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ORIGINAL ARTICLE

Light-Trap Catch of the Fluvial Trichoptera Species in Connection With the Air- and Water Temperature

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ABSTRACT

This study deals with the effectiveness of light trapping of caddisflies (Trichoptera) species in connection with the air- and water temperature. Our Jermy-type light-trap operated in riverside of River Tisza at Szolnok between 1st April and 31st October 2000 every night. We processed catching data of ten species were caught in large quantities. We arranged the data on both the averaged daily air temperature and water temperature in classes. The data are plotted for each species and regression equations were calculated for relative catch of examined species and temperature data pairs. Our results show that both the water and the air temperature modify significantly the flying onto light of the studied caddisfly species. The increase of temperature initially increases the number of caught species; there is only one number of the individuals where we found a decrease.

Key words: *light-trap, caddisflies, water- and air temperature*

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INTRODUCTION AND LITERATURE BACKGROUND

Temperature may have an important role from the point of view of flying activity. The given temperature requirements of insects can be explained by the fact that their body mass is very small com-pared 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 in take 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 and size of the effect depends on the mass and surface if the body of insects (Bacsó, 1964).

This statement is of course valid for the air temperature, water temperature, and the ground temperature.

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).

Air Temperature-

Kimura et al. (2008) found a significant correlation between the daily individual number of caddisflies and the average daily temperature. There was not caught any caddisflies when the daily average temperature was less, than 10.7 °C.

Higler et al. (2008) found that the flight activity of *Ceraclea dissimilis* Stephens already started at higher temperature of 16 °C, and it seems that there was a positive correlation, because of the very large number of flying, when the maximum temperature was over 20 °C. But it was not high catch during all warm evenings. The minimum temperature of catches generally was between 15 and 20 °C at those nights, and the catches follow the trends with the maximum temperatures.

According to Brakel et al. (2015) caddisfly flight periodicity is likely controlled by a combination of innate behaviour and environmental factors, primarily temperature. That is, species will be active for a predetermined period of time if temperature is appropriate.

Water Temperature-

The brook sections' water temperature follows the changes of the air temperature (Kiss, 2012). The water temperature is just as important in terms of light-trap catch of caddisflies. Indeed, the puppet climbs out onto the stones getting out from the water, moults and after 10-15 minutes testing his wings, flying out leaves the stream.

Kiss (2004) found the bottom of the brook is covered with large stones. The depth of water is between 3 cm and 5 cm. The brook flows in several branches of a width of 40-50 cm each. Water temperature is 17.9°C in August and 9.1°C in September.

Water temperatures were recorded by Malicky and Chantaramongkol (1993) only when collecting specimens. Correct measuring of water temperatures would need permanent records to determine the limits. This is important in temperate and cold regions where short-term variation of water temperature may be high.

Water temperature controls both oxygen supply and oxygen demand because oxygen concentrations are inversely related to temperature and metabolic rates of insects are positively related to temperature (Kovalak, 1976).

MATERIAL AND METHODS

The selected caddisflies specimens used in our investigations are originated from previous light-trap collections. There was the most important point of view at the selection of species and swarming the total number of male and female specimens exceeds 700. The collection site, they geographical coordinates and the year of collection are as follow:

Tisza River at Szolnok (47°10′76"N; 20°11′25"E) in year 2000.

The families, species, number of specimen and catching nights of examined caddishflies are shown in Table 1.

Jermy-type light-trap was used in catch of caddisflies.

The light-trap consists of a 125 W mercury lamp and a saving lid with a diameter of 1 metre. There was a collecting funnel under the lamp. Its diameter was 40 cm and this collector drove into a container. We used clear chloroform as killing material. Our light-traps operated in all years and on all settlements between 1st April and 31st October on all nights.

We mean a generation's flying period by swarming. Than the number of individuals of a given species in different observation years is not the same. The collection efficiency of the modifying factors (temperature, wind, moonlight, etc.) are not the same at all locations and at the time of trapping, it is easy to see that the same number of items capture two different observers place or time of the test species mass is entirely different proportion. To solve this problem, the introduction of the concept of relative catch was used decades ago (Nowinszky 2003).

The relative catch (RC) for a given sampling time unit (in our case, one night) and the average number individuals per unit time of sampling, the number of generations divided by the influence of individuals. If the number of specimens taken from the average of the same, the relative value of catch: 1 (Nowinszky 2003).

The data of air and water temperature were taken from year-book of Hungarian Meteorological Service. From the collection data pertaining to examined species we calculated relative catch values (RC) by swarming of examined species.

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

Following we arranged the data on both the averaged daily air temperature and water temperature in classes. Relative catch values were placed according to the features of the given day, and then RC were summed up and averaged. The data are plotted for each species and regression equations were calculated for relative catch of examined species and temperature data pairs. We determined the regression equations, the significance levels which were shown in the Figures.

Table 1: The catching data
(Families, species, number of specimen and catching nights)

Families – Species	River Tisza (Szolnok, 2000)	
	Number of	
	Specimen	Nights
Hydroptilidae		
Agraylea sexmaculata Curtis, 1834	1,725	127
Ecnomidae		
Ecnomus tenellus Rambur, 1842	2,193	103
Polycentropodidae		
Neureclipsis bimaculata Linnaeus, 1758	1,593	95
Hydropsychidae		
Hydropsyche contubernalis Mc Lachlan, 1865	12,302	179
Hydropsyche bulgaromanorum Malicky, 1977	22,224	81
Limnephilidae		
Limnephilus affinis Curtis, 1834	723	104
Leptoceridae		
Athripsodes albifrons Linnaeus, 1758	814	115
Ceraclea dissimilis Stephens, 1836	928	100
Setodes punctatus Fabricius, 1759	1,848	87
Oecetis ochracea Curtis, 1825	385	103

Notes: The taxonomic classification of the species was carried out according to Kiss (2003).

RESULTS AND DISCUSSION

Our results are shown in Fig. 1-10 and Table 2.

Our results show that both the water and the air temperature modify significantly the flying onto light of the studied caddisfly species. The increase of temperature initially increases the number of caught species; there is only one (*Hydropsyche bulgaromanorum* Malicky) number of the individuals where we found a decrease. According to our opinion the increasing catch, in parallel with higher temperature, can be explained that the value of temperature optimum of the species is equal or higher as the maximum values measured at the time of swarming. In the beginning, in parallel with the increase of temperature rising, then at a given taller temperature, when there is decreasing catch, we think more reason for it.

- The more rising temperature is already unfavourable in terms of flight activity

- Prolonged swarming when the temperature continues to rise, but the number of clamped caddisflies has decreased (*Athripsodes atterimus* Linnaeus)
- Due to the different developmental stages the pupation is delayed, this time may be less flying insects (*Limnephilus affinis* Curtis)
- Because of the protracted laying eggs hectic light flying can be detected (*Hydropsyche bulgaromanorum* Malicky)
- The stray beetles can cause more swarming peaks (Kiss et al. 2006)

Table 2: Temperature threshold and optimum of water, temperature and air ones of examined Trichoptera species

Families – Species	**Water temperature (^{0}C)**			**Air temperature (^{0}C)**		
	threshold	**optimum**	**I or D**	**threshold**	**optimum**	**I or D**
Hydroptilidae						
Agraylea sexmaculata Curtis, 1834	10.2	20.4	I–D	5.5	23.2	I
Ecnomidae						
Ecnomus tenellus Rambur, 1842	16.0	25.2	I	12.5	23.3	I
Polycentropodidae						
Neureclipsis bimaculata Linnaeus, 1758	16.0	25.5	I	12.5	20.5	I–D
Hydropsychidae						
Hydropsyche contubernalis Mc Lachlan, 1865	9.5	25.1	I	5.5	22.6	I
Hydropsyche bulgaromanorum Malicky, 1977	18.4	20.3	I	14.0	24.4	D
Limnephilidae						
Limnephilus affinis Curtis, 1834	18.4	21.6	I–D	8.5	23.6	I–D
Leptoceridae						
Athripsodes albifrons Linnaeus, 1758	16.0	22.9	I–D	13.5	23.6	I
Ceraclea dissimilis Stephens, 1836	16.0	22.9	I–D	13.5	23.6	I
Setodes punctatus Fabricius, 1759	16.0	23.9	I	12.5	20.7	I
Oecetis ochracea Curtis, 1825	18.2	24.5	I	13.5	20.7	I–D

Notes: I = increasing, D = decreasing, I–D = at first increasing after it decreasing

Figure 1 Light-trap catch of *Agraylea sexmaculata* Curtis depending on the water- and air temperature (River Tisza Szolnok, 2000)

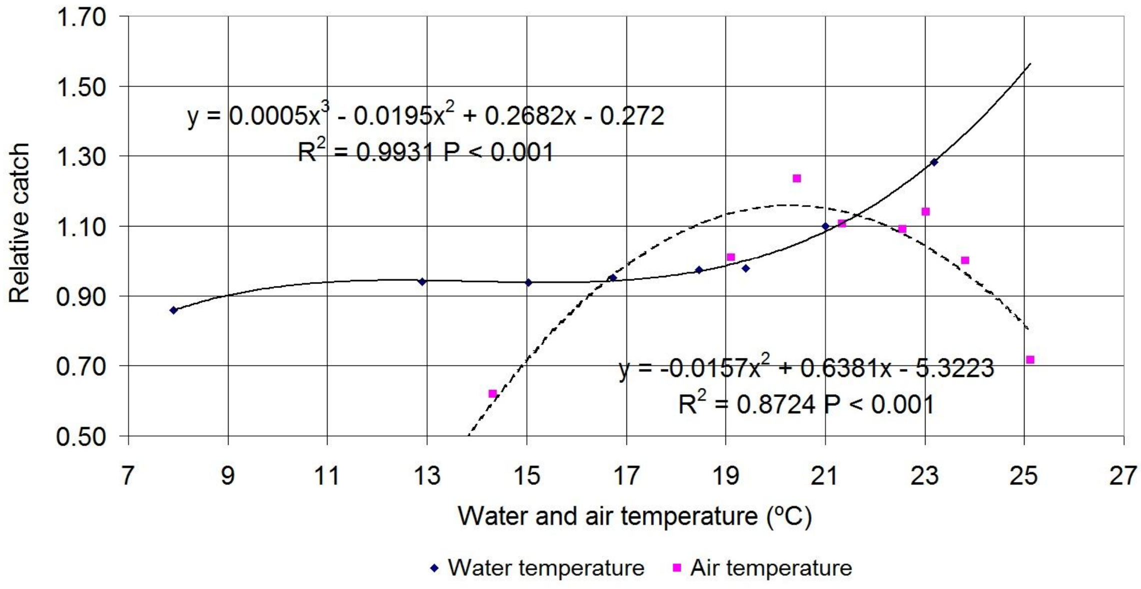


Figure 2 Light-trap cach of *Ecnomus temellus* Rambur depending on the water and air temperature (River Tisza Szolnok, 2000)

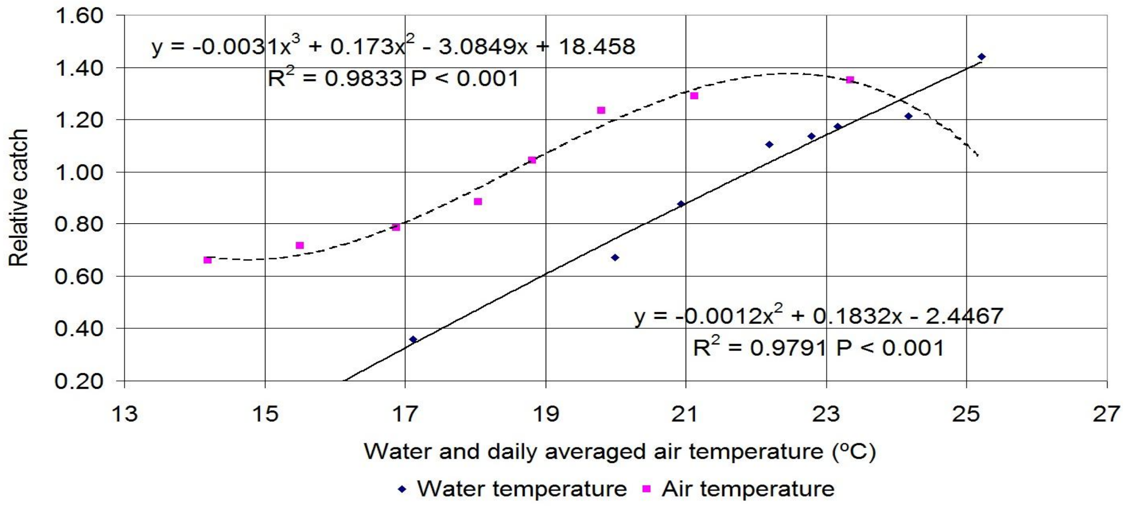


Figure 3 Light-trap catch of *Neureclipsis bimaculata* Linnaeus depending on the water and air temperature (River Tisza, Szolnok, 2000)

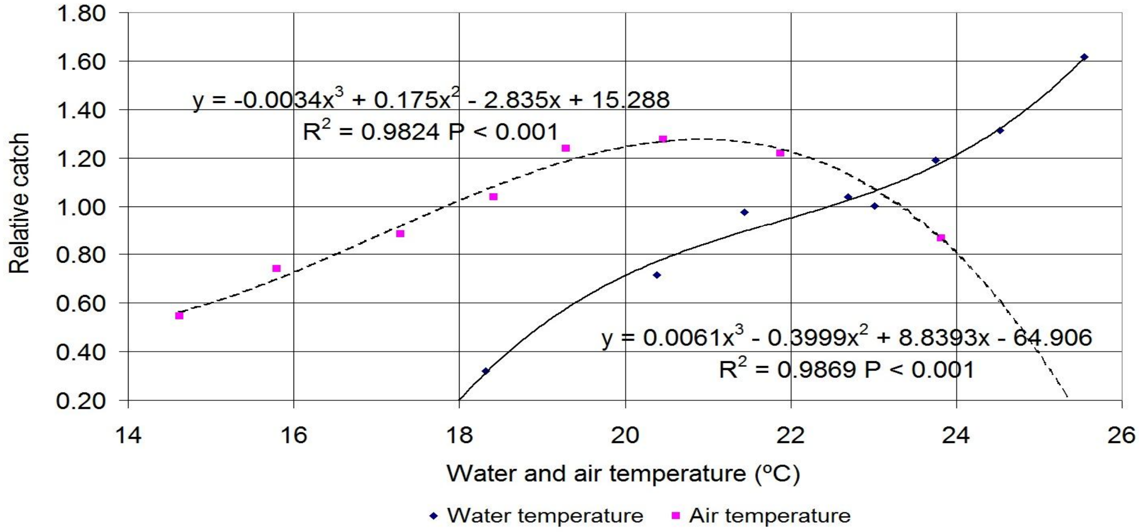


Figure 4 Light-trap catch of *Hydropsyche contubernalis* Mc Lachlan depending on the water and air temperature (River Tisza Szolnok, 2000)

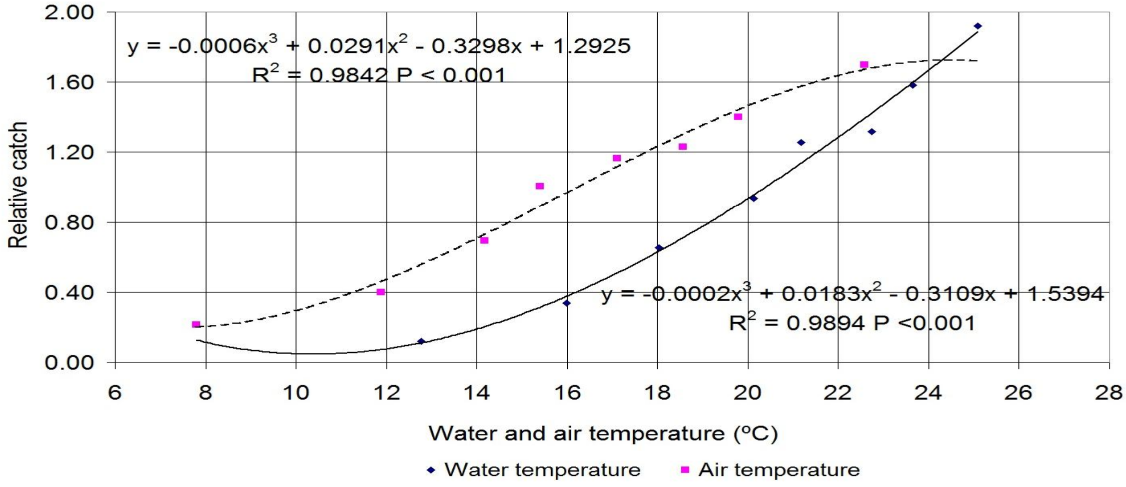


Figure 5 Light-trap catch of *Hydropsyche bulgaromanorum* Malicky depending on the water and air temperature (River Tisza Szolnok, 2000)

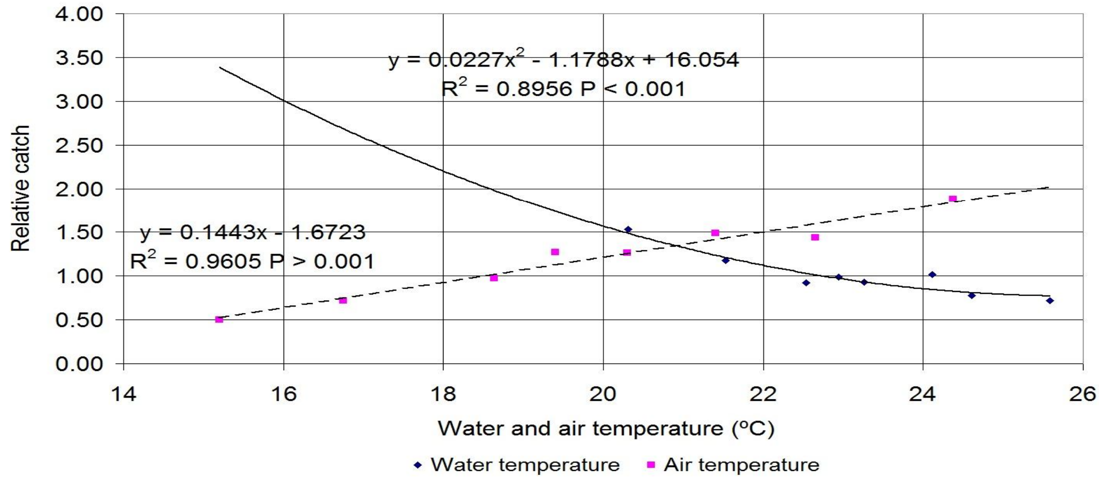


Figure 6 Light-trap catch of *Limnephilus affinis* Curtis depending on the water and air temperature (River Tisza, Szolnok, 2000)

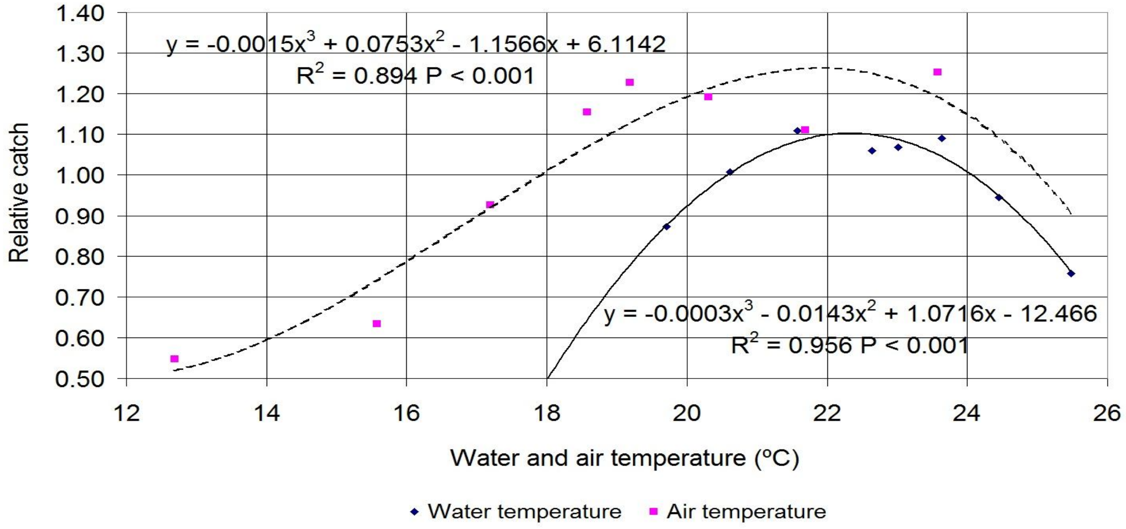
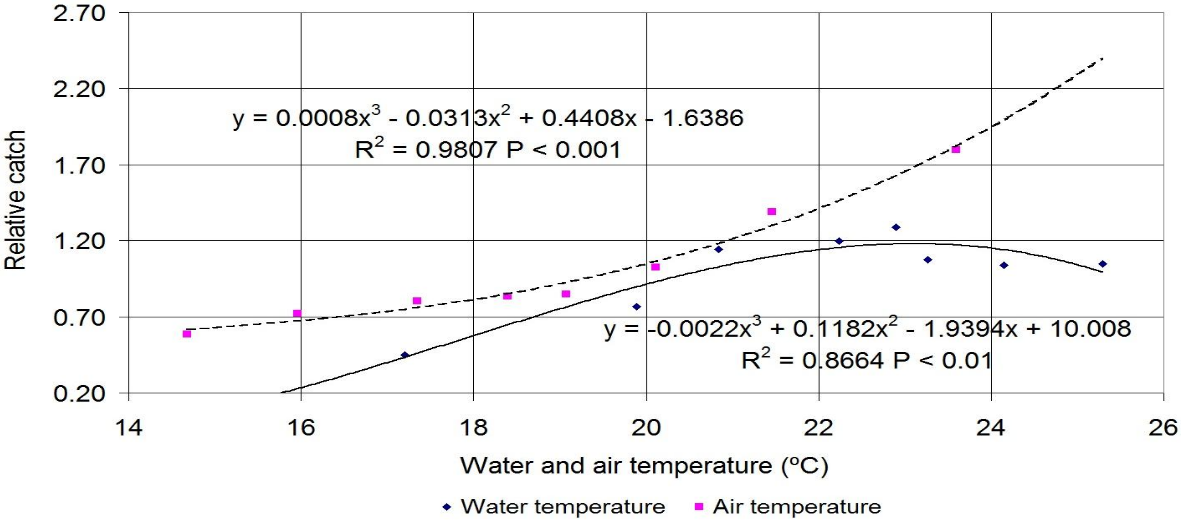


Figure 7 Light-trap catch of *Athripsodes albifrons* Linnaeus depending on the water and air temperature (River Tisza, Szolnok, 2000)



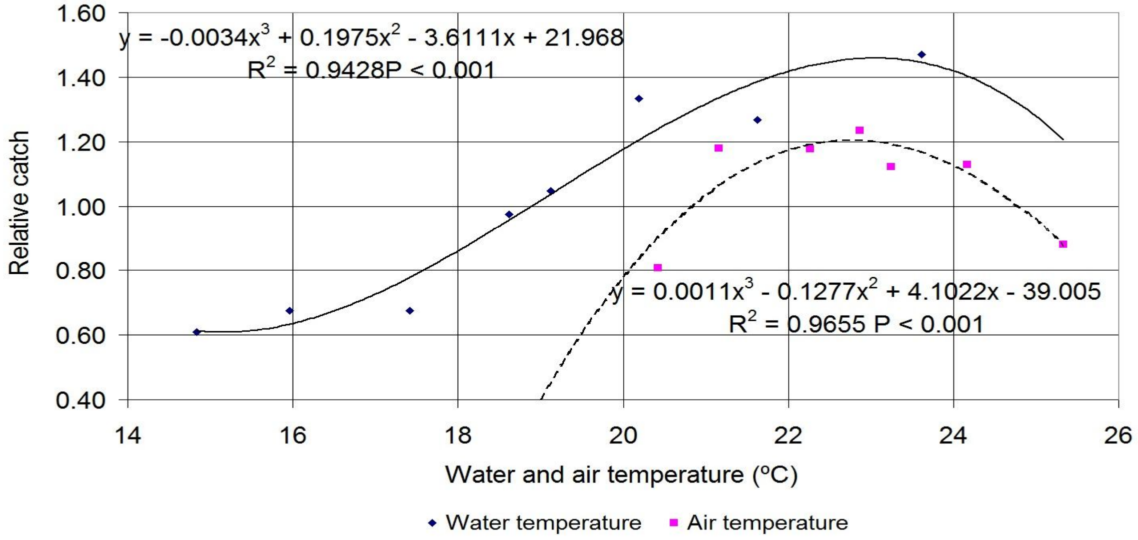


Figure 8 Light-trap catch of *Ceraclea dissimilis* Stephens depending on the water and air temperature (River Tisza, Szolnok, 2000)

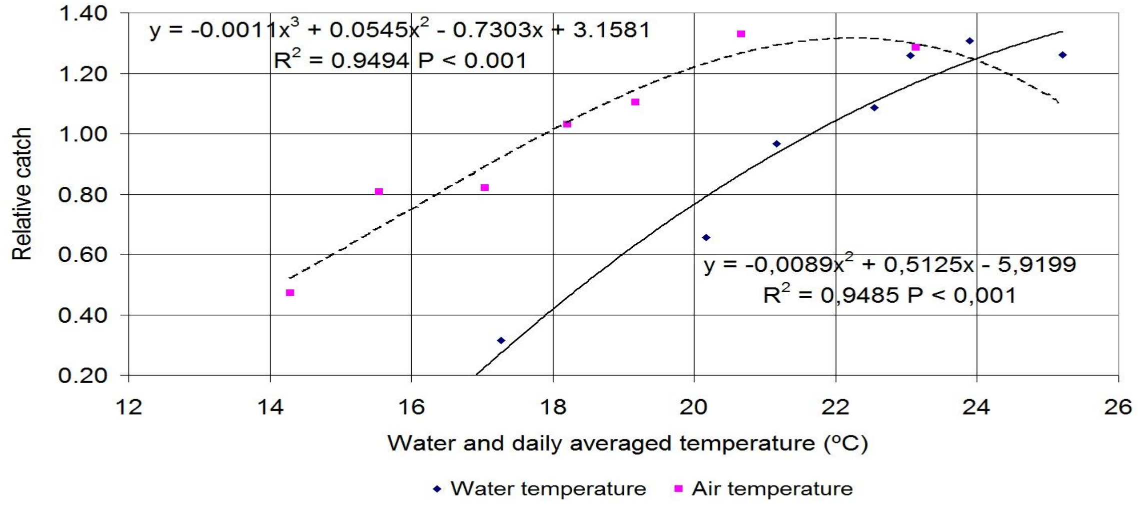


Figure 9 Light-trap catch of *Setodes punctinalis* Fabricius depending on the water and air temperature (River Tisza, Szolnok, 2000)

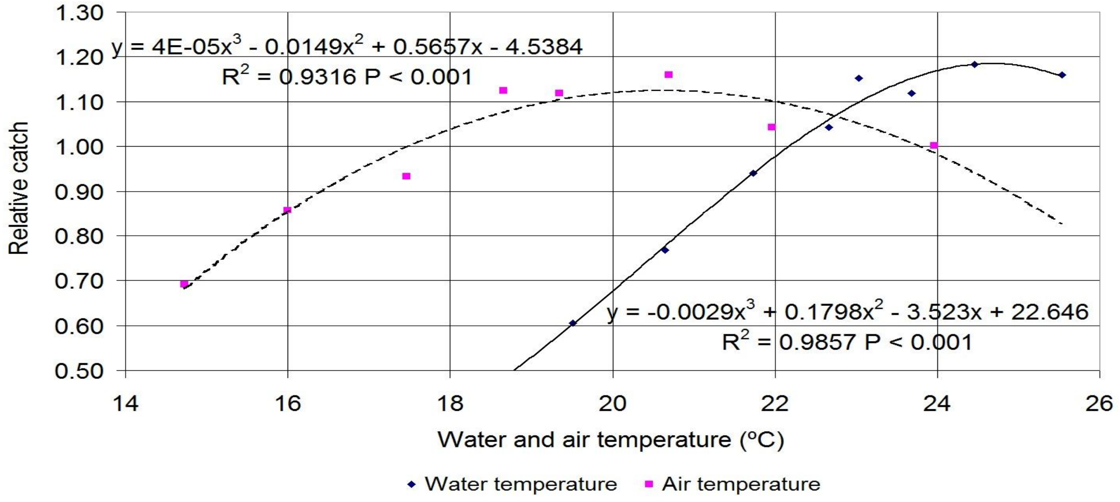


Figure 10 Light-trap catch of *Oecetis ochracea* Curtis depending on the water and air temperature (River Tisza, Szolnok, 2000)

The increase or decrease of the catch is explainable by our previous hypotheses (Nowinszky, 2003). This opposite form of behaviour may be the many reasons. The claim and tolerance to environmental factors of the species are different. Environmental factors interact with each other to exert their effects. Thus the same factor can be different effect. The species have different survival strategy. Adverse effects of two possible answers: passivity, or hiding or even increased activity, because you want to ensure the survival of the species. Therefore, the insect do "to carry out their duties in a hurry". The fact that on the higher and increasing values of geomagnetic horizontal component the catches are not suddenly, but gradually decline, we deduce that the tolerance and response of insect specimens adverse effects to individually change.

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