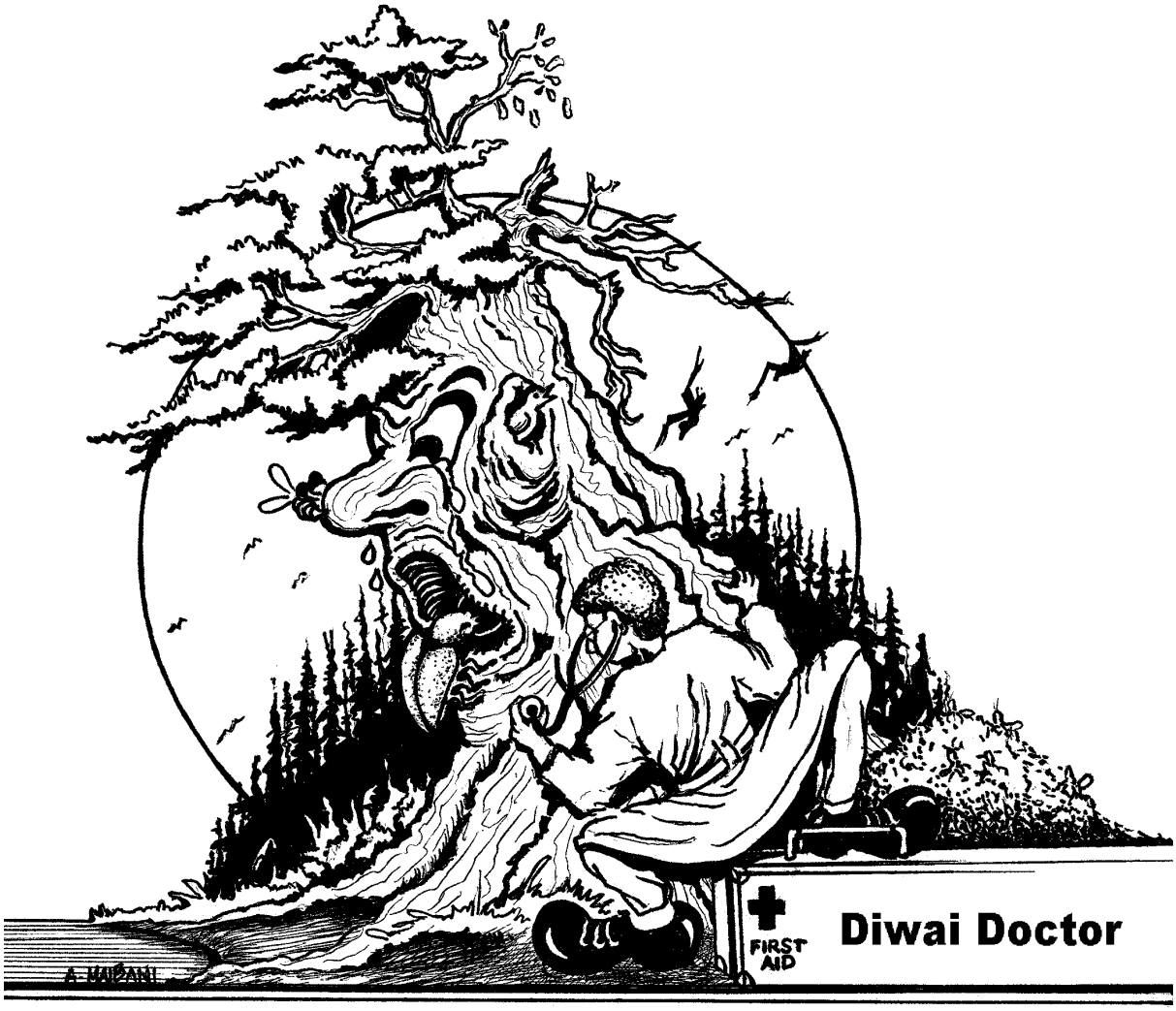
Chapter 6

Forest Insect Pests and their Signs



Imagine, you are suddenly struck with severe head ache. Soon afterwards, you start to sweat and you feel very hot. As soon as you get rid of your clothes, your body is shivering. Even two blankets can't warm you up. Now, your neck starts to ache as well and your limbs feel as heavy as lead. From these signs of an illness, the **symptoms**, you assume that you are suffering from malaria. Since you get really worried about your health, you ask a friend to take you to the hospital in order to seek medical advice. There, you tell the doctor about your symptoms and that you believe that it might be malaria. He checks you and confirms that the symptoms look very much like malaria. The **diagnosis** of your illness is based on the observation of the symptoms that you described. In order to confirm this diagnosis, the doctor decides to collect a blood sample and sends it to the lab. The result of the pathologist confirms your and the doctor's diagnosis - malaria. Since the cause of the sickness has been identified as a particular strain of *Plasmodium*, the doctor can prescribe chloroquine as a **curative treatment**. After having taken the medicine, the symptoms disappear and your disease is cured. Only when and if the disease has been diagnosed, can the disease be cured. A curative treatment is not possible if the doctor is not able to diagnose the illness, ie. if he does not know exactly what you are suffering from.

Cultivated plants and all other organisms in general can suffer from diseases and become sick, too. The task of an agriculturalist or forester is to recognise a disorder and its symptoms early enough so that curative measures can be applied in time and thus the plant can be saved. The situation is a bit more difficult than in the above example, since we can't ask the diseased plant what's wrong with it. A pathologist or entomologist can be engaged to assist in the identification of the pest and to recommend a suitable remedy, but it is the sole responsibility of the agriculturalist or forester in charge to find out any abnormal conditions during regular checks of the crop. A good forester or agriculturalist knows his/her plants and also knows a bit about the pests that can affect them as well as the symptoms of plant diseases.

Imagine another example: during a visit to your Hoop pine plantation you find particular branches starting to wilt and to turn yellow and brown. A closer view shows that the wilt starts at a distinct and sharp line and affects the part of the branch towards the tip. But you cannot yet find out what causes the wilt, whether it is microorganisms or animals like rodents, mites or insects. This is now the difficult part, because very often one can't see the rat or the caterpillar causing the disease. But a good *diwai* doctor doesn't give up that easily. A further scrutiny might be helpful, so you decide to cut open the affected area of the branch and as a result you find another important symptom: galleries in the branch. The first step is done now, all the **symptoms** are found. In this example, a very close look into the galleries uncovers the mystery and elucidates the cause of the wilt. Tiny little black beetles and their white larvae feed inside and burrow into the branchlets, causing the needles to turn into yellow and brown. The job left to be done is to collect some larval and adult beetle specimens as well as some of the affected plant material. A view through a magnifying glass or a stereo microscope reveals that it is *Hyrlurdrectonus araucariae*. The **diagnosis** of this disease is confirmed. Now **curative measures** can be taken, for instance high pruning if the infestation is not yet too severe, otherwise the application of an insecticide would be justified. It would be a waste of money and time to apply a pesticide if we were not able to exactly diagnose the disease, ie. we were not sure whether an insect or a fungus caused the disease. We might end up spraying and wasting an insecticide that is not effective because the disease is a fungal infection.

In this example the attempt to find the pest was successful, but even without the discovery of the beetles, one could have made an exact diagnosis, since there is no other pest that causes these symptoms. In most cases however, it will be difficult or even unusual to

detect the insect, for instance because it feeds only during the night or is present for only a short period of time. Then we have to draw up a diagnosis from the symptoms that are often available. Therefore an agriculturalist or a forester has to be familiar with the specific symptoms of the various diseases that can affect particular crops. The first part of this chapter focuses on the symptoms. Just as a medical doctor uses particular terms to describe the symptoms of an illness, there are certain terms used by professional foresters, agriculturalists, entomologists and pathologists to describe the disorders of a plant. The use of these terms is like a common language understood by various professionals. One of the advantages of this is for instance that the symptoms can be clearly and exactly described by an agriculturalist who is seeking a piece of advice from an entomologist.

The second part of this chapter deals with the various diseases of tree crops in Papua New Guinea caused by insects. The symptoms of the diseases, the insects that are responsible for the particular damage and - if known - their biology are described. Furthermore, suitable remedies for the control of the respective disorders and preventive measures are discussed as recommended by the **Forest Research Institute** (FRI).

6.1 Insect Damage and Sign Categories

A closer look at the damage caused by a particular insect gives us a general idea of which kind of insect has caused the damage. The signs as a result of an insect with piercing-sucking mouthparts look very different from the feeding traces of an insect with chewing mouthparts. Chewing mouthparts result in parts of the plant being chewed or torn off so that there is for instance a hole in a leaf. This type of damage is most likely to be caused by caterpillars of moths and butterflies, by maggots of flies and wasps or by adult beetles or their grubs. Insects with piercing-sucking mouthparts like hemipteran bugs or mites pierce parts of their host plant, causing the affected area to become brown or resulting in wilt or a tumour-like growth, but there is never any part of the plant missing.

Insect signs such as cocoons, larval skins, eggs or silk shelters are another indication of the kind of insect responsible for particular damage and are also very helpful to determine the causal agent. Generally insect damage and signs are divided into four categories:

- **leaf damage**
- **seed and cone damage**
- **shoot, twig, trunk and root damage**
- **insect signs**

However, the damage seen will rarely fit exactly into one of the categories, more often it is a combination of two categories.

6.1.1 Leaf Damage

- **Leaf** and **needle mines** are caused by insects with chewing mouthparts Feeding occurs inside the leaf or needle on the mesophyll, between the lower and upper epidermis (**fig. 6-1 A**, **B**). The different types of mines are described according to their shape as linear mine, serpentine mine, blotch mine, digitate mine, leaf blister (**fig. 6-1 B**), needle mine or a combination of one or more.

- **External leaf** or **needle damage** is caused by insects with chewing mouthparts feeding externally on the leaf or needle. A leaf or needle chewed from the outside, called **free feeding** (**fig. 6-2 C**, **G**), is sometimes left with only the tough veins and the middle rib as skeleton (**skeletonizing**, **fig. 6-1 D**). A small patch eaten through all layers of the leaf, creating a hole in the leaf is referred to as **hole feeding** (**fig. 6-1 C**). If only one surface of the leaf is affected resulting in a more or less transparent 'window', we talk about **window feeding** (**figs. 6-1 C**, **E**).

- **Stippling damage** is caused by the piercing and sucking action of hemipterans and mites. Usually these animals inject saliva for the external digestion of the plant juices prior to

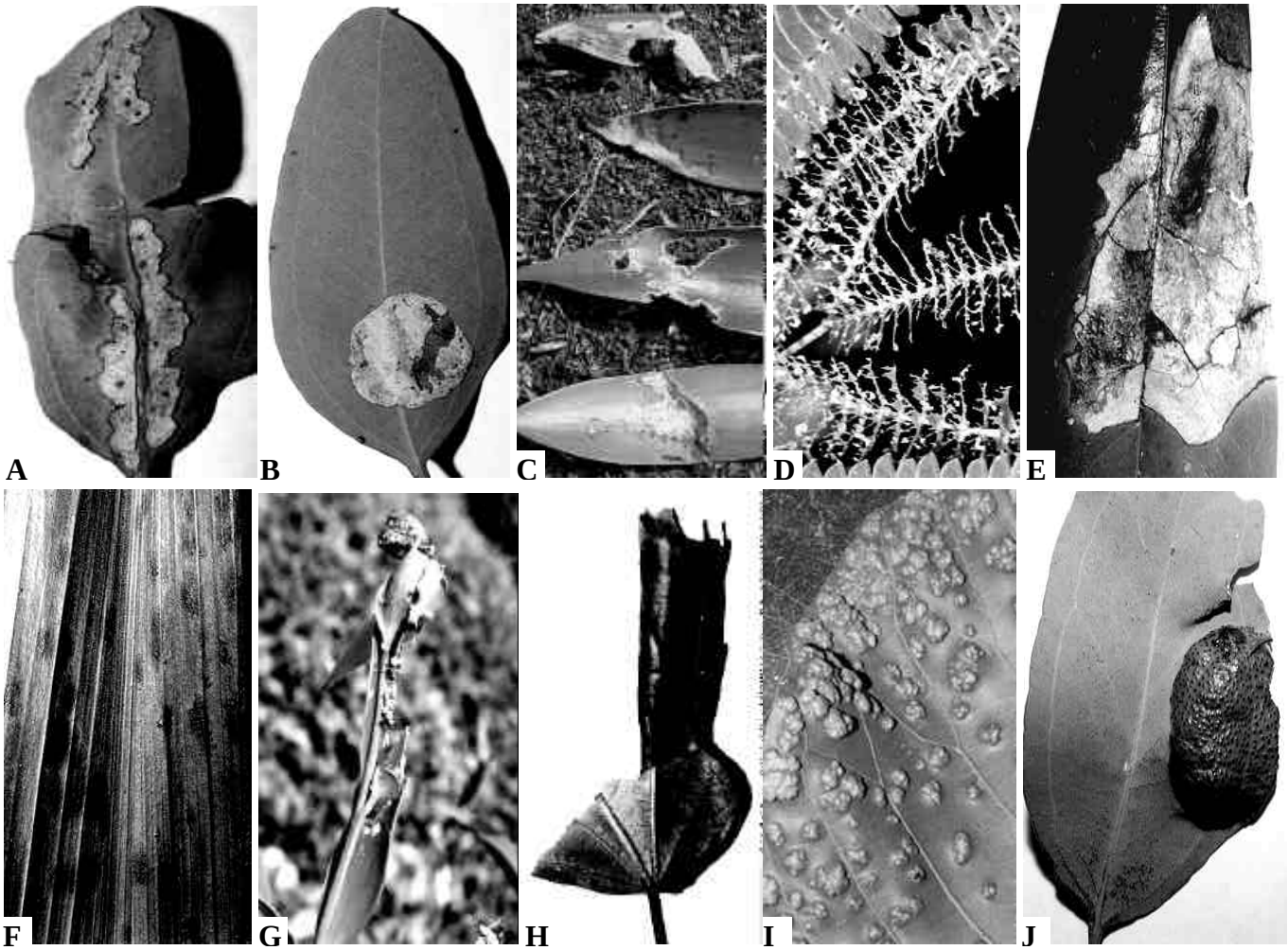


Fig 6-1: Leaf damages: (A) leaf mine; (B) leaf blister caused by the leaf blister sawfly *Phylacteophaga sp*. (Hymenoptera; Pergidae); (C) multiple damage consisting of free feeding, hole feeding and window feeding; (D) sketetonized leaf; (E) window feeding; (F) dead spots; (G) leaf tying and free feeding; (H) leaf rolling; (I, J) leaf galls (photos Schneider, M.F.)

their ingestion. The toxic effect of the saliva results in small, circular 'dead' spots (**fig. 6-1 F**) on the leaf.

- **Shelter feeding** refers to foliage that is modified into a shelter in which an insect hides and feeds. Either one or several leaves are tied together with a silk thread or web, either by one or more caterpillars (**leaf/needle tying**, **web-enclosed foliage**, **fig. 6-1 G**), or folded or rolled and tied together (**leaf folding** and **rolling**, **fig. 6-1 H**). The piercing-sucking action of insects can make the leaf crinkle and curl around the insect, thus providing shelter (**crinkled leaf**). Sometimes, if eggs are laid into the tissue of a leaf, the affected area starts to grow abnormally like a tumour. Those structures are called **leaf** or **petiole galls** (**fig. 6-1 I**, **J**). The immature stages of gall-forming insects develop and feed inside a gall. Galls can also be induced by saliva injected during the piercing-sucking action of **Hemiptera** and **mites**. Galls of other plant tissues are shown in **fig. 6-2 A**.

6.1.2 Seed and Cone Damage

Seeds and cones can be affected in several ways by boring insects like weevils (**cone or seed boring**) or by insects feeding on the surface of a cone (**cone scoring**). Other insects with piercing-sucking mouthparts like Hemiptera, and rarely by insects with chewing mouthparts like Diptera larvae, can cause the cone to shrivel (**shrivelled cones**).

6.1.3 Shoot, Twig, Trunk and Root Damage

• **External bark damage** is caused by mainly boring weevils, feeding on the bark of the trunk or twigs, leaving small holes or otherwise irregular wounds (**bark scoring**). Females of cicadas, tree hoppers or saw flies slit the bark and some jewel beetles and longicorn beetles chew small pits into the bark for oviposition (**oviposition damage**). Insects with piercing-sucking mouthparts can cause damage similar to the stippling damage of a leaf, causing a twig or shoot to wilt (**feeding puncture**, **box 6-1 Y**). Oviposition and feeding by particular insects can cause **galls** on the stem and shoot, shown in **fig. 6-2 A**.

• **Internal bark feeding** usually affects the phloem and is caused for instance by larvae of bark beetles and pin- and shot-hole borers, that tunnel under the bark (**phloem boring**, **under-bark boring** and **bark beetle damage**, **fig. 6-2 B** and **C**).

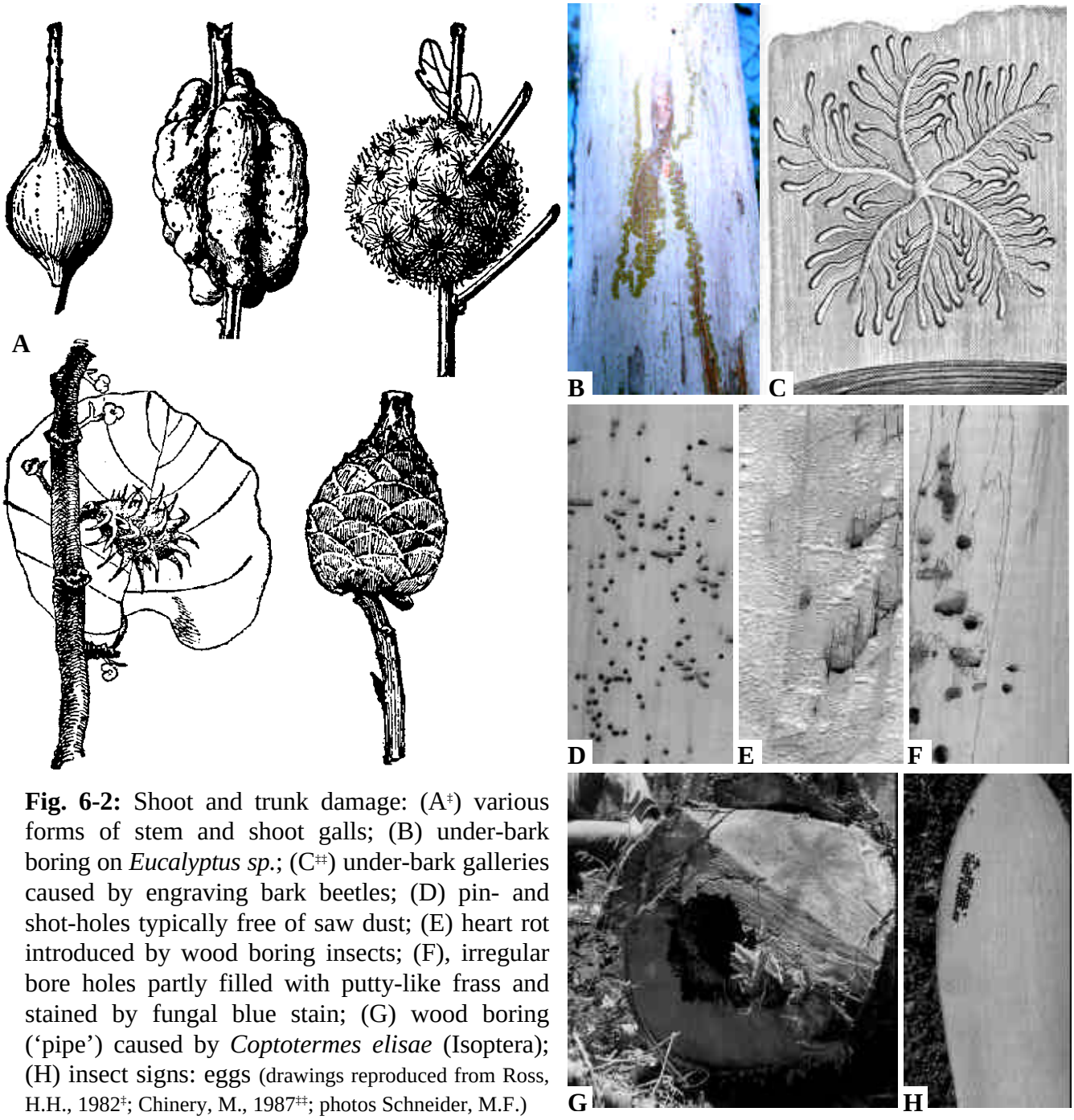


Fig. 6-2: Shoot and trunk damage: (A‡) various forms of stem and shoot galls; (B) under-bark boring on *Eucalyptus sp.*; (C‡‡) under-bark galleries caused by engraving bark beetles; (D) pin- and shot-holes typically free of saw dust; (E) heart rot introduced by wood boring insects; (F), irregular bore holes partly filled with putty-like frass and stained by fungal blue stain; (G) wood boring ('pipe') caused by *Coptotermes elisae* (Isoptera); (H) insect signs: eggs (drawings reproduced from Ross, H.H., 1982‡; Chinery, M., 1987‡‡; photos Schneider, M.F.)

- **Wood boring** can affect the wood and/or the phloem of the trunk, branches (**plate 11 G**) or shoots (**terminal boring** and **shoot boring**,). Many **Scolytidae** and **Platypodidae** beetles are wood borers. The smaller larvae affect the softer tissues such as the phloem, but the bigger the larvae grow, the deeper they might tunnel into the wood. **Ambrosia beetle damage** is caused by the adults of these two families, boring small **pin-holes** or larger **shot-holes** through the bark right into the wood of living or dying trees and freshly cut lumber, shown in **fig. 6-2 D** and **box 6-1C**. Characteristic of this sort of damage is that there are no galleries under the bark and that the bore holes are kept free from saw dust. Furthermore, the holes are often stained by fungi like blue stain or affected by heart rot (**fig. 6-2 E** and **F**). **Powderpost beetle damage** is conspicuous due to the very fine, powder-like saw dust pushed out of the galleries made in trees and timber products. Termites (**Isoptera**) as well as some beetles like larval longicorn beetles (**Cerambycidae**) and weevils (**Curculionidae**) make irregular, interconnecting galleries in the heartwood and under the bark of living and dead trees and in timber products. **Fig. 6-2 F** shows damage caused by weevils. Carpenter ants (**Anthophoridae**) are responsible for **'honeycomb' type wood boring**. A **'pipe'** is a big cavity excavated for the establishment of a termite nest (**fig. 6-2 G**)
- **Reactions of a plant to wounds** indicate damage caused by insects. **Sap** and **gum flow** on the bark of a tree (**box 6-1 F**) can be the result of insects like cicadas, pin- and shot-hole borers or bark beetles, damaging the bark, cambium or phloem. Sometimes a wound caused by insects results in the growth of a **twig gall**, an **abnormal wood grain** or crippled, malformed stems (**box 6-1 T**).

6.1.4 Insect Signs

There is a great number of signs that indicate the presence of insects. These signs are often a useful tool for the identification of the pest insect and should be searched for during monitoring. A few examples are:

- **larval cases** made from silk and other materials such as leaves, stones, little twigs, debris, frass, etc., shown in **fig. 5-47**
- **silk shelters** and **cocoons** (**fig. 6-18**)
- **spittle masses** (**fig. 5-25 H**) produced by larval spittle bugs (**Cercopidae**)
- **eggs** as shown in **figs. 2-34**, **6-2 H** and **6-16 A** or **ootheca** as shown in **fig. 5-18 A**
- **black sooty mould** (**box 6-1 O**) caused by a black fungus growing on **honey dew**, the sweet secretion of aphids, lerps and scales
- **scales**, **tests** and **lerps** of aphids, psyllids and scale insects shown in **figs. 5-25 C**, **E**, **F** and **box 6-1 I**, **N**, **O**
- larval and pupal skins (**exuviae**) or **pupae** shown in **fig. 6-16 B**
- other signs like frass, saw dust, faeces, termite nests and mud galleries (**figs. 3-13**, **3-14**, **6-12 B**, **box 6-1 A**, **L**), silk threads, dead insects, etc.

6.2 Common Forest Insect Pests of Papua New Guinea

This section introduces the common forest insect pests of Papua New Guinea. Included are insect pests that were recorded as damaging commercial trees species in their natural habitat as well as in plantations. Most pests occur periodically and have been recorded only once or twice as severe pests during the history of plantation forestry in PNG. Furthermore, only pests of tree species that are grown on a larger scale in plantations are taken into consideration. There are certainly many more insect species that are potential pests and these will become known as pests, as the number of tree species grown in plantations increases. A key to the common forest insect pests in Papua New Guinea is shown in **box 6-1**. **Box 6-2** and **6-3** give an overview of the insect pests of commercial tree species that have so far been recorded in PNG. The illustrations of the pest insects are shown in **figs. 6-3** and **6-4**. The biology of the important groups of pest insects like termites, beetles and moths is briefly outlined.

A: Araucariaceae
Hoop pine (*Araucaria cunninghamii*) and Klinkii pine (*Araucaria hunsteinii)*

- leaf wilt starting from the tree top downwards and from the tips of the branches inwards (**plate 11 H**)
- crown more or less defoliated
- leader often without leaves
- mud packs at base of the stem
- base of the stem with 'pipe' (**fig. 6-2 G**)
- hollow sound of stem when tapped
- timber of low quality due to the presence of many irregular galleries in the wood
- trees and seedlings of all ages are affected and will eventually die

➳ ***Coptotermes elisae*** **(Desneux)** (**Rhinotermitidae**)**, chapter 6.2.1**


B: Araucariaceae
Hoop pine (*Araucaria cunninghamii*)

- leaf wilt starting at the lower branches moving upwards to the tip of the crown and from the tips of the branches inwards (**plate 11 I**)
- distinctive mines in the cortex between the healthy green and wilt yellow or brown area of the branchlets (**plate 11 G**)
- mainly 4 to 11 year old trees are infested
- infestation can kill host on long term

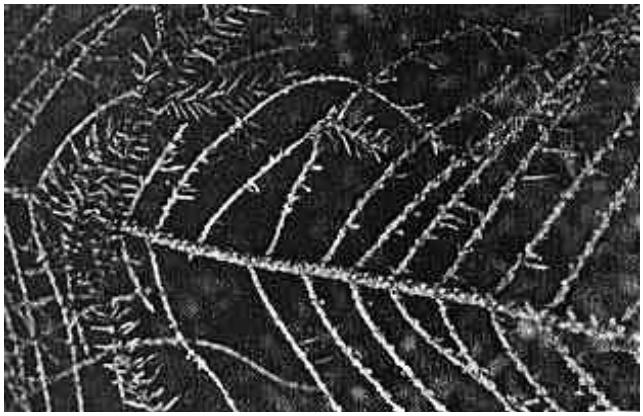
➳ ***Hylurdrectonus araucariae*** **(Schedl) (Scolytidae), chapter 6.2.5**


C: Araucariaceae
Hoop pine (*Araucaria cunninghamii*) and Klinkii pine (*Araucaria hunsteinii)*

- pin- and shot-holes in stem and timber
- holes are free of sawdust and frass
- sawdust-like powder can be often found on the bark below the holes (**fig. 6-12 B**)
- sometimes resin is dripping from the borehole (**box 6-1 F**)
- wood adjacent to the hole is often stained by the fungal blue stain (**fig. 6-12 A**)

➳ **pin- and shot-hole borers (Platypodidae and Scolytidae), chapter 6.2.5**


Box 6-1: Key to Common Forest Insect Pests in Papua New Guinea (continued)



D‡: Araucariaceae
Hoop pine (*Araucaria cunninghamii*)

- surface of leaves and twigs eaten
- branches are defoliated and start to wilt
- infested trees appear brown
- last instar caterpillars can be found at base of the stem

➳ **Millionaire moth *Milionia isodoxa* Prout (Geometridae), chapter 6.2.6**

E: Araucariaceae
Hoop pine (*Araucaria cunninghamii*)

- large borehole (∅ 10 - 15 mm) usually in vicinity of nodes
- attack results in degrade of timber, but can be fatal if attack sustained
- generally injured or pruned trees with resin flow are attacked
- attack occurs clustered on trees older than four years

➳ **Hoop pine weevil *Vanapa oberthuri*(Pouillaude) (Curculionidae), chapter 6.2.5**

F: Araucariaceae
Hoop pine (*Araucaria cunninghamii*) and Klinkii pine (*Araucaria hunsteinii)*

- larger boreholes in standing or recently felled trees
- attack of stressed and injured trees after fire or infestation with primary pest
- often infested simultaneously by several pests, resulting in the host's death
- degrade of timber

➳ **Curculionidae and/or Cerambycidae wood borers, chapter 6.2.5**

G: Araucariaceae
Kauri pine (*Agathis spp.*)

- open feeding on young leaves and shoots resulting in stunted growth
- leaves tied together with silken thread shown in **fig. 6-1 G**
- pupae or pupal skins can be found in leaf shelters

➳ ***Mocis trifasciata* (Stephen) (Noctuidae), fig. 6-4 R**

Box 6-1: Key to Common Forest Insect Pests in Papua New Guinea (continued)

H: Pinaceae
Pinus patula

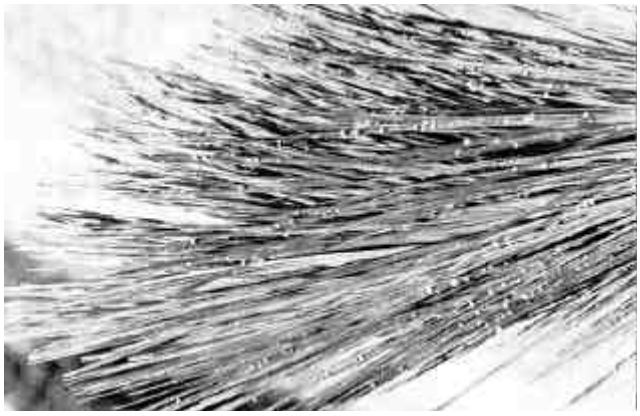
- severe defoliation of the attacked tree
- bundles of needles are cut off at their base and pile up under the tree
- egg masses can be found on the bark below branches (**fig. 6-16 A**)
- infestation of plantation usually starts from the ridge and proceeds downwards into the valley
- outbreaks occur periodically every ten to 20 years

➳ ***Lymantria ninayi* Bethune-Baker (Lymantriidae) and other lepidopteran defoliators, chapter 6.2.6**

I[#]: Pinaceae
Caribbean pine (*Pinus caribaea*)

- sparse foliage of trees, especially of the upper crown
- dark foliage due to black sooty mould growing on honey dew produced by scales
- scales visible on needles
- loss of increment and die-back

➳ **red wax scale *Ceroplastes rubens* Maskell (Coccidae), chapter 6.2.3**



J: Pinaceae
Pinus spp.

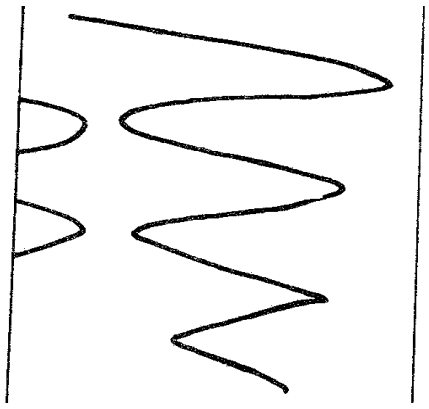
- terminal buds are affected causing malformation and permanent stunting
- seedlings in nurseries and trees on unfavourable sites are attacked
- heavy infestation can eventually kill host

➳ **pine woolly aphid *Pineus pini* (Macquart) (Adelgidae), chapter 6.2.3**

K: Myrtaceae
Kamarere (*Eucalyptus deglupta*)

- zigzag-like tunnels visible on bark
- semi-circular holes in the bark of the tree
- epicormic shoots developing from the trunk
- unhealthy young trees and trees planted in unsuitable conditions are preferably infested and eventually die

➳ **under-bark borer *Agrilus opulentus* (Buprestidae), chapter 6.2.5**

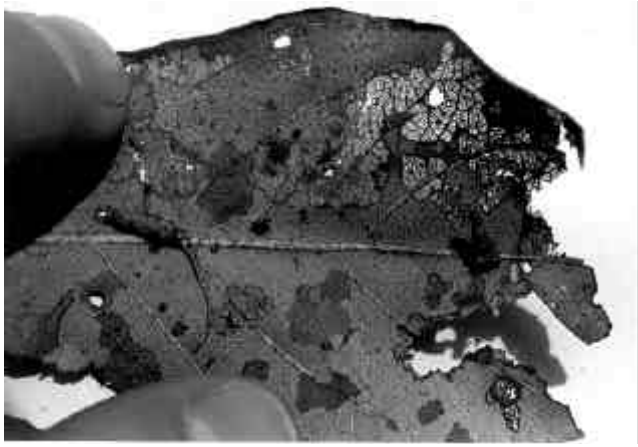


Box 6-1: Key to Common Forest Insect Pests in Papua New Guinea (continued)


L: Myrtaceae
Kamarere (*Eucalyptus deglupta*)

- wilt of whole branches starting from the tips and/or affecting the tree top
- mud covers on the base of the tree up to a few metres
- riddled wood filled with holes
- termite nest with more or less regular and smooth surface often in adjacent tree
- trees are susceptible to damage by wind
- trees of any age can be attacked and eventually die

➳ ***Nasutitermes novarumhebridarium* (Holmgren) (Termitidae), chapter 6.2.1**



M: Myrtaceae
Gum (*Eucalyptus torelliana*)

- skeletonized leaves with brown or dark yellow spots
- defoliation of the host
- conical larval cases or bags of less than one centimetre length attached to leaves
- pupae in shelter attached to leaves by thick silken thread

➳ **case moth *Hyalarcta spp.* (Psychidae), chapter 6.2.6**

N: Myrtaceae
Eucalyptus spp.

- leaves are more or less densely covered with purple or brown blotches and translucent, shell-like lerps
- infested tree can be completely defoliated and eventually dies

➳ **lace or basket lerp *Cardiaspina spp.* (Psyllidae), chapter 6.2.3**

O: Myrtaceae
Eucalyptus spp.

- leaves are covered with white fibrous lerps that more or less defoliate the host
- leaves often stained with black sooty mould growing on honey dew

➳ ***Glycaspis spp.* (Psyllidae), chapter 6.2.3**

Box 6-1: Key to Common Forest Insect Pests in Papua New Guinea (continued)

P: Myrtaceae
Eucalyptus spp.

- young seedlings in the nursery completely defoliated, bent or cut off right above the soil
- damage occurs mostly during night
- stem of seedling debarked or ringbarked at the base

➳ **seedlings either damaged by cutworms (Noctuidae), chapter 6.2.6 or by grasshoppers (Orthoptera), chapter 6.2.2**

Q‡‡‡: Myrtaceae
Eucalyptus spp.

- leaves of terminal branches of younger trees trimmed by larval beetles
- defoliation of tree tops
- crescent-shaped feeding notches on leaves of the lower crown made by adult beetles

➳ **eucalypt leaf beetle *Paropsis spp.* (Chrysomelidae), chapter 6.2.5**

R†: Myrtaceae
Eucalyptus spp.

- fine, powder-like dust on the bark beneath the bore holes
- cross section shows boreholes that are radially arranged
- infestation occurs mainly after fire

➳ ***Xylothrips religiosus* Boisduval and other powder-post beetles (Bostrichidae), chapter 6.2.5**

S††: Meliaceae
Red Cedar (*Toona australis*)

- wilt and defoliation of terminal shoots due to longitudinal mines made by larvae
- development of lateral branches with many leaders
- bushy appearance of tree
- stem crooked and twisted

➳ **cedar shoot borer *Hypsipyla robusta* (Moore) (Pyralidae), chapter 6.2.6**

Box 6-1: Key to Common Forest Insect Pests in Papua New Guinea (continued)

T††: Meliaceae
Red Cedar (*Toona australis*)

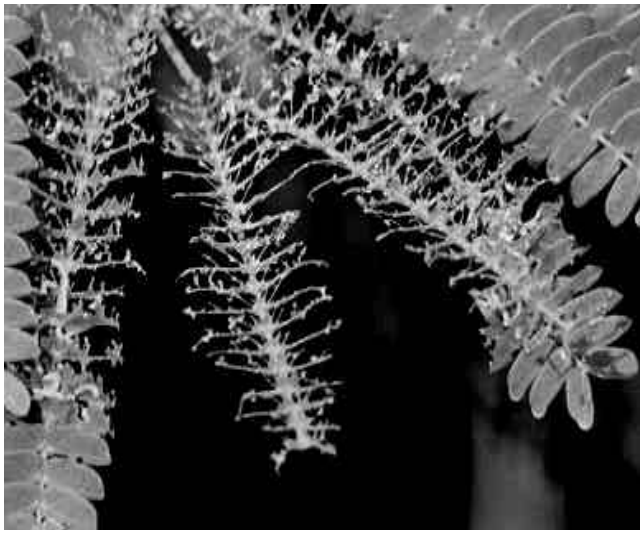
- adult beetles feed on cambium of host
- strips of the bark of the stem and branches are chewed off
- considerable deformation and die-back of the affected stem and branches

➳ **rhinoceros beetle *Xylotrupes gideon* (Linnaeus)(Scarabaeidae), chapter 6.2.5**

U: Verbenaceae
Teak (*Tectona grandis*)

- severe, often complete defoliation of host
- all tissues of the leaves are eaten
- larvae hidden in rolled and tied leaves, pupae in leaf folds or between spun leaves
- forked tops due to damage of the leaders
- damage can kill smaller seedlings
- periodic outbreaks

➳ **teak moth *Hyblaea puera* Cramer (Hyblaeidae), chapter 6.2.6**



V: Leguminosae
White Albizia (*Albizia falcataria*)

- leaflets skeletonized
- during severe infestation host can be completely defoliated
- often pupal exuviae abundant on skeletonized leaves (**fig. 6-4 S**)
- mostly young trees are affected

➳ ***Eurema blanda* (Boisduval) (Pieridae), chapter 6.2.6**

Box 6-1: Key to Common Forest Insect Pests in Papua New Guinea (continued)

W: Leguminosae
Wattle (*Acacia mangium*)

- wilt of whole branches starting from the tips and/or affecting the tree top
- mud covers on the base of the tree up to a few metres
- riddled wood filled with holes
- termite nest with more or less regular and smooth surface often in adjacent tree
- trees are susceptible to damage by wind
- trees of any age can be attacked and eventually die

➳ ***Nasutitermes novarumhebridarium* (Holmgren) (Termitidae), chapter 6.2.1**

X: Leguminosae
Wattle (*Acacia mangium*)

- white, woolly fibres present on leaves
- infestation causes wilt and stunted growth
- affects only seedlings and young trees

➳ **mealy bugs (Pseudococcidae) and white flies (Aleyrodidae), chapter 6.2.3**

Y: Leguminosae
Wattle (*Acacia auriculiformis*)

- shoot tips wilt due to piercing-sucking action of bug
- forked tips due to damage of the shoots
- stunted, bushy growth of tree
- affects only seedlings and young trees

➳ **crusader bug *Mictis profana* (Fabricius) (Coreidae), chapter 6.2.3**

Z: Combretaceae
Swamp Talis (*Terminalia brassii*)

- free feeding of beetles on foliage
- semi-circular holes in the bark of the tree
- infestation of unhealthy young trees and trees planted in unsuitable conditions

➳ **under-bark borer *Agrilus viridissimus* (Buprestidae), chapter 6.2.5**

Box 6-1: Key to Common Forest Insect Pests in Papua New Guinea (photos Schneider M.F.; Wylie, F.R., 1974[‡]; Gray, B. & Wylie, F.R., 1974[††]; Wylie, F.R. & Shanahan, P.J., 1973[†]; Merrifield, L.E. & Howcroft, N.H.S., 1975[‡‡]; reproduced by permission of CSIRO Australia from Farrow, R., 1996[‡‡‡])

Host Family	Species	Pest Species	Family
Araucariaceae:	*Araucaria cunninghamii*	*Coptotermes elisae* (Desneux)	**Rhinotermitidae**
		Coptotermes spp.	**Rhinotermitidae**
		various species	**Acrididae**
		Dihammus spp.	**Cerambycidae**
		Eriococcus sp.	**Eriococcidae**
		Diotimana undulata (Pascoe)	**Cerambycidae**
		Vanapa oberthuri (Pouillaude)	**Curculionidae**
		Sympiezoscelus sp.	**Curculionidae**
		Aesiotes sp.	**Curculionidae**
		Illacuris laticollis (Pascoe)	**Curculionidae**
		Orthorhinus patruelis (Fabricius)	**Curculionidae**
		Platypus spp.	**Platypodidae**
		Diapus spp.	**Platypodidae**
		Crossotarsus spp.	**Platypodidae**
		Xyleborus spp.	**Scolytidae**
		Hylurdrectonus araucariae (Schedl)	**Scolytidae**
		Hylurdrectonus piniarius (Schedl)	**Scolytidae**
		Milionia isodoxa Prout	**Geometridae**
		Milionia spp.	**Geometridae**
	Araucaria hunsteinii	*Potemnemus spp.*	**Cerambycidae**
		Dihammus spp.	**Cerambycidae**
		Illacuris laticollis (Pascoe)	**Curculionidae**
		Mitrastethus australiae	**Curculionidae**
		Platypus spp.	**Platypodidae**
		Diapus spp.	**Platypodidae**
		Crossotarsus spp.	**Platypodidae**
		Xyleborus spp.	**Scolytidae**
	Agathis spp.	*Mocis trifasciata* (Stephen)	**Noctuidae**
Pinaceae:	*Pinus caribaea*	*Ceroplastes rubens* Maskell	**Coccidae**
	Pinus patula	*Xylotrupes gideon* (Linnaeus)	**Scarabaeidae**
		Lymantria ninayi Bethune-Baker	**Lymantriidae**
		Lymantria spp.	**Lymantriidae**
		Dasychira wandammena Bethune-Baker	**Lymantriidae**
	Pinus spp.	*Pineus pini* (Macquart)	**Adelgidae**
		Pteroma plagiophleps Hampson	**Psychidae**
		Alcis papuensis	**Geometridae**
		Paradromulia nigrocellata	**Geometridae**
		Anthela ekeikei	**Anthelidae**
		Anthela spp.	**Anthelidae**
		Syntherata spp.	**Saturniidae**
		Calliteara queenslandica Butler	**Lymantriidae**
Verbenaceae:	*Tectona grandis*	*Gryllotalpa sp.*	**Gryllotalpidae**
		Pternistria levipes Horvath	**Coreidae**
		Pternistria macromera Guerin	**Coreidae**
		Potemnemus spp.	**Cerambycidae**
		Dihammus spp.	**Cerambycidae**
		Oribius cruciatus Faust	**Curculionidae**
		Hyblaea puera Cramer	**Hyblaeidae**
Meliaceae:	*Toona australis*	*Xylotrupes gideon* (Linnaeus)	**Scarabaeidae**
	Toona spp.	*Hypsipyla robusta* (Moore)	**Pyralidae**
Bombacaceae:	*Ochroma pyramidale*	*Nasutitermes novarumhebridarium*	**Termitidae**
		Oxystigma sp.	**Cerambycidae**
		Acalolepta sp.	**Cerambycidae**

Box 6-2: Plantation Tree Species of Papua New Guinea and their Common Insect Pests (continued)

Host Family	Species	Pest Species	Family
Myrtaceae:	*Eucalyptus deglupta*	*Nasutitermes novarumhebridarium*	**Termitidae**
		Microcerotermes biroi (Desneux)	**Termitidae**
		Leptoglossus australis (Fabricius)	**Coreidae**
		Austromalaya sp.	**Pentatomidae**
		Agrilus opulentus	**Buprestidae**
		Eumeta spp.	**Psychidae**
		Zeuzera coffeae Nietner	**Cossidae**
		Striglina floccosa Guenée	**Thyrididae**
		Hyposidera talcata Guenée	**Geometridae**
		Syntherata janetta White	**Saturniidae**
		Megachile frontalis (Fabricius)	**Megachilidae**
	Eucalyptus torelliana	*Xylothrips religiosus* Boisduval	**Bostrichidae**
		Dinoderus minutus (Fabricius)	**Bostrichidae**
		Xylopsocus gibbicollis Macleay	**Bostrichidae**
		Oribius spp.	**Curculionidae**
		Hyalarcta spp.	**Psychidae**
	Eucalyptus spp.	*Valanga irregularis* (Walker)	**Acrididae**
		Glycaspis spp.	**Psyllidae**
		Cardiaspina spp.	**Psyllidae**
		Paratella errudita Melichar	**Flatidae**
		Fergusonina spp.	**Fergusoninidae**
		Rhyparida coriacea Jacoby	**Chrysomelidae**
		Paropsis albae	**Chrysomelidae**
		Paropsis andersonae	**Chrysomelidae**
		Oribius destructor Marshall	**Curculionidae**
		Syntherata spp.	**Saturniidae**
		Dasychira mendosa Hübner	**Lymantriidae**
		various species	**Noctuidae**
		Megastigmus spp.	**Torymidae**
Leguminosae:	*Acacia mangium*	*Nasutitermes novarumhebridarium*	**Termitidae**
		Microcerotermes biroi (Desneux)	**Termitidae**
		various species	**Aleyrodidae**
		various species	**Pseudococcidae**
	Acacia auriculiformis	*Mictis profana* (Fabricius)	**Coreidae**
	Albizia falcataria	*Eurema blanda* (Boisduval)	**Pieridae**
Casuarinaceae:	*Casuarina spp.*	*Rhyparida coriacea* Jacoby	**Chrysomelidae**
		Zeuzera coffeae Nietner	**Cossidae**
		Lymantria ninayi Bethune-Baker	**Lymantriidae**
		Lymantria spp.	**Lymantriidae**
		Agrotis ipsilon Hufnagel	**Noctuidae**
Combretaceae:	*Terminalia brassii*	unknown species	**Eriophyidae**
		Nasutitermes novarumhebridarium	**Termitidae**
		Microcerotermes sp.	**Termitidae**
		Agrilus viridissimus	**Buprestidae**
		Cyphogastra sp.	**Buprestidae**
		Rhyparida coriacea Jacoby	**Chrysomelidae**
		Acalolepta sp.	**Cerambycidae**
		Xiphotheata sp.	**Cerambycidae**
		Acrocerops sp.	**Gracillariidae**
		Striglina floccosa Guenée	**Thyrididae**
		Hyposidera talcata Guenée	**Geometridae**
		Scopelodes venosa Walker	**Limacodidae**
		Dasychira wandammena Bethune-Baker	**Lymantriidae**
Dipterocarpaceae:	*Anisoptera spp.*	*Hyplocerambyx severus* Pascoe	**Cerambycidae**

Box 6-2: Plantation Tree Species of Papua New Guinea and Their most Common Insect Pests

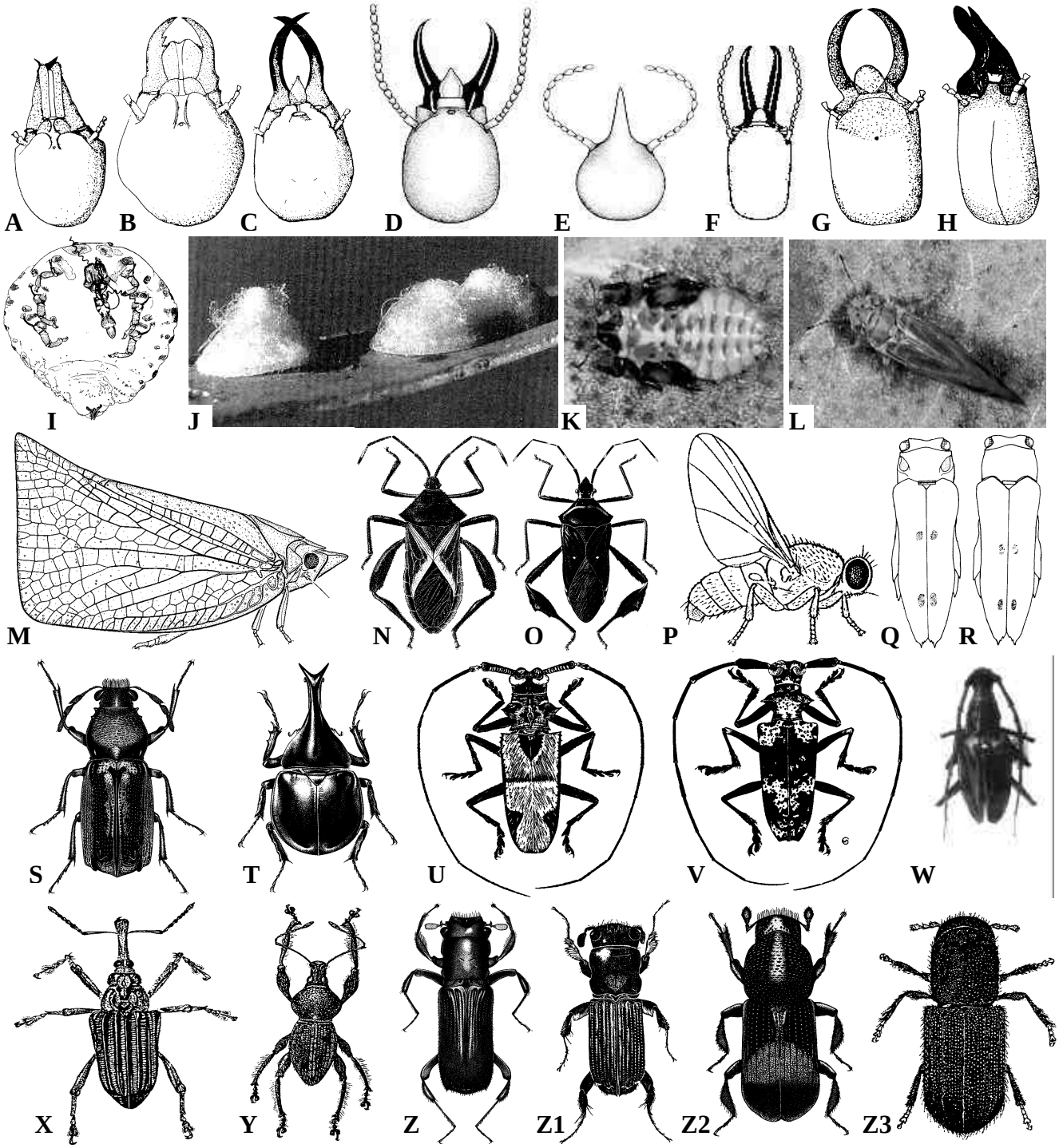


Fig. 6-3: Forest Insect Pests of PNG: (A, B) minor and major *Schedorhinotermes sp.* soldiers (Rhinotermitidae), (C, D) *Coptotermes elisae* soldiers (Rhinotermitidae), (E) *Nasutitermes novarumhebridarium* soldier (Termitidae), (F, G) *Microcerotermes biroi* soldiers (Termitidae), (H) *Pericapritermes sp.* soldier (Termitidae), (I) *Pineus pini* ♀ (Adelgidae), (J) *Glycaspis sp.* (Psyllidae), (K[††], L[††]) *Cardiaspina sp.* nymph and adult (Psyllidae), (M) Flatidae planthopper, (N) *Mictis profana* (Coreidae), (O) *Leptoglossus sp.* (Coreidae), (P[†††]) *Fergusonina sp.* ♀ (Fergusoninidae), (Q[§]) *Agrilus opulentus* ♀ (Buprestidae), (R[§]) *A. viridissimus* ♀ (Buprestidae), (S[$]) *Xylothrips religiosus* (Bostrichidae), (T) *Xylotrupes gideon* ♂ (Scarabaeidae), (U[‡‡]) *Potemnemus sp.* ♂ (Cerambycidae), (V[‡‡]) *Dihammus sp.* ♂ (Cerambycidae), (W[†]) *Hyplocerambyx severus* ♂ (Cerambycidae), (X[‡]) *Vanapa oberthuri* (Curculionidae), (Y[§§]) *Oribius destructor* (Curculionidae), (Z[$]) *Crossotarsus spp.* (Platypodidae), (Z1[‡‡]) *Platypus spp.* (Platypodidae), (Z2[$]) *Xyleborus spp.* (Scolytidae), (Z3[‡]) *Hylurdrectonus araucariae* (Scolytidae) (reprod. from Gressitt, J.L. & Hornabrook, R.W., 1985[$]; Gray, B., 1968[‡]; Gray, B. & Wylie, F.R., 1974[‡‡]; CSIRO, 1991; Farrow, R., 1996[††]; Schneider, M.F.[†]; Thistleton, B.M., 1984[§§]; Roberts, H., 1987[§]; unknown[†††])