Observations on *Poecilips cardamomi* (Schaufuss), the second species of Scolytidae to be found in bracken fern (Col.)[1]

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Abstract

A second species of Scolytidae, *Poecilips cardamomi* (Schaufuss) has been found in bracken fern, *Pteridium aquilinum* (L.) Kuhn. It was found in fern on Penang Hill in Malaysia. Descriptions are given of the egg and larval stages, together with data on nest structure, size and composition. A comparison is made between *P. cardamomi* and *Poecilips pteridophytae* Schedl, the only other recorded species of Scolytidae found in bracken fern.

Introduction

Very few species of Coleoptera have been found in association with ferns (Simmonds, 1967), and the first scolytid, *Poecilips pteridophytae* Schedl, was recorded in 1966 (Gray, 1970; Schedl, 1968). This monophagic species is found fairly widely distributed in Papua New Guinea in association with bracken fern, *Pteridium aquilinum* (L.) Kuhn (Gray, op. cit.). In June 1971, while on a visit to Penang Hill in Malaysia, I discovered another species of Scolytidae, *Poecilips cardamomi* (Schaufuss), in bracken fern. The scolytid has been previously recorded from Ceylon (Schaufuss, 1905), India (Beeson, 1941), People's Republic of China (Schedl, 1960), Sarawak (Browne, in litteris, 1972) and Sumatra (Beeson, 1939). Beeson (1939) gives several host records: *Canarium strictum, Cullenia excelsa, Elaeocarpus tuberculatus, Ellettaria major, Hardwickia pinnata,* and *Vateria indica.* Browne (1961) noted that it had only been collected in fallen fruits.

Subsequent visits were made by the author to Penang Hill for the collection of additional specimens for study and gathering of data which are presented in this paper. In view of the potential, but as yet untried, role of *P. pteridophytae* in the biological control of bracken fern, (Gray, op. cit.),

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comparative notes are also given on their nest size and structure, brood composition and effect on the growth of their host plant.

Descriptions of immature forms of *Poecilips cardamomi*

1. Egg

Eggs are mostly white, but some are creamy in colour, and oval; see Table 1 for size of eggs. Two size groups of eggs were evident upon measurement. The larger eggs, length 0.58—0.76 mm, were more numerous (93 eggs) than the smaller ones (34 eggs), length 0.46—0.57 mm. Since no male adults were collected, these differences in size are not easily explained. A maximum of 25 eggs was found in one of the 121 nests examined, but generally the number found was noticeably less (Table 1).

2. Larva

Mean head capsule width measurements of 88 larvae indicate three instars (see Table 1). Ratio between the mean head capsule width of the first and second instars was 1.00: 1.21, and of the second and third instars 1.00: 1.48. Although both scolytids have the same number of larval instars, the larvae of *P. cardamomi* are on the average, larger at each instar. Body colour, exclusive of the head, is white.

Description of final instar:

Head capsule: (Fig. 1 a). Usually light yellow brown; almost spherical, index (length/width): 0.99 (14 specimens measured). Distribution of setae and sensilla as in Fig. 1 a. The antennae are conical. The antennal field is slightly convex, with three setae lateral to the antennae. Frontal shield cordate. The endocarinal line is distinct and extends approximately three quarter way to the front of the head capsule.

Mandible: (Fig. 1 b). Three encisoral teeth, apical and subapical acute, and the third small and emarginate. Two mandibular setae distant from each other on nearly horizontal alignment. One sensillum on the mesal surface below the first tooth, whereas sensillum below second and third teeth on mandibles of *P. pteridophytae.*

Clypeus: Sides angular, the inner setae about as long as the outer one. One sensillum above but between the inner and outer setae, and closer to the latter.

Labrum and epipharyngeal lining: (Figs. 1 c—1 d). Anterior margin broadly rounded and faintly undulate, less noticeable than in larvae of *P. pteridophytae,* posterior region somewhat attenuated. Tormae long, varying in width, diverging anteriorly and posteriorly, fairly widely separated and pointed posteriorly, but less pointed on inner edge posteriorly than the tormae of *P. pteridophytae.* Three pairs of stiff lancet-like antero-lateral setae on the epipharynx and three pairs of small medial epipharyngeal setae, with two pairs of very small sensilla between second and third pairs. Labral setae and sensilla distributed as in Fig. 1 d. Two pairs of small antero-median

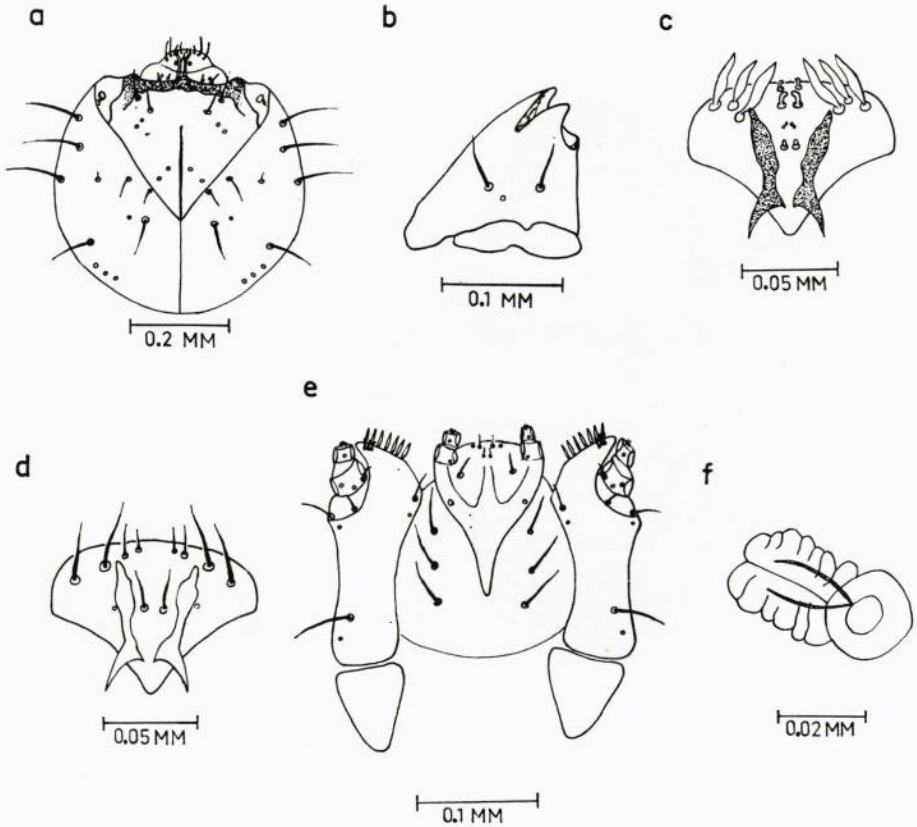


Fig. 1. Head and mouthparts of larvae of *Poecilips cardamomi*. a: Dorsal aspect of head capsule minus mandibles. b: mandible. c: epipharynx. d: labrum. e: ventral aspect of labium and maxillae. f: stigmata.

setae on labrum; two pairs of antero-lateral setae sub-parallel and a pair of setae in between the tormae.

Maxilla: (Fig. 1 e). Rather narrow without pigmented areas. Palpus two-segmented, proximal segment with a short seta and two sensilla, distal segment with one sensillum and apical papillae. Two palpiferal setae. Stipital seta in proximal half of the stipes. Lacinial lobe with seven central, thin lancet-like, setae.

Labium: (Fig. 1 e). The mentum is well chitinized, clearly demarcated and triangular. Posterior region of premental sclerite distinct, outer sides of anterior projections curved. The four setae on ligula are of similar length. Palpus two-segmented, each segment with one sensillum; distal segment with apical papillae. Two pairs of setae and one pair of sensilla on the ligula. Submentum with three postmental setae, distributed approximately in a straight line.

Thorax and Abdomen: Body slightly curved. Stigmata oval with two segmented air-sacs, with a pair of sclerotized rods joining at or near peritreme (Fig. 1 f). On the pedal lobes there are two setae.

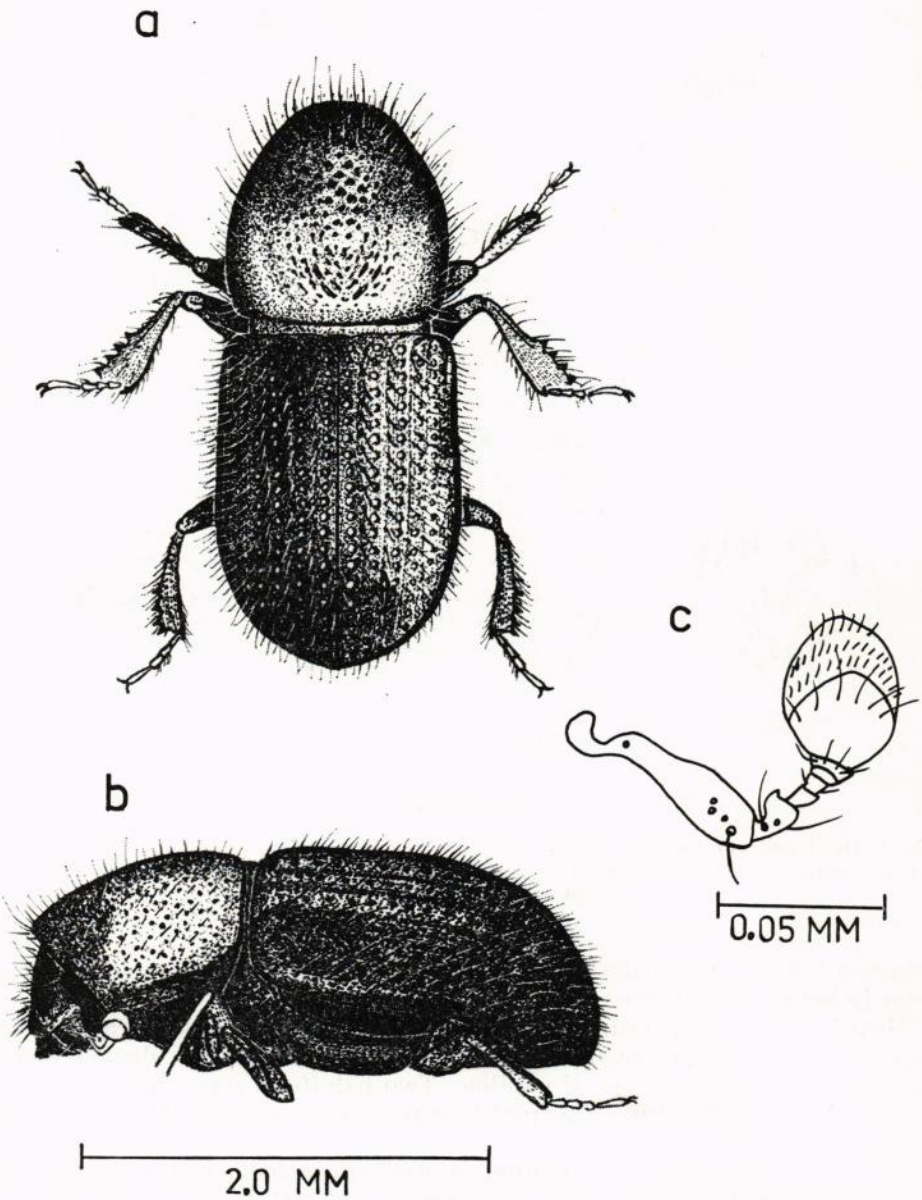


Fig. 2. Female adult of *Poecilips cardamomi*. a: Dorsal aspect. b: lateral aspect. c: antenna.

Table 1. Dimensions of *Poecilips cardamomi* and *P. pteridophytae* specimens collected from bracken fern in Papua New Guinea and Malaysia respectively.

Stage	Character	Number of Specimens	Mean length and Standard error in mm.	Range in mm.
		Poecilips cardamomi		
Egg	length	127	0.635 ± 0.049	0.464—0.758
Egg	width	127	0.425 ± 0.031	0.311—0.496
Larva I	head cap. width	20	0.285 ± 0.045	0.251—0.303
Larva II	„ —	29	0.346 ± 0.037	0.332—0.387
Larva III	„ —	39	0.486 ± 0.035	0.467—0.516
Adult female	pronotal length	37	1.120 ± 0.080	1.033—1.148
Adult female	pronotal width	37	1.080 ± 0.080	0.980—1.129
Adult female	elytra width	37	1.224 ± 0.080	1.127—1.254
		Poecilips pteridophytae		
Adult female	pronotal length	40	0.927 ± 0.040	0.863—0.977
Adult female	pronotal width	40	0.940 ± 0.040	0.883—0.983
Adult female	elytra width	40	1.030 ± 0.050	0.973—1.083

3. **Pupa**

No specimens available for study.

4. **Comparative morphology and size of the adult of *Poecilips cardamomi* and *P. pteridophytae***

Poecilips cardamomi was originally described by Schaufuss (1905) as *Coccotrypes cardamomi*, but it was transferred to the genus *Poecilips* by Schedl (1960). Illustrations of the female adult are presented for the first time (Figs. 2 a—2 c). In form and in characters of the head, pronotum and abdomen the female adult of *P. cardamomi* is very similar to *P. pteridophytae,* but slightly larger in size (Table 1) and their pronotal indexes are significantly different. *Poecilips cardamomi* is reddish-brown to brown-black in coloration, rarely, if ever, as piceous as observed in all mature female specimens (> 2,000) of *P. pteridophytae* examined from 12 localities in Papua New Guinea.

All specimens of *P. cardamomi* were measured in the laboratory within twenty-four hours after collection. The results are given in Table 1, together with measurements of *P. pteridophytae;* as indicated in the results, the Malaysian species is distinctly larger. Total length ranged from 2.75 to 3.25 mm. The mean pronotal index (length/width) of *P. cardamomi* was 1.03, range 1.01—1.07 (37 specimens measured), whereas that of *P. pteridophytae* was 0.98, range 0.94—1.01 (40 specimens measured).

Nest size, structure and composition

Nests of *P. cardamomi* were conspicuously smaller in size than those of *P. pteridophytae,* but the entrance holes of the former species were larger,

being approximately 1.5 mm in diameter (Fig. 3 a), whereas those of *P. pteridophytae* were about 1.00 mm in diameter (Gray, op. cit.). *Poecilips cardamomi* bored a gallery usually horizontally into the stem for a distance of up to 1.0 cm in diameter, depending largely upon the diameter of the stem (Fig. 3 b); a lateral or vertical brood chamber-gallery up to 1.0 cm in length was often found leading off the gallery (Fig. 3 c). In contrast, the nest galleries and brood chamber of *P. pteridophytae* extended vertically down the stem in most instances, but sometimes up, for distances of up to 10 cms (Gray, op. cit.).

Most nests of *P. cardamomi* were situated in the stem beneath the lowest frond; for example, 22 of the 37 nests listed in Table 2 were found beneath the lowest node, nine were in the nodal region and six in the inter-nodal areas. Two nests of *P. cardamomi* were located in fronds, whereas no nest of *P. pteridophytae* has been found in a frond although a much greater number of ferns in Papua New Guinea have been examined.

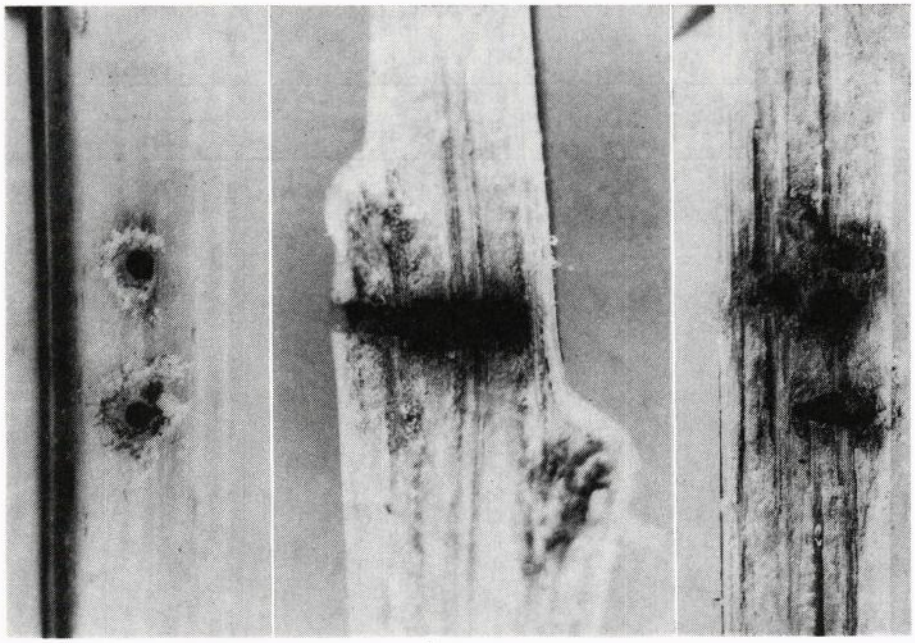
A total of 121 nests were dissected and their composition noted; see Table 2 for details of the 37 nests examined on 23 June, 1971. Sixty-eight nests were occupied by the beetle; of these 28 nests contained only adults, 12 had eggs and adults, 18 had larvae and adults, while only four nests contained eggs, larvae and adults. No pupae, immature adults or males were found present. Of the 28 nests comprising only adults, 27 had a single adult present, while the remaining nest had two adults. In two nests the adults were dead. One other nest contained one dead adult covered by white fungus and two live larvae.

The relatively unmixed brood composition observed in the nests of *P. cardamomi* differed from that of a more mixed brood commonly found in nests of *P. pteridophytae* (as shown in Table 1 in Gray (op. cit.)). Although the brood composition of *P. cardamomi* nests sampled at Penang could be attributed to a new outbreak because no later stages, pupae or immature adults, were present, the presence of a large number of vacated nests suggested otherwise. It would seem that either the Malaysian scolytid is more seasonal because of a more marked seasonal climate at Penang, and/or its development is more synchronized throughout the year than the Papua New Guinea species.

The average number of specimens counted in 68 nests was only four, with a range of 1 to 23, whereas in the 20 nests of *P. pteridophytae* enumerated by Gray (op. cit.) the average was 12, with a range of 1 to 57. This comparison requires additional verification because of the more limited brood composition of nests of the former species and exceptional size of some of the nests of *P. pteridophytae*.

Of the 53 nests uninhabited by the scolytid, seven were occupied by ants. Two nests contained small colonies of *Cardiocondyla emeryi* Forel, a small reddish-brown ant, and a cosmopolitan tramp; four nests had single workers of *Cataulacus* sp., and one nest had two workers of *Technomyrmex albipes* (F. Smith), also a cosmopolitan tramp. No associate insects were found in the viable nests of *P. cardamomi*; a nitidulid, *Carpophilus maculatus* Murr., is frequently present in the nests of *P. pteridophytae* (Gray, op. cit.).

Several of the ferns examined (for example, those numbered 3, 8 and 9 with 4, 5 and 5 nests respectively in Table 2) were a healthy green in appearance, although they had been attacked several times by the scolytid.



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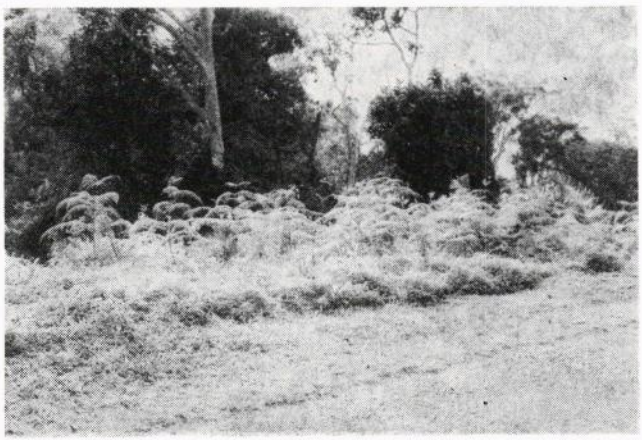

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Fig. 3. a: Stem of bracken fern with two entrance holes of *Poecilips cardamomi*. Note frass around the holes which are approximately 1.5 mm in diameter. — b: Nest of *Poecilips cardamomi* excavated horizontally into the stem of bracken fern. Length of nest is approximately 1.1 cm. — c: Showing relatively small size of nests of *Poecilips cardamomi* and lateral gallery in uppermost nest. — d: Bracken fern infested by *Poecilips cardamomi* near the roadside on Fern Hill on Penang Hill.

Table 2. Position, size and composition of 37 nests of *Poecilips cardamomi* in bracken fern examined on 23 June, 1971 near Fern Hill, 765 metres above-sea-level, on Penang Island in Malaysia.

Fern No.	Nest No.	Position of nest and cm above ground		Nest length in cm	Status of nest	*P. cardamomi* colonies		
						eggs	larvae	adults
1	1	lower stem	10	1.5	Occupied	—	6	1
	2	,, —	19	0.9	,,	—	—	1
	3	internode	40	0.5	,,	4	—	1
	4	,,	50	0.3	,,	5	—	1
2	5	,,	67	0.6	,,	—	3	—
3	6	lower stem	13	0.5	Empty	—	—	—
	7	,, —	72	0.3	,,	—	—	—
	8	node	87	0.3	Ant nest	—	—	—
	9	,,	123	0.8	Empty	—	—	—
4	10	lower stem	53	1.3	Occupied	—	1	1
	11	node	100	0.8	,,	—	1	1
5	12	lower stem	46	0.9	,,	9	—	1
	13	node	136	0.4	,,	—	5	1
6	14	internode	94	0.3	,,	—	—	1
7	15	lower stem	15	0.3	Empty	—	—	—
	16	,, —	47	0.7	,,	—	—	—
	17	,, —	49	0.7	Occupied	6	3	1
	18	,, —	54	0.3	1 Ant	—	—	—
	19	,, —	58	0 9	Occupied	—	5	1
	20	,, —	64	0.6	,,	14	4	1
	21	node	94	0.4	1 Ant	—	—	—
8	22	lower stem	30	0.6	Empty	—	—	—
	23	,, —	62	1.5	,,	—	—	—
	24	node	120	0.3	,,	—	—	—
	25	internode	123	0.6	,,	—	—	—
	26	node	136	0.6	,,	—	—	—
9	27	lower stem	15	0.4	,,	—	—	—
	28	,, —	30	0.8	,,	—	—	—
	29	,, —	33	0.6	,,	—	—	—
	30	,, —	48	0.5	2 Ants	—	—	—
	31	node	68	0.3	1 Ant	—	—	—
10	32	lower stem	48	0.6	Occupied	—	3	1
	33	internode	89	0.7	,,	2	—	1
11	34	lower stem	6	0.5	,,	—	7	1
	35	,, —	13	1.2	,,	—	7	1
	36	node	33	0.4	,,	—	—	1
	37	,,	46	1.5	,,	—	—	1

No infested fern examined on Fern Hill exhibited a moribund or brown discoloration as commonly observed in Papua New Guinea. Therefore, the potential of *P. cardamomi* as a possible biological control agent of bracken fern would appear to be considerably less than *P. pteridophytae*.

Distribution

The beetle was probably confined to a small area alongside the sealed road on Penang Hill (Fig. 3 d), since a thorough search for it in several other patches of bracken fern elsewhere along the roadside proved fruit-

less. The beetle may have been present in bracken fern situated above the road at Fern Hill immediately above the collection site which was inaccessible to the author. I did not observe the scolytid in fern examined in other areas of Penang Island or on the east coast of the mainland of Malaysia, indicating that its distribution is either quite sporadic or probably confined to Penang Hill. A search for the species in other host plants was not carried out, since its identity was not known at the time. However, there is a possibility that the scolytid has become secondarily adapted to the fern.

The finding of two species of Scolytidae in bracken fern by the same person in two different countries upon cursory examination suggests that similar associations may occur in other countries. The author has examined bracken fern near the coast of Oregon, U.S.A., but no scolytids were found. Browne (in litteris, 1972) recently informed me of another association in which *Poecilips sierraleonensis* Eggers was found in the rachis of the fern *Asplenium* in Madagascar. Dr. R. I. Gara (personal comm., 1971) mentioned a possible association between a scolytid and fern in Heiberg Forest in New York State, which will require verification.

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