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ORIGINAL ARTICLE

Influence of Tropopause Characteristics on the Light-Trap Catches of Microlepidoptera Spec. Indet

Puskás J., Nowinszky L. and Kiss M.
Eötvös Loránd University, Savaria Campus Savaria Science Centre
9700 Szombathely, Károlyi Gáspár Square 4, Hungary
Email: pjanos@gmail.com, lnowinszky@gmail.com

ABSTRACT

The present study deals with the light-trap catch of Microlepidoptera spec. indet regards the characteristics of the tropopause, such as height of tropopause, air pressure, wind velocity at the level of tropopause. In addition, the height of wind maximum, wind velocity and air pressure measured at the level of wind maximum were examined.Data on the tropopause characteristics were taken from the Annals of the Central Meteorological Institute of the Hungarian Meteorological Service.Data on Microlepidoptera spec. indet was collected from the material of the national light-trap network from the years between 1962-1969. Categories were created from the characteristics of tropopause data. We calculated relative catch values of the number of moth individuals caught in every swarming. The relative catch was paired to the values of tropopause characteristics every day. We correlated the daily catch results pertaining to the daily values of tropopause characteristics. Then these values were summarized, averaged and depicted in the figures. We found a close connection between all the tropopause characteristics and light-trap catch of Microlepidoptera spec. indet.

***Key words**: light-trap, moths, tropopause*

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INTRODUCTION

The tropopause is the interface separating the lower layers of the atmosphere (troposphere) from the upper layers (stratosphere). It is of varying height.The fluctuations in tropopause height involve weather elements, namely, air temperature, relative humidity, wind speed, precipitation and air pressure. When the arctic air masses are present, the height of the tropopause may be only five Km and the air is very cold. On the other hand, when warm subtropical air masses are present, the height of tropopause is over 13 Km. The subtropical air masses have a very intense biological effect (Péczely, 1979). According to Bacsó- 1964, electric factors in the atmosphere also have an important role to play, mainly when a stream of subtropical air arrives at a great height. This decreases the 3Hz atmospheric impulse number while increasing the cosmic radiation of Sun. The prevailing negative ions in polar air diminish insect activity while the preponderance of positive ions in subtropical warm maritime air enhances the flight activity of insects (Örményi, 1967). Since changes in tropopause height cause changes in the weather in large areas of the lower layers of air, we investigated the influences of characteristics on tropopause on light trapping. The tropopause may cause changes in the efficiency of the light-trapping of insects. Manninger, 1948 stated that insect activity is increased by warm and decreased by cold air.Recently, we have found a connection between the height of the tropopause and light-trap catches of *Agrotis exclamationis* (Nowinszky, *et al.,* 2017), *Melolontha*

melolontha L. and *Hyphantria cunea* Drury (Puskás and Nowinszky, 2011). We have also studied the light-trap catches of *Ostrinia nubilalis* Hbn. and *Xestia c-nigrum* L. (Nowinszky and Puskás, 2013) and Trichoptera species (Nowinszky, *et al.,* 2015) in relation to the height of the tropopause. In our most recent studies (Nowinszky, *et al.,* 2017; Puskás, *et al.,* 2014; Puskás, *et al.,* 2018) we have extended our investigations to the connection between light-trapping of other insects and the height of tropopause, such as Coleoptera and Lepidoptera species.We have found that subtropical warm air masses at high altitudes influence the light-trapping of insects but this influence is not equal. The light-trap catches of Coleoptera (*Melolontha melolontha* L.), Lepidoptera (*Agrotis segetum* Den. et Schiff.), *Agrotis exclamationis* L., *Ostrinia nubilalis* Hbn. and Trichoptera (*Goera pilosa* Fabr.) are efficient in residence time of subtropical air masses but in the residence time of Saharan air masses, they are low. The catching result of Lepidoptera (*Hyphantria cunea* Drury, *Loxostege sticticalis* L., *Nomophila noctuella* Den. et Schiff., *Helicoverpa armigera* Hbn.) and Trichoptera (*Limnephilus affinis* Curtis) is exactly the opposite. We have not found studies dealing with this topic in the literature apart from our own works. In the recent study, the light-trap catches of Microlepidoptera spec. indet in relation to the height of tropopause (meters), air pressure (hPa), temperature (C°), wind velocity (m/sec) at level of tropopause were examined. We also examined the influence of the height of wind maximum (meters), wind velocity (m/sec) and air pressure (hPa) measured at the level of wind maximum.

MATERIALS AND METHODS

The daily data on tropopause characteristics were taken from the Annals of the Central Meteorological Institute of the Hungarian Meteorological Service.

The collecting data of Microlepidoptera spec. indet were taken from the light-trap registers of the Hungarian Light-trap Network, which contains Jermy-type traps equipped with 100 w normal bulbs. In the years 1962, 1963, 1964, 1966, 1967, 1968 and 1969, 590,139 moths were caught using 49 light-traps. All light-traps did not work full years. Some of them were ceased and were put to another village. The moths were caught during 1,479 nights. The observation data means one-night catch of a trap. Because more traps operated per night, the number of observation data was more than the number of nights. So we use 21,761 observation data. The undeterminable moth specimens were recorded as “Microlepidoptera spec. indet.” They could not be identified because they were injured. The number of specimen of a given species in variant years and catching locale is not the same. Therefore, we computed relative catch (RC) values. This is for a given sampling time unit (one night) and the average number individuals per unit time of sampling, the number of generations divided by the influence of individuals. Using relative catch values might solve this problem (Nowinszky, 2003): Relative catch (RC) is the quotient of the number of individuals caught in a given sampling unit (1 hour or 1 night) and the mean values of the number of individuals of the generation counted for the time unit of sampling. If the number of specimens caught corresponds to the average, the relative catch value will be 1. The relative catch data of Microlepidoptera spec. indet were classified into groups in conformity with the characteristics of tropopause, and afterwards the values were summarized and averaged. Relative catch values were placed according to the features of the given day, then were summed up, averaged and depicted. Figures 1-6 also show the confidence intervals

RESULTS AND DISCUSSION

Our results can be seen in Figures 1-6. When Fig. 1 shows the maximum of trapping, there was probably a subtropical air mass in the Carpathian Basin, because the average value of the height of tropopause in the middle latitude is between 10000 and 12000 m. Here the highest values are between 12.0 and 13.5 Km of tropopause. If the air pressure is at level maximum of tropopause (Fig. 2), the height of tropopause is between 12 and 13 Km. The

trapping decreased significantly with the lower values of the air pressure. The highest value of the air temperature at the level of the tropopause is about -56°C. This is about the average level in the middle latitude (Fig. 3). The wind speed at the level of the tropopause is 19 m/sec (i.e. about 65 km/h), which gives the most useful condition for the insects (Fig. 4). The height of the wind maximum falls to the average height of the tropopause (between 9800 and 10900 m). Below and above the average height, the average relative catch value can be observed (Fig. 5). The maximum air pressure is between 9000 and 10000 m. This is considered to be an average tropopause height. For a value close to 350 hPa, the height of the tropopause is approx. between 6000 and 7000 m. At this point, a very cold, arctic air mass may cause the low value of the relative catch (Fig. 6). The relationship between the height and other characteristics of the tropopause and the weather of ground level air are not fully known. These relationships and the changes in phenomena of insect's life need to be studied in the future.

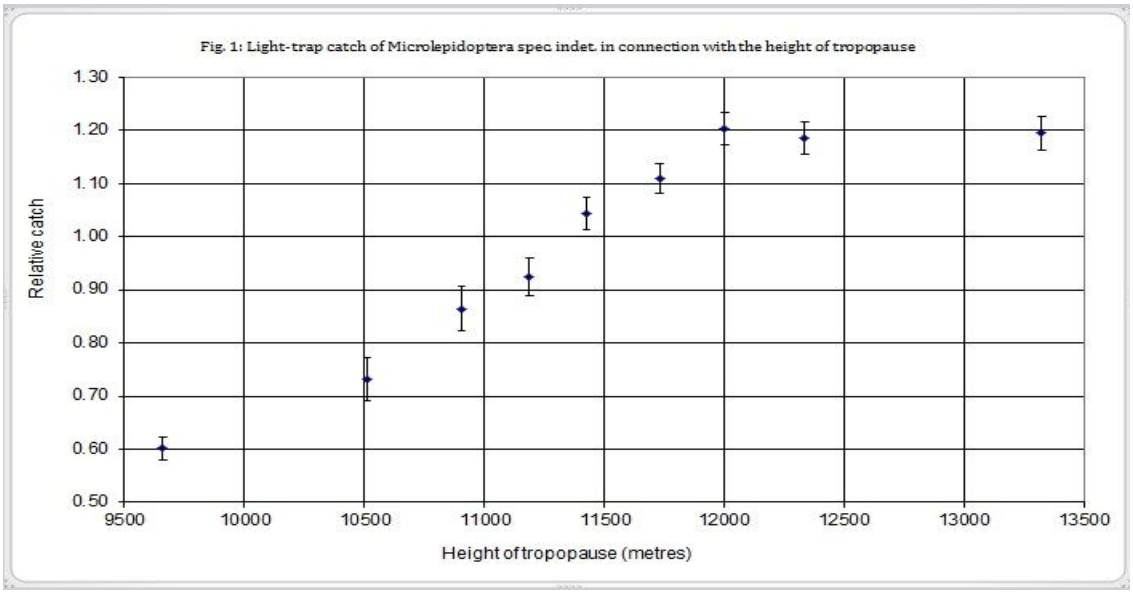

Fig. 1: Light-trap catch of Microlepidoptera spec. indet in connection with the height of tropopause

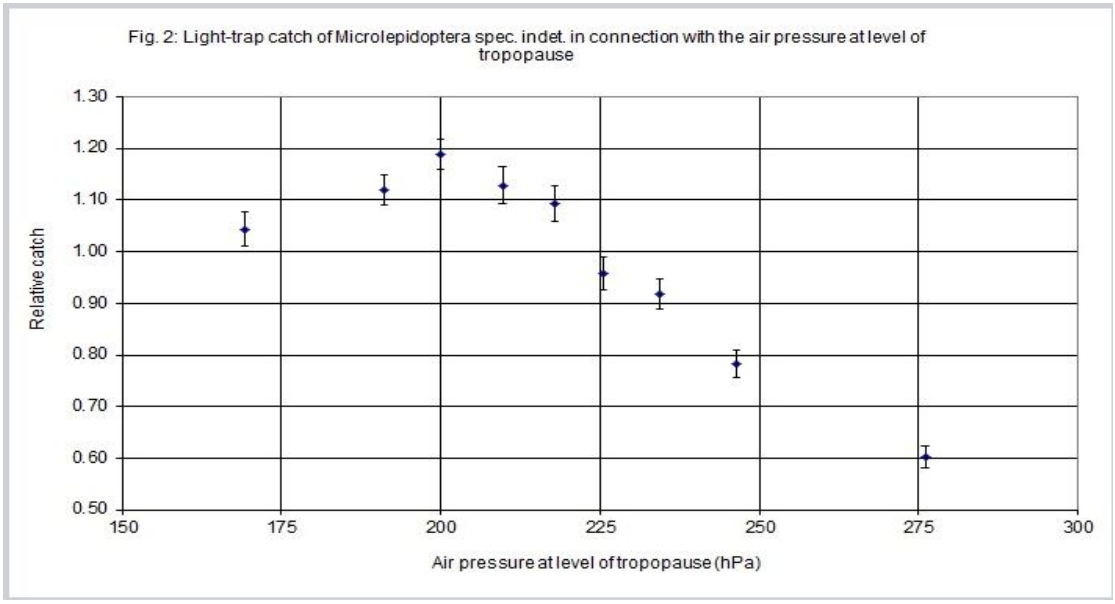

Fig. 2: Light-trap catch of Microlepidoptera spec. indet. in connection with the air pressure at level of tropopause

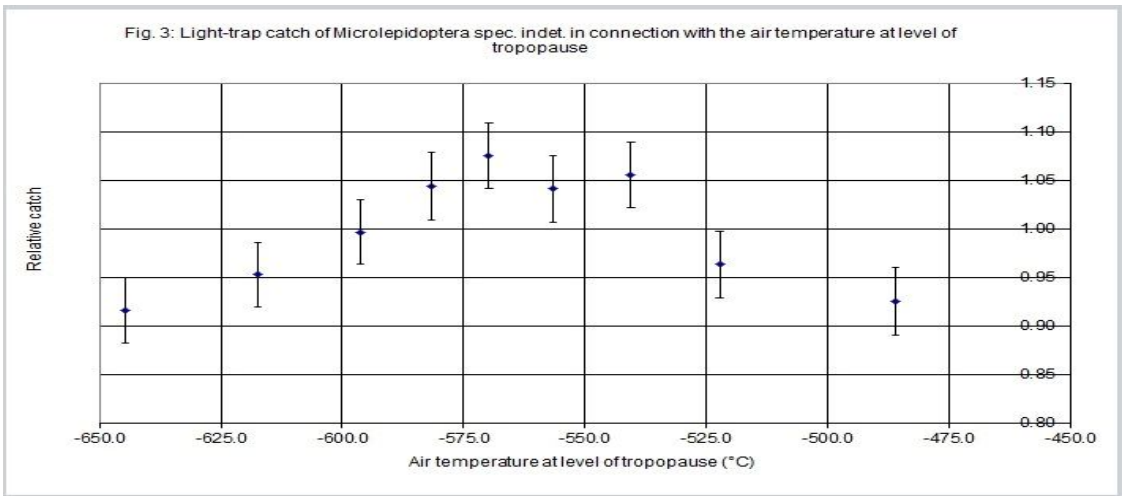

Fig. 3: Light-trap catch of Microlepidoptera spec. indet in connection with the air temperature at level of tropopause

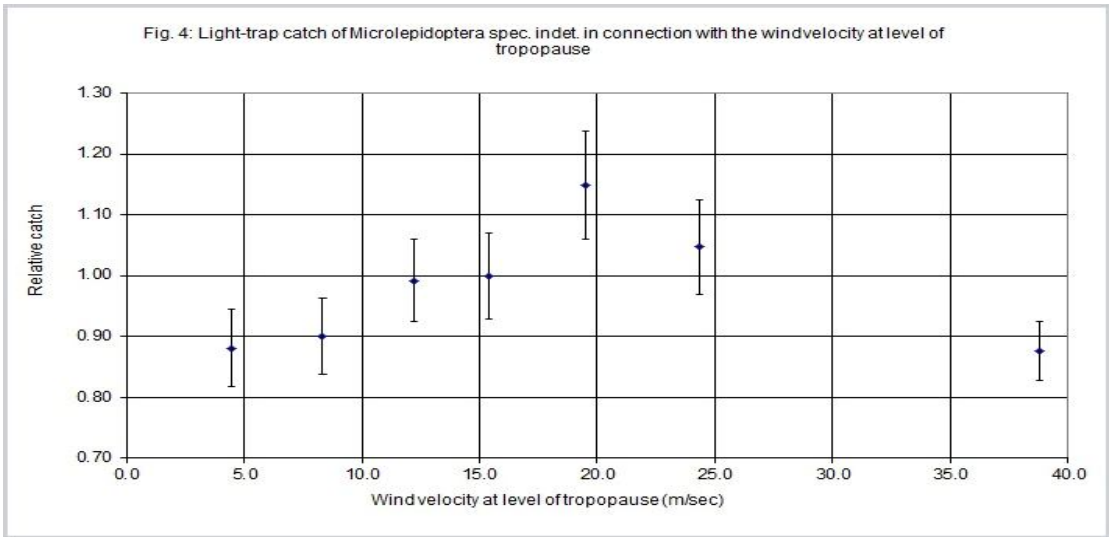

Fig. 4: Light-trap catch of Microlepidoptera spec. indet in connection with the wind velocity at level of tropopause

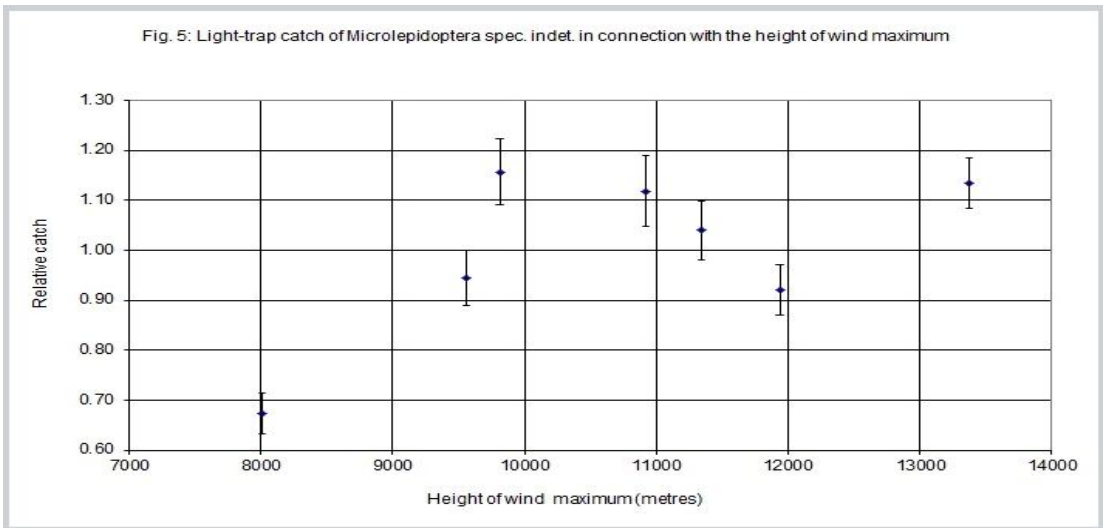

Fig. 5: Light-trap catch of Microlepidoptera spec. indet in connection with the height of wind maximum

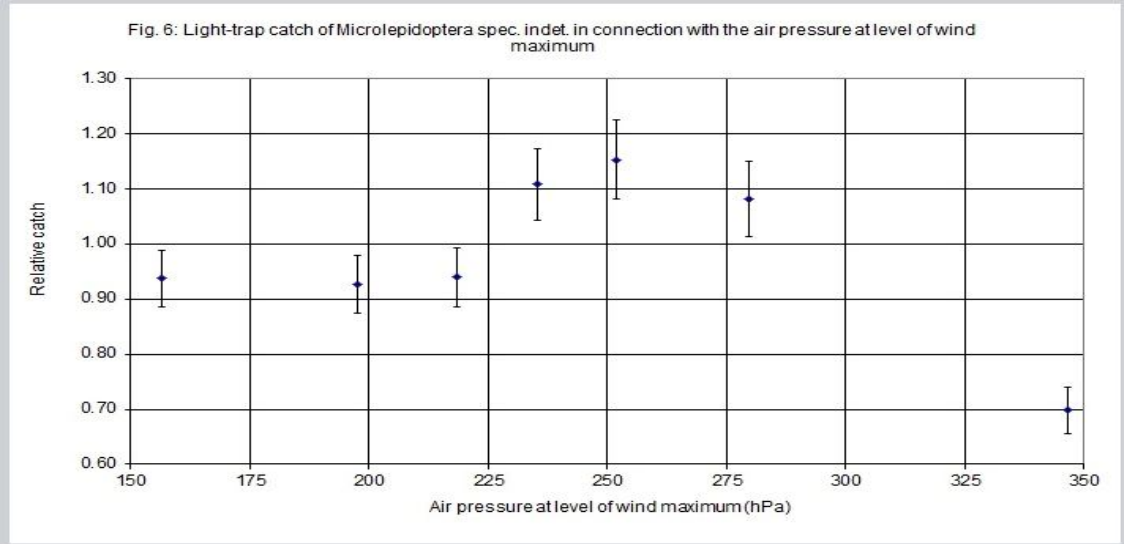

Fig. 6: Light-trap catch of Microlepidoptera spec. indet in connection with the air pressure at level of wind maximum

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