

Studies on the biology of Indonesian Scolytoidea*)

by

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1. *Xyleborus fornicatus* Eichh. as a primary and secondary shot-hole borer in Java and Sumatra (second part)

OCCURRENCE OF *X. fornicatus* IN TEA AND CASTOR PLANTS.

A small black *Xyleborus* sp. often met with as a borer in tea bushes in Java was first mentioned in a publication of Ch. BERNARD in 1907. In papers published in 1908 and 1909 the same author gave additional information on the borer, which had been found in several localities and was considered a threatening danger, particularly in view of the ravages caused by a similar borer in tea plantations in Ceylon. The identity of the borer was not determined before 1911, after comparison with authentic specimens of *X. fornicatus* received from Mr. GREEN in Ceylon (BERNARD 1912).

Our own records on the occurrence of the shot-hole borer in tea in Java are the following: on Maswati Estate near Tjiandjur (leg. LEEFMANS, 1920); on Pasirdatar Estate on the S. slope of Mount Gedé at some 900 m elevation (in the collection of the Tea Experiment Station, Bogor, no year); in a recently dead unpruned tea bush in the Experimental Garden at Bogor, infested with some other ambrosia beetles, 1924 (leg. KALSHOVEN); on Bolang Estate, S.W. of Bogor, 500 m, IX.1926 (in coll. of Tea Exp. Stat.) and on Galunggung Estate near Tasikmalaya, XII.1926 (leg. DE HAAN). These localities are all in W. Java and below 1000 m altitude.

A specimen in the Leiden Museum carrying the label 'Holl. Indien, In thee, Tjijetir, 1902' shows that the borer had already been observed some years before BERNARD got to know it. Probably it was collected by KONINGSBERGER, as Tjijetir is a Government Estate near Tjibadak, W. Java. It must have been identified by EGGERS about 1925.

X. fornicatus found boring in the frame of tea bushes in N.E. Sumatra was first mentioned in a report on pests observed in plantations in 1918 (CORPORAAL 1919, EGGERS 1922). The species was again collected in limited numbers from tea branches at Bahbirong Ulu Estate, X.1921 (leg. CORPORAAL) and on an estate in the Siantar District, V.1923 (leg. BERNARD). No other material appears to have been submitted ever since.

R. MENZEL (1923), the entomologist of the former Tea Experiment Station in Bogor, alludes to a '*Xyleborus*' as often occurring in tea in Java, particularly in sickly and weakened bushes. Evidently, this refers to *X. fornicatus*. Furthermore,

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there is one record, communicated by Dr. Ch. BERNARD in a meeting in 1925, of a local outbreak of the borer in tea gardens in the lower hills of W. Java, near Sukabumi, some years previously. It had lasted 2—3 years and then had disappeared. The same authority attributed an increase in the occurrence of the borer in a plantation in Sumatra to the burning on the spot of pruned branches, a practice which had damaged the nearby bushes (see KALSHOVEN 1925, p. 13). In MENZEL's review of the injurious insects of the tea-plant in Indonesia (1929) the species, as being of minor importance, is dealt with in 2 lines only.

This incidental occurrence of *X. fornicatus* in tea in Java and Sumatra appears to be similar to that observed in India (see ANANDAU RAU in Symposium 1956).

That castor (*Ricinus communis*, fam. Euphorbiaceae) can serve as a regular host of *X. fornicatus* in Java, as it does in Ceylon and India, was first observed by me in Bogor about 1923. It soon became clear, however, that the borer thrives only in full grown castor plants, which may still bear their full foliage, but which have fruited already and are on the decline. The rather soft stems, up to 6 cm in diameter, may be riddled by the borer, which excavates its bifurcated galleries in the wood cylinder around the wide hollow pith (fig. 6). This will likely occur in other parts of Indonesia too, particularly in regions with a wet climate such as W. Java, Sumatra and Borneo have, but such infestations have not been recorded, probably as they are of no economic importance.

SECONDARY INCIDENCE OF *X. fornicatus*.

In the following list instances are given in which a mature brood was found besides the mother beetle in damaged and sickly parts of various hosts, indicating that the borer had not only penetrated into the wood but had succeeded in raising progeny in the medium.

W. Java. Bogor and environments: in *Theobroma cacao* tree killed by rootrot and attacked simultaneously by *X. perforans* Wol. — by far outnumbering *X. fornicatus* —, and 3 other *X.* species, as well as Platypodids and Cerambycids, Experimental Garden, IV.1921; in borer-infested wood of a kapok tree, *Ceiba pentandra*, X.1923; in dying *Kopsia flavida* tree, shedding its leaves, galleries in the branches in company with those of *X. andrewesi*, not in the trunk, Botanical Gardens, II.1924 (fig. 6); in branch, 3.5 cm in diameter, and showing a one-sided broad dead strip, on living *Artocarpus integra* tree, initial and more advanced galleries, no other borers, IV.1924; in branches of *Pithecolobium lobatum*, 2—3.5 cm thick, sold for firewood, several galleries (fig. 6) mixed with a few *Eccoptyerus sexspinosus* Mots. and *X. setulosus* Egg., IV.1924; in newly dead or diseased branches in the crown of fruit trees and wayside trees, viz. *Durio zibethinus* (one gallery — fig. 6 — between many tunnels of *X. perforans* Wol. and *X. similis* Ferr.), *Spondias dulcis* (single gallery, little brood), *Lansium domesticum* (single gallery next to tunnels of *X. andrewesi* Bldf. and *Carposinus brevior* Egg.), *Canarium commune* (single gallery containing 4 ♀ and 1 ♂, branch mainly inhabited by *Arixyleborus grandis* Schedl, *X. artestriatus* Eichh. and a few other species); in diseased *Hevea brasiliensis*, the rubber tree, a few times, once in a mixed infestation with *X. pertuberculatus* Egg., 1924/1925 (see KALSHOVEN 1924); in base of branch which had been ringbarked higher up,

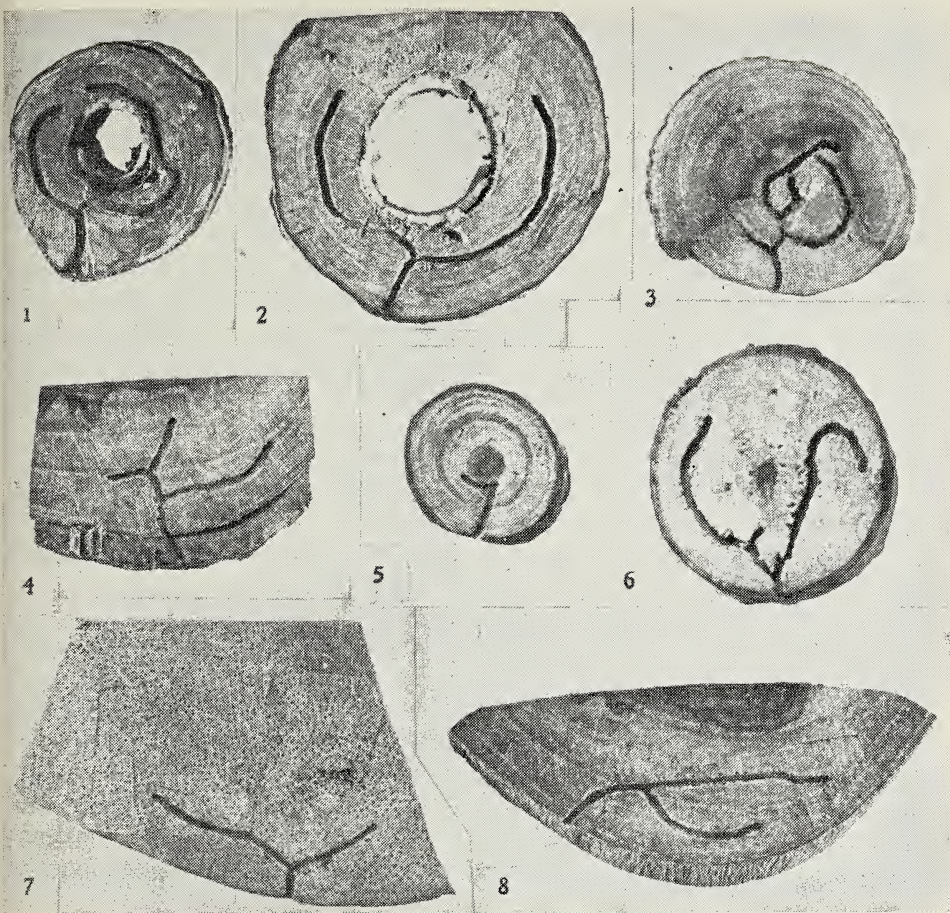


Photo G. VAN DEN BERG, Zool. Labor., Amsterdam

Fig. 6. Galleries of *X. fornicatus*, exposed on cross-sections through the branches and stems. 1 and 2 *Ricinus communis* (castor), 3 *Artocarpus integra*, 4 and 8 *Tectona grandis* (teak), 5 and 6 *Pithecolobium lobatum*, 7 *Durio zibethinus* (all natural size)

on a *Ceiba pentandra*, *X. semigranosus* Bldf. also being present, III.1932; in a fallen branch of an unidentified tree, also harbouring a *Poecilips* sp., one gallery of *fornicatus* with brood including a ♂, all specimens infested with mites, IX.1932; in newly planted cuttings of *Derris elliptica* on Tjipetir Estate near Tjibadak, many broods present including those with ♂ ♂, III.1935; in stem of *Citrus* suffering from *Fusarium* fungus, IV.1937.

Bandjar, 50 m: in billets of teak kept under moist conditions in the forest, some galleries, outnumbered by those of *X. emarginatus* Eichh., *X. amphicranulus* Egg. and others, 1933/1934.

Mount Gedé, Tapos, 800 m: in small dead tree of *Ficus toxicaria*, harbouring also a large number of other bark-boring and wood-boring Scolytids, XI.1932; and in *Moringa oleifera*, several specimens including ♂ ♂, X.1933.

Mount Tjeremai, 1000 m: in 2-years old plants of *Michelia velutina* (manglit) in a forest plantation, another small species, *X. pr. morigerus*, having been collected from the same plants, VII.1932 (leg. APPELMAN).

Mount Salak, 600 m: in a dying sapling of *Schima noronhae* in a forest plantation, at least one gallery with some brood present, in company with *X. asperatus* Bldf., V.1926.

C. J a v a. Semarang, teak area: in a torn branch hanging down from a *Ficus septica*, associated and more numerous shot-hole borers being *X. asperatus* Bldf. and *X. sundaensis* Egg., II.1923; in the thrunk of a teak tree immediately under the place where it had been hollowed out by *Neotermea tectonae* Damm. and where the crown had broken, a small number of galleries (fig. 6), II.1936; in fire-killed poles, 3—12 cm in diameter, of *Planchonia* sp. heavily infested by Cerambycids, Anthribids, and Curculionids, and a second, more numerous shot-hole borer *X. similis* Ferr.; under similar conditions in pole of *Ficus septica*, 3—8 cm thick, here in association with *X. funereus* Lea and *X. interjectus* Bldf.; in trees in dying plot of *Bauhinia malabarica*, mainly infested with Cerambycids, Buprestids and *X. artestriatus* Eichh.

Weleri, Siluwuk Sawangan Estate: in dying branches of *Theobroma cacao*, numerous specimens, several with a small round exit hole of a parasite in the elytral declivity, VII and X.1938. Pekalongan: in a diseased *Parkia speciosa*, in association with other shot-hole borers, VII.1937 (leg. H. R. A. MULLER).

E. J a v a : in dying young *Spondias dulcis* attacked at the collar by the Curculionid *Coelosternechis javanus* Hell., Bodjonegoro, XII.1920; in borer-infested log of *Gossampinus hexaphylla*, Besuki, XII.1923; in dead branch of *Artocarpus integra* in forest plantation near Paree, Kediri, only one gallery with brood, V.1924.

SIZE OF BROOD IN CASES OF SECONDARY INCIDENCE.

The figures available about the brood found in galleries of various lengths in 4 hosts are incorporated in the table on the next page.

The correlation between the progress in the construction of the galleries and the appearance of the various stages in the development of the brood is evident. Oviposition begins when a side branch is added to the initial tunnel, and a total length of 1.5—2.0 cm is excavated. Both branches of the fork are lengthened at intervals.

The maximum number of progeny is about equal to that in the primary incidence of the borer (see table on p. 151), and appears to remain below that encountered in galleries in tea bushes in Ceylon.

UNSUCCESSFUL SECONDARY INCIDENCE OF *X. fornicatus*.

Several times one or a very few mother beetles, unaccompanied by any brood, were found in their galleries in damaged and borer infested limbs of trees, in which other shot-hole borer species were thriving. It was surmised that in these instances the borer had not found suitable conditions for breeding in the medium to which it had been attracted. Some examples may be given here: in stem of *Artocarpus integra* killed by the *Corticium salmonicolor* fungus in a plantation near Paree, E. Java, II.1920; in saplings of *Actinophora fragrans* killed by the zigzag borer, *Agrilus kalshoveni*, in the teak areas of Semarang and Tegal, 1927/

Nr.	Host	Gallery system		Composition of the brood								Number of offspring
		development	length in cm	mother beetle	eggs	larvae	pupae		young adults			
							♀	♂	♀	♂		
1/11	<i>Pithecolobium lobatum</i>	initial tunnel, or beginning of furcation	0.7/2.2	1								
12		initial tunnel	1.3	1	2							
13		bifurcated	2.8	1		9	2		1			12
14		„	2.9	1	2	8	4		2	1		16
15		„	3.6	1		15	4	1	1			21
16		4 branches	4.6	1		9	5	1	4			19
17		bifurcated	4.5	1		5	2	1	1	1		10
18		„	5.6	1		2	1		7			10
19	<i>Spondias</i>	bifurcated	4.0	1	9							
20	<i>dulcis</i>	„	5.7	1	11	5						
21	<i>Kopsia flavida</i>	recently bifurcated	2.9	1	1	4	1					
22		„	3.3	1	3	5	1					
23	<i>Artocarpus</i>		3.9	1		5	2					
24	<i>integra</i>		3.6	1		3	1	1	1			
25			5.8	1		3			4			

1928; in slowly dying fire-damaged *Dysoxylum amooroides*, 18 cm in diameter, containing many broods of *X. andrewesi* Bldf.; in dry lower branches of *Bixa orellana* inhabited by *X. mucronatus* Schedl and *X. haberkorni* Egg., Bandjar, VII.1930; in stem of 4-year old *Swietenia mahagoni* killed by *Corticium salmonicolor* (a dead specimen of *X. fornicatus* found in a short gallery), same dates; in trunk of teak infested with *X. destruens* Bldf., and in a teak tree struck by lightning, Bandjar, VII.1932, IV.1933; in *Cinchona* tree (quinquina) infested with stem rust, in the Lampong district, S. Sumatra, VI.1938.

DISCUSSION ABOUT THE SECONDARY INCIDENCE OF *X. fornicatus*.

Enough observations have been made to show that *X. fornicatus* is not an obligatory primary borer of a few hosts only, but is also attracted to and can breed in plants which are weakened and in a sickly condition or dying as result of various causes, including mechanical damage, root-rot, and infestation by primary fungi. Generally the species occurs simultaneously with other secondary borers, among which there are several other species of *Xyleborus*. No preference has become apparent for specific host plants in these cases nor has any repeated association with other borer species been observed. As a rule little opportunity is offered for *fornicatus* to build up large populations under the conditions prevailing in secondary infestations, as the material available for breeding is often very limited and may soon lose its attractive power or suitability while, moreover, a severe competition of other secondary borers has to be met. The same competition may be the cause of those unsuccessful secondary attacks by *fornicatus* which have come to light. However, it is also possible that the presence of some other bark or wood destroying organisms hinder the infection of the tissues with the ambrosia fungus which is so necessary for a successful breeding of the borer.

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2. A case of primary infestation of *Glochidion* by *Xyleborus xanthopus* Eichh.

DESCRIPTION OF THE ATTACK.

In a four-year old forest plantation seven dying and dead 'kipare' trees were found at Goalpara on the S. slope of Mount Gedé at some 900 m altitude in September 1920. The trees had already lost their foliage, but a few had new sprouts growing from the lower parts. All were conspicuously marked by one or two blackish and wettish streaks along the trunks, where the bark had died and

small shot-holes — 1.4 mm wide — were present. These streaks were of various lengths, extending well over a main branch in the crown, or reaching down to the base. In appearance, the infestation resembled the outward signs of attack by the primary shot-hole borer *Xyleborus destruens* Bldf. on young teak. In the latter case which had become recently known (KALSHOVEN 1920) dirty patches, surrounding large shot-holes arranged in vertical rows along one or more sides of the trunks, constituted the most striking feature.

The shot-hole borer attack on *Glochidion* was mentioned in a few words in my report on forest insect pests in 1920, inserted in VAN HALL's review, published in 1921.

THE HOST AND ITS CONDITION.

The 'kipare' — a *Glochidion*, probably *G. kollmannianum* J.J.S., fam. Euphorbiaceae — was used in this instance as an auxiliary species only, to assist in a rapid closing of the canopy. The species was irregularly distributed over the plantation, which had the puspa tree (*Schima noronhae*) as its main crop. The kipare not uncommonly occurred in the adjacent forest together with some other species of *Glochidion*.

The affected trees which had a fair size for their age were 4—5 mm in height. They showed a rather bushy growth, partly as a result of a former occurrence of a Thyridid top-borer, a very ordinary infestation of the tree species and its allies observed in several parts of Java and not resulting in an apparent weakening of the trees. Another detail still to be mentioned is that the infested trees happened to stand along a path in each other's vicinity.

No other cause of damage having been detected on the trunk or the roots, it was concluded that a new case of primary shot-hole borer attack in forest plantations had been added to those already known (by *X. morigerus* Bldf., *X. destruens* Bldf. and *X. fornicatus* Eichh.).

IDENTITY OF THE BORER.

The beetle which had attacked the trees was a jet-black *Xyleborus* species of the same general shape as *X. fornicatus* but of uniformly larger size: the ♀♀ ranging from 2.6—2.8 mm in length, with a width of 1.2—1.3 mm. The small wingless males were 1.5—1.67 mm in size.

The beetle was definitely identified by Professor K. E. SCHEDL as *X. xanthopus* Eichh., a species originally described from Madagascar.*)

GALLERY SYSTEM AND OFFSPRING.

Some pieces of the infested kipare trunks were examined more closely in the laboratory at Bogor a few days after they had been cut, as were some other additional pieces received after a delay of one month. A number of galleries could be exposed on cross-sections through the trunks. They were of the ordinary type

*) A remark on the synonymy of the species is to be found in a recent paper by SCHEDL (1957) and an additional note is included by the same author in a paper soon to be published in the *Tijdschrift voor Entomologie*.

for the group, consisting of the initial tunnel penetrating into the wood in a curve or obliquely and throwing off, later, one or two side branches in the opposite direction, all situated in a horizontal plane. The branches were sometimes forked again (see sketches, fig. 7). In one case, a tunnel ran down in the pith for some length.



Fig. 7. Sketches of the gallery system of *X. xanthopus*, exposed on cross-sections through trunk of *Glochidion* (\pm natural size).

A few initial galleries in a branch contained a dead female beetle. The other galleries were inhabited by the mother beetle, accompanied, in the more advance cases of tunnelling, by brood in various stages of development as may be seen from the following figures:

Nr.	Date examination	Length of gallery in cm	Composition of the brood							Number of offspring
			mother beetle	eggs	larvae	pupae		young adults		
						♀	♂	♀	♂	
1	16.IX.1920	0.3	1							
2		0.5	1							
3			1	4	1					
4			1	1	12	2	1	14	2	32
5	19.X.1920	3.0	1		1			3	1	
6		6.5	1	4	2			7	2	15
7		9.0	1		4	3		9	1	19

From these data, in combination with the fact that no empty or calloused-over galleries were observed it was inferred that the infestation had been rampant for a comparatively short time, and that young adults, emerging from the well-stocked galleries had already commenced to continue the attack on the same trees.

ADDITIONAL DATA ABOUT *X. xanthopus*.

The species was collected by me only on one other occasion, viz. a single ♀ specimen under the bark of a large fallen tree, at Lembang, W. Java, 1000 m, VI.1921.

However, in the Zoological Museum Amsterdam, there are 23 specimens of

what is apparently this species, all collected by F. C. DRESCHER at Baturraden, Mount Slamet, 1000 m, C. Java, 9.IV.1930. They are labelled *X. fornicatus* Eichh. but according to their size, which is 2.6—2.8 mm (with one exception in a specimen of 2.45 mm), they belong to *X. xanthopus* Eichh. Out of these specimens 16 have the host label totoman (*Breynia microphylla*, fam. Euphorbiaceae), 3 are from anggrung (*Trema orientale*, fam. Ulmaceae) and the remaining single specimens are from sengon (*Albizzia chinensis*, fam. Leguminosae), dadap duri (*Erythrina lithosperma*, same family), plempeng (*Adinandra dumosa*, fam. Guttiferae), and kalapatjung (fam. Myristicaceae). No details are available about the condition of the host trees, but most of DRESCHER's Scolytids have been collected from dying or felled trees.

For Madagascar SCHEDL (1951) has recorded two hosts for *X. xanthopus*, viz. *Enterolobium cyclocarpum* (fam. Leguminosae) and *Vernonia appendiculata* (fam. Compositae).

DISCUSSION.

No further observations have been made on the fate of the infested plot of kipare trees, nor has a similar outbreak of *X. xanthopus* been encountered in later years, but this can be explained by the fact that *Glochidion* species have been scarcely used in more recent forest plantations.

Now the single instance described may be considered to be meagre evidence of the capacity of the species to occur as a primary borer, nevertheless the observations made at the time appear to allow of no other conclusion. Therefore the assumption may be justified that *X. xanthopus* has about the same characteristics as the closely related *X. fornicatus*, since it appears to be able to attack and multiply rapidly in the living tissues of a very suitable host where this occurs in some numbers under optimum conditions of the borer, and besides lives as a secondary borer in various hosts. While *X. fornicatus* as shot-hole borer of kesambi, castor and tea is at home in the plains and lower hills, *X. xanthopus* evidently lives in the mountainous districts and probably finds its main hosts in the Euphorbiaceae.

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Aglia tau L. komt op licht ! Toen ik op 7 mei 1958 in de buurt van Hoog-Soeren op een vliegplaats van *Aglia tau* lichtte, kwamen tot mijn grote verbazing in 20 minuten niet minder dan zes nagenoeg verse mannetjes van deze soort op de oppomplamp af. Mogelijk hebben zowel *A. tau* als *Endromis versicolora* twee vliegtijden: een bruidsvlucht overdag en een gewone 's nachts.

Dat ook *tau* dit jaar aan de late kant was, spreekt wel haast vanzelf.

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