

Overwintering corixid assemblages: structure and sexual maturity

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Abstract

Structure of overwintering corixid taxocenoses and sexual maturity of their species are analyzed. Investigations were realized under two different environmental conditions in Central Europe (Czech Republic, SW Bohemia): (i) "normal" cold winter (average temperatures = from -0.8 to -0.12 °C (November – March) in the centre of South Bohemia; waters were covered by ice and snow from December to February), and (ii) unusual "mild" winter (average temperature = 4.8 °C; waters without ice cover). The overwintering mode depends on the winter temperatures and weather ending into presence or absence of ice and snow-cover of waters. Corixids can overwinter in groups formed by tens or hundreds specimens, actively or inactively on the bottom in the normal winters if the water surface is covered by ice and snow. Assemblages sampled in normal winters are poorer in comparison with both summer taxocenoses and assemblages sampled during a mild winter. Ovarian development is arrested throughout the winter months in normal winters whereas the massive start of vitellogenesis obviously shifted about two months earlier in the mild winter. Winter oviposition is probably a phenomenon specific only for some corixid species in the temperate zone; it was noted only in the mild winter.

Key words: Heteroptera, Corixidae, overwintering, oviposition, Central Europe.

Introduction

Life cycles of selected water bug species were more or less irregularly studied in the South-Western Bohemia (Czech Republic, Central Europe) since 1985 (Papáček and Tříška, 1992). But data (of the second author) on the overwintering of bivoltine corixids remained mostly unpublished. Extremely mild winter 2006/2007 was the occasion for the study of corixid overwintering under unusual winter conditions in Central Europe - without ice cover of waters.

This study based on the field data brings (i) an information on the structure of overwintering corixid taxocenoses and (ii) comparison of sexual maturity of selected overwintering corixid species under the conditions of (a) "normal" cold [average temperatures = from -0.8 to -0.12 °C (November – March) in the centre of South Bohemia, České Budějovice city; surface of the waters was covered by ice and snow from December to February], and (b) "mild" winter 2006/2007 (average temperature = 4.8 °C; waters without ice cover).

Materials and methods

Samplings of material were realized as follows: "Normal" cold winters (systematically only from the end of November to February of the years 1986/87/88, 1997/98): windows ca 3x1 m were broken in the ice cover of water bodies (ice free water column - from 1.5 m to 2.3 m) and the presence of corixids was tested; water bugs were sampled by the net on/in the bottom/bottom substrate or air breathed specimens were netted after their reactivation on the water surface in the sites of overwintering. Three forest pools (former small sand mines connected by channels with peat bogs) and two fish ponds were investigated. "Mild" winter

2006/07: samples were realized by the net nearby by the shore line (water column ca from 0.2 to 0.9 m). Six fish ponds were investigated after expected overwintering at the end of November 2006; one artificial water tank, that was massively inhabited by corixids migrating from fish ponds with discharged water in its neighbourhood, was investigated in January, February and March 2007. Material was determined, dissected, and examined by usual microscopic methods (maximal magnification = 400 x). Sexual maturity was classified according to classification used by Papáček and Tříška (1992). State of the fat tissue and gut content was examined too.

Results and discussion

Cold winters: (1) Samples from deep forest pools (total number of specimens: $n = 853$) were conspicuously uniform. *Corixa dentipes* Thomson, *Corixa punctata* (Illiger) and *Hesperocorixa sahlbergi* (Fieber) (most abundant species; from 47 to 82% of specimens in individual samples), together with notonectids, were regularly sampled as dominant species throughout whole investigated periods. These species were presented regularly also in control samples from summer months. Another species, especially *Sigara lateralis* (Leach), *Sigara nigrolineata* (Fieber), *Sigara striata* (L.), *Hesperocorixa linnaei* (Fieber) and *Callicorixa praeusta* (Fieber) inhabited these waters only in the spring and summer. (2) Individual assemblages from fish ponds ($n =$ about 3,600), sampled in the same places and localities in different terms, were composed either by different set of species or by very different proportions of specimens of individual species. Only seven corixid species were sampled [except one *Cymatia coleoprata* (F.) special overwintering site]: *Sigara distincta* (Fieber), *Sigara falleni* (Fieber), *Sigara fossarum* (Leach), *S. lateralis*, *S. striata*, *C. praeusta*,

Table 1. Comparison of some parameters of selected corixid species sampled in the January of cold and mild winters.

	<i>S. distincta</i>	<i>S. falleni</i>	<i>S. lateralis</i>	<i>S. striata</i>
Cold winters 1986 - 88; 97/98, fish ponds; n = 978				
specimens in samples (%)	7.20	62.50	20.80	2.00
sexual index (males : total number of adults)	0.48	0.46	0.45	0.40
females with yolk granula in oocytes (%)	0.00	0.00	0.00	0.00
Mild winter 2006/07; artificial tank; n = 2740				
specimens in samples (%)	13.36	70.26	9.73	4.06
sexual index (males : total number of adults)	0.44	0.41	0.41	0.23
females with yolk granula in oocytes (%)	94.00	88.00	82.00	78.00
females with chorionated eggs (%)	0.10	0.00	1.00	10.00
egg laying females (%)	0.00	0.00	0.00	8.00

Paracorixa concinna (Fieber) in overwintering sites. More rich control summer samples from the same sites content from ten to thirteen species. Field investigations (a) show that the corixid can overwinter in groups formed by tens or hundreds specimens actively or inactively on the bottom (gut content was present in 4 – 48% of adults sampled in different places of overwintering in January), (b) that their winter assemblages are more poor in comparison with summer taxocenoses, and (c) suggest that some corixid species could choose specific habitats for their overwintering, that are different from summer habitats. (3) Ovarian development was arrested from the end of November to late February. Only oocytes of the different degree of development, without yolk granula, were noted in the vitellaria (table 1). Vitellogenesis started mostly at the end of February. This finding corresponds to the Savage's (1989) statement that in Corixidae the ovaries begin to develop at various times between February and March.

Mild winter 2006/07: (1) Samples (n = 3770) included ten species of Corixidae. Most abundant species were *S. falleni*, *S. distincta* and *S. lateralis* (table 1); the less abundant were *C. praeusta*, *C. punctata*, *P. concinna*, *S. nigrolineata*, *S. striata*; and only single specimens of *Cymatia rogenhoferi* (Fieber), and *H. linnaei* were caught. Structure of this assemblage more or less corresponds to the structure of summer samples in the fish ponds (cf. Indrová, 2004). (2) Development of ovaries (vitellogenesis) started at least in the beginning of January (table 1). The yolk granula were detected in the oocytes of *S. falleni*, *S. distincta* and *S. lateralis*; chorionated eggs were noted in distal parts of vitellaria of few females of two last- mentioned species too.

All stages of ovaria development - oocytes only, oocytes with yolk, chorionated but not ovulated eggs, eggs ovulated and descended into lateral oviducts – were noted in *S. striata* at the 1st half of January. (3) Overwintering corixids were active; fat body of more than 94% of overwintering adults was well developed; gut was full approximately in 88% of specimens.

Males of all the examined corixid species reach sexual maturity very early, after overwintering in the autumn (before the beginning of November) independently on weather conditions. Some males mate with immature females before overwintering. This finding corresponds to the older literary data from temperate zones (Young, 1978). Corixids have probably “bet hedging” reproductive strategy (sensu Tauber *et al.*, 1986), characteristic

by short and long male diapause, that is known also in some temperate notonectids.

In comparison with cold winters, the massive start of vitellogenesis of small Corixidae was obviously shifted earlier about two months (from the end of February to the beginning of January) in the mild winter season 2006/2007. Young (1978) stated that ovarian development and oviposition may occur at very low water temperatures, and in some places ovipositions begin when ponds are still ice-covered (U.K. and New Zealand). On the other hand, only females with arrested development of ovaria were found in cold winters in the investigated area, and egg laying females of *S. striata* were found only in the mild winter season, when the water were not ice-covered. This results indicate the possibility that oviposition in a winter can be a phenomenon specific only for some corixid species with no strictly fixed length of diapause and with more plastic life history traits (table 1).

Acknowledgements

This study and its presentation were supported by the grant of The Czech Ministry of Education No 6007665801.

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