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In this issue....

'VAYALS'

An Important Unique Ecosystem

'Vayals' as they are colloquially called in Malayalam/Tamil are seasonally waterlogged meadows or wet meadows dominated with grasses and sedges, categorized as "Ts" i.e., seasonal/intermittent freshwater marshes/pools on inorganic soils of Ramsar's Classification System for Wetland Type. In Kerala, these unique ecosystem has been mainly reported from protected areas of Wayanad, Parambikulam and Periyar. These natural swampy meadows are ideal habitats for wetland plants, numerous invertebrates, amphibians, reptiles etc. They are always wet and moist dominated by members of Cyperaceae and Eriocaulaceae and there may be small streams which originate from these marshy meadows. Vayals are mainly formed by deposition of top soil from nearby areas which in long run becomes clay and non porous. Due to this reason, water does not penetrate deep into the soil below and the areas become water logged. This condition makes hydrophytes and Cyperaceae members along with grass species to colonize the area. Availability of fresh grasses, sedges and water makes these habitats ideal for wild animals especially herbivores. Exotic weeds like *Lantana camara, Chromolaena odorata* among others invade the area from the fringes and colonization of weeds may directly result in loss of palatable native species, soil quality and water availability. Loss of palatable species and decrease in water availability will also adversely affect the animal community. Hence a long term scientific study in this unique ecosystem is necessary to understand its ecological importance and further to evolve proper management and conservation strategies.

Rhynchospora corymbosa
A dominant species in vayals

Hedychium coronarium
Sugandhi or Saugandhikam

Asclepias curassavica
Chemullichedi or Kammalchedi

Wetlands of Northern Kerala

Hot Spot Centres with Major Ecological Significances

Introduction

Wetlands are the ecotones or transitional zones between permanently aquatic and dry terrestrial ecosystems and include coastal tidal mudflats, mangroves, estuaries, backwaters, seasonal inland marshes, kole lands, riverine wetlands and other water bodies including ponds, tanks, reservoirs, etc (Envis, 2008; Ramsar convention, 2006). Wetlands are considered to be the most productive ecosystem in the world. Studies show that the ecosystem service values of the wetlands are seven times more than that of the forest ecosystem (Constanza *et al.*, 1997). Inspite of ecological importance and economic benefits, wetlands are often considered to be wastelands and are being reclaimed for various purposes. In a recent study conducted by SACON (Vijayan *et al.*, 2004), it is reported that India has lost 38% of its wetlands during the past ten years and another study shows that Kerala has already lost more than 95% of its mangroves, during the last 100 years (Basha, 1992). Since most of the wetlands are distributed within the thickly populated coastal and midland region, these sensitive habitats are under high anthropogenic pressure.

North Kerala, covering five districts, viz. Kasaragod, Kannur, Wayanad, Kozhikode and Malappuram, is endowed with rich array of wetlands. Twenty four rivers flow through this region out of the 44 rivers in Kerala. Altogether 91 wetlands were recorded during this study. There are seventeen wetlands in Kasaragod district lying along and nearby areas of twelve rivers in Kasaragod district. Twenty five wetlands of Kannur district are distributed with six rivers. Nine wetlands of Wayanad district distributed in the Wayanad valley, along the Kabani river and its tributaries. Seventeen wetlands are identified from Kozhikode district which are related to six major rivers in the district. Major wetlands in the Malappuram district are distributed along the Kadalundi and Bharathapuzha.

By following Ramsar convention manual (2006), Wetlands of India (2008) and Envis (2008), the wetlands of North Kerala are broadly classified into sea shores, estuaries, tidal mudflats, mangrove swamps, backwaters, brackish as well as fresh water marshes, ponds and reservoirs, river banks and paddy fields, etc. under broad category of Inland and Coastal.

Wetland Groups of North Kerala

Based on topographical peculiarities, ecological continuity, conservation importance, habitat richness, active birdlife, etc. the 91 wetlands of northern Kerala are broadly categorised under ten wetland groups (Figure 1).

Fig. 1: Wetland atlas of Northern Kerala

1. Manjeswaram group: This is the northern wetland group of Kerala and mainly composed of Estuaries and mangroves such as Mogral-Puthur Estuary, Kumbala-Shiriya Estuary, Mangalppadi Mangroves and Manjeswaram-Hosabetta Estuary.

2. Neeleswaram-Kanhangad group: This wetland group mainly composed of inland type such as Puthiyakotta-Kallunchira wetland, Kovval store Areekkampuzha-Padannekkad wetland, Theerthangara wetland, Seearthingara wetland, Kannankai wetland, Aayettikkavu wetland and Cheruvathur-Mundakkandam wetland. Associated coastal types are Kottappuram mangroves backwater, Neeleswaram-Thaikkadappuram-Azheethala Estuary, Oriyara-Mavillakadappuram Estuary, Kokkal Mangroves backwater and Vadakkekadu Island-backwater.

3. Kuniyan-Chempallikkundu-Cherukunnu group: This group is unique among all other wetland groups of North Kerala because of characteristic combination of inland and coastal type. Most of these wetlands are interlinked, which created a healthy network of wetlands in this region. However due to anthropogenic interference, most of them are fragmented now. Major wetland in this group are Madakkara

mangroves, Ayyoth paddy fields, Ambalappuram-Cherukunnu wetland, Thekkumbad–cherukunnu, Moottilpalam mangroves, Mundappram mangroves, Chera-Panthottam mangroves-back water, Keecheri vayal, Narikkode wetland, Chempallikkundu wetland, Chengoorichal wetland, Pana vayal, Edat-Pullamkandam, Cheruthazham-Ookkara vayal, Palakkode mangrove backwater, Kunnaru back-water-mangroves, Kuniyan–Edattummal wetland, Keezhara vayal, Dalil mangroves and Ezhome vayal. Pazhassi reservoir, an artificial inland type included in this wetland group because of its topographical closeness.

4. Kattampally group: Kattampally backwater is a *manmade* wetland and an important site of migratory birds in Kerala. Earlier the area was the merging point of two important tributaries of Valapatnam river, the Munderi river and Kakkad river. This backwater is formed due to the construction of a barrage across the river to regulate water flow and is a combination of paddy fields, flood plains and mangrove habitats. The area is already enlisted in the Important Bird Area (IBA) by the bird life international organization. A recent water bird census indicates that Kattampally leads with the highest number of birds and highest number of species. Mappila bay, nearer to Kattampally is another important area in this group with respect to birdlife.

5. Dharmadam-Muzhappilangad group: Habitat of this wetland group is peculiar and composed of coastal types such as Muzhuppilangad sea shore, Dharmadam Estuary and Koduvally mangroves.

6. Cherandathur-Elathuruthupandy Group: Because of the large extent of typical wetland like Cherandathur and paddy fields like Elathuruthupandy-pulathuruthupandy, this group forms comparatively an undisturbed wetland group in northern Kerala with high density of birds in smallest area. Important wetlands in this group are Cherandathur wetland, Kottappalli wetland, Pulathuruthupandy-puttampoil wetland, Elathuruthupandy wetland, Aavala wetland, Keezhpayoor–kuruvod pandivayal-kandanchira, Akalappuzha brackish water, Pallikkara–Govindhanket brackish water, Kottappuzha estuary and Korappuzha estuary.

7. Peruvannamuzhi-Kakkayam-Banasura Sagar group: This group is composed of three reservoirs such as Kakkayam, Peruvannamuzhi and Banasura Sagar in the Nilgiris of southern Western Ghats. Ecological importance is minimal with respect to other wetlands of northern Kerala.

8. Wayanad group: This is a high altitude wetland group, composed of vayals and riverine habitats. Major wetlands in this group are Panamaram vayal,

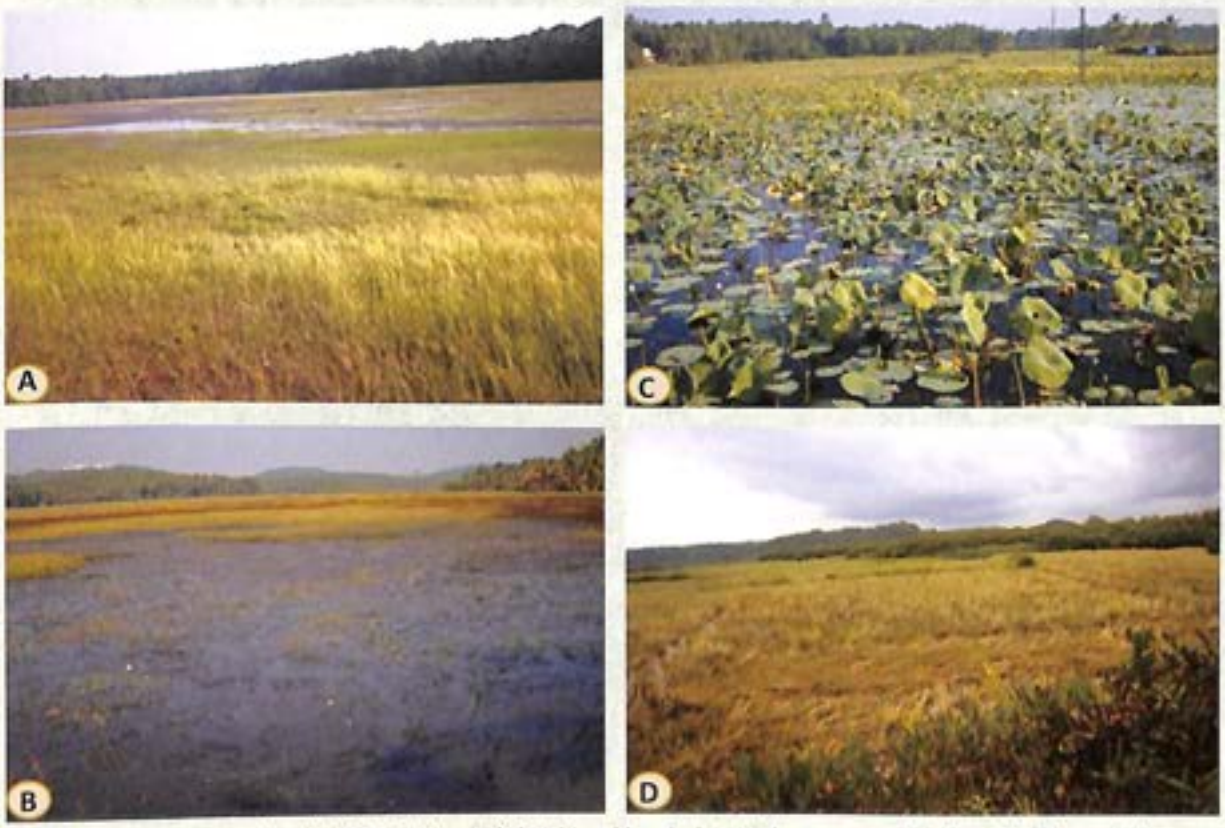

Fig. 2 : Important wetlands of North Kerala (A) Vellimukku chal at Malappuram with dense bird population; (B) Cherandathhur wetland; (C) Thamarakkulam wetland, Thirunavaya, Malappuram with dense aquatic vegetation; (D) Chera panthotottam, Kypad, Kannur - Mangrove associated Wetland

Nadavayal, Koyileri vayal, Vemom vayal, Valliyoorkkavu vayal, Kuruva Islands – paddy field, Varadhoor paddy field and Karappuzha reservoir.

9. Kadalundi-Karimpuzha-Chaliyar group: This forms the richest wetlands network with respect to habitat, birdlife, biodiversity, etc. Major wetlands are Kunduparamba- Erinjikkal brackish water, Nedumkalam punja–kappal chal, Mavoor vayal, Kottuli mangroves brackish water, Olavanna wetland, Kadalundi estuary, Chenapparambu– Thattanthuruthi wetlands, Kadakkattupara wetlands, Vellimukku chali wetland, Punchappadam–chettippadi wetland, Kalppuzha – pachilappadam wetland, Azhinjilam wetlands, Aluckal pallakkuzhi vayal, Edavannappara chalippadam wetland, Vazhakkad vayal, Karimpuzha river and Areekkandam oravampuam vayal.

10. Thirunavaya–Bharathappuzha group: This wetland group is nurtured by Bharathappuzha. Unique vegetal structure is the peculiarity of this wetland. Major wetlands in this group are Mathad kuttorpadam, Moochiikalclarippadam,Thalakkadathoor-Alinchuvade vayal, Pachattiri ettukadavu, Koottayi–purathur estuary, Ottumpuram estuary, Chembra vayal, Karathur Mullanmada vayal, Thirunavaya thamarakkulam vayal, Thirunavaya pallattukayal and Thirunavaya valiyaparappur kayal.

'Hot Spot Centres'

Wetlands are one of the fast depleting resources in the country, perhaps in the world, which are often referred to as wastelands. Ironically, these wetlands are the most productive ecosystems of the world. Wetlands of Kerala is facing several hazards owing to unbridled population explosion, rapid strides in urbanization and industrialization, large scale changes in land use/land cover, burgeoning development projects and improper use of watersheds. These major factors have been responsible for the substantial decline of wetland resources of the area. Most of the wetlands in northern Kerala are smaller in their extent and are highly fragmented due to the change in land use pattern. Also existing wetlands are partially filled/converted or in the process of filling/conversion which directly influences the water table in the thickly populated coastal and midland regions. In coastal region, it results in the presence of salty water in wells, and in the inland areas it leads to water scarcity, soil erosion, flood etc. In addition, devastation of wetlands poses serious threat to the feeding and breeding grounds for many species, especially the migratory birds, since the area is important in South Asian flyway. The recent Millenium Assessment of ecosystems puts freshwater biodiversity as the most threatened of all types.

Among the 91 wetlands of North Kerala, fifteen most important ones with respect to its ecological significance, extent, richness, diversity and density of flora and fauna and degree of threat are listed below. These are the *'hot spot'* regions of wetlands in North Kerala for immediate conservation concern.

1. Kattampally backwater
2. Cherandathur wetlands
3. Chempallikkundu wetland
4. Kadalundy Estuary
5. Kuniyan-Edattummal wetland
6. Vellimukkuchal wetland
7. Koottayi-Purathur Estuary
8. Thirunavaya wetlands (Valiyaparappur, Thamarakkulam & Pallattukayal)
9. Ezhome vayal
10. Pulathuruthupandy wetlands (Elathuruthupandy & Pulathuruthupandy)
11. Neeleswaram - Kanhangad wetlands
12. Mavoor vayal
13. Madakkara mangroves
14. Paana vayal
15. Panamaram wetlands

Kattampally backwater is unique with regard to density, diversity and habitat richness and is lying along the Valapattanam river and linked with Kuniyan-Chempallikkundu-Cherukunnu group of wetlands. The chain of wetlands between Perumba river and Valapattanam river, composed of both Coastal and Inland types forms the most important area in northern Kerala with respect to bird and wetland conservation. Cheranadathur wetland which is connected with the Pulathuruthupandy wetlands is the broadest, richest and comparatively less disturbed Inland wetlands of northern Kerala. Thirunavaya wetlands, a broad submerged area, are considered to be peculiar because of its rich diversity of perennial aquatic vegetation and density of birds. Other wetlands such as Vellimukku chal, Neeleswaram–Kanhangad, Mavoor vayal, Pana vayal and Panamaram wetlands are also important because of its distinctiveness in habitat, bird diversity, conservation status and threat issues. Anthropogenic invasion in the form of land filling, land conversion, pollution, mangrove deforestation, etc. have paved the way for the deterioration of all wetlands. It is observed that the developmental activities in these areas have gained a greater momentum in recent years. It is estimated that more than 40 per cent of total area of 91 wetlands are already converted. Projections and scenarios indicate that it will reach another 40 per cent within a short span. As the wetlands are open and dynamic systems, they are readily vulnerable. Therefore, urgent measures have to be taken to protect these sensitive habitats which can be aptly defined as the "kidneys of nature" which otherwise would jeopardize our ecosystem and ecological balance.

Bird Population – Food and Feeding

Diversity of wetlands in northern Kerala varies from coastal open mudflats, mangroves to inland reservoirs. Most of the natural inland wetlands are seasonal. Some of them are with intense paddy cultivation. Perennial marshes with dense growth of aquatic plants in the coastal belt of northern Kerala are very rich in all the sense. Plants like *Nymphaea, Nelumbo, Nymphoides,* or grasses like *Oryza, Hygrorhiza,* etc. and sedges like *Eleocharis, Fimbristylis, Schoenoplectus, Schoenoplectiella,* etc. are common in the area. Aquatic weeds like *Salvinia, Eichhornia, Ottelia,* etc. also provide substratum for water birds. Due to the presence of dense aquatic vegetation density of aquatic fauna is also high. These perennial marshes provide a variety of food in all seasons. The food availability in these wetlands attracts large number of migratory birds. Aquatic vertebrates like amphibians, reptiles, fishes and small mammals are the major food providers. Amphibians, especially frogs, have periodic population bursts based on time limited water plant and invertebrate resources. Fish in more permanent area of wetlands and fish eggs often laid in shallow water are favorite food of many birds. Some common fishes identified from the Inland wetlands of northern Kerala are *Xenetodon cancila, Gara mullya, Chanda thomassi, Etroplus suratensis, Etroplus maculates, Chela clupoides, Macropodus cupanus, Mastacembellus guntheri, Rasbora daniconius, Hyperamphus xanthopterus, Puntius filamentosa, Mystus gulio, Puntius pinnata,* etc. Wetlands rich in plant biomass are most often dominated by smaller herbivores which are also predated upon by birds. Generally, the food of birds in various seasons in various zones are seeds, seedlings, roots, tubers, fruits, nuts, plant leaves, grasses, sedges, corms, daphnia, duckweeds, snails, crayfish, worms, clams, insects, crabs, crustaceans, fish and eggs, invertebrates, frogs, snakes, birds, mammals, etc. High density and frequency of birds in the wetlands of North Kerala reveals that the area is rich in fishes, amphibians, crustaceans, worms, reptiles, small mammals, etc. apart from its rich vegetation.

Conservation Planning and Recommendations

Even with the National Environmental Policy introduced in 2005, the plight of wetlands continued to be deteriorating without any sign of relief and overall loss estimated by next 5 years is about 60% of the existing wetland area. The planning and proposals here under are to combat this loss and to augment these areas as better biodiversity centers.
The following are the proposals.

1. Promulgation of an ordinance

The Central Government may urge in the state Government to issue an Ordinance with immediate effect covering the

Fig. 3 : Threats to wetlands (A) Karapuzha, Wayanad – Agriculture pattern; (B) Cheruvathur, Mudakkandam, Kasaragod - large scale brick making and mud lifting; (C) Theerthangara wetland, Kasaragod - dense growth of weeds-pollution; (D) Manjeswar, hosabetta, Kasaragod - sand mining

protection measures and maintenance of the wetlands. For this purpose the wetlands listed under this study and the Ramsar site of Kerala may be classified under one schedule. Similarly provisions for notifying further wetlands for inclusion into the schedule may be given in the Ordinance. Detailed discussions and deliberations with conservationists, farmers and other stake holders of the scheduled wetlands may be carried out before constitution the Ordinance. The objective should be Wildlife & Habitat Protection consistent with traditional farming and fishing practices and for maintaining the status of the wetlands. Undoing of civil constructions of yester years obstructing the tidal flow in wetlands like Kattampally also may be provided in the Ordinance.

The urgency of the Ordinance may be communicated to the State Legislation Wing and Department of Environment as early as possible to prevent further damage.

2. Special Status to Kattampally

Background history

Kattampally is about 4 kms away from Puthiyatheru a satellite town of Kannur Municipality. The senior citizens of Kattampally have a different story about Kattampally. During 1950's the lands beyond Kattampally river such as Mayyill, Kannadipparamba, Pamburuthi, etc were cut off from the main land for want of a bridge across Kattampally river. The people of these isolated locations strongly demanded for a bridge across the river for access from the main land. It was a major commitment of the Government. The budgetary provisions with the PWD were not sufficient to meet the requirement. On the other hand Minor Irrigation Department had sufficient funds but not sufficient proposals.

The leaders of those days were pragmatic enough to utilize the funds under the Minor Irrigation/Agriculture department to construct a barrage across Kattampally river which will provide a road bridge on the top, catering to the long term demand of the local people. A project was envisaged and sanctioned for this purpose with the interpretation that by blocking saline water from the sea through the tidal flow, the area upstreams to Kattampally regulator can be better utilized for paddy cultivation. The scheme had similarity to the Thannirmukkam bund in Vembanadu back water with similar high yield claims in Kuttanad paddy field.

The construction of the barrage resulted in compulsory displacement of large number of families from the submergible land. These resulted in famous Kattampally struggle of 1960's. However, the barrage was constructed with eleven spillways to regulate the water flow. Thus instead of a bridge which the local people badly needed, a bridge cum –regulator was provided at Kattampally. Now this has turned out to be a curse for the people upstream. Though the claim was that three time paddy crop could be done, the ultimate effect was disastrous. About 2500 ha of lands upstream could not be cultivated as targeted by the planners. For the last 4 decades the farmers were helpless in generating their income from their land, in place of one time paddy crop and one ton of fish in a ha, during the off season.

All the paddy fields on either side of the river are lying unproductive under this situation. The constant demand from the farmers of this area to do away with the regulator has not so far yielded any result. The Government is yet to take a decision on this. If a sustainable agriculture pattern is not re-adapted in Kattampally, it is likely that the whole wetland may be reclaimed for industrial or other development activities.

Kattampally to be declared as Ramsar site

Kattampally is a group of wetlands comprising about 7.5 km^2 area comprising the wetlands such as Kattampally backwaters, Kakkad puzha, Pulluppy kadavu, Varam kadavu, Purathy and Munderikadavu wetlands. 24 areas in Kerala have been identified as Important Bird Areas (IBA) by Bombay Natural History Society and Birdlife International, as priority sites for conservation as they hold a considerable population of Globally Threatened birds. Out of these, three are wetlands and the rest are forests including the Wildlife Sanctuaries. Kattampally is one among the three wetlands. A recent water bird census conducted by the Forest Department indicates that Kattampally indicate that the area possesses highest number of birds and highest diversity. An estimate shows that the area have more than one per cent geographical population of *Garganey*. Though smaller when compared to the other major Ramsar sites of Kerala, it is obligatory on conservation point of view to include the Kattampally under the Ramsar site on the following grounds.

Group A of the Criteria. Sites containing representative, rare or unique wetland types

Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate bio-geographic region.

Specific criteria based on water birds

Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more water birds.

- In the water bird census conducted in January 2006, 18,622 birds belonging to 51 species were counted. Out of the 63 sites censused in North Kerala, Kattampally is the most important in species diversity as well as in the number of birds. 20,000 birds counted in January 2003 (Asian Water bird Census data).

Criterion 6: A wetland should be considered internationally important if it regularly supports one per cent of the

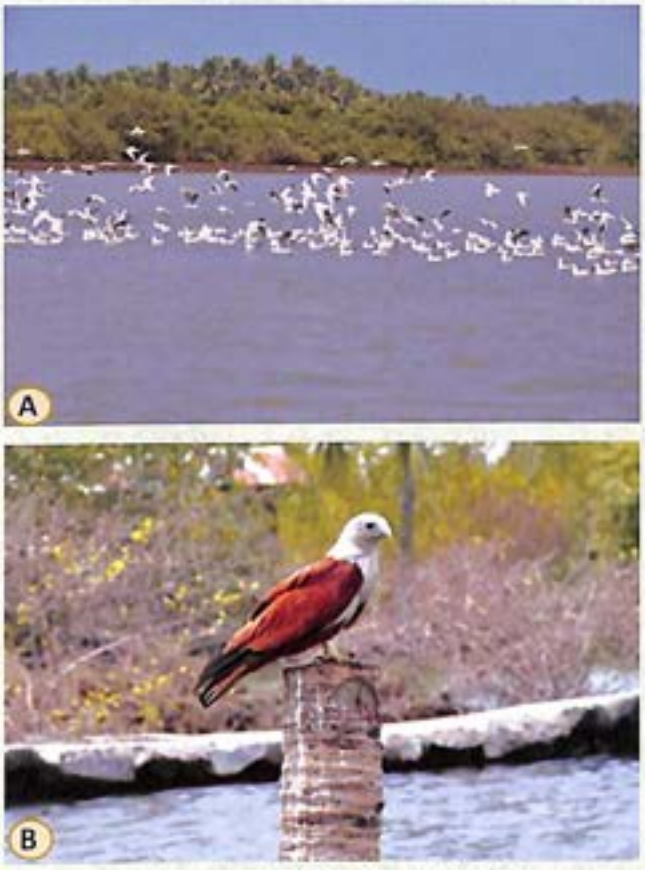

Fig. 4 : Birds associated with wetlands (A) Birds at Kadalundi; (B) Brahminy kite feeding at Kadalundi

individuals in a population of one species or subspecies of water bird.

- This included 6,538 Garganey (a migratory wild duck, wintering in India from Northern Europe and Siberia.). 2500 of these ducks are estimated to comprise 1% of bio-geographical population.
- Seven globally threatened species of birds have been reported from Kattampally such as Oriental Darter (Near Threatened), Greater Spotted Eagle (Vulnerable), Indian Spotted Eagle (Vulnerable), Eastern Imperial Eagle (Vulnerable), Black-tailed Godwit (Near Threatened), Black-headed Ibis (Near Threatened) and Bristled Grass-Warbler (Vulnerable).

Specific criteria based on fish

Criterion 7: If a wetland supports significant proportion of indigenous fish sub species, species or families, life history stages, species interaction and/or population that are representative of wetland benefit and/or values and there by contributes to global biological diversity.

Criterion 8: If the wetland is an important source of food or fishes, spawning ground nursery and/or migration path on which fish stocks, either within the wetland or elsewhere depends.

The above two criteria are applicable to Kattampally wetland groups as per data obtained from various studies about the fish population of Kattampally.

Out of the 25 Ramsar sites in India it could be seen that 7 are below 500 hectares, ranging from 490 hectare to 20 hectares in area. This indicates that area is not a criterion for selection to Ramsar site. Going by the approved criteria for selection to Ramsar site it can be seen that Kattampally deserves the status as a Ramsar site in North Kerala. Hence immediate recommendations can be forwarded for the same.

Presently, Kattampally is facing different anthropogenic pressures. Two bridges and approach roads are under construction at locations nearby Varamkadavu and Pulluppy kadavu cutting across this wetland. Once these road works are completed it is likely that the major chunk of paddy fields and flood plains will be converted and reclaimed for developmental activities. At Varam Kadavu already 10 acres of land have been reclaimed by an ayurvedic firm claiming that the area is filled up for medicinal plantations. Such a scenario will turn out to be highly detrimental to the biodiversity, especially the bird population.

3. Apply caution to wetland projects without EIA

Environmental impact assessment is mandatory only if any project is envisaged for major projects. In North Kerala certain projects are already approved for the development of wetlands which are falling under this study. These projects are understood to be cleared without EIA. Development of a particular area in particular sector also can create havoc to nearby wetlands. A few instances are mentioned here.

a. Cherandathur wetland, Kozhikode district

The District panchayath Kozhikode is going forward with a project of paddy field augmentation scheme in Cherandathur wetlands. The scheme is to reclaim the Cherandathur water logged area out of weeds and leeches and to provide about 460 hectares of lands for paddy cultivation. The water logged portion after removing the leeches will be utilized for geese farming. It is understood that no environmental impact assessment studies have been conducted before sanctioning of this project. Cherandathur is one of the best migratory bird centres of North Kerala. If the existing water logged area is cleared and converted into geese farming centre this will have very adverse affect on the international bird population. It is also likely that such a project would give way to deadly bird flue disease. Hence the district administration authorities need be cautioned about environmental impact of this project.

b. Kottuly wetland, Kozhikode district

The authorities need to take adequate precaution not to further harm the wetland. The remaining infrastructure development works inside the wetland may be dispensed with.

c. Mavoor vayal, Kozhikode district

Strict measures need be taken up not to disturb Mavoor vayal wetland in any manner during the new Industrial Estate formation in the former Gwalior Rayons factory compound of Mavoor.

d. Other urban development activities not to disturb the existing wetlands.

Urban development programmes are being carried out in Kasaragod, Kanhangad, Kannur, Thalassery, Thirur, Ponnani and other municipalities of Kerala. Preventive measures need be taken to maintain the status quo of existing wetlands as scheduled in this study.

4. Declaration of Community Reserve

A list of most important wetlands, *'hot spots'* are here under given based on the ecological importance and bird communities.

I Kattampally backwater
II Cherandathur wetlands
III Chempallikkundu wetland
IV Kadalundy Estuary
V Edattummal-Kuniyan wetland
VI Vellimukkuchal wetland
VII Koottayi-Purathur Estuary
VIII Thirunavaya wetlands (Valiyaparappur, Thamarakkulam & Pallattukayal)
IX Ezhome vayal
X Pulathuruthupandy wetlands (Elathuruthupandy & Pulathuruthupandy)
XI Neeleswaram - Kanhangad wetlands
XII Mavoor vayal
XIII Madakkara mangroves
XIV Paana vayal
XV Panamaram wetlands

Out of this only Kadalundi is declared as a Community Reserve so far. All the other 14 wetlands need to be declared as Community Reserves at the earliest.

5. Declaration of Environmentally Sensitive Zones/ Biodiversity Heritage Sites

National Environment Policy envisages the national inventory of wetlands having Environmentally Sensitive Zones. Unique wetlands to be treated as areas of "Incomparable Values" are to be listed for such inventory. All the 91 wetlands covered in the study can be listed as Environmentally Sensitive Zones and documented in the national inventory of wetlands.

State government has the power to frame rules for the management of biodiversity heritage sites after consulting the central governments. All the wetlands mentioned in the study may be recommended through the State Biodiversity Board to declare as Biodiversity Heritage Sites for future management and conservation activities.

6. The Role of Forest Department

Forest Department shall play a role of nodal agency in all aspects of protection and management of wetlands with respect to biodiversity conservation. The wild life wing of the Department can utilize budgetary provisions from the Conservation of Biodiversity Fund to provide bird monitor cum watcher for protection of the birds in the scheduled wetlands at least from October to March, ie, during the migratory season of the birds. These watchers shall be well versed with ornithology and shall have the capacity to give bird identification and monitoring techniques to students and other visitors reaching the wetlands. To begin with, this programme will give excellent result in bird conservation. They can also organize people's participation in bird protection and thwart any attempt towards hunting or snaring of birds. The local forest officers having jurisdiction shall give further support in extension as well as protection activities.

7. Campaign Programme

Innovative ideas like 'welcome bird campaign' can be organized in Kerala during November, the *Kerala piravi month* (State reorganization in November 1956). This will be in continuation with the Wildlife Week Celebration being regularly conducted in October. Students and bird lovers can be invited to wetlands and introduced to the wonderful world of avian life in selected wetlands. Controlled and well planned ecotourism programme also could be organized during bird season.

8. Provision for incentives

In certain locations the owners of the land suffer a lot due to the migration as well as breeding of the birds. In places like Pamburuthi Island, it can be seen that almost all the trees in the household compounds are utilized by birds for nest building. The house owners suffer from the bird droppings which sometimes even contaminate drinking water also. Inspite of such difficulties also, the house owners are magnanimous enough to accommodate the breeding birds in their compounds. Similarly such conservation efforts are taken by many of the wetland owners also showing interest to protect the visiting birds. The trees identified during heronry count in the five districts brought out data about several private owners possessing the trees. If a system of awarding incentives to such owners in and around the scheduled wetland area it will be a great boost for the bird conservation efforts.

9. Research and Monitoring

With the engagement of bird monitors cum watchers a permanent arrangement can be set up for research and monitoring of wetland birds with respect to the ecology, food and feeding behaviour, breeding, migration etc. in a

Fig. 5 : (A) *Aponogeton appendiculatus* - rare aquatic floating herb; (B) *Cabomba caroliniana* -weed

systemic manner. Experts in this field can be roped in for this purpose. It can be even thought of seriously by the MOEF, if bird ringing can be permitted in selected areas on experimental basis.

10. Adoption of Wetlands

This is another proposal to examine whether the strategy to adopt wetlands by NGO's and Educational Institutions is possible with the help of the Department. A model for this system can be evolved as being done under Participatory Forest Management.

11. Role of local self Governments

There is a crucial role for the LSG's to conserve the wetlands. The main issue is on policy matters. Usually LSG's give preference and priority to developmental activities than to conservation of wetlands. The unseen value of wetlands should be prioritized in policy decisions. For this purpose local representatives may be educated. There should be a systemic arrangement to conduct workshops and seminars with the participation of all the representatives and other stake holders of the wetlands in the concerned Panchayaths. The state Government and the Central Government may take initiative for this 'policy change' campaign and impress upon the LSG's about the need for conservation of wetlands as an issue of global interest and international conservation policy.

12. Wetland Sanitation Programme

Birds are indicators of life in wetlands. The 91 wetlands identified in North Kerala are lively and the water may die due to pollution and eutrofication if not properly cared. To avoid this we should be very careful to prevent the dumping of hazardous waste, plastics and food waste in wetlands. Apart from that polluting the water by insecticides, other poisonous and hazardous materials should also be avoided. The panchayaths and municipalities should make it an agenda to maintain and keep clean all the wetlands within their jurisdictions. Periodic sanitation programme can be carried out in the wetlands by cleaning out all the hazardous and plastic wastes. Regular monitoring shall be carried out to see that only treated water is allowed to reach the wetlands from industrial units, slaughtering houses, restaurants etc. As a policy matter necessary funds should be allocated to the concerned LSG's for this purpose.

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P. Sujanapal, O. Jayarajan[1] and P.C. Rajeevan[2]

Kerala Forest Research Institute, Peechi, Thrissur

[1] Deputy Conservator of Forests (Rtd.), Kannur

[2] Clean Habitat & Environment Service Trust, Kannur

Fig 6: *Nymphoides krishnakesara* -a rare and endangered aquatic herb

Trees for Mitigating Greenhouse Gases

Industrial development is a major concern for the developed and developing countries. Greenhouse gases (GHG) like carbon dioxide (CO_2), carbon monoxide (CO), sulphur dioxide (SO_2), hydrogen sulphide (H_2S), oxides of nitrogen and hydrocarbons are serious matters in these areas. Although emission levels of GHG can be limited to certain levels, it is not possible to completely prevent their entry into atmosphere. These GHG in turn cause health hazards to living organisms. The plant communities such as forests, tree plantations or greenbelts play an important role in mitigating GHG by filtering or absorbing them.

There are substantial evidences that trees remove gaseous contaminants from the atmosphere justifying the importance of planting of trees in the form of farm forestry, agro-forestry, social forestry, urban forestry, coastal afforestation, greenbelts, etc. Species such as *Leucaena leucocephala, Albizia falcataria, Caesalpinea pulcherrima, Spathodea campanulata* and *Gmelina arborea* are reported to have ability to absorb nitrogen dioxide and sulphur dioxide. Similarly, *Mangifera indica* absorbs chlorine and *Ficus elastica* absorbs hydrogen fluoride (Anon, 1984). Pollution resistance mechanisms involve the capacity for metabolising pollutants to less toxic substance and dilution of pollutants by rapid redistribution within plants (Kozlowski and Constantinidou, 1986). Agarwal and Tiwari (1997), based on air pollution tolerance index, proposed *Albizia lebbeck, Ficus gibbosa, Terminalia arjuna, Madhuca latifolia, Pithecellobium dulce, Acacia catechu, Terminalia tomentosa* and *Eucalyptus globulus* as more tolerant to pollution. Studies on scavenging potentials of common tree species showed that species such as *Madhuca indica, Cassia siamea, Eucalyptus* spp. and *Azadirachta indica* have a greater potential for scavenging SO_2 and NO_2 (Reddy and Dubey, 2000).

Cultivation of pollution tolerant species will help in reducing injury caused to the environment. A study by Chacko *et al.* (2001) revealed that trees like *Acacia mangium, Albizia odoratissima, Bambusa vulgaris, Casuarina equisetifolia, Dalbergia lanceolaria, Delonix regia, Holigarna arnottiana* and *L. leucocephala* planted in the campus of a petro-chemical industry at Ambalamugal, Ernakulam Dt. of Kerala registered very fast growth. Wheras, *Acacia nilotica, Acrocarpus fraxinifolius, Adenanthera pavonina, Ailanthus excelsa, Alstonia scholaris, Artocarpus heterophyllus, A. indica, Bambusa arundinacea, Bauhinia purpurea, Cassia marginata, C. siamea, Ceiba pentandra, Dalbergia sissoo,*

48-month-old greenbelt plantation at Kochi Refinery Ltd., Ambalamugal

Enterolobium cyclocarpum, Ficus benghalensis, Ficus religiosa, Holoptelia integrifolia, Jacaranda mimosifolia, Phyllanthus emblica, Samanea saman, S. companulata, Spondias pinnata, Swietenia macrophylla, Syzygium cumini, Terminalia bellirica, Terminalia catappa, Terminalia paniculata and *Thyrsostachys siamensis* registered fast growth. However, they reported that *Ailanthus tryphysa, A. lebbeck, Anacardium occidentale, Anogeissus latifolia, Annona squamosa, Artocarpus hirsutus, Aphanamixis polystachya, Caesalpinea coriaria, Caesalpinea sappan, Carallia brachiata, Cassia fistula, Castanospermum australe, Crysophyllum cainito, Diospyros buxifolia, Elaeocarpus ganitrus, Ficus dalhousiae, G. arborea, Haldina cordifolia, Hopea parviflora, Hydnocarpus pentandra, Lagerstroemia reginae, Litsea coriaria, M. indica, Mimusops elengi, Peltophorum pterocarpum, Persea macrantha, Pongamia pinnata, Psidium guajava, Pterocarpus marsupium, Pterocarpus santalinus, Pterocymbium tinctorium, Saraca asoca, Schleichera oleosa, Strychnos nux-vomica, Tamarindus indica, Terminalia chebula* and *Xylia xylocarpa* as having moderately fast growth. Their study indicated that species with fast growth rate can be used for greening programmes to mitigate emission of greenhouse gases and thus save our challenging environment.

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PK Chandrasekhara Pillai
Silviculture Department, KFRI

MONTHLY WEATHER DATA FOR 2012 AT PEECHI

LATITUDE-10° 31'47" N LONGITUDE- 76° 22'7.5" E ALTITUDE- 45 msl

Month	Max. Temp °C	Min. Temp °C	Avg. Temp °C	Max. rh %	Min. rh %	Rainfall mm	Wind Velocity km/h
January	33.00	18.50	27.65	100.00	35.00	0.00	0.61
February	37.00	19.20	27.58	100.00	18.80	0.00	1.12
March	38.50	22.40	29.93	100.00	20.00	0.00	0.24
April	39.40	20.80	29.92	100.00	41.00	152.80	0.41
May	38.90	22.40	35.30	100.00	52.20	83.00	6.85
June	38.00	21.80	27.13	100.00	53.60	650.60	0.35
July	36.10	21.80	26.97	100.00	62.10	470.00	0.35
August	34.80	22.40	26.13	100.00	67.50	583.20	0.20
September	36.10	22.10	26.88	100.00	55.00	208.40	2.27
October	37.50	22.40	27.31	96.00	51.30	213.40	0.76
November	34.80	18.90	27.31	100.00	41.90	59.40	0.06
December	33.50	19.50	26.72	100.00	47.70	0.00	2.55
Average/Total	36.47	21.02	28.24	99.67	45.51	2420.8	1.31

Dr. CK Somen, Dept. of Tree Physiology, SFM Division

Eco-Restoration of *Hydnocarpus macrocarpa* and *Drypetes malabarica*, Two Endemic Endangered Trees of the Western Ghats

Targeting the eco restoration of RET tree species in the Western Ghats, a major conservation study through restoration of *Hydnocarpus macrocarpa* and *Drypetes malabarica* has been taken up by the Institute. The main objective of the study was to enhance the genetic base of the natural populations of the species by enrichment planting of seedlings in their natural habitats. After the field survey in the potential sites for field planting, ten locations adjacent to the natural habitats of the two species were selected for planting. Planting stock of the two species developed as the outcome of propagation studies were utilized for the restoration activities. Two year old seedlings of *H. macrocarpa* with a height ranged from 50-70 cm, and *D. malabarica* with height from 22-29 cm, established in polybags were used for planting. The planting was carried out during the rainy season in 2012. Altogether, 1400 seedlings of *H. macrocarpa* and 400 seedlings of *D. malabarica* were planted *in situ*.

Fig.1 : Habitat (A) *H. macrocarpa*, (B) *D. malabarica*

The seedlings of *Hydnocarpus macrocarpa* were planted in six *in situ* locations:

1. Kulamavu MPCA (Nagarampara Range)
2. Kulamankuzhikudy (Neriamangalam Range)
3. Rosemala (Thenmala Range)
4. Malakkapara (Sholayar Range)
5. Kallar (Palode Range)
6. Wayanad MPCA (Periya Range)

The four *in situ* locations where seedlings of *Drypetes malabarica* were planted are:

1. Kulamavu MPCA (Nagarampara Range)
2. Kulamankuzhikudy (Neriamangalam Range)
3. Rosemala (Thenmala Range)
4. Malakkapara (Sholayar Range)

In addition, seedlings of both the species were planted in three *ex situ* locations as alternate genetic stock for the species viz., a) KFRI Arboretum at the Main Campus, Peechi, b) KFRI Field Research Centre (FRC),Velupadam, and c) KFRI Sub Centre, Nilambur. 150 seedlings each of *H. macrocarpa* and *D. malabarica* (50 nos. in each site) were planted *ex situ*.

Fig.2 : Planted seedlings in situ
(A) *H. macrocarpa* (B) *D. malabarica*
(C) Display board

Both in the *in situ* and *ex situ*, the establishment and survival of the seedlings were recorded in six months intervals. The seedlings of *H. macrocarpa* showed 40-78% of survival and a height increment from 5-6 cm in different locations *in situ*, compared to 80-96% survival and 6-7 cm in height increment *ex situ*. On the other hand, seedlings of *D. malabarica* have shown 82-87% survival with an average height enhancement from 4-5 cm *in situ*. The survival performance of *D. malabarica ex situ* is under monitoring. Each planting site was also demarcated with metal display board showing the details of planting and GPS locations.

PA Jose, M Sumod and PK Chandrasekhara Pillai [1]

Forest Ecology Department, [1]Silviculture Department, KFRI

Taxonomic Garden in Nilambur

Adequate taxonomic expertise is highly essential to assess the state-of-the-art of biodiversity of a region and to develop appropriate biodiversity conservation policies and programmes. In India, realising the need of taxonomic expertise, several attempts are being made to promote taxonomic research and capacity building. However, when the richness and need for conservation of biodiversity in the sub-continent are considered, the efforts in taxonomic capacity building are to be further intensified. It may be mentioned here that many modern botanical gardens within

Fig. 1: Taxonomic Garden in the Bioresources Nature Trail of KFRI Sub Centre, Nilambur

and outside the country have reoriented their mandate to expand genetic diversity/biodiversity in them. However, even in such gardens, either limited or no attempts are made for the expositions of how plants might be related to one another. Therefore, it is clear that due to absence of display of plants following a taxonomic scheme the gardens offer little opportunities to general public in general and student community in particular to familiarise themselves with plants and to study their relationships. However, there are good examples of growing related plants together and allowing comparison of the characteristics of species within a genus or genera within a family. For instance, the Systematic Beds (sometimes also called 'Order Beds') of herbaceous plants at gardens like Kew and Cambridge and Central Park Arboretum at New York have long provided botany students with a compact synopsis of the plant kingdom arranged in taxonomic sequence. However, in the botanical gardens of India, grouping of plants by type is restricted only to small, separate collection of palms, rose, cacti, or other genera; plant displays that illustrate the scientific classification of plants to provide opportunities to compare the similarities and differences within taxonomic groupings are lacking in the country. Considering these aspects, the Kerala Forest Research Institute undertook a project to establish a Taxonomic Garden (Figure 1) in the Bioresources Nature Trail located at its Sub Centre in Nilambur.

Nilambur, in Malappuram District of Kerala State is the place where the world's first commercial teak plantation was raised during 1842-1844. The historic importance of Nilambur also inspired the establishment of a Teak Museum in the KFRI Sub Centre campus (76° 15' 28" E longitude and 11° 18' 14" N latitude) in the year 1995. Adjacent to the Teak Museum, the Institute has also established a Bioresource Nature Park that has conservation themes for the lower groups of plants such as algae, bryophytes and pteridophytes, plants found in specialized ecological niche such as xerophytes (cacti and succulents) and hydrophytes (aquatic plants), beneficial plants (eg. medicinal plants) and ornamental plants (eg. orchids). Each month, an average of about 10,000 visitors including students and researchers visit the Teak Museum and adjacent the Bioresources Nature Park, both located at the KFRI Sub Centre campus. The Taxonomic Garden (Figure

Fig. 2 : A view of the Taxonomic Garden of KFRI Sub Centre, Nilambur

2) covering about 2 ha area is established adjacent to the Bioresources Nature Park. In the Garden, plants belonging to 120 families can be seen in individual family beds. Aquatic plants are integrated into the Taxonomic Garden by growing them in ponds constructed in a circular pattern near the centre of the garden. Certain angiosperm families are primarily dominated by tree species. Therefore, within

the Taxonomic Garden a separate section where trees are planted can be seen.

In this taxonomic garden, certain deviations from the usual sequence of families in angiosperm systematics can be seen. Such deviations were required in order to overcome horticultural difficulties while establishing the garden. Taxonomic groups above the species level often contain plants from widely dissimilar habitats. Therefore, an attempt has been made to identify species of a family which share similar micro-site conditions. When comes to the family-

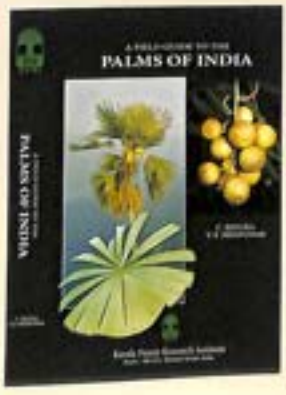
Fig. 3 : Signboards of family beds in the Taxonomic Garden of KFRI Sub Centre, Nilambur

level, the varying degrees of sun and shade tolerance as well as differing nutritional and moisture requirement among plants of closely related families cause problems when they are assembled together under similar conditions. In addition, families predominated by woody plants, climbers, epiphytes, xerophytes and hydrophytes lend themselves less successfully to a sequential taxonomic treatment. Thus, in the present endeavour certain exceptions were made to hard-and-fast rule of the taxonomic sequencing. For instance, four beds in the front row of the garden were used to plant species of one monocot family and three dicot families. Three dicot families were chosen to represent three sub-classes namely polypetalae, gamopetalae and monochlamydae. This arrangement was found to be adequate to explain how monocots are different from dicots, and within the class dicotyledons, how three sub-classes were derived based on the petal characters.

As indicated already, in the taxonomic garden, 120 angiosperm families were assembled. Priority has been given to families that are generally taught in graduate and post-graduate degree classes in subjects like Botany and Forestry in Indian Universities. A signboard of size 60 cm x 60 cm has been fixed in front of each family bed to a height of about 160 cm from the ground. The signboard provides details such as characteristic features of the family, general floral formula, number of genera and species reported from Kerala, number and names of species belonging to different conservation categories and names of species planted in the family bed (Figure 3). In the signboard, bold letters were used to indicate certain key features of the family.

The taxonomic garden probably is the first of its kind in India, with a compact synopsis of angiosperm plants arranged in taxonomic sequence. It is primarily developed to guide school and college students in angiosperm taxonomy and to provide an overall idea of the relationships between different angiosperm families as well as the evolutionary development in flowering plants. Guided tours are arranged for student batches and general public. The visitors are of the view that the Taxonomic Garden as a plant display unit is highly effective in comparing the similarities and differences within taxonomic groupings. There is a scope to expand the activities in the garden to promote teaching, research and capacity building in the field of taxonomy and allied subjects.

UM Chandrashekara
Kerala Forest Research Institute Sub Centre
Nilambur



Book Released!

A Field Guide to the Palms of India

Palms are woody monocotyledons belonging to the family Palmae (Arecaceae). They are a natural group of plants with a characteristic appearance that enables most people to recognize them without great difficulty. The Kerala Forest Research Institute has been surveying and studying the palm resources of India since 1983. The long field experience and research has resulted the publication of a Field guide, which covers 105 palms under 22 genera with simple description, maps and colour photographs representing the species from all over India including Andaman & Nicobar Islands. Relevant illustrations are provided for easy understanding of scientific terms in this guide. The classification of palms is followed by a generic key and under each genus, generic description and species level keys are also included. The species distribution maps are included for each species using GPS co-ordinates taken during the field surveys and for each geographical area separate map is provided. Almost all the species are provided by more than four photographs relevant to the identification point of view.

Abstracts of KFRI Research Reports

KFRI Res. Rep. No. 405

Macro-Propagation of Two Commercial Bamboos *Bambusa balcooa* and *Dendrocalamus brandisii*

Seethalakshmi KK, Raveendran VP

Technologies for large-scale production of planting stock are not available for many commercial bamboo species. This project was undertaken to standardize propagation techniques for production of planting stock of two priority species of bamboos, *Bambusa balcooa* and *Dendrocalamus brandisii*. Experiments conducted with culm cuttings of *B. balcooa* showed 100 per cent rooting and the response depended on concentration of growth regulator treatment and position of cuttings. Attempts to use branch cuttings showed varying results. About 30 per cent rooting was obtained in *B. balcooa* when cuttings were collected and planted in March. Experiments carried out inside the field propagation unit at Kottappara, which contained trenches covered with polythene sheet (poly tunnel) for maintaining high humidity, did not give any promising results.

For *D. brandisii* culm cuttings were used to standardize the protocol of vegetative propagation using five different concentrations of two growth regulating substances - NAA and IBA; three seasons - summer, rainy and winter and three different positions – base, middle and top were taken for the study. In general, the cuttings collected from the basal portions of the culm during the summer season and treated with IBA gave maximum rooting response. Cluster analysis revealed that the cuttings collected during summer season from basal portion of the culms treated with 100ppm of IBA as the superior treatment. Branch cuttings did not give any positive result in this species.

KFRI Res. Rep. No. 406

Documentation and Conservation of Small Mammals of the Sacred Groves of Kerala State, Peninsular India

Padmanabhan P

A survey of small mammals (weighing less than 5 kg) was conducted in the sacred groves of Kerala from 2005 to 2009. About 300 sacred groves are documented. The animals found in the sacred groves were of two types, namely the group of organisms like snakes, frogs, lizards, lower and higher group of fauna which nested there and those which visited the grove temporarily for food and shelter. The floristic composition was highly influenced due to the anthropogenic pressures, cattle grazing, edaphic and climatic factors. The biodiversity of these areas is quite distinct from that of the surroundings. Survey and socio-cultural aspects of sacred groves was studied and threats to the sacred groves documented. The role of small mammals in the sacred grove ecosystem was analyzed. Protection was comparatively higher in religiously protected scared groves. Sixty species of small mammals were documented, of which 75 % were bats and rodents. Numbers of small mammals documented were 3 species of insectivorus, 27 species of Chiroptera, one species of Primates, one species of Pholidata, 14 species of Rodentia, 4 species of carnivore, one species of *Lagomorpha* and one species of *Artiodactyla*. Fragmentation of sacred groves, urbanization, disappearance of old belief system, waste disposal, alteration of habitat, removal of biomass, fragmentation of sacred groves due to partition of joint families and formation of nuclear families, felling of old trees and thereby destruction of roosting sites of small mammals were main threats. Sacred groves which were religiously protected and bigger in size gave more protection to mammals. Prevention of further fragmentation, giving economic remuneration and award for protection of groves, declaring sacred groves as community forestry center with assistance from Government agencies will prevent further fragmentation and protect biodiversity rich sacred groves from extinction.

KFRI Res. Rep. No. 407

Developing A Safer (Biological) Preservative Against Bamboo Borer Based on Traditional Knowledge

Varma RV, Raju Paduvil

During the course of an early study on post- harvest technology to economize bamboo resource utilization, a few biological preservatives based on traditional knowledge were tested. Amongst these, a biological preservative based on traditional knowledge from carpenters involved with temple construction was the most promising. Here an attempt was made to refine the procedure and protocols connected with the preparation of this bio-preservative. The main objective was to scientifically develop a protocol and evaluate the product consisting of 9 biological products against borers and termites attacking bamboo. The laboratory tests proved the efficacy of the preservative against borers attacking

bamboo and also under field conditions prevented termite attack. Commercial production procedure of this bio-preservative and evaluation through an interactive process to gain acceptance among the user agencies have to be explored.

KFRI Res. Rep. No. 408

Natural Enemies of the Red Palm Mite in India

Sudheendrakumar VV, Sankaran KV, Mujeeb Rahman P

Red Palm Mite (RPM), *Raoiella indica* Hirst (Arachnida: Acari: Tenuipalpidae), is a pest of coconut, areca, date palm and many other ornamental as well as commercial palm species. The mite is bright red in colour and attains an average 245 microns long and 182 microns wide. The life cycle completes within 20 to 28 days. The aim of the project was to study the population dynamics of this mite and to survey the natural enemies associated with it in its native range so as to develop a biocontrol strategy to tackle the problem.

Areca catechu and *Cocos nucifera* are the major host plants in India and feeds on the underside of the palm fronds. Field and laboratory studies were carried out in order to assess the relationships between RPM, its natural enemies and other factors such as climate and host. Spatial and temporal surveys were carried out in coconut and arecanut during 2008 and 2009. Two sites were chosen for each species (Palakkad and Peechi for coconut and Kunnamkulam and Nilambur for arecanut), that are drier and wetter, climatically.

The results showed that, in general, RPM populations were initially very low in November and December and high in February and March. All sites showed a significantly higher RPM population in March than in December. Various predators like *Amblyseius* spp., *Stethorus keralicus* etc. were also recorded during the study. It was found that there was a significant effect of site temperature and host plant species on RPM population. Predator (phytoseiid) number was not related to site temperature, but it was slightly related with site humidity. There was, however, a very significant correlation between average phytoseiid number and rainfall of the previous month ($F=23.49$, $p<0.01$), although no correlation was seen between phytoseiid number and rainfall in the current month ($F=0.37$, $p=0.55$). These results indicate that the increase in populations of RPM is not only linked to temperature, but also to the host plant, number of predatory mites present, humidity and rainfall. Laboratory studies proved that phytoseiid feeds on red palm mite, but rearing and bioassay was difficult because phytoseiids always showed escaping behaviour from the arena. Wind-dispersal traps were installed in the field to study the mechanism of dispersal of RPM and study indicated that RPM dispersed through the wind current, which gave some clue to the rapid expansion of the mites in the invasive range. Aerial dispersal occurred when the populations were dense on the tree canopy.

To summarise, the results showed that the most abundant predator associated with RPM is the phytoseiid mite. There were high numbers of phytoseiid mites during the months of December and January but there was a significant drop in numbers in the later period. Phytoseiid mites were highly correlated to rainfall of the previous month, and negatively correlated to RPM populations, even though laboratory data has shown that these mites do feed on RPM. From this information, it could be postulated that the predator is indeed adapted to feeding on RPM but it is poorly synchronised. RPM on the other hand, has an abundance of suitable host plants and ideal weather conditions for population expansion

KFRI Res. Rep. No. 409

Resource Enhancement and Processing of Cane and Bamboo Species Suitable for Handicrafts (6 components)

Seethalakshmi KK

This is the cumulative report of the work done by Kerala Forest Research Institute, Peechi as a part of the UNDP-GO1 project on Cane and Bamboo species suitable for handicrafts sponsored by Ministry of Textiles. The project consisted of the following sub projects. 1. Set up integrated gene pool banks 2. Undertake survey and documentation of cane and bamboo species used in handicrafts 3. Adopting techniques like macro-proliferation and tissue culture in addition to traditional rhizome planting 4. Develop packages for nursery and silviculture techniques 5. Establish germplasm banks for propagation and conservation techniques 6. Set up tissue culture and plant multiplication nurseries 7. Set up farms with NGOs/ farmers 8. Set up oil-curing units 9. Conduct training 10. Publicity and awareness

KFRI Res. Rep. No. 410

Taxonomy of Palms (AICOPTAX Project)

Renuka C

In India the family is represented with 22 genera and 106 species and is of restricted distribution in three major geographical regions viz: Peninsular India, North and North Eastern India and Andaman & Nicobar islands. The largest genus, *Calamus* with 47 species is followed by *Phoenix* with eight species and *Daemonorops* with six species. Out of 106 species, about 43 species are endemic. Palm populations in the wild are decreasing. Genera like *Borassus, Calamus, Corypha* etc., are threatened because of their constant and

increasing utilization. Over exploitation is one of the major threats to the survival of many wild palm species.

KFRI Res. Rep. No. 411

Preparation of Biodiversity Conservation Plan for Muthikulam High Value Biodiversity Area.

Renuka C *et al*

Muthikulam High Value Biodiversity Area is located in Mannarkad Forest Division, which borders the North-western portion of the Western Ghats on the northern side of Palakkad gap in Mannarkad Taluk of Palakkad District. The present Mannarkad Forest Division comprises three Ranges viz., Mannarkad, Attappady and Agali with headquarters at Mannarkad, Mukkali and Kalkandy respectively. Subsequent to the nationalization of private forests, the vested forests of Palakkad District were brought under a newly created Palakkad Special Division with effect from 10.5.1971. With a view to have a compact area of administrative units with boundaries in consonance with the district and taluk boundaries, for even distribution of the protection task and for better administrative convenience, the three forest divisions in Palakkad District namely Palakkad, Palakkad Special and Nemmara were amalgamated and reorganized. Accordingly, the present Mannarkad Division came into being with all Reserve Forests and Vested Forests of Mannarkad Taluk, Palakkad District.

KFRI Res. Rep. 412

Protection and Conservation of Sacred Groves in Kerala

Chandrashekara UM

The sacred grove concept is one of the strategies developed by many human societies to conserve biological resources using a traditional approach. Recognising the importance of sacred groves, both in terms of conservation of biodiversity and cultural diversity, and in view of the threats faced by the groves, the Government of India has launched a Scheme `Protection and Conservation of Sacred groves' within its programme `Intensification of Forest Management'. As a part of this Central Government sponsored scheme, the Department of Forests and Wildlife, Government of Kerala (KFD) initiated the `Protection and Conservation of Sacred Groves' project in Kerala. This scheme is coordinated and monitored by the Biodiversity Cell (BDC) of the KFD and implemented through respective Assistant Conservator of Forests (Social Forestry) of each District. The Assistant Conservator of Forests (ACFs of Social Forestry) invited applications from the owners of sacred groves within their Districts after giving wide publicity through media. An expert committee constituted by the BDC scrutinised the applications and selected the sacred groves to be supported. Initially, twenty eight sacred groves belonging to Devaswoms and Trusts were selected for support. The two tasks namely inventory of these sacred groves for documenting flora and fauna and preparation of Management Plan for each sacred grove have been assigned to the Kerala Forest Research Institute (KFRI). By conducting field visits and stakeholder meetings with local community and owners of the grove, KFRI documented the socio-cultural and ecological dimensions of sacred groves.

The study revealed that the total area of sacred groves ranged from 0.04 ha to 24.0 ha and in majority of the groves, area occupied by the vegetation was more than 76 per cent of total area of the grove. While most of the sacred groves were surrounded by the crop lands, some were bordered by highly degraded forest lands and barren lands. Many sacred groves held water resources in the form of ponds, streams or wells. These water bodies, in many sacred gloves played important ecological roles by providing water for organisms living in and around the groves. Mainly four major forest types, namely evergreen, semi-evergreen, moist deciduous and mangrove forests were seen among twenty-eight sacred groves and the forest patches showed different degrees of degradation. A total of 670 angiosperm species, 154 butterfly species and 122 bird species were recorded from these sacred groves. Among them, 133 angiosperm species, 5 butterfly species and 8 bird species were endemic. Though the inventory of angiosperms, birds and butterflies in sacred groves conducted through this study provided rather preliminary results it indicated directions along which we must work further to document and organise comprehensive programme of maintaining biodiversity. In this document, the need of a Sacred Grove Biodiversity Network (SGBN) of Kerala State as a broad programme of biodiversity monitoring is also projected. The present study also highlighted the role of sacred groves in the religious and socio-cultural life the local people. Majority of the sacred groves are associated with female deities and devotees dedicated offerings, generally agricultural products, for the fulfillment of their wish. Festivals and performing arts related to different sacred groves were documented. Even though some restrictions existed, women participated in the traditional activities, conservation and day-to-day management of many sacred groves. During the participatory appraisal meetings, the participants highlighted the fact that many sacred groves are now threatened. Among twelve major threats faced by sacred groves, dumpage of solid waste materials, trespassing, illegal collection and removal of small fallen timbers and other forest

products were prominent. Altogether 26 management strategies were recognized for the conservation and protection of these sacred groves. Even though the social barrier is more appropriate, the study revealed that in the present day socio-cultural context, physical barriers such as fencing and compound wall are needed to protect sacred groves till the attitude of stakeholders towards sacred groves becomes positive.

The participatory approach adopted in this project helped to prepare the budget estimates for grove-specific management activities. The KFRI prepared the Management Plan for each of the twenty eight sacred groves and submitted to the BDC. Among others, each Management Plan provides details of cultural and ecological significance of the grove, the contribution by the owner and the local community in the conservation efforts, institutional mechanism whereby all stakeholders lend their support to the conservation of the sacred grove, budget estimates for management activities and mechanisms for monitoring and evaluating the management activities. After scrutiny by the Expert Committee, the Management Plans have been forwarded by the BDC to the Government of India for financial support.

KFRI Res. Rep. No. 413

Commercial Volume Tables for Selected Home Garden Trees of Kerala

Krishnankutty CN

Different types of commercial volume prediction equations were developed for each species through regression analysis, using data on diameter (m) at breast-height of sample trees before felling and corresponding volume (m3) of commercial timber measured after felling. Diameter of each tree was calculated from the girth over-bark measured at the breast-height level (1.37 m from ground). Volume was measured under-bark of logs or billets above 40 cm mid-girth over-bark of teak, matty and mango trees. By tabulating the girth at breast-height in cm and volume in m3, commercial volume tables were prepared for each species. The tables provide volume estimates corresponding to different values of girth at breast-height of trees which can easily be measured at site.

KFRI Res. Rep. No. 414

Regeneration Study of Selected Terminalias in Kerala

Chandrasekhara Pillai PK, Chandrashekara UM

Successful management of natural forests depends on good natural regeneration of valuable species. The present investigation was conducted in the Kerala part of Western Ghats from northern to southern forest circles representing all the ranges belonging to each forest division. The study envisaged to assess demographic details of *Terminalia crenulata, T. paniculata, T. travnacorensis* and their regeneration status in natural populations. *T. crenulata* and *T. paniculata* are mainly confined to moist deciduous forests. *T. travacorensis*, a large tree endemic to the Western Ghats, occurs in low level evergreen forests of Kerala. These species are important components of our natural forest ecosystems. A total of 218 plots were enumerated (51.7 ha) throughout Kerala. Seeds of *T. crenulata, T. paniculata and T. travancorensis* were subjected to viability test and pre-sowing treatments to enhance germination under laboratory condition. A trial for vegetative propagation of the species was also carried out. Trees of *T. paniculata were observed in 168 plots, T. crenulata in 101 plots and T. travancorensis in 5 plots with a density (trees ha^{-1}) of 67.14, 19.01 and 0.46.* Frequency, basal area and importance value index (IVI) of the species were 0.78, 0.47, 0.02; 1 m^2, 179.9 m^2, 13.1 m^2; 54.118, 19.031, 0.996 respectively. About 250 species were enumerated from the study sites and *X. xylocarpa* was the major associate species with a density, frequency, basal area and IVI of 28.94, 0.43, 158.6 m^2, and 21.001, respectively. Overall species richness (R=26.93) and diversity (H=3.71) of the study sites showed a high value. Generally, density of *T. paniculata was higher than that for T. crenulata* with a significant difference between forest circles (p=0.01) for *T. paniculata* and p=0.05 for *T. crenulata*). The study indicated that *T. paniculata* is more or less stable compared to *T. crenulata*. However, occurrence of *T. travancorensis* is limited to the few localities in Kerala.

Regeneration enumeration was carried out from all the temporary plots established in each forest division. Generally, regeneration of *T. paniculata* was more when compared to *T. crenulata*. Regeneration in the study sites had a density of 73.58 for *T. paniculata*, 18.47 for *T. crenulata* and 0.019 for *T. travancorensis*. Of the total regeneration of *T. paniculata*, 46% comprised unestablished seedlings (<3 cm collar girth), 24% established saplings (39.9 cm Gbh) and 30% advanced (poles) category (1030 cm Gbh). 56 per cent of the regeneration of *T. crenulata* comprised seedlings, 26% saplings and 18% poles. However, the regeneration of *T. travancorensis* was negligible, i.e., only a single pole of *T. travancorensis* was found from the study sites. Regeneration of *T. paniculata* and *T. crenulata* between forest divisions was significantly different p=0.01). However, it was not in par with mature trees. The study revealed that germination of *T. paniculata* was very low due to infertility and heavy pest infestation. With

respect to *T. travancorensis*, weathering treatment of seeds was needed to get a better germination. Juvenile shoots from the established seedlings responded to rooting hormones. Optimum combination for better rooting was IBA+Kinetin at 6000 ppm.

KFRI Res. Rep. No. 415

Multilocational Field Trials for Selected Bamboo Species in Kerala

Raveendran VP, Seethalakshmi KK, Unni KK

The bamboo multilocational trials in Kerala under NMBA were undertaken by KFRI in the private farm land and Government non-forest lands in Palakkad district. The details

of the trials carried out were: 1. Multilocational species trial: Performance of eight species, viz., *Bambusa bambos , B. tulda, B. nutans, B. balcooa, Dendrocalamus hamiltonii, D. asper, Guadua angustifolia and Ochlandra travancorica.* 2. Spacing trials: Effect of different spacing on growth and performance of *Ochlandra travancorica* 3. Bamboo-based cropping systems: Intercropping in *Bambusa bambos* plots 4. Clump management: Adoption of different practices for management of congested *Bambusa bambos* clumps. Plantations were raised in an area of 2.97 ha at different locations in Palakkad district. Multilocational species trials: 9600 sq. m. at Vilayannur, Spacing trials: 11463 sq. m. at Dhoni, Bamboo-based cropping systems: 3888 sq. m. at Kinassery and Clump management: 4725 sq. m. at Nellikkad. Observations were recorded at six monthly intervals for a period of four years. When the performance of three different types of planting stock was compared, rooted cuttings (*B. balcooa, B. nutans and D. hamiltonii)* performed better than seedlings and TC plants. The highest biomass per culm was observed in *B. balcooa*. From the observations made for three years on spacing trial of *O. travancoria*, it is clear that the seedlings planted at 9m x 4.5m x 4.5 m and 5m x 5 m produced the highest number of culms and thereby the maximum yield. The intercropping with *B. bambos* was found to be promising in the initial years. The clump management plots are ready for initiating the management activities and further studies are required for arriving at more meaningful conclusions.

KFRI Res. Rep. No. 416

Evaluation of the Effectiveness of Water Submersion Method for Protection of Bamboo from Borer Damage

Bhat KV

Submersion of freshly harvested bamboo culms in water for a certain length of time is a traditional method of bamboo preservation followed in rural areas of India. A previous study has indicated a decrease in starch content of culms as a result of this treatment and the involvement of some microorganisms with starch depletion. The present study was conducted to investigate the rate of starch depletion in culms stored under water and the role of microbial population in the process. It was found that the starch stored in culm tissues was reduced by more than half in a two months period at a slow and gradual pace. Extending the length of submersion period by one more month led to further reduction in starch content. The activity of starch hydrolyzing enzyme α-amylase by microorganisms was responsible for the starch depletion. Even the water used in the submersion experiment showed amylase activity but it was low as compared to that in the tissue extract from submerged culms.

The total microbial population comprising bacteria, fungi and actinomycetes within bamboo tissues increased drastically within 15 days after submersion. While aerobic microorganisms showed an early decline after 15th day, anaerobic organisms capable of starch degradation continued to increase up to 45th day. Increase of aerobic microorganisms in stagnant water was not considerable whereas their population increased in running water. Thus anaerobes were the most active starch degraders in stagnant water whereas, aerobes could degrade starch only in running water where oxygen is continuously replenished. About 75% of the bacteria were gram-positive spore forming *Bacillus* species, while 25% were gram negative cocci. There were a few actinomycetes but fungi were rare. The total anaerobes increased continuously even 60 days after keeping the bamboo pieces in stagnant water. But the population increase for aerobic as well as anaerobic starch degraders was not very rapid. The increasing populations of starch degraders within the submerged bamboo tissues and in bamboo-soaked water explain the decline in starch content when submerged under water. It is thus evident that water submersion treatment leads to depletion of storage starch in bamboo culms due to microbial activity and makes it less attractive to borers.

KFRI Res. Rep. No. 417

Strengthening the *ex-situ* conservation of evergreen trees

Unni KK

A total of 181 species have been raised in the conservatory plot. Among these, the species such as *Actinodaphne malabarica, Aglaia barberi, Aglaia malabarica, Atuna travancorica, Beilshmiedia wightii, Canarium strictum, Chrysophyllum roxbourghii, Cynometra beddomei, Diospyros paniculata, Dipterocarpus bourdillonii, Dipterocarpus indicus, Humboldtia bourdillonii, Hydnocarpus macrocarpa, Hydnocarpus pentandra, Kingiodendron pinnatum, Mesua thwiatesii, Otonephelium stipulaceum, Poeciloneuron indicum, Pterospermum rubiginosum, Syzygium stocksii, Syzygium travancoricum, Vepris bilocularis* etc. are, rare endemic and threatened trees of Western Ghats. Altogether 1000 plants representing 45 families and 132 genera have been raised in conservatory plot.

The growth of some selected species planted were monitored at 6 months intervals for the sapling stage and yearly intervals for the tree stage. The general perfomance of seedlings raised in the conservation plot showed some major difference in the growth rate. Some of the species like *Aglaia malabarica, Alangium salvifolium, Ancistrocladus heyneanus, Archidendron monadelphum, Atuna travancorica, Chukrasia tabularis, Cleidion javanicum, Cynometra beddomei, Garcinia spicata, Goniothalamus wynaadensis, Gymnacranthera canarica, Humboldtia brunonis , Meiogyne pannosa, Otonephelium stipulaceum, Syzygium palghatense , Vateria macrocarpa* are very poor in growth and species like *Acrocarpus fraxinifolius, Aphanamixis polystachya, Dimocarpus longan, Carallia brachiata, Croton malabaricus , Chrysophyllum cainito , Cleisanthus collinus , Dimocarpus longan, Dipterocarpus bourdillonii, Euodia lunu- ankenda, Grewia tiliifolia, Harpullia arborea, Holoptelia integrifolia, Hopea parviflora, Hydnocarpus macrocarpa, Hydnocarpus pentandra, Kingiodendron pinnatum, Poeciloneuron indicum, Pterospermum reticulatum, Pterospermum rubiginosum, Semecarpus kathalekanensis, Swietenia macrophylla, Syzygium chavaran, Xylia xylocarpa* showed better growth rate. The *ex-situ* conservation of various species is maintained at FRC, Velupadam for addition of species and also as a source of maintained data for various studies.

KFRI Res. Rep. No. 418

Studies on Controlling Teak Defoliator Outbreaks by Seeding Baculovirus HPNpV in Epicenter Populations

Sudheendrakumar VV, Sajeev TV, Bindu TN

The *Hyblaea puera* nucleopolyhedrovirus (HpNPV) is an ideal biocontrol agent for management of the teak defoliator, *H. puera* because of its host specificity, virulence and eco-friendly nature. However, application of HpNPV in extensive teak plantations is quite difficult owing to the rugged terrain of the plantation and height of the trees. The project was undertaken in the above context to develop a landscape level teak defoliator management strategy using the virus combining the knowledge on the population dynamics of the insect and the vertical transmission characteristics of the pathogen.

Vertical transmission of HpNPV (parent to offspring transmission) influencing different biological characters of the host was parameterized using a 76.81 kbp isolate of HpNPV under laboratory conditions. Infection of the fifth instar larva with a sub lethal dose of one hundred inclusion bodies of the virus revealed reduction in the survival of the larvae (20-40%), pupation (28%), adult emergence (27-66%), fecundity (50-78%), egg laying period (2 days), hatchability of the eggs (40%) but no change in the sex ratio. The reduction in reproductive potency due to vertically transmitted HpNPV from the parent to F1 generation inflicted collapse of the population in the F2 generation. This was further supported by sublethal dosing of HpNPV in a natural epicentre population in the Kariem-Muriem teak plantations, Nilambur, Kerala during March 2008 which also vertical transmission of HpNPV.

The trials on probable resistance of *H. puera* larvae to sublethal virus infection showed that the successive offspring generations were more susceptible to virus infection thereby ruling out the possibility of such a phenomenon in *H. puera*.

The results of this study indicated that one time low dose application of HpNPV during the epicentre phase of the teak defoliator population could contribute to the reduction in the insect population not only in the parent population but also in the F1 generation. This method of HpNPV application in the teak defoliator epicentres may be practiced for management of the teak defoliator at landscape level.

Academic and Extension Activities

Publications in Journals

Balasundaran M, Jayson EA, Jayahari KM, Brinda CM, Arathy K (2012) Non invasive genotyping and genetic diversity of elephants: A case study of 43 captive elephants. Reyono Journal of interdisciplinary studies 1(1): 141-150.

Bindu TN, Balakrishnan P, Sudheendrakumar VV, Sajeev, TV (2012) Density-dependent polyphenism and baculovirus resistance in teak defoliator, *Hyblaea puera* (Cramer). Ecological Entomology (2012), 37, 536–540.

Chandrasekhara Pillai PK, Pandalai RC, Dhamodaran TK, Sankaran KV (2012) Effect of silvicultural practices on fibre properties of *Eucalyptus* wood from short-rotation plantations. New Forests DOI 10.1007/s11056-012-9360-6 (online).

Jijeesh CM, Seethalakshmi KK, Raveendran VP (2012) Flowering, reproductive biology and post flowering behaviour of *Dendrocalamus sikkimensis* Gamble in Kerala, India. Bamboo Science and Culture: The Journal of the American Bamboo Society 25 (1): 1-7.

Jose PA, Pandurangan AG, Hussain A (2012) New variegated garden plant. Indian Horticulture 57(1): 32-33.

Lakshmi M, Bindu R Nair, Chandrasekhara Pillai PK (2012) Pharmacognostic evaluation and phytochemical analysis of bark and leaves of *Terminalia travancorensis* Wight & Arn. (Combretaceae). Journal of Pharmacy Research 5(4): 1988-1991.

Mujeeb Rahman P, Sudheendrakumar VV, Sankaran KV (2012) Does the tiny mite matter? Revisiting invasive pest problem under global climate change scenario Current Science. 103 (3): 252-253.

Thulasidas PK, Bhat KM (2012) Mechanical properties and wood structure characteristics of 35-year old home-garden teak from wet and dry localities of Kerala, India in comparison with plantation teak. Journal of the Indian Academy of Wood Science 9(1):23-32. doi:10.1007/s13196-012-0062-7

Sreekanth PM, Balasundaran M, Nazeem PA, Suma TB (2012) Genetic Diversity of nine natural *Tectona grandis* L.F. populations of Western Ghats in Southern India. Conservation Genetics 13: 1409 - 1419

Papers/Chapters in Books/ Proceedings/Newsletters

Chandrashekara UM (2012) The Growing Importance of Traditional Forest-related Knowledge. In: Saxena KG, Luohui Liang, Koji Tanaka and Shimak Takahashi (eds. Land Management in Marginal Mountain Regions: Adaptation and Vulnerability to Global Change . Pp 89-98; Bishen Singh Mahendra Pal Singh, Dehra Dun. 350p.

Easa PS, Nameer PO, Sunil B (2012) Ecology and One Health. In: (Eds.) Latha C and Sunil B. Proceedings of the National seminar on One Health in addressing the Food Security Challenges", pages, 184-186., held at KVASU, Mannuthy on 16-17 Feb. 2012.

Nameer PO, Easa PS, Ommer PA (2012) Cranial Anatomy as a Tool in Wildlife Taxonomy. In: (Eds.) Chungath, J.J *et al.* Emerging Concepts in Veterinary anatomy pages 124 - 144. Department of Veterinary Anatomy and Histology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala

Prasanth KM, Sreekala PP, Sandeep S, Kripa PK, Sreejesh KK (2012) Heavy metals and its fractions in soils of koratty region, Kerala.2nd International Science Congress at Vrindavan (Mathura), UP, India , 8th - 9th December 2012.

Ramakrishanan PS, Rao KS, Chandrashekara UM, Chhetri N, Gupta HK, Patnaik S, Saxena KG, Sharma E (2012) The Growing Importance of Traditional Forest-related Knowledge. In: Parrotta JA, Trosper RL (eds.) Traditional Forest-related Knowledge: Sustianing Communities, Ecosystems and Biological Diversity, World Forest. Pp.315-356. Springer Science + Business Media, New York. 621p.

Sivaperuman C, Jayson EA (2012) Avifauna of Kole wetlands: Species diversity and bundance distribution patterns. In (Mamta R. & S. Dookia Ed.) Biodiversity of Aquatic Resources, Daya Publishing house, Delhi, India. 145 – 158.

Sivaperuman C, Jayson EA (2012) Population flucations of shorebirds in the Vembanad-Kole Ramsar site, Southern India. Recent Advances in Biodiversity of India, In (Ragunathan et al.Ed.) Zoological Survey of India, Kolkata, P. 419-428.

Suresh K Govind, Jayson E A (2012) Human - elephant conflict (HEC) in Thrissur District, Kerala, India In Proceedings of the Second Indian Biodiversity Congress (Abstract), Indian Institute of Sciences, Bangalore. P.145.

Suresh K Govind, Jayson EA (2012) Crop damage by wild animals in Thrissur District Kerala. In International conference on wildlife with special emphasis on Human-animal conflict (Abstract), St. Berchmans College Changanacherry, Kerala. p.26.

Thomas P Thomas, Sandeep S, Sankar S (2012)Forest plantations and soil health in Kerala – A review. In proceedings of National seminar on Forest Health Management : 21 – 22 March, 2012 , IFGTB, Coimbatore.

Seminars/Workshops/Training attended

Dr. PK Chandrasekhara Pillai

Training on 'Modern Trends in Forestry Research' during April 19-20, 2012 for Forest Guards of Kerala Forest School, Walayar.

Forestry Extension Education Training Programme for the staff of Social Forestry Wing of Central Region, Ernakulum on July 28, 2012.

Training Programme on 'Forest Nursery Management and Planting Stock Production' for Women (20 participants from Mundathicode Grama Panchayat) sponsored by Kerala State Land Use Board, Thrissur during September 26-28, 2012.

Dr. EA Jayson

Sivaperuman C, Jayson EA (2012) Abundance, distribution and conservation of wetland birds in the Kole lands of Kerala (Abstract). Invited lecture entitled "Diversity of birds in Kerala" in the session on Avian biodiversity. National conference on Conservation and management of wetland ecosystems, School of Environmental Studies, M.G. University, Kottayam.

International conference on wildlife with special emphasis on human-wildlife conflict, St. Berchmans College, Changanacherry, Kerala, p.26

10th NIAS-DST course for senior Scientists/ Technologists on "Multidisciplinary perspectives on science, technology and society" September 24- October 05, 2012.

Dr. PS Easa

National Seminar on One Health Initiative in addressing Food Safety Challenges. February 16-17, 2012.

Workshop on Futuristic Goals and March towards Excellence in Science and Technology in Tamilnadu organized by the State Planning Commission, Tamil Nadu on 21st September at Chennai and presented a concept paper.

International Conference on Wildlife Biology with special emphasis on Human- Wildlife Conflict. Organised by SB College, Changanassery on 17-08-2012 and gave a special lecture on Human Wildlife conflict - a review of the problem and the mitigation measures in India.

Biodiversity Conservation Challenges in Orientation Programme for College Teachers, Academic Staff College, Calicut University

Dr. S Sandeep

National seminar on Forest Health Management: March 21 – 22, 2012 , IFGTB, Coimbatore.

Dr. KK Seethalakshmi

Workshop on Bamboo Cultivation, Sustainable Harvesting and Utilization at International Centre, Panaji, Goa on March 23, 2012 . Invited resource person and delivered a lecture on Plantation and harvesting techniques for bamboos and species suitable for cultivation and production of planting stock.

Dr. KA Sreejith

National workshop on 'Methods for assessment of ecosystem services of sacred groves' held at Shillong, on July 13-14 Chandrashekara, UM and Sreejith, KA Methods for calculating biodiversity indices and assessing the level of disturbance in sacred groves of India.

Dr.PK Thulasidas

2012 IUFRO All Division 5 (Forest Products) Conference, 8-13 July 2012, Estoril, Lisbon, Portugal and presented two papers:

1. Wood Property Variations of Indian Teak Provenances by P.K. Thulasidas, E.P. Indira, A.R. Jisha Chand, and Sojan Jose

2. Evolving Elite Plants with Low Lignin and High Cellulose Reed Bamboos (*Ochlandra* spp.) from the Western Ghats of India for Pulp and Paper Industry by PK Thulasidas, KM Bhat, EM Muralidharan, RC Pandalai, S Budhan, Anil Sood and Ajit Shasany

Extension activities/ Guest Lectures/Classes

Dr. V Anitha

Resources person, Bamboo Technical Support Group (south zone) on the economic and livelihood potential of bamboo

Dr. UM Chandrasekhara

Resources person on the Ecology and Management of Sacred Groves at Envrionment and Leadership Training Initiative (ELTI) Workshop organised by Yale University and Smithsonian Tropical Research Institute (STRI) in Kandy, Sri Lanka on July 16-17, 2012.

Dr. PK Chandrasekhara Pillai

Resource person in "Priority Species, Resource Estimation, Plantation Development, Post Harvest Technology and Socio-economic Livelihood Potential of Bamboos" during July 23-27, 2012; September 10-14, 2012 supported by National Bamboo Mission (Bamboo Technical Support Group for South Zone) for the Field Functionaries.

Dr. PS Easa

Role of teachers in Environmental Conservation in Orientation Course for College Teachers, Academic Staff College, Calicut University, 13th September 2012.

Challenges in wildlife Conservation, in Orientation Course for College Teachers, Academic Staff College, Calicut University, 10th November 2012.

Biodiversity Conservation in Orientation Course for College Teachers, John Mathai Centre, Calicut University. 21st January 2013

Biodiversity Conservation, in Orientation Course for College Teachers, Academic Staff College, Calicut University, 7th March 2013.

Dr. EA Jayson

KFRI EP-254/2012 EIA Authority: Second meeting of State Expert Appraisal Committee on 07-04-2012.

Resource Person for M.S. Wildlife Science students of Kerala Veterinary and Animal Sciences University, Pookode, Wayanad during April 2012.

Ph.D. qualifying Viva- Voce examination at MG University on 05-11-2012.

Ph.D. Viva-Voce examination at Zoology Department, Bangalore University on 22 nd June 2012.

Evaluation of Ecological Fragile Land (EFL) survey in Idukki Forest Division along with other committee members on October 15, 2012.

Nilgiri Tahr Census as Joint coordinator on May 29, 2012 in Eravikulam National Park.

Viva-Voce examination of M.Sc. Forestry student of Forestry College, Kerala Agricultural University in September 2012

Dr. R Jayaraj

External examiner for MSc Animal Science students at Central University of Kerala, Kasaragod

Dr. PA Jose

Visited the Abhayaranyam project site managed by the State Forest Department at Kodanad along with Research Co ordinator and other scientists of the Institute on 20 April 2012. The feasibility in establishing a Bio park and Plant conservatory garden for Western Ghats of Kerala in the Abhayaranyam was examined in detail and a draft proposal on the working plan and Budget for the same was prepared along with team scientists.

World Environment Day celebrations of the Institute held on 5 June, 2012. 42 RET plants in 17 spp. were supplied from the nursery for the planting activity.

Dr. UN Nandakumar

Estimated the volume &Value of standing trees proposed to be felled in the Campus of Hindustan News print Limited, Vellore(July –Oct.2012)

Dr. PK Thulasidas

Wood identification and testing for Judicial purposes, Kerala Forest Department, Public Sectors (Govt. Of India/Govt. Of Kerala) and for Private agencies and individuals.

Inspection Reports of forest areas under Pathanapuram Range, Kollam district on 7th May 2012 to offer expert advice on the selection and identification of Hopea wood marked for procurement for the second phase of renovation of Punalur Suspension Brige as per the request of the Director of Archaeology, Thiruvananthapuram.

Inspection and wood quality evaluation at of an old building procured by the Govt. of Kerala. The work was carried out for Asst. Conservator of Forests, Social Forestry Division, Alapuzha and of Dy. Police Supdt, Vigilance and Ant-corruption Bureau, Alapuzha.

Assessment and report submission regarding wood quality of 15 wooden cottages at Ponmudi hill station on request of Central Bureau of Investigation, Anti-Corruption Branch, Special Police Establishment, Cochin-17

Quality evaluation of teakwood used for the renovation of the Sree Chitra Enclave, Museum compound, Trivandrum on request of the Director, Museum & Zoos, Govt. of Kerala and a report submitted.

Dr. KA Sreejith

Resource person on different aspects of such as Assessment of Biodiversity, Climate Change etc. for MS (Wildlife Studies) students of Kerala Veterinary & Animal Science University on June 15-16

Resource person for 'Rivers of Kerala: its importance, problems, reasons and solutions' for social science teachers of Nilambur Educational Sub District at Chugathara Panchayath Hall on September 20, 2012

Classes on different aspects of biodiversity and its conservation on a regular basis for the visitors of KFRI Sub-Centre, Teak-museum and Bio-resource park

Meetings Attended

Dr. PS Easa

Animal Ethics Committee Meeting of the College of Veterinary and Animal Sciences, Mannuthy. 9th January 2012.

Wildlife Management Plan for West Singhbhum and Hazaribagh districts. Meeting/discussion of the Expert Committee. 10th to 14th January 2012.

TRAC Meeting, Wildlife Institute of India. 20th to 22nd February 2012; 18th September 2012 and 17th to 20th March 2013

Governing Council Meeting, SACON 23rd February 2012and 28th March 2013

Field visit for Management Effectiveness Evaluation of Protected Areas in India. 17th to 21st December 2012 (Kudremukh NP), 5th to 8th February 2013 (Silent Valley National Park), 9th to 10th February 2013 (Peppara Wildlife Sanctuary), 24th to 26th March 2013 (Srivelliputhur Grizzled Squirrel Sanctuary), 29th to 30th March 2013 (Point Calimere Sanctuary), 31st March 2013 (Ousudu Wildlife Sanctuary, Pondicherry)

30th May 2012 Chhattisgarh State Wildlife Board Meeting, Chhattisgarh

Meeting of the subcommittee of the Kerala State Board for Wildlife met at Forest Head Quarters -17th January 2013 (Aralam and Kottiyur), 21st January 2013 (Silent valley), 23rd January 2013 (Parambikulam Wild life Sanctuary) 24th January 2013 (Peechi- Vazhani, Chimmoni and Choolannur Wildlife Sanctuaries) and 1st February 2013 (Thiruvananthapuram) all the zones covering the Wildlife Sanctuaries and National Parks in Kerala.

11th February 2013-Wayanad Wildlife Sanctuary, Eco-sensitive Zones demarcation- meeting held at Kalpatta

17th February 2013- Interactive meeting at Chandaka Wildlife Sanctuary with regard to protection problems of Similipal Tiger Reserve and adjacent areas.

Dr. EA Jayson

Advisory Committee meeting of Mangalavanam Bird Sanctuary on 02-04-2012.

State level Steering Committee meeting on Nilgiri Biosphere Reserve meeting at Govt. Secretariat, Trivandrum on 15-06-2012.

Meeting convened by the Chief Wildlife Warden at Thiruvanathapuram on 12- 07-2012 to discuss the draft report of the wildlife census 2012.

Sate Environment Impact Appraisal Committee (SEIAC) meeting at Thiruvanathapuram in the months of July, August, September, November 2012.

Emerging Kerala meeting at Cochin on 13.09.2012.

Research Council meeting of Kerala Veterinary and Animal Sciences University at Mascot Hotel, Trivandrum on 27-11-2012.

Dr. UN Nandakumar

Represented the Director in the Consortium of experts evaluating the activities under 'Kuttanad Package'. Provided inputs for monitoring the activities and also provided suggestions for better implementation of the Package(April – Sept 2012)

Represented the Director in the meetings held in connection with the establishment of "Vembanad wetland Authority' and provided the inputs regarding the approaches required for forming the Authority (April- Sept 2012)

Represented the Director in connection with the visits of Dr.Siddarth Kaul, Advisor, Wetlands, MOEF, Govt. of India. Participated in the discussion and field visits to Shasthamkotta, Ashtamudi Lake and provided inputs for the conservation &management of these wetlands(Sept 2012)

Dr. KK Seethalakshmai

Steering Committee meeting of National Bamboo Mission on 5th May 2012 at Krishi Bhavan, Delhi

Membership in Committees

Dr. V Anitha

Member, State Expert Appraisal Committee Member (SEAC), Kerala.

Dr. PS Easa

Member, Training, Research and Academic Council (TRAC), Wildlife Institute of India, Dehra Dun, Nominated by Ministry of Environment and Forests (MoEF), Govt. of India.

Member, Governing Council, Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore, nominated by MoEF, Govt. of India.

Member, Research, Monitoring and Advisory Committee of Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore nominated by MoEF, Govt. of India.

Member, State Wildlife Advisory Board, Govt. of Chattisgarh.

Member, Protected Area Management Effectiveness Evaluation, South Indian PAs, MoEF, Govt. of India.

Member, Approval Committee of Tiger Conservation Plan for Tiger Reserves in South India, MoEF, Govt. of India.

Member, Expert Committee of Jharkhand Government for impact assessment due to iron ore and coal mining on forests and wildlife and preparation of Wildlife Management Plan for West Singhbhum and Hazaribagh districts.

Expert Member, Similipal Tiger Conservation Foundation, the Forest and Environment Department, Govt. of Odisha

Expert Member, Forest and Wildlife Protection Committee, the Forest and Environment Department, Govt. of Odisha

Main Nominee in Institutional Animal Ethics Committees of College of Veterinary and Animal Sciences (Kerala Veterinary and Animal Sciences University), Panchakarma Institute, (Shornur), Nehru College of Pharmacy (Pampadi), Karuna Medical College (Palkkad) and Central Tuber Crops Research Institute (Thiruvananthapuram) and Link Nominee in Institutional Animal Ethics Committee of Care Keralam Ltd (Koratty), Nominated by Animal Welfare Division, MoEF, Govt. of India.

Member, Committee for performance assessment of the faculties of SACON

Dr. KK Seethalakshmi

External examiner for the viva-voce for doctoral thesis entitled "Strategising an eco-friendly rural housing alternative using bamboo parabolic infill arches as load bearing elements" at Indian Institute of Technology, Delhi.

Dr. KA Sreejith

Expert committee member constituted by Kerala Forest Department to select suitable sacred groves for financial assistance

Book Released !!!

Abstracts – KFRI Research Reports 1975-2012

KFRI has recently published a compilation of the abstracts of its completed research projects carried out from the installation of the Institute in 1975 to as recent as 2012. The book was published as a part of KFRI's never ending process of creating research databases and provides a glimpse into the overall research activities undertaken by KFRI for the past three decades. The book covers a total of 449 research projects spanning to different areas of tropical forestry including biodiversity conservation, ecology and management of tropical natural and planted forests. The contents of the book are classified under 8 subject areas namely,

The copy of the book can be obtained from:

The Librarian,
Kerala Forest Research Institute,
Peechi-680 653.
Thrissur, Kerala

Plantation Forests, Natural Forests, Wildlife Biology, Propagation, Medicinal plants, Environmental and Fundamental studies, Wood Science and Technology and Socio-economics. Each abstract is accompanied by author's name, title of the research project, year of publication, Research Report No: and number of pages of research report. Author index and Subject index are given for the ease of use. This research abstract compilation with a nutshell of past research activities in KFRI would immensely benefit the researchers in tropical forestry and biodiversity conservation.

PhD Awarded

Mr. PK Chandrasekhara Pillai was awarded doctorate degree by the Forest Research Institute (FRI) University, Dehradun in April 2011 for his work on "Effects of Site Management Practices on Growth and Wood Properties of Eucalypts in Kerala" under the guidance of Dr. RC Pandalai, Silviculture Division. The study was carried out in plantations of *Eucalyptus tereticornis* at Punnala (9°06' N & 76°54' E) in Kollam District and *E. grandis* at Surianelli (10°02' N & 77°10' E) in Idukki District. Eucalypt plantations at both the sites were established during 1998. Sivicultural practices like nitrogen fertilizer input and weed management gave a significant improvement in the productivity of first rotation eucalypt plantations. Hence an in-depth study was also undertaken during the second rotation. This was taken up in 2005 after harvesting the first rotation crop. The objectives of the study were (i) to assess the residual effect of nutrient addition and weed management practices carried out during the first rotation on subsequent coppice growth of *E. tereticornis* and *E. grandis* and (ii) to evaluate the effect of nutrient addition and weed management practices on pulpwood properties of the species. The thesis has discussed the importance of plantation forestry, advantages of coppice plantations of eucalypts, need for improving their productivity, residual effect of site management on subsequent rotation and the influence of site management on wood properties. The experiments carried out in the study plots were 1) application of five doses of nitrogen (zero nitrogen, 18 kg N ha^{-1}, 60 kg N ha^{-1}, 187 kg N ha^{-1} and 375 kg N ha^{-1} supplemented with initial application of phosphorus fertilizer @ 63 kg ha^{-1} except in the control) and 2) two levels of weed management (no weeding and full weeding). Physico-chemical properties of eucalypt wood were evaluated from the 6.5 year-old first rotation trees grown in the experimental plots. From the study, it is evident that silvicultural interventions had significant influence on enhancing productivity of first rotation eucalypts; however, it has no residual effect on the coppice crop. However, coppice crop of *E. tereticornis* in the weed management plots showed significant residual effect till 18th month of growth. The study points to the need for further silvicultural inputs for enhancing productivity of subsequent rotations. The study also revealed that silvicultural interventions like nitrogen fertilizer input or weed management have no role in altering major physico-chemical properties of wood that adversely affect the pulpwood quality. However, the effect of weeding was significant for the bark content in *E. tereticornis*. It confirmed that improved tree growth, specifically, in *E. tereticornis* through routine weed management practices will result in low percentage of bark which is a very desirable quality for pulpwood. Dr. Pillai works as Scientist in KFRI.

Mr. Baiju EC was awarded doctorate degree by the Forest Research Institute (FRI) University, in May 2012 for his work on "Landuse and landscape dynamics in a microwatershed of Chaliyar River in the Kerala part of Nilgiri Biosphere Reserve" under the guidance of Dr. UM Chandrasekhara, Ecology Department. The present study, a detailed analysis of landuse and land cover dynamics in a micro-watershed of Chaliyar River in the Kerala part of NBR has been studied. The landscape of Karakkode micro-watershed comprises agricultural lands, natural forests and tree plantations as landscape units. In the semi-evergreen forest of the study area 67 species were enumerated, which represent a mixture of evergreen and deciduous species. About 91.5% of the total importance value index (IVI) of the tree community was contributed by evergreen species – an indication of less to moderate disturbance in the study plots. Thus, the semi-evergreen forest patches of the study area are in progressive succession. Unlike in semi-evergreen forest plots, here density of trees of smaller girth classes is lower than that of larger girth classes.The forest patches located close to the agricultural landscapes are highly degraded.

In the agricultural landscape units of the study area, out of 272 grid points which represent croplands, 234 grid points represent tree based cropping system. For understanding the structural, functional and management aspects of tree based cropping systems, a hierarchical cluster analysis was conducted using the IVI of tree community as main variable. Out of 8 clusters (hereafter, landuse clusters) obtained, two landuse clusters which represent polyculture farms and homegardens possess significantly high number of tree species; number very close to that for tree community in the semi-evergreen forest. The landuse cluster dominated by homegardens is rich in species diversity indicating that the farmers owing croplands (grids) in this cluster have comparatively better knowledge for selecting and managing species.

Out of 234 grid points, 51 were homegardens. The size of the homegarden ranged from 0.25 to 0.48 ha. Altogether 185 species were enumerated from 51 homegardens. The species diversity index value obtained for the homegardens is 1.72 to 2.64, with no significant correlation between species diversity and homegardens size. In the present study, an attempt has been made to classify the homegardens based on their age. Some old homegardens were characterized by the cultivation of more than three perennial crop species and no single species showed dominance in terms of density. These homegardens were considered as old mixed species dominant homegardens (OMSHG). Similarly, some new homegardens were also mixed species dominant homegardens (NMSHG). In few old homegardens and new homegardens, single species dominance was recorded and they were termed as old sing species dominant homegardens (OSSHG) and new single species dominant homegardens (NSSHG). The plant diversity index value was significantly higher in OMSHG followed by NMSHG, OSSHG and NSSHG. About 65% to 83% of total number of naturally growing species in mixed dominant species homegardens and 20% to 30% in single species dominant homegardens are managed. Since homegardens also contribute to *ex-situ* conservation of local plant diversity and serve as gene pool for eroding indigenous plant species. There is an urgent need to strengthen the traditional system of natural resource management for economic viability, ecological sustainability and social acceptability.

The temporal landuse changes in natural forests and agricultural lands are triggered by a combined effect of institutional changes, marketization and globalization. These drives of landuse change can also be responsible for spatial changes in landuse systems in the study area. Time series analysis using satellite images in the year 1973, 1990 and 2000 of the study area showed a drastic change in agricultural landscape in terms of cropping pattern. Village elder interview also pointed out that out of 195 grid points, which were under paddy cultivation about 30-years back, 172 were transformed into 11 different cropping systems. Thus, it is clear that land under different agricultural crops seen in the area has increased significantly at the cost of paddy fields.

The present work concentrates on a case study of a critical global environmental issue for long developed ecological systems. Though the data used in this thesis cover a relatively small region in Biosphere Reserve, the knowledge gained through case study is crucial for developing regional and global models of landuse and land cover change under human and policy influences. Though the analytical methods deployed in this thesis only count a small subset of available research techniques, the approach illustrated in this thesis serve as a demonstration of the integrated research methodology combining ecological and social methods and technologies in coherent manner, i.e., interactive and comprehensive in general and adjustable and focused in specific for seeking better understanding of a unique environmental concern.

Ms. Bindu K Jose was awarded doctorate degree by the Forest Research Institute (FRI) University, Dehradun in December 2012 for her work on "Diet and Dietary Requirements of the Teak Defoliators- *Hyblaea puera* and *Eutectona machaeralis*" under the guidance of Dr. VV Sudheendrakumar, Entomology Department. The main objective of the study was the development of an artificial diet to support all larval stages of the two important defoliator pests on teak, namely *Hyblaea puera* and *Eutectona machaeralis*. A complete artificial diet for these insects was an urgent need as their larval forms of these insects are being used for multiplication of natural enemies and for many research works. Analysis of seasonal and age related variations in chemical and physical properties of teak leaf, identification of functional role of diet ingredients, the relationship between leaf chemical components and population dynamics of teak defoliators and larval feeding patterns were carried out during these period. The study facilitated continuous rearing of *H. puera* and *E. machaeralis* larvae from the first to last instars exclusively on an artificial diet, which is meridic in diet categorization. The biochemical contents of the new diet were comparable with the tender teak leaf on which *H. puera* adapts most.

Seasonal variation seems to be unimportant in biochemical composition of teak leaf. The amount and types of volatiles were found to change according to seasons. During preoutbreak season of the teak defoliator, the tender leaves have six volatiles and five of them were recognized as insect attractants and oviposition stimulants. Mature leaf had three volatiles during the pre-outbreak season. In the outbreak season of the teak defoliator, the tender foliage had increased amounts and different types of volatiles, which would arouse several behavioral responses in insects. Caryophyllene and α- caryophyllene, the new compounds presented in the tender foliage in the pest outbreak season act as allomone, kairomone and insect attractant. Amount of α- pinene, was increased in tender and mature foliage in the outbreak season. In the post outbreak period the tender leaves hold only one volatile, while the mature leaves had no volatiles in them. Dr. Bindu works as a Research Associate in KFRI.

Mr. Ramamoothy Suganthasakthivel was awarded doctorate degree by the Forest Research Institute (FRI) University, Dehradun in December 2012 for his work on "Ecology and behaviour of selected arboreal mammals in the southern Western Ghats, India" under the guidance of Dr. KK Ramachandran, Wildlife Department. The study is one among the first attempt to understand the ecology of arboreal mammals in a non-protected area with a GIS perspective. The study has three objectives: 1. to assess the status distribution of arboreal mammals in Nelliampathy forests, 2. to study the food and feeding habits of selected arboreal mammals and 3. to study the behavior of certain primate species. The study area - Nelliampathy hills or Nelliampathies is a unique biogeographical area in the Anamalais. The accounts depicting the geography of Nelliampathies are extraordinarily weak and include very vast areas unrelated to the local and regional biogeography. The geographical extent of the study area is revised in a GIS background. Rainfall, vegetation, soil, bioclimate, geomorphology and physiographic maps were prepared from the available sources in GIS. The evergreen biotopes of the Nelliampathy plateau were selected as the intensive study area. Sweep surveys, line transect methods and GPS aided troop follows were the methods employed to study the status, distribution and behavior of the arboreal mammals. All the transect surveys were plotted in GIS. Food and feeding behaviour observations of Nilgiri langurs and lion-tailed macaques, and activity pattern of the lion-tailed macaques were studied for over 300 hours with ad libidum methods.

The following are the main conclusions made from this study: Eleven arboreal mammal species were recorded from the evergreen forests of the Nelliampathy forests. Two endemic mammals were reported for the first time in the study area. A large population of the endangered lion-tailed macaque and the vulnerable Nilgiri langur were recorded. The population densities of the important arboreal mammals were also calculated. The distributions of important arboreal mammals were mapped in GIS. The lion-tailed macaques were recorded feeding on 38 plant species whereas Nilgiri langurs fed on 53 plant species. The niche breadth and overlap measures were calculated between the two primate species. The behavioural study was the first study in recording the time activity budget of lion-tailed macaque troops in wild in Kerala. Habitat suitability analysis was done by GIS modelling method - Ecological Niche Factor Analysis (ENFA). Suitability surfaces were created and conservation implications were analyzed with the current landuse practices. A supervised multispectral satellite image classification was done in remote sensing satellite image to map the canopy connectivity of the plateau region. A bottleneck for arboreal mammals was identified in the Nelliampathy plateau region, termed as 'Karapara corridor'. The cardamom plantations in the plateau region are found to provide a feeble connectivity across the Karapara River amidst the canopy less tea plantations and sparse canopied coffee plantations. The drastic conversion of cardamom to coffee by removing the entire canopy and lopping of branches in the plantations along the Karapara River were identified as the major threats for the arboreal mammals in the region. The results are analyzed in GIS platform and the shortcomings in existing management approaches are discussed. The conservation of the evergreen habitats in Nelliampathy would help in preserving one of the endemic and significant populations of lion-tailed macaques and Nilgiri langurs outside the protected areas. The present study reveals the immense application and use of GIS and Remote sensing satellite image analyses in understanding the ecology and conservation of forested habitats in South India. Dr. Suganthasakthivel works as a Research Associate in KFRI.

Dr. C Chandrasekharan Memorial Award 2012

Dr. C Chandrasekharan Memorial Award-2012 is presented to Dr. K S Anoop Das by Dr. Chand Basha IFS (erstwhile Director, KFRI). Dr. Anoop Das is a researcher grown up in a village in Nilambur, Kerala, and worked on Bird communities for his Doctoral Research at Salim Ali Centre for Ornithology and Natural History, Coimbatore. His Post Doctoral Research has contributed to: Building baseline data on the least known taxa methodological revisions in the field of conservation ecology, knowledge on on ecosystem responses, evaluation of ephemeral systems in the tropics, research on climate change. His Ph.D was on the 'Bird community structure along the altitudinal gradient in Silent Valley National Park' (SVNP). Subsequently he worked on the responses of butterflies on natural tree falls in SVNP. Apart from the characterization of butterfly guilds in each of the forest types, his study aimed at identifying indicator species of butterflies for the specific habitat types. A novel study by Dr.K S Anoop Das is on one of the least attended issue, of the lesser known dynamics of the aquatic insect fauna of natural tree holes and its artificial analogues, in the Western Ghats. The programs, in which he is currently engaged are, evaluation of insects as bio-indicators, conservation of sacred groves, impact of pesticides on fishes, evaluation of ecosystem services and climate change effects on temperate and tropical montane bird communities. Dr. Anoop Das has many publications in various national and international journals. He had presented his studies in the conferences conducted at the Cambridge University and Leicester University, in the United Kingdom. He also represented India, in the United Nations Environment program-EPLC's Asia Pacific Environment Forum, conducted in Kangwon National University, South Korea in 2011

Dr. KM Bhat Memorial Award 2013

The 4th Dr. K. M. Bhat Memorial award was awarded to Dr. P. M. Sreekanth, Asst. Professor, Dept. of Biotechnology, Bangalore City College for his doctoral work on "Population Genetic structuring and gene flow estimates of teak from the Western Ghats of Southern India using AFLP markers". The committee also noted the contributions of Dr. Sreekanth such as describing the genetic diversity of teak from the Kerala, Karnataka and Tamil Nadu part of Western Ghats and showed through DNA fingerprinting that the genetic diversity of teak was higher for populations from Kerala; especially the Nilambur population is unique and got separated from other natural teak populations. The Endowment was instituted by the family of late Dr. K. M. Bhat for the best emerging Research Scholar from KFRI. The award was presented on 2nd January 2013 in a function organised at KFRI coinciding with 4th death anniversary of Dr. K. M. Bhat. The Endowment Lecture was delivered by Dr. K. C. Chacko, Programme Coordinator (Rtd), Extension & Training Division, KFRI.

Retirements

Dr. KV Sankaran

Dr. KV Sankaran, Director, KFRI superannuated from service on 31 October 2012 after 30 years of service. As an eminent scientist he contributed immensely in a wide variety of fields such as forest pathology, fungal ecology and taxonomy, plant-microbe interrelationships, tree nutrition and ecology and biocontrol of forest invasive plants during his 30 years of service in the Institue.

He did his masters and doctoral degrees in Botany from the Dept. of Botany, University of Calicut. His doctoral research was on fungi in the root region of black pepper (*Piper nigrum* L.).

Dr. Sankaran joined the Institute in May 1982 as a Research Assistant in the Plant Pathology Division. One of the highlights of his early career was the award of the prestigious Darwin Fellowship in Biosystematics in1994 by the UK Department of Environment to carry out post-doctoral research in Mycology at the International Mycological Institute (IMI), UK. He also did post-doctoral research in soil microbiology at the CSIRO Laboratories, Perth, W. Australia in 1996 having been awarded the Crawford Fund for International Agricultural Research, Australia. During his tenure at the IMI, Dr. Sankaran created a database on fungi recorded on eucalypts worldwide in collaboration with two eminent British mycologists, Drs Brian Sutton and David Minter. The hard copy of this database was published by CABI, UK as a book entitled 'A Checklist of fungi recorded on *Eucalyptus*' (1995).

In Dec. 2005, Dr. Sankaran was nominated as the founder Coordinator of FAO's Asia-Pacific Forest Invasive Species Network (APFISN)- a cooperative alliance of 34 countries. He took up the key task of initiating the activities of the network such as bringing in focal points from member countries, launching the website for APFISN, publishing the Network newsletter and pest fact sheets, convening the meetings of the APFISN Executive Committee, helping member countries to produce checklists of invasive species and linking APFISN with other networks. He also organized fourteen international workshops and training programs on various aspects of invasive alien species in India, Thailand, Vietnam, China, Malaysia, Bhutan and Maldives and played a key role in identifying funding sources. He also successfully completed the pre-project work of the project on Control and management of destructive forest invasive species in South Asian protection and production forests involving India, Srilanka and Maldives to be funded by the FAO. The latest contribution from him is the pictorial book on 'Invasive alien plants in the forests of Asia and Pacific' which is published by FAO Regional Office, Bangkok.

During his tenure at KFRI, Dr. Sankaran handled 20 research projects half of which were funded by International agencies such as ACIAR, Australia, CABI, UK, Darwin Initiative, UK, DFID, UK, CIFOR and FAO which shows that he was highly successful in attracting international funding for research at KFRI. He, in collaboration with CSIRO, Australia, played a key role in developing suitable silvicultural practices to improve productivity of eucalyptus plantations in Kerala which were widely adopted by eucalypt growers in India. He also played a major role (in collaboration with CABI, UK) in developing a bio-control strategy for the invasive weed *Mikania* in the Asia-Pacific region.

Dr. Sankaran has published around 100 research papers in international/national journals, books and proceedings. He has authored two books, 18 research reports and edited a couple of proceedings of workshops. He has traveled widely (in over 30 countries) and has organized/co-organized several workshops/training programs in India and abroad. His term as Director, KFRI was a period of hectic academic activity during which he gave leadership to the successful organisation of the International Training Programme on Innovations in the Management of Planted Teak Forests organized by the Teaknet, the International Symposium on "Providing the Scientific Basis for Fungal Conservation" jointly organised by DST and Royal Society, UK and the Kerala Science Congress. Dr. Sankaran is currently the Deputy Chair of IUFRO Working Party on Invasive alien species and International Trade.

Dr. Sankaran, during his tenure as Director, took particular interest in giving the Institute and the campus a facelift, besides improving the facilities. He will also be remembered for his spontaneous generosity. While wishing him a happy and relaxed retired life we also eagerly look forward for his continued support and guidance.

Dr. P VijayaKumaran Nair

Dr. P Vijayakumaran Nair, Scientist-F, Forest Management Information System Division superannuated on 30 April 2012 after 32 years of service in KFRI. Dr. Nair joined the Kerala Forest Research Institute as Scientist in 1980 in the Wildlife biology Division after completing MSc (Zoology) from Kerala University and Ph D from Indian Institute of Science, Bangalore. His first set of research projects includes habitat studies on wildlife sanctuaries in Kerala. Studies were carried out in Periyar Tiger Reserve, Idukki, Parambikulam, Chinnar and Neyyar wildlife sanctuaries. Resource mapping of bamboos, Periyar Tiger Reserve, Machad, Iravikulam, etc were carried out using GIS and Remote Sensing techniques in the next set of projects. Of the latest work, biodiversity mapping of Myristica swamps in Kulathupuzha, funded by MoEF, Govt. of India is particularly notable. This study established that Myristica swamps are equally important from a faunal diversity perspective also. This was followed by DBT funded species recovery project on a swamp trees. Studies on wetlands were the last set of research projects undertaken. Ecological status of wetlands at district, block, and panchayat level were examined and interactive maps prepared. Dr. P. Vijayakumaran Nair also played an important role in strengthening computer use and managing the institute computer network. We wish him a happy and relaxed retired life.

Dr. K Jayaraman

Dr. Kadiroo Jayaraman, Scientist-F and Programme Coordinator, Forest Management Information System Division joined the KFRI in 1984 as Statistician and superannuated on 31 May 2012. He started his career at KFRI by assisting the Scientists of other Divisions in planning their experiments/surveys and also analysing the data and interpreting the results. He was deeply involved in training the Scientists and Ph. D students in the use of statistical methods in forestry research and brought out a book on statistical methods in forestry research. Later, Dr. Jayaraman was engaged by FAO of the United Nations for conducting similar training programmes in several Asia-Pacific countries.

While at KFRI, Dr. Jayaraman was deputed to the University of Georgia, U.S.A. for conducting postdoctoral research in the field of forest biometrics under a grant from the Ford Foundation. After his return, he was involved in a series of biometrical and forest inventory studies. He successfully guided many Ph. D. Students in this field. Some noteworthy works in this regard are that on growth modelling and optimizing of harvests in respect of plantations of teak, eucalypts and bamboo. He was also involved in conducting state-wide surveys on the status of teak, eucalypts and Social Forestry plantations in Kerala. Dr. Jayaraman was also interested in estimation of wildlife abundance. In this respect, he was involved in the execution of wildlife census in the forests of Kerala. His contribution in applying random parameter models in line transect sampling led to achieving reliable estimates of animal numbers with reduced number of sightings. During his career at KFRI, Dr. Jayaraman had the opportunity to serve as Visiting Scientist at Ontario Forest Research Institute, Canada, Finnish Forest Research Institute, Finland and also University of Arkansas at Monticello, U.S.A. He was also acting as a Statistical Consultant to ADB.

With the formation of Forest Management Information System Division, Dr. Jayaraman's interest got diverted to forest sector analysis and econometric studies on demand and supply of teak wood in Kerala. In the later part of this career at KFRI, Dr. Jayaraman had the additional duties of TEAKNET Coordinator. In this capacity, he was organizing several international events both at the Institute and abroad connected with teak. We wish him a happy and relaxed retired life.

Dr. CN Krishnankutty

Dr. CN Krishnankutty, Scientist-F, Forest Management Information System Division joined the institute on 24 Sept 1981 and superannuated on 31 May 2012 after 31 years of service in KFRI. He was a statistical expert and contributed mainly towards building statistical database on Kerala forestry sector using modern statistical tools. His major projects include analysis of factors influencing timber prices in Kerala, demand and supply of wood in Kerala and their future trends, socio-economic and ecological aspects of developing bamboo resources in

homesteads of Kerala, timber price trends in Kerala, wood balance study in Kerala and market survey and estimation of moisture content in bamboo culms for deriving the weight and price conversion factors. He was instrumental in bringing out commercial volme tables for selected home garden trees of Kerala. He had also made statistical projections on timber supply situation in Kerala for the year 2010-11. He had published many technical reports and research papers in reputed national and international journals. We wish him a happy and relaxed retired life.

Dr. EP Indira

Dr. EP Indira, Scientist-F and Programme Coordinator, Forest Genetics & Biotechnology Division superannuated on 31 July 2012. Dr. Indira joined KFRI on 31 Dec 1979 and had more than 33 years of research experience in the field of Forest Genetics and Tree breeding. Her thrust areas of research are Tree improvement, Reproductive biology & breeding system analysis, Contemporary gene flow and genetic diversity through molecular markers. She has been trained in applications of Molecular markers in Forest Genetics and breeding system at University of Putra Malaysia and Kasetsart University, Thailand. She has been a recipient of research grants from funding agencies like European Union, IPGRI, CABI, Dept. of Biotechnology (GOI) and Kerala Forest Department etc.

She was a member of the Board of studies for M.Sc. Plantation Development, Calicut University. She was also a member of Board of examiners of Kerala Agricultural University, Calicut University, Bharathiar University, Tamil Nadu Agricultural University, Gandhigram Rural University etc. She was a member of Regional variety testing committee of ICFRE, Member of project evaluation committee of Indian Council of Forestry Research and Education (ICFRE) and project proposal evaluation committee of ICFRE institutions, MOEF etc. She was an expert member for editorial scrutiny of many journals. She has many publications as Research reports, more than 50 scientific papers, Chapters in books and popular articles. She was a guide to Ph.D. students of KFRI and a guide to M.Sc. students from colleges in Kerala and Tamil Nadu for their dissertation work. We wish her a happy and relaxed retired life.

Dr. S Sankar

Dr. S Sankar, Scientist-G and Programme Coordinator of Forestry and Human Dimensions Division of Kerala Forest Research Institute, Peechi, joined the institute on 19 Sept 1981 as Scientist and superannuated on 31 August 2012 after 31 years of service in KFRI. During this period, he was associated with more than 35 research projects. His major projects include long term environmental and ecological studies of Pooyamkutty hydroelectric project, perspective plan for the development of forestry sector in Kerala, evaluation of forest schemes of the Kerala Forest Department under the Western Ghat development programme, socio-economic and ecological aspects of developing bamboo resources in homesteads of Kerala, carrying capacity based developmental planning for greater Kochi region, ecological and social importance of conservation of sacred groves in Kerala, role of shola forests in maintaining water courses in the high ranges of the Western Ghats of Kerala, development and testing of sustainable agroforestry models in different agroclimatic zones of Kerala, livelihood improvement of marginal bamboo dependants, environment impact assessment of pilgrimage in Agasthyamalai region, bamboo sector in Kerala: baseline data generation for developing an action plan, primer for training Vana Samrakshana Samithies (VSS) in sustainable management of NTFPs, biodiversity conservation plan for Malayattur and Vazhachal high value Biodiversity areas ,model watershed – maintenance, monitoring and outreach and voluntary relocation plan for settlements in Wayanad Wildlife Sanctuary.

His major fields of expertise were soil science and watershed management, ecotourism, agroforestry and wasteland development, environmental impact assessment, human dimensions of forestry, clean development mechanism. Dr. S. Sankar has been deeply associated with the conservation and management of forests in Kerala and was a participant in save Western Ghats march from Kanyakumari to Goa, coordinated environmental and social impact studies at: Pooyamkutty hydroelectric project & roads of hill highway, diversion of forest land at Sabarimala, environmental impact of Thenmala eco-tourism project, establishment of watersheds with people's participation, and green belt development around factories and townships. Dr. Sankar was a member of the expert committee appointed by the high

court of Kerala in a forest case (1986), of the task force appointed by the Government of Kerala in watershed management and was attached to the national expert committee to study the impact of raising the level in Mullaperiyar reservoir. Dr. Sankar had published over 40 technical reports and over 50 research papers in reputed national and international journals as well as in books. We wish him a happy and relaxed retired life.

Dr. N Sasidharan

Dr. N. Sasidharan, Scientist-G and Programme Coordinator, Forest Ecology and Biodiversity Conservation Division superannuated from Kerala Forest Research Institute after 35 years service on 31 August 2012. He joined the Botany Division on 25 Feb 1977. He was transferred as Scientist-in-Charge of the newly formed Department of Non-wood Forest Products in 1994. He was actively engaged in the establishment of the Herbarium and Medicinal Plants Garden of the Institute. His thrust areas of research are Systematic Botany, Ecology and Non-wood Forest Products. Extensively worked on the forest flora of Kerala, particularly Wildlife Sanctuaries and Forest Trees. He published 40 research reports; 6 books; 95 scientific papers and 12 popular articles. He described 20 new species including 7 trees. Also, developed an interactive computer-Aided Tree Identification program (Tree ID) for the trees of Kerala exclusively based on field and vegetative characters. Another remarkable contribution is the design and development of a computer aided data retrieval system on Flowering Plants of Kerala (version 2.0) with 18,900 images of plants. He is the recipient of Dr. VV Sivarajan Gold Medal from the Indian Association of Angiosperm Taxonomists in 2004 for his contributions in plant taxonomy. He was awarded Dr. BP Pal Fellowship in 2010 by the Ministry of Environment & Forest, Govt. of India for his outstanding contributions in the field of biodiversity. He is now working as Dr. BP Pal Fellow in the Non-Timber Forest Produce Department. He is an elected Councillor of the Indian Association of Angiosperm Taxonomists (IAAT), Member of Kerala State Medicinal Plants Board (SMPB) and the Expert Committee on Medicinal Plants of the National Biodiversity Authority, Govt. of India. We wish him a happy and relaxed retired life.

Dr. Thomas P Thomas

Dr. Thomas P Thomas, Scientist-F and Head Soil science department joined the institute on 31 Dec 1979 as Scientist and superannuated on 30 Sept 2012 after 33 years of service in KFRI. Dr. Thomas did his masters in Soil Science and Agricultural Chemistry from Jawaharlal Nehru Krishi Viswa Vidyalaya, Jabalpur and his P.G. Diploma in Soil Technology from IIT, Kharagpur. He is a doctorate in Forestry from Forest Research Institute University, Dehradun and was an eminent scientist in Soil Science. He has 33 years of research experience in forestry of which about 3 years was in the extension and training centre, the rest being in the soil science department and have brought out several research reports and papers. He retired as Head of Soil Science Department on 30th September, 2012. Research carried out in these years pertains to varied aspects of soil science from characterization, amelioration and management to soil erosion and conservation. Recent works include runoff plot studies, carbon sequestration, crop rotation in forestry and impact of industrial and agricultural activities on soil and water quality including chemical and biological aspects. Participation in State level committees on environment, disaster management etc., organizing meetings as well as undertaking consultancies and extension work were part of the duties in addition to managing the department, guiding research scholars and serving in various internal committees of the institute. We wish him a happy and relaxed retired life.

Dr. KV Bhat

Dr. KV Bhat, Scientist-F, Wood Science and Technology Division joined the institute on 31 May 1982 as Scientist and superannuated on 30 Sept 2012 after 30 years of service in KFRI. His major research expertise were in the field of wood anatomy and histochemistry and was involved in major projects like establishment of a xylarium, physical and anatomical characteristics of wood, development of appropriate tools for harvesting reed bamboos, anatomical changes associated with culm maturation in *Bambusa bambos* (L.) Voss and *Dendrocalamus strictus* Nees, optimisation of harvesting and post- harvest technology to economise bamboo resource utilization, identification means for checking

sandalwood adulteration, post-harvest protection of bamboo from insect borers and evaluation of the effectiveness of water submersion method for protection of bamboo from borer damage. From 2008-2012, he was associated with RME division with following major activities, editorial scrutiny of draft reports, assigning report numbers, preparation of annual reports, brochures, agenda for important meetings and write-ups for other purposes, assisting the research coordinator in conducting meetings, drafting communications and replies, editing papers for teaknet bulletin/symposium proceedings and research/extension work. Dr. Bhat was also a member of editorial boards of Journal of Bamboo and Rattans as well as TEAKNET bulletin. He was also served as SPV Member and technical expert for two wood industry consortia of Kerala and offered guidance in choosing/procurement of suitable machinery for CFC establishment. He had more than 30 research publications in reputed national, international journals as well as in books to his credit. We wish him a happy and relaxed retired life.

Dr. K Swarupanandan

Dr. K Swarupanandan, Scientist-F and Research Coordinator of Kerala Forest Research Institute, Peechi, joined the institute in 1979 as Scientist and superannuated on 31 October 2012 after 33 years of service in KFRI. In 1979, he was appointed as scientist in the Ecology Division of the Kerala Forest Research Institute (KFRI), Peechi, and got immersed in ecological research until 2008. During 2005-2008, he was also the Scientist-in-Charge of the Ecology Division. As principal investigator and associate investigator, he was involved in 20 research/extension/consultancy projects. This provided him an opportunity to work on different ecosystems such as shola forests, grasslands, moist deciduous forests, *Myristica* swamps, mangroves, forest fire, reproductive biology and species recovery of RET tree species. Major achievements from the studies were: (a) South Indian hill-top grasslands are not climatic climaxes, but edaphic or fire-climaxes. (b) Proposed the general succession theory, which conceived each spatio-temporal point as a climax. (c) mangrove afforestation does not take off in Kerala because of a resource conflict. (d) *Myristica* swamps are high hot-spots of biodiversity and deserve high priority for conservation. (e) population estimates, population ecology and reproductive biology of most rare species (plants & animals) are not known. (f) environmental impact assessments for Kottuli wetland, Kozhikode. (g) mangrove afforestation management plan for ICTT, Vallarpadam. (h) field identification key for trees of Kerala. (i) studies on the late-embryogenesis and classification of Dipterocarpaceae. Working with ecology he happened to embark in information science, where he published two papers on metamorphosis of information. During the period June 2008 to October 2012, he also served as Research Coordinator in the institute. The administrative responsibilities inherent of the Research Coordinator position provided him an opportunity to evolve a digital application for storage, retrieval and use of research records for research management. During his research career, he has brought out 84 publications, 16 research reports, 40 Papers in journals, 21 Chapters in books/ Proceedings and 2 edited books. He has also guided a student for his Ph. D. and another student for his Masters dissertation. As required by the profession, he also visited UK, France, Japan, Indonesia and Sri Lanka. We wish him a happy and relaxed retired life.

Dr. Maria Florence

Dr. Maria Florence, Scientist -F and Programme Coordinator of Forest Health Division of Kerala Forest Research Institute, Peechi had superannuated on 31 Dec 2012. She had been working in the institute for the last 32 years in various scientific positions. Major areas of research were Forest Pathology, Disease Resistance, Microbial Diversity, Wood Biodegradation and Biocontrol. During this period, she had been associated with 30 research projects related to Forestry diseases, clonal propagation of eucalypts and acacias for disease resistance and higher productivity, biodegradation caused by sapstain and its biocontrol. She had undergone training on biological control of wood decay in University Abertay Dundee, Scotland, UK. Besides, she had received the IRG Ron Cockroft Award to participate in the 29th International Research Group on Wood Preservation Conference at Maastrict, The Netherlands. She had screened one bacterium, *Bacillus subtilis* B2 and one actinomycete, *Streptomyces* SA18 as potential biocontrol agent for the control of sapstain mainly on rubber wood. She had also developed several disease resistant and fast growing clones of eucalypts and acacias for the Forest Department, Govt. of Kerala. She had also an opportunity to work in the Extension and Training Division of the Institute for 7 years. During that period, she coordinated 83 training programmes including 16 IFS training programmes supported by MoEF, Govt. of India. She had published 23 Research reports, Book on Biodiversity of Fungi and 56 research papers in reputed national and international journals. We wish her a happy and relaxed retired life.

Glimpses on trail.....

Only few are lucky to witness the beauty of wild, here we get a chance to perceive through their viewfinders

Raorchestes manohari
Agasthyamala
Nikon D7000
Sandeep Das
sandeep.koodu@gmail.com

Macaca silenus
"Lion Tailed Macaque"
Vazhachal
Nikon D5100, P Sreedev
sreedev59@gmail.com

Desmodium sp.
Palode, Nikon L810
Salish J Menachery
menachery.salish@gmail.com

Elaeocarpus tuberculatus "Thodayam"
Periyar Tiger Reserve, Cannon G9,
VB Sreekumar, sreekumar@kfri.res.in

Ophiorrhiza radicans
Possibly extinct plant - rediscovered
Rosemala (shendurunii WLS), Sony
DSC-W690, VS Hareesh
hareeshhariz@gmail.com

Bruguiera sexangula
"Swarnakkandal" Flower of
a rare mangrove Chellanum
Ernakulam Nikon D90
P Sujanapal
sujanapal@kfri.res.in

Phoenix loureiroi var. pedunculata
"Chittinthal"
Peerumedu, Canon G9
VB Sreekumar
sreekumar@kfri.res.in

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Cover content contribution:
Dr. VB Sreekumar
Dr. KA Sreejith

Address all communications to:

The Editor, Evergreen
Kerala Forest Research Institute
Peechi-680 653
Thrissur, Kerala, India
Phone: +91 487 2690100
E-mail : evergreen@kfri.res.in
evergreenkfri@gmail.com

Grasslands of Periyar Tiger Reserve