

**EFFECT OF THE WIND SPEED ON THE MIGRATION ACTIVITY OF AQUATIC INSECTS (COLEOPTERA, HETEROPTERA)****Z. CSABAI<sup>1\*</sup> – P. BODA<sup>2</sup>**<sup>1</sup>University of Pécs, Department of General and Applied Ecology, Pécs H-7624, Ifjúság útja 6., Hungary, csabai@ttk.pte.hu<sup>2</sup>University of Debrecen, Department of Hydrobiology, Debrecen H-4032, Egyetem tér 1. Hungary, bodapal@freemail.hu

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**A SZÉLSEBESSÉG VÁLTOZÁSÁNAK HATÁSA A VÍZIROVAROK VÁNDORLÁSI AKTIVITÁSÁRA (COLEOPTERA, HETEROPTERA)****CSABAI ZOLTÁN<sup>1</sup> – BODA PÁL<sup>2</sup>**<sup>1</sup>PTE TTK Általános és Alkalmazott Ökológiai Tanszék, Pécs 7624 Ifjúság 6.<sup>2</sup>DE TTK Hidrobiológiai Tanszék, Debrecen 4032, Egyetem tér 1.

**KIVONAT:** A vízirovarok évszakos és napszakos migrációja és az ezt befolyásoló környezeti tényezők hatása csak kevéssé ismert. Kutatásunk során 9×3 méteres fekete fóliák alkalmazásával, 2000. március és július között heti gyakorisággal, 24 órás mintavételi időszakokban vizsgáltuk a vízbogarak és vízpoloskák vándorlási aktivitását. A mintákat óránkénti bontásban különítettük el. A mintavételekkel párhuzamosan, szintén óránkénti bontásban, kanalas szélesebességmérővel mértük a szél erősség alakulását. 12 km/óra szélesebesség érték felett a bogarak és poloskák vándorlását egyáltalán nem figyeltük meg. 6 és 12 km/óra közötti szélesebességértékek esetén a vándorló rovarok egyedszáma szignifikáns negatív korrelációt mutatott a szélesebesség értékeivel, míg 6 km/óra szélesebesség értékek alatt a két paraméterben összefüggés nem volt kimutatható.

**ABSTRACT:** The seasonal and diel flight periodicity of aquatic insects and the environmental factors governing it are poorly understood. The daily and seasonal migration of the aquatic beetles and aquatic bugs were studied. The samplings were made for 24 hours weekly between March and July 2000 by 9×3 m black foils, samples were separated by hours. In every sampling hour the wind speed was measured by a pocket anemometer. We observed that over 12 km/h wind speed intensity the migration of aquatic Coleoptera and Heteroptera was totally blocked. Between 6 and 12 km/h wind speed intensity there are significant negative correlation between the number of migrating individuals and wind speed, but below 6 km/h wind speed intensity the migration controlling effects of the wind speed was not certifiable.

**Key words:** wind speed intensity, dispersion, correlation

## Introduction

The seasonal and diel flight periodicity of aquatic insects and the environmental factors governing it are poorly understood (BEHR 1990, 1993, FERNANDO 1958, FERNANDO and GAILBRAITH 1973, FICHTNER 1972, LANDIN and STARK 1973, LUNDKVIST et al. 2002, NILSSON and SVENSSON 1992, 1995, WEIGELHOFER et al. 1992).

WEIGELHOFER et al. (1992) have studied the effect of some meteorological parameters (temperature, wind speed, humidity) on the flying activity of some Heteroptera species. They found significant correlation only between temperature and migrating number of individuals. The migration of studied Heteroptera species was not observed below 9.4 °C.

BEHR (1990) have made measurements of meteorological parameters (temperature, moisture, humidity) in parallel with studying immigration into artificial ponds, but he only remark that the weather conditions have high influence on the number of individuals of migrating aquatic beetles.

NILSSON and SVENSSON (1995) have studied immigration rates into waters in clear-cut areas and forested regions.

Apropos of beetles flying activity LUNDKVIST et al (2002) also studied some environmental parameters related to the migration intensity. They observed that the relationship between species and the whole set of environmental variables was highly significant, moreover the most important factors influencing the distribution of beetles were landscape type, distance from the water and vegetation complexity near the traps. The temperature and date of sampling were less important, but the effect of the wind speed was not studied.

In our research program on the daily and seasonal migration of the aquatic beetles and aquatic bugs was started in 2000. The aims were to reveal the various diel and seasonal migration activity patterns of aquatic insects and to explain the effects of the environmental parameters and internal biological features on the flying activity (BODA et al. 2003, CSABAI és BODA 2005, CSABAI et al. 2003, 2004). In this paper the effects of the wind speed intensity on number of individuals of the migrating aquatic insects are discussed.

## Materials and methods

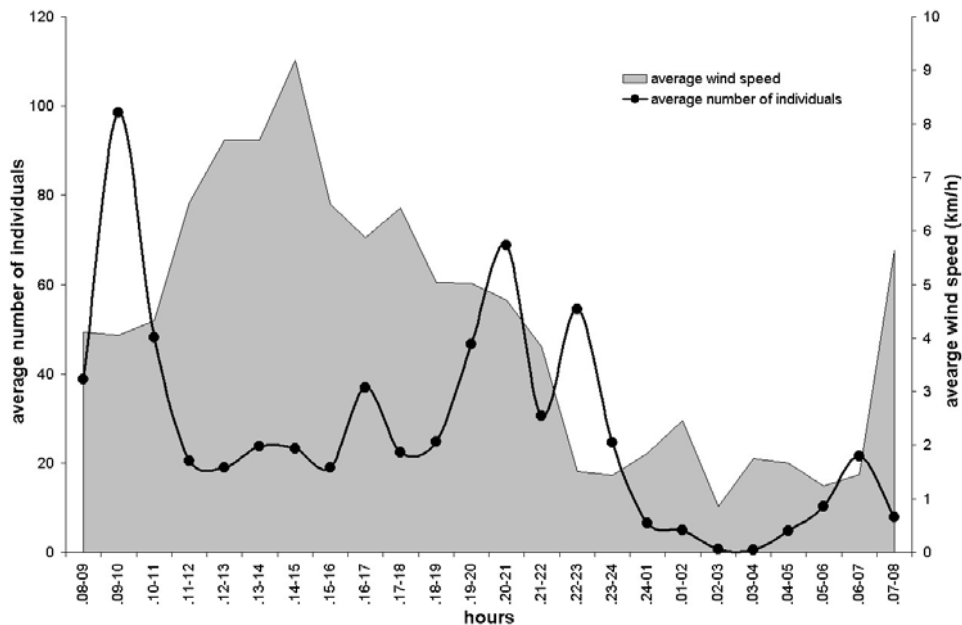
In the beginning of this research program, in the year 2000 the monitoring was performed in the Hortobágy National Park, at the shore of Hagymás-basin marsh (47°33'29" N, 20°55'29" E) characterized by a patchy vegetation with a rich and diverse aquatic insect community. The samplings were made for 24 hours weekly between March and July, samples were separated by hours. The aquatic insects were captured on black agricultural foils with 9×3 meters area. In every sampling hour the wind speed was measured by a pocket anemometer. The sampling procedure was more detailed in CSABAI et al. (2003)

The correlations between the number of individuals and measured wind speed were tested by Pearson correlation analysis.

## Results and discussion

Comparing the average number of individuals per hour with the average wind speed per hour generally a phenomenon could be observed that the average

number of individuals of the migrating insects was lower when the wind intensity was higher, and in calm or at lower wind intensity the number of individuals was higher (figure 1.). Nevertheless after the sunset, in almost dead calm the migration intensity was in lower level too. Significant correlation between this two variables were not certifiable. Each aquatic insects species were sensitive to wind speed in different degree (figure 2), but significant correlation between number of individuals of each species were also not detectable.



**Figure 1.** Apparent but no significant negative correlation between the average number of individuals and average wind speed.

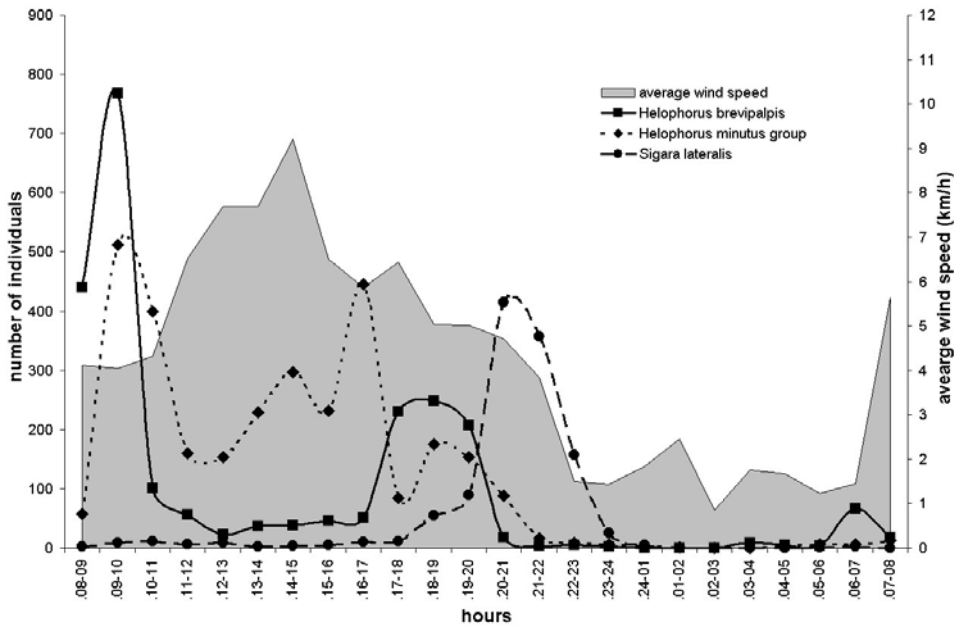
Other observations can be drawn if we separate the wind speed scale into three divisions. Based on the flying ability of these insects we can pronounce that below a certain wind speed value the flying of beetles is not influenced (1. division). Above this – probably species dependent, in general not definitely determinable - value the flying is more or less restrained by wind speed (2. division). There is a maximum threshold, over this value the migration is totally blocked (3. division).

Over 12 km/h wind speed value the migration of insects were not observed in the whole sampling period. Over this value the dispersal activity in the air was totally blocked, even also in the early evening, in gloaming period which is the most suitable for insect to fly (figure 3. and 4.).

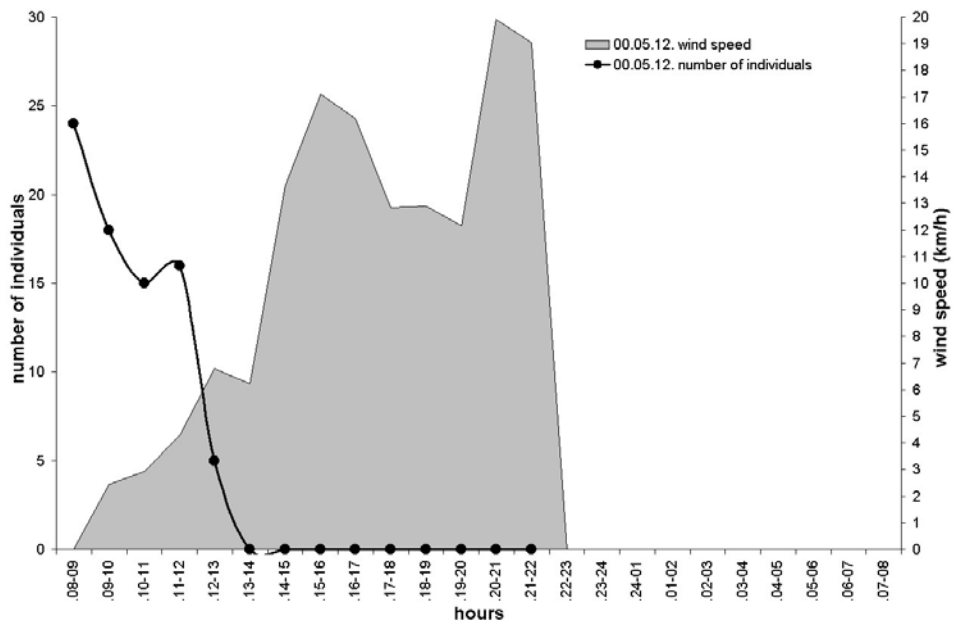
We have compared the number of individuals and the wind speed intensity separated to up mentioned divisions (I.: below cc. 6 km/h and II.: between cc. 6 and 12 km/h).

In the case of the first division in which the wind speed was below cc. 6 km/h no significant correlation could be found between the wind speed intensity and the number of individuals ( $p > 0.1$ ,  $r = -0,011$ ). Below this value the effect of wind speed was not certifiable; in this case probably other parameters are accountable for the controlling of the insect migration.

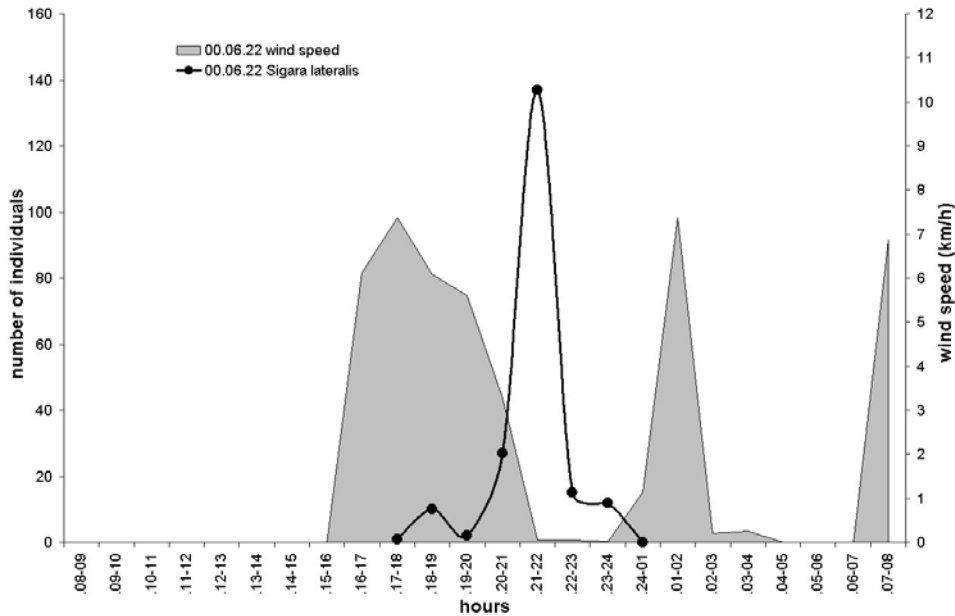
In the case of the second division (6-12 km/h) we received significant negative correlation between these two variables ( $p < 0.001$ ,  $r = -0.724$ ). Higher wind speed intensity have strong effect on the number of the dispersing insects.



**Figure 2.** Apparent but no significant negative correlation between the average number of individuals of three common taxa and average wind speed.



**Figure 3.** Missing migration maximum at early evening and at nightfall in consequence of the high wind speed.



**Figure 4.** Evening migration maximum of *Sigara lateralis* at nightfall with low wind speed.

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