10.37045/aslh-2008-0005 *Acta Silv. Lign. Hung., Vol. 4 (2008) 49-54*

Pre- and Postfrontal Influences on Light Trapping of Winter Moth (*Operophtera brumata* L.)

János PUSKÁS [a*] – László NOWINSZKY [b]

[a] Department of Physical Geography, Berzsenyi Dániel College, Szombathely, Hungary
[b] Department of Technology, Berzsenyi Dániel College, Szombathely, Hungary

Abstract – Light trap catches of the winter moth (*Operophtera brumata L.*) getting from the data of national light-trap network were analysed in connection with weather fronts. It is concluded, that weather fronts modify the catches of light traps according to their specific characters (main types) and according to their successions. It is worthy of attention, however, that even in those cases in which the front reduces the number of insects caught, pre- and post-frontal influences often manifest themselves in an increase of the number of collected specimens. Because of the frequency of weather fronts it would be useful to take their effects into consideration on the quantity of insects captured at light-traps. It is necessary to improve the applied method for this purpose.

weather front / light-trap / insect

Kivonat – Pre- és posztfrontális hatások a kis téliaraszoló (*Operophtera brumata* L.) fénycsapdázására. A szerzők az országos fénycsapda hálózat anyagából megvizsgálták a kis téliaraszoló (*Operophtera brumata* L.) gyűjtési eredményeit. Megállapították, hogy az egyes időjárási frontok típusuknak (közelítő és tartózkodó hideg, meleg, okklúziós, egyidejűleg tartózkodó hideg, meleg és okklúziós) megfelelően és attól függően is mindig azonosan módosítják a fénycsapdázás eredményességét, hogy milyen típus után következnek. Figyelemre méltó, hogy a front hatására csökken a befogott lepkék száma, a pre- és posztfrontális hatások sok esetben a gyűjtött egyedek számának emelkedésében nyilvánulnak meg. Az időjárási frontok gyakorisága miatt célszerű lenne hatásukat a fénycsapdázott rovarok mennyiségi értékelése során figyelembe venni, ehhez azonban az alkalmazott módszer továbbfejlesztése szükséges.

időjárási front / fénycsapda / rovar

1 INTRODUCTION

There were a few studies to examine the activities of insects in relation to several types of weather fronts. This contrasts the intensive researches in medical meteorology. Only some publications can be found in the literature dealing with the relationship of weather fronts to light-trap catches of insects. It would be very important to study this problem, because the frontal passages cause sudden and significant changes in the physical environment of living creatures. The organisms of humans or animals reply with front sensitivity symptoms to

[*] Corresponding author: pjanos@gmail.com; 9700 SZOMBATHELY, Károlyi Gáspár tér 4.

simultaneous changes of all weather factors. The exact calculation of insect population densities is only possible, if the factors influencing their flying activity are known. We can use it for the purpose of plant protecting monitoring and forecasting. The flying activity can significantly change very often, when different weather fronts come, so the number of caught individuals represents the current mass of population in different rates of their real numbers.

The connection of weather fronts and light-trap catches of insects was studied by Wéber (1959) in Hungary. According to him research on the influences of front changes is difficult for many reasons (the fronts can come after each other in a few hours intervals, fronts can pass through a country without changing the air-masses, the intensity of the same types of fronts can be different). In the course of his examination he did not try to draw general regularities, but he elaborated a graphical method to characterise the modifying influence of weather fronts on light-trap catches based on the analysis of each concrete typical event. Járfás (1979) made studies on the influence of individual weather factors instead of weather fronts, because of the above-mentioned problems. Kádár and Szentkirályi (1982, 1992) made examinations on the flight activity of ground beetles (*Coleoptera: Carabidae*) using the data of monthly Calendar of Weather Phenomena issued by the National Meteorological Service. They found significant differences between the influences of cold and warm weather fronts. We examined the flying activity of harmful insects in relation to macrosynoptic weather situations - which have close connection with weather fronts - in one of our publications (Károssy et al., 1992). No fundamental publications have been found in foreign literature dealing with the connection of weather fronts and light trap catches.

The data - produced by the national light-trap network in Hungary, which is unprecedented even at world standards - are suitable to examine the influences of weather fronts with mathematical-statistical methods.

2 MATERIAL AND METHODS

Weather fronts can be typified according to more points of view. Berkes (1961) determined 21 types of fronts for the territory of Hungary and characterised them. However their validity is questionable in space, and they do not expand to the whole country (Csizsinszky, 1964). That is why we revaluated the situations of weather fronts in Hungary. We could get these information from the synoptic maps of "Daily Weather Reports" of Hungarian National Meteorological Service (Puskás, 2001).

The light trap data of winter moth (*Operophtera brumata* L.) were analysed from the database of the national light-trap network in Hungary. The food plants of these species widespread in whole Europe are well known. The winter moth attacks not only all the deciduous trees in forests, but also the fruit-trees. The most preferred food trees are oaks, hornbeam, beech, horse chestnut, lime and European hazel (Szontagh and Tóth, 1977). The moths fly at sunset and in the evening from early October till mid-December.

Catches were collected at 18 light trap stations between 1961-1976. Total number of daily catches was 3712 representing 46290 specimens from 837 nights. Daily catches mean the collecting result at one station at one night independently of the catch size.

The location of warm-, cold- and occluded fronts were determined for each day between 1st March and 30th November for the years 1961-1976 from Daily Weather Report issued by the Hungarian National Meteorological Service. We classified the fronts on the basis of their quality and location compared to the surface of Hungary (Puskás, 2001). The following front groups were used:

1.	on-coming cold front	OCF
2.	cold front	CF
3.	on-coming warm front	OWF
4.	warm front	WF
5.	on-coming occluded front	OOF
6.	occluded front	OF
7.	on-coming warm and cold fronts	OWCF
8.	warm and cold fronts	WCF
9.	simultaneous warm, cold and occluded fronts	WCOF
10.	without fronts	W

On-coming front means that the front comes close to the border or just enters to the territory of Hungary. The first 6 front types contain only one weather front, but in the last three ones there can be found two or three fronts. The cold and warm front types are well-known, therefore we should like to show the characteristics of the other weather front types. In the case of occlusion the quick cold front will pull up to warm front line, so the two different air masses can be completely combined. There is a previous situation in type 7 and 8, because the cold front does not reach the warm one, only later can form the occlusion. We can see a complete cyclone when type 9 develops and all the different three front types are simultaneously in the Carpathian Basin.

In the course of processing we examined separately all the 9 types of front situations for those days which followed a day with no front effect including those ones when the previous silent day was proceeded a day with a front effect. We could use these front types because the fronts can pass the whole territory of the Carpathian Basin in a few hours. That is why prefrontal and postfrontal effects can follow each other during the same night.

We calculated relative catch values (RC) from daily light-trap catches for all stations, so we could process the values of different localities and dates simultaneously together. Relative catch is the quotient of the number of individuals caught during the sampling interval (1 night), and the mean catch of one generation or flight counted for the sample interval. In this way, in the case of expected mean number of individuals, the value of relative catch is 1.

After this we summarised the values of relative catches coming from different observing stations for each night. We made an average from these values for all the types of fronts. We made a comparison between the values of relative catch belonging to the front types of each day and the average values of catches on the days before and following the front to demonstrate the possible increase or decrease of collection results caused by weather fronts. We examined the days before separately if there were no any front effect and also if there were any other type of front in the territory of Hungary. We made a comparison between values of relative catches belonging to each type of weather fronts and the catches on the previous and the following nights to show the influence of fronts. We separated those previous days when there were no any front effect and those ones when fronts were in the territory of our country. We examined the differences of catches belonging to the front types on those days, which came after frontless days. These differences were compared with the expectable values. Although we examined all the effects of types and changes of weather fronts, but we did not use the results, where we did not find significant differences in catching results. We controlled the significance level of differences with t-test after the analysis of variance.

4 RESULTS

The catching success of light-traps for winter moth (*Operophtera brumata L.*) depending on weather front changes is shown in *Table 1.*

Table 1. Light-trapping of winter moth (Operophthera brumata L.) in connection with weather fronts

Days before and after night of light trapping (0 day)													
– 2			– 1			0			+ 1			+ 2	
RC	N	P	RC	N	P	RC	N	P	RC	N	P	RC	N
			Without			OCF							
1.13	115		1.42	120	**	1.18	122		0.99	125	**	1.34	133
			CF			OCF							
1.24	33	*	2.06	31	**	0.78	34	*	1.44	33		0.99	33
			Without			CF							
1.08	141		1.14	180	**	1.36	178	**	1.07	176		0.87	174
			OCF			CF							
1.28	56	**	0.71	60		0.98	66	*	0.46	60	*	0.98	58
			WF			CF							
0.96	41		1.00	39	**	1.72	47	**	0.89	44		1.16	44
			OF			CF							
1.87	12		0.64	13	**	2.39	13	**	0.62	13	**	1.59	13
			Without			OWF							
0.71	63	**	1.44	64		1.57	74	*	1.25	67		1.51	64
			CF			OWF							
0.47	10	*	1.44	13	*	0.30	14	*	1.09	15		1.59	16
			WF			OWF							
0.77	33	**	0.35	33	**	1.53	33		1.22	32		1.02	28
			Without			WF							
0.72	199		0.66	194	*	0.88	228	**	1.29	193		1.08	185
			OWF			WF							
0.82	35		1.17	37	*	0.64	37	*	1.18	43		1.2	44
			OCF			WF							
0.45	13	*	1.71	12		1.31	24	*	2.66	18		1.69	18
			Without			OF							
1.22	75		1.04	76	**	0.41	78	**	1.17	79		1.00	77
			CWF			OF							
1.32	10		2.27	11	*	0.55	11	*	0.84	11		0.71	13
			Without			OWCF							
1.04	20	*	1.72	21		1.92	22		1.34	21	*	0.92	22
			Without			WCF							
1.00	21		1.19	19	**	0.54	22		0.69	20	**	1.03	20
			CF			WCF							
1.36	23		1.52	22	**	0.71	24	*	1.35	23		1.32	22
			Without			WCOF							
1.25	31		1.13	29	**	1.83	31		2.03	28	**	0.95	25

Notes: RC = relative catches, N = number of data
Significance levels: * = $P < 0.05$, ** = $P < 0.01$

5 DISCUSSION

The on-coming cold front (OCF) is unfavourable for the catches, if it comes after a cold front (CF) or a day without front effect. The catching increase on the following and second day after it. The on-coming warm front (OWF) is also unfavourable if it comes after cold front (CF). The warm front (WF) and specially the occluded front (OC) are unfavourable, but in both cases the number of caught specimens increases on the following days. The cold front (CF) is favourable for catching, if it comes after a warm front (WF), an occluded front (OF) or a day exempt from any front effect, but the numbers of specimens caught decreases on the following night. The catching is strikingly high on those nights, when simultaneous warm-, cold- and occluded front (WCOF) effects arrive at the Carpathian Basin. The favourable effect is noticed also at the following night at that case. The number of moths caught increased, when there was a cold front (CF) or a day without front before the on-coming warm front (OWF). In this last case the catching is already high at the night before. The on-coming cold- and warm fronts (OCWF) cause also a strong rise in the number of specimens caught.

Practical utilisation of our results seem to be difficult at this moment, because the effect of front types can not unified as favourable or as unfavourable for the success of light trapping, but they are variable according to the front type on the day before. Our examinations did not justify the Wéber's (1959) observation, which experienced prefrontal effects in connection with warm fronts and postfrontal effects in connection with cold fronts. As we think the cold front hardly can mean favourable weather situation for moths. We can explain the observed high flight activity with an idea written in one of our earlier publications (Nowinszky, 1994) the developing of flying activity in cold front (CF) effects. According to our hypothesis the low values of relative catches always refer to those weather situations, when the flying activity of insects is reduced. We can not explain the high values so unanimously. The important environmental changes cause physiological changes in the body of insects. The life of adult is short that is why the unfavourable weather endangers not only the survival of the individual moth, but also the survival of the whole species. In our opinion the moths can use two strategies to prevent these effects, which hinder their normal life functions. One is an increased activity, which is expressed in the rising intensity of the flying, copulation and egg-laying. The other the opposite and the insects try to hide and to tide over the unfavourable weather situations in an inactive mode. So as we see the high catching values equally can belong to favourable and unfavourable weather situations. In those cases, where we did not known the catching results belonging to the front changing in the Table 1, we did not experience significant differences in the number of caught moths. The reason of this can be data belonging to specific front changes, and partly by the fact that some of front changes do not cause significant differences in the flying activity of moths. On the basis of the present results we can demonstrate that weather fronts and especially some types of them modify the success of light trapping. It is worthy of attention, however, that even in those cases in which the front reduces the number of insects caught, pre- and post-frontal influences often manifest themselves in an increase of the number of collected specimens. If we could explore the effects of weather fronts on the flight activity of each species we would be able to work out more exact plant protecting prognoses. For this reason we feel it very necessary to continue our research.

REFERENCES

BERKES, Z. (1961): [Types of air-masses and fronts in the Carpathian Basin] (in Hungarian). Időjárás. 5: 289-293.

CSIZSINSZKY, M. (1964): [Validity of Budapest front calendar in the territory of Hungary] (in Hungarian). National Meteorological Report about the scientific research in 1963. 2: 95-98.

JÁRFÁS, J. (1979): Forecast of harmful moth species with light-trap (in Hungarian). PhD Dissertation, Kecskemét. 127.

KÁDÁR, F. - SZENTKIRÁLYI, F. (1983): Analyse der Lichtfallenfänge der Laufkäfer (Col., Carabidae) in verschiedenen Apfelanlagen und Maisbeständen. Verh. SIEEC, 10: 150-154.

KÁDÁR, F. - SZENTKIRÁLYI, F. (1992): Influences of Weather Fronts on the Flight Activity of Ground Beetles (Coleoptera, Carabidae). Proceedings of the 4th ECE/XIII. SIEEC, Gödöllő 199: 500-503.

KÁROSSY, CS. - NOWINSZKY, L. - TÓTH, GY. - PUSKÁS, J. (1992): Flying activity of the agricultural harmful insects and the connection of macrosynoptic weather types. Boletin de la Sociedad de Lima. 105: 57-58.

NOWINSZKY, L. [ed.], (1994): Light-trapping of insects influenced by abiotic factors. Part I. Savaria University Press. 155.

PUSKÁS, J. (2001): New weather front types and catalogue for the Carpathian Basin. In. No-winszky L. [ed.]: Light trapping of insects influenced by abiotic factors. Part III. Savaria University Press, Szombathely. 87-118.

SZONTAGH, P. - TÓTH, J. (1977): Forest protecting guide (in Hungarian). Mezőgazdasági Kiadó. 211.

WÉBER, M. (1959): Influence of meteorological front changes on insects attracted by light (in Hungarian). Yearbook of Teachers' Training College Pécs. 259-275.