Tropical Forest Insect Pests

Forest entomology is rich in theory, but much of this is based on observations of temperate forest insects. This comprehensive volume, by a leading researcher in tropical forest entomology, aims to promote a more global theoretical understanding of pest population dynamics and the causes of forest insect outbreaks.

Covering pests of both natural forests and plantations, the book examines the diversity of tropical forest insects; their ecological functions; the concept of pests and the incidence of pests in natural forests, plantations and stored timber. It explores the circumstances under which insect populations increase and acquire pest status. General issues on which foresters and forest entomologists hold strong traditional views, such as the severity of pest incidence in plantations vs. natural forests, in plantations of exotics vs. indigenous tree species and in monocultures vs. mixed plantations are discussed. The final chapter looks in detail at specific insect pest problems of the common plantation tree species across the tropics, and provides recommendations for control.

Containing a wealth of information about tropical forest insects, this book will be valuable for graduate and postgraduate students of forestry, research scientists interested in tropical forest entomology and forest plantation managers in the tropics.

Dr K. S. S. NAIR obtained his PhD in Zoology, specializing in Entomology, from the M. S. University of Baroda in 1964. From 1976 to 1994 he headed the Entomology Division of the Kerala Forest Research Institute in India, and carried out pioneering research on the management of tropical forest insect pests. He was later made Director of the Institute and guided research on various aspects of tropical forestry. Since 1999 he has served as an Editor of the journal Entomon and President of the Association for Advancement of Entomology. Earlier, he also served as Chairman of the IUFRO (International Union of Forestry Research Organizations) Working Party on 'Protection of Forest in the Tropics', for nine years. Dr Nair is now retired and lives in Kerala, India.

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Ecology, Impact, and Management

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Dedication

Dedicated to:
Late Professor J.C. George, who introduced me to research
and
Dr P.M. Ganapathy, who introduced me to forestry

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Illustrations

Preface

This book has grown out of my feeling that tropical forest insects have not received the research attention they deserve. Most books on forest entomology deal with only temperate forest insects and those few that deal with tropical forest insects cover only small regions of the tropics and mostly contain descriptions of pest biology. An exception is a recent book by M.R. Speight and F.R. Wylie (2001) which covers the entire tropics and lays stress on pest management, although their coverage of the subject is very general. Other books on tropical forest entomology covering parts of the tropics are mentioned in the introduction to Chapter 2: particular mention must be made of C. F. C. Beeson's (1941) excellent treatise on the ecology and control of forest insects of India and the neighbouring countries. This book, published some 65 years ago, contains much information that is valid and relevant even today, although it is not accessible to many. Extensive new knowledge has now accumulated on tropical forest insects across the world, but it lies scattered in innumerable journal articles and reports. I have made an attempt in this book to bring this knowledge together and present it in an ecological framework. Knowledge is seldom created by one individual and I have used the knowledge accumulated over time by the dedicated work of innumerable researchers. What is new here is a new framework on which the accumulated knowledge is organized to convey some central ideas relevant to the management of tropical forest insect pests. Facts or observations make sense only when arranged logically and interpreted. My attempt has been to provide an overview of tropical forest insect pests and discuss the basic principles of their ecology in the forest environment, using information about commonly encountered insects across the tropics.

Forest entomology is rich in theory. Much of this is based on observations on temperate forest insects. These theories, particularly, those on population dynamics, have not been static. For example, new theoretical alternatives to the

conventional equilibrium viewpoint of population regulation have emerged in recent years. It is an open question whether the study of tropical forest insects might lead to modification of some of the existing theories, or reinforce them. Tremendous opportunities exist for using long-term observational and experimental data from tropical forests to test theories on insect population regulation. This is because the warm temperatures of the tropics permit year-round growth and multiplication of insects. While many temperate forest insects pass through only one generation per year, many tropical forest insects pass through 12–14 generations in the same period. Therefore testing theories should be easier in the tropical forests. Wider dissemination of knowledge about the tropical forest insects and the research opportunities they offer will promote collaborative work among scientists from developed and developing countries, for the benefit of both and the science of entomology in general. This thought has been one of my main motivations for embarking on this work.

The book is organized into 10 chapters. Chapter 1 gives an overview of the broad features of the tropical forests and their management. This is followed by an overview of tropical forest insects in which their structural and functional diversity and the concept of pests are discussed. Chapter 3 then discusses the several ecological functions the insects perform in the forest ecosystem, and how they influence plant succession. Against the background of these three chapters, the next three describe pest incidence in natural forests (Chapter 4), plantations (Chapter 5) and stored timber (Chapter 6). Characteristics of pest incidence in the three situations are described with examples (except for plantations, where the details are reserved for the last chapter) and generalizations drawn. Pest problems arise when insect numbers increase beyond a certain limit. Therefore, Chapter 7 examines the circumstances under which insect populations increase and how their numbers are regulated in nature.

In Chapter 8, some general issues on which foresters and forest entomologists hold strong traditional views are discussed critically in the light of available evidence. These include the severity of pest incidence in plantations vs. natural forests, in plantations of exotics vs. indigenous tree species and in monocultures vs. mixed plantations. With this background, Chapter 9 examines the pest management options, current practices and constraints in the tropical forestry setting, and suggests guidelines for practice. The last chapter, which occupies nearly half of the book, is devoted to detailed case studies of pest problems of the most common plantation tree species across the tropics. For each of the selected tree species, a tree profile is given which is followed by an overview of pests and detailed pest profiles of the major pests, including control options and knowledge gaps. This chapter contains the core of the data on which the generalizations made in the other chapters rest. But for the bulk, the

information in this chapter should have been incorporated into Chapter 5. But placing it as a separate chapter at the end of the book will facilitate easy reference by practising foresters, planters and researchers who may want specific information on pest problems of particular tree species or details regarding specific pests.

Some observations on the general features of the book seem desirable here. Several changes have occurred recently in the scientific nomenclature of tree species, and the plant families in which they are placed. For example, the tree which was known as *Paraserianthes falcataria* until recently is now *Falcataria moluccana* and the teak tree which has been traditionally placed in the family Verbenaceae is now in the family Lamiaceae. Although these changes are not necessarily accepted by all, some standard is necessary. I have used the Forestry Compendium (2005, CD version) published by the Commonwealth Agricultural Bureau International as the standard for this purpose. Synonyms are given, both for plants and insects, when they are common in recent literature. On countries of occurrence of pests, only known information can be given; updating is necessary in many cases.

I have used the example of the teak defoliator *Hyblaea puera* at several places in the book, in several contexts, to illustrate some points. Also, the pest profile on this species is the longest. This is partly due to the knowledge available and partly to my personal familiarity with the insect. I hope the reader will bear with me for this indulgence.

This book is primarily intended for graduate and postgraduate students in forestry, and research students and research scientists interested in tropical forest entomology. Since its major focus is the researcher, I have included references to published scientific papers to substantiate the statements, at the cost of increasing the work's bulk, although many text books omit these while summarising the knowledge. Unfortunately, published literature is generally taken as truth, which need not always be the case. By including the references, I wish to encourage researchers to be critical and read the original article wherever possible, to understand the conditions under which the reported results were obtained. To stimulate further research, I have included comments on knowledge gaps under each pest profile.

A large part of the knowledge assembled in this book, from the field as well as from literature, was gathered during my career as a research scientist at the Kerala Forest Research Institute, Peechi, India, and I am indebted to the Institute, particularly to its former director, Dr P. M. Ganapathy, for creating an excellent work environment. Gathering of information was also facilitated by a short research assignment at the Center for International Forestry Research, Bogor, Indonesia, and from my association with the International Union of

Forestry Research Organizations (IUFRO) Working Group on 'Protection of Forest in the Tropics', founded by Dr Heinrich Schmutzenhofer. I am deeply indebted to my former entomologist colleagues at the Kerala Forest Research Institute – Dr R. V. Varma, Dr George Mathew, Dr V. V. Sudheendrakumar and Dr T. V. Sajeev – for help in various forms, including supply of photographs or specimens for photographing, reading and making suggestions on parts of the manuscript, providing literature and, above all, encouraging me to undertake this work. The draft of the book was prepared at the Department of Zoology, University of Kerala, Trivandrum, India, where Professor Oommen V. Oommen, Professor D. Muraleedharan and Dr Mariamma Jacob extended various kinds of help and made it pleasant to work. I thank Professor Alan Berryman, Dr Ronald F. Billings, Professor T. N. Ananthakrishnan, Professor A. Mohandas, Professor T. C. Narendran and Dr P. T. Cherian, who read parts of the manuscript and made helpful suggestions. Thanks are also due to Mr Sajan Bhaskaran who made the diagrams and Mr A. M. Shanmugam who processed some of the illustrations. A few of the illustrations were reproduced from other publications with the permission of the publishers, for which I am thankful to them; the sources are acknowledged in the respective legend. Some photographs used in the book were kindly provided by colleagues who are also acknowledged in the respective legend; others were taken by me at various places and times over the years, except a few taken by Dr T. V. Sajeev. This work would not have been possible but for the unstinted support rendered by my wife, Mrs Sathi Nair, in many different ways, including the long, lonely hours spent by her while I was engrossed in the work, particularly at the final stages of preparation of the document.

Last, but most important, the writing of this book was catalysed and supported by the Department of Science and Technology, Government of India, under its Utilisation of Scientific Expertise of Retired Scientists Scheme.

K. S. S. Nair
June 2006

Foreword

This book forms a comprehensive and thoroughly up-to-date text on tropical forest entomology written by an author who has spent his entire career working and living in the tropics. It is both a broad treatment of the principles and practice of tropical forest entomology, and a detailed and penetrating exploration of specific insect pests and the methods used to manage them. What is most significant about this work is its organization of an enormous body of information on tropical insect pests within a general theoretical framework. This is particularly important to students of forest protection, who need to understand the theory of population dynamics and pest outbreaks before they can intelligently manage insect pests.

Dr K. S. S. Nair is eminently qualified to write such a book. He has served as head of the Entomology Division of the Kerala Forest Research Institute in India for some 18 years, and as its director for a further five years, and has also worked at the Centre for International Forestry Research in Indonesia. He has been an active member of the International Union of Forestry Research Organizations (IUFRO) Subject Group 'Entomology' for many years, and has served as chairman of the Working Party on 'Protection of Forest in the Tropics' for eight years, and as deputy coordinator of the subject group 'Forest Health' for nine years. This has given him a broad experience in international forest entomology, both in tropical and temperate forests.

This book will be invaluable to teachers, researchers and forest protection specialists in the tropics. I expect it to become the major textbook in tropical forest entomology as well as an important reference for those involved in research and management of tropical forest pests. It should also bring tropical forest entomology to the attention of a broader audience and, as the author hopes, stimulate collaborative research between scientists in the developed and developing countries. Forest entomology evolved as a science in the Northern Hemisphere. Nair's book will help to correct this bias and thereby lead to a more

global theoretical understanding of pest population dynamics and the causes of forest pest outbreaks.

On a personal note, I remember with pleasure my visit to Kerala in 1986 and, in particular, my walks in the teak plantations with K. S. S. where we contemplated the ways of that mysterious teak defoliator, *Hyblaea puera*. We once stumbled upon an aggregation of moths resting in the undergrowth of a natural forest. When the small shrubs were disturbed they emitted clouds of moths identified as *Hyblaea* by their orange wing-flashes. This discovery helped us to understand the sudden appearance of concentrated, single-aged populations of larvae that completely defoliate stands of teak trees, and made us think of this insect more like a locust than a moth.

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