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# Floristic Analysis of Pteridophytes of Todgarh-Raoli Wildlife Sanctuary Rajasthan, India

R. P. Kanther

Department of Botany, Govt. College Antah, India

**ABSTRACT:** The Pteridophytic flora of Rajasthan is very limited due to the extreme and largely arid and dry climate, which is characteristic feature of the state. This flora is small but significant element occurring quite frequent in Todgarh-Raoli Wild Life Sanctuary, Rajasthan. Systematic survey from all localities of Pteridophytes in this sanctuary has revealed the occurrence of 09 species belonging to 06 genera and 05 families. *Actiniopteris radiata* (Sw.) Link, *Marsilea minuta* L., *Azolla pinnata* R. Br. subsp. *asiatica* and *Adiantum incisum* Forssk. widely distributed throughout the sanctuary. This sanctuary is also represented by *Adiantum capillus-veneris* L. *Adiantum philippense* L., *Marsilea aegyptiaca* Willd. and *Cheilanthes farinosa* (Forssk.) Kaulf. in scattered habitat under shaded moisture and in rock crevices. A check list of Pteridophytic flora along with its distributions in the Todgarh-Raoli Wild Life Sanctuary and its adjoining area has been investigated in this paper. Increasing exploitation of natural resources resulted in depletion of these important Pteridophytes. Local conservational strategies also discussed.

**KEYWORDS:** Pteridophytes, Todgarh-Raoli Wild Life Sanctuary, Local conservational strategies.

## I. INTRODUCTION AND REVIEW

Earlier fern explorer of Rajasthan state was Adam (1990). According to Raizada (1954) Mount Abu was regarded to be the only pteridophytic locality in the state. Bir & Verma (1963) published on ferns of Mt. Abu. The Pteridophytic flora of various localities of Rajasthan has been studied by many workers. Important contributions are those of Bir *et al.* (1963), Mittal (1969), Kanodia & Despande (1962), Bir & Verma (1963), Vyas (1965), Bhardwaja *et al.* (1977, 1984, 1987), Sharma & Bohra (1977), Gena *et al.* (1983), Bohra *et al.* (1980), Bir (1987a, 1987b), Gena (1998), Yadav *et al.* (2002), Sharma (2002), Chaudhary & Dulawat (2006), Chaudhary & Khichi (2006), Dulawat & Chaudhary (2008) and Kanther & Gena (2014a, 2015) As current known this group whose members are predominant, though not all shade and moisture loving plants is represented in the state by 21 genera and 42 species (Gena 1998, Dulawat & Chaudhary 2008, Fraser-Jenkins & Dulawat 2009, Yadav & Meena 2009 and Gupta & Bhardwaj 2010).

So far as Pteridophytic flora of Todgarh-Raoli wild life sanctuary is concerned, no work has been taken up by any of the earlier workers except a brief report of *Cheilanthes farinosa* by Mital (1967), Pteridophytes of Todgarh-Raoli wildlife Sanctuary (Kanther & Gena 2014b) and the ferns and fern-allies of Todgarh-Raoli wildlife sanctuary by Kanther & Gena (2015). Considering this aspect the present work has been investigated mainly Identification, habit, habitat, Phytodiversity and Phenology of the pteridophytes occurring in this sanctuary. Increasing exploitation of natural resources resulted in depletion in these important taxa of Pteridophytes. The erosion of plant biodiversity is a matter of global concern. One by one the building blocks of entire ecosystem are disappearing. The 2008 IUCN Red Data list shows that in India hundreds of Pteridophytes are under the list of threatened and at the risk of extinction. Some RET, species were discussed and common household conservational techniques adapted by tribals of this region have been discussed in this paper.

## II. STUDY AREA PROFILE

Rajasthan state is situated in between 23°3' and 30°12' N latitude and 69°3' and 78°12' E longitude. The Aravalli ranges which is one the oldest mountain range of the world, divides the Rajasthan into two vegetational segments like xerophytic and mesic. Todgarh-Raoli Wildlife Sanctuary located in central position of Aravalli range. Xerophytic and mesic vegetation occurs as mixed formation in this Sanctuary. The sanctuary is also an ecotone of both vegetational segments. Naturally variations in Pteridophytic flora are represented in this region. It is bounded on the north by Ajmer district, on the south by Udaipur district, on the east by Rajshamand district and on the west by Pali district (Text- Fig. 1).



Text Fig. 1 Location of Todgarh-Raoli Wildlife Sanctuary

### III. MATERIALS AND METHODS

The present paper is based on the Phyto-diversity and Survey of pteridophytic flora in different parts of Todgarh-Raoli wild life sanctuary Rajasthan. All the localities have been visited time to time throughout the year and mainly during monsoon period. The Botanical excursions were undertaken from time to time. Rainy season (i.e. from July to October each year) is the best time to visit as many places for the study habit and habitats of ferns and fern-allies. Every locality of the entire areas was extensively covered. All localities were visited corresponding to seasonal variation round the year. Topography of the Sanctuary comprises of hilly rocky and deciduous forest. Therefore the vegetation was much diversified. Collection trips were arranged in such a way to cover all the habitats of enlists all fern species occurring in this sanctuary. Efforts were made to identify the pteridophytic plants from fresh materials and common name in use by local people. The species were identified with the help of Khullar's (1994 & 2000) "*An illustrated fern flora of the West-Himalaya*" Vols. I & II and with the help of well-known Pteridologist and former Vice-Chancellor and my worthy Ph. D. guide **Dr. C. B. Gená**. It was possible due to research promotional support in respect to financial assistance as **MRP** by **UGC**.

### IV. OBSERVATIONS

Out of 06 genera of Pteridophytes distributed in the various localities of Todgarh-Raoli wild life sanctuary 04 genera namely *Actiniopteris*, *Cheilanthe*, *Salvinia* and *Azolla* are representing by single species each. *Marsilea* is represented by two species while *Adiantum* is represented by three species. The majority of fern genera represented in single species in the sanctuary. We have frequently observed that the population densities as well as number of individuals. A checklist of all fern taxa distributed in Todgarh-Raoli wild life sanctuary, Rajasthan has been provided in table-01.

TABLE-01

A check list with descriptions about distributions of Pteridophytes from various localities in Todgarh-Raoli wild life sanctuary and its adjoining regions. Families and species within families are arranged alphabetically.

S.No	Name of family	Name of Genus	Name of fern species	Name of surveyed localities and Distributions.
1.	Adiantaceae	<i>Actiniopteris</i> Link	<i>Actiniopteris radiata</i> (Sw.) Link.	-Most widely xerophytic fern found almost throughout sanctuary.  -Near Dudhaleshwar-Mahadev.  -Near Bheel- beri, Khambli Ghat.  -Near Kachabali villege.
		<i>Adiantum</i> L	<i>Adiantum incisum</i> Forssk.	-One of the most widely distributed fern of Aravalli range and also in throughout the sanctuary.  -On the way of Dudhaleshwar Mahadev, Raoli lake.  -Ghoram- Ghat and Behind the Forest guest house.
			<i>Adiantum capillus-veneris</i> L.	-Quit common especially under moist region Near Dudhaleshwar Mahadev.  -Near Bheel-beri waterfalls Khambli Ghat, Ghoram-Ghat.
			<i>Adiantum philippense</i> L.	It found in the

				localities like Bheel-beri waterfall, Khambli Ghat.  - Ghoram- Ghat in the sanctuary.
2.	Cheilanthaceae	<i>Cheilanthe</i> Kaulf.	<i>Cheilanthes farinosa</i> (Forssk.) Kaulf.	-Various localities of the sanctuary, near Todgarh area hills.  -In the crevices of rock toward the way of Todgarh town.
3.	Marsileaceae	<i>Marsilea</i> L	<i>Marsilea minuta</i> Linn	-Widely distributed water fern various localities of the sanctuary, Near Negaria pond, Near Barakhan, Jassakhera pond and Ghoram- Ghat.
			<i>Marsilea aegyptiaca</i> Willd	Water fern found in Gugia pond and ditches near Bara Khera pond.
4.	Salviniaceae	<i>Salvinia</i> Seg.	<i>Salvinia molesta</i> Mitch.	Commonly occur on stagnant water bodies throughout the sanctuary
5.	Azollaceae	<i>Azolla</i> Lam	<i>Azollapinnata</i> R. Br. subsp. <i>asiatica</i>	Widely distributed Free floating fern of ponds in various localities of the sanctuary like Bara –Khera pond, Raoli lake area, Barakhan pond area, Negaria stream area.



## V.ENUMERATIONS OF THE PTERIDOPHYTES OF TODGARH RAOLI WILD LIFE SANCTUARY, RAJASTHAN:-

An enumeration of pteridophytes with descriptions about distributions from various localities in Todgarh-Raoli wild life sanctuary and its adjoining regions. Families and species within families are arranged alphabetically. Nomenclature is followed according Fraser-Jekins (2016).

### 1. *Actiniopteris radiata* (Swartz) Link, **Adiantaceae** : Genus *Actiniopteris* Link

One of the most widely distributed xerophytic fern of this sanctuary. Grows on old walls and in rock crevices. (Bir & Verma 1963, Mital 1969, Bhardwaja *et al* 1977).

Rhizome short-creeping, scaly and hairy, hairs dark brown, unicellur, Scales brown bicolour (central region black, margins light-coloured), margin entire, apex long acuminate. Stipes 4-10 cm long. lanceolate, apex with a terminal glandular cell, margin entire. The structure of the stipe and the branching of the lamina clearly separate from other members of family.

Ecology: Terrestrial or lithophytes along fully exposed roadside.

### 2. *Adiantum capillus-veneris* Linn. **Adiantaceae** : Genus *Adiantum* Linn.

A very common fern found occurring in plains under moist and shady habitats of this sanctuary (Mital 1969, Bhardwaja *et al* 1977).

Rhizome long creeping, thin, diameter 0.1 to 0.2 cm, scaly dark brown, 0.2 cm

long linear lanceolate, margin entire, apex acuminate, Petiolate flabellate “ fan- shaped”. Upper outer margin often irregularly lobed.

Ecology: Rare species, terrestrial along partially shaded 3. *Adiantum incisum* Forssk., **Adiantaceae** : Genus *Adiantum*

One of the most widely distributed fern of Aravalli as well as in Todgarh Raoli wild life Sanctuary. (Mital 1969, Bhardwaja *et al*, 1977).

Small plants with erect scaly rhizome, lamina simply pinnate, densely hairy pinnae present. Densely scaly, scales brown, linear lanceolate, margin entire, apex acuminate. Upper margin deeply lobed, veins forked free, sori marginal, oblong or reniform, indusiate.

Ecology: Terrestrial or lithophytes along fully exposed roadside.

### 4. *Adiantum philippense* Linn. **Adiantaceae** : Genus *Adiantum*

A common fern species of moist and shady habitats of this sanctuary (Bir & Verma 1963, Mital 1969, Bhardwaja *et al* 1977).

Small plants, rhizome erect or sub-erect, thick, apex scaly, scales brown, linear lanceolate, margin entire, apex acute, Stipes black-brown, clustered towards rhizome. Rachis with a broad terminal pinna or sometime extended and then with a apical vegetative bud. Lamina pinnate. Fronds fan-shaped, glabrous, herbaceous,

Ecology: Rare species, terrestrial along partially shaded

### 5. *Cheilanthes farsinosa* (Forssk.) Kaulf. **Cheilantheae**: Genus *Cheilanthes*

One of the most common xerophytic fern of Rajasthan. Widely distributed throughout Aravalli range and this sanctuary also. (Mital 1969, Bhardwaja *et al*, 1977).

Rhizome short, erect, thick, apex scaly, scales dark brown, lanceolate, margin entire, the thin herbaceous fronds generally without farina. Upper surface dark green glabrous.

Ecology: Rare along partially exposed

### 6. *Marsilea aegyptiaca* Willd **Marsileaceae** : Genus *Marsilea*

First reported by Gupta & Bhardwaja (1957, 1958) and Gupta (1962) from Jodhpur. Quite widely distributed near pond margins in western Rajasthan and also present in the sanctuary. Rhizome long creeping, thin, glabrous but apex hairy. Stipes arise in two dorsal rows on the rhizome, the length depending on the depth of water, lamina quadrifid, cruciform, divided in two four pinnae. Margin entire or crenate,

Ecology: Aquatic and amphibians

### 7. *Marsilea minuta* Linn **Marsileaceae**: Genus *Marsilea*

One of the most widely distributed and common species of this water fern. Grow along the margins of ponds, lakes and streams during rainy season almost throughout the state and also in the sanctuary. (Gupta 1962, Bir & Verma

1963, Mital 1969). Rhizome long creeping, thin, glabrous but apex hairy. Stipes 2-5 cm distant on rhizome. Base faintly connate, greenish, thin. Pinne 1-2 cm long, 0.5 -1.5 cm broad. Margin entire.

Ecology: Aquatic and amphibians

8. *Salvinia molesta* Mitchell. **Salviniaceae** : Genus *Salvinia*

A common floating fern species of Rajasthan (Vyas, 1964), and also found in the sanctuary.

Ecology: Aquatic

9. *Azolla pinnata* R. Brown **Azollaceae** : Genus *Azolla* Lam.

A quite common free floating fern of ponds throughout Rajasthan (Mital 1969, Bhardwaja et al, 1977).

Ecology: Aquatic

**Table-02: Regional analysis of pteridophytic flora of Todgarh Raoli wild life sanctuary, Rajasthan with others important regines of ferns localities in India**

S. No	Name of species (Todgarh Raoli Region)	East Himalayas	West Himalayas	Upper Gangetic	Central India	South India
1.	2.	3.	4.	5.	6.	7.
1.	<i>Actiniopteris radiata</i>	+	+	+	+	+
2.	<i>Adiantum capillus-veneris</i>	+	+	+	+	+
3.	<i>Adiantum incisum</i>	+	+	+	+	+
4.	<i>Adiantum philippense</i>	+	+	-	+	+
5.	<i>Cheilanthes fasinosa</i>	+	+	+	+	+
6.	<i>Marsilea aegyptiaca</i>	+	+	-	-	-
7.	<i>Marsilea minuta</i>	-	-	+	+	+
8.	<i>Salvinia molesta</i>	-	-	+	+	+
9.	<i>Azolla pinnata</i>	-	-	+	+	-
	<b>TOTAL</b>	<b>06</b>	<b>06</b>	<b>07</b>	<b>08</b>	<b>07</b>

#### + Species present

- **Species absent**

From table -02 it is evident that Pteridophytes of Todgarh Raoli wild life sanctuary, Rajasthan shows their affinities to those of other parts of India as follows given in below text fig -02.

1. Common to East Himalayan region = 55%
2. Common to West Himalayan region = 55%

3. Common to Upper Gangetic region = 78%
4. Common to Central Indian region = 88%
5. Common to South Indian region = 78%

Text Fig. No. -02 Regional analysis of pteridophytic flora occurring in Todgarh-Raoli wild life sanctuary indicates relationship to those other parts of India.

## VI. CONSERVATIONAL STRATEGIES

The erosion of plant biodiversity is a matter of global concern. One by one the building blocks of entire ecosystem are disappearing. The 2008 IUCN Red Data list shows that in India hundreds of pteridophytes are under the list of threatened and at the risk of extinction. The life of tribal people and rural communities are closely interwoven with their environment and local flora. It becomes the integrated parts of their culture and custom and folklore. These A large number of pteridophytes are being used by tribal to cure human and veterinary ailments, thus they co-relate it with god or spiritual power or religious ethics. The plants growing around them form an integral part of their culture and customs.

It is our duty to recognize and support the conservational strategies adopted by tribal and rural people by the term of faith, myths, taboos, tradition, religious aspect, sacred grove etc. Conservation of threatened pteridophytic flora is the responsibility of each and everyone's. We are needed to increase awareness among tribals and rural communities in ecological sensitive area.

## VII. DISCUSSIONS

Pteridophytes form a significant sometimes dominant component of biosphere. 09 species belonging to 06 genera and 05 families were recorded from various localities from Todgarh-Raoli wild life sanctuary. The preceding data clearly indicate that pteridophytes have an important component of ecosystem of the sanctuary. *Actiniopteris radiate*, *Adiantum incisum*, and *A. capillus-veneris* are found growing more or less frequently throughout the sanctuary in crevices of rocks at low as well as higher altitude. These species are popular among the tribals due to its considerable medicinal value and is used for curing various skin diseases. Collectors totally uproot the plants with their rhizome, these species grows during the rainy season by their persisting rhizome. It was found from our survey that *Adiantum incisum*, *A. capillus-veneris*, *Azolla pinnata* subsp. *asiatica*, and *Marsilea minuta* occurs frequently at various localities but *Adiantum philippense* is of 'At Risk' status and it is restricted in particular area only *Marsilea aegyptiaca* is rare and it found only at found in Gugia pond and ditches near Bara Khera pond in the sanctuary. Two species of free floating water fern *Salvinia molesta* and *Azolla pinnata* subsp. *asiatica* are found growing abundantly in various ponds, ditches and stagnant water bodies in the sanctuary. It was also observed that *Azolla pinnata* subsp. *asiatica* is used as fodder for animals by local people. Conservational strategies adopted by tribals by the term of religious aspect may be fruitful in long time.

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