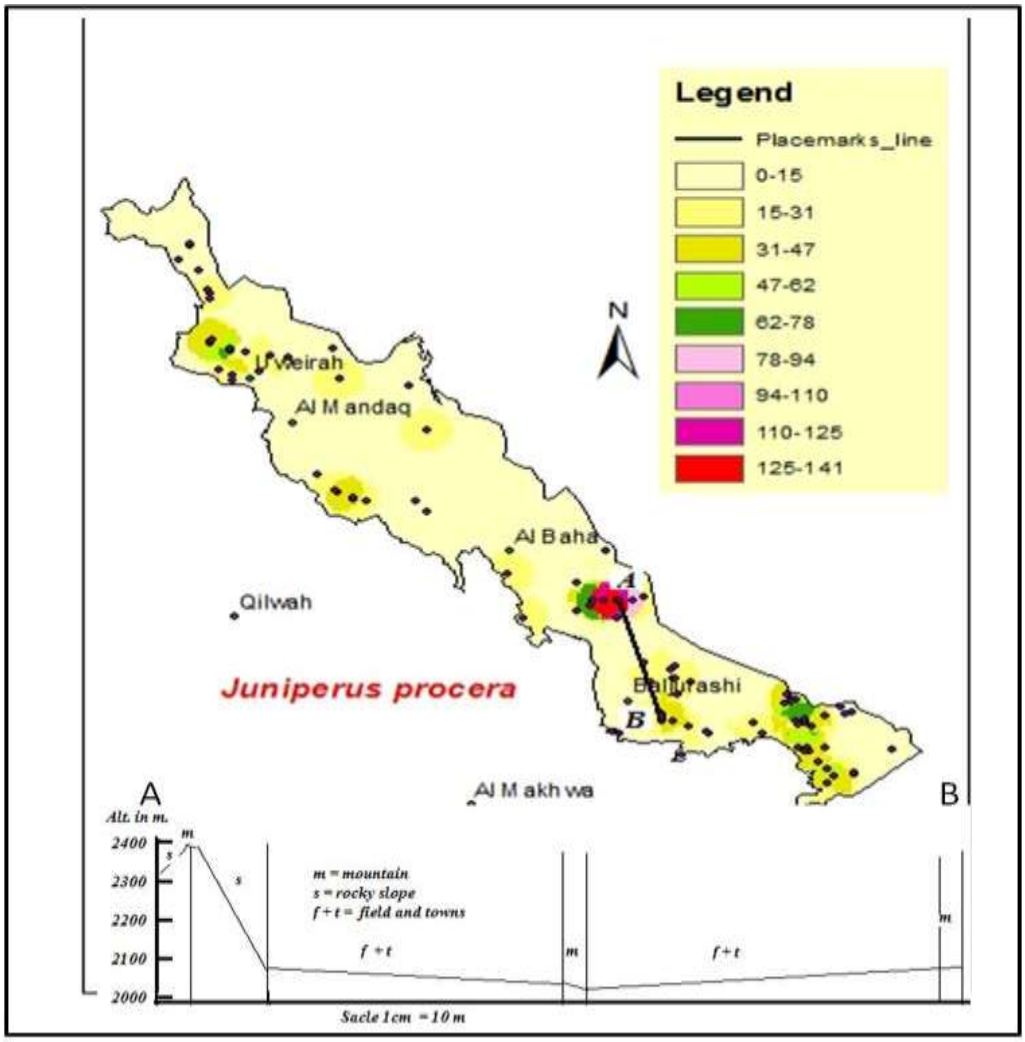

Figure 4:- A map showing the density of *Juniperus procera* in the study area, the cross section from A to B shows that *Juniperus procera* was abundant on the mountain and rocky slope areas but it was absent or existed in a small number on the almost flat fields, near towns and wadis.

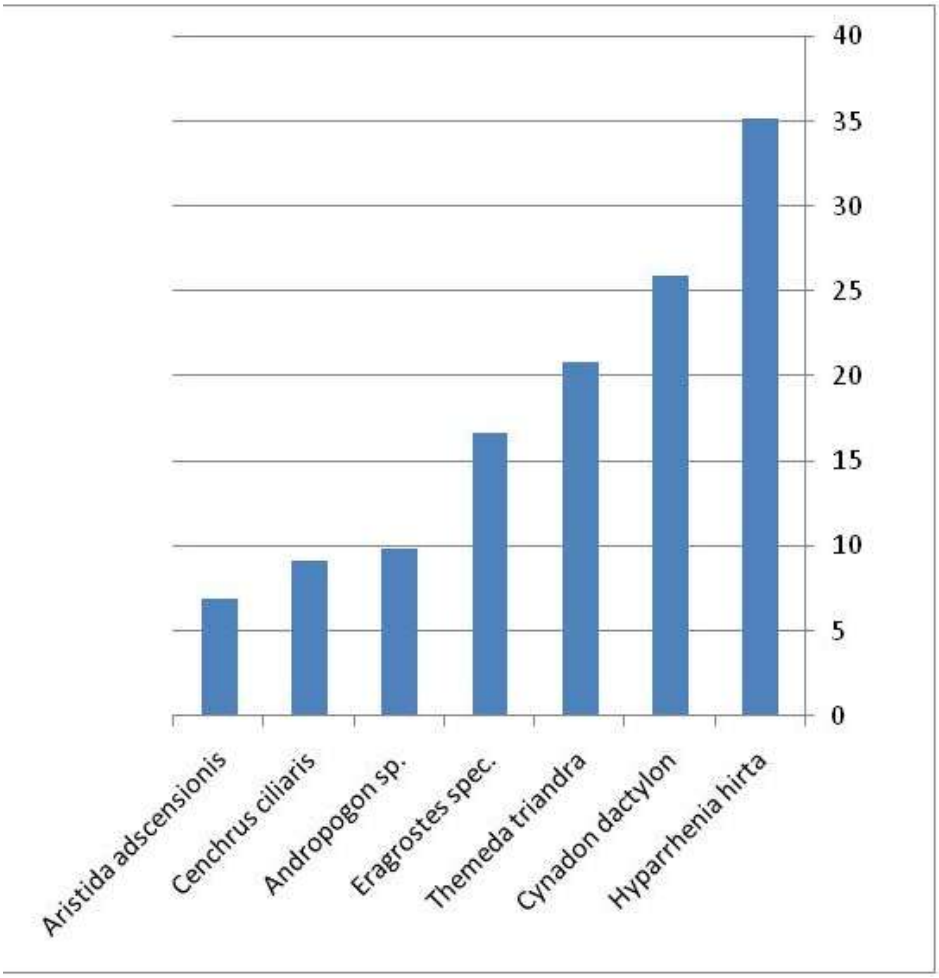

Figure 5:- The Relative density of grass

Results and discussion:-

Floristic analysis:-

A total of 185 plant species belonging to 147 genera and 67 families are recorded in all land forms, in which 3 are endemic to Arabian Peninsula and one is endemic to Saudi Arabia. The data on distribution of genera and species among the families revealed that, the top five dominant families are Asteraceae with 23 genera and 32 species, followed by Poaceae (Graminea) with 11 genera and 12 species, Lamiaceae with 10 genera and 12 species, Apocynaceae with 6 genera and 9 species and Solanaceae with 4 genera and 7 species while the rest ranges from 1 - 4 genera with 4 -6 species (Table 1). There are also 42 families represented by only by one plant species and 3 families by only 2 plant species.

The following plant species are considered rare in the study area, because they were only recorded once: *Acacia ehrenbergiana*, *Achyranthes aspera*, *Capparis cartilaginea*, *Monolluma quadrangula* (= *Caralluma quadrangula*), *Ceratonia siliqua*, *Citrullus colocynthis*, *Conyza incana*, *Ehretia obtusifolia*, *Euclea racemosa*, *Felicia dentate*, *Ficus carica*, *F. ingens*, *F. sycomorus*, *Foeniculum vulgare*, *Lavandula cronopifolia*, *Lycium shawii*, *Meriandra bengalensis*, *Nuxia oppositifolia*, *Osyris quadripartita*, *Pentas lanceolata*, *Plectranthus asirensis*.

Few species are weedy and are found in large quantities in rainy seasons, especially in wet areas or near cultivated and fallow lands. These are *Calendula arvensis*, *Erodium cicutarium*, *Aizoon canariensis* and *Anagallis arvensis*.

The species named *Acacia origena*, *Asphodelus fistulosus*, *Dodonaea viscosa*, *Juniperus procera*, *Maytenus parviflora*, *Nicotiana glauca*, *Olea europaea*, *Psiadia punctulata*, *Pulicaria undulata*, *Rumex nervosus*, *Sageretia thea*, *Solanum incanum* and *Themeda triandra* exist throughout the entire area, in particular on the mountain slopes,

Nicotiana glauca has recently invaded the study area. *Onopordum heteracanthum*, *Achillea biebersteinii*, *Tripteris vaillantii* are widespread species in wad beds, roadsides and fallow lands.

Plant density:-
The number of individuals per hectare (Table 2) is calculated by dividing the total number of individuals into the total areas for each site as surveyed over the different landforms. Accordingly, the most dominant species are listed in table 2.

Variations in number of individuals are observed in the study area. Also some species exist at high numbers in one landform and at low numbers or are absent in other landforms. For example, the number of individuals of Acacia origena, *Asphodelus fistulosus* and *Echinops sp* were high in relatively flat wadi beds and fallow lands and low or absent on rocky slopes, while *Juniperus procera*, *Themeda triandra* and *Hyparrhenia hirta* were high on the rocky slopes and low on fallow land and wadis. The plant density was plotted along the study area using Arc Map application (Fig. 3)

Plant frequency:-
Table 3 shows the frequency for the most abundant species in the study area. Variations in abundance can also be observed. Some species exist at high frequencies in one landform and at low frequencies or absent in other landforms.

Juniperus procera was one of the most abundant species recorded in the study area. It has mean frequency of 0.86, but it is absent or existed at very often on the flat fallow lands, fields and wadis (Fig. 4). *Acacia origena*, *Dodonaea viscosa*, *Psiadia punctulata* and *Sageretia thea* were widespread species (Table 3), with a considerable variation in abundance from one landform to another. The frequency of *Acacia origena* was high in the fallow lands and at times formed woodland, while *Juniperus procera* was high in rocky mountains and low in fallow lands and wadis.

Floristic diversity:-
A total of 187 plant species belonging to 147 genera and 67 families are recorded in all land forms. The distribution of genera and species among the families wise revealed.

The average number of plant species per sample plots was 2.6 species. The highest number of species was 41 and the lowest was 6. Many species were present only in one or very few samples per plot. Out of 187 plant species, only 10 (5%) were present in more than 40% of the sample plots. These species are: *Juniperus procera, Acacia origena, Dodonaea viscosa, Psiadia punctulata, Sageretia thea, Themeda triandra, Olea europaea, Maytenus parviflora, Solanum incanum* and *Hyparrhenia hirta*. The comparative distribution of species and genera within the families is given in Table 4.

The calculation of plant diversity using numbers of individuals for each plant species was achieved by using Shannon index. The use of presence and absence data failed to give logical results, for example the evenness values for all areas were 1.

The Shannon index takes into consideration the relative contribution of all species. The more the abundance is equitably distributed among species, the higher the value of diversity [37].

Shannon's diversity index shows that the sample sites 130 (wadi), 247 (rocky slope), 253 (wadi), 159 (wadi), 262 (wadi), 242 (terraces), 24 (rocky outcrop), 235 (rocky outcrop), 16 (rock outcrop), and 156 (rocky outcrop), were more diverse than the other sample sites. The Shannon index is calculated as 2.905 for site 130, 2.84 for site 247, and 2.778 for site 253. Many diverse sample sites are located on wadis tand sites with rocky outcrops, which support a habitats characterized by relatively deep and moist soil.

As can be seen, site 235 of rocky outcrops has more species than site 247 of rocky slope and 253 of wadi. However, Shannon's diversity indices show that sites 247 and 253 are more diverse. This is because the total number of individuals in sites 247 and 253 are almost equally distributed between the most plant species.

Importance Value Index (IVI) :-
Importance values refer to how important a species is in terms of community structure of a community or species

composition [36, 38]. To determine the importance of each species sampled, the importance value index (IVI) of each plant species was calculated by summing the relative density value, the relative dominance value, and the relative frequency value [35, 36] (see Table 6). The dominant tree species that represent the woodland and forest structure area are *Juniperus procera, Acacia origena* and *Olea europaea*.

As can be observed, from Table 5 few species have more importance value than other species and most of the Importance Values are distributed among just a few species; notably *Juniperus procera, Acacia origena, Hyparrhenia hirta, Achillea biebersteinii* and *Themeda triandra*. These species are widely distributed over the entire study area in particular on the mountain slopes and the plateau. Table 6 shows the most importance plant species of the study area.

The study area is a biodiversity conservation unit typified for its richness and diversity in flora. The richness in biodiversity makes it a gene bank for most species in particular forage grass species. The flora of the study area is characterized by a variety of plant species. The Asteraceae, Poaceae, and Lamiaceae were observed to be the most prevalent family. This may be due to their fast germination ability, associated with favourable environmental conditions which have enabled species to produce numerous seeds which was eventually established at suitable sites easily. These families are also considered the largest natural plant families distributed all over the globe wherever vegetation is found and most of it species is well adapted to the wet and high altitude plateau. This finding was in line with Collenette, [39] which reported that the family of Asteraceae has the highest plant species in Saudi Arabia. Wood, [40] and Al-Khulaidi [6] also reported that the Asteraceae and Poaceae (Graminea) were the most important families of Yemen's flora.

Juniperus procera, *Acacia origena*, *Hyparrhenia hirta*, *Achillea biebersteinii* and *Themeda triandra* are the most important plant species in the study area. *Themeda triandra* can tolerate light to moderate grazing and is considered among the most productive grasslands in the world [41]. *Hyparrhenia hirta* is higher in quality pastures and common in southern Africa and exists throughout Africa to the Mediterranean region, Middle East, Arabia and Pakistan [42-43].

Generally, species diversity is one of the most important indices used to evaluate an ecosystem. A rich ecosystem with high species diversity has a large value while an ecosystem with low value will have low species diversity [44-45]. The present study site had a high species diversity grass.

The Species richness of rocky slopes and wadis could be attributed to rich organic content and mineral resources utilized by the species for growth and production. Giliba et al [46] reported similar findings on woodland of Bereku Forest Reserve in Tanzania. *Juniperus procera* is the dominant tree species, and is considered by the IUCN as Least Concern ver 3.1 species [47]. *Juniperus procera* forms evergreen Afromontane forest that exists on different ecological sites of north eastern, eastern, west-central, and south tropical Africa [48]. *Juniperus procera* is also abundant between 1400 and 2500 m in the south-western Arabia (Saudi Arabia and Yemen) in particular at the slope facing west (Fog-affected Area) [6, 40, 43, 49].

The Relative density of grassland ecosystem of the study area, *Hyparrhenia hirta*, *Cynodon dactylon* and *Themeda triandra* make up about 75 percent of the density cover (Fig.5). *Cynodon dactylon* mainly found on fallow lands and wet sites.

Hyparrhenia hirta exists in grassland, rocky places and open woodland, in southern Africa mostly in upland dambos. It is found from the shores of the Mediterranean sea up to 2600 m in East Africa. It grows satisfactorily with an annual rainfall of 500 mm or more, In South Africa. *Hyparrhenia hirta*, often together with *Themeda triandra* , dominates several of the tall-grass- veld vegetation types, particularly in disturbed veld [50], *Hyparrhenia* grassland type of grassland found [51] in open steep and wooded grassland vegetation or flooded valleys in the higher rainfall areas of Kenya, Ethiopia, Tanzania, Somalia and Uganda [41]. Hyparrhenia spp. and *Themeda triandra* provide late-season grazing for livestock [51] but have low palatability [52].

Acacia origena is found near or on cultivated fields in wadis, terraces, plains and plateaus or mountain slopes of high altitude areas (between 1600 and 2800 m.) of Yemen (e.g. Ibb, NE At Turba, Jabal Saber, Jabal Sumara, Utuma), The woodland dominated by *Acacia origena* with *Themeda triandra*, *Hyparrhenia hirta,* is found on mountain slopes and terraces between 1950 - 2250 m [6].

The numbers of sample plots are not equal in different land forms for the reason that some land form such as wadis and fallow lands showed no increase in species richness with increasing number of plots. That means there is homogeneity in species composition in the land form and there is not extra species recorded in the site.

The flora of the study area is a mixture of the tropical African, Sudanian plant geographical region (Paleotropical origin) and the Mediterranean regions or Afromontane archipelago-like regional centre of endemism, with very few Saharo-Sindian or Saharo-Arabian region (Holarctic origin).

According to White [53], Ramdhani et al [54], the study area lies on the Afromontane archipelago-like regional centre of endemism. According to Zohary [55], the study area falls within Sudanian-region. Most of the Mediterranean and Sahro-Arabian elements are found in the main wadis swhile most of the Sudanian-region elements are found on the mountain slopes.

The Paleotropical origin species include: *Acacia gerrardii, Andropogon sp., Asparagus africanus, Buddleja polystachya, Celtis africana, Clutia lanceolata, Felicia dentate, Ficus carica, Ficus cordata, Ficus ingens, Ficus palmata, Ficus sycomorus, Forsskaolea tenacissima, Hypoestes forskalei, Indigofera spinosa, Jasminum grandiflorum, Maytenus parviflora. Olea europaea, Tamarix nilotica, Withania somnifera, Ziziphus spina-christi*

The Mediterranean elements species include: *Ammi majus, Anagyris foetida, Anarrhinum forsskaolii, Asphodelus fistulosus, Capparis cartilaginea, Ceratonia siliqua, Ephedra aphylla, Juniperus procera, Lavandula cronopifolia, Lavandula dentate, Lavandula pubescens, Marrubium vulgare, Nuxia oppositifolia, Rumex nervosus, Rumex steudelii, Rumex vesicarius, Salvia aegyptiaca, Solanum schimperianum, Teucrium yemense.*

Saharo-Sindian or Saharo-Arabian regions (Holarctic origin) are*: Astragalus atropilosulus. Cymbopogon sp., Ochradenus baccatus, Periploca aphylla, Pulicaria undulate* and *Tribulus terrestris.*

A few species of Sahara-Sahel linking element [53] are found in the region, these are: *Blepharis edulis, Forsskaolea tenacissima,*

Outside Arabia there are few species that are only found in Africa (regional endemic) such as Sudan, Somalia, Ethiopia, Eretria and Kenya) for example: *Acacia origena, Pistacia falcata, Pluchea dioscorides, Psiadia punctulata, Rhus retinorrhoea*.

Conclusion:-

The dominant vegetation structure in the study area is a woodland dominated by *Juniperus procera* and *Acacia origena* and grassland dominated by *Hyparrhenia hirta* and, *Themeda triandra*. Average tree cover is 25%, shrub cover is 17% and herbaceous cover is 36% with an average of 77% vegetation cover.

This study revealed that the Al Baha high land has high species diversity dominated by *Juniperus procera, Hyparrhenia hirta* and *Acacia origena*. Families noted with high number of species in the study area included: Asteraceae, Poaceae, and Lamiaceae. Species richness for some areas was very poor due to over grazing and intensive human activities. Nevertheless, still few sites with high species diversity due to effective conservation and sustainable management of were observed.

The survey showed that the woodlands in many sites are dominated by small sized trees, poor shrub species with high grasses density, indicating that the woodlands were heavily exploited and affected in the previous periods. Good regeneration is in process at the few protected sites. Therefore, to improve the natural diversity and structure of the *Juniperus procera* woodlands, to minimize the influence of the Municipal and surrounding communities pressures and utilize the woodland resources sustainably for present and future generation, the basic needs and traditional rights of Municipal and the communities over the uses of woodland resources and woodland areas should be recognized.

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