STUDIES OF THE OAK LEAFMINER *PHYLLONORYCTER MESSANIELLA* (ZELLER) (LEPIDOPTERA: GRACILLARIIDAE) IN SOUTHERN TASMANIA

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(with three tables and two text-figures)

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The establishment of the oak leafminer on many *Quercus* species in southern Tasmania is recorded and indications of parasitisation levels given.

Key Words: *Phyllonorycter*, Lepidoptera, *Quercus*, Tasmania.

INTRODUCTION

The oak leafminer *Phyllonorycter messaniella* (Zeller) was first recorded in Australia by Common (1976) from Canberra and several sites within a 130 km radius of Sydney. Further establishment has been noted on Norfolk Island by Smithers (1977) and in Melbourne by New (1978, 1981). In Tasmania, Hardy *et al.* (1978) first recorded *P. messaniella* mines on several species of *Quercus* in Hobart and New Town. Since 1978 the distribution of *P. messaniella* within Tasmania has expanded considerably and it has become a serious pest of valued park and street oaks.

This paper reports studies of the leafminer's life history, mine establishment on host trees, parasitoids and a predator in southern Tasmania.

STUDY AREA AND METHODS

Twenty-two *Quercus* spp., both mature trees and seedlings, growing in the Oak Section of the Royal Tasmanian Botanical Gardens were sampled monthly for one year. Every month a total of 20 leaves were taken from each mature tree by sampling five shoots around the lower crown. The presence or absence of mines was noted on seedlings. The mines on each sample leaf were classified into one of the following four categories, established by New (1981), and egg counts were made:

(1) initial entry mines containing first instar larvae;
(2) blotch mines containing second and third instar larvae;
(3) tentiform mines containing fourth instar larvae and pupae;
(4) open mines following emergence or predation.

The mines were dissected while fresh, before desiccation could occur. Larval survival was assessed, based on the numbers of live and dead larvae found in the mines. Extra leaves were retained at 20°C for adult leafminer and parasite emergence. All parasitoid and moth pupae dissected from sample mines were retained for emergence at illumination periods of 11 day–13 night hours.

Three non-oak plant species growing in the Gardens, *Feijoa sellowiana*, *Castanea sativa* and *Fagus sylvatica* have been recorded by Wise (1953a) as hosts of *Phyllonorycter messaniella* in New Zealand. These species all carried mines during the sampling period (table 1).

RESULTS

Host Plants

Mine establishment on *Quercus* spp. and on other tree species attacked by *Phyllonorycter messaniella* during the sampling period are shown in table 1.

All species of *Quercus* except for *Q. palustris* were attacked at the study site.

Life History

The annual distribution of the four mine types established by New (1981) are shown for *Q. robur*,

TABLE 1

***Phyllonorycter messaniella* Mine Establishment on Host Trees**

Tree species	Leaf area* (cm²)	Number of mines/leaf†	Mines/cm²	Max. mines per leaf
Quercus aliena	80.6	24.5	0.3	45
Q. ilex	14.3	18.1	1.3	43
Q. mirbeckii	72.2	20.7	0.3	41
Q. petraea	46.2	20.0	0.4	35
Q. virginiana	9.2	17.5	1.9	32
Q. robur	36.1	16.6	0.5	28
Q. suber	5.9	12.4	2.1	27
Q. garryana	43.7	16.9	0.4	27
Q. casteneifolia	41.2	11.9	0.3	26
Q. lanuginosa	26.0	13.0	0.5	24
Q. cerris	31.1	11.5	0.4	23
Q. incana	35.3	9.6	0.3	19
Q. macrocarpa	60.5	9.4	0.2	18
Q. coccinea	89.0	8.9	0.1	15
Q. hartwissiana (seedling)	37.8	3.4	0.1	10
Q. serrata (seedling)	19.3	0.9	0.1	4
Q. canariensis (seedling)	14.3	ns	ns	4
Q. bicolor (seedling)	50.4	ns	ns	3
Q. rubra	38.6	ns	ns	3
Q. rubra (seedling)‡	73.9	ns	ns	3
Q. acutissima (seedling)	22.7	ns	ns	3
Castanea sativa	58.8	4.2	0.1	3
Fagus sylvatica	14.3	1.4	0.1	3
Feijoa sellowiana	14.3	1.1	0.1	2
Q. borealis (seedling)	89.9	ns	ns	1
Q. canadiensis	12.6	ns	ns	1
Q. palustris (seedling)	18.5	0	0	0

* mean of 10 mature leaves.
† monthly mean.
‡ small sample.
ns not sampled.

a common deciduous host, and for *Q. suber*, the only evergreen host in the study area (fig. 1). Most deciduous hosts had a similar pattern of *Phyllonorycter messaniella* mine establishment and development, with peak establishment (i.e. incidence of Mine Type 1) occurring in October. The common deciduous host *Q. robur* supported two generations of *P. messaniella* per year but some larger-leaved species such as *Q. mirbeckii* and *Q. petra* retained their leaves for nine to ten months of the year and supported three generations of *P. messaniella* per year.

In the winter months, the evergreen *Q. suber* was colonised by *P. messaniella* when deciduous oaks were leafless. In summer, *Q. suber* leaves are attractive oviposition sites for *P. messaniella* but larval survival is low, probably due to desiccation. The contrasting pattern of oviposition by *P. messaniella* on *Q. suber* and *Q. robur* and mine density and larval survival are shown in table 2.

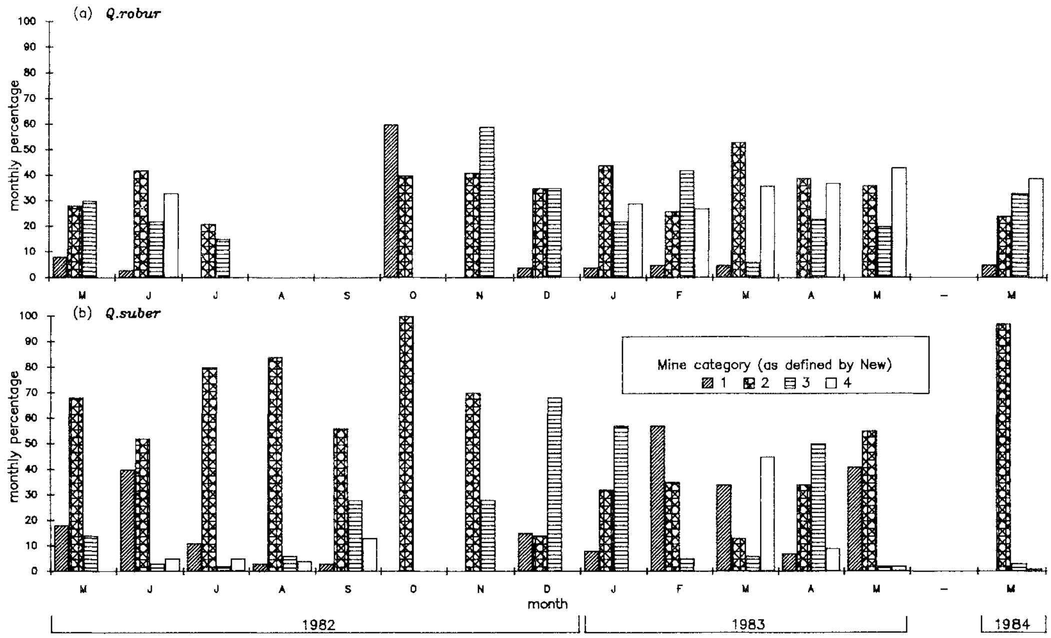

FIG. 1 — Comparison of mine development on (A) Quercus robur *and (B)* Q. suber.

TABLE 2

Oviposition and Larval Survival on the Hosts *Quercus suber* and *Q. robur.*

Period sampled		*Q. suber* (evergreen)			*Q. robur* (deciduous)		
		Eggs/ leaf	Mines/ leaf	Survival %	Eggs/ leaf	Mines/ leaf	Survival %
1982	May	3.9	2.0	20	0	16.6	5
	Jun	3.6	9.0	63	0	10.7	1
	Jul	1.4	9.5	16	0	3.6	0
	Aug	0	12.4	33	–	–	–
	Sep	0	4.7	28	–	–	–
	Oct	0	0.6	0	0.5	0.3	5
	Nov	0.1	0.4	29	0.2	1.7	53
	Dec	0.3	0.7	14	0.2	1.3	38
1983	Jan	0.7	1.1	14	0	2.8	25
	Feb	0.5	0.9	6	0.1	2.6	29
	Mar	0.8	0.8	0	0.4	7.3	19
	Apr	4.8	0.6	17	0	4.5	17
	May	7.2	9.0	91	0	5.0	1
1984	May	19.8	5.7	25	0	6.5	9
1985	May	7.7	2.8	29	0	3.9	27

Parasitisation and Predation

Ten species of chalcidoid wasps (Hymenoptera), including one hyperparasite, were reared from *Phyllonorycter messaniella* mines. One predator was found associated with the mines. Adults of this species were reared from pupae collected in damaged mines (table 3).

The spring and summer generations of *P. messaniella* on all host species are heavily parasitised, while the overwintering generation, on evergreen oaks, has low levels of parasitisation (fig. 2).

Peak levels of parasitisation occurred early in the spring, with up to 57% of mines on *Q. suber* containing parasitoid larvae or pupae. No endoparasitic larvae were found when *P. messaniella* larvae were dissected. Parasitisation in mines on *Q. robur* peaked at 22%. There was considerable variation in levels of parasitisation on different tree species.

Elachertus sp. B (Hymenoptera:Eulophidae) comprised 56% of the total parasitoid emergence while its hyperparasite *Cirrospilus margiscutellum* (Girault) (Hymenoptera:Eulophidae) totalled 29%.

Adults of the hemerobiid *Micromus tasmaniae* (Walker) (Neuroptera) were observed feeding on freshly-deposited eggs. Larval predation was not observed but hemerobiid larvae were found in damaged mines containing the remains of *P. messaniella* larvae. The majority of adults of *M. tasmaniae* were collected on *Q. suber* samples and the majority of pupae of *M. tasmaniae* were found in damaged mines on this tree species.

TABLE 3

Natural Enemies of *Phyllonorycter messaniella* in Southern Tasmania

Parasitoids	**Hymenoptera**
Gen nr. *Elachertus* sp. A	Eulophidae
Gen. nr. *Elachertus* sp. B	Eulophidae
Gen. indet. sp. A	Eulophidae
Gen. indet. sp. B	Eulophidae
Tetrastichus sp.	Eulophidae
Gen. indet. sp. A	Pteromalidae
Gen. indet. sp. B	Pteromalidae
Sierola sp.	Bethylidae
Goniozus sp.	Bethylidae
Hyperparasite	
Cirrospilus margiscutellum (Grlt.)*	Eulophidae
Predator	**Neuroptera**
Micromus tasmaniae Walker	Hemerobiidae

* This hyperparasite attacked only Gen. nr. *Elachertus* spp. A & B.

DISCUSSION

The highest densities of leaf mines recorded in this survey were 45 mines per leaf on *Quercus aliena* and 41 mines per leaf on *Q. mirbeckii. Quercus robur* carried a maximum of 28 mines per leaf. Wise (1953b) records up to 40 mines per leaf on *Q. robur* in New Zealand while Smithers (1977) found 65 mines on leaves of an unidentified oak on Norfolk Island.

Maier (1983) showed that apple leaves abscissed significantly earlier if mined by *Phyllonorycter crataegella*. Pritchard & James (1984) also demonstrated accelerated leaf loss due to *P. messaniella* on holm oak having moderate levels of infestation (12–31%). From observation of oak species at the Hobart study site, high mine density appears to cause early senescence of leaves at the end of summer, with the result that development of many mines was incomplete.

During the collection of leaf samples, no difference in frequency of mined leaves was apparent to a height of 2.6 m. However, visual appraisal using binoculars suggested decreasing numbers of mined leaves in the upper half of sampled trees. Miller (1973) showed a significant decrease in mine density with height of a mature tree but no relationship between mine density and aspect.

At the Hobart study site, adults of *P. messaniella* are in flight for most months of the year, as three generations are supported by the range of deciduous and evergreen oak species available. The evergreen species *Q. suber* enables a successful winter generation to develop, with adults emerging in synchrony with the spring flush of leaf growth on deciduous oaks. In Europe, the holm oak *Q. ilex*, which is considered to be the primary host species, supports two winter generations (Delucchi 1958). The summer generation prefers the soft tissues of *Castanea sativa*. This alternation of hosts is reflected in Tasmania, where the evergreen *Q. suber* supports the small winter generation and the two summer generations are carried on both deciduous and evergreen oak species.

Parasitoids of *P. messaniella* in Tasmania are native insects that have previously been found to

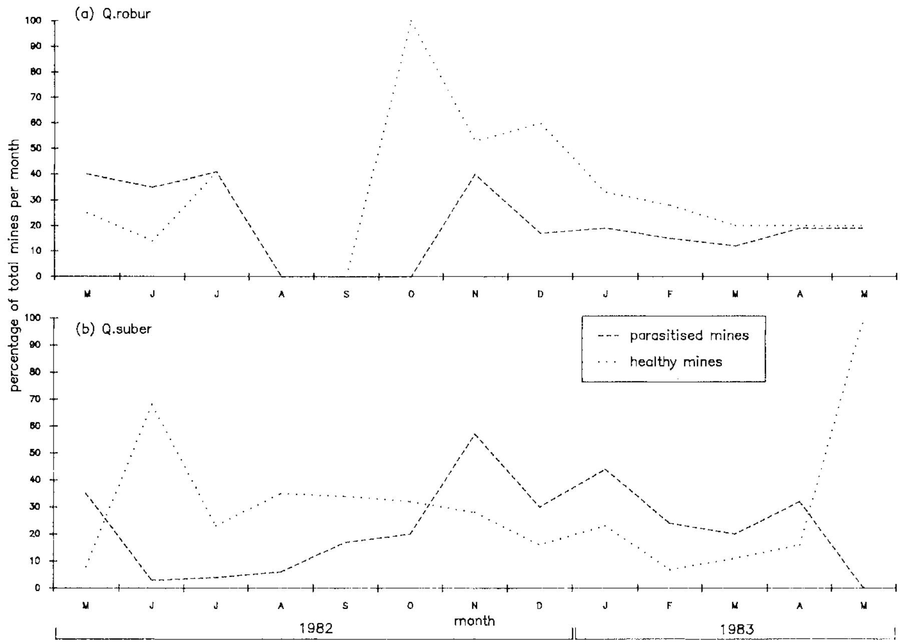

FIG. 2 — Frequency of healthy and parasitised mines of Phyllonorycter messaniella *on* Quercus robur *and* Q. suber *(—— parasitised mines, ... healthy mines).*

be associated with native gall-forming and mining insects (Forestry Commission, unpubl. studies). A similar situation occurs in Canberra and NSW, where six native parasitoid species are recorded from *P. messaniella* mines by Common (1976). In Melbourne, eight native species are noted by New (1981). This contrasts with parasitisation in New Zealand, peaking at 81.8%, caused only by introduced species (Swan 1973, Given 1959). Several species of the hymenopteran genera *Elachertus* Spinola, *Cirrospilus* Westwood and *Tetrastichus* Haliday were recovered by Delucchi (1958) as part of the parasitoid complex of *P. messaniella* in Europe.

The oak leafminer is now widely distributed throughout Tasmania. The trees become unsightly due to the blotchy appearance of the mines and early leaf senescence and reduced growth rates may result. The parasitoid complex does not significantly control populations of *Phyllonorycter messaniella*, nor limit the formation of mines which cause cosmetic and horticultural problems. The leaves of some *Quercus* species, such as *Q. palustris*, are apparently less attractive as oviposition sites. The planting of such species in parks and gardens may reduce the visual impact caused by mine formation.

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