Chapter-5

METHODOLOGY
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(a) Field and herbarium method: The present taxonomic account on pteridophytes of Central India is based on extensive and systematic field survey and regular collection of pteridophytic samples from the various localities (explored / unexplored) of Madhya Pradesh and Chhattishgarh states including various habitats of the area. These areas were thoroughly visited and scanned periodically during 2001-2005.

1. Field survey: Following aspects were studied.
   1. Geographical features of the study area.
   2. Its climate, geology, topography and soil types.
   4. Study of floristic diversity and vegetation type.

Details of fieldwork: The source of materials for this work was the extensive and intensive field collections of specimens made from the study area during the period 2001-2005. Major field explorations were made after the rainy season in month of September 2001 to November 2004. Field trip were made once in month of October- November, during first year (2002), twice in month of February- March and September-October, during second year (2003), again twice in month of February-March and October- November, during third year. During the period more than 850 field number were collected.

In the present communication only those hilly region were explored, where the favorable ecological conditions are full fill for the luxuriant growth pteridophytes. Majority of the pteridophytes of Madhya
MAP – 4: Exploration status in Madhya Pradesh

(Map not up to the scale)
MAP – 5: Exploration status in Chhattishgarh

(Map not up to the scale)
Pradesh and Chhattishgarh regions are restricted to hilly humid and wet places near stream and gorges and away from direct expose of scorching rays of the sun. Thus as far as pteridophytic flora is concerned the specific sites viz., Pachmarhi Biosphere Reserve (Map 6) (Pachmarhi Sanctuary, Satpura National Park, Bori Sanctuary, Tamia and Patalkot hills); Amarkantak (Map 7); Sanjay National Park, Sidhi (Map 8) in Madhya Pradesh (Map 4) and Bailadilla hills (Map 9), Kangar Valley National Park (Map 10) and Keshkal in Chhattishgarh (Map 5) state were explored. Efforts were made to collect specimens with rhizome and fertile part as far as possible.

A brief introduction of each hill station explorer during the period is given:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PERIOD</th>
<th>DURATION</th>
<th>PLACE VISITED</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>3rd Oct.-22nd Oct.</td>
<td>20 days</td>
<td>Pachmarhi Sanctuary</td>
</tr>
<tr>
<td>2002</td>
<td>25th Feb.-15th Mar.</td>
<td>19 days</td>
<td>Tamia &amp; Patalkot Hills</td>
</tr>
<tr>
<td>2003</td>
<td>2nd Sep.-25th Nov.</td>
<td>24 days</td>
<td>Bori Sanctuary</td>
</tr>
<tr>
<td>2003</td>
<td>18th Oct.-10th Nov.</td>
<td>24 days</td>
<td>Sanjay National Park,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Amarkantak</td>
</tr>
<tr>
<td>2004</td>
<td>18th Feb.-8th Mar.</td>
<td>19 days</td>
<td>Satpura National Park</td>
</tr>
<tr>
<td>2004</td>
<td>2nd Oct.-22nd Oct.</td>
<td>21 days</td>
<td>Bastar, Jagdalpur Dantewara</td>
</tr>
</tbody>
</table>

**Madhya Pradesh**

(1) **Pachmarhi Sanctuary**: Area: 417.38 Sq. Km
Altitude: (370 mt-1332mt)

Visited area: Matkuli, Panrpani, Mahadev hills, Chauragarh hills, Denwa forest, Pandav cave forest, Priyadarshini point, Handi Khoh, Apsara vihar, Vanshi vihar, Rajat Prapat, Raj Giri, Lanjee Giri, Jambodeep, Jalgali, Sundar Kund, Jatashankar, Chote Mahadeo, Cave Shelters, Pachmari lake.

(2) Satpura National Park: Area: 1427 Sq. Km

Altitude: (300 mt-1350 mt)

Visited area: Dupgarh, Reechgarh, Silver fall, Dutches fall, Bee fall, Sonbhadra river forest, Tawa river forest, Nagwan forest, Neemghan, Pather chatta, Tridhara, Sangum, Chintamani, Gupt Mahadeo, Little fall, Down fall.

(3) Bori Sanctuary: Area: 485.72 Sq. Km

Altitude: (350 mt-1300mt)

Visited area: Madai forest, Churna forest, Garam pani, Rori Ghat, Nag Mandir forest, Bori forest.

(4) Tamia and Patalkot hills: Altitude: (370 mt-1332mt)

Visited area: Chhindi, Rater, Kareaam, Harakchar, Raja khoh, Van vishram grah, Sun set point, Banjari, Bandar kudni, Gupta Mahadeo, Fern van, Gomukhi, Rimjhim ghati, Mahadeo mandir, Jal prapatDoodhi, Chiran, Sukhabandh, Pachgol, Chatari, Chintipur.

(5) Amarkantak (Annapur): Area: 100 Sq. Km.

Altitude: (800-1103 m)

Visited area: Jwaleshwar, Pataleshwar, Sonmura, Mai ki bagia, Kapil dhara, Dodh dhara, Shambho dhara, Durga dhara, Chandika gufa, Dhuni pani, Lakhshaman dhara, Samundhara, Siddhivinayk, Parashvinayak, Kabir chbotara, Horticulture garden, Agriculture garden.
MAP - 9: MAP SHOWING BAILADILLA HILLS, DENTEWARA
(Not in scale)
(6) **Sanjay National Park (Sidhi):** Area: 100 Sq. Km.
Altitude: (800-1103 m)
Visited area: (1) Bhadwora (Mohan range)- Kanhaiya dah, Bhainswahi, Karcha, Kurchughati, Chafal, Runda, Korea (Border line), Karondi tola, Nagdah, Dugdugia path etc.
(2) Kusmi (Mohan range)- Kaari kohoh, Jarbo kohoh, Kharsoti, Machmahua etc.
(3) Pondi (Pondi range)- Amjhar chanda, Singhar nala, Manukjhariya, Bhoodham dole, Telia alda, Ramha ghati, Bandaria kohoh, Pakwari, Rani moora, Kaari kohoh, Kurmar river, Lurghutti, Domar path etc.

**Chhattishgarh**

(7) **Bastar, Jagdalpur, Dantewara:** Altitude: (700-1550 m)
Visited area: (1) Bastar (Keshkal) (2) Jagdalpur (Kangar Valley National Park: Kutomsar Village, Kutomsar Cave, Dandak Cave, Kailash Cave, Tirathgarh Fall, Shiv Ganga Dhara, Kanger Dhara, Nature Trail, Kanger-Munga Bahar Sangam, Darbha-Jerum Ghat, Netanar, Bhainsa Darha); Chitarkoot (3) Dantewara (Various ranges of Bailadilla hills viz., 662, 663, 665, 698, 699, 701, 702, 673, 677, 692 etc. range areas).

2. **Collection of samples:** Pteridophytic diversity in various localities of Madhya Pradesh and Chhattishgarh states studied and samples were collected in scientific manner without harming other species. The sampling was done to prepare a complete herbarium for future reference. The following aspects have taken into consideration.

-Normally, 2-3 specimens of each species in fertile/vegetative stage were collected.
-Whole plant with rhizome, fronds fertile with lower pinnae and upper pinnae not damaged in case of terrestrial species e.g. *Diplazium esculentum* (Retz.) Sw.
• Epiphytic, climbing and lithophytic species usually possess creeping rhizome which have collected along with vegetative and fertile leaves. Commonly associated species and the host trees were also noted e.g. Lepisorus nudus (Hook.) Ching in Pachmarhi usually grow on the branch of Mangifera indica

• The xerophytic species may be kept in water for few hours before pressing to uncurl the contracted portion e.g. Selaginella bryopteris (L.) Bak.

• Aquatic species have collected along with fruiting bodies (sporocarps) e.g. Marsilea minuta L.

3. Habit photographs of some of the interesting species and study area were taken during the survey.

(b) Preparation of herbarium specimens: During the period of field survey and collection, a slip of field number has tagged in each collected specimens. Relevant field notes were made on the spot noting down interesting and diagnostic features (habit and habitat, size of fronds, colour of scales if present, nature of rhizome, position of sori) of the plant, name of the locality, date of collection, physiological and ecological features of the surveyed area like (altitude, soil type, humidity, temperature etc.)

Fungus or insects due to presence of phenolic acid in their frond do usually not damage the pteridophytes, therefore they may be easily preserve and maintain.

In general collection, pressing and preparation of herbarium specimens follow the recommended procedures (cf. Jain & Rao, 1976)

The specimens were pressed in blotting sheets and kept for 24 hours. The blotters must be exchanged daily usually in the sun, as the specimens were dried. The rhizome was shaken or washed free of soil before the plant was pressed. The fronds have been placed on the sheet so that both the adaxial and abaxial surface is visible.
The dried specimens were poisoned in saturated solution of Mercuric chloride and alcohol in a 1:9 ratio. The poisoned specimens were again kept for overnight in between blotting sheets for complete drying and finally such specimens are ready for mounting on herbarium sheets. Thick stem, stipes, fronds and rhizome were often tied to the sheet with white thread and the knot on the underside of the sheet covered with gummed paper tape so that it can not catch on another specimen. A slip of field number with field note including various data like name of the study area, botanical name of the plant, local name of the plant, name of the family, date of collection, locality, altitude, specific features, distribution, name of the collector etc. was passed below on the right corner of the herbarium sheets. The herbarium sheets have been deposited in the Herbarium of Botanical Survey of India, Central circle, Allahabad (U.P.).

(c) Identification: Each and every specimen were critically identified with help of available literature, study of plant parts like scales, spores, hairs and veins under microscope and they were latter determined in various Indian herbaria. All the identified species have classified and arranged according to Pichii-Sermolli’s (1977) System of Classification and genera within families, species within the genus are arranged alphabetically.

(d) Consultation of herbarium specimen housed in various Indian herbaria (Specimen examined): The specimens collected from various localities of Madhya Pradesh and Chhattishgarh states of Central India housed in various Indian herbaria viz. Botanical Survey of India, Allahabad (BSA), Botanical Survey of India, Dehradun, Central National Herbarium, Hawrah (CAL), State Forest Research Institute, Jabalpur (SFRI), Tropical Forest Research Institute, Jabalpur (TFRI), National Botanicals Research Institute, Lucknow (NBRI), Herbarium of Botany
Department of Dr. Hari Singh Gaur Vishwavidhyalaya Sagar, Herbarium of Botany Department, Allahabad University and Herbarium of Indian Institute of Forest Management, Bhopal has critically studied and listed along with botanical name, local name, family, accession number, date of collection, locality, altitude, specific features, distribution, name of the collector etc.

(e) Literature consultation: During the period the pteridological literatures related to the work were consulted and total 350 reference cards and 200 species cards were prepared.

(f) Laboratory / herbarium investigation treatment and preparation of camera lucida diagrams: In general the descriptions of species were made from collected specimens during the survey, herbarium specimens as well as from previous available literature. The taxonomic descriptions include habit, habitat, size of fronds, stipe, colour of scales if present, nature of rhizome, venation pattern, and indusium, size, position of spore with morphology. In the present details of spore morphology are based on acetolysed spores. Fresh spores mounted in Glycerine jelly are used in addition to determine spore size, shape, color, wall ornamentation and some other morphological features are observed with the aid of compound microscope. Spore sizes mentioned are average based on ten reading in each plane of spores selected at random. Illustration based on voucher specimens no. for all the genera and some species includes line diagram showing habit of the plant and camera lucida diagrams of spores of some interesting species are provided.

In the present taxonomic treatment all the species have classified and arranged according to Pichii-Sermolli’s (1958, 1977) System of Classification. The genera within families, species within the genus have arranged alphabetically. Each and every species has provided
taxonomical data with current nomenclature (in accordance with the rules of ICBN), basionym, important synonyms, original citation, recent literature, key to the families, genera and species, detailed distribution in India and Central India, ecology, foot notes, vernacular name whenever available, habit of each species, chromosome number, specimen examined and depicting illustrations of diagnostic characters to facilitate easy identification in the field and herbarium.

Distribution of the species in India and in Central India is worked out from the literature and is provided after the occurrence of each species in Central India.

The current status of living family, genera and species in form of number throughout the world, India and Central India have provided on the basis of available literature.

The cytological data showing chromosome number of all the species whenever available have provided in the present account.

Maps and photographs of the study areas and habit photographs of some interesting and useful species are also included.

Photographs of herbarium sheets were prepared during the period are provided.

Data in form of graphs showing Metrological records (rainfall and temperature reading) for the period 2000-2004 of the study area are provide.

(g) **Documentation of Rare and Endangered taxa:** From conservation point of view, the endangered (E) and Rare (R) taxa of pteridophytes of Central India have made on the basis of field observation and herbarium consultation. A list of taxa along with their status recorded so far is prepared during the period. Distribution status of each species in term of abundance, scare or otherwise was carefully noted.
(h) **Documentation of Endemic species:** Endemism indicates the importance and uniqueness of the flora of a region or the area.

(i) The causal factors leading to depletion of species and both type of conservation (ex-situ & in-situ) and multiplication measurements have proposed.

(j) **Information on traditional, indigenous, ethnomedicinal, ethnobotanical and other uses of pteridophytes of Central India:**

During the course of survey cum collection tour exclusively it has been observed that few species of pteridophytes are widely used and sold by local tribal communities for the various treatments like fever, epilepsy, leprosy stomach pain, gastro-intestinal disorders eradication of worm in children and venereal disease. Collected information was verified by crosschecking with tribal living herbal medicine practitioners of various ethnic groups though interviews, discussions, personal contacts and keen observations. The details of the plants (*e.g.*, Local name, parts used, mode of use, method of collection) were noted.

The economically and medicinally useful species growing under the political boundaries of Madhya Pradesh and Chhattishgarh are listed here.

Vernacular name, ethnomedicinal / ethnobotanical use of species, except for a few most of these importance are recorded from literature.

(l) List of new records from the area has provided.

(m) **Phytogeographical affinities of the pteridophytic flora of Central India:** The phytogeographical affinities of the pteridophytic flora of Central India were discussed with Himalayan species in north, Orissa in Central and Western ghats, Palni and Nilgiri hill in the south and Andaman and Nicobar in north-south.
(n) Ecological observation of Pteridophytes of Central India: In the present account the pteridophytes of Central India are broadly classified into various ecological categories on the basis of their growth pattern, habit and habitat.