



RESEARCH PAPER

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Understanding the effect of storm as a sign of climate change on the Juniper forest of Ziarat, Balochistan, Pakistan

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Abstract

This investigation was carried out on *Juniperus excelsa*. *Juniperus excelsa* is the dominant species in Juniper forest of Balochistan, Pakistan. Juniper trees are known to be the living fossils because of its long rotation age. The average forest age is between 1500 to 2500 years. The study aim is to highlight the threats of climate change to the Juniper forest. The studies were conducted at four ranges of Ziarat forest which is having sparse vegetation with open canopy. A strong wind was blown on 23-24 of February 2015 which had severely damaged the Juniper forest of Ziarat. The area was traversed and the damaged areas coordinates were taken through GPS. The damaged (Full or partial) trees volume was calculated through Huber's formula of volume. The results showed that prior to open canopy vegetation nearly 132 trees were damaged in the four ranges of Juniper forest at Ziarat district. Out of these 132 trees nearly 32 trees were completely uprooted. Along with trees damage four houses roofs were damaged and blown away by the storm. Through Buford scale of wind it was found that the wind velocity is around 89-102 kph; which has damaged the Juniper trees from north to south aspect. It is concluded that such high velocity wind has never been witnessed within the area of Juniper forest in the past. High intensity wind was observed throughout but foremost damage was caused to Juniper forest at main Ziarat city and Manna areas.

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Introduction

Juniper trees are known to be the living fossils because of its outsized life cycle (Khattak, 1963). The tree with 1.5 m of diameter suggests that it is having more than 2500 years of age (Roberts, 1986). Rafi (1965) explains that these forests are located in dry temperate zone. Different dimensions of *J. excelsa* were highlighted by (Sarangzai *et al.*, 2012). The anatomy and physiology of Juniper trees are explained by (Ahmed *et al.*, 2010). Different environmental factors have its marks on Juniper forest of Ziarat such as wind, temperature and precipitation. Diverse agents affect the forests and are the indicators of climate change. Climatic condition and its variability are unpredicted but with passage of time (decade or more) these variations and climatic properties can be recognised and calculated (Shakoore *et al.*, 2011). In Europe wind is the main source of forest disturbance (Schelhaas *et al.*, 2003). Since 1950 the intensity of wind has increased which resulted in the change of forest management as to counter the possible climate change (Fischer *et al.*, 2013). The same scenario that is increase in the intensity of wind is predicted to continue in future (Christensen *et al.*, 2007; Blennow *et al.*, 2010; Seidl *et al.*, 2014). Wind is an important agent of climate change and need professional approach as to study the impact of wind on coniferous woodland (Cullen, 2002). Disastrous strong winds are enumerated and detected for ages. The impact has not been intensively studied. The intensive studies are required for the knowledge of wind effect and prerequisite for the management of ecosystem. The understanding is necessary because improved understandings of these impacts are required for conservation of ecosystem (Dunn *et al.*, 1983).

Mechanical injuries, especially to trees trunk is the forceful movement caused by the strong wind (James *et al.*, 2006). (Duryea *et al.*, 2007) suggest that the surveys after the strong wind is the main source which highlight the damages caused to forest area. While (Tainter and Baker, 1996) are with the view that predated damages from stem rot and insect pest

to the bole of the trees needs to be individually studied before gauging the damage caused by the strong wind. Through the relation between Abiotic and Biotic factors the intensity of wind damage can be determined (Everham and Brokaw, 1996). Terrain, soil structure and texture are the main abiotic features manipulating wind damage. While close canopy, trees height, trunk size and types of forest trees are the main biotic features (Peterson, 2000). Higher the trees mass the damage due to wind will be on higher scale (Webb, 1999). Though Plants have to change physically, chemically and morphologically as to survive under high intensity of windy climates (Gardiner *et al.*, 2016). The change in climatic conditions and development of forest trees are changing with passage of time which make the task of climate change much more problematical (Peltola *et al.*, 2010).

The main aim of this study is to highlight the different threats to Juniper forest especially the impact of climatic change. Balochistan as province of Pakistan has been blessed with the subsequent major woodland of Juniper trees on the surface of the globe which have vital place because of its unique and fragile ecosystem. Juniper forest of Ziarat has been announced as Man and Biosphere Reserve (UNESCO, 2013). Juniper forest is now facing both anthropogenic and climatic threats. The climate change has been witnessed in the form of high winds, drought and also change in temperature. This forest is known to be the living fossils and due to its long rotational age it could not be renewable resource. It is very much important to protect this forest and to know the impacts of different agents in its degradation. The current study is also an effort as to highlight the threat of climate change in the form of strong wind damage.

Material and methods

A survey was conducted by Forest and Wildlife Department in the month of February and March, 2015 for the damage caused to the Juniper forest of Ziarat. The storm was perceived in the different locations of Juniper forest.

The good patches of Juniper trees are found in the main city of Ziarat and its surroundings. A wild wind was observed on 23- 24 of February 2015; reported by the local residents of Ziarat. The storm wind has caused damages throughout the area of main city of Ziarat. For the damage analysis four groups were formulated as to gauge the intensity of damage caused by the wild wind to the Juniper trees. These four groups were headed by Divisional Forest Officers as group leaders and were accompanied by the government staff especially forest guards of the specified beat of Juniper forest. The data was collected in following steps. The data was collected on a survey form.

Sub-division of the area

The area was divided into four parts on basis of ranges of Juniper forest, which was traversed by each group. The four Ranges i.e. Ziarat Range, Chowtair Range, Spara Ragma Range and Kuch Range of Ziarat district were traversed intensively as to find the damage caused to the Juniper trees. The four Ranges of forest area were traversed and 132 trees were having damage from the wild wind.

Coordinates

The coordinates of damaged area were taken through GPS.

Log length and diameter

The logs length and girth were taken of each damage tree through normal measuring tape. The diameter of the log was calculated by dividing the girth with the π . (Araujo *et al.*, 1999).

Computation of volume

From log length and diameter the volume of damaged trees were calculated through Huber’s formula of volume (Huber’s Cu Volume = (B1/2)*L) (Husch *et al.*, 1972; Velazquez, 2012).

Results and discussion

The four Ranges of Juniper forest of Ziarat were traversed thoroughly as to find the damage caused by the wild wind which was blown on 23-24th of February 2015. The area was mainly divided into four Ranges. The Kuch Range comprising pilla and saroo areas; which were traversed and it was perceived that vegetation was having low height trees.

Table 1. Showing the damage (cft) occurred during 23-24th February, 2015 in respect of Juniper Forest, Ziarat. The most damage is done to Khendisar and Prospect point, while lower level damage was perceived in the rest of areas.

Coordinates		SITE	Volume (CFT)
Latitude	Longitude		
30°23'15.23"N	67°43'49.98"E	Chotra	005.98
30°23'21.34"N	67°43'24.71"E	ChotraWazaSar	326.79
30°24'17.19"N	67°44'4.39"E	SandamenTangi	067.51
30°23'32.27"N	67°44'43.50"E	Khan Wazha	106.33
30°23'7.95"N	67°45'50.21"E	WachaGhuski	129.41
30°22'20.60"N	67°46'12.83"E	GudiTangi	089.13
30°22'35.54"N	67°44'10.77"E	KhendiSar	750.54
30°23'11.13"N	67°47'47.15"E	Khotal Sari	159.80
30°22'15.08"N	67°43'12.63"E	Juniper Hotel area	089.79
30°21'18.96"N	67°44'28.59"E	Prospect Point	376.58
30°22'16.02"N	67°43'46.15"E	GudaChashma	029.76
30°20'34.13"N	67°44'36.69"E	Baba kherwari	030.19
30°20'20.73"N	67°45'21.68"E	Goshki	059.12
30°26'17.01"N	67°45'57.66"E	Manna Dame	468.38
30°23'46.77"N	67°46'47.34"E	Sakhobi	125.84
30°26'19.31"N	67°47'3.34"E	Norek Gut	099.01
30°24'23.14"N	67°48'26.80"E	KawasNeka Graveyard	37.36
		Total	2951.52 cft.

There was no damage in the area; the Juniper trees in Kuch Range were safe from the effect of wind. Separa Ragma Range was thoroughly traversed; the area of Zandara, Manna Garhard, Malkana, Larinakhur and Suri manna were visited. Afterward the area of Sasanamana was checked for wind damage. The area composed of Sasnamannasoori, Gabarg, Sasanak, Sumri gut sasnak, Arzani sang killi,

Sapoongarsasanak. There was no damage to the Juniper trees. The area of Manna dame including Norekshela, Masoorisasanamanna, Mulasaleemsakhobi and Kawasneka graveyard were visited and moderate scale damage was observed. Nearly 18 trees were damage by the wind in these areas. The Chowtair Range was investigated.



Fig. 1. Showing partial and complete damage caused by the storm to the Juniper trees at Khandisar Ziarat.

The area of Chowtair village, Batatair, Farooz Kochi tangi, Bazal, Kamarsharif, Kerbikase and Gurhan were inspected for damages. There was no damage at all in the area. Ziarat Range was traversed thoroughly. Chotra, Chotrawazha, Sademan Tangi, Khan wazha, Wachaghuski, Guditangi, Khandisar, prospect point, Baba kherwari, Goshki, Gudachashma and Sari kothal of Ziarat Range were visited. All these areas were somewhat effected. Prospect point (376.58cft) and Khendisar (750.54 cft) were the most affected areas with in the territory of Ziarat Range as shown in Table 1 and Fig. 2.

The intensity of felled trees was very much high in the area of Ziarat Range and nearly 114 trees were damaged by the wind.

The different areas visited were having Juniper trees in stress. In ChowtairRange the Juniper trees were

having the big mass as compare to the rest of Juniper forest. Kuch and Separa Ragma Ranges were having the small trees with impact from anthropogenic activities. In data collection different beat officers were inquired about the damage caused to the Juniper trees. Main city of Ziarat and its parallel areas were the hot spot of wind damages as shown in Fig. 2.

In damaged trees the stem rot could frequently be seen. In overall 32 number of trees were uprooted and nearly 100 trees were partially damaged throughout the Juniper forest of Ziarat by the wild wind.

The data had provided much of evidence which showed that it was a storm. The movement of storm was from South to North direction as shown in Fig 3. The storm has greater effect on Southern aspect because the aspect was open to the wind; which has leaved its mark on Juniper forest.

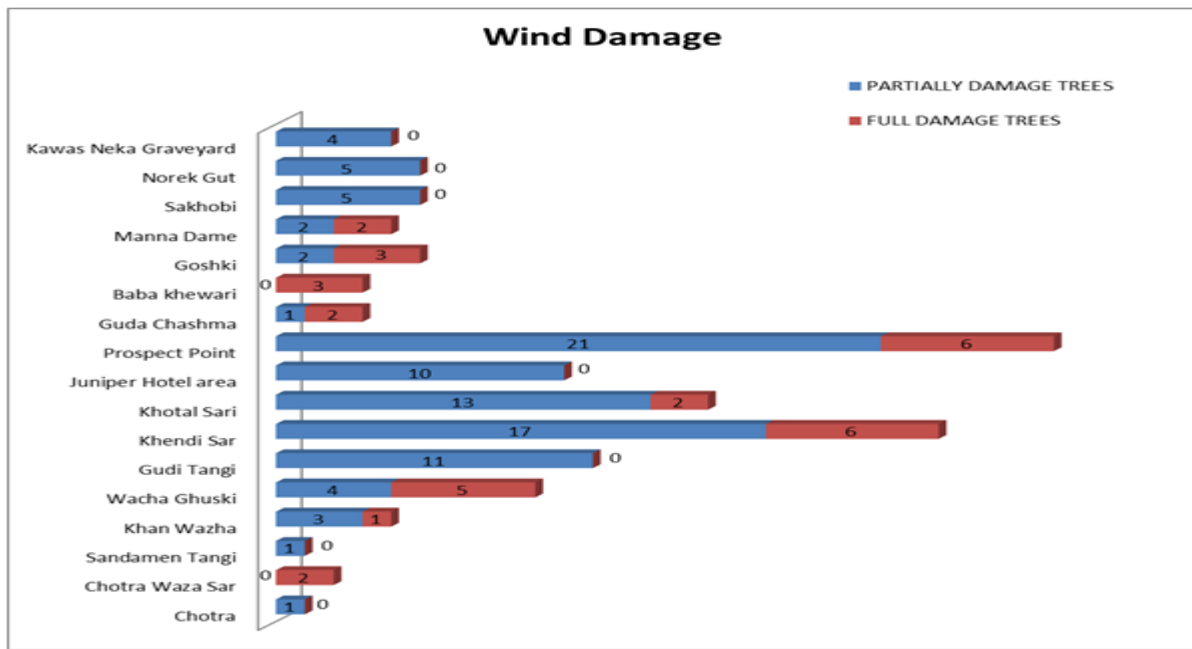


Fig. 2. Showing intensity of wind damage throughout the different areas of Juniper forest Ziarat.

Ziarat district derived its name from the Shrine of Baba Kherwari. Ziarat district is located at Latitude 30°22'52.13"N and Longitude 67°43'37.15"E. Ziarat is a picnic resort and many tourists visit the area in summer because of its Juniper forest and cool climate. Ziarat district is having good patches of Juniper forest which is known for its long rotation age. This forest tree attains 1.5 meters diameters in 2500 or more years. Ziarat is having the second largest Juniper forest of the world.

This forest is declining with the passage of each day. Woodland areas are very dynamic for the preservation and conservation of water, soil and biodiversity throughout the world (Siry, 2005). Both abiotic and biotic factors are playing its role in the limitation of Juniper forest boundaries (Sarangzai *et al.*, 2012). The environmental and anthropogenic factors are contributed in the degradation of Juniper forest and it is thought that this forest will vanish from the district in short period of time.

Different climatic factors contributes in an ecosystem such as temperature, precipitation, wind, water and soil. These are the major abiotic components of an ecosystem. Forest composition and characteristics are

expected to have an effect on the susceptibility of forest to storm damage (Nolet *et al.*, 2012). In current study the impact of wind damage to the Juniper forest is highlighted. In the area of Ziarat district we do not have high intensity winds.

The storm wind which is described in the study is the sign of climate change. Many scientists are also highlighting that these winds will be intensified in future (Dunn *et al.*, 1983). The wind is having great impact both on Juniper trees and the soil.

Steady winds are blown In Ziarat. These winds do not cause a lot of damages. The winds velocity is not alarming. In 2015 Ziarat district is having steady winds. The intensity of winds increases from January to June that is 12.4 kph to 27.68 kph. In month of June and July in which the temperature goes up the intensity of wind reaches to 27.68 kph. After June the intensity become lowered to 10.52 till December. A phenomenon of climate change is prevailing in the area of Ziarat Juniper forest. The storm was the case of climate change which was perceived on 23-24th of February 2015 and the local residents have also admitted that they had never witnessed such a strong wind through their live.

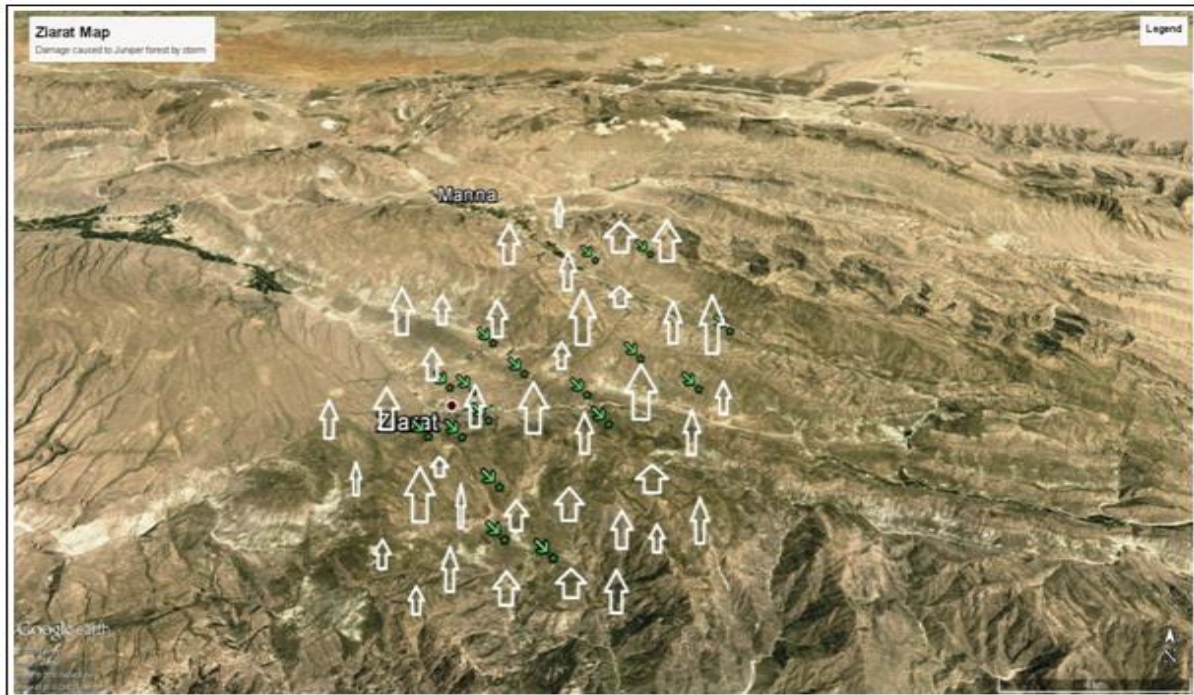


Fig. 3. Showing site location and direction (south to north) of the storm causing damage through the Juniper forest of Ziarat. Shows the location and shows the wind direction.

The data (Freemeteo, 2015) has also not shown the intensity of wind. According to Beaufort Wind Scales when we have uprooted and broken trees then it is a storm which has the velocity of 89-102 kph (Mather, 2005).

The impact of wind in future prospect of Juniper forest would be very negative. The wind may directly hit the trees within the area. These trees are having stem rot and it cannot tolerate high intensity of winds. Wind is having mechanical pressure on plants development that is its morphological and physiological (Niklas and Spatz, 2012).

The future impact of the stormy winds will be huge because of the stress exerted on the trees. Juniper is almost nonrenewable natural resource. Its minor damage cannot be recovered easily and we cannot afford any damage to this precious forest. In future prospect wind damage could be minimized if the management of forest is made flexible as to cope with the unpredicted climatic conditions (Olofsson and Blennow, 2005; Blennow and Olofsson, 2008).

Conclusion

High intensity wind was observed throughout the area of Ziarat district. The intensity of wind was very much high at main Ziarat city and Manna areas. The damage was carried in these two areas; while the rest of Juniper forest was safe and sound from wind damage.

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