DISTRIBUTION OF *Nannorrhops ritchiana* IN DISTRICT KARAK, KPK, PAKISTAN

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Submitted in partial fulfillment of the requirements for the MS degree in Environmental Science at the Department of Environmental Science, Faculty of Basic and Applied Sciences, International Islamic University, Islamabad

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IN THE NAME OF ALLAH THE MOST MERCIFUL

AND BENIFICENT

DEDICATION

DEDICATED TO MY MOTHER

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ABSTRACT

The present study was focused on the distribution and preliminary conservation status of *Nannorrhops ritchiana* H. Wendl. in District Karak, Khyber Pakhtunkhwa, Pakistan. The study area is located in the Southern part of Khyber Pakhtunkhwa. The area is not enriched in flora but there are some valuable plants which deserves our attention. *Nannorrhops ritchiana* is one of such plant which has numerous domestic uses. Due to excessive and unsustainable use of this plant, it is deteriorating at an alarming rate. Field surveys were conducted by adopting predefined questionnaire for the loss and decrease in *Nannorrhops* population. Old age people were interviewed about the decrease in population during the last several decades. Co-ordinates were also taken to know about its distribution and extent of occurrence and area of occupancy. *Nannorrhops ritchiana* is a rare species (narrow distribution) belongs to family Arecaceae. During field survey, distribution, nature of habitat, altitudinal range, life form of associated species, mode of reproduction, population size and the threats faced by this species were studied. The population size i.e. mature plants were recorded from three localities and their number is 734. Its geographic range i.e. Extent of Occurrence is 208 km^2 and Area of Occupancy is 68 km^2. Based on the above results and permanent loss in its population it deserves the status of endangered species locally. Major threats to the flora are loss of habitat, unplanned harvesting, deforestation, over grazing, erosion and forest fires. Remedial measures are also suggested for its sustainability.

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LIST OF ACRONYMS

AOO: Area of Occupancy

CR: Critically Endangered

DD: Data Deficient

EN: Endangered

EW: Extinct in the Wild

EX: Extinct

EOO: Extent of Occurrence

GSPC: Global Strategy for Plant Conservation

IUCN: International Union for Conservation of Nature

KPK: Khyber Pakhtunkhwa

LC: Least Concern

NE: Not Evaluated

NT: Near Threatened

UNEP: United Nations Environment Program

USA: United States of America

VU: Vulnerable

CHAPTER 1

INTRODUCTION

1.1 Background

Vegetation can be attributed as a fundamental component of the globe's natural diversity and a vital resource for the stability of ecosystem and sustainability in natural resource harvesting. A plant resource can be defined as "a plant or a component of plant that is of real or possible worth to the public". In addition to the meagre quantity of crops utilized for fundamental foodstuff and fibres, thousand of uncultivated plants have enormous cultural and economic significance for providing food, medicine, fuel, clothing and refuge for huge numbers of individuals all over the world.

Plants play a key role in preserving earth's fundamental ecological stability and ecosystem balance and offer a vital part of the surroundings for the world's animal life. Therefore, it is very important to keep the plant diversity intact for the smooth running of the global ecosystem. Alongside the plant resources should be utilized in a sustainable manner, but due to current diverse anthropogenic factors i.e. over-exploitation, climate change and pollution, habitat degradation and alien invasive species, the plants are threatened with extinction. Same is the case of Pakistan especially in the drier parts of Khyber Pakhtunkhwa like District Karak where the flora is under extreme pressure mainly because of dry conditions, overgrazing, economic pressure and harvesting stress. *Nannorrhops ritchiana* is one of the taxon that is observed currently under extreme pressure. This species is over-

exploited to get some income as well as some domestic benefits by the local poor community. It is the need of the time to conserve biodiversity at local, national and global level especially those plant species which are under such pressure of growing population and growing dependence of food community.

1.2 Plants Biodiversity

The Global Strategy for Plants Conservation (GSPC) lays down a sequence of solid targets for 2010 to halt the destruction of plants diversity. The target two of the GSPC terms for a first round evaluation of conservations status of the entire known plants, at local, state, and global level, however only a little fraction i.e. just 3 percent of international diversity evaluated so far and the method have to be very much stepped up. That can be completed by motivating plants taxonomist to name species of plants that are in danger of extinction used on hand distributions information from herbarium and others source and as well as first round International Union of Conservation of Nature (IUCN) Red List assessment in their total taxonomic work. Stress must be given on uncommon species with limited range, which is the most probable to be at danger. Enough information is on hand for preliminary evaluation of almost all species, therefore limiting the quantities that have to be transferred to 'Data deficient' category (Callmander *et al.*, 2005).

Diversity whether it is ecological or cultural is a vital characteristic and provides taste, colour, beauty, saviour and steadiness to a system. Biodiversity also called biological diversity provides parallel resources to ecological system in our environment. Biodiversity may be at species, genus, ecosystem or global stage in a region. Biodiversity represents the basis of human survival. Human being is

responsible for eroding the biological diversity at a shocking rate. As we are getting extra knowledge of the natural world, it becomes apparent that there are boundaries to the disturbance of environment. The loss of biodiversity has grave implications on the social and economic aspects of the life. Economic progress and industrialization has damaged the ecosystem in one way or the other. Pakistan has approximately 6000 species of flowering plants. Among these most are native while some are exotic species (Nasir and Ali, 1971-91).

It has been reported in the flora of Pakistan that the numbers of genus having species is much low based on average in the world. The flora also includes number of phytogeographic regions like Saharo-Indian, Euro-Siberian, Mediterranean, Irano-Turanian, Indian and Sino-Japanese. The leading number of species is that of Compositae having (649 species). After that Poaceae (597), Papilionaceae (439), Brassicaceae (250) and Cyperaceae (202) have the highest number of species. The highest number of species belonging to a single genus in Pakistan is that of Astragalus which is represented by 135 species. The Pteridophytes are represented by 189 species with 153 of Sino-Japanese and 36 Euro-Siberian. Most of the endemic flora is restricted to the North western mountain of Pakistan. (Ali and Qaiser, 1986). The families with highest recorded endemic species are Brassicaceae (134 species) and Papilionaceae (32 species). New endemic species are being discovered. The Himalaya is the hub of biodiversity. We have no authoritative "world checklist" of the identified vascular plants (Callmander *et al.*, 2005).

The total number of vascular plant may be 300,000-320,000 as estimated by (Prance *et al.*, 2000). While Bramwell *et al.*, (2002) recorded the total number of

identified vascular plants to be 420,000. According to Govaerts (2001) this number is 270,000 to 425,000 and 10 to 20% still to be discovered and described (Hawksworth and Kalin-Arroyo, 1995).

In Pakistan biodiversity is decreasing at an alarming rate due to urbanization and crumbling of the habitat (Western, 2001; Heywood, 1995; Davis *et al.*, 1994). Due to anthropogenic activities the rate of plants extinction have reached one plant /day and that rate is supposed to be 1000 to 10000 time more rapidly that naturally occur (Hilton- Taylor., 2000). If the present rate of extinction remains constant, 60,000-100 000 species of plants may vanish in the coming fifty years (Bramwell *et al.*, 2002). Slight research has been completed on the flora of Pakistan which is threatened according to 2001 IUCN Red List criteria and categories.

Pakistan has diverse biophysical environment and an enormously rich cultural heritage of its people belonging to diverse ethnic groups and communities. Karak is situated in the Southern part of KP supporting scrub type of vegetation. The district is not enriched from vegetation point of view but there are some important plants which are not only locally important but also globally. *Nannorrhops* is one of such plant which is threatened due to its over-exploitation (Gibbons and Spanner, 1995).

The people of the area are poor and dependent on agriculture and plants resources. The local community depend on Timber and Non Timber Forest Products. For development of the area and to maintain the balance of the environment sustainable use of the biodiversity is indispensable. Though the use of medicinal plants in a traditional way is declining but the collection of information about medicinal plants, classification, use and management by the people holds importance

among ethno botanists. The researchers gather knowledge about the plants and apply this knowledge to biodiversity conservation and community development. Plants with medicinal and ethno botanical values are prone to threat due to their extensive use. The plants may be used in a sustainable way so that the balance of nature maynot be disturbed. Sustainable use can be defined as "the uses of plants at level of harvesting in such a way that plants are able to carry on its supply forever" (Wang *et al.*, 2004).

Many plant species are in danger of extinction owing to raise in human community, with consequent urban drift, water logging and salinity, alteration of habitat, deforestation, soil erosion, alien species, pollution, over harvesting of natural resources and climate change (McNeely *et al.*, 1995; Wilccove *et al.*, 1998; Ahmed *et al.*, 2005; Sheikh *et al.*, 2002; Schickhooff, 2006; Eberhart *et al.*, 2006).

Conservation of biodiversity is an important international issue gaining more and more importance every day. A total of 380 known plant species have become extinct (Walter and Gillet, 1998) so far. Furthermore current investigation support that fifty percent plants species of the world may be in danger of extinction if they are evaluated according to IUCN criteria and categories as given in 2001 (Pitman and Jorgensen, 2002). The modern extinction rate is 100 to 1000 times faster than the average over the last 570 million years (Novacek and Cleveland, 2001).

According to (Hamilton, 2006) 10 to 20% of vascular plant species are threatened. About 580 to 650 flowering plants species that is 12 percent are imagined to be endangered (Nasir, 1991). Conservation of biodiversity needs prompt action both at global and regional level. Based on the cultural tradition and indigenous knowledge of the society, many societies have established their own conservation methods for

plants and ecosystem. Some societies in Pakistan have placed the forest as sacred groves. The natural habitat has already been destroyed to a considerable extent due to economic growth and population explosion. It is need of the time to conserve plant biodiversity at species and ecosystem level.

1.3 Threats to Plant Biodiversity

The extent and distribution of species that survive today is a product of more than 3.5 billion years of evolution, speciation, migration, extinction and human pressures. The total number of existing species is estimated from 7 to 20 million but according to IUCN Red list (1997) it is between 13 to 14 million species. There are 7 to 13 million extinct species recorded so far. The huge difference in the number of extinct species is largely because of the phenomenon of pseudo-extinction which is the transformation of a single phyletic lineage into two or more different lineage. Based on taxonomic literature it is recommended that only 1.75 million of species have been illustrated. There is now a growing apprehension about the status of biodiversity especially about the loss of many undescribed species. Many species are declining due to damage of habitats, fragmented population, climate change, exotic species, pollution and direct anthropogenic influence.

Biodiversity sustains livelihood, lessens poverty, facilitates sustainable development and promotes cooperation between nations. There is no monitoring system for the status and inclinations of biodiversity. It is monitored in the simplest manner. As a result we know slight about the biodiversity loss and the vulnerabilities of species and ecosystem. There is a continue fall off in various local species of both plants and animals, some species are threatened and some are at the verge of

extinction. Four species of mammals (tiger, lion, swamp deer and one horned rhinoceros) are identified to have vanished in the last 40 years from Pakistan.

According to BAP of Pakistan (2000) planted trees and forests cover only 4.2 millions hectare or 4.8 percent of Pakistan. If scrub and planted forests are eliminated, the coverage fall to 2.4 million hectare (2.7 percent). Woody forest is diminishing at the rate of 4-6 percent in year in line with population growth (3% per year). Based on herbarium material (Chaudri and Qureshi, 1991) reported 709 plant species as threatened or endangered in different regions of Pakistan including *Nannorrhops* among the endangered species. Over the last decade, awareness has been raised for the significance of plants biodiversity both in developed and developing nations (Davis, 1994).

Conservation involves dealing with living plants whether wild or cultivated or in botanical gardens. In Nigeria uncultivated plants as a chief source of economies of the rural community and conservation of these plants are the main component of Nigeria culture. (Osemeobo, 1992). Strategies may be devised for wild plants conservation. Conservation of wild plants should develop through study, establishment of arboreta, control of land use, and incorporate agriculture production and habitat protection. In the current Red List (IUCN., 2008), 19 species of flowering plants are listed from Pakistan. Out of these flowering plants three are Near Threatened (NT), eleven are Least Concern (LC), 2 are Vulnerable (VU) and the rest of three were classified as Data Deficient (DD). Similarly Ali and Qaiser (2010a) estimated the conservation status of *Astragalus gahiratensis* in Pakistan on the basis of three-year field study. Based on IUCN Red list criteria and categories (2001), Ali & Qaiser have put this

plant species under the category of critically endangered owing to its collection from only a single location, marked habitat fragmentation and small distribution geographically. Similarly Ali and Qaiser (2010b) have find out *Silene longisepala* conservation status for Chitral-Pakistan, on the basis of three years fieldwork according to the Red List Criteria Categories and (IUCN., 2001) and put the taxon under the "Endangered (EN) Category" owing to its habitat fragmentation, minute population and small geographic location. As for as the vulnerability is concerned, the rare and endemic taxa of a region are most vital as these species of plants have populations of small size, which inhabit geographic range of small size and particular habitats (Mills and Schwartz, 2005; Ricketts *et al.*, 2005; Rabinowitz, 1981; Kruckeberg & Rabinowitz, 1985). Therefore, it is essential to take immediate steps for their protection (Mauchamp *et al.*, 1998). Thus, it should be kept in mind that rare and endemic species of Pakistan deserve our urgent attention.

1.4 The Importance of Loss of Biodiversity

Grainger (1992) and UNEP (1995) put into a table the outcomes of biodiversity loss in tropical forest. Every result gives rise to another one. Cutting of forests result in loss of species diversity. There are two sets of results as (Perrings *et al.*, 1995) established the genetic material loss and decreased flexibility. To what extent flexibility we show if 5% of the species vanish? Why we are compromising on loss of biodiversity? These questions are not scientific but are socio-economic and political. The worth of loss of biodiversity is connected to the extent of significance that our culture lays on biodiversity, and degree of values on land conversion. In his president's column Brussard (1994) in Conservation Biology believed while

discussion on biodiversity with public I have noticed an amazing lack of knowledge that what is this and why it is vital, and why we are worried about that? A lot of people are not aware of, unconcerned to and resist to biodiversity conservation. These were the people in USA not in poor villages of Nepal and Ethiopia in 1994. Keeping in view the current pace of awareness still the destination is far away.

1.5 Threatened Categories

1.5.1 Extinct (EX)

A taxon is considered extinct when it is beyond doubt that the last individual has perished. A taxon is supposed to be vanished when widespread analysis in well-known territory, at suitable moment and during its historical range has nothing to record a taxon. Analysis should be at that time when it is proper to the taxons life form and cycle (IUCN., 2001).

1.5.2 Extinct in the Wild (EW)

A taxon is considered to be extinct in the wild when it is noticed that the taxon only survives in cultivated form. A taxon is supposed to be vanished in wild when widespread analysis in well-known territory, at suitable moment and during its historical range has nothing to record a taxon. Analysis should be at that time when it is proper to the taxon, s life form and cycle (IUCN., 2001).

1.5.3 Critically Endangered (CR)

A taxon is supposed to be critically endangered when the on hand facts point out that it touches any of the criteria from A to E and it is therefore, believed that it faces enormously soaring threat of extermination in the uncultivated form (IUCN., 2001).

1.5.4 Endangered (EN)

A taxon is supposed to be endangered when the on hand facts point out that it touches any of the criteria from A to E for endangered and it is therefore, believed that it faces enormously soaring threat of extermination in the uncultivated form (IUCN., 2001).

1.5.5 Vulnerable (VU)

A taxon is supposed to be vulnerable when the on hand facts point out that it touches any of the criteria from A to E for vulnerable and it is therefore, believed that it faces enormously soaring threat of extermination in the uncultivated form (IUCN.,2001).

1.5.6 Near Threatened (NT)

A taxon is supposed to be near threatened when the on hand facts point out that it does not meet the criteria for critically endangered, endangered or vulnerable now. But it is likely to qualify in the near future for a threatened category (IUCN., 2001).

1.5.7 Least Concern (LC)

A taxon is supposed to be least concern when the on hand facts point out that it does not meet the criteria for critically endangered, endangered , vulnerable or near threatened now. Common and plentiful taxa are incorporated into this category (IUCN., 2001).

1.5.8 Data Deficient (DD)

A taxon is Data Deficient when there is insufficient knowledge to formulate evaluation of its risk of extinction directly or indirectly based on its population status and distribution. Appropriate data are absent and its biology may be well studied.

Data deficient is not a threatened category. More information is needed for a taxon in this category (IUCN., 2001).

1.5.9 Not Evaluated (NE)

A taxon is said to be Not Evaluated when it is has not so far been evaluated against the criteria (IUCN., 2001).

1.6 Description of Site

1.6.1 General Description of District Karak

Karak gains the status of a district on 1st July, 1982. Before that it was a sub-division of Kohat district. It comprises three sub-divisions Karak, Takht-e-Nasrati and Banda Daud Shah. The district Headquarter lies at Karak town. A metalled road called Indus Highway joins Karak with Kohat. This road enters Karak at Karrapa and exits at Manzini Banda (GoP., 1998).

1.6.2 Locations and Boundaries

The district is situated at 32.48 to 33.23 north latitudes and 70.40 to 71.30 east longitudes. It is bordered by Mianwali District on South east, Lakki Marwat on south, Bannu District on south west, Kohat and Hangu District on north and by North Waziristan Agency on the west. The district has total area of 3372 sq kilometres (GoP., 1998).

1.6.3 Topography and Physical Features of Karak District

Karak is situated at 600 to 1400 metres above the sea level. The topography of Karak is uneven. The Khattak ranges begin from the border of Karak with Waziristan and dashes in an east-west way up to the Indus River. The Khattak range is 1,000 metres above the level of sea. The direction of flow is from west to east in the northern part of Khattak hills while in the south of Khattak hills its drainage is from north east to south west. There are two important hill ranges in the district; one is called Surgarh lying in the south eastern part while the other in the North West is known as the Shingarh. The average height of these hills ranges between about 1000 to 1200 metres above sea level. The highest point is 1,482 metres above sea level. The Karak valley which is the largest valley is situated between the Shingarh and Khattak range. It is drained by Alghad of Tarkha and Kashu.The drainage of these alghad is towards south west from north east. Banda Daud Shah is another valley whose drainage is towards east from west. The main rivulet of this region is Toi of Teri. The soil is generally sandy or clayey (GoP., 1998).

1.7 Climate

Karak is located in the semi-arid region having hot summers and very cold winters.

1.7.1 Rainfall

Average rainfall is 300 to 400 mm. In winter the rains are usually of lengthy period and its intensity is low. In summer the monsoon rain is with high intensity and in short showers (Table-1).

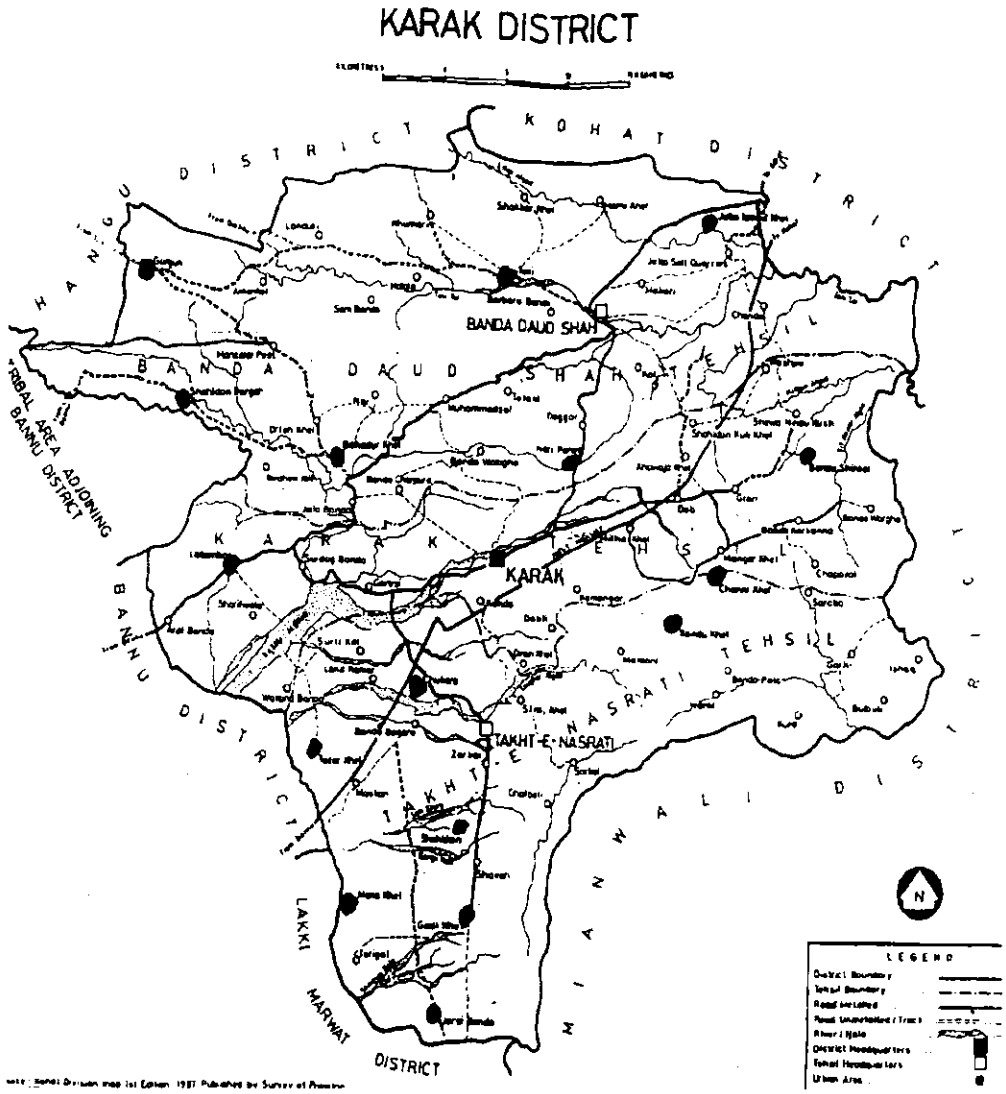

Fig: 1. Map showing general layout of district boundaries

1.7.2 Temperature

The summer is hot and winter very cold. The mean maximum temperature is 44 in the months of June and July whereas the mean minimum temperature can fall as low as 1 in the months of December and January (Table-1).

1.7.3 Wind

The wind direction is uneven in summer. In July, wind comes from north eastern part bringing rainfall and clouds. In hottest months, especially during the June, whirl wind developed on the plain area due to local heating and convectional uprising. Sometimes strong, dry and hot winds with huge dust enter district Karak from the south. Most of the winter season is calm but with the approach of February hot winds blow (Arif, 1999).

1.8 Rivers and Streams

There is no perennial stream in Karak. However there are seasonal streams that have water during rainfall. These torrential streams move towards Kurram River in the west. The names of these streams are Lawagher, Changhoos, Tarkha and Kashoo (GoP., 1998).

1.9: Flora and Fauna

Karak is located in the semi-arid region, supporting thorny scrub type vegetation. *Acacia nilotica, Acacia modesta, Acacia Senegal, Zizyphus jujuba, Zizyphus nummularia, Saccharum munja, Calotropis procera* and *Peganum hermala,*

Table 1: Climatic data of District Karak

Months	Temperature(^{0}C)				Rainfall (mm)	Relative Humidity (%)	
	Mean Maximum	Highest Recorded	Mean Minimum	Lowest Recorded		5 a.m	5 p.m
January	21	28.7	1	0.9	51.2	73	41
February	26	31.2	2	1.2	21.4	74	40
March	33	37.1	4	2.8	58	70	42
April	41	42	12	6.7	Nil	65	31
May	42	45.3	19	11.2	41.2	45	27
June	43	45.8	24	21.3	26	43	25
July	44	50	22	20.8	28.6	46	27
August	39	49.7	19	14.5	77.5	50	31
September	38	47.3	15	9.4	7	73	52
October	34	39.8	10	9.5	Nil	80	55
November	32	39.3	3	4.2	Nil	83	51
December	27	29.7	2	0.4	Nil	81	50

Source: Agricultural Research Farm Ahmadwala, Karak

Olea ferruginea, Tamarix aphylla, Haloxylon recurvum, Fagonia cretica, Calligonum polygoneides, Salvadora oleides, Periploca aphylla, Albezzia lebbek, Cymbopogon jawarancosa, Opuntia dillennii, Salvia moorcraftiana, Plantago lanceolata, Carruluma edulis, Justiscia adathoda, Withania coagulans, Phoenix dactylifera, Rhazya stricta and *Nannorrhops ritchiana* are some of the wild important plants recorded from the area (Rehman, 2000).

Important fauna include grey and black partridge, Rein quail, Skylark, migratory Cranes, Jungle sparrow, common house sparrow, Hoopoe, Yellow vented Bulbul, Red vented Bulbul, myna, Wild pigeon, Crow, Owl (small Owlets too), Swallow, Jackal, Hare, Squirrel, Wild Bore, Hedgehog, Fox, Uromastix, Snake, Rat, Wall lizard, Jakoo, various insect species like; beetle, dragon fly, wasps and honey bees etc. (Rehman, 2000).

1.10 Agriculture

The most important source of income is agriculture. In hilly areas it is supplemented by livestock management. Major crops are wheat, gram, peanut and millet etc.The total geographical area of District Karak is 2, 64,755 hectares. Only 29.26% i.e. 77476 hectares of the total area is estimated to be under cultivation while the remaining 70.74% i.e.1 87,279 hectares is not fit for cultivation. About 2.11 % i.e. 1636 hectare of the cultivated land is irrigated and the rest of 97.89 % i.e. 95840 hectare depends on rainfall (Arif, 1999).

1.11 Geology

The district is divided into the following geological formations;

1) **Bahadar Khel Salt**: White to blackish and vitreous, coarsely crystalline salt usually bonded; massive; overlain by Jatta Gypsum.

2) **Jatta Gypsum**: Colour white to grey, red, purple and greenish in places where argillaceous; overlies by kuldana formation.

3) **Kuldana Formation**: Red to brownish red colour clay contains gypsum crystals. The formation is soft and forms gullies; overlies by Kohat limestone.

4) **Kohat Formation**: Shale and limestone, shale dominant in lower part and limestone in upper part. Shale is colourless, yellowish, greenish and grey in colour. Limestone is white to yellowish in colour; overlain by Kamllal formation.

5) **Kamllal Formation**: Sandstone, greenish grey colour, thick bedded; with clay and silt stone beds.

6) **Chinji Formation**: Sandstone, silty clay and silt stone; colour brownish, grey; fine to coarse grained.

7) **Nagri Formation**: It consists of greyish, green colour at Totaki, fine to medium grained clay form gullies and sandstone walls.

8) **Dhok Pathan Formation**: Sandstone interbedded clay; sandstone grey, greenish in colour, clay reddish colour with siltstone beds.

9) **Soan Formation**: Interbedded conglomerate, sandstone and clay, soft with poor bedding.

10) **Terrace**: Composed of gravel to boulder. It consists of metamorphic rocks.

11) **Alluvium**: Found in the valley on either side of main streams. Composed of clay and sand.

12) **Channel Deposits**: Found in stream beds. Composed of sand and gravel. (GoP., 1998)

1.12 Mining and Minerals

Karak is enriched in minerals. Rock salt, gypsum, limestone; shale/clay, petroleum and natural gas are present in abundance. Except from these minerals Uranium is also in exorbitant quantity. The area also hosts some occurrence of calcium benthonite (GoP., 1998).

1.13 History and Ethnic Structure:

1.13.1 History

Barak sub-tribe of Khattak tribe makes the dominant population of District Karak. By origin they are Karnalri pathans. They have most of the virtues and least of the vices of Pathans as described by one of the British (GoP., 1998).

1.13.2 Races and Tribes

The whole population belong to Khattak tribe of Pathan. All people belong to Muslim Sunni school of thought. They are strict followers of the religion and here mingled their rituals and culture into the true practices of Islam by following veil and related traditions.

1.14 Culture

1.14.1 Dress and Ornaments

People wear shalwar, kamees, turban and chaddar. In winter people wear woollen caps and clothes.

1.14.2 Food

Bread prepared from wheat flour is the daily food of people in Karak. Vegetables and fruits of daily use are brought from the adjacent districts due to semi-arid nature of the district.

1.14.3 Dwelling

There is a joint family system and the houses are mostly kacha. The pucca houses trend is now popular. The house generally consists of two or three rooms. Each family has their own hujra called chowk where male members daily meet and discuss issues of daily life. The chowk is also used as guest room. In winter the young spend most of the night time in chowk, prepare sweat called halwa and play different games. But this culture now changes with the modern machine age like use of computer and playing video games etc. (GoP., 1998).

1.15 Religion

There are hundred percent sunny sects of Muslims in district Karak. Almost all people pray five times a day.

1.16 Occupations

Karak is a rural area. There are no industries where people earn their livelihood. Agriculture is a profession for most of the people. Owing to shortage of water and no irrigation scheme the people from the area has joined armed forces, civil services and police. A good number of people earn their livelihood from Middle East countries (GoP., 1998).

1.17 Population

The population of Karak district, as per census of 1998 was 430,795. Average annual growth rate was recorded to be 3.3% in that period. The population density is 128 persons per square kilometre. The urban population was 27,893 persons or 6.5 percent of the total populations' ratio, that is the number of males for every 100 females, was 96 per cent documented in DCR 1998.

1.18 Literacy

An individual was considered as literate in the Census report of 1998 if he could read a journal or newspaper of similar pattern and could write a letter in any language. The literacy is calculated as the proportion, of literate population to equivalent population aged 10 and above. The literacy rate in Karak has improved from 19.3 % in 1981 to 41.9 % in 1998.The ratio of literacy for males are 68.2% as compared to 18.1 % for females. The proportion is high to a large extent in urban as compared to rural parts both for female and male (GoP., 1998).

1.19 Description of Mazri Palm: *Nannorrhops ritchiana* H.Wendl.

Mazri is an economically important species of plant kingdom belonging to family Arecaceae (Palmae). It is a stemless and gregarious shrubby palm which generally grows in arid mountainous regions up to an altitude of 1524 meters. Mazri is the hardiest of all palm species and it can tolerate temperature ranging from minus 20 degree centigrade to 50 degree centigrade. Although this palm does not form a traditional trunk (known for most of the palms) but it grows in a mounding form about 3-5 meters tall and its clump spreading even more than 4-6 meters. Mazri clump has bushy appearance. It produces flowers on separate branches only once and then dies. Flowers are white in colour. The fruits are brown to orange in colour containing a single seed (stone) and the fruit is edible. The male and female flowers are borne on separate plants being a dioecious tree; it can be propagated by rhizome or seeds. Mazri is xerophytic in nature. The leaves have bluish-green colour, in the local language (Pashto) it is called "Mazaray" while the name of Mazri palm is "Peesh" in Balochi and Sindhi language (GoP., 2010).

1.19.1 Habitat

Mazri is being xerophytic can bear harsh climatic conditions. It can grow in dry and somehow infertile soils as well as in partially compact soils. It can flourish best in sandy-gravel and sandy loam soils. It can also help to protect soil erosion by its well established root system (fibrous roots). Its growth is slow but it has been observed that the use of fertilizer (both natural and artificial) can speed up its growth (GoP., 2010).

1.19.2 Distribution

It is native to the arid mountainous regions of Afghanistan, Pakistan, Iran and Central Asia. It has also reported from Arabian Peninsula. In Pakistan it has wide distribution but small population size which comes under the category of suffisively rare species. It exists in foot hills of Karak, Kohat and Hangu .In Sindh province it is found in district Dadu, towards hilly sides. It has also been reported from district Awaran, Musakhail, Khuzdar and Barkan in Balochistan province. In Federally Administrated Tribal Areas (FATA) it is found in Kurram, Orakzai, North and South Waziristan Agencies (GoP., 2010).

1.19.3 Threats to Mazri Palm

Over-exploitation is the major threat to Mazri palm that stops it natural regeneration. Due to ruthless exploitation it disappears at an alarming rate from many of its former strongholds. Uprooting of whole Mazri clump through mechanical way has led to its unsustainable use. As a result large tracts which were known to have established populations of Mazri palm have been cleared. Use of Mazri leaves as a fuel and for thatching huts and making ropes is also threat to its disappearance. Land use for agriculture purposes is another threat posed by this plant. Population explosion and construction of houses for living is another threat. Except from these threats, this plant is found on such soils called "Shamilats" (lands used for the livelihood of local communities) which makes it susceptible to over-exploitation (GoP., 2010).

1.19.4 Economic Benefits

Mazri palm usually grows well on marginal lands. It provides a good source of income for the rural poor people. A large number of people in KPK, Sindh and Balochistan are engaged in earning livelihood from local Mazri palm cottage industry. In most of the cases it is the best source of earning for people of arid areas with limited natural resources, while in certain conditions this serves as only source for the income of the local people. The people associated with this industry include producers, collectors, traders, manufacturers and retailers. In Balochistan the annual production of Mazri leaves is 27,265 tons. For processing Mazri leaves and manufacturing its products, this industry has employed over 65,000 people (including 78% women). Mazri is sent in semi-finished and raw form from Balochistan to several parts of the Pakistan especially Dadu and Karachi in Sindh for making various products. In KPK Mazri products are exported from Kohat and Karak to many parts of the country particularly Punjab. The most famous market for Mazri products in KPK is Jandai in Mardan and Gumbat in Kohat (GoP., 2010).

1.19.5 Common Uses

Its fibre is used for making ropes, mates, banns, brush, baskets, hand fans, trays, grain bins, cordage, cabinets and ornamental pieces.

- Mazri leaves are used for thatching huts and shelters.
- Fruits are eaten by the local people, especially children collect them, but the fruit is hardly as good as a low grade Date Palm fruit.

- Dried leaves and trunk are used as fuel, which pose a serious threat to the diversity of this species at the local level.
- Some wild animals like Ungulates and others especially Black Bear in Balochistan are reported to feed on young leaves and berries (GoP., 2010).

1.19.6 Medicinal Uses

- Young Mazri leaves are used for treatment of diarrhoea and dysentery in children
- Some uses of fruit are known as anthelmintic, carminative and in cough and flue as well.

1.19.7 Mazri Products

Many useful products are made from the leaves of Mazri palm. These products include baskets, mats, sandals, hats, bread pots, hand fans, rope fibre for cot knitting, brooms, trays, rosaries and many other decoration items (Latif and Shinwari, 2005).

Majority of the flora of the district is greatly under pressure for various purposes. Similarly *Nannorrhops* is also under pressure for making various products like mate, hats sails, grains bin and cordages, ornamental products, various goods for mosque, basket, ropes, broom, trays, hand fans, cabinets and ornamentations piece etc. Therefore, the current study will be useful to the *Nannorrhops ritchiana* conservation for planning of future. In the past no study was undertaken with respect to these plants from the study region. So, current study was planned to document information from local community about the decrease in *Nannorrhops ritchiana* population. The main objectives of the current studies are:

1.20 Objectives

- To carry out a brief but thorough investigation into the distribution and conservation status of *Nannorrhops ritchiana* in District Karak
- To identify the anthropogenic threats and impacts on *Nannorrhops ritchiana* population in local areas.
- Assess the current status and existing threats of *Nannorrhops ritchiana* towards its extinction in the region.
- To recommend measures for *Nannorrhop*s conservation in the area.

CHAPTER 2

REVIEW OF LITERATURE

Chaudhri and Qureshi (1991) made a detailed list of endangered plants and declared 709 plants as threatened without using IUCN criteria. Their list of these endangered plants included *Nannorrhops ritchiana* as endangered plant in Pakistan related to these ecosystems.

Gibbons and Spanner (1995) studied *Nannorrhops ritchiana* in its wild form in Pakistan and the threats faced by this palm. They are of the opinion that we were delighted by seeing this palm in wild form, but at the same time we were shocked that its population has decreased considerably and is still reducing at an alarming rate. Their observations showed that time is not far away when they will perish.

Khan (1997) studied the conservation status of endangered ecosystem and the biodiversity through different conservation measures in Pakistan. The focus is on the juniperus forests of Balochistan, mangrove forests of Sindh coast and Himalayan moist temperate forests which make most of the forest cover in Pakistan. He has also described 57 threatened species of Pakistan including *Nannorrhops ritchiana.*

According to Walter and Gillet (1998) 32000 plants species are threatened with extinction. This figure signifies roughly 13 percent of the estimated 250,000 species of higher plants and bryophytes on earth, but does take into account the many species whose rank has not so far been evaluated.

About 4000-5000 (15%) out of total 30,000 vascular plants in China is estimated to be endangered and rare (An, 1998). Without giving IUCN danger categories, besides *Bryonia cretica* (almost extinct), 13 taxa have been evaluated as "endangered"

and nine other taxa are considered as over collected from Egypt (Batanouny, 1991). Six species (viz.*Aconitum heterophyllum, Podophyllum hexandrum, Nardostachys jatamansi, Picrorhiza kurrooa, Swertia chirata and Bergania ciliata*) were considered as trial cases for thriving protection for a huge quantity of species in Sikkim that are stated to have curative significance and whose continued existence in the uncultivated form is being threatened (Rai *et al.*, 2000).

Coptis teeta has been found as an endangered species in Eastern Himalaya, the scientific information for its conservation is deficient. It has been found native to a minute region and has extremely small size of population. A number of threats could result in its extermination (Pandit & Babu, 1998). For instance the small coniferous Himalayan yew has just turn into a greatly traded species. It is keenly wanted, because it has taxol, used in chemotherapy to treat cancer of ovaries. Huge amount of this plant are gathered and exported annually, though its harvesting is illegitimate in the majority of South Asian countries. All along the trouble gradient *Taxus baccata L.* subsp. *wallichiana* (Zucc) Pilger illustrates variable population patterns. This species is on its way of extinction. The threat is not only because of too much harvesting but also due to degradation of forest sites (Rikhari *et al.*, 2000).

Kala (2000) reported a total of 23 endangered and rare medicinal plants in the Indian trans-Himalaya in Spiti sub-division of Himachal Pradesh distributed over ten major habitat types and vegetation zones. *Saussurea gnaptaloides* and *Picrorhiza kurrooa* are reported to be the most vulnerable and among the plants found in the region.

Oldfield *et al.*, (1998) stated two tree species as threatened based on herbarium material and plant collection record.

Shah and Baig (1999) reported twenty plant species from Pakistan using 1994 IUCN criteria.

Gul *et al.*, (2000) reported 55 medicinal plants from 3 districts of Malakand division to be threatened. About 37 species of flowering plants and ferns have been cited as threatened from Ayubia National Park by Shah (2001).

Sheikh *et al.*, (2002) worked on use, exploitation and prospects for conservation of Naltar Valley, northwestern Karakorum, Pakistan. They also studied the floral biodiversity and its exploitation by various entities. Twenty four plant species are important from ethnobotanical point of view. *Capparis spinosa, Geranium wallichianum, Gentiana tianshanica, Stellaria graminea* and *Thymus serpyllum* are the most important medicinal plants for local and commercial uses. Their demand has increased due to over-exploitation. A few plant species that we consider are under ruthless pressure include: *Geranium* sp, *Senecio* sp, *T. serpyllum, Saussurea* sp. and *G. tianshanica*. These species are widely gathered during the summers from any place where they can be found. *Cedrus deodara* and Willow *Salix* sp.has almost disappeared from the area. Deforestation leads to landslides, soil erosion and eradication of plant taxon is an additional cause in the loss of species at a mass level as well as habitat.

Khan *et al.*, (2003) studied biodiversity conservation in the Indian desert; the Thar Desert. It has medicinal and endemic plants with respect to its own specific characteristics and importance. Forty-five plant species are recorded to be endangered or rare from the region.

Vischi *et al*, (2004) studied six vascular endemic species to determine the conservation status with a limited distribution or native to the hilly regions in the

province of Córdoba, central Argentina, by means of the IUCN 1994 Red List Categories. The population number was calculated via a numerical way based on field information. The expected decline in the population quantity on a 10 yr projection was calculated taking into account the region to be utilized for future afforestation programs. To find out the area of occupancy and the extent of occurrence, a comprehensive bibliographical study was carried out and herbarium specimens placed in some institutions were correctd. *Oenothera cordobensis, Buddleja cordobensis, Croton argentines, Aa. achalensis* and *Adesmia cordobensis* were considered as Vulnerable, whereas *Solanum restrictum* was given the endangered category. The categories allotted to *Solanum restrictum* and *Aa achalensis* are regarded at the worldwide level, while those assigned to *Adesmia cordobensis, Buddleja cordobensis Croton argentines* and *Oenothera cordobensis* were regarded at the local level. In all six cases the danger of extinction is high and appropriate protection strategies should be developed for each species. The most vital danger cause is the planned afforestation in the region using alien woody species. Under these circumstances the formation of a reserve in the studied region would be attractive in order to protect five of the plants studied and deeming that 95% of its species are native, the local flora as an entire.

Shinwari *et al.*, (2007) worked on medicinal and aromatic plants of Margalla hills. In his book he has also written about *Nannorrhops ritchiana* that it was recorded by Stewart from one place in Margalla but now it could not be found. He considered *Nannorrhops* as vulnerable taxon in Pakistan

Shah (2007) evaluated the conservation status of 52 species in accordance with the IUCN Red List categories and criteria (1994 &2001) in Siran valley,

Mansehra KPK Pakistan. Among 52 threatened species, 16 species were found critically endangered, 20 species endangered and 16 species vulnerable. An ex-situ conservation steps were also taken by cultivating medicinal plants (*Atropa acuminata, Geranium wallichianum, Achillea millefolium, Lavatera kashmiriana* and *Paeonia emodi*). In collaboration with the forest department seeds of important endangered tree species (*Ulmus wallichiana, Taxus wallichiana, Acer caesium, Prunus cornuta, Betula utilis* and *Fraxinus excelsior*) were collected and nursery was raised.

Callmander, (2008) studied a new threatened species of Pandanaceae from Northwestern Madagascar, *Pandanus sermolliana*. *Pandanus sermolliana* Callmander & Buerki (Pandanaceae) is reported from moist forests in the Galoka mountain series in northwestern Madagascar. The new species can be easily differentiated from the other members of the genus it most closely resembles, *P. insuetus* Huynh and *P. perrieri* Martelli, by several morphological characters, including drupes that are incompletely fused, with each of the dome-like carpels separated from the base of the pileus, and stigmas that are subvertical or rarely subhorizontal, slightly spinescent, and raised on an incompletely united base. This distinctive species is rare and is classified as "Critically Endangered" based on IUCN Red List criteria.

Jones (2008) studied the distribution and conservation of Montserrat's Endemic Flora. Montserrat's two endemic plant species, *Rondeletia buxifolia* and *Epidendrum montserratense* have been suggested for a candidate Red List status of "Critically Endangered" under the IUCN categories of threatened (IUCN, 2001). Despite this classification, both species have only recently been allocated Protected Species status under national law and there is no enforcement of legislation or actual protection on the ground. Both species are further threatened by lack of knowledge

concerning many aspects of their ecology and biology. Following investigation of these issues, the wide range of threats found to be facing many populations, as well as the lack of knowledge among local communities concerning these species, data were collected from a wide variety of sources, analyzed and compiled such that transparent and reasoned conservation recommendations could be made. Although populations of *R. buxifolia* and *E. montserratense* were found to be more widely distributed than previously thought, their Critically Endangered status was confirmed [CR B1, a, b, iii), v]. These data were then combined with those assessing the response of each species to anthropogenic disturbance and information on the projected development plans for Montserrat in order to make recommendations for the conservation of each species

Alam and Ali (2010) determined the conservation status of *Astragalus gilgitensis* Ali, a critically endangered species in Gilgit, Pakistan. *Astragalus gilgitensis* Ali (*Fabaceae, Papilionaceae*) is distributed in Afghanistan (Kail, Laghman district) and Pakistan (Nomal, Naltar and Chalt, Gilgit district). Originally, it was reported from the Gilgit district. In Pakistan, a current five-year re-assessment reveals that this species has now become restricted to the uncultivated areas of Naltar only. Ten field surveys were conducted from 2003 to 2007 in order to study its distribution, population size, the severity of threats like erosion and anthropogenic impacts i.e. over-grazing, deforestation for fuel wood and recreational activities in the natural habitat of the species. The conservation status of this species according to IUCN Red list categories and criteria 2001 should be regarded as "critically endangered" (CR) in Pakistan.

Gautier *et al.*, (2010) conducted research on distribution of *Cyperus chamaecephalus* which is a species mostly present in forest undergrowth with

inconspicuous inflorescences. They also worked on conservation status of this plant with an Extent of Occurrence (EOO) of 103.666 km^2, an Area of Occupancy (AOO) of 90 km^2 and 8 subpopulations, 6 of which in the protected area network (Montagne d'Ambre, Loky-Manambato [Daraina], Manongarivo, Marojejy, Masoala, Andasibe-Périnet). *Cyperus chamaecephalus* is assigned a preliminary status of "Least Concern" (LC) following the IUCN Red List categories and criteria (IUCN, 2001).

Abbas *et al.,* (2010) determined the conservation status of *Cadaba heterotricha* Stocks in Pakistan. Based on four years wide-ranging field studies together with geographic range, habitat and population size *Cadaba heterotricha was* classified as endangered (EN) species in Pakistan according to IUCN 2001, Red Data List categories and criteria.

Alam and Ali (2010) worked on the conservation status of 19 taxa. The conservation status of these taxa was analyzed using IUCN Red List criteria and Categories. Out of these, *Asparagus gharoensis* Blatter is now extinct; *Scaevola plumierii*(L.) Vahl and *Scaevola taccada* (Gaertn.) Roxb, are regionally extinct; *Allium gilgiticum* Wang & Tang, *Consolida schlagintweitii* (Huth) Munz, *Elymus russellii* (Meld.) T. A. Cope, *Mattiastrum karakoricum* Podlech & Sadat, *Plantago baltistanica* Hartmann and *Saxifraga duthiei* Gandogar, *Arabidopsis brevicaulis* (Jafri) Jafri and *Christolea mirabilis* (Pamp.) Jafri, are possibly extinct; *Berberis pseudumbellata* Parker subsp. *gilgitica* Jafri, *Astragalus clarkeanus* Ali, *Haplophyllum gilesii* (Hemsl.) C. C. Townsend, *Androsace russellii* Y. Nasir, *Asperula oppositifolia* Reg. & Schmalh. subsp. *Baltistanica* Nazim., and *Tanacetum baltistanicum* Podlech are critically endangered, while the remaining two taxa i.e.,

Rhodiola saxifragoides (Fröd.) H. Ohba and Aconitum *violaceum* Jacquem. ex Stapf var. *weileri* (Gilli) H. Riedl is vulnerable.

Ali & Qaiser (2010) contributed to the Red list of Pakistan. They studied conservation status of *Astragalus gahiratensis* Ali (Fabaceae-Papilionoideae). *Astragalus gahiratensis* Ali is endemic taxon restricted to District Chitral Pakistan. The population size was noted from different localities. In 2005 only 127 mature individuals were recorded from 4 localities. in 2006 only 28 mature individuals were find out from 03 localities and in 2007, 107 mature individuals were found in 4 localities, the taxon is placed in critically endangered category. The major danger faced by the taxon is loss of habitat. Due to deforestation and grazing soil erosion takes place which is among the other major threats liable for the decrease in population size. In 3 localities i.e., Chitral-Gokhshal, Chitral Gol-Ishpeder, Chitral-Chaghbeni 13.79%, 18.64% and 75%, decline has been examined in its population size, respectively. It is the need of the time to build up definite conservation strategies for species.

Abbas and Qaiser (2011) studied *convolvulus scindicus*. They also studied conservation assessment and strategies to avoid extirpation. The conservation status of *Convolvulus scindicus* Stocks was assessed using IUCN red list criteria and categories in Pakistan. After three years (2006-2008) of wide-ranging field studies based on population size, range of distribution, nature of locality and anthropogenic activities, the conservation status of *Convolvulus scindicus* has been classified as an endangered (EN) species. Conservation measures are also suggested avoiding its extirpation.

Ali and Qaiser (2010) studied conservation status of *Gaillonia chitralensis* Nazim. *Gaillonia Chitralensis* Nazim. (Rubiaceae) is native to Chitral, Pakistan. In the past this species was recorded from type locality only. This taxon is now reported from 15 new localities after three years of extensive studies, but it was not recorded from the type locality. Based on Extent of occurrence (EOO), Area of occupancy (AOO), fragmented populations and population size it was assigned the status of endangered category according to IUCN Red List criteria and categories 2001. Specific conservation strategies at ground and national level were also recommended to save it from extinction.

Alam and Ali (2010) worked on conservation status of *androsace russellii* Y. Nasir, a critically endangered species in Gilgit, Pakistan. *Androsace russellii* Y. Nasir, belongs to the family Primulaceae and is narrowly distributed endemic species. Originally it was reported from Gharesa glacier Gilgit. This species has now recorded from two localities of Ultar Nullah and Shatu bar in Hunza (Gilgit) based on six year re-assessment (i.e., 2003-2008). Along with distribution, population size, mode of reproduction and nature of habitat was also studied. Due to small population size (69) individuals and small geographic range, (21.85 km^2) extent of occurrence, (0.4 km^2) area of occupancy, this species was given the status of critically endangered. Remedial measures were also suggested.

Haq (2011) described the conservation status of the critically endangered and endangered species in the Nandiar Khuwar catchment District Battagram Pakistan. The study was focused on the vascular plants diversity and difficulties linked with the conservation of flora of Nandiar Khuwar, District Battagram Pakistan. The area is located in the Western Himalayan Province floristically with a total of 37 taxa were

reported which includes 14 critically endangered and 23 endangered species. The information was collected from 270 people including 220 male and 50 female. Major threats to the flora recorded were loss of habitat, unplanned collection, deforestation, over grazing, erosion, attack of pathogens and effect of introduced taxa. Measures for the conservation of plant resources of Nandiar Khuwar catchment were also suggested.

CHAPTER 3

MATERIALS AND METHODS

Detailed tours were organized in October 2010 to April 2011 aimed towards the collection of ample information about the distribution of *Nannorrhops ritchiana* within the study area.

1. Information was also obtained from the local old age people about the decrease in the population of *Nannorrhops ritchiana* and its ethno botanical use, dependence of local community on this plant and subsequent decrease in its population in various localities within the study area (Alam and Ali, 2009).

2. For population size, mature plants of *Nannorrhops ritchiana* were counted in the habitat in Khurri Banda, Mummi Khel, Drangi Banda, Garhai Khula (Teri), Kundi, Aman Kot, Bergaya, Mardan Khel and Gurguri. The plants, which were seen and established to bear flowers or fruits, were counted under the category of "mature individuals" i.e. those plants which can reproduce and produce their offspring, those which could not attain flowering and fruiting stage even when the season was over' were considered as immature plants and were counted separately (Alam and Ali, 2009).

3. The known distribution area was quantified by encompassing 10 known localities of *Nannorrhops* on the map of the observed area. For extent of occurrence (EOO) the geographical coordinates were plotted on georeferenced imagery in wetland office F-8/3, Islamabad (Using Arc View v 9.3) and a polygon was prepared by encircling line through all the known localities of the taxon, excluding the localities which come inside the boundary of the polygon.

4. The area of occupancy i.e., the actual area which is occupied by a taxon within the degree of occurrence (IUCN., 2001) was calculated through widespread walk by encircling individual plants of the species in their marginal habitat. A 2x2 km^2 grid was used on GIS map. Area of occupancy (AOO) was calculated by the presence of taxon in a grid of 4 km^2 area. If a single or more plants are present in a 4 km^2 grid, it is considered to be occupied (Alam and Ali, 2009).

5. Habitat nature: Nature of habitat was found out by bearing in mind association to the area, anthropogenic impacts and soil erosion.

6. Altitude was noted by GPS.

7. *Nannorrhops* life form and every associate were determined by using Raunkaier classification system (Raunkiaer, 1934). It is a system in which plants are classified on the basis of life form categories. This classification is based on the place of the plant's growth point during unfavorable condition (dry season, cold season). The major sub-divisions are Phanerophyte, Chaemophytes, Hemicryptophyte, Cryptophytes, Therophyte, Aerophyte and Epiphyte.

8. Number of fruits and seeds were observed in each plant/cluster of plants and in case the plants were found to be without fruits and flowers, then old records and interview based data was collected from local elderly people about the immature status of these plants (in the non flowering season). Some plants in few localities were recorded as mature as informed by the locals, while they were not originally seen in flowering condition (Alam and Ali, 2009).

9. Herbarium material of *Nannorrhops ritchiana* and their associated species were collected, pressed, poisoned and mounted in each case. The photographs of the species and surrounding area were also taken including habitat, habit and phenology.

These specimens are kept at department of Environmental Sciences IIU Islamabad and will be deposited in the herbarium of Pakistan Islamabad.

10. The herbarium material collected from the field during survey and was pressed in 1.2 x2 feet plant presser for 5-6 days in blotting and newspaper. Subsequently poisoned in a saturated mercuric chloride and ethanol solution. Then dried and pasted on standard herbarium sheets by using glue mixed with $CuSo_4$ finally to be deposited in herbarium in the form of a voucher specimen was appropriately identified with the aid of the Flora of Pakistan (Nasir and Ali, 1970-1989) and already existing valid specimens, deposited at Quaid-i-Azam University Islamabad. The data was finally examined keeping in mind the IUCN Red List Criteria & Categories (IUCN., 2001)

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Habitat and the Altitudinal Range

Nannorrhops ritchiana was recorded in Khurri Banda, Mummi Khel, Drangi Banda, Garhai Khula (Teri), Kundi, Aman Kot, Bergaya, Mardan Khel and Gurguri with altitudinal ranges from 576 meter in Drangi Banda to 909 meter in Gurguri. It was also observed that *Nannorrhops ritchiana* was found only in the plain area and not on north or south facing slopes. These localities represented *Saccharum munja, Saccharum arundinaceum* and *Adathoda vesica* as dominant species. Twenty one plants species were found associated in the localities (during winter and end of winter season i.e. December to February), representing 14 families (Table 2). Out of these, 8 species (38.09%) were trees, followed by 8 (38.09%) shrubs, 5 (23.80%) herbs (Table 3). With reference to Raunkiaer,s classification, Phanerophytes were observed to be the dominant fraction having 13 species (61.09%), followed by Hemicryptophytes having 4 species (19.04%), while Chaemophytes possessed 4 species (19.04%) (Table 4). Similarly (Alam and Ali, 2010) recorded habitat and altitudinal range for *Androsace russellii* using the same technique. (Abbas *et al.*, 2010) also worked on the habit, habitat and associated species of *Cadaba hetrotricha* in Pakistan.

Table 2: Plants species found in localities of *Nannorrhops ritchiana* along with their family, life form and habit

S. No	Family	Botanical name	Habit	Life form
1	Mimosaceae	*Acacia nilotica* (L) Delile	Tree	Phanerophyte
2	Mimosaceae	*Acacia modesta* Wall	Tree	Phanerophyte
3	Oleaceae	*Olea ferruginea Royle*	Tree	Phanerophyte
4	Poaceae	*Saccharum munja Roxb*	Herb	Hemicryptophyte
5	Poaceae	*Saccharum spontaneum L*	Herb	Hemicryptophyte
6	Salvadoraceae	*Salvadora oloeides* Dcne.	Tree	Phanerophyte
7	Acanthaceae	*Adathoda vesica*	Shrub	Phanerophyte
8	Sapotaceae	*Monotheca buxifolia* (Falc) Dcne.ex Engler	Tree	Phanerophyte
9	Papilionaceae	*Crotolaria burhia* Buch-Ham.	Shrub	Chaemophyte
10	Solanaceae	*Withania coagulans* Dunal	Shrub	Chaemophyte
11	Solanaceae	*Withania somnifera* (L) Dunal.	Shrub	Chaemophyte
12	Rhamnaceae	*Zizyphus mauritiana Lam*	Tree	Phanerophyte
13	Rhamnaceae	*Zizyphus nummularia* (Burm.f.)Wt. & Arn.	Tree	Phanerophyte

14	Solanaceae	*Solanum surattense* Brum.f.	Herb	Chaemophyte
15	Zygophyllaceae	*Peganum hermala* L.	Herb	Hemicryptophyte
16	Lamiaceae	*Salvia moorcraftiana* Wall.ex Benth.	Herb	Hemicryptophyte
17	Papilionaceae	*Alhagi maurorum* Medic.	Shrub	Phanerophyte
18	Asclepediaceae	*Periploca aphylla* Decne.	Shrub	Phanerophyte
19	Palmaceae	*Phoenix dactylifera L.*	Tree	Phanerophyte
20	Apocyanaceae	*Rhazya stricta* Decne.	Shrub	Phanerophyte
21	Cactaceae	*Opuntia dillenii* (Ker Gawl) Haw	Shrub	Phanerophyte

4.2 Population Size

The species population size was 734 observed in 2011 (Table 5). Maximum number of mature plants were (386) observed in Azad Banda followed by Mummi Khel (259) and Kundi (89), while rest of localities did not represent the species population. (Abbas *et al.*, 2010) also recorded mature population of *Cadaba hetrotricha*. They recorded 260 mature plants in 2005, 257 in 2006, 254 in 2007 and 251 in 2008 and finally defined the status of the plant as "Critically Endangered". While in our case the study was conducted on two years data i.e. 2010 and 2011, during which the populations were observed both during flowering as well as fruiting seasons, based on area of occupancy, extent of occurrence, continuous decrease in

Population and Population size. Based on our findings although, certain parameters were leading towards the status of "Critically Endangered" for *Nannorrhops* in the study area but considering the collective data for the species and based on relatively short duration of the study this is declared as "Endangered" species. Similarly (Alam and Ali, 2010) while working on the population size of *Androsace russellii,* observed 3 mature plants in 2005, 63 in 2006, 65 in 2007 and 65 in 2008 and declared the species as "Critically Endangered". In our Study area out of 10 localities only three had the mature plants while no mature plant was found in other seven localities. The mature plants in these localities are due to sacred shrine of Salangir Faqeer and Shahadin Neekuh. The plants in these areas are not exploited due to these sacred shrines, so they have attained tree form. In other localities no trees were found due to their exploitation (Gibbons and Spanner, 1995). These trees were present at an altitude between 614 to 802 meter only. (Alam and Ali, 2010) during a study regarding the conservation status of *Cadaba hetrotricha* observed that it has a limited habitat range and can grow between an altitude range of 2700 m to 3800m while in case of our *Nannorrhops* the altitudinal range is narrower compared to *Cadaba hetrotricha.*

Table 3: Proportion of habits in the plants found in *Nannorrhops* locality/Karak

S.NO.	Habit	Observed Species	% in the total
1	Herbs	5	23.80
2	Shrubs	8	38.09
3	Trees	8	38.09

Table 4: Percentage of life forms of the plants species found in *Nannorrhops* locality/Karak

S.NO.	Life form	Number of species	% in the total species
1	Phanerophytes	13	61.90
2	Hemicryptophytes	4	19.04
3	Chaemophytes	4	19.04

Table 5: Population size in different localities

S.No.	Locality	Maximum Altitude (m)	Mature Plants (2011)
1	Khurri Banda	608	Nil
2	Mummi Khel	642	259
3	Azad Banda	614	386
4	Kundi	802	89
5	Drangi	576	Nil
6	Garhai Khula	726	Nil
7	Aman Kot	816	Nil
8	Bergaya	644	Nil
9	Mardan Khel	703	Nil
10	Gurguri	909	Nil
		Total mature plants	**734**

4.3 Population Distribution

Nannorrhops ritchiana was reported from Khurri Banda, Mummi Khel, Azad Banda, Kundi, Drangi Banda, Garhai Khula, Aman Kot, Bergaya, Mardan Khel and Gurguri (Fig.3). This species was also reported from Ruk Marandi and Bund Ba Charagh by the locals, however not recorded by the present study from the afore-mentioned localities. This species was only recorded from Banda Daud Shah Sub division of District Karak, confined to plain areas covering an area of 208 km^2 (Table 6; Fig. 2), while the area of occupancy is 68 km^2 (Table 6). These localities are located at a distance of about 35 km away from each other as they were observed during the study. The species has also vanished from college area in Khurri Banda.

(Abbas *et al.,* 2010) estimated that *Cadaba hetrotricha* occupies an area of 76.96 km^2 in the coastal area of Karachi. Similarly (Alam and Ali, 2010) recorded the distribution of *Androsace russellii* in Gilgit District. The area of occupancy and extent of occurrence were also analyzed. They further stated that this species was found in 3 localities which are at a distance of 20 km away from each other. (Ali and Qaiser, 2010) recorded the distribution of *Astragalis gahiratensis* in Chitral. They observed that *A. gahiratensis* was distributed only in 3 localities of Chitral region, and its extent of occurrence and area of occupancy was also analyzed (extent of occurrence, 140.60 km^2 and area of occupancy, 16 km^2). Using IUCN Red List categories and criteria it has been placed under the "Critically Endangered" category.

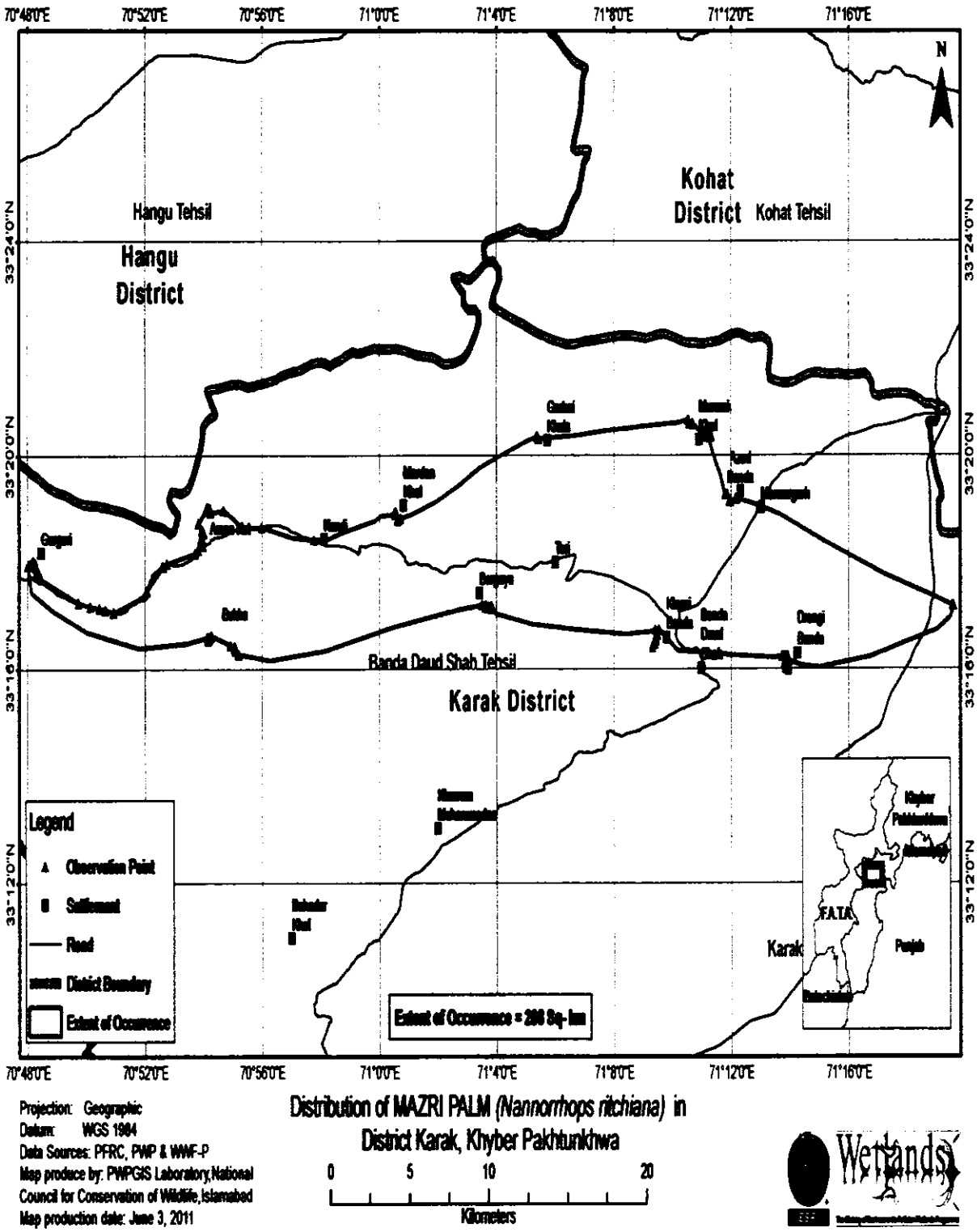

Fig. 2: Map showing Extent of Occurrence of *N. ritchiana* in District Karak

4.4 Life Form

Nannorrhops ritchiana is a Phanerophyte in accordance with Raunkiaer classification system, usually leaves emerging directly from ground but the plants attaining tree form usually have a stout base/stem with spreading leaves. (Alam and Ali, 2010) observed the life form of *Androsace russellii* as a Hemicryptophyte and also of its associated species. (Ali and Qaiser, 2010) also studied the life form of *Astragalus gahiratensis* and its associated species. They mentioned *A. gahiratensis* as a Hemicryptophyte following the Raunkiaer system. Apart from that (Ali and Qaiser, 2010) also assigned the life form to *Gaillonia chatralensis* as Phanerophyte (Raunkiaer, 1934).

N. ritchiana an evergreen plant, giving flowers from July to November. It is usually a medium to large sized shrub that attains tree form if not disturbed for around 15 years or so. But tree form is attained very rarely due to its over-exploitation in the study area. In whole of the District Karak, the tree form was observed only at three places i.e. Mummi Khel, Kundi and Azad Banda and the only reason common for the protected status of the plant is the presence of holy shrines at and near these spots. (The sacred tombs located in these villages are Salangir Faqeer and Shahadin Neekuh). People do not use any part of these plants due to their old believes that no vegetation or animal or any other type of life can be distressed near such tomb or a shrine.

4.5 Types of Reproduction

Both types of reproduction are present in *Nannorrhops* i.e., asexual and sexual reproduction. Similarly (Alam and Ali, 2010) reported both modes of reproduction in *Androsace russellii* in Gilgit Baltistan region of Pakistan. But in study area mostly

asexual reproduction was observed to propagate the plant population while seeds stage is not usually attained by *Nannorrhops* due to its exploitation, if attained there is little evidence of propping up of a new colony based on seed dispersal in the area.

4.5.1 Sexual Reproduction

The flowers are usually produced in large, open groups. These groups are reportedly up to 3 m elongated on the stems top (Ali and Qaiser, 1986) but in our study area for all populations we observed these elongated groups of flowers are only one to 1.5 meters in length. The female and male flowers are produced on separate plants i.e. dioecious. The fruit is a drupe usually brown in color. The growth of the plant is continued from basal sprouts while the individual stems are monocarpic, dying back to the ground after flowering. This palm is one of the hardiest ones that can tolerate as low as −12 °C. Generally the palms are known to be adapted to the higher temperatures but there are quite a few palm species known to tolerate very low temperatures and *Rhapidophyllum hystrix* is also one of such palms that can tolerate as low as -24°C to -26° C.

For its good growth *N. ritchiana* needs very hot summers. Fresh seeds usually required three to four months for its germination at 25 °C.

Table 6: Summary of the observed geographic range

Extent of Occurrence in square km	Area of Occupancy in square km
208	68

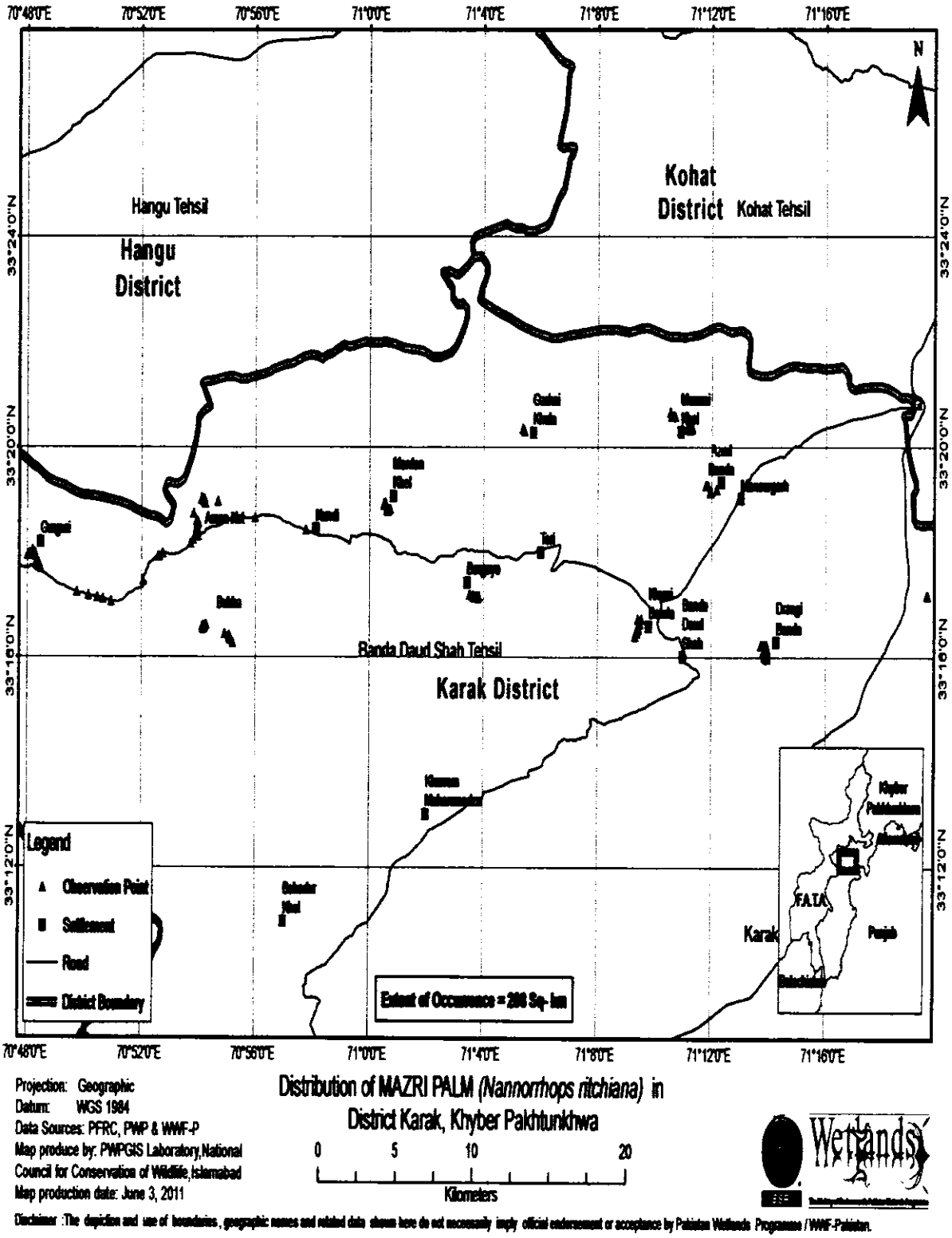

Fig. 3: Distribution Map of *N. ritchiana* in District Karak

4.5.2 Vegetative Reproduction

In *Nannorrhops ritchiana* new individual plants are produced from the underground rhizome as root stock. (Alam and Ali, 2010) observed vegetative reproduction in *Androsace russellii*. The main method of propagation in *Nannorrhops* is vegetative mode due to which the *Nannorrhops* is still present in their habitat; otherwise it would have perished because there is no natural recruitment from seeds.

4.6 Anthropogenic Impacts

Nannorrhops ritchiana is the species which is mostly affected by anthropogenic activities.(Sheikh *et al.*, 2002) recorded the influence of anthropogenic activities like uprooting of plants, extensive grazing and soil slope erosion to be the cause of biodiversity loss in Naltar valley, Northwestern Karakorum Pakistan.

This plant is over exploited by man for making different domestic products. Over-exploitation is the major threat to Mazri palm that hinders its natural regeneration. Due to ruthless exploitation it declined at an alarming rate from many of its former strongholds. Uprooting of whole Mazri clump through mechanical way has led to its unsustainable use. As a result, large tracts of Mazri palm have been cleared.(Ahmed *et al.*, 2005) consider anthropogenic activities to be the root cause of biodiversity loss in coastal areas of Pakistan. (Alam and Ali, 2010) and (Abbas *et al.*, 2010) also noticed the anthropogenic impacts on *Androsace* and *Cadaba* respectively. Use of Mazri leaves as a fuel, for thatching huts and making ropes is also threat to its disappearance (Latif and Shinwari, 2005) (Fig 8). Land use for agriculture purposes is

Fig. 4: Branched trunk of *Nannorrhops*

Fig. 5: Clumped growth of *Nannorrhops*

Fig. 6: Burnt trunk of *Nannorrhops* plant

Fig. 7: Young seedling and leaves of *Nannorrhops*

Fig. 8: Different Products made from *Nannorrhops* leaves after processing

Fig. 9: Young *Nannorrhops* plants affected by gas pipelines and exploration activities

Fig.10: *Nannorrhops* protected community at holy site of Tomb of"Salangir Faqeer" Kundi

Fig.11: Exposed rhizomes of *Nannorrhops* due to soil erosion

Fig. 12: *Nannorrhops* growing on a dry slope

Fig. 13: Establish *Nannorrhops* community

another major threat posed by this plant. Population explosion and construction of houses for living is also another threat. *Saccharum munja* is burnt by locals for better growth; therefore, the *Nannorrhops ritchiana* in their vicinity is also burnt during such activities. Aerial firing, firearm show off and display at various occasions and the wild bores concealed in bushes having some *Nannorrhops* are commonly burnt by locals (Fig 6). Similarly at waste places, shrines and other such areas the gathering of people who use the narcotics and smoke, throw away burning cigarettes frequently cause a serious fire which is also one of the causes of its deterioration.

4.7 Soil Erosion and Destruction of Habitat

The territory of *Nannorrhops ritchiana* has gypsum in some localities, fit for the cement industries which is being dig up and carried with aid of heavy machinery and dozers. Apart from digging activities the area is enriched in natural gas, oils

which is explored by MOL Company. The exploration activities of MOL have devastated the situation (Fig 9). During exploration the *Nannorrhops ritchiana* is uprooted. Soil erosion is another threat in the habitat during rainy season. *Nannorrhops ritchiana* develops extremely well on the plain area as compared to slopes. (Sheikh *et al.*, 2002) also recorded the impact of soil slope erosion on the loss of biodiversity in Naltar valley, Northwestern Karakorum Pakistan. Similar types of threats exist for *Nannorrhops* in our study area.

Abbas *et al.* (2010) noticed soil erosion and destruction of habitat as a factor for the loss of *Cadaba* from their study area. Similarly (Ali and Qaiser, 2010) also consider soil erosion to be a factor in the decrease of population of *Gaillonia chitralensis* in Chitral. (Haq, 2011) also recorded the impacts of soil erosion on the loss of biodiversity in Nandiar Khuwar catchment District Battagram, Pakistan.

4.8 Fuel Purposes

Leaves of *Nannorrhops* are also used for fuel purposes to some extent. But now due to discovery and supply of natural gas to the near villages will have positive effects on its conservation. (Abbas *et al.*, 2010) noticed that *Cadaba* is used for fuel purposes. (Abbas and Qaiser, 2011) also recorded that *Convolvulus scindicus* is used for fuel purpose.

4.9 Grazing Impacts

Nannorrhops ritchiana is less affected by grazing. Very few plants were found to be grazed, although livestock are in enormous number. But other plants of the area are severely affected so it paved the way for soil erosion and the population of *Nannorrhops* is also affected due to soil erosion. (Shah, 2007) recorded the impacts of over grazing on the flora of Siran valley Mansehra, Pakistan. (Abbas *et al.*, 2010)

noticed the grazing impacts on the health of *Cadaba*. (Haq, 2011) also observed that grazing is a prime factor in the loss of biodiversity in Nandiar Khuwar catchment District Battagram, Pakistan.

4.11 General Discussion

The particular features of limitation and loneliness render the *Nannorrhops* to suffer from extinction, particularly in the age of fast habitat degradation or loss (Sala *et al.*, 2000; Heywood & Watson, 1995; Myers, 1988). *Nannorrhops ritchiana* is generally present in hilly areas. This study reveals that the habitat of *Nannorrhops* is in conformity with the previous workers which have also recorded the species from same localities from other parts of the world. Thus, it is implied that *Nannorrhops ritchiana* is specific to habitat and restricted to a narrow range of distribution. The major threat to plant extinction in the whole world is disturbance of species habitat and its fragmentation (Barbosa & Marquet, 2002; Sala *et al.*, 2000). Exploration of oil and gas on a large scale by oil and gas companies is the main reason of destruction and disturbance in the locality of *Nannorrhops ritchiana*. Gully erosion during rains is also a cause of disturbance of species habitat (Abbas *et al.*, 2010). Those plants of *Nannorrhops ritchiana* that grows in plain areas are easily victimized by soil erosion as compared to those plants that are present on cliff and slopes of rocks. There is decrease in the distribution of *Nannorrhops*. It has been completely perished from several places like Bund ba Charagh and Ruk Marandi. It has also been uprooted from college areas in Banda Daud Shah for the construction of college building.

Grazing is also one of the factors that negatively impact the population of plants. The grazing impacts may be severe which depletes plant resources and cause soil erosion or it may be undetectable (Pieper; 1994).The impact of Grazing was nominal

for *Nannorrhops* in the habitat but other species were prominently devasted. Intensifying and uncontrolled grazing have a long lasting and profound effect on the vegetation of locality and it is devastating for the local flora wealth which is already under pressure.

The species is over-exploited for making various domestic products by the local communities is an intricate dilemma and a main reason of extinction of plant (Engler, 2008; Hirway & Goswami, 2007). Keeping in mind the use of plant species in unsustainable way, no precise information has been issued (Davis *et al.*, 1995). No doubts its consequences are dangerous. In addition to that *Nannorrhops* face another danger which is cutting for fuel purposes, because the local people have no approach to the natural gas for sustaining their livelihood. Cutting for fuel purpose is also common in the habitat of *Nannorrhops* thus badly affecting its population. But now due to the local discovery of gas and its supply to the nearby villages will have far reaching effects on the conservation of this plant.

Those species which are constantly rare in their distribution and cover a large geographical area are more susceptible from extinction point of view and need abrupt attention (Rabinowitz; 1981). *Nannorrhops* is recorded from a large distribution area expanding from Pakistan to Afghanistan, Iran and Arabian Peninsula. Yet it is considered rare species by the previous workers. There are many places in Pakistan recorded as supporting populations of *Nannorrhops ritchiana* in publications by Beccari, Blatter, and by Griffith, (1926). But now most of the areas have been deprived of *Nannorrhops ritchiana* population and days are not far away when there will be no plants of *Nannorrhops* in these areas as they are ruthlessly exploited for ropes and basket (Gibbons and Spanner, 1995). As far as our observations are

concerned, *Nannorrhops ritchiana* needs a particular locality. According to Rabinowitz (1981) it is a rare taxon because it has very narrow distribution, specific habitat and narrow geographic range.

Population size is also important and it is affected by unfavorable season during the growing period. Due to this the plant will not be able to produce viable seeds so that they can regenerate (Baggs & Maschinski; 2000). Dry period is not a problem for *Nannorrhops* but there is no natural recruitment in *Nannorrhops ritchiana* as they do not reach to that stage to give seeds and fruit, because they are exploited by the locals before they reach the stage where they can give fruits and seeds. Mature plants were recorded from few places and these were due to sacred and pious personalities buried there. But the fruits produced by these plants are eaten unripe so there is no chance of regeneration from seeds. The conclusion is that population size is decreasing at an alarming rate and there is no recruitment naturally. Due to small population sizes many threatened plant species are disposed to threat (Kruckeberg & Rabinowitz, 1985; Rabinowitz, 1981). In addition to that the *Nannorrhops ritchiana* has very fragmented population. The taxon is restricted to specific habitat. The number of mature individuals of a taxon determined the conservation status of a species (Anon., 2001). The present study was based, using the IUCN red list criteria and categories (Anon., 2001).According to this Red List categories and criteria if a population size is less than 2500 mature individuals and there is permanent decline along with no sub-population making the taxon to be placed in endangered category. *Nannorrhops ritchiana* having population size of 734 is placed under endangered category and is under threat of extermination. These judgments recommend that small population size and permanent decrease in population size is vital for its continued existence.

An additional factor of great importance which should be considered for plant populations is the strategy of vegetative reproduction. Not unusually, in their worth of open body, plants show an inclination towards this option, even when a sexual mode of reproduction still takes place (Rutishauser, 1982). This mechanism might increase the production of new individuals, or may even keep population number sufficient to make sure survival when sexual reproduction does not occur (Vischi *et al.*, 2004).

The geographic range and number of localities/sub-populations also provide a basis for Conservation status of a taxon (Anon., 2001). It has been clearly mentioned in the IUCN categories and criteria that if a taxon has extent of occurrence less than 500 square kilometer with severely fragmented localities or one locality should be regarded as Endangered (EN) keeping in mind the other parameters. The extent of occurrence is 208 km^2 in case of *Nannorrhops ritchiana*. Based on the number of localities it is reported from 10 localities. From the point of view of severely fragmented population and small geographic range *Nannorrhops ritchiana* is put under endangered category in District Karak. These results are in accordance with the IUCN criteria and propose that the limited range of distribution of the concerned species in fragmented population is crucial for its continued existence. Based on manifold threats i.e., specific habitat, habitat loss, restricted range of distribution, over utilization and small population size along with slight natural recruitment, the present study suggest that *Nannorrhops ritchiana* is extremely vulnerable to extermination and entitled to be put under endangered category.

Conservation Status

As the Extent of Occurrence (EOO) of the taxon is 208 km^2 (i.e. less than 5000km^2) and Area of Occupancy (AOO) is only 68 km^2 (i.e. less than 500 km^2) therefore, according to the IUCN Red List Categories and Criteria (Anon., 2001), it should be placed under the "Endangered Category" whereas, its population size is 734 mature individual plants, which shows a fragmented distribution i.e. distributed in 10 small localities. Furthermore, there was a continuing decline in number of mature individual plants and also extreme fluctuation in the AOO was observed during the field study (Fig.2, Table.6) along with the extreme fluctuation in number of mature individual plants. These results of low population size with continuing decline and extreme fluctuation collectively suggest the category of Endangered. Hence, based on the values of population size this taxon is placed under the "Endangered Category". The Hierarchical Alpha Numeric Numbering System is as follows:

EN B 1 a c (i) (ii) (iii) 2 a c (i) (ii) (iii) C

Where:

EN = Endangered

B = Geographic range in the form of:

1 = Extent of occurrence estimated to be less than 5000 km2

a = severely fragmented

c = extreme fluctuation in:

(i) = extent of occurrence

(ii) = area of occupancy

(iii) = number of locations or subpopulations

2 = area of occupancy estimated to be less than 500 km2

a = severely fragmented

c = extreme fluctuation in:

(i) = extent of occurrence

(ii) = area of occupancy

(iii) = number of locations or subpopulations

C = Population size estimated to be fewer than 2500 mature individuals

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Many of the national and global information sources show significant and still increasing loss of biodiversity. Biodiversity loss leads to a reduction in biomass and ecological processes. Such biodiversity losses are predicted from biogeographic theory. However, the number of species under threat of extinction is high, thus, leading to further reduction in populations above critical viability levels. It is difficult to quantify rates, and to quantify the significance of these losses. Constantly increasing human populations with greater consumption, habitat loss, pollution, invasive species means that we have to expect further loss of biodiversity.

Nannorrhops is also one of such species that is harvested ruthlessly and its population is decreasing alarmingly in District Karak. The major threat to *Nannorrhops* is its over-exploitation based on poverty and due to lack of awareness regarding sustainable use of resources. The results obtained from the study area i.e. population size (734 mature plants), extent of occurrence (208 km^2), area of occupancy (68 km^2), and decrease in population shows a discouraging picture and suggests this species to be placed in "Endangered Category".

5.2 Recommendations

The following steps should be taken to promote conservation and sustainable use of Mazri Palm:

- Determining current status of Mazri and its ecological values for dry land ecosystems;
- Promoting sustainable use of this economic plant based on scientific management and sustainable use plans;
- Raising community-based nurseries at various locations in Mazri growing areas for rehabilitation of its depleted populations;
- Introduction of Mazri Palm as a crop on marginal lands;
- Strengthening Mazri cottage industry through establishing proper marketing channels;
- Promoting public-private partnerships for conservation of Mazri to support local livelihood;
- Conducting field research studies for improving its propagation and harvesting techniques;
- Enhancing capacities of local people for better processing of Mazri leaves, manufacturing and marketing its products;
- Enhancing skills of local communities to make value added Mazri products.
- Its conservation status may be assessed in other areas of Pakistan.
- Involvement of local people as stakeholders is a major step forward. Conservation at both field and at policy levels will require further investment of financial and political capital.

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Annexure

Questionnaire for conservation survey

Date--------

Name of plant collector---------- Age---------

Gender---------- Education------ Locality----

Information pertinent to flora conservation status:

Local name of plant collected---------- Collection Time----

Part collected---------- Collection Method-----

Uses of plant----------

Present Availability Status--------

Availability status over the past 10 years: Persistent /Increased /Decreased----------

If decreased then how much------

Why the plant population decreased--------

Reasons----------

Present Locality of Availability--------

Any conservation efforts by the community---------
