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Examination of Female Proportion of Light Trapped Turnip Moth (*Scotia segetum* Schiff.)

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The change of the number of turnip moth (*Scotia segetum* Schiff.) females was examined at 65 different light trap stations between 1957 and 1990. There are two generations of the examined species in Hungary, but the individual number of the first generation is low year by year, so we processed only the data of the second generation.

Only those generations were examined that had more than 100 samples because of the statistical reliability. Thirty-three light trap stations were suitable for this examination. The joint number of yearly caught male and female individuals and also separately the samples of females were summarised for each observing station. The change of female individual number as a function of total individual number was determined from the coherent pairs of value. The connection can be described by linear function. The proportion of females is 38%. The relative frequency of females was also determined in the function of the individual number. The shown point-mass is similar to the damped vibration known at technical systems. It was established that the female proportion was higher than the average if the individual number is low, but it showed average value when the individual number was high. It can also be established that the female proportion is significantly high in some cases before gradation years.

Keywords: turnip moth, *Scotia segetum* Schiff., female proportion, light-trap.

Light-trap is the most widely used sampling device to collect nocturnal insects. The operation is based on the behaviour of insects that they fly to – natural or artificial - light. There is a light trap network in Hungary, having been operated for more than 40 years, collecting material mainly for the purpose of making plant protection prognosis. Specialists determine the number of caught adults and specify the number of males and females of most important insect pests. The degree of probable damage can be estimated from the number of caught adults. In order to increase reliability of the prognosis, it is very important to determine general regularities from the data collected during 40 years.

It is well known since decades that the males and females of different insect species are caught by light trap in different rates. Williams (1939) examined the sex distribution of caught adults for each species. From the 51 species of Noctuidae family, the females of two species were not flying to the light at all. Females of 27 families gave 1–20% of the total number of specimen, in case of 16 species this rate was 20–46%. In case of 3 species the number of males and females was the same, and there were only 3 species where more females were flying to the light than males. Nanu and König (1968) were examining the rate of males and females flying to the light in case of 13 Lepidoptera families. In some families 0.2–30% of females were caught by the trap. Usseglio-Polatera (1987) examined the proportion of males and females flying to the light in case of 23 Trichoptera species. The differences in sex ratio observed in light trap collections must be due to behavioural differences in the activity of sexes rather than by one sex being

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more attracted to the light than the other. Schurr (1971) trapped mainly male specimen of grape berry moth (*Eupoecilia ambiguella* Hbn.) with his white light (560–610 nm) trap. Járfás et al. (1974) examined the sex ratio of turnip moth (*Scotia segetum* Schiff.) by the help of using different light sources, too. The proportion of male specimen was fluctuating in-between 48–66% in case of all light sources. According to El-Abdullah et al. (1984) only 10% of adults caught by the light trap were males in case of the striped stem borer (*Chilo suppressalis* Walker). Sex proportion of tiger beetles, *Dicindela melancholica* F. and *Cicindela nilotica* Dej., varied at different trapping levels (Hanna, 1973).

Observations during several decades did not provide too much of benefit for the plant protection practice. Authors of most of studies were satisfied by stating the numbers of caught males and females and possibly their percentage proportion but they did not draw any conclusions. True, it would be a hopeless attempt to make use of data of a light trap working for short time. It is important that if sex proportion of population living in the environment changes towards females this could be shown by the light trap; growth of the rate of caught females can show the gradation. Accordingly the knowledge of regularity of changes in sex ratio can also be used for prognostic purposes in case of such species where males and females are flying to the light equally well.

Some researchers are giving statements considered generally valid. Novák (1974) publishes sexual index data relating to 96 light trapped moth species. He divided the examined species into 5 categories depending on the rate of caught females, and he considered his results – within limits – constant. According to Malicky (1974) the sex proportion of a species is constant (specific for that species) in case of using identical light sources at different observation sites during several years. The average proportion of females of dog's tooth moth (*Mamestra sausa* Schiff.) was 33% according to Szarukán (1975). There was only minimal difference between the first and second generations. Proportion of light-trapped females of the one-population European corn borer *(Ostrinia nubilalis)* was found 47.3% by Cordillot and Duelli in Switzerland (1989). According to these authors the sex ratio is a species-specific static value though there are yearly differences in the sex ratio. These are not statistical scattering data without biological value but valuable results connected with the change of population (Szeőke and Szarukán, 1982).

According to Mohainé and Herczig (1979) and Lesznyák et al. (1993) with increasing or decreasing of the insect quantity the percent rate of females is also increasing or decreasing. The latter authors established that the rate of females is influenced mainly by minimum values of temperature. According to results of some authors both males and females are attracted to light sources only in certain physiological condition. Terszkov and Kolomiec (1966) are informing that the females of satin moth (*Stilpnotia salicis* L.) can be trapped before egg-laying while the females of gypsy moth (*Lymanthria dispar* L.) after egg-laying. This last publication is interesting because there is no publication on light attraction in case of gypsy moth females of European and American populations – the females of known populations are unable to flight. Females of gypsy moth native in East-Asia – differently from those of European populations – are able to fly (Mészáros, verbal notification). The females of European corn borer (*Ostrinia nubilalis* Hbn.) could fly at any time to the light after the outbreak of the chrysalis (Showers et al., 1974). There are few publications in the literature on similar studies though these could provide important knowledge for the practice. Unfortunately we cannot expect significant new results in this field due to high volume of time and work required by these studies.

If the sex ratio of a species shows significantly changing values at different observation sites in different years, it is worth to examine the regularity of changes. Mainly the time changes are important from prognostic point of view because these could be in connection with the hypercyclical movement. Nowinsky and Kiss (1981) found countrywide increase of the rate of females of turnip moth (*Scotia segetum* Schiff.) before the gradations in years 1962 and 1968.

Material and Methods

Presumably the rate of females has an influence on the number of individuals in the following generation. We examined the change of the number of females of turnip moth (*Scotia segetum* Schiff.) caught at 65 different observation sites in-between 1957 and 1990. Turnip moth has two generations in Hungary but the number of individuals in the first generation is decreasing year by year so we did not take into consideration and only the data of second generation were processed.

From the remaining data collection, the data of generations with more than 99 individuals were handled separately at each observation site in each year according to the requirements of statistical reliability, nevertheless generations where the number of individuals was in-between 5 and 99 were also examined. The number of yearly-trapped males and females was summarised at each observation site. From the value pairs belonging together we determined the changes in the number of females in the function of the total number of individuals.

Results and Discussion

The connection can be expressed as a linear function in all cases, the correlation coefficients are significant on 95% confidence level. It can be ascertained that in generations with more than 99 individuals the rate of females is 0.38 *(Fig. 1)* from the total number of adults. The range of total individuals above 99 was divided into further categories: in-between 100 and 499 the rate of females was 0.46, in-between 500 and 999 it was 0.38 while in-between 100 and 999 it was 0.40.

At each observation site the proportion of female individuals and the correlated 95% confidence level intervals were calculated. These were represented in the function of the total number of individuals. Above 99 individuals the fluctuation and frequency is decreasing to the same extent as the total number of them is increasing and it keeps to the earlier calculated 0.38 value *(Fig. 2)*. This phenomenon is similar to the damped vibration known at technical systems. The distribution of proportions is asymmetric. The fluctuation of

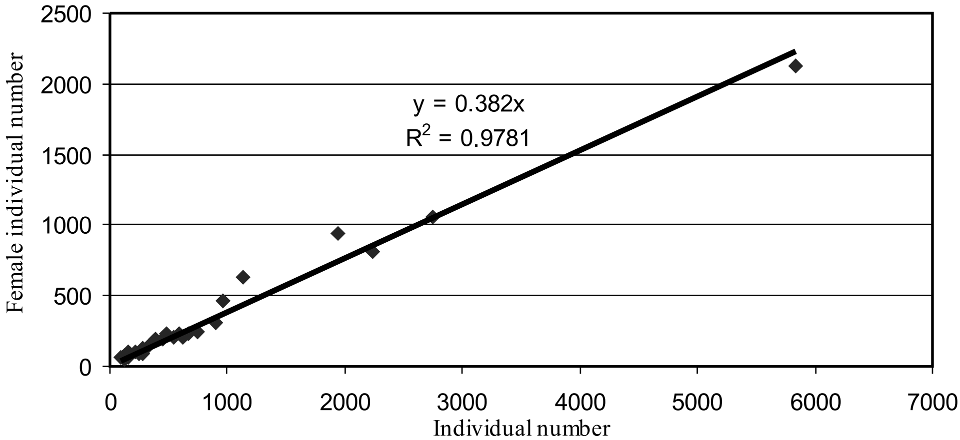

Fig. 1. Female individual number of turnip moth (*Scotia segetum* Schiff.), 2nd generation, for each observing station as a function of all individual number (33 observing stations, individual number > 99)

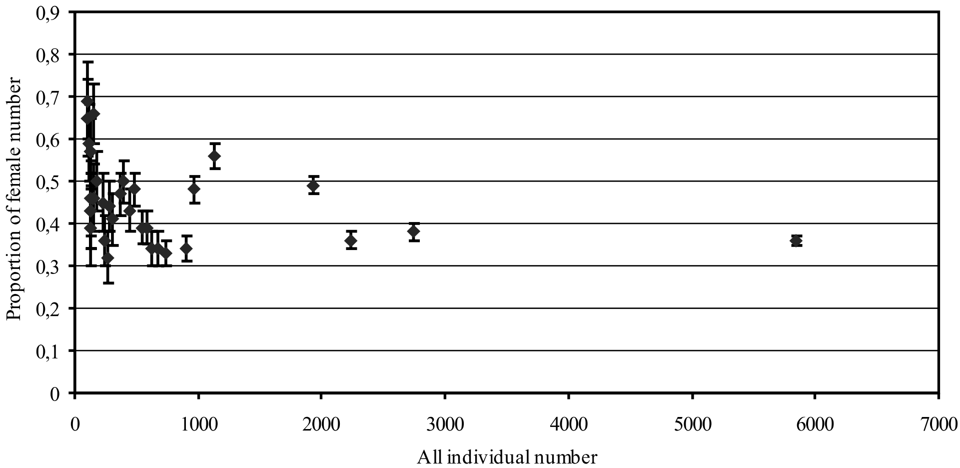

Fig. 2. Female individual number of turnip moth (*Scotia segetum* Schiff.), 2nd generation, for each observing station as a function of all individual number with 95% confidence intervals (33 observing stations, individual number > 99)

numbers of female individuals in case of 5–99 individuals in a generation is similar to the previous case, it keeps to the earlier calculated 0.44 value but the confidence intervals are bigger then the fluctuations. The distribution of proportions is asymmetric.

The average numbers of individuals were also calculated for each observation site. The changes of average numbers of female individuals were determined in the function of the average number of total individuals. The connection is linear here too, above 99 individuals in a generation the rate of females in comparison to the average number of total individuals: 0.40, in-between 5 and 99 is 0.47 *(Table 1).*

Table 1

Proportions of females of turnip moth (*Scotia segetum* Schiff.) at all observing stations and years

	Proportion of females									
	For each observing station								Years	
	IN >99			1000 > IN > 99	500 > IN > 99	1000 > IN > 499	100 > IN ≥ 5		20 years	1962
	F/T	Av. F/T	F/M	F/T	F/T	F/T	F/T	Av. F/T	F/T	F/T
OS	33	33	33	28	21	7	59	59	33	19
B	0.38	0.40	0.61	0.40	0.46	0.38	0.44	0.47	0.42	0.38
R^2	0.9781	0.9568	0.9431	0.9662	0.9779	0.9741	0.9331	0.9372	0.999	0.9767

Notes: IN = Individual numbers, F = Female numbers, T = Total numbers, Av. = average, M = Male numbers, OS = Observing stations, B = female proportion, R^2 = square of correlation coefficients.

The connection and changes of number of female individuals was determined at each observation site also in the function of total number of male individuals. The connection is linear, above 99 individuals in a generation the female – male proportion is 0.61 *(Fig. 3).* The distribution is the same way asymmetric as the proportion of female individual numbers.

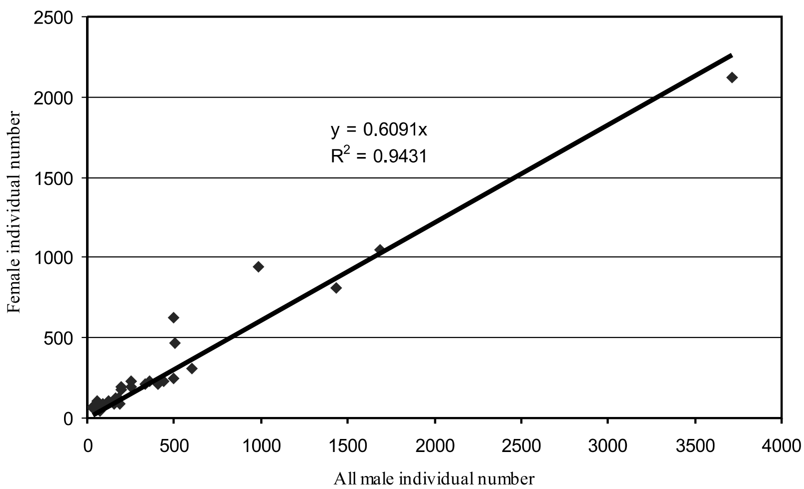

Fig. 3. Female individual number of turnip moth (*Scotia segetum* Schiff.), 2nd generation, for each observing station as a function of all male individual number (33 observing stations, individual number > 99)

According to observations the rate of females many time was extremely high in years preceding the gradations.

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