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A STUDY OF INSECT PEST INCIDENCE IN NATURAL FORESTS

K.S.S.Nair
George Mathew
K.Mohanadas
A.R.R.Menon

KERALA FOREST RESEARCH INSTITUTE
PEECHI, THRISSUR

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ABSTRACT

Insect damage on trees was studied in representative natural forests in Kerala. Observations were made on 20 tree species in the moist deciduous forest (MDF) and 18 tree species in the evergreen forest (EGF). The study plots were situated at Peechi and Vazhani for MDF and Sholayar for EGF.

No major damage was observed although most trees had some insect associates causing occasional damage. Leaf feeding was the most common damage and it was noticed on all tree species, to varying degrees. However, loss due to insect feeding never exceeded 10% of the total foliage present at any particular time except in 4 species each in the two forest types. These exceptions were *Grewia tiliaefolia*, *Haldina cordifolia*, *Lannea coromandelica* and *Tectona grandis* in the MDF and *Anacolosa densiflora*, *Actinodaphne madraspatana*, *Cinnamomum verum* and *Litsea floribunda* in the EGF; but even for these species the highest leaf loss was only 21%. Other types of damage, viz., sap-sucking, gall formation and stem boring were insignificant, except in *Mesua nagassarium* in the EGF, in which some trees were killed, apparently by a stem boring buprestid beetle.

A total of 85 species of insects were found on the 20 tree species studied in the MDF, of which about 60 per cent are new records on the respective hosts in India. Largely due to difficulties in observing and collecting, only 8 species of insects (mostly undetermined) were recorded from the 18 tree species studied in the EGF. These results indicate that a large part of the insect fauna of natural forests remain unrecorded.

The practical significance of the present findings is discussed. It is concluded that this study indicates the high-risk species for elimination from plantation trials but there is no guarantee that species that are at low risk in natural forest will be safe from pest problems in plantations.

1. INTRODUCTION

Plantations of most tree species suffer heavy damage due to insect pest outbreaks, While this fact is well documented from observational data, it is usually assumed, in contrast, that natural forests, particularly, mixed tropical forests, are free from pest damage. This assumption has led to formulation of the generally accepted ecological principle that biotic diversity leads to stability. The tropical rain forest, in particular, has often been quoted as the typical example of a stable ecosystem. The general problem of the relationship between diversity and stability has been discussed by several authors (Graham and Knight, 1965; Grey, 1972; van Emden and Williams, 1974; Way, 1977, Unesco, 1978; Bain, 1981) although primary field data remain inadequate. While some (eg. van Emden and Williams, 1974; Murdoch, 1975) argue that the relationship between diversity and stability is not causative but parallel, others do not support the generalisation itself. For example Grey (1972) did not think that pest outbreaks are rare in mixed tropical forests and Bain (1981), quoting the example of exotic monocultures of *Pinus radiata* in New Zealand, argued that they are at no more risk of pest attack than alternatives like managed native forests, plantations of native species or mixed plantations of exotics. While in temperate regions, pest outbreaks are common' in natural forests which often consist of single species stands, we have very little data on pest incidence in natural forests of the tropical region which usually consist of a mixture of several tree species. Although nearly 1500 injurious insects are associated with forest trees in the Indian region (Beeson, 1941; UNESCO, 1978) and most have been recorded from the natural forest, in general, nothing is known of their pest status. There are, however, a few exceptions like the sal borer, *Hoplocerambyx spinicornis,* (Beeson 1941) the sandal mycoplasma vector, *Redarator bimaculatus* (Ghosh *et al.*, 1983) or the toon weevil, *Pagiophloeus longiclavis* (Sharma *et al.*, 1982) which have made their presence felt by causing tree mortality either directly or through associated microorganisms (Nair, 1986). The present study was undertaken to systematically examine pest incidence in natural evergreen and moist deciduous forests and to explore how this information could be used for more effective forest pest management.

2. MATERIALS AND METHODS

STUDY AREA

The study was conducted in two representative sites each for the moist deciduous and evergreen forest types.

The moist deciduous forest was located in the Trichur Forest Division. After reconnoitring various areas, two least disturbed sites were selected, one in the Peechi Forest Range, in the catchment area of Peechi dam and the other in the Wadakkanchery Forest Range, in the catchment area of Vazhani dam (Fig. 1). The two sites were separated by a distance (aerial) of about 25 km. Both sites fall under the forest type 'South Indian Moist Deciduous Forests' according to the classification of Champion and Seth (1968). This type occurs in areas with 1000 mm to 2000 mm rainfall, with a dry period of 3 months or more and is in its optimum form of development below 700 m elevation. Typically this type of forest is fairly dense with trees attaining a height of about 30-35 m. The flora usually consist of three tiers. The characteristic species of the first tier (top canopy) are *Tectona grandis, Terminalia crenulata, Terminalia bellirica, Lagerstroemia microcarpa, Dillenia pentagyna, Haldina cordifolia, Bombax ceiba* and *Lannea coromandelica.* The second,tier comprises smaller trees like *Wrightia tinctoria, Grewia tiliaefolia, Holarrhena antidysenterica* and *Mallotus philippensis.* The third tier consists of shrubs like *Helectres isora, Desmodium* sp., *Flacourtia* sp., *Gardinia turgida,* and *Meyna laxiflora.* Lianas like *Acacia intsia, Zizyphus xylopyrus, Butea superba* and *Calycopteris floribunda* are also common.

The evergreen forest was located at Sholayar in the Chalakudy Forest Division. The two sites selected were both located in the catchment area of the Sholayar reservoir and were separated by a distance (aerial) of about 20 km. (Fig. 1). Both the sites fall under the forest type 'West Coast Tropical Evergreen Forest' (Champion and Seth, 1968). This type occurs mostly in areas with over 2000 mm rainfall, with a dry period of three months or less and is in its optium form of development at 750 to 1100 m elevation. It is characterised by luxuriant vegetation and the formation of typical tiers. The common characteristic species in the first tier (top canopy) are *Mesua nagassarium, Cullenia exarillata, Elaeocarpus tuberculatus , Palaquium ellipticum, Holigarna arnottiana, Dipterocarpus indicus* and *Hopea glabra.* The second tier consists of species like *Aglaia lawi, Gomphandra tetranda, Myristica dactyloides, Polyalthia coffeoides, Garcinia morella* and *Hydnocarpus pentandra.* The third tier comprises small trees and shrubs like *Cinnamomum verum, Litsea floribunda, Aporusa*

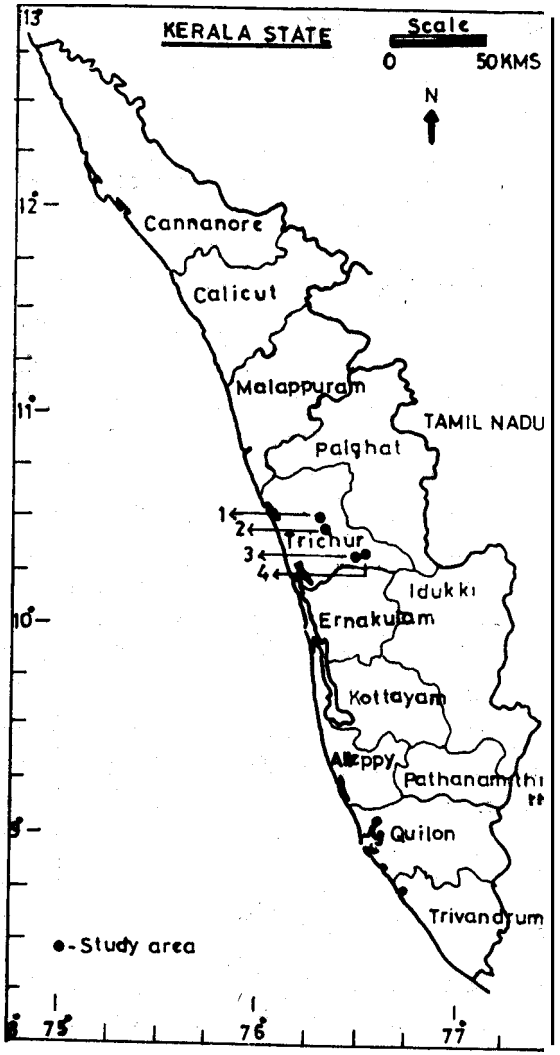

Fig. 1. Map of Kerala, showing location of study plots.
1. Peechi; 2. Vazhani; 3. Ambalapara (Sholayar); 4. Chandanthodu (Sholayar)

lindleyana, etc. Because of the closed canopy, the underground vegetation is devoid of grasses. The herbaceous vegetation is mainly represented by seedlings of forest trees. Lianas *Smilax* and *Toddalia,* and epiphytes are also common.

PLOTS WITHIN STUDY SITES

Based on preliminary enumeration of the tree species present in the study sites, 20 species (Fig. 2) were selected in the moist deciduous forest

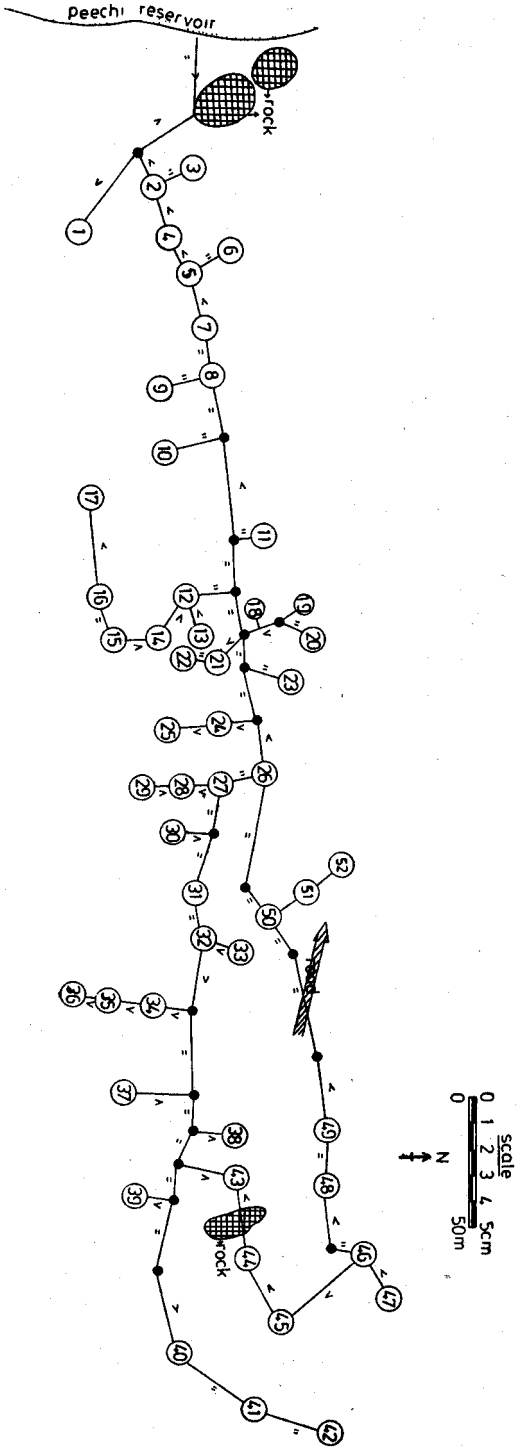

Fig. 2. **A typical study plot in the moist deciduous forest at Peechi. Numbers in circles represent the trees observed.**

TREE IDENTIFICATION KEY

Albizia lebbeck	10, 15
A. odoratissimd	41,46,47
Alstonia scholaris	33, 36, 49
Bombax sp.	21, 51
Bridelie squamosa	12, 19, 22
Careya arborea	1,3
Cassia fistula	16, 23, 34
Dalbergia latifolia	13, 18
Dillania pantagyna	20,24, 26
Garuga pinnata	5, 32, 50
Gmelina arborea	7, 48
Grewia tiliaefolia	29,45
Haldina cordifolia	31, 35, 43
Lagerstroemia microcarpa	14, *21,* 28
Lannea coromandelica	6, *52*
Piliostigma malabaricum	*17, 25,* 42
Terminalia bellirica	30, 39, 40
T. crenulata	4, 11, 37
Tectona grandis	38, 44
Xylia xylocarpa	2, *8,* 9

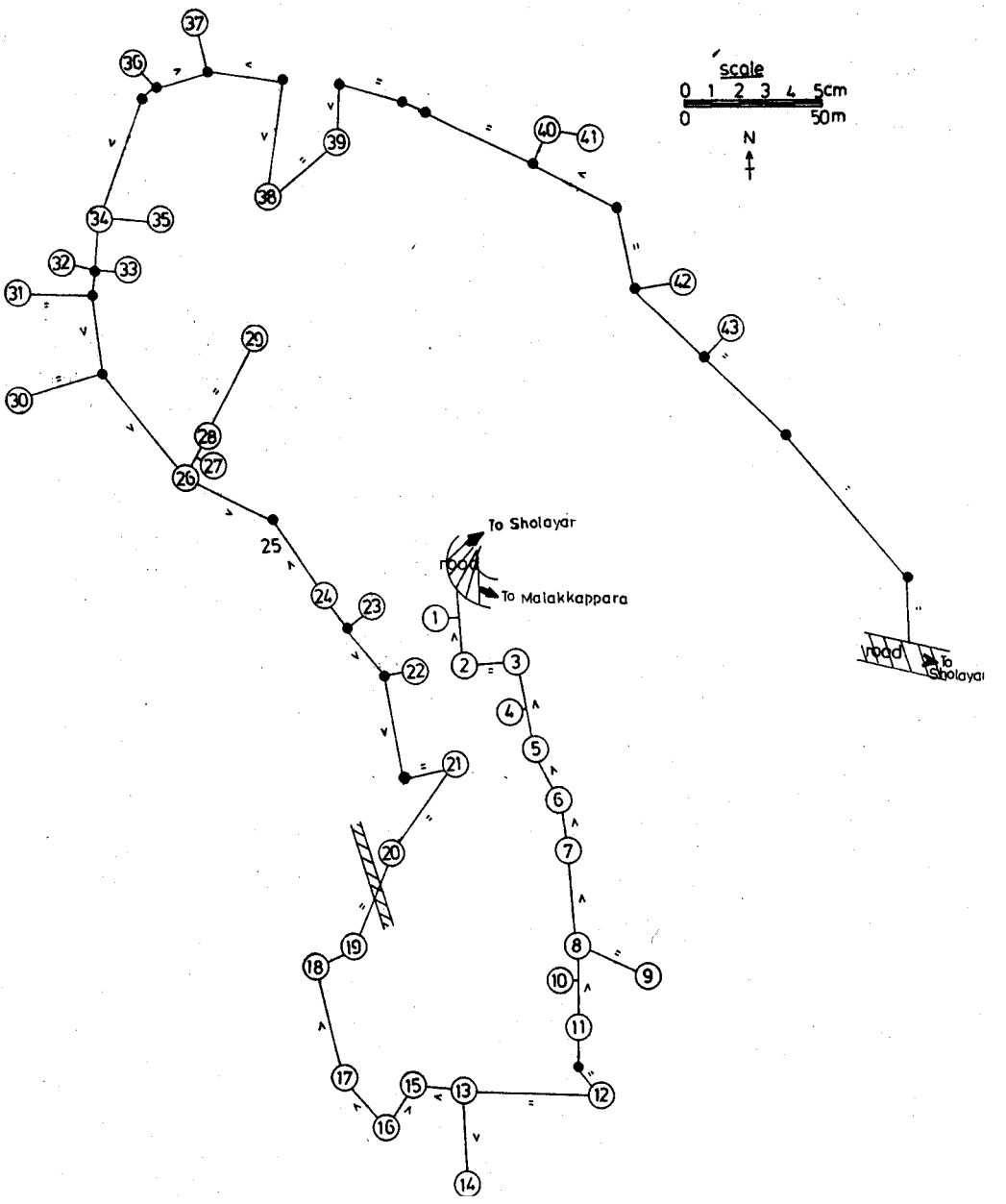

Fig. 3. A typical study plot in the evergreen forest at Ambalapara, Sholayar. Numbers in circles represent the trees observed.

TREE IDENTIFICATION KEY

Actinodaphne madrespetene	13, 14, 33	*Litsea floribunde*	4, 41
Anecolosa densiflora	27, 28, 29	*Mesua nagassarium*	9, 31
Antidesme bunius	12, 16, 17	*Dimocarpus longan*	42,43
Calophyllum polyanthum	38,40	*Olee dioece*	30, 32, 35
Cinnamomum verum	36, 37	*Palaquium ellipticum*	1, 6, 21
Cullenla exarillata	3, 8	*Syzygium cumini*	10,11
Dysoxylum malabaricum	19, 23, 25	*Toona ciliate*	2, 34
Holigerne arnottiana	5, 18, 39	*Vateria indica*	22, 26
Knema attenuata	20, 24	*Vepris bilocularis*	7, 15

and 18 (Fig, 3), in the evergreen forest for observations. At each site, a walking path along which the selected tree species were located, constituted the study plot. In these plots the required number of trees of the selected species were marked for observation and numbered serially, irrespective of the species, and plot charts showing the location of the numbered trees were prepared. Typical plot charts are shown in Figs. 2 and 3. The trees selected were past the sapling stage.

For each species in a given forest type, there were 5 trees (replicates) distributed between the two study sites — 2 in one plot and 3 in the other, This method was followed since some of the selected species were rare in one or the other plot.

OBSERVATIONS

Each plot was visited at monthly intervals for a period of 21 months from September 1983 to May 1985, to cover two growth seasons. A binocular was used to observe the tree canopy closely, and the following data were recorded from the marked trees.

a) Intensity of defoliation

The intensity of defoliation due to leaf feeding insects was rated visually into 4 classes, by assigning scores as follows - 0, no leaf damage; 1, upto 5% of foliage lost; 2, 6 to 50% of foliage lost; 3, 51 to 100% of foliage lost. Using the midpoint of the defoliation percentages in the class range, the scores were later converted to mean monthly defoliation percentage (mean of five values for the 5 replicates of a species) to compare the defoliation intensity between species and over time. The mean of the monthly defoliation percentages over the entire study period was calculated for each species and is called the annual defoliation percentage, an index of defoliation suscepti, bility.

b) Other types of damage

Damage caused by stem-boring, sap-sucking, fruit-boring and gall forming insects were recorded qualitatively.

c) The insects

Whenever possible, the insects found feeding on the marked trees were collected and the immature stages were reared in the laboratory to determine the identity. In many cases, although damage was noticeable, the insects could not be located, Such damage appeared to be mostly due to adult beetles.

Since the trees were tall, collections were mostly made from the lower branches which could be reached with a 4 m pole. When the damage score was 2 or above, special effort was made to collect the insect by employing a person to climb the trees. Collection of insects was almost impossible in the evergreen forest, where the trees were very tall.

The identity of the insects were confirmed by the CAB International Institute of Entomology, London. Some species were recorded for the first time on some of the tree species. This conclusion is based on the 9-parts catalogue of insect pests of forest plants published from the Entomology Branch of the Forest Research Institute, Dehra Dun (Bhasin and Roonwal, 1954; Bhasin *et al.*, 1958; Mathur and Singh, 1960-61). The annotated list of pests and diseases of forest plantation trees by Browne (1968) was also consulted.

3. RESULTS

OCCURRENCE AND NATURE OF DAMAGE

All the tree species under observation showed some damage caused by insects. The most common type of damage was leaf feeding, noticed on all tree species, sometime or other. Sap-sucking insects were recorded on 7 tree species, gall forming insects on 3 tree species, and stem boring insects on 2 tree species (Table 1). The sap-sucking, stem-boring and gall-forming insects were found only rarely and in small numbers and the damage caused by them was apparently negligible.

INTENSITY AND SEASONAL INCIDENCE OF DEFOLIATION

In general, the intensity of defoliation was very low, the annual defoliation percentage ranging between 0.1 and 6.7 for the different species (Table 1). Except for 4 species, ***Grewia tiliaefolia, Haldina cordifolia, Lannea coromandelica*** and ***Tectona grandis,*** defoliation never exceeded 50% (i. e., defoliation score of 3) for any individual tree at any time (Table 1). Even for these species such damage was confined to some of the trees in the observation plots so that the mean monthly defoliation intensity did not exceed about 21% (Fig, 4). For other species, defoliation never exceeded 10%, and for most species it was below 5%.

Among the species in which over 21% defoliation was recorded, the peak incidence occurred in June for ***Grewia, Haldina*** and ***Tectona*** and in October for ***Lannea*** (Fig. 4).

Table 1, Characteristics of insect-host plant association in moist deciduous forest

Tree species	Kind of damage				Damage intensity		No. of insect spp. recorded		
	Leef feeding	Sap sucking	Stem boring	Gall forming	Annu. defol. %	Max. defol score	In this study	In literature	First time here
1. ***Albizia lebbeck*** (Linn.) Benth. (Mimosaceae)	+				0.3	1	1	18	–
2. A. ***odoratissima*** (Linn. f.) Benth. (Mimosaceae)	+			+	0.1	1	1	6	-
3. ***Alstonia scholaris*** (Linn.) R. Br. (Apocyanaceae)	+		+		0.2	1	2	8	0
4. ***Bombax*** sp. ***(B. ceiba / B. insigne)*** (Bombaceae)	+			+	1.7	2	4	39	4
5. ***Bridelia squamosa*** (Lamk.) Grah. (Euphorbiaceae)	+				2.3	2	5	17	1
6. ***Cureya arborea*** Roxb. (Barringtoniaceae)	+	+			4.3	2	10	52	6
7. ***Cassia fistula*** Linn. (Caesalpiniaceae)	+				0.7	1	3	69	1
8. ***Dalbergia latifolia*** Roxb. (Papilionaceae)	+				0.4	1	1	19	I
9. ***Dillenia pentagyna*** Roxb. (Dilleniaceae)	+	+			1.1	1	3	6	3
10. ***Garuga pinnata*** Roxb. (Burseraceae)	+	+	+		1.3	1	12	13	8
11. ***Gmelina arborea*** Roxb. (Verbenaceae)	+				2.5	1	1	101	–
12. ***Grewia tiliaefolia*** Vahl (Tiliaceae)	+				6.3	3	9	38	4
13. ***Haldina cordifolia*** (Roxb.) Ridsd. (Rubiaceae)	+				3.9	3	2	11	1
14. ***Lagerstroemia microcarpa*** Wt. (Lytheraceae)	+				2.3	2	7	19	7
15. ***Lannea coromandelica*** (Houtt.) Merr. (Anacardiaceae)	+	+			6.7	3	4	8	2
16. ***Piliostigma malabaricum*** (Roxb.) Benth. (Caesalpiniaceae)	+	+			1.1	1	2	–	2
17. ***Terminalia bellirica*** (Gaertn.) Roxb. (Combretaceae)	+				2.5	2	2	17	2
18. ***T. crenulata*** Heyne ex Roth. (Combretaceae)	+	+			2.0	2	4	2	4
19. ***Tectona grandis*** Linn. f. (Verbenaceae)	+	+	+		3.5	3	4	187	1
20. ***Xylia xylocarpa*** (Roxb.) Taub. (Mimosaceae)	+				1.8	2	8	60	7

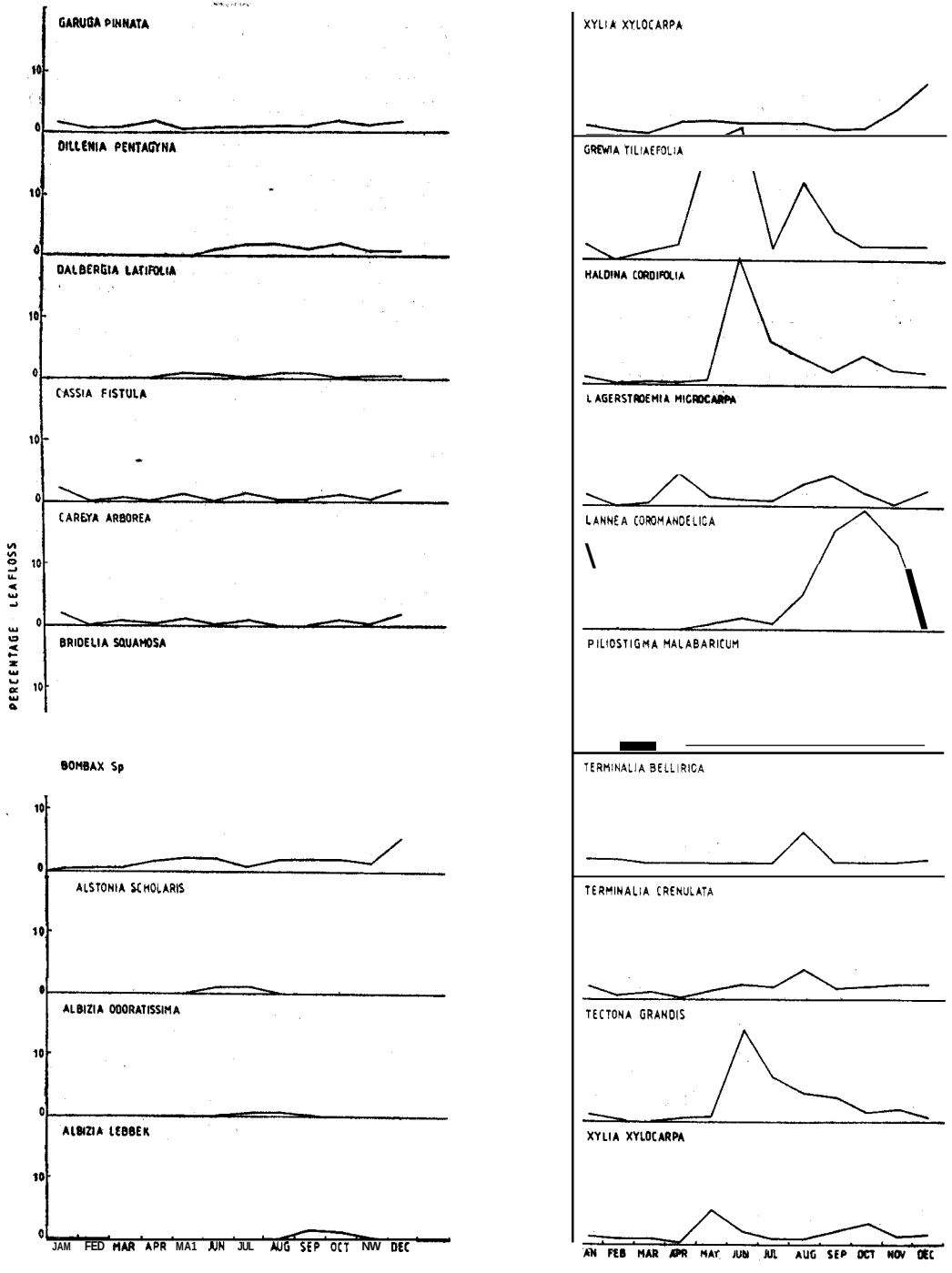

Fig. 4. Seasonal incidence of defoliation in 20 tree species in the moist deciduous forest. Percentages of leaf loss due to insect feeding in each month (mean of 2 years, for 5 trees) are plotted.

The insect fauna

The number of insect species recorded on each tree species in this study along with the number reported earlier and the number recorded here for the first time are given in Table. 1. The species are listed in Appendix I, along with notes on the type of damage. Relevant information on previous records is also given. All tree species had one or more species of insect associates. The maximum number was 12 on ***Garuga pinnata,*** followed by 10 on ***Careya arborea,*** and 9 on ***Grewia tiliaefolia.*** The species, ***Bridelia squamosa, Lagerstroemia microcarpa*** and ***Xylia xylocarpa*** had 5 to 8 insect species; all the remaining had 4 or less (Table 1). Thus the majority of the trees harboured only a small number of insect species. The study has shown that only a small proportion of the insects recorded earlier from these tree species were present in

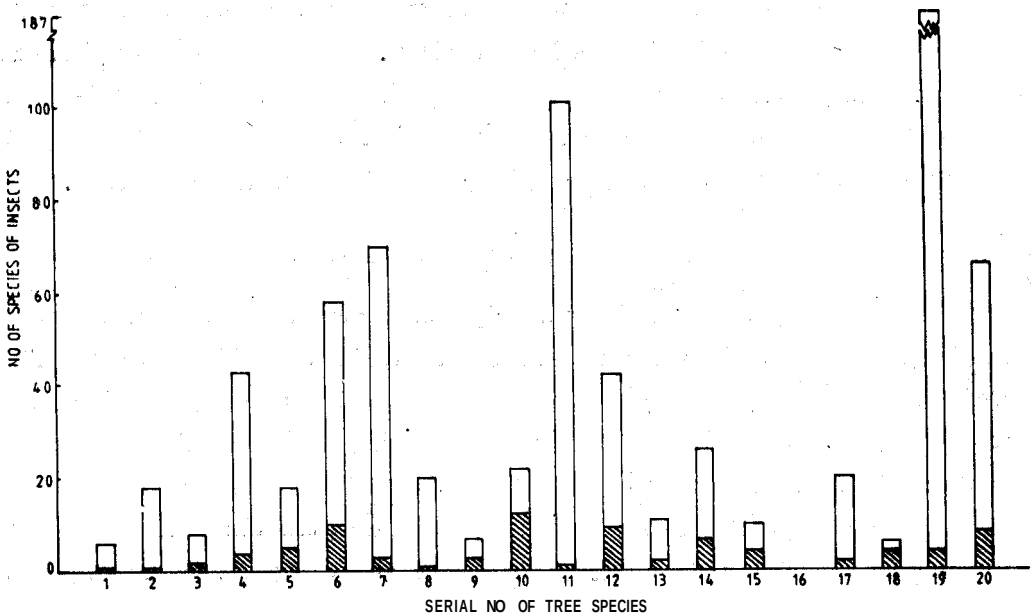

Fig. 5. Number of insect species recorded in this study (hatched area) and in the literature, on 20 tree species in the moist deciduous forest.

TREE IDENTIFICATION KEY

Albizia lebbeck	10, 15	*Gmelina arborea*	7, 48
A. odoratissima	41, 46, 47	*Grewia tiliaefolia*	29,45
Alstonia scholaris	33, 36,49	*Haldina cordifolia*	31, 35, 43
Bombax sp.	21, 51	*Lagerstroemia microcarpa*	14, 27, 28
Bridelia squamosa	12,19,22	*Lannea coromandelica*	6, 52
Careya arborea	1, 3	*Piliostigma malabaricum*	17, 25, 42
Cassia fistula	16, 23, 34	*Terminalia ballirica*	30, 39, 40
Dalbergia latifolia	13, 18	*T. crenulate*	4, 11, 37
Dillenia pantagyna	20, 24, 26	*Tactona grandis*	38, 44
Garuga pinnata	5, 32, 50	*Xylia xylocarpa*	2, 8.

our study sites (Table 1; Fig. 5). Altogether 85 species of insects were found on the 20 tree species, of which 66 were leaf feeders comprising 37 caterpillars and 29 beetles. Interestingly, 54 of these 85 spacies, that is, about 60%, are new records for their respective hosts in India. Additional details are given in Appendix 1.

EVERGREEN FORESTS

OCCURRENCE AND NATURE OF DAMAGE

As in the moist deciduous forest, all trees showed some damage caused by insects, particularly by leaf-feeders (Table 2). Two species- ***Litsea floribunda*** and ***Mesua nagassarium*** were also attacked by wood boring beetles. Sap-sucking and gall forming insects were not observed, but this may have been partly due to difficulties in observing insects on the canopy of the lofty trees.

INTENSITY AND SEASONAL INCIDENCE OF DEFOLIATION

The intensity of defoliation was very low, the annual defoliation percentage ranging between 0.3 and 3.3 except for ***Anacolosa densiflora*** in which it reached 6.2%. Defoliation never exceeded 50% for any tree at any time, the maximum defoliation score being 2 (Table 2). For 7 of the 18 species, the defoliation score never exceeded 1, i. e., no more than 5% of the foliage was lost. The highest mean monthly defoliation percentage was 17 for ***Anacolosa densiflora.*** This was followed by 14% for ***Actinodaphne madraspatana*** and ***Cinnamomum verum,*** and 11 for ***Litsea floribunda.*** For all other species the monthly defoliation percentage was below 10, and for many species it was below 5 (Fig. 6). Most leaf feeding was noticed between February and July.

THE INSECT FAUNA

Although some defoliation was noticed on all tree species, very few of the insects could be collected; the details 'are given in Appendix 2. The few species encountered included 6 leaf feeding insects (5 Lepidoptera and 1Coleoptera) and 2 wood borers (Coleoptera). No insects have been reported earlier from most of the tree species studied.

Table 2. Characteristics of insect-host plant association in evergreen forest

Tree species	Kind of damage		Damage intensity		No. of insect spp recorded		
	Leaf feeding	Stem boring	% defoliation	Max. score	In this study	In literature	First time recorded
1. *Rctinodaphne madraspatana* Bedd. ex. Hook. f. (Lauraceae)	+	–	1.5	2	–	–	–
2. *Anacolosa densiflora* Bedd. (Olacaceae)	+	–	6.2	2	1	–	
3. *Antidesma bunius* Spr. (Euphorbiaceae)	+	–	2.9	2	–	5	–
4. *Calophyllumpolyanthum* Wall. ex Choisy (Guttiferae)	+	–	0.5	2	–	–	–
5. *Cinnamomum verum* J. S. Presl (Lauraceae)	+	–	2.5	2	2	13	1
6. *Cullenia exarillata* J. S. Presl (Malvaceae)	+	–	1.3	2	–	–	–
7. *Dysoxylum malabaricum* Bedd. (Meliaceae)	+	–	1.5	2	–	–	–
8. *Holigarna arnottiana* Hook. f. (Anacardiaceae)	+	–	0.6	1	–	–	–
9. *Knema attenuata* (Hook. f. & Thorns.) Warb. (Myristicaeae)	+	–	2.3	2	–	–	–
10. *Litsea floribunda* (Bl.) Gamb. (Lauraceae)	+	+	3.3	2	2	–	
11. *Mesua nagassarium* (Burm. f.) Kosterm. (Guttiferae)	+	+	0.6	1	1	5	–
12. *Dimocarpus longan* Lour. (Sapindaceae)	+	–	1.8	2	–	–	–
13. *OIea dioica* Roxb. (Oleaceae)	+	–	0.3	1	–	–	–
14. *Palaquium ellipticum* (Dalz.) Bail1 (Sapotaceae)	+	–	1.4	1	1	–	
15. *Syzygium cumini* (Linn.) skeels (Myrtaceae)	+	–	0.5	1	–	53	–
16. *Toona ciliata* Roemer (Meliaceae)	+	–	0.8	1	–	20	–
17. *Vateria indica* Linn. (Dipterocarpaceae)	+	–	1.6	2	1	2	1
18. *Vepris bilocularis* (Wt. et Arn.) Engl. et Prantl (Rutaceae)	+	–	0.8	1	–	–	–

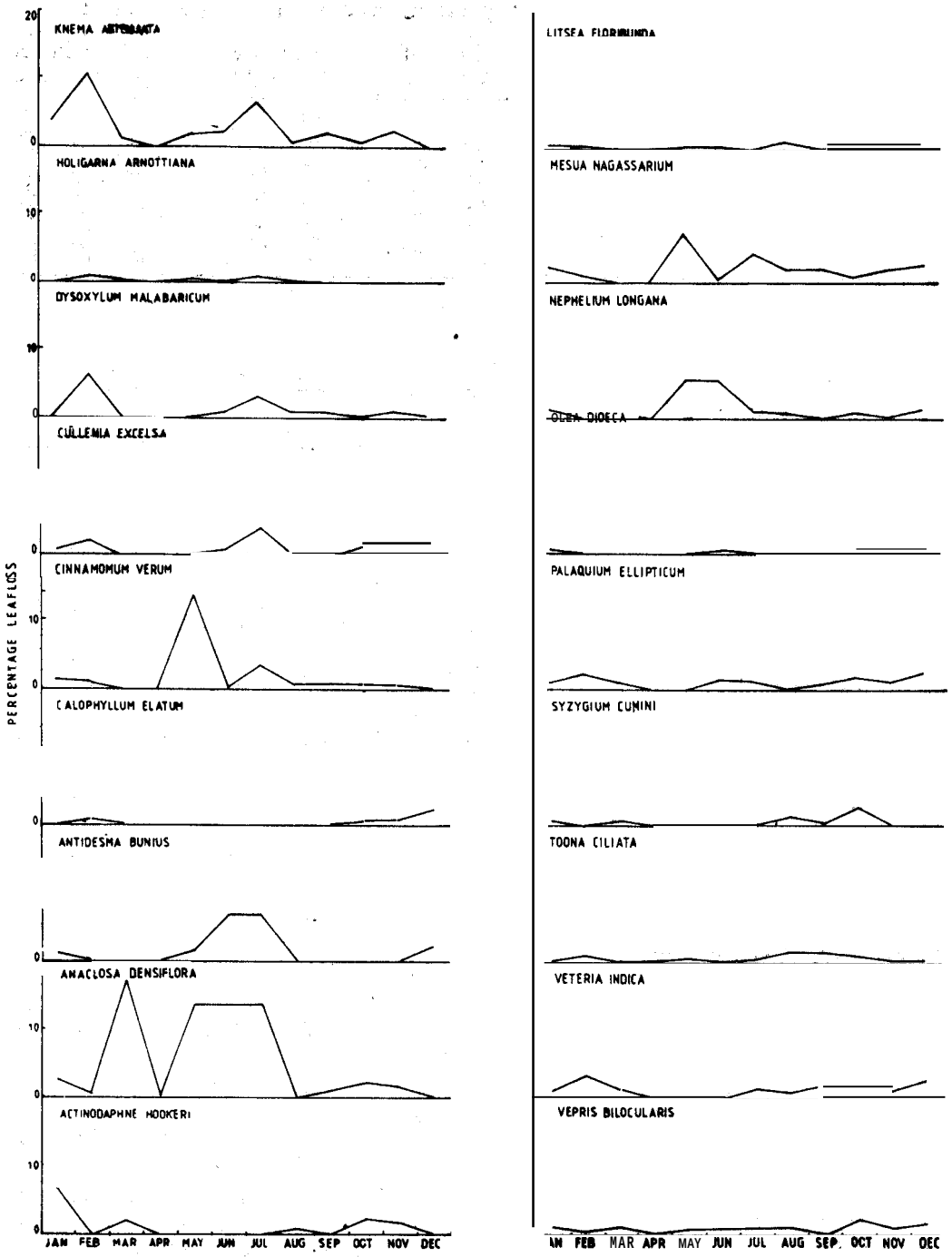

Fig. 6. Seasonal incidence of defoliation in 18 tree species in the evergreen forest. Percentages of leaf loss due to insect feeding in each month (mean of 2 years, for 5 trees) are plotted.

4. DISCUSSION

The general question of the relationship between diversity and stability has been much discussed and some good reviews have been published (van Emden and Williams, 1974; Murdoch, 1975; Way, 1977). A critical study of the literature will show that there is more discussion than data on this topic. Most discussions centre around a few first hand, and numerous second hand observations on pest incidence or lack of it in natural ecosystems, The present study was undertaken in the above context, to gather primary, first hand data. While our results do throw some light on the subject, more critical investigations are necessary to draw conclusions on the relationship between diversity and stability. The scope of this discussion is limited to the practical relevance of the present findings for management of forest pests.

The general tendency to associate stability (in the sense of lack of pest outbreaks) with diversity led to the suggestion that mixed plantations, like mixed forests are less prone to insect: damage. It thus became fashionable to blame monocultures for our pest problems, and mixed plantations were promoted. For example, in Kerala, mixed plantations of teak and ***Bombax,*** or multispecies mixtures consisting of lines or blocks of different species have been raised in some areas. Is there any evidence from this study to suggest that mixtures of different tree species are less prone to insect damage than monocultures?

For this purpose we shall look into the plantation performance of the commonly cultivated species included in this study. These are ***Bombax*** sp., ***Gmelina arborea,*** and ***Tectona grandis.*** Small-scale, experimental plantations have been raised for some other species ***(Albizia lebbeck, A. odoratissima, Alstonia scholaris*** and ***Dalbergia latifolia*** among the moistdeciduous species and ***Mesua nagassarium, Syzygium cumini, Toona ciliata*** and ***Vateria indica*** among the evergreen species) but little information is available on their pest problems in plantations. All the three test species are known to be pest-prone in plantations — ***Bombax*** is affected by the shoot borer, ***Tonica niviferana; Gmelina*** by the defoliator, ***Calopepla leayana*** and the bug, ***Tingis beesoni*** which causes die-back of saplings; and teak by the well known defoliators, ***Hyblaea puera*** and ***Eutectona machaeralis.*** In contrast, the present observations showed that ***Bombax*** and ***Gmelina*** suffered no appreciable insect damage in the natural forest, where for both the species, the well known plantation pests were not encountered. However, on teak the two well known plantation pests, ***Hyblaea*** and ***,Eutectona*** were present in the natural forest and the damage was noticeable. The mean leaf loss however, never exceeded 15%

(Fig. 4), in striking contrast to plantations which suffer regular near-total defoliation every year (Nair *et al* 1985). Some trees in the Vazhani plot suffered more than 50% defoliation on some occasions (due to Hyblaea) but the mean leaf loss did not exceed 15% because only some of the trees under observation were affected. Heavy defoliation of isolated teak trees or of small groups of trees in natural forests have also been recorded in another study (Nair and Sudheendrakumar, 1986a).

These results indicate that pest incidence may occur in natural forest for some tree species, though not all, but the damage may be less severe or less conspicuous. Since the present observations were confined to a small number of trees for each species, distributed over only two locations, and the period of observation was limited to two years, the results are only of indicative value. Taking all the species studied in the natural forest (moist deciduous and evergreen) together, no conspicuous pest outbreak was noticed. But it must be recognized that in the natural forest any outbreak cannot be conspicuous because the trees are dispersed. It appears that regular outbreaks of *Hyblaea puera* do occur in natural forest also during the teak flushing season (see Nair and Sudheendrakumar, 1986a) but do not become conspicuous due to the smaller population size and/or the scattered occurrence of the trees. For other insects such detailed information is not available to indicate whether the comparatively higher mean defoliation scores recorded are reflective of population outbreaks. From the practical point of view, even if the damage is less intense in the natural forest, the advantage will be offset by other operational disadvantages in the natural forest. Practical advantage can result only if this principle of less intense damage will hold good in the case of mixed plantations. The present study is insufficient to shed light on this practical question, because the diversity we may get in such a man-made mixture of tree species is likely to be qualitatively different from the naturally evolved diversity in the natural forest where dynamic trophic relationships have been struck between the producers and the various levels of consumers. There are not enough theoretical reasons to suggest that pest incidence may be low in man-made mixed plantations compared to monocultures, and only long-term experimental trials can shed light on this subject. Each combination of species may perhaps have unique qualities, depending on several factors including their ability to support other insects and undergrowth. It has often been suggested that leaving strips of natural forests between plantations, will lessen the risk of insect damage, by promoting the activity of natural enemies. But this may be a double edged sword, since it may also support the pest during critical periods (see Nair and Sudhetndrakumar, 1986 b).

The second practical question we wish to examine in the light of this study is whether some tree species which are not currently grown in plantations are likely to be inherently free from pest damage. If so, such species could be used to replace the pest-prone ones as there are many tree species that could be put to the same end use in view of similar Wood characteristics. The annual defoliation percentage is an index that could be used to grade the species for defoliation susceptibility. Based on this index which ranged from 0.1 to 6.7 for the various species in the moist deciduous forest, the species can be divided into 3 groups—low, medium and high susceptibility groups. The low susceptibility group (score 0.1 to 2 2) will include 11 species-***Albizia lebbeck, A. odoratissima, Alstonia scholaris, Bombax* sp.*, Cassia fistula, Dalbergia latifolia, Dillenia pentagyna, Garuga pinnata, Piliostigma malabaricum, Terminalia crenulata*** and ***Xylia xylocarpa.*** The medium susceptibility group (score 2.3 to 4.5) will include 7 species – ***Bridelia squamosa, Careya arborea, Gmelina arborea, Haldina cordifolia, Lagerstroemia microcarpa, Terminalia bellerica*** and ***Tectona grandis.*** The high susceptibility group (score 4.5 to 6.7) will include only ***2*** species—Grewia ***tiliaefolia*** and ***Lannea coromandelica.*** However, we cannot rely too much on this rating because of the limited sample of trees observed under each species and the limited period of observation. For example, teak and ***Gmelina*** for which defoliation is recognized as a serious economic problem in plantations fall in the medium susceptibility group. However, the results are of indicative value with respect to the comparative defoliation susceptibility of the species. Thus it is almost certain that the highly susceptible ones in the present ***rating—Grewia tiliaefolia*** and ***Lannea coromandelica*** are at high risk of defoliation in plantations, more than teak and ***Gmelina.*** The study also suggests that ***Dillenia pentagyna*** which has recently been shown to possess long-fibred wood (Bhat *et al.,* 1985) is likely to suffer low pest damage. But these are only indications; the situation in monoculture plantations could be entirely different. While the high risk species could be dropped out of consideration based on the present findings, the low risk species need to be subjected to field trials. The present study has only helped to narrow down the choice of species for field trials. Based on similar rating, for the evergreen species, ***Anacolosa densiflora*** which showed a defoliation score of 6.2 could be eliminated. Field trials alone can bring out the real picture.

Our study has also shown that about 60% of all insects collected from the selected trees are first records for these trees in India. In the evergreen forests evidence was obtained for presence of many leaf-feeding insects, although they could not be callected. Since there are very few published records of insects associated with those tree species, a more detailed study will be rewarding. We examined only 38 of the over 400 arborescent species occuring in the forests of Kerala and the task ahead in studying the insects associated with each of them is obvious

5. CONCLUSIONS

1. In general, fewer instances of insect damage were noticed in the 38 tree species studied in natural forests, both moist deciduous and evergreen. For most species, no noticeable defoliation occurred, but for some, upto 21% leaf loss was recorded at times. Other types of damage were also negligible.

2. At present there is no evidence to indicate that man-made mixtures of tree species (i. e., mixed plantations) will be less pest prone than monocultures. Structural diversity introduced by man in plantations is qualitatively different from the naturally evolved diversity in the natural forest which has a functional dimension added to it. Long-term experimental studies are required to examine the usefulness of mixed plantations in reducing pest incidence.

3. Based on susceptibility to pest damage under natural conditions, 20 species from the moist deciduous forest and 18 from the evergreen forest were rated for degree of susceptibility. *Grewia tiliaefolia* and *Lannea coromandelica* among the moist deciduous species and *Anacolosa densiflora* among the evergreen species were comparatively more susceptible and are at high risk of insect damage if raised in plantations. *Dillenia pentagyna* which has recently been shown to possess long-fibred timber, falls under the low–risk group. The present study is of help only to suggest high risk species for elimination; there is no guarantee that species that are under low risk in natural forest are safe from pest damage in plantations. Only field trials can show the real picture, and this study has providad broad indications for field trials.

4. The study has shown that a large part of the insect fauna of Kerala forests, particularly the evergreen, remain unrecorded.

6. LITERATURE CITED

Bain, J. (1981) Forest monocultures - how safe are they? An Entomologist's view. *New Zealand J. For.* 26 (1); 37-42.

Beeson, C. F.C. (1941) The ecology and control of the forest insects of india and the neighbouring countries. 1961 Reprint, Govt. of India, 767p.

Bhat, K. M., Bhat, K. V. and Dhamodaran, T. K. (1985) Wood and bark properties of branches of selected tree species growing in Kerala. KFRI Res. Report 29: Final Report, Project Wood 06/82, Kerala Forest Res. Inst., India, 34p.

Bhasin, G. D. and Roonwal, M. L. (1954) A list of insect pests of forest plants in India and the adjacent countries, Parts 1 & 2. Indian For. Bull. (N. S.) 171 (1)

Bhasin, G. D., Roonwal, M. L. and Singh, B. (1958) A list of insect pests of forest plants in India and the adjacent countries, Part 3. *Indian For. Bull.* (N. S.), 171 (2)

Browne, F. G. (1968) Pests and diseases of forest plantation trees, Clarendon Press, Oxford, 1330p.

Champion, H. G. and Seth, S. K., 1968) A revised survey of the forest types of India. Manager of Publication, Delhi, 404p.

Ghosh, S. K., Ali, M. I. M., Balasundaran, M. and Mathew, G. (1983) *Rederator bimaculatus,* a possible vector for sandal spike in Kerala. *Int. J. Tropical Plant Diseases,* 1: 197-198.

Graham, S. A. and Knight, F. B. (1965) Principles of forest entomology. McGraw Hill, N. Y: 417p.

Grey, B. (1972) Economic tropical entomology. *Annu. Rev. Ent.* 17: 313-353.

Mathew, G. (1981) A new report of *Pentalitomastix nacoleiae* Eady (Hymenoptera, Encyrtidae) as a polyembryonic parasite of *Parotis Veriumnalis* Guen (Lepidoptera, Pyraustidae) in Kerala, India. Entomon, 6 (2) ; 125.

Mathew, G. (1987) Insects associated with forest plantations of *Gmelina arborea* Roxb. in Kerala, India. *Indian. J. For.* (In Press).

Mathur, R. N. and Singh, B. (1960-61) A list of insect pests of forest plants in India and the adjacent countries, Parts 4-10. *Indian For. Bull,* (N. S.). 171 (3-9)

Murdoch, W. W, (1975). Diversity, complexity, stability and pest control. *J. Appl. Ecol.,* 12: 795-807.

Nair, K. S. S. and Sudheendrakumar, V. V. (1986) The teak defoliator, *Hyblaea puera:* Defoliation dynamics and evidence for short-range migration of moths. *Proc. Indian Acad. Sci. (Anim. Sci.)* 95 (1): 7-21.

Nair, K. S. S., Sudheendrakumar, V. V., Varma, R. V. and Chacko, K. C. (1985): Studies on the seasonal incidence of defoliators and the effect of defoliation on volume increment of teak. KFRI Res. Report 30 Final Report, Proj. Entom 02/77, Kerala Forest Res. Inst., Peechi, India, 78 p.

Nair, K.S. S. (1986) Important insect pest problems of forest plantations in tropical India, *Proc. 18th IUFRO World Congr.* Vol. 1, 134-145,

Nair, K. S. S. and Sudheendrakumar, V. V. (1986) Population dynamics of teak defoliators. *proc. 18th IUFRO World Congress.* Vol. 2, 673-684.

Sharma, J. K., Mohanan, C. and Maria Florence, E. J. (1982) Possible role of insects in spreading diseases of trees caused by fungi in Kerala. In:

Abstracts All India Symp. Vector and Vector-borne diseases. Trivandrum, 26-28 Feb. 1982: 46-47.

UNSECO, (1978) Pests and diseases in forests and plantations. In: *Tropical Forest Ecosystems:* 286-314.

van Emden, H.F. & Williams, G. F. (1974) Insect stability and diversity in agro-ecosystems. *Ann. Rev. Entamol.,* 19: 455-475.

Way, M. J. (1977) Pest and disease status in mixed stands *vs* monocultures; the relevance of ecosystem stability. pp. 127-138 in Cherrett, J. M. and Sagar, G. R. (Eds.). Origins of pest, parasite, disease and weed problems. well Scientific Publications, Oxford, 413p.

Appendix 1. LIST OF INSECTS RECORDED ON 20 TREE SPECIES IN THE MOST DECIDUOUS FORESTS, WITH BRIEF NOTES

Albizia lebbeck

Leaf feeding : **1.** Undetermined caterpillar (Lepidoptera, Geometridae)
It caused only minor damage to foliage.

A total of 18 species including a live tree borer, sap suckers and leaf feeding caterpillars have been recorded earlier,

Albizia odoratissima

Leaf feeding : I Undetermined insect

Only negligible damage to foliage was noticed; no insect could be associated with it. In natural forest outside the experimental plots, a stem borer, ***Xytrocera globosa*** (Coleoptera, Cerambycidae) was found on an injured tree.

Six species of insects including ***X. globosa*** have been recorded earlier.

Alstonia scholaris

Leaf feeding : 1. ***Parotis vertumnalis*** (Guenee) (Lepidoptera, Pyraustidae)

Sap-sucking : 2. Undetermined psyllid (Homoptera, Psyllidae)

Of the two insects, ***P. vertumnalis*** has greater potential for damage. The larva folds the leaflets along the midrib, webs the halves together and feeds from within. Attack was restricted to some leaves and only minor damage was caused. Heavy damage by this insect affecting nearly all leaves has been noticed earlier on isolated, roadside trees at severa1 places in Kerala (Mathew, 1981).

The psyllid caused formation of small, hard, hemispherical galls on the undersurface of leaves. Only a small number of leaves were affected. Although the species was not identified, it is likely to be ***Pauropsylla tuberculata*** Crawford, recorded earlier from India.

A total of 8 species of insects including the two found in this study have been recorded earlier.

Bombax sp.

Two species of Bombax, *B, **ceiba*** and ***B. insigni*** were present in the study area. Since identification is based on flower characteristics and flowers of all trees could not observed, the trees are referred to simply as ***Bombax*** sp.

Leaf feeding : *1. ***Thalassodes opalina*** Butler (Lepidoptera, Geometridae)
*2. ***Euproctis fraterna*** Moore (Lepidoptera, Lymantridae)
*3. ***Indomias hispidus*** (Marshall) Coleoptera, Curculionidae)

Stem boring : *4. ***Glenea homonospila*** Thoms. (Coleoptera, Cerambycidae)

Minor leaf damage consisting of small holes was noticed throughout the year except in January. This damage is presumed to have been caused by the

Species recorded for the first time in India on the respective hosts are indicated by an asterisk.

curculionid beetle, ***I. hispidus;*** the related ***I. cretaceous*** has been recorded earlier from southern India.

Although 39 spp. of insects were recorded earlier from India, they do not include the 4 species found here. ***Tonica niviferana,*** a well known pest in plantations of ***Bombax,*** was not found.

Bridelia squamosa

Leaf feeding : *1. ***Apoderus scitulus*** Wlk. (Coleoptera, Curculionidae)
2. Undetermined looper (Lepidoptera, Geometridae)
3. Undetermined leaf webber (Lepidoptera, Pyralidae)
4. Undetermined caterpillar (Lepidoptera, Pterophoridae)
5. Undetermined leaf miner (Lepidoptera)

The weevil, ***A. scitulus*** caused minor damage by cutting and rolling the edges of leaves. All the other species caused only minor damage in the study area although large build up of the leaf miner, the pterophorid and the leaf webber was noticed at Peechi.

Five species of Coleoptera and 12 species of Lepidoptera have been recorded earlier, A. ***scitulus*** is a new record.. **.....**

Careya arborea

Leaf feeding : *1. ***Aeolonthes dicraea*** Meyrick (Lepidoptera, Oecophoridae)
2. Undetermined leaf miner (Lepidoptera)
3. Undetermined leaf webber (Lepidoptera, Pyralidae)
4. Undetermined looper (Lepidoptera, Geometridae)
5. Undetermined beetle (Coleoptera, Chrysomelidae)

Sap-sucking : *6. ***Tettigoniella indistincta*** Wlk. (Homoptera, Jassidae)
7. ***Centrotypus sp. (Homoptera, Membracidae)

Fruit-boring : *8. ***Limnoecia*** sp. nr. ***peronodus*** Meyr. (Lep., Cosmopterygidae)
*9. ***Teluropus ballardi*** Marshall (Coleoptera, Curcalionidae)
*10. ***Dacus (Bactrocera)***sp. nr. ***tuberculatus***(Bezzi) Dipt,, Tephritidae)

Among the insects recorded, noticeable damage was caused only by the unidentified pyralid which webbed the tender leaves and shoots together and fed from within, and the undetermined chrysomelid beetle which often fed heavily **on** the leaves. The undetermined geometrid caterpillar fed on tender leaves often leaving only the midrib and veins. The sap-sucking and fruit-boring insects were noticed only rarely in small numbers.

Although 52 species of insects have been recorded earlier, all the 6 species identified in this study are new records on this host.

Cassia fistula

Leaf feeding : 1. ***Catopsilia pyranthe*** Herbst (Lepidoptera, Pieridae)
2. ***Deba surrectalis*** Wlk. (Lepidoptera, Pyralidae)

*3. ***Muladeru*** sp. (Coleoptera, Scarabaeidae, Melolonthinae)

Although C. ***pyrunthe*** has been observed to cause total defoliation of some trees outside the study plots at Peechi as well as Vazhachal no major build up was noticed in the study plots. The caterpillars of ***D. surrectalis*** fed on webbed leaves and the beetle ***Maladera*** sp. fed irregularly on the leaf margins.

Sixtynine species of insects have been recorded earlier. This included 13 species of scarabaeids, but ***Maladera*** sp. is a new record.

Dalbergia latifolia

Leaf feeding : *1. ***Peltotrachelus cognatus*** Marshall (Coleoptera, Curculionidae)
This weevil caused only minor leaf damage.

Nineteen species of insects have been recorded earlier, of which ***Plecoptera reflexa*** (Lepidoptera, Noctuidae) is known to be a serious pest of the related tree species, ***Dalbergia sissoo.*** ***P. cognatus*** is a new record.

Dillenia pentagyna

Leaf feeding : *1. Unidentified leaf webber (Lepidoptera, Pyralidae)
*2. Unidentified caterpillar (Lepidoptera, Noctuidae)

Sap-sucking : *3. ***Phymatostetha deschamps*** Lin. (Homoptera, Cercopidae)

Both the caterpillars were found to feed on tender foliage. The cercopid bug, ***P. deschamps*** was present in groups on the foli age, but no visible damage was observed; it is known as a "pest of plantain.

Six species of insects have been recorded earlier, which do not include any pyralid or cercopid, showing that all insects recorded here are new.

Garuga pinnata

Leaf feeding : 1. ***Macalla nubilalis*** Hamps. (Lepidoptera, Phycitidae)
*2. ***Assara albicostalis*** Wlk. (Lepidoptera, Phycitidae)
*3. ***Earias f lavida sulphuraria*** Moore (Lepidoptera, Noctuidae)
*4. ***Adoxophyes moderatana*** Wlk. (Lepidoptera, Tortricidae)
5. Undetermined leaf miner (Lepidoptera)
*6. ***Adoretes coronatus*** Burm. (Coleoptera, Scarabaeidae)
*7. ***Apophylea sericea*** Fb. (Coleoptera, Chrysomelidae)
*8. ***Ophrida marmoria*** Wield (Coleoptera, Chrysomelidae)
*9. ***Campsosternus*** sp (Coleoptera, Elateridae)

Sap-suckmg : *10. ***Drabescus*** sp. (Homoptera, Cicadellidae)
*11. ***Coptosoma vuriegata*** (H..S.) (Heteroptera, Plataspidae)

Gall forming : 12. ***Phacopteron lentiginosum*** Buckton (Homoptera, Psyllidae)

Although a dozen species were recorded, only the psyllid galls were prevalent. The phycitid, ***A. albicostalis*** fed on gall tissue from within.

Thirteen species were recorded earlier, which include only three found in this study. Thus 8 species are new records.

Gmelina arborea

Leaf-feeding : 1. ***Diacrotricha leucomochla*** Fletcher (Lepidoptera, Pterophoridae)

The caterpillars of this moth which was only recently recorded as a pest of ***G. arborea*** (Mathew, 1987) fed along the sides of the principal veins leaving a white streak on the leaf blade. A related species, ***D. agalodesma*** has been recorded earlier.

Altogether 101 species of insects have been recorded on ***G. arborea*** (Mathur and Singh, 1960; Mathew, 1987). Of these, the leaf feeding ***Calopepla leayana*** (Coleoptera, Chrysomelidae) and ***Epiplema fulvilinea*** (Lepidoptera, Epiplemidae), the sapuscking ***Tingis beesoni*** (Heteroptera, Tingitidae) and the live tree borer ***Xyleborus fornicatus*** (Coleoptera, Scolytidae) have been recognized as pests in plantations (Mathew, 1987), but none of them were noticed in natural forests in this study.

Grewia tiliaefolia

Leaf feeding : 1. ***Lygropia orbinusalis*** Wlk. (Lepidoptera, Pyraustidae)
2. & 3. Unidentified loopers, 2 spp. (Lepidoptera)
4. Unidentified hairy caterpillar (Lepidoptera)
*5. ***Nisathra medurensis*** Jac. (Coleoptera, Curculionidae)
6. ***Henicolubus octomaculatus*** Tek. (Coleoptera Curculionidae)
*7. ***Indomias hispidus*** (Marshall) (Coleoptera, Curculionidae)
*8. ***Baris*** sp. (Coleoptera, Curculionidae)
*9 ***Apion*** sp. (Coleoptera, Curculionidae)

The curculionid beetles, particularly ***H. octomaculatus*** caused most damage. They fed on tender leaves immediately after the appearance of the flush, riddling them with holes and causing Over 50% loss Of foliage of some trees in May, June, August and September.

About 38 species of insects have been recorded earlier; 4 beetles found in this study are new records.

Haldina cordifolia

Leaf feeding : 1. Unidentified caterpillar (Lepidoptera, Pyralidae)
*2. Unidentified beetle (Coleoptera)

The pyralid caterpillar folded the leaf along the edge and fed from within. Usually only a single larva was found per leaf. Feeding by the beetle characteristically caused several small holes in the leaf, resulting in loss of more than 50% of the foliage of some trees in June, July, August or October.

Lagerstroemia microcarpa

Leaf feeding : *1. ***Striglina scitaria*** Wlk. (Lepidoptera, Thyrididae)
*2. ***Apocrypta*** , sp. (Coleoptera, Chrysomelidae)
*3. ***Leiochrinus nilgirianus*** Kaszab. (Coleoptera, Tenebrionidae)

*4. ***Myllocerus gracilis*** Marshall (Coleoptera, Curculionidae)

*5. ***Myllocerus*** sp. (Coleoptera, Curculionidae)

*6. ***Notomulciber decemmaculatus*** Breuning (Coleoptera, Cerambycidae)

*7. ***Adoretus bicaudatus*** Arrow (Coleoptera, Scarabaeidae)

Caterpillars of ***S. scitaria*** webbed the leaves and fed inside folded leaves. Both the species of ***Myllocerus*** fed along the leaf margin as well as on leaf surface causing several holes. The scarabaeid A. ***bicuudatus*** caused extensive damage to leaves by feeding irregularly along the leaf margin. In addition to the insects listed here, a coccinellid, ***Hornicolus dispar*** Weise was found on leaf but its habits could not be established.

Nineteen species of insects have been recorded earlier, but all the species found in this study are new records..

Lannea coromandelica (Odina wodier)

Leaf feeding : 1. Unidentified caterpillar (Lepidoptera)

*2. ***Epistictina reicheana*** (Guerin-Meneville) (Col., Chrysomelidae)

*3. ***Philopona inornata*** (Jacoby) (Coleoptera, Chrysomelidae)

Sap-sucking : 4. Unidentified leaf hopper (Hornoptera, Cicadellidae)

Larvae and adults of ***E. reicheana*** fed on the green matter of leaves giving it a dry and withered appearance; over 50% leaf loss occurred on some trees on some occasions.

Although 8 species of insects have been recorded earlier, the two chrysomelids are new.....

Piliostigms malabaricum

Leaf feeding : *1. ***Parotis vertumnalis*** (Guen.) (Lepidoptera, Pyraustidae)

Sap sucking : *2, Unidentified psyllid (Hornoptera, Psyllidae)

P. vertumnalis characteristically webbed the leaves and fed from within. The psyllid occurred gregariously on small branches, attended by ants and was noticed commonly.

No insect has been recorded earlier.

Terminalia bellirica

Leaf feeding : *1. ***Lamida moncusalis*** Wlk. (Lepidoptera, Pyralidae)

*2. ***Dystropicus*** sp. (Coleoptera, Curculionidae)

L. moncusalis, a common pest of cashew in Kerala was found to web the leaves together and feed from within.

Seventeen species of insects were recorded earlier, but both the species found here are new records. Previous records include another species of ***Lamida, L. carbonifera.***

Terminalia crenulata

Leaf feeding : *1. Unidentified leaf miner (Lepidoptera)
*2. ***Ergania baudii*** Faust. (Coleoptera. Curculionidae)

Sap sucking : *3. ***Poophilus*** sp. (Homoptera, Cercopidae)
*4. ***Gargara*** sp. (Hornoptera, Membracidae)

In addition to the above, galls caused by an unknown agent werecommon on leaves and small shoots.

Two species of insects were recorded earlier, but all found in this study are new records.

Tectona grandis

Leaf feeding : 1. ***Hyblaea puera*** Cramer (Lepidoptera, Hyblaeidae)
2. ***Eutectona machaeralis*** (Wlk.) Lepidoptera, Pyraustidae)

Sap sucking : *3. ***Ricania speculum*** (WIk.) Hemiptera, Ricanidae)

Gall forming : 4. ***Asphondylia tectonae*** Mani (Diptera, Cecidomyidae)

The well known teak defoliator, ***H. puera*** caused more than 50% leaf loss of some trees in June 1983; at other times, leaf loss caused by this insect did not exceed 5%. Gall formation was prevalent in some trees.

About 187 species of insects are known to attack teak in the Indian subcontinent. ***R. speculum*** is a new record.

Xylia xylocarpa

Leaf feeding : *1. ***Apoderus scitulus*** Wlk. (Coleoptera, Curculionidae)
*2. ***A. gracilis*** voss (Coleoptera, Curculionidae)
*3. ***Eugnathus curvus*** Faust. (Coleoptera, Curculionidae)
*4. ***Hoplasoma unicolor*** (Illiger) (Coleoptera, Chrysomelidae)

All the insects recorded were beetles which fed on tender leaves. Feeding by ***A. scitulus*** was characterised by small holes with brown periphery. In natural forest outside the study plots the following insects were also recorded.

Muruca testulalis Geyer (Lepidoptera, Pyraustidae)
Recorded from Palappilly; feeds on tender leaves; is a common leaf roller on several pulses.

Phycita spp. (two species) Lepidoptera, Phycitidae)
Both recorded from Palappilly: one species close to ***P. obliquifaciella*** was found to bore into the terminal shoot of seedlings in natural regeneratiou .

*Xyroptila tectonica*** Meyr. (Lepidoptera, Pterophoridae)
Recorded from Palappilly, feeds on foliage.

Arbela tetraonis Moore (Lepidoptera, Melarbelidae)
rded from Peechi, feeds on bark.

About 60 species of insects, were recorded earlier; seven species found in this study are new records.

Appendix 2. LIST OF INSECTS RECORDED ON 18 TREE SPECIES IN THE EVERGREEN FOREST, WITH BRIEF NOTES

Tree species	Damage noticed	Insects recorded in this study and notes on damage	Previous records of insects
Actinodaphne madrasapatana	Leaf feeding	None	None
Anacolosa densiflora	Leaf feeding	1. Undetermined chrysomelid (leaf feeding)	None
Antidesma bunius	Leaf feeding	None	5 SPP.
Calophyllum polyanthum	Leaf feeding	None	None
Cinnamomum verum	Leaf feeding	1. Undetermined lepidopteran (leaf rolling) 2. Undetermined bagworm, resembling ***Pteroma plagiophleps*** Hampson (leaf feeding)	13 spp. including 9 lepidopterans 3 hempterans and 1 coleopteran
Cullenia exarillata	Leaf feeding	None	None
Dysoxylum malabaricum	Leaf feeding	None	None
Holigarna arnottiana	Leaf feeding	None	None
Knema attenuata	Leaf feeding	None	None
Litsea floribunda	Leaf feeding	1, Undetermined lepidopteran (feeds along veins of leaves)	None
	Wood boring	2. Undetermined coleopteran (bores into heartwood, rare occurrence)	
Mesua nagassarium	Wood boring	1. Undetermined buprestid borer. (tunnels into heartwood, sometimes causing death of tree; probably ***Chrysochroa*** sp).	5 spp., including the buprestid ***borer, Chrysochroa*** sp., 2 lepidopterans and 2 hemipterans.
Dimocarpus longan	Leaf feeding	None	None
Olea dioica	Leaf feeding	None	None
Palaquium ellipticum	Leaf feeding	***Striglina scitaria*** Wlk. (Lepidoptera, Thyrididae) (a polyphagous leaf webbing caterpillar)	None

Syzigium cumini	Leaf feeding	None	53 spp., including two wood boring beetles.
Toona ciliata	Leaf feeding	None	20 spp., including leaf feeding, sap-sucking and wood boring insects, of which *Hypsipylla robusta* and *Pagiophloeus longiclavis* are known to cause heavy damage.
Vateria indica	Leaf feeding	1. *Rhodoneura* sp. nr, *myrtaceae* Drury (Lepidoptera, Thyrididae)	*2* spp.
Vepris bilocularis	Leaf feeding	None	None