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A NOTE ON BRYOPHYTIC FLORA OF CERTAIN 'NALS' OF PHULWARI WILD-LIFE SANCTUARY

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ABSTRACT

19 species of bryophytes (liverworts 8, hornworts 3 and 8 mosses) have been reported from different *nals* of Phulwari WLS. Marchantiales is the most dominant order represented by 8 species. The distribution of bryophytes on different habitats was in the order; moist soil (8 species) > stony walls (5 species), moist soil covered rocks (4 species) > tree trunks *i.e.* bark (3 species). Phulwari-ki-nal has maximum number of species (18 species) followed by Hukeri-ki-nal and Gamdi-ki-nal with 16 and 15 species respectively.

INTRODUCTION

Phulwari-ki-nal Wildlife Sanctuary which is commonly known as Phulwari sanctuary is an important sanctuary of southern Rajasthan situated in Kotra and Jhadol Tehsils of Udaipur district along Rajasthan-Gujarat border. It is situated between 73°7' and 73°20'E longitude and 24°0' and 24°30'N latitude and covers an area of 492.68 sq km. As per Champion and Seth's (1968) classification, the forest tract falls under tropical dry deciduous forests. Many pockets of dense riverine forests remain pictures queues here and there. Valleys are supporting nearly pure patches of bamboo brakes and Mahuwa groves at places.

Being the part of Aravalli range system the sanctuary has many narrow shaped valleys which are known as 'nals' in local dialect. Essentially a nallah or stream or river is present in the 'nal'. The stream of the 'nal' may be perennial or seasonal or ephemeral. Water regime in a nal remains higher than the adjacent area. If many parallel 'nals' are there, water regime becomes better in the area. Succession of vegetation keeps pace with water regime hence more water loving species can be seen in 'nals' than the surrounding areas. Phulwari sanctuary has riparian strips along the banks of perennial stream which comprises of many semi-evergreen and evergreen species.

The floristics of the *nals* is very close to many south Indian forests of high rainfall zone. The major 'nals' present in Phulwari WLS are Bor-ki-nal, Dhedri-ki-nal, Gamdi-ki-nal, Guradara-ki-nal, Hukeri-ki-nal, Kewa-ki-nal, Khanchan-ki-nal, Phulwari-ki-nal, Sarli-ki-nal etc.

Due to presence of shady riparian strips and high moisture availability, nals have congenial conditions to support bryophytes flora. Bryophytes are important component of forest. They play an important role in ecosystem function e.g. sequestering nutrients, retaining water, regulating the social micro-environment and acting as carbon sinks (Vitt 2000). Rajasthan has low diversity of bryophytes with approximately 52 mosses, 30 liverworts and 7 hornworts (Chaudhary and Deora 1993, Sharma 2002) in comparison to 2,850 species of bryophytes reported from the country. Because of the extremities of climatic conditions, especially high temperature and low rainfall, only a limited number of species which have wide range of tolerance occur in Rajasthan.

Chaudhary et al. (2006) reported only 67 species of bryophytes in the neighboring state Gujarat. Rawat et al. (2015) reported 51 species of mosses of Rajasthan and Punjab plains and provided delimited boundaries of this zone with most dominant family Pottiaceae.

Choyal and Sharma (2011) studied bryophytes of Thar desert with particular reference to Ganganagar district for their morphological and anatomical adaptations to xeric conditions.

Chaudhary and Deora (2001) provided an illustrated account of 25 species of mosses from Mt. Abu.

Khichi (2007) has worked on bryophytes of Kumbhalgarh sanctuary and listed 44 species from the area.

Alam et al. (2011) also reported important bryoflora of Ranthambhore Tiger Reserve that include highest representation of order Marchantiales followed by Polliales among hepatics.

The bryoflora faces many challenges posed by human activities that directly or indirectly influence the diversity and distributional dynamics of these plants. The tourist influx and commercial exploitation, herds of grazing animals disturb natural microhabitat and niche conditions.

Topographically and microclimate of 'nals' of Phulwari WLS provide affable environment for the growth of bryophytes. Moist, cool and shady places are available everywhere in the sanctuary, which harbors a variety of bryophytes. 'Nals' provides suitable microhabitat for the growth of bryophytes. Especially nallah, springs, rock drips, rock seepage, rock flow, kund (pond) and high tree density area provide congenial microclimate for the luxuriant growth of bryophytes. Further, the trampling by domestic cattle is minimum in 'nals' especially during rainy season. Human disturbance is also low during rainy season due to high water regime of the area.

Since most of the rocks in the area are full of fractures through which water can percolate easily. Hence crevice loving chasmophytic angiosperm plants including ferns and bryophytes grow on vertical rock surface. Thick layer of soil on hill slopes imbibe and retain water. Availability of free water and humidity at such places harbor water loving and hygroscopic plants. High density of trees and presence of multistoried forest also provide more shady area for the growth of bryophytes and ferns. The present work has been carried out as an attempt to assess the bryophytic flora to add to the knowledge of the bryophyte diversity and distributional dynamics at the area.

METHODOLOGY

Phulwari sanctuary was under our observation since 2001 but intensified study was continued from June, 2014. Intensive surveys were done during rainy season to study vegetative and reproductive phases of bryophytes.

Table 1. Bryophytes of various 'nals' of Phulwari WLS

S. No.	Class	Order	Family	Species
A	Hepaticopsida	Marchantiales	Targioniaceae	*Cyathodium burodae* Chavan
1				
2			Aytoniaceae	*Asterella angusta* (Steph) Kachroo
3				*Plagiochasma intermedium* L. et G.
4				*Plagiochasma appendiculatum* Lehm.
5				*Plagiochasma articulatum* Kash.
6			Ricciaceae	*Riccia billardieri* Mont. et Nees
7				*Riccia grollei* Udar.
8				*Riccia crystallina* L.
B	Anthocerotopsida	Anthocerotales	Anthocerotaceae	*Anthoceros subtilis* St.
1				
2				*Anthoceros erectus* Kash.
3				*Notothylus levier* St. ex. Schiff.
C	Bryopsida	Fissidentales	Fissidentaceae	*Fissidens bryoides* Hedw.
1				
2		Pottiales	Pottiaceae	*Hyophila rosea* Williams
3			Barbuloidaceae	*Barbula constricta* Mitt.
4		Funariales	Funariaceae	*Funaria hygrometrica* Hedw.
5			Splachnaceae	*Gymnostomiella vernicosa* (Hook.) Fleisch
6		Isobryales	Erpodiaceae	*Erpodium mangifera* C. Muell
7			Entodontaceae	*Entodon prorepens* (Mitt.) Jaeg.
8			Plagiotheciaceae	*Stereophyllum anceps* (Bosch & Lac.)

Table 2. Distribution of Bryophytes in various 'nals' of Phulwari WLS

S. No.	Species	Occurrence in different nals									
		Bor-ki-nal	Dhedri-ki-nal	Gamdi-ki-nal	Gurandara-ki-nal	Hukeri-ki-nal	Kewa-ki-nal	Khanchal-ki-nal	Phulwari-ki-nal	Sarli-ki-nal	Total
A	**Liverworts**										
1	*Cyathodium burodea* Chavan	–	–	+	–	+	–	–	+	–	3
2	*Asterella angusta* (Steph.) Kachroo	–	–	+	–	+	–	–	+	–	3
3	*Plagiochasma intermedium* L. et G.	–	–	–	+	+	+	–	+	–	4
4	*P. appendiculatum* Lehm	–	–	+	+	+	+	–	+	–	5
5	*P. articulatum* Kash.	+	+	+	+	+	–	–	+	+	7
6	*Riccia billardieri* Mont. et Nees	–	–	+	–	+	+	+	+	–	5
7	*R. grollei* Udar.	–	–	+	–	+	–	–	+	–	3
8	*R. crystallina* L.	+	–	+	–	+	–	+	+	+	6
B	**Hornworts**										
1	*Anthoceros subtilis* St.	+	+	+	+	+	+	–	+	–	7
2	*A. erectus* Kash	–	+	–	–	+	+	+	+	+	6
3	*Notothylus levier* St. ex. Schiff	–	–	+	+	+	+	–	+	+	6
C	**Mosses**										
1	*Fissidens bryoides* Hedw.	–	+	+	–	+	+	–	+	–	5
2	*Hyophila rosea* Williams	–	+	+	+	+	+	–	+	–	6
3	*Barbula constricta* Mitt.	–	–	–	+	+	–	–	–	–	2
4	*Funaria hygrometrica* Hedw	+	+	+	+	+	+	+	+	+	9
5	*Gymnostomiella vernicosa* (Hook.) Fleisch	+	–	+	–	+	–	–	+	–	4
6	*Erpodium mangifera C. Muell*	–	–	+	–	–	–	–	+	–	2
7	*Entodon prorepens* (Mitt.) Jaeg.	+	–	+	–	–	+	+	+	+	5
8	*Stercophyllum anceps* (Bosch & Lac.)	–	–	–	+	–	+	–	+	+	4
	Total	6	6	15	9	16	13	5	18	7	

Table 3. A systematic account of liverworts, hornworts and mosses on the basis of the location of their occurrence

S. No.	Location of Occurrence	Species
1.	Moist soil covered rock	**Hepaticopsida** *Plagiochasma intermedium* L. et G. *P. appendiculatum* Lehm. *P. articulatum* Kash. **Bryopsida** *Hyophila rosea* Williams
2.	Moist soil	**Hepaticopsida** *Cyathodium burodae* Chavan *Asterella angusta* (Steph.) Kachroo *Riccia billardieri* Mont. et Nees *R. grollei* Udar. *R. crystallina* L. **Anthocerotopsida** *Anthoceros subtillis* St. *A. erectus* Kash. *Notothylas levier* St. ex. Schiff
3.	Tree trunk (grow on bark as Epiphyte)	**Bryopsida** *Fissidens bryoides* Hedw. *Erpodium mangifera* C. Muell *Entodon prorepens* Jaeg. (Mitt.)
4.	On stony walls constructed using cement mortar	**Hepaticopsida** *R. crystallina* L. **Bryopsida** *Barbula constricta* Mitt. *Funaria hygrometrica* Hedw *Gymnostomiella vernicosa* (Hook.) Fleisch *Stereophyllum anceps* (Bosch & Lac.)

Help of local forest officials and tribals was seeked as they are good in escorting duty because of their familiarity to all interior paths and trails of the area. The liverworts and hornworts were identified with the help of keys provided by Choudhary and Deora (1993) and Chaudhary et al. (2006).

RESULT AND DISCUSSION

'Nals' of Phulwari WLS support a variety of liverworts, hornworts and mosses like *Riccia spp*, *Cyathodium burodae*, *Anthoceros* sp, *Plagiochasma* spp. and *Asterella angusta* etc.

A systematic enumeration of bryophytic flora recorded from various 'nals' of the Phulwari sanctuary are presented in Tables (1-3).

CONCLUSION

A total number of 19 species (liverworts 8, hornworts 3 and 8 mosses) have been reported from different *nals* of Phulwari WLS. Marchantiales is the most dominant order in bryophytes represented by 8 species across the habitat, the distribution of bryophytes in the order; moist soil (8 species) > stony walls (5 species), moist soil covered rocks (4 species) > tree trunks *i.e.* bark (3 species).

As far as distribution of bryophytic species in various *nals* of Phulwari wildlife Sanctuary is concerned, the richest nal has been Phulwari-ki-nal with 18 species followed by Hukeri-ki-nal and Gamdi-ki-nal with 16 and 15 species respectively.

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