ESTABLISHMENT OF A BIORESOURCES NATURE TRAIL IN THE KERALA PART OF WESTERN GHATS

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CONTENTS

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EXECUTIVE SUMMARY

About 10 ha within the Kerala Forest Research Institute (KFRI) Sub Centre, Nilambur was developed into a Bioresources Nature Trail for ex-situ conservation of different taxonomic groups of plants especially endemic and rare, endangered and threatened (RET) species. This also serve as a centre to promote nature education and ecotourism. The Bioresources Nature Trail harbors 578 plant species. Plants were collected primarily from the natural forests of Kerala. Plants have also been brought natural forests of Karnataka and many places extending up to Dehradun. All the species have been identified, labeled and presented in such a way that visitors can observe the characters of each one of them.

The Nature Trail begins with a floral diagram of an orchid made by planting leafy ornamental plants in front of the orchid house. The orchid house harbors over 76 species of orchids- both terrestrial and epiphytic. The house has a water course inside, starting from a cascade and ending in an underground pond. With overhead mist outlets, the house is kept humid, facilitating the survival of diverse species of orchids.

The fern house comes next which harbor about 71 species of ferns arranged in two tiers along the wall of a cross-shaped green house. Outside the fern house is the hydrophyte garden laid out in the open space. This garden holds 80 species of water plants arranged in sunken tanks and pots. The thallophyte and bryophyte house comes next which is a green house with sunken floor from which pillars arise to facilitate the growth of a diverse variety of bryophytes and algae and for the visitors to observe them closely. There are eight species of algae and eighteen species of bryophytes presented here.

A rock garden and a green house hold 115 species xerophytes and succulents; the local varieties grow on the rock garden and others are maintained in the green house. A medicinal plant garden with 192 species that are commercially used in various traditional medical systems of India are

planted with adequate spacing, facilitating visitor movement. A gymnosperm garden with 18 species is yet another attraction.

The Trail was opened to the public on 12 February 2007 and the response since then is excellent. For the purpose of entry fee, the trail and the the Teak Museum, which had already established itself as a destination for domestic and faraway tourists, are treated as a single unit.

1. INTRODUCTION

The major issues facing biodiversity conservation are the habitat loss of flora and fauna in the face of growing human population, and economic as well as social factors causing over-exploitation and endangerment of biological resources. It has been cautioned that at the present rate of habitat loss, by the year 2030 about 1/3 of biodiversity in India would be extinct or they would remain in isolated refugia of nonviable populations which may enter into the vortex of extinction (Nayar, 1997). This is because of the fact that the tropical forests support communities with a rich array of species and a complex web of interactions are likely to be more fragile than relatively simple and robust temperate ecosystems (May, 1975). For instance, situated on the lap of the Western Ghats in the southwest corner of India, Kerala covers an area of about 38,863 km^2 of which the forest cover is about 10,336 km^2. These tropical forests have a flora of about 10,035 species, which represent 22 percentage of Indian flora including 3800 species of Angiosperms, 4 species of Gymnosperms, 331 species of Pteridophytes, 300 species of Bryophytes, 520 species of Lichens, 325 species of Algae and 4800 species of Fungi (Nayar, 1997). When the endemic species alone are considered, in India, there are about 5,725 endemic taxa of angiosperms which represent 33.5% of Indian flora. Being a part of the Western Ghats, one of the hot spots in the world, Kerala has about 1,381 endemic Angiosperm species (Sasidharan, 2002). Of these, 496 species occurring in isolated populations come under rare, vulnerable and endangered species categories. Further analysis of individual taxonomic groups of plants indicates that in each group, particularly endemic species are under threat. For instance, in the Kerala part of the

Western Ghats out of 331 fern taxa reported 147 taxa are rare, which includes 35 endemic species. Thirty-four species of Bryophytes reported from Kerala are rare and of these, four are endemic species. Based on a study conducted in Kerala, 254 species of macrolichens under 43 genera belonging to 18 families were reported (Kumar, 2000). Out of them, 63 species are new records to peninsular India while 109 species are new records to Kerala and two species are reported for the first time from southern India. It is also reported that the Indian orchids have more risk of extinction owing to unscientific collections, commercial exploitation and reproductive syndromes intrinsic to them. Out of 1200 orchid species known to be harbored in the Indian sub-continent, nearly 300 species are listed as rare, endangered and threatened (RET). It is also reported that a higher percentage of RET orchids (23%) are endemic (15%). Similarly, more RET terrestrial orchids (30%) are endemic than RET epiphytes (18%). In the Western Ghats of India about 410 endangered orchid species can be seen of which 235 species are endemic. In all these studies, the necessity of establishment of *ex situ* conservation centres has been highlighted with an aim to conserve and optimally utilize the genetic resources of above mentioned plant groups.

Plants are the main resource base of traditional medicines. Our country has one of the richest ethnobotanical traditions in the world. It has been estimated that about 7,000 species of plants are used for medicines in India in the traditional systems of medicines viz. Ayurveda, Sidha and Unani. With the awakening among the people all over the world to use more ecofriendly products such as biomedicine, biopesticides and biofertilizers, the demand for traditional system of medicines has increased considerably. Similarly, in the traditional land use systems, collection and utilization of flowers and fruits of several wild plants are still common. Due to loss of habitat and overexploitation of different parts of wild plants and species known for their medicinal properties, genetic base of these species is eroding. It may be pointed out here that *in-situ* conservation is the best way to preserve a species in view of the persisting threats to the flora of the Western Ghats of Kerala due to various anthropogenic activities. However, *in-situ* conservation measures alone may not be always effective and feasible. In this context,

apart from *in-situ* conservation, *ex-situ* conservation and mass propagation of plants are important for not only conserving these bioresources but also to sustainably utilise them. One of the attempts made by the International Union of Conservation of Nature (IUCN) to conserve the world's biodiversity is the establishment of the Botanic Gardens Conservation Secretariat (BGCS) in 1987 to unite and promote the role of botanic gardens in conserving endangered or valuable species. In 1990, BGCS became independent (as Botanic Gardens Conservation International (BGCI) and has grown to include over 400 member institutions in more than 80 countries (Leadly et al., 1993). The recent trend is that botanic gardens should focus on and give priority to the cultivation of the native flora of their own region particularly those that are threatened, and those, which will add significantly to the scientific as well as conservation value of the resource (BGCI, 1993). In August 1999, over 5,000 botanists from 85 countries, who attended the XVI International Botanical Congress at St. Louis, USA noted in resolution that two-third of the world's plant species are in danger or extinction. They also identified the needs for a new coordinating body associated with the UN to be established to monitor the status of plants throughout the world. The need of taking steps to conserve plants of different groups in *in-situ* and in *ex-situ* areas like botanical gardens or in gene banks or preferably combination of these strategies has also been recognised (IBC, 1999). In India, several premier organisations have the mandate to inventorying, monitoring and conserving of biodiversity. These organizations include Botanical Survey of India (BSI), Zoological Survey of India (ZSI) and Forest Survey of India (FSI). Several other supporting institutions in the attempts of in-situ and ex-situ conservation include CSIR, DBT, DST, etc (Stork and Samways, 1995). The BSI and ZSI along with other collaborating institutions have also been instrumental in cataloging the endemic species of flora and fauna, and preparing red data books on threatened plants of India. Several states have also engaged in documenting their biodiversity documentation. This includes the biodiversity documentation prepared by the Kerala Forest Research Institute for plants and animals in Kerala State. In the country, several botanical gardens have been established for ex-situ conservation. Similarly, several small-scale

botanical gardens exist in Universities to help the students in the field of botany, especially plant taxonomy.

It may also be pointed out that the Indian sub continent comprises two major hotspots of biodiversity namely, Himalayan region and the Western Ghats. Here apart form the protected areas even areas outside the protected areas such as agroforestry system and sacred groves are rich in flora and fauna. However, our primary and secondary and even higher institutions of learning do not have such curricula, which help students to appreciate the richness of bioresources and their ecological and socioeconomic importance. Students are hardly ever exposed to different kinds of ecosystems and hence they are unable to observe and identify plants in the field. In this context, attempts need to be made for effective nature education and appreciation of bioresources in the country, which will inculcate in students and teachers at large the importance of biodiversity conservation. Thus to serve multifold objectives of ex-situ conservation of different groups of plants and promotion of nature education and ecotourism, different approaches are needed. In this direction, Kerala Forest Research Institute has made an effort in establishing a Bioresources Nature Trail in the Kerala part of the Western Ghats *as* an ideal nodal pilot project with following specific objectives:

1) To establish a live collection of different taxonomic groups of plants with special reference to endemic and RET species for conservation along a Bioresources Nature Trail and
2) To promote nature education and ecotourism

2. LOCATION AND METHODS

2.1. AREA FOR NATURE TRAIL ESTABLISHMENT

Bioresources Nature Trail was established in the campus of Kerala Forest Research Institute (KFRI) Sub Centre (76^0 15' 28" E longitude and 11^0 18' 14" N latitude) at Nilambur (Figure 1) in Malappuram district, Kerala. The Sub Centre which is about 140 km from the KFRI main campus at Peechi, covers an area of 43.36 ha.

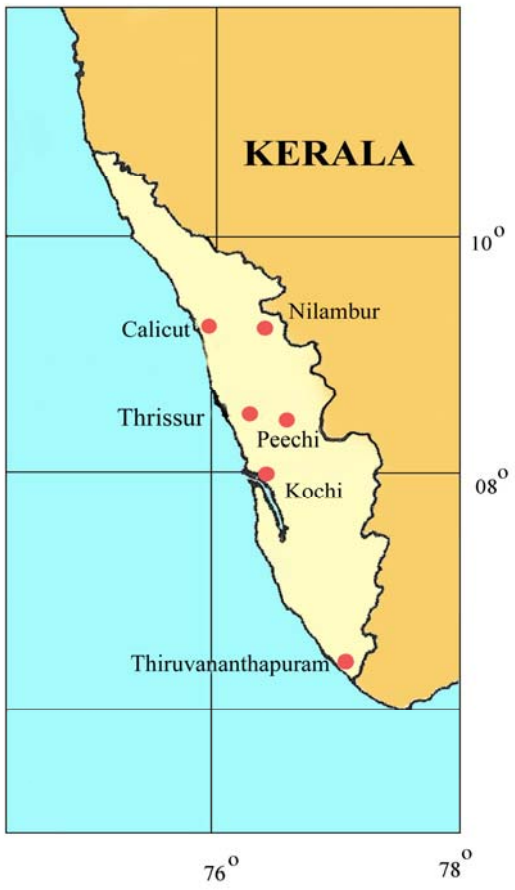


Figure 1. Map of Kerala showing Nilambur where the Bioresources Nature Trail is established.

Nilambur is the place where the world's first teak plantation was raised during 1842-1844 by HV Conolly, the then collector of Malabar. Considering the historic importance of Nilambur, the Teak Museum was established in 1995 in the KFRI Sub Centre campus. This Museum representing the world's only museum established for a single tree species, provides information on cultivation, management, utilization and socio-economic, ecology and other aspects of teak (*Tectona grandis*) - the reputed timber species of South- east Asia. Each month, an average of about 5,000 visitors including farmers, teak users, students and researchers visit this Museum. It was proposed to establish the Bioresources Nature Trail to the Teak Museum, where a small nature trail already exists. Thus visitors of the Teak Museum will have the benefit of visiting the Bioresources Nature Trail as well.

The altitude of the campus of the Sub Centre is about 65 m above msl. Here the annual rainfall is around 2360 mm, and it is during the month of July that the area receives the maximum precipitation of about 422 mm, whereas in January, February and March the precipitation is 30.4 mm, 8.26 mm and 26.4 mm respectively. Mean maximum temperature is 37^0 C and Mean minimum temperature is around 17^0 C. Surface soil is red (oxisol) fine loamy and the sub-surface soil is gravel and red sandy. During the dry period, the humidity is very less and herbs and shrubs tend to dry in the absence of subsoil moisture.

2.2. SPECIMEN COLLECTION

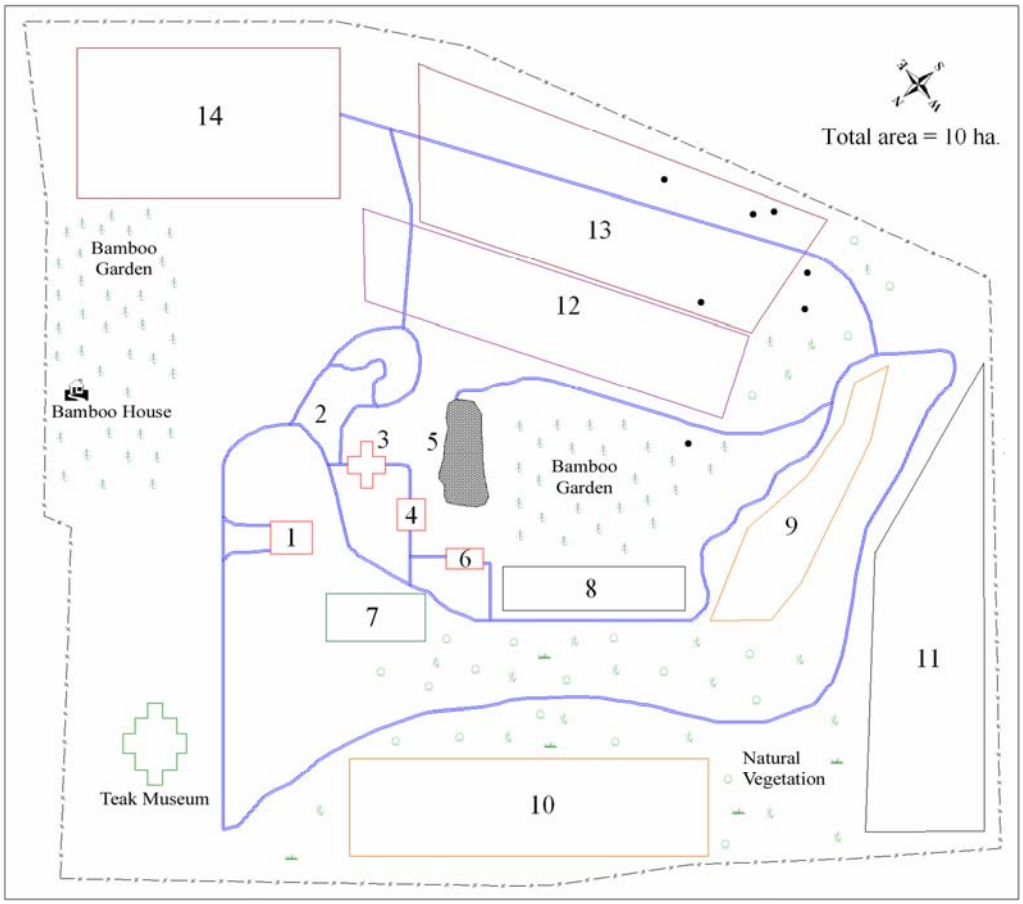
The specimens for the Bioresources Nature Trail were either collected from natural forests / ponds or procured from collections of research institutes or bought from commercial nurseries. The specific locale of collection of the various groups of plants are given along with the description of respective thematic zones in Chapter 3.

2.3. SPECIMEN MAINTENANCE

The collected specimens were maintained live either by planting in soil or in earthen pots. Plants which require critical ambient conditions to survive are maintained in specific houses with provision for light and humidity control. Thus the Trail has provision to house the lichens, ferns, bryophytes and cacti in specific enclosures. The enclosures have walls with half brick work and half net so as to avoid trespassing while bringing in sunlight. The roof is made of semitransparent persplex sheet which also brings in sunlight. All enclosures except for the one for cacti, are provided with overhead mist outlets which are operated daily to maintain humidity. The orchid house also has a water cascade within it with the water flowing through below ground aqueduct to a tank from which it is re-pumped to feed the cascade. The water plants are placed in tanks of varying sizes. Specific details of specimen maintenance are provided in the appropriate sections in the next chapter.

3. THEMATIC ZONES IN THE BIORESOURCES NATURE TRAIL

Layout of the Bioresources Nature Trail is depicted in Figure 2. The specimens collected from various locations have been categorized and presented under the following six seven titles- the orchid house, fern house, hydrophytes garden, thallophytes and bryophyte house, xerophytes and succulents garden, the medicinal plants garden and the gymnosperm garden. All the themes are presented in a landscaped garden carpeted with grass. The ambience of the general area is also enhanced by a wide variety of ornamental plants like *Allamanda, Alternanthera, Begonia, Bougainvillea, Caladium, Cordyline, Coleus, Diffenbachia, Dracaena, Ixora, Lantana, Malpighia, Nerium, Philodendron, Plumeria, Syngonium, Tabernaemontana, Tagetes, Zinnia* etc. (Appendix 1). The entrance to the Bioresources Nature Trail is through a gate with the title and inaugural plaque. The gate also locates an information counter for the Nature Trail.



1	**Orchid house**	**9**	**Butterfly garden**
2	**Hydrophyte garden**	**10**	**RET species garden**
3	**Fern house**	**11**	**Monocot & taxonomic garden**
4	**Thallophyte & bryophyte house**	**12**	**Palm garden**
5	**Rock garden**	**13**	**Edible bamboo garden**
6	**Xerophyte & succulent house**	**14**	**Gymnosperm garden**
7	**Children's park**	●	**Megalithic burial sites**
8	**Medicinal plant garden**		

Figure 2. Schematic map of the Bioresource Nature Trail established within the Kerala Forest Research Institute Sub Centre, Nilambur.

3.1. ORCHID HOUSE

Orchids are considered to be the floral aristocrats of the flowering world. They form a dominant group among plant families and represent highly evolved plants with the most complicated floral structure. The orchid house, the first thematic zone in the Bioresources Nature Trail, is a 109.68 m^2 building which houses terrestrial and epiphytic orchids. In front of the building is a large floral diagram made of colorful plants like *Alternanthera bettzickiana* var.*Variegata*, *Alternanthera versicolor*, *Duranta repens* and *Cuphea hyssopifolia* showing the characteristic floral pattern of orchids. Bordering the floral diagram are displays of *Arachnis*, *Aranda* and *Vanda* hybrids. The Orchid house with 76 species which represent both epiphytic and ground orchids, is a floral paradise in the Bioresources Nature Trail. Daily, the visitors get an opportunity to see one or a few species or varietes of orchids in different stages of blooming and growth. One can also get familiarized with the less common orchids like *Aerides maculosum*, *Dendrobium nutans* and *Nervilia infundibulifolia*; south Indian endemic species like *Aerides ringens*, *Bulbophyllum neilgherrense* and *Bulbophyllum tremulum*; medicinal orchids like *Coelogyne ovalis*, *Eulophia nuda*, *Malaxis rheedii* and *Nervilla aragoana*; commercially important orchid like *Vanilla planifolia*; and *Rhynchostylis retusa*- the prettiest orchid in south India. Apart from the flora collection, the floral diagram depicted using live plants, the water cascade and the misty atmosphere adds to the information content and beauty of the orchid house.

3.1.1. Architecture / Landscaping

The orchid house (Figure 3) has half way brick worked wall the rest of which is netted. This allows sufficient sunlight to come in while avoiding undue heating up of the floor of the house. On one corner of the house is a 10 layered, rock built water cascade camouflaged with different species of ferns, *Begonia*, *Colacasia*, *Impatiens*, *Peperomia* and *Piper* etc. The water running down flows through a zigzagged pathway into an underground tank from which the water is pumped back into the release point above the cascade. The water cascade and a series of 16 overhead mist outlets ensures that the orchid house in maintained at sufficient humidity levels. The orchid house proper has an in-way and out-way through which the visitors move in and out, and the

specimens are arranged in such a way that the visitors can see each orchid separately.

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Figure 3. Design of the Orchid House

3.1.2 Species

The orchid house contains 76 species of orchids (Table 1). They were collected from the natural forests of Nilambur and Waynad Forest Divisions of Kerala, Koppa forest Division of Karnataka, and the Kuduremukh and Bandipur National Trails (Karnataka). Many specimens were also procured from the collections available at the following institutions: Kerala Agricultural University, Mannuthy, Tropical Botanical Garden and Research Institute, Palode, Genepool Garden, Nadugani (Tamil Nadu), Sri Ramakrishnashrama, Mysore, Northeastern Hill University, Shillong and Kerala Forest Research Institute, Peechi. Some specimens which could not be procured from the above places were purchased from commercial nurseries located in Lalbagh, Bangalore, Krishnarajendra Sagar Dam (KRS) Mysore and Atmanilayam Nursery, Parassala. About 26 hybrids (Table 2) belonging to Arachnis, Aranda, Dendrobium, Mokara and Vanda are also planted both for making the orchid house attractive and also explain orchid hybridization technique and economic importance of orchids.

Table 1. List of species in the Orchid house of Bioresources Nature Trail.

No.	Species	No.	Species
1.	*Acampe congesta*	17.	*Cymbidium aloifolium*
2.	*Acampe ochracea*	18.	*Dendrobium anceps*
3.	*Aerides crispum*	19.	*Dendrobium barbatulum*
4.	*Aerides maculosum*	20.	*Dendrobium herbaceum*
5.	*Aerides ringens*	21.	*Dendrobium heterocarpum*
6.	*Bulbophyllum aureum*	22.	*Dendrobium heyneanum,*
7.	*Bulbophyllum fuscopurpureum*	23.	*Dendrobium macrostachyum*
8.	*Bulbophyllum neilgherrense*	24.	*Dendrobium nutans*
9.	*Bulbophyllum tremulum*	25.	*Dendrobium ovatum*
10.	*Calanthe masuca*	26.	*Dendrobium wightii*
11.	*Coelogyne breviscapa*	27.	*Dendrobiun aqueum*
12.	*Coelogyne longipes*	28.	*Disperis neilgherrensis*
13.	*Coelogyne mossiae*	29.	*Epipogium roseum*
14.	*Coelogyne nervosa*	30.	*Eria microchilas*
15.	*Coelogyne ovalis*	31.	*Eria mysorensis*
16.	*Coelogyne punctata*	32.	*Eria nana*

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Table 1 (cont'd).. List of species in the Orchid house of Bioresources Nature Trail.

No.	Species	No.	Species
33.	*Eria pauciflora*	55.	*Nervilia prainiana*
34.	*Eria reticosa,*	56.	*Nervilia sp*
35.	*Eulophia nuda*	57.	*Oberonia brunoniana*
36.	*Eulopia ochreata*	58.	*Oberonia ensiformis*
37.	*Gastrochilus species*	59.	*Oberonia iridifolia*
38.	*Geodorum densiflorum*	60.	*Oberonia santapaui*
39.	*Habenaria crassifolia*	61.	*Oberonia wightiana*
40.	*Habenaria crinifera*	62.	*Oncidium*
41.	*Habenaria decipines*	63.	*Peristeria elata*
42.	*Habenaraia longicornu*	64.	*Phaius luridus*
43.	*Habenaria longicorniculata*	65.	*Phalaenopsis decumbens*
44.	*Habenaria ovalifolia*	66.	*Pholidota pallida*
45.	*Ipsea malabarica*	67.	*Pholidota species*
46.	*Liparis beddomei*	68.	*Porpax reticulata*
47.	*Liparis bilobata*	69.	*Rhynchostylis retusa*
48.	*Luisia birchea*	70.	*Sarcanthus pauciflorus*
49.	*Malaxis intermedia*	71.	*Spathoglottis plicata*
50.	*Malaxis rheedii*	72.	*Spatoglottis malabarica*
51.	*Nervilia aragona*	73.	*Vanda coerelea*
52.	*Nervilia crociformis*	74.	*Vanda spathulata*
53.	*Nervilia infundibulifolia*	75.	*Vanilla planifolia*
54.	*Nervilia plicata*	76.	*Vanda tesselata*

Table 2. List of hybrids of orchids in the Orchid house of Bioresources Nature Trail

No.	Species	No.	Species
1.	*Arachnis*- Maggie Oei	14.	*Dendrobium* - Rinnapa
2.	*Aranda* (A, rachnis x Vanda)	15.	*Dendrobium* - Sonia 17
3.	*Ascocenda* (Ascocentrum x Vanda)	16.	*Dendrobium* - Sonia 17 Mutant
4.	*Dendrobium*- Banyat Pink	17.	*Dendrobium*- Sunlight
5.	*Dendrobium*- Caesar Stripe 4N	18.	*Dendrobium* -Singapore White
6.	*Dendrobium-.* Diana White	19.	Mokara (Arachnis x Ascocentrum x Vanda)
7.	*Dendrobium*- Emma White	20.	Mokara- Chakuan Pink
8.	*Dendrobium* -Heang Beauty	21.	Mokara -Chaopraya BoyBlue
9.	*Dendrobium* -Hieng Beauty	22.	Mokara -Singapore Red
10.	*Dendrobium*- Jaquelyn Concert 4N x Lady Charm	23.	Mokara- WalterOumae White
11.	*Dendrobium*- Jaquelyn Thomas	24.	Vanda- *hybrid*
12.	*Dendrobium*- Kasem Gold	25.	Vanda -*Robert delight*
13.	*Dendrobium- Me* Vipa	26.	Vanda- *Tokyo Blue*

3.2. FERN HOUSE

Ferns are the living dinosaurs of the plant world and their ancestors are the sources of the fossil fuels such as oil and coal that we burn today. They have also been the subjects of great myths and objects of great admiration. The fern house is the second thematic zone in the Bioresources Nature Trail. Total plinth are of the buiding is 120 m^2, which houses terrestrial, lithophytic, hydrophytic and epiphytic ferns. In front of the building a display board giving information on ferns and important species assembled in the fern house is installed. Front portion of the fern house is also decorated by planting *Asplenium ensiforme*, *Cyathia gigantia*, *Dicranopteris linearis*, *Diparia petersenii*, *Nephrelepis biserrata*, *Nephrolepis exaltata*, etc.

3.2.1. Architecture / Landscaping

The fern house is a four armed building, with pathways in the centre and stepped walls on which the specimens are displayed (Figure 4). The house has an array of overhead mist outlets which ensure high humidity within the fern house.

3.2.2. Species

A total of 71 species of ferns are displayed at the Fern house (Table 3). Among them are endemic ferns like *Bolbitis prolifera and Pteris argyraea,* rare and endangered ferns like *Angiopteris evecta*, *Equisetum ramosissimum* and *Adiantum concinnum***,** and species with ornamental values such as *Huperzia phyllantha, Microsorium punctatum* and *Pyrrosia porosa*. Ferns were collected mainly from the natural forests of Nilambur and Wayanad forest divisions of Kerala, Koppa Forest Division and the Kundermukh and Bandipur National Trails of Karnataka. The Genepool garden Nadugani, Tamil Nadu, also provided specimens for the fern house.

Figure 4. Design of the Fern House

Table 3. List of species in the Fern house of Bioresources Nature Trail.

No.	Species	Family
1.	*Acrostichum aureum*	Polypodiaceae
2.	*Actineopteris radiata*	Actinopteridaceae
3.	*Adiantum capillus-vineris*	Adiantaceae
4.	*Adiantum concinnum*	Adiantaceae
5.	*Adiantum indicum*	Adiantaceae
6.	*Adiantum latifolium*	Adiantaceae
7.	*Adiantum lunulatum*	Adiantaceae
8.	*Adiantum peruvianum*	Adiantaceae
9.	*Adiantum radianum*	Adiantaceae
10.	*Amphineuron terminus*	Thelypteridaceae
11.	*Anemia rotundifolia*	Schizaeaceae
12.	*Angiopteris evecta*	Angiopteridaceae
13.	*Asplenium formosum*	Aspleniaceae
14.	*Athyrium hoheneckerianum*	Athyriaceae
15.	*Athyrium sp.*	Athyriaceae
16.	*Azolla pinnata*	Azollaceae
17.	*Blechnum occidentale*	Blechanaceae
18.	*Blechnum orientale*	Blechanaceae
19.	*Blechnum gibbum*	Blechanaceae
20.	*Bolbites braziliensis*	Lomariopsidaceae
21.	*Bolbites heterochaelate*	Lomariopsidaceae
22.	*Bolbites preselliana*	Lomariopsidaceae
23.	*Bolbitis prolifera*	Lomariopsidaceae
24.	*Bolbites semicordata*	Lomariopsidaceae
25.	*Bolbites virens*	Lomariopsidaceae
26.	*Cheilanthes mysoorensis*	Sinopteridaceae
27.	*Christella dentata*	Thelypteridaceae
28.	*Cyathea gigantea*	Cyatheaceae
29.	*Cyclosorus interrupts*	Thelypteridaceae
30.	*Ceratopteris thalictroides*	Ceratopteridaceae
31.	*Davallia feejiensis*	Davalliaceae
32.	*Diplazium esculentum*	Athyriaceae
33.	*Egenolfia asplenifolia*	Lomariopsidaceae
34.	*Equisetum ramosissimum*	Equisetaceae
35.	*Huperzia phyllantha*	Lycopodiaceae

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Table 3 (Cont'd). List of species in the Fern house of Bioresources Nature Trail.

No.	Species	Family
36.	*Leptochilus axillaries*	Polypodiaceae
37.	*Lindsaea ensiformis*	Lindsaeaceae
38.	*Lygodium microphyllum*	Schizaeaceae
39.	*Macrothalypteris*	Thelypteridaceae
40.	*Marsilea minuta*	Marsileaceae
41.	*Microlepis speluncae*	Bennstaedtiaceae
42.	*Microsorium linguiforme*	Polypodiaceae
43.	*Microsorium punctatum 'Flabellatum'*	Polypodiaceae
44.	*Nephrolepis biserrata*	Oleandraceae
45.	*Nephrolepis bostoniensis*	Oleandraceae
46.	*Nephrolepis defii*	Oleandraceae
47.	*Nephrolepis exaltata*	Oleandraceae
48.	*Nephrolepis plumosa*	Oleandraceae
49.	*Nephrolepis tuberosa*	Oleandraceae
50.	*Ophioglossum vulgatum*	Ophioglossaceae
51.	*Phymatosorus scolopendria*	Polypodiaceae
52.	*Pityrogramma calomelanos*	Hemionitidaceae
53.	*Platycerium hillii*	Polypodiaceae
54.	*Pronephrium articulatum*	Thelypteridaceae
55.	*Pronephrium triphyllum*	Thelypteridaceae
56.	*Pteris argyraea*	Pteridaceae
57.	*Pteris quadriurita 'Argentia'*	Pteridaceae
58.	*Pteris vittata*	Pteridaceae
59.	*Pyrrosia lanceolata*	Pteridaceae
60.	*Pyrrosia porosa*	Polypodiaceae
61.	*Salvinia molesta*	Salviniaceae
62.	*Selaginella*	Selaginellaceae
63.	*Selaginella chrysocaulis*	Selaginellaceae
64.	*Selaginella delicatula*	Selaginellaceae
65.	*Selaginella inequalifolia*	Selaginellaceae
66.	*Selaginella involvens*	Selaginellaceae
67.	*Selaginella lepidophylla*	Selaginellaceae
68.	*Selaginella plana*	Selaginellaceae
69.	*Tectaria caudunata*	Dryopteridaceae
70.	*Tectaria polymorpha*	Dryopteridaceae
71.	*Vittaria elongata*	Vittariaceae

3.3. HYDROPHYTE GARDEN

The hydrophyte garden is set in open air. This is an assemblage of species which represent different forms such as floating hydrophytes, submerged rooted hydrophytes, floating leaved, anchored or rooted hydrophytes and emergent rooted hydrophytes. About 80 species are planted in 46 tanks of which 16 are made at site and bigger to contain the larger water plants. The tanks are arranged on either side of the pathway which connects the various thematic zones. The Trail has an irrigation system which refills the tanks to restore the water lost by evaporation.

The garden is developed not only for educational purposes, but also for the enjoyment it offers to the visitors by having number of magnificent water-lilies and lotus in various stages of bud and bloom. Among the featured plants are the sacred lotus *(Nelumbo nucifera)*, immortalized in literature, religion and history for its purity of bloom. The visitors can stroll down a winding walk to view interesting plants like *Alisma oilgococcum*, *Aponogeton natans*, *Ceratophyllum demersum*, *Ceratopteris thalictroides, Eriocaulon cuspidatum*, *Hydrilla verticillata*, *Jussieua repens*, *Lemma paucicostata, Limnophila heterophylla, Ottelia alismoides*, *Phragmites karka*, *Sagittaria guayanensis*, *Salvinia auriculata, Typha angustata*, *Utricularia stellaris* and Wolffia *arrhiza*.

Most of the water plants (Table 4) were collected from natural ponds in Karnataka at KR Nagar, Chickmagalore and Mavenakere and those in Kerala at Kozhikode, Kannur, Ernakulam, Thrissur and Alleppy. Plants were also collected from the Malbar Botanical garden, Calicut and Sri Ramakrishnashrama, Mysore and Atmanilayam Nursery, Parassala.

Table 4. Species in the Hydrophyte garden of Bioresources Nature Trail

No.	Species	Family
1.	*Aeschynomene aspera*	Fabaceae
2.	*Alisma oilgococcum*	Alismataceae
3.	*Alternanthera phylloxytharoides*	Amaranthaceae
4.	*Aponogeton appendiculata*	Aponogetonaceae
5.	*Aponogeton natans*	Aponogetonaceae
6.	*Asteracantha species.*	Acanthaceae
7.	*Azolla pinnata*	Azollaceae
8.	*Bacopa monnieri*	Scrophulariaceae
9.	*Bauhinia anguina*	Caesalpiniaceae
10.	*Bergia capencis*	Elatinaceae
11.	*Blyxa aubertii*	Hydrocharitaceae
12.	*Caboma corillinianum*	Cabomaceae
13.	*Centella asiatica*	Apiaceae
14.	*Ceratophyllum demersum*	Ceratophyllaceae
15.	*Ceratopteris thalictroides*	Ceratopteridaceae
16.	*Crinum asiaticum*	Amaryllidaceae
17.	*Crinum sp.*	Amaryllidaceae
18.	*Cyperus pangoiie*	Cyperaceae
19.	*Cyperus sp*	Cyperaceae
20.	*Derris sp*	Fabaceae
21.	*Echinodorus*	Alismataceae
22.	*Eichhornia crassipes*	Pontederiaceae
23.	*Equisetum ramosissimum*	Equisetaceae
24.	*Eriocaulon cuspidatum*	Eriocaulaceae
25.	*Eriocaulon heterolepis*	Eriocaulaceae
26.	*Hydrilla verticellata*	Hydrocharitaceae
27.	*Hydrocharis dubia*	Hydrocharitaceae
28.	*Hygrophila difformis*	Acanthaceae
29.	*Hygrophila sp.*	Acanthaceae
30.	*Hygrophila schulli*	Acanthaceae
31.	*Hygrorhiza aristata*	Poaceae
32.	*Ipomoea aquatica*	Convolvulaceae
33.	*Ischaemum sp*	Poaceae
34.	*Jussiaea repens*	Onagraceae
35.	*Lagenandra toxicaria*	Araceae
36.	*Lemna paucicostata*	Lemnaceae
37.	*Limnocharis flava*	Limnocharitaceae
38.	*Limnophila conferta*	Scrophulariaceae
39.	*Limnophila heterophylla*	Scrophulariaceae
40.	*Lindernea sp.*	Scrophulariaceae

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Table 4 (cont'd). Species in the Hydrophyte garden of Bioresources Nature Trail

No.	Species	Family
41.	*Ludwigia octovalvis*	Onagraceae
42.	*Marsilea minuta*	Marsileaceae
43.	*Monochoria haspens*	Pontederiaceae
44.	*Monochoria vaginalis*	Pontederiaceae
45.	*Myriophyllum alternifolium*	Haloragaceae
46.	*Nelumbo nucifera*	Nymphaeaceae
47.	*Nymphaea marliacea*	Nymphaeaceae
48.	*Nymphaea omarana*	Nymphaeaceae
49.	*Nymphaea pubescens*	Nymphaeaceae
50.	*Nymphaea rubra*	Nymphaeaceae
51.	*Nymphaea sp.*	Nymphaeaceae
52.	*Nymphaea stellata*	Nymphaeaceae
53.	*Nymphaea stellata(pink)*	Nymphaeaceae
54.	*Nymphaea stellata(rose)*	Nymphaeaceae
55.	*Nymphaea stellata(white)*	Nymphaeaceae
56.	*Nymphoides cristata*	Menyanthaceae
57.	*Nymphoides indica*	Menyanthaceae
58.	*Ottelia alismoides*	Hydrocharitaceae
59.	*Phragmites karka*	Poaceae
60.	*Pistia stratiotes*	Araceae
61.	*Plectranthus species*	Lamiaceae
62.	*Pogostemon auricularia*	Lamiaceae
63.	*Pogostemon heyneana*	Lamiaceae
64.	*Rotala indica*	Lythraceae
65.	*Rotala macrandra*	Lythraceae
66.	*Saccharum spontaneum*	Poaceae
67.	*Sagittaria guayanensis*	Sagiteraceae
68.	*Salvinia auriculata*	Salviniaceae
69.	*Salvinia molesta*	Salviniaceae
70.	*Schoenoplectrus auriculatus*	Cyperaceae
71.	*Scirpus articulatus*	Cyperaceae
72.	*Smithia sensitiva*	Fabaceae
73.	*Thalia geniculata*	Marantaceae
74.	*Typha angustata*	Typhaceae
75.	*Utricularia exolata*	Lentibulariaceae
76.	*Utricularia flexuosa*	Lentibulariaceae
77.	*Utricularia stellaris*	Lentibulariaceae
78.	*Utricularia uliginosa*	Lentibulariaceae
79.	*Vallisneria spiralis*	Hydrocharitaceae
80.	*Wolffia arrhiza*	Lemnaceae

3.4. XEROPHYTE AND SUCCULENT GARDEN

Plants adapted to dry or desert conditions are collectively known as Xerophytes. One of the most important adaptations seen in such plants is prevention of water loss. The four main ways by which Xerophytes prevent water loss are reducing transpiration, increasing water storage, having modified plant parts like thorns, and growing during early hours and cooler seasons. Succulents are xerophytes that have developed storage structures, in which they hoard water, enabling them to survive periods of drought. The Xerophytes and Succulents garden has both outdoor landscaped rock garden and a green house to display medicinal (*Aloe vera*, *Cissus quadrangularis, Sarcostemma acidum*, *Asperagus racemosus*) and ornamental *(Echinocactus grusonii, Echeveria glauca, Agave angustifolia, Pandanus sanderi, Opuntia decumbens*) plants. In the garden one can also familiarize with bio-fence species such as *Agave americana, Bryophyllum pinnatum, Opuntia dillenii* and a bio-fuel species- *Jatropha curcas.*

Xerophytic and succulent species belonging to families like Agavaceae, Aizoaceae, Amaryllidaceae, Araceae, Asteraceae, Cactaceae, Crassulaceae, Asclepiadaceae, Liliaceae, Euphorbiaceae, Apocynaceae, Portulacaceae and Vitaceae are assembled in two settings- those can withstand the precipitation of the area are planted in a rock garden while those which are highly sensitive to ambient precipitation are maintained in a building.

3.4.1. Architecture / Landscaping

As mentioned earlier, the xerophytes and succulents are displayed in two places in the Bioresources Nature Trail - the rock garden and the green house. The rock garden is a landscaped piece of land with steep slope for express drainage of precipitation. The green house has 49.53 m^2 of floor area were the specimens are displayed in elevated angled iron stands.

3.4.2 Species

The specimens (Table 5) were collected from the natural forest areas of Nilambur and Chinnar in Kerala, Bandipur National Trail, Gundalpet, K R

Nagar, Belur and Koppa in Karnataka. Some of the specimens were provided by the Department of Botany, University of Bangalore and Sri Ramakrishnashrama, Mysore. Specimens were also bought from the Indo-American nursery, Bangalore and Continental Cactorium Nursery, Thrissur.

Table 5. List of species in the Xerophytes and Succulents garden of Bioresources Nature Trail

Sl. no.	Species	Family
1.	*Adenium obesum*	Apocynaceae
2.	*Adromischus cristatus*	Crassulaceae
3.	*Agave angustifolia*	Agavaceae
4.	*Agave victoriae-reginae*	Agavaceae
5.	*Aeonium haworthii*	Crassulaceae
6.	*Aeonium simsii*	Crassulaceae
7.	*Aloe bakeri*	Amaryllidaceae
8.	*Aloe jucunda*	Amaryllidaceae
9.	*Aloe variegata*	Amaryllidaceae
10.	*Aloe vera*	Amaryllidaceae
11.	*Aptania cordifolia*	Araceae
12.	*Asparagus racemosus*	Liliaceae
13.	*Astrophytum asterias*	Cactaceae
14.	*Astrophytum myriostigma*	Cactaceae
15.	*Beaucarnea recurvata*	Agavaceae
16.	*Caralluma stalagnifera*	Asclepiadaceae
17.	*Cephalocereus senilis*	Cactaceae
18.	*Cereus jamacaru*	Cactaceae
19.	*Cereus uruguyanas*	Cactaceae
20.	*Chamaecereus silvestrii 'Lutea'*	Cactaceae
21.	*Cissus quadrangularis*	Vitaceae
22.	*Cleistocactus strausii*	Cactaceae
23.	*Cotyledon orbiculata*	Crassulaceae
24.	*Crassula arborescens*	Crassulaceae
25.	*Crassula falcata*	Crassulaceae
26.	*Crassula lycopodioides*	Crassulaceae
27.	*Crassula portulacea*	Crassulaceae
28.	*Crassula pyramidalis*	Crassulaceae
29.	*Cyanotis somaliensis*	Cactaceae
30.	*Dolichothele uberiformis*	Cactaceae
31.	*Dracaena sanderiana*	Liliaceae
32.	*Eberlanzia disorticulata*	Aizoaceae

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Table 5 (cont'd). List of species in the Xerophytes and Succulents garden of Bioresources Nature Trail

Sl. no.	Species	Family
33.	*Echeveria affinis*	Crassulaceae
34.	*Echeveria carnicolor*	Crassulaceae
35.	*Echeveria glauca*	Crassulaceae
36.	*Echeveria leucotricha*	Crassulaceae
37.	*Echinocactus grusonii*	Cactaceae
38.	*Echinocereus triglochidiatus*	Cactaceae
39.	*Epiphyllum anguliger*	Cactaceae
40.	*Espostoa lanata*	Cactaceae
41.	*Euphorbia cristata*	Euphorbiaceae
42.	*Euphorbia decaryi*	Euphorbiaceae
43.	*Euphorbia lactea*	Euphorbiaceae
44.	*Euphorbia lactea `Alba'*	Euphorbiaceae
45.	*Euphorbia supernaus*	Euphorbiaceae
46.	*Euphorbia suzannae*	Euphorbiaceae
47.	*Euphorbia tirucalli*	Euphorbiaceae
48.	*Euphorbia trigona*	Euphorbiaceae
49.	*Euphorbia trigona*	Euphorbiaceae
50.	*Gasteria liliputana*	Apocynaceae
51.	*Gasteria verrucosa*	Apocynaceae
52.	*Gibbaeum petrense*	Aizoaceae
53.	*Graptopetalum paraguyense*	Crassulaceae
54.	*Gymnocalycium* Sp.1	Cactaceae
55.	*Gymnocalycium* Sp.2	Cactaceae
56.	*Gymnocalycium* Sp.3	Cactaceae
57.	*Gymnocalycium mihanovichii*	Cactaceae
58.	*Hatiora salicornioides*	Cactaceae
59.	*Haworthia attenuata*	Cactaceae
60.	*Haworthia cuspidata*	Cactaceae
61.	*Haworthia fasciata*	Cactaceae
62.	*Haworthia humulus*	Cactaceae
63.	*Haworthia limifolia*	Cactaceae
64.	*Hedera helix*	Araliaceae
65.	*Kalanchoe blossfeldiana*	Crassulaceae
66.	*Kalanchoe marnieriana*	Crassulaceae
67.	*Lithops salicola*	Aizoaceae
68.	*Mammillaria*	Cactaceae
69.	*Mammillaria bocasana*	Cactaceae
70.	*Mammillaria bombycina*	Cactaceae
71.	*Mammillaria boolii*	Cactaceae
72.	*Mammillaria celsiana*	Cactaceae
73.	*Mammillaria centricirrha*	Cactaceae

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Table 5 (cont'd). List of species in the Xerophytes and Succulents garden of Bioresources Nature Trail

Sl. no.	Species	Family
74.	*Mammillaria compressa*	Cactaceae
75.	*Mammillaria elegans*	Cactaceae
76.	*Mammillaria elongata*	Cactaceae
77.	*Mammillaria geminispina*	Cactaceae
78.	*Mammillaria prolifera*	Cactaceae
79.	*Myrtillocactus*	Cactaceae
80.	*Notocactus leninghausii*	Cactaceae
81.	*Notocactus magnificus*	Cactaceae
82.	*Notocactus magnificus*	Cactaceae
83.	*Notocactus mammulosus*	Cactaceae
84.	*Opuntia falcata*	Cactaceae
85.	*Opuntia ficus-indica*	Cactaceae
86.	*Opuntia ficus-indica*	Cactaceae
87.	*Opuntia microdasys*	Cactaceae
88.	*Opuntia vilis*	Cactaceae
89.	*Oscularia deltoides*	Aizoaceae
90.	*Pachypodium*	Apocynaceae
91.	*Pachypodium geayi*	Apocynaceae
92.	*Pachypodium lamerei*	Apocynaceae
93.	*Pachyphytum oviferum*	Apocynaceae
94.	*Pachyveria scheideckeri*	Crassulaceae
95.	*Pandanus sanderi*	Pandanaceae
96.	*Peireskiopsis velutina*	Cactaceae
97.	*Portulacaria afra*	Portulacaceae
98.	*Rebutia senilis*	Cactaceae
99.	*Rhipsalis pilocarpa*	Cactaceae
100.	*Sansevieria cylindrica*	Liliaceae
101.	*Sansevieria desertii*	Liliaceae
102.	*Sarcostemma acidum*	Asclepiadaceae
103.	*Schlumbergera bridgesii*	Cactaceae
104.	*Schlumbergera russellian*	Cactaceae
105.	*Sedum marganianum*	Crassulaceae
106.	*Sedum sieboldii*	Crassulaceae
107.	*Sedum treloazii*	Crassulaceae
108.	*Senecio* sp.1	Asteraceae
109.	*Senecio* sp.2	Asteraceae
110.	*Senecio elegans*	Asteraceae
111.	*Senecio petraeus*	Asteraceae
112.	*Sulcorebutia arenacea 'hybrid'*	Cactaceae
113.	*Sulcorebutia arenacea 'hybrid'*	Cactaceae
114.	*Sulcorebutia arenacea 'hybrid'*	Cactaceae
115.	*Yucca whipplei*	Liliaceae

3.5. MEDICINAL PLANT GARDEN

The Medicinal Plant Garden is an assemblage of more than 190 species of medicinal plants, many of which are mainstay drug-producing plants whose products such as variety of alkaloids, glycosides, steroids and other group of compounds are currently in use in clinical practice around the world. The Garden functions as an educational display and source of information to the visitors on conservation, management and sustainable utilization of medicinal plants. The pathways which crisscross the quarter - acre formal style garden provide easy access for visitors to examine some rare but important medicinal plants like *Acorus calamus, Baliospermum montanum, Coscinium fenestratum, Cymbopogon flexuosus, Embelia ribes, Gloriosa superba, Nilgirianthus ciliatus, Rauvolfia serpentine, Terminalia arjuna, Terminalia belerica, Terminalia chebula, Trichopus zeylanicus, Zingiber zerumbet* etc.

3.5.1. Architecture / Landscaping

The medicinal plants are planted in turf of grass in a lattice fashion with pathways between each row of plants. The garden is enclosed in a live fence composed of medicinal plants such as *Alpinia calcarata, Cymbopogon flexuosus* and *Vetiveria zizanioides.*

3.5.2. Species

The garden has 195 species of medicinal plants (Table 6) used in the traditional medical systems of India. The plants were collected from the natural forests of Nilambur forest divisions as also from Tropical Botanical Garden and Research Institute, Palode, Kottackal Aryavaidyasala, Kerala Agricultural University and Forest Research Institute, Dehradun. Some plants were also procured from Rayirath nursery, Thrissur.

Table 6. List of species in the Medicinal plants garden of Bioresources Nature Trail

Sl. No.	Species	Family
1.	*Abrus precatorius*	Fabaceae
2.	*Achyranthes aspera*	Amaranthaceae
3.	*Acorus calamus*	Araceae
4.	*Adhatoda beddomei*	Acanthaceae
5.	*Aerva lanata*	Amaranthaceae
6.	*Alangium salvifolium*	Alangiaceae
7.	*Aloe vera*	Liliaceae
8.	*Alpinia calcarata*	Zingiberaceae
9.	*Alternanthera sessilis*	Amaranthaceae
10.	*Amaranthus gangeticus*	Amaranthaceae
11.	*Amorphophallus companulatus*	Araceae
12.	*Andrographis alata*	Acanthaceae
13.	*Aphanamixis polystachya*	Meliaceae
14.	*Aristolochia indica*	Aristolochiaceae
15.	*Asparagus racemosus*	Liliaceae
16.	*Averrhoa carambola*	Oxalidaceae
17.	*Bacopa monnieri*	Scrophulariaceae
18.	*Baliospermum montanum*	Euphorbiaceae
19.	*Bauhinia acuminata*	Fabaceae
20.	*Biophytum candolleanum*	Oxalidaceae
21.	*Bixa orellana*	Bixaceae
22.	*Boerhaavia diffusa*	Nyctaginaceae
23.	*Butea monosperma*	Fabaceae
24.	*Calotropis gigantea*	Asclepiadaceae
25.	*Capsicum frutescens*	Solanaceae
26.	*Cardiospermum halicacabum*	Sapindaceae
27.	*Carica papaya*	Caricaceae
28.	*Cassia occidentalis*	Fabaceae
29.	*Cassia tora*	Fabaceae
30.	*Catharanthus roseus*	Apocynaceae
31.	*Celastrus paniculatus*	Celastraceae
32.	*Centella asiatica*	Apiaceae
33.	*Cissus quadrangularis*	Vitaceae
34.	*Citrus aurantifolia*	Rutaceae
35.	*Citrus medica*	Rutaceae
36.	*Cleome viscosa*	Capparidaceae
37.	*Clerodendron viscosum*	Verbenaceae
38.	*Clerodendron paniculatum*	Verbenaceae
39.	*Clitoria ternatea*	Fabaceae
40.	*Coccinia grandis*	Cucurbitaceae

----Cont'd----

Table 6 (Cont'd). List of species in the Medicinal plants garden of Bioresources Nature Trail

Sl. No.	Species	Family
41.	*Coleus amboricus*	Lamiaceae
42.	*Coleus parviflorus*	Lamiaceae
43.	*Coleus zeylanicus*	Lamiaceae
44.	*Coscinium fenestratum*	Menispermaceae
45.	*Costus mexicana*	Zingiberaceae
46.	*Costus pictus*	Zingiberaceae
47.	*Costus speciosus*	Zingiberaceae
48.	*Cucumis sativus*	Cucurbitaceae
49.	*Curculigo orchioides*	Amaryllidaceae
50.	*Curcuma aromatica*	Zingiberaceae
51.	*Curcuma longa*	Zingiberaceae
52.	*Cyathula prostrata*	Amaranthaceae
53.	*Cyclea peltata*	Menispermaceae
54.	*Cynodon dactylon*	Poaceae
55.	*Cyperus rotundus*	Cyperaceae
56.	*Datura metel*	Solanaceae
57.	*Desmodium gangeticum*	Fabaceae
58.	*Desmodium gyrans*	Fabaceae
59.	*Dracaena terniflora*	Liliaceae
60.	*Eclipta prostrata*	Asteraceae
61.	*Elaeocarpus serratus*	Elaeocarpaceae
62.	*Elephantopus scaber*	Asteraceae
63.	*Elettaria cardamomum*	Zingiberaceae
64.	*Embelia tsjeriam-cottam*	Myrsinaceae
65.	*Emilia sonchifolia*	Asteraceae
66.	*Ensetae superba*	Musaceae
67.	*Entada scandens*	Mimosaceae
68.	*Eryngium foetidum*	Apiaceae
69.	*Eupatorium triplinerve*	Asteraceae
70.	*Euphorbia nivulia*	Euphorbiaceae
71.	*Evolvulus alsinoides*	Convolvulaceae
72.	*Ficus microcarpa*	Moraceae
73.	*Ficus racemosa*	Moraceae
74.	*Flacourtia jangomas*	Flacourtiaceae
75.	*Garcinia morella*	Clusiaceae
76.	*Geophila repens*	Rubiaceae
77.	*Gloriosa superba*	Liliaceae
78.	*Glycosmis pentaphylla*	Rutaceae
79.	*Gmelina arborea*	Verbenaceae
80.	*Gymnema sylvestre*	Asclepiadaceae

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Table 6 (Cont'd). List of species in the Medicinal plants garden of Bioresources Nature Trail

Sl. No.	Species	Family
81.	*Hedyotis corymbosa*	Rubiaceae
82.	*Heliotropium indicum*	Boraginaceae
83.	*Heliotropium scabrum*	Boraginaceae
84.	*Helminthostachys zeylanica*	Ophioglossaceae
85.	*Hemidesmus indicus*	Asclepiadaceae
86.	*Hemigraphis colorata*	Acanthaceae
87.	*Hemionitis arifolia*	Cheilanthaceae
88.	*Holarrhena pubescens*	Asclepiadaceae
89.	*Holoptelea integrifolia*	Ulmaceae
90.	*Holostemma ada-kodien*	Asclepiadaceae
91.	*Hygrophila auriculata*	Acanthaceae
92.	*Indigofera tinctoria*	Fabaceae
93.	*Ipomoea batatas*	Convolvulaceae
94.	*Ipomoea mauritiana*	Convolvulaceae
95.	*Ipomoea obscura*	Convolvulaceae
96.	*Ixora coccinea*	Rubiaceae
97.	*Jasminum grandiflorum*	Oleaceae
98.	*Jatropha gossypifolia*	Euphorbiaceae
99.	*Jatropha multifida*	Euphorbiaceae
100.	*Justicia adathoda*	Acanthaceae
101.	*Justicia gendarussa*	Acanthaceae
102.	*Justicia nilgherrensis*	Acanthaceae
103.	*Kaempferia galanga*	Zingiberaceae
104.	*Kaempferia rotunda*	Zingiberaceae
105.	*Kalanchoe pinnata*	Crassulaceae
106.	*Laportea crenulata*	Urticaceae
107.	*Lawsonia inermis*	Lythraceae
108.	*Leucas aspera*	Lamiaceae
109.	*Madhuca longifolia*	Sapotaceae
110.	*Maranta arundinaceae*	Marantaceae
111.	*Mentha spicata*	Lamiaceae
112.	*Mimosa pudica*	Fabaceae
113.	*Mimusops elengi*	Sapotaceae
114.	*Murraya koenigii*	Rutaceae
115.	*Musa paradisiaca*	Musaceae
116.	*Myristica malabarica*	Myristaceae
117.	*Myxopyrum smilacifolium*	Oleaceae
118.	*Naravelia zeylanica*	Ranunculaceae
119.	*Naregamia alata*	Meliaceae
120.	*Nervilia aragoana*	Ranunculaceae

-----Cont'd---

Table 6 (Cont'd). List of species in the Medicinal plants garden of Bioresources Nature Trail

Sl. No.	Species	Family
121.	*Ocimum basilicum*	Lamiaceae
122.	*Ocimum sanctum*	Lamiaceae
123.	*Oroxylum indicum*	Bignoniaceae
124.	*Orthosiphon aristatus*	Lamiaceae
125.	*Oxalis corniculata*	Oxalidaceae
126.	*Pandanus amarillyfolia*	Pandanaceae
127.	*Passiflora edulis*	Passifloraceae
128.	*Pentanema indicum*	Asteraceae
129.	*Persea macrantha*	Lauraceae
130.	*Peucedanum graveolens*	Apiaceae
131.	*Phaseolus trilobus*	Fabaceae
132.	*Phyllanthus amarus*	Euphorbiaceae
133.	*Physalis minima*	Solanaceae
134.	*Pimenta dioica*	Myrtaceae
135.	*Piper barberi*	Piperaceae
136.	*Piper betel*	Piperaceae
137.	*Piper longum*	Piperaceae
138.	*Piper nigrum*	Piperaceae
139.	*Plumbago rosea*	Plumbaginaceae
140.	*Plumbago zeylanica*	Plumbaginaceae
141.	*Pogostemon heyneanus*	Lamianceae
142.	*Premna serratifolia*	Verbenaceae
143.	*Pseudarthria viscida*	Fabaceae
144.	*Psidium guajava*	Myrtaceae
145.	*Psilanthus travancorensis*	Rubiaceae
146.	*Pterocarpus marsupium*	Fabaceae
147.	*Pterocarpus santalinus*	Fabaceae
148.	*Punica granatum*	Punicaceae
149.	*Putranjiva roxburgii*	Euphorbiaceae
150.	*Rauwolfia serpentina*	Apocynaceae
151.	*Rauwolfia tetraphylla*	Apocynaceae
152.	*Ricinus communis*	Euphorbiaceae
153.	*Ruta graveolens*	Rutaceae
154.	*Saccharum officinarum*	Poaceae
155.	*Salacia fruticosa*	Hippocrateaceae
156.	*Salacia reticulata*	Hippocrateaceae
157.	*Sapindus trifoliata*	Sapindaceae
158.	*Saraca asoca*	Fabaceae
159.	*Sarcostemma acidum*	Asclepiadaceae
160.	*Sauropus androgynus*	Euphorbiaceae

---Cont'd---

Table 6 (Cont'd). List of species in the Medicinal plants garden of Bioresources Nature Trail

Sl. No.	Species	Family
161.	*Scoparia dulcis*	Scrophulariaceae
162.	*Setaria italica*	Poaceae
163.	*Sida rhombifolia*	Malvaceae
164.	*Solanum nigrum*	Solanaceae
165.	*Solanum violaceum*	Solanaceae
166.	*Solanum xanthocarpum*	Solanaceae
167.	*Sphaeranthus indicus*	Asteraceae
168.	*Spilanthes calva*	Asteraceae
169.	*Spondias pinnata*	Anacardiaceae
170.	*Stachyphrynium spicatum*	Marantaceae
171.	*Strobilanthes ciliatus*	Acanthaceae
172.	*Strychnos potatorum*	Loganiaceae
173.	*Tabernaemontana coronaria*	Apocynaceae
174.	*Tagetes erecta*	Asteraceae
175.	*Tephrosia purpurea*	Fabaceae
176.	*Terminalia bellirica*	Combretaceae
177.	*Terminalia chebula*	Combretaceae
178.	*Thottea siliquosa*	Aristolochiaceae
179.	*Tiliacora acuminata*	Menispermaceae
180.	*Tinospora cordifolia*	Menispermaceae
181.	*Tinospora sinensis*	Menispermaceae
182.	*Tragia involucrata*	Euphorbiaceae
183.	*Tylophora asthmatica*	Asclepiadaceae
184.	*Vallaris solancea*	Apocynaceae
185.	*Vernonia cinerea*	Asteraceae
186.	*Vetiveria zizanioides*	Poaceae
187.	*Vitex negundo var. purpurescens*	*Verbenaceae*
188.	*Woodfordia fruticosa*	Lythraceae
189.	*Wrightia tinctoria*	Apocynaceae
190.	*Zanthoxylum rhetsa*	*Rutaceae*
191.	*Zingiber officinale*	Zingiberaceae
192.	*Zingiber zerumbet*	Zingiberaceae

3.6. THALLOPHYTE AND BRYOPHYTE HOUSE

Thallophytes are the most lowly organized plants because they consist of one cell or a relatively undifferentiated mass of cells called a thallus, instead of having an organized plant bodies such as stem, root and leaf as in higher plants. Algae, which from a sub - group of thallophytes, are responsible for over 90% of the oxygen in this world. They flourish in aquatic and damp areas. Bryophytes are the earliest terrestrial plants, habituated to moist and shaded environment. They provide year-round habitat for a wide array of algal species, aquatic invertebrates and amphibians.

In the Bioresources Nature Trail, a Shade House, below the ground level, with mist, sprinkler and drip irrigation facilities, is designed to grow thallophytes and bryophytes. Here, one can get familiarized with microscopic colonial blue-green algae like *Gloeocapsa*; colonial green algae like *Volvox;* filamentous algae like *Spirogyra, Oedogonium, and Cladophora;* and a macroscopic green algae of the genus *Chara. Bryphytes are represented by* liverworts like *Marchantia linearis, Riccia frostii, Riccardia multifida,* etc*.;* hornworts like *Anthoceros crispulus* and *Notothylas levieri;* and mosses like *Bryum wightii, Campylopus ericoides,* and *Philonotis hastata.*

3.6.1 Architecture / Landscaping

The Thallophytes and Bryophytes house is a 93.33 m^2 building with a floor sunken 2 m down the ground level. From the floor square pillars arise to eye level on which the algae are presented in water in glass containers and the bryophytes are left to grow on appropriate substrata. Each pillar harboring bryophytes are provided with drip nozzles to ensure moisture round the clock.

3.6.2 Species

The house harbors eight species of algae and eighteen species of bryophytes (Table 7). They were collected from the natural forests of Nilambur and Nelliampathy and also procured from Malabar Botanical Garden, Calicut.

Table 7. List of Algae and Bryophytes in the Thallophytes and Bryophytes house of Bioresources Nature Trail.

Algae			
1.	*Chara*	5.	*Oedogonium*
2.	*Cladophora*	6.	*Spirogyra*
3.	*Gleocapsa*	7.	*Ulva*
4.	*Nitella*	8.	*Volvox*
Bryophytes			
1.	*Anthoceros crispulus*	10.	*Notothylas levieri*
2.	*Bryum coronatum*	11.	*Octoblepharum albidum*
3.	*Bryum wightii*	12.	*Phaeoceros laevis*
4.	*Campylopus ericoides*	13.	*Philonotis hastata*
5.	*Campylopus flexuosus*	14.	*Philonotis thwaitesii*
6.	*Chandonanthus birmensis*	15.	*Radula kurzii*
7.	*Cyathodium cavernarum*	16.	*Riccardia multifida*
8.	*Dumortiera hirsute*	17.	*Riccia frostii*
9.	*Marchantia linearis*	18.	*Riccia sp.*

3.7. GYMNOSPERM GARDEN

The gymnosperms are the most ancient seed plants that originated during the late Paleozoic era (about 265 million years ago) but flourished well during the Mesozoic era. Modern gymnosperms are commonly grouped under four orders: the Ginkgoales, the Cycadales, the Coniferales and the Gnetales. The Ginkgoales and Cycadales include living members that have a long fossil history and can be regarded as 'living fossils'. Now the order Ginkgoales is represented by a single species, *Ginkgo biloba*. In the Bioresources Nature Trail, the gymnosperm garden which is spread out over a large leveled area having provision for further additions, five seedlings of *Ginkgo biloba* have been planted and have been provided sufficient shade for their survival and growth.

Cycads flourished well during the Mesozoic and are now represented by nine well-defined genera that are confined to a limited area in the tropical and subtropical countries of the world. Among the nine genera under the family Cycadaceae, the genus Cycas is well represented in India with a few species.

In the Bioresources Nature trail, plants of *Cycas ciricinalis*, a cycad endemic to South India are growing. In addition, the Nature Trail has *Cycas beddomii*, *Cycas revoluta, Cycas rumphii, Zamia pumila* and *Zamia purpurea*.

The Coniferales constitute the largest order among the gymnosperms and comprise six families namely Pinaceae, Taxaceae, Cupressaceae, Podocarpaceae, Araucariaceae and Taxodaceae. In the Western Ghats of India *Podocarpus* (=*Nageia*) *wallichiana* is the only gymnosperm tree found and is also endemic to the region. Five well established saplings of this species are planted in the Bioresources Nature Trail. Apart from them, five to ten propagules for each species namely *Araucaria excelsa*, *Araucaria cunninghamii*, *Cupressus semipervirens*, *Cupressus torulosa*, *Juniperus chinensis*, *Pinus radiata*, *Pinus longifolia*, *Thuja orientalis* and *Thuja occidentalis* are planted in the Nature Trail.

Among the gymnosperms, the Gnetales have reached the summit of evolution and bear a close resemblance to the angiosperms. The order Gnetales is represented by three mono-generic families namely Gnetaceae, Ephedraceae and Welwitschiaceae. In the Biosphere Nature Trail, the order Gnetales is represented by *Gnetum ula*; a woody climber and endemic to the Western Ghats.

4. DEDICATION OF BIORESOURCE NATURE TRAIL TO THE PUBLIC

The Bioresources Nature Trail was dedicated to the public on 12 February, 2007 by Sri. Binoy Viswom, Honb'le Minister for Forest and Housing, Government of Kerala. The function was presided over by Sri. Aryadan Muhammed, Member of the Legislative Assembly, Government of Kerala. The function was attended by a large section of the local population, representatives from media and students of nearby schools. In his welcome address, Dr. R.Gnanaharan, Director Kerala Forest Research Institute (KFRI) expressed his sincere gratitude to the Department of Biotechnology (DBT), Government of India for providing KFRI the opportunity to establish the Bioresources Nature Trail in the Kerala part of Western Ghats. Inaugurating the Bioresources Nature Trail, Sri. Binoy Viswom, Honb'le Minister for Forest and Housing, also thanked the DBT for undertaking unique programmes which help in conservation and sustainable utilization of biodiversity of the country. In his presidential address Shri. Aryadan Muhammed, stressed the need of sustained support and encouragement for strengthening the Bioresources Nature Trail which has been established for ex-situ conservation of RET species and also to promote eco-education and ecotourism. Shri. K.K. Nair IFS(Rtd.) congratulated KFRI for its excellent effort in showcasing the plant diversity of the Western Ghats adjacent to the Teak Museum, which is already attracting a large number of visitors including student groups and other organized groups from different fields of the society. Shri M.A. Razak, President, Nilambur Block Panchayat, Smt. K.K. Unaisa, Member, Nilambur Block Panchayat and Shri Aryadan Shoukath, President, Nilambur Grama Panchayat hoped that the Teak Museum and Bioresources Nature Trail together will make Nilambur known both at national and global level for its contributions to forestry and biodiversity conservation. Regional and state level television channels and news papers covered the inaugural function and the unique features of the Bioresources Nature Trail.

Some News paper reports on the Bioresources Nature Trail at Kerala Forest Research Institute, Nilambur

13 February 2007

Madhyamam

നിലമ്പൂരിൽ ജൈവ വിഭവ ഉദ്യാനം തുറന്നു

നിലമ്പൂർ: കേരള വനഗവേഷണ കേന്ദ്രത്തിനുകീഴിൽ നിലമ്പൂർ തേക്ക് മ്യൂസിയത്തിന് സമീപം ജൈവ വിഭവ ഉദ്യാനം വനംമന്ത്രി ബിനോയ്വിശ്വം ഉദ്ഘാടനം ചെയ്തു. പശ്ചിമഘട്ടത്തിലെ അപൂർവവും വംശനാശ ഭീഷണി നേരിടുന്നതുമായ വിവിധ സസ്യജാലങ്ങളെക്കുറിച്ച് പൊതുജനങ്ങളും വിദ്യാർഥികൾക്കും അറിവ് പകരുക ലക്ഷ്യമിട്ടാണ് ജൈവ വിഭവ ഉദ്യാനം സ്ഥാപിച്ചിരിക്കുന്നത്. തേക്ക് മ്യൂസിയത്തിന് അനുബന്ധമായി ഒമ്പതേക്കർ സ്ഥലത്താണ് ഉദ്യാനം. വിവിധ സസ്യങ്ങൾക്ക് അവയുടെ ആവാസ വ്യവസ്ഥയിൽ വളരാൻ തക്ക സജ്ജീകരണം ഉദ്യാനത്തിലൊരുക്കിയിട്ടുണ്ട്.

അത്യപൂർവവും മനോഹരവുമായ 75ഓളം ഓർക്കിഡുകളാണ് ജൈവപാർക്കിന്റെ പ്രധാന ആകർഷണം. അലങ്കാരചെടിയായി വളർത്തുന്ന 40ഓളം പനകളും 75ഓളം പന്നൽചെടികളും ഉദ്യാനത്തിലെ സവിശേഷ കാഴ്ചയാണ്. വരണ്ട കാലാവസ്ഥയിൽ വളരുന്ന കള്ളിച്ചെടികൾക്കായി റോക്ക് ഗാർഡൻ ഒരുക്കിയിട്ടുണ്ട്.

18ഓളം ഇനം ഔഷധ സസ്യങ്ങൾ വളരുന്ന ഔഷധോദ്യാനം, മുള ഉദ്യാനം എന്നിവ ജൈവ പാർക്കിനെ വ്യത്യസ്തമാക്കുന്നു. ചിത്രശലഭങ്ങൾക്കായി ശലഭോദ്യാനവുമുണ്ട്. കേന്ദ്ര ജൈവ സാങ്കേതിക വകുപ്പ്, സംസ്ഥാന ആസൂത്രണ, ധനകാര്യ വകുപ്പ് എന്നിവയുടെ സാമ്പത്തിക സഹായത്തോടെ 50 ലക്ഷം രൂപ ചെലവഴിച്ചാണ് ഉദ്യാനം നിർമിച്ചത്.

ആര്യാടൻ മുഹമ്മദ് എം.എൽ.എ അധ്യക്ഷത വഹിച്ചു. ബ്ലോക്ക്പ്രസിഡൻറ് എം.എ. റസാഖ്, മെമ്പർ കെ.കെ. ഉനൈസ, ഗ്രാമപഞ്ചായത്ത് പ്രസിഡൻറ് ആര്യാടൻ ഷൗക്കത്ത്, ചീഫ് ഫോറസ്റ്റ് കൺസർവേറ്റർ സി.എസ്. യാലക്കി, കെ.കെ. നായർ എന്നിവർ ആശംസ നേർന്നു. ഡോ. യു.എം. ചന്ദ്രശേഖര സ്വാഗതവും ഡോ. കെ.സി. ചാക്കോ നന്ദിയും പറഞ്ഞു.

നിലമ്പൂർ തേക്ക് മ്യൂസിയത്തിന് സമീപം ജൈവ വിഭവ ഉദ്യാനം വനംമന്ത്രി ബിനോയ്വിശ്വം ഉദ്ഘാടനം ചെയ്യുന്നു

13 February, 2007

Deshabhimani

ജൈവ വിഭവ ഉദ്യാനം തുറന്നുകൊടുത്തു

നിലമ്പൂർ: തേക്ക് മ്യൂസിയത്തിലെ ജൈവവിഭവ ഉദ്യാനം പൊതുജനങ്ങൾക്കായി വനംമന്ത്രി ബിനോയ് വിശ്വം തുറന്നുകൊടുത്തു. ഔഷധസസ്യ ഉദ്യാനം, ശലഭ ഉദ്യാനം, നോക്ക് ഗാർഡൻ, സസ്യ ഉദ്യാനം എന്നിവയാണ് തിങ്കളാഴ്ച പൊതുജനങ്ങൾക്കായി തുറന്നുകൊടുത്തത്.

ജനകീയ കൂട്ടായ്മയോടെ വനസംരക്ഷണത്തിന് പദ്ധതികൾ ആവിഷ്കരിക്കുമെന്ന് മന്ത്രി ബിനോയ് വിശ്വം പറഞ്ഞു. അടുത്ത അധ്യയനവർഷം 20 ലക്ഷം വിദ്യാർഥികൾക്ക് വൃക്ഷത്തൈ നൽകും. ശരിയായി പരിപാലിക്കുന്നവർക്ക് ഗ്രേസ്മാർക്ക് നൽകും. അക്കേഷ്യ മരങ്ങൾ നട്ടുവളർത്തുന്നത് നിർത്തലാക്കി. നിലവിലുള്ളവ ഘട്ടംഘട്ടമായി മുറിച്ചുമാറ്റുമെന്നും അദ്ദേഹം പറഞ്ഞു. ആര്യാടൻ മുഹമ്മദ് എംഎൽഎ അധ്യക്ഷനായിരുന്നു. എം എ റസാക്ക്, ആര്യാടൻ ഷൗക്കത്ത്, സി എസ് എലാക്കി, കെ കെ നായർ, ഡോ. യു എം ചന്ദ്രശേഖരൻ, കെ സി ചാക്കോ എന്നിവർ സംസാരിച്ചു.

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13 February 2007

Kerala Kaumudhi

നിലമ്പൂരിലെ ജൈവ വിഭവ ഉദ്യാനത്തിന്റെ ഉദ്ഘാടനം വനം വകുപ്പ് മന്ത്രി ബിനോയ് വിശ്വം നിർവഹിക്കുന്നു

സാമൂഹ്യവനവൽകരണ പരിപാടിയിൽ അക്കേഷ്യ വച്ചുപിടിപ്പിക്കില്ല: വനംമന്ത്രി

നിലമ്പൂർ: പ്രകൃതിയുടെ സന്തുലിതാവസ്ഥയെ ദോഷകരമായി ബാധിക്കുന്ന അക്കേഷ്യാമരം പോലുള്ളവ സാമൂഹ്യവനവൽക്കരണത്തിന്റെ ഭാഗമായി നട്ടുപിടിപ്പിക്കില്ലെന്ന് സർക്കാർ തീരുമാനിച്ചതായി വനംവകുപ്പ് മന്ത്രി ബിനോയ് വിശ്വം പറഞ്ഞു. നിലമ്പൂർ കേരള വനഗവേഷണ കേന്ദ്രത്തിന്റെ കീഴിൽ പൂർത്തിയായ ജൈവ വിഭവ ഉദ്യാനത്തിന്റെ ഉദ്ഘാടനം നിർവഹിച്ച് സംസാരിക്കുകയായിരുന്നു അദ്ദേഹം.

ജലത്തിനായി നേരിടാൻ പോകുന്ന ക്ഷാമത്തെക്കുറിച്ച് സമൂഹം തന്നെ കൂടുതൽ ബോധവാൻമാരാകേണ്ടതുണ്ട്. ജൈവ സമ്പത്തുകൊണ്ടു സമ്പന്നമായ പശ്ചിമഘട്ടത്തിലെ നിലനിൽപ്പിനെ ആശ്രയിച്ചിരിക്കും നമ്മുടെ വരുംകാലം ജീവിതത്തിന്റെ നിലനിൽപ്പ്. മുല്ലപ്പെരിയാർ അണക്കെട്ടിൽ ഒരടിപോലും വെള്ളം ഉയർത്തുന്ന പശ്ചിമഘട്ടത്തിലെ ജൈവ വ്യവസ്ഥയെ നശിപ്പിക്കും. തമിഴ്നാടിനും ഇതു ദോഷകരമായി ബാധിക്കും. മുല്ലപ്പെരിയാർ പ്രശ്നത്തിൽ വാദഗതികളുയർത്തുന്ന തമിഴ്നാടിന്റെ ശ്രദ്ധയിലും ഇതുപെടുമെന്ന് കരുതുന്നതായി മന്ത്രി പറഞ്ഞു. ആര്യാടൻ മുഹമ്മദ് എം. എൽ. എ. അദ്ധ്യക്ഷനായിരുന്നു.

13 February 2007

Mathrubhumi

ജൈവവിഭവ ഉദ്യാനം ജനങ്ങൾക്കായി തുറന്നുകൊടുത്തു

നിലമ്പൂർ: കേരള വനഗവേഷണ ഇൻസ്റ്റിറ്റ്യൂട്ട് നിലമ്പൂർ സബ്സെൻററിൽ തേക്ക് മ്യൂസിയത്തിന് സമീപം പണിപൂർത്തിയാക്കിയ ജൈവവിഭവ ഉദ്യാനം വനംമന്ത്രി ബിനോയ് വിശ്വം തിങ്കളാഴ്ച പൊതുജനങ്ങൾക്കായി തുറന്നുകൊടുത്തു.

തേക്ക് മ്യൂസിയ പരിസരത്തു നടന്ന ചടങ്ങിൽ ആര്യാടൻ മുഹമ്മദ് എം.എൽ.എ അധ്യക്ഷതവഹിച്ചു.

ബ്ലോക്ക് പഞ്ചായത്ത് പ്രസിഡൻറ് എം.എ.റസാഖ്, ബ്ലോക്ക് പഞ്ചായത്തംഗം കെ.കെ. ഉനൈസ, ഗ്രാമപ്പഞ്ചായത്ത് പ്രസിഡൻറ് ആര്യാടൻ ഷൗക്കത്ത്, ചീഫ് കൺസർവേറ്റർ സി.എസ്.യലാക്കി, റിട്ട. കൺസർവേറ്റർ കെ.കെ.നായർ, ഡോ. യു.എം.ചന്ദ്രശേഖരൻ, കെ.സി.ചാക്കോ എന്നിവർ പ്രസംഗിച്ചു. ജൈവവൈവിധ്യത്തെക്കുറിച്ചുള്ള അറിവും അവ സംരക്ഷിക്കേണ്ടതിൻെറ പ്രാധാന്യവും വ്യക്തമാക്കുന്ന ഉദ്യാനത്തിൽ വിവിധതരം സസ്യങ്ങൾ, ഓർക്കിഡുകൾ, കള്ളിച്ചെടികൾക്കായുള്ള നോക്ക്ഗാർഡൻ, ഔഷധസസ്യോദ്യാനം, ശലഭോദ്യാനം എന്നിവയാണ് ഒരുക്കിയിട്ടുള്ളത്.

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Appendix 1. List of species used for landscaping the Bioresources Nature Trail

No.	Species	Common name	Family
1.	*Acalypha wilkesiana*` Ceylon`	Copper leaf	Euphorbiaceae
2.	*Acalypha wilkesiana*` Dwarf`	Copper leaf	Euphorbiaceae
3.	*Acalypha wilkesiana*` macrohphylla`	Copper leaf	Euphorbiaceae
4.	*Acalypha wilkesiana*` Tahati`	Copper leaf	Euphorbiaceae
5.	*Acalypha wilkesiana*` Tricolor`	Copper leaf	Euphorbiaceae
6.	*Achimenes sp.*	Hot water plant	Gesnericeae
7.	*Adenium obesum*	Desert Rose	Apocynaceae
8.	*Aglaonema commtatum*	Chinese evergreen	Araceae
9.	*Aglaonema costatum*	Chinese evergreen	Araceae
10.	*Aglaonema crispum*	Chinese evergreen	Araceae
11.	*Aglaonema nitidum*	Chinese evergreen	Araceae
12.	*Aglaonema pseudobracteatum*	Chinese evergreen	Araceae
13.	*Allamanda cathartica* 'Hendersonii'	Allamanda	Apocyanaceae
14.	*Allamanda neriifolia*	Allamanda	Apocyanaceae
15.	*Allamanda violacea*	Purple Allamanda	Apocyanaceae
16.	*Alocasia amazonica*		
17.	*Alocasia cuprea*		
18.	*Alpinia sanderae*	Variegated ginger	Zingiberaceae
19.	*Alpinia zerumbat* 'Variegata'	Variegated Shell ginger	Zingiberaceae
20.	*Alternanthera bettzickiana*	Red Calico plant	Amaranthaceae
21.	*Alternanthera bettzickiana* `Snowtop'		Amaranthaceae
22.	*Alternanthera bettzickiana* `Variegata`		Amaranthaceae
23.	*Alternanthera versicolor*	Copper leaf	Amaranthaceae
24.	*Ananas bracteatus*	Red Pineapple	Bromeliaceae
25.	*Ananas comosus*	Pineapple	Bromeliaceae
26.	*Anthurium andreanum*	Tail flower	Araceae
27.	*Anthurium clarinervium*	Anthurium	Araceae
28.	*Arachis pintoii*		Fabaceae
29.	*Arrabidaea magnifica*		Bignoniaceae
30.	*Arundinaria sp.*		Poaceae
31.	*Asparagus densiflorus* `Myers'		Liliaceae
32.	*Asparagus densiflorus* `Myrioclados'		Liliaceae
33.	*Asparagus densiflorus* `Sprengeri'		Liliaceae
34.	*Asparagus plumosus*	Asparagus Fern	Liliaceae
35.	*Begonia coccinea*	Angel Wing Begonia	Begoniaceae
36.	*Begonia rex*		Begoniaceae
37.	*Begonia semperflorens*		Begoniaceae
38.	*Begonia semperflorens* `white comet'	Wax Begonia	Begoniaceae
39.	*Begonia silver pink*		Begoniaceae
40.	*Begonia X`Cleopatra'*	Mapple-leaf Begonia	Begoniaceae
41.	*Bougainvillea buttiana*	Bougainvillea	Nyctaginaceae
42.	*Bougainvillea glabra*	Paper Flower	Nyctaginaceae
43.	*Bougainvillea peruviana*	Paper Flower	Nyctaginaceae
44.	*Bougainvillea spectabilis*	Paper Flower	Nyctaginaceae
45.	*Caesalpinia coriaria*	Divi Divi	Caesalpinaceae
46.	*Caladium hortulanum* `candidum'	Fancy-leaved Caladium	Araceae
47.	*Caladium hortulanum* *`Gen.W.B.Halderman'*	Fancy-leaved Caladium	Araceae
48.	*Caladium hortulanum* `Poecile Anglais'	Fancy-leaved Caladium	Araceae
49.	*Caladium humboldtii*	Minature Caladium	Araceae
50.	*Calathea ornata* `Roseo-lineata'		Marantaceae
51.	*Calathea zebrina*	Zebra Plant	Marantaceae
52.	*Calathia insignis*		Marantaceae
53.	*Calathia lindeniana*		Marantaceae

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Appendix 1 (cont'd). List of species used for landscaping the Bioresources Nature Trail

No.	Species	Common name	Family
54.	*Calliandra haematocephala*		Mimosaceae
55.	*Cananga odorata*	Ylang-Ylang	Annonaceae
56.	*Canna x generalis* `striped beauty'	Indian Shot	Cannaceae
57.	*Catharanthus roseus*	Madagascar Periwinkle	Apocynaceae
58.	*Celosia argentea* 'Pyramidalis'	Pince of Whales Feathers	Amaranthaceae
59.	*Cerbera tanghin*		Apocyanceae
60.	*Chlorophytum comosum* `vittatum'	Spider Plant	Liliaceae
61.	*Cholorophytum laxum*		Liliaceae
62.	*Clematis gouriana*	Bridal bouquet	Rananculaceae
63.	*Clitoria ternatea*	Butterfly pea,	Fabaceae
64.	*Cocos nucifera*	Coconut Palm	Palmaceae
65.	*Codiaeum variegatum* `Carnival`	Croton	Euphorbiaceae
66.	*Codiaeum variegatum* `Punctatum aureum`	South Sea laurel	Euphorbiaceae
67.	*Coleus blumei* `Autumn pink`	Painted nettle	Lamiaceae
68.	*Coleus blumei* `Brilliancy`	Painted nettle	Lamiaceae
69.	*Coleus blumei* `Fantacy`	Painted nettle	Lamiaceae
70.	*Coleus blumei* `Klondyke`	Painted nettle	Lamiaceae
71.	*Coleus blumei* `Red Wizard`	Painted nettle	Lamiaceae
72.	*Coleus blumei* `Sun set`	Painted nettle	Lamiaceae
73.	*Coleus blumei* `Surprise`	Painted nettle	Lamiaceae
74.	*Cordyline terminalis* `Rainbow'	Red Dracaena	Liliaceae
75.	*Cordyline terminalis* `Tricolor'	Red Dracaena	Liliaceae
76.	*Cordyline teminalis* `Alipore Beauty'	Red Dracaena	Liliaceae
77.	*Cordyline teminalis* `Baby Ti'	Ti tree	Liliaceae
78.	*Cordyline teminalis* `Calcutta'	Red Dracaena	Liliaceae
79.	*Cordyline teminalis* `Fire brand'	Red Dracaena	Liliaceae
80.	*Cordyline teminalis* `Garden party'	Red Dracaena	Liliaceae
81.	*Coreopsis lanceolata*	Lanc coreopsis	Asteraceae
82.	*Costus igneus*	Spiral ginger	Costaceae
83.	*Costus malortianus*	Spiral ginger	Costaceae
84.	*Costus speciosus*	Spiral ginger	Costaceae
85.	*Couropita guianensis*	Cannon ball tree	Lecythidaceae
86.	*Cuphea hyssopifolia*	False heather	Lythraceae
87.	*Curculigo recurvata*	Palm grass	Hypoxidaceae
88.	*Cyanotis somaliensis*	Pussy ears	Commelinaceae
89.	*Dendrocalamus gigantia*	Giant bamboo	Poaceae
90.	*Dianella tasmanica* `variegata`	Paroo lily	Liliaceae
91.	*Dieffenbachia* `Exotica`	Dumb cane	Araceae
92.	*Dieffenbachia amoena* `Tropic Snow`	Dumb cane	Araceae
93.	*Dieffenbachia maculata*	Spotted dumb cane	Araceae
94.	*Dracaena deremensis* `compacta'	Dwarf bouquet	Dracaenaceae
95.	*Dracaena deremensis* `Roehrs Gold'		Dracaenaceae
96.	*Dracaena deremensis* `Warneckia'		Dracaenaceae
97.	*Dracaena fragrans* `Victoriae'		Dracaenaceae
98.	*Dracaena godseffiana*	Gold-dust dracaena	Dracaenaceae
99.	*Dracaena margianta* `Tricolor'		Dracaenaceae
100.	*Dracaena sanderiana*		Dracaenaceae
101.	*Dracaena sanderiana* `Lutea'		Dracaenaceae
102.	*Duranta repens*	Duranta	Verbenaceae
103.	*Eucharis korsakovii*	Amazon lily	Amaryllidaceae
104.	*Excoecaria bicolour* `Variegata'		Euphorbiaeae
105.	*Ficus benjamina*	Java fig	Moraceae
106.	*Ficus benjamina* 'Nuda'		Moraceae

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Appendix 1 (cont'd). List of species used for landscaping the Bioresources Nature Trail

No.	Species	Common name	Family
107.	*Ficus benjamina* 'variegata'		Moraceae
108.	*Ficus diversifolia*		Moraceae
109.	*Ficus elastica*	Indian caoutchone tree	Moraceae
110.	*Ficus elastica* 'variegata'		Moraceae
111.	*Ficus nitida*	Indian Laurel	Moraceae
112.	*Filicium decipiens*	Fern Tree	Sapindaceae
113.	*Gazania sp.*		Asteraceae
114.	*Hamelia patens*		Rubiaceae
115.	*Heliconia humilis*	Lobster claws	Heliconiaceae
116.	*Heliconia psittacorum*		Heliconiaceae
117.	*Heliconia rostrata*	Hanging lobster claws	Heliconiaceae
118.	*Hemigraphis colorata*	Red Ivy	Acanthaceae
119.	*Hemigraphis repanda*		Acanthaceae
120.	*Heterocentron elegans*		Melastomataceae
121.	*Hibiscus rosa-sinensis* `Australian rose'	China rose	Malvaceae
122.	*Hibiscus rosa-sinensis* `Delight'	China rose	Malvaceae
123.	*Hibiscus rosa-sinensis* `Juno'	China rose	Malvaceae
124.	*Hibiscus rosa-sinensis* `Kalyani'	China rose	Malvaceae
125.	*Hibiscus rosa-sinensis* `Perey Lancester hybrid'	China rose	Malvaceae
126.	*Hibiscus rosa-sinensis* `Prolific'	China rose	Malvaceae
127.	*Hibiscus rosa-sinensis* `Snowflake'	China rose	Malvaceae
128.	*Hibiscus syriacus*	Rose of Sharon	Malvaceae
129.	*Hibiscus tiliaceus* `Tricolor`	Portia tree	Malvaceae
130.	*Hypoestus sanguinolenta*	Freckle face	Acanthaceae
131.	*Impatiens balsamina*	Rose balsam	Balsaminaceae
132.	*Impatiens walleriana* `Carpet'	Busy lizzie	Balsaminaceae
133.	*Ipomoea learii*	Bluedown flower	Convolvulaceae
134.	*Ixora chinensis* `Nana Pink'	Dwarf Chinese Ixora	Rubiaceae
135.	*Ixora chinensis* `Nana red'	Dwarf Chinese Ixora	Rubiaceae
136.	*Jaquemontia violacea*	Jaquemontia	Convolvulaceae
137.	*Lantana camara* `depressa'	Yellow sage	Verbenaceae
138.	*Lantana camara* `Nivea'	Yellow sage	Verbenaceae
139.	*Lantana camara* `Sanguinea'	Yellow sage	Verbenaceae
140.	*Lantana sellowiana* `Pink'	Trailing Lantana	Verbenaceae
141.	*Lantana sellowiana* `White'	Trailing Lantana	Verbenaceae
142.	*Malpighia coccigera*	Miniature holly	Malpighiaceae
143.	*Maranta arundinacea* 'Variegata'	Arrowroot	Marantaceae
144.	*Maranta leuconeura*	Rabbits tracks	Marantaceae
145.	*Melaleuca leucodendron*	Cajput, River Tea Tree	Myrtaceae
146.	*Mexican grass*		Poaceae
147.	*Michelia champaca*	Michelia	Magnoliaceae
148.	*Monstera deliciosa*	Mexican bread fruit, Swiss cheese plant	Araceae
149.	*Moringa oleifera*	Drumstick	Morinagaceae
150.	*Murraya exotica*	Cinese box, Orange jasmine	Rutaceae
151.	*Musa x paradisiaca*	Common banana	Musaceae
152.	*Mussaenda philippica* `Aurorae'	Mussaenda	Rubiaceae
153.	*Nerium oleander* `Album'	Oleander	Apocynaceae
154.	*Nerium oleander* `carnea'	Oleander	Apocynaceae
155.	*Nyctanthes arbor-tristis*	Coral jasmine	Oleaceae
156.	*Ocimum tenuiflorum*	Sacred basil	Lamiaceae
157.	*Ophiopogon jaburan* 'Variegata'	White lily-turf	Liliaceae

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Appendix 1 (cont'd). List of species used for landscaping the Bioresources Nature Trail

No.	Species	Common name	Family
158.	*Ophiopogon japonicus*	Lily-turf	Liliaceae
159.	*Pandanus baptisii*	Blue Screwpine	Pandanaceae
160.	*Pandanus sanderi*	Screwpine	Pandanceae
161.	*Peperomia obtusifolia* `Variegata'	Baby rubber plant	Piperaceae
162.	*Peperomia sandersii*	Watermelon peperomia	Piperaceae
163.	*Phalaris arundinaria* `Variegata'	Red canary grass	Poaceae
164.	*Philodendron* 'Burgundy'	Philodendron	Araceae
165.	*Philodendron* 'Ceylon gold'	Philodendron	Araceae
166.	*Philodendron elegans*	Philodendron	Araceae
167.	*Philodendron williamsii*	Philodendron	Araceae
168.	*Phyllanthus nivosus* `compacta'	Snow bush	Euphorbiaceae
169.	*Pleomele reflexa* 'Variegata'		Liliaceae
170.	*Plumeria obtusa*	Frangipani	Apocynaceae
171.	*Podranea ricasoliana*		Bignoniaceae
172.	*Polyscias fruticosa*		Araliaceae
173.	*Polyscias filicifolia*	Fern leaf Aralia	Araliaceae
174.	*Portulacca grandiflora*	Sun plant	Portulocaceae
175.	*Pseudaranthemum atropurpureum* 'Tricolor'		Acantahceae
176.	*Reinwarditia trigyna*		Linaceae
177.	*Rhoeo spathecea*	Moses-in-a-boat	Commelinaceae
178.	*Rhoeo spathecea* 'Compacta'		Commelinaceae
179.	*Rosa sp.*		Rosaceae
180.	*Santalum album*	Sandalwood	Santalaceae
181.	*Schefflera arboricola*	Schefflera	Araliaceae
182.	*Schefflera arboricola* 'Variegata'	Schefflera	Araliaceae
183.	*Scindapus aureus* 'marble queen'	Money plant	Araceae
184.	*Senecio confusus*	Mexican Flame vine	Asteraceae
185.	*Spathiphyllum wallisii*	Peace lily	Araceae
186.	*Stictocardia tilifolia*		Convolvulaceae
187.	*Syngonium macrophyllum*		Araceae
188.	*Syngonium podophyllum*	Goosefoot plant	Araceae
189.	*Syngonium podophyllum* 'atrovirens'		Araceae
190.	*Syngonium podophyllum* 'Emerald Gem'		Araceae
191.	*Syngonium wendlandii*		Araceae
192.	*Tabebuia argntea*	Golden bell	Bignoniaceae
193.	*Tabebuia pallida*	Golden bell	Bignoniaceae
194.	*Tabernaemontana coronaria* `Dwarf'	Cape jamine	Apocynaceae
195.	*Tabernaemontana coronaria* `Variegata'	Cape jamine	Apocynaceae
196.	*Tacca chantrieri*	Bat flower	Taccaceae
197.	*Tagetes erecta*	African marigold	Asteraceae
198.	*Tagetes patula*	French marigold	Asteraceae
199.	*Tagetes tenuifolia*	Signet marigold	Asteraceae
200.	*Tecoma gandichaudi*	Yellow bell	Bignoniaeae
201.	*Tecomaria capansis*	Cape honeysuckle	Bignoniaceae
202.	*Thuja orientalis*	Chinese Thuja	Cupressaceae
203.	*Thunbergia grandiflora* 'Alba'		Acanthaceae
204.	*Thunbergia laurifolia*	Clock vine	Acanthaceae
205.	*Tristellateia australis*		Malpighiaceae
206.	*Vetiveria zizanioides*	Khus-Khus	Poaceae
207.	*Wedelia trilobata*		Asteraceae
208.	*Xanthosma lindernii*	Indian Kale	Araceae
209.	*Zebrina pendula*	Wandering jew	Commelinaceae
210.	*Zinnia elegans*	Zinnia	Asteraceae