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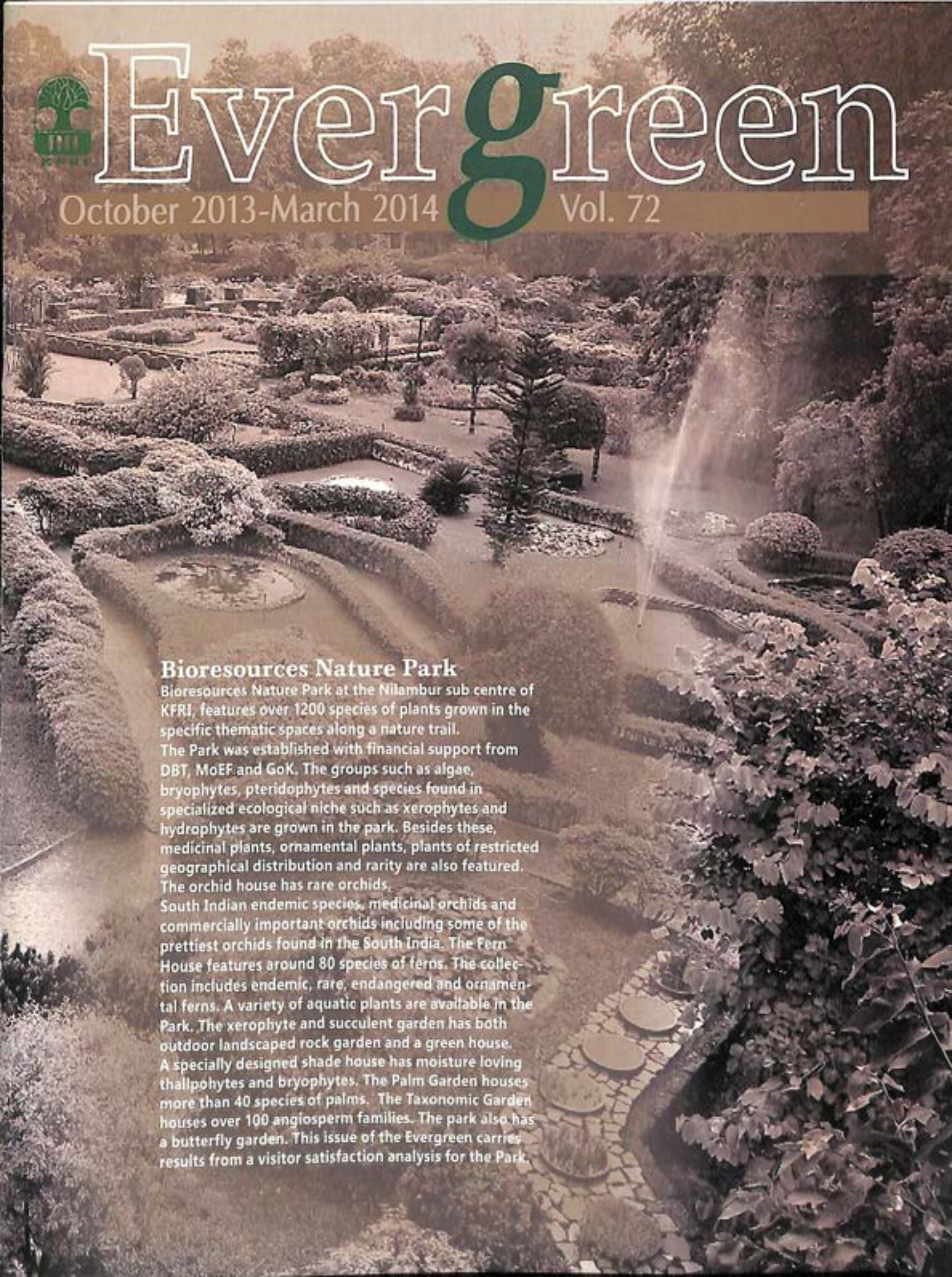

Bioresources Nature Park

Bioresources Nature Park at the Nilambur sub centre of KFRI, features over 1200 species of plants grown in the specific thematic spaces along a nature trail.

The Park was established with financial support from DBT, MoEF and GoK. The groups such as algae, bryophytes, pteridophytes and species found in specialized ecological niche such as xerophytes and hydrophytes are grown in the park. Besides these, medicinal plants, ornamental plants, plants of restricted geographical distribution and rarity are also featured. The orchid house has rare orchids.

South Indian endemic species, medicinal orchids and commercially important orchids including some of the prettiest orchids found in the South India. The Fern House features around 80 species of ferns. The collection includes endemic, rare, endangered and ornamental ferns. A variety of aquatic plants are available in the Park. The xerophyte and succulent garden has both outdoor landscaped rock garden and a green house. A specially designed shade house has moisture loving thallpohytes and bryophytes. The Palm Garden houses more than 40 species of palms. The Taxonomic Garden houses over 100 angiosperm families. The park also has a butterfly garden. This issue of the Evergreen carries results from a visitor satisfaction analysis for the Park.

Visitor-satisfaction analysis for the Bioresources Nature Park

UM Chandrashekara, P Ajith, E Mohandas and K Divya
Kerala Forest Research Institute Sub Centre, Nilambur

The Bioresources Nature Park (BNP) (Figure 1), established by the Kerala Forest Research Institute (KFRI) at its Sub Centre, Nilambur was dedicated to the public on 12 February 2007. Located adjacent to the Teak Museum, the BNP has now evolved as a conservation area for different categories of plants and has acquired status of a preferred nature education and ecotourism destination in Kerala. Within seven years, the annual turnover of visitors to the BNP and Teak Museum complex has increased from 12.8 lakhs to 22.3 lakhs indicating that the visitors are attracted to the BNP for its educational and entertainment functions. An on-site survey was organized to assess the visitors' experience and satisfaction and invited suggestions for improving facilities in the BNP. For this, a two-page questionnaire (in Malayalam and English) was prepared adopting the standard questionnaire design (He and Chen, 2012). The questionnaire included

Figure 1. Bioresources Nature Park

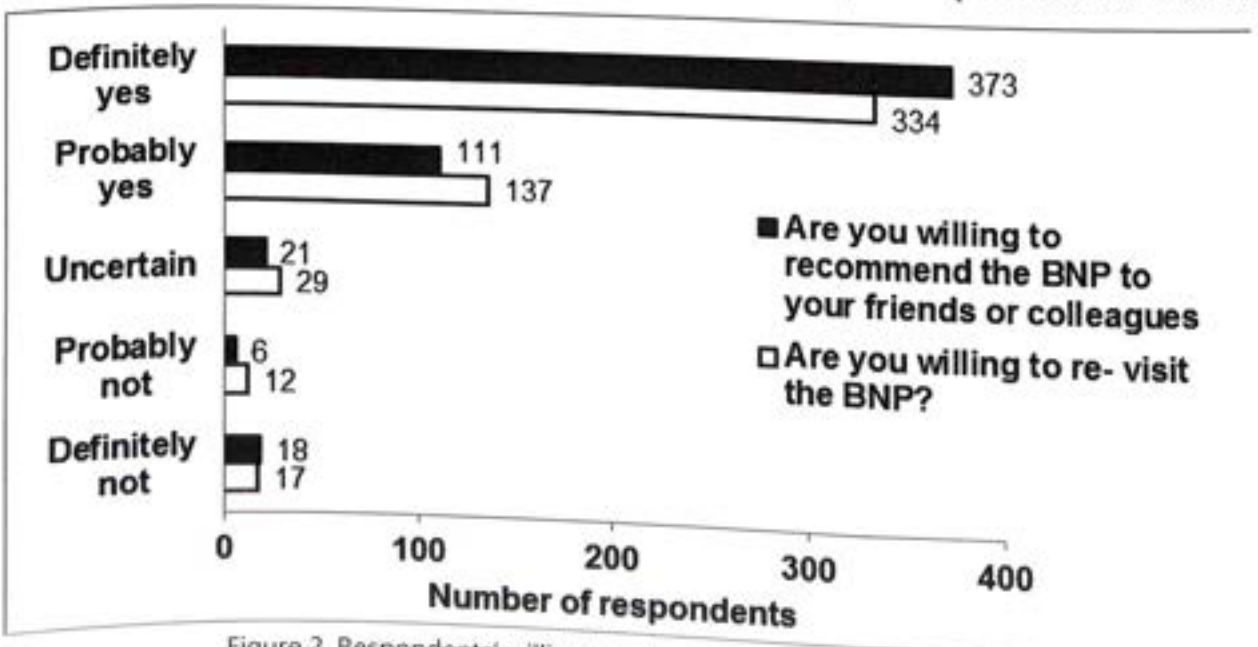

Figure 2. Respondents' willingness to re-visit and recommend BNP to friends and colleagues. (N=529 respondents)

questions related to the main objective of the visit, experience during the visit, degree of satisfaction due to the visit, and general opinion and suggestions of the interviewees.

On-site survey was carried out at the main gate of the BNP after ensuring the visit of the respondents in the BNP. We randomly selected visitors and invited them to complete the questionnaire. Those questionnaires with all of the questions answered, were considered to be qualified questionnaires. The survey was conducted from 14th October 2012 to 13th October 2013 excluding Saturdays, Sundays and festival days owing to the heavy turnout of visitors during these days.

Out of 529 qualified questionnaires, 299 were first time visitors, 94 were second-time visitors and 136 were third or more time visitors to the BNP. About 90 per cent of the respondents were willing to re-visit and recommend the BNP to their friends and colleagues (Figure 2) and this highlighted the fact that the BNP had become the most popular travel destination and public nature education site for local people.

However, a few respondents were neither willing to re-visit nor recommend the BNP to their friends and colleagues mainly due to the lack of facilities such as rest room, dining hall, enough sitting space, among others, in the BNP as in a picnic spot. Further, the purpose of the BNP is to serve as a platform for nature education and the restrictions imposed for preserving the scenic beauty may be disturbing some visitors. About 44 per cent of the total respondents spent 1 to 2 hours in the BNP while 30 per cent spent 2-3 hours (Table 1). Some of them opined that the assemblage of plants according to the thematic area has enabled them to better imbibe the concept of biodiversity.

The respondents who spent more than 3 hours were generally on study tours. According to them, BNP is playing a significant role in nature education through attractive live display of plants and effective way of presenting and propagating

Table 1. Number of respondents who completed the BNP visit at varying time intervals

	Time taken by the respondents				
	< 1 hour	1-2 hours	2-3 hours	3-5 hours	> 5 hours
Number of respondents	87 (15%)	235 (44%)	161 (30%)	37 (7%)	19 (4%)

Table 2. Number of respondents who visited different theme areas in the BNP

Type of visitors	Theme areas									
	0	1	2	3	4	5	6	7	8	9
1st time visitors	26	33	15	7	20	16	28	16	30	107
2nd time visitors	5	22	3	1	4	4	5	12	11	26
3 or more time visitors	1	24	6	7	8	6	4	12	13	51
Total	32	79	24	15	32	26	37	40	54	184

Table 3. Number of respondents who visited different theme areas in the BNP

Theme areas	Number of visitors
Orchid House	410
Butterfly Garden	380
Palm Garden	346
Hydrophyte Garden	333
Fern House	332
Cacti and Succulent House	327
Medicinal Plant Garden	318
Taxonomic Garden	302
Bryophyte House	273

n=529

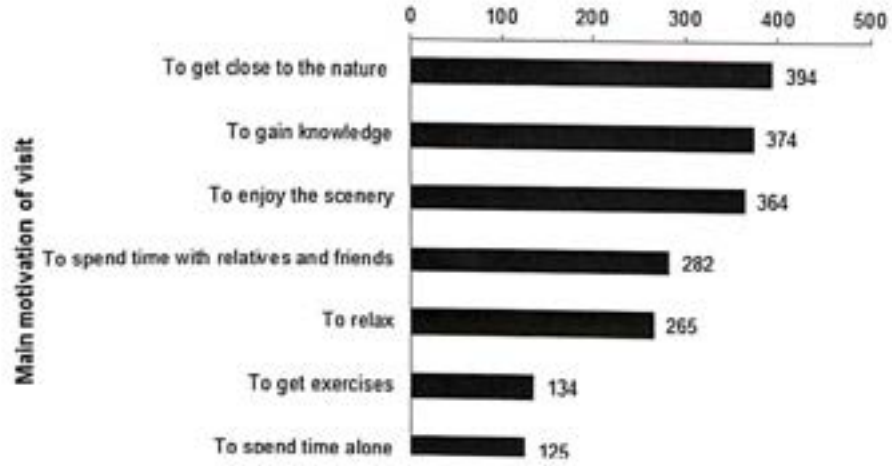

Figure 3. Motivation of visitors in visiting the BNP. (n=529 respondents.)

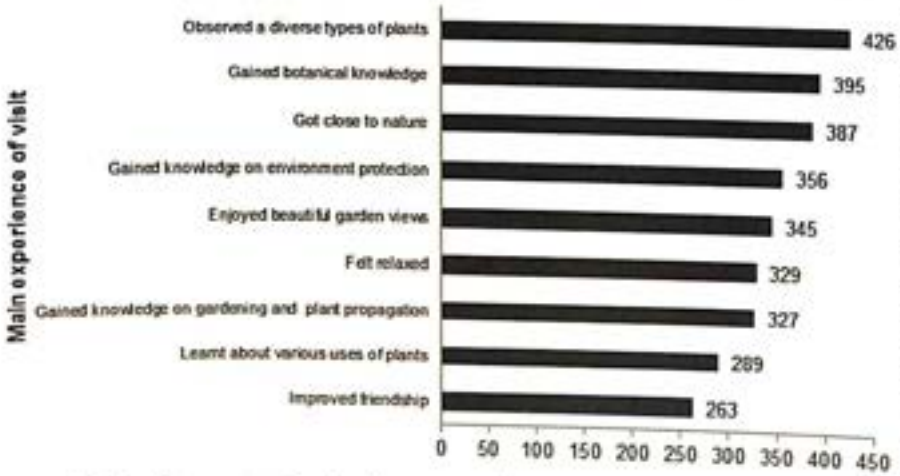

Figure 4. Experiences gained by the respondents by visiting the BNP. (n=529)

information. The educational function rendered by BNP was significantly higher than the entertainment function. The respondents who spent less than one hour have visited the BNP to enjoy the beauty of plants and landscape. However, for all the respondents, irrespective of the duration of their visit the educational experiences offered at the BNP was noteworthy.

Majority of the respondents have visited all nine theme areas of the BNP while 32 respondents did not visit any theme area (Table 2). The respondents who visited BNP either first time, second time or more times felt that they are strongly influenced by the BNP and thus tried to cover maximum number of theme areas besides enjoying the landscape and scenery. The orchid house is the most visited theme area followed by butterfly garden, palm garden, hydrophyte garden etc. (Table 3).

BNP visitors mostly came to gain access to nature or enjoy the scenery of the garden (Figure 3). However, after the visit they felt that they have significantly higher satisfaction than expected as they gained additional educational experiences such as exposure to plant diversity, botany, gardening and plant propagation (Figure 4). According to them, the theme areas and biodiversity knowledge dissemination in BNP were not conflicting with the BNP's entertainment functions. Educational and entertainment functions of BNP are closely knit for enhancing the visitors' satisfaction.

In conclusion, the study revealed a positive public feedback on the services offered by BNP which eventually could attract more potential visitors. The educational services provided by the BNP can be further augmented by including more pedagogically oriented themes from the perspective of biodiversity conservation as well as visual illustration of the biodiversity and beauty of plant diversity.

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Beehive-fence proves to be an effective deterrent against crop raiding elephants

Riju P Nair and EA Jayson
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Human Elephant Conflict (HEC) is a recurring problem wherever the home range of wild elephants (*Elephas maximus*) and humans overlap. With the growth of human population and shrinking natural habitats, the frequency of HEC is on an increase in the Western Ghats. The main reason for the intrusion of wild elephants to human habitation is habitat fragmentation and loss of elephant corridors due to unscrupulous developmental activities. Human-Elephant Conflict occurs due to destruction of crops and human casualties inducing apathy among the people who live on the periphery of the Reserve Forests and is deterrent to conservation efforts (Sukumar, 1991). In India, traditional, cultural and religious attitude towards wild animals make local people tolerant towards wildlife, despite the damage to crops and livestock. Besides these, the fear of wildlife laws keeps people away from the revengeful approach against wildlife. In this backdrop, it is necessary to evolve new cost-effective and low-cost mitigation measures to keep wildlife within their territory. Though digging trenches and erecting electrical fences are effective against the elephants, high cost and recurrent maintenance are needed for these measures. Efficacy of chilli-tobacco rope as a deterrent was significantly better in the low-rain fall region compared to medium and high-rainfall region. However, to improve the people's attitude and perception towards elephants, it is necessary to offer practical and low-cost solutions to minimise farmer-elephant conflicts. In this context, bee-hive fence assumes importance as a viable contribution to the toolbox of options for reducing the conflict.

Beehive fencing is an innovative deterrent against crop raiding elephants which is successfully tested in African countries. The African bee, *Apis mellifera scutellata* is selected for making the fence, which is more aggressive and venomous than the other bee species and is a subspecies of the Western honey bee. In this regard, the first challenge is to test the efficiency of the Asian bee species, *Apis cerana* which is less aggressive in the field but commonly used in apiculture.

Study area

The selected study site, Mayilumpara, is located in Karulai Forest Range under Nilambur South Division at N11016'19.6" & E076019'24.4" The dominant vegetation of the region is evergreen forest which is separated from reserve forest by the Cheranghathodu stream running along the boundaries of forest and private rubber estates. Vast extent of rubber plantations existing adjacent to the forest stretch help the elephants to move out of the forest without attracting attention of the local people. Under the cover of rubber plantation, elephants easily enter the crops, even if the crop is located far away from the forest. Crop preference of the local people is mostly plantain (*Musa paradisiaca*), coconut (*Cocos nucifera*), areca (*Areca catechu*), paddy (*Oryza sativa*), pineapple (*Ananas comosus*), among others.

Materials and methods

Previous observations in the experimental area (n=21) revealed that, elephants entered the crop field through 8 different paths and consumed the edible crops namely plantain, coconut, areca palms and pineapple. Among these, six paths were selected randomly and blocked with the

beehive fence. Three to five beehive boxes were hung on an iron wire, supported by wooden posts (having an interval of 10 m) across a single elephant track blocking it.

The remaining two paths were left unblocked. All the boxes were protected from monsoon rains using plastic sheets. Whenever the elephants touched the iron wire, installed across the path, the beehive boxes were disturbed and the guard bees attacked the elephants, and they were deterred. It is a good control measure, found effective during both day and night hours (King et al., 2009). The guard bees attack the elephants over their sensitive areas such as tip of the trunk, back of the ears and around the eyes (King, 2013). To evaluate the efficacy of this method, the frequency of encounter of the elephants passing through blocked or unblocked paths was recorded by collecting data three times in a month.

Figure 1: Beehive fence at Mylumpara

Result and discussion

A total of 9 encounters were made by elephants in the area, of which three occurrences were through the fenced area, twice by breaking the fence and on one instance they failed to cross the fence. In all the other encounters, the elephants tried to avoid the fence by choosing a different way of entry. Every encounter was made at night and this indicated that the guarding bees were active even at night in the presence of elephants. The buzzing sound of the bees itself kept the elephants away from the fence. With the previous experience of honey bee strikes from the forest, they avoided the fence. Ninety per cent of the encounters were made by a solitary male elephant, locally called as "Ottakomban", which was a habitual crop raider in the area. No elephant herds were recorded from the area as crop raiders or intruders to the human habitats.

After three months of installation, beehive fence acquired more acceptance among the farmers living in the forest fringe areas as it was practical and economically viable. Recently Kerala Forest Department also installed another set of beehive fence at Panichola under Karulai Forest range using 10 beehive boxes. As honey can be extracted from the bee-hives and revenue is accrued from the activity, this can be considered as

Table 1. Occurrence of elephant encounters in the beehive fenced area

No.	Date of encounter	Place of entry	Distance from RF (km)	Crops damaged	No. of elephants	Time of attack
1	29/03/2014	Non fenced	0.50	Pineapple	1	08.30 PM
2	05/04/2014	Fenced	0.60	Pineapple	1	10.00 PM
3	10/04/2014	Non fenced	2.00	Pineapple, Plantain	1	10.00 PM
4	17/04/2014	Non fenced	1.00	Jackfruit, Plantain	1	03.30 AM
5	21/04/2014	Non fenced	3.00	Jackfruit, Plantain	1	02.00 AM
6	19/05/2014	Fenced	5.00	Pineapple	1	09.00 PM
7	23/05/2014	Fenced	0.01	Nil	2	03.30 AM
8	21/06/2014	Non fenced	2.00	Pineapple	1	09.00 PM
9	28/7/2014	Non fenced	1.00	Nil	1	04.00 AM

Figure 2: Beehive with bees

an integrated approach for addressing the HEC. Approximately 15 kg of honey was extracted from eighteen beehives in the experimental site at a time.

Conclusion

Beehive fence, being simple and economically viable, can be effectively used as a good short term control measure against the crop raiding elephants in the forest fringes.

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Tree-ring Measuring Station

PK Thulasidas and MJ Daisy

(Wood Science and Technology Division, Kerala Forest Research Institute, Peechi, Thrissur 680653)

KFRI recently ventured into the study on the impact of climate change on tree growth dynamics of tropical tree species like teak in the Western Ghats region using tree-ring analysis. Under the SERB-DST sponsored project, KFRI has installed the most advanced model of tree-ring measuring station LINTAB 6 from RINNTECH, Germany in Wood Science and Technology Division. It is well employed in dendrochronology and dendroecological studies to elucidate past climate variations that occurred due to severe drought, prolonged wet season, El Nino, etc. The station is connected to a stereomicroscope under which a measuring table carrying the wood disc or increment core is placed to measure the ring width. Ring width is measured through interactive tree-ring measuring software TSAP Win to manage time series data for building the chronology.

Incidence of *Sahyadrassus malabaricus* (Moore) on *Dipterocarpus bourdillonii* seedlings

PA Jose, K Swarupanandan and RC Pandalai

(Department of Botany, Kerala Forest Research Institute, Peechi, Thrissur 680653)

Aimed at restoration of Rare, Endangered and Threatened (RET) species in the Western Ghats, a major recovery study of *Dipterocarpus bourdillonni* was carried out by the Institute as part of the project titled, 'Species recovery of *Dipterocarpus bourdillonii* and *Humboldtia bourdillonii*, two critically endangered, endemic trees of Western Ghats'.

Dipterocarpus bourdillonii Brandis belonging to the family Dipterocarpaceae is an evergreen tree of primary wet-evergreen forests growing to a height of 40 m and attaining a bole girth up to 1.5 m at breast height. The timber of the species was extracted for their softwood in the past. As per the distribution study carried out for the species, the total population size would not be greater than 400 mature trees and hence the species is 'critically endangered' as per IUCN criteria.

During post-evaluation on the restoration of the species *in situ*; incidence of *Sahyadrassus malabaricus* (Moore) (Lepidoptera: Hepialidae) in planted seedlings of *D. bourdillonii* was found for the first time and most of the seedlings were severely damaged by the pest incidence.

Stem borer infestation on *D. bourdillonii* seedlings

The insect, *Sahyadrassus malabaricus* is a moth which happens to be a stem borer and is one of the major threats in most plantation sites. Seedling mortality due to the pest reached up to 60 per cent. The larva of the insect bores into the one year old sapling stem and tunnels through the pith. The opening of the tunnel is covered by a thick mat of wood particles woven with silk, underneath which the larva feeds on the callus tissue that grows (Figs. 1 a-f).

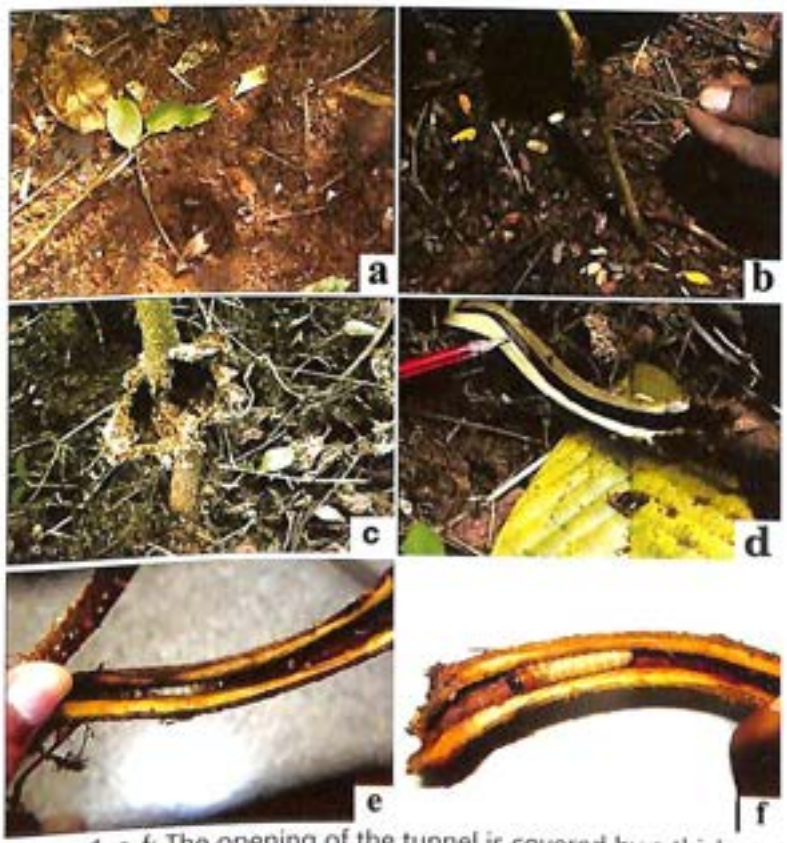

Figure 1. a-f: The opening of the tunnel is covered by a thick mat of wood particles woven with silk, underneath which the larva feeds on the callus tissue that grows

History and life cycle of *Sahyadrassus malabaricus* (Moore)

The early larval instars survive on weedy ground vegetation and eventually migrate and feed on tree saplings. The larval population gets established in August and is replenished by subsequent instars. Forty species of woody shrubs and trees, including many plantation species such as teak, eucalypts, *Gmelina*, *Anthocephalus* and *Albizia* are susceptible to the moth. *Trema orientalis* and *Clerodendrum viscosum* are two of the most favoured hosts. The insect confined to

Peninsular India is widely distributed in this region and seedlings/ saplings of *D. bourdillonii* are affected by the insect. The insect has an annual life cycle, with moths emerging between mid-March to mid-May.

Acknowledgement

Authors gratefully acknowledge Dr. George Mathew, Scientist Emeritus, KFRI for identification of the caterpillar moths.

KFRI Research Reports

KFRI Research Report No. 439

Species recovery plan for *Semecarpus kathalekanensis*: a critically endangered fresh-water swamp species of the Western Ghats.

Nair PV, Pandalai RC

Species recovery plan for *Semecarpus kathalekanensis*: a critically endangered fresh water swamp species of the Western Ghats was taken up as a subproject in the species recovery project. A related species *Semecarpus travancoricum* is found in Kerala. These two species are very similar and are physically indistinguishable from one another. Various silvicultural parameters such as vegetative propagation, germination, growth and survival were recorded. As part of the project, seedlings from Sirsi forests were planted in KFRI Peechi campus and field station at Kulathupuzha. The results of planting trials, growth and other details are described.

KFRI Research Report No. 440

Development of bamboo sector in Kerala: resource enhancement.

Seethalakshmi KK, Muralidharan EM, Sankar S, Pandalai RC, Raveendran VP

Government of India has launched integrated projects which are implemented through two missions viz. National Mission for Bamboo Applications (NMBA) under Ministry of Science and Technology and National Bamboo Mission (NBM) under Ministry of Agriculture and Cooperation for development of bamboo sector. KFRI distributed the planting materials to panchayaths, had undertaken the responsibilities for identification of potential planters and establishment of plantations. A technical seminar was organized on 'Integrated Development of Bamboo Sector in Kerala' during Kerala Bamboo Fest. About one kilometer stretch was planted with seven bamboo species and preliminary observations revealed that behind the salt tolerant species like *Casuarina*, bamboo can be planted. Technical seminars and interaction meetings increased the awareness about bamboo plantations, harvest and post-harvest techniques and value addition among public. The details of flowering, post-flowering behaviour and status of natural regeneration in the areas where flowering occurred has been documented for future reference.

KFRI Research Report No. 441

Transfer of technology of biological control of the teak defoliator pest to the Kerala Forest Department for field implementation and entrepreneurs for commercial production.

Sudheendrakumar VV, Sajeev TV, Varma RV, Bindu K Jose

The teak defoliator *Hyblaea puera* is recognized as the most important pest of teak *(Tectona grandis)*. The larvae of this insect feed on the foliage of teak of all ages. Repeated outbreak of this pest in teak plantations is a common occurrence with high negative impact on volume increment. KFRI has succeeded in developing a bacculovirus based biopesticide (*Hyblaea puera* Nucleopolyhedro virus-HpNPV) in managing this pest of economic importance. A wettable powder formulation of this bio-pesticide had been tested in the field and efficacy established. The HpNPV technology

developed by KFRI is highly target specific and ecofriendly.

KFRI Research Report No. 442

A compendium of project profiles and a digital archive of project records in KFRI.

Swarupanandan K, Hussain KH, Bhat KV, Ragi PG

VOK is a multi-user office management system specifically designed for KFRI. The VOK now contains three modules: (i) The Digital Archive (per se), (ii) the User Tools, and (iii) the External Links. Mod. A search engine (search box) enables quick search of records in each of the Arch-Sects and Arch-Subsects. Res. Management: Review Bodies (RC, IRG), Projects Lists, Project Records, Res. Management (per se), Academic Progs (MSc., PhD.), Training Progs, Extension Progs, and Future Progs. Primary Data: Image Bank, Map Bank, Primary Data (from projects), and Power Points. Utilities: Forms & Formats, Calendar, Staff profiles, and Other Utilities.

KFRI Research Report No. 443

Strengthening of floristic diversity in the KFRI sub centre campus through planting and weed management

Chandrashekara UM

A taxonomic survey was carried out to assess the diversity of angiosperm taxa in the campus of Kerala Forest Research Sub Centre at Nilambur. A total of 1643 taxa belonging to 152 families were recorded in which 1452 taxa represented species (sub species and natural varieties included) and the rest represented cultivars and hybrids. Orchidaceae, Euphorbiaceae and Acanthaceae were families having highest number of taxa, 131, 92 and 71 respectively. Increasing anthropogenic influences on the environment, especially urbanization, have caused negative changes in natural ecosystems in and around Nilambur. The campus is visited by students of several schools and colleges, staff of forest department and members of non-governmental organizations and they get familiarized with the rich bioresources in the campus. Strategies to enhance flowering and non-flowering plant populations and their diversity in the campus are also discussed in the report.

KFRI Research Report No. 444

Field performance of micro and macro propagated planting stock of five commercially important bamboo species.

Seethalakshmi KK, Nandakumar UN, Muralidharan EM, Unni KK, Jijeesh CM

Kerala Forest Research Institute was selected as a nodal agency to implement this programme in Southern India along with the Institute of Wood Science and Technology, Bangalore and Institute of Forest Genetics and Tree Breeding, Coimbatore as partners. The objective of the KFRI component was to evaluate the field performance of micro and macro propagated planting stock of five commercially important species, viz. *Bambusa bambos, Dendrocalamus strictus, Dendrocalamus asper, Dendrocalamus stocksii (Pseudoxytenanthera stocksii)* and *Ochlandra travancorica*. Since micro-propagated planting stock of *O. travancorica* was not available, *Bambusa balcooa* was included in the plantation trials. A trial plantation of 41.19 ha was established at Moolagangal, Attappadi, Palakkad District and 2 ha at Puthenkurizu, Ernakulam District in collaboration with private planters. Totally five species viz. *Bambusa balcooa, B. bambos, Dendrocalamus asper, D. strictus* and *D. stocksii* were planted. The experimental plots of 3 ha each were laid out for *B. balcooa* and *D. asper* with macro and micro propagated planting stock. Both the planting stocks were found to perform similarly.

KFRI Research Repor t No. 445

Major invasive alien weeds in India: Biology and control

Sankaran KV, Suresh TA, Sajeev TV

A detailed description of five important invasive alien species of India, *Chromolaena odorata, Lantana camara, Mikania micrantha, Parthenium hysterophorus* and *Mimosa diplotricha (Mimosa invisa)*

is provided. Its taxonomic descriptions, origin, growth, habitat, seed dispersal, ecology and distribution, utilization, environmental problems and methods of physical, chemical and biological control are discussed in this book. This book will be very useful to the farmers, forest officials and researchers.

KFRI Research Report No. 446

Handbook on invasive plants of Kerala

Sankaran KV, Suresh TA, Sajeev TV

This book, for the first time, brings out a concise list of invasive alien plant species recorded from the State of Kerala. Invasive alien species are those which spread outside their normal distribution range and become invasive in their new locations. At the new place, they escape the predator pressure, which kept their population in check in the native range, and thrive out competing and displacing native species. This book, however, does not list these alien species since left to themselves, they are seldom invasive and they do not spread unaided. Our objective was a qualitative appraisal of the invasive alien species scenario in the State. Each observation point was selected on the basis of visual observations on the presence of plants and their characteristic invasive behavior. All species thus listed were vetted against the checklist of the native flora of Kerala. Eighty two species remained, which were subjected to Invasive Species Risk Assessment based on internationally tested procedures.

KFRI Research Report No. 447

Needs' assessment and formulation of technical co-operation programme (TCP) project for forest invasive species (FIS) in South India, Sri Lanka, and Maldives.

Sankaran KV, Sajeev TV

The workshops aimed at a) listing the currently out breaking invasive species, b) identifying probable immediate invasive species threat to forests, c) identifying model sites, d) identifying training requirements, and e) listing of stakeholders in the respective countries. Twenty nine species of alien invasives were listed in both South India and Sri Lanka and 23 species were listed for Maldives. The Workshop on 'Alien Invasive Species Invasions into Forests of South India' was organized at Kerala Forest Research Institute, Peechi on 25th May 2010. The technical sessions were followed by the presentations of alien invasive status reports in the States of Kerala, Tamil Nadu and Karnataka. Dr. T.V. Ramachandra Prasad, Professor, University of Agricultural Sciences, Bangalore reviewed the status of forest invasive species in Karnataka, Dr. Chinnusamy, Professor, Tamil Nadu Agricultural University, Coimbatore reviewed the Tamil Nadu scenario and Dr. T.V. Sajeev, Scientist, Kerala Forest Research Institute presented the status of FIS in Kerala.

KFRI Research Report No. 448

Standardisation of plantation techniques of mahogany with particular reference to soil nutrition and shoot borer incidence.

Thomas TP, Mohanadas K, Rugmini P

In spite of excellent growth potential and adaptability to a wide range of conditions including degraded sites, the tree is susceptible to shoot borer attack by *Hypsipyla* species. Trials conducted in many countries to control the pest met with little success. The experiment was laid out in split plot design with spacing as the main plot factor and manuring as the sub plot factor. Two spacing levels of 2x2 m and 3x3 m were provided and the manuring treatments consisted of cow dung, compost, sterameal and NPK at 3 levels each along with control. Results conclusively proved the benefit of lateral shade provided through closer spacing in improving the growth as also in reducing shoot borer incidence. *S. mahogany* was found to be extremely slow growing and with greater susceptibility to the shoot borer when compared with *S. macrophylla*.

KFRI Research Report No. 449

A field study to evaluate the efficacy of lemon grass in controlling runoff and soil erosion.

Thomas TP, Sankar S, Unni KK

Cymbopogon albescens and *Vetiveria zizanioides* were planted in contour strips to control runoff and soil erosion. *V. zizanioides* was more effective during this period; it reduced the runoff loss to 13 per cent of the rainfall (286 mm) received. Runoff loss during the same period from control plots was 42 in June, 92 in July, 45 in August and 77 in September. *C. flexuosus* permitted 21 runoff loss while *C. albescens* plots lost 32 and *V. zizanioides* plots lost 12; the loss from control plots was to the tune of 77 per cent. Soil loss as suspended sediment from the runoff plots was also effectively reduced by *C. flexuosus*. Annual soil loss from the plots was 1.43, 3.83 and 1.01 tons/ ha from *C. flexuosus, C. albescens* and *V. zizanioides* plots compared to 5.37 tons/ ha from the control plots. Lemongrass, especially *C. flexuosus* could control runoff and soil loss very effectively; it produced enough shoots and roots to achieve this performance.

KFRI Research Report No. 450

Indexing contents of the back volume collections of KFRI Library.

Sarojam N, Hussain KH, George KF

A number of core journals in forestry and allied subjects are subscribed in KFRI Library since 1975. Back volumes of these journals are kept bound and a separate collection of these volumes is maintained in the library. An index to the contents of these volumes was very much essential to fetch the contents of these volumes for use. Hence a project was undertaken with the objective of developing a database of the contents of each journal and makes it available for searching by author, subject and title. Procedures that followed for developing a specialized information system for the collection are described in this report. The index to KFRI back volume collection is created and uploaded for online search.

KFRI Research Report No. 451

Establishment of a taxonomic garden in KFRI sub centre campus.

Chandrashekara UM

Live models that display the scientific classification of plants are referred to as taxonomic garden. These gardens are highly effective in providing opportunities for comparing similarities and differences within taxonomic groupings. The garden, covering about 2 ha land is located adjoining to the teak museum and bioresources nature park complex. For each family, a separate bed (family bed) was prepared and planted with one to five species. In front of each family bed a signboard depicting details such as characteristic features of the family, general floral formula, number of genera and species reported from Kerala, number of species belonging to different conservation status, and names of species planted in the family bed is provided. The purpose of the taxonomic garden is mainly educational. Strategies for using the garden to promote teaching, research and capacity building in the field of taxonomy and allied subjects are also discussed.

KFRI Research Report No. 452

Processing, storage and supply of seeds of teak and miscellaneous forest tree species through KFSC.

Pandalai RC

Teak (*Tectona grandis*) seeds were collected from different Teak Seed Production Areas (TSPA's) identified by the Kerala Forest Department (KFD) from all over the State and were transported to Kerala Forest Seed Centre (KFSC) for cleaning/ processing and quality testing, during the reporting period (2006-2010). The seed processing included mainly cleaning by winnowing, drying and grading. Viability tests included rapid viability test (cutting test) and conventional test (germination test), carried out to facilitate and ensure uniform germination percentage of teak seeds supplied by KFSC. The results confirmed that seven

days of alternate wetting and drying is the optimum duration for the pre-treatment of teak seeds for maximum seed germination. Seeds of about 70 species were collected, processed and viable seeds stored in different containers at appropriate storage conditions (ambient; cold storage at 16°C and 4°C at 45 per cent humidity conditions) based on the seed physiological nature of a particular species. Brochures in Malayalam giving information on seed processing were brought out.

KFRI Research Report No. 453

Management and monitoring of growth of coppice crop in the experimental plantations of *Eucalyptus tereticornis* (Kayampoovam and Punnala) and *E. grandis* (Surianelli and Vattavada).

Chandrasekhara Pillai PK, Sankaran KV, Pandalai RC

Experimental plantations of eucalyptus were established at four sites in Kerala during 1998 as a part of an India-Australia collaborative project aimed at enhancing productivity through site management practices. These included a plantation of *Eucalyptus tereticornis* established at Punnala in Kollam district and *E. grandis* at Surianelli in Idukki district. The treatments applied included addition of N fertilizer and weed management which resulted in enhanced productivity of both the species. The plantations were harvested in 2005 at the age of 6.5 years. The second rotation coppice crop was managed in the above plantations to analyze whether there was any residual effect of the treatments that were applied in the first rotation.

KFRI Research Report No. 454

Digitization of Indian forest records, forest bulletins and forest leaflets.

Sarojam N, Hussain KH, George KF

Documents of Indian Forest Records, Forest Bulletins, Forest Leaflets, etc. published by Forest Research Institute (FRI), Dehra Dun, available in the KFRI library are very old and brittle posing serious problems in preserving the printed copies. Due to poor circulation and documentation, many of these publications fail to come to the notice of practising foresters and researchers. So the work of digitization of these publications is undertaken and the procedures followed for digitization and bringing it into an integrated searchable database are described.

KFRI Research Report No. 455

Enrichment of microbial culture collection at KFRI

Florence EJM, Mallikarjuna Swamy GE, Mohanan C

Microbial culture collections are crucial resources providing microorganisms for research, references and industrial use. They act as repositories for microbial strains as part of patent deposits, confidential service to store key organisms for research, industry and society. The sources of microorganisms cited in scientific papers can also be confirmed and further studies came out making use of these collections. Microbial culture collections are considered as libraries, but instead of books they hold microorganisms. In the microbial culture collection of Kerala Forest Research institute there are about 1696 species of fungal isolates, belonging to 51 genera. Periodic sub-culturing of the specimens was done at 4-6 month intervals to maintain the virulence of the organisms. Most of the fungi in the collection were collected from different forest ecosystems of Kerala part of the Western Ghats.

KFRI Research Report No. 456

Livelihood improvement of marginal bamboo dependants: Artisans and farmers of selected clusters.

Seethalakshmi KK, Sankar S, Pandalai RC, Muralidharan EM, Damodharan TK, Raveendran VP

The objectives are (1) To identify clusters of marginal bamboo dependants and assess current status with regard to income and employment (2) To organize and conduct training programme on bamboo cultivation and management for farmers (3) To organize and conduct training programme on design and manufacture of premium bamboo

products to artisans (4) To identify master trainers and provide intensive training in processing, design and development of value-added products. (5) To identify species suitable for different value added products jointly with artisans and establish model plantations of selected species with farmers (6) Establish a coordination centre with facilities for purchase and storing of bamboo raw material, mechanized preliminary processing, preservative treatment and distribution of semi-processed material to artisans for manufacture of value added products and their marketing.

KFRI Research Report No. 457

Micropropagation of superior clones of teak of the Western Ghats of Kerala

Muralidharan EM

Rapid micropropagation of selected six clones derived from the plus trees of teak plantations of Kerala was carried out successfully. Shoot cultures were induced by culture of shoot tips of epicormic shoots that sprouted from branch cuttings maintained in the mist chamber. The best combination of hormones was found to be 1.5 mg/ l BAP and 1.5 mg/ l Kin for multiple shoot regeneration. Shoot cultures were maintained through subculture carried out at 4-6 week intervals. *Ex vitro* rooting was successful in microshoots treated with 4000 mg/l IBA and transferred to the hardening chamber. 95 per cent of the plantlets were hardened. Upto 500 plantlets each of the selected clones were produced through the above method. Shoot cultures did not perform well in liquid media even when Polyurethane (PU) foam supports were provided or when the cultures were agitated on shaker. Attempts to maintain teak shoot cultures for long periods without subculture did not give promising results. Cultures on minimal media could be sustained only for eight weeks whereas with a mineral oil overlay cultures could last upto 5 weeks. Only shoot cultures maintained in the dark at 4°C in the refrigerator could be maintained for up to 6 months and rejuvenated to give normal shoot cultures

KFRI Research Report No. 458

Carbon storage potential of different age teak plantations in Kerala

Thomas TP, Rugmini P, Balagopalan M

Carbon sequestration potential of teak trees was estimated by quantifying the above ground and below ground carbon contents of teak at various thinning regimes of 5, 10, 15, 20, 30, 40 and 50 years of age. It was seen that on an average the wood component contained maximum carbon (292.49 kg) per tree followed by branch (77.09 kg) root (76.44 kg) and bark (18.99 kg) at the age of 50 years. Soil component contained 121.65 ton carbon per hectare in the final felling plantation when the 0-60 cm depth was taken into account. Simple linear regressions of log DBH versus above ground biomass on a plantation scale showed that these relationships were strong yielding coefficients of determination (R_2) of 0.810 to even 0.971 in various thinning regimes. DBH versus carbon content also gave high R_2 values of 0.840 to even 0.981 in various thinning regimes which means that 84.0 to 98.1 per cent of the variation in total carbon content on plantation scale could be explained by DBH of trees. It was estimated that the carbon storage potential of teak plantations in Nilambur was around 179.61 tons per hectare considering a final felling regime of 50 years. Carbon stored in the soil upto 60 cm depth in the teak plantations of Nilambur, Kerala at this stage had been worked out to be 121.65 tons per hectare. Considering all the compartments together it can be seen that 301.26 tons per hectare of carbon could be stored by the teak plantations of Kerala.

KFRI Research Report No. 459

Effect of crop rotation with short duration leguminous tree crops on the nutrient status of soil in clear felled teak plantation sites

Thomas TP, Pandalai RC

Teak plantations in Kerala have suffered deterioration in site quality due to successive rotations since the land is sloping and the climate is humid

tropical. Rotation with short duration tree species might go a long way in mitigating some of the harm done to the soil and thus may prove beneficial in the long run. *Acacia auriculiformis* and *Acacia mangium* were planted along with teak in separate blocks with four replications to study the changes, if any, that these short rotation leguminous trees can imprint on the soil. It was seen that both the species of *Acacia* were able to improve soil aggregation and nitrogen availability though they were found to be instrumental in reducing the soil pH which is not good for the acidic soil of the study sites. Litter fall was maximum in *A. mangium* (6077 kg/ ha) which was followed by *A. auriculiformis* (5090 kg/ ha) and *Tectona grandis* (3101 kg/ ha). But litter decomposition was much faster in teak compared to the acacias. It took only a year for all the teak litter to decompose while only 93 per cent of *A. auriculiformis* and 83 per cent of *A. mangium* could decompose in a year's time. Root nodulation was present in both the *Acacia* species. Nitrogen content of soil in the *Acacia* plots was found to be more than that in the teak plots.

KFRI Research Report No. 461

Mapping Forest Resources of Kerala

P Vijayakumaran Nair

Forest boundaries were constructed from existing maps, topo sheets and forest department sources. Forest types and land use were overlaid on this. Plantations and settlements were overlaid on the maps. Details of flora and fauna were compiled from floras, research reports, census reports and sighting records. Mapinfo and Erdas packages were used for mapping and image analysis. Status of the forest at level of range has been examined. The vested forests have practically been amalgamated into the reserve forest system and management of integrated area under two working plans is complete. The forest boundary in most parts of the State has been demarked with cairns or walls and except in a few places, changes in boundary or area under forest is not expected. There has been hardly new conversion to plantations and no new submersion under hydro projects. Poster quality maps were generated at State, regional and divisional level. These are included in KFRI web site and can be searched and downloaded.One glaring lack of accurate vegetation maps for forests of Kerala is evident. With widespread agreement of not following Champion and Seth (1938) classification at subtype level, new mapping schemes at association level or REG/ NDVI parameters have to be developed. Effective fire protection is also changing the forest composition. Stoppage of selection felling and flowering of bamboo is also changing the vegetation. Satellite images have been available from 1974 onwards. Recorded details of tree composition/ IVI tables are the main source of information for periods prior to 1980. Initial images of 50 m resolution are hardly comparable with high resolution images of recent years. Multispectral images of 1980 onwards at 35, 28, 15, and 5.8 m permit supervised classification to identify vegetation. Latest sub meter images require another approach as identification can be carried out at tree level. Wide spread availability of composition data from geo-referenced locations in forests and sacred groves make spatial plotting of continuums. These can effectively supplement vegetation maps.

KFRI Research Report No. 462

Species recovery of *Dipterocarpus bourdillonii* and *Humboldtia bourdillonii*, two critically endangered endemic trees of the Western Ghats

K Swarupanandan, EP Indira, EM Muralidharan, RC Pandalai, PA Jose, M Sanjappa

In 2005, a national chapter on species recovery of rare, endangered and threatened plants of the country was initiated by the Department of Biotechnology (DBT), Government of India. Species recovery of two threatened tree species in Kerala was taken up jointly by the Kerala Forest Research Institute, Peechi and the Botanical

Survey of India, Calcutta. The species investigated were *Dipterocarpus bourdillonii* (Dipterocarpaceae) and *Humboldtia bourdillonii* (Fabaceae). Population ecological, reproductive biological, propagation and recovery aspects were attempted of these two species. Distribution of the species was studied through intense field explorations. Phytosociological studies were conducted in 0.1 ha size and tree regeneration enumerated in sub-samples. Reproductive phenology was studied by periodic field visits and observations on different phenophases. Reproductive biological studies included floral biology, study of pollinators, pollen tube growth, controlled self and cross pollinations, and the performance of the seeds originating from these experiments. Propagation of the species from seeds, through air layering, rooting of branch cuttings, and micro-propagation were attempted. The propagated ramets were augment planted in *in-situ* as well as *ex-situ* sites and their survival and growth performance evaluated at 6-month intervals for a period of two and a half years.

KFRI Research Report No. 464

Natural enemies of the weeds *Impatiens glandulifera* and *Hedychium spp. native* to the Himalayas

KV Sankaran

The Himalayan balsam (*Impatiens glandulifera*) and the wild ginger species complex (*Hedychium gardenarianum, H. coronarium* and *H. flavescens*) are native to the Himalayas and neighbouring areas. These plants were introduced to several countries around the world for ornamental purposes but escaped cultivation and became aggressive colonizers invading natural forests and other ecosystems. They pose a serious threat to native biodiversity and have serious economical and ecological implications. Mechanical and chemical control methods proved inadequate to control spread of these invasive species. Surveys for pests and pathogens associated with the above species in the introduced ranges did not succeed in locating any potential agents for use in classical bio-control. Hence, surveys were conducted in the native ranges of the plants to identify natural enemies with these potentials. The survey in the native ranges of the Himalayan balsam focusing in the Kulu Valley and surrounding areas (foot-hills and mid-Himalayas) showed that the plant shows none of the invasive traits as observed in its introduced range in the UK since the population is kept under check by the natural enemies. The plant is affected by an array of arthropods and pathogens which apparently exert significant pressure on its population. Of the pathogens and pests located, a couple of stem boring weevils including *Alcidodes fasciatus* and *Metialma* sp. and two pathogens, a *Septoria* species causing serious leaf-spot and a rust fungus viz., *Puccinia* sp. infecting the stem and leaves of the plant exhibited potential as biocontrol agents. Surveys in selected States have revealed the presence of a wide variety of arthropods including leaf rollers, fruit/ capsule feeders and stem borers. The bio-control potential of these pests is unclear at present. More intensive surveys covering the entire growing cycle of the plants across seasons may reveal the presence of serious pathogens. The diversity and hybridizing potential of *Hedychium* spp. call for molecular characterization of species to complement morphological determination. Further surveys and checking the host specificity of the pests located in the current survey are warranted for identifying suitable bio-control agents to control the spread of wild gingers in the invaded ranges.

Indian Forestry Abstracts (IFA)

is a new venture of KFRI to present a comprehensive bibliography of current forestry literature published in India, along with an abstract for each citation. The purpose of IFA is to ensure that Indian publications get their due attention from the national and international academic community. A large country like India, with its unique forest types and practices need a country specific listing of research publications to make them more inclusive of Indian forestry. Indian institutions and independent researchers working in India. IFA is an endeavour to reach Indian forestry research to a wider national and international audience. IFA can be accessed free at http://www.indianforestry.org

Academic activities

Research papers in Journals

1. Binu Thomas, Chandrashekara UM. and Rajendran A. 2013. Floristic diversity along an altitudinal gradient of Mannavan Shola forest in Southern Western Ghats of Kerala. Journal of Research in Biology 2: 101-109.

2. Chandrashekara UM. 2013. Assessment of level of human disturbance in village-adjacent natural forest plots in the Kerala part of Nilgiri Biosphere Reserve. International Journal of Ecology and Environmental Sciences 39 (4): 211-221.

3. Chandrashekara UM. 2013. Tree population dynamics in a low land evergreen forest in the Western Ghats of Kerala, India. International Journal of Ecology and Environmental Sciences 39 (4): 231-237.

4. Jose PA. and Pandurangan AG. 2013. Seed storage studies on *Gluta travancorica* Bedd. - An endemic and threatened tree of Southern Western Ghats. Indian Journal of Forestry 36(3): 349-352.

5. Jose PA. and Pandurangan AG. 2013. Vivipary in *Gluta travancorica* Bedd. of the Southern Western Ghats and its phytogeographic and evolutionary significance. Nelumbo - The Bulletin of the Botanical Survey of India 55: 89-93.

6. Jose PA. and Pandurangan AG. 2012. Reproductive biology of *Ochreinauclea missionis* (Wall. ex G. Don) Ridsd. An endemic and vulnerable tree from the Western Ghats, India. Ann. For. 20(2): 161-167.

7. Robi AJ, Jose PA. and Udayan PS. 2014. *Thottea sasidharaniana* sp.nov. (Aristolochiaceae) from peninsular India. Nordic Journal of Botany 32: 11-14.

8. Rugmini P, Sujatha MP, Pandalai RC. and Vijith KT. 2013. Effect of soil properties on the growth of *Acacia auriculiformis* plantations in Kerala, India. Indian Journal of Forestry 36 (2): 155-166.

9. Rugmini P, Pandalai RC, Sujatha MP. and Vijith KT. 2013. Growth model for *Acacia auriculiformis* in relation to soil conditions in Kerala. Ann. For. 21(1): 1-13.

10. Sandeep S. and Sujatha MP. 2013. Mineralogy of kaolin clays in different forest ecosystems in the Southern Western Ghats, India. Current Science 107 (5): 875-881.

11. Suma Arun Dev, Muralidharan EM, Sujanapal P. and Balasundaran M. 2013. Identification of market adulterants in East Indian sandalwood using DNA barcoding. Annals of Forest Science 71 (4): 517-522.

12. Sujatha MP, Renuka C, Kavitha C. and Linto EL. 2013. Influence of edaphic and environmental factors on the growth of rattan in Kerala, India. Journal of Bamboo and Rattan 12 (1-4): 33-41.

Papers in Books/ Proceedings/ Newsletters

- Jose PA. and Sumod M. 2013. Enrichment planting and *ex situ* conservation of *Drypetes malabarica* and *Hydnocarpus macrocarpa*- two endemic and endangered trees of southern Western Ghats. N. Krishnakumar (ed.), Proceedings of National Workshop on Tree Seed Science and Silviculture, Institute of Forest Genetics and Tree Breeding, Coimbatore. pp. 132-133.

- Jose PA., Sumod M. and Robi AJ. 2014. Conservation through restoration of *Hydnocarpus macrocarpa* (Bedd.) Warb.- an endemic and endangered tree of southern Western Ghats. VN. Rajasekharan

Pillai (ed.), Proceedings of the 26th Kerala Science Congress, Kerala State Council for Science, Technology and Environment, Thiruvananthapuram, Kerala. 28th- 31th January 2014, Kerala Veterinary and Animal Science University, Wayanad. pp. 2619-2622.

- Sani Lookose 2014. Traditional teakwood articles used in households of Kerala. Proceedings of the 26th Kerala Science Congress organised at Kerala Veterinary and Animal Sciences University, Kalpetta,Wayanad, 28th-31st January 2014, pp. 35.

- Sujatha MP, Smitha K John and Sandeep S. 2013. Soil carbon management in plantation forestry sector of Kerala. Proceedings of the work shop on "Managing soils for food security and climate change adaptation " held by the Department of Soil Survey and Soil Conservation in consonance with World Soil Day on 05th December 2013.

- Suma Arun Dev, Muralidharan EM, Sujanapal P. and Balasundaran M. 2013. DNA barcoding as a promising tool for the identification of timber adulterants. Proceedings of the National Seminar on Tree Biotechnology 2013, Emerging opportunities in forestry and tree science, (Eds. Dasguptha M, Warrier RR. and Yasodha R.) IFGTB, Coimbatore, Tamil Nadu, India, 23rd-24 thSeptember, 2013, pp. 299-301.

Participation in Seminars/ workshops etc.

- Scientist Interface meeting held during 5th-8th September, 2013 at Kovalam, Thiruvananthapuram.

- 17th Dr. B.V. Mehta Memorial Lecture-2013 conducted by the Thrissur Chapter of Indian Society of Soil Science at College of Horticulture, Vellanikkara on 14th August, 2013 (Sujatha, M.P. and Sandeep,S.)

- 26th Kerala Science Congress held in Kerala Veterinary and Animal Sciences University, Kalpetta, Wayanad

Paper presented:

Jose PA. Conservation through restoration of *Hydnocarpus macrocarpa* (Bedd.) Warb.- an endemic and endangered tree of southern Western Ghats

- 10th National Symposium on Soil Biology and Ecology – Soil Biota and Social Insects for Sustainable Agriculture organized by University of Agricultural Sciences, GKVK, Bangalore during 19th-21st December, 2013.

Paper presented:

Manjunatha, H. P., Chandrashekhara, U. M., Deepak R Chandra and Mallikarjunaswamy, G. E. Species diversity of vesicular-arbuscular mycorrhizal (VAM) fungi in sacred groves of North Kerala, India

- Conference on Sustainable Resource Management for Climate Change Mitigation and Social Security held at Chandigarh during 13th-15th March, 2014.

Paper presented:

Chandrasekhara, U.M. Adaptation and mitigation measures against climate change in the forestry sector of Kerala State.

- National Workshop on 'Tree Seed Science and Silviculture with Special Emphasis on Tree Cultivation Outside the Forest Areas' held on 28th and 29th November 2013 at Institute of Forest Genetics and Tree Breeding, Coimbatore.

Paper presented:

Jose PA. Enrichment planting and *ex situ* conservation of *Drypetes malabarica* and *Hydnocarpus macrocarpa*- Two endemic and endangered trees of Southern western Ghats

Seminars organized

- National Seminar on "Forestry and Agriculture" organized jointly with Gregor Mendel Foundation held at. Kerala Forest Research Institute during 7th-8th November 2013.

- Workshop on Teak Cultivation and Management was organised on 9th November,

2013, for 41 Teacher trainees of KMCT Teacher Training Institute, Calicut.

- Orientation Workshop on Teak Cultivation and Management on 5th November, 2013, for 43 students of Government Higher Secondary School, Karakkunnu.
- Teak study training programme during 10th - 25th January, 2014 for Teacher trainees and VHSE Agriculture students. The programme consisted of Lecture sessions in the Museum and field visits to Teak nursery and plantations.
- Wildlife Week activities for students during the Wildlife Week (1st- 8th October), 2013 through prior registration in Teak Museum, KFRI Sub Centre, Nilambur.

The Asia-Pacific Forest Invasive Species Network (APFISN), KFRI

(TV Sajeev, APFISN Coordinator)

Meetings Attended

- 25th Silver Anniversary Session of the Asia-Pacific Forestry Commission, Rotorua, New Zealand 5th-8th November 2013. Presented the activities of the Asia-Pacific Forest Invasive Species Network.
- 11th meeting of the International Forestry Quarantine Research Group, 28th November - 1st November, 2013, Qingdao, China
- International Congress on Biological Invasions (ICBI) 23rd-27th October, 2013, Qingdao, China
- APFISN Workshop on 'Tools for Ecological and Economic Impact Assessment of Invasive Alien Species in Forest Ecosystems' 4th-5th November, 2013, Energy Resource Centre, Rotorua, New Zealand.

Ph. D. awarded and Academic Attachment Programmes completed (April 2013- March 2014)

Ph.D. awarded		Title/Topic	University	Year	Supervisor
1.	Bindhu T.N. 	Dynamics of Baculovirus epizootics in teak defoliator (*Hyblea puera*) populations	FRI-DU	March 2014	Dr. VV. Sudheendrakumar
2.	Smitha K. John 	Impact of organic matter management strategies on sequestration of soil carbon and productivity of teak plantations on ultisols in Kerala	FRI-DU	March 2014	Dr. MP. Sujatha

Academic attachment programmes

Sl. No.	Name of the student	Year	Supervising guide	Name of College	Subject
1	Manisha Mohan	Jan- March 2014	Dr. E.M. Muralidharan	Bishop Herber College, Trichy	Biotechnology
2	Ramziya Mohd. Haneefa	March – June 2014	Dr. T.B. Suma	St. Josephs College, Irinjalakuda	Molecular Biology
3	Athira D	March – June 2014	Dr. T.B. Suma	St. Josephs College, Irinjalakuda	Molecular Biology
4	Lulu P.K	April – June 2-14	Dr. Mallikarjuna Swamy	SNGIST Arts & Science College, Manakkapady, Karunallur,	Microbiology
5	Nimmy Antony	April – June 2-14	Dr. Mallikarjuna Swamy	SNGIST Arts & Science College, Manakkapady, Karunallur,	Microbiology
7	Neena R	Feb – June 2014	Dr. T.V. Sajeev	Sree Sankara Collelge, Kalady	Environmental Science
8	Rajitha Nath O.	Feb – June 2014	Dr. M.P. Sujatha	Sree Sankara College, Kalady	Soil Science
9	Greeshma Gopi	Feb – June 2014	Dr. S. Sandeep	Sree Sankara College, Kalady	Soil Science
10	Preethi P	Feb – June 2014	Dr. S. Sandeep	Sree Sankara College, Kalady	Soil Science

TEAKNET

(PK Thulasidas, TEAKNET Coordinator)

Meeting with Chinese Teak Researchers

With the support of FAO, KFRI established the Secretariat Office; procured the communication and data processing equipments for the networking. Designing of website (www.teaknet.org) accomplished. The publication of the quarterly electronic newsletter (TEAKNET-Bulletin) and website maintenance and updating data is done by the Secretariat. An information centre for teak was also made operational under TEAKNET through which several publications related to teak research were gathered and stored for use by the needy.

Activities of TEAKNET

- Released quarterly Newsletter "Teaknet Bulletin"
- Updation of Teaknet website
- Enrolment of new members
- A directory of teak growers, traders and researchers was developed.
- Several technical queries from people answered
- Interactive Meeting with the Chinese Teak Researchers; Prof. Liang Kunnan, Prof. Zhou Zaizhi, Dr. Ma Huaming and Dr. Huang Guihua of Research Institute of Tropical Forestry, Chinese Academy of Forestry during 24th February - 2nd March 2014.

KFRI Palmetum

KFRI Palmetum was established in the year 2000 in Peechi Campus and has a collection of 135 species of palms from 52 genera. Out of these, 75 are indigenous species and 60 are exotic with 8 which are Critically Endangered, 9 Endangered, 8 Vulnerable and 23 Near Threatened categories as per IUCN standards. The exotic species include those which are commonly found in Indian parks, gardens and along avenues. The rare species in the KFRI Palmetum are *Bentinckia condapanna, Bentinckia nicobarica, Rhopaloblaste augusta, Calamus nagbettai, C.brandisii, C. vattayila, Wallichia disticha, W.nana, Korthalsia laciniosa, Korthalsia rogersii, Licuala spinosa* and salt tolerant species such as *Phoenix paludosa* and *Nypa fruticans* are also maintained in the Palmetum.

More details at the webpage: http://www.kfri.res.in/cane_and_palmetum.asp

KFRI-PRICED PUBLICATIONS ON PLANTATION MANAGEMENT

Plantation Management			
1.	Litter Dynamics, Microbial Associations and Soil Studies in Acacia auriculiformis Plantations in Kerala	75.00	10.00
2.	Plantation technology: Colophyllum polyanthum (Kattu punna) (IB.18)	50.00	10.00
3.	Plantation technology: Dysoxylum malabaricum (Vella akil) (IB.19)	50.00	10.00
4.	Plantation technology: Garcinia gummi-gutta (Kodampuli) (IB.20)	50.00	10.00
5.	Plantation technology: Gmelina arborea (Kumbil) (IB.21)	50.00	10.00
6.	Plantation technology: Grewia tiliaefolia (Chadachi) (IB.22)	50.00	10.00
7.	Plantation technology: Haldina cordifolia (Manjakadambu) (IB.23)	50.00	10.00
8.	Plantation technology: Lagerstroemia microcarpa (Venthekku) (IB.24)	50.00	10.00
9.	Plantation technology: Melia dubia (Malaveppu) (IB.25)	50.00	10.00
10.	Plantation technology: Vateria-indica (Vellapayin) (IB.26)	50.00	10.00
11.	Ramacham (Malayalam)	10.00	10.00
12.	Root Trainer Technology for Mass Production of Clonal Planting Stock	250.00	25.00
Teak			
1.	Bibliography on Teak. KFRI CD 2	500.00	50.00
2.	Processing and marketing of teakwood products of planted forests: Proceedings	700.00	50.00
3.	Production and marketing of teakwood: Future scenarios. KFRI CD 10	200.00	20.00
4.	Teak (Information Bulletin) (Malayalam)	20.00	
5.	Teak Bibliography (Print)	700.00	70.00
6.	Teak Planner . KFRI CD 7	1000.00	80.00
7.	The Teak Defoliator (CD-ROM)	250.00	25.00

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Snapshots from KFRI Palmetum. see more details in the box in page 22 or visit http://www.kfri.res.in/cane_and_palmetum.asp

Bamboo Technical Support Group (BTSG-KFRI)

(EM Muralidharan, Coordinator)

The BTSG hosted by KFRI since 2006-07 functions under the Bamboo Cell of the National Bamboo Mission of the Ministry of Agriculture and Cooperation, Government of India and offers technical support to the State Bamboo Missions in the southern States. The Annual Action Plan for the year 2013-14 was in force and the main activities involved training imparted to the field functionaries of the State Missions of Maharashtra, Karnataka and Kerala, conducting exposure visits for bamboo farmers, undertaking propagation of the important bamboo species of economic value through vegetative means and tissue culture. Bamboo plants were supplied to farmers during the reporting period from the nurseries in Peechi and FRC, Velupadam. The BTSG contributed to presenting the importance of bamboo at the KFRI stalls in various exhibitions and also through providing advice on appropriate bamboo species and their cultivation in response to queries from the public. The setting up of the Common Facility Centre at the FRC Velupadam was initiated with a workshed and procurement of primary processing machines.

Activities of Training & Extension Division

Training programmes undertaken (20)

Utharakhand Forestry Training Academy –(1), NBM– (5), KSCSTE – (2), ICFRE – (1), KFD – (3), K-bip – (5), Kvasu – (1), Dr. Balasaheb Sawant Konkan Krishividyapeeth College, Dapoli–(1) and one week orientation programme to two IFS officers of Kerala cadre.

KFRI offers specialized training courses in tropical forestry. It will also be possible to provide tailor made training programmes depending upon specific needs of the stake holders. KFRI is an approved training centre of Ministry of Environment, Government of India, for training the officers of Indian Forest Service.

Exhibitions

1. Golden Jubilee Celebration 2013 of Govt. Arts & Science College, Kozhikode.
2. Bamboo Fest, 2013 'Ernakulathappan Ground', Cochin.
3. Oushada Keralam 2013 at Thekkinkadumaidanam, Thrissur.
4. 36th Thrissur Flower Show 2014 at Sree Vadakkumnathakshetra maidanam, Thrissur.
5. Mallappally Fest 13-14, at CMS Higher Secondary School Ground, Mallappally.
6. 26th Kerala Science Congress at Kalpetta, Wayanad (KFRI-stall won Second Prize).
7. 101st National Science Congress, at University of Jammu, Jammu and Kashmir.
8. Exhibition at M.E.S. College, Azmabi, Kodungallur.

Visits

2699 Students (18 Schools, 30 Colleges), NGO's (5 groups), College students from other States (11 colleges from Tamil Nadu, Karnataka, Gujarath, Orissa, Delhi, Madhya Pradesh etc.), Forest officer trainees from Arippa and Walayar visited KFRI.

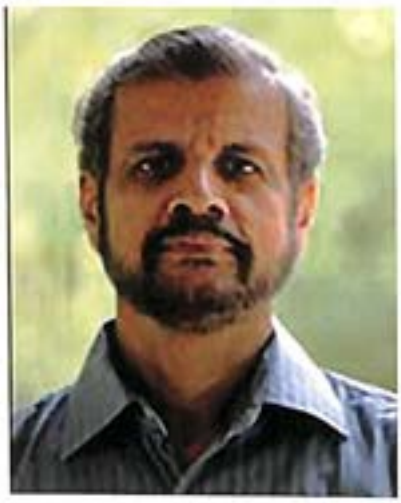
Retirements

Dr. V.V. Sudheendrakumar

Dr. V.V. Sudheendrakumar Scientist F & Programme Coordinator, Forest Health Division superannuated on 30th November, 2013 after 34 years service. During the period 2011-2013 he also held the charge of Registrar, KFRI. In KFRI, his broad theme of interest was on biological control of forest pests. His career in KFRI started with research on teak defoliator and its management. The discovery of a nucleopolyhedrovirus as a natural enemy of the teak defoliator was a breakthrough in the teak defoliator management research. In the subsequent years, he played a key role in developing and implementing several projects on utilisation of the NPV for teak defoliator management with funding from the State, Department of Biotechnology, Govt. of India and Overseas Development Agency (ODA. UK) etc. Based on the above research an Indian patent was obtained for the process of production of the biopesticide using the nucleopolyhedrovirus. During this period he also underwent advanced training on insect virology in the Natural Resources Institute and Forest Commission Research Division, UK.

Apart from his research career he played a key role as research guide of Forest Research Institute University, Dehradun and guided four students for their Ph.D Degree. Dr. Sudheendrakumar is a life-Member of the Society for Biocontrol Advancement. As part of his association with international research bodies, he served two terms as Deputy Chairman of the IUFRO Working Group on "Protection of Forest in the Tropics". During his career he had visited counties like Indonesia, Thailand, Finland, UK etc. He has to his credit several research papers and research reports.

Dr. KK. Ramachandran



Dr. K.K. Ramachandran, Scientist F and Programme Coordinator of Forest Ecology & Biodiversity Convervation Division of Kerala Forest Research Institute, Peechi superannuated on 30th November 2013 after over 35 years of service. He joined KFRI on 17th August, 1978. He was awarded Ph.D for his thesis on the Ecology and Behaviour of Malabar Giant Squirrel, *Ratufa indica maxima* (Schreber). from the University of Kerala. His research interests were vertebrate ecology of the arboreal mammals such as primates and giant squirrels. He has successfully completed ecological studies on the wildlife of Periyar Tiger Reserve, Parambikulam, Chinnar Wild Life Sanctuaries, Silent Valley National Park and Shendurney Wildlife Sanctuary. He has also made specific studies on Lion tailed macaque, Nilgiri langur and Grizzled giant squirrel. He was associate investigator of several interdisciplinary research projects carried out in KFRI such as the Biodiversity studies of the New Amarambalam Reserved Forest, mapping of the biodiversity of the Myristica swamps, Ecosystem structure and dynamism, biodiversity and human dimensions and their linkages of Eringole Sacred Grove and Visitor management studies in Eravikulam National Park, Parambikulam Wildlife Sanctuary and Neyyar Wildlife Sanctuary, etc. He has taken leadership in analysis of the census data on the population estimation of wild elephants in Kerala State during 2005, 2007, 2009 and 2010 and prepared the reports.

He had undergone various national training programmes especially on techniques in wildlife

research and management and animal census techniques, remote sensing applications using visual interpretation and digital analysis, small population biology and the tools of recovery with lion tailed macaque etc. He has also participated in the special training program on landscape ecology and joint forest management as part of the India-Australia Training and Capacity Building Project (Sponsored by AusAID) at the University of Melbourne, School of Forestry, Creswick, Department of Nature Resources & Environment Centre for Tree Technology.

During his research career he has published over 50 publications which include 15 research reports, journal papers, papers in proceedings and extension reports. He has guided three students for their Ph.D programme.

Dr. M. Balagopalan

Dr. M. Balagopalan, joined the Division of Soil Science in 1978. He was Scientist-in-Charge during 1998-2009 and Managing Director, Coirfed, Alappuzha on deputation from 2009 to 2011. He also held positions in KFRI as the Programme Co-ordinator, Instrumentation Division from 2004-2009. He was Head, Soil Science Department from 2011-2012 and Research Co-ordinator from 2012 till his superannuation in November 2013.

Research programmes completed by Dr. M. Balagopalan include those sponsored by Ecoforest, World Bank, Govt. of India, Govt. of Kerala and the other organizations. The study carried out by him during 1980s with respect to taungya cultivation was an eye opener on the negative impact of taungya system of cultivation on forest soil. Taungya was later abolished as a tool for establishing forest plantations. A notable action research programme by Dr. Balagopalan was establishment of bioshield along the coastal areas as part of Tsunami rehabilitation programme.

He is a Fellow, Academy of Plant Sciences and International Congress on Chemistry and Environment. He is also a recipient of International Plant Scientist's Award, instituted by Academy of Plant Sciences. He has guided students for M.Sc., M. Phil. and Ph. D. programmes of Cochin, Calicut and FRI Deemed Universities and is a referee for many scientific journals. He has made visits to many countries and participated in seminars abroad.

Dr. M. Balagopalan authored more than 100 scientific papers, 40 research reports and several information bulletins. He served as consultant to various International and National organizations and served as Expert member in various Committees of Government of Kerala. He has organized several national and International seminars and workshops.

Hussain K.H.

Shri Hussain KH joined the Institute on 28th December, 1981 as library assistant and retired from service on 31st October 2013 as Scientist C. His expertise in programming and designing custom made search and retrieval systems had helped KFRI library to make big strides in digitization, pitching KFRI library well ahead of most specialized libraries in India. He has collaborated with other scientists in KFRI to make KFRI herbarium available online.

Apart from contributing to the digitization and design of search and retrieval systems at KFRI, Hussain has provided directions for several notable projects involving design of similar search systems and digitization in Kerala, Calicut and Mahatma Gandhi Universities, and libraries such as State Central Library, State Legislature Library etc. He continues to campaign and contribute to recover and reconstruct original complete set of Malayalam

type faces in Malayalam computing by design and creation of new open source Unicode Malayalam font sets and by fine tuning design of search and retrieval systems in Unicode Malayalam.

Sunny P.P.

Shri Sunny PP joined the Institute on 23rd April 1979 as skilled maintenance assistant and retired from service on 31st Dec. 2013 as Technical Officer. During his service he played an active role in various activities in the electrical engineering section of the institute.

Thanka E.V.

Smt. Thanka EV joined the institute on 3rd November, 1986 as part time sweeper and retired from service on 28th February, 2014 as helper.

Obituary

Sri. KK Nair

Sri. KK Nair, who had served Kerala Forest Department as Chief Conservator of Forests for about 10 years, expired on 12th January 2014. He was born on 14th July 1922 at Ottappalam, Palakkad district, Kerala.

Having graduated in Botany from Madras Christian College, the exposure to the lush green forest areas with his father Rao Bahadur Sankunni Menon, a famous forest engineer in the erstwhile Madras Presidency made him a passionate nature lover. He started his career as Forest Ranger and his aptitude for forestry took him to Common Wealth Forestry Institute, Oxford where he did his post graduation in land use and was awarded Schlich Memorial Prize for his outstanding performance. Forestry was his soul and forestry education his religion. He was closely associated with KFRI as a member in the Governing Body and Executive Committee during 1979- 1988 and played active role in shaping today's KFRI. He had also held the charge of KFRI Director for a short period during 1975-1976. His wife predeceased him. He is survived by a son Gopal and a daughter Lakshmi and grand children. May his noble soul rest in peace.

Central Instrumentation Unit

Central Instrumentation Unit (CIU) at KFRI was established in 2006. CIU caters to the needs of researchers within and outside the institute. The Unit is equipped with High Performance Liquid Chromatography, Gas Chromatography, GC-mass spectrometer, CHNS elemental analyzer, Autoanalyzer, Real time PCR machine, Spectrophotometer and Soil CO_2 exchange system etc. besides the facilities such as sample preparation lab and other minor instruments like, muffle furnace, precision water bath, analytical balance, rotary shaker and ultrapure water system. Contact details and details of services charges are available on the webpage: http://www.kfri.res.in/instrumentation_facility.asp

Dr. KM. Bhat Memorial Award

Dr. Smitha K John receiving the Award from Dr. R.V. Varma

The 5th Dr. K. M. Bhat Memorial award carrying a Gold Medal, Certificate of Merit and cash prize of Rs. 5,000/- was awarded to Ms. Smitha K. John, Agricultural Officer, Dept. of Agriculture, Govt. of Kerala. Ms. Smitha K. John was selected from among four applications received. Her doctoral work was on "Impact of organic carbon matter management strategy on sequestration of soil carbon and productivity of teak plantations on utisols in Kerala". Based on the quality of her doctoral work as evidenced by her thesis and publications, social relevance, she was adjudged the best and considered worthy of the award. Ms. Smitha joined KFRI as Research Fellow in Soil Science discipline and worked with Dr. M.P. Sujatha for her Ph.D during 2007-2010. Her outstanding contribution has been her principled and courageous stand to uphold social, environmental and legal concerns while serving as an Agricultural Officer under the Kerala Government in the matter of conservation of paddy and wetlands. We hope that she will eventually succeed in reviving healthy organic agriculture and help Kerala be self-sufficient in non-toxic wholesome food.

KFRI Arboretum

KFRI Arboretum is located on the main campus, at Peechi and it was established in 2003 in an area of about 5 hectares. The present holding is 3200 accessions belonging to 178 species from 50 families and 128 genera, with more than 50 taxa endemic to Southern Peninsular India. Among the 178 taxa in the arboretum are two gymnosperms and 176 angiosperms. Among the angiosperms, 162 taxa are dicotyledons from 118 genera and 47 families and 14 species of monocotyledons from 3 genera and 2 families.

Each collection in the arboretum is mapped and the location is marked. The Arboretum is indexed in the Index Seminum with ID No. 1518 and is enlisted in the National Network of Botanical Gardens in India. A visit to arboretum is a rewarding experience to students of biology. This live collection is intended to be a conservatory of rare species, and a ready source of propagules for eco-restoration programmes.

For more details please visit the web page : http://www.kfri.res.in/arboretum.asp.

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