

Floristic studies of the pteridophytes of district Tor Ghar KP, Pakistan

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Tor Ghar KP, Pakistan bölgesinin pteridofitleri üzerine floristik çalışmalar

Abstract: This study was aimed to document the floristic attributes of the pteridophytes of district Tor Ghar; Khyber Pakhtunkhwa, Pakistan. Total 41 species distributed in 20 genera and 10 families were recognized. *Dryopteridaceae* was the largest family with 12 species (29.26%). Second and third large family is *Pteridaceae* and *Thelypteridaceae* with 10 (24.39%) and 5 (12.19%) species respectively. Like-wise, *Dryopteris* was the largest genus with 6 (14.63%) species. The main families were *Aspleniaceae*, *Blechnaceae*, *Dennstaedtiaceae*, *Dryopteridaceae*, *Equisetaceae*, *Lygodiaceae*, *Marseliaceae*, *Pteridaceae*, *Thelypteridaceae*, and *Woodsiaceae*. *Polystichum integrilobium* (Ching ex Y.T. Hsieh) W.M. Chu ex H.S. Kung is reported for the first time for Pakistan and 33 species are new records for the Tor Ghar. These identified species were collected from different localities i.e. Shumli Bandi, Bandi, Pabal, Tilli, Panja Gali, Kotkay, Ganga, Judba, Seri Kohani, Tagram, Nabori, Tor Kandow and Kandar (Hussanzai).

Key words: District Tor Ghar; Pakistan; taxonomy; pteridophytes; distribution pattern

Özet: Bu çalışma, Tor Ghar; Khyber Pakhtunkhwa, Pakistan Bölgesi pteridofitlerinin floristik özelliklerini belgelemeyi amaçlamıştır. On familya ve 20 cins içinde dağılım gösteren toplam 41 tür tanımlanmıştır. *Dryopteridaceae*, 12 türle (%29.26) en büyük familyadır. İkinci ve üçüncü büyük aile sırasıyla 10 (%24.39) ve 5 (%12.19) tür ile *Pteridaceae* ve *Thelypteridaceae*'dir. Aynı şekilde *Dryopteris*, 6 (%14.63) türle en büyük cins olmuştur. Asıl familyalar *Aspleniaceae*, *Blechnaceae*, *Dennstaedtiaceae*, *Dryopteridaceae*, *Equisetaceae*, *Lygodiaceae*, *Marseliaceae*, *Pteridaceae*, *Thelypteridaceae* ve *Woodsiaceae*'dir. *Polystichum integrilobium* (Ching ex Y.T. Hsieh) W.M. Chu ex H.S. Kung, Pakistan için ilk kez rapor edilmiştir ve 33 tür Tor Ghar için yeni kayıt durumundadır. Teşhis edilen bu türler, Shumli Bandi, Bandi, Pabal, Tilli, Panja Gali, Kotkay, Ganga, Judba, Seri Kohani, Tagram, Nabori, Tor Kandow ve Kandar (Hussanzai) gibi farklı yerlerden toplanmıştır.

Anahtar Kelimeler: Tor Ghar bölgesi, Pakistan, taksonomi, pteridofitler, dağılım modeli

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1. Introduction

The term Pteridophytes is a fusion of two Greek words (*pteron*= feather, *phyton*= plants) means the plants having feathers like shape of their fronds. These are also known as 'vascular cryptogams' and Carolus Linnaeus (1754) categorized them in the class Cryptogamia. Pteridophytes is a group of spore producing plants, designed by two lineages, one is Lycophytes (club mosses) fronds and Monilophytes or ferns (Pryer et al., 2004; Smith et al., 2006). Presently, pteridophytes comprises of approximately about 300 genera and 9600 ferns and 1400 fern allies around world (Smith et al., 2006). However according to Chapman (2006) about 15% of all fern and lycophyte species may not yet be known to science, while according to Moran (2008) there are approximately 13.600 species in the tropics with the richest diversity (Kornas, 1993; Linder, 2001). Nearly an updated checklist of Pakistan suggests that there are 206 taxa (194 species; 4 forma; 8 hybrids) distributed in 62 genera and 19 families (Gul et al., 2017).

Systematic studies of pteridophyte flora of Pakistan are not fully done. Previously, few workers have contributed in the exploration of the fern flora of Pakistan. Pteridophyte flora of Kashmir Valley resulted in the discovery of only 90 species and 4 varieties of ferns from Kashmir as their collective contribution (Dar et al., 2002).

Stewart (1972) enlisted about 133 taxa from Pakistan and Kashmir in his catalogue "An Annotated Catalogue of The Vascular Plants of West Pakistan and Kashmir". Later Hope (1903) and Beddome (1892) during their work on the pteridophytes documented 27 species from Chitral and 25 species from British India respectively. Nakaike and Malik (1992) prepared a list of pteridophytes including 82 species of ferns belonging to 30 genera and 18 families of Pakistan. Murtaza et al. (2008) investigated *Schizaea dichotoma* (L.) Smith and were collected specimens from Neelum Valley. Khan (2011) investigated the pteridophytes of district upper Dir and documented 37 fern species from the area. Wani et al. (2012) reported 106 taxa of fern and fern allies of Kashmir Valley, Gores and Ladakh. Sundas et al. (2012) documented 36 fern species belongs to 18 genera and distributed in 13 families. Fraser-Jenkins (2012) worked on the pteridophytes of political India and documented a revised list of 337 pteridophytes according to the six higher IUCN categories. Gul et al. (2016) studied traditional uses of 60 taxa of fern and fern allies distributed in 16 families, and 26 genera from district Mansehra KPK, Pakistan. Gul et al. (2017) recorded 178 pteridophyte taxa distributed in 43 genera and 17 families from district Mansehra KPK, Pakistan. In the present study an attempt has been made to analyze the magnitude of the taxa under consideration by using previous literature and field based observations.

2. Materials and Method

2.1. Study area

Tor Ghar is a combination of two Pashto words (Tor = Black, Ghar = Mountain) which means black mountain, previously Tor Ghar was known by hindko word Kala Dhaka which is the part of Western Himalayan province (Takhtajan et al., 1986). It lies between, 72°48'-72°58'E and 34°32'-34°50'N. It is an uneven, mountainous area of about 800 km, surrounded at south by Tanawal and Agror valley, on the east by Tikuari and Nandiar, District Buner to the west and Indus River on north (Mehmood et al., 2015). The single highway passes from Darband to Thakot is 85 km. Tor Garh is part of the Western Himalayan Province of Irano-Turanian Region (Takhtajan et al., 1986). District is elevated to a range from 450 to 3.500 m (Mehmood et al., 2015).

2.2. Study Plan

At initial stage, a detailed literature survey was carried out. Accordingly, a comprehensive field plan was designed, extensive field surveys were arranged in suitable seasons of the year from January-October 2017 in order to study and collect the specimens of ferns and fern allies from the various localities of Tor Garh. During field survey all data was collected related to the habit, type of habitat(s), geographic range, altitudinal range, life form, distribution range and ethnobotanical uses was studied in the natural habitat. The different localities visited were Shumli bandi, Panja gali, Pabal, Tilli, Seri kuhani, Ganga muchcot, Judba, Nabori, Tor kandow, Kandar, Bandagai etc.

2.3. Identification and Laboratory work

For identification purposes authentic literature and Flora of China and Flora of North America were consulted. However, the morphological features were studied and found out (length, pinnule size, pinnule number, pinna size, pinna number, hairs, and scale on rachis costae and indusia present or absent). Scales, lens, and stereoscope and high resolution compound microscope were used for identification purposes. For anatomy, cross sections of the material were used. Slides were made for each specimen like spore, sporangia, and rachis. Manual methods and microtome (if available) were also used for this purpose. Digital camera was used for anatomical images.

3. Results

In total one hundred twenty plants specimens were collected from various localities of the study area. Based on collected materials, 41 species were recognized having 20 genera and distributed in 10 families. For families, *Dryopteridaceae* was the largest family with 12 species (29.26%), followed by *Pteridaceae* having 10 species (24.39%). In the remaining 8 families 19 species (46.34%) were documented as shown in (Table 1, Fig 1). Genus-wise, *Dryopteris* Adans. was the largest genus with 6 species (14.63%) (Table 2, Fig 2) followed by *Polystichum* Roth. with 5 species (12.19%) of the total plant species. Amongst these taxa 33 were the new records for the study area, while 7 species have been previously reported in the studied area. Habitat wise 13 species are terrestrial which is 31.70%, 26 species are lithophytic which is 63.41% and 2 species are aquatic which

represents 4.87% of total known species from District Tor ghar (Fig. 3). As for altitude is concerned, 25 species (60.97%) are reported from 700-1900. Thirteen species (31.70%) are reported from 1901- 2300, 3 species (7.31%) are reported from 2300-2800 (Fig. 4). Ten species (24.39%) of total recorded species from the area are traditionally used to cure ailments.

Table 1. Family wise distribution of pteridophytes in district Tor Ghar

Family	Genera	Species	% of taxa in total
<i>Aspleniaceae</i>	1	3	7.31
<i>Blechnaceae</i>	1	1	2.43
<i>Dennstaediaceae</i>	1	1	2.43
<i>Dryopteridaceae</i>	3	12	29.26
<i>Equisetaceae</i>	1	3	7.31
<i>Lygodiaceae</i>	1	1	2.43
<i>Marseliaceae</i>	1	2	4.87
<i>Pteridaceae</i>	5	10	24.39
<i>Thelypteridaceae</i>	4	5	12.19
<i>Woodsiaceae</i>	2	3	7.31

Table 2. Ten largest genera in the pteridophyte flora Tor Ghar

Genus	No. Species	% in total
<i>Dryopteris</i>	6	14.63
<i>Polystichum</i>	5	12.19
<i>Adiantum</i>	4	9.75
<i>Equisetum</i>	3	7.31
<i>Asplenium</i>	3	7.31
<i>Thelypteris</i>	2	4.87
<i>Pteris</i>	2	4.87
<i>Marselia</i>	2	4.87
<i>Onychium</i>	2	4.87
<i>Diplazium</i>	2	4.87

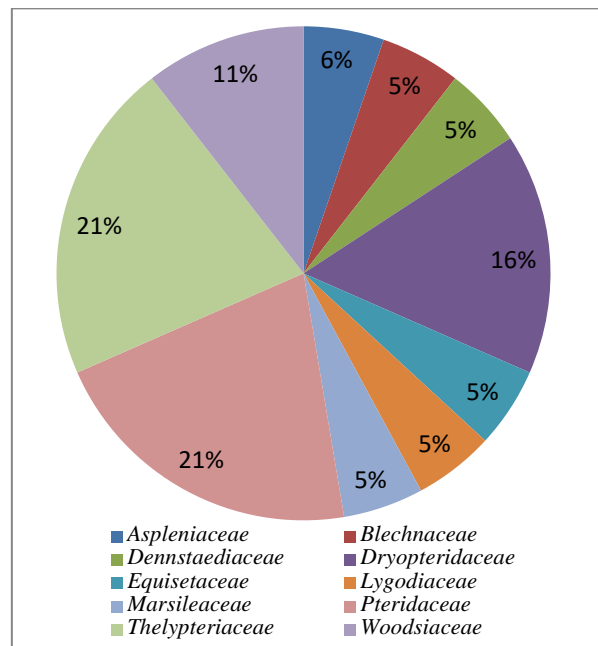


Figure 1. Family-wise distribution of the taxa in district Tor Ghar

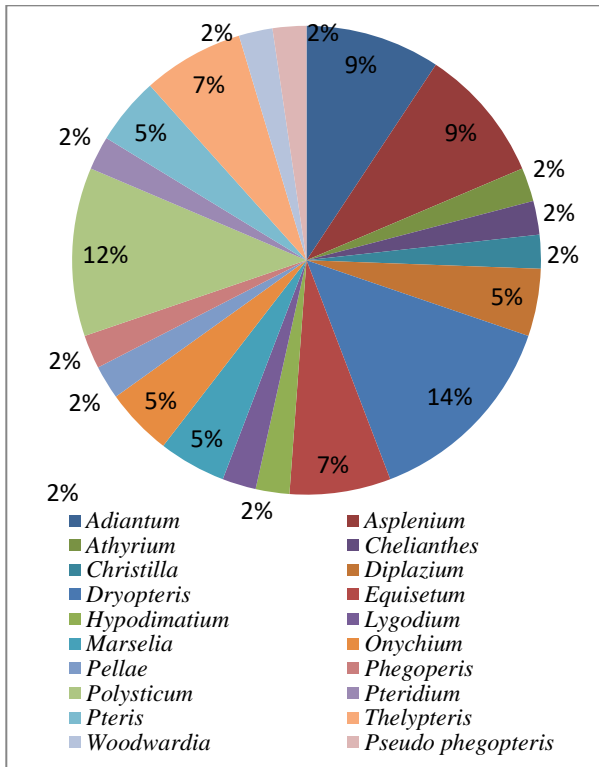


Figure 2. Genus-wise distribution of the taxa in district Tor Ghar

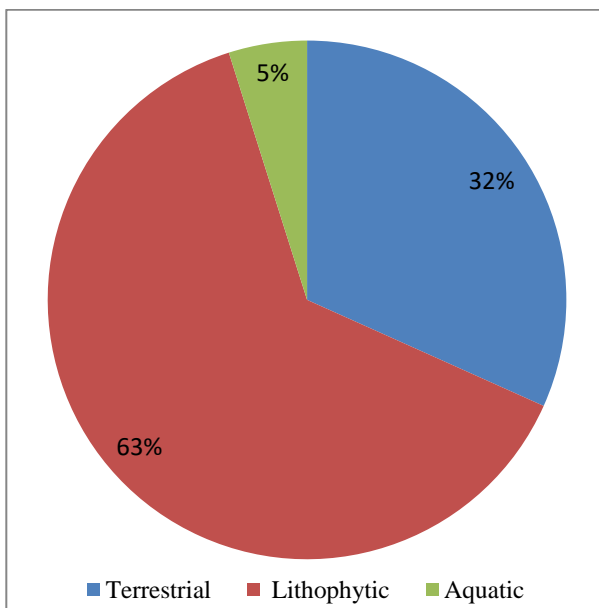


Figure 3. Habitat-wise distribution of the taxa in district Tor Ghar

3.1. New Generic Record

Polystichum integrilobium (Ching ex Y.T. Hsieh) W.M. Chu ex H.S. Kung Sin. 36: 244. 1998) (Fig 5)

Plants summer-green. Rhizome erect thickly covered with lanceolate golden to brown scales. Fronds 16 cm; stipe stramineous, 4 cm, ca. 2 mm in diameter at base scaly, scales dense, narrowly ovate, linear yellow-brownish. Lamina bi-pinnatifid, lanceolate, gradually becomes narrower at base, acuminate; rachis deprived of proliferous bulbils, dense scales both surfaces; stramineous, lanceolate and linear. Pinnae 18 pairs, alternate,

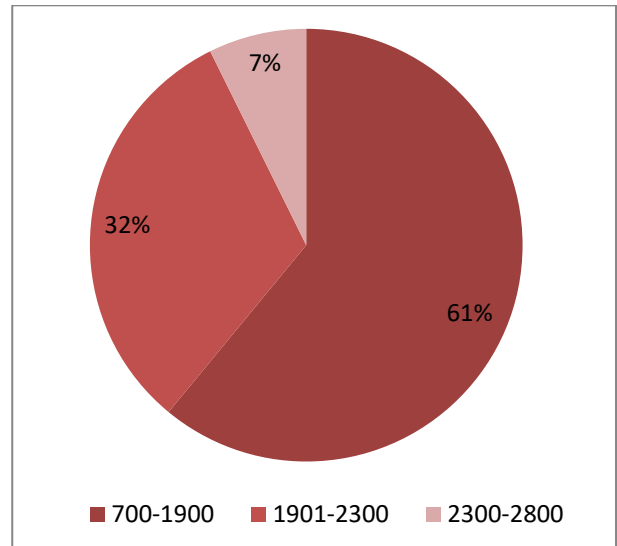


Figure 4. Altitude-wise distribution of the taxa in district Tor ghar

sessile, deltoid to lanceolate, middle pairs 18×7 mm, bases oblique, broadly cuneate, macroscopically auriculate, pinnatifid, apices obtuse. Lobes 5 pairs, nearly opposite, slightly ascendant, approximate, oblong, entire; many lanceolate yellowish brown microscales on abaxial surface, subglabrous adaxially; frond texture papery; venation pinnate on lobes, inarticulate on both surfaces. Sori in a single row on each side of midrib; indusia serrulate.

Specimens Examined: Tor Ghar; Tilli, 1790 m, 12-07-2017, Humaira Bibi, Muhammad Irfan 38 (HUP).

Habitat: Near moist and shady place.

General Distribution: North Western Yunnan (China).

4. Discussions

District Tor Gar falls in the Irano-Turanian phytogeographical region of Pakistan (Takhtadzhian and Cronquist, 1986). In terms of pteridophyte exploration this region remains neglected. Therefore, an attempt has been made to analyze the magnitude of the taxa under consideration.

In Pakistan, the floristic studies of pteridophytes are still not completed. Most of the work has been done on angiosperms but only a little work is presented on lower plants particularly cryptogams. Recently Tor Gar is little explored in terms of higher plants i.e. angiosperms and gymnosperms (Mehmood et al., 2015). Extensive review of literature revealed that only 16 pteridophytes species are known to the district. However, in current investigation 41 taxa are recorded and these belongs to 20 genera and 10 families. One species is reported for the first time for Pakistan and 33 species are new records for the study area. However, these figures represent about 19% (species), 30.64% (genera) and 52.63% of the total known (families) for Pakistan. Of these, 33 species are new records for the study area. The scientists contributed in exploration of flora of pteridophytes were Ching (1940), Fraser-Jenkins (2012), Sundas et al. (2012), Shah et al. (2019), Nakaike and Malik (1992), Zaman et al. (2019) and Gul et al. (2016). The largest family is *Dryopteridaceae* having 12 species and 3 genera

recognized i.e. *Dryopteris*, *Polystichum* and *Hypodematum* Kunze. *Dryopteris* has 6 species, *Polystichum* has 5 species and *Hypodematum* has 1. The same work was done by Gul et al. (2017) and 18 genera were documented. In the current study *Thelypteridaceae* with 4 genera i.e., *Thelypteris* Schmidel with 2 species, *Pseudophegopteris* Ching, *Christella* H.Lév. and *Phegopteris* (C.Presl) Fée have 1 species each, and similar research was done by Ching (1940) who documented 12 genera in *Thelypteridaceae*. *Pteridaceae* with 9 species and 5 genera i.e. *Pteris* has 2 species, *Adiantum* L. has 4 species, *Cheilanthes* Sw. has 1 species, while *Onychium* Kaulf. has 2 species and *Pellea* Link. has 1 species. A similar result was obtained with this work and in general agreement with the work of Fraser-Jenkins (2012) who revised the list of 337 pteridophytes from India. *Asplaniaceae* has 3 species and 1 genus i.e. *Asplenium* L. Similarly, Zaman et al. (2012) documented a total of about 36 fern taxa belonging to 18 genera and 13 families. Three species are identified for family *Equisetaceae* with 1 genus *Equisetum* L. Shah et al. (2019) documented 8 genera belonged to 4 families of pteridophytes from Chakesar valley at district Shangla Pakistan. Three species are identified for family *Woodsiaceae* with 2 genera i.e.,

Athyrium Roth has 1 taxon and *Diplizium* Swartz has 2 taxa. Nakaike and Malik (1992) reported 82 species of pteridophytes belonged to 30 genera, 18 families and distribution pattern from Pakistan. *Dennstedaceae* have 1 genus *Pteridium* Gleditsch ex Scop. and 1 species. The same work was done by Mir et al. (2015) who reported 4 species of pteridophytes for the first time from Kashmir Valley. Two species were identified for family *Marsilaceae* having 1 genus *Marsilea* L. The same work was done by Fazal et al. (2014) who collected 25 species of ferns and ferns allies belonged to 13 genera and 8 families for Maidan valley Dir lower district at Pakistan. *Lygodiaceae* has 1 species and 1 genus i.e. *Lygodium* Sw. The same work was done by Gul et al. (2016) a checklist of 130 species of ferns and lycophytes distributed in 34 genera and 17 families from district Mansehra, KP, Pakistan were documented. *Blechnaceae* has 1 species and 1 genus i.e. *Woodwardia* Sm.

Conflict of Interest

Authors have declared no conflict of interest.

Authors' Contributions

The authors contributed equally.



Figure 5. *Polystichum integrilobium*: A, Close up of frond; B, Closeup of pinna and rachis abaxially; C, Habit; D, Closeup of stipe with scales adaxially; E, Section of scale

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