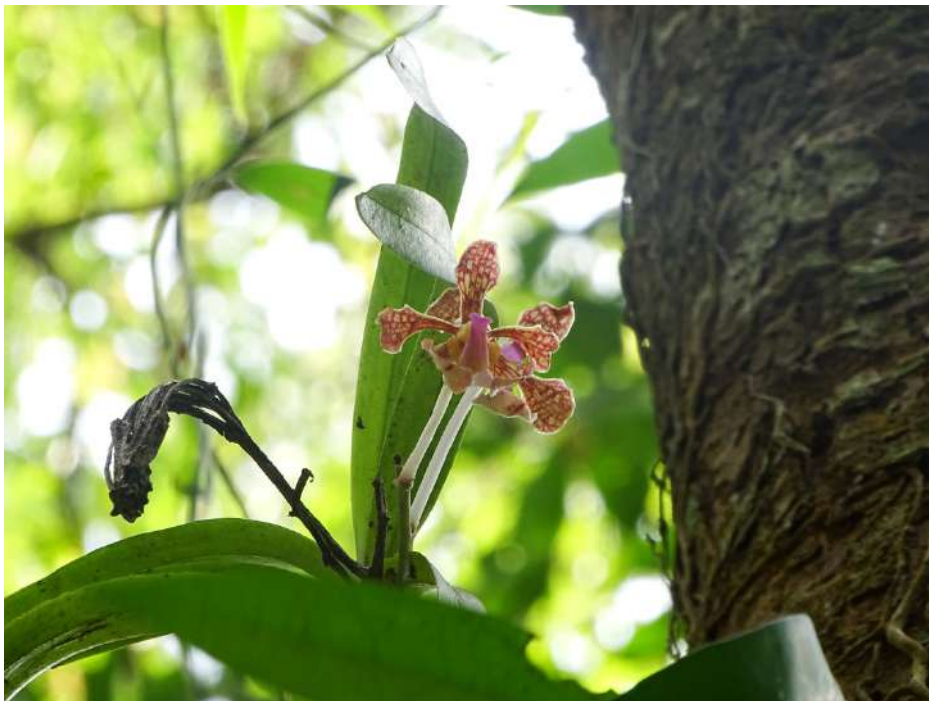


ANNUAL REPORT

2020-2021

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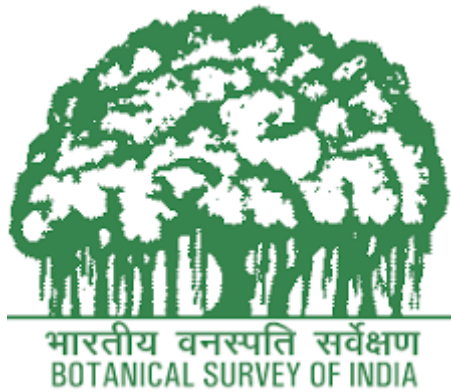


BOTANICAL SURVEY OF INDIA

Ministry of Environment, Forest & Climate Change

ANNUAL REPORT

2020-21



BOTANICAL SURVEY OF INDIA
Ministry of Environment, Forest & Climate Change
Govt. of India

ANNUAL REPORT 2020-21
Botanical Survey of India

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All Regional Centres of Botanical Survey of India

CONTENT

1. BSI organogram
2. Research Programmes
 - A. Annual Research Programme
 - a. AJC Bose Indian Botanic Garden, Howrah
 - b. Andaman & Nicobar Regional Centre, Port Blair
 - c. Arid Zone regional Centre, Jodhpur
 - d. Arunachal Pradesh Regional Centre, Itanagar
 - e. Botanic Garden of Indian Republic, Noida
 - f. Central Botanical Laboratory, Howrah
 - g. Central National Herbarium, Howrah
 - h. Central Regional Centre, Allahabad
 - i. Deccan Regional Centre, Hyderabad
 - j. Headquarter, BSI, Kolkata
 - k. High Altitude Western Himalayan Regional Centre, Solan
 - l. Eastern Regional Centre, Shillong
 - m. Industrial Section Indian Museum, Kolkata
 - n. Northern Regional Centre, Dehradun
 - o. Sikkim Himalayan Regional Centre, Gangtok
 - p. Southern Regional Centre, Coimbatore
 - q. Western Regional Centre, Pune
 - B. Flora of India Programme
3. New Discoveries
 - a. New to science
 - b. New records
4. Ex-situ conservation
5. Publications
 - a. Papers published
 - b. Books published
 - c. Hindi published
 - d. Books published by BSI
6. Training/Workshop/Seminar/Symposium/Conference organized by BSI
7. Participation of BSI Officials In Seminar/Symposium/Conference/Training
8. Activities of Research Scholars
9. Funded/Collaborative project
10. Assistance to Botanic Garden Scheme
11. Herbarium information
12. Awards and Honors
13. Service rendered
14. Events and activities

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
(alongwith Dr. M.E. Hembrom and Dr. Arvind Parihar)

Duration of the Project: April 2019 – Mar 2021

About the work done: (April 2020 to September 2020)

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.

Achievements including :

- a. Total area covered : NIL
- b. Number of tours undertaken : NIL
- c. Number of species collected : NIL
- d. Number of species identified (with name) : NIL
- e. Number of species incorporated : NIL

4.7 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.

4.8 Major impacts reported during the financial year:

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>

4. About the work done:(April 2019 – Mar 2021)

4.5 Methodology adopted:

Compilation work with text, illustrations and phylograms was initiated.

4.6 Achievements including :

- a. Total area covered : NIL
- b. Number of tours undertaken : NIL
- c. Number of species collected : NIL
- d. Number of species identified (with name) : NIL
- e. Number of species incorporated : NIL

4.7 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.

4.8 Major impacts reported during the financial year :

New to Science: Five (5)

Sr. No.	Name of the species	Journal
1.	Lactarius brunneoaurantiacus K. Das & I. Bera; <i>Nordic J. Bot.</i> doi: 10.1111/njb.02940	<i>Nordic Journal of Botany</i>
2.	Lactarius indoscrobiculatus K. Das & I. Bera; <i>Nordic J. Bot.</i> doi: 10.1111/njb.02940	<i>Nordic Journal of Botany</i>
3.	Russula ashihoi K. Das, A. Ghosh, Buyck & Hembrom; <i>Nordic J.Bot.</i> doi: 10.1111/njb.02962	<i>Nordic Journal of Botany</i>
4.	Russula indonigra A. Ghosh, K. Das, Buyck & Hembrom; <i>NordicJ. Bot.</i> doi: 10.1111/njb.02962	<i>Nordic Journal of Botany</i>
5.	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

1. **Name of the project:** Development of Musa section (*Ex-situ* conservation) in AJC Bose Indian Botanic Garden, Howrah (Completed)
2. Executing Scientist (s) : Dr.S.S. Hameed, Scientist-‘E’, Dr.K. Saravanan, Botanist & Mr. S.K. Arjun, Bot.Asst.
3. Duration of the project: One year
4. About the work done:

4.1. **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. Musa sectional systematics possesses a history dating back to 1887. Earlier classification was based on morphological traits such as Bananas with fleshy fruit; ornamental bananas with upright inflorescences and bracts were vibrantly coloured; and Bananas that were giant in size. During the course of time five sections in Musa came into existence like Eumusa, Rhodochlamys, Callimusa, Australimusa, and Ingentimusa. However, Makku Hakkinen in 2013 reduced these five sections of Musa into Musa and Callimusa based on genetic evidence and markers. 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.

4.2. **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.

4.3. **Site of the study:** A well-developed Musa section 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 (Images attached).

4.4. **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.

a. Nil

4.5. Achievements including:

a. Total area covered - NA

b. Number of tours undertaken - NIL

c. Number of species collected – 3 endemic species from Andaman & Nicobar Island

d. Number of species identified - 3

1. *Musa acuminata*, 2. *Musa bulbisiana*, 3. *Musa indandamanensis*

e. Number of species incorporated – N.A

4.6. Output indicators for the assessment of the project:

Monthly, quarterly and annual reports

4.7. Major impacts reported during the financial year:

A Musa section for AJCBIBG developed

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)**

4. About the work done

4.1 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.

4.2 Literature: On the basis of best available mycobiota along with lists and references like Bakshi 1972, Bilgrami et al. 1991, Sorbhoy et al. 1996, De & Roy 2000, Jamaluddin et al. 2004, Sharma 2012, and electronic resource CYBERTRUFFLE'S ROBIGALIA: Observations of fungi and their associated organisms, no reports of mycological activities could be traced from the present survey areas. Hence survey, collection, characterization and documentations of wood rotting fungi from the study areas are justified.

Bakshi, B. K. 1971. *Indian Polyporaceae* (on Trees and Timber). I.C.A.R. New Delhi, India. 246 pp.

Bilgrami KS, Jamaluddin S & Rizwi AM (1979) Fungi of India. Part-I: Lists and References.

Jamaluddin S, Goswami MG & Ojha BM (2004) Fungi of India 1989–2001. Scientific Publishers, Jodhpur, India.

Parashar, I.B. 2015. Wood-rotting non-gilled Agaricomycetes of Himalayas. Fungal Diversity Research Series, Springer Netherlands. 653pp.

Roy, A. & De, A. B. 1996. *Polyporaceae of India*. International Book Distributors, Rajpur Road, Dehradun. 309 pp. & XVII plates.

Sharma, J. R. 2012. *Aphyllorphorales of Himalayas*. BSI Kolkata, 590pp.

Sorbhoy AK, Varshney JL & Agarwal DK (1996) Fungi of India (1982–92). CBS Publishers & Distributors, New Delhi, India.

<http://www.cybertruffle.org.uk/cgi-bin/robicoun>

4.3 Objectives:

‘Survey’, ‘collection’, ‘characterization’, ‘identification’, ‘documentation’ of wood rotting fungi of Valmiki National Park.

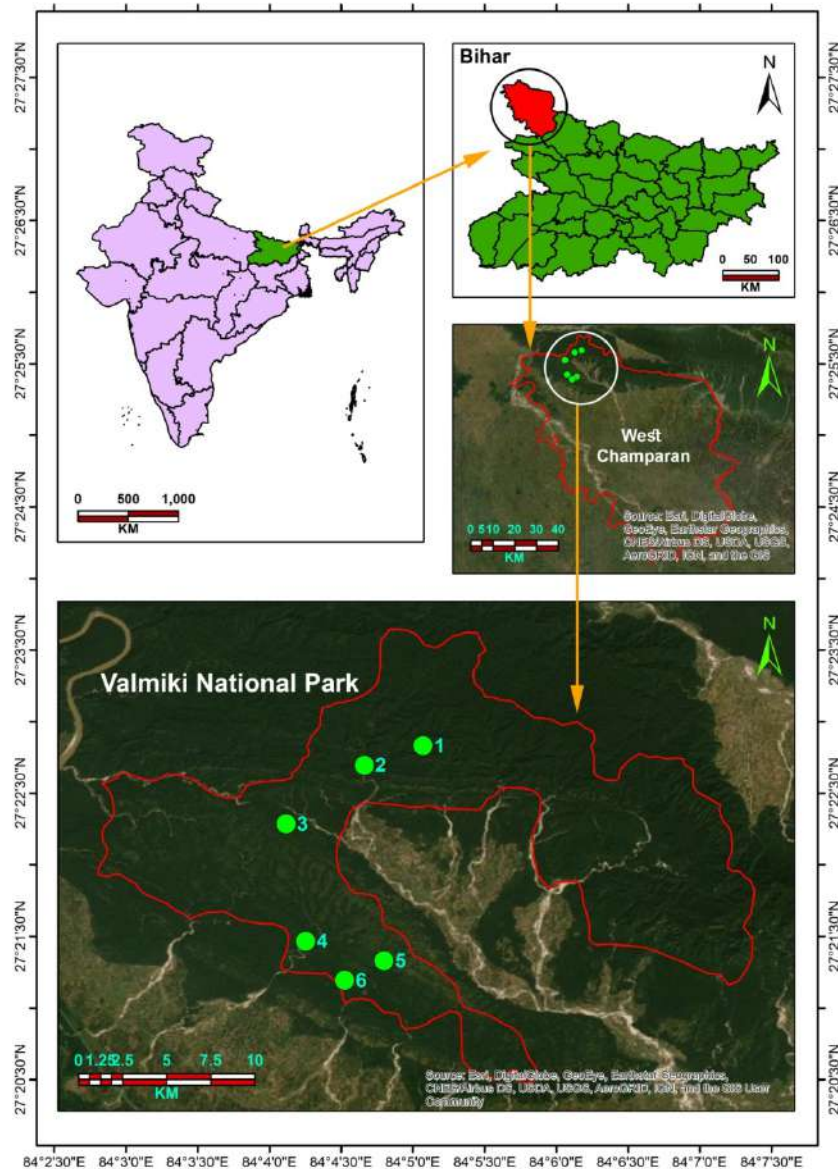
Preparation of the detailed account of wood rotting fungi including their description, host range and specificity, morphology based easy identifying key and notes.

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.

4.4 Site of the study (with map)



4.5 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.

a.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.\

4.6 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 will be 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.***Auriculariaauricula-judae* (Bull.) Quéf. **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 Three (4) species were undertaken.

Project - 4

Flora of India (Volume 27)

ASPARAGACEAE

Updating of existing manuscript and enumeration of 106 taxa completed by Dr. B.K. Singh

Project - 5

Flora of India (Volume 28)

ARECACEAE

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

APONOGETONACEAE

Updating of existing manuscript and enumeration of 9 taxa completed by Dr. B.K. Singh

POTAMOGETONACEAE

Updating of existing manuscript and enumeration of 21 taxa completed by Dr. B.K. Singh

NAJADACEAE

Updating of existing manuscript and enumeration of 12 taxa completed by Dr. B.K. Singh

II. ONGOING PROJECTS

Project -6

1. 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**
2. Executing Scientist (s) : Dr. S.P. Panda, Scientist-C, Dr. R. Saravanan, Botanist & Ms. Titir Saha, Bot. Asstt.
3. Duration of the project : 2020-22
4. About the work done : No tour was made due to COVID-19 pandemic out-break and non-approval of tour

4.1 Introduction : It is universally accepted that the anthropogenic activities are one of the major causes for the destruction of biodiversity and extinction of number of valuable species and there is an urgent need of the conservation. Canadell and Noble (2001) while analyzing the challenges of a changing earth discussed that in recent years the extinction rate has increased sharply and we are now in the midst of the sixth great extinction event in Earth's history. Orchidaceae is one of the most diverse family among the angiosperms, with estimates 25,000 orchid species (Cribb et al., 2003) and more than any other plant family, have high proportion of threatened genera, most containing threatened species. According to the World Conservation Union, almost half of the extinct species are terrestrial herbaceous perennials. One third of the orchids belongs to this category, thus represent a life form class likely to experience a greater extinction risk, particularly under current climatic change scenarios. Swarts and Dixon (2009) reviewed the multiple factors responsible for the rarity of orchids; those include intrinsic factors like requirement of specific pollinator, complicated seed germination process and mycorrhizal association. Dependency on multiple intrinsic factors limits the abundance and distribution of a particular orchid. Orchid capsules produce thousands of seeds and few of them germinate under natural conditions, due the lack of fully developed endosperm or inadequate food reserve. Under natural conditions, seeds of most terrestrial orchid species will germinate only in association with a compatible mycorrhizal fungus (Arditti *et al.*, 1990). Moreover, vegetative propagation of orchids is very slow and tedious process.

Eastern Ghats due to its varied topographic conditions coupled with peculiar geographic locations harbour different kind of life forms. Out of which the orchids deserve special mention being the very rare and unique plants. The Eastern Ghats represent a high magnitude of orchid diversity dwelling in the remote forests of the states of Andhra Pradesh, Odisha and Tamil Nadu which are the best suited species for conserving ex-situ in West Bengal's climate. So far number of endemic (*Cirrhopetalum panigrahi* (S. Misra) S. Misra, *Eriameghasaniensis* (S. Misra) S. Misra, *Habenaria panigrahi* (S. Misra) S. Misra, *Odisha cleistantha* S. Misra etc.) and rare/interesting species (*Dendrobium regium* Prain, *Erialasiopetala* (Willd.) Ormerod, *Bulbophyllum umbellatum* Lindl., *Pecteilis gigantea* (Sm.) Raf., *Habenaria marginata* Colebr. etc.) have been reported. Due to habitat destruction as well as anthropogenic interferences the orchid biota are under severe threat. So collection and germplasm maintenance of these orchids in AJCBIBG will pave the way for conservation for posterity. It will also provide the species another chance to survive in the orchidarium of the AJCBIBG (Acharya Jagadish Chandra Bose Indian Botanic Garden), Botanical Survey of India, Howrah as well as revival of the orchidarium of the garden by enriching the orchid wealth of the garden which is very negligible or poorly represented at present. The *ex-situ* conservation of orchids in AJCBIBG will be very significant bearing in the prospect of future taxonomic works as well as for conservation of biodiversity in general and orchid diversity in particular prior to further genetic erosion of the species in the wild. The epiphytic orchids also like to grow on low light intensity, thus requires a specific green house/poly house for production of healthy plants. It is also worth mentioning that the orchids require a specific temperature, light intensity, photoperiod for better growth and development; however, the requirement varies from species to species. Thus these need to be grown under specific controlled conditions.

This project aims at an immediate step of germplasm conservation of different orchids, growing in Eastern Ghats region along with hybrids and more importantly to establish an orchidarium in AJCBIBG for both the visitors and researchers.

4.2 Literature : N/A

4.3 Objectives:

A. To developed a standard orchidarium in AJCBIBG

B. To conserves the orchids of Eastern Ghats in *ex-situ*

C. To prepare a flowering calendar of the conserved species through phenological studies

D. To impart education and awareness among the people/students visiting the orchidarium

4.4 Site of the study (with map) : N/A

4.5 Methodology adopted :NA

a. Methodology (if any) adopted : N/A

4.6 Achievements including :

a. Total area covered : N/A

b. Number of tours undertaken : Nil

c. Number of species collected : N/A

d. Number of species identified (with name) : N/A

e. Number of species incorporated : N/A

4.7 Output indicators for the assessment of the project : N/A

4.8 Major impacts reported during the financial year : N/A

Project - 7

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

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

3. Duration of the project : **2015-till date**

4. About the work done :

4.1 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. Starting from the British period when introduction registers were maintained to catalogue the garden plants, the present situation has not changed much. 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 remain 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.

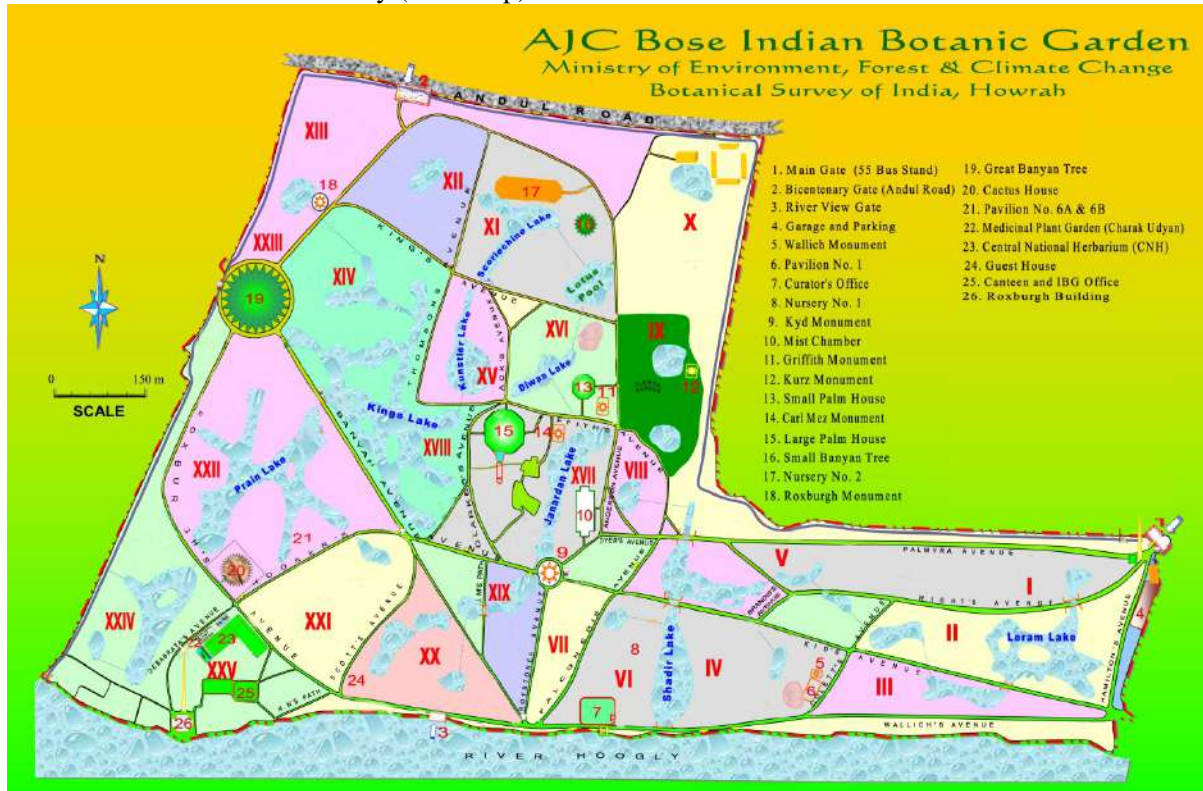
4.2 Literature : NA

4.3 Objectives:

- a) Gathering Information about the introduction of the Tree and Shrubs in the past and present from the researchers of BSI and from the Literatures/Catalogues as per availability.
- b) Locating the Trees and Shrubs in the Garden. Collection of fresh Flowering, Fruiting specimens and Identifying. Checking its present Nomenclature and making necessary corrections.

- c) Mapping of the Identified trees in the software such as ARC GIS and other feasible software.
- d) Creating a map database that helps user to access and identify the Shrubs and tree species in the AJCBIBG.

4.4 Site of the study (with map) :



4.5 Methodology adopted :

- a. New Methodology (if any) adopted : Geo-tagging of the trees and labelling with a serial number for referencing and minimizing the error.

4.6 Achievements including :

- a. Total area covered : 273 acres
- b. Number of tours undertaken : NA
- c. Number of species collected : NA
- d. Number of species identified (with name) : NA
- e. Number of species incorporated : NA

4.7 Output indicators for the assessment of the project :

- a) 480 trees (including all Palms) are labelled with names.
- b) Collection of geo-coordinates of all palm species.
- c) Updating of data in the mobile App.

4.8 Major impacts reported during the financial year :

Development of Mobile Application.

Botanical Survey of India mobile app 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.

B. Research Publications (Nelumbo format):

1. GHOSH, A, DAS, K., BHATT, R.P. AND HEMBROM, M.E. 2020. Two new species of the genus *Russula* from western Himalaya with morphological details and phylogenetic estimations. *Nova Hedwigia* 111(1-2): 115–130.
2. DAS, K., BERA, I. AND GHOSH A. 2020. *Lactarius brunneoaurantiacus* sp. nov. and *L. indoscrobiculatus* sp. nov. from India. *Nordic Journal of Botany* doi: 10.1111/njb.02940.
3. DAS, K., GHOSH, A., BUYCK, B. AND HEMBROM, M.E. 2020. Two new species of *Russula* subgenus *Compactae* from Indian Himalaya based on morphology and molecular phylogenetic inferences. *Nordic Journal of Botany* doi: 10.1111/njb.02962
4. BERA, I., DAS, K. AND GHOSH, A. 2020. Morphological description and phylogenetic estimation of *Lactarius abieticola* (Russulaceae), a new record for Indian mycobiota. *Nelumbo* 62(2): 124 -130.
5. WISITRASSAMEEWONG, K., PARK, M.S., LEE, H., GHOSH, A., DAS, K., BUYCK, B., LOONEY, B.P., CABON, M., ADAMČÍK, S, KIM, C., KIM, C.S. AND LIM, Y.W. 2020. Taxonomic revision of *Russula* subsection *Amoeninae* from South Korea. *Myckeys* 75: 1–29.
6. GHOSH, A., DAS, K. AND CHAKRABORTY, D. 2021. Morphology and molecular approach reveal a new species of the genus *Russula* subsect. *Lepidinae* (Russulaceae) from India. *Phytotaxa* 483(3): 244–254.
7. ROSSI , W., K. DAS, M.E. HEMBROM, S. SANTAMARIA, A. PARIHAR, A. GHOSH, T.W. HENKEL, V. HOFSTETTER, E. RANDRIANJOHANY, A. VIZZINI, X.H. WANG AND B. BUYCK 2020. Fungal Biodiversity Profile 91–100. *CryptogamieMycologie* 41(4): 69–107.
8. GHOSH, A., K. DAS, R.P. BHATT AND M.E. HEMBROM 2020. Two new species of the genus *Russula* from western Himalaya with morphological details and phylogenetic estimations. *Nova Hedwigia* 111(1–2): 115–130.
9. DAS, K., A. GHOSH, B. BUYCK AND M.E. HEMBROM 2020. Two new species of *Russula* subgenus *Compactae* from Indian Himalaya based on morphology and molecular phylogenetic inferences. *Nordic Journal of Botany* 38(11): 1–11.
10. DAS, K., D. CHAKRABORTY, A. GHOSH, M.E. HEMBROM, A. PARIHAR AND I. BERA 2020. *Demystifying 102 Indian Mushrooms*. ENVIS Resource Partner on Biodiversity &BSI, Kolkata. 45pp.
11. M.U. Sharief and S.P. Panda (2020). Folklore artefacts of aboriginal Shompen tribe in Great Nicobar Island, India. *Genet. Resour. Crop Evol.* DOI 10.1007/s 10722-020-01027.
12. S. Misra, S. Panda and S.S. Jena (2019). Notes on *Cirrhopetalum panigrahanum* (S. Misra) S. Misra: an endemic orchid from Odisha, India. *J. Econ. Tax. Bot.* 43 (1-4): 42-44.
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Book Chapter

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1. UDHAV G.V., M.E. HEMBROM, A. GHOSH, V.P. MALI AND A.V. KISKU 2021. Morphological description and phylogenetic estimation of *Favolus roseus* (Polyporaceae), first documented record for Indian mycobiota. Check List
2. PICHAJ S., M.E. HEMBROM, A. GHOSH, P. PALANI AND A.V. KISKU 2021. Recollection after 140 years and Morpho-molecular re-characterization of Indian *Stromatoneurospora phoenix* (Kunze) S.C. Jong & E.E. Davis (Xylariaceae). *Tropical Plant Research*.
3. Parihar, A., Hembrom, M.E., Antonín, V. and Das, K. Combined study on morphology and molecular phylogeny unveils the first report of the mushroom genus *Singerocybe* (Tricholomataceae) from India. (communicated to *Bangladesh Journal of Plant Taxonomy*).
4. Vinod Maina. Ramesh Kumar and C.S. Purohit 2020. A conspectus of Flowering plants of Aliya-bet, Bharuch, Gujarat. *Annals of Forestry*.

C. Ex-situ conservation of RET/ Endemic Plants:

5.1 Garden Management & Maintenance Activities

- a. 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. More than 1000 trees belonging to 195 species were damaged. A detailed report was submitted to BSI (HQ).
- b. Restoration of around 50 plants fallen during Amphan viz. *Adansonia digitata*, *Cycas zeylanica*, *Triplaris americana*, *Intsia bijuga*, *Goniothalamus wynaadensis*, etc.

- c. 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 encaged 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. encaged 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. Around 480 palms belonging to 100 species were labelled and geo-coordinates were recorded.
- e. 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.
- f. Rosarium: Introduced climbing roses along with other rare Indian breed as well as foreign breeds.
- g. 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.
- h. 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.
- i. Cycas section: Maintained 16 seedlings of Cycas spp. Viz.: *Cycas indica* (05), *Cycas beddomei* (06) and *Cycas sphaerica* (05) from DRC, Hyderabad for introduction purpose in Cycas section.
- j. Multiplication of both *V. amazonica* & *V. cruziana* from seeds (about 2000 seedlings) and necessary population well maintained at different lakes of AJCBIBG that served as a good attraction to visiting public. Seedlings have been provided to various govt. agencies/institutes and Universities on request for conservation.
- k. 40 species of RET & E and other endemic plants have been multiplied during the period for ex-situ conservation.
- l. Plant multiplication House: Renovation of plant multiplication house and plantation of cuttings of following plants:
- | | |
|--------------------------|--------------|
| Jasminum sp. | Codium sp. |
| Bougainvillea sp. --- 20 | Bignonia sp. |
| Hibiscus sp. | Ephedra sp. |
- m. Canna section: Reincarnation of Canna section.
- n. Musa section: Development of Musa section by introduction of 6 suckers of 3 species viz.: *Musa indandmanica*, *Musa bulbisina* and *Musa acuminta* received from BSI, ANC, Port Blair.
- o. Cuttings / saplings was done of following plants:
- | | |
|----------------------------|-----|
| <i>Alstonia</i> sp. ----- | 100 |
| <i>Euphorbia</i> sp.----- | 50 |
| <i>Euphorbia</i> sp.----- | 50 |
| <i>Hibiscus</i> spp. ----- | 100 |

- p. 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.
- q. 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.

D. Symposium/ Conferences/ Workshop/ Training Course Attended:

Following officials of this unit have delivered talk as resource person in the following Webinars/training programme.

- 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 a 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.

E. Awards & Honours

NIL

F. 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.

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

Date to be completion : March, 2022



OBJECTIVE

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

BACKGROUND

The plant family Musaceae is represented by a single genus, *Musa* L. only 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. Many taxonomists believe that *Musa* L. taxonomy is a complex and stated that *Musa* taxonomy, including the *Rhodochlamys* section, is still very obscure today just as it has been throughout its history despite several attempts at its clarification. 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. It has generated a lot of interest amongst morphologists, anatomists and taxonomists. Therefore, we feel that the family *Musaceae* needs an adequate review from these Islands.

The Andaman and Nicobar Islands represent an excellent population of *Musa* in protected areas in comparison to unreserved beach forests where they are sparsely scattered. Andaman and Nicobar Archipelago is one of the centre of hot spots of plant diversity in India and a landmass of 572 islands, isles, rocks and reefs with a total area of 8,249 km² and a coastline of 1,962 km. and lies between 6°45"–13°41"N and 92°12"–93°57"E, a region where the *Musaceae* have not been explored systematically because it has received little attention from taxonomists. The *Musaceae* taxonomy is complex because they usually have ephemeral flowers with a short flowering period. 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 2020-21

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., *Musaacuminate* Colla., *Musabalbisiana* 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 great detail. 27 herbarium specimens of Genus *Musa* were examined and identified into 3 species (*Musaacuminate* Colla., *Musabalbisiana* Colla. & and *Musa indandamansis* L.J. Singh). All the identified/determinavited specimens were incorporated into the herbarium (PBL). Wild germ plasm of 03 species of *Musa* (*Musaacuminate* Colla., *Musabalbisiana* Colla. & and *Musa indandamansis* L.J. Singh) was collected and introduced in the Garden has a part of ex-situ conservation. Besides, also collected germplasm of 21 species of Rare & threatened and endemic plants and introduced in garden. Raised nursery of 9 species as a part of ex-situ conservation. 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* (*Musaacuminate* Colla., *Musabalbisiana* 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 described for the first time. Population Assessment of *Musa paramjitiana* L.J. Singh (*Musaceae*): a critically endangered, endemic species in Andaman & Nicobar Islands, India have been described for the first time. 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.

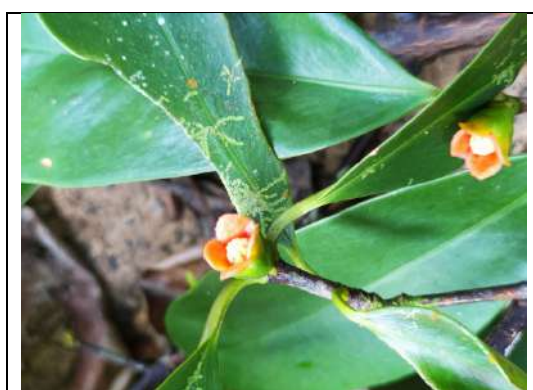
PROJECT - 2

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

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

Date of Initiation : April, 2018

Date to be completion : Ongoing



Garciniadhanikhariensis S.K. Srivast.

OBJECTIVES

Recording of flowering and fruiting 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 at 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.

SUMMARY OF THE WORK DONE & ACHIEVEMENTS/ OUTCOMES:

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 2020-21

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 2020-21

During the course of study 7 species [*Pyrenula aggregataspistea* Aptroot & Cáceres, *Pyrenula ciliata* 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 2020-21

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* (Rchb.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.

	
<p><i>Manilkara littoralis</i> (Kurz) Dubbard - plated in nursery</p>	<p>Seedlings collection in field</p>

NEW DISCOVERIES:

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.



Rivina andamanensis L. J. Singh & M. Chennakesavulu Naik

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.



Dendrophthoe gamblei L.J. Singh, V. Ranjan, Rasingam and J. Swamy

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. *Abrahamia* 5(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

Andaman and Nicobar Regional Centre, BSI, Dhanikhari Experimental Garden cum Arboretum, Port Blair.

As part of ex-situ conservation of EET plants of Andaman and Nicobar Islands, several species are being collected and introduced in the Dhanikhari Experimental Garden cum Arboretum. Some of the plant species are: *Musa acuminata* Colla., *Musa balbisiana* 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 pseudosquarrosum* 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

Book Published:

1. SINGH L. J. AND V. RANJAN (eds.). 2021. New Vistas in Indian Flora, Vol I. M/s *Bishen Singh Mahendra Pal Singh, 23 A Connaught Place, Dehra Dun 248001, Uttarakhand, INDIA.*
2. SINGH L. J. AND V. RANJAN (eds.). 2021. New Vistas in Indian Flora, Vol II. M/s *Bishen Singh Mahendra Pal Singh, 23 A Connaught Place, Dehra Dun 248001, Uttarakhand, INDIA.*

Paper Published:

KAMBLE, M.Y. AND C.P. VIVEK. 2020. Grasses of six Wildlife Sanctuaries in North Andaman Islands, India. *Journal of Non-Timber Forest Products* 26(4): 167–174.

KULLOLI R.N. AND C.S. PUROHIT 2020. *Habenariagibsoniivar.foetida*(Orchidaceae):Anadditionto thefloraofRajasthan. *Species*, 21(67), 202-207.

KULLOLI R.N., C.S. PUROHIT, V. MAINA AND B. KARI. 2020. Recollection of Critical Endangered Plant *Ceropegia odorata* Nimmo ex J. Graham (Asclepiadaceae) after 128 years from Mount Abu wildlife sanctuary, Rajasthan, India. *Journal of New Biological Reports* 9(3): 277 – 280.

KULLOLI R.N., C.S. PUROHIT AND S. KUMAR, 2020. *Aloe trinervis*. *The IUCN Red List of Threatened Species*.

KUMAR S., C.S. PUROHIT AND R.N. KULLOLI. 2020. *Aloe trinervis* sp. nov. A new succulent species from Indian Desert (Asphodelaceae). *Journal of Asia Pacific Biodiversity* 13(2): 325 – 330. <https://doi.org/10.1016/j.japb.2020.03.001>.

MISHRA SANJAY, J.S. JALAL, C.P. VIVEK AND L.J. SINGH. 2020. Two new species of *Luisia* (Vandaeae, Orchidaceae) from the Andaman and Nicobar Islands, India. *Phytotaxa* 453 (3): DOI: <https://doi.org/10.11646/phytotaxa.453.3.7>.

MISHRA SANJAY, J.S. JALAL, C.P. VIVEK , G.A. EKKA, D.K. AGRAWALA AND L.J. SINGH. 2020. A Note on the Occurrence of *Luisia unguiculata* (Orchidaceae) in Andaman and Nicobar Islands, India. *Nelumbo* 62 (1): 50–53. DOI:10.20324/nelumbo/v62/2020/152396.

NAIK M.C AND L.J. SINGH. 2020. *Desmodium heterocarpon* subsp. *Ovalifolium* addition to the flora of India from South Andaman Islands, India. *Species* 22(69), 80-83.

NAIK M.C., L.J. SINGH, G.A. EKKA AND VIVEK C.P. 2020. Addition of four species to the flora of Andaman Islands, India. *Journal of Threatened Taxa* 13 (2): 17843-17846.

NAIK, M. C. AND LAL JI SINGH. 2020. Two legume species additions to the flora of Andman & Nicobar Islands, India. *Abrahamia* 5(1): 1-4.

NAIK, M.C., LAL JI SINGH AND GANESHAISH K.N. 2020. Floristic Diversity and Analysis of South Andaman Islands (South Andaman District), Andaman and Nicobar Islands, India. *Species* 21(68): 343-409.

PUROHIT C. S. 2020. *Dalechampia* & *Micrococoa* – Two generic addition for flora of Aravallirange, India with Status of Family-Euphorbiaceae of Todgarh-Raoli wildlife sanctuary, Rajasthan, India. *JNew Biol Rep* 9 (2): 209– 219.

PUROHIT C.S. 2020. New population records of an Endemic plant- *Melhania magnifolia* Blatt. & Hallb. from Todgarh-Raoli wildlife sanctuary, Rajasthan. *Species*, 21(68): 306-315.

PUROHIT C.S. 2020. Ethno-medicinal and Economic Plants of Todgarh-Raoli wildlife sanctuary, Rajasthan – A Review. In: Souvenir of International Webinar on “Global Environmental Challenges, Biodiversity, Principles of Guru Jambheshwar Ji and Remedies” organized by JNVU, Jodhpur and Jambhani Sahitya Academy, Bikaner page no. 54 – 66.

PUROHIT C.S. 2020. *Ipomoea sagittifolia* Brum. f.- Addition for Flora of Rajasthan and Status of family Convolvulaceae in Todgarh-Raoli Wildlife Sanctuary, Rajasthan. *Int. J. Sci. Res. Sci. Technol.* 7(3): 49 – 65.

PUROHIT C.S. 2020. Seven families addition under class Polypetalae for flora of Todgahr-Raoli wildlife sanctuary, Rajasthan. *Indian Journal of Arid Horticulture* 1(2): 91 – 95.

PUROHIT C.S. 2021. Diversity study of grasses in Rajasthan Desert. In: *New Vistas in Indian Flora* (Eds.: L. J. Singh & V. Ranjan), M/S Bishen Singh Mahendra Pal Singh, Dehradun, India, Vol. II: 691 – 706.

PUROHIT C.S. AND L.J. SINGH. 2021. Status, Distribution and GIS mapping of Threatened and Endemic plants of Shingba Rhododendron Sanctuary, Sikkim. In: *New Vistas in Indian Flora* (Eds.: L. J. Singh & V. Ranjan), M/S Bishen Singh Mahendra Pal Singh, Dehradun, India, Vol. II: 747 – 760.

PUROHIT C.S. AND R. KUMAR. 2020. A review on genus *Calligonum* L. (Polygonaceae) from India and report *Calligonum crinitum* an addition for Flora of India. *Journal of Asia Pacific Biodiversity* 13(2): 319 – 324. <https://doi.org/10.1016/j.japb.2020.03.002>.

PUROHIT C.S., K. JAIN AND MERUSIKHA. 2020. *Cucumis sativus* forma *hardwickii* – New Record for Rajasthan with status of family Cucurbitaceae of Todgarh-Raoli wildlife sanctuary, Rajasthan. *Species*, 21(68): 410 – 423.

PUROHIT C.S., M. SINGH AND A. BHARTI. 2020. New addition of two IUCN Red Listed bird species of Order: Gruiformes for Todgarh-Raoli Wildlife Sanctuary, Rajasthan, India. *International Journal of Zoology Studies* 5(4): 28 – 29.

PUROHIT C.S., M. SINGH, P. SINGH AND A. BHARTI. 2020. Asian Pied Sterling: A new addition to Avian diversity of Todgarh-Raoli wildlife sanctuary, Rajasthan, India. *Journal of New Biological Reports* 9(2): 259 – 261.

PUROHIT C.S., R.N. KULLOLI AND V. MAINA 2020. Rajasthan Marusthal mein Vilupt Prayash Padap Prajatiyan – Sarakshan avum Samvardhan. In Souvenir of International Webinar on “Global Environmental Challenges, Biodiversity, Principles of Guru Jambheshwar Ji and Remedies” organized by JNVU, Jodhpur and Jambhani Sahitya Academy, page no. 75 – 78.

PUROHIT C.S., R.N. KULLOLI, V. MAINA, R. KUMAR AND B. KARI. 2020. A little known orchid *Habenaria longicorniculata* (Orchidaceae) from Mount Abu wildlife sanctuary, Rajasthan and its IUCN status. *Journal of New Biological Reports*. 9(3): 299 – 305.

SINGH L.J., G.A. EKKA, VIVEK C.P. AND D.R. MISRA. 2021. Gymnosperms of the Andaman and Nicobar Islands, India: An Overview. In: *New Vistas in Indian Flora* (Eds.: L. J. Singh & V. Ranjan), M/S Bishen Singh Mahendra Pal Singh, Dehradun, India, Vol. I: 267-280.

SINGH L.J., V. RANJAN, B.K. SINHA, S. MISHRA, C.S. PUROHIT, VIVEK C.P., M.C. NAIK AND G.A. EKKA. 2021. An overview of Phytodiversity of the Andaman and Nicobar Islands, India. In: *New Vistas in Indian Flora* (Eds.: L. J. Singh & V. Ranjan), M/S Bishen Singh Mahendra Pal Singh, Dehradun, India, Vol. I: 383 – 402.

SINGH, L.J. AND M.C. NAIK, 2020. *Rivina andamanensis* (Petiveriaceae): a new species from Andaman and Nicobar Islands, India. *Journal of Asia-Pacific Biodiversity* 13: 482- 486.

SINGH, L.J., V. RANJAN, L. RASINGAM AND J. SWAMY. 2020. A new species of genus *Dendrophthoe* Mart. (Loranthaceae-Loranthaceae) from the Peninsular India. *Journal of Asia-Pacific Biodiversity* 13:487-49.

SINGH, LAL JI MAYANK D. DWIVEDI, SHRUTI KASANA, MUDAVATH C. NAIK, GAUTAM A. EKKA AND ARUN K. PANDEY. 2020. Molecular systematics of the genus *Musa* L. (Zingiberales: *Musaceae*) in Andaman and Nicobar Islands. *Biologia* 75, 1825–1843. <https://doi.org/10.2478/s11756-020-00552-5>.

SINGH, LAL JI, GAUTAM ANUJ EKKA, SANJAY MISHRA, C.P. VIVEK, V. SHIVA SHANKAR, M.C. NAIK AND FOUZIYA SALEEM. 2020. Habitat status of *Musa paramjitiana* L.J. Singh (Musaceae): a critically endangered, endemic species in Andaman & Nicobar Islands, India. *Pleione* 14(1): 121–127.

SRIVASTAVA NITISHA AND L.J. SINGH. 2021. Diversity of Natural Dye Yielding Plant wealth of India. In: *New Vistas in Indian Flora* (Eds.: L. J. Singh & V. Ranjan), M/S Bishen Singh Mahendra Pal Singh, Dehradun, India, Vol. I: 313-322.

VIVEK, C.P., S. MISHRA, G. A. EKKA AND L. J. SINGH. 2020. *Arthraxon hispidus* (Poaceae): A new record for Andaman and Nicobar Islands, India. *J. Econ. Taxon. Bot.* 43 (1-4): 58-59.

YADAV R.B., A. KUMAR, S.K. VERMA AND L.J. SINGH. 2021. Weed Flora of Uttar Pradesh, India. In: *New Vistas in Indian Flora* (Eds.: L. J. Singh & V. Ranjan), M/S Bishen Singh Mahendra Pal Singh, Dehradun, India, Vol. II: 519-528.

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.
- Organized 74th Independence Day Flag Hoisting celebration at BSI, ANRC, Port Blair on 15.08.2020.
- Organised Hindi Fortnight at BSI, ANRC, Port Blair from 01.09.2020 to 15.09.2020.
- Organised celebration of Hindi diwas on 14.09.2020
- 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.
- Organized 72nd Republic Day Flag Hosting celebration, 2021 at BSI, ANRC, Port Blair on 26.01.2021.
- Organised Official Hindi Council meeting on 25.08.2020, 14.12.2020 and 08.03.2021.
- 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.
- Hoisted National Flag on the occasion of 74th Independence Day, 2020 along with officers and staffs, at BSI, ANRC, Port Blair on 15.08.2020.
- Attended 74th Independence Day Flag Hoisting celebration at Netaji Subhash Chandra Bose Stadium, Port Blair on 15.08.2020.
- 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 celebration of Hindi diwas at BSI, ANRC on 14.09.2020.
- 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 the Anniversary of Fifteen Year of Tsunami 2004 held at the Tsunami Memorial situated at Andaman Water Sports Complex, Aberdeen on 26.12.2020.
- 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 Ph.D. synopsis presentation of Miss Oishinee Chakraborty, Research Scholar, ZSI, Port Blair topic entitled “*Studies on the Shallow-Water Hydroids (Cnidaria: Hydrozoa) of the Orders Anthoathecata Cornelius, 1992 and Lepthoathecata Cornelius 1992 from Andaman and Nicobar Islands*” on 25.02.2021.
- Attended Ph.D. Synopsis presentation of Miss Minakshi Dash, Research Scholar, ZSI, Port Blair topic entitled “*Taxonomy and Ecology of Spiders of Andaman & Nicobar Islands, India*” on 25.02.2021.
- 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 Foundation Stone Laying Ceremony of Visiting Scientists Hostel, Zoological Survey of India, Port Blair by Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata in the presence of Shri D.M. Shukla, IFS, PCCF (Wildlife) & Chief Wildlife Warden, Department of Environment and Forests, Andaman and Nicobar Islands on 12.03.2021.
- 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.
- Felicitated Dr. P.V. Prasanna, Scientist-G and Head of Office, BSI, DRC, Hyderabad during office and garden visit on 16.03.2021 and 18.03.2021 respectively.
- Felicitated Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata and Dr. C. Sivaperman, Officer-in-charge, ZSI, Port Blair during office and garden visit on 18.03.2021.

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

- Attended National flag hoisting on the occasion of 74th Independence Day Celebrations at Main Office on 15.08.2020.
- 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 National flag hoisting on the occasion of 72nd Republic Day Celebrations at Main Office 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 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 entitled '*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 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 Foundation Stone Laying Ceremony of Visiting Scientists Hostel, Zoological Survey of India, Port Blair by Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata in the presence of Shri D.M. Shukla, IFS, PCCF (Wildlife) & Chief Wildlife Warden, Department of Environment and Forests, Andaman and Nicobar Islnds on 12.03.2021.
- 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 Islnds on 12.03.2021.
- 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 DISTRIBUTIONS

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.

REVENUE EARNING: Nil.

ANNUAL REPORT FORMAT FOR THE CIRCLE (2020-2021)

ARID ZONE REGIONAL CENTRE, JODHPUR

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 (First draft submitted)

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 2020-21:

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.

Achievements / outcomes in 2020-21:

Information regarding family Ebenaceae was updated as per flora of India format.

Final manuscript of Flora of India, volume 16 is under progress.

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

Executing Scientist: Dr. SrimanLalMeena, Sci.-E, Dr. Sanjay Mishra, Sci.-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 2020-21:

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.

Achievements / outcomes in 2020-21:

Final manuscript of Flora of India, volume 18 is under progress.

3.Project: 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 2020-21:

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: *Adenantha 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, *Phylla 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 laurifoliosus*, *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 laurifoliosus* (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 oojeinense*(Roxb.) H. Ohashi



Millettiapeguensis Ali



Desmodium oojeinense (Roxb.) H. Ohashi



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

D. 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 lebbek</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 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 laurifoliosus</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 pots</i>	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
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%
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New Discoveries:

New to Science:

a. *Aloe trinervis* sp. nov.: A new species from the Indian Desert.

b. Two new species of *Luisia* (Vandaeae, Orchidaceae) viz.

i. *Luisiadiglipurensis* 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. *Luisiajarawana* Sanjay Mishra & Jalal, sp. nov. This new species has been discovered and described based on the collection made on the way to Sagwan Nallah, Middle Andaman of Andaman & Nicobar Islands at 16 m altitude.

Rediscoveries:

i. *Luisiaunguiculata* (Orchidaceae) from Andaman of Andaman & Nicobar Islands.

Recollection:

i. *Ceropregiaodorata* Nimmo ex J. Graham, a Critically Endangered plant was collected after 128 years from Mount Abu Wildlife sanctuary, Rajasthan, India.

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:

Research Papers

1. PRASAD, R.,K.L. MEENA AND M.K. SINGHADIYA 2021. *Veronica polita* Fr. (Plantaginaceae) - an addition to the Flora of Western India from Sariska Tiger Reserve, Rajasthan. *Indian Forester* 147(2): 205–206.DOI: 10.36808/if/2021/v147i2/153126
2. SINGHADIYA,M.K. AND R. PRASAD 2020. Additions to the Flora of Sariska Tiger Reserve, Rajasthan. *Ind. J. Pure App. Biosci.* 8(6): 173–180.
3. PUROHIT, C.S., R.N. KULLOLI, R. KUMAR, V. MAINA AND B. KARI 2020. A little known orchid *Habenarialongicorniculata*(Orchidaceae) from Mount Abu wildlife sanctuary, Rajasthan and its IUCN status. *Journal on New Biological Reports* 9(3) 299 – 305.
4. KUMAR, S., C.S. PUROHIT AND R.N. KULLOLI 2020. *Aloe trinervis* sp. nov.: A new species from the Indian Desert. *Journal of Asia-Pacific Biodiversity.* 13. 10.1016/j.japb.2020.03.001.
5. KULLOLI, R.N., C.S. PUROHIT,V. MAINA AND B. KARI 2020. Recollection of Critically Endangered plant *Ceropregiaodorata*Nimmo ex J. Graham (Asclepiadaceae) after 128 years from Mount Abu Wildlife sanctuary, Rajasthan, India.*J. New Biol. Rep.*9(3): 277–280.
6. KULLOLI, R.N. AND C.S. PUROHIT, 2020. *Habenariagibsonii* var. *foetida* (Orchidaceae): An addition to the flora of Rajasthan. *Species* 21(67), 202–207.
7. MISHRA, S., J.S. JALAL, C.P. VIVEK, G.A. EKKA , D. K. AGRAWALA AND L.J. SINGH 2020. A Note on the occurrence of *Luisiaunguiculata* (Orchidaceae) in Andaman and Nicobar Islands, India. *Nelumbo* 50–53. doi:10.20324/nelumbo/v 62/2020/152396.
8. Vivek, C.P., S. Mishra, L.J. Singh and G.A. Ekka 2020. *Arthraxonhispidus* (Poaceae): A new record for Andaman and Nicobar Islands, India. *J. Econ. Taxon. Bot.* 43(1–4): 58.
9. PEDDI H.K., J. SWAMY, V. MAINA AND R. KUMAR 2020. *Ocimumfilamentosum*Forssk. (Lamiaceae): A new distributional record for Rajasthan, India. *Indian Journal of Forestry* 42(4): 337-338.
10. MISHRA, S., J.S. JALAL, C.P. VIVEK, AND L.J. SINGH2020. Two new species of *Luisia* (Vandaeae, Orchidaceae) from the Andaman and Nicoba Islands, India. *Phytotaxa* 453 (3): 255–264.

Hindi Articles:

1. पुरोहित, सी.एस., आर. कुमारएवंवी. मैना

2020|भारतीयमरूस्थलमेंवानस्पतिकविविधताएवमृदुर्लभपादपोंकासंरक्षण|अभिनवभारत177-182।

Book(s)

1. CHAKRABARTY, T., V. Maina AND M. C. 2021. *Ethnobotany of Jarawa Tribe of Andaman Islands* (with an appendix on typification and taxonomic notes). Chakrabarty Traders, Howrah, West Bengal. pp.1-128.

Book Chapter

1. MEENA, S.L., S. MISHRA, H.K. PEDDI AND V. MAINA 2019. An Outline of Angiospermic Diversity of Gujarat State, India. *New Vistas in Indian Flora* (Vol. II): pp. 541-564 (Eds. L. J. Singh & V. Ranjan).
2. SINGH, LALJI, VINAYRANJAN, B. K. SINHA, S. MISHRA, C.S. PUROHIT, VIVEK C.P., M.C. NAIK AND G.A. EKKA 2019. An Overview of Phytodiversity of the Andaman and Nicobar Islands, India. *New Vistas in Indian Flora* (Vol. I): pp. 383-402 (Eds. L. J. Singh & V. Ranjan).

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, Bangaluru 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 BrajeshMeena, 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. ShandhyaShekhar, 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, Nauli 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 “Micropropogation of threatened plant species and conservation in India” organized by Botanical Survey of India, High Altitude Western Himalayan Regional Centre, Nauli 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 Hydrabad. 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.
- iii. All officers and staff participated in Vigilance Awareness Week 2020 [27th October to 2nd November, 2020].

➤ **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 an 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 an 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 an 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 and generated 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):

Sl. No.	Herbarium Maintenance	AZRC 2020-21
1	No. of Specimens mounted/remounted/labeling	00/00/150
2	No. of Herbarium sheets stitched/ Re-stitching/poisoned/Fumigated	225/00/00/00
3	No. of Herbarium sheets accessioned	5691
4	No. of Herbarium sheets incorporated	5813
5	No. of specimens sent on loan	00

6	No. of loaned specimens received/ Returned on exchange/gift	00
7	No. of Specimens identified (In house)	100
8	No. of Specimens identified for visitors	38 and generated the revenue of rupees 6450/-
9	No. of Genus / species covers changed	209/347
10	No. of species segregated	0
11	Documentation of existing herbarium sheets at herbaria/ Entry of existing herbarium sheets in Excel format/ Field written	1160

Herbarium Digitization (2020-21): Yet to be initiated.

ACTIVITIES OF RESEARCH FELLOW

Junior Research Fellow, BSI, AZRC, Jodhpur

(Reporting Period: 2020-21)

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
3. Date of completion of the Project: 6th June 2022
4. **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.

5. Area and locality of the Allotted Project (with reference Map):Rajasthan and Gujarat

6. Summary of the work done during 2020-2120 (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.


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:</p> <p>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, APCR, Itanagar. He has completed all 155 species belonging to 19 genera) (Total 19 genera) from Pteridaceae Family. Detail is given below of Pteridaceae family:</p> <p>AcrostichumL. (1 species), Actiniopteris Link (1 species), Adiantum L. (26 species), Aleuritopteris Fee (19</p>

	<p>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 along with 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 consist of more than 654 species of ferns and Fern allies under 94 genera belonging to 32 families.</p> <p>Area and locality: Entire Arunachal Pradesh.</p> <p>Summary of Work done: Listed and documented 311 species along with 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>Details is given below.</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:</p> <p>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>Area and locality: Entire Arunachal Pradesh</p> 
<p>Phyto-taxonomic studies in selected High AltitudeWetlands (HAWs) and its environs</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,</p>

<p>representing 5 districts of Arunachal Pradesh.</p> <p>Dr. M. R. Debta, Scientist-C.</p> <p>August 2020 – March 2023</p>	<p>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 herbarium specimens. Relevant literatures were 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 Stylidiaceae, Goodeniaceae, Lobeliaceae, Sphenocleaceae, Clethraceae, Pyroliaceae, 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:</p> <p>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>Stylidiaceae</td> <td>1</td> <td>2</td> <td>2</td> <td>0</td> <td>0</td> </tr> </tbody> </table>	Families	Number of Genera	Number of Taxa	Number of Species	Number of subspecies	Number of varieties	Stylidiaceae	1	2	2	0	0
Families	Number of Genera	Number of Taxa	Number of Species	Number of subspecies	Number of varieties								
Stylidiaceae	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
Materials of the Flora of Arunachal Pradesh Vol. 4. Dr.Umeshkumar L. Tiwari, Scientist-C October 2020 – March 2021	<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>Area and locality: Entire Arunachal Pradesh.</p> <p>Summary of Work Done:</p> <p>Manuscript prepared for: 42 Families, 133 genera and 319 taxa recorded (Final list 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 Dr.Umeshkumar L. Tiwari, Scientist-C	<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>Aræ and Locality: Entire India under Flora of India Project.</p>					

Sep. 2020–Dec 2021

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:

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

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. *Tubocapsicum anomalum*, *Meconopsis merakensis* var. *merakensis*, *Cardamine trifoliolata*, *Elatostema cyrtandrifolium*, *Pilea medogensis*, *Salvia campanulata* var. *codonantha* (new record for India), *Strobilanthes mastersii* and *Strobilanthes oxycalycina*. Among these 2 taxa addition to the flora of India and 8 new addition to the state flora of Arunachal Pradesh.


Materials of the Flora of Arunachal Pradesh, Vol. 4.

Dr. K. Chowlu, Scientist-C.

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.

Area and locality: Entire Arunachal Pradesh

<p>April 2019-March 2021</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 literatures.</p> <p>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 & Rchb. 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>Rhynchostylis 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.) Rchb. 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 pannea</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 :

PUBLISHED:

1. PUSHPESH JOSHI, V. K. RAWAT, BRIJESH KUMAR, HIMANSHU DWIVEDI. Taxonomic studies of genus *Goniophlebium* and *Selliguea* of District Tehri Garhwal, Indian Central Himalaya. *Bull. of Arunachal Forest Research* 1-10 Vol 34 (Issue 1&2): 2019.
2. BENNIAMIN, M. SHUNMUGA SUNDARI, V.K. RAWAT. *Polystichum tangmaeinse* (Dryopteridaceae) – A threatened fern from Arunachal Pradesh. *Bull. Of Arunachal Forest Research* 11-17, Vol 34 (Issue 1&2): 2019.
3. UMESHKUMAR L. TIWARI, V.K. RAWAT. Some addition to the flora of Arunachal Pradesh and India. *Bull. of Arunachal Forest Research*. **29-33**. Vol 34 (Issue 1&2): 2019.
4. KRISHNA CHOWLU, A.N. RAO, MANAS R. DEBTA AND V. K. RAWAT. 2020. *Eulophiapromensis* (Orchidaceae) – An addition to the flora of Manipur, India. *Richardiana* 4: 232-237.

5. SONI, A. K., M. R. DEBTA & V. K. RAWAT. 2020. An Overview of Family Pteridaceae in North East India. *Indian Fern Journal*. 37: 277-287.
6. SONI, A. K. & V. K. RAWAT. 2020. A New subspecies Record for the Pteridophytic Flora of Arunachal Pradesh, India: *Hypodematum crenatum* (Forsk.) Kuhn subsp. *crenatum* (Dryopteridaceae). *Indian Fern Journal*. 37: 288-292.
7. SONI, A. K. & V. K. RAWAT. 2020. *Lindsaea heterophylla* (Lindsaeaceae) A New Record for The Eastern Himalaya, Pteridogeographical Region of India. *Indian Fern Journal*. 37: 293-298.
8. BRIJESH KUMAR, PUSHPESH JOSHI, HIMANSHU DWIVEDI AND V. K. RAWAT. 2020. An Analysis of Pteridophytic Flora of Jammu and Kashmir State. *New Vistas in Indian Flora*. Edited by Singh L. and V. Ranjan. Bishen Singh and Mahendra Pal Singh. 2020.
9. SACHIN M PATIL, VINAY M. RAOLE, V. K. RAWAT AND KISHORE S. RAJPUT. 2020. Diversity, Distribution and Conservation status on the Genus *Tectaria* Cav. From Eastern Himalaya and North East India. *Pleione*. East Himalayan Society for Spermatophyte taxonomy. for 14 (2) issue.
10. Krishna Chowlu, A.N. Rao, Manas R. Debta and Vineet K. Rawat (2020). *Eulophia promensis* (Orchidaceae) – An addition to the flora of Manipur, India. *Richardiana* 4: 232-237.
11. Ashish K. Soni, Manas R. Debta and Vineet K. Rawat (2020). An overview of family Pteridaceae in North East India. *Indian Fern. J.* 37: 277-287.
12. KRISHNA CHOWLU, A. NAGESWARA RAO, MANAS R. DEBTA & V. K. RAWAT. *Eulophia promensis* (Orchidaceae)-An addition to the flora of Manipur, India. *Richardiana*. 4 (12): 232-237. 2020.
13. KRISHNA CHOWLU, A. NAGESWARA & CHAYA DEORI. Synopsis of *Eulophia* R.Br. (Orchidaceae) in Manipur (India) with a new distributional record to the state *Pleione* 14 (2): 361-366. 2020.
14. KRISHNA CHOWLU, A. NAGESWARA RAO & R. MAITY. 2020. Two additions to the orchid flora of Manipur, India. *Richardiana*. 4 (9): 139-146.
15. RATHI R.S., K.C. BHATT, A. PANDEY, U.L. TIWARI, K. PRADHEEP, N.S. PANWAR AND S.P. AHLAWAT (2020). *Tubocapsicum anomalum* (Franch. & Sav.) Makino: A New Record to the Flora of Arunachal Pradesh, India. *Indian Journal of Plant Genetic Resources* 33(1): 115–118.
16. KANWAL K.S., U.L. TIWARI, M.S. LODHI & R.S. RAWAL (2020). *Meconopsis merakensis* var. *merakensis* (Papaveraceae), a new record for India. *Rheedea* 30(3): 391–395.
17. TIWARI, U.L. & V.K. RAWAT 2019. (pub. 2020). Some addition to the flora of Arunachal Pradesh and India. *Bulletin of Arunachal Forest Research* 34(1&2): 29–33.

COMMUNICATED :

1. Vineet K. Rawat and Manas R. Debta. Aesthetic ferns and fern-allies having horticultural potential from Arunachal Pradesh, India. communicated to *Bulletin of Arunachal Forest News*.
2. Umeshkumar L. Tiwari and Manas R. Debta. *Adenosmaglandulifera*- A new species form Arunachal Pradesh, India. communicated to *Phytotaxa*.

3. BOOK CHAPTER PUBLICATIONS :

1. Manas R. Debta and K. Ambrish. 2021. *Vegetation and Floristic Analysis in Col. Sher Jung National Park, Sirmour district, Himachal Pradesh*. In L.J. Singh & V. Ranjan (eds.), *New Vistas in Indian Flora 2*: 613-638.

4. ABSTRACT SUBMITTED :

1. Manas R. Debta, K. Chowlu & V.K. Rawat. Family Rosaceae in Uttarakhand Himalaya. Submitted for the conference to be held at Rajiv Gandhi University, Itanagar under the banner of EHSST on 24.04.21.
2. K. Chowlu, Manas R. Debta & V.K. Rawat. The genus *Bulbophyllum* in Arunachal Pradesh. Submitted for the conference to be held at Rajiv Gandhi University, Itanagar under the banner of EHSST on 24.04.21.
3. K. Chowlu. 2021. Extended distribution of two endemic species of Arunachal Pradesh. *The Orchid Society of India*. 26 pp.
4. K. Chowlu, Manas R. Debta & V.K. Rawat. The genus *Bulbophyllum* in Arunachal Pradesh. Submitted for the conference to be held at Rajiv Gandhi University, Itanagar under the banner of EHSST on 24.04.21.
5. Send abstract on “A diverse endophytic fungal community associated with *Dendrobium* (Orchidaceae) roots confers an ecological relationship as indicated by their metabolic profile” for *Pleione* organized in collaboration with Rajiv Gandhi University and Botanical Survey of India.

ANY OTHER INFORMATION NOT MENTIONED ABOVE :

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.

The incumbent has also finalized following reports as **HOO** of the centre.

1. Finalized a report on the total expenditure incurred by this office towards purchasing of sanitizer, handwash, masks and canned sanitizer for office cleaning in response to a query raised by Rajyasabha starred/unstarred diary No-U348, in response to a query raised by Loksabha diary No-8353 regarding number and name of GSDP trainees, employment of the students enrolled under GSDP, Submitted a write up for Annual report mentioning details of important activities, progress/achievements, promulgation of new Acts/Rules, major publications, etc. to HQ, BSI for onward transmission to the MoEF& CC., Submitted report w.r.t. total number of projects executed, number of outreach activities, skill development courses, total number of seminar and symposia organized, publication in peer reviewed journal to a query by the Principal Scientific Advisor.

In addition to the above, the incumbent has also discharged following **administrative duties**.

- (a) Discharged the **Duties of HOO** and monitoring overall activities including Annual Action Plan Projects, Budget related issues, CPWD issues, land matters as HOO of APRC.
- (b) Attended all virtual Meeting organized by HQ in concern to overall progress Report of AAP and Herbarium Data progress report of APRC.
- (c) Celebrated all the events at APRC time to time as Swachhta Pakhwara in January Month, International Day of Forest on 21 March, Earth day on 22 April, 5 June 2020-World Environment Day 2020, Van Mahotsav wef 1 to 7 July, Hindi Saptah wef 14-20 September, Ozone Day on 16 September with Ozone for life theme, World Himalayan day on 9 September and attended several Webinar organized by BSI and other Deptt..

- (d) Attended all meeting at PCCF office in concern to Biodiversity Board (Dihang Dibang Biosphere Reserve: DDBR and Research advisory committee meeting, Meeting in G B Pant Institute, Regional Institute of Ayurveda, SFRI, state Medicinal plant Board, People Biodiversity Register (PBR meeting) etc.
- (e) Data filled and Accessioned 132 herbarium sheets in Herbarium.
 - (f) Organized several one day field tours to Senki View foot Hills in Papum Pare District for germplasm collection of Ferns along with Photographs.
 - (g) Overall monitoring of the **DDO work** and monitoring all budget related work, payment of salaries, bills, contractual payments, NPS operations, GPF withdrawal, and issuance of transfer related formalities, etc.
 - (h) Overall monitoring of **Herbarium maintenance** 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.
 - (i) Overall monitoring of **Purchase Committee** and looking after all purchase and procurement of office equipments, **Garden maintenance, website updation, Eastate related work, Hindi Rajbhasha, GEM work.**

Miscellaneous work done

- Organized the meeting of Quarterly Hindi Rajbhasha Committee., International Biodiversity Day on 22nd May, World Environment Day on 5th June, all programs organized on the occasion of Hindi Pakhwada, Attended virtual Foundation Day celebration of BSI on 13th February 2021, Attended training programme on BSI website content management on 5th and 6th Oct. 2020, Attended a virtual meeting on MIS updation on 8th October 2020.

Dr Manas R. Debta, Scientist-C

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.

The incumbent has also prepared following reports as Technical Incharge of the centre.

2. Prepared a technical report on Research Information for the decade 2010 to 2020 in respect of APRC, Itanagar for submission to the Planning Secretary, Itanagar in July 2020.
3. Prepared a report on the total expenditure incurred by this office towards purchasing of sanitizer, handwash, masks and canned sanitizer for office cleaning in response to a query raised by Rajyasabha starred/unstarred diary No-U348.
4. Prepared a report in response to a query raised by Lok Sabha diary No-8353 regarding number and name of GSDP trainees, employment of the students enrolled under GSDP.
5. Prepared a database on the list of invasive alien plant species of Arunachal Pradesh under SDG 15.8 for submission to HQ, BSI.
6. Submitted a write up for Annual report mentioning details of important activities, progress/achievements, promulgation of new Acts/Rules, major publications, etc. to HQ, BSI for onward transmission to the MoEF& CC.
7. Submitted report on Innovation Excellence Indicators for BSI, APRC in response to a query by the Principal Scientific Advisor at the instance of PMO.
8. Submitted report w.r.t. total number of projects executed, number of outreach activities, skill development courses, total number of seminar and symposia organized, publication in peer reviewed journal to a query by the Principal Scientific Advisor.
9. Compiled and submitted a list of publications made in the last years (2017-18, 2018-19, 2019-20) in response to a query by the Principal Scientific Advisor at the instance of PMO.
10. Attended a Buyer-Seller meet on 26th March 2021 organized by State Medicinal Plant Board, Arunachal Pradesh and provided necessary inputs.

In addition to the above, the incumbent has also discharged following administrative duties.

- (h) Discharged the duty of Head of Office-I/C in the absence of regular HOO w.e.f. 22.10.2020 to 27.11.2020 and from 24.03.2021 to 04.04.2021.
- (i) Discharging the duty of DDO since September 2020 and monitoring all payment of salaries, bills, contractual payments, NPS operations, GPF withdrawal, and issuance of transfer related formalities, etc.
- (j) 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
- (k) Acting as Chairman, Purchase Committee and looking after all purchase and procurement of office equipments.
- (l) Acting as Garden Incharge; initiated introduction of live plants into the garden, especially zingibers and orchids.
- (m) Acting as Incharge of Website updation in respect of BSI, APRC, Itanagar.
- (n) Carried out the duties of Estate Officer for BSI, APRC and looking after matters related to land encroachment, outsourcing of staff, safety and security of residential campus and office.

Miscellaneous work done

- Attended the meeting of Quarterly Hindi Rajbhasa Committee.

- Attended the program on International Biodiversity Day on 22nd May.
- Attended programme on World Environment Day on 5th June.
- Attended all programs organized on the occasion of Hindi Pakhwada.
- Attended virtual Foundation Day celebration of BSI on 13th February 2021.
- Attended training programme on BSI website content management on 5th and 6th Oct. 2020.
- Attended a virtual meeting on MIS updation on 8th October 2020.

Dr. Krishna Chowlu, Scientist-C

Symposium/ Conferences/ Workshop/ Webinar Attended:

- 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.

The incumbent has also prepared following reports as Technical Incharge of the centre.

11. Had regular discussion with the chairman of the Organizing Committee of Pleione seminar regarding the Seminar arrangement and management of the Seminar.
12. Went to DBT-APSCS & T centre Kemin and had discussion with the Project Director of DBT-APSCS&T Centre Kemin regarding the setup of the orchidarium and helped in identification of orchids.
13. Planted orchid in the garden brought from Sagali and Jotte Village, especially *Dendrobium aphyllum*, *Eria arunachlensis*, *Bulbophyllum piluliferum*, *Geodorum densiflorum*, *Acampe papillosa*, *Eria pannea*, etc.
14. Acting as Incharge of Website updation in respect of BSI, APRC, Itanagar.
15. Carried out the duties of Campus for BSI, APRC and looking after matters related to water problems, land encroachment, and discussed with the DC, Itanagar.
16. Serve as DDO for the month of March 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.
6. Acting as member of website updation of APRC.
7. Looking after all the CPWD related matters, land encroachment and land lease related matters.
8. Maintaining the leave records of all the employees of BSI, APRC.
9. Participated in World Environment Day celebrated at APRC.
10. Participated in International Day of Yoga celebrated at APRC.
11. Performing the duty as member of purchase committee, garden development committee etc.
12. Compiled monthly reports for every month and other technical reports of BSI, APRC.
13. Participated in Hindi Pakhwada programs organized in September, 2020 at APRC.
14. Attended virtual Foundation Day of BSI on 13th February, 2021.
15. Reporting of APAR for Group-C employees of BSI, APRC.
16. Participated in BSI website content management training through video call conducted by NIC w.e.f. 05-10-20 to 06-10-20.
17. Participated in MIS training conducted by BSI through video call on 08-10-20.
18. Participated in World Ozone Day celebration at BSI, APRC on September 16, 2020.

19. Participated in cleanliness drive organized in collaboration with G.B. Pant National Institute of Himalayan Environment (GBPNIHE), Itanagar on 24-09-2020.

20. Assistance provided to Head of Office, other scientists and administrative staff in various administrative and scientific works.



Impatiens latiflora



Satyrium nepalense



Davallia assamica



Pteris cretica

CENTRAL BOTANICAL LABORATORY, HOWRAH

ANNUAL PROGRESS REPORT (2020-2021)

4. Name of the Project : **Ethnobotanical study of some tribal populated districts of Bihar, India**

5. Executing Scientist (s) : Dr. K.A.A. Kabeer, Sri A.C. Halder, Dr. R. Saravanan
Dr. M. Mishra & Dr. P. A. Dhole

6. Duration of the project : 36 months (April 2018 to March 2021)

7. About the work done :

7.1 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.

7.2 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.

7.3 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.

7.4 Site of the study (with map) :



Fig. 1. ETHNOBOTANICALLY SURVEYED DISTRICTS OF BIHAR

7.5 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>.

b. New Methodology (if any) adopted : - Nil

7.6 Achievements including :

f. Total area covered : 13 districts

g. Number of tours undertaken : 7

h. Number of species collected : 1159

i. Number of species identified (with name) : NA

j. Number of species incorporated : In-progress

7.7 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).

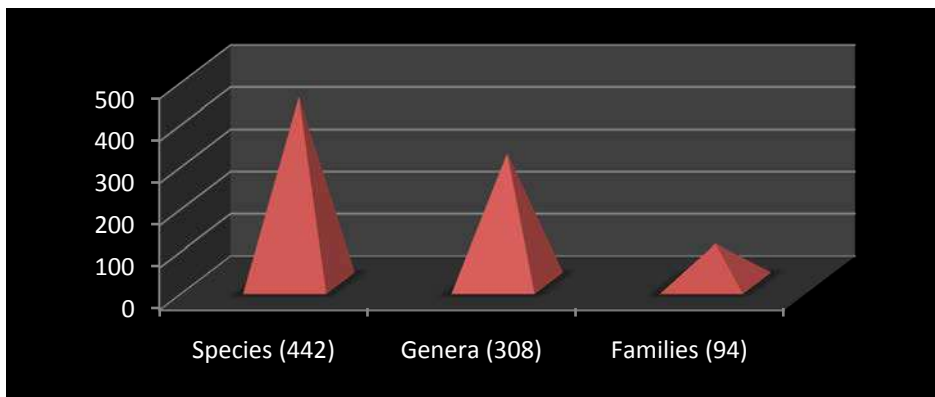


Fig. 1. TOTAL NUMBERS OF SPECIES, FAMILIES AND GENERA COLLECTED FROM BIHAR

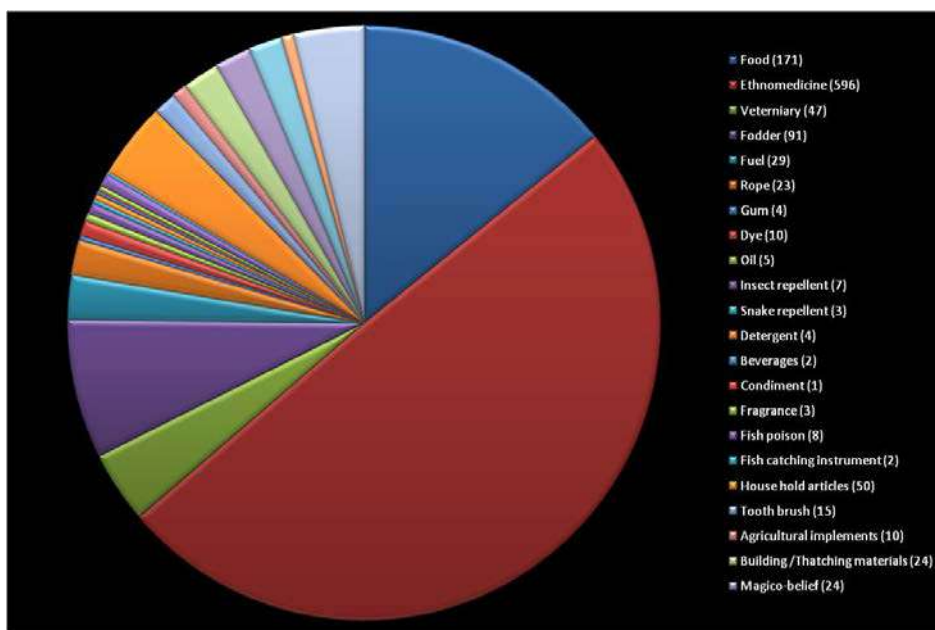


Fig. 2. USES WISE ETHNOBOTANICAL INFORMATION COLLECTED FROM BIHAR

A. Research Publications (in *Nelumbo* format)

Publication details

Published: 05

1. Singh H., M.Mishra & P. A. Dhole* (2019). *Abutilon pannosum* (G. Forst.) Schlet. (Malvaceae)- A New Addition to the Flora of Bihar, India. *Indian J. Forestry* 42(4): 105-106.
2. Singh H., M. Mishra & P. A. Dhole* (2020). Ethnomedicinal Plants Used by the Tribal Communities of West Champaran District of Bihar, India *Pla. Sci.* 3(4):38-44.
3. Singh H., M. Mishra & P. A. Dhole* (2020). Ethnomedicinal uses of plants from Kaimur and Rohtas districts of Bihar, India. *ETHNOBOTANY* vol. 30. 2018. Pp.10-21.

4. P. A. Dhole*. (2021). Wild edible plants with its socio-economic importance used by tribes of Gaya District, Bihar. *Int. J. Adv. Res. Biol. Sci.* 8(1): 51-58.

Accepted: 01

1. K. Althaf Ahamed Kabeer, A.C. Haldar & R. Saravanan. Ethnobotanical Study of Aurangabad and Nawada Districts of Bihar, India. *J. Econ. Taxon. Botany.*

Communicated: 02

1. कॉर्कॉरसओलिटोरियस- बिहारकेजनजातियोंद्वाराइस्तेमालकिएजानेवालाबहुउपयोगीपौधापी. ए. ढोले*, मोनिकामिश्र, आर. सरवननऔरहरीशसिंह
2. डेस्मोस्टेचियाबायपिन्नाटा (एल.) स्टैफ – बिहारराज्यमेंछप्परबनानेकेलिएउपयोगीघासए. सी. हलदर, आर. सरवनन, पी. ए. ढोले*, केअल्ताफअहमदकबीर

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

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:The genus *Impatiens* belongs to the family Balsaminaceae and occurs mostly in tropical and subtropical regions, growing in moist and shady places generally. In India, it is distributed well in Western Himalayas (North India), the hills of north Eastern States and Western Ghats (South India). *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). The chromosome data on plants, having relatively larger chromosomes, were used to construct karyotypes, which on the basis of symmetry and asymmetry relationships were utilized as taxonomic markers, and also to indicate the process and the direction of chromosomal evolution (Kumar & Subramaniam, 1986). 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.

Literature: However there are more than 1000 species of *Impatiens* are known, chromosome number of only 280 species have been worked out cytologically till date (Smith 1934; Jones & Smith 1966; Chinnappa & Gill 1974; Bhaskar 1976, 1980; Larsen 1981; Zinov'eva-Stahevitch & Grant 1984, 1985; Govindarajan & Subramaniam 1986; Rao *et al.* 1986; Ayyangar *et al.* 1987; Akiyama *et al.* 1992; Sugawara *et al.* 1994, 1997; Song *et al.* 2003; Singhal *et*

al. 2017). In case of *Impatiens* species found in India, till date chromosome counts are available for only 95 species from Eastern Himalaya (Chatterjee & Sharma, 1970; Sarkar *et al.*, 1973, 1980; Sharma & Ghosh, 1976), Kashmir Himalaya (Khoshoo, 1955, 1956, 1957, 1966; Koul & Gohil, 1973; Bhat *et al.*, 1975; Jeelani *et al.*, 2010), North-West Himalaya (Kaur & Singhal, 2010; Kumar & Singhal, 2011, 2016; Singhal *et al.*, 2017) and South India (Rao, 1973, 1975, 1978; Bhaskar, 1975, 1976, 1980; Bhaskar & Razi, 1974, 1976, 1978a, 1978b; Govindrajan & Subramanian, 1986; Rao *et al.*, 1986; Ayyangar *et al.*, 1987). This chromosomal information about the genus is far from satisfactory despite having the species richness in Indian flora. A perusal of literature shows that this genus is worked out cytologically (either through mitosis, meiosis or even by pollens mitosis) by several workers in the world time to time as evident from the data compiled for 189 species by Song *et al.* (2003). The different chromosome numbers reported in the genus are $2n = 6, 8, 10, 12, 14, 15, 16, 17, 18, 19, 20, 24, 26, 28, 30, 32, 34, 36, 40, 44, 48, 50, 56$ and 66 (Song *et al.*, 2003). The most frequent chromosome numbers reported are $2n = 14, 16, 18$ and $2n = 20$ covering 70% of the species known chromosomally (Yuan *et al.*, 2004). Variation in chromosome numbers within a taxon at different ploidy levels, viz. aneuploidy, euploidy, polyploidy, dysploidy etc. helps in understanding dominance pattern, endemism, intraspecific variations and invasive nature of a particular species in a region or other (Stebbins, 1938; Sharma & Sharma, 1956; Grant, 1963; Leser *et al.*, 1998; Simon *et al.*, 2001; Goldblatt & Lowery, 2011) and leads to creation of geographical races or speciation (Dobzhansky, 1941; Epling & Dobzhansky, 1942; Bennett, 1987). As per the available literature so far, this genus is vary variable cytologically. Numerous aneuploid and euploid series are found in this group. These variations in chromosome numbers take place during the process of meiosis. Study of meiotic behaviour, chromosomal aberrations, their possible reasons and consequences have been reported by various workers in different plant groups time to time.

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).

a. New Methodology (if any) adopted: NA

Achievements including:

- k. Total area covered : NA
- l. Number of tours undertaken : NA
- m. Number of species collected : NA

- n. Number of species identified (with name) : NA
- o. Number of species incorporated : NA

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.

Major impacts reported during the financial year:

- B. Research Publications (in *Nelumbo* format)

Publications:

- Harish Singh, **Monika Mishra** and P. A. Dhole (2020). Ethnomedicinal plants used by the tribal communities of West Champaran district of Bihar, India. *Plantae Scientia*, 3(4): 38-44.
- Harish Singh, **Monika Mishra** and P. A. Dhole (2020). Ethnomedicinal uses of plants from Kaimur and Rohtas districts of Bihar, India. *Ethnobotany*, 30: 10-21.

Accepted: 01

- P.A.Dhole, **Monika Mishra** and K.A.Sujana (2020). Wild edible plants traditionally used by the tribes in Malkangiri district, Odisha, India. *Journal of Economic and Taxonomic Botany*, 44(1-4): 5-13.

Communicated: 02 (Hindi articles)

- Harish Singh, **Monika Mishra** and P. A. Dhole (2019). *Bihar ke Pachim Champaran Jile ki Janjatiyo Dwara khai jane wali kuch jangli vanspatian.* (Vanaspati Vani).
- P.A.Dhole, **Monika Mishra**, R.Saravanan and H. Singh (2020). *Corchorus olitorious – Bihar ke janjatiyon dwara istemal kiye jane wala bahupayogi poudha.* (Vanaspati Vani)

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. Prian 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 Prian 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 Prian Lake, King Lake and Jora Pipe area to see the alteration in Micro-algal diversity and its abundance, qualitatively and quantitatively.

Literature : The systematic account of fresh water microalgae was enumerated by Phycologists important among them are Ghose (1923), Prasad and Srivastava (1968), Bharati and Bongale (1975), Sarma and Khan (1980), Gupta and Sen (1987), Sabata and Nayer (1992), Gupta (2012) and Gupta (2018). Quantitative, qualitative and periodical occurrence of algal flora in sewage ponds is described by Shukla *et al.* (1989) whereas Deka and Bordoloi (1991) made qualitative assessment of blue-green algae. Species diversity in phytoplankton communities in a few freshwater bodies, mines and extreme environment were studied in detail by Goel *et al.* (1988), Srivastava (1993), Ojha and Sharma (1994), Krishnamurthy and Reddy (1996), Sanilkumar and

Thomas(2006), Goudar and Hegde (2009), Srinivasan *et al.* (2009), Yadav and Singh (2009), Shiddamallayya and Mathad (2009) and Perumal and Anand (2009).

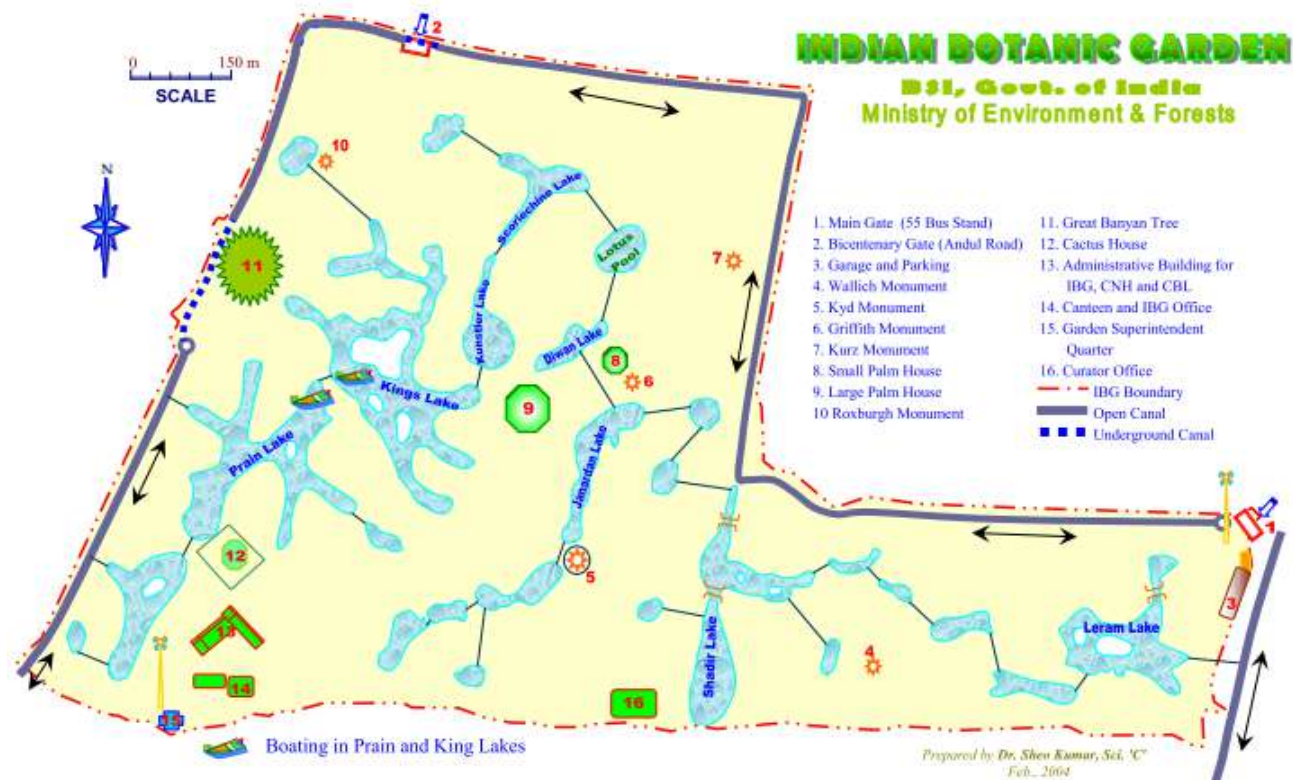
Studies carried on above areas by various authors but study of microalgae and monitoring of water quality in different Lakes of AJCBIBG was remains untouched. So, attempt has been made to study the same.

Objectives:

The main objective of carrying out this work on Microalgae and monitoring of water quality of 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

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

LAKES AND ITS NETWORK



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.

a. 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.

Achievements including :

- p. Total area covered : King Lake, Prain Lake and Jora Pipe Area
- q. Number of tours undertaken : 12
- r. Number of species collected : 120 samples
- s. Number of species identified (with name) : 211
- t. Number of species incorporated :

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 Meters successfully installed first time in BSI** 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 (New Project)

Executing Scientist (s): Dr. Pratibha Gupta

Duration of the project: September, 2020 - continuing

About the work done:

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.

Literature : The systematic account of fresh water microalgae was enumerated by Phycologists important among them are Ghose (1923), Prasad and Srivastava (1968), Bharati and Bongale (1975), Sarma and Khan (1980), Gupta and Sen (1987), Sabata and Nayer (1992), Gupta (2012) and Gupta (2018). Quantitative, qualitative and periodical

occurrence of algal flora in sewage ponds is described by Shukla *et al.* (1989) whereas Deka and Bordoloi (1991) made qualitative assessment of blue-green algae. Species diversity in phytoplankton communities in a few freshwater bodies, mines and extreme environment were studied in detail by Goel *et al.* (1988), Srivastava (1993), Ojha and Sharma (1994), Krishnamurthy and Reddy (1996), Sanilkumar and Thomas (2006), Goudar and Hegde (2009), Srinivasan *et al.* (2009), Yadav and Singh (2009), Shiddamallayya and Mathad (2009) and Perumal and Anand (2009).

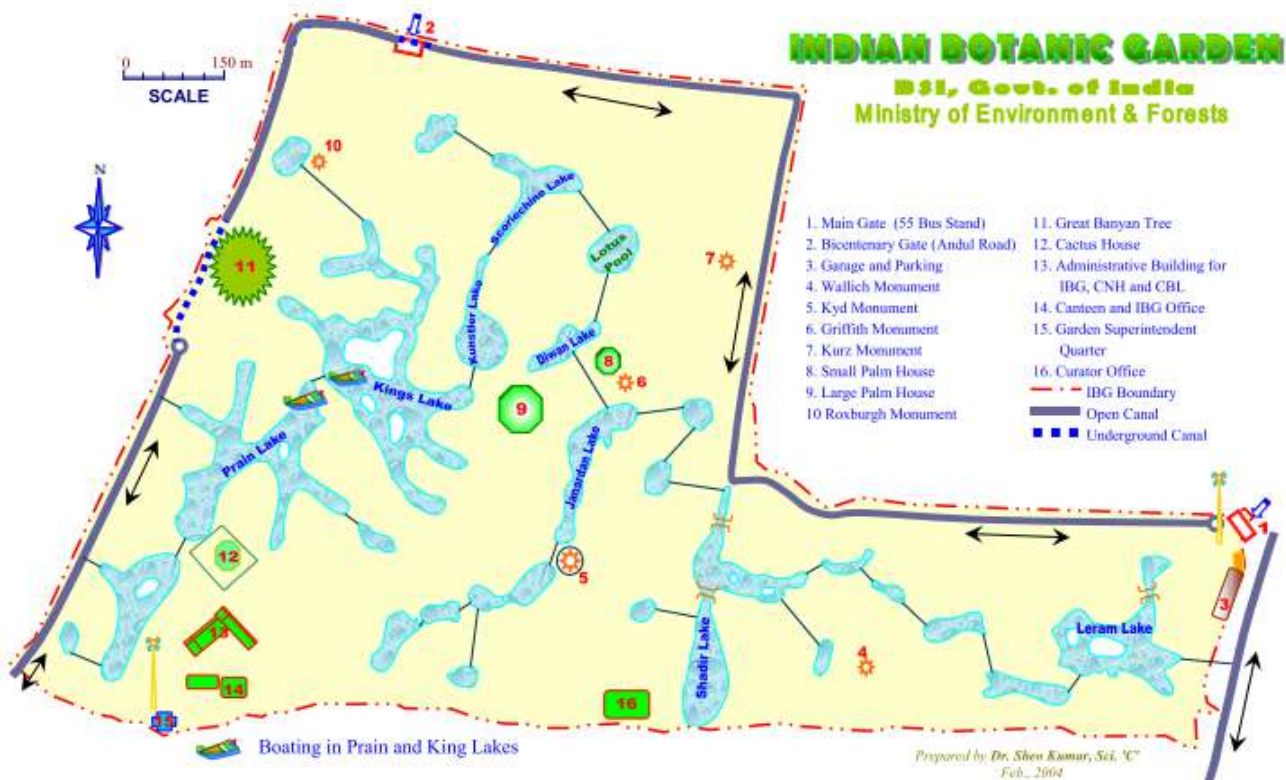
Studies carried on above areas by various authors but study of microalgae and monitoring of water quality in different Lakes of AJCBIBG remains untouched. So, attempt has been made to study the same.

Objectives:

The main objective of carrying out this work on Microalgae and monitoring of water quality of Sadir Lake of AJCBIBG, Howraht 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

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

LAKES AND ITS NETWORK



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.

- a. 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.

Achievements including :

- 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 :

- Received third proof of the Book entitled “Algae of India : A Checklist of Dinophyceae (Dinoflagellates)” on 02.09.2020 which was checked and submitted on 21.09.2020 to the In-charge, Technical Section.

Prepared the Index of Dinophyceae Book and Submitted :

- Prepared the Index of Dinophyceae Book and submitted both hard and soft copy for publication of the Book on 21.09.2020.

Re-submitted the Cover Page of Dinophyceae Book :

- Re-submitted the Cover Page of Dinophyceae Book on 30.09.2020.

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. As per the e.mail dtd. 23.02.2021, 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. As per the e.mail dtd. 11.02.2021, Reviewed Research Paper entitled “Insect venom toxin peptides, its antimicrobial effects and host immune responses: A review” for publication in Internationally Peer-reviewed

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. Nauli 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 “Micropopagation 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, Nauli 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 (NESA), 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. As per the mail dtd. 21.01.2021 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. As per mail dtd. 28.01.2021 on the occasion of Wetland Day on 02.02.2021 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. As per Office mail dtd. 16.02.2021 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. As per the Whatsapp message on 16.02.2021 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 (NESAs), 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: Vagiyanik 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.

Organised First Online Hindi Workshop in BSI:

- i. **First Online One Day Hindi Workshop** was organised in BSI by CBL, Howrah on 18.03.2021 and delivered welcome speech.
- ii. Brochure and circular for first online Hindi Workshop was circulated to All Head of the Office of Regional Centres/ Units of BSI with a request to circulate their Officers and Staff for active participation on 18.03.2021 at 11.30 A.M.

- iii. Most of the Officers and Staff from Regional Centres/ Units of BSI actively participated in first online Hindi Workshop.
- iv. **The Official twitter handle of moef&cc covered this news and Hon'ble Cabinet Minister Shri Prakash Javadekar, MOEF & CC and Shri Babul Supriyo Minister of State MOEF & CC appreciated this efforts of first online Hindi Workshop organised by Head of the Office, CBL, BSI, Howrah and supported and followed by many others.**

B. Research Publications (in *Nelumbo* format)

1. **Gupta, Pratibha** 2020. Epiphytic algal diversity on mango tree of Acharya Jagdish Chandra Bose Indian Botanic Garden, Howrah. *Anusandhan* 8(1): 60 - 64.
2. **Gupta, Pratibha** 2020. Role of various Algae and herbs in prophylactic and therapeutic treatment of COVID - 19 infection. *International (Web) conference on Environment and Society (ICES 2020)* 9: 105.
3. **Gupta, Pratibha** 2020. Don't be afraid of corona. *Curr. Cri.*, P 4.
4. **Gupta, Pratibha** 2020. Corona has to be run away from India. *Curr. Cri.*, P 4.
5. **Gupta, Pratibha** 2020. *Time of corona's Pendemic. Yugkarwat* P 4.
6. Tiwari, Mohit Kumar and **Gupta Pratibha** 2020. *In vitro* study on effect of antitubercular drugs on *Mycobacterium lucknowense* sp. nov. isolated from Indian frog *Rana tigerina*. *Anusandhan* 8(1): 48 - 52.
7. **Gupta Pratibha** 2020. Rashtra Ka Gaurav Hindi. *Vanaspati Vani* (Communicated).

Books :

8. **Gupta, Pratibha** 2021. Algae of India : A Checklist of Dinophyceae (Dinoflagellates) (In Press).
9. **Gupta, Pratibha** 2020. 33rd Indian Scientific Expedition to Antarctica (Journey, Stay, Expedition and Scientific Research) (In Publication Section).

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 fourty 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, genticic

acid, vanillic acid, aesculin, caffeic acid, syringic acid, p-Coumaric acid, naringenin, salicylic acid, ellagic acid luteolin, and sinapic acid) content in fourty 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 fourty 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

6. 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

7. HPLC training given

- HPLC training programme was given to the M.Sc students, Department of Botany, Burdwan University

8. 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**”

9. 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)

10. Publications

- **Tapan Seal**, Kausik Chaudhuri, Basundhara Pillai. Evaluation of antioxidant activities, toxicity studies and its DNA damage protective effect of various solvent extracts of *Litsea cubeba* fruits. **Heliyon**, 6, e03637 (2020).

- ii. **Tapan Seal**, Kausik Chaudhuri, Basundhara Pillai. Wild Edible Plants of Meghalaya State in India: Nutritional, Minerals, Anti-nutritional, Vitamin content and Toxicity Studies. **Pharmacognosy Magazine**, **16**, S142-151 (2020).
- iii. **Tapan Seal** "Nutritive scenario of wild consumable plants of Meghalaya state in India together with heavy metals, anti-nutritional, vitamin and toxicity studies." **Research Journal of Pharmacognosy and Phytochemistry** **12(3)**, 123-134, (2020)
- iv. **Tapan Seal** "Effect of boiling and microwave cooking on nutritional, anti-nutritional and toxicity of wild edible plants of North-Eastern region in India" **International Journal of Pharmacy and Pharmaceutical Sciences** **12 (11)**, 61-70 (2020)
- v. Sagari Chaudhury, Chowdhury Habibur Rahaman, Harish Singh, K Chaudhuri and **Tapan Seal**, Nutritional and medicinal importance of *Dioscorea glabra* R. Baron, a potent wild edible plant consumed by the *Lodha* tribal community of West Bengal, India, **Current Nutrition and Food Science** **16(3)**, 284-295(2020)
- vi. Tuhin Kanti Biswas, Shrabana Chakrabarti, Biswajit Auddy, Tanmoy Mondal, Srikanta Pandit, **Tapan Seal**. *Pterocarpus santalinus*: A Wonder Gift of Nature. **Evidence Based Validation of Traditional Medicines**, 935-964 (2020)
- vii. Ishika Bera, Bejoysekhar Datta, Kanad Das and **Tapan Seal**. Effect of Solvent Extraction System on the Antioxidant Properties of Seven Wild Edible Mushrooms and Identification of Phenolic Compounds by HPLC" for consideration for publication. **Pharmacognosy Magazine** (Manuscript is "pm_424_20" **accepted**)
- viii. Sudeshna Datta and **Tapan Seal**. Anti-diabetic, anti-inflammatory and antioxidant properties of four underutilized ethnomedicinal plants: An in vitro approach. **Research square**2020
- ix. **Tapan Seal**, Kausik Chaudhuri, Basundhara Pillai . Water soluble vitamin in ten wild edible fruits consumed by the tribal people of north-eastern region in India : simultaneous estimation by high performance liquid chromatography (HPLC) method. **International Journal of Pharmaceutical Sciences and Research (AcceptedMS No IJPSR/RA-15647/11-20)**
- x. **Tapan Seal** , K. Sunita. Comparative study of Ethno medicinal plants used by the tribals of Bhadradi Kothagudem district of Telangana and Siddharthnagar district of Eastern Uttar Pradesh. **International Journal of Botany Studies**, **6(1)**, 611-615 (2021)
- xi. S. Ganguli, J.Kumar, **Tapan Seal**. Characterization of secondary metabolites in different parts of *Ocimum gratissimum* L. by in vitro antioxidant activity and HPLC-DAD-analysis. **Pharmacognosy Magazine**, (Ms. No pm_550_20 **accepted**)
- xii. Sudeshna Datta and **Tapan Seal**. Effect of solvent extraction in antioxidant activity and RP-HPLC based study of phenolic acids and flavonoids and *Cayratia trifolia* (L.) Domin. **Journal of Pharmacognosy and Phytochemistry** **9(6)**: 896-900 (2020)
- xiii. Gargi Prasad, **Tapan Seal**, A.A. Mao, Deepu Vijayan, Adani Lokho, Assessment of clonal fidelity and phytomedicinal potential in micropropagated plants of *Bulbophyllum odoratissimum* - an endangered medicinal orchid of Indo Burma megabiodiversity hotspot. **South African Journal of Botany** (Communicated)

CENTRAL NATIONAL HERBARIUM

Research Programmes

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.).

ACHIEVEMENTS: 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, Botanical Assistant,

Dr

Anant Kumar, Botanical Assistant

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.

ACHIEVEMENTS: 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.

ACHIEVEMENTS: 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., *Hyogonium consanguineum* (Thwaites & Mitt.) Hilp., *Hyophila involuta* (Hook.) Jaeger, *Hyophila nymaniana* (M. Fleisch.) M. Menzel, *Hyogonium 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 Váňa & 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*.

ACHIEVEMENTS: 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.

It should be noted that Due to COVID-19 Pandemic no tour could be conducted (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 infuscata* (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).

ACHIEVEMENTS: 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.

AREA AND LOCALITY: NA

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

Achievements: 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).

ACHIEVEMENTS: Completed the allotted work.

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.

ACHIEVEMENTS: Completed the allotted work by given time and the updated manuscript was submitted to the team leader.

PROJECT 2

Flora of India, vol. 20

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

Date of initiation: NA

Date of completion: NA

OBJECTIVE: NA

AREA AND LOCALITY: West Bengal.

SUMMARY: NA.

ACHIEVEMENTS: The subtribe Justicinae comprises 121 species and 15 varieties under 15 genera. The whole subtribe is edited and updated.

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.).

ACHIEVEMENTS: Completed the allotted works by given time 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.

ACHIEVEMENTS: 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).

ACHIEVEMENTS: Completed the allotted works by given time 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).

ACHIEVEMENTS: Completed the allotted works by given time and the updated manuscript was submitted to the team leader.

Other Research Programmes

PROJECT 1

Editing of Flora of Andaman (Volume 2)

Executing officials: Dr K. Karthigeyan, Scientist-E

Date of initiation: NA

Date of completion: NA

OBJECTIVE: NA

AREA AND LOCALITY: Andaman.

SUMMARY: NA.

ACHIEVEMENTS: 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

Date of initiation: NA

Date of completion: NA

OBJECTIVE: NA

AREA AND LOCALITY: West Bengal.

SUMMARY: NA.

ACHIEVEMENTS: 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 prepared 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.

ACHIEVEMENTS: Submitted the manuscript in given time.

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 prepared 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.

ACHIEVEMENTS: 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

- BANDYOPADHYAY S., A. BHATTACHARJEE AND M.N. MITTA 2020. Marketing of achievements through fake awards – A ‘novel’ trend in modern academic and research systems. *Ann. Pl. Sci.* 9 (12): 4103–4104.
- BHARATI, K.A. 2018. Traditional uses of some plants in the surrounding villages of Baraila Lake Salim Ali Jubba Sahani Bird Sanctuary, Bihar. *Ethnobotany* 30: 40–48.
- BHATTACHARJEE, A. AND S. BANDYOPADHYAY 2020. Jaideep Mazumdar: a passionate, silent researcher who left treasures behind. *Phytotaxa*: 470 (1): 117–120.
- BHATTACHARJEE, A., G. KRISHNA AND S. BANDYOPADHYAY 2020. (025) Proposal to clarify that a circumscription applies to a taxon, not to a name. *Taxon* 69(6): 1379.
- BHATTACHARJEE, A., G. KRISHNA AND S. BANDYOPADHYAY 2020. (043) Proposal to amend the definition of “diagnosis” in Article 38.2. *Taxon* 69(6): 1388.
- BHATTACHARJEE, A., M. DEY AND S. BANDYOPADHYAY 2020. (034–035) Proposals to amend Article 9.6 and Example 6. *Taxon* 69(6): 1384.

- BHATTACHARJEE, A., R. BHADRA AND S. BANDYOPADHYAY 2020. (050) Proposal to amend the definition of “synonym” in the Glossary. *Taxon* 69(6): 1393.
- BHATTACHARJEE, A., S. BANDYOPADHYAY AND D. MAITY 2020. (029) Proposal to add a new Example after Article 9.1. *Taxon* 69(6): 1382.
- BHATTACHARJEE, A., S. BANDYOPADHYAY AND M.N. MITTA 2020. Soft copy of unpublished Ph.D. theses in the internet – A serious concern. *Harvest* 5(2): 87.
- BHATTACHARJEE, A., S. DEY AND S. BANDYOPADHYAY 2020. (012) Proposal to modify Article 9.12. *Taxon* 69(3): 630.
- BHATTACHARJEE, A., S. DEY AND S. BANDYOPADHYAY 2020. (044) Proposal to amend Recommendation 40A.1. *Taxon* 69(6): 1389.
- BHATTACHARJEE, B., P. LAKSHMINARASIMHAN, S.K. MUKHERJEE, S. KALIAMOORTHY AND A. BHATTACHARJEE 2020. Notes on the identity of *Vernonia shevaroyensis* (Asteraceae) and its neotypification. *Nelumbo* 62 (2): 148–153.
- BISWA, S.,A. LOKHO & P. LAKSHMINARASIMHAN 2020. Ethnobotanical study of Birhore Tribe in Koderma Wildlife Sancturay Jharkhand, India. *Advances Pl. Sci.* 33: 139–152.
- CHAKRABARTY, T. AND G. KRISHNA 2020. An overlooked new variety of *Tritaxis glabella* from India with a note on the consequent new synonyms of *Croton lawianus* (Euphorbiaceae). *Pl. Sci. Today* 7(3): 302–307.
- CHAKRABARTY, T. AND G. KRISHNA 2020. Typification of *Adelia resinosa*, the basionym of *Mallotusresinosus* (Euphorbiaceae), and its three new synonyms from India. *Phytotaxa* 446(2): 121–127.
- CHAKRABARTY, T. AND G. KRISHNA 2020. Typification of eight accepted names and two synonyms in Indian Euphorbiaceae. *Nelumbo* 62(2): 161–172.
- CHAKRABARTY, T., G. KRISHNA AND ANAND KUMAR 2020. (038) Proposal to add a new Example to Article 9.17. *Taxon* 69(6): 1385–1386. Impact factor: 2.817.
- CHAKRABARTY, T., S. PANDAY AND ANAND KUMAR 2020. Reinstatement of two varieties of *Trigonostemon viridissimus* and seven superfluous lectotypifications in Indo-Burmese *Trigonostemon* (Euphorbiaceae). *J. Asia-Pacific Biodivers.* 13: 766–770. <https://doi.org/10.1016/j.japb.2020.08.007>. Scopus indexed.
- CHAUDHURI, S. 2021. An overview of subtribes Boivinellinae Pilg. and Anthephorinae Benth. in India. *Int. J. Adv. Res. Biol. Sci.* 8(3): 80–88.
- DAS, S. AND K. KARTHIGEYAN 2020. Notes on the lectotype of *Tetrapogon roxburghianus* (Poaceae: Chloridoideae: Cynodonteae). *Phytotaxa* 464(3): 249 – 251.
- DAS, S.K. AND D. SINGH 2020. Epiphytic algae on the Bryophytes of Larsemann Hills, East Antarctica. *Natl. Acad. Sci. Lett.* <https://doi.org/10.1007/s40009-020-00947-7>.
- DAS, S.K., D.S. RAWAT, R.K. GUPTA AND S.P. ADHIKARI 2020. A Taxonomic appraisal on the rare green algal genus *Eccalocystopsis* M.O.P. Iyengar (Chlorellales; Trebouxiophyceae): morphological and numerical approach. *Nord. J. Bot.* 38: 1–8.
- JALAL, J.S., I. DATT RAI, A. BHATTACHARJEE AND G. SINGH 2020. New distributional record of *Gastrochilus affinis* (Orchidaceae) from Western Himalaya with notes on a new synonym and typification. *Nelumbo* 62 (1): 12–15.
- KRISHNA, G., A. BHATTACHARJEE AND K. KARTHIGEYAN 2021. *Hoya edeni* (Apocynaceae: Asclepiadoideae): Notes on its overlooked first drawing, original material at CAL and etymology. *Nelumbo* 62(2): 192 – 196.
- KRISHNA, G., A. BHATTACHARJEE AND S. BANDYOPADHYAY 2020. (039) Proposal to add a new paragraph to Recommendation 9A. *Taxon* 69(6): 1386.
- KRISHNA, G., A. BHATTACHARJEE AND S. BANDYOPADHYAY 2020. (047) Proposal to add a new paragraph with a new Example to Recommendation 50D. *Taxon* 69(6): 1390.
- KRISHNA, G., A. BHATTACHARJEE, S. BANDYOPADHYAY AND M. SANJAPPA 2020. (021) Proposal to amend Recommendation 46C.2. *Taxon* 69(3): 636.

- KRISHNA, G., A. BHATTACHARJEE, W. ARISDASON AND S. BANDYOPADHYAY 2020. (042) Proposal to add a new Example under Article 36.1. *Taxon* 69(6): 1388.
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- 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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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 dyeing agents, plant based dyeing agents and animal based dyeing 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/labelled	463/7237/NIL
No. of Herbarium sheets stitched/re-stitched/poisoned/fumigated/dusted	707/NIL/9216/2510/25896
No. of Herbarium sheets accessioned	NIL
No. of Herbarium sheets incorporated/re-incorporated	8239/NIL
No. of specimens sent on loan	NIL
No. of loaned/gifted specimens received/returned/exchanged	33/31/1662/NIL
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/Field data written	40486/4068/NIL

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. Karthikeyan) 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 nephradeniust* to 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. *angustifolium*. **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 *Solenanthus 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 Rheedea 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.

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.



Pedicularis longiflora Rudolph

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:

Dr. Arti Garg:

Completed description of 101 taxa of *Pedicularis* L. and *Digitalis* L.

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.

As team leader– collected and submitted 99 photographs and 41 line drawings with legends, for publication.

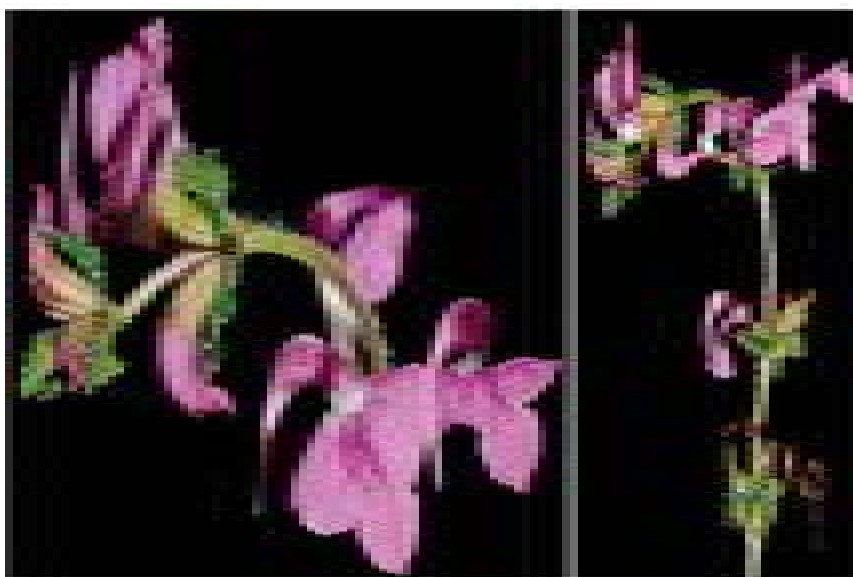
Dr. A. N. Shukla: Submitted Flora of India Vol. 19 (Scrophulariaceae, Described 42 taxa under 10 genera) along with key, phenology, distribution and 99 photographs, 41 line drawings for publication.

Dr. A.K. Verma: Incorporated editor's corrections and manuscript submitted to editor along with all relevant photographs/drawings.

Achievements: Completed and submitted Checklist of 'Flora of India Vol-19' (Scrophulariaceae, Lentibulariaceae and Orobanchaceae) along with a complete Bibliography.



Plant collection in Sikkim Himalayas (Dr. Arti Garg)



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



Pedicularis hoffmeisteri Klotzsch

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).

Achievement and Outcomes: Updated Taxonomic description and documentation of families Sapotaceae (under 13 genera, 38 species and 10 varieties) and Styracaceae (under 4 genera and 7 species and 2 varieties) and submitted on time.

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

Achievements and 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. *chittrakutensis* (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: Project completed and report submitted.

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 GERMPASM' 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.

Achievements:

1. 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 sylvestres* (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), *Phlomidoides 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*Prairie (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).
2. Identified new cytotypes for 07 species of angiosperms.

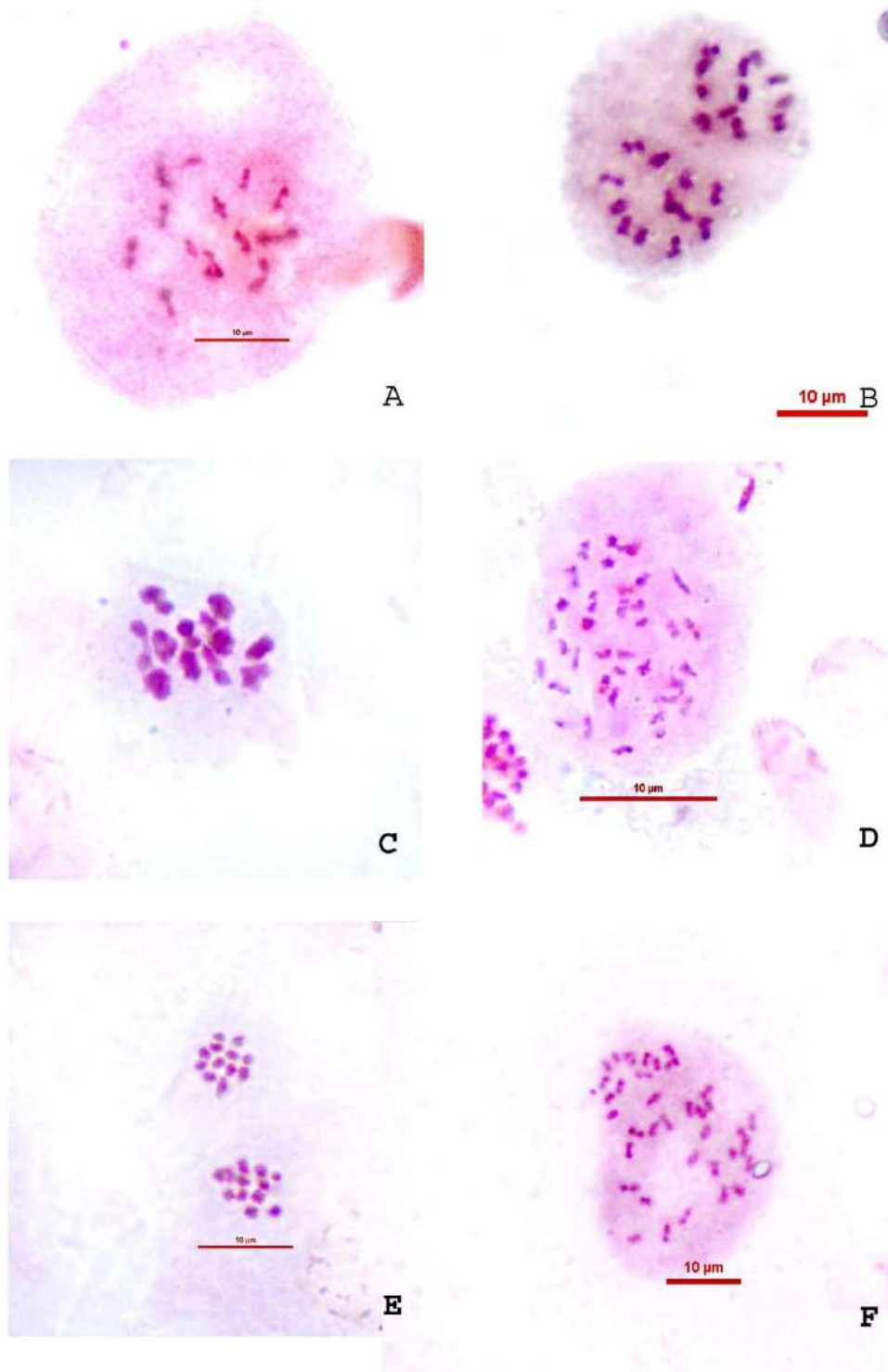


Fig.A: *Senna tora*; Metaphase-I with 14 bivalents.; B: *Solanum diphyllum*; Anaphase-I with 12/12; C: *Solanum nigrum*; Metaphase-I with 12 bivalents; D: *Solanum nigrum*; Metaphase-I with 36 bivalents; E: *Solanum villosum*; Anaphase-I with 12/12; F: *Solanum villosum*; Metaphase-I with 36 bivalents.

Project 5: Pteridophytic flora of India

Name of Official: Dr. Brijesh Kumar, Botanist

Date of Initiation: 2020

Date of Completion: 2023

Introduction:

The Pteridophyte are the oldest land plants on earth, flourished so well in past and dominated the earth vegetation about 280-230 million years ago. Although they are now replaced by seed bearing vascular plants of the present day vegetation still they are considered as a connecting link between non-vascular and vascular plants. Presently, pteridophytes do not form dominant vegetation anywhere in the world flora. They further grouped into two broad groups' fern-allies and ferns. Among these the ferns constitute a major element of the pteridophytic flora. Most of the fern species are distributed in tropical and subtropical areas with limited distribution in temperate regions. They prefer to grow in cool, moist and shady places. In monsoon season, they luxuriously grow with varied range of habitats like trees, boulders, rocks, walls, crevices, deep ravines, forest floors, open and dry slopes and in aquatic environ also.

They contribute c. 2.5 percent of the total Indian flora. In the present state India has about 1300 species of pteridophytes. Present project has been initiated to compile the descriptive account of Pteridophytes Flora of India.

Literature:

Relevant literature on taxonomy of Pteridophytes of different regional floras were consulted.

Objective:

Describe 75 species of pteridophytes for pteridophytic flora of India.

Site of the study (With map): India Map : NA

Methodology adopted:

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

Achievement and Outcomes:

Species 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. cycloloba* 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: Sept., 2018

Date of completion: March, 2021

Area Surveyed: NA

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.

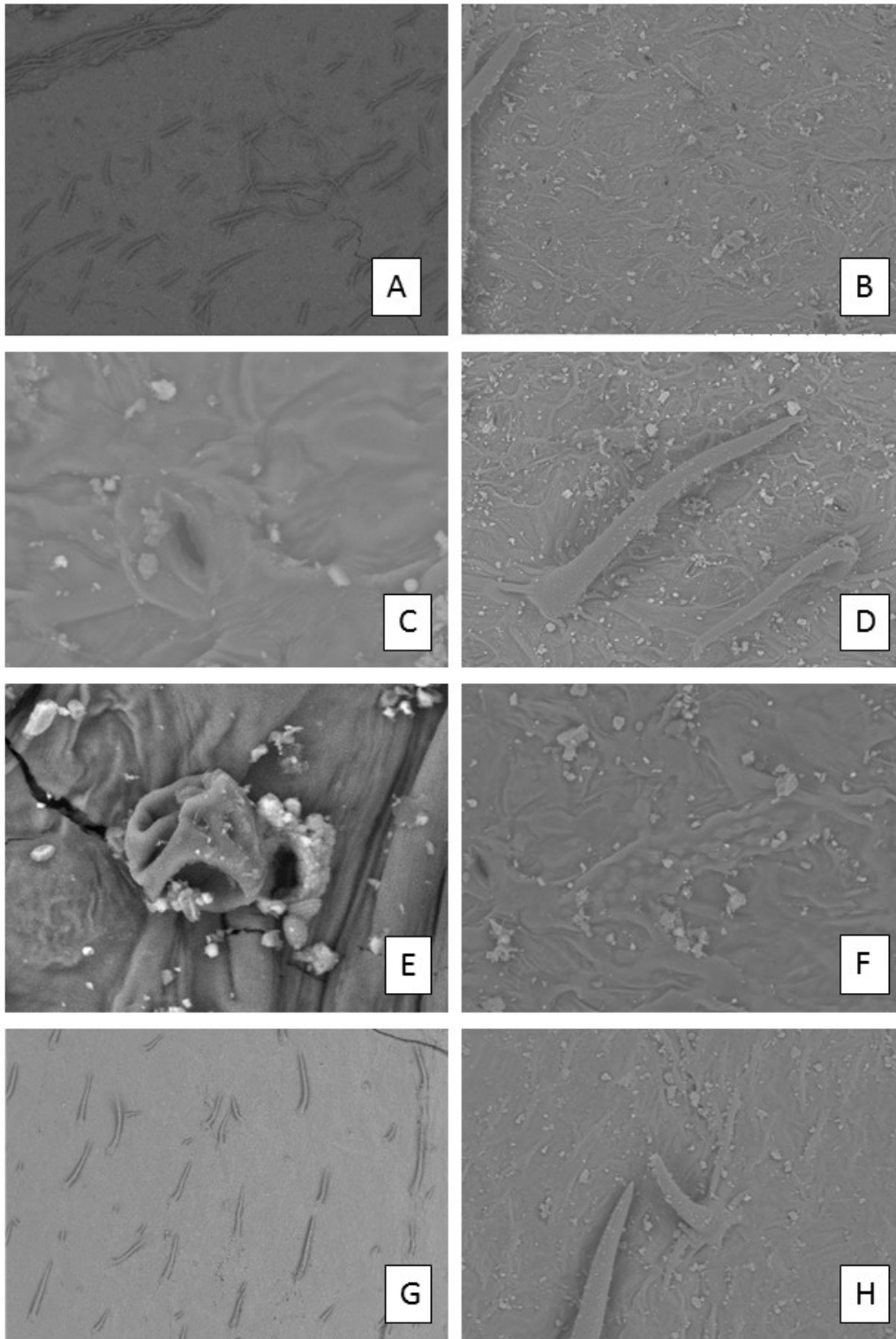
Objectives: To study seed and epidermal details of total 60 species (Acanthaceae and Solanaceae)

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 vahlii 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.

Achievements: Comparative accounts of epidermal studies of 60 species have been worked out and manuscript writing is under process



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

Botanical Survey of India, CRC, Allahabad

Salient finding from the centre-

Dr. Arti Garg, Sci-E:

- **Performed regular duties of Head of Office and Scientist 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 Rheedeia 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.

- 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.

1. List of Publications:

- BORAH, D., SINGH, R. K. AND GARG, A. 2020. New records of four Pedicularis species (Orobanchaceae) for the Flora of Arunachal Pradesh state, India, and two new synonyms for *P. pantlingii*. *NeBio*: 11(3): 180–186.
- BORAH, D., SINGH, R. K. AND GARG, A. 2020. Rediscovery of *Pedicularis denudata* (Orobanchaceae), a little known, rare herb, after 135 years from India. *Phytotaxa* 461(2): 136–138.
- DAS, P., KHARE, P., SINGH, R.P., YADAV, V., TRIPATHI, P., KUMAR, A., PANDEY, V., GAUR, P., SINGH, A., DAS, R., HIREMATH, C., VERMA, A.K., SHUKLA, A.K., AND SHANKAR, K. 2020. Arsenic- induced differential expression of oxidative stress and secondary metabolite content in two genotypes of *Andrographis paniculata*. *Journal of Hazardous Materials*.
- DWIVEDI, M.D., CHAUHAN, S., SRIVASTAVA, A., PRAGYA SOURABH, MISHRA, S. THAKUR, J. AND SHUKLA, A.N.2020. Systematic position and habitat distribution modeling for reintroduction of critically endangered medicinal plant *Pittosporum eriocarpum* Royle (Pittosporaceae). *Pleione*. 14(1): 109–120.
- GARG, A. AND TIWARI, A.P. 2020. Floristic account of the Van Vihar National Park in Bhopal, Madhya Pradesh, India. *Indian J. Forestry*. 42(4): 323–336.
- GARG, A., PATRUT, R.T., PATRUT, A., WOODBORNE, S. AND RAKOSY, L. 2021. Radiocarbon dating and status of the oldest extant Ceylon iron wood (*Manilkara hexandra*) in the riverine Ramsar site of India. *Current Science*. 120 (3):562 – 566. (Research communications)
- GARG, A., SINGH, R.K. AND KHOLIA, B.S. 2020. *Pedicularis raghvendrae* Arti Garg & R. Kr. Singh (Orobanchaceae), a new species from Sikkim Himalaya, India. *Phytotaxa* 452(1): 110–115.
- JOSHI, P., V.K. RAWAT, B.KUMAR, H. DWIVEDI. 2019. Taxonomic studies of genus *Goniophlebium* and *Selliguea* of district Tehri garhwal, Indian Central Himalaya. *Bull. Arunachal Forest Res.*, 34 (1 &2), 1–10.
- KHANNA, K.K., TIWARI, A.P. AND SHUKLA, A.N. 2020. Six taxa of angiosperms as new distributional records for Chhattisgarh, India. *J. New Biolo. Report*. 220–222.
- KUMAR, B., P. JOSHI, H. DWIVEDI AND V.K. RAWAT. 2021. *An Analysis of pteridophytic flora of Jammu and Kashmir State*. In L. J. Singh & V. Ranjan (Eds.) *New Vistas in Indian Flora*. Bishen Singh Mahendra Pal Singh, Dehradun pp. 215–232.
- LAHIRI, R., JYOTSHANA, VERMA, A.K., SHANKER, K. AND LAL, R.K. 2020. Diallel analysis of seven promising genotypes of opium poppy for assessment of their combining ability and efficacy in future genetic

improvement programmes. *Environmental and Experimental Biology* (2020). 18: 161–168(Thomson & Reuters indexed Journal).

- SINGH, R. K. AND GARG, A. 2020. Amritdhara Sacred Grove - an unparalleled Conservatory of Endemic, Endangered and Medicinal plants of Chhattisgarh. *Indian Forester*. 146 (12): 1183-1184.
- SINGH, R.K. AND GARG, A. 2020. *Floristic Diversity of Valmiki Tiger Reserve, West Champaran District, Bihar*. Today & Tomorrow's Printers & Publishers, New Delhi - 110002, pp 1 - 820. ISBN 81-7019-674-7.
- SRIVASTAVA NITISHA, Role of epidermal micromorphology in delimitation of taxa in genus *Andrographis* (Acanthaceae) in India. *Tropical Plant Research*, 7(2): 491–495, 2020.
- SRIVASTAVA, NITISHA and LAL JI SINGH, "Diversity of dye yielding plant wealth in India" in book entitled "New Vistas in Indian Flora" Vol. 1, pp. 313-322, 2021, edited by Lal Ji Singh and Vinay Ranjan, Bishen Singh and Mahendra Pal Singh (Publisher), ISBN: 978-81-943323-5-0.
- TIWARI, A.P., GARG, A. & SHUKLA, A.N. 2021. *Blumea sonbhadrensis*, a new synonym of *Erigeron sublyratus* (Asteraceae). *Phytotaxa*. 480 (3): 291–296.
- TIWARI, A.P., GARG, A. & SHUKLA, A.N. 2021. *Blumea sonbhadrensis*, a new synonym of *Erigeron sublyratus* (Asteraceae). *Phytotaxa*. 480 (3): 291–296.
- TIWARI, A.P., SHUKLA, A.N., KHANNA, K.K. AND SIKARWAR, R.L.S. 2020. Lectotypification of *Alysicarpus gracilis* (Papilionoideae: Leguminosae). *Phytotaxa* 449(2): 200-202.
- VERMA, A.K., SRIVASTAVA, S., MAURYA, O.N., CHUHAN, R.S. AND LAHIRI, R. Realization of paleopolyploidy through cytogenetic and phylogenetic characterization of ten species of *Senna* Mill., Fabaceae-Caesalpinioideae. *Int. Journal of Plant and Environment*. (In Press).

2. 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.

3. 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.

4. 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 Himlaya” 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 Webiner 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.

5. 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: Global 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 Golwalkar 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

6. 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).

DECCAN REGIONAL CENTRE, HYDERABAD
RESEARCH PROGRAMMES

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

The objective of the project is 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.

ACHIEVEMENTS/ OUTCOMES IN 2020-21

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

The objective of the project is 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 - Srisailam). 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.

ACHIEVEMENTS/ OUTCOMES IN 2020-21

Published 03 research papers.

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

SEED PLANTS

Dillenia tirupatiensis J.Swamy & Rasingam, J. Threat. Taxa 12(11): 16636-16640. 2020. (DILLENACEAE): 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

SEED PLANTS

GENUS 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

Pancreatium 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

Eriochloa barbatus (Trin.) S. Yadav & M.R. Almeida (Poaceae) – Telangana

RESEARCH PUBLICATIONS:

BOOKS: 02

1. RASINGAM, L. AND S.M. REHEL 2020. *Forest Plants of the Nilgiri Biosphere Reserve – North-Eastern Nilgiri Biosphere Reserve – A Pictorial Field Guide*, Keystone Foundation, Kotagiri, Tamil Nadu, Pp. 1-362.
2. SWAMY, J. AND A. SONIBALA DEVI 2020. *Anantagiri Hills A Treasure Trove of Medicinal Plants*. Telangana State Medicinal Plants Board. ISBN 978-81-948125-0-0

BOOK CHAPTER: 01

1. RASINGAM, L. 2020. Assessment of Floristic Diversity of Nagarjunasagar-Srisailem Tiger Reserve, India. IN: SINGH, L.J., RANJAN, V. (EDS.) *New Vistas in Indian Flora 2*, Bishen Singh Mahendra Pal Singh, Dehradun. 761-769.

RESEARCH PAPERS: 23

1. Arigela, R.K., Paramesh, L. AND R.K. Singh 2020. *Ipomoea parasitica* (Kunth) G. Don, a new record to the flora of Telangana State, India and typification of the name *Convolvulus parasiticus* Kunth. *Indian Forester* 146(48): 775–777.
2. HARIKRISHNA, P., J. SWAMY, VINOD MAINA AND RAMESH KUMAR (2019). *Ocimum filamentosum* Forssk. (Lamiaceae): A new distributional record for the flora of Rajasthan, India. *Indian Journal of Forestry* 42 (4): 337-338.
3. IBANEZ, T., KEPPEL, G., BAIDER, C., BIRKINSHAW, C., FLORENS, F. B. V., LAIDLAW, M., MENKES, C., PARTHASARATHY, N., RAJKUMAR, M., RATOVOSON, F., RASINGAM, L., REZA, L., AIBA, S., WEBB, E.L., ZANG, R. AND BIRNBAUM, P. 2020. Tropical cyclones and island area shape species abundance distributions of local tree communities, *Oikos* doi: 10.1111/oik.07501
4. LAL JI SINGH, VINAY RANJAN, RASINGAM, L. AND J. SWAMY 2020. A new species of genus *Dendrophthoe* Mart. (Loranthaceae-Loranthaceae) from the Peninsular India, *Journal of Asia-Pacific Biodiversity*, 13(3): 487-493. <https://doi.org/10.1016/j.japb.2020.03.017>

5. MAHESH, Y., L. RASINGAM AND M.V. RAMANA 2020. *Habenaria reniformis* (D. Don) Hook.f. (Orchidaceae) - A New Distributional Record for Andhra Pradesh, *Nelumbo* 62(1): 57-59.
6. NAGARAJU, S., PRASANNA, P. V. AND Y. V. RAO 2019. Two *Tripogon* species as additions to the Grass flora of Telangana State, India. *Journal of Economic and Taxonomic Botany* 43 (1-4): 52-55.
7. PRAMEELA, R. J. SWAMY AND J. PRAKASH RAO 2020. Notes on distribution of *Xanthosoma sagittifolium* (L.) Schott (Araceae) in Peninsular India. *Journal of Indian Botanical Society* 100 (1&2): 87-90.
8. PRAMEELA, R., M. VENKAIAH, J. SWAMY, AND J. PRAKASARAO 2020. Amaryllids of Andhra Pradesh, India. *Tropical Plant Research* 7(3): 594-603.
9. RASINGAM, L. AND J. SWAMY (2020). *Brachystelma telanganense* (Apocynaceae: Asclepiadoideae-Ceropegieae) - a new species from Telangana, India. *Rheedea* 30(3):379-382.
10. RASINGAM, L. AND K. KARTHIGEYAN 2020. *Ziziphus ridleyana*, a new name for *Ziziphus macrophylla* Ridl. (Rhamnaceae), *Phytotaxa* 454 (1): 071–072. <https://doi.org/10.11646/phytotaxa.454.1.7>
11. SAILU, G. AND J. SWAMY 2020. Avifaunal Diversity of Pocharam Wildlife Sanctuary, Medak. *Pitta* 17 (12): 8-15.
12. SINGH, R.K., ARIGELA, R.K., BORAH, D. AND M. TARAM 2020. *Henckelia collegii-sancti-thomasii* (Gesneriaceae), a new synonym of narrow endemic species *H. hookeri* of Northeast India. *NeBio* 11(3): 205–207.
13. Singh, R.K., R.K. Arigela AND K.A. Sujana 2020. Taxonomy and Typification of Endemic Climbing Shrub *Strophanthus wightianus* Wall. ex Wight of Southern Western Ghats, India. *Indian Forester* 146 (5): 469–471.
14. SWAMY, J. (2020). *Pancratium zeylanicum* L. (Amaryllidaceae): An Addition to the Flora of Telangana, India. *Indian Forester* 146 (5): 459-460.
15. SWAMY, J. (2020). *Tripogonella minima* (Poaceae: Chloridoideae: Cynodonteae: Tripogoninae), a new record for Asia from Peninsular India. *Rheedea* 30(3):396-399.
16. SWAMY, J. AND L. RASINGAM (2020). Notes on the distribution of *Tephrosia noctiflora* Bojer ex Baker (Leguminosae) in Andhra Pradesh. *Plantasia* #20, In: *Zoo's Print* 35(5): 113–116.
17. SWAMY, J. AND L. RASINGAM 2020. A new variety of *Amorphophallus konkanensis* (Araceae) from Telangana, India. *Nelumbo* 62 (1): 4-11.
18. SWAMY, J. AND L. RASINGAM. 2021. *Corynandra telanganensis* (Cleomaceae), a new species from India. *Ann. Bot. Fennici* 58: 79–82. <https://doi.org/10.5735/085.058.0113>
19. SWAMY, J. AND P.V. RAMANA 2020. *Rhynchosia nummularia* (L.) DC. (Fabaceae): An Addition to the Flora of Andhra Pradesh, India. *Indian Forester* 146 (4): 361-362.
20. SWAMY, J. AND S. NAGARAJU (2019). *Schonefeldia gracilis* (Poaceae: Chloridoideae): An addition to the flora of Telangana, India. *Journal of Economic and Taxonomic Botany* 43 (1-4): 56-57.
21. SWAMY, J., L. RASINGAM, S. NAGARAJU AND P.R. MANE (2020). A new species of *Dillenia* (Angiosperms: Dilleniaceae) from the Eastern Ghats of Andhra Pradesh, India. *Journal of Threatened Taxa* 12(11): 16636–16640 <https://doi.org/10.11609/jott.5529.12.11.16636-16640>
22. SWAMY, J., NAGARAJU, S., POOJA, R. MANE AND T.J. SHAIKH 2021. *Bothriochloa insculpta* (Hochst. Ex.A. Rich.) A. Camus (Poaceae): A new record for the flora of Telangana, India. *Indian Forester* 147 (1): 89-90.

23. YADAV, P.B.S. AND R.K. ARIGELA 2020. A partially leucistic Indian Peafowl *Pavo cristatus* from Tamil Nadu, India. *Indian BIRDS* 16(3): 94–95.

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.

ACTIVITIES 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 Vizyanagaram 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.

HIGH ALTITUDE WESTERN HIMALAYAN REGIONAL CENTRE, SOLAN

The Annual Progress Report is to be submitted in the following format with respect to April 2020 – September 2020:

8. **Name of the Project:** Floristic diversity of Dr. Y.S. Parmar University Campus, Nauni, Solan, Himachal Pradesh.
9. **Executing Scientist (s) :** Dr. Kumar Ambrish, Scientist- E and Dr. Kuldeep S. Dogra, Scientist- D
10. **Duration of the project :** One year (2020-21)
11. **About the work done :**

4.1 Introduction: 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 sq. km. area. The campus has a rich floristic diversity of angiosperms, gymnosperms, ferns which includes indigenous as well as alien plant species. Besides this many species are under cultivation for horticulture and forestry purposes. The main aim of the university is education and research in the horticulture and forestry aspects and to up lift the livelihood of locals through research and technology transfer using local resources in Himachal Pradesh. Botanical Survey of India has signed a MoU to establish their High Altitude Western Himalayan Regional Centre at Nauni, Solan in 2018 and it was functional here from 10th December, 2019 and inaugurated by Hon'ble Secretary (Sh. C.K. Mishra, IAS) MOEF&CC (GoI), New Delhi on 26th February, 2020. The BSI, HAWHRC now exclusively working on the development of infrastructure of this centre and on other research activities like plant exploration and their conservation. In view of the research activities, the 1st responsibility 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.

There have been few studies conducted to document the floristic diversity of the campus (Sindhi, 1997). In view of the lack of data on the floristic diversity of the Dr. Y.S. Parmar University, Nauni, Solan, the present study has been conducted to document the floristic diversity of the campus in a pictorial form. A total of 576 plant species occurring in the campus of this university which includes wild (*ca.* 444) as well as cultivate species (*ca.* 132). The wild plants belong to 109 families of the flowering plants. Out of these families the most dominant families are Poaceae, Asteraceae, Fabaceae, Lamiaceae, Rosaceae and Solanaceae.

4.2 Literature: Sindhi, S., 1997. Diversity and economic utility of flora of Nauni, District Solan (H.P). A Ph.D.Thesis submitted to Dr.Y.S. Parmar University.

4.3 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.

4.4 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

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

a. **New Methodology (if any) adopted:** NO

4.6 **Achievements including:**

a. **Total area covered :** UHF, Nauni Campus (1.5 Km²)

b. **Number of tours undertaken:** 3 field tours

c. **Number of species listed from literature and collected:** 115 species listed from the published literature and 69 species collected from the campus.

d. **Number of species identified:** 65; *Clematis gouriana* Roxb., *Clematis grata* wall., *Clematis paniculata* Thumb., *Ranunculus arvensis* L., *Ranunculus laetus* wall, *Ranunculus hirtellus* Royle, *Thalictrum foliolosum* 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 ruderales* 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.

4.7 **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.

4.8 **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.

B.Research Publications (in *Nelumbo* format): 1

1. R. Sharma, K.S. Dogra and K. Ambrish 2020. Traditional Knowledge of Medicinal Plants used in the rural areas of Solan District, Himachal Pradesh. *Journal of Non-Timber Forest Products*, 27(2): 104-112.

Annual Action Plan Progress 2020-2021 in respect of ERC/Shillong

PROJECT- 1

Flora of Nagaland

Executing Scientist (s): Dr. A.A. Mao, Dr. N. Odyuo, Dr. D.L. Biate, 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.

Achievements/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: Cyripedioideae (2 genera, 13 species); Sub-family: Orchidoideae (4 genera 7 species) Sub-family: Epidendroideae (28 genera, 211 species).

BACKGROUND

New project

AREA AND LOCALITY: India

SUMMARY OF THE WORK DONE & ACHIEVEMENTS /OUTCOMES

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 WORK DONE

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.

ACHIEVEMENTS:

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* (Klotzsch) Duch, *Armadorum senapatianum* Phukan & A.A.Mao, *Bulbophyllum rothchilsdianum*, *Ceropegia anshariana*, *Cymbidium tigrinum* C.S.P.Parish ex Hook., *Paphiopedilum fairrieianum* (Lindl.) Stein and *Vanda coerulea* Griff. ex Lindl. are completed. Line drawing of 09 plants completed. Wash and layering of *A. senapatianum*, *B. rothchilsdianum*, *C. anshariana*, *C. tigrinum*, *P. fairrieianum*, *V. coerulea*, A 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. fairrieianum*. 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.**

ACHIEVEMENTS /OUTCOMES

Abstract submitted for the upcoming "National Seminar On Plant Taxonomy and Traditional Knowledge in the Himalayas and North-East India.

1. Infusion of Taxonomy and Indian Miniature Painting techniques in botanical illustration by L. IBEMHAL CHANU^{1*} AND MAHAVEER SWAMI.²

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 WORK DONE: 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.

ACHIEVEMENTS /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, 9 *Impatiens* 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 species were 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 (THIRTY FIVE) IN RESPECT OF ERC SHILLONG

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)

Book chapters: 2(two)

1. DEORI, C. 2020. *Diversity, Conservation and Sustainable utilization of Orchid Flora of Northeast India*. The herbal Wealth of North East India. Edited by Bapan Banik and Manas Bhowmik, EBH Publisher, India. Chapter 1. Pp.1-8
2. TALUKDAR, S. R. AND C. DEORI. 2020. *Sacred grooves for conservation and sustainability of medicinal plants in West and South West Khasi hills districts of Meghalaya* The herbal Wealth of North East India. Edited by Bapan Banik and Manas Bhowmik, EBH Publisher, India. Chapter 4. Pp. 36-45

Booklet published: 02(two)

3. HAJONG, S., G.D. HARISH AND D. L. BIATE. 2021. Compiled and published booklet "Community Seed Banks- Effective and low cost method for conservation of traditional crop varieties" Published by ICAR-National Bureau of Plant Genetic Resources, Regional Station Shillong.
4. HAJONG, S., G.D. HARISH AND D. L. BIATE. 2021. Compiled and published booklet "Effective conservation of medicinal & aromatic plants at ICAR-NBPGR RS, Shillong" Published by ICAR-National Bureau of Plant Genetic Resources, Regional Station Shillong.

Research papers published: 6(six)

5. BHANDARI, A., H. SINGH, A. SRIVASTAVA, P. KUMAR, G. S. PANWAR AND A. A. MAO. 2021. In vitro propagation and cytological analysis of *Sophora mollis* Royle: an endangered medicinal shrub. Journal of Genetic Engineering and Biotechnology, 19: 40. <https://doi.org/10.1186/s43141-021-00140-3>
6. 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
7. 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.
8. GOGOI, R., N. SHERPA, B.B.T. TNAM, C.DEORI AND S.R. TALUKDAR Recollection of *Impatiens angustiflora* (Balsaminaceae) and notes on its lectotypification. *Nelumbo* 62(2): 154-160
9. ODYUO, N., D.K. ROY, R. LYTAN, 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
10. PAGAG, K., D. VIJAYAN AND A.A. MAO. 2020. Phytochemical studies of leaves and roots (*In vitro*) of endemic orchid *Arachnis senapatiana* (Phukan & A. A. Mao) Kocyan & Schuiteman. Journal of Pharmacognosy and Phytochemistry 9(6): 1465-1467.

Articles Published: 03(Three)

11. DEORI, C. 2020. Obituary, Tynjuh Mawbor Hynniewta. *Nelumbo* 62(1): 107-110
12. LAKSHMINARASIMHAN, P., N. ODYUO, C. DEORI, D. VIJAYAN, D. L. BIATE, AND K. N. GANDHI. 2020. "A report on the fourth Botanical Nomenclature course organized by the Botanical Survey of India at Shillong". *Harvard Papers in Botany* 25(1): 75-78
13. LAKSHMINARASIMHAN, P., N. ODYUO, C. DEORI, D. VIJAYAN, D. L. BIATE AND K. N. GANDHI. 2020. A Report on the Fourth Botanical Nomenclature Course Organized by the Botanical Survey of India at Shillong. *J. Jpn. Bot.* 95(5): 315–317

Abstracts in conference proceedings published:9(nine) in the souvenir of 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 during March 5-7. 2021.

14. AGRAWALA, D.K., J.S.JALAL,C.DEORI AND A. BHATTACHARJEE. 2021. Taxonomic studies on Indian Orchidaceae. Pg. 4.
15. CHAKRABORTY, O., D.K. AGRAWALA, J.S. JALAL, C.DEORI AND A. BHATTACHARJEE. 2021. Taxonomic studies on the genus *Stereochilus* Lindl.(Orchidaceae) in India. Pg. 131
16. CHAKRABORTY, S., D.K.AGRAWALA, J.S.JALAL, C. DEORI AND A. BHATTACHARJEE. 2021. The genus *Epipactis* Zinn (Orchidaceae) in India Pg. 135
17. DEORI, C. AND S. R. TALUKDAR. 2021. Diversity, conservation and sustainable utilization of orchid flora of community forests of west and south –west khasi hills districts of Meghalaya, India. Pg. 72.
18. DEVI, K. SANGEETA, DAVID L. BIATE, S. HAJONG, D. K. ROY, D. VIJAYAN, A. A. MAO. 2021. Revisiting the *Arundina garminifolia* (Orchidaceae) species complex using microsatellite (ISSR) markers. Pg. 28.

19. NAYAK, S., D.K. AGRAWALA, J.S. JALAL, C.DEORI AND A. BHATTACHARJEE. 2021. Notes on the *Bulbophyllum odoratissimum* complex in India. 2021.Pg. 132
20. ROY, RIJUPALIKA, D.K. AGRAWALA, J.S. JALAL, C.DEORI AND A. BHATTACHARJEE. 2021. *Galeola* Lour.(Orchidaceae)-A myco-heterotrophic genus in India. Pg. 134.
21. SARKAR, S., D.K.AGRAWALA, J.S. JALAL, C.DEORI AND A.BHATTACHARJEE. 2021. Taxonomic studies on the genus *Acanthephippium* Blume(Orchidaceae) in India. Pg. 136
22. SENGUPTA, S., D.K. AGRAWALA, J.S. JALAL, C.DEORI AND A. BHATTACHARJEE. 2021. Species with confusing identity within the genus *Phalaenopsis* Blume(Orchidaceae) in India. Pg. 133.

Abstracts in conference proceedings accepted:9(nine) for the National seminar on Plant Taxonomy and Traditional Knowledge in the Himalayas and North-East India and Annual Conference of East Himalayan Society for Spermatophyte Taxonomy (Taxo-Club) on 24- 25th April, 2021 organized by Dept. of Botany, Rajiv Gandhi University, Arunachal Pradesh, India.

23. CHAKRABORTY, K., A. GHOSH, H. SINGH, D. TUDU, VIJAY, L. I. CHANU, C. DEORI, N. ODYUO. 2021. Diversity of the family Orchidaceae conserved in ASSAM Herbarium, Botanical Survey of India
24. DAWANRI MARWEIN. 2021. “*In vitro* propagation and genetic fidelity assessment of regenerated plants of *Rhododendron formosum* Wall. - an endemic plant to Meghalaya”,
25. DEBALA TUDU, KANKANA CHAKRABORTY, HARMINDER SINGH, VIJAY, L. IBEMHAL CHANU, CHAYA DEORI and N.ODYUO. 2021. Herbarium specimens of the family Zingiberaceae conserved in ASSAM.
26. KANKANA CHAKRABORTY*, ARIJIT GHOSH, HARMINDER SINGH, DEBALA TUDU, VIJAY, L. IBEMHAL CHANU CHAYA DEORI, N. ODYUO. 2012. Diversity of the family Orchidaceae conserved in ASSAM Herbarium, Botanical Survey of India.
27. LARIMA STEN AND DEEPU VIJAYAN. 2021.“Phytochemical screening, antioxidant activity, TLC and UHPLC fingerprinting of methanolic extract of *Quercus semiserrata* Roxb. from Northeast India”
28. SARMA, N., S.R.TALUKDAR, C. DEORI AND N.ODYUO. 2021. Endemic and economically important preserved specimens present in the Museum of Botanical Survey of India, Eastern Regional Centre, Shillong-793003, Meghalaya
29. SENSARMA, S. AND C. DEORI. 2021. Genus : *Ficus* Subgenus: *Sycomorus* in Northeast India: Taxonomy, Distribution and Economic importance
30. TUDU, D., K. CHAKRABORTY, H. SINGH, VIJAY, L. I. CHANU, C. DEORI and N.ODYUO. 2021. Herbarium specimens of the family Zingiberaceae conserved in ASSAM.
31. VIJAY, S. R. TALUKDAR, L. I. CHANU, D. TUDU, K. CHAKRABORTY, C. DEORI AND N. ODYUO. 2021. Classification, Species Diversity and Economic Importance of Poaceae present in ASSAM Herbarium

Research Papers Accepted: 2(two)

32. PATHAK, A., R. DAS, K. KHONGLAM, C. WAHLANG, D. VIJAYAN, N. ODYUO D.L. BAITE AND A.A.MAO. 2021. UHPLC analysis and *in vitro* biological activities of *Areca triandra*Roxb. ex Buch.-Ham.: a substitute of areca nut. Research Journal of Biotechnology (2021)
33. PRASAD, G., T. SEAL, A. A MAO, D. VIJAYAN AND A. LOKHO. 2021. Assessment of clonal fidelity and phytomedicinal potential in micropropagated plants of *Bulbophyllumodoratissimum* - an endangered medicinal orchid of Indo Burma megabiodiversity hotspot. *South African Journal of Botany*.

Research Paper communicated:2(two)

34. HAJONG, K.S. DEVI, R. L. DARNEI, D.L. BIATE, A. PANDEY, G.D. HARISH. 2021. Genetic variation in Sohphlang (*Flemingia procumbens* Roxb.) genotypes revealed by agromorphological traits and ISSR molecular markers. African Journal of Botany.
35. ROY, D. K., R. LY TAN, D. L. BIATE AND N.ODYUO. 2021. *Stadiochilus* R.M. Sm. (Zingiberaceae: Zingiberaceae), a new generic record for India. Communicated to Check List

HERBARIUM INFORMATION, ERC, SHILLONG (April 2020-March, 2021)

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.

Hindi Divas Celebration

- भारतीयवनस्पतिसर्वेक्षण,पूर्वीक्षेत्रीयकेंद्रशिलांग,मेंहिन्दीपखवाड़ा 2020 आयोजनकाविवरण
भारतीयवनस्पतिसर्वेक्षणकेपूर्वीपरिमंडलमेंहिन्दीपखवाड़ाकाआयोजनदिनांक(01सितंबर 2020 से 14 सितंबर 2020)केबीचउत्साहपूर्वकमनायागया।प्रत्येकवर्षकीभातिइसवर्षसर्वव्यापीमहामारीकोविड -19 बीमारीकेकारणकार्यालयद्वाराविभिन्नप्रकारकेप्रतियोगिताओंकाआयोजननहींकियाजासका।इसदौरानकार्यालयपरिसरमेंएक मात्रपठन-पाठनप्रतियोगिताकाआयोजनसर्वव्यापीमहामारीकोविड-19 कोमदेनजररखतेहुयेमानकप्रचालनप्रक्रिया (एस.ओ.पी.)काउपयोगकरतेहुयेकियागयाइसमेंमुद्दासर्वव्यापीमहामारीकोविड -19 बीमारीसेसंबन्धितजागरूकतारखागयाजिसमेंसभीप्रतिभागियोंनेबढ़चढ़करहिस्सालियाएवंविभिन्नप्रकारसेअपनेविचारप्रस्तुत किए।

Vigilance Awareness Week

- Vigilance Awareness Week (27th October to 2nd November, 2020) was observed on 27th October 2020 with integrity pledge with theme "Vigilant India, Prosperous India" and was attended by all officers and staff of ERC, Shillong.

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, ERC, Shillong (April 2020-March, 2021)

A. PUBLIC SERVICE RENDERED

- Identification and authentication: **c. 84** specimens of angiosperms, pteridophytes, were authenticated.
- Visitors attended: **c. 83** visitors including VIPs, dignitaries, 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/-**
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• 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 thyriflorus* (20 nos.), *Podocarpus neriifolius*(5 nos.), *Pyruspashia* (14 cuttings), *Rauwolfia 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/SYMPIOSIUMS/CONFERENCES/MEETINGS ATTENDED BY BSI OFFICIALS, ERC, Shillong

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, Laitumkrah, 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

Dr. Dilip Kr. Roy, Botanist

Mr. Hemanta Kr. Das, Library and Information Assistant

- tnepoleveD elbaniatsUS dna ecruoseroiB fo etutitsnI yb desinagro noitibihxe dihcrO ni detapicitraP, gnollihS reppU, ayalahgeM, gnollihS reppU, no ayalahgeM25 fo ^{ht}February2021

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, Laitumkrah, 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.
- tnepoleveD elbaniatsUS dna ecruoseroiB fo etutitsnI yb desinagro noitibihxe dihcrO ni detapicitraP, gnollihS reppU, ayalahgeM, gnollihS reppU, no ayalahgeM25 fo ^{ht}February2021.
- Attended 16(Sixteen) webinars organised by Botanical Survey of India and other institutions.

Smti. 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.
- tnepoleveD elbaniatsUS dna ecruoseroiB fo etutitsnI yb desinagro noitibihxe dihcrO ni detapicitraP, gnollihS reppU, ayalahgeM, gnollihS reppU, no ayalahgeM25 fo ^{ht}February2021.
- 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.

- tnepoleveD elbaniatsuS dna ecruseroiB fo etutitsnI yb desinagro noitibihxe dihcrO ni detapicitraP, gnollihS reppU, ayalahgeM, gnollihS reppU, no ayalahgeM25 fo ^{ht}February2021.
- Attended 12(twelve) webinars organised by Botanical Survey of India and other institutions.

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.
- tnepoleveD elbaniatsuS dna ecruseroiB fo etutitsnI yb desinagro noitibihxe dihcrO ni detapicitraP, gnollihS reppU, ayalahgeM, gnollihS reppU, no ayalahgeM25 fo ^{ht}February2021.
- 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.
- tnepoleveD elbaniatsuS dna ecruseroiB fo etutitsnI yb desinagro noitibihxe dihcrO ni detapicitraP, gnollihS reppU, ayalahgeM,gnollihS reppU , no ayalahgeM25 fo ^{ht}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 planiculule* (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 leaf), *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.

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.

Achievements/ 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.

Research Based Publications related to the allotted project only: NA

PROJECT: 2

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

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

Duration of project: 1st April 2020 to 31st 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.

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): 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.

Research Based Publications related to the allotted project only: NA

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.) Kangan 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. The progress report given below.

Achievements/ Outcomes :

Manuscripts of 17 families received from different contributors through publication section and four families prepared by me along with other contributors from ISIM. All the manuscript are updated, recent publication data incorporated,

edited as per flora of India guidelines, 30 photo plates prepared and 167 illustrations, reviewed, corrected and formatted as press ready document.

Final Report of Flora of India vol. 22 submitted to HQRS in Hard as well as soft copy on 29.10.2020. The Report contains i-xxix; 1-785 pages, 30 Photo Plates and 167 illustrations.

Photographs provided to Flora of India vol. 18(eight images), 21(thirteen images), 31 & 32(Thirty three images)

Project 4: Checklist of Flora of India vol. 22

Checklist of Flora of India vol. 22 edited, compiled along with contribution of four families. Bibliography of Flora of India Checklist Vol. 22 prepared and submitted.

4. 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
ISIM	3	1	1	-----	----	----	1	----	----

Paper published: Four (4)

1. Sarvanan, R., Kannan, D., Panda, S.P., Datta, S. (2020). Traditionally used wild edibles plants of Kluldiha Wildlife Sanctuary, Odisha, India. *Journal of Pharmacognosy & Phytochemistry* 6: 482-488.
2. Datta, S. & T. Seal (2020) Effect of solvent extraction in antioxidant activity and RP-HPLC based study of phenolic acids and flavonoids in *Cayratia trioloia* (L.) Domin. *Journal of Pharmacognosy and Phytochemistry.*; 9(6): 896-900.
3. Pagag, K and S.K. Borthakur. Macrophytes of the wetlands of Lakhimpur district, Assam (2020). *International J. of Bot. and Res.* 10(2): 65-72. Doi: 10.24247/ijbrdec20208
4. Pagag K., Vijayan Deepu & A. A. Mao (2020). Phytochemical studies of leaves and roots (*in vitro*) of endemic orchid *Arachnis senapatiana* (Phukan & A.A. Mao) Kocyan & Scuiteman. *Journal of Pharmacognosy and Phytochemistry* 9(6). 9-6-1465-1467. Doi:10.22271/phyto.2020.v9.i6u.13155.

Book chapter published: Four (4)

1. Malick, K. C. & M. Bhaumik (2019). ‘Scrophulariaceae’ in *Fl. West Bengal* vol. 4. P. Lakshminarasimhan et al (eds) pp. 96-136. BSI. Kolkata.
2. Mandal, S.K. & M. Bhaumik (2019). ‘Lentibulariaceae’ in *Fl. West Bengal* vol. 4. P. Lakshminarasimhan et al (eds) pp. 140-147. BSI. Kolkata.
3. Bhaumik, M. (2019). ‘Plantaginaceae’ in *Fl. West Bengal* vol. 4. P. Lakshminarasimhan et al (eds) pp. 360-361. BSI. Kolkata.
4. Murmu, S. & M. Bhaumik (2019). ‘Polygonaceae’ in *Fl. West Bengal* vol. 4. P. Lakshminarasimhan et al (eds) pp. 396-416. BSI. Kolkata.

In Hindi: One (1)

1. नन्दिताशर्मा,

कांगकानपगागएवंसुरेन्द्रकुमारशर्मा, 2020.

असमकेलोगोंद्वारात्चचाकीदेखभालऔरसैंदर्योकरणकेलिएपौधोंकापारंपरिकउपयोग. वनस्पतिवाणी।

5. Digitisation of Herbarium Specimens and Database: NIL

6. Maintenance of Herbaria:

Herbarium	1	2	3	4	5	6	7	8	9	10	11	12	13
ISIM	170	Nil	Nil	1765	1730	108	145	Nil	Nil	Nil	Nil	Nil	Nil

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.

7. 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

8. 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 Sinchona sample. 3. Aditya Goswami	---	----	----	----	Rs.38800/- for 77 samples.

&Debapriya Ghosh both Architects from Architectonic Services visited Botanical gallery on 21.10.2020 regarding planning of Antarctica Gallery at 4 th Floor, ISIM.					
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9. Training/Exhibition participated:

Circle/Section	No. and name of training programme participated, if any	No. and name of training programme imparted, if any	No. and name of exhibition participated, if any	No. and name of exhibition conducted, if any
ISIM		NIL	Nil	

10. Special Information (Findings)

- a. New Species/New varieties discovered: Nil
- b. New Records for India. One
- c. New Records for State. Nil
- d. Species collected after 50 years or more. Nil

11. Work done by Indian Botanical Liaison Officer, Royal Botanic Garden, Kew, UK : NIL

12. Progress of Research Fellows working under 'Flora of India': NIL

- Name of the Research Fellow and name of the Guide
- Name of the project with estimated number of genera, species and variety
- Brief description of the project and progress made during the period

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 Lalgargh, Dr. P. Ghosh HOD Botany Seva Bharati Mahavidhyalay, Kapgari, 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**

During this period seven online 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 Webniar 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.

NORTHERN REGIONAL CENTER

PROJECT 01

April 2020 to September 2020.

1. **Name of the Project:** Pictorial Flora of Pteridophytes of Uttarakhand
2. **Executing Scientist :** Dr B. S. Kholia
3. **Duration of the project :** (2018 – 2021)
4. **About the work done :**

4.1 Introduction: Uttarakhand is a hilly Himalayan state of India formed in November 2000 after annexing from Uttar Pradesh; it comprises two regions Kumaun and Garhwal. Pteridophytes are the second highest group of vascular plant in Uttarakhand, they can be seen in everywhere from plains to alpine region, however, their diversity is more in montane and subalpine broad leaved forests. The Pteridophytes of Uttarakhand are yet not documented properly. Though there are several regional or district floras and checklists but most of them lacking full illustrations or coloured images. Further, most of these works were completed before 1990 and now outdated due to recent nomenclature changes and several novelties in Ferns and Fern-allies. Furthermore, recently many remote localities are now connected to the network of roads, on the one hand this facilitated the reach of botanists in many plant rich zones and new habitats, on the other hand the structure of vegetation is changed due these recent developmental activities, climate change and invasion of alien flora etc. Therefore, all the previous works from Uttarakhand are needed to be updated. 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.

- 4.2 **Literature:** Earlier published research papers and scattered publication pertinent to Uttarakhand.
- 4.3 **Objective:** To prepare a pictorial guide of Pteridophytic flora of Uttarakhand.
- 4.4 **Site of the study (with map):** Uttarakhand



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

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

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

4.9 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.

B. Research Publications (in *Nelumbo* format): (see annexure I)

A. October 2020 to March 2021

1. Name of the Project: Pteridophytic Flora of India

2. Executing scientist (s) : B. S. Kholia

3. Duration of the project : 2020-2023

4. About the work done :

4.1 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.

4.2 Literature: After the initial reports of Wallich (1828), Beddome (1865-1892), Clarke 1880, documented the Pteridophytic flora of India nearly more than hundred years ago. In subsequent years as well as after Indian independence detailed Pteridophytic flora of India was not published, though there are some checklists Dixit 1984, Chandra 2004, Fraser-Jenkins 1997, 2008, Fraser Jenkins *et al.*, 2017, 2018, 2020.

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

4.4 Site of the study (with map): India



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

4.6 Achievements including:

- u. **Total area covered :** Entire India
- v. **Number of tours undertaken:** N.A.
- w. **Number of species collected:** N.A.
- x. **Number of species identified (with name)/ Described:** Description of c. 30 species was completed towards the Pteridophytic flora of India.
- y. **Number of species incorporated:** 1479 Herbarium sheets of Pteridophytes.

4.7 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.

4.8 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.

B. Research Publications (in *Nelumbo* format): (see annexure I)

PROJECT 02

A. April 2020 – September 2020

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

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

3.Duration of the project: 2020 – 2021

4. About the work done: Literature survey, herbarium survey and procurement of protologues of all the species of Zingiberaceae. Description writing of 34 species of genus *Zingiber* (6), *Curcuma* (5), *Amomum* (4), *Hedychium* (8), *Globba* (11). Morphological study of live specimens of Zingiberaceae conserved in BSI, NRC garden.

4.1 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.

4.2 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.

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

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



4.5 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.

a. New Methodology (if any) adopted: Nil.

4.6 Achievement including: Procurements of protologues of all species of Zingiberaceae. Description writing of 34 species of various genera (*Zingiber*, *Curcuma*, *Amomum*, *Hedychium*, *Globba*)

a. Total area covered: N.A.

b. Number of tours undertaken: N.A.

c. Number of species collected: N.A.

d. Number of species identified (with name): N.A.

e. Number of species incorporated: N.A.

4.7 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 34 spp. various genera (*Zingiber*, *Curcuma*, *Amomum*, *Hedychium*, *Globba*) of Zingiberaceae.

4.8 Major impacts reported during the financial year: Completed description writing of 34 species. Prepared dichotomous key for genus *Zingiber*, *Curcuma*, *Amomum*, *Hedychium*, *Globba*. The project will be useful for further studies on plants of Zingiberaceae from applied point of view.

B. Research Publications (in *Nelumbo* format): Nil.

A. October 2020 – March 2021

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

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

3.Duration of the project: 2020 – 2021

4.About the work done: Description writing of 118 spp. and two variety of genus *Zingiber* (31), *Curcuma* (35), *Amomum* (14), *Miestera* (14), *Wurfbania* (2), *Hedychium* (4 spp. & 1 var.), *Hellenia* (4), *Caulokaemferia* (5), *Cautleya* (2 spp. & 1 var.), *Elettaria* (2), *Etingera* (3), *Globba* (8 spp. & 1 var.)

4.1 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 work of preparation of descriptive flora of Zingiberaceae of India is undertaken to provide a complete account for the family.

4.2 Literature: As mentioned before.

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

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



4.5 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.

a. New Methodology (if any) adopted: Nil.

4.6 Achievement including: Description writing of 118 species and two varieties of various genera (*Zingiber*, *Curcuma*, *Amomum*, *Miestera*, *Wurfbania*, *Hedychium*, *Hellenia*, *Caulokaemferia*, *Cautleya*, *Elettaria*, *Etingera*, *Globba*) completed.

a. Total area covered: N.A.

b. Number of tours undertaken: N.A.

c. Number of species collected: N.A.

d. Number of species identified (with name): N.A.

e. Number of species incorporated: N.A.

4.7 Output indicators for the assessment of the project: Study of all procured literature of all species. Completed description writing including, phenology, distribution and notes of 118 species and

two varieties of various genera (*Zingiber*, *Curcuma*, *Amomum*, *Miestera*, *Wurfbania*, *Hedychium*, *Hellenia*, *Caulokaemferia*, *Cautleya*, *Elettaria*, *Etingera*, *Globba*) of Zingiberaceae.

4.8 Major impacts reported during the financial year: Completed description writing of 118 species and two varieties. Prepared dichotomous key for genus *Zingiber*, *Curcuma*, *Amomum*, *Miestera*, *Hedychium*, *Bosenbergia*, *Globba*. The project will be useful for further studies on plants of Zingiberaceae from applied point of view.

B. Research Publications (in *Nelumbo* format): Nil.

PROJECT 03

A. April 2020 – September 2020

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

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

3.Duration of the project: 2020 – 2023

4.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.

4.1 Introduction : The genus *Taraxacum* F.A. Wigg., with its large geographical range covers most of the extra-tropical Northern Hemisphere (and scattered in temperate regions of Southern Hemisphere), its enormous sectional diversity and about 3500 published species names (approximately 2500 species), and various combinations of reproduction systems, represents a challenge for plant biologists and taxonomists. The European *Taraxacum* sections, at least in the northern two thirds of Europe, are known to a considerable extent, and many species were studied also from the viewpoint of their mode of reproduction, ploidy level, variation and distribution patterns. In Asia, on the contrary, there are many regions where even the basic taxonomic exploration remains in its infancy. It should be emphasized that the West Himalaya is a territory harboring a substantial part of the sectional diversity of dandelions. There are about 60 sections recognized in *Taraxacum*, and twenty one are recorded in the West Himalaya (Kirschner et al. 2020). We therefore use this unique opportunity to be the first to evaluate the *Taraxacum* taxonomy in rich areas of alpine Himalayas. Tentative estimation of species of *Taraxacum* in Indian Himalayas is c. 100 species.

4.2 Literature: (a) Acquired 45 research articles on morphology, anatomy, and evolution of *Taraxacum* in Western Himalayas (b) Procured protologues description of 75 species of *Taraxacum* found in Western and Eastern Himalaya and surrounding region. (c) Preparation of distinguishable character classification table for the genus *Taraxacum*.

4.3 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.

4.4 Site of the study (with map) :



4.5 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.

4.6 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.

4.7 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.

a.Total area covered: Nil

b.Number of tours undertaken: Nil

c.Number of species collected: Nil

d.Number of species identified (with name): Nil

e.Number of species incorporated: Nil

4.8 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

4.9 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.

B. Research Publications (in *Nelumbo* format): Nil.

A. October 2020 – March 2021

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

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

3.Duration of the project: 2020 – 2023

4.About the work done: 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.

4.1 Introduction : The genus *Taraxacum* F.A. Wigg., with its large geographical range covers most of the extra-tropical Northern Hemisphere (and scattered in temperate regions of Southern Hemisphere), its enormous sectional diversity and about 3500 published species names (approximately 2500 species), and various combinations of reproduction systems, represents a challenge for plant biologists

and taxonomists. The European *Taraxacum* sections, at least in the northern two thirds of Europe, are known to a considerable extent, and many species were studied also from the viewpoint of their mode of reproduction, ploidy level, variation and distribution patterns. In Asia, on the contrary, there are many regions where even the basic taxonomic exploration remains in its infancy. It should be emphasized that the West Himalaya is a territory harbouring a substantial part of the sectional diversity of dandelions. There are about 60 sections recognized in *Taraxacum*, and twenty one are recorded in the West Himalaya (Kirschner et al. 2020). We therefore use this unique opportunity to be the first to evaluate the *Taraxacum* taxonomy in rich areas of alpine Himalayas. Tentative estimation of species of *Taraxacum* in Indian Himalayas is c. 100 species.

4.2 Literature: (a) Study of acquired protologue of species. SEM study of achenes of available species. (b) Preparation of distribution maps for targeted collection. (c) Preparation of distinguishable character classification table for the genus *Taraxacum*.

4.3 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.

4.4 Site of the study (with map) :



4.5 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.

4.6 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.

4.7 Achievements including: 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.

a. **Total area covered:** Nil.

b. **Number of tours undertaken:** Nil.

c. **Number of species collected:** Nil.

d. **Number of species identified (with name):** Nil.

e. **Number of species incorporated:** Nil.

4.8 Output indicators for the assessment of the project: 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.harbhajansinghii* Soest.

4.9 Major impacts reported during the financial year: Preparation of distinguishable character classification table for 75 species of the genus *Taraxacum*. Prepared GIS and RS based distribution mapping for 34 species 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.

B. Research Publications (in *Nelumbo* format): Nil.

PROJECT 04

A. April 2020 – September 2020

1. 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.

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

3. Duration of the project: July 2020- September 2020

4. About the work done:

4.1. Introduction: The family Ranunculaceae is best regarded as a group of ornamental plants and many of the species are of medicinal value. The species of Ranunculaceae are distributed nearly all over the world and represented by 56 genera and 2100 species (Mabberley, 2017), including 19 monotypic genera (Tamura, 1993). About 28 genera and 192 species are distributed in various part of India, with preponderance in Himalayan regions. Two genera, namely *Ranunculus* L. and *Thalictrum* Tourn. ex L. are taken up in the present study which are represented by 65 species (44 taxa of *Ranunculus* + 21 species of *Thalictrum*) in India (Rau, 1993; Srivastava, 2010) and majority of them (40 taxa) are represented in western Himalaya [Hooker & Thomson (1875), Collett (1921), Nair (1977), Chowdhery & Wadhwa (1984), Rau (1993), Aswal & Mehrotra (1994), Dhaliwal & Sharma (1999), Uniyal (2002), Kaur & Sharma (2004), Singh & Sharma (2006), Uniyal & al. (2007), Chandra Sekar & Srivastava (2009), Srivastava (2010), Chawla & al. (2012), Srivastava & Shukla (2015), Pusalkar & Srivastava (2018), Singh (2018), Sinha & al. (2019)]. While doing the floristic works for different states in jurisdiction of Northern regional centre of BSI, it has been observed that opinions on species and infraspecific delimitation and their taxonomic treatment varies and inconsistent among the various workers. These inconsistencies are much prevalent particularly in genus *Ranunculus* and *Thalictrum*, e.g. *Ranunculus cymbalariae* Pursh has been synonymised under *Halerpestes cymbalaria* (Pursh) Greene; *Ranunculus pulchellus* complex; synonymy of *Ranunculus tricuspis* Maxim., *Thalictrum reniforme* Wall. and many more. These taxonomical aspects of the species needed detailed intensive study supported by SEM as the anomalies might be due to lack of comprehensive and detailed micro morpho-structural studies. Achene is treated as 'An indehiscent pericarpium, or fruit, with a pericarp contiguous to the seed(s)' (Spjut, 1994; Simpson, 2006). 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.

4.2. Literature: Fourty taxa of the genus *Ranunculus* and 20 species of *Thalictrum* are represented in North-West Himalaya [Hooker & Thomson (1875), Collett (1921), Nair (1977), Chowdhery & Wadhwa (1984), Rau (1993), Aswal & Mehrotra (1994), Dhaliwal & Sharma (1999), Uniyal (2002), Kaur & Sharma (2004), Singh

&Sharma (2006), Uniyal & al. (2007), Chandra Sekar & Srivastava (2009), Srivastava (2010), Chawla & al. (2012), Srivastava & Shukla (2015), Pusalkar & Srivastava (2018), Singh (2018), Sinha & al. (2019)]. Spjut (1994), Mourad & al. (2000), Shehata & Turki (2001), Simpson (2006) and Emadzade (2010) highlighted the significance of SEM study of achene in different members of Ranunculaceae.

4.3. 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.

4.4. 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.

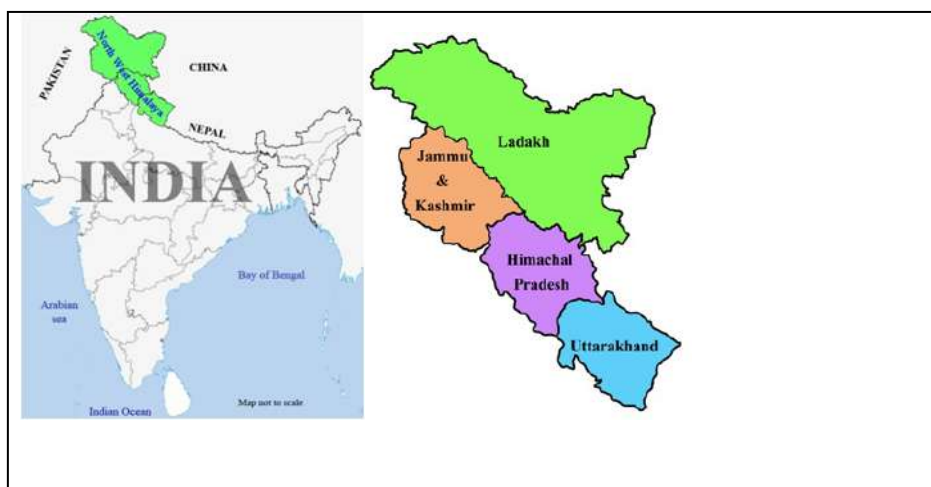


Fig.: Map of North-West Himalaya (map not to the scale)

4.5. 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).

4.6. Achievements including:

- a. **Total area covered:** North-West Himalaya
- b. **Number of tours undertaken:** NA. (It was a herbarium based study).
- c. **Number of species collected:** NA
- d. **Number of species identified (with name):** 15 species
- e. **Number of species reincorporated:** 49 specimens

4.7. 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].

4.8. 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.

B. Research Publications (in *Nelumbo* format): Nil.

A. October 2020 – March 2021

1. 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.

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

3. Duration of the project: July 2020- September 2020

4. About the work done:

4.1. Introduction: The family Ranunculaceae is best regarded as a group of ornamental plants and many of the species are of medicinal value. The species of Ranunculaceae are distributed nearly all over the world and represented by 56 genera and 2100 species (Mabberley, 2017), including 19 monotypic genera (Tamura, 1993). About 28 genera and 192 species are distributed in various part of India, with preponderance in Himalayan regions. Two genera, namely *Ranunculus* L. and *Thalictrum* Tourn. ex L. are taken up in the present study which are represented by 65 species (44 taxa of *Ranunculus* + 21 species of *Thalictrum*) in India (Rau, 1993; Srivastava, 2010) and majority of them (40 taxa) are represented in western Himalaya [Hooker & Thomson (1875), Collett (1921), Nair (1977), Chowdhery & Wadhwa (1984), Rau (1993), Aswal & Mehrotra (1994), Dhaliwal & Sharma (1999), Uniyal (2002), Kaur & Sharma (2004), Singh & Sharma (2006), Uniyal & al. (2007), Chandra Sekar & Srivastava (2009), Srivastava (2010), Chawla & al. (2012), Srivastava & Shukla (2015), Pusalkar & Srivastava (2018), Singh (2018), Sinha & al. (2019)]. While doing the floristic works for different states in jurisdiction of Northern regional centre of BSI, it has been observed that opinions on species and infraspecific delimitation and their taxonomic treatment varies and inconsistent among the various workers. These inconsistencies are

much prevalent particularly in genus *Ranunculus* and *Thalictrum*, e.g. *Ranunculus cymbalariae* Pursh has been synonymised under *Halerpestes cymbalaria* (Pursh) Greene; *Ranunculus pulchellus* complex; synonymy of *Ranunculus tricuspis* Maxim., *Thalictrum reniforme* Wall. and many more. These taxonomical aspects of the species needed detailed intensive study supported by SEM as the anomalies might be due to lack of comprehensive, and detailed micro morpho-structural studies. Achene is treated as ‘An indehiscent pericarpium, or fruit, with a pericarp contiguous to the seed(s)’ (Spjut, 1994; Simpson, 2006). 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.

4.2. Literature : Forty taxa of the genus *Ranunculus* and 20 species of *Thalictrum* are represented in North-West Himalaya [Hooker & Thomson (1875), Collett (1921), Nair (1977), Chowdhery & Wadhwa (1984), Rau (1993), Aswal & Mehrotra (1994), Dhaliwal & Sharma (1999), Uniyal (2002), Kaur & Sharma (2004), Singh & Sharma (2006), Uniyal & al. (2007), Chandra Sekar & Srivastava (2009), Srivastava (2010), Chawla & al. (2012), Srivastava & Shukla (2015), Pusalkar & Srivastava (2018), Singh (2018), Sinha & al. (2019)]. Spjut (1994), Mourad & al. (2000), Shehata & Turki (2001), Simpson (2006) and Emadzade (2010) highlighted the significance of SEM study of achene in different members of Ranunculaceae.

4.3. 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.

4.4. 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.

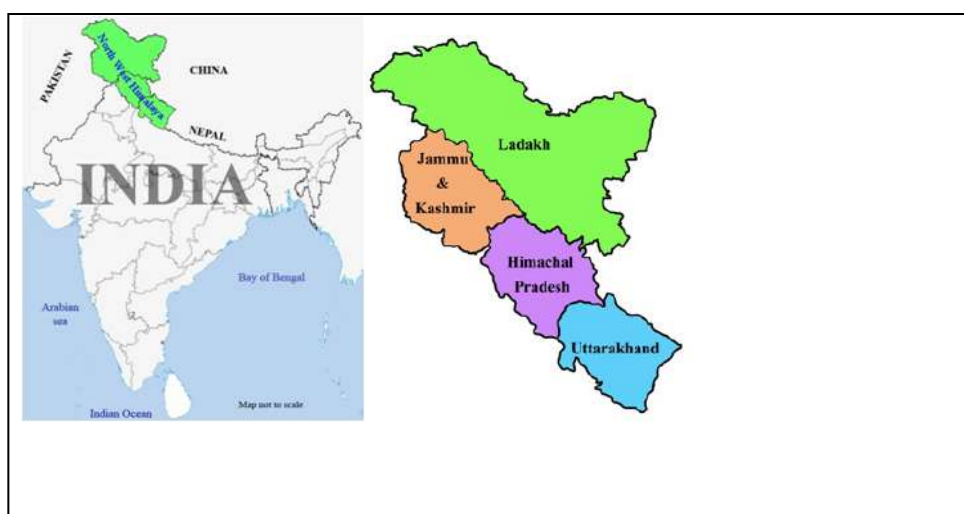


Fig.: Map of North-West Himalaya (map not to the scale)

4.5. 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).

4.6. Achievements including:

a. Total area covered: North-West Himalaya

b. Number of tours undertaken: NA. (It was a herbarium based study).

c. Number of species collected: NA

d. Number of species identified (with name): 14 species.

e. Number of species reincorporated: 36 specimens.

4.7. Output indicators for the assessment of the project: Twenty species of genus *Thalictrum* were listed, reported from North-Western Himalayas in published literature. Of these, specimens of only 12 species are available in BSD having achenes with the specimens, whereas specimens of three species viz., *Thalictrum acaule* Jacquem. ex Cambess., *T. chelidonii* DC., *T. elegans* Wall. ex Royle are without achenes. About 295 specimens of *Thalictrum* were scrutinized to select the appropriate samples of achenes of different species. Two species of *Ranunculus* L. and eleven species of *Thalictrum* Tourn. ex 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. *R. sphaerospermus* Boiss. & Blanche [U.C. Bhattacharyya 41020], 2. *R. trilobus* Desf. [B.P. Uniyal 80046] and 1. *Thalictrum alpinum* L. [M.V. Vishwanathan 54734], 2. *T. cultratum* Wall. [B.M. Wadhwa 66992; T.A. Rao 4383; P.K. Pusalkar 103928; U.C. Bhattacharyya 31019; C.M. Arora 49930], 3. *T. foetidum* L. [S.K. Murti & S. Singh 88264; K. Chandra Sekar 100657, 102954; M.A. Rau 50235; B.M. Wadhwa 59287; Prashant K. Pusalkar 105271; B.D. Naithani 55911; P.K. Hajra 87794], 4. *T. foliolosum* DC. [P.K. Deroliya 131628; B.P. Uniyal 92816; J.N. Vohra & Naithani 78223; Bipin Balodi 75035; Bipin Balodi & Megh Singh 67075], 5. *T. javanicum* Blume [S.C. Majumdar & S. Singh 71862; Bipin Balodi 89798], 6. *T. minus* L. [H.J. Chowdhery & B.P. Uniyal 85726], 7. *T. platycarpum* Hook.f. & Thomson [C.L. Malhotra & Bipin Balodi 83356; P.K. Pusalkar 105254], 8. *T. reniforme* Wall. [Bipin Balodi 88786; P.C. Pant & B.P. Uniyal 80413; B.M. Wadhwa 62472; R. Manikandan 117996], 9. *T. rutifolium* Hook.f. & Thomson [H.J. Chowdhery & B.P. Uniyal 86222; M.V. Vishwanathan 54750], 10. *T. saniculiforme* DC. [M.S. Pundir 96857; Pant & Naithani 39535; Bipin Balodi 89510], 11. *T. secundum* Edgew. [B.D. Naithani 37380].

4.8. Major impacts reported during the financial year: Achenes of two species of *Ranunculus* L. and twelve species of *Thalictrum* Tourn. ex L. were observed under SEM for the documentation of the micro-morphological characters along with micro-photographing of the ultra-structure. About 1100 SEM micro-photographs were taken.

PROJECT 05

A. April 2020 – September 2020

1. 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.

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

3. Duration of the project : July 2020-March 2021

4. 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.) Rchb. ex Meisn; *Catamixis baccharoides* Thomson; *Hedychium flavum* Roxb.; *Ipomoea nil* (Linn.) Roth; *Kaempferia parviflora* Wall. ex Baker; *Nervilia crociformis* (Zoll. & Moritz) Seidenf.; *Ophioglossum reticulatum* L.; *Pogostemon pumilus* (Graham); Press; *Rhynchoglossum notonianum* (Wall.) B.L. Burtt; *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 crociformis*, $2n=4x=c$ 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 ($2n=2x=24$)). In rest of the species desirable meiotic stages could not be obtained.

4.1 Introduction : Chromosomes have been recognized as vital characters for a very long time. Many biosystematic studies have over the years included cytological observations. Chromosomal data of living organisms effectively forms an independent data set for phylogenetic analysis and has probably been most useful in the investigation of groups of closely related and morphologically similar organisms. The interpretation, characterization and identification of a cell's complete chromosome set are the initial stages in the process of using chromosomal characters for systematics. Regardless of being the simplest karyotype parameter, the chromosome number offers some distinct magnetism to cytotaxonomists. It is the fastest, economical, and easiest approach to acquire any significant data about the genome of a species. The chromosome number is the best identified and unique cytotaxonomic datum for almost all families and maximum plant genera. Chromosome counting produces reliable and highly reproducible data. Like other karyotype features, it is not influenced by external conditions, developmental phases, age, etc. Alternatively, an odd or unexpected somatic chromosome number usually means meiotic problems or sterility. A careful study of the chromosome number variation associated with a well-established phylogenetic tree can be a powerful tool for understanding the mechanisms of karyotype evolution, and to resolve the ambiguity of the complex taxonomic groups/ species. The study of chromosome numbers in higher plants (*Lilium*) was started by Strasburger in 1882, despite an interval of more than 138 years the determinations of chromosome numbers in higher plants is still far from being complete, as are seen from the well-known 'Indexes of Plant Chromosome Numbers' (IPCN) and 'Chromosome Count Database' (CCDB). 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.

4.2 Literature: Previous chromosome reports, if any were compiled from online and offline chromosome databases (Darlington and Wylie 1955; Fedorov 1969; Ornduff 1966, 1967; Moore 1970, 1971, 1972, 1973, 1974, 1977; Löve and Löve 1974, 1975; Goldblatt 1981, 1984, 1985, 1988; Goldblatt and Johnson 1990, 1991, 1994, 1996, 1998, 2000, 2003, 2006, Kumar and Subramanian 1986; Khatoon and Ali 1993; Rice *et al.* 2015; IPCN 2020) revealed that the basic cytological information is not available in some of the species conserved. Identification of voucher specimens of cytological studied plants species has also been done with the help of National/regional floras and by comparing with specimens housed in BSD.

4.3 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.

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

4.5 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 (Altınordu, 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.

a. Total area covered : NA

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

c. Number of species collected : 20

d. Number of species identified (with name): 18 (*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); *Boeninghausenia albiflora* (Hook.) Rchb. ex Meisn; *Catamixis baccharoides* Thomson; *Hedychium flavum* Roxb.; *Ipomoea nil* (Linn.) 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*,

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

4.6 Output indicators for the assessment of the project: Meiotic and mitotic studies, chromosome counts of threatened conserved species, their evolutionary significance.

4.7 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: 02

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

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

Chromosome count/s New to India: 03

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

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

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

Threatened species studied: 5

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)

B. Research Publications (in *Nelumbo* format): Two papers communicated.

A. October 2020 – March 2021

1. 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.

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

3. Duration of the project : July 2020-March 2021

4. About the work done: The total numbers of species collected for cytologically studies during this period are twenty-five out of which meiotic/mitotic studies were done in nineteen. In addition, cytologically material

of six species collected in the 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, *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.; *Phlomooides 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*, $2n=2x=24$; *Phlomooides 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.

4.1 Introduction: Chromosomes have been recognized as vital characters for a very long time. Many biosystematic studies have over the years included cytological observations. Chromosomal data of living organisms effectively forms an independent data set for phylogenetic analysis and has probably been most useful in the investigation of groups of closely related and morphologically similar organisms. The interpretation, characterization and identification of a cell's complete chromosome set are the initial stages in the process of using chromosomal characters for systematics. Regardless of being the simplest karyotype parameter, the chromosome number offers some distinct magnetism to cytotaxonomists. It is the fastest, economical, and easiest approach to acquire any significant data about the genome of a species. The chromosome number is the best identified and unique cytotaxonomic datum for almost all families and maximum plant genera. Chromosome counting produces reliable and highly reproducible data. Like other karyotype features, it is not influenced by external conditions, developmental phases, age, etc. Alternatively, an odd or unexpected somatic chromosome number usually means meiotic problems or sterility. A careful study of the chromosome number variation associated with a well-established phylogenetic tree can be a powerful tool for understanding the mechanisms of karyotype evolution, and to resolve the ambiguity of the complex taxonomic groups/ species. The study of chromosome numbers in higher plants (*Lilium*) was started by Strasburger in 1882, despite an interval of more than 138 years the determinations of chromosome numbers in higher plants is still far from being complete, as are seen from the well-known 'Indexes of Plant Chromosome Numbers' (IPCN) and 'Chromosome Count Database' (CCDB). 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.

4.2

Literature: Previous chromosome reports, if any were compiled from online and offline chromosome databases (Darlington and Wylie 1955; Fedorov 1969; Ornduff 1966, 1967; Moore 1970, 1971, 1972, 1973, 1974, 1977; Löve and Löve 1974, 1975; Goldblatt 1981, 1984, 1985, 1988; Goldblatt and Johnson 1990, 1991, 1994, 1996, 1998, 2000, 2003, 2006, Kumar and Subramanian 1986; Khattoon and Ali 1993; Rice *et al.* 2015; IPCN 2020) revealed that the basic cytological information is not available in some of the species conserved. Identification of voucher specimens of cytologically studied plants species has also been done with the help of National/regional floras and by comparing with specimens housed in BSD.

4.3 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.

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

4.5 Methodology adopted :

Sample collection -Material for cytological study was collected from the BSI, Botanic garden, adjoining areas and material collected during previous year's 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.

Scanning electron microscope (SEM) studies –SEM study of few species was also done. Pollen grains and seed materials were removed from dried specimens. The pollen grains were prepared for light microscope (LM) by standard methods described by Erdtman (1952). For SEM, pollen grains and seeds were coated with gold-platinum for 6 minutes on an Emitech-SC7620 sputter coater and examined using a Carl Zeiss EVO18 Special Edition scanning electron microscope (SEM) at 20 kV at Botanical Survey of India, Northern Regional Centre, Dehradun, Uttarakhand, India. All measurements were based on 30 pollen grains. Pollen terminology mainly follows Punt, Hoen, Blackmoore, Nilsson & Thomas, (2007). Pollen fertility was estimated using 1:1 glycerol: aceto-carmine mixture (Marks, 1954) and on an average 5-10 slides were scored for stainable pollen grains. Only well-filled pollen grains with well-stained nuclei were taken as apparently fertile and viable. Photomicrographs of pollen grains were also taken by using Olympus C-X41 microscope with attached digital camera.

c. **New Methodology (if any) adopted:** Scanning electron microscope (SEM). Ideogram and karyotype parameters were determined using karyotype software.

4.6 Achievements including :

a. **Total area covered :** NA

b. **Number of tours undertaken :** NIL

c. **Number of species collected :** 24

d. **Number of species identified (with name):** 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.; *Phlomooides 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

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

4.7 Output indicators for the assessment of the project :

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.

4.8 Major impacts reported during the financial year:

Chromosome count/s New to Science: 02

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

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

Chromosome count/s New to India: 01

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: 10

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**)

B. Research Publications (in *Nelumbo* format)

1. KUMAR,PUNEET., H. SINGH AND S.K. SINGH. 2021. Karyomorphological and SEM studies in newly discovered populations of a critically endangered medicinal plant —*Lilium polyphyllum* D. Don ex Royle from a high altitude protected area of north-western Himalaya. *Microscopy Research and Technique*. (*In press*) <https://doi.org/10.1002/jemt.23784> (Impact factor=**2.769**; NAAS RATING=8.12; SCOPUS)
2. KUMAR,PUNEET AND S.K. SINGH. 2021. Pollen Sterility Relatable to Structural Heterozygosity, and SEM Study in Poison Devil Tree (*Alstonia venenata* R.Br.). *Cytologia***86**(2); (*In press*). (Impact factor=**0.795**;NAAS RATING=6.80; SCOPUS)

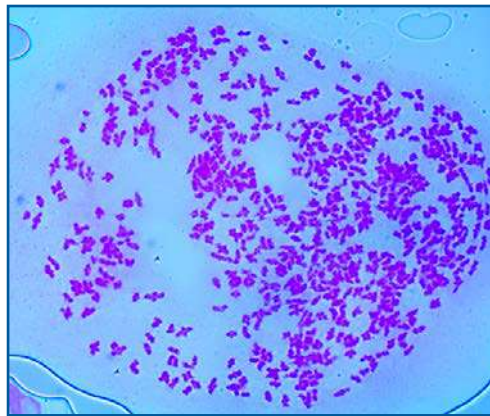


Figure 1. *Ophioglossum reticulatum* L., $n=c$ 630II at Metaphase-I.

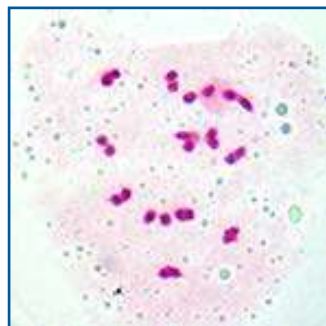


Figure 2. *Gentiana kurroo* Royle L., $n=13$ II at Diakinesis.

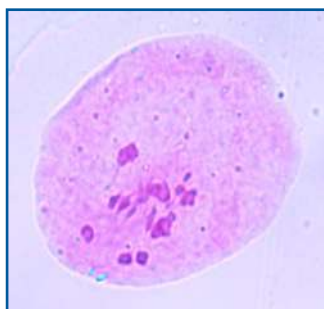


Figure 3. *Pogostemon pumilus* (Graham) Press, $n= 16II$ at Metaphase-I.

PROJECT 06

A. April 2020-September 2020

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

2.Executing Scientist (s) : Dr. Harish Singh

3.Duration of the project : April 2020to March, 2023

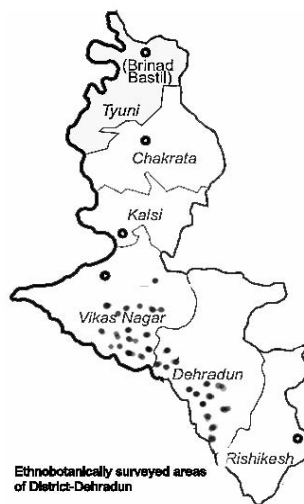
4.About the work done :

4.1 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.

4.2 Literature : 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 (Gaur, 1999; Lata *et al.*, 2008; Pushalkar & Srivastava, 2017), but only few papers have been published on Ethnobotany of Tharu, Bhoxa and indigenous people of *Terai, Bhabar* and plain area of Uttarakhand (Bhujwan *et al.*, 1999; Gaur and Sharma, 2011; Gaur *et al.*, 2010; Maheshwari & Singh, 1990, 1992, 1984; Pant & Pandey, 1995, Prakash & Singh, 2006; Singh, 1988, 1992, 1993, 2003; Singh & Maheshwari, 1992, 1993; Singh, 1999, Singh & Maheshwari, 1990, 1994, Singh and Prakash, 2003, Singh *et al.*, 1987). Collected 116 additional references pertaining to Ethnobotany of Uttarakhand from different sources.

4.3 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.

4.4 Site of the study (with map) :



4.5 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.

4.6 Achievements including:

- a. Total area covered : About 45 sq.km
- b. Number of tours undertaken : One local tour of Dehradun on 26-09-20
- c. Number of species collected : 08 species with ethnobotanical uses
- d. Number of species identified (with name): 08 (*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.)
- e. Number of species incorporated : 08

4.7 Output indicators for the assessment of the project: Monthly report, Tour report, Quarterly report, Annual report

4.8 Major impacts reported during the financial year: This is new project, so impacted will be noted in next year. Even though, 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.

B. Research Publications (in *Nelumbo* format): Nil.

A. October 2020 – March 2021

1. **Name of the Project :** Ethnobotanical study of Tharu and Bhoxa tribe of Uttarakhand, India
2. **Executing Scientist (s) :** Dr. Harish Singh
3. **Duration of the project :** April, 2020 to March, 2023
4. **About the work done :**

4.1 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, Bhoja 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, Bhoja 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.

4.2 Literature : 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 (Gaur, 1999; Lata *et al.*, 2008; Pushalkar & Srivastava, 2017), but only few papers have been published on Ethnobotany of Tharu, Bhoja and indigenous people of *Terai*, *Bhabar* and plain area of Uttarakhand (Bhujwan *et al.*, 1999; Gaur and Sharma, 2011; Gaur *et al.*, 2010; Maheshwari & Singh, 1990, 1992, 1984; Pant & Pandey, 1995, Prakash & Singh, 2006; Singh, 1988, 1992, 1993, 2003; Singh & Maheshwari, 1992, 1993; Singh, 1999, Singh & Maheshwari, 1990, 1994, Singh and Prakash, 2003, Singh *et al.*, 1987). Collected 116 additional references pertaining to Ethnobotany of Uttarakhand from different sources.

4.3 Objectives: Folklore survey and field work in the Tharu, Bhoja 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.

4.4 Site of the study (with map) :



4.5 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.

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

4.6 Achievements including :

- a. **Total area covered** : About 1500 sq.km
- b. **Number of tours undertaken**: conducted two local field tours in Dehradun district among Bhoja tribe on 12-10-20, 23-12-20 and collected 112 field numbers (in duplicate) along with 160 ethnobotanical uses.
- c. 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.
- d. **Number of species collected** : 276 field numbers with ethnobotanical uses
- e. **Number of species identified (with name)** : 87 (*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.) Kuntze, *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.).
- f. **Number of species incorporated** : 87

4.7 Output indicators for the assessment of the project : Monthly report, Tour report, Quarterly report, Annual report

4.8 Major impacts reported during the financial year: This is new project, so impacted will be noted in next year. Even though, 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.

B. Research Publications (in *Nelumbo* format) : Nil

PROJECT 07

A. April 2020 – September 2020

1.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

2.Executing Scientists: Dr. S.K. Singh, Dr. Puneet Kumar & Dr. Purushottam Kumar Deroliya

3.Duration of the project: On-going

4.About the Work done:

4.1 Objectives: Collection tours, introduction and subsequent maintenance of endemic, threatened and economic plant species in the Botanic Gardens.

4.2 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 *Vallisneria 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 species namely, *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 hexapetalus* (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 foliata* 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].

4.7 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

4.8 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.

B. October 2020 – March 2021

1.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

2.Executing Scientists: Dr. S.K. Singh, Dr. Puneet Kumar & Dr. Purushottam Kumar Deroliya

2. Duration of the project: On-going

3. About the Work done:

4.1 Objectives: Collection tours, introduction and subsequent maintenance of endemic, threatened and economic plant species in the Boranic Gardens.

4.2 Achievements: 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* (Forssk.) Aschers. ex Schweinf. and introduced in Botanical garden. In addition of this collected some other plants and introduced in the Botanical Garden namely *Eria alba* Lindl.; *Rhododendron* 02 sp.; *Eria* 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) Brennan 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].

4.7 Output indicators for the assessment of the project: Endemic and threatened plant species are a vital component of plant biodiversity which require immediate human intervention to ensure their long-term survival. Natural and anthropogenic factors are putting in danger such vulnerable plants. 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.

4.8 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 for them. Species which are facing threat or their population in natural habitat is declining 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.

B. Research publication: Nil.

PROJECT 08

A. April 2020 – September 2020

- 1. Name of the Project:** In vitro mass multiplication and propagation and rehabilitation in natural habitat of useful and threatened species of North-West Himalaya.
- 2. Executing Scientist (s):** Dr. Giriraj Singh Panwar & Dr. Bhavana Joshi
- 3. Duration of the project:** 2020-2023
- 4. About the work done:**

- 4.1 Introduction:** The North-Western Himalaya encompasses a wide ecological breadth from subtropical broad leaf forests to alpine grasslands. The region is spread over four Indian states *viz.* Jammu & Kashmir, Himachal Pradesh, Uttarakhand and Ladakh (Union Territory). This wide ecological breadth is a result of combined effect of the range it covers from low-lying hills to high Himalayan mountain with altitudinal range 29°–36° N, 74°– 81° E and moisture regime from cold deserts to rain forests. It covers about 10% of the geographical area, 20% of the forest cover and 40% of the endemic species of the Indian subcontinent. The North-West Himalaya of India is one of the biodiversity hotspots and constitutes nearly 5000 species of angiosperms of which ca. 24% are endemic to the region. It represents nearly 105 species of threatened plant from its different bio-geographical zones. Most of the plant species of this area are of immense economic importance and are being used by the local people for their several requirements since long back. Many of the plant species are being used for the cure of several ailments. Due to their medicinal and other economic importance, these plants are rapidly being depleted from their natural habitat. Most of the plant species of the North-West Himalayas are facing the acute threat and few of them are in the verge of extinction. The economical and medicinal importance of floral diversity of the region has long been mentioned in ancient Hindu texts and has been a subject of curiosity for botanists over the centuries. Rare, Endemic and Threatened plants (RET) are an integral component of the local flora and vegetation, and the disappearance of these species can lead to loss of biodiversity. Therefore, an effective ex-situ conservation strategy is essential to ensure their successful propagation and perpetuation. Thus, these three threatened species were selected for their ex-situ propagation through tissue culture technology.
- 4.2 Literature:** Jalal and Jayanthi, 2015; Jalal et al., 2008; Vij and Verma, 2005; Vij and Verma, 2005; Saxena *et al.*, 2020; Naing *et al.*, 2010; Singh *et al.*, 2019; Singh *et al.*, 2019; Saxena, 2020; Jalal *et al.*, 2008a; Mao and Kharbuli, 2002; Ziemer, 2010.
- 4.3 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.
- 4.4 Site of the study (with map):** NA
- 4.5 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
- 4.6 Achievements including:** The reproducible in vitro propagation protocol was standardized for the targeted species.
- a. Total area covered : NA
 - b. Number of tours undertaken : NA
 - c. Number of species collected : NA
 - d. Number of species identified (with name) : NA
 - e. Number of species incorporated : NA
- 4.7 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.

- 4.8 Major impacts reported during the financial year:** Micropropagation protocols were standardized for the three threatened species viz. *Eulophia dabia*, *N. Khasiana* and *Rhynchosstylis retusa*. Flowering was also reported in the *E. dabia* plants transferred to the open environment.

B. Research Publications: Nil

October 2020 – March 2021

- 1. Name of the Project:** In vitro mass multiplication and propagation and rehabilitation in natural habitat of useful and threatened species of North-West Himalaya.
- 2. Executing Scientist (s):** Dr. Giriraj Singh Panwar & Dr. Bhavana Joshi
- 3. Duration of the project:** 2020-2023
- 4. About the work done:**
 - 4.1 Introduction:** Indian North-West Himalaya is harbouring myriads of floral wealth and as such recognized as a global biodiversity Hot Spot. About 28% plant species are endemic to the country, of which ca. 326 species are from N-W Himalaya and nearly 240 species of the region are listed under various threat categories in the Red Data Book (<http://bsienvis.nic.in>). A large number of plant species domiciled in this region are facing severe threat and few of them are at the verge of extinction due to over exploitation from natural populations by the peoples resides in their vicinity, to meet their various day to day needs and developmental activities and habitat loss. This region abode a large number of ethno-medicinal and medicinal plants having commercial potential, due to that, these plants are exploited from the nature at greater extent by the inhabitants and pharmaceutical industries resulting rapid depletion of their populations in wild. Considering the magnitude of threats inflicted on these valuable plant species, there is urgent need to protect them before they vanished from the nature. The ex-situ conservation approach can pave the way forward for the germplasm conservation of these species.
 - 4.2 Literature:** Wochok, 1981; Fay, 1994; Maunder, 1992; Stewart, 2008;; Deb et al., 2018; Kapai et al., 2010; Engelman, 2011; Mushtaq et al., 2021; Salih et al., 2021.
 - 4.3 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.
 - 4.4 Site of the study (with map):** NA
 - 4.5 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 will be performed in the optimal mediums supplemented with optimized plant growth regulators concentrations. Plantlets will be acclimatized in the glass house and net house for proper acclimatization and finally will be shifted to the open environment. New Methodology (if any) adopted: NA.
 - 4.6 Achievements including:**
 - a. Total area covered:** NA
 - b. Number of tours undertaken :** NA
 - c. Number of species collected :** NA
 - d. Number of species identified (with name) :** NA
 - e. Number of species incorporated :** NA
 - 4.7 Output indicators for the assessment of the project:** NA.
 - 4.8 Major impacts reported during the financial year:** 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.

A. Research Publications: Nil

Annexure I

PUBLICATIONS (2020-2021)

1. BHANDARI, A., H. SINGH, A. SRIVASTAVA, PUNEET KUMAR, G.S. PANWAR AND A.A. MAO. 2021. *In-vitro* propagation and cytological analysis of *Sophora mollis* Royle: an endangered medicinal shrub. *J. of Genetic Engineering and Biotechnology*. 19(40). <https://doi.org/10.1186/s43141-021-00140-3>.
2. FRASER-JENKINS, C.R., B.S. KHOLIA AND D.R. KANDEL. 2020. Recent Changes and Corrections in the Taxonomy of Indian Pteridophytes: Part 2. *Indian Journal of Forestry*. 43(1):58-86.
3. FRASER-JENKINS, C.R., B.S. KHOLIA, AND D. R. KANDEL. 2020. Recent Corrections and Changes to Indian Pteridophytes, part 1. *Indian J. For.* 42 (4): 309–316.
4. GARG, A., SINGH, R. KR. AND KHOLIA, B.S. 2020. *Pedicularis raghvendrae* (Orobanchaceae), a new species from Sikkim Himalaya, India. *Phytotaxa*. 452 (1): 110–115.
5. KHOLIA, B.S. 2019. Know your Botanist. Prof S. S. Bir in ENVIS under ENVIS News letter 24(2): 11.
6. KHOLIA, B.S. 2021. Pteridophyta in M. Sharma, Vascular Flora of Punjab and Chandigarh vol. III. (Monocotyledonae, Gymnospermae & Pteridophyta). Bishen Singh Mahendra Pal Singh Dehradun. pp.1875-1906.
7. KHOLIA, B.S., C. R. FRASER-JENKINS, N. PUNETHA AND S. K. SINGH 2021. On the occurrence of *Oeosporangium tenuifolium* (Burm.f.) Fraser- Jenk. & Pariyar in the Western Himalaya, Uttarakhand, India. *Indian Journal of Forestry* 43(2): 166-168.
8. KUMAR, PUNEET AND S.K. SINGH. 2021. Pollen Sterility Relatable to Structural Heterozygosity, and SEM Study in Poison Devil Tree (*Alstonia venenata* R.Br.). *Cytologia* 86(2); (*In press*). (Impact factor=0.795; NAAS RATING=6.80; SCOPUS)
9. KUMAR, PUNEET., H. SINGH AND J.S. JALAL. 2020. A note on *Corallorhiza trifida* Chatel.: A lesser known partial myco-heterotrophic orchid from Himachal Pradesh, Western Himalaya, India. *Indian Forester*. 146(6): 565-566. (NAAS RATING=5.10)
10. KUMAR, PUNEET., H. SINGH AND KUMAR A. 2020. Traditional knowledge of medicinal and threatened plants used by the local inhabitants dwelling in and around Sechu-Tuan Nalla: a high altitude wildlife sanctuary in Himachal Pradesh, northwest Himalaya. pp 329-333. *In: Proceedings of International Biodiversity Congress (IBC 2018) held at Forest Research Institute, Dehradun, India, 4-6 October, 2018.*
11. KUMAR, PUNEET., H. SINGH AND S.K. SINGH. 2021. Karyomorphological and SEM studies in newly discovered populations of a critically endangered medicinal plant —*Lilium polyphyllum* D. Don ex Royle from a high altitude protected area of north-western Himalaya. *Microscopy Research and Technique*. (*In press*) <https://doi.org/10.1002/jemt.23784> (Impact factor= 2.769; NAAS RATING=8.12; SCOPUS)
12. PÁEZ, V. DE LOS A., A. R. ANDRADA, PUNEET KUMAR, M. S. CARO. 2021. Cytomixis in Angiosperms from Northwestern Argentina. *Botany Letters*, Published online: <https://doi.org/10.1080/23818107.2021.1903994> (Impact factor=1.744; SCOPUS)
13. PANWAR, G. S. AND BHAVANA JOSHI. 2020. Micropropagation of *Tricholepis roylei* Hook.f.-a point endemic species of the Western Himalaya. *J of Genetic Engineering and Biotechnology*. 18(40). 1-8. <https://doi.org/10.1186/s43141-020-00051-9>

14. PANWAR, G.S., B. JOSHI AND S.K. SINGH. 2021. *Is Tricholepis roylei* Hook. f. can be saved through species specific recovery programme? *Indian forester*. (Accepted)
15. PATIL, SAMEER. 2020. A neglected taxon of *Arisaema* (Araceae) from Western Ghats, India. *Journal of Japanese Botany* 95(6): 332–335.
16. PATIL, SAMEER. 2020. A step towards conserving *Anoectochilus elatus*: a South Indian Jewel Orchid. *NeBIO* 11(2): 67–70.
17. PATIL, SAMEER. 2020. *Ceropegia ciliata*: increasing extent irrespective of diminishing Shola landscapes. *NeBIO* 11(3): 192–194.
18. PATIL, SAMEER. 2020. Nomenclature notes and lectotypification in the monotypic genus *Getonia* (Combretaceae). *Rheedea* 30(3): 400–403.
19. PATIL, SAMEER. 2020. *Strobilanthes lakshminarasimhanii* (Acanthaceae): A new species from Kodagu, Karnataka. *Nelumbo* 62(2): 113–116.
20. SINGH, H., J. SINGH., PUNEET KUMAR., V.K. SINGHAL., B.S. KHOLIA AND L. M. TEWARI. 2020. Chromosome count, male meiotic behaviour and pollen fertility analysis in *Agropyron thomsonii* Hook.f. and *Elymus nutans* Griseb. (Triticeae: Poaceae) from Western Himalaya, India. *Caryologia*. 73(2): 89-98. doi: 10.13128/caryologia-618 (Impact factor=0.918; NAAS RATING=6.62; SCOPUS)
21. SINGH, HARISH, M. MISHRA AND P. A. DHOLE. 2020. Ethnomedicinal uses of plants from Kaimur and Rohtas districts of Bihar, India. *Ethnobotany* 30:10-21.
22. SINGH, HARISH, M. MISHRA AND P.A. DHOLE. 2020. Ethnomedicinal Plants used by the tribal communities of West Champaran District of Bihar, India. *Plantae Scientia*. 3 (4): 38-44.
23. SRIVASTAVA, A., H. SINGH, A. BHANDARI, PUNEET KUMAR, G.S. PANWAR AND A.A. MAO. 2021. Ornamental potential of *Gentiana kurroo* could be a boon for its survival: a critically endangered species. *Indian forester*. (Accepted).

BOOK

1. FRASER-JENKINS, C. R., K. N. GANDHI, B.S. KHOLIA AND D.R. KANDEL. 2020. *An annotated checklist of Indian Pteridophytes Part-III*. (Lomariopsidaceae to Salviniaceae). Bishen Singh Mahendra Pal Singh Dehradun. ISBN978-81-949953-7-1.

BSI SIKKIM HIMALAYAN REGIONAL CENTRE, GANGTOK

Jurisdiction: Sikkim (7096 Sq. Km.)

Targets and achievements during the year 2020-2021:

S. No.	Name of Project and executing scientist	Target for 2020-2021 as per annual research programme	Achievements
1.	<p>Flora of India Volume 27 (Zingiberaceae to Smilacaceae)</p> <p>Dr. Rajib Gogoi, Scientist E & HoO</p>	<p>17 families, <i>ca</i> 64 genera and <i>ca</i> 592 species.</p>	<p>As Team leader: Coordinated with team members for the completion of the allotted families. Conducted regular online meetings for discuss about finalization and completion of manuscript. Attended meeting (through video conferencing) with Director BSI and Team Leaders of Flora of India project to update the progress and timeline for completion.</p> <p>Individually, following families were also worked on: Musaceae: All the taxa (<i>ca</i> 10 spp.) of the family were given proper citations, description, flowering and fruiting, distributional data. Family, Generic description, Keys to the species also completed. Report submitted. Improvement in final manuscript done. Dioscoreaceae : Description prepared for 4 spp.were completed. Liliaceae: Description prepared for 2 spp. Report submitted. Improvement in final manuscript done. Aloeaceae: Prepared description of the genus <i>Aloe</i> L. and description, flowering and fruiting time, distribution in India and World, Habitat for the species <i>Aloe vera</i> (L.) Burm.f. completed. Improvement in final manuscript done.</p> <p>Asphodelaceae.s.: Prepared description of the genus <i>Asphodelus</i> L., <i>Dianella</i> Lam. ex Juss., <i>Ermeurus</i>M.Bieb., <i>Hemerocallis</i> L. Description, flowering and fruiting time, distribution in India and World, Habitat for the species <i>Asphodelus tenuifolius</i> Cavan., Dianella ensifolia (L.) Redoute completed, Eremurus himalaicus Baker. <i>Hemerocallis fulva</i> (L.) L. completed. Key preparation is going on. Improvement in final manuscript done.</p> <p align="center">Scientific Achievements:</p> <p>New species <i>Impatiens bakthangensis</i> Gogoi, Sherpa,</p>

S. No.	Name of Project and executing scientist	Target for 2020-2021 as per annual research programme	Achievements
			<p>Chhetri</p> <p>Rediscovery <i>Impatiens angustiflora</i> Hook.f. <i>Impatiens cothurnoides</i> C.E.C. Fisch</p> <p>New Reports: <i>Cheniellaquinanensis</i> subsp. <i>quinanensis</i> <i>C.quinanensis</i> subsp. <i>gandhiana</i> Gogoi & Bandup.</p> <p>Typifications: <i>Impatiens angustiflora</i> Hook.f. <i>Impatiens cathcartii</i> Hook.f. <i>Impatiens cothurnoides</i> C. E. C. Fisch. <i>Impatiens serratifolia</i> Hook.f.</p>
2.	<p>Flora of India Volume 28 (Juncaceae&Juncaginaceae)</p> <p>Dr. Rajib Gogoi, Scientist E &HoO</p>	<p>2 families, 3 genera, 58 species & 2 varieties</p>	<p>Report completed and submitted to D/BSI on 19th May 2020. The report on family Juncaceae containing nomenclatural citation, descriptions, phenology, distribution of 2 genera, 57 species & 2 varieties depicting some selected species in 33 coloured photoplates.</p> <p>The family Juncaginaceae containing 1 genera and 2 species and 2 colored photoplates.</p> <p>As per BSI directorate instruction revised report with format modification submitted to Dr. M. U. Sharief, Team Leader, FoI Vol. 28 on 09th July 2020.</p>
3.	<p>Flora of India Volume 25</p> <p>Flora of India Volume 26 (Hydrocharitaceae to Orchidaceae)</p> <p>Dr. D.K. Agrawala, Scientist D</p>	<p>Total & 26 – ca 4 families, 168 genera, 1304 spp.</p> <p>Volume 25: Family: Hydrocharitaceae (10 genera, 33 species) Family: Burmanniaceae (3 genera, 11 species) Family: Orchidaceae (72 genera, ca. 681 species)</p> <p>Volume 26: <i>Remaining part of Family Orchidaceae (ca 83 genera and 579 spp.)</i></p>	<p>As Team leader: Co-ordinated with team members (data sharing, nomenclature and taxonomy) for compilation of their part.</p> <p>Conducted a meeting (video conferencing) among the team members to discuss about finalization and completion of manuscript.</p> <p>Attended meeting (through video conferencing) with Director BSI and Team Leaders of Flora of India project to have deliberation on the format and consistency in different volumes.</p> <p>Attended meeting (through video conferencing) with Director BSI and Team Leaders of Flora of India project to update the progress and timeline for completion.</p> <p>On 06.11.2020 attended the online meeting among the Flora of India team led by the Director BSI.</p> <p>The data received from team members were compiled and submitted the final manuscript in two volumes containing the treatment of c. 1300 taxa in three families.</p> <p>In this project, the taxonomy and</p>

S. No.	Name of Project and executing scientist	Target for 2020-2021 as per annual research programme	Achievements
			<p>nomenclature of many species could be solved, species with erroneous identity were merged, few were split and species with dubious occurrence were excluded from India.</p> <p>Completed the manuscript of volume 25 and 26 and submitted to DBSI.</p> <p>Individually, prepared the manuscript for 554 species under 65 genera.</p> <p>Significant Contributions:</p> <ol style="list-style-type: none"> 1. Excluded <i>Nephelaphyllumpulchrum</i> Blume from India by identifying all earlier report of this species from India as <i>Nephelaphyllum sikkimensis</i> (Hook.f.) Karthik. 2. Excluded <i>Epipactis gigantea</i> Douglas ex Hook.f. from India by identifying all earlier reports of this species to <i>Epipactisroyleana</i>Lindl. 3. <i>Epigeneiumarunachalense</i> A.N. Rao and <i>Dendrobium nageswarayanum</i> K. Chowlu were reduced to synonymy of <i>Epigeneiumfargesii</i> (Finet) Gagnep. The report of <i>Epigeneiumchapaense</i> Gagnep. from India has also been identified as <i>Epigeneiumfargesii</i>. 4. <i>Nerviliagleadowii</i> A.N. Rao and <i>Nerviliahispidata</i> Blatt. & McCann were reduced as taxonomic synonyms of <i>Nervilia concolor</i> (Blume) Schltr. 5. <i>Ascocentrumsemiteretifolium</i> reported from India was re identified as <i>Holcoglossumnagalandensis</i>. 6. <i>Ascocentrumcurvifolium</i> and <i>Chiloschistalunifera</i> was excluded from India. 7. <i>Cleisocentronneglectum</i> is reduced as synonym under <i>Robiquetia rosea</i> (Lindl.) Garay. 8. <i>Taeniophyllum arunachalense</i> A.N.Rao & J.Lalis reduced as synonym under <i>Taeniophyllum retrospiculatum</i> (King &Pantl.) King &Pantl. 9. <i>Vanda stangeana</i> Rchb.f. is reduced as synonym under <i>Vanda bicolor</i> Griff. 10. <i>Vanda bensonii</i> Bateman has been excluded from India. <p>Presented the “Taxonomic studies in Indian Orchidaceae” at National conference cum workshop on “Interdisciplinary approaches to</p>

S. No.	Name of Project and executing scientist	Target for 2020-2021 as per annual research programme	Achievements
			Taxonomy, Conservation and Economic Utilization of Floriculturally and Medicinally important Orchids” held at BSI, ERC, Shillong during 5-6 March 2021
4.	Flora of India Volume 27 Dr. J.H.Franklin Benjamin Scientist C	Allotted: Flora of India Vol-27 Bromeliaceae (1 genus 1 sp.) Costaceae (2 genus 6 spp.), Marantaceae (6 genus 9 spp.), Taccaceae (1 genus 3 spp.), Aloeaceae (1 genus 1 sp.), Amaryllidaceae (6 genera, 35 species) Hypoxidaceae (2 genera, 15 species) Iridaceae (5 genera, 21 species) Cannaceae (1 genus, 3 species) Stemonaceae (2 genera, 3 species) Alliaceae (2 genera, 35 species) Total 29 Genera/ 132 Species	The manuscript with 33 genera & 326 species (184 cultivated) in 10 families was submitted to the Team Leader in December 16 th 2020. Report Submitted. All the families allotted have been completed in the ‘Flora of India’ format with current nomenclature according to ICN and author citations according to Brummitt and Powel’s “Author of Plant Names”, abbreviations of Periodicals confirmed with BPH and for Books with TL-2. Then each taxa, with complete description, flowering and fruiting, habitat and distribution, chromosome numbers, pollen grain data were given. Cultivated species in these families were segregated and listed separately. Family and Generic descriptions for each family was made. Bracketed Keys for all the genera in the family and all the species within a genus was made. Relevant literatures were cited as necessary. Manuscripts of Smilacaceae & Asparagaceae were edited for Flora of India Vol. 27. On 19-07-2020 & 26-07-2020, took part in Flora of India, Vol. 27, online team meeting.
5.	‘Flora of Sikkim – A Pictorial Guide’ Rajib Gogoi, Scientist E & HoO D.K. Agrawala, Scientist D J.H. Franklin Benjamin Scientist C	Non Action Plan Work.	The checklist flora of Sikkim was initiated to enumerate the total number of flowering taxa in Sikkim, since the state was lacking a complete and comprehensive list. The draft checklist with introductory chapters, index was prepared, edited; the layout of text and photos were designed. Proofreading, editing and final manuscript was completed.
6.	Updating the BSHC Herbarium and its Digitization	No target specified	Scanning and metadata entry for 1605 sheets were done from Barcode BSHC 00025988 to BSHC00027592. Due to Covid-19 induced lockdown, the work flow was affected. Subsequently, the Data entry operator (outsourced) post was curtailed as Austerity Measure to keep budget expenditure below 5% as per instructions.

Research and developmental activities:

1. Ex – Situ Conservation in the Botanical Garden:

Name of the Garden	Number of tours conducted	Total no. of species collected, introduced 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	<p>Dr. Rajib Gogoi Supervised the day to day activities of plantation and nurturing of the plants in Garden of SHRC.</p> <p><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>Elatostema nasutum</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., <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: 1. <i>Rhododendron triflorum</i> Hook.f. (Ericaceae) 2. <i>Magnolia globosa</i> Hook.f. & Thomson (Magnoliaceae)</p>	-	-	-

Live Plants collected for *Ex-situ*

Conservation

1. *Anisadenia saxatilis* Wall.
exMeissn [LINACEAE]
 2. *Elatostemadissectum* Wedd.
[URTICACEAE]
 3. *Elatostemahookerianum*
Wedd. [URTICACEAE]
 4. *Elatostemalineolatum* Wight
[URTICACEAE]
 5. *Elatostema* spp.
[URTICACEAE]
 6. *Gaultheria*
*nummularioides*D.Don
[ERICACEAE]
 7. *Gaultheria* spp.
[ERICACEAE]
 8. *Impatiens pradhanii*H.Hara
[BALSAMINACEAE]
 9. *Leycesteriagracilis* (Kurz)
Airy Shaw
[CAPRIFOLICAEAE]
 10. *Loxostigmagriffithii* (Wight)
C.B.Clarke
[GESNERIACEAE]
 11. *Mazus dentatus* Wall.
exBenth.
[SCROPHULARIACEAE]
 12. *Rhododendron*
*camelliiflorum*Hook.f.
[ERICACEAE]
 13. *Rhododendron*
*dalhousieae*Hook.f.
[ERICACEAE]
 14. *Rhododendron*
*edgeworthii*Hook.f.
[ERICACEAE]
 15. *Rhododendron*
*triflorum*Hook.f.
[ERICACEAE]
 16. *Rhododendron*
*vaccinioides*Hook.f.
[ERICACEAE]
 17. *Rubus wardii*Merr.
[ROSACEAE]
 18. *Salix* spp. [SALICACEAE]
 19. *Strobilanthes helicta*T.Anderso
n [ACANTHACEAE]
 20. *Strobilanthes* spp.
[ACANTHACEAE]
 21. *Vaccinium retusum* (Griff.)
Hook.f. ex C.B.Clarke
[ERICACEAE].
-
1. *Anthogonium gracile* Wall. ex
Lindl. [ORCHIDACEAE]
 2. *Begonia megaptera*D.Don

		[BEGONIACEAE] 3. <i>Citrus medica</i> L. [RUTACEAE] 4. <i>Clerodendrumcolebrookeanu</i> <i>m</i> Walp. [VERBENACEAE] 5. <i>Daphne sureil</i> W.W.Sm. & Cave [THYMELAEACEAE] 6. <i>Elatostemaintegrifolium</i> (D.Don) Wedd. [URTICACEAE] 7. <i>Elatostema</i> spp. [URTICACEAE] 8. <i>Elatostema</i> spp. [URTICACEAE] 9. <i>Elatostema</i> spp. [URTICACEAE] 10. <i>Impatiens decipiens</i> Hook.f. [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			
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2. Documentation of Indigenous knowledge of plant resources: NIL
3. Palynological/Chemical/Pharmacognostic Studies on Indian flora: NIL
4. Publications:
 - b. 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	India n Journ al	Foreig n Journ al	Hinc	Engli sh	Region al Langua ge	Hin di	Eng lish	Regio nal Lang uage
SHRC, Gangto k	5	8	2 + 7 abstr acts	1	-	-	-	-	-	-

- c. Details of Research Publications in Journals and Books etc of all scientists (Alphabetically as per the format of *Nelumbo* Journal):

Papers Published:

1. Biate, D.L. & **AGRAWALA, D.K.** 2020. Rediscovery of *Epilobium trichophyllum* Hausskn: A rare and endemic plant from Sikkim Himalaya, India. *Journal of Threatened Taxa* 12(4): 15518 – 15521.
2. Dey S.M., **GOGOI, R.** & Subir Bandyopadhyay 2019. Report of *Cheniella quinnanensis* subsp. *quinnanensis* and *C. quinnanensis* subsp. *gandhiana* from two more localities in NE India (Leguminosae: Cercidoideae), *ENVIS Newsletter* 24(2): 4-5.
3. **GOGOI, R.** 2020. Methodology of study of *Impatiens* (Balsaminaceae): A Morphological approach, *Plant systematics and ethnobotany: methods and practices* 85-97.
4. **GOGOI, R.** and Sherpa, N. 2020. Taxonomic identity of *Impatiens cathcartii* Hook.f. & *I. serratifolia* Hook.f. with notes on typification of both names. *Bio. Res. Con.* 59(2):1-8, DOI: 10.2478/biocr-2020-0008.
5. **GOGOI, R.,** N. Sherpa and G. Chhetri. 2020. *Impatiens bakthangensis* sp. nov. (Balsaminaceae): a new species from Sikkim, India, *Nordic J Botany*, doi: 10.1111/njb.02872.
6. **GOGOI, R.,** Sherpa, N. and Borah, S. 2020, Taxonomic revision of *Impatiens laxiflora* Edgew. (Balsaminaceae) and its allied species in India, Nepal, Bhutan & China. *Botany Letters*. DOI: 10.1080/23818107.2020.1857834.
7. **GOGOI, R.,** Sherpa, N., Murugesan, M and Meitei, L. R. 2020. Rediscovery of *Impatiens cothurnoides* C.E.C. Fisch., taxonomic identity, lectotypification and notes on its distribution, *Botany Letters*. <https://doi.org/10.1080/23818107.2020.1856715>.
8. **GOGOI, R.,** Sherpa, N., Tham, B.B.T., Deori, C and Talukdar, S. 2020. Recollection of *Impatiens angustiflora* (Balsaminaceae) and notes on its lectotypification. *Nelumbo* 62(2):154-160, DOI: 10.20324/nelumbo/v62/2020/156894.
9. M. Singh, J.S. Jalal, **D.K. AGRAWALA** & H. Negi. 2020. *Liparis pygmaea* (Malaxideae, Orchidaceae), a new distributional record from Western Himalaya, India with notes on typification. *Richardiana*.s. 4: 126 – 133. 2020.
10. Rewicz, A., Adamowski, W., Borah, S. and **GOGOI, R.** 2020. New Data on Seed Coat Micromorphology of Several *Impatiens* spp. from Northeast India., *Acta Societatis Botanicorum Poloniae* 89(3):89312, DOI: 10.5586/asbp.89312.
11. S. Mishra, J.S. Jalal, C.P. Vivek, G.A. Ekka, **D.K. AGRAWALA** & L.J. Singh. 2020. A note on the occurrence of *Luisia unguiculata* (Orchidaceae) in Andaman & Nicobar Islands, India. *Nelumbo* 62(1): 50 – 53. 2020.
12. Upadhyay, A., **GOGOI, R.** & Mitra, P.K. 2021. Ethnobotany of the genus *Elatostema* JR Forster & G. Forster. *Ethnobotany Research and Applications* 21: 1-24.
13. R.G. Vadhyar, K.A. Sujana, **J.H. FRANKLIN BENJAMIN** and G.V.S. Murthy. 2020. *Eugenia sphaerocarpa* (Myrtaceae), a new species from Western Ghats of Kerala, India. *Phytotaxa* 442(2): 121-127. <https://doi.org/10.11646/phytotaxa.442.2.7>. Magnolia Press

Papers/Articles communicated:

1. **D.K. AGRAWALA, R. Roy & R.GOGOI.** Vertical farming of Orchids– an effective tool for value addition and conservation. *ENVIS Newsletter*.

2. Chakraborty, O. S. Sengupta, S. Chakraborty, Rijupalika Roy and **D.K. AGRAWALA**, *Stereochiluserinaceus* (Rchb.f.) Garay (Orchidaceae) – A new distributional record for India with notes on its relationships and threat status assessment. Journal of Orchid Society of India.
3. Chakraborty, S., Aazhivaendhan, **D.K. AGRAWALA** and J.S. Jalal, Notes on the correct identity of *Aphyllorchisgollanii* (Orchidaceae) and Lectotypification of two names. RICHARDIANA.

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. Deori, A. Bhattacharjee	<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 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. *ravikuamreana* (Balsaminaceae) a new variety from Arunachal Pradesh, India, Phytotaxa
8. *Impatiens jacobdevlasii*, 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 *Bulbophyllum crabro* (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 *Gastrochilus affinis* (King & Pantl.) Schltr. (Orchidaceae) from Western Himalaya with notes on a new synonym and typification.
4. *Bulbophyllum raskotii* (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 *Lecanorchis sikkimensis*, 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)].

5. Public service rendered:

Circle/	Public Service Rendered
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Section	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. [ASPARGACEAE] 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 arboraeus</i> Cav. [MALVACEAE]	-	certificate video 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, G.B. Pant National Institute of Himalayan Environment, SRC, Gangtok on 19 th November 2020. 4. Mr. Prakash Chettri, Project Coordinator, G.B.	5 Sale of Book titled "Orchids of India- Pictorial Guide" (1Nos.).	-	-	Rs. 1460/- Transaction Ref.No. 1911200003077 Dated: Nov 19 2020 Revenue deposited via Bharatkosh.gov.in for BSI-SHRC (Government of India) by Selling Books

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.
		Pant National Institute of Himalayan Environment, SRC, Gangtok on 19 th November 2020.				
	04 Visitors	5. Mr. Bikram SubbaLimboo, Ph.D. Scholar, Department of Botany, Sikkim University on 29 th oct 2020. 6. Dr.Sriprakash, Head +2 Visitors from Regional Ayurveda Research Institute Central Council For Research in Ayurvedic Sciences, Tadong, Gangtok	Herbarium consultation for data collection related to locality of specimen collected for the said 12 Medicinal plant specimens 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	-	-	-

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.
		7. Kundey Hang Limboo , Research Scholar, Departmen t of Microbiolo gy, Sikkim University on 26 th November, 2020.				
	02 Visitors	8. Sanjyoti Subba and Nimesh Chamlin g , Survey Expert, Biodivers ity Conserva tion (SBFP PROJEC T MANAG EMENT UNIT) Departm ent of Forest and Environ ment, Governm ent of Sikkim. Date:8/1 2/2020	Technical Guidance for Herbarium Preparation.			

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.
	02 Visitors	9. Dr. Biswajit Bose, Assistant Professor, Department of Botany, SRM University Sikkim, Gangtok on 11th December 2020 and 10. Dr. Rajat Das, Assistant Professor, Department of Pharmacy and Management, SRM University Sikkim, Gangtok on 11th December 2020.	Consult herbarium and literature of wild <i>Tupsitra</i> species from Sikkim Himalayas			
	02 Scientists	11. Dr. Laishram Shantikumar, Scientist-B IBSD, Sikkim Centre, Tadong,	Identification Purpose.	10 specimens (herbarium sheet submitted for 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.
		Gangtok on 17/12/2020 12. Shri. Lokesh Deb, Scientist-D(Pharmacology) IBSD, Sikkim Centre, Tadong, Gangtok on 17/12/2020	Identification Purpose.	16 specimens (herbarium sheet submitted for identification)		
		13. Research Scholar from Regional Ayurveda Research Institute, Central Council for Research in Ayurvedic Sciences, Ministry of Ayush. Visited on : 04/01/2021	<u>Identification purpose.</u>	12 Plant specimens submitted for the identification		
		14. Dr. Priya Darshini Gurung, Govt. of Sikkim, Department of Science and Technology, Vigyan Bhawan, Deorali,	Herbarium consultation of specimens collected from Kyongnosla Alpine sanctuary and Nathang Valley Natural Reserve, East Sikkim.			

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.
		Gangtok-737102. Visited on: 07/01/2021				
		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, Botanical Survey of India. Visited on: 11/01/2021-12/01/2021	Official Visit			
		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"			Rs.2340 i.e.(Rs. 880 + Rs.1460) Transaction Ref.No. 1401210005100 Dated: 14/01/2021 Revenue deposited via Bharatkosh.go

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.
			(1Nos.).			v.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 of Himalayan Environment, Sikkim Regional Centre, Pangthang, Gangtok. Visited on 20/01/2021	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 20th January, 2021			
	12 Visitors	19. Group visit by 12	<u>TAS</u> <u>S</u> (Travel <u>Agent</u>			

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.
		students under TASS (Travel Agent Association of Sikkim) under the BOTANICAL GUIDE TRAINING on 22/01/2021	<u>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 Council for Research in Ayurvedic Sciences, Tadong Gangtok on 4/02/2021	For receiving identification certificate video 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. • <i>Pteris biaurita</i> L • <i>Drynaria quercifolia</i> (L.) J.Sm • <i>Nephrolepis cordifolia</i> (L.) C.Presl • <i>Clematis buchananiana</i> DC. • <i>Senegalia pennata</i> (L.) Maslin 		Rs. 400 Transaction Ref.No. 0902210010369 Dated:9/02/2021 Revenue deposited via Bharatkosh.gov.in for BSI-SHRC
	20 Students	21. Group visit by 20 students	Visit under Green skill development (GSDP)(valu			

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.
		from Sikkim Envis Hub Forest Dept, Government Of Sikkim on 09/02/21	e 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, Arecaceae, Asclepiadaceae, Asteraceae, Balsaminaceae, Basellaceae, Begoniaceae, Berberidaceae, Betulaceae, Boraginaceae, Brassicaceae, Buddlejaceae, Campanulaceae, Caprifoliaceae, Carlemanniaceae, Caryophyllaceae, Celastraceae, Chenopodiaceae, Commelinaceae, Convolvulaceae, Crassulaceae, Cucurbitaceae, Cupressaceae, Cyperaceae, Dipsaceae, Droseraceae, Ericaceae, Eriocaulaceae, Euphorbiaceae, Fabaceae, Fumariaceae, Gentianaceae, Geraniaceae, Gesneriaceae, Grossulariaceae, Hydrangeaceae, Hypericaceae, Iridaceae, Juncaceae, Lamiaceae, Lauraceae, Lentibulariaceae, Liliaceae, Lobeliaceae, Melastomataceae, Monotrapaceae, 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).
- **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, Dipsaceae, Droseraceae, Ericaceae, Eriocaulaceae, Euphorbiaceae, Fabaceae, Fumariaceae, Gentianaceae, Geraniaceae, Gesneriaceae, Grossulariaceae, Hydrangeaceae, Hypericaceae, Iridaceae, Juncaceae, Lamiaceae, Lauraceae, Lentibulariaceae, Liliaceae, Lobeliaceae, Melastomataceae, Monotrapaceae, 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).

6. 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 January, 2021		

10. Special Information (Findings)

11. Work done by Indian Botanical Liaison Officer, Royal Botanic Garden, Kew, UK

12. Progress of Research Fellows working under 'Flora of India'

- Name of the Research Fellow and name of the Guide

- Name of the project with estimated number of genera, species and variety
- Brief description of the project and progress made during the period

13. 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 raised 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.
- Organised and Celebrated “Independence day” at BSI, SHRC.
- 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 10 Orchids 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. ex Meissn [LINACEAE], Elatostemadissectum Wedd. [URTICACEAE], Elatostemahookerianum Wedd. [URTICACEAE], Elatostemalineolatum Wight [URTICACEAE], Elatostema spp. [URTICACEAE], Gaultheria nummularioides D. Don [ERICACEAE], Gaultheria spp. [ERICACEAE], Impatiens pradhanii H. Hara [BALSAMINACEAE], Leycesteriagrabilis (Kurz) Airy Shaw [CAPRIFOLICAEAE], Loxostigmagriffithii (Wight) C. B. Clarke [GESNERIACEAE], Mazus dentatus Wall. ex Benth. [SCROPHULARIACEAE], Rhododendron camelliiflorum Hook. f. [ERICACEAE], Rhododendron dalhousiae Hook. f. [ERICACEAE], Rhododendron edgeworthii Hook. f. [ERICACEAE], Rhododendron triflorum Hook. f. [ERICACEAE], Rhododendron vaccinioides Hook. f. [ERICACEAE], Rubus wardii Merr. [ROSACEAE], Salix spp. [SALICACEAE], Strobilanthes helicta T. Anderson [ACANTHACEAE], Strobilanthes spp. [ACANTHACEAE], Vaccinium retusum (Griff.) Hook. f. ex C. B. Clarke [ERICACEAE]. 7 field numbers were collected and processed: Codonopsis gracilis Hook. f. & Thomson [CAMPANULACEAE]- BSHC 41412 Codonopsis inflata Hook. f. & Thomson [CAMPANULACEAE]- BSHC 41411 Ophiorrhiza treutleri Hook. f. [RUBIACEAE]- BSHC 41409 Persicaria thunbergii (Siebold & Zucc.) H. Gross [POLYGONACEAE]- BSHC 41413 Pimpinella diversifolia DC. [APIACEAE]- BSHC 41410 Stauntonia angustifolia (Wall.) R. Br. ex Wall. [LARDIZABALACEAE]- BSHC 41414 Strobilanthes helicta T. Anderson [ACANTHACEAE]- BSHC 41408. Photographed 22 plant species: Anisadenia saxatilis Wall. ex Meissn [LINACEAE], Codonopsis gracilis Hook. f. & Thomson [CAMPANULACEAE], Codonopsis inflata Hook. f. & Thomson [CAMPANULACEAE], Gaultheria nummularioides D. Don [ERICACEAE], Goodyera schlechtendaliana Rchb. f. [ORCHIDACEAE], Henckelia urticifolia (Buch.-Ham. ex D. Don) A. Dietr. [GESNERIACEAE], Hypericum tenuicaule Hook. f. & Thomson ex Dyer [HYPERICACEAE], Impatiens arguta Hook. f. & Thomson [BALSAMINACEAE], Impatiens falcifera Hook. f. [BALSAMINACEAE], Impatiens pradhanii H. Hara [BALSAMINACEAE], Impatiens stenantha Hook. f. [BALSAMINACEAE], Impatiens uncipectala C. B. Clarke ex Hook. f. [BALSAMINACEAE], Lycopodium japonicum Thunb. [LYCOPODIACEAE], Persicaria thunbergii (Siebold & Zucc.) H. Gross [POLYGONACEAE], Pimpinella diversifolia DC. [APIACEAE], Rubus wardii Merr. [ROSACEAE], Sarcopyramis napalensis Wall. [MELASTOMACEAE], Siphocranion macranthum (Hook. f.) C. Y. Wu [LAMIACEAE], Stauntonia angustifolia (Wall.) R. Br. ex Wall. [LARDIZABALACEAE], Strobilanthes helicta T. 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.	<p>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.</p> <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). 1. Shri Aazhivaendhan 2. MsShreyasi Nayak</p>	<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 be evaluated for load on natural population. • IUCN Red list assessment will be done and conservation measure proposed. • Distribution map and species richness map will be prepared. • Likely habitat of threatened 	<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 (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 Vandeeae- Sub-tribe: Aeridinae • Abstract communicated entitled

Sl. No.	Name of the project	Targets and deliverable	Summary of achievements
	<p>3. Shri Sayak Chakraborty</p> <p>4. Shri Shuvadip Sarkar</p> <p>5. MsSanchayita Sengupta</p> <p>Junior Project Fellows (since Aug. 2018).</p> <p>1. MsOindrila Chakraborty</p>	<p>species will be predicted by habitat modelling.</p> <ul style="list-style-type: none"> • 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, Collabieae and Podochileae)</p> <p>(Allotment: Tribe Vandaeae-Sub-tribes: Aeridineae)</p>	<p>‘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, Laitumkhrah, Shillong, Meghalaya during March 5-7, 2021.</p> <ul style="list-style-type: none"> • Communicated a paper on: <i>Stereochilus</i> userinaceus (Rchb.f.) Garay (Orchidaceae) – A new distributional record for India with notes on its relationships and threat status assessment. • Communicated a paper on: <i>Stereochilus</i> userinaceus (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, Laitumkhrah, Shillong, Meghalaya on March 5-7, 2021 • Abstract communicated entitled ‘Notes on the <i>Bulbophyllum</i> odoratissimum complex 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. • Morphological characteristics finalized for 4 genera with their

Sl. No.	Name of the project	Targets and deliverable	Summary of achievements
			<p>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.</p> <ul style="list-style-type: none"> • 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.

SOUTHERN REGIONAL CENTRE, COIMBATORE

Ongoing project (April 2020 – September 2020)

I. Flora of Kanniyakumari Wildlife Sanctuary, Tamil Nadu

12. Name of the Project : **Flora of Kanniyakumari Wildlife Sanctuary, Tamil Nadu**

13. Executing Scientist (s): Dr. Sujana K. A., Scientist D & Mr. R.G. Vadhyar, Botanical Assistant

14. Duration of the project : 5 years (1-04-2016 to 31-03-2021)

15. About the work done :

15.1 Introduction :

Kanniyakumari is one of the smallest districts in Tamil Nadu and has very high proportion of its landscape under tree cover (70%). The reserve forests and protected areas are owned and managed by the forest department and they constitute about 31 per cent of geographical area. Kanniyakumari Wildlife sanctuary with adjacent areas of Kalakkad Mundanthurai Tiger Reserve and Neyyar Wildlife Sanctuary of Kerala State constitutes the southernmost tips of Western Ghats. Kanniyakumari Wildlife Sanctuary is floristically one of the richest areas in our country. The natural vegetation of this region represents varied biomes ranging from southern thorn forests, dry deciduous, moist deciduous, semi evergreen forests to ever green hill sholas with grassy downs. The tract is exceedingly rich in wildlife harbouring a variety of animals. The vegetation and flora of Kanniyakumari sanctuary are exceptional because of extraordinary variety of species occurring within a small area.

15.2 Literature :

The notable works on the flora of Tamil Nadu are the forest and flora of Tinnevely District (Beddome, 1871), Flora of Tamil Nadu, Series 1: Analysis Vol. 1 (Nair & Henry, 1983), Flora of Tamil Nadu, Series 1: Analysis Vol. 2 (Henry et al, 1987), Flora of Tamil Nadu, Series 1: Analysis Vol. 3 (Henry et al, 1989) and Plant Diversity in Agastyamalai Hills, Southern Western Ghats (Gopalan, 1997). Lawrence (1960) explored the vegetation of Kanniyakumari district, Cape Comorin. Nayar (1959) studied the vegetation of Kanniyakumari District. Sharma et al. (1973) explored vascular flora of Mahendragiri hills and the surrounding regions, Kanniyakumari and Tirunelveli districts. Henry and Swaminathan (1981) published observations on the vegetation of Kanniyakumari district. Sacred groves in Kanniyakumari are also floristically well documented by Sukumaran (2007). Wet land flora of Kanniyakumari district is covered by Sukumaran & Jeeva (2011 & 2012). Recently Vascular Plant Diversity in the Tribal Home gardens of Kanniyakumari Wildlife Sanctuary is published by Mary Suba et al.(2014) and they recorded 368 species based on economic importance. From literature it is seen that the flora of Kanniyakumari Wildlife Sanctuary has not been studied in detail.

15.3 Objectives:

To carry out studies on flowering plant diversity of Kanyakumari Wildlife Sanctuary, Tamil Nadu with special focus on endemic and threatened plants

15.4 Site of the study (with map):

The Kanniyakumari forest division located between 70^o10'-77^o35' East longitudes 08^o5'-08^o35' 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-1, Chithar-II, Upper Kodayar, Lower Kodayar, Kuthiyar, ChinnaKuthiyar, Mukkadal 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.

15.5 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.

d. New Methodology (if any) adopted: SEM based study is used for observing micromorphological characters.

15.6 Achievements including:

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.

z. Total area covered :Nil

aa. Number of tours undertaken: Nil

bb. Number of species collected:Nil

cc. Number of species identified (with name):153 specimens (list attached as annexure 1)

dd. Number of species incorporated:Nil

15.7 Output indicators for the assessment of the project:

- Identified, labelled 604 herbarium specimens
- Monthly, quarterly reports and publications
- Field data documented with GPS information on rare, endemic threatened plants
- List of plants identified and reported as annexed

15.8 Major impacts reported during the financial year:

- 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

B. Research Publications (in *Nelumbo* format)

1. SUJANA, K.A. AND R.G. VADHYAR 2019. Notes on distribution, conservation and pollen morphology of an endemic and threatened wild ginger. *Journal of Non-timber forest Products* 26(2): 89–91.
2. SUJANA, K.A. AND R.G. VADHYAR 2020. Ginger herb *Meistera fulviceps*: a new distribution record for Tamil Nadu. *Plantasia* #18, In: *Zoo's Print* 35(4): 15–17.
3. VADHYAR, R.G., J.H.F. BENJAMIN AND K.A. SUJANA 2020. *Memecylon nervosum* (Melastomataceae), A new Species from South India. *Edinburgh Journal of Botany* 77(3): 403–411.
4. SUJANA, K.A. AND R.G. VADHYAR 2020. *Polyalthia longipedicellata* (Annonaceae): An addition to the flora of Tamil Nadu. *Indian Forester* 146 (8):778-779.

List of specimens identified with field numbers

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. Burt – 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. Burt – 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 – *Psydrax 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. &Schant.) 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 lebbek* (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 – *Argyreia 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 - *Aglaia 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

II. Assessment of Plant diversity in Cauvery North Wildlife Sanctuary; Tamil Nadu

1. Name of the Project : “**Assessment of Plant diversity in Cauvery North Wildlife Sanctuary, Tamil Nadu**”
2. Executing Scientist (s): Dr. R. Manikandan, Sci.-‘E’ & Ms. Mehala Devi R., Bot. Asst.
3. Duration of the project : 19.09.2017 to 31.03.2021
4. About the work done :

4.1 Introduction :

The Cauvery North Wildlife Sanctuary was recently established in the year of 2014, and covering an areas of **504.33** sq. km. It is situated in the Hosur and Dharmapuri Forest Divisions of the two districts namely Krishnagiri and Dharmapuri, in state of Tamil Nadu. The elevation varies from **200 m to 1390m** and the annual rainfall around 800 mm of rainfall from the Hosur Plateau into the river. Though there are sporadic works on floristic account from the adjoining areas of the sanctuary and as there was no details floristic account of the Sanctuary, so the present work is undertaken.

4.2 Literature :

After the re-organization of Botanical Survey of India from Southern Regional Centre, Coimbatore, **Vajravelu and Rathakrishnan (1968)** were the first persons who worked on this district and gave account on contribution to the flora of Dharmapuri district. They have recorded about **473 species**. The Flora of Tamil Nadu Analysis by **Nair & Henry (1983) and Henry & al. (1987, 1989)**, revealed that the state harbours about 5640 species including infra-specific taxa of flowering plants including cultivated species. **Matthew (1981-1984)** made remarkable collections from the Carnatic regions of Tamil Nadu and deposited his collections in Rapinat Herbarium, Tiruchirapalli (RHT). **Suthar Singh et al. (2005)** documented some less known medicinal plants traditionally used in Dharmapuri district, Tamilnadu.

4.3 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.

4.4 Site of the study (with map) : Map of the Cauvery North Wildlife Sanctuary, Tamil Nadu

4.5 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.

4.6 Achievements including :

- A. Total area covered: **396** sq. km. out of **504.33** sq. km
- B. Number of tours undertaken : Nil
- C. Number of species collected : Nil
- D. Number of species identified (with name): **200 field numbers** identified from earlier collections from CNWLS (List attached)
- E. Number of species incorporated: Label writing for almost all specimens were completed and pasted on mounted specimens.

4.7 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.

5. Major impacts reported during the financial year: Nil

B. Research Publications (in *Nelumbo* format): Four

1. MEHALA DEVI, R., NITHYA, S.P., MANIKANDAN, R., ARISDASON, W. AND MURUGAN, C. 2021. Leafless Goglet Plant. ENVIS Newsletter. 25(1): 5–6.
2. MEHALA DEVI R., R. MANIKANDAN AND S.P. NITHYA. 2020. “Natural Dye Yielding Plants of Cauvery North Wildlife Sanctuary, Tamil Nadu, India” J. Non-Timb. Forest Prod. (Accepted).
3. MEHALA DEVI R., R. MANIKANDAN, NITHYA S.P. AND M. PREMKUMAR. 2020. “Poisonous plants of Cauvery North Wildlife Sanctuary, Tamil Nadu, India” Indian J. Tradit. Knowl. (Accepted).
4. MEHALA DEVI R., S.P. NITHYA, M. PREMKUMAR AND R. MANIKANDAN. Recollection of *Strobilanthes carnatica* Carine, J.M. Alexander & Scotland (Acanthaceae), a less-known species Endemic to Southern India. J. Econ. Taxon. Botany. (Communicated).

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 lebeck</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
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 echioides</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
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
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
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

III. Marine Macro Algal Flora of India

1. Name of the Project: “Marine Macro Algal Flora of India”
2. Executing Scientist: Dr. M. Palanisamy, Scientist – ‘E’, BSI, SRC, CBE.
3. Duration of the Project: April, 2019 – March, 2022.
4. About the Work Done:

4.1 Introduction

India (8°–37° N and 68°–97° E), is one of the seventeen mega diversity countries (www.conservation.org) and the 7th largest country in the world with 2.4% of the global geographical area. The

country has a coastline of ca 7,516.16 km and an Exclusive Economic Zone (EEZ) of around 2.5 million km². The Indian coastline has a massive network of beaches, backwaters, estuaries, creeks, cliffs, lagoons, mangroves and coral reefs, which supports a large number of marine flora and fauna. The coastline includes 97 major estuaries, 34 major lagoons, 31 mangroves areas, 5 coral reefs and 31 Marine Protected Areas. The pattern of distribution and diversity of seaweeds in various maritime states in India varies greatly. Tamil Nadu coast shows the highest number of seaweeds with 426 species (Anon., 1978), followed by Maharashtra coast with 240 species (Sonali, 2010); Gujarat coast with 198 species (Jha & al., 2009); Kerala coast with 147 species (Palanisamy and Yadav, 2016), Lakshadweep islands with 82 species (Anon., 1979) and Andaman & Nicobar islands with 80 species (Muthuvelan & al., 2001); Karnataka with 108 taxa, comprising 36 species of Chlorophyceae, 30 species of Phaeophyceae and 42 Rhodophyceae members (Palanisamy & Yadav, 2017); Diu island with 70 species (Mantri & Subba Rao, 2005); Andhra Pradesh with 65 species (Anon, 1984); West Bengal with 14 species (Mukhopadhyay & Pal, 2002); Odisha with 21 species (Rath & Adhikary, 2006).

In order to improve our knowledge on seaweed resources of the country, several checklists and consolidated reports have been published by various phycologists. Dixit (1965, 1968) published a list of 411 species of seaweeds from the Indian coasts including the coasts of Pakistan and Sri Lanka. Srinivasan (1969, 1973) published two volumes on the *Icons of Marine Indian Algae*, describing about 50 species of seaweeds from the Indian coast. Krishnamurthy & Joshi in 1970 published *A Checklist of Indian Marine Algae* that included records from Pakistan and Sri Lanka and listed 520 taxa of seaweeds. Subsequently, Untawale & al. (1983) published a list of marine algae of India in the form of memoirs and recorded 624 species of seaweeds. Duraiswamy (1990) published a detailed taxonomic account of a green seaweed genus *Caulerpa* in India. Silva & al. (1996) published *The Catalogue of the Benthic Marine Algae of the Indian Ocean*, which is considered a monumental work for the Indian seaweeds. Desikachary & al., (1990, 1998) published the *Rhodophyta* (red seaweeds) of India in two volumes. Sahoo & al. (2001), based on the available literature, published a checklist on the *Seaweeds of Indian Coast* and recorded 770 species including 184 species of Chlorophyceae, 166 species of Phaeophyceae and 420 species of Rhodophyceae. Oza & Zaidi (2001) from Central Salt and Marine Chemicals Research Institute (CMFRI), Bhavnagar published *A Revised Checklist of Indian Marine Algae* which included 844 seaweed species including forms and varieties from throughout the Indian coasts. Recently, a revised monograph on brown seaweeds *i.e. Phaeophyceae of India and Neighbourhood* (Volume I & II) have been published by Krishnamurthy & Baluswami (2010) and Krishnamurthy & Ezhili (2013) respectively. More recently, the Botanical Survey of India, Kolkata (Rao & Gupta, 2015) has published an updated checklist on the Indian marine algae, containing a report of 865 taxa of seaweeds which included 212 taxa of Chlorophyceae, 211 taxa of Phaeophyceae and 434 taxa of Rhodophyceae.

However, many of the maritime states have not been explored intensively. Also, the taxonomical problems and nomenclature issue were not considered and have to be updated. Hence, there is a necessity of intensive field exploration in the unexplored or less explored coastal states so that we can bring an updated national seaweed flora. Considering the above facts, the present taxonomic studies on the *Marine macro algal flora of India* has been taken into account

4. 2 Literature

The marine macro algae, also popularly known as seaweeds, are one of the important floral components along with other microscopic algae, seagrasses and mangroves in the marine habitats. It plays an important role in sustainability of the marine ecosystems and serves as primary producer in the food chain. Therefore, documentation and taxonomic study of these marine macro algae is highly significant in order to understand the marine floral resources of the country.

In India, the algal research got momentum only in the 19th century when Prof. M.O.P. Iyengar (1886–1966), the Father of Indian Algology, published a note on seaweeds of the Krusadai Island in the Gulf of Mannar in 1927. Later, he published a series of papers on algal research. Subsequently, Boergesen (1928–1938), published a series of articles between 1928–1938 and recorded more than 150 taxa including 5 new genera and 38 species from the west coast of India, particularly from the coasts of Bombay and Gujarat. Dixit (1930) worked on the chemical properties, mainly the iodine content of several seaweeds and published (1940) a detailed account of seaweeds from Malvan coast, Maharashtra in the west coast of India. Biswas (1932) published the algal flora of Chilika Lake, Odisha in east coast of India and a review of the seaweeds of the west coast of India in 1945. Misra

(1966) published the first monograph *Phaeophyceae of India* and included 93 species of brown seaweeds, belonging to 33 genera. Chennubhotla (1977) of Central Marine Fisheries Research Institute (CMFRI), Cochin published a note on the edible seaweeds in the Indian context. Srinivasan (1969, 1973) published two volumes of *Phycologia Indica: The Icons of Marine Indian Algae*, describing about 50 species of seaweeds from the Indian coast. Krishnamurthy & Joshi in 1970 published *A Checklist of Indian Marine Algae* that included records from Pakistan and Sri Lanka and listed 520 taxa of seaweeds.

Subsequently, Untawale & al. (1983) published a list of marine algae of India in the form of memoir and recorded 624 species of seaweeds. Silva & al. (1996) published *The Catalogue of the Benthic Marine Algae of the Indian Ocean*, which is considered a monumental work for the Indian seaweeds. Desikachary & al., (1990, 1998) published the *Rhodophyta* (red seaweeds) of India in two volumes. Sahoo & al. (2001), published a checklist on the *Seaweeds of Indian Coast* and recorded 770 species including 184 species of Chlorophyceae, 166 species of Phaeophyceae and 420 species of Rhodophyceae. Oza & Zaidi (2001) from Central Salt and Marine Chemicals Research Institute (CMFRI), Bhavnagar published *A Revised Checklist of Indian Marine Algae* which included 844 seaweed species including forma and varieties from throughout the Indian coasts. A revised monograph on brown seaweeds *i.e. Phaeophyceae of India and Neighbourhood* (Volume I & II) has been published by Krishnamurthy & Baluswami (2010) and Krishnamurthy & Ezhili (2013) respectively.

Recently, the Botanical Survey of India, Kolkata (Rao & Gupta, 2015) has published an updated checklist on the Indian marine algae, containing a report of 865 taxa of seaweeds which included 212 taxa of Chlorophyceae, 211 taxa of Phaeophyceae and 434 taxa of Rhodophyceae. However, there is no any comprehensive study on the taxonomic aspects, dealing description, nomenclature, identification keys, photographs etc. of all the marine macro algae (seaweeds) of India are available till date. Therefore, considering the above facts, the present work has been undertaken to provide the fundamental information about Marine macro algal flora of India.

4.3 Objectives

- ❖ Survey and documentation of the marine algae of the unexplored areas.
- ❖ Photography of all the marine algae found in the Indian coast.
- ❖ Consultation of literature and herbarium specimens housed in various herbaria in India.
- ❖ Identification and preparation of Taxonomic keys.
- ❖ The compilation of data in the form of Marine Macro Algal Flora of India.

4.4 Site of the Study

India (8°–37° N and 68°–97° E) is a peninsular country with *ca* 7500 km long coastline, spread into 9 coastal states and 4 UTs. It is one of the seventeen mega diversity countries and the 7th largest country in the world with 2.4% of the global geographical area. The country has a coastline of *ca* 7,500 km and an Exclusive Economic Zone (EEZ) of around 2.5 million km². It is naturally endowed with diverse patterns of habitats like beaches, backwaters, estuaries, creeks, cliffs, lagoons, mangroves and coral reefs, which support a large number of marine flora and fauna.

The Indian coasts consist in nearly of 43% of their total length of sandy beaches, in 11% of rocky with headlands, platforms and cliffs, and in 46% of mud flats and marshy wetlands (ICMAM, 2009). In terms of marine environment, Indian coastline stretches about 5700 km covering 9 states on mainland and about 7500 km including islands and union territories (Oza & Zaidi, 2001) with a very wide range of coastal ecosystems such as estuaries, lagoons, mangroves, backwaters, salt marshes, rocky coasts, sandy stretches and coral reefs (Venkataraman, 1939).

The coastline of India shows wide range of variability in its topography, geographical position and provides the great habitats for the enormous diversity of marine macro algae.

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.intphycsoc.org/), Phycological Society of America (www.psaalgae.org/) etc., were also referred for the identification of seaweeds.

4.6 Achievements

- a. Total area covered: Maritime states of India
- b. Number of tours undertaken: -
- c. Number of Species collected:-
- d. 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
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	Caulerpaceae
28	148680	<i>Dictyota hauckiana</i> Nizamuddin	Dictyotaceae
29	148681	<i>Caulerpa veravalensis</i> Thivy & V.D.Chauhan	Caulerpaceae
30	148682	<i>Scinaia complanata</i> (Collins) A.D.Cotton	Scinaiaceae
31	148683	<i>Caulerpa chemnitzia</i> (Esper) J.V.Lamouroux	Caulerpaceae
32	148684	<i>Grateloupia lithophila</i> Boergesen	Halymeniaceae
33	148685	<i>Codium decorticatum</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
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 tetrastrumatica</i> Hauck	Dictyotaceae
47	148699	<i>Gelidiella acerosa</i> (Forssk.) Feldmann & Hamel	Gelidiellaceae
48	148700	<i>Caulerpa corynephora</i> Mont.	Caulerpaceae
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
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	Caulerpaceae
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

e. Number of species incorporated: -

4.7 Output indicator for the assessment of the project:

- ❖ Totally **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.

4.8 Major impacts reported during the financial year:

- ❖ 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, Caulerpacae, Sargassaceae typify with 5 taxa. Valoniaceae is the trivial family with only one taxon.

Research Publication: 02

1. YADAV, S. K. &M. PALANISAMY. 2020. Eleven New Additions to Marine Macro Algal Flora of Karnataka Coast, India Nelumbo Vol 62 (1): 90-102.
2. VIVEK S, ARON SANTHOSH KUMAR Y &M. PALANISAMY, 2020. Assessment of Secondary metabolites in the Yams of *Dioscorea oppositifolia* L. &*Dioscorea pentaphylla* L. In: Thangaraj Parimelazhagan (Ed.) Phytomedicine: Research and Development- Book published by CRC Press: 262pages. ISBN 9780367857592 (190 – 195pp.).

IV. Ex situ conservation of endemic endangered and threatened Plts. 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. **Background of the Project:**

Wayanad district lies with a hilly terrain on the southern Western Ghats and located in the northeast part of Kerala at a distance of about 76 km from the seashores of Kozhikode. The area lies between North latitude 11° 26' to 12° 00' and East longitude 75° 75' to 76° 56'. The altitude varies from 700- 2100 metres above MSL. It is bounded on the east by Nilgiris and Mysore district of Tamil Nadu and Karnataka respectively, on the north by Coorg district of Karnataka, on the south by Malappuram district and on the west by Kozhikode and Kannur districts of Kerala. To the west and south are the low lands of Malabar, to the east rise the Nilgiri hills, to the northeast lies the Mysore plateau, while to the northwest the chain of Ghats stretches away in to the Coorg. Annual rain fall ranges from 3000 to 4000 mm. Wayanad recorded the mean maximum and minimum temperature for the last five years were 29°C and 18°C respectively with a relative humidity up to 95 per cent during the southwest monsoon period. Total area under forests in Wayanad is 787 sq. km. The forest area in the district is administratively divided into Wayanad Wildlife Sanctuary (Sulthan Bathery, Muthanga, Kurichiad and Tholpetty Ranges 344.44 km²) and other reserve forests. The reserve forest of the district is under two administrative divisions namely Wayanad north (214.29 km²) and Wayanad south divisions (325.339 km²). North division constitutes Mananthavady, Periya and Begur ranges, which is

dominated by evergreen and moist deciduous forests. South division forms Kalpetta, Meppady and Chedelet ranges, which is also dominated by evergreen and moist deciduous forests.

The natural flora of this area is that of the evergreen and moist deciduous forests consisting of a mixture of evergreen and deciduous elements. Some of the dominant trees of this region are *Artocarpus hirsutus*, *Albizia odoratissima*, *Pterocarpus marsupium*, *Gmelina arborea*, *Acrocarpus fraxinifolius*, *Mallotus tetraococcus* and *Terminalia crenulata*. Epiphytic orchids common in these plantations are *Rhynchostylis retusa*, *Aerides ringens* and *Cleisostoma tenuifolium*. High humidity, shade and sheltered condition provide ideal habitat for epiphytic as well as terrestrial orchids, ferns, mosses and herbaceous flowering plants. Orchidaceae, form the largest family in India and take the second position in the order of dominance in Wayanad district; whereas in Kerala and Western Ghats their position is third and fourth respectively. The family Orchidaceae is represented by 165 species belonging to 68 genera. Of these, 59 species belonging to 29 genera are terrestrial in habit, while 106 species in 39 genera are epiphytic.

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

7. Summary of the work done during 2020-21 (not more than 1000 words)

(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
- *Diplocentrum recurvum* Lindl. – 2 plants
- *Habenaria glandilfloriformis* 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:

Endemic plants

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/fruitle phenology. The details are as follows:

Orchids: Flowering & fruitle phenology were recorded for 104 species belongs to 43 genera.

Other Angiosperms: Flowering & fruitle 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 numberF. 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 liters 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.

8. Achievements/ Outcomes in 2020-21:

Interesting Findings:

- New to Science: Nil
- New to India: Nil
- New record for State:
- Rediscovery: Nil
- Ethnobotanical Information: Nil
- **Rare, Endangered and Economic important plants collected and details of conservation initiations**
Neotypification of *Vernonia shevaroyensis* (Asteraceae) was achieved.

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.

V. 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
4. About the work done :
 - 4.1 Introduction :

The Agasthyamalai Biosphere Reserve is located in two states; Kerala and Tamil Nadu. This Biosphere has a total area of 3500 sq km; 1828 sq km is in Kerala and 1672 sq km is in Tamil Nadu. The Agasthyamalai region is partly located on the southern part of the Western Ghats. It contains moist forests and tropical forests. Parts of Agasthyamalai are classified as a mid-elevation tropical wet evergreen rainforest and other areas are subtropical climatic regimes. One of the regions in Agasthyamalai is the Kalakad-Mudanthurai Tiger

Reserve and it is located right in the Agasthyamalai Hills. In the rainforest there are three different seasons throughout the year. Agasthyamalai Biosphere Reserve became part of [World Network of Biosphere Reserves](#) in 2016. The area lying between 77°5' and 77°40' E longitude and 8°50' N latitude, falls within the hilly tracts of the Kollam and Thiruvananthapuram districts of Kerala, and Tirunelveli-Kattabomman and Kanniyakumari districts of Tamil Nadu.

This Biosphere has a forest cover of about 2000 sq.km., with altitudes ranging from 67 to 1868 m. It is composed of Neyyar, Peppara and Shendurney Wildlife Sanctuaries and their adjoining areas of Achencoil, Thenmala, Konni, Punalur, Thiruvananthapuram Divisions and Agasthyavanam Special Division in Kerala and areas of KalakkadMundanthurai Tiger Reserve in Tamil Nadu. The area represents diverse ecosystems with almost all types of vegetation known to occur such as the southern tropical thorn forests, southern tropical moist deciduous forests, tropical semi-evergreen forests, southern tropical wet evergreen (rain) forests, subtropical montane forests and grassy swards at high altitudes. The Agasthyamalai Biosphere Reserve harbours approximately 2000 species of flowering plants which include ca100 endemic and 50 rare and endangered species.

4.2 Literature :

4.3 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.

4.4 Site of the study (with map) : Agasthyamalai Biosphere Reserve (SWG)

4.5 Methodology adopted :

e. New Methodology (if any) adopted :

4.6 Achievements including :

F. Total area covered : Nil

G. Number of tours undertaken : Nil

H. Number of species collected : Nil

I. Number of species identified (with name) : Nil

J. Number of species incorporated : Not Applicable

4.7 Output indicators for the assessment of the project :

✓ **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 grahmii* (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 arnotianum* 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 malabatum* (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 – 4nos.
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 arnotiana* 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 arnotianum* 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 condapanna* 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.

4.8 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 malabratrum* (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)

C. Research Publications (in *Nelumbo* format)

Publications: 2 nos.

Chandore A.N., Auti S.G., Gosavi, K.V.C., Shendage, S.M. and **Kamble, M.Y.** 2020. *Eleocharis equisetina* C. Presl (Cyperaceae) An extended distribution to Andaman & Nicobar Islands and notes on its identity. Indian Forester 146(3): 261-262.

Mane S.S., Rath C., Susmitha B., Gaur S.K., Ratna J.G.V., Srikanth N., Tripathi A.K. and **M.Y. Kamble** (2020). Ethnomedicinal Knowledge among Nicobarese Tribes of Car Nicobar Island of Andaman and Nicobar Islands, India. Journal of Drug Research in Ayurvedic Sciences. 5(1):13–24.

VI. Flora of Kerala

Volume 3

1. Name of the Project: Flora of Kerala Volume-3, (Gamopetalae Part-I)

2. Executing officials/Supervisor: Shri P. Murugan, SRF & Dr. C. Murugan, Scientist 'E'

3. Duration of the project: June, 2018 to July, 2022

4. About the Work Done:

4.1 Background of the Project:

In view of complete the Flora of Kerala, Director, Botanical Survey of India, Kolkata instructed at the Head of Office meeting held at the Central National Herbarium, Kolkata during May, 2018 (03-05-2018 to 04-05-2018). Hence, four students allotted to the Botanical Survey of India, Coimbatore to complete the target of Flora of Kerala Vol 3-7.

Shri P. Murugan, Junior Research Fellow (JRF) joined at the Botanical Survey of India as under Flora of India project on 3rd July 2017 and under gone for training at Central National Herbarium (CNH) for the period of nine months (July 2017 to March 2018). Thereafter, transferred (1st April 2018) to BSI, SRC, Coimbatore for assessing the project entitled '*Flora of Kerala Vol-III, Gamopetalae Part-I (25 Families, 230 Genera and 783 Taxa)*', under the core project *Flora of India series II* was allotted to me on 19th June 2018 (*vide letter No. BSI-292/2/2018-Tech dated 14-06-2018 & BSI, SRC, 5/67(Fl. Ind.) 2018/Tech 775 dated 19-06-2018*). Further collected standard literature, conduction of field survey and consultation of herbarium are in progress. Addition to that, attended the biennial progress report for the Upgradation of JRF to SRF held on Head Quarters, BSI, Kolkata on 30th September 2019 and promoted on 15th October 2019.

4.2 Literature:

Mohanani, N. & A.N. Henry AN 1994. *Flora of Thiruvananthapuram District, Kerala*. Botanical Survey of India, Kolkata.

Mohanani, N. & M. Sivadasan 2002. *Flora of Agasthyamala*. Bishen Singh Mahendra Pal Singh, Dehra Dun.

Nayar, T.S., R.A. Beegam & M. Sibi 2014. *Flowering Plants of the Western Ghats India*. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, Kerala.

Nayar, T.S., Rasiya Beegam, A., Mohanan, N., Rajkumar, G. & M. Sibi 2006. *Flowering Plants of Kerala - A Handbook*. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, Kerala, India.

Sasidharan N. 2013. Flowering plants of Kerala: CD-ROM ver 2.0. Peechi: Kerala Forest Research Institute.

Sasidharan, N. & V.V. Sivarajan 1996. *Flowering Plants of Thrissur Forests*. Scientific Publishers, Jodhpur.

Sasidharan, N. 2004. *Biodiversity Documentation for Kerala. Part 6. Flowering Plants*. Kerala Forest Research Institute, Peechi, Kerala.

Sivarajan, V. V. & P. Mathew 1997. *Flora of Nilambur*. Bishen Singh Mahendra Pal Singh, Dehra Dun.

4.3 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.

4.4 Study 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)

Table 1: 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

4.5 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
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					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>Blepharispernum</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>Gamochaeta</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> Babc

5. Publication:

Research Articles Communication

1. MURUGAN, P., V. RAVICHANDRAN AND C. MURUGAN. Rediscovery of *Ophiorrhiza incarnata* C.E.C.Fisch. (Rubiaceae) after lapse of 83 Years from the Western Ghats, India" to *Journal of Threatened Taxa*, 23.03.2020.
2. MURUGAN, P. AND C. MURUGAN. Validation of the name *Vincetoxicum balakrishnanii* (Apocynaceae-Asclepiadoideae) to *Journal of NeBio*, 19.04.2020.
3. SULAIMAN M., BASIL PAUL, P. MURUGAN AND C. MURUGAN. *Oberonia brachystachys* (Orchidaceae): An addition to the Peninsular India to *Journal of Rheede*, 19.04.2020.
4. MURUGAN, P. AND C. MURUGAN. "Typification of five plant names described by Gamble" to *Bangladesh Journal of Plant Taxonomy* and Manuscript No. BJPT-47613/20, Date: 15.06.2020.
5. MURUGAN, P., R. KOTTAIMUTHU AND C. MURUGAN. "Nomenclature and Typification of thirty five names in Rubiaceae of Southern Western Ghats, India" to the Journal *Phytotaxa* and Manuscript No. 62775, Date: 25.06.2020

Research Articles Published

1. MURUGAN, P., M. SULAIMAN AND BASIL PAUL. 2020. *Tarenna flava* Alston (Rubiaceae): A New Record for Kerala from Agasthyamalai Biosphere Reserve, Western Ghats, India. *Indian Forester* 146(8): 780-781.

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 Introduction

The state Kerala is considered as one of the most biologically rich state on the tropical Malabar coast of South Western India. It is estimated that about 27 percent of the area of the state is under forests. Kerala having characteristic flora among other biogeographic regions of the country. With the goal of preparing a comprehensive flora of India, floras of many States were completed during the last three decades. Though, the flora of most of the districts and protected areas has been studied recently, a comprehensive flora of the State has not yet been prepared other than Volume 1 and 2. The families allotted for Volume 4 are Hydrophyllaceae, Boraginaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Orobanchaceae, Lentibulariaceae, Gesneriaceae, Bignoniaceae, Pedaliaceae, Acanthaceae, Verbenaceae, Symphoremataceae, Avicenniaceae, Lamiaceae, and Plantaginaceae.

4.2 Literature

Plant documentations were prepared with help of literatures like Flora of Travancore (Rama Rao, 1914) Flora of Calicut (Manilal & Sivarajan, 1982) Flora of Cannanore (Ramachandran & Nair, 1988) Flora of Silent Valley (Manilal & al., 1988) Systematic study on the flora of Kottayam (Antony, 1989) Flora of Palghat (Vajravelu, 1990) Flora of Thiruvananthapuram (Mohanam & Henry, 1994) Flowering Plants of Thrissur Forests (Sasidharan & Sivarajan, 1996) Flora of Nilambur (Sivarajan & Mathew, 1997) Flowering Plants of Kerala (Sasidharan, 2004) Flora of Pathanamthitta (Anil Kumar & al., 2005) Flowering Plants of Kerala (Nayar & al., 2006) Flora of Alappuzha (Sunil & Sivadasan, 2009) and Floristic study of Wayanad (Ratheesh Narayanan, 2009) and revisionary studies related to the families like A taxonomic revision of Indian *Solanaceae* (Reema Kumari, 2004), Morphologic and Taxonomic studies of the genus *Leucas* R.Br. (*Lamiaceae*) in Southern Peninsular India (Sunojkumar, 2005), Systematic Position, Phylogeny, and Taxonomic Revision of Indian *Ocimum* (Kumar & al., 2018), Taxonomic Revision and Molecular phylogeny of the genus *Plectranthus* Lamiaceae (Smitha, 2018), Taxonomic studies on the genera *Pogostemon* Desf.,

Anisochilus Wall ex. Benth. And *Scutellaria* L. (Shinoj, 2019) and A taxonomic revision of *Henckelia* (Gesneriaceae) in South India with a new species, one new combination and seven lectotypifications (Janeesha & Nampy, 2020).

4.3 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.

4.8 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. Introduction: As part of allotted Annual Action Plan Project, Volume – 6: (Orchidaceae to Potamogetonaceae) with 38 families viz., Orchidaceae, Zingiberaceae, Marantaceae, Musaceae, Sterlitziaceae, Heliconiaceae, Cannaceae, Costaceae, Bromeliaceae, Haemodoraceae, Taccaceae, Dioscoreaceae, Trichopodaceae, Smilacaceae, Agavaceae, Dracaenaceae, Hypoxidaceae, Amaryllidaceae, Burmanniaceae, Liliaceae, Iridaceae, Pontederiaceae, Xyridaceae, Commelinaceae, Flagellariaceae, Juncaceae, Arecaceae, Pandanaceae, Typhaceae, Araceae, Lemnaceae, Triuridaceae, Alismataceae, Limnocharitaceae, Hydrocharitaceae, Najadaceae, Aponogetonaceae and Potamogetonaceae of Flora of Kerala, has been allotted in September 2020, to prepare, update, edit and format the taxonomic account as per the given pattern of Flora of Kerala based on available literature, herbarium specimens and various online databases. Among 38 families, old manuscripts, which are prepared 2 decades before, are available for following families viz., Zingiberaceae,

Amaryllidaceae, Pontederiaceae, Araceae, Alismataceae. Also recently updated MS are available for Araceae and Commelinaceae. Data on habitat, flowering and fruiting period and distribution were gathered from the field labels of herbarium sheets. Besides, available Floras of all Districts in Kerala, and Protected Areas of Kerala state and research articles published in various journals were referred. Bracketed keys to genera, species and infra-specific taxa, and up-to-date nomenclature with bibliographic citations, vernacular names if any, detailed description, habitat, flowering and fruiting period, distribution (in different district of Kerala, other states in India and world), taxonomic/nomenclatural notes, if any and uses will be prepared for all the families.

4.2. Literature: Consulted all Floras (Districts, and Protected Areas), Monographs, e-Florals/Revisions, Research articles published in various Indian and foreign journals and reports dealing with above said families, apart from nomenclatural citations. Various online international plant databases (International Plant Names Index (IPNI): www.ipni.org; Plants of the World Online (POWO): <http://www.plantsoftheworldonline.org>; Tropicos: www.tropicos.org) have been referred to update the taxonomy, nomenclature and distribution of every taxon. Some important references pertinent to the Flora of Kerala are provided as follows.

- BALASUBRAMANYAN, K., SWARUPANANDAN, K. AND SASIDHARAN, N., 1985. Field Key to the Identification of Indigenous Arborescent Species of Kerala Forests: Report of the Research Project Ecol. 02/1979 (June 1979-May 1985). Kerala Forest Research Institute. Basha SC, 1991. Distribution of Mangroves in Kerala. *Indian Forester* 117: 439- 448.
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- MOHANAN, M. AND HENRY, A.N., 1994. Flora of Thiruvananthapuram.
- NAYAR, M.P., 1996. Hot spots of endemic plants of India, Nepal and Bhutan. Tropical Botanic garden and research Institute.
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- SASIDHARAN, N., 1998. Studies on the flora of Periyar Tiger Reserve. Kerala Forest Research Institute, Peechi, India.
- SASIDHARAN, N., 1999. Study on the flora of Chinnar Wildlife Sanctuary. KFRI re-search report, Kerala Forest Research Institute (KFRI), Peechi, p.167.

4.3. 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.

4.4. Site of the study (with map): Kerala State



4.5. 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.

f. New Methodology (if any) adopted : NA

4.6. Achievements including :

A total of 106 taxa belongs to Orchidaceae were documented.

- Total area covered : NA
- Number of tours undertaken : Nil
- Number of species collected : NA
- Number of species identified (with name) : NA
- Number of species incorporated : NA

4.7. Output indicators for the assessment of the project :

- ✓ Updated nomenclature of 106 plant species with description and distribution.
- ✓ Monthly, quarterly reports prepared and submitted.

4.8. Major impacts reported during the financial year :

B. Research Publications (in *Nelumbo* format): NA.

VII. Flora of India

Volume 11

A. Annual Progress Report is to be submitted in the following format with respect to:

5. Name of the Project: Flora of India Volume 11 (Cactaceae – Apiaceae)
6. Executing Scientist(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)

7. Duration of the project : April 2019 – December 2020

8. About the work done:

4.1. **Introduction:** As part of the Annual Action Plan, the Volume 11 of Flora of India was assigned to the scientists of BSI, SRC in April 2019, to prepare, update/prepare and format the taxonomic account of 10 Angiospermic families (Cactaceae, Aizoaceae, Molluginaceae, Araliaceae, Cornaceae, Alangiaceae, Nyssaceae, Caprifoliaceae, Adoxaceae and Apiaceae) as per the pattern of Flora of India. Of which, the soft copies of the scanned old manuscripts of Cactaceae, Aizoaceae and Molluginaceae were only provided as PDF files (thus they were freshly typed during the period). Therefore, the manuscripts of remaining seven families have been prepared freshly, majorly based on herbarium specimens and literature. For every taxon, habit, habitat, flowering and fruiting period and distribution were gathered from the labels of herbarium sheets. Besides, Floras of Districts, States and Protected Areas of India and research articles published in various journals were referred. Initially, the checklists of all ten 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, bracketed keys to genera, 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.

4.2. **Literature:** Research articles published in various Indian and foreign journals and Floras (Districts, States and Protected Areas), e-Floras/Revisions pertinent to the ten angiospermic families, and online international plant databases (International Plant Names Index (IPNI): www.ipni.org; Plants of the World Online (POWO): <http://www.plantsoftheworldonline.org>; Tropicos: www.tropicos.org) have been referred to update the taxonomy, nomenclature and distribution of every taxon.

4.3. **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.

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

4.5. 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.

g. New Methodology (if any) adopted: Nil

4.6. Achievements including: NA

F. Total area covered:

G. Number of tours undertaken: –

H. Number of species collected: –

I. Number of species identified (with name): –

J. Number of species incorporated: –

4.7. Output indicators for the assessment of the project: –

4.8. Major impacts reported during the financial year: –

B. Research Publications (in **Nelumbo** format): NIL

Volume 20

C. The Annual Progress Report is to be submitted in the following format with respect to:

9. Name of the Project : 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.).

10. Executing Scientist(s) : Dr. W. Arisdason, Scientist “D”.

11. Duration of the project : April 2019 – December 2020

12. About the work done:

12.1 **Introduction:** As part of Annual Action Plan, Subtribes namely Andrographidinae, Asystasiinae and Barleriinae of Tribe Justiceae (Acanthaceae) and Subtribes Polyspermeae and Tetraspermeae of Tribe Ruellieae (Acanthaceae) have been assigned in April 2019, to prepare, update and format the

taxonomic accounts as per the pattern of Flora of India. Initially, the updated checklists of all the five subtribes 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, for every taxon. Subsequently, as the manuscripts of taxonomic accounts of all five subtribes were old and out-dated or not as per Flora of India pattern, the manuscripts were updated through review of pertinent literature and formatted as per Flora of India pattern. The manuscripts were updated with many additions (due to discovery of many novelties and new records from India). Similarly, there are considerable changes in the nomenclature, especially at generic and family level due to recent phylogenetic studies. Therefore, the keys to genera, species and infraspecific taxa were reconstructed. The updated final manuscripts of five subtribes were submitted to the team leader of the Volume 20. Also assisted the team leader in finalizing the final manuscript of the entire volume.

12.2 **Literature:** Research articles published in various Indian and foreign journals and Floras (District, State and Protected Areas of India), e-Floras/Revisions/Monographs pertinent to the Subtribes Andrographidinae, Asystasiinae and Barleriinae of Tribe Justicieae (Acanthaceae) and Subtribes Polyspermeae and Tetraspermeae of Tribe

Ruellieae (Acanthaceae), and online international plant databases (International Plant Names Index (IPNI): www.ipni.org; Plants of the World Online (POWO): <http://www.plantsoftheworldonline.org>; Tropicos: www.tropicos.org) have been referred to update the taxonomy, nomenclature and distribution of the above mentioned four families. Expertise opinions were sought from Indian and foreign experts, either for taxonomy or nomenclature, as and when required.

12.3 **Objectives:** To update the taxonomic account of the Subtribes namely Andrographidinae, Asystasiinae and Barleriinae of Tribe Justicieae (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.

12.4 Site of the study (with map): India

12.5 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.

h. New Methodology (if any) adopted: Nil

12.6 Achievements including: NA

K. Total area covered:

L. Number of tours undertaken: —

M. Number of species collected: —

N. Number of species identified (with name): —

O. Number of species incorporated: —

12.7 Output indicators for the assessment of the project:

12.8 Major impacts reported during the financial year:
Research Publications (in **Nelumbo** format): **02**

1. GNANASEKARAN, G., **W. ARISDASON** AND Y. DENG. 2020. An overview on the validation of the name *Andrographis longipedunculata* (Acanthaceae). *Phytotaxa* 433(1): 75–76.
2. KARTHIGEYAN, K., **W. ARISDASON** AND L. RASINGAM. 2020. Lectotypification of *Justicia anfractuosa* (Acanthaceae), an Endemic and Rare Species from Northeast India. *J. Jap. Bot.* 95(1): 39–40.

Volume 21

1. Name of the Project : FLORA OF INDIA, Vols. 9, 10, 21 & 29
2. Executing Scientist (s) : V. SAMPATH KUMAR
3. Duration of the project : APRIL 2020 TO MARCH 2021
4. About the work done : Period: April 2020 to Sept. 2020

4.1 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) Payens 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 group 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 *Vignea*

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.

- 4.2 Literature: All the references pertaining to all the above manuscripts were consulted either in Library or in online in various websites.
- 4.3 Objectives: To bring out the flora of India volumes.
- 4.4 Site of the study (with map) : NA
- 4.5 Methodology adopted :
 - i. New Methodology (if any) adopted : NA
- 4.6 Achievements including :
 - P. Total area covered : NA
 - Q. Number of tours undertaken : NA
 - R. Number of species collected : NA
 - S. Number of species identified (with name) : NA
 - T. Number of species incorporated : NA
- 4.7 Output indicators for the assessment of the project : Monthly and Quarterly reports
- 4.8 Major impacts reported during the financial year : New combinations made and the one species reported as new record to Western Himalaya.

D. Research Publications (in *Nelumbo* format)

LODH, P., **SAMPATH KUMAR, V.**, MUKHERJEE, S.K. and SINHA, S.N. 2020. *Salvia roborwoskii* Maxim. — an addition to flora of Western Himalaya, India. *NeBio* 11(3): 189–191.

Volume 28

1. **Name of the Project:** Flora of India, Volume – 28 (Alismataceae, Uvulariaceae and Trilliaceae)
2. **Executing Scientists:** Dr. M.U. Sharief, Scientist- E & M. Murugesan, Scientist -C
3. **Duration of the project:** April, 2020–September, 2020
4. **About the work done :**
 - 4.1. Introduction:** 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.
 - 4.2. Literature:** Consulted all Floras (Districts, States and Protected Areas), Monographs, e-Florals/Revisions, Research articles published in various Indian and foreign journals and reports pertinent to the above mentioned 3 families apart from nomenclatural citations. Various online international plant databases (International Plant Names Index (IPNI): www.ipni.org; Plants of the World Online (POWO): <http://www.plantsoftheworldonline.org>; Tropicos: www.tropicos.org) have been referred to update the taxonomy, nomenclature and distribution of every taxon.
 - 4.3. Objectives:**

- To prepare and update the taxonomic account 43 taxa belonging to 3 families viz., Alismataceae, Uvulariaceae and Trilliaceae based on herbarium specimens and literature.
- To reconstruct the bracketed keys to genera, species and infraspecific taxa, wherever necessary, especially when new reports are included or change in nomenclature and taxonomic status.
- 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 (India and world) of every taxon.
- To submit the updated and refined taxonomic account of the allotted genera to the team leader.

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

4.5. 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.

j. New Methodology (if any) adopted : NA

4.6. Achievements including :

- Total area covered : NA
- Number of tours undertaken : Nil
- Number of species collected : NA
- Number of species identified (with name) : NA
- Number of species incorporated : NA

4.7. Output indicators for the assessment of the project :

4.8. Major impacts reported during the financial year :

➤ 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.

Consulted MH herbarium and other virtual herbaria for the identification of the above genera.
Submitted final report to the team leader.

B. Research Publications (in *Nelumbo* format) : –

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:

4.1 Introduction

Coastal zones are the most unique, fragile, dynamic and productive ecosystem which are quite often under pressure from both anthropogenic activities and natural processes. Coastal zone is endowed with a very wide range of different habitats such as Sandy coast, Mangroves, Coral reef zones, Sea grass beds, Sand dunes, Mudflats, Salt marshes, Estuaries, Lagoons, etc. Abiotic components play a vital role in distribution of diversity of marine flora and fauna. Thus, the marine ecosystem forms an integral part of the global biological diversity. The varied tectonic history, underlying lithology, monsoon climate, sea level fluctuations in the quaternary and modern littoral processes have created a great variety of the coastline of the Indian Peninsula (Mukhopadhyay & al., 2014). India (8° – 37° N and 68° – 97° E), is one of the seventeen mega diversity countries (www.conservation.org) and the 7th largest country in the world with 2.4% of the global geographical area and one among the 12 mega-biodiversity countries with the richest and highly endangered eco-regions of the world (Myers & al., 2000). In terms of marine environment, Indian coastline stretches about 7500 km encompasses mainland, islands and union territories (Oza & Zaidi, 2001) with a very wide range of coastal ecosystems such as estuaries, lagoons, mangroves, backwaters, salt marshes, rocky coasts, sandy stretches and coral reefs (Venkataraman, 1939). The Indian coastline of west exposed of surf & rocky shores, where as in east of beaches, lagoons, deltas & marshes (Venkataraman, 2005).

Marine flora is taxonomically very diverse and fall into mangroves, seagrasses, microalgae and Marine macro algae (seaweeds). Among them marine macro algae play a vital role in the regulation of marine ecosystem. They are exclusively found in marine habitats and rarely able to withstand inundation in fresh water as well as in low saline water (Jobri, 2004). The plant body of marine macro algae is differentiated into holdfast for anchoring, stipe to keep erect the thallus and frond in the means of branching pattern seen in angiosperm. They range from unicellular organisms to nonvascular filamentous or thalloid plants (Davies, 2002). Typically, they are epilithic and grow on solid substrata such as rocks, bedrocks, pebbles, mollusc shells and corals. However, they can also be found growing on coastal litters such as plastic ropes, nets and decayed wooden pieces and as epiphytes on other plants like seagrasses and mangroves in shallow, intertidal and sub-tidal

zones and deep waters of sea, even up to a depth of 150 m or up to a depth that can receive more than 0.12% of the photosynthesis light (Markager & Sand-Jensen, 1994).

Marine macro algae belong to the division thallophyta of the sub-kingdom cryptogamae and broadly classified into three classes viz. Chlorophyceae (Green), Phaeophyceae (Brown) and Rhodophyceae (Red), based on the nature of colour, storage of food materials, cell wall and type of photosynthetic pigments (Myslabodski, 2001). In recent years the importance and the economic values of this promising resources has got more momentum throughout the world.

Seaweeds are the potential marine living resources in the world. More than 20,000 seaweeds are distributed throughout the world, of which only 221 (1.1%) are commercially utilized, which includes 145 species for food and 110 species for phycocolloid production (Sahoo, 2000). Since ancient times, seaweeds are used as a direct food source to humans, especially in East Asia (Japan), the Indo-Pacific (China, Indonesia) and Pacific (Hawaii). Presently, there are 42 countries in the world with reports of commercial exploitation of seaweeds. Among them, China holds first rank, followed by North Korea, South Korea, Japan, Philippines, Chile, Norway, Indonesia, USA and India. These top ten countries contribute up to 95% of the world's commercial seaweed utilization (Khan & Satam, 2003). They are used in the nourishment, pharmaceutical, medicinal genetics and biotechnological industries due to their distinct biochemical properties as gelling agents, thickeners or stabilizing and emulsifying agents. These seaweed polysaccharides have a high nutritional property than other natural hydrocolloids such as pectin, xanthan gum (Saha & Bhattachaya, 2010).

At the recent period, a total of 72,500 algal species (including varieties, forma etc.) recorded, of which about 44,000 species scientifically reported and published world-wide (Guiry, 2012). Among them, seaweeds constitute about 10,500 species which include Rhodophyceae with about 7,000 species, followed by Phaeophyceae with 2,000 species and Chlorophyceae with 1,500 species (<http://www.seaweed.ie/>). India (8° – 37° N and 68° – 97° E) emanates in seventeen megadiversity countries (www.conservation.org) and turn out to be 7th largest country in the world with 2.4% of the global geographical area. Coastline of India endowed of ca 7,500 km long with Exclusive Economic Zone (EEZ) of around 2.5 million km². It has an enormous lattice of beaches, backwaters, estuaries, creeks, cliffs, lagoons, mangroves and coral reefs. The coastline includes 97 major estuaries, 34 major lagoons, 31 mangroves areas, 5 coral reefs and 31 Marine Protected Areas (Singh, 2003). The distribution and diversity of seaweeds in various maritime states in India varies greatly and hinge on the ecological and hydrological factors. The marine macro algal diversity is vaster in West coast of India than the East Coast of India.

Tamil Nadu coast shows the highest number of seaweeds with 426 species (Anon., 1978), followed by Maharashtra coast with 240 species (Sonali, 2010); Gujarat coast with 198 species (Jha & al., 2009); Kerala coast with 147 species (Yadav, 2016), Lakshadweep islands with 82 species (Anon., 1979) and Andaman & Nicobar islands with 80 species (Muthuvelan & al., 2001); Karnataka with 108 taxa, comprising of 36 chlorophyceae 30 phaeophyceae and 42 rhodophyceae members (Palanisamy & Yadav, 2017); Diu island with 70 species (Mantri & Subba Rao, 2005); Andhra Pradesh with 80 species (Anon, 1984); West Bengal with 14 species (Mukhopadhyay & Pal, 2002); Odisha with 14 species (Sahoo & al., 2003).

Though the Indian coastline is endowed with enormous diversity of seaweeds, most of the states are having inordinate lacuna in the knowledge on seaweed taxonomy and its diversity. Their values and potential also not yet to utilized in proper manner, hence forth, this present study is attempted to frame out the details on the marine macro algal diversity in Andhra Pradesh coastline, a part of East Coast

4. 2 Literature

The research on the ecology and diversity of the marine algae from Andhra Pradesh was initiated by Sreeramulu (1952 & 1953,) from the coastline of Visakhapatnam. Later on, Umamaheshwara Rao & Sreeramulu (1964) reported the ecological aspects, vertical zonation, & seasonal succession of the coastline of Visakhapatnam. Subsequently, they studied the taxonomic account of marine macro algae and reported 80 taxa which published in “*An annotated list of the marine algae of Visakhapatnam*” (1970a). Among them, 18 taxa were new records to India and several taxa were new additions to east coast of India. Also opined the annual growth variations of *Ulva fasciata*, *Enteromorpha compressa*, *Caulerpa fastigiata*, *C. racemosa*, *C. sertularioides*, *C. taxifolia*, *Padina tetrastromatica*, *Dictyota* sp., *Gelidiopsis variabilis*, *Hypnea* sp., *Acanthophora spicifera* and *Pophyra vietnemensis* (1964 & 1974). In addition to that, Umamaheshwara Rao (1969) discovered a new species *Liagora visakhapatnamensis* and flagged taxonomically from the coastline of Visakhapatnam, Andhra Pradesh.

Whilst, Coastline of Andhra Pradesh was surveyed by CSMCRI (Central Salt & Marine Chemical Research Institute) with the Department of Fisheries, Government of Andhra Pradesh during 1972 – 1982 and reported a sum of 64

species of marine algae including 23 species of green algae, 7 species of brown algae and 34 species of red algae (Kaliaperumal & Chennubhotla, 2015). The genus *Pterocladia* of the Rhodophyceae was reported for first time in India from the Coastline of Visakhapatnam by Umamaheswara Rao and Kaliaperumal (1980). Subba Rao et al. (1983) provided the detailed account on the systematic list of marine algae from Andhra Pradesh with distribution. Totally, 98 species reported of which, encompassing 30 species of green algae, 23 species of brown algae, 44 species of red algae and 1 species of blue-green alga. Thereafter, Numerical study on the Intertidal zonation, population, relative frequency and abundance of 39 species of marine macro algae along the Visakhapatnam Coast by Rao & Rao (1986). Germination of spores, survival rate of germlings, culture of germlings and life history studies on some economically important Indian seaweeds was reviewed by Chennubhotla et al. (1987). The occurrence on the *Bostrychia tenella*, *caloglossa leprieurii*, *Catenella impudica* & *Enteromorpha* sp. was reported and discussed with their associated phylodiversity (Narashimha Rao & Venkanna, 1996) from Sarada Varaha estuarine complex of Visakhapatnam.

Meanwhile, remarkable annotations on the seasonal growth, phenology and spore shedding in red algae such as *Gelidiopsis variabilis* (Kaliaperumal and Umamaheswara Rao, 1982), *Gracilaria corticata* (Subbrangaiah, 1983a), *Hypnea valentiae* (Subbrangaiah and Umamaheswara Rao, 1983), *Gracilaria textorii* (Subbrangaiah, 1984a), *Pterocladia heteroplotos* (Kaliaperumal and Umamaheswara Rao, 1985), *Gracilaria sjoestedtii* (Subbrangaiah, 1985a), *Agalothanion cordatum* (Subbrangaiah, 1985b), *Gelidium pusillum* (Kaliaperumal and Umamaheswara Rao, 1986), *Grateloupia filicina* (Umamaheswara Rao, 1987), *Bangiopsis simplex* (Narasimha Rao, 1989b), *Amphiroa fragilissima* (Subbrangaiah and Vanilla Kumari, 1997a), *Wrangelia argus* (Subbrangaiah et al., 2002), *Polysiphonia platycarpa* (Subbrangaiah et al., 2003a), *Centroceras clavulatum* (Subbrangaiah et al., 2003b), *Porphyra vietnemensis* (Narasimha Rao, 1992; Narasimha Rao and Subbrangaiah, 2010a). Likewise, brown marine macro algae such as *Padina tetrastomatica* and *Dictyota dichotoma* (Umamaheswara Rao and Sreeramulu, 1970b), *Ectocarpus mitchalle* (Narasimha Rao, 1991), *Sargassum vulgare* (Subbrangaiah and Appa Rao, 2004), *Sargassum polystum* (Srinivasa Rao and Umamaheswara Rao, 2002), *Rosenvingea nhatragensis* (Narasimha Rao et al., 2012). Satya Rao et al. (2011) were studied in different decades by several researchers.

Subba Rangaiah & Narasimha (2008) Rao worked on the effect of temperature & salinity on photosynthesis & biomass of *Bostrychia tenella*, *caloglossa leprieurii* & *Catenella impudica* collected from river bed of East Godavari. Followed by, Narasimha Rao & al. (2008) provided the seasonal data on gametophytic, tetrasporophytic and vegetative populations of the *Catenella impudica* from East Godavari river bank. Later, Physio-chemical parameters, macro and micro alga diversity was observed and reported from Kolleru Lake, East Godavari, by Narashimha Rao, 2009. *Chaetomorpha aerea* was reported for first time in Andhra Pradesh from the inter tidal zone of Visakhapatnam coastline and its morphological observations were deliberated by Ghosh & Jai Prakash (2010).

Satya Rao & al. (2011) premeditated the physico-chemical parameters of the sea water and seasonal variations of 39 taxa of marine macro algae from 75 quadrants sited in Bheemili coast, Visakhapatnam. Srinivasa Rao (2012) focused on the distribution of seaweeds from the saline habitats of Kakinada, East Godavari and reported the presence of *Bangiopsis subsimplex*, *Gracilaria tenuistipitata* var *tenuistipitata*, *Chaetomorpha brachygona*, & *Chaetomorpha indica*. Subba Rangaiah & al. (2012) detailed about the effect of environmental factors on oospore shedding in *Sargassum ilicifolium*. Data on seasonal growth and spore shedding in detail was accounted in *Lobophora variegata* (Narashimha Rao, 2014) and its chemical composition and primary compositions were studied by Narashimha Rao & Prayaga Murthy (2012).

In recent days, researches fixated on the prospect of seaweeds and their utilization in different discipline of science correlates with our day-to-day activity. Effect of Seaweed Liquid Fertilizer from *Gracilaria Textorii* and *Hypnea Musciformis* was premeditated to observed the progress of seed germination and productivity of Brinjal, Tomato & Chilly (Narasimha Rao & Reshmi Chatterjee, 2014). Antimicrobial activity of *Sargassum polycystum*, *Sargassum tenerrimum*, *Gelidium pusillum* & *Centroceras clavatum* were assayed against 18 pathogenic microbes by Kausalya & Narasimha Rao (2015). Kaliaperumal & Chennubhotla (2015) reviewed the distribution, diversity, resources, floristic & systematic data, ecology, biology, environmental impacts, utilization and cultivation of marine algae of Andhra Pradesh. Sowjanya & Sekhar (2015 & 2017) accounted a comparative study of seaweed flora over a period of time with reference to climate change in Visakhapatnam Coast and documented the species composition, vertical distribution and monthly variations of 48 taxa of marine macro algae fall under 18 species (37%) of Chlorophyceae nine species (19%) of Phaeophyceae and 21 species (37%) under Rhodophyceae. Diversity, seasonal distribution of 28 marine macro algae were reported at Mutyalammampalem, Visakhapatnam district, East Coast of India by Narasimha Rao & Srinivasa Rao (2016). Experimental

field cultivation of *Kappaphycus alvarezii* was done successfully in the coastal waters of Bay of Bengal at Chepala Timmapuram, Visakhapatnam district using tubular method and netbag method by Periyasamy and Subba Rao (2017).

Eventually, Biochemical composition such as Chlorophyll a, b & c, Salinity, Nitrate, phosphate & Silicate and benefits of *Catenella repens*, *Ulva lactuca*, *Caulerpa racemosa*, *Enteromorpha intestinalis* and *Chaetomorpha melagonium* are assayed by Kakoli Banerjee & al. (2019). In addition to all, Bast & Rani (2019) has discovered the new species *Ulva uniseriata* on the basis of phylogenetic reconstruction using nrDNA ITS1 locus collected from the estuarine region of Pulicat Lake, Nellore District.

However, several researchers focused on the marine macro algae of Andhra Pradesh on various accepts in different decades, they merely surveyed the Visakhapatnam, the midst coastline of Andhra Pradesh. Information on seaweeds from the northern and southern coastline of Andhra Pradesh are sporadic, rare, inadequate and inattentive too. The perusal of literature survey also makes clear that, the work on seaweeds diversity and taxonomy of Andhra Pradesh coast is very meagre. In view of this, this present study is subjected to provide the detailed account on the marine macro algal flora of Andhra Pradesh.

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.intphycsoc.org/), Phycological Society of America ([/www.psaalgae.org/](http://www.psaalgae.org/)) etc., were also referred for the identification of seaweeds.

4.6 Achievements

- 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
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.	Caulerpanceae
38	Caulerpa peltata J.V.Lamour.	Caulerpanceae
39	Caulerpa racemosa (Forssk.) J.Agardh	Caulerpanceae
40	Caulerpa racemosa var. macrophysa (Sonder ex Kuetz.) W.R.Taylor	Caulerpanceae
41	Caulerpa racemosa var. turbinata (J.Agardh) Eubank	Caulerpanceae
42	Caulerpa scapelliformis (R.Br.ex turner) C.Agardh	Caulerpanceae
43	Caulerpa sertularioides (S.Gmelin) Howe	Caulerpanceae
44	Caulerpa taxifolia (Vahl) C.Agardh	Caulerpanceae
45	Caulerpa verticillata J.Agardh	Caulerpanceae
46	Caulerpa veravalensis Thivy & V.D.Chauhan	Caulerpanceae
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 tetrastromatica Hauck	Dictyotaceae
67	Stoehospermum 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** (Huds.) 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 Introduction :

The Gulf of Mannar Biosphere Reserve (GoMBR) is the first marine Biosphere Reserve in Southeast Asia,

declared in the year 1989. It encompasses 21 islands, situated between Rameshwaram and Thoothukudi, and the entire Gulf of Mannar was declared as Marine National Park in 1986, for the purpose of protecting marine wildlife and its environment. The coastline of Gulf of Mannar from Rameswaram in north and Kanyakumari in south is about 170 nautical miles (Kumaraguru & al, 2006). The park and its 10 km buffer zone were declared a Biosphere Reserve in 1989 (Upreti & Shanmugaraj, 1997). The island and their shallow waters form the core of the reserve. This core area is surrounded by a 10 km wide buffer zone. The Gulf of Mannar consists of three important ecosystems namely terrestrial, mangrove and marine. These three very productive ecosystems harbour a rich biodiversity of fauna and flora making it biologically one of the richest coastal regions in India. The Gulf of Mannar is bordered on the west by the southeast coast of India, on the east by the north-west coast of Sri Lanka. There are 21 islands of coral based origin, which are lying as a string of chain opposite to the mainland coast. Each island has its unique characteristics, surrounded by coral reefs with rich faunal and floral diversity.

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.

4.2 Literature :

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4.3 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

4.4 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 Poovarasaputti (Submerged).
- **Vembar Group** (3 islands): Upputhanni, Puluvinichalli and Nallathanni.
- **Thoothukudi Group** (4 islands): Van, Kaswari, Kariyachalli and Velanguchalli (Submerged).

1.1 Methodology adopted :

k. New Methodology (if any) 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 & Sachet, 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 Achievements including :

U. Total area covered : Nil

V. Number of tours undertaken : Nil

W. Number of species collected : Nil

X. 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
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
54.	Lindernia caespitosa (Blume) Panigrahi
55.	Lindernia hyssopioides (L.) Haines
56.	Lindernia minima (Benth.) Mukerjee
57.	Lipocarpha chinensis (Osbeck) J.Kern
58.	Lipocarpha 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 (Forsk.) 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.
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
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.
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 juncoides (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
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.

Y. 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.

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.

E. Research Publications (in *Nelumbo* format): Two

1. MURUGAN, C., MANIKANDAN, R., NITHYA, S.P., KARTHIK, B. AND ARISDASON, W. 2020. *Capparis danielii* (Capparaceae), a new species from the Gulf of Mannar Biosphere Reserve, India. *Phytotaxa* 472(3): 283–291.

2. NITHYA, S.P., ARUMUGAM, S., KARTHIK, B., MANIKANDAN, R. AND MURUGAN, C. 2021. Wild Relatives of Cultivated Crops in Gulf of Mannar Biosphere Reserve, Tamil Nadu, India. *Indian Forester* 147(4): 405-409.

Completed project

16. Name of the Project : Cyperaceae of Tamil Nadu. (Area: 269 sq.km.)

17. 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.

18. Duration of the project :01.04.2015 to 31.03.2020

19. About the work done : Completed the Project

19.1 INTRODUCTION :

The family Cyperaceae (commonly known as sedges), the seventhlargest family in the angiosperms and third in the monocotyledons, is having106 genera and 5,387 species with Carex (2,000 sp.) and Cyperus (550 sp.)as the dominant genera (Govaerts et al., 2007). They are cosmopolitan,grass-like monocots and are often form an important component of manyhabitats ranging from marshes to deserts, and they dominate manyecosystems, including Tundra and Savanna. Some species are habitatspecific,narrowly distributed and of conservation concern, whereas othersare ubiquitous weeds that occur in a variety of environments.

Sedges have featured in literature since antiquity. The family is wellcircumscribed and uncontroversial. It was formally described by De Jussieuin 1789; the name is derived from the genus Cyperus, originally from theGreek kupeiros, meaning sedge. The spikelet and inflorescence structure,together with other evidence, form the basis for classification within thefamily. However, the very small nature of the spikelet and the complexstructure of the inflorescence are often complicate the interpretation andthere is still controversy over the recognition of some of the

subfamilies, tribes and genera. Molecular studies in the family are still in the early stages and have not, as yet, yielded any real solution to the problems. Many species have a tufted growth habit, long, thin-textured, narrow, flat leaves with a sheathing base, jointed culms and much-branched inflorescences of tiny flowers, they are often described as graminoid, meaning grass-like. But some grasses and sedges do not fit to the graminoid image, by having leaf blades rounded in cross section or no leaf blades at all, or having compact, head-like inflorescences etc (Archer, 1998).

The state of Tamil Nadu is floristically very rich including Poaceae (Grasses) and Cyperaceae (Sedges). Since BSI, SRC has already published '*Grasses (Poaceae) of Tamil Nadu*', in continuation of this it is planned to bring out '*Cyperaceae of Tamil Nadu*'. It is estimated about 190 taxa are distributed under family Cyperaceae of Tamil Nadu. There is no comprehensive study, proper survey and exact delimitation of taxa on Cyperaceae till now. To fill all these gaps and to solve the existing taxonomic problems under the family Cyperaceae, this project has been initiated.

The present project was allotted to Mr. K. Yarrayya, Sr. Pres. Asst. in 2015 as part of his Ph.D. work under the guidance of Dr. G.V.S. Murthy, Scientist G. The scholar has conducted some local field trips to Nilgiris, Pulni hills and Anamalayas etc. and collected some of the Cyperaceae specimens during 2015-16. He resigned from his post and left BSI in May 2016. Dr. J.V. Sudhakar has been resigned and left, Also, Dr. G.V.S. Murthy, Scientist- G retired on 31st December 2016. Thereafter, this project has been undertaken by Dr. C. Murugan Scientist –D, & Dr. S. Arumugam, Botanical Assistants. There were four field tours conducted in 2016-17 to different districts of Tamil Nadu.

19.2 LITERATURE :

CLARKE CB, carex. In: HOOKER, J. D (ed.) *Flora of British India Vol 6.*, L. Reeve and Company, London, UK, 1894, pp. 699–748.

KARTHIKEYAN S, JAIN SK, NAYAR MP, SANJAPPA M, *Florae Indicae Enumeratio: Monocotyledonae*, Botanical Survey of India, Calcutta, India, 1989, pp. 33–43.

K. YARRAYYA, G.V.S. MURTHY, S. KALIAMOORTHY AND P.K. RATNAKUMAR. 2015. Sedge flora of Karaivetti Bird Sanctuary, Tamil Nadu. *Indian J. Forest.* 38(2): 173-175.

K. YARRAYYA, G.V.S. MURTHY AND P.K. RATNA KUMAR. 2016. *Cyperus arenarius* Retz. var. *nairii* (Cyperaceae), a new variety from South India. *Taiwania* 61 (3): 221-223.

JIMÉNEZ-MEJÍAS P., STRONG M., GEBAUER S., HILPOLD A., MARTÍN-BRAVO S. AND REZNICEK A. A. 2018. Taxonomic, nomenclatural and chorological reports on Carex (Cyperaceae) in the Neotropics. – *Willdenowia* 48: 117 – 124. doi:\ <https://doi.org/10.3372/wi.48.48108>.

PRASAD V. P. AND N. P. SINGH, 2002. *Sedges of Karnataka (India)*. Scientific Publishers, Jodhpur.

VIJI A. R. AND T. S. PREETHA. 2017. *Fimbristylis scabrida* (Cyperaceae): a new record for Asian Continent. *Annals of Plant Sciences* 6.10 pp. 1711-1712.

VIJI. A. R. AND A. G. PANDURANGAN. 2015. On the occurrence of little known sedge, *Carex walkeri* from Nilgiri. *Int. J. Pure App. Biosci.* 3 (2): 105-107.

YARRAYYA K., MURTHY G. V. S. AND RATNA KUMAR P. K. 2015. Addition of Sedges to the Flora of Tamil Nadu State. *Indian J. Pl. Sci.* 4 (4): 57-59.

4.3 OBJECTIVES OF THE PRESENT STUDY :

- 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.

19.3 Site of the study (with map) :

19.4 Methodology adopted : Conventional method of documentation of species

l. New Methodology (if any) adopted : NA

19.5 Achievements including : NA

ee. Total area covered : N.A

ff. Number of tours undertaken : N.A.

gg. Number of species collected : N.A.

hh. 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 psedoaperta* Boeckeler ex Kuek., *Carexraphidocarpa* Nees, *Carexrara* Boott, *Carexspeciosa* Kunth, *Carex vicinalis* Boott., *Carexwalker* Arn. ex Boott., *Carex wallichiana* Spreng., *Carex wightiana* Nees, *Courtoisinacyperoides* (Roxb.) Soják., *Cyperusalopecuroides* Rottb., *Cyperusarenarius* 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., *Cyperusdiffusus* Vahl, *Cyperus digitatus* Roxb., *Cyperus distans* L. f., *Cyperus dubius* Rottb., *Cyperus elatus* L., *Cyperus esculentus* L., *Cyperusexaltatus* Retz., *Cyperushaspan* L., *Cyperus imbricatus* Retz., *Cyperus involucratus* Rottb., *Cyperusiria* L., *Cyperusjavanicus* Houtt., *Cyperuslaevigatus* L., *Cyperus maderaspatanus* Willd., *Cyperus michelianus* (L.) Delile subsp. *pygmaeus* (Rottb.) Asch. & Graebn., *Cyperus nutans* Vahl, Enum. *Cyperus palianparaiensis* Govind., *Cyperuspangorei* Rottb., *Cyperus paniceus* (Rottb.) Boeckeler, *Cyperuspilosus* 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 latiglumis* 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* Govin
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. *pergamentacea* 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 punctulatus*
(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 unioloides*
(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., *Scleria lithosperma* (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

19.6 Number of species incorporated: all the identified specimens labeled and accessed. It will be incorporated very shortly

19.7 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.

19.8 Major impacts reported during the financial year : Some interesting species under confirmation.

F. Research Publications (in *Nelumbo* format) – Nil.

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 Introduction :

The Gulf of Mannar Biosphere Reserve (GoMBR) is the first marine Biosphere Reserve in Southeast Asia, declared in the year 1989. It encompasses 21 islands, situated between Rameshwaram and Thoothukudi, and the entire Gulf of Mannar was declared as Marine National Park in 1986, for the purpose of protecting marine wildlife and its environment. The coastline of Gulf of Mannar from Rameshwaram in north and Kanyakumari in south is about 170 nautical miles (Kumaraguru & al, 2006). The park and its 10 km buffer zone were declared a Biosphere Reserve in 1989 (Upreti & Shanmugaraj, 1997). The island and their shallow waters form the core of the reserve. This core area is surrounded by a 10 km wide buffer zone. The Gulf of Mannar consists of three important ecosystems namely terrestrial, mangrove and marine. These three very productive ecosystems harbour a rich biodiversity of fauna and flora making it biologically one of the richest coastal regions in India. The Gulf of Mannar is bordered on the west by the southeast coast of India, on the east by the north-west coast of Sri Lanka. There are 21 islands of coral based origin, which are lying as a string of chain opposite to the mainland coast. Each island has its unique characteristics, surrounded by coral reefs with rich faunal and floral diversity.

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.

4.2 Literature :

Balaji (Jr.) S., Edward, J.K.P. & Samuel, V. D. 2012. Coastal and Marine Biodiversity of Gulf of Mannar, Southeastern India- A comprehensive updated species list. Gulf of Mannar Biosphere Reserve Trust, Publication No. 22.

Chacko, P.I., Mahadevan, S. & Ganesan, R. 1955. A guide to the field study of the fauna and flora of Kurusadai Island, Gulf of Mannar. *Contrib. Mar. Biol. Satat.*, Krusadai Isl. 3: 1–20.

Daniel, P. & Umamaheshwari, P. 2001. The Flora of the Gulf of Mannar, Southern India. Botanical Survey of India, Kolkata.

Deshmukh, S. & Venkataramani, G. 1995. The Gulf of Mannar Biosphere Reserve. *In*. Protecting Endangered National Park. RGICS Project No. 7. Rajiv Gandhi Institute for contemporary studies, New Delhi.

Iyengar, M.O.P. 1927. Kurusadai Island flora. *Bull. Madras Gov. Mus.* 1: 185–188.

Kumaraguru, A.K., Joseph, V.E., Marimuthu, N. & Wilson, J.J.2006. Scientific information on Gulf of Mannar – A Bibliography. Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai, Tamil Nadu, India.

Lakshmanan, K.K., Raseswari, M. & Diwakar, K.M. 1984. Mangrove forest of Kurusadai Island, S.E. India and its management. *Environm. Conservation* 11: 174–176.

Melkani, V.K., Edward, J.K.P., Murugan, A., Patterson, J. & Naganathan, V. (Eds). 2014. Capacity Building in Marine Biodiversity Conservation. Training-cum-Information Manual. Gulf of Mannar Biosphere Trust, Ramanathapuram, Tamil Nadu, India and Suganthi Devadason Marine Research Institute, Tuticorin, Tamil Nadu, India. GoMBRT Publication No. 3, December 2014, Third edition.

Neelakantan, K.S. 1994. Management plan for the Gulf of Mannar Marine Biosphere Reserve, 1993–1994 and 1997–1998.

4.3 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

4.4 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 Poovarasaputti (Submerged).
- **Vembar Group** (3 islands): Upputhanni, Puluvinichalli and Nallathanni.
- **Thoothukudi Group** (4 islands): Van, Kaswari, Kariyachalli and Velanguchalli (Submerged).

4.5 Methodology adopted :

a. New Methodology (if any) 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.

4.6 Achievements including :

- a. Total area covered : Nil
- b. Number of tours undertaken : Nil
- c. Number of species collected : Nil
- d. 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 maheshwaraii 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.	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
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.	Lipocarpha chinensis (Osbeck) J.Kern
58.	Lipocarpha 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.
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) Sleseen
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
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.

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 juncoides (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
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.

- e. 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.

4.7 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.

4.8 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.

A. Research Publications (in *Nelumbo* format): Two

1. MURUGAN, C., MANIKANDAN, R., NITHYA, S.P., KARTHIK, B. AND ARISDASON, W. 2020. *Capparis danielii* (Capparaceae), a new species from the Gulf of Mannar Biosphere Reserve, India. Phytotaxa 472(3): 283–291.

NITHYA, S.P., ARUMUGAM, S., KARTHIK, B., MANIKANDAN, R. AND MURUGAN, C. 2021. Wild Relatives of Cultivated Crops in Gulf of Mannar Biosphere Reserve, Tamil Nadu, India. Indian Forest

5. Name of the Project : Floristic Assessment of Megamalai Wildlife Sanctuary, Tamil Nadu. (Area: 269 sq.km.)
6. Executing Scientist (s) :Dr. C. Murugan, Scientist E&Dr. S. Arumugam Bot. Assistant
7. Duration of the project :01.04.2016 to 31.03.2020
8. About the work done : Completed the Project

4.1 INTRODUCTION:

Megamalai Wildlife Sancturay has been declared as Wildlife Sanctuary in 26-06-2009 vide No. II (2)!EF!455!2009 by clause (b) of sub-section (1) of Section 26-A of the Wild Life (Protection) Act, 1972 (Central Act 53 of 1972), the Governor of Tamil Nadu having considered the area, the boundaries of which are specified in the schedule below is of adequate ecological, faunal, floral and geomorphological significance, for the purpose of protecting propagating and developing Wildlife and its environment by the Government of Tamil Nadu.

The Megamalai (9°31' - 9°51' N and 77°10' - 7°30' E), popularly known as high wavy mountains, a major portion of forest of this area remains unexplored for its biodiversity resources. The natural forest regions of Megamalai were cleared for various commercial plantations like tea, coffee and eucalyptus. Forests of this area have been reported as chief wildlife habitat and recently a division of this forest has been declared as Megamalai Wildlife Sanctuary.

Meghamalai in local, language (Tamil) denotes cloud covered mountains i.e. Megha=cloud, Malai=hill. Among the locals, it is known as Patchakumachi (Patcha= green, kumachi= jungle). Meghamalai is also known as High wavy mountains due to the general appearance (wavy) of these high hills from cumbum valley. The term High Wavy Mountain was largely used by British Explorers. It is a part of the Western Ghats is located along the border of Tamil Nadu and Kerala States. The Megamalai is surrounded by the Periyar Tiger Reserve on the south, Srivilliputtur Grizzled Squirrel Sanctuary on the south and southeast, Cumbam floodplains on the north and north-east and alluvial plains of Theni- Periyakulam on the northeast. The landscape has been identified as an important wildlife area by Rodgers & Panwar (1988). In the recent past, this area along with the Grizzled Squirrel Wildlife Sanctuary has recently been proposed as a Tiger Reserve by the Forest Department, Tamil Nadu state. It covers 269.11 Km² (26,910.82 Ha.) and falls in part of Madurai and Theni districts of Tamil Nadu. **(Map -I)**

In general, this area is rugged and mountainous with elevation ranging from 220-2000 m. Digital elevation model of landscape shows that the lower elevation (800m) contributed to about 44% of the area followed by medium elevation (800-1400 m), which is about 38% (Bhupathy et al. 2012). Rock formation of the area is largely composed of charnockites, granite gneiss and pink granites which

have been deformed by folds and faults (Palanivelu et al. 1988). Fifty years of global climate data show variations in annual mean temperature across elevations, i.e., 24.1 ° C (in 500m) and 18°C (in 1700m). Monthly mean minimum and maximum temperatures recorded in 500m were 21.8 °C and 30.6 °C respectively, whereas it was 16.1°C and 24.0°C for 1700m (Bhupathy et al. 2009). Cumulative annual rainfall of lower and higher elevations of the area is 1500 and 2161 mm respectively. Both in higher and lower elevations, the lowest rainfall was recorded during January and the maximum during July (Bhupathy et al. 2009).

Major rivers in the area are the Vaigai and the Suruliar. The Vaigai originates from Varusanad Hills while Suruliar originates from High Wavy Mountains and both join Periyar at different locations. The Public Works Department, Tamil Nadu has constructed five dams namely Highwavys, Manalar, Venniyar, Eravangalar and Shanmuganathi-for electricity generation and for irrigation in and around Cumbam. There are two tribal communities viz Paliyar and Muthuvar, who are spread across various parts of Madurai and Theni District. There are various vegetation types viz Wet evergreen forests, montane forests, high altitude grasslands, southern tropical west coast semi-evergreen forests, southern tropical moist mixed deciduous forests, southern tropical secondary moist mixed deciduous forest, southern tropical dry mixed deciduous forests, southern tropical carnatic umbrella thorn forests, southern dry deciduous scrub forests, etc, which are very important for the richness of the flora of these zones.

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.

4.2 LITERATURE :

Babu, S. & S. Bhupathy (2013). Birds of MeghamalaiLandscape, southern Western Ghats, India. *Journal of Threatened Taxa* 5(15): 4962-4972; <http://dx.doi.org/10.11609/JoTT.o3594.4962-72>

Bhupathy, S., G. Srinivas & N. Sathishkumar (2009) A stud on herpetofaunalcommunities of the Upper Vaigai Plateau, Western Ghats, India. Final Technical Report submitted to Ministry of Environment and Forests, Government of India.

Bhupathy, S., G. Srinivas, N. Sathishkumar, M. Murugesan, S. Babu, R. Suganthasakthivel & P. Sivakumar (2012). Diversity and conservation of selected biota of the Meghamalai landscape, Western Ghats. India. *Current Science* 102(4): 590–595.

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Jeyaprakash, K., M. Ayyanar, K.N.Geetha & T. Sekar(2011). Traditional uses of medicinal plants among the tribal people in Theni District (Western Ghats), Southern India. *Asian Pacific Journal of Tropical Biomedicine* 520–525.

Mittermeier, R.A., R.G. Patricio, H. Michael, P. John, B. Thomas, G. Cristina, J.L. Mittermeier & G.A.B. da Fonseca (2005). Hotspots revisited: Earth's Biologically Richest and Most Endangered Terrestrial Eco-regions. Conservation International and Agrupacion Sierra Madre, Monterrey, Mexico. CEMEX publications, 392pp.

Ravikumar, R. (1999). Novelties from High Wavy Mountains, Southern Western Ghats, Theni District, Tamil Nadu, India. *Rheedea* 9(1): 55–75.

Sasidharan, N., K.P. Rajesh & J. Augustine (1997). Orchids of High Wavy recollected. *Journal of the Bombay Natural History Society* 94: 473–477.

Tamil Nadu Government Gazette (2009). *Declaration of Meghamalai Wildlife Sanctuary*. Regd. No. TN/CCN/467/2009-11: 322–325pp.

4.3 OBJECTIVES OF THE PRESENT STUDY :

- (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 vascular flora 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.

- 8.1 Methodology adopted : Conventional method
- b. New Methodology (if any) adopted : NA
- 8.2 Achievements including :NA
- f. Total area covered : N.A
- g. Number of tours undertaken : N.A.

h. Number of species collected : N.A.

i. 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.Balacr, 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, *Clitoriatermatea* 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 rixense* (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, *Cordiadiachotoma* G.Forst., Boraginaceae; 144036, *Basella alba* L., Basellaceae; 144037, *Corchorus aestuans* L., Tilliaceae; 144038, *Eragrostiellabifaria* (Vahl) Bor, Poaceae; 144039 *Indigoferalinnai* Ali, Leguminosae; 144040, *Trachysmucata* (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, Tilliaceae; 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, *Nymphaea nouchali* 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 candelabrum* 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, *Microstachyschamaelea* (L.) Müll.Arg., Euphorbiaceae;144080, *Cyanthilliumalbicans* (DC.) H.Rob., Asteraceae;144081, *Strychnospotatorum* L.f., Loganiaceae;144082, *Endostemonviscosus* (Roth) M.R.Ashby, ;144083, *Polygalaarvensis* Willd., Polygalaceae;144084, *Vincetoxicumbracteatum* (Thunb.) Meve & Liede, Asclepiadaceae;144085, *Acalyphacapitata* Willd., Euphorbiaceae;144086, *Acalyphafruticosa* Forssk., Euphorbiaceae;144087, *Phyllanthusvirgatus* G.Forst., Phyllanthaceae; 144088, *Polygalaarvensis* Willd., Polygalaceae; 144089, *Cyanotistuberosa* (Roxb.) Schult. & Schult.f., Commelinaceae; 144090, *Pavoniaodorata* Willd., Malvaceae;144091, *Andrographispaniculata* (Burm.f.) Nees, Acanthaceae ;144092, *Aristolochiaindica* L., Aristolochiaceae;144093, *Dalbergialanceolaria* L.f., Leguminosae;144094, *Oldenlandiaherbacea* var. *herbacea*, Rubiaceae ;144095, *Ceropegiaelegans* Wall., Asclepiadaceae;144096, *Ouretanata* (L.) Kuntze, Amaranthaceae;144097, *Oldenlandiaumbellata* L., Rubiaceae;144098, *Teramnuslabialis* (L.f.) Spreng., Leguminosae;144099, *Rhynchosiaaurea* (Willd.) DC., Leguminosae; 144100, *Sesuviumportulacastrum* (L.) L., Aizoaceae; 144101 *Elytraria acaulis* (L.f.) Lindau, Acanthaceae; 144102, *Mucunaatropurpurea* (Roxb.) DC. ex Wight, Leguminosae; 144103, *Ipomoea staphylina* Roem. & Schult., Convolvulaceae; 144104, *Begonia dipetala* Graham, Begoniaceae; 144105, *Monothecium aristatum* (Nees) T.Anderson, Acanthaceae; 144106, *Melothria pendula* L., Cucurbitaceae; 144107, *Dunbaria ferruginea* Wight & Arn., Leguminosae; 144108, *Justicia* sp., Acanthaceae ; 144109, *Argyrea 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, *Rungiapectinata* (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, *Acilepisdivergens* (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, *Aglaia 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.Balakr., 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, *Miliusa 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 gaussonii* 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, *Milusa 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.Balacr., 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, *Argyrea 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, *Oropheia 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 arnotiana* (Miq.) Miq., Moraceae; 144381, *Knoxia mollis* R.Br. ex Wight & Arn., Rubiaceae;144382, *Anisomeles indica* (L.) Kuntze, Lamiaceae; 144383, *Oldenlandia umbellata* Steud., Rubiaceae; 144384, *Argyrea 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, *Argyrea 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

8.3 Number of species incorporated: All the identified specimens labeled and accessioned. It will be incorporated very shortly

8.4 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. *Syzygiumlakshmananii* Murugan & Arum.
4. *Grewia lakshminarasimhanii* Arum., Arisdason, R. Manik. & Murugan (in ed.)
5. *Tripogonjayachandranii* Arum. & Murugan

Rediscovery

Drypetesporteri (Gamble) Pax & K.Hoffm.

8.5 Major impacts reported during the financial year :
Two new species described and accepted for publication during this period

B. Research Publications (in *Nelumbo* format)

ARUMUGAM, S. AND MURUGAN, C. 2019. *Eugeniapachakumachiana* (Myrtaceae) A new species from Western Ghats, India. *Edinburg journal of Botany*.

S. ARUMUGAM, W. ARISDASON, R. MANIKANDAN AND C. MURUGAN 2020. *Grewialakshminarasimhanii* (Malvaceae: Grewioideae), a new species from southern Western Ghats of Tamil Nadu, India. *Journal of Economic Taxonomic Botany*.

WESTERN REGIONAL CENTRE, PUNE

Project 1

Title of the Project : **PTERIDOPHYTE FLORA OF INDIA**

Executing Scientist (s) : **Dr. A. BENNIAMIN, SCIENTIST 'E'**

Date of Initiation and Date to be completion: **August 2020 - March 2023**

Background of the project (Brief Work done from date of project allotment up to March 2021) :

Pteridophytes form a conspicuous element of vegetation as intermediate between the lower cryptogams and higher vascular plants with long geological history on the planet. There are about 12,000 species recorded globally. India has a rich and varied Pteridophytic flora due to the varied nature of topography, variable climatic conditions and its geographical positions. However, there are about 1107 species belonging to 35 families and 130 genera in India (Fraser Jenkins et al.,

2016). The vascular flora of our country in general has about 15,000 species and as a constituent of Indian flora of vascular plants, the ferns and fern-allies form only five percent part as far as the number of species is concerned. But, due to their abundance in individuals as well as their conspicuousness in epiphytic vegetation and in the terrestrial vegetation along forest margins, roadsides and forest floors, the contribution of ferns and fern-allies to the vegetational pattern in India rank only next to the flowering plants. The project Pteridophytic flora of India was allotted in August 2020. During the period studied the Herbarium specimens housed at MH. Critical review of existing past and present literature to restore the taxonomic complex among species. Standardizing and updating of nomenclature using standard worldwide online database.

5. Area and locality of the Allotted Project: INDIA

6. Summary of the work done during 2020-2021

Scientific Work:

- During the year 2020-2021 Under Pteridophytic flora of India Vol 1 (Selaginellaceae, Asplenicaeae, Woodsiaceae, Marattiaceae, Osmundaceae, Plagiogyraceae, Oleandraceae, Dryopteridaceae) Project. A total of 103 species belonging to 10 genera completed for the Pteridophytic flora of India. A detailed description along with key has been prepared.

Ex-situ Plant Conservation: Four species name *Cyathea spinulosa*, *Anogramma leptophylla* and *Botrychium lanuginosum* and *Elaphoglossum stigmatolepis* have been conserved through spore culture and introduced in to Green house of Botanical Garden of BSI,WRC,Pune

7. Achievements/ Outcomes of the project in 2020 - 2021:

- Under Pteridophytic flora of India Vol 1 (Selaginellaceae, Asplenicaeae, Woodsiaceae, Marattiaceae, Osmundaceae, Plagiogyraceae, Oleandraceae, Dryopteridaceae) Project. A total of 103 species belonging to 10 genera completed for the Pteridophytic flora of India. A detailed description along with key has been prepared.
- Published 2 books and 5 papers have been published.
- Awarded 2 Ph.D students received their Doctoral degree under my guidance by Pune University. Pune
- Submitted Two Annual Action Plan Projects 1.Pteridophytes of Goa and Pteridophytes of Pushpagiri Wildlife Sanctuary with 10% periphery.
- Submitted one External Funding Project “**Conservation through Micropropagation and restoration of threatened Pteridophytes from central Western Ghats of Karnataka**” to Department of Science and Technology under SERB, New Delhi.
- Ex Situ Conservation of four species namely *Cyathea spinulosa*, *Anogramma leptophylla* and *Botrychium lanuginosum* and *Elaphoglossum stigmatolepis* have been conserved through spore culture and introduced in to Green house of Botanical Garden of BSI,WRC,Pune.
- **Head of Office** : Attended to all administrative duties as a regular Head of Office of Botanical Survey of India, Western Regional Centre, Pune from 03rd September 2020 to till date supervised/guided/Co ordinated functions of the office.

8. Research Publication related to the allotted project (in Nelumbo format):

Book Published: Two

A. Benniamin, V. K. Rawat, M. S. Sundari, G. P. Gapak, 2021. Medicinal Pteridophytes of Arunachal Pradesh – A Pictorial Guide. Published by State Medicinal Plant Board, Itanagar, Arunachal Pradesh. ISSN No 978-93-5437-644-3

V.K.Rawat, **A.Benniamin**, M.S.Sundari and G.P.Gapak, 2021. Pteridophytes of Itanagar Wildlife Sanctuary- A Pictorial Guide published by State Medicinal Plant

Research Papers published: 5

1. **A. Benniamin**, M. Shunmuga Sundari, C. Bagath Singh and D. Jesubalan. 2020. Spore germination and early gametophyte development of an endemic fern *Elaphoglossum beddomei* Sledge. Indian fern Journal Vol 37 pp 244-249.
2. **A. Benniamin** and M. Shunmuga Sundari. 2020. Diversity and distribution of the genus *Arachniodes* Blume (Dryopteridaceae) in North-East India, Pleione 13 (2) 236 – 246.
3. M. Shunmuga Sundari, **A. Benniamin** and V. Irudayaraj **2020**. Chromosome Study on an Endangered Oak Leaf Fern *Tectaria zeilanica* (Houtt) Sledge (Dryopteridaceae) from South India. International Journal of Plant Biology & Research, 8(1): 1115 (2020).
4. C. Bagath Singh, **A. Benniamin**, D. Jesubalan, 2020. Range Extension of Three South Peninsula Indian fern to Karnataka State Indian fern Journal Vol 37 pp 130-138.
5. C. Bagath Singh and **A. Benniamin**, 2021. Assessment of threat status of *Cyrtomium micropterum* (Kunze) Ching (Dryopteridaceae) in India using IUCN Regional guidelines Journal of Threatened Taxa Vol 13(1) 17554–17560.

PROJECT – 2

Flora of India, Vol. 24 (Urticaceae-Ceratophyllaceae)

Executing Scientists: Dr. Prashant K. Pusalkar & Dr. Priyanka Ingle

Date of Initiation: September, 2018

Date of Completion: 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.

ACHIEVEMENTS/OUTCOME

Finalized and submitted compiled, formatted and edited (print-ready) manuscript of Flora India, volume 24 to BSI, Hqrs/ Publication section.

PROJECT – 3

Phyto Data-Base of Konkan, Maharashtra

Executing Scientist: Dr. Prashant K. Pusalkar

Date of Initiation: September, 2020

Date of Completion: 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 data-basing 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.

ACHIEVEMENTS/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.

Project 4

1. **Name of project:**Bambusicolous fungi of Goa
2. **Executing scientists:** Dr. Rashmi Dubey, Scientist 'E', BSI WRC, Pune
3. **Date of Initiation:**April, 2020
4. **Date of Completion:** March, 2024

5. Objectives of Annual Action Plan Project

To explore 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, lowers, 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.

6. 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 an opportunity for a comprehensive understanding of complex of 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.

7. **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).

8 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 *Conlariumindica* sp. 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

9. ACHIEVEMENTS

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; *Corynesporacassiicola* (Berk. & M.A. Curtis) C.T. Wei 1950-Corynesporaceae- Leaf ; *Chaetosphaerula lignicola* (Tubeufiaceae) on Bamboo stem, Mhadei WLS, Goa; *Diatrypa loranthi* Tend. 1971 (Diatrypaceae) -Bamboo stem ,Mhadei WLS, Goa; *Exserohilum elongatum* Hern. -Restr. & Crous 2018-(Pleosporaceae)-Dead Bamboo; *Kamalamyces 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 sellisii* 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 chlamyosporum* 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; *Nigrospora sphaerica* (Sacc.) E.W. Mason, (1927) (*Sordariomycetes* on leaf of Bamboo, Mhadei WLS, Goa; *Trichoderma asperellum* (1999) (*Hypocreaceae*), on leaf of Bamboo, Mhadei WLS, Goa,

10. Research papers published:

- 1) Rashmi Dubey 2020. *Lonavalomyces* - A New Anamorphic Ascomycetes Genus reported from Lonavala, Western Ghats of India. *Journal on New Biological Reports*. 9(3) 316 – 320 (2020).
- 2) Rashmi Dubey & AMIT D. PANDEY 2020. *Mycoenterolobium borivaliensis* sp. nov. (Pleosporomycetidae, Dothideomycetes) from reported from India. *Journal on New Biological Reports*: 9(3) 312 – 315.
- 3) Sengupta S and Rashmi Dubey 2021: Taxol producing fungi: a critical review in experimental aspects. *J. Mycopathol. Res.* 59 (1): 1-9.
- 4) Rashmi Dubey and Manikpuri S. 2021. *Conlarium indicum*: A novel fungus from Western Ghats of India. (Current Research in Environmental & Applied Mycology (Journal of Fungal Biology) 11(1): 112-118.

Project-5

- 1. Title of the Project** : Flora of Lakshdweep Islands
2. Executing Scientist (s) : Dr. Priyanka Ingle
3. Date of Initiation : September, 2020
4. Date to be completion : March, 2021

5. 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.

6. Area and locality of the Allotted Project: 32.62 sq. km.

7. 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.

8. Achievements/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.

9. Research Publications

1. P. Ingle, S. Bhosle & P. Lakshminarasimhan. 2020. Indian traditional food, food habits and customs in combating pandemics: You are what you eat. *Journal of Economic and Taxonomic Botany* 44(1-4): 5–7.
2. K. Mittal, P. Ingle & R. Dangi. 2020. *Trigonella glabra* (Leguminosae): A new addition to *Trigonella* genetic resources in India. *Journal of Economic and Taxonomic Botany* 44(1-4): 62– 66.

1. Title of the Project : Checklist of the Flowering Plants of Goa
2. Executing Scientist (s) : Dr. C.R. Jadhav & Dr. P.K. Pusalkar
3. Date of Initiation : September, 2020
4. Date of completion : March, 2021
5. Background of the project :

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, Uttara 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* spp., *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.

6. 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.
7. 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.

8. Achievements/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.

