सत्यमेव जयते

2010 International Year of Biodiversity

Taxonomy Capacity Building : Indian Initiative

जहाँ है हरियाली।
वहाँ है खुशहाली।।

Ministry of Environment and Forests
Government of India

October 2010

PREAMBLE

India is one of the recognized megadiverse countries of the world. With an area of about 329 mha, India is seventh largest country in the world. The varied edaphic, climatic and topographic conditions have resulted in a wide range of ecosystems and habitats such as forests, grasslands, wetlands, coastal and marine ecosystems, and deserts which in turn have contributed to immense biological diversity with large variation in species of plants, animals and microbes. The various facets of biodiversity related richness of the country can be gauged from the following salient features :

- With only 2.4% of world's land area, India accounts for 7-8% of the recorded plant and animal species of the world.
- India has ten bio-geographic zones, namely, Trans Himalaya, Himalaya, Indian Desert, Semi-arid, Western Ghats, Deccan Peninsula, Gangetic Plains, Coasts, North-East and Islands. The country also encompasses four global biodiversity hot spots.
- India is endowed with vast forest resources. The total forest and tree cover of the country is estimated at 23.39% of the geographic area, of which forest cover accounts for 21.02% (69.09 mha). The forests in India have been classified into 16 major types and 251 subtypes on the basis of climatic and edaphic features.
- India ranks among the top ten species-rich nations and shows high degree of endemism.

Taxonomy is the science which deals with exploration, identification, description and classification of living organisms. Taxonomy identifies and enumerates the components of biological diversity providing basic knowledge underpinning management of biological resources. A sound taxonomic base is a prerequisite for environmental assessment, ecological research, effective conservation, management and sustainable use of biological resources.

Unfortunately, taxonomic knowledge is far from complete. So far, taxonomists have named about 1.78 million species of animals, plants and micro-organisms, yet the estimated number of species globally is probably between 5 and 30 million. Situation is no different in India. On account of diverse ecosystems present in the country, we have a rich biodiversity to be identified, classified and nurtured for present as well as future generations.

The Governments, through the Convention on Biological Diversity, have acknowledged the existence of a "taxonomic impediment" to the sound management, conservation and sustainable utilisation of biodiversity. The taxonomic impediment includes the knowledge gap in our taxonomic groups, the shortage of trained taxonomists and curators, and the impact these deficiencies have on our ability to conserve, use and share the benefits of our biological diversity. The inability to identify (or obtain identifications of) species is a major component of taxonomic impediment. Simple-to-use identification guides for the non-taxonomist are rare and available for relatively few taxonomic groups and geographic areas.

The other taxonomic issues that need to be addressed in this century are mostly those that require interfacing of systematics and other disciplines such as bio-prospecting, conservation biology, ecosystem management, bioremediation, assessment of conservation status of species and roles of species in communities and ecosystems.

ALL INDIA COORDINATED PROJECT ON CAPACITY BUILDING IN TAXONOMY (AICOPTAX)

For a large developing country like India, a sound taxonomic knowledge base is a prerequisite for environmental assessment, ecological research, effective conservation, management and sustainable use of biological resources, and bio-prospecting. It will provide the basic knowledge underpinning efforts to conserve biological diversity, optimise the use of biological resources in a sustainable way and, thereby, enhance the quality of life.

Botanical survey of India (BSI) and Zoological Survey of India (ZSI), the former more than a century old organisation and the latter nearing 100 years of its existence, are the premier national institutes entrusted with the primary responsibility of survey and inventorying of plant and animal species in India. So far 91,212 species of animals and 46,340 species of plants have been identified and documented, but a much larger number of animals, plants and microbes are yet to be explored and identified for utilisation and conservation.

Requirements of taxonomic work and available expertise in India indicated a dire need to encourage excellence and motivate experts to do work in hitherto neglected groups of organisms, e.g. microbes, less known and difficult groups of plants and animals. The challenge is quite serious primarily because of ageing/retirement of old taxonomists on one hand and disinterest in taxonomic studies by students in the universities on the other hand. This has resulted in a large number of animal and plant groups where no taxonomic expertise exists at any level. Pursuant to the recommendations of a seminar organized in 1996, an All India Coordinated Project on capacity building in Taxonomy (AICOPTAX) was launched in 1999, for filling the existing gaps in taxonomic knowledge base and building capacity in taxonomy.

Specialists drawn from various universities and research institutes, across the country including BSI and ZSI, have taken up taxonomic work on animal viruses, bacteria and archaea, algae, fungi, lichens, bryophytes, pteridophytes, gymnosperms, palms, grasses and bamboos, orchids, diptera, helminthes and nematodes, microlepidoptera and mollusca. Training in plant and animal biosystematics has also been recognized as an important component.

Mission of AICOPTAX

"Enhancement of country's capabilities for inventorying, monitoring, conserving, and utilizing biodiversity as well as for establishing leadership and capacity building in the taxonomy."

Goals of AICOPTAX

- Survey, inventorying and monitoring of India's bio-resources
- Human resource development in taxonomy
- Community participation in the assessment, conservation and utilization of biodiversity

Since its inception, survey and inventorying of plants, animals and microbes have gained considerable momentum; national reference collections have been significantly enriched and huge information on diversity and distribution of components of biodiversity has been collected and disseminated. The data presented here highlights the achievements under this project from 1999-2007.

The AICOPTAX is continued as a central scheme of the Ministry of Environment and Forests, Government of India.

जयराम रमेश
JAIRAM RAMESH

राज्य मंत्री (स्वतंत्र प्रभार)
पर्यावरण एवं वन
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नई दिल्ली-1 1 0 0 0 3
MINISTER OF STATE (INDEPENDENT CHARGE)
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GOVERNMENT OF INDIA
NEW DELHI - 110 003

FOREWORD

I am pleased to introduce the publication: *"Taxonomy Capacity Building: Indian Initiative"* brought out by our Ministry. This publication showcases India's stellar efforts in Taxonomy Capacity Building.

As you are aware, India is one of the recognized mega diverse countries of the world. In terms of species richness, India accounts for almost 8% of the recorded species of the world, ranks among the top ten species rich nations and shows high degree of endemism despite having only 2.4% of the world's land area.

This publication focuses on the achievements of the All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX), which is a flagship scheme of our Ministry. The project is envisaged to address the taxonomic impediments as recognized on a global basis by the Convention on Biological Diversity (CBD).

As a signatory to the Convention on Biological Diversity, India stands committed to capacity building in taxonomy and to undertake exploration and preparation of an inventory of her living resources. Alive to taxonomic impediments, India had started building her capacity in Taxonomy much before the Global Taxonomic Initiative (GTI) came into existence.

Since the inception of the AICOPTAX, survey and inventory of plant, animal and microbial species in the country have gained considerable momentum. National reference collections have been significantly enriched and huge information on diversity and distribution of various components of biodiversity have been collected and disseminated. In particular, 570 taxa new to Science and 449 taxa new to India have been reported through the AICOPTAX.

I congratulate all those who were involved in this assignment. I especially wish to put on record the diligent efforts put in by Dr. J R Bhatt, Scientist-F and Dr. G V Subrahmanyam, Scientist-G in this endeavour. I am confident that sharing of achievements of AICOPTAX would help in addressing the challenges we face today in maintaining the world's biodiversity.

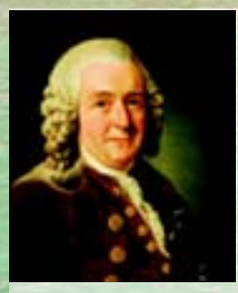
New Delhi
Date: 13/10/2010

Jairam Ramesh

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

2010 International Year of Biodiversity

INTRODUCTION



Carl Linnaeus (1707 – 1778), also known after his ennoblement as Carl von Linné, was a Swedish botanist, physician and zoologist. We owe to Linnaeus the binomial system of nomenclature for all organisms. He is known as the father of taxonomy.

Joseph Dalton Hooker (1817 – 1911) was one of the greatest British botanists and explorers of the 19th century. He was a close friend of Charles Darwin and served as Director of the Royal Botanic Gardens, Kew. He along with G. Bentham evolved a taxonomic system for seed plants (1862-1883) used by many herbaria in the world. J.D. Hooker also compiled the Flora of British India (1875-1892).

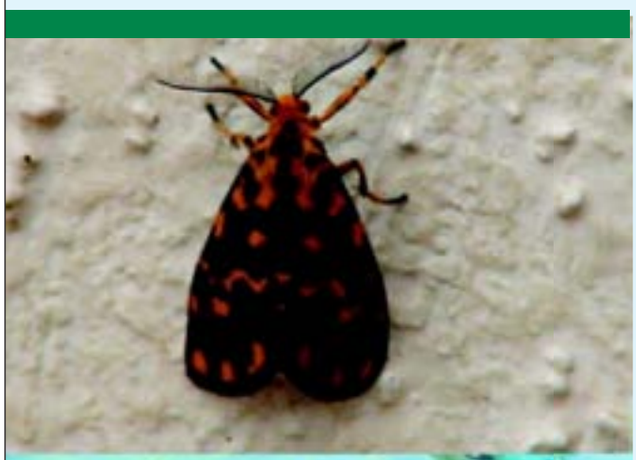
Nikolai Ivanovich Vavilov (1887-1943) was a renowned Russian botanist and geneticist best known for having identified the *'Centres of Origin of Cultivated Plants'.* He made extensive collections in over 50 countries and gathered more than 26,000 varieties of wheat alone. He was imprisoned and neglected to meet an inglorious death. A sad end to a masterful personality!

E K Janaki Ammal (1897 – 1984), founder Fellow of the Indian Academy of Sciences and a recipient of Padma Shri, was a renowned botanist and plant cytogeneticist. She made significant contributions to genetics, evolution, phytogeography of crop plants and ethnobotany. She was invited to reorganize Botanical Survey of India after Independence. Ministry of Environment and Forests has instituted, in her memory, a national annual award each in plant and animal taxonomy.

Taxonomy occupies the position of a mother science in biology as it deals with the classification of all living and extinct organisms. Therefore it is a key science to help ensure sustainable utilization, conservation of biological resources and implementation of the Convention on Biological Diversity (CBD). There is an overall decline in expertise in the taxonomy of several groups of living organisms. Moreover, the existing taxonomic base is eroding rapidly due to non-availability of professionals and lack of trained man-power to replace the retiring specialists. In other words, a wide gap exists between the magnitude of taxonomic expertise needed and the available limited taxonomic knowledge base. Further, many microbes, plants and animals are yet to be discovered and identified. To manage the biological resources and to meet the challenges of 21st century, the issue of 'taxonomic impediment' needs to be addressed urgently.

For devising effective conservation and management strategies, one needs to know: (i) what kind of species are found, (ii) where they occur, (iii) what are their characteristics or attributes, and (iv) how they are related to one another. These questions can be answered only by specialists. Besides the basic inputs needed for understanding biodiversity, the taxonomic studies also result in weaving the data obtained on the species into a system of classification which is used by the scientists and others.

India has been on the forefront of taxonomic studies right from the early part of the nineteenth century. In fact, the British used India as the base for exploration of neighbouring South and South-east Asian countries. The British army medical officers



were the first to realize the need for taxonomic studies for exploration of biological wealth of their colonies.

It is with this goal the British established the Botanical and Zoological Surveys of India as early as 1890 and 1916 respectively. Both the Surveys did pioneering taxonomic work and contributed to the exploitation of natural wealth. An outcome of this exploitation is the preparation of inventories of floristic and faunal elements based on limited collections from generally accessible areas.

After India became independent, both the Surveys have been entrusted with the task of surveying and inventorying plants and animals. However, the magnitude of assessment of India's biodiversity and threats to it are so high that both the Surveys need further strengthening of personnel and resources for meeting the challenging task of inventorying and monitoring the biological resources. Further, the Surveys do not have adequate infrastructure for assessment of the diversity of microbes and a few other specialized groups of potential economic value.

To find out the ways and means by which the existing gaps in taxonomic knowledge could be filled, the Ministry of Environment and Forests (MOEF)– a nodal agency within the Government of India for environmental protection and conservation of biodiversity – organized a two-day national workshop on "Capacity Building in Taxonomy in India" on 15th & 16th February 1996 at Jaipur. Sixty two leading taxonomists of the country participated in the workshop, and after lengthy deliberations, made a number of action oriented recommendations for capacity building in taxonomy. One of the prioritized recommendations was to initiate an All India Coordinated Project on Capacity Building in Taxonomy, besides taking steps for strengthening education and training. This recommendation was endorsed by the then Task Force constituted by the MOEF. The Scientific Advisory Committee to the Cabinet (SAC-C) also endorsed the recommendation. Accordingly, an All India Coordinated Project on Taxonomy Capacity Building was launched in 1999, much before Global Taxonomic Initiative (GTI) came into existence.

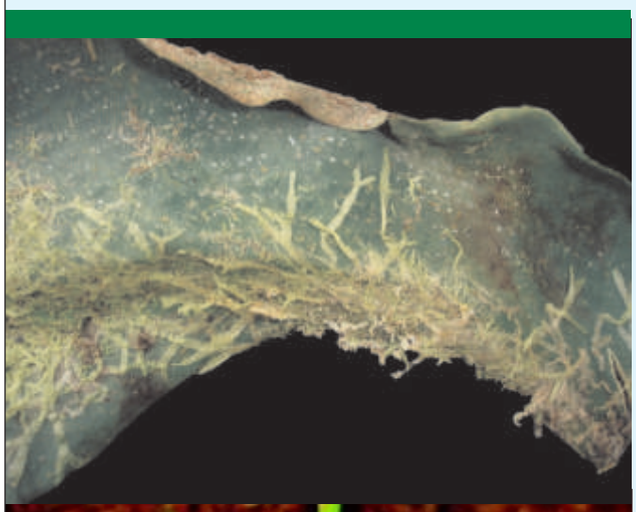
The AICOPTAX has a sole mission - "Enhancement of country's capabilities for inventorying, monitoring, conserving and utilizing biodiversity as well as for establishing leadership in the field of taxonomy at regional and global levels". AICOPTAX, an active programme channelized at the national level to address the problems of inadequate taxonomic knowledge due to limited number of taxonomists available in the country, is fully funded by the MOEF. It has the following main objectives:

- Survey, collection, identification and preservation of elements of biodiversity of the country with emphasis on protected areas.
- Training research fellows and college teachers and building capacity in the field of taxonomy.
- Maintain collections and taxonomic data banks.
- Develop identification manuals.

- Generate information needed for decision making in conservation and sustainable use of biological diversity.
- Integration of taxonomic capacity into the national reporting process.
- Enhance local and regional capacity in taxonomy.

To start with, 30 thematic areas were chosen for investigation under the AICOPTAX. These are :

1. Plant viruses
2. Animal viruses
3. Pathogenic bacteria
4. Non-pathogenic bacteria
5. Pathogenic fungi
6. Non-pathogenic fungi
7. Fresh water phytoplankton/Algae (including blue green algae)
8. Fresh water zooplankton (including euglenoids/ciliates/ rhizopods)
9. Lichens
10. Bryophytes
11. Orchids
12. Palms
13. Grasses and bamboos
14. Pteridophytes and gymnosperms
15. Research in plant biosystematics and advanced training in taxonomy
16. Helminthes and Nematodes
17. Crustacea
18. Mollusca
19. Insects: coleoptera
20. Insects: hymenoptera
21. Insects: microlepidoptera
22. Insects: diptera
23. Insects: blateria and tettigonids
24. Insects: miscellaneous order
25. Arachnida
26. Oomycetes and cellular slime moulds
27. Protozoa and sporozoa
28. Annelida
29. Meiofauna
30. Research in animal biosystematics and advanced training in taxonomy



Of the aforesaid 30 thematic areas, only 15 could be implemented so far. The data reported here are from 1999 to 2007. New discoveries after 2007 are being edited and compiled. The work of the thematic areas of AICOPTAX was assigned to 15 coordinators along with 61 collaborators. The coordinators also oversee and monitor the activities for achieving the aims and objectives outlined in the thematic areas.

The remaining 15 thematic areas are in the process of being taken up for investigation under AICOPTAX in phased manner.

The important achievements of the 15 thematic areas include : discovery of species new to science, new records for India, floristic and faunal accounts, status of species, number of students trained in taxonomy and enrolled for doctoral studies, etc. For brief reports on each theme, the reader may glean through the separate sheets enclosed in this folder. The MOEF has spent about ₹ 10 crores during X five year plan on AICOPTAX. Some significant achievements are given below :

Significant achievements of AICOPTAX

Survey and exploration - Tours undertaken :	1323
Number of collections added to national reference collections	53,715
Number of species identified / characterised / described	12,789
Documentation of flora and fauna (with descriptions)	6,759
Human resource development/training in Biosystematics	
Number of persons trained in taxonomy	450
Number of students enrolled for Ph.D.	105
New Discoveries	
Taxa new to science	570
Taxa new to India	449
Species collected after a gap of 50 years or more	189
Number of rare taxa recorded from new locations	1059
Publications	
Books	7
Research Papers	333
Book chapters	61
Popular articles	14
Papers accepted for publication	118
Training / awareness Workshops organized	12

IMPORTANCE OF TAXONOMIC KNOWLEDGE BASE

- It is absolutely essential to have the correct identification of vector for vector control.
- A thorough taxonomic knowledge base is required for the utilization of genetic resources, weed control and activities of biofertilizers and biopesticides.
- Afforestation programmes, sustainable utilization of non-wood forest produce, management of commercial plantations, and protected areas require taxonomic information.
- The cutting edge biotechnologies depend upon the variations found in living organisms and it is taxonomy that deals with the study and classification of these variations.
- The protection of catchment areas and water purification processes require knowledge on the kinds of species found in biotic communities, and this knowledge is obtained through taxonomic studies.
- Microbial diversity is central to the microbial technologies useful in recycling of resources – conversion of solid biomass into liquid and gaseous fuels.
- The policy formulation and planning of economic developmental projects require environmental impact assessments, which in turn depend on the assessment of floral and faunal diversity.
- The field of ecological restoration involves understanding of the biogeochemical cycles, which is of paramount value in the management of managed and natural ecosystems; this also requires taxonomic inputs.
- Taxonomic data on the soil microbes and invertebrates are critical to the analysis of ecosystem functioning.
- Without taxonomic knowledge, the quarantine measures and issues related to the Convention on International Trade in Endangered Species of Fauna & Flora (CITES) cannot be implemented; detection of adulterants require correct taxonomic identification.
- In the absence of sound taxonomic knowledge, science is thrown into confusion, hindering further progress in acquiring new biological information essential for improvement of quality of human life. Consequently, taxonomy is central to, and an integral part of, the conservation and sustainable utilization of biological diversity.

IMPACT OF TAXONOMIC STUDIES ON SCIENCE AND SOCIETY – SOME EXAMPLES

- There would not have been any industry based on sugar cane in the world, had noble canes were not evolved by Indian scientists by transferring the red rot disease resistant genes of *Saccharum spontaneum* (a wild species found in India) to *Saccharum officinarum*.
- The green revolution witnessed in rice production throughout South-east Asia is due to the transfer of grassy stunt virus resistant genes from the Indian collection of *Oryza nivara* (collected from Uttar Pradesh) to *Oryza sativa* leading to the development of 'IR36' by Dr Khush of IRRI. The 'super rice' of 21st century to be released is also based on transfer of genes from wild species to the cultivated species.
- The transfer of virus resistant genes from the wild species of maize *(Zea diploperennis)* to the cultivated corn resulted in significant enhancement of annual production in USA and elsewhere.
- Cultivated cotton developed from *Gossypium hirsutum* has become susceptible to a wide range of fungal diseases and insect pests, both due to its low genetic range and large acreage of cultivation. The uses of fungicides and pesticides to control these diseases and pests has resulted in high level of environmental pollution and even elimination of a number of non-target species. Taxonomic work on Australian native wild cotton species has identified wild forms of several desirable characters, including resistance to insect pests and microbial diseases. These wild forms of cotton are used for evolving disease and pest resistance varieties that save millions of dollars, which otherwise are spent on controlling them (Practical Approaches for Capacity Building for Taxonomy, UNEP/CBD/SBSTTA/2/5, Montreal, 1996).
- Water ferns belonging to the genus *Salvinia* live on the surface of water bodies including fish ponds, rice fields, etc. It has become a pest with serious economic and social implications in many tropical countries. In Papua New Guinea it had reached an alarming proportion as it had completely blocked rivers and water ways, seriously affecting the traditional resources of the local communities and sometimes even displacing them. The only economical option to control this weed was biological control than opting for chemical or physical controls that affect the environment, that too at prohibitively high cost. The first step in this direction was to taxonomically determine the exact species involved, which was found to be an undescribed Brazilian species now known as *Salvinia molesta*. This weed was found to be controlled by tiny weevils in Brazil. The experiments to biologically control by introducing this weevil species also failed. It was again an insect taxonomist who identified the weevil species of Brazil as a complex group of which the previously undescribed weevil called *Cyrtobages salvininae* – was effective in controlling the water fern. Within years of this taxonomic breakthrough the water weed was eliminated (Practical Approaches for Capacity Building for Taxonomy (UNEP/CBD/SBSTTA/2/5, Montreal, 1996).
- Chlorinated solvents are used to remove dirt and oils from clothes, engines, machines and electronic parts. The dirty solvents on disposal contaminate ground water. A strain of bacterium (Strain 195) that was discovered by the scientists of Cornell University, USA, was found to convert this toxic ground water pollutant–perchlorethylene into a harmless compound ethylene.
- Study of the bacterial diversity of sites contaminated with petroleum hydrocarbons by Dr Banwari Lal and his group at The Energy Research Institute, New Delhi has led to the development of a consortium of 5 bacterial species named as 'Oilzapper', which can biodegrade different fractions of crude oil, hydrocarbon waste generated by oil refinery and the oily waste generated during drilling of oil wells.
- Studies on the bacterial diversity associated with sugarcane, kallar grass and rice grown in nitrogen deficient soils have resulted in the identification of nitrogen-fixing, plant growth promoting bacteria. Several of these bacterial isolates have now been developed into commercial inoculants for reducing the dependence of agriculture on chemical nitrogen fertilizers.

AICOPTAX NETWORK

Coordinators working on 15 thematic areas

Along with 61 Collaborators

BACTERIA & ARCHAEA Prof. T. Satyanarayana	Dr. Manvika Sahgal	Dr. Monica Bhatnagar	Prof. Anjana Sharma	Prof. A.K. Tripathi	Dr. (Mrs.) P.P. Kanekar	
ANIMAL VIRUSES Dr. Kalyan Banerjee	Dr. Madhusudan Hosamani	Dr. Gaya Prasad	Dr. S.K. Bhattacharya	Prof. Archana Ayyagari		
ALGAE Prof. N. Anand/ R. Rengasamy	Dr. (Mrs.) Sangeetha Gajaria	Dr. S.P. Adhikary	Dr. P.K. Misra	Dr. S.P. Hosmani	Dr. Sarathchandra Misra	
BAMBOOS & GRASSES Dr. V.J. Nair	Dr. Muktesh Kumar	Dr. S.R. Yadav	Dr. Paramjit Singh	Dr. B.K. Gupta		
FUNGI Prof. C. Manoharachary	Dr. R.K.S. Kushwaha	Dr. A.K. Pandey	Dr. Alok Adholeya	Prof. D.J. Bhat	Prof. A.K. Roy	Prof. K. Natarajan
LICHENS & BRYOPHYTES Dr. K.P. Singh	Dr. U.V. Mukhija	Dr. D.K. Upreti	Dr. G.P. Sinha	Prof. S.C. Srivastava	Dr. D.K. Singh	
ORCHIDS Dr. C. Sathish Kumar	Dr. H.J. Chowdhery	Dr. P.V. Sree Kumar	Dr. A.N. Rao	Dr. G.S. Rawat	Prof. S.P. Vij	Dr. S. Misra
PALMS Dr. C. Renuka	Dr. P.K. Padmakumar	Prof. S.N. Ramaswamy	Dr. K. Haridasan/ Dr. S.N. Hegde			
PTERIDOPHYTES & GYMNOSPERMS Dr. V.S. Manickam	Dr. R.D. Dixit	Dr. R.C. Srivastava	Dr. Rita Singh	Dr. P.V. Madhusoodanan	Dr. S.P. Khullar	
DIPTERA Prof. P.K. Chaudhuri	Dr. P.T. Cherian	Dr. C. Radhakrishnan	Dr. A.K. Kulkshetra/ Dr. Ipe M. Ipe			
HELMINTHES & NEMATODES Prof. Irfan Ahmed	Dr. Chongtham Dhanachand	Prof. (Mrs.) Veena Tandon	Prof. Vinod Gupta	R.Madhavi	Dr. Padma Bohra	
MICROLEPIDOPTERA Prof. H.S. Rose	Dr. V.K. Walia	Dr. Ajai Srivastava	Dr. George Mathew	Dr. (Ms.) J.K. Grewal	Dr. S.C. Goel	
MOLLUSCA Dr. Ramakrishna	Prof. U.H. Mane	Prof. N.A. Madhyastha	Dr. R. Kasinathan	Prof. A.V. Raman	Dr. Azad R. Rahamani/ Dr. Deepak Apte	
TRAINING IN BIOSYSTEMATICS - PLANTS Prof. C.R. Babu						
TRAINING IN BIOSYSTEMATICS-ANIMALS Dr. J.R.B. Alfred						

Guidance provided by Steering Committee chaired by Prof. H.Y. Mohan Ram – a leading botanist of the country

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

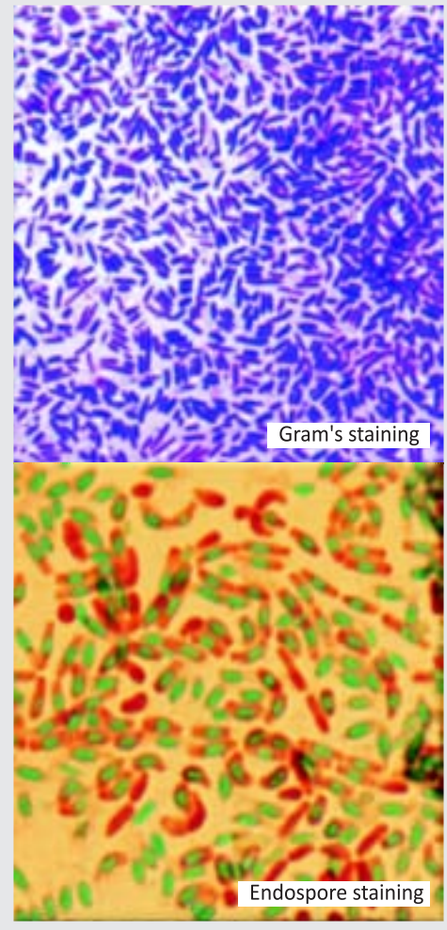
BACTERIA AND ARCHAEA

Prokaryotes are the most ancient group of living organisms. They represent two separate kingdoms, Bacteria and Archaea. Life would not exist on the earth without bacteria because they recycle nutrients from the wastes and dead biomass and perform several other functions in the ecosystem. They are abundant in most environments. In one gram of agricultural soil, more than 2.5 billion bacteria may exist. They thrive in sea, including deep sea. They live in ground water, in and below Antarctica ice and also in thermal vents where temperature is very high.

The diversity of bacteria and archaea is rather difficult to study by conventional taxonomical techniques due to their microscopic size and little variability in their shapes. The taxonomy of bacteria and archaea, therefore, depends heavily on physiological, biochemical and molecular characters. Because of large scale lateral gene transfer across species and genera, the concept of bacterial species has been changing much faster than that of plants and animals. With the advent and advances in high throughput sequencing, it is now becoming more and more desirable to sequence the whole genome for describing a new bacterial or archaeal species. This becomes much more difficult in view of the fact that only 0.1-10% of the total bacterial and archaeal members can be isolated in pure culture. Thus, cultivation-independent molecular techniques are used to give a glimpse of the total diversity.

Of the estimated 50,000 – 3,000,000 species of bacteria and archaea, over 6000 species have been described globally. Around 1000 species have been isolated from different environments in India. In order to understand the diversity of bacteria and archaea present in a great variety of Indian environments and to understand their role in nature and to optimally utilize them, the Centre for Research on Bacteria and Archaea (CRBA) was established under AICOPTAX programme. Both normal and extreme (natural and man made) habitats were targeted by isolation, characterisation and documentation of bacterial species.

The study on the diversity of bacteria and archaea has been undertaken by microbiologists at five collaborating units with a coordinating unit initially at Pantnagar (2000-2005) and later (2005 onwards) at the Department of Microbiology, University of Delhi South Campus, New Delhi with the following objectives: to determine bacterial diversity; characterization and identification of the selected forms; assessment of bio-potentiality; conservation of the bacterial cultures and human resource development.



Bacillus lehensis MLB-2: Identified as new species is a good producer of highly alkaline and cold active protease which finds its application in detergent industry

New Discoveries

Bacteria new to science

Bacillus lehensis A. Ghosh, M. Bharadwaj, T. Satyanarayana, M. Khurana, S. Mayilraj & R.K. Jain

Ochrobactrum oryzae A.K. Tripathi, S.C. Verma, S.P. Chowdhury, M.L. Lebuhn & M. Schloter

Bacteria isolated from Indian environments

T. Satyanarayana and his group (New Delhi)

1 *Bacillus pumilus*
2. *B. thermoleovorans*
3. *B. acidicola*
4. *B. halodurans*
5. *Bacillus* sp.
6. *Paenibacillus* sp.
7. *Streptomyces* sp.
8. *Lactobacillus brevis*
9. *Lactobacillus lactis*
10. *Lactobacillus plantarum*

B.N. Johri, M. Sahgal and their group (Pantnagar)

11. *Rhizobium* sp.
12. *Pseudomonas fluorescens*
13. *P. putida*
14. *Bacillus cereus*
15. *B. megaterium*
16. *B. pumilus*

A.K. Tripathi and his group (Varanasi)

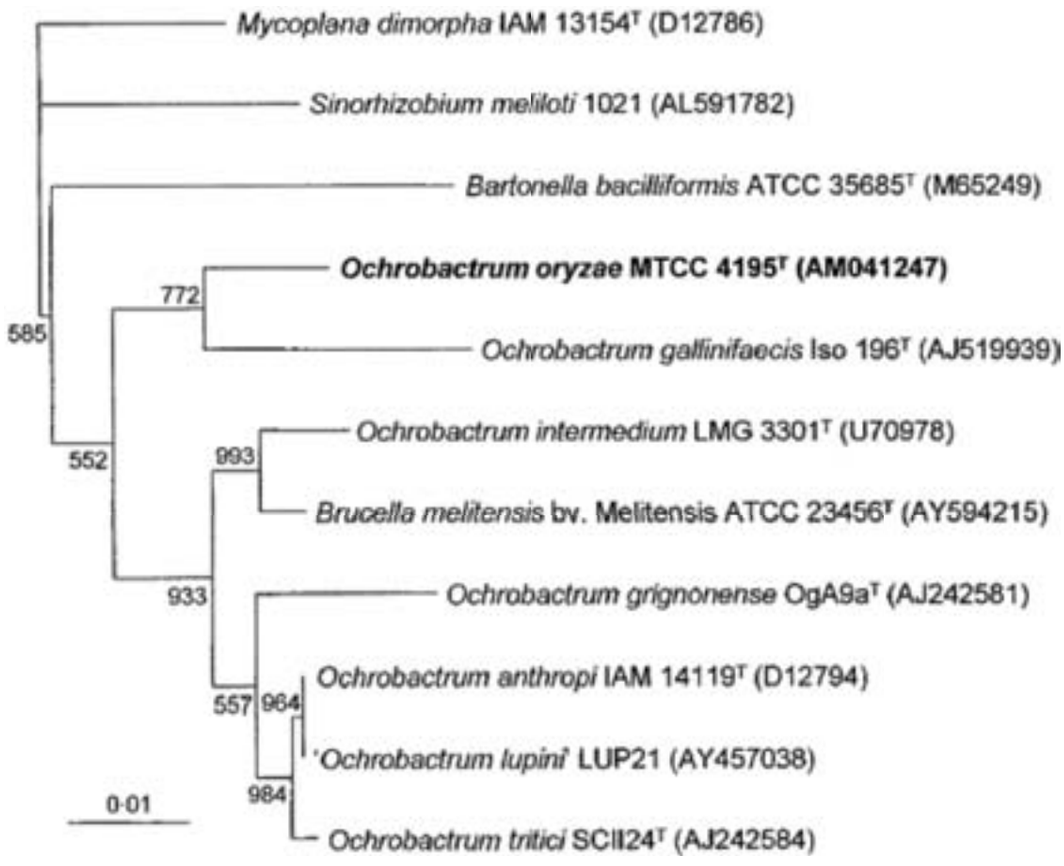
17. *Ralstonia taewanensis*
18. *Microbacterium* sp.
19. *Micrococcus* sp.
20. *Staphylococcus warneri*
21. *Bacillus megaterium*
22. *Rhizobium* sp.
23. *Agrobacterium tumefaciens*
24. *Inquilinus limosus*
25. *Variovorax paradoxus*
26. *Bordetella petrii*
27. *Stenotrophomonas maltophilia*
28. *Pseudomonas pseudoalkaligenes*
29. *Chryseobacterium defluvii*
30. *Azospirillum* sp. TS15
31. *Arthobacter* sp.
32. *Pantoea agglomearns*

Anjana Sharma and her group (Jabalpur)

33. *Acinetobacter calcoaceticus*
34. *Actinobacillus equilli*
35. *Actinobacillus suis*
36. *Aeromonas hydrophila*
37. *Aeromonas salmonicida*
38. *Alcaligens faecalis*
39. *Alteromonas putrefaciens*
40. *Achromobacter* sp.
41. *Bacillus circus*
42. *Bacillus laterosporus*
43. *Bacillus macerans*
44. *Bacillus pumulis*
45. *Bordetella* sp.
46. *Budvicia auatica*
47. *Cedecea lapagei*
48. *Cedecea neteri*
49. *Chromobacterium violaceum*
50. *Citrobacter brakii*
51. *Citrobacter diversus*
52. *Citrobacter freundii*
53. *Citrobacter gilleni*
54. *Citrobacter koseri*
55. *Citrobacter murlinae*
56. *Citrobacter rodenticum*
57. *Citrobacter sedlakii*
58. *Citrobacter werkmanii*
59. *Citrobacter youngae*
60. *Edwardisiella ictaluri*
61. *Edwardisiella tarda*
62. *Enterobacter aerogenes*
63. *Klebsiella* sp.
64. *Vibrio* sp.
65. *Serratia* sp.
66. *Shigella* sp.

P. Kanekar and her group (Pune)

67. *Acidiphilum cryptum*
68. *A. organovorum*
69. *Arthrobacter* sp.
70. *Alkalimonas delamerensis*
71. *Alcaligenes* sp.
72. *Bacillus steaerothermophilus*
73. *B. coagulans*
74. *B. alvei*
75. *B. cereus*
76. *B. licheniformis*
77. *B. brevis*
78. *B. badius*
79. *B. subtilis*
80. *B. pantotheticus*
81. *B. benzovorans*
82. *B. circulans*
83. *B. flexus*
84. *B. cohnii*
85. *B. fermus*
86. *B. fusiformis*
87. *B. horikoshii*
88. *B. haloalkaliphilus*
89. *Cellulosimicrobium cellulans*
90. *Dietzia natronolimnaea*
91. *Enterococcus* sp.
92. *Enterococcus casseliflavus*
93. *Halomonas campisalis*
94. *Halomonas* sp.
95. *Klebsiella pneumoniae*

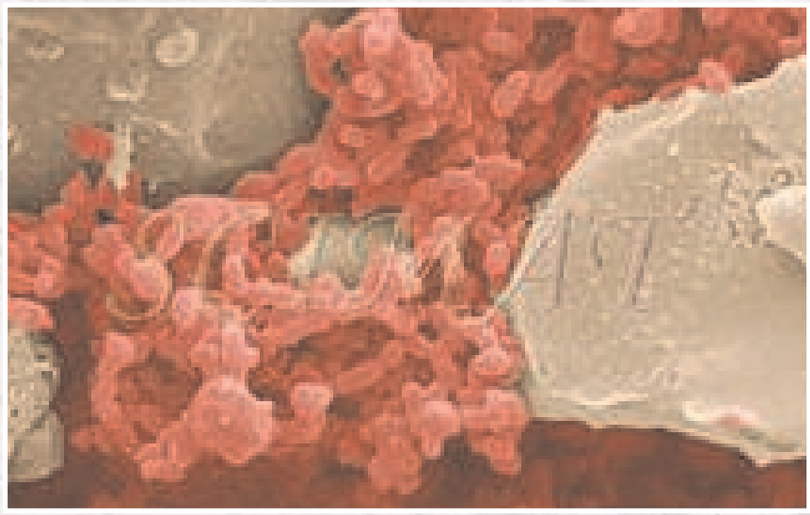


Phylogeny of the newly described species, *Ochrobactrum oryzae,* an endophyte of deep-water rice

96. *Methanobacterium thermoautotrophicum*
97. *Micrococcus kristinae*
98. *M. varians*
99. *M. nishinomiyaensis*
100. *M. halobius*
101. *Methanosarcina* sp.
102. *Marinobacter excellens*
103. *M. alkaliphilus*
104. *Methylobacterium* sp.
105. *Pseudomonas stutzeri*
106. *Planococcus citreus*
107. *Paracoccus koreensis*
108. *Paracoccus* sp.
109. *Staphylococcus sciuri*
110. *S. lentus*
111. *S. hyicus* Subsp. *Chromogens*
112. *S. caseolyticus*
113. *S. hyicus* Subsp. *hyicus*
114. *S. intermedius*
115. *S. hyicus*
116. *Roseinatronobacter monicus*
117. *Rhodobaca bogoriensis*
118. *Vagococcuscarniphilu*
119. Uncultured *Thiomonas*
120. *Acidithiobacillus ferrooxidans*
121. *Acidithiobacillus thiooxidans*
122. *Anoxybacillus gonensis*
123. *Leptospirillum ferrooxidans*
124. *Stenotrophomonas* sp.
125. *Thiomonas* sp.

A. Bhatnagar and M. Bhatnagar group (Ajmer)

126. *Brevibacterium casei*
127. Uncultured *Brachybacterium conglomeratum*
128. *Kocuria* sp.
129. *Micrococcus* sp.
130. *Staphylococcus aureus* subsp. *aureus*
131. *Cellulosimicrobium cellulans*



Serratia marcescens

Citrobacter freundii

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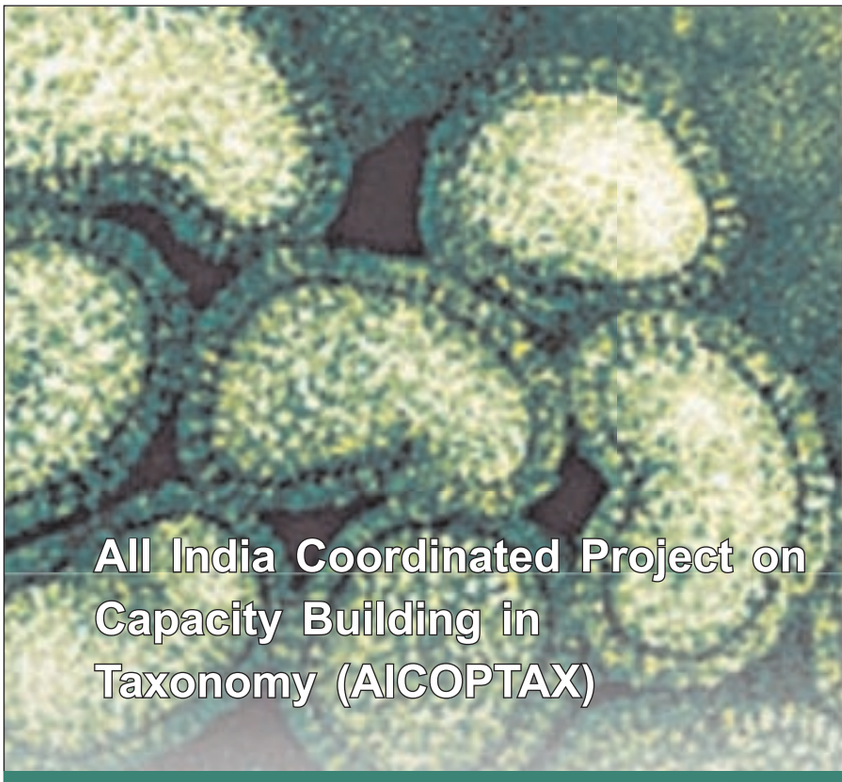
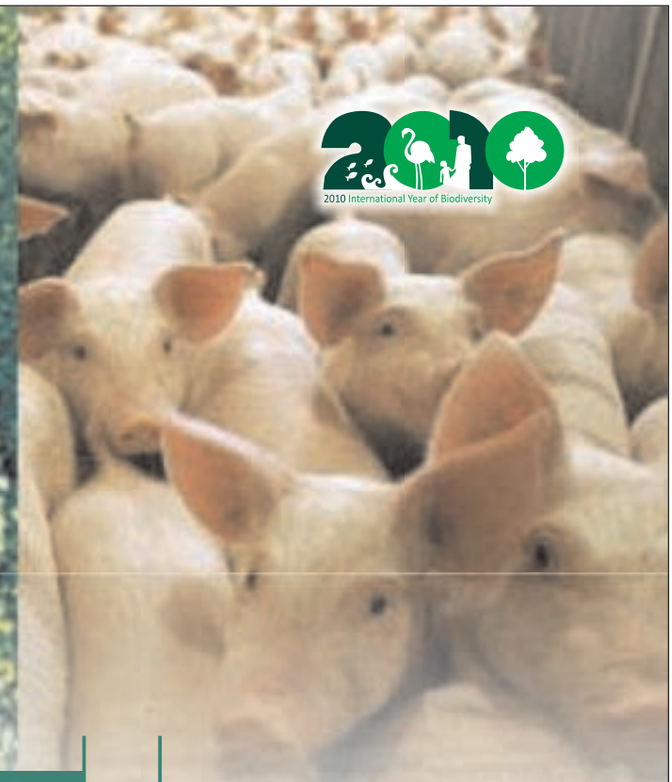
Collaborating Units			
Prof. B. N. Johri (2000 - 2005) Dr. M. Sahgal (2005 onwards)	Dept. of Microbiology, CBSH G.B. Pant University of Agriculture & Technology Pantnagar-263 145, Uttaranchal T : 05944-233341 F : 233473 E : manvikasahgal@rediffmail.com	Ruchi Singh	Diversity of pseudomonads and rhizobia in the Himalayan region
Prof. A. K. Tripathi	School of Biotechnology Banaras Hindu University Varanasi-221 005, UP T : 0542-2310942 (R) 2368331(O) F : 0542-368693/2368174 E : tripathianil@rediffmail.com	S.C. Verma S.P. Chaudhuri V. Parashar	Endophytic and Rhizospheric bacteria
Dr. (Mrs.) P. P. Kanekar	Division of Microbial Sciences Agharkar Research Institute Pune- 411 004, Maharashtra T : 020-25653680 F : 020-25651542 E : ppkanekar@aripune.org	Suchitra Borgave V. Prasad Anita Dhakephalkar Shradha Deshmukh	(i)Aerobic bacteria (*Bacillus* spp., iron and sulphur oxidizers) (ii) Methanogenic archaea
Dr. Monica Bhatnagar	Department of Microbiology MDS University, Ajmer-305 005 Rajasthan T : 091-9413949910 E : bhatnagarashis@gmail.com	H. Chhipa Prateeksha Jangid	(i) Prosthecate bacteria (ii) *Micrococcus* spp.
Prof. Anjana Sharma	Department of Biological Sciences R.D. University, Jabalpur- 482 001, MP T : 0761-2608704 (O) 2416667 (R) F : 0761-2603752 E : anjoo_1999@yahoo.com	S.K. Singh L. Kori	Diversity of *Aeromonas*, *Enterobacter* and *Serratia* of Narmada river





2010 International Year of Biodiversity

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

ANIMAL VIRUSES

The taxonomy of viruses, which is currently in vogue, though accepts the polythetic nature of the characters of the viruses, yet the classification fails in recognizing the evolutionary aspects of their characters. The modern classification divides them into DNA and RNA viruses and further divides them according to the single- and double- strandedness of their DNA or RNA. It is to be noted that the viruses belong exclusively to the two nucleic acid types. Their symmetry, size, etc., are also considered.

Emergence of either new or variants of the old viruses in humans, animals and birds have been reported with increased frequency in the past few years. Recent biotechnological advances have allowed us to detect these viruses (avian flu virus, swine flu virus, dengue, chikungunya fever virus, severe acute respiratory syndrome-associated coronavirus, West Nile virus, HIV, etc.) quickly and understand their genetic and antigenic diversity. Most of these viruses are variants and have evolved in animal, avian and non-vertebrate hosts to become zoonotic. Large scale climate changes due to global warming, deforestation or afforestation, building of dams or canals, changed agricultural practices, rearing of livestock or birds may also contribute to emergence of variant viruses. If the human impact on the ecosphere continues to escalate, the rate of emergence and re-emergence of viruses will increase.

The number of viruses is very large. As we explore new niches for life and as the sensitivity and specificity of detection techniques improve, the list of viruses expands. Presently International Committee on Taxonomy of Viruses (ICTV) recognizes about 1,550 virus species and some 30, 000 virus strains and isolates which are being studied by virologists in different fields of biology. Viruses are not usually classified into conventional taxonomic groups but are grouped according to properties such as size, the type of nucleic acid they contain, the structure of the capsid and the number of protein subunits in it, host species, and immunological characteristics. It also means that when a new species of known virus family or genus is investigated it can be done in the context of the information that is available for other members of that group. With the availability of molecular tools, taxonomic investigation at molecular level has become national imperative to understand how new virus strains with more virulence emerge. Therefore, understanding the phylogenetic relationships between different strains of viruses helps in development of state of the art diagnostic tools and strategy for their monitoring and surveillance across the countries. In this perspective a national coordinated project on taxonomy capacity building on viruses was initiated in 1999- 2000 with multiple centres located in different parts of the country.

In the AICOPTAX study on the virus taxonomy, it was envisaged to isolate and characterize certain groups of viruses and accordingly the following 5 groups started to work:

Department of Virology, Sanjay Gandhi Post Graduate Institute of Medical Scienecs (SGPGI), Lucknow, worked on the non-polio enteroviruses. This group constitutes a large number of viruses affecting man and several animals. Though some work has been done on the enteroviruses, particularly those causing flaccid paralysis in humans, virtually nothing is known about their status in India.

Division of Virology, Indian Veterinary Research Institute (IVRI) at Mukteshwar was to work on the pox group of viruses of animals. This is a difficult group and the scientist concentrated on the pox viruses of sheep and goats.

Department of Veterinary Microbiology, Chaudhary Charan Singh (CCS) Haryana Agricultural University preferred to work on the diarrhoea viruses of animals.

Department of Virology, NIMHANS, Bangalore was to work on neurotropic viruses. However, the group dropped out early from the study.

Needless to say that the knowledge of these viruses from the Indian subcontinent has been very meagre and they are also of pathogenic and economic importance.

(a) Enteroviruses from immunodeficient humans.

It was expected that the immunodeficient patients would have a plethora of organisms which would not be present in normal persons. Such viruses are likely to be new or undescribed.

(b) Bacteriophages of the *Salmonella* organisms.

At present, the *Salmonella* organisms, constituting a major pathogenic group in humans, animals and birds, are showing increasing resistance to the available antibiotics. It is unlikely that in near future inexpensive and effective antibiotics would be available for the drug-resistant pathogenic bacteria. It was, therefore, decided to explore the possibility of isolating bacteriophages for different salmonellae and study their characteristics and taxonomic inter-relationships. It is also to be appreciated that the bacteriophages constitute the largest number of viruses in the world. Therefore, their taxonomy is of paramount importance.

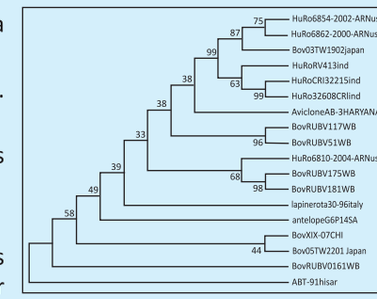


Figure : Phylogenic tree of the VP6 nucleotide sequence of buffalo rotavirus isolate BR-92 (ABT-91 Hisar isolate) indicating its genetic relationship with rotavirus isolates from other countries, constructed by nucleotide sequence analysis by MEGA4 program using the p distance and neighbor joining method.

The present study has the following main objectives: isolation and characterization of viruses; their preservation for future reference and use; study of viruses by specific groups to develop special expertise to handle different groups of viruses; to impart training to younger workers and help them to develop expertise to work on viruses, particularly those of public health importance; to develop a database on the viruses and to develop a critique of virus classification.

Investigators	Addresses Telephone (T) Fax No (F) E-mail Id (E)	Research Fellows	Titles of Projects
Coordinating Unit			
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Collaborating Units			
Prof. A. Ayyagari	Department of Microbiology Sanjay Gandhi Postgraduate Institute of Medical Sciences Raebareli Road, Lucknow- 226 014 T : 0522-2668700 E : aayyagari@yahoo.com	DD Patel	Studies on non-polio enteroviruses
Dr. M. Hosamani	Division of Virology Indian Veterinary Research Institute Mukteshwar, Nainital Dist. Uttaranchal State- 263138. T : 05942-286348 F : 286347 E : m_hosa@email.com	Deepa Rikwal	Studies on pox group of viruses of animals
Dr. G. Prasad/ Dr. Minakshi	Department of Veterinary Microbiology (Project shifted to : Department of Animal Biotechnology) CCS Haryana Agricultural University Hissar. T : 09896296343 (M); 1662-235508 (O) 1662-235508 (R)	–	Studies on diarrhoea viruses of animals.

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

ALGAE

Algae are found in a variety of aquatic habitats – ponds, lakes, ditches, pools, swamps, puddles, brooks, rivers, and in the saline waters of oceans and serve the same purpose in aquatic environments as do grasses on land, that is, they are the chief source of food for animals.

Algae are the simple photosynthetic forms that lack embryogenesis and belong to Thallophyta. They may range from tiny microscopic forms to giant seaweeds or kelps several metres in length. In the five kingdom classification, the word algae refers to organisms in any three kingdoms: in Monera, blue-green algae or cyanobacteria: in Protista several types of unicellular, phytoplanktonic organisms; in the plant kingdom, red, green, and brown algae. As is evident, algae are often named for their colour (e.g., red, green, brown and so on). Their colour depends on the nature of their photosynthetic and accessory pigments. Studying the nature of their pigments helps in their classification. The algae are classified on the basis of their pigments, nature of their flagella, and type of food stored.

Eukaryotic algae lack true embryos and vascular tissues made up of xylem and phloem. The blue-greem algae (cyanobacteria) are prokaryotic and are closely allied to bacteria in structure but have oxygen evolving photosynthesis like eukaryotic algae. Algae can be readily separated from fungi, bryophytes, and vascular plants, since fungi lack photosynthesis, and land plants produce true embryos. More than 23,000 species of algae have been described. Some 5,000 species of algae are known that have secondarily lost photosynthetic pigments and, therefore, exist as saprobes or parasites. Most of these nonchlorophyllous algae are dinoflagellates, euglenoids, and chrysophytes. About 100 'green' algae, a few diatoms, cryptophytes, and 'red' algae are also nonchlorophyllous. All pigmented algae contain chlorophyll-a and variable amounts and kinds of other chlorophylls (b, c, or d) and other accessory pigments (carotenes, xanthophylls, and biliproteins).

Algae are highly diversified group of plants with enormous economic implications not only as primary producers and pollution indicators, but also as a source of several natural products, biofertilizers, biofuels and fine chemicals, single cell protein (SCP), colouring agents and physiological models world-wide.

Represented by about 7187 species in ca 666 genera in India, they are found growing in a variety of habitats ranging from fresh water, terrestrial, marine, etc. Of these ca 1924 species are endemic to the country. The fresh water algae dominated by Chlorophyceae, Bacillariophyceae and Cyanophyceae represent the major portion of Indian algal flora accounting for ca 390 genera and 4500 species followed by terrestrial algae (125 genera and 615 spp.); soil algae (80/1500); marine algae(l69/680). The genera *Spirogyra, Nitella, Volvox, Anacystis, Zygnema, Mougeotia,* etc., are well known. Some fresh water forms, viz. *Volvox, Chlamydomonas, Spirogyra* and *Cosmarium* form scum on the water surface in the stagnant pools, while such forms as *Oedogonium. Cladophora, Coleochaete* and *Chaetophora* grow firmly attached to the submerged rocks and similar substrata in the streams. The terrestrial forms grow on damp soil and tree barks. *Chlorochytrium lemnae* (tissues of Lemna), *Cephaleuros* sp. (parasitic on tea and pepper); *Chlorogonium* sp. (epizoic) and *Scotiella* sp. (occurring in snow) are some other interesting examples. Species of *Nostoc* and *Anabaena* are common in Indian rice fields, and have tremendous potential as biofertilisers.

The marine macro algae (seaweeds), known for their varied colours, are an attractive group of plants found growing on the ocean floors and the long stretches of Indian sea coasts. The Gujarat coast, the islands in Gulf of Mannar and Andaman & Nicobar are of special interest in view of luxuriance and diversity. A total of ca 841 taxa of seaweeds, so far described from Indian coasts. They belong to Rhodophyceae Phaeophyceae and Chlorophyceae. In India, over 45 species of marine algae are useful mainly as source of Agar-Agar (species of *Gelidium, Gelidiella* and *Gracilaria*) and Algins (species of *Sargassum*, *Turbinaria, Dictyota, Padina.* etc.). Some

species are also useful as food (species of *Ulva*, *Enteromorpha, Turbinaria, Gracilaria* and *Porphyra*); as fodder (species of *Dictyota. Padina. Sargassum.* etc.) and manure (all seaweeds in coastal areas).

Algal taxonomic studies in India have been hampered due to lack of herbarium and culture facilities unlike in advanced countries.

Knowledge on fresh water algae is probably very elementary in India, when compared to that of other countries, though algae are becoming more and more open to exploitation worldwide. India being a very large country with diverse habitats, most of these are in need of intensive exploration and detailed study to reveal the algal wealth of our country. We actually lack proper manuals which can help us or future workers to know the algal flora in all its diversity and more so with reference to Indian flora. A relevant database is yet to be created. There is no institution, with experts, which can correctly determine algal materials in times of urgency. There are only very few individuals in our country who do research in these areas. AICOPTAX has set one of its goal to address this issue. It is suggested that priority should be given to concentrate on exploration of fresh water bodies (lotic and lentic situations) and subaerial locations in representative areas in different climatic and altitudinal zones in the country.

1. *Pandorina cylindricum* Iyengar. **2.***Chlorococcum humicola* (Nägeli) Rabenhorst. **3.** *Botryococcus braunii* Kötz. **4.** *Chlorella vulgaris* Beijer. **5.***Golenkinia radiata* Chodat **6.** *Tetraedron octaedricum* (Reinsch) Hans. var. *spinosum* (Reinsch) West & G.S. West **7.** *Ankistrodesmus fulcatus* (Chodest) **8.** *Ankistrodesmus spiralis* (W.B. Turner) Lemmerm. **9.** *Westella linearis* G.M. Sm. **10.** *Selenastrum minutum* (Nägeli) Collins **11.** Kirchneriella lunari (Krchner) Moebius **12.** *Pediastrum simplex* Meyen var. *duodenarium* (Bailey) Rabenh **13.** *Pediastrum simplex* Meyen var. *simplex* Kom.& Fott **14.** *Pediastrum duplex* Mayen. **15.** *Pediastrum duplex* Meyen var. genuinum (A.Braun) Hansgirg **16.** *Pediastrum duplex* Meyen var.reticulatum Lagerh. **17.** *Pediastrum tedras* (Ehrenb.) Ralfs **18.** *Pediastrum tetras* (Ehrenb.) Ralfs var. excisum **19.** *Pediastrum tedras* (Ehrenb.) Ralfs var. tetraodon (Corda) Hansgirg **20.** *Coelastrum microporum* Nägeli **21.)** *Crucigenia tetrapedia* (Kirchen) W.&G.S. West **22.** *Tedrastrum heteracanthum* (Nordest) Chodat **23.** *Scenedesmus acuminatus* (Lagerh.) Chodat **24.** Scnedesmus armatus (Chodat) G.M.Sm. var. bicaudatus (Guglielmetti) Chodat **25.** *Scenedesmus denticulatus* Largerheim **26.** *Scenedesmus longus* Meyen var. naegeli (Breb.) G.M. Sm. **27.** *Scenedesmus opoliensis* P. Richter **28.** *Scenedesmus perforatus* Lemm.var.major (W.B. Turner) Philipiose **29.** *Scenedesmus quadricauda* (Turp.) Brep. var. maximum West & G.S. West **30.** Scenedesmus quadricauda var. quadrispina

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Dr. P.K. Misra	Department of Botany University of Lucknow Lucknow – 226 007 T : (0522) 2741009 R : (0522) 2741293 E : misrapkm@yahoo.com	S. Tripathi S.K. Shukla	Fresh water Algae of Northern & North-Western India
Prof. S.P. Adhikary	Utkal University, Bhubaneswar now transferred to Centre for Biotechnology Visva Bharti, Institute of Science Santiniketan-731235, West Bengal T : 03463-261101 Mob. : 094334010754 E-mail : adhikarysp@visva-bharti.ac.in adhikarysp@gmail.com	Sachitra Kumar Ratha Mrutyunjay Jena Lakshmi Kumari Samad Sudipta Kumar Das Sukumar Bhakta	Fresh water Algae of Eastern India

New Discoveries

Taxa new to India

CHLOROPHYTA

DESMIDS

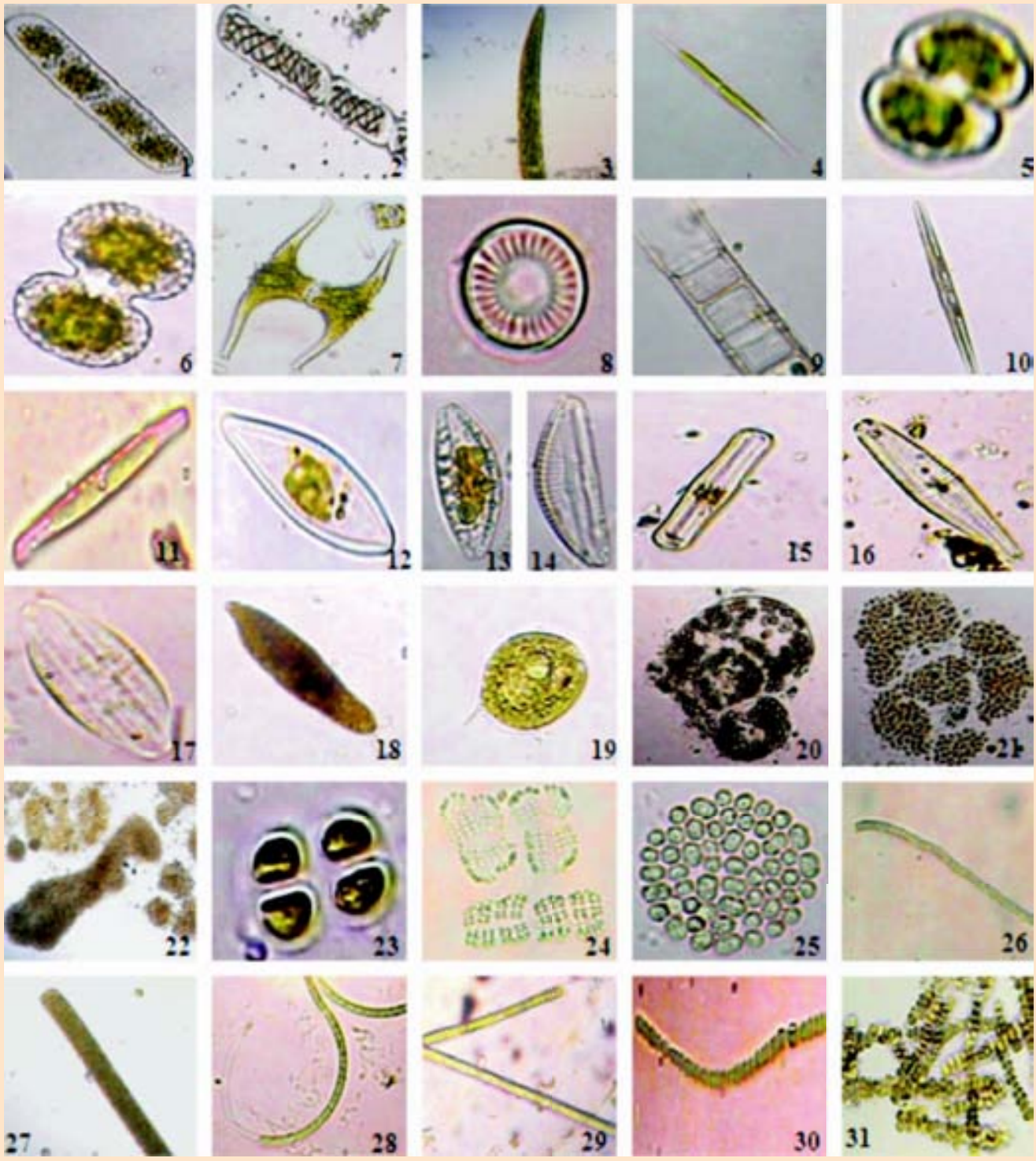
1. *Closterium decorum* Bréb.
2. *Closterium lanceolatum* Kütz. var. *parvulum* W. & G.S. West
3. *Closterium peracerosum* Gay var. *elegans* G.S. West
4. *Closterium setaceum* Ehrenb.
5. *Cosmarium cucurbita* Bréb.
6. *Cosmarium laeve* Rabenh.
7. *Euastrum sinuosum* Lenorm. var. *reductum* Scott & Prescott
8. *Pleurotaenium eugeneum* (W.B. Turner) G.S. West f. *scortia* West & G.S. West
9. *Pleurotaenium trochiscum* West & G.S. West var. *tuberculatum* G.M. Sm.

CHLOROCOCCALES

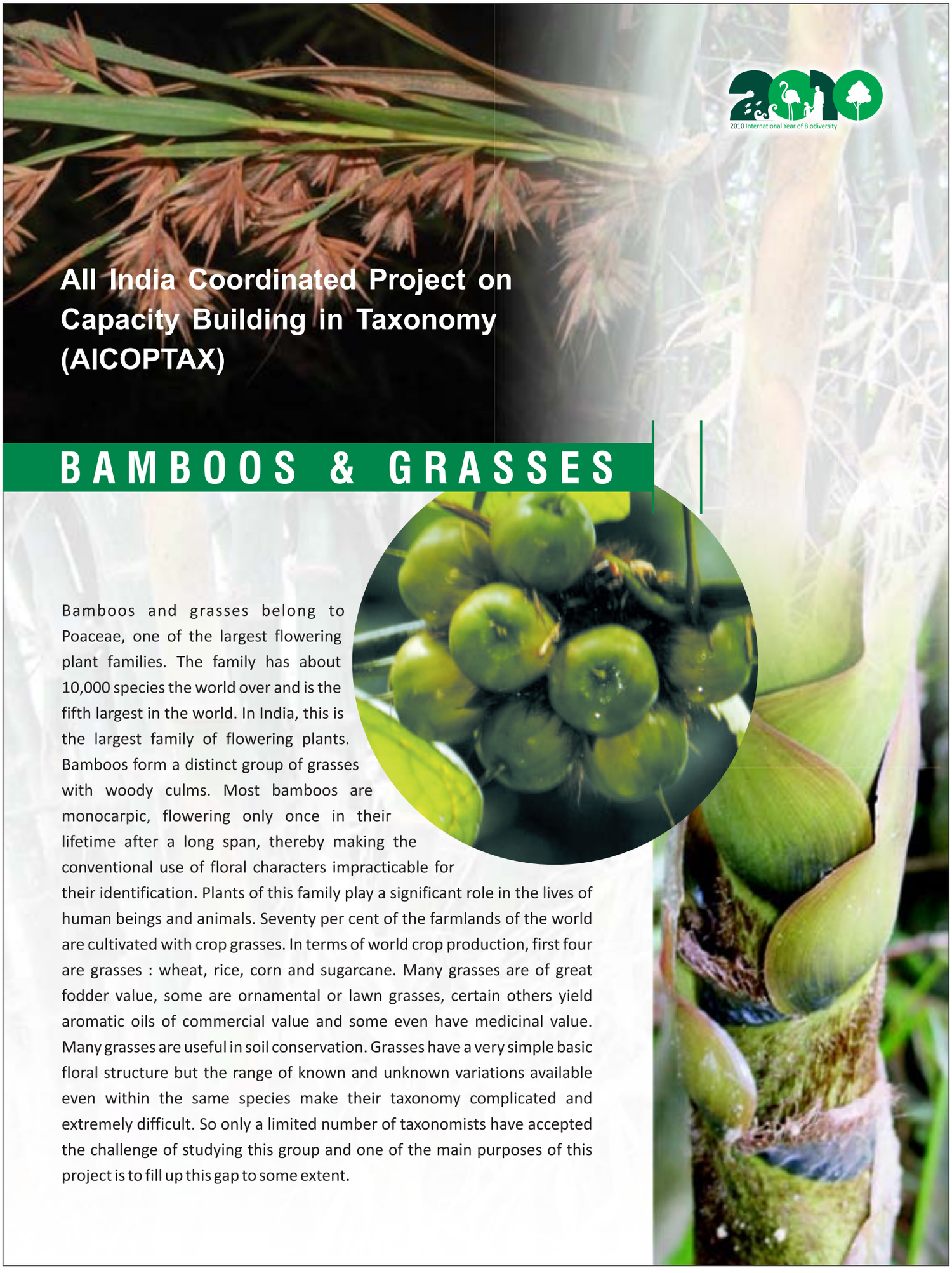
1. *Chlorococcum humicolo* (Nägeli) Rabenh.
2. *Coelastrum reticulatum* (Dang.) Senn
3. *Coenochloris polycocca* (Koršik.) Hind
4. *Coenocytis reniformis* Korsik.
5. *Pediastrum duplex* Mey. var. *coronatum* Racib.
6. *Pediastrum tetras* (Ehrenb.) Ralfs var. *tetraodon* (Corda) Hansg.
7. *Radiococcus nimbatus* (De Wild.) Scmid.
8. *Treubaria setigera* (Archer) G.M. Sm.

BACILLARIOPHYTA

1. *Achnanthes subsessilis* Kütz.
2. *Amphora elliptica* Kütz.
3. *Cocconeis pediculus* Ehrenb.
4. *Cocconema cistula* Ehrenb.
5. *Diadesmis confervacea* Kütz.
6. *Diatoma anceps* (Ehrnb.) Kirchh.
7. *Eunotia amphioxys* Ehrenb.
8. *Fragilaria virescens* Ralfs
9. *Gomphonema parvulum var. micropus* (Kütz.) Cleve
10. *Gomphonema telographicum* Kütz.
11. *Himantidium areus* Ehrenb.
12. *Himantidium minus* Kütz.
13. *Navicula amphirynchus* Ehrenb.
14. *Navicula major* Kütz.
15. *Navicula sphaerophora* Kütz.
16. *Navicula viridis* Kütz.
17. *Navicula viridula* Kütz.
18. *Synedra crystallina* Kütz.
19. *Synedra tergestina* Kütz.
20. *Synedra ulna* (Nitzsch) Ehrenb. var. *amphirhynchus* (Ehrenb.) Grunov
21. *Synedra ulna* (Nitzsch) Ehrenb. var. *oxyrhynchus* (Kütz.) Van Heurck
22. *Tabellaria fenestrata* (Lyngb.) Kütz.



1 Chlorophyceae: 1. *Netrium elongatum* Panikkar **2.** *Spirogyra hyalina* Cleve **3.** *Closterium decorum* Breb. **4.** *Closterium setaceum* Ehrenb. **5.** *Cosmarium portianum* Arc. var.*nephroideum* Witter **6.** Cosmarium impressulum (Elfving) **7.** *Staurastrum princeps* Krieg var, *trifidum* A.M. Scott & Prescott **Bacillariophyceae: 8.** *Cylotellama mgneghiniana* Kötz. **9.** *Melosira granulata* (Ehrenb) Ralfs **10.** *Fragillaria brevistriata* Grun. f. *elongata* G.S. Venkataram. **11.** *Synedra dorsiventralis* O.Muller, **12.** *Navicula radiosa* Kötz. **13.** Cymbella kolbei Hust. **14.** *Cymbella tumescens* A.Cleve **15.** *Pinnularia abanjensis* (Pant) Ross **16.** *Gomphonema laceolaium* Ehrenb., **17.** *Amphora coffeaformis* C. Agardh, **Euglenophyceae: 18.** *Euglena proxima* Dengeard **19.** *Phacus leuronectes* (Muell) Dujardin **Cyanophyceae: 20.** Microcystis robusta (Clark) Nygaard **21.** Microcystis viridis (A.Brann.) Lemmerm. **22.** *Microcystis wesenbergii* Komarak **23.** *Chroococcus indicus* Zeller **24.** *Merismopedia punctata* Meyen **25.** Hydrococcus rivularis Kötz.Thallus **26.** *Spirulina gigantea* Schimidle **27.** *Oscillatoria chalybea* (Martens) Gomont **28.** *Phormidium coeruleum* (Gomont.) Anag. and Gom. **29.** *Lynbya lutea* C. Agardh.) **30.** *Anabaena sphaerica* Born.et **31.** *Westeillopsis prolifica* Janet.



2010 International Year of Biodiversity

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

BAMBOOS & GRASSES

Bamboos and grasses belong to Poaceae, one of the largest flowering plant families. The family has about 10,000 species the world over and is the fifth largest in the world. In India, this is the largest family of flowering plants. Bamboos form a distinct group of grasses with woody culms. Most bamboos are monocarpic, flowering only once in their lifetime after a long span, thereby making the conventional use of floral characters impracticable for their identification. Plants of this family play a significant role in the lives of human beings and animals. Seventy per cent of the farmlands of the world are cultivated with crop grasses. In terms of world crop production, first four are grasses : wheat, rice, corn and sugarcane. Many grasses are of great fodder value, some are ornamental or lawn grasses, certain others yield aromatic oils of commercial value and some even have medicinal value. Many grasses are useful in soil conservation. Grasses have a very simple basic floral structure but the range of known and unknown variations available even within the same species make their taxonomy complicated and extremely difficult. So only a limited number of taxonomists have accepted the challenge of studying this group and one of the main purposes of this project is to fill up this gap to some extent.

Investigators	Addresses Telephone (T) Fax No (F) E-mail Id (E)	Research Fellows	Titles of Projects
Coordinating Unit			
Dr. V.J. Nair	Botanical Survey of India TNAU Campus, Coimbatore - 641 003 Tamil Nadu T : 0422-2432788 F : 2432835	K. Althaf Ahamed Kabeer T. Selvanayakam J. Herald Franklin Benjamin, Adm./Tech. Asstt.	Grass Flora of Tamil Nadu
Collaborating Units for Bamboos			
Dr. Paramjit Singh	Botanical Survey of India, CGO Complex, Salt lake City, Kolkata - 700 064. T : 033-23584240, F : 23215631 E : pchanna@gmail.com	Dr. Pushpa Kumari Tika Prasad Sharma Dipawnita Banik	Bamboos of NE India
Dr. Muktesh Kumar	Botany (FE & BC) Division Kerala Forest Research Institute Peechi - 680 653, Thrissur District, Kerala T : 0487 - 2699037, 2699061, F : 2699249 E : muktesh@kfri.org	M. Ramesh A.J. Robi	Bamboos of Peninsular India and Andaman & Nicobar Islands.
Collaborating Units for Grasses			
Prof. (Dr.) S.R. Yadav	Department of Botany Shivaji University, Kolhapur - 416 004 Maharashtra T : 0231-2690571 extn 9157; 2607025(R) F : 0231-2692333 E : sryadavdu@rediffmail.com	Dr. Girish G. Potdar Priti D. Mahekar Sheetal C. Chivalkar	Grass Flora of Maharashtra
Prof. (Dr.) B.K. Gupta	Botany Department, DAV P.G. College Dehra Dun - 248 001, Uttaranchal T : 09906070663	Manish K. Kandwal	Grass Flora of Uttarakhand

New Discoveries

Species/ varities new to science

Grasses – 9 species/varieties

1. *Eulalia shrirangii* Salunkhe & Potdar
2. *Helictotrichon uniyalii* M.K. Kandwal & B.K. Gupta
3. *Microstegium vimineum* (Trin.) A. Camus var. *loharkhetianum* M.K. Kandwal & B.K. Gupta
4. *Mnesithea veldkampii* Potdar, Gaikwad, Salunkhe & S.R. Yadav
5. *Polypogon nilgiricus* K.A.A. Kabeer & V.J. Nair
6. *Streblochaete sanjappae* K.A.A. Kabeer & V.J. Nair
7. *Themeda pseudotremula* Potdar, Salunkhe & S.R. Yadav
8. *Trachys copeana* K.A.A. Kabeer & V.J. Nair
9. *Tripogon borii* K.A.A. Kabeer, V.J. Nair & G.V.S. Murthy

Bamboos – 5 species

1. *Ochlandra keralensis* M.Kumar, Ramesh & Stephen
2. *Ochlandra soderstromiana* M.Kumar & Stephen
3. *Ochlandra spirostylis* M.Kumar, Seetha & Stephen
4. *Schizostachyum andamanicum* M. Kumar & Ramesh
5. *Schizostachyum kalpongianum* M. Kumar & Ramesh

Taxa new to India

Grasses – genus 1; species / varieties 8

Streblochaete Hochst. ex Pilger - new genus record for India.

1. *Bromus diandrus* Roth
2. *Digitaria abyssinica* (A.Rich.) Stapf
3. *Ehrharta stipoides* Labill.
4. *Panicum plenum* Hitchc. & Chase
5. *Poa arnoldii* Melderis
6. *Sporobolus africanus* (Poir.) A. Robyns & Tourn.
7. *Urochloa villosa* (Lam.) A. Camus var. *barbata* (Bor) Noltie
8. *Vulpia bromoides* (L.) Gray

Bamboos – 3 species

1. *Chimonobambusa quadrangularis* (Fenzi) Makino
2. *Ochlandra stridula* Moon ex Thwaites
3. *Sinarundinaria debilis* Thwaites

Taxa new to regions:

Grasses

1. *Arundinella setosa* Trin. var. *lanifera* C.E.C. Fisch.-new to W. Himalaya
2. *Avena barbata* Pott ex Link - new to S. India
3. *Calamagrostis nagarum* (Bor) G. Singh - new to W.Himalaya
4. *Cyathopus sikkimensis* Stapf - new to W. Himalaya
5. *Digitaria fuscescens* (C.Presl) Henrard - new to S. India
6. *Eragrostis paposa* (Roem. & Schult.) Steud. - new to W. Himalaya
7. *Festuca polycolea* Stapf var. *brevis* Stapf - new to W.Himalaya
8. *Neyraudia reynaudiana* (Kunth) Keng ex Hitchc. - new to W. Himalaya
9. *Oropetium roxburghianum* (Steud.) S.M. Phillips - new to W.Himalaya
10. *Pennisetum alopecuroides* (L.) Spreng. new to W. HImalaya
11. *Poa stapfiana* Bor - new to W. Ghats
12. *Sporobolus ioclados* (Nees ex Trin.) Nees - new to S. India
13. *Zoysia pacifica* (Gouds.) Hotta & Kuroki - new to W.Himalaya

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

FUNGI

There are about 1, 00,000 species of fungi characterized until now. Some of them are one-celled like yeast, others complex like mushrooms. They are important decomposers in the biosphere, cycling its inorganic resources. They obtain energy by extra cellular digestion and absorption. Some parasitic forms cause diseases in plants and animals. Classification of fungi is largely based on the life-cycle involved.

India, with its varied topography, climate, forest types, soil types, altitudes, and specialized niches, besides having tropical and sub-tropical zones, definitely possess a much diversified mycoflora. Every year many new fungi are reported from India. The variety and galaxy of fungi and their natural beauty occupy prime place in the biological world and India has been the cradle for such fungi. One third of the fungal diversity of the globe exists in India. However, only a fraction of total fungal wealth has been subjected to scientific scrutiny so far and mycologists have to explore and unravel the hidden wealth.

Fungi play a significant role in the daily life of human beings, besides their utilization in industry, agriculture, medicine, food textiles, bioremediation, natural cycling, as biofertilizers and in many other ways. Tropical plants are expected to support a high diversity of endophytic fungi. Many endophytes produce unusual secondary metabolites - sources of anticancer, antidiabetic, insecticidal, immunosuppressive and thermoprotective compounds. They need to be explored. Fungal biotechnology has become an integral part of human welfare.

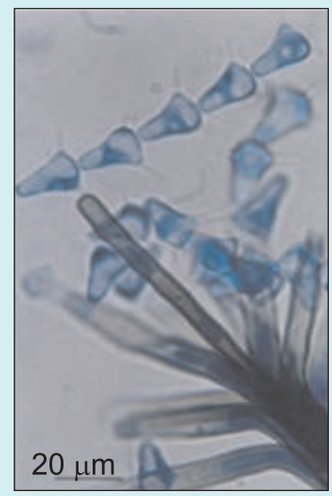
Conservation of fungi has become essential as some of them have become extinct and many are facing threats. This involves conservation of the sites, ecological niches, substrates/habitats/hosts and artificial culturing for germplasm maintenance. Unfortunately, only 5-10 per cent of fungi have so far been cultured artificially.

The present project, in addition to the general objectives of AICOPTAX, also plans mapping of fungi of different regions.

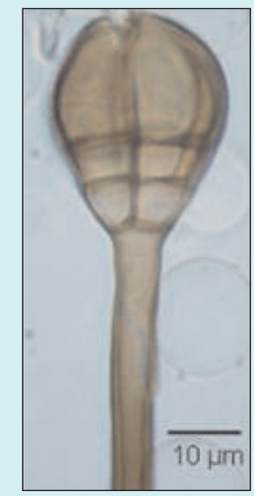
Investigators	Addresses Telephone (T) Fax No (F) E-mail Id (E)	Research Fellows	Titles of Projects
Co-ordinating Unit			
Prof. C. Manoharachary	Botany Department, Osmania University, Hyderabad – 500 007. T : 040-27682244, F : 27090020 E : cmchary@rediffmail.com	K. Sharath Babu Dr. I.K. Kunwar	Taxonomy of fungi and capacity building
Collaborating Units			
Prof. D.J. Bhat	Botany Department, Goa University, Talligao Plateau, Goa – 403 206. T : 0832-2451345 ext: 254, F : 2451184 E : bhatdj@rediffmail.com	T.S. Keshav Prasad Puja B. Gawas	Taxonomy of entomogenous, endophytic and litter fungi
Prof. K. Natarajan*	CAS in Botany, Guindy Campus, Chennai - 600 025. T : 044-22350401 E : knraj42@yahoo.com	Ravindran / Senthilarasu	Studies on the diversity of Agaricales in south India
Prof. A.K. Roy	Botany Department, T.M. Bhagalpur University, Bhagalpur – 812 007. T : 0641-2500063 E : botanyakr@yahoo.co.in	S.K. Pandey	Taxonomy of fungi of Bihar, Jharkhand and adjoining areas of WB
Dr. R.K.S. Kushwaha	Botany Department, Christ Church College, Kanpur – 208 001. T : 0512-2637318, F : 2304627 E : kushwaharks@vsnl.net	Neetu Tripathi	Fungal taxonomy of keratinophilic fungi
Dr. Alok Adholeya	Bioresour. & Biotech. Div., TERI, Darbari Seth Block, IHC Complex, Lodi Road, New Delhi – 110 003. T : 011-24682100 ext: 2609, F : 24682144 E : aloka@teri.res.in	Dr. Reena Singh	Strengthening taxonomic skills in AMF fungi.
Dr. A.K. Pandey	Dept of Biological Sciences, Rani Durgavati University, Jabalpur – 482 001. T : 0761-2601064, F : 603752 E : akprd7@yahoo.com	G. Srivastava Rashmi Dubey	Fungal diversity associated with weeds and medicinal plants

* Deceased

Piricaudiopsis indica



Phialosporostilbe catenata



Acrodictys erecta

Stachybotrys kampalensis

Some Taxa new to science

GENERA NEW TO SCIENCE

1. *Beltraniomyces* Manohar., D.K. Agarwal & N.K. Rao
2. *Ceeveesubramaniomyces* Pratibha, K.D. Hyde & Bhat
3. *Diatrypoidiella* Manohar., Kunwar & D.K. Agarwal
4. *Hawksworthia* Manohar., N.K. Rao, D.K. Agarwal & Kunwar
5. *Manoharachariomyces* N.K. Rao, D.K. Agarwal & Kunwar
6. *Microxyphispora* Manohar., Kunwar & P. Ramesh
7. *Natarajania* Pratibha & Bhat
8. *Vanibandha* Manohar., N.K. Rao, Kunwar & D.K. Agarwal
9. *Vittalia* Gawas & Bhat

SPECIES NEW TO SCIENCE

1. *Acaulospora terricola* Swarupa, Kunwar & Manohar.
2. *Acrodictys elliptica* Manohar., N.K. Rao, D.K. Agarwal & Kunwar
3. *Acrodictys lignicola* Manohar., N.K. Rao, D.K. Agarwal & Kunwar
4. *Amanita uppangalayensis* Natarajan & Senthil.
5. *Annellophora catenata* Manohar, N.K. Rao, D.K. Agarwal & Kunwar
6. *Astrosporina metuloidus* Natarajan & Senthil.
7. *Bahugada hyderabadensis* N.K. Rao, Kunwar, Manohar. & Bhadraiah
8. *Bahusutrabeeja manoharacharii* Pratibha & Bhat
9. *Beltraniella mangiferae* N.K. Rao, Kunwar & Manohar.
10. *Beltraniomyces lignicola* Manohar., D.K. Agarwal & N.K. Rao
11. *Ceeveesubramaniomyces litseai* Pratibha, K.D. Hyde & Bhat
12. *Cercospora centellae* Manohar., Kunwar & Sharath
13. *Cercosporidium terminali* Manohar., Kunwar & N.K. Rao
14. *Chaetochalara indica* Sureshkumar, Kunwar, Sharath & Manohar.
15. *Chalara indica* Pratibha, K.D. Hyde & Bhat
16. *Cheiromyces ananthgiriensis* Manohar., N.K. Rao, Kunwar & D.K. Agarwal
17. *Diatrypoidiella lignicola* Manohar., Kunwar & D.K. Agarwal
18. *Echinosphaeria macrospora* Puja, Bhat & K.D. Hyde
19. *Ellisiopsis indica* Sharath, Sureshk., Kunwar & Manohar.
20. *Endophragmiella ivorii* Manohar. & D.K. Agarwal
21. *Entoloma furfuracea* Natarajan & Senthil.
22. *Entoloma fibulata* Natarajan & Senthil.
23. *Entoloma indicum* Natarajan & C. Ravindran
24. *Entoloma nilgiriense* Natarajan & C. Ravindran
25. *Filoboletus rugosus* Natarajan & Senthil.
26. *Galerina pulverulentus* Natarajan & *Senthil.*
27. *Glomus hyderabadensis* Swarupa, Kunwar, G.S. Prasad & Manohar.
28. *Gymnopilus caulocystidiatus* Natarajan & *Senthil.*
29. *Hawksworthia srisailamensis* Manohar., N.K. Rao, D.K. Agarwal & Kunwar
30. *Helicoma indica* Gawas & Bhat
31. *Hygrocybe uppangalayensis* Natarajan & Senthil.
32. *Hygrocybe cerasinus* Natarajan & Senthil.
33. *Hygrocybe rubrosquamosa* Natarajan & Senthil.
34. *Hydropus indica* Natarajan & Senthil.
35. *Janetia indica* B.S. Reddy, V. Rao & Manohar.
36. *Laccaria indica* Natarajan & Senthil.
37. *Lepiota lecythiformis* Natarajan & Senthil.
38. *Lepiota capitata* Natarajan, Siva & Kaviyarasan
39. *Lepiota sapthagiriensis* Natarajan, Siva & Kaviyarasan
40. *Leucocoprinus favescens* Natarajan, Siva & Kaviyarasan
41. *Leucocoprinus mucronatus* Natarajan, Siva & Kaviyarasan
42. *Leucocoprinus niveus* Natarajan, Siva & Kaviyarasan
43. *Leucocoprinus tirumalaiensis* Natarajan, Siva & Kaviyarasan
44. *Manoharachariomyces lignicola* N.K. Rao, D.K. Agarwal & Kunwar
45. *Marasmius clabatus* Natarajan, Siva & Kaviyarasan
46. *Marasmius lageniformis* Natarajan & Senthil.
47. *Marasmius piriformis* Natarajan, Siva & Kaviyarasan
48. *Marasmius pleurocystidiata* Natarajan & Senthil.
49. *Marasmius rubineus* Natarajan & Senthil.
50. *Memnoniella indica* Kesh. Prasad, Asha & Bhat
51. *Memnoniella mohanramii* Manohar., D.K. Agarwal, Kunwar, Sureshk. & Sharath
52. *Microxyphispora corticola* Manohar., Kunwar & P. Ramesh
53. *Mycovellosiella multiseptata* Manohar., Sharath, Srinivaslu, P. Ramesh & Bagyan.
54. *Natarajania indica* Pratibha & Bhat
55. *Piricaudiopsis indica* Sharath, Sureshk., Kunwar & Manohar.
56. *Phalangispora bharathensis* Kesh. Prasad & Bhat
57. *Phialosporostilbe catenata* Sureshk, Sharath, Kunwar & Manohar.
58. *Pholiota cystidiata* Natarajan & C. Ravindran
59. *Pholiota griseoaurantiacus* Natarajan & Senthil.
60. *Pholiota sylva* Natarajan & C. Ravindran
61. *Pisolithus indicus* Natarajan & Senthil.
62. *Pithomyces djbhatii* Manohar., Kunwar & N.K. Rao
63. *Polychaeton bassiae* Manohar., Kunwar, Sharath & Nagamani
64. *Polychaeton bougainvellae* Manohar., Kunwar, Sharath & Nagamani
65. *Polyschema ylnenei* Manohar., Kunwar & N.K. Rao
66. *Psilocybe mucronata* Natarajan & Senthil.
67. *Psilocybe papillatus* Natarajan & Senthil.
68. *Sorocybe indicus* Puja, K.D. Hyde & Bhat
69. *Speiropsis rogergoosensis* Kesh. Prasad & Bhat
70. *Sporidesmium curvula* Manohar., Kunwar, N.K. Rao & D.K. Agarwal
71. *Sporidesmium lageniforme* Manohar., Kunwar, N.K. Rao & D.K. Agarwal
72. *Sporidesmium mehrotraii* Manohar., Kunwar, N.K. Rao & D.K. Agarwal
73. *Sporidesmium uncinatus* Manohar., Kunwar, N.K. Rao & D.K. Agarwal
74. *Stellomyces kendrickii* Kesh. Prasad & Bhat
75. *Trichocladium palmae* Manohar., N.K. Rao, Kunwar & D.K. Agarwal
76. *Trichocladium sigmoidea* Manohar., N.K. Rao, Kunwar & D.K. Agarwal
77. *Vanibandha sundara* Manohar., N.K. Rao, Kunwar & D.K. Agarwal
78. *Vermiculariopsiella elegans* Kesh. Prasad, D'Souza & Bhat
79. *Vermiculariopsiella endophytica* Puja, Bhat & K.D. Hyde
80. *Vermiculariopsiella indica* Kesh. Prasad, D'Souza & Bhat
81. *Vermiculariopsiella parva* Kesh. Prasad, D'Souza & Bhat
82. *Vittalaea indica* Gawas & Bhat
83. *Zygosporium anupamvarmae* Manohar., D.K. Agarwal, Sureshk., Kunwar & Sharath

Taxa new to India (including new host records)

Fungi (F) / New Hosts (NH)

1. *Camposporium antennatum* Harkn. on litter (F)
2. *Colletotrichum dematium* (Fr.) Grove on *Doxanthia unguis-cati* L. (NH)
3. *Colletotrichum gloeosporioides* (Penz.) Sacc. on *Piper wightiana* (NH)
4. *Cryptophialoidea secunda* (Kuthub. & B. Sutton) Kuthub. & Nawawi on wood. (F)
5. *Cylindrocladium tenue* (Bugnic.) T. Watan. on litter. (F)

Tricholoma sordidum

6. *Fusarium tabacinum* (J.F.H. Beyma) W. Gams on fruits of *Musa paradisiaca* L. (NH)
7. *Glomus pansihalos* S.M. Berch & Koske from the rhizosphere soil of *Nerium oleander* L. (F)
8. *Lasiodiplodia theobromae* (Pat) Grif. & Maubl. on *Pandanus odorotissimus* L. & *Tephrosia purpurea* Pers. (NH)
9. *Monodictys castanae* (Wallr.) S. Hughes on dead wood. (F)
10. *Myrothecium cinctum* (Corda) Sacc. on dead twigs. (F)
11. *Penicillium herquei* Bainier & Sartory from soil. (F)
12. *Periconia atra* Corda on litter. (F)
13. *Physalidium elegans* Luppi Mosca on dead twigs. (F)
14. *Sarcopodium circinatum* Ehrenb. on wood. (F)
15. *Spadicoides grovei* M.B. Ellis on dead twigs. (F)
16. *Stachybotrys dichroa* Grove on litter. (F)
17. *Stachybotrys kampalensis* Hansf. on litter. (F)
18. *Stachybotrys parvispora* S. Hughes on litter. (F)
19. *Tharoopoma missisipiensis* Lentz on dead twigs. (F)
20. *Torula herbarum* var. *quaternella* Sacc. on *Euphorbia tirucalli* L. (NH)
21. *Trichoderma flavofuscum* (J.H. Mill., Giddens & A.A. Foster) Bissett from Himalayan soil. (F)
22. *Zygosporium minus* S. Hughes on litter. (F)

4 C. Taxa new to region

Taxa new to Western Ghats – 19

1. *Aschersonia badia* Patouliard
2. *Aschersonia brunnea* Petch
3. *Aschersonia aleyrodis* Webber
4. *Bahusutrabeeja manoharacharii* Pratibha & Bhat
5. *Chalara indica* Pratibha, K.D. Hyde & Bhat
6. *Echinosphaeria macrospora* Puja & Bhat
7. *Memnoniella indica* Kesh. Prasad & Bhat
8. Natarajania indica Pratibha & Bhat
9. *Phalangispora bharathensis* Kesh. Prasad & Bhat
10. *Sorocybe indicus* Puja & Bhat
11. *Speiropsis rogergoosensis* Kesh. Prasad & Bhat
12. *Stellomyces kendrickii* Kesh. Prasad & Bhat
13. *Vamsapriya indica* Gawas & Bhat
14. *Vermiculariopsiella elegans* Kesh. Prasad, D'Souza & Bhat
15. *Vermiculariopsiella indica* Kesh. Prasad, D'Souza & Bhat
16. *Vermiculariopsiella endophytica* Puja & Bhat
17. *Vermiculariopsiella parva* Kesh. Prasad, D'Souza & Bhat
18. *Vittalaea indica* Gawas & Bhat
19. *Helicoma indica* Gawas & Bhat

Taxa new to Uttar Pradesh state - 11

Taxa new to Central India – 27

2010 International Year of Biodiversity

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

LICHENS & BRYOPHYTES

Lichens and bryophytes constitute a fascinating component of biodiversity and are widely spread in almost all climatic conditions. They are among the very few groups of plants found in Antarctica. Their varied roles in ecosystem functioning and in air pollution monitoring are significant. They play important roles in terrestrial ecosystem such as modification of habitat, nutrient cycling and maintenance of nutrient status of soil and primary production. Both lichens and bryophytes are increasingly being used as "biomonitors" or "bioindicators" of air pollution. Bryophytes can also be effectively used as "bioaccumulators and biological vacuum cleaners," especially in aquatic ecosystems.

Lichens are unique in producing over 830 secondary metabolites which do not occur in other organisms. This has made them very useful to people of diverse cultures, especially as a source of food, dyes, crude drugs, agrochemicals and other useable compounds. Recently, a variety of natural products isolated from lichens have been found to exhibit a wide range of potentially useful biological activities such as inhibition of prostaglandin biosynthesis and cancer growth; anti-inflammatory, analgesic and antipyretic effects; nematocidal and anti-cholesterol activities, etc. It is believed that lichens have even greater potential for novel biological activities including inhibition of tyrosinase, inhibition of activation of Epstein-Barr Virus (EBV), superoxide dismutase-like (SOD-like) activity and antibacterial and antifungal activities.

Similarly, many bryophytes, the amphibians of the 'Plant Kingdom', and the second largest group of green plants next only

Riccardia elata

Leptolejeunea apiculata

to the angiosperms, have high concentration of flavonoids and terpenoids which make them a great source of natural antibiotics, fungicides and pesticides. A number of species of *Cheiloscyphus, Conocephalum, Diplopyllum, Jamesoniella, Scapania,* etc., have considerable pharmaceutical potential.

Over 2,300 species of lichens and 2,450 species of bryophytes including infra specific taxa are so far known from India. Their major centres of diversity and occurrence in the country are the Eastern Himalaya including the North-eastern India, Western Ghats, Western Himalaya and Andaman and Nicobar Islands. They grow up to 5000 m altitude in the Himalaya, showing their best manifestation in tropical to temperate areas. The taxonomic knowledge of both the groups is still inadequate as they are poorly studied because of cryptic nature of plants and lack of trained experts. As a result the major portion of the country is still either under explored or unexplored for these groups.

The present study under the AICOPTAX aims at bridging this gap, both in terms of our knowledge on the diversity and distribution of lichens and bryophytes in the country, and to develop capacity in taxonomy of these groups where only a very few specialists are available.

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Collaborating Units for Bryophytes			
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New Discoveries

Taxa new to science

Lichens - 29 species

1. *Aderkomyces sikkimensis* Pinokiyo, Kr.P. Singh & Lücking
2. *Aspidothelium scutellicarpum* var. *indicum* Kr.P. Singh & Pinokiyo
3. *Astrosphaeriella sundarbanensis* Jagadeesh Ram & Aptroot (non-lichenized ascomycetes)
4. *Brigantiaea patwardhanii* Chitale & Makhija
5. *Carbacanthographis sorediata* B.O. Sharma, Makhija & Khadilkar
6. *Chrysothrix septemseptata* Jagadeesh Ram, Lumbsch, Lücking & G.P. Sinha
7. *Cladonia awasthiana* Ahti & Upreti
8. *Cladonia singhii* Ahti & P.K. Dixit
9. *Diorygma albovirescens* Makhija, Chitale & B.O. Sharma
10. *Diorygma excipuloconvergentum* Makhija, Chitale & B.O. Sharma
11. *Fuscopannaria granulifera* P.M. Jørg. & Upreti
12. *Graphis albidofarinacea* Adaw. & Makhija
13. *Graphis alboglaucescens* Adaw. & Makhija
14. *Graphis cinnamomea* Adaw. & Makhija
15. *Graphis nurerensis* Makhija, Dube, Adaw. & Chitale
16. *Graphis polystriata* Makhija & Dube
17. *Hemithecium amboliense* Makhija & Dube
18. *Hemithecium consociatum* Makhija & Dube
19. *Hemithecium norsticticum* Makhija & Dube
20. *Hemithecium staigerae* Adaw. & Makhija
21. *Leptogium patwardhanii* Dube & Makhija
22. *Leptogium subazureum* Dube & Makhija
23. *Mazosia lueckingii* Kr.P. Singh & Pinokiyo
24. *Parmelia hygrophiloides* Divakar, Upreti & Elix
25. *Parmotrema upretii* Divakar
26. *Pyrenula subcylindrica* Jagadeesh Ram & Upreti
27. *Sclerophyton indicum* Makhija & Adaw.
28. *Sporopodium awasthianum* Kr.P.Singh & Pinokiyo
29. *Thelenella indica* Pinokiyo & Kr.P. Singh

Bryophytes - 8 species

1. *Arachniopsis indica* S.C. Srivast. & Verma
2. *Cephalozia schusteri* Sushil K.Singh & D.K.Singh
3. *Cololejeunea nilgiriensis* Abha Srivast. & S.C. Srivast.
4. *Frullania larjiana* Sushil K.Singh & D.K.Singh
5. *Gongylanthus indicus* S.C. Srivast. & Verma
6. *Jungermannia indrodayana* Sushil K.Singh & D.K.Singh
7. *Lopholejeunea sikkimensis* var. *tenuicostata* Sushil K.Singh & D.K.Singh
8. *Metzgeria coorgense* S.C. Srivast. & Smita Srivast.

Taxa new to India

Lichens - 85 species

1. *Amandinea insperata* (Nyl.) H. Mayrhofer & Ropin
2. *Anisomeridium leptospermum* (Zahlbr.) R.C. Harris
3. *Anisomeridium tamarindi* (Fée) R.C. Harris
4. *Arthonia dispersula* Nyl.
5. *Arthonia obesa* (Müll. Arg.) R. Sant.
6. *Arthonia palmulacea* (Müll.Arg.) R.Sant.
7. *Asterothyrium decipiens* (Rehm) R.Sant.
8. *Aulaxina microphana* (Vain.) R.Sant.
9. *Bacidina mastothallina* (Vain.) Vìzda
10. *Bactrospora jenikii* (Vìzda) Egea & Torrente
11. *Byssolecania deplanata* (Müll.Arg.) R.Sant.
12. *Byssoloma polychromum* (Müll.Arg.) Zahlbr.
13. *Calopadia perpallida* (Nyl.) Vìzda
14. *Caloplaca herbidella* (Nyl. ex Hue) H. Magn.
15. *Caloplaca pollinii* (A. Massal.) Jatta
16. *Cladonia mongolica* Ahti
17. *Chapsa pseudophlyctis* (Nyl.) A. Frisch
18. *Coccocarpia glaucina* Kremp.
19. *Coccocarpia rottleri* (Ach.) Arv.
20. *Coenogonium subluteum* (Rehm) Kalb & Lücking
21. *Coenogonium zonatum* (Müll. Arg.) Kalb & Lücking
22. *Dirinaria leopoldii* (Stein) D.D. Awasthi
23. *Echinoplaca streimannii* Sérus.
24. *Enterographa anguinella* (Nyl.) Redinger
25. *Enterographa divergens* (Müll. Arg.) Redinger
26. *Enterographa mesomela* Sparrius, Saipunkaew & Wolseley
27. *Enterographa multiseptata* R. Sant.
28. *Erythrodecton malacum* (Kremp.) G. Thor
29. *Fissurina egena* (Nyl.) Nyl.
30. *Fissurina elaiocarpa* (A.W. Archer) A. W. Archer
31. *Graphis bulacana* Vain.
32. *Graphis dendrogramma* Nyl.
33. *Graphis librata* C. Knight
34. *Helminthocarpon leprevostii* Fée
35. *Herpothallon albidum* (Fée) Aptroot, Lücking & G. Thor
36. *Herpothallon australasicum* (Elix) Elix & G. Thor
37. *Herpothallon cinereum* G. Thor
38. *Herpothallon granulare* (Sipman) Aptroot & Lücking
39. *Herpothallon philippinum* (Vain.) Aptroot & Lücking
40. *Heterodermia albicans* (Pers.) Swinscow & Krog
41. *Hyperphyscia isidiata* Moberg
42. *Julella geminella* (Nyl.) R.C. Harris
43. *Lasioloma phycophilum* (Vain.) R.Sant.
44. *Lecanora achroa* Nyl.
45. *Lecanora alba* Lumbsch
46. *Lecanora andina* Räsänen
47. *Lecanora flavidofusca* Müll. Arg.
48. *Lecanora formolusa* Lumbsch
49. *Lecanora helva* Stizenb.
50. *Lecanora interjecta* Müll. Arg.
51. *Lecanora queenslandica* C. Knight
52. *Lecanora tropica* Zahlbr.
53. *Lecidoma demissium* (Rutström) G. Schneider & Hetel
54. *Lepraria lobificans* Nyl.
55. *Lithothelium illotum* (Nyl.) Aptroot
56. *Loflammia intermedia* (R. Sant.) Věza
57. *Mazosia rotula* (Mont.) A.Massal.
58. *Mazosia tumidula* (Stirt.) Müll. Arg.
59. *Mycomicrothelia minutula* (Zahlbr.) D. Hawksw.
60. *Myriotrma subminutum* Homchantara & Coppins
61. *Opegrapha rubefacta* Räsänen
62. *Parmotrema overeemii* (Zahlbr.) Elix
63. *Phaeographis epruinosa* (Redinger) Staiger
64. *Phaeophyscia fumosa* Moberg
65. *Physcia albata* (F. Wilson.) Hale
66. *Physcia undulata* Moberg
67. *Placidium squamulosum* (Ach.) Breuss
68. *Polymeridium catapastum* (Nyl.) R.C. Harris
69. *Porina napensis* Lücking
70. *Porina applanata* Vain.
71. *Porina tetramera* (Malme) R. Sant.
72. *Pseudopyrenula subnudata* Müll. Arg.
73. *Pyrenula approximata* Vain.
74. *Sarcographa subtricosa* (Leight,) Müll. Arg.
75. *Strigula concreta* R.Sant.
76. *Strigula hypothallina* R.C. Harris
77. *Strigula maculata* (Cooke & Massee) R.Sant.
78. *Strigula melanobapha* (Kremp.) R.Sant.
79. *Strigula multipunctata* (G. Merr. ex R.Sant.) R.C.Harris
80. *Tapellaria epiphylla* (Müll.Arg.) R.Sant.
81. *Tapellaria molleri* (Hanriq.) R.Sant.
82. *Tapellaria nana* (Fée) R.Sant.
83. *Tapellaria nigrata* (Müll.Arg.) R.Sant.
84. *Tricharia santessonii* D.Hawksw.
85. *Trypethelium ceylonicum* Makhija & Patw.

Bryophytes - 17 species

1. *Cololejeunea desciscens* Steph.
2. *Frullania densiloba* Steph.
3. *Frullania dilatata* (L.) Dumort.
4. *Frullania riojaneirensis* (Raddi) Spruce
5. *Lejeunea obfusca* Mitt.
6. *Leucodon sinensis* Ther.
7. *Mannia fragrans* (Balb.) Frye & Clark
8. *Metzgeria furcata* var. *ulvula* Nees
9. *Metzgeria temperata* Kuwah.
10. *Metzgeria violacea* (Ach.) Dumort.
11. *Mnium japonicum* Lindb.

12. *Plagiochila junghuniana* Sande Lac.
13. *Plagiochila ovalifolia* Mitt.
14. *Plagiochila perradenyensis* Schiffn.
15. *Pohlia gedeana* (Bosch & Lac.) Gangulee
16. *Riccardia palmata* (Hedw.) Carruth.
17. *Scapania glaucocephala* (Taylor) Austin

Taxa new to region

Lichens

Eastern Himalayan Region - 36 species

1. *Aulaxina quadrangula* (Stirt.) R.Sant.
2. *Arthonia trilocularis* Müll.Arg.
3. *Asterothyrium rotuliforme* (Müll.Arg.) Sérus.
4. *Bacidia olivaceorufa* Vain.
5. *Byssoloma chlorinum* (Vain.) Zahlbr.
6. *Calenia aspidota* (Vain.) Vìzda
7. *Calopadia fusca* (Müll.Arg.) Vìzda
8. *Chroodiscus coccineus* (Leight.) Müll.Arg.
9. *Chroodiscus mirificus* (Kremp.) R.Sant.
10. *Coenogonium luteum* (Dicks.) Kalb & Lücking
11. *Fellhanera bouteillei* (Desm.) Vìzda
12. *Fellhanera rhapidophylli* (Rehm) Vìzda
13. *Graphis foliicola* var. *major* D.D.Awasthi & Kr.P.Singh
14. *Lasioloma arachnoideum* (Kremp.) R.Sant.
15. *Loflammia gabrielis* (Müll.Arg.) Vìzda
16. *Mazosia bambusae* (Vain.) R. Sant.
17. *Porina albicera* (Kremp.) Overeem
18. *Porina atriceps* (Vain.) Vain.
19. *Porina atrocoerulea* Müll.Arg.
20. *Porina chrysophora* (Stirt.) R.Sant.
21. *Porina conica* R.Sant.
22. *Porina imitatrix* Müll.Arg.
23. *Porina karnatakensis* Makhija, Adaw. & Patw.
24. *Porina limbulata* (Kremp.) Vain.
25. *Porina lucida* R.Sant.
26. *Porina rufula* (Kremp.) Vain.
27. *Porina trichothelioides* R.Sant.
28. *Porina virescens* (Kremp.) Müll.Arg.
29. *Sporopodium argillaceum* (Müll.Arg.) Zahlbr.
30. *Sporopodium phyllocharis* (Mont.) A.Massal.
31. *Strigula antillarum* (Fée) Müll.Arg.
32. *Strigula janeirensis* (Müll.Arg.) Lücking
33. *Strigula nemathora* var. *hypothelia* (Nyl.) Lücking
34. *Strigula nitidula* Mont.
35. *Strigula orbicularis* Fr.
36. *Strigula subtilissima* (Fée) Müll.Arg.

Gangetic Plains - 56 species

1. *Anisomeridium consobrinum* (Nyl.) Aptroot
2. *Anisomeridium terminatum* (Nyl.) R.C. Harris
3. *Anisomeridium ubianum* (Vain.) R.C. Harris
4. *Arthonia ravida* Stirt.
5. *Arthonia recedens* Stirt.
6. *Arthopyrenia analepta* (Ach.) A. Massal.
7. *Arthothelium adveniens* (Nyl). Müll. Arg.
8. *Arthothelium atro-olivaceum* Makhija & Patw.
9. *Arthothelium bessale* (Nyl.) Zahlbr.
10. *Arthothelium confertum* (A.L. Sm.) Makhija & Patw.
11. *Arthothelium nigrodiscum* Patw. & Makhija
12. *Bactrospora metabola* (Nyl.) Egea & Torrente
13. *Buellia betulinoides* R. Schub. & Klem.
14. *Buellia curatellae* Malme
15. *Caloplaca bassiae* (Willd. ex Ach.) Zahlbr.
16. *Caloplaca ferruginea* (Huds.) Th. Fr.
17. *Chiodecton congestulum* Nyl.
18. *Chiodecton leptosporum* Müll. Arg.
19. *Coccocarpia palmicola* (Spreng.) Arv. & D.J. Galloway
20. *Coenogonium luteum* (Dicks) Kalb & Lücking
21. *Cryptothecia culbersonae* Patw. & Makhija
22. *Cryptothecia scripta* G. Thor
23. *Diorygma megasporum* Kalb, Staiger & Elix
24. *Diorygma pruinosum* (Eschw.) Kalb, Staiger & Elix
25. *Dirinaria aegialita* (Afzel.) Moore
26. *Dirinaria consimilis* (Stirt.) D.D. Awasthi
27. *Dyplolabia afzelii* (Ach.) A. Massal.
28. *Fellhanera bouteillei* (Desm.) Vëza
29. *Fissurina dumastii* Fée
30. *Lecanactis concordans* (Nyl.) Zahlbr.
31. *Leptogium denticulatum* Nyl.
32. *Myriotrema compunctum* (Ach.) Hale
33. *Ochrolechia subpallescens* Verseghy
34. *Opegrapha dimidiata* Müll. Arg.
35. *Opegrapha prosodea* Ach.
36. *Opegrapha puiggarii* Müll. Arg.
37. *Opegrapha vulgata* (Ach.) Ach.
38. *Parmotrema dilatatum* (Vain.) Hale
39. *Parmotrema tinctorum* (Despr. ex Nyl.) Hale
40. *Pertusaria leucosorodes* Nyl.
41. *Pertusaria pertusella* Müll. Arg.
42. *Phaeographis caesioradians* (Leight.) A. W. Archer
43. *Polymeridium proponens* (Nyl.) R.C. Harris
44. *Porina belanospora* (Nyl.) Müll. Arg.
45. *Pyrenula decumbens* (Müll. Arg.) Upreti
46. *Pyrenula defossa* Müll. Arg.
47. *Pyrenula mamillata* (Ajay Singh) Upreti
48. *Pyrenula subacutalis* Upreti
49. *Pyxine retirugella* Nyl.
50. *Ramalina pacifica* Asahina
51. *Relicinopsis dahlii* (Hale) Elix & Verdon
52. *Relicinopsis malaccensis* (Nyl.) Elix & Verdon
53. *Sarcographa glyphiza* (Nyl.) Kr. P. Singh & G.P. Sinha
54. *Stirtonia alboverruca* Makhija & Patw.
55. *Tricharia albostrigosa* R. Sant.
56. *Trypethelium nigrorufum* Makhija & Patw.

Western Ghats - 3 Species

1. *Hemithecium nakanishianum* (Patw. & C.R. Kulk.)Makhija & Dube
2. *Lecidea fuscorubescens* Nyl.
3. *Trapelia coarctata* (Turn. ex Sm.) M. Choisy

Bryophytes

Himalayan Region - 3 Species

1. *Heteroscyphus orbiculatus* Abha Srivast. & S.C. Srivast.
2. *Plagiochila richteri* Steph. ex S.C. Srivast. & R.Dixit
3. *Porella perrottetiana* (Mont.) Trev.

Western Himalayan Region - 16 Species

1. *Campylopus richardii* Brid.
2. *Barbella turgida* Nog.
3. *Plagiothecium neckeroideum* B.S.G.
4. *Jamesoniella autumnalis* (DC.) Steph.
5. *Jungermannia infusca* (Mitt.) Steph.
6. *Jungermannia rubripunctata* (S.Hatt.) Amakawa
7. *Jungermannia subrubra* Steph.
8. *Scapania ferruginea* (Lehm. & Lindenb.) Gottsche
9. *Plagiochila elegans* Mitt.
10. *Lejeunea discreta* Lindenb.
11. *Lejeunea flava* (Swartz) Nees
12. *Trocholejeunea infuscata* (Mitt.) Verd.
13. *Pellia neesiana* (Gottsche) Limpr.
14. *Fossombronia pusilla* (L.) Dumort.
15. *Riccia beyrichiana* Hampe
16. *Riccia cruciata* Kashyap

Western Ghats - 16 Species

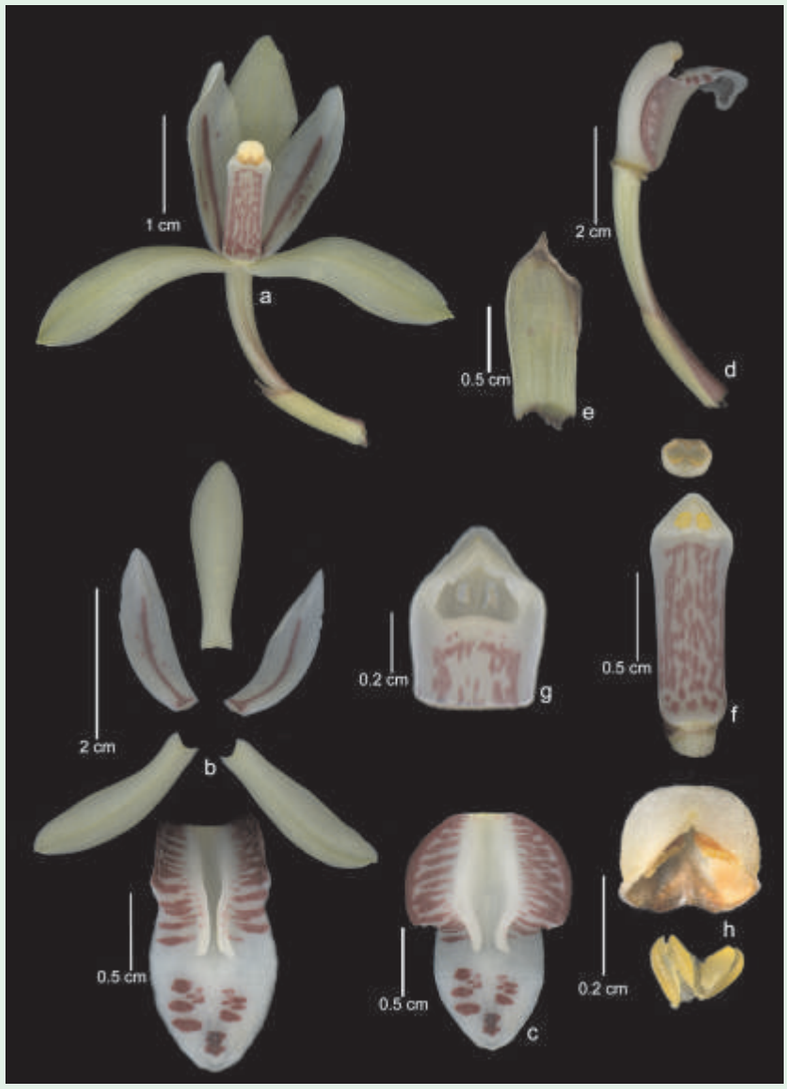
1. *Chandonanthus hirtellus* (Web.) Mitt.
2. *Cheilolejeunea serpentine* (Mitt.) Mizut.
3. *Diplophyllum nanum* Herz.
4. *Entodon prorepens* (Mitt.) Jaeg.
5. *Erythrodontium julaceum* (Schwaegr.) Par.
6. *Jungermannia appressifolia* Mitt.
7. *Lejeunea stevensiana* Steph.
8. *Lejeunea tuberculosa* Steph.
9. *Plagiochila duthiana,* Steph.
10. *P lagiochila flexuosa* Mitt.
11. *Plagiochila gracilis* Steph.
12. *Plagiochila subtropica* Steph.
13. *Porella chinensis* Steph.
14. *Porella chinensis* Steph.
15. *Sematophyllum caespitosum* (Hedw.) Mitt.
16. *Thuidium glaucinum* (Mitt.) Bosch. & Sande Lac.

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

ORCHIDS

Pecteilis hawkesiana
(King & Pantl.) C.S. Kumar

Orchids form a large group of flowering plants that are being cultivated and appreciated the world over for their stunningly beautiful flowers of varying hues, shapes, sizes and the flower last longer than any other group of plants. Like other monocotyledonous plants, orchid flowers too have three outer sepals and three inner petals. But one of the inner petals gets modified into a differently looking, more colourful, sometimes bizarre shaped structure called lip (labellum). The innermost cylindrical structure is the fusion product of male and female sex organs called column or gynostemium. The shape of an orchid flower, in fact, is decided by these two structures. Accordingly, depending on the shape of the flowers, orchids are given funny names e.g., comet orchid (*Angraecum sesquipedale* of Madagascar), bee orchid (*Ophrys* spp. of Europe), butterfly orchid (*Psychopsis papilio* of South America), dove orchid (*Peristeria elata* of Panama), holy cross orchid (*Epidendrum ibaguense* of South America), dancing girl Orchid (*Oncidium* hybrids), bamboo orchid (*Arundina graminifolia* of Indo-Malesia), spider orchid (*Arachnis* hybrids), blue vanda (*Vanda coerulea* of Indo-Thailand), tiger orchid (*Grammatophyllum speciosum* of SE Asia), foxtail orchid (*Rhynchostylis retusa* of Indo-Malesia), etc. Names apart, orchids display extreme variations in vegetative as well as floral morphology which help them survive peculiar habitats.



Cymbidiopsis lancifolia (Hook.) H.J. Chowdhery

Orchids can be terrestrial (i.e., ground dwelling, e.g. species of *Spathoglottis*, most *Paphiopedilum* species etc.), epiphytic (i.e., growing on trees e.g., *Dendrobium*, *Cattleya*, *Vanda*, etc.) or lithophytic (i.e., growing over rocks e. g., *Dendrobium wightii*, *Cattleya elongata*, etc.). The Australian *Rhizanthella* with 2 species is completely subterranean (i.e., fully underground). They may be perennial herbs or lianas like *Vanilla* species which may grow over 30 metres tall. Some of the smallest ones like the Australian *Bulbophyllum minutissimum* measures only a few millimetres! Whereas, woody cane-like plurinodal pseudobulbs of tiger orchid measure over 7.5 metres.

Many orchids have been traditionally used for their medicinal virtues in India. There are references on at least a dozen species in the ancient Indian classics written in Sanskrit. e.g., *Rigveda* and *Atharvaveda*, which advocate the use of leaves of *Vanda tessellata* against rheumatism and allied disorders. *Hortus Malabaricus,* written by the Dutch Commander Van Rheede during 1668-1683 in twelve volumes, contains descriptions and medicinal properties of plants of ancient Malabar, where the native orchid *Liparis odorata* is shown to cure elephantiasis. *Flickingeria nodosa*, called 'jeevanti' in Ayurveda was used as astringent, aphrodisiac and in asthma and bronchitis.

The recognition of ornamental value of orchids was a later development in India, which happened during the colonial period. Amateurs, professional collectors, botanists, missionaries and others went in search of orchids in Indian jungles bringing with them hundreds of unknown and interesting plants. Discovery of lady's slipper orchids and new colours in *Dendrobium*, *Phalaenopsis*, *Vanda*, etc. were welcomed with great expectation and surprise. The early accounts of orchid hunting in India always carried an aura of mystery and adventure.

The orchids are represented in India by about 1141 species in 166 genera. There are at least 5 genera, viz. *Aenhenrya, India, Jejosephia, Smithsonia* and *Xenikophyton* that are endemic to India. A few genera such as *Acrochaene*, *Didiciea*, *Pantlingia* and *Risleya* were once believed endemic but with their recent discovery from elsewhere they cannot be considered true Indian endemics. Estimates of endemic orchids vary from 400 to 450. The genera *Bulbophyllum* (97 species), *Calanthe* (25 species), *Coelogyne* (38 species), *Cymbidium* (22), *Dendrobium* (102), *Eria* (53), *Eulophia* (26), *Goodyera* (20), *Habenaria* (72), *Liparis* (45), *Oberonia* (53), *Peristylus* (28), etc. have high representation in India. There are many ornamental species belonging to genera-in *Acampe, Aerides, Arachnis, Arundina, Ascocentrum, Barchycorythis, Coelogyne, Cottonia, Diplocentrum, Diploprora, Gastrochilus, Ipsea, Kingidium, Luisia, Papilionanthe, Pecteilis, Phaius, Phalaenopsis, Paphiopedilum, Rhytionanthos, Rhynchostylis, Seidenfadeniella, Smithsonia, Thunia, Vanda* and even *Vanilla.*

J.D. Hooker published comprehensive account on Indian orchids during 1888-1890. This book contained 1300 species of orchids in 113 genera described from the erstwhile British India. This means updating and a modern treatment is urgently required. The All India Coordinated Research Project on Orchids launched by the Ministry of Environment and Forests, Government of India precisely aims to fulfill this vacuum.

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Dr. G. S. Rawat	Wildlife Institute of India Post Box No. 18, Chandrabani Dehra Dun - 248 001 T : 0135-2640111, F : 2640117 E : wii@wii.gov.in; rawatg@wii.gov.in	J.S. Jalal P.K. Sahni	Orchids of Uttaranchal Orchids of Jharkhand
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Dr. S. Misra	Regional Plant Resource Centre Nayyapalli, Bhubaneswar – 751 015 Orissa T : 0674-2600482 (O); 9437075245 F : 2550274 E : esmisra@yahoo.com	D. Sahu S. P. Panda	Orchids of Eastern Ghats
Dr. P. V. Sreekumar	Botanical Survey of India Andaman & Nicobar Circle Port Blair	—	Orchids of Andaman & Nicobar Islands

Bulbophyllum ambrosia ssp. *nepalensis* J.J. Wood
(a new record for India)

Dendrobium gratiosissimum Rchb. f.
(collected after more than 100 years)

Coelogyne pempahisheyana H.J.Chowdhery

Bulbophyllum trichocephalum var. ***wallongense*** Agrawala, Sabap. & H.J. Chowdhery

New Discoveries

Taxa new to science

New genera

1. *Luisiopsis* C.S. Kumar & P.C.S. Kumar
   With one species – *Luisiopsis inconspicuua* (Hook. f.) Sath.Kumar & P.C.S. Kumar
2. *Ebarnesia* C.S. Kumar & P.C.S. Kumar
   With three species – *Ebarnesia barnesii* (Summerh.) C.S. Kumar & P.C.S. Kumar
   Ebarnesia flabelliformis (Summerh.) C.S. Kumar & P.C.S. Kumar
   Ebarnesia perrottetiana (A. Rich.) C.S. Kumar & P.C.S. Kumar
3. *Odisha* S. Misra

New species / varieties

1. *Biermannia arunachalensis* A.N. Rao
2. *Bulbophyllum manipurense* C.S. Kumar & P.C.S. Kumar
3. *Bulophyllum kannurense* C.S. Kumar & P.C.S. Kumar
4. *Bulbophyllum arunachalense* C.S. Kumar & P.C.S. Kumar
5. *Bulbophyllum trichocephalum* var. *wallongense* Agrawala, Sabap. & H.J. Chowdhery
6. *Coelogyne pempahisheyana* H.J.Chowdhery
7. *Didymoplexis seidenfadenii* C.S. Kumar & Ormd.
8. *Oberonia munnarense* C.S. Kumar, Saleem & P.C.S. Kumar
9. *Gastrochilus wayanadensis* C.S. Kumar, Saleem & P.C.S. Kumar
10. *Seidenfadeniella wayanadica* C.S. Kumar, P.C.S. Kumar & Saleem
11. *Pteroceras keralensis* C.S. Kumar, P.C.S. Kumar & Saleem

Taxa new to India

1. *Bulbophyllum macrocoleum* Seidenf.
2. *Bulbophyllum propinquum* Krzl.
3. *Dendrobium incurvum* Lindl.
4. *Dendrobium finlayanum* Lindl.
5. *Dendrobium parcum* Rchb. f.
6. *Phalaenopsis fasciata* Rchb. f.

Taxa new to region

Manipur

1. *Cleisostoma discolor* Lindl.
2. *Cleisostoma williamsonii* (Rchb. f.) Garay
3. *Eria globulifera* Seidenf.
4. *Vanda pumila* Hook. f.
5. *Vanilla parishii* Rchb. f.

Andaman Islands

1. *Chiloschista parishii* Seidenf.

Peninsular India

1. *Saccolabiopsis pusilla* (Lindl.) Seidenf. & Garay

Kerala

1. *Bulbophyllum careyanum* (Hook.) Spreng.
2. *Bulbophyllum mysorensis* (Rolfe) J. J. Sm.
3. *Diplocentrum congestum* Wight
4. *Habenaria pelorides* Parish & Rchb. f.

Andhra Pradesh

1. *Acampe carinata* (Griff.) Panigrahi
2. *Acampe rigida* (J.E.Sm.) P.F.Hunt
3. *Ascocentrum curvifolium* (Lindl.) Schtr.
4. *Bulbophyllum neilgherrense* Wight
5. *Cottonia peduncularis* (Lindl.) Rchb.f.
6. *Dendrobium macrostachyum* Lindl.
7. *Dendrobium moschatum* (Buch.-Ham.) Sw.
8. *Dendrobium regium* Prain
9. *Geodorum recurvum* (Roxb.) Alston
10. *Habenaria diphylla* Dalzell
11. *Habenaria panigrahiana* S.Misra
12. *Liparis elliptica* Wight
13. *Liparis nervosa* (Thunb.) Lindl.
14. *Luisia trichorhiza* (Hook.) Blume
15. *Nervilia infundibulifolia* Blatt. & McCann
16. *Oberonia mucronata* (D.Don) Orme. & Seidenf.
17. *Pomatocalpa spicata* Breda
18. *Staurochilus ramosus* (Lindl.) Seidenf.
19. *Vanilla walkeriae* Wight

Tamil Nadu

1. *Phretia elegans* Lindl.

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

PALMS

Palms are one of the multi-use monocots confined to tropical regions of the world. They form, in some way or the other, a vital component in everyday lives of people, especially in Asia and Africa. The aesthetic value of palms is no less important than their traditional and commercial values.

In India 21 genera and about 100 species of palms occur in three major geographical regions, viz. Peninsular India, North eastern India and Andaman & Nicobar Islands. A small number of palm species occur in the Gangetic plains and in the lower hill valleys of northern India.

Palm populations in the wild are on decrease. Many palms are restricted in distribution and the destruction of their natural habitats has been affecting their populations. Many of them are over exploited for their products. Some inherent characteristics of palms such as monocarpic flowering, poor germination of seeds and poor establishment of seedlings have also contributed to the retardation of natural regeneration of palms. In the absence of concrete efforts towards their replenishment, some of these wild palms are likely to face the threat of extinction, eg., *Trachycarpus takil,* species of *Calamus*. The correct identification of species is necessary to plan conservation activities. But palms have often been ignored or poorly collected and studied by field botanists because collection and herbarium preparation of this group are very difficult. Hence, in most herbaria palms are little represented. This inadequate representation fails to give a full picture of palm taxonomy and distribution.

To bridge this gap, and to develop capacity in taxonomy of this group where only a few specialists are available, an All India Coordinated Project was initiated with the financial support from the Ministry of Environment and Forests, Government of India in the year 2000. A coordinating centre at Kerala Forest Research Institute, Peechi, Kerala and three other collaborating units in different places in the country were identified for this purpose.

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Prof. S. N. Ramaswamy	Department of Studies in Botany University of Mysore, Mysore Retired	H.N. Krishnakumar T.N.Manohara	Reproductive biology of palms in relation to taxonomy
Dr. S. N. Hegde Dr. K. Haridasan	State Forest Research Institute Van Vihar, Itanagar	—	Taxonomy of palms of North eastern India

New Discoveries

New species

Calamus shendurunii Anto, Renuka & Sreek.

New record for India

Calamus rivalis Thw.

New record for Kerala

Calamus basui Renuka & Vijayakumaran

Calamus neelagiricus Renuka

Calamus karnatakensis Renuka & Lakshmana.

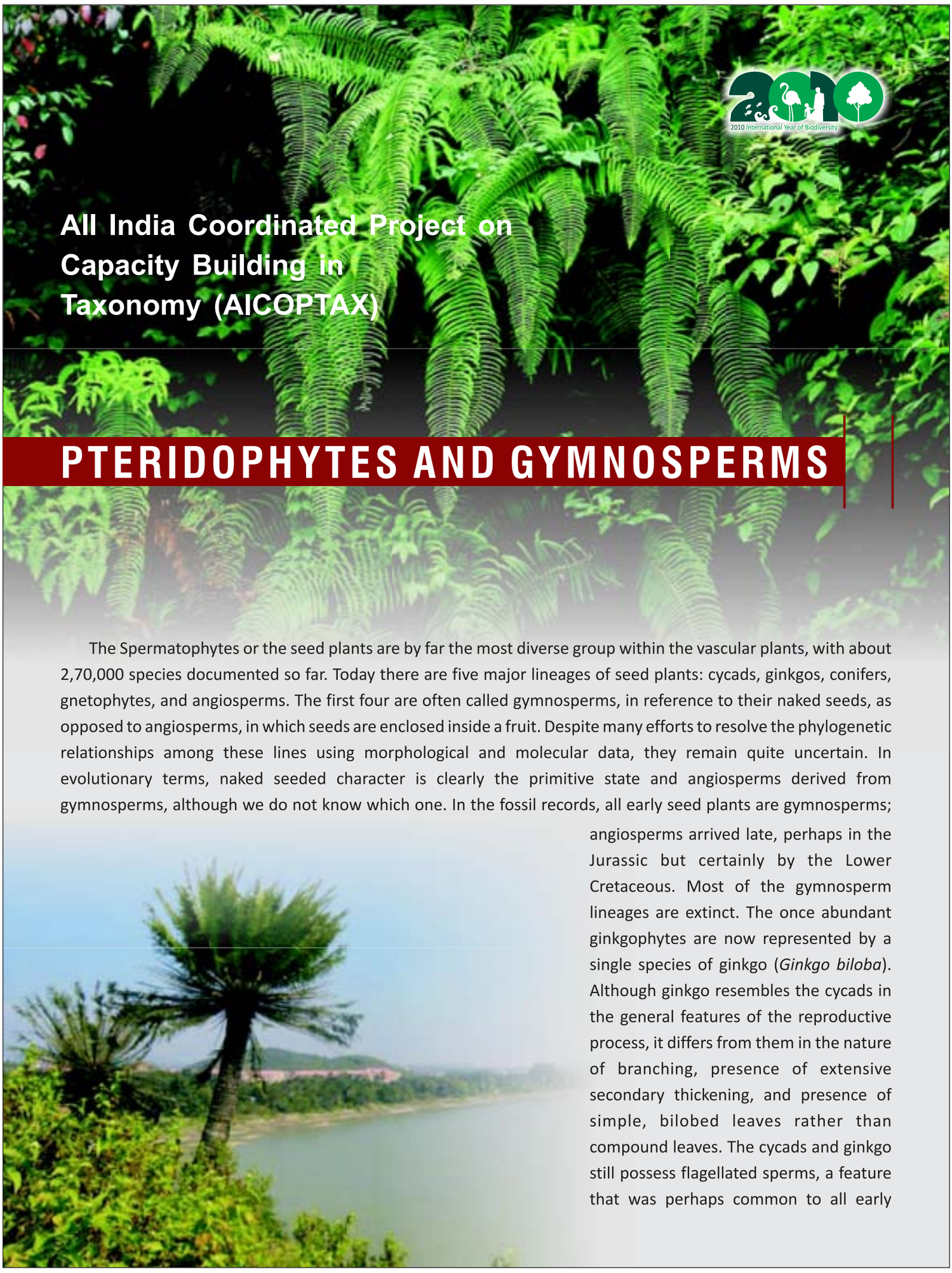
Calamus lacciferus Lakshmana & Renuka

Calamus lakshmanae Renuka

Calamus dransfieldii

Calamus basui

Calamus baratangensis



All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

PTERIDOPHYTES AND GYMNOSPERMS

The Spermatophytes or the seed plants are by far the most diverse group within the vascular plants, with about 2,70,000 species documented so far. Today there are five major lineages of seed plants: cycads, ginkgos, conifers, gnetophytes, and angiosperms. The first four are often called gymnosperms, in reference to their naked seeds, as opposed to angiosperms, in which seeds are enclosed inside a fruit. Despite many efforts to resolve the phylogenetic relationships among these lines using morphological and molecular data, they remain quite uncertain. In evolutionary terms, naked seeded character is clearly the primitive state and angiosperms derived from gymnosperms, although we do not know which one. In the fossil records, all early seed plants are gymnosperms; angiosperms arrived late, perhaps in the Jurassic but certainly by the Lower Cretaceous. Most of the gymnosperm lineages are extinct. The once abundant ginkgophytes are now represented by a single species of ginkgo (*Ginkgo biloba*). Although ginkgo resembles the cycads in the general features of the reproductive process, it differs from them in the nature of branching, presence of extensive secondary thickening, and presence of simple, bilobed leaves rather than compound leaves. The cycads and ginkgo still possess flagellated sperms, a feature that was perhaps common to all early

seed plants. *Gnetum, Welwitschia,* and *Ephedra* are seed plants with highly specialized reproductive structures and certain advanced vegetative characteristics, such as the presence of vessel elements in the secondary wood.

The pteridophytes, consisting of ferns and fern allies, form one of the oldest plant groups occurring on the earth. Their intermediate position between the lower cryptogams and higher vascular plants has made this group very fascinating and interesting.

Ferns have always attracted the attention of naturalists and scientists since ages because of their beautiful foliage (fronds), their evolutionary status in the plant kingdom and occurrence in ecofragile regions.

In India and surrounding South-east Asian countries, different species of pteridophytes are utilized in various traditional systems of medicine. In horticulture, they are widely cultivated as indoor plants. Apart from medicine, like other groups of plants, they regulate climate, stabilize soils, and are an integral part of the ecosystem.

About 12,000 species of pteridophytes are distributed throughout the world, out of which 1200 species are so far recorded from India. Pteridophytes form only 5-7 per cent of the total Indian vascular flora but due to their specific vegetation pattern like abundance in individuals as well as their conspicuousness in epiphytic and terrestrial vegetation along forest margins, roadsides and forest floor, they occupy the second rank to the flowering plants in importance. Today, pteridophytes are facing threats, largely due to habitat destruction.

Gymnosperms constitute a group of great antiquity, reaching far back in geological history to at least two or three hundred million years. They have an excellent fossil record, which is nearly unbroken from the past forms to the fascinating variety of genera and species of the present day. During the Carboniferous era, swampy lowlands were dominated by the extinct trees like giant horsetails and early conifers. The conifers and their relatives subsequently rose in prominence but, during the Cretaceous period (*ca* 135 million years ago), they were increasingly replaced by broad-leaved trees. The male gametes of the conifers are nonflagellate, a feature found in all advanced seed plants. The total living gymnosperm genera in the world are about 63 with about 750 species. Of these, 17 genera and 60 species occur in our country.

Economically they are very important, furnishing a great proportion of our timber, resin, tar and turpentine requirements. Notable as a source of pulpwood for paper manufacture are pines, firs and spruces. Spruces and pines also yield oils used as scents in soaps, air fresheners and perfumes. Seeds of conifers serve as food for wildlife in winter. Conifers are typical of the Himalayas and are also used in landscaping parks and gardens.

***Cycas swamyi* R.Singh & Radha**

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Collaborating Units			
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Dr. Rita Singh	School of Basic and Applied Sciences G.G.S. Indraprastha University Kashmere Gate, New Delhi-110 006 T : 011-2969786, 23900287 F : 011-23865941 E : singhrita@mantraonline.com rsinghipu@yahoo.co.in	P. Sharma P. Radha	Investigations on Indian gymnosperms – the Cycadales and the Ephedrales.
Dr. S.P. Khullar	Dept. of Botany, Panjab University Chandigarh – 160 014 T : 0172-2794484 E : sp.khullar@gmail.com	Anju Baghla S. Verma	Floristics, taxonomy and VAM studies of pteridophytes and gymnosperms.

New Discoveries

Taxa new to science

Pteridophytes

1. *Alsophilla nilgirensis* var. *lobatus* Manickam & Irud.
2. *Crepidomanes agasthianum* Madhus. & C.A. Hameed
3. *Crepidomanes indicum* C.A. Hameed & Madhus.
4. *Crepidomanes lunulatum* Madhus. & C.A. Hameed
5. *Crepidomanes malabaricum* C.A. Hameed & Madhus.
6. *Trichomanes vamana* C.A. Hameed & Madhus.
7. *Polystichum subinerme* var. *orbiculatum* Benniamin & Manickam

Gymnosperms

1. *Cycas annaikalensis* R. Singh & P. Radha
2. *Cycas swamyi* R. Singh & P. Radha

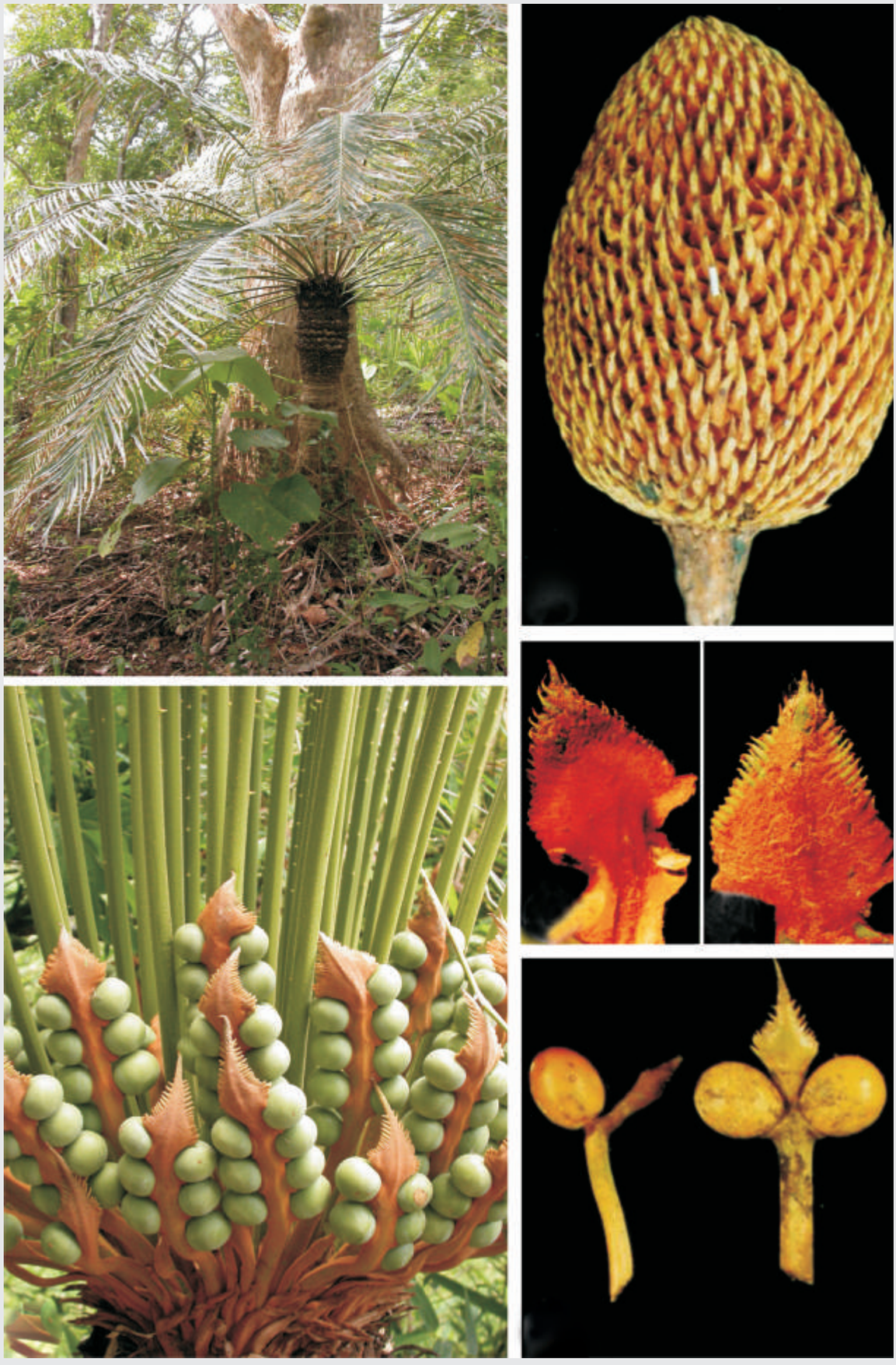
New records for regions

Western Ghats

1. *Arthromeris lehmanii* (Mett.) Ching
2. *Athyrium flabellatum* (C.B. Clarke) Trad.
3. *Athyrium pectinatum* (Wall. ex Hope) Presl
4. *Athyrium rubricaule* (Edgew.) Bir
5. *Athyrium rupicola* (Hope) C.Chr.
6. *Athyrium schimperi* Moug. ex Fee
7. *Bolbitis sinensis* Baker
8. *Cheilanthes dubia* Hope
9. *Cheilanthes formosana* Hayata
10. *Cheilanthes grisea* (Blanf.) Blanf.
11. *Cheilanthes rufa* D.Don
12. *Pteris ensiformis* Burm.f.
13. *Pteris heteromorpha* Fee
14. *Pteris wallichiana* Agardh

Himachal Pradesh

1. *Acrophorus paleolulatus* Pic.Serm.
2. *Araiostegia pulchra* (D. Don) Copel.
3. *Athyrium falcatum* (Hope) C. Chr.
4. *Athyrium kumaonicum* Punetha
5. *Cheilanthes doniana* Fraser-Jenk. & Khullar
6. *Cystopleris tenuisicta* (Blume) Mett.
7. *Drynaria tibetica* Ching & Wu
8. *Dryopteris neorosthornii* Ching
9. *Hypodematium crenatum* (Forssk.) Kuhn subsp. *loyalii* Fraser-Jenk. & Khullar



Cycas annaikalensis R.Singh & P. Radha

All India Co-ordinated Project on Capacity Building in Taxonomy (AICOPTAX)

DIPTERA

The Diptera are considered as the third largest order of the class Insecta comprising more than 100,000 species under about 7000 genera in 622 families in the subcontinent accounting for ca 6% of the world species. The dipterans are cosmopolitan in their distribution and inhabit almost all niches, mostly aquatic. They are ecologically important in breaking down and redistributing organic material between terrestrial and aquatic ecosystems. From the medical and veterinary points of view the dipterans are of great importance in public health. A large area of the subcontinent remains still under explored. The following families of Diptera are proposed for the present study: (1) Agromyzidae (2) Chloropidae (3) Chironomidae (4) Drosophilidae and (5) Tephritidae.

Family Agromyzidae:

Agromyzids, popularly known as leaf-miners are an important group of dipterans of considerable economic importance. They are found as pests on a number of crop plants and are also found infesting a large number of ornamental as well as wild plants. The species of the genera, *Liriomyza, Chromatomyia, Phytomyza*, *Melanagromyza*, *Epidermomyia, Tropicomyia* and *Ophiomyia* are of economic significance. Family Agromyzidae is divided into two subfamilies: Agromyzinae and Phytomyzinae. Agromyzinae has 21 genera such as *Agromyza* Fallen, *Japanagromyza* Sasakawa, *Melanagromyza* Hengel, *Epidermomyia* Ipe, *Tropicomyia* Spencer, *Ophiomyia* Braschnikov and *Hexomyia* Enderlain and Phytomyzinae is with 14 genera namely *Phytobia* Lioy, *Cerodontha* Rondani, *Calycomyza* Hendel, *Amauromyza* Hendel, *Lemurimyza* Spencer, *Liriomyza* Mik, *Phytagromyza* Hendel, *Paraphytomyza* Enderlain, *Phytoliriomyza* Hendel, *Pseudonapomyza* Hendel, *Napomyza* Westwood, *Indonapomyza* Singh & Ipe, *Chromatomyia* Hardy and *Phytomyza* Fallen.

Expertise for their identification is very limited in India and therefore, considerable difficulties are being faced by agriculturists as well as scientists in the agricultural universities engaged in evolving control measures for them.

The present project was taken up with the objective of creating infrastructure for their taxonomic exploration and also to train scientific personnel to work on this group and to fill up the existing vacuum.

Family Chloropidae:

The Chloropidae commonly known as 'grass flies' or 'green eyed flies' are small to medium sized (0.5-5mm) flies having cosmopolitan distribution in grasslands and under growth in forests. Some serve as vectors of eye diseases of human beings and animals, a few phytophagous species destroy wheat, maize, paddy and other crops, some devour egg masses of spiders and mantids and others are predactors of root aphids. Of about 2250 species in 160 genera throughout the globe, 500 species of 75 genera are reported from the Orient. Amongst them only 250 species of about 60 genera are recorded from India and adjacent countries. Before taking up the project, Dr. P.T. Cherian, PI of the collaborating unit at Kerala University, Thiruvananthapuram has described 120 new species in 6 new genera in addition to recording 45 species for the first time from India.

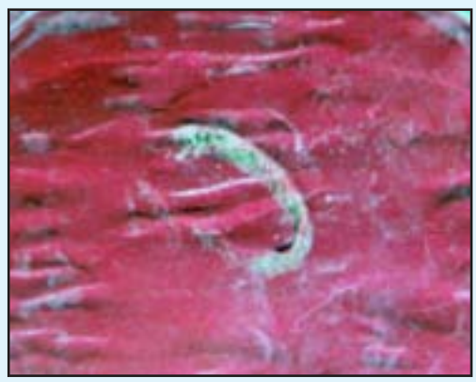
Family Chironomidae:

The Chironomidae is a cosmopolitan family of dipteran insects occurring in all zoo-geographical regions of the world including Antarctica. The dwellings of chironomids include the littoral and benthic regions of marine waters, estuaries, glacial melt water, waterfalls, hot (44.5^{0}C –50.0^{0}C) and cold springs, mountain streams, fast and slow-flowing rivers, lakes, lagoons, ponds, temporary rain-pools, ditches, shallow stagnant waters, rice fields and in many unusual habitats. The midges are known to have nuisance impact on human health and agriculture. Larval haemoglobin causes primarily human allergies and conjunctivitis, rhinitis, hay fever or asthma. The presence of polytene chromosomes in the larval salivary glands is extensively used in various disciplines of Life Sciences as experimental material. Chironomids are indicators of water quality and are used for environmental assessment including heavy metal contamination. The chironomids are important dietary components of birds, fishes and various aquatic organisms. Prior to the present work, the chironomid midges are known by 313 species of 59 genera under 4 subfamilies (Chaudhuri, Alfred & Hazra, 2001).

Family Tephritidae:

The fruit flies belonging to the family Tephritidae, are represented in all zoogeographical regions except Antarctica. Barring very few species, almost all the fruit flies of which biology is known have phytophagous larval stages. The larvae complete their development while feeding on developing ovaries of fruits and seeds or while mining leaf, stem or root tissues and also forming galls in host plants. Many of the fruit flies are serious pests of fruits and vegetables of economic value, while some of the cecidogenous members (gall formers) are beneficial in the biocontrol of weeds, hence of great economic importance.

Judging from the literature on Indian Tephritidae, it would appear that the fruit flies are among the most neglected groups of insects in India. Of the 4352 species of Tephritidae known so far, only 224 species of fruit flies have so far been reported from India, whereas it is generally accepted that from 8–12 percent of the world species of acalyptrate dipterans are represented in India. This indicates that more than 400 species of Tephritidae estimated to occur in India and many of them are yet to be discovered from the biodiversity rich habitats like the Western Ghats. The present study is focused on a major portion of Southern Western Ghats falling within the Kerala state.



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Dr. P.T. Cherian	Department of Zoology, University of Kerala, Kariavattom, Thiruvananthapuram-695 581. T : 0471-2368329 (R) E : cherian_pt07@yahoo.co.in	J. Jasmin T. Selvaraj A.K. Shinimol Jyothy Tilak	Taxonomy of Family Chloropidae
Dr. C. Radhakrishnan	Western Ghat Field Research Station, Zoological Survey of India, Annie Hall Road Kozhikode - 673 002. T : 0495-2701928, 0495-2306166 F : 0495-2701928 E : zoosurcalicut@dataone.in; rkrishna52@sify.com	Ajay Joseph Abinash Peter	Taxonomy of Family Tephritidae

New Discoveries

Family Chironomidae

Subfamily Tanypodinae

1. *Trissopelopia biconuata* Hazra & Chaudhuri
2. *Paramerina clara* Hazra & Chaudhuri
3. *Paramerina ampliseta* Hazra & Chaudhuri
4. *Coffmania adiecta* Hazra & Chaudhuri
5. *Coffmania animispina* Hazra & Chaudhuri

Subfamily Chironominae

6. *Chironomus mayri* Majumdar,Mazumdar & Chaudhuri
7. *Einfeldia arcuta* Majumdar ,Mazumdar & Chaudhuri
8. *Endochirnomus ampliceps* Majumdar & Chaudhuri
9. *Gliptotendipes crassispinus* Majumdar & Mazumdar
10. *Gliptotendipes fumilatus* Majumdar & Mazumdar
11. *Gliptotendipes sinusus* Majumdar & Mazumdar
12. Microtendipes semicyclis Majumdar & Mazumdar
13. *Paratendipes brevirusticus* Majumdar, Mazumdar & Chaudhuri
14. *Polypedillum centisetum* Hazra ,Mazumdar & Chaudhuri
15. *Cladotanytarsus aduncus* Mazumdar & Chaudhuri
16. *Cladotanytarsus dividens* Majumdar & Mazumdar
17. *Parapsectra furnistyla* Majumdar,Mazumdar & Chaudhuri

Subfamily Orthocladiini

18. *Brillia argentituba* Hazra & Chaudhuri
19. *Corynoneura centromedia* Hazra & Chaudhuri
20. *Corynoneura incidera* Hazra & Chaudhuri
21. *Corynoneura nasuticeps* Hazra & Chaudhuri
22. *Paracricotopus spinicornis* Hazra, Saha & Chaudhuri
23. *Paracricotopus missilus* Chaudhuri & Majumdar
24. *Parakiefferiella crassispina* Majumdar & Mazumdar
25. *Rheocricotopus rarispina* Hazra & Chadhuri

Chloropidae

New genera

26. *Heteroscinoides* Cherian
27. *Indometopis* Cherian
28. *Melanochaetomyia* Cherian
29. *Neolcella* Cherian
30. *Paracamarota* Cherian
31. *Parameijerella* Cherian
32. *Tricimbomyia* Cherian
33. *Vanchium* Cherian

New species / varieties

34. *Anacamptoneurum vanchium* sp. nov.

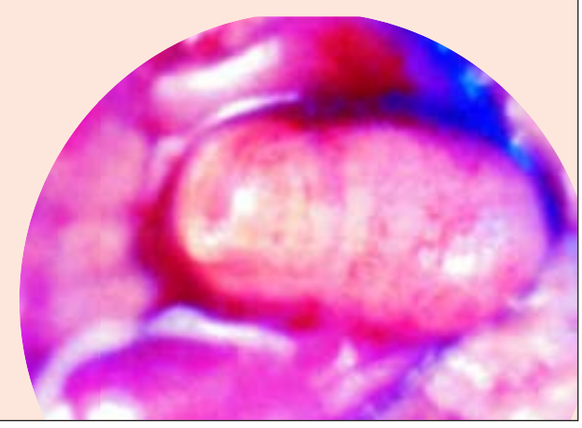
35. *Anacamptoneurum arunachalum* sp. nov.
36. *Anacamptoneurum indicum* sp. nov.
37. *Anacamptoneurum shillongensis* sp. nov.
38. *Anacamptoneurum bengalense* sp. nov.
39. *Anacamptoneurum parafacialis* sp. nov.
40. *Anacamptoneurum tanjorense* sp. nov.
41. *Anacamptoneurum kallingum* sp. nov.
42. *Anacamptoneurum venadensis* sp. nov.
43. *Aragra femorata* Cherian
44. *Aragra mizoramensis* Cherian
45. *Aragra trilineata* Cherian
46. *Cadrema nicobarensis* sp. nov.
47. *Calamoncosis convexa* sp. nov.
48. *Calamoncosis darjeelingensis* sp. nov.
49. *Calamoncosis infusacate* sp. nov.
50. *Calamoncosis keralaensis* sp. nov.
51. *Calamoncosis luteantennata* sp. nov.
52. *Calamoncosis orientalis* Cherian
53. *Calamoncosis rubra* sp. nov.
54. *Calamoncosis venadensis* sp. nov.
55. *Dasyopa humeralis* Cherian
56. *Dasyopa intermedia* Cherian
57. *Dasyopa orientalis* Cherian
58. *Dasyopa prescutellata* Cherian
59. *Dasyopa tomentosa* Cherian
60. *Dicraeus indicus* sp. nov.
61. *Dicraeus keralaensis* sp. nov.
62. *Dicraeus luteopedalis* sp. nov.
63. *Dicraeus pambarensis* sp. nov.
64. *Elachiptera assamensis* Cherian
65. *Elachiptera bengalensis* sp. nov.
66. *Elachiptera indica* sp. nov.
67. *Elachiptera jammuensis* sp. nov.
68. *Elachiptera longicosta* sp. nov.
69. *Elachiptera luteohumeralis* sp. nov.
70. *Elachiptera luteopilosa* sp. nov.
71. *Elachiptera octoseta* sp. nov.
72. *Formosina bengalica* sp. nov.
73. *Formosina equicostalis* sp. nov.
74. *Formosina pentastriata* sp. nov.
75. *Haploginella orientalis* Cherian
76. *Heteroscinoides nigra* Cherian
77. *Incertella indica* Cherian
78. *Incertella luteifrons* sp. nov.
79. *Indometopis granulosa* Cherian
80. *Meijerella antennata* sp. nov.
81. *Meijerella indica* Cherian
82. *Meijerella octoseta* sp. nov.
83. *Meijerella flaviscutellata* sp. nov.
84. *Meijerella longipilosa* sp. nov.
85. *Meijerella tripuraensis*sp. nov.
86. *Melanochaeta apsara* sp. nov.
87. *Melanochaeta atypical* sp. nov.
88. *Melanochaeta lineate* sp. nov.
89. *Melanochaeta meghalayensis* sp. nov.
90. *Melanochaetomyia rubrohalterata* Cherian
91. *Neolcella humeralis* Cherian
92. *Oscinella bhutanensis* sp. nov.
93. *Oscinella fuscidentata* Cherian
94. *Oscinella glabropleuralis* sp. nov.
95. *Oscinella marina* sp. nov.
96. *Oscinella mizoramensis* sp. nov.
97. *Oscinella moirangae* Cherian
98. *Oscinella luteotrasalis* sp. nov.
99. *Oscinella tomentosa* sp. nov.
100. *Paracamarota meghalayensis* Cherian
101. *Paracamarota thenmalayensis* Cherian
102. *Parameijerella femorata* Cherian
103. *Parameijerella lungleinsis* Cherian
104. *Parameijerella mizoramensis* Cherian
105. *Pseudeurina indica* sp. nov.
106. *Pseudogaurax himalayensis* Cherian
107. *Pseudogaurax indicus*sp. nov.
108. *Pseudogaurax orientalis* Cherian
109. *Pseudogaurax meghalayensis* sp. nov.
110. *Pseudogaurax tristriatus* sp. nov.
111. *Pseudogaurax keralayensis* sp. nov.
112. *Pseudogaurax sabroskyi* Cherian
113. *Siphunculina fasciata* Cherian
114. *Siphunculina jasminae* sp. nov.
115. *Siphunculina keralaensis* sp. nov.
116. *Siphunculina manipuriensis* Cherian
117. *Siphunculina nigriseta* sp. nov.
118. *Siphunculina sharmai* Cherian
119. *Siphunculina sudeepi* sp. nov.
120. *Siphunculina ulceria* Cherian
121. *Tricimba confuse* Cherian
122. *Tricimba incise* Cherian
123. *Tricimba indistincta* Cherian
124. *Tricimba keralaensis* sp. nov.
125. *Tricimba nilgriensis* sp. nov.
126. *Tricimba quadristriata* Cherian
127. *Tricimba radhakrishnani* Cherian
128. *Tricimba sextalis* Cherian
129. *Tricimba sharoni* Cherian
130. *Tricimba tuipuiensis* Cherian
131. *Tricimbomyia muzhiyarensis* Cherian
132. *Tricimbomyia shreyas*i sp. nov.
133. *Vricimbomyia hexaseta* Cherian
134. *Vricimbomyia shirinae* Cherian

* All names without authorities denote manuscript names described but not yet published.

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

HELMINTHES AND NEMATODES

Helminthes and nematodes form a large and diverse group in the animal kingdom and are important ecologically and economically. Their varied life styles and presence in almost all habitats are features unmatched in other groups of animals. The helminthes parasitise the entire vertebrate group of animals including man. As parasites of fishes they are important limiting factors not only in fish farming programmes but also affect natural populations in freshwater and marine habitats. A large number of helminthes are parasitic in domestic animals, *viz.* sheep, goats, cows and buffaloes. Humans also suffer from many trematode and cestode infections that afflict different organs and parts of the body. Nematodes play an extremely important role in soil ecology and biology. They occupy all levels of the food chain from bacteriovorous secondary degradation to predators (primary consumers). Because of the varied mode of feeding and their sensitivity to ecological and toxicological factors, nematodes have become extremely important as ecological and biological indicators. In addition, the parasitic habit of numerous soil nematode species has significant economic implications. As parasites of plants (both ecto- and endoparasites) they cause substantial damage and reduction in yield on almost all types of agricultural and horticultural crops. In addition to the direct damage caused by feeding on the plants, many species are known to transmit plant pathogenic viruses, an aspect that has been neglected in India. As parasites of insects, some of them are



capable of destroying many insect pests and thus, play an important role in biocontrol mechanism. *Steinernema* and *Heterorhabditis* are excellent examples of biocontrol agents. As bacterial and fungal feeders they indicate whether the primary decomposition pathways of the soil is fungal dependant or bacterial dependant. An analysis of the community structures of these and other groups of nematodes provide good indices on the nature and fertility of the soil.

Nematodes with an extremely short life span, transparent body, prolific reproduction, the ease with which they can be handled and cultured, and the ability to generate mutants, have become excellent models in biological studies. *Caenorhabditis elegans* represents one of the best models in biological research today.

It may be interesting to note that out of 500,000 species of nematodes that are estimated to exist on earth, only about 25,000 species are known to science.

Investigators	Addresses Telephone (T) Fax No (F) E-mail Id (E)	Research Fellows	Titles of Projects
Coordinating Unit			
Prof. I. Ahmad	Department of Zoology Aligarh Muslim University Aligarh-202 002 M : 09927031785, F : 0571-2702885 E : ahmadirfi@gmail.com	Dr. M.M. Shah Dr. Md. Mahamood Dr. A.A. Shah	(a) Nematodes associated with insects in North-eastern region. (b) Free living nematodes of North-eastern region of India. Free living and plant parasitic nematodes of Jammu & Kashmir.
Collaborating Units			
Prof. R. Madhavi	Department of Zoology Andhra University Visakhapatnam- 530 003 T : 0877-2249941, F : 2248608 E : madhvir@rediffmail.com	T.T. Lakshmi Swarnalatha Devi Dr. P. Sabitha Kumari	A comprehensive taxonomic study on digenetic trematodes (marine) of fishes of the Bay of Bengal
Dr. (Mrs.) P. Bohra	Desert Regional Station Zoological Survey of India Jhalamand, Pali Road Jodhpur-342 005 T/F : 0291-2728551 E : drs_zsi@datainfosys.net razia20m06zsi@yahoo.co.in	M. Khatri A.K. Dwivedi P. Kadela Razia Sultana	Plant and soil nematodes associated with crops of economic importance in Gujarat
Dr. C. Dhanachand*	Department of Life Sciences Parasitology Laboratory Manipur University, Canchipur Imphal-795003. T : 0385-2220787 E : cd_paralab@indiatimes.com	L.A. Singh H. Romani S.S. Singh M. Pramodini Devi	(a) Plant and soil nematodes of Manipur and North-eastern states (b) Helminthes of man and animals
Prof. (Smt.) V. Gupta**	Department of Zoology, University of Lucknow, Lucknow- 226 007 T : 0522-2740067 E : guptavinod@hotmail.com	Sadhna Gupta D.K. Dwivedi	Helminth fauna of fresh water and marine fishes
Prof. (Mrs.) V. Tandon	Parasitology Laboratory Department of Zoology School of Life Sciences NEHU, Shillong T : 0364-2722312, F : 2550300 E : tandonveena@gmail.com	Dr. P. Kar Dr. B. Das P.K. Prasad C. Malswmthluangai Sunila Thapa	Helminth and nematode parasites of animals of North-eastern India

* Deceased ** Not collaborating after 2005

New Discoveries

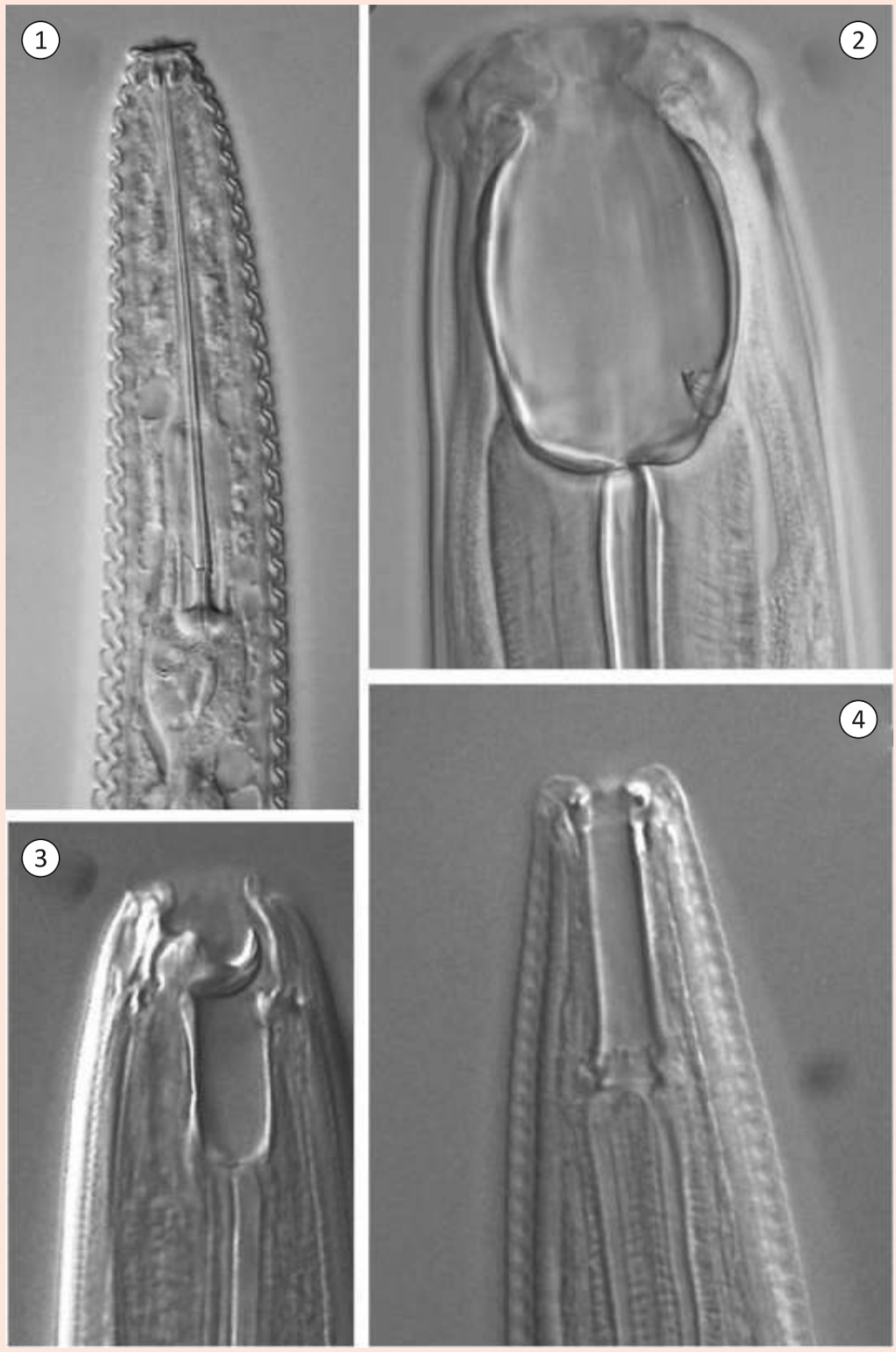
Some Taxa new to science

Soil and insect nematodes

1. *Abunema**
2. *Acrobeles**
3. *Actus conoidus**
4. *Binema anulinervus**
5. *Bunonema indicus**
6. *Bursilla gossypi**
7. *Calodorylaimus wasimii* Baqri & Bohra
8. *Caloosia langolus**
9. *Cameronia manipurensis**
10. *Cameronia triovata**
11. *Cobbonchus subcaudatus**
12. *Criconemella lobella**
13. *Cruznema**
14. *Curviditis jammuvi**
15. *Demaniella keirakensis* Mahamood & al.
16. *Diplogasteroides uriceus**
17. *Diplogastrellus latigubernaculata**
18. *Diplogastrellus phoudelicus**
19. *Diplogastrellus thoubalicus* Ahmad & al.
20. *Distolabrellus neoveechi**
21. *Eucephalobus**
22. *Fictor denticulatus* Mahamood & al.
23. *Fictor setosus* Mahamood & al.
24. *Goffartia macraamphidia**
25. *Goffartia minuta**
26. *Gracilacus vitecus**
27. *Koerneria longispicula**
28. *Koerneria minirobusta**
29. *Latocephalus conicaudatus* Baqri & Bohra
30. *Mesorhabditis bicollumellatus**
31. *Mesorhabditis manipurianus**
32. *Mononchoides megaonchus**
33. *Mononchus subterminus**
34. *Oscheius pinaria**
35. *Parahadronchus kangbilus**
36. *Paroigolaimella poonchiella**
37. *Pelodera neostrongyloides**
38. *Pelodera pyrensis**
39. *Poronemella shamimii* Baqri & Bohra
40. *Prionchulus denticulus**
41. *Prothornenema capitata* Baqri & Bohra
42. *Protorhabditis filicaudatus**
43. *Protorhabditis minirobustus**
44. *Protorhabditis phoudelus**
45. *Protorhabditis pini**
46. *Protrellus shamimi**
47. *Pseudonymus basiri**
48. *Rhabditella kashmirensis**
49. *Rhabditella thoubalensis**
50. *Rhabditis neoanomala**
51. *Rhabditoides papillatum**
52. *Sclerorhabditis tridentatus* Ahmad & al.
53. *Tricephalobus**
54. *Zonothrix alata**

*Names denote manuscript names of species described but not yet published.

1. *Didymosphaera mirabilis* 2. *Bathycotyle coryphaeae* 3. *Hirudinella ventricosa* 4. *Nematobothrium dorsale*



1. Hemicriconemoides silvalleyi; 2. Iotonchus shafii;
3. Mononchoides megaonchus; 4. Teratorhabidtis andrassyi

2010 International Year of Biodiversity

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

MICROLEPIDOPTERA

Interest in moths is growing rapidly amongst naturalists, conservationists, policy makers and the media. India, a mega diverse country, has been in dire need to update the taxonomical status of the order Lepidoptera, particularly Microlepidoptera. The latter includes all of the very small lepidoptera as well as the primitive families. The group Microlepidoptera, presently chosen for taxonomical research, is a major and vital component of the aforesaid order of

the largest class Insecta of the phylum Arthropoda. The economic importance of the group is because of their association with a variety of plants, their role in food chains / webs, role as incidental pollinators and environmental indicators. There has been a general neglect of taxonomical research on the Microlepidopterous fauna of India.

Lepidoptera comprising superfamilies, viz. Tineoidea, Gracillarioidea, Yponomeutoidea, Gelechioidea, Cossoidea, Tortricoidea, Castinoidea, Sesioidea, Zygaenoidea, Immoidea, Copromorphoidea, Schreckensteinioidea, Urodoidea, Epermenioidea, Alucitoidea, Pterophoroidea, Hyblaeoidea, Thyridoidea and Pyraloidea constitute microlepidoptera (Lower Ditrisia).

As such, the order Lepidoptera roughly makes 10 per cent of the animal kingdom and the number of known species is almost equal to the known number of flowering plants. Amongst known species, the number of moths referable to the group Microlepidoptera is relatively too small. The reasons assigned for the neglect of taxonomic studies on these moths are them being too difficult, too small and too dull. In view of inadequate explorations, besides neglect of taxonomic research on the group, the present study was taken up under the aegis of an All India Coordinated Project on Taxonomy (AICOPTAX) launched by the Ministry of Environment and Forests, Government of India, New Delhi to fill the gaps in our knowledge of the diversity and distribution of this group.

Investigators	Addresses Telephone (T) Fax No (F) E-mail Id (E)	Research Fellows	Titles of Projects
Coordinating Unit			
Prof. H.S. Rose	Department of Zoology Punjabi University Patiala – 147 002, Punjab Present Address : Head, Department of Zoology Lovely Professional Univ. Jalandhar-Ludhiana G.T. Road Phagwara, Punjab T : (91)- 175- 2285707 F : Attn. Dr. Rose (91) 175-2282881 E : profhsrose@yahoo.com M : (91) 9815478362	Amit Katewa Deepinderpal Singh Balvinder	Microlepidoptera from North-East and North-West India and the Western Ghats
Collaborating Units			
Dr. A. Srivastava	Rice & Wheat Research Centre Malan – 176047, Kangra Himachal Pradesh T : (91)- 1892- 263295, F : 264550 E : ajai_mustard@rediffmail.com	Indira Dogra Shyama	Microlepidoptera from Jammu & Kashmir, Himachal Pradesh and U.P. Himalaya
Dr. G. Mathew	Kerala Forest Research Institute Peechi, Trissur-680653, Kerala T : (91)- 487- 2699037, F : 2699249 E : mathew@kfri.org	Shamsudeen Rashmi Chandran	Microlepidoptera from Kerala, Karnataka, Tamil Nadu, Maharashtra and Andhra Pradesh
Dr. V.K. Walia	Department of Zoology Punjab University Chandigarh – 160 014 T : (91)- 172- 534272, E : virinder_k_walia@rediffmail.com	Deepak Wadhawan Nisha	Microlepidoptera from Rajasthan, Gujarat, Haryana and Chandigarh
Dr. S.C. Goel (Retd.)	P. G. Department of Zoology S.D. P.G. College Muzaffarnagar – 251 001 Uttar Pradesh T : (91)- 131- 2409053 E : scgoel@datainfosys.net upzsdrscg@yahoo.co.in	D.K. Bhardwaj Bhawna Yadav	Microlepidoptera from plains of Uttar Pradesh, Madhya Pradesh and Bihar
Dr. J.K. Grewal (Retd.)	Department of Zoology Handique Girl's College Guwahati – 781 001, Assam T : (91)-361- 2516979 E : jk_grewal2002@yahoo.com	Sarfraj Nag Diganta Sharmah	Microlepidoptera from Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Meghalaya, Tripura, Sikkim and West Bengal

New Discoveries

Taxa new to science: 137 species

1. *Anarsia parkae* Rose & Pathania
2. *Anarsia priyaensis**
3. *Anarsia renukaensis* Rose & Pathania
4. *Anarsia rosai**
5. *Anarsia tanyharensis* Rose & Pathania
6. *Anarsia tegumentus* Rose & Pathania
7. *Anarsia valvata* Rose & Pathania
8. *Anathamna neospermatophaga* Pooni & Rose
9. *Antehermenias meyricki**
10. *Apithistis arorai **
11. *Apiuncusa asignata*

12. *Apiuncusa discata**
13. *Archips carteri* Rose & Pooni
14. *Archips kangraensis* Rose & Pooni
15. *Archips mertias* Rose & Pooni
16. *Archips pseudotermias* Rose & Pooni
17. *Archips* sp. nov.*
18. *Bactra aurensis**
19. *Bactra beasensis**
20. *Bactra janjahehliensis**
21. *Bhagwantolita pajnii* Rose & Pooni
22. *Blastobasis fuscocephalis**
23. *Blastobasis spinalis**
24. *Capua**
25. *Capua hemidiscata**
26. *Chalcosia linnaeni* Rose & Pooni
27. *Chlorolychnis faridabadensis**
28. *Choreutes heppneri**
29. *Clepsis neomelissa* Rose & Pooni
30. *Compsoctena dehradunensis* Pathania & Rose
31. *Compsoctena himachalensis* Pathania & Rose
32. *Compsoctena robinsoni* Pathania & Rose
33. *Cophomantella juxticata* Rose & Pathania
34. *Cosmopterix albilinearis* Wadhawan & Walia
35. *Cryptolechia dimorphica**
36. *Cryptolechia tegumenta**
37. *Cydia brownorum* Rose & Pooni
38. *Diastaltica asymmetria* Walia & Wadhawan
39. *Dichomeris bispotalis* Walia & Wadhawan
40. *Dichomeris fuscodelta* Walia & Wadhawan
41. *Dichomeris hansi* Walia & Wadhawan
42. *Dichomeris kalesarensis* Walia & Wadhawan
43. *Dichomeris sicaellus* Pathania & Rose
44. *Dichomeris sicasymmetria* Walia & Wadhawan
45. *Edosa dhamensis**
46. *Edosa glossoptera* Rose & Pathania
47. *Edosa neoopsigona* Rose & Pathania
49. *Edosa paraglossoptera* Rose & Pathania
49. *Edosa sattleri* Rose & Pathania
50. *Eretmocera haridwarensis**
51. *Eretmocera landryi**
52. *Eretmocera thakurae**
53. *Eridachtha xanthocephalis**
54. *Ethmia chamundi**
55. *Ethmia nauniensis**
56. *Eucosma pseudostrigulata* Pooni & Rose
57. *Frisilia dimorphicata**
58. *Ganpati valvasymmetria* Walia & Wadhawan
59. *Gelechia agnathosa* Walia & Wadhawan
60. *Gibberifera tucki* Pooni & Rose
61. *Grapholita komaii* Rose & Pooni
62. *Grapholita* sp. nov.*
63. *Harpograptis basoxanthis*
64. *Helcystogramma clarkei* Rose & Pathania
65. *Helcystogramma uedai* Rose & Pathania
66. *Heteralcis spatulata**
67. *Homaloxestis fuscoannulata**
68. *Homaloxestis shivalikensis**
69. *Hygroplasta chungshengi* Pathania & Rose
70. *Hypatima vinculata* Pathania & Rose
71. *Indospastus fuscospotalis**
72. *Labdia banerensis**
73. *Lantanophaga anellatus* Rose & Pooni
74. *Lecithocera acuta**
75. *Lecithocera gozmanyi* Pathania & Rose
76. *Lecithocera shikariensis**
77. *Lecithocera xanthoantenalis**
78. *Lecithocera xanthocostalis**
79. *Lepteucosma alferdi* Pooni & Rose
80. *Lepteucosma byuni* Pooni & Rose
81. *Lepteucosma ferruginoptera* Pooni & Rose
82. *Lumaria clavatus* Rose & Pooni
83. *Lumaria spatulatus* Rose & Pooni
84. *Macrobathra ochrefasciata**
85. *Matsumuraeses patialaensis* Rose & Pooni
86. *Megalorrhipida gielsi* Rose & Pooni
87. *Megalorrhipida paradefectalis* Rose & Pooni
88. *Meridamis obraztsovi* Rose & Pooni
89. *Meridamis punjabensis* Rose & Pooni
90. *Neocalyptis conicus* Rose & Pooni
91. *Neopotamia bisignata**
92. *Oidaematophorus parshuramus* Rose & Pooni
93. *Olethreutes diakonoffi**
94. *Onebala nandiniensis**
95. *Osmopterix bajreshvariensis**
96. *Parasa liharis* Rose
97. *Parasa neopastoralis* Rose
98. *Periacma trispinosa**
99. *Periacma unequispinosa**
100. *Philoptila cornutata**
101. *Pitycona bifurcatus**
102. *Platypeplus**
103. *Platyptilia duneraensis* Rose & Pooni
104. *Plutella**
105. *Promalactis bangangali**
106. *Promalactis baritaii**
107. *Promalactis samridhiensis**
108. *Promalactis dalensis**
109. *Psorosticha sacculata**
110. *Stathmopoda bifascialis**
111. *Stathmopoda mathewi**
112. *Stegasta banjariensis**
113. *Stegasta omelkoi* Rose & Pathania
114. *Stegasta pawani* Walia & Wadhawan
115. *Stegasta valvulata* Walia & Wadhawan
116. *Symmoca dhauladharensis**
117. *Syrmadaula signumforcipatus* Walia & Wadhawan
118. *Telphusa signata* Walia & Wadhawan
119. *Thiotricha albicephalata* Walia & Wadhawan
120. *Thyrsostoma albilustra* Walia & Wadhawan
121. *Thyrsostoma shivai* Walia & Wadhawan
122. *Tinea katasanensis**
123. *Torodora bhattii**
124. *Torodora biovalis**
125. *Torodora fuscoptera* Rose & Pathania
126. *Torodora neodeltospila* Rose & Pathania
127. *Torodora parafuscoptera* Rose & Pathania
128. *Torodora ponomarenkoae* Rose & Pathania
129. *Torodora proxiannuliata**
130. *Torodora pubesensovalvata* Rose & Pathania
131. *Torodora quadrangulata**
132. *Torodora tejae**
133. *Veinspastus**
134. *Veinspastus bicornuta **
135. *Yponomeuta uttaranchalensis* Pathania & Rose
136. *Yponomeuta ashokii **
137. *Yponomeuta sacculata* Pathania & Rose

* Names denote manuscript names of taxa described but not yet published.

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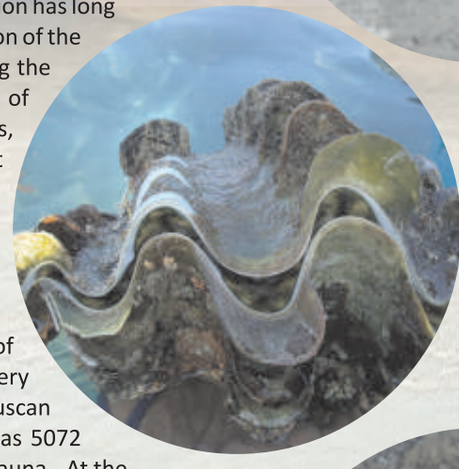
MOLLUSCA



The need for a stronger focus on invertebrate conservation has long been recognized, as information on the status and distribution of the majority of invertebrates simply does not exist. Recognizing the importance of molluscs (an invertebrate) in the life of humankind and the significant role they play in ecosystems, the Mollusc Specialist Group (MSG) of IUCN believes that continuing loss of mollusc diversity is detrimental not only to ecosystems, but, in the long run, also to the welfare of humans. It is for this reason, the Species Specialist Group of Mollusca recognized the importance of taxonomic status *vis-a-vis* its distribution, value and threat.

Molluscs are the second most diverse taxonomic group of animals in terms of numbers of described species, after the very species-rich group of arthropods. The diversity of molluscan distribution is no exception in the country, with as many as 5072 species which is about 8 per cent of the world's molluscan fauna. At the family level 62.8 percent of the families of this group are represented in India. Not many people are aware of this group except a few taxonomists. Molluscs are soft bodied animals, a majority of which are covered by a hard calcareous shell. They include heterogeneous group of animals such as snails, slugs, mussels, oysters, calms, cuttle fishes, squids, octopuses, etc. These animals have adapted themselves to diverse habitats from deep sea to the higher elevation (3,000 m) of the Himalayas and occur in marine, freshwater, intertidal and terrestrial environs.

Majority of mollusks have productive and consumptive uses. Several of them are potential sources of biomedical compounds. Shell lime industry depends completely on sea shells. These are also used in poultry feed. Besides, molluscs also play an important role in litter decomposition and formation of organic detritus in estuaries. The socio-economic importance of molluscs is reflected in their use in folklore, in currently valuable ornaments, and of course, in their edible value.

It has been recorded that diversity is more in the marine system followed by land and wetlands in that order. For marine mollusca, there is no comprehensive data. Records indicate that endemism in Indian molluscs seems to be more pronounced in freshwater ecosystems.

The major threat to molluscan diversity is in the form of over exploitation and collection of under-sized specimens. Moreover, shell craft industries selected only those shells that have saleable value and discard the others.

The aim of this project is to understand the land operculates of the country, which exhibit many geographically significant genera (such as *Cyclophorus, Diplommatina* and *Alycaeus*) typical of the oriental region and are endemic to the country, distributed mostly in the Western Ghats and the Eastern Himalayas. Besides, knowledge on the endemic freshwater species is also far from satisfactory. The level of threat is poorly documented and almost certainly under estimated: a very small fraction (less than 2 per cent) of known molluscan species has had its conservation status properly assessed. The development of a database is necessary for a better knowledge of molluscan diversity and the prevention of introduction of alien species that negatively impact native mollusk species, and control and eradication of those exotic species where such introductions have already occurred. It is for this reason the Project of AICOPTAX – Mollusca, funded by the Ministry of Environment and Forests was undertaken to understand the taxonomy, diversity, distribution and status of the group.

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Collaborating Units			
Prof. U. H. Mane	Marine Research Laboratory Dr. B. R. Ambedkar Marathwada University, Aurangabad - 431 004 T : 0240 – 2403394, F : 2400291 M : 09823067058 E : uhmane@sancharnet.in; director_ccmb@hotmail.com	Dr. R.N. Pandit Dr. S.R. Pidgewar Dr. A.R. Kurhe	Taxonomic research on molluscs of West Coast (diversity and distribution of marine molluscs) Maharashtra coast
Prof. N. A. Madhyastha	Malacology Centre Poornaprajna College, Udupi–576 101 T : 0820 – 2524570 (R) F : 0820 2524453 E : na.madhyastha@gmail.com	K.D. Mumbrekar	Taxonomic research on terrestrial molluscs of Western Ghats
Dr. R. Kasinathan	Annamalai University Centre of Advanced Study in Marine Biology, Parangipettai – 608 502 T : 04144 – 243223 F : 04144 – 243555 E : molluscs_kasinathan@rediffmail.com	Anna Durai Arul Arasu	Taxonomic research on molluscs of East Coast (diversity and distribution) especially from Gulf of Mannar coast of Tamil Nadu
Dr. D. Apte	Bombay Natural History Society Hornbill House, Shaheed Bhagat Singh Road, Mumbai - 400 023 T : 022 – 2282 1811, F : 2283 7615 E : bnhs@bom4.vsnl.net.in	—	Taxonomic research on marine molluscs of Gujarat coast
Prof. A.V. Raman	Marine Science Department Andhra University Visakhapatnam Andhra Pradesh	—	Taxonomic research on marine molluscs of east coast (Andhra coast)

Achatina fulica – an invasive species native to East Africa

New Discoveries

Taxa new to science:

Crymnoconchus dwarakii

Two species belonging to *Crymnoconchus* are yet to be published

Taxa new to India: 5 species

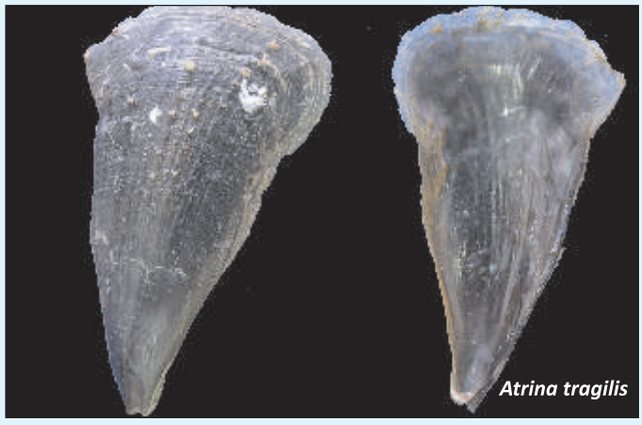
1. *Euplecta hyphasma* (Pfeiffer)
2. *Euplecta turritella* (H. Adams)
3. *Paludomus chilinoides* Reeve
4. *Parreysia (Parreysia) burmanus* (Blanford)
5. *Parreysia perconvexa* Preston

Taxa recorded from regions:

Land molluscs recorded from Western Ghats (Tamil Nadu)

1. *Cryptozona belangeri* Deshayes
2. *Cryptozona gassii* Blanford
3. *Cyathopoma (Jerdonia) nitidum* Beddome
4. *Cyclophorus jerdonii* Benson
5. *Ennea turricula* Blanford
6. *Euplecta acudecta* Benson
7. *Euplecta albizonata* Dohrn
8. *Euplecta indica* Pfeiffer
9. *Euplecta semidecussata* Pfeiffer
10. *Euplecta turritella* H.Adams
11. *Filicaulis (Laevecaulis) frauenfeldi* Semper
12. *Glessula paupercula* Blanford
13. *Hemiplecta beddomei* Blanford
14. *Kaliella sigurensis* Godwin- Austen
15. *Macrochlamys perotetii* Pfeiffer
16. *Macrochlamys woodiana* Pfeiffer
17. *Microlaux coelonconus* Benson
18. *Opeas gracilis* Hutton
19. *Pupisoma evezardii* Gude
20. *Rachis bengalesnis* Lam.
21. *Rachis praetermissus* Blanford
22. *Rachis punctuatus* Anon
23. *Satiella flexilis* Godwin – Austen
24. *Sitala liricinata* Stoliczka
25. *Sitala palmaria* Benson
26. *Theobaldius deplanatus* Pfeiffer
27. *Theobaldius tristis* Blanford
28. *Trachia fallaciosa* Ferrussac
29. *Trachia vittata* Muller

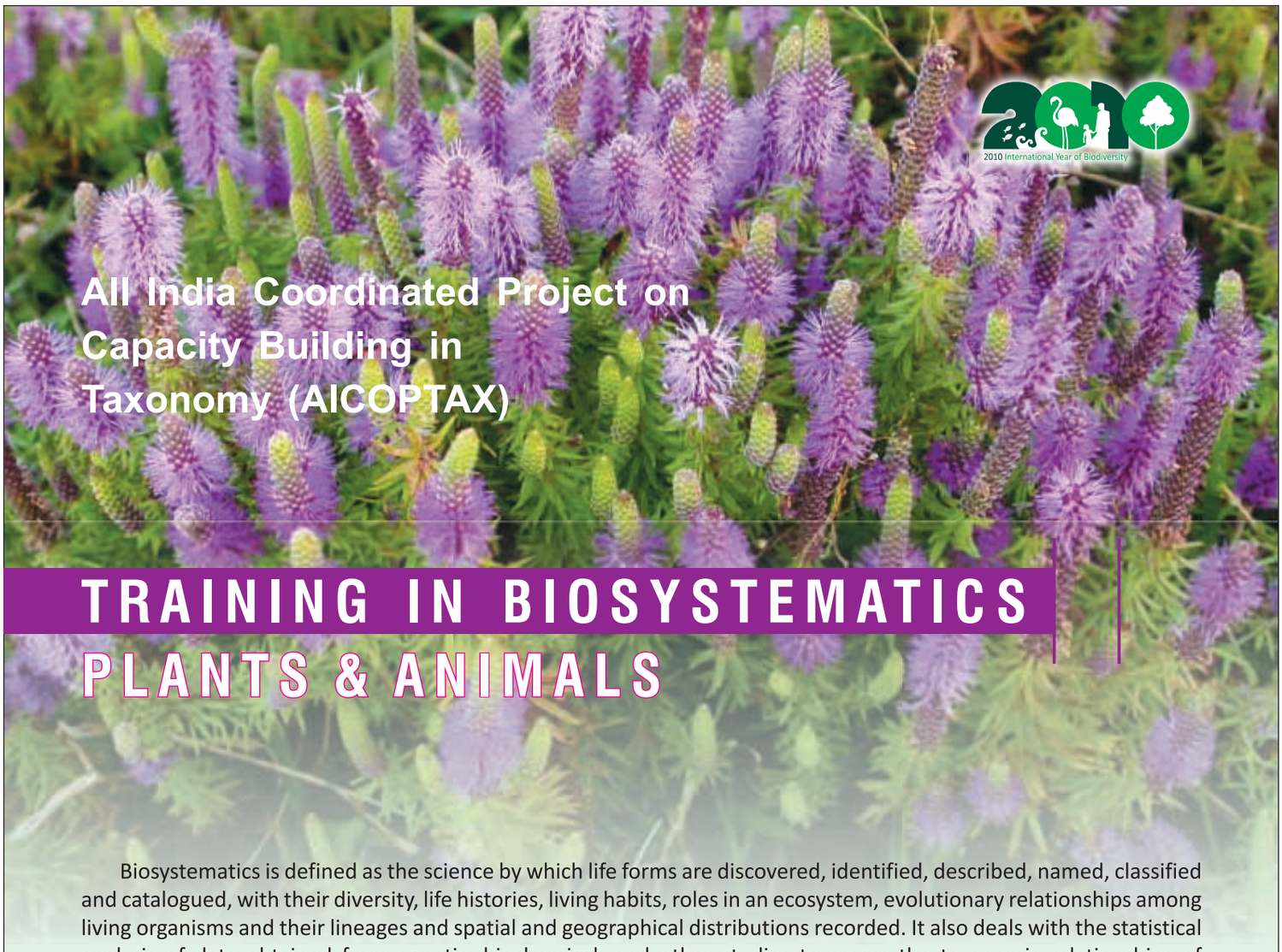
Loligo duvauceli


Atrina tragilis


Indrella sp.


Sepia pharaonis


Vepricardium coronatum



All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

TRAINING IN BIOSYSTEMATICS

PLANTS & ANIMALS

Biosystematics is defined as the science by which life forms are discovered, identified, described, named, classified and catalogued, with their diversity, life histories, living habits, roles in an ecosystem, evolutionary relationships among living organisms and their lineages and spatial and geographical distributions recorded. It also deals with the statistical analysis of data obtained from genetic, biochemical, and other studies to assess the taxonomic relationships of organisms or populations, especially within an evolutionary framework.

TRAINING IN BIOSYSTEMATICS - PLANTS

The programme has two components. One component involves capacity building in taxonomy through training in taxonomy linked to conservation and sustainable utilization of biodiversity. The second component deals with the research programme on biosystematics of *Withania somnifera* (L.) Dunal species complex.

a. Training of in-service teachers, research associates and research students, policy makers and planners

One of the objectives of AICOPTAX is the capacity building in taxonomy linked to conservation and sustainable utilization of biodiversity. Taxonomists having sound knowledge in different facets of taxonomy are urgently needed not only to impart training to students but also to undertake taxonomic research linked to conservation of biodiversity.

A series of workshops have been organized on themes ranging from theory and practice of taxonomy, application of taxonomy in bioprospecting. In workshops on application of taxonomy in conservation and sustainable utilization of biodiversity, emphasis has been given on chemical, biochemical and molecular aspects.

b. Biosystematics of *Withania somnifera* (L.) Dunal complex

Information on the taxonomy, ecology and chemical polymorphism is essential for: (i) standardization of the drug, (ii) development of agrotechnologies and (iii) identification of elite populations. Keeping this in view, biosystematics of *Withania somnifera* has been undertaken.

Withania somnifera is an important medicinal plant known for its rejuvenating properties, and hence called Indian ginseng. A widely distributed species of an essentially old world genus belonging to the family Solanaceae is also known for its use as abortifacient, amoebicide, contraceptive, diuretic, emmenagouge, narcotic, sedative and spasmolytic since times immemorial. It is an archaeophyte and inhabits highly disturbed sites close to human habitations.

Participants at the Valedictory function of one of the workshops

Biosystematic researches on populations of *Withania somnifera* sampled from different ecological zones and ecological niches suggest that:

I. species population show high variability in morphological as well as in chemical attributes;

ii. the ploidy of the populations ranges from 2x to 6x with x = 12;

iii. it is likely that variability built up in the species both in morphological and chemical attributes is associated with ploidy;

iv. the most unusual feature of the species is that different ploids within a population coexist;

v. the most unusual feature observed in *Withania somnifera* is that the progeny from the seeds of a single plant showed ploidy ranging from 2x to 6x; and

vi. understanding of the mechanisms associated with the unique phenomenon may provide a clue to the origin and evolution of the diversity observed in the species.

TRAINING IN BIOSYSTEMATICS - ANIMALS

One aspect of faunal study that can be considered as an integrated programme of work of ZSI is DNA fingerprinting studies on taxa of immense conservation importance with special focus on endangered ones. Recent advances in molecular techniques have opened a new chapter in species conservation efforts, as well as population biology. Techniques employed: DNA sequencing, mini-satellite, micro-satellite, and RAPD procedures. The PCR amplification of mitochondrial DNA, nuclear DNA, ribosomal DNA, and other systems provide far more sophisticated analyses of metapopulation structure, and delineation of species, subspecies, and races, all of which aid in setting species recovery priorities.

A Training Programme was held at Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad on Conservation of Insects through DNA Fingerprinting. The following Scientists and Research Scholars of ZSI were given hands on training in DNA Fingerprinting Technology.

a. Dr. Kailash Chandra
b. Dr. S Z Siddiqui
c. Dr. J K De
d. Dr. Reena Chakraborty
e. Dr. Sandeep Tiwari
f. Ms. Debasree Dam

- DNA Fingerprinting in Animal biosystematics allows identification of parentage, more distant relatives, unidentified individuals, population structure, effective population size, population-specific markers, etc.
- Identification of individuals using DNA fingerprinting methods is emerging as a critical tool in conservation genetics and molecular ecology.
- As a part of training; study of population genetics, phylogenetics, and phylogeography as indicators of a population's natural history and its future prognosis provide valuable data for developing conservation and management plans for endangered species.

Scientists of the Ministry addressing the participants of one of the workshops

Training in Biosystematics - Plants

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Prof. C.R. Babu Coordinator	Centre for Environmental Management of Degraded Ecosystems (CEMDE), School of Environmental Studies, University of Delhi, Delhi – 110 007. T / F : 011-2766 6237 E : crb26@hotmail.com	Dr. Shvetank Sharma Dr. R. Jayakumar Dr. D. Kothamati	Training on Biosystematics in plants Biosystematics of *Withania somnifera* (L.) Dunal species complex.

Training in Biosystematics - Animals

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Dr. J.R.B. Alfred (information provided by Dr. Ramakrishna, Coordinator & Scientist)	Zoological Survey of India Malacology Division M Block, New Alipur Kolkata – 700 053 T : 033 – 2400 3238 F : 033 – 2400 3238 E : ramakrishna.zsi@gmail.com ramakrishna_zsi@yahoo.com	–	Training on Biosystematics in animals

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University of Delhi, Delhi
Dr. Lalita Sehgal, Reader
University of Delhi, Delhi
Dr. Meenakshi Sethi, Reader
University of Delhi, Delhi
Mr. Mayur Y. Kamble, Research Scholar
Shivaji University, Kolhapur
Mr. Shimpale Vinod Bhimarao, Research Scholar
Shivaji University, Kolhapur
Mr. S. Muthuram Kumar, Research Scholar
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Mr. R. Soureche, Research Scholar
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Shivaji University, Kolhapur
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Allahabad Agriculture Institute, Allahabad
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M.D. University, Rohtak
Ms. Promilla Ahlawat, Research Scholar
M.D. University, Rohtak
Ms. Monika Gulia, Research Scholar
M.D. University, Rohtak
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