



## Influence of Daily Temperature Ranges on the Light Trapped Number of Macrolepidoptera Individuals and Species

Nowinszky L.\*, and Puskás J.

*University of West Hungary, H-9700-Szombathely, Károlyi Gáspár Square 4, Hungary, Europe.*

**Abstract:** The Hungarian Forest Research Institute operated a Jermy-type light-trap in the Kámon Botanic Garden, Szombathely (47°15'20"N; 16°36'25"E) between 1962 and 1970.

As the insects are poikilotherm creatures, therefore it is understandable; their body temperature is always the same as the temperature of the environment. It can be assumed, therefore, the temperature ranges, can influence the flight activity of nocturnal Macrolepidoptera individuals and species, so we made this investigation. Different species are swarming in various aspects and the temperature is also different.

Therefore, we processed separately the captured data of species and individuals in spring-, early- and late summer-, and autumn aspects, in connection with daily minimum temperature. The results were plotted and the correlations and their level of significance were determined.

Our results demonstrate that all aspects on low temperature minima both the number of caught species and individuals are low. In contrast, a higher minimum value of specimens was taken and the rising number of those species is caught. The relationship is linear or exponential function characterized.

**Keywords:** Macrolepidoptera, light-trap, temperature ranges.

### 1. Introduction

The temperature has an effect on the insects' organization, and it is based on the van't Hoff rule, which states that there is a correlation between the temperature and reaction rate. The lives of process control biochemical reactions take place faster (Weber, 1960) on higher temperature. The insect body movement activity also depends on the ambient temperature, so it is understandable that the mass flight of the light species optimum temperature occurs (Manninger, 1947).

The given temperature requirements of insects can be explained by the fact that their body mass is very small compared to both its surface and the environment. That is why their body temperature, instead of being permanent and self-sufficient, follows the changing temperature of the environment. This is because the ratios of the body mass and surface of insects determine the difference between the inner heat content and the incoming or outgoing heat. The heat content of the

body is proportionate to its mass, while, on the other hand, the heat energy intake or loss is proportionate to the size of the surface of the body. Therefore, an external effect makes its influence felt as against the inner, small heat content of a relatively small mass. The speed, as well as the size of the impact, follows from the ratio between the mass and surface of the body of the insects (Bacsó, 1964).

And so the temperature value always exerts a substantial influence on the life processes of insects. The chemical processes described as metabolism that determine the life functions of insects always follow the temperature changes in the direct surroundings. Naturally, the activity of the organs of locomotion also depends on the temperature of the environment, which explains why we can expect a massive light-trap turnout by what is an optimal temperature for the given species (Manninger, 1948).

The temperature is constantly changing significantly and accordingly during the day and it may cause changes relatively quickly in the phenomena of insect

\*Corresponding author:

E-mail: lnowinszky@gmail.com; pjanos@gmail.com.

life as well. Presumably, therefore, that not only the current temperature exerts influence for their vital functions, but the temperature changes as well. The daily temperature ranges- the 24-hour period noted between the highest and lowest temperature difference – are in the temperate zone more important than in the tropics, this can lead to living in insects daily activity is strongly dependent on the daily temperature range than in the tropics living species. There are only a few studies in home and international literature, which are in connection with the temperature oscillation and the phenomena of insect life.

Ferenczy *et al.*, (2010) found it surprising that a highly important factor in the average daily temperature range has proved. This fact was so unexpected because it is used as phenology models are generally more similar to the amount of heat temperature, or average kind of parameters are taken good results.

## 2. Material and Methods

The collected data used in this investigation were supplied by material from the Szombathely (Hungary; 47°15'20"N; 16°36'25"E) forestry light-trap that belonging to the national network uniformly equipped with Jerm-type traps worked in the Kámon Botanical Gardens between 1962 and 1970.

We used the whole Macrolepidoptera data for investigation the number of species and individuals in connection with a daily temperature range. There were caught altogether the specimen of 549 different Macrolepidoptera species by light-trap during 9 years. The yearly catching period of light-trap, the number of

caught species and swarming are shown in Table 1 and Table 2.

The caught individuals and species were investigated with combined data for 9 years. They were examined separately according to each aspect: spring, early- and late summer, autumn (Nowinszky and Puskás, 2011).

We ignored the specimen numbers of the various species, examining only the question of whether the daily catch confirms the presence of the species. The different generations of multi generation species were studied separately. However, all clearly recognizable vagile or migrant individuals turning up in between the swarming periods of two generations were regarded as separate generations. And in cases when it was not possible to draw a clear line of distinction between the two generations, we followed the procedure applied with one generation species.

There was a problem in investigation of temperature effect that the light-trap data supplied only one night. Therefore, we worked with the daily temperature ranges.

We calculated groups with consideration to the method of Sturges (Odor and Iglói, 1987) from the number of daily temperatures ranges and the number of the individuals and species. The number of individuals and species were arranged into the proper classes.

The results obtained are plotted. We determined the regression equations, these levels of significance, which was shown in the figures.

## 3. Results and Discussion

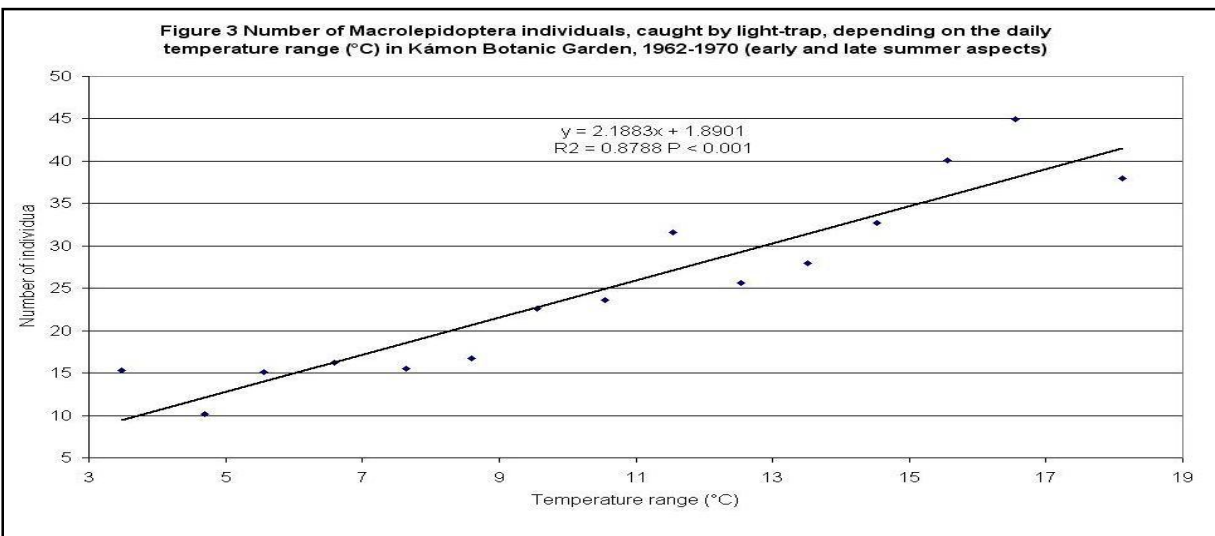
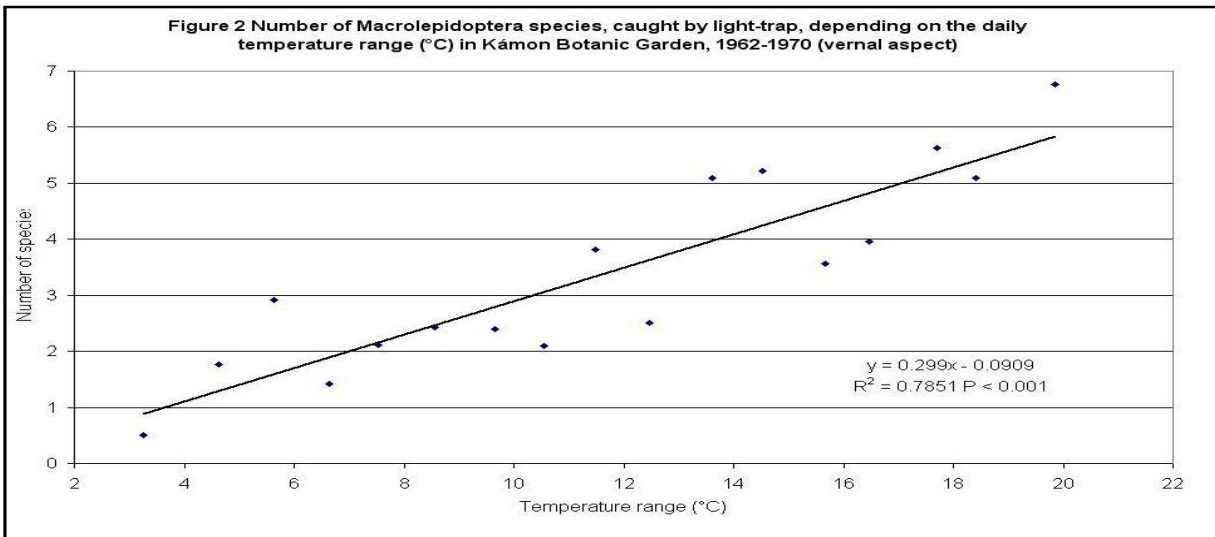
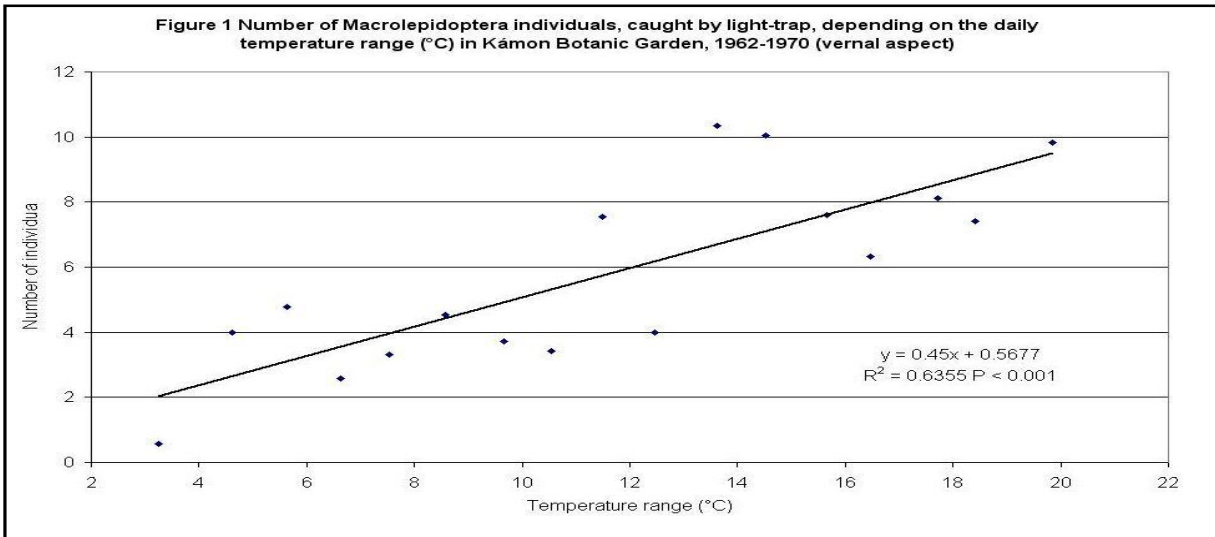
Our results are shown in Fig. 1-6.

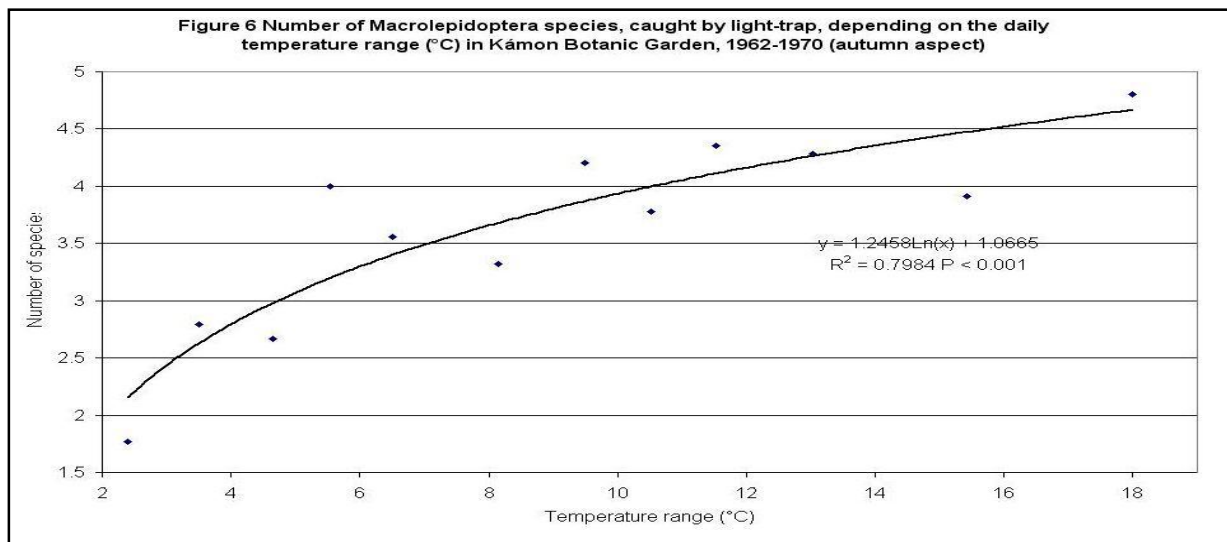
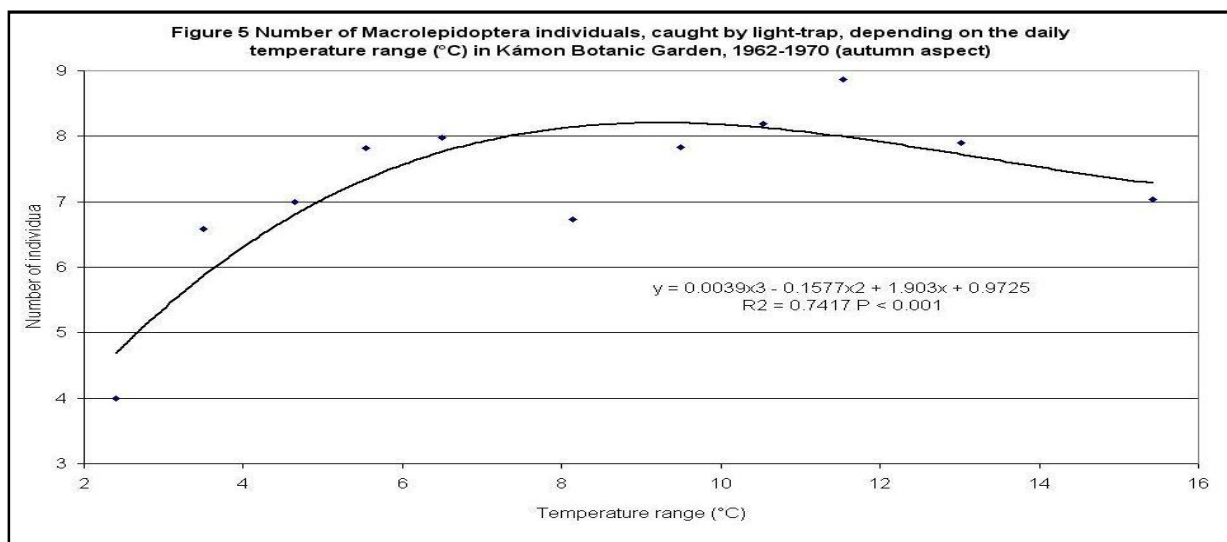
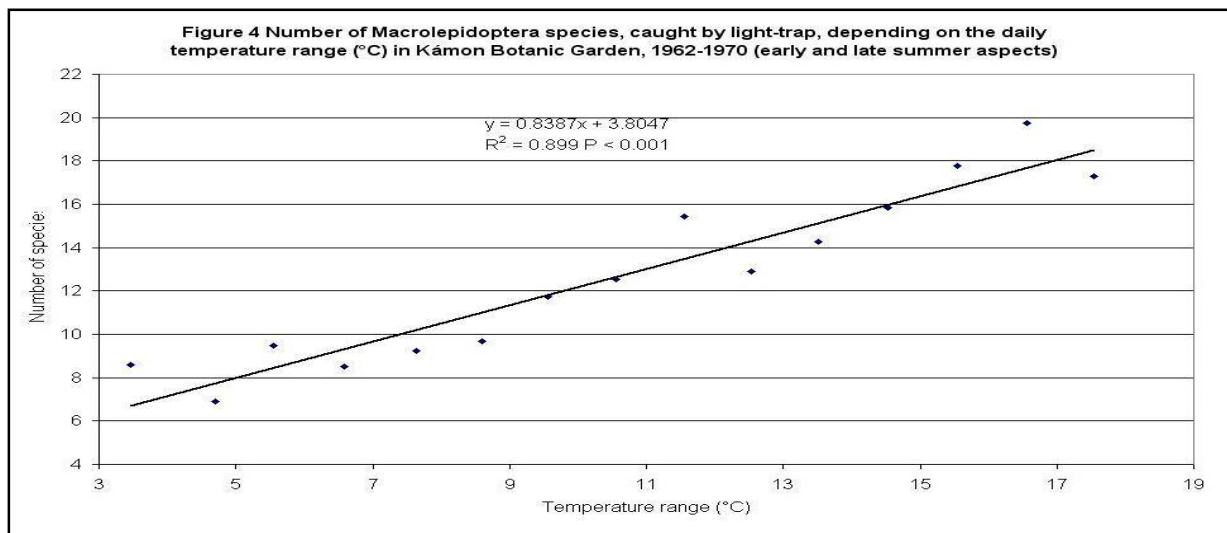
**Table 1. Light-trap catching periods in the Kámon Botanic Garden (Szombathely) as well as the number of caught species and swarming.**

Catching periods	Number of species	Number of swarming
06.03.1962 – 21.11.1962	343	435
08.03.1963 – 03.12.1963	349	472
23.03.1964 – 19.12.1964	354	463
14.03.1965 – 21.12.1965	205	242
02.02.1966 – 02.12.1966	153	191
03.02.1967 – 19.11.1967	261	312
20.02.1968 – 26.11.1968	296	418
13.03.1969 – 27.11.1969	316	427
03.02.1971 – 30.11.1970	323	437

**Table 2. The beginning and end of aspects.**

Spring		Early- and late summer		Autumn	
Beginning	End	Beginning	End	Beginning	End
28.03.1962	30.04.1962	01.05.1962	31.08.1962	01.09.1962	11.10.1962
20.03.1963	30.04.1963	01.05.1963	31.08.1963	01.09.1963	06.10.1963
24.03.1964	30.04.1964	01.05.1964	31.08.1964	01.09.1964	03.11.1964
20.03.1965	30.04.1965	01.05.1965	31.08.1965	01.09.1965	30.09.1965
01.04.1966	30.04.1966	01.05.1966	31.08.1966	01.09.1966	16.09.1966
08.04.1967	30.04.1967	01.05.1967	31.08.1967	01.09.1967	12.10.1967
13.03.1968	30.04.1968	01.05.1968	31.08.1968	01.09.1968	20.10.1968
28.03.1969	30.04.1969	01.05.1969	31.08.1969	01.09.1969	17.10.1969
13.03.1970	13.04.1970	01.05.1970	31.08.1970	01.09.1970	05.11.1970





Our results demonstrate that low temperature minima depress both the number of species and individuals in all aspects. In contrast, higher than the

minimum value can rise in number of caught species and individuals. The relationship can be characterized with linear or exponential function.

The relationship is characterized in the vernal and summer aspects with linear function, in the autumn with logarithmic and polynomial ones.

Similar results have been identified in examined Microlepidoptera species pheromone trap data collection (Nowinszky *et al.*, 2012).

It needs to be explained that when the daily temperature range is small, why the moderate activity is low, indicated by the low catch? Otherwise, when the daily temperature range is high, why increase the number of captured moths, although some species have reduced the catch of the highest temperature range values? We hypothesize that this phenomenon may be due to those days when the daily temperature range is large; the temperature is relatively rapidly and significantly rises and the insect's body temperature also is higher. The significant increase in body temperature and locomotor activity also increases, which can result the increase in the catch. The daily temperature range is lower to a lesser extent the increase in body temperature of insects, such as locomotor activity to a lesser extent increases. However, further studies probably confirm our hypothesis (Nowinszky *et al.*, 2012).

## References

- [1]. Bacsó, N. (1964). Agrometeorological bases of plant protection (in Hungarian). Gödöllő: Agrártudományi Egyetem, Gödöllő, University Lecture Notes 107 pp.
- [2]. Ferenczy, A., Eppich, B., Varga, R.D., Bíró, I., Kovács, A., Petrányi, G., Hirka, A., Szabóki, Cs., Isépy, I., Priszter, Sz, Türei, D., Gimesi, L., Garamvölgyi, Á., Homoródi, R., Hufnagel, L. (2010). Comparative analysis of the relationship between phenological phenomena and meteorological indicators based on insect and plant monitoring (in Hungarian). *Applied Ecology and Environmental Research*, 8(4): 367–376.
- [3]. Manninger, G.A. (1947). The role of the temperature on the insects' life (in Hungarian). *Időjárás*, 51. 23(4-6): 75–78.
- [4]. Manninger, G.A. (1948). Connection between the climate, weather and the harmful animals (in Hungarian). In: Réthly, A., – Aujeszky, L. 1948: Agrometeorology, Quick. 424 p.
- [5]. Nowinszky, L., Puskás, J. (2011). Efficiency of light-traps in relation the number of caught species. *International Journal of Science and Nature*, 2(2): 161–167.
- [6]. Nowinszky, L., Puskás, J., Barczikai, G. (2012). Influence of daily temperature ranges on the pheromone trap catch of harmful Microlepidoptera species. *Journal of Advanced Laboratory Research in Biology*, 3(4):241–245.
- [7]. Odor, P., Iglói, L. (1987). An introduction to the sport's biometry (in Hungarian). ÁISH Tudományos Tanácsának Kiadása. Budapest. 267.
- [8]. Wéber, M. (1960). Biometeorological problems among insects (in Hungarian). *Pécsi Pedagógiai Főiskola Évkönyve*, 278–289.