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Pachmarhi Biosphere Reserve



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Paryavaran Parisar, E-5, Arera Colony

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**A Lead / Coordinating Institution of Pachmarhi Biosphere
Reserve**

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Preface

The main objective of the Biosphere Reserve is conservation of biodiversity at all levels from sub specific to landscape, promotion of development schemes which are culturally linked with local inhabitants in and around BR and giving priorities for research and monitoring as part of longer international network. The responsibility of management and conservation of the biodiversity lies with respective State Govt in which BRs are situated. The Ministry provides funds to various research institutions, Universities, NGO etc. preferably for multidisciplinary resources so that the finding of these resources can be applied to management of these BR. As one of the step, the Ministry has identified some of the Institutions as Lead/Coordinating Institution for BRs in this regard. Environment Planning & Coordinating Organisation is one of the Lead/Coordinating Institutions responsible for Pachmarhi BR.

The main responsibility of is collection, synthesis and dissemination of research based information from all sources for BRs, interaction with research organisations for development of suitable research project, interaction with BR managers to assess needs and crucial issues, publication of various information as biannual publication for educating stakeholders.

In order to fulfill the objectives, the informations have been collected from various published research papers, books, journals, project reports, internet, newspapers etc. Besides this, attempt has been made to include bibliography, ongoing research projects etc. These informations are being published as Biosphere Reserve Information Service (BRIS). This is the 3rd volume of the publication.

It is hoped that informations would be helpful to researchers, managers, local inhabitants, planners, administrators, scientists, NGOs, CBD etc. I would request to our all readers specially researchers/scientists to provide us a copy of the their research papers/books on Pachmarhi Biosphere Reserve so that we may incorporate the summary / abstracts of the research papers/books for disseminating these to larger users through our subsequent publications. This would also result in creation of data bank in EPCO. This would also help to identify the main issues to find out the gaps so as to avoid duplication and to devise appropriate applied research projects for the management action plan of Pachmarhi BR, which would ultimately be helpful in conservation of biodiversity of the area and socio-economic upliftment of the people residing in area. Popular articles related PBR on BRs shall be highly appreciated. We also request to all users specially, field implementing agencies, NGOs and individuals to send us successful stories related to technology implementation at level field specially related to community involvement.

Financial assistance from the Ministry of Environment & Forests, New Delhi is highly acknowledged.

I commend Dr. R.P. Singh, Project Coordinator and Dr. Sujatha Jagdish, Research Associate who worked hard to bring out this publication. The secretarial assistance provided by Mr. Rajneesh Rai , Research Asstt is also acknowledged.

The comments / suggestions for improvement of BRIS publication would be welcomed.

Date:- April , 2003

Swadeep Singh
Executive Director

Biosphere Reserves – General Information

Schemes Sanctioned for Management Action Plan of Pachmarhi Biosphere Reserve during 2002-2003

For conservation of biodiversity and socio-economic uplift of local people of Pachmarhi BR area, the Ministry of Environment & Forests, Government of India sanctioned Rs.81.09 lakhs during 2002-2003. The break-up of funds for various schemes are as follows:

S. No	Particulars	Financial target Rs. lakhs
1.0	Habitat Improvement	
1.1	Lantana Eradication at Pachmarhi Plateau	5.00
1.2	Catchment Area Treatment works	4.00
2.0	Eco –Tourism	
2.1	Nature Trails and Trekking Route	1.00
2.2	Interpretation Centre	2.70
3.0	Eco-Development	
3.1	Eco-development in Revenue Areas	9.00
3.2	Development of Pasture / Grassland	2.10
4.0	<i>In-situ and Ex-situ Conser Plant Species</i>	
4.1	<i>In-situ</i> Conservation of Genepool Reserve Areas	1.00
4.2	Promo for Cultivation of Medicinal & Econo Plants (<i>Ex-situ</i> Cons & Tech Demonst)	2.00
5.0	Promotion of Non-conventional Energy & Composting	
5.1	Promotion of Biogas Plant	2.00
5.2	Promotion of Smokeless Chullha	1.50
5.3	Promotion of LPG	1.50
6.0	Promotion of activities for increasing Crop Production	
6.1	Micro- irrigation Works	5.00
7.0	Socio-econ Upliftment	
7.1	Conservation of Indigenous Species of Fruit Plants	2.00
7.2	Promotion, Training and Distribution of Honey Bee Boxes	2.00
7.3	Animal Health Care, Immunization and Improvement	2.00
7.4	Micro-credit revolving funds	3.00

7.5	Creation of rainwater storage ponds for Fisheries Development	3.00
7.6	Promotion of Mushroom cultivation	1.50
8.0	Social Welfare Activities	
8.1	Organization of Health Camps	2.10
8.2	Providing drinking water facilities	2.00
9.0	Awareness, Education & Training	
9.1	Awareness Campaign for General Public	2.50
9.2	Organi of Nature Camp for School Children	1.20
9.3	Training cum Workshop for Imple Agencies	0.60
9.5	One day Workshop on Eco-tourism	1.00
10.0	Waste water treatment at Pachmarhi Plateau through root zone technique	2.00
11.0	Management of Natural Springs near Anhoni	2.00
12.0	Purchase of Equipment for Awareness	2.50
13.0	Promotion of Bio-villages & Bio-centre concept	9.00
14.0	Monitoring and Evaluation	2.00
15.0	Techno- econo feasibility study of Fuel wood demand & supply at three places in PBR	1.00
16.0	Plantation for sericulture at Pachmarhi	2.29
	Total	81.09

These management action plans are prepared based on the feedback given by various online Departments of Implementaing agencies, NGO's, local people, planner administrators etc. and sent to Government of India, Ministry of Environment and Forests after due approval of the district wise Field Level Implementing committee constituted under the Chairmanship of respective Collectors and, State level Coordination Committee constituted under Chairmanship of Chief Secretary. The suggestions /feedback on various aspects would be greatly welcomed.

Ongoing Research Projects related to Pachmarhi BR

Development of Indicators (Ecological, Economic and Social in Institutional terms) for Sustainable Management of Forest Ecosystem in Buffer Zone of Pachmarhi Biosphere Reserve

Dr. R. K Pandey

Senior Scientist, Ecology & Biodiversity Division
State Forest Research Institute, Polypather, Jabalpur (MP)

Objectives: Considering the theme of the project development of indicators for sustainable forest management of forest ecosystem within the buffer zone and transition areas of Pachmarhi Biosphere Reserve, the following objectives are considered for identifications of indicators:

Assessment of structure and function of forest ecosystem in the study area.

- Biological diversity sustained in the study site.
- Assessment of utilisable resources and dependency (earning sources) on Forest of local inhabitants (villagers)
- Social organization and their occupational pattern of people residing in the project site.

Population Dynamic of some Endangered Species (Mammalian Rodent Species) around Falls in the Pachmarhi Biosphere Reserve

Dr. Vinoy Kumar Shrivastava

Reader, Deptt of Biosciences, Barkatullah University, Bhopal

Objectives: The main objective of this study is to observe the habit and habitat, population dynamic, determination of home range and territory and effect of human interference (due to tourism, hunting by tribal, water pollution created by tourism) on the various endangered mammalian rodent species. Besides this, captive breeding will also be done to increase the population of endangered mammalian rodent species by natural and artificial treatment i.e., hormonal treatment. The utility of the project will be to save and increase the population of endangered mammalian species in Pachmarhi Biosphere Reserve.

Documentation of Indigenous Knowledge of Inhabitants Living in Pachmarhi Biosphere Reserve

Dr R P Singh and Dr. S. N Chaudhary*

Senior Research Officer, Environmental Planning & Coordination Organisation (EPCO), Paryavaran Parishar, E-5 Arera Colony, Bhopal

* Reader, Department of Sociology, Barkatullah University, Bhopal.

Objectives: More specifically the study will be conducted to achieve the following Research objectives;

- To trace traditional knowledge of villagers (mostly tribals in the study area) pertaining to various land and water based natural resources such as agricultural and forestry activities, fishing, touring and so on.
- To find out the level of their traditional knowledge pertaining to socio-economic and cultural institutions and practices.
- To search their traditional techniques to overcome or cope with crisis pertaining to health, natural calamities, birth death.
- To discuss the mechanisms employed by the villagers to legitimise their traditional knowledge
- To explain the inhibiting/facilitating factors experienced by the tribals to conserve, monopolise and manipulate the traditional knowledge.
- To identify the techniques that they use to update traditional knowledge, and continue it form generation to generation.
- To know their views and opinions in order to strengthen their traditional knowledge, store it and make it available to others for developmental purpose.
- To make the traditional knowledge economically more viable from the point of view of improvement in quality of life of the locals.

Analysis of Landuse Changes in and around Pachmarhi Biosphere Reserve using Remote Sensing and GIS Technique

Dr. S. Khan, Dr. R. K. Singh & Alok Choudhary

Remote Sensing Application Centre, Council of Science & Technology,

Science Bhawan,MACT Hills, Nehru Nagar, Bhopal

Objectives: The main objective of the project is to study the temporal changes in Biosphere Reserve area within a span of 10 years (1990–2000) through remote sensing techniques and develop methodology to monitor changes in landuse /land cover of the area as a result of management practices in the study area.

Studies of the Floristic Diversity and Vegetation Types of Pachmarhi Biosphere Reserve, M.P

B. K. Sinha & Parul Sharma

Botanical Survey of India, Central Circle, Allahabad-211002

Objectives: The main objective of the proposed study

- To survey, exploration, identification and documentation of the floristic diversity of the area.
- Study the diversity, distribution status, ecology and impact of biotic interference on them.
- To prepare the account of the forests and vegetation composition of the area.
- To carry out bioperspective survey of the plant resources of the area for identifying economically as well as ethnobotanically important plant species and wild relatives of crop plants for their conservation and sustainable utilization.
- To study endemic, rare, endangered, threatened plant species of the area.
- A special account of the phytodiversity in relation to tribal population in the Biosphere Reserve.
- To study the forest ecosystem in relation to the wildlife.

The work will be of great utility as for preparation of upto date inventory of the flora of Pachmarhi Biosphere Reserve, M.P. and the data collected on them could be utilized to conserve more effectively its valuable floral resources.

Documentation of Indigenous Knowledge of Inhabitants Living in Pachmarhi Biosphere Reserve

Dr R P Singh and Dr S N Chaudhary*

Senior Research Officer, Environmental Planing & Coordination Organisation

(EPCO), Paryavaran Parishar, E-5 Arera Colony, Bhopal
* Reader, Department of Sociology, Barkatullah University, Bhopal.

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- To search their traditional techniques to overcome or cope with crisis pertaining to health, natural calamities, birth death.
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- To explain the inhibiting/facilitating factors experienced by the tribals to conserve, monopolise and manipulate the traditional knowledge.
- To identify the techniques that they use to update traditional knowledge, and continue it form generation to generation.
- To know their views and opinions in order to strengthen their traditional knowledge, store it and make it available to others for developmental purpose.
- To make the traditional knowledge economically more viable from the point of view of improvement in quality of life of the locals.

Eco-tourism in the Biosphere Reserves of India- A case study of Pachmarhi Biosphere Reserve, Nilgiri Biosphere and Kanchendzonga Biosphere Reserve

Dr. Arun Kumar Singh and Dr. P K Guha
Archeological Survey of India, Kolkata.

The main objectives of the research project is :

- To study the changing environment of the area.
- To understand and conserve the biodiversity of the study area.
- To study the cultural landscape of the area and the cultural change among the people.
- To study the interaction of the local population with tourist.

- To understand the ways and means by which the local resources are being utilized by the tourist.
- To know the ways and means which the cultural change is taking place.

Faunal Inventory of Pachmarhi Biosphere Reserve

Kailash Chandra and Y.N Gupta

Zoological Survey of India, Jabalpur

The main objectives of the research project is inventorisation of faunal biodiversity of Pachmarhi Biosphere Reserve for formulating appropriate management strategy for the conservation of biodiversity of the natural ecosystem of the area.

Three New Records of Scarabaeid Beetles from Pachmarhi Biosphere Reserve

Kailash Chandra and Y N Gupta

Central Regional Station, Zoological Survey of India Jabalpur, India

Zoological Survey of India has undertaken a research project to study all groups of animals of Pachmarhi Biosphere Reserve in order to formulate the management strategy for the conservation of its biodiversity in its natural ecosystem. Three extensive survey was carried on for 49 days during 1999 to 2000. It revealed collection of 4343 specimens pertaining to almost all major group of animals including the *Scarabaeid* beetles. The record of 18 species of the Scarabaeid beetles from Pachmarhi Biopshere Reserve have already reported.

In the present study three more species of *Scarabeid* beetles were reported. These are as follows:

(1) *Onitis brahma* Lansberg

Class - Insecta

Order -Coleoptera

Family –Scarabeidaceae

Sub-family –Scarabaeinae

This is one of the largest species of genus *Onitis*. The species has been recorded for the first lime from Pachmarhi Biosphere Reserve

(2) *Mimela xanthorrhina* Hop

Class - Insecta

Order -Coleoptera

Family –Scarabeidaceae

Sub-family -Rutelinae

This species is distinguishable by its pale quasi-trasluscent colour and sides of pronotum and elytra a narrowly but not very sharply bordered with yellow and the pygidium moderately punctured and indefinitely yellow. This species was earlier known from south India and has been recorded for the first time in Pachmarhi Biosphere Reserve.

(3) *Xylotrupes gideon* Linnaeu

Class - Insecta

Order -Coleoptera

Family -Scarabeidaceae

Sub-family -Dynastinae

This is widely distributed species and the genus is represented by a single species in this region. It is found in all the stages in manure heaps and in accumulated vegetable debris. The larvae are also reported to injure the roots of cane-cuttings in sugar plantations. The collection from Pachmarhi is recorded for the first time from Madhya Pradesh.

(Source:-Geobios. 29:63-64,2002)

A Contribution to the Flora of Pachmarhi (M.P.)

H O Saxena

National Botanic Gardens, Luknow

The area of the present study covers Pachmarhi proper and the adjoining hills. The plateau on which the town stands at an elevation of just 1,067 m is 60.00 sq. km in area, surrounded by prominent peaks like Mahadev, Chauragarh and Dhupgarh. Dhupgarh is the highest hill top of the Central India.

Out of the total area of 60.00 sq. km covered by the plateau practically five-sixth is dominated by forest. According to Champion (1968) the forests are classified as Central Indian Sub – Tropical Evergreen Forests of the Southern Sub Tropical Wet Hill Forests. The flora of Pachmarhi consists of a mixture of temperate and tropical elements. The region is remarkable as forming a meeting ground for species characteristic to the himalayan and the south Indian Hills; for e.g *Rubus ellipticus*, *Berberis asiatica*, *Thallictrum foliolosum*, *Ceropegia macrantha*, *Leucas lanata*, *Malaxis mackinnonii*, *Eulophia* spp., *Lindernia hookeri* var. *kumaunensis*, *Eriocaulon xeranthemum* etc are species characteristic to Himalayan region and *Curcuma pseudomontana*, *Senecio bombayensis*, *Senecio wightii*, *Smithia pycnantha*, *Utricularia graminifolia*, *Strobilanthes campanulatus*, *Rostellularia hedyotidifolia*, *Pogostemon purpurascens* and *Crotolaria nana* are species of south and south-west India. It has received attention by several botanists due to its popularity and importance from floristic point view and a number of contributions to the flora were made by them. In the present paper 304 additional species of flowering plants and ferns have been recorded where 16 species are recorded for the first time in M.P and 12 species, which are new for Central India.

(Source: Bull. Bot. Surv. India. Vol 13, Nos.1&2:pp.79-93, 1971)

Further Contribution to the Flora of Pachmarhi Region

S L Kapoor and H L Yadav

National Botanic Gardens, Lucknow

The present study has the privilege of examining the specimens of angiosperms collected from Pachmarhi and its neighbourhood. The Pachmarhi plateau lying at about 22 1/2° latitude and 78 1/2°E longitude and the other neighbouring hilly tracts falling in Madhya Pradesh, have attracted the attention of botanical workers since the later half of the nineteenth century. This paper records an addition of angiosperm species of nearly 67 numbers to the flora of Pachmarhi region where a few new species have been recorded from a new locality within the same zone.

The families represented by more than 10 species are in order of dominance: Gramineae, Papilionaceae, Cyperaceae, Euphorbiaceae, Compositae, Acanthaceae, Scrophulariaceae, Labiateae, Amaranthaceae, Malvaceae, Convolvulaceae and Tiliaceae.

(Source: Indian Forester, 272-276, April 1962)

Fertile *Riccia* Fluitans from Pachmarhi, India

K C Patidar and A Kaul

Department of Botany, P.M.B Gujarati Science College, Indore

Riccia fluitans is considered as a species complex of different taxa viz. *R. fluitans* L. (amend Lorbeer), *R. rhenana* Lorbeer, *R. canaliculata* Hoffm and *R. duplex* Lorbeer. *Riccia fluitans* and *R. rhenana* were only known to be sterile, while *R. canaliculata* and *R. duplex* were known to be fertile under natural conditions. Present study deals with observations on *R. fluitans* from different habitats of Pachmarhi.

At different habitats the thalli differed, the aquatic thalli are ribbon like while that of terrestrial thalli are relatively thicker and broader. Mature sporophytes were abundant in aquatic plants and standard thalli but its frequency was less in terrestrial plants. The orientation of the sporophytes in both the forms is more or less horizontal almost flat dorsal surface of the thallus and conspicuously protrudes ventral surface with rhizoids. The spores are polar, dark, yellowish-red and reddish brown, 65-87µm in diameter in aquatic form with triradiate mark on proximal face. All surfaces of the spores are minutely papillose. The average output of spores per capsule is 217 in terrestrial and 196 in aquatic forms. Sudden appearance of abundant sporophytes on *R. fluitans* may be possible because of the climatic condition of the locality as well as the physicochemical factors of the streams that favour the

production of the sex organs. At present Pachmarhi, *R. fluitans* grows luxuriantly from September to February or even a little later indicating favourable climatic condition for the production of sporophytes in these plants.

(Source: Yushania 6 (1) pp, 21 – 23, 1989)

Culture Studies on *Plagiochasma appendiculatum* Lehm. ET Indenb and *Reboulia hemisphaerica* (L) Raddi populations of Pachmarhi (Central India) in relation to pH on a Comparative Basis

K S Vishvakarma and A Kaul

Deptt. of Botany, Madhav Science College, Ujjain

Bryophytes occur widely because of their adaptability. Hydrogen ion concentration is one of the important physical factors of the environment that influence the distribution of bryophytes. In the present study the influence of pH on growth and spore germination was observed in the population of *P. appendiculatum* and *R. hemisphaerica* present in Pachmarhi (Central India).

P. appendiculatum and *R. hemisphaerica* are widely distributed under different ecological conditions in the Indian sub continent. In Central India, at Pachmarhi, *P. appendiculatum* is much more common than *R. haemishaerica*. There is similarity in life cycles, their development. Physical factors play very important role in the growth of Bryophytes.

During this study it was observed that an acidic range of pH (3.0 to 7.0) in the populations of *P. appendiculatum* and *R. haemisphaerica* was favourable for vegetative propagation. Spores of *P. haemisphaerica* are adjusted to a narrower range of pH for germination than those of *P. appendiculatum*. The pH appears to be one of the important limiting factors for the growth and spore germination of both species.

Bryophytes are small plants and microclimatic factors play an important role in their growth and distribution. Phenotypic plasticity and acclimatization have played a major role in the adaptation of certain mosses and hepatic species to climatic condition.

(Source: Cryptogamie, Bryol, Lichenol. 1988 9 (2): 129 –135)

Contribution to the Flora of Pachmarhi – A Reassessment

O Oommachan, and S K Masih

Deptt. of Biological Sciences, R D University, Jabalpur (MP)

Pachmarhi is a lovely hill girdled plateau known as the "Queen of Satpura range, popularly known as a "Botanists paradise" as every year many batches of Botanical tour parties visit Pachmarhi from different parts of the country for the collection of rare botanical specimens. The flora of this region has been largely removed from the valley regions for cultivation. The review of literature revealed that a number of workers made preliminary survey of the flora of this region.

The present survey identifies total of 909 species belonging to 111 families. Out of this 163 species are new additions. They belong to 54 families of which Agavaceae, Annonaceae, Cannaceae, Crassulaceae, Cuscutaceae, Malphighiaceae, Moringaceae, Nyctangiaceae, Proteaceae, Sansevieriaceae, Saxifragaceae and Sterlitzaceae are additional families. They also made some changes in the positions of the ten dominant families. On the basis of the species numbers are Poaceae (104), Fabaceae (92), Asterceae (58), Acanthaceae (44), Euphorbiaceae (43), Cyperceae (42), Orchidaceae (26), Schrophulariaceae (25), Lamiaceae (25) and Rubiaceae (23). Out of 909 species the ratio between the Dicots and Monocots comes to be 3:1.

(Source : J. Econ. Tax. Bot. Vol.16 (No.2) 1992)

***Plagiochila fruiticosa* Mitt.- An Addition to the Bryoflora of Central Indian Zone**

R M Shukla, D K Jain and A Kaul

Department of Botany, Madhav Science College, Ujjain

Plagiochila fruiticosa is reported for the first time in Central Indian Zone. The species particularly habitates on rocks and on the basis of trees in shady humid conditions inhibited particularly to the lower evergreen and deciduous forest at an elevation of 100-600 m. It was collected in pure tuft as small patches on wet rock near water streams. The study reveals that specific details of plant is : Plants size 5- 10 cm long, 2.0-2.5 mm wide, blackish to brownish green some what glossy stem about 0.5 mm thick, blackish brown, apex yellowish green erect spreading. Oil bodies 3-7 per cell (at leaf base a little more) 8x3.5-4 μ , fusiform or spherical with globules. Perianth bowl-shaped, 1 mm long and wide.

The species is very close to *P.frondeescens* but in this species leaves on main stem are longer. Plants are more winding and robust, cell wall is distinctly thickened, male bracts are less than 8 pairs cells of middle leaf are 13-17x(23)-30-40 μ .

(Source: Yushania 6(4) 1989)

Response of *Marchantia nepalensis* Gemmae towards Certain Factors during Germination and Early Stages of Growth

A Kaul and R Kaul

Department of Botany, Madhav Science College, Ujjain

Present study deals with the effect of certain factors on germination and early stages of growth of *Marchantia nepalensis* Gemmae. At the end of the rainy season large number of gemmae are visible in the gemmae cups of *Marchantia nepalensis* and continues till the end of the winter season while the mature ones are gradually released out of the cup. For the present work, gemmae were removed and germination was tested in $\frac{1}{2}$ Knop's Solution in the cavity over 2% nutrient agar.

Germination usually starts within four days in continuous light. Potassium nitrate solution was also ineffective for the germination of gemmae under such condition. At 30°C constant in the presence of diffused light germination was quite satisfactory but at 35°C it stopped totally. Germination also took place in the absence of potassium nitrate and calcium chloride solutions upto 0.5%, gibberellic acid upto 150 ppm, under diffused light at 16°C, 30°C and alternate temperature of 16°-30°C but above than this was inhibitory. Germination was 100% in freshly collected gemmae but germinability was reduced with the faster rate in those gemmae, which were stored at higher temperatures than at lower temperatures. Longevity was adversely affected on storage at diffused conditions. However, storage at higher temperature had more adverse affect than at lower temperature.

Growth rate was better in early stages under diffused light than continuous light and in the darkness. Growth was better in far-red than red, orange and green lights. Filamentous branches from the cells of the gemmae were developed on storage at 12°C for 60 days where as the developments of two characteristic thalli at the notches were suppressed.

Marchantia nepalensis Gemmae germinated in diffused light, continuous light, red, orange and green light. In darkness, gemmae did not germinate even in the presence of potassium nitrate. It was quite interesting to find that storage at 12°C constant stimulated some of the

cells to form filamentous branches In early stages growth was better in diffused light than in continuous light and in the darkness. Maximum growth was observed in far-red and minimum in green light.

(Source : Journ. Hattori Bot. Lab. (No.38): 435-441, Jul. 1974)

Inventory of Scarabaeid Beetles (Coleoptera) from Madhya Pradesh

Kailash Chandra

Zoological Survey of India, Central Regional Station, Jabalpur, (M.P)

Scarabeid beetles (Coleoptera) were studied in Madhya Pradesh as part of an extensive study of biodiversity in the State by the Zoological Survey of India. The *Sacarbeid* beetles of the order Coleoptera include both useful as well as harmful insects. The coprophage beetles generally known as dung beetles play an important role in nature sanitation by feeding on the dung. The phytophagus beetles commonly known as chafers are pests of agricultural crops, plantations and forests.

The family scarabeidae is the largest family of insects, which contains more than 30,000 species in the world. This paper presents a checklist of scarabeid beetles from Madhya Pradesh including Pachmarhi area, which includes 94 taxa belonging to 9 sub families.

Of these 6 species viz. *Orphnus parvus* (Weid.), *Chiron cylindrus* (Fabricius), *Chironitis arrowi* (Janssens), *Heliocopris gigas* (Linnaeus), *Oxyadoretus nastrus* (Arrow) and *Protaetia alboguttata* (Vigors) are reported for the first time from Madhya Pradesh.

(Source : India. Zoos Print Journal; 15 (11): 359 – 362)

Ecological and Phytogeographical Observations on the Pteridophytic Flora of Pachmarhi Hills (Central India)

S S Bir & S M Vasudeva

Department of Botany, Punjabi University, Patiala

Pachmarhi lies between the Himalayas in the North and Palni & Nilgiri hills in the south of

the Indian subcontinent. Though a lot of information on pteridophytic flora is available about the Himalayan and South Indian members, there was complete absence of any detailed account about Pachmarhi hills. Pachmarhi hills belong to the Gondwana sandstone series. Perennial streams flow through the gorges down below towards the base of the mountains.

A total of 56 members of pteridophytes have been collected from the area. Of these 48 belong to ferns and the rest to the fern allies. These include some rare species such as *Psilotum triquetrum*, *Isoetes panchananii*, *Selaginella exigua*, *Cyathea gigantea* and *C. spinulosa*, *Ophioglossum nudicaule* and *Polybotrya appendiculata*. In addition to these the tree ferns such as *Cyathea gigantea* and *C. spinulosa* are not only conspicuous but are also abundant. Ecological and distribution notes are given for all the species. The most interesting points is that except for two ferns, namely, *Pleopeltis macrocarpa* and *Microsorium membranaceum*, there is a total absence of epiphytic ferns in the Pachmarhi hills inspite of the fact that the annual rainfall in the area is quite heavy (about 250 cms) and that too well distributed from June to September, a period during which majority of the ferns grow and mature in the mountains. Majority of the pteridophytic members are terrestrial, growing inside deep gorges.

Some species namely *Angiopteris erecta*, *Cheilanthes tenuifolia*, *Nephrolepis exaltata*, *Cyathea gigantea*, *C. spinulosa*, *Polystichum amabile*, *Cyclosorus cylindrothrix*, *Asplenium cheilosorum*, *A. normale*, *Paraleptochilus decurrens* and *Pleopeltis macrocarpa* recorded at Pachmarhi are also common with Eastern Himalayas, but not recorded from the Western part. These constitute about 19.4% of the pteridophytic flora of the area. *Selaginella radicata*, *Ophioglossum nudicaule*, *Athyrium falcatum* and *Asplenium inaequilaterale*, growing at Pachmarhi, are also found in South India but not known from the Himalayas. It is also interesting to note that *Equisetum ramosissimum*, *Athyrium schimperi* and *Cyclosorus cylindrothrix* met with both at Pachmarhi and in the Himalayas, are not recorded from South India. There are only two species namely *Selaginella exigua* and *Isoetes panchananii* that are found at Pachmarhi but are not recorded either from the Himalayas or South India.

(Source: J. Indian Bot. Soc 51: 297 – 304)

Culture Studies on *Riccia gangetica* Ahmad IV: Effect of Light Quality on Growth

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The present communication deals with the effect of various light quantities on growth performance of *R.gangetica*, a common species of Ricciaceae at Pachmarhi. Growth performance such as revival capacity and averages of length, breadth, fresh and dry weight of newly formed branches were noted. Continuous irradiation with red, white, blue, green and yellow light has marked effect on the growth.

The best growth performance as measured by number average length, average breadth and fresh and dry weight production of newly formed branches were significantly more in red light quality than in any other light quality tested. It is evident that the light quantity played an important role in sustaining healthy growth of *R.gangetica* in association with other ecological factors.

This paper deals with the effect of light quality on growth of *Riccia gangetica*, Ahmad. It is evident that the light quality played an important role in sustaining healthy growth of *R.gangetica* in association with other ecological factors. Red light sustains healthiest growth.

(Source : National Academy 'Science letters' , India. Vol.7, No.5, May 1984)

Influence of Mineral Salts on Spore Germination in *Plagiochasma appendiculatum* L.et L

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In the present study an attempt was made to investigate influences of various mineral salts on spore germination in *P.appendiculatum*. Mature sporophytes were collected and air dried and finally stored at ordinary conditions. Spore germination was tested in the solutions of various mineral salts and simultaneously control was with distilled water. It was observed that *P. appendiculatum* can germinate even in water but inorganic salts influence germination upto a certain extent. Germination was better in half strength solution as compared to full strength, which reveals that concentration also plays a significant role.

In the present study the germination of spores was enhanced upto a certain extent and nitrate lies next to magnesium in the category of stimulators. Inhibition of germination of spores takes place by sodium chloride and potassium dihydrogen orthophosphate.

A significant importance of magnesium salt is seen in the germination of spores. At lowest concentration the germination accelerates and its absence from medium decreases germination. High tolerance towards calcium is responsible for its success on the walls and tolerance to various mineral salts indicates perpetuation of species over a variety of substrates viz rocks, soils and walls. Tolerance of salts provides an additional insurance for the perpetuation of this taxon in different environments.

(Source: Geobios 8:116 – 118, 1981)

Culture studies on *Riccia gangetica* Ahmed - Effect of pH on Growth

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The pH is one of the important factors, which affects growth of bryophytes. Liverworts prefer to grow in an alkaline range of pH. This paper deals with effect of pH on growth of *R. gangetica* Ahmed, a common species of Ricciaceae at Pachmarhi. During the present experiments, growth performances such as revival capacity, length and breadth and fresh and dry weight production of newly formed branches were noted.

The present study revealed that the percentage revival of thalli was maximum (100%) at pH 5.5 to 6.0 and minimum (20%) at pH 2.5. Number of new branches was minimum (3) at pH 2.5 and pH 4.0 and maximum (9) at pH 5.0 and pH 6.5. Average length of new branches was minimum (2.3mm) at pH 2.5 and maximum (9.4) at pH 5.0. Average breadth of new branches was minimum. (10 mm) at pH 2.5 and maximum (2.3 mm) at pH 4.5. Fresh weight of the new branches was minimum (5.38 mg) at pH 4.0 and maximum (29.29 mg) at pH 6.5.

The number of newly formed branches was maximum at pH 5.0 to 6.5. It is therefore clear that *R.gangetica* is adjusted to acidic range of pH for vegetative growth. Since new branches were formed in acidic range. The better chances of vegetative spread of the species in nature, exists in acidic soils. Along with other ecological factors pH of the substrate plays an important role.

(Source: Cryptogamie, Bryol. Lichenol, 1982, 3,2 : 157-160)

Chlorophyll Concentration and a/b Ratios in Response to Habitats In three Species of *Riccia*

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In the present study, chlorophyll concentration was analysed for three species of *Riccia* grown at three different habitats of Pachmarhi. Bryophyte as a group, tends to be shade adapted with many of them having a low chlorophyll a/b ratio. Three species of *Riccia*, mainly *R.discolor*, *R.gangetica* and *R.fluitans* for chlorophyll concentration and a/b ratios, grown in shady, exposed and aquatic habitats, respectively, were taken for this study. The shady adapted species *R.discolor* had higher average chlorophyll a (0.517 mg/l) and b (0.358mg/l) because sunlight could not penetrate directly on surface view of thalli at Jatashankar locality. In *R.gangetica* average chlorophyll a (0.476 mg/l) and b(0.343 mg/l) is lower as red pigmentation developed due to high light intensity and also grows in exposed condition at this locality and received direct sunrays. Production of red pigment in many species of bryophytes is a characteristic and taxonomically important production is a response to ecological condition. The chlorophyll a & b is lesser in *R.fluitans* than above two species, the usual coloration is green.

Based on these observation, *R.discolor* responds to low light intensity by broad thalli, covers more areas by propagation and increased chlorophyll due to shady habitat, *R.gangetica* responds to high light intensity by red coloration, found in small patches with narrow thalli and less chlorophyll, because grown in exposed and moist condition and *R.fluitans* an aquatic species have very narrow thin thalli and lesser chlorophyll.

(Source :Yushania, Vol.3No.4.1986)

Summary of Books /Reports

Grasses of Madhya Pradesh

Dr. G P Roy

Botanical Survey of India

Several earlier workers have done botanical exploration and publication of checklist of plants for Madhya Pradesh area. The gramineae is one of the largest families of flowering plants. The number of genera is a matter of diverse opinion. It may be 620 genera and about 10,000 species in the world. About 240 genera are represented in India. About 1,200 species are supposed to be occurring in India.

Following grasses (genera /species) are found in Pachmarhi BR.

SNo	Genera	Species
1.	Alloteropsis	<i>Alloteropsis cimicina</i>
2.	Apluda	<i>Apluda mutica</i>
3.	Aristida	<i>Aristida depressa</i>
4.	Arthraxon	<i>Arthraxon lancifolius</i>
5.	Arundinella	<i>Arundinella pumila</i>
6.	Bambusa	<i>Bambusa arundinacea</i>
7.	Bothrichloa	<i>Bothrichloa glabra</i>
8.	Bothrichloa	<i>Bothrichloa intermedia</i>
9.	Bothrichloa	<i>Bothrichloa kuntzeana</i>
10.	Bothrichloa	<i>Bothrichloa apertusa</i>
11.	Brachiaria	<i>Brachiaria reptans</i>
12.	Capillipedium	<i>Capillipedium assimile</i>
13.	Chloris	<i>Chloris virgata</i>
14.		<i>Chloris dolichostachya</i>
15.	Chrysopogon	<i>Chrysopogon polyphyllus</i>
16.	Coix	<i>Coix aquatica</i>
17.		<i>Coix gigantea</i>
18.		<i>Coix lacryma-jobi</i>
19.	Chionachne	<i>Chionachne koenigii</i>
20.	Cymbopogon	<i>Cymbopogon martinii</i>
21.	Cyrtococcum	<i>Cyrtococcum oxyphyllum</i>
22.	Dendrocalamus	<i>Dendrocalamus strictus</i>
23.	Dichanthium	<i>Dichanthium annulatum</i>

24.		<i>Dichanthium aristatum</i>
25.	Digitaria	<i>Digitaria ciliaris</i>
26.		<i>Digitaria longiflora</i>
27.		<i>Digitaria setigera</i>
28.		<i>Digitaria ternata</i>
29.	Echinocloa	<i>Echinocloa colonum</i>
30.	Eleusine	<i>Eleusine indica</i>
31.	Eragrostiella	<i>Eragrostiella brachyphylla</i>
32.	Eragrostis	<i>Eragrostis cilianensis</i>
33.		<i>Eragrostis diarrhena</i>
34.		<i>Eragrostis gangetica</i>
35.		<i>Eragrostis tenella</i>
36.		<i>Eragrostis termula</i>
37.		<i>Eragrostis unioloides</i>
38.	Eulaliopsis	<i>Eulaliopsis binata</i>
39.	Hackelochloa	<i>Hackelochloa granularis</i>
40.	Hemarthria	<i>Hemarthria compressa</i>
41.	Heteropogon	<i>Heteropogon contortus</i>
42.	Iseilema	<i>Iseilema laxum</i>
43.		<i>Iseilema prostratum</i>
44.	Ischaemum	<i>Ischaemum indicum</i>
45.	Manisuris	<i>Manisuris forticulata</i>
46.	Melanocenchris	<i>Melanocenchris jacquemontii</i>
47.	Oplismenus	<i>Oplismenus compositus</i>
48.	Oropetium	<i>Oropetium roxburghianum</i>
49.	Panicum	<i>Panicum notatum</i>
50.		<i>Panicum repens</i>
51.	Paspalidium	<i>Paspalidium flavidium</i>
52.	Paspalum	<i>Paspalum scrobiculatum</i>
53.	Pennisetum	<i>Pennisetum hohenackeri</i>
54.		<i>Pennisetum orientale</i>
55.		<i>Pennisetum pedicellatum</i>
56.	Perotis	<i>Perotis indica</i>
57.	Phragmites	<i>Phragmites karka</i>
58.	Pogonatherum	<i>Pogonatherum paniceum</i>
59.	Pseudosorghum	<i>Pseudosorghum fasciculare</i>
60.	Rhynchelytrum	<i>Rhynchelytrum repens</i>

61.		<i>Rhynchelytrum villosum</i>
62.	Rottboellia	<i>Rottboellia exaltata</i>
63	Saccharum	<i>Saccharum spontaneum</i>
64	Schizachyrium	<i>Schizachyrium exile</i>
65	Setaria	<i>Setaria barbata</i>
66.		<i>Setaria glauca</i>
67.		<i>Setaria pumila</i>
68.	Sorghum	<i>Sorghum halepense</i>
69.		<i>Sorghum miliacum</i>
70.		<i>Sorghum nitidum</i>
71.	Spodiopogon	<i>Spodiopogon rhizophorus</i>
72.	Sporobolus	<i>Sporobolus capillaris</i>
73.		<i>Sporobolus coromandelianus</i>
74.		<i>Sporobolus fertilis</i>
75.		<i>Sporobolus indicus</i>
76.	Themeda	<i>Themeda quadrivalvis</i>
77.		<i>Themeda triandra</i>
78.	Thysanolaena	<i>Thysanolaena mixima</i>
79.	Tripogon	<i>Tripogon jacquemontii</i>
80.	Vetiveria	<i>Vetiveria zizanoides</i>
81.	Zea	<i>Zea mays</i>

(Source: - Flora of India, Series- 4, 1984)

Flora of Pachmarhi and Bori Reserves

Dr. A.K.Mukherjee

Botanical Survey of India

The flora of Pachmarhi and Bori forest ranges consists of 101 families consisting of 452 genera and 778 species. The species consists of 247 trees and shrubs as well as 531 herbs. Out of 101 families, 36 are restricted to Pachmarhi range and 4 to Bori range.

The 3rd position of Asteraceae and 7th position of Hamiaceae, which are more temperate in nature, indicates the semi-temperate nature of the vegetation. The monocotyledonous families namely, Poaceae, Cyperaceae and Orchidaceae account 50 % species under the ten dominant families of the area. It indicates the dominance of monocotyledonous plants in the area.

There are broadly two types of forests in Pachmarhi and Bori forest ranges namely:

The first type is localized at high elevations around Pachmarhi receiving high rainfall over 175 cm. The forest is characterized by larger proportion of evergreen species. Tree ferns are found in the deep gorges with perennial waters.

In lower elevations around Pachmarhi the second type of forest is found. This type occurs in locations having annual rainfall of 100 to 170 cm. In Bori forest range *Tectona grandis* is the dominant species. There are number of interesting plants which do not occur else where in Madhya Pradesh, except in Pachmarhi namely, *Malastoma malabathricum* L., *Murraya paniculata* (L) Jack., *Holmskiodia sanguinea* Retz., *Blumea lanceolaria* (Roxb.) Druce and *Sophora interrupta* Bedd. It is interesting to note that the *Shorea robusta* Gaerten. f is the Western limit of distribution of the species in the midst of the teak areas of Madhya Pradesh, while teak (*Tectona grandis*) is absent from this plateau.

On the contrary the teak is the dominant tree in the Bori valley. It flourishes on trap soil but is invariably poor and stunted on sandstones. The alluvial soil along the banks of the large streams and of the Bori river produces exceptionally fine teak forest also but the low hills along both sides of the valley, which have trap soil, produces the best teak stands. The distribution of Sal and teak is markedly so distinct in Pachmarhi and Bori forest ranges and proves that the edaphic factor is very important for the distribution of certain plants. Among the 101 families reported the families Magnoliaceae, Ranunculaceae, Berberidaceae, Polygonaceae, Dilleniaceae, Dipterocarpaceae, Violaceae, Cochlospermaceae, Passifloraceae, Salicaceae, Myrsinaceae, Primulaceae, Stereculiaceae, Bombacaceae, Droseraceae, Lecythidaceae, Melastomataceae, Sapindaceae, Linaceae, Geraniaceae, Polygalaceae, Araliaceae, Celastraceae, Leeaceae, Oleaceae, Santalaceae, Lentibulariaceae, Stylidiaceae are predominantly found in Pachmarhi region, while Cactaceae, Menyanthaceae, Pedaliaceae are the predominant species in Bori region. The class liliatae including families Hypoxidaceae, Musaceae, Orchidaceae, Aracaceae are predominant in Pachmarhi region while rest 9 families are present in both the regions with largest number of genera (Poaceae, 57 nos.) present. The two families of class Gymnosperms, viz Pinaceae and Cupressaceae are present in Pachmarhi region only.

Among the ten dominant families reported from Pachmarhi and Bori forest ranges, Poaceae ranks 1st with 57 nos. of genera, Fabaceae (including Papilionaceae, Caesalpiniaceae with 8, Acanthaceae with 22, Euphorbiaceae with 12, Lamiaceae with 13, Rubiaceae with 16, Scrophulariaceae with 12, Orchidaceae with 13 genera. These account for 224 genera (49.5 % of the total) and 325 species (41.7%) of the total.

(Source: Flora of Pachmarhi and Bori Reserve published by Dr. A.K.Mukherjee, Botanical Survey of India, 1984)

Study of Natural Springs in Pachmarhi Biosphere Reserve

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Biosphere Reserve is an international designation. India is one of the 12-megabiodiversity countries of the world. The idea of Biosphere Reserve was initiated by UNESCO in 1973-74 under its Man and Biosphere (MAB) programme. In India, the National Biosphere Programme was initiated in 1986 and so 13 for BRs have been designated all over the country. The Pachmarhi Biosphere Reserve, located at Satpura Hill ranges in Central India in the state of Madhya Pradesh was designated as Biosphere Reserve in the march 1999. The detailed Management Action Plan to reduce the conflict between man and the forests and thus conserving the rich biodiversity of the Biosphere Reserve, has been prepared based on environmental considerations for the area. The various thematic maps has been prepared to evaluate present status of the area and to identifying the critical zones related to natural resources, flora, fauna, demand and supply of resources, tourism, socio-economic status, land use, biodiversity etc. The spatial planning tools have been applied under the Zoning Atlas programme for Environmental Management of Pachmarhi Biosphere reserves. The Environmental Management of Pachmarhi Biosphere reserves may be help full in improving the status of ecosystem as a whole, create employment opportunities through Eco-development programme and reduce the dependence on the local natural resources.

(Source: National Seminar Organised by School of Studies in Zoology Vikram University, Ujjain, August 8-10, 2002)

Chromosome Numbers and Evolutionary Status of Ferns and Fern Allies of Pachmarhi Hills (Central India)

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In order to evaluate the ferns and fern allies of Pachmarhi, present investigations were carried out during the years 1970-75. Out of a total of 58 members collected 55 species were worked out. New chromosome numbers were recorded for 4 species. These are as follows:

Selaginella exigua, n=10(2X)

Trigonospora sericea, n=72(4X)

Cyathea gigantea, n=69(2X)

Trigonospora ciliata, n=72(4X)

Ten new cytotypes were also discovered for another 10 species which are as follows:

Selaginella radiata, n=36(8X)

Isoetes panchananii, n=55=1f(10X)

Ophioglossum nudicaule, n=c.500(8X, aneuploid)

Lygodium flexuosum, n=58(4X)

Egenolfia appendiculata, 2n=123(3X)

Athyrium pectinatum, n=80(4X)

Athyrium schimperi, n=80(4X)

Dryoathyrium boryanum, n=120(6X)

Polystichum amabile, n=41(2X)

Some more interesting facts are as follows:

- * Amongst ferns *Marselia quadrifolia* recorded lowest chromosome number (n=20) while that of highest number (n=c.500) was recorded in *Ophioglossum nudicaule*. On the other hand amongst fern allies, highest number (n=108) was recorded in *Equisetum* species and lowest number in *Selaginella exigua* (n=10).
- * *Selaginella radicata* shows the highest grade of polyploidy (octaploid) ever recorded. *Isoetes* also shows the highest grade of polyploidy where as *I. panchananii* is decaploid.
- * Both the species of *Equisetum* showed 108 as haploid chromosome number. Throughout the world, in all the worked out species of the genus, *Equisetum* n=108, 2n=216 is recorded.
- * *Ophioglossum nudicaule* of Pachmarhi shows the highest chromosome number (N= c.500) ever recorded for the species from India.
- * Amongst ferns apogamy has been recorded in *Pteris cretica* 'n'=2n=58(2X), *Adiantum philippense*, n=2n=90,(3X) and *Asplenium cheilosorum*,

$n=2n=108$ (3X). All these ferns show the Dopp-Manton or Mehra manton mechanism.

- * *Asplenium cheilosorum* has partially established apomictic behaviour and the percentage of sporangia having 32 diplospores from 8 celled sporangia as a result of failure of premeiotic mitosis, is variable in different sori on the plant.
- * *Egenolfia appendiculata* is a triploid hybrid and SMC's show different number of bivalents and univalents giving $2n=123$.
- * Finding of sexual diploid of *Asplenium unilaterale* with $n=40$ from Pachmarhi is interesting from the fact that it clearly supports the earlier contention that genus *Asplenium* is dibasic. This gives a cytological basis for segregating *Asplenium unilaterale* group of species into a sub genus *Hymenasplenium (hayata) Bir.*

On comparing the results of pteridophytic species found in Pachmarhi with other well investigated regions of India, it was observed that 18 species were same from four investigated regions i.e, Himalayas, South India, West India and South India. These species are as follows:

Equisetum debile (24X)

Osmunda regalis (2X)

Equisetum debile (24X)

Osmunda quadrifolia (2X)

The ferns *Cheilanthes tenuifolia*, *Pteris biaurita*, *Dicranopteris linearis*, *Dryopteris cochleata*, *D. sparsa*, *Polystichum auriculatum*, *Athyrium falcatum*, *A. pectinatum*, *A. schimperi*, *Dryothyrium boryanum* of Pachmarhi show a higher polyploidy when the results for these species are compared with the Himalayas.

Similarly, when compared with the results from South India, following members of pteridophytes like *Lycopodium cernuum*, *Ophioglossum reticulatum*, *Angiospteris evecta*, *Adiantum philippense*, *Cheilanthes farinosa*, *Pteris quadriaurita*, *Microlepia speluncae*, *Sphenomeris chinensis*, *Polystichum amabile*, *Athyrium japonicum*, *Asplenium normale*, *A. unilaterale*, *Leptochilus decurrens*, *Pleopeltis macrocarpa* from Pachmarhi show lower grade of polyploidy.

The exception which were observed are as follows:

- ❖ Octaploid race of *Selaginella radicata* is known from Pachmarhi and tetraploid is recorded from South India.

- ❖ 6x and 8x races for *Ophioglossum nudicaule* are known from Pachmarhi whereas 4x and 6x plants are recorded from south India.
- ❖ Triploid of *Egenolfia appendiculata* is found in Pachmarhi whereas diploid is recorded in South India.
- ❖ In case of *Dryopteris cochleata* 2x and 4x races are known from Pachmarhi and only 2x from South India.
- ❖ For *Polystichum auriculatum* and *Athyrium pectinatum* 2x from Himalayas and South India and 4x from Pachmarhi are known.
- ❖ Tetraploid race of *Asplenium normale* is recovered from the Himalayas, diploids and tetraploids are known from South India whereas in Central India only diploids are found.
- ❖ Tetraploids of *Sphenomeris chinensis* is recorded from the Himalayas and South India while diploid is known from Pachmarhi.
- ❖ In case of *Dryoathyrium boryanum*, diploid is known from Himalayas, hexaploid from Central India and triploid apogamous from South India.

From above comparisons, it is concluded that pteridophytic members of Pachmarhi show intermediate levels of polyploidy when species to species are compared for the three regions i.e, Central , Himalayan and South Indian region.

This gives ample support to the generalization made earlier by Manton (1969) that "there is decline in the degree of polyploidy as one passes north wards up the Indian sub continent"

Finally it may be concluded that as compared with the Himalayas, the central India members not only show higher incidence of polyploidy but also reflect higher grade and more number of intraspecific races. The same relationship exists between central and South Indian members. Thus we can say that the rate of evolution in the Pachmarhi pteridophytes is faster than the Himalayan but slower than the South Indian members which represent the tropical flora.

(Source : Aspects of Plant Sciences – 6:(119-181), 1982, Today & Tomorrow's Printers & Publishers , New Delhi-110005)

Identification and Preparation of Conservation Plan for Natural Heritage sites in Pachmarhi Biosphere

Dr. Meenakshi Pathak

The paintings on the rock shelters depict varied dimensions of culture and lifestyle of the prehistoric man. The painted shelters were named after the names of the villages in the vicinity of which the shelters were found or known by the local people. For the ease of understanding the area of the Pachmarhi Biosphere, has been divided in eight zones from A to H based on the cardinal directions.

The classification of the rock shelters on the basis of the direction, area and location is as follows:

S.No.	Zones	Location
i	Northern Zone [A]	Bazar Cave-1 Bazar cave-2 Nimbu Bhoj Ghurnar
ii	North-Eastern Zone [B]	Mahadeo-1 Mahadeo-2 Mahadeo-3 Mahadeo-4 Tapka Pani Sambhar Jhil Eshan Shring or Mathew Peep Kaila Khud
iii	Eastern Zone[C]	Kanji Ghat-1 Kanji Ghat-2
iv	South Eastern Zone[D]	Batki Bundal Apsara Vihar Rajat Prapat Tamia Pandav caves
v	South-Eastern Zone[E]	Mahadeo
vi	South-Western Zone[F]	Mount Rosa or Astachal -1 Mount Rosa or Astachal-1 Rori Ghat-1 Rori Ghat-2 Bori Chitrashala Bori Rampur

vii	Western Zone[G]	Vrindavan Langi Hills or Kite Crag Dorothy Deep-1 Dorothy Deep-2 Bee dam-1 Bee dam-2 Churna Madai Pattan
viii	North Western Zone H]	Swem Aam Jambodweep-1 Jambodweep-2 Chhota Mahadeo Khari lane-1 Khari lane-2 Khari lane -3 Parewa Pahari

The location of Pachmarhi from the ecological point of view is such that it meets the basic needs of human being to survive viz. food, water and shelter. Many of these shelters contain large number of paintings in varying states of preservations. The rock surface was not prepared specially before painting, often uneven surfaces and corners were chosen for paintings. For thousands of years the rock paintings have endured rain, sun and thunderstorm, now man is the most potent threat. Most of the shelters have now become accessible due to development of tracks and roads, consequent to the development of tourism in this area and the religious significance attached to the place.

The paintings now face threat of human vandalism and unaware of the local tribal who go deeper to exploit the forests for their livelihood. During festival days the paintings on the shelters are falling off due to the frequent exposure of the surface to the intense heat produced by the fire. The paintings on the accessible shelters are falling prey to the

uncivilized and unaware tourists who engrave insignificant words on the soft sandstone are consequently damaging these valuable paintings.

There appears no check on the people visiting the sites of the rock paintings by the government agencies. In some shelters the painted portions have been carefully carved out using sophisticated electromechanical devices. Also painted surfaces have been successfully scrubbed to collect material of which the paintings are made of. The roots of the trees and the creepers have gone deeper into the cracks on the rock surfaces resulting in peeling and breaking of the surfaces of the rock paintings. The preservation of rock paintings is related directly with the protection of the environment of the plateau of Pachmarhi. Rock paintings are not only a wonderful art form and an integral component of our ethnic culture, but are in themselves an expression of both history and natural history. There is need to protect and preserve the rock art wherever they are, because, only if, these sites are protected, one can learn more about this ancient form and the long vanished civilization that gave it life.

Suggested Conservation Measures

- Periodic removal of vegetation and also the moss deposition along the painted surfaces and under the shelters.
- Prevention of calcium deposition due to seeping water
- Prevention of soil erosion, from sites by planting bushes and shrubs in the area of shelters.
- Provision for diversion of the rainwater from the roofs of the shelters to prevent it from entering or percolating into the shelter.
- Construction of drains to prevent water entering the shelters and also to drain out the water.
- Erection of barricades and /or chain link fencing to enclose the mouths of the caves and shelters to prevent the paintings from touching.
- Educating local habitants particularly residing in the vicinity of the shelters, about the significance of the rock paintings, and their importance for their preservation.
- Training to the personnel of forest, revenue, police departments, local bodies and tourist guides on the significance of the rock paintings, importance of their preservation and law dealing with the offences related to theft and damage to such heritage.

- Preventing entering of drinking water (as it contains chlorine) which is harmful for the paintings.
- Levying of charges on visit to the rock painting sites as part of the Biosphere Reserve programme, where this amount can be used for protection of rock paintings.
- Clearance certificate is to be issued for the foreign tourists / researchers visiting the area inside the Biosphere Reserve.
- All the local tourist guides should be trained on all aspects of the Biosphere Reserve and rock paintings also needs to be done properly to match the grandeur of this heritage site.
- Exemplary punishment to the vandals and those involved in theft of these paintings with its publicity in the media.

(Source: Dr. Meenakshi Pathak, consultant on behalf of Environmental Planning & Coordination Organization under Management Action Plan of Pachmarhi Biosphere Reserve, 2003)

Quantitative and Floristic Study of Vegetation in a Preservation Plot in Bori Forests, M.P

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In the present study an attempt has been made to evaluate the phytosociological characteristics of the forest stand under study by quadrat method. The study area is located in Bori range (compartment No.52, Preservation Plot No.4) of Hoshangabad forest division, Madhya Pradesh. The plot was preserved in 1947 for studies on the natural development of vegetation and since then no forestry operations had been carried out. The topography of the study area is much undulating and covers hill tops, steep to moderate slopes and detritus deposits at the base of hillocks. Many seasonal streams traverse the area and the Bori river, which is perennial, flanks it on one side. The surface of the study area is littered with small to big boulders and occasionally parent rocks are also exposed giving a look of an eroded site. The soil colour is dark brown due to presence of humus and the texture of the moist soil is clayey in nature due to the stickiness.

The entire study area covered an area of 37.5 ha wherein forty quadrates of 10m x 10m size were laid out at random. All trees within the quadrate were enumerated and girth at breast height (1.3m) were recorded for each. Individuals of tree species within girth range of 10 to 30 cm were recorded as saplings. Plants of all species below 10-cm girth were considered as seedlings, shrubs and climbers were counted for each quadrates. Species of ground flora were not considered, as they deserve a separate study.

The observations as well as study reveals that there are about 360 seedlings, 42.5 saplings and 423.4 trees per ha of 40 tree species with a basal area of 0.0042 ha/ha.

The basal area is quite high and corresponds favorably to that supported by Tropical Evergreen forests. This indicates that the moist deciduous forest has dynamic leanings towards higher type of vegetation.

Tectona grandis enjoys the highest importance value index (59.70) followed by *Terminalia tomentosa* (36.93), *Lagerstroemia parviflora* (32.03) indicating their dominance and co-dominance in the stand. There are nine important shrubs and under shrubs with 1181.2 individuals per ha. It is evident from their high frequency values, that shrubs are evenly distributed unlike the tree species. The most common shrubs is *Petalidium barliriodes* (79.9%) followed by *Holarrhena antidysenterica* (42.8) and *Caessaria graveolans* (39.9). The distribution of *Flemingia strobilifera* and *Baliospermum montanum* is not uniform. *Vitex peduncularis* is scanty. There are 6 climber species encountered in the quadrates, where the most common species was *Ventilago caliculata*. *Dendrocalamus strictus* is common and evenly distributed with about 77% chances of occurrence and 357 clumps (188 small and 169 big) per hectare.

Phytosociological characteristics studied

Regeneration: The overall density of tree seedlings is very low which indicates poor regeneration status of the stand. *Syzygium cumini* stands at the top in having 65.7 seedlings per ha. *Diospyros melanoxylon* stands next in order (51.7 seedlings) and this is mainly due to ability of this species in producing prolific root suckers. Tree saplings are still lower in number, being only 42.4 per ha. The maximum numbers of saplings are of *Cassia fistula* (11.4) followed by *Diospyros melanoxylon* (8.5) and *Syzygium cumini* (8.5). This represents a deficit in the structural composition of the stand. It is also interesting to note that the high-ranking species in number of seedlings, saplings and trees, in the diminishing order, are *Syzygium cumini*, *Cassia fistula* and *Tectona grandis*. Without biotic interference it is suggestive of successional trends if the vegetation has chances to develop. The obvious trend is that the mature trees may be wiped off in due course of time and their place may be taken by species presently dominant in sapling stage. Gradually *Tectona grandis* may

disappear, as its natural regeneration is wanting. It may be replaced by such miscellaneous species such as *Diospyros melanoxylon*, *Syzygium cumini* etc. of which natural regeneration occurs prolifically.

Distribution of trees: The chances of occurrences of most of the species lie in frequency class A i.e. 87% of the total species. No single species can acquire a uniform distribution with more than 60% chances of occurrence. Distribution of trees species in different frequency classes is as follows:

Frequency	Classes	No. of species	% of Species
A	0-20	35	87.5
B	21-40	4	10.0
C	41-60	1	2.5
D	61-80	-	-
E	81-100	-	-

Life Forms: All the species under consideration belong to group phanerophytes whose perennating buds are well above the ground. The world normal spectrum (Raunkiaer 1934) shows a phytoclimate of phanerophytic nature comprising about 46% species followed by hemicryptophytes, thermophytes. The situations where phanerophytes and thermophytes share almost equal importance, depict dual character i.e. warm dry climate and warm moist climate, respectively.

Leaf Size: Leaf size is one of the most important functional organs of the plant. Depending upon the size of individual leaves, they have been grouped in six classes. Percentage of species in different leaf size classes are as follows:

Sr. No.	Leaf Size Classes	Size Limits(mm)	No. of Spp.	% Species
1.	Leptophyll	25	1	1.7
2.	Nanophyll	25x9	1	1.7
3.	Microphyll	25x9 ²	2	3.5
4.	Mesophyll	25x9 ³	51	91.0
5.	Macrophyll	25x9 ⁴	1	1.7
6.	Megaphyll	larger than 5	-	-

In the study area, leaves of 91% species belong to mesophyll class and thus roughly correspond to higher limits of Richards indicating moist type of forest.

Floristic statistics: The forest harbours a luxuriant flora. Among the tree species, *Ficus bengalensis*, *Ficus infectoria*, *Ficus hispida*, *Ficus cunea*, *Gmelia arborea*, *Dillenia pentagyna*, *Gardenia latifolia*, *Dalbergia paniculata*, *Salmalia malabarica*, *Litsea sebifera*, *Hymenodictyon excelsum*, *Chloroxylon swietinia* etc. are dominant. Among shrubs, *Celosia argentea*, *Achyranthes aspera*, *Triumfetta rhomboidea*, *Sida veronicaefolia*, *Sida rhombifolia*, *Sida spinosa*, *Urenalobata*, *Ageratum conyzoides*, *Vernonia cinerea*, *Hemigraphis laterbrosa*, *Ruellia petalla* are dominant. The important ferns are *Adiantum lunulatum*, *Adiantum incisum*, *Cheilanthes farinosa*, *Pteris aquilina*, *Abacopteris multilineatum* etc. *Homonoia riparia* and *Tamarix ericoides*, occur in the sandy beds of river Bori. Monocotyledons are poorly represented by the largest quantity in the field. Among dicots, family Papillionaceae are represented by four species. Same is the case with Anacardiaceae and Euphorbiaceae. On the other hand Verbenaceae is represented by single tree species. The distribution of various species amongst monocot and dicot are as follows:

Particular	Dicots		Monocots		Total
	No.	%	No.	%	
Families	28	90.3	3	9.7	31
Genera	46	93.8	3	6.2	49
Species	53	94.4	3	5.4	56

The study indicates that the regeneration of presently dominant species viz. *Tectona grandis*, *Terminalia tomentosa*, *Lagerstroemia parviflora* is very poor being represented by very few number of seedlings and saplings. *Disopyros melanoxyton*, *Syzygium cumini* have relatively better regeneration.

(Source: Technical Bulletin No. 17, Government of Madhya Pradesh, Forest Department, Issued by the Botany Branch of State Forest Research Institute, Jabalpur, MP, 1974-75.)

News Items/ Samachar

HC Orders Stay on Construction in Pachmarhi Area

The Madhya Pradesh High court has an interim order stayed construction ' in and around ' the hill resort of Pachmarhi while admitting a public interest litigation (PIL), seeking protection of the reserved forests and surrounding areas of the hill resort from encroachers.

Counsel for the petitioner S C Sharma submitted before the honorable court, 'Pachmarhi is one of the state of Madhya Pradesh and rich in its natural beauty ' but of late, the petitioner said,' a disturbing encroachments are taking place in the area which has endangered the very existence of the resort'.

Apart from this, the petitioner contented that the illegal construction have also begun to come in the reserved forest areas in violations of the existing rules which he said not only destroy the hill resort but also pave way for ecological imbalances and a hazard to tribal life as well.

The division bench, comprising Chief Justice Bhawani Singh and Justice S L Jain prima facie satisfied with the submission of the petitioner stayed construction in and around the hill resort forthwith and served notices on Secretary Forest, Secretary Revenue, Collector and Superintendent of police (SP), Hoshangabad and three other respondents and asked them to file their replies within four weeks.

(Source: Times of India, 4th November 2002)

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Revised Guidelines on Emoluments and other Conditions of Service for Research Personnel and Benefits to Host Institutions In R&D programmes of the Central Government Departments/Agencies

Attention is invited to the O.M No 19-47/2002-RE dated 16.07.98, issued by the Ministry of Environment & Forests, Government of India, on the above subject. The matter has been further considered by the Government and the following revised guidelines have been approved. These revised guidelines are applicable to research personnel working on R&D programmes funded by the ministry of Environment and Forests.

Emoluments

i Junior Research Fellow (JRF)/Senior Research Fellows (SRF)

S.No	Qualification	Emoluments	
		JRF (1 st & 2 nd year)	SRF (subsequent years)/SRF
(a)	Graduate degree in Engineering disciplines & Post Graduate degree in Science disciplines	Rs. 8,000/- (existing Rs. 5,000/-)	Rs. 9,000/- (existing Rs. 5,600/-)
(b)	In Medical and Engg. subjects MBBS/BDS/MVSc/M.Pharm. ME, M.Tech and BE/B.Tech. BVSc. B.Pharm, or equivalent with 2 yrs experience)	Rs.9,500/- (existing Rs. 6,000/-)	Rs.10,000/- (existing Rs. 6,400/-)

The local institution should review after two years whether JRF/SRF should continue for the third year. Similarly, at the end of the third year the local institution should review his case whether extension for another year should be given.

Selection of JRF/SRF will be done through open advertisement. Preference will be given to NET qualified candidates. In programmes where there is a need to engage research personnel at a level higher than JRF/SRF and such need has been accepted by the funding agency, the remuneration for such personnel may be fixed as indicated below.

ii Research Associates

Research Associates may be fixed at a consolidated amount at one of the 3 levels given below, depending upon the qualifications and experience. The Institute/Organisation concerned may decide the level in which a particular associate should be placed

Essential Qualifications (EQ)

In Science, Medical and Engineering subjects (Ph.D/MD/MDS and MVSc/M Pharm/ME/M.Tech) with 3 years research/teaching/ design and development experience.

S.No.	Category	Existing	Revised Pay
I	RA-I	8000	11,000
II	RA-II	8800	11,500
III	RA-III	10,500	12,000

(iii) **Research Scientists:** The existing scales as under will continue:

S.No	Scales
1.	Rs. 8,000-275-13,500
2.	Rs. 10,000-325-15,200
3.	Rs.12,000-375-16,500
4.	Other scales below Rs.8,000-13,500 as recommended by the 5 th Pay Commission and approved by the Central Government.

Service conditions

- D.A. and CCA :** JRFs and Research Associates will not be entitled to these allowances. The Research Scientists will get D.A. as per rates of Central Government and CCA as per rules of the local Institutions where they are working.
- House Rent Allowance and Medical Benefits:** As at present, HRA and Medical benefits may be allowed to all categories viz., JRF/SRF, Research Associates and Research Scientists as per rules of the institutions where they are working. For this purpose, the fellowship amounts, for JRF/SRF and Research Associates will be taken as Basic Pay.
- Leave and other service benefits:** The existing policy is to continue. Under this JRF/SRFs are eligible only for casual leave while Research Associates/Scientists are entitled to leave as per rules of the institutions. However, participation by any of

these categories in any scientific event in India or abroad will be treated as on duty. Maternity leave as per Government of India instructions would be available to all categories.

- 4 **Bonus & LTC:** Not admissible to any category.
- 5 **Retirement Benefits:** These will not be applicable to JRFs/SRFs/Research Associates. Research Scientists who are appointed for the duration of the project in regular scales of pay as mentioned above may be allowed to be members of the Contributory Provident Fund of the Institution.
- 6 **Encouragement for pursuing higher degree:** Students, selected as JRF/SRF may be encouraged to register for higher degrees and the tuition fees to undertake this may be reimbursed to the student from the contingency grant sanctioned under the project grant
- 7 **Benefits to Host Institutes :** Towards meeting their costs for overhead expenses including infrastructural facilities, an amount of :
 - i. 20% of the total project cost with an upper limit of Rs 5.00 lakhs for educational institutions and Rs 3.00 lakhs for laboratories and institutes under S&T agencies/departments, will be provided as a part of the project and
 - ii. On projects costing more than Rs 50.00 lakhs, the quantum will be decided on a case to case basis.
- 8 The revision of guideline and emoluments contained in this order will be applicable only for projects approved after 01.04.2003. Projects approved before that date would continue to be governed by earlier guideline/emoluments. Further, the existing scales etc. will continue in the case of Research Scientist till further order.
- 9 All the Divisional Heads are requested to ensure that the above guidelines are followed in regard to the remuneration and other benefits to the research personnel engaged in R&D projects funded by them. They are also requested to circulate these orders to their attached and subordinate offices and also to the autonomous institutes funded by them.
- 10 This issue with the concurrence of Integrated Finance Division vide their Diary No 3133/FD/2002 dated 23.12.2002

Source: (MOEF GOI, Office Memorandum, F.No. 19-47/2002-RE, dated January 17th 2003.)

(Sd)

Dr. R.K.Rai

Additional Director to Govt. of India

To

- (i) All heads of Division of Ministry of Environment of Forests of for circulating to all Subordinate Offices/Autonomous Bodies/Field Offices/Attached Offices
- (ii) Director, Finance, MOEF

(Sd)

Dr. R.K.Rai

Additional Director to Govt. of India
