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Four pyrophytic pteridophytes in the Chir pine forest of Kalidhar forest range in Shiwaliks of North West Himalaya in Indian Himalayan region.

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Abstract

Fire always plays a significant role in the secondary succession and maintenance of various communities or ecosystems on earth, like grass community, understorey community in a forest and on a large perspective forest ecosystem. Vascular cryptogams form an important group of plants that is recovered very rapidly after the fire events. This is perhaps due to their rhizomes lying below the ground surface, which are able to evade the fire stress. Current study deals with presence of four pyrophytic (fire–tolerant) pteridophytes in Kalidhar forest range at Jammu district.

Key Words: ***Vascular cryptogams; Pyrophytes; Kalidhar forest; Pteridophytes.***

Introduction

Forest fires are recognized as an important factor in establishing various plant communities on this planet. Fire events being an important cause for natural selection also act as one of the important agents in secondary succession. In other words, they affect each and every species involved in the process of colonization and are responsible for succession (Wright and Bailey, 1982; White, 1985; Scifres and Hamilton, 1993). Different aspects of fire like fire severity, magnitude, extent, span, frequency/recurrence and season of burning, are very crucial in determining effects of fire event on every species. In addition to these factors, species or community characteristics are also important in determining the effects of repeated forest fires on the existing species. Plant species respond to fires in two different ways, either they show resistance or they get burnt. Those species which are killed by fires are called as obligate seeders and those which resprout after fire event are called as sprouters (Keith, 1992; Benson and Mc Dougall, 1993, Whelan, 1995) (Fig 1). Pteridophytes as the earliest land plants are basically the vascular cryptogams. This group composes a significant forest flora of Himalaya by constituting dominant vegetation over there (Tryon, 1986 and Kreft *et al.,* 2010). They are the pioneers in pristine/untouched habitats because of their dispersable spores. Human use of ferns and their allies is almost negligible except circinated leaves of some ferns like *Diplazium esculentum* (Retz.) Sw. etc. The less or negligible use for mankind has restrained attention of researchers towards this group of plants. Fronds of *Cyathea spinulosa* Wall. Ex Hook. and many thelypteroid ferns are however used as fodder in central Himalaya, but, this is done at those regions where grasses are not available in sufficient quantity (Punetha *et al.,*2004).

Ecological role of ferns particularly in forest fire ecology is less understood and require extensive studies. In one of the studies, *Pteridium* sp. are resprouted to get recovered after heathland fires in Survey, UK. The species recovers within few weeks and new frond leaves of the species resprout from the below ground rhizomes and evade fire stress (Belcher *et al.,* 2013). In addition to it, spores of ferns also provide them an ability to disperse under environmental extremes and their dense root-networks in disturbed ecosystems play a great role in ecological restoration (Paul *et al.,* 2014). There are many important contributions regarding diversity of ferns in north-western Himalaya (Stewart, 1942, 1945, 1946; Bir, 1963; Dheer and Sheera, 1975; Hope, 1904; Gaur and Bhatt, 1994; Kapoor, 1985; Kiran, 2000; Singh *et al.,* 2002). However, this ecological role is not worked out from NW Himalaya. During the current investigation, an attempt is made to identify and document the pyrophytic ferns from Himalyan Chir

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pine forests where forest fire is a common and regular event altering the ecology of this fragile ecosystem.

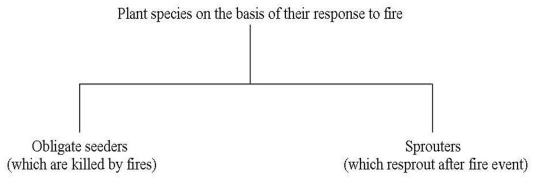

Fig 1. Classification of plants on the basis of their response to forest- fire

Fig 1.

Materials and Method

Study area:

Kalidhar forest geo-referenced between N33^{0}02′59.50″ E74^{0}45′04.46″ to N32^{0}58′28.21″ E74^{0}24′35.44″ with an altitudinal range of 304-1143 meters above mean msl, is a prominent range of Shiwaliks in Jammu and Kashmir, India. The range is a camp site for Gujjar and Bakarwal nomads during winter who migrate to higher altitudes above 1800 meters during summers. Kalidhar exhibits sub-tropical type of vegetation that includes *Pinus roxburghii* Sarg, *Mallotus philippensis* (Lam.) Muell. Arg., *Bauhinia variegata* (L.) Benth., *Phoenix sylvestris* (L.) Roxb. etc. Because of the dominance of *Pinus roxburghii* Sarg. forest fires in this range is a regular feature almost everywhere. The study area is under the direct influence of westerlies during and after the forest fire events.

Sampling:

An extensive survey was conducted to collect the species germinated in an area of 72 ha burnt during 2018. The collected specimens were processed and transformed to herbarium sheets. Pteridophytic species were identified using various keys published in regional and national floras (Jenkins, 2009 and Pande, 1973).

Results and Discussions

Forest fires regulate the vegetation composition at a very large extent, wherein herbaceous species with subterranean parts form the abundant group (Kazanis and Arianoutsou, 2004). As a result, some groups become dominants for example, members of Cistaceae in Mediterranean shrublands (De Luis *et al.,*2006). Diversity pattern after fires has revealed that area with medium fire events even possess maximum diversity (Jhariya *et al.,* 2012). More descriptive results indicated that low fire frequency encourage density of seedlings, but with increased fire frequencies, tree diversity decreases (Verma and Jayakumar, 2015). While working on pteridophytic species in madrean oak woodland in south-eastern Arizona, two species called as *Cheilanthes wootonii* Maxon and *Selaginella rupincola* Underw. have been reported as pyrophytic species after fire events. Their collected biomass has been considered alive because these plants, after drought conditions, have been reported to become dry and regenerate on arrival of rains (Caprio, 1994). Similarly, *Gleichenia dicarpa* has been found efficiently regenerated species in wet sclerophyll burnt forests (Collinson, 2002). *Blechnum cartilagineum* (Blechnaceae), *Pteridium esculentum* (Dennstaedtiaceae), *Todea barbara* (Osmundaceae), *Calochlaena dubia* (Dicksoniaceae) and *Pteridium esculentum* (Dennstaedtiaceae) are few more pteridophytic species in the list of rapidly resprouted species in burned areas of bushland in northern Sydney (Kubiak, 2009). *Gleichenia dicarpa* R. Br. has also helped in forming new habitats for the emergence of grass-dominated savanna and prairie ecosystems after forest fire (Belcher *et al.,* 2013). These ferns are therefore, able to tolerate disturbance caused by fire and also act as positive indicators of forest integrity, because they show typical plant responses to adverse urban-generated ecological conditions (Scott, 2010; Bergeron and Pellerin, 2013). Such type of studies is very scanty in Himalayan forest fire events. In this context, a preliminary investigation was carried out in an area of 72 ha Chir pine burnt forest in Kalidhar range in Jammu Shiwaliks, Jammu and Kashmir, India. In addition to the other plant species, following pyrophytic pteridophytes were collected after forest fire event in the study area:

***Pteris vittata* L.**

Scientific name: *Pteris vittata* L.

Synonyms: *Pteris costata* Bory, *P. diversifolia* Sw., *P.ensifolia* Poir., *P. inaequilateralis* Poir., *P.longifolia* Wall., *P. microdonata* Gaudin, *P.vittata fo. cristata* Ching in Ching &S.H. Wu, *Pycnodoria vittata* (L.) Small

Citation: Lansdown, R.V. 2013. *Pteris vittata*. The IUCN Red List of Threatened Species 2013: e.T177137A1468608.
http://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T177137A1468608.en

Disribution:

Range Description:

This species has a sub-cosmopolitan distribution, from Mediterranean South throughout sub-Saharan Africa south to the Cape and east through the Middle East, Russia and the Indian subcontinent to the far East and south throughSouth-east Asia to Australia. It has apparently been introduced to a number of Pacific Ocean island groups, New Zealand, North, Central and South America (Hassler and Schmidt, 2011).

Country occurrence:

Native: Afghanistan, Algeria, Angola, Antigua and Barbuda, Argentina, Australia, Bahamas, Barbados, Bonaire, Sint Eustatius and Saba, Botswana, Brazil, Cameroon, Cape Verde, China, Comoros, Curacao, Cyprus, Djibouti, Dominica, El Salvador, France, Georgia, Ghana, Greece, Grenada, Guam, Guadeloupe, Honduras, Hong-Kong, Hungary, India [Andhra Pradesh, Assam, Darjiling, Goa, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerela, Madhya Pradesh , Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Sikkim, Tamilnadu, Tripura; recently, it has been reported from Rajouri also (Shagufta *et al.,* 2014)], Indonesia, Israel, Italy, Japan, Kenya, Lebanon, Lesotho, Libya, Madagascar, Malawai, Malaysia, Malta, Mauritius, Martinique, Mexico, Micronesia, Morocco, Mozambique, Namibia, Nepal, New Zealand, Oman, Pakistan, Palau, Palestinian territory, Panama, Papua New Guinea, Peru, Paraguay, Philippines, Portugal, Puerto Rico, Reunion, Saint Kitts and Nevis, Saint Lucia, Saint Martin, Sao Tome and Principe, Saudi Arabia, Singapore, Sint Maarten, Somalia, South Africa, Spain, Sri Lanka, Sudan, Suriname, Swaziland, Taiwan, Tanzania, Thailand, Tunisia, Turkey, Uganda, UAE, US, Yemen, Zambia, Zimbabwe.

Botanical description:

Terrestrial herbs, 10-80 cm height; rhizome erect, densely scaly; scales lanceolate, entire, pale brown; leaves simple pinnate, pale green; stipe, green, scaly, grooved above, rounded below; lamina, simple pinnate, pale green; pinnae, oblong, acuminate ore linear, gradually reduced towards base, basal pinnae ovate or oblong, auricled; sori linear along the margins, covered by translucent reflexed margins; spores trilete, pale brown.

***Adiantum recurvatum* (D.Don) Fraser-Jenk.**

Scientific names: *Adiantum recurvatum* (D.Don) Fraser-Jenk.

Synonyms: *Asplenium recurvatum* D. Don, *Adiantum indicum* Ghatak, *Adiantum incisum* subsp. *indicum* (Ghatak) Fraser- Jenkins, *Adiantum caudatum* var. flabellatum Nayar

Citation: Taxon. Revis. Indian Subcontinental Pteridophytes 145. 2008 [27 Nov 2008]

Distribution:

It is a very rare species found only in India; found on fully exposed vertical rocks in West Bengal and Orissa, Kolkatta, Nepal, Sikkim, Bhutan, Arunachal Pradesh, Assam, Meghalaya, Allahabad, Lucknow, C. and S. India etc. (Fraser-Jenkins, 2008).

Botanical description:

Hairy stipe, rachis and lamina; rachis purple, elongated proliferous apex, striate, hirsute, trapezoid pinnae with divided superior edges and sori at the upper edge.

***Aleuritopteris argentea* (S.G. Gmel.) Fee**

Scientific name: *Aleuritopteris argentea* (S.G. Gmel.) Fee

Synonyms: *Aleuritopteris argentea* var. *flava* Ching & S.K. Wu, *Aleuritopteris argentea* var. *geraniifolia* Ching & S.K. Wu, *Aleuritopteris argentea* var. *major* Ching, *Aleuritopteris flava* (Ching & S. K. Wu) S. R. Ghosh, *Aleuritopteris geraniifolia* Ching, *Aleuritoptris michelli* (Christ) Ching, *Aleuritopteris qianguiensis* W. M. Chu & H.G. Zhou, *Allosorus argenteus* (S. G. Gmel.) C. Presl, *Cassebeera argentea* (S. G. Gmel.)J. Sm., *Cheilanthus argentea* (Gmel.) Kze., *Doryopteris argentea* (S. G. Gmel.) H. Christ, *Doryopteris michelii* Christ, *Dryopteris argentea* (S. G. Gmel.) Christ, *Pteris argentea* Gmel.

Citation: Adiantaceae *Aleuritopteris argentea* Fee Mem. Foug., 5.Gen. Filic. 154. 1850-52. 1850

Botanical description:

A slightly coarser lobed species (with more radiate lamina) and a higher- altitude and higher latitude species.

Distribution:

It was first reported from Bhutan by Fraser-Jenkins and Dulawat (2009). Then, from Arunachal Pradesh by N. Lohit and finally collected by J.D. Hooker

and T. Thomson from Khasi hills, Meghalaya (Jenkins and Dulawat, 2009).

***Aleuritopteris wallichiana* Fraser-Jenk.**

Scientific name: *Aleuritopteris wallichiana* Fraser-Jenk.

Citation: Taxon. Revis. Indian Subcontinental Pteridophytes 132 (fig. 164). 2008 [27 Nov 2008]

Distribution: Nepal, Sikkim,

Botanical description:

It is a hybrid of *A. bicolor* and *A. dealbata.* Broad deltate lamina with narrow segments; somewhat broad, dark-brown scales occurring throughout the basal half of the stipe.

Conclusions

Post-fire behaviour of pteridophytes has remained ignored from the Indian Himayalan region (IHR). As only a few species (04) have been collected from the forest range after fire events and as they are associated with the chir-pine forests, that undergo fire events annually, they may undergo depletion after few years of continuous fires, so, there is a dire need to study their behaviour and conserve them.

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