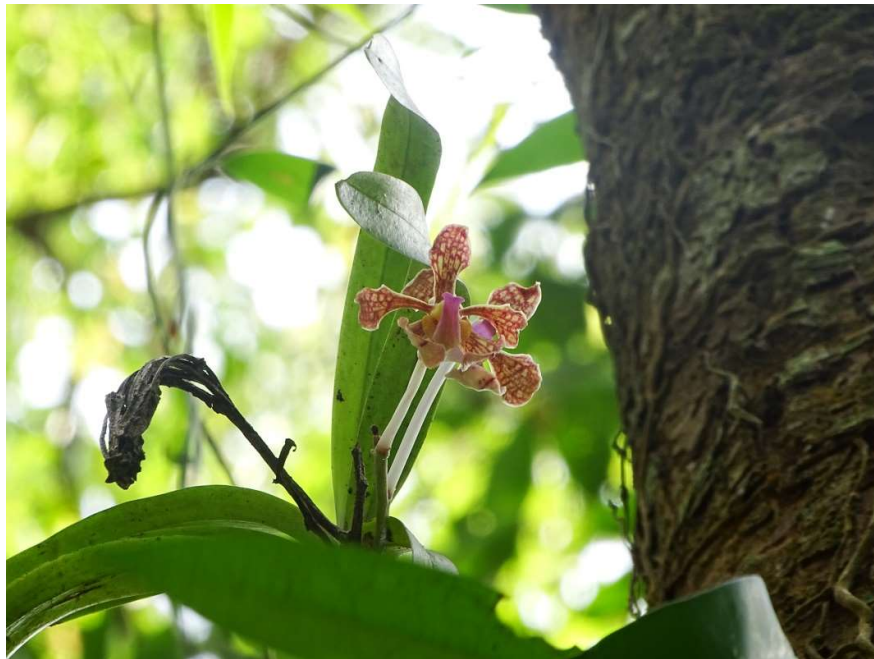


ANNUAL REPORT

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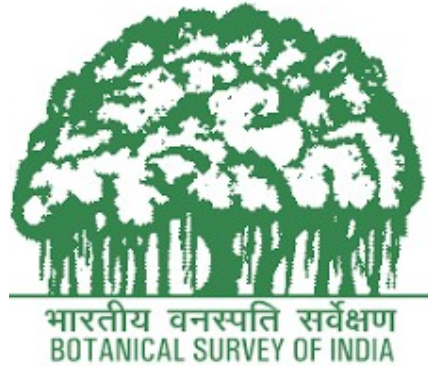


BOTANICAL SURVEY OF INDIA

Ministry of Environment, Forest & Climate Change

ANNUAL REPORT

2020-2021



BOTANICAL SURVEY OF INDIA

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Government of India

ANNUAL REPORT 2020-2021
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Acknowledgements

All Regional Centres of Botanical Survey of India

CONTENT

Research Programmes

Annual Research Programme

1. AJC Bose Indian Botanic Garden, Howrah
2. Andaman & Nicobar Regional Centre, Port Blair
3. Arid Zone Regional Centre, Jodhpur
4. Arunachal Pradesh Regional Centre, Itanagar
5. Botanic Garden of Indian Republic, Noida
6. Central Botanical Laboratory, Howrah
7. Central National Herbarium, Howrah
8. Central Regional Centre, Allahabad
9. Deccan Regional Centre, Hyderabad
10. Eastern Regional Centre, Shillong
11. Headquarter, BSI, Kolkata
12. High Altitude Western Himalayan Regional Centre, Solan
13. Industrial Section Indian Museum, Kolkata
14. Northern Regional Centre, Dehradun
15. Sikkim Himalayan Regional Centre, Gangtok
16. Southern Regional Centre, Coimbatore
17. Western Regional Centre, Pune

1. AJC BOSE INDIAN BOTANIC GARDEN, BSI, HOWRAH

I. COMPLETED PROJECTS

Project - 1

Exploration of Caterpillar fungi in Himalaya: Morpho-taxonomy, Molecular phylogeny, Chemical & nutraceutical properties.

Name of the Executing officer:

Dr. Kanad Das, Scientist E, AJCBIBG, BSI, Howrah (With Dr. M.E. Hembrom and Dr. Arvind Parihar)

Duration of the Project: April 2019 – March 2021

Introduction: Himalayan Caterpillar fungi belonging to the genus *Ophiocordyceps* and its allies are highly prized and most exploited among all the macrofungi. *Ophiocordyceps sinensis*, the most appreciated one, has a long history of being used in Chinese Traditional Medicine. Because of its diversified medicinal properties demand for *O. sinensis* has significantly increased in recent years. Subsequently, to meet the demand of fruiting bodies the entire alpine Himalayan stretch has come under huge pressure of exploitation. In this Himalayan stretch these fungi are collected in Nepal, Bhutan and India (especially Uttaranchal, Sikkim, Himachal Pradesh and Arunachal Pradesh). It is distributed in grass- and shrub-lands that receive a minimum of 350 mm average annual precipitation. It is found at an altitude of 3000–5000 meters above sea level. It is worth mentioning that several species under same or different genera of these caterpillar fungi are lookalikes i.e. morphologically similar. Caterpillar fungi distributed in different parts of Indian Himalaya are to be investigated for identification.

Methodology adopted:

LSU and SSU genes were isolated from samples collected in 2019 from Eastern to North-West Himalaya. These genes were amplified and sequenced. Datasets were prepared with the sequences of allied samples/species and our isolated genes. These sequences were aligned mostly with mafft alignment tool. Maximum likelihood analyses were conducted with the aligned sequences through raxmlGUI 2.0 to get phylograms. SSU- and LSU-based phylograms were constructed separately to get the phylogenetic estimation.

Compilation work with text, illustrations and phylograms was initiated. Field tours could not be conducted because of COVID-19 pandemic related restrictions and non-availability of enough budget.

Output indicators for the assessment of the project: Phylogenetic inferences and data interpretation; Result of HPLC; Comparison of Nutraceutical Properties in different samples located in different parts of Indian Himalaya.

Major impacts reported during the financial year: The results of this study would definitely enhance our understandings of this highly economically important group of fungi. It would not only open up new vistas for its economic utilization but also the morphological and phytochemical standards would help in preventing adulteration and biopiracy. It would again help in developing methods for its conservation and sustainable utilization.

New to Science: Two (2)

| Sr. No. | Name of the species | Journal |
|----------------|---|----------------------|
| 1. | Russula lakhanpalii A. Ghosh, K. Das & R.P. Bhatt; <i>Nova Hedwigia</i> 111(1-2): 118, 2020 | <i>Nova Hedwigia</i> |
| 2. | Russula indocatillus A. Ghosh, K. Das & R.P. Bhatt; <i>Nova Hedwigia</i> 111(1-2): 124, 2020 | <i>Nova Hedwigia</i> |

| | | |
|----|--|---------------------------------|
| 3. | Lactarius brunneoaurantiacus K. Das & I. Bera; <i>Nordic J. Bot.</i> doi: 10.1111/njb.02940 | <i>Nordic Journal of Botany</i> |
| 4. | Lactarius indoscrobiculatus K. Das & I. Bera; <i>Nordic J. Bot.</i> doi: 10.1111/njb.02940 | <i>Nordic Journal of Botany</i> |
| 5. | Russula ashihoi K. Das, A. Ghosh, Buyck & Hembrom; <i>Nordic J. Bot.</i> doi: 10.1111/njb.02962 | <i>Nordic Journal of Botany</i> |
| 6. | Russula indonigra A. Ghosh, K. Das, Buyck & Hembrom; <i>Nordic J. Bot.</i> doi: 10.1111/njb.02962 | <i>Nordic Journal of Botany</i> |
| 7. | Russula baniyakundensis A. Ghosh, K. Das & D. Chakr.; <i>Phytotaxa</i> 483(3): 249, 2020 | <i>Phytotaxa</i> |

New record to India: One (1)

| Sr. No. | Name of the species | Journal |
|---------|---------------------------------------|----------------|
| 1. | Lactarius abieticola X.H. Wang | <i>Nelumbo</i> |

Project - 2

Name of the project: Development of Musa section (*Ex-situ* conservation) in AJC Bose Indian Botanic Garden, Howrah (Completed)

Executing Scientist (s): Dr. S.S. Hameed, Scientist-‘E’, Dr. K. Saravanan, Botanist & Mr. S.K. Arjun, Bot. Asst.

Duration of the project: 2020-2021

Introduction: Musa is one of two or three genera in the family Musaceae; consists of bananas and plantains. Around 70 species of Musa are known, with broad variety of uses. In India more than 120 varieties of banana are being cultivated, however our main objective to introduce all the endemic and wild Musa and Callimusa varieties.

Objectives: To introduce and cultivate wild, endemic and exotic Musa and Callimusa varieties occurring in India through collection and exchange and develop a Musa section in AJCBIBG, Howrah.

Location: A well-developed Musa section spread in 2 acres land developed in AJCBIBG near to the Rosarium (adjacent to the Great Banyan Tree) becomes the integral part of Botanic Gardens in terms of conservation of germplasm as well as for educational purpose and curiosity. This would serve a long way in conserving wild and cultivated Musa varieties in AJCBIBG. The site is well demarcated and the land levelling has been made suitably. Hence, such sections would act as a gene pool of Musas’s for future breeding programmes.

Methodology adopted: The germplasm of different Musa and Callimusa varieties and the germ plasm of the wild and cultivated varieties were obtained from the regional Centres of BSI where the particular species occurs. Further, different varieties of Musa growing in AJCBIBG has also been brought to the site and planted systematically at a place for developing the section. Field tours could not be conducted because of COVID-19 pandemic related restrictions and non-availability of enough budget. Germplasm received from Andaman & Nicobar Islands were identified and transplanted. The seedlings of Musa available scattered in different parts of IBG were also transplanted at the Musa section and maintained.

Work done: 150 saplings of Musa spp. were introduced and maintained. Three endemic species viz *Musa acuminata*, *Musa bulbisiana*, and *Musa indandamanensis* received from BSI, Andaman and Nicobar Islands were identified and introduced. Germplasm of other Musa spp. already available in the garden were transferred and transplanted in the Musa section.

Output indicators for the assessment of the project: Number of saplings introduced and maintained.

Major impacts reported during the financial year: The Musa section in the AJCBIBG displays the germplasm of different varieties of wild bananas collected from different phytogeographic regions of India. It not only serves an ex-situ site for germplasm conservation, but also provides awareness and education to the large number of visitors, students and researchers.

Project - 3

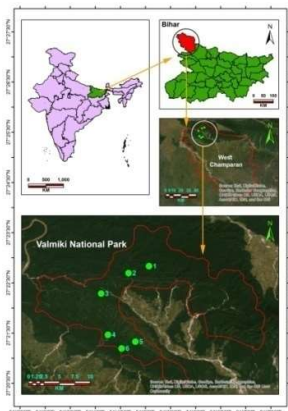
1. Name of the Project: **Wood rotting fungi of Valmiki National Park.**
2. Executing Scientist (s) : **MANOJ EMANUEL HEMBROM, Botanist, BSI, AJCBIBG, Howrah**
3. Duration of the project : **2019(October) – 2021(November).**

Introduction: Wood-rotting macrofungi are highly artificial in terms of taxonomy and mostly belong to two well-known advance fungal phyla of ‘Ascomycota’ and ‘Basidiomycota’. Their primary role is to cause rot on dead and decaying woods either by ‘White rot’ (mostly) or Brown rot (rarely) in ecosystem and hence degrading cellulose hemicelluloses and lignin into their primary Carbon molecules; taking part in natural process of Carbon cycle on earth. On the other hand they are pathogenic to important trees and timbers of forests causing severe economic loss by destroying them. Spalting of wood by these organisms are beneficial for preparation of several decorative artefacts, whereas, various enzymes produced by these fungi could be important in wood and paper processing industries by using biotechnological approaches. Some of these fungi are cultivated for nutraceutical and pharmaceutical purposes in wide scale. Many are providing home and food to small organisms and their loss may cause severe hazardous effects to the environment due to their specific relationships with the environment. Above all, these fungi form micro-environment along with host trees which are supposed to be explored by applying ecological and botanical methods, a potential thrust area of future research. Present project mainly aims to study the taxonomy of these lesser known fungi from Valmiki National Park, Bihar and their preliminary assessment in terms of diversity and distribution.

Objectives:

- ‘Survey’, ‘collection’, ‘characterization’, ‘identification’, ‘documentation’ of wood rotting fungi of Valmiki National Park.
- Preparation of the detailed account of wood rotting fungi including their description, host range and specificity, morphology based easy identifying key and notes.
- Preparation of check-list and distributional map of wood rotting fungi in Valmiki National Park.
- Macro– and microscopic illustrations of all recorded taxa under present investigation for easy identification.
- To undertake phylogenetic studies of selected taxa for their proper taxonomic placement.

Site of the study (with map)



Methodology adopted: Extensive and intensive macrofungal survey & collection were undertaken during July to September 2020 by the collaborator. During survey and collection field-photographs of fruiting bodies were done with the aid of Sony Cyber shot DSC-RX100 digital camera. While collecting specimens in field corresponding geographical references like forest range within Valmiki National Park followed by altitude, latitude and longitude were recorded with the help of GPS. Habitat, substratum/host and macromorphology of fruiting bodies were noted, then specimens were preserved by either by Sun drying (on the basis of availability) and mild heat preservation (temperature range of 45°C–55°C with the help of 200W electric bulb as heat source in field dryer) were done and they were processed for further identification and documentation in the institute. All the collected samples (**150**) were properly preserved, numbered and brought to CNH, BSI, Howrah.

Micromorphological characterizations were undertaken from dried fruiting bodies with the help of Olympus BX 51. All the taxonomic features were recorded (in the form of images and camera lucida drawings) including measurements of 40 spores. Morpho-taxonomic comparisons were made to check the conspecificity or identify the species known from different parts of globe.

New Methodology (if any) adopted: Molecular phylogenetic relationship: One or two or more target genes ITS, LSU, *tefl* were isolated and phylogenetic estimations/inferences with the sequence data were drawn/prepared through Maximum Likelihood (ML) analysis method.

Achievements including:

a. Total area covered: More or less 80 sq. km areas falling under forest ranges of Chiutaha, Madanpur, Harnatand and Raghia, were surveyed by collaborator in Valmiki National Park.

b. Number of tours undertaken: Three (3), unfortunately, it was not possible to undertake any field trip to Chiutaha, Ganauli, Harnatand and Raghia, forest ranges during the season of wood-rotting fungi (July-October, 2020) due to the prevailing situation of Covid 19 pandemic. However survey and collection were done by local collaborator at aforementioned restricted localities.

c. Number of species collected: 150 sets of samples were collected by amateur collectors and collaborators of study area randomly from different host trees including their representative's geo-coordinates and will be received by postal service.

d. Number of species identified (with name): Eight (8) **I.** *Auricularia auricula-judae* (Bull.) Quél. **II.** *Oudemansiella* sp. **III.** *Pycnoporus sanguineus* (L.) Murrill, **IV.** *Rhizochaete rhizomorphosulphurea* (B.K. Bakshi & Suj. Singh) Nakasone **V.** *Coltricia* sp.1, **VI.** *Tyromyces* sp.1, **VII.** *Skeletocutis albomarginata* (Zipp. ex Lév.) Rui Du & Y.C. Dai, **VIII.** *Trametes* sp.1

e. Number of species incorporated: Eight (8)

4.7 Output indicators for the assessment of the project: Microscopy of Fifteen (15) samples was undertaken along with their images and camera lucida drawings.

4.8 Major impacts reported during the financial year: Phylogenetic estimations of four (4) species were undertaken. This documentation of wood-rotting fungi has enhanced our understanding of this less known group. It would definitely help in conservation and possible utilization.

Project - 4

Flora of India (Volume 27)

ASPARAGACEAE

Updating of existing manuscript and documentation of 106 taxa completed by Dr. B.K. Singh and submitted to the team leader.

Project - 5

Flora of India (Volume 28)

ARECACEAE: Manuscript of Aceraceae containing 106 species of palms under 21 genera have been corrected and submitted by Dr. S.S. Hameed.

APONOGETONACEAE: Updating of existing manuscript and documentation of 9 taxa completed by Dr. B.K. Singh

POTAMOGETONACEAE: Updating of existing manuscript and documentation of 21 taxa completed by Dr. B.K. Singh

NAJADACEAE: Updating of existing manuscript and documentation of 12 taxa completed by Dr. B.K. Singh

II. ONGOING PROJECTS

Project -6

Name of the Project: **DEVELOPMENT OF AN ORCHIDARIUM IN AJCBIBG THROUGH COLLECTION, INTRODUCTION AND EX-SITU CONSERVATION OF THE ORCHIDS OF EASTERN GHATS OF INDIA**

Executing Scientist (s) : Dr. S.P. Panda, Scientist-C, Dr. R. Saravanan, Botanist & Ms. Titir Saha, Bot. Asstt.

Duration of the project: 2020-2022

Introduction: Orchids are known for their beautiful flowers with gorgeous colour, floral structure and ornamentation. They are regarded as one of the most sought after flowering plants with ornamental, medicinal aesthetic value. Orchids have highly adaptive features and can survive in alternate habitat condition. Keeping this quality in mind and for demonstration of Orchid wealth of the country the project has been taken up for introduction of Orchids found in the Eastern Ghats region in to the AJCB Indian Botanic Garden. This would be beneficial for conservation and awareness generation on such a vulnerable group of plants.

Objectives:

- To developed a standard orchidarium in AJCBIBG
- To conserve the orchids of Eastern Ghats in *ex-situ* condition.
- To impart education and awareness among the people/students visiting the orchidarium

Work done: The project could not be initiated because of COVID-19 pandemic related restrictions.

Project - 7

Name of the Project: **GIS Phyto-Mapping & Digitization of Shrubs and Trees in AJC Bose Indian Botanic Garden**

Executing Scientist (s): **Dr. C.M. Sabapathy, Dr. Basant Kumar Singh & Dr. Kanad Das**

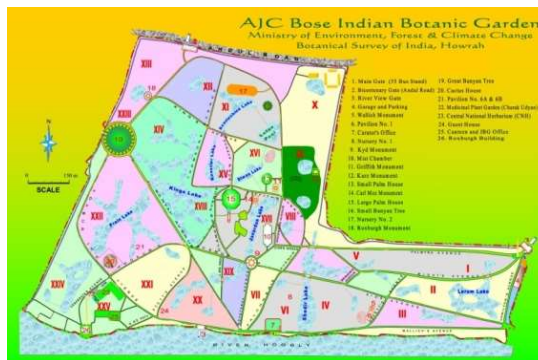
Duration of the project: **2015 - Ongoing**

Introduction: Use of Geographical Information System (GIS) & Remote Sensing in the field of biodiversity study is gaining momentum and becoming an important tool for habitat conservation strategies. Introduction of GIS mapping technique in botanic garden on experimental basis in the context of Convention on Biological Diversity guidelines has proven significant for the management and conservation practices. Acharya Jagadish Chandra Bose Indian Botanic Garden, Howrah is one of the biggest and oldest botanic garden of south-east Asia. Spread over an area of 273 acre, this garden is a living repository of approximately 14000 trees and shrubs under 1377 species (Debnath et al., 2014). Documentation of plant wealth was done in several ways by different workers. Development of printing technology and digital photography has given modernization to this old technique. Publication of Plants of Indian Botanic Garden by Chowdhury et al., 2005 and Census of plants of AJC Bose Indian Botanic Garden – A Report by Debnath et al., 2014 have used the technique of digital photography to popularize the content. But the problem of locating the trees on this large area remains same. To solve this problem, technological intervention is a solution. Locating the trees with geo-coordinates is proved a reliable solution with a scientific approach.

Objectives:

- Data collection about the history of plant introduction in the garden from past records.
- Locating the Trees and Shrubs in the Garden. Collection of fresh flowering, fruiting specimens and identifying. Checking its present nomenclature and making necessary corrections.
- Mapping of the Identified trees in the software such as ARC GIS and other feasible software.
- Creating a map database that helps user to access and identify the Shrubs and tree species in the AJCBIBG.

Map of the garden:



Methodology adopted:

- Geo-tagging of the trees and labelling with a serial number for referencing and minimizing the error.

Work done:

- Total area covered: 273 acres
- 480 trees (including all Palms) are labelled with names.
- Collection of geo-coordinates of all palm species
- Updating of data in the mobile App done

Major impacts reported during the financial year:

The mobile app developed for AJCB Indian Botanic Garden is a user-friendly digital platform for the users that gives a glimpse of the gardens under BSI and the protected areas of India. Under the AJC Bose Indian Botanic Garden users have a wide range of options full of interactive information, narration and navigation features for its different 'Plant Sections', 'Iconic Plants', 'Buildings & Monuments', 'Lakes', 'Garden Plants', etc. The app is also having Special features like 'Nearby Trees', 'Flowering Calendar', 'Quiz' that make this app interesting for users. This mobile app is useful in navigating the important species in the garden and to have reday reference for these species.

Research Publications: Papers published 23; Book chapters published: 04; Papers communicated: 04 (For details of the list of publication please refer to the last chapter)

Garden Management & Maintenance Activities:

- Amphan: Assessment of damage by field survey is done by the committee. Surveyed the garden for both qualitative as well as quantitative assessment of plant (Trees and Shrubs) losses made. Altogether 195 species were damaged of which 350 trees were completed uprooted and 1018 trees were damaged. A detailed report was submitted to BSI (HQ).
- Restoration of around 50 plants fallen during Amphan viz. *Adansonia digitata*, *Cycas zeylanica*, *Triplaris americana*, *Intsia bijuga*, *Goniothalamus wynaadensis*, etc.
- The Great Banyan Tree: Approx. 41 nos. prop roots had been uprooted and approx. 30 nos. branches had been broken or damaged during Amphan in 20.05.2020. Out of 41nos. uprooted prop roots, 10 prop roots restored. Restoration work started by pouring extra soil and covering the bases of partly uprooted/exposed prop roots in 3 places after applying fungicide at the exposed portion. The bases of 7-8 very big and old prop roots were loosen due to mild tilting during Amphan. Extra soil has been poured to the bases of such 2 prop roots till now. The cut branches accumulated in the area were being shifted and cleared of. New support made up of Bamboo had been provided in 3 places for lifting up the drooping branches up to a suitable height. 85. nos. aerial roots are engaged in 'Bamboo Cages' for training them as 'Prop Root' out of which 15 nos. (approx.) are at 15 -20 ft. height. 34. nos. aerial roots have touched the ground as 'new prop root'. Approx. 47 nos. engaged aerial roots are repaired during this period in respect of refixing and replacing of bamboo cages fitted to them according to their growth as per

- necessity. New support made up of Bamboo has been provided in 13 places. Old support made up of Bamboo, repaired and replaced in 20 places. Cleaning and de-weeding of weeds done both by machine and manual operation to make the tree presentable.
- d. Garden Beautification: Development of Succulent Mound with 19 succulent plant species, Cactus Mound with 22 different Cacti, Hedge plantation along the Ganges with 20 different plant species.
 - e. Rosarium: Introduced climbing roses along with other rare Indian breed as well as foreign breeds.
 - f. Medicinal Plant Section (Charak Udyan): Restoration of damaged trees in Amphan; Plantation of 10 medicinal plant species viz. *Vernonia amygdalina*, *Ocimum basilicum*, *Pandanus amaryllifolius*, *Syzygium aromaticum*, *Aloe vera*, *Hibiscus fragrance*, etc.; de-weeding and regular cleaning; pruning of overgrown canopies, etc.
 - g. Cycad Section: Potting of cycads brought from NBRI for hardening and further introduction in the Cycad Section viz. *Cycas beddomei* Dyer, *Cycas clivicola* K. D. Hill, *Cycas indica* A. Lindstr. & K.D.Hill, *Cycas sphaerica* Roxb., *Dioon edule* Lindl., *Zamia angustifolia* Jacq., *Zamia inermis* Vovides, J.D.Rees & Vázq.Torres, *Zamia fischeri* Miq.ex Lam., *Zamia loddigesii* Miq., *Zamia pumila* L., *Zamia standleyi* Schutzman, *Zamia variegata* Warsz. Maintained 16 seedlings of *Cycas* spp. viz.: *Cycas indica* (05), *Cycas beddomei* (06) and *Cycas sphaerica* (05) from DRC, Hyderabad for introduction purpose in Cycad section.
 - h. Multiplication of both *Victoria amazonica* & *Victoria cruziana* done from seeds and germplasm maintained at different lakes of AJCBIBG.
 - i. 40 species of EET plants have been multiplied during the period for ex-situ conservation.
 - j. Plant multiplication House: Renovation of plant multiplication house and plantation of cuttings of following plants: *Jasminum* spp.; *Codium* spp.; *Bougainvillea* spp.; *Bignonia* spp.; *Hibiscus* spp.; *Ephedra* sp.
 - k. Canna section: Revamping of Canna section done.
 - l. Cuttings / saplings was done of following plants: *Alstonia* sp. 100 plants; *Euphorbia* sp. 50 plants; *Euphorbia* sp. 50 plants; *Hibiscus* spp. 100 plant
 - m. Seed collection & multiplication through seed germination of *Mesua ferrea* (Indian rose chestnut-56 seeds), *Helianthus* sp., *Calendula* sp., *Impatiens* sp., *Baccharoides anthemintica*, *Helichrysum* sp. *Cosmos* sp., *Uraria picta*, *Althea* sp., *Dehalia*. *Papaver* spp., *Daisy* sp., *Dianthus* sp., *Dimorphotheca* sp., *Ipomoea* sp., *Allyssum* sp., *Verbena* sp., *Mesembrythemum* sp., etc.
 - n. Multiplication of RET/Endemic and economically important plants: The harvested seeds of double coconut (*Lodoicea maldivica*) have been successfully placed for germination (after a month-long effort of preparation of wooden pots by Dr. A.A. Mao, Director BSI on 29.10.2020 on a specially designed huge wooden pots with suitable media at the corner of curator lawn adjacent to CPWD office. The pots have been adequately guarded with bamboo fencing; and the security has been deployed for safeguarding the asset. Germination process has been continuously monitored maintaining humidity, soil temperature, moisture etc.

Symposium/ Conferences/ Workshop/ Training Course Attended:

- a. Dr. S.P. Panda delivered a talk on Role of AJCBIBG in Ex-situ Conservation of Plants on National Webinar on “Conserving Diversity of Plants for Present and Future Generation” organised by Department of Botany, SG College, Jajpur, Odisha on 21st December,2020.
- b. Dr. S.P. Panda delivered a talk on AJCBIBG: At a Glance in a National webinar on Botanic Gardens and biodiversity of India- Identification, Conservation and Management organised by Govt. Madhav Sadashivrao Golwalkar College, Rewa, MP on 17.02.21.
- c. Dr. B.K. Singh delivered talk on “Role of Botanic Garden in Plant Conservation with Special Reference to AJC Bose Indian Botanic Garden” as Lead Speaker in 2-days National Webinar entitled “LIFE IN THE UNIVERSE AND DIVERSITY” organized by Department of Botany in collaboration with IQAC, Ranaghat College on 15th and 16th July, 2020.
- d. Dr. B.K. Singh delivered talk on “AJC Bose Indian Botanic Garden & ex-situ conservation: A Post Amphan Review” in the State Level Webinar on “Urban and Mangrove Plantation: A Post-

- Amphan Introspection” organized by Department of Botany in collaboration with IQAC, Charuchandra College, Kolkata on 28th July, 2020.
- e. Dr. B.K. Singh delivered talk on “A virtual journey to Botanic Garden” in a 4-days Online Lecture Series on “Virtual Journey through Botanical World” organized by Department of Botany in collaboration with IQAC, THK Jain College, Kolkata on 13th August, 2020.
 - f. Dr. B.K. Singh delivered talk on “Role of Botanic Garden in Plant Conservation” in the National Level Webinar on “Biodiversity of India and its Conservation” organized by Department of Botany in collaboration with IQAC, Bagnan College, Howrah on 20th September, 2020.
 - g. Dr. B.K. Singh delivered talk on Medicinal Plant Identification in a 1day workshop at Herbal Garden organized by Institute of Post Graduate Ayurvedic Education & Research at Shyamadas Vaidya Shastra Pith, Dept. of Health & F.W., Govt. of West Bengal on 12.02.2021.
 - h. Dr. B.K. Singh delivered talk on Nokrek Biosphere Reserve, Meghalaya A Session of The Webinar on “Biosphere Reserves of India- Identification, Conservation and Management” Organised by Govt. M.S. Golwalkar College, Rewa (M.P.) on 19th March, 2021.
 - i. Dr. Manoj E. Hembrom acted as resource person to train 12 researchers (Prof., Asstt. Prof. and Research Scholars) at Department of Botany, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh w.e.f. 30/01/2021 to 06/02/2021 in order to Survey, Collect, Characterize, Identify, Preserve and Document the Polypores of Arunachal Pradesh.

Any other services rendered:

- a) Four manuscripts entitled “Three novel species of *Russula* Pers. subg. *Compactae* (Fr.) Bon from Dinghushan Biosphere Reserve in Southern China”, “A new species of *Craterellus* from Guizhou Province, China” “A new species of *Craterellus* from Guizhou Province, China”, “Two new species of *Russula* subsect. *Virescentinae* from southern China” and “Indian species of genus *Neolentinus* Redhead & Ginns of family *Gloeophyllaceae* Jülich” were reviewed for *Cryptogamy Mycologie and Phytotaxa*.
- b) Dr. Kanad Das supervised the day to day research work of the SPF (under “Flora of India” project), Ms. ISHIKA BERA.
- c) Dr. Kanad Das looked after the day to day duties of BSI ENVIS RP.
- d) Sri Arvind Parihar who was working under the supervision of Dr. Kanad Das (on TAXONOMIC STUDIES ON WOODY AND FLESHY POROID FUNGI OF KODERMA WILDLIFE SANCTUARY) was awarded with Ph.D. in Botany from Andhra University.

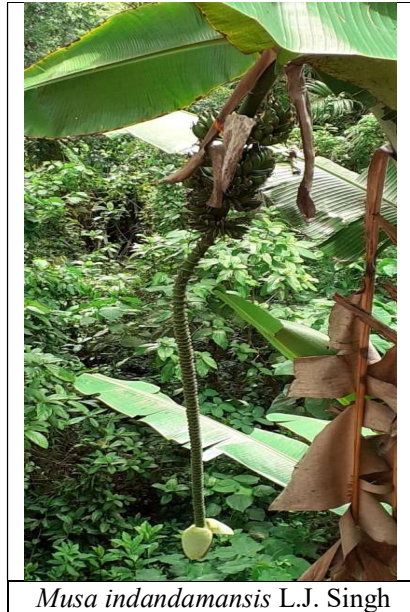
2. ANDAMAN AND NICOBAR REGIONAL CENTRE, PORT BLAIR

PROJECT – 1

Revision of the family Musaceae in Andaman and Nicobar Islands along with population assessment

Executing Scientist (s): Dr. Lal Ji Singh & Shri Gautam Anuj Ekka

Date of Initiation: April, 2020 Target date for completion: March, 2022



OBJECTIVE:

To document all the species of family *Musaceae* and preparation of consolidated account of the family along with their distribution status.

BACKGROUND

Musaceae is represented by a single genus, *Musa* L. from Andaman and Nicobar Islands, India. Earlier studies on the genus have accounted six taxa viz., *M. acuminata* Colla, *M. balbisiana* Colla, *M. indandamanensis* L.J. Singh, *M. paramjithiana* L.J. Singh, *M. sabuana* K. Prasad et al. and *M. balbisiana* Colla var. *andamanica* Singh et al. from Andaman and Nicobar Islands. Systematics in the genus *Musa* has been believed as much complex and need a thorough investigation. Much of the diversity in the section is located in areas in continental Asia that have been and continue to be difficult, and sometimes even dangerous to travel and work in. For this reason, the present-day distribution, extent and status of many of the undescribed species are not clear despite some 200 years of study and still new species await description. Therefore, the present study was proposed to examine thoroughly the morphological characters of all species of *Musa* found in the Andaman and Nicobar Islands.

AREA AND LOCALITY: Andaman and Nicobar Islands: c. 8249 sq. km.

SUMMARY OF THE WORK DONE DURING 2020-2021

Two field tours were undertaken to different Islands such as Middle Andaman and Little Andaman and collected 14 field number specimens along with the GPS details, examined, characterized morphologically and identified into three species viz., *Musa acuminata* Colla., *Musa balbisiana* Colla. & and *Musa indandamansis* L.J. Singh. The diversity of Musaceae with their salient

features, range of distribution, threats and conservation status has been recorded in detail. 27 herbarium specimens of Genus *Musa* were examined and identified into 3 species (*Musa acuminata* Colla., *Musa balbisiana* Colla. & and *Musa indandamansis* L.J. Singh). All the identified specimens were incorporated into the herbarium (PBL). Wild germ plasm of 03 species of *Musa* (*Musa acuminata* Colla., *Musa balbisiana* Colla. & and *Musa indandamansis* L.J. Singh) was collected and introduced in the Garden as a part of ex-situ conservation. Besides, also collected germplasm of 21 species of RET plants and introduced in garden. Raised nursery of 9 species. Described and illustrated 04 new species and 8 new records for the flora of Andaman and Nicobar Islands.

ACHIEVEMENTS/ OUTCOMES IN 2020-21

During the field tours rhizomes and seeds of wild species of *Musa* (*Musa acuminata* Colla., *Musa balbisiana* Colla. & and *Musa indandamansis* L.J. Singh) along with 21 rare, threatened and endemic, species were collected and introduced in the Dhanikhari Experimental Garden cum Arboretum (DEGCA) as a part of *ex-situ* conservation. Molecular systematics of the genus *Musa* L. (Zingiberales: *Musaceae*) in Andaman and Nicobar Islands have been done. Population Assessment of *Musa paramjitiana* L.J. Singh (*Musaceae*): a critically endangered, endemic species in Andaman & Nicobar Islands, India have been done. Besides, 04 new species viz. *Rivina andamanensis* L. J. Singh & M. Chennakesavulu Naik (*Petiveriaceae*) *Dendrophthoe gamblei* L.J. Singh, V. Ranjan, Rasingam and J. Swamy (*Loranthaceae*) *Luisia diglipurensis* Sanjay Mishra & Jalal (*Orchidaceae*) *Luisia jarawana* Sanjay Mishra & Jalal (*Orchidaceae*) were described as new to science and 08 species viz. *Crotalaria verrucosa* L. (*Fabaceae*), *Senna auriculata* (L.) Roxb. (*Fabaceae*), *Arthraxon hispidus* (Thunb.) Makino (*Poaceae*), *Desmodium heterocarpon* subsp. *ovalifolium* (Prain) H. Ohashi (*Fabaceae*), *Ammannia auriculata* Willd. (*Lythraceae*), *Chlorophytum vestitum* Baker (*Asparagaceae*), *Christisonia siamensis* Craib (*Orobanchaceae*), *Elatostema cuneatum* Wight (*Urticaceae*) were recorded as new to Andaman and Nicobar Islands. 2 books, 15 research papers including 5 book chapters have been published in International and National journals and proceedings of seminars and symposia.

PROJECT - 2

Phenological Survey of Tree Species of Dhanikhari Experimental Garden-cum-Arboretum (DEGCA), Nayashahar (Ongoing)

Executing Scientist (s): Dr. Lal Ji Singh and Shri Bishnu Charan Dey

Date of Initiation: April, 2018

Target date of completion: Ongoing



Garcinia dhanikhariensis S.K. Srivast.

OBJECTIVES: Recording of flowering and fruiting phenology of tree species of Andaman and Nicobar Islands

BACKGROUND: The Dhanikhari Experimental Garden cum Arboretum spread over 30 hectare of land more than 1472 species. The knowledge of phenology of plants is critical for the successful management of forest genetic resources as well as conservation and regeneration of species. This project aims to observe the phenology of all the tree species of the experimental garden.

AREA AND LOCALITY: Dhanikhari Experimental Garden Cum Arboretum (DEGCA), Nayashahar, 30 ha.

Work done: Flowering and fruiting of 73 tree species were observed and recorded.

Project- 3

Revision of the lichen family *Pyrenulaceae* in India

Executing Scientist(s): Dr. Jagadeesh Ram T.A.M.

Date of Initiation: April, 2017

Date of completion: March, 2022

OBJECTIVE: To revise members of the family *Pyrenulaceae* in India

BACKGROUND: The project was initiated in 2017. Literature survey was carried out and a total of 132 species were listed in 4 genera viz. *Anthracothecium*, *Lithothelium*, *Pyrenula* and *Pyrgillus*. One Herbarium consultation tour was undertaken to Botanical Survey of India, Eastern Regional Centre, Shillong in 2017. A total of 204 specimens in 9 species of *Anthracothecium* Hampe and 32 species of *Pyrenula* Ach. were consulted. Field tours to the states of Arunachal Pradesh, Kerala, Meghalaya and Tamil Nadu were undertaken in 2018, 2019 and 2020 and collected 177 Field Numbers. A total of 240 specimens including recent and previously preserved collections in PBL were examined and identified into 6 species of *Anthracothecium* and 54 species of *Pyrenula*.

AREA AND LOCALITY: India (Entire Country).

SUMMARY OF THE WORK DONE DURING 2020-2021: A total of 200 specimens were examined and identified into 2 species of *Anthracothecium*, 2 species of *Lithothelium* and 22 species of *Pyrenula*. Taxonomic Descriptions of 13 species of *Pyrenula* were prepared.

ACHIEVEMENTS/ OUTCOMES IN 2020-2021: During the course of study 7 species [*Pyrenula aggregataspistea* Aptroot & Cáceres, *Pyrenula ciliate* Aptroot, *Pyrenula cocoes* Müll. Arg., *Pyrenula fulva* (Kremph.) Müll. Arg. *Pyrenula rinodinospora* Aptroot, *Pyrenula septicollaris* (Eschw.) R.C. Harris and *Pyrenula subglabrata* (Nyl.) Müll. Arg.] discovered as new to India; 5 species [*Anthracothecium prasinum* (Eschw.) R.C. Harris Ajay, *Pyrenula subgregantula* Müll. Arg., *Pyrenula sublaevigata* (Patw. & Makhija) Upreti, *Pyrenula thailandica* Aptroot and *Pyrenula thelomorpha* Tuck] as new records for Andaman and Nicobar Islands.

PROJECT-4

***Ex-situ* conservation of RET species (Bamboos, Palms, Zingibers, endemic tree species) of Andaman & Nicobar Islands at Dhanikhari Exp. Garden cum Arboretum and raise nursery.**

Executing Scientist(s): Dr. C. S. Purohit & Dr. Vivek C. P.

Date of Initiation: August, 2019

Date to be completion: March, 2022

OBJECTIVE: Documentation of RET plants belong to bamboos, palms, zingibers, and trees in the Andaman and Nicobar Islands, collection, introduction, multiplication and conservation of them in Dhanikhari Experimental Garden cum Arboretum and raise nursery.

BACKGROUND: The project was initiated in August, 2019, during the previous year two field tours have been conducted respectively to Diglipur in North Andaman *w.e.f.* 14.10.2019 to 26.10.2019, and Campbell Bay, Nicobar Islands *w.e.f.* 18.03.2020 to 26.03.2020. A total of 51 plant samples (Fld. Nos. 34101 to 34151) of EET species of Andaman and Nicobar Islands have been collected during the tours and processed the specimens for preparing the herbarium. The GPS coordinates of the localities have been recorded and captured the photos of the plants.

AREA AND LOCALITY: The Andaman and Nicobar Islands, c. 8249 sq.km.

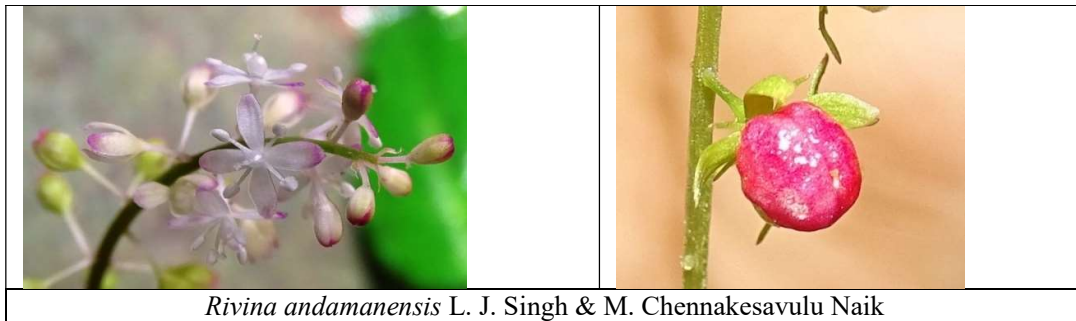
SUMMARY OF THE WORK DONE DURING 2020-2021: Three field tours were conducted in areas of South Andaman and Middle Andaman Islands. The tour to South Andaman was conducted *w.e.f.* 31.06.2020 to 02.07.2021 and collected 46 Nos. of seeds/seedlings/plantlets. The second tour to South Andaman was conducted *w.e.f.* 05.12.2020 to 11.12.2020 and collected 4,006 live plants (2,366 seedlings and 1,642 plantlets), 7 cuttings and 1,135 seeds of 24 threatened endemic plant species and 92 voucher specimens (Field Nos. 34144 to 34166) during the survey. The GPS coordinates of the localities have been recorded and captured the photos of the plants. The third tour was conducted to Middle Andaman *w.e.f.* 11.02.2021 to 17.02.2021 and collected 228 live plants (19 plant species), 780 seeds of 7 threatened endemic plant species and 15 voucher specimens (34167 to 34181) during the survey. The GPS coordinates of the localities have been recorded and captured the photos of the plants. Raised a total of 950 seedlings/sowed seeds of RET species in Garden and transplanted a total of 124 plants in different sections of the Garden.

ACHIEVEMENTS/ OUTCOMES: During the survey the following endemic/threatened plant species were collected from South and Middle Andaman Islands and introduced in the in Dhanikhari Experimental Garden cum Arboretum. *Corypha umbraculifera* L.- 4 seedlings; *Phoenix paludosa* Roxb. - 5 plants; *Knema andamanica* (Warb.) W.J. De Wilde-766 seedlings, *Manilkara littoralis* (Kurz.) Dubbard-526 seedlings, *Pinanga andamanensis* Becc. -512 seedlings, *Pinanga manii* Becc.-150 seedlings & 900 seeds, *Pterocarpus dalbergioides* DC.-110 seedlings & 200 seeds; *Myristica andamanica* Hook.f.- 90 seedlings, *Grewia calophylla* Kurz ex Mast. -286 seeds, *Canarium denticulatum* Blume-35 seedlings, *Dipterocarpus griffithii* - 25 seedlings, *Magnolia andamanica* (King) D.C.S. Raju & M.P. Nayar-8 seedlings, *Carrisa andamanensis* L.J. Singh & Murugan-8 seedlings, *Schizostachyum andamanicum* M. Kumar & Remesh - 545 plantlets, *Amomum andamanicum* V.P. Thomas *et al.* - 500 plantlets, *Amomum maximum* Roxb.-250 plantlets, *Zingiber pseudosquarrosus* L.J. Singh & P. Singh-50 plantlets, *Amomum aculeatum* Roxb.-37 plantlets, *Cyrtandra burtii* N.P. Balakrishnan-10 plantlets, *Psychotria andamanica* Kurz-10 plantlets, *Zingiber sp.*-2 plantlets, *Curcuma sp.*-4 plantlets, *Calamus andamanicus* Kurz-2 plantlets, *Magnolia andamanica* (King) D.C.S. Raju & M.P. Nayar-35 seeds *Bulbophyllum spp.*-20 bulbs; *Dendrobium tenuicaule* Hook.f. - 5 bulbs; *Diospyros spp.*-100 seeds; *Diospyros kurzii* Hiern -10 seedlings; *Garcinia andamanica* King -50 seedlings; *Gigantochloa nigrociliata* (Buse) Kurz - 10 seedlings; *Goniothalamus spp.*-50 seeds; *Lagerstroemia hypoleuca* Kurz-20 fruits; *Myristica andamanica* Hook.f.- 34 seedlings; *Pteroceras muriculatum* (Rehb.f.) P.F. Hunt -2 plantlets; *Semecarpus kurzii* Engl. -60 seeds; *Rhopaloblaste angustata* (Kurz) Moore- 16 seedlings; *Strobilanthes spp.*-10 seedlings; *Terminalia manii* King -10 seedlings & 300 seeds; *Zingiber spp.*-5 plantlets; *Zingiber squarrosus* Roxb.-13 plantlets.

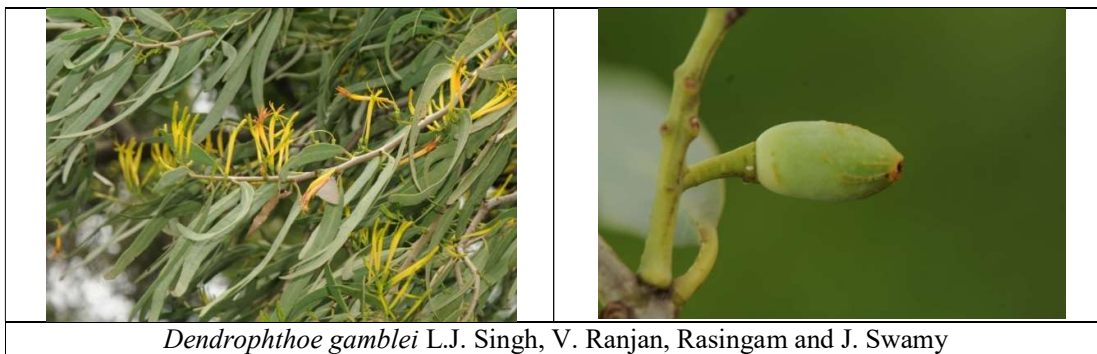


NEW SPECIES

Rivina andamanensis L. J. Singh & M. Chennakesavulu Naik, Journal of Asia-Pacific Biodiversity 13: 482- 486 (PETIVERIACEAE). This new species has been discovered and described based on the collection made from Kalsi forest, Middle Andaman, Andaman and Nicobar Islands, India.



Dendrophthoe gamblei L.J. Singh, V. Ranjan, Rasingam and J. Swamy, Journal of Asia-Pacific Biodiversity 13:487-49 (LORANTHACEAE). This new species has been discovered and described based on the collection made from Yarlampalli, 2000 ft, Anantpur district, Andhra Pradesh, India.



Luisia diglipurensis Sanjay Mishra & Jalal, Phytotaxa 453 (3): 255–264 (ORCHIDACEAE). This new species has been discovered and described based on the collection made from Diglipur, North Andaman, Andaman and Nicobar Islands, India.

Luisia jarawana Sanjay Mishra & Jalal, Phytotaxa 453 (3): 255–264 (ORCHIDACEAE). This new species has been discovered and described based on the collection made from Sawgan nallah, Middle Andaman, Andaman and Nicobar Islands, India.

New distributional records:

Crotalaria verrucosa L. Abrahamia5(1): 1-4. (FABACEAE). This species has been reported for the first time from Andaman and Nicobar Islands, India based on the collection made from Rangat, Middle Andaman, Andaman and Nicobar Islands.

Senna auriculata (L.) Roxb. Abrahamia5(1): 1-4. (FABACEAE), This species has been reported for the first time from Andaman and Nicobar Islands, India based on the collection made from Middle Andaman, Andaman and Nicobar Islands.

Arthraxon hispidus (Thunb.) Makino, Journal of Economic and Taxonomic Botany 43 (1-4): 58-59. (POACEAE). This species has been reported first time from Andaman and Nicobar Islands, India based on the collection made along the pathways in evergreen forests, between Padangada Chowk to Kishorinagar Medical, North Andaman, Andaman and Nicobar Islands, India.

Desmodium heterocarpon subsp. ***Ovalifolium*** (Prain) H. Ohashi, Species 22(69), 80-83. (FABACEAE). This species has been reported for the first time from Andaman and Nicobar Islands, India based on the collection made from Shoal Bay, Wandur, Mount Harriet, Write Myo, South Andaman, Andaman and Nicobar Islands.

Ammannia auriculata Willd., Journal of Threatened Taxa 13 (2): 17843-17846. (LYTHRACEAE). This species has been reported for the first time from Andaman and Nicobar Islands, India based on the collection made from Billiground, Middle Andaman, Andaman and Nicobar Islands.

Chlorophytum vestitum Baker, Journal of Threatened Taxa 13 (2): 17843-17846. (ASPARAGACEAE). This species has been reported for the first time from Andaman and Nicobar Islands, India based on the collection made from Panchavati hills, Rangat, Middle Andaman, Andaman and Nicobar Islands.

Christisonia siamensis Craib, Journal of Threatened Taxa 13 (2): 17843-17846. (OROBANCHACEAE). This species has been reported for the first time from Andaman and Nicobar Islands, India based on the collection made from Mount Harriet, South Andaman, Andaman and Nicobar Islands.

Elatostema cuneatum Wight, Journal of Threatened Taxa 13 (2): 17843-17846. (URTICACEAE). This species has been reported for the first time from Andaman and Nicobar Islands, India based on the collection made from Ross Island, South Andaman, Andaman and Nicobar Islands.

Ex-situ conservation

As part of ex-situ conservation of EET plants of Andaman and Nicobar Islands, several species have been collected and introduced in the Dhanikhari Experimental Garden cum Arboretum. Some of the plant species are: *Musa acuminata* Colla., *Musabalbisiana* Colla. & *Musa indandamansis* L.J. Singh, *Knema andamanica* (Warb.) W.J. De Wilde, *Manilkara littoralis* (Kurz.) Dubbard, *Pinanga andamanensis* Becc., *Pinanga manii* Becc., *Pterocarpus dalbergioides* DC., *Myristica andamanica* Hook.f., *Grewia calophylla* Kurz ex Mast., *Canarium denticulatum* Blume, *Dipterocarpus griffithii* Miq., *Magnolia andamanica* (King) D.C.S. Raju & M.P. Nayar, *Carrisa andamanensis* L.J. Singh & Murugan, *Schizostachyum andamanicum* M. Kumar & Remesh, *Amomum andamanicum* V.P. Thomas *et al.*, *Amomum maximum* Roxb., *Zingiber pseudosquarrosus* L.J. Singh & P. Singh, *Amomum aculeatum* Roxb., *Cyrtandra burtii* N.P. Balakrishnan, *Psychotria andamanica* Kurz, *Tropidia curculigoides* Lindl., *Zingiber sp.*, *Curcuma sp.*, *Calamus andamanicus* Kurz, *Borassus flabellifer* L., *Pinanga manii* Becc., *Grewia calophylla* Kurz ex Mast., *Magnolia andamanica* (King) D.C.S. Raju & M.P. Nayar.

RESEARCH PUBLICATIONS: Books published- 02; Papers published- 25; Book chapters-8 (for details please refer the last chapter).

TRAINING / WORKSHOPS/ SEMINAR/ SYMPOSIUM ORGANISED:

- Organised World Environment Day on 05.06.2020 and planted the seedlings of the Endemic Palm, *Bentinckia nicobarica* (Kurz) Becc. in the Garden.
- Organised International Day of Yoga at BSI, ANRC, Port Blair on 21.06.2020.
- Organised Hindi Fortnight at BSI, ANRC, Port Blair from 01.09.2020 to 15.09.2020.

- Organised virtual drawing competition for school students on the occasion of ‘World Ozone Day-2020’ on 16.09.2020.
- Organised ‘Rashtriya Swachhta Diwas and Fit India Freedom Run campaign’ on 02.10.2020.
- Organised ‘Vigilance Awareness Week - 2020’ and administered the pledge to all the Scientists and staff members of the office on 27.10.2020.
- Organised two days Hindi Workshop on 24.09.2020 to 25.09.2020, 17.12.2020 to 18.12.2020 and 16.03.2021 to 17.03.2021.
- Organised 50th Foundation Day of BSI, ANRC, Port Blair on 30.03.2021.

ATTENDED/ DELIVERED LECTURES:

Dr. Lal Ji Singh, Scientist-E

- Attended meeting regarding Management Plan of Protected Areas at Van Sadan, Department of Environment and Forests, Port Blair on 16.06.2020.
- Attended online meeting pertaining to plan of integrated coastal zone Mangrove Management Project of A & N Islands with the PCCF (Working Plan) on 10.07.2020.
- Attended online meeting pertaining to preparation of data base on Bio-diversity of Andaman & Nicobar Islands with the PCCF (WL) cum CWLW on 28.08.2020.
- Attended the International Webiner on “*The importance of Historical Ecology for interpreting processes of evolution in plants of Ocenic Islands*” organised by the Department of Life Science, Mansarovar Global University, Bhopal on 11.09.2020.
- Attended online meeting pertaining to preparation of data base on People’s Bio-diversity Register in Consultation with Local People under Port Blair Municipal Council (PBMC) of Andaman & Nicobar Islands with the Secretary Municipal Council, Port Blair on 25.09.2020.
- Attended the Webinar on “*Sustaining all lives on Earth: Forest and Wildlife Conservation in Andaman and Nicobar Islands*” organized by the Department of Environment and Forests, Andaman and Nicobar Administration, Port Blair on 26.09.2020.
- Attended online training programme on BSI website content management by NIC team organized by BSI, Headquarter, Kolkata on 05.10.2020 and 06.10.2020.
- Attended online meeting pertaining to the state level expert appraisal committee Andaman and Nicobar Islands (SEAC) at Department of Science and Technology, Andaman and Nicobar Administration, Port Blair on 08.10.2020.
- Attended online conference for MIS explain and flow chart of software organized by BSI, Kolkata on 08.10.2020.
- Attended National Webinar on “*NISARG Bharat: Enhancing Peoples’ Participation in the e-PBR Framework*” organized by National Mission on Biodiversity and Human Well-being Biodiversity Conversations: India’s opportunities and challenges on 09.10.2020.
- Attended National Webinar on “*Role of Botanical Survey of India in Biodiversity Conservation*” organized by BSI, Deccan Regional Centre, Hyderabad on 14.10.2020.
- Attended two days’ workshop through Webinar on “*Coastal and Marine Biodiversity of Islands Ecosystem*” at ZSI, ANRC, Port Blair on 07.01.2021 and 08.01.2021.
- Delivered an invited lecture through Webinar on “*Overview of Floral Diversity of Andaman and Nicobar Islands*” for two days’ workshop on “*Coastal and Marine Biodiversity of Islands Ecosystem*” at ZSI, ANRC, Port Blair on 07.01.2021.
- Hoisted National Flag on the occasion of 72nd Republic Day, 2021 along with officers and staffs, at BSI, ANRC, Port Blair on 26.01.2021.
- Attended 72nd Republic Day Flag Hoisting celebration at Netaji Subhash Chandra Bose Stadium, Port Blair on 26.01.2021.
- Attended Webinar series 27.01.2021 organized by BSI, SRC, Coimbatore and lecture delivered by Fr. Dr. S. Ignacimuthu, S.J. from St. Xavier College, Palayamkottai, on topic entitled ‘*Plant Resources as aid for prevention of COVID-19*’.

- Attended Online Video Conferencing Meeting on 29.01.2021 organized by BSI, Headquarter, Kolkata on topic entitled '*Discussion on IUCN Red List Index for SDG target 15.5*'.
- Attended Webinar series on 02.02.2021 organized by BSI, SRC, Coimbatore and lecture delivered by Prof. N. Parthasarathy from Pondicherry University, on topic, '*Wetlands: Potential Importance and Conservation need under climate change scenario*'.
- Attended virtual observation of the Foundation Day of Botanical Survey of India on 13.02.2021.
- Attended National Webinar Series, Lecture-6 on 17.02.2021 organised by BSI, HAWHRC, Solan and lecture delivered by Dr. Arun K. Pandey, Vice-Chancellor, Mansarovar Global University, Bhopal on topic '*Plant Systematics: Insights from Morphology and Molecules*'.
- Attended Webinar series on 19.02.2021 organized by BSI, SRC, Coimbatore and lecture delivered by Dr. Syd Ramdhani, Senior Lecture and Curator of the Ward Herbarium from University of Kwazulu Natal Durban, South Africa, on topic '*Plant taxonomy and floristics in the Anthropocene Epoch*'.
- Attended Webinar on topic entitled "*Role of Botanical Survey of India in Taxonomic Research in India*" by Dr. M. Sanjappa, Former Director, BSI, on 22.02.2021 organised by BSI, HAWHRC, Solan.
- Attended Green Talk-2, Webinar series on 23.02.2021 organized by BSI, Sikkim Himalayan Regional Centre, Gangtok and lecture delivered by Alex Monro, Royal Botanic Garden, Kew on topic entitled '*Exploration of La Amistad National Park (Costa Rica/ Panama)*'.
- Attended Webinar on topic entitled "*Revising the Generic Limits of Coleus and Plectranthus (Lamiaceae, tribe Ocimeae)*" by Dr. Alan Paton, Royal Botanic Garden, Kew, U.K. on 12.03.2021 organised by Central National Herbarium, BSI, Howrah.
- Attended Inauguration of Molecular Systematics Laboratory, Zoological Survey of India, Port Blair by Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata in the presence of Shri Tarun Coomar, IFS, PCCF, Department of Environment and Forests, Andaman and Nicobar Islands on 12.03.2021.
- Attended online meeting of Town Official Language Implementation Committee (TOLIC) at Secretariat, Andaman and Nicobar Islands on 18.03.2021.

Dr. Jagadeesh Ram, T.A.M., Scientist-E

- Participated '*Rashtriya Swachhta Diwas and Fit India Freedom Run campaign*' on 02.10.2020.
- Attended National Webinar on "*NISARG Bharat: Enhancing Peoples' Participation in the e-PBR Framework*" organized by National Mission on Biodiversity and Human Well-being Biodiversity Conversations: India's opportunities and challenges on 09.10.2020.
- Attended Webinar series 27.01.2021 organized by BSI, SRC, Coimbatore and lecture delivered by Fr. Dr. S. Ignacimuthu, S.J. from St. Xavier College, Palayamkottai, on topic entitled '*Plant Resources as aid for prevention of COVID-19*'.
- Attended Webinar series on 02.02.2021 organized by BSI, SRC, Coimbatore and lecture delivered by Prof. N. Parthasarathy from Pondicherry University, on topic, '*Wetlands: Potential Importance and Conservation need under climate change scenario*'.
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- Attended Webinar on topic entitled “*Role of Botanical Survey of India in Taxonomic Research in India*” by Dr. M. Sanjappa, Former Director, BSI, on 22.02.2021 organised by BSI, HAWHRC, Solan.
- Attended Webinar on topic entitled “*Revising the Generic Limits of Coleus and Plectranthus (Lamiaceae, tribe Ocimeae)*” by Dr. Alan Paton, Royal Botanic Garden, Kew, U.K. on 12.03.2021 organised by Central National Herbarium, BSI, Howrah.
- Attended two days Hindi Workshop at BSI, Port Blair on 16.03.2021 and 17.03.2021.
- Attended 50th Foundation Day celebration of BSI, ANRC, Port Blair at main office on 30.03.2021.

Dr. Chandan Singh Purohit, Scientist- C

- Attended Webinar on “Ensuring water security” organized by Kerala State Council for Technology and Environment in association with ICAR-CIFT & NIT held on 08.05.2020.
- Attended Webinar on “Evolution of Science seen from Histrocial perspective” organized by Department of Botany, Deshbandhu College, University of Delhi held on 12.05.2020 & 13.05.2020.
- Attended Webinar on “Natural Fragrance- Chemistry, Recent Development and Research Avenue” organized by NATUCARE INDIA held on 16.05.2020.
- Attended Webinar on “Fundamentals of microscopy and histochemical analysis for standardization of crude drugs” organized by NATUCARE INDIA held on 17.05.2020.
- Attended Webinar on “Molecular Taxonomy and DNA Barcoding: Concepts Methods and Application” organized by R.D & S.H. National College and S.W.A. Science College, Mumbai held on 20.05.2020.
- Attended Webinar on “*Grasses – Introduction, Economical and Ecological Importance*” in a Series of Webinar on ‘Spectrum of Conservation’ organized by OikoEssence Edutours LLP on 24.05.2020, Mumbai, India.
- Delivered an invited lecture in Webinar on “*Ex-situ conservation of Threatened Angiosperm plants*” organized by NATUCARE INDIA held on 24.05.2020, Mumbai, India.
- Attended Webinar on “*Costa Rica: A Biodiversity Hotspot*” in a Series of Webinar on ‘Spectrum of Conservation’ organized by R.D. & S.H. National College and S.W.A. Science College on 25.05.2020, Mumbai, India.
- Attended Webinar on “*Insect Plant Interaction*” in a Series of Webinar on ‘Spectrum of Conservation’ organized by OikoEssence Edutours LLP on 28.05.2020, Mumbai, India.
- Delivered an invited lecture on “*Phytodiversity of Alpine Sanctuary – Shingba Rhododendron Wildlife Sanctuary*” in a Series of Webinar on ‘Spectrum of Conservation’ organized by OikoEssence Edutours LLP on 30.05.2020, Mumbai, India.
- Attended International Webinar on “Global Environmental Challenges, Biodiversity, Principles of Guru Jambheshwar Ji and Remedies” organized by JNVU, Jodhpur and Jambhani Sahitya Academy, Bikaner on 03.06.2020 to 05.06.2020, Bikaner, Rajasthan.
- Attended “Conservation on Medicinal Plants, Enhancing Nutrition and Developing Immunity against Disease” organized by TERI, IHC, New Delhi on 04.06.2020.
- Attended Online National Conference on Environment – An intelligent Recycling organized by Govt. College for Girls Sector 14, Gurugram on 05.06.2020 to 06.06.2020.
- Presented a research paper entitled “*Conservation of threatened and endemic species of Thar Desert, Rajasthan and their Present Status*” in Online National Conference on Environment – An intelligent Recycling organized by Govt. College for Girls Sector 14, Gurugram on 05.06.2020 to 06.06.2020.
- Awarded certificate on completion of online course on “Remote Sensing & GIS Technology and Applications for University Teachers & Government Officials” conducted by Indian Institute of Remote Sensing (IIRS), ISRO, Dehradun, during 13th June 2020 to 1st July 2020.
- Attended online meeting on 21.12.2020 organized by BSI, headquarter, Kolkata on entitled ‘Meeting for discussion of Annual Action Programme 2021-2022’.

- Attended Webinar series in 2021 on 08.01.2021 organized by BSI, SJRC, Gangtok and lecture delivered by Prof. Bogdan Jaroszeewicz from Poland, on topic entitled ‘Science in Biolowieza Forest – Biolowieza forest in Science’.
- Delivered invited lecture entitled “*Conservation of Threatened Desert Plants*” on 16.01.2021, organized by Govt. Dungar College Bikaner under Gyan Ganga Programme.
- Attended Webinar series 27.01.2021 organized by BSI, SRC, Coimbatore and lecture delivered by Fr. Dr. S. Ignacimuthu, S.J. from St. Xavier College, Palayamkottai, on topic entitled ‘*Plant Resources as aid for prevention of COVID-19*’.
- Attended Online Video Conferencing Meeting on 29.01.2021 organized by BSI, Headquarter, Kolkata on topic entitled ‘*Discussion on IUCN Red List Index for SDG target 15.5*’.
- Attended Webinar series on 02.02.2021 organized by BSI, SRC, Coimbatore and lecture delivered by Prof. N. Parthasarathy from Pondicherry University, on topic, ‘*Wetlands: Potential Importance and Conservation need under climate change scenario*’.
- Attended Webinar series on 19.02.2021 organized by BSI, SRC, Coimbatore and lecture delivered by Dr. Syd Ramdhani, Senior Lecture and Curator of the Ward Herbarium from University of Kwazulu Natal Durban, South Africa, on topic entitled ‘*Plant taxonomy and floristics in the Anthropocene Epoch*’.
- Attended Webiner on topic entitled “*Role of Botanical Survey of India in Taxonomic Research in India*” by Dr. M. Sanjappa, Former Director, BSI, on 22.02.2021 organised by BSI, HAWHRC, Solan.

AWARDS AND HONOURS:

Dr. Chandan Singh Purohit, Scientist-C, BSI, ANRC, Port Blair, received Second Position in e-oral presentation competition in National Conference on Environment – An intelligent Recycling organized by Govt. College for Girls Sector 14, Gurugram on 05.06.2020 to 06.06.2020.

Dr. Chandan Singh Purohit, Scientist-C, BSI, ANRC, Port Blair, received Third Position in National level e-poster competition jointly organized by Durgapur Govt. College and Durgapur Wildlife Information & Nature Guide Society (WINGS) during 05.06.2020 to 10.06.2020.

SERVICES RENDERED:

- Two articles reviewed for the journal *Feddes Repertorium journal of botanical taxonomy and geobotany* and *Phytotaxa* by Dr. Lal Ji Singh, Scientist-E & HOO, BSI, ANRC, Port Blair.
- Two Ph.D. thesis evaluated and reports submitted by Dr. Jagadeesh Ram T.A.M., Scientist-E, BSI, ANRC, Port Blair.
- A manuscript reviewed for *Journal of Threatened Taxa* by Dr. Vivek C.P., Botanical Assistant, BSI, ANRC, Port Blair.
- Visitors attended: VIP’s - 08 nos. and Students - 30 nos.

PLANT SAMPLES DISTRIBUTION

1. On demand live plant saplings of 5 species of medicinal plants (*Cerbera odollam* Gaertn.-01 no.; *Costus pictus* D.Don-01 no.; *Knema andamanica* (Warb.) W.J. de Wilde-01 no.; *Piper longum* L.-01 no.; *Semecarpus kurzii* Engl.-01 no.) to Shri Mukesh Kumar Yadav, Police Department, Andaman and Nicobar Administration, Port Blair on 16.10.2020.
2. On demand live plant saplings of *Alpinia calcarata* (Haw.) Roscoe-10 nos.; *Alpinia luteocarpa* Elmer- 20 nos.; *Alpinia* sp.-10 nos.; *Amomum aculeatum* Roxb.- 52 nos.; *Amomum andamanicum* V.P. Thomas & al.-52 nos.; *Amomum maximum* Roxb.- 52 nos.; *Amomum* sp.- 02 nos.; *Amomum* sp.- 02 nos.; *Curcuma zedoaria* (Christm.) Roscoe- 10 nos.; *Etilingera fenzlii* (Kurz) Škornick. & M. Sabu-08 nos.; Fruits with viable seeds (*Musa bulbisiana* Colla)-08 nos.; *Hedychium coronarium* J. König-04 nos.; *Musa acuminata* Colla-01 no.; *Musa bulbisiana* Colla-04 nos.; *Musa indandamanensis* L.J. Singh- 02 nos.; *Zingiber* sp.- 10 nos.; *Zingiber squarrosum* Roxb.- 10 nos.; *Zingiber zerumbet* (L.) Roscoe ex Sm.- 10 nos. were sent to AJC Bose Indian Botanic Garden, Howrah on 18.02.2021.

3. On demand 06 nos. of fruits of *Garcinia dhanikhariensis* S.K. Srivast. to Prof. A. Gangaprasad, Department of Botany, University of Kerala on 18.02.2021.
4. On demand live plant saplings of *Cissus* spp., *Cycas zeylanica* (J. Schust.) A. Lindstr. & K.D. Hill and *Eryngium foetidum* L. were supplied to Dr. P.V. Prasanna, Scientist G & Head of Office, BSI, DRC, Hyderabad on 19.03.2021.
5. On demand live plant saplings of *Codiaeum variegatum* (L.) A. Juss., *Dracaena* spp., *Elaeocarpus* spp., *Epipremnum pinnatum* (L.) Engl., *Heliconia rostrata* Ruiz & Pav., *Ocimum gratissimum* L. and *Piper betle* L. to Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata on 18.03.2021.

3. ARID ZONE REGIONAL CENTRE, JODHPUR

Project 1:

Name of the project: Flora of India, Volume 16: Upgradation of family Ebenaceae.

Executing Scientist: Dr. Sanjay Mishra, Sci.-C

Date of initiation: 31st July, 2020 **Date of completion:** 25th January, 2021

Background of the Project: With a view to publish the Flora of India, Volume 16 (Myrsinaceae, Sapotaceae, Ebenaceae, Styracaceae, Symplocaceae, Oleaceae, Salvadoraceae, Apocynaceae) this project was undertaken.

Area and locality of the Allotted Project: India

Summary of the work done during 2020-2021: Updated Nomenclature and taxonomic description of the species of family Ebenaceae consisting of 66 taxa (species and varieties). Data regarding distribution, Chromosome numbers were updated. The report was compiled and submitted to the team leader.

Project 2:

Name of the Project: Flora of India, Volume 18: Upgradation of families Polemoniaceae, Hydrophyllaceae, Boraginaceae, Convolvulaceae, Cuscutaceae and Solanaceae.

Executing Scientist: Dr. Sriman Lal Meena, Scientist-E, Dr. Sanjay Mishra, Scientist-C and Dr. P. Harikrishna, Bot. Asstt.

Date of initiation: April, 2019 **Date of completion:** October, 2020

Background of the Project: With a view to publish the Flora of India, volume 18 (family Polemoniaceae, Hydrophyllaceae, Boraginaceae, Convolvulaceae, Cuscutaceae & Solanaceae) this project was undertaken.

Area and locality of the Allotted Project: India

Summary of the work done during 2020-2021: Updated Nomenclature and taxonomic description of the species of family Convolvulaceae (24 genera and 154 species). Generic & Species keys were prepared. Data regarding distribution, Chromosome numbers of each species was incorporated. Final manuscript of Flora of India, volume 18 is under progress.

Project 3:

Ex-situ conservation of RET and economically important species of the Arid region in the experimental Garden of AZRC and documentation of phenological data on flowering & fruiting

Executing Scientists: Shri Vinod Maina, Sci.-E; Dr. Sanjay Mishra, Sci.-C; Dr. M. K. Singhadiya, Botanist; Dr. Sri Ravi Prasad, Bot. Asstt. & P. Harikrishna, Bot. Asstt.

Date of Initiation: Ongoing

Objective: Collection of RET and Economically important species germplasm and introduction in the experimental garden for *ex-situ* Conservation; Documentation of phenological data of plants growing in Desert Botanic Garden.

Background of the Project: The experimental Botanic Garden (Desert Botanical Garden) of this centre has been established during 1994 with an area of c. 8 acres. The main objective of the garden is maintenance of arid germplasm, collection, growing and multiplication of rare / endemic/ endangered / threatened/ medicinal/ economically important and other plant species of North-western arid regions of India, with special focus on Rajasthan and Gujarat state of India. About 300 species of vascular plants and 04 gymnosperms of various categories are conserved in the garden.

Area and locality of the Allotted Project: Rajasthan & Gujarat.

Summary of the work done during 2020-2021: During the year 2020-21, a total number of 16 rare and threatened, 33 medicinal & aromatic and 22 economically important, 11 ornamental, 15 grasses

and some succulent plant species were collected and introduced in the Desert Botanical Garden. Some plant species were multiplied from cuttings, seeds, rhizomes, bulbs, tubers etc (details are given below). Besides, about 200 photographs were also taken. 99 live plant saplings of different species (including EET) were distributed to different people and organizations free of cost for plantation and further multiplication. A new Grass section, Medicinal plant section and Succulent plant section was developed. Seeds of different species were also collected.

Achievements / outcomes in 2020-21:

Cleaning of medicinal & threatened species plot and rearrangements of the pots in NET house, lawn and hedge cutting and routine maintenance of garden has been undertaken.

Initiation for ex-situ conservation of Rare, Endangered and Economic important plants.

A. Plant collection and introduction: following saplings were collected and conserved in Desert Botanic Garden of Botanical Survey of India, Arid Zone Regional Centre, Jodhpur:

1. **Rare and Threatened plants:** *Barleria prionitis* L. var. *dicantha* Blatt & Hallb, *Moringa concanensis* Nimmo, *Dipcadi erythraeum* Webb & Berthel., *Ceropegia bulbosa* Roxb. var. *bulbosa*, *Ceropegia bulbosa* var. *lushii* (Graham) Hook.f, *Commiphora stocksiana* (Engl.) Engl., *Commiphora wightii* (Arn.) Bhandari, *Tecomella undulate* (Sm.) Seem., *Withania coagulans* (Stocks) Dunal, *Cullen plicatum* (Delile) C.H. Stirt., *Butea monosperma* (Lam.) Taub. var. *lutea* (Witt.) Maheshwari, *Pterocarpus marsupium* subsp. *acuminatus* (Prain) Thoth., *Dalbergia latifolia* Roxb., *Santalum album* L., *Eriolaena hookeriana* Wight & Arn., *Capparis divaricata* Lam
2. **Medicinal and Aromatic plants:** *Adenanthera pavonina* L., *Solanum trilobatum* L., *Mallotus philippensis* (Lam.) Müll. Arg., *Spilanthes acmella* (L.) L., *Mimosa pudica* L., *Tylophora indica* (Burm. f.) Merr., *Murraya koenigii* (L.) Spreng., *Azadirachta indica* A. Juss., *Solanum torvum* Sw., *Datura metel* L., *Chlorophytum tuberosum* Santapau & R.R. Fern., *Cissus quadrangularis* L., *Ocimum tenuiflorum* L., *Ocimum basilicum* L., *Tridax procumbens* (L.) L., *Allium ampeloprasum* L., *Withania somnifera* (L.) Dunal, *Catharanthus roseus* (L.) G. Don, *Trianthema portulacastrum* L., *Boerhavia diffusa* L., *Boerhavia erecta* L., *Cheilocostus speciosus* (J. Koenig) C.D. Specht, *Barleria acanthoides* Vahl, *Phyllanthus amarus* Schumacher & Thonn., *Limonia acidissima* Groff, *Phyllanthus nodiflora* (L.) Greene, *Bacopa monnieri* (L.) Wettst., *Plumbago zeylanica* L., *Achyranthes aspera* L., *Tinospora cordifolia* (Willd.) Hook.f. & Thomson, *Nyctanthes arbor-tristis* L., *Momordica balsamina* L., *Hibiscus micranthus* L.f.
3. **Economically important plants:** *Bauhinia racemosa* Lam., *Swietenia macrophylla* King, *Mangifera indica* L., *Senegalia catechu* (L.f.) P.J.H. Hurter & Mabb., *Syzygium cumini* (L.) Skeels, *Phoenix sylvestris* (L.) Roxb., *Cordia gharaf* Ehrenb. ex Asch, *Tamarindus indica* L., *Gmelina arborea* Roxb., *Sapindus laurifolius*, *Acacia senegal* (L.) Willd., *Ougeinia oojeinensis* (Roxb.) Hochr., *Sterculia urens* Roxb., *Ficus carica* L., *Dolichandrone falcata* (Wall. ex DC.) Seem., *Schleichera oleosa* (Lour.) Oken, *Stereospermum chelonoides* (L.f.) DC., *Mangifera indica* L. cultivar. *amarapalli*, *Neolama rckiacadamba* (Roxb.) Bosser (2 no.); *Samanea saman* (Jacq.) Merr., *Pithecellobium dulce* (Roxb.) Benth., *Citrus limon* (L.) Osbeck (20 nos).
4. **Ornamental plants:** *Guazuma ulmifolia* Lam., *Cassia fistula* L., *Erythrina variegata* L., and *Bauhinia variegata* L., *Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult., *Cascabela thevetia* (L.) Lippold, *Gardenia jasminoides* J. Ellis, *Hibiscus rosa-sinensis* L., *Ixora chinensis* Lam., *Ixora singaporensis*, *Mimusops elengi* Bojer
5. **Grasses:** *Saccharum bengalense* Retz., *Desmostachya bipinnata* (L.) Stapf, *Cenchrus biflorus* Roxb., *Cenchrus pennisetiformis* Steud., *Chloris barbata* (L.) Nash, *Cynodon dactylon* (L.) Pers., *Cenchrus ciliaris* L., *Lasiurus scindicus* Henrard, *Vetiveria zizanioides* (L.) Nash, *Dichanthium foveolatum* (Delile) Roberty, *Brachiaria brizantha* (A. Rich.) Stapf, *Cymbopogon jwarancusa* (Jones) Schult., *Cenchrus setiger* Vahl, *Digitaria ciliaris* (Retz.) Koeler, *Cynodon radiatus* Roth. A new grasses section is being developed in the Botanical Garden.

6. Seasonal plants for ornamental purpose: Saplings of following seasonal plant species have been prepared in the nursery of Desert Botanic Garden and planted for beautification of office premises, viz.: *Antirrhinum*, *Aster*, *Calendula*, *California poppy*, *Candytuft*, *Chrysanthemum*, *Dimorpotheaca*, *Garden poppy*, *Gazania*, *Hollyhocks*, *Larkspur*, *Marigold*, *Phlox*, *Sweet william*, *Helianthus sp.* etc.

Seeds of the following species were collected: *Albizia lebbbeck* (L.) Benth., *Commiphora wightii*(Arn.) Bhandari, *Spilanthes acmella* (L.) L., *Acacia senegal* (L.) Willd., *Anamirta cocculus* (L.) Wight & Arn., *Abrus precatorius* L., *Achyranthes aspera* L., *Moringa concanensis* Nimmo, *Ceropegia bulbosa* Roxb. var. *bulbosa*, *Ceropegia bulbosa* var. *lushii* (Graham) Hook.f, *Commiphora stocksiana* (Engl.) Engl., *Tecomella undulate* (Sm.) Seem., *Commiphora wightii* (Arn.) Bhandari, *Withania coagulans* (Stocks) Dunal, *Cullen plicatum* (Delile) C.H.Stirt., *Solanum trilobatum* L., *Spilanthes acmella* (L.) L., *Mimosa pudica* L., *Tylophora indica* (Burm. f.) Merr., *Murraya koenigii* (L.) Spreng., *Azadirachta indica* A.Juss., *Solanum torvum* Sw., *Mangifera indica* L., *Senegalia catechu* (L.f.) P.J.H.Hurter & Mabb., *Syzygium cumini* (L.) Skeels, *Phoenix dactylifera* L., *Cordia gharaf* Ehrenb. ex Asch, *Tamarindus indica* L., *Gmelina arborea* Roxb., *Sapindus laurifolious*, *Acacia senegal* (L.) Willd., *Guazuma ulmifolia* Lam., *Cassia fistula* L., *Erythrina suberosa* Roxb., and *Bauhinia variegata* L., *Clitoria ternatea* L., *Anogeissus pendula* Edgew., *Nyctanthes arbor-tristis* L.

B. Multiplication of Rare, Threatened, Medicinal and other plants: The following plant species have been multiplied in the nursery of Desert Botanic Garden of Botanical Survey of India, Arid Zone Regional Centre, Jodhpur:

Multiplication by seeds: *Desmodium gangeticum* (L.) DC. (50 nos.), *Asparagus racemosus* Willd. (45 nos), *Plumbago zeylanica* L. (20 nos.), *Mimosa pudica* L. (10 nos.), *Dolichandrone falcate* (Wall. ex DC.) Seem. (40 nos.), *Tecomella undulate* (Sm.) Seem. (50 nos.), *Syzygium cumini* (L.) Skeels (100 nos.), and *Azadirachta indica* A. Juss (100 nos.), *Moringa concanensis* Nimmo (250 nos.), *Sapindus laurifolious* (300nos.), *Withania coagulans* (Stocks) Dunal (100nos), *Acacia senegal* (L.) Willd (50 nos), *Pterygota alata* (Roxb.) R.Br. (50nos), *Peltophorum* sp. (45 nos), *Moringa oleifera* Lam. (50 nos), *Bombax ceiba* L.(25 nos), *Aegle marmelos* (L.) Corrêa (30 nos) *Mimusops elengi* L.(20 nos), *Spilanthes acmella*(L.) L. (50 nos.), *Syzygium heyneanum* (Duthie) Gamble (60 nos.) , *Commiphora wightii* (Arn.) Bhandari (20 nos.), *Citrus limon* (L.) Osbeck (20 nos), *Momordica balsamina* L. (2 nos), *Hibiscus micranthus* L.f. (16 nos), *Capparis divaricata* Lam (20 nos)

Multiplication by cuttings: *Commiphora stocksiana* (Engl.) Engl., *Barleria prionitis*L. var. *dicantha* Blatt & Hallb (5 nos.), *Vitex trifolia* L. (50 nos.), *Justicia adhatoda* L. (100 nos.), *Tinospora cordifolia* (Willd.) Miers (250 nos.), *Bambusa vulgaris* Schrad. (Tiger bamboo) (2 nos.) and *Ficus carica* L. (20 nos.), *Rose* sp.(100 nos), *Psidium guajava* L. (50 nos), *Murraya koenigii* (L.) Spreng. (20 nos), *Portulaca* L. (25 nos), *Commiphora agallocha* Engl. (10 nos), *Vitex negundo* L. (30 nos), *Cissus quadrangularis* L.(10 nos), *Bryophyllum pinnatum* (Lam.) Oken (5 nos), *Bougainvillea glabra* Choisy (30 nos), *Sarcostemma* sp. (20 nos), Golden hedge (50 nos), *Cascabela thevetia* (L.) Lippold (50 nos), *Tabernaemontana divaricata* (L.) R.Br. ex Roem. &Schult. (25 nos), *Nerium indicum* Mill. (25 nos), *Morus alba* L.(14 nos),

Multiplication by Rhizome/Bulb/tuber: *Chlorophytum tuberosum* (Roxb.) Baker(50 nos.) ,*Aloe barbadensis* Mill.(10 nos), *Dioscorea alata* L.(3 nos), *Saccharum officinarum* (1 no).

C. Phenological Data: Phenological data of existing plant species of Desert Botanic Garden was recorded thorough out the year and flowering in following plant species were observed for the first time after introduction:

- i. *Millettiapeguensis*Ali.
- ii. *Limonia acidissima*L.
- iii. *Mimusops elengi*L.
- iv. *Terminalia arjuna*(Roxb. ex DC.) Wight & Arn.

- v. *Cycas rumphii* Miq. (introduced from Andaman)
- vi. *Sterculia urens* Roxb.
- vii. *Anogeissus sericea* Brandis var. *nummularia* King ex Duthie
- viii. *Moringa concanensis* Nimmo ex Dalzell & A. Gibson
- ix. *Desmodium oojainense* (Roxb.) H. Ohashi



Millettia peguensis Ali



Desmodium oojainense (Roxb.) H. Ohashi



Terminalia arjuna (Roxb. ex DC.) Wight & Arn.

Garden Services to General Public: 99 live plant saplings of different species (including EET) were distributed to different people and organization free of cost for plantation and further multiplication and provided services to outsiders/visitors.



Plantation programme organised at BSI, AZRC, Jodhpur



A group of Trainee Foresters of Rajasthan state Forest Dept. visited BSI, Jodhpur on 19.02.2021



Different types of *Ex-situ* conservation and multiplication activities in Desert Botanical Garden, BSI, Jodhpur.

Mortality-Survival Reports of plants:

| S.NO. | Plants name | Category | Introduced in poly begs | Germination | Mortality | Mortality in percentage (%) |
|-------|---|---------------------------|-------------------------|-------------|-----------|-----------------------------|
| 1. | <i>Moringa concanensi s</i> Nimmo | Threatened | 200 | 179 | 21 | 10.5 |
| 2. | <i>Salvadora oleoides</i> Decne. | Medicinal | 182 | 167 | 15 | 8.24 |
| 3. | <i>Bauhinia racemosa</i> Lam. | Medicinal | 184 | 52 | 132 | 71.7 |
| 4. | <i>Prosopis cineraria</i> (L.) Druce | Medicinal | 309 | 115 | 194 | 62.78% |
| 5. | <i>Syzygium cumini</i> (L.) Skeels | Economically important | 150 | 137 | 13 | 8.66% |
| 6. | <i>Sesbania grandiflora</i> (L.) Pers. | Medicinal | 90 | 58 | 32 | 35.55% |
| 7. | <i>Albizia lebbeck</i> (L.) Benth. | Medicinal | 185 | 84 | 101 | 54.59% |
| 8. | <i>Erythrina variegata</i> L. | Medicinal | 10 | 10 | 00 | 00.00 |
| 9. | <i>Tecomella undulata</i> (Sm.) Seem. | Threatened | 1000 | 34 | 966 | 96.6% |
| 10. | <i>Bauhinia variegata</i> L. | Ornamental | 40 | 1 | 39 | 97.5% |
| 11. | <i>Phoenix dactylifera</i> L. | Economically important | 130 | 116 | 36 | 27.69% |
| 12. | <i>Tabernaemontana</i> <i>divaricata</i> (L.) R.Br. ex Roem. &Schult. | Ornamental | 10 | 05 | 5 | 50% |
| 13. | <i>Cascabela thevetia</i> (L.) Lippold | Ornamental | 50 | 10 | 40 | 80 |
| 14. | <i>Golden hedge</i> | Ornamental | 50 | 50 | 00 | 00.00 |
| 15. | <i>Aloe barbadensis</i> Mill. | Medicinal | 4 | 4 | 00 | 00.00 |
| 16. | Cactii | Medicinal | 5 | 4 | 01 | 20% |
| 17. | <i>Sarcostemma</i> sp. | Medicinal | 12 | 12 | 00 | 00.00 |
| 18. | <i>Bougainvillea glabra</i> Choisy | Medicinal | 50 | 40 | 10 | 20% |
| 19. | <i>Syzygium heyneanum</i> (Duthie) Gamble | Economically important | 70 | 70 | 00 | 00.00 |

| | | | | | | |
|-----|--|------------------------|-----|-----|-----|--------|
| 20. | <i>Cassia rumphi</i> | Medicinal | 170 | 76 | 94 | 55.29% |
| 21. | <i>Dolichandrone falcata</i> Seem. | Medicinal | 10 | 7 | 03 | 30% |
| 22. | <i>Bryophyllum pinnatum</i> (Lam.) Oken | Medicinal | 10 | 2 | 08 | 80% |
| 23. | <i>Cordia gharaf</i> Ehrenb. ex Asch. | Medicinal | 56 | 20 | 36 | 64.28% |
| 24. | <i>Guazuma ulmifolia</i> Lam. | Medicinal | 155 | 22 | 133 | 85.80 |
| 25. | <i>Pongamia pinnata</i> (L.) Pierre | Medicinal | 120 | 91 | 29 | 24.16% |
| 26. | <i>Commiphora wightii</i> (Arn.) Bhandari | Threatened | 300 | 52 | 248 | 82.66% |
| 27. | <i>Tamarindus indica</i> L. | Medicinal | 172 | 79 | 93 | 54.06% |
| 28. | <i>Gmelina arborea</i> Roxb. | Medicinal | 129 | 64 | 65 | 50.38% |
| 29. | <i>Cassia fistula</i> L. | Medicinal | 400 | 206 | 194 | 48.5% |
| 30. | <i>Sapindus laurifolios</i> Gaertn. | Medicinal | 117 | 100 | 17 | 14.52% |
| 31. | <i>Acacia senegal</i> (L.) Willd. | Economically important | 200 | 147 | 53 | 26.5% |
| 32. | <i>Withania coagulans</i> (Stocks) Dunal | Threatened | 350 | 146 | 204 | 58.28% |
| 33. | <i>Pterygota alata</i> (Roxb.) R.Br. | Economically important | 50 | 03 | 47 | 94% |
| 34. | <i>Ceiba pentandra</i> (L.) Gaertn. | Ornamental | 270 | 65 | 205 | 75.92 |
| 35. | <i>Asparagus racemosus</i> Willd. | Medicinal | 200 | 200 | 00 | 00.00 |
| 36. | <i>Peltophorum</i> sp. | Ornamental | 80 | 16 | 64 | 80% |
| 37. | <i>Balanites aegyptiaca</i> (L.) Delile | Medicinal | 20 | 14 | 06 | 30% |
| 38. | <i>Tinospora cordifolia</i> (Willd.) Miers | Medicinal | 220 | 220 | 00 | 00.00 |
| 39. | <i>Moringa oleifera</i> Lam. | Medicinal | 300 | 297 | 03 | 1% |
| 40. | <i>Ficus religiosa</i> L. | Medicinal | 20 | 17 | 03 | 15% |

| | | | | | | |
|-----|---|------------------------|-----|-----|-----|--------------------|
| 41. | <i>Cissus quadrangularis</i> L. | Medicinal | 50 | 50 | 00 | 00.00 |
| 42. | <i>Bombax ceiba</i> L. | Medicinal | 25 | 1 | 24 | 96% |
| 43. | <i>Vitex negundo</i> L. | Medicinal | 20 | 4 | 16 | 80% |
| 44. | <i>Ceropegia</i> pots | Threatened | 12 | 12 | 00 | 00.00 |
| 45. | <i>Chlorophytum tubrosum</i> Santapau & R.R.Fern. | Medicinal | 20 | 20 | 00 | 00.00 |
| 46. | <i>Ficus</i> sp. | Ornamental | 2 | 2 | 00 | 00.00 |
| 47. | <i>Commiphora agallocha</i> Engl. | Threatened | 10 | 01 | 09 | 90% |
| 48. | <i>Cocculus</i> sp. | Ornamental | 20 | 11 | 09 | 45% |
| 49. | <i>Solanum trilobatum</i> L. | Medicinal | 20 | 11 | 09 | 45% |
| 50. | <i>Solanum torvum</i> Sw. | Medicinal | 20 | 7 | 13 | 65% |
| 51. | <i>Azadirachta indica</i> A. Juss. | Medicinal | 172 | 172 | 00 | 00.00 |
| 52. | <i>Aegle marmelos</i> (L.) Corrêa | Medicinal | 198 | 141 | 57 | 28.7% ^s |
| 53. | <i>Manilkara hexandra</i> (Roxb.) Dubard | Economically important | 112 | 4 | 108 | 96.4% |
| 54. | <i>Portulaca</i> L. | Ornamental | 20 | 11 | 09 | 45% |
| 55. | <i>Dichrostachys</i> sp. | Ornamental | 200 | 14 | 186 | 93% |
| 56. | <i>Nyctanthes</i> L. | Ornamental | 78 | 02 | 76 | 97.43% |
| 57. | <i>Adenanthera pavonine</i> L. | Ornamental | 100 | 00 | 00 | 00.00 |
| 58. | <i>Terminalia chebula</i> Retz. | Medicinal | 100 | 00 | 00 | 00.00 |
| 59. | <i>Mimosa hamata</i> Willd. | Medicinal | 10 | 00 | 00 | 00.00 |
| 60. | <i>Cullen plicatum</i> (Delile) C.H.Stirt. | Threatened | 200 | 07 | 193 | 96.5% |
| 61. | <i>Murraya koenigii</i> (L.) Spreng. | Medicinal | 49 | 16 | 33 | 67.34% |
| 62. | <i>Psidium guajava</i> L. | Economically important | 42 | 00 | 00 | 00.00 |
| 63. | <i>Mangifera indica</i> L. | Economically important | 04 | 04 | 00 | 00.00 |

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|-----|--|------------------------|----|----|----|--------|
| 64. | <i>Mimusops elengi</i> L. | Economically important | 40 | 00 | 00 | 00 |
| 65. | <i>Tylophora indica</i> (Burm. f.) Merr. | Medicinal | 20 | 12 | 08 | 40% |
| 66. | <i>Mimosa pudica</i> L. | Medicinal | 03 | 03 | 00 | 00 |
| 67. | <i>Spilanthes acmella</i> (L.) L. | Medicinal | 12 | 12 | 00 | 00 |
| 68. | <i>Uraria picta</i> (Jacq.) DC. | Economically important | 10 | 00 | 00 | 00 |
| 69. | <i>Atriplex sp.</i> | Economically important | 10 | 00 | 00 | 00 |
| 70. | <i>Santalum album</i> L. | Threatened | 20 | 11 | 09 | 45% |
| 71. | <i>Rose cutting</i> | Ornamental | 20 | 20 | 00 | 00 |
| 72. | <i>Carpentaria acuminata</i> (H.Wendl. &Drude) Becc. | Medicinal | 30 | 00 | 30 | 100 |
| 73. | <i>Caryota mitis</i> Lour. | Ornamental | 42 | 00 | 42 | 100% |
| 74. | <i>Adonidia merrillii</i> (Becc.) Becc. | Medicinal | 66 | 00 | 66 | 100% |
| 75. | <i>Mallotus philippensis</i> (Lam.) Müll.Arg. | Medicinal | 37 | 00 | 37 | 100% |
| 76. | <i>Swietenia mahogani</i> L. | Medicinal | 40 | 00 | 40 | 100% |
| 77. | <i>Mesua ferrea</i> L. | Economically important | 10 | 00 | 10 | 100% |
| 78. | <i>Tabebuia chrysantha</i> (Jacq.) G.Nicholson | Economically important | 27 | 00 | 27 | 100% |
| 79. | <i>Citrus limon</i> (L.) Osbeck | Economically important | 20 | 14 | 06 | 30% |
| 80. | <i>Nyctanthes arbor-tristis</i> L | Medicinal | 78 | 02 | 76 | 97.43% |
| 81. | <i>Momordica balsamina</i> L., | Medicinal | 2 | 2 | 00 | 00.00 |
| 82. | <i>Hibiscus micranthus</i> L.f. | Medicinal | 16 | 13 | 03 | 18.75% |
| 83. | <i>Capparis divaricata</i> Lam. | Threatened | 20 | 1 | 19 | 95% |

New Discoveries:**New to Science:**

- i. *Luisia diglipurensis* Sanjay Mishra & Jalal, *sp. nov.* This new species has been discovered and described based on the collection made from Diglipur, Shyam Nagar, North Andaman of Andaman & Nicobar Islands at 7 m altitude.
- ii. *Luisia jarawana* Sanjay Mishra & Jalal, *sp. nov.* This new species has been discovered and described based on the collection made on the way to SagwanNallah, Middle Andaman of Andaman & Nicobar Islands at 16 m altitude.

Rediscoveries:

- i. *Luisia unguiculata* (*Orchidaceae*) from Andaman of Andaman & Nicobar Islands.

Recollection:**New Distributional Records:**

- i. *Veronica polita* Fr. (PLANTAGINACEAE). This species has been reported for the first time in Western India based on collections made Sariska Tiger Reserve, Alwar district, Rajasthan at 370 m altitude.

Publications:

Book published-01; Papers published: 10; Book chapters-02; Hindi Articles-01 Detailed in the last chapter.

Lecture delivered/ Seminars/ Symposiums/ Conferences/ Workshops/Webinars /Trainings/Meetings attended/ by Scientists of BSI:**➤ Lectures delivered:**

- i. Dr. Sanjay Mishra, Scientist-C, delivered a lecture on “**Role of Botanical Survey of India in Conservation**” to the visiting trainee Forest Guards of Arid Forest Research Centre, Jodhpur on 19.02.2021.
- ii. Shri Ravi Prasad, Bot. Asstt., delivered a lecture on “**Herbarium Techniques**” in a UGC sponsored programme “Gyan Ganga-State level training-cum-workshop under subject specific short-term program-Initiative for Teaching-Learning Excellence in Botany and New Dimensions of Advance Studies in Botany, jointly organised by ‘Directorate of College Education Rajasthan, Jaipur’ and ‘Government College Bundi, Rajasthan’ on 16.02.2021.

➤ Training Programmes attended:

- i. Dr. Sanjay Mishra, Scientist-C, Sri Ravi Prasad, Bot. Asstt. & Dr. P. Hari Krishna, Bot. Asstt. attended online training programme of BSI web content management- organised by BSI, HQ on 05-10-2020 and 06-10-2020.
- ii. Dr. Sanjay Mishra, Scientist-C, Sri Ravi Prasad, Bot. Asstt. & Dr. P. Hari Krishna, Bot. Asstt. attended webinar on BSI MIS system and management-reg. organised by BSI and NIC on 08-10-2020.

➤ Workshop organised: 02 Hindi workshops were organised viz.

- i. ‘*TippanLekhan*’ by Prof. Kishorilal Raiger, JNV University, Jodhpur on 11.09.2020 and
- ii. ‘*Bharat ko Vikshit Rastra Banane Me Hindi Gyan-Vigyan Ke Wahak*’ by Dr. D.D. Ojha, Ex-scientist, DMRC, Jodhpur on 14.09.2020.

➤ Workshop attended:

- i. All the officers and staff members of BSI, AZRC, Jodhpur attended the online Hindi workshop on “*Karyalay Me Patrachar Ke Vivid Swarup by Pradhayapak Smt. Amrita VinaMinj, Rajbhasa Section, Ministry of Home Affairs, Govt. of India*”, organised by Central Botanical Laboratory, BSI, Kolkata on 18.03.2021.

➤ Webinar attended:

- i. Shri Vinod Maina, Scientist-D & Ho.o.O., Dr. Sanjay Mishra, Scientist-C, Dr. M.K. Singhadiya, Botanist and Shri Ravi Prasad, Bot. Asstt. attended the Green Talk webinar ‘Lecture on -Exploration of La Anistad National Park by Dr. Alex Monro, Royal Botanical Garden, Kew’ organised by BSI, SHRC, Gangtok on 23.02.2021 (2:15 pm to 5:15 pm).
- ii. Dr. M.K. Singhadiya, Botanist attended the National webinars on ‘Role of BSI in Taxonomic research in India’, organised by BSI, HAWHRC, Solan on 22.02.2021 and he also attended workshop on ‘ Forestry research sustainable Forest management and livelihood’ organised by Himalayan Forest Research Institute, Shimla on 17.03.2021.
- iii. Shri Ravi Prasad, Bot. Asstt. attended the 43rd All India Botanical conference of Indian Botanical Society, held at NBRI, Lucknow in virtual mode during 19th-21st March, 2021.
- iv. Shri J.P. Yadav, Sr. Lib. & Info. Asstt. attended 02 webinars viz. "A Lifetime of Foraging in Libraries and Archives" by Padma Bhushan Awardee Dr. Ramachandra Guha, organized by LIS Academy, Bengaluru on 13/03/2021; and "Emerging trends in Library and Information Science" by Prof. K.P. Singh and Prof. U.C. Sharma, organized by Central Library, Maharaja Ganga Singh University, Bikaner on 24.02.2021.
- v. Dr. M.K. Singhadiya, Botanist, attended a National webinar on “Green walk -Plant Resource as AID for prevention of Covid-19” and “Green walk -Plant Taxonomy and Floristics in the Anthropocene Epoch” both organised by Botanical Survey of India, SRC, Coimbatore on 27.01.2021 & 19.02.2021 respectively.
- vi. Shri J.P. Yadav, Sr. Lib. & Info. Asstt. attended a National webinar on “Changing Educational scenario: Challenge Before Libraries" by Dr. Sudha Rao, Former Vice Chancellor KSOU, Mysore organized by LIS Academy, Bengaluru on 13.02. 2021.
- vii. Dr. M.K. Singhadiya, Botanist, attended a National webinar on “Science in Bialowieza Forest-Bialowieza Forest in Science” organised by Botanical Survey of India, SHRC, Gangtok on 08.01.2021.
- viii. Dr. Sanjay Mishra, Scientist-C, Shri Ravi Prasad, Bot. Asstt., Dr. P. Hari Krishna, Bot. Asstt., Shri Ramesh Kumar, Bot. Asstt., Shri Brajesh Meena, Bot. Asstt. and Shri J.P. Yadav, Sr. Lib. and Inf. Asstt. attended a **Webinar Lecture** on “**INTERNATIONAL CODE OF NOMENCLATURE (ICN) FOR PLANTS**” by Dr. Kanchi N. Gandhi, Senior Nomenclatural Registrar, Harvard University Herbaria, USA on 06.01.2021, organised by Botanical Survey of India, Deccan Regional Centre, Hyderabad in association with Department Of Botany, Andhra University, Visakhapatnam, India.
- ix. Shri J.P. Yadav, Sr. Lib. and Inf. Asstt., attended a National Seminar (Virtual) viz. ‘IPR’ on 22.12.2020 organised by IG Inst. of Development Research, Mumbai; and ‘Restoring Pride of Places to Libraries and Librarian’s A Demand Side Perspectives’ by Dr. Shandhya Shekhar, CEO, IIT Madaras Research Park organized by LIS Academy, Bengaluru on 09/01/2021.
- x. Dr. Sanjay Mishra, Scientist-C, Dr. M.K. Singhadiya, Botanist, Shri Ravi Prasad, Bot. Asstt. & Dr. P. Hari Krishna, Bot. Asstt. attended one day National Webinar organized by Botanical Survey of India, High Altitude Western Himalayan Regional Centre, Nauni Campus, Solan (H.P.) on “Alien Plant Invasion in India: Status and Consequences”. Date: October 17.12.2020 Time: 11:30 A.M. to 01:00 P.M.
- xi. Dr. M.K. Singhadiya, Botanist, attended a National webinar on Plant Diversity of the Western Ghats, India, Organised by Botanical Survey of India, WRC, Pune on 12.12.2020, Time: 10:30 A.M. to 01:30 P.M.
- xii. Dr. Sanjay Mishra, Scientist-C & Dr. M.K. Singhadiya, Botanist attended one day National Webinar on “Micropropagation of threatened plant species and conservation in

- India” organized by Botanical Survey of India, High Altitude Western Himalayan Regional Centre, Nauni campus, Solan (H.P.) on 30.10.2020.
- xiii. Dr. M.K. Singhadiya, Botanist attended National Webinar on “Redefining Gardening from Hobby to Enterprise: series 2” [Topic 1: Garden types and its benefits; Topic 2: Gardening: A Wonderful hobby and a promising career option] organized by Daulat Ram College, University of Delhi on 11.11.2020.
- xiv. Shri Ravi Pasad, Bot. Asstt. & Dr. P. Hari Krishna, Bot. Asstt. attended 3 days (4–6 Nov., 2020) National Webinar on “Dr. E. K. JanakiAmmal Memorial Lecture series on ‘Ethnobotany in India- Future and Challenges’ organised by National Museum of Natural History, New Delhi in collaboration with University of Trans Disciplinary Health Sciences & Technology, Bengaluru.
- xv. Dr. M.K. Singhadiya, Botanist, attended two National webinars viz. “Plant Diversity of Cold Desert of Western Himalaya and its Conservation Strategies” organized by Botanical Survey of India, High Altitude Western Himalaya Regional Centre, Solan (H.P.) on 05.10.2020 and webinar on “NISARG Bharat: Enhancing peoples participation in the e-PBR framework” organized by Botanical Survey of India, Zoological Survey of India & CSIR on 09.10.2020.
- xvi. Dr. P. Hari Krishna, Bot. Asstt. attended two National webinars viz. “Role of Botanical Survey of India in Biodiversity Conservation” held on 14th Oct., 2020 organised by Botanical Survey of India, Deccan Regional Centre, Hyderabad and Webinar on “Biodiversity and Wildlife Conservation” held on 9th October, 2020 organized by Raj Rishi Govt College, Alwar.
- xvii. Dr. Sanjay Mishra, Scientist- C and Dr. M.K. Singhadiya, Botanist attended the International webinar on ‘The importance of historical ecology for interpreting process of evolution in plants of oceanic islands’ organised by Dept. of Life Sciences, Mansarovar Global University, Bhopal on 11.09.2020.
- xviii. Shri J.P. Yadav, Sr. Lib. and Inf. Asstt. attend 3rd National Vartual Conference: ‘Reinventing Excellence in Librarianship’ during 27-30th August, 2020 organized by Telangana Lib. Association and LIS Academy, University of Hyderabad. and he also attend One Week International Webinar ‘Knowledge access and sharing: Tools and Technologies for Higher academic Research’ organized by Department of Library and Information Science, Bharathidasan University and Holy Cross College, Tiruchirappalli, India Jointly with Library, University of Jaffna, Sri Lanka during 5-11th September, 2020.

➤ **Important events attended:**

- i. All the officers and staff members of BSI, AZRC, Jodhpur attended the live session 132nd Foundation day celebration of Botanical Survey of India on 13.02.2021.
- ii. Shri Vinod Maina, Scientist-E & HoO, Dr. Sanjay Mishra, Scientist-C, Dr. M.K. Singhadiya, Botanist and Shri Ravi Prasad, Bot. Asstt. attended the live session of MOU signing event between ICFRE, Dehradun and BSI, Kolkata in a virtual mode on 15.02.2021.

➤ **Meetings:**

- i. TOLIC meeting was held on 12.01.2021.
- ii. OLIC meeting was organised in this office on 17.12.2020. All the members of Rajbhasha implementation committee attended the meeting.
- iii. Shri Vinod Maina, H.o.O. attended RAG (Research advisory group meeting) meeting of AFRI, Jodhpur on 08.10.2020.

- iv. Shri Vinod Maina, H.o.O. acts as a expert member of the Selection Committee for selecting JRF candidates at AFRI, Jodhpur on 14.10.2020.
 - v. Shri Vinod Maina, H.O.O. attended online -Wildlife Board meeting Chaired by Shri Ashok Gehlot, Honourable C.M. of Rajasthan on 10.09.2020.
 - vi. Shri Vinod Maina, H.o.O. acts as a expert member of the Selection Committee for selecting JRF candidates at AFRI, Jodhpur on 15.09.2020.
 - vii. Shri Vinod Maina, H.o.O. acts as a expert member of the Selection Committee for selecting JRF candidates at ZSI, Jodhpur on 18.09.2020.
 - viii. Dr. Sanjay Mishra, Sci.- C & Dr. P. Harikrishna, Bot. Asstt. attended half yearly TOLIC online meeting hosted by CAZRI, Jodhpur on 18.08.2020 at 3.00 pm.
- **Other Important Activities:**
- i. **Cleanliness programme of AZRC, Jodhpur- Botanical garden:** To commemorate the 151st Birth Anniversary of Mahatma Gandhi, ‘Swachh Bharat Abhiyan’ was observed on October 2, 2020. All officers and staff members participated in this Cleanliness programme.
 - ii. Plantation programme is organized at BSI residential complex (Childrens park), Jodhpur on 22.07.2020. Planted avenue plants for beautification.
 - iii. **Rajbhasha Hindi Week:** Rajbhasha Hindi Week was observed from 07.09.2020 to 14.09.2020 at this office and two competitions viz. **Extempore** and **Poetry 2020. Competitions** were organised during the week and all the winners were felicitated during the closing ceremony.
- **Services provided:**
- i. **Ph.D. Course work classes organised for Ph.D. students of AFRI, Jodhpur:** Shri Vinod Maina, Scientist-E &HoO, delivered a lecture on topic “Ethnobotany and Forest Flora; Dr. Sanjay Mishra, Scientist-C, delivered lectures on “Importance of Systematic Botany in Forestry”; “Concept of species and Genus” and “Plant Nomenclature and Identification of Species”; Shri Ravi Prasad, Bot. Asstt., delivered a lecture on “Economic Botany” and Dr. P. Harikrishna, Bot. Asstt., delivered a lecture on “Herbarium and Arboretum” during 21–23 Dec., 2020. Shri Ravi Prasad, Bot. Asstt., and Dr. P. Harikrishna, Bot. Asstt., guided them during Herbarium, Museum, Botanical Garden and Nursery visit.
 - ii. **99 live plant** saplings of different species (including EET) were distributed to different people and organizations free of cost for plantation and further multiplication.
 - iii. **Identification Service for visitors:**38 plant species of Outsiders indentified and generated the revenue of rupees 6450/-
 - iv. **Sale of Books:**19 books were sold by the library andgenerated the revenue of rupees 5732/-.
 - v. Dr. Sanjay Mishra, Scientist-C, has provided services as external subject expert member of RAC for Ph.D. programme at FRI (D) University centre, AFARI, Jodhpur on 19.02.2021.
 - vi. Dr. Sanjay Mishra, Scientist-C, has provided services as Jury member in the International Conference on Recent Advances in Agricultural Sciences (ICRAAS) organized by Amity University, Uttar Pradesh on 17.03.2021.

Herbarium Information (2020-21):

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|----------------|------------------------------|---------------------|
| Sl. No. | Herbarium Maintenance | AZRC 2020-21 |
|----------------|------------------------------|---------------------|

| | | |
|---|---|---|
| 1 | No. of specimens labelled | 150 |
| 2 | No. of Herbarium sheets stitched | 225 |
| 3 | No. of Herbarium sheets accessioned | 5691 |
| 4 | No. of Herbarium sheets incorporated | 5813 |
| 5 | No. of Specimens identified (In house) | 100 |
| 6 | No. of Specimens identified for visitors | 38 and generated the revenue of rupees 6450/- |
| 7 | No. of Genus / species covers changed | 209/347 |
| 8 | Documentation of existing herbarium sheets at herbaria/ Entry of existing herbarium sheets in Excel format/ Field written | 1160 |

ACTIVITIES OF RESEARCH FELLOW

Junior Research Fellow, BSI, AZRC, Jodhpur

(Reporting Period: 2020-2021)

Title of the project allotted: “Ex-situ conservation of Rare Endangered Threatened, Endemic & Economic plants of Rajasthan and Gujarat under ABG scheme”.

1. Name of candidate: Deepshikha Soni
2. Date of Initiation of the Project: 6th June 2019 Date of completion of the Project: 6th June 2022
3. **Background of the Project:** The major objective of the project is to conserve Rare, Endangered, Threatened, Endemic & Economic plants of Rajasthan and Gujarat and develop the Desert Botanical Garden, BSI, AZRC, Jodhpur.
4. **Area and locality of the Allotted Project (with reference Map):** Rajasthan and Gujarat
5. **Summary of the work done during 2020-2021 (not more than 1000 words):**

The major work during the period under report include visiting different field sites, recording and analysis of field data's (e.g. RET plants, Medicinal plants, Economically important plants, Grasses section, Succulent section) tagging of plants, regular monitoring of plants growth, looking after manuring, watering, repotting, removal of weeds and pest control in nurseries. Collected plant saplings of different wild as well as cultivated species and provided services in development of different plant sections in Botanical garden of BSI, AZRC. Additionally, consulted library and studied the concerned literatures. Visited some of the local botanical gardens and nurseries of Central Arid Zone Research Institute & Arid Forest Research Institute, Jodhpur.

Achievements/Outcomes during 2020-2021:

- i. Collected data on of Rare, Endangered, Threatened, Endemic & Economic plants of Rajasthan and Gujarat.
- ii. Tagged the plants of office premises.
- iii. Consultation of herbarium (BSJO) of the office.
- iv. Collected seeds of different plant species for raising seedlings.
- v. Sown seeds of different plants species for raising seedlings in the polybags.
- vi. Documentation of nursery plants.
- vii. Captured growth data of the RET plants.
- viii. Prepared list of Medicinal & economic plant section of Botanical garden.
- ix. Grown different species of plant by grafting, cutting method etc.
- x. Transferred 340 saplings of *Asparagus racemosus* Willd. from mother beds to polybags

ARUNACHAL PRADESH REGIONAL CENTRE, ITANAGAR

1. PROJECT:

| Name of project/ executing officials/ project period | Achievements/Outcome |
|--|--|
| <p>Family Pteridaceae of India & Polypodiaceae of India for the <i>Pteridophytic Flora of India</i>.</p> <p>Dr. Vineet Kumar Rawat, Scientist-E,</p> <p>October 2020 – March 2023</p> | <p>Objective: Taxonomic Study of family Pteridaceae and Polypodiaceae for pteridophytic Flora of India.</p> <p>Background: The family Pteridaceae and Polypodiaceae allotted under the Pteridophytic Flora of India. The family Pteridaceae is represented by 155 species within 19 genera and family Polypodiaceae is represented by 138 species under 21 genera from India. The Project is initiated in 2020.</p> <p>Area and Locality: This project covers entire country.</p> <p>Summary of Work done: Manuscript prepared for 19 genera and 155 taxa (excluding Pteris) from India along with detail description, keys and Citation. During the period, the incumbent is HOO and looking after all official works including in compiling all technical works related to research of BSI, APRC, Itanagar. He has completed all 155 species belonging to 19 genera (Total 19 genera) from Pteridaceae Family. Detail is given below of Pteridaceae family: Acrostichum L. (1 species), Actiniopteris Link (1 species), Adiantum L. (26 species), Aleuritopteris Fee (19 species), Anogramma Link (2 species), Ceratopteris Brongn. (4 species), Cerosora (Baker) Domin (1 species), Coniogramma Fee (7 species), Cryptogramma R.Br. (3 species), Doryopteris J. Sm. (2 species), Mickelopteris Fraser-Jenk. (2 species), gen. nov. Notholaena R.Br. (7 species), Oeosporangium Vis. (14 species), Onychium Kaulf. (7 species), Pellaea Link (4 species), Pityrogramma Link (2 species), Pteris L. (69 species), Syngamma J. Sm., Taenitis Willd. ex Schkuhr (2 species)</p> <p>Achievements/ Outcomes: The study reports 5 new records for the state of arunachal Pradesh and documentation of 155 taxa under 19 genera alongwith 10 scientific publications.</p> |
| <p>Pteridophytic Flora of Arunachal Pradesh (For Materials of the Flora of Arunachal Pradesh, Vol. 4.)</p> <p>Dr. Vineet Kumar Rawat, Scientist-E,</p> <p>April 2019-March 2021</p> | <p>Background: Arunachal Pradesh is the part of Eastern Himalaya region (one of the part of Hotspot). The state of Arunachal Pradesh is a part of Eastern Himalayan Ranges located between 26° 28' to 29°30' N latitudes and 91° 30' to 97°30' E longitudes. Arunachal Pradesh occupies the largest area (83.743 Sq. Km) in the northeastern region of India, and consists of mountainous ranges sloping to the plains of Assam. The diversity of topographical and climatic condition has favoured the growth of luxuriant forests, Entire Arunachal Pradesh consists of more than 654 species of ferns and Fern allies under 94 genera belonging to 32 families.</p> |

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| | <p>Area and locality: Entire Arunachal Pradesh.</p> <p>Summary of Work done: Listed and documented 311 species alongwith proper citation, description and distribution for materials of Arunachal Pradesh. Documentation completed 311 taxa under 41 genera belonging to 76 plant families 21 families in the year 2020-21.</p> <p>Lycopodiaceae (3 genera/18 species) , Selaginellaceae (1/24), Equisetaceae (1/2), Psilotaceae (1/1), Ophioglossaceae (3/10), Marattiaceae (2/4), Osmundaceae (1/4), Plagiogyriaceae (1/4), Dipteridaceae (1/1), Glecheniaceae (2/6), Lygodiaceae (1/5), Marsileaceae (1/1), Cyatheaceae (1/8), Dicksoniaceae (1/1), Hymenophyllaceae (2/17), Dennstaedtiaceae (6/22), Lindsaeaceae (2/8), Pteridaceae (10/80), Vittariaceae (2/11), Aspleniaceae (1/35), Thelypteridaceae (1/49).</p> <p>Achievements/ Outcomes: description completed of 311 species and Published 4 scientific papers from study area and reported 16 threatened ferns species.</p> |
| <p>Materials of the Flora of Arunachal Pradesh, Vol. 4.</p> <p>Dr. M. R. Debta, Scientist-C.</p> <p>April 2019-March 2021</p> | <p>Background: The materials for flora of Arunachal Pradesh have been published in 03 volumes till date. The last volume to this series was published in 1998. Since then many new discoveries and new reports have been made to the flora of this state in the last two decades by BSI scientists and those from other research institutions and academia. Therefore, the need is felt by BSI HQ to compile all those publications and put into one as an addition to the already available published flora.</p> <p>Summary of Work Done:Listed 250 taxa and documentation completed for 214 species, 03 subspecies and 15 varieties in the year 2020-21. The manuscript comprising a total of 349 species, 06 subspecies and 20 varieties under 238 genera belonging to 76 plant families was submitted to the Team leader for further compilation and final submission of the same to HQ, BSI.</p> |
| <p>Phyto-taxonomic studies in selected High AltitudeWetlands (HAWs) and its environs representing 5 districts of Arunachal Pradesh.</p> <p>Dr. M. R. Debta, Scientist-C.</p> | <p>Background: The wetlands were selected after consultation with State Forest Department, scientists working earlier in BSI, Itanagar and by outreaching to local people. These were selected from Tawang, West Kameng, Upper Siang, Upper Dibang Valley and Lohit districts of Arunachal Pradesh.</p> <p>Area and Locality: 5 districts of Arunachal Pradesh.</p> <p>Summary of Work done: A checklist was prepared comprising of 108 species in the year 2020-21.Preliminary description prepared for 20 species based on literature and herbarum specimens.Relevant literatures were</p> |

| <p>August 2020 – March 2023</p> | <p>consulted and available herbarium specimens from ARUN and GBPNIHE, Itanagar were noted for further scrutiny. Field tours and Herbarium consultation tours could not be made due to Covid-19 induced budget restrictions.</p> <p>Apart from the above listed works, I have also edited and revised the description of 509 species and 05 subspecies under 167 genera belonging to 52 angiospermic plant families and updated key to genera and species of major families such as Malvaceae, Menispermaceae, Fumariaceae, Caryophyllaceae, Rhamnaceae, and Tiliaceae under Flora of Himachal Pradesh, vol. 1 while under deployment at BSI, NRC, Dehradun w.e.f. 26th March 2020 to 11th September 2020.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|----------------|-------------------|----------------------|---------------------|----------------------|---------------------|------------|---|---|---|---|---|--------------|---|---|---|---|---|----------------|---|---|---|---|---|-------------|---|----|----|---|---|-------------|---|---|---|---|---|------------|---|---|---|---|---|---------------|---|---|---|---|---|---------------|---|---|---|---|---|--------------|-----------|-----------|-----------|----------|-----------|
| <p>Flora of India, Vol. 15: Family Styliaceae, Goodeniaceae, Lobeliaceae, Sphenocleaceae, Clethraceae, Pyrolaceae, Monotropaceae and Diapensiaceae.</p> <p>Dr. Umeshkumar L. Tiwari, Scientist-C</p> <p>April 2020 – September 2020</p> | <p>Area and Locality: Entire India under Flora of India Project.</p> <p>Summary of work Done: Manuscript prepared for the families altogether includes 11 genera and 29 taxa (including 28 species, 01 variety) in India along with key for the easy identification of the taxa (29 pp). Compiled volume 15 for Flora of India and details are as follows:</p> <table border="1"> <thead> <tr> <th>Families</th> <th>Number of Genera</th> <th>Number of Taxa</th> <th>Number of Species</th> <th>Number of subspecies</th> <th>Number of varieties</th> </tr> </thead> <tbody> <tr> <td>Styliaceae</td> <td>1</td> <td>2</td> <td>2</td> <td>0</td> <td>0</td> </tr> <tr> <td>Goodeniaceae</td> <td>1</td> <td>2</td> <td>2</td> <td>0</td> <td>0</td> </tr> <tr> <td>Sphenocleaceae</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Lobeliaceae</td> <td>1</td> <td>11</td> <td>11</td> <td>0</td> <td>0</td> </tr> <tr> <td>Clethraceae</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Pyrolaceae</td> <td>2</td> <td>4</td> <td>4</td> <td>0</td> <td>0</td> </tr> <tr> <td>Monotropaceae</td> <td>2</td> <td>3</td> <td>3</td> <td>0</td> <td>0</td> </tr> <tr> <td>Diapensiaceae</td> <td>2</td> <td>5</td> <td>4</td> <td>0</td> <td>1</td> </tr> <tr> <td>Total</td> <td>12</td> <td>29</td> <td>28</td> <td>0</td> <td>01</td> </tr> </tbody> </table> | Families | Number of Genera | Number of Taxa | Number of Species | Number of subspecies | Number of varieties | Styliaceae | 1 | 2 | 2 | 0 | 0 | Goodeniaceae | 1 | 2 | 2 | 0 | 0 | Sphenocleaceae | 1 | 1 | 1 | 0 | 0 | Lobeliaceae | 1 | 11 | 11 | 0 | 0 | Clethraceae | 1 | 1 | 1 | 0 | 0 | Pyrolaceae | 2 | 4 | 4 | 0 | 0 | Monotropaceae | 2 | 3 | 3 | 0 | 0 | Diapensiaceae | 2 | 5 | 4 | 0 | 1 | Total | 12 | 29 | 28 | 0 | 01 |
| Families | Number of Genera | Number of Taxa | Number of Species | Number of subspecies | Number of varieties | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Styliaceae | 1 | 2 | 2 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Goodeniaceae | 1 | 2 | 2 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sphenocleaceae | 1 | 1 | 1 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lobeliaceae | 1 | 11 | 11 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clethraceae | 1 | 1 | 1 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrolaceae | 2 | 4 | 4 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Monotropaceae | 2 | 3 | 3 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Diapensiaceae | 2 | 5 | 4 | 0 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | 12 | 29 | 28 | 0 | 01 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>Materials of the Flora of Arunachal Pradesh Vol. 4.</p> <p>Dr. Umeshkumar L. Tiwari, Scientist-C</p> | <p>Background: The vegetation of Arunachal Pradesh falls under four broad climatic categories and can be classified in five broad forest types with a sixth type of secondary forests. These are tropical forests, sub-tropical forests, pine forests, temperate forests and alpine forests.</p> <p>Summary of Work Done: Manuscript prepared for: 42 Families, 133 genera and 319 taxa recorded (Final list</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| October 2020 – March 2021 | 78 Families, 262 Genera and 599 taxa). Overall 116 Families, 442 Genera and 993 taxa are added to the Materials for the flora of Arunachal Pradesh. | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|----------------|-------------------|----------------------|---------------------|----------------------|---------------------|--------------|---|----|----|---|---|----------|----|----|----|---|---|--------------|-----------|------------|------------|-----------|-----------|
| <p>Flora of India, Vol. 16: Family Symplocaceae and Oleaceae</p> <p>Dr. Umeshkumar L. Tiwari, Scientist-C</p> <p>Sep. 2020–Dec 2021</p> | <p>Background: Flora of India varies with physiographic and climatic conditions in the country. India is situated in the tropical zone of the world and can be divided into six distinct physical geography regions.</p> <p>Arae and Locality: Entire India under Flora of India Project.</p> <p>Summary of Work Done: Manuscript prepared for the families altogether includes 13 genera and 139 taxa (including 113 species, 14 subspecies and 12 varieties) in India along with key for the easy identification of the taxa (29 pp). Compiled volume 16 for Flora of India and details are as follows:</p> <table border="1"> <thead> <tr> <th>Families</th> <th>Number of Genera</th> <th>Number of Taxa</th> <th>Number of Species</th> <th>Number of subspecies</th> <th>Number of varieties</th> </tr> </thead> <tbody> <tr> <td>Symplocaceae</td> <td>1</td> <td>49</td> <td>36</td> <td>7</td> <td>6</td> </tr> <tr> <td>Oleaceae</td> <td>12</td> <td>90</td> <td>77</td> <td>7</td> <td>6</td> </tr> <tr> <td>Total</td> <td>13</td> <td>139</td> <td>113</td> <td>14</td> <td>12</td> </tr> </tbody> </table> <p>Achievements/ Outcomes: Final report submitted for all three projects to HQ and along with the description of 767 taxa (712 species and 26 subspecies and 39 varieties), 287 genera and 83 families in the district. During this period 03 scientific research paper were published and 04 in communication. This result includes some new findings viz. <i>Tubocapsicum anomalum</i>, <i>Meconopsis merakensis</i> var. <i>merakensis</i>, <i>Cardamine trifoliolata</i>, <i>Elatostema cyrtandrifolium</i>, <i>Pilea medogensis</i>, <i>Salvia campanulata</i> var. <i>codonantha</i> (new record for India), <i>Strobilanthes mastersii</i> and <i>Strobilanthes oxycalycina</i>. Among these 2 taxa addition to the flora of India and 8 new addition to the state flora of Arunachal Pradesh.</p> | Families | Number of Genera | Number of Taxa | Number of Species | Number of subspecies | Number of varieties | Symplocaceae | 1 | 49 | 36 | 7 | 6 | Oleaceae | 12 | 90 | 77 | 7 | 6 | Total | 13 | 139 | 113 | 14 | 12 |
| Families | Number of Genera | Number of Taxa | Number of Species | Number of subspecies | Number of varieties | | | | | | | | | | | | | | | | | | | | |
| Symplocaceae | 1 | 49 | 36 | 7 | 6 | | | | | | | | | | | | | | | | | | | | |
| Oleaceae | 12 | 90 | 77 | 7 | 6 | | | | | | | | | | | | | | | | | | | | |
| Total | 13 | 139 | 113 | 14 | 12 | | | | | | | | | | | | | | | | | | | | |
| <p>Materials of the Flora of Arunachal Pradesh, Vol. 4.</p> <p>Dr. K. Chowlu, Scientist-C.</p> | <p>Background: After the publication of Materials of Arunachal Pradesh in the year 1998, many new discoveries and new reports to the state have made to the flora of Arunachal Pradesh by different scientists and researchers. Therefore, it is very much needed to compile all those species published after 1998 and to put them into one available published flora. So all the species were compiled after 1998 by consulting all the different published literatures and compiled them as one report.</p> <p>Summary of Work Done: In this regard, added all total of 120 species from different genus were reported by consulting different journals and books. Regarding this also two small tours were conducted to Sagali side and Itanagar side and collected 19 species of orchids. From this 17 species were identified by consulting different</p> | | | | | | | | | | | | | | | | | | | | | | | | |

| | |
|---|---|
| <p>April 2019-March 2021</p> | <p>literatures. Achievements/ Outcomes: Number of species all total collected and made herbariums: 30 species from the surrounding areas of Itanagar and Sagali area: 1. <i>Eria arunachalensis</i> A.N. Rao, 2. <i>Dendrobium aphyllum</i> (Roxb.) C.E.C. Fisch., 3. <i>Vanda bicolor</i> Griff., 4. <i>Bulbophyllum piluliferum</i> King & Pantl, 5. <i>Dendrobium transparens</i> Wall. ex Lindl., 6. <i>Dendrobium densiflorum</i> Lindl., 7. <i>Ornithochilus difformis</i> (Wall. Ex Lindl.) Schltr., 8. <i>Eulophia macrobulbon</i> (Parish & Rehb. F.) Hook. F., 9. <i>Cymbidium bicolor</i> Lindl., 10. <i>Aerides roseum</i> Loddiges ex Lindl. Ex Paxt., 11. <i>Gastrochilus calceolaris</i> (Buch.-Ham. Ex J.E. Sm.) D. Don, 12. <i>Rhynchstylis retusa</i> Bl., 13. <i>Eulophia promensis</i> Lindl., 14. <i>Dendrobium chrysanthum</i> Wall. Ex Lindl., 15. <i>Dendrobium chrysanthum</i> Wall. Ex Lindl., 16. <i>Geodorum attenuatum</i> Griff., 17. <i>Peristylus constrictus</i> (Lindl.) Lindl., 18. <i>Acampe papillosa</i> (Lindl.) Lindl., 19. <i>Arachnis labrosa</i> (Lindl. ex Paxt.) Rehb. f., 20. <i>Arundina graminifolia</i> (D. Don) Hochr., 21. <i>Cleisocentron pallens</i>(Cathcart ex Lindl.) N. Pearce & P.J. Cribb, 22. <i>Dendrobium aduncum</i> Wall. Ex Lindl., 23. <i>Dendrobium fimbriatum</i> Hook., 24. <i>Dendrobium moschatum</i> (Buch.-Ham.) Sw., 25. <i>Dienia ophrydis</i> (J. Koenig) Ormerod & Seidenf., 26. <i>Eria panna</i> Lindl., 27. <i>Gastrochilus inconspicuous</i> (Hook. F.) Kuntze, 28. <i>Geodorum densiflorum</i> (Lam.) Schltr., 29. <i>Coelogyne prolifera</i> Lindl., 30. <i>Bulbophyllum pteroglossum</i> Schltr.</p> |
| <p>Enumeration of RET specimens of Arunachal Pradesh.</p> <p>Dr. K. Chowlu, Scientist-C</p> <p>November 2019- March 2021</p> | <p>Background: The vegetation of Arunachal Pradesh falls under four broad climatic categories and can be classified in five broad forest types with a sixty type of secondary forests. These are tropical forests, subtropical forest, pine forest, temperate forests and alpine forests. In the degraded forest bamboos and other grasses are of common occurrence.</p> <p>Area and locality: Entire Arunachal Pradesh.</p> <p>Summary of Work done: For the annual action plan all the possible species reported and available so far from Arunachal Pradesh is consulted. Plants Extinct and Possibly/Presumed Extinct is <i>Paphiopedilum wardii</i> Summerh. (Orchidaceae) likewise all the possible list is preparing and it will be submitted in the final report. Consulting all the literatures all total 210 species were listed till March 2021.</p> |
| <p>Dr. Ranjit Daimary, Botanist</p> | <p>NIL (New Project applied in the month of June 2021: <i>waiting for approval</i>) entitled Ex Situ conservation of RET and economically Important Plants of Arunachal Pradesh and Botanical garden of APRC, Itanagar)</p> |

2. RESEARCH PAPER PUBLICATIONS:

Papers published-17; papers communicated -02; Book chapter-01; Abstracts published-05 (For details see the last chapter).

ANY OTHER INFORMATION:

DR. VINEET KUMAR RAWAT, SCIENTIST-E,

1. **Symposium/ Conferences/ Workshop/ Webinar Attended:**

- Attended webinar on “Himalayan Mountain Biodiversity–Threats & Solutions” on 10th December 2020.
- Attended webinar on “Alien Plant invasion in India: status and consequences” by Prof. R.K. Kohli on 17th December 2020.
- Attended webinar on “Revising the Generic Limits of *Coleus* and *Plectranthus* (Lamiaceae, Tribe- Ocimeae)” by Dr Alan Paton, RBG, Kew on 12th March 2021.
- Attended webinar on “Exploration of La Amistad National Park (Costa Rica / Panama)” by Dr Alex Monro, RBG, Kew on 23rd February 2021.
- Attended all virtual Meeting organized by HQ in concern to overall progress Report of AAP and Herbarium Data progress report of APRC.

Dr Manas R. Debta, Scientist-C

- Attended webinar on “Himalayan Mountain Biodiversity–Threats & Solutions” on 10th December 2020.
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- Attended webinar on “Exploration of La Amistad National Park (Costa Rica / Panama)” by Dr Alex Monro, RBG, Kew on 23rd February 2021.
- Discharging the duty of Herbarium-in-charge and looking after herbarium related functions such as fumigation, mounting, dusting, accessioning, incorporation and preservation. In the year 2020-21, the following herbarium work was carried out under my supervision-
 - Number of specimens mounted/remounted: 878
 - Number of specimens poisoned: 649
 - Number of herbarium sheets dusted: 8507
 - Number of herbarium stitched/labeled: 1634
 - Number of herbarium sheets accessioned: 825

Dr. Krishna Chowlu, Scientist-C

- Joined Green talk by Alex Monro, RBG Kew, London, webinar organized by Botanical Survey of India, Sikkim Himalayan Regional Centre, Gangtok on 23.02.2021.
- Join the webinar on Wetlands Potential importance & Conservation need under Climatic scenario organized by Botanical Survey of India, Southern Regional Centre, Coimbatore on 02.02.2021.

Dr. Ranjit Daimary, Botanist

1. SDG report prepared consisting list of 70 invasive alien plant species of Arunachal Pradesh for sending to BSI, Hq.

2. Prepared report on projects executed, outreach activities conducted, national programs organized, number of publications in quality peer reviewed journals of APRC etc. for sending to PMO.
3. Prepared project achievement report of APRC upto September, 2020 for sending to Director, BSI, Kolkata.
4. Herbarium was arranged based on Bentham and Hooker system.
5. Performed the duty as DDO.



Impatiens latiflora



Satyrium nepalense



Davallia assamica



Pteris cretica

BOTANIC GARDEN OF INDIAN REPUBLIC, BSI, MOEF&CC, GOVT. OF INDIA, NOIDA
ANNUAL REPORT FOR THE PERIOD OF 2020-2021

A: EX-SITU CONSERVATION:

(i) Plant collection, introduction and maintenance:

| Name of the Project | Progress |
|--|---|
| Collection of plants for introduction in BGIR | Almost all introduced/conserved plants were maintained with assistance of outsourced services and scientific staff by exercising de-weeding, mowing, hoeing, irrigation, etc. |

Note: No plant collection tours were undertaken in the year 2020-21 due to Covid-19 pandemic. However, as per the commitment BSI Regional Centres i.e. Northern Regional Centre, Dehradun; Central Regional Centre, Allahabad; Deccan Regional Centre, Hyderabad; Southern Regional Centre, Coimbatore; Andaman and Nicobar Regional Centre, Port Blair; Eastern Regional Centre, Shillong supplied saplings and seed to BGIR. The details are as under:

1. BSI CRC Allahabad: Provided 150 Central Indian species – Plantation done in respective areas
2. BSI NRC Dehradun: Provided 55 species of endemic as well as common plants of Uttarakhand.- Plantation done in respective area
3. BSI SRC Coimbatore: Provided 200 saplings of 87 species of endemic and common ornamental vascular plants from Western Ghats. Placed in conservatory for acclimatization
4. BSI DRC Hyderabad: Species of endemic *Cycas* from Eastern Ghats along with endemic plants has been sent twice for transplanting in BGIR. Under Conservatory for acclimatization
5. BSI A & N Port Blair: Provided 20 rare species of endemic taxa (Crypto +Phanerogams)- 90 % Mortality reported
6. BSI Shillong has also provided 40 saplings of 12 sps . : 50 % Mortality reported
7. BSI WRC Pune: Provided 120 saplings of 30 species of endemic vascular plants from Western Ghats.

8. UP Forest Dept Gautam Budha Nagar provided some 2000 saplings of forest trees for BGIR NOIDA in June and July 2021.- 1120 plants planted in BGIR and 280 plants placed in conservatory and 600 plants given to RWA Noida .
9. 1580 plants given to NGO, RWA for Van Mahotsav 2020.

1. Development and Maintenance Work:

Routine Intercultural operations such as weeding, hoeing, watering, integrated insect pest and disease management operations were performed every month. Some of the works undertaken year around is mentioned as below:

- (i) Economic Plant Section
- (ii) Medicinal Plant Section
- (iii) Fruit Section
- (iv) Periphery Woodland Area
- (v) Aquatic Plant Section
- (vi) Cactus and Succulent section

Note: In order to maintain and develop all the above sections, well planed approach/intercultural operations w.r.t Integrated Insect-Pest and disease management, Nutrient management were performed all along the year. Training, Pruning, de-weeding operations performed. As and when required, new plant spp., were introduced in these sections. Plant labels were also placed wherever required.

Achievements:

1. Plant labels with brief descriptions were provided to all endemic trees planted in all eight forest types, Economic plant section, Medicinal Plant section and Fruit section.
 2. Prepared inventory list of all endemic plant spp.as planted in various zones/sections in BGIR.
 3. Hedging were done all along the road sides. About 20,000-22,000 hedge plants of Hamelia patens were planted for hedging and beautification.
2. Plantation work as per annual action programme for woodland development programme:

In the year 2020-21 following plant spp. were planted in various Zones/sections:

- (i) Fruits Sections; 11 sps planted
- (ii) Economic Plant Sections: 08 new species introduced in EPS .
- (iii) Forest Types :

Forest Types: No of endemic plant spp. planted:

Total plants planted: **See Annexure I**

- (a) TROPICAL WET EVERGREEN
- (b) TROPICAL MOIST DECIDUOUS
- (c) TROPICAL SEMI- EVERGREEN
- (d) TROPICAL DRY DECIDUOUS
- (e) TROPICAL THORNY SCRUB
- (f) TROPICAL DRY EVERGREEN
- (g) LITTORAL AND SWAMPY
- (h) SUB-TROPICAL BROAD LEAVED HILL FOREST
- [i] SUB-TROPICAL DRY FOREST

Sections:

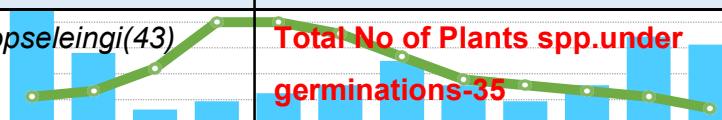
- (i) Medicinal Plant sections:
- (ii) Aquatic sections:
- (iii) Cactus Sections:
- (iv) Avenue Section: *Callistemon lanceolatus* (62), *Putranjiva roxburghii*(55), *Cassia fistula* (43)

3. Seed Bank Development Program:

- (i) Seed collections:

| Taxa for which seeds germinated | Taxa for which seeds germinated this season | |
|---------------------------------|---|------------------------------------|
| <i>Cassia fistula</i> (121) | <i>Hardwickia binata</i> (102) | <i>Catharanthus roseus</i> (150) |
| <i>Limonia acidissima</i> (72) | <i>Caesalpinia bundoc</i> (141) | <i>Putranjiva roxburghii</i> (250) |
| <i>Bauhinia variegata</i> (21) | <i>Sterculia urens</i> (211) | <i>Terminalia arjuna</i> (100) |
| <i>Bauhinia acuminata</i> (44) | <i>Cassipourea</i> (121) | <i>Mimosa pudica</i> (50) |
| <i>Helicteres isora</i> (34) | <i>Melia arborea</i> (310) | <i>Albizia lebbek</i> (50) |
| <i>Tectona grandis</i> (128) | <i>Mitragyna parvifolia</i> (232) | <i>Abrus</i> |

| | | |
|--------------------------------------|-----------------------------------|---|
| | | <i>pricatorious</i> (70) |
| <i>Grewia nervosa</i> (12) | <i>Bridelia retusa</i> (172) | <i>Asparagus</i> <i>racemosa</i> (60) |
| <i>Dalbergia lanceolata</i> (19) | <i>Eleocarpus sphericus</i> (132) | <i>Murraya</i> <i>paniculata</i> (150) |
| <i>Albizia lebbeck</i> (110) | | |
| <i>Mitragyna parvifolia</i> (54) | | |
| <i>Mimosopseleingi</i> (43) | | |
| <i>Schleichera oleosa</i> (21) | | |
| <i>Acacia nilotica</i> (11) | | |
| <i>Acacia catechu</i> (19) | | |
| <i>Vitex negundo</i> (33) | | |
| <i>Nyctanthes arbor-tristis</i> (21) | | |
| <i>Ocimum spp</i> (118) | | |
| <i>Datura metel</i> (23) | | |



Total No of Plants under Germination=3120

(ii) Seed data base: Data of 33 endemic trees have been filled in data entry sheets for data base.

(iii) Seeds of 45 plant spp. were placed for seed germination. As a result about 4315 plants germinated and are growing in seed bank plant conservatories.(list enclosed)

Note: All equipment's such as Seed germinator, dual chamber seed germinator, Hot air oven, BOD cabinet, laminar air flow cabinet, seed storage unit made operational.

4. Herbarium Development Programme:

- (i) Metadata of about 1561 specimens prepared with the help of NMHS project staff.
- (ii) Digitisation of 1500 herbarium specimens under progress.
- (iii) Regular fumigation and maintenance of herbarium specimens in progress.
- (iv) Incorporation of new specimens collected from recently concluded field trips is under process.

| Sl. No | FLOWERING | FRUITING |
|--------|------------|------------|
| 1 | 5.30008576 | 3.93892771 |

5. Phenology studies of endemic plant spp. of BGIR Noida

- (i) Phenology study w.r.t flowering, fruiting, seed setting, seed harvest of 43 endemic plant spp. were studied.

| | FLOWERING | FRUITING |
|-----|-----------|----------|
| Jan | 5.00 | 15 |
| Feb | 6.00 | 9 |
| Mar | 10.00 | 2 |
| Apr | 18.00 | 3 |
| May | 18.00 | 4 |
| Jun | 16.00 | 5 |
| Jul | 12.00 | 8 |
| Aug | 8.00 | 5 |
| Sep | 7.00 | 3 |
| Oct | 6.00 | 5 |
| Nov | 5.00 | 11 |
| Dec | 3.00 | 10 |

t-test value=0.129 (Observed Value)#

6. Meetings/Seminar/Workshop attended:

- (i) Meeting of Steering committee constituted to oversee the development of BGIR arranged and conducted (5 meeting in BGIR)
- (ii) Meeting with Noida Authority Deputy CEO, Director (Revenue) conducted and arranged in BGIR Noida (2 no.)
- (iii) Meeting with CPWD and VYOM conducted and arranged (11 No.) for BGIR landscape plan of action.
- (iv) Meeting with CCU and STP wing Noida Authority conducted for STP channelisation to BGIR Noida.(2 No.)

(v) Seminar/Conferences ;

I. Lecture delivered on role of soil microorganism in enhancing the soil productivity at Dept. of Agriculture sciences, Amity University, Noida on 12th Dec., 2020.

II. Invited: Dept of Biotechnology, Gautam Budha University, Noida, Amity Institute of Agriculture.

III. Attended 3days online course on DNA, Taxonomy and Phylogeny held by Institute of Science and Technology, Chennai (21st -23rd May 2020).

IV .Attended three days online workshop on In-Silico PCR analysis held by Late Shri Vishnu Waman Thakur Charitable Trust, Virar (26th-28th June 2020).

Webinars attended:

- I. Attended Ayuryog Expo Webinar XV: Himalayan medicinal plants: challenges and opportunities on June 8th2020.
- II. Attended webinar on International Webinar on Biodiversity and Environmental Health in Shivaji College, University of Delhi held on 20th May, 2020.
- III. Attended webinar on "PLANT BIOLOGY: A JOURNEY FROM EARTH TO SPACE" organized by the Department of Botany, Ramjas College, University of Delhi, on 22nd- 23rd May, 2020.
- IV. Attended webinar on "Corona kesathbhi, Corona kebaadbhi" organized by the collaboration of Arogya Bharati, Mansarovar Ayurvedic Medical College, Bhopal and Sri Sai Institute of Ayurvedic Research and Medicine Bhopal (M.P.) on 26th May 2020.
- V. Added online faculty development programme on “understanding of Google classroom”held during May 13-14, 2020.
- VI. Attended A webinar on “Botanical Secrets for Wellness: Clued From Nature’s Signature” organized by the Phytomics: The Botanical society of Bhaskaracharya College of AppliedSciences (University of Delhi), held on 16th May 2020.
- VII. Attended webinar on “Evolution of science seen from historical perspective” Conducted by the Department of Botany, Deshbandhu College under the aegis of IQAC on 12th& 13th May 2020.
- VIII. Attended a National webinar on “Nutrition and Immunity- Simplified and Applied” organized by the Department of Food Technology, Bhaskaracharya College of Applied Sciences, University of Delhi on May 19, 2020.
- IX. Attended webinar on “Molecular Taxonomy and DNA barcoding: Concepts, Methods and Applications organized R.D. & S.H. National College and S.W.A. Science College, Mumbai on 20th May, 2020.
- X. Attended National webinar on Biodiversity Conservation” (NWBC 2020) organized by Daulat Ram College under the aegis of Internal Quality Assurance cell (IQAC) on 8th June 2020.
- XI. Attended webinar titled “Biodiversity: Bio- indicators, Monitoring and Ecosystem Health” on 5th June.

- XII. Attended National webinar on “Entrepreneurship Aspects on Biodiversity Conservation and indigenous healing practices of Northeast India” organized by Kalindi college, University of Delhi, held on June 2 2020.
- XIII. Attended webinar on “Overview and Opportunities in the field of LC-MS/MC- based bio analysis” by Mansarovar Global University on 30th May 2020.
- XIV. Attended webinar on “New opportunities in Medicinal Plants Sector for Farmers and Entrepreneurs” organised by department of life sciences, Mansarovar Global University held on 24th May 2020.
- XV. Attended Session on strengthening research capabilities remotely: Empowering Indian Research on COVID- 19 organised by DBT and Elsevier on 22nd May.
- XVI. E-conference on climate change, environmental health and sustainable development goals in post COVID-19 world organised by Guru Gobind Singh Indraprastha University, Delhi on 2nd -5th June 2020.
- XVII. Attended webinar on “Environmental Impact Assessment techniques” by T-GIS online platform, Gujarat on 23rd May 2020.
- XVIII. Attended a three day webinar on “Developing tools for sustainable crop development” by Durham University from 27th -29th May 2020.
- XIX. Attended a National webinar on “Data analysis and statistical computing” organised by Dr. Bhimrao Ambedkar University, Agra on 27th May 2020.
- XX. Attended webinar on “Pattern of Biodiversity across the Indian Himalaya” by Amity University on 27th May 2020.
- XXI. Attended a virtual event on Environment day [5th June 2020] focusing on “Redefining our common future: Safe and Secure”.
- XXII. Attended webinar on “SOLID WASTE UTILIZATION FOR SOIL HEALTH SUSTENANCE: CURRENT PERSPECTIVES” by Dr. Satya Sundar Bhattacharya Assistant Professor, Department of Environmental Science, Tezpur University, Assam on 28th June 2020.
- XXIII. Attended webinar on “MICROBIOME - PERCEPTIONS AND PERSPECTIVES” by Biotechnika Info Labs Pvt. Ltd on 27 June 2020.
- XXIV. Attended a webinar on 24th June 2020 titled “Biological diversity act” by National Biodiversity Authority (NBA-UNDP).

(vi) **Research Publications:** Papers published: 12

7. Public Service rendered :

(I) No of visitors(Indian): 1123

(II) No of Students/scholar: 241

8. Miscellaneous :

(i) World Forestry day, Earth day, Water day, World Environment day, celebrated in BGIR as per Covid Protocol.

**List of existing plant species and 'introduced plants in the gaps' from net house in respective zones wise
on proposed forest types.**

| Whether common fruit bearing | |
|------------------------------|-----------------------------|
| * | Used locally |
| ✓ | Common |
| NA | Not known |
| MU | MINOR USE(e.g using seeds) |
| | Not found any data |
| NO | No use of fruit |

Table 1 List of existing species of Zone 2 and introduced

| EXISTING | | | | | | | | | | |
|----------|------|------------------------------|-----------------------|------------------|------------------|-------------------------------|------------------------------|---------------------------------|---------------------------|-------------------------|
| S.No | Zone | Name of the existing species | Colour of flower | Flowering season | Fruiting season | No. of trees already existing | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
| 1 | 2 | Manilkara hexandra | White or light yellow | December-January | March-April | 150 | * | 12-25 m | growing | Yes |
| 2 | 2 | Terminalia arjuna | Pale yellow | April-May | October-November | 170 | ✓ | 20-25 m | growing | Yes |
| 3 | 2 | Wrightia tinctoria | Light green yellowish | May-September | December-January | 700 | MU | 3-15 m | growing | Yes |
| 4 | 2 | Syzygium cumini | white | March-April | May-july | 220 | * | 10-30 m | growing | Yes |
| 5 | 2 | Ficus racemosa | Not seen | February-March | April-July | 10 | * | 30 m | growing | Yes |
| 6 | 2 | Mangifera | Yellowish or reddish | March-April | June-July | 10 | ✓ | 30 m | growing | Yes |

| | | | | | | | | | | |
|----|---|------------------------|--------------------|----------------------|--------------------|----|---|---------|---------|-----|
| | | indica | | | | | | | | |
| 7 | 2 | Schleichera oleosa | Greenish yellow | December- January | February- March | 25 | * | 10-15 m | growing | Yes |
| 8 | 2 | Sterculia urens | Greenish yellow | October- January | February- June | 10 | * | 15 m | growing | Yes |
| 9 | 2 | Artocarpus hirsutus | Yellowish green | November- January | July- September | 50 | | 35 m | growing | Yes |
| 10 | 2 | Lanea coromendelica | greenish | March- April | June-July | 12 | * | 10-20 m | growing | Yes |

| S.N O | Zon e | To be introduced species | Colour of flower | Flowering season | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
|----------|----------|--------------------------------|--|----------------------------|---------------------------------------|------------------------------------|---------------------------------|-------------------------------|
| 1 | 2 | Areca catechu | White, yellow | April-June | * | 20 m | 4-8 years | Partial |
| 2 | 2 | Ceiba pentandra | Creamy white or pale pink | February to June | * | 45 m | 4-5 years | Yes |
| 3 | 2 | Cycas revoluta (Gymnosperm) | - | Once every 3 to 4 years | | 6-7 m | more than 10 years | No |
| 4 | 2 | Dalbergia lanceolaria | Purplish white | May to June | NA | 20 m | 7-8 years | Yes |
| 5 | 2 | Dalbergia sissoo | Whitish to pink | March to May | NA | 25 m | 7-8 years | Yes |
| 6 | 2 | Ficus religiosa | red | January to June | NA | 30 m | 10 years | Yes |
| 7 | 2 | Manihot esculenta | Pale yellow cream/ tan | February to May | ✓ | 3 m | crop plant | No |
| 8 | 2 | Mimusops elengi | cream | April | * | 16 m | 3-4 years | Yes |
| 9 | 2 | Saraca asoca | Gold/yellow sometimes pink or white | December to March | MU | 7-10 m | 6-8 years | Yes |
| 10 | 2 | Spondias | Greenish white | April to June | MU | 10-15 m | 5 years | Yes |

| | | | | | | | | | |
|----|---|--------------------------------------|---------------------------------------|-------------------|----|---------|------------|---------|--|
| | | pinnata | | | | | | | |
| 11 | 2 | Syzygium cumini | white | March to April | * | 10-30 m | 5-7 years | Yes | |
| 12 | 2 | Trachycarpus takil | Brown or tan | | NO | 10-15 m | 10 years | No | |
| 13 | 2 | Triphasia trifolia | white | December to April | * | 3 m | | Partial | |
| 14 | 2 | Washingtonia robusta | cream | March to June | NA | 25 m | 5-8 years | yes | |
| 15 | 2 | Zamia furfuracea (gymnosperm) | - | March- April | NO | 1.3-2 m | 10 years | No | |
| 15 | 2 | Agathis robusta | purple | - | NA | 50 m | 8-10 years | yes | |
| 15 | 2 | Cinnamomum zeylanicum | green | April-May | NA | 10-15 m | 4-5 years | Yes | |
| 15 | 2 | Diospyros malabarica (Desr.) Kostel. | Ochre-yellow | May-June | MU | 37 m | 8-10 years | Yes | |
| 15 | 2 | Elaeocarpus sp. | White, tinted purple | October | | 10-12 m | 5 years | yes | |
| 15 | 2 | Livistonia chinesis | Blue-black | February-April | NA | 9-15 m | 10 years | Partial | |
| 15 | 2 | Saraca asoca (Roxb.) Willd. | Gold/yellow , sometimes pink or white | February -May | MU | 9 m | | yes | |

Table 2 List of existing species of Zone 2 and introduced

| S.No | Zone | Name of the existing species | Colour of flower | Flowering season | Fruiting season | No. of trees already existing | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
|------|------|------------------------------|------------------|------------------|-----------------|-------------------------------|------------------------------|---------------------------------|---------------------------|-------------------------|
|------|------|------------------------------|------------------|------------------|-----------------|-------------------------------|------------------------------|---------------------------------|---------------------------|-------------------------|

| | | | | | | | | | | |
|---|---|--------------------|-----------------------|------------------|-------------|----|----|---------|---------|-----|
| 1 | 2 | Syzygium cumini | white | March-April | May-July | 50 | * | 10-30 m | growing | Yes |
| 2 | 2 | Manilkara hexandra | White or light yellow | December-January | March-April | 55 | * | 12-25 m | growing | Yes |
| 3 | 2 | Azadirachta indica | white | April-June | June-August | 15 | MU | 15-20 m | growing | Yes |

| S.NO | Zone | To be introduced species | Colour of flower | Flowering season | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
|------|------|--------------------------|---------------------------------|-----------------------|------------------------------|---------------------------------|---------------------------|-------------------------|
| 1 | 2 | Alstonia scholaris | Greenish white or greyish color | October | | 40 m | 8-10 years | yes |
| 2 | 2 | Azadirachta indica | white | February to March | MU | 15-20 m | 4-5 years | yes |
| 3 | 2 | Cymbidium aloifolium | Yellow with red stripes | March to June | | | | |
| 4 | 2 | Lagerstroemia sp. | Pink, purple | August to October | | 20 m | 3 years | yes |
| 5 | 2 | Manilkara hexandra | White or light yellow | August to December | * | 12-25 m | 5-8 years | Yes |
| 6 | 2 | Melia azedarach | Purple or lilac | September to November | * | 15.2 m | 5-6 years | Yes |
| 7 | 2 | Murraya koenigii | white | | * | 4-6 m | 3-5 years | Partial |
| 8 | 2 | Neolamarckia cadamba | Red to orange | July to August | NA | 45 m | 5 years | Yes |

| | | | | | | | | |
|----|---|--------------------------|-----------------|--------------------|----|-----------|------------|---------|
| 9 | 2 | Pithecellobium dulce | white | June to August | ✓ | 10-15 m | 2-3 years | Yes |
| 10 | 2 | Podocarpus neriifolius | yellow | March to mid April | MU | 10-15 m | 4 years | yes |
| 11 | 2 | Pterospermum acerifolium | white | March to June | NA | 12-15 m | 4-5 years | Yes |
| 12 | 2 | Putranjiva roxburghii | yellow | March to June | NA | 20-22 m | | Yes |
| 13 | 2 | Syzygium cumini | white | October | * | 10-30 m | 5-8 years | yes |
| 14 | 2 | Tabernaemontana | white | February to March | NA | 1.5-1.8 m | 2-3 years | Partial |
| 15 | 2 | Terminalia bellirica | Greenish yellow | March to June | MU | 35 m | 8-10 years | yes |
| 16 | 2 | Thevetia peruviana | yellow | August to October | MU | 1.5-4 m | 1-2 years | partial |

Table 3 List of existing species of Zone 3 introduced

| S.No | Zone | Name of the existing species | Colour of flower | Flowering season | Fruiting season | No. of trees already existing | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
|------|------|------------------------------|----------------------|------------------|-----------------|-------------------------------|------------------------------|---------------------------------|---------------------------|-------------------------|
| 1 | 3 | Albizia lebeck | cream | April-July | September | 75 | NA | 20-25 m | Growing | yes |
| 2 | 3 | Anogeissus latifolia | Pale green or yellow | May-July | December | 77 | | 35 m | Growing | yes |
| 3 | 3 | Bridelia retusa | Creamy white | May-August | July-September | 57 | MU | 8 m | Growing | yes |
| 4 | 3 | Cassia fistula | yellow | April-July | August-October | 20 | MU | 10-20 m | Growing | Yes |

| | | | | | | | | | | |
|----|---|-----------------------------------|---|------------------|--------------------|----|----|---------|---------|-----|
| 5 | 3 | Senna sulfurea (=Cassia glauca | Bright yellow (drying orange or pinkish brown) | January-February | April-May | 10 | | 5.4-6 m | Growing | yes |
| 6 | 3 | Dalbergia latifolia | white | January-February | March-April | 20 | NA | 20-40 m | Growing | yes |
| 7 | 3 | Grewia tiliaefolia | Bright pink | January | January-February | 23 | * | 18 m | Growing | yes |
| 8 | 3 | Hardwickia binata | Pale yellowish green | July-August | September-February | 75 | NA | 25-30 m | Growing | yes |
| 9 | 3 | Holoptelea integrifolia | Greenish - yellow to brownish | March-April | May-August | 50 | MU | 25 m | Growing | yes |
| 10 | 3 | Kigelia africana | Dark red | April-May | January-February | 3 | NO | 15-18 m | Growing | yes |
| 11 | 3 | Psidium guajava | white | April-June | July-October | 20 | ✓ | 6-10 m | Growing | yes |
| 12 | 3 | Pterocarpus marsupium | yellow | July-September | April-June | 5 | MU | 30 m | Growing | yes |
| 13 | 3 | Pterospermum acerifolium | white | March-July | July-August | 25 | NA | 15-21 m | Growing | yes |
| 14 | 3 | Salvadora persica | Greenish yellow | January-April | July | 3 | * | 6-7 m | Growing | yes |

| | | | | | | | | | | |
|----|---|--------------------------|---|--------------------|------------------------|----|----|---------|-------------|-----|
| 15 | 3 | Schleichera oleosa | Greenish yellow | Februar y-March | August- September | 34 | * | 10-15 m | Growi ng | yes |
| 16 | 3 | Sapindus mukorossi | white | May- June | November- January | 5 | MU | 12-20 m | Growi ng | yes |
| 17 | 3 | Spathodea campanulata | Reddish orange or crimson (rarely yellow) | March- April | July- November | 25 | MU | 7-12 m | Growi ng | yes |
| 18 | 3 | Syzygium cumini | white | May June | July-August | 57 | * | 10-30 m | Growi ng | yes |
| 19 | 3 | Terminalia arjuna | Pale yellow | April- May | September- November | 60 | MU | 20-25 m | Growi ng | yes |
| 20 | 3 | Terminalia bellirica | Greenish yellow | April- June | November- February | 65 | MU | 35 m | Growi ng | yes |
| 21 | 3 | Terminalia chebula | Dull white to yellow | April- June | January- March | 60 | * | 38 m | Growi ng | yes |
| 22 | 3 | Thespesia populnea | Yellow or orange | January- March | July- November | 20 | * | 6-9 m | Growi ng | yes |
| 23 | 3 | Trewia nudiflora | Pale green | Februar y-March | July- November | 30 | NA | 5 m | Growi ng | yes |

| S.NO | Zone | To be introduced species | Colour of flower | Flowering season | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
|------|------|-----------------------------|----------------------|---------------------|---------------------------------------|--|---------------------------------|-------------------------------|
| 1 | 3 | Alstonia sp. | Greenish white or | October | | 40 m | 8-10 years | yes |

| | | | | | | | | |
|----|---|--------------------------------------|-----------------------|-------------------------|----|---------|--------------------|---------|
| | | | greyish color | | | | | |
| 2 | 3 | Annona reticulata | Greenish yellow | May to June | * | 7.5 m | 3-4 years | partial |
| 3 | 3 | Anogeissus latifolia | Pale green or yellow | June to September | | 35 m | 5-8 years | yes |
| 4 | 3 | Bottle Palm (Hyophorbe lagenicaulis) | White or cream | - | | 6 m | 6-10 years | no |
| 5 | 3 | Caryota sp. (fishtail palm) | white | | | 2.4-6 m | 10-20 years | no |
| 6 | 3 | Cycas revoluta (Gymnosperm) | - | Once every 3 to 4 years | MU | 6-7 m | more than 10 years | no |
| 7 | 3 | Garcinia cowa | Mostly pale yellow | December to September | * | 15 m | 10-12 years | yes |
| 8 | 3 | Lagerstroemia speciosa | Pink or purple | June to July | NA | 20 m | 3 years | yes |
| 9 | 3 | Lagerstroemia sp. | Pink or purple | August to October | | 20 m | 3 years | yes |
| 10 | 3 | Mangifera indica | Yellowish or reddish | November to December | ✓ | 3.7 m | 5 or more years | yes |
| 11 | 3 | Manilkara hexandra | White or light yellow | August to December | * | 12-25 m | 5-8 years | yes |

| | | | | | | | | |
|----|---|----------------------------|--------------------|-------------------------------|----|-----------|------------|---------|
| 12 | 3 | Melia azedarach | Purple or lilac | September to November | * | 15.2 m | 5-6 years | yes |
| 13 | 3 | Moringa oleifera | white | January | | 10-12 m | 2-3 years | yes |
| 14 | 3 | Neolamarckia cadamba | Red to orange | June to August | MU | 45 m | 5 years | yes |
| 15 | 3 | Pithecellobium dulce | white | March to mid April | ✓ | 10-15 m | 2-3 years | yes |
| 16 | 3 | Podocarpus neriifolius | yellow | March to June | MU | 10-15 m | 4 years | yes |
| 17 | 3 | Pterospermum acerifolium | white | March to June | NA | 12-15 m | 5-7 years | yes |
| 18 | 3 | Salix alba | Gray green | February | NO | 30 m | 20 years | yes |
| 19 | 3 | Schefflera arboricola | White, pink or red | Once in a while (May to June) | | 2.5-3 m | 10 years | partial |
| 20 | 3 | Syzygium cumini | white | March to April | * | 10-30 m | 5-8 years | yes |
| 21 | 3 | Tabernaemontana divaricata | white | March to June | NA | 1.5-1.8 m | 2-3 years | partial |
| 22 | 3 | Terminalia bellirica | Greenish yellow | April to May | MU | | 8-10 years | |

| | | | | | | | | |
|----|---|--|-----------------------|---------------------|----|---------|-------------|---------|
| 23 | 3 | Thevetia peruviana | yellow | Throughout the year | MU | 1.5-4 m | 2-3 years | yes |
| 24 | 3 | Triphasia trifolia | white | December to April | * | 3 m | 3-4 years | no |
| 25 | 3 | Washingtonia robusta | cream | March to June | NA | 25 m | 5-8 years | partial |
| 25 | | Grewia asiatica L. | Yellow | March-June | * | 8 m | 4-6 years | yes |
| 25 | | Lagerstroemia sp. | White to purple | August to October | | | | yes |
| 25 | | Madhuca longifolia var. latifolia (Roxb.) A.Chev | Creamy white | February-April | NO | 20 m | 10 years | yes |
| 25 | | Manilkara hexandra | White or light yellow | August to December | * | | 5-8 years | |
| 25 | | Sapindus laurifolius Balb. ex. DC. | Creamy white | December-March | | 6 m | 9-10 years | |
| 25 | | Terminalia chebula | Dull white to yellow | February -May | * | | 10-20 years | |

Table 4 List of existing species of Zone 4 and introduced plants

| S.No | Zone | Name of the existing species | Colour of flower | Flowering season | Fruiting season | No. of trees already existing | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
|------|------|------------------------------|----------------------|--------------------|--------------------|-------------------------------|------------------------------|---------------------------------|---------------------------|-------------------------|
| 1 | 4 | Albizia lebeck | cream | April-July | September-December | 33 | NA | 20-25 | growing | Yes |
| 2 | 4 | Anogeissus latifolia | Pale green or yellow | September-November | December-January | 40 | | 35 m | growing | Yes |
| 3 | 4 | Bridelia retusa | Creamy white | November-January | February-April | 50 | MU | 8 m | growing | Yes |

| | | | | | | | | | | |
|----|---|----------------------------|-------------------------------------|-----------------------|-----------------------|----|----|---------|---------|-----|
| 4 | 4 | Cassia fistula | yellow | April-July | August- December | 25 | MU | 10-20 m | growing | yes |
| 5 | 4 | Hardwickia binata | Pale yellowish green | July-August | September- January | 80 | NA | 25-30 m | growing | yes |
| 6 | 4 | Holoptelea integrifolia | Greenish - yellow to brownish | January- February | April-May | 56 | MU | 25 m | growing | yes |
| 7 | 4 | Terminalia bellirica | Greenish yellow | April-June | November- January | 60 | MU | 35 m | growing | yes |
| 8 | 4 | Terminalia arjuna | Pale yellow | April-June | July-August | 55 | MU | 20-25 m | growing | yes |
| 9 | 4 | Syzygium cumini | white | April-May | June- July | 67 | * | 10-30 m | growing | yes |
| 10 | 4 | Dalbergia latifolia | white | December- February | March-April | 20 | NA | 1.5-2 m | growing | yes |
| 11 | 4 | Grewia tiliaefolia | Bright pink | Decemeber- January | February | 55 | * | 18 m | growing | yes |
| 12 | 4 | Kigelia africana | Dark red | March-May | June-July | 3 | NO | 15-20 m | growing | yes |
| 13 | 4 | Pterocarpus marsupium | yellow | May | June | 45 | MU | 30 m | growing | yes |
| 14 | 4 | Schleichera oleosa | Greenish yellow | March-April | May-June | 25 | * | 10-15 m | growing | yes |

| S.N O | Zon e | To be introduced species | Colour of flower | Flowering season | Wheth er commo n fruit bearing | Approx . height of grown up tree | Approx time taken to grow | Whether provides shadow |
|----------|----------|-----------------------------|---------------------|---------------------|--|--|---------------------------------|-------------------------------|
| 1 | 4 | Acacia catechu | yellow | June to August | NO | 15 m | 5-7 years | yes |

| | | | | | | | | |
|----|---|----------------------|----------------------------------|-------------------------|----|-----------|--------------------|-----|
| 2 | 4 | Acalypha hispida | Bright red to deep pink | February to June | NO | 1.5-3.7 m | 4-6 years | no |
| 3 | 4 | Adenium obesum | Creamish-white with violet edges | July to September | NA | 1.8-2.7 m | 1-2 years | no |
| 4 | 4 | Aegle marmelos | Greenish white | January to May | * | 13 m | 4-5 years | yes |
| 5 | 4 | Albizia lebbek | cream | February to April | NA | 20-25 | 8-10 years | Yes |
| 6 | 4 | Albizia sps(BL) | cream | February to June | | 7-15 m | 8-10 years | yes |
| 7 | 4 | Annona reticulata | Greenish yellow | May to June | * | 7.5 m | 3-4 years | yes |
| 8 | 4 | A indica | white | May to June | MU | | | |
| 9 | 4 | Anogeissus latifolia | Pale green or yellow | September to March | | 35 m | 5-8 years | yes |
| 10 | 4 | Azadirachta indica | white | April to June | MU | 15-20 m | 4-5 years | yes |
| 11 | 4 | Barleria prionitis | Yellow or pale orange | August to March | NA | 1.8 m | 1 year | no |
| 12 | 4 | Bauhinia sp. | purple | January to June | | 6-12 m | 2 years | yes |
| 13 | 4 | Bauhinia variegata | Pink or dark purple | January to April | MU | 6-12 m | 3-4 years | yes |
| 14 | 4 | Clerodendrum indicum | white | na | NA | 1.5-3 m | 2-3 years | no |
| 15 | 4 | Cassia fistula | yellow | May to July | MU | | 10 years | |
| 16 | 4 | Cassia glauca | yellow | May to June | | 5.4-6 m | 8-10 years | yes |
| 17 | 4 | Jacaranda sps | Purple, white | January to March | | 20 m | 2-14 years | yes |
| 18 | 4 | Mimusups sps | cream | June to July | | 25 m | 3-4 years | yes |
| 19 | 4 | Cycas beddomei | - | Once every 3 to 4 years | | 3.5 m | more than 10 years | no |

| | | | | | | | | |
|----|---|--|--------------------------------|------------------------|----|---------|------------|-----|
| 20 | 4 | Dalbergia sissoo | Whitish to pink | March to May | NA | 25 m | 7-8 years | yes |
| 21 | 4 | Desmodium oojeinense | White or pink | February to May | NA | 7-14 m | 6-8 years | yes |
| 22 | 4 | Parkia sps | Bright red | March to May | | 10-15 m | 5-7 years | yes |
| 23 | 4 | Ehretia laevis | white | January to April | MU | 9 m | 4-5 years | yes |
| 24 | 4 | Euphorbia sp. | Yellow, red also | March to June | | .45 m | 2-5 years | no |
| 25 | 4 | Ficus elastica | Not seen | March to May | NA | 30 m | 13 years | yes |
| 26 | 4 | Ficus panda | Not seen | March to May | | 2-30 m | 5-7 years | yes |
| 27 | 4 | Gardenia turgida | White turning yellow with time | November to January | | 8 m | 3-5 years | yes |
| 28 | 4 | Ginkgo biloba | yellow | April to May | | 50 m | 20 years | yes |
| 29 | 4 | Haplophragma adenophyllum | Pale yellow | March to May | | 10-15 m | 4-5 years | yes |
| 30 | 4 | Jacaranda mimosifolia | blue | Late May or early June | NA | 20 m | 2-14 years | yes |
| 31 | 4 | Jatropha gossypifolia | Dark red | March to June | NA | 2 m | 2-3 years | no |
| 32 | 4 | Lagerstroemia speciosa | Pink or purple | June to July | NA | 20 m | 3 years | yes |
| 33 | 4 | Livistona chinensis (chinese fan palm) | Blue-black | - | NA | 15 m | 10 years | yes |
| 34 | 4 | Livistona decipiens (ribbon fan palm) | yellow | - | NA | 9-10 m | 10 years | yes |
| 35 | 4 | Madhuca indica | cream | March to May | | 20 m | 10 years | yes |
| 36 | 4 | Manilkara hexandra | White or light yellow | August to December | * | 12-25 m | 5-8 years | yes |
| 37 | 4 | Melia azedarach | Purple or lilac | September to November | * | 15.2 m | 5-6 years | yes |
| 38 | 4 | Murraya koenigii | Cream, | July to August | * | 2-5 m | 3-5 years | yes |

| | | | | | | | | |
|----|---|----------------------------|--------------------------------------|---|----|-----------|------------|---------|
| | | | white | | | | | |
| 39 | 4 | Murraya paniculata | white | - | MU | 6 m | 3-4 years | yes |
| 40 | 4 | Phyllanthus emblica | white | March to April | * | 18 m | 8-10 years | yes |
| 41 | 4 | Pithecellobium dulce | white | March to mid-April | ✓ | 10-15 m | 2-3 years | yes |
| 42 | 4 | Plumeria alba | White or creamish white | Throughout the year | NA | .9-6.1 m | 1-3 years | yes |
| 43 | 4 | Pongamia pinnata | White, pink or lavender | April to June | NA | 15-25 m | 4-5 years | yes |
| 44 | 4 | Prosopis cineraria | Yellow or creamish white | February to May | MU | 3-5 m | 7-8 years | yes |
| 45 | 4 | Putranjiva roxburghii | yellow | March to May | NA | 20-22 m | | yes |
| 46 | 4 | Salix alba | Gray green | February | NO | 30 m | 20 years | yes |
| 47 | 4 | Santalum album | Purplish brown | March to April and September to October | MU | 20 m | 7-10 years | yes |
| 48 | 4 | Saraca asoca | Gold/yellow, sometimes pink or white | December to March | MU | 7-10 m | 6-8 years | yes |
| 49 | 4 | Schefflera arboricola | White, pink or red | Once in a while (May to June) | | 2.4-3 m | 5 years | yes |
| 50 | 4 | Schleichera oleosa | Greenish yellow | March to June | * | 10-15 m | 5-8 years | yes |
| 51 | 4 | Spondias pinnata | Greenish white | April to June | MU | 10-15 m | 5 years | yes |
| 52 | 4 | Sterculia urens | Greenish yellow | January to April | * | 15 m | 5-7 years | yes |
| 53 | 4 | Tabernaemontana divaricata | white | March to June | NA | 1.5-1.8 m | 3-4 years | partial |

| | | | | | | | | |
|----|---|--|-----------------------|----------------------|----|---------|-------------|---------|
| 54 | 4 | Tamarindus indica | Yellow with red veins | January to April | ✓ | 12-14 m | 3-4 years | yes |
| 55 | 4 | Tecomella undulata | red to orangish red | December to February | MU | 2-6 m | 3-4 years | no |
| 56 | 4 | Terminalia arjuna | Pale yellow | May to June | MU | | 6 years | |
| 57 | 4 | Terminalia bellirica | Greenish yellow | April to May | MU | | 7-8 years | |
| 58 | 4 | Adansonia digitata L. | white | October-December | * | 5-25 m | 8-10 years | partial |
| 59 | 4 | Aegle marmelos (L.) Correa | Greenish white | May-June | * | | 4-5 years | |
| 60 | 4 | Annona squamosa L. | Greenish-yellow | April-August | ✓ | 3-6 m | 2-3 years | yes |
| 61 | 4 | Bauhinia tomentosa | yellow | November-December | MU | 4 m | 2 years | yes |
| 62 | 4 | Buchanania cochinchinensis (Lour.) M.R.Almeida | greenish | January- April | | 18 m | 15-20 years | yes |
| 63 | 4 | Butea monosperma (Lam.) Taub. | Bright orange-red | February- April | NA | 15 m | 10-15 years | yes |
| 64 | 4 | Casuarina equisetifolia L. | red | February-June | NA | 6-35 m | 3-5 years | yes |
| 65 | 4 | Clerodendrum indicum (L.) Kuntze | white | January-May | NA | 2.7 m | | yes |
| 66 | 4 | Commiphora wightii (Arn.) Bhandari | Red to pink | November-July | NA | 4 m | 10 years | yes |
| 67 | 4 | Cordia macleodii Hook.f. & Thomson | white | April-June | | 9-12 m | 12 years | yes |
| 68 | 4 | Desmodium oojeinense (Roxb.) H.Ohashi | Pink or light purple | December-February | NA | 12 m | | yes |
| 69 | 4 | Erythrina suberosa | | April-May | NA | 12 m | 8-10 years | yes |

| | | | | | | | | |
|----|---|--|---|----------------------|----|--------------|-------------|-----|
| | | Roxb. | | | | | | |
| 70 | 4 | Ficus racemosa L. | Not seen | November- January | * | 8 m | 4-8 years | yes |
| 71 | 4 | Gardenia latifolia Aiton. | White turning yellow with time | April-July | | 30 m | 10-15 years | yes |
| 72 | 4 | Haldina cordifolia (Roxb.) Ridsdale | Yellow often tinged with shade of pink | December- March | NA | 40 m | 5-8 years | yes |
| 73 | 4 | Hardwickia binata Roxb. | Pale yellowish green | August- september | NA | 25-30 m | 10-15 years | yes |
| 74 | 4 | Helicteres isora L. | Bright orange | April-December | | 1.5-3 m | 6-7 years | yes |
| 75 | 4 | Indopiptadenia oudhensis | Greenish yellow | February-March | | 156- 908m | 5-8 years | yes |
| 76 | 4 | Lawsonia inermis L. | Yellow, red, white, Pink | April-July | NA | 2-6 m | 5 years | yes |
| 77 | 4 | Limonia acidissima L. | Cream/off- white, red, yellow/gold en-yellow | March-May | * | 9 m | 8-10 years | yes |
| 78 | 4 | Manilkara hexandra (Roxb.) Dubard | White or light yellow | December- January | * | | | |
| 79 | 4 | Populus deltoids W.Bartram ex Marshall | Red, yellow | March-April | | 30-45 m | 8 years | Yes |
| 80 | 4 | Pterocarpus marsupium Roxb. | yellow | November- January | MU | 25 m | 8-10 years | yes |
| 81 | 4 | Pterocarpus santalinus L.f. | yellow | February-May | | 8 m | 3-5 years | yes |

| | | | | | | | | |
|----|---|---|--------------------|----------------------|----|------|-------------|-----|
| 82 | 4 | Prunus cerasoides | Pinkish white | October- November | MU | 30 m | 5-6 years | yes |
| 83 | 4 | Radermachera xylocarpa (Roxb.) ex K. Schum. | Red | March -April | NA | 20 m | 3-7 years | yes |
| 84 | 4 | Schleichera oleosa (Lour.) Merr. | Greenish yellow | March-April | * | | 5-8 years | |
| 85 | 4 | Shorea robusta Roxb. ex Gaertn. | white | January-March | MU | 50 m | | yes |
| 86 | 4 | Simarouba amara Aubl. | white | February- April | * | 35 m | 4-6 years | yes |
| 87 | 4 | Soymida febrifuga (Roxb.) A. Juss. | white | February- April | NA | 25 m | 5 years | yes |
| 88 | 4 | Strychnos nux- vomica L. | Pale green | March-May | MU | 20 m | 15-20 years | yes |
| 89 | 4 | Terminellia arjuna | Pale yellow | May-June | MU | | | |
| 90 | 4 | Terminelia elliptica | Dull yellow | April-May | NA | 20 m | 8 years | yes |

Table 5 List of existing species of Zone 5 introduced

| S.No | Zone | Name of the existing species | Colour of flower | Flowering season | Fruiting season | No. of trees already existing | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
|------|------|------------------------------|--------------------------|--------------------|-----------------------|-------------------------------|------------------------------|---------------------------------|---------------------------|-------------------------|
| 1 | 5 | <i>Wrightia tinctoria</i> | Light green yellowish | August- October | November- December | 45 | MU | 0.3-.75 m | | no |
| 1 | 5 | <i>Dalbergia sericea</i> | Light pink | February- March | April | 35 | | 10 m | | yes |
| 1 | 5 | <i>Terminalia alata</i> | Greenish yellow | March- May | June-August | 66 | | 32 m | | yes |
| 1 | 5 | <i>Terminalia bellirica</i> | Greenish yellow | April-May | June | 67 | MU | 30m | | yes |

| | | | | | | | | | |
|---|---|-----------------------------|-----------------|---------------|------------------|----|----|----------|-----|
| 1 | 5 | <i>Dalbergia sissoo</i> | Whitish to pink | March-May | June-July | 50 | NA | 25 m | yes |
| 1 | 5 | <i>Albizia odoratissima</i> | white | April-October | November-January | 78 | NA | 15- 25 m | yes |
| 1 | 5 | <i>Pithecolobium dulce</i> | white | April-June | July-August | 77 | ✓ | 10-15 m | yes |

| S.NO | Zone | To be introduced species | Colour of flower | Flowering season | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
|------|------|---------------------------------|--------------------------------|--------------------|------------------------------|---------------------------------|---------------------------|-------------------------|
| 1 | 5 | <i>Aegle marmelos</i> | Greenish white | June-September | * | 8-10 m | 4-5 years | yes |
| 2 | 5 | <i>Melia dubia</i> | Greenish white | January-December | * | 0.6-0.7 m | 2-3 years | no |
| 3 | 5 | <i>Azadirachta indica</i> | white | April-June | MU | 15-20 m | 4-5 years | yes |
| 4 | 5 | <i>Bauhinia sp</i> | pink | July to October | | 6-12 m | 2 years | yes |
| 5 | 5 | <i>Bauhinia variegata</i> | Pink or dark purple | January-December | MU | 6-12 m | 2-3 years | yes |
| 6 | 5 | <i>Euphorbia sp.</i> | Yellow, red also | - | | 0.914 m | 4-6 years | no |
| 7 | 5 | <i>Ficus glomerata</i> | Greenish white to purplish red | February-May | * | 18 m | 8-10 years | yes |
| 8 | 5 | <i>Jatropha gossypifolia</i> | Dark red | January-December | NA | 3 m | 2-3 years | yes |
| 9 | 5 | <i>Lagerstroemia parviflora</i> | White to purple | Spring(March-May) | NA | 30 m | 2-3 years | yes |
| 10 | 5 | <i>Lagerstroemia speciosa</i> | Pink or purple | April-July | NA | 20 m | 3 years | yes |

| | | | | | | | | |
|----|---|------------------------------------|---|-------------------|----|------------|-----------|-----|
| 11 | 5 | <i>Pedilanthus tithymaloides</i> | Bright white and pink | April-August | NO | 2 m | 5-7 years | yes |
| 12 | 5 | <i>Portulacaria afra</i> | pink | April-May | | 4.5 m | | yes |
| 13 | 5 | <i>Prosopis cineraria</i> | Yellow or creamy white | August to January | MU | 3-5 m | 7-8 years | yes |
| 14 | 5 | <i>Salvadora persica</i> | Greenish yellow | February to June | * | 6-7 m | 3-7 years | yes |
| 15 | 5 | <i>Tylophora indica</i> | Greenish yellow outside and purplish within | October-December | NA | 1.5- 2.5 m | 5 years | yes |
| 16 | 5 | <i>Cynanchum viminalis</i> (L.) L. | Yellow-green | August-May | MU | 2 m | 4 years | yes |
| 17 | 5 | <i>Ephedra foliata</i> | Pale yellow | - | | 0.3 m | | no |
| 18 | 5 | <i>Prosopis cineraria</i> | Yellow or creamish white | August to January | | 3-5 m | | yes |
| 19 | 5 | <i>Senegalia catechu</i> | Red | - | MU | 15 m | 5-7 years | yes |
| 20 | 5 | <i>Senegalia visco</i> | yellow | April-October | NA | 6-12 m | 3-4 years | yes |

Table 6 List of existing species of Zone 6 introduced

| S.No | Zone | Name of the existing species | Colour of flower | Flowering season | Fruiting season | No. of trees already existing | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provide shadow |
|------|------|------------------------------|------------------|------------------|-----------------|-------------------------------|------------------------------|---------------------------------|---------------------------|------------------------|
| 1 | 6 | <i>Albizia lebbek</i> | cream | April-July | September | 45 | NA | 18-30 m | growing | yes |
| 2 | 6 | <i>Bridelia retusa</i> | Creamy white | May-August | July-September | 25 | MU | 10 m | growing | yes |
| 3 | 6 | <i>Cassia fistula</i> | yellow | April-July | October | 3 | MU | 9-12 m | growing | yes |

| | | | | | | | | | | |
|----|---|--------------------------------|---|-------------------|--------------------|----|----|---------|---------|-----|
| 4 | 6 | <i>Gmelina arborea</i> | Yellow tinged with brown | March-May | March-May | 25 | MU | 3-30 m | growing | yes |
| 5 | 6 | <i>Holoptelea integrifolia</i> | Greenish-yellow to brownish | May | May | 44 | MU | 22 m | growing | yes |
| 6 | 6 | <i>Mitragyna parvifolia</i> | yellow | August-September | November-February | 12 | NO | 12-15 m | growing | yes |
| 7 | 6 | <i>Oroxylum indicum</i> | Reddish purple outside and pale pinkish yellow within | June-July | November-February | 55 | * | 18 m | growing | yes |
| 8 | 6 | <i>Pterocarpus marsupium</i> | yellow | July-September | April-June | 5 | MU | 30 m | growing | yes |
| 9 | 6 | <i>Schleichera oleosa</i> | Greenish yellow | February-March | August-September | 24 | * | 20 m | growing | yes |
| 10 | 6 | <i>Spondius pinnata</i> | Greenish white | May | June | 34 | MU | 10-15 m | growing | yes |
| 11 | 6 | <i>Sterculia urens</i> | Greenish yellow | January-March | April-December | 45 | * | 15-20 m | growing | yes |
| 12 | 6 | <i>Terminalia arjuna</i> | Pale yellow | April-May | September-November | 66 | MU | 30 m | growing | yes |
| 13 | 6 | <i>Terminalia bellirica</i> | Greenish yellow | April-June | December-January | 67 | MU | 30 m | growing | yes |
| 14 | 6 | <i>Dalbergia latifolia</i> | white | December-February | March-May | 45 | NO | 20-40 m | growing | yes |

| S.NO | Zone | To be introduced species | Colour of flower | Flowering season | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
|------|------|--------------------------|------------------|------------------|------------------------------|---------------------------------|---------------------------|-------------------------|
|------|------|--------------------------|------------------|------------------|------------------------------|---------------------------------|---------------------------|-------------------------|

| | | | | | | | | |
|---|---|--|--|-----------------------|----|---------|----------------|-----|
| 1 | 6 | <i>Shorea robusta</i> | white | October-January | MU | 20-25 m | 15 years | yes |
| 2 | 6 | <i>Terminalia bellirica</i> | Greenish yellow | October-January | MU | 30 m | 7-8 years | yes |
| 3 | 6 | <i>Desmodium</i> <i>sps</i> | Pink or light purple | April-May | | 10-12 m | 6-8 years | yes |
| 4 | 6 | <i>Robinia</i> <i>sps</i> | White to pink or pinkish- red | January-March | | 12-30 m | 10-15 years | yes |
| 5 | 6 | <i>Dalbergia</i> <i>latifolia</i> | white | December- February | NA | 20-40 m | 8-10 years | yes |
| 6 | 6 | <i>Acacia</i> <i>auriculiformis</i> | Light green yellowish | March-April | NA | 12 m | 5-6 years | yes |
| 7 | 6 | <i>Phoenix</i> <i>sylvestris</i> | white | January- December | MU | 4-15 m | 7-10 years | yes |
| 8 | 6 | <i>Shorea</i> <i>robusta</i> | white | October-January | | 20-25 m | | yes |
| 9 | 6 | <i>Terminalia</i> <i>bellirica</i> | Greenish yellow | October-January | MU | 30 m | | yes |

Table 7 List of existing species of Zone 7 and introduced (Subtropical Dry evergreen forest)

| S.No | Zone | Name of the existing species | Colour of flower | Flowering season | Fruiting season | No. of trees already existing | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow |
|------|------|------------------------------|-------------------|--------------------|----------------------|-------------------------------|------------------------------|---------------------------------|---------------------------|-------------------------|
| 1 | 7 | <i>Aegle marmelos</i> | Greenish white | June- September | October- December | 10 | * | 8-10 m | Growing | yes |

| | | | | | | | | | | |
|----|---|--|---|--------------------|--------------------|----|----|-----------|---------|-----|
| 2 | 7 | <i>Bauhinia purpurea</i> | pink | September-December | January-March | 22 | MU | 17 m | Growing | yes |
| 3 | 7 | <i>Bridelia retusa</i> | Creamy white | December-January | February-April | 34 | MU | 10 m | Growing | yes |
| 4 | 7 | <i>Ceiba pentandra</i> | Pink, pale pink, pale yellow, white, creamy white | March | April | 7 | * | 15 m | Growing | yes |
| 5 | 7 | <i>Dalbergia latifolia</i> | white | December-February | March-April | 20 | NO | 20-40 m | Growing | yes |
| 6 | 7 | <i>Gmelina arborea</i> | Pale yellow to cream colored or pinkish-buff | February-April | May-July | 29 | MU | 3-30 m | Growing | yes |
| 7 | 7 | <i>Grewia optiva</i> | Yellowish red | May-August | September-November | 35 | MU | 13-15 m | Growing | yes |
| 8 | 7 | <i>Haldina cordifolia</i> | Yellow often tinged with shade of pink | June-July | October-November | 44 | NA | 18-30 m | Growing | yes |
| 9 | 7 | <i>Jatropha curcas</i> | Dark or crimson red | March-July | August-November | 25 | MU | 6 m | Growing | yes |
| 10 | 7 | <i>Mitragyna parvifolia</i> | yellow | July-August | September-October | 10 | NO | 12 -16 m | Growing | yes |
| 11 | 7 | <i>Schleichera oleosa</i> | Greenish yellow | February-March | August-September | 34 | * | 20 m | Growing | yes |
| 12 | 7 | <i>Firmiana simplex</i> (=Sterculia urens) | Greenish yellow | January-February | March-April | 43 | * | 7.-10.6 m | Growing | yes |
| 13 | 7 | <i>Terminalia arjuna</i> | Pale yellow | April-May | September-November | 67 | MU | 30 m | Growing | yes |

| 14 | 7 | <i>Terminalia bellirica</i> | Greenish yellow | April-June | December-January | 66 | MU | 30 m | Growing | yes |
|------|------|-------------------------------|---|--------------------|------------------------------|---------------------------------|---------------------------|-------------------------|---------|-----|
| 15 | 7 | <i>Trewia nudiflora</i> | Pale green | February-March | July-November | 10 | NA | 5-10 m | Growing | yes |
| S.NO | Zone | To be introduced species | Colour of flower | Flowering season | Whether common fruit bearing | Approx. height of grown up tree | Approx time taken to grow | Whether provides shadow | | |
| 1 | 7 | <i>Ceiba pentandra</i> | Pink, pale pink, pale yellow, white, creamy white | March | * | 46 m | 4-5 years | yes | | |
| 2 | 7 | <i>Feronia elephantum</i> | Yellowish green | February-March | | 6-7.5 m | 5-7 years | yes | | |
| 3 | 7 | <i>Grevillea robusta</i> | Golden orange | September-December | NA | 5-40 m | 6 years | yes | | |
| 4 | 7 | <i>Mimusops elengi</i> | Cream or yellowish white | March to April | * | 5-8 m | 3-4 years | yes | | |
| 5 | 7 | <i>Phoenix sylvestris</i> | | August | MU | 4-15 m | 7-10 years | yes | | |
| 6 | 7 | <i>Podocarpus neriifolius</i> | white | – | MU | 1-25 m | 4 years | yes | | |
| 7 | 7 | <i>Thespesia populnea</i> | Yellow or sometimes green | January-March | * | 9 m | 7-10 years | yes | | |

ANNEXURE II

| Locality | Species | Accessions | Collected by | Voucher No |
|---------------|----------------------------|------------------------|---------------------|------------|
| Kaza | <i>Hyoscyamus niger</i> L. | NMHS_BGIR_2019 1 to 69 | Dwivedi et al. 2019 | |
| Kaza, Rangrik | <i>Ephedra gerardiana</i> | NMHS_BGIR_2019 | Dwivedi et | |

| | | | | |
|-----------------------------------|--|----------------------------------|-------------------------------------|---|
| | Wall. ex Stapf | 69 to 83 | <i>al.</i> 2019 | |
| Kaza | <i>Crotolaria</i> spp. | NMHS_BGIR_2019 83 to 97 | Dwivedi <i>et al.</i> 2019 | |
| Kibber | <i>Capparis</i> sp. | NMHS_BGIR_2019 97 to 103 | Dwivedi <i>et al.</i> 2019 | |
| Chicham, Pin valley national park | <i>Allium</i> spp. | NMHS_BGIR_2019 103 to 118 | Dwivedi <i>et al.</i> 2019 | MW169014, MW169015, MW169012 MW169013, MW169001 MW169002 MW169003 MW169004 MW169005 MW169006 MW169007 MW169008 MW169009 MW169010 MW169011 |
| Rangrik | <i>Dactylorhiza hatagirea</i> (D. Don) Soo | NMHS_BGIR_2019 118 to 125 | Dwivedi <i>et al.</i> 2019 | |
| Pin valley N.P | <i>Primula</i> sp. | NMHS_BGIR_2019 125 to 137 | Dwivedi <i>et al.</i> 2019 | |
| Pin valley N.P | <i>Aconitum</i> sp. | NMHS_BGIR_2019 137 to 149 | Dwivedi <i>et al.</i> 2019 | |
| Pin valley N.P | <i>Rheum spiciforme</i> Royle | NMHS_BGIR_2019 149 to 162 | Dwivedi <i>et al.</i> 2019 | |
| Pin valley N.P | Wild rose sp. | NMHS_BGIR_2019 162 to 174 | Dwivedi <i>et al.</i> 2019 | |
| Kullu | <i>Jasminum parkeri</i> Dunn | NMHS_BGIR_2019- 20 174 to 183 | Dwivedi <i>et al.</i> 2019, 2020 | |

| | | | | |
|-------------------------------|---|-----------------------------------|-------------------------------------|-----------------|
| Kullu | <i>Valleriana</i> spp. | NMHS_BGIR_2019 - 20 183 to 197 | Dwivedi <i>et al.</i> 2019, 2020 | |
| Kullu | <i>Stevia</i> spp. | NMHS_BGIR_2019- 20 197 to 206 | Dwivedi <i>et al.</i> 2019, 2020 | |
| Kullu | <i>Viola</i> spp. | NMHS_BGIR_2019- 20 206 to 233 | Dwivedi <i>et al.</i> 2019, 2020 | |
| Kullu | <i>Nardostachys jatamansi</i> (D. Don) DC. | NMHS_BGIR_2019- 20 233 to 272 | Dwivedi <i>et al.</i> 2019, 2020 | |
| Kullu | <i>Saussurea costus</i> (Falc.) Lipsch. | NMHS_BGIR_2019- 20 272 to 326 | Dwivedi <i>et al.</i> 2019, 2020 | |
| Solan | <i>Berberis</i> spp | NMHS_BGIR_2019- 20 326 to 353 | Dwivedi <i>et al.</i> 2019, 2020 | |
| Solan | <i>Trachycarpus takil</i> Becc. | NMHS_BGIR_2019- 20 353 to 372 | Dwivedi <i>et al.</i> 2019, 2020 | |
| Kullu | <i>Barleria</i> spp. | NMHS_BGIR_2019- 20 372 to 392 | Dwivedi <i>et al.</i> 2019, 2020 | |
| Kullu | <i>Rubus</i> spp. | NMHS_BGIR_2019- 20 392 to 421 | Dwivedi <i>et al.</i> 2019, 2020 | |
| Kashmir | <i>Caragana conferta</i> Baker | | | Duthie JF 12192 |
| Andaman and Nicobar Island | <i>Heliconia caribaea</i> Lam. | FJ428106, FJ428180 | | |
| Andaman and Nicobar Island | <i>Heliconia psittacorum</i> L. f. | FJ428105, FJ428179 | | |

| | | | | |
|----------------------------|---|-----------------------|--|--|
| Andaman and Nicobar Island | <i>Musa acuminata</i> Colla | MT028132, MT181062 | | |
| Andaman and Nicobar Island | <i>M. acuminata ssp. banksii</i> F. Muell | FJ428097, FJ428161 | | |
| Andaman and Nicobar Island | <i>M. acuminata ssp. burmannica</i> N.W. Simmonds | FJ428083, FJ428169 | | |
| Andaman and Nicobar Island | <i>M. acuminata ssp. errans</i> R.V. Valmayor | FJ428094, FJ428160 | | |
| Andaman and Nicobar Island | <i>M. acuminata ssp. microcarpa</i> N.W. Simmonds | FJ428087, FJ428174 | | |
| Andaman and Nicobar Island | <i>M. acuminata ssp. siamea</i> N.W. Simmonds | FJ428084, FJ428175 | | |
| Andaman and Nicobar Island | <i>M. acuminata ssp. zebrina</i> Van Houtte | FJ428089, FJ428173 | | |
| Andaman and Nicobar Island | <i>M. aurantiaca</i> Baker | FJ428090, FJ42816 | | |
| Andaman and Nicobar Island | <i>M. balbisiana</i> Colla | MT159446, MT181064 | | |
| Andaman and Nicobar Island | <i>M. balbisiana var. andamanica</i> | MT028138, MT181070 | | |
| Andaman and Nicobar Island | <i>M. barioensis</i> Häkkinen | FJ428067, FJ428185 | | |
| Andaman and Nicobar Island | <i>M. basjoo</i> linuma | FJ428100, FJ428188 | | |
| Andaman and Nicobar Island | <i>M. coccinea</i> Andrews | FJ428062, FJ428192 | | |
| Andaman and Nicobar Island | <i>M. exotica</i> R.V. Valmayor | FJ428063, FJ428198 | | |
| Andaman and Nicobar Island | <i>M. gracilis</i> Holttum | FJ428075, FJ428194 | | |
| Andaman and Nicobar Island | <i>M. hirta</i> Becc. | FJ428074, FJ428199 | | |

| | | | | |
|-------------------------------------|---|--------------------------|-------------------------------------|--|
| Nicobar Island | | | | |
| Andaman and Nicobar Island | <i>M. indandamanensis</i> L. J. Singh | MT028134, MT181066 | | |
| Andaman and Nicobar Island | <i>M. ingens</i> N.W. Simmonds | FJ428077, FJ428184 | | |
| Andaman and Nicobar Island | <i>M. itinerans</i> Cheesman | FJ428098, FJ428177 | | |
| Andaman and Nicobar Island | <i>M. laterita</i> Cheesman | FJ428082, FJ428157 | | |
| Andaman and Nicobar Island | <i>M. maclayi</i> F. Muell | FJ428068, FJ428183 | | |
| Andaman and Nicobar Island | <i>M. monticola</i> Argent | FJ428073 FJ428191 | | |
| Nainital, Uttarakhand | <i>P. eriocarpum</i> Royle | Accession no. awaited | Dwivedi <i>et al.</i> 2019, 2020 | |
| Gangolihat, Uttrakhand, India | <i>P. eriocarpum</i> | Accession no. awaited | Dwivedi <i>et al.</i> 2019, 2020 | |
| Sahastradhara , Uttrakhand | <i>P. eriocarpum</i> | Accession no. awaited | Dwivedi <i>et al.</i> 2019, 2020 | |
| Mussoorie, Uttrakhand, India | <i>P. eriocarpum</i> | Accession no. awaited | Dwivedi <i>et al.</i> 2019, 2020 | |
| | <i>Andrographis paniculate</i> (Burm. f.) Nees | Unvouchered | | |
| | <i>Andrographis lobelioides</i> Wight | Unvouchered | | |
| | <i>Andrographis lineata</i> Nees | Unvouchered | | |
| | <i>Andrographis</i> | Unvouchered | | |

| | | | | |
|----------------------|---|-------------|--|--|
| | <i>glandulosa</i> Nees | | | |
| | <i>Andrographis nallamalayana</i> J.L. Ellis | Unvouchered | | |
| | <i>Andrographis echioides</i> (L.) Nees | Unvouchered | | |
| | <i>Andrographis beddomei</i> C.B. Clarke | Unvouchered | | |
| | <i>Fagopyrum esculentum</i> Moench | Unvouchered | | |
| | <i>Fagopyrum tataricum</i> (L.) Gaertn. | Unvouchered | | |
| | <i>Fagopyrum sagittatum</i> Gilib. | Unvouchered | | |
| | <i>Fagopyrum Kashmirianum</i> Munshi | Unvouchered | | |
| India JK Pahalgam | <i>Saussurea bracteate</i> Decne. | AKP3597P | | |
| India JK Pahalgam | <i>Saussurea costus</i> (Falc.) Lipsch. | AKP3593P | | |
| India JK Shopian | <i>Saussurea gnaphaloides</i> (Royle ex Royle) Sch.Bip. | AKP3599P | | |
| | <i>Saussurea gnaphalodes</i> (Royle ex Royle) Sch.Bip. | AKP278 | | |
| | <i>Saussurea obvallata</i> (DC.) Edgew. | AKP279 | | |
| India JK Shopian | <i>Saussurea glanduligera</i> Sch.Bip. ex Hook.f. | AKP3602P | | |
| | <i>Saussurea obvallata</i> (DC.) Edgew. | AKP268 | | |
| India JK Pahalgam | <i>Saussurea bracteate</i> Decne. | AKP3598P | | |

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|--|---|----------|--|--|
| India JK Ladakh | <i>Saussurea bracteate</i> Decne. | AKP3596P | | |
| India JK Anantnag | <i>Saussurea candolleana</i> <i>Wall. ex C.B. Clarke</i> | AKP3592P | | |
| | <i>Saussurea stoliczkae</i> <i>C.B. Clarke</i> | AKP277 | | |
| | <i>Saussurea bracteata</i> Decne. | AKP276 | | |
| | <i>Saussurea thomsoni</i> C.B. Clarke | AKP280 | | |
| India JK Shopian Kongwattan | <i>Saussurea simpsoniana</i> (Fielding & Gardner) Lipsch. | AKP3594P | | |
| India JK Srinagar Botanical Garden | <i>Saussurea costus</i> (Falc.) Lipsch. | AKP3600P | | |
| India JK Anantnag Pahalgam Lidderwhat | <i>Saussurea costus</i> (Falc.) Lipsch. | AKP3591P | | |
| India JK Ladakh | <i>Saussurea albescens</i> <i>Hook. f & Thomson</i> | AKP3590P | | |
| India JK Pahalgam | <i>Saussurea costus</i> (Falc.) Lipsch. | AKP3593T | | |
| India JK Ladakh | <i>Saussurea thomsonii</i> C.B. Clarke | AKP3595T | | |
| India JK Shopian | <i>Saussurea gnaphalodes</i> (Royle ex Royle) Sch. Bip. | AKP3599T | | |
| India JK Ladakh | <i>Saussurea gossypiphora</i> D. Don | AKP3601T | | |
| India JK | <i>Saussurea bracteate</i> | AKP3597T | | |

| | | | | |
|---|--|----------------|------------------------|-------------|
| Pahalgam | Decne. | | | |
| | <i>Saussurea obvallata</i> (DC.) Edgew. | AKP269 | | |
| India JK Anantnag | <i>Saussurea candolleana</i> Wall. ex C.B. Clarke | AKP3592T | | |
| India JK Shopian Kongwattan | <i>Saussurea simpsoniana</i> Fielding & Gardner) Lipsch. | AKP3594T | | |
| India JK Pahalgam | <i>Saussurea bracteata</i> Decne. | AKP3598T | | |
| India JK Shopian | <i>Saussurea glanduligera</i> Sch. Bip. ex Hook. f. | AKP3602T | | |
| India JK Ladakh | <i>Saussurea bracteata</i> Decne. | AKP3596T | | |
| India JK Srinagar Botanical Garden | <i>Saussurea costus</i> (Falc.) Lipsch. | AKP3600T | | |
| India JK Ladakh | <i>Saussurea albescens</i> Hook. f & Thomson | AKP3590T | | |
| India JK Phalagam | <i>Saussurea jacea</i> (Klotzsch) C.B. Clarke | AKP3610T | | |
| India Uttarakhand | <i>Saussurea costus</i> (Falc.) Lipsch. | AKP3613T | | |
| Tapovan Uttarakhand | <i>Gentiana argentea</i> (D. Don) Griseb. | NMHS_BGIR_2020 | Dwivedi et al. 2020 | Unvouchered |
| On way to Sundardunga Uttarakhand | <i>Gentiana pedicellata</i> Wall. | NMHS_BGIR_2020 | Dwivedi et al. 2019 | Unvouchered |
| Sunderdunga Uttarakhand | <i>Gentiana huxelyi</i> Kusn. | NMHS_BGIR_2020 | Dwivedi et al. 2019 | Unvouchered |

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|---|--|----------------|----------------------------|-------------|
| On way to Kalia Top, Uttarakhand | <i>Gentiana capitata</i> Buch.- Ham. ex D.Don | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | Unvouchered |
| South facing slope Hemkund, Uttarakhand | <i>Gentiana tubiflora</i> (Wall. ex G.Don) Griseb. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | Unvouchered |
| South facing slope Hemkund, Uttarakhand | <i>Kuepferia infelix</i> (C.B. Clarke) Favare (Rare) | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | Unvouchered |
| On way to Khalia top, Uttarakhand | <i>Gentiana quadrifaria</i> Blume | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | Unvouchered |
| North facing Slope Baladi, On way to Sundardunga, Uttarakhand | <i>Gentiana pedicellata</i> Wall. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | Unvouchered |
| Kalia Top, Uttarakhand | <i>Gentiana capitata</i> Buch.- Ham. ex D.Don | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | Unvouchered |
| Sundardunga, Uttarakhand | <i>Gentiana capitata</i> Buch.- Ham. ex D.Don subsp. <i>harwanensis</i> G. Singh | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | Unvouchered |
| Tapovan, Uttarakhand | <i>Gentiana argentea</i> var. <i>albescence</i> Franch. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | Unvouchered |

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|---|--|----------------|----------------------------|--------|
| Khilanmarg, Jammu and Kashmir | <i>Gentiana hugleii</i> Griseb. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 305729 |
| North Polu, Leh , Jammu and Kashmir | <i>Gentiana prostrata</i> var. <i>mangolica</i> Kusn. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 309916 |
| SpangRingsTu mail, Jammu and Kashmir | <i>Gentiana aperta</i> Maxim. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 309908 |
| Thajwas glacier, Sonamarg Jammu and Kashmir | <i>Gentiana membranulifera</i> T.N. Ho | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 305717 |
| SpangRingsTu mail, Kargil, Jammu and Kashmir | <i>Gentiana aquatica</i> var. <i>pseudoaquatica</i> (Kusn.) S. Agarwal | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 309905 |
| SpangRingsTu mail, Kargil, Jammu and Kashmir | <i>Gentianella tumailica</i> M. Shabir, P.Agnihotri, J.K. Tiwari & T. Husain | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 309907 |
| Changla-Leh, Jammu and Kashmir | <i>Gentiana nubigena</i> Edgew. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 309917 |
| Sapi, Kargil, Jammu and Kashmir | <i>Gentianella moorcroftiana</i> | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 309923 |

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|---|---|----------------|----------------------------|--------|
| Dachigham NP, Kashmir | <i>Gentiana kurroo</i> Royle (Critically Endangered) | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 305706 |
| Rothang Pass, Himachal Pradesh | <i>Gentiana sp. nov.</i> | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 308822 |
| Rothang-Pass (H.P) | <i>Gentiana coronata</i> Griseb. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 308820 |
| SpangRings Tumail, Kargil, Ladakh | <i>Gentiana leucomelaena</i> Maxim. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 309904 |
| On way to Pasarkhar Sodh, Kargil, Ladakh | <i>Gentiana tianschanica</i> Rupr. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 309909 |
| Suru Valley, Kargil, Ladakh | <i>Gentiana loureiroi</i> (G.Don) Griseb. | NMHS_BGIR_2020 | Dwivedi <i>et al.</i> 2019 | 305776 |

5. CENTRAL BOTANICAL LABORATORY, HOWRAH

ANNUAL PROGRESS REPORT (2020-2021)

1. Name of the Project : **Ethnobotanical study of some tribal populated districts of Bihar, India**
2. Executing Scientist (s) : Dr. K.A.A. Kabeer, Sri A.C. Halder, Dr. R. Saravanan, Dr. M. Mishra & Dr. P. A. Dhole
3. Duration of the project : 36 months (April 2018 to March 2021)
4. About the work done :
 - 4.1 Introduction: Bihar is an ideal State from ethnobotanical point of view, as rich in floristic as well as in ethnic diversity. Bihar has about 5,720 km² of total forest cover, including 3,372 km² dense forest and 2,348 km² open forest. The State is inhabited by 28 tribal groups namely Asur, Baiga, Bathudi, Bedia, Birhor, Chero, Gond, Ho, Karmali, Kharia, Kharwar, Khond, Munda, Oraon, Paharia, Santal, Savar, etc. (Bhatt & Bhargava, 2006). As per census 2011, the total population of tribes is 7, 58, 351 in the state. Of which, Santhal is largest tribal community (3, 67,612) followed by Oraon (1, 20,362), Kharwar (1, 00,735), Gond (51,792), Munda (17, 754), Lohara (13,993) etc. These tribes are mainly depends on agriculture and working in various Government and private sector for earning their livelihood. The highly tribal populated districts of Bihar are Katihar (140,418), Purnia (111,947), Banka (75,070), Jamui (67,357), Bhagalpur (55,545), Kishanganj (47,116), Pashchim Champaran (44,912), Kaimur (35,662), Araria (29,423), Rohtas (25,663) etc.
 - 4.2 Literature: Though, many papers have been published on various aspects of Ethnobotany on undivided Bihar, but presently most of the area falls under the jurisdiction of Jharkhand. Only few sporadic ethnobotanical papers have been published by some workers (Singh et al., 2013); (Singh et al. 2015); (Sudha et al., 2015) mainly confined on general Ethnobotany of Bihar. Hence, it is proposed to undertake a detailed Ethnobotanical study of some highly populated districts of Bihar.
 - 4.3 Objectives: The main aim of the proposed project is to collect and consolidate the entire knowledge among tribal people regarding the plant- use existing among tribal of the state before they are lost forever.
 - Folklore survey and field work in the some highly tribal populated areas and nearby forests of the state.
 - Collection and identification of plants and plant products used by the tribes for various purposes.
 - Documentation of traditional knowledge about plants and preparation of inventories of folklore plants.
 - Comparative study with already published literature to find out new or less known uses.
 - Live collection of rare and important ethnobotanical plants to develop small-scale ethnobotanical garden for ex-situ conservation point of view.
 - Survey of countryside socio-religious fares and festivals for collection of little or unknown ethnobotanical items /artefacts /handicrafts that may enrich the ethno-museum of C.B.L. and yield interesting information.

4.4 Site of the study (with map) :



Fig. 1. ETHNOBOTANICALLY SURVEYED DISTRICTS OF BIHAR

4.5 Methodology adopted :

Ethnobotanical survey under this project was conducted in densely tribal populated regions in 13 districts of Bihar namely, Araria, Aurangabad, Banka, Gaya, Jamui, Kaimur (Bhabua), Katihar, Kishanganj, Nalanda, Nawada, Purnia, Rohtas and West Champaran from the year 2018 to 2021.

Old and experienced local men, women and medicine men, who are considered to have good knowledge of the plants of that region, were interviewed for the first hand information on ethnobotanical uses of the plants from villages and forest areas. During the survey, interaction was done with several tribal groups as Kharwar, Oraon, Chero, as well as other non-tribal people of the areas. Repeated and cross queries were done for confirmation and verification of the information. The informers were taken to forest for collection of voucher specimens. The voucher specimens were kept between the blotting papers for drying and the blotting papers were bundled in plant press. After drying these specimens were poisoned, mounted, stitched and labeled on herbarium sheet. GPS data was also recorded for location of different places along with plants and their habitat. Apart from ethnobotanical information and voucher specimens, collected exhibits, photographs of tribal, medicine man, their villages, forests, plants and plants products, etc.

These plant specimens were identified with the help of keys and botanical description, described regional Floras by Haines (1921-25), Mooney (1941, 1950) and Singh *et al.* (2001). After matching and verification with the authentic specimens kept in Central National Herbarium, voucher specimens have been deposited in Ethno-botanical Herbarium of Central Botanical Laboratory (CBL), Howrah. In the enumeration, the plant species have been arranged according to field book number with their family, local name(s), locality (ies), habit and ethnobotanical uses. Some already published ethnobotanical informations were also collected from literature for comparative study point of view, if available. The names of authors were checked from Brummitt & Powell (1992) and widely accepted website <http://www.theplantlist.org>.

4.6 Work done :

- a. Total area covered : 13 districts

- b. Number of tours undertaken : 7
- c. Number of species collected : 1159
- d. Number of species incorporated : In-progress

4.7 Output indicators for the assessment of the project & Major impacts reported during the financial year:

During this investigation, a total of 1159 field numbers were collected with 1210 ethnobotanical information. It is analysed that habit wise the maximum numbers of herbs (156), followed by trees (128), shrubs (92), climbers (48) and lianas (18) (Fig. 1). Some dominant families are used for various purposes by the tribal people are Leguminosae (61), Malvaceae (29), Lamiaceae (25), Compositae (21), Apocynaceae (19), Poaceae (16), Euphorbiaceae (15), Rubiaceae (13), Moraceae (12), Solanaceae (11), Amaranthaceae (11), Combretaceae (10), Convolvulaceae (10). These plant species are used by the local tribes and other rural people for different purposes. It is analysed that 143 plant species are used for edible, Ethnomedicine (283), religious (24), veterinary (44), magico-belief (25), detergent (4), house hold articles (48), fodder (100), dye (10), agricultural implements (10), toothbrush (21), sold in weekly market (25), gum (3), scorpion sting (11), snake bite (7), rope (23), biofencing (12), building / thatching materials (23), insect repellent ((9), fuels (33), timber (5), fish poison (8), fish catching instrument (2), oil (5), fragrance (2), country liquor (1) and miscellaneous (43) etc.

As far as group wise utilization is concerned, it is analysed that 171 ethnobotanical information used for food, 596 for ethnomedicine, 47 for veterinary, 91 for fodder, 29 for fuel, 23 for rope, 4 for gum, 10 for dye, 05 for oil, 07 for insect repellent, 03 for snake repellent, 04 for detergent, 02 for beverage, 01 for condiments, 03 for fragrance, 08 for fish poison, 02 for fish catching instrument, 50 for household article, 15 for toothbrush, 10 for agricultural implement, 24 for building materials, 23 for magico-beliefs, 22 for religious, 08 for bio-fencing and 46 for other miscellaneous purposes collected during the study (Fig.2).

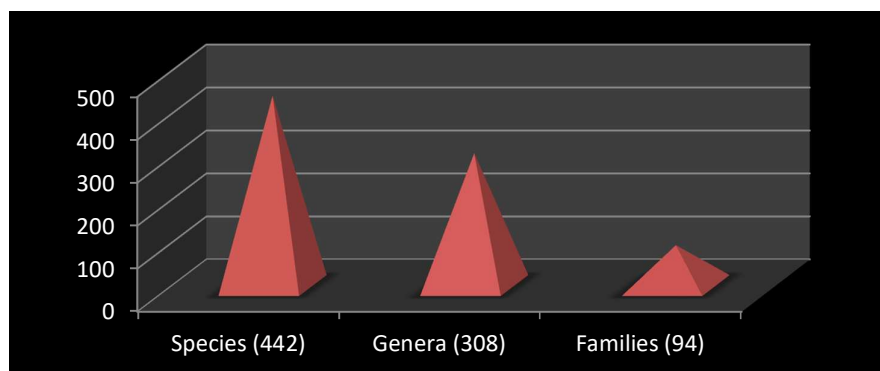


Fig. 1. TOTAL NUMBERS OF SPECIES, FAMILIES AND GENERA COLLECTED FROM BIHAR

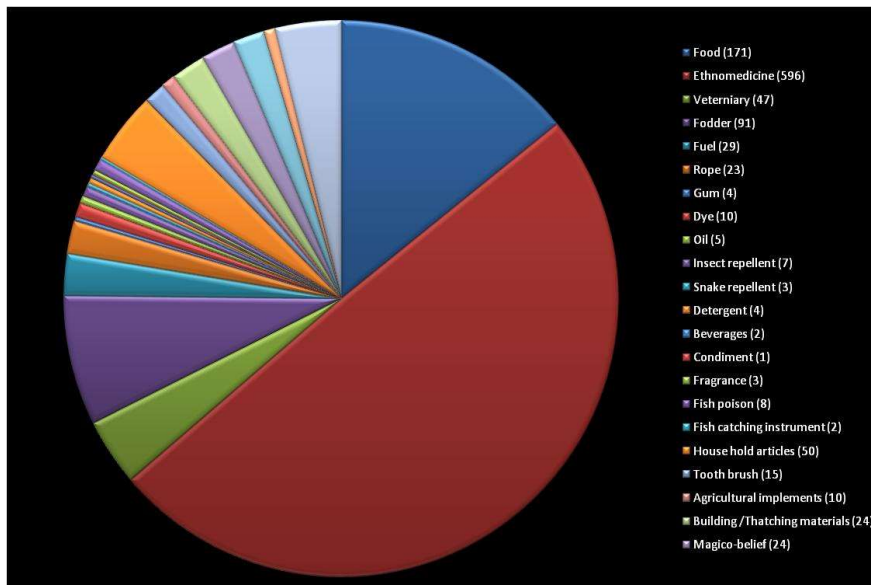


Fig. 2. USES WISE ETHNOBOTANICAL INFORMATION COLLECTED FROM BIHAR

2. Name of the Project: “Chromosome count of Genus *Impatiens* of Sikkim/Darjeeling” (Plant material to be provided by Dr. R. Gogoi, Sci. E)

Executing Scientist(s): Dr. (Mrs.) Monika Mishra, Botanical Assistant, CBL, BSI, Howrah

Duration of the project: September 2018 – March 2021.

About the work done:

Introduction: *Impatiens* species are extremely variable and taxonomically difficult. According to Pico & Dematteis (2014) and Kaur (2018), cytological studies offer powerful tool for proper identification of taxa when morphological approaches fail to identify the species or varieties. The karyomorphological analysis enables to characterize even different forms and varieties of a species (Dash *et al.*, 2017). Since Himalayan region represents the centre of origin of the genus (Jones & Smith, 1966), it is one of the most important areas to obtain a better understanding of the chromosome evolution in *Impatiens*. Keeping in the view, the amount of chromosomal variability already existent in Himalayan taxa, it is necessary to accumulate more cytological evidence from this area and thus, this study of chromosome number of Sikkim-Darjeeling Himalayas have been undertaken.

Objectives: Chromosome count of *Impatiens* species.

Site of the study (with map): Sikkim and Darjeeling

Methodology adopted: For cytological studies, young floral buds of appropriate size were collected in early morning and fixed in freshly prepared Carnoy’s fluid (alcohol: chloroform: acetic acid in 6:3:1 ratio) for 24 hours. The material was then washed and preserved in 70% alcohol at 4°C inside a refrigerator for further study. Meiosis was studied by squashing the anthers in 2% acetocarmine followed by observing the preparations under the microscope. If preparations were of desired nature, cover slips were temporarily sealed with paraffin wax for detailed study. After 24 hours those slides were make permanent for future reference purpose. Chromosome number of the species was determined through analysis of various stages of meiosis from temporary as well as permanent slides at metaphase I/II, anaphase I/II and telophase I/II stages. The photomicrographs were taken from temporary as well as permanent slides at the magnification of 1000x (10x eye piece X 100x objective lens).

Work done:

Among the 14 species investigated during the project, different/new chromosome number was observed for 01 *Impatiens* species i.e. *I. exilis*.

Output indicators for the assessment of the project: A total of 14 species of *Impatiens* were investigated for chromosome count during the period, out of which chromosome number was reported for 09 species (*I. stenantha*, *I. falcifer*, *I. exilis*, *I. radiata*, *I. discolor*, *I. drepanophora*, *I. scabrida*, *I. racemosa* and *I. sulcata*) as in 05 species (*I. arguta*, *I. tripetala*, *I. gammae*, *I. pulchra* and *I. spirifer*) no dividing cells were noticed during the study.

This investigation revealed a total of 04 haploid chromosome numbers i.e. $n=7$, 8, 9 and 10. Among these investigated species, chromosome number $n=7$ was noticed for 02 species (*I. falcifer* and *I. exilis*); while $n=9$ was reported in 05 species (*I. stenantha*, *I. radiata*, *I. drepanophora*, *I. racemosa*, *I. sulcata*). Chromosome number $n=8$ and $n=10$ were noticed in 01 species each (*I. scabrida* and *I. discolor* respectively). However, this study confirmed the previous report on chromosome number of these species, but some differences from previous reports have also been noticed.

On the basis of compiled chromosome data from this study as well as previous reports, it is obvious that most of the presently investigated species, except *I. stenantha* ($2n=18$), *I. exilis* ($2n=14, 28$), *I. discolor* ($2n=20$), showed dysploid numerical chromosome variations viz., *I. falcifer* ($2n=14, 16$), *I. radiata* ($2n=18, 20$), *I. drepanophora* ($2n=18, 20$), *I. scabrida* ($2n=12, 14, 16, 18, 20$), *I. racemosa* ($2n=18, 20$) and *I. sulcata* ($2n=16, 18, 20$). *I. exilis* show polyploidy here.

As observations in this study were made on meiosis of Pollen Mother Cells (PMCs), therefore data on karyomorphology could not be generated but it is clearly noticeable that all the species observed with $n=9$, showed a bimodal karyotype (where one pair (one in gamete) of chromosomes is distinctly longer than other chromosomes), as reported by previous workers. Other species which observed with chromosome number $n=7, 8$ and 10, do not show such type of karyotype structure and all the chromosomes in those species were more or less the same size.

During this investigation course of meiotic behaviour was also studied in these *Impatiens* species. The detailed observations made on PMCs revealed that most of the species (except *I. exilis*) showed various meiotic aberrations, namely univalents, precocious separation, stickiness, laggards, bridges, unequal segregations, late disjunction of bivalents, unoriented anaphase, non-synchronization and micronuclei at different stages of cell division. Average pollen fertility in these species was found to be 92 - 99 %. Possible reasons and consequences of these aberrations have also discussed.

3. Name of the Project: Micro-algae and monitoring of water quality of all lakes of AJCBIBG.

After discussion with Director BSI on 23.07.2019 and decision has been taken to work on two Lakes i.e. Prain Lake and King Lake

Executing Scientist (s): Dr. Pratibha Gupta

Duration of the project: August, 2019 - August, 2020

About the work done:

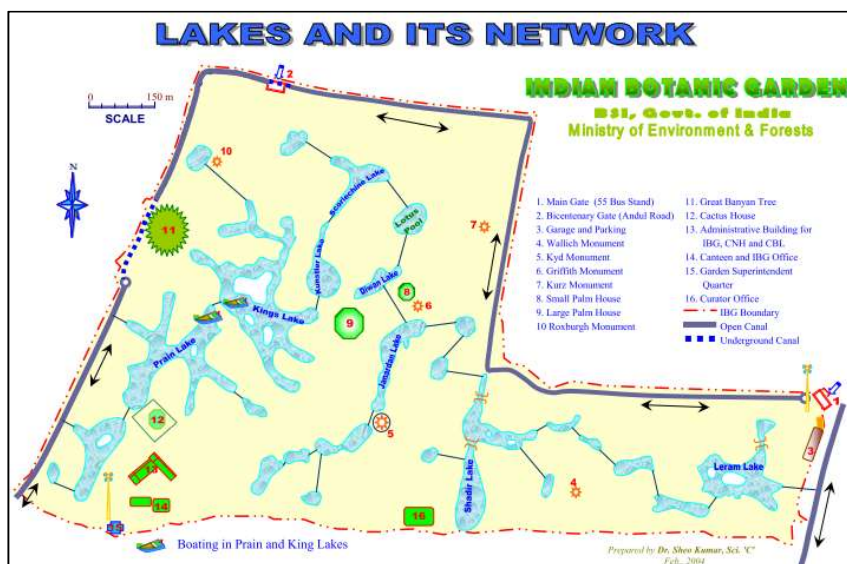
Introduction: All the Lakes of AJC Bose IBG, Howrah was surveyed which are interconnected. It was observed that Sewage / polluted water is entering from outside in to the Prain Lake through Jora Pipe area and water from outside sources also entering in to King

Lake of the AJC Bose Indian Botanic Garden. So the attempt has been made to study the periodicity, succession, distribution and analysis of Physico-chemical parameters of Micro-algae of Prain Lake, King Lake and Jora Pipe area to see the alteration in Micro-algal diversity and its abundance, qualitatively and quantitatively. Study of microalgae and monitoring of water quality in different Lakes of AJCBIBG was remains untouched. So, attempt has been made to study the same.

Objectives:

The main objective of carrying out this work on Microalgae and monitoring of water quality of AJCBIBG :Prain Lake and King Lake to study the periodicity, succession, distribution and analysis of Physico-chemical parameters of Micro-algae of Prain Lake, King Lake and Jora Pipe area to see the alteration in Micro-algal diversity and its abundance, qualitatively and quantitatively

Map of AJCB Indian Botanic Garden with study sites:



Methodology adopted: All the samples were brought into the Laboratory and preserved in Formalin and properly maintained for identification. Water Samples were analysed under Leica DM 2500 sophisticated Research Microscope using **Leica Qvin 3.2 Image Analysis Software and Leica Application Suit V4 Software** with annotation for Identification.

New Methodology (if any) adopted : Readings of each water sample from King Lake, Prain Lake and Jora Pipe Area were recorded by **Purely Sensor Based Multiparameter Water Proof Meter recently installed in 2020 first time in BSI** and analysed 08 parameters viz. pH, ORP, EC, TDS, Salinity, DO, Pressure and Temperature at a time.

Work done:

- a. Total area covered : King Lake, Prain Lake and Jora Pipe Area
- b. Number of tours undertaken : 12
- c. Number of species collected : 120 samples
- d. Number of species identified (with name) : 211

Output indicators for the assessment of the project: During survey in 12 field visits 879 field photographs and 79 videos were taken. GPS readings were recorded from the sample collected areas. 120 numbers of water samples were collected for Microscopic studies. 577 Photomicrographs were taken. 211 species have been identified. Out of 211

species, **06 species are new record from India. Multiparameter water Proof Meter successfully installed** on 20.02.2020 and altogether **66** readings of each parameter of the samples from King Lake, Prain Lake and Jora Pipe Area were recorded after installation and analysed 08 parameters viz. pH, ORP, EC, TDS, Salinity, DO, Pressure and Temperature at a time.

Major impacts reported during the financial year: It was observed that DO reading is below the permissible limit in Prain Lake and Jora Pipe area and much better in King Lake. May be because sewage/ polluted water is entering from outside in to the Prain Lake through Jora Pipe area and this area was almost completely covered with aquatic Macrophytes.

Species observed in the samples are pollution tolerant species. It is very interesting to note that *Oscillatoria sancta* Kütz. ex Gomont found in the samples contains antibiotic activity against number of Bacterial and Fungal species which is already reported.

4. Name of the Project: Micro-algae and monitoring of water quality of Sadir Lake of AJCBIBG”
Howrah

Executing Scientist (s): Dr. Pratibha Gupta

Duration of the project: September, 2020 - continuing

Introduction : As all the Lakes of AJCBIBG, Howrah was surveyed which are interconnected. It was observed that sewage / polluted water is entering from outside in to Sadir Lake. So attempt has been made to study the periodicity, succession, distribution and analysis of Physico-chemical parameters of Micro-algae of Sadir Lake to see the alteration in Micro-algal diversity and its abundance, qualitatively and quantitatively. Studies carried on above areas by various authors but study of microalgae and monitoring of water quality in different Lakes of AJCBIBG was remains untouched. So, attempt has been made to study the same.

Objectives: The main objective of carrying out this work on Microalgae and monitoring of water quality of Sadir Lake of AJCBIBG, Howrah to study the periodicity, succession, distribution and analysis of Physico-chemical parameters to see the alteration in Micro-algal diversity and its abundance, qualitatively and quantitatively

Map of AJCB Indian Botanic garden with study site:



Methodology adopted: All the samples were brought into the Laboratory and preserved in Formalin and properly maintained for identification. Water Samples were analysed under Leica DM 2500 sophisticated Research Microscope using Leica Qvin 3.2 Image Analysis

Software and Leica Application Suit V4 Software with annotation for Identification.

New Methodology (if any) adopted : Readings of each water sample from Sadir were recorded by **Purely Sensor Based Multiparameter Water Proof Meter recently installed in 2020 first time in BSI** and analysed 08 parameters viz. pH, ORP, EC, TDS, Salinity, DO, Pressure and Temperature at a time.

Work done:

- a. Total area covered: Sadir Lake
- b. Number of tours undertaken: 08
- c. Number of species collected: 79 samples
- d. Number of species identified (with name): 81
- e. Number of species incorporated: **02** New Records from India

Output indicators for the assessment of the project: During survey in 08 field visits 841 field Photographs and 51 Videos were taken. GPS readings were recorded from the sample collected areas. Total 79 numbers of water samples were collected for Microscopic studies. 244 Photomicrographs were taken. Altogether **81** species have been identified. Out of 81 species, **02 species are new record from India**. Altogether 79 readings of water samples from Sadir Lake were recorded by **Purely Sensor Based Multiparameter water Proof Meter** and analysed 08 parameters viz. pH, ORP, EC, TDS, Salinity, DO, Pressure and Temperature at a time.

Major impacts reported during the financial year: It was observed that initially the DO reading of Sadir Lake was almost near to permissible limit then slightly starts decreasing below the permissible limit and then again slightly improved in winter season. May be because of influx of quantity of sewage / polluted water is entering from outside in to the Sadir Lake and this area was almost completely covered with aquatic Macrophytes. Most of the pollution tolerant species are dominantly observed in the samples. Work is in Progress.

Other Assignments:

Dinophyceae Book:

Checked Third Proof of Dinophyceae Book; prepared the index and cover page.

Written Book on Antarctica:

- As per letter No. BSI-287/9/2017 –Tech. dtd. 16.06.2020 written Book entitled “33rd Indian Scientific Expedition to Antarctica (Journey, Stay and Research)” and submitted both hard and soft copy for publication in the form of Book on 21.09.2020.

Research Paper Reviewed:

- i. Reviewed research paper entitled “Climate Change and their Mitigation strategies on Agriculture in Tropical islands of Andaman & Nicobar islands, India : study site South Andaman” for publication in *International Journal of Agriculture Sciences* - Bioinfo Publication and submitted Review Report on 14.04.2020.
- ii. Reviewed research paper entitled “Enhancing Brinjal Seed Germination using Biopriming Seed Treatment” for publication in *International Journal of Agriculture Sciences* - Bioinfo Publication and submitted Review Report on 26.04.2020
- iii. Reviewed research paper entitled “A Checklist of Marine Macro Algae of Karnataka coast, India” for publication in *Nelumbo* and submitted Review Report on 02.05.2020.
- iv. Reviewed research paper entitled “Auditory and Expressive Language Development among Preschool Children” for publication in *International Journal of Agriculture Sciences* - Bioinfo Publication and submitted Review Report on 06.05.2020.
- v. Reviewed research paper entitled “Bio- Physical Constraints Encountered by the Sugarcane Growers in Adoption of SSI Technology” for publication in *International Journal of Agriculture Sciences* - Bioinfo

Publication and submitted Review Report on 06.05.2020.

- vi. Reviewed research paper entitled “Physico-chemical changes in short day onion cultivars during growth and development” for publication in *International Journal of Agriculture Sciences* - Bioinfo Publication and submitted Review Report on 24.07.2020.
- vii. Reviewed research paper entitled “Phytoplankton diversity of Deepor Beel, a Ramsar Site of North East India” for publication in *Nelumbo* and submitted Review Report on 09.11.2020.
- viii. Reviewed research paper entitled “Observations on *Nostochopsis lobata* Wood ex Bornet et Flahault 1886 (Cyanoprokaryota; Stigonematales; Nostocophyceae) in Eastern India” for publication in *Nelumbo* and submitted Review Report on 12.11.2020.
- ix. Reviewed research paper entitled “Effect of elevation on the physico-chemical properties of the soils of Tawang district of Arunachal Pradesh” for publication in *International Journal of Agriculture Sciences* - Bioinfo Publication and submitted Review Report on 26.02.2021.
- x. Reviewed research paper entitled “Study on relationship between organizational culture and organizational commitment” for publication in *International Journal of Agriculture Sciences* - Bioinfo Publication and submitted Review Report on 27.02.2021.
- xi. Reviewed Research Paper entitled “Coronavirus disease 2019 in a couple patients Co-infection with untreated HIV” for publication in Internationally Peer-reviewed Journal AS Microbiology and submitted Review Report on 26.02.2021.
- xii. Reviewed Research Paper entitled “Insect venom toxin peptides, its antimicrobial effects and host immune responses: A review” for publication in Internationally Peer-reviewed Journal AS Microbiology and submitted Review Report on 26.02.2021.

Global/ International/ National Web Conference/ Webinar Attended:

- i. Attended Global Web Conference, Pandemic Covid 19: Glocal Impact on Environment and Sustainable Development from 05.06.2020 to 06.06.2020 organised by Internal Quality Assurance Cell (IQAC), Pryagraj and Glocal Environment & Social Association (GESA), New Delhi.
- ii. Attended Webinar on Relevance of yoga in Combating COVID -19 Pandemic on 21.06.2020 (Sunday) at 09.00 A.M. on the occasion of celebration of 6th International Yoga Day organised by Department of Science & Technology, Science and Technology of Yoga and Meditation (Satyam).
- iii. Attended webinar on “Climate Variability & Change-Challenges for Disaster Risk Reduction in India” on 20.08.2020 at 3.00 P.M. organised and conducted by Indian Institute of Public Administration (IIPA), New Delhi.
- iv. Attended one day National Webinar on Role of Indigenous Traditional Knowledge and Herbal Drugs in Combating Against Pandemic COVID-19 held on 11.09.2020 organised by Department of Botany and Internal Quality Assurance Cell, Maulana Azad College 8, Rafi Ahmed Kidwai Rd, Taltala, Kolkata, West Bengal.
- v. Attended National Webinar on “Role of Mathematical Modelling in the prospective of COVID - 19 Pandemic” on 26.09.2020 (Saturday) at 11.00 A.M. organised by B.S.N.V. P.G. College, Lucknow.
- vi. Attended one day National Webinar on the occasion of International habitat Day on 05.10.2020 on the topic “Plant Diversity of Cold desert of Western Himalaya and its Conservation strategies organised by BSI, Higher

- Altitude Western Himalayan Regional Centre, U.H.F. Nauni Campus, Solan (H.P.)”.
- vii. Attended one day Webinar on Women Empowerment and Gender Justice in India on 08.10.2020 at 10.30 A.M. organised by Women Grievance and Welfare Cell, Dr Ram Manohar Lohia Awadh University, Faizabad University, U. P.
 - viii. Attended National Webinar on Role of Botanical Survey of India in Biodiversity Conservation on 14.10.2020 at 11.00 A.M. organized by BSI, Deccan Regional Centre, Hyderabad.
 - ix. Attended Webinar on COVID - 19 Awareness in Festive Season on 17.10.2020 (Saturday) at 07.00 P.M. organized by People’s Association for Science and Environment.
 - x. Attended one day National Webinar on “Micropopogation of Threatened Plant Species and Conservation in India” on 30.10.2020 at 11.30 A.M. organised by Botanical Survey of India, High Altitude Western Himalayan Regional Centre, Nauni Campus, Solan (H.P.) The speaker of the said Webinar was Dr A. A. Mao, Director BSI.
 - xi. Attended Webinar on Harmful effects of burning agriculture residue (Parali) and Municipal solid waste organised by Christ Church College, Kanpur in association with U.P. Pollution Control Board, Kanpur WASH Solutions Lucknow and Swajal Shakti Samadhan, Banda on 27.11.2020.
 - xii. Attended Webinar-cum Brain-Storming Session on “Himalayan Mountain Biodiversity – Threats and Solutions” on the theme : Mountain Biodiversity on the occasion of International Mountain Day, 2020 organized by Sikkim Himalayan Regional Centre, Gangtok on 10.12.2020.
 - xiii. Attended one day Webinar on Plant Diversity of the Western Ghats, India on the occasion of 65th Foundation Day of BSI, Western Regional Centre, Pune organized by Western Regional Centre, Pune on 12.12.2020.
 - xiv. Attended National Webinar Series, Lecture - 3 on Alien Plant Invasion in India : Status and Consequences organized by Botanical Survey of India, High Altitude Western Himalayan Regional Centre, Nauni Campus, Solan (H.P.) on 17.12.2020.
 - xv. Attended 2nd International (Web) Conference on Environment and Society (ICES 2020) : Socio-economic and Environmental Issues : Challenges and Future Prospects in Current Pandemic Situation jointly organised by Glocal Environment & Social Association (GESA) New Delhi, National Environmental Science Academy (NESAs), New Delhi, India and Asian Biological Research Foundation (ABRF), Prayagraj (U.P.), India from 26.12.2020 to 28.12.2020.
 - xvi. Attended Webinar on International Code of Nomenclature (ICN) for Plants jointly organised by Botanical Survey of India, Deccan Regional Centre, Hyderabad and Department of Botany, Andhra University, Visakhapatnam on 06.01.2021 at 11.00 A.M.
 - xvii. Attended Green Talk: Webinar Series in 2021 first talk on Science in Bialowieze Forest – Bialowieze Forest in Science on 08.01.2021 at 2.30 P.M. Talk delivered by Prof. (Dr.) Bogdan Jaroszeewicz, Professor & Director, Bialowieze Geobotanical Station, University of Warsaw organised by Botanical Survey of India, Sikkim Himalayan Regional Centre, Gangtok.
 - xviii. Attended Webinar on "Green Walk"- Plant Resources as Aid for prevention of COVID - 19, organised by Botanical Survey of India, Southern Regional Centre, Coimbatore on 27-01-2021 at 14.30 PM.
 - xix. Attended Webinar on Green walk - “Wetlands: Potential importance and Conservation need under Climate Change Scenario” organised by Botanical Survey of India, Southern Regional Centre, Coimbatore at 11.00 PM.
 - xx. Attended webinar on Plant Taxonomy and Floristics in the Anthropocene Epoch organised by BSI, SRC,

Coimbatore on 19-02-2021 at 2.30 P.M.

- xxi. Attended National Webinar on Plant Diversity and Climate in the past : Palynological Evidences in Sedimentary Archives organised by Department of Botany, Brahmanand College, Kanpur on 16.02.2021 at 4.30 PM.
- xxii. As per Office mail dtd. 16.03.2021 attended Webinar “Green Walk: Plant Taxonomy and Floristic in the Anthropocene Epoch” by Dr. Syd Ramdhani Senior lecturer cum-Curator, Ward Herbarium, School of Life Sciences, University of Kwazulu Natal, Durban, South Africa organized by BSI, SRC, COIMBATORE on 19.02.2021 at on 19-02-2021 at 2. 30 P.M.
- xxiii. As per the message dtd. 20.02.2021 attended National Webinar on “Role of Botanical Survey of India in Taxonomic Research in India” organised by Botanical Survey of India, High Altitude Western Himalayan Regional Centre, Nauni Campus, Solan (H. P.) on 22.02.2021 at 11.30 AM talk delivered by Dr. M. Sanjappa, Ex Director, BSI.
- xxiv. As per Office mail dtd. 20.02.2021 and 23.02.2021 attended Green Talk – 2 Webinar on “Exploration of La Amistad National Park (Costa Rica/ Panama)” by Alex Monro, Research Leader at Royal Botanic Garden Kew, RBG organised by Botanical Survey of India, Sikkim Himalayan Regional Centre, Gangtok at 02.30 PM.
- xxv. As per the message received on 08.03.2021 attended Webinar on "Revising the Generic Limits of *Coleus* and *Plectranthus* (Lamiaceae, Tribe Ocimeae)" talk delivered by Dr Alan Paton, Royal Botanic Gardens, Kew, U.K.” organized at BSI, CNH on 12.03.2021.
- xxvi. Attended Webinar on Management of Water Resources with Emphasis on Mangrove Ecosystem organised by BSI Southern Regional Centre, Coimbatore, India on 22.03.2021 at 3.00 P.M. organised on the occasion of International Water Day.

Delivered Invited Lecture in Global Web Conference:

- Prepared Power Point Presentation and delivered invited Lecture on the topic entitled “Corona Virus Problem and Solution and its Impact on Environment” on 06.06.2020 in session IV, Global Web Conference Pandemic COVID-19: Global Impact on Environment and Sustainable Development (PESD2020) in Webinar.

Delivered Other Lectures:

- On the occasion of Hindi Pakhwara Samapan Programme of CBL delivered lecture on the topic “COVID - 19 Ek Vashvik Mahamari : Karan evam Niwaran” on 28.09.2020.
- On the occasion of World Ozone Day Programme of CBL delivered lecture on the topic “World Ozone Day 2020 “Ozone for life - 35 years” on 16.09.2020.

Delivered Lecture in International Web Conference:

- Prepared Power Point Presentation and delivered Lecture on the topic entitled “Role of various Algae and herbs in prophylactic and therapeutic treatment of COVID - 19 infection” on 28.12.2020 in International (Web) conference on Environment and Society (NESA), New Delhi, India and Asian Biological Research Foundation (ABRF), Prayagraj (U.P.), India.

National e -Workshop Attended:

- Attended e - Workshop on Bharat main Covid 19: Vagiyantik Sandharbh aur Hindi Ki Shabdawali organised by Commission for Scientific and Technical Terminology, Ministry of Human Resource Development, Government of India and Department of Higher Education organised by Christ Church College, Kanpur from 03.06.2020 to 05.06.2020.

- **First Online One Day Hindi Workshop** was organised in BSI by CBL, Howrah on 18.03.2021 and delivered welcome speech.

PLANT CHEMISTRY DEPARTMENT

5. Name of the Project : Wild edible plants of North east region in India : Anti nutritional properties, genotoxicity, DNA damage preventive activity, HPLC studies for vitamin and phenolics content

Progress/Achievements both cumulative and for the reference period including innovations

- 1. Proximate composition:** The antinutrient composition: Oxalate estimation, Phytate content, Saponin content, Tannin content and Cyanogenic glycosides of forty wild edible plants were studied.
- 2. HPLC study:** Quantitative estimation of **Phenolic acids and flavonoids** (Rutin, quercetin, kaempferol, apigenin, myricetin, gallic acid, catechin, ferulic acid, coumarin, naringin, p-hydroxybenzoic acid, protocatechuic acid, gentisic acid, vanillic acid, aesculin, caffeic acid, syringic acid, p-Coumaric acid, naringenin, salicylic acid, ellagic acid luteolin, and sinapic acid) content in forty wild edible plants were carried out using **HPLC**
- 3. Vitamin estimation:** Estimation of **water soluble vitamin (Vit C, Vit B1, Vit B2, Vit B3, Vit B5, Vit B6 and Vit B9)** in sixty eight plant samples were carried out by **HPLC**
- 4. Toxicity studies:** Hemolytic toxicity, Hepatotoxicity studies of thirty wild edible plants were carried out
Genotoxicity studies of forty wild edible plants were studied
- 5. Authentication of Crude plant sample**
Authentication of **142 plant samples** including 112 red sanders received from Different institutions/offices were carried out by HPLC fingerprinting studies and report submitted
 - **Reviewed the following manuscript:**
Reviewed the Manuscript entitled “The rhizome of *Bulbophyllum* orchid is a rich source of cytotoxic bioactive compounds, a potential anticancer agent” submitted to **South African Journal of Botany** (Elsevier publication) SAJB-D-21-00030
 - Reviewed the Manuscript entitled “Bio nanoparticles as elicitors increase accumulation of betulin and betulinic acid in callus cultures” submitted to **South African Journal of Botany** (Elsevier publication) SAJB-D-21-00177
 - Reviewed the Manuscript entitled “Antipyretic, Anti-inflammatory and Analgesic properties analysis by, GC-MS, FT-IR and Phytochemical screening of *Carica Papaya* (L.) and *Nilavembu kudineer choornam*” submitted to **Nelumbo (Manuscript 156393-385176-1-RV)**
 - Reviewed biennial report of the project entitled “Phytochemical screening, proximate composition, nutritional analysis and mineral element status of selected wild edible fruits of Northeast India” submitted by Ms Larima Sten JRF, ERC, BSI
- 6. HPLC training given**
 - HPLC training programme was given to the M.Sc students, Department of Botany, Burdwan University
- 7. Seminar attended**
 - Delivered a lecture in a webinar arranged by SHRC, BSI, on 10th December 2020 and the topic was “**Ethnobotany to Modern Medicine : Way to Drug Development**”

8. Supervision of Research scholars

- Following Research scholars are working in Plant Chemistry Department
- Dr. Dyutiparna Chakraborty , SERB, N-PDF
- Ms Ishika Bera
- Mr. Rabi Shankar Sengupta
- Ms Priya Rauniyar (Research scholar of DDU University)

Publication details: Papers Published- 22; Papers communicated 02; Books communicated -02 (detailed in the last chapter).

6. CENTRAL NATIONAL HERBARIUM

PROJECT-1

Algal Flora of Purbasthali Wetland, Bardhaman, West Bengal

Executing Scientist: Dr R.K. Gupta, Scientist-E

Date of initiation: April, 2020

Date of completion: March, 2023

OBJECTIVE: To document Algal diversity of Purbasthali Wetland, Bardhaman, West Bengal

AREA AND LOCALITY: Bardhaman, West Bengal.

SUMMARY: Conducted one field tour to Purbasthali wetland, West Bengal and collected 93 samples of algae from various habitats of the wetland along with GPS data and covered 3.50 sq. km. Limnological parameters were also recorded in the spot itself and through outside agency (Sources, Colour, Odour, Taste, Arsenic, pH, EC, TDS, Temperature, DO, Nitrate, Nitrite, Ammonia and Light intensity etc.).

Work done: Studied 95 algal samples and identified and taxonomically described 35 species of algae reflected mainly from members of Euglenophyceae, Cyanophyceae, Chlorophyceae and Bacillariophyceae.

PROJECT-2

Angiospermic Flora of Neora Valley National Park, Kalimpong, West Bengal

Executing Scientist: Dr Vinay Ranjan, Scientist- 'E', Dr Gopal Krishna, Bot. Asstt., Dr Anant Kumar, Bot. Asstt.

Date of initiation: April, 2016

Date of completion: March, 2021

OBJECTIVE: The need for botanical exploration in Neora valley national park was due to following points: added 75 km area in the park; accumulation of recent discoveries; and gap of more than two decade in studies on the flora and vegetation. The objective of present study was to: explore, identify and document the floristic diversity of the entire park area including newly added area of NVNP; prepare upgraded angiospermic flora with colour plant photographs; depict the exact coordinates location of plant species and impart training in collection, preservation, herbarium making and identifying the plant elements.

AREA AND LOCALITY: NVNP is one of the oldest reserve forests in India. Since 1881, the area was recognized as reserve forest and in the year 1992, it was declared as National Park. NVNP is situated in Kalimpong district erstwhile Kalimpong sub-division of Darjeeling district, West Bengal. It lies between 26°52'3" - 27°7'3" N latitude and 88°45' - 88°50' E longitude. Initially, NVNP was established with 84 km², later in 2017 area has been increased to 159.9 km². The altitude varies from 183m to 3200 m, the highest point in Rechila Danda peak at 3,170m bordering Sikkim. The northern and north-eastern boundaries are connected to Sikkim and Bhutan respectively. The southern boundaries of the park are adjoining to the forests of Jalpaiguri district. Its backdrop is also an integral part of the Kanchenjunga landscape. For administrative setup, NVNP has been divided into Upper Neora Range and Lower Neora Range with their Range offices at Lava and Samsing respectively. The main entry point of the National Park is through Lava (2138m), which is 33 km away from Kalimpong and 130 km away from Jalpaiguri. Alternatively, the National Park can be approached by road through Samsing (675m) up to Mouchuki (1000m), which is 72 km from Jalpaiguri.

SUMMARY: More than 800 species (Angiosperms) are expected to be reported from the National Park area. Many of them are supposed to be endemic to Eastern Himalayan Regions. Most important outcome of proposed study will be the collection of plants specimens of particular area that will enrich CAL and will be helpful for researchers, students who comes to identify plants of eastern regions of India. The flora will be documented with GIS data, photographs and detailed distribution of all the taxa. Besides these rare, endemic and threatened taxa will also be listed from this national park.

Work done: Ten field tours were undertaken since inception of the project and collected 1826 field numbers in triplicate. All the specimens have been identified. During the report period two New to state flora (*Goodyera recurva* Lindl. & *Zeuxine gracilis* (Breda) Blume) are identified and published in Richardiana

PROJECT-3

Bryo-flora of Jharkhand

Executing Scientist: Dr Devendra Singh, Scientist-D

Date of initiation: April, 2018

Date of completion: March, 2022

OBJECTIVE: Extensive and intensive survey and collection of specimens from different areas of the Jharkhand. Taxonomic characterization of the species based on morphological, anatomical and ultrastructural parameters. Documentation of Bryoflora of Jharkhand in the form of the illustrated flora.

AREA AND LOCALITY: Jharkhand is one of the biodiversity and mineral-rich state in India, lies between 20°58'–25°18'N latitudes and 83°22'–87°56'E longitudes covering the total geographical area of 79,714 sq. km, of which 23,605.47 sq. km (28.82%) is the forest area. It is surrounded by Bihar in the north, Uttar Pradesh and Chattisgarh in the west, Odisha in the south and West Bengal in the east and politically divided into 24 districts. The altitude varies from 265–1371 m and Parasnath is the highest point. Jharkhand has 11 Wildlife Sanctuaries and one National Park (Betla) protected areas which is the most widely accepted and practical approaches for biodiversity conservation.

SUMMARY: During the period 112 specimens belonging to 45 species were identified and 42 species were illustrated and described, one species recorded for the first time in Indian bryoflora, five species recorded for the first from Central India, ten species recorded for the first time from the state of Jharkhand and published 02 book chapters and 03 research papers.

Work done: Forty five species were identified during the period viz., *Anthoceros punctatus* L., *Anthoceros subtilis* Steph., *Asterella wallichiana* (Lehm. & Lindenb.) Pande, K.P. Srivast. & Sultan Khan ex Grolle, *Bartramia roylei* (Hook. f.) Müll. Hal., *Bryum coronatum* Schwaegr, *Bryum pseudotriquetrum* (Hedw.) Schwaegr, *Cyathodium aureonitens* (Griff.) Mitt., *Cyathodium cavernarum* Kunze ex Lehm., *Cyathodium denticulatum* Udar & S.C. Srivast., *Cololejeunea latilobula* (Herzog) Tixier, *Entodontopsis tavoyensis* (Hook.) W.R. Buck & Ireland, *Erpodium mangiferae* Müll. Hal., *Fissidens involutus* Wilson ex Mitt., *Fissidens cranulatus* Mitt., *Fissidens sylvaticus* Griff., *Fossombronina himalayensis* Kashyap, *Funaria hygrometrica* Hedw., *Frullania ericoides* (Nees) Mont., *Heteroscyphus hyalinus* (Steph.) Abha Srivast. & S.C. Srivast., *Hydrogonium consanguineum* (Thwaites & Mitt.) Hilp., *Hyophila involute* (Hook.) Jaeger, *Hyophila nymaniana* (M. Fleisch.) M. Menzel, *Hydrogonium gracilentum* (Mitt.) P.C. Chen, *Lejeunea aloba* Sande Lac., *Lejeunea devendrae* (Sushil K. Singh) P.K. Verma & K.K. Rawat, *Lopholejeunea sikkimensis* Steph., *Marchantia linearis* Lehm. & Lindenb., *Notothylas anaporata* Udar & D.K. Singh, *Notothylas kashyapii* D.K. Singh, *Octoblepharum albidum* Hedwig., *Plagiochasma appendiculatum* Lehm. & Lindenb., *Plagiochasma intermedium* Lindenb. & Gottsche, *Physcomitrium eurystomum* Sendtn., *Reboulia hemisphaerica* (L.) Radd var. *hemisphaerica*, *Phaeoceros carolinianus* (Michx.) Prosk., *Phaeoceros laevis* (L.) Prosk., *Riccia billardierei* Mont. & Nees, *Riccia curtisii* (James ex Austin) Austin, *Riccia frostii* Austin, *Riccia glauca* L., *Riccia huebeneriana* Lindenb., *Riccia perssonii* Sultan Khan, *Riccia sorocarpa* Bisch. var. *sorocarpa*, *Solenostoma tetragonum* (Lindenb.) R.M. Schust. ex Vána & D.G. Long var. *tetragonum*, *Spruceanthus minutilobulus* (Udar & U.S. Awasthi) Sushil K. Singh, *Targionia hypophylla* L.

PROJECT-4

Revision of the genus *Gastrochilus* D. Don (Orchidaceae) in India

Executing Scientist: Dr. Avishek Bhattacharjee, Scientist C

Date of initiation: April, 2018

Date of completion: March, 2022

OBJECTIVE: To complete revisionary account of the genus *Gastrochilus* in India.

AREA AND LOCALITY: Throughout India

SUMMARY: Finalized description, citation, and recorded distribution, phenology of 20 species [*Gastrochilus acaulis* (Lindl.) Kuntze, *G. affinis* (King & Pantl.) Schltr., *G. acutifolius*, *G. arunachalensis* A.N. Rao, *G. bellinus* (Rchb. f.) Kuntze, *G. calceolaris*, *G. dasypogon* (Sm.) Kuntze, *G. distichus*, *G. flabelliformis*, *G. garhwalensis* Z.H. Tsi, *G. inconspicuous*, *G. intermedius* (Griff. ex Lindl.) Kuntze, *G. linearifolius* Z.H. Tsi & Garay, *G. nilagiricus* Kuntze, *G. obliquus* (Lindl.) Kuntze, *G. platycalcaratus* (Rolfe) Schltr., *G. pseudodistichus* (King & Pantl.) Schltr., *G. rutilans* Seidenf., *G. sessanicus* A.N. Rao, *G. sonamii* Lucksom]; Prepared key to the species of the genus *Gastrochilus*. Typification related problem of *Gastrochilus affinis*, *G. bellinus*, *G. dasypogon* have been resolved. Prepared 'specimen examined' for *Gastrochilus acaulis*, *G. acutifolius*, *G. dasypogon*, *G. obliquus* and *G. pseudodistichus*.

Work done: Finalised citation, distribution, phenology of 20 species of the genus *Gastrochilus*; typification of *Gastrochilus affinis*, *G. dasypogon*, *G. bellinus* was done. Published 1 paper in connection with the project during this period.

No tour could be conducted due to COVID 19 Pandemic (due to lockdown and restrictions in travelling and getting permission for survey in different states).

PROJECT-5

Liverworts and Hornworts Flora of Darjeeling District, West Bengal

Executing Scientist: Dr. Monalisa Dey, Scientist C

Date of initiation: April, 2016

Date of completion: March, 2021

OBJECTIVE: Documentation of the Liverworts and Hornworts of Darjeeling district of West Bengal along with taxonomic description, illustration, nomenclature, specimens examined, note on their habitat preferences and an identification key for easy identification of the taxa.

AREA AND LOCALITY: Darjeeling district, West Bengal. Darjeeling district of West Bengal lies in the foothills of Eastern Himalaya, between 26° 27'–27° 13' N latitudes and 87° 59'–88° 53' E longitudes, covering a total area of 3,149 sq. km.

SUMMARY: Prepared description of 40 species, *Acrolejeunea infusca* (Mitt.) Jian Wang bis & Gradst., *Acrolejeunea recurvata* Mitt., *Bazzania himalayana* (Mitt.) Schiffn., *Bazzania ovistipula* (Steph.) Abeyw., *Bazzania tridens* (Reinw., Blume & Nees) Trevis., *Cheilolejeunea trapezia* (Nees) Kachroo & R.M.Schust., *Cololejeunea latilobula* (Herzog) Tixier, *Cololejeunea longiana* Grolle & Mizut., *Cololejeunea serrulata* Steph., *Cololejeunea trichomanis* (Gottsche) Steph., *Colura tenuicornis* (A.Evans) Steph., *Drepanolejeunea angustifolia* (Mitt.) Grolle, *Drepanolejeunea erecta* (Steph.) Mizut., *Drepanolejeunea fleischeri* (Steph.) Grolle & R.L.Zhu, *Drepanolejeunea herzogii* R.L.Zhu & M.L.So, *Drepanolejeunea yunnanensis* (P.C.Chen) Grolle & R.L.Zhu, *Frullania muscicola* Steph., *Frullania retusa* Mitt., *Frullania nepalensis* (Spreng.) Lehm. & Lindenb., *Heteroscyphus bescherellei* (Steph.) S.Hatt., *Heteroscyphus coalitus* (Hook.) Schiffn., *Lejeunea anisophylla* Mont., *Lejeunea curviloba* Steph., *Lepidozia reptans* (L.) Dumort., *Leptolejeunea subdentata* Schiffn. ex Herzog, *Lopholejeunea subfusca* (Nees) Schiffn., *Marchantia emarginata* Reinw., Blume & Nees, *Marchantia linearis* Lehm. & Lindenb., *Metacalypogeia alternifolia* (Nees) Grolle, *Metzgeria consanguinea* Schiffn., *Microlejeunea punctiformis* (Taylor) Steph., *Plagiochila flexuosa* Mitt., *Plagiochila fruticosa* Mitt., *Plagiochila khasiana* Mitt., *Plagiochila nepalensis* Lindenb., *Plagiochila parvifolia* Lindenb., *Radula auriculata* Steph., *Radula obscura* Mitt., *Radula pocsii* K.Yamada, *Radula stenocalyx* Mont.

Identified 214 specimens belonging to 56 species, *Acanthocoleus gilvus* (Gottsche) Kruijt, *Cololejeunea latilobula* (Herzog) Tixier, *Cololejeunea longiana* Grolle & Mizut., *Cololejeunea serrulata* Steph., *Cololejeunea trichomanis* (Gottsche) Steph., *Cheilolejeunea trapezia* (Nees) Kachroo & R.M.Schust., *Colura tenuicornis* (A.Evans) Steph., *Drepanolejeunea erecta* (Steph.) Mizut., *Drepanolejeunea fleischeri* (Steph.) Grolle & R.L.Zhu, *Drepanolejeunea herzogii* R.L.Zhu & M.L.So, *Lejeunea anisophylla* Mont., *Lejeunea curviloba* Steph., *Lejeunea flava* (Sw.) Nees, *Lejeunea obscura* Mitt., *Lejeunea tuberculosa* Steph., *Leptolejeunea balansae* Steph., *Leptolejeunea elliptica* (Lehm. & Lindenb.) Schiffn., *Lopholejeunea subfusca* (Nees) Schiffn., *Microlejeunea punctiformis* (Taylor) Steph., *Ptychanthus striatus* (Lehm. & Lindenb.) Nees., *Spruceanthus semirepandus* (Nees) Verd., *Frullania arecae* (Spreng.) Gottsche, *Frullania muscicola* Steph., *Frullania nepalensis* (Spreng.) Lehm. & Lindenb., *Frullania retusa* Mitt., *Radula auriculata* Steph., *Radula obscura* Mitt., *Radula pocsii* K.Yamada, *Radula stenocalyx* Mont., *Heteroscyphus bescherellei* (Steph.) S.Hatt., *Heteroscyphus coalitus* (Hook.) Schiffn., *Metacalypogeia alternifolia* (Nees) Grolle, *Scapania ferruginea* (Lehm. & Lindenb.) Lehm. & Lindenb., *Scapania ornithopoides* (With.) Waddell, *Lepidozia reptans* (L.) Dumort., *Bazzania himalayana* (Mitt.) Schiffn., *Bazzania ovistipula* (Steph.) Abeyw., *Bazzania tricrenata* (Wahlenb.) Lindb., *Bazzania tridens* (Reinw., Blume & Nees) Trevis., *Plagiochila flexuosa* Mitt., *Plagiochila fruticosa* Mitt., *Plagiochila khasiana* Mitt., *Plagiochila nepalensis* Lindenb., *Plagiochila parvifolia* Lindenb., *Plagiochila sciophila* Nees ex Lindenb., *Plagiochila subtropica* Steph., *Pellia epiphylla* (L.) Corda, *Dumortiera hirsuta* (Sw.) Nees, *Lunularia cruciata* (L.) Dumort. ex Lindb., *Marchantia emarginata* Reinw., Blume & Nees, *Marchantia hartlessiana* Steph., *Marchantia linearis* Lehm.

& Lindenb., *Marchantia paleacea* Bertol., *Marchantia papillata* subsp. *grossibarba* (Steph.) Bischl., *Marchantia subintegra* Mitt., *Plagiochasma appendiculatum* Lehm. & Lindenb.

Studied two specimens [*Drepanolejeunea mawtmiana* Ajit P.Singh & V.Nath: A.P. Singh 208693B (isotype LWG) and *Drepanolejeunea longifolia* Ajit P.Singh & V.Nath: S. Chandra 201213B (isotype LWG)] obtained on loan from National Botanical Research Institute, Lucknow, India (LWG).

Work done: Designated *Drepanolejeunea mawtmiana* as a new synonym of *Drepanolejeunea herzogii*.

PROJECT-6

Editing of Flora of Bihar Vol. 1 (Ranunculaceae-Mimosaceae)

Executing Scientist: Dr Vinay Ranjan, Scientist E, Dr Kumar Avinash Bharati, Scientist C and Dr Anand Kumar, Botanist

Date of initiation: April, 2020 Date of completion: March, 2021

OBJECTIVE: To edit manuscripts from Ranunculaceae to Mimosaceae.

Summary: Completed editing of the allotted work (59 families, 237 genera, 521 taxa and 106 cultivated taxa).

Work done: Completed the allotted work.

PROJECT-7

Editing of Flora of Jharkhand Vol. 1 (Ranunculaceae-Mimosaceae)

Executing Scientist: Dr Vinay Ranjan, Scientist E, Dr Kumar Avinash Bharati, Scientist C and Dr Anand Kumar, Botanist

Date of initiation: April, 2020 Date of completion: March, 2021

OBJECTIVE: To edit manuscripts from Ranunculaceae to Mimosaceae.

AREA AND LOCALITY: NA

SUMMARY: Completed editing of the allotted work (61 families, 239 genera, 524 taxa and 106 cultivated taxa).

Work done: Work completed, manuscript compiled and submitted.

RESEARCH PROGRAMMES ON FLORA OF INDIA PROJECT

PROJECT 1

Flora of India, Vol. 16 (Salvadoraceae, Apocynaceae)

Executing official: Dr. Anand Kumar, Botanist

Date of initiation: April, 2019 Date of completion: December, 2020

OBJECTIVE: To update the manuscript of Salvadoraceae, Apocynaceae.

AREA AND LOCALITY: Throughout India

SUMMARY: Updated two families Salvadoraceae and Apocynaceae. The family Salvadoraceae includes 2 genera, 4 species and 2 varieties in India while Apocynaceae includes 39 genera and 91 species, 5 varieties in India. Additionally, Apocynaceae comprises 9 cultivated genera, 20 cultivated species and 2 doubtful species in India.

Work done: Completed the work and the updated manuscript was submitted to the team leader.

PROJECT -2

Flora of India, Vol. 20 (Gesneriaceae, Bignoniaceae, Pedaliaceae and Acanthaceae)

Executing officials: Late Dr. P. Lakshminarasimhan, W. Arisdason, K. Karthigeyan & Gopal Krishna

Date of initiation: 2019; Date of completion: 2020

OBJECTIVE: Editing and updating of the manuscripts.

AREA AND LOCALITY: Throughout India

SUMMARY: Completed and submitted the manuscript (694 species, 05 subspecies, 48 varieties and 01 forma, including 26 species and 01 variety belonging to 09 genera under cultivation).

Work done: Final manuscript has been submitted to Technical Section, BSI, Kolkata.

PROJECT 3

Flora of India Vol. 21

Executing officials: Dr V. Sampath Kumar, Scientist-E, Dr G. Krishna, Bot. Asstt. and Dr Anant Kumar, Bot. Asstt.

Date of initiation: March 2020

Date of completion: February 2021

OBJECTIVE: Editing and updating of the manuscripts.

AREA AND LOCALITY: Throughout India

SUMMARY: Completed the inventory of the family Plantaginaceae (01 genus and 15 taxa) in India. Edited and updated the tribe Ocimoideae (9 genera and 33 spp.), genera *Leucas* (58 taxa), *Gomphostemma* (22 taxa), *Coleus* (35 taxa), *Scutellaria* (19 spp.), *Stachys* (7 spp.), *Teucrium* (12 spp.) and *Rubiteucrus* (1 sp.).

Work done: Completed the work and the updated manuscript was submitted to the team leader.

PROJECT 4

Flora of India, Vol. 25 and 26 (Hydrocharitaceae to Orchidaceae)

Executing Scientist: Dr. Avishek Bhattacharjee, Scientist C

Date of initiation: April, 2019; Date of completion: December, 2020

OBJECTIVE: To complete floristic accounts of the allotted families for 'Flora of India' as per the format in two volumes (vol. 25 and 26).

AREA AND LOCALITY: Throughout India

SUMMARY: Completed the work allotted (including additional work on 2 genera and 36 taxa) for vol. 25 and 26 of 'Flora of India' [Total 31 genera, 246 taxa; Hydrocharitaceae (10 genera, 33 taxa), Orchidaceae: Subfamily Orchidoideae (13 genera, 72 taxa), Subfamily Epidendroideae (8 genera 141 taxa)] and submitted the final report to the team leader along with 106 photographs, 52 dissection-photoplates and 49 illustrations.

Work done: Completed the allotted work by given time and executed additional work as assigned by the Team Leader. Published 2 papers, 1 book-chapter, 7 abstracts in connection with the project during this period.

PROJECT 5

Flora of India Vol. 27 (Liliaceae, Asphodelaceae)

Executing officials: Dr. Rajib Gogoi and Dr. Mahua Pal

Date of initiation: July 2019; Date of completion: December 2020

OBJECTIVE: To prepare updated checklist, nomenclature, description of the genera and description, flowering and fruiting time, distribution in India and World, habitat of the species of the family Liliaceae and Asphodelaceae.

AREA AND LOCALITY: India

SUMMARY: Prepared description, flowering and fruiting time, distribution in India and World for Liliaceae (7 genera, 39 species and 5 varieties) and Asphodelaceae (5 genera, 7 species and 2 cultivated species and 1 cultivated variety).

Work done: Completed the work and the updated manuscript was submitted to the team leader, Dr. Rajib Gogoi.

PROJECT 6

Flora of India Vol. 28

Executing officials: Dr M.U. Sharief, Dr S.A. Shaheed, Dr V. Ranjan, Dr B.K. Singh and Dr Anant Kumar

Date of initiation: March 2020; Date of completion: February 2021

OBJECTIVE: Editing and updating of the manuscripts.

AREA AND LOCALITY: Throughout India.

SUMMARY: Completed the inventory of the families Butomaceae (2 genera and 2 species), Cymodoceae (4 genera and 7 species), Lemnaceae (4 genera and 15 species), Triuridaceae (1 genus and 2 species) and Zannichelliaceae (1 genus and 2 species).

Work done: Completed the work and the updated manuscript was submitted to the team leader.

OTHER RESEARCH PROGRAMMES

PROJECT 1

Editing of Flora of Andaman and Nicobar Islands (Volume 2)

Executing officials: Dr K. Karthigeyan, Scientist-E

AREA AND LOCALITY: Andaman and Nicobar Islands.

Work done: Edited and submitted the flora of Andaman & Nicobar Islands (volume 2, Myrtaceae to Podocarpaceae) for publication to the Director, BSI along with 50 high resolution photos. Added descriptions of a total of 115 species, and the generic and species keys were revised.

PROJECT 2

Flora of East Kolkata Wetlands

Executing officials: Dr K. Karthigeyan, Scientist-E

AREA AND LOCALITY: West Bengal.

Work done: Published three chapters in the book titled 'Biodiversity profile of East Kolkata Wetlands'.

PROJECT 3

Flora of Bihar, Vol. 2 (Scrophulariaceae)

Executing officials: Dr Kumar Avinash Bharati, Scientist-C

Date of initiation: April 2020; Date of completion: March 2021

OBJECTIVE: To prepare the manuscript for the family Scrophulariaceae.

AREA AND LOCALITY: Bihar

SUMMARY: Prepared taxonomic account of 41 species under 21 genera. In addition, enlisted 6 cultivated species. All the genera and species are enumerated with identification keys, phenology and distribution at district level.

Work done: Submitted the manuscript.

PROJECT 4

Flora of Jharkhand, Vol. 2 (Scrophulariaceae)

Executing officials: Dr Kumar Avinash Bharati, Scientist-C

Date of initiation: April 2020; Date of completion: March 2021

OBJECTIVE: To prepare the manuscript for the family Scrophulariaceae.

AREA AND LOCALITY: Jharkhand

SUMMARY: Prepared taxonomic account of 47 species under 27 genera. In addition, enlisted 7 cultivated species. All the genera and species are enumerated with identification keys, phenology and distribution at district level.

Work done: Submitted the manuscript in given time.

NEW DISCOVERIES

New to Science

Dendrophthoe gamblei L.J. Singh, V. Ranjan, Rasingam & J. Swamy, Journal of Asia-Pacific Biodiversity 13 (2020) 487–493 (LORANTHACEAE). This species has been described and illustrated from peninsular India.

New Distributional Records

Aquarius cordifolius (L.) Christenh. & Byng (ALISMATACEAE): This species has been collected from ponds of West Bengal. It was reported as a new addition to invasive alien flora of India.

Colura corynophora (Nees, Lindenb. & Gottsche) Trevis. (LEJEUNEACEAE): This species has been reported for the first time from India based on the collection made from Mizoram, Lunglei, Thorang WLS, Lawngtlai, Ngengpui WLS at 138 and 629 m altitude.

Gastrochilus affinis (King & Pantl.) Schltr. (ORCHIDACEAE): This species of the family Orchidaceae has been reported for the first time from Western Himalayabased on the collection made fromMunsiyari, Uttarakhand.

Goodyera recurva Lindl. (ORCHIDACEAE): This species has been reported for the first time from West Bengal based on the collection made from Neora Valley National Park at 2500-3000m altitude. It is rare in distribution and confined to Himalayan region and North east India.

Zeuxine garcilis (Breda) Blume (ORCHIDACEAE): This species has been reported for the first time from West Bengal based on the collection made from Neora Valley National Park at 700-1000m altitude.

Ludwigia decurrens Walter (ONAGRACEAE): This species has been reported for the first time from Jharkhand state from the Koderma Wildlife Sanctuary, Koderma district, Jharkhand.

Publications

Papers published-63; Books published-04; Book chapters-11; Abstract published-08

Trainings/Workshops organized

‘Virtual Workshop on Herbarium Techniques’ on 23.12.2020 (jointly organised by the Department of Botany, Bethune College, Kolkata in Collaboration with Central National Herbarium & ENVIS Resource Partner on Biodiversity, Botanical Survey of India, Howrah) – Organised by Dr R.K. Gupta, Scientist-E, Dr Avishek Bhattacharjee, Scientist-C and team.

Training for herbarium methodology & techniques, and plant identification to the students of Institute of Biodiversity and Sustainable Development, Imphal, Manipur from 11.12.2020 to 19.12.2020. During the training, field trips were conducted in outskirts of Imphal (Bishnupur, Iroishama, Loktak etc.) and collected c. 250 plant samples in triplicate. – Attended by Dr Gopal Krishna, Botanical Asstt. and Dr Anant Kumar, Botanical Asstt.

Webinar on “Revising the Generic Limits of *Coleus* and *Plectranthus* (Lamiaceae, Tribe Ocimeae)” on 12th March, 2021. The speaker was Dr Alan Paton in this webinar. – Organised by Dr R.K. Gupta, Scientist-E and team.

Seminar/Symposium/Conference attended:

Dr K. Karthigeyan, Scientist-E

- As an invited speaker, delivered a lecture on the ‘Role of Herbarium in Plant Identification’ during the taxonomy workshop organized by ATREE on 15.12.2020.
- Delivered lecture on ‘Diversity and Conservation of Mangroves in Sundarban Biosphere Reserve, India in the National Webinar on Biosphere Reserves of India: identification, Conservation and Management organized by Govt. Madhav Sadashivrao Golwalkar College, Rewa, M.P on 17th March, 2021.
- Delivered a lecture on Herbarium methodology in the workshop organized by CNH in collaboration with Bethune College Kolkata on 24th December 2020.

Kumar Avinash Bharati, Scientist-C

- Participated in virtual workshop titled “Science Leadership Workshop” organized by the Central university of Punjab, Bathinda and sponsored by INSA (Indian National Science Academy), New Delhi from June 22–28, 2020.
- On 10.12.2020, topic: “The Himalayan Mountain Biodiversity: Threats and solutions”.
- On 4th & 5th December 2020: Annual Conference of Indian Association for Angiosperm Taxonomy
- On 06.01.2021, topic: “International Code of Nomenclature (ICN) for plants” by Dr K. Gandhi, Harvard University, USA.
- On 10.12.2021, topic: Himalayan Mountain Biodiversity Threats & Solutions
- On 23.02.2021, topic: “Exploration of La Amistad National Park (Costa Rica/Panama” by Alex Monro, Royal Botanic Garden, Kew
- On 12.03.2021, topic: “Revising the Generic Limits of *Coleus* and *Plectranthus* (Lamiaceae, Tribe Ocimeae)” by Dr Alan Paton, Royal Botanic Gardens, Kew.
- Delivered talk on “Floristic diversity of Baraila Lake Salim Ali Jubba Sahni Bird Sanctuary, Bihar” in a webinar organized by Department of Science, Vivek College, Bijnor, Uttar Pradesh on 15th July 2020.
- Delivered talk on “Introduction to Ethnobotany & Status of Research in India” in a webinar organized by Shri Mathuradas Mohata College of Science, Nagpur on 22nd January 2021.

Dr Monalisa Dey, Scientist-C

- Participated as a resource person in the Virtual Workshop on Herbarium Techniques organised by The Department of Botany, Bethune College, Kolkata in Collaboration with Central National Herbarium & ENVIS Resource Partner on Biodiversity of Botanical Survey of India on 23rd December, 2020 and gave lecture as well as practical demonstration on Collection and Herbarium Methodology of Bryophytes.

Mr P.P. Ghoshal, Botanist

- Participated in a National Webinar on ‘Webinar-cum-Brainstorming on ‘Himalayan Mountain Biodiversity – Threats & Solutions’ organized by BSI Sikkim Himalayan Regional Centre Gangtok on 10.12.2020.
- Participated in a National level Webinar on “Plant Diversity in India” by Dept. of Botany, Bagnan College in Collaboration with IQAC, Bagnan College on 20/09/2020.
- Participated in a National Webinar on ‘Role of Botanical Survey of India in Biodiversity Conservation’ organized by BSI DRC Hyderabad on 14.10.2020.

Dr Mahua Pal, Botanist

- Attended a National level Webinar on “Plant Diversity in India” arranged by Bagnan College on 20.9.2020.
- Attended 30-th Annual conference of Indian Association for Angiosperm Taxonomy & Webinar on 4.12.2020 & 5.12.2020.
- Attended Webinar on International Code of Nomenclature (ICN) for Plants jointly organised by Botanical Survey of India, Deccan Regional Centre, Hyderabad and Dept. of Botany, Andhra university, Visakhapatnam on 6.1.21.
- Attended Webinar on “Revising the Generic Limits of Coleus and Plectranthus (Lamiaceae, Tribe Ocimeae)” arranged by Central National Herbarium, Botanical Survey of India on 12.3.21.

Dr Anand Kumar, Botanist

- Demonstrated as resource person on process of Digitization of herbarium specimens on 23.12.2020 on ‘Virtual Workshop on Herbarium Techniques’ jointly organized by the Department of Botany, Bethune College, Kolkata in collaboration with Central National Herbarium & ENVIS Resource Partner on Biodiversity, Botanical Survey of India, Howrah.
- Attended Webinar on “International Code of Nomenclature (ICN) for plants” by Dr K.N. Gandhi, Harvard University, USA on 06.01.2021 organized Botanical Survey of India, Deccan Regional Centre, Hyderabad; "Science in Białowieża Forest - Białowieża Forest in science" by Prof. (Dr) Bogdan Jaroszeewicz organized by Botanical Survey of India, Sikkim Himalayan Regional Centre, Gangtok.
- Attended National Webinar-cum-Brainstorming session on ‘Himalayan Mountain Biodiversity–Threats & Solutions’ organized by Botanical Survey of India, SHRC, Gangtok on Dec 10, 2020.

Dr Anant Kumar, Botanical Asstt.

- As a resource person, imparted a virtual training regarding herbarium methodology and technique to students and teachers of Bethune College, Kolkata on 23rd December, 2020 (Wednesday) conducted by Central National Herbarium & ENVIS Resource Partner with the Department of Botany, Bethune College, Kolkata.

Dr Shyam Biswa, Botanical Asstt.

- Delivered a demonstration on practical session as resource person on Herbarium Methodology to undergraduate students and other faculty members, on ‘Virtual Workshop on Herbarium Techniques’ on 23.12.2020 jointly organised by the the Department of Botany, Bethune College, Kolkata in Collaboration with Central National Herbarium & ENVIS Resource Partner on Biodiversity, Botanical Survey of India, Howrah.
- Attended Webinar on “Alien Plant invasion in India, Status and Consequence” on 17th December 2020 organized by BSI Solan Circle (HAWHRC).
- Attended Webinar on “International Code of Nomenclature (ICN) for Plants” by Dr. K. N. Gandhi on 06th January 2021 organized by BSI, DRC, Hyderabad.

Dr Vijay Kumar Mastakar, Botanical Asstt.

- National Webinar On RELEVANCE OF ETHNOBOTANY IN CONTEMPORARY SOCIO – ECONOMIC CONDITIONS 14th August, 2020 Organized by S.K. Jain Institute of Ethnobiology School of Studies in Botany Jiwaji University, Gwalior (M.P.).

- National Webinar On “Frontiers of Biodiversity Conservation and Herbal Research” Organized by: Chaman Lal Mahavidhyalya, Landhaura, Haridwar (UK) (Department of Zoology & Botany) In collaboration with Botanical Survey of India, Kolkata (Ministry of Environment, Forest & Climate Change, India) National Webinar On “Frontiers of Biodiversity Conservation and Herbal Research” 9th August 2020.
- Webinar on the title “Restoring Biodiversity for Environmental Sustainability” organized by National Museum of Natural History, Ministry of Environment, Forest and Climate Change, New Delhi on 28th August, 2020.
- Webinar on Alien Plant Invasion in India: Status and Consequences on 17th December, 2020. Govt. of India Ministry of Environment, Forest and Climate Change Botanical Survey of India High Altitude Western Himalayan Regional Centre, Naini Campus, Solan (H.P.) National Webinar Series Lecture- 3 on 17th December, 2020.
- Webinar on “Evolution of science seen from historical perspective” Conducted by the Department of Botany, Deshbandhu College, University of Delhi under the aegis of IQAC on 12th & 13th May 2020.

Activities of Research Fellows

Taxonomic revision of the subtribes Eleusininae Dumort., Aleuropodinae P.M. Peterson & al., Perotidinae P.M.Peterson & al. and Gymnopogoninae P.M. Peterson & al. (Poaceae: Chloridoideae: Cynodonteae) in India by Shrabasti Das, SPF & Dr. K. Karthigeyan, Scientist- E.

The main objectives of the study are taxonomic revision of the subtribes - Eleusininae Dumort., Aleuropodinae P.M. Peterson & al., Perotidinae P.M.Peterson & al. and Gymnopogoninae P.M. Peterson & al. (Poaceae) in India with reference to correct identity and updated nomenclature and to characterize the macromorphology and micro-morphological characters under SEM and find out an evolutionary line according to taxonomic characters. As per the current estimate, 15 genus and 46 species are belonging to the subtribe Eleusininae Dumort., 5 genus and 11 species are belonging to the subtribe Aleuropodinae P.M. Peterson, 2 genus and 4 species are belonging to the subtribe Perotidinae P.M.Peterson & al., 2 genus and 2 species are belonging to the subtribe Gymnopogoninae P.M. Peterson & al.. in India. About 300 photographs of 15 collected species or plant parts were taken during field tours; voucher specimens for all the collected materials were prepared. Detailed description, illustration and nomenclatural notes of 25 taxa were completed towards the preparation of the final report. In addition to this, SEM of caryopsis will be carried out. The study so far yielded one publication on the lectotypification of *Tetrapogon roxburghianus*.

Revision of the subtribes- Boivinellinae Pilg. and Anthephorinae Benth. (Poaceae) by Shreya Chaudhuri, SRF & Dr. Vinay Ranjan, Scientist-E

The main objective of the Revision of the subtribes- Boivinellinae Pilg. and Anthephorinae Benth. (Poaceae) is to prepare an up-to-date checklist of all the species belonging to the two subtribes. Also, a detailed taxonomic description of all the taxa will be prepared based on the type material, herbarium study, fresh collection, protologues and literature. According to the current estimate there are about 9 genera and 49 species belonging to the two subtribes. Till now, illustration from the herbarium specimens of 7 genera consisting 24 species are completed that belong to the subtribe Boivinellinae also detailed description of 7 species are prepared. Also photographs of the spikelet from herbarium specimen and also from fresh collection are being taken from which photo plates will be prepared. Specimen examined for *Echinochloa colonum* (L.)Link, is being prepared from the herbarium specimen studied in NBRI.

Funded/Collaborative Projects

Dr K. Karthigeyan, Scientist- E

As the Project investigator for the Evaluation of the project titled “Restoration of Mangroves in Sundarban through Afforestation, Integrated Mangrove-Shrimp Farming, Income Generation and Community Participation (2017-2020)” by ‘Nature Environment and Wildlife Society (NEWS), completed all the field surveys and submitted a detailed Final report to the Director, Botanical Survey of India for onward submission. The report was also uploaded in BSI website.

IT works/Digitization

Dr Kumar Avinash Bharati, Scientist-C & Dr Anand Kumar, Botanist

Websites: <https://bsi.gov.in>

A new official website of Botanical Survey of India has been prepared and launched on 30th July 2020. It has been hosted on NIC cloud services “Meghraj”.

<https://efloraindia.bsi.gov.in>

The eFlora of India & Plant Checklist of India application has been hosted on the cloud named “Baadal” (MHRD & IIT Delhi) on 30th March 2021.

- Prepared the work plan and coordinated the databasing with help of 12 scientific staffs and completed on the schedule time. Online Plant Checklist of India databases contains 2.5 lakhs botanical names (21,558 taxa belonging to 275 families and 2744 genera, 1404 cultivated taxa and a total of 1907 infra-specific taxa (including 1518 varieties, 337 subspecies and 52 forma).
- E-Flora of India, 8 vols. (1, 2, 3, 4, 5, 12, 13, and 23) contains 8,813 records.
- Algae of India Checklist databases contain 5,433 records.

[https:// archive.bsi.gov.in](https://archive.bsi.gov.in)

E-archive of BSI has been hosted on the NIC cloud on 23rd March 2021. A total of 61,501 images and associated information are available on the website as follows:

| | |
|---------------------|--------|
| Textile design | 1,704 |
| Natural dyes | 6,171 |
| Botanical Paintings | 5,812 |
| Economic Botany | 20,017 |
| Type specimens | 27,797 |
| Total | 61,501 |

Digitization of herbarium specimens

Supervised the digitization of 14,980 herbarium specimens and backup of images in 1,120 DVDs. Inventory of all the DVDs have been prepared and stored in data-center.

| | |
|-------------------|--------|
| Scanning | 14,980 |
| Metadata in excel | 4,268 |

Miscellaneous IT works

- Multi-copy back up created in 30 external HDD & 1,100 DVDs with inventories, it contains 1,11,991 images of herbarium and archive materials including botanical paintings.
- Back up of 18,492 herbarium images created in HDD which was digitized at Natural History Museum, London by BSI staffs.
- Coordinated scanning of 213 illustrations for “Flora of Gujrat”.
- The database of Natural dye for **3,083 natural dyes** has been corrected and rearranged according to the new search options. The rearrangement part includes type of cloths, multiple dying agents, plant based dying agents and animal based dying agents. The final database has been submitted to NIC for hosting on BSI archive web portal.
- Coordinated training on “management of information resources of official website of BSI” by NIC through video conferencing on 6.10.2020.

Herbarium Information

| Herbarium maintenance | Nos. |
|--|---------------------|
| No. of specimens mounted/remounted | 463/7237 |
| No. of Herbarium sheets stitched/poisoned/fumigated/dusted | 707/9216/2510/25896 |
| No. of Herbarium sheets incorporated | 8239 |
| No. of loaned/gifted specimens received/returned | 33/31/1662 |
| No. of specimens identified | 559 |

| | |
|---|------------|
| No. of Genus/species covers changed | 2105/4455 |
| No. of specimens segregated | 13860 |
| Documentation of existing herbarium sheets at herbaria/entry in Excel sheet | 40486/4068 |

Service Rendered

Revenue Earned: Rs. 4900/- for identification/authentication of plant samples.

Dr K. Karthigeyan, Scientist-E

- As an invited referee, reviewed 03 research articles received from various national and international journals.
- Evaluated 1 Ph.D thesis received from M.S. University, Tamil Nadu.
- As the in-charge of identification services, coordinated and verified the identification of 202 plant specimens and issued identification certificates.

Dr Avishek Bhattacharjee, Scientist-C

I. Attended VIPs/ facilitated scientists/ researchers in consultation of specimens at Hall no. 4 and Dicot-type section:

October, 2020: Attended Shri Raghvendra Singh (IAS), Secretary, Ministry of Culture, Government of India on 18.10.2020 (Sunday) at CNH.

November, 2020: Facilitated Dr. Dipanwita Banik, Scientist, CSIR-North East Institute of Science & Technology, Jorhat on 4.11.2020 at Hall 4 in consultation of herbarium specimens.

December, 2020: Mr. Ankur M. Joshi, a post-graduate student of St. Xavier's College, Mumbai on 4.12.2020 (the main demonstration about the herbarium was given by Dr. Gopal Krishna).

II. Materials sent/provided through Technical Section

April, 2020:Type-image of *Habenaria trifurcata* to Dr. Santanu Dey, Nagaland University, Kohima. **May, 2020:**Type-image of *Habenaria trifurcata* to Dr. Santanu Dey, Nagaland University, Kohima; type images of *Ziziphus kunstleri* to Dr. Timothy M.A. Utteridge, Royal Botanic Gardens, Kew; type images of *Phlogacanthus pulcherrimus* to Dr. Ritesh Kumar Choudhary, Scientist D, Agharkar Research Institute, Pune; type image of *Ophiorrhiza pykarensis* to Dr. M. Sabu, Emeritus Scientist, Malabar Botanical Garden; type images of *Magnolia maingayi* to Dr. Pankaj Kumar, Kadoorie Farm and Botanic Garden (KFBG) Corporation, Hongkong. Seven posters to Dr. P.V. Prasad, HoO and Dr. K. Karthigeyan for selection and then helped in re-composing (with Dr. K. Karthigeyan) those posters with updated data by giving necessary instructions (online) to Mr. Dinesh Sah, Artist, CNH. **June, 2020:**Type-image of *Melocalamus compactiflorus* to Prof. Sarawood Sungkaew, Kasetsart University, Bangkok; type images (4) of *Glyptopetalum quadrangulare* and *Salacia grandiflora* to Ivan A. Savinov, Russian Academy of Sciences, Russia. **July, 2020:** 66 Wallich's specimen-images of *Impatiens spp.* to Dr. Rajib Gogoi, HoO, SHRC, Gangtok; type-image of *Bixagrewia nicobarica* to Dr. Samuele Gerace, University of Pisa, Italy; iii) type-image of *Arundinella intricata* to Dr. Priyanka Agnihotri, Senior Scientist, CSIR-NBRI, Lucknow. **August, 2019:**9 type-images belonging to the family Musaceae to Dr. Rajib Gogoi, HoO, SHRC, Gangtok; type-image of *Trichosanthes listeri* to Dr. Sharad Kambale, AC and S College, Tryambakeshwar, Nashik; type image of *Phyllanthus nephradeniusto* Prof. M.B. Viswanathan, Bharathidasan University, Tiruchirappalli. 2 Roxburg's drawings (*Sida cuneifolia* and *Elaeocarpus ganitrus*) to Prof. Milind M. Sardesai, Savitribai Phule Pune University, Pune. Scanned pages of a literature (provided by Dr. Anant Kumar) on the genus *Thesium* (Santalaceae) to Dr. Natasha Lombard, South African National Biodiversity Institute (SANBI), Pretoria National Botanical Gardens, Pretoria; scanned images of literature (3 pages from the book 'Order out of Chaos') to Amol P. Salve, Research Fellow, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. **September, 2020:** Type-images (4) of *Bentinckia nicobarica* to Mr. Rohit Nivas Mane, Research Fellow, Shivaji University, Kolhapur; 3 specimen-images (general herbarium) of Orchidaceae to Dr. D. Maiti, University of Calcutta, Kolkata; type images of *Typhonium listeri* to Dr. Manudev Madhavan, St. Joseph's College, Kozhikode; images of 9 type-specimens to Dr. Dipankar Borah, Rajiv Gandhi University, Itanagar which were earlier submitted by him at CAL; images of 5 type-specimens to Dr. Sarat Misra, Orchidologist which were earlier submitted by him at CAL

through Dr. S. S. Dash, Scientist E, BSI. **October, 2020:** Specimen-image of *Amorphophallus* sp. to Mr. Khant Zaw Hein, Monywa University, Myanmar. **November, 2020:** Type-image of *Strobilanthes meeboldii* Craib to Dr Bince Mani, Department of Botany, St. Thomas College, Kottayam, Kerala on 6.11.2020. Arranged to send a specimen of *Schizopepon* sp. belonging to the family Cucurbitaceae to Prof. (Dr.) Hanno Schaefer, Technical University of Munich, Germany with permission of NBA. **December, 2020:** Holotype-image of *Chandrasekhariana keralensis* Nair et al. to Dr. Rajendra D. Shinde, Principal, St. Xavier's College, Mumbai; holotype-image of *Hedyotis gamblei* to Dr Deepu Sivadas, JNTBGRI, Thiruvananthapuram; type-images (3) of *Cryptocarya ferrarsi* var. *macrocarpa* and specimen-image (1) of *Cryptocarya ferrarsi* to Dr. R. Jagadeesan, Kerala. Six hundred thirty five (635) packets of loaned specimens of bryophytes to BSI ERC, Shillong. **February, 2020:** Type image of *Barclaya motleyi* var. *kunstleri* to Prof. Niels Jacobsen, University of Copenhagen, Denmark. specimen-images of *Gymnema sylvestre* to Kanchana Vaishnav, Ph.D. Scholar of CSIR-National Botanical Research Institute, Lucknow. **March, 2020:** 24 type-images to Mr. M Uday Kuma, Research Scholar, Madura College, Madurai; 1 type-image of *Trisepalum kingii* to Prof. Santhosh Nampy, University of Calicut. specimen-images of *Gymnema sylvestre* to Kanchana Vaishnav, Ph.D. Scholar of CSIR-National Botanical Research Institute, Lucknow.

III. Reply to queries:

April, 2020: Responded to a query of Dr. Patrick Sweeney, Senior Collections Manager, Yale University Herbarium (YU) on some loaned specimens of bryophytes. **June 2020:** Responded to a query of Dr. Anoop P. Balan, Malabar Botanical Garden & Institute for Plant Sciences, Kozhikode on the type specimen of *Tephrosia travancorica* (Fabaceae); Dr. Shrikant Ingalhalikar, Pune on the type specimen of *Stereospermum tetragonum* var. *angustifoilum*. **August, 2020:** Responded to the query of Dr. Tang Ming, Royal Botanical Gardens, Richmond on specimens of *Synotis borii* (Raizada) R. Mathur belonging to the collections *N. L. Bor* 17280, *C. B. Clarke* 41921 and *C. B. Clarke* 42637; Mr. Pradip V. Deshmukh, Shivaji University, Kolhapur regarding permission to use 1 type image (CAL0000019472) in his publication. **September, 2020:** Responded to the query of Dr. K. N. Nair, Senior Principal Scientist & Professor, CSIR-National Botanical Research Institute, Lucknow on Roxburgh's drawing; Dr. Tang Ming, Royal Botanical Gardens, Richmond on type-specimens of *Senecio mishmi* C. B. Clarke. **November, 2020:** Responded to query of Dr. Sina Khalvati, Bu-Ali Sina University, Iran on availability of type-specimen of *Solananthus tchitounyi*. **February, 2020:** Responded to the query of Mr. Sajid Khan, Research Scholar, Baba Ghulam Shah Badshah University, Rajouri (J&K).

IV. Reviewed 2 manuscripts for Rheedea and 2 for BSI ENVIS-Newsletter.

Dr Kumar Avinash Bharati, Scientist-C

- Shri Babul Supriyo, Hon'ble Minister of State, MOEF&CC, New Delhi visited the AJCB IBG Howrah on 09.10.2020.
- The Secretary, Ministry of Culture, has visited datacenter, CNH on 18.10.2020.
- Reviewed research paper entitled "Mapping Covid-19 International Collaboration in India" for Indian Journal of Biochemistry and Biophysics.
- Reviewed research paper "Plant anti-viral to take up the cudgels for viral infection" for Phytotherapy Research.

Dr Mahua Pal, Botanist

- Mr. Nikhil Sur, from Behala, Kolkata coming to consult old Botanical paintings and to gather information about the history of Botanical Garden for publication of one book written by him on 13.1.21.
- Senior AO, AO, Senior Accountant and Accountant from MOEFCC, New Delhi for visiting Type Section II on 24.2.21 for seeing Roxburgh's Icons and other old archival materials housed there in.
- C. Sudhakar, IPS, Commissioner of Police, Howrah for visiting Type Section II on 11.3.21 for seeing Roxburgh's Icons and other old archival materials housed there in.
- Reviewed 3 manuscripts received from the Executive Editor, Rheedea.

Dr Anand Kumar, Botanist

- Provided comments on the identity of *Adenanthera microsperma* Teijsm. & Binn. or *Adenanthera pavonina* L. sought under RTI to Hqrs.
- Assisted Dr. Vinay Ranjan, Scientist-E in preparation of RTI application received from Shri Ganesan RP and provided to Hqrs.
- Responded queries on type specimens to HoO, CNH for Dr. Timothy M.A. Utteridge from Kew and Dr. M. Sabu, Emeritus Scientist, Malabar Botanical Garden.
- Attended query from Dr Elliot Gardner, Postdoctoral Research Fellow, The Morton Arboretum, USA on *Streblum mitis* Kurz and provided information on this species.
- Provided information regarding Scanner for digitization of herbarium specimens to Dr Rajib Gogoi, Scientist-E & HoO, SHRC for Dr Santosh Rai at Sikkim University.
- Reviewed one article received from the Section editor of Phytotaxa.

Dr Anant Kumar, Botanical Asstt.

- Reviewed a manuscript for Rheedeia journal.

Events & Activities

- **Vigilance Awareness Week from 27th October to 3rd November, 2020.**
- **Hindi Pakhwara from 14th to 28th September, 2020.**

Dr Avishek Bhattacharjee, Scientist-C

- Organised online drawing competition and online poetry writing competition as a member of Organising Committee in connection with celebration of International Day for Biological Diversity, 2020 as per instruction of HoO, CNH.
- Organised the World Ozone Day on 16th September 2020 as a member of the Organising Committee. The programme has been organised by the ENVIS Resource Partner (ENVIS RP) of BSI in collaboration with Central National Herbarium, BSI, Howrah where online slogan writing and drawing competitions have been arranged for the school students.
- Organized the Fit India Freedom Run (run/ walk/ cycling) at CNH on 29th and 30th September, 2020; total 32 staff (including outsourcing staff) and scholars participated in this event.
- Organized the Fit India Plog (Running and Pick Litter) on 2nd October, 2020; total 27 staff (including outsourcing staff) participated in this event.
- As per instruction of HoO, CNH, organized observation of the foundation day of BSI at CNH.
- Organized the photography competition (in collaboration of ENVIS RP and AJCBIBG) on the occasion of World Wildlife Day (3rd March, 2021).

Dr Monalisa Dey, Scientist-C

- Participated as one of the judges of the online slogan writing competition (for slogans written in English) organised by ENVIS Resource Partner (ENVIS RP) of Botanical Survey of India in collaboration with Central National Herbarium, BSI, Howrah on World Ozone Day (16th September 2020).
- Attended and actively participated in the Celebration of 132nd Foundation Day of Botanical Survey of India on 13th February 2021 in Central National Herbarium.

7. CENTRAL REGIONAL CENTRE, ALLAHABAD

Project 1: Flora of India-Vol. 19 (Scrophulariaceae, Lentibulariaceae and Orobanchaceae)

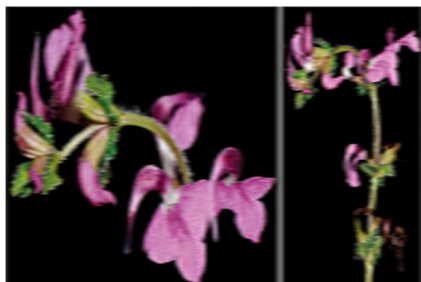
Executing Officials: Dr. Arti Garg, Scientist – E; Dr. A.N. Shukla, Scientist-C; Dr. A. K. Verma, Scientist-C

Date of Initiation: July, 2019; **Date of completion:** Sept., 2020.

Background of the project: India, being one of the 17 megadiversity centres of the world, is a rich repository of botanical wealth, with c. 18532 species of angiosperms, comprising 37.13% of the Indian flora. Survey and documentation of the flora of India is the primary objective of BSI. As part of the magnanimous task of completing the Flora of India, the families Scrophulariaceae, Lentibulariaceae and Orobanchaceae comprising the volume 19, were taken up for documentation of detailed taxonomic description of component species and/or infraspecific taxa, if any, nomenclature, flowering and fruiting season, distribution, ecological notes and uses, including the Checklist of these families.

Summary of the work done: Completed editing of Flora of India Vol. 19 – Families Scrophulariaceae, Orobanchaceae and Lentibulariaceae comprising of 464 taxa under 73 Genera, 412 species, 30 subspecies and 22 varieties and submitted on 10.7.2020 to the Hqrs.

Work done: Final Manuscript (comprising of 464 taxa under 73 Genera, 412 species, 30 subspecies and 22 varieties) has been submitted to BSI, Technical Section, Kolkata.



Pedicularis artiae R. Kr. Singh & B. S. Kholia



Project 2: Flora of India-Vol. 16 (Sapotaceae & Styracaceae)

Executing Officials: Dr. Arti Garg, Scientist - E.

Date of Initiation: July, 2020; **Date of completion:** December, 2020

Objective: To update families Sapotaceae & Styracaceae (74 taxa; August 2020 – Dec. 2020).

Work done: Final manuscript (Sapotaceae: 13 genera, 38 species and 10 varieties and Styracaceae: 4 genera and 7 species and 2 varieties) has been submitted to BSI, Technical Section for publication.

Project 3: Ex-situ conservation of RET and economically important species in the experimental garden of BSI CRC, Allahabad

Executing Official: Dr. A.N. Shukla, Scientist-C; Dr. Arti Garg, Scientist - E.

Date of Initiation: 2020; **Date of completion:** Continuing

Outcomes:

1. Gifted about 1000 plant saplings to company garden for plantation programme.
2. Gifted 300 seeds of *Saraca asoca* to Prof. N.B. Singh, Dept. of Botany, University of Allahabad for multiplication purpose.
3. Conducted garden Inspection tour on 10.9.2020 to Banda University of Agriculture and Technology, Banda and sent feasibility cum inspection report of new botanic garden project entitled “Development of botanical garden and ex-situ conservation of indigenous, particularly rare, endangered and threatened (RET) plants to the Bundelkhand” to Dr. Sandeep Chauhan, Sci. E & Head BGIR, Noida.

4. Collected an endemic plant species *Alectra parasitica* A.Rich. subsp. *chitrakutensis* (M.A.Rau) K.K. Khanna & An. Kumar and medicinal plant *Gloriosa superba* L. from Gerua locality of Banda district and introduced in CRC garden.
5. Brought 25 saplings of *Bougainvillea* spp. and one of Cactus from Horticulture department of Banda University for CRC garden.
6. Renovated Fern cum NET house of CRC Garden.
7. Multiplied 100 plant sapling of *Saraca asoca* in CRC experimental garden
8. Renovated Green India Map in CRC campus.
9. Distributed 120 plant saplings of *Saraca asoca* during Flower Show at Company Garden, Allahabad on 20-21 February, 2021.
10. Attended Flower show at Company garden Allahabad and also won three prizes Two first for Dahelia and one second for Medicinal plant section.
11. Distributed 120 plant saplings of *Saraca asoca* during Flower Show at Company Garden, Allahabad on 20-21 February, 2021.
12. Conducted two field tours to Rewa and Ayodhya to collect live germplasm for CRC garden.



Project 4: Morphological and cytological studies of selected plants from CRC, Garden, Allahabad.

Executing officials: Dr. Ashutosh Kumar Verma

Date of Initiation: 2020; **Date of Completion:** 2021

Status of project: Final report has been submitted to Technical Section, BSI, Kolkata.

Introduction: Botanic gardens are repositories of living plant collections of different taxa. There are about 2500 botanic gardens on global scale (Golding *et al.*, 2010) which cumulatively conserve 6 million

accessions of living plants, representing around 80000 taxa or about one fourth of estimated number of vascular plant species (O'Donnell & Shamrock, 2017). Botanic gardens are considered as best sites for many branches of scientific research. They not only serve as taxonomic and systematic research centres (Dosmann, 2006; Stevens, 2007) but also play an important role as center for wild germplasm of economically important species, ecological data generation, study of plant physiology & plant growth tactics and study of plant animal interactions (Primack and Miller-Rushing, 2009; Wang et al., 2018). Although botanic gardens have great potential to contribute in different streams of biological sciences but in true sense they remain unexplored as generally their activities are mainly confined to collection, introduction and maintenance of plant species. In order to overcome this lacunae there is need to follow 'KNOW YOUR GERMPLASM' approach which provides better foundation to researchers for their research programmes, where inter and intraspecific morphological and genetic diversity of garden plants are assessed and various databases like morphometric database, phenological database, chromosome count database etc are generated to provide actual picture of botanic gardens with respect to germplasm collections.

Botanic garden of the Botanical Survey of India, Central Regional Center (CRC) Allahabad situated at 181 m altitude, 25° 28' North and 81° 51' longitude and covers about 2.5 hectares area. It harbours 638 species having medicinal, economically important, ornamentals rare and threatened plants belonging to 111 families (Ansari & Singh, 2017). The garden comprises many sections including Aquatics, Arboretum, Bambusetum, Gymnosperms, Medicinal Plants, Net House, Ornamental Plants, Plant introduction, RET species and Rosary. Keeping this in mind, unique germplasm collection of BSI, CRC, Garden and unavailability of any report on cytotypic diversity of taxa of aforesaid garden the present project work was undertaken. Under this project work a total number of 51 species of angiosperms belonging to 37 genera under 20 families were analyzed in morpho-cytological frame and data on morphological characteristics, chromosome count and cytotypic diversity were generated.

Objectives:

To examine morphological and phenological characteristics of selected taxa.

To assess intra-specific cytotypic diversity of selected taxa.

Site of study: BSI, CRC, Garden, Allahabad

Methodology: Adapted standard methodologies for morphological and cytological investigations.

Work done: A total number of 51 species belonging to 37 genera under 20 families were analyzed in morphological and cytological frame viz. *Achyranthes aspera* L. (2n=28), *Allium tuberosum* Rottler ex Spreng. (2n=28), *Aloe vera* (L.) Burm. F. (2n=14), *Antigonon leptopus* Hook. & Arn. (2n=42), *Asparagus racemosus* Willd (2n=44), *Azadirachta indica* A. Juss. (2n=28), *Basella alba* L. (Green) (2n=44), *Bauhinia purpurea* L. (2n=28), *Bauhinia variegata* L. (2n=28), *Boerhavia diffusa* L. (2n=56), *Caesalpinia pulcherrima* (L.) Sw. (2n=28), *Cassia fistula* L. (2n=28), *Chlorophytum comosum* (Thunb.) Jacques (2n=28), *C. nepalense* (Lindl.) Baker (2n=26), *C. tuberosum* (Roxb.) Baker (2n=30), *Crotalaria spectabilis* Roth (2n=26), *Datura stramonium* L. (2n=24), *Delphinium ajacis* L. (2n=16), *Gymnema sylvestre* (Retz.) R. Br. ex Sm. (2n=22), *Haworthiopsis limifolia* (Marloth) G.D.Rowley (2n=28), *Helicteres isora* L. (2n=18), *Justicia simplex* D. Don (2n=18), *Justicia adhatoda* L. (2n=34), *Lantana camara* L. (2n=44), *Lantana montevidensis* (Spreng.) Briq. (2n=48), *Ocimum*

basilicum L. (2n=78), *Oroxylum indicum*(L.) Curz. (2n=28), *Papaver rhoeas*L. (2n=14), *Phlomis superba* (Royle) Kamelin & Makhm (2n=22), *Physalis minima*L. (2n=48), *Pongamia pinnata* (L.) Pierre (2n=22), *Rauvolfia serpentina* (L.) Benth. ex Kurz (2n=22), *Rauvolfia tetraphylla*L. (2n=44,66), *Sansevieria cylindrica* Bojer ex Hook (2n=38), *Sansevieria trifasciata*Prain (2n=56), *Sansevieria zeylanica*(L.) Willd. (2n=40), *Santalum album* L. (2n=20), *Saraca asoca*(Roxb.) Willd.(2n=24), *Senna alata*(L.) Roxb. (2n=28), *Senna obtusifolia*(L.) H.S. Irwin & Barneby (2n=28), *Senna tora*L.(2n=28), *Senna sulfurea*(Collad.) H. S. Irwin & Barneby (2n=28), *Solanum diphyllum* L. (2n=24), *Solanum nigrum* L. (2n=24,72), *Solanum villosum*L. (2n=24,72), *Solanum virginianum*(2n=24), *Tamarindus indica*L. (2n=24), *Tinospora cordifolia*(Willd.) Miers ex Hook.f. & Thoms (2n=26), *Uraria picta*(Jacq.) DC. (2n=16), *Urena lobata*L. (2n=28) and *Withania somnifera*(L.) Dunal (2n=48).

Identified new cytotypes for 07 species of angiosperms.

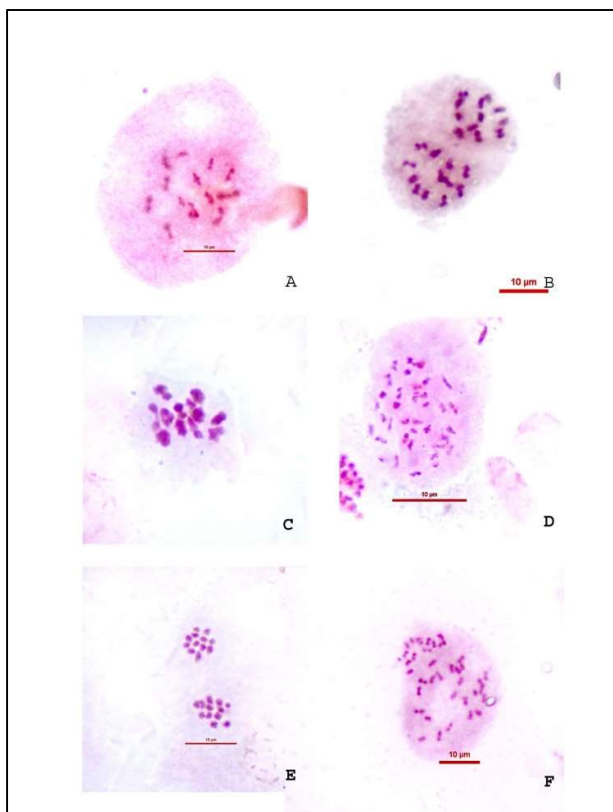


Fig.A: *Senna tora*; Metaphase-I with 14 bivalents.; B:*Solanum*

diphyllum; Anaphase-I with 12/12; C: *Solanum nigrum*; Metaphase-I with 12 bivalents; D: *Solanum nigrum*; Metaphase-I with 36 bivalents; E:*Solanum villosum*; Anaphase-I with 12/12; F: *Solanum villosum*; Metaphase-I with 36 bivalents.

Project 5: Pteridophytic flora of India

Name of Official: Dr. Brijesh Kumar, Botanist

Date of Initiation: 2020; **Date of Completion:** 2023

Objective:

To describe 75 species of pteridophytes for Pteridophytic Flora of India.

Methodology adopted:

Based on earlier published literatures and online resources (POWO, IPNI, TROPICOS) and available herbarium specimens this part work has been completed.

Work done:

Taxa described (75): *Botrychium daucifolium* Wall. ex Hook. & Grev., *B. lanuginosum* Wall. ex Hook. & Grev., *B. lunaria* (L.) Sw., *B. multifidum* (S.G.Gmel.) Rupr., *B. multifidum* subsp. *robustum* (Rupr. ex Milde) Clausen, *B. simplex* E.Hitchc., *B. ternatum* (Thunb.) Sw., *B. virginianum* (L.) Sw., *H. zeylanica* (L.) Hook., *Ophioglossum costatum* R.Br., *O. eliminatum* Khand. & Goswami, *O. gramineum* Willd., *O. lancifolium* C.Presl, *O. lusitanicum* L., *O. oleosum* Khand., *O. parvifolium* Grev. & Hook., *O. pendulum* L., *O. petiolatum* Hook., *O. polyphyllum* A.Braun ex Seub., *O. reticulatum* L., *O. rubellum* Welw. ex A.Braun [Family-Ophioglossaceae]; *Lepisorus amaurolepidus* (Sledge) B.K.Nayar & S.Kaur, *L. nudus* Ching, *L. clathratus* Ching, *L. jakonensis* (Blanf.) Ching, *L. loriformis* Ching, *L. macrosphaerus* Ching, *L. mehrae* Fraser-Jenk., *L. scolopendrium* (Buch.-Ham. ex D.Don) Mehra & Bir, *L. sublinearis* Ching [Family-Polypodiaceae]. *Woodsia alpina* (Bilton) Gray, *W. andersonii* (Bedd.) Christ, *W. cycloba* Hand.-Mazz., *W. elongata* Hook., *W. glabella* R.Br. ex Richardson, *W. hancockii* Baker, *W. lanosa* Hook., *W. rosthorniana* Diels., *Athyrium anisopterum* Christ, *A. atkinsonii* Bedd., *A. attenuatum* (C.B. Clarke) Tagawa, *A. cuspidatum* (Bedd.) M kato, *A. distans* (D.Don) T. Moore, *A. drepanopterum* (Kunze) A. Braun ex Milde, *A. falcatum* Bedd., *A. fimbriatum* T. Moore, *A. flabellulatum* (C. B. Clarke) Tradieu, *A. foliolosum* T. Moore ex R. Sim, *A. himalaicum* Ching ex Mehra & Bir, *A. davidii* (Franch.) Christ, *A. kumaonicum* Punetha, *A. mackinnoniorum* (C.Hope) C.Chr., *A. micropterum* Fraser-Jenk., *A. strigillosum* Moore, *A. nakanoi* Makino, *A. nephrodioides* (Baker) Christ, *A. parasnathens* (C. B. Clarke) Ching ex Bir, *A. pectinatum* (Wall. ex Mett.) C.Presl ex T.Moore, *A. praetermissum* Sledge, *A. puncticaule* (Blume) T. Moore, *A. repens* (Ching) Fraser-Jenkins, *A. rupicola* (Edgew. ex C. Hope) C. Chr., *A. schimperi* Moug. ex Fée, *A. schimperi* subsp. *biserrulatum* (Christ) Fraser-Jenk., *A. setiferum* C.Chr., *A. strigillosum* (T.Moore ex E.J.Lowe) Salomon, *A. vermae* Fraser-Jenkins, *A. wallichianum* Ching, *Cystopteris dickieana* R.Sim, *C. fragilis* (L.) Bernh., *C. montana* (Lam.) Bernh., *Deparia boryana* (Willd.) M.Kato, *D. japonica* (Thunb.) M.Kato, *D. japonica* subsp. *petersenii* (Kunze) Fraser-Jenk. [Family- Woodsiaceae]



Athyrium micropterum Fraser-Jenk.



Woodsia elongata Hook

Project 6: SEM studies of the species belonging to family Acanthaceae and Solanaceae available at BSA

Executing official: Dr. Nitisha Srivastava, Botanical Assistant

Date of initiation: September 2018; **Date of completion:** March, 2021

Background: This project was initiated in year 2018 for the study of seed and epidermal features of the species of family Acanthaceae with herbarium specimens available at BSA. In the Annual Action Plan Projects of 2020-2021 a new family (Solanaceae) was added to the running project.

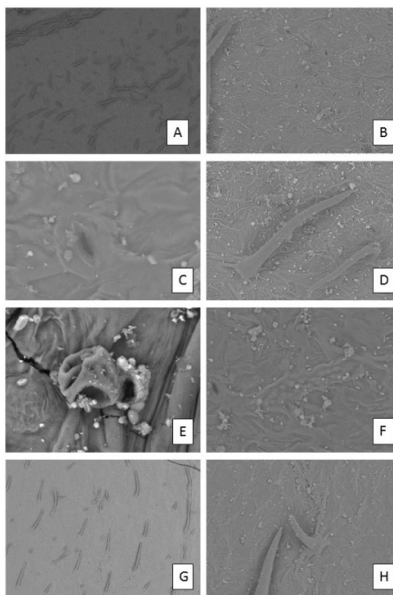
Objectives: To study seed and epidermal details of total 60 species (Acanthaceae and Solanaceae)

Summary of the work done:

Studied epidermal details of following 30 species in SEM.

Haplanthodes verticillatus Nees, *Haplanthodes tentaculatus* Nees, *Ruellia prostrata* Poir., *Eranthemum purpurascens* Wight ex Nees, *Eranthemum roseum* (Vahl) R.Br., *Eranthemum pulchellum* Andrews, *Ruellia suffruticosa* Roxb., *Ruellia tuberosa* L., *Ruellia prostrata* Poir., *Justicia quinqueangularis* K.D.Koenig ex Roxb., *Justicia glauca* Rottler, *Justicia betonica* L., *Justicia vahlia* Roth, *Justicia japonica* Thunb., *Justicia glauca* Rottler, *Justicia gendarussa* Burm.f., *Justicia glabra* K.D.Koenig ex Roxb., *Datura metal* L., *Datura innoxia* Mill., *Datura stramonium* L., *Withania somnifera* L. (Dunal), *Petunia axillaris* (Lam.) Britton, Sterns & Poggenb., *Petunia hybrid* Vilm., *Physalis minima* L., *Physalis peruviana* L., *Cestrum nocturnum* L., *Cestrum diurnum* L., *Nicotiana rustica* L., *Nicotiana tabacum* L., *Nicotiana plumbaginifolia* Viv.

Outcome: Comparative accounts of epidermal studies of 60 species Acanthaceae and Solanaceae families will helpful for identification of complex taxa. Manuscript writing is under process and will be submitted soon.



Barleria cristata- ABCDEF: Lower epidermis of leaf; A: Distribution of non-glandular trichomes, B: Stomatal arrangement, C: Single stoma, D: Details of non-glandular trichomes, E: Details of glandular trichome, F: Single cystoliths; GH: Upper epidermis of leaf; G: distribution of nonglandular trichomes, H: Non-glandular trichome

MISCELLANEOUS INFORMATION

Dr. Arti Garg, Sci-E:

- Successfully renovated Fern cum NET house and Green India Map of CRC Garden.
- Participated in Flower show at Company garden Allahabad and also won three prizes for the office - 2 first prizes for Dahelias and 01 second prize for Medicinal plant section.
- Prepared video of *Adansonia digitata* L. for MOEF&Cc website which received appreciation in form of retwit by the minister.
- Participated in Van Mahotsav plantation programme at company Bagh and planted trees.
- Acted as examiner of student of Dr. Grijesh Tiwari, Head, Botany Department, Allahabad University in April 2020 towards upgrading of JRF to SRF.
- Conducted interview of Research Associate selection in NASI project of Dr. K.P. Singh.
- Evaluated 4 papers on New species, Nomenclature and taxonomy for the journals *Rheedea* and *Phytotaxa*, *Nelumbo* and *Indian Forester*.
- Arranged and compiled various data required for RTI, RET plants, publications for BSI website, replies to Lok Sabha queries on various aspects of conservation of threatened species in CRC garden, GSDP participants etc.
- Attended the visit of Dr. S. Natesh, DBT in connection with ancient trees of India w.e.f. 17- 19.11.2020.

Dr. A.N. Shukla, Sci-C

- Final proof submitted for publication of Flora of Uttar Pradesh Vol. 2 (897 species under 432 genera and 59 families along with additional enumeration of 233 cultivated taxa and 42 photoplates) to D/BSI.
- Sent to photographs of *Rauvolfia serpentina* and *Drosera burmanii* along with details of uses and abundance to BSI Kolkata for inclusion in Biological Diversity Day programme, 22 may 2020.
- Sent to 19 high resolution photographs of rare and endemic plant species and landscapes of Ladakh region along with complete and updated list of Threatened and Endemic taxa to Dr. J.R. Bhatt, Advisor, MoEF & CC, New Delhi.
- Reviewed two manuscripts for *Indian Forester*.
- Sent 10 good quality photographs to Dr. Jayanti, Sci. E, WRC Pune for Flora of India.
- Sent 12 good quality photographs of family Apocynaceae to Dr. S.S. Dash for Flora of India.
- Prepared and sent a report in connection with Lok Sabha question regarding the status of *Boswellia serrata* in Madhya Pradesh and Chhattisgarh to Dr. S.S. Dash head Technical section BSI.
- Reviewed a manuscript for Journal of The Palaeobotanist, BSIP, Lucknow.
- Reviewed a manuscript for Journal of International Journal of Plant and Environment”, Lucknow.

Dr. A. K. Verma, Sci-C

- Prepared “Chromosome count database” for Cyperaceae of India. (415 spp.)
- *Ex-situ* conservation: Conducted a field tour to Rewa, MP and collected germplasm of *Acacia catechu* (L.f.) Willd., *Careya arborea* Roxb., *Commiphora wightii* (Arn.) Bhandari, *Cordia macleodii* Hook.f. & Thomson, *Gymnema sylvestre* (Retz.) R.Br. ex Sm., *Plumbago zeylanica* L., *Prosopis cineraria* (L.) Druce, *Radermachera xylocarpa* (Roxb.) Roxb. ex K.Schum., *Sarcostemma brevistigma* Wight & Arn. for introduction at garden of BSI, CRC, Allahabad.

Dr. Nitisha Srivastava, Bot. Asstt.

- Assisted in final editing of family Poaceae for “Flora of Chhattisgarh” vol. II.
- Prepared generic key for family Commelinaceae for “Flora of Chhattisgarh” vol. II.
- Consulted herbarium for data details of specimens of family Orchidaceae of Chhattisgarh.
- Reviewed 4 manuscripts for Journals: ‘Environmental Science and Pollution Research’, Springer, Switzerland; ‘Medical and Biological Science Research’; ‘Plant Cell Biology and Molecular Biology’ and International Journal of Plant and Soil Sciences.

Meetings Attended:

Dr. Arti Garg, Sci-E

- Attended virtual meetings - with Director, BSI, Kolkata on 21.12.2020 regarding Annual Action Plan;
- Attended meeting on Flora of India project with Director, BSI and other members at Google Meet on 03.06.2020, 13.07.2020 and 14.8.2020.
- Attended meeting on Flora of India with Director, BSI and all nodal office of media cell of Botanical Survey of India on 04.9.2020.
- Attended Hindi meeting on 28.9.2020, 25.11.2020.

Dr. A. N. Shukla, Sci-C

- Attended meeting with Director, BSI, Kolkata on 21.12.2020 regarding Annual Action Plan.
- Attended The Green Talk: Webinar Series in 2021 on "Science in Bialowieza Forest-Bialowieza Forest in Science" organized by Botanical Survey of India, SHRC, Gangtok on 08.01. 2021.
- Attended MoU ceremony between BSI and ICFRE on 15th February, 2021 and also sent two PPT slides to D/BSI for the programme.

- Attended lecture of Dr. A.A. Mao, Director, BSI Kolkata on Foundation Day of Botanical Survey of India, 13 February, 2021.
- Attended Flora of India project meeting with Director, BSI and other members of projects at Google Meet on 03.06.2020.
- Attended Flora of India project meeting with Director, BSI and other members of projects at Google Meet on 13.07.2020.
- Attended virtual meeting with Director, Botanical Survey of India, Kolkata on 14.8.2020.
- Attended virtual meeting with Director, BSI Kolkata and all the regional Head regarding the development of BGIR on 4.8.2020 (along with Dr. G.P. Sinha, Sci. F. and Head)Dr. A.N. Shukla along with Dr. G.P. Sinha attended TOLIC Hindi meeting on 28.7.2020.
- Attended virtual meeting with Director, BSI and all nodal office of media cell of Botanical Survey of India on 4.9.2020.
- Attended Hindi meeting on 3.9.2020
- Attended Meeting of State Wildlife Board Madhya Pradesh headed by C.M. Madhya Pradesh Shri Shivraj Chauhan on 14.01.2021.

Dr. Brijesh Kumar, Botanist

- Attended quarterly meeting of ‘Vibhagiya Rajbhasha Karyanvayan Sammit’ as a Member Secretary on 12.02.2021.
- Attended meeting with Director, BSI, Kolkata on 21.12.2020 along with HoO and Scientist of center regarding Annual Action Plan.
- Attended online meeting with Director, BSI and other Scientists in connection with Pteridophytic Flora of India work, on 12.08.2020, 18.08.2020 & 20.08.2020.
- Attended meeting of ‘Vibhagiya Rajbhasha Karyanvayan Sammit’ as a Invited Member on 27.07.2020.

1. Seminar/symposia organized:

- Dr. Arti Garg, Sci-E and H.o.O. organised and celebrated World yoga day on 21.5.2020 at BSI, CRC, Allahabad.
- Dr. Arti Garg, Sci-E and H.o.O. organised and celebrated World environment day on 05.6.2020 at BSI, CRC, Allahabad.
- Dr. Arti Garg, Sci-E and H.o.O. organised and celebrated Hindi fortnight w.e.f. 7.9.2020 to 16.9.2020 at BSI, CRC, Allahabad.
- Dr. Arti Garg, Sci-E and H.o.O. organised and celebrated vigilance awareness week w.e.f. 26.9.2020 to 02.10.2020 at BSI, CRC, Allahabad.
- Dr. Arti Garg, Sci-E and H.o.O. organised and celebrated World wetland day on 02.2.2021 at BSI, CRC, Allahabad.

Training programme/conference/ Webinar/Workshop attended:

Dr. Arti Garg, Sci-E

- Attended Hindi workshop on 09.12.2020 at BSI, CRC, Allahabad.
- Attended lecture of Dr. A.A. Mao, Director, BSI Kolkata on Foundation Day of Botanical Survey of India, 13 February, 2021
- Attended a webinar from 4 to 6 November 2020 on Dr. E.K. Janaki Ammal Memorial lecture series on Plant taxonomy and Ethnobotany in India-Future and Challenges organized by NMNH New Delhi,
- Attended a webinar-cum-Brainstorming on ‘Himalayan Mountain Biodiversity – Threats & Solutions’ organised by Botanical Survey of India, SHRC, Gangtok on International Mountain Day 10.12.2020,
- Attended a webinar on ‘Plant Diversity of the Western Ghats, India’ organized by Botanical Survey of India, Western Regional Centre, Pune on 12.12. 2020,

- Attended a webinar Lecture-3 on ‘Alien Plant Invasion in India: Status and Consequences’ organised by Botanical Survey of India, HAWRC, Solan on 17.12.2020 at 11:30 am to 01:00PM.

Dr. A.N. Shukla, Sci-C

- Attended webinar on “New opportunity in Medicinal Plants Sector for Farmers and Entrepreneurs” on 24th May 2020, organized by Dept. of Life Sciences, Mansarovar Global University.
- Attended National webinar on Medicinal and Aromatic plants for Boosting Immunity in the era of COVID-19, on May 29, 2020, organized by Dept. of Botany DDU Gorakhpur University.
- Attended national webinar on “Bharat me Covid-19: Vaigyanik Sandesh aur Hindi ki Sabdawali” on 3-5 June 2020 (3-6 PM) organized by Christ Church College Kanpur.
- Attended a National webinar on “Time for Nature” organized by Forest Research Centre for Eco-Rehabilitation Prayagraj, on 5th June 2020.
- Attended National webinar on “Environment and Forest Management in post Covid Pandemic era on 19th June 2020, organized by Forest Research Centre for Eco-Rehabilitation Prayagraj.
- Attended "Pockets of Hope - Series" Webinar on Nanda Devi Biosphere Reserve organized by UNESCO New Delhi; Ministry of Environment, Forest & Climate Change, Government of India; Surabhi Foundation; National Biodiversity Authority of India; WWF-India; and TERI on 19th June, 2020.
- Attended webinar on “Covid-19 on research progress in Life Sciences: Mitigation of losses and way forward” on 5th July 2020, organized by Dept. of Life Sciences, Mansarovar Global University.
- Delivered a lecture on Biodiversity in Webinar organized by Govt. Girls P.G. College, sidhi, M.P. on 29 July 2020.
- Attended a webinar from 4 to 6 November 2020 on Dr. E.K. Janaki Ammal Memorial lecture series on Plant taxonomy and Ethnobotany in India-Future and Challenges organized by NMNH New Delhi.
- Attended Webinar-cum-Brainstorming on ‘Himalayan Mountain Biodiversity – Threats & Solutions’ organised by Botanical Survey of India, SHRC, Gangtok on International Mountain Day 10.12.2020 from 14:30 – 17:45.
- Attended Webinar on ‘ Plant Diversity of the Western Ghats, India ’ organized by Botanical Survey of India, Western Regional Centre, Pune on 12.12. 2020 from 10:30am – 1:30pm.
- Attended Webinar Lecture-3 on ‘Alien Plant Invasion in India: Status and Consequences’ organised by Botanical Survey of India, HAWRC, Solan on 17.12.2020 at 11:30 am to 01:00PM.
- Attended Webinar on "Webinar on International Code of Nomenclature (ICN) for Plants" organized by Botanical Survey of India, Deccan Regional Centre, Hyderabad on 06.01. 2021.

Dr. A.K. Verma, Sci-C

- Attended webinar on “Breeding of Oilseeds: A Challenge for Self- Sufficiency” organized by Bihar Agricultural University, Sabour, Bhagalpur, Bihar.
- Attended Webinar-cum-Brainstorming on ‘Himalayan Mountain Biodiversity – Threats & Solutions’ organized by BSI, SHRC, Gangtok.
- Attended Webinar on ‘Plant Diversity of the Western Ghats, India’ organized by BSI, WRC, Pune.
- Attended Webinar on ‘Alien Plant Invasion in India: Status and Consequences’ organized by BSI, HAWRC, Solan
- Attended a webinar lecture on ‘Evolutionary play of invasive species in a changing Himalyan theater organized by BSI, HAWRC, Solan.
- Attended Webinar on “International Code of Nomenclature (ICN) for Plants" organized by BSI, DRC, Hyderabad.

Dr. Brijesh Kumar, Botanist

- Attended Webinar on "Revising the Generic Limits of *Coleus* and *Plectranthus* (Lamiaceae, Tribe Ocimeae)" “organised by Central National Herbarium, Howrah on 12.03.2021.
- Attended Webinar on "Role of Botanical Survey of India in Taxonomic Research in India" “organised by BSI, HAWHRC, Solan on 22.02.2021.

- Attended Webinar on “Plant Systematics insights from morphology and molecules” organized by Botanical Survey of India, HAWHRC, Solan on 17.02.2021.
- Attended webinar on, “Diversity of Bryophytes in India with special reference to Western Himalaya” organized by Botanical Survey of India, HAWHRC, Solan on 15.01. 2021.
- Attended The Green Talk: Webinar Series in 2021 on "Science in Bialowieza Forest-Bialowieza Forest in Science" organized by Botanical Survey of India, SHRC, Gangtok on 08.01. 2021.
- Attended Webinar on “International Code of Nomenclature (ICN) for Plants" organized by Botanical Survey of India, DRC, Hyderabad on 06.01. 2021.
- Attended Webinar Lecture-3 on ‘Alien Plant Invasion in India: Status and Consequences’ organised by Botanical Survey of India, HAWRC, Solan on 17.12.2020 at 11:30 am to 01:00PM
- Attended Webinar on ‘ Plant Diversity of the Western Ghats, India ’ organized by Botanical Survey of India, Western Regional Centre, Pune on 12.12. 2020 from 10:30am – 1:30pm.
- Attended Webinar-cum-Brainstorming on ‘Himalayan Mountain Biodiversity – Threats & Solutions' organised by Botanical Survey of India, SHRC, Gangtok on International Mountain Day 10.12.2020 from 14:30 – 17:45.
- Attended a webinar on topic, “Diversity and distribution of Pteridophytes in India” organized by Department of Botany, Holy Cross College (Autonomous), Tiruchirappalli on 06.08.2020.

Dr. Nitishas Srivastava, Bot. Asstt.

- Attended a webinar on "International Code of Nomenclature (ICN) for Plants" organized by Botanical Survey of India, Deccan Regional Centre, Hyderabad on 06.01. 2021.
- Attended the Green Talk: Webinar Series in 2021 on "Science in Bialowieza Forest-Bialowieza Forest in Science" organized by Botanical Survey of India, SHRC, Gangtok on 08.01. 2021.
- Attended Webinar Lecture-3 on ‘Alien Plant Invasion in India: Status and Consequences’ organised by Botanical Survey of India, HAWRC, Solan on 17.12.2020 at 11:30 am to 01:00PM.
- Attended a national webinar series, Lecture-7, on "Role of Botanical Survey of India in Taxonomic Research in India" organized by Botanical Survey of India, High Altitude Western Himalayan Regional Centre, Solan (H.P.) on 22/02/2021.
- Attended Webinar on "Revising the Generic Limits of *Coleus* and *Plectranthus* (Lamiaceae, Tribe Ocimeae)" “organised by Central National Herbarium, Howrah on
- Attended two lectures on ‘Use of Hindi in official & personal correspondences’ delivered by Dr. A.K. Verma, Sci-C, BSI, CRC and Dr. Brijesh Kumar, Botanist, BSI, CRC in Hindi karyasala organized by BSI, CRC, Allahabad.(09/12/2020)
- Attended Prof. R. Misra Memorial Lecture on “Impact of urbanization on vegetation covers using fuzzy technique on satellite images” delivered by Prof. Anupam Pandey, Geography Department, University of Allahabad, organized by ICREF, Prayagraj on 02/03/ 2021.

Ms. Sinjini Mukherjee, Bot. Asstt.

- Attended a webinar on International Code of Nomenclature (ICN) for Plants on 06.01.2021.
- Attended a webinar on Green Talk: Webinar series in 2021, first talk on Science in Bialowieza Forest – Bialowieza Forest in Science on 08.01.2021.
- Attended a National Webinar Series Lecture-7 on Role of Botanical Survey of India in Taxonomic Research in India on 22.02.2021 from 11:30 am to 01:00 pm.
- Attended a webinar Impact of Urbanization on Vegetation Covers using Fuzzy Technique on Satellite Images by Prof. Anupam Pandey, Geography Department, University of Allahabad organized by ICFRE on 02/03/2021.

2. Lectures/Talk Delivered:

Dr. Arti Garg, Sci-E

- Delivered online keynote webinar lecture on ‘Role of Palynology in taxonomy’ in workshop at BSIP on 22.3.21; invited lecture on Palynological Techniques on 29th May, 2020 for Dept. of Botany, Bundelkhand University, Jhansi.
- Delivered presentation in Head of Office meeting on
- Delivered lecture on Importance of Rajbhasha on the occasion of Hindi Pakhwada celebration inauguration at BSI, CRC, Allahabad.
- Delivered short talk on Vigilance awareness on Inauguration of Vigilance awareness week on 27th September, 2020.
- Delivered lecture on Conservation of Wetlands of India on the occasion of Wetland Day on 2 Feb., 2021.

Dr. A.N. Shukla, Sci-C

- Delivered an invited Facebook Live lecture on “Plant Diversity” on 17.05.2020 organized by Bharat Utthan Nyas, Kanpur.
- Delivered an invited lecture on Herbarium Techniques on 29th May, 2020 for Ph.D. course work organized by Dept. of Botany, Bundelkhand University, Jhansi.
- Delivered an invited lecture on “Biodiversity” in Global web conference on Pandemic Covid-19: Glocal Impact on Environment and sustainable Development (PSED 2020) June 6th 2020, organized by DDU Govt. P.G. College, Saidabad, Prayagraj.
- Delivered invited on “Role of Botanical Survey of India in Conservation of plant species” in Webinar organized by Govt. P.G. College, Raigarh, M.P. on 13.01.2021.
- Delivered invited on “Plant Diversity and conservation” in National Webinar organized by Govt. P.G.College Teonthar, Rewa, M.P. on 01.02.2021.
- Delivered invited on “Floristic diversity and vegetation types of Chhattisgarh” in National Webinar organized by Govt. Madhav Sadashivrao Golvalkar College, Rewa, M.P. on 18.02.2021.
- Delivered invited on “Conservation of plant species” in Webinar organized by Govt. Aranya Bharti P.G. College, Baihar, M.P. on 22.02.2021.

Dr. A.K. Verma, Sci-C

- Delivered an invited lecture on ‘Use of Hindi in official & personal correspondences-I’ in Hindi karyasala organized by BSI, CRC, Allahabad.
- Delivered an invited lecture on ‘Ozone depletion and its impact on life forms’ at BSI, CRC, Allahabad.
- Delivered an invited lecture on ‘Cytology and its implications in plant taxonomy’ at Govt. TRS College, Rewa.

Dr. Brijesh Kumar, Botanist

- Delivered a lecture in Rajbhasha Karyashala on topic entitled, Karyalay mein Hindi Bhasha ke Prayog’ at BSI, CRC on 09.12.2020

Academic duties:

- Dr. A.N. Shukla evaluated a thesis entitled “A comparative study of Chromatography Fingerprinting analysis and evaluation of antimicrobial, antioxidant activities of *Tephrosia purpurea* and *Phyllanthus niruri*” received from the Department of Biotechnology, A.P.S. University, Rewa, Madhya Pradesh and also Conducted Ph.D. viva of Mrs. Reni Nigam for the award of Ph.D. (23.10.2020).

List of Publications: Book published-01; Papers published- 19; Book chapters-01 (detailed in the last chapter).

8. DECCAN REGIONAL CENTRE, HYDERABAD

PROJECT – 1

Flora of Manjeera Wildlife Sanctuary, Telangana

Executing Scientist (s): Dr. L. Rasingam

Date of Initiation: April 2019; Date to be completion: March 2022

OBJECTIVE

- To document the flora diversity of the Manjeera Wildlife Sanctuary, Telangana state.

BACKGROUND

Manjeera Wildlife Sanctuary is a fresh water ecosystem with an area of 20 sq km located in Sangareddy District of Telangana, India (17°57'52"N 78°02'22"E). The man-made reservoir was notified as wildlife sanctuary on 20th Many 1978 to conserve marsh crocodiles, fresh water terrapins and other water birds. It is located 50 km northwest of Hyderabad and drinking water source for the twin cities. The riverine ecosystem has many small islets *viz.*, Puttigadda, Bapangadda, Sangamadda, Karnamgadda, which harbour good vegetation and the extensive marshy fringes act as nesting sites for water birds. Although Manjeera Wildlife Sanctuary is an important biodiversity area in the Telangana state no complete floristic account for the area is available except few sporadic collections from the surrounding areas. Hence, the project was initiated in the year 2019 to list out all the floral elements.

AREA AND LOCALITY: Sangareddy district, Telangana

SUMMARY OF THE WORK DONE DURING 2020-21

Carried out one field tour to Manjeera Wildlife Sanctuary, Telangana from 23rd to 26th February 2021 and collected 58 field numbers. Identified 113 field numbers into 101 species from the previous collections.

Published one book, one book chapter and 09 research papers.

PROJECT – 2

Grasses of Telangana State, India

Executing Scientist: Dr. Nagaraju Siddabathula

Date of Initiation: April 2019; Date of Completion: March 2022

OBJECTIVE: To document the grass diversity of the Telangana state.

BACKGROUND

Telangana state is situated on the Deccan Plateau, in the central stretch of the eastern seaboard of the Indian Peninsula. The state lies between 15° 50' - 19° 55' North latitudes and 77° 14' - 78° 50' East longitudes, and covers 114,840 km². Telangana is bordered by the states of Maharashtra to the north and northwest, Karnataka to the west, Chhattisgarh to the northeast and Odisha to the east and Andhra Pradesh to the south. The region is drained by two major rivers, with about 79% of the Godavari River catchment area and about 69% of the Krishna River catchment area, but most of the land is arid. It also drained by several minor rivers such as the Bhima, the Manjira and the Musi. The state has 3 National Parks (Kasu Brahmananda Reddy, Mahavir Harina Vanasthali and Mrugavani), 7 Wildlife Sanctuaries (Eturunagaram, Pakhal, Pranahita, Kinnerasani, Manjira, Pocharam and Shivaram) and 2 Tiger Reserves (Kawal and Nagarjunasagar - Srisailem). Pullaiah & al. (2015) reported a total of 208 species of grasses from Telangana state based on earlier literature. Moreover, there is no report/record on the diversity of grasses in Warangal, Khammam and Mahabubnagar districts. Hence, the present study has been taken up to explore the un-explored areas in 2018.

AREA AND LOCALITY: Telangana State

SUMMARY OF THE WORK DONE DURING 2020-21

Conducted one field tour to Warangal District, Telangana State from 23.03.2021 to 01.04.2021 and collected 103 field numbers. Identified 53 species and drafted description for 105 species.

PROJECT – 3

Flora of Kinnerasani Wild Life Sanctuary, Telangana

Executing Official: Dr. J. Swamy

Date of initiation: April 2019; Date of completion: March 2022

OBJECTIVE

The objective of the project is to document the floral diversity of the vascular plants of the Sanctuary and to highlight the plant wealth of the protected area along with threats and conservation measures.

BACK GROUND: Kinnerasani Wildlife Sanctuary (17.583300 and 18.000000 northern latitudes and 80.416670 and 80.500000 eastern longitudes) is located in the Bhadradi-Kothagudem district of Telangana state. The sanctuary is named after the river Kinnerasani, which is a tributary of river Godavari. The sanctuary covers 635.41 km² of area and this terrain serves as the homeland for various animals, birds, reptiles and plants, hence it was declared as wildlife sanctuary in 1977 (G.O. Ms. No. 47 F & R.D. (For-III), Dated 24.01.1977) under the provisions of Section of Wildlife (P) Act 1972.

AREA AND LOCALITY: About 635.41 sq. km² and situated in Bhadradi –Kothagudem districts of Telangana State.

SUMMARY OF THE WORK DONE DURING THE YEAR 2020-21

During this period two field tours have been undertaken to Kinnerasani Wild Life Sanctuary (KWLS), Bhadradi-Kottagudem District, Telangana from 11.11.2020 to 23.11.2020 and 17.03.2021 to 01.04.2021. Collected 334 field numbers and Identified 219 field numbers into 191 species and prepared descriptions for 16 species.

ACHIEVEMENTS/ OUTCOMES IN 2020-21

Published one book (01) and fourteen (14) research papers.

PROJECT – 4

Revamping of BSID Herbarium, Updation, Incorporation & Digitization

Executing Official: Dr. Mudadla Sankararao & Dr. A. Ravikiran

Date of initiation: August 2020

Date of completion: March 2021

OBJECTIVE: The objective of the project is to revamp the herbarium by updating the species and genus covers by computer generated label and digitization.

BACK GROUND: BSI DRC Herbarium is holding nearly 20000 specimens and about 17200 specimens were scanned till date. Among 17200 total scanned images, 1450 scanned specimens were converted from TIFF to JPG during 2019–2020. The scanned images of about 946 specimens were copied and saved in 45 DVDs as back up. Revamping of BSID is in progress and the new project has been assigned for the year 2020-2021.

SUMMARY OF THE WORK DONE DURING THE YEAR 2020-21: In connection with the on-going herbarium digitization project, specimens: incorporated-888, mounted- 99, remounted-1030; prepared new species covers-983, new genus covers-183 and specimen's reincorporated-2108 herbarium sheets, from Ranunculaceae to Poaceae families at BSID. In addition to, Segregated and arranged 4000 herbarium sheets as per field number and also segregated more than 7000 duplicates specimens. Further, one hundred seventy seven (177) Herbarium specimens of Pteridophytes housed at BSID herbarium have been rearranged properly according to Bentham & Hooker's classification system as well as list of the taxa of these families with currently accepted names and other relevant data prepared. In this process new genus (Nos. 40) and species (Nos. 68) folders with printed labels have been prepared (with currently accepted names, synonyms (if any)).

NEW DISCOVERIES

NEW TO SCIENCE

Dillenia tirupatiensis J.Swamy & Rasingam, J. Threat. Taxa 12(11): 16636-16640. 2020. (DILLENIACEAE): This new species has been discovered and described from Tirupati Range, Chittoor District of Andhra Pradesh at 802m altitude.

Brachystelma telanganense Rasingam & J.Swamy, Rheedeia 30(3): 379-382. 2020. (APOCYNACEAE: ASCLEPIADOIDEAE- CEROPEGIEAE): This new species has been discovered and described from Amrabad Tiger Reserve of Telangana state at 780m altitude.

Corynandra telanganensis J.Swamy & Rasingam, Ann. Bot. Fenn. 58(1-3): 79-82. 2020. (CLEOMACEAE): This new species has been discovered and described from Rangareddy district of Telangana state at 551m altitude.

Dendrophthoe gamblei L.J. Singh, V. Ranjan, Rasingam & J. Swamy J. Asia-Pacific Biodiversity 13(3): 487-493. 2020 (LORANTHACEAE): This new species has been discovered and described from the specimens collected from Andhra Pradesh and Tamil Nadu.

NEW VARIETY

Amorphophallus konkanensis Hett., S.R.Yadav & K.S.Patil var. **kinnerasaniensis** J. Swamy & Rasingam, Nelumbo 62(2): 117-120, 2020. (ARACEAE). This new variety has been discovered and described from Kinnerasani Wildlife Sanctuary, Telangana state at 211m altitude.

NEW DISTRIBUTIONAL RECORDS

Tripogonella P.M.Peterson & Romasch. (POACEAE): This genus has been reported for the first time from India based on the collections made from Medak district of Telangana state.

SPECIES RECORDS

Rhynchosia nummularia (L.) DC. (Fabaceae) – Andhra Pradesh

Pancreatum zeylanicum L. (Amaryllidaceae) – Telangana

Tephrosia noctiflora Bojer ex Baker (Leguminosae) – Andhra Pradesh

Schonefeldia gracilis (Poaceae) – Telangana

Ocimum filamentosum Forssk. (Lamiaceae) – Rajasthan

Xanthosoma sagittifolium (L.) Schott (Araceae) – Andhra Pradesh

Bothriochloa insculpta (Hochst. Ex.A. Rich.) A. Camus (Poaceae) – Telangana

RESEARCH PUBLICATIONS:

BOOKS: 02; Papers published- 23; Book chapters-01

SEMINARS/SYMPOSIUM/ CONFERENCE/ WORKSHOP/ TRAINING COURSE ATTENDED BY SCIENTISTS OF BSI

DR. L. RASINGAM

- Delivered a lecture on “An overview of Deccan Regional Centre, Hyderabad at the “National Webinar on Role of Botanical Survey of India in Biodiversity Conservation” on 14th October 2020 organized by BSI, DRC, Hyderabad.
- Delivered a lecture on “The recent advances in Plant Taxonomy in the two days online workshop jointly organised Botanical Survey of India, Deccan Regional Centre and St. Ann’s Women College, Mehdipatnam on 25th November 2020.
- Delivered a key note address on ‘Recent Trends in Plant Taxonomy’ in ‘National Webinar on Emerging aspects of Taxonomy and Biodiversity’ organised jointly by Botanical Survey of India, Deccan Regional Centre, Hyderabad and Government City College, Hyderabad on 3rd February 2021.
- Attended the National Webinar on “Discovery and Genetic Characterization of India’s Biodiversity: Strategies for addressing the Linnaean shortfall in India” on 6th October 2020 jointly organized by the National Biodiversity Authority and the Biodiversity Collaborative.
- Attended the 30th Annual conference of Indian Association for Angiosperm Taxonomy (IAAT) and Webinar on 4th and 5th December 2020.
- Attended the Webinar-cum-Brainstorming on ‘Himalayan Mountain Biodiversity–Threats & Solutions’ organized by Botanical Survey of India, SHRC, Gangtok on 10th December 2020.
- Attended the National Webinar on Plant Diversity of the Western Ghats, India organized by Botanical Survey of India, WRC, Pune on 12th December 2020.
- Attend the online webinar titled “Green walk- Plant resources as aid for preservation of COVID-19” on 27th January 2021 organised by BSI, Southern Regional Centre.

DR. SANKARARAO MUDADLA

- Delivered a talk on Virtual Herbarium at BJR Government Degree College, Narayanaguda on 04.03.2021.
- Delivered a talk on Floristic diversity of Seshachalam Biosphere Reserve at in a National Webinar organised by Govt. M.S. Golwalkar College Rewa in Madhya Pradesh on 16.03.2021.
- Attended a National webinar on New opportunities in the Medicinal Plant sector for farmers and entrepreneurs’ organised by Mansarovar Global University Madhya Pradesh on 24.05.2020.
- Attended a National webinar on ‘Biodiversity & Conservation’ organised by Daulat Ram College Delhi University on 08.06.2020.
- Attended a National webinar on Biodiversity conservation during Covid-19’ organised Andhra Loyola College Vijayawada, Andhra Pradesh on 13.06.2020.
- Attended a National webinar on Recent Biotechnological Tools for Crop Improvement’ organised by Advanced Post Graduate Centre, Acharya N.G. Ranga Agricultural University, Lam, Guntur (A.P.), India in Association with Institutional Development Plan (IDP) under NAHEP. On 24.06.2020.
- Attended a National webinar on ‘Herbs & Drug interaction’ organized by the VIVA College of Arts, Science & Commerce College Mumbai on 06.07.2020.
- Attended a National webinar on ‘Biodiversity conservation its management’ organised by Govt. Girls’ P.G. College, Ujjain (M.P.) from 14.07.2020 - 15.07.2020.
- Attended a National webinar on ‘Need of R&D for scientific validation of Traditional Herbal Medicines’ organized by Department of Botany, Arignar Anna Govt Arts and Science College, Karaikal, Puducherry on 18-08-2020.
- Attended a National webinar on ‘Modern History of Botany in India & Role of Botanical Survey of India’. organized by the Department of Botany, Basirhat College, North 24 Pargnas, West Bengal on 29.08.2020.

- Attended a National webinar on ‘Improvisations in Growing plants (IGP-2020), organized by Gujarat University Ahmadabad, Gujarat’ on 11.09.2020.
- Attended a National webinar on ‘Herbs for Healthcare’ organized by the Department of Botany, Maulana Azad College, Kolkata on 11.09.2020.
- Attended a National webinar on ‘Emerging Aspects of Taxonomy and Biodiversity’ organized by Department of Botany, Government City College (A), Hyderabad, in association with Botanical Survey of India, Deccan Regional Centre, Hyderabad on 03.02.2021.
- Attended the National level one week online short term course on ‘Plant Taxonomy’ organized Department of Botany, Nizam College, Osmania University from 03.08.2020-08.08.2020
- Attended the Faculty development programme on ‘plants for food and health care’ at Yogi Vemana University, Kadapa from 12.08.2020 to 14 .08.2020.

DR. G. SWARNALATHA

- Delivered a lecture on the topic entitled “An Introduction to the Lichenized Fungi” in a two days national level e-workshop on Recent Trends in Plant Taxonomy organized by St. Ann’s College for Womens, Hyderabad in collaboration with Botanical Survey of India, DRC on 25th & 26th November 2020.
- Participated in a webinar on International Code of Nomenclature (ICN) for Plants held on 06.01.2021 organized by Botanical Survey of India, DRC in association with Andhra University, Visakhapatnam.
- Attended online Hindi workshop organized by CBL, BSI, Howrah on 18.03.2021.

DR. S. NAGARAJU

- Attended a National Webinar on Biosphere reserves of India: Identification, Conservation and Management held at Govt. Madhav Sadasivrao Golwalkar College, Rewa (M.P) on 16.03.2021.
- Attended a webinar on Revising the Generic Limits of *Coleus* and *Plectranthus* (Lamiaceae, Tribe Ocimeae- Dr. Alen Paton Kew, and U.K) held at CNH, BSI, Howrah on 12.03.2021.
- Attended online Hindi Kaaryashala held at CBL, BSI, Howrah on 18.03.2021.

DR. J. SWAMY

- Organized “Two Day National Level E-Workshop on Recent Trends in Plant Taxonomy” in collaboration with St. Ann’s College for Women, Mehidipatnam, Hyderabad and Botanical Survey of India, Deccan Regional Centre, Hyderabad on 25 & 26. November 2020 and delivered two lectures on the topics entitled Herbarium methodology and its role in plant taxonomy and conservation and endemic and threatened plants of Andhra Pradesh and Telangana and IUCN classification.
- Organized a National Webinar on “Emerging Aspects of Taxonomy and Biodiversity” in collaboration with Government City College, Osmania University, Hyderabad and delivered a lecture on “Endemism with special reference to Telangana” on 03.02.2021.
- Delivered a lecture on Taxonomic tools: herbarium, floras, botanical keys & GPS and participated in the National level One Week Online Short Term Course on “Plant Taxonomy” held during 3rd to 8th August, 2020 organized by Department of Botany, Nizam College, Osmania University, Hyderabad, Telangana.
- Delivered a lecture on Virtual Exploration, Identification of Plants and Herbarium Methodology in the National level Webinar on “Frontiers in Biological Sciences” held during 24th to 25th September, 2020, organized by Department of Botany, Telangana Social Welfare Residential Degree College for Women, Mahendrahills, Hyderabad, Telangana.
- Delivered a lecture on Herbarium role in conservation in the National level Webinar on “Role of Botanical Survey of India in Biodiversity Conservation” held on 14th October, 2020, organized by Botanical Survey of India, Deccan Regional Centre, Hyderabad, Telangana.
- Delivered lecture on Herbarium methodology with special reference to digital/virtual herbaria and also demonstrated herbarium methodology in one day Workshop cum Training on Herbarium Techniques and

awareness on Virtual and Digital Herbaria jointly organized Department of Botany, BJR Degree College, Narayanaguda, Hyderabad and Botanical Survey of India, Deccan Regional Centre, Hyderabad on 04th March 2021.

- Participated in the National webinar on Techniques in Molecular Biology: A Virtual Laboratory Insight organized by Department of Genetica & Biotechnology, University College for women, Koti, Hyderabad on 12th August 2020.
- Participated in one day National Conference on Plants and Environment. Organised by Department of Botany, Telangana University, Nizamabad, Telangana on 23. 11.2020.
- Participated in the International Webinar organized by Plantgenomia on Genome Editing to Enhance Multiple Disease Resistance in Crop Plants on 20th December 2020.
- Attended two day online course on "DNA Barcoding, Plant Identification and The Species Concept" organised by SAIKAP BIOTECH, Mohali, Punjab from 14th December to 15th December 2020.
- Participated in the webinar on International Code of Nomenclature (ICN) for Plants organized by Botanical Survey of India, DRC in association with Andhra University, Visakhapatnam which was held on 06th January 2021.
- Participated in webinar on "Green Walk"- Plant Resources as Aid for prevention of Covid - 19, organized by Botanical Survey of India, Southern Regional Centre, Coimbatore on 27th January 2021.

AWARDS & HONOURS

- Dr. J. Swamy was nominated for member of the Board of Studies in Botany, under the Faculty of Science, Osmania University.

ACTIVITES OF RESEARCH FELLOWS

Floristic Studies on Papikonda National Park, Andhra Pradesh by Y. Mahesh, JPF & Dr. L. Rasingam, Scientist – D

Conducted three field tours during the year (April 2020 to March 2021) and covered 360 km² areas in 14 beats under four forest ranges. A total of 450 field numbers have been collected and captured photographs for maximum species. Among the 450 field numbers 200 field numbers are identified and prepared description for 58 species. Published 02 research papers and communicated 04 research papers.

HERBARIUM INFORMATION

HERBARIUM MAINTENANCE – DRC

| | |
|------------------------------|------|
| PREPARED NEW GENUS COVERES | 225 |
| PREPARED NEW SPECIES COVERES | 800 |
| SPECIMENS MOUNTED | 04 |
| SPECIMENS INCORPORATED | 04 |
| SPECIMENS REINCORPORATED | 2500 |

HERBARIUM DIGITIZATION (2020-21) – DRC

Digitization – 310

Images converted in to TIFF and Jpeg formats- 1830

SERVICES RENDERED

Dr. L. Rasingam

- Reviewed two manuscripts for *Rheedeia* and four for *Journal of Economic and Taxonomic Botany*.
- Reviewed one article each for *Biodiversity: Research and Conservation Journal* and *Indian Journal of Forestry*.

- Corrected a book entitled “Forest Plants of the Nilgiris, Northeastern Nilgiri Biosphere Reserve- an illustrated field guide” sent by Keystone Foundation, Kotagiri, Tamil Nadu.

Dr. M. Sankararao

- Assisted for preparation of scoring sheet about National programmes for Conservation and development of Forest Genetic Resource plants on 02.07.2020. Assisted four ICFRE staff for herbarium consultation on 14.07.2020
- Assisted online, one scholar from GBRC, Gandhinagar, Gujarat provided information about some species of Liliaceae, Papaveraceae, Solanaceae, Compositae, and Polygonaceae families at BSID on 30.07.2020.
- Reviewed research article Amaryllids of Andhra Pradesh, India (Tropical Plant Research) on 15.09.2020.
- Provided scientific data about flora of Andhra Pradesh as requested by AP Biodiversity board for e-PBR preparation on 19.10.2020.
- Assisted Dr. Jhansi Lecturer in Botany from Vizayanagaram information about the distribution of *Simarouba glauca* DC., on 23.11.2020.
- Assisted Two Koti Women’s College students for herbarium consultation on 24.02.2021
- Authenticated plant specimens from different pharmacy college students *i.e* Mallareddy College of Pharmacy, Pullareddy College of Pharmacy, Hyderabad.

Dr. J. Swamy

- Identified seven hundred and eighty three (783) plants identified for Telangana State Forest Research College, Telangana State Medicinal Plant Board, Telangana State Forest Department and various institutions, of which 90 plant specimens identified and issued authentication certificates to Professors, Research Scholars and Students of various Institutions.
- Herbarium & library service provided to Research Scholars of various institutions from Andhra Pradesh and Telangana *etc.*

EVENTS AND ACTIVITIES

- Organised a National Webinar on “Role of Botanical Survey of India in Biodiversity Conservation” on 14th October, 2020.
- Organized “Two Day National Level E-Workshop on Recent Trends in Plant Taxonomy” in collaboration with St. Ann’s College for Women, Mehdipatnam, Hyderabad on 25th & 26th November 2020
- Organised one day National Webinar on “International Code of Nomenclature (ICN) for Plants” on 6th January 2021.
- Organized “World Wetlands Day” and invited students from various colleges and school and conducted competition on the theme ‘Wetlands and Water’ on 2nd February 2021.
- Organized a National Webinar on “Emerging Aspects of Taxonomy and Biodiversity” in collaboration with Government City College, Osmania University, Hyderabad on 03rd February 2021.

9. EASTERN REGIONAL CENTRE, SHILLONG

PROJECT- 1

Flora of Nagaland

Executing Scientist (s): Dr. A.A. Mao, Dr. N. Odyuo, Dr. D.L. Biata, Dr. D.K. Roy and Mr. R. Lytan.

Date of Initiation: 2016; Target date of completion: 2021 (Extension sought till March 2025)

Objectives: To document the floral diversity of Nagaland.

Background

The present state of Nagaland includes former Naga Hills district of Assam and Tuensang district of North-East Frontier Agency (NEFA). Nagaland lies in the extreme north eastern part of India, covering an area of 16,579 sq. km., between 25°6'-27°4'N and 93°20'-95°15' E. The state is bounded by Assam in the west and north-west and flanked by Tirap district of Arunachal Pradesh, in the north-east. The southern boundary is marked by the state of Manipur, on the east by International boundary between India and Myanmar. The soil of Nagaland can be grouped mainly under Entisol, Entisol, Inceptisols and Ultisols (Source: nagaland.nic.in/soil DIPR-Basic Facts 2011 RTI Manual (nlsic.gov.in)). The forests cover of the state is 12,489 km², which is 75.33% of the state's geographical area. In term of forest canopy density classes, the state has 1279 km² under very dense forest, 4587 km² under moderately dense forest and 6623 km under open forest (FSI: 2017). The vegetation and forests of Nagaland based field study and surveys can be discussed under the following types: a) Sub-alpine meadows, b) Tropical evergreen and Semi-Evergreen forest, c) Tropical deciduous forest, d) Temperate forest, e) Subtropical pine forest, f) Mixed Bamboo forest.

Area and Locality: Nagaland; c. 16,579 sq. km.

Summary of the Work done

During April to March 2021, one field tour was undertaken to Doyang, Wokha Districts, Nagaland for 12 days from 21st October to 1st November 2020 and a total of 160 specimens were collected. The collection in the field were accompanied by field photography of different plants, landscapes, forest types, vegetation etc. During this period a number of 225 species were documented with proper citation and description along with key preparation for 411 number of taxa. A total of 6 species of *Strobilanthes* sp. with complete sheets collected from Nagaland were incorporated into the herbarium.

Final Mss. For Vol. I Comprising of 661 species, 10 subspecies and 5 varieties under 299 genera and 75 families under finalization to be submitted by August 2021.

Outcomes: Detailed examination of the collected specimen and study of the introduced live plants in the Garden from the present project have resulted in publication of 02 new species viz., *Peliosanthes nagalandensis* N. Odyuo, D.K. Roy, N. Tanaka and A.A. Mao; *Peliosanthes tobuensis* N. Odyuo, D.K. Roy, R. Lytan, N. Tanaka and A.A. Mao; and One new generic record to India viz. *Stadiochilus burmanicus* R.M. Sm.

PROJECT- 2

Flora of India, Vol. 25 & 26 (Orchidaceae)

Executing Scientist[s]: Dr. D. K. Agarwala, Dr. J. S. Jalal, Dr. Chaya Deori & Dr. Avishek Bhattacharjee

Date of Initiation: March, 2019; Target of completion: December, 2020

OBJECTIVE: Work on 36 genera and 236 species to be completed Sub-family: Apostasioideae (1 genus, 3 species); Sub-family: Vanilloideae (1 genus, 2 species) Sub-family: Cypridioideae (2 genera, 13 species); Sub-family: Orchidoideae (4 genera 7 species) Sub-family: Epidendroideae (28 genera, 211 species).

SUMMARY OF THE WORK DONE

Project completed: Final Manuscript submitted to the team leader Dr. Dinesh Agrawala, Sc-D, comprising of 236 species under 36 genera along with list of 31 photographic illustrations and 138 photographs of orchids.

PROJECT- 3

Micropropagation of EET Plants of North East India Phase-II

Executing Scientist: Dr. Deepu Vijayan, Scientist-C.

Date of Initiation: April 2015; Target date of completion: Ongoing

OBJECTIVE: To standardize the protocol, mass multiplication of EET plants of Northeast India namely *Eriodes barbata* (Lindl.) Rolfe, *Pholidota katakiana* Phukan & *Micropera rostrata* (Roxb.) N.P. Balakr. Regular subculturing of *in vitro* raised cultures of *Cymbidium tigrinum* and *Armadorum senapatianum* and hardening of lab to land plants to be continued.

BACKGROUND: The project was initiated in 2015. During the previous years, protocol development, statistical analysis and micropropagation of *Armadorum senapatianum*, *Rhododendron coxianum* and *Cymbidium tigrinum* were completed. Some new *in-vitro* seed germination was successful for *Ilex khasiana* and *Armadorum senapatianum*.

AREA AND LOCALITY: North East India

SUMMARY OF THE WORKDONE: Submitted the final report of Annual Action Plan project entitled "DNA barcoding and phylogenetic analysis of 20 selected endemic species of Northeast India and Phytochemical screening of 11 medicinal plants". Inoculation of *Micropera rostrata* and *Eriodes barbata* in MS Medium. Subculturing of *Eriodes barbata* in MS Medium. Splitting of *Eriodes barbata* plants and planted in individual pots for multiplication. Subculturing of *Armadorum senapatianum* in MS Medium. Maintenance of *in vitro* raised plants of *Armadorum senapatianum* and *Cymbidium tigrinum* in plant tissue culture, garden and polyhouse.

Outcome: Initiation of *in vitro* cultures of *Eriodes barbata* in MS Medium. Initiation of *in vitro* cultures of *Micropera rostrata* in MS Medium. Subculturing and maintenance of *Armadorum senapatianum* and *Cymbidium tigrinum*. Maintenance of *in vitro* raised plants of *Armadorum senapatianum* and *Cymbidium tigrinum* in plant tissue culture, garden and polyhouse.

PROJECT-4

Botanical illustration, art, flower painting, and "plant portraits" of selected EET plants of India.

Executing official: L. Ibemhal Chanu, Botanist.

Date of Initiation : Since August 2020; Target date of completion: March 2022

OBJECTIVE: Botanical painting with accuracy of scale and colour with natural stone colour, honey-based colour on hot press white colour paper.

BACKGROUND: Selection of plants parts, photography, develop idea of the composition, rough sketches generated for 10 plants *viz.*, *Aristolochia platanifolia* (Klotzsch) Duch., *Aristolochia saccata* Wall., *Armadorum senapatianum* Phukan & A.A.Mao, *Bulbophyllum rothchilsdianum*, *Ceropegia anshariana.*, *Cymbidium tigrinum* C.S.P.Parish ex Hook., *Ilex khasiana* Purkay, *Nepenthes khasiana* Hook.f., *Paphiopedilum fairrieianum* (Lindl.) Stein & *Vanda coerulea* Griff. ex Lindl. along with SEM study for better vision of microscopic hairs, textures.

AREA AND LOCALITY: Plants are selected from BSI, ERC, Shillong

SUMMARY OF THE WORKDONE: It's an Infusion of Taxonomy and Indian Miniature Painting techniques in botanical illustration. Composition of *Aristolochia platanifolia*, *Armadorum senapatianum*, *Bulbophyllum rothchilsdianum*, *Ceropegia anshariana*, *Cymbidium tigrinum*, *Paphiopedilum fairrieianum*, *Vanda coerulea* are completed. Line drawing of 09 plants completed. Wash and layering of *A. senapatianum*, *B. rothchilsdianum*, *C.*

anshariana, *C. tigrinum*, *P. fairrieatum*, *V. coerulea*. Flowering plant of *C. anshariana* and *C. tigrinum* (with netted venation of roots), with a flower split across showing the pollen track, a flowering twig of *A. senapatianum*, *P. fairrieatum*. Primary color differentiation with properties of pigments are completed for 09 plants. SEM study for 09 plants completed. Photography for pictures of the plant for composition of painting of 09 plants are taken. Compositions were modified and corrected by Dr. A. A. Mao, Director, BSI and addition color techniques were suggested by National Awardee Mahaveer Swami.

PROJECT-5

Herbaceous Flora of Meghalaya,

Executing Scientist: Dr. Chaya Deori, Scientist E

Date of Initiation: Since December, 2020; Target date of completion: March, 2021 (request for extension up to September 2021)

OBJECTIVE: Editing of manuscript of Herbaceous flora of Meghalaya, Vol. 1, which has already been reviewed by publication section, BSI, Kolkata.

BACKGROUND: It was compiled and submitted in 2010 by me along with our ex-scientists of ERC, Shillong. Herbaceous flora Volume-1- comprised of 678 taxa and 340 genera under 88 families Ranunculaceae-Leeaceae-28 families by B. K. Das; Fabaceae-Primulaceae-26 families by Chaya Deori & R. Shanpru; Apocyanaceae-Ceratophyllaceae-34 families by Chaya Deori; Herbaceous Flora Volume-II-comprised of 950 taxa and 300 genera under 27 families: Hydrocharitaceae-Poaceae-27 families by Chaya Deori & Namita Dam.

AREA AND LOCALITY: Meghalaya

SUMMARY OF THE WORKDONE: After the submission of the project in March, 2010 many new additions were made to the herbaceous flora of Meghalaya for both the volumes after consulting authenticated literatures, books, herbariums. 431 taxa were added to 52 families to Volume -1 and 318 taxa were added to Volume-2. After the addition of the species the Manuscript now has been finalized comprising of 1109 taxa under 427 genera and 93 families. It is being edited following the format of Flora work of BSI. Description of the newly added taxa completed. The updating of nomenclature of each species was done following Tropicos, IPNI, World flora online. More than 300 photographs have been selected and the remaining is under process.

OUTCOMES: Correction of 800 taxa completed and 309 taxa remaining, Preparation of keys of families, newly added genera and species remaining. Alphabetically arrangement of photographs, Index to Botanical names, correction of introductory portion remaining.

PROJECT-6

Project: *Ex-situ* conservation and multiplication of endemic, rare, threatened and economically important plants of North-East India at Experimental Botanic Garden, BSI, ERC, Barapani.

Executing Official (s): Shri B.B.T. Tham, Botanist & Shri L.R. Meitei, Botanical Assistant

Date of Initiation of the Project & Date to be completed the Project: Ongoing

Objectives: *Ex-situ* conservation and multiplication of endemic, rare, threatened and economically important plants of North-East India at EBG, Barapani. To record phenological data of flowering and fruiting for the plants available in the garden.

Background: The main target is collection of live plants, specifically endemic, rare, threatened and economically important ones available in the North-Eastern Region for *ex-situ* conservation and multiplication purpose in Experimental Botanic Garden, BSI, ERC, Barapani. The existing Experimental Botanic Garden is located ca. 22 km away from Shillong near Umiam Lake at Umiam, Ribhoi District with an area of ca 25 acres at an altitude ca 1000m (3000 ft.). This Garden is very ideal for growing and conserving the diverse flora of this region as the prevalent conditions both climatic and edaphic of the area is highly suitable and viable for such an exercise. In the process, introduction/acclimatisation and paying considerable attention towards maintenance of germplasm collection growing

and multiplication of endemic, rare, endangered, threatened plant wealth of North-East India in order to save them from extinction is the main priority. About 1500 species of vascular plants, 13 gymnosperms, 75 pteridophytes and 53 bryophytes of North-East India are conserved here. Many of them are rare, endemic and economically important plant species of this region. To enrich the flora of the garden with particular reference to EET and other economically important plants, field tours will be conducted in various parts of NE India on a regular basis for collection and introduction of EET plants in the garden.

Area and Locality: Northeast India is the eastern-most region of India. It comprises the contiguous Seven Sister States (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura) and Sikkim. The areas of the North Eastern States are Arunachal Pradesh- 83,743 sq. km., Assam- 78,438 sq. km., Manipur- 22,327 sq.km., and Meghalaya- 22,429 sq.km., Mizoram- 21,081 sq.km., Nagaland- 16,579 sq.km., Tripura- 10,486 sq. km. and Sikkim- 7,096 sq.km.

Summary of the Work done during 2020-21: Two local field trips were conducted in 1). Mawphlang area, East Khasi Hills, Meghalaya on 06/10/2020 (collected 10 live plants species), and 2).Shella area of East Khasi hills, Meghalaya w.e.f. 09/10/2020 to 11/10/2020 (collected 20 live plants species).A total of 9 EET plant species, 26 economically important plant,9Impatiens species, 67 plant seedlings/saplings were planted in EBG, Barapani, 164 numbers of plantlets of orchids, Begonia. 323 cutting of Azalea sp.,and Nepenthes khasiana are made for multiplication purpose. Seeds of the following 8 species, are collected, processed and stored. 5 specieswere sown in germination beds. Transplanted 12 plant species from germination beds to jute sapling bags for proper growth. Observed and recorded phenological data of flowering and fruiting of 185 species in EBG. Distributed 1557 plant seedlings/saplings to different organisations, groups and individuals for plantation purpose. Identified 4 plant species in EBG, Barapani which were not identified earlier viz., Aglaonema hookerianum Schott, Alangium chinense (Lour.) Harms, Chonemorpha fragrans (Moon) Alston and Ixora pseudoacuminata Deb & Rout.

Achievements/Outcomes in 2020-21

During the study a total of 9 EET plant species and 26 economically important plant species were planted in EBG, Barapani during the period.134 numbers of orchids plantlets belonging to 11 species were propagated from parent plants. Identified 4 plant species in EBG, Barapani which were not identified earlier. Distributed 1566 plant seedlings/saplings to different organisations, groups and individuals for plantation purpose.

RESEARCH PUBLICATIONS: 35; Book chapters published-2(two); Book let: published 2(two); Research

Papers published: 6(six); Articles published- 03 (Three); Abstracts in conference proceedings published- 09

(Seven); Abstracts in conference proceedings accepted- 09 (nine); Research Papers Accepted: 2(two); Research

Paper communicated: 2(two)

HERBARIUM INFORMATION

1. No. of Specimens mounted/remounted/labelled- **1707/295/0**
2. No. of Herbarium sheets Stitched /re-stitched /poisoned/fumigated/dusted-**1810/3502/ 159/0/0**
3. No. of Herbarium sheets dusted & cleaning/poisoned/re-poisoned/fumigated/ Re-cleaning-**5541/418/224//82/16** almirah
4. No. of old specimens/new specimens incorporated/Scanning of Herbarium sheets/Scanning of type sheets-**741/370/166/36**
5. No. of Herbarium sheets accessioned/ re accessioned/scanning of accession registers- **600/0/0**
6. No. of Specimens changing, pressing & processing for mounting -**1157**
7. No. of Specimens sent on loan- **04**
8. No of loaned-gifted specimens received/returned/exchanges- **1345/0/0**
9. No. of species identified- **84**
10. No. of Species/Genus/ family cover changed- **2826/742/0**
11. No. of Species/genus/family cover fold made: **100/0/0**

12. No. of Type specimens folders made/listing and counting: **50/30**
13. No. of documentation of existing herbarium-entry in Excel sheet/Field data written- **882/0**
14. SEM work details: Number of samples/Number of images per sample/Total images- **188/10/1880**
15. No. of identification and data filled up of Backlog specimens: **88**
16. Loan specimens received/returned:**1315**

TRAINING/WORKSHOP ORGANISED AND PARTICIPATED BY BSI, ERC, SHILLONG

National Conference cum workshop

1. National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show was organized by TOSI (Journal of Orchid Society of India), Chandigarh in collaboration with Botanical Survey of India and NEHU, Shillong held from 5th to 7th March 2021, ERC, Shillong- 793003, Meghalaya. There were more than 70 participants, Dr. A.A. Mao, Director, BSI, Kolkata, Dr. D.K.Agrawala, Sc-D, Sikkim Himalayan centre and all the officers and scientific staffs of ERC attended the same. Painting competition was also conducted on 5th for school students in which 57 participants from various school participated in 3 categories. Apart from which flower arrangement and orchid show were conducted.

World Environment Day observed

- On 5th June, 2020, world environment day was observed at ERC, Shillong. 200 saplings were planted behind the parking place of Residential campus, ERC, Shillong by the officers, staffs, research scholars and family members of campus.

Ozone Day Celebration

- Ozone day was observed on 16th September 2020 during which drawing competition was conducted through online on the theme 'Ozone Day Life'. 49 candidates participated and 1st, 2nd, 3rd and consolation prizes were distributed as a token of appreciation to the participants.

Exhibition participated: 1(one)

BSI, ERC participated as an exhibitor and displayed activities in the 'Global Bio India Road Show and Orchid Sale Exhibition'organised by IBSD Shillong on 25th February, 2021.

SERVICE RENDERED

A. PUBLIC SERVICE RENDERED

- Identification and authentication: **c. 84** specimens of angiosperms, pteridophytes, were authenticated.
- Visitors attended: **c. 83** visitors including VIPs, dignatories, foreign delegates, scientists, academicians, researchers and students.
- Plantation programme & sapling distribution: **1566** Saplings and seeds supplied to different Institutions.

B. REVENUE EARNED

- Total revenue earned: Rs.**16,516/-**
- Identification charges of plant specimens-**Rs. 2,050/-**
- Sale of BSI publication: **Rs. 14,466/-**
- Miscellaneous: [Guest house charges]- **Rs.nil/-**
-

EX-SITU CONSERVATION

- **Experimental garden, Barapani, Eastern Regional Centre, Shillong.**

The garden serves as a repository of Endemic, endangered, threatened and economic plant resources of Northeast India and also creates awareness of the importance of its conservation.

During April 2020-March 2021, the following 53 plant species were collected and planted in EBG, Barapani (Umiam) and conserved viz. *Actinidia callosa* (3 nos.), *Aquilaria malaccensis* (3 nos.), *Areca catechu* (6 nos.), *Artocarpus lakoocha* (1 no.), *Begonia hatacoa* (1 no.), *Begonia* sp. (4 nos.), *Boesenbergia* sp. (9 nos.), *Bruceamollis* (5 nos.), *Bryophyllum pinnatum* (3 nos.), *Castanea dentata* (3 nos.), *Castanopsis indica* (1 no.), *Cephalotaxus griffithii* (5 nos.), *Cheilocostus speciosus* (6 nos.), *Cycas revoluta* (7 nos.), *Dioscorea* sp. (1 no.), *Diospyros* sp. (6 nos.), *Garcinia pedunculata* (2 nos.), *Elaeagnus* sp. (9 nos.), *Equisetum* sp. (3 nos.), *Eriosema chinensis* (2 nos.), *Euphorbia antiquorum* (5 cuttings), *Globba* sp. (5 nos.), *Gnetum gnemon* (5 nos.), *Hedychium rubrum* (2 nos.), *Hedychium* sp. (5 nos.), *Holmskioldia sanguinea* (1 no.), *Impatiens angustiflora* (4 nos.), *Impatiens arguta* (4 nos.), *Impatiens bracteata* (3 nos.), *Impatiens chinense* (2 nos.), *Impatiens jurpia* (5 nos.), *Impatiens porrecta* (4 nos.), *Impatiens pulchra* (3 nos.), *Impatiens tripetala* (5 nos.), *Impatiens* sp. (7 nos.), *Impatiens* sp. (8 nos.), *Impatiens* sp. (3 nos.), *Ledebouriasp.* (8 nos.), *Liliaceae* sp. (6 nos.), *Lycopodium* sp. (1 no.), *Magnolia champaca* (5 nos.) *Musa* sp. (5 nos.), *Osbeckia* sp. (6 nos.), *Phlogacanthus thyrsoiflorus* (20 nos.), *Podocarpus nerifolius* (5 nos.), *Pyruspashia* (14 cuttings), *Rauvolfia verticillata* (2 nos.), *Sonerila maculata* (4 nos.), Unidentified sp. (2 nos.), Unidentified sp. (2 nos.), Unidentified sp. (1 no.), *Zingiber* sp. (1 no.) and *Zizyphus mauritiana* (2 nos.).

NEW SPECIES- 02(two)

- ODYUO, N., D.K. ROY, R. LY TAN, N. TANAKA AND A.A. MAO. 2020. *Peliosanthes nagalandensis* and *P.tobuensis* (Asparagaceae: Nolinoideae) - two new species from Northeastern India. *Phytotaxa* 456(3): 285-295

REDISCOVERY/RECOLLECTION-02(two)

- GOGOI, R., N. SHERPA, M. MURUGESAN AND L. R. MEITEI. 2020. Rediscovery of *Impatiens cothurnoides* C.E.C.Fisch., taxonomic identity, lectotypification and notes on its distribution, Botany Letters, DOI: 10.1080/23818107.2020.1856715. Published online: 12 Dec 2020.
- GOGOI, R., N. SHERPA, B.B.T. TNAM, C.DEORI AND S.R. TALUKDAR. 2020. Recollection of *Impatiens angustiflora* (Balsaminaceae) and notes on its lectotypification. *Nelumbo* 62(2): 154-160

NEW DISTRIBUTIONAL RECORD- 01 (One)

- CHOWLU, K., A. N. RAO AND C.DEORI. 2020. Synopsis of *Eulophia* R. Br. (Orchidaceae) in Manipur (India) with a new distributional record to the state. *Pleione*. 14(2): 361-366.

SEMINARS/SYMPOSIUMS/CONFERENCES/MEETINGS ATTENDED

Dr. N. Odyuo, Scientist-E

- Attended National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show held on 5th to 7th March, 2021, at Botanical Survey of India, ERC, Shillong- 793003, Meghalaya and acted as co-chair in a technical session.
- Attended 10 (te) webinars organised by BSI and other institutions.
- Visited Nagaland w.e.f. 21st to 23rd October, 2020 for evaluation of the project entitled 'Ex-situ Conservation of Economical, Endemic and Threatened plants species in the Botanical Garden of Modern College, Piphema Campus, Kohima, Nagaland.
- Attended a meeting on Vigilance and Coordination for the year 2021 held between SP & Head of Branch, CBI, ACB, Shillong and Scientist –E & HoO BSI, ERC Shillong at the office of the O/o HOB, CBI, ACB, Shillong on 19th March, 2021.

- Attended a Research advisory committee meeting at Bio-Resources Development Centre, Govt of Meghalaya on 20th January, 2021.
- Attended a Meeting of the Governing Body of the Meghalaya State Medicinal Plants Board in the Main Conference Hall (Kyllang) in the main Secretariat Building, Shillong on 28th January, 2021.
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Dr. Chaya Deori, Scientist-E

- Presented a Paper as Poster on “Diversity, conservation and sustainable utilization of orchid flora of community forests of west and south–west khasi hills districts of Meghalaya, India” during the National Conference cum Workshop (hybrid mode) on “Interdisciplinary Approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids” and Orchid Show held at Botanical Survey of India (BSI), Eastern Regional Centre, Woodlands, Laitumkhrah, Shillong, Meghalaya from March 5-7. 2021.
- Acted as co-chair in a technical session of the National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show held on 5th to 7th March, 2021, at Botanical Survey of India, ERC, Shillong- 793003, Meghalaya
- Attended 13 (thirteen) webinars organised by BSI and other institutions.
- Attended as an expert member of the Recruitment Committee of BRDC for selection of Junior scientist on 26th June 2020 at Additional Secretariat Building, Shillong.
- Attended 8th Governing Council Meeting of Bio-Resources Development Centre, Shillong on 1st September, 2020 at Main Conference Hall, Main Secretariat Building, Shillong.

Dr. Deepu Vijayan, Scientist-C

- Attended National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show held on 5th to 7th March, 2021, at Botanical Survey of India, ERC, Shillong- 793003, Meghalaya
- Attended 5(five) webinars organised by BSI and other institutions.
- Attended the first meeting of the ABS Expert Committee of the Board on “Access and Benefit Sharing (ABS) Mechanism of Biodiversity Use and its Implementation in Meghalaya” at Sylvan House, Lower Lachumiere, Shillong on 30th November, 2020.
- Attended a meeting of the Purchase Board, Bio-Resources Development Centre on 15th December, 2020 at Main Civil Secretariat Building, Shillong.

Dr. David Lalsama Biata, Scientist ‘C’

- Attended National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show held on 5th to 7th March, 2021, at Botanical Survey of India, ERC, Shillong- 793003, Meghalaya
- Attended 4(four) webinars organised by Botanical Survey of India and other institutions
- Attended a meeting on Central Govt. Employee Welfare Coordination Committee, Shillong (CGEWCC) Shillong Chapter meeting on 9th October, 2020
- Attended a meeting on Research Advisory Committee at Bio-Resources Development Centre, Shillong on 20th January, 2021

Shri B.B.T. Tham, Botanist

- Attended the National Conference cum Workshop on “Interdisciplinary approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids” and Orchid show at BSI, ERC, Shillong w.e.f. March 5-7, 2021

- Attended the Collaborative Community Development Programme for capacity building on Environmental Sustainability conducted by SOS-CVI, Umiam and Botanical Survey of India, Eastern Regional Centre on 11th September 2020 at Mawbsein Village, Ri-bhoi District, Meghalaya

Mr. Hemanta Kr. Das, Library and Information Assistant

- Participated in Orchid exhibition organised by Institute of Bioresource and Sustainable Development, Upper Shillong, Meghalaya, Upper Shillong, Meghalaya on 25th February 2021

Mis. L. Ibemhal Chanu, Botanist

- Attended and participated in the National Conference cum Workshop on “Interdisciplinary approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids” and Orchid show at BSI, ERC, Shillong w.e.f. March 5-7, 2021.

Shri Laishram Ricky Meitei, Bot Asstt.

- Attended National Conference cum Workshop on “Interdisciplinary approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids” and Orchid show at BSI, ERC, Shillong w.e.f. March 5-7, 2021.
- Participated in the Collaborative Community Development Programme on Environmental Sustainability organized by SOS Children’s Village, Shillong and Botanical Survey of India, ERC, Shillong on 11th September 2020 at Mawbsein Village, Ri-bhoi, Meghalaya.

Dr. Satya Ranjan Talukdar, Bot. Asstt.

- Presented a Paper as Poster on “Diversity, conservation and sustainable utilization of orchid flora of community forests of west and south–west khasi hills districts of Meghalaya, India” during the National Conference cum Workshop (hybrid mode) on “Interdisciplinary Approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids” and Orchid Show held at Botanical Survey of India (BSI), Eastern Regional Centre, Woodlands, Laitumkhrah, Shillong, Meghalaya from March 5-7, 2021.
- Attended National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show held on 5th to 7th March, 2021, at Botanical Survey of India, ERC, Shillong- 793003, Meghalaya.
- Institute of Bioresource and Sustainable Development Participated in Orchid exhibition organised by In, Upper Shillong, Meghalaya, Upper Shillong, Meghalaya on 25th February 2021.
- Attended 16(Sixteen) webinars organised by Botanical Survey of India and other institutions.

Smt. Nandita Sarma, Botanical Assistant

- Attended National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show held on 5th to 7th March, 2021, at Botanical Survey of India, ERC, Shillong- 793003, Meghalaya.
- Participated in Orchid exhibition organised by Institute of Bioresource and Sustainable Development, Upper Shillong, Meghalaya, Upper Shillong, Meghalaya on 25th February 2021.
- Attended 20(twenty) webinars organised by Botanical Survey of India and other institutions.

Shri Harminder Singh, Botanical Assistant

- Attended National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show held on 5th to 7th March, 2021, at Botanical Survey of India, ERC, Shillong- 793003, Meghalaya.

- Participated in Orchid exhibition organised by Institute of Bioresource and Sustainable Development, Upper Shillong, Meghalaya, Upper Shillong, Meghalaya on 25th February 2021.
- Attended 12 (twelve) webinars organised by Botanical Survey of India and other institutions.

Shri Vijay, Botanical Assistant

- Attended National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show held on 5th to 7th March, 2021, at Botanical Survey of India, ERC, Shillong- 793003, Meghalaya.
- Participated in Orchid exhibition organised by Institute of Bioresource and Sustainable Development, Upper Shillong, Meghalaya, Upper Shillong, Meghalaya on 25th February 2021.
- Attended 9 (nine) webinars organised by Botanical Survey of India and other institutions.

Miss Kankana Chakraborty, Botanical Assistant

- Attended National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show held on 5th to 7th March, 2021, at Botanical Survey of India, ERC, Shillong- 793003, Meghalaya.
- Participated in Orchid exhibition organised by Institute of Bioresource and Sustainable Development, Upper Shillong, Meghalaya, Upper Shillong, Meghalaya on 25th February 2021.
- Attended 8 (eight) webinars organised by Botanical Survey of India and other institutions.

Award and Honour: 1 (one)

Dr. Chaya Deori, Scientist-E, ERC, Shillong received USHA VIJ memorial award for the year 2021 for her outstanding contribution towards orchid Art and science by the Orchid Society of India (TOSI) during the National Conference cum Workshop on Interdisciplinary Approaches to Taxonomy, Conservation, and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid Show was organized by TOSI (Journal of Orchid Society of India), Chandigarh in collaboration with Botanical Survey of India and NEHU, Shillong held from 5th to 7th March 2021, ERC, Shillong- 793003, Meghalaya.

RESEARCH SCHOLAR ACTIVITIES ERC SHILLONG

1. Flora of Nagaland by Rikertre Lytan, JRF and Dr. Nripemo Odyuo Scientist-E & HoO.

During this year, Descriptions were made for 255 species and Key preparation for 411 taxa. Processed and mounted of one type specimen of *Aglaonema* sp. Morphological studies and dissection were done for *Zingiber pherimaense* Biseshwori & Bipin; *Chlorophytum assamicum* D. Borah & A.P. Das; *Pentasacme caudata* Wall.; *Tupistra khasiana* D.K. Roy, A.A. Mao & Aver. Preparation of Herbarium Meta data (ASSAM) were done for 260 sheets 80 from family Liliaceae and 180 from family Cyperaceae. Data compilation were done for Rare, Endangered and Threatened species of Nagaland and Manipur state wise. One field tour was undertaken to Doyang, Wokha Districts, Nagaland for 12 days from 21st October to 1st November 2020 and a total of 160 specimens were collected. Three Local field tours within the State of Meghalaya were undertaken for collection of *Gaultheria fragrantissima* Wall. seeds and live specimen of some orchid species. During this tenure one new species of *Peliosanthes* has been published and two species are under communicated (one new species of *Aglaonema* sp and one species of *Stadiochilus* sp a new generic record to India). Attended seven webinar “International Code of nomenclature for Plants” jointly organized by BSI, Deccan Regional Centre, Hyderabad and Dept. of Botany, Andhra University, Visakhapatnam on 06th.01.2021; “Science in Bialoweza Forest” organized by BSI, Sikkim Himalayan Regional Centre, Gangtok on 08th.01.2021; “Evolutionary play of invasive species in a changing Himalayan theater” organized by BSI, HAWHRC, Solan on 22nd.02.2021; “Documenting the diversity of La Amistad National Park Panama-Costa Rica” organized by BSI, Sikkim Himalayan

Regional Centre, Gangtok on 23th.02.2021. “Green Talk-Plant Resources as Aid for Prevention of Covid-19” organized by Southern Regional Centre, Coimbatore on 27th .02.2021. “Recent Trends in Biological Sciences’ organized by Department of Botany, St. Joseph’s College (Autonomous), Devagiri, Kozhikode, Kerala during 02-06 March 2021. “Interdisciplinary Approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid show” organized by The Orchid Society of India (TOSI), Department of Botany, Punjab University, Chandigarh & Botanical Survey Of India, Kolkata, on 5th& 6th . 03.2021.

2. Phytochemical screening, proximate composition, nutritional analysis and mineral element status of selected wild edible fruits of northeast India by Larima Sten, JRF and Dr. Deepu Vijayan, Scientist-C

During the period from April 2020- March 2021, tour was conducted to Sohrarim, Laitmawsiang, Pynursla, Pdengchakap, Mawtyngar, Pynursla, Laitmawsiang, Experimental Botanical garden, Barapani, Shillong, and Sohparu for the collections of wild edible fruits. Plant samples was processed by washing, drying, cutting, grinding and taking photographs. Solvent extraction was performed using Soxhlet apparatus and Rotary evaporator. Hot water extraction was prepared for qualitative phytochemical analysis and cold extraction was also carried out for some fruits. Qualitative phytochemical screening of *Anodendron paniculatum* (leaves and fruits). Estimation of protein by Bradford method, total moisture Content for *Antidesma bunius* (fruits), *Tetrastigma dubium* (fruits and seeds) and *Tetrastigma planiculale* (fruits and seeds), total phenolic content for *Quercus semiserrata* (fruit) and *Prunus jenkinsii* (fruit) was carried out. Estimation of total saponin content for *Vaccinium griffithianum* (fruit), *Syzygium megacarpum* (fruit, exocarp), *Quercus semisarrata* (fruit), *Prunus jenkinsii* (fruit), *Anodendron paniculatum* (fruit), *Citrus latipes* (mature fruit, immature fruit, mature fruit cover), *Hodgsonia heteroclita* (exocarp), *Aphananthe cuspidata* (fruit), *Calamus erectus* (fruit and fruit peel), *Debregeasia longifolia* (fruit, leaves), *Cayratia japonica* (fruit), *Ficus auriculata* (fruit), *Artocarpus lakoocha* (fruit, flower) and *Meyna spinosa* (fruit). DPPH and ABTS radical scavenging activity of *Quercus semiserrata* (fruit), *Vaccinium griffithianum* (fruit), *Syzygium megacarpum* (fruit and exocarp), *Citrus latipes* (mature fruit, mature fruit peel), *Debregeasia longifolia* (fruit), *Aphananthe cuspidata* (fruit), *Anodendron paniculatum* (fruit, leaves) and *Prunus jenkinsii* (fruit). Reducing Power Assay (RPA) for *Quercus semiserrata* (fruit), *Syzygium megacarpum* (fruit), *Aphananthe cuspidata* (fruit), *Citrus latipes* (immature fruit), *Cayratia japonica* (fruit), *Vaccinium griffithianum* (fruit), *Prunus jenkinsii* (fruit), *Calamus erectus* (fruit peel) and *Citrus latipes* (mature fruit). Estimation of carotenoids for *Anodendron paniculatum* (fruit and leave), *Cayratia japonica* (fruit), *Calamus erectus* (fruit and fruit peel), *Prunus jenkinsii* (fruit), *Syzygium megacarpum* (fruit), *Aphananthe cuspidata* (fruit), *Quercus semiserrata* (fruit), *Vaccinium griffithianum* (fruit), *Viburnum feotidum* (fruit) and *Antidesma bunius* (fruits). Determination of niacin content for *Viburnum feotidum* (fruits) and *Antidesma bunius* (fruits). Thin Layer Chromatographic analysis (TLC) of gallic acid, *Syzygium megacarpum* (fruits and exocarp), *Quercus semiserrata* (fruit), *Prunus jenkinsii* (fruit), *Vaccinium griffithianum* (fruit), *Calamus erectus* (fruit), *Hodgsonia heteroclita* (seed cover), *Meyna spinosa* (fruit) and *Citrus latipes* (immature fruit, mature fruit peel) for methanolic extract. Ultra High Performance Liquid Chromatographic (UHPLC) analysis of phenolics, flavonoids and vitamins standards and eight fruit samples. Attending National Conference cum Workshop on Interdisciplinary approaches to taxonomy, conservation, and economic utilization of Floriculturally and Medicinally Important Orchids and Orchid Show organized by The Orchid Society of India (TOSI), Department of Botany Punjab University and BSI, Kolkata, West Bengal jointly with NEHU from 5th-7th March, 2021.

3. Taxonomic revision and phylogenetic study of Zingiberaceae with special reference to endemic and endangered species of North East India by Suparna Debnath, JRF and Dr. Deepu Vijayan, Scientist-C

During April 2020-March 2021, 5 field tours were conducted to different areas of Meghalaya such as Jarain, Amlarem, Pdengchakap, Barapani Experimental Garden, BSI, Pynursla, Umtyngngar, Laitlyngkot and Mawphlang during which different plants of the family Zingiberaceae were collected. As a part of molecular phylogeny isolated genomic DNA and agarose gel [0.8% (w/v)] electrophoresis in 1x TBE buffer, along with Lambda DNA to check quality and quantity of 17 Zingiberaceous plants. PCR standardisation using nuclear (ITS) and chloroplast (matK, rbcL, trnH-psbA, trnC-ycf6), trnF-ndhJ, trnL intron) markers were carried out in the genomic DNA of different Zingiberous plants. Received good quality DNA sequences for 2 primer pairs (rbcL, c & d) of *Hedychium chingmeianum*, *Zingiber bipinianum*, *Zingiber kangleipakense* and *Zingiber pherimaense*. DNA sequence were used to construct phylogenetic

tree using four phylogenetic tree construction methods: neighbor-joining (NJ) method, the maximum parsimony method (MP) method, the maximum likelihood (ML) method, and the Bayesian inference (BI) method. Dissected and taken photographs and measurements of plant parts of 10 species of the family Zingiberaceae. Prepared photoplates for 8 species of Zingiberaceae (*Curcuma amada*, *Globba saltatoria*, *Hedychium coronarium*, *Hemiorchis pantlingii*, *Zingiber bipinianum*, *Bosenbergia longiflora*, *Cautleya gracillis* and *Caulokaempferia secunda*) using Adobe Photoshop 7.0. During this period several miscellaneous works have been done such as, prepared abstract of the paper- **Phylogenetic reconstruction of newly discovered species of the genus *Zingiber* (Zingiberaceae) from Northeast India based on chloroplast sequence data** for the National seminar on Plant Taxonomy and Traditional Knowledge in the Himalayan and Northeast India and Annual Conference of East Himalayan Society for Spermatophyte Taxonomy, organized by Rajiv Gandhi University, Arunachal Pradesh from 24th-25th April, 2021; herbarium label information was recorded for 286 sheets from the family Zingiberaceae for metadata of the herbarium specimens of Assam for Flora of India Project; recorded RET species of Assam and Mizoram under the reference regarding “Intimation of Endemic & Endangered (RET) species” Arunachal Pradesh and other states of N.E.R. of India; hands on training for molecular taxonomy and DNA barcoding was given to Ms. Vaishali (internship student) from 28th January- 5th February, 2021 under the supervision of Dr. D. Vijayan, Scientist-C and supervisor, BSI, ERC; attended National Conference cum Workshop (Hybrid mode) on Interdisciplinary Approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid show from March 5-7, 2021 organized by The Orchid Society of India, Chandigarh and Botanical Survey of India, Kolkata.

4. Taxonomic studies of *Ficus* L. of Northeast India by Sreyoshee Sensarma, SRF and Dr. Chaya Deori, Scientist E

During this year, Citations have been made. 5 tours and one small one day field tour is completed(2 herbarium and 3 field tours). Collected 36 specimens among which 20 specimen have been identified. Have described 31 spp. Submitted 30 descriptions of *Ficus* spp. In the Flora of India Project Made 7 photo plates and 7 illustrations. Have consulted almost 760 protologues, downloaded them and also collected 25 types. Have typed the references. Made the Checklist of *Ficus* L. of North-east India. Made a Google Earth Map of Surveyed areas of Mizoram. Dissected 12 spp. of *Ficus* Attended seven webinar “International Code of nomenclature for Plants” jointly organized by BSI, Deccan Regional Centre, Hyderabad and Dept. of Botany, Andhra University, Visakhapatnam on 06th.01.2021; “Science in Bialoweza Forest” organized by BSI, Sikkim Himalayan Regional Centre, Gangtok on 08th.01.2021; “Evolutionary play of invasive species in a changing Himalayan theater” organized by BSI, HAWHRC, Solan on 22nd.02.2021; “Documenting the diversity of La Amistad National Park Panama-Costa Rica” organized by BSI, Sikkim Himalayan Regional Centre, Gangtok on 23th.02.2021. “Green Talk-Plant Resources as Aid for Prevention of Covid-19” organized by Southern Regional Centre, Coimbatore on 27th .02.2021. “Recent Trends in Biological Sciences” organized by Department of Botany, St. Joseph’s College (Autonomous), Devagiri, Kozhikode, Kerala during 02-06 March 2021. “Interdisciplinary Approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids and Orchid show” organized by The Orchid Society of India (TOSI), Department of Botany, Punjab University, Chandigarh & Botanical Survey Of India, Kolkata, on 5th& 6th of March, 2021.

5. Micropropagation of some selected endemic and threatened plants of Northeast India by Ms. Dawanri Marwein, JRF & Dr. Deepu Vijayan, Scientist C.

During the period from April 2020 – March 2021, *In vitro* propagation protocol and genetic fidelity analysis of *Rhododendron formosum* Wall. have been standardized and manuscript is under preparation. Standardization of surface sterilization protocol, *in vitro* and *ex vivo* seed germination experiments, multiple shoot induction and rooting experiments of *Rhododendron inaequale* Hutch. and *Adinandra griffithii* Dyer. have been carried out. Culture initiation and shoot multiplication of *Pyrenaria barringtoniifolia* Seem. and *Rhododendron iteophyllum* Hutch. have been carried out. Regular subculturing and rooting of *Rhododendron wattii* Cowan., *Pyrenaria khasiana* R.N.Paul. *Cymbidium tigrinum* and *Cymbidium whiteae* have been carried out. Seed germination experiments of *Calanthe masuca*, *Coelogyne corymbosa*, *Coelogyne viscosa*, *Pholidota katakiana* and *Micropera rostrata* have been carried out. *In vitro* raised plants of *Rhododendron formosum* Wall., *Pyrenaria khasiana* R.N.Paul., *Rhododendron inaequale* Hutch., *Rhododendron wattii* Cowan. and *Adinandra griffithii* Dyer. were transferred for hardening. Regular watering

and maintenance of the seeds and seedlings of *Pyrenaria camelliflora* Kurz., *Pyrenaria khasiana* R.N.Paul., *Rhododendron formosum* Wall., *Rhododendron inaequale* Hutch. and *Adinandra griffithii* Dyer. in the polyhouse and in the garden of BSI, ERC, Shillong. Seedlings of *Rhododendron inaequale* Hutch. were reintroduced in the garden of BSI, ERC, Shillong. Seedlings of *Pyrenaria khasiana* R.N.Paul. were reintroduced in the garden of BSI, Experimental Garden, Barapani. Two local tours were conducted to different forest areas of Meghalaya for the collection of plant samples. Data compilation were done for Rare, Endangered and Threatened species of Meghalaya and Tripura. Attended 7 webinars and participated in the Two-day Online Workshop on Data Analysis using SPSS.

10. HEADQUARTERS, BSI, KOLKATA

Project-1 : Marine Macro Algal Flora of West Bengal coast, India

Executing Officials : Dr. S.K. Yadav, Botanist & Shri K. Majumdar, Pres. Asstt.

Date of initiation : April 2019; **Date of completion** : March 2022

OBJECTIVE: Exploration of Marine Macro Algal Flora of West Bengal coast

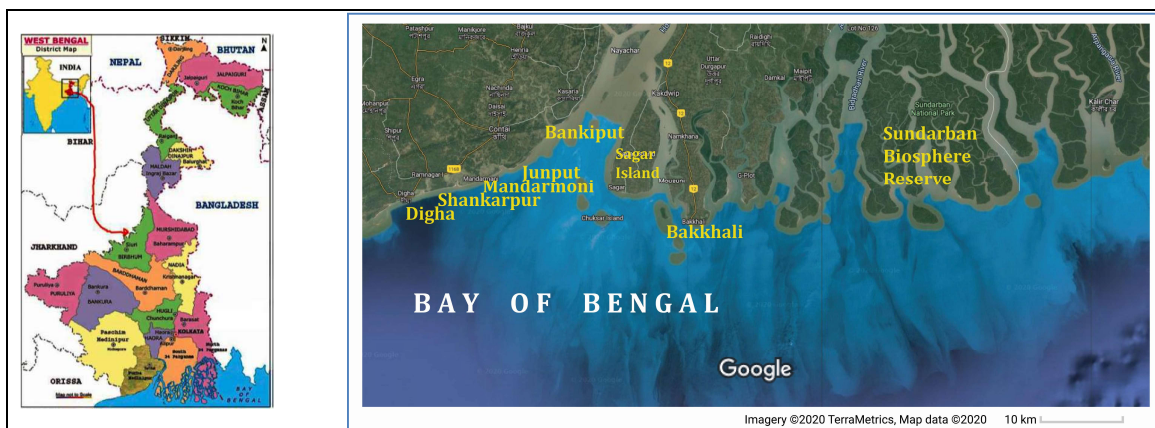
BACKGROUND: The Marine Macro Algal Flora of the West Bengal coastline is unexplored / under explored. Therefore, a thorough study and field exploration is required for proper documentation of the marine macro algae of the study area.

AREA AND LOCALITY:

West Bengal Coastal areas, including Sundarban Biosphere Reserve

SUMMARY & ACHIEVEMENT/OUTCOME:

During the period, 50 field numbers of marine macro algae (seaweed) specimens were studied and identified. All the identified herbarium sheets were properly labelled and deposited in to the Central National Herbarium (CAL), Howrah. Besides, collected and referred **48** references pertaining to the marine macro algal taxonomy and diversity of the India coast. Completed taxonomic description and nomenclature updation of 9 species of seaweeds namely *Ulva clathrata* (Roth) C. Agardh; *U. compressa* L.; *U. lactuca* L.; *U. flexuosa* Wulfen; *U. linza* L.; *U. prolifera* O.F. Muell. (FAMILY: ULVACEAE); *Chaetomorpha aerea* (Dillwyn) Kuetz. (FAMILY: CLADOPHORACEAE); *Catenellacaespitosa* (With.) L. Irvine and *C. nipae* Zanardini (FAMILY: CAULACANTHACEAE).. Based on the present study and review of literature, prepared a preliminary checklist of the marine algae of the West Bengal coastline. Published 3 research papers from this project in various scientific journals.



Papers published- 6; Papers communicated-01

Project-2 :Flora of Eagle Nest Wild Life Sanctuary and its adjacent regions, West Kameng District Arunachal Pradesh

Executing Officials : Sanjay Kumar and Dr. S. S. Dash

Date of initiation : April 2018; **Date of completion** : March 2022

OBJECTIVE: To conduct detailed floristic Survey in Eagle nest Wild life Sanctuary and Documentation of the flora occurring within the boundary of the sanctuary and its adjacent regions. To preparation of a pictorial guide of the sanctuary and its adjacent region. Provide GPS based database with help of ArcGIS software.

AREA AND LOCALITY: Eagle Nest Wild Life Sanctuary and its adjacent Region, West Kameng, Arunachal Pradesh, c. 518 sq.km.

SUMMARY & ACHIEVEMENT/OUTCOME: Herbarium material of second exploration (10.07.2019 to 03.08.2019) has been processed per standard Herbarium procedure. The identification of earlier collection is going on and simultaneously description of 53 plant species ie. *Lygodium flexuosum* (Linn.) Sw.; *Lepisorus nudus* (Hooker) Ching, *Pteris wallichiana* J. Agardh, *Abies densa* Griffith, *Magnolia campbellii* Hook.f. & Thom., *Magnolia champaca* (Linn.) Baill. ex Pierre, *Cautleya gracilis* (Sm.) Dandy, *Rhododendron anthopogon* D. Don, *Rhododendron campanulatum* D. Don, *Rhododendron keysii* Nuttall etc., has been completed.



Project -3. Flora of India Vol. 8 (c. 523 taxa)

Executing Scientist(s) :Dr. S.S. Dash & Dr. Debasmita Dutta Pramanick

Date of Initiation :2019; **Date of completion** :2021

OBJECTIVE: Updating nomenclature and documentation of 36 genera, 441 species and 80 infraspecific taxa of the families Rosaceae, Chrysobalanaceae&Neuradaceae in India.

BACKGROUND: This project was initiated in 2019. During 2019-20, One Herbarium consultation tour was conducted to DD & BSD during which a total 1364 no. of specimens were studied and reconfirmed identity of 12 specimens at DD. Updated nomenclature and description of 120 taxa along with proper citation, basionym, relevant synonyms, phenology, distribution, uses, chromosome nos. and taxonomic notes. A checklist comprising of 36 genera and 523 taxa was prepared for 'Checklist of Flora of India'.

AREA AND LOCALITY:India

SUMMARY & ACHIEVEMENT/OUTCOME:

Volume 8 comprising of 36 genera, 441 species and 80 infraspecific taxa of the families Rosaceae, Chrysobalanaceae&Neuradaceae in India was completed in the 'Flora of India' format with current nomenclature according to ICN and author citations according to Brummitt and Powell's "Author of Plant Names", abbreviations of Periodicals confirmed with BPH and for Books with TL-2. **Final Manuscript has been submitted to Team leader.**

11. HIGH ALTITUDE WESTERN HIMALAYAN REGIONAL CENTRE, SOLAN

Name of the Project: Floristic diversity of Dr. Y.S. Parmar University Campus, Nauni, Solan, Himachal Pradesh.

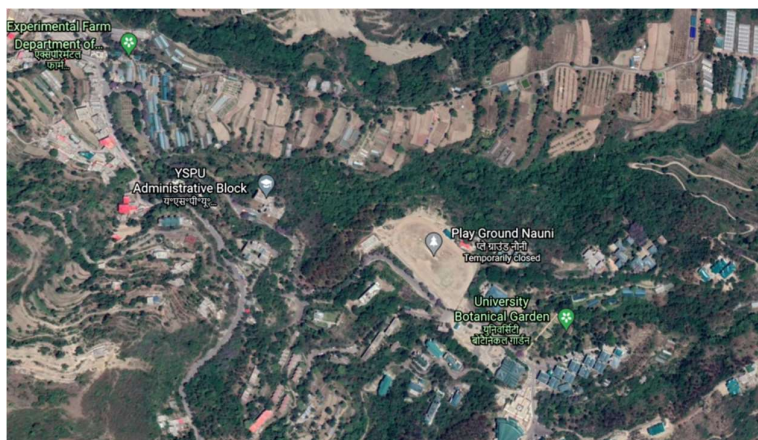
Executing Scientist (s) : Dr. Kumar Ambrish, Scientist- E; Dr. Kuldip S. Dogra, Scientist- D

Duration of the project : One year (2020-21)

Introduction: As a part of research project, the 1st activity of the BSI, HAWHRC is to document and compile the floristic diversity of the Dr. Y.S. Parmar University, Nauni, which has also being desired by the Hon'ble V.C. of the University. This document will be very helpful to the faculties, researchers and students of UHF Nauni who are engaged in applied aspects of plant research and resource conservation.

Objectives: Documentation of the floristic diversity of Dr. Y.S. Parmar University Campus, Nauni, Solan, Himachal Pradesh in pictorial form which includes Botanical and local name of species, brief description, flowering and fruiting period, its medicinal or economic uses if any along with digital photographs.

Site of the Study (with map): The campus of the Dr. Y.S. Parmar University is situated at Nauni, in Solan district about 12 Km from Solan on Solan to Rajgarh Road, at an altitude of 1300 m. It covers about 5.5 km² area.



Map of the Dr. Y.S. Parmar University, Nauni, Solan

Methodology adopted: Floristic survey of the area, Plant collection, drying and processed for herbarium records at BSI-BSS, Solan

- Total area covered :** UHF, Nauni Campus (1.5 Km²)
- Number of tours undertaken:** 3 field tours
- Number of species listed from literature and collected:** 115 species listed from the published literature and 69 species collected from the campus.
- Number of species identified:** 65; *Clematis gouriana* Roxb., *Clematis grata* wall., *Clematis paniculata* Thumb., *Ranunculus arvensis* L., *Ranunculus laetus* wall, *Ranunculus hirtellus* Royle, *Thalictrum foliosum* DC., *Michelia champaca* L., *Cissampelos pareira* L., *Cocculus laurifolius* DC., *Berberis lycium* Royle, *Argemone mexicana* L., *Papaver dubium* L., *Fumaria parviflora* Lam., *Capsella bursa- pastoris* Medic., *Erysimum hieracifolium* L., *Lepidium ruderae* L., *Nasturtium officinale* R.Br, *Raphanus sativum* L., *Sisymbrium sophia* L., *Sisymbrium thalianum* J. Gay & Monn, *Crataeva nurvala* Buch-Ham. *Viola serpens* wall. *Viola tricolor* L., *Flacoutia indica* (Burm. f.) Merr., *Xylosma longifolia* Clos, *Populus deltoides* Marshall, *Salix alba* L., *Polygala abyssinica* R.Br. ex. Fresen., *Polygala Chinensis* L., *Polygala triphylla* Buch-Ham. ex. D.Don., *Silene conoidea* L., *Stellaria media* L., *Stellaria bulbosa* wulf., *Hypericum oblongifolium* Choisy., *Abelmoschus moschatus* (L.) Medic., *Abelmoschus fliculnius* (L.) Wt. & Arm., *Achania grandiflora* L., *Hibiscus rosa-sinensis* L., *Malva pusilla* Sm., *Malva rotundifolia* L., *Malva verticillata* L., *Malvastrum coromandelianum* (L.) Garcke , *Sida rhombifolia* L., *Sida acuta* Burm.f., *Bombax ceiba* L., *Ceiba speciosa* (A.St.-Hil.) Ravenna, *Pterospermum acerifolium* (L.) Willd., *Pterygota alata* (Roxb.) R. Br., *Grewia asiatica* L., *Grewia optiva* J.R. Drumm. Ex. Burrett, *Triumfetta annua* L., *Triumfetta pilosa* Roth, *Reinwardtia indica* Dumort., *Geranium divaricatum* Ehrh. Beitr., *Geranium ocellatum* Camb., *Oxalis corniculata* L.,

Impatiens balsamina L., *Citrus aurantifolia* (Christmann & Panz.) Swingle, *Citrus aurantium* L., *Citrus jambhiri* Lushington, *Citrus reticulata* Blanco, *Murraya koenigii* (L.) Spreng., *Zanthoxylum armatum* DC., *Melia azedarach* L. and *Euonymus pendulus* Wall.

Output indicators for the assessment of the project: The campus is a home of many herbaceous plant species which have a quit useful medicinal and economic value. The alien plant species are also predominantly introduced in the campus of the University for horticulture and forestry purposes which are now rapidly spreading in the campus and surrounding areas of the Nauni University.

Major impacts reported during the financial year: There are number of alien plant species reported from the campus which includes *Chorisia speciosa*, *Paulownia tomentosa*, *Jasminum mesnyi*, *Solidago Canadensis*, *Salvia coccinea*, *Verbena brasiliensis*, *Nicotiana tabacum* etc.

RESEARCH PUBLICATIONS: Papers published-01

12. INDUSTRIAL SECTION INDIAN MUSEUM, KOLKATA

PROJECT-1

Title of the Project: Collection of Algae specimens deposited at ISIM.

Executing Scientist (s): Dr. K. Pagag, Botanist, Dr. S. Datta, Botanical Asstt. and Dr M. Bhaumik, Scientist 'E'

Duration of Project: 1st April 2020 - 31st March, 2021.

Background of the Project: Botanical collections are crucial tool in the field of biodiversity studies, environment impact assessment and genetics as well as taxonomic researches. They provide the base for identification as well as evaluation of species conservation status. The National Centre for Seaweed Herbarium at Marine Algal Research Station (MARS) at Mandapam, Tamil Nadu is an internationally acclaimed centre with about 5,000 specimens of more than 280 seaweed species and the only internationally recognized centre having a diverse collection of seaweeds from across the country, predominantly from Tamil Nadu and Gujarat, and designated as a reference repository at the national level. Thus there is a need for development of more herbaria of marine algae of India and providing a source of authentic identification that can be used to further the taxonomic study of algae in India and research information can communicate to the public, government and Industry.

Area and locality of the Allotted Project (with coloured line drawing Map not Google Map): NA

Summary of the work done during 2020-21 (not more than 1000 words): The herbarium of Industrial Section Indian Museum, Botanical Survey of India (BSIS) currently house 5081 marine algae specimens belonging to c. 56 families and c. 112 genera. The specimens are from different coastal areas of India with a large collection from different islands of Andaman and Nicobar archipelago. The collections were all made by Dr. K.S. Srinivasan during the period of 1944 to 1955. Few collections were made by an anonymous collector during the period of 1914 to 1917 as a part of study economic plants for British India. There is also a minor representation of marine algae from California by Elmer Yale Dawson and Queensland, Australia by A.B. Cribb, as a part of marine algae herbarium of BSIS.

While preparing the database all specimens were cleaned, dusted and loose or unmounted specimens are mounted on herbarium sheets where it is necessary. All specimens studied, detail metadata prepared and nomenclature updated with the help of www.algaebase.org (Guiry & Guiry 2020). This specimen database prepared here consists of the label data of all collections. The data include the scientific name, collection date, collector's name and collection number (where ever present) and place of collection.

Outcomes: A database of c. 5081 sheets was prepared, 500 loose sheets were mounted. Final Report (132 pages + 10 pages colour illustrations) submitted to HQRS in hardbound and softcopy. A dedicated almirah procured and all specimens kept in the almirah. The family, genera and taxa are arranged alphabetically as per hierarchy.

PROJECT: 2

Title of the Project: Documentation of exhibits and materials of Botanical gallery in Industrial Section Indian Museum

Exexuting Scientist (s): Dr. S. Datta, Botanical Asstt. Dr. K. Pagag, Botanist and Dr M. Bhaumik, Scientist 'E'

Duration of project: 1st April 2020to31st March, 2022

Background of the Project: The Industrial Section, Indian Museum was established on 1st April, 1887, situated at 1, Sudder Street Kolkata (became a part of Botanical Survey of India since January, 1911). The Botanical Gallery (ca 10,000 sq. ft. area in 2nd floor of the Museum) has permanent exhibit display in 8 thematic Bays displaying Indian timbers, Food products, Medicinal produces, Vegetable fibers, Oil and oilseeds, Dyes and Tans and finally Gums and Resin at east end. The Gallery provides information on both wild and cultivated economical plants commonly used in India. The Botanical Gallery houses different artifacts that date back to 1890 collected by different collectors working under the Reporter of Economic Products. A comprehensive catalogue of the exhibits of this gallery is therefore essential.

Summary of the work done during 2020-21 (not more than 1000 words): A detail record of each exhibit is being prepared with its collection details. Few collections by eminent collectors like Sir G. Watt and D. Hooper were also recorded who have played a significant role in the layout of the botanical museum present today. The collections are not only important in understanding the uses of the plant world but also provide an insight of the further exploration in the field of economic botany. There have been several collections outside India from Afghanistan, Burma and Bangladesh which is important in understanding the different uses of the plants across the country.

Achievements/ Outcomes: A catalogue of exhibits of Gum & Resin section was being prepared with 739 specimens enlisted. The most important collection is a Gutta-percha sample which was exhibited in Calcutta exhibition in 1883-84. The catalogue of Oil & Oil seeds section is being prepared (with 650 specimens listed), for fibre section (c. 200 specimens are listed) with details. Fibre samples of *Pandanus furcatus* Exb. No. 32023, *Furcraea foetida* and *Furcraea* sp. were identified which were exhibited at the Calcutta International Exhibition.

PROJECT 3:

Flora of India: Volume 22 (Nyctaginaceae-Elaeagniaceae)

Team Leader: Dr M. Bhaumik, Scientist 'E'

Teammembers: Dr. A.K. Sahoo, Scientist E; Dr. Debasmita Dutta Pramanik, Scientist-C; Dr. Sankara Rao, Scientist-C; Dr. Geeta Chowdhury, Botanist; Dr. (Mrs.) Kangkan Pagag, Botanist; Dr. (Mrs.) Sudeshna Datta, Bot. Asstt., Sri S.K. Sharma, Sr. Prev. Asstt.

The volume 22 contains 21 families about 132 genera, 650 species, 6 subspecies and 81 varieties.

Achievements/ Outcomes:

Final report of Flora of India Vol. 22 (21 families about 132 genera, 650 species, 6 subspecies and 81 varieties along with 30 Photo Plates and 167 illustrations) has been submitted to Technical Section, BSI Kolkata for publication.

Publications: Paper published- 4; Book chapters-04; Hindi article-01

Maintenance of Herbaria: 1. No. of Specimens mounted, 2. No. of Specimens remounted, 3. No. of Herbarium sheets Stitched/labeled, 4. No. of Herbarium sheets dusted/fumigated, 5. No. of specimens poisoned, 6. No. of Genus cover/species cover changed, 7. No. of Specimens incorporated, 8. No. of Specimens sent on loan, 9. No. of Specimens received on exchange/loan, 10. No. of cibachromes received from Kew, 11. No. specimens received on gifts, 12. No. of species identified, 13. No. of Herbarium sheets accessioned.

Library:

| Circle | Number of Journals incorporated | | Number of Reports, Newsletters, Brochures incorporated | | Number of books incorporated |
|-------------|---------------------------------|------------------|--|---------------------|------------------------------|
| | Indian Journals | Foreign Journals | Departmental | Other Institutional | |
| ISIM | 31 | Nil | 3 | 2 | 68 |

Public Service Rendered:

| Section | No. of Scientist (Indian/Foreign) & visitors (students etc.) visited | No. & name of VIPs, dignitaries visited | Details of special information/plant or other related material supplied | No. & Name of specimens/plant or other related materials identified. | No. of Photo copy supplied | Total revenue received for providing information/identification service/photocopy etc. |
|---------|--|---|---|--|----------------------------|--|
| ISIM | 03 (Three). 1. Shri Joydip Mukherjee and Alope Banerjee on 04.09.2020, regarding documentation of <i>Sinchona</i> sample. 3. Aditya Goswami & Debapriya | --- | ----- | ----- | ----- | Rs.38800/- for 77 samples. |

| | | | | | | |
|--|---|--|--|--|--|--|
| | Ghosh both Architects from Architectonic Services visited Botanical gallery on 21.10.2020 regarding planning of Antarctica Gallery at 4 th Floor, ISIM. | | | | | |
|--|---|--|--|--|--|--|

Special Information (Findings)

a. New Records for India. One

13. Other Research Activities:

Dr. Manas Bhaumik, Scientist E & HoO

Lecture delivered (2020-2021)

1. Participated in a discussion as a panelist on Greening Avenue: Choices post Amphan”organized by HIDCO Govt. of West Bengal on 04.06.2020.
2. Delivered a lecture on World Environment day 2020 uploaded to youtube organized by Indian Museum, Ministry of Culture, Govt. of India.
3. Deliver a talk as Resource person in a webinar entitled “Role of Museum for conservation of Biodiversity” on 16.01.2021 organized by Dr. D. Das HOD Botany GGDC College
4. Lalgah, Dr. P. Ghosh HOD Botany Seva Bharati Mahavidhyalay, Kargari, West Bengal & Flora & fauna Asia Group.

Identification and Report of NDPS sample

1. During this period (2020-21) 77 NDPS sample received from different police stations and out of them 49 reports has been issued.
2. One banana sample has been identified and reported for the student of Department of Food, Science and technology, I.K. Gujral Punjab Technological University Punjab. On 20.01.2021.

Review of Scientific papers

Five research article has been reviewed for Nelumbo (two), Indian Forester (two) and Nordic Journal of Botany(one). The details are

1. An article ‘ New variety of *Celosia argentea* L. (Amaranthaceae) from Assam, India’ by B. Das et al. for Nelumbo.
2. One Mss. (*Meeboldia linearis* sp. nov. (Apiaceae) from Xizang, China) Reviewed for Nordic Journal of Botany
3. One Article reviewed "Taxonomic Revision of Genus *Alternanthera* (Amaranthaceae) in the Indian Himalayan State of Jammu and Kashmir" for Nelumbo.
4. One paper reviewed “ A taxonomical note from Parappool: A lesser Known Lateritic Plateau in Kerala” for Indian Forester.
5. One paper ”Ornamental potential of *Gentiana Kurroo* could be a boon for its survival: a critically endangered species’ is reviewed for Indian Forester

Meeting attended

1. Attend a meeting as a DPC member to GSI HQRS Kolkata on 25.08.2020.

2. Two online meeting attended for Website development.
3. Online meeting attended on 8.10.2020 regarding MIS
4. Attend two online meeting regarding Fl. of India.

Webinar and offline lecture attended

1. Participated webinar on 20.05.2020 organized by R.D & S.H. National College and SWA Science College Mumbai.
2. Attend a webinar on “Himalayan Mountain Biodiversity–Threats & Solutions’ organized by BSI BSISHRC Gangtok on 10.12.2020.
3. One webinar on ‘Revising the generic limits of Coleus and Plectranthus (Lamiaceae) by Allen Paton, RBG Kew. On 12.03.2021
4. Attend a Webinar on International Code of nomenclature (ICN) for plants organised by BSI, SRC on 06.01.2021.
5. Attend Nathaniel Wallich memorial lecture on Foundation day of Indian Museum 02.02.2021

Misc information and reports

1. Monthly, quarterly and annual technical reports send to hqrs regularly
2. Report on RTI send to hqrs timely.
3. Information regarding details of Capital Assets of ISIM provided to HQRS on 14.10.2020.
4. ACR/APAR report of all ISIM officials reviewed and send to hqrs.
5. Information provided to hqrs as per attached format enquired from PMO.
6. Furnishing information regarding no. of employees opting for LTC cash voucher scheme and Festival advance scheme on 4.11.2020 to HQRS
7. Assisted four member team of Auditors, Director General Audit, Environment and Scientific department, Kolkata Branch during their Audit w.e.f. 13.11.2020-20.11.2020. Inspection Report received from Audit, scientific dept., necessary steps taken and compliance report send to Audit office as well as hqrs for information.
8. Expression of Interest pertaining to MOU between CAFRI & BSI replied.
9. Information on ISIM building data provided to HQRS.
10. One botanical sample reported to HQRS vide D/BSI letter No. BSI-295/1/2019/Misc.-Tech/185 dated 12.02.2021
11. Information provided to Hqrs regarding digital public session by Honr. Minister MoEFCC on 03.03.2021.
12. Web page of BSI,ISIM updated with Hindi version (at bsi.gov.in) and uploaded on 21.12.2020.
13. Write up of Economic Botany herbarium prepared and send to Dr. Avinash Bharati to upload on 23.12.2020
14. Two quarries for internal audit complied for hqrs on 15.02.2021
15. Direct recruitment of 8 MTS post processed, permission obtained from hqrs, NOC obtained from redeployment cell, proforma duly filled up submitted to Staff Selection Commission and the post has been advertised in February 2021
16. Comply reply to Asstt. Election commission of India Kolkata South On 15.12.2020
17. Revised datasheet of Herbarium image house at ISIM sent to Digital Herbarium to CNH and onward transmission to NIC Ministry.
18. Participating a survey of Natural History Museum UK about improving visitor’s interest
19. State floral diversity data send for Finalization of formats for compilation of Biodiversity Accounts by Statistical Ministry.

Other administrative work

1. Two service book updated Ms. Anantha Lakshmi and Mr. Rahapal on 2.10.2020
2. 4+3 ACR reviewed on 02 & 03rd December 2020
3. One Packet species cover (500 sheets) issued to CNH on loan basis.
4. Application for Botanist forwarded to D/BSI.

5. Miscellaneous PAO work done.
6. Dually filled proforma for direct recruitment of 8 post of MTS deposited to Staff Selection Commission(ER), Kolkata on 04.01.2021
7. Miscellaneous administrative work performed.
8. Vigilance awareness week 2020 observed on 27.10.2020. All officials participated whole heartedly
9. 34 type images and metadata of ISIM herbarium send for BSI e-archive web portal. On 09.2.2021
10. Arrange to install one 55" signage at Botanical Gallery on 09.2.2021.

Miscellaneous

1. Act as an external examiner on Departmental LDC examination of Geological Survey of India (GSI), Kolkata officials. Twenty seven written copies checked as per standard copies provided by GSI and Report with grade for successful candidate provided to GSI.
2. Act as a Judge for online Poetry competition On 'International Biodiversity Day 2020' organized by CNH, Howrah 22.05.2020.

Mrs. Geeta Chaudhury, Botanist

1. Family 'Amaranthaceae' updated and finalized for Flora of India Vol. 22 and submitted to teal leader.
2. Perform responsibilities as regular DDO and attend Audit party during their work at ISIM.
3. Identified & prepared and delivered NDPS reports.
4. Reviewing & Reporting of APAR of ISIM officials 4 & 2, respectively.

Dr. (Mrs.) Kangkan Pagag, Botanist

1. Supervised cleaning and updating of Botanical Gallery.
2. Carried out the duties of Hindi Rajbhasa Adhikari or Hindi Officer.
3. Carried out duty of Purchase Committee Member.
4. Assisted in preparation of Increment Certificate.
5. Prepared a list of numbers of Angiosperms and Pteridophytes of states of India.
6. Prepared a list of no. of endemic and RET plants of states of India.
7. Attended a National Webinar on occasion of International Habitat Day on 5th October, 2020 in the topic Plant Diversity of Cold Desert of Western Himalaya and its conservation strategies presented by Dr S.K. Srivastava, former Joint Director & HOO, BSI, NRC, Dehra Dun, organized by BSI, HAWHRC, Solan, H.P.
8. Attended a National Webinar on 9th October, 2020 in the topic NISARG Bharat: Enhancing Peoples' participation in the e-PBR Framework organized by Biodiversity Collaborative supported by office of the Pincipal Scientific Advisor to the Govt. of India.
9. Organized Hindi Diwas and Karyashalaya.
10. Carried out the physical verification of consumable articles at store of the office and submitted report as Charman of the Committee.
11. Attended two webinar organized by BSI, Western Regional Centre, Pune and BSI, Deccan Regional Centre, Hyderabad.
12. Consulted herbarium specimens of Central National Herbarium (CNH).
13. Attend online Hindi workshop on ' Karyalayan patrachar ke vivid swaroop' organized by CBL and lecture presented by Smt. Amrita Veena Minj, Rajbhasa Bivhag Kolkata.

(Mrs.) Sudeshna Datta :

- a) Assisted in fumigation of herbarium(BSIS) & new gallery.
- b) Assisted in identification and preparation of NDPS reports.
- c) Prepared data for representation in KIOSK.
- d) Collected seeds of *Adenanthera pavonina L.*, for display in bead showcase.
- e) Prepared data for 17 vols. Of textile fabrics for digitization.
- f) Prepared metadata of Natural Dyes of Wardle for NIC.
- g) Identified Musa specimen for student.

- h) Assisted research scholar with J F Watson Fabrics of India book.
- i) Acted as a member of verification committee for consumable goods from 2011-2020. Prepared a list of consumable items and followed by physical verification of the same.
- j) Incorporated Algae specimens and prepared a separate algae section
- k) Incorporated Algae specimens and prepared a separate algae section.
- l) Visited CNH to consult *Pternopetalum* species (Apiaceae) for writing an article.

Ms. Sushreya Pal, Botanical Asstt.

- a) Assisted in fumigation of herbarium & new gallery.
- b) Assisted visitors & staffs during gallery duty on weekends.
- c) Listing of Food samples in Botanical gallery for preparation of comprehensive database of gallery specimens.

Shri Abinash Pradhan, Botanical Asstt.

- a) Assisted in fumigation of herbarium and gallery.
- b) Assisted HOO as and when required.
- c) Assisted visitors and staffs during gallery duty on weekends
- d) Listing of wood samples in Botanical gallery for preparation of comprehensive database of gallery specimens

Shri Surendra Kumar Mahato

- a) Put up note and prepare officer order for payment of Newspaper bills.
- b) Other misc. works like prepare officer order for the payment of Car Rental and Telephone bills.
- c) Put up note and prepare officer order for payment of journal bills.
- d) Participated store verification work as a member of the committee along with other officials.
- e) Prepared office /sanction orders for payment of various bills.
- f) Other misc. works as assigned by O/S.

9. Miscellaneous :

1. Office premises totally sanitized twice on 02.06.2020 and 19.06.2020, 17.07.2020 with ISIM authorized pest control Agency.
2. Sri U. S. Mitra, Stenographer, Gr.I, promoted and transferred to BSI, CRC Allahabad deployed at BSI,ISIM.
3. Smt. Ananthalkshmi, Botanical Asstt. Promoted and joined at BSI ISIM, deployed at BSI,SRC, Coimbatore.
4. Ms. Sushreya Pal joined as Botanical Assistant to this establishment on 05/10/2020.
5. Shri Surendra Kumar Mahato joined as Lib. & Inf. Asstt. to this establishment on 16/10/2020.
6. Vigilance Awareness Week-2020 observed on 27.10.2020. All officials participated whole heartedly.
7. Shri Debasish Chowdhury, DCM, Grade-II, Hqrs., BSI joined in BSI, ISIM on 23rd November, on deputation.
8. One Packet species cover (500 sheets) issued to CNH on loan basis.
9. Mrs Geeta Chaudhury, Botanist retired on superannuation w.e.f. 31/01/2021.
10. Dr (Ms.) Kangkan Pagag, Botanist assumed charge as DDO after retirement of Mrs Geeta Chaudhury, Botanist.

14. NORTHERN REGIONAL CENTER

PROJECT -1

Name of the Project: Pictorial Flora of Pteridophytes of Uttarakhand

Executing Scientist: Dr B. S. Kholia

Duration of the project: (2018 – 2021)

About the work done:

Introduction: In recent studies (Fraser-Jenkins 1997, 2008, Fraser-Jenkins et al. 2016, 2018) it was found that, some earlier work is based on erroneous identification and incomplete in many ways, thus a complete, comprehensive and updated fern flora of Uttarakhand with live images is urgently required for botanists and forest managers. Further recently the Botanical Survey of India has published the Flora of Uttarakhand comprising all the families and genera of the Angiosperms but the Pteridophytes were not included. Therefore, to fill this gap on vascular flora of Uttarakhand present Pictorial work is initiated here.

Objective: To prepare a pictorial guide of Pteridophytic flora of Uttarakhand.

Site of the study (with map): Uttarakhand



Methodology adopted: Classical Taxonomic, revisionary, and floristic approach which includes, collection, identification, documentation and flora writing.

Achievements including: Identified 168 plant species and completed label writing of 260 herbarium sheets in all respect.

Output indicators: Identified 168 plant species and completed label writing of 260 herbarium sheets in all respect.

Major impacts reported during the financial year : The work will be useful for common people, foresters, students, researchers, policy makers and other stakeholders towards better understanding of the Uttarakhand Pteridophytes as well as making policies for conservation.

Project -2

Name of the Project: Pteridophytic Flora of India

Executing scientist (s) : B. S. Kholia

Duration of the project : 2020-2023

Introduction: Pteridophytes are the second highest group of vascular plants in India and are represented by c. 1200 taxa. They are distributed from sea level to snow line in the alpine Himalayas. A comprehensive account of Pteridophytes was written during the British period by Col. R. H. Beddome - a British surgeon and Army officer. His illustrative work was published in between 1856-1893. After this significant work, several regional and state floras, and more recently a comprehensive checklist of Indian Pteridophytes published by Fraser-Jenkins et al. (2017-2020). But at present there is no modern detailed descriptive account available for the Indian Pteridophytes. In view of the aforesaid reason and to fill the gap of knowledge the present work was taken up by the BSI.

Objectives: Revision and flora writing of selected families of Indian Pteridophytes

Methodology adopted: Classical Taxonomic, revisionary, and floristic approach which includes, collection, identification, documentation and flora writing.

Achievements including:

Total area covered : Entire India

Number of species identified (with name)/ Described: Description of c. 30 species was completed towards the Pteridophytic flora of India.

Number of species incorporated: 1479 Herbarium sheets of Pteridophytes.

Output indicators for the assessment of the project: Made the inventory of taxa for the allotted families and genera. Description of 30 species was completed under the project. In addition, reviewed 7 research papers and three project reports related to Indian Pteridophytes and filled up label information on 1600 mounted herbarium sheets of Pteridophytes and also Attended 8 (eight) online webinars, delivered three lectures during UGC refreshers course for University faculties.

Major impacts reported during the financial year: Description of 30 species was completed towards the Pteridophytic flora of India. Additionally, 7 species viz., *Huperzia pinifolia* Trevis., *Ophioglossum gomezianum* Welw. ex A. Braun, *Dennstaedtia smithii* (Hook.) T. Moore, *Arthromeris nigropaleacea* S.G. Lu, *Lepisorus tricholepis* K.H. Shing & Y.X. Lin, *Dennstaedtia smithii* (Hook.) T. Moore, *Katoellayunnanensis* (Christ) Fraser-Jenk. & Kholia reported as a New Record for India based on misidentification of earlier researchers. Besides, designated 2 Epitype, 19 Lectotype and one Neotype and published 6 of Pteridophytes. new combination of Indian Pteridophytes. Also a new species, *Pedicularis raghvendrae* (*Orobanchaceae*) was described based on Dr B.S. Kholia's collection from Sikkim.

PROJECT -3

Name of the Project : Flora of India Vol. 27 (Zingiberaceae)

Executing Scientist(s): Dr. S.K. Singh, Dr. Ramesh Kumar, Dr. Sameer Patil, Dr. Sachin Sharma

Duration of the project: 2020 – 2021

About the work done: Literature survey, herbarium survey and procurement of protologues of all the species of Zingiberaceae. Description writing of 152 species of genus *Zingiber*, *Curcuma*, *Amomum*, *Miestera*, *Wurfbania*, *Hedychium*, *Hellenia*, *Caulokaemferia*, *Cautleya*, *Elettaria*, *Etingera*, *Globba*. Morphological study of live specimens of Zingiberaceae conserved in BSI, NRC garden.

Introduction: Zingiberaceae is a tropical family of 57 genera consisting of c. 1700 species mostly concentrated in Indo-Malayan region. In India the family is represented by 21 genera harbouring c. 240 species. The members of the family can be found all across India in wild and also under cultivation, but the concentration of species is higher in Northeast and Southern India. The family is well known for its condiments and spices like ginger, turmeric, cardamom, etc. A modern comprehensive account of Zingiberaceae is lacking for the entire country. Therefore, a descriptive flora of Zingiberaceae of India is undertaken.

Literature: Listing and literature survey pertaining to members of Zingiberaceae in India done and consulted all the relevant literatures available the libraries of BSI, FRI and other institutions. Acquired protologues for all species belonging to 21 genera of Zingiberaceae. Preparation of standard species description format to maintain uniformity of work as per flora of India guidelines.

Objectives: Detailed description of all the known species of Zingiberaceae.

Site of the study (with map): Entire India.

Methodology adopted: Preparing the description of species pertaining to the available type and general herbarium specimens and other protologues. Providing distribution, phenology and nomenclature on the basis of herbarium details and previous publications. Updating the nomenclature of species as per the standard format provided by BSI, HQ.

Achievement including: Procurements of protologues of all species of Zingiberaceae. Description writing of 34 species of various genera.

Output indicators for the assessment of the project: Procurement of all available literature for complete study of all species. Preparation of character comparison table to assess differential analysis among the species. Completed description writing including, phenology, distribution and notes of 152 spp. various genera of Zingiberaceae.

Major impacts reported during the financial year: Completed description writing of 152 species. The project will be useful for further studies on plants of Zingiberaceae from applied point of view.

PROJECT-4

Name of the Project: Taxonomic Revision of genus *Taraxacum* in India

Executing Scientist(s): Dr. Sameer Patil and Dr. S.K. Singh

Duration of the project: 2020 – 2023

About the work done: Literature survey, herbarium survey and procurement of protologue of all Himalayan *Taraxacum* species. Study of protologue of each species and recorded its extent of distribution along Himalayan habitats. Study of herbarium specimens available at BSI, Dehradun. Procured herbarium specimens of *Taraxacum* from other circles of BSI for study purpose. Preparation of character comparison table for differential analysis and mathematical computation of Himalayan *Taraxacum* species. Study of procured protologues for morphological analysis and classification of species. Prepared character comparison table for 75 species to study computational analysis. Preparation of GIS and RS maps of 34 species on the basis of herbarium and published literature as a target for collection during field tour. SEM study of achenes of seven species of *Taraxacum* procured from duplicate herbarium of BSID. Description writing of seven species of *Taraxacum* of western Himalaya.

Objectives :(i) To define and classify c. 83 species of genus *Taraxacum* in India. (ii) To describe the species on the basis of morphological characters and provide a taxonomic key for identification (iii) To perform SEM study of capsules of *Taraxacum* species in India.

Methodology adopted: Literature study of available material. GIS mapping of the distribution of every species of *Taraxacum* in Indian Himalayan region. Collection of material through field collection tours. Confirming identity of collected material. Propagation of plants through seed collection for observing morphological variations. SEM study of achenes of collected plant material from field and also acquired from duplicate herbarium specimens. Characterization and classification of *Taraxacum* species.

New Methodology (if any) adopted: Preparation of probable distribution Ecological Niche Modelling maps of every species to target the exact location of occurrence for maximum positive results during collection.

Achievements including: Procurement of protologues of all Himalayan species of *Taraxacum* for morphological analysis. Collection of distribution and phonological data for preparing GIS maps for each species. Collection of achenes from duplicate herbarium for SEM analysis. Preparation of morphological characteristic comparison table for computational analysis. Preparation of GIS and RS maps of 34 species on the basis of herbarium and published literature as a target for collection during field tour. SEM study of achenes of seven species of *Taraxacum* procured from duplicate herbarium of BSID. Description writing of seven species of *Taraxacum* of western Himalaya.

Output indicators for the assessment of the project: Procurement of all available literature for complete study of all species. Preparation of character comparison table to assess differential analysis among the species. Collected material of achenes of *Taraxacum* from duplicate herbarium for SEM study. Compiled distribution and phonological data for GIS mapping of *Taraxacum* species. Study of all procured literature of all species. Prepared character comparison table to assess differential analysis among the species. Completed description writing including, phenology, distribution and notes of 7 species of *Taraxacum* on basis of protologues and herbarium specimens. Preparation of GIS maps of 34 species for understanding distribution of species and extracting maximum output during field collection. SEM study of seven species of *Taraxacum* seeds namely *T. officinale* F.H.Wigg., *T. leucanthum* (Ledeb.) Ledeb., *T. luridum* G.E.Haglund, *T. phoenicolepis* Soest, *T. eriopodum* DC., *T. elegans* Soest and *T.harbhajan-singhii* Soest.

Major impacts reported during the financial year: Preparation of distinguishable character classification table for the genus *Taraxacum*. Prepared GIS and RS based distribution mapping and analyzed altitudinal variation pattern through ENM of *Taraxacum* species in Western Himalayas. SEM study of seven species of *Taraxacum* achenes. This output will be useful for further applied studies on the genus.

PROJECT -5

Name of the Project: Scanning Electron Microscope (SEM) Study of Achenes of the genus *Ranunculus* L. and *Thalictrum* Tourn. ex L. in N-W Himalaya.

Executing Scientist (s): Dr. Purushottam Kumar Deroliya and Dr. S.K. Singh

Duration of the project: July 2020- September 2020

Introduction: Fruit (Achene) structure in Ranunculaceae is an important taxonomic parameter for the diagnosis both at generic level and species level often referred as Achenes and are very small. Due to small nature, they are difficult to observe the ornamentation through necked eyes. The microstructures borne by them are not clearly distinguishable through stereo zoom microscope. Thus, it is imperative to study this microstructure under Scanning Electron Microscope to provide additional taxonomic details of this primitive group of plant.

Objectives: To carried out ectodermal study of Achenes of the available taxa in BSD. Micro-photographing of the ultra-structure observed under SEM. Analyze the ultra-structure with reference to taxonomical acceptance of the primitive and complex taxa.

Site of the study (with map) : North-West Himalaya comprising the area of two states *viz.*, Himachal Pradesh, Uttarakhand and two union territories *viz.*, Jammu & Kashmir, Ladakh, lies in the northern part of India. It is ringed by Pakistan to the West, China to the North, China and Nepal to the East and covers an area of 3,27,200 KM² (Dhar & Samant, 1993), which is about 62% of Indian Himalayan Region and about 10% of total area of India.

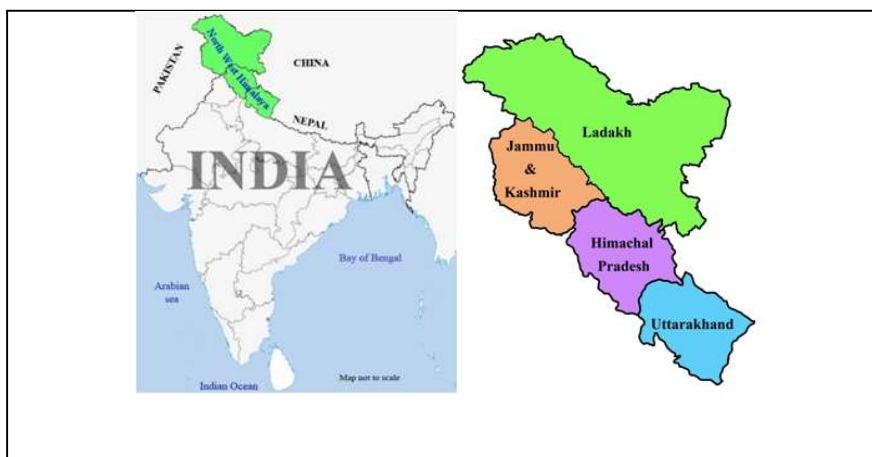


Fig.: Map of North-West Himalaya (map not to the scale)

Methodology adopted: Samples of achenes were collected from duplicate section of BSD herbarium and which were not available in duplicate those were taken carefully from the herbarium sheet. Collected achenes were washed and dipped in 90% Ethyl alcohol for 6 to 24 hours to remove fungal or other contamination, if contains. Washed achenes were kept in tissue papers for two to six hours in front of hot air blower for evaporation of alcohol. Before SEM study, all the samples were observed and imaged under dissecting microscope. After sputter coating the samples with gold-palladium by EMITECH SC7620 sputter coater, all SEM observations were made with a Zeiss EVO 18 Special Edition and digital microphotographs were taken. The terminology of surface sculpture was adopted after Stearn (1978). The terminology of surface sculpture was adopted after Stearn (1978) and Barthlott (1981).

Achievements including:

- a. **Total area covered:** North-West Himalaya
- b. **Number of species identified (with name):** 29 species

c. Number of species reincorporated:85 specimens

Output indicators for the assessment of the project: Total forty taxa (37 species and 3 varieties) of the genus *Ranunculus* and 20 species of *Thalictrum* were listed, reported from North-Western Himalayas in published literature. Of these, only 17 taxa of the genus *Ranunculus* and 12 species of the genus *Thalictrum* are available in BSD having achenes with the specimens and 4 species viz., *R. cymbalariae* Pursh, *R. lingua* L., *R. membranaceus* Royle, *R. uttaranchalensis* Pusalkar & D.K. Singh are without achenes. About 390 specimens of genus *Ranunculus* were scrutinized to select the appropriate samples of achenes of different species. Fifteen species of *Ranunculus* L. documented in respect of micro-morphological characters along with micro-photographing of the ultra-structure of achenes observed under the SEM have been completed including 1. *Ranunculus adoxifolius* Hand.-Mazz. [U.C. Bhattacharyya 52094; M.V. Viswanathan 54797; K. Chandra Sekar 103763], 2. *R. arvensis* L. [N.C. Nair 21825; 22038; B.P. Uniyal 80226; R.R. Rao & S. Kumar 81667; A.K. Goel 63819; N.P. Singh 25453], 3. *R. brotherusii* Freyn. [H.J. Chowdhery & B.P. Uniyal 86045; P.K. Hajra 74080], 4. *R. diffusus* DC. [U.C. Bhattacharyya 40434; Bipin Balodi 88872; J.N. Vohra 54379; T.A. Rao 7449; B.M. Wadhwa 57784; C.L. Malhotra 72594; B.P. Uniyal & M.S. Pundir 96923], 5. *R. distans* Wall. ex D. Don [J.P. Sharma 32591; U.C. Bhattacharyya 40367, 15002; Rajnikant & Kapil 131417; M. Sanjappa 110749; C.L. Malhotra 72581], 6. *R. hirtellus* Royle [N.C. Nair 16976; U.C. Bhattacharyya 45289; T.A. Rao 7703; P.K. Pusalkar 104270], 7. *R. hyperboreus* Rottb. [M.A. Rau 50224; P.K. Pusalkar 102260], 8. *R. lobatus* Jacquem. ex Cambess. [P.K. Pusalkar 103348], 9. *R. longicaulis* Ledeb. ex A. Spreng. [M.V. Viswanathan 54798; H.J. Chowdhery & B.P. Uniyal 85993], 10. *R. munroanus* J.R. Drumm. ex Dunn [H.J. Chowdhery & B.P. Uniyal 85921], 11. *R. muricatus* L. [O.P. Misra 45838; B.P. Uniyal 88594; R.R. Rao & S. Kumar 83559; B.P. Uniyal 93502, 79249], 12. *R. natans* C.A. Mey. [U.C. Bhattacharyya 51967, 45327], 13. *R. palmatifidus* H. Riedl. [K. Chandra Sekar 103650; B.P. Uniyal & Bipin Balodi 93962], 14. *R. pulchellus* C.A. Mey. [M.V. Viswanathan 54738; B.M. Wadhwa 59933], 15. *R. sceleratus* L. [B.P. Uniyal 80373; R.R. Rao & S. Kumar 83549; N.C. Nair 21990; U.C. Bhattacharyya 21125].

Major impacts reported during the financial year: Achenes of fourteen species of *Ranunculus* L. (mentioned above) were observed under SEM for the documentation of the micro-morphological characters along with micro-photographing of the ultra-structure. About 965 SEM micro-photographs were taken.

PROJECT -6

Name of the Project: Cytological studies in some selected chromosomally lesser-known/unknown plants and Liverworts from Botanic Garden of BSI, NRC, Dehradun, and adjoining areas.

Executing Scientist (s): Dr. Puneet Kumar and Dr. S. K. Singh

Duration of the project: July 2020-March 2021

About the work done: The total numbers of species collected for cytologically studies during this period are twenty, out of which meiotic/mitotic studies were done in eleven. In addition, cytologically material of *Lilium polyphyllum* D. Don ex Royle collected in previous year tour was also studied cytologically. The voucher specimens for all the cytologically studied species were identified. Material for cytological studies was collected of species namely, *Gentiana kurroo* Royle; *Cheilocostus speciosus* (J.König) C. Specht; *Costus pictus* D. Don and *Withania somnifera* (L.) Dunal., *Roscoea alpina* Royle (two floral variants purple and white) and *Roscoea purpurea* Sm; *Agrimonia eupatoria* L. (Rosaceae); *Boenninghausenia albiflora* (Hook.) Rehb. ex Meisn; *Catamixis baccharoides* Thomson; *Hedychium flavum* Roxb.; *Ipomoea nil* (L.) Roth; *Kaempferia parviflora* Wall. ex Baker; *Nervilia crocifformis* (Zoll. & Moritzi) Seidenf.; *Ophioglossum reticulatum* L.; *Pogostemon pumilus* (Graham); Press; *Rhynchoglossum notonianum* (Wall.) B.L. Burt; *Stephania glabra* (Roxb.) Miers; *Rhus punjabensis*, *Platanthera* sp. (Orchidaceae) and one species of family Liliaceae. Of these, desirable stages for counting the chromosome number were observed in eleven species (*Agrimonia eupatoria*, $2n=4x=56$; *Gentiana kurroo*, $2n=2x=26$; *Withania somnifera*, $2n=4x=48$; *Boenninghausenia albiflora*, $2n=2x=20$; *Hedychium flavum*, $2n=2x=34$; *Ipomoea nil*, $2n=2x=30$; *Kaempferia parviflora*, $2n=2x=22$; *Nervilia crocifformis*, $2n=4x=c$ 40; *Ophioglossum reticulatum*, $2n=21x=c$ 1260; *Pogostemon pumilus*, $2n=2x=32$; *Rhynchoglossum notonianum*, $2n=2x=20$; *Stephania glabra*, $2n=2x=26$; *Lilium polyphyllum* D. Don ex Royle ($2n=2x=24$)). *Alstonia venenata* R. Br.; *Asparagus racemosus* Willd.; *Bixa orellana* L.; *Frerea indica* Dalzell; *Ipomoea nil* (L.) Roth; *Ipomoea cairica* (L.) Sweet; *Oxalis latifolia* Kunth.; *Sophora mollis* (Royle) Graham ex Baker. *Globba orixensis* Roxb.; *Eulophia dabia* (D. Don) Hochr.; *Himalaiella heteromalla* (D. Don) Raab-Straube; *Christella papilio* (C. Hope) K. Iwats.; *Delphinium ajacis* L.; *Jasminum parkeri* Dunn; *Mahonia jaunsarensis*

Ahrendt; *Oxalis debilis* Kunth; *Papaver rhoeas* L.; *Persea odoratissima* (Nees) Kosterm.; *Phlomoidea superba* (Royle ex Benth.) Kamelin & Makhm.; *Physalis angulata* L.; *Physalis minima* L.; *Sophora mollis* (Royle) Baker; *Tricholepis roylei* Hook.f.; *Vitex negundo* var. *purpurascens* Sivar. & Moldenke and *Swertia* sp. Of these, desirable stages for counting the chromosome number could be found only in twenty species (*Alstonia venenata*, $2n=2x=22$; *Asparagus racemosus*, $2n=2x=22$; *Ipomoea nil*, $2n=2x=30$; *Sophora mollis*, $2n=2x=18$; *Eulophia dabia*, $2n=8x=28$; *Himalaiella heteromalla*, $2n=4x=32$; *Christella papilio*, $2n=2x=72$; *Delphinium ajacis*, $2n=2x=16$; *Jasminum parkeri*, $2n=2x=26$; *Mahonia jaunsarensis*, $2n=2x=28$; *Oxalis debilis*, $2n=4x=28$; *Papaver rhoeas*, $2n=2x=14$; *Persea odoratissima*, $2n=2x=24$; *Phlomoidea superba*, $2n=2x=22$; *Physalis angulata*, $2n=4x=28$; *Physalis minima*, $2n=4x=48$; *Tricholepis roylei*, $2n=4x=32$ and *Vitex negundo* var. *purpurascens*, $2n=4x=32$); Besides, cytologically material of *Aconitum heterophyllum* Wall. ex Royle, $2n=2x=16$; *Allium stracheyi* Baker, $2n=2x=16$; *Allium victorialis* L., $2n=2x=16$; *Astragalus melanostachys* Benth. ex Bunge, $2n=2x=12$; *Delphinium brunonianum* Royle, $2n=2x=16$ and *Hedysarum microcalyx* Baker, $2n=2x=14$ collected in previous year was also studied cytologically. In rest of the species desirable meiotic stages could not be obtained.

Introduction: Despite the fact that chromosome information can play vital role in solving taxonomic ambiguities, this important tool is still underutilized and no account of chromosome number in many endemic and threatened species is available till date.

Objectives: Collection of material for cytological studies. To determine the original chromosome number through male meiosis/mitosis. Depending on the availability of material, chromosome studies will be based on meiosis or mitosis, respectively. The meiotic behaviour and pollen fertility will be studied for each species. Aberrant genotypes/Morph-variants if found will be subjected to detailed cytological analysis.

Site of the study (with map): Botanic Garden of BSI, NRC, Dehradun, and adjoining areas.

Methodology adopted:

Sample collection -Material for cytological study was collected from the BSI, Botanic garden, adjoining areas and material collected during previous years tours was also studied.

Identification - Voucher specimens of the cytologically worked out species were identified by consulting the BSD Herbarium, other online Herbaria and relevant literature.

Cytological studies

Cytological preparations- The chromosome counts in each case were made through male meiotic/mitotic studies. Germinated radicles were used in the study of mitotic chromosomes. Radicles with appropriate length were pre-treated and subsequently fixed in Carnoy's solution for 24 h, transferred to 70% ethanol, and stored in a freezer. Slides were prepared by squashing the radicle tips in aceto-carmine stain. For the observation of meiotic chromosomes, the floral buds were also be fixed in Carnoy's solution for 24 h and transferred to 70% ethanol, and stored in a freezer. Cytological preparations were made by squashing the anthers in 1% acetic carmine. Meiotic preparations were made through standard cytological procedures. A number of freshly prepared slides were examined from each collection to determine the exact chromosome number. The cells in different phases of division (meiosis or mitosis) were observed and interpreted.

Karyotype analysis- For karyotype study, chromosome nomenclature of Levan, Fredgam & Sandberg (1964) was followed. Ideogram and karyotype parameters were determined using karyotype software (Altinordu, Peruzzi, Yu & He, 2016). The morphometric parameters calculated statistically are long arm length of chromosome (l), short arm length of chromosome (s), total chromosome length (c), arm ratio of chromosome (r) and centromeric index (Ci) and type of chromosome. The chromosome pairs were arranged in order of decreasing length.

Meiotic products (sporads and pollen grains) analysis- This was done to verify the normality of sporads and the viability of pollen grains. For sporad analysis, floral buds were squashed in 1% acetocarmine. PMCs/meiocytes were analysed at late telophase-II. Sporads were analysed and categorized on the basis of number of microspores units present in the meiocytes. Pollen fertility in all the cytologically investigated species was estimated through stainability tests.

Photomicrographs- Photomicrographs of chromosome counts, meiotic abnormalities, sporads, pollen grains, etc. were taken from the freshly prepared slides using Olympus-CX41 microscope fitted with digital camera. Important points of cytological interest regarding various meiotic irregularities were recorded and indicated by arrow/s in photomicrographs.

New Methodology (if any) adopted: Ideogram and karyotype parameters were determined using karyotype software.

Number of tours undertaken: Three one day local tours to Chakrata, Bhopalpani, Deoban, Mussoorie in Dehradun District.

Number of species collected: 20

Number of species identified (with name): 42 (*Gentiana kurroo* Royle; *Cheilocostus speciosus* (J.König) C. Specht; *Costus pictus* D.Don and *Withania somnifera* (L.) Dunal., *Roscoea alpine* Royle (two floral variants purple and white) and *Roscoea purpurea* Sm; *Agrimonia eupatoria* L. (Rosaceae); *Boenninghausenia albiflora* (Hook.) Rchb. ex Meisn; *Catamixis baccharoides* Thomson; *Hedychium flavum* Roxb.; *Ipomoea nil* (Linn.) Roth; *Kaempferia parviflora* Wall.ex Baker; *Nervilia crocififormis* (Zoll. & Moritz) Seidenf.; *Ophioglossum reticulatum* L.; *Pogostemon pumilus* (Graham); Press; *Rhynchoglossum notonianum* (Wall.) B.L. Burt; *Stephania glabra* (Roxb.) Miers; *Rhus punjabensis*, *Alstonia venenata* R. Br.; *Asparagus racemosus* Willd.; *Bixa orellana* L.; *Frerea indica* Dalzell; *Ipomoea nil* (L.) Roth; *Ipomoea cairica* (L.) Sweet; *Oxalis latifolia* Kunth.; *Sophora mollis* (Royle) Graham ex Baker. *Globba orixensis* Roxb.; *Eulophia dabia* (D.Don) Hochr.; *Himalaiella heteromalla* (D.Don) Raab-Straube; *Christella papilio* (C. Hope) K. Iwats.; *Delphinium ajacis* L.; *Jasminum parkeri* Dunn; *Mahonia jaunsarensis* Ahrendt; *Oxalis debilis* Kunth; *Papaver rhoeas* L.; *Persea odoratissima* (Nees) Kosterm.; *Phlomoides superba* (Royle ex Benth.) Kamelin & Makhm.; *Physalis angulata* L.; *Physalis minima* L.; *Sophora mollis* (Royle) Baker; *Tricholepis roylei* Hook.f. and *Vitex negundo* var. *purpurascens* Sivar. & Moldenke)

Number of species incorporated: Herbarium processing of all the cytologically studied voucher specimens is under progress.

Output indicators for the assessment of the project: Meiotic and mitotic studies, chromosome counts of threatened conserved species, their evolutionary significance. Twenty-five species studied cytologically. Of these, chromosome counts for two taxa namely, *Mahonia jaunsarensis*, and *Vitex negundo* var. *purpurascens* have been reported for the first time at worldwide level. In addition, chromosome count in *Jasminum parkeri* is recorded from India for the first time. First ever mitotic counts have also been made in two species. *Sophora mollis* (Royle) Baker has been studied cytologically for the first time from W. Himalaya, India. SEM has been used for the first time to study the surface features of pollen grains and seed in critically endangered, *L. polyphyllum*. SEM has also been used for the first time to study the surface features of pollen grains in endemic (South India) species, *Alstonia venenata* under ex-situ conservation in Botanic Garden of BSI, NRC, Dehradun. Ten species among these are either in threatened or endemic category. Cytological results add to current chromosome count database these species. The total numbers of species cytologically studied in this whole project are 37. These species are distributed among 34 genera, belonging to 24 families of dicots, monocots and ferns. Chromosome analysis showed that 70.27 % (26) species are polyploids (4x to 21x) while only 29.73 % (11) existed at diploid level. Basic chromosome number in studied taxa ranges between 6x to 36x. Aneuploidy is also very common among the taxa. From above analysis it is quite evident that polyploidy has played important role in the evolution these species.

Major impacts reported during the financial year: Eleven species studied cytologically and identified. Of these, chromosome counts for two species namely, *Catamixis baccharoides* and *Pogostemon pumilus* have been reported for the first time at worldwide level. In addition, first chromosome counts are also recorded from India in three species. Five species among these are either endemic or in threatened category. Cytological results add to current chromosome count database these species. The details are as following:

Chromosome count/s New to Science: 04

Mahonia jaunsarensis Ahrendt, $2n=2x=28$

Vitex negundo var. *purpurascens* Sivar. & Moldenke, $2n=4x=32$

Catamixis baccharoides Thomson, $2n=2x=34$

Pogostemon pumilus (Graham) Press, $2n=2x=32$

Chromosome count/s New to India: 04

Rhynchoglossum obliquum Blume, $2n=2x=20$

Stephania glabra (Roxb.) Miers, $2n=2x=26$

Kaempferia parviflora Wall.ex Baker, $2n=2x=22$

Jasminum parkeri Dunn, $2n=2x=26$

First ever mitotic counts : 02

Phlomooides superba (Royle ex Benth.) Kamelin & Makhm., $2n=2x=22$

Jasminum parkeri Dunn, $2n=2x=26$

Chromosome count/s New to western Himalaya: 01

Sophora mollis (Royle) Baker, $2n=2x=18$

First ever SEM based study in the species: 02

Alstonia venenata R. Br.

Lilium polyphyllum D. Don ex Royle

Threatened species studied: 15

Catamixis baccharoides Thomson (CR)

Gentiana kurroo Royle (CR)

Kaempferia parviflora Wall.ex Baker

Lilium polyphyllum D. Don ex Royle (CR)

Nervilia crocifformis (Zoll. & Moritzi) Seidenf.(CITES)

Aconitum heterophyllum Wall. ex Royle (CR)

Allium stracheyi Baker

Alstonia venenata R. Br.

Eulophia dabia (D.Don) Hochr (CITES)

Hedysarum microcalyx Baker

Jasminum parkeri Dunn (Point endemic)

Mahonia jaunsarensis Ahrendt (Endemic to Jaunsar)

Phlomooides superba (Royle ex Benth.) Kamelin & Makhm.

Sophora mollis (Royle) Baker

Tricholepis roylei Hook.f. (Point endemic)

RESEARCH PUBLICATIONS

Book published-01; Papers published-24; papers communicated-01

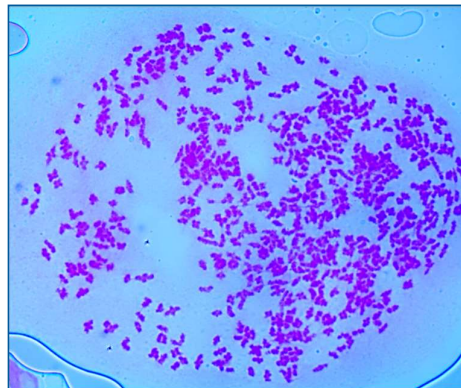


Figure 1. *Ophioglossum reticulatum* L., $n=c$ 630II at Metaphase-I.



Figure 2. *Gentiana kurroo* RoyleL., $n=13\text{II}$ at Diakinesis.

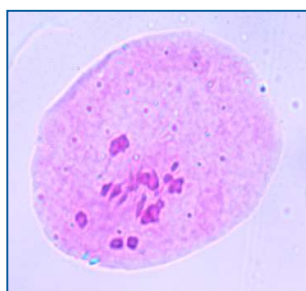


Figure 3. *Pogostemon pumilus* (Graham) Press, $n= 16\text{II}$ at Metaphase-I.

PROJECT 07

Name of the Project: Ethnobotanical study of Tharu and Bhoxa tribe of Uttarakhand, India

Executing Scientist (s): Dr. Harish Singh

Duration of the project: April 2020 to March, 2023

About the work done :

Introduction: Uttarakhand is an ideal State from ethnobotanical point of view, as rich in floristic as well as in ethnic diversity with varied climate zone. The State is inhabited by 5 tribal groups namely Tharu, Bhoxa, Bhotia, Jaunsari, and Raji. Only Bhoxa and Tharu tribe are residing in sub-Himalayan tract (*Terai*, *Bhabar* and plain area) of Uttarakhand. Through scrutiny of literature, it is found, more than 400 research papers/ articles/ books have been already published on various aspects of Ethnobotany of Himalayan region of Uttarakhand but only few papers have been published on Ethnobotany of Tharu, Bhoxa and indigenous people of *Terai*, *Bhabar* and plain area of Uttarakhand. Hence, it was proposed to collect all the traditional knowledge on utilization of plants from the Tharu, Bhoxa and indigenous people of sub-Himalayan tract (Udham Singh Nagar, Dehradun and Pauri districts) of Uttarakhand before their complete extinction through extensive field survey as well as from literature survey.

Objectives: Folklore survey and field work in the Tharu, Bhoxa and indigenous populated areas and nearby forests of the state. Collection and identification of plants and plant products used by them for various purposes. Documentation of traditional knowledge about utilization of plants and preparation of inventories of folklore plants. Germplasm collection of rare and important ethnobotanical plants to develop small-scale ethnobotanical garden for *ex-situ* conservation point of view. Survey of countryside socio-religious fairs and festivals for collection of little or unknown ethnobotanical specimens/ items /artifacts /handicrafts that may enrich the ethno-museum of BSI, NRC, Dehradun.

Site of the study (with map) :



Methodology adopted: A Hand Book of Ethnobotany (Jain & Mudgal, 1999) used for ethnobotanical data collection methodology. Dictionary of Folk medicine and Ethnobotany (Jain, 1991); Compendium of Indian Folk medicine and Ethnobotany (Jain & Jain 2017) mostly consulted for comparative study. Conventional methodology applied for collection and preservation of plant specimens. Various website such as www.ipni.org, www.tropicos.org, www.plantlist.org, were used for updating the validity of the plant names.

New Methodology (if any) adopted: Added Prior Informed Consent (PIC) form and New Ethnobotanical herbarium label.

Work done:

Total area covered : About 1545 sq.km

Number of tours undertaken : Three local field tours in Dehradun district among Bhoja tribe and collected 112 field numbers (in duplicate) along with 160 ethnobotanical uses. Another field tour was conducted among Tharu tribe in Udham Singh Nagar district from 08-03-21 to 14-03-21 and collected 168 field numbers (in duplicate) with 206 ethnobotanical uses.

Number of species collected : 284 field numbers with ethnobotanical uses

Number of species identified (with name): 96 (*Spilanthes acmella* (L.) L., *Bacopa monnieri* (L.) Wettst., *Cissus repanda* (Wight & Arn.) Vahl, *Cannabis sativa* L., *Solanum americanum* Mill., *Cissampelos pariera* L., *Scoparia dulcis* L., *Vitex negundo* L., *Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm., *Senna tora* (L.) Roxb. *Bauhinia semla* Wonderlin, *Calliandra haematocephala* Hassk., *Justicia adhatoda* L., *Glycosmis pentaphylla* (retz.) DC., *Solanum mauritianum* Scop., *Clerodendrum infortunatum* L., *Murraya koenigii* (L.) Spreng., *Litsea glutinosa* Lour.C.B. Robins., *Sida acuta* Burm.f., *Solanum violaceum* Ortega, *Solanum viarum* L., *Datura metel* L., *Senna tora* (L.) Roxb., *Senna occidentalis* (L.) Link, *Cissampelos pareira* L., *Achyranthes aspara* L., *Rubus niveus* Thunb., *Baliospermum solanifolium* (Burm.) Suresh, *Curculigo orchioides* Gaertn., *Mallotus philippensis* (Lam.) Muell.Arg., *Plumbago zeylanica* L., *Ehretia laevis* Roxb., *Ageratum conyzoides* (L.) L., *Flacourtia jangomas* (Lour.) Raeush., *Dioscorea belophylla* (Prain) Voigt ex Haines, *Carissa carandas* L., *Drimia indica* (Roxb.) Jessop, *Lantana camara* L., *Flemingia chapper* Benth., *Porana paniculata* Roxb., *Ardisia solanacea* (Poir.) Roxb., *Naringi crenulata* (Roxb.) Nicolson, *Abrus pulchellus* Thwaites, *Asparagus racemosus* Willd., *Syzygium cumini* (L.) Skeels, *Holoptelia integrifolia* Planch, *Shorea robusta* Gaertn., *Holarrhena pubescens* Wall. ex G.Don, *Terminalia chebula* Retz., *Colebrookea oppositifolia* Sm., *Dendrocalamus strictus* (Roxb.) Nees, *Ficus racemosa* L., *Urtica dioica* L., *Ricinus communis* L., *Morus alba* L., *Bauhinia variegata* L., *Rumex nepalensis* Spreng., *Vallisneria spiralis* (L.) L., *Calotropis gigantea* (L.) Dryand., *Arundo donax* L., *Bryophyllum pinnatum* (Lam.) Oken, *Nyctanthes arbor-tristis* L., *Ficus palmata* Forssk., *Dysphania ambrosioides* (L.) Mosyakin & Clemants, *Hemdesmus indicus* (L.) R.Br. ex Schult, *Spilanthes acmella* (L.) L., *Bacopa monnieri* (L.) Wettst., *Cissus repanda* (Wight & Arn.) Vahl, *Cannabis sativa* L.,

Solanum americanum Mill., *Cissampelos pariera* L., *Scoparia dulcis* L. *Vitex negundo* L., *Terminalia bellirica* (Gaertn.) Roxb., *Achyranthes aspera* L., *Jatropha curcas* L., *Bauhinia vahlii* Wight & Arn., *Toona ciliata* M.Roem., *Hyptis suaveolens* (L.) Poit., *Ipomoea carnea* Jacq., *Murraya koenigii* (L.) Spreng, *Clematis gouriana* Roxb. ex DC., *Capsella bursa-pastoris* (L.) Medik., *Vitex negundo* L., *Woodfordia fruticosa* (L.) Kurz, *Tridax procumbens* (L.) L., *Ziziphus nummularia* (Burm.f.) Wight & Arn., *Solanum americanum* Mill., *Ficus religiosa* L., *Eriophorum comosum* (Wall.) Nees, *Dalbergiasissoo* DC., *Grewia optiva* J.R.Drumm. ex Burret, *Tinospora sinensis* (Lour.) Merr., *Tinospora sinensis* (Lour.) Merr., *Justicia adhatoda* L., *Ficus racemosa* L., *Ageratum conyzoides* (L.) L., *Carissa carandas* L., *Ricinus communis* L.).

Number of species incorporated : 95

Output indicators for the assessment of the project: Total 366 ethnomedicinal formulations were recorded during tours, serves as a base line data for further research activities by pharma companies.

Major impacts reported during the financial year: These ethnobotanical species and their traditional uses may be used as base line data for the formulation of drug to pharma as well as nutraceutical companies.

PROJECT 08

Name of the Project: *Ex-situ* conservation of endemic threatened and economic plant species in the associated garden of NRC and documentation of monthly data on flowering and fruiting

Executing Scientists: Dr. S.K. Singh, Dr. Puneet Kumar & Dr. Purushottam Kumar Deroliya

Duration of the project: On-going

About the Work done:

Objectives: Collection tours, introduction and subsequent maintainace of endemic, threatened and economic plant species in the Boranic Gardens.

Achievements: One day tour conducted to Mussoorie and adjoining areas on 10.07.2020. Species collected and introduced in the garden are *Incarvillea emodi* (Royle ex Lindl.). Conducted one day field tour to Asan barrage and Karwapani swamp on 01.08.2020 and collected *Vallisineria spirallis* L.; *Azolla pinnata* R. Br.; *Marsdenia roylei* Wight and *Potamogeton crispus* L. In addition, maintained the existing collection in the Botanic Garden under ex situ conservation. About 900 plants 25 species of endemic, threatened and economic plant specie snamely, *Indopiptadenia oudhensis* (Brandis) Brenan; *Prunus cerasoides* D.Don; *Musa velutina* H. Wendl. & Drude; *Quercus leucotrichophora* A. Camus ex Bahadur; *Sophora mollis* (Royle) Baker.; *Terminellia arjuna* (Roxb.) Wight & Arn.; *Acer oblongum* Wall.ex DC.; *Livistonia chinensis* R.Br.; *Artabotrys hexapetala* (L. f.) Bhandari; *Tetrapana papyrifera* (Hook.) K.Koch; *Agathis robusta* (C. Moore ex F. Muell.) F.M. Bailey; *Tinospora sinensis*(Lour.) Merr.; *Cinnamomum camphora* (L.) J. Presl; *Terminellia chebula* (Retz.) Gaertn.; *Chlorophytum cosmosum* (Thunb.) Jacques; *Piper* sp.; *Vitis vinifera* L.; *Musa rubra* Wall. ex Kurz; *Mentha piperita* L.; *Bauhinia tomentosa* L.; *Ephedra foliate* Boiss. ex C.A.Mey.; *Terminellia elliptica* Willdenow; *Cymbopogon flexuosus* (Nees ex Steud.) J.F. Watson; *Dioscorea alata* L.; *Stevia rebaudiana* (Bertoni) Bertoni; *Cinnamomum zelanicum* Blume propagated in the garden were sent to BGIR Noida on 08.07.2020. Phenological data April [Flowering (Fl.) 28; Fruiting (FR.) 11], May [Fl 28; FR 26], June [F22; FR 17], July [Fl 22; FR 26], August [Fl 25; FR 22], September [Fl 25; FR 23]. Two tours conducted to Gopeshwar (25.02.2021) and Nakraunda swamp (16.9.2020) collected some RET species namely *Cymbidium iridifolium* Roxb.; *Cymbidium iridioides* D.Don; *Dendrobium monticola* P.F.Hunt & Summerh.; *Dendrobium crepidatum* Lindl. & Paxton; *Dendrobium christyanum* Rchb.f.; *Dactylorhiza hatagirea* (D.Don) Soó; *Coelogyne cristata* Lindl.; *Bulbophyllum umbellatum* Lindl.; *Bulbophyllum cardiophyllum* J. J. Verm.; *Oreorchis indica* (Lindl.) Hook.f.; *Zeuxine flava* (Wall. ex Lindl.) Trimen; *Cyathea spinulosa* Wall.ex Hook.; *Potentilla anserina* L., *Acorus calamus* L.; *Bacopa monnieri* (L.) Wettst; *Calamus tenuis* Roxb; *Equisetum ramosissimum* Desf.; *Talinum fruticosum* (L.) Juss. And *Talinum portulacifolium* (Forsk.) Aschers. ex Schweinf. and introduced in Botanical garden. In addition of this collected some other plans and introduced in the Botanical Garden namely *Eria alba* Lindl.; *Rhododendron* 02 sp.; *Eiria* sp; *Celtis australis* L.; *Skimmia anquetilia* N. P. Taylor & Airy Shaw; *Madhuca butyracea* (Roxb.) J.F.Macbr.; *Selaginella* sp. In addition, maintained the existing collection in the Botanic Garden under ex situ conservation. About 200 plants of endemic, threatened and economic plant species namely, *Terminalia elliptica* Willd.; *Cinnamomum camphora* (L.) J.Presl; *Elaeocarpus lacunosus* Wall.ex Kurz; *Indopiptadenia oudhensis* (Brandis) Brenan propagated in the garden were

distributed to local people on the occasion of Ozone Day, 16.09.2020. Phenological data: October [Fl 27; FR 19], November [Fl 21; FR 27], December [Fl 10; FR 19], January [Fl 18; FR 28], February [Fl 21; FR 27], March [Fl 40; FR 24].

Output indicators for the assessment of the project: The best method of maximizing a species chance of survival is by relocating part of the population to a less threatened location. Conservation and management of endemic threatened and economically important targeted species introduced in the garden. Regular recording of the phenological data has been done for conserved species

Major impact reported during the financial year: Display of endemic, threatened and economically important plants species to researchers and students from various Universities, Institutes and stakeholders which may otherwise not possible. Species which are facing threat of declining population in natural habitat and endangered species are successfully conserved. Propagation of such species and their subsequent rehabilitation in the natural habitats and distribution to various stakeholders is possible through such conservation efforts. It is extremely useful for conducting research and scientific work on different species available at Botanic Gardens under Ex-situ conservation.

PROJECT 09

Name of the Project: In vitro mass multiplication and propagation and rehabilitation in natural habitat of useful and threatened species of North-West Himalaya.

Executing Scientist (s): Dr. Giriraj Singh Panwar & Dr. Bhavana Joshi

Duration of the project: 2020-2023

About the work done:

Objectives: Collection of explants/plant propagules (seed, live plants or plant parts) from the wild population. Standardization of micropropagation protocol for the selected species by direct and indirect organogenesis methods using different explants such as shoot tip, nodal segment, axillary bud, young leaves and other meristematic tissues. Hardening of plantlets in the green house/net house and shifting of acclimatized plants to the open environment as well as field.

Methodology adopted: The standard methodology and procedures were adopted for performing the in vitro experiments in the selected species. Seeds were collected of all the species from their respective wild localities and were used for the development of in vitro aseptic cultures. Further organogenesis was performed in the optimal mediums supplemented with optimized plant growth regulators concentrations. Plantlets were acclimatized in the glass house and net house for proper acclimatization and finally shifted to the open environment. New Methodology (if any) adopted: NA

Output indicators for the assessment of the project: Micropropagation protocols were standardized for the endemic and endangered species viz. *Eulophia dabia*, *Nepenthes khasiana* and *Rhynchosyilis retusa*. All the three species were successfully established to the open environment and saplings of *E. dabia* were also provided to the forest Department of Uttarakhand.

Major impacts reported during the financial year: Micropropagation protocols were standardized for the three threatened species viz. *Eulophia dabia*, *N. Khasiana* and *Rhynchosyilis retusa*. Flowering was also reported in the *E. dabia* plants transferred to the open environment. Seeds of *Zanthoxylum armatum*, *Cyathea spinulosa*, *Trachycarpus takil* and *Mezotropis pellita* were collected from the wild and experimental botanical Garden. Seeds of the above mentioned species were inoculated onto basal MS medium for the in vitro germination. Seeds of *Zanthoxylum armatum* and *Mezotropis pellita* were also sown in soil for the ex-vitro germination. Shoot tip and nodal segment explants of *Malaxix acuminata*, *Dendrobium crepidatum*, *Magnolia kisopa* and *Zanthoxylum armatum* were inoculated into MS medium supplemented with different concentration of plant growth regulators.

15. SIKKIM HIMALAYAN REGIONAL CENTRE, GANGTOK

PROJECT-1

Flora of India Vol. 27 (Agavaceae-Zingiberaceae)

Name of executing officer: Dr. Rajib Gogoi (Team Leader), Scientist-E, Dr. J.H. Franklin, Scientist-C, Dr. Mahua Pal, Botanist & Dr. B.K. Singh, Botanist

Duration of the project: July, 2019 to December, 2020

Achievements: Final manuscript is completed.

Output indicators for the assessment of the project: Standard plant taxonomic principles and classical tools, implementation of rules and recommendations of International Code of Nomenclature for algae, fungi, and plants, specifically the Shenzhen Code.

Major impacts reported during the financial year: After completion of 'Flora of India' project, a comprehensive account of the families, genera and species will be available to the country with the help of which anyone can access the current status and abundance of taxa. It will help Forest department for implementation of working plan.

PROJECT-2

Flora of India Vol. 28 (Juncaceae, Juncaginaceae)

Name of executing officer: Dr. Rajib Gogoi, Scientist-E

Duration of the project: July, 2019 to December, 2020

Achievements: The final manuscript on family Juncaceae containing nomenclatural citation, descriptions, phenology, distribution of 02 genera, 57 species & 02 varieties depicting some selected species in 33 coloured photoplates and the family Juncaginaceae containing 01 genera and 02 species and 02 colored photoplates has been finalized and submitted to Team leader..

Output indicators for the assessment of the project: Standard plant taxonomic principles and classical tools, implementation of rules and recommendations of International Code of Nomenclature for algae, fungi, and plants, specifically the Shenzhen Code.

Major impacts reported during the financial year: After completion of 'Flora of India' project, a comprehensive account of the families, genera and species will be available to the country with the help of which anyone can access the current status and abundance of taxa. It will help Forest department for implementation of working plan.

PROJECT-3

Flora of India Vol. 25 [Hydrocharitaceae, Burmanniaceae and Orchidaceae (in part)] & vol. 26 [Orchidaceae (remaining part)]

Name of executing officer (s): Dr. D.K. Agrawala (Team Leader); Dr. J.S. Jalal, Dr. Chaya Deori, Dr. Avishek Bhattacharjee

Duration of the project: April, 2019 to December, 2020

Achievements: The data received from team members were compiled and manuscript comprising of treatment of c. 1285 taxa in three families was finalized. During this study, excluded *Nephelaphyllum pulchrum* Blume from India by identifying all earlier report of this species from India as *Nephelaphyllum sikkimensis* (Hook.f.) Karthik.; excluded *Epipactis gigantea* Douglas ex Hook.f. from India by identifying all earlier reports of this species to *Epipactis royleana* Lindl., *Epigeneium arunachalense* A.N. Rao and *Dendrobium nageswaryanum* K. Chowlu were reduced to synonymy of *Epigeneium fargesii* (Finet) Gagnep. The report of *Epigeneium chapaense* Gagnep. from India has also been identified as *Epigeneium fargesii*, *Nervilia gleadowii* A.N. Rao and *Nervilia hispida* Blatt. & McCann were reduced as taxonomic synonyms of *Nervilia concolor* (Blume) Schltr., *Ascocentrum semiteretifolium* reported from India was reidentified as *Holcoglossum nagalandensis*. *Ascocentrum curvifolium* and *Chiloschista lunifera* were excluded, *Cleisocentron neglectum* is reduced as synonym under *Robiquetia rosea*, *Taeniophyllum arunachalense* is synonymized under *Taeniophyllum retrospiculatum*, *Vanda stangeana* is reduced as synonym under

Vanda bicolor. *Vanda bensonii* has been excluded from India, *Liparis chungthangensis* has been reduced under *Liparis cathcartii*. *Liparis platyphylla* has been reduced under *Liparis deflexa*. *Liparis beddomei* has been excluded from India and *Thrixspermum indicum* has been reduced under *Thrixspermum crassilabre*.

Output indicators for the assessment of the project: Implementation of ‘Style Manual for Flora of India’ published by BSI in 1980 along with subsequent and required modifications made time to time. Standardization of nomenclature as per the latest ICN (Turland et al, 2018) and the names of authors, journals and books have been abbreviated as per IPNI, Brummit & Powell (1992), B.P.H. and TL-2 respectively.

Major impacts reported during the financial year: After completion of ‘Flora of India’ project, a comprehensive account of the families, genera and species will be available to the country with the help of which anyone can access the current status and abundance of taxa. It will help Forest department for implementation of working plan.

Research and developmental activities:

1. Ex – Situ Conservation in the Botanical Garden:

| Name of the Garden | Number of tour conducted | Total no. of species collected, <u>introduced</u> and maintained | Name and number of species collected, introduced and maintained | | |
|--------------------------|---|---|---|-------------------------------|------------|
| | | | Rare/threatened | Medicinal/economic importance | Ornamental |
| BSI campus garden | 1 One local tour conducted on 12-09-2020 | Dr. Rajib Gogoi Supervised the day to day activities of plantation and nurturing of the plants in Garden of SHRC. <i>Ginkgo biloba</i> L., <i>Trachycarpus fortunei</i> (Hook.) H.Wendl., <i>Asparagus</i> sp., <i>Paris polyphylla</i> Sm., <i>Agapetes serpens</i> (Wight) Sleumer, <i>Aloe vera</i> (L.) Burm.f., <i>Zantedeschia aethiopica</i> (L.) Spreng., <i>Polygonatum</i> spp., <i>Rohdeanepalensis</i> (Raf.) N.Tanaka, <i>Aeschynanthus gracilis</i> C.S.P.Parish ex C.B.Clarke, <i>Viola pilosa</i> Blume, <i>Elatostemansutum</i> Hook.f., <i>Valeriana jatamansi</i> Jones ex Roxb., <i>Wallichia oblongifolia</i> Griff., <i>Houttuynia cordata</i> Thunb., <i>Hypericum uralum</i> Buch.-Ham. ex D.Don, <i>Impatiens cathcartii</i> Hook.f., <i>Astilbe rivularis</i> Buch.-Ham. ex D.Don, <i>Cannabis sativa</i> L., | - | - | - |

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|--|--|--|--|--|--|
| | | <p><i>Lyonia ovalifolia</i> (Wall.) Drude</p> <p>Along with the above two nursery beds were raised with the shoot cuttings of <i>Cephalotaxus griffithii</i> Hook .f. & <i>Camellia japonica</i> L.</p> <p><i>Rhododendron griffithianum</i> Wight, <i>Rhododendron maddenii</i> Hook.f., <i>Rhododendron grande</i> Wight & <i>Prunus cerasoides</i> Buch.-Ham. ex D. Don</p> <p>Rescued ca. 10 spp. Of Orchids from the tree cutting sites due to smart city project in Gangtok and planted in BSI, Garden. Planted the following:</p> <ol style="list-style-type: none"> 1. <i>Rhododendron triflorum</i> Hook.f. (Ericaceae) 2. <i>Magnolia globosa</i> Hook.f. & Thomson (Magnoliaceae) <p><u>Live Plants collected for Ex-situ Conservation</u></p> <ol style="list-style-type: none"> 1. <i>Anisadenia saxatilis</i> Wall. ex Meissn [LINACEAE] 2. <i>Elatostema dissectum</i> Wedd. [URTICACEAE] 3. <i>Elatostema hookerianum</i> Wedd. [URTICACEAE] 4. <i>Elatostema lineolatum</i> Wight [URTICACEAE] 5. <i>Elatostema</i> spp. [URTICACEAE] 6. <i>Gaultheria nummularioides</i> D. Don [ERICACEAE] 7. <i>Gaultheria</i> spp. [ERICACEAE] 8. <i>Impatiens pradhanii</i> H. Hara [BALSAMINACEAE] 9. <i>Leycesteria gracilis</i> (Kurz) Airy Shaw [CAPRIFOLICAEAE] 10. <i>Loxostigma griffithii</i> (Wight) C.B. Clarke [GESNERIACEAE] | | | |
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|--|--|--|--|--|--|
| | | <p>11. <i>Mazus dentatus</i> Wall. ex Benth. [SCROPHULARIACEAE]</p> <p>12. <i>Rhododendron camelliflorum</i> Hook.f. [ERICACEAE]</p> <p>13. <i>Rhododendron dalhousiae</i> Hook.f. [ERICACEAE]</p> <p>14. <i>Rhododendron edgeworthii</i> Hook.f. [ERICACEAE]</p> <p>15. <i>Rhododendron triflorum</i> Hook.f. [ERICACEAE]</p> <p>16. <i>Rhododendron vaccinioides</i> Hook.f. [ERICACEAE]</p> <p>17. <i>Rubus wardii</i> Merr. [ROSACEAE]</p> <p>18. <i>Salix</i> spp. [SALICACEAE]</p> <p>19. <i>Strobilanthes helicta</i> T. Anderson [ACANTHACEAE]</p> <p>20. <i>Strobilanthes</i> spp. [ACANTHACEAE]</p> <p>21. <i>Vaccinium retusum</i> (Griff.) Hook.f. ex C.B. Clarke [ERICACEAE].</p> <p>1. <i>Anthogonium gracile</i> Wall. ex Lindl. [ORCHIDACEAE]</p> <p>2. <i>Begonia megaptera</i> D. Don [BEGONIACEAE]</p> <p>3. <i>Citrus medica</i> L. [RUTACEAE]</p> <p>4. <i>Clerodendrum colebrookianum</i> Walp. [VERBENACEAE]</p> <p>5. <i>Daphne sureii</i> W.W. Sm. & Cave [THYMELAEACEAE]</p> <p>6. <i>Elatostema integrifolium</i> (D. Don) Wedd. [URTICACEAE]</p> <p>7. <i>Elatostema</i> spp. [URTICACEAE]</p> <p>8. <i>Elatostema</i> spp. [URTICACEAE]</p> <p>9. <i>Elatostema</i> spp. [URTICACEAE]</p> <p>10. <i>Impatiens decipiens</i> Hook.f.</p> | | | |
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| | | [BALSAMINACEAE] 11. <i>Impatiens jurpia</i> Buch.-Ham. [BALSAMINACEAE] 12. <i>Piper pedicellatum</i> C.DC. [PIPERACEAE] 13. <i>Luculia gratissima</i> (Wall.) Sweet. [RUBIACEAE]- 9 saplings 14. <i>Begonia palmata</i> D. Don [BEGONIACEAE]- 2 individuals 15. <i>Elatostema</i> spp. [URTICACEAE]- 1 individual | | | |
|--|--|--|--|--|--|

2. Publications:

a. Research Based Publication:

| Circle/ Unit/ Local Offices | No. of papers and abstract published | | No. of papers & abstracts accepted/communicated | | Number of books published | | | No. of articles published | | |
|--------------------------------------|--------------------------------------|-----------------|---|-----------------|---------------------------|---------|-------------------|---------------------------|---------|-------------------|
| | Indian Journal | Foreign Journal | Indian Journal | Foreign Journal | Hindi | English | Regional Language | Hindi | English | Regional Language |
| SHRC, Gangtok | 5 | 8 | 2 + 7 abstracts | 1 | - | - | - | - | - | - |

b. Details of Research Publications in Journals and Books etc of all scientists (Alphabetically as per the format of *Nelumbo* Journal):

Papers presented in conference/ symposium/ Abstract published:

| Authors Name | Title |
|--|---|
| 1. D.K. Agrawala, J.S. Jalal, C. Deori, A. Bhattacharjee. | Taxonomic studies on Indian Orchidaceae. Communicated for presentation during the national conference cum workshop on “Interdisciplinary approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally important Orchids” to be held at BSI, ERC Shillong on 5-6 March 2021 |
| 2. Oindrila Chakraborty, D.K. Agrawala, J.S. Jalal, C. Deori & A. Bhattacharjee. | Taxonomic studies on the genus <i>Stereochilus</i> Lindl. (Orchidaceae) in India. Communicated for presentation during the national conference cum workshop on “Interdisciplinary approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally important Orchids” to be held at BSI, ERC Shillong on 5-6 March 2021 |
| 3. Rijupalika Roy, D.K. Agrawala, J.S. Jalal, C. | <i>Galeola</i> Lour. (Orchidaceae) – A myco-heterotrophic genus in India. Communicated for presentation during the national conference cum workshop on “Interdisciplinary approaches to Taxonomy, Conservation and Economic |

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|--|---|
| Deori, A. Bhattacharjee | Utilization of Floriculturally and Medicinally important Orchids” to be held at BSI, ERC Shillong on 5-6 March 2021. |
| 4. Shreyasi Nayak, D.K. Agrawala, J.S. Jalal, C. Deori, A. Bhattacharjee. | Notes on the <i>Bulbophyllumodoratissimum</i> complex in India. Communicated for presentation during the national conference cum workshop on “Interdisciplinary approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally important Orchids” to be held at BSI, ERC Shillong on 5-6 March 2021. |
| 5. Sanchayita Sengupta, D.K. Agrawala, J.S. Jalal, C. Deori, A. Bhattacharjee. | Species with confusing identity within the genus <i>Phalaenopsis</i> Blume (Orchidaceae) in India. Communicated for presentation during the national conference cum workshop on “Interdisciplinary approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally important Orchids” to be held at BSI, ERC Shillong on 5-6 March 2021. |
| 6. Sayak Chakraborty, D.K. Agrawala, J.S. Jalal, C. Deori, A. Bhattacharjee. | The Genus <i>Epipactis</i> Zinn (Orchidaceae) in India. Communicated for presentation during the national conference cum workshop on “Interdisciplinary approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally important Orchids” to be held at BSI, ERC Shillong on 5-6 March 2021. |
| 7. Shuvadip Sarkar, D. K. Agrawala, J.S. Jalal, C. Deori, A. Bhattacharjee. | Taxonomic studies on the genus <i>Acanthephippium</i> Blume (Orchidaceae) in India. Communicated for presentation during the national conference cum workshop on “Interdisciplinary approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally important Orchids” to be held at BSI, ERC Shillong on 5-6 March 2021. |

Paper reviewed by Dr. Rajib Gogoi:

1. "Ethno-medicinally significant edible wild fruits of Sikkim Himalaya, Journal of Advanced Plant Sciences
2. A new species *Impatiens* L. (Balsaminaceae) from Kodaikkanal Wildlife sanctuary, India" for the Taiwania., Taiwania
3. A new species of *Impatiens* (Balsaminaceae) and rediscovery of *Impatiens aliciae* from the Western Ghats of India", Taiwania
4. Additional notes on *Impatiens* (Balsaminaceae) from Yunnan, China for the Journal Phytokeys.
5. Conservation and Management of Plant Bioresources by the Tai Phake of Assam: Role of Home Garden and Monastery” for of 'Botanical Society of Assam'.Journal Of Advanced Plant Sciences
6. Ethno-medicinally significant edible wild fruits of Sikkim Himalaya., Journal Of Advanced Plant Sciences
7. *Impatiens cathcartii* var. *ravikumreana* (Balsaminaceae) a new variety from Arunachal Pradesh, India, Phytotaxa
8. *Impatiens jacobdevlasi*, a new species and rediscovery of *I. subcordata* (Balsaminaceae) from Central highlands of Sri Lanka”. Phytotaxa
9. *Impatiens maheswarii* (Balsaminaceae), a new species from Northeast India, Phytotaxa.
10. *Impatienssikkimensis* (Balsaminaceae), a New Record for the Flora of Bhutan.Nelumbo
11. *Impatiens tajoensis* (Balsaminaceae) a new species from Arunachal Pradesh, India., Phytotaxa
12. *Impatiens viridiauriculata* - A new species from southern Western Ghats of Tamil Nadu, India., Nordic J. Botany
13. *Impatiens yunlingensis* (Balsaminaceae), a new species from Yunnan, China , Systematic Botany

Paper reviewed by Dr. D.K. Agrawala:

1. Rediscovery of *Monomeriabarbata* Lindl. (1830) in northeast India after 125 years and a note on its transfer to *Bulbophyllumcrabro* (C.S.P. Parish & Rchb.f.) J.J. Verm. Schuit. & de Vogel (2014). Nelumbo.
2. Notes on the identity of wild *Strophanthus* species (Apocynaceae) in India. Nelumbo.
3. New distributional record of *Gastrochilusaffinis* (King & Pantl.) Schltr. (Orchidaceae) from Western Himalaya with notes on a new synonym and typification.
4. *Bulbophyllumraskotii* (Orchidaceae): an addition to the Orchid flora of India
5. *Habenariareniformis* (D. Don) Hook.f. (Orchidaceae) - A new distributional record for Peninsular India.

6. Exomorphological variation in *Gaultheria fragrantissima* Wall. (Ericaceae: Vaccinioideae) in India: A Micromorphological Solution from Leaf Stomata and Pollen Morphology., Journal of Bioresources.
7. *Habenariagibsonii* var. *foetida* Blatt. & McCann (Orchidaceae): an addition to the orchid flora of Rajasthan, India, Journal of Threatened Taxa
8. New site of occurrence for *Lecanorchissikkimensis*, a rare and endangered mycoheterotrophic orchid of Sikkim Himalaya, Journal of Threatened Taxa
9. Floral Diversity Assessment and its Documentation for Indira Gandhi Centre for Atomic Research, Kalpakkam Site, Phytotaxonomy
10. Two new synonyms of *Vernonia shevaroyensis* (Asteraceae) and its neotypification. Nelumbo

Paper reviewed by Dr. J.H. Franklin Benjamin:

1. Elevation of *Symplocos macrophylla* subsp. *namboodiriana* (Symplocaceae) to the species level, Phytotaxa [ISSN 1179-3163 (online)].

3. Public service rendered:

| Circle/ Section | Public Service Rendered | | | | | |
|--|---|---|--|---|-------------------------------|--|
| | Number of Scientist (Indian/Foreign) and visitors (students etc.) Visited | Number and name of VIPs, dignitaries visited | Details of special information/ plant or other related material supplied | Number and name of Specimens/plant or other related materials identified. | Number of Photocopy supplied. | Total revenue received for providing information/ identification service/photo copy etc. |
| SHRC, Gangtok Total 57 visitors in 21 batches | 02 | 1. Dr. Champa Sharma, Veterinary Officer, Department of A.H & V.S, Soreng S.D.V.H, Govt. of Sikkim. 2. Dr. Ashok Kumar Sinha, Research officer, Regional Ayurveda Research Institute, (AYUSH) Gangtok. | For plant identification | 5 specimens identified 1. <i>Asparagus racemosus</i> Willd. [ASPARAGACEAE] 2. <i>Ocimum gratissimum</i> L. [LAMIACEAE] 3. <i>Cheilocostus speciosus</i> (J.Koenig) C.D. Specht [COSTACEAE] 4. <i>Bergenia ciliata</i> (Haw.) Sternb. [SAXIFRAGACEAE] 5. <i>Malvaviscus arboreus</i> Cav. [MALVACEAE] | - | certificate viden SHRC-5/40/2020-Tech Dated-3/12/2020 and payment for same. Rs. 250/- Transaction Ref.No. 0712200001477 Dated: Dec 7 2020 Revenue deposited via Bharatkosh.gov.in for BSI-SHRC |
| | 02 Visitors | 3. Ms. Abigail, Project Coordinator | 5 Sale of Book titled "Orchids of India- A Pictorial | - | - | Rs. 1460/- Transaction Ref.No. 1911200003077 Dated: Nov |

| Circle/ Section | Public Service Rendered | | | | | |
|--------------------|---|---|---|---|-------------------------------|--|
| | Number of Scientist (Indian/Foreign) and visitors (students etc.) Visited | Number and name of VIPs, dignitaries visited | Details of special information/plant or other related material supplied | Number and name of Specimens/plant or other related materials identified. | Number of Photocopy supplied. | Total revenue received for providing information/identification service/photo copy etc. |
| | | <p>r, G.B. Pant National Institute of Himalayan Environment, SRC, Gangtok on 19th November 2020.</p> <p>4. Mr. Prakash Chettri, Project Coordinator, G.B. Pant National Institute of Himalayan Environment, SRC, Gangtok on 19th November 2020.</p> | <p>Guide” (1Nos.).</p> | | | <p>19 2020 Revenue deposited via Bharatkosh.gov.in for BSI-SHRC (Government of India) by Selling Books</p> |
| | 04 Visitors | <p>5. Mr. Bikram SubbaLimboo, Ph.D. Scholar, Department of Botany, Sikkim University on 29th oct 2020.</p> | <p>Herbarium consultation for data collection related to locality of specimen collected for the said 12 Medicinal plant specimens</p> | - | - | - |

| Circle/ Section | Public Service Rendered | | | | | |
|--------------------|---|--|---|---|-------------------------------|---|
| | Number of Scientist (Indian/Foreign) and visitors (students etc.) Visited | Number and name of VIPs, dignitaries visited | Details of special information/plant or other related material supplied | Number and name of Specimens/plant or other related materials identified. | Number of Photocopy supplied. | Total revenue received for providing information/identification service/photo copy etc. |
| | | 6. Dr.Sriprakash, Head +2 Visitors from Regional Ayurveda Research Institute Central Council For Research in Ayurvedic Sciences, Tadong, Gangtok | For identification of 6 folk claims (6 medicinal plant specimens) collected from West Sikkim vide letter no F.NO.6-28/2014/RA RI-GTK/TECH/THCRP/549 | | | |
| | | 7. Kundey Hang Limboo , Research Scholar, Department of Microbiology, Sikkim University on 26 th November, 2020. | | | | |
| | 02 Visitors | 8. Sanjyoti Subba and Nimesh Chamling , Survey Expert, Biodiversity Conserva | Technical Guidance for Herbarium Preparation. | | | |

| Circle/ Section | Public Service Rendered | | | | | |
|--------------------|--|---|---|--|--|--|
| | Number of Scientist (Indian/Fore ign) and visitors (students etc.) Visited | Number and name of VIPs, dignitaries visited | Details of special information/ plant or other related material supplied | Number and name of Specimens/plant or other related materials identified. | Number of Photoco py supplied. | Total revenue received for providing information/ identification service/photo copy etc. |
| | | tion (SBFP PROJEC T MANAG EMENT UNIT) Departm ent of Forest and Environ ment, Governm ent of Sikkim. Date:8/1 2/2020 | | | | |
| | 02 Visitors | 9. Dr. Biswajit Bose, Assistant Professor, Departmen t of Botany, SRM University Sikkim, Gangtok on 11thDecem ber 2020 and 10. r. Rajat Das, Assistant Professor, Departmen t of Pharmacy and | Consult herbarium and literature of wild <i>Tupsitra</i> species from Sikkim Himalayas | | | |

| Circle/ Section | Public Service Rendered | | | | | |
|--------------------|---|---|---|--|-------------------------------|---|
| | Number of Scientist (Indian/Foreign) and visitors (students etc.) Visited | Number and name of VIPs, dignitaries visited | Details of special information/plant or other related material supplied | Number and name of Specimens/plant or other related materials identified. | Number of Photocopy supplied. | Total revenue received for providing information/identification service/photo copy etc. |
| | | Management, SRM University Sikkim, Gangtok on 11th December 2020. | | | | |
| | 02 Scientists | 11. Dr. Laishram Shantikumar, Scientist-B IBSD, Sikkim Centre, Tadong, Gangtok on 17/12/2020 12. Shri. Lokesh Deb, Scientist-D (Pharmacology) IBSD, Sikkim Centre, Tadong, Gangtok on 17/12/2020 | Identification Purpose. Identification Purpose. | 10 specimens (herbarium sheet submitted for identification) 16 specimens (herbarium sheet submitted for identification) | | |
| | | 13. Research Scholar from Regional Ayurveda Research Institute, Central Council for Research in Ayurvedic | <u>Identification purpose.</u> | 12 Plant specimens submitted for the identification | | |

| Circle/ Section | Public Service Rendered | | | | | |
|--------------------|---|---|---|---|-------------------------------|--|
| | Number of Scientist (Indian/Foreign) and visitors (students etc.) Visited | Number and name of VIPs, dignitaries visited | Details of special information/ plant or other related material supplied | Number and name of Specimens/plant or other related materials identified. | Number of Photocopy supplied. | Total revenue received for providing information/ identification service/photo copy etc. |
| | | Sciences, Ministry of Ayush. Visited on : 04/01/2021 | | | | |
| | | 14. Dr. Priya Darshini Gurung, Govt. of Sikkim, Department of Science and Technology, Vigyan Bhawan, Deorali, Gangtok-737102. Visited on: 07/01/2021 | Herbarium consultation of specimens collected from Kyongnosla Alpine sanctuary and Nathang Valley Natural Reserve, East Sikkim. | | | |
| | | 15. Dr. Jayanta Ghosh, Research Scholar, Department of Botany, University of Calcutta. Visited from 14/01/2021-18/01/2021. | Herbarium Consultation of specimens collected from North Sikkim belonging to 64 families. | | | |
| | | 16. Dr.A.A. Mao, Director, Botanica | Official Visit | | | |

| Circle/ Section | Public Service Rendered | | | | | |
|--------------------|---|---|---|---|-------------------------------|---|
| | Number of Scientist (Indian/Foreign) and visitors (students etc.) Visited | Number and name of VIPs, dignitaries visited | Details of special information/ plant or other related material supplied | Number and name of Specimens/plant or other related materials identified. | Number of Photocopy supplied. | Total revenue received for providing information/ identification service/photo copy etc. |
| | | 1 Survey of India. Visited on: 11/01/2021-12/01/2021 | | | | |
| | | 17. Mr. Mihin Targu, Research Scholar, NEHU, Shillong. Visited on: 14/01/2021 | Sale of Books: 1. "Balsams of Eastern Himalayas" (1Nos.) 2. "Orchids of India- A Pictorial Guide" (1Nos.). | | | Rs.2340 i.e.(Rs. 880 + Rs.1460) Transaction Ref.No. 1401210005100 Dated: 14/01/2021 Revenue deposited via Bharatkosh.gov.in for BSI-SHRC (Government of India) by Selling Books) |
| | 02 Scientists | 18. Two scientists : Dr. Rajesh Joshi, Scientist-in-charge, and Dr. Devendra Kumar, Scientist 'D' and four Research scholars, from G.B. Pant National Institute | Workshop on "HABITAT MODELLING TECHNIQUES" jointly organised by Botanical Survey of India, Sikkim Himalayan Regional Centre, Gangtok and G.B. Pant National Institute of Himalayan Environment, | | | |

| Circle/ Section | Public Service Rendered | | | | | |
|--------------------|---|---|---|---|-------------------------------|--|
| | Number of Scientist (Indian/Foreign) and visitors (students etc.) Visited | Number and name of VIPs, dignitaries visited | Details of special information/plant or other related material supplied | Number and name of Specimens/plant or other related materials identified. | Number of Photocopy supplied. | Total revenue received for providing information/identification service/photo copy etc. |
| | | of Himalayan Environment, Sikkim Regional Centre, Pangthang, Gangtok. Visited on 20/01/2021 | Sikkim Regional Centre, Pangthang, Gangtok was held on 20th January, 2021 | | | |
| | 12 Visitors | 19. Group visit by 12 students under TASS (Travel Agent Association of Sikkim) under the supervision of Mr. Sailesh Pradhan and Mr Kailash Pradhan. on 22/01/2021 | <u>TASS (Travel Agent Association of Sikkim) under the BOTANICAL GUIDE TRAINING under the supervision of Mr. Sailesh Pradhan and Mr Kailash Pradhan.</u> | | | |
| | 02 Visitors | 20. Two Visitors from Regional Ayurveda Research Institute Central | For receiving identification certificate and payment for same | 8 specimens identified : <ul style="list-style-type: none"> • <i>Callicarpa arborea</i> Roxb. • <i>Cuscuta reflexa</i> Roxb. • <i>Abelmoschus manihot</i> (L.) Medik. | | Rs. 400 Transaction Ref.No. 0902210010369 Dated: 9/02/2021 Revenue deposited via |

| Circle/ Section | Public Service Rendered | | | | | |
|--------------------|---|---|--|--|-------------------------------|---|
| | Number of Scientist (Indian/Foreign) and visitors (students etc.) Visited | Number and name of VIPs, dignitaries visited | Details of special information/plant or other related material supplied | Number and name of Specimens/plant or other related materials identified. | Number of Photocopy supplied. | Total revenue received for providing information/identification service/photo copy etc. |
| | | Council for Research in Ayurvedic Sciences, Tadong Gangtok on 4/02/2021 | | <ul style="list-style-type: none"> • <i>Pteris biaurita</i> L • <i>Drynariaquercifolia</i> (L.) J.Sm • <i>Nephrolepis cordifolia</i> (L.) C.Presl • <i>Clematis buchananiana</i> DC. • <i>Senegalia pennata</i> (L.) Maslin | | Bharatkosh.gov.in for BSI-SHRC |
| | 20 Students | 21. Group visit by 20 students from Sikkim Envis Hub Forest Dept, Government Of Sikkim on 09/02/21 | Visit under Green skill development (GSDP)(value additional marketing of TFP products) Plant origin , under Sikkim Envis Hub Forest Dept., Government Of Sikkim. | | | |

- Digitisation of Herbarium Specimens and Database: Scanning and metadata entry for 1605 sheets were done from Barcode BSHC 00025988 to BSHC00027592
- **Herbarium Data Label entered in Excel for the following families: BSHC 00025988 to BSHC00027592**(Acanthaceae, Aceraceae, Alliaceae, Amaranthaceae, Anacardiaceae, Apiaceae, Apocynaceae, Aquifoliaceae, Araceae, Araliaceae, Arcaceae, Asclepiadaceae, Asteraceae, Balsaminaceae, Basellaceae, Begoniaceae, Berberidaceae, Betulaceae, Boraginaceae, Brassicaceae, Buddlejaceae, Campanulaceae, Caprifoliaceae, Carlemanniaceae, Caryophyllaceae, Celastraceae, Chenopodiaceae, Commelinaceae, Convolvulaceae, Crassulaceae, Cucurbitaceae, Cupressaceae, Cyperaceae, Dipsacaceae, Droseraceae, Ericaceae, Eriocaulaceae, Euphorbiaceae, Fabaceae, Fumariaceae, Gentianaceae, Geraniaceae, Gesneriaceae, Grossulariaceae, Hydrangeaceae, Hypericaceae, Iridaceae, Juncaceae, Lamiaceae, Lauraceae, Lentibulariaceae, Liliaceae, Lobeliaceae, Melastomataceae, Monotrapaceae, Myrsinaceae, Nartheciaceae, Onagraceae, Orchidaceae, Orobanchaceae, Oxalidaceae, Papaveraceae, Parnassiaceae, Pinaceae, Piperaceae,

Plumbaginaceae, Poaceae, Polygonaceae, Potamogetonaceae, Primulaceae, Pteridaceae, Pyrolaceae, Ranunculaceae, Rosaceae, Rubiaceae, Rutaceae, Salicaceae, Saururaceae, Saxifragaceae, Schisandraceae, Scrophulariaceae, Simaroubaceae, Smilacaceae, Solanaceae, Stachyuraceae, Symplocaceae, Tamaricaceae, Toefieldiaceae, Urticaceae, Vaccinaceae, Verbenaceae, Violaceae, Zingiberaceae).

- **Scanning of the following families: BSHC 00025988 to BSHC00027592**(Acanthaceae, Aceraceae, Alliaceae, Amaranthaceae, Anacardiaceae, Apiaceae, Apocynaceae, Aquifoliaceae, Araceae, Araliaceae, Arecaceae, Asclepiadaceae, Asteraceae, Balsaminaceae, Basellaceae, Begoniaceae, Berberidaceae, Betulaceae, Boraginaceae, Brassicaceae, Buddlejaceae, Campanulaceae, Caprifoliaceae, Carlemanniaceae, Caryophyllaceae, Celastraceae, Chenopodiaceae, Commelinaceae, Convolvulaceae, Crassulaceae, Cucurbitaceae, Cupressaceae, Cyperaceae, Dipsacaceae, Droseraceae, Ericaceae, Eriocaulaceae, Euphorbiaceae, Fabaceae, Fumariaceae, Gentianaceae, Geraniaceae, Gesneriaceae, Grossulariaceae, Hydrangeaceae, Hypericaceae, Iridaceae, Juncaceae, Lamiaceae, Lauraceae, Lentibulariaceae, Liliaceae, Lobeliaceae, Melastomataceae, Monotropaceae, Myrsinaceae, Nartheciaceae, Onagaraceae, Orchidaceae, Orobanchaceae, Oxalidaceae, Papaveraceae, Parnassiaceae, Pinaceae, Piperaceae, Plumbaginaceae, Poaceae, Polygonaceae, Potamogetonaceae, Primulaceae, Pteridaceae, Pyrolaceae, Ranunculaceae, Rosaceae, Rubiaceae, Rutaceae, Salicaceae, Saururaceae, Saxifragaceae, Schisandraceae, Scrophulariaceae, Simaroubaceae, Smilacaceae, Solanaceae, Stachyuraceae, Symplocaceae, Tamaricaceae, Toefieldiaceae, Urticaceae, Vaccinaceae, Verbenaceae, Violaceae, Zingiberaceae).

4. Maintenance of Herbaria

| Herbarium | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|-----------|-----|---|------|---|------|---|----|----|---|----|----|----|----|
| | 644 | - | 1273 | - | 2590 | - | 48 | 31 | | | | 10 | 87 |

1. No. of Specimens mounted, 2. No. of Specimens remounted, 3. No. of Herbarium sheets Stitched/labeled, 4. No. of Herbarium sheets dusted/fumigated, 5. No. of specimens poisoned, 6. No. of Genus cover/species cover changed, 7. No. of Specimens incorporated, 8. No. of Specimens sent on loan, 9. No. of Specimens received on exchange/loan, 10. No. of cibachromes received from Kew, 11. No. specimens received on gifts, 12. No. of species identified, 13. No. of Herbarium sheets accessioned.

8. Library:

| Circle | Number of Journals incorporated | | Number of Reports, Newsletters, Brochures incorporated | | Number of books incorporated |
|--------|---------------------------------|------------------|--|---------------------|------------------------------|
| | Indian Journals | Foreign Journals | Departmental | Other Institutional | |
| | 19 | - | - | - | 10 |

9. Training/Exhibition participated:

| Circle/ Section | No. and name of training programme participated, if any | No. and name of training programme imparted, if any: 1 | No. and name of exhibition participated, if any | No. and name of exhibition conducted, if any |
|-----------------|---|--|---|--|
| - | | 1. Workshop on "HABITAT MODELLING TECHNIQUES" jointly organised by Botanical | | |

| | | | | |
|--|--|---|--|--|
| | | Survey of India , Sikkim Himalayan Regional Centre, Gangtok and G.B. Pant National Institute of Himalayan Environment, Sikkim Regional Centre, Pangthang, Gangtok was held on 20 th Janauary, 2021 | | |
|--|--|---|--|--|

10. Special Information (Findings)

11. Any other information:

Dr.Rajib Gogoi, Scientist E:

- Acted as Head of Office in respect of BSI, SHRC.
- Checked and provided required technical details as Co-PI to a project proposal on “Bioprospecting and molecular characterization of endemic Rhododendron species of Eastern Himalaya” to be sent to D/BSI, which was later sent to DBT, New Delhi.
- Provided examples of ‘*Impatiens*’ species for which name changes has happened due to taxonomic reason to Prof. A.K. Koul, Chairman, RAMC.
- Organised International Biodiversity Day on 22.05.2020: Planted plant saplings and raided cuttings of *Taxus baccata* L., *Cephalotaxus griffithii* Hook.f. & *Camellia japonica* L. with all the staff and students of this office.
- Supervised Ph.D. Student: Mr. Ashutosh Upadhyay, SRF, BSI, working for “Revision of the genus *Elatostema* of NE India” under the project “Flora of India”.
- Participated as panellist on a Webinar organised by GB Pant Institute of Himalayan Environment, Pangthang on the eve of International Biodiversity Day on 22.05.2020 and put forwarded views on the subject “Role of Biodiversity to combat Pandemic”.
- Supervised the ongoing work on “Checklist of Flora of Sikkim”.
- Provided adequate scientific input to the team of Scientist of IBSD, Gangtok on monograph on Medicinal Plants of Sikkim.
- Prepared the project proposal on “Establishment of Grand Conservatory for Conservation of Endangered Medicinal and Aromatic Plants in Indian Himalayan Region” for submission to DBT, New Delhi.
- Attended as Subject expert for promotion of Asst. Professors in Botany, Sikkim University on 04.08.2020.
- Delivered valedictory talk on 16.08.2020 in an International Webinar on the subject “Himalayan Biodiversity” organized by Shree Aayappa College of Wemen, Coimbatore, Tamilnadu & Maharishi Dayanand University, Rohtak, Haryana.
- Acted as Chairman in assessment committee for JRF to SRF, NMHS funded research Project on Orchids on 18.08.2020.
- Revised the annual report in respect to BSI, SHRC.
- Inaugurated Hindi Pakhwara on 09.09.2020 at BSI, SHRC, Gangtok.
- Acted as Chairman in selection committee for JRF to RA, at GB Pant National Inst. Himalayan Environment, Pangthang, Gangtok on 28.08.2020.
- Attended webinar by D/BSI for discussion issues related to Media Cell of BSI and its function.
- Participated as a panelist for “Knowledge Networking in Himalayas” on 10.09.2020 at GB Pant National Inst. Himalayan Environment, Pangthang, Gangtok.
- Participated the talk by Prof. Tod Stuessy of Ohio State University, USA on the topic “*The importance of historical ecology for interpreting processes of evolution in plants of Oceanic Islands*” organised by Global Mansarovar University, Bhopal on 11.09.2020.

- Organized a meeting with representatives of Medicinal Plant Board, Forest Dept., Govt. of Sikkim and Botany department, Sikkim University at BSI, SHRC, Gangtok in connection with medicinal plants of Sikkim on 17.09.2020 as requested by Forest department.
- Attended video conferencing on BSI web management provided by NIC, Kolkata on 05.10.2020.
- Attended video conferencing on MIS of BSI by Digital Herbarium, BSI, Kolkata.
- Sent 5 video clips on plants growing in BSI, SHRC Garden as requested by central media cell, BSI, HQ, Kolkata for making a video on Autumn Flowers.
- Undertook a local field tour to Bhusuk area, E. Sikkim on 04.10.2020.
- Undertook a local field tour to Namchi, South Sikkim on 23.10.2020.
- Attended meeting along with Dr. J.H. Franklin Benjamin with Director, NTFP team, members from Sikkim University in connection with a medicinal plant project by Forest & Environment Dept., Govt. of Sikkim on 11-11-2020.
- Attended a meeting with Secretary, Department of Forest & Environment, Govt. of Sikkim on 19.11.2020 in connection with publication of Flora of Sikkim, Checklist.
- Attended Wildlife Board meeting of Govt. of Sikkim on 25th Nov. 2020 at CM Auditorium at Gangtok.
- Organised National Webinar on 10.12.2020 the topic “Himalayan Mountain Biodiversity Threats & Solutions” in connection with International Mountain Day.
- Received Director BSI, from Bagdogra Airport on 10.01.2021.
- Attended Director at BSI-SHRC on 11 to 12 January 2021.
- Executed a MoU with Sikkim University for research collaboration between both the Institutes.
- Visited GB Pant Inst., Gangtok with D/BSI on 12th January 2021.
- Visited Secretary, Forest & Environment Dept., Govt of Sikkim in connection with collaboration work with BSI.
- Attended Wildlife Board meeting of Govt. of Sikkim on 25th Nov. 2020 at CM Auditorium at Gangtok.
- Participated in a video conference for drafting a reply to MOEF&CC on BSI involvement and contribution in achieving SDG target 15.5 for calculating the RED LIST INDEX of Indian plants. The reply was drafted and circulated among the participants. The final draft was submitted to D/BSI.
- Executed a MoU with Directorate of Cinchona and Other Medicinal Plants, Mungpoo, West Bengal on 4th February, 2021 for publication of a book.
- Acted as Charman selection committee for JRF/JPF at GB Pant Inst., Gangtok with D/BSI on 12th February 2021.
- Supervised the typesetting/printing work for the book “Flora of Sikkim-a pictorial guide”
- Local tour conducted to Kyongnosla Alpine Sanctuary on 21.02.2021.
- Organised International Webinar on 23.02.2021, talk delivered by Dr. Alex Monro, RBG, Kew, London on the topic “Exploration of La Amistad National Park (Costa Rica / Panama)” for the 2nd Green Talk as part of the series organised by BSI-SHRC-Gangtok.

Delivered Lectures :

- On 26.02.2020, delivered lecture on “Biodiversity of NE India” to 30 visiting students and faculties from Ranaghat College, West Bengal.
- Delivered a talk on “Wild Edible plants of NE India” on an International Webinar organized by AJCB College, Department of Botany, Kolkata on 19.08.2020, Assam on 13.07.2020.
- Delivered a talk on “Phytodiversity of NE India” on an National Webinar organized by Bagnan College, Department of Botany, Howrah, West Bengal on 20.09.2020.

Dr. D.K. Agrawala, Scientist D:

- Drafted a project proposal on “Conservation and Mass Multiplication of Economical Important Orchids” and sent to D/BSI.
- Completed the technical details of project proposal “Conservation and mass multiplication of commercially important orchids through biotechnological tools” and submitted to D/ BSI.

- Provided examples of ‘Threatened’ Indian species for which name changes has happened due to taxonomic reason to Prof. A.K. Koul, Chairman, RAMC.
- Supervised and monitored progress of project staff.
- Involved in Official purchasing through GeM.
- On 04.08.2020, attended the Brainstorming Session for Development of Botanical Garden of Indian Republic, Noida, organized by Director BSI through video conferencing.
- During 13th – 14th August, 2020 attended ‘Online research seminar on Biodiversity in socio-ecological production landscapes of Darjeeling and Sikkim Himalaya: How should these be managed?’ organized by Sikkim University and ATREE.
- On 15.09.2020, attended the meeting of State Environment Impact Assessment Authority and State Expert Appraisal Committee as a member.
- On 28.09.2020, attended the Institute Ethical Committee meeting of RARI, Ministry of Ayush for clearance of various inhouse projects.
- Prepared and sent comments on “Red Listing of Orchids of Arunachal Pradesh as per IUCN criteria” as desired from D/BSI.
- Evaluated the project report “Taxonomic revision of sub-tribe Platantherinae (Orchidaceae) from India” received vide OM no. BSI-292/2/2019-Tech. dated 14.09.2020.
- Supervised and monitored progress of project staff of Externally Funded Project (Systematics and conservation of Indian Orchids with special emphasis to Himalayan species, funded by NMHS).
- Evaluated annual report of Himalayan Research Fellowship programme received from NMHS-PMU, Almora.
- Involved in GeM, purchase committee meeting and CPWD related work.
- Attended two students from G.B. Pant Institute and demonstrated the process of Orchid identification and description.
- Attended meeting of Sikkim Environment Assessment Committee (SEAC) on 01.12.2020 and 14.12.2020.
- On 10.12.2020, attended Webinar cum Brainstorming on “Himalayan mountain biodiversity – Threats and Solutions” as a part of Mountain Day celebration and delivered lecture on “Conservation and Livelihood perspective of Himalayan Orchids”.
- Drafted 2 abstracts on “Floristic wealth of India” and “Indian Orchids – Exploring the Diversity and Harnessing its Value” and sent to D/BSI. Prepared presentation on “Floristic wealth of India” and sent to D/BSI.
- On 16.12.2020, attended 1st meeting of the Task Force constituted for review of BSI mandate and to explore possible aspects of improvement.
- Assisted the HoO in organizing the first talk of Green Talk-Webinar Series 2021 on 08.01.2021. The talk was delivered by Prof. Bogdan Jaroszewicz, Professor and Director of Bialowieza Geobotanical Station, University of Warsaw.
- Drafted a document on review of BSI Mandate and its possible updating and submitted to Dr. P.V. Prasanna, Scientist G and Co-ordinator of the Task-Force constituted for this purpose.
- During 11.01.2021 – 13.01.2021 assisted the HoO in coordinating the visit of D/BSI and attended the events: Signing of MoU between BSI and Sikkim University for research collaboration; Signing of agreement between BSI and Sikkim Forest Department for publication of “Flora of Sikkim- a pictorial guide”, visit to G.B. Pant Institute and coordination meeting at BSI, SHRC with Central and State government researchers.
- Organized a video conference for drafting a reply to MOEF&CC on BSI involvement and contribution in achieving SDG target 15.5 for calculating the RED LIST INDEX of Indian plants. The reply was drafted and circulated among the participants. The final draft was submitted to D/BSI.
- Worked for editing and proofreading of the manuscript “Flora of Sikkim – A Pictorial Guide.
- On 21.01.2021 attended the online training programme for Institute Ethical Committee members organized by Indian Council for Medical Research and The Ministry of AYUSH.
- On 27.01.2021 and 09.02.2021 attended the meeting of SEAC for environmental clearance of Waste disposal project at Mangan.
- Assisted the HOO in preparing the reply related to audit queries received from BSI, HQ.
- Discharged the duties of CDDO.

Delivered Lecture :

- On 16.10.2020, delivered a lecture on “Introduction to IUCN Red Listing and challenges for its application” at BSI, SHRC, Gangtok.

Dr.J.H. Franklin Benjamin, Scientist C:

- Discharged the duties of CDDO
- Discharged the duties of ‘in-charge’ Technical Section, Store, Library, member of Departmental Purchase Committee, Nodal Officer (Social Media).
- Designing and printing of wall mount displays in SHRC.
- Compiled data for NitiAyog SDG for Sikkim Centre.
- Attended as a member for assessing biennial progress of JPFs under NMHS project on 1Orchids on 18-08-2020.
- Attended online meet on the review of Flora of India volume 27 on August 30, 2020.
- Attended webinar by D/BSI for discussion issues related to Media Cell of BSI and its function on 04-09-2020.
- Undertook one day local tour to Rateychu on 12-09-2020 and collected and introduced 21 live plants for *ex-situ* conservation in BSI SHRC Garden [Anisadenia saxatilis Wall. exMeissn [LINACEAE], Elatostemadissectum Wedd. [URTICACEAE], Elatostemahookerianum Wedd. [URTICACEAE], Elatostemalineolatum Wight [URTICACEAE], Elatostema spp. [URTICACEAE], Gaultheria nummularioidesD.Don [ERICACEAE], Gaultheria spp. [ERICACEAE], Impatiens pradhaniiH.Hara [BALSAMINACEAE], Leycesteriagracilis (Kurz) Airy Shaw [CAPRIFOLICAEAE], Loxostigmagriffithii (Wight) C.B.Clarke [GESNERIACEAE], Mazus dentatus Wall. exBenth. [SCROPHULARIACEAE], Rhododendron camelliiflorumHook.f. [ERICACEAE], Rhododendron dalhousieaeHook.f. [ERICACEAE], Rhododendron edgeworthiiHook.f. [ERICACEAE], Rhododendron triflorumHook.f. [ERICACEAE], Rhododendron vaccinioidesHook.f. [ERICACEAE], Rubus wardiiMerr. [ROSACEAE], Salix spp. [SALICACEAE], StrobilantheshelictaT.Anderson [ACANTHACEAE], Strobilanthes spp. [ACANTHACEAE], Vaccinium retusum (Griff.) Hook.f. ex C.B.Clarke [ERICACEAE]. 7 field numbers were collected and processed: CodonopsisgracilisHook.f. & Thomson [CAMPANULACEAE]- BSHC 41412 CodonopsisinflataHook.f. & Thomson [CAMPANULACEAE]- BSHC 41411 OphiorrhizatrentleriHook.f. [RUBIACEAE]- BSHC 41409 Persicariathunbergii (Siebold &Zucc.) H.Gross [POLYGONACEAE]- BSHC 41413 Pimpinella diversifolia DC. [APIACEAE]- BSHC 41410 Stauntonia angustifolia (Wall.) R.Br. ex Wall. [LARDIZABALACEAE]- BSHC 41414 StrobilantheshelictaT.Anderson [ACANTHACEAE]- BSHC 41408. Photographed 22 plant species: Anisadenia saxatilis Wall. exMeissn [LINACEAE], CodonopsisgracilisHook.f. & Thomson [CAMPANULACEAE], CodonopsisinflataHook.f. & Thomson [CAMPANULACEAE], Gaultheria nummularioidesD.Don [ERICACEAE], GoodyeraschlechtendaliansaRchb.f. [ORCHIDACEAE], Henckeliaurticifolia (Buch.-Ham. ex D.Don) A.Dietr. [GESNERIACEAE], Hypericum tenuicauleHook.f. & Thomson ex Dyer [HYPERICACEAE], Impatiens argutaHook.f. & Thomson [BALSAMINACEAE], Impatiens falciferaHook.f. [BALSAMINACEAE], Impatiens pradhaniiH.Hara [BALSAMINACEAE], Impatiens stenanthaHook.f. [BALSAMINACEAE], Impatiens uncipectalaC.B.Clarke ex Hook.f.[BALSAMINACEAE], Lycopodium japonicum Thunb. [LYCOPODIACEAE], Persicariathunbergii (Siebold &Zucc.) H.Gross [POLYGONACEAE], Pimpinella diversifolia DC. [APIACEAE], Rubus wardiiMerr. [ROSACEAE], SarcopyramisnapalensisWall. [MELASTOMACEAE], Siphocranionmacranthum (Hook.f.) C.Y.Wu [LAMIACEAE], Stauntonia angustifolia (Wall.) R.Br. ex Wall. [LARDIZABALACEAE], StrobilantheshelictaT.Anderson [ACANTHACEAE], Swertia bimaculata (Siebold & Zucc.) Hook.f. & Thomson ex C.B.Clarke [GENTIANACEAE], Torenia violacea (Azaola ex Blanco) Pennell [SCROPHULARIACEAE].
- Attended online meet on website uploading by NIC Delhi on 05-10-2020.
- Vice Chancellor meet on Hindi Closing ceremony
- Participated in Swachh Bharath on 2 October 2020.
- Attended online consultation meet on Management Information System (MIS) of BSI on 08-10-2020.
- Compiled Unit’s Annual Report from January to December 2020 in required format for forwarding to the Ministry of Environment, Forest & Climate Change.
- On 22-10-2020, drafted and submitted to BSIHQ, content/creative write up for Launch of Social Media Campaign on benefits of Medicinal Plants (OM/BSI 281/19-Tech. (Media/Web), dated 21-10-2020.)
- On 26-10-2020, assisted the Head of Office in Indenting the Requisition for Fieldman & MTS for Staff Selection Commission.
- On 28-10-2020, a list of Invasive Alien Species was submitted to BSIHQ.
- On 03-11-2020, attended DPC meeting as member.

- On 04, 10 & 11-11-2020, prepared and sent a report to BSIHQ, 'Information for Office of the Principal Scientific Advisor to the Govt of India'.
- On 06-11-2020, attended DBSI's online review meeting on the progress of Flora of India.
- On 06-11-2020, assisted the HoO in preparing the draft MOU with NTFP, Forest Department, Government of Sikkim.
- On 11-11-2020, a meeting with Joint Director, NTFP, Forest Department, Government of Sikkim at Deorali, Gangtok was attended to discuss the modalities of the MOU and working plan.
- On 12-11-2020, attended online Ph.D. viva-voce of Mr. Ravi Kiran Arigela, Botanical Assistant, BSI DRC (<https://meet.google.com/ruh-cnnon-wfe>). Title of the Thesis: Studies on Endemic and Threatened Flora of Kodaikanal Wildlife Sanctuary, Tamil Nadu, India. Supervisor: Dr. G.V.S. Murthy, Former Scientist G, BSI.
- On 12-11-2020, prepared 2 questionnaire for medicinal plant survey of the NTFP, Forest Department, Government of Sikkim.
- On 19-11-2020, meeting with the PCCF cum Secretary, Forest, Environment and Wildlife, Government of Sikkim.
- Assisted the HoO in conducting the Webinar-cum-Brainstorming on Mountain Biodiversity – Threats & Solutions' on December 10, 2020. A report was made.
- Visited Secretary & PCCF, Forest Department, Government of Sikkim in relation with checklist of flora of Sikkim on 24-11-2020 & 02-12-2020.
- As Chairman of Library Verification Committee, initiated the verification of library books.
- Checklist of Flora of Sikkim: Design and layout of the book was initiated at press. The editing of the text is completed. Preliminary checking of Nomenclature and taxa is completed. Preparing Introduction and proof reading & editing of the manuscript of the 'Flora of Sikkim – A Pictorial Guide' and made press ready.
- New Digital Signature Certificate token for DDO was procured.
- Compiled and sent information to BSIHQ on AR 21, AR 22(i) & AR 22(ii) as audit reply.
- Compiled and sent information to BSIHQ on Local audit on the accounts of Botanical Survey of India during the last 5 year on 11-02-2021.
- Assisted the HoO in preparing the invitation of Webinar on 23rd February 2021.
- Assisted the HoO in writing a brief on 'Climate Change Impact on Biodiversity, Crops and Economy.
- Assisted the HoO in finalising the forewords of forthcoming book.
- Attended Webinar Series "Green walk"-Plant Taxonomy and Floristics in the Anthropocene Epoch" by BSI, SRC, Coimbatore on 19-02-2021.

14. FUNDED PROJECTS, IF ANY

- Assessment of Floristic Diversity in Protected Area Networks – Phase I (PAN Projects)
 - All Indian Coordinated Project on Capacity building in Taxonomy (AICOPTAX)
- Collaborative projects
- Other projects:

| Sl. No. | Name of the project | Targets and deliverable | Summary of achievements |
|---------|---|--|--|
| 1. | Systematics and Conservation of Indian Orchids with Special Emphasis to Himalayan Species. (Tenure: three years) Funded by: National Mission on Himalayan Studies (NMHS) under Himalayan Research Fellowship Scheme. Project reference no.: GBPNI/NMHS-2017-18/HSF-08, dated: 28.03.2018. | <ul style="list-style-type: none"> • Literature survey and prepare a check-list with synonyms and distribution. • Study the Types, Protologues and herbarium specimen/ images. • Morpho-molecular characterization. • Solving of species complex with proper delimitation. • Endemics and less known species will be relocated. • Preparation of complete description and illustration. • Over-exploited species will | <ul style="list-style-type: none"> • Abstract communicated entitled 'Taxonomic studies on the genus Acanthephippium Blume (Orchidaceae) in India' for National Conference cum Workshop on "Interdisciplinary Approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids" and Orchid Show at Botanical Survey of India (BSI), Eastern Regional Centre, Woodlands, Laitumkhrah, Shillong, Meghalaya during March 5-7, 2021. • The students attended the 6th Himalayan Researchers Consortium |

| Sl. No. | Name of the project | Targets and deliverable | Summary of achievements |
|---------|---|--|--|
| | <p>Principal Investigator: Dr. D.K. Agrawala</p> <p>Research Associate: Dr.Rijupalika Roy(Joined 14.10.2019)</p> <p>Senior Project Fellows (since Aug. 2018).</p> <ol style="list-style-type: none"> 1. Shri Aazhivaendhan 2. MsShreyasi Nayak 3. Shri Sayak Chakraborty 4. Shri Shuvadip Sarkar 5. MsSanchayita Sengupta <p>Junior Project Fellows (since Aug. 2018).</p> <ol style="list-style-type: none"> 1. MsOindrila Chakraborty | <p>be evaluated for load on natural population.</p> <ul style="list-style-type: none"> • IUCN Red list assessment will be done and conservation measure proposed. • Distribution map and species richness map will be prepared. • Likely habitat of threatened species will be predicted by habitat modelling. • Inventurization in IHR, occurrence, distribution pattern, affinities • Morphological characterization • Solving taxonomy, nomenclature & decoding species complex • Confirmation of Endemics, near-endemics and less known species & Habitat modeling • Assessment of threat status by applying IUCN criteria • Developing distribution and species richness map • Germplasm collection & ex-situ conservation • Documentation and publication <p>(Allotment: Sub-families Vanilloideae, Orchidoideae and Epidendroideae).</p> <p>(Allotment: Tribe Malaxideae):</p> <p>(Allotment: Genus <i>Bulbophyllum</i>)</p> <p>(Allotment: Tribe Vandaeae-Sub-tribes: Vandinae, Deceptorinae, Phaleonopsidinae)</p> <p>(Allotment: Tribes Arethuseae, Nervilieae, Gastrodieae, Tropideae and Neottieae)</p> <p>(Allotment: Tribes Cymbidieae, Epidendreae, Collabieaeand Podochileae)</p> <p>(Allotment: Tribe Vandaeae-Sub-tribes: Aeridineae)</p> | <p>(HRC)-2021 held through Online Webinar Mode during 2–3 February 2021 and Presented the work progress under the project “Systematics and Conservation of Indian Orchids with Special Emphasis to Himalayan Species” of the allotment: Tribe Vandaeae- Sub-tribe: Aeridinae</p> <ul style="list-style-type: none"> • Abstract communicated entitled ‘Taxonomic studies on the genus <i>Stereochilus</i>Lindl. (Orchidaceae) in India’ for National Conference cum Workshop on “Interdisciplinary Approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids” and Orchid Show at Botanical Survey of India (BSI), Eastern Regional Centre, Woodlands, Laitumkhrach, Shillong, Meghalaya during March 5-7, 2021. • Communicated a paper on: <i>Stereochiluserinaceus</i> (Rchb.f.) Garay (Orchidaceae) – A new distributional record for India with notes on its relationships and threat status assessment. • Communicated a paper on: <i>Stereochiluserinaceus</i> (Rchb.f.) Garay (Orchidaceae) – A new distributional record for India with notes on its relationships and threat status assessment. • Communicated abstract for poster on “Species with confusing identity within the genus <i>Phalaenopsis</i> Blume (Orchidaceae) in India” to be presented in National Conference cum Workshop on “Interdisciplinary Approaches to Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids” and Orchid Show at Botanical Survey of India (BSI), Eastern Regional Centre, Woodlands, Laitumkhrach, Shillong, Meghalaya on March 5-7, 2021 • Abstract communicated entitled ‘Notes on the <i>Bulbophyllumodoratissimum</i> complex in India’ for National Conference cum Workshop on “Interdisciplinary Approaches to |

| Sl. No. | Name of the project | Targets and deliverable | Summary of achievements |
|---------|---------------------|-------------------------|---|
| | | | <p>Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally Important Orchids” and Orchid Show at Botanical Survey of India (BSI), Eastern Regional Centre, Woodlands, Laitumkhrah, Shillong, Meghalaya during March 5-7, 2021.</p> <ul style="list-style-type: none"> • Morphological characteristics finalized for 4 genera with their respective species i.e. <i>Arachnis</i> Blume (3 spp.), <i>Ascocentrum</i> Schltr. (2 spp.), <i>Biermannia</i> King & Pantl. (4 spp.), <i>Chilochista</i> Lindl. is completed. • Attended the Webinar on Science in Bialowieża Forest – Bialowieża Forest in science on 08.01.2021 organized by BSI, SHRC. • Communicated manuscript on vertical farming of orchids communicated in journal house. • Attended 30th Annual conference of Indian Association for Angiosperm Taxonomy and Webinar (4th and 5th December 2020). • Attended Webinar cum Brainstorming on “Himalayan Mountain Diversity- Threats and Solutions” on 10.12.2020 at BSI, SHRC. |

16. SOUTHERN REGIONAL CENTRE, COIMBATORE

PROJECT-1

Flora of Kanniyakumari Wildlife Sanctuary, Tamil Nadu

Name of the Executing Official (s): Dr. Sujana K. A., Scientist D & Mr. R.G. Vadhyar, Botanical Assistant

Duration of the project: 5 years (1-04-2016 to 31-03-2021)

About the work done:

Objectives:

To carry out studies on flowering plant diversity of Kanyakumari Wildlife Sanctuary, Tamil Nadu with special focus on endemic and threatened plants

Site of the study (with map):

The Kanniyakumari forest division located between 70°10'-77°35' East longitudes 08°05'-08°35' North latitudes was declared as Kanniyakumari Wildlife Sanctuary during 2002 vide G.O.Ms.No.152 dated:16.07.2002 with an extent of 45777.57 ha. Later in 2007, Kani tribal settlements, approach road to settlements and area leased out to Arasu Rubber Corporation were excluded from the sanctuary and vide G.O. (Ms) No.128 (E&F) dated 20.11.2007 and an area of 40239.55 hectares was declared as Kanniyakumari Wildlife Sanctuary. The area is in a Wildlife Corridor which in addition to tigers, is home to the threatened species like Indian Bison, elephant, Indian Rock Python, Lion-tailed Macaque, Mouse deer, Nilgiri Tahr and Sambar deer. The highest point is 1829.4 m at the trijunction of Mahendragiri, Kalakad and Veerapuli Reserved Forests. Other important peaks are Mahendragiri (1645.2 m) in Mahendragiri RF, Mottaichi peak (1590.4 m) and Varaittumudi (1426.2 m) and Vanamuttimalai in Kalmalai RFs. The valleys and flat lands between the spurs are accessible and contain valuable forests. The ecological significance of the Kanniyakumari Wildlife Sanctuary can be seen in that the area serving as a catchment for 10 reservoirs namely Pechiparai, Perunchani, Chithar-I, Chithar-II, Upper Kodayar, Lower Kodayar, Kuthiyar, ChinnaKuthiyar, Mukkadai and Poigai Anai. The sanctuary is bounded at North by Kalakkad-Mundanthurai Tiger Reserve Boundary, in East by Tirunelveli District Boundary, in South by Kodayar left bank channel and Thovalai channel and in West by Kerala State Boundary. The KWLS is administratively divided into 10 divisions: Therkkumalai East Reserve Forest, Therkkumalai West Reserve Forests, Thadagamalai Reserve Forests, Poigaimalai Reserve Forest, Mahendragiri Reserve Forests, Velimalai Reserve Forest, Veerapuli Reserve Forest, Kilmalai Reserve Forest, Thodalikadu Reserve Forest. Asambu Reserve Forest.

Methodology adopted: Conventional methods used for this study that includes; seasonal intensive and extensive survey, plant collection, herbarium processing and incorporation documentation, identification and publication.

New Methodology (if any) adopted: SEM based study is used for observing micromorphological characters.

Work done:

The research team proceeded to field tour on 21 September 2020. Processed and 460 specimens collected in previous field tours. Identified and reported 151 specimens. Number of species identified (with name): 153 specimens (list attached as annexure 1)

Output indicators for the assessment of the project: Identification and labelling of 604 herbarium specimens, documenting field data on rare, endemic threatened plants with GPS information, List of plants identified and reported as annexed (Annexure-I)

Major impacts reported during the financial year: The study report comprising of detail information of floristic diversity of the Sanctuary will provide a base-line data to forest department that will be helpful for implementing management plan of the sanctuary.

Published 1 new species to science and 2 new distributional records to Tamil Nadu state

New species published

Memecylon nervosum Vadhyar, J.H.F. Benj. & Sujana

New distributional records to Tamil Nadu

Meistera fulviceps (Thwaites) Skornick. & M.F. Newman

Polyalthia longipedicellata (Alister et al.) Shailajakumari et al.

- Information of floristic diversity of Kanyakumari WLS submitted to DFO and Wildlife Warden, KKWLS Tamil Nadu for preparing and implementing management plan of the sanctuary.
- A report on Floristic diversity of Kanyakumari WLS submitted to D/BSI for 41st expert committee meeting on Ecological Sensitive Zones held on 22-23 June, 2020

List of specimens identified with field numbers (Annexure-I)

1. 146855-*Anaphyllum wightii* Schott - Araceae
2. 146822-*Isonandra lanceolata* Wight - Sapotaceae
3. 146917-*Psidium guineense* Sw. - Myrtaceae
4. 146933 -*Psidium guineense* Sw. - Myrtaceae
5. 144682-*Meistera fulviceps* (Thwaites) Skornick. & M.F. Newman - Zingiberaceae
6. 146991-*Hydnocarpus pentandrus* (Buch.-Ham.) Oken - Achariaceae
7. 146907-*Meistera newmanii* (M. Sabu & V.P. Thomas) Skornick. & M.F. Newman - Zingiberaceae
8. 146927-*Meistera newmanii* (M. Sabu & V.P. Thomas) Skornick. & M.F. Newman - Zingiberaceae
9. 146976-*Hibiscus platanifolius* (Willd.) Sweet - Malvaceae
10. 146954-*Connarus paniculatus* Roxb. - Connaraceae
11. 147583-*Memecylon heyneanum* Benth. ex Wight & Arn. - Melastomataceae
12. 147609 -*Barleria nitida* Nees – Acanthaceae
13. 140746 -*Psychotria nudiflora* Wight & Arn. – Rubiaceae
14. 140748 -*Psychotria nudiflora* Wight & Arn. – Rubiaceae
15. 140749 -*Benkara malabarica* (Lam.) Tirveng. – Rubiaceae
16. 140750 - *Cayratia tenuifolia* (Wight & Arn.) Gagnep. – Vitaceae
17. 140755- *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult. – Poaceae
18. 140761 - *Jasminum auriculatum* Vahl – Oleaceae
19. 140762 – *Blepharispermum petiolare* DC. – Asteraceae
20. 140763 - *Viscum angulatum* B. Heyne ex DC. – Santalaceae
21. 140767 - *Scleria levis* Retz. – Cyperaceae;
22. 140770 - *Paramignya scandens* (Griff.) Craib – Rutaceae
23. 140772 - *Celastrus paniculatus* Willd. – Celastraceae
24. 140779 - *Oplismenus burmanni* (Retz.) P. Beauv. – Poaceae
25. ; 140780 - *Neolitsea scrobiculata* Gamble – Lauraceae
26. 144649 – *Psychotria nudiflora* var. *latifolia* Deb & M.G. Gangop. – Rubiaceae
27. 144653 – *Canscora diffusa* (Vahl) R.Br. ex Roem. & Schult. – Gentinaceae
28. 144657 – *Dillenia pentagyna* Roxb. – Dilleniaceae
29. 144659 - *Isonandra lanceolata* Wight – Sapotaceae
30. 144681 - *Viburnum coriaceum* Blume – Caprifoliaceae
31. 144687 - *Peperomia tetraphylla* (G.Forst.) Hook. & Arn. – Piperaceae
32. 144689 - *Euphorbia rothiana* Spreng. – Euphorbiaceae
33. 144690 – *Rungia wightiana* Nees – Acanthaceae

34. 144691 - *Elaeocarpus serratus* L. – Elaeocarpaceae
35. 144692 – *Isonandra zeylanica* Jeuken – Sapotaceae
36. 144693 – *Connarus monocarpus* L. – Connaraceae
37. 144694 - *Zeuxine gracilis* (Breda) Blume – Orchidaceae
38. 144695 – *Gomphostemma keralensis* Vivek., Gopalan & Ansari – Lamiaceae
39. 144696 - *Biophytum intermedium* Wight – Oxalidaceae
40. 144697 - *Rubus glomeratus* Blume – Rosaceae
41. 144698 - *Bischofia javanica* Blume – Euphorbiaceae
42. 144699 – *Glochidion hohenackeri* (Muell.-Arg.) Bedd. – Euphorbiaceae
43. 144700 - *Pycneus malabaricus* C.B. Clarke - Cyperaceae
44. 140665- *Memecylon nervosum* Vadhyar, J.H.F. Benj. & Sujana - Melastomataceae
45. 140760 - *Memecylon nervosum* Vadhyar, J.H.F. Benj. & Sujana - Melastomataceae
46. 140814- *Naravelia zeylanica* (L.) DC. – Ranunculaceae
47. 140855 – *Memecylon heyneanum* Benth. ex Wight & Arn. – Melastomataceae
48. 140869 – *Memecylon heyneanum* Benth. ex Wight & Arn. – Melastomataceae
49. 140871 – *Memecylon heyneanum* Benth. ex Wight & Arn. – Melastomataceae
50. 140872 – *Meiogyne pannosa* (Dalz.) Sinclair – Annonaceae
51. 140894 – *Henkelia missionis* (Wall. ex R. Br.) A. Weber & B. L. Burtt – Gesneriaceae
52. 140895 - *Memecylon nervosum* Vadhyar, J.H.F. Benj. & Sujana – Melastomataceae
53. 146831 - *Memecylon nervosum* Vadhyar, J.H.F. Benj. & Sujana – Melastomataceae
54. 146937 - *Dolichandra unguiculata* (Vell.) L.G. Lohmann – Bignoniaceae
55. 146977–*Hypolytrum nemorum* (Vahl) Spreng. – Cyperaceae
56. 147015–*Henkelia missionis* (Wall. ex R. Br.) A. Weber & B. L. Burtt – Gesneriaceae
57. 147041 –*Porpax braccata* (Lindl.) Schuit., Y.P. Ng & H. A. Pedersen – Orchidaceae
58. 147048 - *Justicia vahli* A. Dietr. ex Nees – Acanthaceae
59. 147583- *Memecylon heyneanum* Benth. ex Wight & Arn. – Melastomataceae
60. 147609 - *Barleria nitida* Nees - Acanthaceae
61. 140741 - *Jasminum calophyllum* Wall. ex G. Don – Oleaceae
62. 140768 – *Eranthemum capense* L.- Acanthaceae
63. 140784 – *Barleria courtallica* Nees – Acanthaceae
64. 140787 – *Asparagus racemosus* Willd. Asparagaceae
65. 140792 – *Grewia flavescens* Juss. – Malvaceae
66. 140795 - *Justicia glabra* K.D. Koenig ex Roxb. – Acanthaceae
67. 140798 - *Cocculus hirsutus* (L.) W. Theob. – Menispermaceae
68. 140799 – *Jasminum auriculatum* Vahl – Oleaceae
69. 144601 – *Melinis repens* (Willd.) Zizka – Poaceae
70. 144603 – *Capparis rheedei* DC. – Capparaceae
71. 144604 – *Ficus mollis* Vahl – Moraceae
72. 144606 – *Actephila excelsa* (Dalzell) Müll. Arg. – Euphorbiaceae
73. 144610 – *Aporosa cardiosperma* (Gaertn.) Merr. – Euphorbiaceae
74. 144611 – *Vincetoxicum hirsutum* (Wall.) Kuntze - Apocynaceae
75. 144612 – *Aporosa indoacuminata* Chakrab. & N.P. Balakr. – Euphorbiaceae
76. 144614 – *Phoebe lanceolata* (Nees) Nees – Lauraceae
77. 144615- *Aporosa indoacuminata* Chakrab. & N.P. Balakr. – Euphorbiaceae
78. 144616 – *Mallotus aureopunctatus* (Dalzell) Müll. Arg. – Euphorbiaceae
79. 144620 - *Salacia fruticosa* Wall. – Hippocrateaceae
80. 144621- *Jasminum flexile* Vahl – Oleaceae
81. 144623 – *Rungia apiculata* Bedd. – Acanthaceae
82. 144624 – *Syzygium gardneri* Thwaites – Myrtaceae
83. 144625 – *Flacourtia montana* J. Graham – Flacourtiaceae
84. 144626 – *Psychotria dicoccos* Gaertn. – Rubiaceae

85. 144631- *Polyalthia malabarica* var. *longipedicellata* Alister, G. Rajkumar, Nazarudeen & Pandur. – Annonaceae
86. 144636 – *Benkara malabarica* (Lam.) Tirveng. – Rubiaceae
87. 144638 – *Vincetoxicum capparidifolium* (Wight & Arn.) Kuntze – Apocynaceae
88. 144639 – *Azanza lampas* (Cav.) Alef. – Malvaceae
89. 144659 - *Isonandralanceolata* Wight – Sapotaceae;
90. 144666 – *Cymbidium aloifolium* (L.) Sw. – Orchidaceae
91. 144671 – *Syzygium neesianum* Arn. – Myrtaceae
92. 144677 - *Schoenoplectiella articulata* (L.) Lye – Cyperaceae
93. 140755 – *Isonandra zeylanica* Jeuken – Sapotaceae
94. 140773 - *Ficus microcarpa* L.f. – Moraceae
95. 140777 – *Embelia basaal* (Roem. & Schult.) A. DC. – Primulaceae
96. 140778 – *Themeda cymbaria* Hack. – Poaceae
97. 140785 - *Grewia bracteata* Roth – Tiliaceae
98. 140789 – *Paracalyx scariosus* (Roxb.) Ali – Leguminosae
99. 140799 - *Jasminum auriculatum* Vahl – Oleaceae
100. 140800 - *Grewia serrulata* DC – Tiliaceae
101. 144635 - *Phyllanthus assamicus* Müll.Arg. – Euphorbiaceae
102. 144670 – *Cissampelopsis ansteadii* (Tadul. & Jacob) C. Jeffrey & Y.L. Chen - Menispermaceae
103. 144683 – *Symplocos oligandra* Bedd. – Symplocaceae
104. 146802 - *Grewia serrulata* DC. – Tiliaceae
105. 146805 – *Actephila excelsa* (Dalzell) Müll.Arg. – Euphorbiaceae
106. 146808 - *Cissus vitiginea* L. – Vitaceae
107. 146811 - *Albizia lebbeck* (L.) Benth. – Leguminosae
108. 146815 – *Gymnosporia emarginata* (Willd.) Thwaites - Celastraceae
109. 146817 - *Vincetoxicum indicum* (Burm.f.) Mabb. – Apocynaceae
110. 146820 - *Benkara malabarica* (Lam.) Tirveng. – Rubiaceae
111. 146823 - *Solanum violaceum* Ortega – Solanaceae
112. 146828 - *Carissa spinarum* L. – Apocynaceae
113. 146841 - *Glycosmis macrocarpa* Wight – Rutaceae
114. 146851 - *Chlorophytum heynei* Baker- Liliaceae
115. 146852 - *Dendrobium aqueum* Lindl.-Orchidaceae
116. 146853 – *Eria polystachya* A.Rich.-Orchidaceae
117. 146855 – *Anaphyllum wightii* Schott- Araceae
118. 147038 – *Exacum courtallense* Arn.- Gentianaceae
119. 140816 – *Exacum lawii* C.B. Clarke- Gentianaceae
120. 140838 - *Exacum courtallense* Arn.- Gentianaceae
121. 140861 - *Dianella ensifolia* (L.) Redouté – Liliaceae
122. 140875- *Ceropegia decaisneana* Wight – Asclepiadaceae
123. 140871- *Asparagus racemosus* Willd.-Asparagaceae
124. 140864 – *Peristylus goodyeroides* (D. Don) Lindl – Orchidaceae
125. 147012 – *Drypetes confertiflora* (Hook.f.) Pax & K. Hoffm. – Euphorbiaceae
126. 147074 - *Ixora lanceolaria* Colebr. – Rubiaceae
127. 147096 – *Pinalia mysorensis* (Lindl.) Kuntze – Orchidaceae
128. 147506 - *Begonia albococcinea* Hook. – Begoniaceae
129. 147524 – *Dicliptera foetida* (Forssk.) Blatt. – Acanthaceae
130. 147526 - *Stephania wightii* (Arn. ex Wight) Dunn – Menispermaceae
131. 147530 – *Syzygium neesianum* Arn. – Myrtaceae
132. 147532 - *Liparis elliptica* Wight – Orchidaceae
133. 147533 – *Rungia apiculata* Bedd. – Acanthaceae
134. 147535 – *Bulbophyllum stocksii* (Benth. ex Hook.f.) J.J.Verm., Schuit. & de Vogel – Orchidaceae

135. 147537 – *Argyrea osyrensis* (Roth) Choisy – Convolvulaceae
136. 147539 - *Ixora nigricans* R.Br. ex Wight & Arn. – Rubiaceae
137. 147601 - *Glycosmis angustifolia* Lindl. ex Wight & Arn. – Rutaceae
138. 147602 – *Pavetta travancorica* Bremek. – Rubiaceae
139. 147603 - *Ixora malabarica* (Dennst.) Mabb. – Rubiaceae
140. 147604 – *Orophea uniflora* Hook.f. & Thomson – Annonaceae
141. 147607 - *Aglaiia elaeagnoidea* (A.Juss.) Benth. – Meliaceae
142. 147614 - *Combretum ovalifolium* Roxb. ex G.Don – Combretaceae
143. 147569 - *Memecylon heyneanum* Benth. ex Wight & Arn. – Melastomataceae
144. 147606 – *Psychotria connata* Wall. – Rubiaceae
145. 147574 – *Nothopegia travancorica* Bedd. ex Hook.f. – Anacardiaceae
146. 147575 - *Polyalthialongipedicellata* (Alister, G. Rajkumar, Nazarudeen & Pandur.) Shailajakumari, Parthipan, A. K. Sreekala & E.S.S. Kumar- Annonaceae
147. 147576 – *Mallotus distans* Muell.-Arg – Euphorbiaceae
148. 147581 - *Glycosmis angustifolia* Lindl. ex Wight & Arn. – Rutaceae
149. 147583 – *Memecylon heyneanum* Benth. ex Wight & Arn.
150. 147011 – *Tarenna alpestris* (Wight) N.P. Balakr. – Rubiaceae
151. 147015 – *Henckelia missionis* (Wall. ex R.Br.) A. Weber & B.L. Burtt - Gesneriaceae
152. 147034 - *Impatiens diversifolia* Wall. ex Wight & Arn. - Balsaminaceae
153. 147041 - *Porpax braccata* (Lindl.) Schuit., Y.P. Ng & H.A. Pedersen - Orchidaceae

PROJECT-2

Assessment of Plant diversity in Cauvery North Wildlife Sanctuary; Tamil Nadu

Name of the Executing Officer (s): Dr. R. Manikandan, Scientist- 'E' & Ms. Mehala Devi R., Bot. Asst.

Duration of the project: 19.09.2017 - 31.03.2021

Objectives:

- Documentation of the floral diversity of the Cauvery North Wildlife Sanctuary.
- To categorize the threat status for the threatened and endemic plants from the study area.
- Herbarium consultation to different herbaria
- Study of plant resources and their utilization practices by local communities living in and around the Sanctuary.

Site of the study (with map) : Cauvery North Wildlife Sanctuary, Tamil Nadu

Methodology adopted :

Since 2018 January the present study on Floristic Studies of Cauvery North Wildlife Sanctuary was carried out and so far seven field explorations were made by covering different seasons and vegetation. A total of 1305 field numbers have been vouched along with the GPS data and Colour photographs. The collected plant samples were processed, mounted and identified using regional floras, herbarium specimens housed at MH and adopted recent nomenclatural changes. During the plant collection in the field, characters such as habitat, habit, GPS data, phenology of flowering and fruiting, colour of the flower, fruit, seed and distribution were observed and noted.

Work done :

- A. Total area covered: 396 sq. km. out of 504.33 sq. km
- B. Number of species identified (with name): 200 field numbers identified from earlier collections from CNWLS (List attached)
- C. Number of species incorporated: Label writing for almost all specimens were completed and pasted on mounted specimens.

Output indicators for the assessment of the project:

- ✓ *Strobilanthes carnatica* Carine, J.M. Alexander & Scotland (Acanthaceae) was collected from the type locality after 40 years.
- ✓ Almost all the specimens collected from the sanctuary are identified.
- ✓ Label writing for almost all specimens were completed and pasted for all the mounted specimens.
- ✓ A list of 70 endemic species was collected from the study area.
- ✓ Herbarium consultation was conducted to THE RAPINAT HERBARIUM, St. Joseph's College (Autonomous), Tiruchirapalli, Tamil Nadu from 04.01.2021 to 13.01.2021 (10 days).
- ✓ Four hundred (400) specimens were consulted from the study area.

Major impacts reported during the financial year: This study will provide a comprehensive account of floristic wealth of Cauvery North Wildlife Sanctuary which will be an aid of identification of taxa, documentation of uses of plants by local people surrounding the Sanctuary, evaluation of endemic plants and their conservation.

LIST OF SPECIMENS IDENTIFIED FROM CAUVERY NORTH WILDLIFE SANCTURAY ALONG WITH FIELD NUMBER (200 nos.) FROM APRIL 2020 TO SEPTEMBER 2021

| S. No. | Field No. | Scientific Name | Family |
|--------|-----------|--|---------------|
| 1. | 142023 | <i>Abrus precatorius</i> L. | Fabaceae |
| 2. | 141677 | <i>Abutilon hirtum</i> (Lam.) Sweet | Malvaceae |
| 3. | 145819 | <i>Abutilon indicum</i> (L.) Sweet | Malvaceae |
| 4. | 141480 | <i>Abutilon indicum</i> (L.) Sweet | Malvaceae |
| 5. | 145860 | <i>Acalypha capitata</i> Willd. | Euphorbiaceae |
| 6. | 145915 | <i>Acalypha ciliata</i> Forssk. | Euphorbiaceae |
| 7. | 145866 | <i>Acalypha fruticosa</i> Forssk. | Euphorbiaceae |
| 8. | 141666 | <i>Acanthospermum hispidum</i> DC. | Asteraceae |
| 9. | 142160 | <i>Achyranthes coynei</i> Santapau | Amaranthaceae |
| 10. | 141583 | <i>Adina cordifolia</i> (Roxb.) Brandis | Rubiaceae |
| 11. | 141755 | <i>Adina cordifolia</i> (Roxb.) Brandis | Rubiaceae |
| 12. | 145874 | <i>Ageratum conyzoides</i> L. | Asteraceae |
| 13. | 141792 | <i>Aglaia elaeagnoidea</i> (A.Juss.) Benth. | Meliaceae |
| 14. | 145854 | <i>Albizia amara</i> (Roxb.) Boivin | Fabaceae |
| 15. | 141442 | <i>Albizia amara</i> (Roxb.) Boivin | Fabaceae |
| 16. | 141519 | <i>Albizia amara</i> (Roxb.) Boivin | Fabaceae |
| 17. | 141638 | <i>Albizia amara</i> (Roxb.) Boivin | Fabaceae |
| 18. | 141760 | <i>Albizia odoratissima</i> (L.f.) Benth. | Mimosaceae |
| 19. | 141468 | <i>Albizia lebbeck</i> (L.) Benth. | Fabaceae |
| 20. | 145847 | <i>Allmania nodiflora</i> (L.) R.Br. ex Wight | Amaranthaceae |
| 21. | 141976 | <i>Allmania nodiflora</i> (L.) R.Br. ex Wight | Amaranthaceae |
| 22. | 142017 | <i>Allmania nodiflora</i> (L.) R.Br. ex Wight | Amaranthaceae |
| 23. | 145898 | <i>Allophylus cobbe</i> (L.) Forsyth f. | Sapindaceae |
| 24. | 142158 | <i>Alloteropsis cimicina</i> (L.) Stapf | Poaceae |
| 25. | 141639 | <i>Alternanthera philoxeroides</i> (Mart.) Griseb. | Amaranthaceae |
| 26. | 141668 | <i>Alternanthera pungens</i> Kunth | Amaranthaceae |
| 27. | 145908 | <i>Alysicarpus monilifer</i> (L.) DC. | Fabaceae |
| 28. | 141422 | <i>Ammannia baccifera</i> L. | Lythraceae |

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| 29. | 141423 | <i>Ammannia baccifera</i> L. | Lythraceae |
| 30. | 141405 | <i>Ammannia baccifera</i> L. | Lythraceae |
| 31. | 145917 | <i>Ampelocissus latifolia</i> (Roxb.) Planch. | Vitaceae |
| 32. | 145926 | <i>Ampelocissus tomentosa</i> (Roth) Planch. | Vitaceae |
| 33. | 145855 | <i>Andrographis echiioides</i> (L.) Nees | Acanthaceae |
| 34. | 141986 | <i>Anisomeles indica</i> (L.) Kuntze | Lamiaceae |
| 35. | 141448 | <i>Anisomeles malabarica</i> (L.) R.Br. | Lamiaceae |
| 36. | 141937 | <i>Apluda mutica</i> L. | Poaceae |
| 37. | 141594 | <i>Aponogeton crispus</i> Thunb. | Aponogetonaceae |
| 38. | 142182 | <i>Arisaema tortuosum</i> (Wall.) Schott | Araceae |
| 39. | 141569 | <i>Asparagus racemosus</i> Willd. | Asparagaceae |
| 40. | 142169 | <i>Asystasia dalzelliana</i> Santapau | Acanthaceae |
| 41. | 141406 | <i>Bacopa monnieri</i> (L.) Wettst. | Plantaginaceae |
| 42. | 141454 | <i>Bacopa monnieri</i> (L.) Wettst. | Plantaginaceae |
| 43. | 141575 | <i>Bauhinia racemosa</i> Lam. | Fabaceae |
| 44. | 142005 | <i>Bauhinia tomentosa</i> L. | Fabaceae |
| 45. | 141896 | <i>Benkara malabarica</i> (Lam.) Tirveng. | Rubiaceae |
| 46. | 145850 | <i>Blainvillea acmella</i> (L.) Philipson | Asteraceae |
| 47. | 141640 | <i>Bombax ceiba</i> L. | Malvaceae |
| 48. | 141572 | <i>Breynia vitis-idaea</i> (Burm.f.) C.E.C.Fisch. | Phyllanthaceae |
| 49. | 141975 | <i>Breynia vitis-idaea</i> (Burm.f.) C.E.C.Fisch. | Phyllanthaceae |
| 50. | 145925 | <i>Bulbostylis barbata</i> (Rottb.) C.B.Clarke | Cyperaceae |
| 51. | 141696 | <i>Bulbostylis barbata</i> (Rottb.) C.B.Clarke | Cyperaceae |
| 52. | 141775 | <i>Bulbostylis barbata</i> (Rottb.) C.B.Clarke | Cyperaceae |
| 53. | 141524 | <i>Butea monosperma</i> (Lam.) Kuntze | Fabaceae |
| 54. | 142162 | <i>Caesalpinia bonduc</i> (L.) Roxb. | Fabaceae |
| 55. | 141944 | <i>Cajanus albicans</i> (Wight & Arn.) Maesen | Fabaceae |
| 56. | 145923 | <i>Cajanus sericeus</i> (Baker)Maesen | Fabaceae |
| 57. | 141870 | <i>Calpurnia aurea</i> (Aiton) Benth. | Fabaceae |
| 58. | 141509 | <i>Canavalia cathartica</i> Thouars | Fabaceae |
| 59. | 141767 | <i>Canthium coromandelicum</i> (Burm.f.) Alston | Rubiaceae |
| 60. | 145838 | <i>Canthium coromandelicum</i> (Burm.f.) Alston | Rubiaceae |
| 61. | 145804 | <i>Capparis zeylanica</i> L. | Capparaceae |
| 62. | 145897 | <i>Cassytha filiformis</i> L. | Lauraceae |
| 63. | 141942 | <i>Celosia argentea</i> L. | Amaranthaceae |
| 64. | 142165 | <i>Celosia polygonoides</i> Retz. | Amaranthaceae |
| 65. | 141516 | <i>Celosia polygonoides</i> Retz. | Amaranthaceae |
| 66. | 141685 | <i>Celosia polygonoides</i> Retz. | Amaranthaceae |
| 67. | 142000 | <i>Celosia polygonoides</i> Retz. | Amaranthaceae |
| 68. | 141511 | <i>Cenchrus ciliaris</i> L. | Poaceae |
| 69. | 145927 | <i>Ceropegia candelabrum</i> var. <i>biflora</i> (L.) Ansari | Apocynaceae |
| 70. | 145856 | <i>Ceropegia juncea</i> Roxb. | Apocynaceae |
| 71. | 145842 | <i>Chamaecrista absus</i> (L.) H.S.Irwin & Barneby | Fabaceae |
| 72. | 141990 | <i>Chamaecrista pumila</i> (Lam.)K.Larsen | Fabaceae |
| 73. | 145833 | <i>Chamaecrista pumila</i> (Lam.) V.Singh | Fabaceae |
| 74. | 141887 | <i>Chamaecrista pumila</i> (Lam.) V.Singh | Fabaceae |
| 75. | 145808 | <i>Chlorophytum malabaricum</i> Baker | Asparagaceae |

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| 76. | 142156 | <i>Cissus woodrowii</i> (Stapf ex Cooke) Santapau | Vitaceae |
| 77. | 145803 | <i>Citrus maxima</i> (Burm.) Merr. | Rutaceae |
| 78. | 142199 | <i>Citrus medica</i> L. | Rutaceae |
| 79. | 145902 | <i>Clausena anisata</i> (Willd.) Hook.f. ex Benth. | Rutaceae |
| 80. | 141833 | <i>Cleistanthus collinus</i> (Roxb.) Benth. ex Hook.f. | Phyllanthaceae |
| 81. | 145916 | <i>Cleome aspera</i> J.Koenig ex DC. | Cleomaceae |
| 82. | 141673 | <i>Cleome aspera</i> J.Koenig ex DC. | Cleomaceae |
| 83. | 142154 | <i>Cleome monophylla</i> L. | Cleomaceae |
| 84. | 141709 | <i>Clitoria ternatea</i> L. | Fabaceae |
| 85. | 145906 | <i>Cochlospermum religiosum</i> (L.) Alston | Bixaceae |
| 86. | 142024 | <i>Coffea wightiana</i> Wall. ex Wight & Arn. | Rubiaceae |
| 87. | 141779 | <i>Corbichonia decumbens</i> (Forssk.) Exell | Lophiocarpaceae |
| 88. | 142009 | <i>Corchorus aestuans</i> L. | Malvaceae |
| 89. | 141460 | <i>Corchorus olitorius</i> L. | Malvaceae |
| 90. | 141678 | <i>Corchorus urticifolius</i> Wight & Arn. | Malvaceae |
| 91. | 145867 | <i>Cordia monoica</i> Roxb. | Boraginaceae |
| 92. | 145914 | <i>Cordia monoica</i> Roxb. | Boraginaceae |
| 93. | 141743 | <i>Cordia monoica</i> Roxb. | Boraginaceae |
| 94. | 142015 | <i>Cordia monoica</i> Roxb. | Boraginaceae |
| 95. | 142153 | <i>Crinum asiaticum</i> L. | Amaryllidaceae |
| 96. | 141735 | <i>Crinum latifolium</i> L. | Amaryllidaceae |
| 97. | 141983 | <i>Crotalaria bifaria</i> L.f. | Fabaceae |
| 98. | 141954 | <i>Crotalaria calycina</i> Schrank | Fabaceae |
| 99. | 141997 | <i>Crotalaria laburnifolia</i> L. | Fabaceae |
| 100. | 145826 | <i>Crotalaria medicaginea</i> Lam. | Fabaceae |
| 101. | 145935 | <i>Crotalaria medicaginea</i> Lam. | Fabaceae |
| 102. | 141470 | <i>Crotalaria medicaginea</i> Lam. | Fabaceae |
| 103. | 141477 | <i>Crotalaria medicaginea</i> Lam. | Fabaceae |
| 104. | 142147 | <i>Crotalaria mysorensis</i> Roth | Fabaceae |
| 105. | 141466 | <i>Crotalaria pallida</i> Aiton | Fabaceae |
| 106. | 141445 | <i>Crotalaria paniculata</i> Willd. | Fabaceae |
| 107. | 141644 | <i>Crotalaria pulchra</i> Andrews | Fabaceae |
| 108. | 145911 | <i>Crotalaria pusilla</i> Roxb. ex Wight & Arn. | Fabaceae |
| 109. | 141687 | <i>Crotalaria verrucosa</i> L. | Fabaceae |
| 110. | 141518 | <i>Crotalaria willdenowiana</i> DC. | Fabaceae |
| 111. | 142021 | <i>Crotalaria willdenowiana</i> DC. | Fabaceae |
| 112. | 145934 | <i>Cryptolepis buchananii</i> R.Br. ex Roem. & Schult. | Apocynaceae |
| 113. | 145870 | <i>Cryptolepis grandiflora</i> Wight | Asclepideaceae |
| 114. | 141856 | <i>Cucumis melo</i> L. | Cucurbitaceae |
| 115. | 142157 | <i>Curcuma neilgherrensis</i> Wight | Zingiberaceae |
| 116. | 145891 | <i>Cyanotis arachnoidea</i> C.B.Clarke | Commelinaceae |
| 117. | 141876 | <i>Cyanotis arachnoidea</i> C.B.Clarke | Commelinaceae |
| 118. | 141933 | <i>Cyanotis axillaris</i> (L.) D.Don ex Sweet | Commelinaceae |
| 119. | 142195 | <i>Cyanotis cristata</i> (L.) D.Don | Commelinaceae |
| 120. | 145818 | <i>Cyanotis cristata</i> (L.) D.Don | Commelinaceae |
| 121. | 141932 | <i>Cyanotis cristata</i> (L.) D.Don | Commelinaceae |
| 122. | 142148 | <i>Cyanotis fasciculata</i> (B.Heyne ex Roth) Schult. & Schult.f. | Commelinaceae |

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| 123. | 145904 | <i>Cyanotis fasciculata</i> (B.Heyne ex Roth) Schult. & Schult.f. | Commelinaceae |
| 124. | 141936 | <i>Cyanotis fasciculata</i> (B.Heyne ex Roth) Schult. & Schult.f. | Commelinaceae |
| 125. | 141902 | <i>Cyanotis tuberosa</i> (Roxb.) Schult. & Schult.f. | Commelinaceae |
| 126. | 141672 | <i>Cyanotis tuberosa</i> (Roxb.) Schult. & Schult.f. | Commelinaceae |
| 127. | 142146 | <i>Cyanthillium cinereum</i> (L.) H.Rob. | Asteraceae |
| 128. | 141958 | <i>Cyanthillium cinereum</i> (L.) H.Rob. | Asteraceae |
| 129. | 145811 | <i>Cyclea peltata</i> (Lam.) Hook.f. & Thomson | Menispermaceae |
| 130. | 145807 | <i>Cymbopogon flexuosus</i> (Nees ex Steud.) W. Watson | Poaceae |
| 131. | 145886 | <i>Cymbopogon polyneuros</i> (Steud.) Stapf | Poaceae |
| 132. | 141484 | <i>Cyperus articulatus</i> L. | Poaceae |
| 133. | 145824 | <i>Cyperus difformis</i> L. | Cyperaceae |
| 134. | 141401 | <i>Cyperus difformis</i> L. | Cyperaceae |
| 135. | 141471 | <i>Cyperus difformis</i> L. | Cyperaceae |
| 136. | 141560 | <i>Cyperus distans</i> L.f. | Cyperaceae |
| 137. | 141412 | <i>Cyperus iria</i> L. | Cyperaceae |
| 138. | 141838 | <i>Cyperus nutans</i> var. <i>eleusinoides</i> (Kunth) Haines | Cyperaceae |
| 139. | 141705 | <i>Cyperus rotundus</i> L. | Cyperaceae |
| 140. | 142039 | <i>Cyphostemma auriculatum</i> (Roxb.) P.Singh & B.V.Shetty | Vitaceae |
| 141. | 141435 | <i>Dalbergia lanceolaria</i> L.f. | Fabaceae |
| 142. | 141765 | <i>Dalbergia lanceolaria</i> L.f. | Fabaceae |
| 143. | 141803 | <i>Dalbergia lanceolaria</i> L.f. | Fabaceae |
| 144. | 141629 | <i>Dalbergia lanceolaria</i> subsp. <i>paniculata</i> (Roxb.) Thoth. | Fabaceae |
| 145. | 141924 | <i>Dalbergia latifolia</i> Roxb. | Fabaceae |
| 146. | 142145 | <i>Datura metel</i> L. | Solanaceae |
| 147. | 145840 | <i>Datura metel</i> L. | Solanaceae |
| 148. | 142191 | <i>Dendrobium nanum</i> Hook.f. | Orchidaceae |
| 149. | 141625 | <i>Dendrocalamus strictus</i> (Roxb.) Nees | Poaceae |
| 150. | 141455 | <i>Dentella repens</i> (L.) J.R.Forst. & G.Forst. | Rubiaceae |
| 151. | 141561 | <i>Dentella repens</i> (L.) J.R.Forst. & G.Forst. | Rubiaceae |
| 152. | 142010 | <i>Derris scandens</i> (Roxb.) Benth. | Fabaceae |
| 153. | 145862 | <i>Derris scandens</i> (Roxb.) Benth. | Fabaceae |
| 154. | 142030 | <i>Desmodium gangeticum</i> (L.) DC. | Fabaceae |
| 155. | 145903 | <i>Desmodium velutinum</i> (Willd.) DC. | Fabaceae |
| 156. | 141740 | <i>Dichrostachys cinerea</i> (L.) Wight & Arn. | Fabaceae |
| 157. | 142011 | <i>Dicliptera cuneata</i> Nees | Acanthaceae |
| 158. | 142170 | <i>Didymocarpus tomentosus</i> Wight | Gesneriaceae |
| 159. | 145825 | <i>Digitaria abludens</i> (Roem. & Schult.) Veldkamp | Poaceae |
| 160. | 142144 | <i>Dioscorea oppositifolia</i> L. | Dioscoreaceae |
| 161. | 145894 | <i>Diospyros melanoxylon</i> Roxb. | Ebenaceae |
| 162. | 145814 | <i>Diplocyclos palmatus</i> (L.) C.Jeffrey | Cucurbitaceae |
| 163. | 142007 | <i>Dracaena angolensis</i> (Welw. ex Carrière) Byng & Christenh. | Asparagaceae |
| 164. | 145813 | <i>Dyschoriste nagchana</i> (Nees) Bennet | Acanthaceae |
| 165. | 141768 | <i>Dyschoriste nagchana</i> (Nees) Bennet | Acanthaceae |
| 166. | 145802 | <i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants | Chenopodiaceae |
| 167. | 145832 | <i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants | Amaranthaceae |
| 168. | 141446 | <i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants | Chenopodiaceae |
| 169. | 145858 | <i>Ehretia aspera</i> Willd. | Boraginaceae |

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| 170. | 145924 | <i>Ehretia aspera</i> Willd. | Boraginaceae |
| 171. | 141910 | <i>Ehretia aspera</i> Willd. | Boraginaceae |
| 172. | 142034 | <i>Ehretia microphylla</i> Lam. | Boraginaceae |
| 173. | 145929 | <i>Elaeodendron glaucum</i> (Rottb.) Pers. | Celastraceae |
| 174. | 141517 | <i>Elytraria acaulis</i> (L. fil.) Lindau | Acanthaceae |
| 175. | 142143 | <i>Endostemon viscosus</i> (Roth) M.R.Ashby | Lamiaceae |
| 176. | 141953 | <i>Endostemon viscosus</i> (Roth) M.R.Ashby | Lamiaceae |
| 177. | 141865 | <i>Enicostema axillare</i> (Poir. ex Lam.) A.Raynal | Gentianaceae |
| 178. | 145857 | <i>Enneapogon persicus</i> Boiss. | Poaceae |
| 179. | 142171 | <i>Equilabium molle</i> (Aiton) Mwany. & A.J.Paton | Lamiaceae |
| 180. | 141979 | <i>Equilabium molle</i> (Aiton) Mwany. & A.J.Paton | Lamiaceae |
| 181. | 142150 | <i>Eragrostiella bifaria</i> (Vahl) Bor | Poaceae |
| 182. | 145816 | <i>Erigeron bonariensis</i> L. | Asteraceae |
| 183. | 141618 | <i>Erythrina suberosa</i> Roxb. | Fabaceae |
| 184. | 145863 | <i>Euphorbia antiquorum</i> L. | Euphorbiaceae |
| 185. | 141498 | <i>Euphorbia antiquorum</i> L. | Euphorbiaceae |
| 186. | 141558 | <i>Euphorbia antiquorum</i> L. | Euphorbiaceae |
| 187. | 145932 | <i>Euphorbia prostrata</i> Aiton | Euphorbiaceae |
| 188. | 145919 | <i>Euphorbia serpens</i> Kunth | Euphorbiaceae |
| 189. | 141514 | <i>Euphorbia thymifolia</i> L. | Euphorbiaceae |
| 190. | 141461 | <i>Euploca ovalifolia</i> (Forssk.) Diane & Hilger | Boraginaceae |
| 191. | 141776 | <i>Euploca ovalifolia</i> (Forssk.) Diane & Hilger | Boraginaceae |
| 192. | 141777 | <i>Euploca ovalifolia</i> (Forssk.) Diane & Hilger | Boraginaceae |
| 193. | 141402 | <i>Exacum pedunculatum</i> L. | Gentianaceae |
| 194. | 141853 | <i>Ficus amplissima</i> Sm. | Moraceae |
| 195. | 141528 | <i>Ficus benghalensis</i> L. | Moraceae |
| 196. | 141609 | <i>Ficus drupacea</i> Thunb. | Moraceae |
| 197. | 141846 | <i>Ficus drupacea</i> Thunb. | Moraceae |
| 198. | 142174 | <i>Ficus microcarpa</i> L.f. | Moraceae |
| 199. | 145895 | <i>Ficus microcarpa</i> L.f. | Moraceae |
| 200. | 141829 | <i>Ficus mollis</i> Vahl | Moraceae |

PROJECT-3

Marine Macro Algal Flora of India

Name of the Executing Officer: Dr. M. Palanisamy, Scientist – ‘E’

Duration of the Project : April, 2019 – March, 2022.

Objectives

To survey and documentation of the marine algae of the unexplored areas along with photography of all the marine algae found in the Indian coast; Identification and preparation of Taxonomic keys; consultation of literature and herbarium specimens housed in various herbaria in India The compilation of data in the form of Marine Macro Algal Flora of India

Site of the Study: India

Methodology adopted

Exploration tours and collection of Seaweeds

The exploration tours for the collection of seaweeds were scheduled based on the seasons (divided in to 4 quarter) to record and report the seasonal wise as well as to collect the seasonal available and depended species. The duration (days) was centered on the atmospheric factors such as atmospheric temperature, rain fall, humidity,

seawater current and tides, pH, water temperature, etc. The tide charts prepared to fix period for the collection of seaweeds at low tides. Important field materials such as camera, water analysis kit, field books, note book, polythene bags (zipped), standard plastic containers (100, 250, 500 ml, 1000 ml), buckets, trays, mounting boards, blotting papers, newspapers, forceps, needles, brushes, markers, soft cotton cloth, iron presser, ropes, fevicol (SH) and preservatives (ethyl alcohol and formalin) were carried during field tours.

The seaweed samples were collected from sub-tidal & inter tidal zones. All the possible seaweed substrata such as rocks, bedrocks, artificial cement boulders, cliffs, calcareous mollusc shells and coastal wastes like nets, plastics, cloths etc. by scrapping with hands and mollusc shells. Small and delicate or coralline algae were collected with great care to avoid any damage of the specimen. The Scuba diving kit and snorkel kit were used for collection, where the location is highly deep. The collected samples were kept in the zip lock covers and container. While making collection, important field details such as habit, habitats, nature of the coast, locality and its GPS position, vegetation were noted in field notebook. Further, important physico-chemical parameters of sea water such as salinity, atmospheric and water temperatures, pH value, Total Dissolved Solids (TDS), and Dissolved Oxygen (DO) values were measured using the water analysis kit. The habit, habitats and coastal natures were photographed using the camera (Nikon D3300 & Nikon Underwater camera). All the collected marine macro algal samples were washed thoroughly with sea water, followed by using fresh water to remove attached sand particles, sediments and debris without damaging the specimens. Later, they were preserved by adopting two methods.

1. Wet Preservation 2. Dry Preservation

Wet Preservation

After removal of debris from the specimens, preserved in mixed solution of 4% of formalin, 1% of ethyl alcohol and 95 % of filtered seawater in different size plastic containers (50 ml, 100 ml, 250 ml, 500 ml and 1000 ml) and tightly sealed. All the containers were labeled properly with name of the species, field number, date, place of collection and collector/s name. All the preserved materials were brought to the laboratory for further study.

Dry Preservation

Under dry method, the seaweed specimens were preserved in the form of herbarium sheets. For each field number, minimum two herbarium sheets were prepared adopting the standard herbarium techniques (Srinivasan, 1969; Dhargalkar & Kavlekar, 2004). The following steps were followed for the preparation of herbarium sheets:

The collected specimens were segregated into three groups *viz.*, red, brown and green. The samples were floated in water filled tray and standard herbarium sheet (28 × 42 cm) was immersed in between tray and specimens and gently lifted the herbarium sheet with spreaded specimens. The mounted samples were covered with piece of white cotton cloths to avoid any damage of the specimens because the algal samples are very delicate. Each herbarium sheet was pasted a field number on left side of the sheet. The mounted sheets were kept in between the blotting papers.

All the sheets were piled up one above the other and placed in between iron mess press and tied properly with the help of cotton ropes. The tied bundles containing the herbarium sheets were kept under sunlight for 2–6 days for proper drying of specimens. During this period, blotting papers and white cloths were periodically changed for avoiding contamination. All the dried herbarium sheets were labeled with standard label slip (8 × 12 cm), containing various details such as institution, region name, botanical name, family, local name, locality, GPS coordinates, distribution, abundance, associated plants, notes, field number, date of collection, Photography status, collectors' name and identifying author/s name. All the preserved (wet and dry) specimens are deposited at the Madras Herbarium (MH), Botanical Survey of India, Southern Regional Centre, Coimbatore for future reference.

Microscopic Studies

Microscopic study plays an important role in the precise identification of seaweeds. Many of the species are morphologically looking very similar and create confusion in identification. In such cases, anatomical characters support in confirming the identity of the species. For anatomical study, the best samples were selected from the wet preserved materials and subjected to free hand sectioning using stainless razor blade. The best sections were selected after observing them using stereo microscope (Nikon SZ51 & Carl Zeis Axio A1). The selected sections were stained (with iodine for green, methylene blue for brown and safranin for red algae), and cover slips were

gently placed above without the formation of any air bubbles. The sections were examined using optical microscopes (NIKON SMZ1500 & NIKON ECLIPSE 50i) coupled with computer attached digital sight DS-Fil camera to study the general morphology and anatomical characters.

Description

Based on the field observation and critical examination of morphological and anatomical characters of the specimens, a list of characters was prepared in the form of a data sheet and it was followed consistently while making the description of every taxon to maintain uniformity.

Identification

All the taxa submitted for identification have been arranged systematically, following the classifications proposed by Fritsch (1935, 1944) with slight modification as per Papenfuss (1951, 1955) and Silva & al. (1996). For each taxon, the currently accepted botanical name has been given in *Italic*, followed by author/s and original citation. Nomenclature has been updated following the recent International Code of Nomenclature for Algae, Fungi and Plants (McNeill & al., 2012). The names of authors given based on the reference from “*Authors of Plant Names*” by Brummitt & Powell (1992).

The following references (Flora, Literature, Monograph and Pictorial guide) were used to confirm the identity: *Phaeophyceae in India* (Misra, 1966); *Phycologia Indica: The Icons of Indian Seaweeds* (Srinivasan, 1969, 1973); *Rhodophyta* (Desikachary & al., 1990, 1998); *Catalogue of the Benthic Marine Algae of the Indian Ocean* (Silva & al., 1996); *Algae of India and Neighboring Countries I. Chlorophycota* (Krishnamurthy, 2000); *Phaeophyceae of India and Neighbourhood* (Krishnamurthy & Baluswamy, 2010) and *Algae of Australia: Green and Brown Algae* (Kraft, 2007; Huisman, 2015). The authentically deposited seaweed herbarium (collected from the peninsular states of India) in MH, Coimbatore has been referred.

In addition, other online resources such as Algaebase, (www.algaebase.org), WoRMS (www.marinespecies.org), Macroalgal Herbarium Portal (macroalgae.org), Seaweed Site: Information on marine algae (www.seaweed.ie/), Seaweed Research and Utilization (www.seaweedindia.net/), Marine Biological Association of the UK (www.mba.ac.uk/), Iris Seaweed Research Group (www.irishseaweedresearch.com/), International Phycological Society (www.intphycosoc.org/), Phycological Society of America ([/www.psaalgae.org/](http://www.psaalgae.org/)) etc., were also referred for the identification of seaweeds.

Work done

Number of Species identified: 112 Nos.

LIST OF IDENTIFIED SEAWEED TAXA COLLECTED FROM THE COASTLINE OF GUJARAT COAST DURING 10.03.2020 – 21.03.2020

| S. No. | Field no | Name of the taxa | Family |
|--------|----------|---|------------------|
| 1 | 148653 | <i>Iyengaria stellata</i> (Boergesen) Boergesen | Scytosiphonaceae |
| 2 | 148654 | <i>Colpomenia sinuosa</i> (Mertens ex Roth) Derbès & Solier | Scytosiphonaceae |
| 3 | 148655 | <i>Acanthophora spicifera</i> (M.Vahl) Børgesen | Rhodomelaceae |
| 4 | 148656 | <i>Hydropuntia edulis</i> (S.G.Gmelin) Gurgel & Fredericq | Gracilariaceae |
| 5 | 148657 | <i>Dictyopteris australis</i> (Sonder) Askenasy | Dictyotaceae |
| 6 | 148658 | <i>Acanthophora nayadiformis</i> (Delile) Papenfuss | Rhodomelaceae |
| 7 | 148659 | <i>Gracilaria textorii</i> (Suringar) Hariot | Gracilariaceae |
| 8 | 148660 | <i>Cystoseira myrica</i> (S.G.Gmelin) C.Agardh | Sargassaceae |
| 9 | 148661 | <i>Palisada cruciata</i> (Harv.) K.W.Nam | Rhodomelaceae |

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|----|--------|---|------------------|
| | | | e |
| 10 | 148662 | <i>Ulva lactuca</i> L. | Ulvaceae |
| 11 | 148663 | <i>Sargassum johnstonii</i> Setchell & N.L.Gardner | Sargassaceae |
| 12 | 148664 | <i>Halymenia floresii</i> (Clemente) C.Agardh | Halymeniaceae |
| 13 | 148665 | <i>Chondrus crispus</i> Stackh | Gigartinaceae |
| 14 | 148666 | <i>Gracilaria textorii</i> (Suringar) Hariot | Gracilariaceae |
| 15 | 148667 | <i>Gracilaria verrucosa</i> (Hudson) Papenfuss | Gracilariaceae |
| 16 | 148668 | <i>Scinaia hatei</i> Boergesen | Scinaiaceae |
| 17 | 148669 | <i>Solieria robusta</i> (Greville) Kylin | Solieriaceae |
| 18 | 148670 | <i>Dermonema virens</i> (J.Agardh) Pedroche & Ávila | Liagoraceae |
| 19 | 148671 | <i>Helminthocladia simplex</i> Doty & Abbott | Liagoraceae |
| 20 | 148672 | <i>Hypnea valentiae</i> (Turner) Mont. | Cystocloniaceae |
| 21 | 148673 | <i>Coelarthrum opuntia</i> (Endlicher) Boergesen | Rhodymeniaceae |
| 22 | 148674 | <i>Hydropuntia edulis</i> (S.G.Gmelin) Gurgel & Fredericq | Gracilariaceae |
| 23 | 148675 | <i>Ulva lactuca</i> L. | Ulvaceae |
| 24 | 148676 | <i>Sebdenia flabellata</i> (J. Agardh) P.G. Parkinson | Sebdeniaceae |
| 25 | 148677 | <i>Iyengaria stellata</i> (Boergesen) Boergesen | Scytosiphonaceae |
| 26 | 148678 | <i>Palisada perforata</i> (Bory) K.W.Nam | Rhodomelaceae |
| 27 | 148679 | <i>Caulerpa taxifolia</i> (M.Vahl) C.Agardh | Caulerpaeae |
| 28 | 148680 | <i>Dictyota hauckiana</i> Nizamuddin | Dictyotaceae |
| 29 | 148681 | <i>Caulerpa veravalensis</i> Thivy & V.D.Chauhan | Caulerpaeae |
| 30 | 148682 | <i>Scinaia complanata</i> (Collins) A.D.Cotton | Scinaiaceae |
| 31 | 148683 | <i>Caulerpa chemnitzia</i> (Esper) J.V.Lamouroux | Caulerpaeae |
| 32 | 148684 | <i>Grateloupia lithophila</i> Boergesen | Halymeniaceae |
| 33 | 148685 | <i>Codium decortcatum</i> (Woodward) M.Howe | Coidiaceae |
| 34 | 148686 | <i>Halymenia dilatata</i> Zanardini | Halymeniaceae |
| 35 | 148687 | <i>Acanthophora nayadiformis</i> (Delile) Papenfuss | Rhodomelaceae |
| 36 | 148688 | <i>Hypnea valentiae</i> (Turner) Mont. | Cystocloniaceae |
| 37 | 148689 | <i>Laurencia dendroidea</i> J.Agardh | Rhodomelaceae |
| 38 | 148690 | <i>Hydroclathrus clathratus</i> (C.Agardh) M.Howe | Scytosiphonaceae |
| 39 | 148691 | <i>Botryocladia leptopoda</i> (J.Agardh) Kylin | Rhodymeniaceae |
| 40 | 148692 | <i>Colpomenia sinuosa</i> (Mertens ex Roth) Derbès & Solier | Scytosiphonaceae |
| 41 | 148693 | <i>Spatoglossum asperum</i> J.Agardh | Dictyotaceae |
| 42 | 148694 | <i>Acanthophora muscoides</i> (Linnaeus) Bory | Rhodomelaceae |
| 43 | 148695 | <i>Halymenia floresii</i> (Clemente) C.Agardh | Halymeniaceae |

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|----|--------|---|------------------|
| 44 | 148696 | <i>Udotea flabellum</i> (J.Ellis & Solander) M.Howe | Udoteaceae |
| 45 | 148697 | <i>Laurencia dendroidea</i> J.Agardh | Rhodomelaceae |
| 46 | 148698 | <i>Padina tetrastratica</i> Hauck | Dictyotaceae |
| 47 | 148699 | <i>Gelidiella acerosa</i> (Forssk.) Feldmann & Hamel | Gelidiellaceae |
| 48 | 148700 | <i>Caulerpa corynephora</i> Mont. | Caulerpanceae |
| 49 | 149201 | <i>Codium decorticatum</i> (Woodward) M.Howe | Codiaceae |
| 50 | 149202 | <i>Dictyota hauckiana</i> Nizamuddin | Dictyotaceae |
| 51 | 149203 | <i>Lobophora variegata</i> (J.V.Lamouroux) Womersley ex E.C.Oliveira | Dictyotaceae |
| 52 | 149204 | <i>Ulva flexuosa</i> Wulfen | Ulvaceae |
| 53 | 149205 | <i>Hypnea cervicornis</i> J.Agardh | Cystocloniaceae |
| 54 | 149206 | <i>Ulva beytensis</i> Thivy & Sharma | Ulvaceae |
| 55 | 149207 | <i>Ulva lactuca</i> L. | Ulvaceae |
| 56 | 149208 | <i>Champia compressa</i> Harv. | Champiaceae |
| 57 | 149209 | <i>Gracilaria corticata</i> var. <i>cylindrica</i> Umamaheswara Rao | Gracilariaceae |
| 58 | 149210 | <i>Cystoseira myrica</i> (S.G.Gmelin) C.Agardh | Sargassaceae |
| 59 | 149211 | <i>Cystoseira trinodis</i> (Forssk.) C.Agardh | Sargassaceae |
| 60 | 149212 | <i>Sargassum swartzii</i> C. Agardh | Sargassaceae |
| 61 | 149213 | <i>Canistrocarpus cervicornis</i> (Kuetz.) De Paula & De Clerck | Dictyotaceae |
| 62 | 149214 | <i>Hydroclathrus clathratus</i> (C.Agardh) M.Howe | Scytosiphonaceae |
| 63 | 149215 | <i>Solieria filiformis</i> (Kuetz.) Gabrielson | Solieriaceae |
| 64 | 149216 | <i>Laurencia parvula</i> Borgesen | Rhodomelaceae |
| 65 | 149217 | <i>Amphiroa fragilissima</i> (L.) J.V.Lamour. | Corallinaceae |
| 66 | 149218 | <i>Gracilaria corticata</i> (J.Agardh) J.Agardh | Gracilariaceae |
| 67 | 149219 | <i>Codium dwarkense</i> Borgesen | Codiaceae |
| 68 | 149220 | <i>Codium decorticatum</i> (Woodward) M.Howe | Codiaceae |
| 69 | 149221 | <i>Chnoospora minima</i> (Hering) Papenfuss | Scytosiphonaceae |
| 70 | 149222 | <i>Grateloupia indica</i> Boergesen | Halymeniaceae |
| 71 | 149223 | <i>Gracilaria salicornia</i> (C.Agardh) E.Y.Daw | Gracilariaceae |
| 72 | 149224 | <i>Colpomenia sinuosa</i> (Mertens ex Roth) Derbès & Solier | Scytosiphonaceae |
| 73 | 149225 | <i>Halimeda tuna</i> (J.Ellis & Solander) J.V.Lamour. | Halymeniaceae |
| 74 | 149226 | <i>Amphiroa anceps</i> (Lamarck) Decaisne | Corallinaceae |
| 75 | 149227 | <i>Chamaedoris auriculata</i> Boergesen | Siphonocladaceae |
| 76 | 149228 | <i>Valonia aegagropila</i> C. Agardh | Valoniaceae |
| 77 | 149229 | <i>Gelidiella acerosa</i> (Forssk.) Feldmann & Hamel | Gelidiellaceae |
| 78 | 149230 | <i>Iyengaria stellata</i> (Boergesen) Boergesen | Scytosiphonaceae |

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| | | | ae |
| 79 | 149231 | <i>Kappaphycus alvarezii</i> (Doty) Doty ex P.C.Silva | Solieriaceae |
| 80 | 149232 | <i>Ulva rigida</i> C.Agardh | Ulvaceae |
| 81 | 149233 | <i>Udotea flabellum</i> (J.Ellis & Solander) M.Howe | Udoteaceae |
| 82 | 149234 | <i>Dictyota bartayresiana</i> J.V.Lamour. | Dictyotaceae |
| 83 | 149235 | <i>Grateloupia indica</i> Boergesen | Halymeniaceae |
| 84 | 149236 | <i>Acrosiphonia orientalis</i> (J.Agardh) P.C.Silva | Ulotrichaceae |
| 85 | 149237 | <i>Ulva rigida</i> C.Agardh | Ulvaceae |
| 86 | 149238 | <i>Dermonema virens</i> (J.Agardh) Pedroche & Ávila | Liagoraceae |
| 87 | 149239 | <i>Solieria robusta</i> (Greville) Kylin | Solieriaceae |
| 88 | 149240 | <i>Caulerpa scalpelliformis</i> (R.Brown ex Turner) C.Agardh | Caulerpaeae |
| 89 | 149241 | <i>Gracilaria corticata</i> (J.Agardh) J.Agardh | Gracilariaceae |
| 90 | 149242 | <i>Laurencia parvula</i> Borgesen | Rhodomelaceae |
| 91 | 149243 | <i>Amphiroa anceps</i> (Lamarck) Decaisne | Corallinaceae |
| 92 | 149244 | <i>Gracilaria corticata</i> (J.Agardh) J.Agardh | Gracilariaceae |
| 93 | 149245 | <i>Cystoseira indica</i> (Thivy & Doshi) Mairh | Sargassaceae |
| 94 | 149246 | <i>Stoechospermum polypodioides</i> (J.V.Lamour.) J.Agardh | Dictyotaceae |
| 95 | 149247 | <i>Chamaedoris auriculata</i> Boergesen | Siphonocladaceae |
| 96 | 149248 | <i>Laurencia parvula</i> Borgesen | Rhodomelaceae |
| 97 | 149249 | <i>Ulva intestinalis</i> L. | Ulvaceae |
| 98 | 149250 | <i>Udotea indica</i> A.Gepp & E.S.Gepp | Udoteaceae |
| 99 | 149251 | <i>Halimeda tuna</i> (J.Ellis & Solander) J.V.Lamour. | Halimedaceae |
| 100 | 149252 | <i>Codium dwarkense</i> Borgesen | Codiaceae |
| 101 | 149253 | <i>Iyengaria stellata</i> (Boergesen) Boergesen | Scytosiphonaceae |
| 102 | 149254 | <i>Chnoospora minima</i> (Hering) Papenfuss | Scytosiphonaceae |
| 103 | 149255 | <i>Sargassum swartzii</i> C. Agardh | Sargassaceae |
| 104 | 149256 | <i>Gelidiella acerosa</i> (Forssk.) Feldmann & Hamel | Gelidiellaceae |
| 105 | 149257 | <i>Gracilaria verrucosa</i> (Hudson) Papenfuss | Gracilariaceae |
| 106 | 149258 | <i>Gracilaria textorii</i> (Suringar) Hariot | Gracilariaceae |
| 107 | 149259 | <i>Grateloupia indica</i> Boergesen | Halymeniaceae |
| 108 | 149260 | <i>Acrosiphonia orientalis</i> (J.Agardh) P.C.Silva | Ulotrichaceae |
| 109 | 149261 | <i>Gracilaria corticata</i> (J.Agardh) J.Agardh | Gracilariaceae |
| 110 | 149262 | <i>Ulva fasciata</i> Delile | Ulvaceae |
| 111 | 149263 | <i>Amphiroa anceps</i> (Lamarck) Decaisne | Corallinaceae |
| 112 | 149264 | <i>Gracilaria verrucosa</i> (Hudson) Papenfuss | Gracilariaceae |

Major impacts reported during the financial year: This study will enhance our knowledge on seaweed resources of the country and definitely taxonomical problems and nomenclature issues of seaweed algae remains unresolved so far.

- ❖ Total of **112 field numbers** of seaweeds have been **labelled and identified** from the previous collection from Gujarat coast (collected during 10.03.2020 – 21.03.2020). Totally, **77 taxa** of 22 families under 15 orders were recognized. Among them, **Rhodophyceae is the predominant class** with 38 taxa followed by Chlorophyceae with 21 taxa and Phaeophyceae represents 18 taxa. Dictyotaceae is the primary family encompasses of 9 taxa, and Ulvaceae, Gracilariaceae, Halymeniaceae, Caulerpaceae, Sargassaceae typify with 5 taxa. Valoniaceae is the trivial family with only one taxon.

PROJECT-4

Ex situ conservation of endemic endangered and threatened plants of the region and recording of phenology of flowering / fruiting of species in garden.

1. **Title of the Project:** Ex-situ conservation of endemic endangered and threatened plants of the region and recording of phenology of flowering / fruiting of species in garden.
2. **Executing Scientist (s):** Dr. S. Kaliamoorthy, Scientist - E and Dr. T. S. Saravanan, Botanical Assistant
3. **Date of Initiation:** Continuous project
4. **Date to be completion:** Continuous project
5. **Summary of the work done during 2020-21**
(Highlights & Objective of the project and Progress of the work done)
 1. Ex-situ conservation of endemic endangered and threatened plants of the region.
 2. Recording of phenology of flowering / fruiting of species in the garden.

- Total Field Tours undertaken in 2020-21
Due to pandemic situation and shortage of budget fund, two tours proposed to visit Wayanad district, Kerala could not be conducted.

Local Tours conducted: one

Area of study: Manjakuttai, Yercaud

Number of species collected & introduced: 18 species

- Number of Photographs taken during the tour and total photographs identified (A CD with proper labelled photographs to be submitted).
18 photographs of plant species were recorded with identification.

Details of live plant species collected and introduced in the garden

- *Papilionanthe subulata* (Willd.) Garay – 3 plants
- *Vanda testacea* (Lindl.) Rchb.f. – 2 plants
- *Diplozentrum recurvum* Lindl. – 2 plants
- *Habenaria glandifloriformis* Blatt. & McCann. - 4 plants
- *Habenaria rariflora* A. Rich. – 2 plants
- *Brachystelma saldanhae* S.J. Britto & P.V. Bruyns – 6 plants
- *Ledebouria revoluta* (L.f.) Jessop – 3 plants
- *Ledebouria hyderabadensis* M.V. Ramana, Prasanna & Venu – 5 plants

Multiplication:

Orchids:

Goodyera procera (Ker Gawl.) Hook. – 11 Plants

Eria psuedoclavicaulis Blatt & Maccann – 12 Plant

Coelogyne pallens Lindl. - 2 Plants
Coelogyne fimbriata Lindl. - 2 Plants

Ornamental Plants (Orchids):

Acampe praemorsa (Roxb.) Blatt&Macaan - 3 Plants
Dendrobium fimbriatum W. J. Hook. - 25 Plants
Bulbophyllum fischeri Seiden f. - 4 Plants
Epidendrum radicans Pav. ex Lindl. - 35 Plants

Rare / Endangered Plants:

Amomum hypoleucum Thw. - 7 Plants
Angiopteris erecta Desv. - 3 Plants
Arachis villosa Benth. - 7 Plants
Cyathea nilgirensis Holttum - 3 Plants
Davallia griffithiana Hook. - 2 Plants
Equisetum arvense L. - 3 Plants
Hardwickia binata Roxb. - 5 Cuttings
Impatiens yercaudensis Bhaskar - 15 Cuttings
Nageia wallichianus (C.Presl) Kuntz. - 5 Cuttings
Ophioglossum reticulatum L. - 15 Plants
Piper cubeba L.f.- 2 Plants
Psilotum nudum P. Beauv.- 5 Plants
Remusatia vivipara (Roxb.) Schott - 3 Plants
Sarcostemma intermedium Decne - 10 Plants
Schefflera venulosa (Wight & Arn.) Harms - 3 Plants
Sterculia populnifolia Roxb.- 3 Cuttings
Taxus baccata L.- 5 Cuttings

Experimental Garden - Seedlings:

Alpinia caerulea (R.Br.) Benth - 3 Plants
Asclepias curassavica L.- 5 Plants
Dorstenia indica Wight- 6 Plants
Episcia cupreata (Hook.) Hanst. - 3 Plants
Hemerocallis fulva (L.) L. - 2 Plants
Molineria capitulate (Lour.) Herb.- 2 Plants
Narine sarniensis (L.) Herb. - 6 Plants
Peperomia caperata Yunck. - 3 Plants
Plectranthus barbatus Andrews- 2 Plants
Salvia leucantha Cav.- 2 Plants
Spathiphyllum cannifolium Dryand. ex Sims) Schott. - 7 Plants
Zingiber neesatum (J.Graham) Ramamoorthy - 5 Plants

Cuttings:

Homalocladium platycladum (F.Muell.) L.H.Bailey - 4 Nos
Impatiens platypetala Lindl.- 5 No
Impatiens platypetala Lindl. - 15 Nos
Iresine herbstii Hook. - 10 Nos
Kalanchoe laxiflora Baker - 8 Nos
Monosis shevaroyensis (Gamble) H. Rob. and Skavarla - 20 Nos.
Pelargonium graveolens L'Her.- 3 Nos

Plectranthus scutellarioides (L.) R.Br. - 10 Nos

Rhinacanthus nastutus (L.) Kurz.- 2 Nos

Thunbergia coccinea Wal - 15 Nos
Trachelospermum jasminoides (Lindl.) Lem- 10 Nos

Multiplication:

Begonia X erythrophylla Herincq- 3 Plants
Begonia 'China Doll'(Dillard) – 6 Plants
Begonia bowerae Ziesenh. – 3 Plants
Begonia heracleifolia Cham & Schltl -9 Plants
Begonia malabarica Lam. – 3 Plants
Begonia pustulata Liebm – 6 Plants
Calathea zebrina (Sims)Lindl. – 5 Plants
Calathea zebrine Lindl.– 5 Plants
Ctenantha setose (Roscoe) Eiechler - 5 Plants
Cuphea platycendra Hort.– 5 Plants
Hedychium coronarium J. Koenig –5 Plants
Ludwigia adscendens (L.) H.Hara – 2 Plants
Phaedranassa dubia (Kunth) J.F.Macbr. - 10 Plants
Zephyranthes candida (Lindl.) Herb. - 5 Plants
Zephyranthes rosea Lindl.– 5 Plants
Zingiber wightianum Thwaites - 10 Plants

Objective two was accomplished by recording the flowering/fruiting phenology.

Orchids: Flowering & fruiting phenology were recorded for 104 species belongs to 43 genera.

Other Angiosperms: Flowering & fruiting phenology were recorded for 79 species belongs to 65 genera.

Distribution of saplings of Endemic Endangered and Threatened / ornamental / medicinal species developed in NO&EG, Yercaudto the Forest Department, Salem for plantation in the reserve forest areas of Yercaud.

- ✓ *Monosis shevaroyensis* (Gamble) H. Rob. and Skavarla – 1 plant
- ✓ *Garcinia talbotii* Raizada ex Santapau – 10 plants
- ✓ *Bentinckia condappana* Berry ex Roxb. (Endangered) – 20 plants

- **Number of specimens incorporated in the Herbarium during the study:** N/A
- **Plant species documented in 2020-21 (detailed information):** N/A
- **Highlights of the collections:** During the period of report the protocols for the *Micropropagation of Crotalaria longipes* Wight & Arn. The in vitro developed plantlets were assessed for their genetic integrity using ISSR markers.

Externally Funded Project:

Title of the MoEF & CC funded Lead Garden Project: MoEF & CC sponsored project entitled “*Ex-situ* Conservation and Propagation of Indigenous, Threatened and Endemic Plants through Improvement of Infrastructure Facilities in National Orchidarium & Experimental Garden (NOEG) (Lead Garden Proposal), was sanctioned vide letter number F. No. 10/28/2014-CS (BG) dated 24/07/2015.

Achievements:

Micropropagation of Target plants (Micropropagation protocols for 3 plants were achieved):

1. *Monosis shevaroyensis* (Gamble) H. Rob. and Skavarla – multiplied through micropropagation using nodal and leaf explants.
2. *Crotalaria shevaroyensis* Gamble - multiplied through micropropagation using nodal and leaf explants.
3. *Canarium strictum* Roxb - multiplied through micropropagation using nodal explants.

The following orchid species were multiplied through asymbiotic seed germination method

1. *Xenikophytonsmeeanum* (Rchb.f.) Garay
2. *Aerides crispa* Lindl.
3. *Dendrobium aqueum* Lindl.
4. *Bulbophyllum fuscopurpureum* Wight
5. *Dendrobium aqueum* Lindl.
6. *Eria pseudoclavicaulis* Blatt.

Vegetative Propagation of Target Plants using seeds

1. *Crotalaria shevaroyensis* Gamble
2. *Bentinckia condapana* Berry ex Roxb.
3. *Canarium strictum* Roxb

Vermiculture:

Well decomposed vermicompost was prepared using earthworms available in the natural forest areas. Leaf litter available from the garden premises were used for preparing vermicompost. The vermicompost prepared was effectively used for the vegetative propagation experiments using stem of threatened plants and other ornamentals.

9. Research Based Publications related to the allotted project only: (As per NELUMBO Format)

Bandana Bharracharjee, P. Lakshminarasimhan, Siobhan Mukherjee, **S. Kaliamoorthy** and Avishek Bhattacharjee (2020) Notes on the identity of *Vernonia shevaroyensis* (Asteraceae) and its neotypification. Nelumbo Vol. 62 (2): 148 – 153.

PROJECT-5

EX SITU CONSERVATION OF ENDEMIC TREE SPECIES OF THE REGION in NOEG, Yercaud

1. Name of the Project : ***Ex-situ* conservation of Endemic tree species of the region in NOEG, Yercaud**
2. Executing Scientist (s) : Dr. Mayur Yashwant Kamble, Scientist E
3. Duration of the project : On going

Objectives:

- Multiplication and maintenance of existing collections.
- Q2. Documentation of phenology.
- Plantation of multiplied saplings of endemic tree species in the Arboretum and Garden.
- Distribution of saplings of endemic species to Botanical Gardens, Research Organizations and Forest Departments, for reintroduction and ex-situ conservation.

Site of the study (with map) : Agasthyamala Biosphere Reserve (SWG)

Multiplication of Endemic Tree species:

Multiplied following endemic, endangered and threatened species in experimental garden through seeds or stem cuttings from existing germplasm as well as previously collected seeds from Agasthyamalai Biosphere Reserve, Western Ghats: 714 nos. **ENDEMIC TREES: 580 nos. of seedlings**

Through seeds: 490 nos.

1. *Arenga wightii* Griff. (ARECACEAE); Vulnerable – 16 nos.
2. *Bentinckia condapanna* Berry ex Roxb. (ARECACEAE); Endangered – 270 nos.
3. *Garcinia gummi-gutta*(L.) Robs. (CLUSIACEAE); Least concern – 43 nos.

4. *Garcinia imberti* Bourd. (CLUSIACEAE); Endangered – 117 nos.
5. *Goniothalamus wightii* Hook.f. & Thomson (ANNONACEAE); Endangered – 27 nos.
6. *Ixora brachiata* Roxb. (RUBIACEAE); Least concern – 17 nos.

Through stem cuttings: 90 nos.

7. *Euphorbia vajravelui* Binojk. & N.P. Balakr. (EUPHORBIACEAE); Vulnerable – 90 nos.

ENDEMIC SHRUBS: 120 nos.

Through seeds

1. *Crotalaria longipes* Wight & Arn. (FABACEAE); Endangered – 120 nos.

THREATENED LIANA: 14 nos.

Through seeds

1. *Gnetum ula* Brongn (Least Concern) – 14 nos.

✓ **MAINTENANCE OF ENDEMIC TREE SPECIES IN THE GARDEN:**

Saplings of following species developed in the germination trays/beds through seeds or stem cuttings and transferred in earthen pots, nursery bags; maintaining in glass house, shady areas, etc in experimental garden.

1. *Actinodaphne bourdillonii* Gamble (LAURACEAE); Not Evaluated
2. *Alstonia venenata* R. Br. (APOCYNACEAE); Not Evaluated
3. *Arenga wightii* Griff. (ARECACEAE); Vulnerable
4. *Artocarpus hirsutus* Lam. (MORACEAE); Least Concern
5. *Baccaurea courtallensis* (Wight) Muell.-Arg. (EUPHORBIACEAE); Near Threatened
6. *Bentinckia condapanna* Berry ex Roxb. (ARECACEAE); Endangered
7. *Bentinckia nicobarica* (Kurz) Becc. (ARECACEAE); Endangered
8. *Calophyllum apetalum* Willd. (CLUSIACEAE); Vulnerable
9. *Cinnamomum malabattrum* (Burm.f.) J. Presl. (LAURACEAE); Not Evaluated
10. *Cullenia exarillata* A. Robyns (BOMBACACEAE); Vulnerable
11. *Dipterocarpus indicus* Bedd. (DIPTEROCARPACEAE); Endangered
12. *Garcinia gummi-gutta*(L.) Robs. (CLUSIACEAE); Least Concern
13. *Garcinia imberti* Bourd.; Endangered
14. *Garcinia indica* (Thouars) Choisy; Vulnerable
15. *Garcinia talbotii* Raizada ex Santapau; Least Concern
16. *Gluta travancorica* Bedd. (ANACARDIACEAE); Endangered
17. *Goniothalamus wightii* Hook.f. & Thomson (ANNONACEAE) Endangered
18. *Hardwickia binata* Roxb. (FABACEAE); Not Evaluated
19. *Holigarna arnottiana* Hook. f. (ANACARDIACEAE); Least Concern
20. *Holigarna grahamii* (Wight) Kurz; Least Concern
21. *Hopea parviflora* Bedd. (DIPTEROCARPACEAE); Near Threatened
22. *Humboldtia decurrens* Bed. ex Oliv. (FABACEAE); Near Threatened
23. *Hydnocarpus pentandrus* (Buch.-Ham.) Oken (FLACOURTIACEAE); Least Concern
24. *Ixora brachiata* Roxb. (RUBIACEAE); Least Concern
25. *Kingiodendron pinnatum* (Roxb. ex DC.) Harms (FABACEAE); Endangered
26. *Knema attenuata* (Hook.f. & Th.) Warb. (MYRISTICACEAE); Least Concern
27. *Monosis travancorica* (Hook.f.) H. Rob. & Skvarla; Endangered
28. *Palaquium ellipticum* (Dalz.) Baill. (SAPOTACEAE); Least Concern
29. *Pinanga dicksonii* (Roxb.) Blume (ARECACEAE); Vulnerable
30. *Pterospermum reticulatum* Wight & Arn. (STERCULIACEAE); Vulnerable
31. *Sageraea laurina* Dalzell (ANNONACEAE); Near Threatened
32. *Syzygium mundagam* (Bourd.) Chithra (MYRTACEAE); Vulnerable

33. *Syzygium palodense* Shareef, E.S.S. Kumar & Shaju (MYRTACEAE); Vulnerable
34. *Syzygium stocksii* (Duthie) Gamble (MYRTACEAE); Not Evaluated
35. *Syzygium travancoricum* Gamble (MYRTACEAE); Critically endangered
36. *Tabernaemontana gamblei* Subram. & Henry (APOCYNACEAE); Endangered
37. *Vateria indica* L. (DIPTEROCARPACEAE); Critically endangered
38. *Vernonia shevaroyensis* Gamble (ASTERACEAE); Not Evaluated
39. *Xanthophyllum arnottianum* Wight (XANTHOPHYLLACEAE); Vulnerable

✓ **Plantation of Endemic tree species in Arboretum and garden premises: Following species has been planted and being maintained: 270 nos.**

1. *Arenga wightii* Griff. (ARECACEAE); Vulnerable – 5 nos.
2. *Bentinckia condappana* Berry ex Roxb.; Endangered – 55 nos.
3. *Bentinckia nicobarica* (Kurz) Becc. (ARECACEAE); Endangered – 5 nos.
4. *Cinnamomum malabattrum* (Burm.f.) J. Presl. (LAURACEAE) – 1 no.
5. *Cynometra travancorica* Bedd.; (FABACEAE); Endangered – 2 no.
6. *Crotalaria longipes* Wight & Arn.; Endangered – 125 nos.
7. *Euphorbia vajravelui* Binojk. & N.P. Balakr. (Vulnerable) – 10 nos.
8. *Garcinia gummi-gutta* (L.) Robs.; Least Concern – 4 nos.
9. *Garcinia imberti* Bourd.; Endangered – 2 nos.
10. *Garcinia indica* (Thouars) Choisy; Vulnerable – 6 nos.
11. *Garcinia talbotii* Raizada ex Santapau (CLUSIACEAE); Least Concern – 10 nos.
12. *Gluta travancorica* Bedd. (ANACARDIACEAE); Endangered – 14 nos.
13. *Holigarna arnottiana* Hook. f. (ANACARDIACEAE); Least Concern – 5 nos.
14. *Hopea parviflora* Bedd. (DIPTEROCARPACEAE); Near Threatened – 5 nos.
15. *Kingiodendron pinnatum* (Roxb. ex DC.) Harms (FABACEAE); Endangered – 2 nos.
16. *Knema attenuata* (Hook.f. & Th.) Warb. (MYRISTICACEAE); Least Concern – 2 nos.
17. *Monosis travancorica* (Hook.f.) H. Rob. & Skvarla (ASTERACEAE); Endangered – 2 nos.
18. *Palaquium ellipticum* (Dalz.) Baill. (SAPOTACEAE); Least Concern – 2 nos.
19. *Syzygium mundagam* (Bourd.) Chithra (MYRTACEAE); Vulnerable – 4 nos.
20. *Syzygium palodense* Shareef, E.S.S. Kumar & Shaju (MYRTACEAE); Vulnerable – 2 nos.
21. *Syzygium travancoricum* Gamble (MYRTACEAE); Critically endangered – 2 nos.
22. *Syzygium stocksii* (Duthie) Gamble; Endangered – 2 nos.
23. *Tabernaemontana gamblei* Subram. & Henry (APOCYNACEAE); Endangered – 2 nos.
24. *Xanthophyllum arnottianum* Wight (XANTHOPHYLLACEAE); Vulnerable – 2 nos.

Indigenous tree planted: 1 no.

1. *Mesua ferrea* L. (CLUSIACEAE) – 2 nos.

✓ **Distribution of saplings of Endemic, Endangered and Threatened species multiplied in the garden to other botanical gardens, research organizations and State Forest Departments for reintroduction in forest areas and plantation in their gardens and ex-situ conservation.**

- Horticultural Research Station, Tamil Nadu Agriculture University, Yercaud on 16/09/2020 for plantation.

1. *Bentinckia condappana* Berry ex Roxb. (ARECACEAE) – 20 nos.

✓ **Documentation of flowering and fruiting phenology of tree species in NOEG Yercaud:**

Documented flowering and fruiting phenology of tree species growing in NOEG Yercaud during Q2.

3.1 Major impacts reported during the financial year :

- ✓ A. Multiplied endemic, endangered and threatened species in experimental garden through seeds from existing germplasm and/or previously collected seeds from Agasthyamalai Biosphere Reserve. Methods adopted for multiplication involves:

- **Propagation through Seeds:**

All collected seeds were thoroughly cleaned, treated with fungicide and sown in the in the pots, nursery beds, germination trays with different germination media viz. garden soil, coco peat, soil & sand, etc. The germinated ones were planted in grow bags/pots and maintained in the nursery.

- **Propagation through Stem cuttings:**

Stem cuttings collected were treated with fungicide and growth regulators like IAA, IBA, NAA and potted in grow bags.

- **Monitoring:**

Performing regular multiplication and maintenance.

- ✓ Standardized methods for propagation of trees and shrubs through seeds, stem cuttings, offsets. Multiplied *ca* 714 nos. saplings under 9 nos. of endemic, endangered and threatened arborescent (7 nos.) and non-arborescent (2 nos.) species during April 2020 – September 2020 and are being conserved in experimental garden.

- ✓ The remarkable species multiplied in the garden includes:

Arenga wightii Griff., *Bentinckiacondapanna*Berry ex Roxb., *Crotalaria longipes* Wight & Arn., *Euphorbia vajravelui* Binojk. & N.P. Balakr., *Garcinia gummi-gutta* (L.) Robs., *Garcinia imberti* Bourd., *Goniothalamus wightii* Hook.f. & Thomson.

- ✓ Endemic, Endangered and Threatened species maintaining in the garden during April 2020-September 2020: 51 nos.

- **Critically Endangered**, 3 nos.: *Abutilon ranadei* Woodrow & Stapf (MALVACEAE); *Nothopegiacastaneifolia* (Roth) Ding Hou (ANACARDIACEAE); *Syzygium travancoricum* Gamble(MYRTACEAE).

- **Endangered**, 12 nos.: *Bentinckiacondapanna*Berry ex Roxb.,*Bentinckia nicobarica* (Kurz) Becc. (ARECACEAE); *Crotalaria longipes* Wight & Arn. (FABACEAE); *Dipterocarpus indicus* Bedd. (DIPTEROCARPACEAE); *Garcinia imberti* Bourd. (CLUSIACEAE); *Gluta travancorica* Bedd. (ANACARDIACEAE); *Goniothalamus wightii* Hook.f. & Thomson (ANNONACEAE); *Hopea parviflora* Bedd (DIPTEROCARPACEAE); *Humboldtia vahliana*Wight (FABACEAE); *Monosis travancorica* (Hook.f.) H. Rob. & Skvarla (ASTERACEAE); *Syzygium stocksii* (Duthie) Gamble (MYRTACEAE); *Tabernaemontana gamblei*Subram. & Henry (APOCYNACEAE).

- **Vulnerable**, 13 nos.:

Arenga wightii Griff. (ARECACEAE); *Calophyllum apetalum* Willd. (CLUSIACEAE); *Cullenia exarillata* A. Robyns (BOMBACACEAE); *Euphorbia vajravelui*Binojk. & N.P. Balakr. (EUPHORBIACEAE); *Garcinia indica* (Thouars) Choisy; *Garcinia rubro-echinata* Kosterm.; *Garcinia travancorica* Bedd. (CLUSIACEAE); *Kingiodendron pinnatum* (Roxb. ex DC.) Harms (FABACEAE); *Pinanga dicksonii* (Roxb.) Blume (ARECACEAE); *Pterospermum reticulatum* Wight & Arn. (STERCULIACEAE); *Syzygium mundagam* (Bourd.) Chithra; *Syzygium palodense* Shareef, E.S.S. Kumar & Shaju (MYRTACEAE); *Xanthophyllum arnottianum* Wight (XANTHOPHYLLACEAE).

➤ **Near Threatened**, 4 nos.:

Baccaurea courtallensis (Wight) Muell.-Arg. (EUPHORBIACEAE); *Cyathea nilgirensis* Holttum (CYATHEACEAE); *Humboldtia decurrens* Bed. ex Oliv. (LEGUMINOSAE–CAESALPINIOIDEAE); *Sageraea laurina* Dalzell (ANNONACEAE);

➤ **Least Concern**, 10 nos.:

Artocarpus hirsutus Lam. (MORACEAE); *Garcinia gummi-gutta*(L.) Robs.; *Garcinia talbotii* Raizada ex Santapau (CLUSIACEAE); *Holigarna arnottiana* Hook. f.; *Holigarna grahamii* (Wight) Kurz (ANACARDIACEAE); *Hydnocarpus pentandrus* (Buch.-Ham.) Oken (FLACOURTIACEAE); *Ixora brachiata* Roxb. (RUBIACEAE); *Knema attenuata* (Hook.f. & Th.) Warb. (MYRISTICACEAE); *Palaquium ellipticum* (Dalz.) Baill. (SAPOTACEAE); *Vateria indica* L. (DIPTEROCARPACEAE).

➤ **Not Evaluated**, 9 nos.: *Actinodaphne bourdillonii* Gamble (LAURACEAE); *Alstonia venenata* R.Br. (APOCYNACEAE); *Barleria acuminata* Nees (ACANTHACEAE); *Barleria grandiflora* Dalzell; *Barleria involucrata* Nees var. *elata* (Dalzell) C.B. Clarke; *Cinnamomum malabattrum* (Burm.f.) J. Presl. (LAURACEAE); *Hardwickia binata* Roxb. (FABACEAE); *Vernonia shevaroyensis* Gamble (ASTERACEAE); *Thunbergia mysorensis* (Wight) T. Anderson (ACANTHACEAE).

✓ Development of Arboretum: Saplings 270 nos. under 24 nos. of Endemic species has been planted and more than 30 endemic tree species are being maintained in newly developed Arboretum and experimental garden.

✓ New distributional records 1 no.:

1. Flora of Andaman & Nicobar Islands- *Eleocharis equisetina* C. Presl (Cyperaceae)

A. Research Publications (in *Nelumbo* format)

PROJECT-6

Flora of India, Volume 11 (Cactaceae – Apiaceae)

Name of the Executing Official(s): Dr. C. Murugan, Scientist “E” & Team Leader, Dr. R. Manikandan, Scientist “E”, Dr. K.A. Sujana, Scientist “D”, Dr. W. Arisdason, Scientist “D” and Dr. M. Murugesan, Scientist “C”

Dr. Murugan: (Araliaceae: 71 genera, 276 species and 11 varieties) [jointly with Dr. W. Arisdason]

Dr. R. Manikandan: (ApiaceaePart2: 58 genera, 120 species and 01 variety)

Dr. K.A. Sujana: (Cornaceae: 04 genera and 10 species; Alangiaceae: 01 genus and 07 species; Nyssaceae: 01 genus and 01 species; Caprifoliaceae: 06 genera and 47 species; Adoxaceae: 01 genus and 01 species)

Dr. W. Arisdason: [Cactaceae: 76 genera, 178 species and 33 varieties; Aizoaceae: 03 genera and 07 species; Molluginaceae: 05 genera, 09 species and 02 varieties and Araliaceae: 71 genera, 276 species and 11 varieties) [jointly with Dr. C. Murugan]

Dr. M. Murugesan: (Apiaceae Part 1: 156 species and 10 varieties in 13 genera)

Duration of the project : April 2019 – December 2020

About the work done:

Objectives: To prepare freshly the taxonomic accounts of families based on herbarium specimens and literature and also to update the taxonomic accounts of the old manuscripts of some families; to (re)construct user-friendly polythetic keys to the genera, species and infraspecific taxa, wherever necessary, especially when new discoveries and new reports are included or changes in nomenclature and taxonomic status; to provide up-to-date nomenclature of every taxon with standardized bibliographic citations; to provide authentic information on the occurrence and distribution (India and world) of every taxon; and to submit the updated and refined taxonomic account of the entire Volume 11 of Flora of India to the Director, BSI and Publication-in-Charge.

Site of the study: India

Methodology adopted: The standard plant taxonomic principles and classical tools have been followed and used, respectively. The rules and recommendations of International Code of Nomenclature for algae, fungi, and plants, specifically the Shenzhen Code (Turland & al., 2018) have been strictly adhered. Illustrations were made based on authentic herbarium specimens housed in herbaria of different regional centres of BSI, especially the holdings at MH, and colour photographs have also been gathered from various researchers, besides the personal photographs of scientists engaged in the present work.

Output indicators for the assessment of the project: Implementation of standard taxonomic principles, rules and recommendations of International Code of Nomenclature for algae, fungi, and plants, specifically the Shenzhen Code.

Major impacts reported during the financial year: After completion of 'Flora of India' project, a comprehensive account of the families, genera and species will be available to the country with the help of which anyone can access the current status and abundance of taxa. It will help Forest department for implementation of working plan.

PROJECT-7

Flora of India Volume 20 (Gesneriaceae – Acanthaceae)

(i) Tribe Justiceae (Subtribes Andrographidinae, Asystasiinae and Barleriinae): Acanthaceae [109 species (including 04 cultivated), 03 subspecies and 07 varieties in 12 genera] – only this was officially allotted. Primary draft submitted by Dr. Tinku Ghosh and Dr. H.S. Debnath, ex-Joint Director, BSI. *Andrographis* and *Haplanthus* by Dr. G. Gnanasekaran, ex-Botanical Assistant and Dr. G.V.S. Murthy, Scientist "G" (Retd.).

(ii) Tribe Ruellieae (Subtribes Polyspermeae and Tetraspermeae): Acanthaceae [181 species (including 01 cultivated), 05 varieties and 01 forma in 09 genera]. Primary draft submitted by Dr. W. Dinesh Albertson and Dr. P. Venu, Scientist "G" (Retd.).

Name of the Executing Official (s) : Dr. W. Arisdason, Scientist "D".

Duration of the project : April 2019 – December 2020

About the work done:

Objectives: To update the taxonomic account of the Subtribes namely Andrographidinae, Asystasiinae and Barleriinae of Tribe Justiceae (Acanthaceae) and Subtribes Polyspermeae and Tetraspermeae of Tribe Ruellieae (Acanthaceae); to reconstruct the keys to the genera, species and infraspecific taxa, wherever necessary, especially when new discoveries and new reports are included or changes in nomenclature and taxonomic status; to provide up-to-date nomenclature of every taxon with standardized bibliographic citations; to provide authentic information on the occurrence and distribution (India and world) of every taxon; and to submit the updated final version of the manuscript of all five subtribes to the team leader of Volume 20.

Site of the study (with map): India

Methodology adopted: The standard plant taxonomic principles and classical tools have been followed and used, respectively. The rules and recommendations of International Code of Nomenclature for algae, fungi, and plants, specifically the Shenzhen Code (Turland & al., 2018) have been strictly adhered.

Output indicators for the assessment of the project: Standard plant taxonomic principles and classical tools, implementation of rules and recommendations of International Code of Nomenclature for algae, fungi, and plants, specifically the Shenzhen Code.

Major impacts reported during the financial year: After completion of 'Flora of India' project, a comprehensive account of the families, genera and species will be available to the country with the help of

which anyone can access the current status and abundance of taxa. It will also help Forest department for implementation of working and management plan.

PROJECT-8

Flora of India, Volume 9, 10, 21 & 29

Name of the Executing Officer: Dr. V. Sampath kumar

Duration of the project: April 2020 to March 2021

About the work done:

Introduction:

Vol. 9, Family Lecythidaceae – Galley proof corrected

Differed the editor opinion of merging some of the taxa and treating cultivated species as excluded one. In distribution also the editor changed the geographical area 'Malesia' to the country name 'Malaysia' which were also corrected accordingly. Besides, the updating includes the reinstatement of the subspecies *spicata* (Blume) Payson of *Barringtoniaacutangula* (L.) Gaertn., transfer of some merged Literature to the respective genera and inclusion of *Barringtoniamacrostachya* (Jack) Kurz as excluded species as G.T. Prance cited the type of *Barringtonia wallichiana* R. Knuth (one of the synonyms) as "INDIA: N. Wallich 3636", however, the Wallich Cat. No. 3636 clearly reveals that the specimens were collected and identified by Nathaniel Wallich as *Stravadium acuminatum* Wall. was from Chappedong, Burma/Myanmar.

Vol. 10, family Lythraceae – Updating

Assisted in updating of the family Lythraceae submitted by T. Mathew and M. P. Nayar, various literature pertaining to the family including protologues were sent to Late Dr. B.K. Sinha, Scientist 'F'.

For Flowering Plants of India "An Annotated Checklist" (Dicotyledons-Vol. II), the galley proof received from the Publication Section, the families Avicenniaceae, Labiatae/Lamiaceae, Phrymaceae, Plantaginaceae, Symphrometaceae and Verbenaceae. The proof reading was carried out thoroughly and found major mistakes were done during the editing, which were corrected patiently both in PDF as well as marked in a word file for easy understanding. The major errors made by the editors found were, sensu was wrongly used, chronological order wrongly arranged and the species are not arranged properly in alphabetical sequence.

Further, for the family Lecythidaceae, the checklist was prepared in connection with Flowering Plants of India "An Annotated Checklist" (Dicotyledons-Vol. II) and submitted to the Publication Section in-charge, BSI, Hqrs., Kolkata. Apart from this, two papers published by me on Magnoliaceae in India were sent to the Publication Section in-charge, BSI to incorporate corrections in the manuscript of Magnoliaceae checklist.

Vol. 21, families Lamiaceae, Plantaginaceae, Symphrometaceae and Verbenaceae

Certain groups submitted by others in hard copy were typed and edited, which includes *Gomphostemma* Wall. ex Benth., *Leucas* R.Br., *Scutellaria* L., and *Teucrium* L. as well as the family Verbenaceae. Besides, the manuscripts for the families Plantaginaceae and Symphrometaceae were prepared along with the group members and were also edited as per the new Flora of India format.

Vol. 29: of Carex L. subgenus Vigneae

The manuscript submitted by Dr. Bikash Jana, former SRF, CNH, Howrah was thoroughly corrected and sent to him with certain modifications and suggestions. Many additions of species and change of artificial key to the species were also suggested, which would be included as a part of Flora of India volume 29.

Literature: All the references pertaining to all the above manuscripts were consulted either in Library or in online in various websites.

Objectives: To bring out the flora of India volumes.

Achievements: New combinations made and the one species reported as new record to Western Himalaya.

Output indicators for the assessment of the project: Implementation of standard plant taxonomic principles and classical tools, adherence of ICN rules and recommendations.

Major impacts reported during the financial year: After completion of 'Flora of India' project, a comprehensive account of the families, genera and species will be available to the country with the help of which anyone can access the current status and abundance of taxa. It will also help Forest department for implementation of working and management plan.

PROJECT-9

Flora of India, Volume – 28 (Alismataceae, Uvulariaceae and Trilliaceae)

Name of Executing Officer(s): Dr. M.U. Sharief, Scientist- E & M. Murugesan, Scientist -C

Duration of the project: April, 2020–September, 2020

Objectives:

To prepare, update, edit and format the taxonomic account of 43 taxa belonging to three families viz., Alismataceae, Uvulariaceae and Trilliaceae as per the given pattern of Flora of India based on available literature, herbarium specimens and various online databases, jointly with Dr. M. U. Sharief. Checklists of all the species under 3 families were prepared, wherein the correct/currently accepted name with protologue citation, basionym, and relevant synonyms with complete bibliographic citations, and distribution in India were provided. Subsequently, the taxonomic account of all genera formatted as per Flora of India pattern. Bracketed keys to species and infraspecific taxa, and up-to-date nomenclature with bibliographic citations, vernacular names, detailed description, habitat, flowering and fruiting period, distribution (in India and world), taxonomic/nomenclatural notes, if any and uses have been prepared for every taxon.

Site of the study (with map): India

Methodology adopted :

All the species were updated as per the given format of flora of India. The standard plant taxonomic principles and classical tools have been followed and used, respectively. The rules and recommendations of International Code of Nomenclature for algae, fungi, and plants, specifically the Shenzhen Code (Turland & al., 2018) have been strictly adhered. Illustrations were made based on authentic herbarium specimens housed in herbaria of different regional centres of BSI, especially the holdings at MH, and colour photographs have also been gathered from various researchers, besides the personal photographs of scientists engaged in the present work.

Work done:

Updated, edited and submitted the final manuscript for 43 taxa belonging to following 3 families viz.,

1. **ALISMATACEAE:** 18 taxa under 6 genera; *Alisma canaliculatum* A. Braun & C. D. Bouche; *A. gramineum* Lej.; *Alisma lanceolatum* Withering; *Alisma plantago-aquatica* L. ssp. *plantago-aquatica*; *Alisma plantago-aquatica* L. ssp. *orientale* (Samuel.) Samuel.; *Caldesia grandis* Samuel.; *C. janaki-ammalii* Guha et Mondal; *C. oligococca* (F.V. Muell) Buch. var. *oligococca*; *C. oligococca* (F.V. Muell) Buch. var. *echinata* Hartog; *Caldesia parnassifolia* (Bassi ex L.) Parl.; *Limnophyton obtusifolium* (L.) Migq.; *Ranalisma rostrata* Stapf.; *Sagittaria guayanensis* H.B.K. ssp. *lappula* (D. Don) Bogin; *S. latifolia* Willd.; *S. longiloba* Engelman ex J. G. Smith; *S. montevidensis* Cham. et Schlecht. ssp. *montevidensis* Rataj; *S. trifolia* L. and *Weisneria triandra* (Dalz.) Mich.

2. **UVULARIACEAE:** 13 taxa under 4 genera; *Clintonia udensis* Trautv. & Meyer; *Disporum calcaratum* D. Don; *D. cantoniense* (Lour.) Merr. var. *contoniense*; *D. cantoniense* (Lour.) Merr. var. *sikkimense* Hara; *D. leschenaultianum* D. Don var. *leschenaultianum*; *D. leschenaultianum* D. Don var. *angustifolium* Gamble; *D. leucanthum* Hara; *D. longistylum* (H. Leveille & Vaniot) H. Hara; *D. mishmiensis* Hareesh & M. Sabu; *Streptopus chatterjeeanus* S. Dasgupta; *S. parasimplex* Hara & Ohashi; *S. simplex* D. Don; *Tricyrtis maculata* (D. Don) J.F. Macbr.

3. **TRILLIACEAE:** 12 taxa under 3 genera; *Paris polyphylla* Sm. var. *alba* H. Li & R. J. Mitchell; *P. polyphylla* Sm. var. *fargesii* (Franch.) S. Dasgupta; *P. polyphylla* Sm. var. *latifolia* F.T. Wang & C. Yu Chang; *P. polyphylla* Sm. var. *polyphylla*; *P. polyphylla* Sm. var. *violacea* (Lev.) Dasgupta; *P. polyphylla* Sm. var. *wallichii* Hara; *P. polyphylla* Sm. var. *yunnanensis* (Franchet) Handel-Mazzetti; *P. thibetica* Franchet. var. *apetala* Handel-Mazzetti; *P. thibetica* Franchet. var. *thibetica*; *Trillidium govanianum* (Wall. ex D. Don) Kunth; *Trillium smallii* Maxim.; *T. tschonoskii* Maxim.

Output indicators for the assessment of the project : Implementation of standard plant taxonomic principles and classical tools, adherence of ICN rules and recommendations.

Major impacts reported during the financial year : After completion of 'Flora of India' project, a comprehensive account of the families, genera and species will be available to the country with the help of which anyone can access the current status and abundance of taxa. It will also help Forest department for implementation of working and management plan.

Flora of Kerala, Volume 3(GamopetalaePart-I)

Name of the Executing officials: Shri P. Murugan, SRF & Dr. C. Murugan, Scientist 'E'

1. Duration of the project:June, 2018 to July, 2022

Objectives:

The floristic diversity of the Kerala state is vast and rich in plant diversity. The state is not completely surveyed. The present study will be mainly based on morphological features of the members Gamopetalae in Kerala, with help of herbarium specimens and also fresh collections and documented of the plant diversity with the following objectives:

- I. Survey and documentation of the plant diversity
- II. Identification of endemic taxa and threatened taxa according to IUCN criteria.
- III. Documentation of plant resources and their utilization practices by local tribal communities living in and around the areas and their traditional conservation.

4.3Study Area and Map:

Kerala State lies along the Southern West coast of India between 8° 18' and 12° 48' N latitude and 74° 52' and 77° 22' E longitude. It is bounded by Karnataka in the North, Tamil Nadu in the South and East and the Arabian Sea in the West. It has a warm-humid tropical climate. The mean daily temperature ranges from 19.8°C to 37°C. However, at higher altitudes the temperature often drops to 7°C during winter. The average annual rainfall of the state ranges from 101.6 to 362 cm. The state receives maximum rainfall around 65% during southwest monsoon from June to August, and the rest from September to December during northeast monsoon. The state has a complex topography with mountains, valleys, ridges and coastal area. The altitude varies from sea level to 2695 m above mean sea level (Anaimudi), which is the highest peak in Peninsular India.

Project Allotted: Flora of Kerala: Gamopetalae Part-I (25 Families, 230 Genera and 783 Taxa)

Table1: List of families.

| Sl. No. | Name of the Family | No. of the Genera | No. of the Species |
|---------|-------------------------|-------------------|--------------------|
| 1. | CAPRIFOLIACEAE | 2 | 4 |
| 2. | RUBIACEAE | 55 | 253 |
| 3. | VALERIANACEAE | 1 | 3 |
| 4. | COMPOSITAE (ASTERACEAE) | 66 | 189 |
| 5. | GOODENIACEAE | 1 | 1 |
| 6. | CAMPANULACEAE | 4 | 10 |
| 7. | LOBELIACEAE | 1 | 6 |
| 8. | VACCINIACEAE | 1 | 2 |
| 9. | ERICACEAE | 2 | 2 |
| 10. | PLUMBAGINACEAE | 1 | 2 |
| 11. | PRIMULACEAE | 2 | 3 |
| 12. | MYRSINACEAE | 7 | 24 |
| 13. | SAPOTACEAE | 8 | 22 |
| 14. | EBENACEAE | 1 | 31 |
| 15. | SYMPLOCACEAE | 1 | 14 |

| | | | |
|--------------|----------------|------------|------------|
| 16. | OLEACEAE | 6 | 34 |
| 17. | NYCTANTHACEAE | 1 | 1 |
| 18. | SALVADORACEAE | 1 | 1 |
| 19. | APOCYNACEAE | 26 | 40 |
| 20. | ASCLEPIADACEAE | 21 | 72 |
| 21. | PERIPLOCACEAE | 6 | 8 |
| 22. | LOGANIACEAE | 5 | 13 |
| 23. | BUDDLEIACEAE | 1 | 1 |
| 24. | GENTIANACEAE | 6 | 28 |
| 25. | MENYANTHACEAE | 1 | 7 |
| Total | | 230 | 783 |

4.4 Achievements:

During this period (April, 2020 to September, 2020), Senior Research Fellow, consulted one herbarium (MH!) (Table 2) and documented 87 genera and 27 spp (Table 3, 4 & 5).

Herbarium Consultation: During this period one herbarium consulted at MH! and details are given below.

Table 2: Madras Herbarium consulted.

| Sl. No. | Period | Name of the Institute | No. of Genus | No. of Species | No. of Specimens Examined |
|---------|---------------------------------|----------------------------------|--------------|----------------|---------------------------|
| 1 | 01.04.2020 to 30.0.9.2020 | BSI, SRC, Madras Herbarium (MH!) | 116 | 256 | 520 |

Table 3: List of species and generic description were documented.

| Sl. No. | Name of the Family | Number of the Genera documented | Number of the Species documented |
|---------|-------------------------|---------------------------------|----------------------------------|
| 1 | Compositae (Asteraceae) | 87 | 27 |

Table 4: List of Generic description completed.

| Sl. No. | Name of the Genus |
|---------|--|
| 1 | <i>Acanthospermum</i> Schrank |
| 2 | <i>Achillea</i> L. |
| 3 | <i>Acilepis</i> D.Don |
| 4 | <i>Acmella</i> Rich. ex Pers. |
| 5 | <i>Adenoon</i> Dalzell |
| 6 | <i>Adenostemma</i> J.R.Forst. & G.Forst. |
| 7 | <i>Ageratina</i> Spach |
| 8 | <i>Ageratum</i> L. |
| 9 | <i>Anaphalis</i> DC. |
| 10 | <i>Artemisia</i> L. |

| | |
|----|------------------------------------|
| 11 | <i>Ayapana</i> Spach |
| 12 | <i>Bidens</i> L. |
| 13 | <i>Blepharispermum</i> DC. |
| 14 | <i>Blumea</i> DC. |
| 15 | <i>Centipeda</i> Lour. |
| 16 | <i>Centratherum</i> Cass. |
| 17 | <i>Chromolaena</i> DC. |
| 18 | <i>Cichorium</i> L. |
| 19 | <i>Cirsium</i> Mill. |
| 20 | <i>Cissampelopsis</i> (DC.) Miq. |
| 21 | <i>Conyza</i> Less. |
| 22 | <i>Coreopsis</i> L. |
| 23 | <i>Cosmos</i> Cav. |
| 24 | <i>Cotula</i> L. |
| 25 | <i>Crassocephalum</i> Moench |
| 26 | <i>Cyanthillium</i> Blume |
| 27 | <i>Cyathocline</i> Cass. |
| 28 | <i>Dahlia</i> Cav. |
| 29 | <i>Dichrocephala</i> L'Hér. ex DC. |
| 30 | <i>Eclipta</i> L. |
| 31 | <i>Elephantopus</i> L. |
| 32 | <i>Eleutheranthera</i> Poit. |
| 33 | <i>Emilia</i> Cass. |
| 34 | <i>Epaltes</i> Cass. |
| 35 | <i>Erechtites</i> Raf. |
| 36 | <i>Erigeron</i> L. |
| 37 | <i>Euryops</i> (Cass.) Cass. |
| 38 | <i>Gaillardia</i> Foug. |
| 39 | <i>Gamochoaeta</i> Wedd. |
| 40 | <i>Gerbera</i> L. |
| 41 | <i>Glossocardia</i> Cass. |
| 42 | <i>Gnaphalium</i> L. |
| 43 | <i>Grangea</i> Adans. |
| 44 | <i>Gynura</i> Cass. |
| 45 | <i>Helianthus</i> L. |
| 46 | <i>Helichrysum</i> Mill. |
| 47 | <i>Homognaphalium</i> Kirp. |
| 48 | <i>Hypochoeris</i> L. |
| 49 | <i>Kleinia</i> Jacq. |
| 50 | <i>Lagascea</i> Cav. |
| 51 | <i>Launaea</i> Cass. |
| 52 | <i>Leucanthemum</i> Mill. |
| 53 | <i>Lipoblepharis</i> Orchard |
| 54 | <i>Melampodium</i> L. |
| 55 | <i>Mikania</i> Willd. |
| 56 | <i>Monosis</i> DC. |
| 57 | <i>Moonia</i> Arn. |
| 58 | <i>Myriactis</i> Less. |
| 59 | <i>Parthenium</i> L. |

| | |
|----|--|
| 60 | <i>Pentanema</i> Cass. |
| 61 | <i>Phyllocephalum</i> Blume |
| 62 | <i>Picris</i> L. |
| 63 | <i>Pseudoconyza</i> Cuatrec. |
| 64 | <i>Pseudognaphalium</i> Kirp. |
| 65 | <i>Psiadia</i> Jacq. |
| 66 | <i>Senecio</i> L. |
| 67 | <i>Sigesbeckia</i> L. |
| 68 | <i>Solidago</i> L. |
| 69 | <i>Sonchus</i> L. |
| 70 | <i>Sphagneticola</i> O.Hoffm. |
| 71 | <i>Sphaeranthus</i> L. |
| 72 | <i>Strobocalyx</i> (Blume ex DC.) Sch.Bip. |
| 73 | <i>Struchium</i> P.Browne |
| 74 | <i>Symphyotrichum</i> Nees |
| 75 | <i>Synedrella</i> Gaertn. |
| 76 | <i>Tagetes</i> L. |
| 77 | <i>Tanacetum</i> L. |
| 78 | <i>Taraxacum</i> F.H.Wigg. |
| 79 | <i>Tarlmounia</i> H.Rob., S.C.Keeley, Skvarla & R.Chan |
| 80 | <i>Tithonia</i> Desf. ex Juss. |
| 81 | <i>Tricholepis</i> DC. |
| 82 | <i>Tridax</i> L. |
| 83 | <i>Uniyala</i> H.Rob. & Skvarla |
| 84 | <i>Vernonia</i> Schreb. |
| 85 | <i>Wollastonia</i> DC. ex Decne. |
| 86 | <i>Xanthium</i> L. |
| 87 | <i>Youngia</i> Cass. |

Table 5: List of Species description completed.

| Sl. No. | Name of the Species |
|---------|--|
| 1 | <i>Acilepis dendigulensis</i> (DC.) H.Rob. |
| 2 | <i>Acilepis divergens</i> (DC.) H.Rob. & Skvarla |
| 3 | <i>Acilepis fysonii</i> (Calder) H.Rob. & Skvarla |
| 4 | <i>Acilepis heynei</i> (Bedd. ex Gamble) H.Rob. & Skvarla |
| 5 | <i>Acilepis ornata</i> (Talbot) H.Rob. & Skvarla |
| 6 | <i>Acilepis saligna</i> (DC.) H.Rob. |
| 7 | <i>Acilepissetigera</i> (Arn.) H.Rob. & Skvarla |
| 8 | <i>Acmella ghoshinis</i> (Sheela) Reshmi & Rajalakshmi ex Kottaim. |
| 9 | <i>Acmella tetralobata</i> (Reshmi & Rajalakshmi) Reshmi & Rajalakshmi ex Kottaim. |
| 10 | <i>Acmella vazhachalensis</i> (Sheela) Reshmi & Rajalakshmi ex Kottaim. |
| 11 | <i>Kleinia subrahmanianii</i> Sunil & Naveen Kumar |
| 12 | <i>Lipoblepharis urticifolia</i> (Blume) Orchard |
| 13 | <i>Monosis travancorica</i> (Hook.f.) H.Rob. & Skvarla |
| 14 | <i>Sphagneticola calendulacea</i> (L.) Pruski |

| | |
|----|---|
| 15 | <i>Sphagneticola trilobata</i> (L.) Pruski |
| 16 | <i>Tarlmounia elliptica</i> (DC.) H.Rob. |
| 17 | <i>Uniyala multibracteata</i> (Gamble) H.Rob. & Skvarla |
| 18 | <i>Uniyala salviifolia</i> (Wight) H.Rob. & Skvarla |
| 19 | <i>Uniyala wightiana</i> (Arn.) H.Rob. & Skvarla |
| 20 | <i>Vernonia gossypina</i> Gamble |
| 21 | <i>Vernonia malabarica</i> Hook.f. |
| 22 | <i>Vernonia meeboldii</i> W.W.Sm. |
| 23 | <i>Vernonia raui</i> Uniyal |
| 24 | <i>Wollastonia biflora</i> (L.) DC. |
| 25 | <i>Xanthium strumarium</i> L. |
| 26 | <i>Youngia japonica</i> (L.) DC. |
| 27 | <i>Youngia nilgiriensis</i> Bab |

Volume 4

1. Name of the Project: Flora of Kerala Vol. 4.

2. Executing Scientist: Shri Basil Paul, SRF & Dr. Sujana K. A., Scientist, Scientist 'D' under the supervision of Dr. M. U. Sharief, Scientist E, HoO.

3. Duration of the Project: 01.04.2020 – 31.03.2022

4. About the work done:

4.1 Objectives

To document the flora of Kerala for the Flora of Kerala, Vol. 4 (Gamopetale Part – II) according to the format of previous volumes.

4.4 Study area

Kerala, the southernmost state of India is located between 8° 18' and 12° 48' N latitude and 74° 52' and 77° 22' E longitudes and surrounded by Arabian Sea in the west; Western Ghats in the east; Karnataka in the North and Tamil Nadu in the south. The state has an area of 38, 864 km², which is only 1.18 % of India, also support about 25 percent of the flora of the country. The state enjoys a tropical climate with alternating four major seasons of winter (Dec – Feb), summer (March – May), south west monsoon (June – Aug.) and north-east monsoon (Sept – Nov). The forests of the state are classified into wet evergreen, semi evergreen, moist deciduous, dry deciduous and thorn forests.

4.5 Methodology

Plant documentations were prepared based on the literatures in connection with flora of Kerala and available herbarium specimens deposited at major national and international herbaria.

4.6 Achievements

A total of 87 taxa belongs to 4 families were documented.

Acanthaceae (16), Lamiaceae (54), Pedaliaceae (5) and Solanaceae (12)

4.7 Output indicators for the assessment of the project:

- Updated nomenclature of 87 plant species with description and distribution.
- Monthly, quarterly reports prepared and submitted.

1.1 Major impacts reported during the financial year: Nil.

Volume 6

1. **Name of the Project:** Flora of Kerala, Volume – 6: (Orchidaceae to Potamogetonaceae; 38 families).
2. **Executing Scientist (s):** Shri M. Sulaiman, SRF & Dr. M. Murugesan, Scientist ‘C’
3. **Duration of the project:** April, 2020–March, 2022
4. **About the work done :**

4.1. Objectives:

- To prepare and also to update the taxonomic account of 38 families based on herbarium specimens and available literature.
- To reconstruct the bracketed keys to the species and infra-specific taxa, wherever necessary, especially when new reports are included or change in nomenclature and taxonomic status. Also to prepare fresh bracketed keys for few families for which manuscripts are not available.
- To provide up-to-date nomenclature of every taxon with standardized bibliographic citations
- To update and standardize the nomenclature of every taxon.
- To provide authentic and up-to-date information on the occurrence and distribution of every taxon.
- To submit the updated and refined taxonomic account of the allotted families.

4.2. Site of the study (with map): Kerala State



4.3. Methodology adopted :

All the species were updated as per the given format of flora of Kerala. The standard plant taxonomic principles and classical tools have been followed and used, respectively. The rules and recommendations of International Code of Nomenclature for algae, fungi, and plants, specifically the Shenzhen Code (Turland & al., 2018) have been strictly adhered. Illustrations were made based on authentic herbarium specimens housed in herbaria of different regional centres of BSI, especially the holdings at MH, and colour photographs have also been gathered from various researchers, besides the personal photographs of scientists engaged in the present work.

4.4. Work done:

A total of 106 taxa belongs to Orchidaceae were documented.

4.5. Output indicators for the assessment of the project :

- ✓ Updated nomenclature of 106 plant species with description and distribution.

- ✓ Monthly, quarterly reports prepared and submitted.

4.6. Major impacts reported during the financial year :

B. Research Publications (in *Nelumbo* format): NA.

Funded Project

I. Study of Diversity of Marine Macro Algae of Andhra Pradesh

- 1. Name of the Project:** “*Study of Diversity of Marine Macro Algae of Andhra Pradesh, India*” under *AICOPTAX* scheme.” sponsored by MoEF & CC, New Delhi
- 2. Executing Scientist:** **Dr. M. Palanisamy**, Scientist – ‘E’, BSI, SRC, CBE.
- 3. Duration of the Project:** Dec, 2016 – Dec, 2019
Duration of the Project period is completed on 31.12.2019 and the **project was extended for 2 more years** (January, 2020 – December, 2021) by the competent authority (Review committee members) of MoEF & CC, New Delhi [Ref. No. F. No. 22018/22/2015-RE (Tax) dt.16.08.2019].

4. About the Work Done:

4.3 Objectives

- ❖ Survey and collection of seaweeds.
- ❖ Taxonomic enumeration and diversity of seaweeds.
- ❖ Study the Physico-chemical parameters of coastal water.
- ❖ Study the seaweed population density of various localities.
- ❖ Organizing Capacity Building short-term and long-term training, workshops by involving well known resource persons from across the country in Seaweed-taxonomy.
- ❖ Preparation and submission of the final report encompassing the seaweeds of Andhra Pradesh
- ❖ Coast including an exhaustive account on its taxonomy and diversity.

4.4 Site of the Study

Andhra Pradesh lies between 12°41' - 19°07' N latitude and 69°37' - 84°44' E longitude. The state is bordered by Maharashtra, Chhattisgarh, Telangana and Orissa in the north, the Bay of Bengal in the East, Tamil Nadu to the south and Karnataka to the west. Among the other states, Andhra Pradesh has got a coastline of around c.972 km, running from Pulicat Lake (Nellore district) in the south to Donkuru (Srikakulam District) in the North. The study area will be divided into three major zone i.e. South (Nellore, Guntur and Prakasam), middle (Krishna, West Godavari and East Godavari) and north (Visakhapatnam, Srikakulam and Vizianagaram). Andhra Pradesh coast line is much suitable for seaweeds growth and sporadically reported from Visakhapatnam.

4.5 Methodology adopted

Exploration tours and collection of Seaweeds

The exploration tours for the collection of seaweeds were scheduled based on the seasons (divided in to 4 quarter) to record and report the seasonal wise as well as to collect the seasonal available and depended species. The duration (days) was centered on the atmospheric factors such as atmospheric temperature, rain fall, humidity, seawater current and tides, pH, water temperature, etc. The tide charts prepared to fix period for the collection of seaweeds at low tides. Important field materials such as camera, water analysis kit, field books, note book, polythene bags (zipped), standard plastic containers (100, 250, 500 ml, 1000 ml), buckets, trays, mounting boards, blotting papers, newspapers, forceps, needles, brushes, markers, soft cotton cloth, iron presser, ropes, fevicol (SH) and preservatives (ethyl alcohol and formalin) were carried during field tours.

The seaweed samples were collected from sub-tidal & inter tidal zones. All the possible seaweed substrata such as rocks, bedrocks, artificial cement boulders, cliffs, calcareous mollusc shells and coastal wastes like nets, plastics, cloths etc. by scrapping with hands and mollusc shells. Small and delicate or coralline algae were collected

with great care to avoid any damage of the specimen. The Scuba diving kit and snorkel kit were used for collection, where the location is highly deep. The collected samples were kept in the zip lock covers and container. While making collection, important field details such as habit, habitats, nature of the coast, locality and its GPS position, vegetation were noted in field notebook. Further, important physico-chemical parameters of sea water such as salinity, atmospheric and water temperatures, pH value, Total Dissolved Solids (TDS), and Dissolved Oxygen (DO) values were measured using the water analysis kit. The habit, habitats and coastal natures were photographed using the camera (Nikon D3300 & Nikon Underwater camera). All the collected marine macro algal samples were washed thoroughly with sea water, followed by using fresh water to remove attached sand particles, sediments and debris without damaging the specimens. Later, they were preserved by adopting two methods.

1. Wet Preservation
2. Dry Preservation

Wet Preservation

After removal of debris from the specimens, preserved in mixed solution of 4% of formalin, 1% of ethyl alcohol and 95 % of filtered seawater in different size plastic containers (50 ml, 100 ml, 250 ml, 500 ml and 1000 ml) and tightly sealed. All the containers were labeled properly with name of the species, field number, date, place of collection and collector/s name. All the preserved materials were brought to the laboratory for further study.

Dry Preservation

Under dry method, the seaweed specimens were preserved in the form of herbarium sheets. For each field number, minimum two herbarium sheets were prepared adopting the standard herbarium techniques (Srinivasan, 1969; Dhargalkar & Kavlekar, 2004). The following steps were followed for the preparation of herbarium sheets:

The collected specimens were segregated into three groups *viz.*, red, brown and green. The samples were floated in water filled tray and standard herbarium sheet (28 × 42 cm) was immersed in between tray and specimens and gently lifted the herbarium sheet with spreaded specimens. The mounted samples were covered with piece of white cotton cloths to avoid any damage of the specimens because the algal samples are very delicate. Each herbarium sheet was pasted a field number on left side of the sheet. The mounted sheets were kept in between the blotting papers.

All the sheets were piled up one above the other and placed in between iron mess press and tied properly with the help of cotton ropes. The tied bundles containing the herbarium sheets were kept under sunlight for 2–6 days for proper drying of specimens. During this period, blotting papers and white cloths were periodically changed for avoiding contamination. All the dried herbarium sheets were labeled with standard label slip (8 × 12 cm), containing various details such as institution, region name, botanical name, family, local name, locality, GPS coordinates, distribution, abundance, associated plants, notes, field number, date of collection, Photography status, collectors' name and identifying author/s name. All the preserved (wet and dry) specimens are deposited at the Madras Herbarium (MH), Botanical Survey of India, Southern Regional Centre, Coimbatore for future reference.

Microscopic Studies

Microscopic study plays an important role in the precise identification of seaweeds. Many of the species are morphologically looking very similar and create confusion in identification. In such cases, anatomical characters support in confirming the identity of the species. For anatomical study, the best samples were selected from the wet preserved materials and subjected to free hand sectioning using stainless razor blade. The best sections were selected after observing them using stereo microscope (Nikon SZ51 & Carl Zeis Axio A1). The selected sections were stained (with iodine for green, methylene blue for brown and safranin for red algae), and cover slips were gently placed above without the formation of any air bubbles. The sections were examined using optical microscopes (NIKON SMZ1500 & NIKON ECLIPSE 50i) coupled with computer attached digital sight *DS-Fil* camera to study the general morphology and anatomical characters.

Description

Based on the field observation and critical examination of morphological and anatomical characters of the specimens, a list of characters was prepared in the form of a data sheet and it was followed consistently while making the description of every taxon to maintain uniformity.

Identification

All the taxa submitted for identification have been arranged systematically, following the classifications proposed by Fritsch (1935, 1944) with slight modification as per Papenfuss (1951, 1955) and Silva & al. (1996). For each taxon, the currently accepted botanical name has been given in *Italic*, followed by author/s and original citation.

Nomenclature has been updated following the recent International Code of Nomenclature for Algae, Fungi and Plants (McNeill & al., 2012). The names of authors given based on the reference from “*Authors of Plant Names*” by Brummitt & Powell (1992).

The following references (Flora, Literature, Monograph and Pictorial guide) were used to confirm the identity: *Phaeophyceae in India* (Misra, 1966); *Phycologia Indica: The Icons of Indian Seaweeds* (Srinivasan, 1969, 1973); *Rhodophyta* (Desikachary & al., 1990, 1998); *Catalogue of the Benthic Marine Algae of the Indian Ocean* (Silva & al., 1996); *Algae of India and Neighboring Countries I. Chlorophycota* (Krishnamurthy, 2000); *Phaeophyceae of India and Neighbourhood* (Krishnamurthy & Baluswamy, 2010) and *Algae of Australia: Green and Brown Algae* (Kraft, 2007; Huisman, 2015). The authentically deposited seaweed herbarium (collected from the peninsular states of India) in MH, Coimbatore has been referred.

In addition, other online resources such as Algaebase, (www.algaebase.org), WoRMS (www.marinespecies.org), Macroalgal Herbarium Portal (macroalgae.org), Seaweed Site: Information on marine algae (www.seaweed.ie/), Seaweed Research and Utilization (www.seaweedindia.net/), Marine Biological Association of the UK (www.mba.ac.uk/), Iris Seaweed Research Group (www.irishseaweedresearch.com/), International Phycological Society (www.inphycsoc.org/), Phycological Society of America (/www.psaalgae.org/) etc., were also referred for the identification of seaweeds.

4.6 Work done

- a. Total area covered:** Coastline of Andhra Pradesh (Ca.972 Km)
- b. Number of tours undertaken:** -
- c. Number of Species collected:** -
- d. Number of Species described:** 70 Nos.

| S.No. | Name of the Taxa | Family |
|--------------|---|------------------|
| 1 | Monostroma latissimum Wittr. | Monostromataceae |
| 2 | Ulva clathrata (Roth) C.Agardh | Ulvataceae |
| 3 | Ulva compressa L. | Ulvataceae |
| 4 | Ulva conglobata Kjellm | Ulvataceae |
| 5 | Ulva fasciata Delile | Ulvataceae |
| 6 | Ulva flexuosa Wulfen | Ulvataceae |
| 7 | Ulva intestinalis L. | Ulvataceae |
| 8 | Ulva lactuca L. | Ulvataceae |
| 9 | Ulva linza L. | Ulvataceae |
| 10 | Ulva profunda W.R.Taylor | Ulvataceae |
| 11 | Ulva prolifera O.F.Mull. | Ulvataceae |
| 12 | Ulva quilonensis Sindhu & Panikkar | Ulvataceae |
| 13 | Ulva rigida C.Agardh | Ulvataceae |
| 14 | Ulva uniseriata F.Bast | Ulvataceae |
| 15 | Acrosiphonia orientalis (J.Agardh) P.C.Silva | Acrosiphonaceae |
| 16 | Chaetomorpha aerea (Dillwyn) Kuetz. | Cladophoraceae |
| 17 | Chaetomorpha antennina (Bory) Kuetz. | Cladophoraceae |
| 18 | Chaetomorpha brachygona Harv. | Cladophoraceae |
| 19 | Chaetomorpha linoides Kuetz. | Cladophoraceae |
| 20 | Chaetomorpha linum (Muell.) Kuetz. | Cladophoraceae |
| 21 | Chaetomorpha litorea Harv. | Cladophoraceae |
| 22 | Chaetomorpha spiralis Okamura | Cladophoraceae |
| 23 | Cladophora colabensis Boergesen | Cladophoraceae |
| 24 | Cladophora glomerata (L.) Kuetz. | Cladophoraceae |
| 25 | Cladophora patentiramea (Mont.) Kuetz. | Cladophoraceae |

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|----|---|-----------------|
| 26 | Cladophora socialis Kuetz. | Cladophoraceae |
| 27 | Rhizoclonium tortuosum (Dillwyn) Kuetz | Cladophoraceae |
| 28 | Boodlea struveoides Howe | Boodleaceae |
| 29 | Phyllocladon anastomosans G.T. Kraft & M.J.Wynne | Boodleaceae |
| 30 | Acrocladus herpesticus (Mont.) Boedeker | Boodleaceae |
| 31 | Valoniopsis pachynema (G.Martens) Boergesen | Valoniaceae |
| 32 | Chara baltica (C.J.Hartmann) Bruzelius | Characeae |
| 33 | Bryopsis hypnoides J.V.lamour. | Bryopsidaceae |
| 34 | Bryopsis pennata J.V.lamour. | Bryopsidaceae |
| 35 | Bryopsis plumosa (Huds.) C.Agardh | Bryopsidaceae |
| 36 | Trichosolen mucronatus (Boergesen) W.R.Taylor | Bryopsidaceae |
| 37 | Caulerpa microphysa (Weber Bosse) Feldm. | Caulerpaceae |
| 38 | Caulerpa peltata J.V.Lamour. | Caulerpaceae |
| 39 | Caulerpa racemosa (Forssk.) J.Agardh | Caulerpaceae |
| 40 | Caulerpa racemosa var. macrophysa (Sonder ex Kuetz.) W.R.Taylor | Caulerpaceae |
| 41 | Caulerpa racemosa var. turbinata (J.Agardh) Eubank | Caulerpaceae |
| 42 | Caulerpa scapelliformis (R.Br.ex turner) C.Agardh | Caulerpaceae |
| 43 | Caulerpa sertularioides (S.Gmelin) Howe | Caulerpaceae |
| 44 | Caulerpa taxifolia (Vahl) C.Agardh | Caulerpaceae |
| 45 | Caulerpa verticillata J.Agardh | Caulerpaceae |
| 46 | Caulerpa veravalensis Thivy & V.D.Chauhan | Caulerpaceae |
| 47 | Codium indicum Dixit | Codiaceae |
| 48 | Halimeda macroloba Decaisne | Halimedaceae |
| 49 | Halimeda opuntia (L.) J.V.Lamour. | Halimedaceae |
| 50 | Avrainvillea rawsonii (Dickie) M. Howe | Udoteaceae |
| 51 | Ectocarpus siliculosus (Dillwyn) Lyng. | Ectocarpaceae |
| 52 | Chnoospora bicanaliculata V.Krishnam. & Thomas | Chnoosporaceae |
| 53 | Chnoospora minima (Hering) Papenf. | Chnoosporaceae |
| 54 | Rosenvingea intricata (J.Agardh) Boergesen | Scyosiphonaceae |
| 55 | Feldmannia irregularis (Kuetz.) Hamel | Scyosiphonaceae |
| 56 | Feldmannia mitchelliae (Harvey) H.S.Kim | Scyosiphonaceae |
| 57 | Sphacelaria tribuloides Meneghini | Scyosiphonaceae |
| 58 | Dictyopteris australis (Sonder) Askenasy | Dictyotaceae |
| 59 | Dictyota dichotoma (Huds.) J.V.Lamour. | Dictyotaceae |
| 60 | Lobophora variegata Womersley ex E.C.Oliveira | Dictyotaceae |
| 61 | Padina australis Hauck | Dictyotaceae |
| 62 | Padina boergesenii Allender & Kraft | Dictyotaceae |
| 63 | Padina boryana Thivy | Dictyotaceae |
| 64 | Padina gymnospora (Kuetz.) Sonder | Dictyotaceae |
| 65 | Padina pavonica (L.) Thivy | Dictyotaceae |
| 66 | Padina tetrastratica Hauck | Dictyotaceae |
| 67 | Stoechospermum polypodioides (J.V.Lamouroux) J.Agardh | Dictyotaceae |
| 68 | Sargassum cinereum J.Agardh | Sargassaceae |
| 69 | Sargassum cinctum J.Agardh | Sargassaceae |
| 70 | Sargassum ilicifolium (Turner) C.Agardh | Sargassaceae |

e. Number of species incorporated: -

4.7 Output indicator for the assessment of the project:

- ❖ The present study reveals that, **134 taxa** of seaweeds were reported from the coastline of Andhra Pradesh. Among them, **one taxon** new addition to India, **25 taxa** were **new distributional additions** to the state flora of Andhra Pradesh. The **prospects, commercial and economic values of the 58 taxa** of the marine macro algae from Andhra Pradesh were inventoried. The taxonomical **description of 70 species was prepared** in the prescribed format of BSI, Kolkata Also, the population studies on seaweeds from Andhra Pradesh were detailed.
- ❖ Also, **Conducted Ph.D. doctoral committee Meeting-1** of. Shri.Aron Santhosh Kumar Y (Project Fellow) under this AICOPTAX Project in BSI, SRC, Coimbatore on 03.07.2020. The Ph.D. doctoral committee Meeting-1 report sent to Bharathiar University through HOO. SRC, Coimbatore.

4.8 Major impacts reported during the financial year:

- ❖ The present study reveals that, **134 taxa** of seaweeds were reported from the coastline of Andhra. Among them, **one taxon** new addition to India, **25 taxa** were **new distributional additions** to the state flora of Andhra Pradesh. The **prospects, commercial and economic values of the 58 taxa of the marine macro algae** from Andhra Pradesh were inventoried.
- ❖ Maximum seaweed diversity was recorded at the northern part of the state, especially at Yerramukkam, Bandaruvanipeta, Bheemlipatnam, Chintapalle, Akkupalli, Yerramukkam, Mangamaripeta, Thimmapuram and towards south in Pulicat Lake. Seaweed species richness was observed in Srikakulam and followed by Vijayanagaram, Visakhapatnam, & Pulicat Lake (Nellore). The abundance of seaweed species has been found be enormous at Visakhapatnam and followed by, Srikakulam, Vizianagaram and Nellore. **Chondracanthus acicularis** (Roth) Fredericq, **Ulva fasciata** Delile, **Gelidiopsis variabilis** (Greville ex J.Agardh) F.Schmitz, **Gracilaria corticata** (J. Agardh) J. Agardh are the relative abundance species and associated with other species of seaweeds. The economically and commercially important seaweeds such as **Ulva compressa** L., **Ulva lactuca** L., **Ulva rigida** C.Agardh, **Padina tetrastratica** Hauck, **Gelidium micropterum** Kuetz., **Gelidium pusillum** (Stackh.) Le Jolis and **Gracilaria corticata** (J. Agardh) J. Agardh, **Gelidiopsis spp.**, **Sargassum spp.**, **Caulerpa Spp.**, **Porphyra sp.**, are found.
- ❖ The green algae species such as **Ulva compressa** L., **Ulva prolifera** O.F.Muell., **Chaetomorpha linoides** Kuetz. & **Ulva spp** have been found throughout the coastal areas of Andhra Pradesh; **Ulva intestinalis** L., **Ulva profunda** W.R. Taylor., **Chaetomorpha crassa** (C. Agardh) and **Gracilaria verrucosa** (Hudsn.) Papenf., were only found in the estuaries and back water area of Andhra Pradesh. Species like **Wrangelia tanegana** Harv., **Liagora ceranoides** J.V.Lamour. and **Gracilaria textorii** (Suringar) Hariot merely found at Srikakulam District. Meanwhile most of the **Sargassum spp.**, were found at the inner most regions of the inter tidal zones. Further, two genera of seagrasses (**Halophila spp** & **Halodule sp.**) have been recorded. Various types of rocky bodies such as pebbles, cliffs, bed rocks, granite stones, out crops, and artificially constructed concrete bodies were mostly covered and harshly matted to various types of mollusc shells. This calcareous mollusc shells are also the one of the predators, which may inhibit and avert the seaweed diversity.
- ❖ Also, Duration of the Project period is completed on 31.12.2019, and the **project was extended for 2 more years** (January, 2020 – December, 2021) by the competent authority (Review committee members) of MoEF & CC, New Delhi [Ref. No. F. No. 22018/22/2015-RE (Tax) dt.16.08.2019.]. The preparation to **e-flora** is in process.

II. Flora of Gulf of Mannar Biosphere Reserve after Tsunami

1. Name of the Project : Reinvestigation on Flora of Gulf of Mannar Biosphere Reserve after Tsunami
2. Executing Scientist (s) : Dr. C. Murugan, Scientist- 'E' & PI, Dr. R. Manikandan, Scientist- 'E' & Co- PI & Ms. Nithya, S.P., JPF
3. Duration of the project : 2018–2021
4. About the work done :

4.1 Objectives:

- Impact assessment of floral diversity after 2004 Tsunami
- Survey and documentation of all flowering plants in all 21 islands in different seasons.
- Herbarium preparation and identification of all the collected flowering plants
- Preparing a comprehensive checklist of flowering plants of Gulf of Mannar Biosphere Reserve along with brief description
- Checking the taxonomical and present nomenclatural status of all the plants in Biosphere Reserve
- Assess the threat factors for the endemic and threatened plants from the study area.
- Species specific and area specific conservation strategies will be provided for future ecological security

4.2 Site of the study:

The Gulf of Mannar Biosphere Reserve extends from Rameswaram to Kanyakumari and lies between 78°8'–79°30' E and 8°35'–9°25' N, spreads in an area of 10,500 km² (Melkani & al., 2014). The Gulf of Mannar has a chain of 21 uninhabited islands, which are classified into 4 main groups;

- **Mandapam Group** (7 islands): Shingle, Kurusadai, Poomarichan, Pullivasal, Muyal, Manoli and Manoliputti
- **Keezhakarai group** (7 islands): Anaipar, Valimunai, Appa, Thalaiyari, Vaalai, Mulli and Poovarasanputti (Submerged).
- **Vembar Group** (3 islands): Upputhanni, Puluvinichalli and Nallathanni.
- **Thoothukudi Group** (4 islands): Van, Kaswari, Kariyachalli and Velanguchalli (Submerged).

1.1 Methodology adopted :

Extensive field surveys have been carried out in different seasons from July, 2018 to February, 2021 to document the flowering plants of the Biosphere Reserve. Plants with either flowers or fruits were collected from different areas of Gulf of Mannar Biosphere Reserve that is from Ramanathapuram to Keezhakarai, including both islands and mainland. A total of three specimens were collected for each taxon. While collecting the plants the habit, colour and fragrance of flowers or fruits, place of collection, date of collection, distribution, abundance in that particular area, any characteristic notes, collector name, soil type, elevation, latitude and longitude, etc. were noted in the field notebook. Photographs of different vegetation types of the area surveyed, plants with their habitat, habit, associated plants, close-up of flowers and fruits. The collected specimens are well preserved in the form of herbarium, by following the standard herbarium techniques (Fosberg & Sacht, 1965; Forman & Bridson, 1989). The collected plants were identified by using the Floras and also by matching with specimens housed at Madras Herbarium (MH). A detailed description of every collected taxon is also prepared. The voucher specimens will be housed at Madras Herbarium, Botanical Survey of India, Southern Regional Centre, Coimbatore, for future reference.

1.2 Work done :

A. Number of species identified (with name) : 212

| Sl. No. | Binomial | | |
|---------|--|-----|---------------------------------------|
| 1. | Indigofera hirsuta L. | | Kunth |
| 2. | Indigofera linnaei Ali | 9. | Ipomoea aquatica Forssk. |
| 3. | Indigofera nummulariifolia (L.) Livera ex Alston | 10. | Ipomoea cairica (L.) Sweet |
| 4. | Indigofera obifolia Forssk. | 11. | Ipomoea carnea Jacq. |
| 5. | Indigofera tinctoria L. | 12. | Ipomoea dasysperma J.Jacq. |
| 6. | Indigofera tirunelvelica Sanj | 13. | Ipomoea nil (L.) Roth |
| 7. | Indigofera trita L.f. | 14. | Ipomoea obscura (L.) Ker Gawl. |
| 8. | Iphigenia indica (L.) A. Gray ex | 15. | Ipomoea pescaprae (L.) R. Br. |
| | | 16. | Ipomoea pes-tigridis L. |
| | | 17. | Ipomoea rumicifolia Choisy |

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| 18. | Ipomoea sagittifolia Burm.f. |
| 19. | Ipomoea violacea L. |
| 20. | Ixora pavetta Andr. |
| 21. | Jasminum auriculatum Vahl |
| 22. | Jatropha curcas L. |
| 23. | Jatropha glandulifera Roxb. |
| 24. | Jatropha gossypifolia L. |
| 25. | Jatropha maheshwarii Subram. & Nayar |
| 26. | Justicia adhatoda L. |
| 27. | Justicia prostrata (Roxb. ex C.B.Clarke) Gamble |
| 28. | Justicia tranquebariensis L.f. |
| 29. | Kleinia grandiflora (Wallich ex DC.) N. Rani |
| 30. | Kohautia aspera (B. Heyne ex Roth. Bremek.) |
| 31. | Kohautia gracilis (Wall.) DC. |
| 32. | Lablab purpureus (L.) Sweet |
| 33. | Lagenaria siceraria (Molina) Standl. |
| 34. | Lanea coromandelica (Houtt.) Merr. |
| 35. | Lantana camara L. |
| 36. | Lantana involucrata L. |
| 37. | Launaea intybacea (Jacq.) Beauverd |
| 38. | Launaea sarmentosa (Willd.) Alston |
| 39. | Lawsonia inermis L. |
| 40. | Lemna gibba L. |
| 41. | Lepidagathis pungens Nees |
| 42. | Lepidagathis scariosa Nees |
| 43. | Leptadenia reticulata (Retz.) Wight & Arn. |
| 44. | Leptochloa chinensis (L.) Nees |
| 45. | Leucaena leucocephala (Lam.) de Wit |
| 46. | Leucas anandaraoana P. Umam. & P. Daniel |
| 47. | Leucas aspera (Willd.) Link |
| 48. | Leucas diffusa Benth. |
| 49. | Leucas urticifolia (Vahl) Sm. |
| 50. | Leucas wightiana Wall. ex Benth. |
| 51. | Limnophila indica (L.) Druce |
| 52. | Limnophyton obtusifolium (L.) Miq. |
| 53. | Lindernia antipoda (L.) Alston |

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| 54. | Lindernia caespitosa (Blume) Panigrahi |
| 55. | Lindernia hyssopioides (L.) Haines |
| 56. | Lindernia minima (Benth.) Mukerjee |
| 57. | Lipocarpa chinensis (Osbeck) J.Kern |
| 58. | Lipocarpa squarrosa (L.) Goetgh. |
| 59. | Lopholepis ornithocephala (Hook.) Steud. |
| 60. | Ludwigia hyssopifolia (G.Don) Exell |
| 61. | Ludwigia perennis L. |
| 62. | Luffa acutangula (L.) Roxb. |
| 63. | Luffa cylindrica (L.) M.Roem. |
| 64. | Lumnitzera racemosa Willd. |
| 65. | Macroptilium atropurpureum (DC.) Urb. |
| 66. | Madhuca ifolia (J. Koenig ex L.) J.F. Macbr. |
| 67. | Maerua apetala (Roth) M.Jacobs |
| 68. | Maerua obifolia (Forssk.) A.Rich. |
| 69. | Malachra capitata (L.) L. |
| 70. | Malvastrum coromandelianum (L.) Garcke |
| 71. | Mangifera indica L. |
| 72. | Manilkara hexandra (Roxb.) Dubard |
| 73. | Manisuris myurus L. |
| 74. | Martynia annua L. |
| 75. | Melhania incana B.Heyne ex Wight & Arn. |
| 76. | Melia azedarach L. |
| 77. | Melinis repens (Willd.) Zizka |
| 78. | Melochia corchorifolia L. |
| 79. | Merremia dissecta (Jacq.) Hallier f. |
| 80. | Merremia emarginata (Burm. f.) Hallier f. |
| 81. | Merremia hederacea (Burm. f.) Hallier f. |
| 82. | Merremia tridentata (L.) Hallier f. |
| 83. | Micrococca mercurialis (L.) Benth. |
| 84. | Mimosa pudica L. |

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| 85. | Mitracarpus hirtus (L.) DC. |
| 86. | Mollugo cerviana (L.) Ser. |
| 87. | Mollugo disticha (L.) Ser. |
| 88. | Murdannia spirata (L.) G.Brückn. |
| 89. | Murdannia striatipetala Faden |
| 90. | Murraya koenigii (L.) Spreng. |
| 91. | Najas marina L. |
| 92. | Nechamandra alternifolia (Roxb. ex Wight) Thwaites |
| 93. | Nelumbo nucifera Gaertn. |
| 94. | Nothosaerva brachiata (L.) Wight |
| 95. | Nymphaea rubra Roxb. ex Andrews |
| 96. | Oceana serrulata (R.Br.) Byng & Christenh |
| 97. | Ocimum americanum L. |
| 98. | Ocimum basilicum L. |
| 99. | Orthosiphon pallidus Royle ex Benth. |
| 100. | Orthosiphon thymiflorus (Roth) Sleesen |
| 101. | Ottelia alismoides (L.) Pers. |
| 102. | Ouret lanata (L.) Kuntze |
| 103. | Oxystelma esculentum (L. f.) Sm. |
| 104. | Pachygone ovata (Poir.) Miers ex Hook.f. & Thomson |
| 105. | Pandanus odorifer (Forssk.) Kuntze |
| 106. | Parasopubia delphiniifolia (L.) H.-P. Hofm. & Eb. Fisch. |
| 107. | Parkinsonia aculeata L. |
| 108. | Paspalum scrobiculatum L. |
| 109. | Passiflora foetida L. |
| 110. | Pavetta indica L. |
| 111. | Pavonia odorata Willd. |
| 112. | Pavonia procumbens (Wight & Arn.) Walp. |
| 113. | Pavonia zeylanica (L.) Cav. |
| 114. | Pedaliium murex L. |
| 115. | Peltophorum pterocarpum (DC.) K. Heyne |
| 116. | Pemphis acidula J.R. Forst. & G. Forst. |
| 117. | Pentalinon luteum (L.) B.F.Hansen & Wunderlin |
| 118. | Pentatropis capensis (L. f.) |

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| | Bullock |
| 119. | Peplidium maritimum (L.f.) Asch. |
| 120. | Pergularia daemia (Forssk.) Chiov |
| 121. | Perotis indica (L.) Kuntze |
| 122. | Persicaria glabra (Willd.) M.Gomez |
| 123. | Phoenix loureiroi Kunth |
| 124. | Phoenix pusilla Gaertn. |
| 125. | Phyla nodiflora (L.) Greene |
| 126. | Phyllanthus amarus Schumach. & Thonn. |
| 127. | Phyllanthus emblica L. |
| 128. | Phyllanthus maderaspatensis L. |
| 129. | Phyllanthus reticulatus Poir. |
| 130. | Phyllanthus rotundifolius Klein ex Willd. |
| 131. | Phyllanthus virgatus G. Forst. |
| 132. | Physalis angulata L. |
| 133. | Picellobium dulce (Roxb.) Benth. |
| 134. | Pistia stratiotes L. |
| 135. | Platostoma menthoides (L.) A.J.Paton |
| 136. | Pleurostyliia opposita (Wall.) Alston |
| 137. | Plumbago zeylanica L. |
| 138. | Portulaca tuberosa Roxb. |
| 139. | Pouzolzia zeylanica (L.) Benn. |
| 140. | Premna corymbosa Rottler & Willd. |
| 141. | Premna mollissima Roth. |
| 142. | Premna serratifolia L. |
| 143. | Prosopis juliflora (Sw.) DC. |
| 144. | Pseudoconyza viscosa (Mill.) D'Arcy |
| 145. | Psilotrichum elliotii Baker |
| 146. | Pterocarpus santalinus L.f. |
| 147. | Pulicaria wightiana (DC.) C.B.Clarke |
| 148. | Ricinus communis L. |
| 149. | Rivea hypocrateriformis Choisy |
| 150. | Rostellularia diffusa (Willd.) Nees |
| 151. | Rothia indica (L.) Druce |
| 152. | Ruellia patula Jacq. |
| 153. | Ruellia prostrata Poir. |
| 154. | Ruellia simplex C.Wright |
| 155. | Ruellia tuberosa L. |

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| 156. | Rungia repens (L.) Nees |
| 157. | Ruppia maritima L. |
| 158. | Saccharum spontaneum L. |
| 159. | Salvadora persica L. |
| 160. | Santalum album L. |
| 161. | Sapindus emarginatus Vahl |
| 162. | Scaevola plumieri (L.) Vahl |
| 163. | Scaevola taccada (Gaertn.) Roxb. |
| 164. | Schoenoplectiella juncooides (Roxb.) Lye |
| 165. | Scleromitron diffusum (Willd.) R.J.Wang |
| 166. | Scoparia dulcis L. |
| 167. | Scutia myrtina (Burm.f.) Kurz |
| 168. | Senna alata (L.) Roxb. |
| 169. | Senna alexandrina Mill. |
| 170. | Senna auriculata (L.) Roxb. |
| 171. | Senna italica Mill. |
| 172. | Senna occidentalis (L.) Link |
| 173. | Senna siamea (Lam.) H.S.Irwin & Barneby |
| 174. | Senna tora (L.) Roxb. |
| 175. | Senna uniflora (Mill.) H.S.Irwin & Barneby |
| 176. | Sesamum alatum Thonn. |
| 177. | Sesamum indicum L. |
| 178. | Sesuvium portulacastrum (L.) L. |
| 179. | Setaria verticillata (L.) P.Beauv. |
| 180. | Sida acuta Burm.f. |
| 181. | Sida cordata (Burm.f.) Borss. Waalk. |
| 182. | Sida cordifolia L. |
| 183. | Sida spinosa L. |
| 184. | Solanum incanum L. |
| 185. | Solanum insanum L. |
| 186. | Solanum pubescens Willd. |
| 187. | Solanum trilobatum L. |
| 188. | Solanum violaceum Ortega |
| 189. | Solanum virginianum L. |
| 190. | Spermacoce articularis L.f. |
| 191. | Spermacoce exilis (L.O.Williams) C.D.Adams ex W.C.Burger & C.M.Taylor |
| 192. | Spermacoce hispida L. |
| 193. | Sphaeranthus amaranthoides Burm.f. |
| 194. | Spinifex littoreus (Burm.f.) Merr. |
| 195. | Sporobolus coromandelianus |

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|------|---|
| | (Retz.) Kunth |
| 196. | Sporobolus maderaspatanus Bor |
| 197. | Suaeda nudiflora (Willd.) Moq. |
| 198. | Suriana maritima L. |
| 199. | Synedrella nodiflora (L.) Gaertn. |
| 200. | Synostemon bacciformis (L.) G.L.Webster |
| 201. | Syringodium isoetifolium (Asch.) Dandy |
| 202. | Syzygium cumini (L.) Skeels |
| 203. | Tamarindus indica L. |
| 204. | Tarenna asiatica (L.) Kuntze ex K.Schum. |
| 205. | Tecomella undulata (Sm.) Seem. |
| 206. | Tecticornia indica (Willd.) K.A.Sheph. & Paul G.Wilson |
| 207. | Tephrosia barberi J.R.Drumm. |
| 208. | Tephrosia pumila (Lam.) Pers. |
| 209. | Ziziphus mauritiana Lam. |
| 210. | Ziziphus nummularia (Burm.f.) Wight & Arn. |
| 211. | Zornia diphylla (L.) Pers. |
| 212. | Zoysia matrella (L.) Merr. |

- B. Number of species incorporated: Label writing for almost all specimens were completed and also pasted on mounted specimens. Further accession and bar coding for all collected specimens are under progress.

1.3 Output indicators for the assessment of the project :

The present field survey of 64 days to the Gulf of Mannar Biosphere Reserve area has been recorded a total of 797 taxa under 443 genera belonging to 111 families have been recorded.

1.4 Major impacts reported during the financial year :

During the present study, a plant species new to science has been discovered and described from the study area.

According to Daniel & Umamaheshwari (2001) there is only one tree of *Maerua apetala* found at Vattakottai, Kanyakumari. However, during the present study, it has been recorded from two more places in Keezhakarai. During the present study, 111 taxa of flowering plants have been added to the Flora of Gulf of Mannar, which have not been collected/recorded by the earlier workers from the study area.

Completed project

4. Name of the Project : Cyperaceae of Tamil Nadu. (Area: 269 sq.km.)
5. Executing Scientist (s) :. **Executing Officials :2015-16**

Dr.G.V.S. Murthy, Scientist – F
Mr. Yarraya, K. Sr. Pre. Assist.

2016-17

Dr.G.V.S. Murthy, Scientist – G
Dr. C. Murugan, Scientist - D
Dr. J.V.Sudhakar, Botanical Asst.
Dr. S. Arumugam, Botanical Asst.

2017-18

Dr. C. Murugan, Scientist - D
Dr. J.V.Sudhakar, Botanical Asst.
Dr. S. Arumugam, Botanical Asst.

2018-2020

Dr. C. Murugan, Scientist - E
Dr. S. Arumugam, Botanical Asst.

6. Duration of the project :01.04.2015 to 31.03.2020
7. About the work done : Completed the Project

OBJECTIVES:

- i. Survey and inventorisation of the Cyperaceae in the state Tamil Nadu
- ii. Documentation of Cyperaceae and their utilization practices by local tribal communities and their traditional conservation approaches of the various parts of the state.
- iii. Identification of endemic species and also listing the rare and threatened species according to IUCN data.
- iv. Listing of economically important Cyperaceae species and their distribution of the state.

Methodology adopted : Conventional method of documentation of species

Number of species identified (with name) : 147 species were identified from 397 field numbers.

Actinoscirpus grossus (L.f.) Goetgh. & D.A. Simpson, *Bulbostylis barbata* (Rottb.) C.B. Clarke subsp. *barbata*, *Bulbostylis barbata* (Rottb.) C.B. Clarke subsp. *pulchella* (Thwaites) T.Koyama, *Bulbostylis densa* (Wall.) Hand. - Mazz., *Bulbostylis puberula* C.B. Clarke, *Bulbostylis subspinescens* C.B. Clarke, *Bulbostylis swamyii* Govind., *Bolboschoenus maritimus* (L.) Palla, *Carex baccans* Nees, *Carex breviculmis* R.Br., *Carex capillacea* Boott, *Carex christii* Boeckeler, *Carex eluta* Nelmes, *Carex filicina* Nees, *Carex glaucina* Boeckeler, *Carex hokarsarensis* E.U. Haq.&Dar, *Carex jackiana* Boott, *Carex kotagirica* A. Maji & V.P., *Carex lateralis* Kuek., *Carex lenta* D. Don, *Carex leucantha* Arn. ex Boott., *Carex ligulata* Nees, *Carex lindleyana* Nees, *Carex longicuris* Nees, *Carex longipes* D. Don ex Tilloch & Taylor, *Carex maculata* Boott, *Carex myosurus* Nees, *Carex nubigena* D. Don, *Carex phacota* Spreng., *Carex pseudoaperta* Boeckeler ex Kuek., *Carex raphidocarpa* Nees, *Carex rara* Boott, *Carex speciosa* Kunth, *Carex vicinalis* Boott., *Carex walker* Arn. ex Boott., *Carex wallichiana* Spreng., *Carex wightiana* Nees, *Courtoisiacyperoides* (Roxb.) Soják., *Cyperus alopecuroides* Rottb., *Cyperus arenarius* Retz., *Cyperus articulatus* L., *Cyperus bulbosus* Vahl, *Cyperus castaneus* Willd., *Cyperus cephalotes* Vahl, *Cyperus clarkei* T. Cooke, *Cyperus compactus* Retz., *Cyperus compressus* L., *Cyperus conglomeratus* subsp. *pachyrrhizus* (Nees ex Boeckeler) T. Koyama *Cyperus corymbosus* Rottb., *Cyperus cuspidatus* Kunth *Cyperus cyperinus* (Retz.) Suringar, *Cyperus cyperoides* (L.) Kuntze, *Cyperus difformis* L., *Cyperus diffusus* Vahl, *Cyperus digitatus* Roxb., *Cyperus distans* L. f., *Cyperus dubius* Rottb., *Cyperus elatus* L., *Cyperus esculentus* L., *Cyperus exaltatus* Retz., *Cyperus haspan* L., *Cyperus imbricatus* Retz., *Cyperus involucratus* Rottb., *Cyperus siria* L., *Cyperus javanicus* Houtt., *Cyperus laevigatus* L., *Cyperus maderaspatanus* Willd., *Cyperus michelianus* (L.) Delile subsp. *pygmaeus* (Rottb.) Asch. & Graebn., *Cyperus nutans* Vahl, Enum. *Cyperus palianparaiensis* Govind., *Cyperus pangorei* Rottb., *Cyperus paniceus* (Rottb.) Boeckeler, *Cyperus pilosus* Vahl, *Cyperus platyphyllus* Roem. & Schult., *Cyperus platystylis* R. Br., *Cyperus polyanthelus* Govind. *Cyperus procerus* Rottb., *Cyperus prolifer* Lam., *Cyperus pulchellus* R. Br. *Cyperus rotundus* L., *Cyperus rubicundus* Vahl, *Cyperus squarrossus* L. *Cyperus stoloniferous* Retz., *Cyperus tenuiculmis* Boeckeler *Cyperus tenuispica* Steud., *Cyperus zollingeri* Steud., *Eleocharis acutangula* (Roxb.) Schult *Eleocharis atropurpurea* (Retz.) J. Presl & C. Presl *Eleocharis congesta* D. Don *Eleocharis dulcis* (Burm.f.) Trin. ex Hensch., *Eleocharis geniculata* (L.) Roem. & Schult., *Eleocharis retroflexa* (Poir.) Urb. subsp. *chaetaria* (Roem. & Schult.) T. Koyama *Eleocharis spiralis* (Rottb.) Roem. & Schult., *Eleocharis swamyii* Govind. *Eleocharis tetraquetra* Nees *Fimbristylis aestivalis* (Retz.) Vahl, *Fimbristylis aggregata* C.E.C. Fisch., *Fimbristylis amplocarpa* Govind. *Fimbristylis aphylla* Steud., *Fimbristylis argentea* (Rottb.) Vahl, *Fimbristylis bisumbellata* (Forssk.) Bubani, Tam.:Kadu korai *Fimbristylis carpopoda* Govind *Fimbristylis cinnamometorum* (Vahl) Kunth, *Fimbristylis complanata* (Retz.) Link, *Fimbristylis consaguinea* Kunth, *Fimbristylis contorta* C.E.C. Fisch. *Fimbristylis crystallina* Govind. *Fimbristylis cymosa* R.Br. var. *spathacea* (Roth) T. Koyama in *Fimbristylis dichotoma* (L.) Vahl, *Fimbristylis dipsacea* (Rottb.) C.B. Clarke *Fimbristylis doliiformis* Govind. *Fimbristylis eligulata* Govind. *Fimbristylis eragrostis* (Nees & Meyen) Hance *Fimbristylis falcata* (Vahl) Kunth, *Fimbristylis ferruginea* (L.) Vahl, *Fimbristylis insignis* Thwaites, *Fimbristylis kingii* Gamble ex Boeckeler, *Fimbristylis latiglumifera* Govind. *Fimbristylis latenuciera* Govind. *Fimbristylis longistigmata* Govind. *Fimbristylis matthewii*

Murugesan et al. *Fimbristylis microcarya* F.Muell., *Fimbristylis miliacea* (L.) Vahl, *Fimbristylis monospicula* Govind. *Fimbristylis monticola* Hochst. ex Steud. *Fimbristylis mycosa* Govind. *Fimbristylis narayanii* C.E.C. Fisch. *Fimbristylis nutans* (Retz.) Vahl, *Fimbristylis ovata* (Burm. f.) J. Kern *Fimbristylis pandurata* Govind. *Fimbristylis paupercula* Boeckeler *Fimbristylis pierotii* Miq. *Fimbristylis polytrichoides* (Retz.) Vahl, *Fimbristylis pustulosa* Govind. *Fimbristylis quinquangularis* (Vahl) Kunth, *Fimbristylis rectifolia* Govind. *Fimbristylis rigidiuscula* Govind. *Fimbristylis rugosa* Govind. *Fimbristylis salbundia* (Nees) Kunth, *Fimbristylis sanjappae* W. Khan & Solanke *Fimbristylis scabrisquama* Govind. *Fimbristylis schoenoides* (Retz.) Vahl, *Fimbristylis semidisticha* Govind. *Fimbristylis sieberiana* Kunth, *Fimbristylis squarrosa* Vahl var. *esquarrosa* Makino *Fimbristylis strigosa* Govind. *Fimbristylis subtrabeculata* C.B. Clarke *Fimbristylis tenera* Roem &Schult., *Fimbristylis tetragona* R. Br., *Fimbristylis tortifolia* Govind. *Fimbristylis triflora* (L.) Schum. ex Engler *Fimbristylis tristachya* R. Br., *Fimbristylis tumida* Govind. *Fimbristylis uliginosa* Hochst. ex Steud *Fimbristylis velliangiriensis* Murugesan *Fimbristylis woodrowii* C.B. Clarke. *Fuirena ciliaris* (L.) Roxb., *Fuirena cuspidata* (Roth) Kunth, *Fuirena pubescens* (Lam.) Kunth var. *pergamentea* C.E.C. Fisch, *Fuirena swamyii* Govind., *Fuirena trilobites* C.B. Clarke, *Fuirena umbellata* Rottb., *Fuirena uncinata* (Willd.) Kunth, *Hypolytrum nemorum* (Vahl) Spreng., *Kyllinga brevifolia* Rottb., *Kyllinga bulbosa* P. Beauv., *Kyllinga melanosperma* Nees, *Kyllinganemoralis* (J.R. Forst. & G. Forst.) Dandy ex Hutch. & Dalziel, *Kyllinga odorata* Vahl subsp. *cylindrica* (Nees) T. Koyama, *Kyllingapolyphylla* Willd. ex Kunth subsp. *babiensis* W. Khan & Lakshminarismhan, *Kyllinga pseudoalata* W. Khan & R.D. Taur, *Kyllinga squamulata* Vahl, *Kyllinga triceps* Rottb. *Lepironia articulata* (Retz.) Domin, *Lipocarpha chinensis* (Osbeck) J. Kern, *Lipocarphagracilis* (Rich. ex Pers.) Nees, *Lipocarpha raynaliana* Govind., *Lipocarphasquarrosa* (L.) Goetgh., *Pycreus curvibracteatus* (Govind.) Singh & Singh, *Pycreus debilissimus* C.B. Clarke, *Pycreus flavescens* (L.) P. Beauv. ex Rchb., *Pycreus flavidus* (Retz.) T. Koyama, *Pycreus latovaginatus* (Govind.) Singh & Singh, *Pycreus lurida* (Govind.) Singh & Singh, *Pycreus mahadevanii* Govind., *Pycreus malabaricus* C.B. Clarke forma *stricticulmis* (Govind.) W. Khan, *Pycreus membranaceus* (Vahl) Govind., *Pycreus plumbeonuceus* (Govind.) Singh & Singh, *Pycreus polystachyos* (Rottb.) P. Beauv., *Pycreus pumilus* (L.) Nees, *Pycreus puncticulatus* (Vahl) Nees, *Pycreus rubriglomosus* (Govind.) Singh & Singh, *Pycreus sanguinolentus* (Vahl) Nees ex C.B. Clarke, *Pycreus stramineus* (Nees) C.B. Clarke, *Pycreus sulcinus* C.B. Clarke, *Pycreus uniolooides* (R.Br.) Urb., *Queenslandiella hyalina* (Vahl) Ballard, *Rhynchosporacorymbosa* (L.) Britton, *Rhynchosporagracillima* Thwaites, *Rhynchospora rubra* (Lour.) Makino, *Rhynchospora rugosa* (Vahl) Gale subsp. *brownie* (Roem. & Schult.) T. Koyama, *Rhynchospora wightiana* (Nees) Steud., *Schoenoplectiella articulata* (L.) Lye, *Schoenoplectiella juncooides* (Roxb.) Lye, *Schoenoplectiella lateriflora* (J.F. Gmel.) Lye, *Schoenoplectiella mucronata* (L.) J. Jung & H.K. Choi, *Scirpus fluitans* L., *Scirpus jacobii* C.E.C. Fisch., *Scirpus littoralis* Shrad., *Scirpus littoralis* Shrad., *Scleria caricina* (R. Br.) Benth., *Scleria corymbosa* Roxb., *Scleria levis* Retz., *Sclerialithosperma* (L.) Sw., *Scleria mikawana* Makino, *Scleria neesii* Kunth, *Scleria parvula* Steud., *Scleria swamyii* Govind., *Scleria terrestris* (L.) Fassett, *Trichophorum subcapitatum* (Thwaites & Hook.) D.A. Simpson

7.1 Number of species incorporated: all the identified specimens labeled and accessed.

7.2 Output indicators for the assessment of the project : In total, 397 Field Numbers were vouched during the study period across the Tamil Nadu. All the 397 x 2 specimens were poisoned and mounted properly. The identified species were prepared labels and pasted in the herbarium sheet. The final report will be submitted as soon as possible. The Final report contains detailed description with nomenclature citation, phenology, and distribution of each and every species. All the 147 species were prepared key and photoplates of some interesting Cyperaceae species are also included.

7.3 Major impacts reported during the financial year : Some interesting species under confirmation.

Name of the Project : Reinvestigation on Flora of Gulf of Mannar Biosphere Reserve after Tsunami

1. Executing Scientist (s) : Dr. C. Murugan, Scientist- 'E' & PI, Dr. R. Manikandan, Scientist- 'E' & Co- PI & Ms. Nithya, S.P., JPF
2. Duration of the project : 2018–2021
3. About the work done :

3.1 Introduction :

This study is proposed for the survey and documentation, taxonomical analysis and reinvestigation of the flora and vegetation of Gulf of Mannar Biosphere Reserve after Tsunami 2004, though the floristic exploration was done by Daniel & Umamaheshwari from Botanical Survey of India during the period 1993–1996, and reported 784 angiospermic taxa belonging to 113 families (Daniel & Umamaheshwari, 2001). The 2004 Tsunami caused severe damages to the flora and fauna of the Biosphere Reserve. Therefore, the present study has been taken up to assess the existing flora and vegetation, and to record the changes in the floral diversity of the Biosphere Reserve after the Tsunami.

3.2 Objectives:

- Impact assessment of floral diversity after 2004 Tsunami
- Survey and documentation of all flowering plants in all 21 islands in different seasons.
- Herbarium preparation and identification of all the collected flowering plants
- Preparing a comprehensive checklist of flowering plants of Gulf of Mannar Biosphere Reserve along with brief description
- Checking the taxonomical and present nomenclatural status of all the plants in Biosphere Reserve
- Assess the threat factors for the endemic and threatened plants from the study area.
- Species specific and area specific conservation strategies will be provided for future ecological security

3.3 Site of the study (with map) :

The Gulf of Mannar Biosphere Reserve extends from Rameswaram to Kanyakumari and lies between 78°8'–79°30' E and 8°35'–9°25' N, spreads in an area of 10,500 km² (Melkani & al., 2014). The Gulf of Mannar has a chain of 21 uninhabited islands, which are classified into 4 main groups;

- **Mandapam Group** (7 islands): Shingle, Kurusadai, Poomarichan, Pullivasal, Muyal, Manoli and Manoliputty
- **Keezhakkarai group** (7 islands): Anaipar, Valimunai, Appa, Thalaiyari, Vaalai, Mulli and Poovarasanputti (Submerged).

- **Vembar Group** (3 islands): Upputhanni, Puluvinichalli and Nallathanni.
- **Thoothukudi Group** (4 islands): Van, Kaswari, Kariyachalli and Velanguchalli (Submerged).

3.4 Methodology adopted :

Extensive field surveys have been carried out in different seasons from July, 2018 to February, 2021 to document the flowering plants of the Biosphere Reserve. Plants with either flowers or fruits were collected from different areas of Gulf of Mannar Biosphere Reserve that is from Ramanathapuram to Keezhakarai, including both islands and mainland. A total of three specimens were collected for each taxon. While collecting the plants the habit, colour and fragrance of flowers or fruits, place of collection, date of collection, distribution, abundance in that particular area, any characteristic notes, collector name, soil type, elevation, latitude and longitude, etc. were noted in the field notebook. Photographs of different vegetation types of the area surveyed, plants with their habitat, habit, associated plants, close-up of flowers and fruits. The collected specimens are well preserved in the form of herbarium, by following the standard herbarium techniques (Fosberg & Sacht, 1965; Forman & Bridson, 1989). The collected plants were identified by using the Floras and also by matching with specimens housed at Madras Herbarium (MH). A detailed description of every collected taxon is also prepared. The voucher specimens will be housed at Madras Herbarium, Botanical Survey of India, Southern Regional Centre, Coimbatore, for future reference.

3.5 Work done : Number of species identified (with name) : 212

| Sl. No. | Binomial |
|---------|--|
| 1. | Indigofera hirsuta L. |
| 2. | Indigofera linnaei Ali |
| 3. | Indigofera nummulariifolia (L.) Livera ex Alston |
| 4. | Indigofera obifolia Forssk. |
| 5. | Indigofera tinctoria L. |
| 6. | Indigofera tirunelvelica Sanj |
| 7. | Indigofera trita L.f. |
| 8. | Iphigenia indica (L.) A. Gray ex Kunth |
| 9. | Ipomoea aquatica Forssk. |
| 10. | Ipomoea cairica (L.) Sweet |
| 11. | Ipomoea carnea Jacq. |
| 12. | Ipomoea dasysperma J.Jacq. |
| 13. | Ipomoea nil (L.) Roth |
| 14. | Ipomoea obscura (L.) Ker Gawl. |
| 15. | Ipomoea pescaprae (L.) R. Br. |
| 16. | Ipomoea pes-tigridis L. |
| 17. | Ipomoea rumicifolia Choisy |
| 18. | Ipomoea sagittifolia Burm.f. |
| 19. | Ipomoea violacea L. |
| 20. | Ixora pavetta Andr. |
| 21. | Jasminum auriculatum Vahl |
| 22. | Jatropha curcas L. |
| 23. | Jatropha glandulifera Roxb. |
| 24. | Jatropha gossypifolia L. |
| 25. | Jatropha maheshwarii Subram. & Nayar |

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| 26. | Justicia adhatoda L. |
| 27. | Justicia prostrata (Roxb. ex C.B.Clarke) Gamble |
| 28. | Justicia tranquebariensis L.f. |
| 29. | Kleinia grandiflora (Wallich ex DC.) N. Rani |
| 30. | Kohautia aspera (B. Heyne ex Roth. Bremek.) |
| 31. | Kohautia gracilis (Wall.) DC. |
| 32. | Lablab purpureus (L.) Sweet |
| 33. | Lagenaria siceraria (Molina) Standl. |
| 34. | Lannea coromandelica (Houtt.) Merr. |
| 35. | Lantana camara L. |
| 36. | Lantana involucrata L. |
| 37. | Launaea intybacea (Jacq.) Beauverd |
| 38. | Launaea sarmentosa (Willd.) Alston |
| 39. | Lawsonia inermis L. |
| 40. | Lemna gibba L. |
| 41. | Lepidagathis pungens Nees |
| 42. | Lepidagathis scariosa Nees |
| 43. | Leptadenia reticulata (Retz.) Wight & Arn. |
| 44. | Leptochloa chinensis (L.) Nees |
| 45. | Leucaena leucocephala (Lam.) de Wit |

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| 46. | Leucas anandaraoana P. Umam. & P. Daniel |
| 47. | Leucas aspera (Willd.) Link |
| 48. | Leucas diffusa Benth. |
| 49. | Leucas urticifolia (Vahl) Sm. |
| 50. | Leucas wightiana Wall. ex Benth. |
| 51. | Limnophila indica (L.) Druce |
| 52. | Limnophyton obtusifolium (L.) Miq. |
| 53. | Lindernia antipoda (L.) Alston |
| 54. | Lindernia caespitosa (Blume) Panigrahi |
| 55. | Lindernia hyssopioides (L.) Haines |
| 56. | Lindernia minima (Benth.) Mukerjee |
| 57. | Lipocarpa chinensis (Osbeck) J.Kern |
| 58. | Lipocarpa squarrosa (L.) Goetgh. |
| 59. | Lopholepis ornithocephala (Hook.) Steud. |
| 60. | Ludwigia hyssopifolia (G.Don) Exell |
| 61. | Ludwigia perennis L. |
| 62. | Luffa acutangula (L.) Roxb. |
| 63. | Luffa cylindrica (L.) M.Roem. |
| 64. | Lumnitzera racemosa Willd. |
| 65. | Macroptilium atropurpureum (DC.) Urb. |
| 66. | Madhuca ifolia (J. Koenig ex L.) J.F. Macbr. |
| 67. | Maerua apetala (Roth) M.Jacobs |
| 68. | Maerua obifolia (Forssk.) A.Rich. |
| 69. | Malachra capitata (L.) L. |
| 70. | Malvastrum coromandelianum (L.) Garcke |
| 71. | Mangifera indica L. |
| 72. | Manilkara hexandra (Roxb.) Dubard |
| 73. | Manisuris myurus L. |
| 74. | Martynia annua L. |
| 75. | Melhania incana B.Heyne ex Wight & Arn. |
| 76. | Melia azedarach L. |
| 77. | Melinis repens (Willd.) Zizka |
| 78. | Melochia corchorifolia L. |
| 79. | Merremia dissecta (Jacq.) Hallier f. |
| 80. | Merremia emarginata (Burm. f.) Hallier f. |
| 81. | Merremia hederacea (Burm. f.) Hallier f. |

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| 82. | Merremia tridentata (L.) Hallier f. |
| 83. | Micrococca mercurialis (L.) Benth. |
| 84. | Mimosa pudica L. |
| 85. | Mitracarpus hirtus (L.) DC. |
| 86. | Mollugo cerviana (L.) Ser. |
| 87. | Mollugo disticha (L.) Ser. |
| 88. | Murdannia spirata (L.) G.Brückn. |
| 89. | Murdannia striatipetala Faden |
| 90. | Murraya koenigii (L.) Spreng. |
| 91. | Najas marina L. |
| 92. | Nechamandra alternifolia (Roxb. ex Wight) Thwaites |
| 93. | Nelumbo nucifera Gaertn. |
| 94. | Nothosaerva brachiata (L.) Wight |
| 95. | Nymphaea rubra Roxb. ex Andrews |
| 96. | Oceana serrulata (R.Br.) Byng & Christenh |
| 97. | Ocimum americanum L. |
| 98. | Ocimum basilicum L. |
| 99. | Orthosiphon pallidus Royle ex Benth. |
| 100. | Orthosiphon thymiflorus (Roth) Sleesen |
| 101. | Ottelia alismoides (L.) Pers. |
| 102. | Ouret lanata (L.) Kuntze |
| 103. | Oxystelma esculentum (L. f.) Sm. |
| 104. | Pachygone ovata (Poir.) Miers ex Hook.f. & Thomson |
| 105. | Pandanus odorifer (Forssk.) Kuntze |
| 106. | Parasopubia delphiniifolia (L.) H.-P. Hofm. & Eb. Fisch. |
| 107. | Parkinsonia aculeata L. |
| 108. | Paspalum scrobiculatum L. |
| 109. | Passiflora foetida L. |
| 110. | Pavetta indica L. |
| 111. | Pavonia odorata Willd. |
| 112. | Pavonia procumbens (Wight & Arn.) Walp. |
| 113. | Pavonia zeylanica (L.) Cav. |
| 114. | Pedaliium murex L. |
| 115. | Peltophorum pterocarpum (DC.) K. Heyne |
| 116. | Pemphis acidula J.R. Forst. & G. Forst. |
| 117. | Pentalinon luteum (L.) B.F.Hansen & Wunderlin |
| 118. | Pentatropis capensis (L. f.) Bullock |

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| 119. | Peplidium maritimum (L.f.) Asch. |
| 120. | Pergularia daemia (Forssk.) Chiov |
| 121. | Perotis indica (L.) Kuntze |
| 122. | Persicaria glabra (Willd.) M.Gomez |
| 123. | Phoenix loureiroi Kunth |
| 124. | Phoenix pusilla Gaertn. |
| 125. | Phyla nodiflora (L.) Greene |
| 126. | Phyllanthus amarus Schumach. & Thonn. |
| 127. | Phyllanthus emblica L. |
| 128. | Phyllanthus maderaspatensis L. |
| 129. | Phyllanthus reticulatus Poir. |
| 130. | Phyllanthus rotundifolius Klein ex Willd. |
| 131. | Phyllanthus virgatus G. Forst. |
| 132. | Physalis angulata L. |
| 133. | Picellobium dulce (Roxb.) Benth. |
| 134. | Pistia stratiotes L. |
| 135. | Platostoma menthoides (L.) A.J.Paton |
| 136. | Pleurostyliea opposita (Wall.) Alston |
| 137. | Plumbago zeylanica L. |
| 138. | Portulaca tuberosa Roxb. |
| 139. | Pouzolzia zeylanica (L.) Benn. |
| 140. | Premna corymbosa Rottler & Willd. |
| 141. | Premna mollissima Roth. |
| 142. | Premna serratifolia L. |
| 143. | Prosopis juliflora (Sw.) DC. |
| 144. | Pseudoconyza viscosa (Mill.) D'Arcy |
| 145. | Psilotrichum elliotii Baker |
| 146. | Pterocarpus santalinus L.f. |
| 147. | Pulicaria wightiana (DC.) C.B.Clarke |
| 148. | Ricinus communis L. |
| 149. | Rivea hypocrateriformis Choisy |
| 150. | Rostellularia diffusa (Willd.) Nees |
| 151. | Rothia indica (L.) Druce |
| 152. | Ruellia patula Jacq. |
| 153. | Ruellia prostrata Poir. |
| 154. | Ruellia simplex C.Wright |
| 155. | Ruellia tuberosa L. |
| 156. | Rungia repens (L.) Nees |
| 157. | Ruppia maritima L. |
| 158. | Saccharum spontaneum L. |
| 159. | Salvadora persica L. |
| 160. | Santalum album L. |
| 161. | Sapindus emarginatus Vahl |

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| 162. | Scaevola plumieri (L.) Vahl |
| 163. | Scaevola taccada (Gaertn.) Roxb. |
| 164. | Schoenoplectiella juncooides (Roxb.) Lye |
| 165. | Scleromitron diffusum (Willd.) R.J.Wang |
| 166. | Scoparia dulcis L. |
| 167. | Scutia myrtina (Burm.f.) Kurz |
| 168. | Senna alata (L.) Roxb. |
| 169. | Senna alexandrina Mill. |
| 170. | Senna auriculata (L.) Roxb. |
| 171. | Senna italica Mill. |
| 172. | Senna occidentalis (L.) Link |
| 173. | Senna siamea (Lam.) H.S.Irwin & Barneby |
| 174. | Senna tora (L.) Roxb. |
| 175. | Senna uniflora (Mill.) H.S.Irwin & Barneby |
| 176. | Sesamum alatum Thonn. |
| 177. | Sesamum indicum L. |
| 178. | Sesuvium portulacastrum (L.) L. |
| 179. | Setaria verticillata (L.) P.Beauv. |
| 180. | Sida acuta Burm.f. |
| 181. | Sida cordata (Burm.f.) Borss. Waalk. |
| 182. | Sida cordifolia L. |
| 183. | Sida spinosa L. |
| 184. | Solanum incanum L. |
| 185. | Solanum insanum L. |
| 186. | Solanum pubescens Willd. |
| 187. | Solanum trilobatum L. |
| 188. | Solanum violaceum Ortega |
| 189. | Solanum virginianum L. |
| 190. | Spermacoce articularis L.f. |
| 191. | Spermacoce exilis (L.O.Williams) C.D.Adams ex W.C.Burger & C.M.Taylor |
| 192. | Spermacoce hispida L. |
| 193. | Sphaeranthus amaranthoides Burm.f. |
| 194. | Spinifex littoreus (Burm.f.) Merr. |
| 195. | Sporobolus coromandelianus (Retz.) Kunth |
| 196. | Sporobolus maderaspatanus Bor |
| 197. | Suaeda nudiflora (Willd.) Moq. |
| 198. | Suriana maritima L. |
| 199. | Synedrella nodiflora (L.) Gaertn. |
| 200. | Synostemon bacciformis (L.) G.L.Webster |
| 201. | Syringodium isoetifolium (Asch.) Dandy |
| 202. | Syzygium cumini (L.) Skeels |

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| 203. | Tamarindus indica L. |
| 204. | Tarenna asiatica (L.) Kuntze ex K.Schum. |
| 205. | Tecomella undulata (Sm.) Seem. |
| 206. | Tecticornia indica (Willd.) K.A.Sheph. & Paul G.Wilson |
| 207. | Tephrosia barberi J.R.Drumm. |
| 208. | Tephrosia pumila (Lam.) Pers. |
| 209. | Ziziphus mauritiana Lam. |
| 210. | Ziziphus nummularia (Burm.f.) Wight & Arn. |
| 211. | Zornia diphylla (L.) Pers. |
| 212. | Zoysia matrella (L.) Merr. |

Number of species incorporated: Label writing for almost all specimens were completed and also pasted on mounted specimens. Further accession and bar coding for all collected specimens are under progress.

3.6 Output indicators for the assessment of the project : The present field survey of 64 days to the Gulf of Mannar Biosphere Reserve area has been recorded a total of 797 taxa under 443 genera belonging to 111 families have been recorded.

3.7 Major impacts reported during the financial year :

During the present study, a plant species new to science has been discovered and described from the study area.

Murugan, C., Manikandan, R., Nithya, S.P., Karthik, B. & Arisdason, W. (2020). *Capparis danielii* (Capparaceae), a new species from the Gulf of Mannar Biosphere Reserve, India. , Phytotaxa 472(3): 283–291.

According to Daniel & Umamaheshwari (2001) there is only one tree of *Maerua apetala* found at Vattakottai, Kanyakumari. However, during the present study, it has been recorded from two more places in Keezhakarai. During the present study, 111 taxa of flowering plants have been added to the Flora of Gulf of Mannar, which have not been collected/recorded by the earlier workers from the study area.

Name of the Project : Floristic Assessment of Megamalai Wildlife Sanctuary, Tamil Nadu. (Area: 269 sq.km.)

1. Executing Scientist (s) :Dr. C. Murugan, Scientist E&Dr. S. Arumugam Bot. Assistant
2. Duration of the project :01.04.2016 to 31.03.2020
3. About the work done : Completed the Project

4.1 INTRODUCTION:

The flora and fauna of Megamalai landscape attracted several researchers during the 19th and early 20th centuries. The natural resources of this area wereexploited by the British since 1801. The first status report on this forest was prepared by Colonel Beddome in 1857, which indicated rapid denudation due to a large number of commercial activities. The area was under dense montane rain forests during early 1900 (Blatter & Hallberg 1918). Afterwards, there is no any intensive and extensive floristic survey in that region except by very few sporadic collections.

OBJECTIVES:

- (i) To Survey the Vascular Flora along with its ecological niche.
- (ii) To document ethno-sociology to understand the species association and diversity.
- (iii) To document the vascularflora particularly endemic with special reference to the ecological association
- (iv)To collect and reintroduce the rare, endemic, endangered and economically useful plant species for conservation of the germplasm.
- (v) To compare and evaluate the utilization aspect of the flora, ie. Food, Medicinal and other Economic values.
- (vi) Mapping of Vascular Flora using remote sensing and GIS.
- (vii) To publish a comprehensive floristic account on the plant wealth as per Flora format of this Wildlife Sanctuary.

Number of species identified (with name) : Identification completed for 400 field numbers at species level.

144001 *Pyrenacantha volubilis* Wight, Icacinaceae; 144002, *Pleiospermium alatum* (Wall. ex Wight & Arn.) Swingle, Rutaceae; 144003 *Breynia quadrangularis* (Willd.) Chakrab. & N.P.Balabr, Phyllanthaceae; 144004, *Barleria acuminata* Wight ex Nees, Acanthaceae; 144005, *Caralluma adscendens* (Roxb.) Haw., Asclepiadaceae; 144006, *Ocimum americanum* L.; 144007, *Leucas aspera* (Willd.) Link, Lamiaceae; 144008, *Tarenna asiatica* (L.) Kuntze ex K.Schum., Rubiaceae; 144009, *Microcos heterotricha* (Mast.) Burret, Tiliaceae; 144010, *Ceropegia elegans* Wall., Asclepiadaceae; 144011, *Dioscorea pentaphylla* L., Dioscoreaceae; 144012, *Ehretia retusa* (G.Don) Wall. ex A.DC., Boraginaceae; 144013, *Albizia amara* (Roxb.) Boivin, Leguminosae; 144014, *Dioscorea pentaphylla* L., Dioscoreaceae; 144015, *Physalis pruinosa* L. Solanaceae; 144016, *Gymnosporia emarginata* (Willd.) Thwaites, Celastraceae; 144017, *Trichosanthes cucumerina* L., Cucurbitaceae; 144018, *Cissus vitiginea* L., Vitaceae; 144019, *Premna paucinervis* (C.B.Clarke) Gamble, Verbenaceae; 144020, *Dovyalis rhamnoides* (Burch. ex DC.) Burch. ex Harv. & Sond., Salicaceae; 144021, *Clitoria ternatea* L., Leguminosae; 144022, *Scutia myrtina* (Burm.f.) Kurz, Rhamnaceae; 144023, *Milusa indica* Lesch. ex A.DC., Annonaceae; 144024, *Secamone emetica* (Retz.) R.Br. ex Sm., Asclepiadaceae; 144025, *Hymenodictyon orixense* (Roxb.) Mabb., Rubiaceae; 144026, *Zehneriascabra* (L.f.) Sond., Cucurbitaceae; 144027, *Zehneriascabra* (L.f.) Sond., Cucurbitaceae; 144028, *Atalantiaracemosa* Wight ex Hook., Rubiaceae; 144029, *Commiphora caudata* (Wight & Arn.) Engl., Burseraceae; 144030, *Momordica dioica* Roxb. ex Willd., Cucurbitaceae; 144031, *Oldenlandia* sp., Rubiaceae; 144032 *Litsea mysorensis* Gamble, Lauraceae; 144033, *Boucerosia pauciflora* Wight, Asclepiadaceae; 144034, *Strobilanthes carinei* J.R.I.Wood, Acanthaceae; 144035, *Cordiadiotoma* G.Forst., Boraginaceae; 144036, *Basella alba* L., Basellaceae; 144037, *Corchorus aestuans* L., Tiliaceae; 144038, *Eragrostiellabifaria* (Vahl) Bor, Poaceae; 144039 *Indigofera linnaei* Ali, Leguminosae; 144040, *Trachysm muricata* (L.) Pers. ex Trin., Poaceae; 144041, *Macrotyloma uniflorum* (Lam.) Verdc., Leguminosae; 144042, *Indigofera hirsuta* L., Leguminosae; 144043, *Polycarpha acorymbosa* (L.) Lam., Caryophyllaceae; 144044, *Crotalaria calycina* Schrank, Leguminosae; 144045, *Strobilanthes carinei* J.R.I.Wood, Acanthaceae; 144046, *Neonotonia wightii* (Wight & Arn.) J.A.Lackey, Leguminosae; 144047, *Desmodium* sp., Leguminosae; 144048, *Grewia hirsuta* Vahl, Tiliaceae; 144049, *Dodonaea viscosa* Jacq. Sapindaceae; 144050, *Flueggea leucopyrus* Willd., Euphorbiaceae; 144051, *Flueggea leucopyrus* Willd.; 144052, *Adinacordifolia* (Roxb.) Brandis, Rubiaceae; 144053, *Terminalia anogeissiana* Gere & Boatwr., Combretaceae; 144054, *Gloriosa superba* L., Colchicaceae; 144055, *Rhynchosia cana* (Willd.) DC., Leguminosae; 144056, *Indigofera barberi* Gamble, Leguminosae; 144057, *Habenaria roxburghii* Nicolson, Orchidaceae; 144058, *Euploca strigosa* (Willd.) Diane & Hilger, Boraginaceae; 144059, *Leptadenia reticulata* (Retz.) Wight & Arn., Apocynaceae; 144060, *Euclasta oligantha* (Hochst. ex Steud.) M.R.Almeida, Poaceae; 144061, *Chamaecrista kleinii* (Wight & Arn.) V.Singh, Leguminosae; 144062, *Endostemon viscosus* (Roth) M.R.Ashby, Lamiaceae; 144063, *Mitrephora heyneana* (Hook.f. & Thomson) Thwaites, Annonaceae; 144064, *Nymphaeanouchali* Burm.f., Nymphaeaceae; 144065, *Cissampelos pareira* L., Menispermaceae; 144066, *Vandatestacea* (Lindl.) Rchb.f., Orchidaceae; 144067, *Excoecaria* sp., Euphorbiaceae; 144068, *Ceropegia spiralis* Wight, Asclepiadaceae; 144069, *Solanum giganteum* Jacq., Solanaceae; 144070, *Gardenia resinifera* Roth, Rubiaceae; 144071, *Cissus repanda* (Wight & Arn.) Vahl, Vitaceae; 144072, *Ocimum gratissimum* L., Lamiaceae; 144073, *Stachytarpheta mutabilis* (Jacq.) Vahl, Verbenaceae; 144074, *Hemidesmus indicus* (L.) R. Br. ex Schult., Asclepiadaceae; 144075, *Ceropegia candellabrum* var. *biflora* (L.) Ansari, Asclepiadaceae; 144076, *Cleome felina* L.f., Cleomaceae; 144077, *Xenostegia tridentata* (L.) D.F.Austin & Staples, Convolvulaceae; 144078, *Vignatrilobata* (L.) Verdc., Leguminosae; 144079, *Microstachys chamaelea* (L.) Müll.Arg., Euphorbiaceae; 144080, *Cyanthillium albicans* (DC.) H.Rob., Asteraceae; 144081, *Strychnos potatorum* L.f., Loganiaceae; 144082, *Endostemon viscosus* (Roth) M.R.Ashby, ; 144083, *Polygala arvensis* Willd., Polygalaceae; 144084, *Vincetoxicum bracteatum* (Thunb.) Meve & Liede, Asclepiadaceae; 144085, *Acalypha capitata* Willd., Euphorbiaceae; 144086, *Acalypha fruticosa* Forssk., Euphorbiaceae; 144087, *Phyllanthus virgatus* G.Forst., Phyllanthaceae; 144088, *Polygala arvensis* Willd., Polygalaceae; 144089, *Cyanotistuberosa* (Roxb.) Schult. & Schult.f., Commelinaceae; 144090, *Pavonia odorata* Willd., Malvaceae; 144091, *Andrographis paniculata* (Burm.f.) Nees, Acanthaceae; 144092, *Aristolochia indica* L., Aristolochiaceae; 144093, *Dalbergia lanceolaria* L.f., Leguminosae; 144094, *Oldenlandia herbacea* var. *herbacea*, Rubiaceae; 144095, *Ceropegia elegans* Wall., Asclepiadaceae; 144096, *Oureta lanata* (L.) Kuntze, Amaranthaceae; 144097, *Oldenlandia umbellata* L., Rubiaceae; 144098, *Teramnus labialis* (L.f.) Spreng., Leguminosae; 144099, *Rhynchosia aurea* (Willd.) DC., Leguminosae; 144100, *Sesuvium portulacastrum* (L.) L., Aizoaceae; 144101 *Elytraria acaulis* (L.f.) Lindau, Acanthaceae; 144102, *Mucuna atropurpurea* (Roxb.) DC. ex Wight, Leguminosae; 144103, *Ipomoea staphylina*

Roem. & Schult., Convolvulaceae; 144104, *Begonia dipetala* Graham, Begoniaceae; 144105, *Monotheceium aristatum* (Nees) T.Anderson, Acanthaceae; 144106, *Melothria pendula* L., Cucurbitaceae; 144107, *Dunbaria ferruginea* Wight & Arn., Leguminosae; 144108, *Justicia* sp., Acanthaceae ; 144109, *Argyreia capitiformis* (Poir.) Ooststr., Convolvulaceae; 144110, *Taxillus cuneatus* (B.Heyne) Danser, Loranthaceae; 144111, *Rhynchosia rothii* Benth. ex Aitch., Leguminosae; 144112, *Fimbristylis complanata* (Retz.) Link, Cyperaceae; 144113, *Fimbristylis ferruginea* (L.) Vahl., Cyperaceae; 144114, *Dolichos trilobus* L., Leguminosae; 144115, *Rhynchosia densiflora* (Roth) DC., Leguminosae; 144116, *Enteropogon dolichostachyus* (Lag.) Keng, Poaceae; 144117, *Indigofera trifoliata* L., Leguminosae; 144118, *Cansjera rheedei* J.F.Gmel., Opiliaceae; 144119, *Drypetes porteri* (Gamble) Pax & K.Hoffm., Putranjivaceae; 144120, *Cyperus alternifolius* L., Cyperaceae; 144121, *Sonerila grandiflora* R.Br. ex Wall., Melastomataceae; 144022, *Justicia* sp.; 144123, *Sonerila parameswaranii* K.Ravik. & V.Lakshm., Melastomataceae; 144124, *Anoectochilus elatus* Lindl., Orchidaceae; 144125, *Asystasia chelonoides* Nees, Acanthaceae; 144126, *Hibiscus lunariifolius* Willd., Malvaceae 144127, *Sonerila versicolor* Wight, Melastomataceae; 144128, *Piper mullesua* Buch.-Ham. ex D.Don, Piperaceae; 144129, *Urochloa ramosa* (L.) T.Q.Nguyen, Poaceae; 144130, *Papilionanthe subulata* (Willd.) Garay, Orchidaceae; 144031, *Aeschynanthus perrottetii* A.DC., Gesneriaceae; 144132, *Ixora nigricans* R.Br. ex Wight & Arn., Rubiaceae; 144133, *Eugenia mooniana* Wight, Myrtaceae; 144134, *Rungia pectinata* (L.) Nees, Acanthaceae; 144135, *Balanophora fungosa* J.R.Forst. & G.Forst., Balanophoraceae; 144136, *Balanophora fungosa* J.R.Forst. & G.Forst., Balanophoraceae; 144137, *Garcinia echinocarpa* Thwaites, Clusiaceae; 144138, *Hedyotis devicolamensis* Deb & Ratna Dutta., Rubiaceae; 144139, *Symplocos monantha* Wight, Symplocaceae; 144140, *Zehneria scabra* (L.f.) Sond., Cucurbitaceae; 144141, *Sonerila versicolor* Wight, Melastomataceae; 144142, *Syzygium benthamianum* (Duthie) Gamble, Myrtaceae; 144143, *Syzygium myhendrae* (Bedd. ex Brandis) Gamble, Myrtaceae; 144144, *Cissampelopsis corymbosa* (Wall. ex DC.) C.Jeffrey & Y.L.Chen, Asteraceae; 144145, *Oberonia chandrasekharanii* V.J.Nair, V.S.Ramach. & R.Ansari, Orchidaceae; 144146, *Jasminum multiflorum* (Burm.f.) Andrews, Oleaceae; 144147, *Eurya nitida* Korth., Theaceae; 144148, *Oberonia anamalayana* J. Joesph, Orchidaceae; 144149, *Diclipterabaphica* Nees, Acanthaceae; 144150, *Trichosanthes cucumerina* L., Cucurbitaceae; 144151, *Hypericum wightianum* Wall. ex Wight & Arn., Hypericaceae; 144152, *Impatiens munnarensis* E.Barnes, Balsaminaceae; 144153, *Eugenia mooniana* Wight, Myrtaceae; 144154, *Acilepis peninsularis* (C.B.Clarke) H.Rob. & Skvarla, Asteraceae; 144155, *Myrsine wightiana* Wall. ex A.DC., Primulaceae; 144156, *Taxillus recurvus* (Wall. ex DC.) Tiegh., Loranthaceae; 144157, *Pavetta indica* var. *indica*, Rubiaceae; 144158, *Photinia integrifolia* Lindl., Rosaceae; 144159, *Passiflora leschenaultii* DC., Passifloraceae; 144160, *Acilepis divergens* (DC.) H.Rob. & Skvarla, Asteraceae; 144161, *Trichosanthes cucumerina* L., Cucurbitaceae; 144162, *Trichosanthes cucumerina* L., Cucurbitaceae; 144063, *Utricularia scandens* Benj. Lentibulariaceae; 144164, *Osbeckia zeylanica* L.f., Melastomataceae; 144165, *Nesaea brevipes* Koehne, Lythraceae; 144166, *Crotalaria candicans* Wight & Arn., Leguminosae; 144067, *Gymnosporia montana* (Roth) Benth., Celastraceae; 144068, *Gyrocarpus americanus* Jacq., Hernandiaceae; 144169, *Pisonia aculeata* L., Nyctaginaceae; 144170, *Impatiens flaccida* Arn., Balsaminaceae; 144171, , *Eugenia mooniana* Wight, Myrtaceae; 144172, *Meiogyne pannosa* (Dalzell) J.Sinclair, Annonaceae; 144173, *Ficus tinctoria* subsp. *gibbosa* (Blume) Corner, Moraceae; 144174, *Aglaiia edulis* (Roxb.) Wall., Meliaceae; 144175, *Memecylon sessile* Benth. ex Wight & Arn., Melastomataceae; 144176, *Elaeocarpus gausseii* Weibel, Elaeocarpaceae; 144077, *Symplocos racemosa* Roxb., Symplocaceae; 144078, *Isonandra perrottetiana* A.DC., Sapotaceae; 144179, *Gymnostachyum pubescens* (Lam.) M.R.Almeida, Acanthaceae; 144180, *Peperomia heyneana* Miq., Piperaceae; 144181, *Syzygium bharathii* Ramas., Myrtaceae; 144182, *Smilax zeylanica* L., Smilacaceae; 144183, *Zeuxine gracilis* (Breda) Blume, Orchidaceae; 144184, *Amomum pterocarpum* Thwaites, Zingiberaceae; 144185, *Syzygium bharathii* Ramas., Myrtaceae; 144186, *Dunbaria ferruginea* Wight & Arn., Leguminosae; 144187, *Aristolochia krisagathra* Sivar. & Pradeep, Aristolochiaceae; 144188, *Rhynchosia hirta* (Andrews) Meikle & Verdc., Leguminosae; 144189, *Coffea arabica* L., Rubiaceae; 144190, *Smilax zeylanica* L., Smilacaceae; 144191, *Strobilanthes carinei* J.R.I.Wood, Acanthaceae; 144192, *Biophytum sensitivum* (L.) DC., Oxalidaceae; 144093, *Osbeckia octandra* DC., Melastomataceae; 144194, *Lonicera affinis* Hook. & Arn., Caprifoliaceae; 144195, *Epiprinus mallotiformis* (Müll.Arg.) Croizat. Euporbiaceae; 144196, *Gynochthodes umbellata* (L.) Razafim. & B.Bremer; 144197, *Taxillus tomentosus* (B.Heyne ex Roth) Tiegh., Loranthaceae; 144198, *Grewia serrulata* DC., Tiliaceae; 144199, *Achyranthes aspera* L. Blume, Amaranthaceae; 144200, *Ipomoea obscura* (L.) Ker Gawl., Convolvulaceae; : 144201 *Sarcococca brevifolia* Stapf ex Gamble, Buxaceae; 144202, *Impatiens verticillata* Wight, Balsaminaceae; 144203, *Strychnos*

wallichiana Steud. ex A.DC., Loganiaceae; 144204, *Christisonia bicolor* Gardner, Orobanchaceae; 144205, *Elaeocarpus tuberculatus* Roxb., Elaeocarpaceae; 144206, *Rungia repens* (L.) Nees, Acanthaceae; 144207, *Ficus beddomei* King; 144208, *Begonia dipetala* Graham, Begoniaceae; 144209, *Vincetoxicum hirsutum* (Wall.) Kuntze., Asclepiadaceae; 144210, *Strophanthus wightianus* Wall. ex Wight, Apocyanaceae; 144211, *Connarus monocarpus* L., Connaraceae; 144212, *Epipogium roseum* (D.Don) Lindl., Orchidaceae; 144213, *Archidendron clypearia* subsp. *subcoriaceum* (Thwaites) I.C.Nielsen; 144214, *Pavetta indica* L., Rubiaceae; 144215, *Moonia heterophylla* Arn., Asteraceae; 144216, *Boehmeria virgata* var. *macrostachya* (Wight) Friis & Wilmot-Dear, Urticaceae; 144217, *Ilex wightiana* Wall. ex Wight, Icacinaceae; 144218, *Lycianthes laevis* (Dunal ex Poir.) Bitter, Solanaceae; 144219, *Polyscias acuminata* (Wight) Seem., Araliaceae; 144120, *Piper* sp., Piperaceae; 144221, *Ranunculus wallichianus* Wight & Arn., Ranunculaceae; 144222, *Breynia saksenana* (Manilal, Prasann. & Sivar.) Chakrab. & N.P.Balacr., Euphorbiaceae; 144223, *Chassalia curviflora* (Wall.) Thwaites., Rubiaceae; 144224, *Casearia coriacea* Vent., Flacourtiaceae; 144225, *Rubus niveus* Thunb., Rosaceae; 144126, *Elatostema sessile* J.R.Forst. & G.Forst., Urticaceae; 144227, *Milium indica* Lesch. ex A.DC., Annonaceae; 144228, *Chrysoglossum ornatum* Blume (=C. *maculatum* Hook.f.), Orchidaceae; 144129, *Biophytum sensitivum* (L.) DC., Oxalidaceae; 144230, *Euonymus crenulatus* Wall. ex Wight & Arn., Celastraceae; 144031, *Eugenia mooniana* Wight, Myrtaceae; 144232, *Medinilla beddomei* C.B.Clarke, Melastomataceae; 144233, *Gynura travancorica* W.W.Sm., Astraceae; 144234, *Ophiorrhiza rugosa* var. *prostrata* (D.Don) Deb & Mondal, Rubiaceae; 144235, *Dendrobium anamalayanum* Chandrab., V.Chandras. & N.C.Nair, Orchidaceae; 144136, *Carex speciosa* Kunth., Cyperaceae; 144237, *Scolopia crenata* (Wight & Arn.) Clos, Flacourtiaceae; 144238, *Anisochilus robustus* Hook.f., Lamiaceae; 144039, *Disperis monophylla* Blatt. ex C.E.C.Fisch., Orchidaceae; 144240, *Cyperus cyperoides* (L.) Kuntze, Cyperaceae; 144241, *Uniyala comorinensis* (W.W.Sm.) H.Rob. & Skvarla, Asteraceae; 144242, *Malaxis densiflora* (A.Rich.) Kuntze, Orchidaceae; 144243, *Zanthoxylum ovalifolium* Wight, Rutaceae; 144244, *Prunus ceylanica* (Wight) Miq., Rosaceae; 144245, *Neolitsea scrobiculata* (Meisn.) Gamble, Lauraceae; 144246, *Impatiens munnarensis* E.Barnes, Balsaminaceae; 144247, *Casearia rubescens* Dalzell, Flacourtiaceae; 144248, *Decalepis hamiltonii* Wight & Arn., Asclepiadaceae; 144249, *Ophiorrhiza grandiflora* Wight, Rubiaceae; 144250, *Lasianthus acuminatus* Wight, Rubiaceae; 144151, *Cyperus distans* L.f., Cyperaceae; 144252, *Grewia umbellifera* Bedd., Tiliaceae; 144253, *Actinodaphne bourdillonii* Gamble, Lauraceae; 144254, *Cyperus flavidus* Retz., Cyperaceae; 144255, *Taxillus cuneatus* (B.Heyne) Danser, Loranthaceae; 144256, *Grewia tiliifolia* Vahl, Tiliaceae; 144257, *Brachycorythis iantha* (Wight) Summerh., Orchidaceae; 144258, *Meliosma simplicifolia* (Roxb.) Walp., Sabiaceae; 144259, *Eleocharis acutangula* (Roxb.) Schult., Cyperaceae; 144260, *Juncus tenuis* Willd., Juncaceae; 144261, *Pterocarpus marsupium* Roxb., Leguminosae; 144262, *Curcuma pseudomontana* J.Graham, Zingiberaceae; 144263, *Phyllanthus cinereus* Müll.Arg., Euphorbiaceae; 144264, *Erythroxylum monogynum* Roxb., Erythroxylaceae; 144265, *Fimbristylis complanata* (Retz.) Link, Cyperaceae; 144266, *Pimpinella* sp., Apiaceae; 144267, *Ziziphus mauritiana* Lam., Rhamnaceae; 144268, *Eugenia pachakumachiana* Arum & Murugan, Myrtaceae; 144269, *Derris benthamii* (Thwaites) Thwaites, Leguminosae; 144270, *Grewia tiliifolia* Vahl, Tiliaceae; 144271, *Psydrax dicoccos* Gaertn., Rubiaceae; 144272, *Cadaba fruticosa* (L.) Druce, Capparaceae; 144273, *Jasminum auriculatum* Vahl, Oliaceae; 144274, *Capparis sepiaria* L., Capparaceae; 144275, *Strychnos potatorum* L.f., Loganiaceae; 144276, *Elaeagnus indica* Servett., Elaeagnaceae; 144277, *Macrosolen capitellatus* (Wight & Arn.) Danser, Loranthaceae; 144278, *Grewia umbellifera* Bedd., Tiliaceae; 144279, *Senna septemtrionalis* (Viv.) H.S.Irwin & Barneby, Leguminosae; 144280, *Oxalis articulata* Savigny, Oxalidaceae; 144281, *Alpinia calcarata* (Andrews) Roscoe, Zingiberaceae; 144282, *Stenocarpus salignus* R.Br., Proteaceae; 144283, *Paspalum dilatatum* Poir., Poaceae; 144284, *Breynia retusa* (Dennst.) Alston, Euphorbiaceae; 144285, *Indigofera colutea* var. *colutea*, Leguminosae; 144286, *Osyris lanceolata* Hochst. & Steud., Santalaceae; 144287, *Fimbristylis ferruginea* (L.) Vahl, Cyperaceae; 144288, *Andrographis paniculata* (Burm.f.) Nees, Acanthaceae; 144289, *Bridelia retusa* (L.) A.Juss., Euphorbiaceae; 144290, *Erythroxylum obtusifolium* (Wight) Hook.f., Erythroxylaceae; 144291, *Ficus arnottiana* (Miq.) Miq., Moraceae; 144292, *Polygala bolbothrix* Dunn, Polygalaceae; 144293, *Cordia monoica* Roxb., Boraginaceae; 144294, *Benkara malabarica* (Lam.) Tirveng., Rubiaceae; 144295, *Flacourtia jangomas* (Lour.) Raeusch., Flacourtiaceae; 144196, *Syzygium cumini* (L.) Skeels, Myrtaceae; 144297, *Radermachera xylocarpa* (Roxb.) Roxb. ex K.Schum., Bignoniaceae; 144298, *Flueggea virosa* (Roxb. ex Willd.) Royle; 144299, *Syzygium myhendrae* (Bedd. ex Brandis) Gamble, Myrtaceae; 144300, *Nothopegia vajravelui* K.Ravik. & V.Lakshm., Anacardiaceae. 144301 *Elaeocarpus gausseii* Weibel, Elaeocarpaceae; 144302, *Symplocos cochinchinensis* (Lour.) S.Moore, Symplocaceae; 144303, *Symplocos acuminata* (Blume) Miq.,

Symplocaceae; 144304, *Saprosma foetens* subsp. *ceylanica* (Gardner) M.Gangop. & Chakrab., Rubiaceae; 144305, *Ehretia aspera* Willd., Boraginaceae; 144306, *Jasminum auriculatum* Vahl, Oleaceae; 144307, *Eriolaena hookeriana* Wight & Arn., Sterculiaceae; 144308, *Murraya koenigii* (L.) Spreng., Rutaceae; 144309, *Excoecaria oppositifolia* var. *crenulata* (Wight) Chakrab. & M.Gangop., Euphorbiaceae; 144310, *Miliusa eriocarpa* Dunn, Annonaceae; 144311, *Mitrephora heyneana* (Hook.f. & Thomson) Thwaites, Annonaceae; 144312, *Antidesma* sp., Euphorbiaceae; 144213, *Antidesma diandrum* (Roxb.) B.Heyne ex Roth, Euphorbiaceae; 144314, *Madhuca latifolia* (Roxb.) J.F.Macbr., Sapotaceae; 144315, *Grewia rotundifolia* Juss., Tiliaceae; 144316, *Lannea coromandelica* (Houtt.) Merr., Anacardiaceae; 144317, *Crinum asiaticum* L., Liliaceae; 144318, *Cissus quadrangularis* L., Vitaceae; 144319, *Cleome felina* L.f., Cleomaceae; 144320, *Clausena willdenowii* Wight & Arn., Rutaceae; 144321, *Xantolis tomentosa* var. *elengioides* (A.DC.) Vajr., Sapotaceae; 144322, *Nephelium longana*(Lam.) Cambess., Sapindaceae; 144323, *Micromelum pubescens* Blume, Rutaceae; 144324, *Cyperus cyperinus* Retz., Cyperaceae; 144325, *Solanum erianthum* D.Don, Solanaceae; 144326, *Nephelium longana* (Lam.) Cambess, Sapindaceae; 144327, *Leucas lanata* Baker, Lamiaceae; 144328, *Loranthus intermedius* Wight ex Hook.f., Loranthaceae; 144329, *Eugenia pachakumatchiana* Arum. & Murugan, Myrtaceae; 144330, *Chukrasia tabularis* A.Juss., Meliaceae; 144331, *Memecylon talbotianum* D.Brandis, Melastomataceae; 144332, *Derris benthamii* (Thwaites) Thwaites, Leguminosae; 144333, *Euonymus dichotomus* B.Heyne ex Wall., Celastraceae; 144334, *Mallotus stenanthus* Müll.Arg., Euphorbiaceae; 144335, *Mallotus stenanthus* Müll.Arg., Euphorbiaceae; 144336, *Canthium parviflorum* Lam., Rubiaceae; 144337, *Miliusa eriocarpa* Dunn, Annonaceae; 144338, *Breynia rhamnoides* Müll.Arg., Euphorbiaceae; 144339, *Mesua ferrea* L., Clusiaceae; 144340, *Dimorphocalyx glabellus* var. *lawianus* (Hook.f.) Chakrab. & N.P.Balakr., Euphorbiaceae; 144341, *Buchanania lanzan* Spreng., Anacardiaceae; 144342, *Clerodendrum serratum* (L.) Moon, Verbenaceae; 144343, *Lantana wightiana* Wall. ex Gamble, Verbenaceae; 144344, *Glycosmis mauritiana* (Lam.) Tanaka, Rutaceae; 144345, *Ochna heyneana* Wight & Arn., Ochnaceae; 144346, *Psychotria subintegra* (Wight & Arn.) Hook.f., Rubiaceae; 144347, *Uvaria narum* (Dunal) Blume, Annonaceae; 144348, *Crotalaria pallida* Aiton, Leguminosae; 144349, *Ophiorrhiza mungos* L., Rubiaceae; 144350, *Murdannia zeylanica* (C.B.Clarke) G.Brückn., Commelinaceae; 144351, *Acalypha racemosa* Wall. ex F.W.Andrews, Euphorbiaceae; 144352, *Phyllanthus missionis* Hook.f., Euphorbiaceae; 144353, *Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Guill. & Perr., Combretaceae; 144354, *Cordia obliqua* Willd., Boraginaceae; 144355, *Viscum verruculosum* Wight & Arn., Viscaceae; 144356, *Oryza meyeriana* (Zoll. & Moritzi) Baill., Poaceae; 144357, *Biophytum sensitivum* (L.) DC., Oxalidaceae; 144358, *Clausena dentata* (Willd.) M.Roem., Rutaceae; 144359, *Argyreia involucrata* C.B.Clarke, Convolvulaceae; 144360, *Chassalia curviflora* var. *curviflora*, Rubiaceae; 144361, *Hiptage benghalensis* (L.) Kurz, Malpigiaceae; 144362, *Epithema carnosum* Benth., Gesneriaceae; 144363, *Diospyros chloroxylon* Roxb., Ebenaceae; 144364, *Procris crenata* C.B.Rob., Urticaceae; 144365, *Hedychium coronarium* J.Koenig, Zingiberaceae; 144366, *Orophea thomsonii* Bedd., Annonaceae; 144367, *Ecbolium linneanum* Kurz, Acanthaceae; 144368, *Costus speciosus* (J.Koenig) Sm., Costaceae; 144369, *Bridelia retusa* (L.) A.Juss., Euphorbiaceae; 144370, *Polyalthia cerasoides* (Roxb.) Bedd., Annonaceae; 144371, *Vanda tessellata* (Roxb.) Hook. ex G.Don, Orchidaceae; 144372, *Phyllanthus debilis* J.G.Klein ex Willd., Euphorbiaceae; 144373, *Ocimum gratissimum* L., Lamiaceae; 144374, *Acacia canescens* (Britton) García-Barr. & Forero, Leguminosae; 144375, *Didymocarpus tomentosus* Wight, Gesneriaceae; 144376, *Jasminum auriculatum* Vahl, Oleaceae; 144377, *Asystasia chelonoides* var. *variabilis* (Nees) M.R.Almeida, Acanthaceae; 144278, *Alysicarpus monilifer* (L.) DC., Leguminosae; 144379, *Indigofera trifoliata* L., Leguminosae; 144380, *Ficus arnottiana* (Miq.) Miq., Moraceae; 144381, *Knoxia mollis* R.Br. ex Wight & Arn., Rubiaceae; 144382, *Anisomeles indica* (L.) Kuntze, Lamiaceae; 144383, *Oldenlandia umbellata* Steud., Rubiaceae; 144384, *Argyreia involucrata* C.B.Clarke, Convolvulaceae; 144385, *Swertia angustifolia* Buch.-Ham. ex D.Don, Gentianaceae; 144386, *Andrographis megamalayana* Gnanasek., Karupp. & G.V.S.Murthy, Acanthaceae; 144387, *Hedyotis purpurascens* Hook.f., Rubiaceae; 144388, *Nothapodytes nimmoniana* (J.Graham) Mabb., Icacinaceae; 144389, *Gomphostemma heyneanum* Wall. ex Benth., Scrophulariaceae; 144390, *Lycianthes bigeminata* (Nees) Bitter, Solanaceae; 144391, *Habenaria diphylla* (Nimmo) Dalzell, Orchidaceae; 144392, *Impatiens herbicola* Hook.f., Balsaminaceae; 144393, *Habenaria longicorniculata* J.Graham, Orchidaceae; 144394, *Satyrium nepalense* D.Don, Orchidaceae; 144395, *Argyreia choisyana* Regel & Körn., Convolvulaceae; 144396, *Pimpinella candolleana* Wight & Arn., Apiaceae; 144397, *Solanum xanthocarpum* Schrad., Solanaceae; 144398, *Solanum multiflorum* Roth., Solanaceae; 144399, *Jasminum auriculatum* Vahl, Oleaceae; 144400, *Premna wightiana* Schauer, Verbenaceae

3.1 Number of species incorporated: All the identified specimens labeled and accessioned. It will be incorporated very shortly

3.2 Output indicators for the assessment of the project : The during the period of four years (2016 -2020) we have been conducted fourteen tours to Megamali wildlife sanctuary, Theni district, Tamil Nadu. In different seasons we have covered this sanctuary, the survey resulted 623 genera with 1301 taxa including some of the new species, rediscovery, new record and nomenclature of the some species were published from this sanctuary.

New to science

1. *Eugenia megamalayana* Murugan & Arum.
2. *Eugenia pachakumachiana* Arum. & Murugan (in ed.)
3. *Syzygium lakshmananii* Murugan & Arum.
4. *Grewia lakshminarasimhanii* Arum., Arisdason, R. Manik. & Murugan (in ed.)
5. *Tripogon jayachandranii* Arum. & Murugan

Rediscovery

Drypetesporter (Gamble) Pax & K.Hoffm.

3.3 Major impacts reported during the financial year :
Two new species described and accepted for publication during this period

Publications:

Papers published-20; Book chapetr-01; Papers communicated-07

17. WESTERN REGIONAL CENTRE, PUNE

Project 1

Pteridophyte Flora of India

Name of Executing Officer (s) :Dr. A. Benniamin, Scientist E

Duration of the project: August, 2020 – March, 2023

About the work done:

Introduction:

The project Pteridophytic flora of India was initiated in August, 2020.

Methodology adopted:

Herbarium specimens housed at MH were studied. Critically reviewed existing past and present literature to restore the taxonomic complex among species. Standardized and updated nomenclature of taxa using standard worldwide online database.

Area and locality of the Allotted Project: India

Output indicators for the assessment of the project: Preparation of description of 103 species belonging to 10 genera of Pteridophytes along with key. Ex-situ conservation of four species viz. *Cyathea spinulosa*, *Anogramma leptophylla*, *Botrychium lanuginosum* and *Elaphoglossum stigmatolepis* through spore culture and introduced in to Green house of Botanical Garden of BSI, WRC, Pune.

Major impacts reported during the financial year: This study will fulfill the gap areas of pteridophytic researches in Indian context and will be useful for scientific fraternities, policy makers and other stake holders towards better understanding of the Pteridophytes, in identification of taxa in field, their distribution pattern and making policies for their conservation.

PROJECT – 2

Flora of India, Vol. 24 (Urticaceae-Ceratophyllaceae)

Name of Executing Officer(s): Dr. Prashant K. Pusalkar, Scientist-B & Dr. Priyanka Ingle, Scientist-C

Duration of the project: September, 2018-March, 2021

Objective

Completion of Flora of India, Volume 24 comprising detailed descriptive inventory of all Indian taxa belonging to twelve flowering plant families, namely Urticaceae, Cannabaceae, Ulmaceae, Moraceae, Juglandaceae, Myricaceae, Platanaceae, Casuarinaceae, Betulaceae, Fagaceae, Salicaceae, and Ceratophyllaceae.

Background

The project was initiated in 2018, with targeted completion of the checklist of twelve flowering plant families, namely Urticaceae, Cannabaceae, Ulmaceae, Moraceae, Juglandaceae, Myricaceae, Platanaceae, Casuarinaceae, Betulaceae, Fagaceae, Salicaceae, and Ceratophyllaceae by March 2019, followed by the targeted completion of national-level complete updated descriptive documentation of volume 24 of Flora India, comprising above said flowering plant families by March 2021.

Area and Locality: India

Summary of the Work Done During 2020-2021

1. Completed taxonomic documentation and updation (203 taxa) of the family Cannabaceae, Juglandaceae, Myricaceae, Ulmaceae, Moraceae (partly) and Urticaceae with taxa additions (novelties, new distributional records), literature screening, specimen study and character updation/extension, description standardization and distribution/habitat/phenology/chromosome data updation along with nomenclature corrections (updated/made changes in existing data as per recent revisions/phylogeny-results, diagnostic character valuation and subsequent taxonomic rank assessment/changes).
2. Coordinated/communicated with other authors (of the families Salicaceae, Fagaceae, Moraceae (Genus *Ficus*), part of Flora India vol. 24), for manuscript submission, reference and description updation, formatting and corrections as per approved Flora India format.
3. Completed description finalization (Families, Genera and species/intraspecific taxa), taxonomic plant identification key making (for genera/species and intraspecific taxa) and nomenclature updation of the families Urticaceae, Moraceae (partly), Cannabaceae, Myricaceae, Casuarinaceae, Ulmaceae, Platanaceae, Juglandaceae, and Ceratophyllaceae;
4. Completed line drawing and colour photo plates making/editing. Edited, captioned, referenced and finalized line drawings and photo plates were submitted with the Flora India volume 24 manuscripts.

Outcome

Finalized and submitted compiled, formatted and edited (print-ready) manuscript of Flora India, volume 24 to BSI, Hqrs/ Publication section.

Output indicators for the assessment of the project:

Taxonomic documentation and updation of members of the allotted families, consultation of literature, specimens study, description of taxa, distribution/habitat/phenology/chromosome data updation along with nomenclature corrections.

Major impacts reported during the financial year: After completion of Flora of India project, a comprehensive account of family, genus, species and infraspecific taxa will be available to the scientific communities as well as stake holders and policy makers so that any one can access the status of any taxa. This may also be helpful for forest division to make a baseline database of vegetation of the country.

PROJECT – 3

Phyto Data-Base of Konkan, Maharashtra

Name of Executing Officer: Dr. Prashant K. Pusalkar, Scientist-E

Duration of the project: September, 2020- March, 2023

Objective

Preparation of complete Phyto Data-Base of Konkan region, covering diverse phyto-documentation aspects ranging from general phyto-diversity documentation to threats and status analysis of the flora, including documentation of unique and vulnerable conservation-dependent habitats/ ecosystems.

Background

The green Konkan coast, with diverse phyto-resources distributed in varied zones ranging from foot hills of Western Ghats to coastal Laterite plateaus ('Sada') and further from coastal sand dunes to mangrove forests and adjoining marine ecosystem, is unique and one of the richest phyto-diversity zones of the country. However, unlike the adjoining Western Ghat region, the phyto-diversity documentation of this coastal green belt is scattered and without consolidated compiled database. The project initiated in 2020 with the aim to form complete phyto-diversity databasing of species-rich Konkan coast, as baseline data for green resource status and diversity assessment, management, and conservation.

Area and Locality: Konkan region, Maharashtra.

Summary of the Work Done During 2020-2021

Initiated preparation of Konkan Phyto Data-Base with documentation of phyto-diversity from scientific literature and Herbarium specimen study along with compilation of phyto-research references. Completed identity confirmation and data documentation (487 species under 32 flowering plant families - under different categories such as Arboreal diversity, Climber diversity, Special and Unique Plant groups, Endemics and Conservation-dependent Species) with nomenclature updation, distribution and status documentation.

Outcome

Completed Phyto-diversity Data-basing documentation of 487 species under 32 flowering plant families, under different categories, such as Arboreal diversity, Climber diversity, Special and Unique Plant groups, Endemics and Conservation-dependent Species.

Output indicators for the assessment of the project: Databasing flora of Konkan, literature consultation, herbarium study, compilation of phyto-research references of Konkan, nomenclature update, updating distribution and status.

Major impacts reported during the financial year: This study will provide a complete database of species-rich Konkan coast, as baseline data for green resource status and diversity assessment, management, and conservation. This report will be a ready reckoner of diverse phyto-resources of Konkan coast which will help to identify Endemics and Conservation-dependent Species.

PROJECT 4

Bambusicolous fungi of Goa

Name of Executing Officer: Dr. Rashmi Dubey, Scientist E

Duration of the project: April, 2020-March, 2024

Objectives

Exploring the diversity of Bambusicolous fungi of Goa and its adjoining areas; Morphological identification of the bambusicolous fungal species along with Scanning Electron Microscopic studies; Isolation and molecular characterisation of Bambusicolous fungal species associated with different parts of Bamboo (leaves, culms, branches, sheathes, lower, rhizomes, and roots); To evaluate the validity of bambusicolous fungal taxa and clarify their phylogenetic relationships by Multigene sequencing; Cataloguing, preservation and maintenance of fungal germplasm.

Background

India is the second richest country in bamboo genetic resources after China and is likely to support an equally diverse mycota. But India's knowledge of bamboo fungi is still at the cataloguing stage. Bambusicolous fungi records are indexed, but the bamboo species hosting bambusicolous fungi are often not reported, secondly most bamboo species are in the wild and not domesticated for phytopathological scrutiny, and the complex lifestyle of bamboo species which encompasses fast growth, giant height, often growing in difficult terrain limits surveillance and impedes insights on bamboo pathology. Thus these works will be an opportunity for a comprehensive understanding of complex Bambusicolous Fungi. Standard methodology will be adopted as: Survey and collection of samples, laboratory processing for morpho and molecular studies (DNA extraction, PCR amplification, DNA sequencing) and Phylogenetic analyses for conducting the studies.

The project was initiated in April 2020 but the proposed field tours could not be materialized due to pandemic Covid - 19.

Area and Locality: Goa is a part of the coastal country known as the Konkan, which is an escarpment rising up to the Western Ghats of India. Goa encompasses an area of 3,702 km² (1,429 sq mi). Equatorial forest cover in state stands at 1,424 km² (549.81 sq mi).

Summary of the work done during 2020-21

During 2020-21, the proposed field tour could not be materialized due to shortage of funds in Office and strict lockdown due to pandemic Covid -19. The report of Annual Action Plan Project report "Taxonomic Studies of Micro fungi of Sanjay Gandhi National Park (Maharashtra) along with Its 10 % Peripheral Area" was submitted to Director, BSI on 10.09.2020. A new genus *Lonavalomyces indicus*. Dubey 2020 and two new species *Mycoenterolobium borivaliensis*. Dubey and Pandey 2020 and *Conlarium indicasp.nov.* were published described during the period. Scanning Electron Microscopic studies were conducted for 12 spp and Molecular Phylogeny was conducted for 39 spp. Prepared the closure report and Research highlights report of SERB DST project entitled "Morphological and Molecular Characterisation of Terrestrial Litter fungi of North Western Ghats of India (External Funding Project SERB, New Delhi. Attended webinars:12

Outcome

Few samples were collected while attending other tours and work was started for AAP project. A total of 21 samples were collected and 24 fungal sp. were identified, which are as follows: *Acrodictys bambusicola* M.B. Ellis (Pezizomycotina)- Dead Bamboo, Dr. Salim Ali Bird Sanctuary, Goa; *Beltraniella spiralis* Piroz. & S.D. Patil, 1966 (Beltraniaceae)-Dead Bamboo, Mhadei WLS, Goa; *Corynesporacassicola* (Berk. & M.A. Curtis) C.T. Wei 1950-Corynesporaceae- Leaf ; *Chaetosphaerulina lignicola* (Tubeufiaceae) on Bamboo stem, Mhadei WLS, Goa; *Diatrypeloranthi* Tend. 1971 (Diatrypaceae) -Bamboo stem, Mhadei WLS, Goa; *Exserohilum elongatum* Hern. -Restr. & Crous 2018-(Pleosporaceae)-Dead Bamboo; *Kamalomyces bambusicola* Y.Z. Lu & K.D. Hyde 2017-(Dothideomycetes)-Dead bamboo stem- Dr. Salim Ali Bird Sanctuary, Goa; *Monodictys putredinis* (Wallr.) S. Hughes Dead bamboo stem, Dr. Salim Ali Bird Sanctuary, Goa; *Paradictyoarthrinium diffractum* Matsush. 1996 (*Paradictyoarthrinaceae*) -Dead Bamboo, Mhadei WLS, Goa; *Pithomyces ellisii* V.G. Rao & Chary 1972-(Didymellaceae)- Dead bamboo stem, Mhadei WLS, Goa, Dr. Salim Ali Bird Sanctuary, Goa; *Sporidesmium ehrenbergii* M.B. Ellis 1958-Amorphothecaceae- Dead bamboo stem; *Sporidesmium* sp. 1-Dothideomycetes-Dry Bamboo stem, Dr. Salim Ali Bird Sanctuary, Goa; *Aspergillus flavus* Link. 1890 (*Aspergillaceae*), on leaf of Bamboo, Dr. Salim Ali Bird Sanctuary, Goa; *Fusarium chlamydosporum* Wollenw. & Reinking, (1925), *Nectriaceae*, on leaf of Bamboo, Mhadei WLS, Goa; *Fusarium incarnatum* (Desm.) Sacc., (1886), *Nectriaceae*, on leaf of Bamboo, Dr. Salim Ali Bird WLS, Goa ; *Fusarium proliferatum* (Matsush.) Nirenberg ex Gerlach & Nirenberg (1982), *Nectriaceae*, on leaf of Bamboo, Dr. Salim Ali Bird Sanctuary, Goa; *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl., (1909), (*Botryosphaeriaceae*) on leaf of Bamboo, Dr. Salim Ali

Bird WLS, Goa ;*Trichoderma asperellum*(1999), (Hypocreaceae),on leaf of Bamboo Mhadei WLS, Goa; *Hypocreales* sp. on leaf of Bamboo, Dr. Salim Ali Bird Sanctuary, Goa; *Phoma herbarum Westend. 1852* (Didymellaceae),on leaf of Bamboo, Dr. Salim Ali Bird Sanctuary, Goa; *Nigrosporasphaerica*(Sacc.) E.W. Mason, (1927) (Sordariomycetes) on leaf of Bamboo, Mhadei WLS, Goa; *Trichoderma asperellum*(1999) (Hypocreaceae),on leaf of Bamboo, Mhadei WLS, Go.

Output indicators for the assessment of the project: Morphological identification of the bambusicolous fungal species, Scanning Electron Microscopic studies, isolation and molecular characterisation of Bambusicolous fungal species, phylogenetic inferences by Multigene sequencing; Cataloguing, preservation and maintenance of fungal germplasm.

Major impacts reported during the financial year: This study will help in comprehensive understanding of complex of Bambusicolous Fungi which is still at the cataloguing stage in India.

PROJECT-5

Flora of Lakshadweep Islands

Name of Executing Officer: Dr. Priyanka Ingle, Scientist-C

Duration of the project: September, 2020-March, 2021

Background of the project:

The Lakshadweep archipelago consists of 36 islands, 12 atolls, 3 reefs and 5 submerged sand banks in the Arabian Sea between latitudes 8° N to 12° 30' N and longitudes 71° E to 74° E. The islands have a total geographic area of about 32.62 km² and the lagoons enclosed by the atolls cover an area of about 4200 km². Only 10 islands are inhabited. These islands are similar in floristic composition due to prevalence of similar type of soil, climate and rainfall in all these islands. Lakshadweep harbours c. 358 angiosperms represented by 79 families, 265 genera and 5 pteridophytes. The low species diversity in the islands may be due to the calcareous nature of soil. Also the main source of water is rain, which sieves down quickly due to the high porosity of the soil. Hence, plants with roots long enough to reach water can only survive. The lagoon side or western side of islands is dominated by littoral species like *Ipomoea pes-caprae* (L.) R. Br., *Launaeasar mentosa* (Willd.) Sch. Bip. ex Kuntze, *Pemphis acidula* J.R. Forst., *Scaevola taccada* (Gaertn.) Roxb., *Spinifex littoreus* (Burm.f.) Merr., *Suriana maritima* L. and *Volkameria nermis* L. while eastern shore is dominated by *Cordia subcordata* Lam. and *Guettarda speciosa* L. The middle portion of the islands is dominated by coconut trees. Other species include *Artocarpus saltilis* (Parkinson ex F.A. Zorn) Fosberg, *Colubrina asiatica* (L.) Brongn., *Dodonaea viscosa* Jacq., *Hernandia nymphaeifolia* (C. Presl) Kubitzki, *Hibiscus tiliaceus* L., *Morinda citrifolia* L., *Pisonia grandis* R. Br., *Tacca leontopetaloides* (L.) Kuntze and *Thespesia populnea* Sol. ex Corrêa.

Area and locality of the Allotted Project: 32.62 sq. km.

Summary of the work done during 2020-21:

During this period updated citations and standardized nomenclature of 358 taxa by using global databases. Prepared the generic and species keys wherever required. Studied herbarium specimens available at BSI, prepared data and included approximately 300 specimens examined on the basis of prepared as well as available data from CAL, MH, etc.

Outcomes in 2020-21:

This work results in the updated Flora of Lakshadweep Islands which includes 358 angiospermic taxa (including infraspecific taxa) represented by 79 families, 268 genera and 5 pteridophytic taxa.

Output indicators for the assessment of the project: Updating citation, standardizing nomenclature, preparation of generic and species keys.

Major impacts reported during the financial year: This study will provide updated floristic account of Lakshadweep Islands which will serve as base-line data which will help the researchers, scientists and other academicians who are engaged in Island flora.

PROJECT-6

Checklist of the Flowering Plants of Goa

Name of the Executing officer (s) : Dr. C.R. Jadhav & Dr. P.K. Pusalkar

Duration of the project : September, 2020- March, 2021

Background

In December, 1961, after lapse of about 450 years, the Old Portuguese colonies became a part of India and subsequently on 30th May 1987, Goa became 25th State of India. It is the state on the southwestern Coast of India within the region known as Konkan. Geographically it is separated from Deccan highlands by the Western Ghats. It is situated between the latitudes 14°53'54" N and 15°40'00" N and longitudes 73°40'33" E and 74°20'13" E and surrounded by Ratnagiri district of Maharashtra State on the north, Uttar Kannada District of the Karnataka State on the south and the Western Ghats on the east and the Arabian Sea on the west. The area of Goa is 3702 sq. km with 131 km long coast line which is more or less dentate with creeks, inlets and river deltas. Its maximum length is 105 sq. km and the width 60 km. It is divided into two districts namely North Goa and South Goa having capitals Panaji and Margao respectively. North Goa district is further divided into five talukas namely Tiswadi / Ilhas (Panaji), Bardez (Mapusa), Pernem, Bicholim and Sattari (Valpoi). South Goa district is further divided into seven talukas namely Ponda, Marmugao-Vasco, Margao, Quepem, Canacona (Chaudi), Sanguem, and Dharbandora. Panaji is the capital of the state. It is the most fertile part of the Konkan region of India. Being in the tropical zone and near the Arabian Sea, it has a hot and humid climate for most of the year. Vegetation of Goa can be broadly classified into four types the first Estuarine vegetation of Mangroves along swampy river banks; second Strand and creek vegetation along coastal belt; third Plateau vegetation along undulating terrain and foot hills and fourth Semi-evergreen and evergreen vegetation along the upper Ghats. Species of *Rhizophora*, species of *Avicinia*, *Bruguiera gymnorhiza*, *Kandelia candel* are the common Mangrove species in estuarine vegetation. *Pongamia pinnata*, *Calophyllum inophyllum*, *Derris trifoliata*, *Caesalpinia crista*, *Scaevola taccada* are common in Coastal belts. *Cocos nucifera* and *Casuarina equisetifolia* are found commonly cultivated in this region. *Neanotis rheedei*, *N. lancifolia*, *Naregamia alata*, *Begonia crenata*, *Cyperus squarrosus*, etc., are commonly seen in Creeks and ridges. *Carissa spinarum*, *Getonia floribunda*, *Grewia abutilifolia*, *Vitex negundo*, species of *Crotalaria*, *Ixora*, *Terminalia*, *Dalbergia* and *Flacourtia indica*, *Careya arborea*, *Catunaregam spinosa*, *Meyna laxiflora* are common in Scrubs and deciduous forests. *Actinodaphne angustifolia*, *Ficus talbotii*, *Sapindus trifoliatus*, *Holigarna* spp., *Psydrax dicoccos*, *Ixora* spp., *Hopea pona*, *Oleadioica*, *Cinnamomum* spp., *Glycosmism auritiana*, *Leea* spp., *Garcinia* pp., *Artocarpus* spp., *Mammea suriga* are frequently seen in Ghat areas. There was a need of National Data Base on Plants of India. For this, it was always emphasized to prepare State wise/Region wise Data base. Therefore, work on a checklist of Goa, National Data Base was proposed and undertaken.

Area and Location of the Allotted Project: Area is 3702 Sq. km. It is situated between the latitudes 14°53'54" N and 15°40'00" N and longitudes 73°40'33" E and 74°20'13" E.

Summary of the work done during 2020-21:

During the period, literature in Library was consulted. About 800 species/ taxa (of Dicotyledons) species were listed along with their Families, synonyms, localities and phonological data from Flora of Goa, Diu, Daman, Dadra and Nagarhaveli (Vol.1 & 2) by Rolla Sheshagiri Rao, 1985. These names were checked and updated with global database.

Outcome in 2020-21:

A list I of about 800 species /taxa has been prepared along with their latest accepted names, Families, localities and phonological data for preparation of National Data Base on plants. A photograph of *Mappia nimmoniana* (J.Graham) Byng & Stull is given below.

Output indicators for the assessment of the project: Literature consultation, listing of 800 taxa (Dicot), updating nomenclature.

Major impacts reported during the financial year: This checklist will serve as database of vegetation of Goa coast which will be addition towards National Data Base on Plants of India.

Research Publications

Books published-02 ; Papers published-11

PUBLICATIONS 2020-21

BOOK PUBLISHED:

1. BENNIAMINA., V. K. RAWAT, M. S. SUNDARI AND G. P. GAPAK 2021. Medicinal Pteridophytes of Arunachal Pradesh – A Pictorial Guide. State Medicinal Plant Board, Itanagar, Arunachal Pradesh.
2. CHAKRABARTY, T., V. MAINA AND M. C. NAIK 2021. Ethnobotany of Jarawa Tribe of Andaman Islands (with an appendix on typification and taxonomic notes). Chakrabarty Traders, Howrah, West Bengal. pp.1-128.
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5. MAJUMDAR S. AND M. DEY 2020. A Handbook on Bryophytes with Special Reference to Type Specimens of Liverworts and Hornworts in Indian Herbaria. *ENVIS Resource Partner on Biodiversity*, Botanical Survey of India, Kolkata.
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PAPERS PUBLISHED:

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