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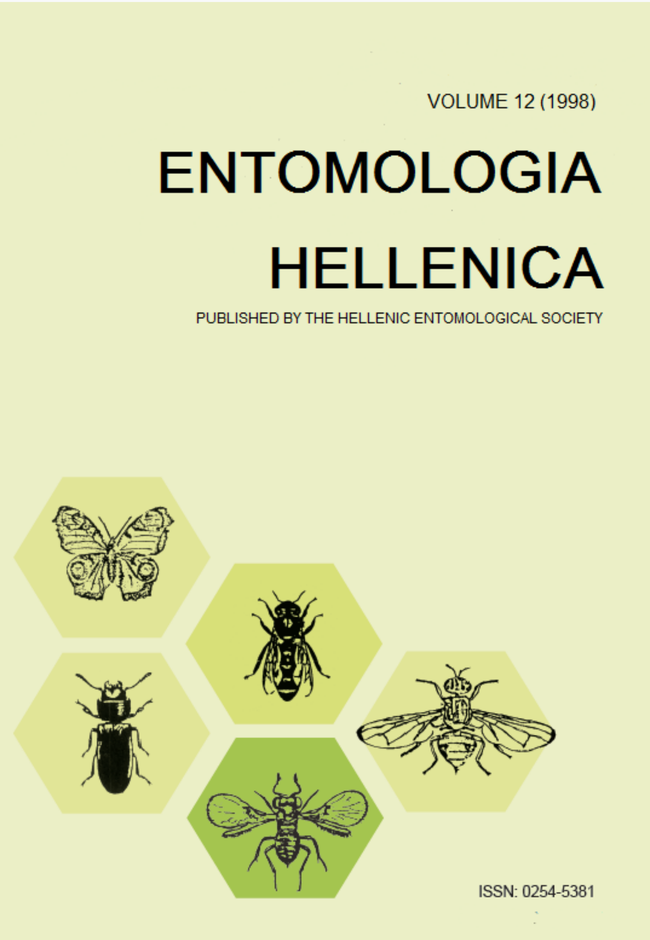

The Phenology of Synanthedon myopaeformis Borkhausen (Lepidoptera: Sesiidae) in the Region of Larissa, Central Greece

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The Phenology of *Synanthedon myopaeformis* Borkhausen (Lepidoptera: Sesiidae) in the Region of Larissa, Central Greece[1]

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ABSTRACT

The phenology of *Synanthedon myopaeformis* Borkhausen. (Lepidoptera: Sesiidae) was studied in the region of Larissa, Central Greece, for three consecutive years (1993-1995) . *S. myopaeformis* most propably completes one generation per year on apple trees. It overwinters as lavra of different sizes in the feeding tunnels in the trunk and branches. Pupation takes place from the end of March to the beginning of September with a peak in late May - beginning June. The emergence of adults takes place from late April to the beginning of October with the main peak in mid June. The larvae of the new generation start to appear from the beginning of May with a maximum in late June–beginning of July. Most of the infestation is observed in the grafting points and the pruning wounds. The results indicate that the pest becomes increasingly important in the study area. This study, could be useful in determining the optimum timing of control measures.

Introduction

The wood borer *Synanthedon myopaeformis* Borkhausen. (Lepidoptera: Sesiidae), was in the past a secondary pest of apple trees in Greece. Recently, however, the pest population levels have increased considerably (Kyparissoudas 1991) and particularly in the Larissa region (Central Greece) it is considered as a primary pest causing serious economic damage. The increasing economic importance of the pest has also been reported in many European countries, like Italy (Castellari 1987), Germany (Dickler and Hofmann 1974), Switzerland (Blaser and Charmillot 1985) and the Netherlands (Frankenhuyzen and Van Jassen 1978). Possible reasons that could explain the change in the population dynamics of the pest are the tree age, the susceptibility of certain varieties, the cultural techniques and outbreaks of other pests and diseases which favour the development of *S. myopaeformis* (Audemard and Monnet 1984).

The larvae of *Synanthedon myopaeformis* live in feeding tunnels in the cambium where overwintering occurs. Most of the infestation occurs in the grafting points and the pruning wounds. Pupation takes place inside the feeding tunnels. After adult emergence, the exuviae remain protruding on the tree at the exit hole and indicate the infestation level of each tree (Yonce 1980, Nielsen 1981).

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A detailed study of the biology of the pest in Greece is missing and chemical control often includes unnecessary treatments with great economic and ecological consequences. For this reason it was considered useful to study the biology of the pest in the region of Larissa, an area where *S. myopaeformis* is of particular importance, in order to gain useful information for the development of a pest management programme.

Materials and Methods

The study was carried out at a 10 acres apple orchard of "palmeta" shape in the Anavra village in the region of Agia, Larissa and lasted three years (1993-1995). The trees of the orchard were 15 years old (cv Golden, Starking Delicious and Granny Smith). All observations and measurements of the various biological parameters were conducted in situ at weekly intervals from March until October of each year.

The stage of the insect (lavra, pupa) was determined in 100 new by each check tunnels of randomly selected trees. Because of the difficulty in defining larvae according to their ages in the field, they were distinguished according to size. Three different size groups were used: 1) 0-7 mm. The larvae obtain this length very soon, within 10 days after hatching. Larvae of this size didn't observe during the winter. 2)15-25 mm. The greatest ammount of larvae is observed to have this size in early spring before the beginning of pupation. 3)8-14 mm is the medium size.

In order to record the emergence of adults, the number of exuviae protruding on the trunk and the branches up to a height of 1,5 m above the ground were counted in 200 marked trees of the orchard. After counting the exuviae were removed. Additional evidence for the adult emergence was obtained by enclosing infested branches in March in nylon mesh cloth and then observing the adults emerged throughout the season (April - October).

The adult male population was monitored with 5 pheromone traps. These were Pherocon 1c Trap of Trece incorporated. The type of trap was Delta. The traps were placed under the crown of the trees at 1,5 m from the ground on the side exposed to sunlight and the distance between traps was 50 m. The dispensers with the pheromone (Trece incorporated, Pherocon Sandoz LTD, Basel Switzerland) were renewed every twenty days.

Daily records of temperature for the study area were available from the Regional Center of Plant Protection and Quality Control of Volos which is operating a meteorological station in the region of Agia.

Results and Discussion

Figures 1, 2, 3, 4, show the number of larvae < 7 mm, 8 - 14 mm and > 15 mm, and the number of

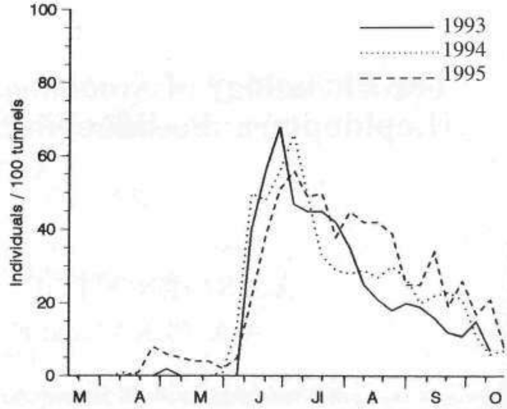

FIG. 1. Larvae < 7 mm of *S. myopaeformis* in 100 tunnels at weekly intervals from middle March until middle October for three consecutive years.

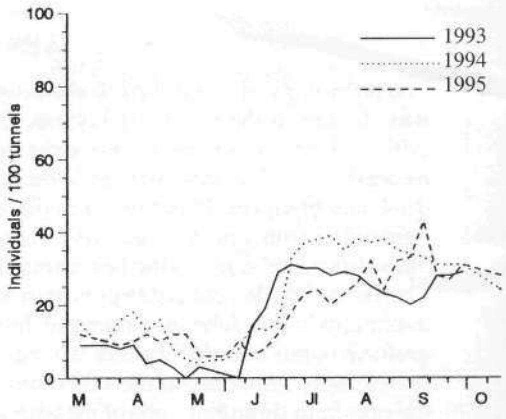

FIG. 2. Larvae 8-14 mm of *S. myopaeformis* in 100 tunnels at weekly intervals from middle March until middle October for three consecutive years.

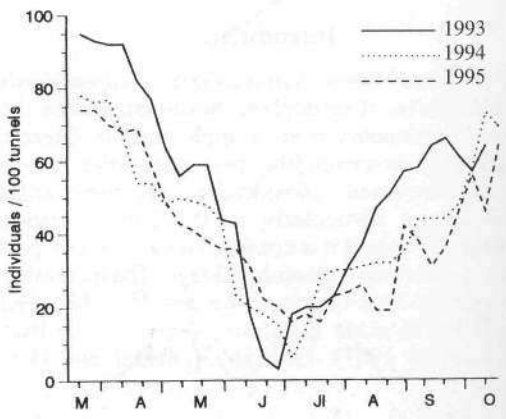

FIG. 3. Larvae > 15 mm of *S. myopaeformis* in 100 tunnels at weekly intervals from middle March until middle October for three consecutive years.

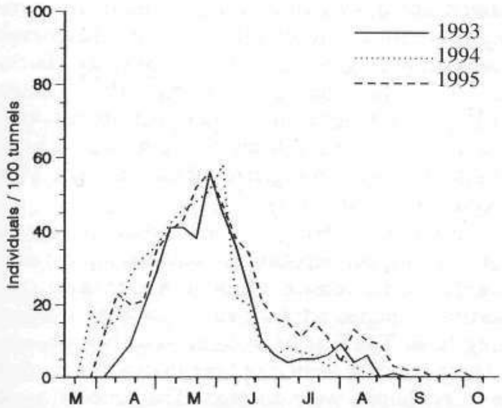

FIG. 4. Pupae of *S. myopaeformis* in 100 tunnels at weekly intervals from middle March until middle October for three consecutive years.

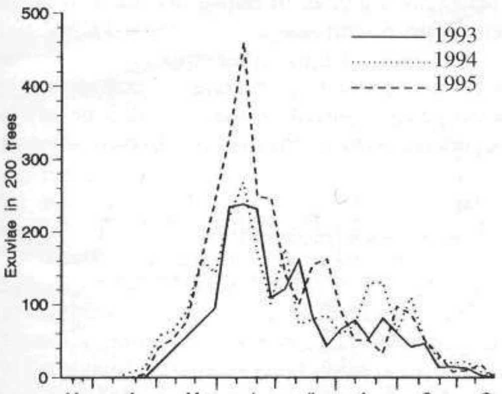

FIG. 5. Exuviae of *S. myopaeformis* in 100 tunnels at weekly intervals from middle March until middle October for three consecutive years.

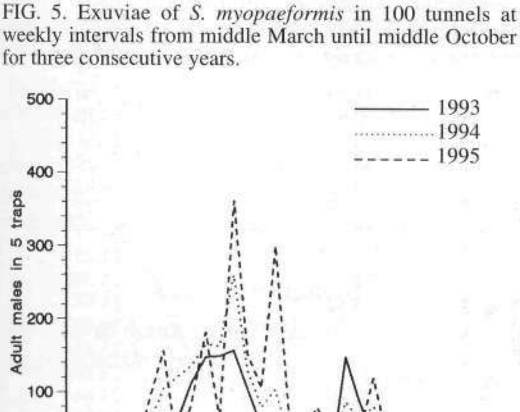

FIG. 6. Adult males of *S. myopaeformis* in 5 traps at weekly intervals from middle March until middle October for three consecutive years.

pupae respectively found in 100 tunnels every week from the middle of March until the middle of October for 1993, 1994 and 1995. Figure 5 shows the number of exuviae indicating the number of adults emerged found in 200 trees and figure 6 the number of adult males caught in 5 traps every week during the above period.

The phenology of the population of all stages was similar (almost indentical) in the three years of the study. The data of each week of the three years for each of the parameters (larvae < 7 mm, larvae 8 -14 mm, larvae > 15 mm, pupae) were averaged in order to be observed how the evolution of each one of the above stages effected the evolution of the other stages in every week during the study period. (Fig. 7)

As shown in Fig. 1,2,3,4 in mid of March, the population of *S. myopaeformis* was at the size of the larvae < 7 mm which overwintered. The length of the overwintering larvae ranged from 8 mm - 25 mm. The length of the greatest proportion of these larvae was above > 15 mm (Fig. 3). Soon after, pupation began and the number of larvae > 15 mm decreased continuously up to the end of June while the number of pupae continuously increased and reached the maximum in late May- beginning June (Fig, 3, 4).

The larvae < 7 mm started to appear from the beggining of June but relatively high numbers were not observed before the middle of June. The number of them reached the maximum in late June - beginning of July and from then on it continuously decreased up to the end of the season (Fig 1).

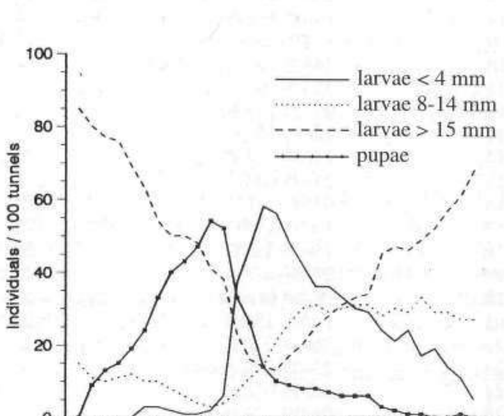

FIG. 7. Numbers of larvae < 7 mm, 8-14 mm, and > 15 mm and pupae of *S. myopaeformis* found in 100 tunnels at weekly intervals from mid March until mid October (average of three consecutive years 1993-1995).

As indicated by the counts of exuviae (Fig. 5) the emergence of adults took place from late April until almost the end of the season but a well-formed peak occurred in mid June. The greatest proportion of the adults (two thirds approximately) emerged from the middle of May until the mid of July. In 1993 a total of 9 exuviae per tree was found while the corresponding numbers for 1994 and 1995 were 12 and 14,5 respectively.

The pattern of male captures in pheromone traps generally coincides with that of adult emergence as it is expressed by the weekly records of exuviae (Fig. 6).

The overall results indicate that most propably *S. myopaeformis* completes one generation per year in the study area. Although we cannot exclude the possibility that some individuals give rise to a new second generation before the end of the season, if this happens, it probably concerns an insignificant proportion of the population. The view of one generation per year was supported by adult emergence from enclosed (with nylon mess cloth) infested branches until October and in which no oviposition could take place from March. In cooler climates (e.g. in northern European countries) it is reported that *S. myopaeformis* completes one generation every two years. (Dickler 1977, Lyashenko 1981, Monnet 1987), while in Egypt three generations per year are reported but this is concluded from the three well defined peaks of adult emergence observed each year (Awadallah et al. 1981).

The overwintering larvae start to pupate in early spring but pupation is extended almost during the whole season although the greatest proportion of pupae are formed in late May - beginning June. The first adult emergence was observed at the end of April, not later than a month after the first pupae were formed. The proportion of adult emergence increased rapidly as the temperature rises and the peak of adult emergence occurred in the middle of June, 15 days after the corresponding peak of pupae. At this period the temperature approaches 25° C (Table 1).

The emerged adults after ovipositing gave rise to the new generation of larvae < 7 mm whose the main peak occurred at the end of June or the beginning of July, (Fig. 1) 15 - 20 days after the

Table 1. Mean weekly temperature during the years 1993, 1994, 1995.

Week	Date	Mean weekly temperature °C '93	'94	'95
1	22/03-28/03	12.32	11.26	9.77
2	29/03-04/04	9.90	11.72	10.38
3	05/04-11/04	12.61	11.99	10.30
4	12/04-18/04	14.34	15.56	10.53
5	19/04-25/04	14.20	14.95	15.37
6	26/04-02/05	14.26	15.37	15.56
7	03/05-09/05	14.32	13.98	15.30
8	10/05-16/05	16.24	17.00	18.05
9	17/05-23/05	19.47	21.20	17.14
10	24/05-30/05	21.43	23.54	21.80
11	31/05-06/06	22.23	20.97	22.20
12	07/06-13/06	24.47	20.97	22.51
13	14/06-20/06	21.45	23.04	24.20
14	21/06-27/06	24.27	23.88	24.82
15	28/06-04/07	23.96	25.33	23.72
16	05/07-11/07	23.65	23.77	24.57
17	12/07-18/07	23.17	24.60	24.25
18	19/07-25/07	24.31	25.55	25.39
19	26/07-01/08	25.66	24.42	24.94
20	02/08-08/08	24.29	24.27	24.49
21	09/08-15/08	22.58	27.70	23.41
22	16/08-22/08	23.38	24.39	22.26
23	23/08-29/08	26.13	22.98	22.84
24	30/08-05/09	19.09	23.47	20.44
25	06/09-12/09	21.03	23.28	21.28
26	13/09-19/09	21.41	23.00	20.95
27	20/09-26/09	16.81	20.53	18.39
28	27/09-03/10	18.87	22.32	14.78
29	04/10-10/10	17.06	27.95	
30	11/10-17/10	18.00	15.69	

peak of adult emergence, an indication particularly useful for the control of *S. myopaeformis.*

The long period of occurrence of the various stages during the season and the resulting great amount of overlapping between the stages can be explained by the variation in the physiological age of the overwintering larvae (Fig. 2, 3) which is reflected in the phenological events of the subsequent stages.

As indicated by the results, pheromone trap catches correspond to the adult emergence. Pheromone traps are often used to monitor the adult population of *S. myopaeformis* and to provide indices for control (Nielsen 1981). However, trap efficiency may be influenced by a number of factors such as changes in flight activity of males due to weather changes and the position of the trap in the orchard in relation to its long range of attractiveness (Snow 1985). Possible changes in trap efficiency can explain the observed changes in trap catches which are not explained by the adult emergence curve.

The weekly counts of exuviae provide an accurate method for recording adult emergence and for assessing infestation levels as suggested for other sesiids (Yonce 1980, Nielsen 1981). Furthermore this method has been suggested for determining the economic importance of *S. myopaeformis* as a pest according to different infestation levels. Based on the number of exuviae per tree, economic injury levels have been proposed for young (< 6 years) and older trees to be 2 and 20 exuviae per tree respectively (Monnet 1987). The progressively increasing infestation levels observed during the study indicate the increasing importance of *S. myopaeformis* for the apple orchards of the Larissa region and therefore control measures become necessary (Fig. 5).

This study provides information useful for the correct timing of pesticide applications, particularly when summer treatments against the adults and/or the newly emerged larvae are desired

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KEY WORDS. *Synanthedon myopaeformis,* wood borer, apple tree, phenology.

Φαινολογία του *Synanthedon myopaeformis* Borkhausen (Lepidoptera, Sesiidae) στην Περιοχή της Λάρισας

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ΠΕΡΙΛΗΨΗ

Στη διάρκεια των ετών 1993, 1994, και 1995 μελετήθηκε η φαινολογία του ξυλοφάγου εντόμου *Synanthedon myopaeformis* Borkh. (Lepidoptera, Sesiidae) στη περιοχή της Αγιάς Λάρισας όπου τα τελευταία χρόνια παρατηρείται έξαρση της προσβολής. Το μεγαλύτερο ποσοστό προσβολής παρατηρείται στις τομές κλάδευσης και στην περιοχή του εμβολίου. Τα αποτελέσματα έδειξαν ότι το έντομο πιθανότατα συμπληρώνει στην περιοχή μια γενιά το χρόνο. Διαχειμάζει ως προνύμφη σε στοές στο κορμό και στους χονδρούς βραχίονες. Η νύμφωση αρχίζει περί τα τέλη Μαρτίου με μέγιστο περί το τέλος Μαΐου με αρχές Ιουνίου. Οι πρώτες έξοδοι των ακμαίων παρατηρούνται το τελευταίο δεκαήμερο του Απριλίου, ένα μήνα περίπου μετά τις πρώτες νυμφώσεις, και το μέγιστο περί τα μέσα Ιουνίου, 15 ημέρες περίπου μετά το μέγιστο των νυμφώσεων. Οι έξοδοι των ακμαίων κλιμακώνονται μέχρι το τέλος Οκτωβρίου αλλά τα 2/3 περίπου των εξόδων λαμβάνουν χώρα μέχρι τα μέσα Ιουλίου. Οι νεαρές προνύμφες της νέας γενιάς παρατηρούνται από αρχές Ιουνίου, με μέγιστο τέλος Ιουνίου - αρχές Ιουλίου. Η καταμέτρηση των νυμφικών εκδυμάτων είναι μια αξιόπιστη μέθοδος ελέγχου των εξόδων των ακμαίων στον οπωρώνα και παρέχει τη δυνατότητα σύγκρισης του ύψους της προσβολής ανάμεσα σε διαδοχικά χρόνια. Στον πειραματικό οπωρώνα παρατηρήθηκε μια σταθερή αύξηση της προσβολής από χρόνο σε χρόνο στη διάρκεια της μελέτης. Οι φερομονικές παγίδες είναι επίσης ένας δείκτης παρακολούθησης του ενηλίκου πληθυσμού στον οπωρώνα που όμως επηρεάζεται από διάφορους παράγοντες και οι οποίοι πρέπει να λαμβάνονται υπόψη. Τα στοιχεία της μελέτης αυτής μπορούν να χρησιμεύσουν για τον άριστο χρόνο επέμβασης στη περιοχή ώστε ν' αποφευχθούν περιττοί ψεκασμοί.