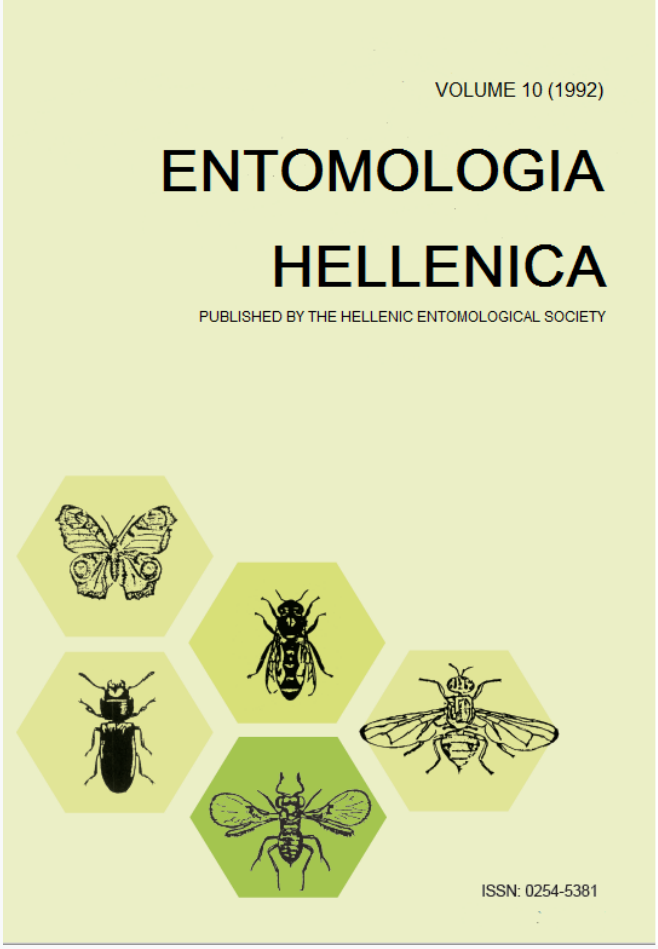
ENTOMOLOGIA HELLENICA

Vol 10 (1992)



Phenology of Population of Immature Stages of Pear Psylla, Cacopsylla pyri, in the Region of Magnesia (Greece)

E. T. Stratopoulou, E. T. Kapatos

doi: 10.12681/eh.13998

To cite this article:

Stratopoulou, E. T., & Kapatos, E. T. (1992). Phenology of Population of Immature Stages of Pear Psylla, Cacopsylla pyri, in the Region of Magnesia (Greece). *ENTOMOLOGIA HELLENICA*, *10*, 11–17. https://doi.org/10.12681/eh.13998

Phenology of Population of Immature Stages of Pear Psylla, *Cacopsylla pyri* , in the Region of Magnesia (Greece)[1]

E.T. STRATOPOULOU and E.T. KAPATOS

National Agricultural Research Foundation, Plant Protection Institute of Volos, Greece

ABSTRACT

The phenology of the population of immature stages of pear psylla, *Cacopsylla pyri* (L.), was studied in Greece (region of Magnesia), during the period 1988-1991 and it was found to follow a basic pattern. Pear psylla produces 5-6 generations per year. The first generation develops during the period February-middle April and it is quite discrete. Three overlapping generations are developed during the period from middle April until middle August but the amount of overlapping varies from year to year. From middle August until the end of the season pear psylla produces 1-2 generations, i.e. only a part of the fifth generation completes the sixth one. Population density is generally low during the first generation but during May-June reaches very high levels. During summer, strong environmental pressure, supresses the population of pear psylla to low levels but it recovers again during September-October.

Introduction

Pear psylla, *Cacopsylla pyri* (L.), (Homoptera: Psyllidae) has become one of the most important problems in pear growing areas in Greece and other countries (Hodkinson 1984, Broumas et al. 1989). Particularly in the region of Magnesia (eastern central Greece) this problem has dramatically increased during the last years (1982-1988) because conventional insecticidal treatments could provide effective control only temporarily and repeated treatments were necessary for crop protection.

It was realized that a new control strategy is required which must be designed on the basis on the entire yearly population system of pear psylla, thus maximizing the effect of a particular treatment and taking into account natural enemies and other pests of pear within a pest management approach.

This new strategy, however, requires, among others, the detailed knowledge of the yearly fluctuations and composition of pear psylla population which are determined, mainly, by the number of generations as a result of other interacting biological parameters, the reproductive potential during the year and the action of mortality factors on the various stages.

For a continuously breeding insect, such as pear psylla, for most of the season (i.e. from February up to the appearance of the winter form in autumn) the phenology of the population is to a great extent temperature dependent and, therefore, information from other places are only of relative importance.

However, published information from other countries of Europe (Bonnemaison et Missonier 1956, Nguyen 1962, Atger 1979, Matias 1984) and from another area of Greece (Broumas et al. 1989) indicate that pear psylla completes 4-7 generations per year although it is not clear how this number of generations was determined.

In this work, which is a part of an ongoing study of the population dynamics of pear psylla in the region of Magnesia, data are given on the fluctuations and composition of pear psylla population of immature stages during the years 1988, 1989, 1990 and 1991.

[1] Received for publication March 21, 1992.

Materials and Methods

In 1988 and 1989 the study was carried out at an experimental site (Koropi) located 22 kilometers south of the town of Volos but in 1990 and 1991 an additional experimental site was used (Neapoli) adjacent to the town.

The trees of the study sites were of the variety «Kristali» which is the main variety of pears growing in the region of Magnesia, they were free from insecticidal treatments but they received the usual agricultural practices (prunning, fertilization, etc).

In each site and year, six trees, of medium size, were used for sampling and samples were taken every 7-10 days from the beginning of February until the end of the season (late November). The samples were taken from the middle of the canopy, which expresses the general trend of the distribution of infestation within the tree in respect to height, and four samples were taken from the four directions (E, W, S, N) of each tree (i.e. a total of 24 samples). Each sample consisted of two small branches of two years growth bearing a number of all kinds of organs (flower buds, leaf buds and young shoots) where pear psylla develops. The samples were examined under the microscope and all stages of pear psylla (eggs, L_{1-3}, L_{4-5}) (Bonnemaison et Missonier, 1956), living or dead, were recorded. Thus, a mean number of stages for each kind of organ was produced for each tree and finally, according to the proportion of each kind of organs in the tree, a weighted total number of stages per 10 organs for each tree (a total of 60 organs for the six trees) was calculated. The proportion of each organ in the tree was estimated in February (flower buds, leaf buds) and beginning of May (young shoots). This sampling procedure was considered to be the optimum after studying in detail the distribution of immature stages of pear psylla within the tree (Stratopoulou and Kapatos, 1992a).

In order to make the populations graphs more understandable only number of eggs and L_{4-5} are presented because the occurrence of these two different stages within the same generation differs significantly and therefore the determination and separation of generations is more easily discussed.

In the autumn of 1990 and 1991 and in order to determine the appearance of the adults of winter form and their proportion in the total adult population during autumn, samples of adults (30-50 individuals) were taken regularly from middle September onwards by beating branches of the pear trees surrounding the experimental site and collecting the adults in trays (Burt and Brunner 1981).

Results

Figure 1 shows the population of eggs and L_{4-5} (in logarithmic scale) of pear psylla during 1988 at the experimental site of Koropi. The first oviposition period starts from beginning of February, although mature females are present from the middle of January (Stratopoulou, unpublished), and continues until late March-beginning of April with a maximum of egg-laying in the middle of March. The first L_{4-5} of this first generation occurred at the beginning of April and their peak number at the end of April.

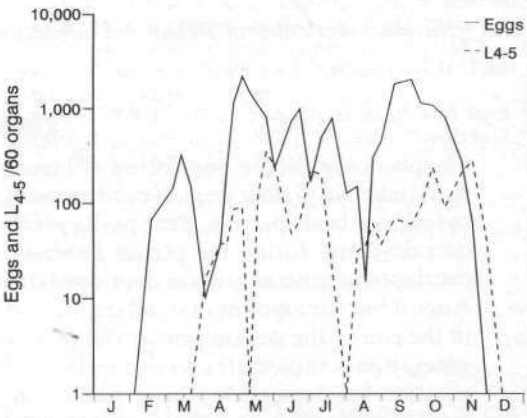


FIG. 1. The population of eggs and L_{4-5} of pear psylla (number per 60 organs in logarithmic scale) at the experimental site of Koropi during 1988.

During the period from middle April until middle August a continuous egg laying is observed but three well formed peaks occurred at the beginning of May, middle June and middle July respectively. The population of L_{4-5}, during the same period, follows the fluctuations of the egg populations and three peaks are observed in late May, beginning of July and middle August respectively. Another distinct oviposition period is observed during the period from middle August until November, followed by a continuous formation of L_{4-5}.

Figure 2 shows the composition of the population of immature stages of pear psylla during the same year (1988) at the same experimental site (Koropi). Egg hatching started in middle March and by late March a considerable proportion of the population of immature stages is in the larval stages. Thus, egg hatching is synchronized with the progressive opening of flower buds within which the larvae develop. After egg hatching, as it is expected for a continuously breeding insect like pear psylla, all stages were present during the season but most of the population is at the egg stage. The com-

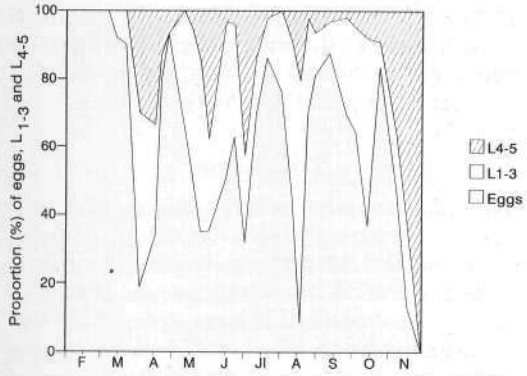


FIG. 2. Composition of population of immature stages of pear psylla (proportion of eggs, L_{1-3}, L_{4-5} in the total population) at the experimental site of Koropi during 1988.

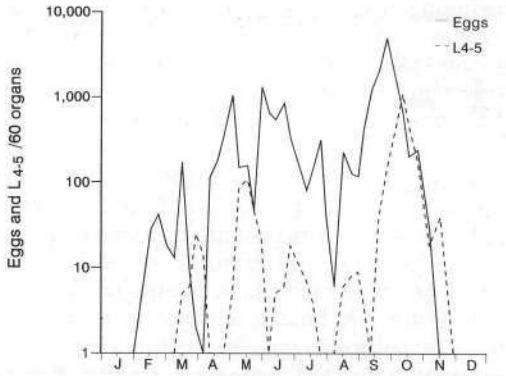


FIG. 4. The population of eggs and L_{4-5} of pear psylla (number per 60 organs in logarithmic scale) at the experimental site of Neapoli during 1990.

position of the population, however, changes considerably at certain periods. The proportion of eggs in the total population, for instance, drops to low levels at six periods and this corresponds to an increased proportion of L_{4-5}, except in the last period (beginning of October). Corresponding changes are observed in the proportion of L_{1-3} which is the intermediate stage of development between egg and L_{4-5}.

The results obtained during 1989 at the same experimental site (Koropi) were similar with those obtained in 1988 and they are shown in Figure 3. The same trends are observed, as those observed in 1988, for the populations of both eggs and L_{4-5}.

Figure 4 shows the populations of eggs and L_{4-5} during 1990 at the experimental site of Neapoli. Three main periods of oviposition are observed during this year. The first period lasted from the beginning of February until late March, the second from beginning April until beginning July with no distinct peaks of egg-laying as it was observed during 1988 and 1989 and the third one from middle July until the end of October. However, the population of L_{4-5} does not exactly follow the fluctuations of the egg population but three distinct peaks are observed during the period from end March until end July and three others less distinguishable during the period from beginning August until the end of November. The data from the other experimental site (Koropi) for this year fit the same pattern as observed in Neapoli.

Figure 5 shows the composition of the population of immature stages (Eggs, L_{1-3}, L_{4-5}) at the experimental site of Neapoli during 1990. Egg hatching started at the end of February and during the period from February until middle July the results indicate three main changes in

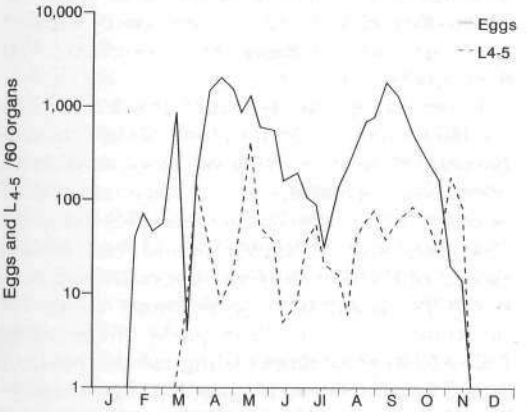


FIG. 3. The population of eggs and L_{4-5} of pear psylla (number per 60 organs in logarithmic scale) at the experimental site of Koropi during 1989.

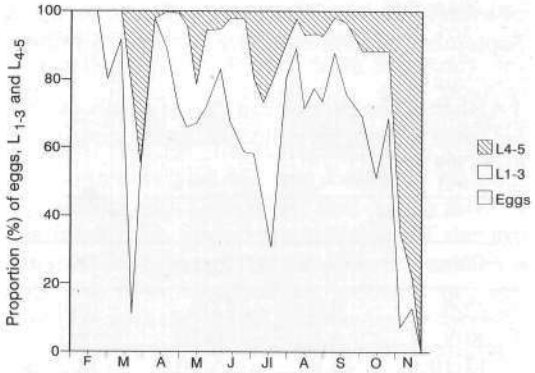


FIG. 5. Composition of population of immature stages of pear psylla (proportion of eggs, L_{1-3}, L_{4-5} in the total population) at the experimental site of Neapoli during 1990.

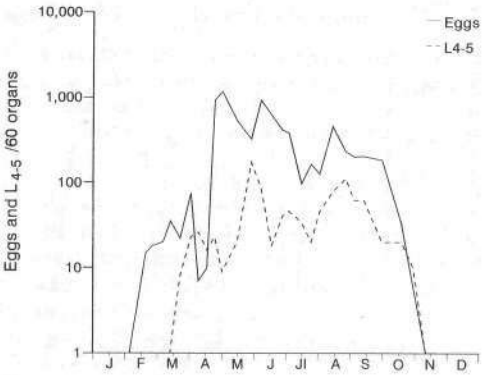


FIG. 6. The population of eggs and L_{4-5} of pear psylla (number per 60 organs in logarithmic scale) at the experimental site of Neapoli during 1991.

the proportion of eggs in the total population which coincide with changes in the proportion of L_{4-5}. During the rest of the season eggs were the predominant stage with minor changes in the proportion of the various immature stages.

During 1991 the results indicate, at both the experimental sites, an intermediate pattern of population phenology compared with the one observed in 1988 and 1989 and the other in 1990. This is shown in Figure 6 where the results obtained in Neapoli are presented. The population of both eggs and L_{4-5} during the period from February until middle June show the three main fluctuations as those observed in 1988 and 1989 but during the rest of the season a continuous egg laying and production of L_{4-5} is observed.

Table 1 gives the proportion of the adults of winter form in the total adult population captured during autumn of 1990 and 1991. Adults of winter form started to appear from the end of September beginning of October and by middle October a considerable proportion of adults captured was of the winter form while from the beginning of November only a few adults of summer form were found in the samples.

TABLE 1. The proportion (%) of adults of winter form in samples collected during autumn of 1990 and 1991.

1990		1991	
Date	%	Date	%
22/9	0.0	24/9	0.0
30/9	9.1	6/10	8.3
13/10	45.8	15/10	38.2
29/10	69.2	24/10	66.7
11/11	96.0	5/11	94.1

Discussion

The pattern of population phenology of a continuously breeding insect, as is pear psylla, is determined by many biological parameters such as duration of oviposition and reproductive potential of adult females, time of development and differential mortality of the various stages, parameters that are greatly influenced by environmental factors (weather, plant condition, etc).

The analysis and comparison of the results obtained in this study indicated that the phenology of the population of immature stages of pear psylla follows a basic pattern although some differences occur between years.

The main oviposition period of the overwintering adult females lasts from the beginning of February until the end of March but mass egg laying, usually, takes place after the end of February. Egg hatching, usually, starts at the beginning of March and it is sychronized with the progressive opening of the flower buds (of this variety) within which larvae develop, thus the probability of survival of the newly emerged larvae is maximized. The time when maximum number of L_{4-5} occurs varies from year to year (end March-middle April), apparently depending upon temperature during this period. This first generation of immature stages of pear psylla can be considered rather discrete because the amount of overlapping of the same stage between this generation and the next is rather small and in some cases (e.g. Koropi in 1989) does not exist at all.

From middle April, where new leaves have started to develop, until the end of the season in November, pear psylla produces a number of overlapping generations, but their amount of overlapping varies from year to year. In 1988-1989 and during the period from middle April until middle August, it appears that pear psylla produced three generations which are determined from the three peaks of egg laying followed by three more distinguishable peaks of L_{4-5}. This conclusion is supported by the analysis of the composition of the population of immature stages during the same period.

From middle August until the end of the

season a continuous egg laying is observed with a maximum in September followed by an almost continuous formation of L_{4-5}. However, from the end of September-beginning of October, adults of the winter form, which undergo a reproductive diapause, start to emerge and by middle October they constitute a considerable proportion of the adult population. This phenomenon is controlled by photoperiod but in critical values (12h), temperature, which varies from year to year, could be of determinative importance (Nguyen 1972). Therefore, it is unknown whether pear psylla during this period completes two generations or only a small part of the eggs laid after the middle of August develop to adults of the summer form that will oviposit again before the end of the season. Preliminary evidence from experiments with artificially infested pear branches support this latter suggestion (Stratopoulou and Kapatos, unpublished).

In 1990 and during the period from middle April until November, due to higher amount of overlapping, two main periods of oviposition were observed. One from middle April until middle July and the second from middle July until the end of the season. However, the curve of L_{4-5} numbers presents characteristic peaks as in the previous years. This is reflected in the analysis of the composition of the populations of immature stages of the same year which follows an approximately similar pattern as in 1988-1989.

In 1991, the population phenology of immature stages of pear psylla follows an intermediate pattern between that observed in 1988-1989 and the other in 1990. Both number of eggs and L_{4-5} have the same main fluctuations as in 1988-1989 but less distinguishable.

It is suggested from the results obtained in this study that *C. pyri* in this area produces 5-6 generations per year, i.e. only a part of the population of the fifth generation completes the sixth one. The first generation is rather discrete but from then onwards generations overlap to an extent that varies from year to year. In most of the cases generations up to middle August can be distinguished from the peak numbers of eggs and larvae.

The analysis of the composition of the population of immature stages can be used indicatively for the determination and separation of generations although this is the result of the interaction of many biological parameters. This analysis supports the suggestion for the number of generations because in all cases the composition of the population shows four major changes in the proportion of the various stages during the period from February until the middle of August.

Population density of the first generation in February-March is, usually, low but in the second generation during April-May it reaches very high levels. In order to get an idea of the order of magnitude of the rate of increase between the first and the second generation, the maximum numbers of eggs recorded in each generation were compared. The rate of increase from the first to the second generation of eggs ranged from 2.5 to 22 times. During summer, strong environmental pressure (high temperatures reducing reproductive potential, increased action of predators, condition of leaves) reduces population levels and this was particularly observed during 1988 and 1990. More favourable conditions in September, however, allow the population of pear psylla to recover again.

These results are not directly comparable with data obtained in other countries where temperature is considerably different. However, results obtained in Italy (Campania) (Priore 1991) show considerable similarity with the ones obtained in this study and they suggest that pear psylla completes five generations per year, the fifth one lasting from end August-beginning September until the beginning of October. Also, results obtained in another area in Greece (Larissa) (Broumas et al. 1987) suggest that pear psylla completes 4-5 generations per year and during summer no generation is developed. The results obtained in this study, however, indicated clearly that pear psylla during summer continues to develop although population density is generally very low.

The conclusions derived from this study, together with other information, were used to develop a new control strategy (Stratopoulou and Kapatos 1992) that minimizes the number of treatments and utilizes ecological criteria. The results indicated clearly that during most of the infestation period the majority of the population is at the egg stage and therefore chemicals with ovicidal action are required, in combination with the existing larvicides, to increase the effective period of a particular treatment. Chemical control during winter (at the beginning of the oviposition period) against the overwintering adults is justified because of the great

potentiality for increase of the first generation. Also, chemical control against the second generation of immature stages (May) is justified because levels of population of this generation are usually, very high. On the contrary, during summer the levels of infestation of pear psylla are, usually, very low and specific treatments against this pest are not necessary. The maintenance of low levels of population of pear psylla could be achieved by applying selective insecticides against *Cydia pomonella* (L.) (Lepidoptera-Tortricidae), thus enhancing the action of natural enemies.

Acknowledgement

We wish to thank Mrs A. Sakellariou for help in examining the samples and Miss E. Zacharopoulou for typing the manuscript.

References

Atger, P. 1979. Les psylles du poirier. Biologie et controle en verger. Phytoma, 31: 19-22.

Bonnemaison, L. et J. Missonier 1956. Le psylle du poirier (*Psylla pyri* L.). Morphologie et Biologie. Methodes de lutte. Annls Epiphyt. 7: 263-331.

Broumas, T., C. Souliotis, E. Stavraki and D. Zdoucopoulos 1987. Bioecological observations of *Cacopsylla pyri* L. on pear trees in the area of Larissa. Proc. 2nd Nat. Ent. Cong. Athens, 1987.

Broumas, T., C. Souliotis, D. Zdoucopoulos and A. Tsourgiani 1989. Study of the dynamics of populations of pear-tree psylla and control experiments. Proc. 3rd Nat. Ent. Cong., Thessaloniki (Greece). 1989.

Burts, E.C. and J.F. Brunner 1981. Dispersion statistics and sequential plan for adult pear psylla. J. Econ. Entomol. 74: 291-294.

Hodkinson, I.D. 1984. The taxonomy, distribution and host plant range of the pear feeding psyllids (Homoptera: Psylloides). Bull. OILB/SROP, 7(5): 32-44.

Matias, C. 1984. Les psylles du poirier an Portugal-Dynamique des populations-Reorientation de la lutte. Bull. OILB/SROP 7(5): 21-23.

Nguyen, T.X. 1962. Cycle biologique d'un Psylle du poirier (*Psylla pyri* L.) (Homoptera: Psyllidae) dans le midi de la France. Bull. Soc. Histoire Nat. Toulouse, 97: 233-240.

Nguyen, T.X. 1972. Etudes de la diapause imaginale de *Psylla pyri* L. (Homoptera-Psyllidae). I Determinisme du polymorphisme saisonnier des adultes. Ann. Zool. Ecol. Anim. 4: 281-309.

Priore, R. 1991. Osservazioni biologiche sulla Psilla del pero (*Cacopsylla pyri* L.) in Campania (anni 1986-1988). Inf. Fitop. 3/1991: 57-61.

Stratopoulou, E.T. and E.T. Kapatos 1992. Development of a control strategy against pear psylla utilizing ecological criteria. Georgia-Ktinotrophia (5): 26-30.

Stratopoulou, E.T. and E.T. Kapatos (1992a). Distribution of Population of Immature Stages of Pear Psylla (*Cacopsylla pyri* L.) within the Tree and Development of Sampling Strategy. Entomologia Hellenica 10: 5-10.

KEY WORDS: Phenology of *Cacopsylla pyri*, Composition of population of *Cacopsylla pyri*, Population fluctuations of *Cacopsylla pyri*.

Φαινολογία του Πληθυσμού των Ατελών Σταδίων της Ψύλλας της Αχλαδιάς (*Cacopsylla pyri*) στην Περιοχή της Μαγνησίας

Ε.Θ. ΣΤΡΑΤΟΠΟΥΛΟΥ και Ε.Θ. ΚΑΠΑΤΟΣ

Εθνικό Ίδρυμα Αγροτικής Έρευνας
Ινστιτούτο Προστασίας Φυτών Βόλου

ΠΕΡΙΛΗΨΗ

Οι διακυμάνσεις και η σύνθεση του πληθυσμού της ψύλλας της αχλαδιάς *Cacopsylla pyri* (L.) μελετήθηκαν στην περιοχή της Μαγνησίας στη διάρκεια των ετών 1988-1991. Η φαινολογία του πληθυσμού των ατελών σταδίων της ψύλλας της αχλαδιάς στην περιοχή της Μαγνησίας ακολουθεί ένα βασικό πρότυπο, παρατηρούνται όμως διαφορές από χρόνο σε χρόνο. Η ψύλλα της αχλαδιάς στην περιοχή αυτή φαίνεται να έχει 5-6 γενιές το χρόνο. Η 1η γενιά αναπτύσσεται στο διάστημα Φλεβάρη-μέσα Απρίλη και είναι διακεκριμένη. Στο διάστημα μέσα Απρίλη-μέσα Αυγούστου παράγονται τρεις γενιές με βαθμό επικάλυψης που διαφέρει από χρόνο σε χρόνο, ενώ στο διάστημα

μέσα Αυγούστου-τέλη Νοεμβρίου παράγονται ακόμη 1-2 γενιές, δηλαδή ένα μέρος μόνο του πληθυσμού της 5ης γενιάς παράγει μια γενιά ακόμη. Η πυκνότητα του πληθυσμού είναι γενικά χαμηλή στη διάρκεια της 1ης γενιάς αλλά στο χρονικό διάστημα Μαΐου-Ιουνίου είναι συνήθως πολύ υψηλή. Το καλοκαίρι ο πληθυσμός πέφτει σε χαμηλά επίπεδα λόγω ισχυρής περιβαλλοντολογικής πίεσης αλλά ευνοϊκότερες συνθήκες το φθινόπωρο επιτρέπουν πάλι την άνοδό του.